



Plan the Deployment

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Planning Workflow

You must perform the following planning and information-gathering tasks before attempting to install, configure, and set up your Catalyst Center appliance. After you complete these tasks, you can continue by physically installing your appliance in the data center.

1. Review the recommended cabling and switching requirements for standalone and cluster installations. See [Interface Cable Connections](#).
2. Gather the IP addressing, subnetting, and other IP traffic information that you will apply during appliance configuration. See [Required IP Addresses and Subnets](#).
3. Prepare a solution for the required access to web-based resources. See [Required Internet URLs and Fully Qualified Domain Names](#) and [Provide Secure Access to the Internet](#).
4. Reconfigure your firewalls and security policies for Catalyst Center traffic. See [Required Network Ports](#). If you are using Catalyst Center to manage a Cisco Software-Defined Access (SD-Access) network, see also [Required Ports and Protocols for Cisco Software-Defined Access](#).
5. Gather the additional information used during appliance configuration and first-time setup. See [Required Configuration Information](#) and [Required First-Time Setup Information](#).

Catalyst Center and Cisco Software-Defined Access

You can use Catalyst Center to manage any type of network, including networks that employ the Cisco SD-Access fabric architecture. Cisco SD-Access transforms conventional networks into intent-based networks, where business logic becomes a physical part of the network, making it easy to automate day-to-day tasks such as configuration, provisioning, and troubleshooting. The Cisco SD-Access solution reduces the time taken to adapt the network to business needs, improves issue resolutions, and reduces security-breach impacts.

A complete discussion of the Cisco SD-Access solution is outside the scope of this guide. Network architects and administrators planning to implement a Cisco SD-Access fabric architecture for use with Catalyst Center can find additional information and guidance from the following resources:

- For more information on how Catalyst Center leverages Cisco SD-Access to automate solutions that are not possible with normal networking approaches and techniques, see [Software Defined Access: Enabling Intent-Based Networking](#).
- For guidance in using Cisco SD-Access access segmentation to enhance network security, see the [Software-Defined Access Segmentation Design Guide](#).
- For guidance on deploying SDA with Catalyst Center, see the [Software-Defined Access Deployment Guide](#).
- For more information on Catalyst Center and the Cisco SD-Access solution, and the roles that other Cisco and third-party products and solutions play in this innovative architecture, see the [Design Zone](#).

Interface Cable Connections

Connect the ports on the appliance to a switch that provides the following types of network access. At a minimum, you must configure the Enterprise and Intracluster port interfaces, as they are required for Catalyst Center functionality.

When NIC bonding is enabled on an appliance, a secondary instance of the Enterprise, Intracluster, Management, and Internet ports resides on the Intel X710-DA4 NIC. Connect these ports to a switch that's different from the one that you will connect the primary instance of these ports to (see [NIC Bonding Overview](#)).



Note

- During appliance configuration, the Maglev Configuration wizard does not let you proceed until you assign the **Cluster Link** option to an interface. For both single-node and three-node deployments in a production environment, assign the Intracluster port as the Cluster Link.
 - Be aware that the interface marked as the Cluster Link cannot be changed after configuration completes. Later, if you must change the interface marked as the Cluster Link, you are required to reimage the appliance. (For a description of the tasks you need to complete in order to reimage your Catalyst Center appliance, see [Reimage the Appliance](#).) With this in mind, we recommend that you set up the Cluster Port with an IP address, so as to allow for expansion to a three-node cluster in the future. Also, make sure that the cluster link interface is connected to a switch port and is in the UP state.
 - If you plan to build multiple clusters, you must use a separate IP scheme for each cluster in order to prevent cross-cluster interaction (which might corrupt the clusters).
-

- **(Required) 10-Gbps Enterprise Port (Network Adapter 1):** The purpose of this port is to enable Catalyst Center to communicate with and manage your network. Connect this port to a switch with connections to the enterprise network and configure one IP address with a subnet mask for the port.

Primary instance:

- On the 44- and 56-core appliance, this is the left-hand port on the Intel X710-DA2 NIC that resides in PCIe slot 1.
- On the 112-core appliance, this is the top 10-Gbps port on the Intel X710-DA2 NIC that resides in PCIe slot 9.

Secondary instance:

- On the 44- and 56-core appliance, this is the second port on the Intel X710-DA4 NIC that resides in PCIe slot 2.
- On the 112-core appliance, this is the third 10-Gbps port from the top on the Intel X710-DA4 NIC that resides in PCIe slot 12.

- **(Required) 10-Gbps Intracluster Port (Network Adapter 2):** The purpose of this port is to enable communications among the primary and secondary nodes in a cluster. Connect this port to a switch with connections to the other nodes in the cluster and configure one IP address with a subnet mask for the port.

Primary instance:

- On the 44- and 56-core appliance, this is the right-hand port on the Intel X710-DA2 NIC that resides in PCIe slot 1.
- On the 112-core appliance, this is the bottom 10-Gbps port on the Intel X710-DA2 NIC that resides in PCIe slot 9.

Secondary instance:

- On the 44- and 56-core appliance, this is the first port on the Intel X710-DA4 NIC that resides in PCIe slot 2.
- On the 112-core appliance, this is the bottom 10-Gbps port on the Intel X710-DA4 NIC that resides in PCIe slot 12.

- **(Optional) 1-Gbps/10-Gbps Management Port (Network Adapter 3):** This port provides access to the Catalyst Center GUI, allowing users to use the software on the appliance. Connect this port to a switch with connections to your enterprise management network, and configure one IP address with a subnet mask for the port.

Primary instance: Labeled **1** on the appliance's rear panel.

Secondary instance:

- On the 44- and 56-core appliance, this is the fourth port on the Intel X710-DA4 NIC that resides in PCIe slot 2.
- On the 112-core appliance, this is the top 10-Gbps port on the Intel X710-DA4 NIC that resides in PCIe slot 12.

- **(Optional) 1-Gbps/10-Gbps Internet Port (Network Adapter 4):** This port, labeled **2** on the rear panel, is optional. Use it only if you cannot connect the appliance to the Internet (including to your Internet proxy server) using the 10-Gbps Enterprise Port (Network Adapter 1). If you need to use this port, connect it to a switch with connections to your Internet proxy server and configure one IP address with a subnet mask for the port.

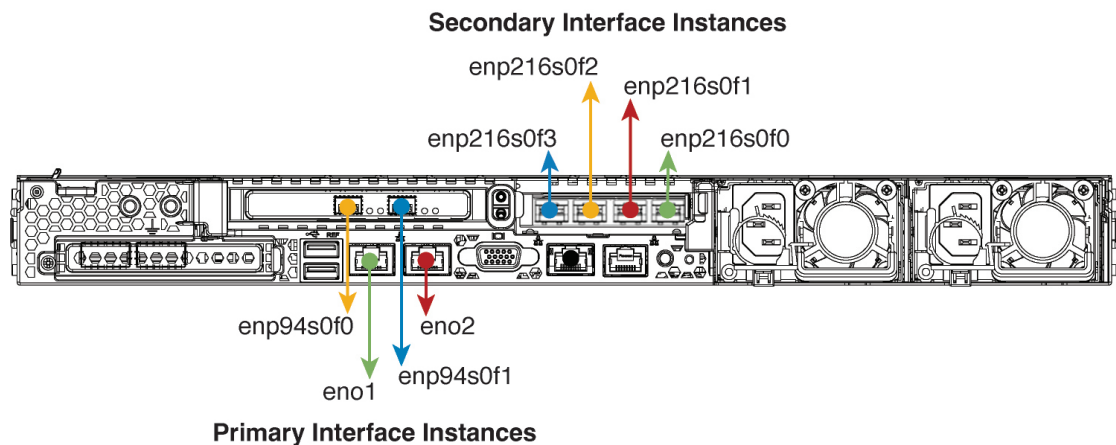
Primary instance: Labeled **2** on the appliance's rear panel.

Secondary instance:

- On the 44- and 56-core appliance, this is the third port on the Intel X710-DA4 NIC that resides in PCIe slot 2.
 - On the 112-core appliance, this is the second 10-Gbps port from the top on the Intel X710-DA4 NIC that resides in PCIe slot 12.
- **(Optional, but strongly recommended) 1-Gbps Cisco IMC Port:** This port provides browser access to the Cisco Integrated Management Controller (Cisco IMC) out-of-band appliance management interface and its GUI. Its purpose is to allow you to manage the appliance and its hardware. Connect this port to a switch with connections to your enterprise management network and configure an IP address with a subnet mask for the port.

The following figures show the recommended connections for a single-node Catalyst Center cluster, as well as the label that's assigned to each interface:

Figure 1: Recommended Cabling for 44- and 56-Core Appliance



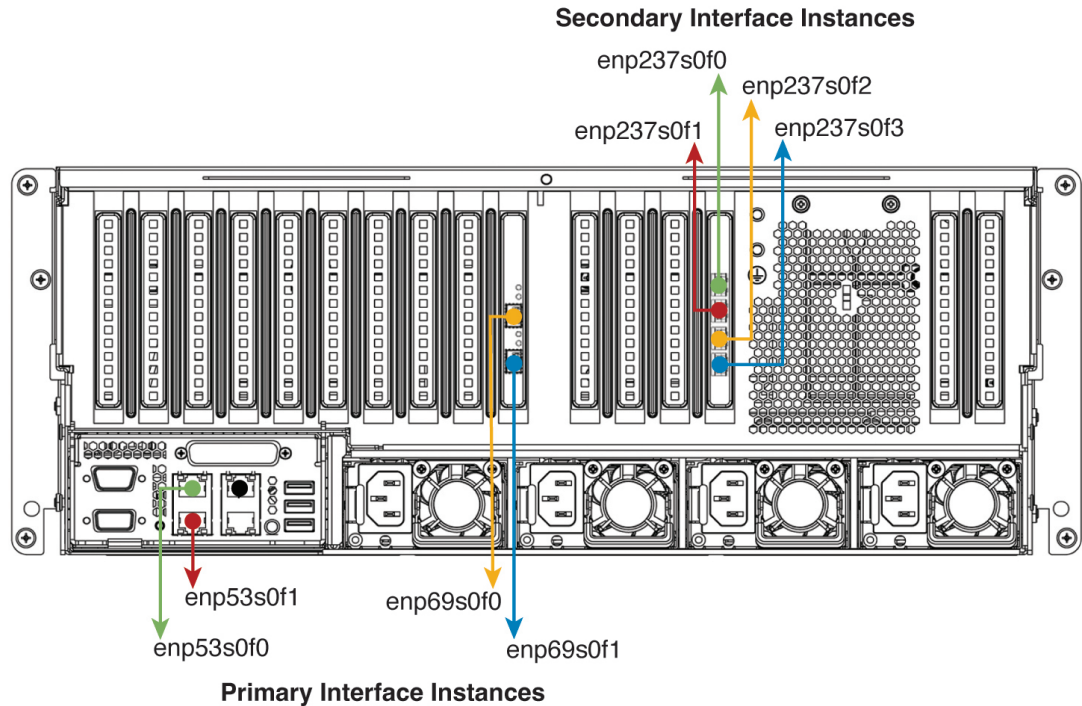
Legend

- 10-Gbps Enterprise Port (Network Adapter 1)
- 10-Gbps Intracluster Port (Network Adapter 2)
- 1-Gbps/10-Gbps Management Port (Network Adapter 3)
- 1-Gbps/10-Gbps Internet Port (Network Adapter 4)
- 1-Gbps Cisco IMC Port



Note For both the Management and Internet interface, their primary instance has a bandwidth of 1 Gbps and their secondary instance 10 Gbps.

Figure 2: Recommended Cabling for 112-Core Appliance



Note For both the Management and Internet interface, their primary instance has a bandwidth of 1 Gbps and their secondary instance 10 Gbps.

The connections for each node in a three-node Catalyst Center cluster are the same as those for a single-node cluster and use the same ports. Do the following when you cable a three-node cluster:

- Connect the primary instance of each node's Enterprise, Intracluster, Management, and Internet Port, as well as the Cisco IMC port, to the primary switch.
- Connect the secondary instance of each node's Enterprise, Intracluster, Management, and Internet Port to the secondary switch.

For more details on each of the ports, see the rear panel diagram and accompanying descriptions for your chassis in [Front and Rear Panels](#).



Note Multinode cluster deployments require all the member nodes to be in the same network and at the same site. The appliance does not support distribution of nodes across multiple networks or sites.

When cabling the 10-Gbps enterprise and cluster ports, note that the ports support only the following media types:

- SFP-10G-SR-S (Short range, MMF)
- SFP-10G-LR (Long range, SMF)
- SFP-H10GB-CU1M (Twinax cable, passive, 1 Meter)
- SFP-H10GB-CU3M (Twinax cable, passive, 3 Meters)
- SFP-H10GB-CU5M (Twinax cable, passive, 5 Meters)
- SFP-H10GB-ACU7M (Twinax cable, active, 7 Meters)

Required IP Addresses and Subnets

Before beginning the installation, you must ensure that your network has sufficient IP addresses available to assign to each of the appliance ports that you plan on using. Depending on whether you are installing the appliance as a single-node cluster or as a primary or secondary node in a three-node cluster, you will need the following appliance port (NIC) addresses:

- **Enterprise Port Address** (Required): One IP address with a subnet mask.
- **Cluster Port Address** (Required): One IP address with a subnet mask.
- **Management Port Address** (Optional): One IP address with a subnet mask.
- **Internet Port Address** (Optional): One IP address with a subnet mask. This is an optional port, used only when you cannot connect to the cloud using the Enterprise port. You do not need an IP address for the Internet port unless you must use it for this purpose.
- **CIMC Port Address** (Optional, but strongly recommended): One IP address with a subnet mask.



Note All of the IP addresses called for in these requirements must be valid IPv4 addresses with valid IPv4 netmasks. Ensure that the addresses and their corresponding subnets do not overlap. Service communication issues can result if they do.

You will also need the following additional IP addresses and dedicated IP subnets, which are prompted for and applied during configuration of the appliance:

- **Cluster Virtual IP Addresses:** One virtual IP (VIP) address per configured network interface per cluster. This requirement applies to three-node clusters and single-node clusters that are likely to be converted into a three-node cluster in the future. You must supply a VIP for each network interface you configure.

Each VIP should be from the same subnet as the IP address of the corresponding configured interface. There are four interfaces on each appliance: Enterprise, Cluster, Management, and Internet. At a minimum, you must configure the Enterprise and Cluster port interfaces, as they are required for Catalyst Center functionality. An interface is considered configured if you supply an IP address for that interface, along with a subnet mask and one or more associated gateways or static routes. If you skip an interface entirely during configuration, that interface is considered as not configured.

Note the following:

- If you have a single-node setup and do not plan to convert it into a three-node cluster in the future, you are not required to specify a VIP address. However, if you decide to do so, you must specify a VIP address for every configured network interface (just as you would for a three-node cluster).
- If the intracluster link for a single-node cluster goes down, the VIP addresses associated with the Management and Enterprise interfaces also go down. When this happens, Catalyst Center is unusable until the intracluster link is restored (because the Software Image Management [SWIM] and Cisco Identity Services Engine [ISE] integration is not operational and Cisco Catalyst Assurance data is not displayed because information cannot be gathered from Network Data Platform [NDP] collectors).
- Do *not* use a link-local or nonroutable IP address for the Enterprise or Management interface.
- **Default Gateway IP Address:** The IP address for your network's preferred default gateway. If no other routes match the traffic, traffic will be routed through this IP address. Typically, you should assign the default gateway to the interface in your network configuration that accesses the internet. For information on security considerations to keep in mind when deploying Catalyst Center, see the [Cisco Digital Network Architecture Center Security Best Practices Guide](#).
- **DNS Server IP Addresses:** The IP address for one or more of your network's preferred Domain Name System (DNS) servers. During configuration, you can specify multiple DNS server IP addresses by entering them as a space-separated list.
- **(Optional) Static Route Addresses:** The IP addresses, subnet masks, and gateways for one or more static routes. During configuration, you can specify multiple static-route IP addresses, netmasks, and gateways by entering them as a space-separated list.

You can set one or more static routes for an interface on the appliance. You should supply static routes when you want to route traffic in a specific direction other than the default gateway. Each of the interfaces with static routes will be set as the *device* the traffic will be routed through in the IP route command table. For this reason, it is important to match the static route directions with the interface through which the traffic will be sent.

Static routes are not recommended in network device routing tables such as those used by switches and routers. Dynamic routing protocols are better for this. However, you should add static routes where needed, to allow the appliance access to particular parts of the network that can be reached no other way.

- **NTP Server IP Addresses:** The DNS-resolvable hostname or IP address for at least one Network Time Protocol (NTP) server.

During configuration, you can specify multiple NTP server IP addresses/masks or hostnames by entering them as a space-separated list. For a production deployment, we recommend that you configure a minimum of three NTP servers.

Specify these NTP servers during preflight hardware synchronization, and again during the configuration of the software on each appliance in the cluster. Time synchronization is critical to the accuracy of data and the coordination of processing across a multihost cluster. Before deploying the appliance in a production environment, make sure that the time on the appliance system clock is current and that the

NTP servers you specified are keeping accurate time. If you are planning to integrate the appliance with ISE, you should also ensure that ISE is synchronizing with the same NTP servers as the appliance.

- **Container Subnet:** Identifies one dedicated IP subnet for the appliance to use in managing and getting IP addresses for communications among its internal application services, such as Assurance, inventory collection, and so on. By default, Catalyst Center configures a link-local subnet (**169.254.32.0/20**) for this parameter, and we recommend that you use this subnet. If you choose to enter another subnet, ensure that it does not conflict with or overlap any other subnet used by Catalyst Center's internal network or any external network. Also ensure that the minimum size of the subnet is 21 bits. The subnet you specify must conform with the IETF RFC 1918 and RFC 6598 specifications for private networks, which support the following address ranges:

- 10.0.0.0/8
- 172.16.0.0/12
- 192.168.0.0/16
- 100.64.0.0/10

For details, see RFC 1918, [Address Allocation for Private Internets](#), and RFC 6598, [IANA-Reserved IPv4 Prefix for Shared Address Space](#).



Important

- Ensure that you specify a valid CIDR subnet. Otherwise, incorrect bits will be present in the 172.17.1.0/20 and 172.17.61.0/20 subnets.
 - After configuration of your Catalyst Center appliance is completed, you *cannot* assign a different subnet without first reimaging the appliance (see [Reimage the Appliance](#)).
-

- **Cluster Subnet:** Identifies one dedicated IP subnet for the appliance to use in managing and getting IPs for communications among its infrastructure services, such as database access, the message bus, and so on. By default, Catalyst Center configures a link-local subnet (**169.254.48.0/20**) for this parameter, and we recommend that you use this subnet. If you choose to enter another subnet, ensure that it does not conflict with or overlap any other subnet used by Catalyst Center's internal network or any external network. Also ensure that the minimum size of the subnet is 21 bits. The subnet you specify must conform with the IETF RFC 1918 and RFC 6598 specifications for private networks, which support the following address ranges:

- 10.0.0.0/8
- 172.16.0.0/12
- 192.168.0.0/16
- 100.64.0.0/10

For details, see RFC 1918, [Address Allocation for Private Internets](#), and RFC 6598, [IANA-Reserved IPv4 Prefix for Shared Address Space](#).)

If you were to specify 10.10.10.0/21 as your Container subnet, you could also specify a Cluster subnet of 10.0.8.0/21 since these two subnets do not overlap. Also note that the configuration wizard detects overlaps (if any) between these subnets and prompts you to correct the overlap.

**Important**

- Ensure that you specify a valid CIDR subnet. Otherwise, incorrect bits will be present in the 172.17.1.0/20 and 172.17.61.0/20 subnets.
- After configuration of your Catalyst Center appliance is completed, you *cannot* assign a different subnet without first reimaging the appliance (see [Reimage the Appliance](#)).
- When entering an IP address for the Cluster port, container subnet, or cluster subnet, don't specify an address that falls within the 169.254.0.0/23 subnet.

The recommended total IP address space for the two Container and Cluster subnets contains 4,096 addresses, broken down into two /21 subnets of 2,048 addresses each. The two /21 subnets must not overlap. The Catalyst Center internal services require a dedicated set of IP addresses to operate (a Catalyst Center microservice architecture requirement). To accommodate this requirement, you must allocate two dedicated subnets for each Catalyst Center system.

One reason the appliance requires this amount of address space is to maintain system performance. Because it uses internal routing and tunneling technologies for east-west (inter-node) communications, using overlapping address spaces forces the appliance to run Virtual Routing and Forwarding (VRF) FIBs internally. This leads to multiple encaps and decaps for packets going from one service to another, causing high internal latency at a very low level, with cascading impacts at higher layers.

Another reason is the Catalyst Center [Kubernetes-based service containerization](#) architecture. Each appliance uses the IP addresses in this space for each Kubernetes K8 node. Multiple nodes can make up a single service. Currently, Catalyst Center supports more than 100 services, each requiring several IP addresses, and new features and corresponding services are being added all the time. The address space requirement is purposely kept large at the start to ensure that Cisco can add new services and features without running out of IP addresses or requiring customers to reallocate contiguous address spaces simply to upgrade their systems.

The services supported over these subnets are also enabled at Layer 3. The Cluster space, in particular, carries data between application and infrastructure services, and is heavily used.

The RFC 1918 and RFC 6598 requirement is because of the requirement by Catalyst Center to download packages and updates from the cloud. If the selected IP address ranges do not conform with RFC 1918 and RFC 6598, this can quickly lead to problems with public IP address overlaps.

Required Internet URLs and Fully Qualified Domain Names

The appliance requires secure access to the following table of URLs and Fully Qualified Domain Names (FQDNs).

The table describes the features that make use of each URL and FQDN. You must configure either your network firewall or a proxy server so that IP traffic can travel to and from the appliance and these resources. If you cannot provide this access for any listed URL and FQDN, the associated features will be impaired or inoperable.

For more on requirements for proxy access to the internet, see [Provide Secure Access to the Internet](#).

Table 1: Required URLs and FQDN Access

In order to...	...Catalyst Center must access these URLs and FQDNs
Download updates to the system and application package software; submit user feedback to the product team.	Recommended: *.ciscoconnectdna.com:443 ¹ Customers who want to avoid wildcards can specify these URLs instead: <ul style="list-style-type: none"> • https://www.ciscoconnectdna.com • https://cdn.ciscoconnectdna.com • https://registry.ciscoconnectdna.com • https://registry-cdn.ciscoconnectdna.com
Catalyst Center update package.	<ul style="list-style-type: none"> • https://*.ciscoconnectdna.com/ • *.cloudfront.net • *.tesseractcloud.com
Smart Account and SWIM software downloads.	<ul style="list-style-type: none"> • https://apx.cisco.com • https://cloudsso.cisco.com/as/token.oauth2 • https://*.cisco.com/ • https://download-ssc.cisco.com/
Authenticate with the cloud domain.	https://dnaservices.cisco.com
Integrate with ThousandEyes.	<ul style="list-style-type: none"> • *.awsglobalaccelerator.com • api.thousandeyes.com
Manage Cisco Enterprise Network Function Virtualization Infrastructure Software (NFVIS) devices.	*.amazonaws.com
Collect customer behavior telemetry.	https://data.pendo.io
Allow API calls to enable access to Cisco CX Cloud Success Tracks. Otherwise, the enhancements made to extended configuration-based scanning for the Security Advisories, Bug Identifier, and EOX features that Machine Reasoning Engine (MRE) supports will not operate as expected.	https://api-cx.cisco.com
Integrate with Webex.	<ul style="list-style-type: none"> • http://analytics.webexapis.com • https://webexapis.com
User feedback.	https://dnacenter.uservoice.com

In order to...	...Catalyst Center must access these URLs and FQDNs
Integrate with Cisco Meraki.	<p>Recommended: *.meraki.com:443</p> <p>Customers who want to avoid wildcards can specify these URLs instead:</p> <ul style="list-style-type: none"> • dashboard.meraki.com:443 • api.meraki.com:443 • n63.meraki.com:443
Check SSL/TLS certificate revocation status using OCSP/CRL.	<ul style="list-style-type: none"> • http://validation.identrust.com/crl/hydrantidca01.crl • http://commercial.ocsp.identrust.com <p>Note These URLs should be reachable both directly and through the proxy server that's configured for Catalyst Center.</p>
Allow Cisco authorized specialists to collect troubleshooting data when Catalyst Center Remote Support functionality is enabled.	wss://prod.radkit-cloud.cisco.com:443
Integrate with cisco.com and Cisco Smart Licensing.	<p>*.cisco.com:443</p> <p>Customers who want to avoid wildcards can specify these URLs instead:</p> <ul style="list-style-type: none"> • software.cisco.com • cloudsso.cisco.com • cloudsso1.cisco.com • cloudsso2.cisco.com • apiconsole.cisco.com • api.cisco.com • apx.cisco.com • sso.cisco.com • apmx-prod1-vip.cisco.com • apmx-prod2-vip.cisco.com • tools.cisco.com • tools1.cisco.com • tools2.cisco.com • smartreceiver.cisco.com
Connect to the Network-Based Application Recognition (NBAR) cloud.	prod.sdavc-cloud-api.com:443

In order to...	...Catalyst Center must access these URLs and FQDNs
Render accurate information in site and location maps.	<ul style="list-style-type: none"> • www.mapbox.com • *.tiles.mapbox.com/*:443. For a proxy, the destination is *.tiles.mapbox.com/*
For Cisco AI Network Analytics data collection, configure your network or HTTP proxy to allow outbound HTTPS (TCP 443) access to the cloud hosts.	<ul style="list-style-type: none"> • https://api.use1.prd.kairos.ciscolabs.com (US East Region) • https://api.euc1.prd.kairos.ciscolabs.com (EU Central Region)
Access a menu of interactive help flows that let you complete specific tasks from the GUI.	https://ec.walkme.com
Access the licensing service.	https://swapi.cisco.com
Integrate with Cisco Spaces.	<ul style="list-style-type: none"> • https://dnaspaces.io • https://dnaspaces.eu • https://ciscospaces.sg

¹ Cisco owns and maintains ciscoconnectdna.com and its subdomains. The Cisco Connect DNA infrastructure meets Cisco Security and Trust guidelines and undergoes continuous security testing. This infrastructure is robust, with built-in load balancing and automation capabilities, and is monitored and maintained by a cloud operations team to ensure 24x7x365 availability.

Provide Secure Access to the Internet

By default, the appliance is configured to access the internet in order to download software updates, licenses, and device software, as well as provide up-to-date map information, user feedback, and so on. Providing internet connections for these purposes is a mandatory requirement.

Using an HTTPS proxy server is a reliable way to access remote URLs securely. We recommend that you use an HTTPS proxy server to provide the appliance with the access it needs to the URLs listed in [Required Internet URLs and Fully Qualified Domain Names](#). During appliance installation, you are prompted to enter the URL and port number of the proxy server you want to use for this purpose, along with the proxy's login credentials (if the proxy requires them).

As of this release, the appliance supports communication with proxy servers over HTTP only. You can place the HTTPS proxy server anywhere within your network. The proxy server communicates with the internet using HTTPS, while the appliance communicates with the proxy server via HTTP. Therefore, we recommend that you specify the proxy's HTTP port when configuring the proxy during appliance configuration.

If you need to change the proxy setting after configuration, you can do so using the GUI.

Required Network Ports

The following tables list the well-known network service ports that the appliance uses. You must ensure that these ports are open for traffic flows to and from the appliance, whether you open them using firewall settings or a proxy gateway.

Additional ports, protocols, and types of traffic must be accommodated if you are deploying the appliance in a network that employs SDA infrastructure. For details, see [Required Ports and Protocols for Cisco Software-Defined Access](#).



Note For information on security considerations when deploying Catalyst Center, see the [Cisco Catalyst Center Security Best Practices Guide](#).

Table 2: Ports: Incoming Traffic

Port Number	Permitted Traffic	Protocol (TCP or UDP)
22	SSH	TCP
67	BOOTP	UDP
80	HTTP	TCP
111	NFS (used for Assurance backups)	TCP and UDP
123	NTP	UDP
162	SNMP	UDP
443	HTTPS	TCP
514	Syslog	UDP
2049	NFS (used for Assurance backups)	TCP and UDP
2068	HTTPS	TCP Note This port acts as the remote KVM console redirect port. If Cisco IMC is used during appliance configuration, the port must be open until configuration of the appliance is complete.
2222	SSH	TCP
9991	Multicast Domain Name System (mDNS)	TCP
20048	NFS (used for Assurance backups)	TCP and UDP

Port Number	Permitted Traffic	Protocol (TCP or UDP)
21730	Application Visibility Service (used for CBAR device communication)	UDP
32767	NFS (used for Assurance backups)	TCP and UDP

Table 3: Ports: Outgoing Traffic

Port Number	Permitted Traffic	Protocol (TCP or UDP)
22	SSH (to network devices)	TCP
23	Telnet (to network devices)	TCP
53	DNS	UDP
80	Port 80 can be used for an outgoing proxy configuration. Other common ports (such as 8080) can also be used when a proxy is configured using the Configuration wizard (if a proxy is already in use for your network). To access Cisco-supported certificates and trust pools, configure your network to allow outgoing IP traffic from the appliance to the Cisco addresses listed at: https://www.cisco.com/security/pki/	TCP
123	NTP	UDP
161	SNMP agent	UDP
443	HTTPS	TCP
5222, 8910	Cisco ISE XMP for PxGrid	TCP
9060	Cisco ISE ERS API traffic	TCP

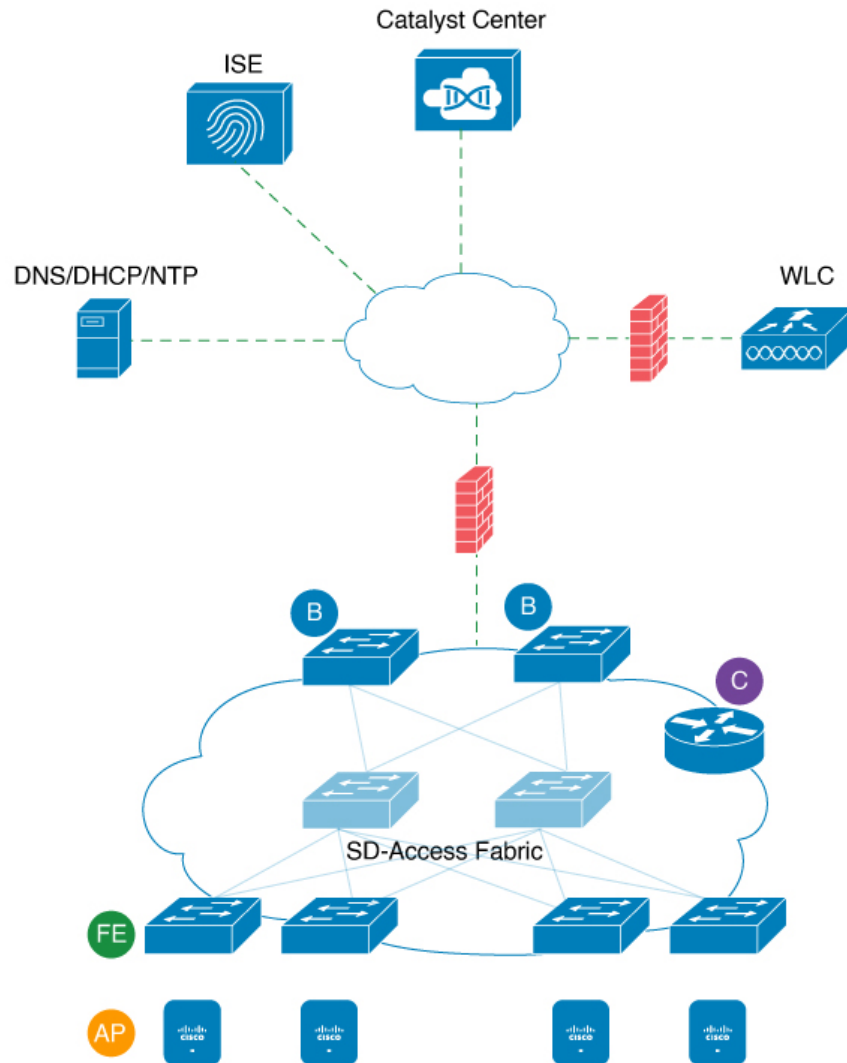


Note Additionally, you can configure your network to allow outgoing IP traffic from the appliance to the Cisco addresses at: <https://www.cisco.com/security/pki/>. The appliance uses the IP addresses listed at the above URL to access Cisco-supported certificates and trust pools.

Required Ports and Protocols for Cisco Software-Defined Access

This topic details the ports, protocols, and types of traffic native to a typical Cisco SD-Access fabric deployment that is similar to the one shown in the following figure.

Figure 3: Cisco SD-Access Fabric Infrastructure



If you have implemented Cisco SD-Access in your network, use the information in the following tables to plan firewall and security policies that secure your Cisco SD-Access infrastructure properly while providing Catalyst Center with the access it requires to automate your network management.

Table 4: Catalyst Center Traffic

Source Port ²	Source	Destination Port	Destination	Description
Any	Catalyst Center	UDP 53	DNS Server	From Catalyst Center to DNS server
Any	Catalyst Center	TCP 22	Fabric underlay	From Catalyst Center to fabric switches' loopbacks for SSH

Any	Catalyst Center	TCP 23	Fabric underlay	From Catalyst Center to fabric switches' loopbacks for TELNET
Any	Catalyst Center	UDP 161	Fabric underlay	From Catalyst Center to fabric switches' loopbacks for SNMP device discovery
ICMP	Catalyst Center	ICMP	Fabric underlay	From Catalyst Center to fabric switches' loopbacks for SNMP device discovery
Any	Catalyst Center	TCP 443	Fabric underlay	App hosting for switches and NFVIS
Any	Catalyst Center	UDP 6007	Switches and routers	From Catalyst Center to switches and routers for NetFlow
Any	Catalyst Center	TCP 830	Fabric underlay	From Catalyst Center to fabric switches for Netconf (Cisco SD-Access embedded wireless)
UDP 123	Catalyst Center	UDP 123	Fabric underlay	From Catalyst Center to fabric switches for the initial period during LAN automation
Any	Catalyst Center	UDP 123	NTP Server	From Catalyst Center to NTP server
Any	Catalyst Center	TCP 22, UDP 161	Cisco Wireless Controller	From Catalyst Center to Cisco Wireless Controller
ICMP	Catalyst Center	ICMP	Cisco Wireless Controller	From Catalyst Center to Cisco Wireless Controller
Any	AP	TCP 32626	Catalyst Center	Used for receiving traffic statistics and packet capture data used by the Cisco Catalyst Assurance Intelligent Capture (gRPC) feature.

² Cluster, PKI, SFTP server, and proxy port traffic are not included in this table.

Table 5: Internet Connectivity Traffic

Source Port	Source	Destination Port	Destination	Description
Any	Catalyst Center	TCP 443	registry.ciscoconnectdna.com	Download Catalyst Center package updates
Any	Catalyst Center	TCP 443	www.ciscoconnectdna.com	Download Catalyst Center package updates
Any	Catalyst Center	TCP 443	registry-cdn.ciscoconnectdna.com	Download Catalyst Center package updates
Any	Catalyst Center	TCP 443	cdn.ciscoconnectdna.com	Download Catalyst Center package updates
Any	Catalyst Center	TCP 443	software.cisco.com	Download device software

Any	Catalyst Center	TCP 443	cloudsso.cisco.com	Validate Cisco.com and Smart Account credentials
Any	Catalyst Center	TCP 443	cloudsso1.cisco.com	Validate Cisco.com and Smart Account credentials
Any	Catalyst Center	TCP 443	cloudsso2.cisco.com	Validate Cisco.com and Smart Account credentials
Any	Catalyst Center	TCP 443	apiconsole.cisco.com	CSSM Smart Licensing API
Any	Catalyst Center	TCP 443	sso.cisco.com	Cisco.com credentials and Smart Licensing
Any	Catalyst Center	TCP 443	api.cisco.com	Cisco.com credentials and Smart Licensing
Any	Catalyst Center	TCP 443	apx.cisco.com	Cisco.com credentials and Smart Licensing
Any	Catalyst Center	TCP 443	dashboard.meraki.com	Meraki integration
Any	Catalyst Center	TCP 443	api.meraki.com	Meraki integration
Any	Catalyst Center	TCP 443	n63.meraki.com	Meraki integration
Any	Catalyst Center	TCP 443	dnacenter.uservoice.com	User feedback submission
Any	Catalyst Center Admin Client	TCP 443	*.tiles.mapbox.com	Render maps in the browser (for access through proxy; the destination is *.tiles.mapbox.com/*)
Any	Catalyst Center	TCP 443	www.mapbox.com	Maps and Cisco Wireless Controller country code identification

Table 6: Cisco Software-Defined Access Fabric Underlay Traffic

Source Port ³	Source	Destination Port	Destination	Description
UDP 68	Fabric underlay	UDP 67	DHCP server	From fabric switches and routers to the DHCP server for DHCP Relay packets initiated by the fabric edge nodes.
Any	Fabric underlay	TCP 80	Catalyst Center	From fabric switch and router loopback IPs to Catalyst Center for PnP
Any	Fabric underlay	TCP 443	Catalyst Center	From fabric switch and router loopback IPs to Catalyst Center for image upgrade
Any	Fabric underlay	UDP 162	Catalyst Center	From fabric switch and router loopback IPs to Catalyst Center for SNMP Traps
Any	Fabric underlay	UDP 514	Catalyst Center	From fabric switches and routers to Cisco Catalyst Assurance
Any	Fabric underlay	UDP 6007	Catalyst Center	From fabric switches and routers to Catalyst Center for NetFlow

Any	Fabric underlay	UDP 123	Catalyst Center	From fabric switches to Catalyst Center; used when doing LAN automation
ICMP	Fabric underlay	ICMP	Catalyst Center	From fabric switch and router loopbacks to Catalyst Center for SNMP: device discovery
UDP 161	Fabric underlay	Any	Catalyst Center	From fabric switch and router loopbacks to Catalyst Center for SNMP: Device Discovery
Any	Fabric underlay	UDP 53	DNS Server	From fabric switches and routers to DNS server for name resolution
TCP and UDP 4342	Fabric underlay	TCP and UDP 4342	Fabric Routers and Switches	LISP-encapsulated control messages
TCP and UDP 4342	Fabric underlay	Any	Fabric Routers and Switches	LISP control-plane communications
Any	Fabric underlay	UDP 4789	Fabric Routers and Switches	Fabric-encapsulated data packets (VXLAN-GPO)
Any	Fabric underlay	UDP 1645/1646/1812/1813	ISE	From fabric switch and router loopback IPs to ISE for RADIUS
ICMP	Fabric underlay	ICMP	ISE	From fabric switches and routers to ISE for troubleshooting
UDP 1700/3799	Fabric underlay	Any	ISE	From fabric switches to ISE for care-of address (CoA)
Any	Fabric underlay	UDP 123	NTP Server	From fabric switch and router loopback IPs to the NTP server
Any	control-plane	UDP and TCP 4342/4343	Cisco Wireless Controller	From control-plane loopback IP to Cisco Wireless Controller for Fabric-enabled wireless

³ Border routing protocol, SPAN, profiling, and telemetry traffic are not included in this table.

Table 7: Cisco Wireless Controller Traffic

Source Port	Source	Destination Port	Destination	Description
UDP 5246/5247/5248	Cisco Wireless Controller	Any	AP IP Address Pool	From Cisco Wireless Controller to an AP subnet for CAPWAP
ICMP	Cisco Wireless Controller	ICMP	AP IP Address Pool	From Cisco Wireless Controller to APs allowing ping for troubleshooting

Any	Cisco Wireless Controller	<ul style="list-style-type: none"> • TCP 443 (Cisco AireOS wireless controllers) • TCP 25103 (Cisco 9800 wireless controllers and Cisco Catalyst 9000 switches with streaming telemetry enabled) 	Catalyst Center	From Cisco Wireless Controller to Catalyst Center for Assurance
Any	Cisco Wireless Controller	UDP 69/5246/5247 TCP 22	AP IP Address Pool	From Cisco Wireless Controller to an AP subnet for CAPWAP
Any	Cisco Wireless Controller	UDP and TCP 4342/4343	Control plane	From Cisco Wireless Controller to control-plane loopback IP address
Any	Cisco Wireless Controller	TCP 22	Catalyst Center	From Cisco Wireless Controller to Catalyst Center for device discovery
UDP 161	Cisco Wireless Controller	Any	Catalyst Center	From Cisco Wireless Controller to Catalyst Center for SNMP
Any	Cisco Wireless Controller	UDP 162	Catalyst Center	From Cisco Wireless Controller to Catalyst Center for SNMP traps
Any	Cisco Wireless Controller	TCP 16113	Cisco Mobility Services Engine (MSE) and Cisco Spectrum Expert	From Cisco Wireless Controller to Cisco MSE and Spectrum Expert for NMSP
Any	Cisco Wireless Controller	UDP 6007	Catalyst Center	From wireless controllers to Catalyst Center for NetFlow network telemetry
ICMP	Cisco Wireless Controller	ICMP	Catalyst Center	From Cisco Wireless Controller to allow ping for troubleshooting
Any	Cisco Wireless Controller and various syslog servers	UDP 514	Cisco Wireless Controller	Syslog (optional)
Any	Cisco Wireless Controller	UDP 53	DNS Server	From Cisco Wireless Controller to DNS server
Any	Cisco Wireless Controller	TCP 443	ISE	From Cisco Wireless Controller to ISE for Guest SSID web authorization
Any	Cisco Wireless Controller	UDP 1645,1812	ISE	From Cisco Wireless Controller to ISE for RADIUS authentication
Any	Cisco Wireless Controller	UDP 1646, 1813	ISE	From Cisco Wireless Controller to ISE for RADIUS accounting

Any	Cisco Wireless Controller	UDP 1700, 3799	ISE	From Cisco Wireless Controller to ISE for RADIUS CoA
ICMP	Cisco Wireless Controller	ICMP	ISE	From Cisco Wireless Controller to ISE ICMP for troubleshooting
Any	Cisco Wireless Controller	UDP 123	NTP server	From Cisco Wireless Controller to NTP server

Table 8: Fabric-Enabled Wireless AP IP Address Pool Traffic

Source Port	Source	Destination Port	Destination	Description
UDP 68	AP IP Address Pool	UDP 67	DHCP server	From an AP IP Address pool to DHCP server.
ICMP	AP IP Address Pool	ICMP	DHCP server	From an AP IP Address pool to ICMP for troubleshooting.
Any	AP IP Address Pool	514	Various	Syslog—Destination configurable. Default is 255.255.255.255.
Any	AP IP Address Pool	UDP 69/5246/5247/5248	Cisco Wireless Controller	From an AP IP Address pool to Cisco Wireless Controller for CAPWAP.
ICMP	AP IP Address Pool	ICMP	Cisco Wireless Controller	From an AP IP Address pool to Cisco Wireless Controller, allowing ping for troubleshooting.

Table 9: Cisco ISE Traffic

Source Port ⁴	Source	Destination Port	Destination	Description
Any	ISE	TCP 64999	Border	From ISE to border node for SGT Exchange Protocol (SXP)
Any	ISE	UDP 514	Catalyst Center	From ISE to syslog server (Catalyst Center)
UDP 1645/1646/1812/1813	ISE	Any	Fabric underlay	From ISE to fabric switches and routers for RADIUS and authorization
Any	ISE	UDP 1700/3799	Fabric underlay, Cisco Wireless Controller	From ISE to fabric switch and router loopback IP addresses for RADIUS Change of Authorization (CoA). UDP port 3799 must also be open from ISE to the wireless controller for CoA.
ICMP	ISE	ICMP	Fabric underlay	From ISE to fabric switches for troubleshooting
Any	ISE	UDP 123	NTP Server	From ISE to NTP server
UDP 1812/1645/1813/1646	ISE	Any	Cisco Wireless Controller	From ISE to Cisco Wireless Controller for RADIUS

ICMP	ISE	ICMP	Cisco Wireless Controller	From ISE to Cisco Wireless Controller for troubleshooting
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⁴ Note: High availability and profiling traffic are not included in this table.

Table 10: DHCP Server Traffic

Source Port	Source	Destination Port	Destination	Description
UDP 67	DHCP server	UDP 68	AP IP Address Pool	From DHCP server to fabric APs
ICMP	DHCP server	ICMP	AP IP Address Pool	ICMP for troubleshooting: Fabric to DHCP
UDP 67	DHCP server	UDP 68	Fabric underlay	From DHCP to fabric switches and routers
ICMP	DHCP server	ICMP	Fabric underlay	ICMP for troubleshooting: Fabric to DHCP
UDP 67	DHCP server	UDP 68	User IP Address Pool	From DHCP server to fabric switches and routers
ICMP	DHCP server	ICMP	User IP Address Pool	ICMP for troubleshooting: User to DHCP

Table 11: NTP Server Traffic

Source Port	Source	Destination Port	Destination	Description
UDP 123	NTP Server	Any	ISE	From NTP server to ISE
UDP 123	NTP Server	Any	Catalyst Center	From NTP server to Catalyst Center
UDP 123	NTP Server	Any	Fabric underlay	From NTP server to fabric switch and router loopback
UDP 123	NTP Server	Any	Cisco Wireless Controller	From NTP server to Cisco Wireless Controller

Table 12: DNS Traffic

Source Port	Source	Destination Port	Destination	Description
UDP 53	DNS Server	Any	Fabric underlay	From DNS server to fabric switches
UDP 53	DNS Server	Any	Cisco Wireless Controller	From DNS server to Cisco Wireless Controller

Required Configuration Information

During appliance configuration, you will be prompted for the following information, in addition to the [Required IP Addresses and Subnets](#):

- **Linux Username:** This is **maglev**. This username is the same on all the appliances in a cluster, including the primary node and secondary nodes, and cannot be changed.
- **Linux Password:** Identifies the password for the Linux user named **maglev**. This password ensures secure access to each appliance using the Linux command line. If required, you can assign a different password for the **maglev** user that's configured on each appliance in a cluster.

You must create the Linux password because there is no default. The password must meet the following requirements:

- Minimum length of eight characters.
- Cannot contain a tab or a line break.
- Contains characters from at least three of the following categories:
 - Uppercase letters (A–Z)
 - Lowercase letters (a–z)
 - Numbers (0–9)
 - Special characters (for example, ! or #)

The Linux password is encrypted and hashed in the Catalyst Center database. If you are deploying a multinode cluster, you will also be prompted to enter the primary node's Linux password on each of the secondary nodes.

- **Password Generation Seed (Optional):** Instead of creating a Linux password, you can enter a seed phrase and click **Generate Password**. The **Maglev Configuration** wizard generates a random and secure password using this seed phrase. You can further edit the generated password by using the **Auto Generated Password** field.
- **Administrator Passphrase:** Identifies the password used for web access to Catalyst Center in a cluster. This is the password for the superuser account **admin**, which you use to log in to Catalyst Center for the first time (see [Complete the Quick Start Workflow](#)). You are prompted to change this password when you log in for the first time.

You must create this password because there is no default. The Administrator Passphrase must meet the same requirements as the Linux password, described earlier.

- **Cisco IMC User Password:** Identifies the password used for access to the Cisco IMC GUI. The factory default is *password*, but you are prompted to change it when you first set up Cisco IMC for access using a web browser (see [Enable Browser Access to Cisco Integrated Management Controller](#)).

The Cisco IMC user password must meet the same requirements as the Linux password described earlier. It can be changed back to *password* only by a reset to factory defaults.

- **Primary Node IP Address:** Required only when you are installing secondary nodes in a cluster. This is the IP address of the cluster port on the primary node (see [Interface Cable Connections](#)).

Required First-Time Setup Information

After you have configured your appliances, log in to Catalyst Center and complete the essential setup tasks. During this first-time setup, you should have the following information:

- **New Admin Superuser Password:** You will be prompted to enter a new password for the Catalyst Center admin super user. Resetting the super user password enhances operational security. This is especially important if, for example, the enterprise staff who installed and configured the Catalyst Center appliance is not a Catalyst Center user or administrator.
- **Cisco.com Credentials:** The Cisco.com user ID and password that your organization uses to register software downloads and receive system communications through email.
- **Cisco Smart Account Credentials:** The Cisco.com Smart Account user ID and password your organization uses for managing your device and software licenses.
- **IP Address Manager URL and Credentials:** The host name, URL, admin user name, and admin password of the third-party IP address manager (IPAM) server you plan to use with Catalyst Center. This release supports InfoBlox and Bluecat.
- **Proxy URL, Port, and Credentials:** The URL (host name or IP address), port number, user name, and user password of the proxy server you plan to use with Catalyst Center in order to get updates to the Catalyst Center software, manage device licenses, and retrieve other downloadable content.
- **Catalyst Center Users:** User names, passwords, and privilege settings for the new Catalyst Center users you will be creating. We recommend that you always use one of these new user accounts for all your normal Catalyst Center operations. Avoid using the admin super user account for activities, except reconfiguring Catalyst Center and operations where super user privileges are explicitly required.

For details about how to launch and respond to the first-time setup wizard that prompts you for this information, see [Complete the Quick Start Workflow](#).

You will also need the following information to complete the remaining setup tasks, which can be done after your first login:

- **ISE Server IP and Credentials:** You will need the Cisco ISE server IP address and credentials, administrative user name, and password. These are needed to log in to and configure your organization's ISE server to share data with Catalyst Center, as explained in [Integrate Cisco ISE With Catalyst Center](#).

Installation of or upgrade to the latest 2.3.7.x release of Catalyst Center checks to see if Cisco ISE is configured as an authentication and policy (AAA) server. If the correct version of Cisco ISE is already configured, you can start migrating group policy data from Cisco ISE to Catalyst Center.

If Cisco ISE is not configured, or if the required version of Cisco ISE is not present, Catalyst Center installs, but Group Based Policy is disabled. You must install or upgrade Cisco ISE and connect it to Catalyst Center. You can then start the data migration.

Catalyst Center data present in the previous version is preserved when you upgrade. The data migration operation merges data from Catalyst Center and Cisco ISE. If the migration encounters a conflict, preference is given to data from Cisco ISE.

If Catalyst Center becomes unavailable, and it is imperative to manage policies before Catalyst Center becomes available once more, there is an option in Cisco ISE to override the Read-Only setting. This allows you to make policy changes directly in Cisco ISE. After Catalyst Center is available again, you must disable the Read-Only override on Cisco ISE, and re-synchronize the policy data on Catalyst Center.

Group Based Access Control Settings page. Only use this option when absolutely necessary, since changes made directly in Cisco ISE are not propagated to Catalyst Center.

- **Authorization and Policy Server Information:** If you are using Cisco ISE as your authentication and policy server, you will need the same information listed in the previous bullet, plus the ISE CLI user name, CLI password, server FQDN, a subscriber name (such as *cc*), the ISE SSH key (optional), the protocol choice (RADIUS or TACACS), the authentication port, the accounting port, and retry and timeout settings.

If you are using an authorization and policy server that is not Cisco ISE, you will need the server's IP address, protocol choice (RADIUS or TACACS), authentication port, accounting port, and retry and timeout settings.

This information is required to integrate Catalyst Center with your chosen authentication and policy server, as explained in [Configure Authentication and Policy Servers](#).

- **SNMP Retry and Timeout Values:** This is required to set up device polling and monitoring, as explained in [Configure SNMP Properties](#).