ipinfusion™

# OcNOS®

## Open Compute Network Operating System for Service Providers

## Streaming Telemetry

**Version 7.0.0**

**February 2026**

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**Trademarks:**

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# PREFACE

## About this Guide

This guide describes how to configure Streaming Telemetry in OcNOS.

## Audience

This guide is intended for network administrators and other engineering professionals who configure OcNOS.

## Conventions

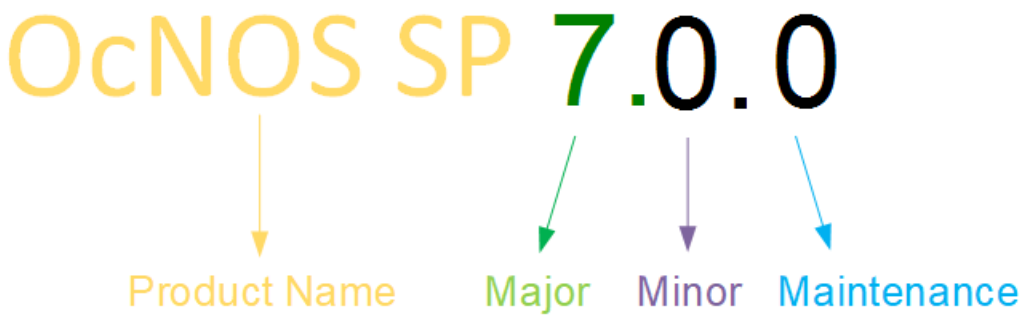
The Table 1 table shows the conventions used in this guide.

**Table 1. Conventions**

| Convention | Description |
|---|---|
| Italics | Emphasized terms; titles of books |
| **Note:** | Special instructions, suggestions, or warnings |
| `monospaced type` | Code elements such as commands, parameters, files, and directories |

## IP Infusion Product Release Version

Each integer in release numbers indicates Major, Minor, and Maintenance release versions. Build numbers that follow the release numbers are for internal tracking and verification of the software build process and are visible to customers as part of the software version number.




**Product Name:** IP Infusion Product Family

**Major Version:** New customer-facing functionality that represents a significant change to the code base; including a significant marketing change or direction in the product.

**Minor Version:** Enhancements or extensions to existing features, changes to address external needs, or internal improvements to satisfy new sales regions or marketing initiatives.

**Maintenance Version:** A collection of product bugs or issues usually scheduled every 30 or 60 days, based on the number of issues.

# Related Documentation

For information about installing OcNOS, see the *Installation Guide* for your platform.

# Feature Availability

Each OcNOS SKU contains a set of supported features. For a list of available features based on the SKU that you purchased, refer to the *Feature Matrix* .

# Migration Guide

Check the *Migration Guide* for necessary configuration changes before migrating from one version of OcNOS to another.

# IP Maestro Support

Monitor devices running OcNOS Release 6.3.4-70 and above using IP Maestro software.

# Technical Support

IP Infusion maintains an online technical support site that provides a variety of technical support programs for licensed OcNOS customers at the Technical Assistance Center.

Customers and partners enjoy full access to the support website. The site allows customers and partners to open technical support calls, update open calls with new information, and review the status of open or closed calls. The password-protected site includes technical documentation, Release Notes, and descriptions of service offerings.

## Technical Sales

Contact the IP Infusion sales representative for more information about the OcNOS solution.

## Technical Documentation

For core commands and configuration procedures, visit: Product Documentation.

For training videos, visit: OcNOS Free Training Videos.

For a list of supported platforms and SKUs of OcNOS features, refer to the OcNOS Feature Matrix.

## Documentation Disclaimer

The global documentation site is evolving to provide an enhanced website user experience for select topics included in this release. Some guides are now available outside the existing documentation library and can be accessed directly from custom documentation landing pages. These guides offer robust in-built search functionality.

For the latest documentation, visit the product-specific documentation landing page and select the relevant guide.

## Comments

If you have comments, or need to report a problem with the content, contact techpubs@ipinfusion.com.

# Command Line Interface

This chapter introduces the OcNOS Command Line Interface (CLI) and how to use its features.

## Overview

You use the CLI to configure, monitor, and maintain OcNOS devices. The CLI is text-based and each command is usually associated with a specific task.

You can give the commands described in this manual locally from the console of a device running OcNOS or remotely from a terminal emulator such as putty or xterm. You can also use the commands in scripts to automate configuration tasks.

## Chapter Organization

The chapters in command references are organized as described in Command Description Format (page 23).

The chapters in configuration guides are organized into these major sections:

- An overview that explains a configuration in words
- Topology with a diagram that shows the devices and connections used in the configuration
- Configuration steps in a table for each device where the left-hand side shows the commands you enter and the right-hand side explains the actions that the commands perform
- Validation which shows commands and their output that verify the configuration

## Command Line Interface Help

You access the CLI help by entering a full or partial command string and a question mark “?”. The CLI displays the command keywords or parameters along with a short description. For example, at the CLI command prompt, type:

```
> show ?
```

The CLI displays this keyword list with short descriptions for each keyword:

```
show ?
  application-priority            Application Priority
  arp                             Internet Protocol (IP)
  bfd                             Bidirectional Forwarding Detection (BFD)
  bgp                             Border Gateway Protocol (BGP)
  bi-lsp                          Bi-directional lsp status and configuration
  bridge                          Bridge group commands
  ce-vlan                         COS Preservation for Customer Edge VLAN
  class-map                       Class map entry
  cli                             Show CLI tree of current mode
  clns                            Connectionless-Mode Network Service (CLNS)
  control-adjacency               Control Adjacency status and configuration
  control-channel                 Control Channel status and configuration
  cspf                            CSPF Information
  customer                        Display Customer spanning-tree
  cvlan                           Display CVLAN information
  debugging                       Debugging functions
  etherchannel                    LACP etherchannel
```

```
  ethernet                        Layer-2
...
```

If you type the ? in the middle of a keyword, the CLI displays help for that keyword only.

```
> show de?
debugging  Debugging functions
```

If you type the ? in the middle of a keyword, but the incomplete keyword matches several other keywords, OcNOS displays help for all matching keywords.

```
> show i? (CLI does not display the question mark).
interface  Interface status and configuration
ip         IP information
isis       ISIS information
```

## Command Completion

The CLI can complete the spelling of a command or a parameter. Begin typing the command or parameter and then press the tab key. For example, at the CLI command prompt type **sh**:

```
> sh
```

Press the tab key. The CLI displays:

```
> show
```

If the spelling of a command or parameter is ambiguous, the CLI displays the choices that match the abbreviation. Type **show i** and press the tab key. The CLI displays:

```
> show i
  interface  ip         ipv6       isis
> show i
```

The CLI displays the **interface** and **ip** keywords. Type **n** to select **interface** and press the tab key. The CLI displays:

```
> show in
> show interface
```

Type ? and the CLI displays the list of parameters for the **show interface** command.

```
> show interface
  IFNAME  Interface name
  |       Output modifiers
  >       Output redirection
  <cr>
```

The CLI displays the only parameter associated with this command, the **IFNAME** parameter.

## Command Abbreviations

The CLI accepts abbreviations that uniquely identify a keyword in commands. For example:

```
> sh int xe0
```

is an abbreviation for:

```
> show interface xe0
```

## Command Line Errors

Any unknown spelling causes the CLI to display the error **Unrecognized command** in response to the ?. The CLI displays the command again as last entered.

```
> show dd?
% Unrecognized command
> show dd
```

When you press the Enter key after typing an invalid command, the CLI displays:

```
(config)#router ospf here
                        ^
% Invalid input detected at '^' marker.
```

where the ^ points to the first character in error in the command.

If a command is incomplete, the CLI displays the following message:

```
> show
% Incomplete command.
```

Some commands are too long for the display line and can wrap mid-parameter or mid-keyword, as shown below. This does *not* cause an error and the command performs as expected:

```
area 10.10.0.18 virtual-link 10.10.0.19 authentication-key 57393
```

### Command Negation

Many commands have a **no** form that resets a feature to its default value or disables the feature. For example:

- The **ip address** command assigns an IPv4 address to an interface
- The **no ip address** command removes an IPv4 address from an interface

## Syntax Conventions

Table 2 describes the conventions used to represent command syntax in this reference.

**Table 2. Syntax conventions**

| Convention | Description | Example |
|---|---|---|
| **monospaced font** | Command strings entered on a command line | **show ip ospf** |
| **lowercase** | Keywords that you enter exactly as shown in the command syntax. | `show ip ospf` |
| `UPPERCASE` | See Variable Placeholders (page 22) | `IFNAME` |
| **()** | Optional parameters, from which you must select one. Vertical bars delimit the selections. Do not enter the parentheses or vertical bars as part of the command. | `(A.B.C.D\|<0-4294967295>)` |
| **()** | Optional parameters, from which you select one or none. Vertical bars delimit the | `(A.B.C.D\|<0-4294967295>\|)` |

**Table 2. Syntax conventions (continued)**

| Convention | Description | Example |
|---|---|---|
| | selections. Do not enter the parentheses or vertical bars as part of the command. | |
| `()` | Optional parameter which you can specify or omit. Do not enter the parentheses or vertical bar as part of the command. | `(IFNAME\|)` |
| `{}` | Optional parameters, from which you must select one or more. Vertical bars delimit the selections. Do not enter the braces or vertical bars as part of the command. | `{intra-area <1-255>\|inter-area <1-255>\|external <1-255>}` |
| **`[]`** | Optional parameters, from which you select zero or more. Vertical bars delimit the selections. Do not enter the brackets or vertical bars as part of the command. | `[<1-65535>\|AA:NN\|internet\|local-AS\|no-advertise\|no-export]` |
| `?` | Nonrepeatable parameter. The parameter that follows a question mark can only appear once in a command string. Do not enter the question mark as part of the command. | `?route-map WORD` |
| `.` | Repeatable parameter. The parameter that follows a period can be repeated more than once. Do not enter the period as part of the command. | `set as-path prepend .<1-65535>` |

## Variable Placeholders

Table 3 shows the tokens used in command syntax use to represent variables for which you supply a value.

**Table 3. Variable placeholders**

| Token | Description |
|---|---|
| `WORD` | A contiguous text string (excluding spaces) |
| `LINE` | A text string, including spaces; no other parameters can follow this parameter |
| `IFNAME` | Interface name whose format varies depending on the platform; examples are: **`eth0`**, **`Ethernet0`**, **`ethernet0`**, **`xe0`** |
| `A.B.C.D` | IPv4 address |
| `A.B.C.D/M` | IPv4 address and mask/prefix |
| `X:X::X:X` | IPv6 address |
| `X:X::X:X/M` | IPv6 address and mask/prefix |
| `HH:MM:SS` | Time format |
| `AA:NN` | BGP community value |

**Table 3. Variable placeholders (continued)**

| Token | Description |
|---|---|
| `XX:XX:XX:XX:XX:XX` | MAC address |
| `<1-5>`<br>`<1-65535>`<br>`<0-2147483647>`<br>`<0-4294967295>` | Numeric range |

## Command Description Format

The Table 4 table explains the sections used to describe each command in this reference.

**Table 4. Command descriptions**

| Section | Description |
|---|---|
| Command Name | The name of the command, followed by what the command does and when should it be used |
| Command Syntax | The syntax of the command |
| Parameters | Parameters and options for the command |
| Default | The state before the command is executed |
| Command Mode | The mode in which the command runs; see Command Modes (page 27) |
| Applicability | The command introduced in a specific release version and modified or updated in subsequent versions. |
| Example | An example of the command being executed |

## Keyboard Operations

The Table 5 table lists the operations you can perform from the keyboard.

**Table 5. Keyboard operations**

| Key combination | Operation |
|---|---|
| Left arrow or Ctrl+b | Moves one character to the left. When a command extends beyond a single line, you can press left arrow or Ctrl+b repeatedly to scroll toward the beginning of the line, or you can press Ctrl+a to go directly to the beginning of the line. |
| Right arrow or Ctrl-f | Moves one character to the right. When a command extends beyond a single line, you can press right arrow or Ctrl+f repeatedly to scroll toward the end of the line, or you can press Ctrl+e to go directly to the end of the line. |
| Esc, b | Moves back one word |
| Esc, f | Moves forward one word |
| Ctrl+e | Moves to end of the line |

**Table 5. Keyboard operations (continued)**

| Key combination | Operation |
|---|---|
| Ctrl+a | Moves to the beginning of the line |
| Ctrl+u | Deletes the line |
| Ctrl+w | Deletes from the cursor to the previous whitespace |
| Alt+d | Deletes the current word |
| Ctrl+k | Deletes from the cursor to the end of line |
| Ctrl+y | Pastes text previously deleted with Ctrl+k, Alt+d, Ctrl+w, or Ctrl+u at the cursor |
| Ctrl+t | Transposes the current character with the previous character |
| Ctrl+c | Ignores the current line and redisplays the command prompt |
| Ctrl+z | Ends configuration mode and returns to exec mode |
| Ctrl+l | Clears the screen |
| Up Arrow or Ctrl+p | Scroll backward through command history |
| Down Arrow or Ctrl+n | Scroll forward through command history |

## Show Command Modifiers

**Note:** The show command output included in the guides is for illustration purposes only. Based on the combination of features enabled and ongoing enhancements made to the commands, the output for these commands may vary. For instance, the actual command output may differ depending on the software version, configuration, and platform. Field names, values, and formats are subject to change.

You can use two tokens to modify the output of a **show** command. Enter a question mark to display these tokens:

```
# show users ?
  | Output modifiers
  > Output redirection
```

You can type the | (vertical bar character) to use output modifiers. For example:

```
> show rsvp | ?
  begin     Begin with the line that matches
  exclude   Exclude lines that match
  include   Include lines that match
  last      Last few lines
  redirect  Redirect output
```

### Begin Modifier

The **begin** modifier displays the output beginning with the first line that contains the input string (everything typed after the **begin** keyword). For example:

```
# show running-config | begin xe1
...skipping
interface xe1
ipv6 address fe80::204:75ff:fee6:5393/64
!
interface xe2
```

```
ipv6 address fe80::20d:56ff:fe96:725a/64
!
line con 0
login
!
end
```

You can specify a regular expression after the **begin** keyword, This example begins the output at a line with either “xe2” or “xe4”:

```
# show running-config | begin xe[2-4]

...skipping
interface xe2
 shutdown
!
interface xe4
 shutdown
!
interface svlan0.1
 no shutdown
!
route-map myroute permit 2
!
route-map mymap1 permit 10
!
route-map rmap1 permit 2
!
line con 0
 login
line vty 0 4
 login
!
end
```

## Include Modifier

The **include** modifier includes only those lines of output that contain the input string. In the output below, all lines containing the word “input” are included:

```
# show interface xe1 | include input
    input packets 80434552, bytes 2147483647, dropped 0, multicast packets 0
    input errors 0, length 0, overrun 0, CRC 0, frame 0, fifo 1, missed 0
```

You can specify a regular expression after the **include** keyword. This examples includes all lines with “input” or “output”:

```
#show interface xe0 | include (in|out)put
    input packets 597058, bytes 338081476, dropped 0, multicast packets 0
    input errors 0, length 0, overrun 0, CRC 0, frame 0, fifo 0, missed 0
    output packets 613147, bytes 126055987, dropped 0
    output errors 0, aborted 0, carrier 0, fifo 0, heartbeat 0, window 0
```

## Exclude Modifier

The **exclude** modifier excludes all lines of output that contain the input string. In the following output example, all lines containing the word “input” are excluded:

```
# show interface xe1 | exclude input
Interface xe1
  Scope: both
  Hardware is Ethernet, address is 0004.75e6.5393
  index 3 metric 1 mtu 1500 <UP,BROADCAST,RUNNING,MULTICAST>
```

```
  VRF Binding: Not bound
  Administrative Group(s): None
  DSTE Bandwidth Constraint Mode is MAM
  inet6 fe80::204:75ff:fee6:5393/64
    output packets 4438, bytes 394940, dropped 0
    output errors 0, aborted 0, carrier 0, fifo 0, heartbeat 0, window 0
    collisions 0
```

You can specify a regular expression after the **exclude** keyword. This example excludes lines with “output” or “input”:

```
show interface xe0 | exclude (in|out)put
Interface xe0
  Scope: both
  Hardware is Ethernet  Current HW addr: 001b.2139.6c4a
  Physical:001b.2139.6c4a  Logical:(not set)
  index 2 metric 1 mtu 1500 duplex-full arp ageing timeout 3000
  <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  Bandwidth 100m
  DHCP client is disabled.
  inet 10.1.2.173/24 broadcast 10.1.2.255
  VRRP Master of :  VRRP is not configured on this interface.
  inet6 fe80::21b:21ff:fe39:6c4a/64
    collisions 0
```

### Redirect Modifier

The **redirect** modifier writes the output into a file. The output is not displayed.

```
# show cli history | redirect /var/frame.txt
```

The output redirection token (>) does the same thing:

```
# show cli history >/var/frame.txt
```

### Last Modifier

The **last** modifier displays the output of last few number of lines (As per the user input). The last number ranges from 1 to 9999.

For example:

```
#show running-config | last 10
```

## String Parameters

The restrictions in Table 6 apply for all string parameters used in OcNOS commands, unless some other restrictions are noted for a particular command.

**Table 6. String parameter restrictions**

| Restriction | Description |
|---|---|
| Input length | 1965 characters or less |
| Restricted special characters | “?”, “,”, “>”, “\|”, and “=”<br>The “\|” character is allowed only for the **description** command in interface mode. |

## Command Modes

Commands are grouped into modes arranged in a hierarchy. Each mode has its own set of commands. The table below lists the command modes common to all protocols.

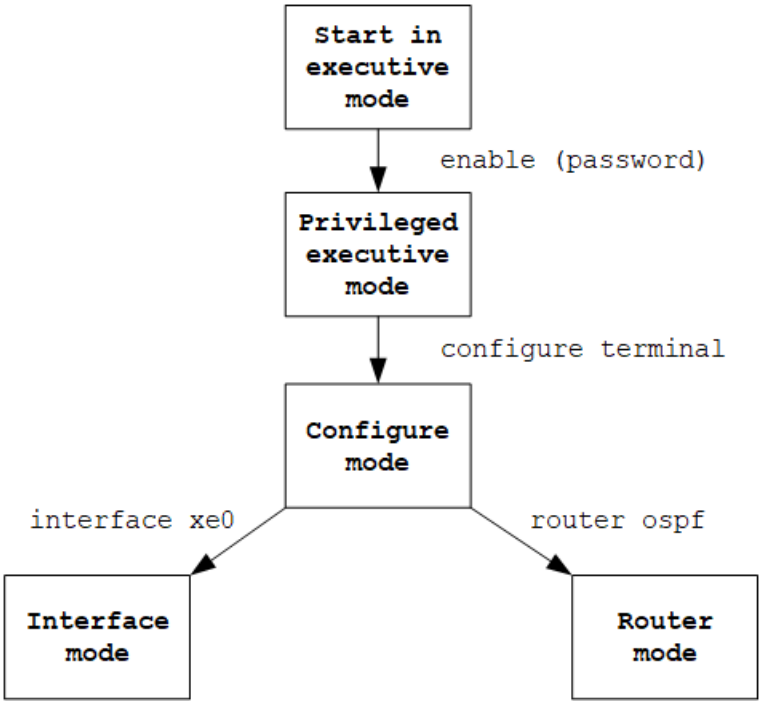
**Table 7. Common Command Modes**

| Name | Description |
|---|---|
| `Execution mode` | Also called *view* mode, this is the first mode to appear after you start the CLI. It is a base mode from where you can perform basic commands such as show, exit, quit, help, and enable. |
| Privileged execution mode | Also called *enable* mode, in this mode you can run additional basic commands such as debug, write, and show. |
| Configure mode | Also called *configure terminal* mode, in this mode you can run configuration commands and go into other modes such as interface, router, route map, key chain, and address family.<br><br>Configure mode is single user. Only one user at a time can be in configure mode. |
| Interface mode | In this mode you can configure protocol-specific settings for a particular interface. Any setting you configure in this mode overrides a setting configured in router mode. |
| Router mode | This mode is used to configure router-specific settings for a protocol such as BGP or OSPF. |

### Command Mode Tree

The diagram below shows the common command mode hierarchy.

**Figure 1. Common command modes**




To change modes:

1. Enter privileged executive mode by entering **`enable`** in Executive mode.
2. Enter configure mode by entering **`configure terminal`** in Privileged Executive mode.

The example below shows moving from executive mode to privileged executive mode to configure mode and finally to router mode:

```
> enable mypassword
# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
(config)# router ospf
(config-router)#
```

**Note:** Each protocol can have modes in addition to the common command modes. See the command reference for the respective protocol for details.

## Transaction-based Command-line Interface

The OcNOS command line interface is transaction based:

- Any changes done in configure mode are stored in a separate *candidate* configuration that you can view with the `show transaction current` command.
- When a configuration is complete, apply the candidate configuration to the running configuration with the command.

- If a `commit` fails, no configuration is applied as the entire transaction is considered failed. You can continue to change the candidate configuration and then retry the `commit`.
- Discard the candidate configuration with the `abort transaction` command.
- Check the last aborted transaction with the `show transaction last-aborted` command.
- Multiple configurations cannot be removed with a single . You must remove each configuration followed by a `commit`.

**Note:** All commands MUST be executed only in the default CML shell (**`cmlsh`**). If you log in as root and start **`imish`**, then the system configurations will go out of sync. The **`imish`** shell is not supported and should not be started manually.

# STREAMING TELEMETRY

## Overview

Streaming telemetry allows users to monitor network health by efficiently streaming operational data of interest from OcNOS devices. This structured data is transmitted to remote management systems for proactive network monitoring and understanding CPU and memory usage in managed devices for troubleshooting.

Users can create a database with telemetry data to establish a baseline for normal network operation and predict or mitigate network issues.

In OcNOS various gRPC Network Management Interface (gNMI) Subscription Modes, Telemetry Modes, and Encoding Types are supported, providing efficient network management capabilities.

**Note:** Streaming telemetry supports connections that come through an IPv6 interface in Dial-in mode but not supported in dial-out mode.

## Feature Characteristics

In OcNOS various gRPC Network Management Interface (gNMI) Subscription Modes, Telemetry Modes, and Encoding Types are supported, providing efficient network management capabilities.

### gNMI Subscription Modes

#### Streaming Telemetry Dial-In Mode

In Streaming Telemetry Dial-In Mode (page 99), the collector initiates a connection to the target device (OcNOS) and subscribes to receive telemetry data from OcNOS devices.

#### Streaming Telemetry Dial-Out Mode (Persistent Subscriptions)

In Streaming Telemetry Dial-Out Mode (page 133), the target (OcNOS) initiates the gRPC tunnel connection to the collector. Once the connection is established, the collector invokes the “Publish" RPC on the target. Subscriptions configured on the target are then streamed on that connection at the specified sample interval. These subscriptions remain active on OcNOS devices as long as the corresponding configuration on the target exists. If the gRPC tunnel connection is interrupted or the target reboots, the gNMI server on the target re-establishes the connection to the gNMI collector, ensuring continued streaming.

### gNMI In-Band Support

OcNOS supports streaming telemetry data transmission across multiple VRF instances, enabling users to manage data for up to four VRFs simultaneously. If users do not define a VRF, the system automatically allows streaming telemetry in the default VRF.

This improves efficiency and monitoring capabilities within the network.

# Streaming Telemetry Modes

## Stream Mode

Enables continuous and real-time transmission of telemetry data from OcNOS devices to the monitoring system. OcNOS supports **sample** and **on-change** streaming modes under the gNMI Stream subscription type, which define how updates are delivered to the collector.

Both streaming modes deliver data continuously once the subscription is active, enabling real-time operational visibility and efficient data collection from OcNOS systems.

### Sample Streaming Mode

Sample Stream Mode (page 101) sends telemetry updates at regular, configured intervals, regardless of whether the monitored data values have changed. This mode is suitable for continuous performance monitoring where periodic sampling is required.

**Notes:**

- The SAMPLE stream mode applies to both Dial-in and Dial-out gNMI subscription types.
- Sample Streaming mode does not support leaf-level paths and supports only container-level paths.

### On-Change Streaming Mode

On-Change Stream Mode (page 103) sends telemetry updates only when the value of the subscribed data item changes. This event-driven approach reduces network and system load and provides real-time visibility into state changes.

**Notes:**

- The on-change stream mode is supported only for Dial-in subscription mode. The on-change stream mode is not supported for dial-out subscription mode.
- The on-change streaming mode does not support OpenConfig sensor paths.

## Poll Mode

Poll mode subscriptions allow for on-demand data retrieval through a long-lived RPC. Subscribers initiate this mode by sending a Subscribe request message, followed by sending an empty Poll message to receive the desired data.

**Note:** The system supports **Poll mode** only in Dial-in subscription mode.

## Once Mode

In Once mode subscription, the OcNOS device responds to a subscribe request with a one-time data retrieval, similar to a get request. Upon receiving the Once mode subscribe request, the device sends back the subscribe response for all subscriptions in the list and terminates the RPC.

**Note:** The system supports **Once mode** only in Dial-in subscription mode.

## Encoding Types

**Note:** OcNOS supports the protobuf, JSON, and JSON-IETF encoding types for both the dial-in and dial-out gNMI subscription modes.

### Protocol Buffers (protobuf)

Offers a compact binary serialization format for efficient encoding and transmission of structured telemetry data. Protobuf is optimized for performance and bandwidth efficiency.

### JavaScript Object Notation

Provides a human-readable data interchange format commonly used for telemetry data representation. JavaScript Object Notation (JSON) encoding facilitates interoperability and ease of integration with various applications and tools. It adheres to the JSON specification outlined in RFC7159, employing relevant quoting. Consequently, string values are quoted while number values remain unquoted.

### JSON-IETF

This variant of JSON encoding adheres to the IETF standards, ensuring consistency and compatibility with industry specifications. `JSON_IETF` encoded data conforms the rules outlined in RFC7951 for JSON serialization.

### Encoding Limitations (Protobuf)

- Union (oneof) types are not supported in the Protobuf encoding.
- Map types with complex (user-defined) keys are not supported in the Protobuf encoding.

These limitations mean that if the user's YANG model (or data schema) uses `oneof` or `maps` keyed by complex types (e.g., composite objects), telemetry data under Protobuf encoding will not properly represent those constructs. Use JSON or JSON-IETF encoding as an alternative for the paths mentioned above where Protobuf encoding is not supported.

# gnmic Installation

gNMI Specification can be found at: https://github.com/openconfig/reference/blob/master/rpc/gnmi/gnmi-specification.md.

## gNMI Collector Tool

- For dial-in subscription mode, except when using "`proto`" encoding, use the open-source gNMI collector tool (`gnmic`). Install the open-source gNMI collector tool (`gnmic`) with the command:

  ```
  bash -c "$(curl -sL https://get-gnmic.openconfig.net)
  ```

- For dial-out subscription mode or when "`proto`" encoding is needed, use the `gnmic` tool from the gNMI collector package. It is delivered with the OcNOS installer, named `OcNOS-<SKU NAME>-<version>-telemetry-client-bin.tar`, and includes the gNMI Client collector application (`gnmic`) and the `IPI_OC.proto` files.

# Support for IPI Native Data Models and OpenConfig Data Models

**Streaming Telemetry Data Models:** OcNOS supports IPI native data models and OpenConfig data models, providing standardized representations of network configurations and telemetry data. This support enhances interoperability and facilitates consistent management across heterogeneous network environments.

## Wildcard Support in Sensor Paths

OcNOS supports wildcard characters in sensor paths (XPaths) to simplify subscription requests and minimize the number of XPaths needed to monitor multiple instances. The following wildcard types are supported:

### Explicit Wildcard for Key Names

Allows selecting all instances of a keyed list.

#### Example

The XPath below explicitly uses asterisk (`*`) for the name key in the interface list, which means it retrieves counters for all interfaces regardless of their names. This is useful when user do not need to specify individual interface names and want to subscribe to all available interfaces.

```
ipi:/interfaces/interface[name=*]/state/counters
```

### Implicit Wildcard (Omission of Key Name)

Automatically selects all instances when a key is not explicitly mentioned.

#### Example

Here, the name key is completely omitted, which implies that the query applies to all interfaces. This method functions similarly to using an explicit wildcard (`*`), but it assumes that the key name is optional, applying to all list instances automatically.

```
ipi:/interfaces/interface/state/counters
```

### Partial Wildcard for Key Name

Matches instances with a key name that starts with a given prefix.

#### Example

The wildcard `*` is applied at the end of the key name, meaning this XPath matches all interfaces whose names start with `xe`. For instance, it will match `xe0, xe1, xe100`, etc. However, it will not match `eth0, ge1`, etc. This is useful for filtering a subset of interfaces with a common prefix, reducing the number of specific XPaths required.

```
ipi:/interfaces/interface[name=xe*]/state
```

### Partial Wildcard for Multiple Keys

Partial wildcard applies to the first key when multiple keys exist.

**Valid Example**

This example allows retrieving information from all CMIS components while still applying filters for specific lanes and flags.

```
ipi:/components/component[name=CMIS*]/transceiver/cmis-module/media-monitors/lanes/lane
[number=2]/flags/flag[id=*]/state
```

- **`component[name=CMIS*]:`** Matches all components where the name starts with "CMIS" (e.g., CMIS-1, CMIS-module-10, etc).
- **`lane[number=2]:`** Applies only to lane number 2.
- **`flag[id=*]:`** Retrieves all flags within lane number 2.

**Invalid Example**

The wildcard is at the beginning of the key (`*CMIS`), which is not supported. Only suffix-based (**`CMIS*`**) wildcarding is allowed.

```
ipi:/components/component[name=*CMIS]/transceiver/cmis-module/media-monitors/lanes/lane
[number=2]/flags/flag[id=*]/state
```

## Use case 1: Wildcard Support in Dial-In Mode

In this example, the explicit wildcard `name=*` in **`ipi:/components/component[name=*]/state/memory`** XPath allows real-time monitoring of memory usage for all components without needing to specify individual component names. The `gnmic` command subscribes to this data stream to retrieve available and utilized memory for components like **HARD-DISK** and **RAM** from the target at `10.12.162.22:9339`. With a `90-seconds` sampling interval, the system collects data efficiently while minimizing the complexity of manual configuration. This approach simplifies network monitoring by dynamically including all relevant components, making it easier to track system performance in real time.

```
OcNOS# ./gnmic -a 10.12.162.22:9339 -u admin -p admin --insecure --mode STREAM --stream-mode sample -
-sample-interval 90s sub --path '/components/component[name=*]/state/memory' --encoding json_ietf
{
  "source": "10.12.162.22:9339",
  "subscription-name": "default-1729755066",
  "timestamp": 1729774623040087176,
  "time": "2024-10-24T12:57:03.040087176Z",
  "updates": [
    {
      "Path": "components/component[name=\"HARD-DISK\"]/state/memory",
      "values": {
        "components/component/state/memory": {
          "available": 118183952384,
          "utilized": 5681184768
        }
      }
    }
  ]
}
{
  "source": "10.12.162.22:9339",
  "subscription-name": "default-1729755066",
  "timestamp": 1729774623040734590,
  "time": "2024-10-24T12:57:03.04073459Z",
  "updates": [
    {
      "Path": "components/component[name=\"RAM\"]/state/memory",
      "values": {
        "components/component/state/memory": {
```

```
          "available": 33637269504,
          "utilized": 1130364928
        }
      }
    }
  ]
}
```

## Use case 2: Wildcard Support in Dial-Out Mode

This example uses a partial wildcard for key names in Dial-Out mode to subscribe to telemetry data for all components whose names start with `PORT`, eliminating the need to list them individually. The XPath **`ipi:/components/component[name=PORT*]/state`** ensures the system automatically monitors all port-related components, such as `PORT-SFP-5, PORT-SFP-7, and PORT-SFP-11`. The system sends telemetry data to the target at `10.12.66.160:11161` every `90 seconds`, dynamically retrieving information on memory, board FRU, and temperature for matching components.

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
!
sensor-group interface vrf management
 sensor-path ipi:/components/component[name=PORT*]/state
!
destination-group tunnel-1 vrf management
 tunnel-server ip 10.12.66.160 port 11161
!
subscription-name sub-1 vrf management
 destination-group tunnel-1
 sensor-group interface sample-interval 90
!
!
```

```
OcNOS#show streaming-telemetry

 Number of telemetry instances : 1 (management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 30 (Dial-In : 0, Dial-out : 30)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : sub-1
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : Default-60 (seconds)

     Destination-group         Status         Tunnel-IP:Port
```

```
     -----------------         ------         --------------
     tunnel-1                ACTIVE           10.12.66.160:11161
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
       interface          90           ipi:/components/component[name=PORT*]/state
                                        [*]ipi:/components/component[name=PORT*]/state/memory
                                        [*]ipi:/components/component[name=PORT*]/state/board-fru
                                        [*]ipi:/components/component[name=PORT*]/state/temperature

 [*]-> Indicates child path learnt from parent config, not configured by user
```

## gnmic Output

The `gnmic` output confirms that telemetry updates include firmware, hardware version, location, operational status, and parent chassis details for each matching port component.

By using a partial wildcard, the system improves scalability by automatically incorporating new port components without modifying the sensor path configuration, reducing manual effort and ensuring real-time network monitoring.


```
#./gnmic --config abc.yaml --use-tunnel-server publish --insecure
{
  "source": "e8:c5:7a:8f:98:26",
  "subscription-name": "sub-1",
  "timestamp": 1725361959730514173,
  "time": "2024-09-03T11:12:39.730514173Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"PORT-SFP-5\"]/state",
      "values": {
        "components/component/state": {
          "description": "NA",
          "empty": false,
          "firmware-version": "NA",
          "hardware-version": "NA",
          "location": "17",
          "mfg-name": "NA",
          "name": "PORT-SFP-17",
          "oper-status": "NA",
          "parent": "CHASSIS",
          "part-no": "NA",
          "product-name": "NA",
          "removable": false,
          "serial-no": "NA",
          "software-version": "NA",
          "type": "port"
        }
      }
    }
  ]
}
{
  "source": "e8:c5:7a:8f:98:26",
  "subscription-name": "sub-1",
  "timestamp": 1725361959731082952,
  "time": "2024-09-03T11:12:39.731082952Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"PORT-SFP-7\"]/state",
      "values": {
        "components/component/state": {
          "description": "NA",
          "empty": false,
          "firmware-version": "NA",
          "hardware-version": "NA",
```

```
          "location": "5",
          "mfg-name": "NA",
          "name": "PORT-SFP-5",
          "oper-status": "NA",
          "parent": "CHASSIS",
          "part-no": "NA",
          "product-name": "NA",
          "removable": false,
          "serial-no": "NA",
          "software-version": "NA",
          "type": "port"
        }
      }
    }
  ]
}
{
  "source": "e8:c5:7a:8f:98:26",
  "subscription-name": "sub-1",
  "timestamp": 1725361959731795490,
  "time": "2024-09-03T11:12:39.73179549Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"PORT-SFP-11\"]/state",
      "values": {
        "components/component/state": {
          "description": "NA",
          "empty": false,
          "firmware-version": "NA",
          "hardware-version": "NA",
          "location": "7",
          "mfg-name": "NA",
          "name": "PORT-SFP-7",
          "oper-status": "NA",
          "parent": "CHASSIS",
          "part-no": "NA",
          "product-name": "NA",
          "removable": false,
          "serial-no": "NA",
          "software-version": "NA",
          "type": "port"
        }
      }
    }
  ]
}
{
  "source": "e8:c5:7a:8f:98:26",
  "subscription-name": "sub-1",
  "timestamp": 1725361959732153620,
  "time": "2024-09-03T11:12:39.73215362Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"PORT-SFP-13\"]/state",
      "values": {
        "components/component/state": {
          "description": "NA",
          "empty": false,
          "firmware-version": "NA",
          "hardware-version": "NA",
          "location": "11",
          "mfg-name": "NA",
          "name": "PORT-SFP-11",
          "oper-status": "NA",
          "parent": "CHASSIS",
          "part-no": "NA",
          "product-name": "NA",
          "removable": false,
```

```
          "serial-no": "NA",
          "software-version": "NA",
          "type": "port"
        }
      }
    }
  ]
}
{
  "source": "e8:c5:7a:8f:98:26",
  "subscription-name": "sub-1",
  "timestamp": 1725361959731446131,
  "time": "2024-09-03T11:12:39.731446131Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"PORT-SFP-9\"]/state",
      "values": {
        "components/component/state": {
          "description": "NA",
          "empty": false,
          "firmware-version": "NA",
          "hardware-version": "NA",
          "location": "13",
          "mfg-name": "NA",
          "name": "PORT-SFP-13",
          "oper-status": "NA",
          "parent": "CHASSIS",
          "part-no": "NA",
          "product-name": "NA",
          "removable": false,
          "serial-no": "NA",
          "software-version": "NA",
          "type": "port"
        }
      }
    }
  ]
}
{
  "source": "e8:c5:7a:8f:98:26",
  "subscription-name": "sub-1",
  "timestamp": 1725361959731621187,
  "time": "2024-09-03T11:12:39.731621187Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"PORT-SFP-10\"]/state",
      "values": {
        "components/component/state": {
          "description": "NA",
          "empty": false,
          "firmware-version": "NA",
          "hardware-version": "NA",
          "location": "14",
          "mfg-name": "NA",
          "name": "PORT-SFP-14",
          "oper-status": "NA",
          "parent": "CHASSIS",
          "part-no": "NA",
          "product-name": "NA",
          "removable": false,
          "serial-no": "NA",
          "software-version": "NA",
          "type": "port"
        }
      }
    }
  ]
}
```

# XPath Formatting Rules for Streaming Telemetry

OcNOS Streaming Telemetry uses XPath expressions to subscribe to YANG-modeled data. Properly formatting XPath ensures accurate and consistent collection of telemetry data, regardless of whether users configure Dial-In, Dial-Out, or GET RPC modes.

## XPath Formatting Rules for gnmic Subscriptions

OcNOS enforces specific formatting rules for XPath in gNMIc subscription commands.

1. **String Key Formatting:** Xpath with string keys must be enclosed in double quotes (`""`).

   **Example:**

   ```
   --path '/components/component[name="TEMPERATURE-MAC"]/state'

   --path "/components/component[name=\"TEMPERATURE-MAC\"]/state"
   ```

2. **Integer Key Formatting:** Xpath with integer keys must be provided without double quotes.

   **Example:**

   ```
   --path "ipi:/bgp/bgp-instances/bgp-instance[bgp-as=100]/peers/peer[peer-
   address=\"1.1.1.1\"]/state"

   --path  'ipi:/bgp/bgp-instances/bgp-instance[bgp-as=100]/peers/peer[peer-
   address="1.1.1.1"]/state'
   ```

3. **Implicit Wildcard Keys:** Xpath with implicit wildcard keys can be provided with or without single quotes.

   **Example:**

   ```
   --path '/components/component/state'

   --path /components/component/state
   ```

4. **Key Order in Sensor Paths:** When using multiple keys in sensor paths, key-value pairs must be configured in the same order as defined by the IPI data model sensor path list. Incorrect ordering may cause subscription failures or unexpected behavior in telemetry data collection.

   > **Note:** This key ordering is applicable only for Dial-Out operations.

   **Example: Incorrect Order (Invalid Configuration)**

   In this example, "`vrf-name`" appears before "`local-discriminator`", which does not match the expected order.

   ```
   ipi:/bfd/sessions/session[vrf-name="default"][local-
   discriminator="2050"]/state/counters/packets/ipv4
   ```

   **Example: Correct Order (Valid Configuration)**

   In this example, "`vrf-name`" appears after "`local-discriminator`", which matches the expected order.

   ```
   ipi:/bfd/sessions/session[local-discriminator="2050"][vrf-
   name="default"]/state/counters/packets/ipv4
   ```

## XPath Format Support by Telemetry Mode

### Dial-In XPath Formats

| XPath Examples | Command Line (CLI) Support | YAML Support | Comments |
|---|---|---|---|
| `"ipi:/interfaces/interface [name=\"eth0\"]/state"` | Yes | Yes | Valid path |
| `'ipi:/interfaces/interface[name="eth0"]/state'` | Yes | Yes | Valid path |
| `ipi:/interfaces/interface[name=\"eth0\"]/state` | Yes | No | Valid path for CLI and invalid path for YAML |
| `ipi:/interfaces/interface[name="eth0"]/state` | No | Yes | Invalid path for CLI and valid path for YAML |
| `'ipi:/interfaces/interface [name=\"eth0\"]/state'` | No | No | Invalid path |

### Dial-Out XPath Formats

| XPath Examples | Command Line (CLI) Support | Comments |
|---|---|---|
| `ipi:/interfaces/interface[name="eth0"]/state` | Yes | Valid path |
| `/interfaces/interface[name="eth0"]/state` | Yes | Valid path (OpenConfig) |
| `/interfaces/interface[name=eth0]/state` | Yes | Valid path (OpenConfig) |
| `"ipi:/interfaces/interface[name=\"eth0\"]/state"` | No | Invalid path |
| `'ipi:/interfaces/interface[name="eth0"]/state'` | No | Invalid path |
| `ipi:/interfaces/interface[name=\"eth0\"]/state` | No | Invalid path |

### Get RPC XPath Formats

| XPath Examples | Command Line (CLI) Support | YAML Support | Comments |
|---|---|---|---|
| `ipi:/interfaces/interface[name=eth0]/state` | Yes | Yes | Valid path |
| `ipi:/interfaces/interface[name="eth0"]/state` | Yes | Yes | Valid path |
| `'ipi:/interfaces/interface[name="eth0"]/state'` | Yes | Yes | Valid path |
| `'ipi:/interfaces/interface[name=eth0]/state'` | Yes | Yes | Valid path |
| `"ipi:/interfaces/interface [name=\"eth0\"]/state"` | Yes | Yes | Valid path |
| `/interfaces/interface[name=eth0]/state` | Yes | Yes | Valid path (OpenConfig) |
| `/interfaces/interface[name="eth0"]/state` | Yes | Yes | Valid path (OpenConfig) |
| `'ipi:/interfaces/interface [name=\"eth0\"]/state'` | No | No | Invalid path |

**Note:** The Get RPC response for string key values is returned without double quotes (“ ”), regardless of how the key values were specified in the requested XPath. The response below returns without double quotes (" ") for the `po1` interface in the Path field: `"Path": "ipi:interfaces/interface [name=po1]"`.

```
 ./gnmic -a 10.12.162.22:9339 -u admin -p admin --insecure get  --path 'ipi:/interfaces/interface
[name="po1"]' --encoding json_ietf --type config --timeout 120s
[
  {
    "source": "10.12.162.22:9339",
    "timestamp": 1730122009406462625,
    "time": "2024-10-28T13:26:49.406462625Z",
    "updates": [
      {
        "Path": "ipi:interfaces/interface[name=po1]",
        "values": {
          "interfaces/interface": {
            "interfaces": {
              "interface": [
                {
                  "config": {
                    "enable-switchport": "",
                    "mtu": "300",
                    "name": "po1"
                  },
                  "name": "po1"
                }
              ]
            }
          }
        }
      }
    ]
  }
]
```

# Scale and Minimum Sample Interval Supported

To limit the impact of telemetry on critical features of the OcNOS target device, certain limits have been implemented for different platform types.

**High End Platforms:** A system is considered high range if it has eight or more CPU cores and is not based on an "Intel Atom" processor.

**Standard Range Platforms:** A system is considered standard range if it has fewer than eight CPU cores or is based on an "Intel Atom" processor.

**Notes:**

- If telemetry subscribe paths are not explicitly configured using the command telemetry maximum-subscribe-paths (page 84), the system sets them to **100 sensor paths for high-end platforms** and **50 sensor paths for standard platforms**.
- If telemetry mimum sample intervals are not explicitly configured using the command telemetry minimum-sample-interval (page 85), the system sets them to **10 seconds for high-end platforms** and **90 seconds for standard platforms**.
- The total count of sensor paths includes the child paths of a subscribe request. For instance, if a subscribe request has four child paths, the total sensor paths count equals five (the given path plus four child paths). Use the show streaming-telemetry (page 66) command to display the minimum sample interval and the maximum number of sensor paths configured.

## Scale Scenarios

### New Subscribe RPC Request Makes Total Paths To Not Exceed Max Allowed

When new paths are added to the existing paths already handled by the gNMI server, the total number does not exceed the Default (page 84) limit or the user-configured value. Consequently, the gNMI server accepts this subscribe request and proceeds with the processing.

### New Subscribe RPC Request Makes Total Paths To Reach Allowed Max:

With the new Subscribe RPC Request, the total paths handled would be exactly equal to its Default (page 84) or the user-configured values. When the gNMI server accepts the new subscribe request, it processes it but logs a warning that the maximum number of paths has been reached. This warning indicates that it will not handle any new subscribe RPC stream mode requests until the number of currently handled paths drops below 100 or below the user-configured subscribe path values.

### New Subscribe RPC Request Makes Total Paths To Exceed Allowed Max

With the new Subscribe RPC request, the gNMI server returns an error if the total paths exceed its Default (page 84) or the user-configured values. The RPC request is not closed but will be accepted and responded to when the total number of paths handled drops to a level that can accommodate this RPC request.

### Minimum Sample Interval

Any sampling mode request with a sample interval of less than the minimum allowed will result in an error. However, if a sample interval is 0, it defaults to the minimum sample interval supported by the gNMI server for that platform type.

# gNMI Server Cache Optimization

The gNMI server optimizes cache updates to reduce CPU usage and scale efficiently with higher sensor path counts.

## Cache Update Mechanism

To optimize telemetry throughput and minimize latency, the gNMI server implements a high-performance caching layer. Upon receiving raw JSON data from the Redis database, the system deserialize the JSON payloads into native GoStructs. These structures are then indexed within a high-speed hash map, using the XPath string as the unique key.

## Staggering Sensor-path Processing

To reduce CPU spikes caused by processing multiple sensor-paths back-to-back, the telemetry service introduces a few milliseconds delay between processing two sensor-paths. This staggering helps distribute processing load more evenly across the sampling interval.

**Wildcard paths:** Processing of translated paths will be staggered anywhere between 5 milliseconds and 30 milliseconds, depending on how many paths the wildcard sensor-path translates to. This reduces CPU spikes and prevents back-to-back data processing from these paths.

## Key Benefits

- Reduces CPU consumption during telemetry streaming.
- Storing data in a hash map enables O(1) retrieval speeds, ensuring constant-time lookups.
- Supports large telemetry scale efficiently with smooth operation.
- Prevents gNMI stream disconnections caused by backend overload.
- Dynamically smooths CPU spikes using intelligent delay between sensor-paths.
- Ensures latest data is streamed with minimal processing overhead.

# Streaming Telemetry Commands

This section lists the telemetry commands.



# crypto pki load source-interface

Use this command to copy the server certificate (cert.pem) and CA certificate (ca.pem) from an external source to OcNOS.

**Note:** If the certificate is already present on the OcNOS device but not located in the standard directory, the "file:" option can be used to copy the `cert.pem` or `ca.pem` files to the standard location.

## Command Syntax

```
crypto pki load (source-interface IFNAME|) WORD
```

## Parameters

**WORD**

Path to certificate file. Supported formats:

- http://your-server-ip/path/to/file/cert.pem (or ca.pem)
- https://your-server-ip/path/to/file/cert.pem (or ca.pem)
- ftp://your-server-ip/path/to/file/cert.pem (or ca.pem)
- tftp://your-server-ip/path/to/file/cert.pem (or ca.pem)
- file:///mnt-point/usb/path/to/file/cert.pem (or ca.pem)

**source-interface IFNAME**

Source interface used for certificate transfer.

## Default

None

## Command Mode

Exec mode

## Applicability

Introduced in OcNOS version 7.0.0.

## Example

This command loads the specified certificate from the given external URL into the device certificate store.

```
OcNOS#crypto pki load ftp://root:root@10.14.105.105/ca.pem

crypto pki load http://root:root@10.14.105.105/cert.pem

OcNOS#crypto pki load source-interface eth0 http://root:root123@10.14.105.213/cert.pem
```

# crypto pki generate rsa common-name

Use this command to generate a private RSA key and a corresponding Certificate Signing Request (CSR) which are required for OcNOS using an IP address as the Common Name (CN). This key or CSR pair enables the device to establish TLS connections for both NetConf clients and gNMI-based telemetry subscriptions.

## Command Syntax

```
crypto pki generate rsa common-name ipv4 IPADDR
```

## Parameters

**IPADDR**
IPv4 or IPv6 addresses to be used as the Common Name in the CSR. Example format: 192.168.1.5 or 10::10:10/112

## Default

None

## Command Mode

Privileged execution mode

## Applicability

This command was introduced in OcNOS version 5.0.

## Examples

- The CSR appears when the user run the show crypto csr (page 64) command.
- Later: Submit the CSR to a CA, receive the signed certificate, and load it onto the device as part of a TLS deployment for NetConf or gNMI.
- For telemetry sessions using gNMI : The device may use this certificate for server identity; clients must validate it when connecting over TLS.
- Always ensure the CN (the IP address) matches the device's identity as seen by the client, or incorporate the address in the SAN if required by the user CA policy.

```
#crypto pki generate rsa common-name ipv4 7.7.7.7
#show crypto csr
-----BEGIN CERTIFICATE REQUEST-----
MIICVzCCAT8CAQAwEjEQMA4GA1UEAwwHNy43LjcuNzCCASIwDQYJKoZIhvcNAQEB
BQADggEPADCCAQoCggEBAMkzIZaxNYPd8PW0hexecUFKq9pJn5IJzJkOQDtoVFOT
zeLPRxBaOt1NVd+lEF+wy3AgnGMw004g4AP7qaE+S5X1vKGAjagtfh/gfDAPDUtM
CpYLMCACM7n76OmyP9eUpkMbOSPkZDIBZfjUMxDTFwkzCBH+BF6SkSxtA24NUA9z
5heCIb1ArXYjdlIeB+9FfiVdOZ5yxQsLY8604ONL7Upl766SArGQo6oZ1dJ+bc91
sQVCEpF40SdCNn+Uw3R0cPfQF81BJD4H0EHf1VnHtYJwQ1yax6qc5ghT9R/rABDa
BFB3R09QpjV4Ihd/MyrdQmEIoXHeNNvSGDj9+eiEpksCAwEAAaAAMA0GCSqGSIb3
DQEBCwUAA4IBAQAwXkQmNf3yiL+pmpwvE+gU8KVp3i4cvD13Vjh7IQMkCT47WPaM
DUiYgwk+dPVAI+iWZq4qTvUNn6xahOyN5rnkTz9eipsQ1YHPpZB7hj5fimWwzJws
m4Tun0GZieEBCROqUpbuW+6QDvtR3XSzHhdGGSIteZv9cYyKhNuO07okwr67c2Ea
1lB7Pcu1tOb4wj3xjqaO/ENDG+nmdUPaIKZrAwf2fEOarOaHgKwcl1AHHbusbJWL
qH0fA1OyVgfvg/WuCPP6Peg/Cpla7bDWqeGYt9vFTtekKoOMQLzJwl6oINbtBCcw
DZJpeaQpUhFm+ZOjwibZ5NGPBRSTuYncp5xJ
```

```
-----END CERTIFICATE REQUEST-----
#

OcNOS#crypto pki generate rsa common-name ipv4 10::10:10/112
OcNOS#show crypto csr
-----BEGIN CERTIFICATE REQUEST-----
MIICXTCCAUUCAQAwGDEWMBQGA1UEAwwNMTA6OjEwOjEwLzExMjCCASIwDQYJKoZI
hvcNAQEBBQADggEPADCCAQoCggEBALk8PXeYrU+c/I3DCXAzJ1ZiXCH+JsS2ssh5
E2W8WrsDIZ92Xe1zVFdc6FdlQFg7d3gLubi1N5Y9MIAvDMnimPZYm2tIj9B5c1Xy
Z89YAMlHq5TuIVAlsXNJGlGvZsEUEWKV8ti7AQvuyw9fJ7pIkqaFNm5sH2LW6pAL
eg+1fNqMXpd5O5HI9p0SPevqNWvoxTb2PqK+XZY0ITi7Hi5P8teXswhFBsOW1rIH
09Q4hFvPlbIHHQAE5GSWmPyXotQArbVHJmIQyYHE3cYTXwBRUUXllRzbs2k0gAIJ
9rKuLPAILz4FQCXuBnCDfzwEMhZJ2SmwKuUw9V2V6r60LXBGSScCAwEAAaAAMA0G
CSqGSIb3DQEBCwUAA4IBAQBR4SOh6M+2r8SveEt6vTHpW2k33aEZpod9dw/+Qxd/
OMCOF/dCHyanaO0ZiKzTkyd8iEe60KRsStt0X7m7B3wctBfl4oVgioUuLYe77D18
s52T65ojLEPLTCiNANHpiGttZqd0LUL4HdD3Tm6lNQlIkMQsEA6KQP9d4jei0shs
G1kR8t7IuwinZU55On2Yg1RiGe4ulZW9YEi0h2vPiONRZMdsW4gVja3SrfGN3Xt0
NoBA43zf/zzECm3YsHT+ikXXDbqedQLmTGlniuUVS0/WlmH0fVCk9YaVxII1jMtp
Mx/R4Y0uROl3UGZveWTlTLzONeIyj/hxUgBLOACa5vx4
-----END CERTIFICATE REQUEST-----
```

# debug cml

Use this command to enable or disable debugging information for CML streaming telemetry.

## Command Syntax

```
debug cml enable telemetry
debug cml disable telemetry
```

## Parameters

None

## Default

By default, debugging information is disabled.

## Command Mode

Exec Mode

## Applicability

This command was introduced in OcNOS version 6.4.1.

## Examples

The following example illustrates how to enable and disable the telemetry debugging information.

```
OcNOS#debug cml enable telemetry
OcNOS#debug cml disable telemetry
```

# debug telemetry gnmi

Use this command to enable or disable gNMI server debugging logs with severity levels.

## Command Syntax

```
debug telemetry gnmi (enable) (severity (debug|info|warning|error|fatal|panic|d-panic)|)
debug telemetry gnmi (disable) (severity (debug|info|warning|error|fatal|panic|d-panic)|)
```

## Parameters

**debug**
Logs a message at debug level

**info**
Logs a message at info level

**warning**
Logs a message at warning level

**error**
Logs a message at error level

**fatal**
Logs a message and causes the program to exit with return code 1.

**panic**
Logs a message and triggers the program to generate a traceback.

**d-panic**
Logs at the Panic level

**d-panic**
Logs at the Panic level

**d-panic**
Logs at the Panic level

## Default

Disabled. The gNMI server debugging level in the disabled state is set to the Error level.

## Command Mode

Configure mode

## Applicability

Introduced in OcNOS version 6.4.1 and added the `vrf (NAME|management)` parameter in the OcNOS version 6.5.2.

Removed the `vrf (NAME|management)` parameter in the OcNOS version 6.6.0.

## Examples

The following example illustrates how to enable and disable the telemetry debug logs and their corresponding show output.

```
OcNOS(config)#feature streaming-telemetry
OcNOS(feature-telemetry-config)#commit
OcNOS(feature-telemetry-config)#exit
OcNOS(config)#debug telemetry gnmi enable severity warning
OcNOS(config)#commit
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
debug telemetry gnmi enable severity warning
!
OcNOS(config)#debug telemetry gnmi disable severity warning
OcNOS(config)#commit
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
!
```

# destination-group

Use this command to create a destination-group for persistent subscriptions on the OcNOS device. The VRF parameter must match the VRF specified in the feature streaming-telemetry (page 55) command. Can create and attach multiple destination-groups to activate streaming telemetry subscriptions.

Use the no form of this command to delete a destination-group.

## Command Syntax

```
destination-group TUNNEL-NAME (vrf (management|NAME)|)
no destination-group TUNNEL-NAME (vrf (management|NAME)|)
```

## Parameters

**TUNNEL-NAME**
Specify the name assigned to the tunnel server or collector endpoint used for telemetry data transmission.

**vrf NAME**
(Optional) Creates a destination-group for persistent subscriptions in a user-defined VRF.

**vrf management**
(Optional) Creates a destination-group for persistent subscriptions in the management VRF.

## Default

None

## Command Mode

Configure mode

## Applicability

Introduced in OcNOS version 6.5.2.

## Example

The following example creates a destination group named `tunnel-1` in a default VRF for transmitting telemetry data.

```
OcNOS(config)#destination-group tunnel-1
OcNOS(telemetry-grpc-tunnel-group)#commit
```

# destination-group GRPC

Use this command to add a destination-group under subscriptions. Can create multiple destination-groups within a subscription mode.

Use `no` parameter of this command to remove the destination-groups.

**Note:** Ensure that the GRPC-GROUP-NAME is configured in the device's configuration mode before adding it to a subscription mode.

## Command Syntax

```
destination-group GRPC-GROUP-NAME
no destination-group GRPC-GROUP-NAME
```

## Parameters

**GRPC-GROUP-NAME**
Specify the name assigned to the tunnel server or collector endpoint used for telemetry data transmission.

## Default

None

## Command Mode

Telemetry-subscription Mode

## Applicability

Introduced in OcNOS version 6.5.2.

## Example

Ensure that the GRPC-GROUP-NAME (`tunnel-1`) is already configured in the current configuration mode.

```
OcNOS#configure terminal
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
sensor-group stream-1
 sensor-path ipi:/interfaces/interface[name="eth0"]/state/counters
!
destination-group tunnel-1
 tunnel-server ip 10.12.66.160 port 11163
!
subscription-name sub-1
 sensor-group stream-1 sample-interval 1000
!
!
```

The following commands illustrates how to add a destination group (`tunnel-1`) under subscription mode (`sub-1`) and verify the configuration using the show command output.

```
OcNOS(config)#subscription-name sub-1
OcNOS(telemetry-subscription)#destination-group tunnel-1
OcNOS(telemetry-subscription)#commit
OcNOS(telemetry-subscription)#exit
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
sensor-group stream-1
 sensor-path ipi:/interfaces/interface[name="eth0"]/state/counters
!
destination-group tunnel-1
 tunnel-server ip 10.12.66.160 port 11163
!
subscription-name sub-1
 destination-group tunnel-1
 sensor-group stream-1 sample-interval 1000
!
!
```

# encoding

Use this command to specify or modify encoding types for subscriptions in streaming telemetry.

Use `no` parameter of this command to remove the encoding option.

**Note:** Modifying the encoding type is not allowed for active subscriptions.

## Command Syntax

```
encoding (json-ietf|json|proto)
no encoding
```

## Parameters

**json-ietf**
Specifies the JSON encoding based on the IETF draft standard.

**json**
Specifies the default JSON encoding type.

**proto**
Specifies the Protocol Buffers v3 encoding type.

## Default

None

## Command Mode

Telemetry-subscription Mode

## Applicability

Introduced in OcNOS version 6.5.2.

## Example

The following commands demonstrate how to create a telemetry subscription named `sub-3` using the JSON encoding type.

```
OcNOS#configure terminal
OcNOS(config)#subscription-name sub-3
OcNOS(telemetry-subscription)#encoding json
OcNOS(telemetry-subscription)#commit
```

# feature streaming-telemetry

Use this command to enable the streaming telemetry and, upon configuration, to start the gNMI server. The gNMI server initiates listening for incoming gRPC connections on port 9339 if a custom port (page 58) value is not configured.

**Notes:**

- OcNOS supports streaming telemetry data transmission across multiple VRF instances, enabling users to manage data for up to four VRFs simultaneously. If users do not define a VRF, the system automatically allows streaming telemetry in the default VRF.
- After configuring the `feature streaming-telemetry` command, the system enters the feature telemetry configuration mode.

Use the `no` parameter of this command to disable the streaming telemetry, it will stop the gNMI server.

## Command Syntax

```
feature streaming-telemetry (vrf (NAME|management)|)
no feature streaming-telemetry (vrf (NAME|management)|)
```

## Parameters

**vrf NAME**
(Optional) Defines streaming telemetry in a user-defined VRF. Specify the VRF instance name.

**vrf management**
(Optional) Defines streaming telemetry in the management VRF.

## Default

By default, the streaming-telemetry feature is disabled.

## Command Mode

Configure mode

## Applicability

Introduced in OcNOS version 6.4.1 and added the `vrf (NAME|management)` parameter in the OcNOS version 6.5.2. Introduces multiple VRFs support in theOcNOS version 6.6.0.

## Examples

The following example illustrates how to enable the streaming telemetry on the default, management, user-defined VRFs, and multiple VRFs.

**Default VRF**

```
OcNOS#configure terminal
```

```
OcNOS(config)#feature streaming-telemetry
OcNOS(feature-telemetry-config)#commit
OcNOS(feature-telemetry-config)#exit
```

### Management VRF

```
OcNOS#configure terminal
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#commit
OcNOS(feature-telemetry-config)#exit
```

### User-defined VRF

```
OcNOS#configure terminal
OcNOS(config)#ip vrf VRF1
OcNOS(config-vrf)#exit
OcNOS(config)#feature streaming-telemetry vrf VRF1
OcNOS(feature-telemetry-config)#commit
OcNOS(feature-telemetry-config)#exit
```

Multiple VRFs

```
OcNOS(config)#ip vrf management
OcNOS(config-vrf)#exit
OcNOS(config)#ip vrf user1
OcNOS(config-vrf)#exit
OcNOS(config)#ip vrf user2
OcNOS(config-vrf)#exit

OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#port 32768
OcNOS(feature-telemetry-config)#exit
OcNOS(config)#feature streaming-telemetry
OcNOS(feature-telemetry-config)#exit
OcNOS(config)#feature streaming-telemetry vrf user1
OcNOS(feature-telemetry-config)#port 42768
OcNOS(feature-telemetry-config)#exit
OcNOS(config)#feature streaming-telemetry vrf user2
OcNOS(feature-telemetry-config)#port 52768
OcNOS(feature-telemetry-config)#commit
OcNOS(feature-telemetry-config)#exit

OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry
!
feature streaming-telemetry vrf management
 port 32768
!
feature streaming-telemetry vrf user1
 port 42768
!
feature streaming-telemetry vrf user2
 port 52768
!
!
```

# grpc-tunnel-server retry-interval

Use this command to set the interval for retry attempts when establishing a connection for the GNMI server to the tunnel-server.

Use `no` parameter of this command to unset the retry-interval timer.

## Command Syntax

```
grpc-tunnel-server retry-interval <30-3000>
no grpc-tunnel-server retry-interval
```

## Parameters

**retry-interval <30-3000>**
Specifies the duration between retry attempts. The default retry-interval is 60 seconds.

## Default

None

## Command Mode

Feature telemetry configure mode

## Applicability

Introduced in the OcNOS version 6.5.2. Changed the command mode support from configure mode to feature telemetry configure mode `(feature-telemetry-config)` and removed the VRF parameters in OcNOS version 6.6.0.

## Example

The following configuration illustrates how to set the retry-interval timer for the gNMI server to the tunnel-server with a value of 80 seconds in a default VRF.

```
OcNOS#configure terminal
OcNOS(config)#feature streaming-telemetry
OcNOS(feature-telemetry-config)#grpc-tunnel-server retry-interval 80
OcNOS(feature-telemetry-config)#commit
```

# port

Use this command to configure a non-TLS port for streaming-telemetry.

Use the no parameter of this command to reset the non-TLS port to its default value.

## Command Syntax

```
port <1024-65535>
no port
```

## Parameters

**port <1024-65535>**

Specifies the port number range for the insecure TLS gRPC connection.

## Default

The non-TLS port is set to 9339.

## Command Mode

Feature telemetry configure mode

## Applicability

Introduced in OcNOS version 6.6.0. Updated the port range from <32768-60999> to <1024-65535> to allow flexibility with the default port configuration in OcNOS version 7.0.0.

## Examples

```
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#port 54321
OcNOS(feature-telemetry-config)#commit

OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
 port 54321
!
```

**Note:** The same port number can be configured across multiple VRF instances of streaming-telemetry.

```
OcNOS#show runn streaming-telemetry
!
feature streaming-telemetry vrf management
 port 40000
!
feature streaming-telemetry vrf user1
 port 40000
!
feature streaming-telemetry vrf user2
 port 40000
!
```

```
feature streaming-telemetry vrf user3
 port 40000
!
!
!
```

**Note:** User can configure the default port number like other port values, and the show command displays the default port number.

```
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#port 9339
OcNOS(feature-telemetry-config)#commit
2025 Aug 29 04:49:09.158 : OcNOS : CML : CRITI : Default port configured 9339
OcNOS(feature-telemetry-config)#
OcNOS(feature-telemetry-config)#
OcNOS(feature-telemetry-config)#exit
OcNOS(config)#
OcNOS(config)#
OcNOS(config)#
OcNOS(config)#
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
 port 9339
!
debug telemetry gnmi enable severity debug
!
!
!
```

# sensor-group

Use this command to create a sensor group for persistent subscriptions in an OcNOS device. Multiple sensor groups can be created to specify the paths of interest for streaming telemetry. The VRF parameter must match the VRF specified in the feature streaming-telemetry (page 55) command. These sensor groups are attached to subscriptions to activate streaming telemetry.

Use `no` parameter of this command to remove a created sensor group.

## Command Syntax

```
sensor-group SENSOR-NAME (vrf (management|NAME)|)
no sensor-group SENSOR-NAME (vrf (management|NAME)|)
```

## Parameters

**SENSOR-NAME**
Specifies the name of the sensor group.

**vrf management**
(Optional) Creates a sensor group in the management VRF.

**vrf NAME**
(Optional) Creates a sensor group in a user-defined VRF.

## Default

None

## Command Mode

Configure mode

## Applicability

Introduced in OcNOS version 6.5.2.

## Example

The following commands demonstrate how to create a sensor group named `stream-1` for persistent telemetry subscriptions in a default VRF on an OcNOS device:

```
OcNOS#configure terminal
OcNOS(config)#sensor-group stream-1
OcNOS(telemetry-sensor-group)#commit
OcNOS(telemetry-sensor-group)#exit
```

# sensor-group sample-interval

Use this command to to associate a sensor group with a specific sampling interval under subscriptions for activating streaming telemetry. Multiple sensor groups can be created.

Use `no` parameter of this command to remove the sensor-groups from a subscription.

**Note:** Before adding a SENSOR-GROUP-NAME to a subscription, ensure the sensor group is already configured in the configuration mode.

## Command Syntax

```
sensor-group SENSOR-GROUP-NAME sample-interval <10-3600>
no sensor-group SENSOR-GROUP-NAME
```

## Parameters

**SENSOR-GROUP-NAME**
Specifies the name of the sensor group to be associated with the subscription.

**sample-interval <10-3600>**
Defines the sampling interval in seconds for the sensor group. The interval can range from 10 to 3600 seconds.

## Default

None

## Command Mode

Telemetry-subscription Mode

## Applicability

Introduced in OcNOS version 6.5.2.

## Example

Ensure that the SENSOR-GROUP-NAME (`stream-1`) is already configured in the current configuration mode.

```
OcNOS#configure terminal
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
sensor-group stream-1
 sensor-path ipi:/interfaces/interface[name="eth0"]/state/counters
!
subscription-name sub-1
!
!
```

The following commands illustrates how to add a sensor group (`stream-1`) under subscription mode (`sub-1`) and verify the configuration using the show command output.

```
OcNOS(config)#subscription-name sub-1
OcNOS(telemetry-subscription)#sensor-group stream-1 sample-interval 1000
OcNOS(telemetry-subscription)#commit
OcNOS(telemetry-subscription)#exit
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
sensor-group stream-1
 sensor-path ipi:/interfaces/interface[name="eth0"]/state/counters
!
subscription-name sub-1
 sensor-group stream-1 sample-interval 1000
!
!
```

# sensor-path

Use this command to add sensor paths under sensor-groups. Can add multiple sensor paths to a single sensor group.

Use `no` parameter of this command to remove sensor paths.

## Command Syntax

```
sensor-path SENSOR-PATH
no sensor-path SENSOR-PATH
```

## Parameters

**SENSOR-PATH**
Specifies the path of the telemetry data to include in the sensor group.

## Default

None

## Command Mode

Telemetry-sensor-group Mode

## Applicability

Introduced in OcNOS version 6.5.2.

## Example

The following example demonstrates how to configure a sensor group (`stream-1`) and add multiple sensor paths to it for streaming telemetry.

```
OcNOS#configure terminal
OcNOS(config)#sensor-group stream-1
OcNOS(telemetry-sensor-group)#sensor-path ipi:/interfaces/interface[name="eth0"]/state/counters
OcNOS(telemetry-sensor-group)#sensor-path /interfaces/interface[name="xe2"]/state/counters
OcNOS(telemetry-sensor-group)#sensor-path openconfig:/interfaces/interface[name="xe3"]/state/counters
OcNOS(telemetry-sensor-group)#commit
OcNOS(telemetry-sensor-group)#exit
```

# show crypto csr

Use this command to display the Certificate Signing Request (CSR) that was generated with the crypto pki generate rsa common-name (page 46) command. The CSR is used in both NetConf and gNMI telemetry TLS workflows to request a certificate from a CA and validate the device identity.

**Note:** Manually execute the `show crypto csr` command on the console, as NetConf support for it is not available.

## Command Syntax

```
show crypto csr
```

## Parameters

None

## Default

None

## Command Mode

Privileged execution mode

## Applicability

This command was introduced in OcNOS version 5.0.

## Example

- After running show crypto csr command, copy the full CSR output to a file (for example `ServerCert.csr`) and submit it to a CA for signing.
- In gNMI telemetry deployments, the certificate returned via the CSR may include Subject Alternative Name (SAN) fields to match the server identity.
- Ensure that the Common Name (CN) and SAN values match the device's expected identity to avoid TLS validation failures from clients.

```
#crypto pki generate rsa common-name ipv4 7.7.7.7
#show crypto csr
-----BEGIN CERTIFICATE REQUEST-----
MIICVzCCAT8CAQAwEjEQMA4GA1UEAwwHNy43LjcuNzCCASIwDQYJKoZIhvcNAQEB
BQADggEPADCCAQoCggEBAMkzIZaxNYPd8PW0hexecUFKq9pJn5IJzJkOQDtoVFOT
zeLPRxBaOt1NVd+lEF+wy3AgnGMw004g4AP7qaE+S5X1vKGAjagtfh/gfDAPDUtM
CpYLMCACM7n76OmyP9eUpkMbOSPkZDIBZfjUMxDTFwkzCBH+BF6SkSxtA24NUA9z
5heCIb1ArXYjdlIeB+9FfiVdOZ5yxQsLY8604ONL7Upl766SArGQo6oZ1dJ+bc91
sQVCEpF40SdCNn+Uw3R0cPfQF81BJD4H0EHf1VnHtYJwQ1yax6qc5ghT9R/rABDa
BFB3R09QpjV4Ihd/MyrdQmEIoXHeNNvSGDj9+eiEpksCAwEAAaAAMA0GCSqGSIb3
DQEBCwUAA4IBAQAwXkQmNf3yiL+pmpwvE+gU8KVp3i4cvD13Vjh7IQMkCT47WPaM
DUiYgwk+dPVAI+iWZq4qTvUNn6xahOyN5rnkTz9eipsQ1YHPpZB7hj5fimWwzJws
m4Tun0GZieEBCROqUpbuW+6QDvtR3XSzHhdGGSIteZv9cYyKhNuO07okwr67c2Ea
1lB7Pcu1tOb4wj3xjqaO/ENDG+nmdUPaIKZrAwf2fEOarOaHgKwcl1AHHbusbJWL
```

```
qH0fA1OyVgfvg/WuCPP6Peg/Cpla7bDWqeGYt9vFTtekKoOMQLzJwl6oINbtBCcw
DZJpeaQpUhFm+ZOjwibZ5NGPBRSTuYncp5xJ
-----END CERTIFICATE REQUEST-----
```

# show streaming-telemetry

Use this command to display the streaming-telemetry details of persistent (dial-out) and dynamic (dial-in) subscription connection details, including the POLL mode subscriptions per VRF.

The `show streaming-telemetry` and all its sub-commands also shows the maximum sensor-paths and minimum sample-interval for that platform.

## Command Syntax

```
show streaming-telemetry (vrf (NAME|management)|)
```

## Parameters

**vrf NAME**
(Optional) Defines streaming telemetry in a user-defined VRF. Specify the VRF instance name.

**vrf management**
(Optional) Defines streaming telemetry in the management VRF.

## Command Mode

Execution mode

## Applicability

Introduced in OcNOS version 6.5.2 and added the `vrf (NAME|management)` parameters in the OcNOS version 6.6.0. Introduced two fields, "CPU monitoring" and "CPU monitoring threshold", in all the show streaming-telemetry command output in the OcNOS Version 6.6.1.

## Examples

The following example displays the streaming telemetry details.

```
OcNOS#show streaming-telemetry

 Number of telemetry instances : 3 (default,VRF1,management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 6 (Dial-In : 0, Dial-out : 6)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : storage
```

```
   Status               : ACTIVE
   Enc-Type             : JSON
   Tunnel-server details:
   ~~~~~~~~~~~~~~~~~~~~~
   Tunnel-server Retry-interval  : Default-60 (seconds)

    Destination-group         Status         Tunnel-IP:Port
    -----------------         ------         --------------
    Collector1                ACTIVE      10.12.101.72:11161
   Sensor-group details:
   ~~~~~~~~~~~~~~~~~~~~
   Sensor-group          SI            Origin:Path
   ------------         ----           -----------
      Platform            10           ipi:/components/component[name="RAM"]/ram/state
                                       ipi:/components/component[name="HARD-DISK"]/storage/state

2. Subscription Details (VRF-Name: VRF1):
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  Port         : 50000
  TLS          : Disabled
  insecure-tls : False

Dial-Out Subscription Details:
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
1. Subscription-name    : storage
   Status               : ACTIVE
   Enc-Type             : JSON
   Tunnel-server details:
   ~~~~~~~~~~~~~~~~~~~~~
   Tunnel-server Retry-interval  : Default-60 (seconds)

    Destination-group         Status         Tunnel-IP:Port
    -----------------         ------         --------------
    Collector3                ACTIVE      10.21.3.4:11123
   Sensor-group details:
   ~~~~~~~~~~~~~~~~~~~~
   Sensor-group          SI            Origin:Path
   ------------         ----           -----------
      Platform            95           ipi:/components/component[name="RAM"]/ram/state
                                       ipi:/components/component[name="HARD-DISK"]/storage/state

3. Subscription Details (VRF-Name: management):
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  Port         : 60000
  TLS          : Disabled
  insecure-tls : False

Dial-Out Subscription Details:
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
1. Subscription-name    : storage2
   Status               : ACTIVE
   Enc-Type             : JSON
   Tunnel-server details:
   ~~~~~~~~~~~~~~~~~~~~~
   Tunnel-server Retry-interval  : Default-60 (seconds)

    Destination-group         Status         Tunnel-IP:Port
    -----------------         ------         --------------
    Collector2                ACTIVE      10.21.3.4:11123
   Sensor-group details:
   ~~~~~~~~~~~~~~~~~~~~
   Sensor-group          SI            Origin:Path
   ------------         ----           -----------
      Platform            95           ipi:/interfaces/interface/state
                                       [*]ipi:/interfaces/interface/state/counters

[*]-> Indicates child path learnt from parent config, not configured by user
```

The below table explains the output fields.

**Table 8. show streaming-telemetry output details**

| Field | Description |
|---|---|
| Number of telemetry instances | Displays the total telemetry instances configured, including VRFs like management, user-defined, and default. |
| Platform type | Displays the platform type is standard or high range. |
| Maximum sensor-paths | Shows the maximum number of sensor paths configured. For more details, refer to the telemetry maximum-subscribe-paths (page 84) command. |
| Minimum sample-interval | Indicates the minimum sampling interval in seconds. For more details, refer to the telemetry minimum-sample-interval (page 85) command. |
| CPU monitoring | Displays the current operational state of CPU-based telemetry control. It shows:<br>• ENABLED (NORMAL) – when telemetry is enabled and the current CPU usage is below the configured threshold.<br>• ENABLED (PAUSED) – when telemetry is enabled and the CPU usage exceeds the configured threshold, causing telemetry streams to pause.<br>• DISABLED - when telemetry CPU monitoring is explicitly disabled via configuration. |
| CPU monitoring threshold | Displays the active CPU threshold value (in percentage) configured to trigger the pause or resume logic for telemetry streaming. |
| Number of active sensor-paths | Shows the total number of active sensor paths for Dial-In and Dial-Out subscriptions. |
| SI | Represents the sampling interval (SI) in seconds at which telemetry data is collected. |
| Enc-Type | Indicates the encoding type (Enc-type) used for each subscription. |
| Origin:Path | Displays the origin and path of the data being monitored. |
| Port | Specifies the port (page 58) number range for the TLS gRPC connection. |
| TLS | Indicates whether the TLS connection is enabled or disabled. |
| insecure-tls | Indicates the TLS connection is secure (false) or not (true). |

**Table 9. persistent-subscription output details**

| Field | Description |
|---|---|
| Subscription-name | Shows the name of the Dial-Out subscription. |
| Status | Indicates whether the subscription is ACTIVE or INACTIVE. |
| Tunnel-server details | Provides details about the tunnel server, including destination group, status, tunnel-server retry interval, and tunnel-IP:Port. |
| Tunnel-server Retry-interval | Displays the duration between retry attempts in seconds. |
| Sensor-group details | Show the details about the sensor group, including the sampling interval (SI) and origin:path. |
| Destination Group (DG) | Define the tunnel server settings to which telemetry data is sent for dial-out |

**Table 9. persistent-subscription output details (continued)**

| Field | Description |
|---|---|
| | subscriptions. |
| Sensor Group (SG) | Sensor group associated with the subscription. |

# show streaming-telemetry dynamic-subscriptions

Use this command to display the streaming telemetry dial-in configurations.

## Command syntax

```
show streaming-telemetry (vrf (NAME|management)|) dynamic-subscriptions
```

## Parameters

**vrf NAME**
(Optional) Defines streaming telemetry in a user-defined VRF. Specify the VRF instance name.

**vrf management**
(Optional) Defines streaming telemetry in the management VRF.

## Command Mode

Execution mode

## Applicability

This command was introduced in OcNOS version 6.4.1. Added the `vrf (NAME|management)` parameter in the OcNOS version 6.6.0. Introduced two fields, "CPU monitoring" and "CPU monitoring threshold", in all the show streaming-telemetry command output in the OcNOS Version 6.6.1.

## Examples

The following example displays the streaming telemetry dial-in configuration output.

```
OcNOS#show streaming-telemetry vrf management dynamic-subscriptions

 Number of telemetry instances : 1 (management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 3 (Dial-In : 3, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 60000
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.16.12.10:48290    16525    91     JSON_IETF    openconfig:/components/component
[name="TEMPERATURE-HWM_Heater"]/state
                                                    openconfig:/components/component
[name="TEMPERATURE-HWM_Heater"]/state/temperature
```

```
                                                    openconfig:/components/component
[name="TEMPERATURE-HWM_Heater"]/state/memory
```

Here is the explanation of the output fields.

**Table 10. show streaming-telemetry output details**

| Field | Description |
|---|---|
| Number of telemetry instances | Displays the total telemetry instances configured, including VRFs like management, user-defined, and default. |
| Platform type | Displays the platform type is standard or high range. |
| Maximum sensor-paths | Shows the maximum number of sensor paths configured. For more details, refer to the telemetry maximum-subscribe-paths (page 84) command. |
| Minimum sample-interval | Indicates the minimum sampling interval in seconds. For more details, refer to the telemetry minimum-sample-interval (page 85) command. |
| CPU monitoring | Displays the current operational state of CPU-based telemetry control. It shows:<br>• ENABLED (NORMAL) – when telemetry is enabled and the current CPU usage is below the configured threshold.<br>• ENABLED (PAUSED) – when telemetry is enabled and the CPU usage exceeds the configured threshold, causing telemetry streams to pause.<br>• DISABLED - when telemetry CPU monitoring is explicitly disabled via configuration. |
| CPU monitoring threshold | Displays the active CPU threshold value (in percentage) configured to trigger the pause or resume logic for telemetry streaming. |
| Number of active sensor-paths | Shows the total number of active sensor paths for Dial-In and Dial-Out subscriptions. |
| SI | Represents the sampling interval (SI) in seconds at which telemetry data is collected. |
| Enc-Type | Indicates the encoding type (Enc-type) used for each subscription. |
| Origin:Path | Displays the origin and path of the data being monitored. |
| Port | Specifies the port (page 58) number range for the TLS gRPC connection. |
| TLS | Indicates whether the TLS connection is enabled or disabled. |
| insecure-tls | Indicates the TLS connection is secure (false) or not (true). |

**Table 11. Dynamic-subscriptions output details**

| Field | Description |
|---|---|
| Dial-In Subscription Details | Check the Dial-in subscription details. |
| ClientIP: Port | Verify that the client IP and port listed matches the client that should be receiving telemetry data. |
| SI: Sampling-interval | Confirm that the sampling interval matches the desired frequency at which data is collected and sent. |

**Table 11. Dynamic-subscriptions output details (continued)**

| | |
|---|---|
| Enc-type: Encoding-type | Ensure that the encoding type (e.g., JSON_IETF) matches the expected format for telemetry data. |
| Origin:Path | Review the sensor paths to ensure that they correspond to the specific data sources or paths of interest. |

# show streaming-telemetry persistent-subscriptions

Use this command to display a brief summary of the streaming-telemetry dial-out configurations. This command provides a concise view of the persistent subscription settings configured on the device.

## Command Syntax

```
show streaming-telemetry (vrf (NAME|management)|) persistent-subscriptions brief
show streaming-telemetry (vrf (NAME|management)|) persistent-subscriptions details (SUBSCRIPTION-
NAME|)
```

## Parameters

**SUBSCRIPTION-NAME**
Displays detailed configuration information specific to the named persistent subscription.

**vrf NAME**
(Optional) Defines streaming telemetry in a user-defined VRF. Specify the VRF instance name.

**vrf management**
(Optional) Defines streaming telemetry in the management VRF.

## Default

None

## Command Mode

Execution mode

## Applicability

Introduced in OcNOS version 6.5.2. Added the `vrf (NAME|management)` parameter in the OcNOS version 6.6.0. Introduced two fields, "CPU monitoring" and "CPU monitoring threshold", in all the show streaming-telemetry command output in the OcNOS Version 6.6.1.

## Example

The command output lists each persistent subscription with its associated details.

```
OcNOS#show streaming-telemetry persistent-subscriptions details

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 2 (Dial-In : 0, Dial-out : 2)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
```

```
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : storage
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : Default-60 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
     Collector1                ACTIVE      10.12.101.72:11161
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
       Platform            10           ipi:/components/component[name="RAM"]/ram/state
                                        ipi:/components/component[name="HARD-DISK"]/storage/state
```

```
OcNOS#show streaming-telemetry vrf VRF1 persistent-subscriptions brief

 Number of telemetry instances : 3 (default,VRF1,management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 27 (Dial-In : 3, Dial-out : 24)

 DG           : Destination Group
 SG           : Sensor Group
 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type

 1. Subscription Details (VRF-Name: VRF1):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 50000
   TLS          : Disabled
   insecure-tls : False

 Dial-out subscription in brief:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 Tunnel-server Retry-interval  : Default-60 (seconds)

 Subscription-Name   Status      Enc-Type          DG         SG-SI
 -----------------   ------     --------          --         -----
     storage         ACTIVE       JSON          Collector3    Platform - 95
```

Here is the explanation of the output fields.

**Table 12. show streaming-telemetry output details**

| Field | Description |
|---|---|
| Number of telemetry instances | Displays the total telemetry instances configured, including VRFs like management, user-defined, and default. |
| Platform type | Displays the platform type is standard or high range. |
| Maximum sensor-paths | Shows the maximum number of sensor paths configured. For more details, refer to the telemetry maximum-subscribe-paths (page 84) command. |
| Minimum sample-interval | Indicates the minimum sampling interval in seconds. For more details, refer to |

**Table 12. show streaming-telemetry output details (continued)**

| Field | Description |
|---|---|
| | the telemetry minimum-sample-interval (page 85) command. |
| CPU monitoring | Displays the current operational state of CPU-based telemetry control. It shows:<br>• ENABLED (NORMAL) – when telemetry is enabled and the current CPU usage is below the configured threshold.<br>• ENABLED (PAUSED) – when telemetry is enabled and the CPU usage exceeds the configured threshold, causing telemetry streams to pause.<br>• DISABLED - when telemetry CPU monitoring is explicitly disabled via configuration. |
| CPU monitoring threshold | Displays the active CPU threshold value (in percentage) configured to trigger the pause or resume logic for telemetry streaming. |
| Number of active sensor-paths | Shows the total number of active sensor paths for Dial-In and Dial-Out subscriptions. |
| SI | Represents the sampling interval (SI) in seconds at which telemetry data is collected. |
| Enc-Type | Indicates the encoding type (Enc-type) used for each subscription. |
| Origin:Path | Displays the origin and path of the data being monitored. |
| Port | Specifies the port (page 58) number range for the TLS gRPC connection. |
| TLS | Indicates whether the TLS connection is enabled or disabled. |
| insecure-tls | Indicates the TLS connection is secure (false) or not (true). |

**Table 13. persistent-subscription output details**

| Field | Description |
|---|---|
| Subscription-name | Shows the name of the Dial-Out subscription. |
| Status | Indicates whether the subscription is ACTIVE or INACTIVE. |
| Tunnel-server details | Provides details about the tunnel server, including destination group, status, tunnel-server retry interval, and tunnel-IP:Port. |
| Tunnel-server Retry-interval | Displays the duration between retry attempts in seconds. |
| Sensor-group details | Show the details about the sensor group, including the sampling interval (SI) and origin:path. |
| Destination Group (DG) | Define the tunnel server settings to which telemetry data is sent for dial-out subscriptions. |
| Sensor Group (SG) | Sensor group associated with the subscription. |

# show running-config streaming-telemetry

Use this command to display streaming telemetry status in the running configuration.

## Command Syntax

```
show running-config streaming-telemetry
```

## Parameters

None

## Command Mode

Execution mode and Configure mode

## Applicability

This command was introduced in OcNOS version 6.4.1.

## Examples

The following example shows the streaming telemetry status in the `show running-config` output.

```
OcNOS#configure terminal
OcNOS(config)#feature streaming-telemetry
OcNOS(config)#commit
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
!
OcNOS(config)#exit
```

# subscription-name

Use this command to create named subscriptions for persistent telemetry configurations in an OcNOS device. The VRF parameter must match the VRF specified in the feature streaming-telemetry (page 55) command. Multiple subscriptions can be created. These subscriptions are essential for activating streaming telemetry, as they define specific settings such as associated destination groups and sensor groups.

Use `no` parameter of this command to delete a subscription.

## Command Syntax

```
subscription-name NAME (vrf (management|NAME)|)
no subscription-name NAME (vrf (management|NAME)|)
```

## Parameters

**subscription-name NAME**
Specifies the unique name to the persistent subscription.

**vrf NAME**
(Optional) Creates named subscriptions in a user-defined VRF.

**vrf management**
(Optional) Creates named subscriptions in the management VRF.

## Default

None

## Command Mode

Configure mode

## Applicability

Introduced in OcNOS version 6.5.2.

## Example

The following command demonstrates configuring a subscription (`sub-1`) on an OcNOS device. The subscription remains `in-active` because the sensor groups and destination groups have not been added to it.

```
OcNOS#configure terminal
OcNOS(config)#subscription-name sub-1
OcNOS(telemetry-subscription)#commit
Subscription sub-1 is "in-active": sensor-group(s) and destination-group(s) are not configured.
OcNOS(telemetry-subscription)#exit
```

```
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
!
subscription-name sub-1
!
```

# suppress-threshold

Use this command to set a custom CPU usage threshold for triggering the pause of streaming telemetry operations. When the 5-minute average CPU usage goes above the configured threshold and stays above the threshold for at least a minute, OcNOS will suppress telemetry activity to protect control plane resources.

Use the `no` parameter of this command to remove the custom threshold and revert to the default value of 40%.

## Command Syntax

```
suppress-threshold <20-80>
no suppress-threshold
```

## Parameters

**<20-80>**

Specifies the CPU usage percentage threshold for pausing telemetry. Valid range: 20–80. The default value is 40.

## Default

Disabled

## Command Mode

Telemetry CPU monitor mode

## Applicability

Introduced in OcNOS version 6.6.1.

## Example

### Set a Custom CPU Threshold

Define a threshold (e.g., 50%) for CPU usage before pausing telemetry activity when CPU usage exceeds 50%, allowing headroom for normal operation:

```
OcNOS(config)#telemetry cpu-monitor enable
OcNOS(telemetry-cpu-monitor)#suppress-threshold 50
OcNOS(telemetry-cpu-monitor)#commit
```

### View the Active Configuration

Verify the active CPU monitoring configuration, including the set threshold:

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
telemetry cpu-monitor enable
 suppress-threshold 50
!
```

### Reset to Default Threshold

Delete the custom threshold and revert to the default value (40%):

```
OcNOS(telemetry-cpu-monitor)#no suppress-threshold
OcNOS(telemetry-cpu-monitor)#commit
```

# telemetry cpu-monitor

Use this command to enable or disable CPU monitoring for streaming telemetry. This mechanism ensures telemetry subscriptions pause automatically when CPU load exceeds a configured threshold.

Use the `no` parameter of this command to set the CPU monitoring to its default behavior (enabled).

## Command Syntax

```
telemetry cpu-monitor (enable | disable)
no telemetry cpu-monitor
```

## Parameters

**enable**
Turns on CPU monitoring for telemetry.

**disable**
Turns off CPU monitoring; telemetry will not be paused due to high CPU load.

## Default

Enabled

## Command Mode

Configure mode

## Applicability

Introduced in OcNOS version 6.6.1.

## Example

Use this command to check whether CPU monitoring is currently enabled or disabled in the telemetry configuration:

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
telemetry cpu-monitor disable
!
!


OcNOS#sh streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 3 (vrf1,management,default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : DISABLED
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 70 (Dial-In : 4, Dial-out : 66)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path
```

```
 1. Subscription Details (VRF-Name: vrf1):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 2. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 35000
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.16.99.109:46682    35379    90     JSON_IETF    ipi:/interfaces/interface[name="eth0"]/state
                                                    ipi:/interfaces/interface
[name="eth0"]/state/counters


 3. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 36000
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 40.1.1.2:49598    20535    10     JSON_IETF    ipi:/interfaces/interface[name="eth0"]/state
                                                    ipi:/interfaces/interface
[name="eth0"]/state/counters
```

Enable CPU monitoring to let the system automatically pause telemetry during high CPU load:

```
OcNOS#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
OcNOS(config)#telemetry cpu-monitor enable
OcNOS(telemetry-cpu-monitor)#commit
OcNOS(telemetry-cpu-monitor)#exit
OcNOS(config)#exit

OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf vrf1
 grpc-tunnel-server retry-interval 30
!
feature streaming-telemetry vrf management
 port 35000
 grpc-tunnel-server retry-interval 30
!
feature streaming-telemetry
 port 36000
 grpc-tunnel-server retry-interval 30
!
telemetry cpu-monitor enable
!
!

OcNOS#show streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 3 (vrf1,management,default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
```

```
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 70 (Dial-In : 4, Dial-out : 66)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: vrf1):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 2. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 35000
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.16.99.109:46682    35379    90     JSON_IETF    ipi:/interfaces/interface[name="eth0"]/state
                                                    ipi:/interfaces/interface
[name="eth0"]/state/counters


 3. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 36000
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 40.1.1.2:49598    20535    10     JSON_IETF    ipi:/interfaces/interface[name="eth0"]/state
                                                    ipi:/interfaces/interface
[name="eth0"]/state/counters
```

Disable CPU monitoring if telemetry should run without interruption, regardless of CPU load:

```
OcNOS(config)#telemetry cpu-monitor disable
OcNOS(config)#commit
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
telemetry cpu-monitor disable
!
!
```

Remove the CPU monitor configuration entirely:

```
OcNOS(config)#telemetry cpu-monitor enable
OcNOS(telemetry-cpu-monitor)#commit
OcNOS(telemetry-cpu-monitor)#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
telemetry cpu-monitor enable
```

```
!
!


OcNOS(config)#no telemetry cpu-monitor
OcNOS(config)#commit
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry
 grpc-tunnel-server retry-interval 60
!
!
!
```

# telemetry maximum-subscribe-paths

Use this command to set the maximum number of telemetry subscription paths. Users can control how many sensor paths they can subscribe to at a time.

Use no form of the command to reset the telemetry subscribe path count to its default value.

## Command Syntax

```
telemetry maximum-subscribe-paths <10-1000>
no telemetry maximum-subscribe-paths
```

## Parameters

**maximum-subscribe-paths <10-1000>**

Specifies the range of supported telemetry subscription paths to configure across all VRFs.

## Default

If telemetry subscribe paths are not explicitly configured, the system sets it to **100 sensor paths for high-end platforms** and **50 sensor paths for standard platforms**.

## Command Mode

Configure mode

## Applicability

Introduced in OcNOS version 6.6.0

## Examples

The show command output below displays the available configuration on a device.

```
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
!
!
```

Here, the maximum subscription paths are set to `200`, and the show command output confirms the configuration.

```
OcNOS(config)#telemetry maximum-subscribe-paths 200
OcNOS(config)#commit
```

```
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
telemetry maximum-subscribe-paths 200
!
!
```

# telemetry minimum-sample-interval

Use this command to set the minimum sample interval in seconds between telemetry data samples. Prevents excessive network and system resource consumption by ensuring telemetry updates are not sent too frequently.

Use no form of the command to reset the minimum sample interval to its default value.

## Command Syntax

```
telemetry minimum-sample-interval <10-3600>
no telemetry minimum-sample-interval
```

## Parameters

**minimum-sample-interval <10-3600>**

Specifies the range in seconds for the minimum sampling interval across all VRFs.

## Default

If telemetry mimum sample intervals are not explicitly configured, the system sets it to **`10 seconds for high-end platforms`** and **`90 seconds for standard platforms`**.

## Command Mode

Configure mode

## Applicability

Introduced in OcNOS version 6.6.0

## Examples

This example sets the telemetry minimum sampling interval to `12 seconds`, and the show command output confirms the configuration.

```
OcNOS(config)#telemetry minimum-sample-interval 12
OcNOS(config)#commit
```

```
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
telemetry minimum-sample-interval 12
!
!
```

# tls tls-port

Use this command to enable secure or insecure TLS connection for streaming-telemetry.

Use the no parameter of this command to disable the secure or insecure TLS and restart the telemetry with a non-TLS connection.

**Note:** In OcNOS, streaming telemetry over TLS secures incoming packets for dial-in connections. Transport Layer Security (TLS) is not supported for dial-out mode subscriptions.

## Command Syntax

```
tls tls-port <1024-65535>
no tls tls-port

tls tls-port <1024-65535> insecure
no tls tls-port <1024-65535> insecure
no insecure
```

## Parameters

**tls-port <32768-60999>**
Specifies the port number range for the secure TLS gRPC connection.

**insecure**
Disables certificate validation in a TLS-enabled connection.

## Default

Disabled

## Command Mode

Feature telemetry configure mode

## Applicability

Introduced in OcNOS version 6.6.0. Updated the port range from `<32768-60999>` to `<1024-65535>` to allow flexibility with the default port configuration in OcNOS version 7.0.0.

## Examples

### Secure TLS

Enable or disable the TLS connection on the desired port.

To verify the TLS connection status, check the `TLS` and `insecure-tls` fields in the show output. If the `TLS` field shows `enabled`, the TLS connection is active. If the `insecure-tls` field is marked as `false`, it means that the provided certificates are validated.

```
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#tls tls-port 34567
OcNOS(feature-telemetry-config)#commit
```

```
OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
tls tls-port 34567
!

OcNOS#show streaming-telemetry vrf management

 Number of telemetry instances : 1 (management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 1 (Dial-In : 1, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 34567
   TLS          : Enabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.12.42.10:49828    53207    90          JSON    ipi:/interfaces/interface[name="eth0"]/state

OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#no tls tls-port 34567
OcNOS(feature-telemetry-config)#commit
```

### Insecure TLS

Enable or disable insecure TLS connection on the desired port. In the show output fields, if the `insecure-tls` field is marked as `true`, it means that the provided certificates are not validated.

```
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#tls tls-port 34567 insecure
OcNOS(feature-telemetry-config)#commit

OcNOS(config)#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
tls tls-port 34567 insecure
!
!

OcNOS#show streaming-telemetry vrf management

 Number of telemetry instances : 1 (management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 2 (Dial-In : 2, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path
```

```
 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 34567
   TLS          : Enabled
   insecure-tls : True

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.14.105.105:47938    13085    90          JSON    ipi:/interfaces/interface[name="eth0"]/state
                                                     ipi:/interfaces/interface
[name="eth0"]/state/counters
```

```
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#no tls tls-port 34567 insecure
OcNOS(feature-telemetry-config)#commit

OR

OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#no insecure
OcNOS(feature-telemetry-config)#commit
```

# tunnel-server

Use this command to add tunnel-servers under destination groups. Can create multiple tunnel servers within a destination group.

Use `no` parameter of this command to remove a tunnel server from the destination group.

## Command Syntax

```
tunnel-server ip A.B.C.D port <1-65535>
no tunnel-server ip A.B.C.D port <1-65535>
```

## Parameters

**ip A.B.C.D**
Specifies the tunnel server IP address.

**port <1-65535>**
Specifies the tunnel server port-number.

## Default

None

## Command Mode

Telemetry-GRPC-tunnel-group Mode

## Applicability

Introduced in OcNOS version 6.5.2.

## Example

The following command demonstrates how to add a tunnel server within the destination group.

```
OcNOS#configure terminal
OcNOS(config)#destination-group tunnel-1
OcNOS(telemetry-grpc-tunnel-group)#tunnel-server ip 10.12.66.160 port 11163
OcNOS(telemetry-grpc-tunnel-group)#commit
OcNOS(telemetry-grpc-tunnel-group)#exit
```

# Troubleshooting

Follow the below troubleshooting steps, to debug telemetry related issues:

**Verify Collector (gnmic) Command Options:** Verify the input parameters, such as the sensor path, prefix and origin "`ipi:`".

**Check the Encoding Method Compatibility:** Check that the request conforms to the supported encoding methods.

**Ensure Proper Connectivity:** Validate the connectivity between the router and the remote management system. This involves verifying network settings, ports, firewalls, and any potential disruptions in communication.

**Collector:** If `gnmic` does not receive a response or not receiving expected response, restart the request using the "`--log`" option. If more verbose debug output is needed, consider adding the "`--debug`" option as well. The gnmic tool displays the possible cause for any error, which helps in debugging the issue.

**Note:** When no updates are available for a subscribed XPath in `gnmic`, the client does not return a `NULL` or empty response. Instead, it remains in a waiting (hang) state until the device sends a new update that matches the subscribed path.

```
gnmic -a 10.12.91.111:9339 -u ocnos -p ocnos --encoding json_ietf --insecure --mode STREAM --stream-
mode sample --sample-interval 10s sub --path "ipi:/ldp/peers/peer[peer-address=\"6.6.6.6\"]/state"
```

In this example, the subscription is monitoring the LDP peer state for `6.6.6.6`.

- If the LDP session is active, telemetry updates will be sent every `10 seconds`.
- If the LDP session goes down, the subscribed path becomes `non-existent` in the telemetry database.
- In such cases, no gNMI update is sent at the configured sample interval, and the client appears to `"hang" (wait)` until the session comes back up or another matching update is generated.

**gNMI Server:** If the issue is on server side, follow the steps below to troubleshoot telemetry issues on the OcNOS target. Enable debug and verify the logs in `/var/log/messages` file.

1. In configure mode, enable debug with a specific severity level either "`info`" or "`debug`" level, using the debug telemetry gnmi (page 49) command.

   **Note:** To disable the debug telemetry, configure `debug telemetry gnmi (disable)` command.

2. In Exec mode, enable telemetry related debugs, using the debug cml (page 48) command.

   **Note:** To disable telemetry related debugs, configure "`debug cml disable telemetry`" command.

3. To check the state of streaming telemetry, collect the output of the following commands based on the telemetry mode:
   - For Dial-in mode, use: `show streaming-telemetry dynamic-subscriptions (page 70)`.

- For Dial-out mode, use: `show streaming-telemetry persistent-subscriptions (page 73)`.

**Notes:**

- For Dial-out mode, Subscription status could become inactive for the following reasons:
  - Sensor group(s) and destination group(s) are not configured
  - Destination group(s) are not configured
  - Sensor group(s) are not configured
  - Sensor-group(s) doesn't have any sensor-path(s) configured, and destination-group(s) doesn't have any tunnel-server(s) configured.
  - Destination-group(s) doesn't have any tunnel-server(s) configured
  - Sensor-group(s) doesn't have any sensor-path(s) configured
- If telemetry is in "`disabled`" state, then telemetry feature need to enabled.

4. Collect the output of the **`show techsupport gnmi`** command to gather diagnostic information and the logs in `/var/log/messages` file, to triage further.
5. If telemetry is not working, verify that CPU monitoring is ENABLED and the gNMI server is in the PAUSE state. The server enters the PAUSE state when CPU usage exceeds the configured threshold and resumes normal operation once the CPU usage drops below the threshold.

# GNMI GET RPC MODE

## Overview

The gNMI Get RPC in OcNOS enables on-demand retrieval of network configuration, state, or operational data. It allows clients to fetch real-time state or configuration snapshots without requiring continuous monitoring.

**Notes:**

- The system supports IPI and OpenConfig (OC) XPaths and uses `JSON_IETF` encoding for responses.
- Implicit wildcard paths (`e.g., /interfaces/interface/state`) are supported, simplifying data retrieval, but explicit wildcard paths are not.

## Feature Characteristics

The Figure 2. Sample Get RPC Request (page 92) and Figure 3. gNMI Get Mode Data Flow (page 93) illustrates the gNMI Get RPC workflow in OcNOS, where a gNMI client requests specific telemetry data from a gNMI server (OcNOS target), which then processes the request and retrieves data from the Centralized Management and Logging Daemon (CMLd) and Protocol Modules (PM) or SQL Database. The response is converted into `JSON_IETF` format and sent back to the client.

**Figure 2. Sample Get RPC Request**

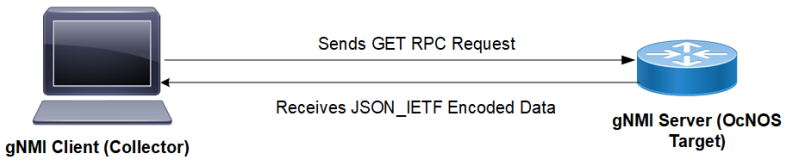
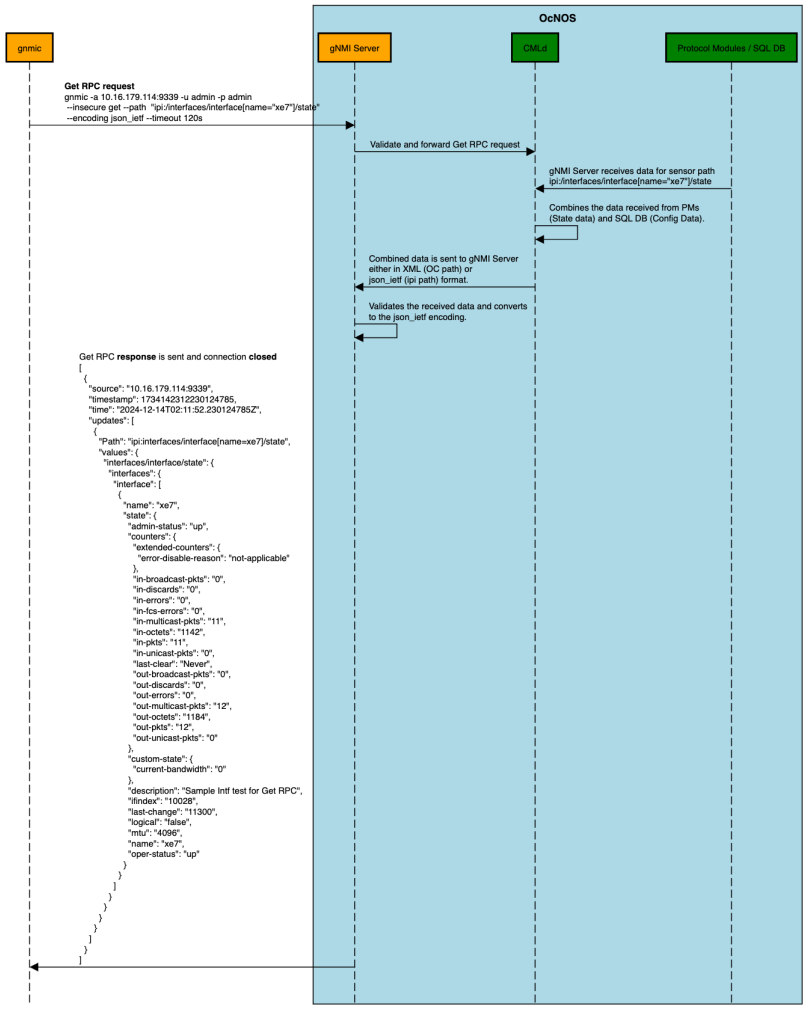


**Figure 3. gNMI Get Mode Data Flow**




1. The gNMI client sends a Get RPC request to the OcNOS device with the required sensor path, data type (`State, Configuration, or All`), and encoding type (JSON_IETF).
2. The gNMI server validates the request and forwards it to CMLd. It performs validations on XPath correctness, encoding type (`JSON_IETF`), requested data type (`State, Configuration, or All`). Once validated, the gNMI server forwards the request to CMLd.
3. CMLd fetches state data from PMs and configuration data from the SQL database. The retrieved data is combined before being sent back to the gNMI server.
4. The gNMI server processes the response, converts it into `JSON_IETF` format, and sends it to the gNMI client (`gnmic`).
5. The Get RPC response is received, and the connection is closed.

## Benefits

**Reduced Network Overhead:** Fetches only requested data, minimizing unnecessary telemetry traffic.

**On-Demand Data Access:** Eliminates the need for continuous monitoring while providing real-time insights.

# Configuration

This section explains how to send and receive Get RPC requests for three use cases: Configuration data, State data, and All data types.

## Prerequisites

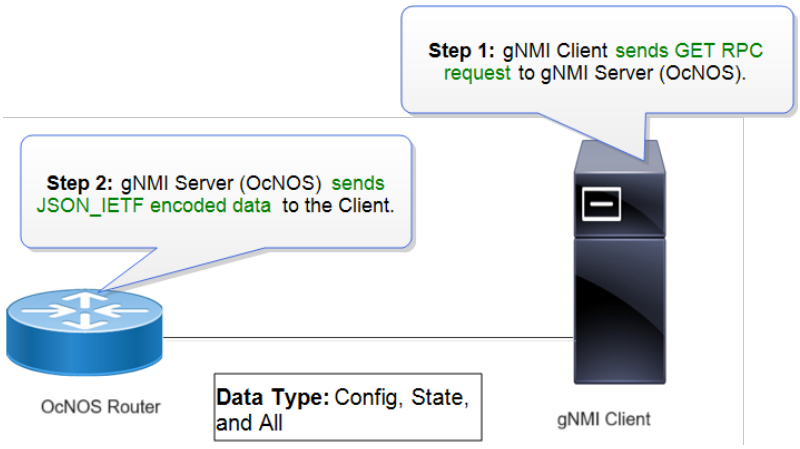
Before configuring streaming telemetry with TLS, ensure the following:

- A supported OcNOS router running a compatible release.
- Access to the management interface of the router.
- Any gNMI client that complies with gNMI specifications can be used as a client.
- Download and install the gNMI collector package by referring to the gnmic Installation (page 32) section.
- Generate the server and client certificates following the Certificate Management for OcNOS and gNMI (page 152) process to enable secure communication.

## Topology

The Figure 4. Get RPC Connection (page 94) illustrates how the gNMI client connects to the OcNOS router to send all data type Get RPC request.

**Figure 4. Get RPC Connection**




**Note:** Before configuring, meet all Prerequisites (page 94).

### Use Case 1:Get RPC Requests for Configuration Data Type

The `gnmic` command retrieves `configuration data` from the specified device. The **`--type config`** flag specifies that the data is of type `configuration`. The response includes configuration settings for the interface named `po1`, such as the `MTU` value and the `enable-switchport` setting, which are part of the device's configuration.

```
 ./gnmic -a 10.12.162.22:9339 -u admin -p admin --insecure get  --path 'ipi:/interfaces/interface
[name="po1"]' --encoding json_ietf --type config --timeout 120s
[
  {
    "source": "10.12.162.22:9339",
    "timestamp": 1730122009406462625,
    "time": "2024-10-28T13:26:49.406462625Z",
    "updates": [
      {
        "Path": "ipi:interfaces/interface[name=po1]",
        "values": {
          "interfaces/interface": {
            "interfaces": {
              "interface": [
                {
                  "config": {
                    "enable-switchport": "",
                    "mtu": "300",
                    "name": "po1"
                  },
                  "name": "po1"
                }
              ]
            }
          }
        }
      }
    ]
  }
]
```

## Use Case 2:Get RPC Requests for State Data Type

The `gnmic` command retrieves `state` data from the specified device. The **`--type state`** flag specifies that the data being retrieved is of type `state`. The response includes various operational details for the interface named `ge1`, such as its admin-status, oper-status, and various packet counters, which reflect the current state of the interface. This data provides information on the interface's operational condition, such as whether it is up or down, and details like in-packets, out-packets, and error-disable-reason, which monitors and troubleshoots the interface's performance.

```
./gnmic -a 10.12.162.22:9339 -u admin -p admin --insecure get --path  "ipi:/interfaces/interface
[name=\"ge1\"]/state" --encoding json_ietf --type state --timeout 120s
[
  {
    "source": "10.12.162.22:9339",
    "timestamp": 1730123321680355567,
    "time": "2024-10-28T13:48:41.680355567Z",
    "updates": [
      {
        "Path": "ipi:interfaces/interface[name=ge1]/state",
        "values": {
          "interfaces/interface/state": {
            "interfaces": {
              "interface": [
                {
                  "name": "ge1",
                  "state": {
                    "admin-status": "up",
                    "counters": {
                      "extended-counters": {
                        "error-disable-reason": "not-applicable"
                      },
                      "in-broadcast-pkts": "0",
                      "in-discards": "0",
                      "in-errors": "0",
```

```
                    "in-fcs-errors": "0",
                    "in-multicast-pkts": "0",
                    "in-octets": "0",
                    "in-pkts": "0",
                    "in-unicast-pkts": "0",
                    "last-clear": "2024 Oct 28 11:59:43 (01:48:58 ago)",
                    "out-broadcast-pkts": "0",
                    "out-discards": "0",
                    "out-errors": "0",
                    "out-multicast-pkts": "0",
                    "out-octets": "0",
                    "out-pkts": "0",
                    "out-unicast-pkts": "0"
                  },
                  "custom-state": {
                    "current-bandwidth": "0"
                  },
                  "enable-switchport": "",
                  "ifindex": "5001",
                  "last-change": "103900",
                  "logical": "false",
                  "name": "ge1",
                  "oper-status": "down"
                }
              }
            ]
          }
        }
      }
    ]
  }
]
```

## Use Case 3:Get RPC Requests for All Data Types

The `gnmic` command retrieves `all data` types for the specified BGP instance. In this case, the **`--type`** flag is not used, meaning that the command will retrieve both configuration and state data related to the BGP instance with AS number `100`. The response includes the configuration and state information for the BGP instance and its peers, such as:

- **Configuration Data:**
  a. `bgp-as: 100` confirms the AS number for the BGP instance.
  b. `peer-address: 4.4.4.1` and `peer-as: 100` show the configuration of BGP peers.
- **State Data:**
  a. `bgp-peer-state: idle` indicates the state of the BGP peer (idle in this case).
  b. The counters, such as `notification-in: 0, update-message-in: 0`, and `update-message-out: 0`, reflect the number of BGP notifications and update messages received and sent.
  c. `total-prefixes: 0` indicates that no prefixes are being exchanged yet.

```
# ./gnmic -a 10.12.162.22:9339 -u admin -p admin --insecure get  --path "ipi:/bgp/bgp-instances/bgp-
instance[bgp-as=100]" --encoding json_ietf --timeout 120s
[
  {
    "source": "10.12.162.22:9339",
    "timestamp": 1730120826528664430,
    "time": "2024-10-28T13:07:06.52866443Z",
```

```
"updates": [
  {
    "Path": "ipi:bgp/bgp-instances/bgp-instance[bgp-as=100]",
    "values": {
      "bgp/bgp-instances/bgp-instance": {
        "bgp": {
          "bgp-instances": {
            "bgp-instance": [
              {
                "bgp-as": "100",
                "config": {
                  "bgp-as": "100"
                },
                "peers": {
                  "peer": [
                    {
                      "config": {
                        "peer-address": "4.4.4.1",
                        "peer-as": "100"
                      },
                      "peer-address": "4.4.4.1",
                      "state": {
                        "bgp-peer-state": "idle",
                        "counters": {
                          "notification-in": "0",
                          "notification-out": "0",
                          "update-message-in": "0",
                          "update-message-out": "0"
                        },
                        "dynamically-configured": "false",
                        "peer-address": "4.4.4.1",
                        "peer-as": "100",
                        "peer-type": "ibgp"
                      }
                    },
                    {
                      "config": {
                        "peer-address": "4.4.4.5",
                        "peer-as": "100"
                      },
                      "peer-address": "4.4.4.5",
                      "state": {
                        "bgp-peer-state": "idle",
                        "counters": {
                          "notification-in": "0",
                          "notification-out": "0",
                          "update-message-in": "0",
                          "update-message-out": "0"
                        },
                        "dynamically-configured": "false",
                        "peer-address": "4.4.4.5",
                        "peer-as": "100",
                        "peer-type": "ibgp"
                      }
                    }
                  ]
                },
                "rib": {
                  "address-family": [
                    {
                      "afi": "link-state",
                      "safi": "link-state",
                      "state": {
                        "afi": "link-state",
                        "safi": "link-state"
                      }
                    }
                  ]
```

```
                    },
                    "state": {
                      "bgp-as": "100",
                      "router-run-time-ip-address": "0.0.0.0",
                      "scan-remain-time": "35",
                      "table-version": "1",
                      "total-prefixes": "0",
                      "version": "4"
                    }
                  }
                ]
              }
            }
          }
        }
      ]
    }
]
```

# STREAMING TELEMETRY DIAL-IN MODE

## Overview

Dial-in mode in streaming telemetry enables collectors to initiate connections with OcNOS routers to receive operational data of interest. In this mode, the collector sends a Subscribe Remote Procedure Call (RPC) request to the gNMI server (OcNOS target device), specifying the data paths to monitor. The server then streams the requested telemetry data to the collector, facilitating proactive network monitoring and troubleshooting.

### Feature Characteristics

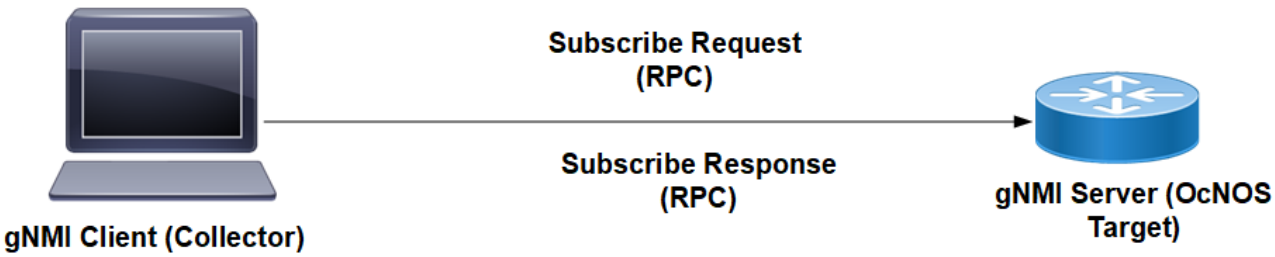
The gNMI-based Dial-in mode telemetry for the management plane supports three types of telemetry subscriptions: **Poll, Once, and Stream**.

The gNMI-based collector connects to the OcNOS target device and invokes the Subscribe RPC, specifying the set of path(s) of interest. Two key components are involved in this process:

- **gNMI Server (OcNOS Target):** The gNMI server operates within the OcNOS device, serving as the source of telemetry data. It supports the gNMI protocol, allowing gNMI-based clients (collectors) to request and receive streaming data. The server streams the requested data to the client according to the specified parameters.
- **gNMI Client (Collector):** The gNMI client, also known as the collector, runs outside the OcNOS target device and is responsible for receiving and gathering telemetry data. In this context, it is the entity that connects to the OcNOS target device to collect data using the gNMI protocol. The collector initiates the Subscribe RPC to specify the data of interest.

Figure 5 illustrates the gNMI client's (Collector) Subscribe request and response (RPC) interaction with the gNMI server (OcNOS Target).

**Figure 5. Sample Subscribe Request**




The gNMI-based Dial-in mode telemetry enables the "STREAM" type subscription with Sample Stream Mode (page 101) and On-Change Stream Mode (page 103) for the Subscribe RPC.

### Benefits

**Proactive Network Monitoring:** Obtain real-time insights into network health and performance, and how to enable quicker response to issues.

**Resource Utilization Monitoring:** Monitor CPU and memory utilization to optimize resource allocation and performance.

**Predictive Troubleshooting:** Identify patterns and potential issues before they impact the network, reducing downtime.

**Automation and Resilience:** Use telemetry data to automate network management tasks and design a more resilient network.

# Prerequisites

Before configuring Dial-In mode, ensure that:

- A supported OcNOS router running a compatible release.
- Access to the management interface of the router.
- Any gNMI client that complies with gNMI specifications can be used as a client.
- Refer to the gnmic Installation (page 32) to download the gNMI collector package.

# gNMI Subscription Limits

OcNOS enforces subscription limits to protect system resources and ensure fair allocation across multiple clients.

## Global Subscription Limit

**Limit:** 128 concurrent Subscribe RPCs (aggregate)

This parameter defines the maximum number of active gNMI subscriptions the gNMI server permits across all connected clients.

- In standard deployment patterns, a single Subscribe RPC is typically used to multiplex multiple sensor paths of a similar sensor type. Consequently, a 128-subscription limit is more than sufficient for the majority of network monitoring use cases.
- This is a “safety-first” threshold. Each active subscription requires the server to maintain a stateful stream, dedicated goroutines, and data caches. Without this cap, the system could experience critical memory exhaustion and CPU spikes.

## Per-Client Subscription Limit

**Limit:** 64 concurrent Subscribe RPCs (per connection)

This constraint ensures that no single gNMI client can consume the entire global subscription pool.

- By capping individual connections at 64 RPCs, the system guarantees that even if one client hits its local limit, at least 50% of the global capacity remains available for other collectors.
- This limit encourages collectors to bundle sensor paths efficiently within a single RPC rather than opening redundant streams.

# Sample Stream Mode

The gNMI-based Dial-in mode telemetry enables the "STREAM" type subscription with "SAMPLE" mode for the Subscribe RPC.

## Sampling Stream Mode Data Flow Description: Subscribe Request and Response

Figure 6 illustrates a sample gnmic Subscribe Request and Subscribe Response between the collector and the OcNOS target device.

### Step 1: Subscription Request Initiation

- The gnmic collector server initiates a Subscribe Request by sending a Subscribe RPC in Stream type.
- This subscription request aims explicitly to gather data related to interface state counters and CPU state.
- A fixed 30/45-second sampling interval is set for data collection.

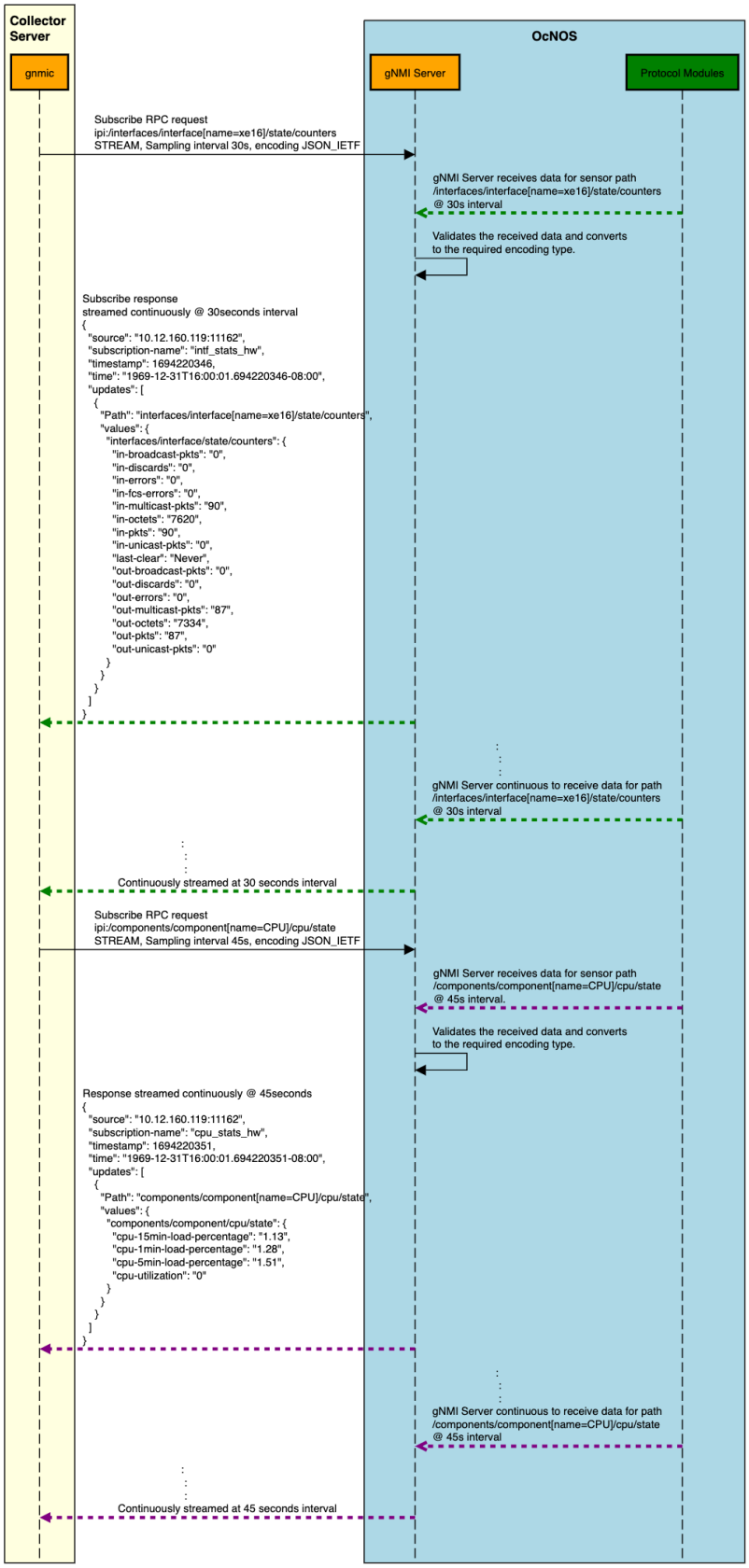
### Step 2: Data Collection and Processing

- The gNMI server, within the OcNOS router, is responsible for data collection.
- At regular 30/45-second intervals, it retrieves data from the sensor path, focusing on interface state counters and CPU State.
- The received data undergoes a validation process, and the data is transformed into the required encoding type.

### Step 3: Continuous Subscription Response Streaming

- The gNMI Server responds to the subscription request by continuously streaming Subscribe Response data.
- This streaming process maintains the same 30/45-second interval as the data collection.
- The collected data is streamed in real-time to the gnmic collector server.

**Figure 6. Sampling Stream Mode Message Flow: Subscribe Request and Response**



## Sample Stream Mode Benefits

For "counters" type attributes, use a cadence-based sampling mode. This approach enables efficient data push from the target to the collector and smoothly accommodates multiple collectors while minimizing CPU cycles.

# On-Change Stream Mode

The gNMI-based Dial-in mode telemetry enables the "STREAM" type subscription with "On-Change" mode for the Subscribe RPC. The gNMI-based Dial-in mode telemetry enables the STREAM type subscription with the ON_CHANGE mode for the Subscribe RPC. This mode provides an event-driven data streaming mechanism where updates are sent only when subscribed data values change, optimizing bandwidth and CPU usage compared to periodic streaming.

## On-Change Stream Mode Data Flow Description

Figure 7 illustrates a sample gnmic Subscribe Request and Subscribe Response message flow between the gNMI client (collector) and the OcNOS target device when the on-change stream mode is used.

### Step 1: Subscription Request

The gNMI client sends a Subscribe Request message to the OcNOS gNMI Server with mode set to `on-change`, specifying the sensor path(s) and an optional heartbeat interval.

### Step 2: Subscription Initialization

The OcNOS gNMI Server forwards this request to the subscribed data objects.

### Step 3: Initial Data Transmission

- The OcNOS target sends a Subscribe Response containing the initial data set for all subscribed paths to the client.
- A heartbeat timer is started to manage optional periodic refreshes.

### Step 4: Monitoring Phase

The OcNOS gNMI Server continuously monitors subscribed data items. Whenever any of these data items change, an event notification is triggered. Each notification includes the `timestamp` of when the updated path's value changed at source (protocol module).

### Step 5: Data Change Detection and Notification Delivery

- Upon detecting a change, the OcNOS gNMI Server compiles the updated values reports from the hash map based internal database.
- It immediately sends a gNMI Notification containing the new data to the client.
- The heartbeat timer is reset each time a notification is sent.

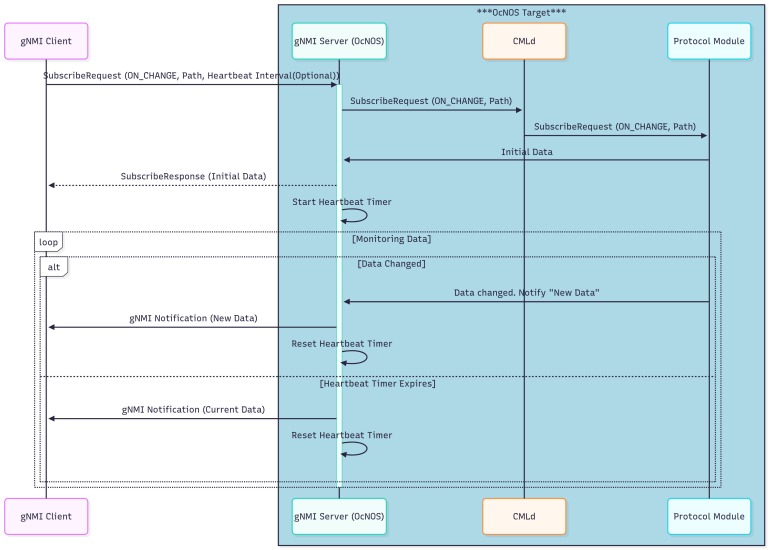
### Step 6: Heartbeat Trigger

If no data change occurs and the heartbeat timer expires, the OcNOS gNMI server sends a current data notification to confirm the session remains active. The timestamp in this notification reflects the last data state change, as no new updates have occurred.

### Step 7: Delete Notification

If any subscribed node (e.g., VLAN, interface) is deleted, a gNMI notification with a `delete` field is sent, containing the path of the removed node.

**Figure 7. On-Change Stream Mode Message Flow**




**Note: Resource Usage:** Minimal resource usage compared to SAMPLE mode; not paused even under CPU load threshold.

## Supported Sensor Path Types in On-Change Mode

- The On-Change stream mode in OcNOS supports two categories of sensor paths—container-level and leaf-level. The wildcard sensor path type is applicable to both categories, allowing flexible monitoring and notification of data changes across YANG-modeled objects.
- The On-Change stream mode provides flexible subscription granularity. Depending on the operational requirement, clients can subscribe at the container or leaf level, with optional wildcard sensor paths to extend the scope of change detection within those levels.
- See the On-change Supported Sensor Paths (page 274) section for the complete list of supported on-change telemetry sensor paths.

**Note:** The on-change streaming mode does not support OpenConfig sensor paths.

| Sensor Path Type | Description | Example Path | Behavior |
|---|---|---|---|
| Container-level sensor path | Subscribe request specifies a container-level path. Any data item under this container, when changed, triggers a gNMI update notification. | /interfaces/interface/state | If any child node (e.g., admin-status, oper-status) changes, OcNOS sends an update for that leaf. |
| Leaf-level sensor path | Subscribe request specifies a direct leaf node. OcNOS sends a gNMI update only when this specific attribute changes. | /interfaces/interface/state/oper-status | Update sent only when the operational status changes (e.g., from up to down). |
| Wildcard sensor path | Subscribe request uses wildcard (*) to match multiple elements.<br><br>**Note:** OcNOS supports full wildcards (implicit or explicit), but not partial wildcards. | /interfaces/interface [name=*]/state/oper-status | Sends updates for all matching interface instances when any of their values change. |

## On-Change Stream Mode Benefits

- **Reduced Network Traffic:** Transmits data only when actual changes occur, minimizing telemetry volume.
- **Real-Time Change Visibility:** Enables instant awareness of state transitions (e.g., link up or down).
- **Lower CPU Utilization:** Fewer updates reduce overhead on both OcNOS and the collector.
- **Efficient Storage and Analytics:** Downstream collectors store fewer redundant samples.
- **Ideal for Event-Driven Monitoring:** Suited for operational events such as BGP peer state, interface status, or system alarms.

# Configuration

In this example, streaming telemetry with OcNOS is demonstrated, using '`gnmic`' as the gNMI Client.

**Note:** To install the gnmic tool for managing network devices using gNMI, refer to the gnmic Installation (page 32)

**Figure 8. Dial-In Streaming Telemetry Topology**


**Note:** Before configuring Dial-In, meet all Prerequisites (page 100).

Enable streaming telemetry in a default VRF on OcNOS:

```
OcNOS#configure terminal
OcNOS(config)#feature streaming-telemetry
OcNOS(feature-telemetry-config)#commit
OcNOS(feature-telemetry-config)#exit
```

## Telemetry Subscription Request via gnmic Command

The gnmic client is a command-line tool used to interact with the OcNOS gNMI Server for telemetry operations. It allows users to establish, manage, and test telemetry subscriptions directly from the command line or using a configuration file.

Telemetry subscriptions define how and what data the OcNOS device streams to the collector. The `gnmic subscribe` command is used to initiate a subscription request from the collector (client) to the OcNOS gNMI target (server).

Using this command, users can:

- Specify subscription type (`STREAM, ONCE, or POLL`)
- Select stream mode (`sample or on-change`)
- Configure encoding format (`json, json_ietf, or proto`)
- Provide sensor paths for data collection (via YAML or command-line options)
- Optionally define parameters such as `sample intervals` or `heartbeat intervals`

The command can be executed in two ways:

- Using a YAML input file for multiple sensor paths
- Using a single path option for direct subscription testing

### Telemetry Subscription Request via gnmic Command and YAML Input

Use this command to initiate multiple telemetry subscriptions at once, with all sensor paths and parameters defined in a YAML configuration file.

```
gnmic -a <ipaddress:port> -u <UserName> -p <Password> --insecure  --config <path to config file>
subscribe
```

## Telemetry Subscription Request via gnmic Command with a Single Path Option

Use the below gnmic command with a single path option to request a telemetry subscription for a specific data path.

- Use this command to start a streaming telemetry session in `SAMPLE mode`, where data is sent at regular intervals based on the specified sample interval.

```
gnmic -a  <ipaddress:port> -u <UserName> -p <Password> --encoding [json, json_ietf] --insecure --
mode STREAM --stream-mode sample --sample-interval sample-interval-value sub --path <path>
```

- Use this command to perform a one-time (`ONCE`) or on-demand (`POLL`) telemetry query for the specified path.

```
gnmic -a  <ipaddress:port> -u <UserName> -p <Password> --encoding [json, json_ietf] --insecure --
mode [POLL, ONCE] sub --path <path>
```

- Use this command to start a `SAMPLE mode` streaming session using `Protobuf encoding`, referencing the `IPI_OC.proto` file for data structure definitions.
- Use this command to initiate an `on-change` stream using Protobuf encoding, where telemetry updates are sent only when subscribed data values change. However, proto encoding does not support paths with complex or union key types.

```
gnmic -a <ipaddress:port> -u <UserName> -p <Password> --encoding proto --insecure --mode STREAM -
-stream-mode sample --sample-interval sample-interval-value sub --path <path> --proto-file IPI_
OC.proto

gnmic -a <ipaddress:port> -u <UserName> -p <Password> --encoding proto --insecure --mode STREAM -
-stream-mode on-change sub --path <path> --proto-file IPI_OC.proto
```

- Use this command to initiate an `on-change` stream using `JSON or JSON-IETF` encoding for real-time change-based telemetry updates.
- Use this command to initiate an `on-change` stream with a configured heartbeat interval, ensuring periodic updates even when no data changes occur.

```
gnmic -a  <ipaddress:port> -u <UserName> -p <Password> --encoding [json, json_ietf] --insecure --
mode STREAM --stream-mode on-change sub --path <path>

gnmic -a  <ipaddress:port> -u <UserName> -p <Password> --encoding [json, json_ietf] --insecure --
mode STREAM --stream-mode on-change --heartbeat-interval <value> sub --path <path>
```

### Supported gnmic Options

The following table explains the supported fields and their usage.

**Table 14. gnmic Option Details**

| Option | Description |
|---|---|
| --encoding | Specifies the encoding format as either `json`, `proto`, or `json_ietf`. The default encoding format is `json`. |
| --mode | Sets the mode of operation. Supported modes are `STREAM, POLL, and ONCE.` |
| --insecure | Allows insecure gRPC or TLS connections to the OcNOS gNMI target. |
| --stream-mode | Defines the stream mode under the STREAM type. Supported values are `sample` and `on-` |

**Table 14. gnmic Option Details (continued)**

| Option | Description |
|---|---|
| | `change`. |
| --sample-interval | Sets the data sampling interval (for `SAMPLE` mode only).<br>  **Note:** Recommended value is `10s` or greater. |
| --config | Specifies the YAML configuration file path (for multiple subscription paths). Example: `input_path.yaml`. |
| --path | Sets the path to subscribe to specific data (Example: `'ipi:/interfaces/interface [name]/state'`).<br>  **Note:** Multiple paths can be specified using repeated `--path` options. |
| --prefix | Defines a common prefix for all specified paths (Example: `'ipi:/interfaces'`). |
| --proto-file | Specifies the path to the `.proto` file for Protobuf encoding. Example: `IPI_OC.proto`. |
| --heartbeat-interval | (Applicable for on-change mode only) Specifies the interval, in seconds, for sending periodic updates even when no data change occurs. This acts as a keepalive mechanism, ensuring that the client continues to receive updates confirming session health and data continuity. Example: `--heartbeat-interval 30s`. |

## Invoking Subscribe RPC with gnmic

This section provides various examples of using the Dial-in subscribe RPC with the gnmic command, as listed.

### Use Case 1: Monitoring Interface State with Single Path Option

In this use case, gnmic subscribes to a specific path using the Subscribe RPC, monitoring the state of an interface with the path `'ipi:/interfaces/interface[name=”ce51”]/state'`.

```
#gnmic -a 10.12.91.111:9339 -u ocnos -p ocnos --encoding json_ietf --insecure   --mode STREAM --
stream-mode sample --sample-interval 10s sub --path 'ipi:/interfaces/interface[name="ce51"]/state'

{
  "source": "10.12.91.111:9339",
  "subscription-name": "default-1695368813",
  "timestamp": 1550833401338910123,
  "time": "2019-02-22T11:03:21.388930123Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"ce51\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "23",
            "in-octets": "2126",
            "in-pkts": "23",
            "in-unicast-pkts": "0",
```

```
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "28",
            "out-octets": "2552",
            "out-pkts": "28",
            "out-unicast-pkts": "0"
          },
          "ifindex": 10051,
          "last-change": 15500,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}
```

The output of the Subscribe RPC includes the following information:

**Table 15. Subscribe RPC Output details**

| Option | Description |
|---|---|
| source | The source IP address and port of the gNMI server. |
| subscription-name | The name of the subscription. |
| timestamp | Indicates the exact time when the source (protocol modules) collects the telemetry data, not when the gNMI server sends the response packet (for `sampling` stream mode). |
| time | The timestamp in a human-readable format. |
| updates | An array of updates, each containing Path and Values. |
| Path | The path to the subscribed data. |
| values | The values of the subscribed data. |

### Validation

The below show command provides details about the subscriptions that have been established, including the client ID, sampling interval, encoding type, and the sensor paths that are being monitored.

```
OcNOS#show streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 2 (Dial-In : 2, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
```

```
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID    SI     Enc-Type      Origin:Path
 -------------        ------  ----   --------      ------------
 10.12.43.165:59304    4148   10     JSON_IETF      ipi:interfaces/interface
[name="ce51"]/state/counters

                                                     ipi:interfaces/interface[name="ce51"]/state
```

## Use Case 2: Monitoring Interface State with Multiple Path Option

In this use case, gnmic subscribes to a specific path using the Subscribe RPC, monitoring the state of an interface with the multiple path `'ipi:/interfaces/interface[name=”ce51”]/state'` and `'ipi:/interfaces/interface[name=”ce52”]/state'`.

```
#gnmic -a  10.12.91.111:9339 -u ocnos -p ocnos --encoding json_ietf  --insecure   --mode STREAM --
stream-mode sample --sample-interval 11s sub --path 'ipi:/interfaces/interface[name="ce51"]/state' --
path 'ipi:/interfaces/interface[name="ce52"]/state'

{
  "source": "10.12.91.111:9339",
  "subscription-name": "default-1695377304",
  "timestamp": 1550833401384910124,
  "time": "2019-02-22T11:03:21.388940124Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"ce51\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "10",
            "in-octets": "1060",
            "in-pkts": "10",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "10",
            "out-octets": "1020",
            "out-pkts": "10",
            "out-unicast-pkts": "0"
          },
          "ifindex": 10051,
          "last-change": 22500,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}

{
  "source": "10.12.91.111:9339",
  "subscription-name": "default-1695377304",
  "timestamp": 1550833401385910125,
  "time": "2019-02-22T11:03:21.388950125Z",
```

```
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"ce52\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "13",
            "in-octets": "1664",
            "in-pkts": "13",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "10",
            "out-octets": "1020",
            "out-pkts": "10",
            "out-unicast-pkts": "0"
          },
          "ifindex": 10052,
          "last-change": 22500,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}
```


### Validation

The below show command provides details about the subscriptions that have been established, including the client ID, sampling interval, encoding type, and the sensor paths that are being monitored.

```
OcNOS#show streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 4 (Dial-In : 4, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID    SI     Enc-Type      Origin:Path
 -------------        ------  ----   --------      ------------
 10.12.43.145:59334    42000   11     JSON_IETF      ipi:interfaces/interface
[name="ce52"]/state/counters
                                                     ipi:interfaces/interface[name="ce52"]/state
```

```
                                                    ipi:interfaces/interface
[name="ce51"]/state/counters
                                                    ipi:interfaces/interface[name="ce51"]/state
```

## Use Case 3: Monitoring Interface State Using Proto Encoding for IPI Xpath

In this use case, gnmic subscribes to the specified path using the Subscribe RPC, monitoring the state of an interface `'ipi:/interfaces/interface[name=”eth0”]/state'` using the proto encoding.

```
./gnmic -a 10.12.160.119:9339 -u admin -p admin --insecure --mode STREAM --stream-mode sample --
sample-interval 10s subscribe --path 'ipi:/interfaces/interface[name="eth0"]/state' --encoding proto
--proto-file IPI_OC.proto

{
  "source": "10.12.160.119:9339",
  "subscription-name": "default-1713864599",
  "timestamp": 1550833401388910124,
  "time": "2019-02-22T11:03:21.388910124Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "adminStatus": "up",
          "counters": {
            "inMulticastPkts": "159435",
            "inOctets": "902863924",
            "inPkts": "732970",
            "lastClear": "Never",
            "outOctets": "8931839",
            "outPkts": "105457"
          },
          "ifindex": 3,
          "lastChange": 8000,
          "operStatus": "up"
        }
      }
    }
  ]
}
```

### Validation

The below show command provides details about the subscriptions that have been established, including the client ID, sampling interval, encoding type, and the sensor paths that are being monitored.

```
OcNOS#show streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 2 (Dial-In : 2, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
```

```
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID    SI     Enc-Type      Origin:Path
 -------------        ------  ----   --------      ------------
 10.12.66.120:53246    14087    10         PROTO    ipi:/interfaces/interface[name="eth0"]/state
                                                      ipi:/interfaces/interface
[name="eth0"]/state/counters
```

## Use Case 4: Monitoring Interface State Using JSON Encoding for IPI Xpath

In this use case, gnmic subscribes to the specified path using the Subscribe RPC, monitoring the state of an interface `'ipi:/interfaces/interface[name=”eth0”]/state'` using the JSON encoding.

```
./gnmic -a 10.12.160.119:9339 -u admin -p admin --insecure --mode STREAM --stream-mode sample --
sample-interval 10s subscribe --path 'ipi:/interfaces/interface[name="eth0"]/state' --encoding json

{
  "source": "10.12.160.119:9339",
  "subscription-name": "default-1713864619",
  "timestamp": 1550833421055660410,
  "time": "2019-02-22T11:03:41.05566041Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
            "in-discards": 0,
            "in-errors": 0,
            "in-multicast-pkts": 159470,
            "in-octets": 902867237,
            "in-pkts": 733016,
            "in-unicast-pkts": 0,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 0,
            "out-octets": 8938196,
            "out-pkts": 105490,
            "out-unicast-pkts": 0
          },
          "ifindex": 3,
          "last-change": 8000,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}
```

### Validation

The below show command provides details about the subscriptions that have been established, including the client ID, sampling interval, encoding type, and the sensor paths that are being monitored.

```
OcNOS#show streaming-telemetry dynamic-subscriptions
```

```
 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 2 (Dial-In : 2, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID    SI     Enc-Type      Origin:Path
 -------------        ------  ----   --------      ------------
 10.12.66.120:53340    50687    10    JSON            ipi:/interfaces/interface[name=eth0]/state
                                                      ipi:/interfaces/interface
[name=eth0]/state/counters
```

## Use Case 5: Monitoring Interface State Using JSON Encoding for OpenConfig Xpath

In this use case, gnmic subscribes to the specified path using the Subscribe RPC, monitoring the state of an interface `'/interfaces/interface[name=”eth0”]/state'` using the JSON encoding for OpenConfig Xpath.

```
./gnmic -a 10.12.160.119:9339 -u admin -p admin --insecure --mode STREAM --stream-mode sample --
sample-interval 10s subscribe --path '/interfaces/interface[name="eth0"]/state' --encoding json

{
  "source": "10.12.160.119:9339",
  "subscription-name": "default-1713864712",
  "timestamp": 1550833514789102094,
  "time": "2019-02-22T11:05:14.789102094Z",
  "updates": [
    {
      "Path": "interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "AdminStatus": "UP",
          "Counters": {
            "InBroadcastPkts": 0,
            "InDiscards": 0,
            "InErrors": 0,
            "InFcsErrors": null,
            "InMulticastPkts": 159643,
            "InOctets": 902872585,
            "InPkts": 733096,
            "InUnicastPkts": 0,
            "LastClear": 0,
            "OutBroadcastPkts": 0,
            "OutDiscards": 0,
            "OutErrors": 0,
            "OutMulticastPkts": 0,
            "OutOctets": 8944684,
            "OutPkts": 105520,
            "OutUnicastPkts": 0
          },
```

```
          "Ifindex": 3,
          "LastChange": 8000,
          "Logical": false,
          "Name": "eth0",
          "OperStatus": "UP"
        }
      }
    }
  ]
}
```

### Validation

The below show command provides details about the subscriptions that have been established, including the client ID, sampling interval, encoding type, and the sensor paths that are being monitored.

```
OcNOS#show streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 2 (Dial-In : 2, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID    SI     Enc-Type      Origin:Path
 -------------        ------  ----   --------      ------------
 10.12.66.120:53390    16340    10    JSON          openconfig:/interfaces/interface
[name='eth0']/state
                                                   openconfig:/interfaces/interface
[name='eth0']/state/counters
```

## Use Case 6: On-Change Stream Mode Behavior for BGP Operational State

When `on-change` stream mode is enabled for a BGP sensor-path, OcNOS monitors specific operational state parameters under the BGP container and sends gNMI notifications only when a value changes.

### Initial Device Configuration

The following example shows the initial running configuration of the OcNOS device before enabling or modifying BGP attributes:

```
OcNOS#sh running-config
!
feature streaming-telemetry
!
!
```

```
!
!
service password-encryption
!
snmp-server enable traps link linkDown
snmp-server enable traps link linkUp
!
qos enable
!
errdisable cause stp-bpdu-guard
feature dns relay
ip dns relay
ipv6 dns relay
!
ip vrf management
!
interface eth11
!
interface eth10
!
interface eth9
!
interface eth8
!
interface eth7
!
interface eth6
!
interface eth5
!
interface eth4
!
interface eth3
!
interface eth2
 ip address 192.168.10.10/24
!
interface eth1
!
interface eth0
 ip address 172.16.0.16/24
!
interface lo
 ip address 127.0.0.1/8
 ipv6 address ::1/128
!
 exit
!
router bgp 10
 neighbor 192.168.10.11 remote-as 11
 !
 address-family ipv4 unicast
 neighbor 192.168.10.11 activate
 exit-address-family
 !
 exit
!
!
end

!
```

**Configuration Change: Add and Remove Local-AS**

In this step, a `local-as` value is configured for the BGP neighbor and then removed. This change in the local-as attribute triggers an on-change notification from OcNOS to the gNMI client.

```
router bgp 10
 neighbor 192.168.10.11 local-as 222
commit

router bgp 10
 no neighbor 192.168.10.11 local-as 222
commit
```

### gNMI Subscription Request

Use the following gnmic command to subscribe to the specific BGP path in on-change stream mode. This command requests notifications whenever the `local-as` value changes for the specified BGP neighbor.

```
$ gnmic -a 172.16.0.16:9339 -u ocnos -p ocnos --insecure --mode STREAM --stream-mode on-change sub --
path 'ipi:/bgp/bgp-instances/bgp-instance[bgp-as=10]/peers/peer[peer-
address="192.168.10.11"]/state/local-as' --encoding json_ietf
{
  "source": "172.16.0.16:9339",
  "subscription-name": "default-1756953095",
  "timestamp": 1756953092055491455,
  "time": "2025-09-03T23:31:32.055491455-03:00",
  "updates": [
    {
      "Path": "ipi:bgp/bgp-instances/bgp-instance[bgp-as=10]/peers/peer[peer-
address=\"192.168.10.11\"]/state/local-as",
      "values": {
        "bgp/bgp-instances/bgp-instance/peers/peer/state/local-as": {
          "local-as": 10
        }
      }
    }
  ]
}
{
  "sync-response": true
}


{
  "source": "172.16.0.16:9339",
  "subscription-name": "default-1756953095",
  "timestamp": 1756953099494562310,
  "time": "2025-09-03T23:31:39.49456231-03:00",
  "updates": [
    {
      "Path": "ipi:bgp/bgp-instances/bgp-instance[bgp-as=10]/peers/peer[peer-
address=\"192.168.10.11\"]/state/local-as",
      "values": {
        "bgp/bgp-instances/bgp-instance/peers/peer/state/local-as": {
          "local-as": 222
        }
      }
    }
  ]
}
{
  "sync-response": true
}


{
  "source": "172.16.0.16:9339",
  "subscription-name": "default-1756953095",
  "timestamp": 1756953112436537202,
  "time": "2025-09-03T23:31:52.436537202-03:00",
  "updates": [
    {
      "Path": "ipi:bgp/bgp-instances/bgp-instance[bgp-as=10]/peers/peer[peer-
```

```
address=\"192.168.10.11\"]/state/local-as",
      "values": {
        "bgp/bgp-instances/bgp-instance/peers/peer/state/local-as": {
          "local-as": 10
        }
      }
    }
  ]
}
{
  "sync-response": true
}
```

#### *Initial Notification from OcNOS*

When the subscription is initiated, OcNOS sends the current state of the `local-as` value for the subscribed path. This represents the initial sync response.

```
{
"source": "172.16.0.16:9339",
...
"timestamp": 1756953092055491455,
  "time": "2025-09-03T23:31:32.055491455-03:00",
....
"local-as": 10
}
```

#### *Update Notification When Local-AS Changes*

When the configured `local-as changes` from `10 to 222`, OcNOS immediately sends an update notification reflecting the new value. The `timestamp` field of this message indicates the time when the value of the updated path was collected from the protocol module.

```
{
"source": "172.16.0.16:9339",
...
  "timestamp": 1756953099494562310,
  "time": "2025-09-03T23:31:39.49456231-03:00",
 ....
"local-as": 222
}
```

#### *Update Notification When Local-AS Reverts*

When the `local-as` is `removed and reverts` to the value 10, another update notification is sent.

```
{
"source": "172.16.0.16:9339",
...
  "timestamp": 1756953112436537202,
  "time": "2025-09-03T23:31:52.436537202-03:00",
.....
"local-as": 10
}
```

## Use Case 7: Dial-In Telemetry Connection over IPv6 Interface

This example illustrates how streaming telemetry works over an IPv6 interface in Dial-In mode using Figure 8.

### Configuration on Node 1 (gNMI Server)

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
!
telemetry minimum-sample-interval 10
debug telemetry gnmi enable severity debug
!
!
!
```

#### *Interface Configuration*

```
OcNOS#show running-config interface xe16
!
interface xe16
 ip vrf forwarding management
 ip address 5.5.5.5/24
 ipv6 address 2a02:5501:31:801::1a/64
!
```

### Verification on Node 1 (gNMI Server)

```
OcNOS#show streaming-telemetry

 Number of telemetry instances : 1 (management)
 Platform type                 : Standard range
 Maximum sensor-paths          : 50
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 1 (Dial-In : 1, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 [2a02:5501:31:801::19]:62452    30784    30     JSON_IETF    ipi:/interfaces/in
terface[name="eth0"]/state/counters
```

### Configuration on Node 2 (gNMI Client)

```
OcNOS#show running-config interface xe16
!
interface xe16
 ipv6 address 2a02:5501:31:801::19/64
!
```

### gNMI client Response

The client establishes a successful IPv6-based gNMI subscription to OcNOS and receives telemetry updates as shown below:

```
./gnmic -a 2a02:5501:31:801::1a --port 9339 -u ocnos -p ocnos --insecure -e json_ietf  --mode STREAM
--stream-mode sample --sample-interval 30s sub --path "ipi:/interfaces/interface
[name=\"eth0\"]/state/counters" --log


{
  "source": "2a02:5501:31:801::1a",
  "subscription-name": "default-1755631437",
  "timestamp": 1755631321493278525,
  "time": "2025-08-19T19:22:01.493278525Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": "0",
          "in-discards": "0",
          "in-errors": "0",
          "in-multicast-pkts": "4111",
          "in-octets": "269755",
          "in-pkts": "3547",
          "in-unicast-pkts": "0",
          "last-clear": "Never",
          "out-broadcast-pkts": "0",
          "out-discards": "0",
          "out-errors": "0",
          "out-multicast-pkts": "0",
          "out-octets": "10130",
          "out-pkts": "93",
          "out-unicast-pkts": "0"
        }
      }
    }
  ]
}




{
  "source": "2a02:5501:31:801::1a",
  "subscription-name": "default-1755631437",
  "timestamp": 1755631350496850538,
  "time": "2025-08-19T19:22:30.496850538Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": "0",
          "in-discards": "0",
          "in-errors": "0",
          "in-multicast-pkts": "4136",
          "in-octets": "271197",
          "in-pkts": "3568",
          "in-unicast-pkts": "0",
          "last-clear": "Never",
          "out-broadcast-pkts": "0",
          "out-discards": "0",
          "out-errors": "0",
          "out-multicast-pkts": "0",
          "out-octets": "10130",
          "out-pkts": "93",
```

```
          "out-unicast-pkts": "0"
        }
      }
    }
  ]
}


{
  "source": "2a02:5501:31:801::1a",
  "subscription-name": "default-1755631437",
  "timestamp": 1755631380500095865,
  "time": "2025-08-19T19:23:00.500095865Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": "0",
          "in-discards": "0",
          "in-errors": "0",
          "in-multicast-pkts": "4160",
          "in-octets": "273459",
          "in-pkts": "3591",
          "in-unicast-pkts": "0",
          "last-clear": "Never",
          "out-broadcast-pkts": "0",
          "out-discards": "0",
          "out-errors": "0",
          "out-multicast-pkts": "0",
          "out-octets": "10130",
          "out-pkts": "93",
          "out-unicast-pkts": "0"
        }
      }
    }
  ]
}
```

# YAML File Input for Multiple Path Subscription

## Use Case 1: Configuring One Subscription Requests with Multiple Path Option

This use case illustrates the configuration of a subscription request with multiple paths using a YAML file input. It streamlines the subscription setup process by specifying the desired paths and subscription parameters directly in the YAML file.

### YAML File Content (single_request.yaml)

```
#cat single_request.yaml
subscriptions:                                          #Container for subscriptions
 RAM_stats_hw:                                          #A named subscription for RAM statistics
  prefix: "ipi:"                                       #Common prefix for paths in this subscription
  paths: "/components/component[name=\"RAM\"]/ram/state"         #List of subscription paths for the
RAM_stats_hw subscription
    stream-mode: sample                                   #Stream mode for RAM statistics
    sample-interval: 11s                                 #Sampling interval for RAM statistics (e.g.,
11 seconds)
    encoding: json_ietf                                   #Encoding format for RAM statistics (e.g.,
JSON_IETF)


  intf-tray_stats_hw:                                    #A named subscription for interface tray
statistics
```

```
    prefix: "ipi:"                                          #Common prefix for paths in this
subscription
    paths:                                                 #List of subscription paths for the intf-tray_
stats_hw subscription
      "ipi:/interfaces/interface[name=\"xe1\"]/state"
      "ipi:/interfaces/interface[name=\"vlan1.8\"]/state"

    stream-mode: sample                                      #Stream mode for interface tray statistics
    sample-interval: 14s                                    #Sampling interval for interface tray
statistics (e.g., 14 seconds)
    encoding: json_ietf                                      #Encoding format for interface tray
statistics (e.g., JSON_IETF)
```

### gnmic Command

```
# gnmic -a  10.12.91.111:9339 -u ocnos -p ocnos  --insecure  --config single_request.yaml subscribe

{
  "source": "10.12.91.111:9339",
  "subscription-name": "interface_stats_hw",
  "timestamp": 1550833401388910121,
  "time": "2019-02-22T11:03:21.388910184Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"xe1\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "0",
            "in-octets": "0",
            "in-pkts": "0",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "2",
            "out-octets": "164",
            "out-pkts": "2",
            "out-unicast-pkts": "0"
          },
          "ifindex": 10001,
          "last-change": 0,
          "logical": false,
          "oper-status": "down"
        }
      }
    }
  ]
}

{
  "source": "10.12.91.111:9339",
  "subscription-name": "interface_stats_hw",
  "timestamp": 1550833401388910129,
  "time": "2019-02-22T11:03:21.388110124Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"vlan1.10\"]/state",
      "values": {
        "interfaces/interface/state": {
```

```
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "0",
            "in-octets": "0",
            "in-pkts": "0",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "0",
            "out-octets": "0",
            "out-pkts": "0",
            "out-unicast-pkts": "0"
          },
          "ifindex": 25010,
          "last-change": 22500,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}
```


### Validation

The below show command provides details about the subscriptions that have been established, including the client ID, sampling interval, encoding type, and the sensor paths that are being monitored.

```
OcNOS#show streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 4 (Dial-In : 4, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------

 10.12.43.135:58208        45333   12     JSON_IETF      ipi:interfaces/interface
[name="xe1"]/state/counters
                                                        ipi:interfaces/interface[name="xe1"]/state
                                                        ipi:interfaces/interface
[name="vlan1.10"]/state/counters
```

```
                                                        ipi:interfaces/interface
[name="vlan1.10"]/state
```

## Use Case 2: Configuring Multiple Subscription Requests with Multiple Path Option

This use case illustrates the configuration of multiple subscription request with multiple paths using a YAML file input. It streamlines the subscription setup process by specifying the desired paths and subscription parameters directly in the YAML file.

### YAML File Content (multiple_subs.yaml)

```
#cat multiple_subs.yaml
subscriptions:                                                  # Container for subscriptions

RAM_stats_hw:                                                  # A named subscription for RAM
statistics

paths: "ipi:/components/component[name=\"RAM\"]/ram/state"                          # List of
subscription paths for the RAM_stats_hw subscription

stream-mode: sample                                              # Stream mode for RAM
statistics

sample-interval: 11s                                            # Sampling interval for RAM
statistics (e.g., 11 seconds)

encoding: json_ietf                                              # Encoding format for RAM
statistics (e.g., JSON_IETF)

storage_stats_hw:                                               # A named subscription for
storage statistics

paths: "ipi:/components/component[name=\"HARD-DISK\"]/storage/state"                 # List of
subscription paths for the storage_stats_hw subscription

stream-mode: sample                                              # Stream mode for storage
statistics

sample-interval: 12s                                            # Sampling interval for
storage statistics (e.g., 12 seconds)

encoding: json_ietf                                              # Encoding format for
storage statistics (e.g., JSON_IETF)

power-supply_stats_hw:                                           # A named subscription for
power supply statistics

paths:                                                         # List of subscription paths for
the power-supply_stats_hw subscription
   "ipi:/components/component[name=\"PSU-1\"]/power-supply/state"
   "ipi:/components/component[name=\"PSU-2\"]/power-supply/state"


stream-mode: sample                                              # Stream mode for power
supply statistics

sample-interval: 13s                                            # Sampling interval for power
supply statistics (e.g., 13 seconds)

encoding: json_ietf                                              # Encoding format for power
supply statistics (e.g., JSON_IETF)

intf-tray_stats_hw:                                              # A named subscription for
interface tray statistics
```

```
paths:                                                                  # List of subscription paths for
the intf-tray_stats_hw subscription
   "ipi:/interfaces/interface[name=\"xe1\"]/state"
   "ipi:/interfaces/interface[name=\"vlan1.8\"]/state"

stream-mode: sample                                                       # Stream mode for interface
tray statistics

sample-interval: 14s                                                    # Sampling interval for
interface tray statistics (e.g., 14 seconds)

encoding: json_ietf                                                       # Encoding format for
interface tray statistics (e.g., JSON_IETF)
```

### gnmic Command

```
# gnmic -a  10.12.91.111:9339 -u ocnos -p ocnos  --insecure  --config multiple_subs.yaml subscribe

{
  "source": "10.12.91.111:9339",
  "subscription-name": "ram_stats_hw",
  "timestamp": 1550833401388910128,
  "time": "2019-02-22T11:03:21.388910128Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"RAM\"]/ram/state",
      "values": {
        "components/component/ram/state": {
          "available-high-memory": "0",
          "available-memory": "14743",
          "buffers": "15",
          "current-process-count": 232,
          "free-swap": "0",
          "shared-memory": "8",
          "total-high-memory": "0",
          "total-memory": "16012",
          "total-swap": "0",
          "used-memory": "1269"
        }
      }
    }
  ]
}

{
  "source": "10.12.91.111:9339",
  "subscription-name": "storage_stats_hw",
  "timestamp": 1550833401388910127,
  "time": "2019-02-22T11:03:21.388910127Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"HARD-DISK\"]/storage/state",
      "values": {
        "components/component/storage/state": {
          "free-memory": "16908",
          "total-memory": "30208",
          "used-memory": "5020"
        }
      }
    }
  ]
}

{
```

```
  "source": "10.12.91.111:9339",
  "subscription-name": "power-supply_stats_hw",
  "timestamp": 1550833401388910126,
  "time": "2019-02-22T11:03:21.388910126Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"PSU-1\"]/power-supply/state",
      "values": {
        "components/component/power-supply/state": {
          "capacity": "650",
          "fan1-rpm": 24288,
          "operational-status": "not-present",
          "output-current": "8.28",
          "output-voltage": "12.07",
          "power-consumption": "99",
          "temperature-sensor1": "22",
          "temperature-sensor2": "28",
          "temperature-sensor3": "24"
        }
      }
    }
  ]
}

{
  "source": "10.12.91.111:9339",
  "subscription-name": "power-supply_stats_hw",
  "timestamp": 1550833401388910125,
  "time": "2019-02-22T11:03:21.388910125Z",

  "updates": [
    {
      "Path": "ipi:components/component[name=\"PSU-2\"]/power-supply/state",
      "values": {
        "components/component/power-supply/state": {
          "operational-status": "running",
          "temperature-sensor1": "0",
          "temperature-sensor2": "0",
          "temperature-sensor3": "0"
        }
      }
    }
  ]
}

{
  "source": "10.12.91.111:9339",
  "subscription-name": "intf-tray_stats_hw",
  "timestamp": 1550833401388910123,
  "time": "2019-02-22T11:03:21.388910123Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"xe1\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "0",
            "in-octets": "0",
            "in-pkts": "0",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
```

```
            "out-errors": "0",
            "out-multicast-pkts": "5",
            "out-octets": "410",
            "out-pkts": "5",
            "out-unicast-pkts": "0"
          },
          "ifindex": 10001,
          "last-change": 0,
          "logical": false,
          "oper-status": "down"
        }
      }
    }
  ]
}

{
  "source": "10.12.91.111:9339",
  "subscription-name": "intf-tray_stats_hw",
  "timestamp": 1550833401388910122,
  "time": "2019-02-22T11:03:21.388910122Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"vlan1.8\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "0",
            "in-octets": "0",
            "in-pkts": "0",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "0",
            "out-octets": "0",
            "out-pkts": "0",
            "out-unicast-pkts": "0"
          },
          "ifindex": 25008,
          "last-change": 22500,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}
```


### Validation

The below show command provides details about the subscriptions that have been established, including the client ID, sampling interval, encoding type, and the sensor paths that are being monitored.

```
OcNOS#show streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
```

```
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 8 (Dial-In : 8, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.12.43.155:58267        9453     14    JSON_IETF      ipi:interfaces/interface
[name="xe1"]/state/counters
                                                        ipi:interfaces/interface[name="xe1"]/state
                                                        ipi:interfaces/interface
[name="vlan1.8"]/state/counters
                                                        ipi:interfaces/interface
[name="vlan1.8"]/state
 10.12.43.155:58114        31533    11    JSON_IETF      ipi:components/component
[name="RAM"]/ram/state
 10.12.43.155:58345        3374     12    JSON_IETF      ipi:components/component[name="HARD-
DISK"]/storage/state
 10.12.43.155:58222        35994    13    JSON_IETF      ipi:components/component[name="PSU-
1"]/power-supply/state
                                                        ipi:components/component[name="PSU-
2"]/power-supply/state
```

## Use Case 3: Configuring Multiple Subscription Requests with Prefix Option

This use case illustrates the configuration of multiple subscription request with prefix option using a YAML file input. It streamlines the subscription setup process by specifying the desired paths and subscription parameters directly in the YAML file.

### YAML File Content (prefix_path.yaml)

```
#cat prefix_path.yaml
subscriptions:                                                          #Container for
subscriptions

RAM_stats_hw:                                                          #A named subscription for
RAM statistics

prefix: "ipi:"                                                          #Common prefix for paths in
this subscription

paths:"/components/component[name=\"RAM\"]/ram/state"                              #List of
subscription paths for the RAM_stats_hw subscription

stream-mode: sample                                                       #Stream mode for RAM
statistics

sample-interval: 11s                                                    #Sampling interval for RAM
statistics (e.g., 11 seconds)

encoding: json_ietf                                                       #Encoding format for RAM
statistics (e.g., JSON_IETF)
```

```
intf-tray_stats_hw:                                                    #A named subscription for
interface tray statistics

prefix: "ipi:"                                                        #Common prefix for paths in
this subscription

paths:                                                               #List of subscription paths
for the intf-tray_stats_hw subscription
   "ipi:/interfaces/interface[name=\"xe1\"]/state"
   "ipi:/interfaces/interface[name=\"vlan1.8\"]/state"


stream-mode: sample                                                    #Stream mode for
interface tray statistics

sample-interval: 14s                                                  #Sampling interval for
interface tray statistics (e.g., 14 seconds)

encoding: json_ietf                                                    #Encoding format for
interface tray statistics (e.g., JSON_IETF)
```

### gnmic Command

```
# gnmic -a  10.12.91.111:9339 -u ocnos -p ocnos  --insecure  --config prefix_path.yaml subscribe
{
  "source": "10.12.91.111:9339",
  "subscription-name": "ram_stats_hw",
  "timestamp": 1550833401188910121,
  "time": "2019-02-22T11:03:21.388910121Z",

  "updates": [
    {
      "Path": "components/component[name=\"RAM\"]/ram/state",
      "values": {
        "components/component/ram/state": {
          "available-high-memory": "0",
          "available-memory": "14793",
          "buffers": "16",
          "current-process-count": 231,
          "free-swap": "0",
          "shared-memory": "8",
          "total-high-memory": "0",
          "total-memory": "16012",
          "total-swap": "0",
          "used-memory": "1219"
        }
      }
    }
  ]
}

{
  "source": "10.12.91.111:9339",
  "subscription-name": "intf-tray_stats_hw",
  "timestamp": 1550830401388910120,
  "time": "2019-02-22T11:03:21.388900120Z",
  "updates": [
    {
      "Path": "interfaces/interface[name=\"xe1\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
```

```
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "0",
            "in-octets": "0",
            "in-pkts": "0",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "9",
            "out-octets": "738",
            "out-pkts": "9",
            "out-unicast-pkts": "0"
          },
          "ifindex": 10001,
          "last-change": 0,
          "logical": false,
          "oper-status": "down"
        }
      }
    }
  ]
}

{
  "source": "10.12.91.111:9339",
  "subscription-name": "intf-tray_stats_hw",
  "timestamp": 1550833401288910122,
  "time": "2019-02-22T11:03:21.388912122Z",
  "updates": [
    {
      "Path": "interfaces/interface[name=\"vlan1.8\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-fcs-errors": "0",
            "in-multicast-pkts": "0",
            "in-octets": "0",
            "in-pkts": "0",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "0",
            "out-octets": "0",
            "out-pkts": "0",
            "out-unicast-pkts": "0"
          },
          "ifindex": 25008,
          "last-change": 22500,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}
```

**Validation**

The below show command provides details about the subscriptions that have been established, including the client ID, sampling interval, encoding type, and the sensor paths that are being monitored.

```
OcNOS#show streaming-telemetry dynamic-subscriptions

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 5 (Dial-In : 5, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.12.43.154:50167        32137    11    JSON_IETF      ipi:components/component
[name="RAM"]/ram/state

 10.12.43.154:50614        36412    14    JSON_IETF     ipi:interfaces/interface
[name="vlan1.8"]/state/counters
                                                        ipi:interfaces/interface
[name="vlan1.8"]/state
                                                        ipi:interfaces/interface
[name="xe1"]/state/counters
                                                        ipi:interfaces/interface[name="xe1"]/state
```

# Implementation Examples

## Multi-Tenant Data Center Monitoring:

### Scenario

A cloud service provider (CSP) hosts thousands of virtual machines and containerized workloads for enterprises. Maintaining high-performance networking is critical to prevent latency-sensitive applications from failing.

The network operations team requires real-time telemetry data to troubleshoot performance bottlenecks, but polling data for every tenant consumes too many resources. Instead, the team uses OcNOS Streaming Telemetry Dial-In Mode to facilitate proactive monitoring of tenant networks.

### Implementation

- Enable streaming telemetry on OcNOS-based spine-leaf switches connecting virtualized workloads.

- Use gNMI Dial-In Mode to request interface statistics only for specific tenant networks experiencing issues.
- Integrate with a cloud observability platform (e.g., Splunk or Prometheus) to correlate telemetry data with application performance metrics.
- Take proactive measures to redistribute the workloads to mitigate any downtime of the applications due to network issues.

For step-by-step configurations, refer to the Dial-In configuration section.

# Dial-In Mode Command

Refer to the streaming telemetry dial-in mode commands in the Streaming Telemetry Commands (page 43) section.

# Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

| Key Terms/Acronym | Description |
|---|---|
| JSON | JavaScript Object Notation |
| RPC | Remote Procedure Call |
| gNMI | gRPC Network Management Interface |
| JSON-Internet Engineering Task Force (JSON-IETF) | JSON-IETF is a data interchange format that follows the specifications defined by the IETF. It is a lightweight, text-based format used for representing structured data. JSON-IETF is commonly used for configuration and data exchange in various network and Internet-related protocols. |
| Streaming Telemetry | A monitoring approach that efficiently transmits operational data from OcNOS routers to remote management systems in real-time for analysis, troubleshooting, and network monitoring. |
| Telemetry Data | Structured operational data generated by routers that is transmitted in real-time to external systems for analysis. |
| Remote Management System | An external system responsible for monitoring, managing, and analyzing data received from network devices. |
| Network Health | The overall condition and performance of a network, including factors like stability, resource utilization, and data flow. |
| Resilient Network | A network designed to withstand failures or disruptions, maintaining functionality even in challenging conditions. |

# STREAMING TELEMETRY DIAL-OUT MODE

## Overview

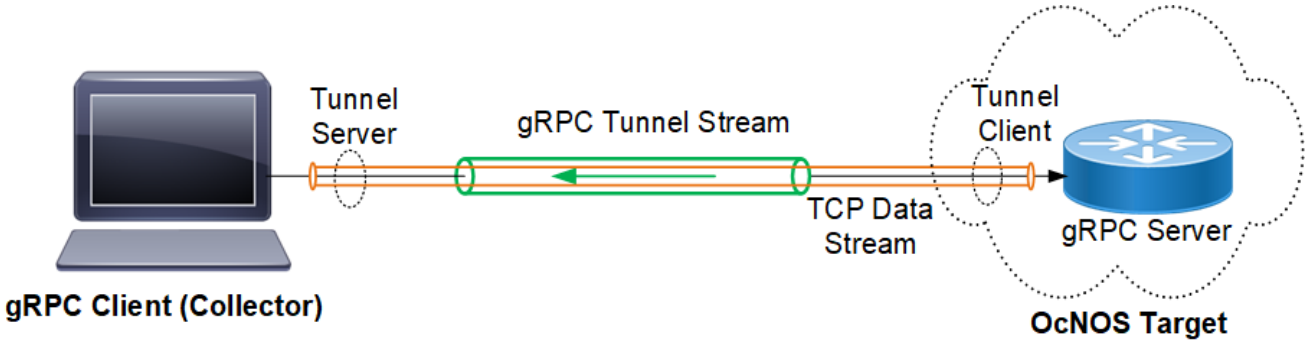
In OcNOS, dial-out telemetry subscriptions, also known as persistent subscriptions, ensure continuous data streaming, even if the Remote Procedure Call (gRPC) session terminates unexpectedly. With persistent subscriptions, the OcNOS device continuously retries to establish a gRPC connection to the collector server, thus maintaining persistent data streaming.

### Feature Characteristics

The dial-out telemetry feature in OcNOS comprises several key aspects ensuring seamless data streaming and connectivity with collector servers:

The described topology outlines a system architecture that utilizes gRPC-based tunneling for persistent streaming telemetry.

**Figure 9. Dial-Out Subscription Mode**




Here is a detailed explanation of the components and data flow:

- **gNMI Client (gRPC Client):** The gNMI client, which acts as the gRPC client in this scenario, is responsible for handling telemetry data and connecting to the OcNOS target device.
- **Tunnel Server:** The tunnel server, part of the gNMI collector process, listens for incoming gRPC tunnel streams from the gRPC server.
- **gRPC Tunnel Stream:** Represents the persistent communication channel established between the tunnel client (OcNOS) and the tunnel server (collector).
- **Tunnel Client:** The gRPC tunnel client operates on the OcNOS device and connects to the tunnel server. It manages the tunneling of telemetry data.
- **gRPC Server:** Interacts with the tunnel client to establish and manage the tunnel.

> **Note:** Ensure that the tunnel server is reachable over the network from the tunnel client, and configure both the tunnel client and tunnel server with compatible authentication mechanisms.

## Data Flow

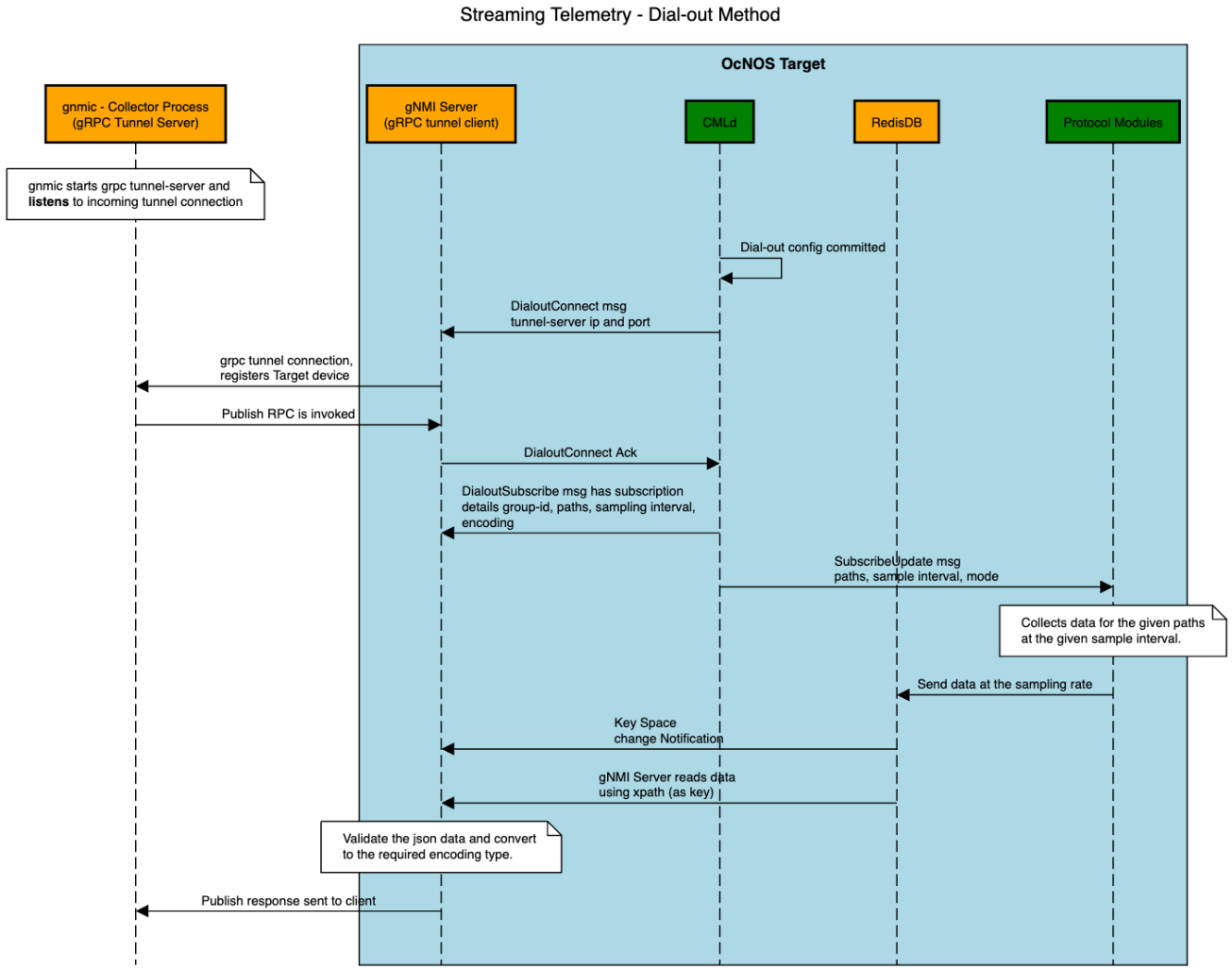
The Figure 10 flow chart illustrates streaming telemetry in Dial-out Mode.

- **Initialization:** When the dial-out command subscription-name (page 77) is applied successfully, the tunnel client on the OcNOS device initiates a connection to the tunnel server hosted on the collector.
- **Tunnel Establishment:** Upon successful connection, the gRPC client and server establish a persistent tunnel stream. This tunnel facilitates the continuous transmission of telemetry data.

> **Note:** OcNOS supports insecure tunnel connections.

- **Telemetry Data Transmission:** When telemetry data needs to be transmitted from the OcNOS device, the gNMI client sends a Publish RPC request over the established tunnel.
- **Subscription Configuration:** Telemetry commands follow the OpenConfig telemetry model, standardizing the configuration of telemetry subscriptions and related entities.

**Figure 10. Data Flow: Dial-Out Mode**



## Benefits

- Ensures continuous data streaming even in the event of gRPC session termination, enhancing network monitoring and troubleshooting capabilities.
- Simplifies configuration and management of telemetry subscriptions using standard OpenConfig models.
- Facilitates secure and reliable communication between the OcNOS device and the collector server.
- Enhances interoperability by enabling integration with third-party gRPC client applications like gNMI client, expanding telemetry options for network operators.

# Prerequisites

Before configuring Dial-Out mode, ensure that:

- A supported OcNOS router running a compatible release is required.
- Access to the management interface of the router is necessary.
- Refer to the gnmic Installation (page 32) to download the gNMI collector package.

# Configuration

Set up the OcNOS router to transmit streaming telemetry data to a gNMI client using the dial-out method.

The sample configuration on the OcNOS router sets up streaming telemetry subscriptions using gNMI to monitor specific paths related to the state of Hard Disk, RAM, and Chassis. The router sends telemetry data to the specified collector over a configured tunnel connection. The gNMI client subscribed to these paths will receive updates regarding the state of RAM and Hard Disk at the specified intervals. This setup enables proactive monitoring and management of key hardware components on the network device.

## Topology

In this setup, an OcNOS router functions as the data source for streaming telemetry, while a gNMI client acts as the receiver of telemetry data. The OcNOS router sends telemetry data to the gNMI client over a dial-out connection.

**Figure 11. Dial-out Streaming Telemetry Topology**

## Use Case 1: Configuring and Validating Telemetry on Management VRF

**Note:** Before configuring Dial-out, meet all Prerequisites (page 135).

1. Enable streaming telemetry on a management VRF.

```
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#exit
```

2. Create Sensor Group

   Create a sensor group (`Platform`) where sensor paths will be specified for dial-out subscriptions. Specify sensor paths within the sensor group (`Platform`) to monitor the chassis state.

```
OcNOS(config)#sensor-group Platform vrf management
OcNOS(telemetry-sensor-group)#sensor-path ipi:/components/component[name="CHASSIS"]/state
OcNOS(telemetry-sensor-group)#exit
```

3. Create Destination Group

   Create a destination group (`Collector2`) where tunnel server settings will be configured for dial-out subscriptions. Specify the tunnel server (`gNMI Client`) IP address (`10.21.3.4`) and port (`11123`) within the destination group (`Collector2`).

```
OcNOS(config)#destination-group Collector2 vrf management
OcNOS(telemetry-grpc-tunnel-group)#tunnel-server ip 10.21.3.4 port 11123
OcNOS(telemetry-grpc-tunnel-group)#exit
```

4. Create Persistent Subscription

   Establish a persistent subscription (`storage2`) with an encoding type (`JSON-IETF`). Associate it with the destination group (`Collector2`), and sensor group (`Platform`) to monitor the chassis state with a sample interval (`95 seconds`).

```
OcNOS(config)#subscription-name storage2 vrf management
OcNOS(telemetry-subscription)#encoding json-ietf
OcNOS(telemetry-subscription)#destination-group Collector2
OcNOS(telemetry-subscription)#sensor-group Platform sample-interval 95
OcNOS(telemetry-subscription)#commit
OcNOS(telemetry-subscription)#exit
```

5. Verify the Running Configurations on Management VRF

   To confirm the configuration, use the `show running-config streaming-telemetry` command, which displays all configured settings, including sensor groups, destination groups, and subscriptions:

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
!
sensor-group Platform vrf management
 sensor-path ipi:/components/component[name="CHASSIS"]/state
!
destination-group Collector2 vrf management
 tunnel-server ip 10.21.3.4 port 11123
!
subscription-name storage2 vrf management
 destination-group Collector2
 sensor-group Platform sample-interval 95
!
```

6. Validate theTelemetry Configuration on Management VRF

Use the `show streaming-telemetry persistent-subscriptions details` command to verify the active telemetry sessions. The output should confirm:

- Telemetry instances running on `management VRF`
- Active sensor paths (`4`) and sample intervals (`10`)
- Destination group status and configured IP:Port details `10.21.3.4:11123`.
- Dial-out subscriptions marked as `ACTIVE`

The validation output confirms that the telemetry subscription (`storage2`) is active, sending data to `Collector2`, and monitoring the chassis state at a `95-second` interval.

```
OcNOS#show streaming-telemetry persistent-subscriptions details

 Number of telemetry instances : 1 (management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 4 (Dial-In : 0, Dial-out : 4)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : storage2
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : Default-60 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
     Collector2                ACTIVE      10.21.3.4:11123
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
       Platform            95           ipi:/components/component[name="CHASSIS"]/state
                                        [*]ipi:/components/component[name="CHASSIS"]/state/memory
                                        [*]ipi:/components/component[name="CHASSIS"]/state/board-
fru
                                        [*]ipi:/components/component
[name="CHASSIS"]/state/temperature

 [*]-> Indicates child path learnt from parent config, not configured by user
```

## Use Case 2: Configuring and Validating Telemetry on a User-defined VRF

**Note:** Before configuring Dial-out, meet all Prerequisites (page 135).

1. Create the VRF `VRF1` and enable streaming telemetry in a user-defined VRF on an OcNOS router.

```
OcNOS(config)#ip vrf VRF1
OcNOS(config-vrf)#exit
OcNOS(config)#feature streaming-telemetry vrf VRF1
OcNOS(feature-telemetry-config)#exit
```

2. Create Sensor Group

   Create a sensor group (`Platform`) where sensor paths will be specified for dial-out subscriptions. Specify sensor paths within the sensor group (`Platform`) to monitor the state of RAM and Hard Disk.

```
OcNOS(config)#sensor-group Platform vrf VRF1
OcNOS(telemetry-sensor-group)#sensor-path ipi:/components/component[name="RAM"]/ram/state
OcNOS(telemetry-sensor-group)#sensor-path ipi:/components/component[name="HARD-
DISK"]/storage/state
OcNOS(telemetry-sensor-group)#exit
```

3. Create Destination Group

   Create a destination group (`Collector3`) where tunnel server settings will be configured for dial-out subscriptions. Specify the tunnel server (`gNMI Client`) IP address (`10.21.3.4`) and port (`11123`) within the destination group (`Collector3`).

```
OcNOS(config)#destination-group Collector3 vrf VRF1
OcNOS(telemetry-grpc-tunnel-group)#tunnel-server ip 10.21.3.4 port 11123
OcNOS(telemetry-grpc-tunnel-group)#exit
```

4. Create Persistent Subscription

   Establish a persistent subscription (`storage`) with an encoding type (`JSON-IETF`). Associate it with the destination group (`Collector3`), and sensor group (`Platform`) to monitor the state of RAM and Hard Disk with a sample interval (`95 seconds`).

```
OcNOS(config)#subscription-name storage vrf VRF1
OcNOS(telemetry-subscription)#encoding json-ietf
OcNOS(telemetry-subscription)#destination-group Collector3
OcNOS(telemetry-subscription)#sensor-group Platform sample-interval 95
OcNOS(telemetry-subscription)#commit
OcNOS(telemetry-subscription)#exit
```

5. Verify the Running Configurations on User-defined VRF

   To confirm the telemetry configuration, use the `show running-config streaming-telemetry` command, which displays all active settings, including enabled telemetry features, sensor groups, destination groups, and subscriptions:

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf VRF1
!
debug telemetry gnmi enable severity debug
!
sensor-group Platform vrf VRF1
 sensor-path ipi:/components/component[name="RAM"]/ram/state
 sensor-path ipi:/components/component[name="HARD-DISK"]/storage/state
!
destination-group Collector3 vrf VRF1
 tunnel-server ip 10.21.3.4 port 11123
!
subscription-name storage vrf VRF1
 destination-group Collector3
 sensor-group Platform sample-interval 95
!
```

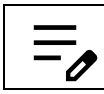
6. Validate the Telemetry Configuration on User-defined VRF

   To verify telemetry is actively streaming data, use the `show streaming-telemetry persistent-subscriptions details` command. The output confirms:

   - Telemetry instances running on `VRF1`
   - Number of active sensor paths (`2`) and sample intervals (`10`)
   - Destination group status and configured IP:Port details `10.21.3.4:11123`.
   - Dial-out subscriptions marked as `ACTIVE`

```
OcNOS#show streaming-telemetry persistent-subscriptions details

 Number of telemetry instances : 1 (VRF1)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 2 (Dial-In : 0, Dial-out : 2)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: VRF1):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : storage
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : Default-60 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
     Collector3                ACTIVE      10.21.3.4:11123
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
       Platform            95           ipi:/components/component[name="RAM"]/ram/state
                                        ipi:/components/component[name="HARD-DISK"]/storage/state
```

## Use Case 3: Configuring and Validating Telemetry on Default VRF



**Note:** Before configuring Dial-out, meet all Prerequisites (page 135).

1. Enable Streaming Telemetry in a default VRF on an OcNOS router.

```
OcNOS(config)#feature streaming-telemetry
OcNOS(feature-telemetry-config)#exit
```

2. Create Sensor Group

Create a sensor group (`Platform`) where sensor paths will be specified for dial-out subscriptions. Specify sensor paths within the sensor group (`Platform`) to monitor the state of RAM and Hard Disk.

```
OcNOS(config)#sensor-group Platform
OcNOS(telemetry-sensor-group)#sensor-path ipi:/components/component[name="RAM"]/ram/state
OcNOS(telemetry-sensor-group)#sensor-path ipi:/components/component[name="HARD-
DISK"]/storage/state
OcNOS(telemetry-sensor-group)#exit
```

3. Create Destination Group

   Create a destination group (`Collector1`) where tunnel server settings will be configured for dial-out subscriptions. Specify the tunnel server (`gNMI Client`) IP address (`10.12.101.72`) and port (`11161`) within the destination group (`Collector1`).

```
OcNOS(config)#destination-group Collector1
OcNOS(telemetry-grpc-tunnel-group)#tunnel-server ip 10.12.101.72 port 11161
OcNOS(telemetry-grpc-tunnel-group)#exit
```

4. Create Persistent Subscription

   Establish a persistent subscription (`storage`) with an encoding type (`JSON-IETF`). Associate it with the destination group (`Collector1`), and sensor group (`Platform`) to monitor the state of RAM and Hard Disk with a sample interval (`10 seconds`).

```
OcNOS(config)#subscription-name storage
OcNOS(telemetry-subscription)#encoding json-ietf
OcNOS(telemetry-subscription)#destination-group Collector1
OcNOS(telemetry-subscription)#sensor-group Platform sample-interval 10
OcNOS(telemetry-subscription)#commit
OcNOS(telemetry-subscription)#exit
```

5. Verify the Telemetry Running Configurations on default VRF

   To confirm the configuration, use the `show running-config streaming-telemetry` command, which displays all configured settings, including sensor groups, destination groups, and subscriptions:

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry
!
debug telemetry gnmi enable severity debug
!
sensor-group Platform
 sensor-path ipi:/components/component[name="RAM"]/ram/state
 sensor-path ipi:/components/component[name="HARD-DISK"]/storage/state
!
destination-group Collector1
 tunnel-server ip 10.12.101.72 port 11161
!
subscription-name storage
 destination-group Collector1
 sensor-group Platform sample-interval 10
!
!
```

6. Validate the Telemetry Configuration on Default VRF

   Use the `show streaming-telemetry persistent-subscriptions details` command to verify that telemetry is actively streaming data. The output confirms:

   - Telemetry instance running on the `default VRF`
   - Number of active sensor paths (`2`) and sample intervals (`10`)
   - Destination group status and configured IP:Port details (`10.12.101.72:11161`)

- Dial-out subscriptions marked as `ACTIVE`

```
#show streaming-telemetry persistent-subscriptions details

 Number of telemetry instances : 1 (default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 2 (Dial-In : 0, Dial-out : 2)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : storage
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : Default-60 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
     Collector1                ACTIVE      10.12.101.72:11161
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
       Platform            10           ipi:/components/component[name="RAM"]/ram/state
                                        ipi:/components/component[name="HARD-DISK"]/storage/state
```

## Use Case 4: Configuring and Validating Telemetry with Multiple Key Sensor Paths in Management VRF

**Note:** Before configuring Dial-out, meet all Prerequisites (page 135).

1. Enable Streaming Telemetry in a Management VRF on an OcNOS router.

   ```
   OcNOS(config)#feature streaming-telemetry vrf management
   OcNOS(feature-telemetry-config)#commit
   OcNOS(feature-telemetry-config)#exit
   ```

2. Create Sensor Group

   Define a sensor group (`bfd`) to monitor the state of BFD session counters for IPv4 packets. Configure the sensor path using multiple key values.

**Notes:**

- Key-value pairs must be configured in the same order defined by the IPI data model sensor path list. For more details, refer to the XPath Formatting Rules for Streaming Telemetry (page 39) section.
- OcNOS does not support the following sensor-path key-pattern combinations in dial-out mode. Avoid these configurations:
  - **Partial + Implicit sensor-path:** `ipi:/bgp/bgp-instances/bgp-instance[bgp-as=1*]/peers/peer/state`
  - **Explicit + Implicit sensor-path:** `ipi:/bgp/bgp-instances/bgp-instance[bgp-as=*]/peers/peer/state`
  - **Implicit + Explicit sensor-path:** `ipi:/bgp/bgp-instances/bgp-instance/peers/peer[peer-address=*]/state`
- Ensure that sensor-path configurations use only supported wildcard types, explicit key values, or full implicit paths when setting up dial-out subscriptions.

```
OcNOS(config)#sensor-group bfd vrf management
OcNOS(telemetry-sensor-group)#sensor-path ipi:/bfd/sessions/session[local-
discriminator="2050"][vrf-name="default"]/state/counters/packets/ipv4
OcNOS(telemetry-sensor-group)#commit
OcNOS(telemetry-sensor-group)#exit
```

3. Create Destination Group

   Configure the destination group (`tunnel-1`) with the gNMI client's IP address (`10.16.12.40`) and port (`11123`).

```
OcNOS(config)#destination-group tunnel-1 vrf management
OcNOS(telemetry-grpc-tunnel-group)#tunnel-server ip 10.16.12.40 port 11123
OcNOS(telemetry-grpc-tunnel-group)#commit
OcNOS(telemetry-grpc-tunnel-group)#exit
```

4. Create Persistent Subscription

   Create a persistent subscription (`sub-1`) and associate it with the `tunnel-1` destination group and `bfd` sensor group. Set a sample interval of `100 seconds`.

```
OcNOS(config)#subscription-name sub-1 vrf management
OcNOS(telemetry-subscription)#destination-group tunnel-1
OcNOS(telemetry-subscription)#sensor-group bfd sample-interval 100
OcNOS(telemetry-subscription)#commit
OcNOS(telemetry-subscription)#exit
```

5. Verify the Telemetry Running Configurations for Multiple Key Sensor Paths

   To confirm the configuration, use the `show running-config streaming-telemetry` command. The output displays all configured settings, including sensor groups, destination groups, and subscriptions.

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
!
sensor-group bfd vrf management
 sensor-path ipi:/bfd/sessions/session[local-discriminator="2050"][vrf-
name="default"]/state/counters/packets/ipv4
!
destination-group tunnel-1 vrf management
 tunnel-server ip 10.16.12.40 port 11123
!
```

```
subscription-name sub-1 vrf management
 destination-group tunnel-1
 sensor-group bfd sample-interval 100
!
!
```

6. Validate the Telemetry Configuration for Multiple Key Sensor Paths

   Use the `show streaming-telemetry` command to confirm the telemetry instance is running and verify sensor group details. The expected output should confirm:

   - Telemetry is running on the `management VRF`
   - One active sensor path for dial-out telemetry
   - Configured subscription (`sub-1`)
   - Destination group (`tunnel-1`) should be `ACTIVE`
   - BFD sensor path is properly monitored at a `100-second` sample interval

```
OcNOS#show streaming-telemetry

 Number of telemetry instances : 1 (management)
 Platform type                 : Standard range
 Maximum sensor-paths          : 50
 Minimum sample-interval       : 90
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 1 (Dial-In : 0, Dial-out : 1)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : sub-1
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : Default-60 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
       tunnel-1                IN-ACTIVE      10.16.12.40:11123
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
            bfd           100           ipi:/bfd/sessions/session[local-discriminator="2050"]
[vrf-name="default"]/state/counters/packets/ipv4
```

# Telemetry Subscription Invoked via gnmic Command and YAML Input

Start the gNMI collector with the `--use-tunnel-server` and `publish` options to receive the streamed gRPC responses. Execute the following command to start the gRPC tunnel server in listening mode, enabling it to accept incoming connections from gRPC tunnel clients (OcNOS target).

```
./gnmic --insecure --config <path to Tunnel-server yaml file> --use-tunnel-server publish
```

## Invoke Publish RPC on OcNOS Target

The following output represents telemetry data published by the `gnmic` command, monitoring the state of Hard Disk and RAM on the specified OcNOS router.

```
# ./gnmic --insecure --config abc.yaml --use-tunnel-server publish
2024/04/12 11:22:50.516313 [gnmic] version=dev, commit=none, date=unknown, gitURL=,
docs=https://gnmic.openconfig.net
2024/04/12 11:22:50.516377 [gnmic] using config file "abc.yaml"
2024/04/12 11:22:50.517770 [gnmic] starting output type file
2024/04/12 11:22:50.517971 [file_output:default-stdout] initialized file output: {"Cfg":
{"FileName":"","FileType":"stdout","Format":"json","Multiline":true,"Indent":"  ","Separator":"\n","O
verrideTimestamps":false,"AddTarget":"","TargetTemplate":"","EventProcessors":null,"MsgTemplate":"","
ConcurrencyLimit":1000,"EnableMetrics":false,"Debug":false}}
2024/04/12 11:22:50.518018 [gnmic] StartPublishCollector is invoked
2024/04/12 11:22:50.518446 [gnmic] Initializing error chan
2024/04/12 11:22:54.508410 [gnmic] tunnel server discovered target {ID:e8:c5:7a:fe:fd:32 Type:GNMI_
GNOI}
2024/04/12 11:22:54.508720 [gnmic] adding target
{"name":"e8:c5:7a:fe:fd:32","address":"e8:c5:7a:fe:fd:32","username":"root","password":"****","timeou
t":10000000000,"insecure":true,"skip-verify":false,"buffer-size":100,"retry-timer":10000000000,"log-
tls-secret":false,"gzip":false,"token":"","tunnel-target-type":"GNMI_GNOI"}
2024/04/12 11:22:54.508756 [gnmic] calling publishStream
2024/04/12 11:22:54.508772 [gnmic] publishStream is invoked
2024/04/12 11:22:54.508779 [gnmic] targetPublishStream is invoked
2024/04/12 11:22:54.508830 [gnmic] a.targetsChan: 0xc0004eb1a0
2024/04/12 11:22:54.508840 [gnmic] t.Config.Outputs: []
2024/04/12 11:22:54.508850 [gnmic] starting target "e8:c5:7a:fe:fd:32" listener
2024/04/12 11:22:54.508879 [gnmic] queuing target "e8:c5:7a:fe:fd:32"
2024/04/12 11:22:54.508902 [gnmic] subscribing to target: "e8:c5:7a:fe:fd:32"
2024/04/12 11:22:54.508918 [gnmic] calling clientPublish
2024/04/12 11:22:54.508930 [gnmic] targetDialOpts: []grpc.DialOption
2024/04/12 11:22:54.508968 [gnmic] a.targetsChan: 0xc0004eb1a0
2024/04/12 11:22:54.508976 [gnmic] t.Config.Outputs: []
2024/04/12 11:22:54.509402 [gnmic] dialing tunnel connection for tunnel target "e8:c5:7a:fe:fd:32"
Publish Request sent to e8:c5:7a:fe:fd:32{
  "source": "e8:c5:7a:fe:fd:32",
  "subscription-name": "storage",
  "timestamp": 1712920892603436151,
  "time": "2024-04-12T16:51:32.603436151+05:30",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"HARD-DISK\"]/storage/state",
      "values": {
        "components/component/storage/state": {
          "free-memory": 0,
          "total-memory": 61057,
          "used-memory": 0
        }
      }
    }
  ]
}
{
  "source": "e8:c5:7a:fe:fd:32",
```

```
  "subscription-name": "storage",
  "timestamp": 1712920892603253590,
  "time": "2024-04-12T16:51:32.60325359+05:30",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"RAM\"]/ram/state",
      "values": {
        "components/component/ram/state": {
          "available-high-memory": 0,
          "available-memory": 15084,
          "buffers": 101,
          "current-process-count": 227,
          "free-swap": 0,
          "shared-memory": 28,
          "total-high-memory": 0,
          "total-memory": 16010,
          "total-swap": 0,
          "used-memory": 926
        }
      }
    }
  ]
}
```


The output of the Publish RPC includes the following information:

**Table 16. Publish RPC Output details**

| Option | Description |
|---|---|
| source | Displays the MAC address associated with the management port of the target. Each gNMI device have a unique target ID, allowing the collector to distinguish responses between various targets. |
| subscription-name | The name of the subscription. |
| timestamp | The timestamp of the response. |
| time | The timestamp in a human-readable format. |
| updates | An array of updates, each containing Path and Values. |
| Path | The path to the published data. |
| values | The values of the published data. |

The telemetry data output includes detailed fields for monitoring the state of the Hard Disk and RAM, offering insights into the memory and storage utilization of the OcNOS router.

1. Hard Disk State
    - **Free Memory:** The amount of free memory available on the hard disk.
    - **Total Memory:** The total capacity of memory on the hard disk.
    - **Used Memory:** The amount of memory currently in use on the hard disk.
2. RAM State
    - **Available High Memory:** The available high memory in the RAM.
    - **Available Memory:** The total available memory in the RAM.
    - **Buffers:** The number of buffer processes running in the RAM.

- **Current Process Count:** The count of active processes in the RAM.
- **Free Swap:** The amount of free swap space in the RAM.
- **Shared Memory:** The shared memory usage in the RAM.
- **Total High Memory:** The total high memory capacity in the RAM.
- **Total Memory:** The total memory capacity in the RAM.
- **Total Swap:** The total swap space available in the RAM.
- **Used Memory:** The amount of memory currently in use in the RAM.

# Implementation Examples

## ISP Backbone Network Monitoring

### Scenario

An Internet Service Provider (ISP) operates a large-scale network across multiple cities. The Network Operations Center (NOC) needs real-time monitoring of core routers, including CPU utilization, link bandwidth usage, and BGP peer status. Instead of polling data periodically using SNMP, they implement OcNOS Streaming Telemetry Dial-Out Mode to push telemetry data directly to a central collector.

### Implementation

- Enable streaming telemetry on core routers handling internet traffic.
- Configure sensor groups to monitor BGP neighbors, interface utilization, and hardware health.
- Set up a telemetry collector (Prometheus, InfluxDB, or a custom-built system) to receive dial-out telemetry streams.
- Establish persistent subscriptions for real-time alerts on link congestion, dropped packets, and CPU spikes.

For step-by-step configurations, refer to the Dial-Out configuration section.

# Dial-Out Commands

Refer to the streaming telemetry dial-out mode commands in the Streaming Telemetry Commands (page 43) section.

# Revised CLI Commands

The following is the revised command for telemetry.

## show techsupport

- The existing syntax now includes the newly added parameter for telemetry, namely `gnmi`.
- The command **`show techsupport gnmi`** collects gNMI-related information for technical support. For more details, refer to the **`show techsupport`** command in the ***Software Monitoring and Reporting*** section in the ***OcNOS Sysytem Management Guide***.

# Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

| Key Terms/Acronym | Description |
|---|---|
| gRPC | Remote Procedure Call |
| Persistent Subscription | Telemetry subscription that maintains continuous data streaming even after interruptions in connectivity. |
| gRPC Network Management Interface (gNMI) | A standardized protocol for network management using gRPC and protocol buffers. |
| Destination Group | Specifies the collector server's details and connection parameters for telemetry subscriptions. |
| Sensor Group | Contains sensor paths that define the specific data to be monitored and transmitted. |
| OpenConfig | Standardized model for network configuration and telemetry using a vendor-neutral approach. |

# STREAMING TELEMETRY OVER TRANSPORT LAYER SECURITY

## Overview

Transport Layer Security (TLS) is a cryptographic protocol that secures communication over networks by encrypting data exchanged between systems. TLS ensures confidentiality and integrity, which prevents unauthorized access and data tampering.

Streaming telemetry with TLS secures the real-time transmission of network monitoring data between gNMI Server (OcNOS Target) and gNMI Client (Collector). By encrypting telemetry streams, TLS prevents data interception, manipulation, and unauthorized access, ensuring that only trusted endpoints can exchange sensitive network performance metrics.

### Feature Characteristics

To secure networks, configure and copy the TLS server, client, and CA certificates to the OcNOS device, following the telemetry certificate generation process. The session between the gNMI server and the gNMI client remains encrypted using TLS. The system validates connections with the certificates used by the server and client.

**Insecure TLS:** Allows users to enable an insecure option where client certificates are validated only if provided.

**Note:** In OcNOS, streaming telemetry over TLS secures incoming packets for dial-in connections. Transport Layer Security (TLS) is not supported for dial-out mode subscriptions.

### Benefits

**Enhanced Security:** Encrypts telemetry data in transit, preventing unauthorized access and data interception. TLS ensures confidentiality, integrity, and authentication, making sure only trusted endpoints exchange telemetry data.

**Real-Time Secure Monitoring:** Ensures telemetry insights are securely delivered to collectors without risk of interception.

**Scalability:** Supports high-frequency telemetry streams with minimal performance overhead.

**Flexibility:** Supports both secure (TLS-enabled) and insecure (optional) modes based on deployment needs.

## User Authentication and Certificate Loading for gNMI TLS Connections

OcNOS enhances gNMI TLS connection support by additional authentication and certificate management capabilities.

The gNMI client-server communication continues to use TLS for secure transport. In addition to validating the client X.509 certificate's Common Name (CN) for authentication, OcNOS supports gRPC-contained user and password–

based authentication. This enhancement addresses customer requirements for flexible authentication methods during secure telemetry sessions.

**TLS-based Connection Security:** TLS provides encryption and integrity for all gNMI communication between the client and the OcNOS server.

**Client Authentication Options**

- **X.509 Certificate Validation:** The device validates the client certificate's Common Name (CN) to authenticate the client identity.
- **User and Password Authentication:** gRPC-contained credentials (username and password) are supported in addition to certificate-based validation.

## Loading X.509 Certificates on OcNOS

To simplify certificate handling and enable seamless Zero Touch Provisioning (ZTP) workflows, crypto pki load source-interface (page 45) command is used to load X.509 server and CA certificates directly from an external source.

Updated the port (page 58) and tls tls-port (page 86) commands port range from `<32768-60999>` to `<1024-65535>` to support flexible TLS deployment with the default port configuration.

## gNMI TLS Authentication Command

Use the gnmic client to initiate a TLS-secured gNMI connection using both X.509 certificate authentication and gRPC-contained user credentials.

```
gnmic -a <device_address:port> -u <username> -p <password> get  \

--path "ipi:/components/component[name=\"HARD-DISK\"]/storage/state" \

--tls-cert ClientCert.pem --tls-key client.pem --tls-ca ca.pem \

--tls-server-name "OcNOS" --encoding "JSON_IETF" --debug
```

This command:

- Connects securely to the OcNOS gNMI server using TLS.
- Authenticates the client with both user credentials and certificates.
- Retrieves the specified sensor path data in JSON_IETF encoding format.

## Configuration

The following steps illustrate an example use case for configuring and validating a secure gNMI TLS connection with user authentication and X.509 certificates.

### Step 1: Load Server and CA Certificates

Use the crypto pki load source-interface (page 45) command to copy the required server and CA certificates from an external source to OcNOS. This enables TLS authentication for gNMI sessions.

```
OcNOS#crypto pki load http://root:sysmgmt123@10.16.99.115/cert.pem
OcNOS#crypto pki load http://root:sysmgmt123@10.16.99.115/ca.pem
```

The above commands load the server certificate (`cert.pem`) and CA certificate (`ca.pem`) from an HTTP server into the device certificate store.

## Step 2: Enable Streaming Telemetry and Configure TLS Port

Enter configuration mode and enable the Streaming Telemetry feature under the management VRF. Specify a TLS port in the supported range (1024–65535).

```
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#tls tls-port 55545
OcNOS(feature-telemetry-config)#commit
2025 Aug 23 04:09:51.461 : OcNOS : CML : CRITI : Commit Progress: 100%
[||||||||||||||||||||||||||||||||||||||||||||||||||]                    ETA: --:--:--

OcNOS(feature-telemetry-config)#exit
```

## Step 3: Verify Telemetry Configuration

Use the show running-config streaming-telemetry (page 76) command to verify the telemetry configuration.

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
tls tls-port 55545
!
```

Check the operational status using the show streaming-telemetry (page 66) command.

```
OcNOS#show streaming-telemetry

 Number of telemetry instances : 1 (management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 40
 Number of active sensor-paths : 1 (Dial-In : 1, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 55545
   TLS          : Enabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.14.105.105:45210    53937    90     JSON_IETF    ipi:/interfaces/interface[n
ame="eth0"]/state/counters
```

## Step 4: Establish Secure gNMI Connection from Client

From the gNMI client system, initiate a secure TLS-based connection using both user credentials and certificates.

Use the following sample `gnmic` command:

```
./gnmic -a 10.16.179.118:55545 -u ocnos -p ocnos -e json_ietf  --mode STREAM --stream-mode sample --
sample-interval 90s sub --path "ipi:/interfaces/interface[name=\"eth0\"]/state/counters" --tls-ca
ca.pem --tls-cert ClientCert.pem --tls-key client.pem --tls-server-name "OcNOS" --log
```

This command authenticates using the provided username and password, validates the TLS certificates, and streams telemetry data for the specified sensor path.

## Step 5: Observe Streaming Output

When the connection is successfully established, the gNMI client receives periodic telemetry updates.


```
{
  "source": "10.16.179.118:55545",
  "subscription-name": "default-1755922991",
  "timestamp": 1755922360262334487,
  "time": "2025-08-23T04:12:40.262334487Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": "0",
          "in-discards": "0",
          "in-errors": "0",
          "in-multicast-pkts": "19886",
          "in-octets": "48551882",
          "in-pkts": "57036",
          "in-unicast-pkts": "0",
          "last-clear": "Never",
          "out-broadcast-pkts": "0",
          "out-discards": "0",
          "out-errors": "0",
          "out-multicast-pkts": "0",
          "out-octets": "1369239",
          "out-pkts": "8408",
          "out-unicast-pkts": "0"
        }
      }
    }
  ]
}
```



```
{
  "source": "10.16.179.118:55545",
  "subscription-name": "default-1755922991",
  "timestamp": 1755922449267968226,
  "time": "2025-08-23T04:14:09.267968226Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": "0",
          "in-discards": "0",
          "in-errors": "0",
          "in-multicast-pkts": "19961",
          "in-octets": "48557417",
          "in-pkts": "57108",
          "in-unicast-pkts": "0",
          "last-clear": "Never",
          "out-broadcast-pkts": "0",
          "out-discards": "0",
```

```
          "out-errors": "0",
          "out-multicast-pkts": "0",
          "out-octets": "1370733",
          "out-pkts": "8423",
          "out-unicast-pkts": "0"
        }
      }
    }
  ]
}
```

# Certificate Management for OcNOS and gNMI

**Note:** Before proceeding with certificate generation, ensure that the date and time on the OcNOS device matches those on the virtual machine (VM) where all certificates are generated. A discrepancy can result in errors such as **`certificate is expired`**, which may hinder connection establishment.

## Generate CA certificates

To create a Certificate Authority (CA) certificate and its corresponding private key, use the following OpenSSL command:

```
openssl req -newkey rsa:2048 -new -nodes -x509 -days 3650 -keyout rootCAKey.pem -out rootCACert.pem
```

## Generate Server Certificates

1. To generate the server key, server certificate request (CSR), and certificate authority (CA) certificate, follow the below steps at the OcNOS cmlsh prompt:
   - Use the following command, replacing `<server-ip>` with the server's actual IPv4 address:

   ```
   crypto pki generate rsa common-name ipv4 <server-ip>
   ```

2. After generating, view the CSR with:

   ```
   show crypto csr
   ```

   - Copy the output from the `show crypto csr` command and paste it into a file named `ServerCert.csr`.

3. **Subject Alternative Name Requirement:** For the gNMI server, it is important to include the Subject Alternative Name (SAN) in the server certificate. To incorporate SAN into the server certificate, use the `san.ext` extension file.

   ```
   cat san.ext

   subjectAltName = @alt_names

   [alt_names]
   DNS.1 = OcNOS
   ```

   Utilize the san.ext file and the CSR to generate the server certificate using the following `OpenSSL` command:

   ```
   openssl x509 -req -sha256 -in ServerCert.csr -extfile san.ext -CA rootCACert.pem -CAkey
   rootCAKey.pem -CAcreateserial -out ServerCert.pem -days 365
   ```

## Generate Client Certificates

1. Create a configuration file named `ClientCertReq.config` with the following content:

```
[req]
distinguished_name = dn
prompt = no

[dn]
CN = <common-name>
C = IN
L = BNG
O = IPI
```

> **Note:** The client's IP address can be used as a common name. Separate client certificates can be generated for more than one client, but it's important to use the same CA certificate to generate all client certificates.

2. Generate the client certificate and key with the following commands:

```
openssl req -newkey rsa:2048 -keyout ClientKey.pem -out ClientCert.csr -config
./ClientCertReq.config -nodes -days 365
```

```
openssl x509 -req -sha256 -in ClientCert.csr -CA rootCACert.pem -CAkey rootCAKey.pem -
CAcreateserial -out ClientCert.pem -days 365
```

## Rename and Copy Certificates

1. Rename and prepare the certificates for deployment as follows:

```
cp ClientKey.pem client.pem

cp ServerCert.pem cert_gnmid.pem

cp rootCACert.pem ca.pem

cat ClientCert.pem >> client.pem
```

2. Copy the server certificate and CA certificate to the OcNOS device using:

```
scp cert_gnmid.pem root@<mgmtIP>:/cfg/usr/local/etc/tls/certs/

scp ca.pem root@<mgmtIP>:/cfg/usr/local/etc/tls/certs/
```

3. Copy Client Certificates where gnmic can access `copy ClientCert.pem client.pem and ca.pem`
4. Enable TLS for dial-in and dial-out configurations by placing client certificates in the `/cfg/usr/local/etc/tls/client/` directory on the OcNOS device.

> **Note:** Create a directory named `client` within the `/cfg/usr/local/etc/tls/` directory on the OcNOS device. Then, copy the client certificates (`ClientCert.pem, client.pem, and ca.pem`) into the `client` folder at `/cfg/usr/local/etc/tls/client/`.

## Insecure TLS Configuration

TLS encryption secures the session between the gNMI server and client, with both parties validating the provided certificates. Users can enable TLS with the insecure option but note that the system will only verify client certificates if they are provided. Here is an example for the insecure TLS setup.

## gNMI Client

**Note:** In OcNOS, streaming telemetry over TLS secures incoming packets for dial-in connections. Transport Layer Security (TLS) is not supported for dial-out mode subscriptions.

To authenticate a certificate, `gnmic` utilizes the client certificate, key, and CA certificate. Below are the command syntax and examples for dial-in subscription mode to establish secure and insecure TLS connections using the gNMI client, providing flexibility depending on the user's security requirements.

### Syntax: Secure TLS

```
gnmic -a <ipaddress:port> -u <UserName> -p <Password> --mode STREAM --stream-mode sample --sample-
interval <sample-interval-value> sub --path <path> --tls-cert ClientCert.pem --tls-key client.pem --
tls-ca ca.pem --tls-server-name "<subject-alt-name>"
```

Example to establish a secure TLS dial-in connection:

```
./gnmic -a 10.12.160.33:55545 -u admin -p admin --mode STREAM --stream-mode sample --sample-interval
90s sub  --path "ipi:/interfaces/interface[name=\"eth0\"]/state" --tls-cert ClientCert.pem --tls-key
client.pem --tls-ca ca.pem --tls-server-name "OcNOS" --debug
```

### Syntax: Insecure TLS

```
./gnmic -a <ipaddress:port> -u <Username> -p <Password> --mode STREAM --stream-mode sample --sample-
interval <sample-interval-value> sub --path <path> --tls-cert ClientCert.pem --tls-key client.pem --
tls-ca ca.pem --tls-ca ca.pem --tls-server-name "<subject-alt-name>" --debug

./gnmic -a <ipaddress:port> -u <Username> -p <Password> --mode STREAM --stream-mode sample --sample-
interval <sample-interval-value> sub --path <path> --tls-ca ca.pem --tls-server-name "<subject-alt-
name>" --debug
```

Example to subscribe using an insecure TLS connection:

```
./gnmic -a 10.12.160.33:55545 -u admin -p admin --mode STREAM --stream-mode sample --sample-interval
90s sub --path "ipi:/interfaces/interface[name=eth0]/state" --tls-cert ClientCert.pem --tls-key
client.pem --tls-ca ca.pem --tls-server-name "<subject-alt-name>" --debug

./gnmic -a 10.12.160.33:55545 -u admin -p admin --mode STREAM --stream-mode sample --sample-interval
90s sub --path "ipi:/interfaces/interface[name=eth0]/state" --tls-ca ca.pem --tls-server-name
"<subject-alt-name>" --debug
```

# TLS Configuration

This section outlines the sample configuration for streaming telemetry over TLS in dial-in subscription mode.

## Prerequisites

Before configuring streaming telemetry with TLS, ensure the following:

- A supported OcNOS router running a compatible release.
- Access to the management interface of the router.
- Any gNMI client that complies with gNMI specifications can be used as a client.
- Download and install the gNMI collector package by referring to the gnmic Installation (page 32) section.
- Generate the server and client certificates following the Certificate Management for OcNOS and gNMI (page 152) process to enable secure communication.

## Topology

In the following topology (Figure 12), the gNMI Server (OcNOS Router) establishes a telemetry session with the gNMI Client (Collector). TLS encrypts the telemetry stream, ensuring secure, real-time monitoring of network performance data.

**Figure 12. TLS Connection**


**Note:** Before configuring, meet all Prerequisites (page 155).

## Enable TLS Connection

Enable streaming telemetry in management VRF and TLS to encrypt and protect the data transmitted during dial-in sessions with the TLS port number `55545`.

```
OcNOS(config)#feature streaming-telemetry vrf management
OcNOS(feature-telemetry-config)#tls tls-port 55545
OcNOS(feature-telemetry-config)#commit
OcNOS(feature-telemetry-config)#exit
OcNOS(config)#debug telemetry gnmi enable severity debug
OcNOS(config)#commit
```

## Validation

To verify the TLS connection status, check the `TLS` and `insecure-tls` fields in the show output. If the `TLS` field shows `enabled`, the TLS connection is active. If the `insecure-tls` field is marked as `false`, it confirms that it is a secure TLS connection.

```
OcNOS#show streaming-telemetry

 Number of telemetry instances : 1 (management)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 Number of active sensor-paths : 6 (Dial-In : 6, Dial-out : 0)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 55545
   TLS          : Enabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.14.105.105:41982    22122    30          JSON    ipi:/interfaces/interface[name="eth0"]/state
                                                     ipi:/interfaces/interface
[name="eth0"]/state/counters
                                                     ipi:/interfaces/interface[name="xe8"]/state
                                                     ipi:/interfaces/interface
[name="xe8"]/state/counters
                                                     ipi:/components/component[name="CPU"]/cpu/state
                                                     ipi:/components/component[name="HARD-
DISK"]/storage/state
```

### Streaming Telemetry Running Configuration

To verify the telemetry configuration and view the overall commands used for TLS configuration, use the `show running-config streaming-telemetry` command on the OcNOS router.

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf management
 tls tls-port 55545
!
debug telemetry gnmi enable severity debug
!
!
```

## gnmic Response

Below is a sample response illustrating how gnmic retrieves telemetry metrics.

```
./gnmic -a 10.16.179.113:55545 -u admin -p admin --mode STREAM --stream-mode sample --sample-interval
30s sub  --path "ipi:/interfaces/interface[name=\"eth0\"]/state" --path "ipi:/interfaces/interface
[name=\"xe8\"]/state" --path "ipi:/components/component[name=\"CPU\"]/cpu/state" --path
"ipi:/components/component[name=\"HARD-DISK\"]/storage/state" --tls-cert ClientCert.pem --tls-key
client.pem --tls-ca ca.pem --tls-server-name "OcNOS"
```

```
{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333698145383105,
  "time": "2025-03-18T21:34:58.145383105Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "ifindex": 3,
          "last-change": 9200,
          "logical": false,
          "oper-status": "up",
          "vrf-name": "management"
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333698159202200,
  "time": "2025-03-18T21:34:58.1592022Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": 0,
          "in-discards": 0,
          "in-errors": 0,
          "in-multicast-pkts": 36404,
          "in-octets": 3370900,
          "in-pkts": 38518,
          "in-unicast-pkts": 0,
          "last-clear": "Never",
          "out-broadcast-pkts": 0,
          "out-discards": 0,
          "out-errors": 0,
          "out-multicast-pkts": 0,
          "out-octets": 342580,
          "out-pkts": 2555,
          "out-unicast-pkts": 0
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333698166395384,
  "time": "2025-03-18T21:34:58.166395384Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"xe8\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "ifindex": 10009,
          "last-change": 12700,
          "logical": false,
```

```
          "oper-status": "up"
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333698178179386,
  "time": "2025-03-18T21:34:58.178179386Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"xe8\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": 0,
          "in-discards": 0,
          "in-errors": 0,
          "in-fcs-errors": 0,
          "in-multicast-pkts": 141,
          "in-octets": 15582,
          "in-pkts": 183,
          "in-unicast-pkts": 42,
          "last-clear": "Never",
          "out-broadcast-pkts": 0,
          "out-discards": 0,
          "out-errors": 0,
          "out-multicast-pkts": 1649,
          "out-octets": 229334,
          "out-pkts": 1700,
          "out-unicast-pkts": 51
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333698250104789,
  "time": "2025-03-18T21:34:58.250104789Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"CPU\"]/cpu/state",
      "values": {
        "components/component/cpu/state": {
          "cpu-15min-load-percentage": 3.55,
          "cpu-1min-load-percentage": 5.71,
          "cpu-5min-load-percentage": 3.89,
          "cpu-utilization": 6.35,
          "cpu-utilization-alert": 90,
          "cpu-utilization-critical": 80,
          "processor-count": 8
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333698250711580,
  "time": "2025-03-18T21:34:58.25071158Z",
  "updates": [
```

```
    {
      "Path": "ipi:components/component[name=\"HARD-DISK\"]/storage/state",
      "values": {
        "components/component/storage/state": {
          "head-count": 16,
          "sector-count": 250000000,
          "total-memory": 122070,
          "unformatted-bytes-or-sector": 0,
          "unformatted-bytes-or-track": 0
        }
      }
    }
  ]
}


{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333727146348463,
  "time": "2025-03-18T21:35:27.146348463Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
            "in-discards": 0,
            "in-errors": 0,
            "in-multicast-pkts": 36424,
            "in-octets": 3372999,
            "in-pkts": 38547,
            "in-unicast-pkts": 0,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 0,
            "out-octets": 345007,
            "out-pkts": 2564,
            "out-unicast-pkts": 0
          },
          "ifindex": 3,
          "last-change": 9200,
          "logical": false,
          "oper-status": "up",
          "vrf-name": "management"
        }
      }
    }
  ]
}
{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333727167695852,
  "time": "2025-03-18T21:35:27.167695852Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"xe8\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
            "in-discards": 0,
```

```
            "in-errors": 0,
            "in-fcs-errors": 0,
            "in-multicast-pkts": 141,
            "in-octets": 15582,
            "in-pkts": 183,
            "in-unicast-pkts": 42,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 1650,
            "out-octets": 229475,
            "out-pkts": 1701,
            "out-unicast-pkts": 51
          },
          "ifindex": 10009,
          "last-change": 12700,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}


{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333727251455652,
  "time": "2025-03-18T21:35:27.251455652Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"CPU\"]/cpu/state",
      "values": {
        "components/component/cpu/state": {
          "cpu-15min-load-percentage": 3.55,
          "cpu-1min-load-percentage": 4.9,
          "cpu-5min-load-percentage": 3.91,
          "cpu-utilization": 2.57,
          "cpu-utilization-alert": 90,
          "cpu-utilization-critical": 80,
          "processor-count": 8
        }
      }
    }
  ]
}
{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333727251935488,
  "time": "2025-03-18T21:35:27.251935488Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"HARD-DISK\"]/storage/state",
      "values": {
        "components/component/storage/state": {
          "head-count": 16,
          "sector-count": 250000000,
          "total-memory": 122070,
          "unformatted-bytes-or-sector": 0,
          "unformatted-bytes-or-track": 0
        }
      }
    }
  ]
}
```

```
{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333757147739862,
  "time": "2025-03-18T21:35:57.147739862Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
            "in-discards": 0,
            "in-errors": 0,
            "in-multicast-pkts": 36444,
            "in-octets": 3375108,
            "in-pkts": 38576,
            "in-unicast-pkts": 0,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 0,
            "out-octets": 347514,
            "out-pkts": 2574,
            "out-unicast-pkts": 0
          },
          "ifindex": 3,
          "last-change": 9200,
          "logical": false,
          "oper-status": "up",
          "vrf-name": "management"
        }
      }
    }
  ]
}
{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333757169646737,
  "time": "2025-03-18T21:35:57.169646737Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"xe8\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
            "in-discards": 0,
            "in-errors": 0,
            "in-fcs-errors": 0,
            "in-multicast-pkts": 141,
            "in-octets": 15582,
            "in-pkts": 183,
            "in-unicast-pkts": 42,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 1651,
            "out-octets": 229616,
            "out-pkts": 1702,
            "out-unicast-pkts": 51
```

```
          },
          "ifindex": 10009,
          "last-change": 12700,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333757252957426,
  "time": "2025-03-18T21:35:57.252957426Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"CPU\"]/cpu/state",
      "values": {
        "components/component/cpu/state": {
          "cpu-15min-load-percentage": 3.47,
          "cpu-1min-load-percentage": 3.8,
          "cpu-5min-load-percentage": 3.72,
          "cpu-utilization": 2.03,
          "cpu-utilization-alert": 90,
          "cpu-utilization-critical": 80,
          "processor-count": 8
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333757253488377,
  "time": "2025-03-18T21:35:57.253488377Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"HARD-DISK\"]/storage/state",
      "values": {
        "components/component/storage/state": {
          "head-count": 16,
          "sector-count": 250000000,
          "total-memory": 122070,
          "unformatted-bytes-or-sector": 0,
          "unformatted-bytes-or-track": 0
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333787148439365,
  "time": "2025-03-18T21:36:27.148439365Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
```

```
            "in-discards": 0,
            "in-errors": 0,
            "in-multicast-pkts": 36468,
            "in-octets": 3377517,
            "in-pkts": 38608,
            "in-unicast-pkts": 0,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 0,
            "out-octets": 350031,
            "out-pkts": 2584,
            "out-unicast-pkts": 0
          },
          "ifindex": 3,
          "last-change": 9200,
          "logical": false,
          "oper-status": "up",
          "vrf-name": "management"
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333787175261207,
  "time": "2025-03-18T21:36:27.175261207Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"xe8\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
            "in-discards": 0,
            "in-errors": 0,
            "in-fcs-errors": 0,
            "in-multicast-pkts": 141,
            "in-octets": 15582,
            "in-pkts": 183,
            "in-unicast-pkts": 42,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 1652,
            "out-octets": 229757,
            "out-pkts": 1703,
            "out-unicast-pkts": 51
          },
          "ifindex": 10009,
          "last-change": 12700,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
```

```
  "timestamp": 1742333787254084630,
  "time": "2025-03-18T21:36:27.25408463Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"CPU\"]/cpu/state",
      "values": {
        "components/component/cpu/state": {
          "cpu-15min-load-percentage": 3.47,
          "cpu-1min-load-percentage": 3.96,
          "cpu-5min-load-percentage": 3.75,
          "cpu-utilization": 2.58,
          "cpu-utilization-alert": 90,
          "cpu-utilization-critical": 80,
          "processor-count": 8
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333787254608376,
  "time": "2025-03-18T21:36:27.254608376Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"HARD-DISK\"]/storage/state",
      "values": {
        "components/component/storage/state": {
          "head-count": 16,
          "sector-count": 250000000,
          "total-memory": 122070,
          "unformatted-bytes-or-sector": 0,
          "unformatted-bytes-or-track": 0
        }
      }
    }
  ]
}


{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333817149889539,
  "time": "2025-03-18T21:36:57.149889539Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
            "in-discards": 0,
            "in-errors": 0,
            "in-multicast-pkts": 36491,
            "in-octets": 3379761,
            "in-pkts": 38638,
            "in-unicast-pkts": 0,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 0,
            "out-octets": 352373,
            "out-pkts": 2592,
```

```
            "out-unicast-pkts": 0
          },
          "ifindex": 3,
          "last-change": 9200,
          "logical": false,
          "oper-status": "up",
          "vrf-name": "management"
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333817179553310,
  "time": "2025-03-18T21:36:57.17955331Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"xe8\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": 0,
            "in-discards": 0,
            "in-errors": 0,
            "in-fcs-errors": 0,
            "in-multicast-pkts": 141,
            "in-octets": 15582,
            "in-pkts": 183,
            "in-unicast-pkts": 42,
            "last-clear": "Never",
            "out-broadcast-pkts": 0,
            "out-discards": 0,
            "out-errors": 0,
            "out-multicast-pkts": 1653,
            "out-octets": 229898,
            "out-pkts": 1704,
            "out-unicast-pkts": 51
          },
          "ifindex": 10009,
          "last-change": 12700,
          "logical": false,
          "oper-status": "up"
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333817255106323,
  "time": "2025-03-18T21:36:57.255106323Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"CPU\"]/cpu/state",
      "values": {
        "components/component/cpu/state": {
          "cpu-15min-load-percentage": 3.47,
          "cpu-1min-load-percentage": 3.97,
          "cpu-5min-load-percentage": 3.78,
          "cpu-utilization": 2.8,
          "cpu-utilization-alert": 90,
          "cpu-utilization-critical": 80,
```

```
          "processor-count": 8
        }
      }
    }
  ]
}

{
  "source": "10.16.179.113:55545",
  "subscription-name": "default-1742333759",
  "timestamp": 1742333817255632799,
  "time": "2025-03-18T21:36:57.255632799Z",
  "updates": [
    {
      "Path": "ipi:components/component[name=\"HARD-DISK\"]/storage/state",
      "values": {
        "components/component/storage/state": {
          "head-count": 16,
          "sector-count": 250000000,
          "total-memory": 122070,
          "unformatted-bytes-or-sector": 0,
          "unformatted-bytes-or-track": 0
        }
      }
    }
  ]
}
```


# Implementation Examples

## Secure Network Monitoring in a Data Center

**Scenario:** A data center is tasked with monitoring the health and performance of various network devices, including switches, routers, and servers, across a large-scale infrastructure. The network administrators need to securely stream telemetry data in real time to ensure smooth operations, prevent failures, and guarantee secure access to sensitive performance data.

**Solution:** Using gNMI with Transport Layer Security (TLS), the administrators configure the gNMI server (the network router) and the gNMI client (a telemetry collector system) for streaming telemetry. The telemetry streams include performance metrics from multiple sensors, such as interface states and component statuses, collected in real-time for analysis.

# Troubleshooting TLS Issues in OcNOS

When TLS is enabled for streaming telemetry in OcNOS, various certificate-related errors may occur. The following are common issues and their resolutions:

1. `%% TLS is enabled but certificates are not present. Please generate key and certificates to enable tls for streaming-telemetry`

   **Resolution:** Follow all the steps from Certificate Management for OcNOS and gNMI (page 152) to generate and copy certificates to OcNOS.

2. `%% TLS is enabled but client certificates are not present. Please upload client key and certificates to "/cfg/usr/local/etc/tls/client"`

**Resolution:** When TLS is enabled before configuring the dial-out configurations, copy the client certificates `ca.pem, ClientCert.pem, and client.pem` to `/cfg/usr/local/etc/tls/client` on OcNOS.

3. `Failed to load TLS credentials: tls: private key does not match public key`

   **Resolution:** This means the `/cfg/usr/local/etc/tls/certs/cert_gnmid.pem` file is not matching with `/cfg/usr/local/etc/tls/keys/key.pem`. Generate the server certificate again by copying the output of the `show crypto csr` command into the `ServerCert.csr` file. Restart the gnmid to load the new certificates.

4. `authentication handshake failed: tls: failed to verify certificate: x509: certificate signed by unknown authority`

   **Resolution:** The CA certificate on the server (OcNOS) is not matching with the CA certificate on the client side. Use the same CA certificate to generate the server and client certificates.

5. `authentication handshake failed: tls: failed to verify certificate: x509: certificate is valid for OcNOS, not Admin`

   **Resolution:** `--tls-server-name` in the gnmic command should be the same as the `subjectAltName` defined in the `san.ext` file.

6. `authentication handshake failed: tls: failed to verify certificate: x509: certificate is not valid for any names, but wanted to match Admin`

   **Resolution:** The error means `san.ext` is not used (`subjectAltName` is not defined) while generating the server certificate `ServerCert.pem`. Define a SAN and use it while generating the server certificate, and use the same SAN for the flag `--tls-server-name` in gnmic.

# TLS Commands

To configure the system for secure and insecure TLS connections, use the commands tls tls-port (page 86) and port (page 58).

# TLS Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

| Key Terms/Acronym | Description |
|---|---|
| Transport Layer Security (TLS) | A cryptographic protocol that secures telemetry data transmission by encrypting the communication channel. |
| gNMI Server (Target) | The network device (e.g., router) that generates and streams telemetry data to the gNMI Client. |
| gNMI Client (Collector) | The software that collects telemetry data from the gNMI Server. |
| Encryption | The process of converting telemetry data into a secure format to prevent unauthorized access during transmission. |
| gRPC Network Management Interface (gNMI) | A protocol used for streaming telemetry data between a network device (Target) and a monitoring system (Collector). |
| Authentication | The process of verifying the identity of a client or server before establishing a secure telemetry connection. |
| Certificate Authority Certificate (CA Certificate) | A digital certificate issued by a trusted entity to authenticate the identity of servers and clients in TLS-secured telemetry. |

| | |
|---|---|
| Insecure TLS Mode | A configuration that allows telemetry streaming with optional client certificate validation for flexibility. |
| TLS Port | The network structure illustrating the connection between a gNMI Server and a gNMI Client using TLS. |

# STREAMING TELEMETRY CPU MONITORING

## Overview

Streaming telemetry CPU monitoring in OcNOS is designed to maintain critical system performance even under high CPU load. This feature ensures that telemetry operations, including both dial-in and dial-out, do not degrade control plane applications or other essential system functions by regulating telemetry activities based on CPU usage.

### Feature Characteristics

OcNOS implements CPU monitoring through these mechanisms:

- **CPU Usage Monitoring:** The system monitors the **5-minute average CPU usage**, enabled by default through the CML daemon (CMLd).
- **Configurable Threshold:** Users can define a CPU usage threshold between 20% and 80%; the default is 40%.
- **State Transition Logic:** The telemetry functionality transitions between a "Normal" and "Paused" state based on the monitored CPU usage relative to the configured threshold.
  - **Transition to Pause:** When the 5-minute average CPU usage goes above the default or configured threshold and stays above the threshold for at least a minute, the telemetry state transitions from "Normal" to "Pause".
  - **Transition to Normal:** When the 5-minute average CPU usage drops below 3/4th of the default or configured threshold and remains low for 300 seconds, the telemetry state transitions from "Pause" to "Normal."
- **Actions in "Paused" State:**
  - Pause existing dial-in subscriptions by sending unsubscribe messages to protocol modules, which frees up CPU usage in PMs, redis-server, and gnmid. No gNMI responses are sent for these paused subscriptions.
  - Pause existing dial-out telemetry subscriptions. No gNMI responses are sent for these paused subscriptions.
  - Rejects new incoming dial-in connections.
  - When in the pause state, on any new dial-out subscription activation, the corresponding sensor-paths enter a paused state immediately.
- **Actions in "Normal" State:**
  - Resume paused dial-in and dial-out subscriptions by resending subscribe messages to the relevant sensor-paths.
  - Accept new subscription connections (dial-in). In Dial-out mode, on subscription activation, corresponding sensor-paths are activated immediately. gNMI responses are sent as usual at the sample interval.
- **Status Display:** Use the command `show streaming-telemetry` to check the current status of the telemetry functionality (Normal or Paused).

**Note:** The OpenConfig data model does not support CPU monitoring.

## Benefits

CPU monitoring protects system health by dynamically reducing telemetry overhead during CPU stress conditions:

- During scale scenarios or critical control plane applications that require a higher number of CPU cycles, non-critical applications like telemetry can take less CPU cycles by entering into a pause state.
- Ensures more CPU cycles are available for high-priority processes.

# CPU Monitoring Configuration

This procedure outlines the steps to configure Streaming Telemetry with CPU monitoring in OcNOS. CPU monitoring helps prevent overload during high utilization by pausing telemetry sessions when the CPU crosses a configured threshold.

## Prerequisites

Ensure that the streaming telemetry is correctly configured with the appropriate sensor groups, destination groups, and subscriptions.

1. Enable streaming telemetry on required VRFs, and set the ports and tunnel retry interval.

```
!
ip vrf management
!
ip vrf vrf1
!
feature streaming-telemetry vrf vrf1
 grpc-tunnel-server retry-interval 30
!
feature streaming-telemetry vrf management
 port 35000
 grpc-tunnel-server retry-interval 30
!
feature streaming-telemetry
 port 36000
 grpc-tunnel-server retry-interval 30
!
```

2. Define sensor groups and paths to device metrics that are published as telemetry data.

```
sensor-group int vrf vrf1
 sensor-path ipi:/components/component[name="RAM"]/ram/state
 sensor-path ipi:/components/component[name="CPU"]/cpu/state
 sensor-path ipi:/components/component[name="HARD-DISK"]/storage/state
 sensor-path ipi:/components/component[name="PSU-1"]/power-supply/state
 sensor-path ipi:/components/component[name="FAN-3"]/fan/state
 sensor-path ipi:/interfaces/interface[name="eth0"]/state
 sensor-path ipi:/components/component[name="CHASSIS"]/state
 sensor-path /interfaces/interface[name="eth0"]/state
 sensor-path /interfaces/interface[name="xe4"]/state/counters
 sensor-path /components/component[name="RAM"]/state/memory
 sensor-path /components/component[name="CPU"]/cpu/utilization/state
 sensor-path /components/component[name="HARD-DISK"]/state
 sensor-path /components/component[name="HARD-DISK"]/state/memory
```

```
 sensor-path /components/component[name="HARD-DISK"]/state/temperature
 sensor-path /components/component[name="CHASSIS"]/state
 sensor-path /components/component[name="CHASSIS"]/state/memory
 sensor-path /components/component[name="CHASSIS"]/state/temperature
!
sensor-group ipi vrf management
 sensor-path ipi:/components/component[name="RAM"]/ram/state
 sensor-path ipi:/components/component[name="CPU"]/cpu/state
 sensor-path ipi:/components/component[name="HARD-DISK"]/storage/state
 sensor-path ipi:/components/component[name="PSU-1"]/power-supply/state
 sensor-path ipi:/components/component[name="FAN-3"]/fan/state
 sensor-path ipi:/interfaces/interface[name="eth0"]/state
 sensor-path ipi:/components/component[name="CHASSIS"]/state
 sensor-path /interfaces/interface[name="eth0"]/state
 sensor-path /interfaces/interface[name="xe4"]/state/counters
 sensor-path /components/component[name="RAM"]/state/memory
 sensor-path /components/component[name="CPU"]/cpu/utilization/state
 sensor-path /components/component[name="HARD-DISK"]/state
 sensor-path /components/component[name="HARD-DISK"]/state/memory
 sensor-path /components/component[name="HARD-DISK"]/state/temperature
 sensor-path /components/component[name="CHASSIS"]/state
 sensor-path /components/component[name="CHASSIS"]/state/memory
 sensor-path /components/component[name="CHASSIS"]/state/temperature
!
sensor-group ipi1
 sensor-path ipi:/components/component[name="RAM"]/ram/state
 sensor-path ipi:/components/component[name="CPU"]/cpu/state
 sensor-path ipi:/components/component[name="HARD-DISK"]/storage/state
 sensor-path ipi:/components/component[name="PSU-1"]/power-supply/state
 sensor-path ipi:/components/component[name="FAN-3"]/fan/state
 sensor-path ipi:/interfaces/interface[name="eth0"]/state
 sensor-path ipi:/components/component[name="CHASSIS"]/state
 sensor-path /interfaces/interface[name="eth0"]/state
 sensor-path /interfaces/interface[name="xe4"]/state/counters
 sensor-path /components/component[name="RAM"]/state/memory
 sensor-path /components/component[name="CPU"]/cpu/utilization/state
 sensor-path /components/component[name="HARD-DISK"]/state
 sensor-path /components/component[name="HARD-DISK"]/state/memory
 sensor-path /components/component[name="HARD-DISK"]/state/temperature
 sensor-path /components/component[name="CHASSIS"]/state
 sensor-path /components/component[name="CHASSIS"]/state/memory
 sensor-path /components/component[name="CHASSIS"]/state/temperature
!
```

3. Configure destination groups that defines where telemetry data should be sent. Establishes IP and port of remote collector (e.g., a telemetry server or analytics engine).

```
destination-group des2 vrf vrf1
 tunnel-server ip 20.1.1.2 port 10300
!
destination-group des1 vrf management
 tunnel-server ip 10.16.99.109 port 10600
!
destination-group des3
 tunnel-server ip 40.1.1.2 port 10200
!
destination-group des1
!
```

4. Create persistent subscriptions and bind a sensor group to a destination group, specifying how often data should be sent.

```
subscription-name sub1 vrf vrf1
 destination-group des2
 sensor-group int sample-interval 10
!
subscription-name sub2 vrf management
```

```
 destination-group des1
 sensor-group ipi sample-interval 10
!
subscription-name sub3
 destination-group des3
 sensor-group ipi1 sample-interval 10
!
!
```

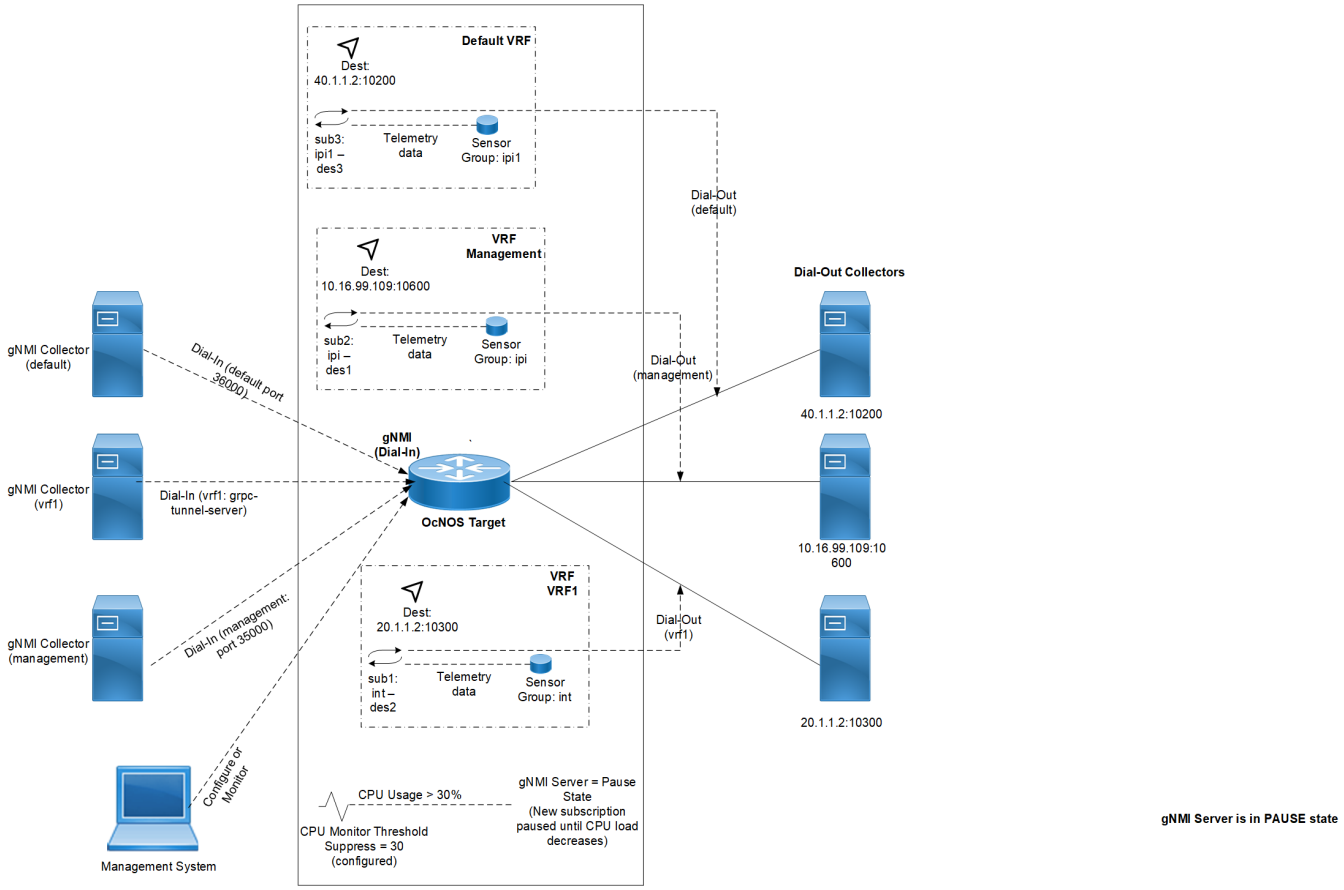
## Topology

The figure below illustrates the OcNOS gNMI telemetry environment with both dial-in and dial-out connections across three VRFs: default, management, and vrf1. The OcNOS target streams telemetry data to gNMI collectors using predefined sensor groups. When a 5-minute CPU average usage exceeds the configured 30% threshold, the gNMI server enters a PAUSE state, suppressing telemetry and rejecting new subscriptions until CPU load decreases.

**Key elements:**

- **Dial-In Clients:** gNMI collectors initiate subscriptions via default, management (port 35000), and vrf1 tunnel-server.
- **Dial-Out Subscriptions:** OcNOS pushes telemetry to remote collectors at specified destinations per VRF.
- **Telemetry Flow:** Each VRF associates a subscription name, destination collector, and sensor group.
- **CPU Monitor Logic:** If CPU > configured 30% threshold, telemetry streaming is paused, as shown by the PAUSE state indicator.

**Figure 13. Telemetry CPU Monitoring**



### Enable CPU Monitoring and Set Suppression Threshold

To prevent high CPU utilization from impacting telemetry responsiveness, enable CPU monitoring to manage system load dynamically. And define a suppression threshold (CPU usage percentage 30%) above which telemetry is paused.

```
OcNOS(config)# telemetry cpu-monitor enable
OcNOS(telemetry-cpu-monitor)# suppress-threshold 30
OcNOS(telemetry-cpu-monitor)# commit
OcNOS(telemetry-cpu-monitor)# end
```

### gNMI Client Behavior When CPU Monitoring is Active

If CPU usage exceeds the configured threshold, the gNMI server enters the PAUSE state. New telemetry subscription requests are paused until the system CPU usage drops below the configured threshold. Below is one such scenario, in which the message confirms that the telemetry server has paused accepting new subscriptions to reduce CPU load.

```
# ./gnmic -a 10.16.154.118:35000 -u ocnos -p ocnos --encoding json_ietf --insecure --mode STREAM
--stream-mode sample --sample-interval 90s subscribe --path 'ipi:/interfaces/interface
[name="eth0"]/state' --log
2025/06/11 11:57:50.415698 [gnmic] version=dev, commit=none, date=unknown, gitURL=,
docs=https://gnmic.openconfig.net
2025/06/11 11:57:50.415717 [gnmic] using config file ""
2025/06/11 11:57:50.415822 [gnmic] starting output type file
2025/06/11 11:57:50.415861 [gnmic] queuing target "10.16.154.118:35000"
2025/06/11 11:57:50.416005 [file_output:default-stdout] initialized file output: {"Cfg":
{"FileName":"","FileType":"stdout","Format":"json","Multiline":true,"Indent":"  ","Separator":"\n
","OverrideTimestamps":false,"AddTarget":"","TargetTemplate":"","EventProcessors":null,"MsgTempla
te":"","ConcurrencyLimit":1000,"EnableMetrics":false,"Debug":false}}
2025/06/11 11:57:50.416085 [gnmic] starting target "10.16.154.118:35000" listener
2025/06/11 11:57:50.416156 [gnmic] subscribing to target: "10.16.154.118:35000"
2025/06/11 11:57:50.417046 [gnmic] target "10.16.154.118:35000" gNMI client created
2025/06/11 11:57:50.417086 [gnmic] sending gNMI SubscribeRequest: subscribe='subscribe:
{subscription:{path:{origin:"ipi" elem:{name:"interfaces"} elem:{name:"interface" key:{key:"name"
value:"\"eth0\""}} elem:{name:"state"}} mode:SAMPLE sample_interval:90000000000} encoding:JSON_
IETF}', mode='STREAM', encoding='JSON_IETF', to 10.16.154.118:35000
2025/06/11 11:57:50.418932 [gnmic] target "10.16.154.118:35000": subscription default-1749643070
rcv error: rpc error: code = Unimplemented desc = GNMI Server is in PAUSE state. Please retry
later when system CPU load is lesser
2025/06/11 11:57:50.418961 [gnmic] target "10.16.154.118:35000": subscription default-1749643070
rcv error: retrying in 10s
2025/06/11 11:58:00.419755 [gnmic] target "10.16.154.118:35000": subscription default-1749643070
rcv error: rpc error: code = Unimplemented desc = GNMI Server is in PAUSE state. Please retry
later when system CPU load is lesser
2025/06/11 11:58:00.419881 [gnmic] target "10.16.154.118:35000": subscription default-1749643070
rcv error: retrying in 10s
```

## Validation

Verify the CPU monitoring state and threshold value using the `show streaming-telemetry` command along with the subscription details.

### Enabled (Normal) State

The CPU monitoring field displays `ENABLED (NORMAL)` when the gNMI target's CPU usage is below the configured threshold (`30%`), allowing both dial-in and dial-out telemetry streams to operate without restriction.

```
OcNOS#show streaming-telemetry
```

```
 Number of telemetry instances : 3 (vrf1,management,default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (NORMAL)
 CPU monitoring threshold      : 30
 Number of active sensor-paths : 70 (Dial-In : 4, Dial-out : 66)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: vrf1):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : sub1
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : 30 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
           des2                IN-ACTIVE      20.1.1.2:10300
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
            int            10           ipi:/components/component[name="RAM"]/ram/state
                                        ipi:/components/component[name="CPU"]/cpu/state
                                        ipi:/components/component[name="HARD-DISK"]/storage/state
                                        ipi:/components/component[name="PSU-1"]/power-supply/state
                                        ipi:/components/component[name="FAN-3"]/fan/state
                                        ipi:/interfaces/interface[name="eth0"]/state
                                        [*]ipi:/interfaces/interface[name="eth0"]/state/counters
                                        ipi:/components/component[name="CHASSIS"]/state
                                        [*]ipi:/components/component[name="CHASSIS"]/state/memory
                                        [*]ipi:/components/component[name="CHASSIS"]/state/board-fru
                                        [*]ipi:/components/component
[name="CHASSIS"]/state/temperature
                                        /interfaces/interface[name="eth0"]/state
                                        [*]/interfaces/interface[name="eth0"]/state/counters
                                        /interfaces/interface[name="xe4"]/state/counters
                                        /components/component[name="RAM"]/state/memory
                                        /components/component[name="CPU"]/cpu/utilization/state
                                        /components/component[name="HARD-DISK"]/state
                                        /components/component[name="HARD-DISK"]/state/memory
                                        /components/component[name="HARD-DISK"]/state/temperature
                                        /components/component[name="CHASSIS"]/state
                                        /components/component[name="CHASSIS"]/state/memory
                                        /components/component[name="CHASSIS"]/state/temperature

 [*]-> Indicates child path learnt from parent config, not configured by user

 2. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 35000
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
```

```
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.16.99.109:46708     4574    90     JSON_IETF    ipi:/interfaces/interface[name="eth0"]/state
                                                    ipi:/interfaces/interface
[name="eth0"]/state/counters


 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : sub2
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : 30 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
           des1                ACTIVE         10.16.99.109:10600
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
            ipi            10           ipi:/components/component[name="RAM"]/ram/state
                                        ipi:/components/component[name="CPU"]/cpu/state
                                        ipi:/components/component[name="HARD-DISK"]/storage/state
                                        ipi:/components/component[name="PSU-1"]/power-supply/state
                                        ipi:/components/component[name="FAN-3"]/fan/state
                                        ipi:/interfaces/interface[name="eth0"]/state
                                        [*]ipi:/interfaces/interface[name="eth0"]/state/counters
                                        ipi:/components/component[name="CHASSIS"]/state
                                        [*]ipi:/components/component[name="CHASSIS"]/state/memory
                                        [*]ipi:/components/component[name="CHASSIS"]/state/board-fru
                                        [*]ipi:/components/component
[name="CHASSIS"]/state/temperature
                                        /interfaces/interface[name="eth0"]/state
                                        [*]/interfaces/interface[name="eth0"]/state/counters
                                        /interfaces/interface[name="xe4"]/state/counters
                                        /components/component[name="RAM"]/state/memory
                                        /components/component[name="CPU"]/cpu/utilization/state
                                        /components/component[name="HARD-DISK"]/state
                                        /components/component[name="HARD-DISK"]/state/memory
                                        /components/component[name="HARD-DISK"]/state/temperature
                                        /components/component[name="CHASSIS"]/state
                                        /components/component[name="CHASSIS"]/state/memory
                                        /components/component[name="CHASSIS"]/state/temperature

 [*]-> Indicates child path learnt from parent config, not configured by user

 3. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 36000
   TLS          : Disabled
   insecure-tls : False

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 40.1.1.2:49602     2342    10     JSON_IETF    ipi:/interfaces/interface[name="eth0"]/state
                                                    ipi:/interfaces/interface
[name="eth0"]/state/counters


 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : sub3
```

```
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : 30 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
           des3                ACTIVE         40.1.1.2:10200
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
           ipi1            10          ipi:/components/component[name="RAM"]/ram/state
                                       ipi:/components/component[name="CPU"]/cpu/state
                                       ipi:/components/component[name="HARD-DISK"]/storage/state
                                       ipi:/components/component[name="PSU-1"]/power-supply/state
                                       ipi:/components/component[name="FAN-3"]/fan/state
                                       ipi:/interfaces/interface[name="eth0"]/state
                                       [*]ipi:/interfaces/interface[name="eth0"]/state/counters
                                       ipi:/components/component[name="CHASSIS"]/state
                                       [*]ipi:/components/component[name="CHASSIS"]/state/memory
                                       [*]ipi:/components/component[name="CHASSIS"]/state/board-fru
                                       [*]ipi:/components/component
[name="CHASSIS"]/state/temperature
                                       /interfaces/interface[name="eth0"]/state
                                       [*]/interfaces/interface[name="eth0"]/state/counters
                                       /interfaces/interface[name="xe4"]/state/counters
                                       /components/component[name="RAM"]/state/memory
                                       /components/component[name="CPU"]/cpu/utilization/state
                                       /components/component[name="HARD-DISK"]/state
                                       /components/component[name="HARD-DISK"]/state/memory
                                       /components/component[name="HARD-DISK"]/state/temperature
                                       /components/component[name="CHASSIS"]/state
                                       /components/component[name="CHASSIS"]/state/memory
                                       /components/component[name="CHASSIS"]/state/temperature

 [*]-> Indicates child path learnt from parent config, not configured by user
```

## Enabled (Paused) State

The CPU monitoring field displays `ENABLED (PAUSED)` when the gNMI target's CPU usage exceeds the configured threshold (`30%`), causing the system to suppress telemetry activity and reject new incoming dial-in connections. When in the pause state, on any new dial-out subscription activation, the corresponding sensor-paths enter a paused state immediately.

```
OcNOS#sh streaming-telemetry

 Number of telemetry instances : 3 (vrf1,management,default)
 Platform type                 : High range
 Maximum sensor-paths          : 100
 Minimum sample-interval       : 10
 CPU monitoring                : ENABLED (PAUSED)
 CPU monitoring threshold      : 30
 Number of active sensor-paths : 68 (Dial-In : 2, Dial-out : 66)

 SI           : Sampling Interval in seconds
 Enc-Type     : Encoding type
 Origin:Path  : Sensor Path


 1. Subscription Details (VRF-Name: vrf1):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 9339
```

```
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : sub1
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : 30 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
           des2                IN-ACTIVE      20.1.1.2:10300
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
            int            10           ipi:/components/component[name="RAM"]/ram/state
                                        ipi:/components/component[name="CPU"]/cpu/state
                                        ipi:/components/component[name="HARD-DISK"]/storage/state
                                        ipi:/components/component[name="PSU-1"]/power-supply/state
                                        ipi:/components/component[name="FAN-3"]/fan/state
                                        ipi:/interfaces/interface[name="eth0"]/state
                                        [*]ipi:/interfaces/interface[name="eth0"]/state/counters
                                        ipi:/components/component[name="CHASSIS"]/state
                                        [*]ipi:/components/component[name="CHASSIS"]/state/memory
                                        [*]ipi:/components/component[name="CHASSIS"]/state/board-fru
                                        [*]ipi:/components/component
[name="CHASSIS"]/state/temperature
                                        /interfaces/interface[name="eth0"]/state
                                        [*]/interfaces/interface[name="eth0"]/state/counters
                                        /interfaces/interface[name="xe4"]/state/counters
                                        /components/component[name="RAM"]/state/memory
                                        /components/component[name="CPU"]/cpu/utilization/state
                                        /components/component[name="HARD-DISK"]/state
                                        /components/component[name="HARD-DISK"]/state/memory
                                        /components/component[name="HARD-DISK"]/state/temperature
                                        /components/component[name="CHASSIS"]/state
                                        /components/component[name="CHASSIS"]/state/memory
                                        /components/component[name="CHASSIS"]/state/temperature

 [*]-> Indicates child path learnt from parent config, not configured by user

 2. Subscription Details (VRF-Name: management):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 35000
   TLS          : Disabled
   insecure-tls : False
   CPU Monitored Sensor Groups : ipi

 Dial-In STREAM Mode Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 ClientIP:Port          ID      SI      Enc-Type      Origin:Path
 -------------        ------   ----     --------      ------------
 10.16.99.109:46708     4574    90     JSON_IETF    ipi:/interfaces/interface[name="eth0"]/state
                                                    ipi:/interfaces/interface
[name="eth0"]/state/counters


 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : sub2
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
```

```
    Tunnel-server Retry-interval  : 30 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
           des1                ACTIVE         10.16.99.109:10600
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
            ipi            10           ipi:/components/component[name="RAM"]/ram/state
                                        ipi:/components/component[name="CPU"]/cpu/state
                                        ipi:/components/component[name="HARD-DISK"]/storage/state
                                        ipi:/components/component[name="PSU-1"]/power-supply/state
                                        ipi:/components/component[name="FAN-3"]/fan/state
                                        ipi:/interfaces/interface[name="eth0"]/state
                                        [*]ipi:/interfaces/interface[name="eth0"]/state/counters
                                        ipi:/components/component[name="CHASSIS"]/state
                                        [*]ipi:/components/component[name="CHASSIS"]/state/memory
                                        [*]ipi:/components/component[name="CHASSIS"]/state/board-fru
                                        [*]ipi:/components/component
[name="CHASSIS"]/state/temperature
                                        /interfaces/interface[name="eth0"]/state
                                        [*]/interfaces/interface[name="eth0"]/state/counters
                                        /interfaces/interface[name="xe4"]/state/counters
                                        /components/component[name="RAM"]/state/memory
                                        /components/component[name="CPU"]/cpu/utilization/state
                                        /components/component[name="HARD-DISK"]/state
                                        /components/component[name="HARD-DISK"]/state/memory
                                        /components/component[name="HARD-DISK"]/state/temperature
                                        /components/component[name="CHASSIS"]/state
                                        /components/component[name="CHASSIS"]/state/memory
                                        /components/component[name="CHASSIS"]/state/temperature

 [*]-> Indicates child path learnt from parent config, not configured by user

 3. Subscription Details (VRF-Name: default):
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
   Port         : 36000
   TLS          : Disabled
   insecure-tls : False

 Dial-Out Subscription Details:
 ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 1. Subscription-name    : sub3
    Status               : ACTIVE
    Enc-Type             : JSON
    Tunnel-server details:
    ~~~~~~~~~~~~~~~~~~~~~
    Tunnel-server Retry-interval  : 30 (seconds)

     Destination-group         Status         Tunnel-IP:Port
     -----------------         ------         --------------
           des3                ACTIVE         40.1.1.2:10200
    Sensor-group details:
    ~~~~~~~~~~~~~~~~~~~~
    Sensor-group          SI            Origin:Path
    ------------         ----           -----------
           ipi1            10           ipi:/components/component[name="RAM"]/ram/state
                                        ipi:/components/component[name="CPU"]/cpu/state
                                        ipi:/components/component[name="HARD-DISK"]/storage/state
                                        ipi:/components/component[name="PSU-1"]/power-supply/state
                                        ipi:/components/component[name="FAN-3"]/fan/state
                                        ipi:/interfaces/interface[name="eth0"]/state
                                        [*]ipi:/interfaces/interface[name="eth0"]/state/counters
                                        ipi:/components/component[name="CHASSIS"]/state
                                        [*]ipi:/components/component[name="CHASSIS"]/state/memory
                                        [*]ipi:/components/component[name="CHASSIS"]/state/board-fru
                                        [*]ipi:/components/component
[name="CHASSIS"]/state/temperature
```

```
                                        /interfaces/interface[name="eth0"]/state
                                        [*]/interfaces/interface[name="eth0"]/state/counters
                                        /interfaces/interface[name="xe4"]/state/counters
                                        /components/component[name="RAM"]/state/memory
                                        /components/component[name="CPU"]/cpu/utilization/state
                                        /components/component[name="HARD-DISK"]/state
                                        /components/component[name="HARD-DISK"]/state/memory
                                        /components/component[name="HARD-DISK"]/state/temperature
                                        /components/component[name="CHASSIS"]/state
                                        /components/component[name="CHASSIS"]/state/memory
                                        /components/component[name="CHASSIS"]/state/temperature

 [*]-> Indicates child path learnt from parent config, not configured by user
```

## Client Response for Dial-Out

The following section outlines the client response behavior for dial-out telemetry subscription requests.


```
"source": "e8:c5:7a:db:d5:30",
  "subscription-name": "sub3",
  "timestamp": 1748547313731512436,
  "time": "2025-05-29T19:35:13.731512436Z",
  "updates": [
    {
      "Path": "interfaces/interface[name=\"xe4\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": 1011,
          "in-discards": 0,
          "in-errors": 1455,
          "in-fcs-errors": 0,
          "in-multicast-pkts": 2493,
          "in-octets": 2922028,
          "in-pkts": 33686,
          "in-unicast-pkts": 28439,
          "last-clear": 0,
          "out-broadcast-pkts": 1,
          "out-discards": 0,
          "out-errors": 0,
          "out-multicast-pkts": 60,
          "out-octets": 5293702,
          "out-pkts": 33389,
          "out-unicast-pkts": 33328
        }
      }
    }
  ]
}
2025/06/11 12:19:16.133574 /workdir/build/src/OpenYuma/src/gnmic/app/publish.go:111: [gnmic] target
"e8:c5:7a:db:d5:30": gNMI Subscribe Response: &{SubscriptionName:default-1749639836
SubscriptionConfig:null Response:update:{timestamp:1748547315121875897 update:{path:{elem:
{name:"components"} elem:{name:"component" key:{key:"name" value:"\"RAM\""}} elem:{name:"state"}
elem:{name:"memory"}} val:{json_val:"{\"available\":33037484032,\"utilized\":2102394880}"}}
GroupId:"sub3"}}
{
  "source": "e8:c5:7a:db:d5:30",
  "subscription-name": "sub3",
  "timestamp": 1748547315121875897,
  "time": "2025-05-29T19:35:15.121875897Z",
  "updates": [
    {
      "Path": "components/component[name=\"RAM\"]/state/memory",
      "values": {
        "components/component/state/memory": {
          "available": 33037484032,
          "utilized": 2102394880
        }
```

```
      }
    }
  ]
}
2025/06/11 12:19:16.136542 /workdir/build/src/OpenYuma/src/gnmic/app/publish.go:111: [gnmic] target
"e8:c5:7a:db:d5:30": gNMI Subscribe Response: &{SubscriptionName:default-1749639836
SubscriptionConfig:null Response:update:{timestamp:1748547315128078085 update:{path:{elem:
{name:"components"} elem:{name:"component" key:{key:"name" value:"\"CPU\""}} elem:{name:"cpu"} elem:
{name:"utilization"} elem:{name:"state"}} val:{json_val:"
{\"avg\":5.78,\"instant\":1.4,\"interval\":300000000000}"}} GroupId:"sub3"}}
{
  "source": "e8:c5:7a:db:d5:30",
  "subscription-name": "sub3",
  "timestamp": 1748547315128078085,
  "time": "2025-05-29T19:35:15.128078085Z",
  "updates": [
    {
      "Path": "components/component[name=\"CPU\"]/cpu/utilization/state",
      "values": {
        "components/component/cpu/utilization/state": {
          "avg": 5.78,
          "instant": 1.4,
          "interval": 300000000000
        }
      }
    }
  ]
}
2025/06/11 12:19:16.139617 /workdir/build/src/OpenYuma/src/gnmic/app/publish.go:111: [gnmic] target
"e8:c5:7a:db:d5:30": gNMI Subscribe Response: &{SubscriptionName:default-1749639836
SubscriptionConfig:null Response:update:{timestamp:1748547305039676028 update:{path:{elem:
{name:"components"} elem:{name:"component" key:{key:"name" value:"\"HARD-DISK\""}} elem:
{name:"state"}} val:{json_val:"{\"id\":\"HARD-DISK\",\"memory\":
{\"available\":119226236928,\"utilized\":7207911424},\"name\":\"HARD-DISK\"}"}} GroupId:"sub3"}}
{
  "source": "e8:c5:7a:db:d5:30",
  "subscription-name": "sub3",
  "timestamp": 1748547305039676028,
  "time": "2025-05-29T19:35:05.039676028Z",
  "updates": [
    {
      "Path": "components/component[name=\"HARD-DISK\"]/state",
      "values": {
        "components/component/state": {
          "id": "HARD-DISK",
          "memory": {
            "available": 119226236928,
            "utilized": 7207911424
          },
          "name": "HARD-DISK"
        }
      }
    }
  ]
}
2025/06/11 12:19:16.140979 /workdir/build/src/OpenYuma/src/gnmic/app/publish.go:111: [gnmic] target
"e8:c5:7a:db:d5:30": gNMI Subscribe Response: &{SubscriptionName:default-1749639836
SubscriptionConfig:null Response:update:{timestamp:1748547315121269930 update:{path:{elem:
{name:"components"} elem:{name:"component" key:{key:"name" value:"\"HARD-DISK\""}} elem:
{name:"state"}} val:{json_val:"{\"id\":\"HARD-DISK\",\"memory\":
{\"available\":119226236928,\"utilized\":7207911424},\"name\":\"HARD-DISK\"}"}} GroupId:"sub3"}}
{
  "source": "e8:c5:7a:db:d5:30",
  "subscription-name": "sub3",
  "timestamp": 1748547315121269930,
  "time": "2025-05-29T19:35:15.12126993Z",
  "updates": [
    {
      "Path": "components/component[name=\"HARD-DISK\"]/state",
```

```
      "values": {
        "components/component/state": {
          "id": "HARD-DISK",
          "memory": {
            "available": 119226236928,
            "utilized": 7207911424
          },
          "name": "HARD-DISK"
        }
      }
    }
  ]
}
2025/06/11 12:19:16.144182 /workdir/build/src/OpenYuma/src/gnmic/app/publish.go:111: [gnmic] target
"e8:c5:7a:db:d5:30": gNMI Subscribe Response: &{SubscriptionName:default-1749639836
SubscriptionConfig:null Response:update:{timestamp:1748547315121269930 update:{path:{elem:
{name:"components"} elem:{name:"component" key:{key:"name" value:"\"HARD-DISK\""}} elem:
{name:"state"} elem:{name:"memory"}} val:{json_val:"
{\"available\":119226236928,\"utilized\":7207911424}"}} GroupId:"sub3"}}
{
  "source": "e8:c5:7a:db:d5:30",
  "subscription-name": "sub3",
  "timestamp": 1748547315121269930,
  "time": "2025-05-29T19:35:15.12126993Z",
  "updates": [
    {
      "Path": "components/component[name=\"HARD-DISK\"]/state/memory",
      "values": {
        "components/component/state/memory": {
          "available": 119226236928,
          "utilized": 7207911424
        }
      }
    }
  ]
}
2025/06/11 12:19:16.149807 /workdir/build/src/OpenYuma/src/gnmic/app/publish.go:111: [gnmic] target
"e8:c5:7a:db:d5:30": gNMI Subscribe Response: &{SubscriptionName:default-1749639836
SubscriptionConfig:null Response:update:{timestamp:1748547315122589861 update:{path:{elem:
{name:"components"} elem:{name:"component" key:{key:"name" value:"\"CHASSIS\""}} elem:{name:"state"}}
val:{json_val:"{\"description\":\"UFI_S9600-72XC\",\"empty\":false,\"firmware-version\":\"Extend
Board ID-9/BMC-3.03/BMC AUX-0x00.0x00.0x00.0x00\",\"id\":\"CHASSIS\",\"mfg-date\":\"2023-11-
09\",\"mfg-name\":\"Ufi Space\",\"model-name\":\"S9600-72XC-R\",\"name\":\"CHASSIS\",\"oper-
status\":\"ACTIVE\",\"part-no\":\"S9600-72XC-RB5B\",\"removable\":false,\"serial-
no\":\"WLF1DAVH00004P5\",\"software-version\":\"UFI_S9600-72XC-OcNOS-6.6.1.123-SP_MPLS_Q2-Alpha\"}"}}
GroupId:"sub3"}}
{
  "source": "e8:c5:7a:db:d5:30",
  "subscription-name": "sub3",
  "timestamp": 1748547315122589861,
  "time": "2025-05-29T19:35:15.122589861Z",
  "updates": [
    {
      "Path": "components/component[name=\"CHASSIS\"]/state",
      "values": {
        "components/component/state": {
          "description": "UFI_S9600-72XC",
          "empty": false,
          "firmware-version": "Extend Board ID-9/BMC-3.03/BMC AUX-0x00.0x00.0x00.0x00",
          "id": "CHASSIS",
          "mfg-date": "2023-11-09",
          "mfg-name": "Ufi Space",
          "model-name": "S9600-72XC-R",
          "name": "CHASSIS",
          "oper-status": "ACTIVE",
          "part-no": "S9600-72XC-RB5B",
          "removable": false,
          "serial-no": "WLF1DAVH00004P5",
          "software-version": "UFI_S9600-72XC-OcNOS-6.6.1.123-SP_MPLS_Q2-Alpha"
```

```
        }
      }
    }
  ]
}

source": "40.1.1.1:36000",
  "subscription-name": "default-1749643105",
  "timestamp": 1748546733499057800,
  "time": "2025-05-29T19:25:33.4990578Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state/counters",
      "values": {
        "interfaces/interface/state/counters": {
          "in-broadcast-pkts": "0",
          "in-discards": "0",
          "in-errors": "0",
          "in-multicast-pkts": "7684",
          "in-octets": "1326420",
          "in-pkts": "16794",
          "in-unicast-pkts": "0",
          "last-clear": "Never",
          "out-broadcast-pkts": "0",
          "out-discards": "0",
          "out-errors": "0",
          "out-multicast-pkts": "0",
          "out-octets": "1717703",
          "out-pkts": "11419",
          "out-unicast-pkts": "0"
        }
```

## Client Response for Dial-In

The following section outlines the client response behavior for dial-in telemetry subscription requests.

```
{
  "source": "40.1.1.1:36000",
  "subscription-name": "default-1749643105",
  "timestamp": 1748546733486092566,
  "time": "2025-05-29T19:25:33.486092566Z",
  "updates": [
    {
      "Path": "ipi:interfaces/interface[name=\"eth0\"]/state",
      "values": {
        "interfaces/interface/state": {
          "admin-status": "up",
          "counters": {
            "in-broadcast-pkts": "0",
            "in-discards": "0",
            "in-errors": "0",
            "in-multicast-pkts": "7677",
            "in-octets": "1318458",
            "in-pkts": "16671",
            "in-unicast-pkts": "0",
            "last-clear": "Never",
            "out-broadcast-pkts": "0",
            "out-discards": "0",
            "out-errors": "0",
            "out-multicast-pkts": "0",
            "out-octets": "1637007",
            "out-pkts": "11159",
            "out-unicast-pkts": "0"
          },
          "ifindex": 3,
          "last-change": 0,
          "logical": false,
```

```
          "oper-status": "up",
          "vrf-name": "management"
        }
      }
    }
```

## Running Configuration

```
OcNOS#show running-config streaming-telemetry
!
feature streaming-telemetry vrf vrf1
 grpc-tunnel-server retry-interval 30
!
feature streaming-telemetry vrf management
 port 35000
 grpc-tunnel-server retry-interval 30
!
feature streaming-telemetry
 port 36000
 grpc-tunnel-server retry-interval 30
!
sensor-group int vrf vrf1
 sensor-path ipi:/components/component[name="RAM"]/ram/state
 sensor-path ipi:/components/component[name="CPU"]/cpu/state
 sensor-path ipi:/components/component[name="HARD-DISK"]/storage/state
 sensor-path ipi:/components/component[name="PSU-1"]/power-supply/state
 sensor-path ipi:/components/component[name="FAN-3"]/fan/state
 sensor-path ipi:/interfaces/interface[name="eth0"]/state
 sensor-path ipi:/components/component[name="CHASSIS"]/state
 sensor-path /interfaces/interface[name="eth0"]/state
 sensor-path /interfaces/interface[name="xe4"]/state/counters
 sensor-path /components/component[name="RAM"]/state/memory
 sensor-path /components/component[name="CPU"]/cpu/utilization/state
 sensor-path /components/component[name="HARD-DISK"]/state
 sensor-path /components/component[name="HARD-DISK"]/state/memory
 sensor-path /components/component[name="HARD-DISK"]/state/temperature
 sensor-path /components/component[name="CHASSIS"]/state
 sensor-path /components/component[name="CHASSIS"]/state/memory
 sensor-path /components/component[name="CHASSIS"]/state/temperature
!
sensor-group ipi vrf management
 sensor-path ipi:/components/component[name="RAM"]/ram/state
 sensor-path ipi:/components/component[name="CPU"]/cpu/state
 sensor-path ipi:/components/component[name="HARD-DISK"]/storage/state
 sensor-path ipi:/components/component[name="PSU-1"]/power-supply/state
 sensor-path ipi:/components/component[name="FAN-3"]/fan/state
 sensor-path ipi:/interfaces/interface[name="eth0"]/state
 sensor-path ipi:/components/component[name="CHASSIS"]/state
 sensor-path /interfaces/interface[name="eth0"]/state
 sensor-path /interfaces/interface[name="xe4"]/state/counters
 sensor-path /components/component[name="RAM"]/state/memory
 sensor-path /components/component[name="CPU"]/cpu/utilization/state
 sensor-path /components/component[name="HARD-DISK"]/state
 sensor-path /components/component[name="HARD-DISK"]/state/memory
 sensor-path /components/component[name="HARD-DISK"]/state/temperature
 sensor-path /components/component[name="CHASSIS"]/state
 sensor-path /components/component[name="CHASSIS"]/state/memory
 sensor-path /components/component[name="CHASSIS"]/state/temperature
!
sensor-group ipi1
 sensor-path ipi:/components/component[name="RAM"]/ram/state
 sensor-path ipi:/components/component[name="CPU"]/cpu/state
 sensor-path ipi:/components/component[name="HARD-DISK"]/storage/state
 sensor-path ipi:/components/component[name="PSU-1"]/power-supply/state
 sensor-path ipi:/components/component[name="FAN-3"]/fan/state
 sensor-path ipi:/interfaces/interface[name="eth0"]/state
```

```
 sensor-path ipi:/components/component[name="CHASSIS"]/state
 sensor-path /interfaces/interface[name="eth0"]/state
 sensor-path /interfaces/interface[name="xe4"]/state/counters
 sensor-path /components/component[name="RAM"]/state/memory
 sensor-path /components/component[name="CPU"]/cpu/utilization/state
 sensor-path /components/component[name="HARD-DISK"]/state
 sensor-path /components/component[name="HARD-DISK"]/state/memory
 sensor-path /components/component[name="HARD-DISK"]/state/temperature
 sensor-path /components/component[name="CHASSIS"]/state
 sensor-path /components/component[name="CHASSIS"]/state/memory
 sensor-path /components/component[name="CHASSIS"]/state/temperature
!
destination-group des2 vrf vrf1
 tunnel-server ip 20.1.1.2 port 10300
!
destination-group des1 vrf management
 tunnel-server ip 10.16.99.109 port 10600
!
destination-group des3
 tunnel-server ip 40.1.1.2 port 10200
!
destination-group des1
!
subscription-name sub1 vrf vrf1
 destination-group des2
 sensor-group int sample-interval 10
!
subscription-name sub2 vrf management
 destination-group des1
 sensor-group ipi sample-interval 10
!
subscription-name sub3
 destination-group des3
 sensor-group ipi1 sample-interval 10
!
telemetry cpu-monitor enable
 suppress-threshold 30
!
!
```

# Implementation Example

## Dynamic Resource Management in Service Provider Data Center

### Scenario

A Tier-1 Service Provider operates a set of distributed regional data centers interconnected through a backbone MPLS network. The infrastructure utilizes OcNOS-powered access and edge routers to manage tenant connectivity, L2 or L3 VPNs, BGP route reflectors, and multi-tenancy overlays. During periods of: Route churn (e.g., BGP session flaps), topology changes (e.g., ECMP rehashes), and high control-plane activity (e.g., LDP or IS-IS convergence), the routers experience CPU spikes that risk delaying or dropping telemetry responses. This leads telemetry collectors to mark the node as "unreachable," triggering false alarms and noise in Network Operations Center (NOC) dashboards. To ensure telemetry does not destabilize the control plane during these peaks, the service provider implements OcNOS Streaming Telemetry CPU Monitoring.

### Implementation

- Enable CPU monitoring on all access and core routers to track 5-minute CPU average and respond dynamically.
- Configure CPU thresholds (e.g., 50%) to automatically pause non-essential telemetry when CPU is over-utilized.
- Integrate telemetry pause or normal status into the NOC dashboard by polling the `show streaming-telemetry` status on each router.
- Correlate telemetry gaps in observability tools (e.g., Prometheus, InfluxDB) with CPU state transitions to suppress alert noise.

For step-by-step configurations, refer to the CPU Monitoring Configuration (page 170) section.

### Benefits

- Maintains telemetry continuity for high-priority data during load surges.
- Prevents telemetry from overloading the control plane, ensuring routing and convergence stability.
- Auto-resumes full telemetry without manual intervention once CPU load normalizes.
- Delivers graceful degradation and self-healing behavior aligned with SLAs.

# CPU Monitoring Commands

Below is the list of CPU monitoring commands; for more details, refer to the Streaming Telemetry Commands (page 43) section.

- suppress-threshold (page 78)
- telemetry cpu-monitor (page 80)

## Revised Commands

### show streaming-telemetry

To verify the status of telemetry CPU usage and the configured threshold, introduced two fields in all the `show streaming-telemetry` command output:

- **CPU monitoring:**

Displays the current operational state of CPU-based telemetry control. It shows:

  - ENABLED (NORMAL) – when telemetry is enabled and the current CPU usage is below the configured threshold.
  - ENABLED (PAUSED) – when telemetry is enabled and the CPU usage exceeds the configured threshold, causing telemetry streams to pause.
  - DISABLED - when telemetry CPU monitoring is explicitly disabled via configuration.

- **CPU monitoring threshold:** Displays the active CPU threshold value (in percentage) configured to trigger the pause or resume logic for telemetry streaming.

These fields help operators identify whether streaming telemetry is operating normally, in a throttled state due to high CPU, or completely unmonitored due to the feature being turned off.

For more details, refer to the show streaming-telemetry, show streaming-telemetry persistent-subscriptions (page 73), and show streaming-telemetry dynamic-subscriptions (page 70) commands.

# CPU Monitoring Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

| Key Terms or Acronyms | Description |
|---|---|
| CPU Monitoring | A mechanism that tracks the device's CPU usage to manage telemetry activity. |
| 5-minute average | Average CPU usage over a 5-minute sliding window. |
| Paused State | State where telemetry activities are temporarily suppressed due to high CPU load. |
| Normal State | State where telemetry functions as usual, CPU usage is under the defined threshold. |
| Protocol Modules (PMs) | Internal components processing gNMI, telemetry, or routing. |
| Redis-server | Backend process used for internal data caching or distribution. |
| Prometheus or InfluxDB | Monitoring and observability tools are commonly used to collect and visualize telemetry data. |
| Network Operations Center (NOC) | The central team and dashboard monitor network health. |
| Service-Level Agreement (SLA) | Guaranteed level of service performance. |
| Equal-Cost Multi-Path (ECMP) | Routing strategy using multiple best paths for traffic. |
| Label Distribution Protocol (LDP) | Used in MPLS to distribute labels. |
| Intermediate System to Intermediate System (IS-IS) | Interior gateway routing protocol. |
| Route churn | Frequent route changes or flaps in dynamic routing environments. |
| Telemetry Pause Indicator | Visual or log marker showing telemetry suppression due to high CPU. |

# STREAMING TELEMETRY IPI DATA MODELS

## Overview

Streaming telemetry incrementally supports all IPI data models, listed in this section. Telemetry supports only operational containers and a subset of leaf attributes.

### Telemetry IPI Pyang Tree

The Pyang tree output illustrates the supported containers or leaf, along with a list of supported container-level paths.

### Container Level Sensor Paths and Leaf Attributes

Lists the container level sensor paths and leaf attributes supported for IPI data models.

**Note:** For details on wildcard support, refer to the Wildcard Support in Sensor Paths (page 33) and XPath Formatting Rules for Streaming Telemetry (page 39) sections.

# IPI-Platform

## Pyang Tree: ipi-platform

```
  +--rw components {feature-list:HAVE_CMMD}?
     +--ro component* [name]
        +--ro name                      -> ../state/name
        +--ro state
        |  +--ro name?                           string
        |  +--ro type?                           ipi-platform-types:cmm_component_type_t
{feature-list:NOT_HAVE_TIBIT}?
        |  +--ro location?                       string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro mfg-name?                       string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro mfg-date?                       yang:date-and-time {feature-list:NOT_HAVE_
TIBIT}?
        |  +--ro description?                    string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro hardware-version?               string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro firmware-version?               string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro software-version?               string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro serial-no?                      string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro part-no?                        string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro removable?                      boolean {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro oper-status?                    ipi-platform-types:cmm_component_oper_status_t
{feature-list:NOT_HAVE_TIBIT}?
        |  +--ro product-name?                   string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro asset-tag?                      string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro component-additional-details*   string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro parent?                         -> /components/component/state/name {feature-
list:NOT_HAVE_TIBIT}?
        |  +--ro empty?                          boolean {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro memory {feature-list:NOT_HAVE_TIBIT}?
        |  |  +--ro available?   uint64
        |  |  +--ro utilized?    uint64
        |  +--ro board-fru {feature-list:NOT_HAVE_TIBIT}?
        |  |  +--ro board-name?        string
        |  |  +--ro board-serial-no?   string
        |  |  +--ro board-mfg-name?    string
        |  |  +--ro board-mfg-date?    yang:date-and-time
        |  +--ro temperature {feature-list:HAVE_CMMD}?
        |     +--ro instant?                          decimal64
        |     +--ro min?                              decimal64
        |     +--ro max?                              decimal64
        |     +--ro avg?                              decimal64
        |     +--ro interval?                         uint32
        |     +--ro sensor-name?                      string
        |     +--ro sensor-index?                     uint8
        |     +--ro alarm-status?                     boolean
        |     +--ro alarm-threshold?                  decimal64
        |     +--ro alarm-severity?                   cml_alarm_severity_t
        |     +--ro minimum-emergency-temperature?    decimal64
        |     +--ro maximum-emergency-temperature?    decimal64
        |     +--ro minimum-alert-temperature?        decimal64
        |     +--ro maximum-alert-temperature?        decimal64
        |     +--ro minimum-critical-temperature?     decimal64
        |     +--ro maximum-critical-temperature?     decimal64
        +--ro bmc-sensor-data-record {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro state
        |     +--ro sensor-name?             string
        |     +--ro value?                   ipi-platform-types:cmm_bmc_value_t
        |     +--ro units?                   string
        |     +--ro lower-non-recoverable?   decimal64
        |     +--ro lower-non-critical?      decimal64
        |     +--ro lower-critical?          decimal64
        |     +--ro upper-non-critical?      decimal64
```

```
        |     +--ro upper-critical?          decimal64
        |     +--ro upper-non-recoverable?   decimal64
        |     +--ro operational-status?      string
        |     +--ro threshold?               decimal64
        |     +--ro event-type?              ipi-platform-types:cmm_bmc_event_type_t
        +--ro cpu {feature-list:HAVE_CMMD}?
        |  +--ro state
        |     +--ro processor-count?             uint32
        |     +--ro cpu-1min-load-percentage?    decimal64
        |     +--ro cpu-5min-load-percentage?    decimal64
        |     +--ro cpu-15min-load-percentage?   decimal64
        |     +--ro cpu-utilization?             decimal64
        |     +--ro cpu-utilization-alert?       uint8
        |     +--ro cpu-utilization-critical?    uint8
        +--ro storage {feature-list:HAVE_CMMD}?
        |  +--ro state
        |     +--ro head-count?                    uint16
        |     +--ro sector-count?                  uint32
        |     +--ro unformatted-bytes-or-track?    uint16
        |     +--ro unformatted-bytes-or-sector?   uint16
        |     +--ro total-memory?                  uint64
        +--ro ram {feature-list:HAVE_CMMD}?
        |  +--ro state
        |     +--ro total-memory?            uint64
        |     +--ro used-memory?             uint64
        |     +--ro available-memory?        uint64
        |     +--ro shared-memory?           uint64
        |     +--ro buffers?                 uint64
        |     +--ro total-swap?              uint64
        |     +--ro free-swap?               uint64
        |     +--ro current-process-count?   uint16
        |     +--ro total-high-memory?       uint64
        |     +--ro available-high-memory?   uint64
        |     +--ro unit-size?               uint32
        +--ro transceiver {feature-list:HAVE_CMMD,feature-list:NOT_HAVE_TIBIT}?
        |  +--ro state
        |  |  +--ro grid-spacing?                decimal64
        |  |  +--ro first-frequency?             decimal64
        |  |  +--ro last-frequency?              decimal64
        |  |  +--ro transceiver-temperature?     decimal64
        |  |  +--ro presence?                    ipi-platform-transceiver-types:ddm_cmm_trans_
presence_t
        |  |  +--ro transceiver-voltage?         decimal64
        |  |  +--ro type?                        ipi-platform-transceiver-types:ddm_cmm_trans_
type_t
        |  |  +--ro transceiver-identifier?      ipi-platform-transceiver-types:ddm_cmm_trans_
identifier_t
        |  |  +--ro connector-type?              ipi-platform-transceiver-types:ddm_cmm_trans_
connector_type_t
        |  |  +--ro vendor-name?                 string
        |  |  +--ro vendor-part-number?          string
        |  |  +--ro vendor-revision-number?      string
        |  |  +--ro vendor-serial-number?        string
        |  |  +--ro vendor-manufacturing-date?   string
        |  +--ro sfp
        |  |  +--ro state
        |  |     +--ro transmit-status?                 ipi-platform-transceiver-types:ddm_tx_
rx_state_t
        |  |     +--ro recieve-loss-status?             ipi-platform-transceiver-types:ddm_tx_
rx_state_t
        |  |     +--ro sfp-identifier?                  ipi-platform-transceiver-types:ddm_cmm_
trans_sfp_extended_identifier_t
        |  |     +--ro sfp-options-implemented?         ipi-platform-transceiver-types:ddm_cmm_
trans_sfp_options_implemented_t
        |  |     +--ro fiber-channel-sfp-speed?         ipi-platform-transceiver-types:ddm_cmm_
trans_fiber_channel_speed_t
        |  |     +--ro sfp-infiniband-compliance-code?  ipi-platform-transceiver-types:ddm_cmm_
trans_sfp_infiniband_compliance_t
```

```
        |  |     +--ro sfp-escon-compliance-code?       ipi-platform-transceiver-types:ddm_cmm_
trans_sfp_escon_compliance_t
        |  |     +--ro sfp-plus-cable-technology?       ipi-platform-transceiver-types:ddm_cmm_
trans_sfp_plus_cable_tech_t
        |  +--ro xfp
        |  |  +--ro state
        |  |     +--ro transmit-status?                              ipi-platform-transceiver-
types:ddm_tx_rx_state_t
        |  |     +--ro recieve-loss-status?                          ipi-platform-transceiver-
types:ddm_tx_rx_state_t
        |  |     +--ro xsfp-identifier?                              ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_extended_identifier_t
        |  |     +--ro xfp-10g-ethernet-compliance-code?             ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_10g_eth_compliance_t
        |  |     +--ro xfp-10g-fiber-channel-compliance-code?        ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_10g_fiber_chn_compliance_t
        |  |     +--ro xfp-10g-copper-link-compliance-code?          ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_10g_copper_links_rsvd_t
        |  |     +--ro xfp-lower-speed-link-compliance-code?         ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_lower_speed_links_t
        |  |     +--ro xfp-sonet-interconnect-compliance-code?       ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_sonet_interconnect_t
        |  |     +--ro xfp-sonet-short-haul-compliance-code?         ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_sonet_short_haul_t
        |  |     +--ro xfp-sonet-long-haul-compliance-code?          ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_sonet_long_haul_t
        |  |     +--ro xfp-sonet-very-long-haul-compliance-code?     ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_sonet_very_long_haul_t
        |  |     +--ro xfp-serial-encoding-algorithm?                ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_encoding_t
        |  |     +--ro xsfp-options-implemented?                     ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_options_implemented_t
        |  |     +--ro xfp-auxillary-voltage?                        ipi-platform-transceiver-
types:ddm_cmm_trans_xfp_voltage_aux_monitor_t
        |  +--ro qsfp
        |  |  +--ro state
        |  |     +--ro reset-status?               ipi-platform-transceiver-types:ddm_cmm_trans_
reset_t
        |  |     +--ro power?                      ipi-platform-transceiver-types:ddm_cmm_trans_
power_t
        |  |     +--ro lane1-transmission?         ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane1-transmission-loss?    ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane1-recieve-loss?         ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane2-transmission?         ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane2-transmission-loss?    ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane2-recieve-loss?         ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane3-transmission?         ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane3-transmission-loss?    ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane3-recieve-loss?         ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane4-transmission?         ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane4-transmission-loss?    ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro lane4-recieve-loss?         ipi-platform-transceiver-types:ddm_tx_rx_
state_t
        |  |     +--ro qsfp-identifier?            ipi-platform-transceiver-types:ddm_cmm_qsfp_
extended_identifier_t
        |  |     +--ro fiber-channel-qsfp-speed?   ipi-platform-transceiver-types:ddm_cmm_trans_
fiber_channel_speed_t
        |  |     +--ro qsfp-options-implemented?   ipi-platform-transceiver-types:ddm_cmm_trans_
qsfp_options_implemented_t
```

```
        |  +--ro channels
        |  |  +--ro channel* [index]
        |  |     +--ro index    -> ../state/index
        |  |     +--ro state
        |  |        +--ro index?                                    uint8
        |  |        +--ro input-power?                              decimal64
        |  |        +--ro input-power-alert-max-threshold?          decimal64
        |  |        +--ro input-power-critical-max-threshold?       decimal64
        |  |        +--ro input-power-critical-min-threshold?       decimal64
        |  |        +--ro input-power-alert-min-threshold?          decimal64
        |  |        +--ro output-power?                             decimal64
        |  |        +--ro output-power-alert-max-threshold?         decimal64
        |  |        +--ro output-power-critical-max-threshold?      decimal64
        |  |        +--ro output-power-critical-min-threshold?      decimal64
        |  |        +--ro output-power-alert-min-threshold?         decimal64
        |  |        +--ro laser-bias-current?                       decimal64
        |  |        +--ro laser-bias-current-alert-max-threshold?   decimal64
        |  |        +--ro laser-bias-current-critical-max-threshold? decimal64
        |  |        +--ro laser-bias-current-critical-min-threshold? decimal64
        |  |        +--ro laser-bias-current-alert-min-threshold?   decimal64
        |  +--ro cmis-module {feature-list:HAVE_CMMD,feature-list:NOT_HAVE_TIBIT}?
        |     +--ro eeprom
        |     |  +--ro state
        |     |     +--ro identifier?                  ipi-platform-sff8024-types:cmm_sff8024_
identifier_t
        |     |     +--ro vendor-name?                 string
        |     |     +--ro vendor-oui?                  string
        |     |     +--ro part-number?                 string
        |     |     +--ro revision-level?              string
        |     |     +--ro serial-number?               string
        |     |     +--ro manufacturing-date?          string
        |     |     +--ro clei-code?                   string
        |     |     +--ro module-power-class?          ipi-platform-cmis-types:cmm_cmis_module_
power_class_t
        |     |     +--ro module-max-power?            decimal64
        |     |     +--ro cooling-implemented?         ipi-platform-cmis-types:cmm_cmis_yes_no_
t
        |     |     +--ro temperature-max?             int16
        |     |     +--ro temperature-min?             int16
        |     |     +--ro operatin-voltage-min?        decimal64
        |     |     +--ro optical-detector?            ipi-platform-cmis-types:cmm_cmis_
optical_detector_t
        |     |     +--ro rx-power-measurement?        ipi-platform-cmis-types:cmm_cmis_rx_
power_measur_t
        |     |     +--ro tx-disable-module-wide?      ipi-platform-cmis-types:cmm_cmis_yes_no_
t
        |     |     +--ro cable-assembly-link-length?  int16
        |     |     +--ro connector-type?              ipi-platform-sff8024-types:cmm_sff8024_
connector_type_t
        |     |     +--ro cca-5ghz?                    uint8
        |     |     +--ro cca-7ghz?                    uint8
        |     |     +--ro cca-12p9ghz?                 uint8
        |     |     +--ro cca-25p8ghz?                 uint8
        |     |     +--ro media-interface-technology?  ipi-platform-cmis-types:cmm_cmis_media_
intf_tech_t
        |     |     +--ro cmis-revision?               string
        |     |     +--ro memory-model?                ipi-platform-cmis-types:cmm_cmis_memory_
model_t
        |     |     +--ro mci-max-speed?               ipi-platform-cmis-types:cmm_cmis_mci_
max_speed_t
        |     |     +--ro active-firmware-revision?    string
        |     |     +--ro inactive-firmware-revision?  string
        |     |     +--ro hardware-revision?           string
        |     |     +--ro media-type?                  ipi-platform-cmis-types:cmm_cmis_media_
type_t
        |     |     +--ro max-smf-link-length?         decimal64
        |     |     +--ro max-mmf-om2-link-length?     uint8
        |     |     +--ro max-mmf-om3-link-length?     uint16
```

```
        |     |     +--ro max-mmf-om4-link-length?      uint16
        |     |     +--ro max-mmf-om5-link-length?      uint16
        |     |     +--ro wavelength-nominal?           decimal64
        |     |     +--ro wavelength-tolerance?         decimal64
        |     |    +--ro advertisement
        |     |    |  +--ro applications
        |     |    |  |  +--ro application* [id]
        |     |    |  |     +--ro id       -> ../state/id
        |     |    |  |     +--ro state
        |     |    |  |     |  +--ro id?   uint8
        |     |    |  |     +--ro host
        |     |    |  |     |  +--ro state
        |     |    |  |     |     +--ro interface-type?           ipi-platform-cmis-types:cmm_cmis_
interface_type_t
        |     |    |  |     |     +--ro application-bitrate?      ipi-platform-cmis-types:cmm_cmis_
bit_rate_t
        |     |    |  |     |     +--ro lane-count?               uint8
        |     |    |  |     |     +--ro signal-bitrate?           ipi-platform-cmis-types:cmm_cmis_
bit_rate_t
        |     |    |  |     |     +--ro modulation-format?        ipi-platform-cmis-types:cmm_cmis_
modulation_format_t
        |     |    |  |     |     +--ro bits-per-unit-interval?   decimal64
        |     |    |  |     |     +--ro lane-assignment?          ipi-platform-cmis-types:cmm_cmis_
lane_assignment_t
        |     |    |  |     |     +--ro host-config?              string
        |     |    |  |     +--ro media
        |     |    |  |        +--ro state
        |     |    |  |           +--ro interface-type?           ipi-platform-cmis-types:cmm_cmis_
interface_type_t
        |     |    |  |           +--ro application-bitrate?      ipi-platform-cmis-types:cmm_cmis_
bit_rate_t
        |     |    |  |           +--ro lane-count?               uint8
        |     |    |  |           +--ro signal-bitrate?           ipi-platform-cmis-types:cmm_cmis_
bit_rate_t
        |     |    |  |           +--ro modulation-format?        ipi-platform-cmis-types:cmm_cmis_
modulation_format_t
        |     |    |  |           +--ro bits-per-unit-interval?   decimal64
        |     |    |  |           +--ro lane-assignment?          ipi-platform-cmis-types:cmm_cmis_
lane_assignment_t
        |     |    |  +--ro controls
        |     |    |  |  +--ro state
        |     |    |  |     +--ro wavelength-control?             ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  |     +--ro tunable-transmitter?            ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  |     +--ro tx-output-squelching-method?    ipi-platform-cmis-types:cmm_cmis_
tx_squelch_method_t
        |     |    |  |     +--ro forced-tx-output-squelching?    ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  |     +--ro tx-output-squelching-disable?   ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  |     +--ro tx-output-disable?              ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  |     +--ro input-polarity-flip-tx?         ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  |     +--ro rx-output-squelching-disable?   ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  |     +--ro rx-output-disable?              ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  |     +--ro output-polarity-flip-rx?        ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |    |  +--ro diagnostics
        |     |    |  |  +--ro module
        |     |    |  |  |  +--ro state
        |     |    |  |  |     +--ro simultaneous-host-and-media-loobpack?   ipi-platform-cmis-
types:cmm_cmis_yes_no_t
        |     |    |  |  |     +--ro report-bit-error-ratio?                 ipi-platform-cmis-
types:cmm_cmis_yes_no_t
        |     |    |  |  |     +--ro count-bits-and-errors?                  ipi-platform-cmis-
```

```
types:cmm_cmis_yes_no_t
        |     |  |  +--ro host
        |     |  |  |  +--ro state
        |     |  |  |     +--ro output-loopack?           ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro input-loopack?            ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro per-lane-loopack?         ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro report-input-snr?         ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro report-fec?               ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro prbs-checker-post-fec?    ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro prbs-checker-pre-fec?     ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro prbs-checker-types?       ipi-platform-cmis-types:cmm_cmis_
prbs_support_type_t
        |     |  |  |     +--ro prbs-generator-post-fec?  ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro prbs-generator-pre-fec?   ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |  |     +--ro prbs-generator-types?     ipi-platform-cmis-types:cmm_cmis_
prbs_support_type_t
        |     |  |  +--ro media
        |     |  |     +--ro state
        |     |  |        +--ro output-loopack?           ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro input-loopack?            ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro per-lane-loopack?         ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro report-input-snr?         ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro report-fec?               ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro prbs-checker-post-fec?    ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro prbs-checker-pre-fec?     ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro prbs-checker-types?       ipi-platform-cmis-types:cmm_cmis_
prbs_support_type_t
        |     |  |        +--ro prbs-generator-post-fec?  ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro prbs-generator-pre-fec?   ipi-platform-cmis-types:cmm_cmis_yes_
no_t
        |     |  |        +--ro prbs-generator-types?     ipi-platform-cmis-types:cmm_cmis_
prbs_support_type_t
        |     |  +--ro durations
        |     |  |  +--ro state
        |     |  |     +--ro modsel-wait-time?              uint32
        |     |  |     +--ro dpinit-maximun-duration?       ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  |     +--ro dpdeinit-maximun-duration?     ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  |     +--ro dptxturnon-maximum-duration?   ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  |     +--ro dptxturnoff-maximum-duration?  ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  |     +--ro modulepwrup-maximum-duration?  ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  |     +--ro modulepwrdn-maximum-duration?  ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  |     +--ro npinit-maximum-duration?       ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  |     +--ro npdeinit-maximum-duration?     ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  |     +--ro nptxturnon-maximum-duration?   ipi-platform-cmis-types:cmm_cmis_
durations_t
```

```
        |     |  |     +--ro nptxturnoff-maximum-duration?   ipi-platform-cmis-types:cmm_cmis_
durations_t
        |     |  +--ro laser
        |     |  |  +--ro state
        |     |  |  |  +--ro supported-grids?                     ipi-platform-cmis-types:cmm_
cmis_laser_grid_support_t
        |     |  |  |  +--ro fine-tune-supported?                 ipi-platform-cmis-types:cmm_
cmis_yes_no_t
        |     |  |  |  +--ro fine-tune-resolution?                decimal64
        |     |  |  |  +--ro fine-tune-low-offset?                decimal64
        |     |  |  |  +--ro fine-tune-high-offset?               decimal64
        |     |  |  |  +--ro per-lane-programmable-output-power?   ipi-platform-cmis-types:cmm_
cmis_yes_no_t
        |     |  |  |  +--ro minimum-programmable-output-power?    decimal64
        |     |  |  |  +--ro maximum-programmable-output-power?    decimal64
        |     |  |  +--ro grids
        |     |  |     +--ro grid* [id]
        |     |  |        +--ro id       -> ../state/id
        |     |  |        +--ro state
        |     |  |           +--ro id?                          ipi-platform-cmis-types:cmm_
cmis_laser_grid_spacing_t
        |     |  |           +--ro lowest-channel-frequency?    decimal64
        |     |  |           +--ro highest-channel-frequency?   decimal64
        |     |  |           +--ro channel-count?               uint16
        |     |  +--ro monitoring
        |     |  |  +--ro module
        |     |  |  |  +--ro monitors
        |     |  |  |     +--ro monitor* [id]
        |     |  |  |        +--ro id       -> ../state/id
        |     |  |  |        +--ro state
        |     |  |  |           +--ro id?          ipi-platform-cmis-types:cmm_cmis_module_
monitor_id_t
        |     |  |  |           +--ro supported?   ipi-platform-cmis-types:cmm_cmis_yes_no_t
        |     |  |  +--ro host
        |     |  |  |  +--ro monitors
        |     |  |  |  |  +--ro monitor* [id]
        |     |  |  |  |     +--ro id       -> ../state/id
        |     |  |  |  |     +--ro state
        |     |  |  |  |        +--ro id?              ipi-platform-cmis-types:cmm_cmis_host_
monitor_id_t
        |     |  |  |  |        +--ro supported?       ipi-platform-cmis-types:cmm_cmis_yes_no_
t
        |     |  |  |  |        +--ro lanes-assigned?   ipi-platform-cmis-types:cmm_cmis_lane_
assignment_t
        |     |  |  |  +--ro flags
        |     |  |  |     +--ro flag* [id]
        |     |  |  |        +--ro id       -> ../state/id
        |     |  |  |        +--ro state
        |     |  |  |           +--ro id?              ipi-platform-cmis-types:cmm_cmis_host_
flag_id_t
        |     |  |  |           +--ro supported?       ipi-platform-cmis-types:cmm_cmis_yes_no_
t
        |     |  |  |           +--ro lanes-assigned?   ipi-platform-cmis-types:cmm_cmis_lane_
assignment_t
        |     |  |  +--ro media
        |     |  |     +--ro monitors
        |     |  |     |  +--ro monitor* [id]
        |     |  |     |     +--ro id       -> ../state/id
        |     |  |     |     +--ro state
        |     |  |     |        +--ro id?              ipi-platform-cmis-types:cmm_cmis_media_
monitor_id_t
        |     |  |     |        +--ro supported?       ipi-platform-cmis-types:cmm_cmis_yes_no_
t
        |     |  |     |        +--ro lanes-assigned?   ipi-platform-cmis-types:cmm_cmis_lane_
assignment_t
        |     |  |     +--ro flags
        |     |  |        +--ro flag* [id]
        |     |  |           +--ro id       -> ../state/id
```

```
        |     |  |           +--ro state
        |     |  |              +--ro id?              ipi-platform-cmis-types:cmm_cmis_media_
flag_id_t
        |     |  |              +--ro supported?       ipi-platform-cmis-types:cmm_cmis_yes_no_
t
        |     |  |              +--ro lanes-assigned?  ipi-platform-cmis-types:cmm_cmis_lane_
assignment_t
        |     |  +--ro pages
        |     |     +--ro state
        |     |        +--ro network-path-pages-supported?   ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |        +--ro vdm-pages-supported?            ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |        +--ro vdm-groups?                     ipi-platform-cmis-types:cmm_cmis_
vdm_pages_support_t
        |     |        +--ro diagnostics-pages-supported?    ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |        +--ro user-page-supported?            ipi-platform-cmis-types:cmm_cmis_
yes_no_t
        |     |        +--ro banks-per-page?                 ipi-platform-cmis-types:cmm_cmis_
bank_per_page_support_t
        |     +--ro module-state
        |     |  +--ro state
        |     |  |  +--ro fault-state?     ipi-platform-cmis-types:cmm_cmis_module_fault_state_t
        |     |  |  +--ro current-state?   ipi-platform-cmis-types:cmm_cmis_module_state_t
        |     |  +--ro datapaths
        |     |     +--ro datapath* [lane]
        |     |        +--ro lane     -> ../state/lane
        |     |        +--ro state
        |     |           +--ro lane?             uint8
        |     |           +--ro current-state?    ipi-platform-cmis-types:cmm_cmis_datapath_
states_t
        |     |           +--ro host-rate?        decimal64
        |     |           +--ro media-rate?       decimal64
        |     |           +--ro interface-name?   string
        |     +--ro module-monitors
        |     |  +--ro monitors
        |     |  |  +--ro monitor* [id]
        |     |  |     +--ro id       -> ../state/id
        |     |  |     +--ro state
        |     |  |        +--ro id?             ipi-platform-cmis-types:cmm_cmis_module_monitor_
id_t
        |     |  |        +--ro description?    string
        |     |  |        +--ro value?          decimal64
        |     |  |        +--ro high-alarm?     decimal64
        |     |  |        +--ro high-warning?   decimal64
        |     |  |        +--ro low-warning?    decimal64
        |     |  |        +--ro low-alarm?      decimal64
        |     |  +--ro monitor-alarm
        |     |     +--ro state
        |     |        +--ro alarm-id?            ipi-platform-cmis-types:cmm_cmis_module_
monitor_id_t
        |     |        +--ro alarm-type?          ipi-platform-cmis-types:cmm_cmis_threshold_
alarm_t
        |     |        +--ro current-value?       decimal64
        |     |        +--ro threshold-minimum?   decimal64
        |     |        +--ro threshold-maximum?   decimal64
        |     +--ro host-monitors
        |     |  +--ro lanes
        |     |     +--ro lane* [number]
        |     |        +--ro number           -> ../state/number
        |     |        +--ro state
        |     |        |  +--ro number?        uint8
        |     |        |  +--ro dp-assigned?   boolean
        |     |        +--ro monitors
        |     |        |  +--ro monitor* [id]
        |     |        |     +--ro id       -> ../state/id
        |     |        |     +--ro state
```

```
        |     |        |        +--ro id?             ipi-platform-cmis-types:cmm_cmis_host_
monitor_id_t
        |     |        |        +--ro description?    string
        |     |        |        +--ro value?          decimal64
        |     |        |        +--ro high-alarm?     decimal64
        |     |        |        +--ro high-warning?   decimal64
        |     |        |        +--ro low-warning?    decimal64
        |     |        |        +--ro low-alarm?      decimal64
        |     |        +--ro flags
        |     |        |  +--ro flag* [id]
        |     |        |     +--ro id       -> ../state/id
        |     |        |     +--ro state
        |     |        |        +--ro id?            ipi-platform-cmis-types:cmm_cmis_host_flag_
id_t
        |     |        |        +--ro description?   string
        |     |        |        +--ro value?         boolean
        |     |        +--ro monitor-alarm
        |     |        |  +--ro state
        |     |        |     +--ro alarm-id?            ipi-platform-cmis-types:cmm_cmis_host_
monitor_id_t
        |     |        |     +--ro alarm-type?          ipi-platform-cmis-types:cmm_cmis_
threshold_alarm_t
        |     |        |     +--ro current-value?       decimal64
        |     |        |     +--ro threshold-minimum?   decimal64
        |     |        |     +--ro threshold-maximum?   decimal64
        |     |        +--ro flag-alarm
        |     |           +--ro state
        |     |              +--ro alarm-id?   ipi-platform-cmis-types:cmm_cmis_host_flag_id_t
        |     +--ro media-monitors
        |        +--ro lanes
        |           +--ro lane* [number]
        |              +--ro number           -> ../state/number
        |              +--ro state
        |              |  +--ro number?   uint8
        |              +--ro monitors
        |              |  +--ro monitor* [id]
        |              |     +--ro id       -> ../state/id
        |              |     +--ro state
        |              |        +--ro id?             ipi-platform-cmis-types:cmm_cmis_media_
monitor_id_t
        |              |        +--ro description?    string
        |              |        +--ro value?          decimal64
        |              |        +--ro high-alarm?     decimal64
        |              |        +--ro high-warning?   decimal64
        |              |        +--ro low-warning?    decimal64
        |              |        +--ro low-alarm?      decimal64
        |              +--ro flags
        |              |  +--ro flag* [id]
        |              |     +--ro id       -> ../state/id
        |              |     +--ro state
        |              |        +--ro id?            ipi-platform-cmis-types:cmm_cmis_media_
flag_id_t
        |              |        +--ro description?   string
        |              |        +--ro value?         boolean
        |              +--ro monitor-alarm
        |              |  +--ro state
        |              |     +--ro alarm-id?            ipi-platform-cmis-types:cmm_cmis_media_
monitor_id_t
        |              |     +--ro alarm-type?          ipi-platform-cmis-types:cmm_cmis_
threshold_alarm_t
        |              |     +--ro current-value?       decimal64
        |              |     +--ro threshold-minimum?   decimal64
        |              |     +--ro threshold-maximum?   decimal64
        |              +--ro flag-alarm
        |                 +--ro state
        |                    +--ro alarm-id?   ipi-platform-cmis-types:cmm_cmis_media_flag_id_t
        +--ro power-supply {feature-list:HAVE_CMMD}?
```

```
        |  +--ro state
        |     +--ro operational-status?    cml_cmm_power_supply_operstatus_t
        |     +--ro capacity?              decimal64
        |     +--ro power-consumption?     decimal64
        |     +--ro input-power?           decimal64
        |     +--ro input-voltage?         decimal64
        |     +--ro output-voltage?        decimal64
        |     +--ro input-current?         decimal64
        |     +--ro output-current?        decimal64
        |     +--ro temperature-sensor1?   decimal64
        |     +--ro temperature-sensor2?   decimal64
        |     +--ro temperature-sensor3?   decimal64
        |     +--ro fan1-rpm?              uint32
        |     +--ro fan2-rpm?              uint32
        |     +--ro fan3-rpm?              uint32
        |     +--ro fan4-rpm?              uint32
        +--ro fan {feature-list:HAVE_CMMD}?
        |  +--ro state
        |     +--ro rpm?            uint32
        |     +--ro minimum-rpm?    uint32
        |     +--ro maximum-rpm?    uint32
        |     +--ro fan-status?     cml_cmm_fan_status_t
        |     +--ro fan-location?   cml_cmm_fan_location_t
        +--ro fan-tray {feature-list:HAVE_CMMD}?
           +--ro state
              +--ro tray-number?   uint8
              +--ro status?        cml_cmm_fan_tray_status_t
              +--ro led-color?     cml_cmm_led_color_code_t
              +--ro fan-count?     uint32
```

hardware-profile-filter-groups

```
module: ipi-platform
  +--rw profiles {feature-list:HAVE_BROADCOM}?
     +--rw hardware-profile
     |  +--rw filters
     |     +--ro tcam-utilization {feature-list:HAVE_ACL}?
     |        +--ro filter-groups
     |           +--ro filter-group* [group-id]
     |              +--ro group-id    -> ../state/group-id
     |              +--ro state
     |                 +--ro group-id?            uint32
     |                 +--ro group-name?          cml-data-types:cml_line_t
     |                 +--ro free-entries?        int32
     |                 +--ro used-entries?        int32
     |                 +--ro used-percentage?     int32
     |                 +--ro total-entries?       int32
     |                 +--ro dedicated-entries?   int32
     |                 +--ro shared-entries?      int32
```

hardware-l2vpn-instances-limits

```
module: ipi-platform
  +--rw profiles {feature-list:HAVE_BROADCOM,feature-list:HAVE_CMMD,feature-list:HAVE_BROADCOM_
OR_HAVE_MARVELL}?
  |  +--rw hardware-profile
  |  |  +--ro hardware-l2vpn-instances-limits {feature-list:HAVE_BROADCOM,feature-list:HAVE_
DUNE,feature-list:HAVE_CMMD}?
  |  |     +--ro instances
  |  |     |  +--ro state
  |  |     |  |  +--ro capacity?     uint32
  |  |     |  |  +--ro used?         uint32
  |  |     |  |  +--ro free?         uint32
  |  |     |  |  +--ro percentage?   uint8
  |  |     |  +--ro services
  |  |     |     +--ro service* [name]
```

```
   |  |     |        +--ro name     -> ../state/name
   |  |     |        +--ro state
   |  |     |           +--ro name?         platform_l2vpn_services_t
   |  |     |           +--ro capacity?     uint32
   |  |     |           +--ro used?         uint32
   |  |     |           +--ro free?         uint32
   |  |     |           +--ro percentage?   uint8
   |  |     +--ro vsi
   |  |     |  +--ro state
   |  |     |  |  +--ro capacity?     uint32
   |  |     |  |  +--ro used?         uint32
   |  |     |  |  +--ro free?         uint32
   |  |     |  |  +--ro percentage?   uint8
   |  |     |  +--ro services
   |  |     |     +--ro service* [name]
   |  |     |        +--ro name     -> ../state/name
   |  |     |        +--ro state
   |  |     |           +--ro name?         platform_l2vpn_services_t
   |  |     |           +--ro capacity?     uint32
   |  |     |           +--ro used?         uint32
   |  |     |           +--ro free?         uint32
   |  |     |           +--ro percentage?   uint8
   |  |     +--ro multicast-groups
   |  |        +--ro state
   |  |        |  +--ro capacity?     uint32
   |  |        |  +--ro used?         uint32
   |  |        |  +--ro free?         uint32
   |  |        |  +--ro percentage?   uint8
   |  |        +--ro services
   |  |           +--ro service* [name]
   |  |              +--ro name     -> ../state/name
   |  |              +--ro state
   |  |                 +--ro name?         platform_l2vpn_services_t
   |  |                 +--ro capacity?     uint32
   |  |                 +--ro used?         uint32
   |  |                 +--ro free?         uint32
   |  |                 +--ro percentage?   uint8
```

hardware-routing-limits

```
module: ipi-platform
  +--rw profiles {feature-list:HAVE_BROADCOM,feature-list:HAVE_CMMD,feature-list:HAVE_BROADCOM_
OR_HAVE_MARVELL}?
   |  +--rw forwarding-profiles
   |     +--ro hardware-routing-limits {feature-list:HAVE_BROADCOM,feature-list:HAVE_DNX,feature-
list:HAVE_CMMD}?
   |        +--ro lpm
   |        |  +--ro state
   |        |     +--ro capacity?     uint32
   |        |     +--ro used?         uint32
   |        |     +--ro free?         uint32
   |        |     +--ro percentage?   uint8
   |        +--ro ipv4-lpm
   |        |  +--ro state
   |        |     +--ro capacity?     uint32
   |        |     +--ro used?         uint32
   |        |     +--ro free?         uint32
   |        |     +--ro percentage?   uint8
   |        +--ro ipv6-lpm
   |        |  +--ro state
   |        |     +--ro capacity?     uint32
   |        |     +--ro used?         uint32
   |        |     +--ro free?         uint32
   |        |     +--ro percentage?   uint8
   |        +--ro mpls-labels-pop
   |        |  +--ro state
```

```
  |        |     +--ro capacity?     uint32
  |        |     +--ro used?         uint32
  |        |     +--ro free?         uint32
  |        |     +--ro percentage?   uint8
  |        +--ro mpls-labels-swap
  |           +--ro state
  |              +--ro capacity?     uint32
  |              +--ro used?         uint32
  |              +--ro free?         uint32
  |              +--ro percentage?   uint8
```

## Sensor Paths: ipi-platform

The paths listed below represent telemetry paths for monitoring the state of various components, including CPU, storage, RAM, power supply, fans, fan trays, CMIS, and transceivers.

### CPU

```
Sensor Path
        ipi:/components/component[name]/cpu/state

Leaf Attributes
        ipi:/components/component[name]/cpu/state/cpu-1min-load-percentage
        ipi:/components/component[name]/cpu/state/cpu-5min-load-percentage
        ipi:/components/component[name]/cpu/state/cpu-15min-load-percentage
        ipi:/components/component[name]/cpu/state/cpu-utilization
        ipi:/components/component[name]/cpu/state/cpu-utilization-critical
        ipi:/components/component[name]/cpu/state/processor-count
        ipi:/components/component[name]/cpu/state/cpu-utilization-alert
```

### Storage

```
Sensor Path
        ipi:/components/component[name]/storage/state/

Leaf Attributes
        ipi:/components/component[name]/storage/state/total-memory
        ipi:/components/component[name]/storage/state/head-count
        ipi:/components/component[name]/storage/state/sector-count
        ipi:/components/component[name]/storage/state/unformatted-bytes-or-track
        ipi:/components/component[name]/storage/state/unformatted-bytes-or-sector
```

### RAM

```
Sensor Path
        ipi:/components/component[name]/ram/state/

Leaf Attributes
        ipi:/components/component[name]/ram/state/total-memory
        ipi:/components/component[name]/ram/state/used-memory
        ipi:/components/component[name]/ram/state/available-memory
        ipi:/components/component[name]/ram/state/shared-memory
        ipi:/components/component[name]/ram/state/buffers
        ipi:/components/component[name]/ram/state/total-swap
        ipi:/components/component[name]/ram/state/free-swap
        ipi:/components/component[name]/ram/state/current-process-count
        ipi:/components/component[name]/ram/state/total-high-memory
        ipi:/components/component[name]/ram/state/available-high-memory
        ipi:/components/component[name]/ram/state/unit-size
```

## Power-Supply

```
Sensor Path
        ipi:/components/component[name]/power-supply/state/

Leaf Attributes
        ipi:/components/component[name]/power-supply/state/capacity
        ipi:/components/component[name]/power-supply/state/power-consumption
        ipi:/components/component[name]/power-supply/state/input-power
        ipi:/components/component[name]/power-supply/state/input-voltage
        ipi:/components/component[name]/power-supply/state/input-current
        ipi:/components/component[name]/power-supply/state/output-voltage
        ipi:/components/component[name]/power-supply/state/output-current
        ipi:/components/component[name]/power-supply/state/operational-status
        ipi:/components/component[name]/power-supply/state/fan1-rpm
        ipi:/components/component[name]/power-supply/state/fan2-rpm
        ipi:/components/component[name]/power-supply/state/fan3-rpm
        ipi:/components/component[name]/power-supply/state/fan4-rpm
        ipi:/components/component[name]/power-supply/state/temperature-sensor1
        ipi:/components/component[name]/power-supply/state/temperature-sensor2
        ipi:/components/component[name]/power-supply/state/temperature-sensor3
```

## Fan

```
Sensor Path
        ipi:/components/component[name]/fan/state/

Leaf Attributes
        ipi:/components/component[name]/fan/state/rpm
        ipi:/components/component[name]/fan/state/fan-status
        ipi:/components/component[name]/fan/state/fan-location
        ipi:/components/component[name]/fan/state/minimum-rpm
        ipi:/components/component[name]/fan/state/maximum-rpm
```

## Fan-Tray

```
Sensor Path
        ipi:/components/component[name]/fan-tray/state/

Leaf Attributes
        ipi:/components/component[name]/fan-tray/state/status
        ipi:/components/component[name]/fan-tray/state/tray-number
        ipi:/components/component[name]/fan-tray/state/led-color
        ipi:/components/component[name]/fan-tray/state/fan-count
```

## Transceiver State

```
Sensor Path
        ipi:/components/component[name]/transceiver/state/

Leaf Attributes
        ipi:/components/component[name]/transceiver/state/grid-spacing
        ipi:/components/component[name]/transceiver/state/first-frequency
        ipi:/components/component[name]/transceiver/state/last-frequency
        ipi:/components/component[name]/transceiver/state/transceiver-temperature
        ipi:/components/component[name]/transceiver/state/transceiver-voltage
        ipi:/components/component[name]/transceiver/state/presence
        ipi:/components/component[name]/transceiver/state/type
```

```
        ipi:/components/component[name]/transceiver/state/transceiver-identifier
        ipi:/components/component[name]/transceiver/state/connector-type
        ipi:/components/component[name]/transceiver/state/vendor-name
        ipi:/components/component[name]/transceiver/state/vendor-part-number
        ipi:/components/component[name]/transceiver/state/vendor-revision-number
        ipi:/components/component[name]/transceiver/state/vendor-serial-number
        ipi:/components/component[name]/transceiver/state/vendor-manufacturing-date
```

## Transceiver SFP State

```
Sensor Path
        ipi:/components/component[name]/transceiver/sfp/state/

Leaf Attributes
        ipi:/components/component[name]/transceiver/sfp/state/transmit-status
        ipi:/components/component[name]/transceiver/sfp/state/recieve-loss-status
        ipi:/components/component[name]/transceiver/sfp/state/sfp-identifier
        ipi:/components/component[name]/transceiver/sfp/state/sfp-options-implemented
        ipi:/components/component[name]/transceiver/sfp/state/fiber-channel-sfp-speed
        ipi:/components/component[name]/transceiver/sfp/state/sfp-infiniband-compliance-code
        ipi:/components/component[name]/transceiver/sfp/state/sfp-escon-compliance-code
        ipi:/components/component[name]/transceiver/sfp/state/sfp-plus-cable-technology
```

## Transceiver XFP State

```
Sensor Path
        ipi:/components/component[name]/transceiver/xfp/state/

Leaf Attributes
        ipi:/components/component[name]/transceiver/xfp/state/transmit-status
        ipi:/components/component[name]/transceiver/xfp/state/recieve-loss-status
        ipi:/components/component[name]/transceiver/xfp/state/xsfp-identifier
        ipi:/components/component[name]/transceiver/xfp/state/xfp-10g-ethernet-compliance-code
        ipi:/components/component[name]/transceiver/xfp/state/xfp-10g-fiber-channel-compliance-
code
        ipi:/components/component[name]/transceiver/xfp/state/xfp-10g-copper-link-compliance-
code
        ipi:/components/component[name]/transceiver/xfp/state/xfp-lower-speed-link-compliance-
code
        ipi:/components/component[name]/transceiver/xfp/state/xfp-sonet-interconnect-compliance-
code
        ipi:/components/component[name]/transceiver/xfp/state/xfp-sonet-short-haul-compliance-
code
        ipi:/components/component[name]/transceiver/xfp/state/xfp-sonet-long-haul-compliance-
code
        ipi:/components/component[name]/transceiver/xfp/state/xfp-sonet-very-long-haul-
compliance-code
        ipi:/components/component[name]/transceiver/xfp/state/xfp-serial-encoding-algorithm
        ipi:/components/component[name]/transceiver/xfp/state/xsfp-options-implemented
        ipi:/components/component[name]/transceiver/xfp/state/xfp-auxillary-voltage
```

## Transceiver QSFP State

```
Sensor Path
        ipi:/components/component[name]/transceiver/qsfp/state/

Leaf Attributes
        ipi:/components/component[name]/transceiver/qsfp/state/reset-status
        ipi:/components/component[name]/transceiver/qsfp/state/power
```

```
        ipi:/components/component[name]/transceiver/qsfp/state/lane1-transmission
        ipi:/components/component[name]/transceiver/qsfp/state/lane1-transmission-loss
        ipi:/components/component[name]/transceiver/qsfp/state/lane1-recieve-loss
        ipi:/components/component[name]/transceiver/qsfp/state/lane2-transmission
        ipi:/components/component[name]/transceiver/qsfp/state/lane2-transmission-loss
        ipi:/components/component[name]/transceiver/qsfp/state/lane2-recieve-loss
        ipi:/components/component[name]/transceiver/qsfp/state/lane3-transmission
        ipi:/components/component[name]/transceiver/qsfp/state/lane3-transmission-loss
        ipi:/components/component[name]/transceiver/qsfp/state/lane3-recieve-loss
        ipi:/components/component[name]/transceiver/qsfp/state/lane4-transmission
        ipi:/components/component[name]/transceiver/qsfp/state/lane4-transmission-loss
        ipi:/components/component[name]/transceiver/qsfp/state/lane4-recieve-loss
        ipi:/components/component[name]/transceiver/qsfp/state/qsfp-identifier
        ipi:/components/component[name]/transceiver/qsfp/state/fiber-channel-qsfp-speed
        ipi:/components/component[name]/transceiver/qsfp/state/qsfp-options-implemented
```

## Transceiver Channels

```
Sensor Path
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/

Leaf Attributes
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/index
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/input-power
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/input-power-
alert-max-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/input-power-
critical-max-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/input-power-
critical-min-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/input-power-
alert-min-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/output-power
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/output-power-
alert-max-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/output-power-
critical-max-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/output-power-
critical-min-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/output-power-
alert-min-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/laser-bias-
current
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/laser-bias-
current-alert-max-treshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/laser-bias-
current-critical-max-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/laser-bias-
current-critical-min-threshold
        ipi:/components/component[name]/transceiver/channels/channel[index]/state/laser-bias-
current-alert-min-threshold
```

## Platform State

```
Sensor Path
        ipi:/components/component[name]/state/

Leaf Attributes
        ipi:/components/component[name]/state/name
        ipi:/components/component[name]/state/type
        ipi:/components/component[name]/state/location
        ipi:/components/component[name]/state/mfg-name
        ipi:/components/component[name]/state/description
        ipi:/components/component[name]/state/hardware-version
```

```
        ipi:/components/component[name]/state/firmware-version
        ipi:/components/component[name]/state/software-version
        ipi:/components/component[name]/state/serial-no
        ipi:/components/component[name]/state/part-no
        ipi:/components/component[name]/state/removable
        ipi:/components/component[name]/state/oper-status
        ipi:/components/component[name]/state/product-name
        ipi:/components/component[name]/state/asset-tag
        ipi:/components/component[name]/state/component-additional-details
        ipi:/components/component[name]/state/parent
        ipi:/components/component[name]/state/empty
```

### Platform State: Memory

```
Sensor Path
        ipi:/components/component[name]/state/memory
Leaf Attributes
        ipi:/components/component[name]/state/memory/available
        ipi:/components/component[name]/state/memory/utilized
```

### Platform State: Board FRU

```
Sensor Path
        ipi:/components/component[name]/state/board-fru
Leaf Attributes
        ipi:/components/component[name]/state/board-fru/board-name
        ipi:/components/component[name]/state/board-fru/board-serial-no
        ipi:/components/component[name]/state/board-fru/board-mfg-name
        ipi:/components/component[name]/state/board-fru/board-mfg-date
```

### Platform State: Temperature

```
Sensor Path
        ipi:/components/component[name]/state/temperature
Leaf Attributes
        ipi:/components/component[name]/state/temperature/instant
        ipi:/components/component[name]/state/temperature/min
        ipi:/components/component[name]/state/temperature/max
        ipi:/components/component[name]/state/temperature/avg
        ipi:/components/component[name]/state/temperature/interval
        ipi:/components/component[name]/state/temperature/sensor-name
        ipi:/components/component[name]/state/temperature/sensor-index
        ipi:/components/component[name]/state/temperature/alarm-status
        ipi:/components/component[name]/state/temperature/alarm-threshold
        ipi:/components/component[name]/state/temperature/alarm-severity
        ipi:/components/component[name]/state/temperature/minimum-emergency-temperature
        ipi:/components/component[name]/state/temperature/maximum-emergency-temperature
        ipi:/components/component[name]/state/temperature/minimum-alert-temperature
        ipi:/components/component[name]/state/temperature/maximum-alert-temperature
        ipi:/components/component[name]/state/temperature/minimum-critical-temperature
        ipi:/components/component[name]/state/temperature/maximum-critical-temperature
```

### Hardware Profile: State

```
Sensor Path
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-group
[group-id]/state
Leaf Attributes
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-
group/state/dedicated-entries
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-
group/state/free-entries
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-
```

```
group/state/group-id
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-
group/state/group-name
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-
group/state/shared-entries
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-
group/state/total-entries
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-
group/state/used-entries
        ipi:/profiles/hardware-profile/filters/tcam-utilization/filter-groups/filter-
group/state/used-percentage
```

### Hardware Profile: IPv4 LPM State

```
Sensor Path
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv4-lpm/state
Leaf Attributes
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv4-lpm/state/capacity
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv4-lpm/state/free
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv4-lpm/state/percentage
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv4-lpm/state/used
```

### Hardware Profile: IPv6 LPM State

```
Sensor Path
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv6-lpm/state
Leaf Attributes
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv6-lpm/state/capacity
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv6-lpm/state/free
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv6-lpm/state/percentage
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/ipv6-lpm/state/used
```

### Hardware Profile: LPM State

```
Sensor Path
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/lpm/state
Leaf Attributes
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/lpm/state/capacity
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/lpm/state/free
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/lpm/state/percentage
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/lpm/state/used
```

### Hardware Profile: MPLS Labels Pop State

```
Sensor Path
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-pop/state
Leaf Attributes
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-pop/state/capacity
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-pop/state/free
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-
pop/state/percentage
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-pop/state/used
```

### Hardware Profile: MPLS Labels Swap State

```
Sensor Path
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-pop/state
Leaf Attributes
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-pop/state/capacity
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-pop/state/free
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-
pop/state/percentage
```

```
        ipi:/profiles/forwarding-profiles/hardware-routing-limits/mpls-labels-pop/state/used
```

### Hardware L2VPN Instances: MPLS Labels Service State

```
Sensor Path
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-
limits/instances/services/service[name]/state
Leaf Attributes
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-
limits/instances/services/service[name]/state/capacity
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-
limits/instances/services/service[name]/state/free
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-
limits/instances/services/service[name]/state/name
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-
limits/instances/services/service[name]/state/percentage
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-
limits/instances/services/service[name]/state/usage
```

### Hardware L2VPN Instances: State

```
Sensor Path
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/instances/state
Leaf Attributes
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/instances/state/capacity
        ipi:profiles/hardware-profile/hardware-l2vpn-instances-limits/instances/state/free
        ipi:profiles/hardware-profile/hardware-l2vpn-instances-limits/instances/state/percentage
        ipi:profiles/hardware-profile/hardware-l2vpn-instances-limits/instances/state/usage
```

### Hardware L2VPN Instances: Multicast Group Services State

```
Sensor Path
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/service[name]/state
Leaf Attributes
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/service[name]/state/capacity
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/service[name]/state/free
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/service[name]/state/name
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/service[name]/state/percentage
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/service[name]/state/usage
```

### Hardware L2VPN Instances: Multicast Group State

```
Sensor Path
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-groups/state
Leaf Attributes
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/state/capacity
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/state/free
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/state/percentage
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/multicast-
groups/services/state/usage
```

### Hardware L2VPN Instances: VSI Service State

```
Sensor Path
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/services/service
[name]/state
Leaf Attributes
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/services/service
[name]/state/capacity
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/services/service
[name]/state/free
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/services/service
[name]/state/name
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/services/service
[name]/state/percentage
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/services/service
[name]/state/usage
```

### Hardware L2VPN Instances: VSI State

```
Sensor Path
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/state
Leaf Attributes
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/state/capacity
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/state/free
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/state/percentage
        ipi:/profiles/hardware-profile/hardware-l2vpn-instances-limits/vsi/state/usage
```

# IPI-INTERFACE

## Pyang Tree: ipi-interface

```
  +--rw interfaces
     +--rw interface* [name]
        +--rw name      -> ../config/name
        +--rw config
        |  +--rw name?   string
        +--ro state
           +--ro ifindex?        uint32
           +--ro admin-status?   ipi-if-types:if_interface_admin_status_t
           +--ro oper-status?    ipi-if-types:if_interface_oper_status_t
           +--ro last-change?    yang:timeticks
           +--ro logical?        boolean
           +--ro description?    cml-data-types:cml_line_t
           +--ro vrf-name?       -> /ipi-network-instance:network-instances/network-
instance/ipi-vrf:vrf/config/vrf-name {feature-list:HAVE_VRF}?
           +--ro mtu?            uint32
           +--ro counters
              +--ro in-octets?            yang:counter64
              +--ro in-pkts?              yang:counter64
              +--ro in-unicast-pkts?      yang:counter64 {feature-list:HAVE_BROADCOM,feature-
list:HAVE_HAL,feature-list:NOT_HAVE_SWFWDR}?
              +--ro in-broadcast-pkts?    yang:counter64 {feature-list:HAVE_BROADCOM,feature-
list:HAVE_HAL,feature-list:NOT_HAVE_SWFWDR}?
              +--ro in-multicast-pkts?    yang:counter64
              +--ro in-discards?          yang:counter64
              +--ro in-errors?            yang:counter64
              +--ro in-fcs-errors?        yang:counter64 {feature-list:HAVE_BROADCOM,feature-
list:HAVE_HAL,feature-list:NOT_HAVE_SWFWDR}?
              +--ro out-octets?           yang:counter64
              +--ro out-pkts?             yang:counter64
              +--ro out-unicast-pkts?     yang:counter64 {feature-list:HAVE_BROADCOM,feature-
list:HAVE_HAL,feature-list:NOT_HAVE_SWFWDR}?
              +--ro out-broadcast-pkts?   yang:counter64 {feature-list:HAVE_BROADCOM,feature-
list:HAVE_HAL,feature-list:NOT_HAVE_SWFWDR}?
              +--ro out-multicast-pkts?   yang:counter64 {feature-list:HAVE_BROADCOM,feature-
list:HAVE_HAL,feature-list:NOT_HAVE_SWFWDR}?
              +--ro out-discards?         yang:counter64
              +--ro out-errors?           yang:counter64
              +--ro last-clear?           ipi-if-types:if_last_clear_time_t
```

## Sensor Paths: ipi-interface

### Interface State

```
Sensor Path
         ipi:/interfaces/interface[name]/state

Leaf Attributes
         ipi:/interfaces/interface[name]/state/name
         ipi:/interfaces/interface[name]/state/ifindex
         ipi:/interfaces/interface[name]/state/admin-status
         ipi:/interfaces/interface[name]/state/oper-status
         ipi:/interfaces/interface[name]/state/last-change
         ipi:/interfaces/interface[name]/state/logical
         ipi:/interfaces/interface[name]/state/description
         ipi:/interfaces/interface[name]/state/mtu
         ipi:/interfaces/interface[name]/state/vrf-name
```

## Interface Counters

```
Sensor Path
         ipi:/interfaces/interface[name]/state/counters

Leaf Attributes
         ipi:/interfaces/interface[name]/state/counters/in-octets
         ipi:/interfaces/interface[name]/state/counters/in-pkts
         ipi:/interfaces/interface[name]/state/counters/in-unicast-pkts
         ipi:/interfaces/interface[name]/state/counters/in-broadcast-pkts
         ipi:/interfaces/interface[name]/state/counters/in-multicast-pkts
         ipi:/interfaces/interface[name]/state/counters/in-discards
         ipi:/interfaces/interface[name]/state/counters/in-errors
         ipi:/interfaces/interface[name]/state/counters/in-fcs-errors
         ipi:/interfaces/interface[name]/state/counters/out-octets
         ipi:/interfaces/interface[name]/state/counters/out-pkts
         ipi:/interfaces/interface[name]/state/counters/out-unicast-pkts
         ipi:/interfaces/interface[name]/state/counters/out-broadcast-pkts
         ipi:/interfaces/interface[name]/state/counters/out-multicast-pkts
         ipi:/interfaces/interface[name]/state/counters/out-discards
         ipi:/interfaces/interface[name]/state/counters/out-errors
         ipi:/interfaces/interface[name]/state/counters/last-clear
```

## Extended Ethernet Counters

```
Sensor Path
         ipi:/interfaces/interface[name]/ethernet/state/counters/extended-ethernet-counters

Leaf Attributes
         ipi:/interfaces/interface[name]/ethernet/state/counters/extended-ethernet-
counters/receive-pkt-rate
         ipi:/interfaces/interface[name]/ethernet/state/counters/extended-ethernet-
counters/send-pkt-rate
         ipi:/interfaces/interface[name]/ethernet/state/counters/extended-ethernet-
counters/receive-bit-rate
         ipi:/interfaces/interface[name]/ethernet/state/counters/extended-ethernet-
counters/send-bit-rate
```

## Interface Ethernet State

```
Sensor Path
         ipi:/interfaces/interface[name]/ethernet/state

Leaf Attributes
         ipi:/interfaces/interface[name]/ethernet/state/negotiated-port-speed
```

# IPI-VXLAN

## Pyang Tree: ipi-vxlan

```
 +--rw vxlan {feature-list:HAVE_VXLAN}?
     +--ro tunnel* [destination-vtep-ip]
        +--ro destination-vtep-ip    -> ../state/destination-vtep-ip
        +--ro state
           +--ro destination-vtep-ip?   inet:ipv4-address
           +--ro counters
              +--ro out-bytes?     yang:counter64
              +--ro out-packets?   yang:counter64
              +--ro in-bytes?      yang:counter64
              +--ro in-packets?    yang:counter64
```

## Sensor Paths: ipi-vxlan

### VXLAN State

```
Sensor Path
         ipi:/vxlan/tunnel[destination-vtep-ip]/state/counters

Leaf Attributes
         ipi:/vxlan/tunnel[destination-vtep-ip]/state/counters/out-bytes
         ipi:/vxlan/tunnel[destination-vtep-ip]/state/counters/out-packets
         ipi:/vxlan/tunnel[destination-vtep-ip]/state/counters/in-bytes
         ipi:/vxlan/tunnel[destination-vtep-ip]/state/counters/in-packets
```

# IPI-Platform-CMIS

## Pyang Tree: ipi-platform-cmis

```
+--rw components {feature-list:HAVE_CMMD}?
     +--ro component* [name]
        +--ro name                       -> ../state/name
        +--ro state
        |  +--ro name?                            string
        |  +--ro type?                            ipi-platform-types:cmm_component_type_t
{feature-list:NOT_HAVE_TIBIT}?
        |  +--ro location?                        string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro mfg-name?                        string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro mfg-date?                        yang:date-and-time {feature-list:NOT_HAVE_
TIBIT}?
        |  +--ro description?                     string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro hardware-version?                string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro firmware-version?                string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro software-version?                string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro serial-no?                       string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro part-no?                         string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro removable?                       boolean {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro oper-status?                     ipi-platform-types:cmm_component_oper_status_t
{feature-list:NOT_HAVE_TIBIT}?
        |  +--ro product-name?                    string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro asset-tag?                       string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro component-additional-details*   string {feature-list:NOT_HAVE_TIBIT}?
        |  +--ro parent?                          -> /components/component/state/name {feature-
list:NOT_HAVE_TIBIT}?
        |  +--ro empty?                           boolean {feature-list:NOT_HAVE_TIBIT}?
        +--ro transceiver {feature-list:HAVE_CMMD,feature-list:NOT_HAVE_TIBIT}?
           +--ro state
           |  +--ro grid-spacing?              decimal64
           |  +--ro first-frequency?           decimal64
           |  +--ro last-frequency?            decimal64
           |  +--ro transceiver-temperature?   decimal64
           |  +--ro transceiver-voltage?       decimal64
           +--ro cmis-module {feature-list:HAVE_CMMD,feature-list:NOT_HAVE_TIBIT}?
              +--ro eeprom
              |  +--ro state
              |     +--ro identifier?                   ipi-platform-sff8024-types:cmm_sff8024_
identifier_t
              |     +--ro vendor-name?                  string
              |     +--ro vendor-oui?                   string
              |     +--ro part-number?                  string
              |     +--ro revision-level?               string
              |     +--ro serial-number?                string
              |     +--ro manufacturing-date?           string
              |     +--ro clei-code?                    string
              |     +--ro module-power-class?           ipi-platform-cmis-types:cmm_cmis_module_
power_class_t
              |     +--ro module-max-power?             decimal64
              |     +--ro cooling-implemented?          ipi-platform-cmis-types:cmm_cmis_yes_no_
t
              |     +--ro temperature-max?              int16
              |     +--ro temperature-min?              int16
              |     +--ro operatin-voltage-min?         decimal64
              |     +--ro optical-detector?             ipi-platform-cmis-types:cmm_cmis_
optical_detector_t
              |     +--ro rx-power-measurement?         ipi-platform-cmis-types:cmm_cmis_rx_
power_measur_t
              |     +--ro tx-disable-module-wide?       ipi-platform-cmis-types:cmm_cmis_yes_no_
t
              |     +--ro cable-assembly-link-length?   int16
              |     +--ro connector-type?               ipi-platform-sff8024-types:cmm_sff8024_
```

```
connector_type_t
               |     +--ro cca-5ghz?                     uint8
               |     +--ro cca-7ghz?                     uint8
               |     +--ro cca-12p9ghz?                  uint8
               |     +--ro cca-25p8ghz?                  uint8
               |     +--ro media-interface-technology?   ipi-platform-cmis-types:cmm_cmis_media_
intf_tech_t
               |     +--ro cmis-revision?                string
               |     +--ro memory-model?                 ipi-platform-cmis-types:cmm_cmis_memory_
model_t
               |     +--ro mci-max-speed?                ipi-platform-cmis-types:cmm_cmis_mci_
max_speed_t
               |     +--ro active-firmware-revision?     string
               |     +--ro inactive-firmware-revision?   string
               |     +--ro hardware-revision?            string
               |     +--ro media-type?                   ipi-platform-cmis-types:cmm_cmis_media_
type_t
               |     +--ro max-smf-link-length?          decimal64
               |     +--ro max-mmf-om2-link-length?      uint8
               |     +--ro max-mmf-om3-link-length?      uint16
               |     +--ro max-mmf-om4-link-length?      uint16
               |     +--ro max-mmf-om5-link-length?      uint16
               |     +--ro wavelength-nominal?           decimal64
               |     +--ro wavelength-tolerance?         decimal64
               +--ro advertisement
               |  +--ro applications
               |  |  +--ro application* [id]
               |  |     +--ro id       -> ../state/id
               |  |     +--ro state
               |  |     |  +--ro id?   uint8
               |  |     +--ro host
               |  |     |  +--ro state
               |  |     |     +--ro interface-type?           ipi-platform-cmis-types:cmm_cmis_
interface_type_t
               |  |     |     +--ro application-bitrate?      ipi-platform-cmis-types:cmm_cmis_
bit_rate_t
               |  |     |     +--ro lane-count?               uint8
               |  |     |     +--ro signal-bitrate?           ipi-platform-cmis-types:cmm_cmis_
bit_rate_t
               |  |     |     +--ro modulation-format?        ipi-platform-cmis-types:cmm_cmis_
modulation_format_t
               |  |     |     +--ro bits-per-unit-interval?   decimal64
               |  |     |     +--ro lane-assignment?          ipi-platform-cmis-types:cmm_cmis_
lane_assignment_t
               |  |     +--ro media
               |  |        +--ro state
               |  |           +--ro interface-type?           ipi-platform-cmis-types:cmm_cmis_
interface_type_t
               |  |           +--ro application-bitrate?      ipi-platform-cmis-types:cmm_cmis_
bit_rate_t
               |  |           +--ro lane-count?               uint8
               |  |           +--ro signal-bitrate?           ipi-platform-cmis-types:cmm_cmis_
bit_rate_t
               |  |           +--ro modulation-format?        ipi-platform-cmis-types:cmm_cmis_
modulation_format_t
               |  |           +--ro bits-per-unit-interval?   decimal64
               |  |           +--ro lane-assignment?          ipi-platform-cmis-types:cmm_cmis_
lane_assignment_t
               |  +--ro controls
               |  |  +--ro state
               |  |     +--ro wavelength-control?            ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |  |     +--ro tunable-transmitter?           ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |  |     +--ro tx-output-squelching-method?   ipi-platform-cmis-types:cmm_cmis_
tx_squelch_method_t
               |  |     +--ro forced-tx-output-squelching?   ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |  |     +--ro tx-output-squelching-disable?  ipi-platform-cmis-types:cmm_cmis_
```

```
yes_no_t
               |  |     +--ro tx-output-disable?              ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |  |     +--ro input-polarity-flip-tx?         ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |  |     +--ro rx-output-squelching-disable?   ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |  |     +--ro rx-output-disable?              ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |  |     +--ro output-polarity-flip-rx?        ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |  +--ro diagnostics
               |  |  +--ro module
               |  |  |  +--ro state
               |  |  |     +--ro simultaneous-host-and-media-loobpack?   ipi-platform-cmis-
types:cmm_cmis_yes_no_t
               |  |  |     +--ro report-bit-error-ratio?                 ipi-platform-cmis-
types:cmm_cmis_yes_no_t
               |  |  |     +--ro count-bits-and-errors?                  ipi-platform-cmis-
types:cmm_cmis_yes_no_t
               |  |  +--ro host
               |  |  |  +--ro state
               |  |  |     +--ro output-loopack?           ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro input-loopack?            ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro per-lane-loopack?         ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro report-input-snr?         ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro report-fec?               ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro prbs-checker-post-fec?    ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro prbs-checker-pre-fec?     ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro prbs-checker-types?       ipi-platform-cmis-types:cmm_cmis_
prbs_support_type_t
               |  |  |     +--ro prbs-generator-post-fec?  ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro prbs-generator-pre-fec?   ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |  |     +--ro prbs-generator-types?     ipi-platform-cmis-types:cmm_cmis_
prbs_support_type_t
               |  |  +--ro media
               |  |     +--ro state
               |  |        +--ro output-loopack?           ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro input-loopack?            ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro per-lane-loopack?         ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro report-input-snr?         ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro report-fec?               ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro prbs-checker-post-fec?    ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro prbs-checker-pre-fec?     ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro prbs-checker-types?       ipi-platform-cmis-types:cmm_cmis_
prbs_support_type_t
               |  |        +--ro prbs-generator-post-fec?  ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro prbs-generator-pre-fec?   ipi-platform-cmis-types:cmm_cmis_yes_
no_t
               |  |        +--ro prbs-generator-types?     ipi-platform-cmis-types:cmm_cmis_
prbs_support_type_t
               |  +--ro durations
```

```
              |  |  +--ro state
              |  |     +--ro modsel-wait-time?               uint8
              |  |     +--ro dpinit-maximun-duration?        ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro dpdeinit-maximun-duration?      ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro dptxturnon-maximum-duration?    ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro dptxturnoff-maximum-duration?   ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro modulepwrup-maximum-duration?   ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro modulepwrdn-maximum-duration?   ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro npinit-maximum-duration?        ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro npdeinit-maximum-duration?      ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro nptxturnon-maximum-duration?    ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  |     +--ro nptxturnoff-maximum-duration?   ipi-platform-cmis-types:cmm_cmis_
durations_t
              |  +--ro laser
              |  |  +--ro state
              |  |  |  +--ro supported-grids?                      ipi-platform-cmis-types:cmm_
cmis_laser_grid_support_t
              |  |  |  +--ro fine-tune-supported?                  ipi-platform-cmis-types:cmm_
cmis_yes_no_t
              |  |  |  +--ro fine-tune-resolution?                 decimal64
              |  |  |  +--ro fine-tune-low-offset?                 decimal64
              |  |  |  +--ro fine-tune-high-offset?                decimal64
              |  |  |  +--ro per-lane-programmable-output-power?   ipi-platform-cmis-types:cmm_
cmis_yes_no_t
              |  |  |  +--ro minimum-programmable-output-power?    decimal64
              |  |  |  +--ro maximum-programmable-output-power?    decimal64
              |  |  +--ro grids
              |  |     +--ro grid* [id]
              |  |        +--ro id       -> ../state/id
              |  |        +--ro state
              |  |           +--ro id?                          ipi-platform-cmis-types:cmm_
cmis_laser_grid_spacing_t
              |  |           +--ro lowest-channel-frequency?    decimal64
              |  |           +--ro highest-channel-frequency?   decimal64
              |  |           +--ro channel-count?               uint16
              |  +--ro monitoring
              |  |  +--ro module
              |  |  |  +--ro monitors
              |  |  |     +--ro monitor* [id]
              |  |  |        +--ro id       -> ../state/id
              |  |  |        +--ro state
              |  |  |           +--ro id?          ipi-platform-cmis-types:cmm_cmis_module_
monitor_id_t
              |  |  |           +--ro supported?   ipi-platform-cmis-types:cmm_cmis_yes_no_t
              |  |  +--ro host
              |  |  |  +--ro monitors
              |  |  |  |  +--ro monitor* [id]
              |  |  |  |     +--ro id       -> ../state/id
              |  |  |  |     +--ro state
              |  |  |  |        +--ro id?              ipi-platform-cmis-types:cmm_cmis_host_
monitor_id_t
              |  |  |  |        +--ro supported?       ipi-platform-cmis-types:cmm_cmis_yes_no_
t
              |  |  |  |        +--ro lanes-assigned?   ipi-platform-cmis-types:cmm_cmis_lane_
assignment_t
              |  |  |  +--ro flags
              |  |  |     +--ro flag* [id]
              |  |  |        +--ro id       -> ../state/id
              |  |  |        +--ro state
              |  |  |           +--ro id?              ipi-platform-cmis-types:cmm_cmis_host_
```

```
flag_id_t
               |  |  |           +--ro supported?        ipi-platform-cmis-types:cmm_cmis_yes_no_
t
               |  |  |           +--ro lanes-assigned?   ipi-platform-cmis-types:cmm_cmis_lane_
assignment_t
               |  |  +--ro media
               |  |     +--ro monitors
               |  |     |  +--ro monitor* [id]
               |  |     |     +--ro id       -> ../state/id
               |  |     |     +--ro state
               |  |     |        +--ro id?               ipi-platform-cmis-types:cmm_cmis_media_
monitor_id_t
               |  |     |        +--ro supported?        ipi-platform-cmis-types:cmm_cmis_yes_no_
t
               |  |     |        +--ro lanes-assigned?   ipi-platform-cmis-types:cmm_cmis_lane_
assignment_t
               |  |     +--ro flags
               |  |        +--ro flag* [id]
               |  |           +--ro id       -> ../state/id
               |  |           +--ro state
               |  |              +--ro id?               ipi-platform-cmis-types:cmm_cmis_media_
flag_id_t
               |  |              +--ro supported?        ipi-platform-cmis-types:cmm_cmis_yes_no_
t
               |  |              +--ro lanes-assigned?   ipi-platform-cmis-types:cmm_cmis_lane_
assignment_t
               |  +--ro pages
               |     +--ro state
               |        +--ro network-path-pages-supported?   ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |        +--ro vdm-pages-supported?            ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |        +--ro vdm-groups?                     ipi-platform-cmis-types:cmm_cmis_
vdm_pages_support_t
               |        +--ro diagnostics-pages-supported?    ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |        +--ro user-page-supported?            ipi-platform-cmis-types:cmm_cmis_
yes_no_t
               |        +--ro banks-per-page?                 ipi-platform-cmis-types:cmm_cmis_
bank_per_page_support_t
               +--ro module-state
               |  +--ro state
               |  |  +--ro fault-state?     ipi-platform-cmis-types:cmm_cmis_module_fault_state_t
               |  |  +--ro current-state?   ipi-platform-cmis-types:cmm_cmis_module_state_t
               |  +--ro datapaths
               |     +--ro datapath* [lane]
               |        +--ro lane     -> ../state/lane
               |        +--ro state
               |           +--ro lane?             uint8
               |           +--ro current-state?    ipi-platform-cmis-types:cmm_cmis_datapath_
states_t
               |           +--ro host-rate?        decimal64
               |           +--ro media-rate?       decimal64
               |           +--ro interface-name?   string
               +--ro module-monitors
               |  +--ro monitors
               |  |  +--ro monitor* [id]
               |  |     +--ro id       -> ../state/id
               |  |     +--ro state
               |  |        +--ro id?             ipi-platform-cmis-types:cmm_cmis_module_monitor_
id_t
               |  |        +--ro description?    string
               |  |        +--ro value?          decimal64
               |  |        +--ro high-alarm?     decimal64
               |  |        +--ro high-warning?   decimal64
               |  |        +--ro low-warning?    decimal64
               |  |        +--ro low-alarm?      decimal64
               |  +--ro monitor-alarm
```

```
              |     +--ro state
              |        +--ro alarm-id?            ipi-platform-cmis-types:cmm_cmis_module_
monitor_id_t
              |        +--ro alarm-type?          ipi-platform-cmis-types:cmm_cmis_threshold_
alarm_t
              |        +--ro current-value?       decimal64
              |        +--ro threshold-minimum?   decimal64
              |        +--ro threshold-maximum?   decimal64
              +--ro host-monitors
              |  +--ro lanes
              |     +--ro lane* [number]
              |        +--ro number           -> ../state/number
              |        +--ro state
              |        |  +--ro number?        uint8
              |        |  +--ro dp-assigned?   boolean
              |        +--ro monitors
              |        |  +--ro monitor* [id]
              |        |     +--ro id       -> ../state/id
              |        |     +--ro state
              |        |        +--ro id?             ipi-platform-cmis-types:cmm_cmis_host_
monitor_id_t
              |        |        +--ro description?    string
              |        |        +--ro value?          decimal64
              |        |        +--ro high-alarm?     decimal64
              |        |        +--ro high-warning?   decimal64
              |        |        +--ro low-warning?    decimal64
              |        |        +--ro low-alarm?      decimal64
              |        +--ro flags
              |        |  +--ro flag* [id]
              |        |     +--ro id       -> ../state/id
              |        |     +--ro state
              |        |        +--ro id?            ipi-platform-cmis-types:cmm_cmis_host_flag_
id_t
              |        |        +--ro description?   string
              |        |        +--ro value?         boolean
              |        +--ro monitor-alarm
              |        |  +--ro state
              |        |     +--ro alarm-id?            ipi-platform-cmis-types:cmm_cmis_host_
monitor_id_t
              |        |     +--ro alarm-type?          ipi-platform-cmis-types:cmm_cmis_
threshold_alarm_t
              |        |     +--ro current-value?       decimal64
              |        |     +--ro threshold-minimum?   decimal64
              |        |     +--ro threshold-maximum?   decimal64
              |        +--ro flag-alarm
              |           +--ro state
              |              +--ro alarm-id?   ipi-platform-cmis-types:cmm_cmis_host_flag_id_t
              +--ro media-monitors
                 +--ro lanes
                    +--ro lane* [number]
                       +--ro number           -> ../state/number
                       +--ro state
                       |  +--ro number?   uint8
                       +--ro monitors
                       |  +--ro monitor* [id]
                       |     +--ro id       -> ../state/id
                       |     +--ro state
                       |        +--ro id?             ipi-platform-cmis-types:cmm_cmis_media_
monitor_id_t
                       |        +--ro description?    string
                       |        +--ro value?          decimal64
                       |        +--ro high-alarm?     decimal64
                       |        +--ro high-warning?   decimal64
                       |        +--ro low-warning?    decimal64
                       |        +--ro low-alarm?      decimal64
                       +--ro flags
                       |  +--ro flag* [id]
```

```
                      |     +--ro id       -> ../state/id
                      |     +--ro state
                      |        +--ro id?            ipi-platform-cmis-types:cmm_cmis_media_
flag_id_t
                      |        +--ro description?   string
                      |        +--ro value?         boolean
                      +--ro monitor-alarm
                      |  +--ro state
                      |     +--ro alarm-id?            ipi-platform-cmis-types:cmm_cmis_media_
monitor_id_t
                      |     +--ro alarm-type?          ipi-platform-cmis-types:cmm_cmis_
threshold_alarm_t
                      |     +--ro current-value?       decimal64
                      |     +--ro threshold-minimum?   decimal64
                      |     +--ro threshold-maximum?   decimal64
                      +--ro flag-alarm
                         +--ro state
                            +--ro alarm-id?   ipi-platform-cmis-types:cmm_cmis_media_flag_id_t
```

## Sensor Paths: ipi-platform-cmis

### Transceiver EEPROM State

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/eeprom/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/identifier
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/vendor-name
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/vendor-oui
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/part-number
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/revision-level
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/serial-number
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/manufacturing-date
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/clei-code
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/module-power-class
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/module-max-power
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/cooling-
implemented
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/temperature-max
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/temperature-min
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/operatin-voltage-
min
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/optical-detector
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/rx-power-
measurement
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/tx-disable-module-
wide
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/cable-assembly-
link-length
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/connector-type
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/cca-5ghz
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/cca-7ghz
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/cca-12p9ghz
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/cca-25p8ghz
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/media-interface-
technology
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/cmis-revision
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/memory-model
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/mci-max-speed
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/active-firmware-
revision
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/inactive-firmware-
revision
```

```
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/hardware-revision
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/media-type
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/max-smf-link-
length
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/max-mmf-om2-link-
length
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/max-mmf-om3-link-
length
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/max-mmf-om4-link-
length
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/max-mmf-om5-link-
length
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/wavelength-nominal
         ipi:/components/component[name]/transceiver/cmis-module/eeprom/state/wavelength-
tolerance
```

## CMIS State

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/state

Leaf Attributes
         ipi:/components/component[name]/state/name
         ipi:/components/component[name]/state/type
         ipi:/components/component[name]/state/location
         ipi:/components/component[name]/state/description
         ipi:/components/component[name]/state/mfg-name
         ipi:/components/component[name]/state/mfg-date
         ipi:/components/component[name]/state/hardware-version
         ipi:/components/component[name]/state/firmware-version
         ipi:/components/component[name]/state/serial-no
         ipi:/components/component[name]/state/part-no
         ipi:/components/component[name]/state/removable
         ipi:/components/component[name]/state/parent
```

## Transceiver Advertisement Control

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/controls/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/forced-tx-output-squelching
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/input-polarity-flip-tx
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/output-polarity-flip-rx
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/rx-output-disable
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/rx-output-squelching-disable
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/tunable-transmitter
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/tx-output-disable
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/tx-output-squelching-disable
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/tx-output-squelching-method
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/controls/state/wavelength-control
```

## Transceiver Advertisement Diagnostics Module

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/diagnostics/module/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/module/state/count-bits-and-errors
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/module/state/report-bit-error-ratio
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/module/state/simultaneous-host-and-media-loobpack
```

## Transceiver Advertisement Diagnostics Host

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/diagnostics/host/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/input-loopack
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/output-loopack
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/per-lane-loopack
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/prbs-checker-post-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/prbs-checker-pre-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/prbs-checker-types
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/prbs-generator-post-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/prbs-generator-pre-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/prbs-generator-types
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/report-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/host/state/report-input-snr
```

## Transceiver Advertisement Diagnostics Media

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/diagnostics/media/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/input-loopack
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/output-loopack
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/per-lane-loopack
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/prbs-checker-post-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/prbs-checker-pre-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/prbs-checker-types
```

```
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/prbs-generator-post-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/prbs-generator-pre-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/report-fec
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/diagnostics/media/state/report-input-snr
```

## Transceiver Advertisement Duration

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/durations/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/durations/state/dpdeinit-maximun-duration
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/durations/state/dpinit-maximun-duration
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/durations/state/dptxturnoff-maximum-duration
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/durations/state/dptxturnon-maximum-duration
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/durations/state/modsel-wait-time
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/durations/state/modulepwrdn-maximum-duration
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/durations/state/modulepwrup-maximum-duration
```

## Transceiver Advertisement Laser

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/laser/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/laser/state/supported-grids
         ipi:/components/component[name]/transceiver/cmis-module/advertisement/laser/state/fine-
tune-high-offse
         ipi:/components/component[name]/transceiver/cmis-module/advertisement/laser/state/fine-
tune-low-offset
         ipi:/components/component[name]/transceiver/cmis-module/advertisement/laser/state/fine-
tune-resolution
         ipi:/components/component[name]/transceiver/cmis-module/advertisement/laser/state/fine-
tune-supported
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/laser/state/maximum-programmable-output-power
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/laser/state/minimum-programmable-output-power
         ipi:/components/component[name]/transceiver/cmis-module/advertisement/laser/state/per-
lane-programmable-output-power
```

## Transceiver Advertisement Laser Grid

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/laser/grids/grid[id=SPACING TYPE]/state
```

```
Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/laser/grids/grid/state/channel-count
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/laser/grids/grid/state/highest-channel-frequency
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/laser/grids/grid/state/id
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/laser/grids/grid/state/lowest-channel-frequency
```

## Transceiver Advertisement Monitoring

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/monitoring/module/monitors/monitor[id=APP Id]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/module/monitors/monitor/state/id
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/module/monitors/monitor/state/supported
```

## Transceiver Advertisement Host Monitoring

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/monitoring/host/monitors/monitor[id= APP Id]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/host/monitors/monitor/state/id
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/host/monitors/monitor/state/supported
```

## Transceiver Advertisement Host Flags Monitoring

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/monitoring/host/flags/flag[id=APP Id]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/host/flags/flag/state/id
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/host/flags/flag/state/supported
```

## Transceiver Advertisement Media Monitoring

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/monitoring/media/monitors/monitor[id=APP Id]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/media/monitors/monitor/state/id
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/media/monitors/monitor/state/supported
```

## Transceiver Advertisement Media Flags Monitoring

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/monitoring/media/flags/flag[id = APP Id]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/media/flags/flag/state/id
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/monitoring/media/flags/flag/state/supported
```

## Transceiver Advertisement Pages

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/pages/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/pages/state/banks-per-page
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/pages/state/network-path-pages-supported
         ipi:/components/component[name]/transceiver/cmis-module/advertisement/pages/state/user-
page-supported
         ipi:/components/component[name]/transceiver/cmis-module/advertisement/pages/state/vdm-
groups
         ipi:/components/component[name]/transceiver/cmis-module/advertisement/pages/state/vdm-
pages-supported
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/pages/state/diagnostics-pages-supported
```

## Transceiver Advertisement Host Application

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/applications/application[id=APP_ID]/host/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/host/state/interface-type
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/host/state/application-bitrate
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/host/state/lane-count
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/host/state/signal-bitrate
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/host/state/modulation-format
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/host/state/bits-per-unit-interval
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/host/state/lane-assignment
```

## Transceiver Advertisement Media Application

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-
module/advertisement/applications/application[id=APP_ID]/media/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/media/state/interface-type
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/media/state/application-bitrate
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/media/state/lane-count
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/media/state/signal-bitrate
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/media/state/modulation-format
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/media/state/bits-per-unit-interval
         ipi:/components/component[name]/transceiver/cmis-
module/advertisement/applications/application[id]/media/state/lane-assignment
```

## Transceiver CMIS Module State

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/module-
state/datapaths/datapath[lane=LANE_ID]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/module-state/datapaths/datapath
[lane]/state/current-state
         ipi:/components/component[name]/transceiver/cmis-module/module-state/datapaths/datapath
[lane]/state/host-rate
         ipi:/components/component[name]/transceiver/cmis-module/module-state/datapaths/datapath
[lane]/state/interface-name
         ipi:/components/component[name]/transceiver/cmis-module/module-state/datapaths/datapath
[lane]/state/lane
         ipi:/components/component[name]/transceiver/cmis-module/module-state/datapaths/datapath
[lane]/state/media-rate
```

## Transceiver CMIS Module Monitor States

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/module-
monitors/monitors/monitor[id=MONITOR_ID]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/module-
monitors/monitors/monitor[id]/state/description
         ipi:/components/component[name]/transceiver/cmis-module/module-
monitors/monitors/monitor[id]/state/high-alarm
         ipi:/components/component[name]/transceiver/cmis-module/module-
monitors/monitors/monitor[id]/state/high-warning
         ipi:/components/component[name]/transceiver/cmis-module/module-
monitors/monitors/monitor[id]/state/id
         ipi:/components/component[name]/transceiver/cmis-module/module-
monitors/monitors/monitor[id]/state/low-alarm
         ipi:/components/component[name]/transceiver/cmis-module/module-
monitors/monitors/monitor[id]/state/low-warning
         ipi:/components/component[name]/transceiver/cmis-module/module-
monitors/monitors/monitor[id]/state/value
```

## Transceiver CMIS Module Monitor Alarms

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/module-
monitors/monitor-alarm/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/module-monitors/monitor-
alarm/state/alarm-id
         ipi:/components/component[name]/transceiver/cmis-module/module-monitors/monitor-
alarm/state/alarm-type
         ipi:/components/component[name]/transceiver/cmis-module/module-monitors/monitor-
alarm/state/current-value
         ipi:/components/component[name]/transceiver/cmis-module/module-monitors/monitor-
alarm/state/threshold-minimum
         ipi:/components/component[name]/transceiver/cmis-module/module-monitors/monitor-
alarm/state/threshold-maximum
```

## Transceiver CMIS Host Monitor States

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/host-
monitors/lanes/lane[number=LANE_NUMBER]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/state/dp-assigned
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/state/number
```

## Transceiver CMIS Host Monitoring for Monitors

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/host-
monitors/lanes/lane[number=LANE_NUMBER]/monitors/monitor[id=MONITOR_ID]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/monitors/monitor[id]/state/description
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/monitors/monitor[id]/state/id
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/monitors/monitor[id]/state/value
```

## Transceiver CMIS Host Monitoring for Flags

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/host-
monitors/lanes/lane[number=LANE_NUMBER]/flags/flag[id=FLAG_ID]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/flags/flag[id]/state/description
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/flags/flag[id]/state/id
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/flags/flag[id]/state/value
```

## Transceiver CMIS Host Monitoring for Alarms

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/host-
monitors/lanes/lane[number=LANE_NUMBER]/monitor-alarm/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/monitor-alarm/state/alarm-id
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/monitor-alarm/state/alarm-type
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/monitor-alarm/state/current-value
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/monitor-alarm/state/threshold-minimum
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/monitor-alarm/state/threshold-maximum
```

## Transceiver CMIS Host Monitoring for Alarm Flags

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/host-
monitors/lanes/lane[number=LANE_NUMBER]/flag-alarm/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/host-monitors/lanes/lane
[number]/flag-alarm/state/alarm-id
```

## Transceiver CMIS Media Monitoring for State

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/media-
monitors/lanes/lane[number=LANE_NUMBER]/monitor/monitor[id=MONITOR_ID]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitors/monitor[id]/state/description
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitors/monitor[id]/state/high-alarm
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitors/monitor[id]/state/high-warning
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitors/monitor[id]/state/id
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitors/monitor[id]/state/low-alarm
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitors/monitor[id]/state/low-warning
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitors/monitor[id]/state/value
```

## Transceiver CMIS Media Monitoring for Flags

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/media-
monitors/lanes/lane[number=LANE_NUMBER]/flags/flag[id=FLAG_ID]/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/flags/flag[id]/state/description
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
```

```
[number]/flags/flag[id]/state/id
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/flags/flag[id]/state/value
```

## Transceiver CMIS Media Monitoring for Alarms

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/media-
monitors/lanes/lane[number=LANE_NUMBER]/monitor-alarm/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitor-alarm/state/alarm-id
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitor-alarm/state/alarm-type
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitor-alarm/state/current-value
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitor-alarm/state/threshold-minimum
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/monitor-alarm/state/threshold-maximum
```

## Transceiver CMIS Media Monitoring for Alarm Flags

```
Sensor Path
        ipi:/components/component[name=CMIS-MODULE-NAME]/transceiver/cmis-module/media-
monitors/lanes/lane[number=LANE_NUMBER]/flag-alarm/state

Leaf Attributes
         ipi:/components/component[name]/transceiver/cmis-module/media-monitors/lanes/lane
[number]/flag-alarm/state/alarm-id
```

# IPI-RIB-VRF

## Pyang Tree: ipi-rib-vrf

```
module: ipi-rib-vrf
 augment /ipi-network-instance:network-instances/ipi-network-instance:network-
instance/ipivrf:vrf:
  +--ro ribs {feature-list:HAVE_VRF,feature-list:HAVE_RIBD}?
     +--ro ipv4
     |  +--ro state
     |     +--ro counters
     |        +--ro total-routes?          yang:counter32
     |        +--ro total-routes-in-fib?   yang:counter32
     +--ro ipv6 {feature-list:HAVE_IPV6}?
        +--ro state
           +--ro counters
              +--ro total-routes?          yang:counter32
              +--ro total-routes-in-fib?   yang:counter32
 augment /ipi-network-instance:network-instances/ipi-network-instance:network-
instance/ipivrf:vrf:
  +--rw maximum-fib-routes {feature-list:HAVE_VRF,feature-list:HAVE_RIBD}?
     +--rw ipv4
     |  +--rw config!
     |  |  +--rw max-limit            uint32
     |  |  +--rw limit-action         ipi-rib-types:rib_max_route_action_t
     |  |  +--rw warning-threshold?   uint8
     |  +--ro state
     |     +--ro max-limit                uint32
     |     +--ro limit-action             ipi-rib-types:rib_max_route_action_t
     |     +--ro warning-threshold?       uint8
     |     +--ro threshold-exceeded?      boolean
     |     +--ro utilization-percentage?  uint32
     +--rw ipv6 {feature-list:HAVE_IPV6}?
        +--rw config!
        |  +--rw max-limit            uint32
        |  +--rw limit-action         ipi-rib-types:rib_max_route_action_t
        |  +--rw warning-threshold?   uint8
        +--ro state
           +--ro max-limit                uint32
           +--ro limit-action             ipi-rib-types:rib_max_route_action_t
           +--ro warning-threshold?       uint8
           +--ro threshold-exceeded?      boolean
           +--ro utilization-percentage?  uint32
```

## Sensor Paths: ipi-rib-vrf

### FIB IPv4 Routes

```
Sensor Path
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv4/state

Leaf Attributes
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv4/state/max-limit
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv4/state/limit-action
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv4/state/warning-threshold
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv4/state/threshold-exceeded
```

```
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv4/state/utilization-percentage
```

## FIB IPv6 Routes

```
Sensor Path
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv6/state

Leaf Attributes
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv6/state/max-limit
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv6/state/limit-action
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv6/state/warning-threshold
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv6/state/threshold-exceeded
         ipi:/network-instances/network-instance[instance-name instance-type]/vrf/maximum-fib-
routes/ipv6/state/utilization-percentage
```

## RIB IPv4 VRF Routes

```
Sensor Path
        ipi:/network-instances/network-instance[instance-name instance-
type]/vrf/ribs/ipv4/state/counters/

Leaf Attributes
             ipi:/network-instances/network-instance[instance-name instance-
type]/vrf/ribs/ipv4/state/counters/total-routes
             ipi:/network-instances/network-instance[instance-name instance-
type]/vrf/ribs/ipv4/state/counters/total-routes-in-fib
```

## RIB IPv6 VRF Routes

```
Sensor Path
        ipi:/network-instances/network-instance[instance-name instance-
type]/vrf/ribs/ipv6/state/counters/

Leaf Attributes
             ipi:/network-instances/network-instance[instance-name instance-
type]/vrf/ribs/ipv6/state/counters/total-routes
             ipi:/network-instances/network-instance[instance-name instance-
type]/vrf/ribs/ipv4/state/counters/total-routes-in-fib
```

# IPI-RIB

## Pyang Tree: ipi-rib

```
module: ipi-rib
  +--rw routing {feature-list:HAVE_RIBD}?
     +--rw global
        +--ro counters
           +--ro total-routes-ipv4-vrf?   yang:counter32
           +--ro total-routes-ipv6-vrf?   yang:counter32
```

## Pyang Tree: ipi-vrf

```
module: ipi-vrf
  +--rw vrf-global {feature-list:HAVE_VRF}?
     +--ro counters
        +--ro total-vrfs?   yang:counter32
```

## Sensor Paths: ipi-rib

### RIB Global Counters

```
Sensor Path
        ipi:/routing/global/counters/

Leaf Attributes
        ipi:/routing/global/counters/total-routes-ipv4-vrf
        ipi:/routing/global/counters/total-routes-ipv6-vrf
```

### VRF Global Counters

```
Sensor Path
        ipi:/vrf-global/counters

Leaf Attributes
        ipi:/vrf-global/counters/total-vrfs
```

### VRF State

```
Sensor Path
        ipi:/network-instances/:network-instance[instance-name instance-type]/vrf/state/

Leaf Attributes
         ipi:/network-instances/:network-instance[instance-name instance-type]/vrf/state/vrf-
name
```

# IPI-IS-IS

## Pyang Tree: ipi-is-is

```
module: ipi-isis
  +--rw isis {feature-list:HAVE_ISISD}?
     +--rw isis-instances
     |  +--rw isis-instance* [instance]
     |     +--rw instance               -> ../config/instance
     |     +--rw config
     |     |  +--rw instance?   string
     |     |  +--rw vrf-name    string
     |     +--ro state
     |     |  +--ro counters
     |     |  |  +--ro system-level-1-adjacency-count?   uint32
     |     |  |  +--ro system-level-2-adjacency-count?   uint32
     |     |  |  +--ro system-total-adjacency-count?     uint32
     |     |  +--ro next-global-update-level-1?   uint32
     |     |  +--ro next-global-update-level-2?   uint32
     |     |  +--ro overload?                     ipi-isis-types:isis_overload_state_t
     |     |  +--ro instance?                     string
     |     |  +--ro vrf-name                      string
     |     +--ro level-runtime* [type] {feature-list:HAVE_ISISD}?
     |     |  +--ro type     -> ../state/type
     |     |  +--ro state
     |     |     +--ro counters
     |     |     |  +--ro authentication-type-fails?                    uint32
     |     |     |  +--ro authentication-fails?                         uint32
     |     |     |  +--ro corrupted-lsps?                               uint32
     |     |     |  +--ro database-overloads?                           uint32
     |     |     |  +--ro manual-address-drop-from-areas?               uint32
     |     |     |  +--ro attempt-to-exceed-maximum-sequence-numbers?   uint32
     |     |     |  +--ro sequence-number-skips?                        uint32
     |     |     |  +--ro own-lsp-purges?                               uint32
     |     |     |  +--ro lsp-sourced?                                  uint32
     |     |     |  +--ro maximum-area-address-mismatches?              uint32
     |     |     |  +--ro id-length-mismatch?                           uint32
     |     |     |  +--ro partition-changes?                            uint32
     |     |     |  +--ro spf-runs?                                     uint32
     |     |     |  +--ro partial-route-calculation-count?              uint32
     |     |     |  +--ro lan-designated-is-changes?                    uint32
     |     |     +--ro type?            ipi-isis-types:isis_level2_t
     |     |     +--ro topology-type?   uint8
     |     +--rw network-entity-title
     |        +--ro state
     |           +--ro net*   string
     +--rw interfaces {feature-list:HAVE_ISISD}?
        +--rw interface* [name]
           +--rw name            -> ../config/name
           +--ro neighbor-lan* [system-id]
           |  +--ro system-id    -> ../state/system-id
           |  +--ro adjacency* [level]
           |  |  +--ro level    -> ../state/level
           |  |  +--ro state
           |  |     +--ro level?             ipi-isis-types:isis_level_t
           |  |     +--ro adjacency-state?   ipi-isis-types:isis_state_t
           |  +--ro state
           |     +--ro system-id?       string
           |     +--ro neighbor-snpa?   string
           |     +--ro up-time?         string
           +--rw config
           |  +--rw name?   -> /ipi-interface:interfaces/interface/name
           +--ro neighbor-P2P
              +--ro state
```

```
                +--ro adjacency-state?   ipi-isis-types:isis_state_t
                +--ro up-time?           string
                +--ro system-id?         string
                +--ro neighbor-snpa?     string
```

## Sensor Paths: ipi-is-is

### IS-IS State

```
Sensor Path
         ipi:/isis/isis-instances/isis-instance[instance]/state

Leaf Attributes
          ipi:/isis/isis-instances/isis-instance/state/next-global-update-level-1
          ipi:/isis/isis-instances/isis-instance/state/next-global-update-level-2
        /isis/isis-instances/isis-instance/state/overload
```

### IS-IS Counters

```
Sensor Path
         ipi:/isis/isis-instances/isis-instance[instance]/state/counters

Leaf Attributes
          ipi:/isis/isis-instances/isis-instance/state/counters/system-level-1-adjacency-count
          ipi:/isis/isis-instances/isis-instance/state/counters/system-level-2-adjacency-count
          ipi:/isis/isis-instances/isis-instance/state/counters/system-total-adjacency-count
```

### IS-IS LSP State

```
Sensor Path
         ipi:/isis/isis-instances/isis-instance[instance]/level-runtime[type]/state

Leaf Attributes
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime[type]/state/topology-
type
```

### IS-IS LSP Counters

```
Sensor Path
         ipi:/isis/isis-instances/isis-instance[instance]/level-runtime[type]/state/counters

Leaf Attributes
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/attempt-to-exceed-maximum-sequence-numbers
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/authentication-fails
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/authentication-type-fails
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/corrupted-lsps
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/database-overloads
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/id-length-mismatch
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/lan-designated-is-changes
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/lsp-sourced
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/manual-address-drop-from-areas
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
```

```
[type]/state/counters/maximum-area-address-mismatches
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/own-lsp-purges
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/partial-route-calculation-count
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/partition-changes
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/sequence-number-skips
          ipi:/isis/isis-instances/isis-instance[instance]/level-runtime
[type]/state/counters/spf-runs
```

## IS-IS Interface State

```
Sensor Path
         ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/state

Leaf Attributes
          ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/state/neighbor-snpa
          ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/state/system-id
          ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/state/up-time
```

## IS-IS Interface Adjacency State

```
Sensor Path
         ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/adjacency[level]/state

Leaf Attributes
          ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/adjacency
[level]/state/adjacency-state
```

## IS-IS Network Entity State

```
Sensor Path
          ipi:/isis/isis-instances/isis-instance/network-entity-title/state/

Leaf Attributes
          ipi:/isis/isis-instances/isis-instance/network-entity-title/state/net
```

## IS-IS Interface Neighbor State

```
Sensor Path
         ipi:/isis/interfaces/interface[name]/neighbor-P2P/state

Leaf Attributes
          ipi:/isis/interfaces/interface[name]/neighbor-P2P/state/up-time
          ipi:/isis/interfaces/interface[name]/neighbor-P2P/state/adjacency-state
          ipi:/isis/interfaces/interface[name]/neighbor-P2P/state/system-id
          ipi:/isis/interfaces/interface[name]/neighbor-P2P/state/neighbor-snpa
```

# IPI-BGP

## Pyang Tree: ipi-bgp

```
+--rw bgp {feature-list:HAVE_BGPD}?
   +--rw bgp-instances {feature-list:HAVE_BGPD}?
      +--rw bgp-instance* [bgp-as]
         +--rw bgp-as                -> ../config/bgp-as
         +--rw config
         |  +--rw bgp-as?   uint32
         +--rw peer-groups {feature-list:HAVE_BGPD}?
         |  +--rw peer-group* [peer-group-tag]
         |     +--rw peer-group-tag      -> ../state/peer-group-tag
         |     +--ro state
         |     |  +--ro peer-group-tag?   string
         |     +--rw address-families
         |        +--rw address-family* [afi safi]
         |           +--rw afi                -> ../state/afi
         |           +--rw safi               -> ../state/safi
         |           +--ro state
         |           |  +--ro afi?    ipi-bgp-types:bgp_afi_type_t
         |           |  +--ro safi?   ipi-bgp-types:bgp_safi_type_t
         |           +--rw maximum-prefixes
         |              +--rw maximum-prefix* [prefix-count]
         |                 +--rw prefix-count    -> ../state/prefix-count
         |                 +--ro state
         |                    +--ro prefix-count?             uint32
         |                    +--ro stop-update?              boolean
         |                    +--ro maximum-prefix-warning?   boolean
         |                    +--ro threshold-percentage?     uint8
         |                    +--ro warning-only?             boolean
         +--rw peers {feature-list:HAVE_BGPD}?
         |  +--rw peer* [peer-address]
         |     +--rw peer-address        -> ../config/peer-address
         |     +--rw config
         |     |  +--rw peer-address?    ipi-bgp-types:bgp_ip_addr_t
         |     |  +--rw peer-shutdown?   boolean
         |     +--ro state
         |     |  +--ro counters
         |     |  |  +--ro notification-in?      int32
         |     |  |  +--ro notification-out?     int32
         |     |  |  +--ro update-message-in?    int32
         |     |  |  +--ro update-message-out?   int32
         |     |  +--ro peer-address?                    ipi-bgp-types:bgp_ip_addr_t
         |     |  +--ro peer-shutdown?                   boolean
         |     |  +--ro connection-established-count?    int32
         |     |  +--ro bgp-peer-state?                  ipi-bgp-types:bgp_peer_status_t
         |     |  +--ro local-ip?                        ipi-bgp-types:bgp_ip_addr_t
         |     |  +--ro local-as?                        uint32
         |     +--rw address-families
         |        +--rw address-family* [afi safi]
         |           +--rw afi                -> ../config/afi
         |           +--rw safi               -> ../config/safi
         |           +--rw config
         |           |  +--rw afi?    ipi-bgp-types:bgp_afi_type_t
         |           |  +--rw safi?   ipi-bgp-types:bgp_safi_type_t
         |           +--ro state
         |           |  +--ro counters
         |           |  |  +--ro keepalive-in-messages?           int32
         |           |  |  +--ro keepalive-out-messages?          int32
         |           |  |  +--ro open-messages-in?                int32
         |           |  |  +--ro open-messages-out?               int32
         |           |  |  +--ro as-path-count?                   int32
         |           |  |  +--ro as-path-extended-count?          int32
```

```
            |           |  |  +--ro received-packet-count?           int32
            |           |  |  +--ro packet-in-queue?                 int32
            |           |  |  +--ro packet-out-queue?                int32
            |           |  |  +--ro sent-packet-count?               int32
            |           |  |  +--ro refresh-received-packet-count?   int32
            |           |  |  +--ro refresh-sent-packet-count?       int32
            |           |  +--ro max-paths-ibgp?                          int16
            |           |  +--ro configured-max-paths-ebgp?               int16
            |           |  +--ro max-paths-ebgp?                          int16
            |           |  +--ro configured-max-paths-ibgp?               int16
            |           |  +--ro max-paths-eibgp?                         int16
            |           |  +--ro configured-max-paths-eibgp?              int16
            |           |  +--ro community-count?                         int32
            |           |  +--ro confederation-id-check?                  boolean
            |           |  +--ro peer-and-extended-asn-capability?        ipi-bgp-types:bgp_adv_
rcv_type_t
            |           |  +--ro address-family-capability?               ipi-bgp-types:bgp_adv_
rcv_type_t
            |           |  +--ro ipv6-next-hop-global?                    inet:ipv6-address
            |           |  +--ro ipv6-next-hop-local?                     inet:ipv6-address
            |           |  +--ro remote-port?                             int32
            |           |  +--ro remote-address?                          ipi-bgp-types:bgp_
hostname_t
            |           |  +--ro local-host?                              ipi-bgp-types:bgp_
hostname_t
            |           |  +--ro ipv4-next-hop?                           inet:ipv4-address
            |           |  +--ro local-port?                              int32
            |           |  +--ro default-information-originate?           boolean
            |           |  +--ro inbound-path-policy?                     boolean
            |           |  +--ro outbound-path-policy?                    boolean
            |           |  +--ro default-originate-information-sent?      cml-data-types:cml_line_
t
            |           |  +--ro graceful-restart?                        ipi-bgp-types:bgp_adv_
rcv_type_t
            |           |  +--ro address-family-dependent-capability?     boolean
            |           |  +--ro peer-address-family-table-version?       int32
            |           |  +--ro address-family-table-version?            int32
            |           |  +--ro forward-status-preserve?                 string
            |           |  +--ro orf-type-prefix?                         cml-data-types:cml_line_
t
            |           |  +--ro orf-type-prefix-send-mode?               ipi-bgp-types:bgp_adv_
rcv_type_t
            |           |  +--ro orf-type-prefix-receive-mode?            ipi-bgp-types:bgp_adv_
rcv_type_t
            |           |  +--ro orf-type-prefix-old?                     cml-data-types:cml_line_
t
            |           |  +--ro orf-type-prefix-send-mode-old?           ipi-bgp-types:bgp_adv_
rcv_type_t
            |           |  +--ro orf-type-prefix-receive-mode-old?        ipi-bgp-types:bgp_adv_
rcv_type_t
            |           |  +--ro prefix-count?                            int32
            |           |  +--ro send-prefix-count?                       int32
            |           |  +--ro flag-shut-down?                          ipi-bgp-types:bgp_
peerflag_shutdown_t
            |           |  +--ro count?                                   int32
            |           |  +--ro notify-info?                             boolean
            |           |  +--ro notify-last-reset-time?                  string
            |           |  +--ro connection-type?                         ipi-bgp-types:bgp_
connection_type_t
            |           |  +--ro next-connection-timer?                   int32
            |           |  +--ro connection-dropped-count?                int32
            |           |  +--ro graceful-restart-status?                 string
            |           |  +--ro graceful-restart-time?                   int32
            |           |  +--ro bgp-established-up-time?                 string
            |           |  +--ro last-read-time?                          string
            |           |  +--ro link-type?                               ipi-bgp-types:bgp_link_
type_t
            |           |  +--ro ebgp-hop-away-count?                     int32
```

```
           |           |  +--ro router-id?                                inet:ipv4-address
           |           |  +--ro advertisement-interval?                   int32
           |           |  +--ro calculated-hold-time?                     int32
           |           |  +--ro calculated-keepalive?                     int32
           |           |  +--ro dynamic-capability?                       cml-data-types:cml_line_
t
           |           |  +--ro route-refresh-capability?                 ipi-bgp-types:bgp_route_
refresh_cap_type_t
           |           |  +--ro no-interface-binding?                     boolean
           |           |  +--ro additional-path-receive-capability?       string {feature-
list:HAVE_BGP_ADD_PATH}?
           |           |  +--ro additional-path-send-capability?          string {feature-
list:HAVE_BGP_ADD_PATH}?
           |           |  +--ro capability-ipv4-unicast?                  ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro capability-label-unicast?                 ipi-bgp-types:bgp_
capability_type_t {feature-list:HAVE_BGP_LU}?
           |           |  +--ro capability-ipv4-multicast?                ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro capability-vpnv4-unicast?                 ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro capability-vpnv6-unicast?                 ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro capability-rtfilter-unicast?              ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro capability-l2vpn-evpn?                    ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro capability-ipv6-unicast?                  ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro capability-ipv6-multicast?                ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro capability-ipv6-label-unicast?            ipi-bgp-types:bgp_
capability_type_t
           |           |  +--ro evpn-ad-route-count?                      uint32 {feature-
list:HAVE_BGP_EVPN}?
           |           |  +--ro evpn-mac-ip-route-count?                  uint32 {feature-
list:HAVE_BGP_EVPN}?
           |           |  +--ro evpn-inclusive-multicast-route-count?     uint32 {feature-
list:HAVE_BGP_EVPN}?
           |           |  +--ro evpn-segment-route-count?                 uint32 {feature-
list:HAVE_BGP_EVPN}?
           |           |  +--ro evpn-ip-prefix-route-count?               uint32 {feature-
list:HAVE_BGP_EVPN}?
           |           +--rw maximum-prefixes
           |              +--rw maximum-prefix* [prefix-count]
           |                 +--rw prefix-count    -> ../state/prefix-count
           |                 +--ro state
           |                    +--ro prefix-count?             uint32
           |                    +--ro stop-update?              boolean
           |                    +--ro maximum-prefix-warning?   boolean
           |                    +--ro threshold-percentage?     uint8
           |                    +--ro warning-only?             boolean
           +--rw address-family-vrfs {feature-list:HAVE_BGPD}?
              +--rw address-family-vrf* [afi safi vrf-name]
                 +--rw afi            -> ../config/afi
                 +--rw safi           -> ../config/safi
                 +--rw vrf-name       -> ../config/vrf-name
                 +--rw config
                 |  +--rw afi?                                    ipi-bgp-types:bgp_vrf_afi_type_t
                 |  +--rw safi?                                   ipi-bgp-types:bgp_vrf_safi_type_
t
                 |  +--rw vrf-name?                               string
                 |  +--rw multipath-relax?                        empty
                 |  +--rw graceful-shutdown?                      empty
                 |  +--rw graceful-shutdown-capable?              empty
                 |  +--rw graceful-shutdown-local-preference?     uint32
                 |  +--rw additional-paths-mode?                  ipi-bgp-types:bgp_additional_
path_type_t {feature-list:HAVE_BGP_ADD_PATH}?
                 |  +--rw additional-path-select-all?             empty {feature-list:HAVE_BGP_
```

```
ADD_PATH}?
                |  +--rw additional-paths-best-select-count?   uint8 {feature-list:HAVE_BGP_
ADD_PATH}?
                |  +--rw enable-pic?                           empty {feature-list:HAVE_BGP_
PIC_CORE_EDGE}?
                +--ro state
                |  +--ro afi?                                  ipi-bgp-types:bgp_vrf_afi_type_t
                |  +--ro safi?                                 ipi-bgp-types:bgp_vrf_safi_type_
t
                |  +--ro vrf-name?                             string
                |  +--ro multipath-relax?                      empty
                |  +--ro graceful-shutdown?                    empty
                |  +--ro graceful-shutdown-capable?            empty
                |  +--ro graceful-shutdown-local-preference?   uint32
                |  +--ro additional-paths-mode?                ipi-bgp-types:bgp_additional_
path_type_t {feature-list:HAVE_BGP_ADD_PATH}?
                |  +--ro additional-path-select-all?           empty {feature-list:HAVE_BGP_
ADD_PATH}?
                |  +--ro additional-paths-best-select-count?   uint8 {feature-list:HAVE_BGP_
ADD_PATH}?
                |  +--ro enable-pic?                           empty {feature-list:HAVE_BGP_
PIC_CORE_EDGE}?
                +--rw vrf-peers
                |  +--rw vrf-peer* [peer-address]
                |     +--rw peer-address        -> ../config/peer-address
                |     +--rw config
                |     |  +--rw peer-address?                      inet:ip-address
                |     |  +--rw peer-as?                           uint32
                |     |  +--rw source-identifier?                 string
                |     |  +--rw bgp-version?                       uint8
                |     |  +--rw peer-connection-interval?          uint32
                |     |  +--rw enforce-multihop?                  empty
                |     |  +--rw peer-shutdown?                     empty
                |     |  +--rw peer-shutdown-description?         cml-data-types:cml_line_t
                |     |  +--rw neighbor-passive?                  empty
                |     |  +--rw disable-capability-negotiation?    empty
                |     |  +--rw enable-dynamic-capability?         empty
                |     |  +--rw min-route-advertisement-interval?  uint32
                |     |  +--rw peer-as-origin-interval?           uint32
                |     |  +--rw neighbor-as-override?              empty
                |     |  +--rw peer-interface-name?               string {feature-list:HAVE_
VRF}?
                |     |  +--rw peer-description?                  cml-data-types:cml_line_t
                |     |  +--rw peer-restart-time?                 uint32 {feature-list:HAVE_
RESTART,feature-list:HAVE_VRF}?
                |     |  +--rw site-origin-identifier?            string {feature-list:HAVE_
VRF}?
                |     |  +--rw graceful-shut?                     empty
                |     |  +--rw graceful-shut-timer?               uint32
                |     |  +--rw enable-peer-bfd?                   empty {feature-list:HAVE_
BFD}?
                |     |  +--rw enable-peer-bfd-multihop?          empty {feature-list:HAVE_
BFD}?
                |     +--ro state
                |     |  +--ro counters
                |     |  |  +--ro notification-in?      int32
                |     |  |  +--ro notification-out?     int32
                |     |  |  +--ro update-message-in?    int32
                |     |  |  +--ro update-message-out?   int32
                |     |  +--ro connection-established-count?   int32
                |     |  +--ro error-notify-sent?              boolean
                |     |  +--ro notify-code-string?             cml-data-types:cml_line_t
                |     |  +--ro bgp-peer-state?                 ipi-bgp-types:bgp_peer_status_t
                |     +--rw maximum-prefixes
                |        +--rw maximum-prefix* [prefix-count]
                |           +--rw prefix-count    -> ../state/prefix-count
                |           +--ro state
                |              +--ro prefix-count?             uint32
```

```
                |              +--ro stop-update?              boolean
                |              +--ro maximum-prefix-warning?   boolean
                |              +--ro threshold-percentage?     uint8
                |              +--ro warning-only?             boolean
                +--rw peer-groups
                   +--rw peer-group* [peer-group-tag]
                      +--rw peer-group-tag      -> ../state/peer-group-tag
                      +--ro state
                      +--rw maximum-prefixes
                         +--rw maximum-prefix* [prefix-count]
                            +--rw prefix-count    -> ../state/prefix-count
                            +--ro state
                               +--ro prefix-count?             uint32
                               +--ro stop-update?              boolean
                               +--ro maximum-prefix-warning?   boolean
                               +--ro threshold-percentage?     uint8
                               +--ro warning-only?             boolean
```

## Sensor Paths: ipi-bgp

### BGP State

```
Sensor Path
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state

Leaf Attributes
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/connection-
established-count
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/bgp-peer-
state
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/peer-
shutdown
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/local-as
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/local-ip
```

### BGP Counters

```
Sensor Path
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/counters

Leaf Attributes
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-
address]/state/counters/notification-in
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-
address]/state/counters/notification-out
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-
address]/state/counters/update-message-in
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-
address]/state/counters/update-message-out
```

### BGP Address Family State

```
Sensor Path
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi=AFI][safi=SAFI]/state

Leaf Attributes
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/bgp-established-up-time
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/prefix-count
```

```
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/send-prefix-count
```

## BGP Address Family Counters

```
Sensor Path
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi=AFI][safi=SAFI]/state/counters

Leaf Attributes
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/keepalive-in-messages
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/keepalive-out-messages
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/open-messages-in
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/open-messages-out
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/as-path-count
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/as-path-extended-count
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/received-packet-count
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/packet-in-queue
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/packet-out-queue
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/sent-packet-count
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/refresh-received-packet-count
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/address-
families/address-family[afi][safi]/state/counters/refresh-sent-packet-count
```

## BGP Address Family VRF State

```
Sensor Path
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state

Leaf Attributes
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/address-family-table-version
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/advertisement-interval
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/bgp-peer-state
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/calculated-hold-time
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/calculated-keepalive
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/community-count
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/connection-type
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/count
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/flag-shut-down
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/graceful-restart-time
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/link-type
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/peer-address-family-table-version
```

```
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/router-id
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/send-prefix-count
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi
safi vrf-name]/vrf-peers/vrf-peer[peer-address]/state/connection-established-count
```

## BGP Address Family VRF Counters

```
Sensor Path
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters

Leaf Attributes
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/keepalive-in-messages
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/keepalive-out-messages
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/open-messages-in
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/open-messages-out
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/as-path-count
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/as-path-extended-count
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/received-packet-count
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/packet-in-queue
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/packet-out-queue
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/sent-packet-count
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/refresh-received-packet-count
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/refresh-sent-packet-count
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/notification-in
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/notification-out
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/update-message-in
         ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/address-family-vrfs/address-family-vrf[afi]
[safi][vrf-name]/vrf-peers/vrf-peer[peer-address]/state/counters/update-message-out
```

# IPI-BFD

## Pyang Tree: ipi-bfd

```
 +--rw bfd {feature-list:HAVE_BFD}?
     +--rw global
     |  +--ro state
     |     +--ro start-time?                   yang:timeticks {feature-list:HAVE_BFD_MONO}?
     |     +--ro administrative-state?         ipi-bfd-types:oambfd_admin_state_t {feature-
list:HAVE_BFD_MONO}?
     |     +--ro image-type?                   ipi-bfd-types:oambfd_image_type_t {feature-
list:HAVE_BFD_MONO}?
     |     +--ro next-session-discriminator?   string {feature-list:HAVE_BFD_MONO}?
     |     +--ro counters
     |        +--ro total-sessions?   yang:counter32
     +--rw interfaces {feature-list:HAVE_BFD}?
     |  +--rw interface* [name]
     |     +--rw name      -> ../config/name
     |     +--rw config
     |     |  +--rw name?   -> /ipi-interface:interfaces/interface/name
     |     +--ro state
     |        +--ro interface-index?   uint32
     |        +--ro interface-state?   ipi-bfd-types:oambfd_if_state_t
     +--ro sessions {feature-list:HAVE_BFD}?
        +--ro session* [local-discriminator vrf-name]
           +--ro local-discriminator    -> ../state/local-discriminator
           +--ro vrf-name               -> ../state/vrf-name
           +--ro state
           |  +--ro counters
           |  |  +--ro packets
           |  |  |  +--ro ipv4
           |  |  |  |  +--ro received?           yang:counter64
           |  |  |  |  +--ro transmitted?        yang:counter64
           |  |  |  |  +--ro echo-transmitted?   yang:counter64
           |  |  |  +--ro ipv6 {feature-list:HAVE_IPV6}?
           |  |  |     +--ro received?           yang:counter64
           |  |  |     +--ro transmitted?        yang:counter64
           |  |  |     +--ro echo-transmitted?   yang:counter64
           |  |  +--ro up-transitions?   yang:counter32
           |  +--ro lower-layer-type?                 ipi-bfd-types:oambfd_sess_lower_layer_t
           |  +--ro uptime?                           yang:timeticks
           |  +--ro version?                          uint32
           |  +--ro local-port?                       inet:port-number
           |  +--ro remote-port?                      inet:port-number
           |  +--ro negotiated-detection-multiplier?  uint8
           |  +--ro forward-hello-timer-hits?         uint32
           |  +--ro remote-heard?                     boolean
           |  +--ro fate-shared?                      boolean
           |  +--ro remote-administrative-down?       boolean
           |  +--ro remote-demand-mode-enabled?       boolean
           |  +--ro remote-echo-enabled?              boolean
           |  +--ro poll-bit?                         boolean
           |  +--ro storage-type?                     ipi-bfd-types:bfd_storage_type_t
           |  +--ro downtime?                         yang:timeticks
           |  +--ro discontinuity-time?               yang:timeticks
           |  +--ro authentication-key-id?            uint32
           |  +--ro last-up-time?                     yang:timeticks
           |  +--ro hold-down-timer?                  uint32
           |  +--ro hold-down-timer-hits?             uint32
           |  +--ro session-type-status?              ipi-bfd-types:oambfd_session_type_status_
t
           |  +--ro remote-address?                   inet:ip-address
           |  +--ro local-address?                    inet:ip-address
           |  +--ro vrf-name?                         string
```

```
           |  +--ro interface-index?                  uint32
           |  +--ro interface-name?                   string
           |  +--ro remote-discriminator?             string
           |  +--ro local-discriminator?              string
           |  +--ro session-state?                    ipi-bfd-types:oambfd_session_state_t
           |  +--ro session-type?                     ipi-bfd-types:bfd_session_type_state_t
           |  +--ro session-diagnostics?              ipi-bfd-types:oambfd_perform_diag_t
           |  +--ro negotiated-tx-interval?           uint32
           |  +--ro negotiated-rx-interval?           uint32
           +--ro micro-bfd-sessions {feature-list:HAVE_BFD_HW_OFFLOAD}?
           |  +--ro interface* [member-interface] {feature-list:HAVE_BFD_HW_OFFLOAD}?
           |     +--ro member-interface    -> ../state/member-interface
           |     +--ro state
           |        +--ro member-interface?             -> /ipi-
interface:interfaces/interface/name
           |        +--ro remote-session-state?         ipi-bfd-types:oambfd_session_state_t
           |        +--ro remote-session-diagnostics?   ipi-bfd-types:oambfd_perform_diag_t
           |        +--ro interface-index?              uint32
           |        +--ro interface-name?               string
           |        +--ro remote-discriminator?         string
           |        +--ro local-discriminator?          string
           |        +--ro session-state?                ipi-bfd-types:oambfd_session_state_t
           |        +--ro session-type?                 ipi-bfd-types:bfd_session_type_state_t
           |        +--ro session-diagnostics?          ipi-bfd-types:oambfd_perform_diag_t
           |        +--ro negotiated-tx-interval?       uint32
           |        +--ro negotiated-rx-interval?       uint32
           +--ro echo
           |  +--ro state
           |     +--ro local-echo-port?                     inet:port-number
           |     +--ro echo-desired-minimum-tx-interval?    uint32
           |     +--ro echo-required-minimum-rx-interval?   uint32
           |     +--ro negotiated-interval?                 uint32
           +--ro mpls {feature-list:HAVE_CUSTOM1_MPLS_BFD}?
           |  +--ro state {feature-list:HAVE_MPLS_OAM}?
           |  |  +--ro fec-address?            inet:ipv4-address
           |  |  +--ro lsp-type?               ipi-bfd-types:oambfd_mpls_lsp_type_t
           |  |  +--ro tunnel-name?            string
           |  |  +--ro tunnel-label?           uint32
           |  |  +--ro ftn-index?              uint32
           |  |  +--ro lsp-ping-interval?      uint32
           |  |  +--ro minimum-tx?             uint32
           |  |  +--ro minimum-rx?             uint32
           |  |  +--ro detection-multiplier?   uint8
           |  +--ro virtual-circuit-connectivity-verification
           |     +--ro state {feature-list:HAVE_VCCV}?
           |        +--ro vc-identifier?                    uint32
           |        +--ro incoming-vc-label?                uint32
           |        +--ro outgoing-vc-label?                uint32
           |        +--ro control-channel-type?             ipi-bfd-types:oambfd_mpls_cc_type_t
           |        +--ro connectivity-verification-type?   ipi-bfd-types:oambfd_mpls_cv_type_t
           |        +--ro attachment-circuit-index?         uint32
           |        +--ro tunnel-label?                     uint32
           |        +--ro peer-address?                     inet:ipv4-address
           +--ro packet
              +--ro state {feature-list:NOT_HAVE_BFD_HW_OFFLOAD}?
                 +--ro packet-version?                       uint32
                 +--ro packet-diagnostics?                   ipi-bfd-types:oambfd_perform_diag_
t
                 +--ro packet-state?                         ipi-bfd-types:oambfd_session_
state_t
                 +--ro demand-enabled?                       boolean
                 +--ro poll-sequence-initiated?              boolean
                 +--ro final-bit?                            boolean
                 +--ro detection-multiplier?                 uint8
                 +--ro length?                               uint32
                 +--ro packet-local-discriminator?           string
                 +--ro packet-remote-discriminator?          string
```

```
                +--ro packet-desired-minimum-tx-interval?    uint32
                +--ro packet-required-minimum-rx-interval?   uint32
                +--ro required-minimum-echo-rx-interval?     uint32
```

## Sensor Paths: ipi-bfd

### BFD State

```
Sensor Path
        ipi:/bfd/global/state

Leaf Attributes
             ipi:/bfd/global/state/start-time
             ipi:/bfd/global/state/administrative-state
             ipi:/bfd/global/state/image-type
             ipi:/bfd/global/state/next-session-discriminator
```

### BFD State Counters

```
Sensor Path
        ipi:/bfd/global/state/counters

Leaf Attributes
             ipi:/bfd/global/state/counters/total-sessions
```

### BFD Interface

```
Sensor Path
        ipi:/bfd/interfaces/interface[name=INTERFACE_NAME]

Leaf Attributes
             ipi:/bfd/interfaces/interface[name]/state/interface-index
             ipi:/bfd/interfaces/interface[name]/state/interface-state
```

### BFD Sessions

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-name=default]

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/vrf-name
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/local-discriminator
```

### BFD Session State

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-name=default]/state

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/lower-layer-type
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/uptime
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/version
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/local-port
```

```
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/remote-port
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/negotiated-
detection-multiplier
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/forward-hello-timer-
hits
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/remote-heard
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/fate-shared
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/remote-
administrative-down
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/remote-demand-mode-
enabled
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/remote-echo-enabled
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/poll-bit
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/storage-type
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/downtime
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/discontinuity-time
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/authentication-key-
id
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/last-uptime
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/hold-down-timer
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/hold-down-timer-hits
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/session-type-status
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/remote-address
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/local-address
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/vrf-name
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/interface-name
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/remote-discriminator
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/local-discriminator
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/session-state
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/session-type
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/session-diagnostics
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/negotiated-
detection-multiplier
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/negotiated-tx-
interval
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/negotiated-rx-
interval
```

## BFD Session State Counters

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-name=default]/state/counters

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/state/counters/up-
transitions
```

## BFD Session State Counter IPv4 Packets

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-
name=default]/state/counters/packets/ipv4

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-
name]/state/counters/packets/ipv4/received
             ipi:/bfd/sessions/session[local-discriminator][vrf-
name]/state/counters/packets/ipv4/transmitted
             ipi:/bfd/sessions/session[local-discriminator][vrf-
name]/state/counters/packets/ipv4/echo-transmitted
```

## BFD Session State Counter IPv6 Packets

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-
name=default]/state/counters/packets/ipv6

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-
name]/state/counters/packets/ipv6/received
             ipi:/bfd/sessions/session[local-discriminator][vrf-
name]/state/counters/packets/ipv6/transmitted
             ipi:/bfd/sessions/session[local-discriminator][vrf-
name]/state/counters/packets/ipv6/echo-transmitted
```

## Micro-BFD Sessions State

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-name=default]/micro-bfd-
sessions/interface[member-interface=NAME]/state

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/member-interface
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/remote-session-state
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/remote-session-diagnostics
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/interface-index
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/remote-discriminator
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/local-discriminator
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/session-state
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/session-type
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/session-diagnostics
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/negotiated-tx-interval
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/micro-bfd-
sessions/interface[member-interface]/state/negotiated-rx-interval
```

## BFD Session Echo State

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-name=default]/echo/state

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/echo/state/local-echo-port
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/echo/state/echo-desired-
minimum-tx-interval
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/echo/state/echo-required-
minimum-rx-interval
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/echo/state/negotiated-
interval
```

## BFD Session MPLS State

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-name=default]/mpls/state

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/fec-address
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/lsp-type
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/tunnel-name
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/tunnel-label
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/ftn-index
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/lsp-ping-
interval
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/minimum-tx
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/minimum-rx
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/state/detection-
multiplier
```

## BFD Session VCCV State

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-name=default]/mpls/virtual-
circuit-connectivity-verification/state

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/virtual-circuit-
connectivity-verification/state/vc-identifier
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/virtual-circuit-
connectivity-verification/state/incoming-vc-label
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/virtual-circuit-
connectivity-verification/state/outgoing-vc-label
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/virtual-circuit-
connectivity-verification/state/control-channel-type
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/virtual-circuit-
connectivity-verification/state/connectivity-verification-type
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/virtual-circuit-
connectivity-verification/state/attachment-circuit-index
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/virtual-circuit-
connectivity-verification/state/tunnel-label
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/mpls/virtual-circuit-
connectivity-verification/state/peer-address
```

## BFD Session Packet State

```
Sensor Path
        ipi:/bfd/sessions/session[local-discriminator=NAME][vrf-name=default]/packet/state/

Leaf Attributes
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/packet-
version
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/packet-
diagnostics
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/packet-state
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/demand-
enabled
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/poll-
sequence-initiated
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/final_bit
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/detection-
multiplier
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/length
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/packet-local-
discriminator
             ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/packet-
remote-discriminator
```

```
            ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/packet-
desired-minimum-tx-interval
            ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/packet-
required-minimum-rx-interval
            ipi:/bfd/sessions/session[local-discriminator][vrf-name]/packet/state/required-
minimum-echo-rx-interval
```

# IPI-LLDPv2

## Pyang Tree: ipi-lldpv2

```
+--rw lldp
   +--rw global
   |  +--ro state
   |     +--ro enable?                        empty
   |     +--ro notification-interval?         uint16 {feature-list:HAVE_SNMP}?
   |     +--ro system-capabilities-enabled?   cml-data-types:cml_line_t
   |     +--ro host-name-information?         string
   |     +--ro counters
   |        +--ro remote-inserts?   yang:counter32
   |        +--ro remote-deletes?   yang:counter32
   |        +--ro remote-drops?     yang:counter32
   |        +--ro remote-ageouts?   yang:counter32
   +--rw interfaces
      +--rw interface* [name]
         +--rw name         -> ../config/name
         +--rw config
         |  +--rw name?                -> /ipi-interface:interfaces/interface/name
         |  +--rw disable-lldp-agent?   empty
         |  +--rw agent-circuit-id?     string
         |  +--rw med-device-type?      ipi-lldp-types:lldp_meddev_t
         |  +--rw local-name?           string
         +--ro neighbors
            +--ro agent* [agent-type]
               +--ro agent-type    ipi-lldp-types:lldp_agent_t
               +--ro neighbor* [mac-address]
                  +--ro mac-address         -> ../state/mac-address
                  +--ro state
                  |  +--ro mac-address?                  cml-data-types:cml_mac_addr_t
                  |  +--ro system-name?                  string
                  |  +--ro chassis-component?            string
                  |  +--ro chassis-id-type?              uint8
                  |  +--ro port-component?               string
                  |  +--ro port-id?                      string
                  |  +--ro port-description?             string
                  |  +--ro port-sub-type?                uint16
                  |  +--ro interface-alias?              string
                  |  +--ro interface-agent-circuit-id?   string
                  |  +--ro ttl?                          uint16
                  |  +--ro interface-number?             uint32
                  |  +--ro interface-number-sub-type?    string
                  |  +--ro port-vlan-id?                 uint16
                  |  +--ro pp-vlanid?                    uint16
                  |  +--ro protocol?                     ipi-lldp-types:lldp_protoid_t
                  |  +--ro vid-usage-digest?             uint32
                  |  +--ro management-vlan?              uint16
                  |  +--ro auto-negotiation-support?     uint8
                  |  +--ro auto-negotiation-capability?  uint16
                  |  +--ro operational-mau-type?         uint16
                  |  +--ro link-aggregate-capability?    cml-data-types:cml_line_t
                  |  +--ro link-aggregate-id?            uint32
                  |  +--ro max-frame-size?               uint16
                  |  +--ro system-description?           string
                  |  +--ro system-capabilities?          cml-data-types:cml_line_t
                  |  +--ro system-capabilities-enabled?  cml-data-types:cml_line_t
                  |  +--ro vlan-list* [vlan-id]
                  |     +--ro vlan-id      uint16
                  |     +--ro vlan-name?   string
                  +--ro management-lists
                     +--ro management-list* [address]
                        +--ro address    -> ../state/address
```

```
                        +--ro state
                           +--ro address?                      string
                           +--ro address-sub-type?             cml-data-types:cml_line_t
                           +--ro interface-number-sub-type?    string
                           +--ro interface-number?             uint32
                           +--ro oid?                          string
```

## Sensor Paths: ipi-lldpv2

### LLDP State

```
Sensor Path
        ipi:/lldp/global/state/

Leaf Attributes
             ipi:/lldp/global/state/host-name-information
             ipi:/lldp/global/state/notification-interval
             ipi:/lldp/global/state/system-capabilities-enabled
             ipi:/lldp/global/state/counters*
```

### LLDP Counters

```
Sensor Path
        ipi:/lldp/global/state/counters

Leaf Attributes
             ipi:/lldp/global/state/counters/remote-ageouts
             ipi:/lldp/global/state/counters/remote-deletes
             ipi:/lldp/global/state/counters/remote-drops
             ipi:/lldp/global/state/counters/remote-inserts
```

### LLDP Interface State

```
Sensor Path
        ipi:/lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state

Leaf Attributes
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/auto-negotiation-capability
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/auto-negotiation-support
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/chassis-component
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/chassis-id-type
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/link-aggregate-capability
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/mac-address
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/management-vlan
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/max-frame-size
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/operational-mau-type
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/port-description
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/port-id
             ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/port-sub-type
```

```
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/port-vlan-id
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/pp-vlanid
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/protocol
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/system-capabilities
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/system-capabilities-enabled
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/system-description
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/system-name
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/ttl
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/vid-usage-digest
```

## LLDP Interface State VLAN

```
Sensor Path
        ipi:/lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/vlan-list[vlan-id]

Leaf Attributes
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/vlan-list[vlan-id]/vlan-id
            ipi:lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/vlan-list[vlan-id]/vlan-name
```

## LLDP Interface State Management

```
Sensor Path
        ipi:/lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/management-lists[address]/management-list/state

Leaf Attributes
        ipi:/lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/management-list[address]/address
        ipi:/lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/management-list[address]/address-sub-type
        ipi:/lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/management-list[address]/interface-number-sub-type
        ipi:/lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/management-list[address]/interface-number
        ipi:/lldp/interfaces/interface[name]/neighbors/agent[agent-type]/neighbor[mac-
address]/state/management-list[address]/oid
```

# IPI-QoS

## Pyang Tree: ipi-qos-if

```
module: ipi-qos-if

  grouping interfaces-grouping
    +-- interfaces {feature-list:HAVE_QOS}?
       +-- interface* [name]
          +-- name?             -> ../config/name
          +-- config
          |  +-- name?   -> /ipi-interface:interfaces/interface/name
          +-- service-policy
             +-- ingress
             |  +--ro class-maps-level-1
             |     +--ro class-map-level-1* [class-map-name-level-1]
             |        +--ro class-map-name-level-1?   -> ../state/class-map-name-level-1
             |        +--ro state
             |        |  +--ro class-map-name-level-1?   string
             |        |  +--ro counters
             |        |     +--ro matched-packets?       yang:counter64
             |        |     +--ro matched-octets?        yang:counter64
             |        |     +--ro transmitted-packets?   yang:counter64
             |        |     +--ro transmitted-octets?    yang:counter64
             |        |     +--ro dropped-packets?       yang:counter64
             |        |     +--ro dropped-octets?        yang:counter64
             |        +--ro class-maps-level-2
             |           +--ro class-map-level-2* [class-map-name-level-2]
             |              +--ro class-map-name-level-2?   -> ../state/class-map-name-level-2
             |              +--ro state
             |              |  +--ro class-map-name-level-2?   string
             |              |  +--ro counters
             |              |     +--ro matched-packets?       yang:counter64
             |              |     +--ro matched-octets?        yang:counter64
             |              |     +--ro transmitted-packets?   yang:counter64
             |              |     +--ro transmitted-octets?    yang:counter64
             |              |     +--ro dropped-packets?       yang:counter64
             |              |     +--ro dropped-octets?        yang:counter64
             |              +--ro class-maps-level-3
             |                 +--ro class-map-level-3* [class-map-name-level-3]
             |                    +--ro class-map-name-level-3?   -> ../state/class-map-name-
level-3
             |                    +--ro state
             |                       +--ro class-map-name-level-3?   string
             |                       +--ro counters
             |                          +--ro matched-packets?       yang:counter64
             |                          +--ro matched-octets?        yang:counter64
             |                          +--ro transmitted-packets?   yang:counter64
             |                          +--ro transmitted-octets?    yang:counter64
             |                          +--ro dropped-packets?       yang:counter64
             |                          +--ro dropped-octets?        yang:counter64
             +-- egress
                +--ro class-maps-level-1
                   +--ro class-map-level-1* [class-map-name-level-1]
                      +--ro class-map-name-level-1?   -> ../state/class-map-name-level-1
                      +--ro state
                      |  +--ro class-map-name-level-1?   string
                      |  +--ro queues
                      |     +--ro queue* [id]
                      |        +--ro id?           uint8
                      |        +--ro counters
                      |        |  +--ro total-transmitted-packets?       yang:counter64
                      |        |  +--ro total-transmitted-octets?        yang:counter64
                      |        |  +--ro total-dropped-packets?           yang:counter64
```

```
                     |        |  +--ro total-dropped-octets?           yang:counter64
                     |        |  +--ro green-transmitted-packets?      yang:counter64
                     |        |  +--ro non-green-transmitted-packets?  yang:counter64
                     |        |  +--ro green-dropped-packets?          yang:counter64
                     |        |  +--ro yellow-dropped-packets?         yang:counter64
                     |        |  +--ro red-dropped-packets?            yang:counter64
                     |        |  +--ro rate-kbps?                      decimal64
                     |        |  +--ro rate-mbps?                      decimal64
                     |        |  +--ro rate-gbps?                      decimal64
                     |        +--ro queue-size
                     |           +--ro state
                     |              +--ro max-threshold?        yang:counter64
                     |              +--ro max-threshold-type?   ipi-qos-types:qos_threshold_t
                     +--ro class-maps-level-2
                        +--ro class-map-level-2* [class-map-name-level-2]
                           +--ro class-map-name-level-2?   -> ../state/class-map-name-level-2
                           +--ro state
                           |  +--ro class-map-name-level-2?   string
                           |  +--ro queues
                           |     +--ro queue* [id]
                           |        +--ro id?           uint8
                           |        +--ro counters
                           |        |  +--ro total-transmitted-packets?       yang:counter64
                           |        |  +--ro total-transmitted-octets?        yang:counter64
                           |        |  +--ro total-dropped-packets?           yang:counter64
                           |        |  +--ro total-dropped-octets?            yang:counter64
                           |        |  +--ro green-transmitted-packets?       yang:counter64
                           |        |  +--ro non-green-transmitted-packets?   yang:counter64
                           |        |  +--ro green-dropped-packets?           yang:counter64
                           |        |  +--ro yellow-dropped-packets?          yang:counter64
                           |        |  +--ro red-dropped-packets?             yang:counter64
                           |        |  +--ro rate-kbps?                       decimal64
                           |        |  +--ro rate-mbps?                       decimal64
                           |        |  +--ro rate-gbps?                       decimal64
                           |        +--ro queue-size
                           |           +--ro state
                           |              +--ro max-threshold?        yang:counter64
                           |              +--ro max-threshold-type?   ipi-qos-types:qos_
threshold_t
                           +--ro class-maps-level-3
                              +--ro class-map-level-3* [class-map-name-level-3]
                                 +--ro class-map-name-level-3?   -> ../state/class-map-name-
level-3
                                 +--ro state
                                    +--ro class-map-name-level-3?   string
                                    +--ro queues
                                       +--ro queue* [id]
                                          +--ro id?           uint8
                                          +--ro counters
                                          |  +--ro total-transmitted-
packets?       yang:counter64
                                          |  +--ro total-transmitted-
octets?        yang:counter64
                                          |  +--ro total-dropped-
packets?           yang:counter64
                                          |  +--ro total-dropped-
octets?            yang:counter64
                                          |  +--ro green-transmitted-
packets?       yang:counter64
                                          |  +--ro non-green-transmitted-
packets?   yang:counter64
                                          |  +--ro green-dropped-
packets?           yang:counter64
                                          |  +--ro yellow-dropped-
packets?          yang:counter64
                                          |  +--ro red-dropped-
packets?             yang:counter64
                                          |  +--ro rate-kbps?                       decimal64
```

```
                                          |  +--ro rate-mbps?                       decimal64
                                          |  +--ro rate-gbps?                       decimal64
                                          +--ro queue-size
                                             +--ro state
                                                +--ro max-threshold?        yang:counter64
                                                +--ro max-threshold-type?   ipi-qos-types:qos_
threshold_t
```

### Pyang Tree: ipi-qos

```
module: ipi-qos
  +--rw qos {feature-list:HAVE_QOS}?
     +--rw global
        +--rw config
        |  +--rw enable-qos?   cml-data-types:cml_enable_disable_t
        +--ro state
           +--ro counters
              +--ro policy-entries?   yang:counter32
```

## Sensor Paths: ipi-qos

### QoS Global State Counters

```
Sensor Path
        ipi:/qos/global/state/counters

Leaf Attributes
             ipi:/qos/global/state/counters/policy-entries
```

### QoS Interface State Counters

```
Sensor Path
        ipi:/qos/interfaces/interface[name=INTERFACE_NAME]/service-policy/ingress/class-maps-
level-1/class-map-level-1[class-map-name-level-1=NAME1]/state/counters

Leaf Attributes
             ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/state/counters/matched-packets
             ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/state/counters/matched-octets
             ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/state/counters/transmitted-packets
             ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/state/counters/transmitted-octets
             ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/state/counters/dropped-packets
             ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/state/counters/dropped-octets
```

### QoS Interface Ingress Class-Map State

```
Sensor Path
        ipi:/qos/interfaces/interface[name=INTERFACE_NAME]/service-policy/ingress/class-maps-
level-1/class-map-level-1[class-map-name-level-1=NAME1]/class-maps-level-2/class-map-level-2
[class-map-name-level-2=NAME2]/state/counters

Leaf Attributes
             ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/state/counters/matched-packets
             ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
```

```
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/state/counters/matched-octets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/state/counters/transmitted-packets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/state/counters/transmitted-octets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/state/counters/dropped-packets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/state/counters/dropped-octets
```

## QoS Interface Ingress Class-Map State Counters

```
Sensor Path
        ipi:/qos/interfaces/interface[name=INTERFACE_NAME]/service-policy/ingress/class-maps-
level-1/class-map-level-1[class-map-name-level-1=NAME1]/class-maps-level-2/class-map-level-2
[class-map-name-level-2=NAME2]/class-maps-level-3/class-map-level-3[class-map-name-level-
3=NAME3]/state/counters

Leaf Attributes
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/counters/matched-
packets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/counters/matched-
octets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/counters/transmitted-
packets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/counters/transmitted-
octets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/counters/dropped-
packets
            ipi:/qos/interfaces/interface[name]/service-policy/ingress/class-maps-level-
1/class-map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-
level-2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/counters/dropped-
octets
```

## QoS Interface Egress Class-Map (Level 1) State Counters

```
Sensor Path
        ipi:/qos/interfaces/interface[name=INTERFACE_NAME]/service-policy/egress/class-maps-
level-1/class-map-level-1[class-map-name-level-1=NAME1]/state/queues/queue[id=QUEUE_ID]/counters

Leaf Attributes
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/total-transmitted-packets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/total-transmitted-octets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/total-dropped-packets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/total-dropped-octets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/green-transmitted-packtes
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
```

```
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/non-green-transmitted-
packtes
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/green-dropped-packets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/yellow-dropped-packets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/red-dropped-packets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/rate-kbps
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/rate-mbps
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/state/queues/queue[id]/counters/rate-gbps
```

## QoS Interface Egress Class-Map (Level 1-2) State Counters

```
Sensor Path
        ipi:/qos/interfaces/interface[name=INTERFACE_NAME]/service-policy/egress/class-maps-
level-1/class-map-level-1[class-map-name-level-1=NAME1]/class-maps-level-2/class-map-level-2
[class-map-name-level-2=NAME2]/state/queues/queue[id=QUEUE_ID]/counters

Leaf Attributes
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/total-transmitted-packets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/total-transmitted-octets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/total-dropped-packets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/total-dropped-octets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/green-transmitted-packtes
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/non-green-transmitted-packtes
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/green-dropped-packets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/yellow-dropped-packets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/red-dropped-packets
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/rate-kbps
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/rate-mbps
             ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/state/queues/queue[id]/counters/rate-gbps
```

## QoS Interface Egress Class-Map (Level 1-3) State Counters

```
Sensor Path
        ipi:/qos/interfaces/interface[name=INTERFACE_NAME]/service-policy/egress/class-maps-
level-1/class-map-level-1[class-map-name-level-1=NAME1]/class-maps-level-2/class-map-level-2
[class-map-name-level-2=NAME2]/class-maps-level-3/class-map-level-3[class-map-name-level-
3=NAME3]/state/queues/queue[id=QUEUE_ID]/counters
```

```
Leaf Attributes
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/total-transmitted-packets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/total-transmitted-octets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/total-dropped-packets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/total-dropped-octets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/green-transmitted-packtes
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/non-green-transmitted-packtes
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/green-dropped-packets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/yellow-dropped-packets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/red-dropped-packets
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/rate-kbps
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/rate-mbps
            ipi:/qos/interfaces/interface[name]/service-policy/egress/class-maps-level-1/class-
map-level-1[class-map-name-level-1]/class-maps-level-2/class-map-level-2[class-map-name-level-
2]/class-maps-level-3/class-map-level-3[class-map-name-level-3]state/queues/queue
[id]/counters/rate-gbps
```

# IPI-MPLS

## Pyang Tree: ipi-mpls

```
  +--rw mpls {feature-list:HAVE_MPLS}?
     +--rw interfaces
        +--rw interface* [name]
           +--rw name               -> ../config/name
           +--rw config
           |  +--rw name?   -> /ipi-interface:interfaces/interface/name
           +--ro state
           |  +--ro name?   -> /ipi-interface:interfaces/interface/name
           +--rw label-switching
              +--ro state
                 +--ro enable    boolean
```

## Sensor Paths: ipi-mpls

### MPLS Label-Switching State

```
Sensor Path
        ipi:/mpls/interfaces/interface/label-switching/state

Leaf Attributes
        ipi:/mpls/interfaces/interface/label-switching/state/enable
```

### MPLS Global State Counters

```
Sensor Path
        ipi:/mpls/global/state/counters

Leaf Attributes
        ipi:/mpls/global/state/counters/label-entries
```

# IPI-L2VPN-VPLS

## Pyang Tree: ipi-l2vpn-vpls

```
module: ipi-l2vpn-vpls
  +--rw vpls {feature-list:HAVE_VPLS,feature-list:HAVE_MPLS}?
     +--rw global
        +--ro state
           +--ro counters
              +--ro total-instances?   yang:counter32
```

## Sensor Paths: ipi-l2vpn-vpls

### L2VPN VPLS Global State Counters

```
Sensor Path
        ipi:/vpls/global/state/counters

Leaf Attributes
        ipi:/vpls/global/state/counters/total-instances
```

# IPI-L2VPN-VPWS

## Pyang Tree: ipi-l2vpn-vpws

```
module: ipi-l2vpn-vpws
  +--rw vpws {feature-list:HAVE_MPLS,feature-list:HAVE_MPLS_VC}?
     +--ro global
        +--ro state
           +--ro counters
              +--ro total-pseudowires?   uint32
```

## Sensor Paths: ipi-l2vpn-vpws

### L2VPN VPWS Global State Counters

```
Sensor Path
        ipi:/vpws/global/state/counters

Leaf Attributes
        ipi:/vpws/global/state/counters/total-pseudowires
```

# IPI-LDP

## Pyang Tree: ipi-ldp

```
  +--rw ldp {feature-list:HAVE_LDPD}?
     +--ro peers {feature-list:HAVE_LDPD}?
        +--ro peer* [peer-address]
           +--ro peer-address    -> ../state/peer-address
           +--ro state
              +--ro peer-address?    inet:ipv4-address
              +--ro session-state?   ipi-ldp-types:ldp_session_state_t
              +--ro session-role?    ipi-ldp-types:ldp_session_role_t
```

## Sensor Paths: ipi-ldp

### LDP Peers State

```
Sensor Path
        ipi:/ldp/peers/peer/state/

Leaf Attributes
        ipi:/ldp/peers/peer/state/session-state
        ipi:/ldp/peers/peer/state/session-role
```

# IPI-EVPN-MPLS

## Pyang Tree: ipi-evpn-mpls

```
module: ipi-evpn-mpls
  +--rw evpn-mpls {feature-list:HAVE_NVO,feature-list:HAVE_MPLS,feature-list:HAVE_BGP_EVPN}?
     +--rw mpls-tenants
        +--rw mpls-tenant* [tenant-identifier]
           +--rw tenant-identifier    -> ../config/tenant-identifier
           +--rw config
           |  +--rw tenant-identifier?   uint32
           |  +--rw vpws-identifier?     uint32 {feature-list:HAVE_EVPN_VPWS}?
           +--ro state
           |  +--ro tenant-identifier?   uint32
           |  +--ro vpws-identifier?     uint32 {feature-list:HAVE_EVPN_VPWS}?
           +--ro route-count-info
              +--ro state
                 +--ro mac-only?   uint32
```

## Sensor Paths: ipi-evpn-mpls

### EVPN MPLS Tenant State

```
Sensor Path
        ipi:/evpn-mpls/mpls-tenants/mpls-tenant/route-count-info/state

Leaf Attributes
        ipi:/evpn-mpls/mpls-tenants/mpls-tenant/route-count-info/state/mac-only
```

### EVPN MPLS Global State

```
Sensor Path
        ipi:/evpn-mpls/global/route-count/state

Leaf Attributes
        ipi:/evpn-mpls/global/route-count/state/max-route
        ipi:/evpn-mpls/global/route-count/state/active-route
```

# IPI-VRRP

## Pyang Tree: ipi-vrrp

```
  +--rw vrrp {feature-list:HAVE_VRRPD}?
     +--rw ipv4-instances
        +--rw ipv4-instance* [virtual-router-id]
           +--rw virtual-router-id    -> ../config/virtual-router-id
           +--rw config
           |  +--rw virtual-router-id?   uint8
           +--ro state
           |  +--ro virtual-router-id?   uint8
           +--rw interfaces
              +--rw interface* [interface-name]
                 +--rw interface-name    -> ../config/interface-name
                 +--rw config
                 |  +--rw interface-name?         -> /ipi-interface:interfaces/interface/name
                 |  +--rw disable-preempt-mode?   boolean
                 +--ro state
                 |  +--ro interface-name?         -> /ipi-interface:interfaces/interface/name
                 |  +--ro disable-preempt-mode?   boolean
                 +--ro addresses
                 |  +--ro state
                 |     +--ro operational-primary-address?   inet:ipv4-address
                 |     +--ro operational-master-address?    inet:ipv4-address
                 +--ro session-info
                 |  +--ro state
                 |     +--ro running-priority?         uint8
                 |     +--ro virtual-mac-mbyte-word?   cml-data-types:cml_mac_addr_t
                 |     +--ro administrative-state?     ipi-vrrp-types:vrrp_admin_state_t
                 |     +--ro uptime?                   string
                 +--ro session-status
                 |  +--ro state
                 |     +--ro vrrp-state?   ipi-vrrp-types:vrrp_session_state_t
                 +--ro timers
                    +--ro state
                       +--ro master-advertise-interval?   uint32
```

## Sensor Paths: ipi-vrrp

### VRRP Interface State

```
Sensor Path
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/state/


Leaf Attributes
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/state/disable-preempt-mode
```

### VRRP Session Information State

```
Sensor Path
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-info/state

Leaf Attributes
```

```
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-info/state/administrative-state
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-info/state/running-priority
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-info/state/virtual-mac-mbyte-word
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-info/state/uptime
```

## VRRP Session Status State

```
Sensor Path
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-status/state


Leaf Attributes
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-status/state/vrrp-state
```

## VRRP Timers State

```
Sensor Path
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/timers/state/

Leaf Attributes
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/timers/state/master-advertise-interval
```

## VRRP Addresses State

```
Sensor Path
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/addresses/state/

Leaf Attributes
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/addresses/state/operational-master-address
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/addresses/state/operational-primary-address
```

# IPI-IP SLA

## Pyang Tree: ipi-ip-sla

```
module: ipi-ip-sla
  +--rw ip-sla {feature-list:HAVE_IPSLA,feature-list:HAVE_BFD}?
     +--rw processes
        +--rw process* [identifier]
           +--rw identifier           -> ../config/identifier
           +--rw config
           |  +--rw identifier?   uint16
           +--ro state
           |  +--ro identifier?   uint16
           +--ro ip-sla-statistics
              +--ro state
                 +--ro destination?                string
                 +--ro packets-sent?               uint32
                 +--ro packets-received?           uint32
                 +--ro packets-lost?               decimal64
                 +--ro minimum-round-trip-delay?   uint64
                 +--ro maximum-round-trip-delay?   uint64
                 +--ro average-round-trip-delay?   uint64
```

## Sensor Paths: ipi-ip-sla

### IP SLA Statistics

```
Sensor Path
        ipi:/ip-sla/processes/process[identifier]/ip-sla-statistics/state/

Leaf Attributes
        ipi:/ip-sla/processes/process[identifier]/ip-sla-statistics/state/packets-sent
        ipi:/ip-sla/processes/process[identifier]/ip-sla-statistics/state/packets-received
        ipi:/ip-sla/processes/process[identifier]/ip-sla-statistics/state/average-round-trip-
delay
        ipi:/ip-sla/processes/process[identifier]/ip-sla-statistics/state/destination
        ipi:/ip-sla/processes/process[identifier]/ip-sla-statistics/state/packets-lost
        ipi:/ip-sla/processes/process/ip-sla-statistics/state/maximum-round-trip-delay
        ipi:/ip-sla/processes/process/ip-sla-statistics/state/minimum-round-trip-delay
```

# IPI-LAG

## Pyang Tree: ipi-lag

```
module: ipi-if-aggregate

  augment /ipi-interface:interfaces/ipi-interface:interface:
    +--rw member-aggregation {feature-list:HAVE_LACP}?
       +--ro state
          +--ro agg-type        ipi-lag-types:lag_link_agg_type_t
          +--ro aggregate-id    uint16
  augment /ipi-interface:interfaces/ipi-interface:interface:
    +--rw aggregator {feature-list:HAVE_LACP}?
       +--ro state
          +--ro agg-min-links-state?   ipi-lag-types:lag_agg_min_links_status
          +--ro agg-up-timestamp?      ipi-lag-types:lag_up_time_t
```

## Sensor Paths: ipi-lag

### LAG Interface State

```
Sensor Path
        ipi:/interfaces/interface[name]/

Leaf Attributes
        ipi:/interfaces/interface[name]/aggregator/state/agg-min-links-state
        ipi:/interfaces/interface/aggregator/state/agg-up-timestamp
        ipi:/interfaces/interface[agg-if-name]/ethernet/state/hw-mac-address
        ipi:/interfaces/interface[name]/member-aggregation/state/aggregate-id
        ipi:/interfaces/interface[name]/member-aggregation/state/agg-type
```

### LAG Interface Member State

```
Sensor Path
        ipi:/interfaces/interface/member-aggregation/state

Leaf Attributes
        ipi:/interfaces/interface/member-aggregation/state/agg-type
        ipi:/interfaces/interface/member-aggregation/state/aggregate-id
```

# IPI-VLAN

## Pyang Tree: ipi-vlan

```
module: ipi-vlan
  +--rw vlan-global {feature-list:HAVE_VLAN}?
     +--ro counters
        +--ro total-vlans?   yang:counter32
```

### Sensor Paths: ipi-vlan

#### VLAN Global Counters

```
Sensor Path
        ipi:/vlan-global/counters/total-vlans

Leaf Attributes
        ipi:/vlan-global/counters/total-vlans/total-vlans
```

# IPI-ACL

### Pyang Tree: ipi-acl

```
module: ipi-acl
  +--rw acl {feature-list:HAVE_ACL}?
     +--rw acl-sets
     |  +--rw acl-set* [name type]
     |     +--rw name            -> ../state/name
     |     +--rw type            -> ../state/type
     |     +--ro state
     |     |  +--ro name?   string
     |     |  +--ro type?   ipi-acl-types:acl_types_t
     |     +--rw acl-entries
     |     |  +--rw acl-entry* [sequence-id]
     |     |     +--rw sequence-id    -> ../state/sequence-id
     |     |     +--ro state
     |     |     |  +--ro sequence-id?   uint32
     |     |     +--rw ipv4
     |     |     |  +--ro state
     |     |     |     +--ro counters
     |     |     |     |  +--ro matched-packets?   yang:counter64
     |     |     |     +--ro forwarding-action?                ipi-acl-types:acl_forwarding_
action_t
     |     |     |     +--ro vlan-id?                          uint16
     |     |     |     +--ro monitor-action?                   ipi-acl-types:acl_monitor_
action_t {feature-list:HAVE_SFLOW,feature-list:HAVE_CUSTOM1_ACL}?
     |     |     |     +--ro source-address?                   ipi-acl-types:acl_any_ipv4_src_
addr_t
     |     |     |     +--ro destination-address?              ipi-acl-types:acl_any_ipv4_dest_
addr_t
     |     |     |     +--ro dscp?                             ipi-acl-types:acl_dscp_t
     |     |     |     +--ro precedence?                       ipi-acl-types:acl_precedence_t
     |     |     |     +--ro inner-vlan-id?                    uint16
     |     |     |     +--ro (protocol)?
     |     |     |     |  +--:(tcp)
     |     |     |     |  |  +--ro protocol-tcp?               boolean
     |     |     |     |  |  +--ro tcp-source-port?            ipi-acl-types:acl_tcp_src_port_t
     |     |     |     |  |  +--ro tcp-destination-port?       ipi-acl-types:acl_tcp_dest_port_
t
     |     |     |     |  |  +--ro tcp-flags?                  ipi-acl-types:acl_tcp_flags_t
     |     |     |     |  +--:(udp)
     |     |     |     |  |  +--ro protocol-udp?               boolean
     |     |     |     |  |  +--ro udp-source-port?            ipi-acl-types:acl_udp_src_port_t
     |     |     |     |  |  +--ro udp-destination-port?       ipi-acl-types:acl_udp_dest_port_
t
     |     |     |     |  +--:(icmp)
     |     |     |     |  |  +--ro protocol-icmp?              boolean
     |     |     |     |  |  +--ro icmp-message?               ipi-acl-types:acl_icmp_options_t
{feature-list:HAVE_CUSTOM1_ACL}?
     |     |     |     |  |  +--ro icmp-type?                  uint8 {feature-list:HAVE_
CUSTOM1_ACL}?
```

```
     |     |     |     |  |  +--ro icmp-code?                  uint8 {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     |     |  +--:(other-protocols)
     |     |     |     |     +--ro protocol-name?              ipi-acl-types:acl_ip_protocols_t
     |     |     |     +--ro source-port-operator?             ipi-acl-types:acl_src_port_
operations_t
     |     |     |     +--ro lower-source-port-in-range?       uint16
     |     |     |     +--ro upper-source-port-in-range?       uint16
     |     |     |     +--ro destination-port-operator?        ipi-acl-types:acl_dest_port_
operations_t
     |     |     |     +--ro lower-destination-port-in-range?  uint16
     |     |     |     +--ro upper-destination-port-in-range?  uint16
     |     |     |     +--ro redirect-interface-name?          string {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     |     +--ro fragments?                        boolean {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     +--rw ipv6 {feature-list:HAVE_IPV6,feature-list:HAVE_ACL}?
     |     |     |  +--ro state
     |     |     |     +--ro counters
     |     |     |     |  +--ro matched-packets?   yang:counter64
     |     |     |     +--ro forwarding-action?               ipi-acl-types:acl_forwarding_
action_t
     |     |     |     +--ro vlan-id?                         uint16
     |     |     |     +--ro monitor-action?                  ipi-acl-types:acl_monitor_
action_t {feature-list:HAVE_SFLOW,feature-list:HAVE_CUSTOM1_ACL}?
     |     |     |     +--ro source-address?                  ipi-acl-types:acl_any_ipv6_src_
addr_t
     |     |     |     +--ro destination-address?             ipi-acl-types:acl_any_ipv6_dest_
addr_t
     |     |     |     +--ro dscp?                            ipi-acl-types:acl_dscp_t
     |     |     |     +--ro inner-vlan-id?                   uint16 {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     |     +--ro flow-label?                      uint32 {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     |     +--ro (protocol)?
     |     |     |     |  +--:(tcp)
     |     |     |     |  |  +--ro protocol-tcp?             boolean
     |     |     |     |  |  +--ro tcp-source-port?          ipi-acl-types:acl_tcp_src_port_t
     |     |     |     |  |  +--ro tcp-destination-port?     ipi-acl-types:acl_tcp_dest_port_
t
     |     |     |     |  |  +--ro tcp-flags?                ipi-acl-types:acl_tcp_flags_t
{feature-list:HAVE_CUSTOM1_ACL}?
     |     |     |     |  +--:(udp)
     |     |     |     |  |  +--ro protocol-udp?             boolean
     |     |     |     |  |  +--ro udp-source-port?          ipi-acl-types:acl_udp_src_port_t
     |     |     |     |  |  +--ro udp-destination-port?     ipi-acl-types:acl_udp_dest_port_
t
     |     |     |     |  +--:(icmp)
     |     |     |     |  |  +--ro protocol-icmp?            boolean
     |     |     |     |  |  +--ro icmp-message?             ipi-acl-types:acl_icmpv6_
options_t {feature-list:HAVE_CUSTOM1_ACL}?
     |     |     |     |  |  +--ro icmp-type?                uint8 {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     |     |  |  +--ro icmp-code?                uint8 {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     |     |  +--:(sctp)
     |     |     |     |  |  +--ro protocol-sctp?            boolean
     |     |     |     |  |  +--ro sctp-source-port?         uint16
     |     |     |     |  |  +--ro sctp-destination-port?    uint16
     |     |     |     |  +--:(other-protocols)
     |     |     |     |     +--ro protocol-name?            ipi-acl-types:acl_ipv6_
protocols_t
     |     |     |     +--ro source-port-operator?           ipi-acl-types:acl_src_port_
operations_t
     |     |     |     +--ro lower-source-port-in-range?     uint16
     |     |     |     +--ro upper-source-port-in-range?     uint16
     |     |     |     +--ro destination-port-operator?      ipi-acl-types:acl_dest_port_
operations_t
```

```
     |     |     |     +--ro lower-destination-port-in-range?   uint16
     |     |     |     +--ro upper-destination-port-in-range?   uint16
     |     |     |     +--ro redirect-interface-name?           string {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     |     +--ro fragments?                         boolean {feature-list:HAVE_
CUSTOM1_ACL}?
     |     |     +--rw arp {feature-list:HAVE_ACL}?
     |     |     |  +--ro state
     |     |     |     +--ro counters
     |     |     |     |  +--ro matched-packets?   yang:counter64
     |     |     |     +--ro forwarding-action?              ipi-acl-types:acl_forwarding_
action_t
     |     |     |     +--ro vlan-id?                        uint16
     |     |     |     +--ro monitor-action?                 ipi-acl-types:acl_monitor_action_t
{feature-list:HAVE_SFLOW,feature-list:HAVE_CUSTOM1_ACL}?
     |     |     |     +--ro inner-vlan-id?                  uint16
     |     |     |     +--ro (source-mac-options)?
     |     |     |     |  +--:(any-mac)
     |     |     |     |  |  +--ro source-mac-any?           boolean
     |     |     |     |  +--:(host-mac)
     |     |     |     |  |  +--ro source-mac-host?          ipi-acl-types:acl_mac_addr_t
     |     |     |     |  +--:(mac-with-mask)
     |     |     |     |     +--ro source-mac-address?       ipi-acl-types:acl_mac_addr_t
     |     |     |     |     +--ro source-mac-mask?          ipi-acl-types:acl_mac_addr_t
     |     |     |     +--ro arp-packet-type?                ipi-acl-types:acl_arp_type_t
     |     |     |     +--ro source-ip-address?              ipi-acl-types:acl_any_ipv4_src_
addr_t
     |     |     |     +--ro destination-ip-address?         ipi-acl-types:acl_any_ipv4_dest_
addr_t
     |     |     |     +--ro (destination-mac-options)?
     |     |     |        +--:(any-mac)
     |     |     |        |  +--ro destination-mac-any?      boolean
     |     |     |        +--:(host-mac)
     |     |     |        |  +--ro destination-mac-host?     ipi-acl-types:acl_mac_addr_t
     |     |     |        +--:(mac-with-mask)
     |     |     |           +--ro destination-mac-address?  ipi-acl-types:acl_mac_addr_t
     |     |     |           +--ro destination-mac-mask?     ipi-acl-types:acl_mac_addr_t
     |     |     +--rw mac
     |     |     |  +--ro state
     |     |     |     +--ro counters
     |     |     |     |  +--ro matched-packets?   yang:counter64
     |     |     |     +--ro forwarding-action?              ipi-acl-types:acl_forwarding_
action_t
     |     |     |     +--ro vlan-id?                        uint16
     |     |     |     +--ro monitor-action?                 ipi-acl-types:acl_monitor_action_t
{feature-list:HAVE_SFLOW,feature-list:HAVE_CUSTOM1_ACL}?
     |     |     |     +--ro inner-vlan-id?                  uint16
     |     |     |     +--ro (source-mac-options)?
     |     |     |     |  +--:(any-mac)
     |     |     |     |  |  +--ro source-mac-any?           boolean
     |     |     |     |  +--:(host-mac)
     |     |     |     |  |  +--ro source-mac-host?          ipi-acl-types:acl_mac_addr_t
     |     |     |     |  +--:(mac-with-mask)
     |     |     |     |     +--ro source-mac-address?       ipi-acl-types:acl_mac_addr_t
     |     |     |     |     +--ro source-mac-mask?          ipi-acl-types:acl_mac_addr_t
     |     |     |     +--ro ethertype?                      ipi-acl-types:acl_ether_type_t
     |     |     |     +--ro arp-packet-type?                ipi-acl-types:acl_arp_packet_type_
t
     |     |     |     +--ro cos-value?                      uint8
     |     |     |     +--ro learn-disable?                  boolean {feature-list:HAVE_DNX}?
     |     |     |     +--ro (destination-mac-options)?
     |     |     |        +--:(any-mac)
     |     |     |        |  +--ro destination-mac-any?      boolean
     |     |     |        +--:(host-mac)
     |     |     |        |  +--ro destination-mac-host?     ipi-acl-types:acl_mac_addr_t
     |     |     |        +--:(mac-with-mask)
     |     |     |           +--ro destination-mac-address?  ipi-acl-types:acl_mac_addr_t
```

```
     |     |     |           +--ro destination-mac-mask?      ipi-acl-types:acl_mac_addr_t
     |     |     +--rw copp {feature-list:HAVE_COPP_FILTER}?
     |     |        +--rw ipv4
     |     |        |  +--ro state
     |     |        |     +--ro forwarding-action?                ipi-acl-types:acl_forwarding_
action_t
     |     |        |     +--ro log-action?                       uint32 {feature-list:HAVE_
SFLOW}?
     |     |        |     +--ro ttl?                              uint8
     |     |        |     +--ro ip-options?                       boolean
     |     |        |     +--ro fragments?                        boolean
     |     |        |     +--ro (protocol)?
     |     |        |     |  +--:(tcp)
     |     |        |     |  |  +--ro protocol-tcp?              boolean
     |     |        |     |  |  +--ro tcp-source-port?           ipi-acl-types:acl_tcp_src_
port_t
     |     |        |     |  |  +--ro tcp-destination-port?      ipi-acl-types:acl_tcp_dest_
port_t
     |     |        |     |  |  +--ro tcp-flags?                 ipi-acl-types:acl_tcp_flags_t
     |     |        |     |  +--:(udp)
     |     |        |     |  |  +--ro protocol-udp?              boolean
     |     |        |     |  |  +--ro udp-source-port?           ipi-acl-types:acl_udp_src_
port_t
     |     |        |     |  |  +--ro udp-destination-port?      ipi-acl-types:acl_udp_dest_
port_t
     |     |        |     |  +--:(icmp)
     |     |        |     |  |  +--ro protocol-icmp?             boolean
     |     |        |     |  |  +--ro icmp-type?                 uint8
     |     |        |     |  +--:(other-protocols)
     |     |        |     |     +--ro protocol-name?             ipi-acl-types:acl_ip_
protocols_t
     |     |        |     +--ro (source-ipv4-type)?
     |     |        |     |  +--:(source-ipv4-address-type)
     |     |        |     |  |  +--ro source-address?            ipi-acl-types:acl_any_ipv4_
src_addr_t
     |     |        |     |  +--:(source-ipv4-prefix-group-type)
     |     |        |     |     +--ro source-prefix-group?      string
     |     |        |     +--ro (destination-ipv4-type)?
     |     |        |     |  +--:(destination-ipv4-address-type)
     |     |        |     |  |  +--ro destination-address?      ipi-acl-types:acl_any_ipv4_
dest_addr_t
     |     |        |     |  +--:(destination-ipv4-prefix-group-type)
     |     |        |     |     +--ro destination-prefix-group? string
     |     |        |     +--ro source-port-operator?           ipi-acl-types:acl_copp_src_
port_operations_t
     |     |        |     +--ro destination-port-operator?      ipi-acl-types:acl_copp_dest_
port_operations_t
     |     |        |     +--ro lower-source-port-in-range?     uint16
     |     |        |     +--ro upper-source-port-in-range?     uint16
     |     |        |     +--ro lower-destination-port-in-range? uint16
     |     |        |     +--ro upper-destination-port-in-range? uint16
     |     |        +--rw ipv6 {feature-list:HAVE_IPV6}?
     |     |           +--ro state
     |     |              +--ro forwarding-action?             ipi-acl-types:acl_forwarding_
action_t
     |     |              +--ro log-action?                    uint32 {feature-list:HAVE_
SFLOW}?
     |     |              +--ro hop-limit?                     uint8
     |     |              +--ro (protocol)?
     |     |              |  +--:(tcp)
     |     |              |  |  +--ro protocol-tcp?           boolean
     |     |              |  |  +--ro tcp-source-port?        ipi-acl-types:acl_tcp_src_
port_t
     |     |              |  |  +--ro tcp-destination-port?   ipi-acl-types:acl_tcp_dest_
port_t
     |     |              |  +--:(udp)
     |     |              |  |  +--ro protocol-udp?           boolean
     |     |              |  |  +--ro udp-source-port?        ipi-acl-types:acl_udp_src_
port_t
```

```
     |     |              |  |  +--ro udp-destination-port?        ipi-acl-types:acl_udp_dest_
port_t
     |     |              |  +--:(icmp)
     |     |              |  |  +--ro protocol-icmpv6?             boolean
     |     |              |  +--:(other-protocols)
     |     |              |     +--ro protocol-name?               ipi-acl-types:acl_copp_ipv6_
protocols_t
     |     |              +--ro (source-ipv6-type)?
     |     |              |  +--:(source-ipv6-address-type)
     |     |              |  |  +--ro source-address?              ipi-acl-types:acl_copp_any_
ipv6_src_addr_t
     |     |              |  +--:(source-ipv6-prefix-group-type)
     |     |              |     +--ro source-prefix-group?         string
     |     |              +--ro (destination-ipv6-type)?
     |     |              |  +--:(destination-ipv6-address-type)
     |     |              |  |  +--ro destination-address?         ipi-acl-types:acl_copp_any_
ipv6_dest_addr_t
     |     |              |  +--:(destination-ipv6-prefix-group-type)
     |     |              |     +--ro destination-prefix-group?    string
     |     |              +--ro source-port-operator?              ipi-acl-types:acl_copp_src_
port_operations_t
     |     |              +--ro destination-port-operator?         ipi-acl-types:acl_copp_dest_
port_operations_t
     |     |              +--ro lower-source-port-in-range?        uint16
     |     |              +--ro upper-source-port-in-range?        uint16
     |     |              +--ro lower-destination-port-in-range?   uint16
     |     |              +--ro upper-destination-port-in-range?   uint16
     |     +--ro summary-info {feature-list:HAVE_ACL}?
     |        +--ro state
     |        |  +--ro counters
     |        |  |  +--ro total-acl-entries?   yang:counter32
     |        |  +--ro statistics-enabled?   empty
     |        +--ro interfaces
     |           +--ro interface* [interface-name]
     |              +--ro interface-name    -> ../state/interface-name
     |              +--ro state
     |                 +--ro interface-name?     string
     |                 +--ro filter-direction?   ipi-acl-types:acl_filter_direction_t
     |                 +--ro interface-type?     ipi-acl-types:acl_interface_type_t
     |                 +--ro interface-status?   ipi-acl-types:acl_interface_status_t
     +--ro global {feature-list:HAVE_ACL}?
        +--ro state
           +--ro counters
              +--ro total-global-acl-entries?   yang:counter32
```

## Sensor Paths: ipi-acl

### ACL ARP State

```
Sensor Path
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/arp/state/

Leaf Attributes
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/counters/matched-packets
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/arp/state/arp-
packet-type
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/destination-mac-any
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/destination-mac-host
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/destination-mac-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/destination-mac-mask
```

```
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/forwarding-action
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/inner-vlan-id
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/source-ip-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/source-mac-any
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/source-mac-host
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/source-mac-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/arp/state/source-mac-mask
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/arp/state/vlan-
id
```

## ACL CoPP IPv4 State

```
Sensor Path
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/copp/ipv4/state

Leaf Attributes
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/destination-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/destination-prefix-group
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/destination-port-operator
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/forwarding-action
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/fragments
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/ip-options
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/log-action
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/lower-destination-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/lower-source-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/protocol-tcp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/tcp-destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/tcp-flags
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/tcp-source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/protocol-udp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/udp-destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/udp-source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/icmp-type
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/protocol-icmp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/protocol-name
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/source-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/source-prefix-group
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/source-port-operator
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
```

```
id]/copp/ipv4/state/ttl
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/upper-destination-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv4/state/upper-source-port-in-range
```

## ACL CoPP IPv6 State

```
Sensor Path
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/

Leaf Attributes
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/destination-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/destination-prefix-group
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/destination-port-operator
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/forwarding-action
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/fragments
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/hop-limit
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/log-action
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/lower-destination-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/lower-source-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/protocol-tcp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/tcp-destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/tcp-source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/protocol-udp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/udp-destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/udp-source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/protocol-icmpv6
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/protocol-name
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/source-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/source-prefix-group
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/source-port-operator
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/upper-destination-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/copp/ipv6/state/upper-source-port-in-range
```

## ACL IPv4 State Counters

```
Sensor Path
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/counters

Leaf Attributes
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
```

```
id]/ipv4/state/counters/matched-packets
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/destination-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/destination-port-operator
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv4/state/dscp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/forwarding-action
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/inner-vlan-id
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/lower-destination-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/lower-source-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/precedence
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/protocol-tcp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv4/state/tcp-
destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv4/state/tcp-
flags
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv4/state/tcp-
source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/protocol-udp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv4/state/udp-
destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv4/state/udp-
source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/icmp-code
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/icmp-message
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/icmp-type
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/protocol-icmp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/protocol-name
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/source-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/source-port-operator
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/upper-destination-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/upper-source-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv4/state/vlan-id
```

## ACL IPv6 State Counters

```
Sensor Path
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv6/state

Leaf Attributes
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/counters/matched-packets
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/destination-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/destination-port-operator
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv6/state/dscp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/forwarding-action
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/lower-destination-port-in-range
```

```
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/lower-source-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/protocol-tcp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv6/state/tcp-
destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv6/state/tcp-
source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/protocol-udp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv6/state/udp-
destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/ipv6/state/udp-
source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/protocol-icmp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/protocol-sctp
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/sctp-destination-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/sctp-source-port
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/protocol-name
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/source-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/source-port-operator
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/upper-destination-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/upper-source-port-in-range
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/ipv6/state/vlan-id
```

## ACL MAC State

```
Sensor Path
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/mac/state/

Leaf Attributes
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/counters/matched-packets
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/mac/state/arp-
packet-type
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/mac/state/cos-
value
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/destination-mac-any
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/destination-mac-host
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/destination-mac-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/destination-mac-mask
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/ethertype
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/forwarding-action
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/inner-vlan-id
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/learn-disable
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/source-mac-any
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/source-mac-host
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
```

```
id]/mac/state/source-mac-address
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-
id]/mac/state/source-mac-mask
        ipi:/acl/acl-sets/acl-set[name][type]/acl-entries/acl-entry[sequence-id]/mac/state/vlan-
id
```

## ACL Summary Information

```
Sensor Path
        ipi:/acl/acl-sets/acl-set[name][type]/summary-info

Leaf Attributes
        ipi:/acl/acl-sets/acl-set[name][type]/summary-info/state/counters/total-acl-entries
        ipi:/acl/acl-sets/acl-set[name][type]/summary-info/interfaces/interface[interface-
name]/state/interface-name
        ipi:/acl/acl-sets/acl-set[name][type]/summary-info/interfaces/interface[interface-
name]/state/filter-direction
        ipi:/acl/acl-sets/acl-set[name][type]/summary-info/interfaces/interface[interface-
name]/state/interface-type
        ipi:/acl/acl-sets/acl-set[name][type]/summary-info/interfaces/interface[interface-
name]/state/interface-status
```

## ACL Global State Counters

```
Sensor Path
        ipi:/acl/global/state/counters

Leaf Attributes
        ipi:/acl/global/state/counters/total-global-acl-entries
```

# On-change Supported Sensor Paths

## IPI-VRRP

### Sensor Paths: ipi-vrrp

#### VRRP State

```
Sensor Path
        ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/
Leaf Attributes
             ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-info/state/administrative-state
             ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-status/state/vrrp-state
             ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/addresses/state/operational-master-address
             ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/addresses/state/operational-primary-address
             ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/state/disable-preempt-mode
             ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-info/state/running-priority
             ipi:/vrrp/ipv4-instances/ipv4-instance[virtual-router-id]/interfaces/interface
[interface-name]/session-info/state/virtual-mac-mbyte-word
```

## IPI-IS-IS

### Sensor Paths: ipi-isis

#### IS-IS Neighbors

```
Sensor Path
        ipi:/isis/interfaces/interface[name]/
Leaf Attributes
             ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/state/neighbor-snpa
             ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/state/system-id
             ipi:/isis/interfaces/interface[name]/neighbor-lan[system-id]/adjacency
[level]/state/adjacency-state - For brodcast interface neighbors
             ipi:/isis/interfaces/interface[name]/neighbor-P2P/state/adjacency-state
             ipi:/isis/interfaces/interface[name]/neighbor-P2P/state/system-id
             ipi:/isis/interfaces/interface[name]/neighbor-P2P/state/neighbor-snpa
             ipi/isis/interfaces/interface[name]/neighbor-P2P/state/adjacency-state - For P2P
interface neighbor
```

# IPI-BGP

## Sensor Paths: ipi-bgp

### BGP Peers

```
Sensor Path
        ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/
Leaf Attributes
             ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/peer-
shutdown
             ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/bgp-
peer-state
             ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/local-ip
             ipi:/bgp/bgp-instances/bgp-instance[bgp-as]/peers/peer[peer-address]/state/local-as
```

# IPI-Interface

## Sensor Paths: ipi-interface

### Interfaces State

```
Sensor Path
        ipi:/interfaces/interface[name]/state/
Leaf Attributes
             ipi:/interfaces/interface[name]/state/description
             ipi:/interfaces/interface[name]/state/admin-status
             ipi:/interfaces/interface[name]/state/oper-status
             ipi:/interfaces/interface[name]/state/last-change
             ipi:/interfaces/interface[name]/state/mtu
```

# IPI-Platform

## Sensor Paths: ipi-platform

### Transceiver State

```
Sensor Path
        ipi:/components/component[name]/transceiver/state/
Leaf Attributes
             ipi:/components/component[name]/transceiver/state/presense
             ipi:/components/component[name]/transceiver/state/vendor-name
             ipi:/components/component[name]/transceiver/state/type
             ipi:/components/component[name]/transceiver/state/vendor-serial-number
             ipi:/components/component[name]/transceiver/state/vendor-part-number
             ipi:/components/component[name]/transceiver/state/vendor-revision-number
             ipi:/components/component[name]/transceiver/state/vendor-manufacturing-date
```

### Platform State

```
Sensor Path
        ipi:/components/component[name]/state/
```

```
Leaf Attributes
             ipi:/components/component[name]/state/name
             ipi:/components/component[name]/state/location
             ipi:/components/component[name]/state/mfg-name
             ipi:/components/component[name]/state/mfg-date
             ipi:/components/component[name]/state/description
             ipi:/components/component[name]/state/software-version
             ipi:/components/component[name]/state/serial-no
             ipi:/components/component[name]/state/part-no
             ipi:/components/component[name]/state/oper-status
             ipi:/components/component[name]/state/product-name
             ipi:/components/component[name]/state/parent
```

### CPU State

```
Sensor Path
        ipi:/components/component[name="CPU"]/state/
Leaf Attributes
             ipi:/components/component[name="CPU"]/state/name
             ipi:/components/component[name="CPU"]/state/location
             ipi:/components/component[name="CPU"]/state/mfg-name
             ipi:/components/component[name="CPU"]/state/mfg-date
             ipi:/components/component[name="CPU"]/state/description
             ipi:/components/component[name="CPU"]/state/software-version
             ipi:/components/component[name="CPU"]/state/serial-no
             ipi:/components/component[name="CPU"]/state/part-no
             ipi:/components/component[name="CPU"]/state/oper-status
             ipi:/components/component[name="CPU"]/state/product-name
             ipi:/components/component[name="CPU"]/state/parent
```

### PSU-1 State

```
Sensor Path
        ipi:/components/component[name="PSU-1"]/state/
Leaf Attributes
             ipi:/components/component[name="PSU-1"]/state/name
             ipi:/components/component[name="PSU-1"]/state/location
             ipi:/components/component[name="PSU-1"]/state/mfg-name
             ipi:/components/component[name="PSU-1"]/state/mfg-date
             ipi:/components/component[name="PSU-1"]/state/description
             ipi:/components/component[name="PSU-1"]/state/software-version
             ipi:/components/component[name="PSU-1"]/state/serial-no
             ipi:/components/component[name="PSU-1"]/state/part-no
             ipi:/components/component[name="PSU-1"]/state/oper-status
             ipi:/components/component[name="PSU-1"]/state/product-name
             ipi:/components/component[name="PSU-1"]/state/parent
```

### RAM State

```
Sensor Path
        ipi:/components/component[name="RAM"]/state/
Leaf Attributes
             ipi:/components/component[name="RAM"]/state/name
             ipi:/components/component[name="RAM"]/state/location
             ipi:/components/component[name="RAM"]/state/mfg-name
             ipi:/components/component[name="RAM"]/state/mfg-date
             ipi:/components/component[name="RAM"]/state/description
             ipi:/components/component[name="RAM"]/state/software-version
             ipi:/components/component[name="RAM"]/state/serial-no
             ipi:/components/component[name="RAM"]/state/part-no
             ipi:/components/component[name="RAM"]/state/oper-status
             ipi:/components/component[name="RAM"]/state/product-name
             ipi:/components/component[name="RAM"]/state/parent
```

### Hard-Disk State

```
Sensor Path
        ipi:/components/component[name="HARD-DISK"]/state/
Leaf Attributes
             ipi:/components/component[name="HARD-DISK"]/state/name
             ipi:/components/component[name="HARD-DISK"]/state/location
             ipi:/components/component[name="HARD-DISK"]/state/mfg-name
             ipi:/components/component[name="HARD-DISK"]/state/mfg-date
             ipi:/components/component[name="HARD-DISK"]/state/description
             ipi:/components/component[name="HARD-DISK"]/state/software-version
             ipi:/components/component[name="HARD-DISK"]/state/serial-no
             ipi:/components/component[name="HARD-DISK"]/state/part-no
             ipi:/components/component[name="HARD-DISK"]/state/oper-status
             ipi:/components/component[name="HARD-DISK"]/state/product-name
             ipi:/components/component[name="HARD-DISK"]/state/parent
```

### Fan-1 State

```
Sensor Path
        ipi:/components/component[name="FAN-1"]/state/
Leaf Attributes
             ipi:/components/component[name="FAN-1"]/state/name
             ipi:/components/component[name="FAN-1"]/state/location
             ipi:/components/component[name="FAN-1"]/state/mfg-name
             ipi:/components/component[name="FAN-1"]/state/mfg-date
             ipi:/components/component[name="FAN-1"]/state/description
             ipi:/components/component[name="FAN-1"]/state/software-version
             ipi:/components/component[name="FAN-1"]/state/serial-no
             ipi:/components/component[name="FAN-1"]/state/part-no
             ipi:/components/component[name="FAN-1"]/state/oper-status
             ipi:/components/component[name="FAN-1"]/state/product-name
             ipi:/components/component[name="FAN-1"]/state/parent
```

### FRU State

```
Sensor Path
        ipi:/components/component[name="MAINBOARD_FRU"]/state/
Leaf Attributes
             ipi:/components/component[name="MAINBOARD_FRU"]/state/name
             ipi:/components/component[name="MAINBOARD_FRU"]/state/location
             ipi:/components/component[name="MAINBOARD_FRU"]/state/mfg-name
             ipi:/components/component[name="MAINBOARD_FRU"]/state/mfg-date
             ipi:/components/component[name="MAINBOARD_FRU"]/state/description
             ipi:/components/component[name="MAINBOARD_FRU"]/state/software-version
             ipi:/components/component[name="MAINBOARD_FRU"]/state/serial-no
             ipi:/components/component[name="MAINBOARD_FRU"]/state/part-no
             ipi:/components/component[name="MAINBOARD_FRU"]/state/oper-status
             ipi:/components/component[name="MAINBOARD_FRU"]/state/product-name
             ipi:/components/component[name="MAINBOARD_FRU"]/state/parent
```

### TEMP State

```
Sensor Path
        ipi:/components/component[name=<TEMP>]/state/
Leaf Attributes
             ipi:/components/component[name=<TEMP>]/state/name
             ipi:/components/component[name=<TEMP>]/state/location
             ipi:/components/component[name=<TEMP>]/state/mfg-name
             ipi:/components/component[name=<TEMP>]/state/mfg-date
             ipi:/components/component[name=<TEMP>]/state/description
             ipi:/components/component[name=<TEMP>]/state/software-version
             ipi:/components/component[name=<TEMP>]/state/serial-no
```

```
            ipi:/components/component[name=<TEMP>]/state/part-no
            ipi:/components/component[name=<TEMP>]/state/oper-status
            ipi:/components/component[name=<TEMP>]/state/product-name
            ipi:/components/component[name=<TEMP>]/state/parent
```

### Platform State: PSU

```
Sensor Path
        ipi:/components/component[name]/power-supply/state/
Leaf Attributes
            ipi:/components/component[name]/power-supply/state/operational-status
```

### Platform State: Temperature

```
Sensor Path
        ipi:/components/component[name]/state/temperature/
Leaf Attributes
            ipi:/components/component[name]/state/temperature/alarm-threshold
```

### Platform State: Memory

```
Sensor Path
        ipi:/components/component[name]/ram/state/
Leaf Attributes
            ipi:/components/component[name]/ram/state/total-memory
```

### Platform State: Fan

```
Sensor Path
        ipi:components/component[name]/fan/state/
Leaf Attributes
            ipi:/components/component[name]/fan/state/fan-status
```

# STREAMING TELEMETRY OPENCONFIG DATA MODELS

## Overview

Streaming telemetry incrementally supports all listed OpenConfig data models, providing standardized representations of network configurations and telemetry data.

### Telemetry OpenConfig Pyang Tree

The Pyang tree output illustrates the supported containers or leaf, along with a list of supported container-level paths.

### Container Level Sensor Paths and Leaf Attributes

Lists the container level sensor paths and leaf attributes supported for OpenConfig data models.

**Note:** For details on wildcard support, refer to the Wildcard Support in Sensor Paths (page 33) and XPath Formatting Rules for Streaming Telemetry (page 39) sections.

# OpenConfig-Platform

## Pyang Tree: openconfig-platform

```
+--rw components
   +--rw component* [name]
      +--rw name                          -> ../config/name
      +--rw config
      |  +--rw name?   string
      +--ro state
      |  +--ro name?               string
      |  +--ro id?                 string
      |  x--ro location?           string
      |  +--ro description?        string
      |  +--ro mfg-name?           string
      |  +--ro mfg-date?           oc-yang:date
      |  +--ro hardware-version?   string
      |  +--ro firmware-version?   string
      |  +--ro software-version?   string
      |  +--ro serial-no?          string
      |  +--ro part-no?            string
      |  +--ro removable?          boolean
      |  +--ro oper-status?        identityref
      |  +--ro empty?              boolean
      |  +--ro parent?             -> ../../../component/config/name
      |  +--ro temperature
      |  |  +--ro instant?           decimal64
      |  |  +--ro avg?               decimal64
      |  |  +--ro min?               decimal64
      |  |  +--ro max?               decimal64
      |  |  +--ro interval?          oc-types:stat-interval
      |  |  +--ro alarm-status?      boolean
      |  |  +--ro alarm-threshold?   decimal64
      |  |  +--ro alarm-severity?    identityref
      |  +--ro memory
      |  |  +--ro available?   uint64
      |  |  +--ro utilized?    uint64
      |  +--ro allocated-power?    decimal64
      +--rw power-supply
      |  +--ro state
      |     +--ro oc-platform-psu:enabled?          boolean
      |     +--ro oc-platform-psu:capacity?         decimal64
      |     +--ro oc-platform-psu:input-current?    decimal64
      |     +--ro oc-platform-psu:input-voltage?    decimal64
      |     +--ro oc-platform-psu:output-current?   decimal64
      |     +--ro oc-platform-psu:output-voltage?   decimal64
      |     +--ro oc-platform-psu:output-power?     decimal64
      +--rw fan
      |  +--ro state
      |     +--ro oc-fan:speed?   uint32
      +--rw cpu
      |  +--rw oc-cpu:utilization
      |     +--ro oc-cpu:state
      |        +--ro oc-cpu:instant?    decimal64
      |        +--ro oc-cpu:avg?        decimal64
      |        +--ro oc-cpu:interval?   oc-types:stat-interval
      +--rw oc-transceiver:transceiver
      |  +--ro oc-transceiver:state
      |     +--ro oc-transceiver:module-functional-type?   identityref
      |     +--ro oc-transceiver:form-factor?              identityref
      |     +--ro oc-transceiver:connector-type?           identityref
      |     +--ro oc-transceiver:vendor?                   string
      |     +--ro oc-transceiver:vendor-part?              string
      |     +--ro oc-transceiver:vendor-rev?               string
```

```
        |     +--ro oc-transceiver:serial-no?               string
        |     +--ro oc-transceiver:date-code?               string
        |     +--ro oc-transceiver:supply-voltage
        |     |  +--ro oc-transceiver:instant?   decimal64
        |     +--ro oc-transceiver:output-power
        |     |  +--ro oc-transceiver:instant?   decimal64
        |     +--ro oc-transceiver:input-power
        |     |  +--ro oc-transceiver:instant?   decimal64
        |     +--ro oc-transceiver:laser-bias-current
        |        +--ro oc-transceiver:instant?   decimal64
        +--rw oc-opt-term:optical-channel
           +--ro oc-opt-term:state
              +--ro oc-opt-term:output-power
              |  +--ro oc-opt-term:instant?   decimal64
              +--ro oc-opt-term:input-power
              |  +--ro oc-opt-term:instant?   decimal64
              +--ro oc-opt-term:laser-bias-current
                 +--ro oc-opt-term:instant?   decimal64
```

## Sensor Paths: openconfig-platform

The listed paths below represent telemetry OpenConfig paths for monitoring the platform state of various components, including CPU, RAM, power supply, fans, CMIS, and transceivers.

### CPU

```
Sensor Path
        /components/component[name]/cpu/utilization/state

Leaf Attributes
            /components/component[name]/cpu/utilization/state/avg
            /components/component[name]/cpu/utilization/state/instant
            /components/component[name]/cpu/utilization/state/interval
```

### RAM

```
Sensor Path
         /components/component[name]/state/memory/

Leaf Attributes
            /components/component[name]/state/memory/available
            /components/component[name]/state/memory/utilized
```

### Power-Supply

```
Sensor Path
         /components/component[name]/power-supply/state/

Leaf Attributes
            /components/component[name]/power-supply/state/capacity
            /components/component[name]/power-supply/state/output-power
            /components/component[name]/power-supply/state/input-voltage
            /components/component[name]/power-supply/state/input-current
            /components/component[name]/power-supply/state/output-voltage
            /components/component[name]/power-supply/state/output-current
            /components/component[name]/power-supply/state/enabled
```

## Fan

```
Sensor Path
        /components/component[name]/fan/state

Leaf Attributes
            /components/component[name]/fan/state/speed
```

## Platform State

```
Sensor Path
        /components/component[name]/state

Leaf Attributes
            /components/component[name]/state/id
            /components/component[name]/state/type
            /components/component[name]/state/location
            /components/component[name]/state/mfg-date
            /components/component[name]/state/description
            /components/component[name]/state/hardware-version
            /components/component[name]/state/firmware-version
            /components/component[name]/state/software-version
            /components/component[name]/state/serial-no
            /components/component[name]/state/part-no
            /components/component[name]/state/removable
            /components/component[name]/state/oper-status
            /components/component[name]/state/parent
            /components/component[name]/state/empty
```

### Platform State: Memory

```
Sensor Path
        /components/component[name]/state/memory

Leaf Attributes
            /components/component[name]/state/memory/available
            /components/component[name]/state/memory/utilized
```

### Platform State: Temperature

```
Sensor Path
        /components/component[name]/state/temperature

Leaf Attributes
            /components/component[name]/state/temperature/instant
            /components/component[name]/state/temperature/min
            /components/component[name]/state/temperature/max
            /components/component[name]/state/temperature/avg
            /components/component[name]/state/temperature/interval
            /components/component[name]/state/temperature/alarm-status
            /components/component[name]/state/temperature/alarm-threshold
            /components/component[name]/state/temperature/alarm-severity
```

## CMIS State

```
Sensor Paths: ipi-platform-cmisTransceiver EEPROM StateSensor Path
```

```
        openconfig:/components/component[name=CMIS-MODULE-NAME]/state

Leaf Attributes
             /components/component[name]/state/name
             /components/component[name]/state/type
             /components/component[name]/state/id
             /components/component[name]/state/description
             /components/component[name]/state/mfg-name
             /components/component[name]/state/mfg-date
             /components/component[name]/state/hardware-version
             /components/component[name]/state/firmware-version
             /components/component[name]/state/software-version
             /components/component[name]/state/serial-no
             /components/component[name]/state/part-no
             /components/component[name]/state/model-name
             /components/component[name]/state/clei-code
             /components/component[name]/state/removable
             /components/component[name]/state/oper-status
             /components/component[name]/state/empty
             /components/component[name]/state/parent
             /components/component[name]/state/last-poweroff-time
```

## CMIS Temperature

```
Sensor Paths: ipi-platform-cmisTransceiver EEPROM StateSensor Path
        openconfig:/components/component[name=CMIS-MODULE-NAME]/state/temperature

Leaf Attributes
             /components/component[name]/state/temperature/instant
```

## CMIS Transceiver State

```
Sensor Paths: ipi-platform-cmisTransceiver EEPROM StateSensor Path
        openconfig:/components/component[name=CMIS-MODULE-NAME]/transceiver/state

Leaf Attributes
             /components/component[name]/transceiver/state/form-factor
             /components/component[name]/transceiver/state/connector-type
             /components/component[name]/transceiver/state/vendor
             /components/component[name]/transceiver/state/vendor-part
             /components/component[name]/transceiver/state/vendor-rev
             /components/component[name]/transceiver/state/serial-no
             /components/component[name]/transceiver/state/date-code
             /components/component[name]/transceiver/state/module-functional-type
             /components/component[name]/transceiver/state/supply-voltage/instant
```

## CMIS Optical Channel State

```
Sensor Paths: ipi-platform-cmisTransceiver EEPROM StateSensor Path
        openconfig:/components/component[name='OCH-0/<CMIS-PORT>']/optical-channel/state

Leaf Attributes
             /components/component[name]/optical-channel/state/input-power/instant
             /components/component[name]/optical-channel/state/output-power/instant
             /components/component[name]/optical-channel/state/laser-bias-current/instant
```

# OpenConfig-Interface

## Pyang Tree: openconfig-interfaces

```
 +--rw interfaces
     +--rw interface* [name]
        +--rw name      -> ../config/name
        +--rw config
        |  +--rw name?   string
        +--ro state
           +--ro name?           string
           +--ro ifindex?        uint32
           +--ro admin-status    enumeration
           +--ro oper-status     enumeration
           +--ro last-change?    oc-types:timeticks64
           +--ro logical?        boolean
           +--ro counters
              +--ro in-octets?            oc-yang:counter64
              +--ro in-pkts?              oc-yang:counter64
              +--ro in-unicast-pkts?      oc-yang:counter64
              +--ro in-broadcast-pkts?    oc-yang:counter64
              +--ro in-multicast-pkts?    oc-yang:counter64
              +--ro in-errors?            oc-yang:counter64
              +--ro in-discards?          oc-yang:counter64
              +--ro out-octets?           oc-yang:counter64
              +--ro out-pkts?             oc-yang:counter64
              +--ro out-unicast-pkts?     oc-yang:counter64
              +--ro out-broadcast-pkts?   oc-yang:counter64
              +--ro out-multicast-pkts?   oc-yang:counter64
              +--ro out-discards?         oc-yang:counter64
              +--ro out-errors?           oc-yang:counter64
              +--ro last-clear?           oc-types:timeticks64
```

## Sensor Paths: openconfig-interface

The listed paths below represent telemetry OpenConfig paths for monitoring the interface and counters state.

### Interface State

```
Sensor Path
         /interfaces/interface[name]/state

Leaf Attributes
             /interfaces/interface[name]/state/name
             /interfaces/interface[name]/state/ifindex
             /interfaces/interface[name]/state/admin-status
             /interfaces/interface[name]/state/oper-status
             /interfaces/interface[name]/state/last-change
             /interfaces/interface[name]/state/logical
```

### Counters State

```
Sensor Path
         /interfaces/interface[name]/state/counters

Leaf Attributes
             /interfaces/interface[name]/state/counters/in-octets
             /interfaces/interface[name]/state/counters/in-pkts
```

```
/interfaces/interface[name]/state/counters/in-unicast-pkts
/interfaces/interface[name]/state/counters/in-broadcast-pkts
/interfaces/interface[name]/state/counters/in-multicast-pkts
/interfaces/interface[name]/state/counters/in-discards
/interfaces/interface[name]/state/counters/in-errors
/interfaces/interface[name]/state/counters/in-fcs-errors
/interfaces/interface[name]/state/counters/out-octets
/interfaces/interface[name]/state/counters/out-pkts
/interfaces/interface[name]/state/counters/out-unicast-pkts
/interfaces/interface[name]/state/counters/out-broadcast-pkts
/interfaces/interface[name]/state/counters/out-multicast-pkts
/interfaces/interface[name]/state/counters/out-discards
/interfaces/interface[name]/state/counters/out-errors
/interfaces/interface[name]/state/counters/last-clear
```