Overview of the IoT FND North Bound API

This section describes the North Bound API (NB API) supported by the Cisco IoT Field Network Director (Cisco IoT FND or IoT FND). Topics include:

IoT FND maintains a database of inventory information about network devices, groups, properties, metrics, and events. You can use NB API to retrieve network statistics and properties for deployed networked devices. You can also access the database using the IoT FND NB API (Figure 1).

The IoT FND NB API is a Simple Object Access Protocol (SOAP) API that provides methods for:

- Read-only access to the IoT FND database
- Push-based event reporting
- Invoking management operations such as mesh firmware updates, rule creation, and mesh migration

Many APIs return lists of identifiers or objects. Because these lists could be very long in a large network, every method has three optional arguments: queryId, count, and offset. NB APIs use the Web Services Description Language (WDSL) to define network services.

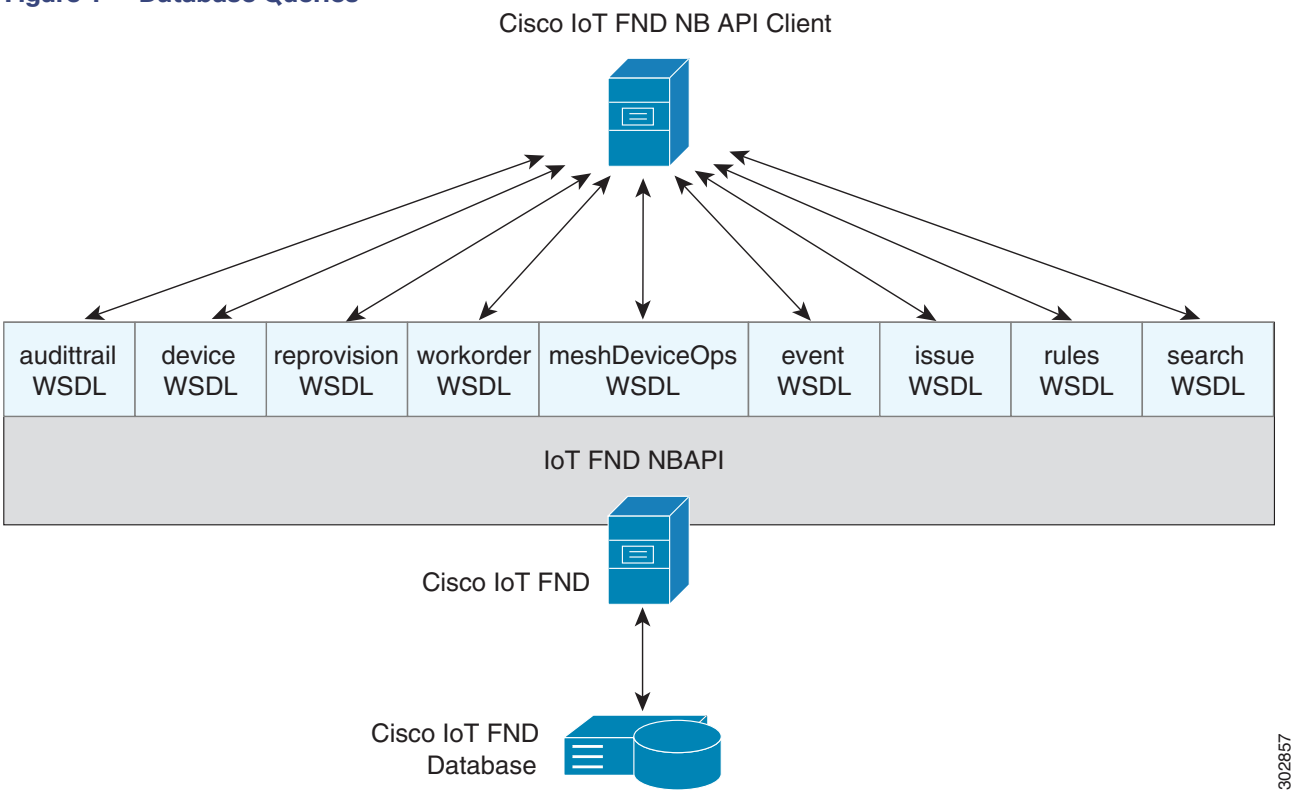
When no argument is included, the call returns the first count list items. The maximum count is 1000 items.

To iterate through the full contents of a list, select a queryId, which is a random string. Then repeat the call using the same queryId, and increment the offset by *count* for each call, starting from 0. When the call returns an empty list, the iteration is complete, and the queryId is invalidated on the server. Reusing queryId starts the request from the beginning. If a particular queryId is not used for 10 minutes, it is cleared to conserve resources.

The API uses HTTPS and HTTP Basic Authentication for username and password authorization, and for sending event data.

Note: IoT FND Release 2.1.1-54 and later do not support TLSv1.0 or TLSv1.1 based connections. Only TLS1.2 based connections are supported.

Figure 1 Database Queries



Document Conventions

This document uses the following conventions:

Conventions	Indication
bold font	Commands and keywords and user-entered text appear in **bold** font.
italic font	Document titles, new or emphasized terms, and arguments for which you supply values are in *italic* font.
[ ]	Elements in square brackets are optional.
{x | y | z }	Required alternative keywords are grouped in braces and separated by vertical bars.
[x | y | z]	Optional alternative keywords are grouped in brackets and separated by vertical bars.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.
courier font	Terminal sessions and information the system displays appear in courier font.
< >	Nonprinting characters such as passwords are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

Note: Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.

Caution: **Means *reader be careful.* In this situation, you might perform an action that could result in equipment damage or loss of data.**

Warning: **IMPORTANT SAFETY INSTRUCTIONS**

Means danger. You are in a situation that could cause bodily injury. Before you work on any equipment, be aware of the hazards involved with electrical circuitry and be familiar with standard practices for preventing accidents. Use the statement number provided at the end of each warning to locate its translation in the translated safety warnings that accompanied this device.

Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see *What's New in Cisco Product Documentation*.

To receive new and revised Cisco technical content directly to your desktop, you can subscribe to the What's New in Cisco Product Documentation RSS feed. The RSS feeds are a free service.

IoT FND NB API Modules

IoT FND defines the following API modules:

API Module	WSDL URL	Method Calls
audittrail Audit Trail API, page 17	https://*<server_address>*/nbapi/audittrail?wsdl	deleteAuditTrailsByTime getAuditTrailsByOperation getAuditTrailsByTime getAuditTrailsByUser getAuditTrailsByUserAndIp getAuditTrailsByUserAndOperation getAuditTrailsByUserIpAndOperation
device Device Management API, page 29	https://*<server_address>*/nbapi/device?wsdl	addDevices exportDevices getJob removeDevices setDevices updateDevices
reprovision Mesh Firmware Migration API, page 37	https://*<server_address>*/nbapi/reprovision?wsdl	cancelReprovision showReprovisionStatus startReprovisionByEidList startReprovisionByEidListAbridged startReprovisionByGroup startReprovisionByGroupAbridged
meshDeviceOps Firmware Upgrade API, page 45	https://*<server_address>*/nbapi/meshDeviceOps?wsdl	getFirmwareUploadStatus getFirmwareImageInfoList scheduleReload setBackupFirmwareImage startUpload stopUpload
Note: Firmware upgrades are only supported on Cisco IOS.		
workorder Workorders API, page 53	https://*<server_address>*:portnumber/nbapi/workorder	RequestUserAuthentication RequestSignedAuthorization UploadServiceReport

API Module	WSDL URL	Method Calls
event Event API, page 63	https://*<server_address>*/nbapi/event?wsdl	searchEvents subscribeForCgmeshOutage subscribeForEvents unSubscribeForCgmeshOutage unSubscribeForEvents
issue Issues API, page 87	https://*<server_address>*/nbapi/issue?wsdl	searchIssues
rules Rules API, page 93	https://*<server_address>*/nbapi/rules?wsdl	activateRule createRule deactivateRule dropRule findRulesByName findRulesByUsername
search Search API, page 105	https://*<server_address>*/nbapi/search?wsdl	getDeviceDetails getDeletedDevices getUpdatedDeviceDetails getGroups getMetricHistory searchDevices findEidsForIpAddress findEidsForIpAddressByDeviceType

To view the WSDL of the API in a Web browser, use this URL format:

https://*<server_address>*/nbapi/*<api>*?wsdl

For example:

https://10.27.167.19/nbapi/event?wsdl

Query Syntax

The IoT FND NB API supports the following simple query language:

- Search `:= filter ?[filter ...]`
- Filter `:= Filter := <fieldName><operator><value>`
- Operator `:= < | <= | > | >= | <> | = | :`

Search query examples:

```
"deviceType:cgr1000 uptime>=100 uplinkTxDrops<-50"
"deviceType:cgmesh uptime>=100"
"" (search everything)
"uptime>=100 status:up"
"eid:xyz"
"xyz"
```

Property Field Names for All Devices

Table 1 describes the property field names available to all devices. Field names are case sensitive.

Table 1 Property Field Names for All Devices

Field Name	Type	Description	Example
eid	string	Unique identifier for the device. For routers and communication modules, this is the string representation of the X.500 distinguished name subject ID contained in the devices X.509 certificate. This field name is obtained from the notice-of-shipment file.	CGR1240/K9 CGR1120/K9
deviceType	enum	Identifier for the device type that indicates which IoT FND module coordinates communications with the device. ■ Cisco Connected Grid Routers 1000 series are **cgr1000** ■ Cisco Aggregation Services Routers 1000 series are **asr1000** ■ Cisco Integrated Service Routers 3900 series are **isr3900** ■ Cisco 800 Series Integrated Services Routers (ISR 800s) are **c800** ■ Cisco 800 Series Integrated Services Routers (IR 800s) are **ir800** ■ Cisco 800 Series Access Points are **ap800** ■ Cisco 500 Series Wireless Personal Area Network (WPAN) Industrial Routers (IR 500) are **ir500** ■ Communications modules are **cgmesh** ■ The IoT FND database is **db** This identifier is obtained from the notice-of-shipment file.	cgmesh cgr1000
ip	string	Primary IP address that IoT FND uses to contact the device. Can be IPv4 or IPv6. This address is obtained when the device registers with IoT FND.	1.1.1.1
lat	decimal	Latitude of the device obtained from manual CSV import.	10
lng	decimal	Longitude of the device obtained from manual CSV import.	-11.1
alt	decimal	Altitude of the device obtained from manual CSV import.	10
mapLevel	decimal integer	Minimum map zoom level at which the device is displayed on the map. This is useful for viewing large networks. This value is obtained from manual CSV import and is an optional field.	16
geoHash	string	String hash latitude and longitude values used for automatic hierarchical grid-based clustering of the devices.	s1qeg9spc8n95rrw1dww7

Table 1 Property Field Names for All Devices (continued)

Field Name	Type	Description	Example
lastHeard	timestamp	Time when the device was last heard from or contacted. This is used as the primary determiner of device activity level and status. This value is automatically set when the device reports to the IoT FND or the IoT FND contacts the device.	2011-05-02 00:00:00
status	enum	Current status of the device automatically set by IoT FND. Values are limited to up, down, and unheard.	up
certC	string	X.500 country name from the certificate subject, if one exists. This value is obtained from the notice-of-shipment file, as are all “cert” properties.	US
certST	string	X.500 state or province name, if one exists.	CA
certL	string	X.500 locality name, if one exists.	San Jose
certO	string	X.500 organization name, if one exists.	Cisco Systems, Inc.
certOU	string	X.500 organizational unit name, if one exists.	Operations Department
certCN	string	X.500 common name, if one exists.	App Client
certSN	string	X.500 serial number, if one exists.	12:34:A4:B9
pid	string	Product ID for the device. For routers and communication modules, this is the Cisco Secure Unique Device Identifier (SUDI) product ID from the certificate.	CGR1240/K9
vid	string	Version ID for the device. Obtained from the SUDI for routers and communication modules.	1.0
sn	string	Serial number for the device.	JAF1741ALPA

Property Field Names for Supported Routers

Table 2 describes the property field names available to supported Connected Grid routers. The field names are case sensitive.

Table 2 Property Field Names for Supported Routers

Field Name	Type	Description
activeLinkType	string	Physical link type over which device communicates with other devices, including IoT FND.
endUserIPv6Prefix	string	End user IPv6 address for basic mapping rule for the device.
endUserIPv6PrefixLen	string	Prefix length for the end user IPv6 address.
mapTipv6Address	string	Map-T settings IPv6 address.
mapTipv4Address	string	Map-T settings IPv4 address.
mapTpsid	string	Map-T status PSID.
meshAddress	string	IP address of the mesh link automatically assigned by IoT FND during registration.
meshLocalAddress	string	Local WPAN address of the mesh link automatically assigned by IoT FND during registration.
meshPrefix	string	Subnet prefix address.
meshPrefixLength	string	Subnet prefix address length.
meshPanid	string	Subnet Private Area Network (PAN) ID.

Property Field Names for Range Extenders

Table 3 describes the property field names available to range extenders. The field names are case sensitive.

Table 3 Property Field Names for Range Extenders

Field Name	Type	Description
batteryState	string	Determine the current battery state.
bbuManufacturer	string	The manufacturer of the Battery Backup Unit (BBU).
bbuPid	string	The physical model name of the BBU.
bbuPresent	string	The BBU hardware is present.
bbuReady	string	The BBU is ready.
bbuSn	string	The serial number of the BBU.
bbuVid	string	The physical hardware version of the BBU.
powerSource	string	Determine if the device is running on AC or DC power.

Property Field Names for Communications Modules

Table 4 describes the property field names available to communications modules. The field names are case sensitive.

Table 4 Property Field Names for Communications Modules

Field Name	Type	Description
meshAddress	string	The IP address of the mesh link automatically assigned by IoT FND during registration.
meshLocalAddress	string	Local WPAN address of the mesh link automatically assigned by IoT FND during registration.
meshPrefix	string	Subnet prefix address.
meshPrefixLength	string	Subnet prefix address length.
meshPanid	string	Subnet PAN ID.

Metrics Field Names

Metrics collected by IoT FND are defined per device type, and maintained in a XML file specific to each device type. IoT FND locates the XML files after it loads the boot strap image.

Note: Do not use metrics defined for interfaces for searches.

Metrics for Communication Modules

Table 5 describes the metrics for communication modules.

Table 5 Metrics for Communication Modules

Metric Name	Unit	Min	Max	Description
uptime	sec	0	31536000	Amount of time, in seconds, that the module has been running since last boot.
meshTxSpeed	b/s	0	76800	Current speed of data transmission over the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
meshTxDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the uplink interface because the outbound queue was full.

Table 5 Metrics for Communication Modules

Metric Name	Unit	Min	Max	Description
meshRxSpeed	b/s	0	76800	Rate of data received by the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
meshRxReassemblyDrops	drops/sec	0	1	Rate of incoming packet fragments dropped because there was no space in the reassembly buffer.
meshHops	hops	1	8	Number of hops the element is from the root of its RPL routing tree.
meshLinkCost	–	1	3	RPL cost value for the link between the element and its uplink neighbor.
meshPathCost	–	1	24	RPL path-cost value between the element and the root of the routing tree.
meshRssi	dBm	-80	20	Measured RSSI value of the primary mesh RF uplink.
meshReverseRssi	dBm	-80	20	RSSI value measured by the mesh uplink neighbor.

Metrics for Communication Module Loopback Interface

Table 6 describes the metrics for communication modules loopback interface.

Table 6 Metrics for Communication Modules Loopback Interface

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period (for example, an hour).
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
rxSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period (for example, an hour).
txUnicastPackets	packets/sec	0	76800	Current packet receive rate over the interface, measured in packets per second, averaged over a short element-specific time period (for example, an hour).

Metrics for WPAN Module Interfaces

Table 7 describes the metrics for WPAN module interfaces.

Table 7 Metrics for the WPAN Module Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period (for example, an hour).
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.

Table 7 Metrics for the WPAN Module Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period (for example, an hour).
txUnicastPackets	packets/sec	0	76800	Current packet send rate over the interface, measured in packets per second, averaged over a short element-specific time period (for example, an hour).
rxUnicastPackets	packets/sec	0	76800	Current packet receive rate over the interface, measured in packets per second, averaged over a short element-specific time period (for example, an hour).

Metrics for PPP Interfaces

Table 8 describes the metrics for PPP interfaces.

Table 8 Metrics for PPP Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period.
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
rxSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period.
txUnicastPackets	packets/sec	0	76800	Current packet send rate over the interface, measured in packets per second, averaged over a short element-specific time period.
rxUnicastPackets	packets/sec	0	76800	Current packet receive rate over the interface, measured in packets per second, averaged over a short element-specific time period.

Metrics for RPL Interfaces

Table 9 describes the metrics for Routing Protocol for Low Power and Lossy Networks (RPL) interfaces..

Table 9 Metrics for RPL Interfaces

Metric Name	Unit	Min	Max	Description
hops	hops	1	8	Number of hops the element is from the root RPL tree.
linkCost	–	1	3	RPL cost value for the link between the element and its uplink neighbor.
pathCost	–	1	24	RPL path cost value between the element and the root of the routing tree.
rssi	dBm	-80	20	Measured RSSI value of the primary mesh RF uplink.
reverseRSSI	dBm	-80	20	RSSI value measured by the element's mesh uplink neighbor.

Metrics for Supported Connected Grid Routers

Table 10 describes the metrics for supported routers.

Table 10 Metrics for Supported Routers

Metric Name	Unit	Min	Max	Description
batteryLevel	%	0	100	Percentage of charge remaining in the first battery.
batteryLevel2	%	0	100	Percentage of charge remaining in the second battery.
batteryRuntime	minutes	0	65535	Runtime remaining on the first battery.
batteryRuntime2	minutes	0	65535	Runtime remaining on the second battery.
cellRSSI	dBm	-100	0	Cell Received Signal Strength Indicator (RSSI).
chassisTemp	Celsius	0	100	Internal temperature of the device.
meshEndpointCount	devices	0	10000	Number of active mesh endpoints connected to this element.
meshRoutes	entries	0	1000	Number of entries that a given router has in its source-route table. This is a method to measure the number of elements in a given PAN.
meshRxReassemblyDrops	drops/sec	0	1	Rate of incoming packet fragments dropped because there was no space in the reassembly buffer.
meshRxSpeed	b/s	0	76800	Rate of data received by the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
meshTxDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the uplink interface because the outbound queue was full.
meshTxSpeed	b/s	0	76800	Current speed of data transmission over the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
serial0rxSpeed	b/s	0	100000000	Receive rate for the Serial 0 interface.
serial0txSpeed	b/s	0	100000000	Transmit rate for Serial 0 interface.
serial1rxSpeed	b/s	0	100000000	Receive rate for the Serial 1 interface.
serial1txSpeed	b/s	0	100000000	Transmit rate for Serial 1 interface.
uplinkRssi	dBm	-100	-50	Measured RSSI value of the primary RF uplink used for all RF uplinks.
uplinkRxDrops	drops/sec	0	1	Rate of packets received on the uplink interface, but then dropped because the inbound queue was full.
uplinkRxSpeed	b/s	0	3000000	Rate of data received by the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
uplinkTxDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the uplink interface because the outbound queue was full.
uplinkTxSpeed	b/s	0	500000	Current speed of data transmission over the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
uptime	sec	0	31536000	Amount of time, in seconds, that the element has been running since last boot.

Metrics for Supported Connected Grid Routers

Table 11 describes the metrics for supported routers.

Table 11 Metrics for Supported Routers

Metric Name	Unit	Min	Max	Description
batteryLevel	%	0	100	Percentage of charge remaining in the first battery.
batteryLevel2	%	0	100	Percentage of charge remaining in the second battery.
batteryRuntime	minutes	0	65535	Runtime remaining on the first battery.
batteryRuntime2	minutes	0	65535	Runtime remaining on the second battery.
cellRSSI	dBm	-100	0	Cell Received Signal Strength Indicator (RSSI).
chassisTemp	Celsius	0	100	Internal temperature of the device.
fourTo6Translations	-	0	100000000	MAP-T metrics map4to6Translations.
meshEndpointCount	devices	0	10000	Number of active mesh endpoints connected to this element.
meshRoutes	entries	0	1000	Number of entries that a given router has in its source-route table. This is a method to measure the number of elements in a given PAN.
meshRxReassemblyDrops	drops/sec	0	1	Rate of incoming packet fragments dropped because there was no space in the reassembly buffer.
meshRxSpeed	b/s	0	76800	Rate of data received by the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
meshTxDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the uplink interface because the outbound queue was full.
meshTxSpeed	b/s	0	76800	Current speed of data transmission over the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
serial0rxSpeed	b/s	0	100000000	Receive rate for the Serial 0 interface.
serial0txSpeed	b/s	0	100000000	Transmit rate for Serial 0 interface.
serial1rxSpeed	b/s	0	100000000	Receive rate for the Serial 1 interface.
serial1txSpeed	b/s	0	100000000	Transmit rate for Serial 1 interface.
sixTo4Translations	-	0	100000000	MAP-T metrics map6to4Translations.
uplinkRssi	dBm	-100	-50	Measured RSSI value of the primary RF uplink used for all RF uplinks.
uplinkRxDrops	drops/sec	0	1	Rate of packets received on the uplink interface, but then dropped because the inbound queue was full.
uplinkRxSpeed	b/s	0	3000000	Rate of data received by the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
uplinkTxDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the uplink interface because the outbound queue was full.
uplinkTxSpeed	b/s	0	500000	Current speed of data transmission over the uplink network interface, measured in bits per second, averaged over a short element-specific time period.
uptime	sec	0	31536000	Amount of time, in seconds, that the element has been running since last boot.

Metrics for VPN Interfaces

Table 12 describes the metrics for the VPN interfaces.

Table 12 Metrics for VPN Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period.
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
txSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period.

Metrics for 3G Interfaces

Table 13 describes the metrics for 3G interfaces.

Table 13 Metrics for 3G Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period.
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
txSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period.

Metrics for WiMAX Interfaces

Table 14 describes the metrics for WiMAX interfaces.

Table 14 Metrics for WiMAX Module Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period.
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
txSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period.

Metrics for WPAN Interfaces

Table 15 describes the metrics for the WPAN interfaces.

Table 15 Metrics for WPAN Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period.
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
txSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period.

Metrics for Management Interfaces

Table 16 describes the metrics for management interfaces.

Table 16 Metrics for Management Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period.
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
txSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period.

Metrics for Ethernet Interfaces

Table 17 describes the metrics for Ethernet interfaces.

Table 17 Metrics for Ethernet Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period.
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
txSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period.

Metrics for Serial Interfaces

Table 18 describes the metrics for the serial interfaces.

Table 18 Metrics for Serial Interfaces

Metric Name	Unit	Min	Max	Description
txSpeed	b/s	0	76800	Current speed of data transmission over the interface, measured in bits per second, averaged over a short element-specific time period.
txDrops	drops/sec	0	1	Rate of packets dropped while trying to transmit on the interface because the outbound queue was full.
txSpeed	b/s	0	76800	Rate of data received by the network interface, measured in bits per second, averaged over a short element-specific time period.