End-user Guide for Cisco IoT FND, Release 26.2.1

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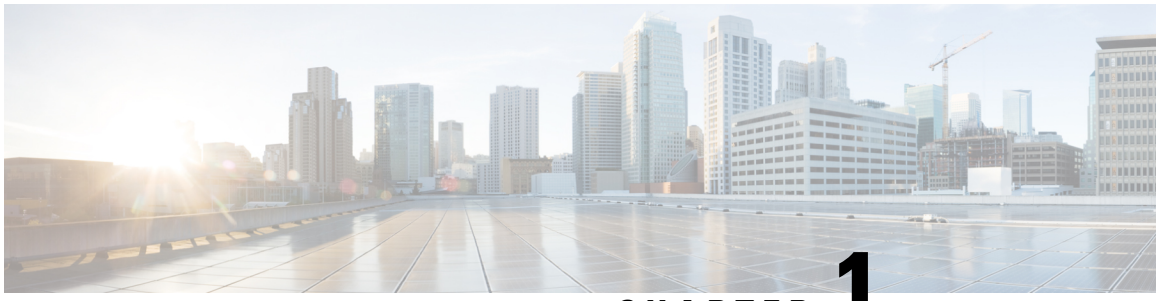


CHAPTER 1

Feature History

Here is a list of new software and hardware features:

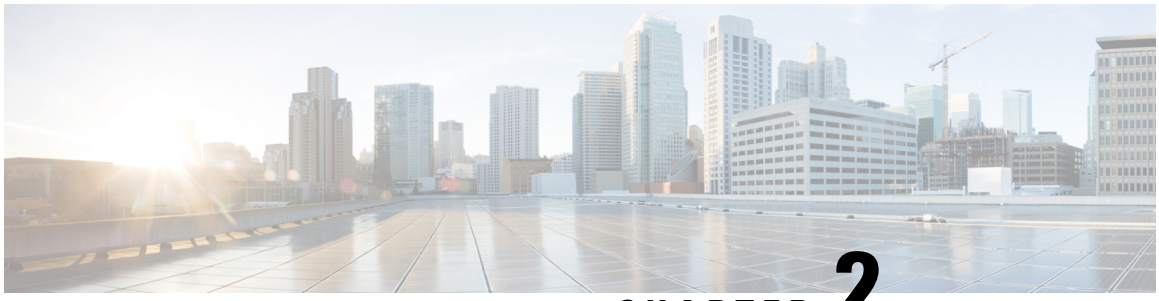
Table 1: New Software Features

Feature	Description
Upload custom web certificates	Upload a custom web certificate through the Cisco IoT FND user interface and. Restart the Cisco IoT FND service after an upload or restore to apply the certificate.
Execute Cisco IOS XE commands from the Cisco IoT FND UI	Use the Troubleshoot tab to run supported, nonconfigurative Cisco IOS XE EXEC commands on supported routers without signing in to the device CLI. Cisco IoT FND displays command output or errors and records the execution in the audit log.
Detect and manage deprecated insecure CLI commands	Cisco IoT FND detects deprecated insecure CLI commands in router templates and configuration-push workflows, displays warnings, and lets you review the detected commands.
Support for deployments with up to 50,000 routers	Cisco IoT FND supports high-availability virtual-machine deployments with PostgreSQL for router management at scales up to 50,000 routers.
Support for AMI deployments with up to 10,000 routers and 10,000,000 endpoints	Cisco IoT FND supports Advanced Metering Infrastructure deployments with up to 10,000 routers and 10,000,000 endpoints.
Server-setting enhancements	Adds server-setting controls for applicable utility deployments.
Audit Trail search	Adds search functionality to the Audit Trail page so that administrators can quickly locate specific records in large audit datasets.
GPS coordinates in mesh routing-tree exports	Adds device latitude and longitude coordinates to mesh routing-tree data exported through the Cisco IoT FND user interface and northbound API.
Additional cellular modem information	Displays the cellular modem device model ID, PRI version, carrier PRI version, and OEM PRI version on the Device Info page.

Table 2: New hardware features

Feature	Description

Support for Cisco 5G Reduced Capability modules	Cisco IoT FND adds management support for the Cisco P-5GS6-RC-GL pluggable interface module and the Cisco IRMH-5GS6-RC-GL universal interface module.
Support for Cisco IR1001-G2 Rugged Series Secure Router	Cisco IoT FND provides centralized application management for the Cisco IR1001-G2 Rugged Series Secure Router.



CHAPTER 2

Overview of Cisco IoT Field Network Director

This section provides an overview of the Cisco IoT Field Network Director (Cisco IoT FND) and describes its role within the Cisco Internet of Things (IoT) Network solution. Topics include:

Cisco IoT Connected Grid Network

The Cisco IoT Connected Grid Network is a multi-service network infrastructure managed by Cisco IoT FND for smart-grid applications.

Cisco IoT Connected Grid Network Details

Table 3: Feature History

Feature Name	Release Information	Description
Additional HER Support	Cisco IoT FND Release 5.0	Cisco IoT FND supports Cisco Catalyst 8500 and 8300 series HER platforms: Cisco Catalyst 8500-12X and Cisco Catalyst 8300-1N1S-4T2X.

This section provides an overview of:

- Cisco IoT FND Features and Capabilities
- IoT FND Architecture
- Resilient Mesh Endpoints
- Grid Security

The Cisco IoT Field Network Director (IoT FND) is a network management system that manages multi-service network and security infrastructure for IoT applications, such as smart grid applications, including Advanced

Metering Infrastructure (AMI), Distribution Automation (DA), distributed intelligence, and substation automation. IoT FND is a scalable, highly secure, modular, and open platform with an extensible architecture. IoT FND is a multi-vendor, multi-service communications network management platform that enables network connectivity to an open ecosystem of power grid devices.

IoT FND is built on a layered system architecture to enable clear separation between network management functionality and applications, such as a distribution management system (DMS), outage management system (OMS), and meter data management (MDM). This separation helps utilities roll out Smart Grid projects incrementally, for example with AMI, and extend into distribution automation using a shared, multi-service network infrastructure.

Features

- Geographic Information System map-based visualization, monitoring, troubleshooting, and alarm notifications.
- Group-based configuration management for routers and smart meter endpoints.
- Operating-system compatibility for Cisco IOS, Guest OS, and IOx, including application management.
- Rule-engine infrastructure for customizable threshold-based alarm processing and event generation.
- North Bound API for transparent integration with utility head-end and operational systems.
- High availability and disaster recovery.

Cisco IoT FND provides Geographic Information System visualization and monitoring capabilities. Through the browser-based interface, utility operators manage and monitor devices in a Cisco IoT Connected Grid Field Area Network (FAN) solution using IPv6 over Low-power Wireless Personal Area Networks (6LoWPANs). The FAN includes the following devices:

- Cisco 1000 Series Connected Grid Routers (CGRs), also called pole-top or DIN-rail-mount routers. These devices are referred to as routers in this document and identified by model on the Field Devices page.
- Cisco 800 Series Integrated Services Routers provide WAN connectivity to end devices and are referred to as routers in this document.
    - C819HG-4G-V-K9
    - C819HG-4G-A-K9
    - C819HG-U-K9
    - C819HGW-S-A-K9
    - C819H-K9

  IoT FND also manages the following non-hardened Cisco 819 ISRs:
    - C819G-B-K9
    - C819G-U-K9
    - C819G-4G-V-K9
    - C819G-7-K9

- Cisco 4000 Series Integrated Services Routers consolidate network, security, compute, storage, and unified communications functions in a modular platform.
- Cisco 800 Series Industrial Integrated Services Routers are compact, ruggedized Cisco IOS Software routers. IoT FND supports the following models:
  - IR807
  - IR809
  - IR829
- The Cisco Wireless Gateway for LoRaWAN connects to Ethernet switches or routers and provides LoRaWAN radio access with backhaul support through Ethernet, 4G/LTE, or Wi-Fi.
- Cisco Interface Module for Long Range Wide Area Network (LoRaWAN) is an extension module for the Cisco IR809 and IR829 industrial routers.
- Cisco 500 Series Wireless Personal Area Network Industrial Routers provide RF mesh connectivity to IPv4 and serial IoT devices.

Note CGRs, IR800s, IR500s, and other Cisco Resilient Mesh endpoints can coexist on a network, but cannot be in the same device group. See Configuring Devices in the Managing Devices chapter.

- Cisco 800 Series Access Points are integrated with IR800s .
  - AP803 embedded in IR829

The FAN also includes the following devices:

- Cisco Aggregation Services Routers ASR 1000 series, Cisco Integrated Services Routers ISR 3900 series, ISR 4300, ISR 4400, and Cisco 8000 Series Routers are referred to as head-end routers or HERs in this document.

Table 4: PIDs Supported for Cisco 8000 Series Routers

Device Type	PID	Category
C8000	C8500L-8S4X	Head-End Routers
C8000	C8000V	Head-End Routers
C8000	C8500-12x	Head-End Routers
C8000	C8300-1N1S-4T2X	Head-End Routers

- Cisco IPv6 RF and PLC connectivity.
- The IP67-rated Cisco Catalyst IR8100 Heavy-Duty Series routers are modular, secure, rugged outdoor routers suitable for harsh physical environments.
  - IR8140H-K9

- IR8140H-P-K9

- Cisco Catalyst IR1800 Rugged Series Routers are secure 5G routers designed with a high level of modularity.

  IoT FND supports the following IR1800 models:

  - IR1821-K9
  - IR1831-K9
  - IR1833-K9
  - IR1835-K9

IoT FND typically resides in the utility control center with other utility head-end operational systems, such as an AMI head end, distribution management system, or outage management system. IoT FND provides enterprise-class fault, configuration, accounting, performance, and security functionality.

The Cisco IoT FND North Bound Application Programmable Interface (NB API) allows utility applications such as DMS, OMS, and MDM to retrieve service-specific data from a shared, multi-server communication network infrastructure. For more information, see the North Bound API User Guide for Cisco IoT Field Network Director, Release 4.x.

The NB API can send events using HTTPS. NB API clients must subscribe to IoT FND by providing a valid HTTPS URL to send events.

Cisco IoT FND Features and Capabilities

- **Configuration Management** — Cisco IoT FND facilitates configuration of a large number of Cisco CGRs, Cisco ISRs, Cisco IRs, Cisco ASRs, C8000, and mesh endpoints. Use Cisco IoT FND to bulk-configure devices by placing them into configuration groups, editing settings in a configuration template, and then pushing the configuration to all devices in the group.
- **Device and Event Monitoring** — Cisco IoT FND displays easy-to-read tabular views of extensive information that is generated by devices, allowing you to monitor your network for errors. Cisco IoT FND provides an integrated Geographic Information System (GIS) map-based visualization of FAN devices such as routers and smart meters.
- **Firmware Management** — Cisco IoT FND serves as Firmware Management a repository for Cisco CGR, Cisco ISR, Cisco IR, and mesh endpoint firmware images. Use Cisco IoT FND to upgrade the firmware running on groups of devices by loading the firmware image file onto the Cisco IoT FND server, and then uploading the image to the devices in the group. Once uploaded, use IoT FND to install the firmware image directly on the devices. In release 3.0.1-36 and later, a Subnet List view on the Firmware Upgrade page for Mesh Endpoints lets you filter and view subnets by PAN identifier (PAN ID) and Group (details include number of nodes within a group, hops away from the router and operational status). A subnet progress histogram has also been added.
- **OS Migration** — The CG-OS to IOS migration is supported until release 4.7.x.
- **Zero Touch Deployment** — This ease-of-use feature automatically registers (enrolls) and distributes X.509 certificates and provisioning information over secure connections within a connected grid network.
- **Tunnel Provisioning** — Protects data exchanged between Cisco ASRs/C8000 and Cisco CGRs, Cisco ISRs and Cisco IRs, and prevents unauthorized access to Cisco CGRs, to provide secure communication between devices. Cisco IoT FND can execute CLI commands to provision secure tunnels between Cisco

CGRs, Cisco ISRs and Cisco IRs and Cisco ASRs/Cisco 8000. Use IoT FND to bulk-configure tunnel provisioning using groups.

- **IPv6 RPL Tree Polling** — The IPv6 Routing Protocol for Low-power and Lossy Networks (RPL) finds its neighbors and establishes routes using ICMPv6 message exchanges. RPL manages routes based on the relative position of the mesh endpoints to the CGR that is the root of the routing tree. RPL tree polling is available through the mesh nodes and CGR periodic updates. The RPL tree represents the mesh topology, which is useful for troubleshooting. For example, the hop count information received from the RPL tree can determine the use of unicast or multicast for the firmware download process. IoT FND maintains a periodically updated snapshot of the RPL tree.
- **Dynamic Multipoint VPN and FlexVPN** — For Cisco IR800 devices, DMVPN and FlexVPN do not require IoT FND to apply device-specific tunnel configuration to the HER during tunnel provisioning. HER tunnel provisioning is only required for site-to-site VPN tunnels.
- **Embedded Access Point (AP) Management** — IoT FND provides management of embedded APs on C819 and IR829 routers.
- **Guest OS (GOS) Support** — For Cisco IOS CGR 1000 and IR800 devices that support Guest OS, IoT FND allows approved users to manage applications running on the supported operating systems. IoT FND supports all phases of application deployment, and displays application status and the Hypervisor version running on the device.
- **Device Location Tracking** — For CGR 1000, IR1101, IR800, N2450, and IR8100 devices, IoT FND displays real-time location and device location history. Ensure that you enable the router GPS tracking option for this feature.
- **Software Security Module (SSM)** — This is a low-cost alternative to the Hardware Security Module (HSM), and is used for signing CSMP messages sent to meters and IR500 devices.
- **Customer Certificates** — Cisco IoT FND allows you to use your own CA and ECC-based certificates to sign smart meter messages.
- **Diagnostics and Troubleshooting** — The IoT FND rule engine infrastructure provides effective monitoring of triage-based troubleshooting. Device troubleshooting runs on-demand device path trace and ping on any CGR 1000, IR800, , range extender, gateway, or meter (mesh endpoints).
- **High Availability** — To ensure uninterrupted network management and monitoring, you can deploy the Cisco IoT FND solution in a High Availability (HA) configuration. By using clusters of load-balanced IoT FND servers and primary and standby IoT FND databases, Cisco IoT FND constantly monitors the health of the system, including connectivity within clusters and server resource usage. If a server cluster member or database becomes unavailable or a tunnel fails, another takes its place seamlessly. Additionally, you can add reliability to your IoT FND solution by configuring redundant tunnels between a Cisco CGR and multiple Cisco ASRs/C8000.
- **Power Outage Notifications** — Mesh Endpoints (MEs) implement a power outage notification service to support timely and efficient reporting of power outages. In the event of a power outage, MEs perform the necessary functions to conserve energy and notify neighboring nodes of the outage. Routers relay the power outage notification to IoT FND, which then issues push notifications to customers to relate information on the outage.
- **Resilient Mesh Upgrade Support** — Over-the-air software and firmware upgrades to field devices such as Cisco CGRs and Resilient Mesh Endpoints (RMEs) (for example, AMI meter endpoints).

- **Audit Logging** — Logs access information for user activity for audit, regulatory compliance, and Security Event and Incident Management (SEIM) integration. This simplifies management and enhances compliance by integrated monitoring, reporting, and troubleshooting capabilities.
- **North Bound APIs** — Eases integration of existing utility applications such as outage management system (OMS), meter data management (MDM), trouble-ticketing systems, and manager-of-managers.
- **Role-Based Access Controls** — Integrates with enterprise security policies and role-based access control for AMI network devices.
- **Event and Issue Management** — Fault event collection, filtering, and correlation for communication network monitoring. IoT FND supports a variety of fault-event mechanisms for threshold-based rule processing, custom alarm generation, and alarm event processing. Faults display on a color-coded GIS-map view for various endpoints in the utility network. This allows operator-level custom fault-event generation, processing, and forwarding to various utility applications such as an outage management system. Automatic issue tracking is based on the events collected.

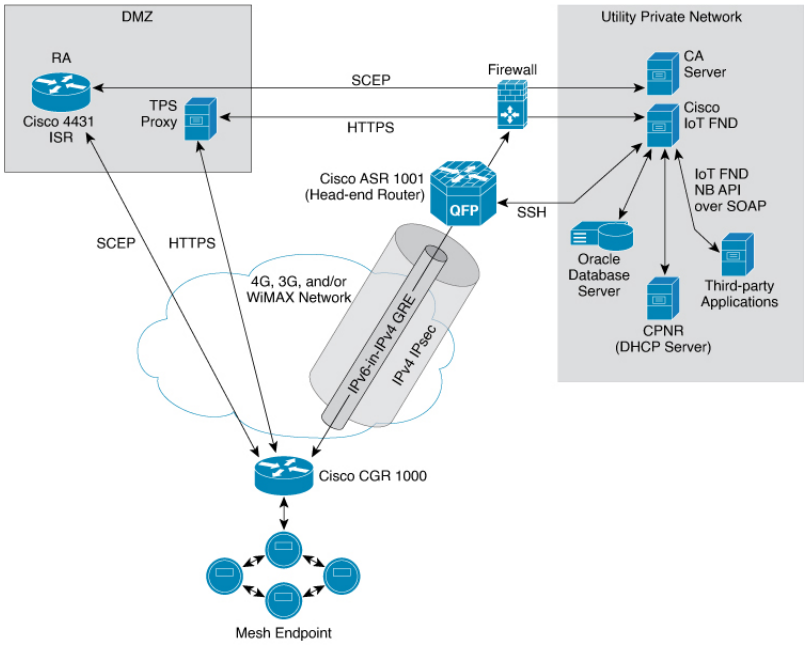
IoT FND Architecture

Figure 1: Zero Touch Deployment Architecture, on page 8 provides a high-level view of the systems and communication paths that exist in a typical utility company operating on a Cisco CGR connected grid network in which Zero Touch Deployment is in use.

For Cisco IOS CGRs, we recommend a tunnel configuration using FlexVPN.

For IR800s, we recommend using Dynamic Multipoint VPN (DMVPN) or FlexVPN.

Figure 1: Zero Touch Deployment Architecture



In this example, the firewall provides separation between those items in the utility company public network (DMZ) and its private network.

The utility company private network shows systems that might reside behind the firewall such as the Cisco IoT FND, the Oracle database server, the Cisco IoT FND North Bound API, the DHCP server, and the Certificate Authority (CA). The Cisco IoT FND Tunnel Provisioning Server proxy (TPS proxy) and Registration Authority (RA) might be located in the DMZ.

After installing and powering on the Cisco CGR, it becomes active in the network and registers its certificate with the RA by employing the Simple Certificate Enrollment Protocol (SCEP).

The Registration Authority (Integrated Service Router (ISR) in Figure 1: Zero Touch Deployment Architecture, on page 8), functioning as a Certificate Authority (CA) proxy, obtains certificates for the Cisco 1000 Series Connected Grid Router (CGR1240 and CGR1120). The Cisco CGR then sends a tunnel provisioning request over HTTPS to the TPS proxy that forwards it to IoT FND.

Cisco IoT FND manages collection of all information necessary to configure a tunnel between Cisco CGRs and the head-end router (Cisco 1000 Series Aggregation Services Routers).

Main Components of IoT FND Solution

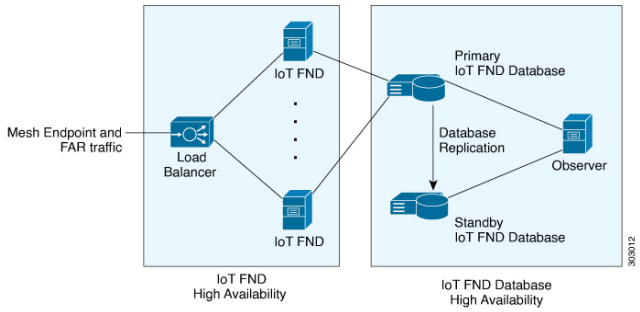
Component	Description
IoT FND Application Server	This is the heart of IoT FND deployments. It runs on an RHEL server and allows administrators to control different aspects of the IoT FND deployment using its browser-based graphical user interface. IoT FND HA deployments include two or more IoT FND servers that are connected to a load balancer.
NMS Database	This Oracle database stores all information that is managed by your IoT FND solution, including all metrics received from the MEs and all device properties such as firmware images, configuration templates, logs, event information, and so on.
Software Security Module (SSM)	This is a low-cost alternative to the Hardware Security Module (HSM), and is used for signing CSMP messages sent to meters and IR500 devices.
TPS Proxy	Allows routers to communicate with IoT FND when they first start up in the field. After IoT FND provisions tunnels between the routers and HER (ASRs/C8000), the routers communicate with IoT FND directly.
Load Balancer	The load balancer distributes traffic among the IoT FND servers in your network. You can employ a load balancer in your network within a Zero Touch Deployment (ZTD) architecture to provide High Availability (HA). IoT FND uses the BIG-IP load balancer from F5.

High Availability and Tunnel Redundancy

The example in Figure 1: Zero Touch Deployment Architecture, on page 8 is of a single-server deployment with one database and no tunnel redundancy. However, you could take advantage of Cisco IoT FND HA support to deploy a cluster of Cisco IoT FND servers connected to a load balancer, as shown in Figure 2: IoT FND Server and Database HA, on page 10. The load balancer sends requests to the servers in a round-robin fashion. If a server fails, the load balancer keeps servicing requests by sending them to the other servers in the cluster.

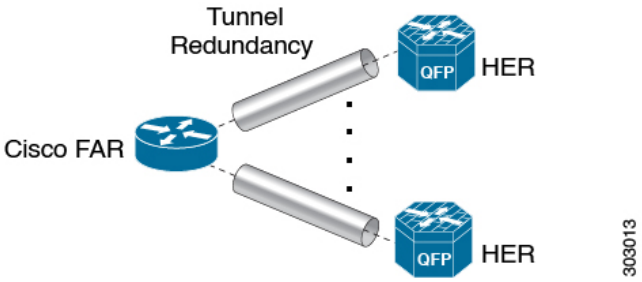
You could also deploy a standby Cisco IoT FND database to provide another layer of high availability in the system with minimal data loss.

Figure 2: IoT FND Server and Database HA



To provide tunnel redundancy, IoT FND allows you to create multiple tunnels to connect a CGR to multiple ASRs/C8000, as shown in Figure 3: IoT FND Tunnel Redundancy, on page 10.

Figure 3: IoT FND Tunnel Redundancy



For more information about HA, see Database High Availability.

List of Standard Ports Used in Cisco IoT FND

The table provides the list of standard ports used in Cisco IoT FND.

Service	Port	Access Interface
GUI	443	Management
Cisco IoT FND Demo mode	80	Production
Tunnel Provisioning	9120	Production
TPS	9122	Production
FAR	9125	Production
CG-MESH (CSMP)	61624	Production
CG-MESH (CSMP CoAP version 18)	61628	Production
CG-MESH (Outage)	61625	Production
CG-MESH (Restoration)	61626	Production
Oracle DB Server	1522	Management

Service	Port	Access Interface
PostGreSql DB Server	5432	Management
Influx	8086	Management
Kapacitor	9092	Management
WSMA (for IOS-XE)	443	Production
WSMA (for Classic IOS)	8443	Production
RADIUS (for authentication)	1812	Production
RADIUS (for accounting)	1813	Production
FND-RA	61629	Production
EST Proxy	6789	Production
Registration + Periodic	9121	Production
Bandwidth Op Mode	9124	Production
PnP — HTTP	9125	Production
Web Sockets — Device Communication	9121	Production
LwM2M	5683	Production
DB Replication for HA	1622	Production
DHCP IPv4	67	Production
DHCP IPv6	547	Production
SSH	22	Management for Cisco IoT FND and Production for devices
NTP Server	123	Production
SNMP (for polling)	161	Production
SNMP (for notifications)	162	Production
Syslog service	514	Production
SSM Server	8445	Production

Resilient Mesh Endpoints

The Cisco Field Area Network (FAN) solution brings the first multi-service communications infrastructure to the utility field area network. It delivers applications such as AMI, DA, and Protection and Control over a common network platform.

Advanced meter deployments follow a structured process designed to match the right solution to the needs of the utility company. This process moves in phases that require coordination between metering, IT, operations, and engineering. The first phase for most utilities is identification of goals, followed by analysis of data needs, and business processes. After an evaluation of the business case is complete and a technology chosen, system implementation and validation complete the process.

Once the utility company moves past the business case into system implementation, unforeseen complications can sometimes slow or delay a deployment. The true value of a plug-and-play system is that it saves cost and improves the return on investment by allowing the benefits of advanced metering to be realized sooner.

The features that enable a true plug-and-play RF or PLC mesh network system include:

- **Self-initializing endpoints**: CGRs automatically establish the best path for communication through advanced self-discovery – meters and infrastructure deploy without programming.
- **Scalability**: This type of network enables pocketed deployments where each Cisco IoT FND installation can accept up to 10 million meters/endpoints. Large capacity enables rapid, multi-team deployments to occur in various parts of the targeted AMI coverage area, while saving infrastructure and communication costs.

In a true mesh network, metering and range extender devices communicate to and through one another and decide their own best links, forming the RF Mesh Local Area Network (RFLAN) or PLC LAN. These ME devices become the network and possess dynamic auto-routing functions that eliminate the need for dedicated repeater infrastructure or intermediate (between endpoint and collector) tiered radio relay networks. The result is a substantial reduction in dedicated network infrastructure as well as powerful and more flexible fixed-network communication capability.

Range extenders are installed by the utility company to strengthen mesh coverage and provide redundancy, supplementing network reliability in difficult environmental settings such as dense urban areas where buildings obstruct the normal mesh signal propagation, or in low-meter-density geographically sparse regions and RF-challenged areas. A range extender automatically detects and connects to the mesh after installation or outage recovery, and then provides an alternate mesh path.

In a normal deployment scenario, these MEs form a stable RFLAN or PLC LAN network the same day they are deployed. Once the collector is installed, placing MEs throughout the deployment area is as simple as changing out a meter. MEs form a network and begin reporting automatically.

Mesh endpoints send and receive information. A two-way mesh system allows remote firmware upgrades, as well as system settings changes and commands for time-of-use periods, demand resets, and outage restoration notifications. Not having to physically “touch the meter” is a major value, especially when entering the advanced demand response metering domain that requires time-of-use (TOU) schedule changes and interval data acquisition changes to meet specific client needs. These commands can be sent to groups or to a specific ME. Meter commands can be scheduled, proactive, on-demand, or broadcast to the entire network.

Communication between the data center/network operations center (NOC) and the collector is accomplished by widely available and cost-efficient mass marketed TCP/IP-based public wide area network (WAN) or with the utility company-owned WAN. The flexibility and open standard public WAN architectures currently available and in the future create an environment that allows continued ongoing cost reduction and future options, without being tied into one type of connectivity over the life of the asset. It is best if the AMI system avoids using highly specialized WAN systems.

After deployment is complete, the system can transmit scheduled hourly (and sub hourly) data to support utility applications such as billing reads, advanced demand response initiatives, load research, power quality, and transformer asset monitoring.

Easy access and reliable on-demand capability allow the utility to perform grid diagnostics and load research system-wide or for selected groups of meters. Other standard features support outage management, tamper detection, and system performance monitoring.

Table 5: Feature History

Feature Name	Release Information	Description
Enhance DB queries to support scaled mesh deployment	IoT FND 4.8	The Oracle DB is scaled up to 8,000/ 8,000,000 routers/ endpoints. Under **ADMIN** > **System Management** > **Provisioning Settings** page, the CSMP optimization settings are introduced to configure the timeout in order to acquire lock when processing CSMP messages. The CSMP optimization setting is available only for Oracle DB set up and not for PostgreSQL DB setup.

Grid Security

Designed to meet the requirements of next-generation energy networks, Cisco Grid Security solutions take advantage of our extensive portfolio of cybersecurity and physical security products, technologies, services, and partners to help utility companies reduce operating costs while delivering improved cybersecurity and physical security for critical energy infrastructures.

Cisco Grid Security solutions provide:

- **Identity management and access control**: Secure utility facilities, assets, and data with user authentication and access control are custom-built for grid operations.
- **Threat defense**: Build a layered defense that integrates with firewall, VPN, intrusion prevention, and content security services to detect, prevent, and mitigate threats.
- **Data center security**: Turn network, computing, and storage solutions into a secure, shared pool of resources that protects application and data integrity, secures communications between business processes and applications within the utility, and secures connectivity to external resources such as providers of renewable energy.
- **Utility compliance**: Improve risk management and satisfy compliance and regulatory requirements such as NERC-CIP with assessment, design, and deployment services.
- **Security monitoring and management**: Identify, manage, and counter information security threats and maintain compliance through ongoing monitoring of cyber events.

Scale Support

Cisco IoT FND provides the following deployments for the mesh management and router-only management.

- Bare Metal Deployment with Oracle (Mesh Management)
- VM Deployment with Oracle
- VM Deployment with Postgres

- Bare Metal Deployment with Oracle (Router Management)

Bare Metal Deployment with Oracle (Mesh Management)

This deployment is a large-scale AMI deployment for mesh management and supports up to 10,000 routers / 10,000,000 endpoints.

VM Deployment with Oracle

This deployment is a large-scale AMI deployment for mesh management and supports up to 10,000 routers / 10,000,000 endpoints.

VM Deployment with Postgres

This deployment is for router management with the following scale support:

Cisco IoT FND Release	Scale Support
5.0 and later releases	50,000 routers
4.11.0 to 4.12.0	25,000 routers
4.9.1 to 4.10.0	15,000 routers
4.9.0	10,000 routers
4.7.x to 4.8.x	6,000 routers

VM Deployment with Postgres for High Availability (HA)

This deployment is for router management with the following scale support:

Cisco IoT FND Release	Scale Support
Cisco IoT FND Release 26.2.1	50,000 routers
Cisco IoT FND Release 5.1.1	10,000 routers

Bare Metal Deployment with Oracle (Router Management)

This deployment is a small-scale deployment for router management with the following scale support:

Cisco IoT FND Release	Scale Support
4.11.0 and later releases	25,000 routers
4.3 to 4.10	10,000 routers

Achieve scale up to 50,000 routers

Achieve scale up to 50,000 routers

Outlines the feature history and enhancements that enable Cisco IoT FND router scaling.

Table 6: Feature History

Feature Name	Release	Description
Achieve Scale Beyond 25,000 Routers	Cisco IoT FND Release 5.0	Starting from Cisco IoT FND Release 5.0, you can manage upto 50,000 routers using Cisco IoT FND on a VM using Postgres + Influx databases.
Modified GC and memory settings	Cisco IoT FND Release 5.1	Use a script that automatically configures optimal Java heap and GC settings for large-scale Cisco IoT FND deployments, streamlining memory tuning and enhancing performance for environments with 25,000 or more routers.
Achieve Scale upto 50,000 Routers	Cisco IoT FND Release 26.2.1	VM deployment with Postgress for High availability (HA) now support up to 50,000 routers. VM deployment with Oracle for mesh management supports up to 10,000 routers and 10,000,000 endpoints.

Information about achieve scale up to 50,000 routers

Starting from Cisco IoT FND Release 5.0, you manage up to 50,000 routers efficiently on a virtual machine utilizing a PostgreSQL database. This upgrade allows for seamless management of large-scale network deployments.

Benefits of achieving scale up to 50,000 routers

- Scale your network operations significantly, accommodating growth without the need for additional hardware investments.
- Managing a large number of routers from a single platform helps you streamline operations, simplify configuration, and reduce the complexity of managing dispersed devices.

Achieving scale up to 50,000 routers

Here's how you can achieve scale up to 50,000 routers using Cisco IoT FND:

Note We recommend you onboard up to 15 devices, concurrently. Ensure that the number of devices attempting to PnP Bootstrap doesn't exceed 15.

Configure Influx memory

When you upgrade to Cisco IoT FND Release 5.0 and attempt to achieve scale up to 50,000 routers, the Influx DB uses a lot of memory that might bring down the performance of Cisco IoT FND. You can address the high memory usage issue using this topic.

To adjust the Influx DB configuration:

1. Locate the `influxdb.conf` file, typically found in `/etc/influxdb/influxdb.conf`.
2. Open the file using a text editor with root privileges:

   ```
   sudo nano /etc/influxdb/influxdb.conf
   ```
3. Modify the cache settings:
   a. Set the `cache-max-memory-size` to **1g**:

      ```
      cache-max-memory-size = "1g"
      ```
   b. Set the `cache-snapshot-memory-size` to **10m**:

      ```
      cache-snapshot-memory-size = "10m"
      ```

Note The `cache-snapshot-memory-size` property is by default commented out. You should uncomment the property and then enter 10m.

4. Save your changes and exit the editor.
5. Restart the Influx DB.

   ```
   sudo systemctl restart influxdb.service
   ```
6. Verify the status of the service to ensure it’s running correctly:

   ```
   sudo systemctl status influxdb.service
   ```

Configure memory, CPU, and disk space of Cisco IoT FND VM

Before You Begin

Here are the respective minimum CPU, memory, and disk space requirements to achieve scaling up to 50,000 routers:

Table 7: For Non-HA and HA Deployments

Scale	CPU	Memory	Add-on Disk space
10,000 routers	10	32 GB	600 GB
10,000 - 50,000 routers	24 (Cores per socket: 4 and sockets: 6)	96 GB	800 GB

Increase The Disk Space

Here are the instructions to increase the disk space of Cisco IoT FND VM:

1. Intiate a graceful shut down of the VM from within the Cisco IoT FND VM shell.
2. Navigate to VMware vSphere and edit the CPU and memory size. For more information see, Change the Memory Configuration and Configure CPU Resources.

Note We recommend you enter **96 GB** memory and **24** CPU (Cores per socket: 4 and sockets: 6) for a scale of 10,000 - 50,000 routers.

3. Save the memory and CPU configurations.
4. Add a new standard hard disk. For more information see, Add a New Hard Disk to a Virtual Machine.

Note Choose **Thin Provision** from the **Disk Provisioning** drop-down list.

5. Switch on the VM.
6. As a root user, using the SSH command log in to Cisco IoT FND and present the disk changes to the internal Guest OS to extend the logical volume.
7. Log in to Cisco IoT FND server as root using the SSH command and use the `fdisk -l` command to view the partition table of all the disks available on the system.

   Note down the device file for the newly added disk space of 800GB. In our case, it is `/dev/sdb`:

```
[root@iot-fnd ~]# fdisk -l

Disk /dev/sdb: 800 GiB, 858993459200 bytes, 1677721600 sectors

Units: sectors of 1 * 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/sda: 450 GiB, 483183820800 bytes, 943718400 sectors

Units: sectors of 1 * 512 = 512 bytes
```

```
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0xb2ce243b

Device Boot Start End Sectors Size Id Type
/dev/sda1 * 2048 2099199 2097152 1G 83 Linux
/dev/sda2 2099200 943718399 941619200 449G 8e Linux LVM



Disk /dev/mapper/rhel-root: 70 GiB, 75161927680 bytes, 146800640 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/mapper/rhel-swap: 11.8 GiB, 12700352512 bytes, 24805376 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/mapper/rhel-home: 367.2 GiB, 394243604480 bytes, 770007040 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
```

8. Navigate to the device file for the newly added disk and execute the following commands, In our case device file is `/dev/sdb` as noted in step 7.

```
[root@iot-fnd ~]# fdisk /dev/sdb

Welcome to fdisk (util-linux 2.32.1).
Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.

Device does not contain a recognized partition table.
Created a new DOS disklabel with disk identifier 0xbd4033c8.
```

```
Command (m for help): p
Disk /dev/sdb: 800 GiB, 858993459200 bytes, 1677721600 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0xbd4033c8

Command (m for help): n
Partition type
p primary (0 primary, 0 extended, 4 free)
e extended (container for logical partitions)
Select (default p): p
Partition number (1-4, default 1):
First sector (2048-1677721599, default 2048):
Last sector, +sectors or +size{K,M,G,T,P} (2048-1677721599, default 1677721599):

Created a new partition 1 of type ‘Linux’ and of size 800 GiB.

Command (m for help): p
Disk /dev/sdb: 800 GiB, 858993459200 bytes, 1677721600 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0xbd4033c8

Device Boot Start End Sectors Size Id Type
/dev/sdb1 2048 1677721599 1677719552 800G 83 Linux

Command (m for help): t
Selected partition 1
Hex code (type L to list all codes): L

0 Empty 24 NEC DOS 81 Minix / old Lin bf Solaris
```

```
1 FAT12 27 Hidden NTFS Win 82 Linux swap / So c1 DRDOS/sec (FAT-
2 XENIX root 39 Plan 9 83 Linux c4 DRDOS/sec (FAT-
3 XENIX usr 3c PartitionMagic 84 OS/2 hidden or c6 DRDOS/sec (FAT-
4 FAT16 <32M 40 Venix 80286 85 Linux extended c7 Syrinx
5 Extended 41 PPC PreP Boot 86 NTFS volume set da Non-FS data
6 FAT16 42 SFS 87 NTFS volume set db CP/M / CTOS / .
7 HPFS/NTFS/exFAT 4d QNX4.x 88 Linux plaintext de Dell Utility
8 AIX 4e QNX4.x 2nd part 8e Linux LVM df BootIt
9 AIX bootable 4f QNX4.x 3rd part 93 Amoeba e1 DOS access
a OS/2 Boot Manag 50 OnTrack DM 94 Amoeba BBT e3 DOS R/O
b W95 FAT32 51 OnTrack DM6 Aux 9f BSD/OS e4 SpeedStor
c W95 FAT32 (LBA) 52 CP/M a0 IBM Thinkpad hi ea Rufus alignment
e W95 FAT16 (LBA) 53 OnTrack DM6 Aux a5 FreeBSD 2e BeOS fs
f W95 Ext'd (LBA) 54 OnTrackDM6 a6 OpenBSD ee GPT
10 OPUS 55 EZ-Drive a7 NeXTSTEP ef EFI (FAT-12/16/
11 Hidden FAT12 56 Golden Bow a8 Darwin UFS f0 Linux/PA-RISC b
12 Compaq diagnost 5c Priam Edisk a9 NetBSD f1 SpeedStor
14 Hidden FAT16 <3 61 SpeedStor ab Darwin boot f4 SpeedStor
16 Hidden FAT16 63 GNU HURD or Sys af HFS / HFS+ f2 DOS secondary
17 Hidden HPFS/NTF 64 Novell Netware b7 BSDI fs fb Vmware VMFS
18 AST SmartSleep 65 Novell Netware b8 BSDI swap fc Vmware VMKCORE
1b Hidden W95 FAT3 70 DiskSecure Mult bb Boot Wizard hid fd Linux raid auto
1c Hidden W95 FAT3 75 PC/IX bc Acronis FAT32 L fe LANstep
1e Hidden W95 FAT1 80 Old Minix be Solaris boot ff BBT
Hex code (type L to list all codes): 8e
Changed type of partition 'Linux' to 'Linux LVM'.

Command (m for help): w
The partition table has been altered.
Calling ioctl() to re-read partition table.
Syncing disks.
```

Note You have successfully created the new partition for the add-on disk. Ensure to note down the device file for the new partition created `/dev/sdb1` as shown in the logs.

9. Restart the VM. Here's an example:

```
[root@iot-fnd ~]# reboot
```

Create A Physical Volume

1. Login to Cisco IoT FND server as root using the SSH command and Use `fdisk -l` command to view the partition table of all the disks available on the system.

```
[root@iot-fnd ~]# fdisk -l

Disk /dev/sda: 450 GiB, 483183820800 bytes, 943718400 sectors

Units: sectors of 1 * 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes

Disklabel type: dos

Disk identifier: 0xb2ce243b

Device Boot Start End Sectors Size Id Type

/dev/sda1 * 2048 2099199 2097152 1G 83 Linux

/dev/sda2 2099200 943718399 941619200 449G 8e Linux LVM


Disk /dev/sdb: 800 GiB, 858993459200 bytes, 1677721600 sectors

Units: sectors of 1 * 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes

Disklabel type: dos

Disk identifier: 0xbd4033c8

Device Boot Start End Sectors Size Id Type

/dev/sdb1 2048 1677721599 1677719552 800G 8e Linux LVM



Disk /dev/mapper/rhel-root: 70 GiB, 75161927680 bytes, 146800640 sectors

Units: sectors of 1 * 512 = 512 bytes
```

```
Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/mapper/rhel-swap: 11.8 GiB, 12700352512 bytes, 24805376 sectors

Units: sectors of 1 * 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/mapper/rhel-home: 367.2 GiB, 394243604480 bytes, 770007040 sectors

Units: sectors of 1 * 512 = 512 bytes

Sector size (logical/physical): 512 bytes / 512 bytes

I/O size (minimum/optimal): 512 bytes / 512 bytes
```

2. Create a physical volume using `pvcreate <partition-file-name>` command. Use the partition file noted in the previous section. Here's an example:

```
[root@iot-fnd ~]# pvcreate /dev/sdb1
Physical volume "/dev/sdb1" successfully created.
```

3. Determine the volume group to extend using the command `vgdisplay`. Here's an example:

```
[root@iot-fnd ~]# vgdisplay

--- Volume group ---

VG Name rhel

System ID

Format lvm2

Metadata Areas 1

Metadata Sequence No 4

VG Access read/write

VG Status resizable

MAX LV 0

Cur LV 3

Open LV 3

Max PV 0

Cur PV 1

Act PV 1

VG Size <449.00 GiB
```

```
PE Size 4.00 MiB

Total PE 114943

Alloc PE / Size 114943 / <449.00 GiB

Free PE / Size 0 / 0

VG UUID Y0XXtt-lpyz-fkyc-9D3J-lBdV-rJyK-PYCGsH

[root@iot-fnd ~]# lvdisplay

--- Logical volume ---

LV Path /dev/rhel/swap

LV Name swap

VG Name rhel

LV UUID 7tB68Y-z54E-x5eI-sOld-Oeru-WQ3v-qrjGy6

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:55 -0500

LV Status available

# open 2

LV Size <11.83 GiB

Current LE 3028

Segments 1

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:1

--- Logical volume ---

LV Path /dev/rhel/home

LV Name home

VG Name rhel

LV UUID 0B5Jp4-fD08-JGlk-kf5n-gwY5-oiCk-W5kZ0z

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:55 -0500

LV Status available

# open 1
```

```
LV Size <367.17 GiB

Current LE 93995

Segments 1

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:2


--- Logical volume ---

LV Path /dev/rhel/root

LV Name root

VG Name rhel

LV UUID s8Yhkw-gmYQ-B9TR-Zemj-M2gA-xPVx-eXWdnP

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:56 -0500

LV Status available

# open 1

LV Size 70.00 GiB

Current LE 17920

Segments 1

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:0
```

As highlighted above, you need to extend the **Volume Group** named **rhel**.

4. Extend the physical volume using the `vgextend rhel/dev/sdb1` command. Here's an example:

```
[root@iot-fnd ~]#

[root@iot-fnd ~]# vgextend rhel /dev/sdb1

Volume group “rhel” successfully extended

[root@iot-fnd ~]#
```

5. View the logical volumes:

```
[root@iot-fnd ~]# lvdisplay

--- Logical volume ---
```

```
LV Path /dev/rhel/swap

LV Name swap

VG Name rhel

LV UUID 7tB68Y-z54E-x5eI-sOld-Oeru-WQ3v-qrjGy6

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:55 -0500

LV Status available

# open 2

LV Size <11.83 GiB

Current LE 3028

Segments 1

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:1


--- Logical volume ---

LV Path /dev/rhel/home

LV Name home

VG Name rhel

LV UUID 0B5Jp4-fD08-JGlk-kf5n-gwY5-oiCk-W5kZ0z

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:55 -0500

LV Status available

# open 1

LV Size <367.17 GiB

Current LE 93995

Segments 1

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:2
```

```
--- Logical volume ---

LV Path /dev/rhel/root

LV Name root

VG Name rhel

LV UUID s8Yhkw-gmYQ-B9TR-Zemj-M2gA-xPVx-eXWdnP

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:56 -0500

LV Status available

# open 1

LV Size 70.00 GiB

Current LE 17920

Segments 1

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:0
```

6. Extend the Logical Volume: Increases the size of the logical volume `/dev/rhel/root` by 799 GB using space from `/dev/sdb1`.

```
[root@iot-fnd ~]# lvextend -L+799.00G /dev/rhel/root /dev/sdb1

Size of logical volume rhel/root changed from 70.00 GiB (17920 extents) to 869.00 GiB
(222464 extents).

Logical volume rhel/root successfully resized.
```

Note Note that an add-on 800 GB hard disk is added in the example. This results in extending the logical volume by 799 GB. The appropriate value should be used based on the disk space added.

7. Display the **Volume Group** information:

```
[root@iot-fnd ~]# vgdisplay

--- Volume group ---

VG Name rhel

System ID

Format lvm2

Metadata Areas 2

Metadata Sequence No 6
```

```
VG Access read/write

VG Status resizable

MAX LV 0

Cur LV 3

Open LV 3

Max PV 0

Cur PV 2

Act PV 2

VG Size <1.22 TiB

PE Size 4.00 MiB

Total PE 319742

Alloc PE / Size 319487 / <1.22 TiB

Free PE / Size 255 / 1020.00 MiB

VG UUID Y0XXtt-lpyz-fkyc-9D3J-lBdV-rJyK-PYCGsH
```

8. Grow the filesystem: Expand the filesystem on the logical volume `/dev/rhel/root` to use the newly added space.

```
[root@iot-fnd ~]# xfs_growfs /dev/rhel/root

meta-data=/dev/mapper/rhel-root isize=512 agcount=4, agsize=4587520 blks

= sectsz=512 attr=2, projid32bit=1

= crc=1 finobt=1, sparse=1, rmapbt=0

= reflink=1 bigtime=0 inobtcount=0

data = bsize=4096 blocks=18350080, imaxpct=25

= sunit=0 swidth=0 blks

naming =version 2 bsize=4096 ascii-ci=0, ftype=1

log =internal log bsize=4096 blocks=8960, version=2

= sectsz=512 sunit=0 blks, lazy-count=1

realtime =none extsz=4096 blocks=0, rtextents=0

data blocks changed from 18350080 to 227803136
```

9. Check filesystem using the `df -h` command, the root directory size is updated to 869GB.

   Also, use the `lvdisplay` command to confirm that the logical volume is extended, viewing the updated size information.

```
[root@iot-fnd ~]# df -h

Filesystem Size Used Avail Use% Mounted on

devtmpfs 47G 0 47G 0% /dev
```

```
tmpfs 47G 52K 47G 1% /dev/shm

tmpfs 47G 9.4M 47G 1% /run

tmpfs 47G 0 47G 0% /sys/fs/cgroup

/dev/mapper/rhel-root 869G

/dev/sda1 1014M 254M 761M 26% /boot

/dev/mapper/rhel-home 367G 2.6G 365G 1% /home

tmpfs 9.4G 12K 9.4G 1% /run/user/42

overlay 869G 15G 855G 2%
/var/lib/docker/overlay2/c6cace1e574c1fb9212758ee5ceea08fea6da7fb9a3f1f0e65321e524665da09/merged

overlay 869G 15G 855G 2%
/var/lib/docker/overlay2/f34d0ef4ef597f6077357370a4546ad8966a4d576cd5b92806c8f3904d20c1a3/merged

tmpfs 9.4G 0 9.4G 0% /run/user/0

[root@iot-fnd ~]#


[root@iot-fnd ~]# lvdisplay

--- Logical volume ---

LV Path /dev/rhel/swap

LV Name swap

VG Name rhel

LV UUID 7tB68Y-z54E-x5eI-sOld-Oeru-WQ3v-qrjGy6

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:55 -0500

LV Status available

# open 2

LV Size <11.83 GiB

Current LE 3028

Segments 1

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:1


--- Logical volume ---

LV Path /dev/rhel/home
```

```
LV Name home

VG Name rhel

LV UUID 0B5Jp4-fD08-JGlk-kf5n-gwY5-oiCk-W5kZ0z

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:55 -0500

LV Status available

# open 1

LV Size <367.17 GiB

Current LE 93995

Segments 1

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:2


--- Logical volume ---

LV Path /dev/rhel/root

LV Name root

VG Name rhel

LV UUID s8Yhkw-gmYQ-B9TR-Zemj-M2gA-xPVx-eXWdnP

LV Write Access read/write

LV Creation host, time localhost, 2022-02-16 01:14:56 -0500

LV Status available

# open 1

LV Size 869.00 GiB

Current LE 222464

Segments 2

Allocation inherit

Read ahead sectors auto

- currently set to 8192

Block device 253:0
```

For a deployment of up to 25,000 routers, if you add 600 GB of secondary hard disk, the `/dev/mapper/rhel-root` would increase to approximately 670 GB (70 GB default + 600 GB additional).

For a deployment of 50,000 routers, when you add 800 GB of secondary hard disk, this would result in the `/dev/mapper/rhel-root` expanding to approximately 870 GB (70 GB default + 800 GB additional).

Configure Java heap size

Here are the steps to increase the heap size for Cisco IoT FND:

1. Log in to Cisco IoT FND server using the SSH command as a root user.
2. Navigate to and edit the file `/opt/fnd/conf/fnd-env.list`.
3. Add the following lines to configure the heap size if the lines don't exist already:

```
MAX_JVM_HEAP_SIZE=18g
MIN_JVM_HEAP_SIZE=1g
MAX_JVM_PERM_SIZE=512m
```

Note If the lines already exist, modify the values to 18g, 1g, and 512m.

For large-scale deployment (25,000 routers and beyond), modify the values to:

```
MAX_JVM_HEAP_SIZE=24g
MIN_JVM_HEAP_SIZE=1g
MAX_JVM_PERM_SIZE=512m
```

4. Reload the Cisco IoT FND container using the upgrade script in the `/opt/fnd/scripts/upgrade.sh` directory:

```
[root@iot-fnd scripts]# ./upgrade.sh

This script must be run with root privileges.
Usage: Load container images: No resource required
       For container reload: No resource required

1) Load container images
2) Container reload
3) Quit
Enter your choice: 2
```

5. Verify the status:

```
/opt/fnd/scripts/fnd-container.sh status
```

6. Once Cisco IoT FND is up, log in to Cisco IoT FND using the browser.
7. From the Cisco IoT FND menubar, choose **Devices** > **Servers** > **NMS Servers**.
8. Click **IoT-FND+fnd-server** and ensure that the CPU is 24 or more.
9. Ensure that the memory is 93 GB or more.

Note The discrepancy between the 96 GB added and the 93 GB shown is due to the difference in storage measurement units—manufacturers use decimal (1 GB = 1 billion bytes), while systems use binary (1 GiB = 1,073,741,824 bytes)—plus some space is reserved for system overhead.

10. In the **IoT-FND Application Information** area, confirm that the memory allocation is 18 GB.

Edit the retention policy

To edit the retention policy and reduce the retention period:

1. From the Cisco IoT FND menubar, choose **ADMIN** > **Data Retention**.
2. Enter **15** days in the following fields:
   - **Keep Event data for**
   - **Keep Historical Dashboard data for**
   - **Keep Historical Metrics Statistics for**
3. Retain the default value **7** for the **Keep Dashboard data for** and **Keep Device Network Statistics for** fields.
4. Click the **Save** button.

Note You'll see only data for 15 days in the dashlet that is set to display data for 4 weeks.

Implement the recommended property settings

Here are the recommended property settings to achieve scale up to 50,000 routers:

1. From the Cisco IoT FND menubar, choose **ADMIN** > **Server Settings** > **Property Settings**.
2. Enter the following values in the respective fields:
   - **Maximum Router Firmware Upload Count**: **5**.
   - **Maximum Router Firmware Install Count:**: **5**.
   - **Router Firmware Upload Retry Count**: **5**.
   - **Router Push Configuration Count Per Group**: **16**.

Note We recommend that you enter **16** or lesser as the value for the **Router Push Configuration Count Per Group** field.

Configure the metrics interval

To configure the metrics interval:

1. From the Cisco IoT FND menubar, choose **CONFIG** > **Device Configuration**.
2. Choose a router group and navigate to the **Edit Configuration Template** tab.

Note Ensure that you don't exceed 5 groups and a maximum of 1000 devices per configuration group.

3. To adjust the periodic inventory notification interval, find the line `cgna profile cg-nms-periodic`, which is set to report metrics every hour. Change the interval from 60 to 480 or more. Here is an example:

```
cgna profile cg-nms-periodic
interval 480
exit
```

4. Save the Configuration template.
5. Perform a push configuration.

Information about the mhistory_da Kapacitor Task

Starting from Cisco IoT FND Release 5.0, we are disabling the `mhistory_da` task, which runs every 24 hours to aggregate historical metrics, to address the high memory usage by Influx DB. This change has no impact on existing functionalities of Cisco IoT FND.

Edit the VM Settings to Reduce I/O Usage

Here are steps to edit the VM settings (VMX file) to reduce the I/O usage and add host memory:

Caution Adding these settings to a VM can reduce the I/O load on the hard disk; however, these adjustments require additional memory on the host. Add these settings only if there is sufficient free memory on the host to accommodate all the memory allocated to the VM, otherwise this may cause a memory starvation condition that can reduce performance of all the running VMs or possibly affect the host operating system. Exercise caution when using these settings.

Note Ensure you back up the VM before beginning.

Switch off the Cisco IoT FND VM.

2. Navigate to the datastore on the VMware vSphere client.
3. Export the **FND-VM.vmx** file.
4. Add the following lines to the exported `.vmx` file:

```
MemTrimRate="0"
sched.mem.pshare.enable="FALSE"
prefvmx.useRecommendedLockedMemSize="TRUE"
mainmem.backing="swap"
```

5. Re-upload the modified `.vmx` file to the same location in the datastore.
6. Switch the VM back on after the modifications.

Configure GC settings for Cisco IoT FND Release 5.1 upgrade

When you upgrade to Cisco IoT FND Release 5.1 from an older release, you need to modify Garbage Collection (GC) and memory settings to manage large scale deployments (more than 25,000 routers).

Before you begin

- Ensure that you are running Cisco IoT FND on an Postgres OVA based deployment.
- Ensure that you upgrade the RPM script using the `upgrade-ova-5.1.0.rpm` that Cisco shares with you. For more information see, Install Cisco IoT FND RPM.

Here are the instructions to configure the GC settings:

Procedure

Step 1 Navigate to the path `/opt/fnd/scripts/`

Step 2 Run the `setupGCSettingsForLargeScale.sh` script with no arguments:

Example:

```
sudo /opt/fnd/scripts/setupGCSettingsForLargeScale.sh
```

The script modifies `/opt/fnd/conf/fnd-env.list` with the desired GC and memory settings.

Step 3 Reload the Cisco IoT FND container from the `/opt/fnd/scripts`:

a) Run `upgrade.sh`

b) Select **Option 2** to reload the container.

You've successfully configured the GC settings.

What to do next

Check the Cisco IoT FND servers page and confirm that the Java HEAP size is updated to 24 GB.

Configure GC settings for a fresh Cisco IoT FND Release 5.1 install

When you are setting up Cisco IoT FND running Cisco IoT FND Release 5.1, you need to modify GC and memory settings to manage large scale deployments (25,000 routers or more).

Before you begin

- Ensure that you are running Cisco IoT FND on an Postgres OVA based deployment.
- Ensure that you upgrade the RPM script using the `upgrade-ova-5.1.0.rpm` that Cisco shares with you. For more information see, Install Cisco IoT FND RPM.

Here are the instructions to configure the GC settings:

Procedure

Step 1 Navigate to the path `/opt/fnd/scripts/`

Step 2 Run the `setupGCSettingsForLargeScale.sh` script with no arguments:

Example:

```
sudo /opt/fnd/scripts/setupGCSettingsForLargeScale.sh
```

The script modifies `/opt/fnd/conf/fnd-env.list` with the desired GC and memory settings.

Step 3 Reload the Cisco IoT FND container from the `/opt/fnd/scripts`:

a) Run `upgrade.sh`

b) Select **Option 2** to reload the container.

You've successfully configured the GC settings.

What to do next

Check the Cisco IoT FND servers page and confirm that the Java HEAP size is updated to 24 GB.

How to Use This Guide

This section has the following topics to help you quickly find information on common, CGR, mesh endpoint, or administration tasks, and document conventions.

Common Tasks

The table lists tasks that users can perform on both routers and mesh endpoints. The ability to perform tasks is role-based. For information on user roles, see System-Defined User Roles in the Managing User Access chapter.

Table 8: Common Tasks

Task	Use
Device Viewing Tasks	
View Devices	Working with Router Views and Managing Endpoints in the Managing Devices chapter.
Device Labeling Tasks	
Add labels	Add Labels in the Managing Devices chapter.
Remove labels	Removing Labels in the Managing Devices chapter.
Search and Device Filtering Tasks	
Use filters	Using Filters to Control the Display of Devices in the Managing Devices chapter.
Diagnostics and Troubleshooting Tasks	
Ping	Pinging Devices in the Managing Devices chapter.
Traceroute	Tracing Routes to Devices in the Managing Devices chapter.

Task	Use
Download logs	Downloading Logs in the Manage System Settings chapter.
Monitoring Tasks	
View and search events	Monitoring Events in the Monitor System Activity chapter.
View and search issues	Monitoring Issues in the Monitor System Activity chapter.
View tunnel status	Monitoring Tunnel Status in the Manage Tunnel Provisioning chapter.
General Tasks	
Change password	Resetting Passwords in the Manage User Access chapter.
Set time zone	Configuring the Time Zone in the Document Title, Release 4.x.
Set user preferences	Setting Preferences for the User Interface in the Managing Devices chapter.

CGR Tasks

The table lists CGR tasks. For information about user roles, see System-Defined User Roles.

Table 9: CGR Tasks

Task	Use
Router Configuration Group Tasks	
Add CGRs to configuration groups	Creating Device Groups.
Delete a configuration group	Deleting Device Groups.
List devices in a configuration group	Listing Devices in a Configuration Group.
Assign devices to groups	• Adding Routers to IoT FND • Adding HERs to IoT FND • Moving Devices to Another Configuration Group in Bulk • Moving Devices to Another Configuration Group Manually
Rename configuration groups	Renaming a Device Configuration Group.
Router Configuration Tasks	
Change device configuration properties	Changing Device Configuration Properties.
Edit configuration templates	• Editing the Router Configuration Template • Editing the AP Configuration Template

Task	Use
Push configurations	Pushing Configurations to Endpoints.
Monitoring a Guest OS	Monitoring a Guest OS in the Managing Devices chapter.
Tunnel Provisioning Tasks	
Configure tunnel provisioning	Configuring Tunnel Provisioning.
Edit tunnel provisioning templates	Configuring Tunnel Provisioning Templates in the Manage Tunnel Provisioning chapter.
Reprovisioning tunnels	• Tunnel Reprovisioning Template • Factory Reprovisioning Template
Firmware Management Tasks	
Assign devices to firmware groups	Assigning Devices to a Firmware Group.
Upload images to firmware groups	Uploading a Firmware Image to a Router Group.

Mesh Endpoint Tasks

The table lists Mesh Endpoint (ME) tasks. For information about user roles, see System-Defined User Roles.

Table 10: Mesh Endpoint Tasks

Task	Use
ME Configuration Group Tasks	
Add mesh endpoint configuration groups	Creating Device Groups.
Delete mesh endpoint configuration groups	Deleting Device Groups.
Rename mesh endpoint configuration groups	Renaming a Device Configuration Group.
Assign mesh endpoint devices to a configuration group	Moving Devices to Another Group.
List devices in a configuration group	Listing Devices in a Configuration Group.
ME Configuration Tasks	
Change mesh endpoint configuration properties	Changing Device Configuration Properties.
Edit mesh endpoint configuration templates	Editing the Endpoint Configuration Template.
Push configuration to mesh endpoints	Pushing Configurations to Endpoints.
Add mesh endpoint firmware groups	Adding Firmware Groups.
Assign devices to firmware groups	Assigning Devices to a Firmware Group.

Task	Use
Upload images to firmware groups	Uploading a Firmware Image to a Resilient Mesh Endpoint Group.

Administration Tasks

The table lists administration tasks.

Table 11: Administration Tasks

Task	Use
Access Management Tasks	
Set password policies	Managing Password Policy, on page 93
Define roles	Managing Roles and Permissions, on page 121
Manage user accounts	Managing Users, on page 114
Manage Authentication	Managing User Authentication, on page 94
Manage Domains	Managing Domains, on page 118
System Management Tasks	
Manage active sessions	Managing Active Sessions, on page 130
Display the audit trail	Displaying the Audit Trail, on page 133
Manage certificates	Managing Certificates, on page 135
Configure data retention	Configure data retention, on page 138
Manage licenses	Managing Licenses, on page 139
Manage logs	Cisco IoT FND Logs, on page 139
Configure server settings	Configuring Server Settings, on page 148
Manage the syslog	Manage System Settings, on page 129
Configure tunnel settings	Configuring Provisioning Settings, on page 144
View logs	Cisco IoT FND Logs, on page 139

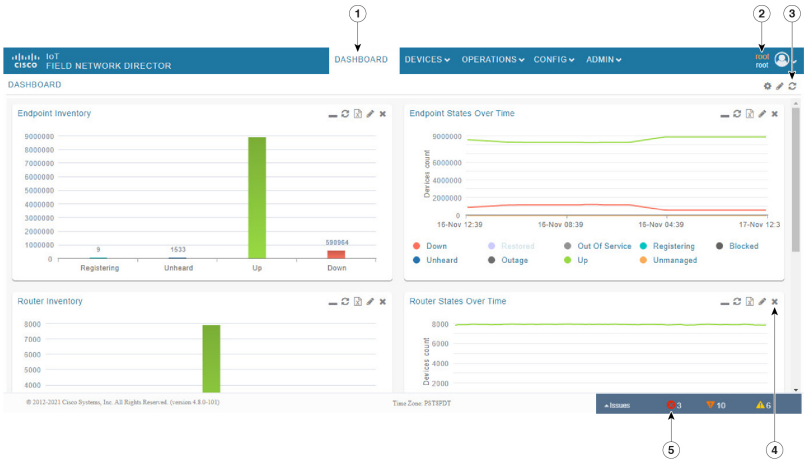
Interface Overview

The Interface Overview provides a general overview of the IoT FND GUI.

IoT FND Interface Overview Details

The IoT FND displays the dashboard after you log in. See “Using the Dashboard” in the Monitoring System chapter of this guide.

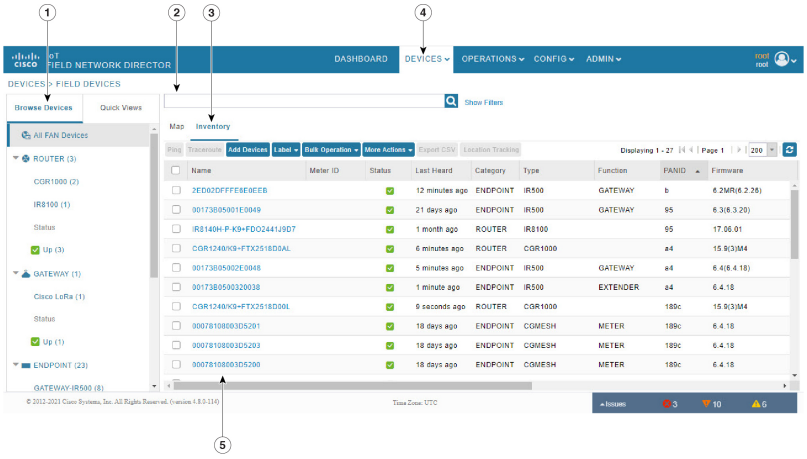
Figure 4: IoT FND Dashboard



1	Menu and Submenu tabs. Roll over the menus to display submenus, which display as tabs below the main menus.	4	Dashlet action buttons, from left to right: • Minimize or close the dashlet window • Refresh the dashlet • Export data • Filter, when available • Close the dashlet

2	<user name> menu • Preferences: Sets display settings of the user interface. • Switch Domain • Change Password • Time Zone • Guided Tour • Log Out	5	Issues Status bar Summary of issues by device and severity. Viewing Device Severity Status on the Issues Status Bar
3	• Dashboard Settings: Sets the refresh rate and adds dashlets to the dashboard. • Filter: Defines custom filters and selectable time periods. • Refresh page.		

Figure 5: Main Window Elements



1	Browse Devices Pane	4	Main Menu
2	Filters	**5**	Device EID links to the Device Info page
3	Inventory page displays multiple entries of the same open issue for a device as a single entry.		

Working with Views

Use the Browse Devices pane to view default and custom groups of devices. The total number of registered devices displays next to the Browse Devices pane.

You can refine the List display using Filters. Built-in filters are automatically deployed by clicking a device group in the Browse Devices pane. Use the Quick View tab to access saved custom filters.

Click the device Name or EID link to display a device information page. Click the **<<Back** link in the Device Info page to return to the previous page.

Using the Tabs

Each device page has tabs in the main window to view associated information. The active tab is in bold type when you are on that tab. See Main Window Elements.

Navigating Page Views

By default, device management pages display in List view. On the Routers and Mesh pages, select the Map tab to display devices on a GIS map. See Viewing Devices in Map View and Viewing Mesh Endpoints in Map View.

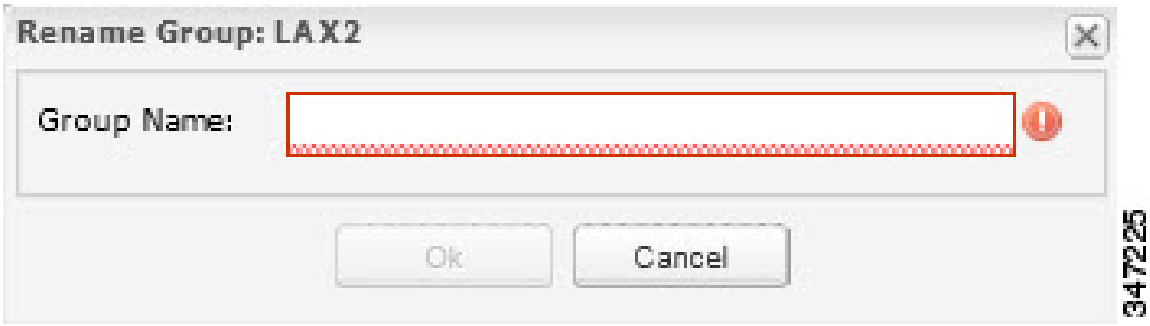
Working with Filters

Create custom filters by clicking the Show Filters link and using the provided filter parameters in the Search Devices field. Click the Quick Views tab to display saved custom filters. See Create or Edit Quick View Filters.

Completing User-entry Fields

Errored Group Name User-entry Field shows an error in the user-entry field. IoT FND displays a red alert icon, highlights the field in red, and disables the **OK** button. These errors occur when an invalid character is entered or when a required entry is not completed.

Figure 6: Errored Group Name User-entry Field



Use guided tours

Use this task to enable and start guided tours in Cisco IoT FND.

Guided tours are opened from the dashboard or the root user menu and step users through configuration pages and windows.

Before you begin

Note The Guided Tour feature must be enabled by the first-time FND root user that logs into the FND system before you can use the feature.

Procedure

Step 1 At first login, as a root user, click Dashboard. A No Devices or Dashlets panel appears, which displays the following options: ADD LICENSE, ADD DEVICES, ADD DASHLET and GUIDED TOUR.

Step 2 Click GUIDED TOUR.

Note
You may need to add a license or create a dummy device to enable the Guided Tour.

Step 3 At the root user menu (upper-right corner) that appears, select Guided Tour. This opens a Guided Tour Settings window that lists all available Guided Tours:

- Add Devices
- Device Configuration
- Device Configuration Group Management
- Tunnel Group Management
- Tunnel Provisioning
- Provisioning Settings
- Firmware Update
- Zero Touch Provisioning Setup Guided Tour

Step 4 After you select one of the Guided Tours, you will be redirected to the Sign In pane. That configuration page and windows appear to step you through the configuration steps and let you Add or Update Values as necessary.

Note
When you select the Zero Touch Provisioning option list in step 3 above, a Zero Touch Provisioning setup guided tour window appears that lists all the prerequisites for the device on-boarding: (Provisioning Settings, Group Management, Manage Configuration: Bootstrap Template, Tunnel Provisioning, Device Configuration, Add Devices).

Icons

The table lists the icons that display in the UI.

Table 12: IoT FND Icons

Icon	Description
	This router icon is used for CGRs, ISRs, and IRs (routers), and HERs.
	This is the server icon.
	This is the DA gateway (IR500) device icon.
	This is a meter icon.
	This is an endpoint icon. Its color varies based upon status of the device.
	The up icon indicates that the device is up and online.
	The down icon indicates that the device is down.
	The unheard icon indicates that the device has not yet registered with IoT FND.
	The outages icon indicates that the device is under power outage.
	The restored icon indicates that the device has recovered from an outage.
	The default group icon indicates that this is the top-level device group. All devices appear in this group after successful registration.
	This is the Add Group icon.
	These are the Edit and Delete Group icons.
	On the Events page, click this button to initiate an export of event data to a CSV file.
	The Group icon indicates that this is a custom device group.

Icon	Description
	The Custom Label icon indicates a group of devices. Use labels to sort devices into logical groups. Labels are not dependent on device type; devices of any type can belong to any label. A device can also have multiple labels.
	On the Dashboard page, click this button to set the refresh data interval and add dashlets.
	On the Dashboard page, click this button to initiate an export of dashlet data to a CSV file.
	On the Dashboard page, click this button to refresh dashlet data.
	On the Dashboard page, click this button to change the data retrieval interval setting and add filters to the dashlets. On line-graph dashlets, this button not only provides access to the data retrieval interval setting and filters, but you can also access graph-specific data settings. This icon is green when a filter is applied.
	On the Dashboard page in the dashlet title bar, click this button to show/hide the dashlet. When the dashlet is hidden, only its title bar displays in the Dashboard.
	In Map view, this is the RPL tree root device icon. This can be a CGR or mesh device, as set when Configuring RPL Tree Polling. The colors reflect the device status: Up, Down, and Unheard. The RPL tree connection displays as blue or orange lines. • Orange lines indicate that the link is up. • Blue lines indicate that the link is down.
	In Map view, this is a device group icon. The colors reflect the device status: Up, Down, and Unheard.
	On the Events and Issues pages, and on the Issues Status bar, these icons indicate the event severity level, top-to-bottom, as follows: • Critical • Major • Minor • Info Each event type has a preset severity level. For example, a Router Down event is a Major severity level event.
	On the Firmware Update page, click the Schedule Install and Reload button to configure firmware updates.
	On the Firmware Update page, click the Set as Backup button to set the selected image as the firmware image backup.

Main Menus

This section describes the IoT FND menus such as dashboard, admin, config, devices, and operations available in the title bar at the top of the page.

Dashboard Menu

This user-configurable page displays information about the connected grid.

Devices Menu

The Devices menu provides access to the device management pages:

- Field Devices-This page displays a top-level view of registered routers and mesh endpoints in your grid.
- Head-End Routers-This page displays a top-level view of registered HERs in your grid.
- Servers-This page displays a top-level view of IoT FND and database servers in your network.
- Assets-This page displays non-Cisco equipment that is mapped to Cisco equipment that is managed by IoT FND. Up to five assets can be mapped to a Cisco device and you can upload up to five files (such as .jpeg or .txt) that support those assets.

Operations Menu

The Operations menu provides access to the following tabs:

- Events—This page displays events that have occurred in your grid.
- Issues—This page displays unresolved network events for quick review and resolution by the administrator.
- Tunnel Status—This page lists provisioned tunnels and displays information about the tunnels and their status.
- Work Orders – This page allows users to add, edit, or delete a work order.

Config Menu

The Config menu provides access to the following tabs:

- Device Configuration—Use this page to configure device properties.
- Firmware Update—Use this page to install a new image on one or multiple devices, change the firmware group of a device, view the current firmware image on a device (routers, endpoints) and view subnet details on mesh endpoints.
- Device File Management—Use this page to view device file status, and upload and delete files from FARs.
- Rules—Use this page to create rules to check for event conditions and metric thresholds.
- Tunnel Provisioning—Use this page to provision tunnels for devices.
- Groups—Use this page to assign devices to groups.

Admin Menu

The Admin menu is divided into two areas for managing system settings and user accounts:

- Access Management pages:
  - Domains—Use this page to add domains and define local or remote administrators and users.
  - Password Policy—Use this page to set password conditions that user passwords must meet.
  - Authentication—Use this page to configure local, remote, or Single Sign-On authentication for IoT-DM users.
  - Roles—Use this page to define user roles.
  - Users—Use this page to manage user accounts.
- System Management pages:
  - Active Sessions—Use this page to monitor IoT FND sessions.
  - Audit Trail—Use this page to track user activity.
  - Certificates—Use this page to manage certificates for CSMP (CoAP Simple Management Protocol), IoT-DM, and the browser (Web) used by IoT FND.
  - Data Retention—Use this page to determine the number of days to keep event, issue, and metric data in the NMS database.
  - License Center—Use this page to view and manage license files.
  - Logging—Use this page to change the log level for the various logging categories and download logs.
  - Provisioning Settings—Use this page to configure the IoT FND URL, and the Dynamic Host Configuration Protocol v4 (DHCPv4) Proxy Client and DHCPv6 Proxy Client settings to create tunnels between CGRs and ASRs.
  - Server Settings—Use this page to view and manage server settings.
  - Syslog Settings—Use this page to view and manage syslog settings.
  - Jobs – Use this page to view the detailed summary of the jobs and their respective sub jobs.

User interface preferences

Provides configuration options for the user interface, accessible via the Preferences menu located in the upper-right corner of the UI.

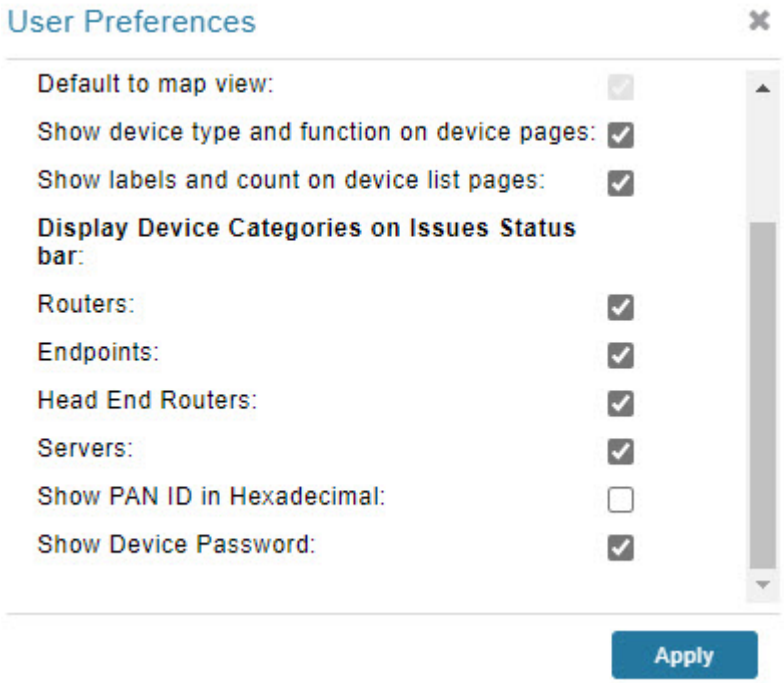


Table 13: User Preference Settings

Options	Description
Show chart on events page	Displays the device events in chart for the current day. To view the chart, go to the OPERATIONS > Events page.
Show summary counts on events/issues page	Displays the summary of the device events and issues, based on the severity level, in the left pane. To view events, go to OPERATIONS > Events page. To view issues, go to OPERATIONS > Issues page.
Enable map	Displays the Map tab in the DEVICES > Field Devices and the OPERATIONS > Issues pages.
Default to map view	Sets the Map tab as the default view in the DEVICES > Field Devices and the OPERATIONS > Issues pages. **Note** To use this option, you must check the Enable Map check box.
Show device type and function on device pages	Displays the device types in the left pane and device function tabs in the right pane of the Device Listing page.

Options	Description
Show labels and counts on device list pages	Displays the device status and count for each device type in the left pane of the Device Listing page.
Display Device Categories on Issues Status bar	The Issues Status bar located in the right-lower end of the user interface displays the device issues for all the device categories. However, you have the option to select the device category as per the requirement. • Routers • Endpoints • Head End Routers • Servers
Show Device Password	The Show Device Password option is available only for the root users and the user with permission "Manage Device Credentials". For other users, this option is not available. By default, this option is not selected. Check the Show Device Password check box and click Apply to view the device credentials under Config Properties tab in the Device Details page.
Show PAN ID in hexadecimal	Displays the PAN ID in hexadecimal in the Device Listing page.

EID Field

Table 14: Feature History

Feature Name	Release Information	Description
EID Field	Cisco IoT FND Release 5.0	EID field is added in most of the Cisco IoT FND pages for you to access the **Device Info** of the devices which are associated with the EID.

Information About EID Field

Endpoint Identifier (EID) is used to uniquely identify a device or entity within a system. Starting from Cisco IoT FND Release 5.0, a new column called EID is available in all the Cisco IoT FND interface pages. Each EID has a link which you can click, to access the details of each device. The EID column appears along with the device name column in all the tables and pages.

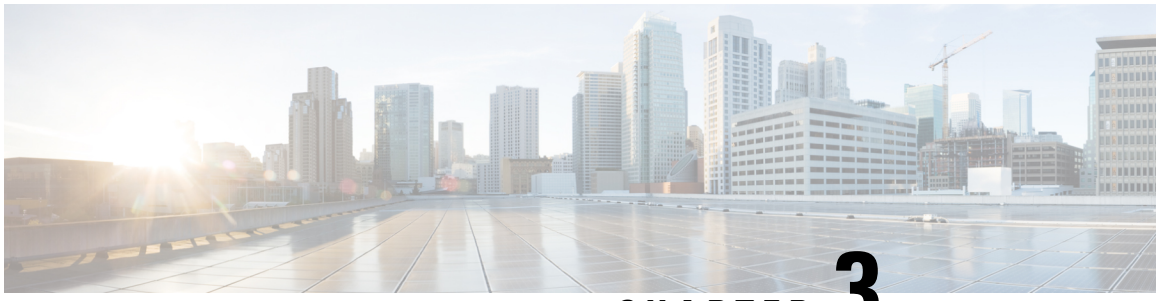
Benefits of EID Link

EID links allow easy navigation to the **Device Info** page with a single click. It is now easier to locate and view any device from any page using the EID link from any page in the Cisco IoT FND interface.

The EID links are present in:

Table 15: EID Links

EID Links	Navigation
Devices	Choose **Devices** > • **Field Devices**, • **Head-End Routers**, • **Servers**,
Operations	Choose **Operations** > • **Events**, • **Issues**, • **Tunnel Status**,
Config	Choose **Config** > • **Device Configuration**, • **Firmware Update**, • **Device File Management**, • **Tunnel Provisioning**. • **Groups**,



CHAPTER 3

Simplified Cisco IoT FND Architecture

Tunnel management with a unique Pre-Shared Key (PSK) and the assignment of IP addresses using Cisco IoT FND IP Address Management (IPAM) aims to simplify the configuration process and reduce the number of components in Cisco IoT FND. In the simplified architecture, the PSK replaces existing security components such as CA, AAA, and RA, while the IPAM replaces the external DHCP server. This simplified architecture is supported only in greenfield deployments and is designed for router management only.

However, you have the discretion to use a unique PSK and the IPAM in the architecture. Cisco IoT FND continues to support existing PKI-based certificate communication between FAR and Cisco IoT FND, PKI-based certificates for tunnels between FAR and HER, and external DHCP servers for tunnel IP addressing.

Tunnel Management with Pre-Shared Key

A unique pre-shared key (PSK) solution is used for the tunnel management between FAR and HER, which significantly simplifies the authentication and authorization process in the headend infrastructure and allows the users to self-manage. The PSK is supported on all Cisco IOS and IOS-XE device types.

The table provides various scenarios where PSK can be used effectively in combination with either SUDI or a CA server in the greenfield deployment.

Deployment	Scenario	Recommendation
Greenfield deployment	Without CA server	• Use PSK for authentication and authorization of communication between FAR and HER. • Use SUDI for authentication and authorization of communication between FND and FAR.
	With CA server	Choose one of the following combinations: • Use PSK for authentication and authorization of communication between FAR and HER. • Use a custom CA certificate for authentication and authorization of communication between FND and FAR. (or) • Use a custom CA certificate for authentication and authorization of communication between both FAR and HER, FND and FAR.
Note In both scenarios, with or without CA server, it is mandatory to generate the IoT FND certificate from the CA server and install it on the IoT FND server (cgms_keystore).		

Note For the brownfield deployment, IoT FND continues to support CA, RA, and AAA for the FAR communication with FND and HER.

Configuring FND for Tunnel Management with PSK

Use the following steps to configure FND for managing tunnels with PSK.

Procedure

Step 1 Run the following script to configure FND with IPAM and PSK settings.

```
/opt/cgms/bin/setupCgms.sh
```

```
Do you want to change IPAM and PSK Settings (y/n)? y
```

Step 2 On entering "**y**", you are provided with a new option to select PSK scheme for IPsec tunnel management.

```
Do you want to manage Tunnels using Unique Pre-Shared Keys (y/n)? y

08-20-2023 12:43:03 IST: INFO: User response: y
08-20-2023 12:43:03 IST: INFO: FND Configured to manage Tunnels using Unique Pre-Shared Keys
08-20-2023 12:43:03 IST: INFO: ========== IoT-FND Setup Completed Successfully ==========
```

Step 3 On entering "**y**", FND is configured with PSK.

FND updates the Preferences table by setting the property `com.cisco.cgms.pnp.tunnelMgmtUsingPsk` as True. By default, this property is False.

Generating PSK

A unique pre-shared key is generated when you import a device through CSV or NB API. The pre-shared key is a 15-character alphanumeric string which is unique and generated randomly for each device. The generated key is encrypted and stored in the database for each router. For more information on tunnel management with PSK, see Workflow for Tunnel Management with PSK, on page 70.

Default templates

Templates are used for pushing the configuration commands and data to devices from Cisco IoT FND. Templates help in configuring many devices simultaneously with a single file. Numerous templates are available for tunnel management based on different device configurations.

These default templates are available for tunnel management:

- Router Tunnel Addition Template,
- HER Tunnel Addition Template,
- Router Bootstrap Configuration Template,
- HER Tunnel FlexVPN Configuration Template.

Table 16: Feature History

Release Information	Feature Name	Description
Cisco IoT FND Release 4.11.0	Tunnel Management with pre-shared key (PSK)	PSK is used during the tunnel provisioning to authenticate the communication between FAR and HER. This feature reduces the certificate dependency for tunnel formation. If PSK is enabled as part of Cisco IoT FND installation, then Cisco IoT FND generates a unique pre-shared key for each FAR in Cisco IoT FND. .
Cisco IoT FND Release 5.1	Template Versioning	Template versioning allows you to create new Cisco IoT FND templates with unique version numbers from both existing as well as newly created templates. You can create, edit, save or delete templates using template versioning in Cisco IoT FND.

Template versioning in Cisco IoT FND

Starting from the Cisco IoT FND release 5.1.0, you can create new templates with unique version numbers from both existing as well as newly created templates. You can use the templates for pushing configuration commands from Cisco IoT FND to devices.

Template versioning lets you track and manage changes to your configuration templates. You can save the latest template as a new version or choose to select an existing template from the previously saved versions for configuring devices in Cisco IoT FND.

Consider these points before using template versioning in Cisco IoT FND:

- The template's version number is assigned automatically by Cisco IoT FND itself in a sequential order.
- The first template which already exists is referred to as the default template.
- The latest template version is auto-selected and appears in the combo box with a text area, which you can use for editing configuration details of any device.
- Whenever Cisco IoT FND is upgrade to 5.1.0 from the earlier versions, then the previous version template appears as the latest template version in Cisco IoT FND 5.1.0. Also, the default template version is created based on the device types.
- For config groups prior to Cisco IoT FND release 5.1.0, the latest template version will be version-2 and in Cisco IoT FND release 5.1.0 the default template is version-1.

- For tunnel provisioning groups, prior to Cisco IoT FND release 5.1.0, the latest template version will be version-1 and in Cisco IoT FND release 5.1.0 the default template is version-0.
- Template versioning does not apply to individual devices and you need to consider this before using the **Device Info** > **Push Configuration** option.

Supported devices

Template versioning is enabled for these devices in Cisco IoT FND, which are running:

Software	Routers
Cisco IOS XE	The supported routers running Cisco IOS XE: • Cisco Catalyst IR8100, • Cisco Catalyst IR1800, • Cisco Catalyst IR1100,
Cisco IOS	The supported running Cisco IOS: • Cisco Catalyst IR800, • Cisco Connected Grid Router CGR1000.

Benefits of template versioning

The template versioning feature allows you to:

- Easily identify and manage previously used templates with different version numbers.
- Reuse or modify configuration details of devices by creating a new template with the latest version.
- Easily track modifications and revert to previously saved template configurations.
- Refer to template changes for troubleshooting purposes.

Configure template using device configuration

Use this task to save a template.

Before you begin

You need to consider the following points before configuring and saving new templates:

- When you edit or make changes to any existing template then that template becomes the latest template.
- You can only save the latest version of the template which can be used to generate the next version of the template later.
- All previous versions of the templates except the latest version will appear as read only templates and you cannot edit or modify these versions.
- There is no maximum limit set for the number of templates that you can create at any given time.

- You can save a new version of the template even if **Target Firmware Version** is changed in the **Router Bootstrap Configuration** tab.
- The default template version is version-1 in **CONFIG** > **Device Configuration** page.

Procedure

Step 1 From the Cisco IoT FND menubar, select **CONFIG** > **Device Configuration**.
Step 2 Select the router from the router group.
Step 3 Click **Edit Configuration Template**.
Step 4 Edit the latest template using the text area which appears with the template.
Step 5 Click **Save**.

Cisco IoT FND saves the template as a new version with the latest version number.

Note If you click **Save** without modifying the latest template, then you will receive a message stating that there were no changes made in the template. In this case, edit the template and then try saving it again.

What to do next

You can push the saved configuration in the template using the **Push Configuration** option, see Pushing Configurations to Routers.

Configure template using tunnel provisioning page

Use this task to save a template.

Before you begin

You need to consider the following points before configuring and saving new templates:

- When you edit any existing template or make changes to the existing template then that template becomes the latest template.
- You can only save the latest version of the template which can be used to generate the next version of the template later.
- All previous versions of the templates other than the latest version will appear as read only templates and you cannot edit or modify them.
- There is no maximum limit set for the number of templates that you can create at any given time.
- The default template version is version-0 in the **CONFIG** > **Tunnel Provisioning** page.

Procedure

Step 1 From the Cisco IoT FND menubar, select **CONFIG** > **Tunnel Provisioning** page.

Step 2 Choose and click from the menu options as given:

- **Tunnel Provisioning** > **Router Tunnel Addition**,
- **Tunnel Provisioning** > **HER Tunnel Addition**,
- **Tunnel Provisioning** > **HER Tunnel Deletion**,
- **Tunnel Provisioning** > **Router Bootstrap Configuration.**

Step 3 Select router from the router group.

Step 4 Edit the latest template using the text area.

Step 5 Click **Save**.

The template is saved as a new template with the latest version number.

Note If you click **Save** without modifying the latest template, then you will receive a message indicating there were no changes made in the template. In this case you can try creating the template once again.

What to do next

You can push the saved configuration in the template using the **Push Configuration** option, see Pushing Configurations to Routers.

View template using device configuration

Use this task to view template using device configuration option.

Procedure

Step 1 From the Cisco IoT FND menubar, select **CONFIG** > **Device Configuration**.

Step 2 Select router from the router group.

Step 3 Select the template version you want to view from the **Template Version** drop-down list.

You will see the template details displayed in the text area.

View template using tunnel provisioning

Use this task to view template using tunnel provisioning option.

Procedure

Step 1 From the Cisco IoT FND menubar, select **CONFIG**.

Step 2 From **CONFIG** page, choose and click from the menu options as given:

- **Tunnel Provisioning** > **Router Tunnel Addition**,
- **Tunnel Provisioning** > **HER Tunnel Addition**,
- **Tunnel Provisioning** > **HER Tunnel Deletion**,
- **Tunnel Provisioning** > **Router Bootstrap Configuration.**

Step 3 Select router from the router group.

Step 4 Select the template version you want to view from the **Template Version** drop-down list.

You will see the template details displayed in the text area.

Delete template

Use these steps to delete a template.

Before you begin

You cannot delete the latest template and the default template versions as the delete button is disabled for these versions.

You can access the template versioning combo box , by selecting one of these two navigation paths in Cisco IoT FND from the Cisco IoT FND menubar:

- **CONFIG** > **Device Configuration**.
- **CONFIG** >
  - **Tunnel Provisioning** > **Router Tunnel Addition**,
  - **Tunnel Provisioning** > **HER Tunnel Addition**,
  - **Tunnel Provisioning** > **HER Tunnel Deletion**,
  - **Tunnel Provisioning** > **Router Bootstrap Configuration.**

Procedure

Step 1 From the template versioning combo box select a template version.

Step 2 Click **Delete**.

The template is deleted.

Router tunnel addition template

There are two default router addition templates available for authentication. Based on the configuration settings in `setupCgms.sh`, the default template is selected to manage tunnels using PSK.

Configure router tunnel addition using template

Use this task to configure the router tunnel addition using template.

Before you begin

Note By default, the peer name is set to `her-tunnel` in `crypto ikev2 keyring FlexVPN_Keyring` and `Flexvpn_ikev2_profile`. You can configure the peer name to match the name that is given in `identity local key-id` in the HER configuration.

Procedure

Step 1 Edit the template as given in the example to configure router tunnel addition.

Example:

```
<#-- This template only supports FARs running IOS. -->
<#if !far.isRunningIos()>
  ${provisioningFailed("FAR is not running IOS")}
</#if>

<#--
  For FARs running IOS configure a FlexVPN client in order to establish secure
  communications to the HER. This template expects that the HER has been
  appropriately pre-configured as a FlexVPN server.
-->
<#if far.isRunningIos()>
  <#assign sublist=far.eid?split("+")[0..1]>
  <#assign sn=sublist[1]>
  <#--
    Configure a Loopback0 interface for the FAR.
  -->
  interface Loopback0
    <#--
      If the loopback interface IPv4 address property has been set on the CGR
      then configure the interface with that address. Otherwise obtain an
      address for the interface now using DHCP.
    -->
    <#if far.loopbackV4Address??>
      <#assign loopbackIpv4Address=far.loopbackV4Address>
    <#elseif far.isIPAMForLoopbackSelected()??>
      <#assign loopbackIpv4Address=far.IPAMForLoopbackIpv4()>
    <#else>
      <#--
        Obtain an IPv4 address that can be used to for this FAR's Loopback
        interface. The template API provides methods for requesting a lease from
        a DHCP server. The IPv4 address method requires a DHCP client ID and a link
        address to send in the DHCP request. The 3rd parameter is optional and
        defaults to "IoT-FND". This value is sent in the DHCP user class option.
```

```
        The API also provides the method "dhcpClientId". This method takes a DHCPv6
        Identity association identifier (IAID) and a DHCP Unique IDentifier (DUID)
        and generates a DHCPv4 client identifier as specified in RFC 4361. This
        provides some consistency in how network elements are identified by the
        DHCP server.
      -->
      <#assign
loopbackIpv4Address=far.ipv4Address(dhcpClientId(far.enDuid,0),far.dhcpV4LoopbackLink).address>
    </#if>
    ip address ${loopbackIpv4Address} 255.255.255.255
    <#--
      If the loopback interface IPv6 address property has been set on the CGR
      then configure the interface with that address. Otherwise obtain an
      address for the interface now using DHCP.
    -->
    <#if far.loopbackV6Address??>
      <#assign loopbackIpv6Address=far.loopbackV6Address>
    <#elseif far.isIPAMForLoopbackSelected()??>
      <#assign loopbackIpv6Address=far.IPAMForLoopbackIpv6()>
    <#else>
      <#--
        Obtain an IPv6 address that can be used to for this FAR's loopback
        interface. The method is similar to the one used for IPv4, except clients
        in DHCPv6 are directly identified by their DUID and IAID. IAIDs used for
        IPv4 are separate from IAIDs used for IPv6, so we can use zero for both
        requests.
      -->
      <#assign loopbackIpv6Address=far.ipv6Address(far.enDuid,0,far.dhcpV6LoopbackLink).address>
    </#if>
    ipv6 address ${loopbackIpv6Address}/128
  exit

  <#--
    Default to using FlexVPN for the tunnel configuration of FARs running IOS.
  -->
 <#if (far.useFlexVPN!"true") = "true">
    <#--
      IPv4 ACL which specifies the route(s) FlexVPN will push to the HER.
      We want the HER to know the route to the CGR's loopback interface.
    -->
    ip access-list standard FlexVPN_Client_IPv4_LAN
      permit ${loopbackIpv4Address}
    exit

    <#--
      IPv6 ACL which specifies the route(s) FlexVPN will push to the HER.
      We want the HER to know the route to the CGR's loopback interface.
      If a mesh has been configured on this CGR we want the HER to know the route to the mesh.
    -->
    ipv6 access-list FlexVPN_Client_IPv6_LAN
      <#if far.meshPrefix??>
        permit ipv6 ${far.meshPrefix}/64 any
      </#if>
      sequence 20 permit ipv6 host ${loopbackIpv6Address} any
    exit

    <#--
      FlexVPN authorization policy that configures FlexVPN to push the CGR LAN's
      specified in the ACLs to the HER during the FlexVPN handshake.
    -->
    crypto ikev2 authorization policy FlexVPN_Author_Policy
      route set access-list FlexVPN_Client_IPv4_LAN
      route set access-list ipv6 FlexVPN_Client_IPv6_LAN
      route set interface
```

```
exit

crypto ikev2 proposal FlexVPN_IKEv2_Proposal
  encryption aes-cbc-256
  group 14
  integrity sha256
exit
crypto ikev2 policy FLexVPN_IKEv2_Policy
  proposal FlexVPN_IKEv2_Proposal
exit

<#-- FlexVPN authorization policy is defined locally. -->
aaa authorization network FlexVPN_Author local

crypto ikev2 keyring FlexVPN_Keyring
  peer her-tunnel
    address ${far.ipsecTunnelDestAddr1}
    identity key-id her-tunnel
    pre-shared-key ${far.mgmtVpnPsk}
  exit
exit

crypto ikev2 profile FlexVPN_IKEv2_Profile
  match identity remote key-id her-tunnel
  identity local fqdn ${sn}.cisco.com
  authentication remote pre-share
  authentication local pre-share
  keyring local FlexVPN_Keyring
  dpd 120 3 periodic
  aaa authorization group psk list FlexVPN_Author FlexVPN_Author_Policy
exit

<#--
  If the headend router is an ASR then use a different configuration for the
  transform set as some ASR models are unable to support the set we'd prefer
  to use.
-->
<#if her.pid?contains("ASR")>
  crypto ipsec transform-set FlexVPN_IPsec_Transform_Set esp-aes esp-sha-hmac
    mode tunnel
  exit
<#else>
  crypto ipsec transform-set FlexVPN_IPsec_Transform_Set esp-aes esp-sha256-hmac
    mode tunnel
  exit
</#if>

crypto ipsec profile FlexVPN_IPsec_Profile
  set ikev2-profile FlexVPN_IKEv2_Profile
  set pfs group14
  set transform-set FlexVPN_IPsec_Transform_Set
exit

<#assign wanInterface=far.interfaces(far.tunnelSrcInterface1!"Cellular")>
interface Tunnel0
  description IPsec tunnel to ${her.eid}
  ip unnumbered loopback0
  ipv6 unnumbered loopback0
  tunnel destination dynamic
  tunnel protection ipsec profile FlexVPN_IPsec_Profile
  tunnel source ${wanInterface[0].name}
exit

<#if !(far.ipsecTunnelDestAddr1??)>
```

```
    ${provisioningFailed("FAR property ipsecTunnelDestAddr1 must be set to the destination address
to connect this FAR's FlexVPN tunnel to")}
  </#if>
  crypto ikev2 client flexvpn FlexVPN_Client
    peer 1 ${far.ipsecTunnelDestAddr1}
    client connect Tunnel0
  exit
  ip http secure-client-auth
  no ip http tls-version TLSv1.2
 <#else>
  <#--
    Configure the tunnel using DMVPN.
  -->
  router eigrp 1
    network ${loopbackIpv4Address}
  exit
  ipv6 router eigrp 2
    no shutdown
  exit
  interface Loopback0
    ipv6 eigrp 2
  exit
  crypto ikev2 proposal DMVPN_IKEv2_Proposal
    encryption aes-cbc-256
    group 14
    integrity sha256
  exit
  crypto ikev2 policy DMVPN_IKEv2_Policy
    proposal DMVPN_IKEv2_Proposal
  exit
  crypto ikev2 keyring DMVPN_Keyring
    peer her-tunnel
      address ${far.ipsecTunnelDestAddr1}
      identity key-id her-tunnel
      pre-shared-key ${far.mgmtVpnPsk}
    exit
  exit
  crypto ikev2 profile DMVPN_IKEv2_Profile
    match identity remote key-id her-tunnel
    identity local fqdn ${sn}.cisco.com
    authentication remote pre-share
    authentication local pre-share
    keyring local DMVPN_Keyring
    dpd 120 3 periodic
  exit
  <#--
    If the headend router is an ASR then use a different configuration for the
    transform set as some ASR models are unable to support the set we'd prefer
    to use.
  -->
  <#if her.pid?contains("ASR")>
    crypto ipsec transform-set DMVPN_IPsec_Transform_Set esp-aes esp-sha-hmac
      mode tunnel
    exit
  <#else>
    crypto ipsec transform-set DMVPN_IPsec_Transform_Set esp-aes 256 esp-sha256-hmac
      mode tunnel
    exit
  </#if>
  crypto ipsec profile DMVPN_IPsec_Profile
    set ikev2-profile DMVPN_IKEv2_Profile
    set pfs group14
    set transform-set DMVPN_IPsec_Transform_Set
  exit
```

```
    <#if !(far.nbmaNhsV4Address??)>
      ${provisioningFailed("FAR property nbmaNhsV4Address has not been set")}
    </#if>
    <#if !(far.nbmaNhsV6Address??)>
      ${provisioningFailed("FAR property nbmaNhsV6Address has not been set")}
    </#if>
    <#assign wanInterface=far.interfaces(far.tunnelSrcInterface1!"Cellular")>
    interface Tunnel0
      <#assign lease=far.ipv4Address(dhcpClientId(far.enDuid,1),far.dhcpV4TunnelLink)>
      ip address ${lease.address} ${lease.subnetMask}
      ip nhrp map ${far.nbmaNhsV4Address} ${far.ipsecTunnelDestAddr1}
      ip nhrp map multicast ${far.ipsecTunnelDestAddr1}
      ip nhrp network-id 1
      ip nhrp nhs ${her.interfaces("Tunnel0")[0].v4.addresses[0].address}
      ipv6 address ${far.ipv6Address(far.enDuid,1,far.dhcpV6TunnelLink).address}/128
      ipv6 eigrp 2
      ipv6 nhrp map ${far.nbmaNhsV6Address}/128 ${far.ipsecTunnelDestAddr1}
      ipv6 nhrp map multicast ${far.ipsecTunnelDestAddr1}
      ipv6 nhrp network-id 1
      ipv6 nhrp nhs ${far.nbmaNhsV6Address}
      tunnel mode gre multipoint
      tunnel protection ipsec profile DMVPN_IPsec_Profile
      tunnel source ${wanInterface[0].name}
    exit
    router eigrp 1
      network ${lease.address}
    exit
  </#if>
</#if>
```

Step 2 Save the template.

HER tunnel addition template

Similar to Router Tunnel Addition templates, there are two default HER tunnel addition templates available. Based on the configuration settings in `setupCgms.sh`, the default template is selected to manage tunnels using PSK or not.

Configure HER tunnel addition template

Use this task to configure HER tunnel addition using template.

Procedure

Step 1 Edit the template as given in the example to configure HER tunnel addition.

Example:

per-Router HER Config

```
<#-- This template only supports HERs running IOS or IOS XE. -->
<#if !her.isRunningIos() && !her.isRunningIosXe()>
  ${provisioningFailed("HER is not running IOS or IOS XE")}
</#if>

<#if far.isRunningIos()>
```

```
  <#assign sublist=far.eid?split("+")[0..1]>
  <#assign sn=sublist[1]>

  crypto ikev2 keyring FlexVPN_Keyring
    peer ${sn}
      identity fqdn ${sn}.cisco.com
      pre-shared-key ${far.mgmtVpnPsk}
   exit
  exit
</#if>
```

Step 2 Save the template.

Router bootstrap configuration template

Note For SUDI authentication, you must use `cgna initiator profile` as the tunnel profile.

Note Based on the device types, the following ports are used:

- For Cisco IOS-XE device types, use port 443.
- For Cisco IOS device types, use port 8443.

Configure router bootstrap using template

Use this task to configure router bootstrap using template.

Procedure

Step 1 Edit the template as given in the example to configure router bootstrap.

Example:

```
<#assign sublist=far.eid?split("+")[0..1]>
<#assign pid=sublist[0]>
<#assign sn=sublist[1]>

hostname ${sn}
!
aaa new-model
!
aaa authentication login default local
aaa authorization exec default local
!
aaa session-id common
aaa password restriction
!
ip host fnd.iot.cisco.com <fnd ip address>
ip domain name cisco.com
```

```
!
password encryption aes
!
!
archive
  path bootflash:archive/
maximum 8
!
username admin privilege 15 password <router password>
!
!
no cdp run
!
!
interface Loopback999
 ip address <ip address for the interface> 255.255.255.255
!
ip forward-protocol nd
!
no ip http server
ip http tls-version TLSv1.2
ip http authentication aaa login-authentication default
ip http secure-server
ip http secure-port 443
ip http client source-interface lo0
ip http client secure-trustpoint CISCO_IDEVID_SUDI

ip ssh time-out 60
ip ssh authentication-retries 2
crypto key generate rsa
ip ssh version 2
!
ipv6 unicast-routing
!
control-plane
!
line con 0
length 0
transport preferred none
escape-character 3
stopbits 1

!

line vty 6 15
session-timeout 10
exec-timeout 5 0
session-limit 2
transport input ssh
!
wsma agent exec
profile exec
!
wsma agent config
profile config
!
!wsma agent filesys
!
!wsma agent notify
!
!
wsma profile listener exec
transport https path /wsma/exec
!
```

```
wsma profile listener config
transport https path /wsma/config

event manager directory user policy "flash:/managed/scripts"
event manager policy no_config_replace.tcl type system authorization bypass
!
!
cgna gzip
!
!
cgna initiator-profile cg-nms-tunnel
 add-command show hosts | format flash:/managed/odm/cg-nms.odm
 add-command show interfaces | format flash:/managed/odm/cg-nms.odm
 add-command show version | format flash:/managed/odm/cg-nms.odm
 add-command show ipv6 dhcp | format flash:/managed/odm/cg-nms.odm
 add-command show ipv6 interface | format flash:/managed/odm/cg-nms.odm
 callhome-url https://tps.iot.cisco.com:9120/cgna/ios/config
 execution-url https://<ip address of Loopback999 interface>:443/wsma/config
 interval 10
 gzip
 post-commands
 active
```

Step 2 Edit the template as given in the example to configure ACL optionally as an additional security step.

Example:

```
access-list 10 permit <IP address of TPS>
access-list 10 deny any

interface gigabitEthernet 0/0/0
ip access-group 10 in
exit
```

Note

- In the above sample configuration, the communication with FAR is only through IP address of TPS until the tunnel is established.
- You can also remove the ACL configuration using the command as given in the example, in the router tunnel addition template.

```
no access-list 10
interface gigabitEthernet 0/0/0
no ip access-group 10 in
exit
```

Step 3 Save the template.

HER tunnel FlexVPN configuration template

You can configure HER tunnel FlexVPN using a template.

Configure HER tunnel FlexVPN using template

Use this task to configure the HER tunnel FlexVPN using template.

Procedure

Step 1 Edit the template as given in the example to configure HER tunnel FlexVPN.

Example:

```
version 17.12
service timestamps debug datetime msec
service timestamps log datetime msec
platform qfp utilization monitor load 80
platform punt-keepalive disable-kernel-core
platform sslvpn use-pd
platform console virtual
!
hostname xxxxxxx
!
boot-start-marker
boot-end-marker
!
!
aaa new-model
!
!
aaa authentication login default local
aaa authentication login AUTH local
!......
........
crypto pki trustpoint SLA-TrustPoint
 enrollment pkcs12
 revocation-check crl
 hash sha256
!
!
crypto pki certificate chain TP-self-signed-141726200
 certificate self-signed 01
  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
.......
  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  xxxxxxxxxxxxxx
        quit
crypto pki certificate chain SLA-TrustPoint
 certificate ca 01
  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
.....
  xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
  xxxxxxxxxxxxxx
        quit
!
!
!
license udi pid C8000V sn 9OA9SRYYZVZ
license boot level network-advantage addon dna-advantage
memory free low-watermark processor 203066
diagnostic bootup level minimal
!
!
spanning-tree extend system-id
```

```
!
username xxxxxx privilege 15 password 0 xxxxxxxxxx
!
redundancy
!
crypto ikev2 authorization policy FlexVPN_Author_Policy
 route set interface
 route set access-list FlexVPN_Client_Default_IPv4_Route
!
crypto ikev2 redirect client
crypto ikev2 proposal FlexVPN_IKEv2_Proposal
crypto ikev2 profile FlexVPN_IKEv2_Profile
 match identity remote fqdn domain cisco.com
 identity local key-id CLUSTER-2
 authentication remote pre-share
 authentication local pre-share
 keyring local FlexVPN_Keyring
 dpd 120 3 periodic
 aaa authorization group psk list FlexVPN_Author FlexVPN_Author_Policy
 virtual-template 1 !
!......
........
!
crypto isakmp invalid-spi-recovery
!
!
crypto ipsec transform-set FlexVPN_IPsec_Transform_Set esp-aes esp-sha256-hmac
 mode transport
!
crypto ipsec profile FlexVPN_IPsec_Profile
 set transform-set FlexVPN_IPsec_Transform_Set
 set pfs group14
!.....
......
!
interface Loopback0
 ip address xx.xx.xx.xx 255.255.255.255
!
interface GigabitEthernet1
 ip address xx.xx.xx.xx 255.255.255.128
 negotiation auto
 no mop enabled
 no mop sysid
!
interface GigabitEthernet2
 ip address xx.xx.xx.xx 255.255.255.0
...
....
mgcp behavior rsip-range tgcp-only
mgcp behavior comedia-role none
mgcp behavior comedia-check-media-src disable
mgcp behavior comedia-sdp-force disable !
mgcp profile default
!
line con 0
 stopbits 1
line aux 0
line vty 0 4
 password cisco123
 transport input ssh
!
!
netconf legacy
netconf ssh
```

```
!
!
End
```

Step 2 Save the template.

HER tunnel deletion template

Note Ensure that the keyring name mentioned in "crypto ikev2 keyring FlexVPN_Keyring" and "FlexVPN_IKEv2_Profile" match the HER keyring name.

Configure HER tunnel deletion using template

Use this task to configure HER tunnel deletion using template.

Procedure

Step 1 Edit the template as given in the example to configure HER tunnel deletion for HERs on Cisco IOS and Cisco IOS-XE.

Example:

```
Remove Router PSK config from HER
<#-- This template only supports HERs running IOS or IOS XE. -->
<#if !her.isRunningIos() && !her.isRunningIosXe()>
  ${provisioningFailed("HER is not running IOS or IOS XE")}
</#if>

<#if far.isRunningIos()>
  <#assign sublist=far.eid?split("+")[0..1]>
  <#assign sn=sublist[1]>

  crypto ikev2 keyring FlexVPN_Keyring
    no peer ${sn}
  exit
</#if>
```

Step 2 Save the template.

IPv4/IPv6 host resolution during device upgrade to Cisco IOS XE Release 17.12 and later releases

This task enables you to reliably manage hostname resolution on Cisco IOS XE devices across upgrades and downgrades by explaining the dual (split) versus single-line `ip host` behavior. This guidance helps you update templates, understand checkpoint/config file handling, and verify outcomes during tunnel provisioning and config pushes, avoiding configuration loss after upgrades.

Here is a list of context for you to keep in mind:

- Applies to Cisco IOS-XE devices only.
- Cisco IOS-XE Release 17.12 and earlier releases behavior: Devices use split host entries per IP family (dual entries). For example:

```
ip host fnd.iot.cisco.com 198.51.100.10
ip host fnd.iot.cisco.com 2001:db8:1000:10::10
```

- Cisco IOS-XE Release 17.12 and later releases behavior: Devices expect a single host entry that combines IPv4 and IPv6 on the same line (single-line). For example:

```
ip host fnd.iot.cisco.com 198.51.100.10 2001:db8:1000:10::10
```

- When you upgrade a Cisco IOS XE device from 17.12 to later releases, the device continues to receive split host entries, the first entry is replaced by the second entry and it is used for resolution. Cisco IoT FND checks the device OS version; if it is greater than Cisco IOS XE Release 17.12, Cisco IoT FND normalizes host entries to a single line (IPv4 + IPv6) in checkpoint files.

  Here are the checkpoint filenames: `express-setup-config`, `before-tunnel-config`, and `before-registration-config`.

- When you downgrade, Cisco IoT FND splits entries back into separate IPv4 and IPv6 lines.
- Templates continue to contain split entries, a config push or tunnel provisioning can override normalized lines on the device. Templates must be edited to align with the device version behavior. Here are the examples of templates: Default Router Bootstrap Configuration Template, Device-level Configuration Templates, and Router Tunnel Addition Template.

Before you begin

- Use `show running-config | sec host` on the device to confirm the current host entry format.
- Confirm device versions and identify which devices are running Cisco IOS XE Release 17.12 and later releases.

Procedure

Step 1 Update the templates to match device behavior.

Example:

```
ip host fnd.iot.cisco.com 198.51.100.10.
ip host fnd.iot.cisco.com 2001:db8:1000:10::10.
ip host tps.iot.cisco.com 203.0.113.20. and ip host tps.iot.cisco.com 2001:db8:2000:20::20.
ip host her-a.iot.cisco.com 192.0.2.50. and ip host her-a.iot.cisco.com 2001:db8:50::1.
ip host ir1101-1.site.example 192.0.2.101. and ip host ir1101-1.site.example 2001:db8:101::5.
```

Example:

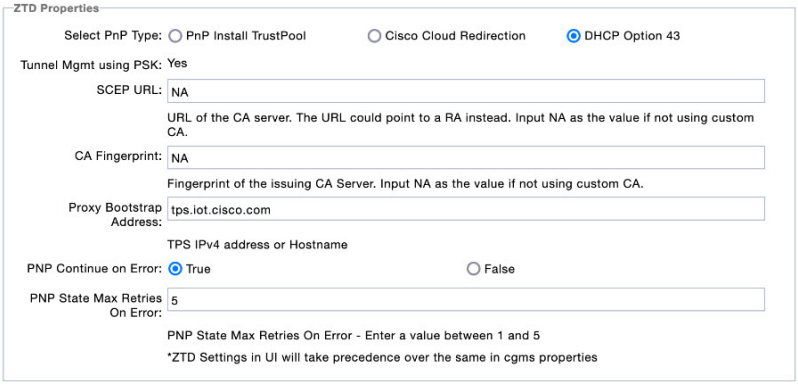
```
ip host fnd.iot.cisco.com 198.51.100.10 2001:db8:1000:10::10.
ip host tps.iot.cisco.com 203.0.113.20 2001:db8:2000:20::20.
ip host her-a.iot.cisco.com 192.0.2.50 2001:db8:50::1.
ip host ir1101-1.site.example 192.0.2.101 2001:db8:101::5.
```

Step 2 Initiate tunnel provisioning or device-level config pushes from Cisco IoT FND. Ensure that the templates already match the expected format; otherwise, a push may override normalization.

Devices on Cisco IOS XE release 17.12 and later releases receive and retain single-line `ip host` entries, preserving both IPv4 and IPv6 resolution on one line.

Configuring ZTD Properties

The ZTD Properties section allows you to manage the device certificates with either SUDI or a CA server. On configuring FND with PSK for tunnel management, by default, the devices use SUDI certificate for the communication with FND. However, if you want to manage using a CA server, provide details in the **SCEP URL** and **CA Fingerprint** fields (**ADMIN** > **SYSTEM MANAGEMENT** > **PROVISIONING SETTINGS**).



Changes To TCL Script

This section explains about the two different versions of a TCL script used for configuring a trustpoint in a network device managed using Cisco IoT FND. The trustpoint is part of the device Public Key Infrastructure (PKI), which handles certificates and cryptographic keys.

TCL Script For Cisco IOS XE Release 17.4.x And Lower Releases

Here's the original TCL script version released in Cisco IOS XE Release 17.4.x and lower releases:

```
set clist [ list "config terminal" \
                    "crypto pki trustpoint $tp_name" \
                    "serial-number none" \
                    "ip-address none" \
                    "password" \
                    "no subject-name" \
                    "subject-name $subject_name" \
                    "enrollment retry count $ZTD_SCEP_enrollment_retry_count" \
                    "enrollment retry period $ZTD_SCEP_enrollment_retry_period" \
                    "crypto pki enroll $tp_name" \
                    "end"]
```

Updated Script For Cisco IOS XE Release 17.9.x And Later Releases

Here's the updated TCL script starting from Cisco IOS XE Release 17.9.x and later releases:

```
set clist [ list "config terminal" \
                    "crypto pki trustpoint $tp_name" \
                    "serial-number none" \
                    "ip-address none" \
                    "no subject-name" \
                    "subject-name $subject_name" \
```

```
"enrollment retry count $ZTD_SCEP_enrollment_retry_count" \
"enrollment retry period $ZTD_SCEP_enrollment_retry_period" \
"end"]
```

Reason For The Changes

The script is modified to no longer use an empty password, aligning with the new PKI policy that recommends to migrate to strong type-6 encryption.

Note Starting from Cisco IOS XE Release 17.9.x and later releases, the Subject Alternative Name (SAN) is included with the Certificate Signing Request (CSR). For more information see, CSCsk85992.

Workflow for Tunnel Management with PSK

This section provides the workflow for tunnel management with PSK.

Staging

To stage the router with Cisco IoT FND TPS URL:

Procedure

Step 1 Configuring Cisco IoT FND for PSK-based tunnels differ for each deployment as given below.

For **VM deployment with Postgres DB**, as the cgms service will already be running on OVA installation, the cgms service is restarted using the steps below while executing `setupCgms.sh` script. In this deployment, user creates a new Tunnel Provisioning group for PSK based tunnel management configuration.

a) Stop the cgms service.

```
./fnd-container.sh stop
```

b) Run the following script to configure FND to create IPsec tunnels for management with PSK.

```
/opt/cgms/bin/setupCgms.sh
```

c) Start the cgms service.

```
./fnd-container.sh start
```

d) Create new groups in the tunnel provisioning to on board devices that use PSK tunnels.

Step 2 Generate a public CA signed server certificate for TPS and Cisco IoT FND using the existing CSR generation workflow.

Step 3 Configure FlexVPN on HER. For more information on the configuration, see HER tunnel FlexVPN configuration template, on page 64.

Step 4 Import the device to Cisco IoT FND through CSV or NB API.

a) During the device import, set the **tunnelHerEid** property on FAR to know the associated HERs. Ensure to set this property for the PnP to continue, else, the PnP cannot proceed.

Cisco IoT FND generates a unique pre-shared key for each device and adds the generated key to the device property while storing in the database.

Step 5 Stage the router with Cisco IoT FND TPS URL using DHCP option 43 or PnP Install Trustpool / Cloud Redirection for PnP.

What to do next

Pnp Bootstrapping

PnP Bootstrapping

To bootstrap a device:

Before you begin

Staging.

Procedure

Step 1 Field area router (PnP agent) calls FND (through FND TPS).

Step 2 FND pushes the Trust Anchor (root certificate) to the device.

Step 3 To push the FAR PSK to the associated HER, a new state `CONFIGURING_HEADEND` is added in PnP.

Note
This state is executed only if IPsec tunnels are configured for management with PSK.

a) FND pushes the PSK to HER associated with the device in a separate batch process.

- On successful PSK configuration push on HER, an event is generated on FAR with the following message.

  ```
  PSK Tunnel configuration pushed successfully to HER
  ```

- On failure to push the PSK configuration on HER, an event is generated on FAR with the following message.

  ```
  PSK Tunnel configuration failed on HER
  ```

  Note
  FND keeps retrying (no limit) to push the configuration to HER until it succeeds as long as PnP requests come in.

Step 4 FND pushes the Bootstrap template to the device, which includes a tunnel creation profile and loopback IP configuration. For more information on the default templates, see Default templates, on page 51.

a) Set the following commands in the bootstrap template for SUDI-based authentication.

```
no ip http secure-client-auth
ip http tls-version TLSv1.2
ip http client secure-trustpoint CISCO_IDEVID_SUDI
```

Use the `cgna initiator` profile as a tunnel creation profile. This is due to a platform limitation for Cisco IOS-XE device types, which does not support SUDI when the device is acting as a server in the TLS communication.

Step 5 On successful completion of PnP, the device status is marked as `Bootstrapped` in FND.

What to do next

Tunnel Provisioning, on page 72

Tunnel Provisioning

To push the PSK configuration to the router:

Before you begin

- Staging, on page 70
- PnP Bootstrapping, on page 71

Procedure

Step 1 Field area router calls FND (through FND TPS).

Authentication based on mTLS:

a) Validate the FND server based on the FND trust anchor.
b) Validate the field area router based on SUDI.

Step 2 FND pushes the PSK along with other tunnel configurations present in the Router Tunnel Addition template to the router and activates the registration profile.

a) Ensure that the following command is added in the Router Tunnel Addition template for the registration to work.

```
ip http secure-client-auth

no ip http tls-version TLSv1.2
```

What to do next

Device Configuration, on page 72

Device Configuration

To push device configuration to the router:

Before you begin

Complete the following workflows:

- Staging, on page 70
- PnP Bootstrapping, on page 71
- Tunnel Provisioning, on page 72

Procedure

Step 1 Field area router calls FND (through IPsec).

Authentication based on mTLS:

- Validate the FND server based on FND trust anchor.
- Validate the field area router based on SUDI.

Step 2 FND pushes the device configuration present in the Configuration Template to the router.

Step 3 On successful completion, the device is marked as `UP` in FND.

Pushing PSK Configuration to HER Cluster

This section explains the steps that are required to push the PSK configuration to HER in the cluster.

Pushing PSK Configuration to Existing HERs in the Cluster

Use the following steps to push the PSK configuration to the existing HERs in the cluster, which are added to the cluster before the tunnel establishment.

Procedure

Step 1 Import all HERs in the cluster to FND and have them managed with the device status as UP.

Step 2 For FND to be aware of the list of HERs in a cluster, add the list of HER eids separated by comma in the `tunnelhereid` property.

Step 3 On receiving a PnP request from a FAR, the `tunnelhereid` property is checked to get the list of HERs in the cluster.

Step 4 PSK configuration is pushed to each HER in the cluster.

- PnP continues if at least one of the HERs in the cluster receives the PSK configuration successfully.
- If the PSK configuration push fails on HERs, then correct the HER or replace it with a new HER by updating the `tunnelHerEid` property of the FAR.

The following events are generated for the PSK configuration push to HER in a cluster.

- If the PSK configuration push to HER is successful, then an event is generated for the router with the following message.

  `"PSK Tunnel configuration pushed successfully to HER [**eid**]"`

- If the PSK configuration push to HER fails, then an event is generated for the router with the following message.

  `"PSK Tunnel configuration failed on HER [**eid**]".`

Pushing PSK Configuration to New HER in the Cluster

Use the following steps to push the PSK configuration to a new HER, which is added to the cluster after the tunnel is established.

Note The addition or removal of HERs from the `tunnelHerEid` list is added to a table named `pending_tunnel_her_in_cluster` in the DB. FND has a separate thread that runs every five minutes to pick up the entries from the table and based on the `add_peer` flag, it either pushes the PSK configuration or removes the PSK configuration to or from the HER.

Procedure

Step 1 Import the new HER to FND and have it managed with the device status as UP.

Step 2 Update the FAR using **Change Device Properties** to add the new HER to the `tunnelhereid` property list.

Note
HER must be managed by FND before updating FAR using **Change Device Properties**.

Step 3 The PSK configuration is pushed to the new HER added to the `tunnelHerEid` property list and an associated event (success or failure) is generated on the FAR.

If any HER is removed from the `tunnelHerEid` property, then the PSK configuration of that HER is removed and an event is generated for successful configuration removal on the HER.

Viewing Events

This section provides information on the events generated on FAR and HER when pushing and removing PSK tunnel configuration.

- Viewing FAR Events
- Viewing HER Events

Viewing FAR Events

Use the following steps to view the events generated when pushing PSK tunnel configuration on HER during FAR onboarding.

1. Choose **DEVICES** > **FIELD DEVICES**.
2. Select the device on the right pane. The Device Info page appears.
3. Click the **Events** tab to view the following events.

Event Name	Severity Level	Description
PSK Tunnel Configuration Pushed to HER	INFO	On successful completion of pushing PSK tunnel configuration on HER.
PSK Tunnel Configuration on HER Failed	Major	On failure to push the PSK tunnel configuration on HER.

Viewing HER Events

Use the following steps to view the events generated when removing the PSK tunnel configuration from HER and FAR during FAR decommissioning.

1. Choose **DEVICES** > **HEAD-END ROUTERS**.
2. Select the HER on the right pane. The Device Info page appears.
3. Click the **Events** tab to view the following events.

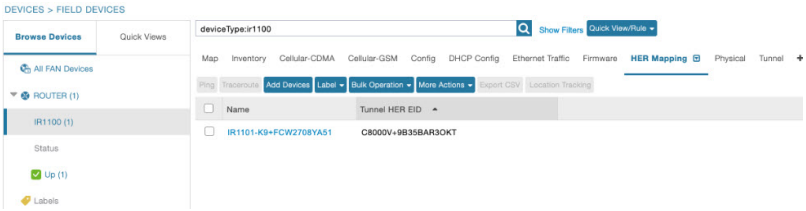
Event Name	Severity Level	Description
HER PSK Tunnel Configuration Removed for FAR	INFO	On successful removal of PSK configuration from HER.
HER PSK Tunnel Configuration Removal Failure for FAR	Major	On failure to remove the PSK configuration from HER. **Note** In this case, you should remove the PSK configuration from HER manually.

HER Mapping with FAR

Use the following steps to view the HERs associated with the FAR.

1. Choose **DEVICES** > **FIELD DEVICES**.
2. Select the device on the left pane.
3. Click the **HER Mapping** tab on the right pane.
4. The HER associated with the device appears under the **Tunnel HER EID** column.

   Use the filter option to search for HERs based on HER EID.



Decommissioning a Device

Whenever there is a device decommissioning, FND automatically removes the PSK configuration from HER using the HER deletion template which is available by default. If the HER is in a cluster, FND removes the PSK configuration from all HERs.

For information on HER deletion template, see HER tunnel deletion template, on page 67.

For information on events generated during PSK configuration removal from HER, see Viewing HER Events, on page 75.

List of Ports used in Simplified IoT FND Architecture for Router only Deployments

The table provides the list of standard ports used in simplified IoT FND architecture.

Service	Port
GUI	443
Tunnel Provisioning	9120
TPS	9122
PostGreSql DB Server	5432
Influx	8086
Kapacitor	9092
WSMA (for IOS-XE)	443
WSMA (for Classic IOS)	8443
Registration + Periodic	9121
Bandwidth Op Mode	9124
PnP — HTTP	9125
Web Sockets — Device Communication	9121
DB Replication for HA	1622

Service	Port
SSH	22
NTP Server	123
SNMP (for polling)	161
SNMP (for notifications)	162
SSM Server	8445
FND Demo Mode	80
Syslog service	514

PSK Challenge String Support

The pre-shared key challenge string is supported to enhance the security between FND and FAR in the SUDI+PSK based tunnel management. In this process, FND generates the challenge string during its first communication with the device. The generated nonce is pushed to the device and signed using the SUDI certificate. The signed response is validated against the SUDI certificate and the hash of the nonce is verified against the nonce sent by FND. The nonce is verified only for the first time when a device communicates with FND.

Only Cisco IOS-XE devices support the challenge string using the SUDI certificate.

Note By default, the challenge string validation is enabled for PSK-based tunnels. However, you can skip the device validation using the challenge string by setting the cgms.properties to false. After disabling the property, you have to restart the cgms service.

```
enable-challenge-string-auth=false
```

Device Validation Using a Challenge String

FND validates the device during onboarding by sending a challenge string using the following command.

```
sh platform sudi certificate sign nonce <generated number>
```

- On successful verification, FND authenticates the device for further communications.
- If the verification fails, an error message is logged in the server.log file, and the device is not onboarded.

PSK Rotation

To protect against pre-shared key (PSK) vulnerabilities and hacks, PSK rotation is utilized in Cisco IoT FND, which provides an additional layer of security for the device communication. This involves running the script either manually or schedule using a cron. The script is bundled with the cgms tools package of Cisco IoT FND. The cgms tools package is installed on a Cisco IoT FND Postgres VM. However, you can also install

the cgms tools package on a separate VM (It is not necessary to have Cisco IoT FND installed in this VM). For information on installing cgms tools on a separate VM, see Installing CGMS Tools RPM on a Separate VM, on page 80.

When the script is run, it rotates the pre-shared key at both HER and FAR and flaps the tunnels for a secure network. The PSK rotation feature is available only to customers who use PSK for tunnel management with FlexVPN.

- Manual PSK Rotation
- Schedule PSK Rotation Using Cron

Prerequisites

Ensure that all prerequisites are met before running the PSK rotation script for every fresh install or upgrade.

- Run the script during the maintenance window.
- Ensure that the Cisco IoT FND service is not active when executing the script.
- Ensure that there are no active operations (like configuration push, firmware upgrade) running in Cisco IoT FND.
- Copy the following files from cgms rpm package (`/opt/cgms`) to cgms-tools package (`/opt/cgms-tools`).

Filename	Copy From (cgms package)	Copy To (cgms-tools package)
fnd_psk_enc	/opt/cgms/server/cgms/conf/.fnd_psk_enc	/opt/cgms-tools/conf
fnd_psk.keystore	/opt/cgms/server/cgms/conf/fnd_keystore	/opt/cgms-tools/conf
jdbc.properties	/opt/cgms/tools/conf/jdbc.properties	/opt/cgms-tools/conf/jdbc.properties
cgms_keystore	/opt/cgms/server/cgms/conf/cgms_keystore	/opt/cgms-tools/conf
cgms.properties	/opt/cgms/server/cgms/conf/cgms.properties	/opt/cgms-tools/conf

Manual PSK Rotation

Run the following script (location: `/opt/cgms-tools/bin`) to rotate the PSK.

```
$ ./rotate-psk <csv-file>
```

The `<csv-file>` refers to the CSV file location, which contains the list of HER name or FAR name (with HER peer name).

- If the CSV file contains the name of the HER, then the HER PSK of all the FARs and the FAR PSK are rotated.
- If the CSV file contains the name of the FAR, then the PSK of the specified FAR and the HER associated with the FAR are rotated.

Sample CSV file with HER NAME:

```
HER_NAME, HER_PEER_NAME, KEYRING_NAME, DOMAIN_NAME
C8000V+9B35BAR3OKT, CLUSTER-2, FlexVPN_Keyring, cisco.com
C8000V+9OA9SRYYZVZ, CLUSTER-1, FlexVPN_Keyring1, cisco.com
```

Note HER_PEER_NAME is the `identity local key-id name` configured on the HER.

Sample CSV file with FAR NAME:

```
FAR_NAME, HER_PEER_NAME , KEYRING_NAME, DOMAIN_NAME
IR1835-K9+FCW2730Y1UZ, CLUSTER-1, FlexVPN_Keyring, cisco.com
IR1101-K9+FCW2710ZA25, CLUSTER-2, FlexVPN_Keyring1, cisco.com
IR1101-K9+FCW2708YA53, CLUSTER-2, FlexVPN_Keyring2, cisco.com
```

The status of the device PSK rotation, for both success or a failure, is available in the CSV file (`rotate-psk-timestamp.csv`).

Log Location:

- The output status log of PSK rotation for each device is stored at: `/opt/cgms-tools/log/rotate-psk-<timestamp>.csv`.

  Sample CSV output:

  ```
  ROUTER,MESSAGE,STATUS
  IR1835-K9+FCW2730Y1UZ,PSK update for FAR IR1835-K9+FCW2730Y1UZ was failure as FAR is
  down ,FAILURE
  IR1835-K9+FCW2730Y2UZ,PSK update success for FAR IR1835-K9+FCW2730Y1UZ connected to HER
   C8000V+9B35BAR3OKT,SUCCESS
  ```

- Debug logs are stored at: `/opt/cgms-tools/log/rotate-psk.log`.

Schedule PSK Rotation Using Cron

Alternatively, cron is used to run the script automatically at a specific time and day of a month. You can schedule PSK rotation for the following deployments:

- Postgres OVA

The following prerequisites are must:

- Ensure that the script is scheduled to run during the monthly maintenance window to avoid conflict with other active operations in Cisco IoT FND.
- For a successful PSK rotation, it is recommended to allow a 24-hour gap between each script execution.

Note After each successful PSK rotation, the tunnel is toggled. As a result, the tunnel between HER and FAR comes up with a new PSK value.

Postgres OVA Deployment

Follow the steps to schedule PSK rotation for Postgres OVA.

Procedure

Step 1 Install the tools `rpm` in VM.

Step 2 Enable the db connection in `pg_hba.conf` with the following entry.

```
host all all <IP of the VM to be entered here>/32 md5
```

Step 3 Restart `postgresql`.

```
service postgresql-12 stop
 service postgresql-12 start
```

Step 4 Copy the following files from docker container to cgms-tools package.

a) `docker cp fnd-container:/opt/cgms/server/cgms/conf/.fnd_psk_enc /opt/cgms-tools/conf`
b) `docker cp fnd-container:/opt/cgms/server/cgms/conf/fnd_psk.keystore /opt/cgms-tools/conf`
c) `docker cp fnd-container:/opt/cgms/tools/conf/jdbc.properties /opt/cgms-tools/conf/jdbc.properties`
d) `docker cp fnd-container:/opt/cgms/server/cgms/conf/cgms_keystore /opt/cgms-tools/conf`
e) `docker cp fnd-container:/opt/cgms/server/cgms/conf/cgms.properties /opt/cgms-tools/conf`

Installing CGMS Tools RPM on a Separate VM

Follow the steps to install CGMS tools rpm on a separate VM.

Procedure

Step 1 Install the `cgms-tools` rpm.

- For the Postgres deployment, extract the cgms tools file (CISCO-IOTFND-VPI-K9-CGMS-TOOLS-<release>-<build>.zip) from the upgrade script (CISCO-IOTFND-VPI-K9-UPGRADE-SCRIPTS-<release>-<build number>.zip) and install the cgms tools in the server. For more information, see Postgres Installation Guide.

Step 2 Copy the prerequisite files from the Cisco IoT FND server to the path where the `cgms-tools` package is installed.

- `copy .fnd_psk_enc from /opt/cgms/server/cgms/conf/.fnd_psk_enc to /opt/cgms-tools/conf`
- `copy fnd_psk.keystore from /opt/cgms/server/cgms/conf/fnd_psk.keystore to /opt/cgms-tools/conf`
- `copy jdbc.properties from /opt/cgms/tools/conf/jdbc.properties to /opt/cgms-tools/conf/jdbc.properties`
- `copy cgms_keystore from /opt/cgms/server/cgms/conf/cgms_keystore to /opt/cgms-tools/conf`
- `copy cgms.properties from /opt/cgms/server/cgms/conf/cgms.properties to /opt/cgms-tools/conf`

Step 3 Provide Postgres IP in the `jdbc.properties` as below.

```
jdbc.url=jdbc:postgresql://<Postgres IP>:5432/cgms
```

Step 4 Add the route in the server for the device reachability.

On successful cgms tools installation, the PSK rotation script is executed.

IPAM for Loopback

Loopback IP addresses for FAR devices forming tunnels was assigned by an external DHCP Server with FND acting as the DHCP client. IoT FND now generates the IPv4 and IPv6 addresses for the provided subnet while forming the tunnels without relying on the third-party DHCP Server. The consumption of internal IP addresses applies only for first-time IoT FND installation and the users with administrative privileges only can access. This is supported only in root domain.

Procedure

Step 1 While setting up IoT FND, run the setupCgms.sh script on the IoT FND server and choose your preferred IP allocation method for loopback IPs in the user prompt. For more information about running the setupCgms.sh script, see Setting Up IoT FND.

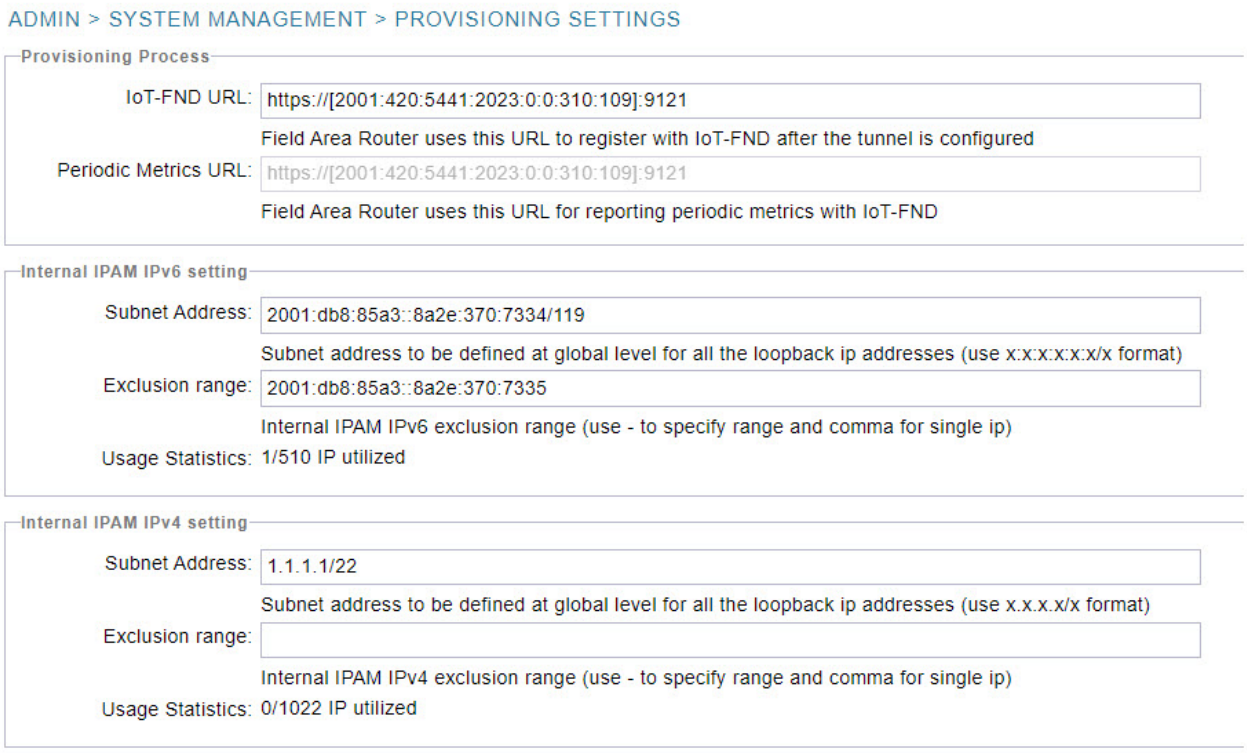
Step 2 If you choose IPAM, configure the subnet in the **Admin** > **System Management** > **Provisioning Settings** page.

Note
To configure the subnet range, set the limit in **ipam-ipv6-subnet-limit** or **ipam-ipv4-subnet-limit** property in cgms.properties file. The default values for the properties are 108 (generates around 1,048,576 IPv6) and 12 (generates around 1,048,576 IPv4) respectively.

Caution
Do not decrease the subnet size. If you intend to utilize more than 1 million IP addresses, we recommend consulting with Cisco for expert guidance and support.

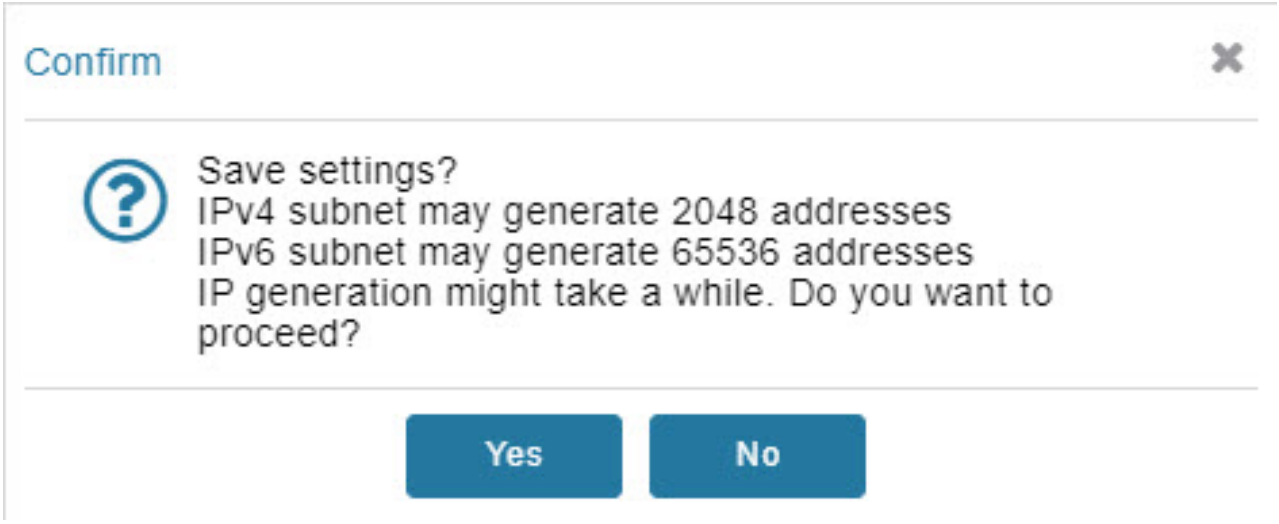
Step 3 Provide the exclusion range as a single IP address, a range, or a list of multiple IP addresses separated by commas. The Usage Statistics is a label that shows the IP addresses utilized for the provided subnet.

Note
Provide values in either or both of the IPAM IPv6 and IPAM IPv4 setting.



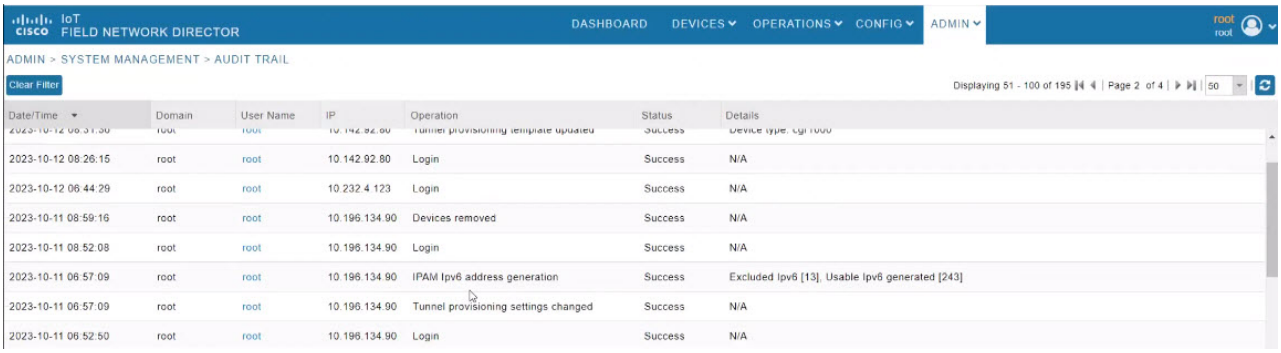
Step 4 Click the Disk icon to save changes. The following window pops up to show the probable IP addresses that will be generated.

Note
If you choose to modify the subnet after the warning, then IoT FND deletes all the existing ip addresses created under previous subnet except the one being used and generates fresh ip addreses for new subnet.



Step 5 Click **Yes**.

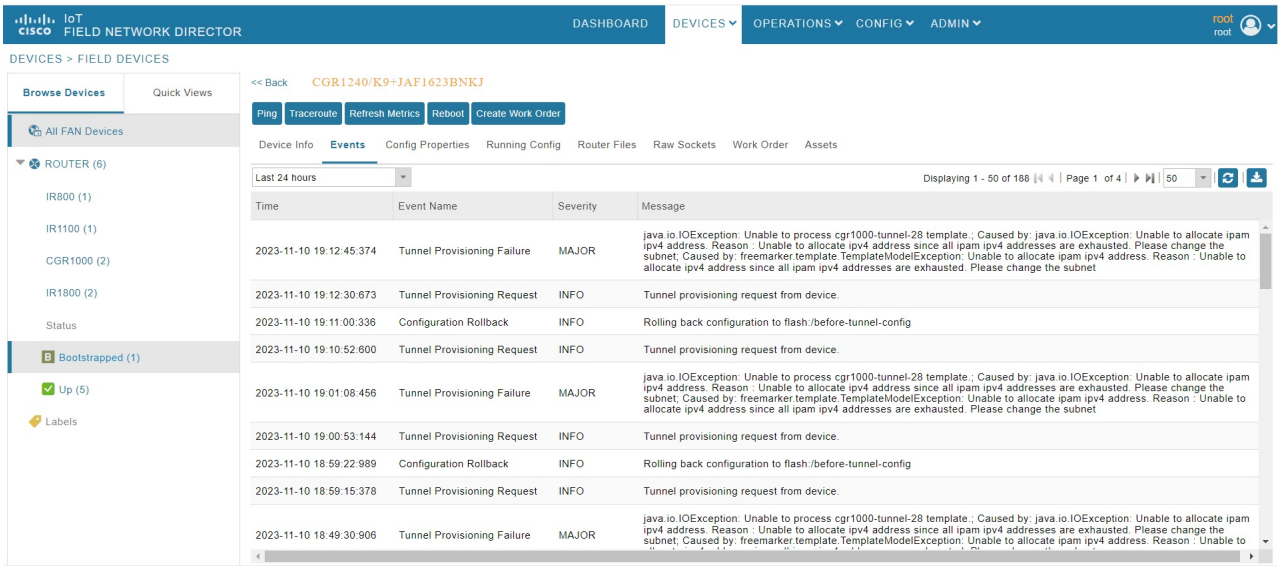
Step 6 Navigate to **ADMIN** > **SYSTEM MANAGEMENT** > **AUDIT TRAIL** page to check for the number of excluded IPs and the generated usable IPs.



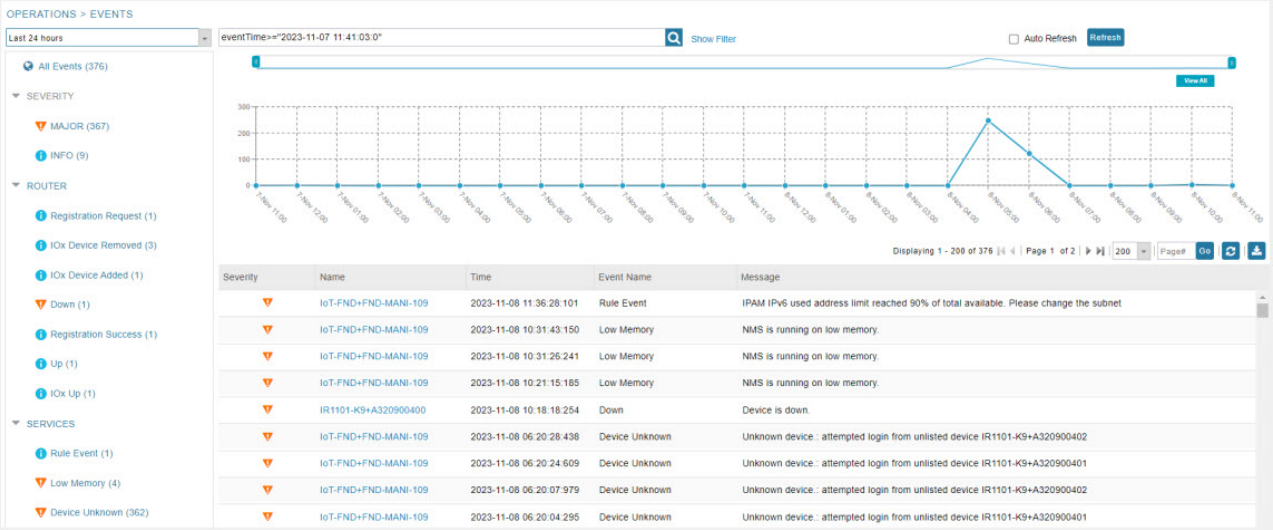
After configuring subnet settings and generating IP addresses, initiate the tunnel provisioning process.

Note
During tunnel provisioning, if the IP address is provided in the CSV in the `loopbackv4address` and `loopbackv6address` property when adding routers, it is utilized as the loopback IP address. In case the IP address is not provided in the CSV, then internal IP address is fetched.

If the tunnel provisioning fails as IP address lease exceeds, then the error message is seen in the **DEVICES** > **FIELD DEVICES** page under Events tab.



Note
In the **Operations** > **Events** page, check the event generated. A minor event is generated if the percentage of utilization crosses 80% of total generated IP. Similarly, a major event is generated if the percentage of utilization crosses 90% of total generated IP. You can configure the limit for major threshold in **ipam-ipAddress-pool-thresold-limit** property in cgms.properties file. The default value is set to 90, if not configured.



Once tunnels are assigned an IP address, the DB is also updated.

For tunnel reprovisioning, the router uses the same IP address.

IPAM for All Interfaces

The IP addresses for FAR devices forming tunnels was assigned by an external DHCP server with IoT FND acting as the DHCP client. IoT FND now generates the IPv4 and IPv6 addresses for the provided subnet while forming the tunnels without relying on the third-party DHCP server. The consumption of internal IP addresses applies only for first-time IoT FND installation and the users with administrative privileges only can access. This is supported only in root domain.

Starting from IoT FND release 4:12 onwards, IoT FND supports IPAM for all interfaces. You can define multiple subnets and IoT FND manages those subnets.

Note When you upgrade to IoT FND release 4:12, one subnet is migrated, subnet id is created and listed under the respective tabs in the Provisioning settings page.

Procedure

Step 1 To enable IPAM, run the setupCgms.sh script on the IoT FND server while setting up IoT FND. Choose IPAM in the user prompt. IPAM takes precedence over DHCP server for IP address management. For more information about running the setupCgms.sh script, see Setting Up IoT FND.

Step 2 If you choose IPAM, configure the subnet in the **Admin** > **System Management** > **Provisioning Settings** page.

Step 3 Click the IPAM-IPv4 and IPAM-IPv6 tabs to define the IPv4 and IPv6 subnets.

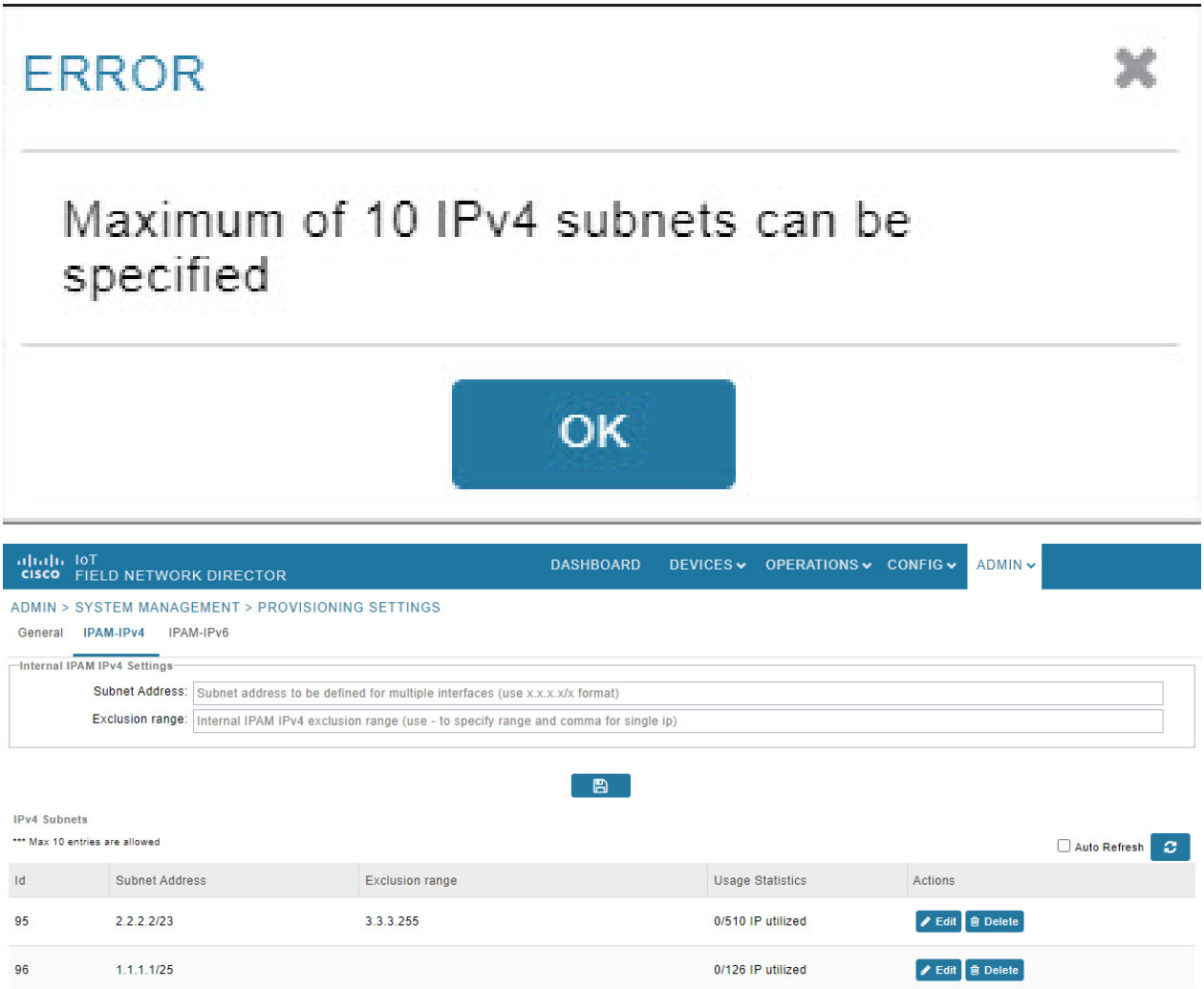
Note

To configure the subnet range, set the limit in **ipam-ipv6-subnet-limit** or **ipam-ipv4-subnet-limit** property in cgms.properties file. The default values for IPv6 and IPv4 properties are 108 (generates around 1,048,576 IPv6) and 12 (generates around 1,048,576 IPv4) respectively.

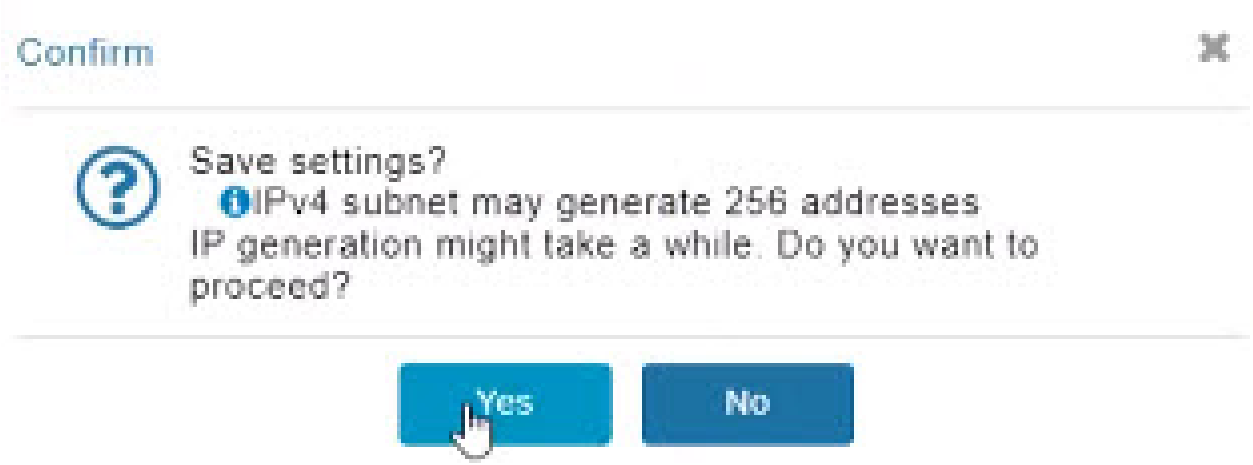
Caution
Do not decrease the subnet size. If you intend to utilize more than 1 million IP addresses, we recommend consulting with Cisco for expert guidance and support.

Step 4 Enter the Subnet Address and Exclusion range. The Exclusion range can be provided as a single IP address, range, or list of multiple IP addresses separated by commas.

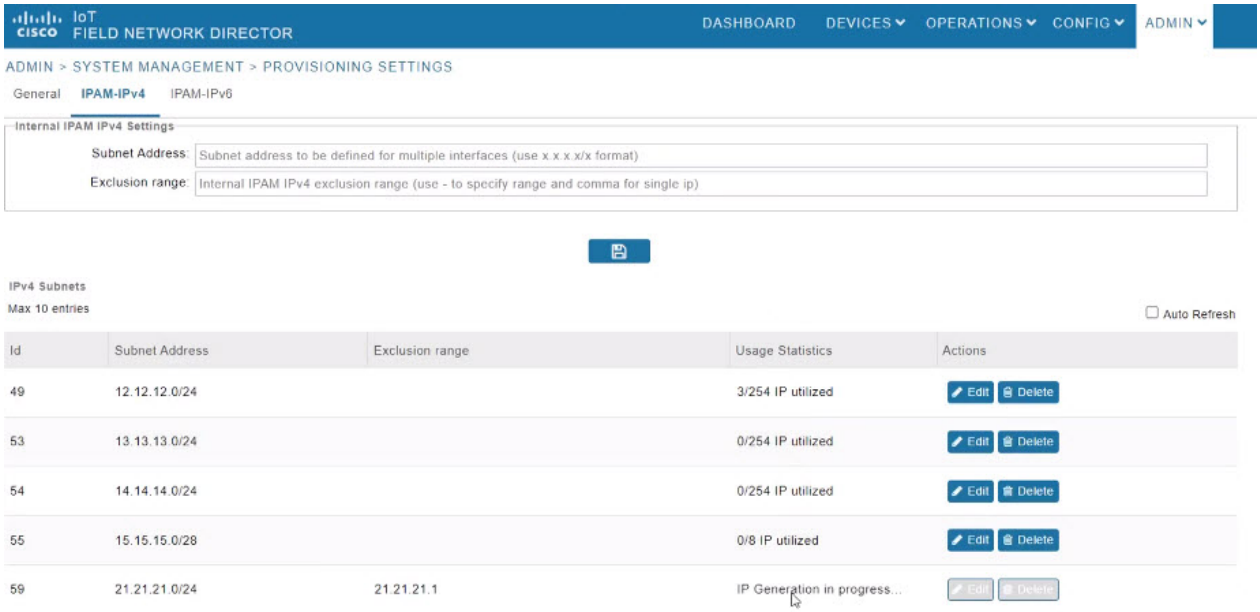
Note
You cannot define more than 10 subnets. The following error message appears when you try to define additional subnets. This is applicable for IPv6 subnets as well.



Step 5 Click the Disk icon to save changes. The following window pops up to show the probable IP addresses that will be generated.



Step 6 Click **Yes**. The IP address generation is in progress.



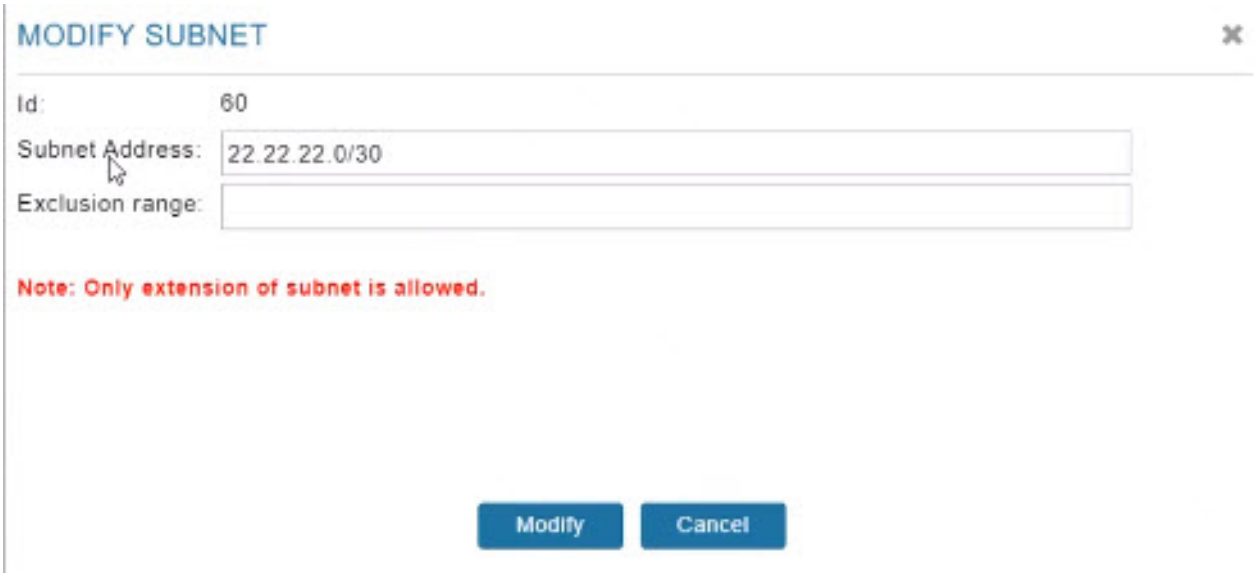
The following table describes the fields in the IPv4 Subnets tab.

Field	Description
Id	Indicates the subnet id allocated for the defined subnet.
Subnet Address	Indicates the defined subnet address.
Exclusion range	Indicates the range of IP addresses within a subnet that are excluded from being assigned to devices.
Usage Statistics	Indicates the IP addresses utilized for the provided subnet.
Actions	You can either modify or delete the subnets.

Step 7 To edit the subnet details:

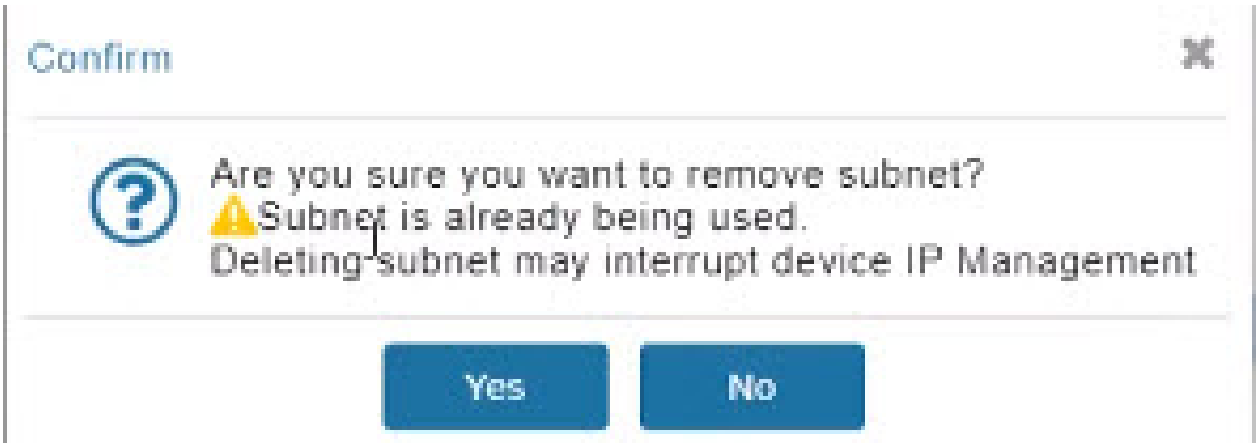
- Click Edit to modify the subnet.
- Edit the Subnet Address and Exclusion range and click **Modify**.

Important
You can only extend the subnet while editing and shrinking the subnet is not allowed.

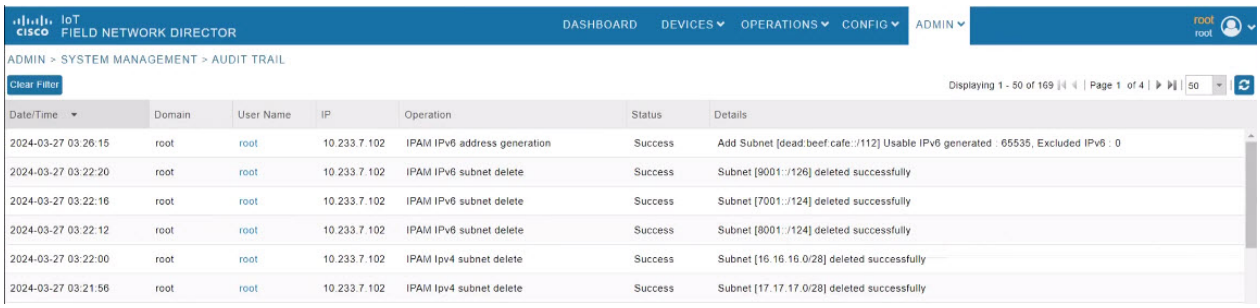


You can also delete the subnet by clicking the delete icon. In case you delete the subnet where some of the IPs are utilized, the following warning pops up. Click **Yes** to proceed.

Note
It is recommended to recheck before proceeding as there are no restrictions in deletion.



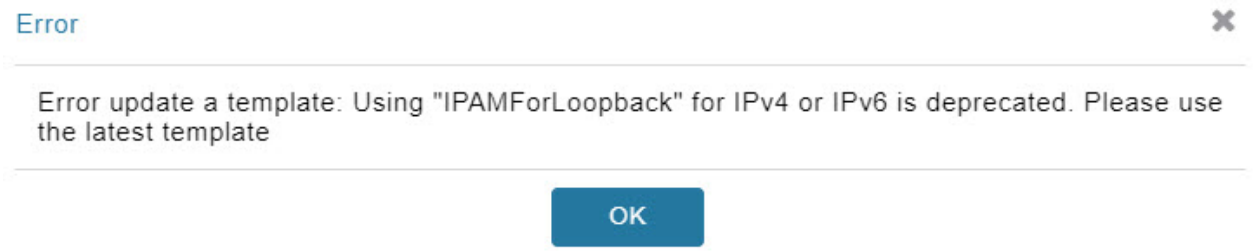
Step 8 Navigate to **ADMIN** > **SYSTEM MANAGEMENT** > **AUDIT TRAIL** page to see the addition, modification, and deletion of the subnets.



Step 9 Go to **CONFIG** > **TUNNEL PROVISIONING** and click Router Tunnel Addition. Enter the Subnet ID in the Router Tunnel Addition template and click Save.

```
interface Loopback0
    <#--
      If the loopback interface IPv4 address property has been set on the CGR
      then configure the interface with that address. Otherwise obtain an
      address for the interface now using DHCP.
    -->
    <#if far.loopbackV4Address??>
      <#assign loopbackIpv4Address=far.loopbackV4Address>
    <#elseif far.isIPAMSelected()??>
      <#assign loopbackIpv4Address=far.IPAMIpv4address(1)>
    <#else>
      <#--
        Obtain an IPv4 address that can be used to for this FAR's Loopback
        interface. The template API provides methods for requesting a lease from
        a DHCP server. The IPv4 address method requires a DHCP client ID and a link
        address to send in the DHCP request. The 3rd parameter is optional and
        defaults to "IoT-FND". This value is sent in the DHCP user class option.
        The API also provides the method "dhcpClientId". This method takes a DHCPv6
        Identity association identifier (IAID) and a DHCP Unique IDentifier (DUID)
        and generates a DHCPv4 client identifier as specified in RFC 4361. This
        provides some consistency in how network elements are identified by the
        DHCP server.
      -->
      <#assign
loopbackIpv4Address=far.ipv4Address(dhcpClientId(far.enDuid,0),far.dhcpV4LoopbackLink).address>
    </#if>
    ip address ${loopbackIpv4Address} 255.255.255.255
    <#--
      If the loopback interface IPv6 address property has been set on the CGR
      then configure the interface with that address. Otherwise obtain an
      address for the interface now using DHCP.
    -->
    <#if far.loopbackV6Address??>
      <#assign loopbackIpv6Address=far.loopbackV6Address>
    <#elseif far.isIPAMSelected()??>
      <#assign loopbackIpv6Address=far.IPAMIpv6address(21)>
    <#else>
```

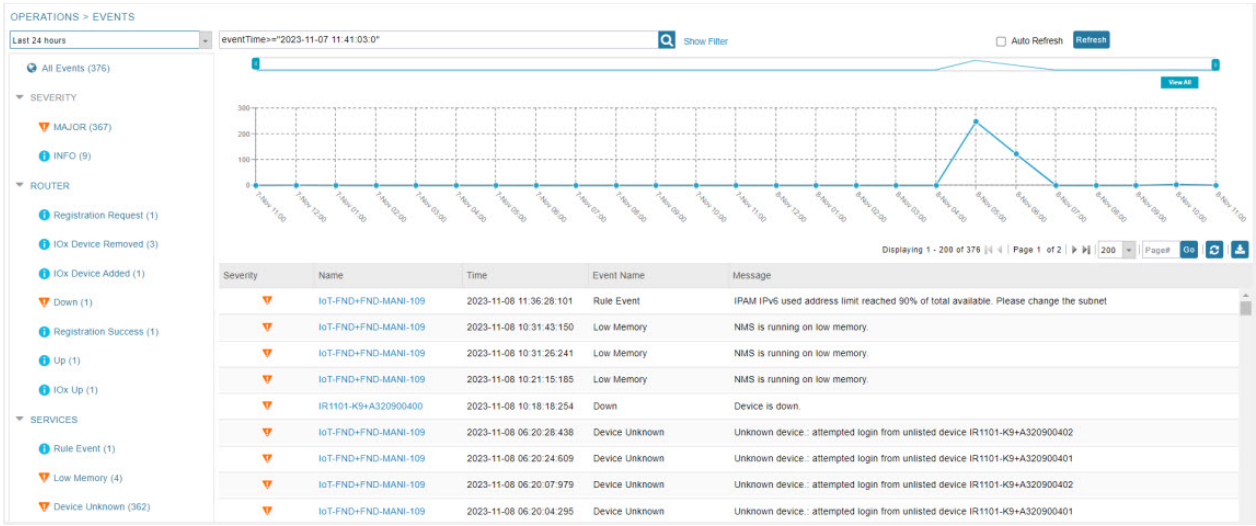
Note
IoT FND throws the following error while processing the template during tunnel provisioning if the template contains obsolete methods.



Step 10 After configuring subnet settings and generating IP addresses, initiate the tunnel provisioning process. Once the PNP is complete, the IP addresses are allocated to the respective interfaces which can be seen under the IPv4 and IPv6 tabs in the **Admin** > **System Management** > **Provisioning Settings** page.

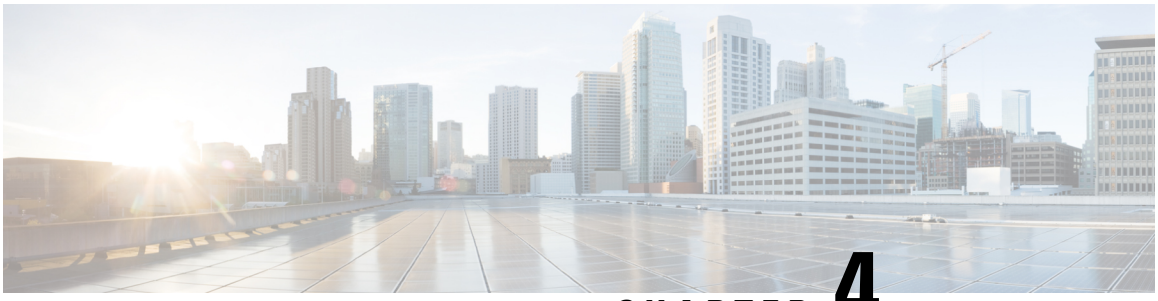
Note
During tunnel provisioning, if the IP address is defined in the CSV in `loopbackv4address` and `loopbackv6address` property while adding routers, it is utilized as the loopback IP address. In case the IP address is not provided in the CSV, then internal IP address is fetched. This is applicable for loopback interface only.

Step 11 In the **Operations** > **Events** page, an event is generated if the percentage of utilization crosses 90% of total generated IP.You can configure the limit for major threshold in **ipam-ipAddress-pool-thresold-limit** property in cgms.properties file. The default value is set to 90, if not configured.



Once tunnels are assigned an IP address, the DB is also updated.

During decommissioning of the device or subnet, IPAM IP address is marked unused. Click Refresh and the IP addresses is released.

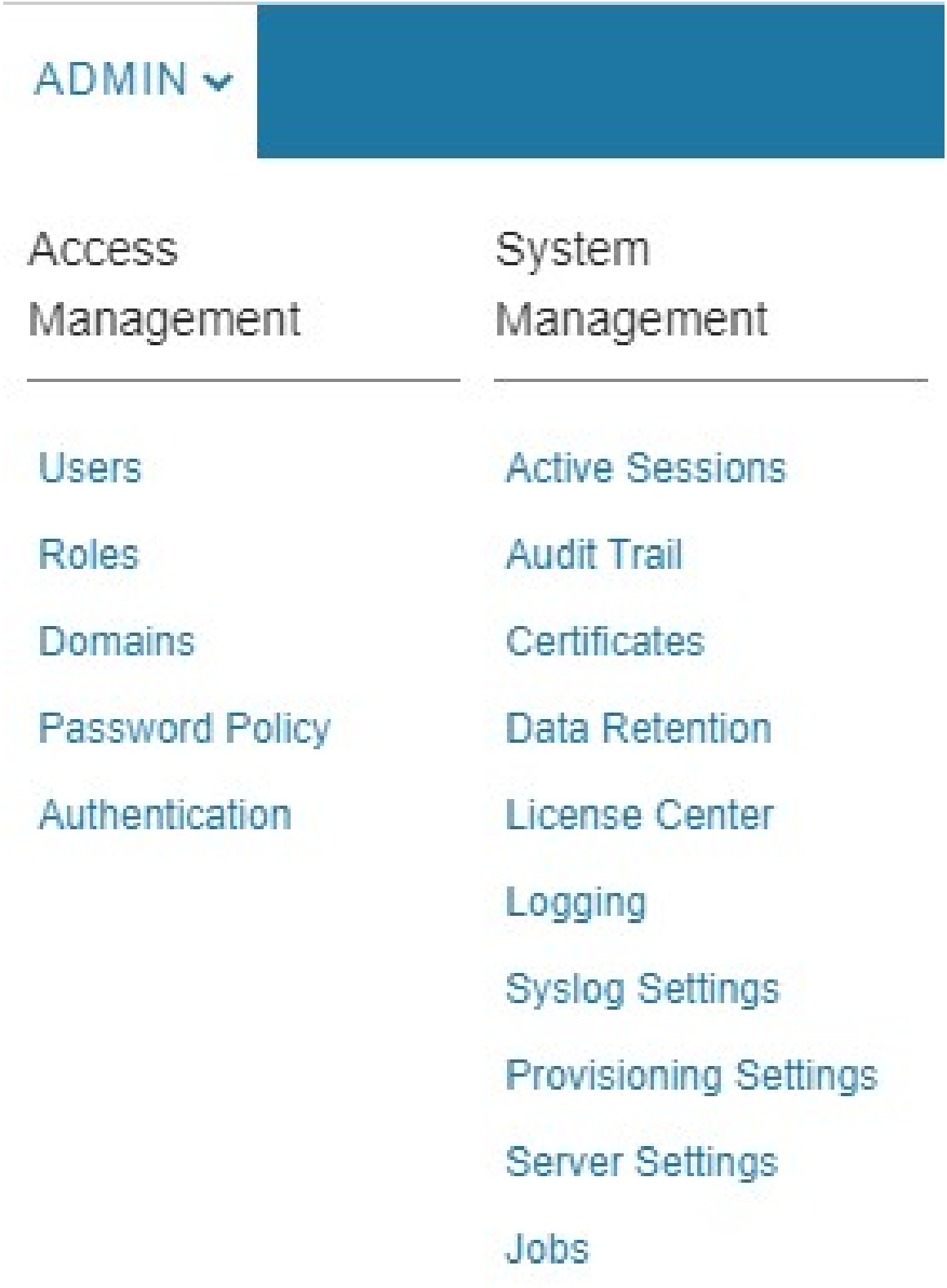


CHAPTER 4

Manage User Access

This section explains how to manage users and roles in IoT FND.

All user management actions are accessed through the **Admin** > **Access Management** menu.


ADMIN
Access Management
Users
Roles
Domains
Password Policy
Authentication
System Management
Active Sessions
Audit Trail
Certificates
Data Retention
License Center
Logging
Syslog Settings
Provisioning Settings
Server Settings
Jobs

Managing Password Policy

IoT FND provides default password policy values that you can enforce among IoT FND users.

Note To modify these values, you must be logged in either as root or as a user with Administrative Operations permissions.

Caution: In some cases, changing password policies immediately terminates all user sessions and resets all passwords.

Note The “Password history size” and “Max unsuccessful login attempts” policies do not apply to IoT FND North Bound API users.

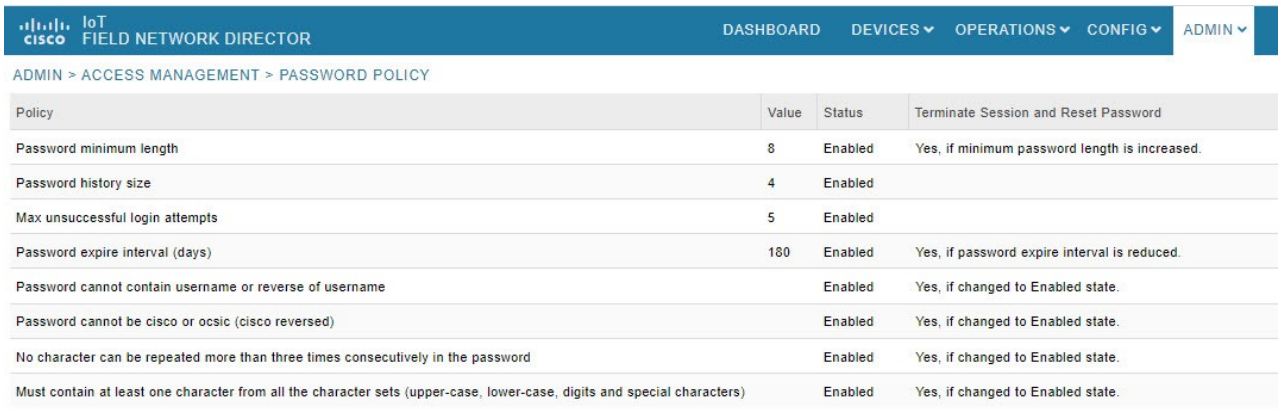
These changes ***invalidate*** all user sessions and expire their passwords (including the root user):

- When you increase the minimum length of passwords
- When you decrease the password expiry interval
- When you enable **"Password cannot contain username or reverse of username"**
- When you enable **"Password cannot be cisco or ocsic (cisco reversed)"**
- When you enable **"No character can be repeated more than three times consecutively in the password"**
- When you enable **"Must contain at least one character from all the character sets (upper-case, lower-case, digits and special characters)"**

To edit password policies:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Password Policy**.



Step 2 To enable or disable a policy, choose the appropriate option (**Enabled** or **Disabled**) from the Status drop-down menu.

Note
IoT FND supports a maximum password length of 32 characters.

Step 3 To modify the value of a policy, if applicable, enter the new value in the Value field.

Step 4 Click **Save** to start enforcing the new policies.

Note
The password policy you configure in IoT FND applies only to local users and not to remote Active Directory (AD) users. The password policy for AD users is determined and enforced by the AD admin.

Managing User Authentication

This section explains how to configure remote and single sign-on authentication in Cisco IoT FND.

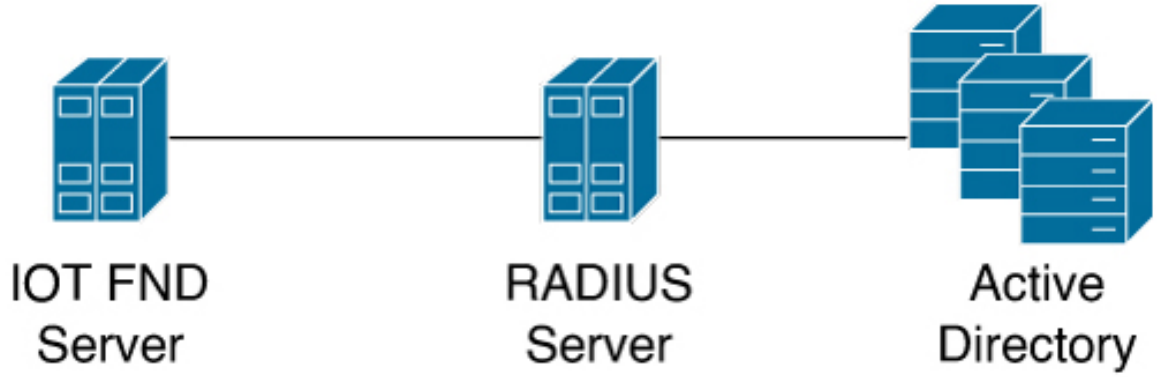
Configuring Remote Authentication

To configure remote authentication for IoT FND, you need to perform the configurations steps (listed below) in Active Directory (AD) and IoT FND.

Support for Remote Authentication

With Remote Authentication, it is easier to integrate Cisco IoT FND into an existing AD and Network Policy Server (NPS) infrastructure. This allows administrators to configure Cisco IoT FND access for users in AD.

When you configure remote authentication in Cisco IoT FND, it hands over the authentication and authorization responsibility to AD and NPS. AD performs user authentication to check the validity of user credentials. The RADIUS server performs user authorization to check whether a user belongs to a group that defines the user role. If so, the server returns the role name to Cisco IoT FND.



Note Cisco IoT FND supports the MSCHAPv2 protocol. To integrate RADIUS servers with Cisco IoT FND, ensure the MSCHAPv2 protocol is enabled on the RADIUS servers.

Important If remote authentication fails in an AD/NPS environment that enforces NTLMv2-only authentication, refer to the Troubleshoot remote authentication failures when NTLMv2-only policy is enforced section of the Troubleshooting Guide for Cisco IoT Field Network Director guide.

The following is the flow of user authentication and authorization by AD and NPS:

1. The user enters their credentials.

If user was created locally on the NMS server, authentication and authorization occurs locally.
If Cisco IoT FND determines that the user is a remote user, authentication and authorization occurs on the configured RADIUS server.
If remote authentication is not configured, authentication fails and user is denied access.

2. For remote users, if authentication and authorization are successful, the assigned user role returns to the NMS server from the RADIUS server.
3. If the role that returns is valid, the user is granted access.

Note When remote authentication is enabled, user management is done in AD. If an AD user logs in who was deleted from Cisco IoT FND, their profile is added back to Cisco IoT FND. To prevent access to Cisco IoT FND, their AD user profiles must first be deleted from AD.

Configuring Remote Authentication in Cisco IoT FND

Enable remote authentication in Cisco IoT FND using a RADIUS server to centralize account management and improve security.

To configure remote authentication:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Authentication**.

Step 2 Select the authentication type as **Local or Remote Authentication**.

Step 3 Enter information about the RADIUS server:

Field	Description
IP	The IP address of the RADIUS server.
RADIUS Server Description	A descriptive name of the RADIUS server.
Shared Secret	The shared secret you configured on the RADIUS server.
Confirm Shared Secret	
Authentication Port	The RADIUS server port that Cisco IoT FND uses to send request to. The default port is 1812.
Accounting Port	The RADIUS server accounting port. The default port is 1813.
Retries	The number of times to send a request to the RADIUS server before Cisco IoT FND times out and remote authentication fails because no response was received from the RADIUS server.
Timeout (in seconds)	The number of seconds before Cisco IoT FND times out and remote authentication fails because no response was received from the RADIUS server.

Step 4 To ensure that Cisco IoT FND reaches the RADIUS server, click **Test Connectivity**.

a) Enter your Remote (AD) username and password.

b) Click **Submit**.

The results of the configuration test are displayed.

c) Click **OK**.

Step 5 Click **Save** when done.

Cisco IoT FND uses your specified RADIUS server for user authentication and accounting. You can now manage user access through your centralized identity provider.

What to do next

Verify that remote users can successfully log in and that authentication and accounting logs are being generated as expected. If issues occur, double-check the RADIUS server settings and connectivity.

Note If remote authentication fails due to NTLMv2-only enforcement, refer to the Troubleshoot remote authentication failures when NTLMv2-only policy is enforced section in the Troubleshooting Guide for Cisco IoT Field Network Director.

Configuring Security Policies on the RADIUS Server

To authorize users for IoT FND access, configure security policies for the RADIUS server.

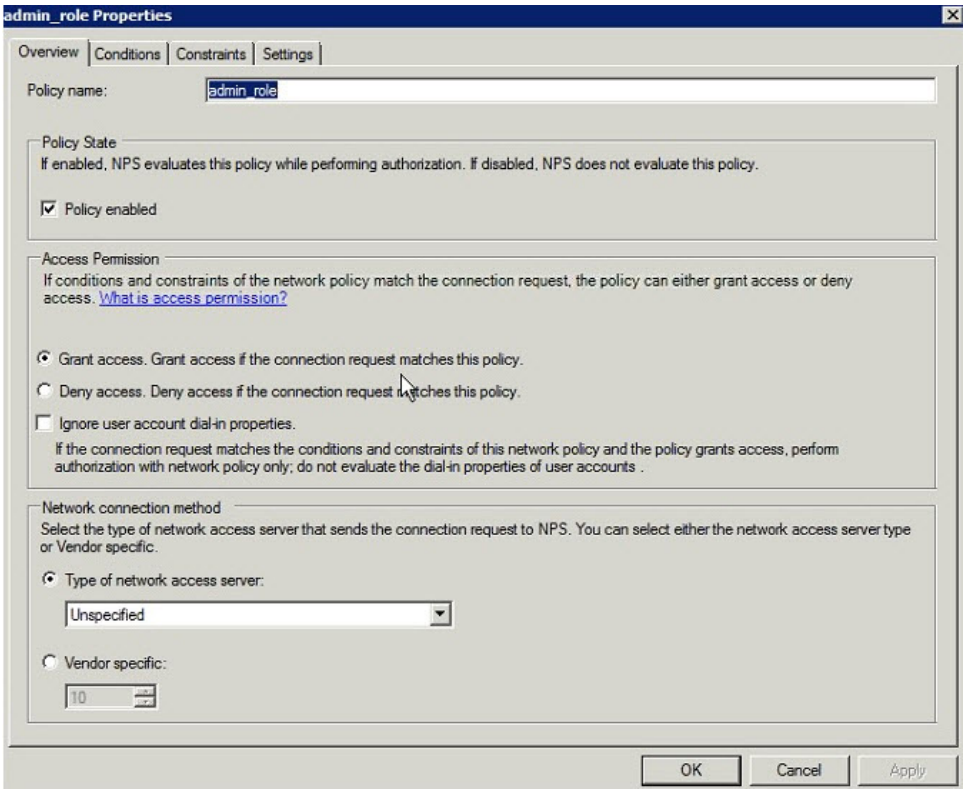
To configure security policies on the RADIUS server, follow these steps:

Procedure

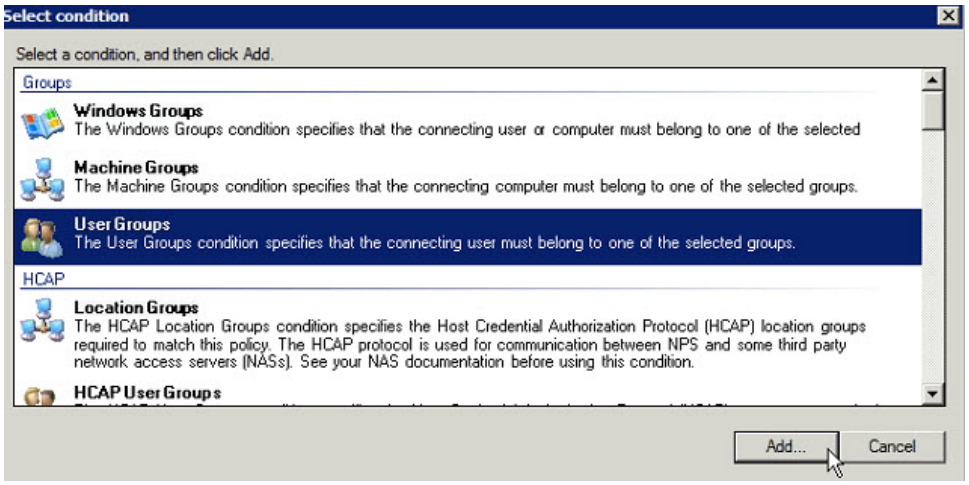
Step 1 Create a network policy for each security group you created in AD.

Step 2 Configure the policy as follows:

a) In the **Overview** tab, define the policy name, enable it, and grant access permissions.

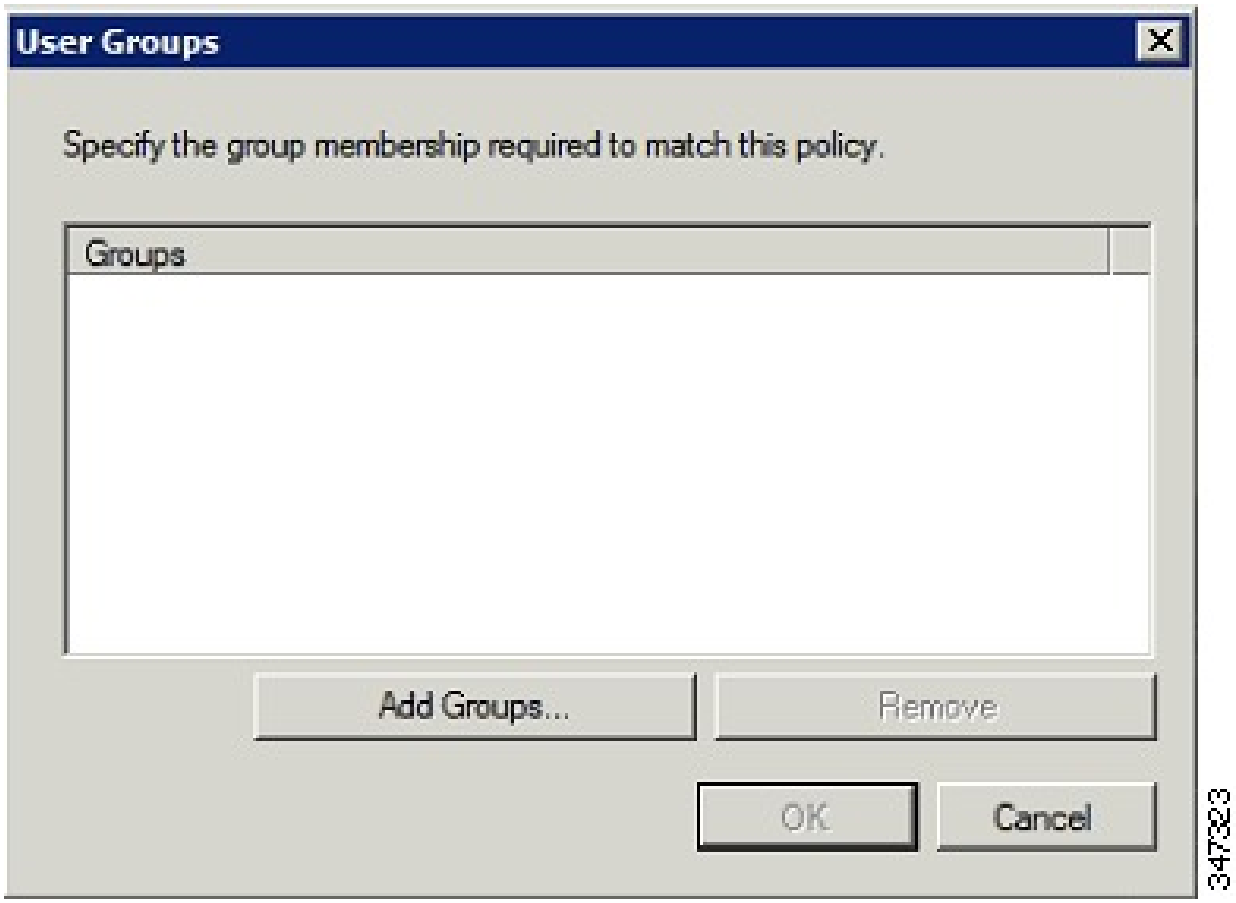


b) Click the **Conditions** tab, select the User Groups condition, and click **Add** .



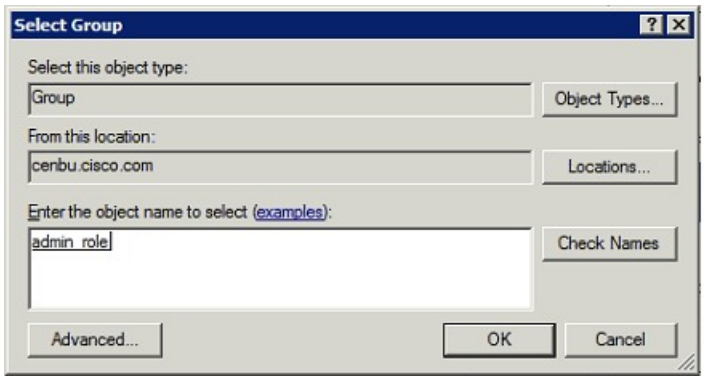
The User Groups condition specifies that the connecting user must belong to the selected group. For this policy to pass, the user being authorized must belong to the user group configured in this policy.

c) In the **User Groups** window, click **Add Groups**.

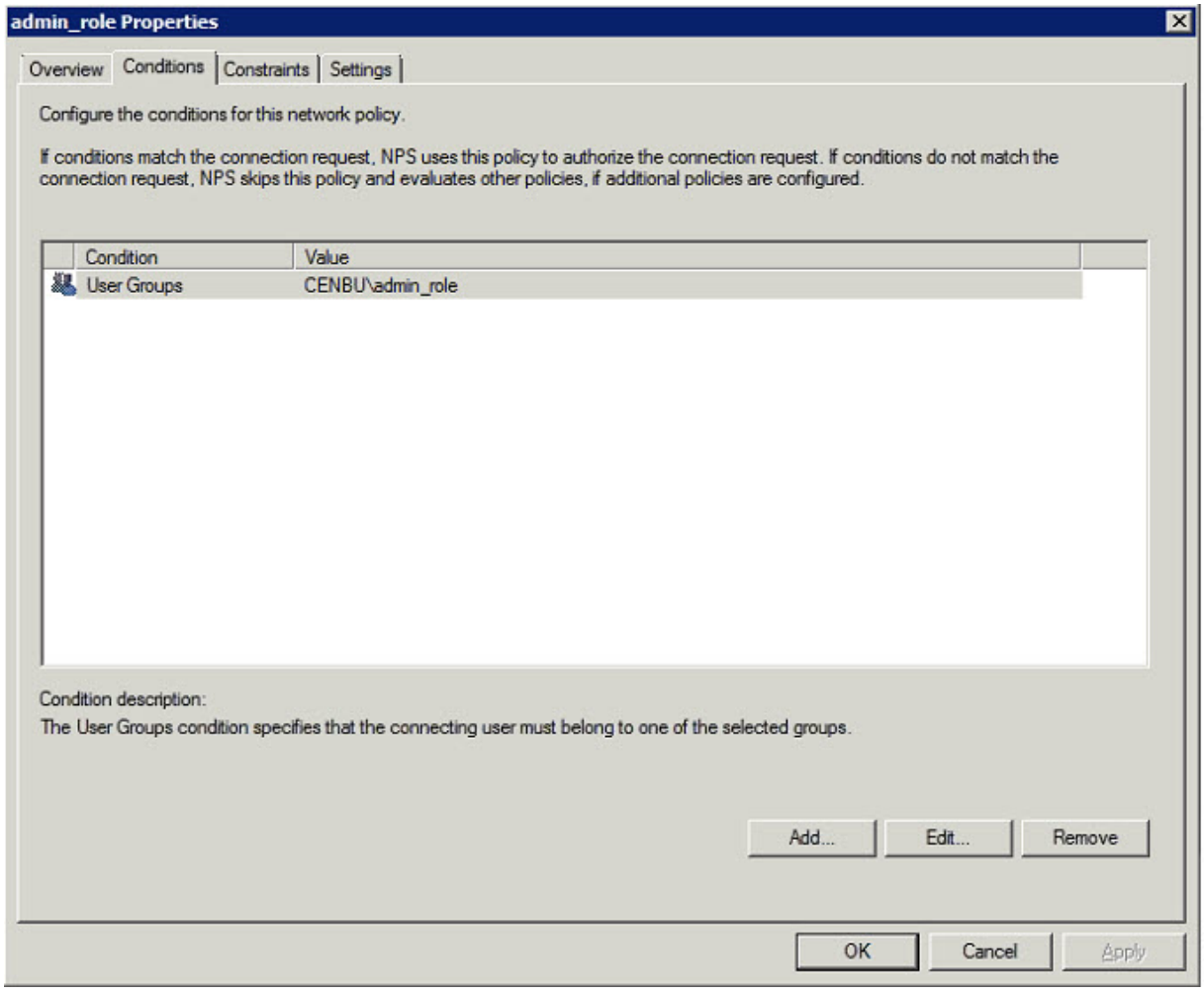


d) In the **Select Group** window, enter the name of the group

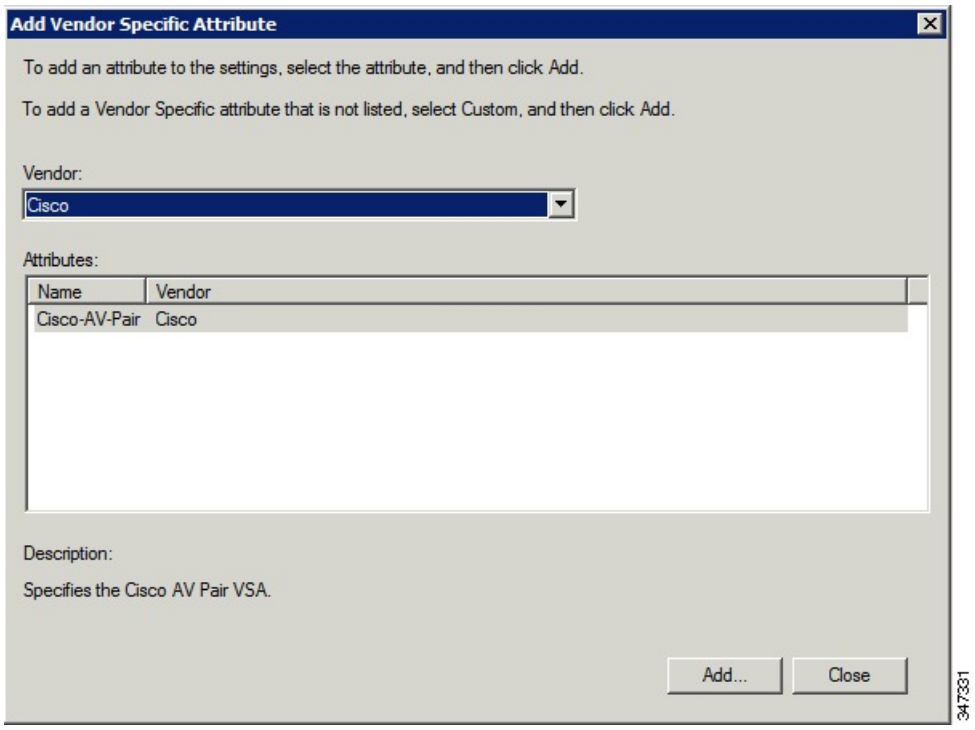
e) Click **OK** to close the **Select Group** dialog box, and then click **OK** to close the User dialog box.



f) Click **Cancel** to close the Select condition window. The condition appears in the Conditions pane.



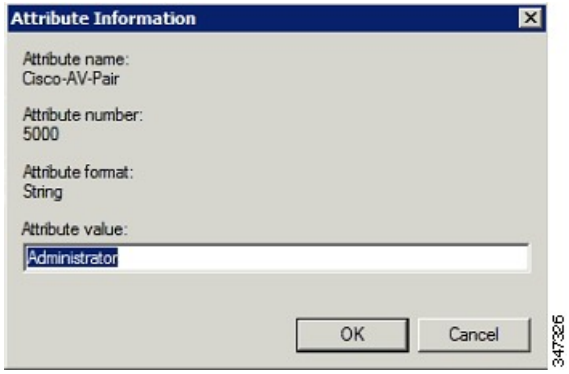
g) Click the Settings tab, and then click **Add** to display the Attribute Information window.



h) Click **Add** to define a Vendor Specific Attribute (VSA) that is sent to IoT FND (RADIUS client) after the user credentials and security group membership are verified.

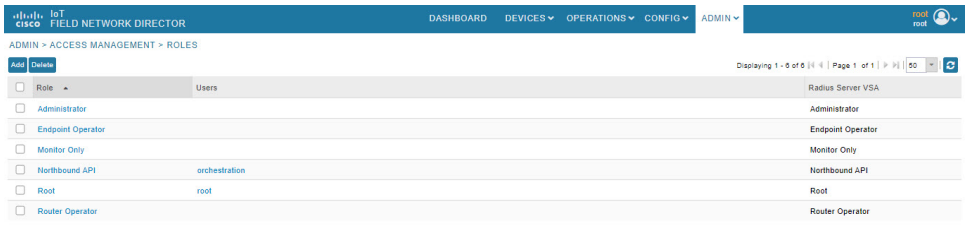
The VSA to configure is:

Configure VSA
Attribute Name: Cisco-AV-Pair
Attribute number: 5000
Attribute format: String.
Attribute value: Enter the attribute value to send to IoT FND.

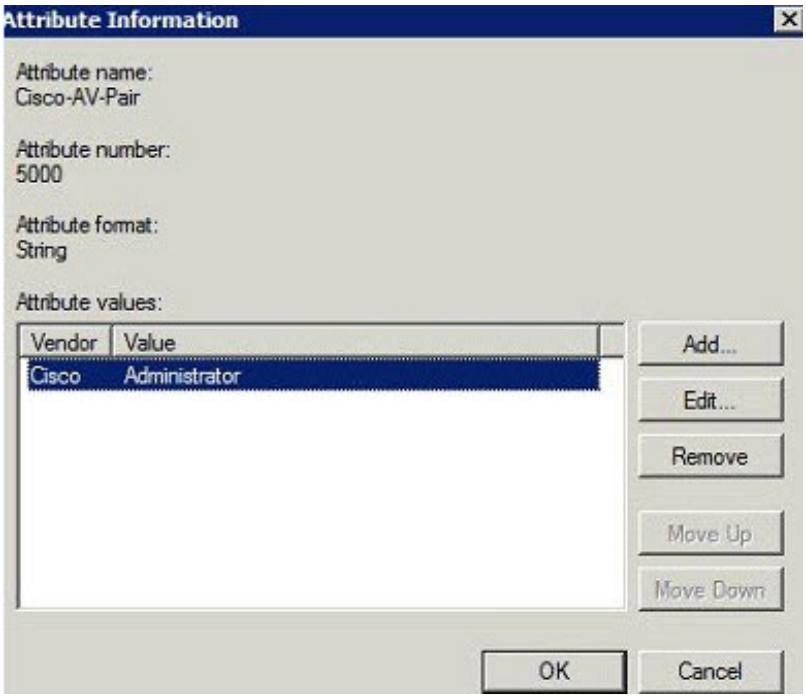


Note

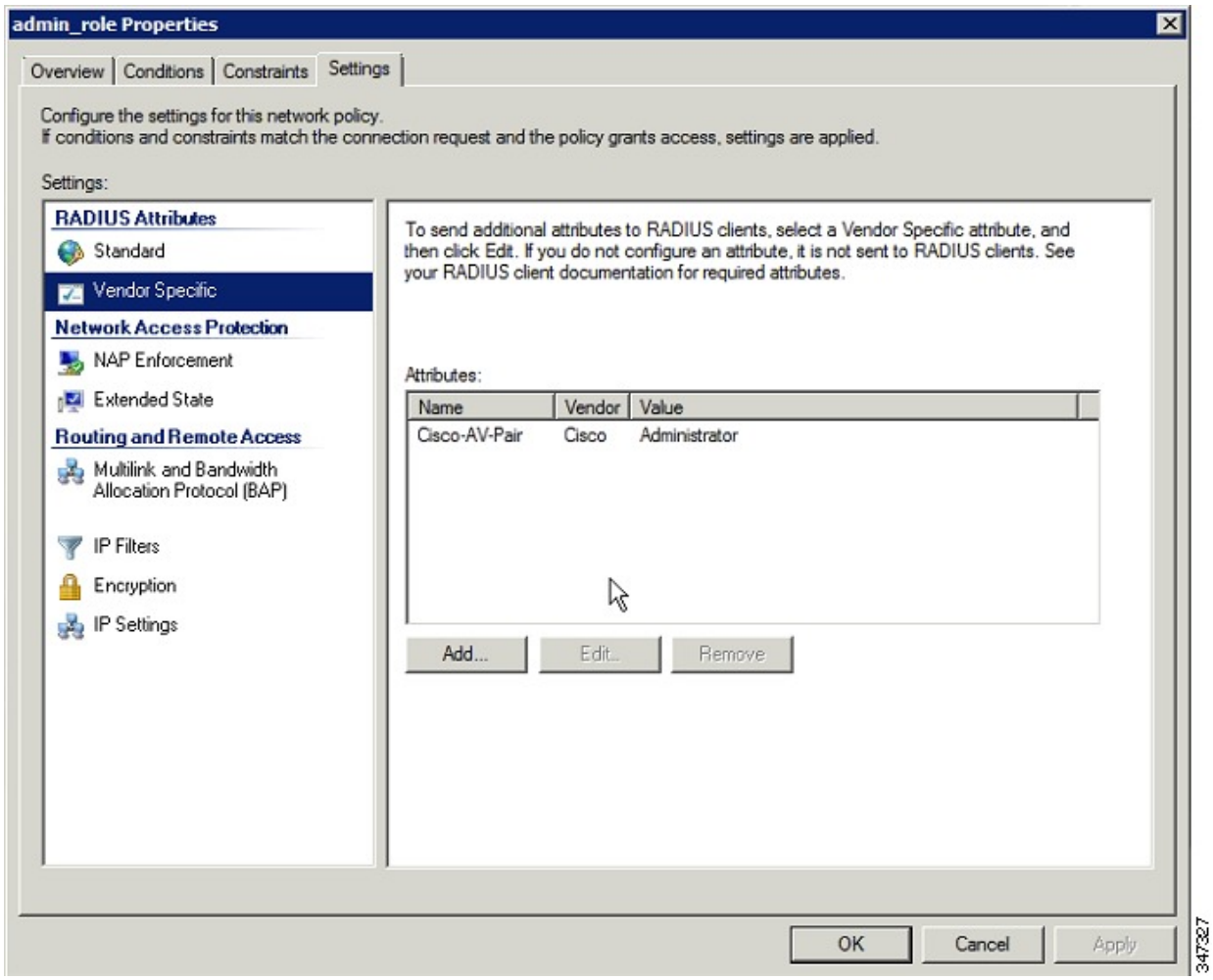
The string entered in the Attribute value field must be the exact string listed in the Radius Server VSA column on the Roles page in IoT FND (**ADMIN** > **Access Management** > **Roles**).



i) Click **OK**.



The VSA attribute appears in the Settings pane.



j) Click **OK**.

Configuring Remote Authentication in AD

Use this procedure to ensure Cisco IoT FND leverages your enterprise's existing Active Directory infrastructure for secure, role-based remote authentication through RADIUS.

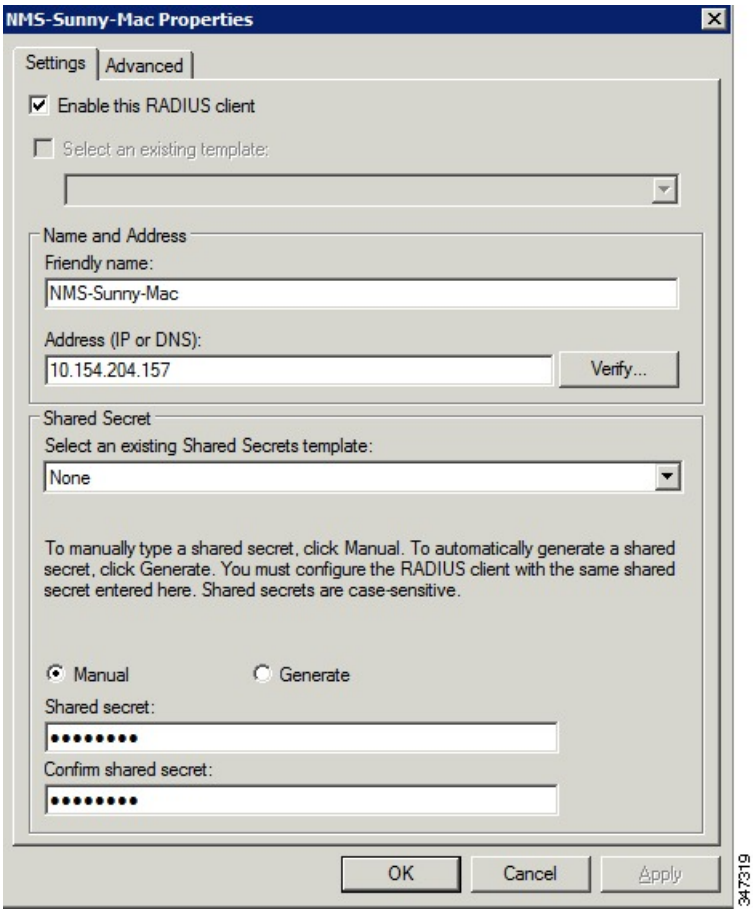
To allow IoT FND to remotely authenticate users, configure the following within Active Directory

Procedure

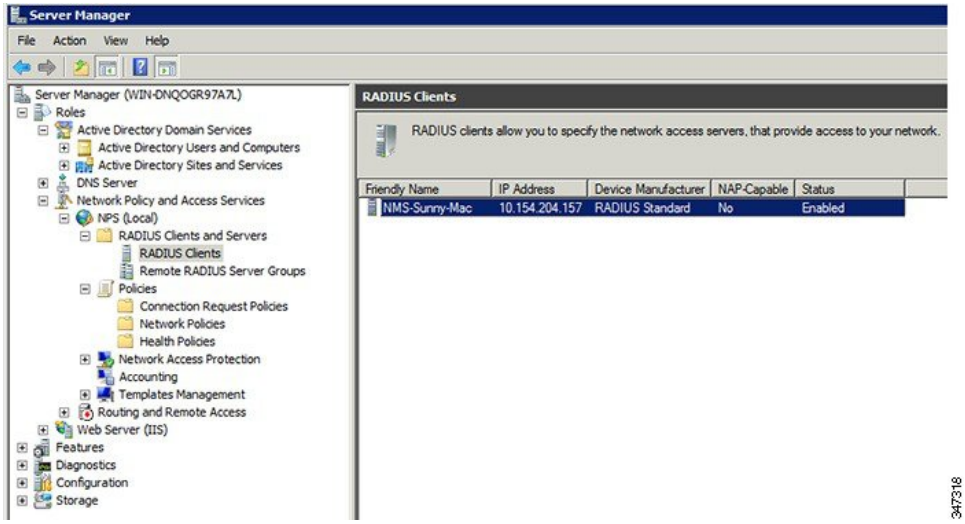
Step 1 Log in to NPS.

Step 2 Add IoT FND as a radius client on the RADIUS server.

Provide a friendly name, and IP address or DNS name of the IoT FND server and configure the shared secret that IoT FND uses to connect to the RADIUS server.

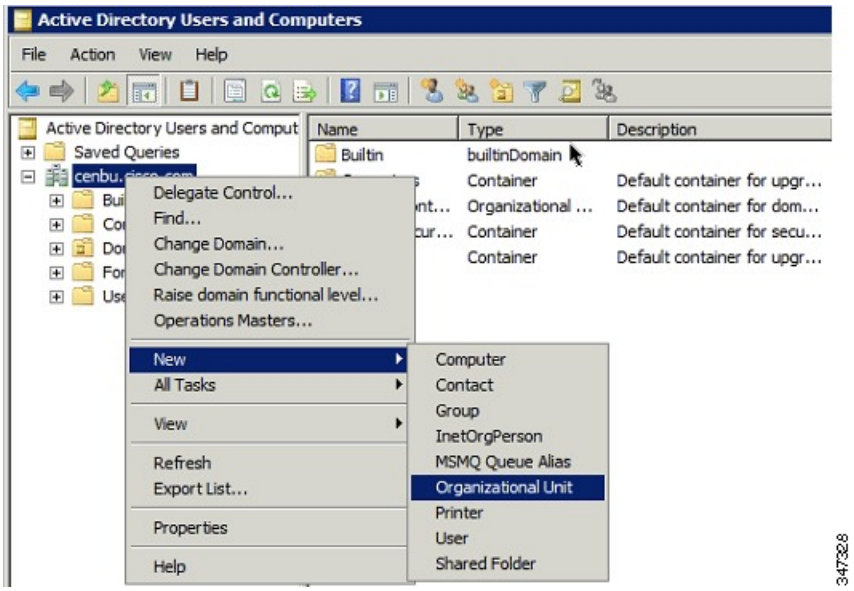


An entry for the RADIUS client appears under RADIUS Clients and Servers.



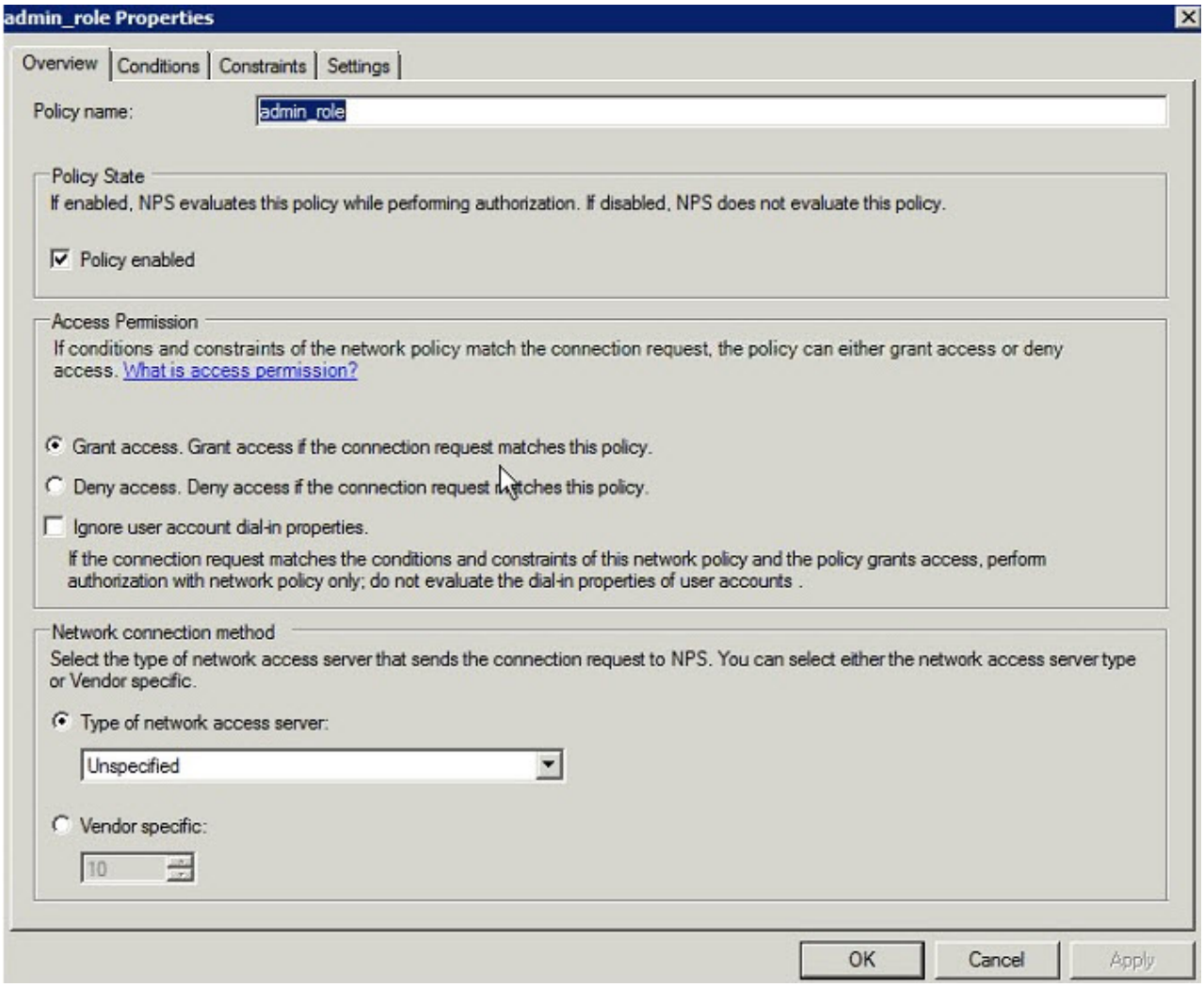
Step 3 Log in to AD and create an Organizational Unit.

Cisco recommends that you create all security groups (IoT FND roles) within this Organizational Unit.



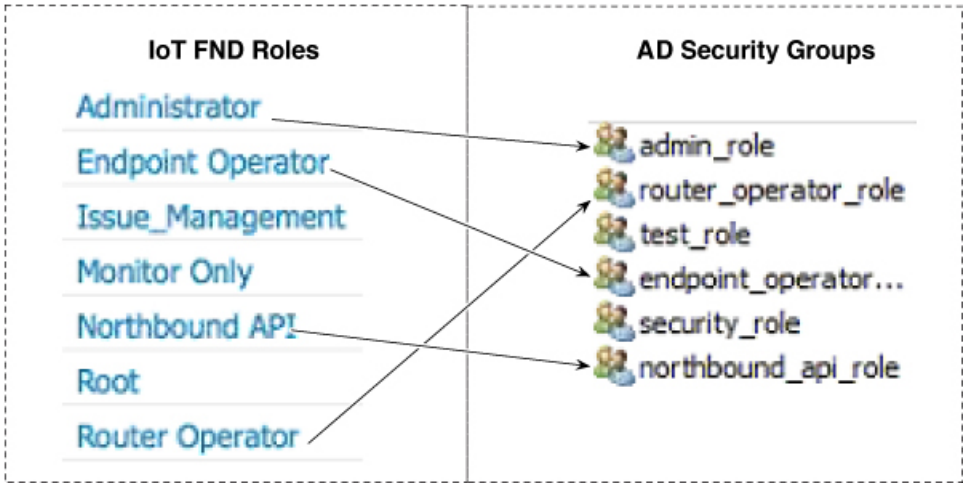
Step 4 Add security groups corresponding to IoT FND roles to the Organizational Unit.

The following example shows the security groups defined in the NMS_ROLES Organizational Unit.



Tip: When creating the security groups, ensure that they map one-to-one to IoT FND roles (that is, every role defined in IoT FND maps to only one AD security group). The name of the security group does not have to match a role name in IoT FND, but for organizational purposes, Cisco recommends using names that correlate the security group name to a IoT FND role.

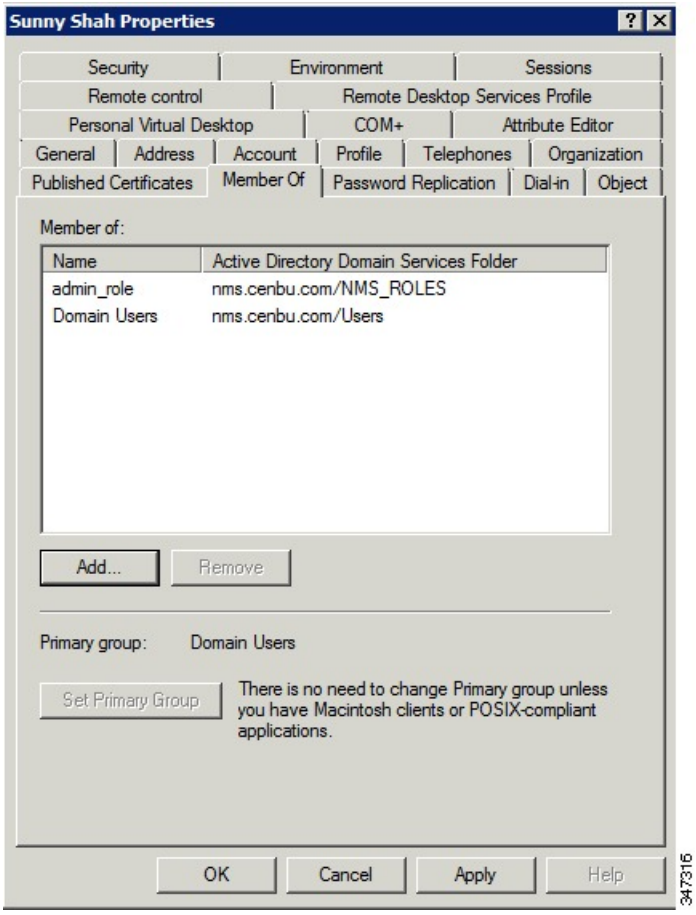
Note
You cannot create or assign the IoT FND root role in AD.



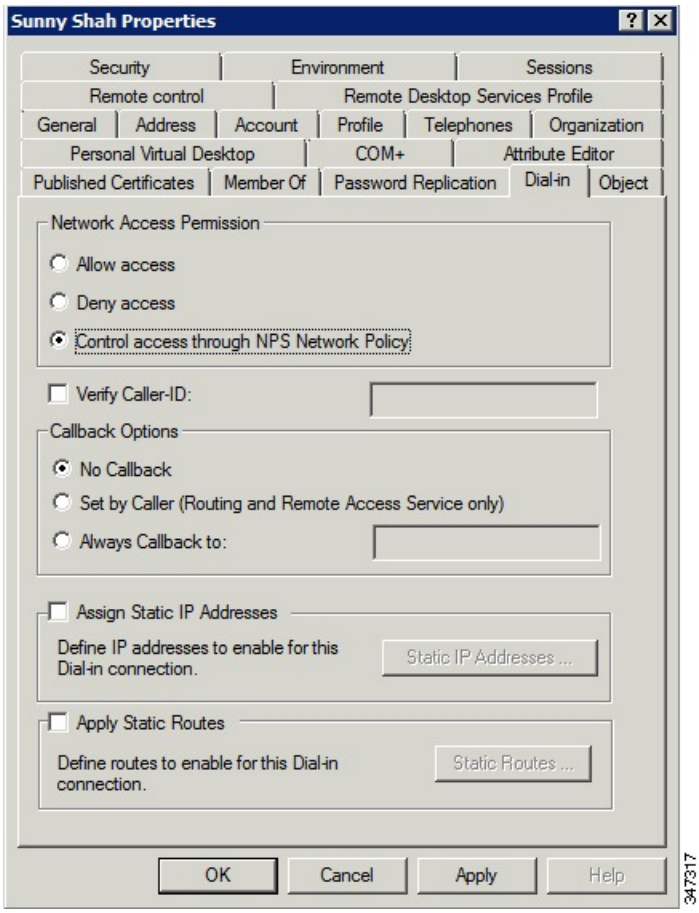
Step 5 Assign AD users a role by adding them to the security group mapping to that role.

Since, users can only belong to one security group, the IoT FND role that the user is assigned after log in is dependent on their assigned AD security group.

Tip: In AD, users cannot be assigned multiple IoT FND roles, and cannot belong to multiple security groups. To assign permissions from more than one role to a group of users, create a new IoT FND role with the required permissions, and a create the corresponding AD security group. Users in this new group can then carry out the tasks allowed by this role.



Step 6 Configure the Dial-in Network Access Permission to use the NPS Network Policy.



Enabling and Disabling Remote User Accounts

In IoT FND you cannot enable or disable remote AD user accounts. To enable or disable remote AD user accounts, use your AD server.

Deleting Remote User Accounts

In IoT FND, you can delete remote user accounts. However, this only removes the user from the IoT FND Users page (**ADMIN** > **Access Management** > **Users**); it does not delete the user account from AD. If a deleted user logs in to IoT FND and AD authentication is successful, an entry for the user is added to the IoT FND Users page.

Logging In to IoT FND Using a Remote User Account

Logging in to IoT FND using a remote AD user account is transparent to the user. In the background, IoT FND checks whether the account is local, and for remote users sends an authentication request to the RADIUS server configured on the Remote Authentication page (**ADMIN** > **Access Management** > **Remote Authentication**). If both authentication and authorization are successful, IoT FND adds an entry for the user in the Users page (**ADMIN** > **Access Management** > **Users**).

Unlike entries for local users on the Users page, the user name filed in remote user entries is not a link. You cannot click the name of a remote user to obtain more information about the user.

Note Remote users cannot be managed through IoT FND. If a remote user wants to update their password, they must use their organization's AD password update tool. Remote users cannot update their password using IoT FND.

Configuring Single Sign-On Authentication

Starting with Cisco IoT FND 4.8 release, Single Sign-On (SSO) authentication is supported. SSO allows you to access multiple web applications using one set of login credentials. With SSO enabled, the time and effort are minimized as you need not sign-in and sign-out separately while accessing multiple applications.

You can enable SSO on IoT FND using the following ways:

- Configure IDP Manually
- Import IDP Metadata File into FND

Table 17: Feature History

Feature Name	Release Information	Description
Single Sign-On (SSO)	IoT FND 4.8	SSO allows you to access multiple web applications using one set of login credentials.

Single Sign-On Authentication

Single Sign-On (SSO) is an authentication process that allows you to sign into one application and then securely access other authorized applications without the need to resupply your credentials. SSO allows you to sign on only once with a username and password to access browser-based applications and services within a single browser instance. SSO uses Security Assertion Markup Language (SAML) for authentication.

Note
- SSO is an optional feature
- Only HTTPS protocol is required to access all the web applications. HTTP access to web application is not supported when the SSO is enabled.

For more information on SSO—SAML solution, refer to:

- Elements in SSO SAML Solution , on page 110
- How SAML Works, on page 111
- Limitations for SSO Authentication, on page 114
- Configuring IDP Manually for SSO Authentication, on page 111

- Importing IDP Metadata for SSO Authentication, on page 113

SAML 2.0 Protocol

Security Assertion Markup Language (SAML) is an XML-based standard or framework to exchange user authentication details between an Identity Provider (IdP) and a service provider.

The identity provider authenticates the user credentials and issues SAML assertions. Each assertion is an XML document that contains security information, which is transferred from the identity provider to the service provider.

A generic SAML authentication flow consists of:

- Client—A browser-based user.
- Service Provider—An application or service the user tries to access.
- Identity Provider—An entity performing the user authentication

For more information, refer to Elements in SSO SAML Solution , on page 110

Elements in SSO SAML Solution

SAML uses the following elements to authenticate and authorize the user credentials.

Elements	Description
Client	A browser-based client such as FND users. **Note** Firefox and MS Edge are the officially supported browsers for FND.
Service Provider	An application or service that trusts the SAML assertion and relies on the IDP to authenticate the users.
Identity Provider (IDP) server	A third-party server, which authenticates user credentials and issues SAML assertions.
IDP Store	Storage that maintains user credentials and their associated roles. Available stores are LDAP store, Active Directory, or RDBMS.
SAML Assertion	An assertion is an XML document that contains trusted statements about a user. Example: username. SAML assertions are digitally signed to ensure their authenticity. It consists of pieces of security information, which are transferred from IDP to the service provider for user authentication.
SAML Request	An authentication request generated by the service provider.

Elements	Description
Metadata	An XML file generated by the service provider application and an IDP server. • The service provider metadata file contains information such as entity ID, redirect URLs, certificate key. • The IDP metadata file contains server information to configure the service provider.
Assertion Consumer Service (ACS) URL	A URL that instructs the IDP where to post SAML assertions.

How SAML Works

A synopsis of SAML workflow:

- Administrator logs into FND and enables SSO for all users.
  - Configuring IDP Manually for SSO Authentication, on page 111
  - Importing IDP Metadata for SSO Authentication, on page 113
- FND performs web certification checks. If the verification is successful, the SSO users are directed to the IDP login page; else, an error message appears.
- IDP checks whether the session is active.
  - For active session, you receive a SAML token.
  - For inactive session, you are redirected to IDP login page.
- IDP validates the credentials of the user.
- On successful login, SAML response is sent to ACS URL.
- FND server receives SAML response and extracts information such as user ID and roles associated with the user.
- FND maps the roles received to the roles in FND and gets the associated permissions for the user.
- User information is stored in the FND database and SSO is enabled for the user.

Configuring IDP Manually for SSO Authentication

To configure IDP manually for SSO authentication:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Authentication**.

Step 2 In the Authentication Settings page, select the **Single Sign-On Authentication** radio button.

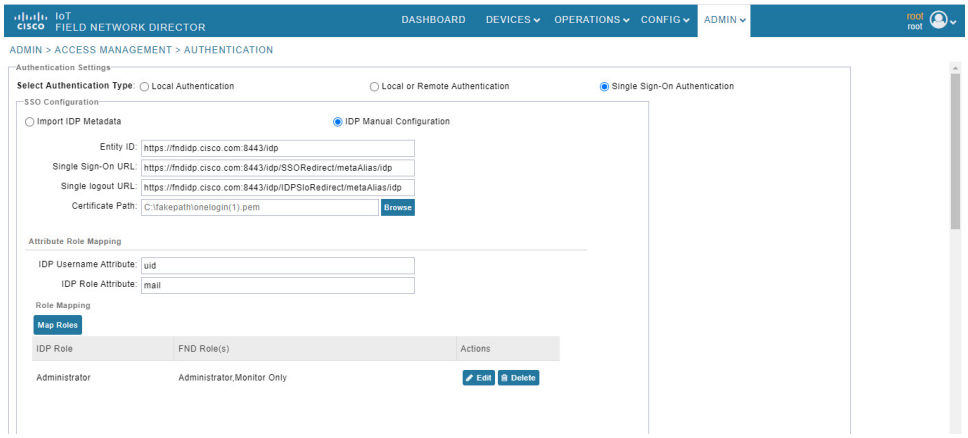
Step 3 Select the **IDP Manual Configuration** radio button.

Step 4 In the SSO Configuration section, provide the following information:

Fields	Description
Entity ID	IDP URL.
Single Sign-On URL	Target URL of IDP, where the service provider sends the authentication request message.
Single logout URL	URL location of IDP, where the service provider sends the SLO request.
Certificate Path	Browse and select the public certificate keys for IDP.

Step 5 Enter **IDP Username Attribute** and **IDP Role Attribute**.

Note
The username and role attributes specified are validated with the username and role in the SAML XML response. The same information is configured on the IDP server as well.



Step 6 Click **Map Roles**. The Role Mapping window appears.

Step 7 Enter **IDP Role**.

Step 8 Check the **FND Role** check box.

Note
You can map one IDP role to one or more FND roles.

Step 9 Click **Map**.

The Role Mapping section displays the mapping of IDP role to FND roles.

Step 10 Click **Save**. The IDP data gets saved in the IDP_SERVER_DETAILS DB table.

Step 11 Click **Export FND Metadata** to export the FND metadata file.

The generated XML file is saved in the local drive. The file contains information on the service provider (entity ID, single sign-on URL, single logout URL, and certificate path). This file is used for importing IDP to avoid manual configuration.

Importing IDP Metadata for SSO Authentication

To import IDP metadata for SSO authentication:

Procedure

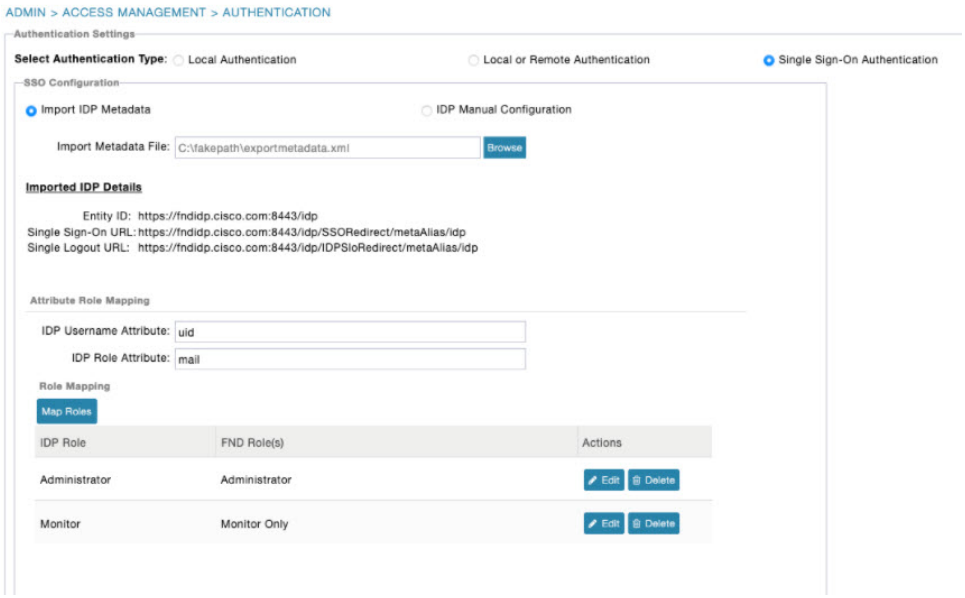
Step 1 Choose **ADMIN** > **Access Management** > **Authentication**.

Step 2 In the Authentication Settings page, select the **Single Sign-On Authentication** radio button.

Step 3 Select the **Import IDP Metadata** radio button.

Step 4 Browse and select **Import Metadata File** from the local drive.

On importing, the **Imported IDP Details** section has information on Entity ID, Single Sign-On URL, and Single Logout URL.



Step 5 Enter **IDP Username Attribute** and **IDP Role Attribute**.

Note
The username and role attributes specified are validated with the username and role in the SAML XML response. The same information is configured on the IDP server as well.

Step 6 Click **Map Roles**. The Role Mapping window appears.

Step 7 Enter **IDP Role**.

Step 8 Check the **FND Role** check box.

Note
You can map one IDP role to one or more FND roles.

Step 9 Click **Map**.

The Role Mapping section displays the mapping of IDP role to FND roles.

Step 10 Click **Save**.

The IDP data gets saved in the IDP_SERVER_DETAILS DB table.

Step 11 Click **Export FND Metadata** to export the FND metadata file.

The generated XML file is saved in the local drive. The file contains information on the Service Provider information (entity ID, single sign-on URL, single logout URL, and certificate path). This file is used for importing IDP to avoid manual configuration.

Limitations for SSO Authentication

- Supports only browser-based logins; therefore, Northbound (NB) API is not supported.

Note NB API needs local authentication, which SAML does not support.

- Supports only root domain.

Logging out of SSO

- On successful logout, IDP login page appears. For example, if you manually log out of FND, then FND sends a SAML logout request to IDP and IDP in-turn logs out of the third-party application as well .
- On inactive session, FND resends SAML authentication request to IDP to see if the session is still active.

Fallback URL When SSO Fails

Use the FND console URL as a fallback URL to configure the authentication settings when SSO login fails. The root users and the users with administrative privileges only can access the FND console URL.

FND Console URL	`https://<FND-IP>/consolelogin.seam`

Note The FND console URL is not used for the IDP authentication.

Managing Users

This section explains about managing users.

Adding Users

To add users to Cisco IoT FND:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Users**.

Step 2 Click + icon to **Add User**.

Step 3 Enter the following user information:

Field	Description
User Name	Enter the user name.
New Password	Enter the password. The password must conform to the IoT FND password policy.
Confirm Password	Re-enter the password.
Time Zone	Choose a time zone from the drop-down menu.

Step 4 Click **Assign Domain** to open the configuration panel:

a) Select the domain name from the drop-down menu.

b) Assign Role(s) and its associated Permission for the user by selecting the role check box.

Note
Assign only one role to a user. If a user needs multiple roles, you must create a custom role that encompasses all the necessary predefined permissions and assign it to the user. For instructions on creating and assigning a custom user role, refer to Custom User Roles, on page 124.

Step 5 Click **Assign to save the entries**.

The application creates a record for this user in the Cisco IoT FND database.

Step 6 To add the new user, click the **Disk** icon; otherwise, click **X** to close the window and return to the Users page.

A new user account is enabled by default. This means that the user can access Cisco IoT FND. You can make future edits to the User entry by selecting the Edit or Delete buttons that appear under the **Actions** column.

Enabling Users

You must enable the user account for users to access IoT FND. When users log in for the first time, IoT FND prompts them to change their password.

To enable user accounts in IoT FND:

Procedure

Step 1 Choose **Admin** > **Access Management** > **Users**.

Step 2 Check the check boxes for the user account(s) to enable.

Step 3 Click the solid person icon.

Step 4 To confirm action, click **Yes**.

Editing Users

To edit user settings in IoT FND:

Procedure

Step 1 Choose **Admin** > **Access Management** > **Users**.

Step 2 To edit user credentials:

a) Click the user name link.
b) Edit the role assignments.
c) Click **Save**.

Resetting Passwords

As the root user of the Linux server on which IoT FND runs, you can reset your password and use the password utility to reset the password for any other IoT FND user.

To reset a password:

Procedure

Enter this command **[root@yourname-lnx1 bin}#./password_admin.sh root**

IoT FND manages its own user account database; therefore, you must add all new local users from the IoT FND user interface at the **Admin** > **Access Management** > **Users** page.

Note
Remote users are automatically added to the database. You can also enable, disable, edit, or delete users on this page.

Note
A user with a disabled account cannot log in until an administrator enables their account. After a user account is active, the user must reset their password. There is no limit to the number of users that you can define on the system other than the available database storage.

Note
Starting from Cisco IoT FND release 4.8.0, in case you forgot your Cisco IoT FND password, the user with the role of **administrator** can assist you in resetting your password without you having to know your old password.

Viewing Users

To view IoT FND users:

Procedure

Choose **ADMIN** > **Access Management** > **Users** to open the Users page.

IoT FND displays this information about users:

Field	Description
User Name	Specifies the user name.
Default Domain	Shows the default domains for each user.
Enabled	Indicates whether the user account is enabled.
Time Zone	Specifies the user's time zone.
Roles	Specifies the roles assigned to the user.
Audit Trail	A link to the user's audit trail.
Remote User	Indicates whether the user account is stored locally. If the value is false, the user account is stored in Active Directory and is accessed via the RADIUS server configured in the Remote Authentication page (**ADMIN** > **Access Management** > **Users** > **Remote Authentication**).

Deleting Users

Deleting user accounts removes user preferences such as the default map location from the system. Disable a user account to temporarily deactivate it.

To delete users from IoT FND:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Users**.

Step 2 Check the box next to the User Name entry that you want to remove from the User Account list.

Step 3 To delete the entry, click the trash can icon.

Step 4 To confirm action, click **Yes**.

Disabling Users

To prevent users from accessing IoT FND, disable their accounts. Disabling user accounts does not delete their records from the IoT FND database.

To disable user accounts in IoT FND:

Procedure

Step 1 Choose **Admin** > **Access Management** > **Users**.

Step 2 Check the check boxes for the user account(s) to disable.

Step 3 Click the outlined person icon.

Note
If you disable a user account, IoT FND resets the user password.

Step 4 To confirm action, click **Yes**.

Managing Domains

In IoT FND, you can add domains and define local or remote administrators and users.

Viewing Domains

To view IoT FND domains, open the Domains page (**ADMIN > Access Management > Domains**).

IoT FND displays the following information about domains:

Field	Description
Domains	Specifies domains with root or non-root access. • Root - The Admin user who defines root access for other users while creating a domain. • Non-root - Admin creates the domain without root access.
Users	Defines local or remote administrators and users.
Description	Provides a brief information about the domain.

Field	Description
Hierarchy	Specifies the level of domains where the root domain is the top most in the structure.
CGK1K	Lists the total number of CGR1K devices mapped to the domain.
IR800	Lists the total number of IR800 devices mapped to the domain.
LORAWAN	Lists the total number of LORAWAN devices mapped to the domain.
IR500	Lists the total number of IR500 devices mapped to the domain.
ENDPOINT	Lists the total number of ENDPOINT devices mapped to the domain.
CELL_ENDPOINT	Lists the total number of CELL ENDPOINT devices mapped to the domain.
IR8100	Lists the total number of IR8100 devices mapped to the domain.

Adding Domains

The user can add a domain and map an existing user to the created domain or create a new user and map the domain to the newly created user.

To add a domain in IoT FND:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Domains**.

Step 2 Click + icon to open the **Add Domain** page.

Step 3 Enter the following domain information.

Field	Description
Domain Name	Enter a name for the domain.
Domain Hierarchy	Specify the level of domains, where the root domain is the top most in the structure.

Field	Description
Domain Administrator	Indicates the user who can modify any information in the domain. You can choose either one of the following options: • Local - The domain administrator can add new user or choose an existing user. • Remote - The domain administrator can only add new users.
User Name	Enter the name of the new user.
Password	Enter the password.
Confirm Password	Re-enter the password.
Existing User	Select the existing user from the **Existing User** drop-down list.

The License allocation section shows the devices available along with the following information:

- **Licenses Assigned**
- **Licenses Consumed**
- **Licenses Available**

Enter the number of licenses that can be assigned under each device for the newly created domain in the **Licenses Assigned** section.

Step 4 Click the Disk icon; otherwise, click **X** to close the window and return to the **Domains** page.

Editing Domains

To edit user settings in IoT FND:

Procedure

Step 1 Choose **ADMIN > Access Management > Domains**.

Step 2 To edit domain details:

a) Click the domain link.
b) Edit the licenses assigned for each device type.
c) Click the Disk icon to save the details; otherwise, click **X** to close the window and return to the **Domains** page.

Deleting Domains

The user cannot delete a domain if any device or user is associated with the domain. The root domain cannot be deleted.

To delete domains from IoT FND:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Domains**.

Step 2 Check the box next to the domain name that you want to remove from the Domain list.

Step 3 To delete the entry, click the trash can icon.

Step 4 To confirm action, click Yes.

Managing Roles and Permissions

Roles define the type of tasks specific role IoT FND users can perform. The operations the user can perform are based on the permissions enabled for the role.

IoT FND lets you assign a system-defined role to a user such as admin or operator (**ADMIN** > **Access Management** > **Roles**). The operations the user can perform are based on the permissions enabled for the role.

Basic User Permissions

The table describes basic IoT FND user permissions.

Table 18: IoT FND User Permissions

Permission	Description
Add/Modify/Delete Devices	Allows users to import, remove, and change router and endpoint devices.
Administrative Operations	Allows users to perform system administration operations such as user management, role management, and server configuration settings.
Asset Management	Allows users to view details on Assets (non-Cisco equipment) that are associated with an FND managed device.

Permission	Description
Battery Endpoint Operations	IoT FND supports the following special battery-powered endpoints: • ACT, BACT, CAM • L+G LFN The interaction with these endpoints should be kept to a minimum in order to reduce draw down of battery within the endpoints.
Endpoint Certificate Management	Permission for erasing node certificates on IR500 gateways.
Endpoint Configuration	Allows users to edit configuration templates and push configuration to mesh endpoints.
Endpoint Firmware Update	Allows users to add and delete firmware images and perform ME firmware update operations.
Endpoint Group Management	Allows users to assign, remove, and change devices from ME configuration and firmware groups.
Endpoint Reboot	Allows users to reboot the ME device.
GOS Application Management	Allows uses to add and delete Guest OS applications.
Issue Management	Allows users to close issues.
Label Management	Allows users to add, change, and remove labels.
LoRA Modem Reboot	Permission for rebooting LoRaWAN gateways and modems.
Manage Device Credentials	Allows users to view router credentials such as Wi-Fi pre-shared key, admin user password, and master key.
Manage Head-End Devices Credentials	Allows users to view the ASR/C8000 admin NETCONF password.
NB API Audit Trail	Allows users to query and delete audit trails using IoT FND NB API.
NB API Device Management	Allows users to add, remove, export, and change router and endpoint devices using IoT FND NB API.
NB API Endpoint Group Management	Permission for accessing the Group Management NB API.
NB API Endpoint Operations	Allows users to manage endpoint operations using IoT FND NB API.
NBAPI Event Subscribe	Allows users to search events, subscribe and unsubscribe from events (including Outage events) using IoT FND NB API.
NB API Issues	Allows users to search issues.
NB API Orchestration Services	Permission for IOK Orchestration Service to access the Orchestration NB APIs.
NB API Reprovision	Allows users to reprovision devices using IoT FND NB API.
NB API Rules	Allows users to search, create, delete, activate, and deactivate rules using IoT FND NB API.
NB API Search	Allows users to search devices, get device details, group information, and metric history using IoT FND NB API.

Permission	Description
NB API Tunnels	Permission for accessing the Tunnel Status NB APIs.
Password Policy	Provides a flexible password policy system to manage user passwords. It contains configurable properties for password expiration, failed login attempts, password strength and other aspects of password maintenance.
Router Configuration	Allows users to edit router configuration templates and push configuration to routers.
Router File Management	Permission for managing router files on the Device File Management GUI page.
Router Firmware Update	Allows users to add and delete firmware images and perform firmware update operations for routers.
Router Group Management	Allows users to assign, remove, and change device assignments to router configuration and firmware groups.
Router Reboot	Allows users to reboot the router.
Rules Management	Allows users to add, edit, activate, and deactivate rules.
Security Policy	Allows users to block mesh devices, refresh mesh keys, and so on.
Tunnel Provisioning Management	Allows users to manage tunnel groups, edit/apply tunnel-related templates, and perform factory reprovisioning.
View Device Configuration	Allows users to view field device configuration.
View Head-End	Allows users to view ASR/C8000 configuration, tunnel provisioning, and HER events.

System-Defined User Roles

Note The system-defined Root role cannot be assigned to users.

The table lists system-defined roles. These roles cannot be modified.

Table 19: System-defined User Roles

Role	Description
Administrator	This role combines these basic permissions: • Administrative Operations • Label Management • Rules Management

Role	Description
Endpoint Operator	This role combines these basic permissions: • Label Management • Endpoint Configuration • Endpoint Firmware Update • Endpoint Group Management • Endpoint Reboot
Monitor Only	Optional role. This role is not defined for every user.
North Bound API	This role combines these basic permissions: • NB API Audit Trail • NB API Device Management • NB API Endpoint Operations • NB API Event Subscribe • NB API Orchestration Service • NB API Rules • NB API Search
Root	The system-defined root role cannot be assigned to users. This role can use the password utility to reset the password for any IoT FND user.
Router Operator	This role combines these basic permissions: • Label Management • Router Configuration • Router Firmware Update • Router Group Management • Router Reboot

Custom User Roles

In IoT FND you can define custom roles. For each role you create, you can assign it one or more basic user permissions (see Basic User Permissions, on page 121). These permissions specify the type of actions users with this role can perform.

Adding Roles

To add IoT FND user roles:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Roles**.
Step 2 Click **Add**.
Step 3 Enter the name of the role.
Step 4 Check the appropriate check boxes to assign permissions.
Step 5 Click **Save** .
Step 6 To continue to add roles, click **Yes**; otherwise, click **No** to return to the Roles page.

Editing Roles

You cannot edit system-defined roles, but you can edit custom roles.

To edit IoT FND custom roles:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Roles**.
Step 2 Click the role to edit.
Step 3 Make changes to the permission assignments by checking or unchecking the relevant check boxes.
Step 4 Click **Save**.

Deleting Roles

You cannot delete a custom role if it is in use.

To delete IoT FND user roles:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Roles**.
Step 2 Check the check boxes of the roles to delete.
Step 3 Click **Delete**.
Step 4 Click **Yes**.

Step 5 Click **OK**.

Viewing Roles

To view IoT FND user roles:

Procedure

Step 1 Choose **ADMIN** > **Access Management** > **Roles**.

For every role, IoT FND lists the Users assigned to this role and the RADIUS Server VSA.

Step 2 To view permission assignments for the role, click the role link.

Configure bootloader password for GRUB2

Before you begin

- After you finish configuring the bootloader password for GRUB2, the next time you try to edit the GRUB menu during system reboot, the system will prompt you for the username and password set in the first step of this procedure.
- Only the user with the correct password will be able to access or modify the GRUB menu.
- Ensure that the bootloader password is set. This prevents an unauthorized user from entering boot parameters or changing the boot partition.

  Create an encrypted password with `grub2-setpassword`:

  ```
  # grub2-setpassword
  Enter password: <password>
  Confirm password: <password>
  ```

  If password protection is enabled, only the designated superuser can edit a GRUB2 menu item.

Use this task to secure the GRUB bootloader with `PBKDF2` password protection while accessing the VMware ESXi server in Cisco IoT FND.

Procedure

Step 1 Run the command as given in the example to generate the password hash.

Example:

```
grub2-mkpasswd-pbkdf2
Enter password:
Reenter password:
PBKDF2 hash of your password is grub.pbkdf2.sha512.10000.XXX…XXX
```

Step 2 Copy the `PBKDF2` hash generated in the previous step.

Step 3 Edit the GRUB custom configuration file and append the additional lines as given in the example.

Example:

```
#vim /etc/grub.d/40_custom
set superusers="root"
password_pbkdf2 root <generated-pbkdf2-hash-from-step1>
```

Step 4 Regenerate the GRUB configuration file as given in the example.

Example:

```
# grub2-mkconfig -o /boot/grub2/grub.cfg
Generating grub configuration file ...
Adding boot menu entry for UEFI Firmware Settings ...
Done
```

If you forget the GRUB password, you will not be able to access or change the GRUB menu when your system boots. This may prevent you from starting the system using certain options or performing important recovery tasks. Ensure that you keep the GRUB password safe and secure.

The bootloader password for GRUB2 is configured.

Remove bootloader password for GRUB2

Use this task to remove the GRUB bootloader password.

Procedure

Step 1 Edit the GRUB custom configuration file as given in the example.

Example:

```
# vim /etc/grub.d/40_custom
Remove or comment out the lines that set the superusers and password_pbkdf2, For example:

set superusers="root"
password_pbkdf2 root <generated-pbkdf2-hash>
```

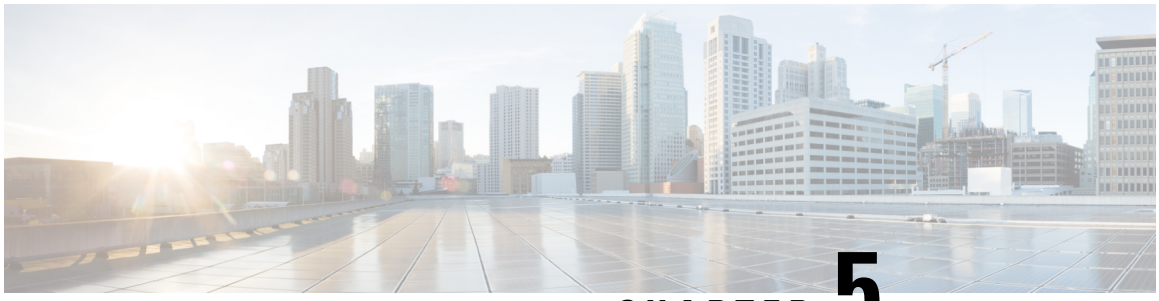
Step 2 Run the command to update the GRUB configuration without password and regenerate the GRUB configuration file as given in the example.

Example:

```
#grub2-mkconfig -o /boot/grub2/grub.cfg
```

After this step is complete, the GRUB menu no longer prompts for a password while rebooting.

The bootloader password for GRUB2 gets removed.



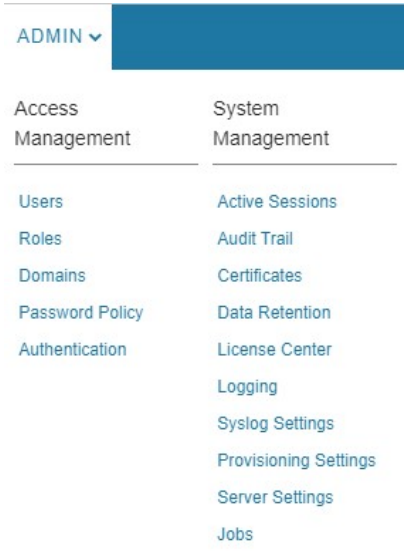
CHAPTER 5

Manage System Settings

This section describes how to manage system settings.

Note To manage system settings, you must be logged in either as root or as a user with Administrative Operations permissions.

System settings are managed from the **ADMIN** > **System Management** menu.



Managing Active Sessions

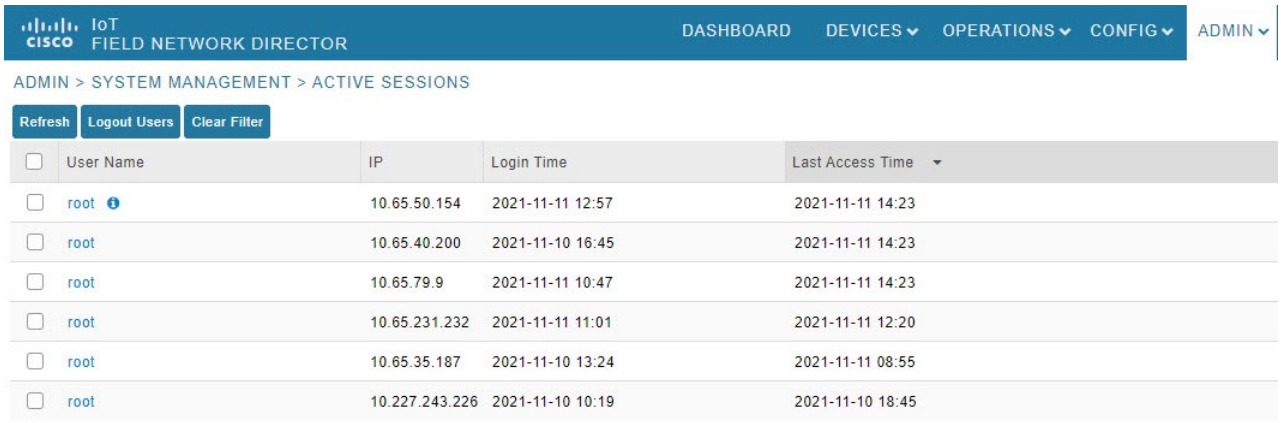
IoT FND tracks active user sessions and lets you log out users.

Viewing Active Sessions

To view active user sessions:

Procedure

Choose **ADMIN** > **System Management** > **Active Sessions**.
IoT FND displays the Active Sessions page.



The table describes the Active Session fields:

Field	Description
User Name	The user name in the session record. To view user settings, click the user name.
IP	The IP address of the system the user employs to access IoT FND.
Login Time	The log in date and time for the user.
Last Access Time	The last time the user accessed the system.

Tip
Click the **Reload** button (upper-left hand corner) to update the users list.

Logging Out Users

To log out an IoT FND user:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Active Sessions**.

Step 2 Select the check boxes for those users you want to log out.

Step 3 Click **Logout** Users.

Step 4 Click **Yes** to confirm logout of the users.

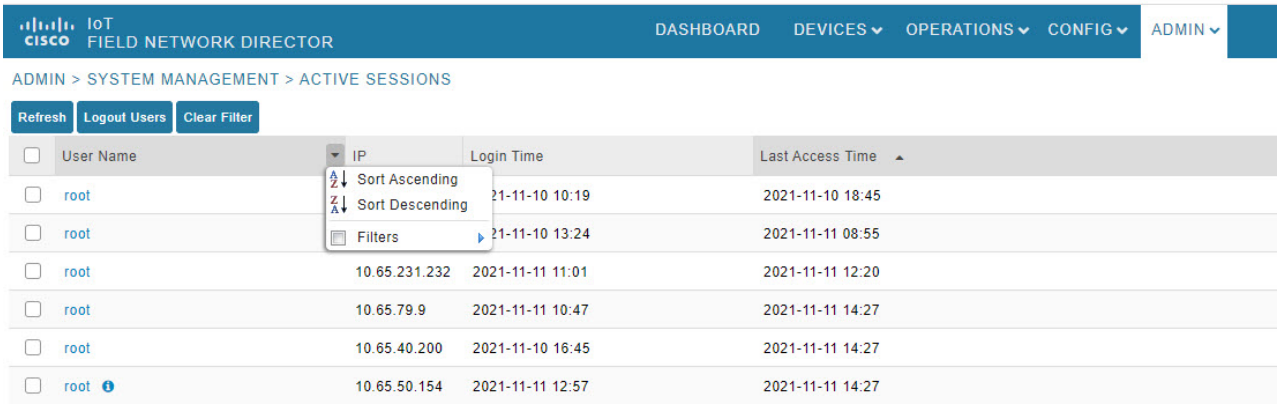
Filtering the Active Sessions List

To filter the Active Sessions list using column filtering:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Active Sessions**.

Step 2 Hover the mouse over the User Name column heading to expose the filter icon (triangle). Enter the user name or the first characters of the user name to filter the list.



For example, to list the active sessions for the root user, enter **root**.

Tip
To remove the filter, from the User Name drop-down menu, clear the **Filters** check box or click **Clear Filter**.

Google Snap to Roads

Google Snap to Roads is a map visualization feature in Cisco IoT FND that uses the Google Roads API to associate a sequence of reported GPS positions with the most likely roads traveled.

GPS positions reported by a moving device might not align exactly with a road on the map. GPS signal conditions, sampling intervals, and measurement noise can cause the displayed route to appear beside the road or contain gaps and abrupt changes.

When Google Snap to Roads is enabled, Cisco IoT FND uses the reported latitude and longitude coordinates to obtain corresponding points aligned with the road geometry. Cisco IoT FND uses the returned points to display a road-aligned route on the map.

- The service evaluates a sequence of GPS positions rather than treating each position as an independent point.
- The displayed route follows the geometry of the road that the service determines was most likely traveled.
- The snapped route is an estimated representation and does not verify the route that the device actually traveled.

Factors that affect route accuracy

The accuracy of the snapped route depends on the quality and frequency of the GPS positions reported by the device. The service works best when consecutive positions are part of a continuous route and are located close to one another.

The displayed route might be less accurate under the following conditions:

- Consecutive GPS positions are far apart.
- GPS reporting is interrupted or contains large changes in location.
- Two or more roads run close together, such as parallel roads, service roads, or stacked highways.
- The device travels on a private, newly constructed, or unmapped road.
- The reported positions do not represent a continuous route.

Note Google recommends that consecutive GPS positions be no more than 300 metres apart for the best snapping results. Sparse or noisy position data can cause the service to select a road different from the one actually traveled.

Google Snap to Roads requires a valid Google Maps API key. To request a key, contact the designated Cisco support team or representative and provide the fully qualified domain name used to access the Cisco IoT FND application.

Configure the Google Maps API key

Configure the API key required to display Google Maps in Cisco IoT FND.

The API key is associated with the fully qualified domain name (FQDN) used to access the Cisco IoT FND application.

Before you begin

- Contact the designated Cisco support team or representative to request a Google Maps API key. Provide the FQDN used to access the Cisco IoT FND application.
- Use a Cisco IoT FND account that has permission to modify server settings.

Procedure

Step 1 Sign in to Cisco IoT FND.
Step 2 Choose **ADMIN** > **Server Settings** > **Map Settings**.
Step 3 Enter the API key in the **Google Map Key** field.
Step 4 Click the save icon.
Step 5 Choose **DEVICES** > **Field Devices**.
Step 6 Open the **Map** tab and verify that the map displays without an authorization error.

Maps functionality and Google Snap to Roads are available in Cisco IoT FND.

What to do next

If the map displays an authorization error, confirm that the FQDN used to access Cisco IoT FND was provided when the API key was requested. Contact the designated Cisco support team or representative if the error continues.

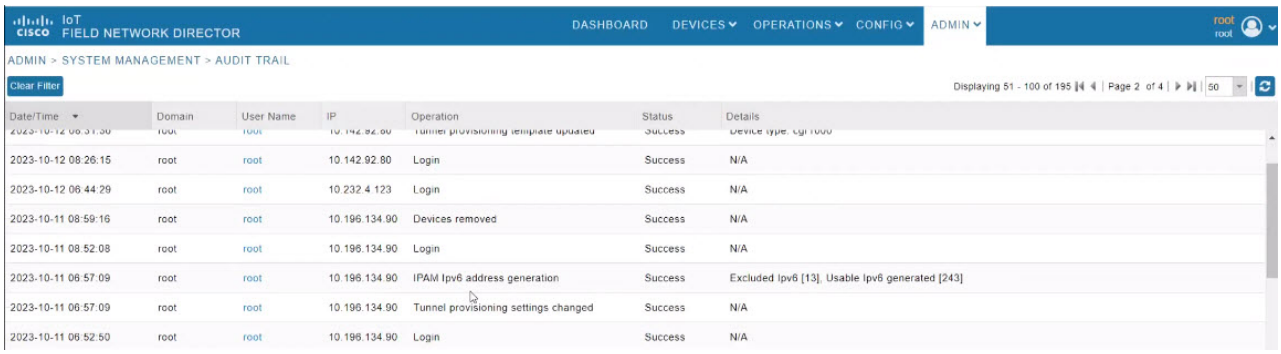
Displaying the Audit Trail

Use the audit trail to track IoT Field Network Director user activity.

To display the Audit Trail:

Procedure

Choose **ADMIN** > **System Management** > **Audit Trail**.



The table below describes the Audit Trail Fields:

Field	Description
Date/Time	Date and time of the operation.
Domain	Specifies domains with root or non-root access. • Root - The Admin user who defines root access for other users while creating a domain. • Non-root - Admin creates the domain without root access.
User Name	The user who performed the operation. To view user settings, click the user name.
IP	IP address of the system that the user employs to access IoT FND.
Operation	Type of operation performed.
Status	Status of the operation.
Details	Operation details.

Tip
Click the **Refresh** icon (far right) to update the list.

Filter the Audit Trail list

Use the Audit Trail to locate and review specific system-management records.

Use search or column filtering to locate entries in the Audit Trail list.

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Audit Trail**.

Step 2 Enter all or part of a value in the **Search** field to locate specific audit trail entries.

Cisco IoT FND filters the list and displays the matching entries. Clear the **Search** field to display all audit trail entries.

Step 3 From the **User Name** drop-down list, point to **Filters**, and enter all or part of a user name in the field that appears.

For example, to list Audit Trail entries for the user Jane, enter **`jane`**.

Tip
To remove the filter, clear the **Filters** check box from the **User Name** drop-down list or click **Clear Filter**.

Managing Certificates

The **Certificates** page displays the certificates for CSMP (CoAP Simple Management Protocol), and web certificates used by Cisco IoT FND and lets you download these certificates.

To display the CSMP, and web certificates:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Certificates**.

Step 2 To view a certificate, click its corresponding heading (such as **Certificate for Routers**).

Step 3 To download a certificate, select encoding type (**Binary** or **Base64**) radio button, and then click **Download**.

For more information about certificates, see Generating and Installing Certificates in the Cisco IoT Field Network Director Installation Guide-Oracle Deployment.

Configuring CA Certification to verify the App Signature

Allows you to import and add a trust anchor to the default profile for a Cisco IOx device that is being managed by IoT FND such as IC3000 or IR800. (The default profile is not visible to the user). You can enable this capability on the Application Security tab of the Certificate page.

The Application Security tab only appears when both of the following conditions are met:

- The user should have application management permission.
- At least one IOx device is being managed such as IC3000 or IR800.

To import and add a trust anchor to a default profile for a Cisco IOx device:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Certificates**.

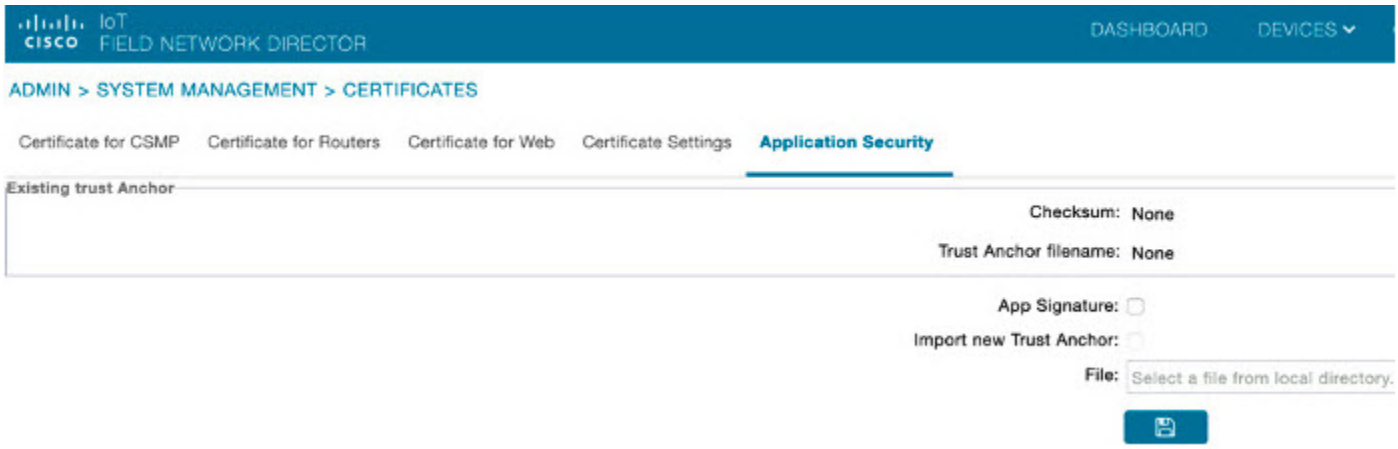
Step 2 Select the Application Security tab. The page that appears displays any existing trust anchors.

Note

By default, no information will display for new installations or updates and the fields for Checksum and Trust Anchor will display a value of **'None'**.)

Step 3 To import a new a new trust anchor, check the boxes next to App Signature and Import New Trust Anchor and then enter a path to the file. Click the disk icon to Save your entries. File will also be pushed to Fog Director.

Note
After you save and reload the Certificates page, the Checksum and Trust Anchor File name appear on the page replacing the previous values of None.



CGMS Certificate Renewal for Routers

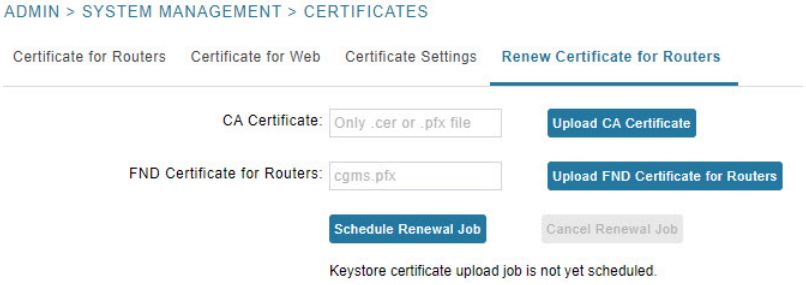
The **Renew Certificate for Routers** option in the UI automates the CGMS and/or CA certificate renewal process by updating the certificates in the keystore and encrypting the router password with new certificate. The supported certificate file extension is either (`.cer`) or (`.pfx`). We recommend you to schedule the automation job during the maintenance window to avoid conflict with other active operations (such as configuration push, firmware upgrade) running in FND.

To automate cgms or CA certificate renewal for routers:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Certificates**.

Step 2 Select the **Renew Certificate for Routers** tab.

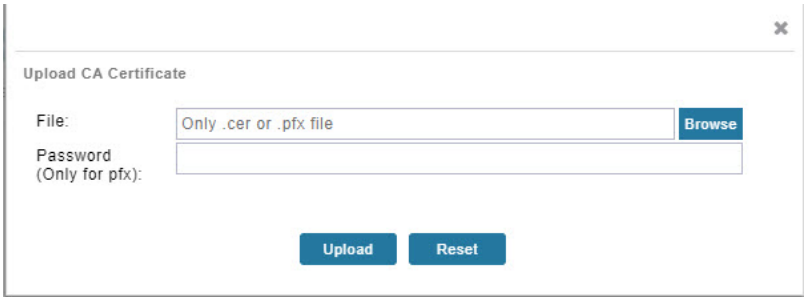


Step 3 Click either **Upload CA Certificate** or **Upload FND Certificate for Routers** to upload a CA or CGMS certificate.

Note
You can also upload both CA certificate and CGMS certificate simultaneously.

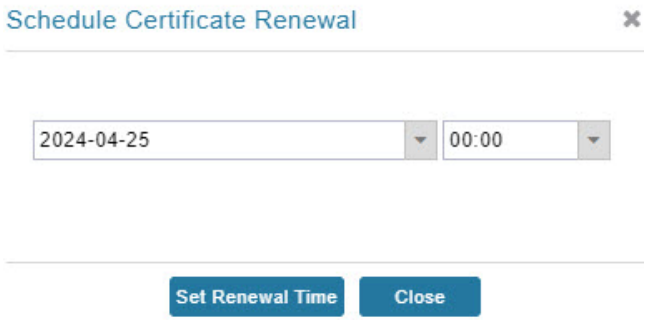
Step 4 Browse and select a valid CGMS or CA certificate in either (`.cer`) or (`.pfx`) format.

Step 5 Enter the password (applicable only for (`.pfx` file) and then click **Upload**.



Step 6 After uploading the certificate, click **Schedule Renewal Job**.

Step 7 Specify the date and time and then click **Set Renewal Time** to schedule the renewal job. The scheduled job appears in the page.



Use **Cancel Renewal Job** to cancel the scheduled job.

Data retention

The **Data Retention** page helps you control how long the historical data is kept in the application database and when old records are purged. It's primarily used to manage database growth, keep the system responsive, and align with your organization's compliance policies. Here are the major data categories that can be retained or pruned.

- Events data: Historical event records and their state transitions.
- Fimware operation data
- Historical dashboard data
- Historical endpoint metrics
- Closed issues

- JobEngine data
- Historical metrics statistics
- Service provider down routers data

Feature name	Release info	Description
Manage data retention of open issues	Cisco IoT FND Release 5.1	Cisco IoT FND retrieves open issues and prunes them based on a configurable retention period. By default, open issues are retained for 31 days, and older items are automatically removed. You can control this period using the **Keep Open Issues data for** field.

Configure data retention

This task guides you to configure data retention metrics on your Cisco IoT FND.

The **Data Retention** page lets you determine the number of days to retain the events, issues, and metrics related data in the Cisco IoT FND database.

Note Data retention prunes events even if they have associated open issues.

Here are the instructions to set Cisco IoT FND data retention:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **ADMIN** > **System Management** > **Data Retention**.

Step 2 For each of the retention categories, specify the number of days to retain the data as specified in the table.

Table 20: Data Retention field permitted maximum values

Field	Minimum Values in Days	Maximum Values in Days	Default Values in Days
Keep Event data for	1	90	31
Keep Endpoint Firmware Operation data for	7	180	7
Keep Historical Dashboard data for	1	90	62
Keep Dashboard data for	1	7	7
Keep Historical Endpoint Metrics for	1	7	7

Field	Minimum Values in Days	Maximum Values in Days	Default Values in Days
Keep Closed Issues data for	1	90	31
Keep Job Engine data for	1	30	7
Keep Historical Router Statistics data for	1	90	30
Keep Device Network Statistics data for	1	7	7
Keep Open Issues data for	1	90	31
Keep Service Provider down routers data for	1	31	31

Step 3 To save the maximum values, click the **save**icon.

Step 4 To revert to default settings, click the **Reset** icon.

You've successfully configured data retention on Cisco IoT FND.

Managing Licenses

This section is moved to a new location with improved user experience. For more information on managing licenses on Cisco IoT FND see, Classic Licensing In Cisco IoT FND.

Cisco IoT FND Logs

Table 21: Feature history

Feature name	Release information	Description
Feature-Specific and Heartbeat Logs	Cisco IoT FND Release 5.1	In Cisco IoT FND, errors, startup events, and heartbeat logs are recorded in dedicated logs instead of a single consolidated server log. A predefined list of feature-specific logs provides quick access, allowing you to efficiently monitor system activity.

Cisco IoT FND logs

Cisco IoT FND logs are systematic records of events, operations, and system activities generated by Cisco IoT FND and the managed devices. These logs capture information such as system status, configuration changes, user actions, communications, errors, and warnings. Cisco IoT FND logs are essential for:

- tracking the health and performance of the Cisco IoT network and devices
- diagnosing and resolving issues by reviewing historical events and error messages
- maintaining a secure environment by recording user activities and configuration changes for compliance purposes.

Cisco IoT FND provides various types of logs:

- system logs
- audit logs
- event logs
- hearbeat logs
- feature-specific logs

Benefits

- Cisco IoT FND logs provide better visibility into system activity, supporting proactive monitoring and ongoing operational health.
- Feature-specific logs make it easier to identify and resolve issues by separating errors, startup events, and heartbeat messages into dedicated log files.
- The predefined list of log categories improves accessibility and organization, helps you quickly locate and review relevant logs.
- The segregation of heartbeat messages prevents excessive log volume in main server logs, making analysis more efficient in large-scale deployments.

Prerequisites

- Logs require disk space. For example, with 5 million meters (8-hour reporting) and 5,000 routers (60-minute notifications), disk usage is about 7 MB/sec. Ensure your server has sufficient space for logs.
- To view feature-specific logs and heartbeat logs, your Cisco IoT FND should be running Cisco IoT FND Release 5.1 and later releases.

Restrictions

- Cisco IoT FND logs does not include separate logs from Cisco Fog Director. Cisco Fog Director has its own built-in logging mechanism that records information related to edge operations, such as application lifecycle events, local errors, device interactions, and communication with the central Cisco IoT FND server.
- During server startup, relevant ports are temporarily blocked at the firewall level to prevent processing until the server is fully initialized and ready to handle requests.

Configue log level settings

This task guides you to configure log level settings using Cisco IoT FND for various log level categories.

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Logging**.

Step 2 Click **Log Level Settings** tab.

Step 3 Check the check boxes of the logging categories that you would like to configure.

Step 4 Choose either the **Debug** or **Informational** log level from the **Change Log Level to** drop-down menu.

Note

- To generate all possible logging messages, use the **Debug** level.
- To generate a subset of these messages, use the **Informational** level.
- When you first open Cisco IoT FND, the logging level for all categories is automatically set to **Informational** by default. If you change the logging level, for example, to **Debug** during your session, your custom settings are saved and used the next time you log in, as long as the IoT FND server has not been restarted.

Step 5 If you'd like to debug particular devices, enter their Eids in the **Eids for debugging** text box.

Step 6 Click **Go**.

Note
Once server.log gets too big, it is saved as an archive (often with a new name or number), and a fresh server.log file is created to continue logging new information.

Step 7 Click the disk icon to save the configuration.

You've configured log level settings.

Download Cisco IoT FND Logs

To download logs:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Logging**.

Step 2 Click the **Download Logs** tab.

Step 3 Click the **Download Logs** button.

- When you click this button in a single-server deployment, IoT FND compresses the log files into a single zip file and adds an entry to the Download Logs pane with a link to the zip file.

- In IoT FND cluster deployments, when you click this button, the IoT FND server to which you are connected:
  - Compresses the log files on the server into a single zip file and adds an entry to the Download Logs pane with a link to the zip file.
  - Initiates the transfer of the log files in .zip format from the other servers to this server. As files become available, the server adds entries for these files to the Download Logs pane.

Step 4 To download a zip file locally, click its file name.

Tip
In a cluster environment, if you need to send log files to Cisco Support, ensure that you send the log files of all cluster servers.

Configure feature specific logs

This task guides you to configure feature-specific logs using Cisco IoT FND.

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Logging**.

Step 2 Click **Log Level Settings** tab.

Step 3 Select **Feature Specific Log** from the **Select Log Type** drop-down list. Here's a list of feature-specific logs:

Feature Category Name	Description
Pnp Bootstrapping	Includes WSMA and CGNA, Router bootstrapping, firmware, template.log name (pnp_bootstrapping.log)
Tunnel Provisioning	Includes WSMA and CGNA, DHCP, reprovisioning, tunnel provisioning, templates.log name (tunnel_provisioning.log)
Registration	Includes WSMA and CGNA, CSMP, Configuration, Snmp, generic endpoint, LWM2M, NETCONF, reprovision, websocket, templates.log name (registration.log)
Periodic Metrics Collection	WSMA and CGNA, CSMP, Generic endpoint, LWM2M, metrics, NETCONF, websocket, log name (periodic_metrics_collection.log)
Config Push	WSMA and CGNA,CSMP, configuration, job engine, LWM2M, websocket, template. log name (config_push.log)
Firmware Upgrade	WSMA and CGNA, CSMP, Firmware, job engine, LWM2M, software patch service, websocket.log name (firmware_upgrade.log)

Step 4 Check the **Include System Log Category** check box adjacent to each feature category if you want to include all the system logs.

Step 5 Click **Enable** in the **Actions** column.

Note

- If the **Enable** button is visible, logging is stopped and can be resumed by clicking it; if the **disable** button is visible, logging is active and can be halted by clicking it.
- For all the logs that you want Cisco IoT FND to display at a feature-specific level, you need to enable the debug logs for the corresponding category.

  The respective category is displayed in the info button for each feature.

Step 6 Click **Download** in the **Actions** column to download the feature specific logs.

Note
The downloadable logs appear in the **File** column.

Step 7 Select **Feature Specific Log** from the **Select Log Type** drop-down list.

Step 8 In the desired **Feature Category Name**, click **Enable**.

Step 9 Click **Download** once the logs are available after processing.

You've downloaded feature specific logs.

Configure heartbeat logs

This task guides you to configure heartbeat logs using Cisco IoT FND.

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Logging**.

Step 2 Click **Log Level Settings** tab.

Step 3 Select **Heartbeat log** from the **Select Log Type** drop-down list.

Step 4 Check the **Log router heartbeat in server.log** if you want to include the heartbeat logs in the server.log.

Step 5 If you don't enable **Log router heartbeat in server.log**, the logs are saved in heartbeat.log.

Step 6 Click the **Save** icon.

Step 7 Click **Download Logs** tab and wait for the logs to process and appear.

Step 8 Once the log file appears, click the file to download the logs to your local storage.

You've configured heartbeat logs

Configuring Provisioning Settings

The Provisioning Settings page (**ADMIN** > **System Management** > **Provisioning Settings**) lets you configure the IoT FND URL, DHCPv4 Proxy Client, and DHCPv6 Proxy Client settings required for IoT FND to create tunnels between routers and ASRs/C8000 (Provisioning Settings page). For an example of tunnels as used in the IoT FND, see Tunnel Provisioning Configuration Process topic in the Managing Tunnel Provisioning chapter.

During Zero Touch Deployment (ZTD), you can add DHCP calls to the device configuration template for leased IP addresses.

Note For Red Hat Linux 7.x server installations, you must configure specific IPv4 and IPv6 addresses from the IoT FND Linux host server to which to bind DHCP IPv4 and IPv6 clients by setting the following values in IoT FND:

ADMIN > **Provisioning Settings** > **DHCPv6 Proxy Client** > **Client Listen Address**	Set the value to the IPv6 address of the interface to use to obtain IPv6 DHCP leases from the DHCP server. The default value is "::". Change the default setting to an actual IPv6 address on the Linux host machine.
ADMIN > **Provisioning Settings** > **DHCPv4 Proxy Client** > **Client Listen Address**	Set the value to the IPv4 address of the interface to use to obtain IPv4 DHCP leases from the DHCP server. The default value is "0.0.0.0". Change the default setting to an actual IPv4 address on the Linux host machine.

Note To configure tunnel and proxy settings, you must be logged in either as root or as a user with Administrative Operations permissions.

Under **ADMIN** >**System Management** > **Provisioning Setting** page, the CSMP optimization settings help to configure the timeout to acquire lock when processing the csmp messages. By default, the timeout value is 5 seconds which can be configured between 1 to 30 seconds.

Note This csmp setting is applicable only for Oracle deployments.

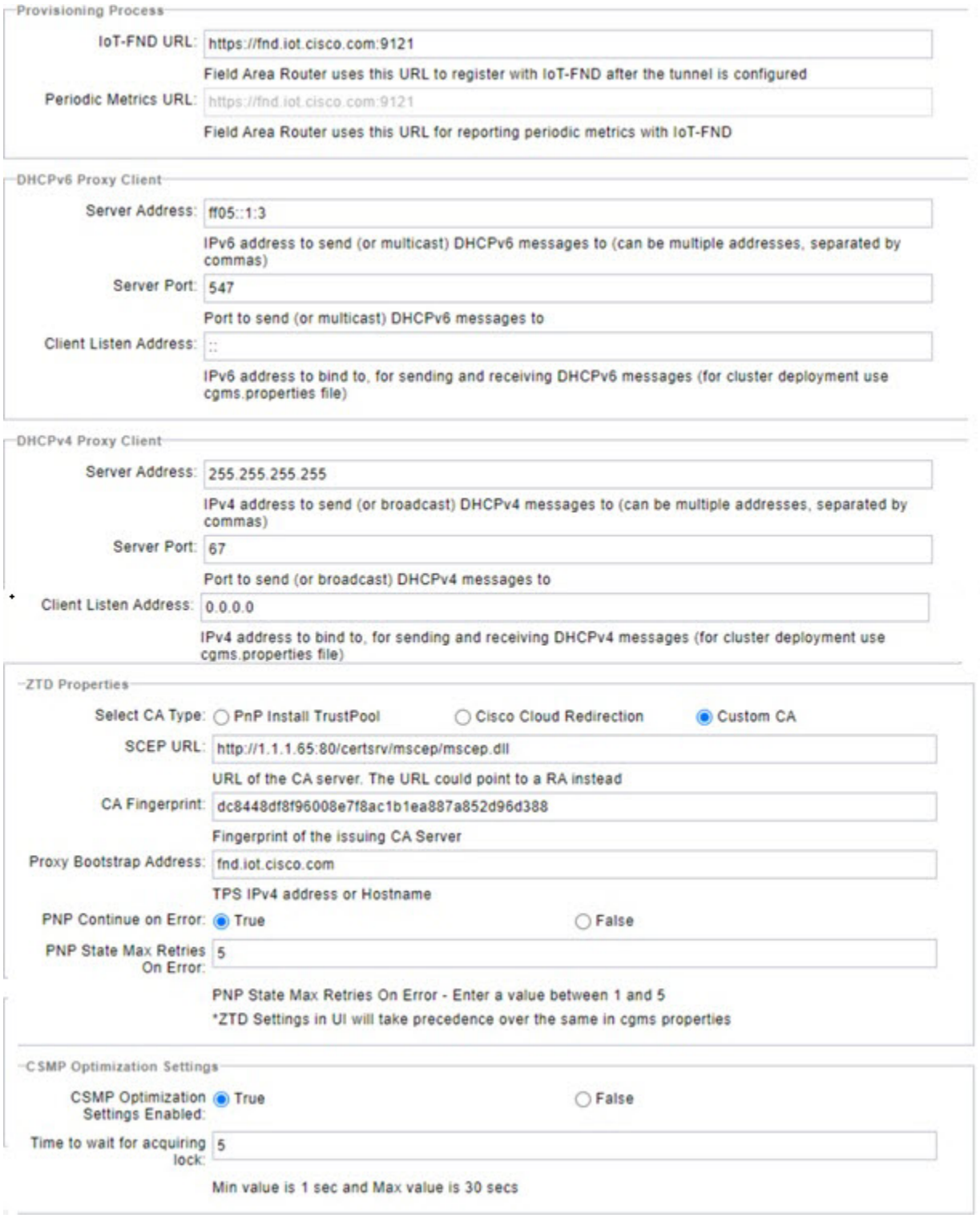
If the timeout happens, then during registration, the following message is displayed in the server.log file.

```
"Failed to acquire lock for <Endpoint Eid> during registration.
Another Operation seems to be in progress."
```

During csmp notification, the following log message is displayed in the server.log file when handing csmp messages.

```
"Failed to acquire lock to update Endpoint Status. Another Operation seems to be in progress."
```

Provisioning Settings Page


Provisioning Process
IoT-FND URL:
https://fnd.iot.cisco.com:9121
Field Area Router uses this URL to register with IoT-FND after the tunnel is configured
Periodic Metrics URL:
https://fnd.iot.cisco.com:9121
Field Area Router uses this URL for reporting periodic metrics with IoT-FND
DHCPv6 Proxy Client
Server Address:
ff05::1:3
IPv6 address to send (or multicast) DHCPv6 messages to (can be multiple addresses, separated by commas)
Server Port:
547
Port to send (or multicast) DHCPv6 messages to
Client Listen Address:
::
IPv6 address to bind to, for sending and receiving DHCPv6 messages (for cluster deployment use cgms.properties file)
DHCPv4 Proxy Client
Server Address:
255.255.255.255
IPv4 address to send (or broadcast) DHCPv4 messages to (can be multiple addresses, separated by commas)
Server Port:
67
Port to send (or broadcast) DHCPv4 messages to
Client Listen Address:
0.0.0.0
IPv4 address to bind to, for sending and receiving DHCPv4 messages (for cluster deployment use cgms.properties file)
ZTD Properties
Select CA Type:
PnP Install TrustPool
Cisco Cloud Redirection
Custom CA
SCEP URL:
http://1.1.1.65:80/certsrv/mscep/mscep.dll
URL of the CA server. The URL could point to a RA instead
CA Fingerprint:
dc8448df8f96008e7f8ac1b1ea887a852d96d388
Fingerprint of the issuing CA Server
Proxy Bootstrap Address:
fnd.iot.cisco.com
TPS IPv4 address or Hostname
PNP Continue on Error:
True
False
PNP State Max Retries On Error:
5
PNP State Max Retries On Error - Enter a value between 1 and 5
*ZTD Settings in UI will take precedence over the same in cgms properties
CSMP Optimization Settings
CSMP Optimization Settings Enabled:
True
False
Time to wait for acquiring lock:
5
Min value is 1 sec and Max value is 30 secs

Configuring the IoT FND Server URL

The IoT FND URL is the URL that routers use to access with IoT FND after the tunnel is established. This URL is also accessed during periodic inventories. During ZTD, routers transition from accessing IoT FND through the TPS proxy to using this URL, which must be appropriate for use through the tunnel.

To configure the IoT FND URL:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Provisioning Settings**.

Step 2 In the **IoT FND URL** field, enter the URL of the IoT FND server.

The URL must use the HTTPS protocol and include the port number designated to receive registration requests. By default, the port number is 9121. For example:

```
https://nms.sgbu.example.com:9121
```

Step 3 Click **Save**.

Configuring DHCP Option 43 on Cisco IOS DHCP Server

To configure for IPv4, enter:

```
ip dhcp pool fnd-pool
network 192.0.2.0 255.255.255.0
default-router 192.0.2.1
option 43 ascii "5A;K4;B2;I192.0.2.215;J9125"
```

```
5 – DHCP type code 5
A – Active feature operation code
K4 – HTTP transport protocol
B2 – PnP/FND server IP address type is IPv4
I - 192.0.2.215 – PnP/FND server IP address
J9125 – Port number 9125
```

Configuring DHCPv4 Proxy Client

To configure DHCPv4 Proxy client settings:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Provisioning Settings**.

Step 2 Configure the DHCPv4 Proxy Client settings:

a) In the **Server Address** field, enter the address of the DHCPv4 server that provides tunnel IP addresses.

Note

You can enter multiple addresses separated by commas. However, in most cases, you only need one server. IoT FND tries to get the tunnel IP addresses from the first server in the list. If it cannot, it moves to the next server in the list, and so on.

b) In the **Server Port** field, enter the port address on the DHCP server to send DHCPv4 requests to.

Note
Do not change the default port number (67) unless you have configured your DHCP server to operate on a non-standard port.

c) In the **Client Listen Address** field, enter the address to bind to for send and receive DHCPv4 messages.

Note
This is the address of the interface that the DHCP server uses to communicate with IoT FND. You can enter multiple backup addresses separated by commas.

Step 3 Click **Save**.

Configuring DHCPv6 Proxy Client

To configure DHCPv6 Proxy client settings:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Provisioning Settings**.

Step 2 Configure the DHCPv6 Proxy client settings:

a) In the **Server Address** field, enter the address of the DHCPv6 server that provides tunnel IP addresses.

You can enter multiple addresses separated by commas. However, in most cases, you only need one server. IoT FND tries to get the tunnel IP addresses using DHCP protocols. If it cannot, it goes to the next server in the list and so on.

b) In the **Server Port** field, enter the port address on the DHCP server to send DHCPv6 requests.

Note
Do not change the default port number (547) unless you have configured your DHCP server to operate on a non-standard port.

c) In the **Client Listen Address** field, enter the address to bind to for DHCPv6 send and receive messages.

This is the address of the interface that the DHCP server uses to communicate with IoT FND. You can enter multiple backup addresses separated by commas.

Tip
For IoT FND installations where the host has multiple interfaces, the client sends requests using each listed source address. The default values, “0.0.0.0” (IPv4) and “::” (IPv6), cause the client to send requests out each interface. Usually, one interface faces the DHCP server(s). In these installations, setting the **Client Listen Address** field to the IP address of the facing interface sends all client requests out that interface.

Step 3 Click **Save**.

Configuring Server Settings

The Server Settings page (**ADMIN** > **System Management** > **Server Settings**) lets you view and manage server settings.

Configuring Download Log Settings

Note Configuring download log settings is only required for IoT FND cluster setup.

The Download Logs page lets you configure the Keystore settings.

To configure download log settings:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Server Settings**.

Step 2 Click the **Download Logs** tab.

Step 3 Configure these settings:

Table 22: Keystore Settings

Field	Description
Keystore Filename	Click **Upload Keystore File** to upload a Keystore file with the public key of the X.509 certificate that IoT FND uses. You can reuse the same Keystore file.
Keystore Password	Enter the password that IoT FND uses to access the Keystore file on start up.
Confirm Keystore Password	
FTP Password	Enter the FTP password.
Confirm FTP Password	

Step 4 To save the configuration, click the disk icon.

Configuring Web Sessions

The Web Sessions page lets you specify the number of timeout seconds after which IoT FND terminates web sessions and logs users out.

To configure web session timeout:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Server Settings**.

Step 2 Click the **Web Session** tab.

Step 3 Enter the number of timeout seconds.

The valid values are 0–86400 (24 hours).

Note
If a web session is idle for the specified amount of time, IoT FND terminates the session and logs the user out.

Step 4 To save the configuration, click the disk icon.

Configuring Device Down Timeouts

The **Server Settings** page allows you to configure the device down timeout globally for head-end routers (ASR , C8000) and other devices managed by IoT FND, such as routers (CGR1000, IR800, IR8100,), endpoints, and gateways. When the specified device down timeout interval is reached, devices move to the Down state in the IoT FND GUI based on the last-heard value from the device and the tunnel interface state.

From the Device Configuration page (**CONFIG** > **DEVICE CONFIGURATION**), you can configure device downtime for a specific router or endpoint configuration group. For more information, see Configuring the Mark-Down Timer.

Note For HER devices, you can set the device down timeout only on the Server Settings page.

Device status changes to Uo when IoT FND detects any of the following:

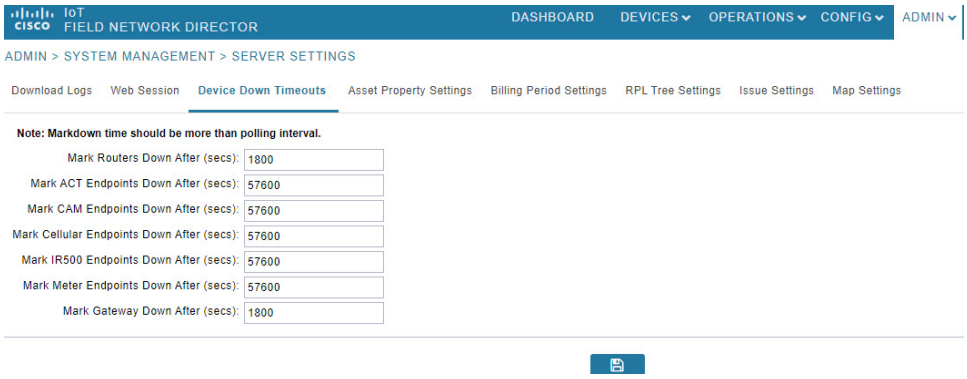
- Periodic inventory notifications
- Events
- Manual metric refreshes
- Device registrations

To configure device down timeout settings:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Server Settings**.

Step 2 Click the **Device Down Timeouts** tab.



Note
The device down timeout value must be greater than the corresponding polling intervals. For example, if the polling interval for routers is 30 minutes, or 1800 seconds, the value in the **Mark Routers Down After (secs)** field must be 1801 or greater.

Step 3 Click the disk icon to save the configuration.

Configuring Billing Period Settings

IoT FND lets you configure the start day of the monthly billing periods for cellular and Ethernet (satellite) services.

To configure the billing period settings:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Server Settings**.
Step 2 Click the **Billing Period Settings** tab.
Step 3 Enter the starting days for the cellular and Ethernet billing periods.
Step 4 From the drop-down menu, choose the time zone for the billing period.
Step 5 To save the configuration, click the disk icon.

RPL tree settings

Routing Protocol for Low Power and Lossy Networks (RPL) is the IPv6 Routing Protocol for LLN (Low-Power and Lossy Networks) as defined in RFC6550. The Routing Protocol for Low Power and Lossy Networks feature implements RPL on Cisco IOS software.

The RPL tree routing table is generated using the CSMP messages from the Mesh nodes. The data that is obtained from the mesh nodes is often outdated. The solution for this issue is to use the RPL tree routing data from FAR which is more up to date.

There are two types of RPL tree settings available in Cisco IoT FND:

- RPL Tree Update from Mesh Nodes
- RPL Tree Update from Routers

Table 23: Feature History

Release	Feature Name	Description
Cisco IoT FND Release 5.1	RPL Tree Update from both Mesh and Routers Nodes	You can collect endpoint metrics from both mesh nodes as well as routers independent of RPL tree settings.

RPL tree updates from mesh nodes

The default RPL tree update is always set to `Mesh Nodes`. This is a global setting for the entire Cisco IoT FND system.

RPL data is reported to the Cisco IoT FND by the mesh nodes as part of `IPRoute` and `IPRouteRPLMetrics` during the periodic inventory reporting.

Table 24: Global RPL tree settings for Cisco IoT FND

Field	Description
Enable RPL tree update from	Select Routers. **Note** By default, **Mesh Nodes** is selected.
Number of **Periodic Notifications** between **RPL Tree Polls**	Number of periodic notification from CGR between each RPL pull.
Maximum time between **RPL Tree Polls** in minutes	Maximum time Cisco IoT FND waits to pull RPL from a CGR for the associated PAN.

RPL tree update from routers

When mesh node data is outdated, the RPL tree from FAR provides the most current information. As the RPL tree is not pushed via periodic notifications, Cisco IoT FND gets this data at intervals configured through the **Device Configuration Group** properties.

Cisco IoT FND determines its RPL tree polling frequency based on periodic notifications, configured to poll FAR for updates after every 'N' such notifications. In case any periodic notifications are missed, the RPL tree is fetched from FAR after a maximum time threshold is reached.

Because FAR polls data at a much higher frequency than individual mesh nodes, its RPL data offers a more accurate and real-time snapshot of the entire Personal Area Network (PAN). Cisco IoT FND obtains the RPL tree for the associated PAN by executing the **show rpl dag 1 itable** command on the CGR.

Table 25: Device configuration group properties

Field	Description
RplTreePullingCycle	The number of periodic notification intervals. **Note** The default maximum number of **RplTreePullingCycle** is 8.
RplTreePullingMaxTime	The maximum time interval between the pulls in minutes. **Note** The default maximum time between pulls is 480 minutes (8 * 60).

When processing a periodic notification event, if either of these thresholds have passed, then Cisco IoT FND starts RPL tree retrieval from FAR.

The RPL pull times can be configured to each CGR configuration group as shown in the Device Configuration Group Properties. For the settings to take effect, the Global Settings must be set to `Routers`, See Global RPLTree Settings for Entire FND.

RPL tree update from both mesh and router nodes

Starting from Cisco IoT FND release 5.1.0, you can fetch the endpoint metrics from both mesh nodes as well as router nodes using the **Both Mesh & Router Nodes** option in RPL tree settings in Cisco IoT FND.

When you select **Both Mesh & Router Nodes** option, Cisco IoT FND updates the metrics based on whichever update is received first. See Global RPL tree settings for Cisco IoT FND for mesh and see Device configuration group properties for router nodes.

RPL tree retrieval

Cisco IoT FND currently collects the following information from CGR as part of RPL tree data:

- Node IP address
- Next hop IP address
- Number of parents
- Number of hops from root node
- ETX for path
- ETX for link
- Forward RSSI
- Reverse RSSI

Note No changes are required on FAR configuration when RPL updates setting is changed to routers or vice versa. If changed, Cisco FND automatically schedules for gathering the RPL updates from FARs.

Configure RPL tree polling

Use this task to configure RPL tree polling.

Before you begin

Note

- RPL tree polls are triggered by router periodic notification events, but the RPL tree itself is not pushed automatically.

  Therefore, Cisco IoT FND must explicitly poll for the RPL tree at the configured intervals. You can configure both the RPL tree polling cycle with the number of periodic notifications between polls and the maximum time allowed between these polls.

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Server Settings**.

Step 2 Choose **RPL Tree Settings** tab.

Step 3 Click **Mesh Nodes** or **Routers** or **Both Mesh & Router Nodes** radio button in **Enable RPL tree update from** option to receive the RPL tree update from the specific devices at specified intervals.

Note

- The **Mesh Nodes** radio button is ON, by default. The **Mesh Nodes** option in the **RPL Tree Settings** tab ensures proper functionality of the L+G endpoints graph.
- If you select **Both Mesh & Router Nodes**, the **Number of Periodic Notifications between RPL Tree Polls** and **Maximum Time between RPL Tree (minutes)** fields get enabled automatically.

a) Enable the `processLinkPathCostRssifRssirRouter` property in the `cgms.properties` file optionally, if you select the **Both Mesh & Router Nodes** option, to process Link Cost, Path Cost, RSSI, and Reverse RSSI as given in the example.

Example:

```
processLinkPathCostRssifRssirRouter=true
```

Step 4 Enter the number of events that pass between RPL tree polling intervals in the **Number of Periodic Notifications between RPL Tree Polls** field for Router polling.

Note
The default value is eight. If thresholds are exceeded during periodic notification events, Cisco IoT FND performs an RPL tree poll.

Step 5 Enter the maximum amount of time between tree polls in the **Maximum Time between RPL Tree (minutes)** field in minutes,

Note
The default value is 480 minutes (8 hours).

Step 6 Click the disk icon to save configuration.

Configure the Issue Status Bar

The Issue Status bar displays issues by device type (as set in user preferences) and severity level in the lower-left browser frame.

To enable the Issue Status bar and configure the refresh interval:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Server Settings** > **Issue Settings**.

Step 2 To display the Issue status bar in the browser frame, check the **Enable/Disable Status Bar** > checkbox.

Step 3 In the Issue **Status Bar Refresh Interval (seconds)** field, enter a refresh value in seconds.

The valid values are 30 secs (default) to 300 secs (5 minutes).

Step 4 Navigate to the **Certificate Settings** tab and enter the threshold value in the **Certificate Expiry Threshold (days)** field for your supported routers or the Cisco IoT FND application server.

The valid value is 180 days (default) to 365 days.

Note
When the configured Certificate Expiry Threshold default date is met, a Major event, certificateExpiration, is created. When the Certificate has expired (>180 days), a Critical event, certificateExpired, is created.

Manage the Syslog

When Cisco IoT FND receives device events, it stores them in its database and sends syslog messages to a syslog server that allows third-party application integration.

Note The syslog server receives only the Cisco IoT FND device events (listed on Operations > Events page) and not the other Cisco IoT FND application logs in the server.log.

To configure Syslog forwarding:

Procedure

Step 1 Choose **ADMIN** > **System Management** > **Syslog Settings**.

Step 2 In the **Syslog Server IP Address** field, enter the IP address of the Syslog server.

Step 3 In the **Syslog Server Port Number** field, enter the port number (default is 514) over which to receive device events.

- Click **Enable Syslog Sending Events** to enable message forwarding to the Syslog server.
- Click **Disable Syslog Sending Events** to disable message forwarding to the Syslog server.

For Cisco IoT FND cluster solutions, each server in the cluster sends events to the same Syslog server.

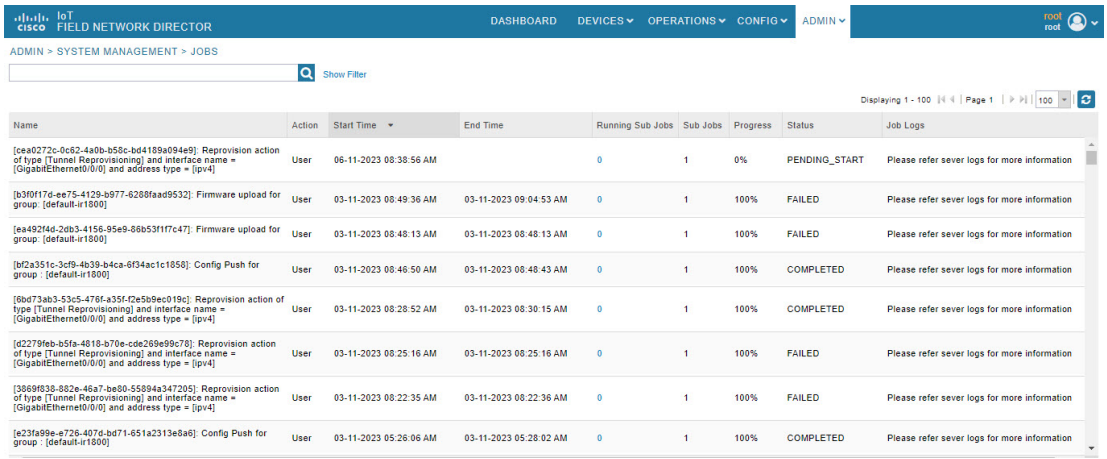
View Jobs

The user triggered jobs in Cisco IoT FND are displayed in the Jobs page. The information about the jobs and their sub jobs are stored in the database in order to ensure that jobs are not lost in case of system restart or failure. Cisco IoT FND allows you to monitor and respond to job scheduling events, such as job completion or failure. The status of the jobs of Cisco IoT FND such as config push, firware upload and install, and reprovisioning can be seen in the Jobs page. This Jobs page provides a detailed summary of the jobs along with their respective sub jobs.

The supported job types are add/remove/export device, update statuses, change properties, add/remove labels (bulk operation), add/update/remove assets, upload firmware image to devices, install firmware image on devices, tunnel/factory re-provisioning, config push, and export events/dashboard dashlet data.

To view the jobs:

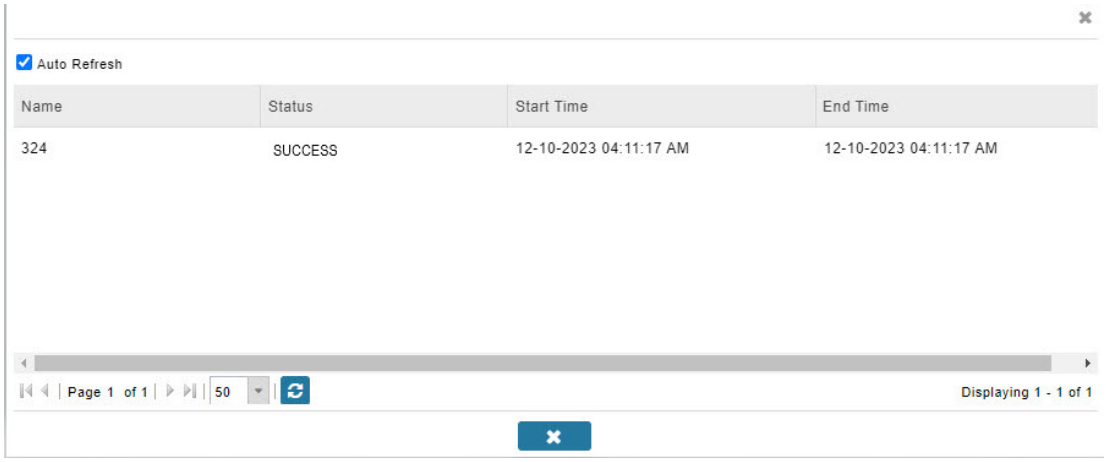
- Choose **ADMIN** > **SYSTEM MANAGEMENT** > **JOBS**. Cisco IoT FND displays the Jobs page.



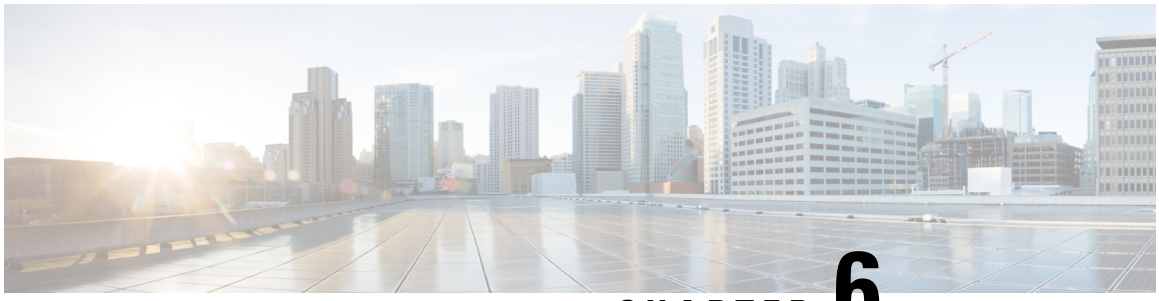
Note

- The logs are not displayed for tunnel provisioning, config push, and firware upgrade. You can view the server logs for more information.
- The completed or failed jobs show 0 under running sub jobs.
- The jobs are displayed in the Jobs page as per their retention time.

- Clicking on Running Sub Jobs opens up the pop-up window to show the status of the running jobs.



- The filter allows you to filter jobs based on name, action, sub jobs, and status. To filter the job list using column filtering, click show filter to insert the search string. For example, click Name from the drop down and provide the search string. Click + icon to add the job selected and click search icon to display the search results.



CHAPTER 6

Manage devices

Device management is the process of monitoring, configuring, and maintaining network-connected hardware within the Cisco IoT FND platform.

In the **Devices** menu, you can add, update, and remove devices, and perform other device management tasks that do not include device configuration. Under Devices, the sub-menu options such as Field Devices, Head-End Routers, Servers, and Asset include Browse Devices that provide a list of routers, endpoint, or gatewaus available for management.

The table includes all possible options available under Browse Devices.

Browse Devices options	Description
Routers	Includes router models such as CGR1000, IR800, IR1100 Pluggable and Expansion Modules (IR-1100-SP). Enables you to view the devices based on the status such as Up, Down, and Unheard.
Head-End Routers	Includes ASR1000, ISR3900, ISR4000, C8000, and so on. Enables you to view the devices based on the status such as Up, Down, and Unheard.
Endpoints	Includes meters and IR500 gateways Enables you to view the devices based on the status such as Up, Down, and Unheard.
IoT Gateways	Includes LoRaWAN gateway (IXM-LPWA-900) and IC3000 Enables you to view the devices based on the status such as Up, Down, and Unheard.

Note In some textual displays of the Cisco IoT FND, routers may display as “FAR” rather than the router model (cgr1000, etc).

Field Area Routers (FARs)

Field Area Routers are core components of a Field Area Network that provide connectivity between field devices, such as meters, sensors, and control equipment, and the head-end routers.

Cisco Iot FND enables you to,

- manage the FAR lifecycle,
- perform configuration and maintenance activities, and
- monitor and troubleshoot router performance.

Supported Field Area Routers

Cisco IoT FND supports the following Field Area Routers:

- Cisco Catalyst IR1800 Rugged Series Routers
- Cisco Catalyst IR8100 Heavy-Duty Series Routers (IR8140)
- Cisco Catalyst IR1100 Rugged Series Routers (IR1101)
- Cisco 1000 Series Connected Grid Routers (CGR1120 and CGR1240)
- Cisco 800 Series Industrial Integrated Services Routers (IR800)
- Cisco 800 Series Routers

Cisco also identifies Cisco 800 Series Access Points (AP800) as supported when integrated with C800 and IR829 devices.

Add router device files

Use the Device File Management page to manage router device files within the application.

Procedure

Step 1 Navigate to **Config** > **Device file management** .

Step 2 Select **Actions** > **Upload** to open the Upload File to Routers page.

Step 3 Search for the router device file using the full name or an abbreviated string.

- Search by full name (for example, CGR1120/K9+JAF1648BBCK).
- Search by an abbreviated device file string (for example, CGR120/K9+JAF or BBCK) to display a range of available routers.

Step 4 Select the routers for the upload.

The system displays the number of router files available based on your search criteria, with all routers selected by default. You can adjust the display count using the drop-down menu (options: 10, 50, 100, 200) and clear the check boxes for any routers you do not want to include.

Step 5 Click **Upload** .

Delete files from routers

Free up device storage by deleting files from routers using the device file management interface.

Use this task when you need to clear unnecessary or outdated files from routers within a device group. This helps maintain available storage and ensures devices remain operational.

Follow these steps to remove files from routers:

Procedure

Step 1 From the main menubar, choose **Config** > **Device File Management**.

Step 2 From the left pane, select the file that you want to delete.

Step 3 On the **Actions** tab, click **Delete** .

The **Delete file from List** dialog box appears.

Step 4 Select a file to delete.

You can delete the file from all routers in the selected group or any subset of routers in the group.

Step 5 Click **Delete File** .

The **Delete File from Routers** dialog box displays.

Step 6 Check the check boxes of the routers from which you want to delete the file.

- You can click Change File to select a different file to delete from the selected routers.
- You can select multiple routers.
- Only one file can be deleted at a time.
- You can click Clear Selection and (x) close the windows to stop deletion.

Step 7 Click **Delete** .

If there are no file transfer or deletion, configuration push, firmware upload, or install or reprovision operations in progress for the group, the delete operation begins. Cisco IoT FNDsearches the.../managed/files/ directory on the devices for the specified file name.

Note
On deletion, all file content is purged from the selected devices, but not from the Cisco IoT FND database. File clean-up status displays for the selected group.

You can select another group and file to perform a separate file deletion while file transfer or deletion processes are in progress for this group. When you cancel file deletion process before it completes, the currently running file deletion process completes and all waiting file deletion processes are cancelled.

File operations status, progress percentage, and any error messages are displayed in the job status area.

The selected file is deleted from the chosen routers. File deletion status is displayed for all affected devices; unsuccessful deletions will display error information for follow-up action.

Structure of router import records in Notice-of-Shipment XML files

This reference provides the structure of the <R> record used for importing router configurations into Cisco IoT FND.

You use the Notice-of-Shipment XML file sent to you by your Cisco partner. This file contains an <R> record for every router shipped to you. This is an example of an <R> record for a CGR:

```
<AMI>
 <Relays>
  <DCG deviceClass=?10.84.82.56?>
   <PID>CGR1240/K9</PID>
   <R>
    <ESN>2.16.840.1.114416.3.2286.333498</ESN>
    <SN>FIXT:SG-SALTA-10</SN>
    <wifiSsid>wifi ssid 1</wifiSsid>
    <wifiPsk>wifi psk 1</wifiPsk>
    <adminPassword>ppswd 1</adminPassword>
    <type6PasswordMasterKey>secret 1</type6PasswordMasterKey>
    <tunnelSrcInterface1>Ethernet2/3</tunnelSrcInterface1>
   </R>
  </DCG>
 </Relays>
</AMI>
```

Note For a list of all Device Properties that you can configure using the XML configuration template, refer to Device Properties, on page 334 .

Table 26: Router Import Fields

Field	Description
PID	The product ID, as supplied by Cisco. This is not printed on the product.

Field	Description
SN	The router serial number. **Note** Cisco IoT FND forms the router EID by combining the PID and SN.
ESN	A serial number assigned by your Cisco partner to the WPAN mesh card inside the router. This field is not used by Cisco IoT FND.
wifiSsid	This information is configured on the router by your Cisco partner during the manufacturing configuration process. Cisco IoT FND stores this information in its database for future use.
wifiPsk	
adminPassword	
adminUsername	
type6PasswordMasterKey	
tunnelSrcInterface1	

View router details

Enable network administrators to access, monitor, and review router information through the Field Devices page.

You use the **Field Devices** page to view network devices for monitoring and configuration. By default, devices are shown in the Default view.

Procedure

Step 1 Navigate to **Devices** > **Field Devices**.

Step 2 Under **Browse Devices** pane, review the listed network devices available for monitoring or configuration.

The Field Devices page displays devices in the Default view by default.

You can see detailed information for each router, allowing you to monitor status and configure devices as needed.

View router device properties

The **Field Devices** page defaults to the List view, which contains basic device properties, unless you select the **Default to map view** option in user preferences.

Procedure

Step 1 Select a router or group of routers in the Browse Devices pane.

Step 2 Click the desired tab in the main pane to view specific device properties.

Each tab displays different sets of device properties. For example, the Default view displays basic device properties, while the Cellular-GSM view displays properties specific to the cellular network.

What to do next

For information on customizing router views, see Customize device views, on page 266 . For details on device properties, see Device Properties, on page 334 . For common actions such as adding labels, see Common device operations, on page 261 .

View routers in map view

Before you begin

Access the User Preferences page to enable the map feature.

Procedure

Step 1 Select the root or user name at the top, upper-right-hand corner of the screen and click **Preferences** .

Step 2 Select the **Enable map** checkbox.

Note
The additional options are found as selectable options on the User Preferences page (Servers, Show PAN ID in Hexadecimal).

Step 3 Navigate to **Devices** > **Field Devices** , choose the router, and click **Map** .

The RPL tree connection displays data traffic flow as blue or orange lines:

- Orange lines indicate that the link is an uplink: data traffic flows in the up direction on the map.
- Blue lines indicate that the link is a downlink: data traffic flows in the down direction on the map.

Note You can view any RPL tree by clicking the device in Map view, and closing the information pop-up window.

View router usage statistics

From Cisco IoT FND release 4.11 onwards, the **Device Details** page provides a new Router Usage Stats chart for the Cisco IOS (CGR1000 and IR800) and IOS-XE (IR1101, IR8100, IR1800) devices. This chart displays the historical trend of the CPU, memory, and disk usage on an hourly (6 hours), daily (one day), weekly (one week), and monthly (four weeks) basis. You can also visualize the time-specific data by customizing the date and time. However, the maximum date range that you can define is limited to the data retention period specified in the UI (refer to Configure data rention). The data retention period that you can set ranges from a minimum of one to a maximum of 90 days.

For more information, see Set time filters to view charts, on page 450 .

Procedure

Step 1 Choose **Devices** > **Field Devices** > **Browse Devices** > **ROUTER** .

Step 2 Select the device type. The Inventory tab displays the devices for the selected device type. You can also filter the usage data based on CPU, memory, or disk.

Step 3 Click the required device on the right pane to view the Router Usage Stats chart for the selected device.

IOS-XE command execution in Cisco IoT FND UI

The IOS-XE command option in Cisco IoT FND is a **Troubleshoot** tab capability for running supported IOS-XE EXEC commands from the device details page during troubleshooting. This feature provides a controlled user-interface path for operational command execution, which can be used for Cisco IOS-XE device troubleshooting through the Cisco IoT FND user interface.

Role in device troubleshooting

The command option extends the device details workflow by letting users collect command output without leaving the Cisco IoT FND and logging into the device CLI.

Supported platforms

The IOS-XE command option is supported for these Cisco IOS-XE devices:

- IR8140
- IR1800
- IR1100
- IR1000

Command processing model

Cisco IoT FND validates command input before execution and sends accepted commands to the device. The UI returns the device output or an applicable error response after execution.

Table 27: Feature history

Release information	Feature name	Description
Cisco IoT FND Release 26.2.1	IOS-XE Exec command execution support in FND UI	Adds an IOS-XE command option to the device details **Troubleshoot** tab in Cisco IoT FND.

Use the Troubleshoot tab to execute IOS-XE commands

Use the **Troubleshoot** tab on a supported device details page to execute safe IOS-XE commands from the Cisco IoT FND user interface. The command output appears in the **Response** area.

Note Use this tab only for supported operational commands that do not change device configuration or introduce security risks.

The **Troubleshoot** tab is available for supported Cisco IOS-XE devices, including IR8140, IR1800, IR1100, and IR1000.

Before you begin

- Ensure that your user role has the **Execute IOS-XE Commands** permission.

Note To grant the **Execute IOS-XE Commands** permission without modifying the base role, create a custom role that incorporates all existing permissions and the troubleshooting permission, and assign it exclusively to the users who need it. For instructions on creating and assigning a custom user role, refer Custom User Roles.

- The selected device is a supported Cisco IOS-XE device and is not in the unmanaged, out of service, or unheard state.
- No active firmware upload or upgrade is running for the selected device. You cannot execute commands while a firmware upload or upgrade is active.

Procedure

Step 1 Choose **Devices** > **Field Devices**, and in the **Browse Devices** pane, select the supported IOS-XE router device type.

The **Field Devices** page lists routers, endpoints, and gateways in the **Browse Devices** pane.

Step 2 Click the name of the device that you want to troubleshoot.

The device details page opens for the selected device.

Step 3 Click the **Troubleshoot** tab.

The tab is not visible for unsupported devices or for devices in the unmanaged, out of service, or unheard state. The feature supports device states such as registration and bootstrap.

Step 4 Click the information icon to review the supported command rules.

The information icon shows the supported commands, supported special characters, allowed characters, and disallowed characters. Cisco IoT FND validates commands in the UI and backend.

Step 5 In the **Command** field, enter a supported IOS-XE EXEC command or select a previously executed command from the drop-down list.

The command field uses **`show version`** as the placeholder example. Cisco IoT FND supports safe abbreviations, such as **`sh`**, **`tr`**, and **`tracert`**, when the abbreviations match the supported command rules.

Commands are limited to 200 characters. You can enter up to five supported commands with semicolons.

Note

- Do not enter commands that change device configuration. If a command is unsupported, exceeds the command limits, or contains blocked characters or patterns, Cisco IoT FND displays an error popup and does not execute the command.
- Cisco IoT FND retains up to 10 recently executed commands for each user and device combination. Duplicate commands are not retained as separate entries; the repeated command moves to the most recent position.
- Cisco IoT FND stores the recent command list and the current command response in memory. The system clears these values after a service restart or upgrade.

  Cisco IoT FND also persists command execution history and responses in the database. The persisted records remain available for export through **Export PDF**.

Step 6 In the **Timeout (sec)** field, keep the default timeout value or enter a longer timeout value.

Step 7 Click **Execute**.

Command execution occurs in the background. You can navigate to other screens while the command runs.

The **Response** area shows command execution progress while the command is running.

Step 8 Review the command output in the **Response** area.

The **Response** area expands with vertical and horizontal scroll bars for long command output.

If a network-related error occurs, Cisco IoT FND displays the applicable error popup. Network-related errors include device unreachable, connection timeout, network cable unplugged, device rebooting, and WSMA service downtime.

You can use the **Clear Responses** button to clear the **Response** text field.

Step 9 (Optional) To export the command-history records of the device,

a) In **Export Count**, enter the number of previously executed command history records to export. You can export from 1 to 500 records.

b) Click **Export PDF**.

When you click **Export PDF**, the exported filename uses the format `export-command-history-<DeviceEID>-<Timestamp>.pdf`.

Cisco IoT FND displays the IOS-XE command output or applicable error response and records the command execution in the audit log with the user identity, command, and execution timestamp.

Filter routers using built-in filters

You can refine the list of displayed routers by using the built-in router filters such as **Up**, **Down**, or **Unheard** status available under ROUTERS in the **Browse Devices** pane. You can also use the saved custom searches in the **Quick View** pane.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices**

Step 2 In the **Browse Devices** pane, locate **ROUTERS**.

You can also apply the saved custom seaches from the **Quick View** tab.

Step 3 Under **status**, select the desired filter (for example, Up, Down, Unheard) to apply it.

The list updates to show routers matching the selected status in the right pane.

Selecting a filter inserts a corresponding search string (e.g., status:up) into the Search field automatically. For example, clicking the **Up** filter under **ROUTERS** inserts the search string **status:up**.

To filter routers by system security mode, use the **System Security Mode** filter or enter a search string such as **systemSecurityMode:secure**.

You can also use the saved custom searches from the **Quick View** pane to apply frequently-used filters.

View router configuration groups

Use the Browse Devices pane to display routers that belong to one of the groups (such as CGR1000) listed under ROUTER.

Procedure

Step 1 Navigate to the **Devices** > **Field Devices** page.

Step 2 From the **Browse Devices** pane, select the desired group listed under ROUTER to display the associated routers.

View router firmware groups

Allow administrators to review and confirm which firmware versions are available for various router models.

Use this task to check the firmware versions associated with router groups, ensuring the correct images are available before applying updates.

Follow these steps to verify available firmware images for router groups:

Procedure

Step 1 Choose **Config** > **Firmware Update**.

Step 2 From the left pane, click the **Groups** tab and choose the desired router group (for example, Default-cgr1000, Default-ir1100, Default-ir800 or).

Step 3 Review the firmware images displayed under the **Name** field for each selected router group.
For groups like Default-ir800, multiple router models such as IR809 and IR829 may be listed with corresponding firmware images.

You can view and verify the available firmware images associated with each router group, ready for further update actions as needed.

View router tunnel groups devices

A router tunnel group is used to organize and manage router devices within the network infrastructure. Viewing these associations helps streamline device management and troubleshooting.

Follow these steps to view router devices assigned to tunnel groups:

Procedure

Step 1 From the main menu, choose **Config** > **Tunnel Provisioning**.

Step 2 Locate and select the desired router tunnel group under the ROUTER listing.

Step 3 Review the list of router devices associated with the selected tunnel group.

Export mesh routing tree data

Export mesh routing tree data for a selected router, including the parent-child node hierarchy, to an Excel (.xlsx) file.

Cisco IoT FND exports routing information for the parent node (router) and its associated child nodes (meters) from the **Mesh Routing Tree** tab. The Excel (.xlsx) file captures the multihop parent-child hierarchy in separate sheets for each hop level. By default, each sheet displays the parent nodes for that hop level. Expand or collapse the rows to view the parent-child relationships.

Before you begin

- This export option is available only for routers, not for other device categories such as endpoints.
- Ensure that your environment supports Microsoft Excel files and has sufficient storage for the exported file.

Follow these steps to export mesh routing tree data:

Procedure

Step 1 Choose **Devices** > **Field Devices** > **Browse Devices** > **Routers**.

Step 2 Click the device for which you want to export routing tree data.

The **Device Info** page appears.

Step 3 Click the **Mesh Routing Tree** tab.

Step 4 Click **Export Routing Tree**.

The Excel file is saved to the file system with the following name:

`export-routingtree-<timestamp>.xlsx`

The exported data captures the relationships between the root node and its associated child nodes. The first sheet is named **Root**. Subsequent sheets are named **Hop-level-<hop number>**, such as **Hop-level-1** and **Hop-level-2**.

Starting with Cisco IoT FND Release 26.2.1, when location information is available, the exported file includes the latitude and longitude coordinates of each device.

- The **Root** sheet provides information about the parent node (router) and its first-hop child nodes.
- The subsequent **Hop-level-<hop number>** sheets provide information about the child nodes at each hop level.

For Cisco IR8100 routers, the exported routing tree data is based on the selected WPAN interface.

Router push configuration count

The router push configuration count is a system parameter that limits the volume of concurrent configuration updates sent to network devices.

- Controls the rate of configuration delivery.
- Prevents device overload during mass updates.
- Ensures sequential processing of network changes.

Router Push Configuration Count management

Manage and track the number of configuration changes applied to a group of routers during the configuration push using Cisco IoT FND.

Table 28: Feature History

Feature Name	Release	Description
Manage Router Push Configuration Count	Cisco IoT FND Release 5.0	Define the number of router configuration changes or updates that you want to apply to routers within a specific group, simultaneously. Manage and track the number of configuration changes applied to a group of routers during the configuration push using Cisco IoT FND.

Router Push Configuration Count Per Group value

The **Router Push Configuration Count Per Group** is a configuration parameter that determines the maximum number of parallel router push operations allowed within a group.

- The default value is 5.
- The maximum permissible value is 100.
- The configuration value applies globally to all router push configurations.

Note Define the **Router Push Configuration Count Per Group** value globally to all router push configurations using Cisco IoT FND. The maximum parallel or concurrent router push configuration count is applied to all the group of routers.

Benefits of managing router push configuration count

This reference outlines the operational advantages of using the router push configuration count feature to optimize network management and minimize manual configuration risks.

The following benefits are associated with managing router push configuration counts:

- Adaptability: You can quickly adapt configuration counts to meet changing network requirements, enhancing overall network management.
- Error Reduction: The **Router Push Configuration Count Per Group** field minimizes the risk of errors that might occur with manual file edits.

Configure router push configuration count

Procedure

Step 1 From the main menu, choose **Admin** > **Server Settings** > **Property Settings** .

Step 2 Enter the number of router push configurations to be pushed to a group in the **Router Push Configuration Count Per Group** field.

The maximum number of router push configurations you can enter is 16.

Step 3 Click **Save**.

The router push configuration count is set.

Push configurations to routers

Use this task to push configuration to routers.

Router configuration pushes are performed from the Push Configuration tab for selected router groups or subsets.

Note CGRs, IR800s, and ISR 800s can coexist on a network; however, you must create custom configuration templates that include the router types.

Procedure

Step 1 Choose **Config** > **Device Configuration**.

Step 2 Select the group or subset of a group to push the configuration to the **Configuration Groups** pane.

Step 3 Click the **Push Configuration** tab to display that window.

Step 4 In the **Select Operation** drop-down list, choose **Push ROUTER Configuration**.

For IR800 groups with embedded AP devices, choose **Push AP Configuration** to push the AP configuration template.

If the router configuration contains a deprecated insecure CLI command and the target router is in secure mode, Cisco IoT FND moves the router to insecure mode before applying the configuration.

Step 5 In the Select Operation drop-down list, choose **Push ENDPOINT Configuration** .

Step 6 Click **Start**.

The Push Configuration page displays the status of the push operation for every device in the group. If an error occurs while pushing configuration to a device, the error and its details display in the relevant columns.

If a push operation includes deprecated insecure CLI commands, review the warning or error message details in the device status table after the operation completes.

In the Status column, one of these values appears:

• NOT_STARTED — The configuration push has not started.
• RUNNING — The configuration push is in progress.
• PAUSED — The configuration push is paused. Active configuration operations complete, but those in the queue are not initiated.
• STOPPED — The configuration push was stopped. Active configuration operations complete, but those in the queue are not initiated.
• FINISHED — The configuration push to all devices is complete.
• STOPPING — The configuration push is in the process of being stopped. Active configuration operations complete, but those in the queue are not initiated.
• PAUSING — The configuration push is in the process of being paused. Active configuration operations complete, but those in the queue are not initiated.

What to do next

Note To refresh the status information, click the **Refresh** button.

Note After deprecated insecure CLI commands are removed from the template and router configuration, use the **Move to Secure Mode** operation on the **Push Configuration** tab to move the router back to secure mode.

Enable SD card password protection

Use this task to enable CGR SD card password protection.

Password protection for the SD card in the CGR helps prevent unauthorized access and prevents transference of the CGR SD card to another system with a different password.

The Device Info pane displays CGR SD card password protection status in the Inventory section. The Config Properties tab displays the SD card password in the Router Credentials section.

Before you begin

Note This does not apply to IR800s.

Procedure

Step 1 Choose **Config** > **Device Configuration**.

Step 2 Select the CGR group or CGRs to push the configuration to in the Configuration Groups pane

Step 3 Select the **Push Configuration** tab.

Step 4 In the **Select Operation** drop-down menu, choose **Push SD Card Password**

Step 5 Click **Start**. Click **Yes** to confirm action or No to stop action.

Step 6 Select **SD Card protection** > **Enable**.

Step 7 Select the desired protection method:

• Property: This password is set using a CSV or XML file, or using the Notification Of Shipment file.
• Randomly Generated Password: Enter the password length.
• Static Password: Enter a password.

Step 8 Click **Push SD Card Password**.

Replace routers in Cisco IoT FND

Before you begin

Before proceeding with a Return Material Authorization (RMA) for any device integrated with Cisco IoT FND that you want to replace, perform these steps:

Procedure

Step 1 Perform a backup of the configuration from the router that you want to replace.

Step 2 Install the new router in the same location as the router that you want to replace.

Step 3 Before connecting the new device to the network, restore the configuration from the backup device.

Step 4 Verify if the new router that you are adding as a replacement is functioning as expected while it is connected to the network.

What to do next

Note For more details on how to add new FAR devices and routers, see Managing Devices .

Improved Audit Trail

The Improved Audit Trail is a security feature that enables the systematic tracking and extraction of user and system events.

- Supports CSV format for external analysis.
- Maintains detailed event timestamps and user identifiers.
- Facilitates automated log retention and archival.

CSV file download for audit trail

Provides access to .CSV files used for adding, removing, or editing devices within Cisco IoT FND to maintain an accurate audit trail.

Table 29: Feature History

Feature Name	Release	Description
Improved Audit Trail	Cisco IoT FND Release 5.0	When you add, remove, or edit files using .CSV files on Cisco IoT FND, a log is generated in the **Audit Trail** page. You can download the .CSV file that you used to change the devices.

Information about improved Audit Trail

The enhanced Audit Trail page provides direct access to .csv files for device actions performed in Cisco IoT FND Release 5.0 and later.

- Provides direct download links for .csv files.
- Supports tracking of changes made through .csv file uploads.
- Includes logs for actions performed via NBAPIs.

Note Download the .CSV file logs even when you use NBAPIs for your device actions.

Benefits of improved audit trail

This reference outlines the advantages of the improved audit trail, specifically focusing on transparency, accountability, and simplified record management through .csv file downloads.

- Gain immediate access to detailed records of device management actions, allowing for clear and transparent auditing of changes made via .csv files. This helps maintain accountability and ensures compliance with organizational policies.
- Downloading and storing the .csv files directly from the audit trail simplifies record-keeping practices.

Download CSV files from audit trail

You can download audit trail CSV files from the Cisco IoT FND system management interface.

Procedure

Step 1 From the Cisco IoT FND menu bar, choose **Admin** > **System Management** > **Audit Trail**.

Step 2 Locate a log entry for **Devices added** , **Changed Device Properties** , or **Devices removed** in the audit trail list.

Step 3 In the **Details** column, find the clicable CSV link.

Step 4 Click the CSV file to download the file.

The CSV file contains information such as the timestamp, user ID, and device details.

Router admin password rotation in Cisco IoT FND

Cisco IoT FND supports router administrator password rotation for supported Cisco IOS and Cisco IOS XE devices. The feature uses the `rotate_admin_password.sh` script in the Cisco IoT FND cgms tools package and a CSV file that maps device identifiers to administrator passwords. This script is either run manually or scheduled using a cron job

The cgms tools package can be installed on a Cisco FND Oracle Bare Metal, a Postgres VM, or a separate VM. FND installation is not required on the separate VM. For information on installing cgms tools on a separate VM, see Install CGMS Tools RPM on a separate VM .

The following topics describe supported platforms, CSV file requirements, manual password rotation, and scheduled password rotation.

Table 30: Password rotation support

Feature	Release	Description
Admin Password Rotation	Cisco IoT FND Release 5.0	The Cisco IoT FND tools package includes the rotate_admin_password.sh script with CSV input to rotate administrator passwords across Cisco IoT FND devices that use Cisco IOS or Cisco IOS XE.

Supported platforms

This reference lists the supported Cisco IOS and Cisco IOS-XE device types for the current environment.

The supported device types are:

- Cisco IOS Device Types: CGR1000 and IR800
- Cisco IOS-XE Device Types: IR8100, IR1800, and IR1100

Prerequisites

Complete the following prerequisites before executing the `rotate_admin_password` script:

- Password preference synchronization, on page 175 in the `command.txt` file and the device configuration.
- Define parameters in the CSV File .
- Ensure that routers are in `Up` state.
- No active operation such as config push, firmware upgrade should be running in Cisco IoT FND.

Deployment Configuration

Based on the deployment type, copy the required files to the `cgms-tools` package.

- **Oracle Bare Metal Deployment**

Filename	Copy From	Copy To
.fnd_psk_enc	/opt/cgms/server/cgms/conf/.fnd_psk_enc	/opt/cgms-tools/conf
fnd_psk.keystore	/opt/cgms/server/cgms/conf/fnd_psk.keystore	/opt/cgms-tools/conf
jdbc.properties	/opt/cgms/tools/conf/jdbc.properties	/opt/cgms-tools/conf/jdbc.properties
cgms_keystore	/opt/cgms/server/cgms/conf/cgms_keystore	/opt/cgms-tools/conf
cgms.properties	/opt/cgms/server/cgms/conf/cgms.properties	/opt/cgms-tools/conf

- **Postgres Virtual Machine Deployment**

Copy From	Copy To
docker cp fnd-container:/opt/cgms/server/cgms/conf/.fnd_psk_enc /opt/cgms-tools/conf	/opt/cgms-tools/conf
docker cp fnd-container:/opt/cgms/server/cgms/conf/fnd_psk.keystore	/opt/cgms-tools/conf
docker cp fnd-container:/opt/cgms/tools/conf/jdbc.properties	/opt/cgms-tools/conf/jdbc.properties
docker cp fnd-container:/opt/cgms/server/cgms/conf/cgms_keystore	/opt/cgms-tools/conf
docker cp fnd-container:/opt/cgms/server/cgms/conf/cgms.properties	/opt/cgms-tools/conf

Password preference synchronization

Password preference synchronization is the process of matching the device-level password type with the corresponding command defined in the command.txt file.

- Device configuration must match the command.txt entry.
- Plaintext configurations require the password command.
- Encrypted configurations require the secret command.
- Router password configuration: The router is configured with either plaintext or secret password.
- Command.txt file: The `command.txt` file has two commands, namely "password" and "secret" as shown below. Based on the password configured in the device (plaintext or secret), provide the command (password or secret) in the `command.txt` file.

```
username {username} privilege 15 password {password}
username {username} privilege 15 secret {password}
```

Password combinations for synchronization

The table lists the allowed password combinations for a successful admin password rotation.

Table 31: Supported Password Combinations

Device Configuration	Command.txt
Plaintext	Password (plaintext)
Encrypted	Secret

Attention The admin password rotation fails if there is a password preference mismatch in the `command.txt` and the router configuration. The following table lists the password preference combinations that are not supported.

Table 32: Unsupported Password Combinations

Device Configuration	Command.txt
Plaintext	Secret
Secret	Plaintext

CSV File

The CSV file is a configuration input that maps device identifiers to their respective admin passwords for the rotation process.

The `rotate_admin_password` script is executed based on the information you provide in the CSV file, which contains the device EID and the password.

The CSV file requires the following information for device password rotation:

- EID: The EID can either be router-specific or HER-specific. If you provide the HER EID, the admin password is rotated for all the routers that are associated with the HER. If you provide the router-specific EID, the admin password is rotated for that specific router.
- Password : Cisco IoT FND provides options for plaintext, encrypted, or blank password fields in the CSV file.

CSV File Configuration Details

The CSV file serves as a configuration input that maps device identifiers to their respective admin passwords for the rotation process.

The following table outlines the password options available for the CSV file:

Plaintext Password

In the CSV file, provide a password that is a combination of uppercase (A-Z), lowercase (a-z), numbers (0-9), and special character (!@#$%^&*.).

Sample CSV file for routers :

```
EID,ADMINPASSWORD
IR1101-K9+FCW2226006G,cisco123!
IR1101-K9+FCW2226004G,Cisco123
IR8140H-P-K9+FDO2J46Z,pdsL$123
```

Encrypted Password

If you want to encrypt the admin password, use the signature tool.

Sample CSV file for routers :

In the following example, the plaintext password is encrypted using the signature tool.

```
[root@iot-tps bin]# cat Single_Device_encrypted.csv
EID,ADMINPASSWORD
IR1831-K9+FCW2729Y2QV,VAXKhqI03xomp40f9xdyhIqYl4hh+6pztOAsRGwhrFUjD0xp+
F7zrIJUWOHpBiGC7yVIsqZyb70AEPuLVuZXGFLU/gQ9wpDSkoBNLVyxBYkSABD5vBG5Z2OS
TtaSva3xjnR9kGnw2P30nXSxEB2PNYHjpi8NVQLEiAz8JwVWLePt2xs6v+kXmsKYFrxZE6e2
Q5Mi9z+FW5COSiDLpt1//aLHIQIzR3QHgsiCi0RG/dVxvBn4Ra6NdYBqAsl17GVcFyvkSJhNs
KyeW0bPvuDpAAgRiga2i3rlJ5m0im/eT513aQWJXjHOotJmU/6sZ4jDzWQKop96modyEYuzrvNQrg==
```

Blank

If the admin password field is blank in the CSV file, the password is autogenerated.

Sample CSV file for routers :

```
EID,ADMINPASSWORD
IR1101-K9+FCW2226005G
```

Sample CSV file for HERs :

```
HEREID,ADMINPASSWORD
CSR1000V+9J04F38WNBP
```

Note

- Regardless of your password preference (plaintext, encrypted, or blank) specified in the CSV file:
  - The admin password is encrypted in the Cisco IoT FND logs, which is decrypted using the signature tool.
  - The admin password appears either in plaintext or secret format depending on the password preference set in the `command.txt` file and the device configuration. For more information, see Password preference synchronization, on page 175 .
- To see the password in the Cisco IoT FND, navigate to **Devices** > **Field Devices** > **Config Properties Tab** > **Router Credentials** .

Customize parallel administrator password updates

By default, you can update passwords on up to 20 routers in parallel. You can customize the default value of 20 based on your deployment needs.

Procedure

Step 1 Locate the configuration file at `/opt/cgms-tools/conf/rotate-admin-password.properties`.

Step 2 Edit the `rotate-admin-password.properties` file using a text editor.

Step 3 Locate the `rotate_admin_pwd_thread_count=20` attribute.

Step 4 Change the value to the desired number of threads.

Example:

```
rotate_admin_pwd_thread_count=50
```

Configure the generated password length for router admin rotation

Use the rotate-admin-password properties file to set the length of passwords that Cisco IoT FND generates. The default generated password length is 15 characters.

Cisco IoT FND creates a password automatically when the ADMINPASSWORD field in the CSV file is blank for router-specific rotation or during HER-level password rotation. You can configure the auto-generated password length during password rotation.

Follow these steps to configure the generated password length for router admin rotation.

Procedure

Step 1 Open the configuration file located at `/opt/cgms-tools/conf/rotate-admin-password.properties` using a text editor.

Step 2 Locate the `generated_admin_pwd_length` attribute.

The default password length is 15.

Step 3 Change the value of `generated_admin_pwd_length` to your desired password length.

Example:

```
generated_admin_pwd_length=30
```

The maximum password length is 100 characters.

Step 4 Save the rotate-admin-password.properties file.

Step 5 Run the rotate_admin_password.sh script, providing the required CSV file as input.

In the CSV file, keep the ADMINPASSWORD field blank to have Cisco IoT FND generate the router administrator password during password rotation.

Cisco IoT FND uses the length you specified for automatically generated router administrator passwords during password rotation.

Update administrator passwords on multiple routers

The `rotate_admin_password.sh` script is available with the cgms tools package in the Cisco IoT FND bundle OVA/rpm at `/opt/cgms-tools/bin/rotate_admin_password.sh`. It supports Cisco IOS and Cisco IOS XE device types.

Procedure

Step 1 Specify the password rotation details in the CSV file.

For router-specific rotation, specify the router EID and the password in the CSV file. The password can be plaintext, secret, or system generated.

For HER level rotation, specify the HER in the CSV file. The password is system-generated and rotated for all devices that tunnel with the specified HER.

Step 2 Run the `rotate_admin_password.sh` script with the CSV file.

Example:

```
$ ./rotate_admin_password.sh <csv-file>
```

Note
The `<csv-file>` is the path to the CSV file containing the list of EIDs and admin passwords.

Success case:

```
[root@iot-fnd log]# cat rotate_admin_password_status_1750360977943.csv
                "EID","MESSAGE","STATUS"
                "IR1831-K9+FCW2729Y2QL",
                "Successfully updated the admin password.
                The new password is <rotated password>","SUCCESS"
```

Failure case:

```
[root@iot-fnd-oracle log]# cat rotate_admin_password_status_1749039357401.csv
                "EID","MESSAGE","STATUS"
                "IR1101-K9+FCW2708YA7X","'adminPassword' length must be greater than or
equal to 3,
              'adminPassword' must contain at least 3 out of 4 types: uppercase, lowercase,
 numbers,
                permitted special characters !""#$%&'()*+,-./:;<=>@[]^_`{|}~","FAILURE"
```

Rotate the router admin password manually

Use this task to rotate the router admin password manually.

Manual password rotation uses the router admin password rotation script and a CSV file that lists EIDs and admin passwords.

Before you begin

Completing the Prerequisites, on page 174 is a must.

Procedure

Step 1 Run the script to change the password for the router admin.

```
$ ./rotate_admin_password.sh <csv-file>
```

The CSV file contains the list of EIDs and admin passwords. For more information, see CSV File, on page 176.

Step 2 On successful execution of the script, disconnect and reconnect to the router with the new password.

a) If the password update is successful, the database is updated with the new password and the Tcl script updates the password in the `before-tunnel-config`, `before-registration-config`, and `express-setup-config`.

b) If the password update fails, refer to the log for more information.

You can see the log for more information on the success or failure status, which is available at: `/opt/cgms-tools/log/rotate-router-admin-password.log`.

c) For consolidated success and failure logs on specific devices, you can view them in .csv file.

For example, rotate_admin_password_status_123.csv

What to do next

Upon successful script execution, verify if the operations such as refresh metrics, config push, firmware upgrade are working fine in FND.

Schedule admin password rotation with CronJob

This topic provides guidance on scheduling the `rotate_admin_password` script as a cron job during monthly maintenance windows. We recommend scheduling the cron job during the monthly maintenance window to avoid conflicts with the active operations in Cisco IoT FND. For example, schedule the script to run at 12:00 AM on the first day of every month.

The script automation is supported for these deployments:

- Schedule Oracle bare metal deployment, on page 180
- Schedule Postgres VM deployment, on page 181

Note For a successful password rotation, it is recommended to allow a 24-hour gap between each script execution.

Schedule Oracle bare metal deployment

Use this task to schedule admin password rotation for Oracle bare metal deployment.

Oracle bare metal deployments use a crontab entry to run the router admin password rotation script on a schedule.

Before you begin

Complete the Prerequisites, on page 174 before scheduling admin password rotation.

Procedure

Oracle Bare Metal Deployment: Run the script to schedule for the password rotation.

```
$ cd /etc
$ crontab -e
#Add below line in crontab. Save the file
0 0 1 * * /opt/cgms-tools/bin/rotate_admin_password.sh <location to csv>
```

Note
Ensure the CSV file is properly formatted and accessible. For more information, see CSV File, on page 176.

What to do next

Upon successful script execution, verify if the operations such as refresh metrics, config push, firmware upgrade are working fine in Cisco IoT FND.

Schedule Postgres VM deployment

Use this task to schedule admin password rotation for Postgres VM deployment.

Postgres VM deployments require the CGMS Tools RPM, database access in `pg_hba.conf`, and cron scheduling for password rotation.

Before you begin

Complete the Prerequisites, on page 174 before scheduling admin password rotation.

Procedure

Step 1 Install or upgrade the tools rpm in VM.

a) For install use the command **rpm -ivh** as given in the example:

```
rpm -ivh  cgms-tools-5.0.0-117.x86_64.rpm
```

b) For upgrade use the command **rpm -Uvh** as given in the example:

```
rpm -Uvh cgms-tools-5.0.0-117.x86_64.rpm
```

Step 2 Enable the db connection in pg_hba.conf with the following entry.

```
host    all             all             <VM IP with Subnet>           scram-sha-256
```

Example:

Replace <VM IP with Subnet> with `203.0.113.10/32`

Step 3 Restart postgresql.

```
service postgresql-12 stop
service postgresql-12 start
```

Step 4 Copy the following files from the docker container to the cgms-tools package.

- `docker cp fnd-container:/opt/cgms/server/cgms/conf/.fnd_psk_enc /opt/cgms-tools/conf`
- `docker cp fnd-container:/opt/cgms/server/cgms/conf/fnd_psk.keystore /opt/cgms-tools/conf`
- `docker cp fnd-container:/opt/cgms/tools/conf/jdbc.properties /opt/cgms-tools/conf/jdbc.properties`
- `docker cp fnd-container:/opt/cgms/server/cgms/conf/cgms_keystore /opt/cgms-tools/conf`
- `docker cp fnd-container:/opt/cgms/server/cgms/conf/cgms.properties /opt/cgms-tools/conf`

Step 5 Provide Postgres IP in the jdbc.properties as below.

```
jdbc.url=jdbc:postgresql://<Postgres IP>:5432/cgms
```

Step 6 Add the route in the server for the device reachability. Also, make sure the devices are reachable from the VM.

What to do next

After the script executes successfully, verify if the operations such as refresh metrics, config push, firmware upgrade are working fine in Cisco IoT FND.

Cisco IoT FND WPAN

Cisco Wireless Personal Area Network (WPAN) is a short-range wireless network that connects devices within a small area, typically implemented through Cisco Connected Grid WPAN modules for routers.

- Supports multiple network-based applications.
- Operates using Cisco routers.
- Provides robust security features for access control, device identity, key management, and encryption.

WPAN Feature History

Table 33: Feature History

Feature Name	Release Information	Description
Support of Dual WPAN for IR8100	Cisco IoT FND Release 4.8.1	Cisco IoT FND 4.8.1 supports dual WPAN on IR8100 routers. The dual WPAN support allows you to add more endpoints to the router. You can insert the WPAN modules in any of the three available UIM slots in IR8100 router.
WPAN Reboot in Cisco IoT FND	Cisco IoT FND Release 5.1	The **Reboot WPAN** button is added to the **Device info** page in Cisco IoT FND for these routers running: • Cisco IOS XE: Cisco Catalyst IR8140, • Cisco IOS: Cisco Connected Grid Router CGR1000.

View WPAN configuration

Use this task to view the WPAN configuration details.

Before you begin

You can use the example in this task to retrieve the current Dual-PHY WPAN device RPL slot tree, RPL slot table, RPL IP route info table, along with the configuration information for slots 4/1 and 3/1.

Procedure

Run the command as given in the example.

Example:

```
cisco-FAR5#show run int wpan 4/1
Building configuration...
Current configuration : 320 bytes
!
interface Wpan4/1
 no ip address
 ip broadcast-address 0.0.0.0
 no ip route-cache
 ieee154 beacon-async min-interval 100 max-interval 600 suppression-coefficient 1
 ieee154 panid 5552
 ieee154 ssid ios_far5_plc
 ipv6 address 2001:RTE:RTE:64::4/64
 ipv6 enable
 ipv6 dhcp relay destination  2001:420:7BF:5F::500
end
cisco-FAR5#show run int wpan 3/1
Building configuration...
Current configuration : 333 bytes
!
interface Wpan3/1
 no ip address
 ip broadcast-address 0.0.0.0
 no ip route-cache
 ieee154 beacon-async min-interval 120 max-interval 600 suppression-coefficient 1
 ieee154 panid 5551
 ieee154 ssid ios_far5_rf
 slave-mode 4
 ipv6 address 2001:RTE:RTE:65::5/64
 ipv6 enable
 ipv6 dhcp relay destination  2001:420:7BF:5F::500
end
cisco-FAR5#show wpan 4/1 rpl stree
----------------------------- WPAN RPL SLOT TREE [4] -----------------------------
  [2001:RTE:RTE:64::4]
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1800    // SY RF nodes
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1801
                   \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A00
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1802
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1803
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1804
\--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1805
                   \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A03
                   \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A07
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1806
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1807
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1808
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1809
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:180A
           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:180B
                   \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A01
                           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C05
                           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C06
                           \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C07
                   \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A02
                   \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A04
```

```
                    \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A05
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C03
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C08
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C09
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C0A
                    \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A06
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C02
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C04
                    \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A08
                    \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A09
                    \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A0A
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C00
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C01
                            \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1C0B
                    \--(RF )-- 2001:RTE:RTE:64:207:8108:3C:1A0B
            \--(PLC)-- 2001:RTE:RTE:64:217:3BCD:26:4E00    // CY PLC nodes
            \--(PLC)-- 2001:RTE:RTE:64:217:3BCD:26:4E01
            \--(PLC)-- 2001:RTE:RTE:64:217:3BCD:26:4E02
            \--(PLC)-- 2001:RTE:RTE:64:217:3BCD:26:4E03
            \--(PLC)-- 2001:RTE:RTE:64:217:3BCD:26:4E04
            \--(PLC)-- 2001:RTE:RTE:64:217:3BCD:26:4E05
            \--(PLC)-- 2001:RTE:RTE:64:217:3BCD:26:4E06
            \--(PLC)-- 2001:RTE:RTE:64:217:3BCD:26:4E07
RPL SLOT TREE: Num.DataEntries 44, Num.GraphNodes 45 (external 0) (RF 36) (PLC 8)
cisco-FAR5#ping
 2001:RTE:RTE:64:217:3BCD:26:4E01
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:RTE:RTE:64:217:3BCD:26:4E01, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 254/266/294 ms
cisco-FAR5#ping
 2001:RTE:RTE:64:207:8108:3C:1C00
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2001:RTE:RTE:64:207:8108:3C:1C00, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 272/441/636 ms
cisco-FAR5#
cisco-FAR5#show wpan 4/1 rpl stable
------------------------------ WPAN RPL ROUTE SLOT TABLE [4] ------------------------------
NODE_IPADDR                    NEXTHOP_IP                      SSLOT LAST_HEARD
2001:RTE:RTE:64:207:8108:3C:1800        2001:RTE:RTE:64::4                      3      17:49:12
// SY RF nodes
2001:RTE:RTE:64:207:8108:3C:1801        2001:RTE:RTE:64::4                      3      18:14:05
2001:RTE:RTE:64:207:8108:3C:1802        2001:RTE:RTE:64::4                      3      18:14:37
2001:RTE:RTE:64:207:8108:3C:1803        2001:RTE:RTE:64::4                      3      17:56:56
2001:RTE:RTE:64:207:8108:3C:1804        2001:RTE:RTE:64::4                      3      17:48:53
2001:RTE:RTE:64:207:8108:3C:1805        2001:RTE:RTE:64::4                      3      17:47:52
2001:RTE:RTE:64:207:8108:3C:1806        2001:RTE:RTE:64::4                      3      17:49:54
2001:RTE:RTE:64:207:8108:3C:1807        2001:RTE:RTE:64::4                      3      17:46:38
2001:RTE:RTE:64:207:8108:3C:1808        2001:RTE:RTE:64::4                      3      18:22:01
2001:RTE:RTE:64:207:8108:3C:1809        2001:RTE:RTE:64::4                      3      17:50:02
2001:RTE:RTE:64:207:8108:3C:180A        2001:RTE:RTE:64::4                      3      17:50:02
2001:RTE:RTE:64:207:8108:3C:180B        2001:RTE:RTE:64::4                      3      18:24:00
2001:RTE:RTE:64:207:8108:3C:1A00        2001:RTE:RTE:64:207:8108:3C:1801        3      17:56:34
2001:RTE:RTE:64:207:8108:3C:1A01        2001:RTE:RTE:64:207:8108:3C:180B        3      18:27:34
2001:RTE:RTE:64:207:8108:3C:1A02        2001:RTE:RTE:64:207:8108:3C:180B        3      18:03:06
2001:RTE:RTE:64:207:8108:3C:1A03        2001:RTE:RTE:64:207:8108:3C:1805        3      18:25:18
2001:RTE:RTE:64:207:8108:3C:1A04        2001:RTE:RTE:64:207:8108:3C:180B        3      17:57:15
2001:RTE:RTE:64:207:8108:3C:1A05        2001:RTE:RTE:64:207:8108:3C:180B        3      18:23:39
2001:RTE:RTE:64:207:8108:3C:1A06        2001:RTE:RTE:64:207:8108:3C:180B        3      18:04:16
2001:RTE:RTE:64:207:8108:3C:1A07        2001:RTE:RTE:64:207:8108:3C:1805        3      17:55:00
2001:RTE:RTE:64:207:8108:3C:1A08        2001:RTE:RTE:64:207:8108:3C:180B        3      18:19:35
2001:RTE:RTE:64:207:8108:3C:1A09        2001:RTE:RTE:64:207:8108:3C:180B        3      18:02:02
2001:RTE:RTE:64:207:8108:3C:1A0A        2001:RTE:RTE:64:207:8108:3C:180B        3      18:18:00
```

```
2001:RTE:RTE:64:207:8108:3C:1A0B        2001:RTE:RTE:64:207:8108:3C:180B        3       18:02:46
2001:RTE:RTE:64:207:8108:3C:1C00        2001:RTE:RTE:64:207:8108:3C:1A0A        3       18:22:03
2001:RTE:RTE:64:207:8108:3C:1C01        2001:RTE:RTE:64:207:8108:3C:1A0A        3       18:24:03
2001:RTE:RTE:64:207:8108:3C:1C02        2001:RTE:RTE:64:207:8108:3C:1A06        3       18:25:03
2001:RTE:RTE:64:207:8108:3C:1C03        2001:RTE:RTE:64:207:8108:3C:1A05        3       18:15:05
2001:RTE:RTE:64:207:8108:3C:1C04        2001:RTE:RTE:64:207:8108:3C:1A06        3       18:24:05
2001:RTE:RTE:64:207:8108:3C:1C05        2001:RTE:RTE:64:207:8108:3C:1A01        3       18:10:02
2001:RTE:RTE:64:207:8108:3C:1C06        2001:RTE:RTE:64:207:8108:3C:1A01        3       18:05:03
2001:RTE:RTE:64:207:8108:3C:1C07        2001:RTE:RTE:64:207:8108:3C:1A01        3       18:11:03
2001:RTE:RTE:64:207:8108:3C:1C08        2001:RTE:RTE:64:207:8108:3C:1A05        3       18:15:05
2001:RTE:RTE:64:207:8108:3C:1C09        2001:RTE:RTE:64:207:8108:3C:1A05        3       18:15:04
2001:RTE:RTE:64:207:8108:3C:1C0A        2001:RTE:RTE:64:207:8108:3C:1A05        3       18:15:04
2001:RTE:RTE:64:207:8108:3C:1C0B        2001:RTE:RTE:64:207:8108:3C:1A0A        3       18:24:03
2001:RTE:RTE:64:217:3BCD:26:4E00        2001:RTE:RTE:64::4                      4       18:21:40
// CY PLC nodes
2001:RTE:RTE:64:217:3BCD:26:4E01        2001:RTE:RTE:64::4                      4       17:47:23
2001:RTE:RTE:64:217:3BCD:26:4E02        2001:RTE:RTE:64::4                      4       18:20:16
2001:RTE:RTE:64:217:3BCD:26:4E03        2001:RTE:RTE:64::4                      4       17:49:07
2001:RTE:RTE:64:217:3BCD:26:4E04        2001:RTE:RTE:64::4                      4       18:21:49
2001:RTE:RTE:64:217:3BCD:26:4E05        2001:RTE:RTE:64::4                      4       18:22:06
2001:RTE:RTE:64:217:3BCD:26:4E06        2001:RTE:RTE:64::4                      4       18:22:51
2001:RTE:RTE:64:217:3BCD:26:4E07        2001:RTE:RTE:64::4                      4       18:24:04
Number of Entries in WPAN RPL ROUTE SLOT TABLE: 44 (external 0)
cisco-FAR5#show wpan 4/1 rpl itable
----------------------------- WPAN RPL IPROUTE INFO TABLE [4] -----------------------------
NODE_IPADDR                     RANK  VERSION     NEXTHOP_IP                      ETX_P      ETX_LRSSIR
  RSSIF HOPS  PARENTS     SSLOT
2001:RTE:RTE:64:207:8108:3C:1800        835   1     2001:RTE:RTE:64::4                      0
762   -67   -71   1     1     3    // SY RF nodes
2001:RTE:RTE:64:207:8108:3C:1801        692   2     2001:RTE:RTE:64::4                      0
547   -68   -67   1     1     3
2001:RTE:RTE:64:207:8108:3C:1802        776   2     2001:RTE:RTE:64::4                      0
711   -82   -83   1     1     3
2001:RTE:RTE:64:207:8108:3C:1803        968   2     2001:RTE:RTE:64::4                      0
968   -72   -63   1     1     3
2001:RTE:RTE:64:207:8108:3C:1804        699   1     2001:RTE:RTE:64::4                      0
643   -71   -66   1     1     3
2001:RTE:RTE:64:207:8108:3C:1805        681   1     2001:RTE:RTE:64::4                      0
627   -70   -64   1     1     3
2001:RTE:RTE:64:207:8108:3C:1806        744   1     2001:RTE:RTE:64::4                      0
683   -69   -68   1     1     3
2001:RTE:RTE:64:207:8108:3C:1807        705   1     2001:RTE:RTE:64::4                      0
648   -76   -63   1     1     3
2001:RTE:RTE:64:207:8108:3C:1808        811   2     2001:RTE:RTE:64::4                      0
811   -68   -69   1     2     3
2001:RTE:RTE:64:207:8108:3C:1809        730   1     2001:RTE:RTE:64::4                      0
692   -68   -70   1     1     3
2001:RTE:RTE:64:207:8108:3C:180A        926   1     2001:RTE:RTE:64::4                      0
926   -66   -68   1     1     3
2001:RTE:RTE:64:207:8108:3C:180B        602   2     2001:RTE:RTE:64::4                      0
314   -74   -69   1     1     3
2001:RTE:RTE:64:207:8108:3C:1A00        948   1     2001:RTE:RTE:64:207:8108:3C:1801        692
256   -73   -75   2     1     3
2001:RTE:RTE:64:207:8108:3C:1A01        646   2     2001:RTE:RTE:64:207:8108:3C:180B        323
256   -73   -75   2     3     3
2001:RTE:RTE:64:207:8108:3C:1A02        948   1     2001:RTE:RTE:64:207:8108:3C:180B        602
256   -73   -75   2     2     3
2001:RTE:RTE:64:207:8108:3C:1A03        803   2     2001:RTE:RTE:64:207:8108:3C:1805        503
256   -68   -78   2     3     3
2001:RTE:RTE:64:207:8108:3C:1A04        858   1     2001:RTE:RTE:64:207:8108:3C:180B        602
256   -65   -69   2     1     3
2001:RTE:RTE:64:207:8108:3C:1A05        646   2     2001:RTE:RTE:64:207:8108:3C:180B        323
256   -71   -69   2     2     3
2001:RTE:RTE:64:207:8108:3C:1A06        858   1     2001:RTE:RTE:64:207:8108:3C:180B        602
```

```
256   -73   -75   2     2     3
2001:RTE:RTE:64:207:8108:3C:1A07        979   1     2001:RTE:RTE:64:207:8108:3C:1805        627
352   -71   -73   2     1     3
2001:RTE:RTE:64:207:8108:3C:1A08        646   2     2001:RTE:RTE:64:207:8108:3C:180B        390
256   -75   -70   2     3     3
2001:RTE:RTE:64:207:8108:3C:1A09        948   1     2001:RTE:RTE:64:207:8108:3C:180B        602
256   -70   -69   2     3     3
2001:RTE:RTE:64:207:8108:3C:1A0A        646   2     2001:RTE:RTE:64:207:8108:3C:180B        390
256   -75   -71   2     2     3
2001:RTE:RTE:64:207:8108:3C:1A0B        858   1     2001:RTE:RTE:64:207:8108:3C:180B        602
256   -68   -68   2     2     3
2001:RTE:RTE:64:207:8108:3C:1C00        902   2     2001:RTE:RTE:64:207:8108:3C:1A0A        646
256   -70   -74   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C01        902   2     2001:RTE:RTE:64:207:8108:3C:1A0A        646
256   -71   -72   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C02        1114  1     2001:RTE:RTE:64:207:8108:3C:1A06        858
256   -74   -73   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C03        1114  1     2001:RTE:RTE:64:207:8108:3C:1A05        858
256   -76   -77   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C04        902   2     2001:RTE:RTE:64:207:8108:3C:1A06        646
256   -75   -68   3     2     3
2001:RTE:RTE:64:207:8108:3C:1C05        1114  1     2001:RTE:RTE:64:207:8108:3C:1A01        858
256   -66   -74   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C06        1114  1     2001:RTE:RTE:64:207:8108:3C:1A01        858
256   -74   -72   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C07        1114  1     2001:RTE:RTE:64:207:8108:3C:1A01        858
256   -70   -75   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C08        1114  1     2001:RTE:RTE:64:207:8108:3C:1A05        858
256   -74   -70   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C09        1114  1     2001:RTE:RTE:64:207:8108:3C:1A05        858
256   -70   -74   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C0A        1114  1     2001:RTE:RTE:64:207:8108:3C:1A05        858
256   -70   -69   3     1     3
2001:RTE:RTE:64:207:8108:3C:1C0B        902   2     2001:RTE:RTE:64:207:8108:3C:1A0A        646
256   -76   -74   3     1     3
2001:RTE:RTE:64:217:3BCD:26:4E00        616   2     2001:RTE:RTE:64::4                      0
616   118   118   1     1     4     // CY PLC nodes
2001:RTE:RTE:64:217:3BCD:26:4E01        702   1     2001:RTE:RTE:64::4                      0
646   118   118   1     1     4
2001:RTE:RTE:64:217:3BCD:26:4E02        557   2     2001:RTE:RTE:64::4                      0
557   118   118   1     1     4
2001:RTE:RTE:64:217:3BCD:26:4E03        626   1     2001:RTE:RTE:64::4                      0
579   118   118   1     1     4
2001:RTE:RTE:64:217:3BCD:26:4E04        609   2     2001:RTE:RTE:64::4                      0
609   118   118   1     1     4
2001:RTE:RTE:64:217:3BCD:26:4E05        602   2     2001:RTE:RTE:64::4                      0
602   118   118   1     1     4
2001:RTE:RTE:64:217:3BCD:26:4E06        594   2     2001:RTE:RTE:64::4                      0
594   118   118   1     1     4
2001:RTE:RTE:64:217:3BCD:26:4E07        584   2     2001:RTE:RTE:64::4                      0
584   118   118   1     1     4
Number of Entries in WPAN RPL IPROUTE INFO TABLE: 44
```

The WPAN configuration details are displayed.

Configure SNMP v3 informational events

Use this task for enabling SNMP v3 informational events.

For Cisco IOS routers you configure SNMP v3 informational events to replace the default SNMP v3 traps. For Cisco IOS routers, converting these SNMP v3 traps to SNMP v3 informational events sends an acknowledgment to the router for every event received from the router.

The router then verifies if the trap is received by Cisco IoT FND or not.

Procedure

Run the commands given in the example after uncommenting the lines in the default configuration file.

Example:

```
<#-- Enable the following configurations for the nms host to receive informs
instead of traps -->
<#-- no snmp-server host ${nms.host} traps version 3 priv ${far.adminUsername} -->
<#-- snmp-server engineID remote ${nms.host} ${nms.localEngineID} -->
<#-- snmp-server user ${far.adminUsername} cgnms remote ${nms.host} v3 auth sha
${far.adminPassword} priv aes 256 ${far.adminPassword} -->
<#-- snmp-server host ${nms.host} informs version 3
priv ${far.adminUsername} -->
```

The SNMP v3 informational events are enabled.

What to do next

Once the SNMP v3 informational events are enabled you can push the new configuration file to all routers in the group.

Enable router GPS tracking

Use this task to enable GPS traps.

You can enable GPS traps to trigger an event if the router moves a distance threshold, after a time threshold, or both.

For example, you can configure stationary, pole-top CGR monitoring for a distance threshold, to detect movement from theft or pole incident; for mobile routers, set both thresholds to determine distance over time.

Before you begin

Note

- The recommended distance threshold is 100 feet (30 m).
- Because GPS traps only generate informational logs, it is recommended that you create a rule-based event with high severity (such as **CRITICAL**) to inform the administrator of router movement. An example of this type of rule definition is:`configGroup:name eventName:deviceLocChanged`. For more information, see Creating a Rule .

Procedure

Run the command in the given example after uncommenting these lines in the default configuration template.

Example:

```
<#--
Enable the following configurations to generate events that track if the router
moves by a certain distance (unit configurable) or within a certain time (in minutes)
-->
<#-- cgna geo-fence interval 10 -->
<#-- cgna geo-fence distance-threshold 100 -->
<#-- cgna geo-fence threshold-unit foot -->
<#-- cgna geo-fence active -->
```

Router GPS tracking gets enabled.

WPAN reboot option in Cisco IoT FND

Cisco Wireless Personal Area Network (WPAN) is a type of wireless network that connects devices within a small area, supporting multiple network-based applications on Cisco routers.

- Supports Cisco Catalyst IR8140 running Cisco IOS XE software.
- Supports Cisco 1000 Series Connected Grid Router CGR1000 running Cisco IOS software.
- Requires a router that supports the WPAN interface module.

WPAN Reboot Configuration

To reboot WPAN, use the **Reboot WPAN** button available in the device details page in Cisco IoT FND.

Note You can use the **Reboot WPAN** option only for routers which support the WPAN interface module.

Reboot WPAN

Use this task to reboot WPAN in Cisco IoT FND.

The Reboot WPAN action is available from the Device Details page for supported routers.

Before you begin

Note The **Reboot WPAN** feature in Cisco IoT FND works only for routers which have a WPAN interface.

Procedure

Step 1 From the main menu, choose **Deviecs** > **Field Devices** > **Browse Devices** > **ROUTER**.

Step 2 Select router from the **ROUTER** group.

Note
You can only select Cisco Catalyst IR8140 or Cisco Connected Grid Router CGR1000 as routers for rebooting WPAN in Cisco IoT FND.

Step 3 Click the router from the list of routers.

Step 4 Click **Reboot WPAN** in the device details page.

a) Select the WPAN slot if more than one WPAN cards are available on the router.

You will receive a confirmation message, asking whether you want to continue with the reboot or not.

Step 5 Click **Yes**.

Note
If you do not wish to continue with the WPAN reboot, then you can click **No**.

Once WPAN has rebooted successfully, the status is displayed as **Completed successfully**.

Note There are two scenarios in which WPAN reboot can fail:

- WPAN reboot fails due to missing module: In this case the **Reboot WPAN** button is not enabled in the page and you do not have to perform any action in this case.
- WPAN reboot fails even when the module is present but is not rebooting: In this case you will receive an error message asking you to wait for 30 seconds and then try rebooting again.

View WPAN reboot audit log

After the WPAN reboot is complete for a router, you can check the status of the router in the audit log.

Procedure

Step 1 From the main menu, choose **Admin** > **System Management**.

Step 2 Click **Audit Trail** .

The status of the router after WPAN reboot is displayed in the table.

View WPAN reboot events

Use this task to check the status of the routers after rebooting WPAN.

After the the WPAN reboot is complete for the selected routers, you can check the status of these routers in the **Events** page.

Procedure

Step 1 From main menu bar, choose **Devices** > **Field Devices** > **Browse Devices** > **ROUTER**.

Step 2 Select and click Cisco Catalyst IR8140 or Cisco Connected Grid Router CGR1000 router from the router group.

The device inventory page is displayed.

Step 3 Click **Events** .

Note
You can also view the events listed in the Cisco IoT FND **OPERATIONS** > **Events** page.

The status of the router after WPAN reboot is displayed in the table.

Dual WPAN support for Cisco Catalyst IR8100 router

Dual WPAN support is a configuration capability that allows Cisco IoT FND to manage multiple WPAN modules on a single Cisco Catalyst IR8100 router.

- Supports insertion of WPAN modules into any of the three available UIM slots.
- Maps inventory details and metrics based on the specific slot number of the module.
- Provides slot-specific naming conventions for WPAN-related information to distinguish between multiple modules.

Cisco IoT FND uses the slot number in which the module is inserted for mapping the inventory details of the respective WPAN interface. In Cisco IoT FND, WPAN related information for the WPAN inserted in slot number 1 is displayed by default. The WPAN related information for the WPAN inserted in slot 2 or slot 3 are suffixed with corresponding slot number.

Key considerations

Before using the Cisco Catalyst IR8100 dual WPAN, observe the following configuration and operational requirements:

- Display all WPAN parameters according to slot number, while user-configurable parameters display according to interface number.
- Note that user-configurable parameters are not mapped by slot number. The existing parameters represent the first WPAN, and names with a suffix of 2 represent the second WPAN (for example, meshPrefixConfig, meshPrefixConfig2).
- Re-register the device after adding or removing a WPAN.

- Ensure the Cisco Catalyst IR8100 router firmware version is 17.08.01 or greater to support dual WPAN features in Cisco IoT FND 4.8.1. Cisco IoT FND maps the properties or metrics of WPAN based on the slot number in which it is inserted. If the firmware version is lower, Cisco IoT FND processes properties and metrics as it does for a single WPAN rather than by slot number.

  You can consider these two scenarios to understand how dual WPAN works with slot numbers. If the WPAN is inserted in slot 2 of the Cisco Catalyst IR8100 router with firmware version less than 17.08.01, the related properties or metrics always point to a set of attributes without the slot number suffix.

  - With Cisco IoT FND 4.8.1, the firmware upgrade of Cisco Catalyst IR8100 router from version less than 17.08.01 to a version greater than or equal to 17.08.01 leads the existing WPAN module to map the respective properties or metrics based on slot number. So the historic properties or metrics of the same Cisco Catalyst IR8100 router are mapped to one set of mesh properties or metrics (without slot number suffix) and the latest data is mapped to slot specific properties or metrics set.
  - After the Cisco IoT FND 4.8.1 upgrade, the already registered Cisco Catalyst IR8100 device with firmware version greater than or equal to 17.08.01 use the properties or metrics of the WPAN based on slot number. However, the historic properties or metrics of the same Cisco Catalyst IR8100 router is mapped to existing set of mesh properties or metrics (without the slot number suffix).

- Understand that if a WPAN is inserted in slot 2 of a router with firmware version less than 17.08.01, related properties or metrics point to attributes without the slot number suffix.
- Acknowledge that the High Availability feature is not supported for dual WPAN, consistent with its lack of support for single WPAN on the Cisco Catalyst IR8100 router.

Prerequisites for dual WPAN

Configure dual WPAN interfaces using different PAN IDs and IPv6 prefixes, while maintaining either the same or different SSIDs.

- Ensure both WPANs remain in an Active-Active state in either WiSUN or CRMESH mode.
- The dual WPAN interfaces are configured with: different PAN IDs and IPv6 prefixes, and same SSID or different SSID.

Note Mix of stack modes is not supported.

Dual WPAN support in Field Devices

Provides details on accessing WPAN information and the FAN view within the Cisco IoT FND **Field Devices** page under **Devices**. The FAN view is available in the devices list inCisco IoT FND.

Add user configurable parameters for WPAN interfaces

Use this task to add user configurable parameters for both the WPAN interfaces.

Procedure

Step 1 From the main menu, navigate to **Devices** > **Field Devices** device list page.

Step 2 Upload a csv file.

For more information on uploading csv, see Changing Device Properties in Bulk .

Step 3 From the left pane. click the **Browse Devices** tab and select IR8100.

Step 4 Click **Mesh Config** tab to view the uploaded values.

You can also view the uploaded values using the **Config Properties** tab on the same page which has the **Mesh Link Config** details displayed for both the WPANs along with the parameters which are suffixed according to the slot number.

The user configurable parameters for both the WPAN interfaces are added.

Dual WPAN support in Router Device

Provides visibility into the number of endpoints connected to specific WPAN interfaces within the router device view.

In the Cisco IoT FND router device view, the Mesh Count column indicates the number of endpoints connected in the WPAN 0/1/0 inserted in slot 1. By default, the Mesh Count column is displayed. The mesh count 2 and mesh count 3 columns indicate the number of endpoints that are connected to WPAN 0/2/0 and WPAN 0/3/0. The mesh count 2 and mesh count 3 columns can be added in the Field Device page by choosing them to be in the default view. For more information, see Add Device Views, on page 267 .

View dual WPAN details in Cisco IR8100 router

Use this task to view the dual WPAN information in Cisco IR8100 router.

Procedure

From the main menu, choose **Devices** > **Field Devices** > **IR8100** router.

Note

- The **Inventory** > **IR8100** device view displays the parameters for the WPAN inserted in slot 1 by default. The **Mesh** tab and **Mesh Config** tab displays the existing properties related to WPAN inserted in slot 1.
- WPAN parameters are included for the WPANs that are inserted in other slots. You can view these additional attributes by customizing your default view.

The WPAN details in Cisco IR8100 router are displayed.

Add or edit a new tab in default view

Use this task for adding or editing a new tab in the existing default view of the dual WPAN in Cisco IR8100 router.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** > **IR8100** router.

Step 2 Click + in the devices page, or

Step 3 Click the drop-down list near the **Mesh** tab or **Mesh Config** tab to edit the current view and add WPAN specific fields.

This helps to view WPAN related details specific to WPAN 0/2/0 or WPAN 0/3/0. For more information, see Customizing Device Views .

The new WPAN related tab is added.

View additional dual WPAN fields using filters

Use this task to view the filters based on the slot number in which the WPAN is inserted.

Before you begin

Note The newly added WPAN parameters are displayed in the **Show Filters** option view.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** > **IR8100** router.

Step 2 Click **Show Filters** in the default view.

Step 3 Select the WPAN parameters from the drop-down list.

Step 4 Enter the search criteria.

The search results are displayed in the page accordingly. For more information on filters, see Using Router Filters .

Access Device Info tab

The **Device Info** tab allows you to monitor parameters retrieved from both WPANs. Each section displays columns for the WPAN interface name with corresponding parameter values.

Procedure

Step 1 Navigate to **Devices** > **Field Devices**

Step 2 Click on a device to navigate to the **Device Info** tab.

Step 3 Review the settings under **Mesh Link Settings** , **Mesh Link Metrics** , and **Mesh Link Keys** sections.

Step 4 Review the **Network Interface** fields as described in the following table.

Table 34: Network interface fields

Field	Description
Interface	Indicates the name of the interface

Field	Description
Admin Status	Provides admin status (up/down)
Oper. Status	Provides operational status (up/down)
IP Address	Indicates the IP address of the device
Physical Address	Indicates the latitude and longitude of the device
Tx Speed (bps)	Indicates the speed (bits/sec) of data transmitted by the interface
Tx Drops (bps)	Indicates the number of packets dropped (drops/sec)
Rx Speed (bps)	Indicates the speed (bits/sec) of data received by the interface

What to do next

For more information on **Mesh Link Settings** , see Link Metrics .

For more information on Mesh Link Keys, see Mesh Link Keys .

View Device Info tab

Use this task to view the Cisco IoT FND **Device Info** tab.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** > **IR8100** router.

Step 2 Click on router from the list of routers.

Note

- The **Network Interface** table in the **Device Info** page provides the details of both the WPAN interfaces that are connected in any of the three available slots.
- The Cisco IR8100 device is connected to CAM module through new virtual port group interface which is processed to retrieve information of the RPL tree. Based on the settings in the RPL tree, the mesh routing tree is displayed.
- The **Device Info** tab displays the **Mesh Link Traffic** chart according to the time period selected on the top-right side of the page. The information given in the chart is color coded to distinguish the slot in which the WPAN is inserted. For example, the color used for Tx or Rx speed of WPAN in slot 1 is different from that of WPAN in slot 2.
- You can click on the color code and the respective line in the chart is removed from the graph. This applies for all the charts.
- The endpoint hop count chart shows an aggregated endpoint count between the hops connected to both the WPAN interfaces.

The **Device Info** page is displayed.

View dual WPAN events

Use this task to view the dual WPAN events in Cisco IoT FND.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** > **IR8100** router.

Step 2 Click on router from the list of routers.

Step 3 Click **Events** tab.

The dual WPAN events page is displayed.

View Running Config tab

Use this task to view the **Running Config** tab in Cisco IoT FND.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** > **IR8100** router.

Step 2 Click on router from the list of routers.

Step 3 Click **Running Config** tab.

The **Running Config** page gets displayed.

View Mesh Routing Tree

The **Mesh Routing Tree** tab allows you to select the available WPAN interface for which you want to see the mesh routing table information. For example, if you want to see the mesh routing tree information of WPAN inserted in slot number one, then you must select WPAN0/1/0.

Before you begin

Note

- By default, the **WPAN Interface** drop-down list displays the WPAN interface inserted in lower slot number. Therefore, the information pertaining to the respective WPAN is displayed. So, you must select the available WPAN from the drop-down list for which you want to view the information.
- During RPL tree polling, the information is fetched from both WPAN interfaces and processed by Cisco IoT FND. For more information on polling, refer to Configure RPL tree polling .
- For the Cisco IR8100 device with CAM module, the RPL tree information is captured from the respective CAM module and displayed in the **Mesh Routing Tree** tab. The Cisco IR8100 device as the root element and the act devices connected to the CAM module are shown.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** > **IR8100** router.

Step 2 Click on router from the list of routers.

Step 3 Click **Mesh Routing Tree** tab.

Step 4 Select the required WPAN slot number from the **WPAN Interface** drop-down list.

The table describes the fields under **Mesh Routing Tree** tab in the **Device Info** page.

Field	Description
EID	Element Identifier.
Name	Router EID (Device identifier).
Status	Provides status of device (up/down).
Type	It represents the FAR and endpoint device type.
IP Address	Indicates the IP address of the device.
Last Heard	Last date and time the device contacted IoT FND.
Meter ID	Meter ID of the device.
Transmit Speed (bits/sec)	Indicates the speed (bits/sec) of data transmitted by the interface.
Packet Drops (packets/sec)	Indicates the number of packets dropped (drops/sec).
Receive Speed (bits/sec)	Indicates the speed (bits/sec) of data received by the interface.
RPL Hops (hops)	Number of hops that the element is from the root of its RPL routing tree.
RPL Link Cost (etx)	RPL cost value for the link between the element and its uplink neighbour.
RPL Path Cost (etx)	RPL path cost value between the element and the root of the routing tree.
RSSI	Shows the measured RSSI value of the primary mesh RF uplink (dBm) over time.
Reverse RSSI	RSSI received from the neighbour.
Active Link Type	Determines the most recent active RF or PLC link of a meter.

The table displays the mesh routing information for the selected WPAN.

Configure Dual WPAN support in Device Configuration

Dual WPAN is supported in the Cisco IoT FND **Device Configuration** page under the **Config** menu.

Procedure

Step 1 Navigate to the device configuration path.

Choose **Config** > **Device Configuration** > **ROUTER** > **Default-Ir8100** .

Step 2 Configure WPAN parameters in the **Group Members** tab.

The table is updated with four more columns for representing the user configured parameters such as meshPrefixConfig2, meshPrefixLengthConfig2, meshPanIdConfig2, and meshAddressConfig 2 metrics. The existing parameter represents the first WPAN and the parameters with the suffix represent the configured parameter for the second WPAN.

Step 3 Define user configurable parameters in the **Edit Configuration Template** tab.

FND maps the defined parameters to the WPAN parameter value configured through CSV.

a. Navigate to the **Edit Configuration Template** tab.

b. Enter the parameter values in the template and click the disk icon. The WPAN specific user configurable parameters are displayed in the **Running Config** tab in the device details page.

Note
You can change device properties by clicking the **Change Device Properties** button above the devices pane.

Step 4 Export the template keys as a CSV file.

In the **Device Configuration** page, click the **Export Template Keys as CSV** button. The WPAN related user configurable parameters are exported in a CSV file.

View dual WPAN in Device Configuration page

Use this task to view the dual WPAN parameters in the **Device Configuration** page in Cisco IoT FND.

Procedure

From the main menu, choose **Config** > **Device Configuration** > **ROUTER** > **Default-Ir8100** router.

Note
In the **Group Members** tab, the table is updated with four more columns for representing the user configured parameters such as meshPrefixConfig2, meshPrefixLengthConfig2, meshPanIdConfig2, meshAddressConfig 2 metrics. The existing parameter represents for first WPAN and the parameters with suffix represents the configured parameter for the second WPAN.

The dual WPAN details are displayed in the **Device Configuration** page.

Edit the dual WPAN user-configurable parameters

Use this task to edit the user configurable dual WPAN parameters in the **Device Configuration** page in Cisco IoT FND.

The **Edit Configuration Template** page allows you to define user configurable parameters in the template. Cisco IoT FND maps the defined parameters to the WPAN parameter value configured through CSV.

Follow these steps to edit the dual WPAN user-configurable parameters.

Procedure

Step 1 From the main menu, choose **Config** > **Device Configuration** > **Router** > **Default-Ir8100** router.

Step 2 Click **Edit Configuration Template** .

Step 3 Enter the parameter values in **Edit Configuration Template** box.

Step 4 Click **Save** to apply the changes.

Note

- You can change device properties by clicking the **Change Device Properties** button.
- You can export the dual WPAN related user configurable parameters in a csv file format by clicking **Export Template Keys as CSV** button.

The user configurable dual WPAN parameters are edited and saved.

View dual WPAN in Dashboard

Use this task to view dual WPAN in the **Dashboard** page in Cisco IoT FND.

Procedure

Step 1 From the main menu, choose **Dashboard** .

Step 2 Click on the gear icon called **Settings** .

Step 3 Click **Dashlets** drop-down box in the **Dashboard Settings** window.

Step 4 Select the interface enabled devices from the **Dashlets** drop-down box.

Step 5 Click **Close** .

The **Devices with interfaces enabled but down** filter settings combo box is displayed.

Step 6 Select **Type** , **Device** , **Interface** , **WPAN** ***x*|*y*|*z*** .

Note
The **Type** refers to the type of device, **Device** refers to the router like Cisco IR8100 router, **Interface** is the **WPAN** ***x*|*y*|*z*** interface type listed in the drop-down box.

Step 7 Click **Save** .

A gauge chart with device interface is displayed.

Step 8 Click on the needle of the gauge chart.

The devices for which the interfaces are enabled is displayed in the gauge chart.

The status of the device interface is displayed in the form of a gauge chart.

PIMs in Cisco IoT FND

Pluggable Interface Modules (PIMs) are pluggable modular components that can be easily installed or removed on any router platform.

The PIMs are used for

- configuring and upgrading network devices.
- providing flexibility for adding different interfaces.

PIM Feature History

The following table lists the support history for various PIMs in Cisco IoT FND.

Table 35: Feature History

Release Information	Feature Name	Description
Cisco IoT FND Release 5.1	P-5GS6-GL PIM Support for Cisco Catalyst IR1800 and Cisco Catalyst IR1100 routers	Adds support for P-5GS6-GL 5G stand alone PIM for the Cisco Catalyst IR1800 and Cisco Catalyst IR1100 routers.
Cisco IoT FND Release 5.1	IRMH-5GS6-GL and IRMH-5GR16SA PIMs Support for Cisco Catalyst IR8100 routers	Adds support for IRMH-5GS6-GL and IRMH-5GR16SA stand alone PIMs for Cisco Catalyst IR8100 routers.
Cisco IoT FND 4.11	P-LTEA7-NA (EM7411), P-LTEA7-EAL (EM7421), and P-LTEA7-JP (EM7431) PIMs support for Catalyst IR1100 routers	Adds support for Cat7 LTE PIMs for North America, Rest of World, and Japan, supporting multiple slots and modems.
Cisco IoT FND Release 4.10	P-LTE-450 PIM support for Cisco Catalyst IR1100 routers	Adds support for P-LTE-450 Mhz or PIM, which is a third-party LTE module that supports private networks and operates at a 450 MHz frequency.

PIMs

This topic provides a comprehensive lookup table for PIM hardware support, detailing the specific router platforms, software requirements, and documentation links for each module.

Table 36: PIM Support Matrix

PIM Name	PID	Devices Supported	Minimum Supported Cisco IoT FND Release	Cisco IoT FND Supported Device Version	Description
P-LTE-450 MHz PIM	P-LTE-450	Cisco Catalyst IR1100	Cisco IoT FND Release 4.10	Cisco IOS XE Release 17.9.3 and later releases	Third-party LTE module (Cisco/Intelliport) for private LTE networks in the 450 MHz band; supports multi-PDN and multiple APNs per SIM; base or compute slot only. For more details, see Cisco Catalyst IR1100 Rugged Series Router
LTE Cat7 PIM (North America)	P-LTEA7-NA (EM7411)	Cisco Catalyst IR1101	Cisco IoT FND Release 4.11	Cisco IOS XE Release 17.13.1 and later releases	LTE Cat7 cellular pluggable module for North America; supports dual modem configuration; can be inserted in base, expansion module, or compute module slots. For more details, see Cisco Catalyst IR1101 Rugged Series Router Hardware Installation Guide

PIM Name	PID	Devices Supported	Minimum Supported Cisco IoT FND Release	Cisco IoT FND Supported Device Version	Description
LTE Cat7 PIM (Rest of World)	P-LTEA7-EAL (EM7421)	Cisco Catalyst IR1101	Cisco IoT FND Release 4.11	Cisco IOS XE Release 17.13.1 and later releases	LTE Cat7 cellular pluggable module for regions outside North America and Japan; supports dual modem configuration; insertable in multiple slots. For more details, see Cisco Catalyst IR1101 Rugged Series Router Hardware Installation Guide
LTE Cat7 PIM (Japan)	P-LTEA7-JP (EM7431)	Cisco Catalyst IR1101	Cisco IoT FND Release 4.11	Cisco IOS XE Release 17.13.1 and later releases	LTE Cat7 cellular pluggable module for Japan region; supports dual modem configuration; can be inserted in base, expansion module, or compute module slots. For more details, see Cisco Catalyst IR1101 Rugged Series Router Hardware Installation Guide

PIM Name	PID	Devices Supported	Minimum Supported Cisco IoT FND Release	Cisco IoT FND Supported Device Version	Description
5G Stand Alone PIM	P-5GS6-GL	Cisco Catalyst IR1800 and Cisco Catalyst IR1100	Cisco IoT FND Release 5.1	Cisco IOS XE Release 17.7.1 and later releases	5G stand-alone pluggable module for 5G and fallback 4G cellular connectivity; supports multiple APNs and interfaces; enhances flexibility on the IR1100 and IR1800 platforms. For more details, see Cisco Catalyst IR1800 Rugged Series Router Hardware Installation Guide , Cisco Catalyst IR1101 Rugged Series Router Hardware Installation Guide .
5G Stand Alone PIM	IRMH-5GS6-GL and IRMH-5GR16SA	Cisco Catalyst IR8100	Cisco IoT FND Release 5.1	Cisco IOS XE 17.17.1 and later releases	5G stand-alone pluggable module for 5G and fallback 4G cellular connectivity; robust wireless options; advanced networking for the IR8100 platform. For more details, see Cisco Catalyst IR8100 Heavy Duty Series Router

PIM cellular connectivity

This reference provides a mapping of Cisco IoT router models to their respective PIM slots and supported cellular interfaces to facilitate network configuration.

Table 37: PIM Cellular Interface Support

Router Model	PIM Slot(s)	Supported Cellular Interfaces	Notes
Cisco Catalyst IR1101	Slot 1	Cellular 0/1/0 and Cellular 0/1/1	Gigabit Ethernet interface as first supported interface, followed by Cellular interfaces. Both LTE PIM and 5G PIM are recognized with Gigabit Ethernet and Cellular interfaces. **Note** Slot 1 is used for base pluggable module.
Cisco Catalyst IR1101	Slot 3, Slot 4	Cellular 0/3/0 and Cellular 0/3/1, Cellular 0/4/0 and Cellular 0/4/1	Only LTE PIMs are recognized with Gigabit Ethernet and Cellular interfaces for dual SIM or dual radio. **Note** Slot 3 or 4 depends on the LTE module inserted in the expansion module or compute module.
Cisco Catalyst IR8100	Slot 2, Slot 3	Cellular 0/2/0, Cellular 0/2/1, Cellular 0/3/0 and Cellular 0/3/1	Both LTE PIM and 5G PIMs are recognized, with two logical interfaces (e.g., for dual SIM or dual radio).
Cisco Catalyst IR1800	Slot 4	Cellular0/4/0 and Cellular0/4/1	Both LTE PIM and 5G PIMs are recognized, two logical interfaces (e.g., for dual SIM or dual radio).
Cisco Catalyst IR1800	Slot 5	Cellular0/5/0 and Cellular0/5/1	Both LTE PIM and 5G PIMs are recognized, with two logical interfaces (e.g., for dual SIM or dual radio).

View PIMs in field devices page

Access detailed information about the PIM modules connected to a router for monitoring and troubleshooting.

Use this task to view these PIM details in the **Device Info** page: Use this task to view PIM details of a router's interfaces, including their cellular link settings, Cellular Link Info, cellular Link Metrics, and Pluggable Module Info. This is useful for verifying configuration and diagnosing connectivity issues.

Before you begin

Note

- The **Network Interface** table in the **Device Info** page displays the GigabitEthernet interfaces.
  - A P-LTE-450 MHz module connected to the base module uses interface GigabitEthernet 0/1/0.
  - The same module connected to the compute module uses interface GigabitEthernet 0/4/0.
- P-LTE-450 can be connected in the base slot or expansion CM slot and always appears as Modem2. The APNs use 3, 4, and 5 as interface numbers.
- Ensure that Cisco IoT FND has detected the router and the inserted module during device registration.

Follow these steps to view PIM details for a field device.

Procedure

Step 1 Choose **Devices** > **Field Devices** > **Browse Devices** > **Router**.

Step 2 Click the router you want to inspect from the list.

Step 3 On the Device Info page, view the following details:

- **Cellular Link Settings**,
- **Cellular Link Info**,
- **Cellular Link Metrics**,
- **Pluggable Module Info**.

The Device Info page displays PIM details for the selected router, including module, interface, and cellular metrics.

Note

- See NB API guide, for more information about the properties and metrics used for pluggable and expansion interfaces. Also, see getMetricHistory and getDeviceDetails for more details.

What to do next

See *View Metrics in the Cellular Link Traffic and RSSI Charts* .

Display cellular module information after an upgrade

If a device was registered with Cisco IoT FND while running a Cisco IOS XE release earlier than 26.1.1, information about an installed cellular module might not appear on the **Device Info** page after you upgrade the device to Cisco IOS XE Release 26.x.

Selecting **Refresh Metrics** or waiting for periodic metrics collection does not update the inventory that Cisco IoT FND created during registration.

To display the cellular module information, remove the device from Cisco IoT FND and add it again.

Note Removing a router from Cisco IoT FND returns its leased IP addresses to Cisco Network Registrar and removes its corresponding tunnels from the head-end routers. We recommend that you perform this procedure during a planned maintenance window.

Procedure

Step 1 Choose **DEVICES** > **Field Devices**.

Step 2 Select the affected device.

Step 3 Choose **More Actions** > **Remove Devices**, and select **Yes** to confirm the removal.

Step 4 Add the router to Cisco IoT FND and complete the registration.

For more information, see Adding Routers to IoT FND.

Step 5 After registration is complete, choose **DEVICES** > **Field Devices**, and select the device.

Step 6 On the **Device Info** page, verify that the cellular module information is displayed.

View cellular link traffic and cellular RSSI chart metrics

Use this task to view these details of PIM metrics and charts from the **Device Info** page:

- **Cellular Link Traffic**
- **Cellular RSSI**

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** > **Browse Devices** > **Router**.

Step 2 Click the router in the list of routers.

The cellular details and charts appear on the **Device Info** page.

Monitor a Guest OS

Cisco IOS CGR1000s and IR800s support a virtual machine to run applications on a Guest OS (GOS) instance running beside the Cisco IOS virtual machine. The GOS is Linux. Applications running on the GOS typically collect statistics from the field for monitoring and accounting purposes. The Cisco IOS firmware bundle installs a reference GOS on the VM instance on the CGR or IR800s.

Cisco IoT FND supports the following role-based features on the GOS:

- Monitoring GOS status
- Upgrading the reference GOS in the Cisco IOS firmware bundle

Note Cisco IoT FND only supports the reference GOS provided by Cisco.

Procedure

Navigate to the **DEVICES** > **Field Devices** page on the CGR1000 or IR829 configuration page to monitor the GOS.

Install a GOS

Depending on CGR factory configuration, a GOS may be present in the VM instance. The GOS installs with the Cisco IOS firmware bundle (see Router firmware update process). The GOS, Hypervisor, and Cisco IOS all upgrade when you perform a Cisco IOS image bundle installation or update.

The following components and requirements facilitate GOS installation and management:

- Cisco IoT FND: Performs discovery and checks if the initial communications setup is complete.
- CGR: Must have a DHCP pool and Gigabit Ethernet 0/1 interface configured to provide an IP address and act as the gateway for the GOS.

After any Cisco IOS install or upgrade, Cisco IoT FND verifies the GOS setup requirements and populates a Guest OS tab on the Device Info page for that particular router.

Note If the router is configured with Guest-OS CLI during the router's registration with Cisco IoT FND, the system detects that Guest-OS is running and populates a new Guest OS tab on the Device Info page for that particular router. From that page, you can trigger a Guest-OS restart. After the Guest-OS is restarted, a pop-up with the status of the operation is seen on the UI and messages are logged in the server.log file.

Procedure

Step 1 Navigate to **Devices** > **Field Device**.

Step 2 From the **Browse Devices** pane, select a CGR1000s or IR800s router and open the **Device info** page of a device.
If the router is configured with Guest-OS during registration, Cisco IoT FND displays a Guest OS tab on the Device Info page.

Step 3 Click the **Guest OS** tab.

Step 4 Verify the GOS details.

See the Cisco 1000 Series Connected Grid Routers Configuration Guides web portal for information on configuring the CGR.

Restart a GOS

Cisco IoT FND enables you to restart Guest OS to initiate system recovery and configuration updates.

Procedure

Step 1 Navigate to the **Guest OS** tab.

Step 2 Click the **Restart GOS** button.

Step 3 Click **Yes** to confirm the restart.

Once the Guest-OS restarts, a pop-up with the status of the operation appears in the UI and messages are logged in the server.log file.

Push GOS configurations

You can push the GOS configuration to the CGR using the Cisco IoT FND config template. This is the only way to configure the DHCP pool.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** .

Step 2 Select a CGR1000 or IR800 device to open the **Device Info** page.

Step 3 Click the **Push Configuration** tab and click **Save Template**.

Step 4 Click **Submit** to push the configuration.

Embedded Access Points on Cisco IR829 ISRs

Cisco IoT FND allows you to manage embedded access point (AP) attributes on IR829 ISRs, which are identified as AP800 in the user interface.

You can perform and manage the following aspects for AP800s in Cisco IoT FND:

- Discovery
- AP configuration
- Periodic inventory collection
- Firmware update of APs when operating in Autonomous Mode
- Event Management over SNMP

Note Cisco IoT FND can only manage APs when operating in Autonomous mode.

AP800 Firmware upgrade support during Zero Touch Deployment (ZTD). You must define a specific firmware image to use during ZTD. You can only define a unified image (k9w8 - factory shipped) for update via ZTD. For more information, refer to the AP800 Firmware Upgrade During Zero Touch Deployment topic of this guide.

Note Not all IR800 routers have embedded APs. . The IR829 ISR features matrix is here .

Embedded Access Point (AP) credentials

This reference provides details on the configurable fields used for access point authentication within the Device Info view.

Table 38: Embedded Access Point Credentials Fields

Field	Key	Configurable	Description
AP Admin Username	N/A	Yes	The user name used for access point authentication.
AP Admin Password	N/A	Yes	The password used for access point authentication.

Embedded AP properties

Provides a summary of the properties and status metrics displayed on the Embedded AP tab for supported devices.

The table describes the fields on the Embedded AP tab of the IR800 Device Info view.

Table 39: Embedded AP Properties

Field	Key	Description
Inventory	N/A	Summary of name, EID, domain, status, IP address, hostname, domain name, first heard, last heard, last property heard, last metric heard, model number, serial number, firmware version, and uptime details.
Wi-Fi Clients	N/A	Provides client MAC address, SSID, IPv4 address, IPv6 address, device type, state, name, and parent.
Dot11Radio 0 Traffic	N/A	Provides admin status (up/down), operational status (up/down), physical address, Tx speed (bps), Tx drops (bps), and Rx speed (bps).
Dot11Radio 1 Traffic	N/A	Provides admin status (up/down), operational status (up/down), physical address, Tx speed (bps), Tx drops (bps,) and Rx speed (bps).
Tunnel3	N/A	Provides admin status (up/down), operational status (up/down), Tx speed (bps), Tx drops (bps), and Rx speed (bps).
BVI1	N/A	Provides admin status (up/down), operational status (up/down), IP address, physical address, Tx speed (bps), Tx drops (bps) and Rx speed (bps).
GigabitEthernet0	N/A	Provides admin status (up/down), operational status (up/down), physical address, Tx speed (bps), Tx drops (bps), and Rx speed (bps).

Refresh router mesh FFN keys

Use this task to refresh router mesh FFN keys.

Using the Refreshing Router Mesh FFN Key option, you can refresh the mesh key of CGR1000 or IR8100 for the Fully Functional Nodes (FFN) such as IR500 and L+G devices (lgnn and lgelectric). The router mesh key is refreshed if you suspect unauthorized access attempts to a router or to avoid device downtime when they expire.

Note Cisco IoT FND refreshes the mesh keys automatically when the refresh time is reached.

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** > **Browse Devices**.

Step 2 Select CGR1000 or IR8100 routers from the left pane.

Step 3 Check the check boxes of the routers to refresh in the right pane (default view).

Step 4 Choose **More Actions** > **Refresh Router Mesh FFN Key** from the drop-down list.

Step 5 Click **Yes** to continue.

Alternatively, you can refresh the mesh key of CGR1000 or IR8100 from the Devices Details page using the **Refresh Router Mesh FFN Key** button.

Application Management Support in Cisco IoT FND

Cisco IoT FND provides centralized application management for IR1100 and IR1800 devices running Polaris OS (IOS-XE).

- IOx node lifecycle management via the Cisco IoT FND UI.
- Docker application installation and management through the APPS menu and Device Details page.
- Requirement for integrated Cisco IoT FND and Fog Director (FD) environments.

Deployment Requirements

Note The application management for IR1100 and IR1800 devices and Cisco IR1000 Rugged Series Secure Routers is supported only on OVA installations and not on standalone Cisco IoT FND installation.

Prerequisites

Ensure the following configurations are enabled for application hosting:

- Enabling IOx
- Configuring a VirtualPortGroup to a Layer 3 Data Port

Verify that Cisco IoT FND and FD Integrated OVA with FD version v1.18.1 and above are utilized.

For more configuration related information, see Cisco Catalyst IR1101 Rugged Series Router Software Configuration Guide or Cisco Catalyst IR1800 Rugged Series Router Software Configuration Guide .

Register application-hosting routers with Cisco IoT FND through CSV

Use this task to register the devices with Cisco IoT FND through CSV.

IR1100, IR1800, or Cisco IR1000 Rugged Series Secure Routers device registration uses a CSV file that is uploaded from the Add Devices workflow.

Procedure

Step 1 Prepare the CSV and add the IOx device to Cisco IoT FND. The CSV format is in the following format:

eid,name,status,lastHeard,meshEndpointCount,

runningFirmwareversion,ip,openIssues,labels,lat,lng

IR1101-K9+FCW23500H4Z,IR1101-K9+FCW23500H4Z,up,Jul 12 2022 8:21:46 AM UTC,17.05.01,10.104.198.12,49.933798, 65.696298

Step 2 From the main menu, navigate to **Devices** > **Field Devices** > **Add Devices**.

Step 3 Specify the location of your CSV file and click **Add**.

Once the device is registered in Cisco IoT FND, the App tab in the Field Devices page is enabled.

Start the IOx service in the Device Details page

Use this task to start the IOx service from the Device Details page.

The IOx service status is checked from the IOx tab on the Device Details page before starting the service.

Procedure

Step 1 Navigate to **IOx** tab check whether IOx is started.

Step 2 Click **Start IOx** button if the service has not started.

Step 3 Click **Yes** in the confirmation dialog box.

Step 4 Navigate to **App** tab and click **Show Advanced**.

Note
Click **Refresh Device** in the **Troubleshooting** section, if the registered device is not populating the resource usage information in App Tab. The host information and device details are fetched from the device to Cisco IoT FND.

Note
If the last heard state of the device is Just now, then it confirms that the device is properly registered and started with IOx service.

Import the application from the Apps main menu

Use this task to import an application package from the Apps main menu.

After a device is refreshed successfully through FD and properly discovered by Cisco IoT FND, the **Apps** main menu is used to import the application package for installation to the router IOx node.

Procedure

Step 1 From the main menu, select **Apps**.

Step 2 Click **Import App**.

Step 3 Select the package from the local drive and click **Import**. The application is imported and listed in the left pane.

Install the application

Use this task to install an imported application on a selected device.

Application installation starts after the application import is complete and the application is selected for installation.

Before you begin

Note If you install the application without configuring the interface or enabling the IOx, you will get the following error "No networks have been configured on this device" and the application installation will fail.

Procedure

Step 1 Select the device in which the application must be installed.

Step 2 Click **Add Selected Devices**. The device is added to the Selected Devices section where the Last Heard status of the device can be seen.

Note
As the device is recently registered, the status of the device is shown as just now.

Step 3 Click **Next**.

Step 4 Check the Installation Summary where the device details are given in five different tabs and click **Done, Let's Go** .

Note
If you install incompatible application, then you will get the following CPU architecture error.

Step 5 Click **Done, Let's Go**. The application is activated for the device and the installation process is started.

"Installation Successful on device" message appears once installation is complete. The device that is capable of IOx is discovered automatically and the Host Name, Ip Address are properly populated in Cisco IoT FND.

Troubleshoot host name search for application installation

Use this troubleshooting guidance when you want to install an application for a device from a large device list and need host name search to work in Cisco IoT FND. Choose **Apps** > **Install**.

1. Choose **Config** > **Router Tunnel Addition**. Enable **IOX** and configure a simple virtual port using following configuration items:

```
iox
interfaceVirtualPortGroup0
description
ip address
ipv6 address
```

2. In **Config** > **Router Tunnel Addition**, ensure that `no ip http secure-client-auth` is not part of the tunnel configuration.

3. In **Config** > **Device Configuration** > **Edit Configuration Template**, ensure that `no ip http secure-client-auth` is not part of the configuration template.
4. Choose **Config** > **Tunnel Provisioning**, select the device, and then choose **Push Configuration**. Include `no ip http secure-client-auth` in the push configuration.
5. Choose **Config** > **Tunnel Provisioning** and select the device. Select **App**, choose **Show Advanced** under **Device Details**, and then click **Refresh Device**.

Apply this guidance when host name search does not work while you install an application from **Apps** > **Install**, especially when you must find a device in a large device list.

Host name search works only when the required IOx, router tunnel, and HTTP client authentication settings are configured in the expected locations.

After you apply these settings and refresh the device details, host name search works during application installation.

If the search still does not work, verify each configuration location again and confirm that the device refresh completed from the advanced device details view.

Manage the application

The Cisco IoT FND interface provides the Apps menu to maintain application lifecycle.

Procedure

Step 1 From the main menu, click **Apps**.

Step 2 Click the application.
As the application is just installed and started, the other options are listed.

Step 3 Click the horizontal ellipsis **…** icon and select the application action to be performed on the application.

Stop the application

You can stop a running application in the Apps menu and verify the application status change within the App management page.

Procedure

Step 1 From the main menu, click **Apps** and select the application.

Step 2 Click the ellipses (…) and select **Stop** from the drop-down menu.

Step 3 On the summary page, select the device and click **Add Selected Devices**.

Step 4 Click **Done, Let's Go**.

Step 5 Verify the application status in the App management page.

The screen "Stopping iox-aarch64-hello-world succeeded on 1 device(s)." appears.

Step 6 On the Device Details page, click the **App** tab and check the status of the application under **App/Service Details** section

The status is shown as STOPPED.

You can either start or uninstall the application from this page or from the APPS main menu. If you click **Uninstall** , the operation is complete and the following message is displayed "Successfully performed undeploy action on iox-aarch64-hello-world app."

Uninstalling the application

Use this task when you need to remove an application from one or more devices using the Apps menu in the management interface.

Follow these steps to uninstall the application.

Procedure

Step 1 From the main menu, click **Apps** .

Step 2 Select an application and choose **Uninstall** from the drop-down list.

Step 3 In the Uninstall App page, select the device and click **Add Selected Devices** .

Step 4 Click **Done, Lets go** .

The uninstallation is successful.

Export the application

Use this procedure to export the application and save it to the local drive.

Procedure

Step 1 Navigate to the **Apps** menu.

Step 2 Click the application and choose **Export** from the drop-down list.

The application downloads to the local drive.

Head-End Routers

A Head-End Router is a network device that provides the connection between the Field Area Network and the headend environment.

- Routes traffic between Field Area Routers and headend components in the DMZ and data center.
- Supports management and monitoring via Cisco IoT FND.
- Maintains connectivity between field infrastructure and headend systems.

Supported Head-End routers

Cisco IoT FND supports the following Head-End router models:

- Cisco 8000 Series Routers
- Cisco ASR 1000 Series Aggregation Services Routers (ASR 1001 or ASR 1002)
- Cisco 4000 Series Integrated Services Routers (ISR)
- Cisco Cloud Services Router 1000V Series (CSR)

Note Cisco IoT FND monitors HER status and configuration, and provisions or views FAR-to-HER tunnels.

Manage Head-End routers

Head-End Routers (HERs) are network devices managed through the Cisco IoT FND interface, providing visibility into tunnel status and device properties via customizable list views. When you open the Head-End Routers page in List view, the basic HER device properties appear. Unless Enable Map is selected in user preferences, by default, the page displays the HERs in List view.

- Tunnel 1
- Tunnel 2

Procedure

Step 1 From the main menu, choose **Devices** > **Head-End Routers**.
By default, the page displays the HERs in List view.

Step 2 To view any additional HER properties, click any of the following tabs:

- Tunnel 1
- Tunnel 2

Each one of these views displays different sets of device properties. These views display information about the HER tunnels.

What to do next

For information on how to customize HER views, see Customize device views, on page 266 .

For information about the device properties displayed in each view, see Device Properties, on page 334 .

For information about the common actions in these views (for example, adding labels and changing device properties) that also apply to other devices, see Common device operations, on page 261 .

Add HERs to Cisco IoT FND

Before you begin

Before adding an HER to Cisco IoT FND, configure the HER to allow management by Cisco IoT FND using Netconf over SSH:

```
hostname
 <her_hostname>ip domain-name
 <domain.com>aaa new-model
no ip domain-lookup
ip ssh time-out 120
ip ssh version 2
crypto key gen rsa
netconf ssh
netconf max-sessions 16
```

Where <*her_hostname*> is the hostname or IP address of the Cisco IoT FND server, and <*domain.com*> is the name of the domain name where the HER and Cisco IoT FND reside. The time-out value of 120 is required for large networks.

Ensure that you can ping the management interface of the HER and access the management interface of the HER over SSH and vice versa.

Procedure

Step 1 Create a CSV file that consists of a header line followed by one or more lines, each representing an HER.

Note
For device configuration field descriptions, see Device Properties, on page 334 .

Table 40: HER Import Fields

Field	Description
eid	The element identifier (EID) of the device, which consists of the product ID (PID), a plus sign, and the serial number (SN) of the HER (for example, *HER_PID* + *HER_SN*).
deviceType	The device type must be asr1000 or isr3900.
ip	The IP address of the HER. The address must be reachable from the Cisco IoT FND server.
netconfAddress	
netconfUsername	The SSH username and password that Cisco IoT FNDuses to connect to the HER.
netconfPassword	

Step 2 From the Cisco IoT FND main menu, choose **Devices** > **Head-End Routers**

Step 3 Click **Add Devices**.

Step 4 Upload the CSV file you created.

After upload, the status will show as Completed, with counts of successful and failed uploads.

When a Head-End Router (HER) is added, Cisco IoT FND initially reports its status as Unheard. This status transitions to Up automatically once the system completes its first successful poll. By default, Cisco IoT FND performs background polling every 15 minutes to retrieve device metrics. You may also manually initiate this polling sequence by clicking Refresh Metrics

Map routers to HERs

After you determine the Router-to-HER mapping, which is essential for tunnel provisioning, you can configure the mapping in Cisco IoT FND in one of two ways:

- Adding the mapping information to every router record in the Notice-of-Shipment XML file.
- Creating a CSV file specifying the mapping of routers to HERs.

Procedure

Step 1 For Router-to-HER Mappings to the Notice-of-Shipment XML file, add the **tunnelHerEid** and **ipsecTunnelDestAddr1** HER properties to the router record in the Notice-of-Shipment XML file.

- The **tunnelHerEid** property specifies the EID of the HER.
- The **ipsecTunnelDestAddr1** property specifies the tunnel IP address of the HER.

Example:

```
...
  <tunnelHerEid>ASR1001+JAE15460070</tunnelHerEid>
  <ipsecTunnelDestAddr1>172.27.166.187</ipsecTunnelDestAddr1>
 </R>
</DCG>
```

Step 2 For Router-to-HER Mappings to a CSV file, create a CSV file specifying the mapping of routers to HERs by adding a line for every router-to-HER mapping.

The line must specify the EID of the router, the EID of the corresponding HER, and the tunnel IP address of the HER.

Example:

```
eid,tunnelHerEid,ipsecTunnelDestAddr1
CGR1240/K9+FIXT:SG-SALTA-10,ASR1001+JAE15460070,172.27.166.187
```

Gateways and expansion modules

A gateway connects field devices or local applications to the wider network. In Cisco IoT FND, the device category depends on the gateway type: a gateway can appear under GATEWAY, ENDPOINT, or its hosting ROUTER. Use the category shown in this table to find the correct configuration and monitoring path.

Supported devices and where to manage them

Table 41: Gateway and expansion-module management paths

Supported device	Device category	Onboard and configure	Monitor and maintain
Cisco Industrial Compute Gateway IC3000	GATEWAY	Review the prerequisites, add the gateway by CSV, and use a gateway configuration template to push settings such as NTP.	In **DEVICES** > **Field Devices**, select the IC3000 under GATEWAY. The Device Info page provides current metrics and the supported on-demand actions, including **Refresh Metrics** and **Reboot**.
Cisco IR510 WPAN gateway	ENDPOINT > Gateway	Use endpoint configuration profile instances. Cisco IoT FND can update IR510 and IR530 software by sending differential patch files instead of a complete image.	Find the device under **DEVICES** > **Field Devices** > **ENDPOINT** > **Gateway**.
Cisco Wireless Gateway for LoRaWAN: IXM-LPWA-800-16-K9 and IXM-LPWA-900-16-K9	GATEWAY; the IXM-LPWA-800 is also visible from its IR800 hosting router	The IXM-LPWA-800 operates as an IOS interface hosted by an IR809 or IR829. The IXM-LPWA-900 operates as a standalone gateway. Use the LoRaWAN tasks to create a tunnel and manage the module.	Select the device under **GATEWAY** > **default-lorawan** or Cisco LoRa to view device information, events, configuration properties, running configuration, and assets. You can also reboot or remove the module.
Cisco IR1100 expansion module and Cisco IRM-1100-4S8I expansion module	Hardware attached to a Cisco Catalyst IR1100 or IR1101 router	Install and configure the expansion module, restart the router, and ensure that the router is registered with Cisco IoT FND. The IRM-1100-4S8I requires Cisco IOS XE Release 17.18.01a or later.	Module information is updated during periodic metrics collection. On the IR1100 Device Info page, verify the module name, description, product ID, and serial number under Expansion Module Info.

Important Do not assume that every gateway is listed under GATEWAY. Cisco IR510 is managed as an endpoint, and an IXM-LPWA-800 can be viewed from both its gateway entry and its IR800 hosting router.

Recommended management flow

1. Meet the device-specific software, application, and registration prerequisites.
2. Onboard the device and confirm that it appears in the expected device category.
3. Edit the applicable configuration template or profile, push the configuration, and verify the push result.

4. Use Device Info, metrics, events, running configuration, and asset information to monitor the device. Use the available reboot, software-update, tunnel, or removal actions for maintenance.

Managing IC3000 gateway communications

The IC3000 supports edge computing and communicates with Cisco IoT FND through the IOx application, Cisco Fog Director which is accessible via IOT FND .

Summary

The following components and actions facilitate device communication:

- IC3000: Registers with Cisco IoT FND upon startup and maintains a persistent WebSocket connection for configuration and management.
- Cisco IoT FND: Pushes configuration settings, including metric periodic profiles, user management, and heartbeat intervals to the device.

Workflow

These stages describe the communication lifecycle and management of the IC3000 gateway.

1. Initial communication involves establishing a secure HTTPS session, which is subsequently upgraded to a WebSocket connection.
   - Once established, the client and server communicate over the same TCP connection for the lifecycle of the WebSocket connection.
   - The WebSocket protocol allows the client and server to operate independently without requiring constant connection requests.
2. Users can perform on-demand management actions for the IC3000 device.
   - Navigate to **DEVICES** > **Field Devices** .
   - Select the IC3000 device under GATEWAY in the left-pane to access the Device Info page.

   Available on-demand actions include:
   - Refresh Metrics
   - Reboot

What's next

For additional details on IC3000 devices, refer to the Cisco IC3000 Industrial Compute Gateway Deployment Guide .

Prerequisites for managing the Cisco Industrial Compute IC3000 gateway

This reference provides the necessary steps and documentation links to manage the IC3000 gateway, including pre-built IOx application deployment and local management installation.

Before you can manage the IC3000 with the Cisco IoT FND, you must review the details in Unboxing, Installing and Connecting to the IC3000 topic of the Cisco IC3000 Industrial Compute Gateway Deployment Guide.

Important Before you can manage the IC3000 Gateway using Cisco IoT FND 4.3 and greater, you must first Deploy Pre-built IOx Applications via the App tab within Cisco IoT FND.

For more information, refer to the Use Case Example within the Cisco IC3000 Industrial Compute Gateway Deployment Guide .

This section within the Cisco IC3000 Industrial Compute Gateway Deployment Guide addresses the following actions, specific to IC3000:

- Installing a Prebuilt Applications via Local Manager

Add an IC3000 gateway

To add a gateway to IoT FND, create a CSV file that consists of a header line followed by one or more lines, each representing a separate gateway.

Procedure

Create a CSV file with the following format:

Example:

```
eid,deviceType,lat,lng,IOxUserName,IOxUserPassword
IC3000+FOC2219Y47Z,ic3000,10,10,system,
r6Bx/jSWuFi2vs9U1Zh21NSILakPJNwS1CY/jQBYYRcxSH8qLpgUtOn7nqywr/
vOkVPYbNPAFXj4Pbag6m1spjZLR6oc1PkT9eF6108frFXy+
eI2FFaUZlSCKTdjSqfur5EwEu1E5u54ckMi1e07X8INZuNdFNFU7ZgElt3es8yrpR3i/
EgDOdSb5dqw0u3lOeVrEtPY0xBHraYgPv+dBh3XtW4i2Kv/sveiTBPx2FiNRvuLWil7Qm+
D7bl1Fh4ZJCivapy7EYZirwHHAVJlQh6bWYrGAccNPkY+KqIZDCyX/
Ck5psmgzyAHKmj8Dq7K0nBsnq2+b2VKReEhsj9+Fw==
```

Edit the IC3000 gateway configuration template

Update the IC3000 gateway device configuration by modifying the relevant template and ensuring changes take effect on registered devices.

Use this task when you need to change device settings managed by a configuration template for an active or registered IC3000 gateway.

Follow these steps to edit the IC3000 gateway configuration template.

Procedure

Step 1 Choose **Config** > **Device Configuration** .

Step 2 From the left pane, select the **Gateway** group that contains the template you want to edit.

Step 3 Click **Edit Configuration Template**.

Step 4 Edit the configuration and use the **Push Configuration** tab to push the new configuration to the active or registered device.

Step 5 Click **Save Changes**.

Configure NTP

Use this task to push NTP configuration through Cisco IoT FND.

NTP configuration is pushed by editing the GATEWAY group configuration template and selecting the NTP configuration options.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**

Step 2 Under CONFIGURATION GROUPS (left pane), select the **GATEWAY group** with the template to edit.

Step 3 Click **Edit Configuration Template**.

Step 4 Select both **NTP Configuration** and **NTP Server Configuration** checkboxes. If NTP server is configured with authentication, select **NTP Auth Configuration** checkbox.

Note
The Auto Get checkbox under **NTP Configuration** deletes the NTP configuration that is manually pushed to the device from IoT FND. Hence, **NTP Configuration** should be configured along with **NTP Server Configuration** and **NTP Auth Configuration**.

Step 5 Enter values for all the fields under **NTP Server Configuration** and **NTP Auth Configuration** with the appropriate parameters.

Step 6 Click **Save Changes**.

Cisco IR510 WPAN gateways

The Cisco IR510 industrial router provides unlicensed 902-928MHz, ISM-band IEEE 802.15.4g/e/v WPAN communications to diverse Cisco IoT applications such as smart grid, Distribution Automation, and SCADA.

- Provides higher throughput and distributed intelligence.
- Includes GPS and enhanced security features.
- Supports unlicensed 915-MHz industrial, scientific, and medical band WPAN communications.

Manage Cisco IR510 WPAN gateways

Cisco IR510 industrial router is identified and managed as an ENDPOINT in Cisco IoT FND.

As the next generation of the DA gateway, IR510 provides higher throughput, distributed intelligence, GPS, and enhanced security.

Procedure

Step 1 Navigate to **Devices** > **Field Devices** > **ENDPOINT** > **Gateway** to identify the Cisco IR510 industrial router as an endpoint.

Step 2 Update the existing installed software base for Cisco IR510 and IR530 industrial routers.

Note
- Cisco IoT FND uploads only the new software updates, rather than the full image, by using `bsdiff` and `bspatch` files.

Profile instances

Cisco IoT FND implements profile-based configuration for Cisco IR510 routers.

Cisco IoT FND profile based configuration allows you to define a specific profile instance as part of configuration, that you can assign to multiple Cisco IR500 routers configuration groups. See Table 6. Pre-defined Profiles for IR510, for the list of supported profile types.

Note
- Each profile type has a default profile instance. The default profile instance cannot be deleted.
- You can create a profile instance and associate that profile with multiple configuration groups on Cisco IR510 router.
- A **None** option is available for all the profile types which indicates that the configuration does not have any settings for that profile type.
- When a configuration push is in progress for a configuration group, all the associated profiles are locked (a lock icon is displayed) and profiles cannot be updated or deleted during this time.
- A lock icon is displayed for a locked profile.

Table 42: Pre-defined profiles for IR510

Profile Name	Description	Properties Configurable in CSV File
Forward Mapping Rule (FMR) Profile **Config** > **Device configuration** > **Config Profiles tab** > **FMR PROFILE** Interface configuration **Config** > **Device configuration** > **GROUPS tab** > **Default-ir500** > **Edit Configuration Template** Select the FMR profile from the drop-down menu	Processes IPv4 traffic between MAP nodes that are in two different MAP domains. Each FMR rule has IPv4 Prefix, IPv4 Prefix Length and EA Bits Length. You can define up to 10 FMR Profiles. FMR settings are pushed to the device as a part of MAP-T Settings during configuration push.	Forward Mapping Rule IPv6 Prefix: fmrIPv6Prefix0 to fmrIPv6Prefix9 Forward Mapping Rule IPv6 Prefix Length: fmrIPv6PrefixLen0 to fmrIPv6PrefixLen9
DSCP profile **Config** > **Device configuration** > **Config Profiles tab** > **DSCP PROFILE** Interface configuration **Config** > **Device configuration** > **GROUPS tab** > **Default-ir500** > **Edit Configuration Template** Select the DSCP profile from the drop-down menu	Sets the DSCP marking for the Ethernet QoS configuration. DSCP marking has eight (8) marking options to choose. - User Controlled - Default Queue (Best Effort) - Normal Queue: Low drop probability (AF11) - Normal Queue: Medium drop probability (AF12) - Normal Queue: High drop probability (AF13) - Medium Queue: Low drop probability (AF21) - Medium Queue: Medium drop probability (AF22) - Medium Queue: High drop probability (AF23) You can specify a maximum of 10 IPv4 addresses and associated DSCP markings.	NA

Profile Name	Description	Properties Configurable in CSV File
MAP-T Profile **Config** > **Device configuration** > **Config Profiles tab** > **MAP-T PROFILE** Interface configuration **Config** > **Device configuration** > **GROUPS tab** > **Default-ir500** > **Edit Configuration Template** Configures Basic Mapping Rule (BMR) and Default Mapping Rule (DMR) settings for IR509/IR510	Configures endUser properties.	endUserIPv6PrefixbmrIPv6PrefixLen
Serial Port Profile (DCE and DTE) **Config** > **Device configuration** > **Config Profiles tab** > **SERIAL PROFILE** Interface configuration **Config** > **Device configuration** > **GROUPS tab** > **Default-ir500** > **Edit Configuration Template** Select the Serial Port profile (DTE) and/or Serial Port profile (DCE) from the drop-down menu	You can use different serial port profiles for DCE and DTE serial port settings). You can configure the following settings on the serial interface: • Port affinity • Media Type • Data Bits • Parity • Flow Control • DSCP Marking • Baud rate • Stop Bit **Note** You can also configure Raw Socket Sessions settings at the this page.	NA

Profile Name	Description	Properties Configurable in CSV File
DHCP Client Profile **Config** > **Device configuration** > **Config Profiles tab** > **DHCP CLIENT PROFILE** Interface configuration **Config** > **Device configuration** > **GROUPS tab** > **Default-ir500** > **Edit Configuration Template** Select the DSCP Client profile from the drop-down menu	The DHCPv4 server allocates an address to each client according to a static binding between a client-id and an IPv4 address. FND configures this static binding supports up to 10 client mappings. The DHCP Client ID binding profile configuration associates a client ID to an IPv4 Host address. The Client-id of each Client is expected to be unique within a single IR510. Any string can be used as client-id (for example, client-id=”iox”) can be mapped to a binding address in the pool.	NA
DHCP Server Profile **Config** > **Device configuration** > **Config Profiles tab** > **DHCP SERVER PROFILE** Interface configuration **Config** > **Device configuration** > **GROUPS tab** > **Default-ir500** > **Edit Configuration Template** Select the DSCP Server profile from the drop-down menu	Information that the DHCPV4 Server returns as part of DHCP Options in the response, can be configured in the DHCP server profile configuration includes: **1.** Lease Time **2.** DNS server list	NA

Profile Name	Description	Properties Configurable in CSV File
NAT44 Profile **Config** > **Device configuration** > **Config Profiles tab** > **NAT 44 PROFILE** Interface configuration **Config** > **Device configuration** > **GROUPS tab** > **Default-ir500** > **Edit Configuration Template** Select the NAT44 profile from the drop-down menu	You can use one of the following methods to configure the NAT44 properties for the IR500 device: - CSV import method - NAT44 profile instance within FND user interface You configure three fields for NAT44: Internal Address, Internal Port and External Port You can configure up to fifteen NAT 44 Static Map entries **Note** Before you push the configuration, be sure to: 1. Enable Ethernet on the configuration group to which the device belongs (select check box) 2. Save Configuration Group	NA
Access Control List (ACL) Profile **Config** > **Device configuration** > **Config Profiles tab** > **ACL PROFILE** Interface configuration **Config** > **Device configuration** > **GROUPS tab** > **Default-ir500** > **Edit Configuration Template** Select the ACL Profile from the drop-down menu.	Perform packet filtering to control which packets move through the network for increased security. You can define up to 20 ACL Profiles. Each defined ACL has one associated Access Control Entry (ACE) for a maximum of 20 ACEs. The check process goes through ACL from 1 to 20. There is an implicit deny for all ACL at the end of 20 ACL unless configured differently. To configure the interface for the Default-IR500, with Groups tab selected: In the right-pane, choose Edit Configuration Template tab and select the Enable Interface ACL check box.	NA

Create profile

Follow these steps to add a new config profile.

Procedure

Step 1 From Cisco IoT FND menubar, choose **Config** > **Device Configuration** > **Config Profiles** tab.

Step 2 Click the **+** (plus icon) at the top of the configuration panel to open the **Add Profile** entry panel.

Step 3 Enter **Name** for the new profile and select the **Profile Type** from the drop-down list.

Step 4 Click **Add** .

A new **Profile** entry appears in the left pane under the **Profile Type** sub-heading.

The new profile is created.

Delete a profile

Use this task when you need to delete a configuration profile that is no longer required.

Follow these steps to delete a configuration profile:

Procedure

Step 1 In Cisco IoT FND, choose **Config** > **Device Configuration** > **Config Profiles** tab.

Step 2 Select the profile you want to delete from the list.

Note
The **Default-Profile** cannot be deleted.

Step 3 Click the available delete option to remove the profile.

A confirmation message appears.

Step 4 Click **Yes** to confirm the deletion.

The selected configuration profile is removed from the Cisco IoT FND system.

Rename a profile

Use this task to rename a config profile.

Config profiles are renamed from the Config Profiles tab in the Device Configuration area.

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG DEVICE CONFIGURATION Config Profiles** tab.

Step 2 Select the **Profile Name** that you want to rename.

Note
You cannot select **Default-Profile** for renaming.

Step 3 Click on the pencil icon to open the **Rename Profile** pop-up window.

Step 4 Make your edit and click **OK**.

The new name appears in the list of profiles.

Clone a profile

Create a new configuration profile based on an existing profile for rapid deployment of similar configurations.

Use this task when you need to deploy similar device configurations and wish to avoid creating a new profile from scratch.

Follow these steps to clone a configuration profile.

Procedure

Step 1 From the Cisco IoT FND menubar, choose **Config** > **Device Configuration** > **Config Profiles** tab.

Step 2 Select the **Profile Name** that you want to clone.

Step 3 Click **Clone Profile** to open the **Clone Profile** pop-up window.

Step 4 In **Profile Name**, enter a unique name for the new profile. .

Note
The profile name must be different from existing profile names.

Step 5 Click **OK** .

A new profile appears under the same Profile Type, ready for deployment or further customization.

Cisco Catalyst IR1100 expansion modules in Cisco IoT FND

An expansion module is a hardware component that adds functionality by providing new interfaces or features when inserted into supported routers or gateways.

- Provides additional connectivity options such as Small Form-Factor Pluggable (SFP) or General Purpose Input/Output (GPIO) ports.
- Enables centralized management and monitoring through Cisco IoT FND.
- Supports network infrastructure adaptation to changing industrial requirements.

Expansion Module Feature History

Table 43: Feature history

Feature name	Release information	Description
Cisco IRM-1100-4S8I expansion module	Cisco IoT FND Release 5.1	You can boost your network flexibility and industrial integration using Cisco IRM-1100-4S8I expansion module featuring 4x SFP L2/L3 ports and 8x GPIO ports.
Cisco IR1100 expansion module	Cisco IoT FND Release 4.7	Adds support for Cisco IR1100 Expansion Module, allowing you to manage and configure the module using Cisco IoT FND on Cisco Catalyst IR1100.

Install Cisco IRM-1100-4S8I expansion module

This task describes how to install the Cisco IRM-1100. The Expansion Module attaches to the Cisco Catalyst IR1101 Base using 4 mating screws, and is connected through a mating connector. The Expansion Module is grounded and powered through the connection to the IR1101.

Before you begin

- Unpack the box and verify that all items listed on the invoice were shipped with the Cisco IRM-1100-4S8I expansion module.

  The following items are shipped with your Expansion Module:

  - 4 mating screws to connect the IRM-1100 to the IR1101

- Cisco IR1100 must run Cisco IOS XE Release 17.18.01a and later releases.
- Hard swap is not supported for the Cisco IRM-1100-4S8I expansion module on Cisco IoT FND. You need to restart your Cisco IR1100 device and register the device once again with Cisco IoT FND. For more information see, Register IR1100 with Cisco IoT FND .
- You don't need to re-register your device if it was already registered before the reboot.
- The expansion module info is automatically displayed in Cisco IoT FND during periodic metrics updates.
- You can configure the expansion module using Cisco IoT FND including the interfaces ports and SFPs.
- The IRM-1100-4S8I works only only on the top side of Cisco IR1101.

Procedure

Follow the instructions in the Cisco Catalyst IR1101 Rugged Series Router Software Configuration Guide to configure the expansion module.

View expansion module info

This task guides you to view the expansion module info on Cisco IoT FND.

Before you begin

- Ensure that you have attached the expansion module to the Cisco IR1100 device.
- Ensure that you've restarted Cisco IR1100 and registered it once again with Cisco IoT FND. For more information see, Register IR1100 with Cisco IoT FND .

Procedure

Step 1 From the main menu, choose **Devices** > **Field Devices** .

Step 2 From the **Router** list, select an IR1100 device from the left tree.

Step 3 Click the device **Name** and view the **Expansion Module Info** section.

Field	Description
PID1	Displays the exapansion module attached to the device.
Name	Displays the expansion module's name.
Description	Describes the expansion module's SFP and digital I/Os.
PID	Displays the PID of the expansion module.
SN	Displays the serial number of the expansion module found in the device.

You can see the PID and SN details.

You've viewed the expansion module info.

Manage the Cisco Wireless Gateway for LoRaWAN

The two Cisco Wireless Gateway for LoRaWAN products are:

- A virtual interface (IXM-LPWA-800-16-K9) of the Cisco 809 and 829 Industrial Integrated Service Routers (IR809, IR829) to provide LoRa radio access with the IR809 and IR829 providing an IP backhaul (Gigabit Ethernet, Fiber, 4G/LTE, and Wi-Fi). In this case, LoRaWAN has an Operating Mode of IOS Interface and displays the Hosting Device ID for the IR800 system to which it connects (See Cisco Catalyst IR1100 expansion modules in Cisco IoT FND, on page 228).
- A standalone unit (IXM-LPWA-900-16-K9) using its own built-in Fast Ethernet backhaul to access LAN switches, routers, Wi-Fi AP or other IP interfaces. When functioning as a standalone gateway, LoRaWAN has an Operating Mode of Standalone.

To view the LoRaWAN Gateway:

Procedure

Step 1 Navigate to **DEVICES** > **Field Devices** .

Step 2 Select a device under **GATEWAY** > **default-lorawan** or Cisco LoRa in the left-pane.

Step 3 Click the desired IXM-LPWA-900 or IXM-LPWA-800 system in the Name column to display Device Info, Events, Config Properties, Running Config, and Assets.

Note
You can view Device details for the IXM-LPWA-800 system at both the **ROUTER** > **IR800** page and the GATEWAY page.

Step 4 Perform supported actions for the GATEWAY at the Device Info page using the Map, Default, or Plus icon buttons.

LoRaWAN gateway module

The LoRaWAN (IXM-LPWA-800) interface connects to an IR800 router.

There are two ways to upload the LRR image for a LoRaWAN module to the IR800 router: during Zero Touch Deployment (ZTD) and by on-demand configuration push.

Note IoT FND does not support discovery for the LoRaWAN module. Rather, IoT FND recognizes it as an IR800 module and will communicate with it via Cisco IOS.

Create a LoRaWAN IXM tunnel

Procedure

Step 1 To create a user-defined LoRaWAN (IXM) Tunnel, choose CONFIG Tunnel Provisioning .

Step 2 In the left-pane, under GATEWAY, select the LoRaWAN system for which you want to configure a tunnel.

Step 3 Select the **Gateway Tunnel Addition** tab.

Step 4 In the **Add Group** window that appears, enter a Name for the LoRaWAN (IXM) Tunnel and select Gateway as the Device Category.

Step 5 Click **Add**.

The new tunnel appears under the GATEWAY heading in the left-pane.

Reboot the LoRaWAN modem

Use this task to reboot the modem on the LoRaWAN module.

The LoRaWAN tab shows the module information and the Device Info pane displays the Last Reboot Time field after a modem reboot completes.

Procedure

Step 1 Click the relevant IXM-LORA link under the Name column to display the information seen below:

Step 2 Click **Reboot Modem**. When the reboot completes, the date and time display in the Last Reboot Time field in the Device Info pane for the LoRaWAN module. You can only process one modem reboot at a time.

The Reboot Modem action generates two events: LoRa Modem Reboot Initiated and LoRa Modem Reboot Success.

View LoRaWAN modules

Procedure

Step 1 From the Cisco IoT FND menu, choose **DEVICES** > **Field Devices**.

Step 2 In the Browse Devices list, select an IR800 router and then select the LoRaWAN tab.

Remove a LoRaWAN module

Use this task to remove a LoRaWAN module from the IR800 router inventory.

The LoRaWAN tab for the selected IR800 router lists the LoRaWAN module that can be disabled and removed from inventory.

Procedure

Step 1 In the **Browse Devices** pane, select the IR800, which has the LoRAWAN module that needs to be disabled and removed from inventory.

Step 2 Select the **LoRaWAN** tab and check the box next to the LoRaWAN module to be removed.

Step 3 Click **Remove Devices** from the **More Actions** drop-down list.

Mesh endpoints and meters

An endpoint is a field device that Cisco IoT FND manages under the ENDPOINT category. Depending on its function, an endpoint can be a meter, range extender, gateway, or another network node. A mesh endpoint communicates through a resilient mesh network instead of requiring a direct connection to the management system.

Identify the endpoint or meter family first, then use the common endpoint flow for group configuration, configuration push, inventory monitoring, troubleshooting, firmware, and certificate maintenance.

Supported endpoint and meter coverage

Table 44: Endpoint and meter families documented in this section

Device family	FND classification or examples	Available management
Resilient-mesh endpoints	ENDPOINT; examples include GATEWAY-IR500, EXTENDER-IR500, METER-CGMESH, and supported third-party meters	Create endpoint groups, edit templates, push and verify configurations, synchronize group membership, view inventory or map location, block unauthorized devices, and generate on-demand troubleshooting reports.
MMB GEN 2 endpoints	CGMESH endpoints with PIDs CGEREF6 and CGEREF6_IE; supported with CGR1000 and IR8140	Install and register the devices, manage configuration and firmware groups, view dashboard and device details, and investigate events and issues. These devices use an endpoint license and endpoint RBAC.
Landis+Gyr endpoints and meters	M125 and M225 gas modules, and E360/E660 (Revelo) electric meters	Configure and verify supported devices, then monitor device inventory and Mesh Link Metrics. For L+G endpoints, Cisco IoT FND reports the mesh parent value as 1 because it does not receive the mesh-parent count from the N2450 router.
Itron Bridge Meters	ITRON30 operating as METER-CGMESH after conversion from RFLAN	Upgrade cg-mesh firmware to 5.6.x, push channel-notch settings, schedule activation, and use on-demand or automatic certificate re-enrollment when required. Channel-notch operations require Root or Endpoint Operator permissions.
Wi-SUN 1.0 mesh endpoints	Cisco IR509, IR510, IR529, and IR530 platforms, subject to the documented mesh-software and router-software requirements	Review registration and configuration-push validation, verify the Mesh Protocol value in endpoint inventory, and apply the release-specific bootstrap and event behavior described in the Wi-SUN topics.

Note Out-of-service (OOS) is an operational state, not a separate hardware family. Use the OOS topics to add, update, license, filter, audit, or remove devices that must remain represented in Cisco IoT FND while they are out of service.

Manage the endpoint lifecycle

1. Find the endpoint in Field Devices and confirm its registration, status, device type, firmware, and configuration-group membership.

2. Create an endpoint group for devices that share configuration or operational requirements.
3. Edit the group template, push the configuration, and verify the status for every device. Synchronize endpoint membership when the management-system group and device state differ.
4. Monitor endpoints in the default or map view. Use configuration and firmware group views, routing-path information, events, issues, and on-demand statistics to identify connectivity, registration, routing, or firmware problems.
5. Maintain the fleet by updating firmware, blocking unauthorized devices, managing OOS status and licenses, and renewing certificates before or after expiration as supported by the device family.

Before you configure a device

- Confirm that the device family, Cisco IoT FND release, mesh software, and device firmware combination is supported.
- Use an account with the required endpoint permissions. Some meter operations are restricted to Root or Endpoint Operator roles.
- Apply device-family prerequisites before using the common endpoint flow. For example, Itron Bridge Meters require device-type conversion and a firmware upgrade before channel-notch configuration.

Manage endpoints

In Cisco IoT FND interface, the Field Devices page enables you to view the enpoint device status and details for monitoring the connected devices.

Procedure

Step 1 Navigate to **DEVICES** > **Field Devices** .

Step 2 View the default List view to see all managed endpoints.

Create endpoint groups

Follow these steps to create an endpoint configuration group.

Procedure

Step 1 Choose **Config** > **Device Configuration** .

Step 2 Select the default group (Default-act, Default-bact, Default-cam, Default-cgmesh, Default-ir500, Default-lglfn, Default-lgelectric, Default-lgnn).

Step 3 Select the **Groups** tab in the top left panel, and then click the + icon under the heading to open the Add Group entry panel.

Note

The device category (such as endpoint or router) auto-populates.

Step 4 Enter a name for the group. The device category such as endpoint, gateway, or router, auto-populates.

Step 5 Click **Add** .

The new group entry appears in the appropriate device category list (left pane).

What to do next

- To change the name of a group, see Rename a device configuration group, on page 291
- To remove a group, see Delete device groups, on page 292

Edit an endpoint configuration template

Update the configuration parameters for an endpoint template to reflect required device settings.

Edit an endpoint configuration template when you need to modify settings for endpoints managed through the device configuration interface. Updated templates ensure that all endpoints use the most recent settings.

Follow these steps to edit an endpoint configuration template.

Procedure

Step 1 Choose **Config** > **Device Configuration** .

Step 2 From the left pane. select the **Endpoint** group containing the template to edit.

Step 3 Click **Edit Configuration Template** .

Step 4 Edit the template.

For example, in the **Report Interval** field, enter the number of seconds between data updates. Mesh endpoints send metrics every 28,800 seconds (8 hours) by default.

You can change these values on the **Edit Configuration Template** tab:

• **Report Interval** : The number of seconds between data updates.
• **BBU Settings** : Enable this option to configure BBU Settings for range extenders with a battery backup unit.
• **Enable Ethernet** : Check this check box to enable Ethernet for selected devices or configure NAT 44 settings on selected DA Gateway devices. **Note** For NAT 44 configuration, you must specify values for all three fields in a CSV file. The default values are 127.0.0.1, 0, 0, respectively. You do not need to configure any other settings for a particular map index. If these settings are invalid for that map index, they are ignored during a configuration push.

- **MAP-T Settings** : The IPv6 and IPv4 settings for the device.

Note
For Cisco IOS CGRs, MAP-T rules are set by indicating the MAP-T IPv6 basic mapping rule (BMR), IPv4 BMR, and IPv6 default mapping rule (DMR). On Cisco IR509 devices, the MAP-T IPv6 is an IPv6 prefix that integrates the MAP-T BMR IPv6 rules, IPv4 suffix value, and length being based on the BMR EA length value.

- **Serial Interface 0 (DCE)Settings** : The data communications equipment (DCE) communication settings for the selected device.

Note
There can be only one session per serial interface. You must configure the following parameters for all TCP Raw Socket sessions (for each virtual line and serial port) for the selected DA Gateway device(s):

- Initiator – Designates the device as the client/server
- TCP idle timeout (min) – Sets the time to maintain an idle connection.
- Local port – Sets the port number of the device
- Peer port – Sets the port number of the client/server connected to the device.
- Peer IP address – Sets the IP address of the host connected to the device.
- Connect timeout – Sets the TCP client connect timeout for Initiator DA Gateway devices.
- Packet length – Sets the maximum length of serial data to convert into the TCP packet.
- Packet timer (ms) – Sets the time interval between each TCP packet creation.
- – Special Character – Sets the delimiter for TCP packet creation.

- **Serial Interface 1 (DTE) Settings** : The data terminal equipment (DTE) communication settings for the selected device.

Note
The IPv6 prefix must valid. Maximum prefix lengths are:

- IPv6: 0–128
- IPv4: 0–32

Step 5 Click **Save Changes** .

Cisco IoT FND commits the changes to the database and increases the version number.

Push configurations to endpoints

Use this task to push configuration to mesh endpoints.

Endpoint configuration pushes are performed from the Push Configuration tab for an ENDPOINT group or subset.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**.

Step 2 Select the group or subset of a group to push the configuration to the ENDPOINT list.

Step 3 Click the **Push Configuration** tab.

Note
The **Push Configuration** tab supports a subnet view for crmesh endpoints that summarizes:

Pan ID	Identifies the Personal Area Network Identifier for a group of endpoints (nodes).
Subnet Prefix	Identifies the IPv6 subnet prefix for the endpoint.
Nodes in Group (Total in Subnet)	Number of nodes within the group and the number of nodes in the subset.
Config Synced	Shows how many nodes within a Pan ID are in the process of or have finished a configuration push out of the total nodes in that Pan.

Step 4 In the **Select Operation** drop-down list, choose **Push ENDPOINT Configuration**.

Step 5 Click **Start**. Confirm action by clicking the **Yes** button or stop the action by clicking the **No** button.

The Push Configuration page displays the status of the push operation for every device in the group. If an error occurs while pushing configuration to a device, the error and its details display in the relevant columns.

In the Status column, one of these values appears:

• NOT_STARTED — The configuration push has not started.
• RUNNING — The configuration push is in progress.
• PAUSED — The configuration push is paused. Active configuration operations complete, but those in the queue are not started.
• STOPPED — The configuration push was stopped. Active configuration operations complete, but those in the queue are not started.
• FINISHED—The configuration push to all devices is complete.
• STOPPING — The configuration push is in the process of being stopped. Active configuration operations complete, but those in the queue are not started.
• PAUSING — The configuration push is in the process of being paused. Active configuration operations complete, but those in the queue are not started.

What to do next

To refresh the status information, click the **Refresh** button.

Synchronize endpoint membership

Use this task to synchronize endpoint membership.

Endpoints maintain information about the Cisco IoT FND group to which they belong. If the group information changes, the endpoint becomes out of sync. For example, if you rename an endpoint group, the members of the group might not be modified immediately (for example, due to a packet loss). If a device is out of sync, any operation you perform on the group through Cisco IoT FND does not reach the device. To ensure that the endpoints remain in sync, use the Sync Membership button to push the group information to group members.

Note Devices sync for the first time after they register with Cisco IoT FND.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**

Step 2 Select an ENDPOINT group (left pane) such as Default-cgmesh.

Step 3 Select the Group Members tab (right pane), click on the name of an endpoint. (Note: The Group Members tab is a new addition to this page).

Step 4 Click **Sync Config Membership button on the page that appears**.

Step 5 When prompted, click Yes to confirm synchronization.

Step 6 Click **OK**.

View endpoints in default view

The Default view is a device management interface that lists FAN devices, including routers, endpoints, and gateways, along with their basic properties.

- Displays basic device properties for all FAN devices.
- Provides access to specialized property tabs upon device selection.
- Supports customization of views to display specific device data.

Procedure

Step 1 From the main menu, choose **DEVICES** > **Field Devices**.

Step 2 From the left pane, click All FAN Devices.

The default view of all FAN devices such as Routers, Endpoints (meters, gateways), and IoT Gateway and their basic device properties display.

Step 3 Under **Browse Devices**, an ENDPOINT device or group.
The tabs to display additional endpoint property view appear in the right pane. Each of these views displays a different set of device properties.

Note
Listed below are all the possible tabs (left to right as they appear on the screen).

What to do next

For information on how to customize endpoint views, see Customize device views, on page 266 .

For information about the device properties displayed in each view, see Device Properties, on page 334 .

For information about the common actions in these views (for example, adding labels and changing device properties) that also apply to other devices, see Common device operations, on page 261 .

View Mesh Endpoints in Map View

To view mesh endpoints in Map view:

Procedure

Step 1 Select Enable map in <*user*> > **Preferences** .

Step 2 Click the **Map** tab.

Block mesh devices to prevent unauthorized access

Prevent unauthorized mesh devices from connecting to Cisco IoT FND and joining your mesh network, reducing security risk.

If you detect or suspect unauthorized access attempts by a mesh endpoint or IR500 device in your network, you can block those devices from accessing Cisco IoT FND.

Caution If you block a mesh endpoint, you cannot unblock it using Cisco IoT FND. To re-register the mesh endpoints with Cisco IoT FND, you must contact your mesh endpoints administrator.

Follow these steps to block mesh devices from accessing Cisco IoT FND.

Procedure

Step 1 Choose **Devices** > **Field Devices** > **Endpoint**.

Step 2 Check the check boxes of the mesh devices to refresh.

Step 3 From the **More Actions** menu, choose **Block Mesh Device**.

Note
If your mesh endpoints are running Cisco Resilient Mesh Release 6.1 software or greater, FND will automatically invoke the Blacklist for endpoints (cg-mesh, IR509, IR510, IR529, IR530) that you suspect are not valid endpoints with the WPAN. You do not need to select **More Actions** > **Block Mesh Device** . Additionally, the mesh endpoint will show a 'blocked' status.

Step 4 Click **Yes** in the Confirm dialog box.

Step 5 Delete the mesh endpoint from the NPS server to prevent the device from rejoining the mesh network.

Display mesh endpoint configuration groups

A mesh endpoint configuration group is a logical collection of settings applied to mesh-enabled devices to ensure consistent network behavior.

Procedure

Navigate to the **CONFIG** > **Device Configuration** to view the available configuration groups.

Display mesh endpoint firmware groups

Mesh endpoint firmware groups are logical collections of devices categorized by their firmware version to simplify management and monitoring within the network.

You can use the Browse Devices pane to display the mesh endpoint devices that belong to one of the groups listed under ENDPOINTS.

Procedure

Step 1 Navigate to the **Browse Devices** pane.

Step 2 Locate the **ENDPOINTS** section.

Step 3 Select the desired firmware group to display the associated mesh endpoint devices.

Troubleshoot on-demand statistics for endpoints

Table 45: Feature History

Feature Name	Release Information	Description
Troubleshoot on-demand statistics for endpoints	Cisco IoT FND 4.8	You can generate predefined system reports within Cisco IoT FND to help troubleshoot issues with endpoints such as GATEWAY-IR500, EXTENDER-IR500, METER-CGMESH, or any third-party METERS. A Troubleshoot page is displayed for each supported endpoint.

You can generate predefined system reports in Cisco IoT FND to troubleshoot issues with endpoints such as GATEWAY-IR500, EXTENDER-IR500, METER-CGMESH, or third-party meters. For each supported endpoint, a **Troubleshoot** page is provided to assist with diagnostics.

Table 46: Predefined system reports

Report	Description
All TLVs	Generates a report from the list of available TLV identifiers in the device.
Connectivity	Generates a device connectivity report with the following parameters: • WPAN Status • PPP Link Stats • Neighbor 802.15.4g
General	Generates a report with the following general parameters associated to the device: • TLV Index • Device ID • Current Time • Uptime • IEEE 802.1x Status • IEEE 802.1x Settings • Firmware Image Information

Report	Description
Registration	Generates a report with the following registration parameters: • Network Management System Redirect Request • Report Subscribe • Connected Grid Management System Settings • Connected Grid Management System Status • Connected Grid Management System Notification • Connected Grid Management System Stats • Signature Certificate • Signature Settings
Routing	Generates a report with the following routing parameters: • IP Address • RPL Settings • IEEE 802.11i Status • DHCPv6 Client Status • IEEE 802.15.4 Beacon Stats • Stored Information • Fast Synchronization Status • RPL Stats

Procedure

Step 1 Choose **DEVICES** > **Field Devices** > **Browse Devices** > **ENDPOINT**.

Step 2 Click the device on the right pane to view the device information.

Step 3 On the Device Info page, click the **Troubleshoot** tab.

Step 4 Under the **Get Report** section of the **Troubleshoot** page, select the report type.

Note
Based on the report type selected, the check boxes are auto-selected on the Troubleshoot page; indicating that the report displayed is only for the selected parameters.

Step 5 Click **Get Report** .

A report appears on the **Report Output** page.

Step 6 Click the **Report** icon to export the report in CSV format.

MMB GEN 2 devices

Cisco IoT FND enables the installation, registration, configuration, and firmware management of MMB GEN 2 endpoint devices. You can push the configuration template to the default configuration group, and update the firmware image. Additionally, the IR8140 offers dual WPAN support. For more information, see MMB devices management, on page 243.

Table 47: MMB Device Information Mapping in Cisco IoT FND

Device Type	Device Category	Device Function	PID
CGMESH	Endpoints	CGE	CGEREF6
CGMESH	Endpoints	CGE	CGEREF6_IE

License

The MMB devices use the endpoint license for registering with Cisco IoT FND.

RBAC

The existing endpoint RBAC is applicable for the MMB devices as well. No new role or permission added to manage MMB devices in Cisco IoT FND.

Prerequisites

Ensure that the platforms and MMB devices have the supported firmware versions before you install and register the MMB devices in Cisco IoT FND.

Devices	Firmware Version
CGR1240	15.9(3)M7a
IR8140	17.11.1a
MMB	2.4.8 and later
WPAN	6.6.5

MMB devices management

This section explains how to manage the MMB devices in Cisco IoT FND.

Install and register MMB Devices

Before you begin

Cisco IoT FND manages only the MMB devices with firmware version 2.4.8 and later.

To install and register the MMB devices:

Procedure

Step 1 Choose **Devices** > **Field Devices** > **Browse Devices** > **Endpoint**.

Step 2 On the **Inventory** page, click **Add Devices**.

The **Add Devices** window allows you to add the MMB devices in FND through the CSV file.

Step 3 Browse and select the CSV file, then click **Add**. The CSV file should have the minimum required fields such as EID, device type, and device function.

Step 4 Use the CSMP mechanism to register the MMB devices with FND. On successful completion of registeration, the MMB devices are listed in either MESH-CGMesh or CGE-CGMESH device type.

For more information, see OpenCSMP .

Manage Configuration Groups

From the **Device Configuration** page, you can manage configuration groups. It is recommended to create a separate configuration group for MMB devices or move existing meters to a different group to avoid UI field display issues caused by unsupported features like EST certificate enrollment.

Procedure

Navigate to the **CONFIG** > **Device Configuration** page to access the following configuration options:

Tabs	Description
Group Members	Lists the MMB devices in the default configuration group.
Edit Configuration Template	Allows you to set the report interval in seconds and select the TLS version. **Note** **Certificate AutoRenew Settings** , **DTLS Settings** , and **Interface ACL Settings** fields are not available as EST certificate enrollment is not supported.
Push Configuration	Pushes the endpoint configuration to the default configuration group. **Note** **Push Endpoint Re-enrollment** option is not available as EST certificate enrollment is not supported.
Group Properties	Allows you to specify the markdown time for endpoints.

Tabs	Description
Transmission Settings	Allows you to set the following: • Transmission Speed: Allows you to customize the transmission speed (slow, medium, or fast). • Multicast Threshold (nodes): Enter the minimum number of nodes.

Firmware Group

A firmware group is a logical container used to manage firmware images and associated MMB devices.

- Supports the default Default-Cgmesh group.
- Allows for the creation of custom groups for better organization.
- Provides centralized control over firmware deployment and transmission settings.

Firmware Group Interface Components

The following table outlines the tabs available for managing firmware groups:

Table 48: Firmware Group Tabs

Tabs	Description
Firmware Management	Allows you to upload the firmware image for the selected firmware group. **Note** **Install Patch** option is disabled.
Devices	Lists the devices in the firmware group. You also have the option to filter the devices based on the device properties.
Logs	Provides the status of the firmware upload.
Transmission Settings	Allows you to specify the transmission speed.

MMB device data on Dashboard

Provides visibility into historical trends for MMB device data through specific endpoint dashlets.

The Cisco IoT FND Dashboard displays historical trends for the following charts:

- Endpoint states over time
- Endpoint config group template mismatch over time
- Endpoint firmware group template mismatch over time

- Endpoint inventory
- Hop count distribution
- Config group template mismatch
- Firmware group template mismatch
- RF and PLC Media utilization over time

View device details

To list and view the device details:

Procedure

Step 1 Choose **DEVICES** > **FIELD DEVICES** > **Browse Devices** > **ENDPOINTS** .

Step 2 Select the device type, MESH-CGMesh or CGE-CGMESH, to view the device list on the right pane.

Step 3 Click the device on the right side to view the device details.

Note
As the EST certificate enrollment is not supported for the MMB devices, the **Block Mesh Device** , **Re-enrollment** , and the **Erase Node Certificate** buttons are not shown in the Device Info page.

View MMB device events and issues

Use this procedure to access the event and issue logs for MMB devices.

Procedure

Step 1 From the Cisco IoT FND main menu, choose **OPERATIONS** > **Events** > **ENDPOINT**.
The events list appears in the right pane.

Step 2 Choose **OPERATIONS** > **Issues**.

Step 3 Under **ENDPOINT**, select the required issue.
The issues list appears in the right pane.

What to do next

For additional information on viewing and filtering events and issues, see View Events and View issues .

Limitations

This topic outlines the specific limitations regarding MMB device coexistence and registration within the Cisco IoT FND platform.

The following limitations apply to the deployment and management of MMB devices:

- **Cisco IoT FND Limitation** : ITRON meters and MMB devices cannot coexist in the Default-CGMesh group. We recommend you to have separate groups for ITRON meters and MMB devices for the configuration and firmware management.
- **Platform Limitation** : Registering the MMB devices with FND using LoWPAN interface is not supported. For more information, see CSCwh31845 .

Unsupported features for MMB devices

This section provides a summary of unsupported features for MMB devices within the Cisco IoT FND, Release 4.11.

Table 49: Unsupported Features for MMB Devices

User Interface Components	Unsupported Features
Configuration Management (**CONFIG** > **Device Configuration**)	• EST certificate enrollment • ACL
Firmware Management (**CONFIG** > **Firmware Update**)	• Install patch • Firmware downgrade • Firmware image backup (in the upload and running slots) • Wi-SUN stack switch

Landis+Gyr devices

Cisco IoT FND supports Landis+Gyr (L+G) routers and endpoints as managed field devices. L+G routers provide the routing and collection point for L+G RF mesh endpoints, while L+G endpoints represent the field devices that report meter, grid, or low-frequency network information through the L+G mesh.

In Cisco IoT FND, L+G routers appear in the `ROUTER` device category and are assigned to `Default-lgrouter` unless moved to a custom router group. L+G endpoints appear in the `ENDPOINT` device category and are assigned to endpoint groups such as `Default-lglfn`, `Default-lgelectric`, `Default-lgnn`, or `Default-lgradio`, depending on endpoint type.

For L+G border routers, the communication path depends on the deployment configuration. In secure mode, device communication uses HTTPS to the Cisco IoT FND device communication URL. In bandwidth optimization mode, only periodic metrics use HTTP while other router communication remains secure. IGMA profiles on devices that use IGMA must point to the Cisco IoT FND registration, metrics, and tunnel URLs configured for the deployment. The URL host name, port, and path must match the values configured in Cisco IoT FND provisioning settings and in the device profile.

Supported L+G devices

Cisco IoT FND supports two types of L+G devices:

- Routers

- Endpoints

CC UI Type	Device Type (Cisco)	Provisioned Type	Provisioned Subtype	Model / PID	Category	Function / Application
GAS	LGLFN	Endpoint	GASMeter	M125	ENDPOINT	METER
GAS	LGLFN	Endpoint	GASMeter	M225 GPR	ENDPOINT	METER
GAS	LGLFN	Endpoint	GASMeter	M255 GPR-PT	ENDPOINT	METER
Grid Management	LGNN	Endpoint	GSManagement	N550	ENDPOINT	NETWORK NODE
Grid Management	LGNN	Endpoint	GSManagement	OFDM N550	ENDPOINT	Not specified
Grid Management	LGNN	Endpoint	GSManagement	R650	ENDPOINT	EXTENDER
Grid Management	LGNN	Endpoint	GSManagement	R651	ENDPOINT	EXTENDER
Grid Management	LGNN	Endpoint	GSManagement	R661	ENDPOINT	EXTENDER
Electric	LGELECTRIC	Endpoint	METER-L+G-ElectricMeter	REVELO C&I	ENDPOINT	METER
Electric	LGELECTRIC	Endpoint	Not specified	REVELO	ENDPOINT	METER
Electric	LGELECTRIC	Endpoint	Not specified	OFDM S4x	ENDPOINT	Not specified
Electric	LGELECTRIC	Endpoint	Not specified	S4x-DNP	ENDPOINT	Not specified
Electric	LGELECTRIC	Endpoint	Not specified	S4x	ENDPOINT	Not specified
Electric	LGELECTRIC	Endpoint	Not specified	FOCUS-Axe	ENDPOINT	Not specified
Radio	LGRADIO	Endpoint	Not specified	N2250-R	ENDPOINT	Not specified
Radio	LGRADIO	Endpoint	Not specified	N2450-R	ENDPOINT	Not specified
Radio	LGRADIO	Endpoint	Not specified	OFDM N2450-R	ENDPOINT	Not specified
Router	LGROUTER	Router	Not specified	N2450	ROUTER	Not specified
Router	LGROUTER	Router	Not specified	OFDM N2450	ROUTER	Not specified
Router	LGROUTER	Router	Not specified	N2250	ROUTER	Not specified

Configure and verify L+G devices

Use this procedure after importing L+G routers or endpoints, after changing provisioning settings, or after moving L+G devices to a different configuration group.

Before you begin

- Confirm that the L+G device type is supported in the current Cisco IoT FND release.
- Prepare the CSV or XML import file using the supported import method for the deployment.
- Verify that Cisco IoT FND provisioning settings contain the correct Cisco IoT FND URL and periodic metrics URL.
- Verify that network security devices allow traffic from L+G routers to the configured Cisco IoT FND registration and metrics endpoints.
- For IGMA-based communication, confirm that the device IGMA profile URLs match the Cisco IoT FND provisioning settings and deployment mode.

Procedure

Step 1 Import the L+G router or endpoint into Cisco IoT FND by using the supported CSV or XML import workflow.

Step 2 From Cisco IoT FND menubar, choose **DEVICES** > **Field Devices** > **Browse Devices**.

Step 3 For L+G routers, select `ROUTER` in the left pane. For L+G endpoints, select `ENDPOINT`. Locate the L+G device by EID and open the device details page.

Step 4 Verify the device category and group membership: L+G routers should appear under `ROUTER` and use `Default-lgrouter` or the intended custom router group. L+G endpoints should appear under `ENDPOINT` and use the expected L+G endpoint group, such as `Default-lglfn`, `Default-lgelectric`, `Default-lgnn`, or `Default-lgradio`.

Step 5 Verify that the EID uses the same letter case in the import file, certificates, device profile, Cisco IoT FND UI, and logs.

Step 6 Verify that `Status`, `Last Heard`, and `Last Metric Heard` reflect the expected operational state. For routers, click `Refresh Metrics` and confirm that `Last Metric Heard` updates after the refresh completes. For endpoints, open the endpoint details and verify that inventory, mesh parent information, and endpoint metrics appear as expected. For L+G endpoints, IoT FND displays the mesh parent value as `1` when the L+G router does not report mesh parent details.

Step 7 If the device remains `Unheard`, `Down`, or has stale telemetry, use the troubleshooting procedures in the troubleshooting guide.

You've configured L+G devices and verified them using Cisco IoT FND.

What to do next

- For stale `Last Metric Heard` values or failed refresh operations, see Troubleshoot L+G device metric refresh.
- For IGMA registration, telemetry, metric, tunnel, firmware, or WebSocket session failures, see Debug IGMA websocket sessions for L+G border routers.

View mesh parent information for L+G endpoints

Use this task to view mesh parent information for L+G endpoints.

IoT FND displays the mesh parent value as 1 for L+G endpoints. In case of Cisco routers, such as CGR1000, IR8100, the mesh parent value is shared with FND considering the total number of primary and alternative mesh nodes. Likewise, FND does not receive the mesh parent value from the L+G N2450 router. As a result, FND always considers the mesh parent value as 1 for L+G endpoints.

Procedure

Step 1 Choose **DEVICES** > **FIELD DEVICES** > **Browse Devices** > **ENDPOINTS**.

Step 2 Click the device type in the left pane.

Step 3 Click the device in the right pane for which you want to view the mesh parent information. The Device Details page appears with the mesh parent information under **Mesh Link Metrics**.

Alternatively, you can view the mesh parent value in the Inventory table of the Field Devices page under the ENDPOINT device category.

Itron Bridge Meters

The Itron Bridge Meter management feature allows Endpoint Operators to transition RFLAN meters to cg-mesh device types and configure channel notch settings for regulatory compliance.

- Requires conversion of RFLAN meters to cg-mesh device types.
- Requires firmware upgrades to cg-mesh 5.6.x.
- Supports scheduling of channel notch configuration activation.

Channel Notch Configuration and Properties

Operators can define up to four pairs of Notch Range Start and End Channels, which act as blacklists to prohibit nodes from using specific channel ranges. These channel ranges must have increasing channel numbers for each range and cannot have any overlapping ranges. The following properties are associated with this feature:

- channelNotchMaxAttempts: Defines the maximum attempts to send configuration and schedule information to endpoints (default is 20).
- channelNotchSettingEnabled: Enables the channel notch feature (default is true).
- allowNewNotchSettings: Allows notch settings to be modified and defines settings used in the configuration push (deafult is true).

Note Only Root and Endpoint Operators can perform endpoint operations and scheduling for the Channel Notch feature.

Managing Channel Notch Activation

To manage an Itron Bridge Meter, an operator must convert the meter to a cg-mesh device type and push channel notch settings via the CONFIG pages. When scheduling activation, the operator sets a reload time for the configuration. The system uses three mechanisms to ensure PAN-wide

synchronization: scheduling via TLV 367, async beacons with excluded channel ranges, and immediate activation for nodes offline for five days.

- Supports scheduling of time that the new Channel Notch Settings should take effect by using TLV 367. The new Channel Notch Settings are stored in the platform flash. When the scheduled time arrives, the setting is copied to the device flash and then the node is rebooted to load the new config.
- CGR sends an async beacon which includes the excluded channel range (ECR) through the new Channel Hopping Schedule.
- When the nodes have been offline for five days, nodes will immediately enable the new Channel Notch Settings.

Related Topics

Manage Itron bridge meters, on page 251

Manage Itron bridge meters

An Endpoint Operator can manage Itron Bridge Meters such as ITRON30 as a cg-mesh device type (METER-CGMESH) using Cisco IoT-FND. This meter type was previously run in RFLAN mode.

Note Only Root and Endpoint Operators (RBAC) can see and perform the endpoint operations and scheduling for the Channel Notch feature.

Before you begin

To manage an Itron Bridge Meter in cg-mesh mode, an Endpoint Operator (RBAC) must convert the RFLAN meter to a cg-mesh device type and upgrade all cg-mesh firmware to cg-mesh 5.6.x.

Procedure

Step 1 Push channel notch settings to all nodes.

Note
After successful registration, the channel notch settings (in the bootstrap config.bin file) must be pushed to all nodes by the Endpoint Operator as soon as possible to be compliant with local regulations.

a) Navigate to **CONFIG** > **CHANNEL NOTCH CONFIG** to view display a list of the Config groups along with the details of group members and endpoints of each subnet
b) Click the **Push Channel Config** button to initiate a Config push of current channel settings to the endpoints for all routers in the selected router config groups.

Step 2 Schedule activation of the Channel Notch Config.

Note
Before you can schedule activation of a Channel Notch Config, the router config groups must have successfully received their channel notch configuration.

a) Click the **Schedule Channel Notch Config** button.

A pop-up panel appears for you to set a reload time (day and time) that the Channel Notch Config will be activated.

b) Change the Channel Notch Config of the corresponding routers through Config Push. This is performed at the same time of the Channel Notch activation.

What to do next

After endpoints have completed the initial enrollment and joined the mesh network, the endpoints may need to re-enroll the Utility IDevID and/or the LDEVID due to certificate expiration or proactive refresh of the certificates. FND 4.7 supports on-demand and auto re-enrollment. This action is seen in the Device Configuration page for a group of devices and on the Device Detail page for a single device.

Itron CAM module support in Cisco IoT FND

Use this reference to identify the Cisco IoT FND release that introduced IR8100 support for Itron CAM modules.

Table 50: Itron CAM module support

Feature	Release	Description
IR8100 with CAM Module Support	IoT FND 4.10	Itron CAM is the hardware module inserted into IR8100. The integration only applies to IR8100 routers.

Install the Itron CAM module

Use this task to prepare CGR or IR8100 requirements and upload the ACTD driver for an Itron CAM module.

The Itron CAM module installation requires device-side services before IoT FND can upload and manage the ACTD driver.

Before you begin

Guest OS (GOS) must be running on a CGR before you install the Itron CAM module.

Similarly, IOx must be running on IR8100 before you install the CAM module.

Procedure

Step 1 ACTD driver must be installed and running within the CGR Guest OS before you can use IoT FND to deploy, upgrade or monitor ACTD. This ensures that IoT FND can reach the CGR Guest OS to manage the ACTD driver. This can be done by configuring NAT on the CGR or setup a static route on CGR and HER as follows:

a) In the cgms.properties file, you must set the “manage-actd” property to true as follows:

```
manage-actd=true
```

b) Two new device properties are added for the user to specify the Guest OS external reachable IP address and the IOx access port in case port mapping is used.

```
gosIpAddress <external IP address of Guest OS>
ioxAccessPort  <default=8443>
```

Step 2 From within IoT FND, do the following to upload the ACTD driver:

a) Choose **CONFIG** > **FIRMWARE UPDATE** > **Images** tab.
b) Select CGR-Default profile from under the Groups panel and click the **Upload Image** button.
c) Click + to open the Upload Image panel.
d) Select the type ACTD-CGR and select the appropriate Image from the drop-down menu such app-actd-ver-x.y.z.tar. In the confirmation box, click **Upload Image**.
e) Click Yes to confirm upload.

Note
For IR8100 device with CAM module, select Default-Ir8100 under the Groups panel and select the type as ACTD-IR8100 while uploading the image.

View the Routing Path

The Routing Path table provides visibility into the topological connection of the device, showing the hops connected to the root of its RPL routing tree.

Procedure

Step 1 Navigate to **Devices** > **Field Devices** .
Step 2 From the left-pane under **Endpoint**, select the CAM module .
Step 3 View the **Routing Path** table in the **Device Info** page.

View new events for Cisco IR500

In Cisco IoT FND, events provide updated status information for the specified hardware. New events added for Cisco IR500 can be monitoried from the Fied Devices page.

Procedure

Step 1 Navigate to **DEVICE** > **Fied Devices** > **.**
Step 2 Under Browse Devices pane, click **ENDPOINT**.
Additional events that are added for IR500 display on this page.

Wi-SUN 1.0 support

Wi-SUN 1.0 support includes supported features, registration validation, and configuration rules for Cisco IR509, IR510, IR529, and IR530 platforms.

Registration validation

- Registration and Configuration Push Validation Notifications (Success or Failure) are sent for Cisco IR500 devices and other resilient mesh endpoints.

Mesh software behavior

In Mesh Software 6.3, only the Wi-SUN 1.0 protocol is supported for all mesh endpoints. It displays Wi-SUN 1.0 from the mesh 6.3 firmware onward under the Mesh Protocol heading on the **Devices** > **Field Devices** > **Endpoint** > **Inventory** page.

The Wi-SUN settings have been removed from the Cisco IR500 Config Group template: **Config** > **Device Configuration** > **Default-ir500** > **Edit Configuration Template** in Cisco IoT FND 4.7.

When using Mesh Software 6.2, for a Cisco IR510 running Wi-SUN mode 1.0, the Power Outage (PON) and Restore (PRN) messages will be sent as regular CSMP (Layer 2 to CSMP messages) / CoAP18 messages to port 61628. There is no change to the events generated by the new PON and PRN messages. Your router must be running 15.9(3)M1 or greater for this capability.

In Mesh Software 6.1, the Wi-SUN protocol is supported for all Cisco IR500 platforms. The mesh protocol setting between CG-Mesh and Wi-SUN 1.0 can only be set in the bootstrap configuration.

For Mesh Software 6.1, mesh endpoints send the PON and PRN messages to Cisco IoT FND port 61625 as UDP messages. There are no changes in the events that are generated by the new PON and PRN CSMP messages.

Review Wi-SUN 1.0 support

Define and review the supported actions for Wi-SUN 1.0 on the Cisco IR509 and IR510 WPAN gateways and the Cisco IR529 and IR530 Resilient Mesh Range Extenders along with WPAN OFDM module installed within a CGR 1000 platform.

Procedure

Step 1 From the main menu, choose **Config** > **Device Configuration** and **Device** > **Field Devices** > **ENDPOINTS** pages to define and review Wi-SUN 1.0 supported actions.

Step 2 On the **Devices** > **Field Devices** > **Browse Devices** , use the Mesh Protocol search parameter to filter gateway devices by Wi-SUN or Pre-Wi-SUN mode.

function: gateway deviceType:ir500

Step 3 From the More Actions menu, use **Block Mesh Device** to block a resilient mesh endpoint that you suspect is not a valid endpoint within the WPAN.

The action applies to Cisco IR509, IR510, IR529, and IR530 resilient mesh endpoints.

Step 4 For Cisco IR510, configure the DSCP Markings Rule with the supported precedence and class options.

The DSCP Markings Rule allows configuration of low, medium, and high precedence with a combination of 4 classes to provide 8 assignable options for DSCP Marking Profiles including default user-controlled options. Previously, only three markings were supported.

Out-of-Service devices

The OOS device state is a status indicating the end of life of a device in Cisco IoT FND, resulting from meter or module changes, service withdrawals, or device deletions.

- Applicable to routers, endpoints, and gateways managed by Cisco IoT FND.
- Combines characteristics of both Managed and Unmanaged device statuses.
- Applies only to classic licenses and does not consume license capacity, though a license is required for the device to exist in FND.

OOS Device State Details

Table 51: Feature History

Feature Name	Release Information	Description
Out-of-Service (OOS) device state	Cisco IoT FND 4.8	The OOS device state marks the end of life of a device in Cisco IoT FND. The end of life of a device is a result of meter or module change, withdrawal from services, or deletion of device from router, endpoint, or gateway.

Note If there is no license available for the same device type, then the OOS devices move to Unmanaged state based on priority while adding new devices.

Guidelines for managing OOS devices using CSV — Cisco IoT FND UI

Managing OOS devices via CSV allows administrators to synchronize device states with the Cisco IoT FND database.

- Supports adding, updating, or deleting device records.
- Requires specific device status definitions.
- Affects license count calculations based on the performed action.

Note The devices should have "outofservice" status in the CSV file to perform any action such as add, update, or delete in Cisco IoT FND.

Adding OOS devices using CSV — Cisco IoT FND UI

The OOS devices do not consume license, however, the license should be available for them to exist in FND.

Note If the license is unavailable, then the OOS devices move to **Unmanaged** status.

Procedure

Step 1 Choose **Devices** > **Field Devices** > **Browse Devices** .
Step 2 Click **Add Devices** on the right pane to add router, endpoint, or gateway devices.
Step 3 Click Browse to locate the csv file that has the OOS devices.
Step 4 Click **Open**, and then click **Add**.
Step 5 Click **Close** when done.

Delete OOS devices using a CSV file

Delete field devices that are out-of-service by uploading a CSV file.

Use this task to remove multiple out-of-service devices from the system without impacting license allocation.
Before you begin

Prepare a CSV file listing all devices to be deleted with their appropriate identifiers (outofservice status).

Follow these steps to remove OOS devices using a CSV file.

Procedure

Step 1 Choose **Devices** > **Field Devices** > **Browse Devices**.
Step 2 On the right pane, click **Bulk Operation** > **Remove Devices**.
Step 3 Click **Browse** to locate the CSV file containing the list of devices (in OOS status) to delete.
Step 4 Click **Open** to upload the file.
Step 5 Click **Remove** .
Step 6 Click **Close** when finished.

Updating Device Status Using CSV

You can update any device state to OOS state using the **Change Device Properties** option. This action frees up the license count for adding new devices.

Note You cannot move Unmanaged devices to OOS state.

Procedure

Step 1 Choose **DEVICES** > **Field Devices** > **Browse Devices** .

Step 2 On the right pane, choose **Bulk Operation** > **Change Device Properties** .

Step 3 Click Browse to locate the CSV file.

Step 4 Click **Open** .

Step 5 Click **Change** to change the existing device status to Out of Service status.

Step 6 Click **Close** when done.

Guidelines for managing OOS devices using CSV — IoT FND NB API

This reference provides the necessary information to manage OOS devices using the SOAP-based Cisco IoT FND NB API.

You can add, update, or delete OOS devices using Cisco IoT FND NB API using the CSV file. The NB API used is SOAP (Simple Object Access Protocol) UI.

Note The devices should have "outofservice" status in the CSV file to perform any action such as add, update, or delete in IoT FND.

- Adding OOS devices does not consume license. However, license should be available for the devices. If there is a request for adding new devices, then the devices in OOS state move to Unmanaged state on priority to accommodate new devices.
- Updating a device state to OOS state frees up the license count. You can update any Managed device state to OOS state. But this action prompts for license enforcement and reinstatement.
- Deleting OOS devices does not change the license count.

Add, update, or delete OOS devices using CSV — Cisco IoT FND NB API

Manages OOS devices by adding, updating, or deleting them through the Cisco IoT FND NB API using CSV files.

To add, update, or delete OOS devices:

Procedure

Step 1 Open the Cisco IoT FND NB API (SOAP UI: https://www.soapui.org/).

Step 2 From the **Soap** menu, select **New Soap Project**.

Step 3 In the **New SOAP Project** window, do the following:

a) Enter **Project Name**.
b) Click **Browse** to locate the Initial WSDL (Web Services Description Language).
c) Check the **Create Requests** check box.
d) Click **OK**.

Step 4 Right-click one of the following API options and select **New Request**:

a. **addDevices** — To add OOS devices.

b. **updateDevices** — To update device status to OOS.

c. **removeDevices** — To delete OOS devices.

Step 5 In the **New Request** window, enter the request name and click **OK** .

An XML window appears on the right pane.

Step 6 Click **SoapUI log** on the right lower pane.

The **Add Authorization** window appears.

Step 7 In the **Add Authorization** window, do the following:

a) Select the Authorization type as **Basic** and click **OK** .
b) Enter **Username** , **Password** , and **Domain** details.
c) Click **Attachments** tab.
d) Click + icon to locate the CSV file containing the list of OOS devices.

You can perform one of the following actions:

- **Add** — Select the CSV file to add OOS devices to FND.
- **Update** — Select the CSV file to update the device state as OOS in FND.
- **Delete** — Select the CSV file to delete OOS devices from FND.

e) Click **Open** .
f) In the confirmation box, click **Yes** .
g) Select the Part Number.

Step 8 In the XML file, provide the following information:

- Update the filename (copy the .csv filename from the Name field).
- Enter root as username.
- Update the HTTPS URL with FND IP details.

Step 9 Click the green arrow on the left top corner to send the request.

On successful completion of the NB API request, SoapUI shows a Job ID on the right side of the pane.

Manage licenses for OOS devices

Managing licenses for OOS devices ensures proper compliance and status tracking for hardware units currently removed from active production environments.

Procedure

Navigate to **ADMIN** > **System Management** > **License Center** to manage licenses.

What to do next

The content of this section is moved to a different location with improved user experience. For information on managing licenses of OOO devices, refer to Managing Licenses For OOS Devices .

Supported actions for OOS devices

Provides the ability to perform ping and traceroute operations on OOS devices directly from the Device Info page.

Cisco IoT FND enables you to ping and traceroute OOS devices of router, endpoint, or gateway on the **Device Info** page (**DEVICES** > **Field Devices** > **Browse Devices**).

Restrictions for OOS device actions

Note that while ping and traceroute operations remain available for OOS devices, several management actions are restricted to prevent system errors.

- Avoid performing Refresh Metrics, Reboot, Sync Config Membership, Sync Firmware Membership, Block Mesh Device, Erase Node Certificates, or Create Work Order on OOS devices.
- Expect an error message when attempting to use the Push Configuration option on OOS devices within the **CONFIG** > **Device Configuration** page.
- Refrain from using upload or install image options on OOS devices in the **CONFIG** > **Firmware Update** page, as these actions trigger an error message.
- Do not include OOS devices in file uploads within the **CONFIG** > **Device File Management** page to avoid error messages.

Note You are not allowed to delete the existing file that has OOS devices now.

View events and audit trails for OOS devices

Cisco IoT FND provides visibility into system events and audit logs for devices currently in an out-of-service state.

- Event tracking for OOS state transitions.
- Audit trail logging for state changes between Managed and OOS.

Procedure

Step 1 From the Cisco IoT FND menubar, choose **Operations** > **Events**.

Step 2 View the existing events for OOS devices. The generated event provides information on when the device moved to OOS state.

Note
You cannot generate events for the devices that are currently in OOS state.

Note
The Get Report option (in the Troubleshoot tab) is not supported for OOS devices.

To filter existing OOS device events, refer to Viewing OOS Devices Using Filters, on page 260.

Step 3 To view the audit trail for OOS devices, choose **ADMIN** > **System Management** > **Audit Trail**.

The audit trail provides information on when the device moved to OOS state from Managed state and the other way round.

Viewing OOS Devices Using Filters

You can view the events generated for OOS devices using the filter option.

Procedure

Step 1 Choose **OPERATIONS** > **Events** .

Step 2 Click **Show Filter** .

a) Select **Event Name** from the first drop-down list.
b) Select **Out of Service** from the third drop-down list.
c) Click the + icon to add the selected event name.

Step 3 Click the search icon.

The OOS device events are displayed.

Note

You can also customize your search using the **Custom Time Filter** drop-down list on the left pane. This option allows you to filter events based on relative or absolute time.

Common device operations

This reference provides the necessary information for users to effectively manage and monitor device data using IoT FND.

Re-enroll certificates for ITRON30 and Cisco IR500 devices

Endpoints must re-enroll the Utility IDevID and/or the LDevID due to certificate expiration or proactive refresh. The re-enrollment message is sent as a unicast; multicast is not supported.

Supported devices include IR510, IR530, and ITRON30. Supported certificates include Get NMS Cert, NPS/AAA Cert, LDevID, and IDevID.

Procedure

Step 1 Navigate to **CONFIG** > **Device Configuration**.

Step 2 Click the **Push Configuration** tab to review the status of re-enrollment. You can review the status on the Device Details page for a single device or the Device Configuration page for a group of devices.

Step 3 Click the **Edit Configuration Template** tab.

Step 4 Click the **TLS Version** drop-down list and select the appropriate TLS version.

Options are: 1.2, 1.0 and 1.2, or N/A.

Step 5 To view the certificate information of a device, navigate to the Device Details page and click the **Certificate Info** tab.

Audit re-enrollment for Gateway-IR500 Endpoints

The system tracks re-enrollment operations for Gateway-IR500 endpoints in the audit trail.

Procedure

Step 1 Navigate to **ADMIN** > **SYSTEM MANAGEMENT** > **AUDIT TRAIL**.

Step 2 Access the audit trail to verify the re-enrollment status.

The audit trail reports the following information for the re-enrollment operation:

- Operation: Re-enrollment (Get NMS Cert and NPS/AAA Cert)
- Status: Initiated

- Details: Group default-cg-mesh
- Device category: endpoint

Bulk device operations

Bulk import actions are administrative tasks that enable the simultaneous processing of multiple device records in Cisco IoT FND.

Add devices in bulk

In Cisco IoT FND, you can devices like Routers, Head-End Routers, IC3000 Gateway, Endpoint and Extenders and IR500 in bulk.

The **Add Devices** option on any devices page allows you to add devices in bulk using a CSV file.

To add devices in bulk:

Procedure

Step 1 On any Device page (for example, **Devices** > **Field Devices**), choose **Add Devices**.

Step 2 In the **Add Devices** window, click **Browse** to locate the CSV file containing the device information to import, and then click **Add** .

Note
Cisco IoT FND will allow to select only CSV or XML files from the system. The file with other extension will be in disabled state.

Cisco IoT FND will not allow you to upload file names with special characters such as &,<,>,",',`,\,/,=,{,},[,],(,),%, and ;.

For more information about adding gateways, see Add an IC3000 gateway, on page 220 .

For more information about adding HERs, see Add HERs to Cisco IoT FND, on page 216 .

For more information about adding routers, see Structure of router import records in Notice-of-Shipment XML files, on page 160 .

Note
For routers, you can also use the Notice-of-Shipment XML file provided by your Cisco partner to import routers.

Step 3 Click **Add**.

Step 4 Click **Close**.

Change device properties in bulk

Update several device properties simultaneously, such as latitude and longitude, by leveraging Cisco IoT FND's bulk operation feature.

Use this task when you need to update multiple device records in Cisco IoT FND efficiently, for example, adjusting location data or other settings for many devices at once.

```
eid,lat,lng,ip,
ASR1001+JAE15460070,42.0,-120.0
```

Follow these steps to change device properties in bulk.

Procedure

Step 1 Go to any device page in Cisco IoT FND.

Step 2 Select **Bulk Operation** > **Change Device Properties** .

Step 3 Click **Browse** to locate the CSV containing the list of devices and corresponding properties to configure, and then click **Open** to upload the file.

Step 4 Click **Change** to apply the new device properties.

Step 5 Click **Close** when done.

Move devices to another configuration group in bulk

Use this task to move devices to another configuration group in bulk.

Bulk moves use a CSV or XML file to identify devices that move from one configuration group to another.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**.

Step 2 Click **Assign Devices to Group**.

Step 3 Click **Browse** to locate the CSV or XML file containing the list of devices to move, and then click **Open**.

Step 4 From the Group drop-down menu, choose the target group for the devices.

Step 5 Click **Assign to Group**.

Step 6 Click **OK**.

For example, this CSV file specifies the EIDs of three CGRs to move:

```
eid
CGR1120/k9+JS1
CGR1120/k9+JS2
CGR1120/k9+JS3
```

Remove devices in bulk

Use this task to remove devices in bulk.

You can remove devices in bulk using a CSV file listing the EIDs of the devices to remove.

Caution When you remove routers, IoT FND returns all the leased IP addresses associated with these devices to CNR and removes the corresponding tunnels from the HERs.

Procedure

Step 1 Choose **Devices** > *Device Type*.

Step 2 Choose **Bulk Operation** > **Remove Devices**.

Step 3 Click **Browse** to locate the CSV file containing the devices to delete, and then click **Choose**.

This is an example of the CSV format expected. In this case, the CSV file specifies three CGRs and one HER:

```
eid
cgr1000-CA-107
cgr1000-CA-108
cgr1000-CA-109
asr1000-CA-118
```

Step 4 Click **Remove**.

The Status section of the Remove Devices window displays the status of the operation. The History section describes additional information about the operation. If there was any failure, click the corresponding link in the Failure# column to get more information about the error.

Step 5 Click **Close** when done.

Device Labels

A device label is a logical identifier used to categorize devices for improved organization and management.

Manage labels

Use this task to manage custom labels in Cisco IoT FND.

You use the Label Management window to display all custom labels, label properties, and search for custom labels.

Procedure

Step 1 Hover your mouse over LABELS and click the edit (pencil) icon.

Step 2 Click **Update** to accept label property changes or **Cancel** to retain label properties.

Step 3 Click **Close**.

Add Labels

To add labels to selected devices, in List view:

Procedure

Step 1 Check the check boxes of the devices to label.

Step 2 Choose **Label** > **Add Label** .

Step 3 Enter the name of the label or choose an existing label from the drop-down list.

Step 4 Click **Add Label** .

Tip
You can add multiple labels to one device.

Step 5 Click **OK** .

What to do next

To add labels in bulk, see Add Labels in bulk, on page 265 .

Remove labels

Use this task to remove labels from selected devices.

Label removal is performed from List view after selecting devices that have the label.

Procedure

Step 1 Check the check boxes of the devices from which to remove the label.

Step 2 Choose **Label** > **Remove Label**.

Step 3 Click **OK**.

To remove labels in bulk, see Remove labels in bulk, on page 266.

Add Labels in bulk

You can group devices logically by assigning them labels. Labels are independent of device type, and devices of any type can belong to any label. A device can also have multiple labels. Unlike configuration groups and firmware groups, there are no policies or metadata associated with labels.

Cisco IoT FND lets you add labels in bulk using a CSV file. In the CSV file, specify the list of devices to be labeled.

Procedure

Step 1 On any device page, choose **Bulk Operation** > **Add Label** .

Step 2 Click **Browse** to locate the CSV file that contains the list of devices to label, and then click *Open* .

This is an example of the expected CSV format:

```
eid
cgr1000-CA-107
cgr1000-CA-108
cgr1000-CA-109
asr1000-CA-118
```

Step 3 In the **Label** field, enter the label or choose one from the drop-down menu.

Step 4 Click **Add Label** .

The label appears in the Browse Devices tab (left pane) under LABELS.

Step 5 Click **Close** when done.

Remove labels in bulk

Use this task to remove labels in bulk.

IoT FND lets you delete labels in bulk using a CSV file.

Procedure

Step 1 On any device page, choose **Bulk Operation** > **Remove Label**.

Step 2 Click **Browse** to locate the CSV containing the list of devices to remove the label from, and then click **Open**.

Step 3 From the drop-down menu, choose the label to remove.

Step 4 Click **Remove Label**.

Step 5 Click **Close**.

Customize device views

This reference describes the customization options available for device list views, including tab management and column configuration.

Cisco IoT FND allows the following customizations for list views:

- Add and delete tabs.
- Specify the properties to display in the columns for each view (see Device properties by category, on page 335 for available properties).
- Change the order of columns.

Add Device Views

To add the device views, navigate to **Devices** > **Field Devices** > **Router**.

Procedure

Step 1 Click the + icon at the end of the tabs list in the **Field Devices** page.

Step 2 In the **Add new View** dialog box, enter the name of the new tab.

Step 3 Select the properties from the **Available Columns** list and click the left-arrow button, or drag them into the **Active Columns** list to add them.

Table 52: Active and Available Columns

Column Labels Event	Description
Changing the order of column labels.	Use up and down arrow buttons or drag the properties to the desired position to change the column order.
Deleting column labels.	Click the right arrow button or drag properties out of the **Active Columns** list to remove them.
Shifting multiple column labels.	Hold the Shift key to select multiple column labels and move them to either list.

Note
In Cisco IoT FND Release 5.0 and later, the system displays user-defined properties along with other properties under **Available Columns**. You can move these properties to **Active Columns**.

Note
In addition, the user defined properties can also be viewed and added from the drop-down list.

Step 4 Click **Save View** .

Edit device views

Update device views in the router field device interface to tailor the visible inventory columns for better workflow and clarity.

Use this task to customize which columns are shown and their order for field router devices, aiding efficient inventory management.

To edit or delete the device views, navigate to **DEVICES** > **FIELD DEVICES** > **ROUTER** .

Follow these steps to edit or delete a device view:

Procedure

Step 1 Choose **Devices** > **Field Devices**.

Step 2 Under **Browse Devices**, select a device type.

Step 3 In the right pane, click the drop-down arrow next to the **Inventory** field.

The **Edit/Delete View** dialog box appears.

Step 4 In the **Edit/Delete View** dialog box, perform the following actions:

a) Remove properties by selecting them in the **Active Columns** list and moving them out using the right-arrow button.
b) Add properties by selecting them in the **Available Columns** list and moving them into the **Active Columns** using the left-arrow button.
c) Reorder properties by moving items up or down in the **Active Columns** list.
d) To cancel changes and exit, close the dialog box.

Step 5 Click the disk icon to apply the changes.

Delete a device view

You might need to remove a device view if the configuration is no longer needed or to declutter your management interface. Starting from Cisco IoT FND Release 5.0, you can also delete default views.

Follow these steps to remove a device view.

Procedure

Step 1 Select a device type under the **Browse Devices** pane, and click the **Default** drop-down arrow.

The **Edit/Delete View** dialog box appears.

Step 2 Click the available delete option to remove the custom view.

Note
Starting from Cisco IoT FND Release 5.0, you can delete the default views as well.

Step 3 Click **Yes** in the confirmation dialog box.

Select devices

When you select devices, a yellow bar displays that maintains a count of selected devices and has the **Clear Selection** and **Select All** commands. The maximum number of devices you can select is 1000.

Procedure

Step 1 To select all devices listed on a page, check the check box next to device **Name**.

Step 2 To select devices across all pages, click **Select All**.

Step 3 To select a group of devices, check the check boxes of individual devices listed on a page and across pages.

The count increments with every device selected, and selections on all pages are retained.

Device filters

Filters in Cisco IoT FND are tools that allow users to control which devices are displayed in Map View and List view, making it easier to manage large numbers of devices.

- Cisco IoT FND supports up to 10 million devices.
- Filters help users locate and display devices efficiently.
- Filters are available in the Browse Devices and Quick View tabs.

Built-in device filters

Built-in device filters display in the **Browse Devices** pane. These filters control the display of devices in **Inventory** and **Map** views. For every filter entry, Cisco IoT FND provides a device count in parenthesis. Cisco IoT FND automatically updates the device count without having to reload the page. The top-level Endpoints label is selected, which inserts the following built-in filter in the Search Devices field: **deviceType:cgmesh firmwareGroup:default-cgmesh** .

This table lists all the filter attributes and operators and how they could be used when creating a filter.

Table 53: Filters

Filter Attribute	Operator	Resulting Action
Label	:	Filters devices by their assigned labels. Use this filter to quickly find devices that have been tagged with specific labels for organization or categorization purposes.
Asset	:	Filters devices by their asset name. Use this filter to search for devices associated with specific asset identifiers or asset management records.
Config Group	:	Filters devices by their configuration group membership. Use this filter to find all devices that belong to a specific configuration group for managing or viewing devices with similar configuration settings.
Firmware Group	:	Filters devices by their firmware group assignment. Use this filter to locate devices in a specific firmware group for tracking firmware versions or planning firmware updates.

Filter Attribute	Operator	Resulting Action
Groups	:	Filters devices by general group membership using text search. Use this filter to find devices belonging to any group by entering group name keywords.
Tunnel Group	:	Filters devices by their tunnel group assignment. Use this filter to find devices that are part of specific tunnel configurations for network connectivity management.
Category	:	Filters devices by their device category classification. Use this filter to narrow down devices to specific categories (e.g., routers, endpoints, gateways) within the fan device family.
Domain	:	Filters devices by their network domain. Use this filter to search for devices within a specific network domain or administrative boundary.
EID	:	Filters devices by their unique Element Identifier. Use this filter to quickly locate a specific device using its unique EID for troubleshooting or configuration.
Firmware	:	Filters devices by their currently running firmware version. Use this filter to find all devices running a specific firmware version for identifying devices needing updates or to verify deployment success.
Function	:	Filters devices by their functional role or purpose. Use this filter to locate devices based on their designated function in the network (e.g., gateway, repeater, collector).
Hardware ID	:	Filters devices by their hardware identifier. Use this filter to search for devices with specific hardware IDs for inventory management or hardware-specific troubleshooting.

Filter Attribute	Operator	Resulting Action
IP	:	Filters devices by their IP address. Use this filter to find devices using IP address search (exact match or partial) for network troubleshooting or connectivity verification.
Last GPS Heard	between	Filters devices by the date/time when GPS location was last received. Use this filter to identify devices with recent or outdated GPS data for monitoring mobile devices or detecting connectivity issues.
Last Heard	between	Filters devices by the date/time they last communicated with the system. Use this filter to find devices that haven't reported recently (potential offline devices) or verify recent device activity.
Latitude	between	Filters devices by their geographic latitude coordinate. Use this filter to search for devices within specific latitude ranges for geographic-based device management or mapping.
Longitude	between	Filters devices by their geographic longitude coordinate. Use this filter to search for devices within specific longitude ranges to locate devices in particular geographic areas.
Model Number	:	Filters devices by their product ID or model number. Use this filter to find all devices of a specific model for model-specific configuration, updates, or inventory reporting.
Name	:	Filters devices by their assigned device name. Use this filter to search for devices using their friendly names for quick identification and access.

Filter Attribute	Operator	Resulting Action
Serial Number	:	Filters devices by their unique serial number. Use this filter to locate a specific device using its serial number for warranty tracking, RMA, or precise device identification.
Status	:	Filters devices by their operational status. Use this filter to find devices in specific states (e.g., up, down, unheard, unmanaged) for monitoring network health or troubleshooting issues.
System Security Mode	:	Filters routers by their system security mode. Use this filter to find routers in secure or insecure mode.
Type	:	Filters devices by their specific device type. Use this filter to narrow down to specific device types within the fan family for type-specific management or reporting.
Up Time	between	Filters devices by their uptime duration (in numeric range). Use this filter to find devices with specific uptime ranges for identifying recently rebooted devices or those with stability issues.

Add a filter

Before you begin

- Ensure that you have understood the function of the filter operators before using them.
- If using date fields, ensure that you have the dates formatted as yyyy-MM-dd HH:mm:ss:SSS.

Use these steps to add a filter to the **Search** field.

Procedure

Step 1 If the **Add Filter** fields are not present under the **Search** field, click **Show Filters** .

Step 2 In the drop-down menu that displays **Label** as the default entry, choose a filter.

These filters apply to all device information categories. For more details about categories, see View router device properties , on page 161 .

Step 3 In the **Operator** (:) drop-down menu, choose an operator.

If you choose a numeric metric from the Label menu (for example, **Transmit Speed**), you can specify a range of values in the filter you are adding. For date/time filters, “between” is the operator. Use the calendar buttons to set the date range for the filter. This table lists the operators you can use to create filters.

Table 54: Filter Operators

Operator	Description
:	Equal to
>	Greater than
>=	Greater than or equal to
<	Less than
<=	Less than or equal to
<>	Not equal to

Step 4 In the **Value** field, enter a value to match or a range of values in the case of numeric metrics or select an available value from the drop-down menu.

Step 5 Click the Add (+) button to add the filter to the existing filter syntax in the **Search** field.

Cisco IoT FND supports this simple query language syntax:

Search := filter [filter ...]

Filter := fieldname operator value

operator := < | <= | > | >= | <> | = | :

Note the following when creating filters to search fields:

- Each field has a data type (String, Number, Boolean, and Date).
- String fields can contain a string, and you can search them using string equality (“:”).
- Numeric fields can contain a decimal number (stored as a double-precision float), and you can search them using the numeric comparison operators (“>”, “>=”, “<“, “<=”, “<>”).
- Boolean fields can contain the strings “true” or “false”.
- Date fields can contain a date in this format: yyyy-MM-dd HH:mm:ss:SSS. You can search dates using numeric comparison operators.

Step 6 Repeat the process to continue adding filters.

Table 55: Filter Examples

Filter	Description
`configGroup:"default-cgr1000"`	Finds all devices that belong to the default-cgr1000 group.
`name:00173*`	Finds all routers with a name starting with 00173.
`deviceType:cgr1000 status:up label:"Nevada"`	Finds all CGR 1000s in the Nevada group that are up and running.

What to do next

Create quick view filters using the filter criteria that you added, for easy and quick filtering of devices. See Create or edit quick view filters, on page 274 .

Create or edit quick view filters

Use the quick view filter to display devices that match your search criteria in the **Quick View** pane. You can create, edit, or manage quick view filters to control which devices appear on the **Devices** page.

Before you begin

- Filter devices by your chosen search criteria. For details on filtering devices, refer to Filter Devices.
- You can create quick view filters for devices in **Devices** > **Field Devices** and **Devices** > **Head-End Routers** pages.

Follow these steps to create or edit a quick view filter.

Procedure

Step 1 On the **Field Devices** or **Head-End Routers** page, click **Show Filters**, select your criteria, and start a search.

Step 2 When the filtered results are displayed, click the **Quick View/Rule** drop-down menu and select **Create Quick View** .

Step 3 In the **Create Quick View** window, review the search query, enter a filter name, and save the quick view filter.

The new quick view filter appears in the **Quick Views** tab.

Step 4 To edit a quick view filter, select the filter in the **Quick Views** tab and click the **Quick View/Rule** drop-down menu.

Step 5 Select **Edit Quick View**. In the **Update Quick View**window, make your changes and save them.

To remove a quick view filter, select it and choose the delete icon.

Instructions to view detailed device information

Provides instructions for viewing detailed device information by selecting the device name or EID in Cisco IoT FND.

Detailed device information displayed

This topic provides references to detailed information regarding server, head-end router, and endpoint configurations.

- View server information, on page 322
- View Head-end Router, Router, and Endpoint Information, on page 275

Note IoT FND automatically refreshes the detailed device information without the need to reload the page.

View Head-end Router, Router, and Endpoint Information

Procedure

Step 1 Select **DEVICES** > **Field Devices** .

Step 2 From the **Browse Devices** pane, select a device type (router, head-end router, or endpoint) .

Step 3 Click the Name of a specific system from the device list to view available information.

Information Category	Description
Device Info (all)	Displays detailed device information (see Device Properties, on page 334). For routers and endpoints, IoT FND also displays charts (see Device charts in the Monitoring chapter of this guide.
Events (all)	Displays information about events associated with the device.
Config Properties (routers, endpoints: meter-cgmesh, gateway-IR500, meter-cellular)	Displays the configurable properties of a device (see Device Properties, on page 334). You can configure these properties by importing a CSV file specifying the properties to configure and their new values, as described in Change device configuration properties, on page 289 .
Running Config (routers)	Displays the running configuration on the device.
Routing Tree (CGR1000, endpoints: gateway-IR500, meter-cgmesh, meter-OW Riva)	Displays the routing tree. For routers, the pane displays all the possible routers from the endpoints to the router. For endpoints, the Routing Tree pane displays the mesh route to the router.
Link Traffic (routers)	Displays the type of link traffic over time in bits per second.
Router Files (routers)	Lists files uploaded to the .../managed/files/ directory.

Information Category	Description
Raw Sockets (routers)	Lists metrics and session data for the TCP Raw Sockets (see table in the Raw Sockets Metrics and Sessions).
Embedded AP (IR829 only)	Lists inventory (configuration) details and metrics for the attached access point.
AP Running Config (IR8829 only)	Lists the running configuration file for the attached access point.

Actions performed on the Detailed Device Information page

This topic provides a reference for the device-specific actions available on the Detailed Device Information page, including connectivity testing, configuration synchronization, and device maintenance.

Action	Description
Show on Map (endpoints)	Displays a popup window with a map location of the device. This is the equivalent of entering **eid:** *Device_EID* in the search field in Map View.
Ping	Sends a ping to the device to determine its network connectivity. See Ping devices, on page 279 .
Traceroute	Traces the route to the device. See Trace routes to devices, on page 279 .
Refresh Metrics (Head-end routers and routers only)	Instructs the device to send metrics to IoT FND. **Note** IoT FND assigns historical values for metrics for each device. To access historical metric values, use the GetMetricHistory North Bound API call.
Reboot	Enables a reboot of the modem on LoRaWAN.
Sync Config Membership (Mesh endpoints only)	Synchronizes the configuration membership for this device. See Synchronize endpoint membership, on page 238 .
Sync Firmware Membership (Mesh endpoints only)	Click **Firmware Membership** to synchronize the firmware membership for this device, and then click **Yes** to complete the process.

Action	Description
Block Mesh Device (Mesh endpoints only)	Blocks the mesh endpoint device. **Caution** This is a disruptive operation. **Note** You cannot use Block Mesh Device with the Itron OpenWay RIVA CAM module or the Itron OpenWay RIVA Electric devices and Itron OpenWay RIVA G-W (Gas-Water) devices.
Erase Node Certificates	Removes Node certificates.
Create Work Order (Routers and DA Gateway only)	Creates a work order. See Demo and Bandwidth Operation Modes, on page 293 .

Note For Generic Endpoint devices, the **Sync Config Membership** and **Sync Firmware Membership** actions might fail and display an error. For more information, see CSCww48194.

Export device information

Use this task to export device information displayed in the current List view.

IoT FND lets you export the device properties of the selected devices in List view. IoT FND exports only properties in the current view.

Procedure

Step 1 Select the devices to export by checking their corresponding check boxes.

Step 2 Click **Export CSV**.

Step 3 Click **Yes** in the confirmation dialog box.

What to do next

IoT FND creates a CSV file, export.csv, containing the information that displays in the List view pane. By default, IoT FND saves this file to your default download directory. When a file with the same name exists, IoT FND adds a number to the default filename (for example, export-1.csv and export-2.csv).

The export.csv file consists of one header line defining the exported fields followed by one or more lines, each representing a device. Here is an example of an export of selected devices from the Field Devices page:

```
name,lastHeard,meshEndpointCount,uptime,runningFirmwareVersion,
openIssues,labels,lat,lng
CGR1240/K9+JSJLABTES32,2012-09-19 00:58:22.0,,,,
Door Open|Port Down,,50.4,-130.5
```

```
sgbuA1_cgr0,,,,,,,42.19716359,-87.93733641
sgbuA1_cgr1,,,,,,,44.3558597,-114.8060403
```

Change the sorting order of devices

Click the arrowhead icon in the column heading to list the entries in an ascending or descending manner.

Track assets associated with devices

Asset tracking is the process of associating and managing non-Cisco equipment with devices managed by Cisco IoT FND.

Assets represent non-Cisco equipment that is associated with an FND-managed Cisco device. It enables comprehensive device management by associating external equipment with Cisco routers.

- One or more assets can be mapped to a particular device.
- A maximum of five assets can be associated with one device.
- Each asset can have up to five files attached.
- An asset can only be mapped to one device at a time.

View assets associated with devices

Use this task to identify the assets associated with a router or review all tracked assets from the **Assets** page.

An asset is non-Cisco equipment associated with a device managed by Cisco IoT FND. You can view assets for an individual router from its device details page or view all tracked assets from the **Assets** page.

Before you begin

If you plan to perform a bulk asset operation, prepare the applicable input file:

- A CSV file for adding assets, changing asset properties, or removing assets.
- A ZIP or TAR file for adding files to assets.

When adding assets, include the Asset Name and Asset Type fields in the CSV file. All other fields are optional.

Procedure

Step 1 Navigate to **DEVICES** > **Field Devices**.

Step 2 In the **Browse Devices** pane, select routers such as CGR1000, IR800, .

Step 3 View the associated assets on the device details page for these routers.

Step 4 Navigate to **DEVICES** > **Assets** to view a summary of all assets tracked across devices.

a) Perform bulk operations on assets:

- Add Assets: Upload a CSV file of assets to FND. A history of past file uploads displays at the bottom of the page.

  Example of Asset content in CSV file:

```
assetName,assetType,deviceEid,assetDescription,vin,
hvacNumber,housePlate,attachToWO
asset1,RDU,00173bab01300000,Sample description,value1, value2, value3,no
```

Note
Asset Name and Asset Type are the mandatory fields in the CSV file. All other fields are optional.

- Change Asset Property: Use a CSV file to make changes to existing assets.
- Remove Assets: Use a CSV file to remove specific assets.
- Add Files to Assets: Use a zip or tar file to append additional information to asset content.

What to do next

After completing an operation, review the asset summary and, for asset uploads, the upload history on the **Assets** page.

Ping devices

Use this task to ping selected devices from List view.

When troubleshooting device issues, ping registered devices to rule out network connectivity issues. If you can ping a device, it is accessible over the network.

Procedure

Step 1 Check the check boxes of the devices to ping.

Note
If the status of a device is Unheard, a ping gets no response.

Step 2 Click **Ping** button in heading above List view entries.

A window displays the ping results. If you check the check box for **Auto Refresh**, IoT FND pings the device at predefined intervals until you close the window. Click the **Refresh** button (far right) to ping the device at any time.

Step 3 To close ping display, click X icon.

Trace routes to devices

Use this task to trace routes to selected devices from List view.

The Traceroute command lets you determine the route used to reach a device IP address.

Note You cannot use the Traceroute command with the Itron OpenWay RIVA CAM module or the Itron OpenWay RIVA Electric devices and Itron OpenWay RIVA G-W (Gas-Water) devices.

Procedure

Step 1 Check the check boxes of the devices to trace.

Note
You can only trace routes to devices registered with IoT FND. If the status of a device is Unheard, you cannot trace the route to it.

Step 2 Click **Traceroute**.

A window displays with the route-tracing results. Expand the Result column to view complete route information. Click the **Refresh** button to resend the Traceroute command. Check the **Auto Refresh** check box to resend the Traceroute command at predefined intervals until you close the window.

Step 3 Click X to close the window.

Google Snap to Roads feature in Cisco Iot FND

The Google Snap to Roads feature is a premium service that corrects GPS coordinate inaccuracies by mapping recorded latitude and longitude data to the most likely roads traveled by a vehicle.

- Eliminates incorrect coordinates collected along a route.
- Replaces raw data with points snapped to actual road paths.
- Requires a valid Google Map API Key enabled within the Cisco IoT FND user interface under **Admin** > **Map Settings**.

Configure map settings

In Map view, Cisco IoT FND lets you configure these settings for maps:

- Automatically zoom to devices
- Display the map in grayscale
- Default map location (North America by default)

Follow these steps to configure map settings.

Procedure

Step 1 Choose **Devices** > **Field Devices** .

Step 2 Click the **Map** tab.

Step 3 Configure Map Preferences

Use the following table to configure your map display settings:

Table 56:

Setting	Action
Zoom to Devices	Check the **Zoom to Devices** Check box to enable automatic zooming.
Grayscale	Check the **Grayscale** check box to display the map in grayscale,
Overlay	Use the **Overlay** drop-down menu to select display options: • For routers, you can overlay None, All, or Associated Endpoints on the map. • For endpoints, you can overlay None, All, All Associated Routers, All Modulations, Active Link Type
Quick View/Rule	Navigate to your desired area on the map, then click **Quick View/Rule** (at the top of the page) to set it as the default view.

Step 4 Click **OK** .

Viewing devices in map view

Cisco IoT FND provides a map view for visualizing device information based on geographic location. In Map view, IoT FND displays a Geographic Information System (GIS) map and uses GIS Map services to show device icons on the map based on the latitude and longitude information of the device. When this information is not defined for a device, IoT FND does not display the device on the map.

Procedure

Step 1 Select your profile and choose **Preferences** (upper-right hand corner).

Step 2 Select the **Enable map** check box, and click **Apply** .

Step 3 Choose **DEVICES** > **Field Devices** .

Step 4 Click the **Map** tab.

By default, IoT FND displays all devices registered in its database on the map. Depending on the zoom level of the map and the device count, individual device icons might not display. Instead, IoT FND displays device group icons.

To view individual devices, zoom in until the device icons appear. You can also click on a device to display a popup window that includes the **Zoom In** link to move the map display to the device level.

IoT FND displays the device count next to each device group or category in the Browse Devices pane (left pane).

To display a subset of all devices, click one of the filters listed in the Browse Devices pane.
IoT FND changes the map region based on your selection and displays the devices found by the filter. For example, you can use the **Routers > Up** filter to display all routers that are up and running. You can also use saved custom filters in the Quick View pane (left pane) to filter the device view. For information about creating custom filters, see Create or edit quick view filters, on page 274 .
To display information about a device or group, click its icon on the map.

A popup window displays listing basic device or group information.

To view device specifics, click **Details** or the device EID link in the Device popup window.

You can also ping the device, perform a trace route, and create a work order from this window.

Step 5 Close the Device popup window to view the RPL tree associated with the device. See Configure RPL tree polling in the Managing System Settings chapter.

The RPL tree connection displays as blue or orange lines; where blue indicates that the link is down, and orange indicates that the link is up.

Step 6 Click the refresh button to update the Map view.

Remove devices

Use this task to remove selected devices from List view.

Device removal is performed from List view after selecting the devices to remove.

Note When you remove routers, IoT FND returns all the leased IP addresses associated with these devices to the Cisco Network Registrar (CNR) server and removes the corresponding tunnels from the head-end routers.

Procedure

Step 1 Check the check boxes of the devices to remove.

Step 2 Choose **More Actions** > **Remove Devices**.

Step 3 Click **Yes**.

Configure device groups and rules

Search in the Device Configuration Page

Device configuration search

The search feature is a navigation tool that allows users to locate specific device configurations within the Device Configuration page.

- Enables keyword-based filtering of device configurations.
- Reduces manual effort required to identify individual devices.

Feature History

Table 57: Feature History

Feature Name	Release	Description
Search in the Device Configuration page	Cisco IoT FND Release 5.0	The **Device Configuration** page has a new search bar to search through the various device configurations. This search helps narrow down your scope to easily identify a device.

Benefits of search in the Device Config page

This reference outlines the primary advantages of using the search functionality to manage device configurations effectively.

- Quickly locate specific device configurations without manually scrolling through extensive lists, saving time and effort.
- The search feature allows for precise filtering, ensuring that you find exactly what you need with minimal effort.

Use the search filters in the Device Configuration page

Use the search feature on the Cisco IoT FND Device Configuration page to filter and find devices based on specific criteria.

Procedure

Step 1 From the Cisco IoT FND menu bar, choose **CONFIG** > **Device Configuration**.

Step 2 In the **Groups** tab, select a router under the **ROUTER** section.

The details of the selected router appear on the right side of the page.

a) In the right pane, use the search bar to enter your search criteria.
b) Alternatively, click **Show Filter** next to the search bar to display additional fields.
c) Click the first drop-down field and select an option from the list.

Option	Description
Status	Filters devices based on status. Available statuses: blocked, bootstrapped, bootstrapping, down, outage, outofservice, registering, restored, unheard, unmanaged, unsupported, up.
Name	Type the name of the device in the text box.
EID	Type the EID of the device in the text box.
IP Address	Enter the IP address of the device in the text box.
Last Heard	Filters devices that communicated with Cisco IoT within a specific timeframe.
Mesh Prefix Config	Filters device configurations based on mesh prefixes.
Mesh Prefix Length Config	Filters device configurations using mesh prefix length configurations.
Mesh PANID Config	Filters device configurations using Mesh PANID configurations.
Mesh Address Config	Filters device configurations using Mesh Address configurations.
Mesh Prefix Config 2	Filters device configurations using secondary mesh prefix configurations.
Mesh Prefix Length Config 2	Filters device configurations using secondary mesh prefix length configurations.
Mesh PANID Config 2	Filters device configurations using secondary Mesh PANID configurations.
Mesh Address Config 2	Filters device configurations using secondary Mesh Address configurations.

d) Enter the search value in the third field and click the + button.
The search values populate in the search bar.
e) Click the search icon to perform a search based on the applied filters.

Step 3 In the **Groups** tab, select an endpoint under the **ENDPOINT**section.

The details of the selected endpoint appear on the right side of the page.

a) In the right pane, use the search bar to enter your search criteria.
b) Alternatively, click **Show Filter** next to the search bar to display additional fields.
c) Click the first drop-down field and select an option from the list.

Option	Description
Status	Filters devices based on status (blocked, bootstrapped, bootstrapping, down, outage, outofservice, registering, restored, unheard, unmanaged, unsupported, up).
Name	Type the name of the device in the text box.
EID	Type the EID of the device in the text box.
IP Address	Enter the IP address of the device in the text box.
Last Heard	Filters devices that communicated with Cisco IoT within a specific timeframe.
Config Synced	Filters devices with configurations synced with Cisco IoT FND (true or false).
Operation Type	Filters endpoints based on operation type: Config Push, SD Card Password Push, Access Point Config Push, Access Point Bootstrap Push, Re-Enrollment Push, Channel Notch Push, Schedule Channel Notch Push.
Push Status	Filters endpoints based on configuration push status: NOT_STARTED, QUEUED, CONFIGURING, SUCCESS, ERROR, CONFIGURING_SD_CARD_PASSWORD, CONFIGURING_ACCESS_POINT, CONFIGURING_AP_BOOTSTRAP, CONFIG_PUSHED, ATTEMPTS_EXHAUSTED, INIT, ENROLLING, WAITING_ENROLL, CONFIGURING_CHANNEL_NOTCH_SETTINGS, CHANNEL_NOTCH_SETTINGS_CONFIGURED, CONFIGURING_CHANNEL_NOTCH_LOAD_REQUEST, CHANNEL_NOTCH_REQUEST_CONFIGURED, SKIPPED.

d) Enter the search value in the third field and click the + button.
The search values populate in the search bar.
e) Click the search icon to perform a search based on the applied filters.

Step 4 In the **Groups** tab, select a gateway under the **GATEWAY** section.

The details of the selected gateway appear on the right side of the page.

a) In the right pane, use the search bar to enter your search criteria.
b) Alternatively, click **Show Filter** next to the search bar to display additional fields.
c) Click the first drop-down field and select an option from the list.

Option	Description
Status	Filters devices based on status (blocked, bootstrapped, bootstrapping, down, outage, outofservice, registering, restored, unheard, unmanaged, unsupported, up).
Name	Type the name of the device in the text box.

Option	Description
EID	Type the EID of the device in the text box.
IP Address	Enter the IP address of the device in the text box.
Last Heard	Filters devices that communicated with Cisco IoT within a specific timeframe.

d) Enter the search value in the third field and click the + button.
The search values populate in the search bar.
e) Click the search icon to perform a search based on the applied filters.

Configuring devices

This reference outlines the configuration management workflows for devices in Cisco IoT FND, including group settings, template editing, and deployment processes.

The following configuration tasks are available for devices:

- Configure device group settings, on page 286
- Edit the ROUTER configuration template, on page 297
- Edit an endpoint configuration template, on page 235
- Push configurations to routers, on page 169
- Push configurations to endpoints, on page 236

Configure device group settings

Use device groups to manage devices in bulk.

When you add devices, Cisco IoT FND assigns the devices to default configuration groups based on the device type.

Procedure

Step 1 Navigate to **DEVICES** > **Field Devices**.

Step 2 Under **Browse Devices**, select **ROUTER**.

a) On the right pane, click **Add Devices** and add routers to Cisco IoT Field Network Director.

Cisco IoT FND automatically adds the routers to the appropriate default ROUTER configuration groups, such as **default-cgr1000** or .

Step 3 Under **Browse Devices**, select **ENDPOINT**.

a) On the right pane, click **Add Devices** and add MEs, such as meters and range extenders, to Cisco IoT FND.

Cisco IoT FND adds the MEs to the default ENDPOINT configuration group, **default-cgmesh**.

b)

The devices are available in the corresponding default configuration groups for bulk management.

View default device groups

By default, Cisco IoT FND defines several device groups listed on the **Device Configuration** page left pane. Each default group defines a default configuration template that you can push to all devices in that group. If you need to apply a different template to a group of devices, create a new group and modify its default configuration template as needed.

Procedure

Step 1 Navigate to **CONFIG** > **Device Configuration**.

Step 2 From the left pane, click the **Groups** tab.
The available default device groups display as shown in the following table.

Table 58: Default Device Groups

Group Name	Description
Default-act	By default, all Itron OpenWay RIVA Electric devices (ENDPOINT) are members of this group. • Individual RIVA electric devices listed under the Group heading display as OW Riva CENTRON.
Default-bact	By default, all Itron OpenWay RIVA G-W (Gas-Water) devices (ENDPOINT) are members of this group. • Individual RIVA water meters listed under the Group heading display as OW Riva G-W. • Individual RIVA gas meters listed under the Group heading display as OW Riva G-W.
Default-cam	By default, all Itron OpenWay RIVA CAM modules (ENDPOINT) are members of this group. • Individual RIVA CAM modules listed under the CAM heading display as OW Riva CAM.
Default-lglfn	By default, all L+G LFN (limited function node) battery endpoints are members of this group.
Default-lgelectric	By default, all L+G electric endpoints are members of this group.
Default-lgnn	By default, all L+G grid management endpoints are members of this group.

Group Name	Description
Default-lgrouter	By default, all L+G routers are members of this group.
Default-ir800	By default, all IR807s, IR809s, and IR829s (ROUTER) are members of this group.
Default-cgmesh	By default, all crmesh endpoints (ENDPOINT) are members of this group.
Default-cgr1000	By default, all CGRs (ROUTER) are members of this group.
Default-ir500	By default, all IR500s (ENDPOINT) are members of this group.
Default-lorawan	By default all LoRaWAN Gateways (IOT GATEWAY) are members of this group.
Default-ir1100	By default, all IR1100 (ROUTER) are members of this group.
Default-ir8100	By default, all IR8100 (ROUTER) are members of this group.
Default-ir1800	By default, all IR1800 (ROUTER) are members of this group.

Note You cannot delete the default groups, but you can change their names, although we do not recommend it. Also, the default ROUTER and ENDPOINT groups use the same icon, while custom groups use a different icon.

What to do next

- Create router groups, on page 288
- Create endpoint groups, on page 234

Create router groups

Creating router groups enables you to organize routers into custom configuration groups to manage network devices.

Note CGRs, IR800s, can coexist on a network. However, you must create custom templates that include all router types.

Follow these steps to create router groups.

Procedure

Step 1 Choose **Config** > **Device Configuration** .

Step 2 Select the default configuration group: **Default-cgr1000** , **Default-ir800** , , **Default-ir1100** , **Default-ir8100** , **Default-ir1800** , , or **Default-lgrouter** .

Step 3 Select the **Groups** tab on the top-left page, and then click the + icon to open the **Add Group** entry panel.

Step 4 Enter the name of the group. The Device Category auto-fills router by default.

Note
If you enter invalid characters (for example, "=", "+", and "~"), IoT FND displays a red alert icon, highlights the field in red, and disables the **Add** button.

Step 5 Click **Add** .

The new group entry appears in the ROUTER list (left pane).

What to do next

- To change the name of a group, see Rename a device configuration group, on page 291
- To remove a group, see Delete device groups, on page 292

Change device configuration properties

You can change the configurable properties of devices by uploading a Device Properties CSV file with modified values for the devices.

Procedure

Step 1 Choose **Config** > **Device Configuration** .

Step 2 Click **Change Device Properties** .

Step 3 Click **Browse** and select the Device Properties CSV or XML file to upload.

Step 4 Click **Change** .

Step 5 Click **Close** when done.

For a list of configurable device properties in Cisco IoT FND, see Device Properties, on page 334 .

Configure inventory notifications, heartbeat, and mark-down timers

This reference provides the necessary configuration paths for managing inventory timers, heartbeat intervals, and mark-down timers within the **Edit Configuration Template** and **Group Properties** tabs.

- Configuring Periodic Inventory Timer
- Configuring Heartbeat Notification
- Configuring the Mark-Down Timer

Configure periodic inventory timer

Follow these steps to configure the periodic inventory timer for a router configuration group:

Procedure

Step 1 Click **Config** > **Device Configuration** .

Step 2 Select a router configuration group from the left pane.

Step 3 Click **Edit Configuration Template** to configure the periodic inventory notification interval in the template. The default periodic inventory notification interval is 60 minutes for routers and 8 hours for endpoints.

Note
We recommend you to use the default periodic value. However, you can also customize the periodic interval, but the value that is defined should be more than the default value of 60 minutes and not less. For example, if you want to enable the periodic inventory notification to report metrics every 120 minutes, then add the following lines to the template:

```
<#-- Enable periodic inventory notification every 2 hours to report metrics. -->
cgna profile cg-nms-periodic
      interval 120
    exit
```

Step 4 Click the disk icon to save the changes.

Configure heartbeat notification

The heartbeat notification interval for a router configuration group enables to determine the frequency at which the device sends heartbeat notifications to the system.

Follow these steps to configure the heartbeat notification for a router configuration group.

Procedure

Step 1 Click **Config** > **Device Configuration** .

Step 2 Select a router configuration group from the left pane.

Step 3 Click **Edit Configuration Template** to configure the heartbeat notification interval in the template. The default heartbeat notification interval is 15 minutes.

Note
We recommend you to use the default heartbeat value. However, you can also customize the default value, but the value that is defined should be more than default value and not less. For example, if you want to enable the heartbeat notification every 30 minutes, then add the following lines to the template:

```
cgna heart-beat interval 30
```

Note
Ensure that the heartbeat interval is less than the mark-down timer value set by you. For more information on the device mark-down timer, refer to Configure mark-down timer, on page 291 .

Step 4 Click the disk icon to save the changes.

Configure mark-down timer

The **Group Properties** page allows you to set the mark-down timer value for a default or user-defined configuration group of a router, endpoint, or gateway. The mark-down timer value that you set must be greater than the heartbeat value defined in the Edit Configuration Template .

Based on the heartbeat value received from the device every few minutes, Cisco IoT FND updates the last heard value of the device in the Device Info page (**DEVICES** > **Field Devices** > **ROUTER**).

Note If the last heard value is greater than the device mark-down value, then Cisco IoT FND marks the device state as **Down** in the Cisco IoT FND GUI. However, before marking the device **Down** , Cisco IoT FND must check the status of the tunnel interface that is associated with the device. If the tunnel interface is **Down** as well, then Cisco IoT FND marks the device state as **Down** . If the tunnel interface state is Up, then Cisco IoT FND must wait until the tunnel interface state goes **Down** as well before marking the device as **Down** in the Cisco IoT FND GUI.

Follow these steps to configure mark-down timer.

Procedure

Step 1 Click **Config** > **Device Configuration** .

Step 2 Select a router configuration group from the left pane.

Step 3 Click **Group Properties** .

Step 4 In the **Mark Routers Down After** field, enter the number of seconds after which the Cisco IoT FND marks the device **Down** if it does not receive the heartbeat value from the device during the specified heartbeat time interval.

Note
Ensure that the periodic configuration notification frequency in the configuration template is less than the value you entered in the **Mark Routers Down After** field. We recommend 1:3 ratio of heartbeat interval to mark-down timer. For more information on configuring the heartbeat interval, refer to Configure heartbeat notification, on page 290 .

Step 5 Click the disk icon to save the changes.

Rename a device configuration group

Use this task to rename a device configuration group.

In the **Device Configuration** page, there are two device configuration groups available, namely user-defined groups and default groups of router, endpoint, or gateway. IoT FND allows you to rename the user-defined device configuration groups only. You cannot rename the default device configuration groups.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**.

Step 2 Select a group from the list of configuration groups (left pane).

Step 3 Hover over the name of the group in the list. A pencil icon appears.

Note
Starting with Cisco IoT FND 4.8 release, the default device configuration groups cannot be renamed, whereas the user-defined device configuration groups can be renamed. The pencil icon does not appear for the default device configuration groups.

Step 4 Click the pencil icon to open the **Edit Group** panel.

Step 5 Enter the new name in the **Rename Group** dialog box, and then click **OK**.

Note
If you enter invalid characters (for example, "=", "+", and "~"), IoT FND displays a red alert icon, highlights the field in red, and disables the **OK** button.

Delete device groups

Delete a device group to remove obsolete or no-longer-needed configuration groupings from your system.

Device groups organize devices for configuration and management. Deleting a group helps keep your configuration organized by removing outdated or empty groups.

Before you begin

Ensure all devices in the group you wish to delete have been moved to another group. You cannot delete a group that still contains devices.

Follow these steps to delete a device group:

Procedure

Step 1 Choose **Config** > **Device Configuration**.

Step 2 From the left pane, select the configuration group you want to delete from the list.

Step 3 Verify that the group is empty.

Step 4 Click **Delete Group**.

The Delete icon displays as a red minus sign when you hover over the name of the group in the list.

Step 5 Click **Yes** to confirm the deletion, and then click **OK** .

The selected device group is deleted from your device list.

Methods to move devices to another group

Moving devices is the process of reassigning a device from its current configuration group to a different target group within the system.

Methods for Moving Devices

Administrators can utilize the following two methods to move devices between configuration groups:

- Manual reassignment through the device management interface.
- Bulk reassignment using configuration import tools. See Move devices to another configuration group in bulk, on page 263.

Move devices to another configuration group manually

Use this task to move selected devices to another configuration group manually.

The Device Configuration page lets you select devices in one configuration group and choose a target configuration group.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**.
Step 2 Select a group from the list of configuration groups (left pane).
Step 3 Select the check box of the devices to move.
Step 4 Click **Change Configuration Group**.
Step 5 From the drop-down menu in the dialog box, choose the target group for the devices.
Step 6 Click **Change Config Group**.
Step 7 Click **OK**.

List devices in a configuration group

Use this task to list devices in a configuration group.

The Device Configuration page lists devices for a selected configuration group.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**.
Step 2 Select a group from the list of configuration groups (left pane).
Step 3 To get more information about a device in the list, click its EID (for example: CGR1240/K9+JAF1723AHGD)

Demo and Bandwidth Operation Modes

The Demo and Bandwidth Operation Modes are configuration settings that determine the communication protocol (HTTP or HTTPS) used between FND and routers.

- Demo Mode: Minimizes setup requirements for small networks by eliminating the need for router certificates or SSL.
- Bandwidth optimization mode: Reduces network bandwidth by using HTTP for periodic metrics while maintaining HTTPS for other operations.

Communication Methods by Operation Mode

The following table outlines the communication protocols used for various processes based on the selected FND operation mode.

Table 59: Communication Method Given FND Operation Mode

Process	Demo Mode	Bandwidth Optimization Mode	Default Mode
IOS Registration	All communications over HTTP	HTTPS	All communications over HTTPS
AP Registration		HTTPS	
LoRA Registration		HTTPS	
AP Bootstrap		HTTPS	
IOS Tunnel Provisioning		HTTPS	
Configuration Push		HTTPS	
File Transfer		HTTPS	
Metrics		HTTP and HTTPS	

Change Cisco IoT FND management mode

Use this task to change FND router management mode to Demo mode.

Demo mode requires updates to the `cgms.properties` and `tpsproxy.properties` files.

Procedure

Step 1 Add the following to the cgms.properties file:

```
fnd-router-mgmt-mode=1 <---where 1
represents Demo Mode
```

Step 2 Add the following to the tpsproxy.properties file:

```
            inbound-proxy-destination=
http://<FND-IP/Hostname>:9120 <---where 9120 represents Inbound proxy
tps-proxy-enable-demo-mode=true
<---Enables the TPS proxy to accept HTTP connections
```

Step 3 For the AP registration process, you must add the following two properties to the cgms.properties file:

```
rtr-ap-com-protocol=http
rtr-ap-com-port=80
```

Change router configuration

Use this task to manage routers in Demo mode.

Demo mode router management requires profile URL changes that use HTTP protocol.

Procedure

Step 1 Manually change the URL for all the profiles to use HTTP protocol:

```
url http://nms.iot.cisco.com:9121/cgna/ios/registration
url http://nms.iot.cisco.com:9121/cgna/ios/metrics
```

Step 2 Update WSMA profile URL to use HTTP protocol (Only Required in Demo Mode)

```
wsma profile listener config
transport http path /wsma/config
wsma profile listener exec
transport http path /wsma/exec
```

Step 3 Update URL of iot-fnd-register, iot-fnd-metric and iot-fnd-tunnel profiles to use HTTP protocol on Cisco Wireless Gateway for LoRaWAN (IXM-LPWA).

```
configure terminal
igma profile iot-fnd-register
url http://fnd.iok.cisco.com:9121/igma/register
exit
exit
configure terminal
igma profile iot-fnd-metric
url http://fnd.iok.cisco.com:9121/igma/metric
exit
exit
configure terminal
igma profile iot-fnd-tunnel
url http://fnd.iok.cisco.com:9121/igma/tunnel
exit
exit
```

Configure demo mode in user interface

Note By default, all communications between FND and the router will be over HTTPS.

Follow these steps to configure demo mode.

Procedure

Step 1 Choose **Admin** > **System Management** > **Provisioning Settings** .

Step 2 In the **Provisioning Process** panel, enter the Cisco IoT FND URL in the following format:`http:// <ip address:9121>` in both the Cisco IoT FND URL and Periodic Metrics URL.

What to do next

Note The FAR uses the Cisco IoT FND URL to communicate with Cisco IoT FND after the tunnel is configured and uses the Periodic Metrics URL to report periodic metrics and notifications with Cisco IoT FND.

Configure unified mode

Note Setting the AP to the unified mode, requires that the configuration be pushed by Cisco IoT FND to the router (IR800) from the router config template, After the configuration is pushed to the router, the management of the AP is done from the Cisco Wireless LAN Controller (WLC) and not from Cisco IoT FND:

Follow these steps to configure unified mode

Procedure

Step 1 Choose **Config** > **Device Configuration**, and select Default-ir800 from the **Groups** panel.

Step 2 Click the **Edit AP Configuration Template** tab.

Step 3 To perform a unified upgrade, enter this configuration in the **Edit AP Configuration Template** window:

```
ip dhcp pool embedded-ap-pool
network <router_ip> 255.255.255.0
dns-server <dns_ip>
default-router <router_ip>
option 43 hex f104.0a0a.0a0f (single WLC IP address(10.10.10.15)
in hex
format)
ip address <router_ip> 255.255.255.0
!
service-module wlan-ap 0 bootimage unified
```

Step 4 Click the Disk icon at the bottom of the panel to save the configuration.

Step 5 On the **Router Device Details** page, click the **Embedded AP** tab.

The pane displays the message “Unified access points are not managed” because these devices are now controlled by the Cisco Wireless LAN Controller instead of Cisco IoT FND.

Device configuration data export in Cisco IoT FND

Use this reference to identify the Cisco IoT FND release that introduced export support for firmware and configuration group data.

Table 60: Export support

Feature	Release	Description
Export firmware and configuration group data	Cisco IoT FND Release 5.1	Exports firmware group update information from the Firmware Update page and configuration group update information from the Device Configuration page for routers and endpoints.

Export device configuration data

This task helps you export device configuration data from Cisco IoT FND.

Before you begin

- Ensure that your local system has enough space to download the firmware and configuration data.
- Ensure that your local system supports .csv files.

Here are the instructions to export device configuration data from Cisco IoT FND:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **Device Configuration**

Step 2 Select a router or an endpoint group from the **Groups** tab.

a) Use the **Show Filter** option to narrow down your device group search using the available filters.

Step 3 Select a group member that you'd like to download from the group members table. You can make multiple selections as well.

Step 4 Click the export icon adjacent to the refresh icon.

The device config data is downloaded as a .csv file to your local system.

You've successfully exported the device configuration data.

Edit the ROUTER configuration template

Use this task to edit a ROUTER group configuration template.

IoT FND lets you configure routers in bulk using a configuration template. When a router registers with IoT FND, IoT Field Network Director pushes the configuration defined in the default template to the device and commits the changes to the router startup configuration. IoT FND then retrieves the running configuration from the router before changing the device status to **Up**.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**.

Step 2 Under CONFIGURATION GROUPS (left pane), select the group with the template to edit.

Step 3 Click **Edit Configuration Template**

Step 4 Edit the template.

The template is expressed in FreeMarker syntax

Note
The router configuration template does not validate all configuration data entered. Cisco IoT FND checks supported Cisco IOS XE router templates for deprecated insecure CLI commands. If a deprecated insecure CLI command is detected, Cisco IoT FND displays a warning and enables the **View Insecure CLIs** button. Verify the configuration before saving.

Step 5 Click **Save Changes**.

To review the detected commands before saving, click **View Insecure CLIs**. The dialog lists the CLI command, description, status, and target versions. Click **Export to CSV** to export the list.

What to do next

IoT FND commits the changes to the database and increases the template version number.

Edit an AP group configuration template

Update configuration templates for AP device groups to reflect changes in device settings or requirements.

Use this task when you need to adjust FreeMarker-based AP configuration templates for one or more device groups.

Follow these steps to edit an AP group configuration template.

Procedure

Step 1 Choose **Config** > **Device Configuration**.

Step 2 In the left pane, select the device group with embedded AP devices with the template to edit.

Step 3 Click **Edit AP Configuration Template** .

Step 4 Make the necessary changes to the template.

The template uses FreeMarker syntax. For more information about FreeMarker, go to http://freemarker.org/.

Example AP configuration template:

```
ip dhcp pool TEST_POOL
network 10.10.10.0 255.255.255.0
default-router 10.10.10.1
lease infinite
!
dot11 ssid GUEST_SSID
```

```
authentication open
authentication key-management wpa
wpa-psk ascii 0 12345678
guest-mode
!
interface Dot11Radio0
no ip address
encryption mode ciphers aes-ccm
ssid GUEST_SSID
!
interface Dot11Radio0
no ip address
encryption mode ciphers aes-ccm
ssid GUEST_SSID
```

Note
The AP configuration template does not validate the configuration data entered. Verify the configuration before saving.

Step 5 Click **Save Changes** .

The system commits your changes to the database and increases the template revision number.

Insecure CLI detection for router templates

Cisco IoT FND detects deprecated insecure CLI commands in router templates and warns users before the template or configuration push workflow continues. The detection helps users identify commands that can affect the system security mode of Cisco IOS XE routers.

Supported device types

Insecure CLI detection applies to these Cisco IOS XE device types:

- IR8140
- IR1800
- IR1100
- IR1000

Where detection appears

Cisco IoT FND checks router CLI commands in these template workflows:

- Group-level ROUTER configuration templates in **CONFIG** > **Device Configuration**.
- Device-level configuration push templates on the router **Push Configuration** tab.

Detection result

When Cisco IoT FND detects a deprecated insecure CLI command, the template editor displays a warning and enables the **View Insecure CLIs** button. The warning does not prevent the template from being saved.

The **View Insecure CLIs** dialog lists the CLI command, description, status, and target versions for each detected command.

View and export insecure CLI commands

Use this task to review the insecure CLI commands that Cisco IoT FND detects in a router configuration template.

The **View Insecure CLIs** button appears when Cisco IoT FND detects a deprecated insecure CLI command in the selected template revision.

Procedure

Step 1 Choose **CONFIG** > **Device Configuration**.

Step 2 Under **Configuration Groups**, select the router configuration group that contains the template to review.

Step 3 Click the **Edit Configuration Template** tab.

Step 4 Select the template revision that displays the insecure CLI warning.

Step 5 Click **View Insecure CLIs**.

Step 6 Review the commands in the **Insecure CLI Commands** dialog.

The dialog displays the **CLI Command**, **Description**, **Status**, and **Target Versions** columns.

Step 7 Click **Export to CSV** to download the list of insecure CLI commands.

Step 8 Click **Close**.

Insecure CLI handling behavior

Use this reference to understand how Cisco IoT FND handles deprecated insecure CLI commands in router template and configuration push workflows.

Behavior summary

Table 61: Deprecated insecure CLI handling

Workflow	Location	Cisco IoT FND behavior	User action
Group template save	**CONFIG** > **Device Configuration** > **Edit Configuration Template**	Cisco IoT FND displays a warning when a deprecated insecure CLI command is present. You can save the template.	Click **View Insecure CLIs** to review the command list and export it to CSV.
Group configuration push	**CONFIG** > **Device Configuration** > **Push Configuration**	Cisco IoT FND allows the configuration push. If the target router is in secure mode, Cisco IoT FND moves the router to insecure mode before applying the deprecated insecure CLI command.	Remove deprecated insecure CLI commands and use **Move to Secure Mode** when the router is ready to return to secure mode.

Workflow	Location	Cisco IoT FND behavior	User action
Device-level template save	**Devices** > **Field Devices** > **Router**, then the router **Push Configuration** tab	Cisco IoT FND displays a warning when a deprecated insecure CLI command is present. You can save the device-level template.	Review the insecure CLI command list before pushing the configuration.
Device-level configuration push	Router **Push Configuration** tab	Allows the configuration push and reports status in the device status table.	Review warning or error details after the push operation completes.
Inventory and filtering	**Devices** > **Field Devices** > **Router** > **Inventory**	Cisco IoT FND displays the router system security mode in the **System Security Mode** inventory column and filter.	Use the **System Security Mode** filter to find routers in secure or insecure mode.

Move a router to secure mode

Use this task to move a Cisco IOS XE router to secure mode from Cisco IoT FND.

If a deprecated insecure CLI command is applied to a router in secure mode, Cisco IoT FND moves the router to insecure mode before applying the configuration. Before moving the router back to secure mode, remove deprecated insecure CLI commands from the applicable template and from the router configuration.

Note If deprecated insecure CLI commands remain on the router, the move to secure mode operation does not complete.

Procedure

Step 1 Update the applicable router configuration template to remove deprecated insecure CLI commands.

If a deprecated insecure CLI command is already present in the router configuration, push the corresponding removal command before moving the router to secure mode.

Step 2 Choose **CONFIG** > **Device Configuration**.

Step 3 Under **Configuration Groups**, select the router configuration group that contains the router.

Step 4 Click the **Push Configuration** tab.

Step 5 From the **Select Operation** drop-down list, choose **Move to Secure Mode**.

Step 6 Select the router that you want to move to secure mode.

Step 7 Click **Submit**.

Step 8 Review the operation status in the **Device Status** table.

Rule configuration

An Cisco IoT FND rule is a configuration object that defines a filter and associated actions performed by the system upon receiving events or metrics that match specified criteria.

- Checks for event conditions.
- Evaluates metric thresholds.
- Automates device labeling and logging processes.

Rule Capabilities and Operations

When working with rules, you can perform the following operations:

- Add rules with conditions and actions.
- Define a rule with a condition using a device search query, which matches devices according to properties and metrics.
- Define a rule with an action that adds labels to matching devices or to the devices that sent a matching event.
- Define a rule with an action that removes a label from a matching device or the device that sent a matching event.
- Define a rule with an action that places a *user alert* event into the log, which includes a user-defined message.

Rule Automation Example

Whenever the status of a router in a configuration group changes to Up, you can add a custom message to the server log (server.log) and add the appropriate labels to the device.

Viewing and Editing Rules

To view rules:

Procedure

Step 1 Choose **CONFIG > Rules** .

IoT FND displays the list of rules stored in its database. The Rule field describes the fields displayed in the list.

Field	Description
Name	The name of the rule.
Active?	Whether the rule is active. Rules are not applied until you activate them.

Field	Description
Rule definition	The syntax of the rule. Some examples are listed below. • IoT FND executes this rule when a device battery 0 level drops below 50%: `battery0Level<50` • `deviceType:cgmesh eventName:up` • `deviceType:ir500 eventName:outage`
Rule Actions	The actions performed by the rule. For example: `Log Event With: CA-Registered, Add Label: CA-Registered` In this example, the actions: • Set the eventMessage property of the Rule Event generated by this rule to CA-Registered. • Add the label CA-Registered to the matching device.
Updated By	The username of user who last updated the rule.
Updated At	The date and time when the rule was last updated.

Step 2 To edit a rule, click its name.

For information on how to edit rules, see Create a rule, on page 303

Create a rule

Cisco IoT FND enables you to create custom rules to monitor and manage network events within the system.

Follow these steps to add a rule:

Procedure

Step 1 Choose **Config** > **Rules** .

Step 2 Click **Add** .

Step 3 Enter a name for the rule.

Note
If you enter invalid characters (for example, “=”, “+”, and “~”), Cisco IoT FND displays a red alert icon, highlights the field in red, and disables the **OK** button.

Step 4 To activate the rule, check the **Active** check box.

Step 5 In the **Construct Rule** panel, enter the syntax of the rule.

Use the same syntax used for creating filters. See Search Syntax.

Step 6 In the **Create Rule** panel, check the check box of at least one action:

Field	Action
Log event with	Specify the message to add to the log entry of the event in the server log, the severity, and event name. • **Severity** — Select the severity level to assign to the event. • **User-defined Event** — Assign a name to the event Search by event name . For example, if you enter Red Alert in this field, set the Severity to CRITICAL and enter CHECK ROUTER in the Event Name field, the eventMessage field in the logged entry for the event that matches the rule is set to Red Alert, as shown in this sample entry from the server log (server.log): `16494287: NMS-200-5: May 02 2017 22:32:41.964 +0000: %CGMS-7 -UNSPECIFIED: % [ch=EventProducer][sev=DEBUG][tid=com.espertech.esper.Outbound-CgmsEventProvider-1]: Event Object which is send = EventObject [netElementId=50071, eventTime=1335997961962, eventSeverity=0, eventSource=cgr1000, eventType=UserEventType, <userinput>eventMessage=Red Alert</userinput> , <userinput>eventName=CHECK ROUTER</userinput> , lat=36.319324, lng=-129.920815, geoHash=9n7weedx3sdydv1b6ycjw, eventTypeId=1045, eid=CGR1240/K9+JAF1603BBFF]` **Note** In Cisco IoT FND, the message you define in the **Log event with** field appears in the Message field of the matching event entries listed on the Events page (**Operations** > **Events**), and the new Event Name is a new search filter.
Add Label	Enter the name of a new label or choose one from the **Add Label** drop-down menu.
Show label status on Field Devices page	Shows the status of the device that triggered this rule in the LABELS section of the Browse Devices pane.
Remove Label	Choose the label to remove from the **Remove Label** drop-down menu.

Step 7 Click the disk icon to save the changes .

Activate Rules

Cisco IoT FND only applies rules that you activate.

Procedure

Step 1 Choose **CONFIG** > **Rules**.
Step 2 Check the check boxes of the rules to activate.
Step 3 Click **Activate**.
Step 4 Click **Yes** to activate the rule.
Step 5 Click **OK** .

Deactivate rules

Deactivating a specific rule prevents the system from applying it to network traffic.

If you deactivate a rule, Cisco IoT FND does not apply it.

Follow these steps to deactivate rules.

Procedure

Step 1 Choose **Config** > **Rules**.
Step 2 Check the check boxes of the rules to deactivate.
Step 3 Click **Yes** to deactivate the rule.
Step 4 Click **OK** .

Delete rules

Removes specific configuration rules from your system.

Use this task to delete obsolete rules from the interface.

Follow these steps to delete rules.

Procedure

Step 1 Choose **Config** > **Rules** .
Step 2 Select the checkboxes for the rules you want to delete.
Step 3 Click **Delete** .
Step 4 Click **Yes** to confirm the deletion, then click **OK**.

The selected rules are deleted from the system’s configuration.

Device-level configuration push

Device-level configuration push is a management capability that allows administrators to apply specific configurations directly to a device using FreeMarker templates.

Cisco IoT FND checks device-level Cisco IOS XE router templates for deprecated insecure CLI commands. If a deprecated insecure CLI command is detected, Cisco IoT FND displays a warning so that you can review the command before saving or pushing the configuration.

- Supports configuration deployment with or without rollback mechanisms.
- Integrates with registration and active running configuration views for monitoring.
- Facilitates updates during reprovisioning, ZTD, and re-ZTD processes.

Table 62: Feature History

Feature Name	Release Information	Description
Device-Level Configuration Push	Cisco IoT FND Release 5.0	Push configurations at the device level using the **Push Configuration** tab in the **CONFIG** > **Device Configuration** page.

Configuration Push Methods and Running Config Details

The following methods are available for pushing configurations to a device:

- Config Push with Rollback : Pushes the configuration by first rolling back to the before-registration-config and then applying the new configuration.
- Config Push without Rollback: Pushes the configuration to the device without rolling back to the before-registration-config.

The Running Config tab provides visibility into the following configurations:

- Registration Config : Displays the before-registration-config configuration that is baselined in Cisco IoT FND.
- Active Running Config: Displays the running configuration received from the device after the without rollback config push.

Note Cisco IoT FND supports configuration push at the group-level with rollback capabilities to prevent any misconfigurations caused by manual changes. During the Config Push with Rollback operation, you cannot perform tunnel provisioning or firmware upgrade.

Important Do not start a configuration push while a firmware update operation is active. Cisco IoT FND blocks the configuration push and displays an error. Wait until the firmware update operation is no longer active, and then submit the configuration push.

Note If a deprecated insecure CLI command is pushed to a router in secure mode, Cisco IoT FND moves the router to insecure mode before applying the configuration.

Push a configuration with rollback

The Push with rollback option updates the device configuration by first rolling back to the before-registration-config configuration and then applying the new configuration.

Note When applying a configuration at the device level, if you simultaneously attempt to push a configuration at the group level (for the selected device), then the group-level configuration operation is skipped for the device.

Important Cisco IoT FND blocks configuration pushes during a firmware update. Wait until the firmware update operation is no longer active, and then submit the configuration push.

Configuration Sequence: The configuration is pushed to the device in the following sequence:

1. Roll back to (`before-registration-config`)
2. Apply group-level configuration
3. Apply device-level configuration

Note If the device-level configuration is not defined, then the configuration is pushed in this sequence:

a. Roll back to (`before-registration-config`)

b. Apply group-level configuration

Procedure

Step 1 From the main menubar, choose **Devices** > **Field Devices** > **Router** .

Step 2 Select Cisco IOS or IOS-XE device type from the left pane.

Step 3 In the right pane, click the device for which you want to push the configuration.

Step 4 Click the **Push Configuration** tab.

Step 5 Define the device configuration in the FreeMarker template.

If the template contains a deprecated insecure CLI command, Cisco IoT FND displays a warning so that you can review the command before pushing the configuration.

Step 6 Click **Save** .

Step 7 Select **Push with rollback** from the **Push Router Configuration** drop-down list.

Step 8 Click **Submit** to initiate the config push operation.

- **Config Push Status** : After the config push is initiated, the status is updated in the **Device Status** section. The statuses include:
  - Queued
  - Configuring
  - Success
  - Error

Note
Once the config push with rollback is initiated, the config push status keeps updated every 60 seconds.

Note
The config push status is viewed from either **Push Config** tab or at the group-level (**CONFIG** > **DEVICE CONFIGURATION** > **Push Configuration** tab.

- **Viewing Running Config** : Click the **Running Config** tab to view registration config which is pushed to the device, along with group level config if it exists and the active running config is cleared.

Note
If you perform either a device level config push with roll back or group level config push both get pushed to the device and are displayed in the registration config section and the if the active running config exists, it gets cleared.

Note
If a deprecated insecure CLI command is pushed to a router in secure mode, Cisco IoT FND moves the router to insecure mode before applying the configuration.

What to do next

- Viewing Config Push Events, on page 310
- Viewing the Audit Trail, on page 311

Push a configuration without rollback

The Push without rollback option allows you to apply the configuration to the device without rolling back to the existing configuration (before-registration-config). In this scenario, FND directly pushes the config commands that are defined in the FreeMarker template to the device assuming that the device is already configured at the group level. You can also push the configuration to multiple devices simultaneously in different web sessions.

Viewing New Configuration : You can view the new configuration that is pushed to the device in the **Active Running Config** section of the **Running Config** tab.

Important Cisco IoT FND blocks configuration pushes during a firmware update. Wait until the firmware update operation is no longer active, and then submit the configuration push.

Follow these steps to push a configuration without rollback.

Procedure

Step 1 From the main menubar, choose **Devices** > **Field Devices** > **Router**.

Step 2 Select Cisco IOS or IOS-XE device type from the left pane. The **Inventory** page appears.

Step 3 In the right pane, click the device for which you want to push the configuration.

Step 4 In the Device Info page, click the **Push Configuration** tab.

Step 5 Define the device configuration in the FreeMarker template.

If the template contains a deprecated insecure CLI command, Cisco IoT FND displays a warning so that you can review the command before pushing the configuration.

Step 6 Click **Save Template** .

Step 7 Select **Push without rollback** from the **Push Router Configuration** drop-down list.

Step 8 Click **Submit** .

Step 9 A warning message appears. Click **Yes** .

Note
For viewing running config, click the **Running Config** tab to view both the registration config and the active running config sections. The pushed configuration is displayed in the active running config section.

Config Push Status : After the config push is initiated, the status is updated in the **Device Status** section.

Note

- Both registration and active running configs are displayed when config push is performed without a rollback .
- Once the config push without rollback is initiated, the config push status keeps updated every 10 seconds.
- Maintain the history of commands in the device-level template to preserve them during the reprovisioning process or group-level config operations.

Note
If a deprecated insecure CLI command is pushed to a router in secure mode, Cisco IoT FND moves the router to insecure mode before applying the configuration.

What to do next

- Viewing Config Push Events, on page 310

- Viewing the Audit Trail, on page 311

Note Once the tunnel reprovisioning is successful and the device is registered to Cisco IoT FND, the active running configs gets cleared and only registration config is displayed. If device level and group level configurations are present they are pushed to the device and will appear in the registration config section. This will clear the active running configuration.

Viewing Config Push Events

This section explains the various event statuses available for the configuration push at the device level and group level.

- Viewing config push events at the device level without rollback
- Viewing config push events at the device level with rollback
- Viewing config push events at the group level (for the selected device)

Procedure

Step 1 Choose **DEVICES** > **FIELD DEVICES** > **ROUTER** .

Step 2 Select the device type and click the required device on the right pane.

Step 3 Click the **Events** tab to display events for the selected device, or filter events using the drop-down list.

a) Viewing config push events at the device level without rollback:

- The events of a successful configuration push include:
  - Device Configuration Push Initiated Without Rollback
  - Device Configuration Push Successful
- The events of a failed configuration push include:
  - Device Configuration Push Initiated Without Rollback
  - Device Configuration Push Failed

b) Viewing config push events at the device level with rollback:

- The different events of a successful configuration push include:
  - Device Configuration Push Initiated With Rollback
  - Configuration Rollback
  - Registration Request
  - Registration Success
  - Device Configuration Push Successful

- The different events of a failed configuration push include:
  - Device Configuration Push Initiated With Rollback
  - Configuration Rollback
  - Registration Request
  - Registration Failure
  - Device Configuration Push Failed

c) Viewing config push events at the group level (for the selected device):
- Choose **CONFIG** > **DEVICE CONFIGURATION** > **ROUTER** .
- Select the default configuration group of the selected device.
- Click the **Push Configuration** tab to view the device status in the Device Status table.
  - The various events of a successful configuration push is shown in the **Events Name** column.
  - The various events of a failed configuration push is shown in the **Events Name** column.

Note
Alternatively, you can also view the events from the Operations menu (**OPERATIONS** > **EVENTS**).

Viewing the Audit Trail

To view the audit trail:

Procedure

Choose **ADMIN** > **System Management** > **Audit Trail** .

There are two audit trail statuses:

- Success: When the device-level configuration template is saved.
- Initiated: When the configuration push starts, either with or without rollback.

Security, certificates, and trust services

Cisco IoT FND Username and Password Validation

Cisco IoT FND username and password validation is a security feature that verifies credentials provided via CSV file input to ensure they comply with defined security policies.

- Validates input from both UI and North Bound API (NBAPI) sources.
- Enforces character complexity and format requirements for admin passwords and usernames.
- Prevents the storage of insecure credentials in the Cisco IoT FND database.

Validation Criteria and Feature History

Cisco IoT FND username and password validation helps in deciphering the admin passwords based on which proper error message can be generated. It also ensures that all username and password credentials are secure and meet necessary standards for the communication between Cisco IoT FND and routers along with other devices.

The following table outlines the feature introduction:

Table 63: Feature History

Feature Name	Release Information	Description
Username and Password Validation	Cisco IoT FND Release 5.0	Cisco IoT FND includes username and password validation check for CSV file input.

Admin passwords must adhere to the following rules:

- Include characters from at least three of these categories: uppercase letters, lowercase letters, numbers, and special characters (excluding '?' and '\').
- Must not contain three consecutive identical characters.
- Must not match the username or the reversed username.
- Permitted characters are: a-z, A-Z, 0-9, and special characters !"#$%&'()*+,-./:;<=>@[]^_`{|}~.

General usernames and passwords must use only the following permitted characters: a-z, A-Z, 0-9, and special characters !"#$%&'()*+,-./:;<=>@[]^_`{|}~.

CSV File Operation Failures

The following examples demonstrate invalid entries that trigger validation failures in both the UI and NBAPI:

- adminUsername=Admin1
- adminPassword=Admin1

- cgrusername1=test1_®
- wimaxpkmusername=pkm1_®
- wimaxpkmpassword=pkm1@123?

Note For UI operations, a failure pop-up message is displayed.

For NBAPI operations, the system returns a fault string: `<faultstring>CSV file upload failed. Few or all entries are invalid and does not match the minimum criteria. Please check server.log for more details.</faultstring>`

For UI operation - Server log example:

```
10424: fnd-hsm-ora: Dec 15 2024 18:20:11.873 +0000: %IOTFND-3-UNSPECIFIED:
%[ch=FileUploadJsonAction][sev=ERROR][tid=default task-1]: Failed to upload csv file as
following entries are invalid and do not match the minimum criteria:
[EID:IR807G-LTE-GA-K9+DUMMY-1, 'wimaxpkmusername' should contain following permitted
characters: A-Za-z0-9!"#$%&'()*+,-./:;<=>@[]^_`{|}~ ; 'adminPassword' field has following
errors: 'adminPassword' should not contain 'adminUsername' or reverse of the 'adminUsername'
 field value ; 'cgrusername1' should contain following permitted characters:
A-Za-z0-9!"#$%&'()*+,-./:;<=>@[]^_`{|}~ ; 'wimaxpkmpassword' should contain following
permitted characters: A-Za-z0-9!"#$%&'()*+,-./:;<=>@[]^_`{|}~]
```

For NBAPI operations - Server log example:

```
10462: fnd-hsm-ora: Dec 15 2024 18:24:07.291 +0000: %IOTFND-3-UNSPECIFIED:
%[ch=NBAPICsvFileValidator][sev=ERROR][tid=default task-1][rip=173.38.209.10][rp=22211]:
Failed to upload csv file as following entries are invalid and do not match the minimum
criteria: [EID:IR807G-LTE-GA-K9+DUMMY-1, 'wimaxpkmusername' should contain following permitted
 characters: A-Za-z0-9!"#$%&'()*+,-./:;<=>@[]^_`{|}~ ; 'adminPassword' field has following
 errors: 'adminPassword' should not contain 'adminUsername' or reverse of the 'adminUsername'
 field value ; 'cgrusername1' should contain following permitted characters:
A-Za-z0-9!"#$%&'()*+,-./:;<=>@[]^_`{|}~ ; 'wimaxpkmpassword' should contain following
permitted characters: A-Za-z0-9!"#$%&'()*+,-./:;<=>@[]^_`{|}~]
```

LDevID: Auto-Renewal of Certs and Saving Configuration

The auto-enroll command pushes LDevID-update and autorenewal_update TCL scripts to managed FAR devices to ensure they possess the latest certificates.

Note This feature is not supported on IC3000 or IXM devices.

Note By default, the certificate is renewed when it reaches the lifetime of 90% or you can use the following property to set the required percentage as per your requirement.

`ldevid-auto-enroll-limit=<%>`

Support expired SUDI certificate

Starting from release 4.7.x, Cisco IoT FND supports expired SUDI certificates. It is a security mechanism that allows Cisco IoT FND to authenticate devices even when their SUDI certificates have passed their expiration date.

- Enables authentication during SCEP enrollment for devices with expired SUDI certificates.
- Skips certificate expiry checks at the security module for Zero Touch Deployment (ZTD) and WSMA communication flows.
- Maintains operational continuity for previously enrolled devices using LDevID. LDevID certificates have limited lifetimes and can be renewed or re-acquired using Cisco SUDI as credentials.

However, if a device with an expired Cisco SUDI certificate that was not previously enrolled or a previously enrolled device that was reinitialized and is added to a system using FND, authentication during SCEP enrollment fails unless FND skips the expiry check while validating the SUDI certificate as part of incoming request.

SUDI Certificate Lifecycle and Support

During the initial Simple Certificate Enrollment Protocol (SCEP) process, the Cisco SUDI certificate authenticates with the Registration Authority (RA) to acquire an Local Device Identifier (LDevID) certificate. Once the LDevID is enrolled, it handles ongoing communication with Cisco IoT FND, rendering the SUDI certificate unnecessary unless specific re-initialization events occur.

Events requiring the SUDI certificate include:

- Factory reset
- Return Material Authorization (RMA)
- Router configuration rollback to express-setup-config

Supported Cisco Field Area Routers (FARs) in which the SUDI is burned into the device include:

- C819, CGR1120, CGR1240, IR807, IR809, IR829, IXM, and IR1101.

Note The SUDI for these systems expires on either the date of manufacture plus 20 years or May 14, 2029, whichever is earlier.

SUDI Certificate Details

The following output displays the status and validity dates of a typical SUDI certificate and its associated CA certificate:

```
SUDI Certificate:
Certificate
Status: Available
Certificate Serial Number (hex): 01CDAFB1
Certificate Usage: General Purpose
Issuer:
cn=ACT2 SUDI CA
```

```
o=Cisco
Subject:
Name: CGR1240
Serial Number: PID:CGR1240/K9 SN:FTX2133G01Z
cn=CGR1240
ou=ACT-2 Lite SUDI
o=Cisco
serialNumber=PID:CGR1240/K9 SN:FTX2133G01Z
Validity Date:
start date: 03:19:56 UTC Aug 17 2017
end date: 03:19:56 UTC Aug 17 2027
Associated Trustpoints: CISCO_IDEVID_SUDI
CA Certificate
Status: Available
Certificate Serial Number (hex): 61096E7D000000000000C
Certificate Usage: Signature
Issuer:
cn=Cisco Root CA 2048
o=Cisco Systems
Subject:
cn=ACT2 SUDI CA
o=Cisco
CRL Distribution Points:
http://www.cisco.com/security/pki/crl/crca2048.crl
Validity Date:
start date: 17:56:57 UTC Jun 30 2011
end date: 20:25:42 UTC May 14 2029
Associated Trustpoints: CISCO_IDEVID_SUDI
```

Enrollment over Secure Transport (EST) support matrix

This topic provides an overview of EST certificate enrollment and details the support matrix for various platforms and releases. This feature is supported on Itron meters, L+G meters, IR510, and IR530.

Table 64: EST Support

CR-Mesh Release	Platform	EST Support
6.2.34 MR onwards	IR530, IR510	Enrollment and re-enrollment
	ITRON30	Re-enrollment
6.3.20 onwards	IR510, IR530, ITRON30	Enrollment and re-enrollment

EST Overview

The EST service acts as an intermediary between a Certification Authority and a client, utilizing HTTP to manage secure PKI transactions.

- Provides an authenticated and authorized communication channel.
- Supports certificate management operations.

EST Protocols and Authentication Methods

EST operates using the following protocols and authentication methods:

- Constrained Application Protocol (COAP): A web transfer protocol designed for constrained nodes and networks, such as low-power, lossy networks.
- TLS/SSL Handshake: Used for communication between the Registration Authority (RA) and the CA.
- Datagram Transport Layer Security (DTLS): The preferred method for securing CoAP messages when nodes lack IPv6 addresses; it uses UDP and is based on TLS.
- Trust Anchor: Explicitly configured on the client or server to support EST TLS authentication.

Configure FND Registration Authority (RA)

Follow these steps to configure the FND Registration Authority.

Procedure

Step 1 Install the FND-RA rpm.

Step 2 Configure FND-RA by running the setup script and providing the required server details.

```
[root@iot-fnd-ra fnd-ra]# cd /opt/fnd-ra/bin
python3.9 ra_setup.pyc
Do you want to change the Authentication server[y/n]? y
What Authentication server are you using?
1) Microsoft Certificate Services Auth
2) RADIUS
Enter 1 or 2
Authentication Server: 2
Host Name or IP address of the RADIUS server [10.29.36.224]:
Port Number of the RADIUS server (MIN=1, MAX=65535) [1812]:
Number of retries allowed for authentication requests (MIN=1, MAX=30) [5]:
RADIUS timeout in seconds (MIN = 1, MAX = 30) [5]:
Do you want to set the RADIUS realm [y/n]: n
Do you want to change the CA server[y/n]? y
What CA server are you using?
1) Microsoft CA
2) EST Proxy
Enter 1 or 2
CA Server: 2
Host Name or IP address of the EST CA [] 10.29.36.232
Port number of the EST CA (MIN=1, MAX=65535) [6789]:
EST CA proxy user ID[estuser]: <causer>
Timeout for the EST CA (MIN=1, MAX=60) [10]: 10
Do you want to set the Injected Path Segment [y/n]: n
Do you want to change the CA/Auth server credentials [y/n]? y
Enter CA/Auth credentials
Path and file name of the private key file: /home/certs/server-key.pem
Password to use with EST Proxy: password
RADIUS shared secret: <radius password>
Do you want to change RA server settings[y/n]? y
Host Name or IP Address for the RA to listen on[]: 10.29.36.243
Path to the identity certificate of RA []: /home/certs/server-cert.pem
Path and file name to the trusted certificate store for the RA[]:
[/home/certs/est_trust_certificate.pem
Path and file name to the CACerts response file[]:
/home/certs/multicacerts.crt
RA log level (debug/info/warn/error) [debug]: debug
Transport protocol (http/coap) [coap]: coap
What is the DTLS handshake timeout (MIN=2, MAX=60) [5]:5
```

```
What is the DTLS MTU size (MIN=256, MAX=1152) [1152]:1152
Do you want to change the FND server details[y/n]? y
FND IP address or host name [2100::5]: 10.29.36.235
FND Username [root]: root
Allow self signed certificate for fnd (y/n) [y]: y
FND password : <FND UI password for root user>
Please find your selections below:
Host Name or IP address of the RADIUS server : 10.29.36.224
Port Number of the RADIUS server (MIN=1, MAX=65535) : 1812
Number of retries allowed for authentication requests (MIN=1, MAX=30) : 5
RADIUS timeout in seconds (MIN = 1, MAX = 30) : 5
Do you want to enable Enhanced Certificate Auth CSR Checking (on/off) :
off
Certificate attribute to be used in the local PKI domain? : commonName
Name for manufacturer 1 : cisco
Certificate attribute to be used in this manufacturer's local PKI domain :
serialNumber
Path of the trust store for manufacturer 1 : /opt/fnd-ra/conf/sudica.pem
Host Name or IP address of the EST CA : 10.29.36.232
Port number of the EST CA (MIN=1, MAX=65535) : 6789
EST CA proxy user ID : estuser
Timeout for the EST CA (MIN=1, MAX=60) : 10
Host Name or IP Address for the RA to listen on : 10.29.36.243
Path to the identity certificate of RA : /home/certs/server-cert.pem
Path and file name to the trusted certificate store for the RA:
/home/certs/est_trust_certificate.pem
Path and file name to the CACerts response file :
/home/certs/multicacerts.crt
RA log level (debug/info/warn/error) : debug
Transport protocol (http/coap) : coap
What is the DTLS handshake timeout (MIN=2, MAX=60) : 5
What is the DTLS MTU size (MIN=256, MAX=1152) : 1152
FND IP address or host name : 10.29.36.235
FND Username : root
Allow self signed certificate for fnd (y/n) y
Do you confirm the selections[y/n]? : y
```

Step 3 Start the RA service.

Example:

```
[root@iot-fnd-ra fnd-ra]# service fnd-ra start
```

Step 4 Verify the status of the RA service.

Example:

```
[root@iot-fnd-ra fnd-ra]# service fnd-ra status
```

Step 5 Verify the configuration.

Example:

```
#cat /opt/fnd-ra/conf/nginx.con
```

Configure DTLS Relay and Monitor Cisco-RA Watchdog in Cisco IoT FND

Enable secure relay communication and verify Registration Authority monitoring within Cisco IoT FND.

Supported from Cisco IoT FND version 4.5.0.122 onwards. Use this task to set up DTLS relay settings for device groups and monitor the Cisco-RA Watchdog and authentication status.

Follow these steps to configure DTLS relay settings and monitor Cisco-RA Watchdog.

Procedure

Step 1 Choose **Config** > **Device Configuration** .

Step 2 Under **Endpoint**, select **Default-IR500**.

Step 3 Click **Edit Configuration Template**.

Step 4 In the **DTLS Relay Settings** section, select **Enable** from the drop-down list.

Step 5 Enter the **RA Server IPv6 Address** and push the configuration to the first and subsequent hop nodes that have joined CGR and registered with FND.

Step 6 To monitor Watchdog Cisco-RA, choose **Devices** > **Servers** > **Services** > **Registration Authority Servers** .

Step 7 To verify Cisco RA/EST-CA and RADIUS IPv4 address authentication, choose **Devices** > **Servers** > **Services** > **Registration Authority Servers** .

Cisco IoT FND server log samples

This reference provides log samples to verify successful and unsuccessful authentication and registration attempts for FND connectivity.

The following example shows the server.log for incorrect password:

```
tail -f /opt/cgms/server/cgms/log/server.log | grep 10.29.36.243
6844: localhost: Apr 03 2019 22:48:36.589 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=CustomLoginModule][sev=INFO][tid=http-/0.0.0.0:443-7][rip=10.29.36.243]
[rp=10051]: userName :[root]
6845: localhost: Apr 03 2019 22:48:36.625 +0000: %IOTFND-3-UNSPECIFIED: %
[ch=AAAUtils][sev=ERROR][tid=http-/0.0.0.0:443-7][rip=10.29.36.243]
[rp=10051]: Passwords do not match for local user 'root'
6846: localhost: Apr 03 2019 22:48:36.635 +0000: %IOTFND-3-UNSPECIFIED: %
[ch=CustomLoginModule][sev=ERROR][tid=http-/0.0.0.0:443-7]
[rip=10.29.36.243][rp=10051]: Local Northbound API user 'root' failed
authentication.
```

This example shows the server.log when the RA registration is successful:

```
tail -f /opt/cgms/server/cgms/log/server.log | grep 10.29.36.243
7105: localhost: Apr 03 2019 22:58:44.582 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=CustomLoginModule][sev=INFO][tid=http-/0.0.0.0:443-6][rip=10.29.36.243]
[rp=10057]: userName :[root]
7106: localhost: Apr 03 2019 22:58:44.610 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=CustomLoginModule][sev=INFO][tid=http-/0.0.0.0:443-6][rip=10.29.36.243]
[rp=10057]: Local Northbound API user 'root', IP '10.29.36.243'
successfully authenticated. Passwords matched.
6916: kml-fnd1: Apr 15 2019 17:53:44.680 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=SessionListener][sev=INFO][tid=http-/0.0.0.0:443-7]: Session timeout:
1800 secs.
6917: kml-fnd1: Apr 15 2019 17:53:44.681 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=BaseApiWebService][sev=INFO][tid=http-/0.0.0.0:443-7]: Checking
permission for user : root
6918: kml-fnd1: Apr 15 2019 17:53:44.712 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=ServiceServer][sev=INFO][tid=http-/0.0.0.0:443-7]: Received service
notification request from service [RAiot-fnd-ra]
```

This example shows the server.log when the RA registration is unsuccessful because the user does not have NBAPI orchestration permission:

```
907: kml-fnd1: Apr 15 2019 17:53:07.492 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=CustomLoginModule][sev=INFO][tid=http-/0.0.0.0:443-7][rip=172.27.126.8]
[rp=42167]: userName :[kaberi]
6908: kml-fnd1: Apr 15 2019 17:53:07.520 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=CustomLoginModule][sev=INFO][tid=http-/0.0.0.0:443-7][rip=172.27.126.8]
[rp=42167]: Local Northbound API user 'kaberi', IP '172.27.126.8'
successfully authenticated. Passwords matched.
6909: kml-fnd1: Apr 15 2019 17:53:07.526 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=SessionListener][sev=INFO][tid=http-/0.0.0.0:443-7]: Session timeout:
1800 secs.
6910: kml-fnd1: Apr 15 2019 17:53:07.527 +0000: %IOTFND-6-UNSPECIFIED: %
[ch=BaseApiWebService][sev=INFO][tid=http-/0.0.0.0:443-7]: Checking
permission for user : kaberi
6911: kml-fnd1: Apr 15 2019 17:53:07.546 +0000: %IOTFND-3-UNSPECIFIED: %
[ch=CustomPermissionResolver][sev=ERROR][tid=http-/0.0.0.0:443-7]:
Northbound API user 'kaberi' is NOT allowed to perform action
'nbapi-orchestrationService'.
```

Supported Cisco RA events on Cisco IoT FND

This topic provides a reference for RA events generated by nodes and monitored within Cisco IoT FND.

The following RA events are supported from Cisco IoT FND version 4.5.0.122 onwards:

- Enroll request/response/failure: Generated during initial enrollment and re-enrollment of node with CA server. Failure occurs when the CA server (./runserver.sh is not running) is not up or port is blocked.
- Auth success/failure: Generated during the dot1x authentication of node with the RADIUS server. Failure occurs when the Radius server IP is wrong in the FND-RA script (nginx.conf), or dot1x entries are either wrong or not present.
- CACert Request/Response: Generated during the CA cert re-enrollment.
- Device Unknown Event: RA Events generated by a node which is not recognized/registered on FND.
- SSL Event: Generated when there is an SSL protocol error.

Hardware Security Module

The Hardware Security Module (HSM) is a physical computing device that safeguards and manages digital keys for strong authentication. Cisco IoT FND accesses the HSM (Hardware Security Module) server using the HSM Client.

- Requires the installation of an HSM Client on the Linux server hosting the Cisco IoT FND application.
- Utilizes the HSM client API for integration and dynamic slot ID assignment. The HSM client assigns a slot number to the HSM Server and also to the HA Group.
- Supports version-specific slot numbering, where version 5.4 or earlier uses slot 1, and version 6.x or later uses slot 0.

HSM Client Configuration and Slot ID Management

Cisco IoT FND retrieves the slot value dynamically from the HSM Client API. During upgrades from version 5.4 to 7.3, the slot ID change may not populate dynamically, requiring manual intervention. (CSCvz38606)

Note The slot ID change will be communicated to the FND server by the HSM Client API upon restart of the Cisco IoT FND application. If the HSM Client fails to send the correct slot value to the FND application server, you can manually set the slot ID in the */etc/Chrystoki.conf* configuration file by adding the following entry:

```
Presentation = {OneBaseSlotID=1;}.
```

Verification of FND and HSM Integration After FND and HSM Upgrade

If HSM is deployed with a FND application for storing the CSMP keys and certificates; then, after a FND upgrade or after a HSM client upgrade, the following checks can be made to ensure that HSM integration is working.

Procedure

Step 1 Go to **Admin** > **Certificates** in the FND GUI and check if the CSMP certificate is present.

Note
If it is a High Availability (HA) setup for the FND server, then follow the step above for both FND servers. If the CSMP certificate is missing, then follow the steps listed in the common errors table for "HSM 5.x certificate will not load."

Step 2 Enter **`cat/opt/cgms/server/cgms/log/server.log | grep HSM`**
`cat/opt/cgms/server/cgms/log/server.log | grep HSM`.

Retrieved public key:

```
3059301306072a8648ce3d020106082a8648ce3d03010703420004d914167514ec0a110f3170eef74
2a000572cea6f0285a3074db87e43da398ab016e40ca4be5b888c26c4fe91106cbf685a04b0f61d599
826bdbcff25cf065d24
```

Note
If it is a High Availability (HA) setup for the FND server, then follow the step above for both FND servers.

Step 3 Verify the connectivity of the HSM client and HSM server by checking if NTLS is established on port 1792 and if the HSM client can retrieve the HSM partition number and name using the **`./vtl verify`** and **`ccfg listservers`** commands in the lunacm utility.

```
[root@fndblr17 ~]# cd /usr/safenet/lunaclient/bin
[root@fndblr17 bin]#
[root@fndblr17 bin]#./vtl verify
vtl (64-bit) v7.3.0-165. Copyright (c) 2018 SafeNet. All rights reserved.
The following Luna SA Slots/Partitions were found:
Slot Serial # Label
==== ============== =====
- 1358678309716 TEST2
TEST2 is partition name
1358678309716 is the serial number assigned to partition TEST2
[root@fndblr17 bin]#./lunacm
lunacm (64-bit) v7.3.0-165. Copyright (c) 2018 SafeNet. All rights reserved.
Available HSMs:
Slot Id -> 0
```

```
Label -> TEST2
Serial Number -> 1358678309716
Model -> LunaSA 7.4.0
Firmware Version -> 7.4.2
Configuration -> Luna User Partition With SO (PED) Key Export With Cloning Mode
Slot Description -> Net Token Slot
Slot Id -> 4
HSM Label -> TEST2HAGroup1
HSM Serial Number -> 11358678309716
HSM Model -> LunaVirtual
HSM Firmware Version -> 7.4.2
HSM Configuration -> Luna Virtual HSM (PED) Key Export With Cloning Mode
HSM Status -> N/A - HA Group
Current Slot Id: 0
lunacm:>ccfg listservers
Server ID Server Channel HTL Required
_____________________________________________________________________
1 172.27.126.15 NTLS no
Command Result : No Error
lunacm:>exit
[root@fndblr17 bin]#
```

Step 4 Run the **cmu list** command to retrieve the label of the key and CSMP certificate.

This command requires the HSM partition password (or the HSM HAGroup password in case of HA).

```
[root@fndblr17 bin]# cd /usr/safenet/lunaclient/bin
[root@fndblr17 bin]#./cmu list
Certificate Management Utility (64-bit) v7.3.0-165. Copyright (c) 2018 SafeNet. All rights
reserved.
Please enter password for token in slot 0 : *******
handle=2000001 label=NMS_SOUTHBOUND_KEY
handle=2000002 label=NMS_SOUTHBOUND_KEY--cert0
You have new mail in /var/spool/mail/root
[root@fndblr17 bin]#
```

Step 5 If communication issues persist, enable CK logs to diagnose the HSM client API and FND interaction.

CK logs are resource intensive; enable them only when required and disable them after use. Logs are generated in the **/tmp** directory.

To enable cklogs:

- Go to **/usr/safenet/lunaclient/bin** and run **./vtl cklogsupport enable** .

```
[root@fndserver ~]#cd /usr/safenet/lunaclient/bin
[root@fndserver bin]# pwd
/usr/safenet/lunaclient/bin
[root@fndserver bin]#./vtl cklogsupport enable
vtl (64-bit) v7.3.0-165. Copyright (c) 2018 SafeNet. All rights reserved.
Chrystoki2 LibUNIX = /usr/safenet/lunaclient/lib/libCryptoki2.so
Chrystoki2 LibUNIX64 = /usr/safenet/lunaclient/lib/libCryptoki2_64.so
Cklog not enabled (entry is Null)
Enabling cklog
[root@fndserver bin]#
```

- The log file is generated at **/tmp/cklog.txt** .

```
[root@fndserver bin]# cd /tmp
[root@fndserver tmp]# ls | grep cklog.txt
cklog.txt
[root@fndserver tmp]#
```

Note

HSM does not recommend cklogs to be enabled all the time.

To disable:

Run **[root@fndserver bin]#./vtl cklogsupport disable** .

```
[root@fndserver ~]# cd /tmp
[root@fndserver tmp]# ls -al | grep cklog.txt
-rw-r--r--. 1 root root 12643866 Oct 11 00:17 cklog.txt
[root@fndserver tmp]#
[root@fndserver tmp]# mv cklog.txt cklog_old_11oct21.txt
[root@fndserver tmp]# ls -al | grep old
-rw-r--r--. 1 root root 12646086 Oct 11 00:20 cklog_old_11oct21.txt
[root@fndserver tmp]#
```

Manage servers

The Servers page displays server device properties in a default list view. You can obtain specific information about a server by selecting its name. By default, the page displays the servers in List view. When you open the Servers page in List view, Cisco IoT FND displays the Default list view. This view displays basic server device properties.

Procedure

Step 1 Navigate to **Devices** > **Servers** .

Step 2 Click the name of the server to view its details.

What to do next

For information about customizing views, see Customize device views, on page 266 . For details regarding device properties or common operations, see Device Properties, on page 334 and Common device operations, on page 261 .

View server information

Procedure

Step 1 Select **DEVICES** > **Servers**.

Step 2 Click the name of the server to open the server details page.

Table 65: NMS Server Pane Areas

Area and Field Name	Description
Host System Information	
Hostname	Hostname of the IoT FND server.

Area and Field Name	Description
Host Operating System	Operating system.
CPU	CPU specifications and CPU Usage graph.
Total Memory	Total amount of RAM memory (GB) available on the system and Memory Usage graph.
Current System Time	Current system time.
Host Disk Information	
File System	File system.
Size	Size of file system disk space (GB).
Used	Amount of file system disk space used (GB).
Available	Available file system disk space (GB).
Use %	Percentage of file system disk space used.
Mounted On	The directory in which the file system is mounted.
IoT FND Application Information	
EID	EID of the server.
Start Time	Time when the IoT FND server started.
Number of Restarts	The number of times the IoT FND application has restarted.
Memory Allocation	Memory space allocation in GB for the IoT FND application.
Graphs	
CPU usage	Displays usage information during set and custom-defined intervals. For more information on viewing the chart for default or custom-defined time intervals, refer to Set time filters to view charts, on page 450
Memory Usage	Memory usage plotted in MB.
CSMP	CoAP Simple Management Protocol (CSMP) message statistics.

Manage Application Management Servers

To display details on the Fog Director, navigate through the top-level menu.

Procedure

Step 1 From the main menu, click **Devices** > **Services**.

Step 2 Select **Application Management Servers**.
Details such as Host System Information, Host Disk Information and Service Information appear. Graphs display details on CPU usage and memory usages.

Manage NMS and database servers

In the Browse Devices pane, both NMS and Database servers appear under the All Server Devices heading. In single NMS or Database server deployments, only one server appears under the NMS and/or Database Servers heading. In cluster deployments, multiple NMS servers appear under the NMS Servers heading.

Note By default, only those NMS and Database Servers in an Up state display.

Procedure

Step 1 To display all NMS servers, click **Devices** > **Servers** in the top-level menu and then select NMS Servers within the **Browse Devices** pane.

Step 2 To display all Database servers, click **Devices** > **Servers** in the top-level menu and then select Database Servers within the Browse Devices pane.

In single-server deployments, only one database server appears under Database Servers. If a secondary database is configured, it also appears under the same entry.

Files, firmware and reference data

Manage Files

In Cisco IoT FND, the Device file management page enables administrators to handle router-specific scripts and configuration files.

- Supports dual backhaul script execution.
- Facilitates Embedded Event Manager script deployment.
- Performs automated file validation through the Template module.

Note File management is role-dependent and may not be available to all users. See Manage Roles and Permissions in the Managing User Access chapter.

Procedure

Navigate to **CONFIG** > **Device File Management** to manage router files.

File types and attributes

Provides details on EEM script types, including embedded applets and TCL scripts, and outlines the attributes used by Cisco IoT FND to manage transferred files.

Two types of EEM scripts are used on the router: an embedded applet, and Tool Command Language (TCL) scripts that execute on the router individually. You can upload and run new EEM TCL scripts on the router without doing a firmware upgrade. EEM files upload to the *eem* directory in router flash memory. These scripts display in the **Import File** page File Type column as *eem script*. You must edit the configuration template file to activate the EEM TCL scripts (see Edit the ROUTER configuration template, on page 297). This feature works with all router OS versions currently supported by Cisco IoT FND.

You can also transfer other file types to the router for better file management capability. You must first import the files to Cisco IoT FND to upload files to the router. Cisco IoT FND processes the file and stores it in the Cisco IoT FND database with the following attributes:

- Filename
- Description
- Import Date/Time
- Size
- Sha1 Checksum
- MD5 Checksum
- File Content

Add a router device file to Cisco IoT FND

When you want the router device to be managed by Cisco IoT FND, upload the router device files on the Device File Management page.

Procedure

Step 1 Navigate to **Config** > **Device file management**.

Step 2 Select **Actions** > **Upload** to navigate to the **Upload File to Routers** page.

Step 3 Search for the device by entering the device name or an abbreviated string in the search field.
The search displays a list of all routers that match your criteria. You can also enter the file path to the router in the File Path field.

Step 4 Configure the display settings and select the files to upload.

- Define how many devices display on the screen by selecting a value (10, 50, 100, or 200) from the drop-down menu at the far-right of the screen.
- Remove the check mark next to any individual router file that you do not want to upload.

Step 5 Click **Upload File** to finalize the list and upload the files.

Delete a file from Cisco IoT FND

Remove obsolete or unnecessary files from the Cisco IoT FND database.

Use this task to permanently remove files that have been uploaded to the Cisco IoT Field Network Director (FND) database, provided that those files are not part of an active file transfer. This process does not delete files from routers where the file may have previously been transferred.

Note Confirm the file size is less than 100 KB if you want to view the contents before deletion. The Name link enables you to view uploaded text files.

Follow these steps to delete imported files from the Cisco IoT FND database.

Procedure

Step 1 From the main menubar, choose **Config** > **Device File Management** page, and select a file from the List dialog box (far-left panel).

Step 2 Click the **Actions** tab, and then click **Delete** .

Step 3 In the **Delete from List** panel, select a file and click **Delete File** .

The selected file is removed from the Cisco IoT FND database. The file persists on routers where it has already been deployed.

Transferring Files

You can transfer files from the NMS database to any firmware, configuration or tunnel provisioning group, or to individual routers. The maximum import file size is 200 MB.

Procedure

Step 1 On the **CONFIG** > **Device File Management** page, select the group to transfer the file from the **Browse Devices** left pane.

Step 2 Click **Import Files** or **Upload** on the **Actions** tab. The **Select File from List** dialog box displays.

Step 3 Select the file to transfer to the routers in the selected group.

Step 4 Click **Upload File** .

The **Upload File to Routers** dialog box displays.

Step 5 Check the check boxes of the routers to which you want to transfer the file.

Step 6 Click **Upload** .

What to do next

If there is no file transfer or deletion, configuration push, firmware upload, or install or reprovision operations in progress for the group, the upload starts.

You can choose to transfer files to all routers in the selected group or select only a subset of the routers in the group. You can also select another group and file to perform a separate file transfer or deletion simultaneously.

All files that are transferred from IoT FND reside on the router in `flash:/managed/files/` for Cisco IOS CGRs.

The status of the last file transfer is saved with the group as well as the operation (firmware update, configuration push, and so on) and status of the group.

The following file transfer status attributes are added to all group types:

- File Operation: upload
- Start Date/Time of the last transfer
- End Date/Time
- Filename
- Allow overwrite: Select True to allow overwrite of file on the CGR
- Success Count
- Failure Count
- Total Count: The number of CGRs selected for the operation
- Status: NOTSTARTED, RUNNING, FINISHED, STOPPING, STOPPED

Viewing Files

To view imported text file content:

Procedure

Step 1 Select **CONFIG** > **Device File Management** .

Step 2 Click the EID link (such as CGR1240/K9+JAF1626BLDK) listed under the Name column to display the Device Info pane.

Step 3 Click the **Router Files** tab.

Step 4 Click the filename link to view the content in a new window.

What to do next

Note IoT FND only displays files saved as plaintext that are under 100 KB. You cannot view larger text files or binary files of any size. Those file types do not have a hyperlink.

Monitor Actions

The **Actions** tab on the **CONFIG** > **Device File Management** page provides visibility into the status of the last file transfer or deletion. It displays various attributes including start and finish times, file paths, process status, and error counts.

Procedure

Step 1 Navigate to the **CONFIG** > **Device File Management** page and click the **Actions** tab.

Step 2 Review the status of the last file transfer or deletion using the following attributes:

Attributes
Start Time and Finish time of the last transfer
File name
Status of the process: UNKNOWN, AWAITING_DELETE, DELETE_IN_PROGRESS, DELETE_COMPLETE, CANCELLED, FINISHED, NONE, NOTSTARTED, UPLOAD_IN_PROGRESS, UPLOAD_COMPLETE, STOPPING, STOPPED
Completed Devices: Displays the total number of (upload complete/total number of target devices)
Error/Devices: Number of errors and errored device count
File Path
Status: Icon displays: ?, X or check mark
Name: EID link to Device Info page
Last Status Time
Activity: UPLOAD, DELETE, NONE
File: Name of file
Status: Text description of status
Progress: Percentage number

Attributes
Message: Describes any issues discovered during the process
Error: Description of the error type

Step 3 Click the **Cancel** button if you need to terminate any active file operation.

Monitor files

On the **CONFIG** > **Device File Management** page, the **Managed Files** tab displays a list of routers and the files uploaded to their .../managed/files/ directories. Devices listed in the main pane are members of the selected group.

The following information is included in this list:

- EID link (Name) to the Device Info page
- Number of files (#Files) stored on the device
- File Names uploaded

Procedure

Step 1 Navigate to **CONFIG** > **Device File Management**.

Step 2 Click the **Managed Files** tab.

Step 3 Filter the list by selecting a file name from the **Filter By File Name** drop-down menu.

Select **All** from the menu to include all devices in the group.

Step 4 Click the refresh button to update the list during file transfer or deletion processes.

Battery backup units in Cisco IoT FND

Battery Backup Units (BBUs) are emergency power sources that maintain router operation when AC power is unavailable.

- Provide power to routers during AC power failure.
- Support up to three BBU units per router.
- Enable remote management and firmware upgrades via Cisco IoT FND.

BBU Configuration and Management

Administrators can enable or disable BBUs and manage firmware at the router group level for supported devices, including

- Cisco CGR 1000 Series router CGR1240: For more information on BBUs in CGR 1000 Series router CGR1240, see BBUs in Cisco 1240 Connected Grid Router .
- Cisco Catalyst IR8140: For more information on BBUs in Cisco Catalyst IR8140 router, see BBUs in Cisco Catalyst IR8140.

For more information on router battery session, see Router Battery.

Consider these operational requirements when managing BBUs:

- Warning messages appear if you disable a BBU while AC power is off, which may result in router shutdown.
- Management actions apply to all BBUs on a router simultaneously rather than individual units.
- Cisco IoT FND displays an error if you attempt to manage BBUs that are not physically present.
- BBUs are disabled by default during onboarding and are activated automatically during Zero Touch Deployment (ZTD).
- A two-minute cooldown period is required between consecutive enable or disable operations.

Table 66: Feature History

Release Information	Feature Name	Description
Cisco IoT FND Release 5.1	Support for Enabling or Disabling Battery Backup Units (BBUs) in Cisco IoT FND with BBU Firmware Upgrade	Provides options to enable or disable BBUs and upgrade firmware for CGR1240 and IR8140 routers. Additionally, you can upgrade the BBU firmware images for these routers at the router group level by uploading and installing them in Cisco IoT FND.

Enable BBUs

Use this task to enable BBUs on a router in Cisco IoT FND.

The Battery Backup Unit menu is available from the Device Info page for routers that have a BBU.

Before you begin

Note

- You can use the **Enable BBU** option only if a BBU is present on the router and if it is already in the disabled state. Otherwise, this option appears disabled in the **Device info** > **Battery Backup Unit** drop-down list.
- If you attempt to enable a Battery Backup Unit (BBU) that is already enabled on a router, you will receive a message with this notification: `BBU is already Enabled. Do you forcefully want to enable BBU?`

Procedure

Step 1 From Cisco IoT FND menubar, choose **DEVICES** > **FIELD DEVICES** > **Groups**.
Step 2 Select **ROUTER**.
Step 3 Click router in the list of routers.
Step 4 Click **Battery Backup Unit** from the menu options which appear over **Device Info** page.
Step 5 Click **Enable BBU**.
Step 6 Click **Yes**.

The battery is enabled, and the status is displayed on the command status pop-up screen as completed.

Disable BBUs

To disable the Battery Backup Unit on a managed router using Cisco IoT FND, ensuring the system accurately reflects the BBU's status.

Perform this task when you need to turn off the BBU on a router for maintenance, replacement, or troubleshooting, using the Cisco IoT FND interface.

Before you begin

Note
- Ensure the router has a BBU that is presently enabled.
- You can only use the **Disable BBU** option if the BBU is present and enabled.
- If the BBU is already disabled, attempting to disable it will prompt a message: `BBU is already Disabled. Do you forcefully want to disable BBU?`

Follow these steps to disable a Battery Backup Unit:

Procedure

Step 1 From Cisco IoT FND menubar, choose **Devices** > **Field Devices** > **Groups** .
Step 2 Select **Router** .
Step 3 Click router in the list of routers.
Step 4 Open the router's Device Info page and go to **Battery Backup Unit**.
Step 5 Click **Disable BBU**.
Step 6 Click **Yes** to confirm the action.

The BBU is disabled, and the updated status displays in the interface as "Completed." If the operation fails, the status is shown as "Failed" and the BBU remains enabled.

What to do next

Once you enable or disable BBU on the router, you can proceed with checking the BBU status in the **Router Battery** section of the **Device info** page or you can check the status in **ADMIN** > **SYSTEM MANAGEMENT** > **AUDIT TRAIL** page.

To confirm the BBU status, check the Router Battery section on the router's device info page, or review the status under **Admin** > **System Management** > **Audit Trail**.

BBU firmware images

BBU firmware images are software files used to update and enhance the BBU firmware of routers in Cisco IoT FND.

- Supports firmware upgrades at the router group level.
- Functions similarly to router firmware image installations in Cisco IoT FND.

Add BBU firmware image

Use this task to add BBU firmware image.

Before you begin

Before proceeding with BBU firmware upgrade, you need to consider these points:

- Ensure that the AC power supply is ON before you begin the BBU firmware upgrade process. If the AC power is OFF, then the firmware upgrade is skipped for the supported routers during firmware installation.
- Ensure the BBU is in the enabled state.
- Cisco Catalyst IR8140 routers with firmware version below 17.09.01 and CGR 1000 Series CGR1240 routers with firmware version below 15.9.3.M7a are not supported for BBU upgrades and they are skipped during installation.

Procedure

Follow the steps given in: Add firmware images

Note
Select **IOS-BBU** as the firmware image.

The BBU image appears in the **Firmware Images** list.

What to do next

See, Upload BBU firmware image .

Upload BBU firmware image

Use this task to upload BBU firmware image.

Before you begin

Note

- The BBU firmware image used for upload is present in the `bootflash:/bbu_fw` directory.
- You must select **IOS-BBU** in the **Select Type** drop-down list for uploading BBU firmware image.
- For BBU firmware upgrades the **Mode of installation** option is disabled during upload.

Procedure

Follow the steps given in: Upload firmware images .

BBU firmware image is uploaded.

Note In case the upload fails for any reason, you will receive a corresponding error message, after which you can retry uploading the BBU firmware image.

What to do next

See, Install BBU firmware image .

Install BBU firmware image

Use this task to install a BBU firmware image.

BBU firmware image installation starts after the BBU firmware image upload completes successfully and without errors.

Before you begin

Ensure BBU firmware image upload has completed successfully and without errors, before you can proceed with installing BBU firmware image.

Procedure

Follow the steps given in: Install firmware images.

The BBU firmware image is installed.

Note In case the BBU firmware image installation fails for any reason, you will receive a corresponding error message, after which you can retry the BBU firmware installation again.

What to do next

See View BBU firmware images.

View BBU firmware images

Use this task to view BBU firmware image.

Procedure

Follow the steps given in: View firmware images .

You can view the list of firware images associated with the router including the BBU firmware image you installed.

Device Properties

Provides a comprehensive overview of device properties and their configuration status in Cisco IoT FND.

The **System Security Mode** inventory property identifies whether a supported Cisco IOS XE router is operating in secure or insecure mode.

Types of device properties

Cisco IoT FND stores two types of device properties in its database to facilitate device identification and location mapping.

The supported device property types are:

- **Actual device properties** : These are the properties defined by the device, such as IP Address, Transmit Speed, and SSID.
- **Cisco IoT FND device properties** : These are properties defined by Cisco IoT FND for devices, such Latitude and Longitude properties, which Cisco IoT FND uses to display device locations on its GIS map.

Note The Key column provides the version of the property name in the Cisco IoT FND database that you can use in filters. For example, to search for the device with an IP address of 10.33.0.30, enter **ip:10.33.0.30** in the Search Devices field.

Device properties by category

This reference provides an overview of Cisco IoT FND device properties, detailing how configurable and discovered fields are utilized for device searches and configuration templates.

Every device in Cicso IoT FND presents a list of fields, which are used for device searches. The available fields for a device are defined in the **Device Type** field. Fields are either configurable or discovered. Configurable fields are set using XML and CSV files; the device EID is the lookup key. Discovered fields are presented from the device. Fields are also accessible in the device configuration templates for routers.

Router Config

Provides a detailed overview of the Router Config fields available under Field Devices. The table provides keys and configuration status, to support accurate device property management.

Table 67: Router Config Device View

Field	Key	Configurable	Description
Use GPS Location	useGPSLocationConfig	Yes	The internal GPS module provides the router location (longitude and latitude).

Router Credentials

Provides a reference for the configuration fields used to manage router authentication and security credentials for the Router Credentials available in Config Properties of Field Devices.

Table 68: Router Credentials Fields

Field	Key	Configurable	Description
Administrator Username	N/A	Yes	The user name used for root authentication.
Administrator Password	N/A	Yes	The password used for root authentication.
Master key	N/A	Yes	The master key used for device authentication.
SD Card Password	N/A	No	SD card password protection status.
Token Encryption Key	N/A	Yes	The token encryption key.
CGR Username	N/A	Yes	The username set for the CGR.
CGR Password	N/A	Yes	The password set on the CGR for the associated username.

Router DHCP Proxy Config

Provides the configuration keys and descriptions for DHCPv4 and DHCPv6 link addresses used during lease requests for loopback and tunnel interfaces. The table provide the configuration fields for DHCP proxy settings in the Config Properties page of Field Devices.

Table 69: DHCP Proxy Config Fields

Field	Key	Configurable	Description
DHCPv4 Link for Loopback Interfaces	dhcpV4LoopbackLink	Yes	Refers to the IPv4 link address to use within DHCP DISCOVER messages when requesting a lease for loopback interfaces.
DHCPv4 Link for Tunnel Interfaces	dhcpV4TunnelLink	Yes	Refers to the IPv4 link address to use within DHCP DISCOVER messages when requesting a lease for tunnel interfaces.
DHCPv6 Link for Loopback Interfaces	dhcpV6LoopbackLink	Yes	The IPv6 link address to use in DHCPv6 Relay-forward messages when requesting a lease for loopback interfaces.
DHCPv6 Link for Tunnel Interfaces	dhcpV6TunnelLink	Yes	The IPv6 link address to use in DHCPv6 Relay-forward messages when requesting a lease for tunnel interfaces.

Router Tunnel 1 Config

Provides the configuration details for the Router Tunnel 1 settings located in Config Properties of Field Devices.

Table 70: Router Tunnel 1 Config Device View

Field	Key	Configurable	Description
Tunnel Source Interface 1	tunnelSrcInterface1	Yes	Defines the interface over which the first tunnel is built to provide WAN redundancy.
OSPF Area 1	ospfArea1	Yes	Defines the OSPFv2 Area 1 in which the router (running IPv4) is a member.

Field	Key	Configurable	Description
OSPFv3 Area 1	ospfV3Area1	Yes	Defines OSPFv3 Area 1 in which the router (running IPv6) is a member.
OSPF Area 2	ospfArea2	Yes	Defines the OSPFv2 Area 2 in which the router (running IPv4) is a member.
OSPFv3 Area 2	ospfV3Area2	Yes	Defines OSPFv3 Area 2 in which the router (running IPv6) is a member.
IPsec Dest Addr 1	ipsecTunnelDestAddr1	Yes	Defines the destination IP address for IPsec tunnel 1.
GRE Dest Addr 1	greTunnelDestAddr1	Yes	Defines the destination IP address for GRE tunnel 1.

Router Tunnel 2 Config

Provides the field definitions for the Router Tunnel 2 Config area located in the Config Properties page of Field Devices.

Table 71: Router Tunnel 2 Config Device View

Field	Key	Configurable	Description
Tunnel Source Interface 2	tunnelSrcInterface2	Yes	Defines the interface over which the second tunnel is built to provide WAN redundancy.
OSPF Area 2	ospfArea2	Yes	Defines the OSPFv2 Area 2 in which the router (running IPv4) is a member.
OSPFv3 Area 2	ospfV3Area2	Yes	Defines OSPFv3 Area 2 in which the router (running IPv6) is a member.
IPsec Dest Addr 2	ipsecTunnelDestAddr2	Yes	Defines the destination IP address for IPsec tunnel 2.
GRE Dest Addr 2	greTunnelDestAddr2	Yes	Defines the destination IP address for GRE tunnel 2.

Router Tunnel Config

This reference provides the configuration details and field descriptions for the Router Tunnel Config settings available in the Config Properties page of Field Devices.

Table 72: Router Tunnel Config Device View

Field	Key	Configurable	Description
Tunnel Config	tunnelHerEid	Yes	Displays the EID number of the HER that the router connects with through secure tunnels.
Common Name of Certificate Issuer	N/A	No	Displays the name of the certificate issuer.
NMBA NHS IPv4 Address	N/A	Yes	Displays the Non-Broadcast Multiple Access (NBMA) IPv4 address.
NMBA NHS IPv6 Address	N/A	Yes	Displays the NBMA IPv6 address.
Use FlexVPN Tunnels	N/A	Yes	Displays the FlexVPN tunnel setting.
Optimize Tunnel Provision	optimizeTunnelProv	Yes	Displays whether tunnel provisioning optimization is enabled. When set to `TRUE` for FlexVPN or DMVPN tunnels, Cisco IoT FND does not lock the HER during tunnel provisioning.

WiFi Interface Config

This reference provides details for the WiFi interface configuration fields located on the Config Properties page of Field Devices.

Table 73: WiFi Interface Config Fields

Field	Key	Configurable	Description
SSID	wifiSsid	No	The service set identifier (SSID) assigned to the WiFi interface on the router.
Pre-Shared Key	type6PasswordMasterKey	No	The key used to encrypt other pre-shared keys stored on the router.

WiMAX Config

Use these properties to set up a username and password for the Pairwise Key Management (PKM) of a CGR 1000.

Note The WiMAX module must be installed and running. CGR1000s that ship with a pre-installed WiMAX module have a pre-installed WiMAX configuration.

Table 74: WiMAX Config Fields

Field	Key	Description
PkmUsername	PkmUsername	Pairwise Key Management (PKM) Username for WiMAX.
PkmPassword	PkmPassword	Pairwise Key Management (PKM) Password for WiMAX

Mesh Link Config

Provides details for the Mesh Link Config fields located on the **Config Properties** page of a router.

Table 75: Mesh Link Config Fields

Field	Key	Configurable	Description
Mesh Prefix Config	meshPrefixConfig	Yes	The subnet prefix address.
Mesh Prefix Length Config	meshPrefixLengthConfig	Yes	The subnet prefix address length.
Mesh PAN ID Config	meshPanidConfig	Yes	The subnet PAN ID.
Mesh Address Config	meshAddressConfig	Yes	The IP address of the mesh link.

Mesh Link Keys

This topic provides details regarding the configuration and status fields for mesh link keys.

Table 76: Mesh Link Keys Fields

Field	Key	Configurable	Description
Key Refresh Time	meshKeyRefresh	No	The last date the mesh link keys were uploaded.
Key Expiration Time	meshKeyExpire	Yes	The date the mesh link keys expire.

Mesh Link Metrics

This reference provides the field definitions and release history for mesh link metrics used to monitor N2450 device performance.

Table 77: Mesh Link Metrics

Field	Key	Description
Receive Speed	meshRxSpeed	The rate of data received by the uplink network interface, in bits per second, averaged over a short element-specific timeframe (for example: one hour).
Transmit Speed	meshTxSpeed	The current speed of data transmission over the uplink network interface, in bits per second, averaged over a short element-specific timeframe (for example: one hour).
Mesh Endpoint Count	meshEndPointCount	Number of active connected mesh endpoints.

Router Battery

Provides details on the battery backup unit (BBU) fields available in the Device Info page to assist in power management and monitoring.

Table 78: Router Battery Device View

Field	Key	Configurable	Description
Battery 0 Charge	battery0Charge	No	Shows the battery voltage of BBU 0.
Battery 0 Level (%)	battery0Level	No	Displays the percentage of charge remaining in BBU 0 as a percentage of 100.
Battery 0 Remaining Time	battery0Runtime	No	How many hours remain before the BBU 0 needs to be recharged.
Battery 0 State	battery0State	No	How long BBU 0 has been up and running since its installation or its last reset.
Battery 1 Level (%)	battery1Level	No	Displays the percentage of charge remaining in BBU 1 as a percentage of 100.

Field	Key	Configurable	Description
Battery 1 Remaining Time	battery1Runtime	No	How many hours remain before BBU 1 needs to be recharged.
Battery 1 State	battery1State	No	How long BBU 1 has been up and running since its installation or its last reset.
Battery 2 Level (%)	battery2Level	No	Displays the percentage of charge remaining in BBU 2 as a percentage of 100.
Battery 2 Remaining Time	battery2Runtime	No	How many hours remain before BBU 2 needs to be recharged.
Battery 2 State	battery2State	No	How long BBU 2 has been up and running since its installation or its last reset.
Battery Total Remaining Time	batteryRuntime	No	The total aggregate charge time remaining for all batteries.
Number of BBU	numBBU	No	The number of battery backup units (BBUs) installed in the router. The router can accept up to three BBUs (battery 0, battery 1, battery 2).
Power Source	powerSource	No	The router power source: AC or BBU.

Router Health

This reference provides the Router Health fields available in Device Info page. The table provide details such as keys, configurability, and functional descriptions of the Router Health view.

Table 79: Router Health Device View

Field	Key	Configurable	Description
Uptime	uptime	No	Indicates the length of time (in seconds) that the router has been up and operating since its last reset.

Field	Key	Configurable	Description
Door Status	doorStatus	No	Options for this field are: • "Open" when the door of the router is open • "Closed" after the door is closed
Chassis Temperature	chassisTemp	No	Displays the operating temperature of the router. You can configure alerts to indicate when the operating temperature falls outside of the customer-defined temperature range.

SCADA Metrics

The table provide the SCADA metrics view available on the SCADA tab of the Device Info page. Provides details such as field names, keys, and configuration status for router communication.

Table 80: SCADA Metrics View

Field	Key	Configurable	Description
Channel Name	channel_name	No	Identifies the channel on which the serial port of the router communicates to the RTU.
Protocol Type	protocol	No	Identifies the Protocol Translation type.
Messages Sent	N/A	No	The number of messages sent by the router.
Messages Received	N/A	No	The number of messages received by the router.
Timeouts	N/A	No	Displays the timeout value for connection establishment.
Aborts	N/A	No	Displays the number of aborted connection attempts.

Field	Key	Configurable	Description
Rejections	N/A	No	Displays the number of connection attempts rejected by IoT FND.
Protocol Errors	N/A	No	Displays the number of protocol errors generated by the router.
Link Errors	N/A	No	Displays the number of link errors generated by the router.
Address Errors	N/A	No	Displays the number of address errors generated by the router.
Local IP	N/A	No	Displays the local IP address of the router.
Local Port	N/A	No	Displays the local port of the router.
Remote IP	N/A	No	Displays the remote IP address of the router.
Data Socket	N/A	No	Displays the Raw Socket server configured for the router.

WiMAX Link Metrics

This reference provides definitions for the WiMAX Link Health fields in Device Info that are used to monitor data transmission rates and signal strength.

Table 81: WiMAX Link Health Fields

Field	Key	Description
Transmit Speed	wimaxTxSpeed	The current speed of data transmission over the WiMAX uplink network interface, measured in bits per second, averaged over a short element-specific time period (for example, an hour).
Receive Speed	wimaxRxSpeed	The rate of data that has been received by the WiMAX uplink network interface, measured in bits per second, averaged over a short element-specific time period (for example, an hour).
RSSI	wimaxRssi	The measured RSSI value of the WiMAX RF uplink (dBm).

Field	Key	Description
CINR	wimaxCinr	The measured CINR value of the WiMAX RF uplink (dB).

WiMAX Link Settings

This reference provides the field definitions and keys for the WiMAX Link Settings in the Device Info page.

Table 82: WiMAX Link Settings Fields

Field	Key	Description
BSID	wimaxBsid	The ID of the base station connected to the WiMAX device.
Hardware Address	wimaxHardwareAddress	The hardware address of the WiMAX device.
Hardware Version	wimaxHardwareVersion	The hardware version of the WiMAX device.
Microcode Version	wimaxMicrocodeVersion	The microcode version of the WiMAX device.
Firmware Version	wimaxFirmwareVersion	The firmware version of the WiMAX device.
Device Name	wimaxDeviceName	The name of the WiMAX device.
Link State	wimaxLinkState	The link state of the WiMAX device.
Frequency	wimaxFrequency	The frequency of the WiMAX device.
Bandwidth	wimaxBandwidth	The bandwidth the WiMAX device is using.

Cellular Link Metrics for CGRs

This reference defines the metrics and keys used to track cellular interface performance, signal quality, and bandwidth usage on CGRs.

Table 83: Cellular Link Metrics for CGRs

Field	Key	Description
Transmit Speed	cellularTxSpeed	Displays the current speed (bits/sec) of data transmitted by the cellular interface over the cellular uplink for a defined period (such as an hour).

Field	Key	Description
Receive Speed	cellularRxSpeed	Displays the average speed (bits/sec) of data received by the cellular uplink network interface for a defined period (such as an hour).
RSSI	cellularRssi	Indicates the radio frequency (RF) signal strength of the cellular uplink. Valid values are 0 to -100. The LED states on the cellular interface and corresponding RSSI values are: • Off: RSSI < = -110 • Solid amber: -100 < RSSI <= -90 • Fast green blink: -90 < RSSI <= -75 • Slow green blink: -75 < RSSI <= -60 • Solid green: RSSI > -60
Bandwidth Usage (Current Billing Cycle)	CellBwPerCycle (bytes)	Displays current bandwidth usage (in bytes) of a particular route for the current billing cycle.
Cell Module Temperature	cellModuleTemp	Internal temperature of 3G module.
Cell ECIO	cellularEcio	Signal strength of CDMA at the individual sector level.
Cell Connect Time	cellConnectTime	Length of time that the current call lasted. This field only applies only to CDMA.
Cellular RSRP	cellularRsrp	Reference Signal Received Power is the average power of resource elements that carry cell specific reference signals over the entire bandwidth.
Cellular RSRQ	cellularRsrq	Indicates the quality of the received reference signal.
Cellular SNR	CellularSnr	The Signal to Noise Ratio is the ratio of signal power to that of all other electrical signals in a location.

Cellular Link settings

This reference provides a comprehensive list of cellular link settings, including network types, module status, and identification numbers, to support device management in Cisco IoT FND.

Note Beginning with IoT FND 3.2, Cisco routers IR829, CGR1240, CGR1120, and Cisco 819 4G LTE ISRs (C819) support a new dual-active radio module that supports dual modems and 2 physical interfaces (interfaces 0 and 1, interfaces 2 and 3) per modem. See SKUs below:

- IR829GW-2LTE-K9
- CGM-LTE-LA for CGR 1000 routers
- C819HG-LTE-MNA-K9

Cellular properties supported on the dual modems and their two physical interfaces (and four logical interfaces 0, 1, 2 and 3), display as follows:

Cellular Link Settings	Interface 0 and Interface 1	Interface 2 and Interface 3
—	—	—

Note Starting with IoT FND 4.10, Cisco router IR1100 supports a new dual-active radio module that supports single modem and maximum of 3 APNs. The APNs hold interface numbers 3, 4, and 5 in IoT FND.

Additionally, the 4G LTE dual-active radio module does not support or display all fields summarized in Cellular Link Settings Fields

Table 84: Cellular Link Settings Fields

Field	Key	Configurable	Description
Cellular Network Type	N/A	Yes	Defines the type of cellular network for example, GSM or CDMA.
Module Status	cellularStatus	No	Displays whether the cellular interface module is active in the network. There is also an unknown state for the module.
Network Name	N/A	Yes	Defines the service provider name, for example, AT&T or Verizon.
Cell ID	cellularID	No	Displays the cell ID for the cellular interface. This value must exist to activate the interface.
Cellular SID	cellularSID	No	Displays the System Identification Number for the CDMA cellular area.

Field	Key	Configurable	Description
Cellular NID	cellularNID	No	Displays the Network Identification Number for the CDMA cellular area.
Cellular Roaming Status	cellularRoamingStatus	No	Indicates whether the modem is in the Home network or Roaming.
Cellular Modem Serial Number	N/A	No	Displays the serial number of the connected modem.
Cellular Modem Firmware Version	cellularModemFirmwareVersion	No	Displays the version of the modem firmware on the module installed within the CGR.
Connection Type	connectionType	No	Displays the connection type as: Packet switched, Circuit switched, or LTE.
Location Area Code	locationAreaCode	No	Displays the Location Area Code (LAC) given by the base station.
Routing Area Code	routingAreaCode	No	Displays the routing area code given by the base station.
APN	cellularAPN	No	Displays the Access Point Name (APN) of the AP to which the cellular interface connects.
IMSI	cellularIMSI	No	The International Mobile Subscriber Identity (IMSI) identifies an individual network user as a 10-digit decimal value within a GSM and CDMA network. Possible values are: • 10-digit decimal value • Unknown
IMEI	cellularIMEI	No	Displays the International Mobile Equipment Identity (IMEI) for the cellular interface within a GSM network only. The IMEI value is a unique number for the cellular interface.

Field	Key	Configurable	Description
Cellular Module Temperature	cellularModemTemp	—	Displays the modem temperature.
ICCID	cellularICCID	—	The Integrated Circuit Card Identification Number is a unique 18-22 digit code that includes a SIM card's country, home network, and identification number.
MSISDN	cellularMSISDN	—	The Mobile Station International Subscriber Directory Number is an unique number that identifies a mobile subscriber.
Device Model ID	N/A	No	Displays the model identifier of the cellular modem.
PRI Version	N/A	No	Displays the PRI version installed on the cellular modem.
Carrier PRI Version	N/A	No	Displays the carrier-specific PRI version installed on the cellular modem.
OEM PRI Version	N/A	No	Displays the OEM PRI version installed on the cellular modem.

IOx Node properties

This reference provides the keys and descriptions for the IOx Node Properties fields to assist in configuring platform network settings.

Table 85: IOx Node Properties Fields

Field	Key	Description
DHCPv4 Link for IOX Node Gateway	dhcpV4IOxLink	The DHCPv4 gateway address
IOx Node Gateway IPv4 Address	ioxGwyV4Address	The IPv4 gateway address
IOx Node IPv4 Subnet mask	ioxV4Subnetmask	The IPv4 subnet mask address
IOx Node Gateway IPv6 Address	ioxGwyV6Address	The IPv6 gateway address
IOx Node IPv6 Subnet Prefix Length	ioxV6PrefixLength	The IPv6 subnet prefix length
Preferred IOx Node interface on the platform	ioxInterface	The interface on the platform
IOx Node External IP Address	ioxIpAddress	The external IP address

Field	Key	Description
IOx Access Port	ioxAccessPort	The access port

Head-End Routers Netconf Config

Provides the configuration parameters required to establish a Netconf SSH session on head-end routers.

Table 86: Head-End Routers Netconf Config Client Fields

Field	Key	Configurable	Description
Netconf Username	netconfUsername	Yes	Identifies the username to enter when establishing a Netconf SSH session on the HER.
Netconf Password	netconfPassword	Yes	Identifies the password to enter when establishing a Netconf SSH session on the HER.

Head-End Routers Tunnel 1 Config

Provides a reference for the fields available in the Tunnel 1 Config area of the Head-End Routers Config Properties page.

Table 87: Head-End Routers Tunnel 1 Config Fields

Field	Key	Configurable	Description
IPsec Tunnel Source 1	ipsecTunnelSrc1	Yes	Identifies the source interface or IP address of IPsec tunnel 1.
IPsec Tunnel Dest Addr 1	ipsecTunnelDestAddr1	Yes	Identifies the destination interface or IP address of IPsec tunnel 1.
GRE Tunnel Source 1	greTunnelSrc1	Yes	Identifies the source interface or IP address of GRE tunnel 1.
GRE Tunnel Dest Addr 1	greTunnelDestAddr1	Yes	Identifies the destination interface or IP address of GRE tunnel 1.

Head-End Routers Tunnel 2 Config

This reference provides the field definitions for the Tunnel 2 configuration settings located on the Head-End Routers Config Properties page.

Table 88: Head-End Routers Tunnel 2 Config Device Fields

Field	Key	Configurable	Description
IPsec Tunnel Source 2	ipsecTunnelSrc2	Yes	Identifies the source interface or IP address of IPsec tunnel 2.
IPsec Tunnel Dest Addr 2	ipsecTunnelDestAddr2	Yes	Identifies the destination interface or IP address of IPsec tunnel 2.
GRE Tunnel Source 2	greTunnelSrc2	Yes	Identifies the source interface or IP address of GRE tunnel 2.
GRE Tunnel Dest Addr 2	greTunnelDestAddr2	Yes	Identifies the destination interface or IP address of GRE tunnel 2.

DA Gateway properties

This reference provides details for the DA Gateway metrics area fields used to monitor and configure device communication parameters.

Table 89: DA Gateway Metrics Area Fields

Field	Key	Description
SSID	N/A	The mesh SSID.
PANID	N/A	The subnet PAN ID.
Transmit Power	N/A	The mesh transmit power.
Security Mode	N/A	Mesh Security mode: • 0 indicates no security mode set • 1 indicates 802.1x with 802.11i key management
Meter Certificate	meterCert	The subject name of the meter certificate.
Mesh Tone Map Forward Modulation	toneMapForwardModulation	Mesh tone map forward modulation: • 0 = Robo • 1 = DBPSK • 2 = DQPSK • 3 = D8PSK

Field	Key	Description
Mesh Tone Map Reverse Modulation	N/A	Mesh tone map reverse modulation: • 0 = Robo • 1 = DBPSK • 2 = DQPSK • 3 = D8PSK
Mesh Device Type	N/A	The primary function of the mesh device (for example, meter, range extender, or DA gateway).
Manufacturer of the Mesh Devices	N/A	Manufacturer of the mesh device as reported by the device.
Basic Mapping Rule End User IPv6 Prefix	N/A	End-user IPv6 address for basic rule mapping for the device.
Basic Mapping Rule End User IPv6 Prefix Length	N/A	Specified prefix length for the end-user IPv6 address.
Map-T IPv6 Address	N/A	IPv6 address for MAP-T settings.
Map-T IPv4 Address	N/A	IPv4 address for MAP-T settings.
Map-T PSID	N/A	MAP-T PSID.
Active Link Type	N/A	Link type of the physical link over which device communicates with other devices including IoT FND.

Device Health

This reference provides details on the Uptime field to assist in tracking device operational duration.

Table 90: Device Health Fields

Field	Key	Description
Uptime	uptime	The amount of time in days, hours, minutes and seconds that the device has been running since the last boot. *Unknown* appears when the system is not connected to the network.

Ethernet Link metrics

This topic provides the definitions for the Ethernet link metrics fields used to analyze traffic transmission and reception on the interface.

Table 91: Ethernet Link Metrics Area Fields

Field	Key	Description
Transmit Speed	ethernetTxSpeed	Indicates the average speed (bits/sec) of traffic transmitted on the Ethernet interface for a defined period of time.
Receive Speed	ethernetRxSpeed	Indicates the average speed (bits/sec) of traffic received on the Ethernet interface for a defined period of time.
Transmit Packet Drops	ethernetTxDrops	Indicates the number of packets dropped (drops/sec) when the transmit queue is full.

Inventory

This reference provides a comprehensive list of inventory fields, their corresponding keys, configurability status, and descriptions for CGR1000 devices.

Table 92: Inventory Fields

Field	Key	Configurable	Description
Config Group	configGroup	Yes	Name of the configuration group to which the device belongs.
Device Category	deviceCategory	No	Category of the device.
Device Type	deviceType	No	Device type that determines other fields, the way the device communicates, and the way it appears in IoT FND.
Domain Name	domainName	Yes	Domain name configured for this device.
EID	eid	No	Primary element ID of the device, which is used as the primary unique key for device queries.
Firmware Group	firmwareGroup	Yes	Name of the firmware group to which the device belongs.
Firmware Version	runningFirmwareVersion	No	Firmware version running on the device.
Hardware Version	vid	No	Hardware version of the device.
Hypervisor Version	hypervisor	No	(Cisco IOS CGRs running Guest OS only) The version of the Hypervisor.

Field	Key	Configurable	Description
Hostname	hostname	No	Hostname of the device.
IP Address	ip	Yes	IP address of the device. Use this address for the IoT FND connection through a tunnel.
Labels	label	Yes	Custom label assigned to the device. A device can have multiple labels. Labels are assigned through the UI or API, but not through an XML or CSV file.
Last Heard	lastHeard	No	Last date and time the device contacted IoT FND.
Last Metric Heard	N/A	No	Time of last polling (periodic notification).
Last Property Heard	N/A	No	The time of last property update for the router.
Last RPL Tree Update	N/A	No	The time of last Routing Protocol for Low power and Lossy Networks (RPL) tree poll update (periodic notification).
Location	N/A	No	Latitude and longitude of the device.
Manufacturer	N/A	No	Manufacturer of the endpoint device.
Function	crmesh	No	Function of the mesh device. Valid values are Range Extender and Meter.
Meter Certificate	meterCert	No	Global or unique certificate reported by the meter.
Meter ID	meterId	No	Meter ID of the mesh endpoint (ME).
Model Number	pid	No	Product ID of the device.
Name	name	Yes	Unique name assigned to the device.
SD Card Password Lock	N/A	Yes	(CGRs only) State of the SD card password lock (on/off).
Serial Number	sn	No	Serial number of the device.

Field	Key	Configurable	Description
Status	status	No	Status of the device.
System Security Mode	systemSecurityMode	No	System security mode of the router. The value indicates whether the router is in secure mode or insecure mode.
Tunnel Group	tunnelGroup	Yes	Name of the tunnel group to which the device belongs.

Link Metrics

This reference provides details on the link metrics fields used to monitor the status and performance of device network interfaces.

Table 93: Link Metrics Fields

Field	Key	Description
Active Link Type	activeLinkType	Determines the most recent active RF or PLC link of a meter.
Meter ID	meterId	Meter ID of the device.
PANID	meshPanid	PAN ID of the endpoint.
Mesh Endpoints	meshEndpointCount	Number of RMEs.
Mesh Link Transmit Speed	meshTxSpeed	Current speed of data transmission over the uplink network interface (bits/sec) averaged over a short element-specific time period (for example, an hour).
Mesh Link Receive Speed	meshRxSpeed	Rate of data received by the uplink network interface (bits/sec) averaged over a short element-specific time period (for example, an hour).
Mesh Link Transmit Packet Drops	N/A	Number of data packets dropped in the uplink.
Route RPL Hops	meshHops	Number of hops that the element is from the root of its RPL routing tree.
Route RPL Link Cost	linkCost	RPL cost value for the link between the element and its uplink neighbor.
Route RPL Path Cost	pathCost	RPL path cost value between the element and the root of the routing tree.

Field	Key	Description
Transmit PLC Level	tx_level dBuV	Supported on the PLC and the Itron OpenWay RIVA Electric devices and the Itron OpenWay RIVA G-W (Gas-Water) devices only (u within dBuV = micro)

Link Settings

Provides a reference for the fields and keys used to manage and monitor link settings for RME devices.

Table 94: Link Settings Fields

Field	Key	Description
Firmware Version	meshFirmwareVersion	The Cisco Resilient Mesh Endpoint (RME) firmware version.
Mesh Interface Active	meshActive	The status of the RME.
Mesh SSID	meshSsid	The RME network ID.
PANID	meshPanid	The subnet PAN ID.
Transmit RF Power	meshTxPower	The RME transmission power (dBm).
Security Mode	meshSecMode	The RME security mode.
Transmit PLC TX Level	tx_level dBuV	The PLC level for Itron OpenWay RIVA CAM module and Itron OpenWay RIVA Electric devices (dBuV) where u = micro
RPL DIO Min	meshRplDioMin	An unsigned integer used to configure the Imin of the DODAG Information Object (DIO) Trickle timer.
RPL DIO Double	meshRplDioDbl	An unsigned integer used to configure the Imax of the DIO Trickle timer.
RPL DODAG Lifetime	meshRplDodagLifetime	An unsigned integer used to configure the default lifetime (in minutes) for all downward routes that display as Directed Acyclic Graphs (DAGs).
RPL Version Incr. Time	meshRplVersionIncrementTime	An unsigned integer used to specify the duration (in minutes) between incrementing the RPL version.

NAT44 Metrics

This reference provides the field definitions and keys for monitoring NAT44 metrics on the device.

Table 95: NAT44 Metrics Fields

Field	Key	Description
NAT44 Internal Address	nat44InternalAddress0	The internal address of the NAT 44 configured device.
NAT 44 Internal Port	nat44InternalPort0	The internal port number of the NAT 44 configured device.
NAT 44 External Port	nat44ExternalPort0	The external port number of the NAT 44 configured device.

PLC Mesh Info

Provides details on the PLC Mesh Info fields, including modulation types, channel capacity indicators, and firmware versions for PLC modules.

Table 96: PLC Mesh Info Fields

Field	Key	Description
Mesh Tone Map Forward Modulation	toneMapForwardModulation	Mesh tone map forward modulation: 0 = Robo, 1 = DBPSK, 2 = DQPSK, 3 = D8PSK.
Mesh Tone Map Forward Map	toneMapForward	Indicates the number of usable subcarriers in the channel, shown as a binary octet (for example, 0011 1111). Ones indicate viable channels. The more ones on the map, the higher the channel capacity.
Mesh Tone Map Reverse Modulation	toneMapRevModulation	Mesh tone map reverse modulation: 0 = Robo, 1 = DBPSK, 2 = DQPSK, 3 = D8PSK.
Mesh Tone Map Reverse Map	toneMapReverse	Indicates the number of usable subcarriers in the channel, shown as a binary octet (for example, 0011 1111). Ones indicate viable channels. The more ones in the map, the higher the channel capacity. The reverse map information and RSSI combine to determine viable channels.
Mesh Absolute Phase of Power	N/A	Mesh absolute phase of power is the relative position of current and voltage waveforms for a PLC node.

Field	Key	Description
LMAC Version	N/A	Version of LMAC firmware in use by the PLC module DSP processor, which provides lower media access functionality for PLC communications compliant with the IEEE P1901.2 PHY standard.

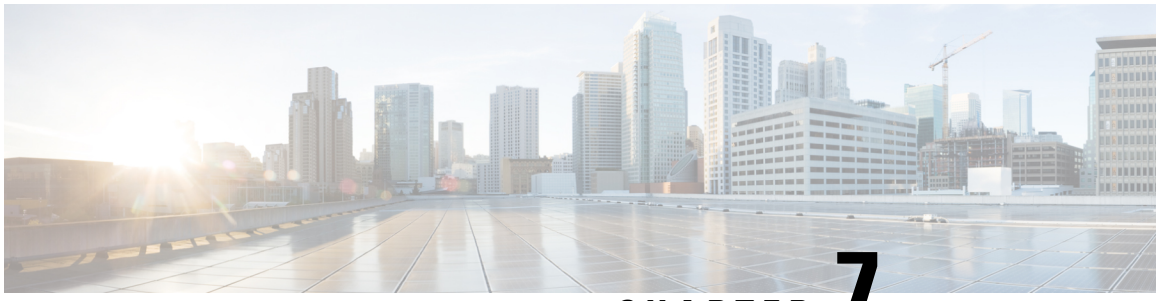
Raw Sockets Metrics and Sessions

Provides details on the metrics and session parameters for Raw Sockets configuration available on the Config Properties page under Field Devices.

Table 97: Raw Sockets Metrics and Sessions View

Field	Key	Description
Metrics		
Tx Speed (bps)	rawSocketTxSpeedS[portNo]	The transmit speed of packetized streams of serial data in bits per second.
Rx Speed (bps)	rawSocketRxSpeedS[portNo]	The receive speed of packetized streams of serial data in bits per second.
Tx Speed (fps)	rawSocketTxFramesS[portNo]	The transmit speed of packetized streams of serial data in frames per second.
Rx Speed (fps)	rawSocketRxFramesS[portNo]	The receive speed of packetized streams of serial data in frames per second.
Sessions		
Interface Name	N/A	The name of the serial interface configured for Raw Socket encapsulation.
TTY	N/A	The asynchronous serial line on the router associated with the serial interface.
VRF Name	N/A	Virtual Routing and Forwarding instance name.
Socket	N/A	The number identifying one of 32 connections.

Field	Key	Description
Socket Mode	N/A	Client or server. The mode in which the asynchronous line interface is set up.
Local IP Address	N/A	The IP address that either the server listens for connections on (in Server Socket Mode), or to which the client binds to initiate connections to the server (in Client Socket Mode).
Local Port	N/A	The port that either the server listens to for connections (in Server Socket Mode), or to which the client binds to initiate connections to the server (in Client Socket Mode).
Dest. IP Address	N/A	The destination IP address of the remote TCP Raw Socket server.
Dest. Port	N/A	Destination port number to use for the connection to the remote server.
Up Time	N/A	The length of time that the connection has been up.
Idle Time	N/A	The length of time that no packets were sent.
Time Out	N/A	The currently configured session idle timeout, in minutes.



CHAPTER 7

Manage Firmware Upgrades

This section describes managing firmware upgrade settings in IoT FND, and includes the following sections:

Use IoT FND to upgrade the firmware running on routers (CGR1000s, IR800s), AP800s and Cisco Resilient Mesh Endpoints (RMEs) such as meters and range extenders. IoT FND stores the firmware binaries in its database for later transfer to routers in a firmware group through an IoT FND and IoT-DM file transfer, and to RMEs using IoT FND.

Cisco provides the firmware bundles as a zip file. For Cisco IOS, software bundles include hypervisor, system image and IOx images (for example, Guest-OS, Host-OS).

Firmware system images are large (approximately 130 MB); kickstart images are approximately 30 MB. Every firmware bundle includes a manifest file with metadata about the images in the bundle. You can pause, stop, or resume the upload process.

Router Firmware Updates

IoT FND updates router firmware in two steps:

Procedure

Step 1 Uploads the firmware image from IoT FND to the router. Firmware images upload to the flash:/managed/images directory on the router.

Note
In some cases the router might be in a Firmware Group. Refer to Configuring Firmware Group Settings, on page 374.

Because of their large size, firmware-image uploads to routers take approximately 30 minutes, depending on interface speeds

Note
If you set the property, collect-cellular-link-metrics, to 'true' in cgms.properties, then the following Cellular link quality metrics are collected for CGR1000, IR800 and IR1100, each time you initiate a firmware upload from IoT FND:

- RSRP: Reference Signal Received Power which is the power of the reference signal
- RSRQ: Reference Signal Received Quality or the quality of the reference signal which is the a ratio of RSSI to RSRP
- SINR: Signal-to-Noise Ratio which compares the strength of the signal to the background noise.
- RSSI: Received Signal Strength Indicator or the strength of the reference signal

Additionally, the following cgna profile is created on the CGR1240 and activated when the firmware upload is triggered.

```
cgna profile cg-nms-cellularlinkmetrics
add-command show cellular 3/1 all | format
flash:/managed/odm/cg-nms.odm
interval 5
url https://<FND IP address>:9121/cgna/ios/metrics
gzip
active
```

Note
On execution of the cgna profile above, the metrics data is persisted in the Metrics_History table in the database and can be collected by using the getMetricHistory NBAPI.

Step 2 Installs the firmware on the device and reloads it.

During the firmware install the boot parameters on the routers are updated according to the new image file and the router is reloaded after enabling the *cg-nms-register* cgna profile.

Note
You must initiate the firmware installation process. IoT FND does not automatically start the upload after the image upload.

When a router contacts IoT FND for the first time to register and request tunnel provisioning, IoT FND rolls the router back to the default factory configuration (ps-start-config) before uploading and installing the new firmware image.

Note
This rollback requires a second reload to update the boot parameters in ps-start-config and apply the latest configuration. This second reload adds an additional 10–15 minutes to the installation and reloading operation.

Upgrading Guest OS Images

Guest OS images can be installed or upgraded through the Cisco IoT FND Firmware Update page.

Guest OS Image Upgrade Details

Depending on CGR factory configuration, a Guest OS (GOS) may be present in the VM instance. You can install or upgrade Cisco IOS on the **CONFIG** > **FIRMWARE UPDATE** page. See Router Firmware Updates. The GOS, hypervisor, and Cisco IOS are upgraded when you perform a Cisco IOS image bundle installation or update.

After any Cisco IOS installation or upgrade, when IoT FND discovers a GOS, it checks whether the initial communications setup is complete before performing the required setup. The CGR must have a DHCP pool and the GigabitEthernet 0/1 interface configured to provide an IP address and act as the gateway for the GOS.

The new GOS image overwrites existing configurations. IoT FND has an internal backup and restore mechanism that ports existing applications to the upgraded Guest OS. See Monitoring a Guest OS for more information.

See Cisco 1000 Series Connected Grid Routers Configuration Guides for information about configuring the CGR.

Note If IoT FND detects a non-Cisco OS installed on the VM, the firmware bundle will not upload and the Cisco reference GOS will not install.

Upgrading WPAN Images

At the **CONFIG** > **FIRMWARE UPDATE** page, you can upload the independent WPAN images (IOS-WPAN-RF, IOS-WPAN-PLC, IOS-WPAN-OFDM, IOS-WPAN-IXM) to IoT FND using the Images sub-tab (left-hand side) and Upload Image button like other image upgrades. This process is known as a non-integrated WPAN firmware upgrade.

Note: The WPAN firmware image integrated with the IOS CGR image option is still supported.

Also, if only the WPAN firmware upgrade from the image bundled with IOS image is desired (for example, when the WPAN firmware upgrade option was not checked during IOS upgrade), the “Install from Router” option is also provided under respective WPAN image types (IOS-WPAN-RF or IOS-WPAN-PLC).

For detailed steps, go to Firmware images, on page 378.

Changing Action Expiration Timer

You can use the cgnms_preferences.sh script to set or retrieve the action expiration timer value in the IoT FND database:

```
/opt/cgms
/bin/cgnms_preferences setCgrActionExpirationTimeout 50
```

Valid options are:

Procedure

Step 1 set <*pkg*>*actionExpirationTimeoutMins*<*value*>

where:

- <*pkg*> is the preference package (required for *set* and *get* operations).
- *actionExpirationTimeoutMins* is the preference key (required for *set* and *get* operations).
- <*value*> is the preferred value, in minutes (required for *set* and *setCgrActionExpirationTimeout* operations).

Step 2 setCgrActionExpirationTimeout <value>

Step 3 get <*pkg*>*actionExpirationTimeoutMins*

Step 4 *getCgrActionExpirationTimeout*

Example

In the following example, the action timer value is retrieved, set, the current value retrieved again, the value removed, and a null value retrieved:

```
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
getCgrActionExpirationTimeout
2013-08-12 22:38:42,004:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
5
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
setCgrActionExpirationTimeout 50
2013-08-12 22:38:51,907:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
Successfully set the preferences.
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
getCgrActionExpirationTimeout
2013-08-12 22:38:58,591:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
50
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
get com.cisco.cgms.elements.ciscocgr actionExpirationTimeoutMins
2013-08-12 22:39:12,921:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
50
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
set com.cisco.cgms.elements.ciscocgr actionExpirationTimeoutMins 15
2013-08-12 22:39:23,594:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
Successfully set the preferences.
[root@userID-lnx2 cgms]#./dist/cgms-1.x/bin/cgnms_preferences.sh
get com.cisco.cgms.elements.ciscocgr actionExpirationTimeoutMins
2013-08-12 22:39:29,231:INFO:main:CgmsConnectionProvider: registered
the database url for CG-NMS: [jdbc:oracle:thin:@localhost:1522:cgms]
15
```

Manage Router Firmware Upgrades

Manage Router Firmware Upgrades

Table 98: Feature History

Feature Name	Release	Description
Manage Router Firmware Upgrades	Cisco IoT FND Release 5.0	Manage router firmware upgrade and install counts using Cisco IoT FND, eliminating the need to manually edit .jboss property files.

Information About Manage Router Firmware Upgrades

Manage router firmware upgrade and install counts directly using Cisco IoT FND. You no longer have to manually edit .jboss property files, simplifying the firmware management process. The router firmware management is now intuitive and accessible. Define the **Maximum Router Firmware Upload Count**, **Maximum Router Firmware Install Count**, and **Router Firmware Upload Retry Count** values globally on Cisco IoT FND. Apply the maximum parallel or concurrent firmware upgrade values to all the group of routers on Cisco IoT FND.

Restrictions For Manage Router Firmware Upgrades

Here are the default counts for the respective fields:

- **Router Firmware Upload Count**: 48
- **Router Fimware Install Count**: 48
- **Router Firmware Upload Retry Count**: 5

Here are some of the maximum counts for the respective fields:

- **Router Firmware Upload Count**: 48
- **Router Fimware Install Count**: 48
- **Router Firmware Upload Retry Count**: 100

Use Cases For Manage Router Firmware Upgrades

- Manage firmware upgrades and installations for a large fleet of routers across multiple locations, ensuring all devices are up to date.
- Minimize configuration errors that might occur with manual property file edits, ensuring smoother and more reliable firmware management.

Configure Router Firmware Upgrades Using Cisco IoT FND

Here are the instructions to configure the router firmware upgrades using Cisco IoT FND:

1. From the Cisco IoT FND Menubar, choose **ADMIN** > **Server Settings** > **Property Settings**.
2. Enter the number of routers in the **Router Firmware Upload Count** field on which a firmware file is uploaded to the device repository. For example, 48
3. Enter the number of routers in the **Router Firmware Install Count** field on which you want to apply the uploaded firmware to the routers for upgrading them. For example, 45
4. Enter the number of attempts that you want Cisco IoT FND to try when there's a failure of firmware uploads in the **Router Firmware Upload Retry Count** field. For example, 5

Manage Firmware Upgrade Properties For A Router Group

Manage Firmware Upgrade Properties For A Router Group

Feature Name	Release	Description
Manage Firmware Upgrade Properties For A Router Group	Cisco IoT FND Release 5.0	Cisco IoT FND includes a **Router Firmware Upload Retry Count** in the **Firmware Update** page. Customize the retry count at the router group level, allowing for tailored firmware update strategies for specific groups of routers.
Enable fimware upload progress percentage	Cisco IoT FND Release 5.1	Cisco IoT FND displays the firmware upload progress for Cisco IoT routers running Cisco IOS-XE namely: • Cisco Catalyst IR1100 • Cisco Catalyst IR8100 • Cisco Catalyst IR1800

Information About Manage Firmware Upgrade Properties For A Router Group

Cisco IoT FND introduces a **Router Firmware Upload Retry Count** field in the **Firmware Update** page. You can customize the retry count at the router group level, allowing you to implement tailored firmware upgrade strategies for specific groups of routers. The firmware upload retry count is not defined by default at the group level. In case you don't define the upload retry count, the global value in the **Property Settings** page is applied to the groups as well.

Benefits Of Manage Firmware Upgrade Properties For A Router Group

- You can customize the retry count for firmware uploads at both global and router group levels, providing greater control over the update process.
- You can enhance the reliability of firmware updates, reducing the likelihood of failed uploads due to network issues or other disruptions.
- Different groups of routers can have tailored firmware update strategies, allowing for more efficient management based on specific network conditions or requirements.

Restrictions For Manage Firmware Upgrade Properties For A Router Group

The default value of **Router Firmware Upload Retry Count** is 5 and the maximum value is 100.

Configure Firmware Upgrade Properties For A Router Group

Here are the steps to configure firmware upload retry count using Cisco IoT FND:

1. From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.
2. Select a router group from the **Firmware Groups** list.
3. Click **Group Properties**.
4. Enter a value between 0 to 100 in the **Router Firmware Upload Retry Count**.

Enable firmware upload progress percentage

This task helps you enable the firmware upload progress percentage for Cisco IOS-XE routers using Cisco IoT FND.

Before you begin

You must enable the progress percentage for it to appear in the firmware image update page.

Here are the steps to enable the progress percentage:

Procedure

Step 1 From the Cisco IoT FND dashboard, choose **ADMIN** > **Server Settings**.

Step 2 Navigate to the **Property Settings** tab.

Step 3 Check the **Enable Fimrware upload progress % for IOS-XE devices** check box.

Step 4 Configure the **IOS-XE Firmware upload progress timer (seconds)** field based on which the the progress percentage is updated in Cisco IoT FND. The default value is 90 seconds and the range is between 30 seconds to 180 seconds.

You've enabled firmware upload progress percentage. This percentage progress will appear for Cisco IOS-XE routers in the **Firmware Upload** page.

Working with Resilient Mesh Endpoint Firmware Images

This section describes how to add Resilient Mesh Endpoint (RME) firmware images to IoT FND, and how to upload and install the images on routers.

Overview

When you instruct IoT FND to upload a firmware image to the members of an RME firmware group or subnet, IoT FND pushes the image to the group members in the background and tracks the upload progress to ensure that the devices receive the image.

A Resilient Mesh Endpoint (RME) stores three firmware images:

- Uploaded image: Image most recently uploaded.
- Running image: Image that is currently operational.
- Backup image: It serves as a golden (fallback) image for the RME if there is an issue with the running image.

Note You can initiate up to 3 firmware downloads simultaneously.

Note IR500s and other RME devices can coexist on a network; however, for firmware management they cannot belong to the same group.

Note RME devices can report BL/Boot Loader image types to IoT FND, but IoT FND cannot upload boot loader images to devices.

Actions Supported and Information Displayed at the Firmware Management Pane

At the Firmware Management pane, you can filter the display by Subnet, PanID or Group when you are in the Devices tab.

For every image in the list, IoT FND displays the information as noted in the table:

Table 99: Image Information Displayed by IoT FND

Item	Description
Image	Image name.
Uploaded	Specifies the number of devices that uploaded the image. Click the number to display a list of these devices.

Item	Description
Running	Specifies the number of devices running this image. Click the number to display a list of these devices.
Backup	Specifies the number of devices using this image as a backup. Click the number to display a list of these devices.
Boot Loader	Specifies the boot loader image version.
LMAC	Specifies the LMAC image version.
BBU	Specifies the BBU image version.
Status	Specifies the status of the upload process.
Scheduled Reload	Specifies the scheduled reload time.
Actions	Provides two actions: • Schedule Install and Reload —Schedule the installation date and time of the loaded image and the reboot of the endpoint by selecting the Calendar icon. • Set as Backup —Set the firmware backup image by selecting the clock icon with reverse arrow. See Setting the Installation Schedule, on page 367 for complete steps.

Set a Firmware Backup Image

To set an image as a firmware image backup:

Procedure

Step 1 Click the Set as Backup button. (See the icon in the Actions summary in Table 99: Image Information Displayed by IoT FND, on page 366).

Step 2 Click **Yes** to confirm backup.

Setting the Installation Schedule

To set the installation schedule for an image:

Procedure

Step 1 Click the **Schedule Install and Reload** button (Calendar icon). For more information, see Table 99: Image Information Displayed by IoT FND, on page 366.

The following message appears if you try to schedule a reload operation for the node that is scheduled for stack switch operation.

Step 2 In the page that appears, specify the date and time for the installation of the image and rebooting of device.

Figure 7: Schedule and Install and Reload Page

Step 3 Click the **Set Reboot Time** button.

Firmware Update Transmission Settings

You can configure the Transmission Speed for pacing mesh firmware downloads at the Transmission Settings tab (See CONFIG > FIRMWARE UPDATE page).

Procedure

Step 1 Select the Transmission Speed. Options are Slow (default), Medium, Fast or Custom.

The Slow setting is recommended as the initial setting. You can increase the Slow setting to Medium (or even Fast) if the following conditions exist:

- The slow setting does not cause any issues in the database and it is able to handle the workload presented without raising any alarms.
- There is a need to improve on the time taken to do the firmware download.

Step 2 Configure the minimum number of nodes necessary to enable the Multicast firmware upload.

Note
For Custom Transmission Speed, you will have to specify Multicast Threshold, Unicast Delay and Minimum Multicast Delay values. Refer to the table below for the definitions of the terms on the **CONFIG** > **FIRMWARE UPDATE** > **Transmissions Settings** page.

Figure 8: CONFIG > FIRMWARE UPDATE

Table 100: Definitions of variables seen on CONFIG > FIRMWARE UPDATE Transmissions Settings page

Item	Description
Minimum Multicast Delay (seconds)	Time between subsequent blocks when sending multi-cast messages/blocks/packets to a node.
Multicast Threshold (nodes)	Minimum number of nodes needed to ensure that a multicast transmission can happen in a subnet, if the number of elements requiring a specific image block is greater than or equal to the multicast-threshold value.
Transmission Speed	Options are Slow (default), Medium, Fast or Custom.
Unicast Delay (seconds)	Time between subsequent blocks when sending unicast messages, blocks or packets to a node.

Uploading a Firmware Image to a Resilient Mesh Endpoint (RME) Group

To upload a firmware image to mesh endpoint group members:

Procedure

Step 1 Choose **CONFIG** > **FIRMWARE UPDATE**.

Step 2 Click the **Groups** tab (left-pane).

Step 3 Select the Endpoint firmware group to update.

Step 4 In the right panel, select Firmware Management and then click the Upload Image button. In the entry panel that appears, do the following:

a) From the Select Type drop-down menu, choose the firmware type for your device.

b) From the Select an Image drop-down menu, choose the firmware bundle to upload.

c) Click **Upload Image**.

d) (Optional) Check the Install patch box, if you choose *to install only the patch* of the new image (For more information, see Figure 9: Check Install Patch Item to ONLY Install the Patch Rather than the Full Image, on page 369).

Figure 9: Check Install Patch Item to ONLY Install the Patch Rather than the Full Image

e) Click **OK**.

IoT FND adds the image to the list of images in the Firmware Management pane and starts the upload process in the background. A bar chart displays the upload progress (percentage complete). See Figure 10: Firmware Update - Percentage Complete (top-portion of screen), on page 369 and Figure 11: Firmware Update - Upload Summary (bottom-portion of screen), on page 369.

Note
Click the Sync Membership button to ensure that FND and the member endpoint firmware group information are the same.

Figure 10: Firmware Update - Percentage Complete (top-portion of screen)

Figure 11: Firmware Update - Upload Summary (bottom-portion of screen)

Uploading a Firmware Image to FND

To upload a firmware image to mesh endpoint group members:

Procedure

Step 1 Choose **CONFIG** > **FIRMWARE UPDATE**.

Step 2 Select the **Images** tab (left-pane).

Step 3 Select the Endpoint Image type (such as BBU, IOx-IR500 LMAC) to be uploaded.

Step 4 Click on + (plus icon) next to the FIRMWARE IMAGES heading to browse the firmware from your local system.

Step 5 Browse and click on **Add file**.

IoT FND can upload the following image types to ENDPOINT devices as shown in the table below:

Table 101: Firmware Images for Endpoints

Image Type	Description
RF	For endpoints with RF radio only.
PLC	For endpoints with Power line communication (PLC) radio only.
BBU	For Battery back up (BBU) units.
LMAC	For Local MAC connected devices.
IOx-IR500	For IR500 devices running Cisco IOx software.

Figure 12: Using IoT FND to Upload Images to an Endpoint

Modifying Display of Firmware Management Page

You can filter the Firmware Management page display by Subnet, PanId or Group in the Devices tab.

To modify the display of firmware management page:

Procedure

Step 1 Choose **CONFIG** > **FIRMWARE UPDATE**.

Step 2 Click the **Sync Membership** button to ensure that the information for FND and the member endpoint firmware group is the same.

Figure 13: CONFIG > FIRMWARE UPDATE

Viewing Mesh Device Firmware Image Upload Logs

To view the mesh device firmware image upload logs:

Procedure

Step 1 Click the **Sync Membership** button to sync the group members in the same firmware group.

Step 2 Click the **Devices** tab to view member's devices.

Step 3 Click the **Logs** tab to view log files for the group.

For more information, refer to Figure 10: Firmware Update - Percentage Complete (top-portion of screen), on page 369
.

AP800 Firmware Upgrade During Zero Touch Deployment

During the PnP bootstrapping, whenever an access point (AP) or router sends the firmware request, FND will need to make the choice as to whether Unified Firmware or Autonomous Firmware is updated on the AP to make it accessible to the Cisco Wireless LAN Controller (WLC) after a firmware upgrade.

Note Once you set up the DHCP server on a Cisco IOS router, WLC generally handles the software updates for the AP.

Allows you to set the desired firmware that will update an IR829 router during ZTD.

There are two possible firmware options:

- **Option 1**: Set the 'unified' version (k9w8: the factory-shipped version) as the desired firmware.
- **Option 2** : Set the autonomous firmware as the desired firmware version.

During the ZTD process, the firmware upgrade of an access point (AP) or embedded AP on an IR829 router will upgrade using the firmware version you define as the autonomous firmware.

To define the Autonomous Firmware for an IR829 router:

Procedure

Step 1 Choose **CONFIG** > **DEVICE CONFIGURATION**.

Step 2 Select the desired router: Default-ir800 (left-pane).

Step 3 Check the installed firmware version, BEFORE upload. if equal to the latest version, skip firmware upgrade.

Step 4 Before you upload the software to the router, check the image and version:

- If the router image version is equal to the latest version, skip upgrade.
- If router image has the latest

Step 5 Select Edit AP Configuration Template tab (right-pane).

Step 6 Enter the following text in the right-pane:

```
ip dhcp pool embedded-ap-pool
network <router_ip> 255.255.255.0
dns-server <dns_ip>
default-router <router_ip>
option 43 hex f104.0a0a.0a0f (Note: Enter a single WLC IP
address(10.10.10.15) in hex format)
ip address <router_ip> 255.255.255.0
! {Note the symbol in this line is an exclamation point}
service-module wlan-ap 0 bootimage unified
```

Step 7 Click disk icon (bottom of page) to save the commands in the configuration template.

Image Diff Files for IR809 and IR829

To reduce the file size that transfers across network for IR809 and IR829, you can send a partial image:

- At the Upload Image page, select type: IOS-IR800.
- Check box for option: “install patch for IOS and hypervisor from this bundle.”

Gateway Firmware Updates

IC3000 Firmware Updates:

- At the **CONFIG** > **FIRMWARE UPDATE** page, you can add or delete the IC3000 firmware image.

Note Firmware image upload depends on interface speeds. You can set the timeout duration (in minutes) for firmware upload in cgms.properties file using "igma-idle-timeout" key. If you don’t set this duration, then default timeout duration will be 15 minutes.

- At the **Images** tab page, expand the Gateway icon and click on IC3000 to see a list of available IC3000 images.

Enhancement to Firmware Update Page for Device Status Types

Table 102: Feature History

Feature Name	Release Information	Description
Enhancement to Firmware Update Page for Device Status Types	Cisco IoT FND Release 5.0	Cisco IoT FND includes two additional device statuses in the **Firmware Update** page: **Down Devices** and **All Devices**. Use the **Down Devices** link to filter the down devices search and **All Devices** displays the count of total devices in the firmware group of routers.

Enhancement to Firmware Update Page for Device Status Types

Starting from Cisco IoT FND 5.0 release, the **Firmware Update** page includes a new device status count link called **Down Devices** which is added for routers. The status field is used in identifying and calculating the count of **All Devices**, **Written Devices**, **Error Devices** and **Down Devices** within a given firmware group.

The **Down Devices** link is used to filter the search for all the down devices in the firmware group of routers. A device is considered down when the status appears with a red cross icon, indicating it is offline. The **All Devices** count displays the total number of devices in the firmware group of routers.

Note The **Down Devices**, **Error Devices** and **Written Devices** status counts are hyperlinked for filtering the search based to the device state.

Benefits of Using Device Status Count Links

Device status count links help in filtering the search for devices based on their status types. These links also help in determining the count of the devices in each state.

Accessing Device Status Links

In the **Firmware Update** page click the link for each device status count to view the devices based on their state.

Avoid Firmware Upgrade Overlap with Certificate Auto Renewal

Problem

As part of the reload process, the cellular modem is powered off during firmware upgrade. If there is an Embedded Event Manager (EEM) script which is in the running configuration, which executes the write memory operation after getting a renewed certificate, then it saves the startup configuration with the cellular modem turned off. This results in an outage after router reload. Once the router reloads and comes up again, due to cellular modem which is in the powered off state, the router cannot register with Cisco IoT FND.

Solution

There are two steps for upgrade:

- Firmware upload.
- Firmware installation.

In case of an overlapping duration between certificate auto renewal and firmware installation, ensure that the firmware installation is initiated only after the certificates are successfully auto renewed for routers. Also, select only those routers which have already completed the certificate auto renewal for the firmware upgrade group.

Note This is applicable only for firmware installation as firmware upload has no such restriction.

Identifying and Avoiding Routers for Firmware Upgrade

To identify and avoid selecting the routers which have certificate expiration, follow the given step:

1. From the Cisco IoT FND menu bar, click **OPERATIONS** > **Issues**.

Note Avoid selecting any router which appears in the **Issues** table with certification expiry message.

Configuring Firmware Group Settings

This section describes how to add, delete, and configure firmware groups, and includes the following topics:

- Adding Firmware Groups, on page 375
- Assigning Devices to a Firmware Group, on page 375
- Renaming a Firmware Group, on page 377
- Deleting Firmware Groups, on page 377

Note Upload operations only begin when you click the **Resume** button.

When you add routers or RMEs to IoT FND, the application sorts the devices into the corresponding default firmware group: default-<*router*> or default-cgmesh. Use these groups to upload and install firmware images on member devices. Add firmware groups to manage custom sets of devices. You can assign devices to firmware groups manually or in bulk. Before deleting a firmware group, you must move all devices in the group to another group. You cannot delete non-empty groups.

When creating firmware groups note the guidelines:

- CGRs, IR800s can coexist on a network; however, for firmware management, they cannot belong to the same firmware group.
- IR500s and other RMEs devices can coexist on a network; however, for firmware management, they cannot belong to the same group.

The Groups tab on the **CONFIG** > **FIRMWARE UPDATE** page displays various device metrics.

Figure 14: CONFIG > FIRMWARE UPDATE

Tip At the Firmware Update page, click the Error/Devices link (not shown) in the **Firmware Update** page to apply a filter.

Click **Clear Filter** to revert to an unfiltered view of the selected device group.

Adding Firmware Groups

To add a firmware group:

Procedure

Step 1 Choose **CONFIG** > **FIRMWARE UPDATE**.

Step 2 Click the **Groups** tab.

Step 3 In the Groups pane, select one of the following:

- Default-cgr1000
- Default-ir500
- Default-ir800
- Default-cgmesh

Step 4 Click + next to Firmware Groups heading in the Groups pane to Add Group.

Step 5 In the **Add Group** dialog box, enter the name of the firmware group. Device Category options depend on the device type you select in Step 3.

Step 6 Click **Add**.

The new group label appears under the corresponding device type in the Firmware Groups pane.

Note
To assign devices to the new group, see Assigning Devices to a Firmware Group, on page 375.

Assigning Devices to a Firmware Group

This section explains moving devices to another firmware group in bulk or manually.

Moving Devices to Another Group In Bulk

To move devices from one group to another in bulk:

Procedure

Step 1 Create a CSV or XML file listing devices that you want to move using the format shown in the following examples:

***DeviceType/EID* for CGRs:**	***EID* only for mesh endpoints:**	***EID* only for IR800s**
eid CGR1120/k9+JS1 CGR1120/k9+JS2 CGR1120/k9+JS3	eid 00078108003c1e07 00078108003C210b	eid ir800
***EID* only for ISR 800s:**	***EID* only for IR500s:**	***EID* only for IC3000**
eid C819HGW-S-A-K9+FTX174685V0 C819HGW-S-A-K9+FTX174686V0 C819HGW-S-A-K9+FTX174687V0	eid da1 da2 da3	eidIC3000+FOC2219Y47Z

Note
Each file can only list one device type.

Step 2 Choose **CONFIG** > **FIRMWARE UPDATE**.

Step 3 Click the **Groups** tab.

Step 4 Click the **Assign devices to Firmware Group** button (found above the Groups tab).

Step 5 In the window that appears, click **Browse** and locate the device list CSV or XML file.

Step 6 From the **Group** drop-down menu, choose the destination group.

Step 7 Click **Assign to Group**.

Note
IoT FND moves the devices listed in the file from their current group to the destination group.

Step 8 Click **Close**.

Moving Devices to Another Group Manually

To manually move devices to a group:

Procedure

Step 1 Choose **CONFIG** > **FIRMWARE UPDATE**.

Step 2 Click the **Groups** tab.

Step 3 In the Firmware Groups pane, select the desired firmware group based on device type.

Note
If this is an ENDPOINT firmware group, click the **Devices** tab above the main pane.

Step 4 Check the check boxes of the devices that you want to move.

Step 5 Click **Change Firmware Group** to open a pop up window.

Step 6 From the **Firmware Group** drop-down menu, choose the firmware group to which you want to move the devices or enter a new group name.

Step 7 Click **Change Firmware Group**.

Step 8 Click **Close**.

Renaming a Firmware Group

In the **Firmware Update** page, there are two firmware groups available, namely user-created groups and default groups of router, endpoint, or gateway. IoT FND allows you to rename the user-created firmware groups only. You cannot rename the default firmware groups.

To rename a firmware group:

Procedure

Step 1 Choose **CONFIG** > **FIRMWARE UPDATE**.

Step 2 Click the **Groups** tab.

Step 3 In the Firmware Groups pane, select the firmware group to rename.

Step 4 Move the cursor over the firmware group and click the **Edit Group Name** pencil icon.

Note
Starting with IoT FND, you can only rename the user-created firmware groups and you cannot rename the default firmware groups. The pencil icon does not appear for the default firmware groups.

Step 5 In the **Rename Group** window, enter the new name and then click **OK**.

Note
When you enter an invalid character entry (such as, @, #, !, or +) within the Rename Group field, IoT FND displays a red alert icon, highlights the field in red, and disables the **OK** button.

Deleting Firmware Groups

Note Before deleting a firmware group, you must move all devices in the group to another group. You cannot delete non-empty groups.

To delete a firmware group:

Procedure

Step 1 Choose **CONFIG** > **FIRMWARE UPDATE**.

Step 2 Click the **Groups** tab.

Step 3 In the Firmware Groups pane, select a firmware group to display a list of all possible firmware images for that group in the right pane.

Step 4 Check the box next to the firmware group that you want to delete.

Step 5 Click Clear Selection that appears above the entry (yellow bar).

Step 6 To confirm deletion, click **Yes**.

Step 7 Click **OK**.

Firmware images

Firmware images in Cisco IoT FND are software files that you use to update and enhance the firmware of managed Cisco IoT devices.

A router group in Cisco IoT FND is a collection of routers that you can organize together to simplify managing, monitoring, and configuring tasks across multiple routers simultaneously.

Table 103: Feature history

Feature name	Release information	Description
Export firmware and configuration group data	Cisco IoT FND Release 5.1	Export the firmware group update information from the **Firmware Update** page, and export the configuration group update information from the **Device Configuration** page. The export option is available only for routers and endpoints.
Enable firmware upload progress percentage	Cisco IoT FND Release 5.1	Cisco IoT FND displays the firmware upload progress for Cisco IoT routers running Cisco IOS-XE namely: • Cisco Catalyst IR1100 • Cisco Catalyst IR8100 • Cisco Catalyst IR1800

Feature name	Release information	Description
Upgrade firmware of cellular modems	Cisco IoT FND Release 5.1	Upgrade firmware of the cellular modems based on cellular technologies like LTE and 5G for Cisco Catalyst IR1100, Cisco Catalyst IR8100, and Cisco Catalyst IR1800 using Cisco IoT FND.
Scheduled upload and install of firmware images	Cisco IoT FND Release 5.1	Schedule the uploading and installing firmware images to a router group.
Bundle Boot and Install Boot modes for Cisco Catalyst IR8100	Cisco IoT FND Release 5.1	You can select between Bundle Boot and Install Boot Modes in the router firmware upgrade process.
Automatic bootflash space cleanup for Cisco IOS XE Devices	Cisco IoT FND Release 5.1	Cisco IoT FND automatically removes unused firmware images from both `bootflash:` and `bootflash:/managed/images` directories during every firmware upload, install, and during registration post the reload, ensuring optimal use of storage space without any manual intervention. This proactive cleanup not only simplifies the upgrade process but also helps prevent storage-related issues, allowing upgrades to proceed smoothly.

Feature name	Release information	Description
Bootflash Space Cleanup	Cisco IoT FND Release 5.0	Check the **Remove unused firmware images from bootflash** check box to remove unused firmware bin files from the bootflash when Cisco IoT FND uploads the image to the router. The check box is enabled for the following devices running Cisco IOS-XE: • Cisco Catalyst IR1100 • Cisco Catalyst IR8100 • Cisco Catalyst IR1800 **Note** Starting from Cisco IoT FND Release 5.1, this button is disabled on Cisco IoT FND and works in the backend without you having to enable it.

Add firmware images

Import the firmware file into the Cisco IoT FND database so it can be managed and later deployed to Cisco IoT routers.

Here are the steps to add firmware images to Cisco IoT FND:

Procedure

Step 1 In the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

Step 2 Click the **Images** tab.

Step 3 Select **ROUTER** or **ENDPOINT** or **GATEWAY** and then select a device group. For example, IOS-XE-IR1100.

Step 4 Click the **+** icon adjacent to **FIRMWARE IMAGES**.

Step 5 Click **Browse** to locate the firmware image. Select the image, then click **Add File**.
The image appears in the **Firmware Images** list.

What to do next

Upload firmware images

Upload firmware images

This task guides you to upload firmware images to a router group, Cisco IoT FND pushes the image to the router group in the background and tracks the upload progress to ensure that the devices receive the firmware image.

Here are the steps to upgrade firmware on a router group:

Before you begin

- Firmware image upload and installation require the following free disk space:
  - For bundle boot mode: 20 MB + uploaded file size
  - For install boot mode: 800 MB + uploaded file size
- Auto-cleanup is applicable to both Bundle and Install boot modes. Cisco IoT FND checks both `bootflash:` and `bootflash:/managed/images` during cleanup. In Install boot mode, cleanup removes unwanted package files, .conf files, and .bin files from both locations.
- If you find firmware files in `bootflash:` or `bootflash:/managed/images`, Cisco IoT FND cleans up all files except the currently running one. You must manually remove any other files that are not .bin, .pkg, or .conf.
- For Cisco IOS XE devices, Cisco IoT FND automatically performs bootflash space cleanup during every firmware upload, install, and post-reload registration. Any image not part of the active boot parameters or referenced in before-tunnel-config, before-registration-config, express-setup-config, or factory-config is proactively removed from `bootflash` and `bootflash:/managed/images`, regardless of whether a space issue is detected.

  If, after this proactive cleanup, a router group still does not have enough free space, Cisco IoT FND continues space-recovery cleanup by removing additional unused files until sufficient space is available to upload the new image. If there is still not enough space, you must manually delete unused files on the router.
- Starting from Cisco IoT FND Release 5.1, you'll see an auto-cleanup error when there is not enough space for the firmware upload to progress. Cleanup operations always examine both `bootflash:` and `bootflash:/managed/images`.
- In install boot mode, files in the bootflash directory are cleaned up. In a brownfield scenario, the installed images point to the `bootflash managedimages.bin` file directory, so cleanup occurs in both `bootflash` and `managedimages.bin`.
- If any devices in the router group encounter errors during firmware upload, Cisco IoT FND prevents firmware installation and you can see an error message indicating the presence of errored devices. For errored or cancelled devices, move them to a separate install group and repeat the upload and installation process.
- If you cancel the firmware upload for some devices, firmware installation proceeds only on devices that successfully completed the upload. For errored or cancelled devices, move them to a separate install group and repeat the upload and installation process.

Procedure

Step 1 In the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

Step 2 Click the **Groups** tab.

Step 3 Select the router group that you want to upgrade.

Step 4 Click **Upload Image**.

Step 5 The **Select Type:** drop-down list is auto-selected based on the selected router group.

Step 6 For Cisco IOS XE devices, select between **Bundle Boot Mode** and **Install Boot Mode** from the **Mode of installation** drop-down list.

Note

- Bundle boot mode is a software loading method used in Cisco IOS XE devices, such as routers and switches, where the device boots and runs the operating system directly from a single consolidated image file (the "bundle" file, typically with a `.bin` extension) rather than from extracted individual package files.
- Install boot mode is a software operating mode in Cisco IOS XE devices in which the device boots and runs the operating system from a set of extracted software package files, rather than from a single monolithic image.
- You require minimum free space of upto 800 MB, in the `bootflash` directory to use the **Install Boot Mode**.
- You can't downgrade to versions that exclusively support only **Bundle Boot Mode** if the device is already operating in Install Mode.

Step 7 Select an image from the **Select an Image** drop-down list.

Note
In Cisco IoT FND Release 5.0, you can use the **Remove unused firmware images from bootflash** checkbox when uploading Cisco IOS-XE images. If there isn't enough space for the new image, checking the checkbox deletes all unused .bin files from `bootflash` and `bootflash:/managed/images`, keeping only those required for boot parameters and active images. This ensures enough disk space for the upload.

Step 8 Click **Upload Image Now** to initiate the firmware upgrade process instantly.

Note
Use the **Cancel** or **Pause** buttons to either cancel or pause the firmware image upload.

Step 9 Click **Schedule** to execute the firmware upgrade process at a preferred time. Check the **Enable timeout for scheduled upload** check-box to set a timeout for the uploading operation.

Note
If you want to reschedule a future scheduled Firmware job, you need to cancel this firmware job and schedule again.

You can view the firmware upload percentage in the **Update Progress** column in the firmware images table.

What to do next

Install firmware images.

Install firmware images

Use this task to install a firmware image to a router group after you upload a firmware image to Cisco IoT FND.

Before you begin

- If you cancel the firmware upload for some devices, firmware installation proceeds only on devices that successfully completed the upload. For errored or cancelled devices, move them to a separate install group and repeat the upload and installation process.
- For Cisco IOS XE devices, Cisco IoT FND automatically performs bootflash space cleanup during every firmware upload, install, and post-reload registration. Any image not part of the active boot parameters or referenced in before-tunnel-config, before-registration-config, express-setup-config, or factory-config is proactively removed from `bootflash` and `bootflash:/managed/images`, regardless of whether a space issue is detected.

  If, after this proactive cleanup, a router group still does not have enough free space, Cisco IoT FND continues space-recovery cleanup by removing additional unused files until sufficient space is available to upload the new image. If there is still not enough space, you must manually delete unused files on the router.
- Auto-cleanup is applicable to both Bundle and Install boot modes. Cisco IoT FND checks both `bootflash:` and `bootflash:/managed/images` during cleanup. In Install boot mode, cleanup removes unwanted package files, .conf files, and .bin files from both locations.
- Firmware image upload and installation require the following free disk space:
  - For bundle boot mode: 20 MB + uploaded file size
  - For install boot mode: 800 MB
- Starting from Cisco IoT FND Release 5.1, you'll see an auto-cleanup error when there is not enough space for the firmware install to progress.
- Once the new firmware is installed and during the device registration, the copy of new firmware image is copied copied to the bootflash directory for failsafe and is also configured in bootparams.
- The automatic bootflash cleanup is not supported in PnP (Plug and Play) workflow.

Procedure

Step 1 In the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

Step 2 Click the **Groups** tab.

Step 3 In the **Groups** tab, select the router group for which you want to install the firmware.

Step 4 Click **Install Image**.

Step 5 In the **Install Image to:** dialog box, select **Install Image Now** to install the image instantly.

Step 6 Select **Schedule** to schedule the installation based on your requirement.

Note
If you want to reschedule a future scheduled Firmware job, you need to cancel this firmware job and schedule again.

Step 7 Check the **Enable timeout for scheduled install** check box if you want to set a timeout for the installation.

Step 8 Use the **Cancel** or **Pause** buttons to cancel or pause the firmware installation.

Note

- If you restart Cisco IoT FND during the image installation process, it automatically resumes any firmware installations that were in progress before going offline.
- The firmware installation operation can time out on some routers. During installation, a job scheduler runs every two hours to terminate any firmware install jobs that are stuck at 35% progress. You can adjust the scheduler's default interval by setting the "firmware-install-timeout-schedule-cron-hour" key in the cgms.properties file to any value greater than 0 and less than 24. This scheduler applies only to jobs stalled at the 35% mark.
- When a firmware install or image upload operation for routers takes too long, it can cause other jobs in the queue to wait longer. You can set the timeout duration for stuck firmware jobs using the `router-firmware-upload-timeout-minutes` and `router-firmware-install-timeout-minutes` keys in the cgms.properties file; the default is 8 hours (480 minutes).

What to do next

View the firmware images

Firmware upgrade behavior

This topic describes how Cisco IoT FND manages device firmware upgrades across greenfield and brownfield deployments, covering install versus bundle boot modes, storage locations (`bootflash` and `managed/images`), progress/status milestones (35%, 50%, 75%, 100%), space requirements for install mode (800 MB), file cleanup at defined checkpoints (success, failure, registration, and retries), error/skip conditions related to install-mode support, and rollback handling using `packages.conf` and `prev_packages.conf` to prevent `prev_packages.conf.xx` accumulation.

- Covers greenfield and brownfield upgrade paths, including install and bundle boot modes.
- Identifies storage locations used during upgrades: `bootflash` and `managed/images`.
- Outlines file cleanup behavior on success and failure, including actions during registration and retry phases.
- Details status and progress updates, including milestones at 35%, 50%, 75%, and 100% with `UPDATING_FIRMWARE` and "update complete."
- Requires at least 800 MB free space before starting an install-mode upgrade.
- Describes rollback handling with `packages.conf` and `prev_packages.conf`, including an additional reload to avoid `prev_packages.conf.xx` file sprawl.
- Highlights brownfield two-reload behavior and associated cleanup in `managed/images` and `bootflash`. Notes that Cisco IoT FND retries deletions and can enforce cleanup across boot modes when initial deletion fails.
- All firmware related activities on Cisco IoT FND are captured in the **Audit Trail** page. Starting from Cisco IoT FND Release 5.1, you can see the **Mode of installation** used to perform the firmware upload or install.

Table 104: Terminology

Term	Details
Greenfield	Device uses images in `bootflash` (previous package is in `bootflash`).
Brownfield	Device previously used bundle boot mode with images under `managed/images`, now upgrading using install boot mode in `bootflash` (requires two reloads).
`bootflash`	Device's local storage.
`managed/images`	Directory used by bundle boot mode.
Install boot mode	Boots using installed packages in `bootflash`.
Bundle boot mode	Boots using a single `.bin` image (often under `managed/images`).
`packages.conf` / `prev_packages.conf`	Boot configuration files; `prev_packages.conf` is used for rollback/revert.

Table 105: File cleanup behavior

Scenario	Cleanup Actions
Greenfield, install succeeds.	During registration, Cisco IoT FND deletes unused extracted files, the uploaded `.bin`, unused `.bin` file and `prev_packages.conf` (if not needed) from `bootflash`.
Greenfield, install fails.	Device rolls back; Cisco IoT FND removes the uploaded `.bin` and any unused files from `bootflash`.
Brownfield, install succeeds (first reload).	At first registration, Cisco IoT FND removes the unused `.bin` under `managed/images`.
Brownfield, install succeeds (second reload).	Cisco IoT FND removes any unused `.bin` from `bootflash`.
Brownfield, install fails (first reload still works).	Cisco IoT FND cleans up the `.bin` under `managed/images`.
Brownfield, second upgrade attempt fails.	Cisco IoT FND removes unwanted extracted files and the uploaded `.bin` from `bootflash`.
Deletion fails right after install.	Cisco IoT FND retries deletion during upload and install phases; can enforce cleanup of leftover files related to the other boot mode.

Table 106: Status and progress

Flow	Status	Progress	Message
Generic: while installing	`INSTALLING FIRMWARE`	0% → 10%	—
Generic: after commands sent.	`UPDATING_FIRMWARE`	0% → 35%	—
Generic: successful installation and reload, upon registration.	Update complete	100%	—

Flow	Status	Progress	Message
Brownfield with install boot mode.	`UPDATING_FIRMWARE`	35%	—
Brownfield with install boot mode: after first reload and registration.	`UPDATING_FIRMWARE`	50%	"Two reloads are required as firmware already installed in managed/images using bundle boot mode is upgrading using install boot mode in bootflash directory."
Brownfield with install boot mode: second installation commands sent for `bootflash`.	`UPDATING_FIRMWARE`	75%	Same as above.
Brownfield with install boot mode: successful completion.	Update complete	100%	—
Any failure.	Error/failure state	—	Status updates accordingly.

Table 107: Error and skip conditions

Category	Condition	FND Response	Message
Error	Device already in install boot mode; user uploads a bundle-mode image.	Show `ERROR`; advise using install boot mode.	"Firmware has already installed using install boot mode. Please select install boot mode for upgrade."
Skip (upload)	Running firmware does not support install boot mode (< 17.09.01).	Skip upload with message.	"The running firmware version is not supporting install boot mode. Firmware upgrade using Install mode is supported in 17.09.01 or later."
Skip (test-only)	Property `skip-install-bootmode-firmware-version-check` used.	Bypass version check (testing only; not for production; not documented).	—
Upload error	Uploaded image does not support install boot mode (< 17.09.01).	Show error popup and fail upload.	Appropriate error presented.
Note	Skip checks apply to upload.	Installation-phase skip logic remains unchanged.	Existing behavior is preserved.

Table 108: Handling `prev_packages.conf` reverts

Condition	FND Actions	Rationale
Device reverts during install-mode upgrade and boots using `prev_packages.conf`.	Upon registration: set boot parameter to `packages.conf`, copy `prev_packages.conf` to `packages.conf`, then reload.	Prevents staying on `prev_packages.conf`, which would create `prev_packages.conf.01`, `.02`, etc.; platform does not allow normal deletion of older `prev_packages.0x` files, so FND avoids accumulation.

Upgrade the cellular modem

Starting from Cisco IoT FND Release 5.1, you can upgrade the firmware of the cellular modem of Cisco IoT routers based on cellular technologies like 5G and LTE using Cisco IoT FND. Here are the supported devices:

- Cisco Catalyst IR1100
- Cisco Catalyst IR8100
- Cisco Catalyst IR1800

Here are the steps involved in upgrading the cellular modem of a supported Cisco IoT router:

1. Upload the firmware image to Cisco IoT FND.
2. Upload the firmware image from Cisco IoT FND to the supported Cisco IoT router.
3. Install the firmware image to the supported Cisco IoT router.

Before you begin

- Ensure to identify the modem type and Stock Keeping Unit (SKU) as the upgrade sequence might vary. The cellular modems in some cases require upto 3 firmware related files depending on the modem and the carrier. Here are the 3 files that can help you upgrade the firmware of cellular modems:
  - Firmware file
  - Carrier PRI file (.nvu)
  - OEM PRI file

  Here are some SKU examples:

SKU ID	Modem Type	Firmware Download Link
P-LTE-GB	WP7607	Download
P-LTE-IN	WP7608	Download
P-5GS6-GL	FN980	Download

- Each firmware file must be uploaded individually. Don't group the firmware image files in a single folder.
- If you have Semtec modems, you can place the Firmware and the Carrier PRI files in the same folder and upgrade them together. Upgrade the OEM PRI file separately.

- If you have Telit modems, use .bin files for upgrading the firmware.
- If the uploaded firmware image file doesn't match the required modem or slot details, Cisco IoT FND skips the upload or installation with a warning.
- Once the installation is completed, the uploaded file is auto-deleted.
- We don't recommend downgrading the cellular modem using Cisco IoT FND.
- That firmware progress time is converted to server time zone and is scheduled accordingly. Similarly, the status of the upgrade is converted back to your time zone.
- If the modem supports three files, upload the Firmware file and Carrier PRI file, and install them. After successful installation, upload the OEM PRI file and install it. If the modem supports two files, upload the Firmware file and install it. After successful installation, upload the OEM PRI file and install it. If the modem supports one file, upload and install it.

Here are the instructions to upgrade the firmware of cellular modems of Cisco IoT routers using Cisco IoT FND:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

Step 2 Click the **Images** tab and select either **LTE** or **5G** based on the cellular technology. Click the **+** icon.

Step 3 Choose a **Modem**, a **Carrier**, and browse for the firmware image file to select it. Click **Add File**.
You'll see the file you just added, listed in the **Cellular Firmware Images** table.

If the cellular modem doesn't exist on the registered device, Cisco IoT FND doesn't display the modem model while you upload the images to Cisco IoT FND.

Step 4 Click **Groups** tab, select a supported Cisco IoT router from the list and click **Upload Image**. Uploading an image with the same extension overwrites the existing image.

Step 5 Select the appropriate options from the **Select Type**, **Modem**, **Carrier**, **Slot** drop-down lists. Ensure to select the image that you just uploaded to Cisco IoT FND in the **Select an Image** drop-down list. Click either **Upload Image Now** or **Schedule as** based on your requirement. Check the **Clean cellular image Directory** check box to delete the existing cellular directory and its images before uploading the new image.

Step 6 Once the image is uploaded to the router, click **Install Image**. For more information see, Install firmware images.

You've successfully upgraded the firmware of the cellular modems of Cisco IoT routers.

What to do next

- The cellular images are uploaded to the device on the cellular directory. If the directory doesn't exist, Cisco IoT FND creates a directory on the device and will upload the images to the path `bootflash:/managed/cellular/`
- We recommend that you don't downgrade the cellular modems.
- When the installation is triggered from Cisco IoT FND, the cellular modem will reboot to upgrade the image. During this time, connectivity between the cellular modem and the Cisco IoT FND will be unavailable.

- The Cisco IoT FND pushes the applet `checkCellularManagedDir` and the cgna-profile `cg-nms-cellularFWIntfMetrics`.
- The applet runs every 15 minutes and executes the profile to communicate with the Cisco IoT FND. If successful, the cellular directory is removed, and the firmware activity in the Cisco IoT FND will be marked as `UPDATE_COMPLETE`.
- After successful installation, Cisco IoT FND removes the cellular directory on the router. In addition, Cisco IoT FND removes `aplet checkCellularManagerDir` and `cgna-profile cg-nms-cellularFWIntfMetrics`.
- After successful installation, verify the Firmware Version, Carrier, and OEM PRI version on the **Device Info** page in the **Cellular Link Settings** section.
- If the installation fails, the cellular directory will be removed after five retry attempts if the connection between the router and Cisco IoT FND fails. In addition, Cisco IoT FND removes `aplet checkCellularManagerDir` and `cgna-profile cg-nms-cellularFWIntfMetrics`.
- If the cellular modem upgrade fails and the modem comes up with the old image version, Cisco IoT FND still marks the router as `UPDATE_COMPLETE`. Cisco IoT FND allows upgrading the same cellular image that is currently running on the cellular modem.

  In a dual-modem router, Cisco IoT FND marks the upgrade as `UPDATE_FAILED` if modem 1's upgrade fails or its interfaces go down even when modem 2 establishes a connection between the router and Cisco IoT FND.

  Cisco IoT FND marks the upgrade as `UPDATE_COMPLETE` if modem 1's interfaces come up after the upgrade but modem 1 fails to connect and modem 2 establishes the connection; if no connection is established, the upgrade times out per configuration.

View firmware images

Use the following instructions to view the firmware images on Cisco IoT FND:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **FIRMWARE UPDATE**.

Step 2 Click the **Images** tab.

Step 3 Select a ROUTER or an ENDPOINT to display all firmware images for those devices in the Cisco IoT FND database. You can view a list of firware images associated with the particular device type. You can view details such as name, version, hardware ID, vendor hardware ID, size, active download etc.

Step 4 Click **Delete** to delete a particular firmware image.

Export firmware images data

This task helps you export the existing firmware images data from Cisco IoT FND.

Before you begin

- Ensure that your local system has enough space to download the firmware and configuration data.
- Ensure that your local system supports .csv files.

Here are the instructions for you to export firmware images data from Cisco IoT FND:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

Step 2 Select the firmware group. Select multiple group members or filter them using the firmware group's search filter. Find the export icon for endpoints on the **Devices** tab of each endpoint firmware group.

Step 3 Click the export icon adjacent to the refersh icon.
The firmware images data is downloaded as a .csv file to your local system.

You've successfully exported the fimrware images data.

What to do next

Search Firmware Updates

Search Firmware Updates

Search Firmware Updates

Table 109: Feature History

Feature Name	Release	Description
Search Firmware Updates	Cisco IoT FND Release 5.0	Search through the existing firmware updates using the filters introduced in this release. This feature aims to make the firmware updates page searchable.

Information About Search Firmware Updates

Starting from Cisco IoT FND Release 5.0, search through the firmware updates in the **Firmware Update** page. Use the exhaustive filters provided along with the search option to narrow down your search.

Benefits of Search Firmware Updates

- Quickly locate specific devices, data, or configurations, and reduce the time spent navigating through the system.

- As the network grows, the functionality can help you handle larger datasets, ensuring that performance and usability remain consistent.

Perform a Search Using Search Firmware Updates

1. From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Updates**.
2. In the default page, perform a search using the search bar. Click **Show Filter**.
3. In the Filters pane, click the first drop-down box and choose from the following options:

Option	Description
Status	Choose Status as a search criteria if you want to filter the devices based on their statuses. Here are the statuses that you can choose from: • blocked • bootstrapped • bootstrapping • down • outage • outofservice • registering • restored • unheard • unmanaged • unsupported • up
Name	Type in the name of the device that you are looking for in the text box.
EID	Type the EID of the device that you are looking for in the text box.
IP Address	Enter the IP address of the device that you are looking for in the text box.
Firmware Version	Use the firmware version of the device to filter the devices running a particular firmware version.

Option	Description
Activity	Choose Activity as a filter if you want to filter out devices based on their activity. Here are some of the device activities: • Unknown • Partially Uploaded • Awaiting Upload • Skipped • Error • Fully Uploaded **Note** You can use any VM on which Cisco IoT FND is installed to monitor all the activities.
Update Progress	You can filter the devices that are going through a firmware update process. Choose **between** in the second drop-down box and enter the firmware upgrade versions in the text boxes provided.
Last Firmware Status Heard	Use this filter if you want to filter devices based on the date and time they broadcasted their firware update status.

4. Click + button to populate the search bar.
5. Click the **Search** icon to perform a search based on the filters.

Push StackMode

Starting from Cisco IoT FND Release 4.8.1, Cisco IoT FND supports multiple mesh networking modes for IoT deployments. You must be an admin or you should have firmware upgrade permission to perform the switch from CR-Mesh to Wi-SUN stack mode. Switching from CR-Mesh to Wi-Sun mode changes the underlying radio protocol used by devices in the network. CG-Mesh is Cisco mesh technology, while Wi-Sun leverages the IEEE 802.15.4g standard with Wi-SUN profiles for interoperability within a broader ecosystem. During the switching process, a single or multiple PAN nodes are grouped and scheduled for switching devices from CG-Mesh to Wi-SUN stack. Wi-SUN stack supports both unicast and multicast transmissions. For more information see, Mesh protocol modes.

Supported Platforms

Cisco IoT FND supports the following platforms for switching devices from CG-Mesh to Wi-SUN stack:

- ITRON30
- CR-Mesh

- Cisco 500 Series WPAN Industrial Routers

Table 110: Feature History

Feature Name	Release Information	Description
Support For Wi-SUN Stack Switch	Cisco IoT FND Release 4.8.1	Switch devices from CR-Mesh to Wi-SUN StackMode.
Abort StackMode jobs	Cisco IoT FND Release 5.1	Abort the StackMode jobs using Cisco IoT FND. You can abort the operations you performed using **Push StackMode**, **Push StackMode Time**, and **Cancel StackMode** options.
Abort backup and reload	Cisco IoT FND Release 5.1	Abort both the **Schedule Install and Reload** and **Set as Backup** operations.

Prerequisites

Here are the prequisites for switching to Wi-SUN mode from CR-Mesh mode using Cisco IoT FND:

- Ensure that the following supported devices are running the minimum required versions
  - Cisco CGR: Cisco IOS Release 15.9(3)M1 and later releases.
  - Cisco IR8140: Cisco IOS-XE 17.x and later releases.
- Once you are done with switching of the devices from CR-Mesh to Wi-SUN stack mode, ensure to update the WPAN OFDM/FSK stack mode to Wi-SUN stack. If the WPAN OFDM/FSK is not updated, the node can't join back the network and will move to **Down** state in Cisco IoT FND.
- Ensure that the firmware version is 6.2.35 MR and later versions to use Push Stack Mode.

Note Starting from Cisco IoT FND 5.1.2, you can execute the Push Stack Mode even when the devices in a PAN are running 6.2.35 MR or lower versions. You can still execute the Push Stack Mode which ignores the devices that don't match the version criteria.

Switch from CR-Mesh to Wi-SUN StackMode

You can push your devices to Wi-SUN mode from CR-Mesh mode by scheduling the task at your convenience.

Configure Push StackMode

Here are the instructions to push devices to Wi-SUN stack mode:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

Step 2 Click the **Groups** tab in the left pane.

Step 3 Select the default or user-defined firmware group from the **ENDPOINT**.

Step 4 Check the **PAN ID** check box in the **StackMode Switch** table.

Step 5 Click **Push StackMode** to set your device mode to Wi-SUN stack mode.

Step 6 A confirmation dialog-box appears, click **Yes**. If you see a stack mode failure message, retry pushing to StackMode.

Step 7 Based on the status of the push stack mode process, the following states are displayed for the selected PAN ID in the **StackMode Switch** table:

Field	Description
Stack Operation Type	Displays the following states for the Push StackMode operation: • **StackMode Push Initiated**: Displays initiation of the stack mode operation. • **StackMode Push Completed**: Displays the completion of the stack mode operation. • **No operation** when no operation is initiated.
Stack Operation Status	Displays the overall success and failure status of the devices for the selected PAN during the StackMode operation.
Job Status	Displays the following statuses: • In-progress • Success • Aborted
Abort StackMode Operation	Click the **Abort** button if you'd like to abort the Push StackMode operation.

Your device modes are set to Wi-SUN stack mode.

Schedule Push StackMode Time

Here are steps to configure Push StackMode Time:

Procedure

Step 1 From Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

Step 2 From the **StackMode Switch** table, check the **PAN ID** check box.

Note
You can select only the PAN ID that has successfully completed the push StackMode configuration.

Step 3 Click **Push StackMode Time**.

A **Confirm** dialog box appears to schedule the switching initiation process for moving CR-Mesh devices to Wi-SUN stack.

Based on the status of the StackMode time process, the following states are displayed for the selected PAN ID in the **StackMode Switch** table.

Table 111: PAN ID Status

Field	Description
Stack Operation Type	Displays the following states for the Push StackMode operation: • **StackMode Switch Time Push Initiated** : Displays initiation of the stack mode schedule operation. • **StackMode Switch Time Completed**: Displays the completion of the stack mode schedule operation.
Stack Operation Status	Displays the overall success and failure status of the devices for the selected PAN during the StackMode operation.
Job Status	Displays the following statuses: • In-progress • Success • Aborted
Abort StackMode Operation	Click the **Abort** button if you'd like to abort the Push StackMode Time operation.

Note

- If you abort an in-progress Push StackMode Time job, the job stops immediately and retains all progress completed before the abort. To complete Push StackMode Time for the remaining devices, run Push StackMode Time again to restart the workflow.
- When you run Push StackMode Time again for an aborted or unsuccessful workflow, Cisco IoT FND sends requests only to the pending devices. It ignores devices that successfully received the Push StackMode Time request during the previous run.
- When you perform Push StackMode Time more than once on a workflow, the timestamp on devices in the same PAN might vary depending on the time configured in each run. We recommend that you push the same timestamp

each time. If different timestamps are configured across devices in the same PAN, the devices switch to Wi-SUN mode according to their configured time, which might prevent some nodes from rejoining the network.

- If you want to reschedule the Push StackMode Time and set the same for all devices in the same PAN ID, we recommend that you cancel Push StackMode and run Push StackMode and Time as a fresh workflow.

Step 4 Select the time and date in the **Schedule Switch Wi-SUN Stack** dialog box and click **Schedule** .

Note
Ensure that the scheduled time is not more than 49 days from the current date.

Note
If the scheduled time is in the past, an error message appears.

Step 5 Click **Yes** to confirm the stack switching operation.

On confirming the stack switching process, the stack operation type gets updated to **Stack Switch Time Push Initiated** state for the selected PAN ID.

Step 6 Click **OK** in the **Success** dialog box.

On successful completion of the stack switch process, the stack operation type column in the table gets updated to **Stack Switch Time Push Completed** state for the selected PAN ID.

Note
We recommend that you wait until all the devices in the selected PAN get switched to Wi-SUN stack, as there is a possibility of some devices failing to switch in the scheduled time. However, the failed devices automatically switch to Wi-SUN StackMode after a one-day time period.

If you don't schedule Push Stack Mode Time after you Push StackMode, the endpoint devices switch to Wi-SUN mode after 24 hours.

Note
If you want to reschedule the stack time for some reason, then you have to cancel the current stack switch operation, push the StackMode again, and reinitiate the scheduling stack switch process.

Cancel Wi-SUN Stack Switch Operation

Here are the steps to cancel Wi-SUN stack switch operation:

Before you begin

- Starting from Cisco IoT FND Release 5.1.2, use the cancel switch operation during any stage of the Push StackMode workflow.
- Cancel switch operation cancels the scheduled Push StackMode workflow as well.

Procedure

Step 1 From the Cisco IoT FND menubar, Choose **CONFIG** > **Firmware Update**.

Step 2 In the **Firmware Management** page, check the **PAN ID** check box for which you have completed either configuration or scheduling operation.

Step 3 Click **Cancel StackMode**.

Based on the status of the StackMode cancellation process, the following states are displayed for the selected PAN ID in the **StackMode Switch** table.

Table 112: PAN ID Status

Field	Description
Stack Operation Type	Displays the following states for the Push StackMode operation: • **StackMode Cancel Initiated:** Displays the intitiation of cancelling the StackMode operation. • **StackMode Cancel Completed**: Displays the completion of cancelling the StackMode Operation.
Stack Operation Status	Displays the overall success and failure status of the devices for the selected PAN during the StackMode operation.
Job Status	Displays the following statuses: • In-progress • Success • Aborted
Abort StackMode Operation	Click the **Abort** button if you'd like to abort the cancel Push StackMode push operation.

Step 4 Click **Yes** to cancel the stack switch operation.

A **Success** dialog box appears to indicate the successful cancellation of the Wi-SUN stack switch operation.

Validate Push StackMode

In the **StackMode Push Initiated** state, the devices in the selected PAN ID are validated based on the following parameters:

- Firmware version
- StackMode configuration

Table 113: Push StackMode Validation

Scenarios	System Validation	User Action
Firmware version 6.2 MR.	Checks if the devices in the selected PAN ID are running firmware version 6.2 MR. • If the firmware version is lower than 6.2 MR, then an error message appears. **Note** for more information on the devices that are running a lower version go to the **Devices** tab.	• You must upgrade the devices to firmware version 6.2 MR or later versions. • After upgrading the devices, you must again push new StackMode for the selected PAN ID.
	• If the firmware version is greater than 6.2 MR, then the devices are already in Wi-SUN stack.	
StackMode configuration.	Checks if all devices in the selected PAN ID received the StackMode configuration. • Some devices in the selected PAN ID fail to receive the configuration.	• Push StackMode again for the selected PAN ID. or • Remove the devices that are in Down state from FND and again push StackMode for the remaining devices in the PAN ID.
	• If all the devices in the selected PAN ID received the StackMode configuration, then you can schedule the devices for stack switch operation initiation.	You can schedule the devices for Wi-SUN stack switch only on successful completion of pushing StackMode configuration to all devices in the selected PAN.

Note On successful completion of the validation, the stack operation state for the selected PAN ID changes to **Stack Mode Push Completed**.

Abort backup and reload

Starting from Cisco IoT FND 5.1, you can abort both the **Schedule Install and Reload** and **Set as Backup** operations.

Before you begin

Here are the steps that you need to follow to abort the schedule and reload operations

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**

Step 2 Click the **Groups** tab and select an **ENDPOINT** of your choice.

Step 3 From the available list of images in the **Image Status** table, click either **Schedule Install or Reload** or **Set as Backup** based on your requirement.

Step 4 The current status of the schedule install or reload or set as backup is displayed in the **Current Status** field.

Step 5 Click either **Abort Reload** or **Abort Backup** to cancel the operation.

You've aborted the backup or reload operation.

View StackMode information

From the **Devices** tab, you can view the StackMode status and StackMode time of each device for the following processes:

- Pushing Devices to Wi-SUN StackMode
- Scheduling Devices for Wi-SUN Stack Switch
- Canceling Wi-SUN Stack Switch Operation

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **FIRMWARE UPDATE** > **Groups** tab.

Step 2 Select the default or user-defined firmware group from the **ENDPOINT**.

Step 3 Select the **PAN ID** from the StackMode Switch table.

Step 4 Click the **Devices** tab.

The **Stack Change Status** column displays the following states:

Table 114: Device State

Device State	Description
Not Started	Indicates the supported devices that are not initiated for Wi-SUN stack switch.
Not Applicable	Indicates the devices that are not supported for Wi-SUN stack switch.
Configuring StackMode	Indicates the devices that are pushed for StackMode operation.
Configured Stackmode	Indicates the devices that are successfully configured with StackMode.

Device State	Description
Scheduling Stackmode time	Indicates the devices that are scheduled for StackMode switch.
Success	Indicates the devices that are successfully switched from CG-Mesh to Wi-SUN stack.
Canceling stackmode switch	Indicates the devices that are scheduled for canceling StackMode switch.
Cancelled stackmode switch	Indicates the devices that are successfully cancelled from switching to Wi-SUN stack.

Filtering Options

a) Click **Show Filter**. The page displays three drop-down lists.
b) Select the search option from the first drop-down list. For example, if you select Status from the first drop-down list, the available list of states appears in the third drop-down list.
c) Select the required option in the third drop-down list and click +.

   Your selection is displayed in the text box above the drop-down lists.

d) Click the search icon.

   The table displays information based on the search criteria set by you.

View logs for Wi-SUN stack switch

To view logs for Wi-SUN stack switch:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.
Step 2 Select the firmware group from the **ENDPOINT** in the left pane.
Step 3 In the **Firmware Management** page, select the **PAN ID** for which you want to see the logs.
Step 4 Click the **Logs** tab.

In the **Logs** page, you can view the events that are recorded for the selected PAN ID.

View Audit Trail for Wi-SUN stack switch

To view audit trail for Wi-SUN stack switch :

Procedure

Step 1 From the Cisco IoT FND menubar, choose **ADMIN** > **System Management** > **Audit Trail**.

Step 2 In the Audit Trail page, click the **Date/Time** drop-down arrow to filter the audit trail based on the date and time.

You can view the audit trail of the stack operations that were performed on the selected PAN ID.

Upgrading Firmware Image during Bootstrapping

During bootstrapping, you can enter a different image if the installed image at manufacturing is inappropriate. This is supported for IR1800 and IR8100 devices from the versions 17.13.01 and above. Plug and Play (PnP) must be supported on these devices.

Note Ensure that IR8100 device has the network-essentials license to register the device to IoT FND.

PnP Device Information service retrieves current firmware version on the device and the PnP ImageInstall service performs the image installation. The CGNA ‘image-retrieve' service transfers the image file from IoT FND to router.

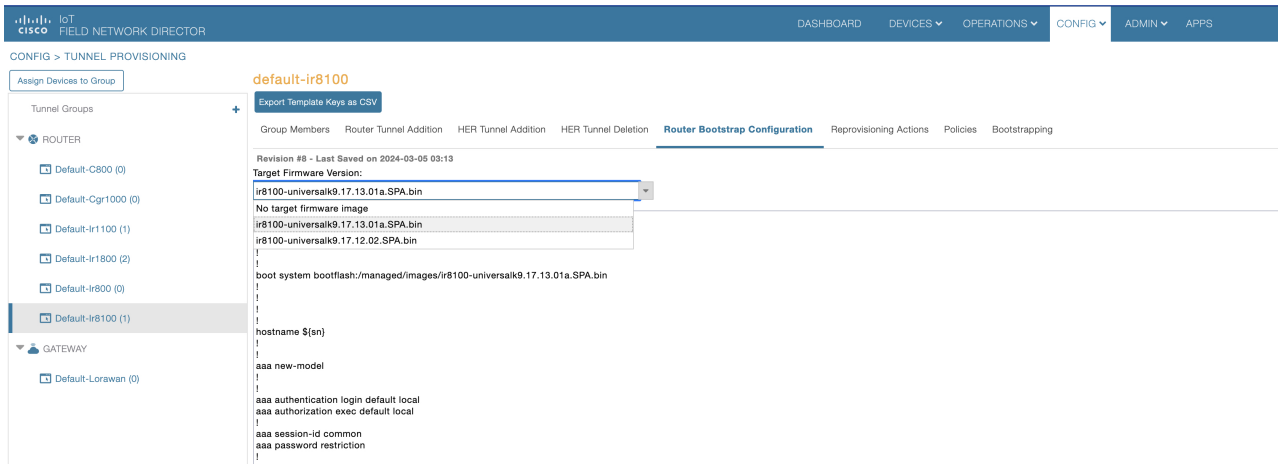
Procedure

Step 1 Set the firmware-update-bootstrap property in cgms.properties to ‘true’.

Step 2 On the Tunnel Provisioning Page, navigate to **CONFIG** > **TUNNEL PROVISIONING** > **ROUTER BOOTSTRAP CONFIGURATION**.

Step 3 Select the device group in the left pane, choose the Target Firmware Version from the drop down that lists the images in IoT FND, and click **Save**.

The PnP workflow configures the device to load the new image upon the next reload by executing the boot system command. The configuration changes are saved on the device. The PnP reload happens and sends a message to the PnP server after which an event is generated denoting image installation.



Note
The PnP workflow supports device upgrade only if the target image version is higher than the running (current) image version.

If the target image runs the same or lower version, then the device upgrade is skipped during the PnP workflow.

During PNP, you also have the option to skip the firmware upgrade and proceed with PNP if the source operating system on these devices is found to be unreliable. Enter the image versions as comma separated values in **pnp-skip-update-ios-xe-fw-versions** property in cgms.properties file. This property is applicable for all IR1100, IR1800, and IR8100 devices. For more information, see Skipping Firmware Upgrades during PNP, on page 402.

Skipping Firmware Upgrades during PNP

During Zero Touch Deployment (ZTD), certain scenarios may arise where Plug-and-Play (PNP) devices come bundled with software that exhibits instability or issues. If the source operating system (OS) on these devices is found to be unreliable, it can potentially disrupt the entire registration process. In such instances, during the PNP process, you can skip the firmware upgrade step while allowing PNP to proceed seamlessly. However, you can upgrade the firmware once the PNP process is complete.

To perform a PNP with firmware upgrade skip:

Procedure

Step 1 Set the image versions in pnp-skip-update-ir1100-fw-versions property in cgms.properties file.

Note
The pnp-skip-update-ir1100-fw-versions property is applicable for IOS-XE routers only.

Step 2 Set the image versions in pnp-skip-update-ios-xe-fw-versions property in cgms.properties file.

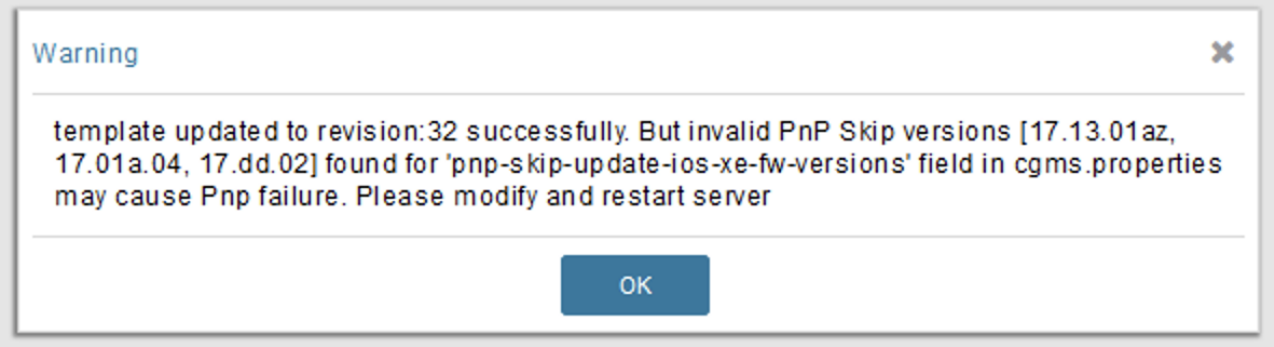
Note
The pnp-skip-update-ios-xe-fw-versions property is applicable for IOS-XE routers only.

Step 3 Choose **CONFIG** > **Tunnel Provisioning**. Select the router group for which you intend to execute the PNP process.

Step 4 Click **Router Bootstrap Configuration** tab.

Step 5 Under Target Firmware Version, specify the image version you want to skip and click **Save**.

The template is saved. However upon performing PNP, during router bootstrap configuration, a warning popup appears if any invalid entry is found. In that case, modify the field and restart server.

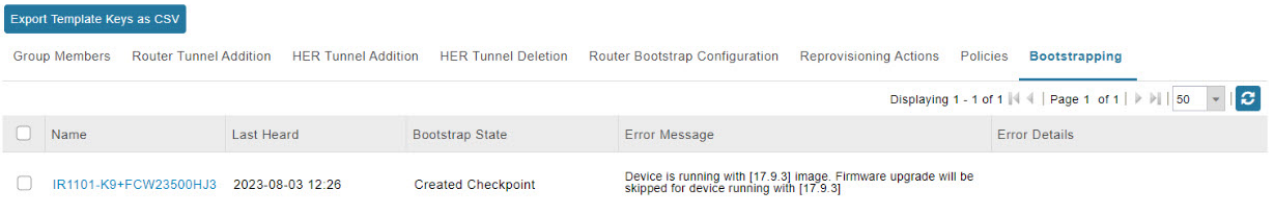


If firmware install is skipped during PnP process, the log details are stored in server.log file. The sample INFO log is shown below:

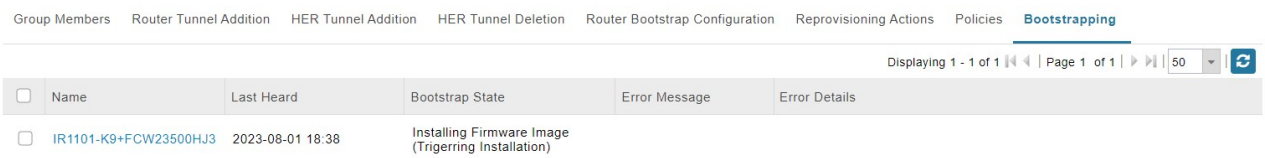
```
Aug 03 2023 19:24:26.854 +0000: %IOTFND-6-UNSPECIFIED:
 %[ch=WorkResponseHandler][eid=IR1101-K9+FCW23500HJ3][ip=1.1.1.121]
[sev=INFO][tid=tunnelProvJetty-67]: Retrieved device image version
[17.9.3] is present in PnP firmware image skip list. Firmware image update
 during PnP process will be skipped.
```

Note
In order to upgrade the device with the latest firmware version, skip entering the current image version in cgms.properties and proceed with PNP.

Step 6 Navigate to the Bootstrapping tab where the Error Message field is updated though the PNP progresses as is.



The Bootstrapping tab shows the status of the PNP under the Bootstrap State field.



Update Target Firmware Versions For All Users

In the Cisco IoT FND Release 4.12.x and earlier releases, when you change the target firmware versions in the **Router Bootstrap Configuration** tab as a root user. The target firmware changes don't reflect in Cisco IoT FND when you're logged in as a different user with specific roles assigned to you by the root user. For more information on managing roles and permissions see, Managing Roles and Permissions.

Starting from Cisco IoT FND Release 5.0, when the root user changes the target firmware version, the changes reflects for all the other associated Cisco IoT FND users.

CHAPTER 8

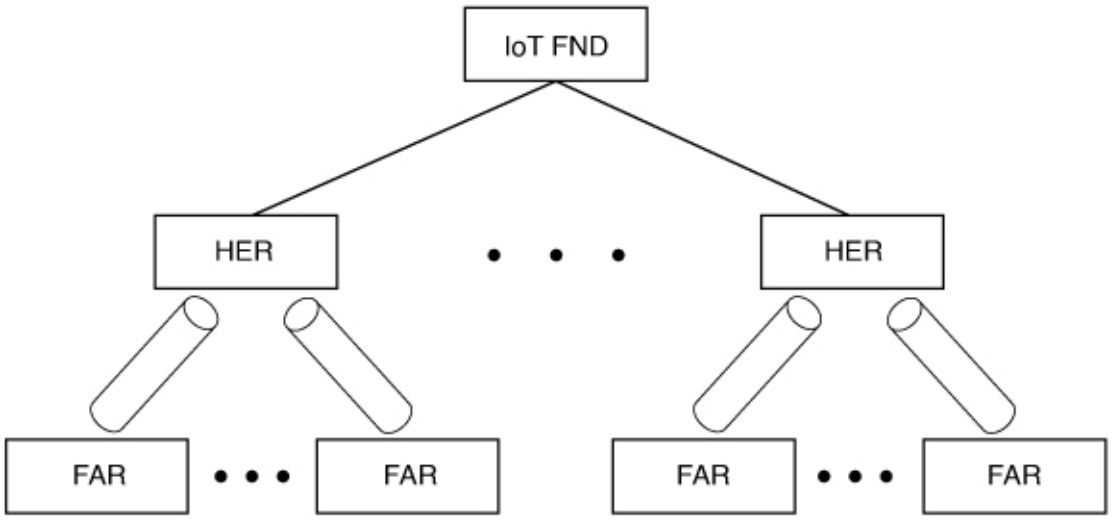
Manage Tunnel Provisioning

This section describes how to configure Cisco IoT FND for tunnel provisioning and how to manage and monitor tunnels connecting FARs (CGRs) and HERs.

Overview

Cisco IoT FND sends the commands generated from processing the tunnel provisioning templates to FARs and HERs to provision secure tunnels between them. The default Cisco IoT FND templates contain CLI commands to set up and configure GRE and IPsec tunnels. One HER can serve up to 500 FARs, which may include multiple tunnels with the same HER EID and name.

Figure 15: Tunnels Connect FARs and their Corresponding HERs



To provision tunnels between HERs and FARs, Cisco IoT FND executes CLI tunnel configuration commands on these devices. By default, Cisco IoT FND provides basic tunnel configuration templates containing the CLI tunnel configuration commands. You can also use your own templates. Although the tunnel provisioning process is automatic, you must first complete the configuration steps outlined in Tunnel Provisioning Configuration Process. After that, whenever a FAR comes online, Cisco IoT FND automatically provisions it with a tunnel. Before you configure Cisco IoT FND for tunnel provisioning, ensure that the Cisco IoT FND TPS Proxy is installed and running.

Note Cisco IoT FND can handle a maximum of 12 Tunnel provisioning or reprovisioning requests in parallel.

ZTD without IPSec

Beginning with Cisco IoT FND Release 3.1.x, you have the option to initiate ZTD with no IPSec configured by ensuring that the Tunnel Provisioning Template is empty of any CLI. This initial approach of bringing up your network without a factory configuration does not preclude subsequent use of IPSec in your network

Tunnel Provisioning Configuration Process

Before you begin

You must generate the keystore files on Cisco IoT FND and the TPS Proxy before configuring tunnel provisioning. Then configure Cisco IoT FND and the TPS Proxy to communicate with one another. Refer to Setting Up TPS Proxy, Configuring IoT FND to Use the TPS Proxy, and Starting the IoT FND TPS Proxy. Use the `systemctl` command for the TPS Proxy if the OS version is RHEL 8.x or later.

RHEL Version	Command
8.x	`systemctl <start/stop/status/restart> tpsproxy`
7.x	`service tpsproxy <start/stop/status/restart>`

To configure Cisco IoT FND for tunnel provisioning:

1	Configure the DHCP servers. Configure DHCP servers to provide unique IP addresses to Cisco IoT FND. The default Cisco IoT FND tunnel provisioning templates configure a loopback interface and the IP addresses required to create the tunnels. Cisco IOS CGRs and FARs use FlexVPN. Ensure that the template contains only the addresses for the loopback interface.	Configuring the DHCP Server for Tunnel Provisioning. **Note** In Cisco IoT FND Release 4.6.1 and later, you can use the Tunnel Provisioning Optimization feature. When using FlexVPN or DMVPN for a FAR, the `optimizeTunnelProv=true` property tells Cisco IoT FND to avoid HER configuration during tunnel provisioning. Upload this property for each router using the CSV file.

2	Configure the tunnel settings. Configure the NMS URL and DHCP proxy client settings on the Provisioning Settings page in Cisco IoT FND: **ADMIN** > **System Management** > **Provisioning Settings**.	See Configuring Provisioning Settings in the Manage System Settings chapter.
3	Cisco IOS CGRs use the CGNA service.	See Managing Devices.
4	Configure HER management. Configure HERs to allow management by Cisco IoT FND using NETCONF over SSH.	Configure HERs before adding them to Cisco IoT FND.
5	Add HERs to Cisco IoT FND.	See Adding HERs to IoT FND in the Manage Devices chapter.
6	Review the Cisco IoT FND tunnel provisioning templates to ensure that they create the correct type of tunnel.	See Tunnel Provisioning Templates in the Manage Tunnel Provisioning chapter.
7	Optional: If you plan to use your own templates for tunnel provisioning, create one or more tunnel provisioning groups and modify the default tunnel provisioning templates.	See Tunnel Provisioning Templates.
8	Configure FARs to contact Cisco IoT FND over HTTPS through the Cisco IoT FND TPS Proxy.	This step is typically performed at the factory, where FARs are configured to contact the TPS Proxy.
9	Add FARs to Cisco IoT FND. Import the FARs into Cisco IoT FND using the Notice-of-Shipment XML file.	See Adding Routers to IoT FND in the Manage Devices chapter.
10	Map FARs to their corresponding HER.	See Manage Tunnel Provisioning.

After completing the previous steps, deploy the FARs and power them on. Tunnel provisioning occurs automatically.

This is the sequence of events after a FAR is turned on:

Procedure

Step 1 Upon joining the uplink network after being turned on, the FAR sends a request for certificate enrollment.

Step 2 The FAR requests tunnel provisioning from Cisco IoT FND through the Cisco IoT FND TPS Proxy.

Step 3 Cisco IoT FND looks up the FAR record in the database and determines which tunnel provisioning templates to use. Cisco IoT FND also determines which HERs to use to establish the tunnel.

Step 4 For Cisco IOS CGRs, the default templates configure the CGR to use FlexVPN. The FlexVPN client is configured on the CGR, which contacts the HER and requests that a FlexVPN tunnel be dynamically constructed.

Step 5 Before processing FAR templates, Cisco IoT FND processes the HER Tunnel Deletion template and sends the resulting commands to the HERs. This removes existing tunnel configuration that may be associated with the FAR.

Step 6 Cisco IoT FND uses the FreeMarker template engine to process the FAR Tunnel Addition template. The engine converts the template to CLI configuration commands, which Cisco IoT FND uses to configure and bring up one end of the tunnel on the FAR.

Step 7 Cisco IoT FND uses the FreeMarker template engine to process the HER Tunnel Addition template. The engine converts the template to commands for configuring the tunnel on the HERs.

Step 8 For Cisco IOS CGRs, if no errors occur while applying the commands generated by the templates to the FAR and HERs, Cisco IoT FND configures a new active CGNA profile named `cg-nms-register` and deactivates the `cg-nms-tunnel` profile. The `cg-nms-register` profile uses the Cisco IoT FND URL.

The specified URL uses the Cisco IoT FND registration port, which defaults to 9121, instead of the tunnel provisioning port. The fully qualified domain name in that URL is different and resolves to an IP address that is reachable only through the tunnels.

Autosync of CGMS Properties Files

Cisco IoT FND facilitates the seamless synchronization of the cgms properties files located both inside and outside the container. This feature ensures that any modifications made to one file is auto reflected in the other, maintaining consistency and simplifying configuration management.

Note

- When you restart the CGMS service or the Cisco IoT FND container, the CGMS property files inside and outside of the docker are in-sync with each other.
- The version of Cisco IoT FND you are using must be for Cisco IoT FND Release 5.0 or later releases.

Table 115: Feature History

Release	Feature Name	Description
Cisco IoT FND Release 5.0	Autosync of CGMS Properties Files	Cisco IoT FND ensures that any changes made to the CGMS properties file, whether inside or outside the container, are automatically mirrored in the corresponding file. This synchronization maintains consistency across configurations, reducing the risk of errors and ensuring seamless application performance.
Cisco IoT FND Release 5.1	Add or Delete Customer User Properties Using Cisco IoT FND UI	You can use the **Custom User Property** UI option in Cisco IoT FND to easily add or delete user defined properties of connected devices, instead of editing the `userPropertyTypes.xml` file.

Benefits of autosync of CGMS properties files

- Autosync of cgms properties files feature ensures that both the internal and external .cgms properties files are always in sync, reducing the risk of configuration mismatches.
- Minimizes the potential for human error by autosyncing changes in the cgms properties files, which helps maintain reliable system performance.
- Enhances the overall reliability of Cisco IoT FND and ensures that all components operate with the same configuration settings.

Custom user property in Cisco IoT FND

Starting from Cisco IoT FND Release 5.1, you can add or delete the user defined properties in Cisco IoT FND by using the **Custom User Property** option.

For custom user defined device properties, use the UI option instead of editing these `userPropertyTypes.xml` file.

Note

- The XML support which existed earlier is discontinued from Cisco IoT FND Release 5.1, for custom user property as only the UI based configuration is allowed.
- The **Custom User Property** button is enabled for routers only in Postgres 5.1 deployments and for routers and endpoints in Oracle deployments.
- The custom user properties are fetched at the device level for each device type.
- NBAPI now supports adding and deleting custom user properties across multiple device types, categories, and property types. The XML file previously used for adding or deleting custom user properties in the earlier Cisco IoT FND releases and located in the `/conf` directory is no longer supported, as this functionality has migrated.
- All the user defined properties from the earlier Cisco IoT FND release versions, will appear in the Cisco IoT FND UI after migration.

Benefits of using UI option for editing custom user property

UI based custom user property addition or deletion, helps in:

- User-Friendly Interface: You can modify properties using an intuitive user interface which is easy to use.
- Reduced Errors: It minimizes syntax errors by providing validation.
- Role-Based Access: Only authorized users can modify custom user defined property files.

Supported devices

UI based support for adding custom user property is supported on these routers and endpoints in Cisco IoT FND:

Table 116: Supported devices

Device Type	Supported Devices
Routers	The supported routers are: • Cisco Connected Grid Router 1000 Series CGR1000, • Cisco 800 Series Integrated Services Router C800, • Cisco IR800 Industrial Integrated Services Router IR800, • Cisco Small Business Router SBR, • Cisco Catalyst IR1100 Rugged Series Router IR1100, • Cisco Catalyst IR1800 Rugged Series Router IR1800, • Cisco Catalyst IR8100 Heavy Duty Series Router IR8100, • Cisco Embedded Services Router Series ESR5900, • L+G Border Router.
Endpoints	The supported endpoints are: • Cisco Connected Grid Mesh Endpoint CGMESH, • Cisco Industrial Router 500 Series IR500, • Cisco Connected Asset Management Endpoint CAM, • Cisco Actuator Control Terminal: ACT, • Cisco IoT Cellular Node CELLNODE, • Cisco Building Automation Control Terminal BACT, • Cisco Local Gateway Network Node LGNN, • Cisco Local Gateway Electric Endpoint LGELECTRIC, • Cisco Local Gateway Radio Endpoint LGRADIO, • Cisco Local Gateway Low-Frequency Network Endpoint LGLFN.

Add custom user property using the Manual Entry method

Use this task to add custom user property in Cisco IoT FND for routers in Postgres 5.1 deployment and for routers and endpoints in Oracle deployment.

Before you begin

Note You can only add or delete user defined custom properties through UI as editing is not allowed. The rest of the custom user property functionalities like accessing, searching, exporting and mapping these properties for devices remain the same as in earlier Cisco IoT FND releases.

Procedure

Step 1 From Cisco IoT FND menubar, choose **DEVICES** > **FIELD DEVICES** > **Browse Devices**.

Step 2 Select **ROUTER**.

Note
For endpoints click **ENDPOINT**.

Step 3 Click **Custom User Property** on the **Inventory** page.

Step 4 Select **ALL**, **ROUTER**. or **ENDPOINT**. from **Select Device Category** drop-down list.

Step 5 Select device category from **Select Device Type** drop-down list.

Step 6 Enter **Name** of the custom user property.

Note
- **Name** field is case sensitive.
- **Name** must only contain alphanumeric or underscore characters, as special characters or spaces are not allowed.

Step 7 Enter **Display Name** and **Description** of the custom user property.

Step 8 Check **Is Secure**, to mask the custom user property information for security reasons.

If you check **Is Secure** option, then during the search you will receive a warning message asking you to restart the CGMS service and click **Add**.

You will receive a notification as **Save successful**, once the custom user property is added successfully.

Step 9 Click **OK**.

You can export the saved user defined property details by clicking on the **Export** icon.

The custom user property is added for the selected router or endpoint and the details appear in the **Existing Custom Properties** list in the same dialog box.

Add custom user property using the Bulk Import (CSV) method

Use the **Custom User Property** option to add user-defined properties through the UI.

Procedure

Step 1 From the Cisco IoT FND menubar, choose **DEVICES** > **FIELD DEVICES** > **Browse Devices**.

Step 2 Select **ROUTER**. For endpoints, select **ENDPOINT**.

Step 3 Select **Custom User Property** on the Inventory page.

Step 4 Under **Select Method**, select **Bulk Import (CSV)**.

Step 5 Verify that the CSV file contains the mandatory columns deviceCategory, deviceType, name, displayName, and description. The isSecure column is optional.

Step 6 Next to **CSV File**, select **Browse**, and select the CSV file.

Step 7 Select **Import**.

Step 8 Verify that the imported properties appear in the **Existing Properties** list.

Step 9 Select **Close**.

The custom user properties are imported for the device categories and types specified in the CSV file.

Delete custom user property

Use this task to delete custom user property of routers and endpoints in Cisco IoT FND.

Procedure

Step 1 From Cisco IoT FND menubar, choose **DEVICES** > **FIELD DEVICES** > **Browse Devices**.

Step 2 Select **ROUTER**.

Note
For endpoints click **ENDPOINT**.

Step 3 Click **Custom User Property** on the **Inventory** page.

Step 4 Select **ALL**, **ROUTER**. or **ENDPOINT**. from **Select Device Category** drop-down list.

This will fetch the list of existing custom user properties in **Existing Custom Properties**.

Step 5 Click **Delete**.

You will receive a confirmation notification, asking if you want to proceed with removing the custom user property or not.

Step 6 Click **Yes**.

The custom user property is deleted, and you will receive a **Delete successful** message.

Step 7 Click **OK**.

Note
You will see a warning marked in red color on the delete message, if the property you are trying to delete is already used by a net element.

If the user property has not been used earlier and if the properties table has no related data for this new property type, then you will see a yellow colored icon displayed in the delete message.

The custom user property is removed from the **Existing Custom Properties** list.

Configuring Tunnel Provisioning

This section describes how to configure IoT FND for tunnel provisioning.

Configuring the DHCP Server for Tunnel Provisioning

For tunnel provisioning to succeed, configure the DHCP server used by IoT FND to supply addresses to create tunnels between the FARs and HERs. For example, configure the DHCP server to provide IP addresses for tunnel provisioning on a permanent-lease basis.

IoT FND makes the DHCP requests based on the settings defined in the tunnel provisioning templates. During tunnel provisioning, the IoT FND templates can make two kinds of DHCP requests:

- Request an IP address, and then make it available to the template.
- Request a subnet with two IP addresses, and then make both addresses available to the template.

IoT FND can make these requests for IPv4 addresses and IPv6 addresses.

The ability to request DHCP addresses from the template gives you maximum flexibility when defining tunnel configurations because you allocate the exact address needed for each FAR and corresponding interface on the HER. The default tunnel provisioning templates provided address the most common use case: one IPsec tunnel between the FAR and its corresponding HER. Each end of this IPsec tunnel gets a dynamically allocated IPv4 address:

- If your DHCP server supports subnet allocation, use it to obtain two addresses that belong to the same subnet.
- If your DHCP server only supports address allocation, configure it so that the two DHCP address requests return addresses that can be used as ends of an IPsec tunnel.
- If your routing plan calls for allocating unique IPv4 addresses for each FAR and assigning it to a loopback interface above the IPsec tunnel, allocate this address using the IoT FND template.

If you choose to build IPv6 GRE tunnels, allocate the IPv6 addresses for each end of the tunnel using DHCP prefix delegation or individual address requests.

This section describes example DHCP settings for tunnel provisioning. How you configure these settings depends on your installation. This section provides general guidelines for configuring the DHCP server for tunnel provisioning using the Cisco Network Registrar (CNR).

Configuring DHCP for Tunnel Provisioning Using CNR

The CNR CLI script in the following example configures the CNR DHCP server to service requests made by the default tunnel provisioning templates in IoT FND. When using this script, ensure that the subnets are appropriate for your DHCP server environment.

Example CNR DHCP Server Tunnel Provisioning Script

```
# These commented out commands support re-applying the configuration by first
# removing any previously applied configuration, in reverse order. This should
# not be done in a production environment, but may be useful when initially
# developing and testing a configuration.

# scope v4address-perm delete
# dhcp-address-block v4subnet-perm delete
# prefix v6subnet-perm delete
# prefix v6address-perm delete
# policy permanent delete

# Configure the server to automatically map any IPv4 or IPv6 user class
# option values to selection tags. By default CG-NMS includes a value of
# "CG-NMS" for the user class in its requests. The tag is used to insure
# prefixes and scopes configured to satisfy requests from CG-NMS are only
# used for that purpose.

dhcp set map-user-class-id=append-to-tags

# Since CG-NMS uses the leased addresses and subnets in router
# configuration the addresses and subnets must be permanently allocated
# for that purpose. Create a policy that instructs the DHCP server to
# offer a permanent lease.

policy permanent create
policy permanent set permanent-leases=enabled

# Configure DHCPv6.

# The default CG-NMS tunnel template will request IPv6 addresses for
# use with CGR loopback interfaces.

prefix v6address-perm create 2001:DB8:0:0:1::/80 dhcp-type=dhcp
prefix v6address-perm set description="Pool for leasing addresses for loopback
interfaces."
prefix v6address-perm set policy=permanent
prefix v6address-perm set selection-tags=CG-NMS

# The default CG-NMS tunnel template will request IPv6 prefixes for
# use with GRE tunnels. Force use of a /127 prefix.

prefix v6subnet-perm create 2001:DB8:0:0:2::/80 dhcp-type=prefix-delegation
prefix v6subnet-perm set description="Pool for leasing prefixes for GRE tunnels."
prefix v6subnet-perm set policy=permanent
prefix v6subnet-perm set selection-tags=CG-NMS
prefix-policy v6subnet-perm set default-prefix-length=127
prefix-policy v6subnet-perm set shortest-prefix-length=127

# Configure DHCPv4.

# The default CG-NMS tunnel template will request IPv4 subnets for
# use with IPsec tunnels. Note that currently address pools for
# IPv4 subnet allocation can only be configured using the CLI as the
# CNR Web UI does not currently support them.
```

```
# If CNR allowed you to set a description on DHCP address blocks it would be:
# "Pool for leasing subnets for IPsec tunnels."

dhcp-address-block v4subnet-perm create 192.0.2.0/24
dhcp-address-block v4subnet-perm set default-subnet-size=31
dhcp-address-block v4subnet-perm set policy=permanent
dhcp-address-block v4subnet-perm set selection-tags=CG-NMS

# The default CG-NMS tunnel template will request IPv4 addresses for
# use with loopback interfaces.

scope v4address-perm create 198.51.100.0 255.255.255.0
scope v4address-perm set description="Pool for leasing addresses for
loopback interfaces."
scope v4address-perm set policy=permanent
scope v4address-perm addRange 198.51.100.2 198.51.100.254
scope v4address-perm set selection-tag-list=CG-NMS

# Configure detailed logging of incoming and outgoing packets. This is useful when
# debugging issues involving DHCP, however this level of logging will lower the
# performance of the DHCP server. If this is a production server under heavy load
# it may be necessary to forgo detailed packet logging.

dhcp set log-settings=missing-options,incoming-packet-detail,
outgoing-packet-detail,unknown-criteria,client-detail,
client-criteria-processing,dropped-waiting-packets,v6-lease-detail

# Save the changes and reload the server to have them take effect.
save
dhcp reload

# List the current configuration.

policy list
prefix list
dhcp-address-block list
scope list
dhcp show
```

Configuring Tunnel Group Settings

You use groups in IoT FND to bulk configure tunnel provisioning. By default, all FARs are added to the appropriate default group (default-cgr). Default groups contain the templates used for tunnel provisioning.

Creating Tunnel Groups

If you plan to use one set of templates for all FARs, whether using the default templates, modified default templates or custom templates, do not create additional groups. To define multiple sets of templates, create groups and customize the templates for these groups.

Note CGRs can be in the same tunnel provisioning group if your custom templates are applicable to both router types.

To create a tunnel group:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 Click + icon in left pane to add a group.

Step 3 Enter a name of the new group, and then click **OK**.

The group appears in the Tunnel Groups pane.

After creating a tunnel group, the next step is to move FARs from other groups to it, as described in Moving FARs to Another Group, on page 418.

Deleting Tunnel Groups

Only empty groups can be deleted. Before you can delete a tunnel group, you must move the devices it contains to another group.

To delete an empty tunnel group:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 In the TUNNEL GROUPS left pane, select the tunnel group to delete.

Step 3 Click (-) to delete the group.

Step 4 Click **Yes** to confirm deletion.

Viewing Tunnel Groups

The Tunnel Provisioning page lists information about existing tunnel groups.

Follow these steps to view the tunnel groups defined in IoT FND:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 Click **Group Members** tab.

Step 3 In the TUNNEL GROUPS pane (left), select a group.

IoT FND displays the following Tunnel Group information for each router in the group. Not all routers support all fields.

Table 117: Tunnel Group Fields

Field	Description

Name	Router EID (device identifier).
Status	Status of the router: • Unheard—The router has not contacted IoT FND yet. • Unsupported—The router is not supported by IoT FND. • Up—The router is in operation. • Down—The router is turned off.
Last Heard	Last time the router contacted or sent metrics to IoT FND. If the router never contacted IoT FND, **never** appears in this field. Otherwise, IoT FND displays the date and time of the last contact, for example,**4/10 19:06**.
Tunnel Source Interface 1Tunnel Source Interface 2	Router interface used by the tunnel.
OSPF Area 1 OSPF Area 2	Open shortest path first (OSPF) areas 1 and 2.
OSPFv3 Area 1 OSPFv3 Area 1	OSPFv3 area 1 OSPFv3 area 2.
IPsec Dest Addr 1 IPsec Dest Addr 2	IPv4 destination address of the tunnel.
GRE Tunnel Dest Addr 1 GRE Tunnel Dest Addr 2	IPv6 destination address of the tunnel.
Certificate Issuer Common Name	Name of the CA that issued the certificate.

Renaming a Tunnel Group

In the Tunnel Provisioning page, there are two tunnel provisioning groups available, namely user-created group and default group. IoT FND allows you to rename the user-created Tunnel Provisioning Groups only. You cannot rename the default Tunnel Provisioning Groups.

Note You can rename the user-created tunnel group at any time. Cisco recommends using short, meaningful names. Names cannot be more than 250 characters long.

To rename a tunnel group:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 In the TUNNEL GROUPS pane, mouse over the tunnel group to rename and click the **Edit** pencil icon.

Note
The pencil icon does not appear for Default Tunnel Provisioning groups.

Step 3 Enter the new Group Name and then click **OK**.

What to do next

Note When you enter an invalid character entry (such as, @, #, !, or +) in the entry field, the field is highlighted in red and disables the **OK** button.

Moving FARs to Another Group

You can move FARs to another group either in bulk or manually.

Moving FARs to Another Group Manually

To move FARs to another group manually:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 Click the **Group Members** tab.

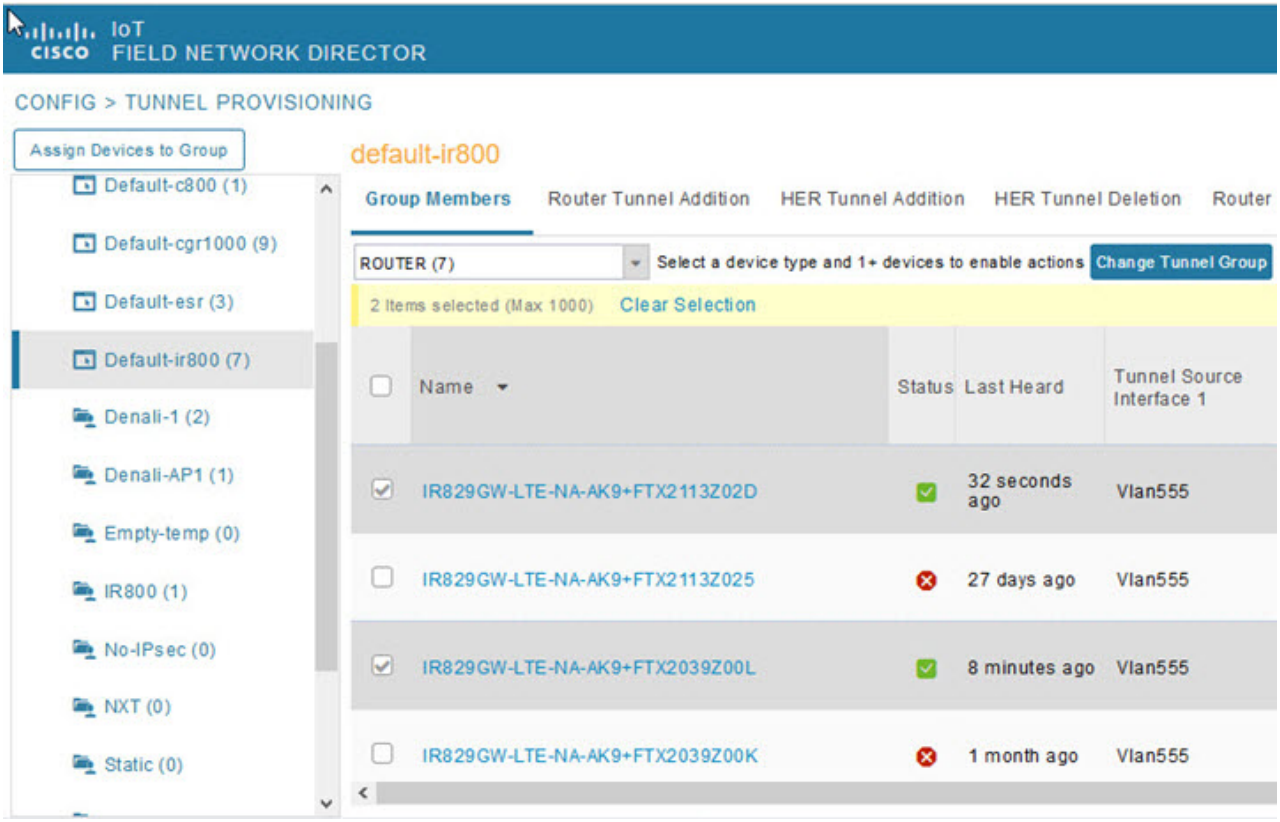
Step 3 In the TUNNEL GROUPS pane, select the tunnel group with the routers to move.

Step 4 Choose the device type from the **Select a device type** drop-down menu.

Step 5 Check the check boxes of the FARs to move.

To select all FARs in a group, click the check box at the top of the column. When you select devices, a yellow bar displays that maintains a count of selected devices and has the Clear Selection and Select All commands. The maximum number of devices you can select is 1000.

Step 6 Click the **Change Tunnel Group** button.



Step 7 From the drop-down menu, choose the tunnel group to which you want to move the FARs.

Step 8 Click **Change Tunnel Group**.

Step 9 Click **OK** to close the dialog box.

Moving FARs to Another Group in Bulk

You can move FARs in bulk to another group by importing a CSV or XML file containing the names of the FARs to move. Ensure that the file contains entries in the format shown the following example:

```
eid
CGR1120/k9+JSM1
CGR1120/k9+JSM2
CGR1120/k9+JSM3
CGR1120/k9+JSM4
C819HGW-S-A-K9+FTX174685V0
```

The first line is the header, which tells IoT FND to expect FAR EIDs in the remaining lines (one FAR EID per line).

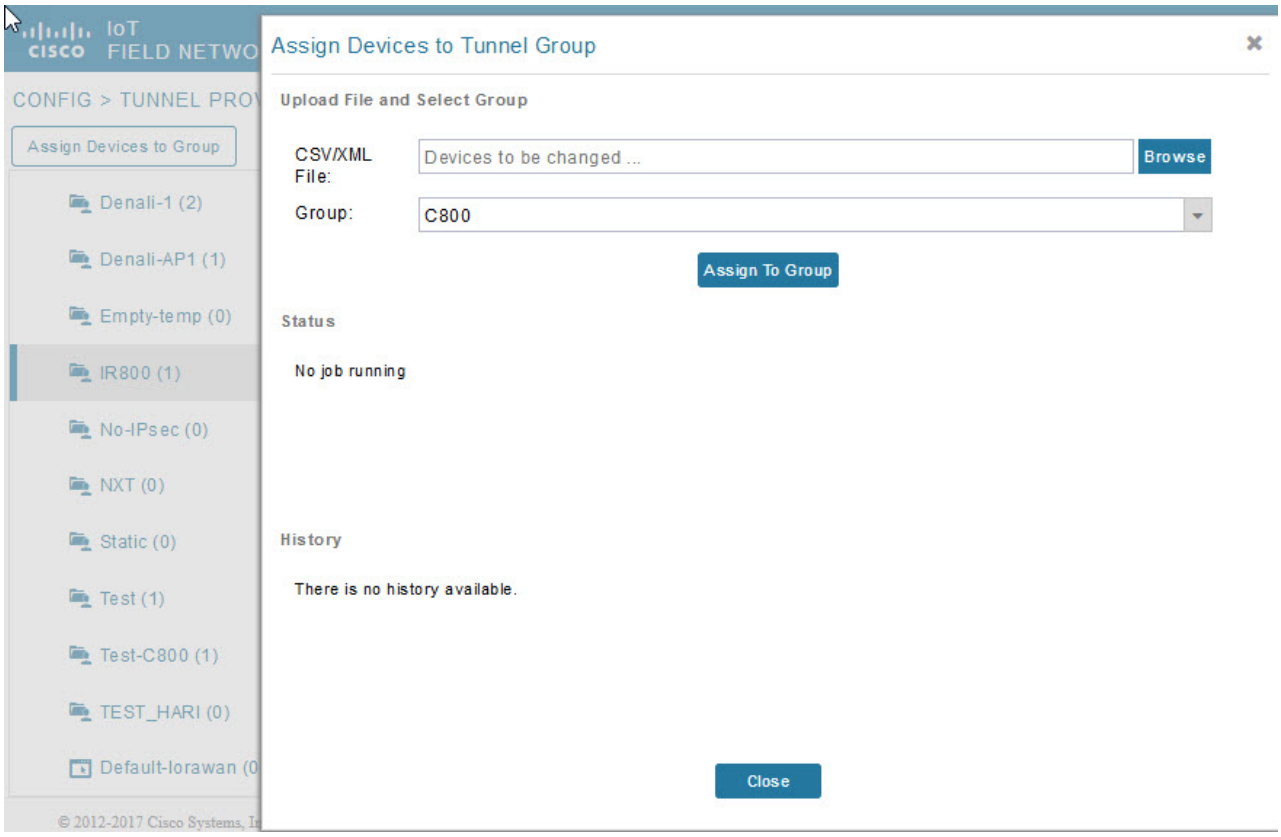
To move FARs to another group in bulk:

Procedure

Step 1 Create a CSV or XML file with the EIDs of the devices to move to a different group.

Step 2 Choose **CONFIG** > **Tunnel Provisioning**

Step 3 Click **Assign Devices to Tunnel Group** to open an entry panel.



Step 4 Click **Browse** and locate the file that contains the FARs that you want to move.

Step 5 From the **Group** drop-down menu, choose the destination tunnel group.

Step 6 Click **Assign To Group**.

Step 7 Click **Close**.

Configuring Tunnel Provisioning Templates

IoT FND has three default tunnel provisioning templates:

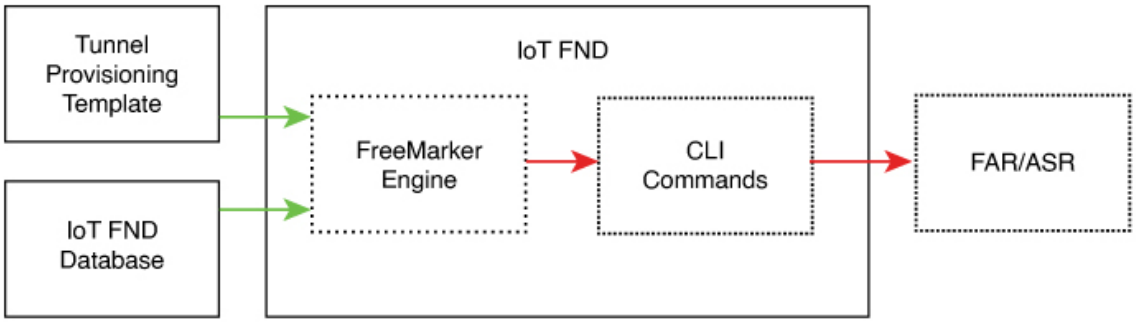
- Field Area Router Tunnel Addition—IoT FND uses this template to generate the CLI configuration commands for creating one end of an IPsec tunnel on the FAR.
- Head-End Router Tunnel Addition—IoT FND uses this template to generate the CLI configuration commands for creating the other end of the IPsec tunnel on the HER.
- Head-End Router Tunnel Deletion—IoT FND uses this template to generate the CLI configuration commands for deleting any existing tunnel to the FAR at the other end of the tunnel.

Cisco IoT FND checks tunnel provisioning templates for deprecated insecure CLI commands when the template is saved. If Cisco IoT FND detects a deprecated insecure CLI command, the application shows a warning and enables the **View Insecure CLIs** button.

Tunnel Provisioning Template Syntax

The IoT FND tunnel provisioning templates are expressed with the FreeMarker syntax. FreeMarker is an open-source Java-based engine for processing templates and is built into IoT FND. As shown in CLI Command Generation from Templates in IoT FND, FreeMarker takes as input the tunnel provisioning template and data supplied by IoT FND, and generates CLI commands that IoT FND runs on the FARs and HERs in the "configure terminal" context.

Figure 16: CLI Command Generation from Templates in IoT FND



In IoT FND, the tunnel provisioning templates consist of router CLI commands and FreeMarker variables and directives. The use of FreeMarker syntax allows IoT FND to define one template to provision multiple routers.

This section describes the basic FreeMarker syntax in the tunnel provisioning templates. For information about FreeMarker visit http://freemarker.sourceforge.net/.

Configuring the Field Area Router Tunnel Addition Template

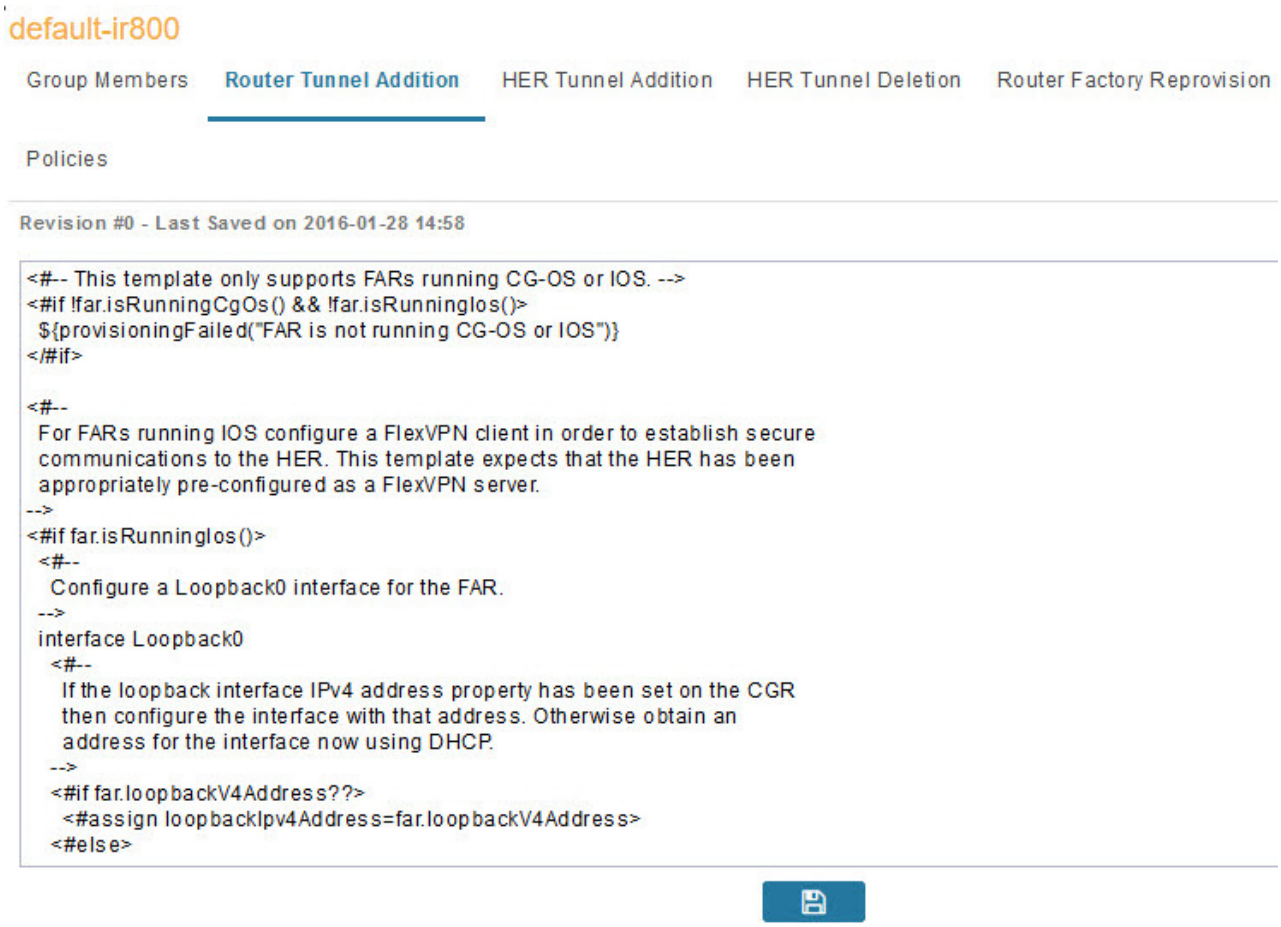
To edit the FAR Tunnel Addition template to provide one end of an IPsec tunnel on FARs in the group:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 In the **TUNNEL GROUPS** pane, select the tunnel group with the template to edit.

Step 3 Click the **Router Tunnel Addition** tab.



Step 4 Modify the default template.

Tip
Use a text editor to modify templates and copy the text into the template field in IoT FND.

Step 5 Click the Disk icon to **save changes**.

If Cisco IoT FND detects a deprecated insecure CLI command, it displays a warning. Click **View Insecure CLIs** to review the detected commands. Use **Export to CSV** to export the command list.

Step 6 Click **OK** to confirm the changes.

See also, Tunnel Provisioning Template Syntax, on page 421.

Configuring the Head-End Router Tunnel Addition Template

Note To ensure that both endpoints are in a matching subnet, this template must use the same Identity Association Identifier (IAID) as the FAR template.

To edit the HER Tunnel Addition template to create the other end of the IPsec tunnel on HERs in the group:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 In the TUNNEL GROUPS pane, select a tunnel group.

Step 3 Click the **HER Tunnel Addition** tab.

Step 4 Modify the default HER addition template.

Step 5 Click the Disk icon to **save changes**.

If Cisco IoT FND detects a deprecated insecure CLI command, it displays a warning. Click **View Insecure CLIs** to review the detected commands. Use **Export to CSV** to export the list of insecure commands.

Step 6 Click **OK** to confirm the changes.

Configuring the HER Tunnel Deletion Template

To edit the HER tunnel deletion template to delete existing tunnels to FARs at the other end of the tunnel:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 In the TUNNEL GROUPS pane, select the tunnel group whose template to edit.

Step 3 Click the **HER Tunnel Deletion** tab.

Step 4 Modify the default HER deletion template.

Step 5 Click the Disk icon to **save changes**.

If Cisco IoT FND detects a deprecated insecure CLI command, it displays a warning. Click **View Insecure CLIs** to review the detected commands. Use **Export to CSV** to export the command list.

Step 6 Click **OK** to confirm the changes.

Configuring FND for IXM

Cisco IoT FND supports the following configurations for the Cisco Wireless Gateway for LoRaWAN:

- Firmware upgrade
- Hardware monitoring and events reporting
- IP networking configuration and operations (for example, IP address and IPsec)
- Zero Touch provisioning that includes either installing Thingpark LRR software or configuring Common Packet Forwarder (CPF)

PNP Support for IXM

By default, PNP (Plug and Play) automatic discovery mode for Dynamic Host Configuration Protocol (DHCP), Domain Name System (DNS) and Cisco Connection Online (CCO) is enabled. When using DHCP server with option 43, for example, on boot-up, the IXM device gets the IP address from the DHCP server. The device gets the PNP Server IP address (TPS or FND IP) through option 43. The PNP request is sent to IoT FND. IoT FND applies the config to the running config and configures the startup config by executing the **copy running-config startup-config** command. IoT FND terminates the PNP profile when IoT FND pushes the configuration to IXM.

For CCO redirection, associate the root certificate with the PNP profile. For this, export the FND root certificate using the below command under **/opt/cgms/server/cgms/conf**.

keytool -export -alias root -file mydomain.der -keystore cgms_keystore && openssl x509 -inform der -in mydomain.der -out certificate_root.pem

Upload the root certificate in the PNP redirection page or along PNP profile.

Procedure

Step 1 Set the following property in cgms.properties to true in order to trust the (IXM) server.

trust-ixm-server-cert=true //Default value is false

Step 2 Restart FND service.

Note
To clean the startup config and trigger PNP, enter the following command.

```
archive download-sw firmware /factory /
force-reload <image file path>
```

Gateway Bootstrap Configuration Template

In the **Config** > **Tunnel Provisioning** page, choose Default-Lorawan. In the Gateway Bootstrap Configuration tab, enter the commands to LoRaWAN before triggering PnP on the device.

The sample config is given below.

```
hostname <hostname>
!crypto ipsec profile primary
   ipaddr <ipaddr> iketime 86000 keytime 86000 aes 256
  subnet <subnet> ip>/24
  exit
ip domain lookup
ip domain name cisco.com
ip host fnd.iot.cisco.com <fnd ip address>
!
interface Fast Ethernet 0/1
  ipaddress dhcp
  exit
!
ip default-gateway <default gateway ip>
```

```
!
username <username> password <password>
!
ip ssh authenticaton-retires 3
radio off
ip ssh admin-access
ip ssh port 22
!
ntp server ip <ntp server ip>
ipsec isakmp admin <password> group 19 <password>
ipsec enable
!
igma secure enable
!
igms event destination <FND IP> 5683
!
igma profile iot-fnd-register
  active
  add-command show fpga
  add-command show inventory
  add-command show ip interface FastEthernet 0/1
  add-command show ipsec status info
  add-command show platform status
  add-command show radio
  add-command show version
  interval 2
  url https://fnd.iot.cisco.com:9121/igma/register
  exit
!
igma local-trustpoint sudi
```

Preparing IoT FND for IXM Zero Touch Deployment

Follow these steps to prepare IoT FND for IXM Zero Touch Deployment (ZTD)

- Using Thingpark LRR Software
- Enabling CPF (Common Packet Forwarder)

Note To enable CPF, set enable-cpf=true flag in cgms.properties file.

Procedure

Step 1 If you are using Pre-Shared Key (PSK) authentication for tunneling, add the **userPropertyTypes.xml** file to the IoT FND server under `/opt/cgms/server/cgms/conf`.

Step 2 Restart the IoT FND service after adding the following.

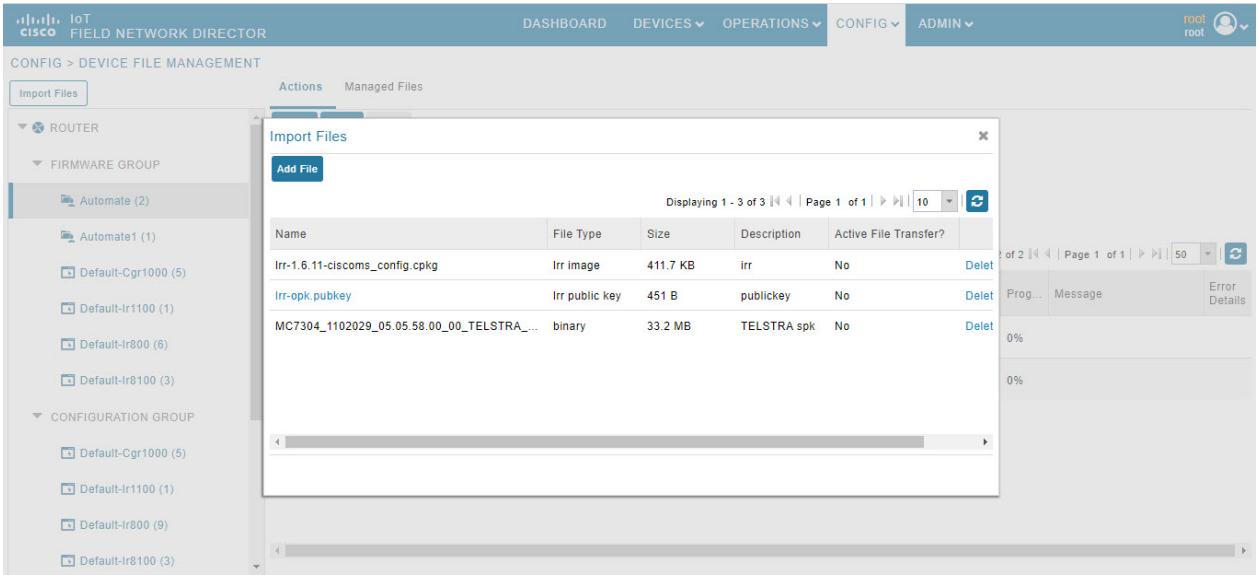
Note
If you are using Rivest-Shamir-Adleman (RSA), ignore this step.

The userPropertyTypes.xml is shown below.

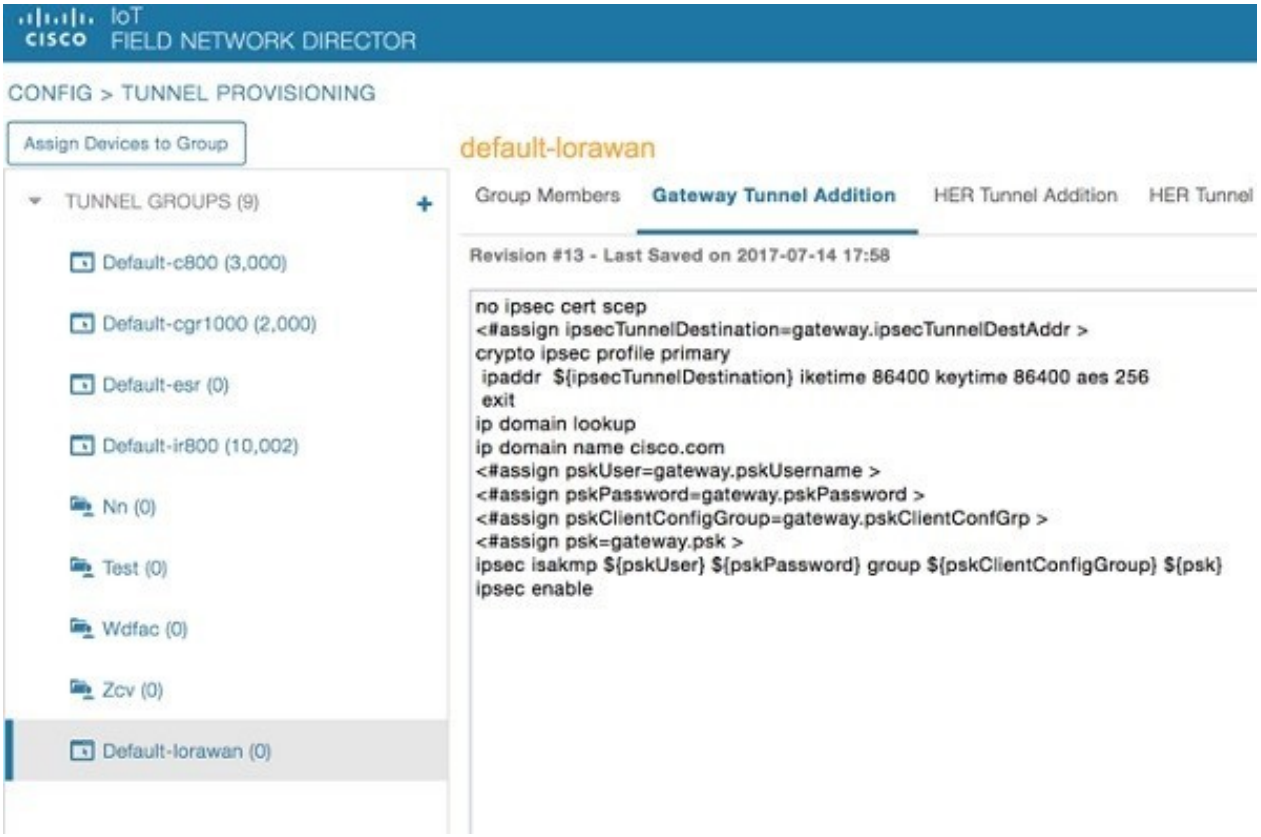
```
<?xml version="1.0" encoding="UTF-8"?>
<cgms xmlns="http://www.w3schools.com"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.w3schools.com propertyTypes.xsd">
  <propertyTypes kind="lorawan">
  <!--Psk Properties -->
   <propertyType>
      <name>pskUsername</name>
      <displayName>XAUTH Username</displayName>
      <description>Username for PSK IPsec XAUTH</description>
   </propertyType>
   <propertyType>
      <name>pskPassword</name>
      <issecure>1</issecure>
      <displayName>XAUTH Password</displayName>
      <description>Password for PSK IPsec XAUTH</description>
   </propertyType>
   <propertyType>
      <name>pskClientConfGrp</name>
      <displayName>PSK Client Configuration Group</displayName>
      <description>PSK Client Configuration Group</description>
   </propertyType>
   <propertyType>
      <name>psk</name>
      <issecure>1</issecure>
      <displayName>Pre Shared Key</displayName>
      <description>Pre Shared Key</description>
   </propertyType>
  </propertyTypes>
</cgms>
```

Step 3 In the **Config** > **Device File Management** page, click **Import Files**.

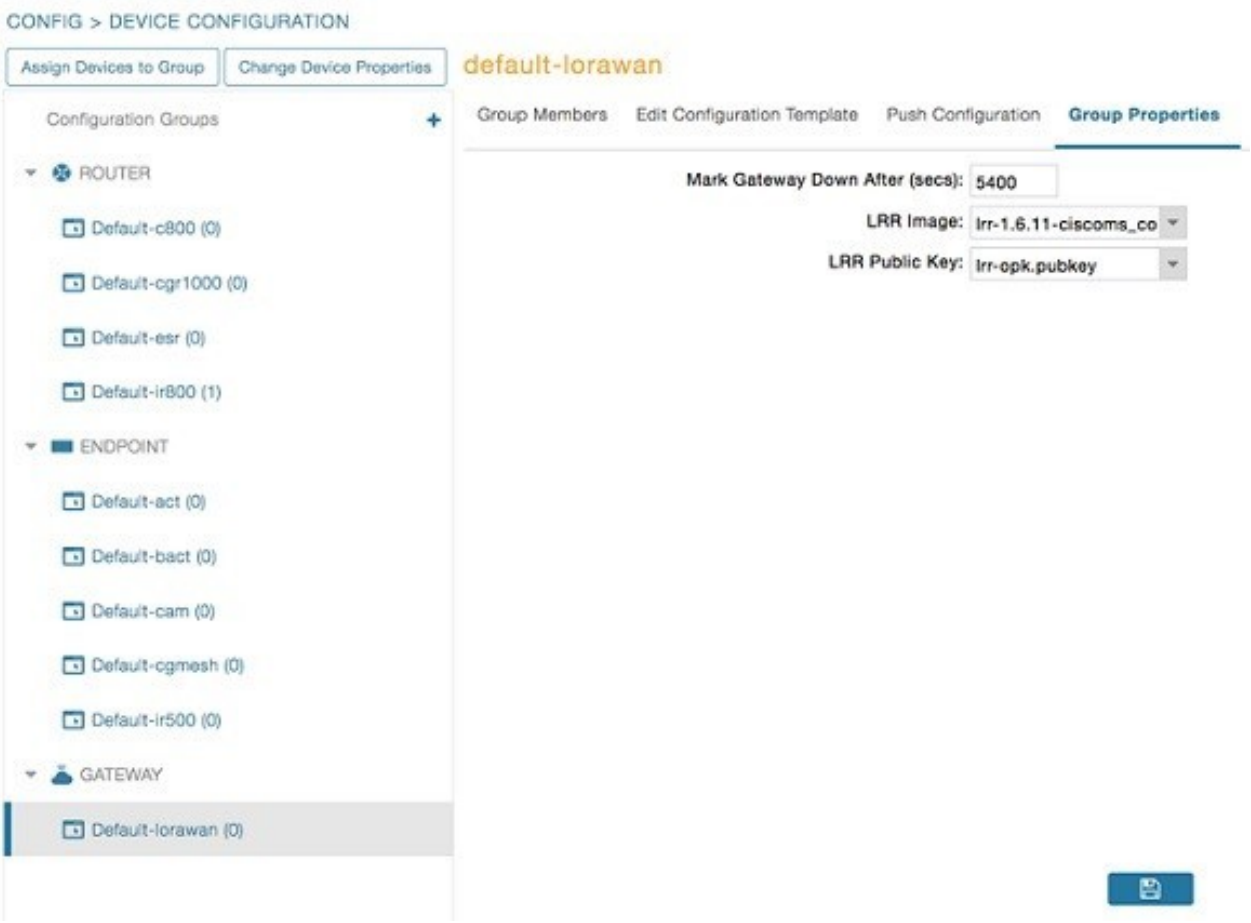
Step 4 Click **Add File** to add the Actility LRR and public key to IoT FND.



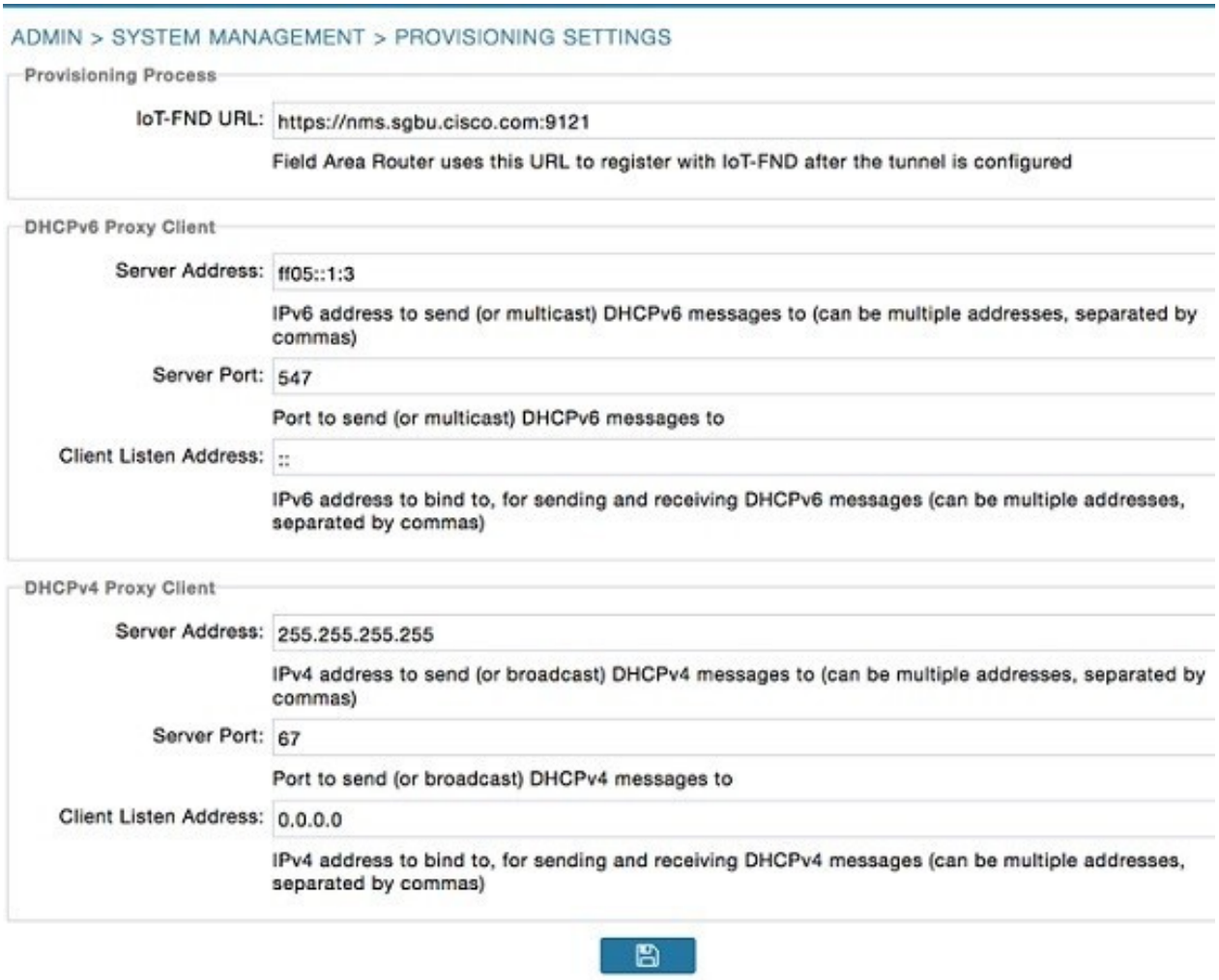
Step 5 In the **Config** > **Tunnel Provisioning** page, update the tunnel configuration group with the following parameters in the Gateway Tunnel Addition tab and click **Save**.



Step 6 In **Config** > **Device Configuration** page, click the Group Properties tab. Update the device configuration group properties with the following parameters for Default–lorawan and click **Save**.



Step 7 Go to **Admin** > **System Management** > **Provisioning Settings** page. The common name is populated in IoT-FND URL field.



Step 8 Make sure you have obtained certificates from the Certificate Authority (CA). Execute the **show ipsec certs** command to verify that the LDevID certs are enrolled by the device. Make sure the firewall allows ports 9120, 9121, 9122, and all the SSH, telnet, and DHCP ports. Make sure the TPS name is pingable and execute the **copy running express-setup-config** command.

```
Hostname IXM
!
ip domain lookup
ip domain name cisco.com
!
ip name-server 55.55.0.15
!
interface FastEthernet 0/1 description interface
ip address 4.4.4.2 255.255.255.0 exit
!
ip default-gateway 4.4.4.1
!
ntp server ip 55.55.0.1
!
clock timezone America/Los_Angeles
!
igma profile iot-fnd-tunnel
```

```
active
add-command show fpga interval 5
url https://ps.sgbu.cisco.com:9120/igma/tunnel exit

ipsec cert scep https://55.55.0.15/csertsrv/msecp.dll us ca mil
cisco iot test true ndes true 2048
```

Note
You need to add the HER configuration manually, for example, the tunnel crypto profiles and transform sets. The following is a sample template, where VPN uses PSK as authentication.

```
username cisco password 0 cisco

crypto isakmp policy 1
    encr aes 256
    hash sha256
    authentication pre-share
    group 19
crypto isakmp keepalive 10
!
crypto isakmp client configuration group 19
    key cisco
    domain cisco.com
    pool POOL
    acl split
    save-password
    netmask 255.255.255.128
crypto isakmp profile test
    match identity group 19
    client authentication list AUTH
    isakmp authorization list NET
    client configuration address respond
    client configuration group 19
    virtual-template 1
!
!
crypto ipsec transform-set test esp-aes 256 esp-sha256-hmac
 mode tunnel
!
!
crypto ipsec profile ipsecprof
    set security-association lifetime kilobytes disable
    set transform-set test
    set isakmp-profile test

interface Virtual-Template1 type tunnel
    tunnel protection ipsec profile ipsecprof
    ip unnumbered GigabitEthernet0/1
    tunnel source GigabitEthernet 0/1
    tunnel mode ipsec ipv4

ip local pool POOL 20.20.0.0 20.20.255.255
```

Step 9 Encrypt the PSK passwords using the signature-tool under `/opt/cgms-tools/bin`.

Step 10 Add the encrypted passwords in the CSV file and prepare it for upload.

Step 11 Add the modem to IoT FND and add ISR4K using the sample CSV shown below.

```
eid,netconfUsername,netconfPassword,ip,deviceType,lat,domain,lng,
ipsecTunnelDestAddr,tunnelHerEid, pskUsername,pskPassword,pskClientConfGrp,psk

IXM-LPWA-900-16-K9+FOC21028RAK,,,,lorawan,10,root,10,4.4.4.1,
C3900-SPE250/K9+FOC172417YT,cisco,ki8OjEO5Pr+
```

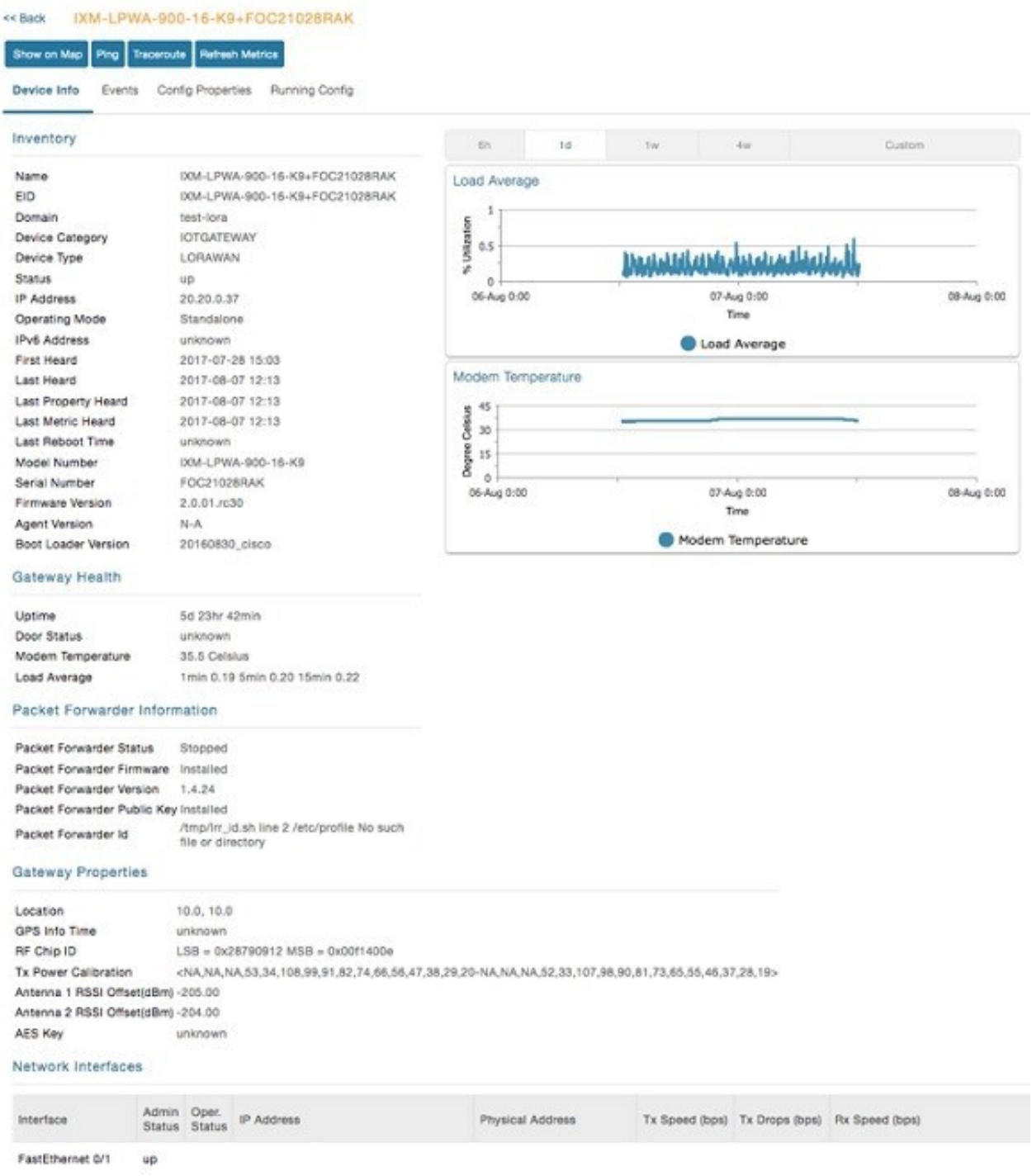
```
krJTtUooUMD0GoqmOAznc2JObiUUr4ismXyP0uXs8JRuSPOfojMDavGIHiO8unUUJm3zdxv0LP8b6fe5G+
oshy76A6IqX1jk7ymSFOaVPQBT8fUS6onjsuSThiLERS0B6Brn2gRx/
KpQMk9IdYQMOSsHh4khvtxbqBZy6j++pIjeG4+ dPz/v52DmJR+DOrE7ZQpfvS9PSHkJoaqC2o6PrKN5YZ50G9+
Tm+diPmbyv/PdHKtXn1ny3qBAdbfDwOjlA+NtJPld3/ 06vq6WhHsgujYwMJWs7Cuu3rR0/FVHF/
5wFxarakJsfo/zd69EpzrI8Hsic/QmMzA==,19, ki8OjEO5Pr+
krJTtUooUMD0GoqmOAznc2JObiUUr4ismXyP0uXs8JRuSPOfojMDavGIHiO8unUUJm3zdxv0LP8b6fe5G+
oshy76A6IqX1jk7ymSFOaVPQBT8fUS6onjsuSThiLERS0B6Brn2gRx/KpQMk9IdYQMOSsHh4khvtxbqBZy6j++pIjeG4+
dPz/v52DmJR+DOrE7ZQpfvS9PSHkJoaqC2o6PrKN5YZ50G9+Tm+diPmbyv/PdHKtXn1ny3qBAdbfDwOjlA+NtJPld3/
06vq6WhHsgujYwMJWs7Cuu3rR0/FVHF/5wFxarakJsfo/zd69EpzrI8Hsic/QmMzA==C3900-SPE250/K9+FOC172417YT,
nms,sgbu123!,55.55.0.18,isr3900,,,,,,,,
```

Note
The sample CSV for CPF is shown below.

```
eid,netconfUsername,netconfPassword,ip,deviceType,lat,domain,lng,
ipsecTunnelDestAddr,tunnelHerEid, pskUsername,pskPassword,pskClientConfGrp,psk,
cpfNetworkServer,cpfServerPort,cpfAntOmniGain1,cpfAntLoss1,cpfAntOmniGain2,
cpfAntLoss2,cpfCountry,cpfGatewayId,cpfAuthMode
```

```
ki8OjEO5Pr+krJTtUooUMD0GoqmOAznc2JObiUUr4ismXyP0uXs8JRuSPOfo
jMDavGIHiO8unUUJm3zdxv0LP8b6fe5G+oshy76A6IqX1jk7ymSFOaVPQBT8fUS6onjsuSThi
LERS0B6Brn2gRx/KpQMk9IdYQMOSsHh4khvtxbqBZy6j++pIjeG4+
dPz/v52DmJR+DOrE7ZQpfvS9PSHkJoaqC2o6PrKN5YZ50G9+Tm+diPmbyv/
PdHKtXn1ny3qBAdbfDwOjlA+NtJPld3/
06vq6WhHsgujYwMJWs7Cuu3rR0/FVHF/5wFxarakJsfo/zd69EpzrI8Hsic/QmMzA==,19,
ki8OjEO5Pr+krJTtUooUMD0GoqmOAznc2JObiUUr4ismXyP0uX
s8JRuSPOfojMDavGIHiO8unUUJm3zdxv0LP8b6fe5G+
oshy76A6IqX1jk7ymSFOaVPQBT8fUS6onjsuSThiLERS0B6Brn2gRx/
KpQMk9IdYQMOSsHh4khvtxbqBZy6j++pIjeG4+dPz/v52DmJR+
DOrE7ZQpfvS9PSHkJoaqC2o6PrKN5YZ50G9+Tm+diPmbyv/PdHKtXn1ny3qBAdbfDwOjlA+NtJPld3/
06vq6WhHsgujYwMJWs7Cuu3rR0/FVHF/5wFxarakJsfo/zd69EpzrI8Hsic/
QmMzA==,19.19.19.2,5000,1,2,3,4,N/A,::1,none C3900-SPE250/K9+FOC172417YT,
nms,sgbu123!,55.55.0.18,isr3900,,,,,,,,,,,,,,,,
```

Step 12 Once the modem is registered, the status of the IXM device is shown as up in IoT FND in the Device Info page. Click the modem link to view the detailed IXM modem information.

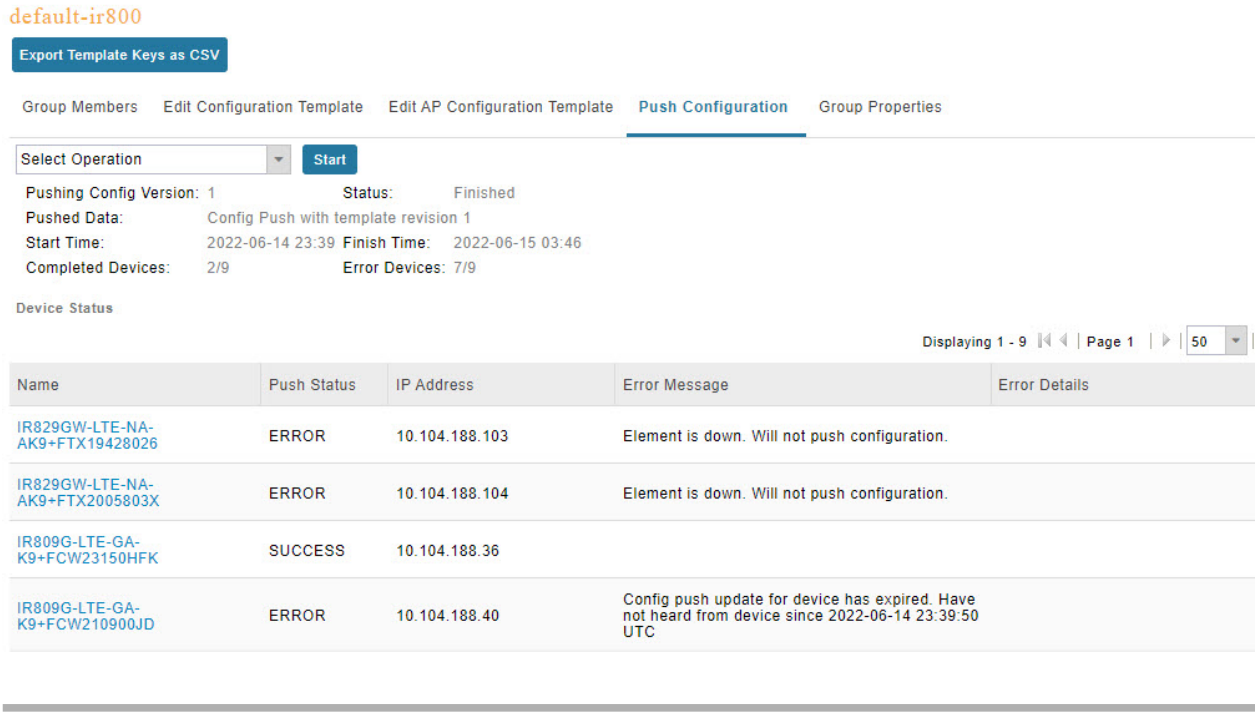


Note
Please check the following events if there are issues with ZTD.

2017-08-21 15:29:45:886	Registration Success	INFO	Registration of LoRaWAN Gateway successful.LoRaWAN Gateway Registration Success for EID [00M-LPWA-900-16-K9+FOC21026RAK].
2017-08-21 15:29:45:846	Up	INFO	LoRaWAN Gateway is up
2017-08-21 15:29:03:220	Registration Request	INFO	Registration request from LoRaWAN Gateway.LoRaWAN Gateway Registration Request from EID [IXM-LPWA-900-16-K9+FOC21026RAK].
2017-08-21 15:24:40:008	Down	MAJOR	LoRaWAN Gateway is down
2017-08-21 15:24:14:692	Tunnel Provisioning Success	INFO	Tunnel provisioning successful.
2017-08-21 15:23:27:798	Tunnel Provisioning Request	INFO	Tunnel provisioning request from LoRaWAN Gateway.

Step 13 If configuration update is required or a new modem is added to the router, follow the steps from point 1 or you can invoke a configuration push.

In the **Config** > **Device Configuration** page, click Default-IR800 and go to Push Configuration tab to invoke a configuration push. Select Push ROUTER Configuration from the drop-down and click **Start**.



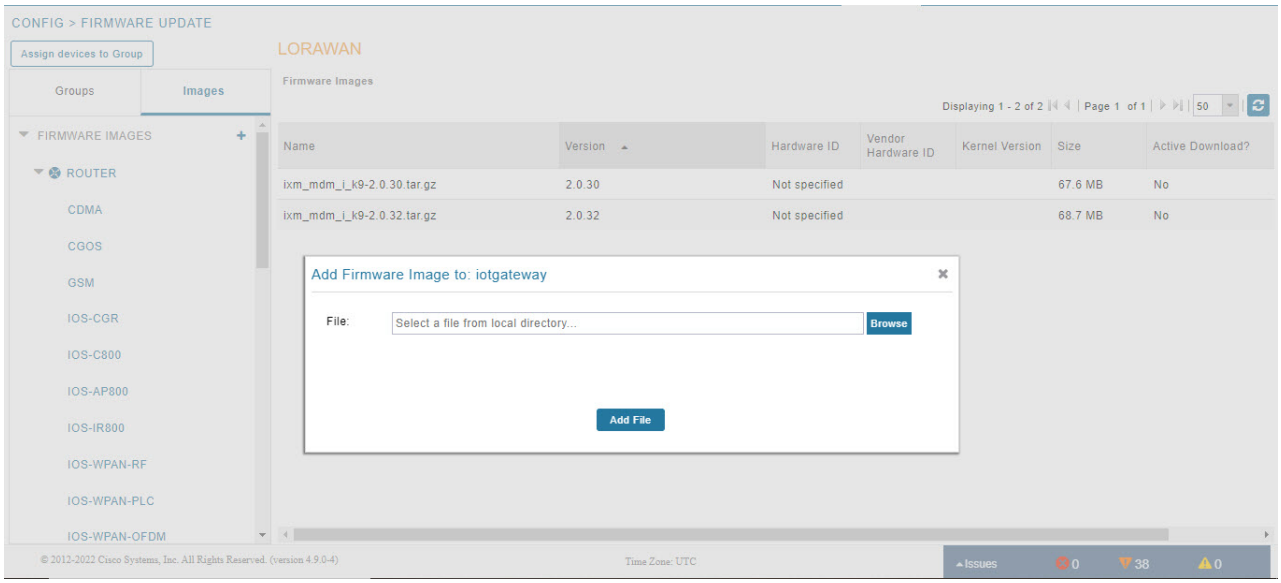
IXM Firmware Update

Follow the steps for upgrading the firmware.

Procedure

Step 1 In **Config** > **Firmware Update** page, go to Images tab. Select Default-Lorawan under Gateway in the left pane and click + to open the entry panel.

Step 2 Browse and select the firmware file from local directory. Click **Add File** to load the firmware file to IoT FND.

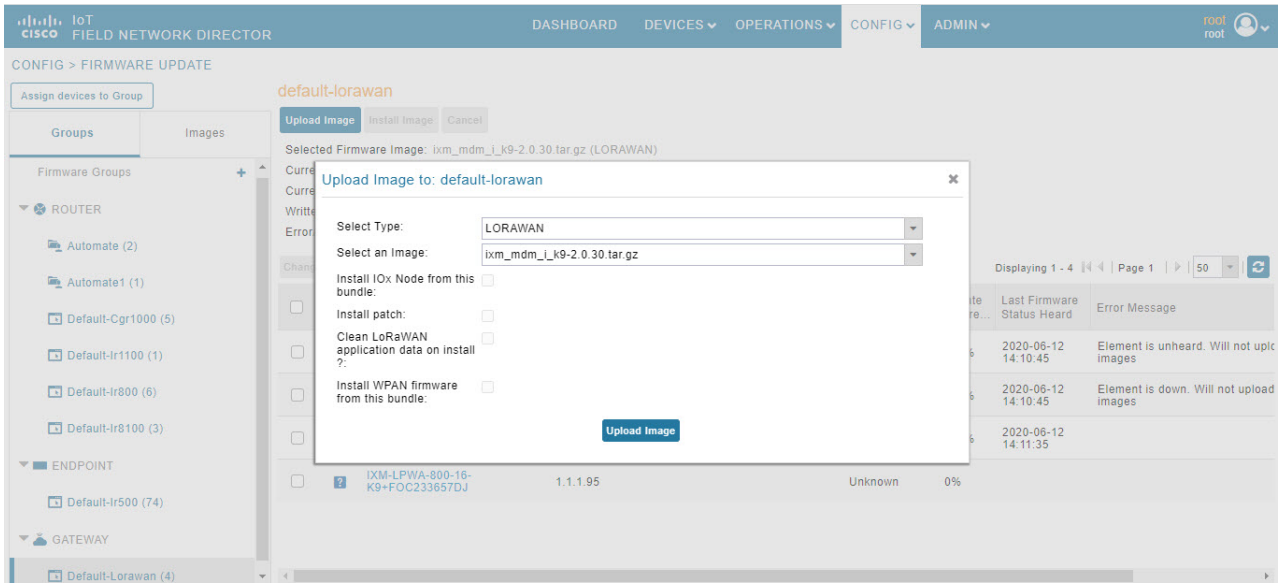


Step 3 In the Firmware Update page, go to Groups tab. Select Default-Lorawan under Gateway in the left pane.

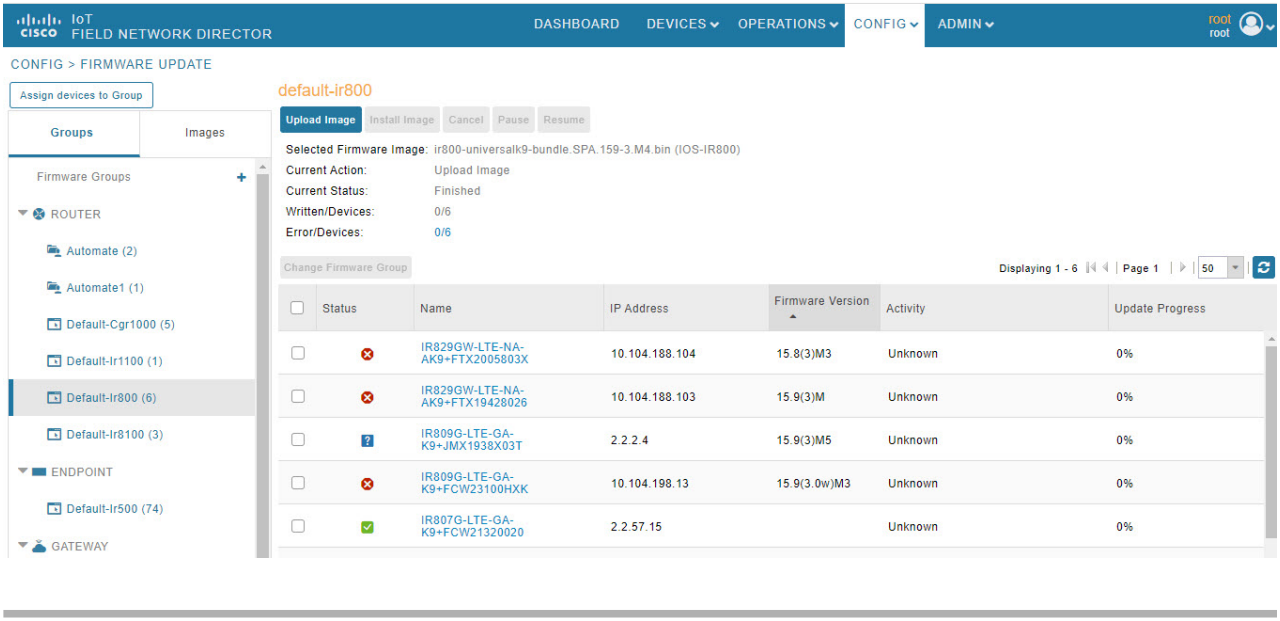
Step 4 Click **Upload Image** to push the firmware to the IXM modem. For more information, see Upload firmware images, on page 381.

Note
If you want to erase the LRR or public key, select **Clean LoRaWAN application data on install ?** option.

Note
Firmware image upload depends on interface speeds. You can set the timeout duration (in minutes) for firmware upload in cgms.properties file using "igma-idle-timeout" key. If you don't set this duration, then default timeout duration will be 15 minutes.

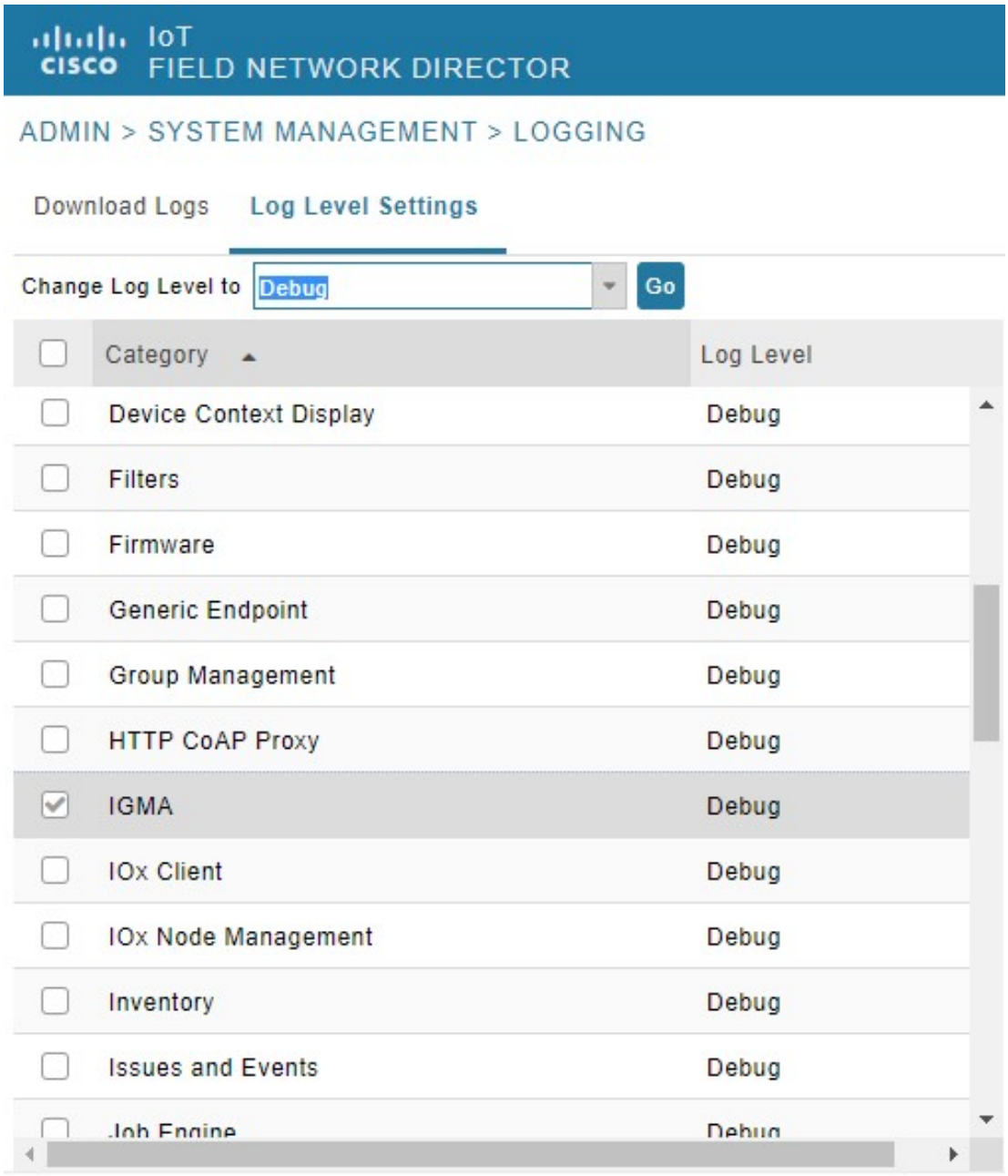


Step 5 Click **Install Image** button to install the image once the upload is complete.



Troubleshoot

- Click **Admin** > **System Management** > **Logging** to enable the following debug categories on IoT FND before troubleshooting.



- TPS does not have any messages from IXM.
  - Check if the certificates are installed correctly on IXM and from the same CA as the FND certs.
  - Make sure the IGMA profile is pointing to the correct tunnel profile and the proxy name resolution is correct.
  - Make sure the proxy can be pinged.
  - Make sure the IGMA profile has the correct commands.
- IoT FND does not have any messages from the IXM.

- Check if the tunnel network is reachable from the FND cluster.
- Make sure the IGMA profile is pointing to the correct FND profile and the name resolution is correct.
- Make sure IoT FND can be pinged.

- Tunnel provisioning request failed.
  - Check IoT FND tunnel template for command accuracy.
- IoT FND registration failed.
  - Check IoT FND configuration template for command accuracy.
  - Tunnel issues (for example, flapping or disconnect).

Monitoring Tunnel Status

To view tunnel status, choose **OPERATIONS** > **Tunnel Status**. The Tunnel Status page lists devices and their provisioned tunnels and displays relevant information about tunnels and their status. Tunnels are provisioned between HERs and FARs.

When you select Show Filter at the top of the page (when selected, replaced by Hide Filter), a number of search fields appear. You can filter by all the Field Names listed in Tunnel Status Fields. The value entered in one search field will determine the available selections in the other fields. Select Hide Filter to remove the search fields.

Tunnel Status Fields describes the tunnel status fields. To change the sort order of tunnels in the list by name, click the HER Name column heading. A small arrow next to the heading indicates the sort order.

Note It takes time for the status of the newly created tunnel to be reflected in IoT FND.

Table 118: Tunnel Status Fields

Field	Description
HER Name	The EID of the HER at one end of the tunnel. To view the HER details, click its EID. **Note** Because one HER can serve up to 500 FARs, there may be multiple tunnels in the list with the same HER EID. The Network Interfaces area of the Device Info page displays a list of tunnels configured on the HER. The Config Properties and Running Config tabs also contain information about tunnels configured on this HER.

Field	Description
HER Interface	The name of the HER tunnel interface. These names are automatically generated when tunnels are created (Tunnel1, Tunnel2, Tunnel3, and so on) or Virtual-Interface1, Virtual-Interface 2 and so on).
Admin Status	The administrative status of the tunnel (up or down). This indicates if the administrator enabled or disabled the tunnel.
Oper. Status	The operational status of the tunnel (up or down). If the tunnel is down, traffic does not flow through the tunnel, which indicates a problem to troubleshoot. Ping the HER and FAR to determine if they are online, or log on to the routers over SSH to determine the cause of the problem.
Protocol	The protocol used by the tunnel (IPSEC, PIM, or GRE).
HER Tunnel IP Address	The IP address of the tunnel at the HER side. Depending on the protocol used, the IP address appears in dotted decimal (IPv4) or hexadecimal (IPv6) slash notation.
HER IP Address	The destination IP address of the tunnel on the HER side.
FAR IP Address	The destination IP address of the tunnel on the FAR side.
FAR Interface	The name of the interface on the FAR used by the tunnel.
FAR Tunnel IP Address	The IP address of the tunnel on the FAR side. **Note** The IP addresses on both sides of the tunnel are on the same subnet.
FAR Name	The EID of the FAR. To view the FAR details, click its EID. The Network Interfaces area of the Device Info page displays a list of tunnels configured on the FAR. The Config Properties and Running Config tabs also contain information about tunnels configured on this FAR.

Reprovisioning CGRs

In IoT FND, CGR reprovisioning is a process for modifying the configuration files on CGRs.

CGR Reprovisioning Basics

This section explains CGR reprovisioning actions and sequence.

CGR Reprovisioning Sequence

When you start tunnel or factory reprovisioning on a tunnel provisioning group, the reprovisioning algorithm sequentially goes through 12 CGRs at a time and reprovisions them.

After IoT FND reprovisions a router successfully or if an error is reported, IoT FND starts the reprovisioning process for the next router in the group. IoT FND repeats the process until all CGRs are reprovisioned.

There is a timeout of 4 hours when reprovisioning each CGR in the group. If the CGR does not report successful reprovisioning or an error within the timeout period, then IoT FND changes the Reprovisioning Status of the CGR to Error and displays a timeout error and any further information displays in the Error Details field.

CGR Reprovisioning Actions

In IoT FND, you can perform the following two CGR reprovisioning actions at the Reprovisioning Actions pane of the Tunnel Provisioning page (**CONFIG** > **Tunnel Provisioning** > **Reprovisioning Actions**). You can also activate mesh firmware.

Tip You can also type in the interface instead of selecting the preloaded interface values.

Table 119:

Reprovisioning Actions	Description
Factory Reprovisioning	Drop-down menu allows you to change the express-setup-config file loaded on the CGR during factory configuration. This file contains a minimal set of information and is loaded on the CGR at the factory. This file provides the CGR with information to contact IoT FND (call home) through the TPS Proxy after the CGR is deployed and powered on.
Tunnel Reprovisioning	Drop-down menu allows you to change the golden-config file on a CGR. This file has the tunnel configuration defined on the CGR.
Mesh Firmware Activation	Drop-down menu allows you to select the Interface (such as cellular, Ethernet, etc.) and Interface Type (IPv6 or IPv4).

Reprovisioning Actions Pane Fields describes the fields on the Reprovisioning Actions pane.

Table 120: Reprovisioning Actions Pane Fields

Field	Description
Current Action	The current reprovisioning action being performed and the associated interface.

Field	Description
Reprovisioning Status	The status of the reprovisioning action.
Completed devices /All Scheduled Devices	The number of CGRs that were processed relative to the number of all CGRs scheduled to be processed.
Error devices/ All Scheduled Devices	The number of CGRs that reported an error relative to the number of all CGRs scheduled to be processed.
Name	The EID of the CGR.
Reprovisioning Status	The status of the reprovisioning action for this CGR.
Last Updated	The last time the status of the reprovisioning action for this CGR was updated.
Template Version	The version of the Field Area Router Factory Reprovision template being applied.
Error Message	The error message reported by the CGR, if any.
Error Details	The error details.

Tunnel Reprovisioning

If you make changes to the Field Area Router Tunnel Addition template and want all CGRs already connected to IoT FND reprovisioned with new tunnels based on the modified template, use the tunnel reprovisioning feature of IoT FND.

Tunnel reprovisioning places the CGR in a state where no tunnels are configured, and then initiates a new tunnel provisioning request. To reprovision tunnels, IoT FND sequentially goes through the FARs (12 at a time) in a tunnel provisioning group. For every CGR, IoT FND rolls back the configuration of the CGR to that defined in the ps-start-config template file.

After a rollback to ps-start-config, the CGR contacts IoT FND to request tunnel provisioning. IoT FND processes the Field Area Router Tunnel Addition template and sends the resultant configuration commands for creating new tunnels to the CGR.

For Cisco IOS routers, the checkpoint files are before-tunnel-config, before-registration-config, and Express-setup-config. You perform a configuration replace for Cisco IOS based CGRs.

Note The Field Area Router Factory Reprovision template is not used when performing tunnel reprovisioning.

To configure and trigger tunnel reprovisioning:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 In the TUNNEL GROUPS pane, select the tunnel group whose template to provision.

Step 3 Click the **Reprovisioning Actions** tab.

Step 4 From the Action drop-down menu, choose **Tunnel Reprovisioning**.

Step 5 Click **Start**.

IoT FND changes the Reprovisioning Status field to Initialized, and then to Running.

Note
If you click **Stop** while tunnel reprovisioning is running, IoT FND stops the reprovisioning process only for the FARs in the queue that were not selected. However, for those CGRs in the queue that were selected for reprovisioning, the process completes (success or error) and cannot be stopped.

The reprovisioning process completes after IoT FND finishes attempting to reprovision each CGR in the tunnel provisioning group. If a CGR cannot be reprovisioned, IoT FND displays the error message reported by the CGR.

Recover from a communication failure during tunnel reprovisioning

A communication failure can occur after Cisco IoT FND applies the tunnel configuration but before it completes the CGNA profile configuration on a Cisco IOS router. For example, Cisco IoT FND might report the following error while communicating with the router WSMA configuration URL:

```
HTTP response '502: Bad Gateway'
```

When the failure occurs:

- The tunnel configuration might already be present on the router.
- The `cg-nms-register` profile might not be configured or activated.
- The `cg-nms-tunnel` profile might remain active.
- Reprovisioning might not complete until you restore the router configuration and retrigger tunnel provisioning.

Before you begin

- Restore network communication with the router.
- Obtain privileged CLI access to the router.
- Confirm that the `flash:/before-tunnel-config.bak` pre-tunnel backup checkpoint exists.

Do not continue if the backup checkpoint is missing or you cannot verify its contents. Contact Cisco Support for assistance.

Caution Replacing the running configuration can temporarily interrupt router connectivity.

Follow these steps to recover from a communication failure during tunnel reprovisioning.

Procedure

Step 1 Log in to the router.

Step 2 Restore the router configuration from the pre-tunnel backup checkpoint.

```
configure replace flash:/before-tunnel-config.bak
```

Respond to any confirmation prompts that the router displays. Wait for the configuration replacement to complete before you continue.

Step 3 Delete the current pre-tunnel checkpoint file.

```
delete flash:/before-tunnel-config
```

Respond to any confirmation prompts that the router displays.

Step 4 Retrigger tunnel provisioning by executing the `cg-nms-tunnel` profile.

Example:

```
cgna exec profile cg-nms-tunnel
```

Step 5 Monitor the tunnel provisioning operation in Cisco IoT FND and verify the profile transition.

- The router has the required tunnel configuration.
- The `cg-nms-register` profile is configured and active.
- The `cg-nms-tunnel` profile is inactive.

After tunnel provisioning completes successfully, the router registers with Cisco IoT FND through the provisioned tunnel.

Factory Reprovisioning

Use the Factory Reprovisioning feature in IoT FND to change the factory configuration of CGRs (express-setup-config).

Factory Reprovisioning involves these steps:

1. Sending the roll back command to the CGR.
2. Reloading the CGR.
3. Processing the Field Area Router Factory Reprovision template, and pushing the resultant commands to the CGR.
4. Saving the configuration in the express-setup-config file.

   After these steps complete successfully, IoT FND processes the Field Area Router Tunnel Addition, Head-End Router Tunnel Addition, and Head-End Router Tunnel Deletion templates and pushes the resultant commands to the CGR (see Tunnel Provisioning Configuration Process, on page 406).

To configure and trigger factory reprovisioning:

Procedure

Step 1 Choose **CONFIG** > **Tunnel Provisioning**.

Step 2 In the TUNNEL GROUPS pane, select the tunnel group whose template you want to edit.

Step 3 Click the **Router Factory Reprovision** tab and enter the template that contains the configuration commands to apply.

Note
The Router Factory Reprovision template is processed twice during factory reprovisioning; once when pushing the configuration and again before saving the configuration in express-setup-config. Because of this, when making your own template, use the specific if/else condition model defined in the default template.

Step 4 Click **Disk icon to Save**.

Step 5 If needed, make the necessary modifications to the Field Area Router Tunnel Addition, Head-End Router Tunnel Addition, and Head-End Router Tunnel Deletion templates.

Step 6 Click **Reprovisioning Actions** tab.

Step 7 Select **Factory Reprovisioning**.

Step 8 From the Interface drop-down menu, choose the CGR interface for IoT FND to use to contact the FARs for reprovisioning.

Step 9 From the Interface Type drop-down menu, choose **IPv4** or **IPv6**.

Step 10 Click the **Start** button.

IoT FND changes the Reprovisioning Status field to Initialized, and then to Running.

Note
If you click **Stop** while factory reprovisioning is running, IoT FND stops the reprovisioning process only for the FARs in the queue that were not selected. However, for those CGRs in the queue that were selected for reprovisioning, the process completes and cannot be stopped.

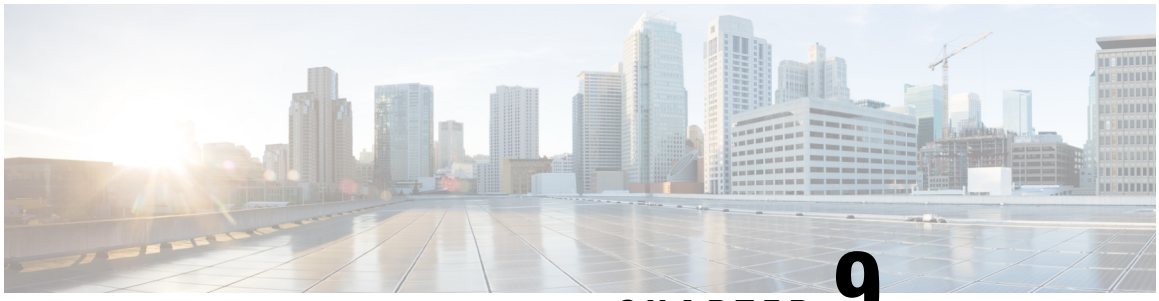
The reprovisioning process completes after IoT FND has finished attempting to reprovision each CGR in the tunnel provisioning group. If a CGR cannot be reprovisioned, IoT FND displays the error message reported by the CGR.

Sample Field Area Router Factory Reprovision Template

This sample template changes the WiFi SSID and passphrase in the factory configuration.

```
<#--IMPORTANT: This template is processed twice during factory
reprovisioning. The if/else condition described below is needed to
determine which part of the template is applied.
In this example, if no schedule name wimaxMigrationRebootTimer is found in
runningConfig, then the if part of the if/else section is applied. During
the second pass, this template runs the commands in the else section and
the no scheduler command is applied. If modifying this template, do not
remove the if/else condition or else the template fails. -->
```

```
<#if !far.runningConfig.text?contains("scheduler schedule name
wimaxMigrationRebootTimer")>

<#--Comment: This is a sample of generating wifi ssid and passphrase
randomly-->

wifi ssid ${far.randomSSID("PREFIX_")}
authentication key-management wpa2
wpa2-psk ascii ${far.randomPassword(10)}
exit

feature scheduler
scheduler job name wimaxMigration
reload
exit

scheduler schedule name wimaxMigrationRebootTimer
time start +02:00
job name wimaxMigration
exit

<#else>

no scheduler job name wimaxMigration
no scheduler schedule name wimaxMigrationRebootTimer

</#if>
```



CHAPTER 9

Monitor System Activity

This section describes how to monitor IoT FND system activity, including the following topics:

Quick Start for New Installs

Quick Start for New Installs prompts you for information to determine the appropriate deployment. No Devices or licenses are added during the Quick Start Process. When you first open a new install of FND software, the DASHBOARD page appears and you select QUICK SETUP.

To quick start for new installs:

Procedure

Step 1 At first login, as a root user, click **Dashboard**. A No Devices or Dashlets panel appears, which displays the following options:

- ADD LICENSE
- ADD DEVICES
- ADD DASHLET
- GUIDED TOUR

Step 2 Click **GUIDED TOUR**.

Note
You may need to add a license or create a dummy device to enable the Guided Tour. The Guided Tour feature must be enabled by the first-time FND root user that logs into the FND system before you can use the feature.

Step 3 At the root user menu (upper-right corner) that appears, select **Guided Tour**. This opens a Guided Tour Settings window that lists all available Guided Tours:

- Add Devices
- Device Configuration
- Device Configuration Group Management
- Tunnel Group Management
- Tunnel Provisioning
- Provisioning Settings
- Device Configuration and Device Groups
- Firmware Update

Step 4 After you select one of the Guided Tours, you will be redirected to that configuration page and windows appear to step you through the configuration steps and let you Add or Update Values as necessary.

Note
When you select the Zero Touch Provisioning option list in step 3 above, a Zero Touch Provisioning setup guided tour window appears that lists all the prerequisites for the device on-boarding: (Provisioning Settings, Group Management, Manage Configuration: Bootstrap Template, Tunnel Provisioning, Device Configuration, Add Devices).

Using the Dashboard

The Cisco IoT FND Dashboard displays *dashlets* to provide a visual overview of important network metrics for a device. You can select what you want to display.

Types of Dashlets

The Dashboard displays three types of dashlets for a selected device:

- Pie-chart dashlets display a ratio of the device properties as a pie chart.
- Bar-chart dashlets display device properties.
- Line-graph dashlets display graphs that show device variances over time.

Tip Graphs set to intervals longer than one day may not display the data at the last datapoint exactly as shown in the matching field on the Device Info page. This is because data aggregation is occurring less frequently than polling done to update the fields on the Device Info page. Set these graphs to the 6h or 1d intervals to update the data more frequently. Use intervals longer than one day to view data trends.

Customize Dashboard Dashlets

At the DASHBOARD page use the three icons (Cog, Pencil, Refresh) in the upper-right hand-corner of the page to customize your Dashlets.

To customize the dashoard dashlets:

Procedure

Step 1 Click the Dashboard Settings Cog icon to Add Dashlets and Set Refresh Interval for all active dashlets.

Step 2 Click the pencil icon to Add or Remove a Filter for a device.

Step 3 Click the **Refresh** icon to refresh the dashlet.

At individual dashlets you can:

Step 4 Click the dash (-) icon to minimize the dashlet.

Step 5 Click the Refresh icon to refresh the dashlet.

Step 6 Click the (+) icon to export data (.csv format) from the dashlet.

Step 7 Click the filter icon (pencil icon) to: (Options vary by dashlet type):

Define reporting intervals by selecting defined periods such as (6h, 1d, 1w, 4w), Last Billing Period and Current Billing Period, or define your own Custom time period.
Define a Series Selector, which allows you to define different possible states for a chart. For example, the Endpoint Config Group Mismatch Over Time chart has the following Series Selector options: Config Out of Sync and Config in Sync. Clicking the Series Selector option names on the chart can cause the data to display or not display on the chart. When not selected, a name appears in a faded hue on the chart.
Use drop-down menus found in some table headings to display data in an ascending or descending order or display an additional heading option (such as Down Routers Over Time) in the table.
Define the number of entries that display on the chart by selecting a value from the Show drop-down menu.
Display data as either a bar chart or pie chart.
Define a custom line-graph chart. Select the number of devices to chart for line-graph chart displays.
Select a series to refine data in line-graph chart displays.
Filter line-graph chart displays by group.
Add a Filter.

Step 8 Click (**X**) to close the dashlet.

Pre-defined Dashlets

Table 121: Feature History

Feature Name	Release Information	Description
User Experience Enhancements	Cisco IoT FND Release 5.0	The Cisco IoT FND dashboard includes pre-defined dashlets, where an additional **Name** field is added along with the Element Identifier (**EID**). You can delete the default views of the devices you select in the **Devices** > **Field Devices** page. You can also add the user-defined properties in the customized tab in the **Field Devices** page.

Dashlet	Description
Config Group Template Mismatch	This pie chart shows the number of devices with matched and mismatched configuration group templates. (Chart applies only to mesh endpoint configuration groups).
Devices with interfaces enabled but down	This gauge chart displays the count of devices that have interfaces that are enabled but down and the count of interfaces. To display this dashlet, click add (Operation column) at the Dashboard Settings page, and then define the device type and interface (such as Type:cgr1000, Interface:Async 1/1) and save your entries. Once the dashlet is on the Dashboard, click the needle of the gauge chart to launch the Device Details list page that shows all devices that meet the criteria of having enabled, but down interfaces.
Distribution of modulations across meters	This line graph shows the distribution of modulations across meters. Modulations graphed: 8PSK, QPSK, BPSK, ROBO, OFDM600,OFDM200, FSK150, QPSK12.5.
Distribution of modulations across IR500 Devices	This line graph shows the distribution of modulations across IR500 devices. Modulations graphed: 8PSK, QPSK, BPSK, ROBO, OFDM600,OFDM200, FSK150, QPSK12.5.
Endpoint Config Groups Template Mismatch Over Time	This line graph shows the number of endpoints across all configuration groups and particular configuration groups that are out of sync for the configured time interval.
Endpoint Firmware Group Membership Mismatch Over Time	This line graph shows the number of endpoints across all firmware groups and particular firmware groups that are out of sync for the configured time interval.
Endpoint Inventory	This endpoint status displays the proportion (and count) of endpoints. For example, the count of devices with an Unheard status relative to the other states: Registering, Up, Down, and Outage.

Dashlet	Description
Endpoint States Over Time	This line graph shows a count of endpoints and their states for the configured time interval. States shown: Registering, Down, Outage, Unheard, Up, Restored, Unmanaged.
Firmware Group Membership Mismatch	This pie chart shows the number of devices with mismatched firmware groups (applicable only to endpoint firmware groups).
Gateway Inventory	This pie chart shows the gateway count and its percentage of the whole by the following states: Unheard, Up, Down.
Hop Count Distribution	This pie chart shows the hop count distribution for mesh devices.
Router Inventory	This pie chart shows a router count and its percentage of the whole by the following states: Unheard, Up, Down.
Router States Over Time	This line graph shows the state of all routers over a configured time interval. States supported: Up, Down, Unmanaged, Unsupported and Unheard. Use the Add Filter button to track: • Specific router (Type) • Router Configuration Groups • Router Firmware Groups
Routers With Top Cellular Bandwidth Usage	This bandwidth chart displays the following information for the top *n* routers: EID, NAME, Interface, Bandwidth Usage and Bandwidth Usage (in Bytes) for a router per the defined filter. The filter defines possible time periods (6h, 1d, 1w, 4w, Custom, Last Billing Period) to display. To define the filter, click the pencil icon. **Note** You must define the Monthly Cellular Billing Period Start Day for the Last Billing Period option at the following page: **Admin** > **System Management** > **Server Settings** > **Billing Period Settings** .
Routers With Top Ethernet Bandwidth Usage	This bandwidth chart displays the following information for the top *n* routers: EID, NAME, Interface, Bandwidth Usage and Bandwidth in Usage (in Gigabits) for a router per the defined filter. The filter defines possible time periods (6h, 1d, 1w, 4w, Custom, Last Billing Period) to display. To define the filter, click the pencil icon. **Note** You must define the Monthly Ethernet Billing Period Start Day for the Last Billing Period option at the following page: **Admin** > **System Management** > **Server Settings** > **Billing Period Settings** .
Routers With Least Cellular RSSI	This Cellular RSSI chart displays the following information for the top *n* routers: EID, NAME, Interface, Cellular RSSI and Cellular RSSI (in dBm) for a router.

Dashlet	Description
Service Providers with Maximum Down Routers for Cellular 1	This dashlet shows the service provider names, their associated cell IDs (if available), their associated total router count, the count of down routers, and a sparkline showing the down routers over time (when you select the option per Tip noted below). This dashlet displays the aggregated maximum Down Routers for device types CGR1000 and IR800 for single modem routers. **Tip** Move your cursor over any column heading to display the Down Routers Over Time listings in either ascending or descending order.
Service Providers with Maximum Down Routers for Cellular 2	This dashlet shows the service provider names, their associated cell IDs (if available), their associated total router count, the count of down routers, and a sparkline showing the down routers over time (when you select the option per Tip noted below). This dashlet displays the aggregated maximum Down Routers for device types CGR1000 and IR800 for dual modem routers. **Tip** Move your cursor over any column heading to display listings in either ascending or descending order or to display the Down Routers Over Time column.

Repositioning Dashlets

You can configure the Dashboard to display charts in your preferred arrangement.

Procedure

Step 1 Click and drag the title bar of a chart to the desired position.

Step 2 Click (x) within a chart to remove the chart from the page.

Step 3 Collapse a dashlet to display only its title bar (such as Endpoint Inventory) by clicking the Minimize button (-).

Step 4 To refresh a dashlet, click the **Refresh** button.

Set time filters to view charts

Use this task to set custom time filters for charts.

Use the **Filter** option to view charts for default or custom-defined time intervals. The chart provides statistical information on devices (such as device information, events, or issues) and FND servers.

- Default time intervals: The options available are **6h** (6 hours), **1d** (one day), **1w** (one week), or **4w** (four weeks). For example, **6h** collects the device data for the last 6 hours and **1d** collects the device data for the last 24 hours.

Note You can hover over the chart to view the tooltip information. The tooltip appears by default in the charts for small data and displays information in the combination of data values, text, and/or tokens. For charts with a huge dataset, the tooltip doesn't appear by default. You have to select and expand the specific portion of the chart for which you need the information and then hover over to see the tooltip.

Note You see only aggregated data for **1w**, **4w**, and **Custom** charts and not real-time data, to avoid performance impact on Cisco IoT FND. The processing of a huge amount of data and displaying them in real-time slows down Cisco IoT FND.

- Custom: This option allows you to customize the time frame for collecting the device data. The chart in the dashlets provides the device data specific to the time frame set by you.

Note In some cases, the date and time displayed in the chart varies from the time frame customized by you. This time discrepancy is due to the time difference in the respective location of the Cisco IoT FND server and the Cisco IoT FND client. To rectify this time difference, you have to set the time zone in the Cisco IoT FND to your current location, using **User** > **Time Zone** (right top corner in the user interface).

Procedure

Step 1 Click **Filter** (pencil icon) in the right corner of the dashlet.

Step 2 Click the **Custom** button.

Step 3 In the **Enter Custom Time** window, select the time frame from the **From** and **To** fields.

Step 4 Click **OK**.

Note
The **From** and **To** fields are only enabled when the time range is set to Custom.

Setting the Dashlet Refresh Interval

To set the refresh interval for dashlets:

Procedure

Step 1 Choose **DASHBOARD** menu.

Step 2 Click the **Dashboard Settings** button (cog icon) in the upper-right corner of the page under the root <user> icon.

The Dashboard Settings panel appears.

Step 3 From the drop-down menu, choose a refresh interval.

Step 4 Close the Dashboard Settings dialog box when finished.

Adding Dashlets

To add dashlets to the Dashboard:

Procedure

Step 1 Choose **DASHBOARD** menu.

Step 2 Click the **Settings** button (cog icon) in the upper-right hand corner of the page.

Step 3 Click **Add Dashlets (+)**.

Note
No dashlets display in this dialog box if all are displaying on the Dashboard.

Step 4 To add a listed dashlet to the Dashboard, select the name of dashlet.

Step 5 Close the Dashboard Settings dialog box by clicking (x) in upper-right corner of panel when finished.

Table 122: Router Metrics

Field Name	Key	Description
Bandwidth Usage	cellularBandwidth	The total accumulated amount of bytes sent and received over the cellular uplink backhaul.
Battery 0 Level	battery0Level	The percentage of charge remaining in battery 0.
Battery 0 Remaining Time	battery0Runtime	The runtime remaining on battery 0.
Battery 1 Level	battery1Level	The percentage of charge remaining in battery 1.
Battery 1 Remaining Time	battery1Runtime	The runtime remaining on battery 1.
Battery 2 Level	battery2Level	The percentage of charge remaining in battery 2.
Battery 2 Remaining Time	battery2Runtime	The runtime remaining on battery 2.
C1222 Multicast Incoming Traffic	c1222McastInTraffic	C1222 multicast receive traffic on the WPAN interface.
C1222 Multicast Outgoing Traffic	c1222McastOutTraffic	C1222 multicast transmit traffic on the WPAN interface.

Field Name	Key	Description
C1222 Multicast Traffic	c1222McastTraffic	C1222 multicast traffic on the WPAN interface.
C1222 Total Incoming Traffic	c1222InTraffic	Total C1222 receive traffic on the WPAN interface.
C1222 Total Outgoing Traffic	c1222OutTraffic	Total C1222 transmit traffic on the WPAN interface.
C1222 Total Traffic	c1222Traffic	Total C1222 traffic on the WPAN interface.
C1222 Unicast Incoming Traffic	c1222UcastInTraffic	C1222 unicast receive traffic on the WPAN interface.
C1222 Unicast Outgoing Traffic	c1222UcastOutTraffic	C1222 unicast transmit traffic on the WPAN interface.
C1222 Unicast Traffic	c1222UcastTraffic	C1222 unicast traffic on the WPAN interface.
Cellular Module Temperature	cellModuleTemp	The internal temperature of 3G module.
Chassis Temperature	chassisTemp	The internal temperature of the device.
CINR	wimaxCinr	The measured CINR value of the WiMAX RF uplink.
CSMP Incoming Traffic	csmpInTraffic	CSMP receive traffic on the WPAN interface.
CSMP Multicast Incoming Traffic	csmpMcastInTraffic	CSMP multicast receive traffic on the WPAN interface.
CSMP Multicast Outgoing Traffic	csmpMcastOutTraffic	CSMP multicast transmit traffic on the WPAN interface.
CSMP Multicast Traffic	csmpMcastTraffic	CSMP multicast traffic on the WPAN interface.
CSMP Outgoing Traffic	csmpOutTraffic	CSMP transmit traffic on the WPAN interface.
CSMP Traffic	csmpTraffic	Total CSMP traffic on the WPAN interface.
CSMP Unicast Incoming Traffic	csmpUcastInTraffic	CSMP unicast receive traffic on the WPAN interface.
CSMP Unicast Outgoing Traffic	csmpUcastOutTraffic	CSMP unicast transmit traffic on the WPAN interface.
CSMP Unicast Traffic	csmpUcastTraffic	Total CSMP unicast traffic on the WPAN interface.
Current Call Duration	cellConnectTime	The amount of time the current call lasted; applicable to CDMA only.
DHCP Incoming Traffic	dhcpInTraffic	DHCP receive traffic on the WPAN interface.
DHCP Outgoing Traffic	dhcpOutTraffic	DHCP transmit traffic on the WPAN interface.
DHCP Traffic	dhcpTraffic	Total DHCP traffic on the WPAN interface.
Dot 1x Traffic	dot1xTraffic	Total Dot 1x traffic on the WPAN interface.
Dot1x Incoming Traffic	dot1xInTraffic	Dot1x receive traffic on the WPAN interface.
Dot1x Outgoing Traffic	dot1xOutTraffic	Dot1x transmit traffic on the WPAN interface.
ECIO	cellularEcio	The signal strength of CDMA at individual sector level.

Field Name	Key	Description
ICMP Incoming Traffic	icmpInTraffic	ICMP receive traffic on the WPAN interface.
ICMP Outgoing Traffic	icmpOutTraffic	ICMP transmit traffic on the WPAN interface.
Lowpan Incoming Traffic	lowpanInTraffic	Lo WPAN receive traffic on the WPAN interface.
Lowpan Outgoing Traffic	lowpanOutTraffic	Lo WPAN transmit traffic on the WPAN interface.
Mcast Incoming Traffic	mcastInTraffic	Multicast receive traffic on the WPAN interface.
Mcast Outgoing Traffic	mcastOutTraffic	Multicast transmit traffic on the WPAN interface.
Mesh Endpoint Count	meshEndpointCount	Number of active connected mesh endpoints.
ND NS Incoming Traffic	ndnsInTraffic	ND NS receive traffic on the WPAN interface.
Outage Incoming Traffic	outageInTraffic	Outage on receive traffic on the WPAN interface.
Overall Battery Remaining Time	batteryRuntime	Battery runtime remaining (all batteries).
Raw Socket Rx S1	rawSocketRxSpeedS1	Raw socket receive data rate for serial interface 1.
Raw Socket Rx S2	rawSocketRxSpeedS2	Raw socket receive data rate for serial interface 2.
Raw Socket Rx(Frames) S1	rawSocketRxFramesS1	Raw socket receive data rate, in frames, for serial interface 1.
Raw Socket Rx(Frames) S2	rawSocketRxFramesS2	Raw socket receive data rate, in frames, for serial interface 2.
Raw Socket Tx S1	rawSocketTxSpeedS1	Raw socket transmit data rate for serial interface 1.
Raw Socket Tx S2	rawSocketTxSpeedS2	Raw socket transmit data rate for serial interface 2.
Raw Socket Tx(Frames) S1	rawSocketTxFramesS1	Raw socket transmission data rate, in frames, for serial interface 1.
Raw Socket Tx(Frames) S2	rawSocketTxFramesS2	Raw socket transmission data rate, in frames, for serial interface 2.
Receive Packet Reassembly Drops	meshRxReassemblyDrops	The rate of receive packet fragments dropped because of no space in the reassembly buffer.
Receive Speed	ethernetRxSpeed	The rate of data received by the Ethernet uplink network interface, in bits per second, averaged over a short element-specific time period (for example, an hour).
Receive Speed	wimaxRxSpeed	The rate of data received by the WiMAX uplink network interface, in bits per second, averaged over a short element-specific time period (for example, one hour).
Receive Speed	cellularRxSpeed	The rate of data received by the cellular uplink network interface, in bits per second, averaged over a short element-specific time period (for example, one hour).

Field Name	Key	Description
Receive Speed	meshRxSpeed	The rate of data received by the uplink network interface, in bits per second, averaged over a short element-specific time period (for example, one hour).
Remaining ICMP Incoming Traffic	remainIcmpInTraffic	Remaining ICMP receive traffic on the WPAN interface.
Remaining ICMP Outgoing Traffic	remainIcmpOutTraffic	Remaining ICMP transmit traffic on the WPAN interface.
Remaining ICMP Traffic	remainIcmpTraffic	Total remaining ICMP traffic on the WPAN interface.
Remaining IP Incoming Traffic	remainIpInTraffic	Remaining IP receive traffic on the WPAN interface.
Remaining IP Outgoing Traffic	remainIpOutTraffic	Remaining IP transmit traffic on the WPAN interface.
Remaining IP Traffic	remainIpTraffic	Total remaining IP traffic on the WPAN interface.
RPL DAO Incoming Traffic	rplDaoInTraffic	DAO receive traffic on the WPAN interface.
RPL DIO Incoming Traffic	rplDioInTraffic	DIO receive traffic on the WPAN interface.
RPL Incoming Traffic	rplInTraffic	RPL receive traffic on the WPAN interface.
RPL RA Outgoing Traffic	rplRaOutTraffic	RA transmit traffic on the WPAN interface.
RPL Source Route Table Entries	meshRoutes	The number of entries a given router has in its source-route table. This provides a way to measure the number of elements in the PAN.
RPL Total Traffic	rplTraffic	Total RPL traffic on the WPAN interface.
RSSI	cellularRssi	The measured RSSI value of the cellular RF uplink.
RSSI	wimaxRssi	The measured RSSI value of the WiMAX RF uplink.
Total Incoming Traffic	totalInTraffic	Total receive traffic on the WPAN interface.
Total Outgoing Traffic	totalOutTraffic	Total transmit traffic on the WPAN interface.
Transmit Packet Drops	ethernetTxDrops	The rate of packets dropped because the outbound queue was full while trying to transmit on the Ethernet uplink interface.
Transmit Packet Drops	meshTxDrops	The rate of packets dropped because the outbound queue was full while trying to transmit on the mesh uplink interface.
Transmit Speed	ethernetTxSpeed	The current speed of data transmission over the Ethernet uplink network interface, in bits per second, averaged over a short element-specific time period (for example, one hour).
Transmit Speed	cellularTxSpeed	The current speed of data transmission over the cellular uplink network interface, in bits per second, averaged over a short element-specific time period (for example, one hour).

Field Name	Key	Description
Transmit Speed	wimaxTxSpeed	The current speed of data transmission over the WiMAX uplink network interface, in bits per second, averaged over a short element-specific time period (for example, one hour).
Transmit Speed	meshTxSpeed	The current speed of data transmission over the uplink network interface, in bits per second, averaged over a short element-specific time period (for example, one hour).
Ucast Incoming Traffic	ucastInTraffic	Unicast receive traffic on the WPAN interface.
Ucast Outgoing Traffic	ucastOutTraffic	Unicast transmit traffic on the WPAN interface.
Uptime	uptime	The amount of time, in seconds, that the device has been running since last boot
Utilization Bytes (slots 1–8)	ethernetUtilBytes[slot number]	The data, in bytes, transmitted and received by the Ethernet on the uplink or downlink network interface at slot x.
Utilization Bytes (slot 9-11)	ethernetUtilBytes[9-11]	(Cisco IOS CGRs running GOS only) The data, in bytes, transmitted and received by the Ethernet on the uplink or downlink network interface at module/slot 0/0, 0/1, or 0/2, respectively.

Table 123: Router Properties

Field Name	Key	Description
Battery 0 State	battery0State	The state of battery 0 charge (combined attribute).
Battery 1 State	battery1State	The state of battery 1 charge (combined attribute).
Battery 2 State	battery2State	The state of battery 2 charge (combined attribute).
Cellular Roaming Status	cellRoamingStatus	The roaming status of the cellular module on the CGR.
Network Name	cellularNetworkName	The network that the cellular device is associated with.
Module Status	cellularStatus	The status and state of the cellular module.
Cellular Network Type	cellularType	The cellular network type (CDMA or GSM).
Door Status	doorStatus	The device door status (Open or Closed).
Power Source	powerSource	The device current power source.
Link State	wimaxLinkState	The device WiMAX link state.

Removing Dashlets

To remove dashlets from the Dashboard:

Procedure

Step 1 Choose **DASHBOARD** menu.

Step 2 Close the dashlet by clicking (X) in the upper-right corner of the panel.

Using Pie Charts to Get More Information

Roll over any segment of a pie chart to display a callout with information on that segment.

Click the Router Inventory and Mesh Endpoint Inventory pie charts to display the devices in List View.

Setting Time Filters To View Charts

Use the **Filter** option to view charts for default or custom-defined time intervals. The chart provides statistical information on devices (such as device information, events, or issues) and FND servers.

- Default time intervals: The options available are **6h** (6 hours), **1d** (one day), **1w** (one week), or **4w** (four weeks). For example, **6h** collects the device data for the last 6 hours and **1d** collects the device data for the last 24 hours.

Note You can hover over the chart to view the tooltip information. The tooltip appears by default in the charts for small data and displays information in the combination of data values, text, and/or tokens. For charts with a huge dataset, the tooltip doesn't appear by default. You have to select and expand the specific portion of the chart for which you need the information and then hover over to see the tooltip.

Note You see only aggregated data for **1w**, **4w**, and **Custom** charts and not real-time data, to avoid performance impact on Cisco IoT FND. The processing of a huge amount of data and displaying them in real-time slows down Cisco IoT FND.

- Custom: This option allows you to customize the time frame for collecting the device data. The chart in the dashlets provides the device data specific to the time frame set by you.

Note In some cases, the date and time displayed in the chart varies from the time frame customized by you. This time discrepancy is due to the time difference in the respective location of the Cisco IoT FND server and the Cisco IoT FND client. To rectify this time difference, you have to set the time zone in the Cisco IoT FND to your current location, using **User** > **Time Zone** (right top corner in the user interface).

To set time filters to view charts:

Procedure

Step 1 Click **Filter** (pencil icon) in the right corner of the dashlet.
Step 2 Click the **Custom** button.
Step 3 In the **Enter Custom Time** window, select the time frame from the **From** and **To** fields.
Step 4 Click **OK**.

Note
The **From** and **To** fields are only enabled when the time range is set to Custom.

Collapsing Dashlets

To collapse the dashlets:

Procedure

Step 1 Choose **DASHBOARD** menu.
Step 2 Click the minimize icon **(-)** at the upper-right of the dashlet window to hide the window.

Using the Series Selector

You use the Series Selector to refine line-graphs to display by device status. The device options are:

- Routers: Down, Outage, Unsupported, Unheard, and Up
- Mesh Endpoint Config Group: Config Out of Sync and Config In Sync
- Mesh Endpoint Firmware Group: Membership Out of Sync and Membership In Sync
- Mesh Endpoint States: Down, Outage, Unheard, and Up

To use the Series Selector:

Procedure

Step 1 Click **Series Selector**.

Step 2 In the **Series Selector** dialog box, check the check boxes for the data series to show in the graph.

Step 3 Click **Close**.

Using Filters

You use filters to refine the displayed line-graph data by groups. Applied filters display after the dashlet title.

To use the filters:

Procedure

Step 1 Click the interval icon (pencil) in the upper-right corner of the panel to display the 2 filtering parameters on the chart: a time frame (such as 6h) and components (such as Endpoint Configuration Groups, Mesh Endpoints (MEs).

Step 2 Click a time frame.

Step 3 From the first drop-down menu, choose a group type.

Step 4 From the first drop-down menu, choose a group type.

Step 5 From the third drop-down menu, choose a group.

Step 6 Click **Apply**.

The pencil icon is green and the filter displays next to the dashlet name to indicate that a filter is applied.

Note
Click the **Remove Filter** button to remove the filter and close the filter options.

Exporting Dashlet Data

You can export dashlet data to a CSV file.

To export dashlet data:

Procedure

Step 1 On the desired dashlet, click the export button (+).
A browser download session begins.

Step 2 Navigate to your default download directory to view the export file.

Note
The filename begins with the word “export-” and includes the dashlet name (for example, export-Node_State_Over_Time_chart-1392746225010.csv).

Monitoring Events

This section provides an overview of events and how to search and sort events.

Set Time Range and Page View Preferences for Operations > Events

In the Events tab of a device, you can define the following information:

- Relative time periods: ‘Last 24 hours’, ‘Last 15 Minutes’, ‘Last 4 hours’, ‘Last 7 days’, ‘Last 30 days’ and ‘All Time’ from the drop-down menu at the left-hand side of the page
- Absolute time periods reference a specific day such as Sunday, April 25, Saturday, April 24, Friday, April 24

You can also select the number of events to display on a page (such as ‘10’, ‘50’, ‘100’, and ‘200’) by selecting that value from the drop-down menu at the far-right side of the page.

View Events

Feature Name	Release Information	Description
Endpoint outage or restoration event message	Cisco IoT FND Release 5.1	Cisco IoT FND captures the endpoint outage and restoration timestamp along with Cisco IoT received timestamp in the **Field Device Events Events** pages.

The **Events** page lists all events related to the devices that Cisco IoT FND tracks. All events are stored in the Cisco IoT FND database server and Cisco IoT FND displays them as events chart, which is a visual view of events in a time-line.

Click one of the warning messages from the left tree, for example, severity or router to view more information. The **Device Info** tab displays detailed information of the selected device. You can view the events chart of the device for default or custom-defined time intervals. For more information on viewing the chart for default or custom-defined time intervals, refer to Setting Time Filters To View Charts, on page 457.

However, depending on the number of devices the Cisco IoT FND server manages, the **Events** page can sometimes timeout. Choose **User Name** > **Preferences**, and uncheck the **Show chart on events page** and **Show summary counts on the events/issues page** check boxes.

Procedure

Step 1 To limit the amount of event data displayed on this page, use the Filter drop-down menu (at the top of the left pane).

Note
For example, you can show the events for the last 24 hours relative to the last 30 days, or events for a specific day within the last seven days.

Step 2 To enable automatic refresh of event data to refresh every 14 seconds, check the checkbox next to the **Refresh** button. To immediately refresh event data click the **Refresh** button or the refresh icon.

Note
The number of event data displayed on the **Events** page is dependent on your data retention settings. For more information see, Data retention.

All Events Pane Filters

Use the preset filters in the All Events pane to only view those event types.

Device Events

In the left pane, IoT FND tracks events for the following devices:

- Routers
- Endpoints
- Head-end Devices
- CR Mesh Devices
- NMS Servers
- Database Servers

Event Severity Level

In the left pane, select an event severity level to filter the list view to devices with that severity level:

- Critical
- Major
- Minor
- Info

Each event type has a preset severity level. For example, a Router Down event is a Major severity level event.

Filtering by Severity Level

To filter by severity level, click the pencil icon:

Procedure

Step 1 Choose **OPERATIONS** > **Events**

Step 2 Click the **SEVERITY** show/hide arrow (left-pane).

Note
Only those severity levels (**CRITICAL**, **MAJOR**, **MINOR**, or **INFO**) that have occurred display in the left pane under the SEVERITY heading.

Step 3 Click a severity level to display all events of that severity level in the Events pane (right-pane).

Preset Events By Device

IoT FND has a preset list of events it reports for each device it tracks. A list of those events is summarized under each device in the left pane on the Events page. For example, in the left pane click the show/hide icon ( ) next to Routers to expand the list of all events for routers.

Advanced Event Search

To use the filter to search for events:

Procedure

Step 1 Choose **OPERATIONS** > **Events**.

Step 2 Above the All Events heading (left pane), select a Relative (such as 7 days, 24 hours, 15 minutes) or Absolute (Day of the Week such as March 12) search time frame and an event category [SEVERITY | ROUTER or ENDPOINT} from the drop-down menu to narrow down your search. For example, you can select a SEVERITY option of MAJOR, MINOR or INFO and information for the chosen severity will display for all systems being managed by FND.

Step 3 Click the **Show Filter** link at the top of the main pane.

Step 4 Use the filter drop-down menus and fields to specify your search criteria.

Step 5 Click the plus button (+) to add the search strings to the Search field.

Repeat the process of adding search strings to the Search field as needed.

Step 6 Click **Search Events** or press Enter.

The search results display in the Events pane.

You can also add search strings manually, as shown in the following examples:

- To filter events by Name (EID), enter the following string in the Search Events field:
  - **name:** *router eid string*
  - Search Events by Name Filter

Note

Note the use of the asterisk (*) wild card with this filter.

- To filter by event time period, enter the following string in the Search Events field, as shown in graph below:
  - **eventTime** *operator"YYYY-MM-DD HH:MM:SS:SSS"*
  - Supported operators are: <, >, >=, <=, :

Note
Do not enter a space between **eventTime** and the operator.

Sorting Events

To sort events in ascending or descending order, roll over any column and select the appropriate option from the heading drop-down menu.

Searching By Event Name

To search by event name (for example, Battery Low):

Procedure

Step 1 Choose **OPERATIONS** > **Events**.
Step 2 In the left pane, click the device type.
Step 3 Click the **Show Filter** link at the top of the right pane to display the search fields.
Step 4 Choose **Event Name** from the left drop-down menu.
Step 5 Choose the event name from the options in the right drop-down menu.
Step 6 Click the plus button (+) at the right to add the filter to the Search Events field.
The filter syntax appears in the Search Events field.
Step 7 Click the **Search Events** button (magnifying glass icon).
The search results display in the Events pane.

Searching by Labels

Allows you to search and filter events based on Label names tagged to Field Devices.

To search by labels:

Procedure

Step 1 Choose **OPERATIONS** > **Events**.

Step 2 Click **All Events** in the left pane.

Step 3 Click the **Show Filter** link at the top of the right pane.

Step 4 Choose **Label** from the left drop-down menu.

Step 5 Choose the event name from the options in the right drop-down menu or create your own.

Step 6 Click the plus button (+) at the right to add the filter to the Search Events field.

The filter syntax appears in the Search Events field.

Step 7 Click the **Search Events** button (magnifying glass icon).

The search results display in the Events pane.

Export events

You can export events to a CSV file to examine as a log of event severity, time, name and event description by device.

To export events:

Procedure

Step 1 Choose **Operations** > **Events**.

Step 2 Click the desired severity level or device type in the left pane.

Step 3 Click the **Export** button .

A browser download session begins.

Step 4 Navigate to your default download directory to access the CSV file.

Events Reported

The table lists the events reported by IoT FND. Details include the event severity (Critical, Major, Minor, Information) and the devices that report those events.

Table 124: Events Reported

Events	Devices	Severity
CRITICAL EVENTS		
Certificate Expired	AP800, CGR1000, FND, IR800	Critical

Events	Devices	Severity
DB FRA Space Critically Low	Database	Critical
DB Table Space Critically Low	Database	Critical
Invalid CSMP Signature	CGMESH, IR500	Critical
Outage	Cellular, CGMESH, IR500	Critical
RPL Tree Size Critical	CGR1000	Critical
SD Card Removal Alarm	CGR1000	Critical
MAJOR EVENTS		
AAA Failure	CGR1000, IR800	Major
ACT2L Failure	CGR1000, IR800	Major
Archive Log Mode Disabled	Database	Major
Battery Failure	CGR1000	Major
Battery Low	CGR1000, IR500	Major
BBU Configuration Failed	IR500	Major
BBU Firmware Download Failed	IR500	Major
BBU Firmware Mismatch Found	CGR1000	Major
BBU Firmware Upgrade Failed	IR500	Major
BBU Lock Out	IR500	Major
BBU Power Off	IR500	Major
Block Mesh Device Operation Failed	CGR1000	Major
Certificate Expiration	AP800, CGR1000, FND, IR800	Major
DB FRA Space Very Low	Database	Major
Default Route Lost	CGMESH, IR500	Major
Device Unknown	FND	Major
Door Open	CGR1000, IR800, LORA	Major
Dot1X Authentication Failure	CGR1000	Major
Dot1X Authentication Flood	CGR1000, IR800	Major

Events	Devices	Severity
Down	AP800, ASR, C8000, Cellular, CGMESH, CGR1000, Database, FND, IR500, IR800, ISR3900, LORA	Major
Element Configuration Failed	CGR1000, IR800	Major
High CPU Usage	LORA	Major
High Flash Usage	LORA	Major
High Temperature	LORA	Major
HSM Down	FND	Major
Interface Down	ASR, C8000, ISR3900	Major
Linecard Failure	CGR1000, IR800	Major
Line Power Failure	CGR1000, IR800	Major
Link Down	IR500	Major
Low Flash Space	CGR1000, IR800	Major
Low Memory/Memory Low	CGR1000, FND, IR800, LORA (Memory Low)	Major
Low Temperature	LORA	Major
Mesh Connectivity Lost/ Node Connectivity Lost	CGMESH, IR500	Major
Mesh Link Key Timeout/ Node Link Key Timeout	CGMESH, IR500	Major
Metric Retrieval Failure	ASR, C8000, CGR1000, IR800, ISR3900	Major
Modem Temperature Cold Alarm	CGR1000, IR800	Major
Modem Temperature Warm Alarm	CGR1000, IR800	Major
Node Connectivity Lost	CGMESH, IR500	Major
Node Link Key Timeout	CGMESH, IR500	Major
Packet Forwarder Usage High	LORA	Major
Port Down	AP800, CGR1000, IR800	Major
Port Failure	AP800, CGR1000, IR800	Major
Refresh Router Mesh Key Failure	CGR1000, IR8100	Major

Events	Devices	Severity
Refresh Router Mesh LFN Key Failure	IR8100	Major
RPL Tree Size Warning	CGR1000	Major
Software Crash	CGR1000, IR800	Major
SSM Down	FND	Major
System Software Inconsistent	CGR1000, IR800	Major
Temperature Major Alarm	CGR1000, IR800	Major
Time Mismatch	CGMESH, IR500	Major
Tunnel Down	CGR1000, IR800	Major
Tunnel Provisioning Failure	CGR1000, IR800	Major
Unknown WPAN Change	CGMESH, IR500	Major
MINOR EVENTS		
DB FRA Space Low	Database	Minor
Dot1X Re-authentication	CGMESH, IR500	Minor
Temperature Minor Alarm	CGR1000, IR800	Minor
Temperature Low Minor Alarm	CGR1000, IR800	Minor
RPL Tree Reset	CGR1000	Minor
INFORMATION EVENTS		
Archive Log Mode Enabled	Database	Information
Battery Normal	CGR1000	Information
Battery Power	CGR1000	Information
BBU Firmware Download Passed	CGR1000	Information
Certificate Expiration Recovery	AP800, CGR1000, FND, IR800	Information
Cold Boot	AP800, CGMESH, CGR1000, IR500, IR800	Information
Configuration is Pushed	FND	Information
Configuration Rollback	AP800, CGR1000, IR800	Information
DB FRA Space Normal	Database	Information
DB Table Space Normal	Database	Information

Events	Devices	Severity
Device Added	Cellular, CGMESH, CGR1000, IR500, IR800	Information
Device Location Changed	CGR1000, IR800	Information
Device Removed	Cellular, CGMESH, CGR1000, IR500, IR800	Information
Door Close	CGR1000, IR800, LORA	Information
Dot11 Deauthenticate Send	CGR1000, IR800	Information
Dot11 Disassociate Send	CGR1000, IR800	Information
Dot11 Authentication Failed	CGR1000, IR800	Information
Hardware Insertion	CGR1000, IR800	Information
Hardware Removal	CGR1000, IR800	Information
High CPU Usage Recovery	LORA	Information
High Flash Usage Recovery	LORA	Information
High Temperature Recovery	LORA	Information
HSM Up	FND	Information
Interface Up	ASR, C8000, ISR3900	Information
Line Power	CGR1000, IR800	Information
Line Power Restored	CGR1000, IR800	Information
Link Up	IR500	Information
Low Flash Space OK	CGR1000, IR800	Information
Low Memory OK/Low Memory Recovery	CGR1000, IR800, LORA (Low Memory Recovery)	Information
Manual Close	ASR, C8000, Cellular, CGMESH, CGR1000, IR500, IR800, ISR3900	Information
Major RPL Tree Size Warning OK	CGR1000	Information
Manual NMS Address Change	CGMESH, IR500	Information
Manual Re-Registration	CGMESH, IR500	Information
Mesh Certificate Change/ Node Certificate Change	CGMESH, IR500	Information

Events	Devices	Severity
Mesh Module Firmware Upgrade has been successful	CGR1000	Information
Migrated To Better PAN	CGMESH, IR500	Information
Modem Status Changed	LORA	Information
Modem Temperature Cold Alarm Recovery	CGR1000, IR800	Information
Modem Temperature Warm Alarm Recovery	CGR1000, IR800	Information
NMS Address Change	CGMESH, IR500	Information
NMS Returned Error	CGMESH, IR500	Information
Node Certificate Change	CGMESH, IR500	Information
Packet Forwarded High Usage Recovery	LORA	Information
Packet Forwarder Status	LORA	Information
Packet Forwarded High Usage Recovery	LORA	Information
Port Up	AP800, CGR1000, IR800	Information
Power Source OK	CGR1000, IR800	Information
Power Source Warning	CGR1000, IR800	Information
Registered	ASR, C8000, ISR3900	Information
Registration Failure	AP800, Cellular, CGR1000, IR800, LORA	Information
Registration Request	AP800, CGR1000, IR800, LORA	Information
Registration Success	AP800, Cellular, CGR1000, IR800, LORA	Information
Rejoined With New IP Address	CGMESH, IR500	Information
Restoration	Cellular, CGMESH, IR500	Information
Restoration Registration	CGMESH, IR500	Information
RPL Tree Size Critical OK	CGR1000	Information
Rule Event	ASR, C8000, CGMESH, CGR1000, Database, FND, IR500, IR800, ISR3900	Information

Events	Devices	Severity
SSM Up	FND	Information
Temperature Low Recovery	LORA	Information
Temperature Low Minor Alarm Recovery	CGR1000, IR800	Information
Temperature Major Recovery	CGR1000, IR800	Information
Temperature Low Major Alarm Recovery	CGR1000, IR800	Information
Temperature Minor Recovery	CGR1000, IR800	Information
Time Mismatch Resolved	CGMESH, IR500	Information
Tunnel Provisioning Request	CGR1000, IR800	Information
Tunnel Provisioning Success	CGR1000, IR800	Information
Tunnel Up	CGR1000, IR800	Information
Unknown Event	AP800, ASR, C8000,Cellular, CGMESH, CGR1000, Database, FND, IR500, IR800, ISR3900, LORA	Information
Unknown Registration Reason	CGMESH, IR500	Information
Unsupported	AP800, CGR1000, IR800, LORA	Information
Up	AP800, ASR, C8000,Cellular, CGMESH, CGR1000, Database, FND, IR500, IR800, ISR3900, LORA,	Information
Warm Start	IR500	Information
WPAN Watchdog Reload	CGR1000	Information

Monitoring Issues

This section provides an overview of issues and how to search for and close issues in IoT FND.

Viewing Issues

IoT FND offers different ways to monitor issues:

The **OPERATIONS** > **ISSUES** page provides a snapshot of the health of the network by highlighting only major and critical issues that are active within the network.

You can also view the device information by clicking on one of the devices listed under router or endpoint on the left pane. The **Device Info** tab displays detailed information of the selected device along with the issues chart. You can view the issues chart of the device for default or custom-defined time intervals. For more information on viewing the chart for default or custom-defined time intervals, refer to Setting Time Filters To View Charts, on page 457.

The issues status bar bar displays in the footer of the browser window and shows a count of all issues by severity for selected devices. You can set the device types for issues that display in the Issues status bar in User Preferences.

The Issues page provides an abbreviated subset of unresolved network events for quick review and resolution by the administrator. Issues remain open until either the associated event is resolved (and IoT FND generates a resolution event) or the administrator manually closes the event.

Only one issue is recorded when multiple entries for the same event are reported. Each issue has a counter associated with it. As an associated event is closed, the counter decrements by one. Every open or closed issue has an associated event.

Click the Issues status bar to view the Issues Summary pane, which displays issues listed by the selected device category. Click count links in the Issues Summary pane to view complete issue criteria filtered by severity on the **OPERATIONS** > **Issues** page.

Note The closed issues data that displays on the Issues page is limited by the **Keep Closed Issues** for data retention setting (**ADMIN** > **System Management** > **Data Retention**), which is based on the time the issue was closed. When the issue was closed displays as the Last Update Time for the issue.

Displaying Truncated Views of the OPERATIONS > Issues Page

At the **DEVICES** > **FIELD DEVICES** > **Browse Devices** > **Inventory** page, multiple entries of the same Open Issue (such as Device-NMS Time Mismatch, Down) for a given device will display as one entry only. This reduces multiple entries of the same Open Issue for a Field Device from filling up the display window.

At the **DEVICES** > **FIELD DEVICES** > **Browse Devices** > **Inventory** page, you can also minimize the width of the Open Issues column by clicking on the column and dragging the cursor to the left.

To indicate that the column display has been reduced, the column displays three periods (...). You can later view the expanded view of that content by clicking on the column and expanding the column to the right. If you want to see more details for an Open Issue, you can go to the **OPERATIONS** > **Issues** page.

Viewing Device Severity Status on the Issues Status Bar

A tally of issues listed by severity for the selected devices displays in the issues status bar in the bottom-right of the browser window frame. You can set the device types for issues that display in the Issues status bar in User Preferences.

To view the device severity status on the issue status bar:

Procedure

Step 1 Click the Issues status bar to view the **Issues Summary** pane, which displays issues listed by the selected device category.

Step 2 Click the count links in the Issues Summary pane to view complete issue criteria filtered by severity on the **OPERATIONS** > **Issues** page.

Adding Notes to Issues

On the **OPERATIONS** > **Issues** page, you can add notes about Issues for a device.

Click the **Notes** link inline to access any notes entered for the Issue or add a note on the Notes for Issues Name page.

You can edit and delete notes from issues on this page. Issues can have multiple notes. Notes on the Issues Name page display the time the note was created, the name of the user who wrote the note, and the text of the note. You can also add a note when closing an Issue. Notes are purged from the database with the issue.

Note In some cases, existing notes may exist for the system and the Notes for Issues Name pane displays.

To add a note to an issue:

Procedure

Step 1 Click the **Notes** link inline or check the check box of the device and click **Add Note**.

The Notes for Issues Name pane displays.

Step 2 Click **Add Note**.

The Add Note dialog displays.

Step 3 Insert your cursor in the **Note** field and type your note.

Step 4 Click **Add** when finished.

To edit an existing note in an issue:

a) Click the **Notes** link inline with the issue.

The Notes for Issues Name pane displays.

b) Click the pencil icon at the right of the note that you want to edit.

c) Edit the note, and click **Done** when finished.

To delete a note from an issue:

a) Click the **Notes** link inline with the issue.

The Notes for Issues Name pane displays.

b) Click the red (X) icon at the right of the note.
c) Click **Yes** to confirm the deletion.

To add a note when closing an issue:

a) At the **Operations** > **Issues** page, check the box next to the issue you are closing.
b) Click the **Close Issue** button that appears above the event listings.
c) In the Confirm dialog box, insert your cursor in the Note field and type the note text.
d) To confirm that you want to close the issue and save the note, click **Yes**.

Searching Issues Using Predefined Filters

To search for open issues for a specific system or severity level:

Procedure

Step 1 Choose **OPERATIONS** > **Issues**.

To list only open issues, click **All Open Issues** (left pane).

Note
By default, IoT FND displays all issues that occurred within the specified data retention period (see Configure data retention, on page 138):

- To see Closed Issues associated with an event type or severity level, change **issueStatus:OPEN** to **issueStatus:CLOSED** in the Search Issues field, and then click **Issues Search**.
- To list all closed issues, in the left pane, click **All Closed Issues**.

Step 2 Click a device category, event type, or severity level to filter the list.

The filter syntax appears in the Search Issues field, and the search results display in the main pane.

Search Issues Using Custom Filters

To search by creating custom filters:

Procedure

Step 1 Choose **OPERATIONS** > **Issues**.

Step 2 Click **Show Filter**.

Step 3 From the Filter drop-down menus, choose the appropriate options.

For example, to filter Severity levels by Name (EID):

- In the left pane, select a Severity level (such as Major). The filter name populates the first field (top) of the Filter.

- From the second Filter drop-down menu on the left, choose **Name**.
- In the third Filter field, enter the EID of the device to discover issues about.
- Click the search icon (magnifying glass) to begin the search.

You can also enter the search string in the Search Issues field.

For example: issueSeverity:MAJOR issueStatus:OPEN name:IR807G-LTE-GA-K9+FCW21320020

Step 4 Click **Search Issues**.

The issues, if any, display in the Search Issues section (right pane).

Step 5 Click the **Events** link to display events associated with an issue.

The Events for Issue Name pane displays all events for that device.

Step 6 Click **Search Issues** or any link in the left pane to return to the Issues pane.

Closing an Issue

In most cases, when an event is resolved, the issue is closed automatically by the software. However, when the administrator has actively worked on resolving the issue, it might make sense to close the issue directly. When the issue is closed, IoT FND generates an event.

To close a resolved issue:

Procedure

Step 1 Choose **OPERATIONS** > **Issues**.

Step 2 Locate the issue by following the steps in either the Searching Issues Using Predefined Filters or Search Issues Using Custom Filters, on page 473 section.

Step 3 In the Search Issues section (right pane), check the check boxes of the issues to close.

Step 4 Click **Close Issue**.

Note
You can also add a note to the issue at this time.

Step 5 Click **Yes**.

Viewing Device Charts

This section explains about the router and mesh endpoint charts.

Router Charts

IoT FND provides these charts in the Device Info pane on the Device Details page for any router:

Table 125: Device Detail Charts

Chart	Description
Link Traffic	Shows the aggregated WPAN rate for a router over time. To view the chart for default or custom-defined time intervals, refer to Setting Time Filters To View Charts, on page 457.
Mesh Endpoint Count	Shows the number of MEs over time.
Cellular Link Metrics	Shows the metrics (transmit and receive speed), RSSI, Bandwidth Usage (current Billing Cycle) for all logical cellular GSM and CDMA interfaces.
Cellular Link Settings	Shows properties for cellular physical interfaces with dual and single modems.
Cellular Link Traffic	Shows the aggregated WPAN rate per protocol over time.
Cellular RSSI	Cellular RSSI.
WiMAX Link Traffic	Shows the receiving and sending rates of the WiMAX link traffic for the router over time.
WiMAX RSSI	Shows the receiving and sending rates of the WiMAX RSSI traffic for the router over time.
Ethernet Link Traffic	Shows the receiving and sending rates of the Ethernet traffic for the router over time.
Cellular Bandwidth Usage Over Time	Shows the bandwidth usage over time for the cellular interface.
Ethernet Bandwidth Usage Over Time	Shows the bandwidth usage over time for the Ethernet interface.

The Router Device Page provides information on the router device.

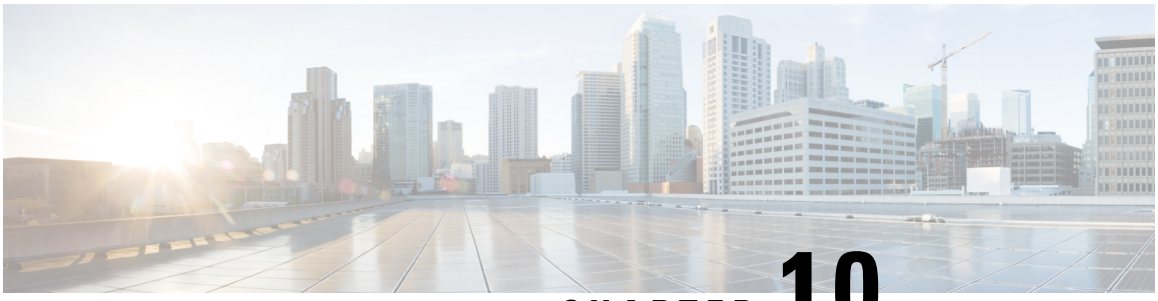
Mesh Endpoint Charts

IoT FND provides the device detail charts in the Device Info pane on the Device Details page for any mesh endpoint.

Table 126: Device Detail Charts

Chart	Description
Link Traffic	Shows the aggregated WPAN rate for an endpoint over time. To view the chart for default or custom-defined time intervals, refer to Setting Time Filters To View Charts, on page 457
Path Cost and Hops	Shows the RPL path cost value between the element and the root of the routing tree over time (see Configuring RPL Tree Polling).

Chart	Description
Link Cost	Shows the RPL cost value for the link between the element and its uplink neighbor over time.
RSSI	Shows the measured RSSI value of the primary mesh RF uplink (dBm) over time.



CHAPTER 10

OpenCSMP

CSMP is a device lifecycle management lightweight protocol optimized for resource constrained devices deployed within large-scale, bandwidth-constrained IoT networks. CSMP is therefore a popular choice for device management within Cisco Resilient Mesh (CR-Mesh) and Wi-SUN Field Area Networks, which are deployed at scale for critical infrastructure such as utility metering, utility distribution automation, and municipal street lighting. Cisco has made CSMP publicly available as OpenCSMP, an open-source project hosted on CiscoDevNet GitHub for community development.

Cisco IoT FND prefers CSMP stack as its communication protocol. OpenCSMP is therefore chosen as a preferred third-party device using CSMP as the communication protocol to implement and validate features for third-party devices.

Feature History

Table 127: Feature History

Release Information	Feature Name	Description
Cisco IoT FND Release 4.8.1	Registration	Register your third-party endpoint devices in Cisco IoT FND using OpenCSMP.
Cisco IoT FND Release 4.12.0	Refresh metrics and Configuration push	Refresh device metrics to retrieve the latest data and push updated configurations to devices.
Cisco IoT FND Release 5.0	Vendor TLV support and firmware upgrade (unicast)	Define custom Vendor TLVs for device-specific metadata, and perform unicast firmware upgrades to keep devices up-to-date. The Vendor TLV127 fetches vendor specific custom device metadata. The Unicast firmware upgrade feature updates and fetches device firmware information.
Cisco IoT FND Release 5.1	Delete existing third-party generic endpoints device type	You can delete the existing third-party generic endpoints device type from Cisco IoT FND.

Note

- Third-party endpoint support in Cisco IoT FND through OpenCSMP is supported only for Full Function Nodes (FFNs). Limited Function Nodes (LFNs) are not officially supported and validated.
- Multicast firmware upgrade feature is not supported and validated for third-party endpoints using OpenCMSP.

Register Third-Party Devices in Cisco IoT FND

This task helps you to register third-party devices in Cisco IoT FND.

For each device type to be added, multiple separate metadata files are available as templates under the endpoint-meta-templates directory. This directory is available when you install or upgrade to Cisco IoT FND 4.8.1 and later releases.

Procedure

Step 1 In the `opt/cgms/server/cgms/conf` directory, you can view the list of required templates to create an endpoint.

- defaultdeviceTypeTemplate.json.template
- defaultdeviceTypeTemplateNoIPRoute.json.template
- deviceTypeEventTypes.xml.template
- deviceTypeIssueTypes.xml.template
- deviceTypeMeta.json.xml.template
- deviceTypeMetricTypes.xml.template
- deviceTypePropertyTypes.xml.template

- deviceTypeSystemRules.xml.template

Step 2 Run the `addGenericEndpoints.sh` script in `opt/cgms/bin` directory. The system prompts for the device type name.

Step 3 Provide the device type name. The script creates the endpoint-meta directory under `opt/cgms/server/cgms/conf` directory, if not present already. If the name of the new device type is provided as endpointdevice1, then the sub directory is created under endpoint-meta directory:

opt/cgms/server/cgms/conf/endpoint-meta/endpointdevice1

The `addGenericEndpoints.sh` script copies all the template files from endpoint-meta-templates directory, renames them as per the device type name provided and moves it under new device type directory. The below example shows how the files will be renamed when the device type name is provided as endpointdevice1:

- defaultendpointdevice1Template.json
- defaultendpointdevice1TemplateNoIPRoute.json
- endpointdevice1EventTypes.xml
- endpointdevice1IssueTypes.xml
- endpointdevice1Meta.json.xml
- endpointdevice1MetricTypes.xml
- endpointdevice1PropertyTypes.xml
- endpointdevice1SystemRules.xml

Note
Addition of new template files or removal of existing set of template files is not allowed.

Step 4 Edit the `endpointdevice1Meta.json` file for registration of new device by providing values in the required fields.

Example:

```
{
“device_info”: {
“device_type”: “ ”,
“device_function”: “ “,
“device_description”: “ “,
“display_string”: “ “,
“pids”: [ ] ,
“vendorId”: “ “,
    “vendorName”: “ “,
“device_actions”: [
“reboot”,
“ping”,
“traceroute”,
“inventory”,
]

    “configure_vendortlv”: “”,
    “hw_info”: “ “
}
}
```

The description for each field is provided below.

Field	Description
device_type	Enter alphanumeric characters for the name of the device type to be registered (for example, endpointdevice1).
device_function	Mention any of the existing mesh functions. The list of device functions currently supported in IoT FND are meter, extender, gateway, cge, root, controller, sensor, networknode, gasmeter.
device_description	Provide a brief information about the device type.
display_string	Enter only the display name for the endpoint device as it is displayed in the left side tree in Field Devices page under Endpoint category. The display string is in the format of <device function>-<display string> (for example, METER-ENDPOINTDEVICE1). The device function is obtained from the function entered by you.
pids	Enter the device pids as comma separated values (for example, “spid1”, “spid2”).
vendorId	Enter the vendorId which is used in Vendor TLV 127
vendorName	Enter the vendor name which corresponds to the vendorId.
device_actions	The actions that can be performed on the Device Details page are Show on Map, Ping, Traceroute, Refresh Metrics, Reboot, Sync Config Membership.
configure_vendortlv	By default, it is set to false. Enter true for FND to support config push of vendor TLV 127.
hw_info	Enter the hardware info for the device type which is present in the firmware image header.

Step 5 Start Cisco IoT FND after adding or updating the metadata files. The Cisco IoT FND reads the endpoint-meta directory and creates the appropriate tables for each device type. If any issues occur during startup, it logs the errors in server.log and continues with the startup process.

Step 6 After you restart the Cisco IoT FND, import the CSV file to add devices. For more information on adding endpoints, seen Adding Routers, Head-End Routers, IC3000 Gateway, Endpoint and Extenders and IR500 in Bulk . On addition, the device gets listed under Endpoints Category in the Field Devices page.

You've registerd a third-party device in Cisco IoT FND.

What to do next

Register devices in cluster environment.

Register devices in a cluster environment

This task helps you to register third-party endpoint devices to Cisco IoT FND in a cluster environment.

Execute the `addGenericEndpoints.sh` script to register the third-party devices and create the endpoint-meta directory. You can edit the **devicetypeMeta.json** file in the endpoint-meta directory to add the device details and restart Cisco IoT FND.

Procedure

Step 1 Run the `addGenericEndpoints.sh` script and add the device types in various Cisco IoT FND instances.

Example:

```
[2025-10-03 10:14:22] INFO: Starting addGenericEndpoints.sh
[2025-10-03 10:14:22] INFO: Target FND: fnd.example.com
[2025-10-03 10:14:22] INFO: Input file: endpoints.csv
[2025-10-03 10:14:22] INFO: Timeout: 60s, Retries: 3, Dry-run: false

[2025-10-03 10:14:22] INFO: Validating CSV…
[2025-10-03 10:14:22] INFO: Found 3 rows:
  - EndpointId=GE-0001, Type=GENERIC, MAC=00:11:22:33:44:55, IP=10.10.1.11, Description="Test GE 1"
  - EndpointId=GE-0002, Type=GENERIC, MAC=AA:BB:CC:DD:EE:FF, IP=10.10.1.12, Description="Test GE 2"
  - EndpointId=GE-0003, Type=GENERIC, MAC=00:11:22:33:44:ZZ, IP=10.10.1.13, Description="Bad MAC"

[2025-10-03 10:14:22] INFO: Authenticating to FND…
[2025-10-03 10:14:23] INFO: Auth OK (token acquired).

[2025-10-03 10:14:23] INFO: Creating generic endpoints…
[2025-10-03 10:14:23] INFO: POST /api/vX/genericEndpoints GE-0001 … 201 Created.
[2025-10-03 10:14:23] WARN: POST /api/vX/genericEndpoints GE-0002 … 409 Conflict (already exists).
[2025-10-03 10:14:23] ERROR: POST /api/vX/genericEndpoints GE-0003 … 400 Bad Request (invalid MAC).

[2025-10-03 10:14:23] INFO: Assigning network: "Default" to created endpoints…
[2025-10-03 10:14:23] INFO: GE-0001: Network assignment OK.

[2025-10-03 10:14:23] INFO: Summary
  - Total processed: 3.
  - Created: 1.
  - Updated: 0.
  - Skipped (exists): 1.
  - Failed: 1.

[2025-10-03 10:14:23] INFO: Failures
  - GE-0003: Invalid MAC address format. Expected AA:BB:CC:DD:EE:FF.

[2025-10-03 10:14:23] INFO: Logs written to /var/tmp/addGenericEndpoints_2025-10-03_10-14-22.log
[2025-10-03 10:14:23] INFO: Done (exit status 1).

Dry-run example (no changes applied):

[2025-10-03 10:20:07] INFO: Starting addGenericEndpoints.sh (dry-run)
[2025-10-03 10:20:07] INFO: Would create: GE-0004, GE-0005.
[2025-10-03 10:20:07] INFO: Would assign network: "Default".
[2025-10-03 10:20:07] INFO: No changes applied (dry-run).
```

The devices are registered and endpoint-meta directory is created.

Step 2 Restart Cisco IoT FND instances.
Cisco IoT FND picks up the device types that are added in all the IoT FND instances.

You've registered third-party endpoint devices to Cisco IoT FND in a cluster environment.

What to do next

Add property types, metric types, and issue types

Add property, metric, and issue types

This task helps you to add proprty, metric, and issue types to a newly registered third-party device.

Procedure

Step 1 Create a new device type using the script, if not done already.

Step 2 Edit the json or xml files present in the new device type directory for newer metric, property, event, or issue types.

For example, if you want to include other metric types apart from the available list, you can edit the existing template and include other metric types. The same applies for property types, event types, issue types, and system rules as well.

Note
Restart IoT FND after editing the metadata files.

You've successfully added proprty, metric, and issue types to a newly registered third-party device

What to do next

Check examples of mesh property, mesh metric, event, issue types and system rules.

Mesh property types

Here's an example of mesh property types:

```
<?xml version="1.0" encoding="UTF-8" ?>
<cgms xmlns="http://www.w3schools.com"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xsi:schemaLocation="http://www.w3schools.com propertyTypes.xsd">
  <propertyTypes kind="cgmesh">
    <propertyType>
      <name>meshAddress</name>
      <displayName>Mesh Link IP Address</displayName>
     <description>The IP address of the mesh link. Assigned automatically by the NMS during
 registration</description>
    </propertyType>
    <propertyType>
      <name>meshLocalAddress</name>
      <displayName>Mesh Link Local Address</displayName>
      <description>The local WPAN address of the mesh link. Assigned automatically by the
NMS during registration</description>
    </propertyType>
    <propertyType>
      <name>meshPrefix</name>
      <displayName>Mesh Link Prefix</displayName>
      <description>The subnet prefix address</description>
    </propertyType>
    <propertyType>
```

```
      <name>meshPrefixLength</name>
      <displayName>Mesh Link Prefix Length</displayName>
      <description>The subnet prefix address length</description>
    </propertyType>
    <propertyType>
      <name>meshSsid</name>
      <displayName>SSID</displayName>
      <description>The mesh SSID</description>
    </propertyType>
    <propertyType>
      <name>meshPanid</name>
      <displayName>PANID</displayName>
      <description>The subnet PAN ID</description>
    </propertyType>
    <propertyType>
      <name>meshTxPower</name>
      <displayName>Transmit Power</displayName>
      <description>The mesh transmit power</description>
    </propertyType>
    <propertyType>
      <name>meshSecMode</name>
      <displayName>Security Mode</displayName>
      <description>Mesh Security mode: 0 indicates none, 1 indicates 802.1x with 802.11i
key management</description>
    </propertyType>
    <propertyType>
      <name>meterId</name>
      <displayName>Meter Id</displayName>
      <description>The Meter Id of comm module</description>
    </propertyType>
    <propertyType>
      <name>meterCert</name>
      <displayName>Meter Certificate</displayName>
      <description>The subject name of the meter certificate</description>
    </propertyType>
    <propertyType>
      <name>toneMapFwdModulation</name>
      <displayName>Mesh Tone Map Forward Modulation</displayName>
      <description>Mesh tone map forward modulation: 0 = 'Robo', 1 = 'DBPSK', 2 = 'DQPSK',
 3 = 'D8PSK'</description>
    </propertyType>
    <propertyType>
      <name>toneMapFwdMap</name>
      <displayName>Mesh Tone Map Forward Map</displayName>
      <description>Mesh tone map forward map bit vector, e.g.,
"0011000011100111"</description>
    </propertyType>
    <propertyType>
      <name>toneMapRevModulation</name>
      <displayName>Mesh Tone Map Reverse Modulation</displayName>
      <description>Mesh tone map reverse modulation: 0 = 'Robo', 1 = 'DBPSK', 2 = 'DQPSK',
 3 = 'D8PSK'</description>
    </propertyType>
    <propertyType>
      <name>toneMapRevMap</name>
      <displayName>Mesh Tone Map Reverse Map</displayName>
      <description>Mesh tone map reverse map bit vector, e.g.,
"0011000011100111"</description>
    </propertyType>
    <propertyType>
      <name>manufacturer</name>
      <displayName>Manufacturer of the Endpoints</displayName>
      <description>Manufacturer of the endpoint as reported through CSMP from the
mesh</description>
```

```
 </propertyType>
 <propertyType>
   <name>physicalDescr</name>
   <displayName>Physical Description</displayName>
   <description>Description of the hardware</description>
 </propertyType>
 <propertyType>
<name>bbuPresent</name>
   <displayName>BBU Present</displayName>
   <description>Battery Backup is present.</description>
 </propertyType>
 <propertyType>
   <name>bbuReady</name>
   <displayName>BBU Ready</displayName>
   <description>Battery Backup Unit is ready.</description>
 </propertyType>
 <propertyType>
   <name>powerSource</name>
   <displayName>Power Source</displayName>
   <description>The current power source of the device.</description>
 </propertyType>
 <propertyType>
   <name>batteryState</name>
   <displayName>Battery State</displayName>
   <description>The current battery state of the device.</description>
 </propertyType>
 <propertyType>
   <name>lastRegReason</name>
   <displayName>Last Registration Reason</displayName>
   <description>Reason for the most recent device registration</description>
   <propertyValueMap text="unknown" value="0"/>
   <propertyValueMap text="Cold boot" value="1"/>
   <propertyValueMap text="Manual re-registration" value="2"/>
   <propertyValueMap text="Rejoined with new IP" value="3"/>
   <propertyValueMap text="NMS address changed" value="4"/>
   <propertyValueMap text="Redirected NMS address" value="5"/>
   <propertyValueMap text="NMS error" value="6"/>
   <propertyValueMap text="Certificate changed" value="7"/>
   <propertyValueMap text="Power restoration" value="8"/>
   <propertyValueMap text="Parent node changed" value="9"/>
   <propertyValueMap text="Firmware updated" value="10"/>
 </propertyType>
 <propertyType>
   <name>previousMeshPanid</name>
   <displayName>Previous PANID</displayName>
   <description>The previous subnet PAN ID</description>
 </propertyType>
 <propertyType>
   <name>useCoap6</name>
   <displayName>Use CoAP Version 6</displayName>
   <description>Device is using CoAP version 6 for management messages</description>
 </propertyType>
 <propertyType>
   <name>meshProtocol</name>
   <displayName>Mesh Protocol</displayName>
   <description>Display the Mesh Protocol</description>
       <propertyValueMap text="Pre Wi-SUN" value="0"/>
       <propertyValueMap text="Wi-SUN 1.0" value="1"/>
 </propertyType>
 <propertyType>
   <name>sdkVersion</name>
   <displayName>SDK Version</displayName>
   <description>SDK version of the device</description>
 </propertyType>
```

```
    <propertyType>
      <name>patchCapability</name>
      <displayName>Patch Capability</displayName>
      <description>Patch Capability including patch support, version, window size and
lookahead size</description>
    </propertyType>
    <propertyType>
      <name>patchChopSize</name>
      <displayName>Patch Chop Size</displayName>
      <description>Maximum Chop Size nodes can support</description>
    </propertyType>
    <propertyType>
      <name>patchVolumeSize</name>
      <displayName>Patch Volume Size</displayName>
      <description>Patch Volume size</description>
    </propertyType>
    <propertyType>
      <name>certAutoRenewSettings</name>
      <displayName>Certificate Auto Renew Settings</displayName>
      <description>Display the Certificate Renew Settings</description>
    </propertyType>
    <propertyType>
      <name>aclInterfaceNameLp</name>
      <displayName>Interface Name</displayName>
      <description>Interface Name for Low Pan Interface</description>
    </propertyType>
    <propertyType>
      <name>aclDroppedCounterLp</name>
      <displayName>Dropped Counter</displayName>
      <description>Dropped Counter for Low Pan Interface</description>
    </propertyType>
    <propertyType>
      <name>aclDroppedSrcIpLp</name>
      <displayName>Dropped Source IP</displayName>
      <description>Dropped Source IP for Low Pan Interface</description>
    </propertyType>
    <propertyType>
      <name>aclDroppedDstIpLp</name>
      <displayName>Dropped Destination IP</displayName>
      <description>Dropped Destination IP for Low Pan Interface</description>
    </propertyType>
    <propertyType>
      <name>aclProtocolLp</name>
      <displayName>Protocol</displayName>
      <description>Protocol for Low Pan Interface</description>
    </propertyType>
    <propertyType>
      <name>aclDirectionLp</name>
      <displayName>Direction</displayName>
      <description>Direction for Low Pan Interface</description>
    </propertyType>
    <propertyType>
      <name>aclSrcPortLp</name>
      <displayName>Source Port</displayName>
      <description>Source Port for Low Pan Interface</description>
    </propertyType>
    <propertyType>
      <name>aclDstPortLp</name>
      <displayName>Destination Port</displayName>
      <description>Destination Port for Low Pan Interface</description>
    </propertyType>
    <propertyType>
      <name>aclMaxRateLimit</name>
      <displayName>ACL Max Rate Limit (kb/s)</displayName>
```

```
      <description>ACL Max Rate Limit used for Rate Limit validation</description>
    </propertyType>
  </propertyTypes>
</cgms>
```

Mesh metrics

Here's an example of mesh metrics:

```
<?xml version="1.0" encoding="UTF-8" ?>
<cgms xmlns="http://www.w3.org"
      xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <metricTypes kind="cgmesh">
    <metricType>
      <name>uptime</name>
      <valueType>gauge</valueType>
      <displayName>Uptime</displayName>
      <unit>sec</unit>
      <description>The amount of time in seconds that the element has been running since
last boot</description>
      <lowerBound>0</lowerBound>
      <upperBound>31536000</upperBound>
      <displayFormat>secondsToTime</displayFormat>
    </metricType>
    <metricType>
      <name>meshTxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Link Transmit Speed</displayName>
      <unit>bits/sec</unit>
     <description>The current speed of data transmission over the uplink network interface,
 measured in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
      <name>meshTxDrops</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Link Transmit Packet Drops</displayName>
      <unit>drops/sec</unit>
      <description>The rate of packets that were dropped while trying to transmit on the
uplink interface because the outbound queue was full</description>
      <lowerBound>0</lowerBound>
      <upperBound>1</upperBound>
      <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
      <name>meshRxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Link Receive Speed</displayName>
      <unit>bits/sec</unit>
     <description>The rate of data that has been received by the uplink network interface,
 measured in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
      <name>meshRxReassemblyDrops</name>
```

```
      <valueType>gauge</valueType>
      <displayName>Mesh Link Receive Packet Reassembly Drops</displayName>
      <unit>drops/sec</unit>
      <description>The rate of incoming packet fragments that were dropped because there
was no space in the reassembly buffer</description>
      <lowerBound>0</lowerBound>
      <upperBound>1</upperBound>
    </metricType>
    <metricType>
      <name>meshHops</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Route RPL Hops</displayName>
      <unit>hops</unit>
      <description>The number of hops that the element is from the root of its RPL routing
 tree</description>
      <lowerBound>1</lowerBound>
      <upperBound>8</upperBound>
      <displayFormat>###</displayFormat>
    </metricType>
    <metricType>
      <name>meshLinkCost</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Route RPL Link Cost</displayName>
      <unit></unit>
      <description>The RPL cost value for the link between the element and its uplink
neighbor</description>
      <lowerBound>1</lowerBound>
      <upperBound>3</upperBound>
      <invalidValue>65535</invalidValue>
      <displayFormat>###.##</displayFormat>
    </metricType>
    <metricType>
      <name>meshAbsolutePhase</name>
      <valueType>gauge</valueType>
      <displayName>Mesh absolute phase of power</displayName>
      <unit></unit>
      <description>Relative position of current and voltage waveforms for a PLC
Node</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <name>meshPathCost</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Route RPL Path Cost</displayName>
      <unit></unit>
      <description>The RPL path cost value between the element and the root of the routing
 tree</description>
      <lowerBound>1</lowerBound>
      <upperBound>24</upperBound>
      <invalidValue>65535</invalidValue>
      <displayFormat>###.##</displayFormat>
    </metricType>
    <metricType>
      <name>meshRssi</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Route RSSI</displayName>
      <unit>dBm</unit>
      <description>The measured RSSI value of the primary mesh RF uplink</description>
      <lowerBound>-80</lowerBound>
      <upperBound>20</upperBound>
      <invalidValue>-128</invalidValue>
    </metricType>
    <metricType>
```

```
  <name>meshReverseRssi</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Route Reverse RSSI</displayName>
  <unit>dBm</unit>
 <description>The RSSI value measured by the element's mesh uplink neighbor</description>

  <lowerBound>-80</lowerBound>
  <upperBound>20</upperBound>
  <invalidValue>-128</invalidValue>
</metricType>
<metricType>
  <name>toneMapFwdTxResRaw</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Forward Tx Res Raw</displayName>
  <unit></unit>
  <description>The txres field integer value in tone map forward message</description>
  <lowerBound>-1000</lowerBound>
  <upperBound>1000</upperBound>
</metricType>
<metricType>
  <name>toneMapFwdTxGainRaw</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Forward Tx Gain Raw</displayName>
  <unit></unit>
  <description>The txres gain integer value in tone map forward message</description>
  <lowerBound>-1000</lowerBound>
  <upperBound>1000</upperBound>
</metricType>
<metricType>
  <name>toneMapFwdTxGain</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Forward Tx Gain</displayName>
  <unit></unit>
  <description>Equals to txResRaw * txResGain</description>
  <lowerBound>-1000000</lowerBound>
  <upperBound>1000000</upperBound>
</metricType>
<metricType>
  <name>toneMapFwdToneQuality</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Forward Tone Quality</displayName>
  <unit></unit>
  <description>The number of bits set in the tone map forward vector</description>
  <lowerBound>0</lowerBound>
  <upperBound>24</upperBound>
</metricType>
<metricType>
  <name>toneMapRevTxResRaw</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Reverse Tx Res Raw</displayName>
  <unit></unit>
  <description>The txres field integer value in tone map reverse message</description>
  <lowerBound>-1000</lowerBound>
  <upperBound>1000</upperBound>
</metricType>
<metricType>
  <name>toneMapRevTxGainRaw</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Reverse Tx Gain Raw</displayName>
  <unit></unit>
  <description>The txres gain integer value in tone map reverse message</description>
  <lowerBound>-1000</lowerBound>
  <upperBound>1000</upperBound>
</metricType>
```

```
    <metricType>
      <name>toneMapRevTxGain</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Tone Map Reverse Tx Gain</displayName>
      <unit></unit>
      <description>Equals to txResRaw * txResGain</description>
      <lowerBound>-1000000</lowerBound>
      <upperBound>1000000</upperBound>
    </metricType>
    <metricType>
      <name>toneMapRevToneQuality</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Tone Map Reverse Tone Quality</displayName>
      <unit></unit>
      <description>The number of bits set in the tone map reverse vector</description>
      <lowerBound>0</lowerBound>
      <upperBound>24</upperBound>
    </metricType>
    <metricType>
      <name>meshRank</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Route RPL Rank</displayName>
      <unit></unit>
      <description>Rank is a representation of the location of the node within the RPL
tree</description>
      <lowerBound>0</lowerBound>
      <upperBound>100</upperBound>
    </metricType>
    <metricType>
      <name>meshActiveLinkType</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Active Link Type</displayName>
      <unit></unit>
      <description>Most recent device link type.
      Metric is populated only when RPL info is pulled from the associated router.
      </description>
      <lowerBound>0</lowerBound>
      <upperBound>4</upperBound>
      <displayFormat>valueToEnum</displayFormat>
    </metricType>
    <metricType>
      <name>meshRfPhyRxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Receive Speed (RF)</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been received by the network interface over
RF, measured in bits per second, averaged over a short element-specific time period (e.g.
an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
      <name>meshRfPhyTxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Transmit Speed (RF)</displayName>
      <unit>bits/sec</unit>
     <description>The rate of data that has been transmitted by the network interface over
 RF, measured in bits per second, averaged over a short element-specific time period (e.g.
 an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###</displayFormat>
</metricType>
```

```
    <metricType>
      <name>meshPlcPhyRxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Receive Speed (PLC)</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been received by the network interface over
PLC, measured in bits per second, averaged over a short element-specific time period (e.g.
 an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
      <name>meshPlcPhyTxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Transmit Speed (PLC)</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been transmitted by the network interface over
 PLC, measured in bits per second, averaged over a short element-specific time period (e.g.
 an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
      <name>meshPlcRoboLinkUsage</name>
      <valueType>gauge</valueType>
      <displayName>Modulation Robo link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Robo</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshPlcBpskLinkUsage</name>
      <valueType>gauge</valueType>
      <displayName>Modulation Bpsk link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Bpsk</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshPlcQpskLinkUsage</name>
      <valueType>gauge</valueType>
      <displayName>Modulation Qpsk link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Qpsk</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshPlcPsk8LinkUsage</name>
      <valueType>gauge</valueType>
      <displayName>Modulation 8PSK link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation 8PSK</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshPlcOpskLinkUsage</name>
      <valueType>gauge</valueType>
      <displayName>Modulation Opsk link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Opsk</description>
      <lowerBound>0</lowerBound>
    </metricType>
```

```
    <metricType>
      <name>meshRfFsk2C150WFecLU</name>
      <valueType>gauge</valueType>
      <displayName>Modulation Classic 2FSK 150 with FEC link usage</displayName>
      <unit></unit>
     <description>Cumulative link usage of modulation Classic 2FSK 150 with FEC</description>

      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshRfFsk2C150WtFecLU</name>
      <valueType>gauge</valueType>
      <displayName>Modulation Classic 2FSK 150 without FEC link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Classic 2FSK 150 without
FEC</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshRfFsk2Dr50WtFecLU</name>
      <valueType>gauge</valueType>
      <displayName>Modulation 2FSK 50 without FEC link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation 2FSK 50 without FEC</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshRfFsk2Dr150WtFecLU</name>
      <valueType>gauge</valueType>
      <displayName>Modulation 2FSK 150 without FEC link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation 2FSK 150 without FEC</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshRfFsk2Dr150WFecLU</name>
      <valueType>gauge</valueType>
      <displayName>Modulation 2FSK 150 with FEC link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation 2FSK 150 with FEC</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <name>meshLowpanTxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Link Transmit Speed for Lowpan</displayName>
      <unit>bits/sec</unit>
     <description>The current speed of data transmission over the uplink network interface,
 measured in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###.##</displayFormat>
    </metricType>
    <metricType>
      <name>meshLowpanTxDrops</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Link Transmit Packet Drops for Lowpan</displayName>
      <unit>drops/sec</unit>
      <description>The rate of packets that were dropped while trying to transmit on the
uplink interface because the outbound queue was full</description>
      <lowerBound>0</lowerBound>
      <upperBound>1</upperBound>
      <displayFormat>###,###.##</displayFormat>
```

```
    </metricType>
    <metricType>
      <name>meshLowpanRxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Link Receive Speed for Lowpan</displayName>
      <unit>bits/sec</unit>
     <description>The rate of data that has been received by the uplink network interface,
 measured in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###.##</displayFormat>
    </metricType>
    <metricType>
      <name>meshLowpanPhyTxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Physical Mesh Link Transmit Speed</displayName>
      <unit>bits/sec</unit>
     <description>The current speed of data transmission over the physical layer, measured
 in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###.##</displayFormat>
    </metricType>
    <metricType>
      <name>meshLowpanPhyRxSpeed</name>
      <valueType>gauge</valueType>
      <displayName>Physical Mesh Link Receive Speed</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been received by the phyical layer, measured
in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
      <displayFormat>###,###.##</displayFormat>
    </metricType>
    <metricType>
      <deviceType>loopback</deviceType>
      <name>txSpeed</name>
      <valueType>counter</valueType>
      <displayName>Transmit Speed</displayName>
      <unit>bits/sec</unit>
      <description>The current speed of data transmission over the interface, measured in
bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>loopback</deviceType>
      <name>txDrops</name>
      <valueType>counter</valueType>
      <displayName>Transmit Packet Drops</displayName>
      <unit>drops/sec</unit>
      <description>The rate of packets that were dropped while trying to transmit on the
interface because the outbound queue was full</description>
      <lowerBound>0</lowerBound>
      <upperBound>1</upperBound>
    </metricType>
    <metricType>
      <deviceType>loopback</deviceType>
      <name>rxSpeed</name>
      <valueType>counter</valueType>
```

```
      <displayName>Receive Speed</displayName>
      <unit>bits/sec</unit>
     <description>The rate of data that has been received by the network interface, measured
 in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>loopback</deviceType>
      <name>txUnicastPackets</name>
      <valueType>counter</valueType>
      <displayName>Transmit Unicast Packets</displayName>
      <unit>packets/sec</unit>
     <description>The current packet send rate over the interface, measured in packets per
 second, averaged over a short element-specific time period (e.g. an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>loopback</deviceType>
      <name>rxUnicastPackets</name>
      <valueType>counter</valueType>
      <displayName>Receive Unicast Packets</displayName>
      <unit>packets/sec</unit>
      <description>The current packet receive rate over the interface, measured in packets
 per second, averaged over a short element-specific time period (e.g. an hour)</description>

      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>txSpeed</name>
      <valueType>counter</valueType>
      <displayName>Transmit Speed</displayName>
      <unit>bits/sec</unit>
      <description>The current speed of data transmission over the interface, measured in
bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
        <name>queueJumpRate</name>
        <valueType>counter</valueType>
        <displayName>Rate of queue jump</displayName>
        <unit>packets/sec</unit>
       <description>The rate at which the packets were dropped from the queue due to higher
 priority network traffic</description>
        <lowerBound>0</lowerBound>
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
        <deviceType>wpan</deviceType>
        <name>queueEvictionRate</name>
        <valueType>counter</valueType>
        <displayName>Rate of queue evictions</displayName>
        <unit>packets/sec</unit>
        <description>The rate at which the packets were enqueued due to lower priority
network traffic</description>
        <lowerBound>0</lowerBound>
```

```
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>txDrops</name>
      <valueType>counter</valueType>
      <displayName>Transmit Packet Drops</displayName>
      <unit>drops/sec</unit>
      <description>The rate of packets that were dropped while trying to transmit on the
interface because the outbound queue was full</description>
      <lowerBound>0</lowerBound>
      <upperBound>1</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rxSpeed</name>
      <valueType>counter</valueType>
      <displayName>Receive Speed</displayName>
      <unit>bits/sec</unit>
     <description>The rate of data that has been received by the network interface, measured
 in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>txUnicastPackets</name>
      <valueType>counter</valueType>
      <displayName>Transmit Unicast Packets</displayName>
      <unit>packets/sec</unit>
      <description>The current packet send rate over the interface, measured in packets per
 second, averaged over a short element-specific time period (e.g. an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rxUnicastPackets</name>
      <valueType>counter</valueType>
      <displayName>Receive Unicast Packets</displayName>
      <unit>packets/sec</unit>
      <description>The current packet receive rate over the interface, measured in packets
 per second, averaged over a short element-specific time period (e.g. an hour)</description>

      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rfPhyRxSpeed</name>
      <valueType>counter</valueType>
      <displayName>Receive Speed on RF link</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been received by the network interface over
RF, measured in bits per second, averaged over a short element-specific time period (e.g.
an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rfPhyTxSpeed</name>
```

```
      <valueType>counter</valueType>
      <displayName>Transmit Speed on RF link</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been transmitted by the network interface over
 RF, measured in bits per second, averaged over a short element-specific time period (e.g.
 an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
</metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>plcPhyRxSpeed</name>
      <valueType>counter</valueType>
      <displayName>Receive Speed on PLC link</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been received by the network interface over
PLC, measured in bits per second, averaged over a short element-specific time period (e.g.
 an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>plcPhyTxSpeed</name>
      <valueType>counter</valueType>
      <displayName>Transmit Speed on PLC link</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been transmitted by the network interface over
 PLC, measured in bits per second, averaged over a short element-specific time period (e.g.
 an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
</metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rfFsk150LinkUsage</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation Fsk150 link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation fsk150</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>plcRoboLinkUsage</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation Robo link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Robo</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>plcBpskLinkUsage</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation Bpsk link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Bpsk</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>plcQpskLinkUsage</name>
      <valueType>cumulative</valueType>
```

```
      <displayName>Modulation Qpsk link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Qpsk</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>plcOpskLinkUsage</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation Opsk link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Opsk</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rfFsk2C150WFecLU</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation Classic 2FSK 150 with FEC link usage</displayName>
      <unit></unit>
     <description>Cumulative link usage of modulation Classic 2FSK 150 with FEC</description>

      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rfFsk2C150WtFecLU</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation Classic 2FSK 150 without FEC link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation Classic 2FSK 150 without
FEC</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rfFsk2Dr50WtFecLU</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation 2FSK 50 without FEC link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation 2FSK 50 without FEC</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rfFsk2Dr150WtFecLU</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation 2FSK 150 without FEC link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation 2FSK 150 without FEC</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>rfFsk2Dr150WFecLU</name>
      <valueType>cumulative</valueType>
      <displayName>Modulation 2FSK 150 with FEC link usage</displayName>
      <unit></unit>
      <description>Cumulative link usage of modulation 2FSK 150 with FEC</description>
      <lowerBound>0</lowerBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>phyTxSpeed</name>
```

```
      <valueType>counter</valueType>
      <displayName>Transmit Speed on PHY layer(PLC and RF combined)</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been transmitted by the network interface over
 physical layer, measured in bits per second, averaged over a short element-specific time
period (e.g. an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>wpan</deviceType>
      <name>phyRxSpeed</name>
      <valueType>counter</valueType>
      <displayName>Receive Speed on PHY layer(PLC and RF combined)</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been received by the network interface over
physical layer, measured in bits per second, averaged over a short element-specific time
period (e.g. an hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>ppp</deviceType>
      <name>txSpeed</name>
      <valueType>counter</valueType>
      <displayName>Transmit Speed</displayName>
      <unit>bits/sec</unit>
      <description>The current speed of data transmission over the interface, measured in
bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>ppp</deviceType>
      <name>txDrops</name>
      <valueType>counter</valueType>
      <displayName>Transmit Packet Drops</displayName>
      <unit>drops/sec</unit>
      <description>The rate of packets that were dropped while trying to transmit on the
interface because the outbound queue was full</description>
      <lowerBound>0</lowerBound>
      <upperBound>1</upperBound>
    </metricType>
    <metricType>
      <deviceType>ppp</deviceType>
      <name>rxSpeed</name>
      <valueType>counter</valueType>
      <displayName>Receive Speed</displayName>
      <unit>bits/sec</unit>
      <description>The rate of data that has been received by the network interface, measured
 in bits per second, averaged over a short element-specific time period (e.g. an
hour)</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>ppp</deviceType>
      <name>txUnicastPackets</name>
      <valueType>counter</valueType>
      <displayName>Transmit Unicast Packets</displayName>
      <unit>packets/sec</unit>
      <description>The current packet send rate over the interface, measured in packets per
 second, averaged over a short element-specific time period (e.g. an hour)</description>
```

```
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>ppp</deviceType>
      <name>rxUnicastPackets</name>
      <valueType>counter</valueType>
      <displayName>Receive Unicast Packets</displayName>
      <unit>packets/sec</unit>
      <description>The current packet receive rate over the interface, measured in packets
 per second, averaged over a short element-specific time period (e.g. an hour)</description>

      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>RPL</deviceType>
      <name>hops</name>
      <valueType>gauge</valueType>
      <displayName>Hops</displayName>
      <unit>hops</unit>
      <description>The number of hops that the element is from the root of its RPL routing
 tree</description>
      <lowerBound>1</lowerBound>
      <upperBound>8</upperBound>
      <displayFormat>###</displayFormat>
    </metricType>
    <metricType>
      <deviceType>RPL</deviceType>
      <name>linkCost</name>
      <valueType>gauge</valueType>
      <displayName>Link Cost</displayName>
      <unit></unit>
      <description>The RPL cost value for the link between the element and its uplink
neighbor</description>
      <lowerBound>1</lowerBound>
      <upperBound>3</upperBound>
      <invalidValue>65535</invalidValue>
      <displayFormat>###</displayFormat>
    </metricType>
    <metricType>
      <deviceType>RPL</deviceType>
      <name>pathCost</name>
      <valueType>gauge</valueType>
      <displayName>Path Cost</displayName>
      <unit></unit>
      <description>The RPL path cost value between the element and the root of the routing
 tree</description>
      <lowerBound>1</lowerBound>
      <upperBound>24</upperBound>
      <invalidValue>65535</invalidValue>
    </metricType>
    <metricType>
      <deviceType>RPL</deviceType>
      <name>rssi</name>
      <valueType>gauge</valueType>
      <displayName>RSSI</displayName>
      <unit>dBm</unit>
      <description>The measured RSSI value of the primary mesh RF uplink</description>
      <lowerBound>-80</lowerBound>
      <upperBound>20</upperBound>
      <invalidValue>-128</invalidValue>
    </metricType>
    <metricType>
```

```
  <deviceType>RPL</deviceType>
  <name>reverseRssi</name>
  <valueType>gauge</valueType>
  <displayName>Reverse RSSI</displayName>
  <unit>dBm</unit>
 <description>The RSSI value measured by the element's mesh uplink neighbor</description>

  <lowerBound>-80</lowerBound>
  <upperBound>20</upperBound>
  <invalidValue>-128</invalidValue>
</metricType>
<metricType>
  <deviceType>RPL</deviceType>
  <name>tmFwdTxResRaw</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Forward Tx Res Raw</displayName>
  <unit></unit>
  <description>The txres field integer value in tone map forward message</description>
  <lowerBound>-1000</lowerBound>
  <upperBound>1000</upperBound>
</metricType>
<metricType>
  <deviceType>RPL</deviceType>
  <name>tmFwdTxGainRaw</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Forward Tx Gain Raw</displayName>
  <unit></unit>
  <description>The txres gain integer value in tone map forward message</description>
  <lowerBound>-1000</lowerBound>
  <upperBound>1000</upperBound>
</metricType>
<metricType>
  <deviceType>RPL</deviceType>
  <name>tmFwdTxGain</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Forward Tx Gain</displayName>
  <unit></unit>
  <description>Equals to txResRaw * txResGain</description>
  <lowerBound>-1000000</lowerBound>
  <upperBound>1000000</upperBound>
</metricType>
<metricType>
  <deviceType>RPL</deviceType>
  <name>tmFwdToneQuality</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Forward Tone Quality</displayName>
  <unit></unit>
  <description>The number of bits set in the tone map vector</description>
  <lowerBound>0</lowerBound>
  <upperBound>24</upperBound>
</metricType>
<metricType>
  <deviceType>RPL</deviceType>
  <name>tmRevTxResRaw</name>
  <valueType>gauge</valueType>
  <displayName>Mesh Tone Map Reverse Tx Res Raw</displayName>
  <unit></unit>
  <description>The txres field integer value in tone map reverse message</description>
  <lowerBound>-1000</lowerBound>
  <upperBound>1000</upperBound>
</metricType>
<metricType>
  <deviceType>RPL</deviceType>
  <name>tmRevTxGainRaw</name>
```

```
      <valueType>gauge</valueType>
      <displayName>Mesh Tone Map Reverse Tx Gain Raw</displayName>
      <unit></unit>
      <description>The txres gain integer value in tone map reverse message</description>
      <lowerBound>-1000</lowerBound>
      <upperBound>1000</upperBound>
    </metricType>
    <metricType>
      <deviceType>RPL</deviceType>
      <name>tmRevTxGain</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Tone Map Reverse Tx Gain</displayName>
      <unit></unit>
      <description>Equals to txResRaw * txResGain</description>
      <lowerBound>-1000000</lowerBound>
      <upperBound>1000000</upperBound>
    </metricType>
    <metricType>
      <deviceType>RPL</deviceType>
      <name>tmRevToneQuality</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Tone Map Reverse Tone Quality</displayName>
      <unit></unit>
      <description>The number of bits set in the tone map reverse vector</description>
      <lowerBound>0</lowerBound>
      <upperBound>24</upperBound>
    </metricType>
    <metricType>
      <deviceType>RPL</deviceType>
      <name>absolutePhase</name>
      <valueType>gauge</valueType>
      <displayName>Mesh absolute phase of power</displayName>
      <unit></unit>
      <description>Relative position of current and voltage waveforms for a PLC
Node</description>
      <lowerBound>0</lowerBound>
      <upperBound>76800</upperBound>
    </metricType>
    <metricType>
      <deviceType>RPL</deviceType>
      <name>rank</name>
      <valueType>gauge</valueType>
      <displayName>Mesh Route RPL Rank</displayName>
      <unit></unit>
      <description>Rank is a representation of the location of the node within the RPL
tree</description>
      <lowerBound>0</lowerBound>
      <upperBound>100</upperBound>
    </metricType>
    <metricType>
      <name>nodeLocalTime</name>
      <valueType>gauge</valueType>
      <displayName>NodeTime</displayName>
      <unit>sec</unit>
      <description>UTC time as reported by the device</description>
      <lowerBound>0</lowerBound>
      <upperBound>4294967296</upperBound>
    </metricType>
    <metricType>
      <name>batteryLevel</name>
      <valueType>gauge</valueType>
      <displayName>Battery Level</displayName>
      <unit>percent</unit>
      <description>The percentage of charge remaining in battery</description>
```

```
      <lowerBound>0</lowerBound>
      <upperBound>101</upperBound>
    </metricType>
    <metricType>
      <name>batteryRuntime</name>
      <valueType>gauge</valueType>
      <displayName>Battery Remaining Time</displayName>
      <unit>minutes</unit>
      <description>The runtime remaining on battery</description>
      <lowerBound>0</lowerBound>
      <upperBound>65535</upperBound>
    </metricType>
    <metricType>
      <name>batteryChargeTime</name>
      <valueType>gauge</valueType>
      <displayName>Battery Charging Time</displayName>
      <unit>minutes</unit>
      <description>The time required to charge battery</description>
      <lowerBound>0</lowerBound>
      <upperBound>65535</upperBound>
    </metricType>
    <metricType>
        <name>totalQueueJumpCnt</name>
        <valueType>gauge</valueType>
        <displayName>Mesh Link Queue Jump Count</displayName>
        <unit>packets</unit>
       <description>Total count of jump packets or number of dequeue packets</description>

        <lowerBound>0</lowerBound>
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
        <name>totalQueueEvictionCnt</name>
        <valueType>gauge</valueType>
        <displayName>Mesh Link Queue Eviction Count</displayName>
        <unit>packets</unit>
        <description>Total count of eviction packets or number of enqueue
packets</description>
        <lowerBound>0</lowerBound>
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
        <name>meshQueueJumpRate</name>
        <valueType>gauge</valueType>
        <displayName>Mesh Link Queue Jump Rate</displayName>
        <unit>packets/sec</unit>
        <description>Rate at which the packets were dropped from the queue due to higher
priority network traffic</description>
        <lowerBound>0</lowerBound>
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
        <name>meshQueueEvictionRate</name>
        <valueType>gauge</valueType>
        <displayName>Mesh Link Queue Eviction Rate</displayName>
        <unit>packets/sec</unit>
        <description>Rate at which the packets were enqueued due to lower priority network
 traffic</description>
        <lowerBound>0</lowerBound>
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
```

```
    </metricType>
    <metricType>
        <name>interPanMigration</name>
        <valueType>gauge</valueType>
        <displayName>Inter Pan Migrations</displayName>
        <unit>count</unit>
        <description>Count of inter pan migrations</description>
        <lowerBound>0</lowerBound>
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
        <name>intraPanMigration</name>
        <valueType>gauge</valueType>
        <displayName>Intra Pan Migrations</displayName>
        <unit>count</unit>
        <description>Count of intra pan migrations</description>
        <lowerBound>0</lowerBound>
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
    </metricType>
    <metricType>
        <name>missedPeriodicInventory</name>
        <valueType>gauge</valueType>
        <displayName>Missed Periodic Inventory Collections</displayName>
        <unit>count</unit>
        <description>Count of Missed Periodic Inventory Collections</description>
        <lowerBound>0</lowerBound>
        <upperBound>1000000000</upperBound>
        <displayFormat>###,###</displayFormat>
    </metricType>
  </metricTypes>
</cgms>
```

Event types

Here's an example of event types:

```
<?xml version="1.0" encoding="UTF-8" ?>
<event xmlns="http://www.w3schools.com" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.w3schools.com cmEvent.xsd">
<eventTypes kind="cgmesh">
<eventType>
<eventTypeName>UNKNOWN</eventTypeName>
<eventCategory>unknown</eventCategory>
<eventSearchName>unknown</eventSearchName>
<eventTypeDisplayString>Unknown Event</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Unknown event.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>restoration</eventTypeName>
<eventCategory>restoration</eventCategory>
<eventSearchName>restoration</eventSearchName>
<eventTypeDisplayString>Restoration</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Device restored from outage.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>up</eventTypeName>
<eventCategory>up</eventCategory>
```

```
<eventSearchName>up</eventSearchName>
<eventTypeDisplayString>Up</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Device is up.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>down</eventTypeName>
<eventCategory>down</eventCategory>
<eventSearchName>down</eventSearchName>
<eventTypeDisplayString>Down</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>Device is down.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>outage</eventTypeName>
<eventCategory>outage</eventCategory>
<eventSearchName>outage</eventSearchName>
<eventTypeDisplayString>Outage</eventTypeDisplayString>
<eventSeverity>CRITICAL</eventSeverity>
<eventTypeDefaultMessage>Outage detected on device.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>UserEventType</eventTypeName>
<eventCategory>rule</eventCategory>
<eventSearchName>ruleEvent</eventSearchName>
<eventTypeDisplayString>Rule Event</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Event generated by rule.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>timeMismatch</eventTypeName>
<eventCategory>timeMismatch</eventCategory>
<eventSearchName>timeMismatch</eventSearchName>
<eventTypeDisplayString>Time Mismatch</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>NMS server time mismatches with the device local
time.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>timeMismatchResolved</eventTypeName>
<eventCategory>timeMismatchResolved</eventCategory>
<eventSearchName>timeMismatchResolved</eventSearchName>
<eventTypeDisplayString>Time Mismatch Resolved</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>NMS server time matches with the device local
time.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>manualCloseEvent</eventTypeName>
<eventCategory>Operation</eventCategory>
<eventSearchName>manualCloseEvent</eventSearchName>
<eventTypeDisplayString>Manual Close(Issue)</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Admin changed issue state to closed.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>unknownRegReason</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>unknownRegReason</eventSearchName>
<eventTypeDisplayString>Unknown Registration Reason</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered for unknown reason.</eventTypeDefaultMessage>
</eventType>
<eventType>
```

```
<eventTypeName>coldBoot</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>coldBoot</eventSearchName>
<eventTypeDisplayString>Cold Boot</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered due to cold boot.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>manualReRegistration</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>manualReRegistration</eventSearchName>
<eventTypeDisplayString>Manual Re-Registration</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered due to manual
registration.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>rejoinedWithNewIP</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>rejoinedWithNewIP</eventSearchName>
<eventTypeDisplayString>Rejoined with New IP Address</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered with new IP address.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>nmsAddrChange</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>nmsAddrChange</eventSearchName>
<eventTypeDisplayString>NMS Address Change</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered due to NMS address
change.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>manualNMSAddrChange</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>manualNMSAddrChange</eventSearchName>
<eventTypeDisplayString>Manual NMS Address Change</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered due to manual NMS address
change.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>nmsError</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>nmsError</eventSearchName>
<eventTypeDisplayString>NMS Returned Error</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered due to NMS error.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>meterCertChange</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>meterCertChange</eventSearchName>
<eventTypeDisplayString>Mesh Certificate Change</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered due to certificate
change.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>unknownWPANChange</eventTypeName>
<eventCategory>WPAN Change</eventCategory>
<eventSearchName>unknownWPANChange</eventSearchName>
<eventTypeDisplayString>Unknown WPAN Change</eventTypeDisplayString>
```

```
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>Mesh node changed PAN for unknown reason.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>meshConnectivityLost</eventTypeName>
<eventCategory>WPAN Change</eventCategory>
<eventSearchName>meshConnectivityLost</eventSearchName>
<eventTypeDisplayString>Mesh Connectivity Lost</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>Mesh node lost all connectivity.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>meshLinkKeyTimeout</eventTypeName>
<eventCategory>WPAN Change</eventCategory>
<eventSearchName>meshLinkKeyTimeout</eventSearchName>
<eventTypeDisplayString>Mesh Link Key Timeout</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>Mesh node link key timed out.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>defaultRouteLost</eventTypeName>
<eventCategory>WPAN Change</eventCategory>
<eventSearchName>defaultRouteLost</eventSearchName>
<eventTypeDisplayString>Default Route Lost</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>Mesh node lost default route.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>migratedToBetterPAN</eventTypeName>
<eventCategory>WPAN Change</eventCategory>
<eventSearchName>migratedToBetterPAN</eventSearchName>
<eventTypeDisplayString>Migrated to Better PAN</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node migrated to better PAN.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>METER_REAUTHENTICATION</eventTypeName>
<eventCategory>Authentication</eventCategory>
<eventSearchName>dot1xReauth</eventSearchName>
<eventTypeDisplayString>Dot1x Reauthentication</eventTypeDisplayString>
<eventSeverity>MINOR</eventSeverity>
<eventTypeDefaultMessage>Multiple attempts to send the mesh-key to the meter failed.
Reauthenticating.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>AUTHENTICATION_FAILED</eventTypeName>
<eventCategory>Authentication</eventCategory>
<eventSearchName>dot1xAuthFailure</eventSearchName>
<eventTypeDisplayString>Dot1x Authentication Failure</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>Dot1x authentication failed for meter.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>restorationRegistration</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>restorationRegistration</eventSearchName>
<eventTypeDisplayString>Restoration Registration</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Mesh node registered after an outage.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>signatureFailure</eventTypeName>
<eventCategory>Security</eventCategory>
<eventSearchName>signatureFailure</eventSearchName>
```

```
<eventTypeDisplayString>Invalid CSMP Signature</eventTypeDisplayString>
<eventSeverity>CRITICAL</eventSeverity>
<eventTypeDefaultMessage>Invalid signature reported by mesh node</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>deviceAdded</eventTypeName>
<eventCategory>DeviceLifecycle</eventCategory>
<eventSearchName>deviceAdded</eventSearchName>
<eventTypeDisplayString>Device Added</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>New device is added</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>deviceRemoved</eventTypeName>
<eventCategory>DeviceLifecycle</eventCategory>
<eventSearchName>deviceRemoved</eventSearchName>
<eventTypeDisplayString>Device Removed</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Device is removed</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>registrationFailed</eventTypeName>
<eventCategory>Registration</eventCategory>
<eventSearchName>registrationFailed</eventSearchName>
<eventTypeDisplayString>Device Registration Failed</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>FND receive CGMSNotification with code = 3 during device
registration</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>registering</eventTypeName>
<eventCategory>registering</eventCategory>
<eventSearchName>registering</eventSearchName>
<eventTypeDisplayString>Registering</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Device is registering</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>blocked</eventTypeName>
<eventCategory>blocked</eventCategory>
<eventSearchName>blocked</eventSearchName>
<eventTypeDisplayString>Blocked</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Device is blocked</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>blockMeshDeviceFailed</eventTypeName>
<eventCategory>Security</eventCategory>
<eventSearchName>blockMeshDeviceFailed</eventSearchName>
<eventTypeDisplayString>Block Mesh Device Failure</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>Block mesh device operation failed.</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>estError</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>estError</eventSearchName>
<eventTypeDisplayString>EST Error</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Error occurred processing EST request from the
device</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>sslError</eventTypeName>
```

```
<eventCategory>EST</eventCategory>
<eventSearchName>sslError</eventSearchName>
<eventTypeDisplayString>SSL Error</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>SSL Error occurred processing EST request from the
device</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>cacertRequest</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>cacertRequest</eventSearchName>
<eventTypeDisplayString>CACert Request</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Received EST CACert request from the device</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>cacertResponse</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>cacertResponse</eventSearchName>
<eventTypeDisplayString>CACert Response</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Sent EST CACert response to the device</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>enrollRequest</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>enrollRequest</eventSearchName>
<eventTypeDisplayString>Enroll Request</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Received EST Enroll request from the device</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>reenrollRequest</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>reenrollRequest</eventSearchName>
<eventTypeDisplayString>Re-Enroll Request</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Received EST Re-Enroll request from the
device</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>enrollSuccess</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>enrollSuccess</eventSearchName>
<eventTypeDisplayString>Enroll Success</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Device EST Enrollment succeeded</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>reenrollSuccess</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>reenrollSuccess</eventSearchName>
<eventTypeDisplayString>Re-Enroll Success</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Device EST Re-Enrollment succeeded</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>enrollFailure</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>enrollFailure</eventSearchName>
<eventTypeDisplayString>Enroll Failure</eventTypeDisplayString>
<eventSeverity>CRITICAL</eventSeverity>
<eventTypeDefaultMessage>Device EST Enrollment failed</eventTypeDefaultMessage>
</eventType>
```

```
<eventType>
<eventTypeName>reenrollFailure</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>reenrollFailure</eventSearchName>
<eventTypeDisplayString>Re-Enroll Failure</eventTypeDisplayString>
<eventSeverity>CRITICAL</eventSeverity>
<eventTypeDefaultMessage>Device EST Re-Enrollment failed</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>authenticationSuccess</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>authenticationSuccess</eventSearchName>
<eventTypeDisplayString>Authentication Success</eventTypeDisplayString>
<eventSeverity>INFO</eventSeverity>
<eventTypeDefaultMessage>Device EST authentication succeeded</eventTypeDefaultMessage>
</eventType>
<eventType>
<eventTypeName>authenticationFailure</eventTypeName>
<eventCategory>EST</eventCategory>
<eventSearchName>authenticationFailure</eventSearchName>
<eventTypeDisplayString>Authentication Failure</eventTypeDisplayString>
<eventSeverity>MAJOR</eventSeverity>
<eventTypeDefaultMessage>Device EST authentication failed</eventTypeDefaultMessage>
</eventType>
</eventTypes>
</event>
```

Issue Types

Here's an example of issue types:

```
<?xml version="1.0" encoding="UTF-8" ?>
<issue xmlns="http://www.w3schools.com" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.w3schools.com cgrEvent.xsd">
<issueTypes kind="cgmesh">
<issueType>
<issueTypeName>UNKNOWN</issueTypeName>
<issueCategory>unknown</issueCategory>
<issueSearchName>unknown</issueSearchName>
<issueTypeDisplayString>Unknown Issue</issueTypeDisplayString>
<issueSeverity>INFO</issueSeverity>
<issueTypeDefaultMessage>The issue raised/closed does not have a defined issue
type.</issueTypeDefaultMessage>
</issueType>
<issueType>
<issueTypeName>deviceDown</issueTypeName>
<issueCategory>Device</issueCategory>
<issueSearchName>down</issueSearchName>
<issueTypeDisplayString>Down</issueTypeDisplayString>
<issueSeverity>MAJOR</issueSeverity>
<issueTypeDefaultMessage>Device is down.</issueTypeDefaultMessage>
</issueType>
<issueType>
<issueTypeName>registrationFailed</issueTypeName>
<issueCategory>Device</issueCategory>
<issueSearchName>registrationFailed</issueSearchName>
<issueTypeDisplayString>Device Registration Failed</issueTypeDisplayString>
<issueSeverity>MAJOR</issueSeverity>
<issueTypeDefaultMessage>Device Registration failed due to configuration
error</issueTypeDefaultMessage>
</issueType>
```

```
<issueType>
<issueTypeName>deviceOutage</issueTypeName>
<issueCategory>Device</issueCategory>
<issueSearchName>Outage</issueSearchName>
<issueTypeDisplayString>Outage</issueTypeDisplayString>
<issueSeverity>CRITICAL</issueSeverity>
<issueTypeDefaultMessage>Device is in outage.</issueTypeDefaultMessage>
</issueType>
<issueType>
<issueTypeName>deviceTimeMismatch</issueTypeName>
<issueCategory>Device</issueCategory>
<issueSearchName>deviceTimeMismatch</issueSearchName>
<issueTypeDisplayString>Device-NMS Time Mismatch</issueTypeDisplayString>
<issueSeverity>MAJOR</issueSeverity>
<issueTypeDefaultMessage>Device time and NMS time are not in sync.</issueTypeDefaultMessage>
</issueType>
<issueType>
<issueTypeName>signatureFailure</issueTypeName>
<issueCategory>Security</issueCategory>
<issueSearchName>signatureFailure</issueSearchName>
<issueTypeDisplayString>Invalid CSMP Signature</issueTypeDisplayString>
<issueSeverity>CRITICAL</issueSeverity>
<issueTypeDefaultMessage>Verify certificate setup. Also verify that mesh node and IoT-FND
are time synchronized.</issueTypeDefaultMessage>
</issueType>
<issueType>
<issueTypeName>enrollFailure</issueTypeName>
<issueCategory>EST</issueCategory>
<issueSearchName>enrollFailure</issueSearchName>
<issueTypeDisplayString>Enroll Failure</issueTypeDisplayString>
<issueSeverity>CRITICAL</issueSeverity>
<issueTypeDefaultMessage>Device EST Enrollment failed.</issueTypeDefaultMessage>
</issueType>
<issueType>
<issueTypeName>reenrollFailure</issueTypeName>
<issueCategory>EST</issueCategory>
<issueSearchName>reenrollFailure</issueSearchName>
<issueTypeDisplayString>Re-Enroll Failure</issueTypeDisplayString>
<issueSeverity>CRITICAL</issueSeverity>
<issueTypeDefaultMessage>Device EST Re-Enrollment failed.</issueTypeDefaultMessage>
</issueType>
<issueType>
<issueTypeName>authenticationFailure</issueTypeName>
<issueCategory>EST</issueCategory>
<issueSearchName>authenticationFailure</issueSearchName>
<issueTypeDisplayString>Authentication Failure</issueTypeDisplayString>
<issueSeverity>CRITICAL</issueSeverity>
<issueTypeDefaultMessage>Device EST authentication failed.</issueTypeDefaultMessage>
</issueType>
</issueTypes>
</issue>
```

System rules

Here's an example of system rules:

```
<?xml version="1.0" encoding="UTF-8" ?>
<cgms xmlns="http://www.w3schools.com" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">

  <rules kind="">
    <rule>
```

```
      <name>Down Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:down</query>
      <action type="manage_issue" parameter="issueTypeName:deviceDown issueStatus:OPEN" />
    </rule>
    <rule>
      <name>Up from Down Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:up</query>
      <action type="manage_issue" parameter="issueTypeName:deviceDown issueStatus:CLOSED"
/>
    </rule>

    <rule>
      <name>Registration Failed Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:registrationFailed</query>
      <action type="manage_issue" parameter="issueTypeName:registrationFailed
issueStatus:OPEN" />
    </rule>
    <rule>
      <name>Up from Registration Failed Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:up</query>
      <action type="manage_issue" parameter="issueTypeName:registrationFailed
issueStatus:CLOSED" />
    </rule>

    <rule>
      <name>Outage Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:outage</query>
      <action type="manage_issue" parameter="issueTypeName:deviceOutage issueStatus:OPEN"
/>
    </rule>
    <rule>
      <name>Up from Outage Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:up</query>
     <action type="manage_issue" parameter="issueTypeName:deviceOutage issueStatus:CLOSED"
 />
    </rule>
    <rule>
      <name>Restored from Outage Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:restoration</query>
     <action type="manage_issue" parameter="issueTypeName:deviceOutage issueStatus:CLOSED"
 />
    </rule>

    <rule>
      <name>Time Mismatch Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:timeMismatch</query>
      <action type="manage_issue" parameter="issueTypeName:deviceTimeMismatch
issueStatus:OPEN" />
    </rule>
    <rule>
      <name>Time Mismatch Resolved Rule</name>
      <username>system</username>
      <query>deviceType:{0} eventName:timeMismatchResolved</query>
      <action type="manage_issue" parameter="issueTypeName:deviceTimeMismatch
issueStatus:CLOSED" />
    </rule>
```

```
    <rule>
      <name>Signature Validation Failure</name>
      <username>system</username>
      <query>deviceType:{0} eventName:signatureFailure</query>
     <action type="manage_issue" parameter="issueTypeName:signatureFailure issueStatus:OPEN"
 />
    </rule>
  </rules>
</cgms>
```

License Support

The registered third-party devices utilize the active endpoint license for lifecycle management in Cisco IoT FND.

View Endpoints on Cisco IoT FND Dashboard

On the Cisco IoT FND dashboard, you can view the following properties for the registered devices in the endpoints dashlets:

- Endpoint States Over Time
- Endpoint Config Group Template Mismatch Over Time
- Endpoint Firmware Group Template Mismatch Over Time
- Endpoint Inventory
- Hop Count Distribution
- Config Group Template Mismatch
- Firmware Group Template Mismatch
- RF and PLC Media utilization over time

View Endpoints

This task guides you to view the endpoints on **Field Devices** page.

The registered endpoint devices appear on the Field Devices page, with the device type and function as defined in the meta data file; their function is similar to the existing endpoints in Cisco IoT FND.

To view the registered devices:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **DEVICES** > **Field Devices** > **ENDPOINTS** to view the inventory of the registered device.

Step 2 Click the registered endpoint device to view the device information.

Both the **Device Inventory** and the **Device Details** pages display the tabs, buttons, filter options similar to the existing endpoints in Cisco IoT FND.

You've viewed the endpoints on the field devices page.

View VendorTLV

This task guides you to view VendorTLV details on the **Field Devices** page.

The vendor TLV details are added in the inventory page. It also displays vendor name in the following format as vendor name (vendor-id). For example, Cisco (ID: 5771) , where ID refers IANA PEN of the vendor received by Cisco IoT FND during device registration.

Procedure

Step 1 From the Cisco IoT FND menubar, choose **DEVICES** > **Field Devices** > **ENDPOINTS** to view the inventory of the registered device.

Step 2 In the **Device Details** page, navigate to **VendorTLV info** tab to view the vendor name, vendor ID and the list of **Subtype** and its **Value** .

You've viewed the VendorTLV details on Cisco IoT FND.

View response from the Endpoints for the VendorTLV

This task helps you view the responses from the Endpoints for the VendorTLV:

Procedure

Step 1 Choose **DEVICES** > **Field Devices** > **ENDPOINTS** to view the inventory of the registered device.

Step 2 In the Device Details page, navigate to **Troubleshoot** tab to view the response from the endpoint for the VendorTLV 127.

You've viewed the responses from the Endpoints for the VendorTLV.

Configure markdown timer

This task guides you to configure markdown timer:

Once the endpoint is added with the generic device type, the **Mark Generic Endpoints Down After** option is enabled in **Device Down Timeouts** tab.

To configure the Markdown timer:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **ADMIN** > **System Management** > **Server Settings** .
Step 2 Click the **Device Down Timeouts** tab.
Step 3 Enter the time in the **Mark Generic Endpoints Down After** field.
Step 4 Click the disk icon to save the configuration.

You've configured the markdown timer

Configure the Vendor TLVs

This tasks gives you a list of the supported vendor TLVs and helps you configure them using Cisco IoT FND:

Before you begin

Table 128: Supported periodic metric TLVs

TLV ID	TLV Name
23	Interface Metrics
17	IP Route
25	IP Route RPL Metrics
58	Group Info
75	Firmware Image Info
22	Uptime
61	LoWPAN PHY Stats
88	DiffServ Metrics
13	Report Subscribe
127	Vendor TLV

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **Device Configuration** > **Edit Configuration Template** tab.
Step 2 Select the **Vendor TLV Subtype** from the drop-down list and click **Add Vendor TLV** to configure the Vendor TLV.

You've configured the VendorTLVs.

Push configuration

This task involves the configuration management of newly registered endpoint devices in Cisco IoT FND, focusing on default configuration groups, TLV metrics, and vendor-specific configurations depending on the release version and RPL Tree settings.

Release	Feature Availability
Cisco IoT FND Release 4.12	Configure and process only the report interval TLV metrics for new endpoint devices.
Cisco IoT FND Release 5.0	Change and retrieve Vendor TLV details and push configuration to new endpoint devices.

Before you begin

- Here's the default template configuration:

```
[{
    "name": "ReportSubscribe",
    "value": {
        "interval": 28800,
        "tlvid": [
            "InterfaceMetrics",
            "IPRoute",
            "IPRouteRPLMetrics",
            "GroupInfo",
            "FirmwareImageInfo",
            "Uptime",
            "LowpanPhyStats",
            "DiffServMetrics",
            "ReportSubscribe",
            "VendorTlv"
        ]
    }
}]
```

- Conditional Settings Based on RPL Tree Selection

RPL Tree Setting	File to Update	Action
Mesh Nodes	`default[devicetype]Template.json`	Add VendorTLV in metadata file.
Router	`default[devicetype]NoIPRouteTemplate.json`	Add VendorTLV in metadata file.

- The `deviceTypeEventTypes.xml` definitions apply to new endpoint devices.

Here are the instructions:

Procedure

Step 1 Check Cisco IoT FND version to know available configuration options.

Step 2 Verify metadata files for the correct default configuration group mapping.

Step 3 For Mesh Nodes, update `default[devicetype]Template.json` with VendorTLV.

Step 4 For Router, update `default[devicetype]NoIPRouteTemplate.json` with VendorTLV.

Step 5 Confirm default template JSON matches the standard provided above.

Step 6 Ensure `deviceTypeEventTypes.xml` includes applicable events for endpoint devices.

Step 7 From the Cisco IoT FND menubar, choose **CONFIG** > **Device Configuration** > **Push Configuration**.

Step 8 Select **Push ENDPOINT Configuration** from the drop-down list and click **Submit** to push the configuration to the devices from Cisco IoT FND.

You've pushed configurations from Cisco IoT FND to the endpoints.

Sign the CSMP message

To enable the CSMP signing in Cisco IoT FND the following configuration is required:

- Ensure that the CSMP certificate present in Cisco IoT FND is installed in the endpoint.
- Enable the CSMP signing setting in the endpoints.

Firmware upgrade

Starting from Cisco IoT FND release 5.0 the following TLVs are supported as a part of Firmware upgrade and management.

TLV ID	TLV Name
65	Transfer Request
67	Image Block
68	Load Request
69	Cancel Load Request
70	Set Backup Request
71	Transfer Response
72	Load Response
73	Cancel Load Response
74	Set Backup Response
75	Firmware Image Info

Cisco IoT FND reads the following fields in the firmware image header:

```
hdrVersion - mandatory
hdrLen - mandatory
appRevMajor - mandatory
appRevMinor - mandatory
appBuild - mandatory
appLen - mandatory
appName - mandatory
appGitBranch - not mandatory
appGitCommit - not mandatory
appGitFlag - not mandatory
appBuildDate - mandatory
hw_info - mandatory
kernelVersion - not mandatory
```

Configure transmission settings

This task guides you to configure the transmission settings for your endpoints.

Transmission speed control allows you to optimize data transfer rates to match the network conditions and operational needs.

Before you begin

- For firmware upload, you can select the transmission speed as Fast, Medium, or Slow.
- For Load Request, Backup Request, and Cancel Load Request, you can select Fast, Medium, Slow, or Custom, and provide a unicast delay of at least 10 seconds (with a retry delay of 10 x 3 seconds). To avoid redundant requests for Load, Backup, and Cancel Load Requests, you can select the Transmission speed as Custom and provide the unicast delay of 10sec (Retry delay: 10 x 3 sec).
- Transmission speed options and their settings:

Tranmission speed	Unicast delay (sec)	Retry interval (sec)
Fast	1	10
Medium	2	10
Slow	3	10

Here are the instructions to configure the transmission settings:

Procedure

Step 1 From the Cisco IoT FND menubar, choose **CONFIG** > **Firmware Update**.

Step 2 Choose an **ENDPOINT** from the device group tree.

Step 3 Navigate to the **Transmission Settings** tab.

Step 4 Here are the options to choose from:

- Transmission Speed: Fast
- Transmission Speed: Medium
- Transmission Speed: Slow
- Transmission Speed: Custom

Step 5 Enter **Multicast Threshold (nodes)**.

Step 6 Ensure **Unicast Delay (secs)** and **Minimum Unicast Delay (secs)** for Custom transmission speed.

Step 7 Click **Save**.

You've sucessfully configured the transmission speed for your endpoints.

Delete existing third-party generic endpoints device type

This task guides you to delete existing third-party generic endpoint device types from Cisco IoT FND.

Procedure

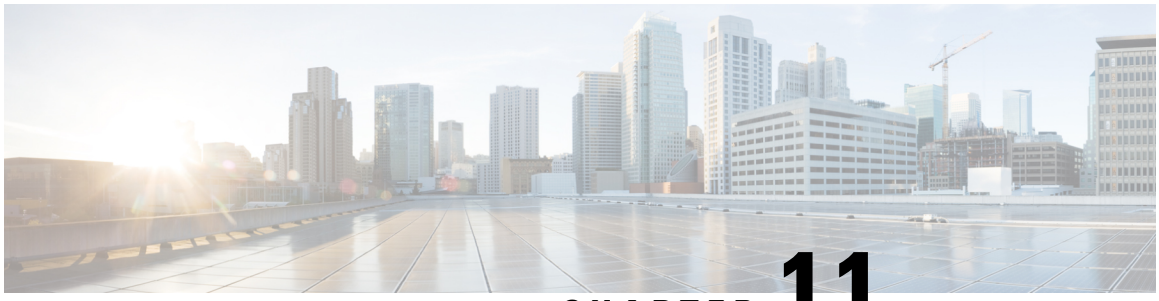
Step 1 Remove devices from Cisco IoT FND GUI with the device type you want to delete.

Step 2 Stop the Cisco IoT FND.

Step 3 Remove the device type using the `removeGenericEndpoints.sh` script found in `/opt/cgms/bin`

Step 4 Restart Cisco IoT FND.

You've succesfully removed the existing endpoints from Cisco IoT FND.



CHAPTER 11

Telemetry

Cisco IoT FND enables seamless telemetry integration with CDNA and supports both online and offline data transfer modes. Cisco IoT FND collects telemetry data and ensures reliable delivery to CDNA, regardless of network connectivity conditions. Here are some ways in which you can use telemetry:

- in online mode, Cisco IoT FND collects and immediately pushes telemetry data to CDNA in real time.
- telemetry ensures continuous and dependable telemetry data transfer across diverse network environments.

Table 129: Feature history

Feature name	Release information	Description
Telemetry	Cisco IoT FND 5.1	Cisco IoT FND supports flexible telemetry data integration with Cisco DNA Center (CDNA), enabling seamless data transfer in both online and offline modes.

Benefits

- Telemetry helps you automatically track and report on regulatory compliance by continuously monitoring configuration changes and network activity.
- By analyzing telemetry data, you can identify underutilized or overburdened network resources, enabling smarter allocation and cost savings.
- Telemetry allows you to observe long-term patterns and trends in network behavior, supporting better forecasting and strategic planning.

Prerequisites

Here are some of the prerequisites to use telemetry:

- Ensure that the server running Cisco IoT FND is connected to the internet when operating in online mode.
- You need to be a root user to access telemetry data. For more information on user access on Cisco IoT FND see, Manage user access.

Telemetry is applicable only on Cisco IoT FND running Cisco IoT FND Release 5.1 and later releases.

Restrictions

Here are some restrictions of telemety that you need to consider before using the feature:

- Only if you are a root user, you can enable or disable telemetry, add or modify proxy details and telemetry job run time for internet access in case Cisco IoT FND is unable to reach Cisco telemetry.
- Cisco IoT FND runs a job daily to collect the telemetry and store it in the Cisco IoT FND database. This job is scheduled to run at 2:00AM by default. You can change the default time once you've given consent to send telemetry data.
- After you consent to sending telemetry data to CDNA and if telemetry fails for 7 consecutive days, Cisco IoT FND stops collecting and pushing telemetry data. You as a root user has to enable telemetry using Cisco IoT FND once again.
- Telemetry data is retained in Cisco IoT FND only for 7 days before being auto-deleted.

Configure telemetry

This task guides you in providing consent to extract Cisco IoT FND telemetry data for reporting and improving your experience.

Before you begin

Log in as a root user

Use these steps to configure telemetry on your Cisco IoT FND:

Procedure

Step 1 Log in to Cisco IoT FND as a root user.

Step 2 In the **Telemetry Acceptance** page, confirm that you are accepting to extract Cisco IoT FND telemetry data. Check the **Accept** check box.

Field	Field description
Customer Name	Enter your organization's name.
Proxy URL	Enter the Proxy settings URL to reach cisco telemetry
Proxy Username	Enter Proxy user name
Proxy Password	Enter Proxy password

Step 3 Click the **save** icon.

Step 4 If you don't want to consent to extracting telemetry data, click **Reject**.

Step 5 The **Telemetry Acceptance** page appears only during your first login as a root user. If you'd want to accept telemetry at a later point of time, go to **ADMIN** > **Telemetry**.

You've succesfully configured telemetry on Cisco IoT FND.

Monitor telemetry

Once you've configured telemetry on Cisco IoT FND, you can view the telemetry data using this task.

Before you begin

Ensure that you've provided consent to telemetry extraction from your Cisco IoT FND

Here are the instructions to view the telemetry data

Procedure

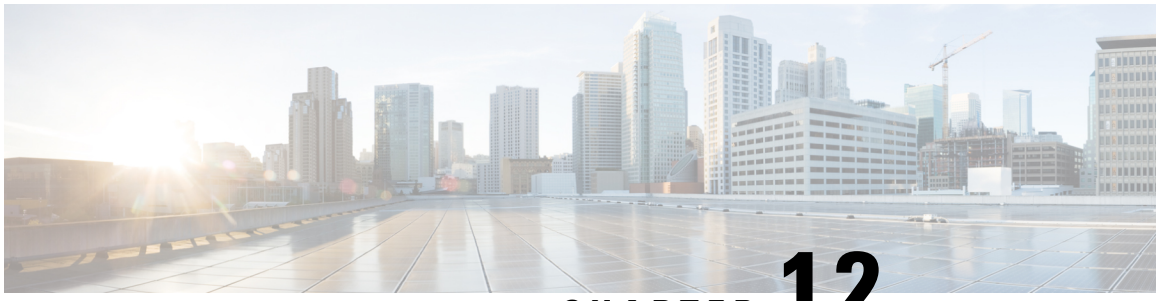
Step 1 From the Cisco IoT FND menubar, choose **ADMIN** > **System Management** > **Telemetry**.

Step 2 You can view the following telemetry data on Cisco IoT FND:

Telemetry data	Supported Cisco IoT FND Release
Customer name	Cisco IoT FND Release 5.1
Device types registered in FND	Cisco IoT FND Release 5.1
Count of devices for each device types registered in FND	Cisco IoT FND Release 5.1
Firmware versions running on the device for each device type	Cisco IoT FND Release 5.1
Count of devices for each running firmware version for each device type	Cisco IoT FND Release 5.1
Customer type ex: AMI or DA	Cisco IoT FND Release 5.1
Customer deployment method ex: PKI or PSK	Cisco IoT FND Release 5.1
Customer installation type ex: Postgres OVA/Oracle Baremetal/Oracle OVA	Cisco IoT FND Release 5.1
Database version	Cisco IoT FND Release 5.1
Number of config groups(count) and firmware groups(count)	Cisco IoT FND Release 5.1
Number of templates for each device types	Cisco IoT FND Release 5.1
Number of open issues	Cisco IoT FND Release 5.1

Telemetry data	Supported Cisco IoT FND Release
Number of dashlets used by customers	Cisco IoT FND Release 5.1
Count of devices having iox enabled	Cisco IoT FND Release 5.1
Count of devices having pluggable and expansion module	Cisco IoT FND Release 5.1
Count of event and issue types	Cisco IoT FND Release 5.1
RAM allocated to FND	Cisco IoT FND Release 5.1
CPU allocated to FND	Cisco IoT FND Release 5.1
CPU allocated to FND	Cisco IoT FND Release 5.1
IPAM is enabled	Cisco IoT FND Release 5.1
Count of active, inactive and total users	Cisco IoT FND Release 5.1
Authentication type	Cisco IoT FND Release 5.1
Count of app servers	Cisco IoT FND Release 5.1
Count of domains	Cisco IoT FND Release 5.1

You've successfully verified the telemetry data.



CHAPTER 12

Troubleshooting IoT FND

This chapter is moved to the Troubleshooting Guide for Cisco IoT Field Network Director.