TARANA

BROADBAND REINVENTED

G1 Telemetry Streaming

App Note

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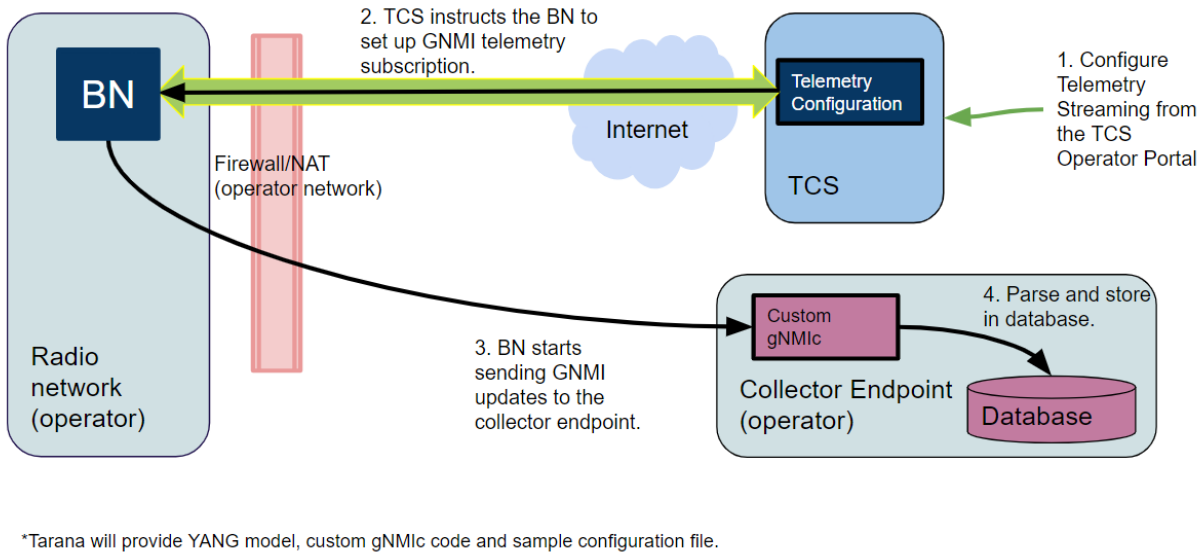
Telemetry Streaming

Tarana Cloud Suite (TCS) provides a way for companies to configure Tarana base nodes to send telemetry data directly to third-party network management systems using Google Remote Procedure Calls (gRPC) Network Management Interface (gNMI).

By default, TCS collects all telemetry data through the base node. If you have a network management system (NMS) that collects and aggregates telemetry data from multiple sources, you can configure your Tarana network to stream telemetry data directly to your aggregating NMS.

You can configure base node telemetry streaming globally, at the region level, or at the sector level. When you configure streaming globally, all base nodes in the network stream telemetry data to the Network Management Interface (NMI). When you configure streaming at the region or sector level, you configure it as an exception to the global configuration, meaning that if you activate telemetry streaming globally, all regions or sectors stream telemetry except those you specifically exclude at the region or sector level. If you deactivate telemetry streaming globally, no sectors stream telemetry data except those you specifically activate at the region or sector level.

The minimum software release for this feature is 0.997.028.00. The minimum software release for IPv6 end points is 3.207.002.00



*Tarana will provide YANG model, custom gNMIc code and sample configuration file.

Figure 1 Telemetry Using gNMI Dialout

Prerequisites for the Collector Endpoint

- The collector endpoint is a Linux server accessible by the Tarana base nodes.
- Disk/storage requirements: Provision based on the size of the network and streaming interval. Each telemetry is as follows:
  - Per base node - 40 KB
  - Per remote node - 35 KB
- Use the custom ***gNMIc*** (gNMI CLI client) source code hosted on GitHub and the accompanying ***telemetry_cfg.yaml*** file provided by Tarana. Detailed documentation for gNMIc is available at: https://gnmic.kmrd.dev/
- [Optional] ***InfluxDB*** for storing telemetry updates in a database. Tarana has verified integration with ***InfluxDB***. See https://www.influxdata.com/get-influxdb/ to get **InfluxDB**. For other supported output options, refer to the ***gNMIc*** User Guide.

Build the gNMIc Binary

If you want a pre-built binary for the gNMIc collector from Tarana, please contact Tarana Support.

Step 1. Contact Tarana Support for access to the Tarana gNMIc repository.

Step 2. Generate a personal access token in GitHub. Instructions are available here: https://docs.github.com/en/enterprise-server@3.4/authentication/keeping-your-account-and-data-secure/managing-your-personal-access-tokens

Step 3. Set up credentials for repository access.

```
# Configure Go environment variables
$ go env -w GOPRIVATE=github.com/TaranaWireless/*

# Create the .netrc file and add the GitHub token (from Step 2)
$ touch $HOME/.netrc
$ echo “machine github.com login <username> password <access-token>” >
$HOME/.netrc
```

Step 4. Clone the repository.

```
$ git clone --depth=1 --branch v0.30.0-tw2
https://<username>@github.com/TaranaWireless/gnmic.git
```

Step 5. Verify and update the Go version.

```
# Check Go version
$ go version

# If the version is lower than 1.19, upgrade using the following commands in a
directory (<go-dir>) where go will be installed.
$ wget https://go.dev/dl/go1.19.10.linux-amd64.tar.gz
$ tar -xvf go1.19.10.linux-amd64.tar.gz

# Update Go environment variables to the change the version
$ export GOROOT="<go-dir>"
$ export GOPATH="<go-dir>"

# Add the new version to $PATH
$ export PATH=<go-dir>/bin:$PATH

# Check Go version
$ go version
[go version go1.19.10 linux/amd64]
```

Step 6. Build the gNMIc binary.

```
# From the directory which contains the source code for gNMIc
$ go mod tidy
$ go build
```

Configure the Collector Endpoint

Step 1. Copy the ***gNMIc*** binary and ***telemetry_cfg.yaml*** to a folder on the collector endpoint.

Step 2. Edit the ***telemetry_cfg.yaml*** file to configure the telemetry streaming options. See Appendix A Sample Configuration File (Secure Mode) and Appendix B Sample Configuration File (Non-Secure Mode) for sample ***telemetry_cfg.yaml*** files.

Step 3. Enable gNMIc to start listening and gather the streaming data, by entering the following commands on the Linux server.

```
# Ensure the gNMIc binary has execute (x) permissions
$ chmod +x gnmic

Start listening using gNMIc
$ ./gnmic listen --address <SERVER_IP>:<GNMIC_PORT> --org tarana --config
telemetry_cfg.yaml
```

Step 4. [Optional] If using InfluxDB, enter the following commands on the Linux server.

```
# Ensure the InfluxDB binary has execute (x) permissions
$ chmod +x influxd

Start listening using InfluxDB
$ ./influxd --http-bind-address :<INFLUXDB_PORT>
```

InfluxDB can now be accessed using a browser at: <SERVER_IP>:<INFLUXDB_PORT>

Follow the instructions to set up login credentials, an organization, and a data bucket. For more information, refer to the InfluxDB documentation: https://docs.influxdata.com/influxdb

Enable Telemetry Streaming from TCS

To configure TCS to use a telemetry streaming collection endpoint, follow these steps:

1. Navigate to **Admin > Network Configuration**.
2. To display global settings, select the **Operator** name in the network entity tree.
3. Select **Edit** at the bottom of the settings pane.
4. Enter the metrics collector end point information:
   - **Destination Address:** Destination URL or IP address of the host that receives the telemetry data from the base node. (Default: telemetry.taranawireless.com).
   - **Port:** UDP port on which the host receives telemetry data.
   - **Streaming Interval:** Select an interval for the base node to send telemetry data. Allowable values are from 1 minute to 60 minutes.
5. [Optional] Toggle the **Streaming** switch to "Enabled" if streaming needs to be enabled globally.
6. Select **Done** to commit the configuration changes and exit.

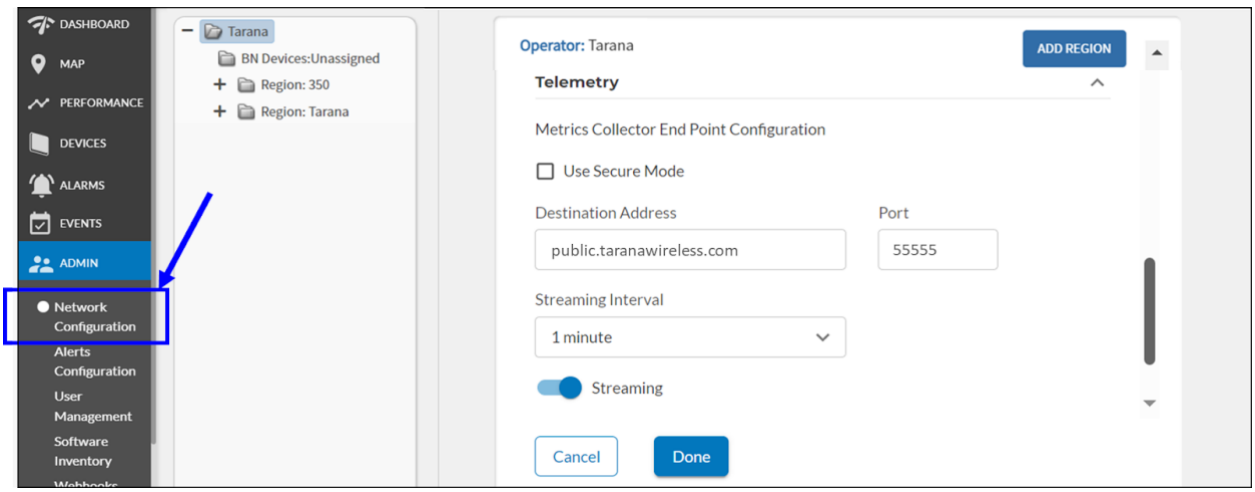


Figure 2 Enabling Telemetry Streaming from TCS

If telemetry streaming is configured but disabled at the Operator level, you can enable it at the Region or Sector level. Follow these steps:

1. Navigate to **Admin > Network Configuration**.
1. Navigate to the Region or Sector in the network entity tree, then select the entity name to display the settings.
2. Select **Edit** at the bottom of the settings page.
3. In the Metrics Collector End Point Configuration section, select **Override**.
4. Enter **Destination Address**, **Port,** and **Streaming Interval**, and toggle the **Streaming** switch to activate the feature.
5. Select **Done** to commit the configuration changes and exit.

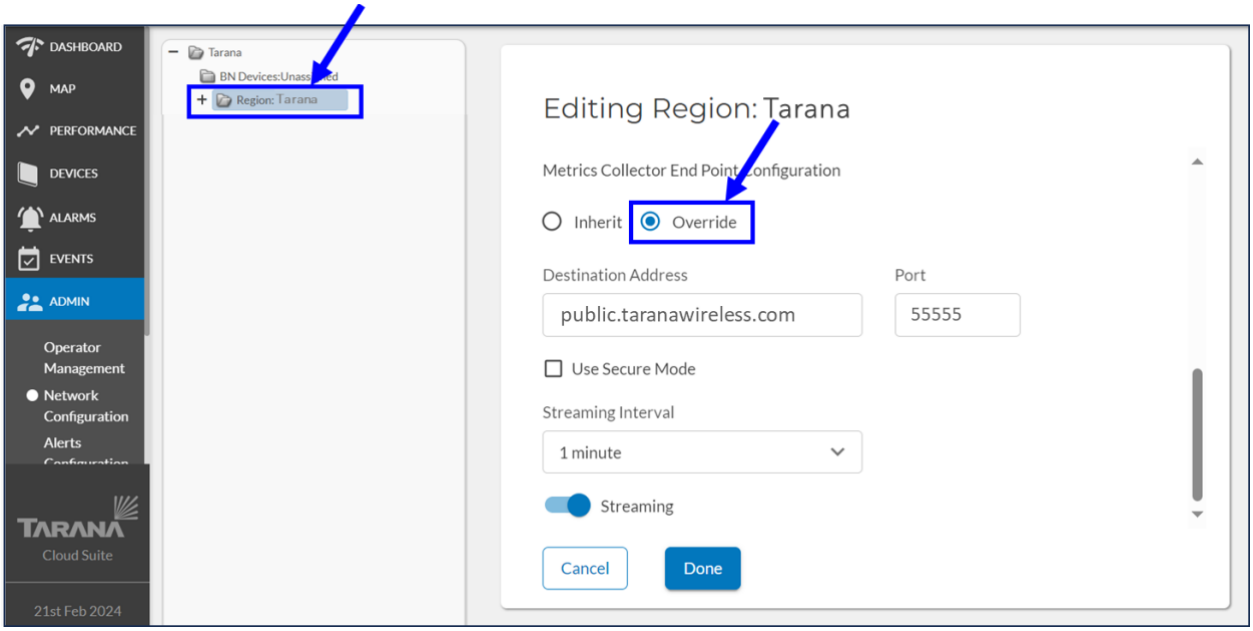


Figure 3 Region-level Override

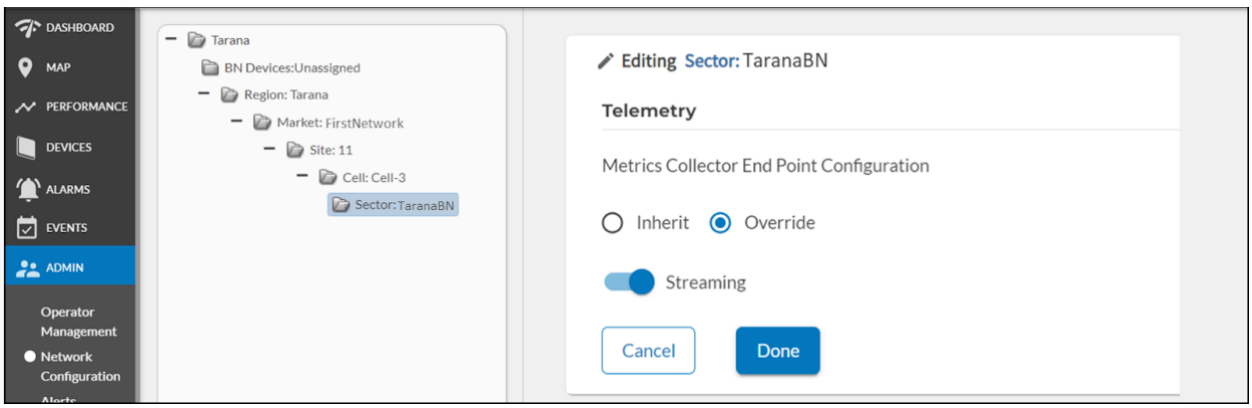


Figure 4 Sector-level Override

Secure Mode

Users have the option to enable **Secure Mode** for their streamed data. This prompts the user to enter an Access Key in addition to the Destination Address and Port for the metrics collector end point. TLS 1.3 is supported for secure mode.

- **Access Key**: This is used to authenticate the device (alphanumeric key length: 8-64).
- **Destination Address:** Destination URL or IP address of the host that receives the telemetry data from the base node. (Default: telemetry.taranawireless.com).
- **Port:** UDP port on which the host receives telemetry data.

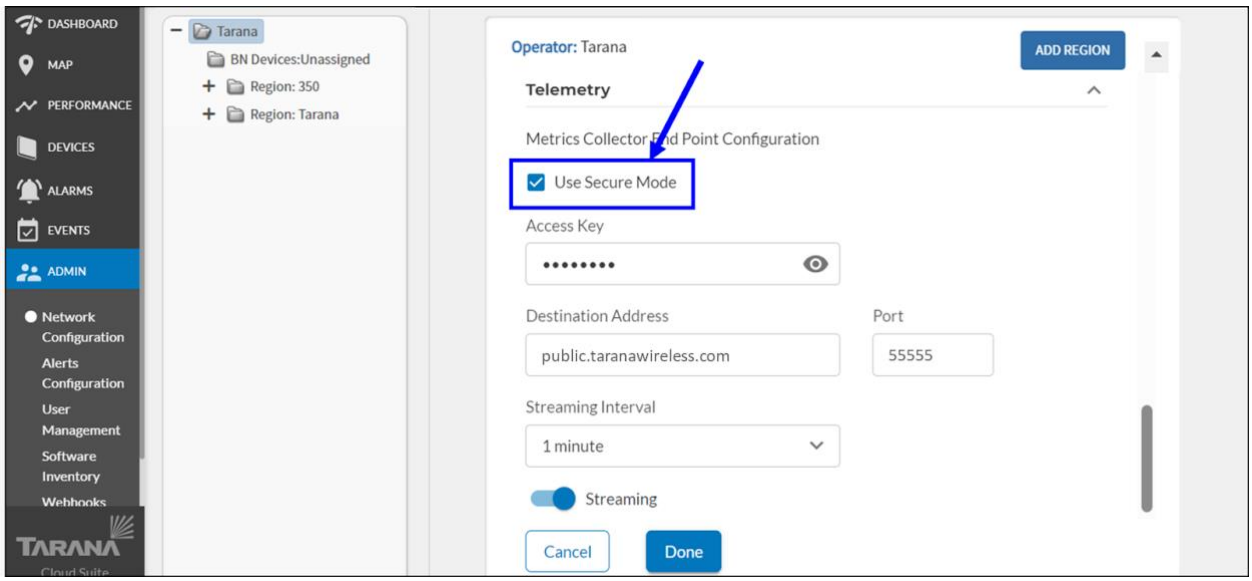


Figure 5 Secure Mode

Note: the Access Key will not be visible to users unless clicking the 'eye' icon within the Access Key field when in Edit mode.

Prerequisites for Secure Mode

1. Devices must be running SYS version 1.600.003.00 or higher.
2. The endpoint must be provisioned with a public certificate.

Troubleshooting Telemetry Streaming

If the base nodes are not able to send telemetry data, verify the following:

- Destination information (IP or FQDN address and port) on TCS is correct.
- gNMIc collector is running on the collector endpoint.
- Relevant firewall rules are implemented correctly.

A failure of telemetry streaming will result in an alarm, which can be seen in the **Alarms** section of TCS.

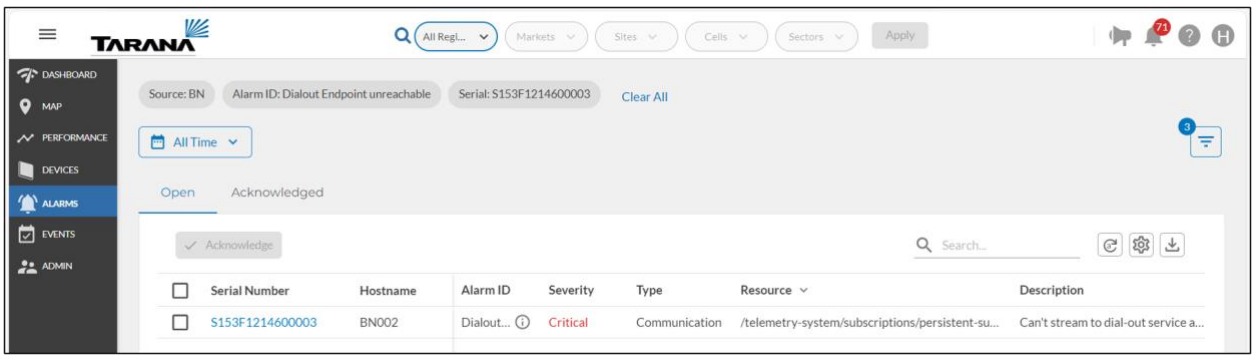


Figure 6 Troubleshooting Telemetry Streaming

Fast Telemetry

The fast telemetry feature is designed to help provide remote guidance during remote node installation. During the remote node installation process, it is important to align the remote node correctly with respect to its intended base node to maximize the link performance. Currently, the remote node webUI provides real-time feedback for the alignment metric and other related performance metrics to the installer. The fast telemetry feature makes it possible to collect the same high-granularity data for remotely-assisted installations.

A prerequisite for this feature is that telemetry streaming must already be enabled. Once enabled, a northbound API is used to enable fast telemetry on a per-remote node basis. Once the fast telemetry session has been started on an remote node, it sends the alignment data for 30 minutes. Users will have the option via northbound API to stop the alignment data before the 30-minute window ends. At any point in time, no more than 5 remote nodes can be in this mode on a given sector (base node).

Prerequisites for Fast Telemetry

- Telemetry streaming must be enabled on the base node for which the user wants to enable fast telemetry.
- The data collection for the fast telemetry metrics is in the same destination log file as the telemetry streaming data.
- The northbound API key is required to enable fast telemetry.

Enabling Fast Telemetry from TCS using Northbound APIs

The fast telemetry feature is supported by device software version 1.600.003.00 or higher on both the base node and remote node. To enable fast telemetry on a specific remote node, a POST call is made on the base node (provided telemetry streaming is enabled) that includes the serial number of the remote node. This API is found under Device Config & Operations in the list of northbound APIs.

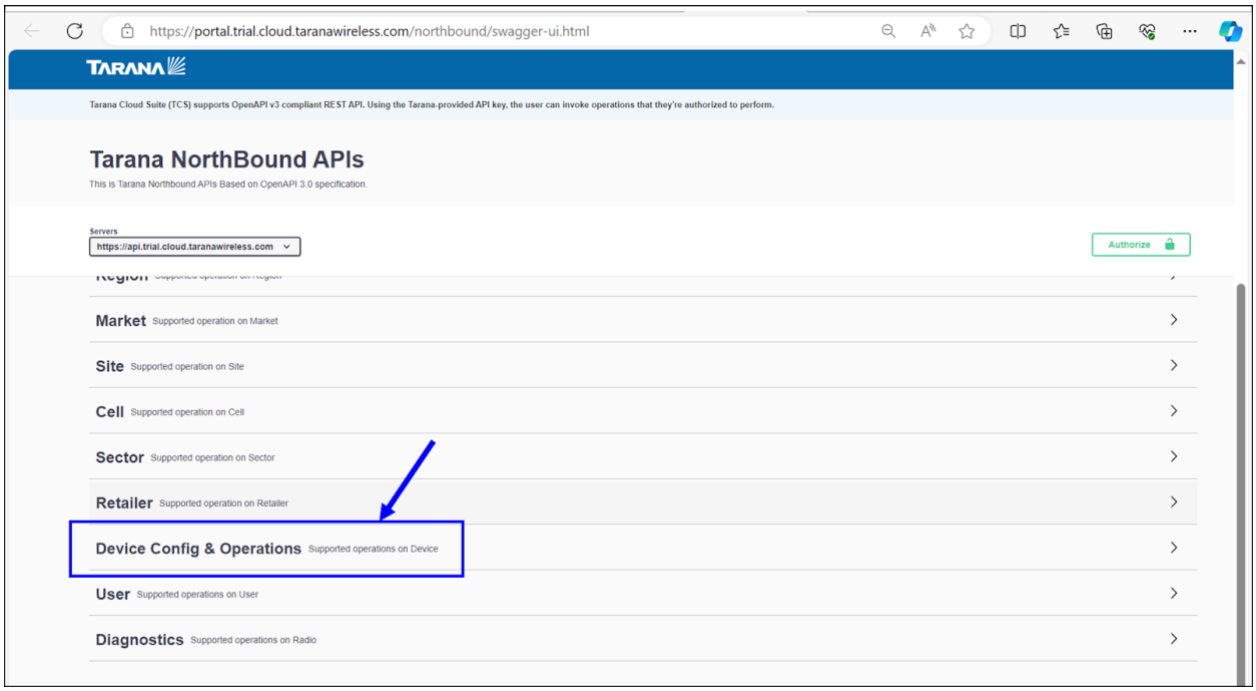


Figure 7 Configuring Northbound APIs in TCS

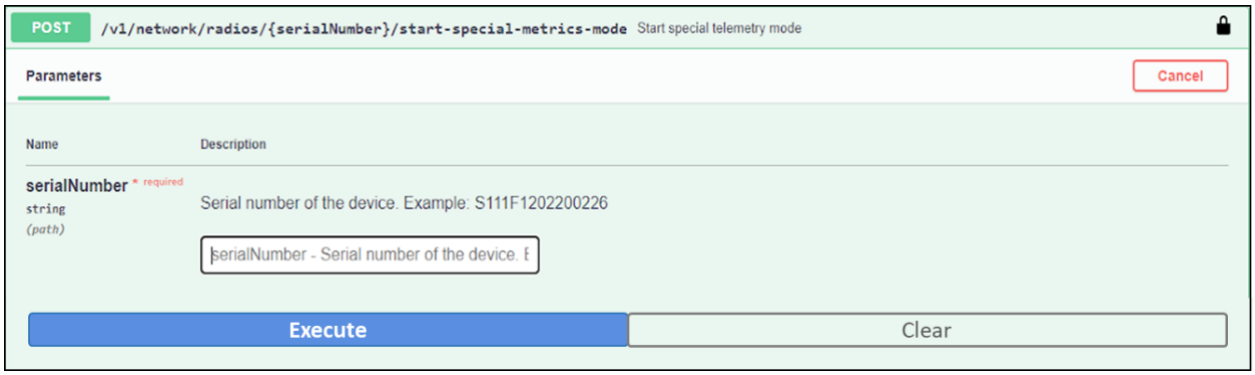


Figure 8 Adding the Remote Node Serial Number

If the enablement is successful, the API will return a response code “200”.

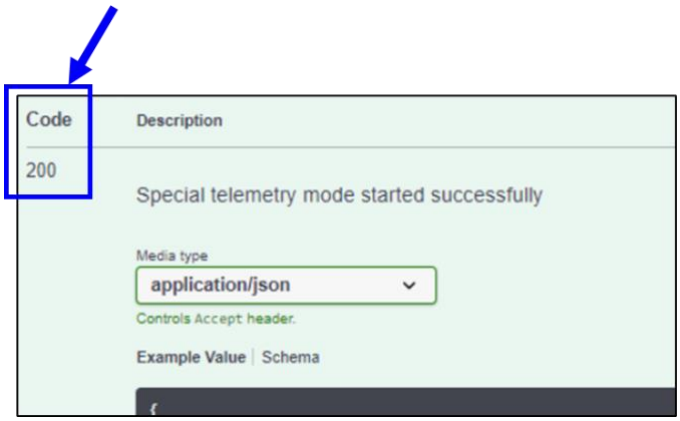


Figure 9 Successful Enablement

In the interest of triggering/automating fast telemetry upon installation, the “First Seen” information can be used in the “New Device Installed” alert in TCS for the newly-installed remote node. This alert can be added from **Admin → Add New Alert**.

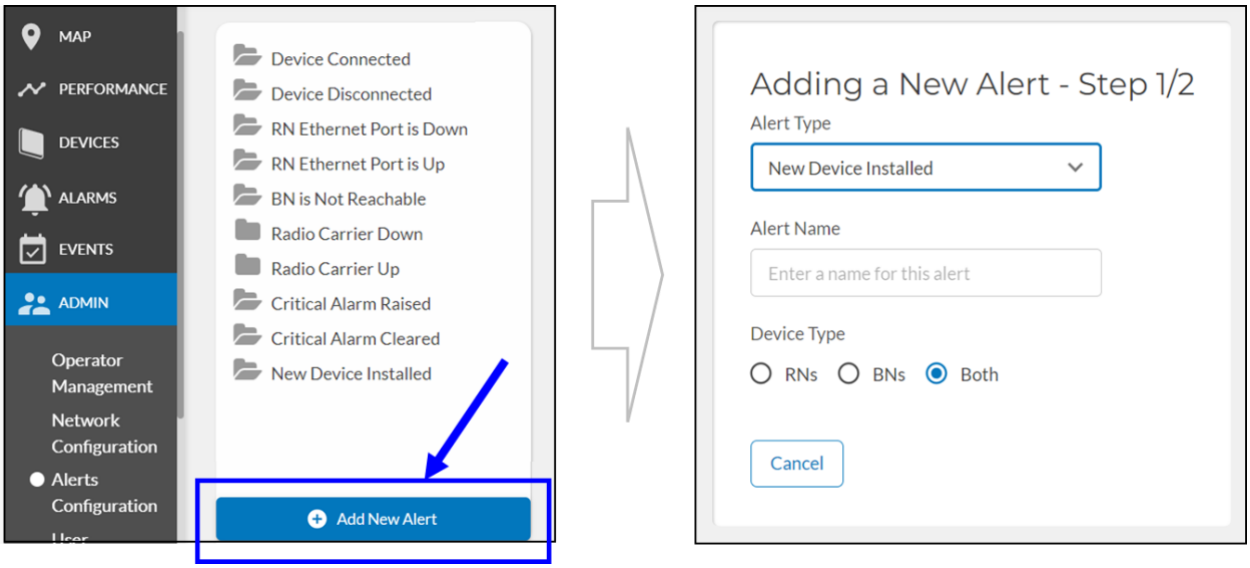


Figure 10 Adding "New Device Installed" Alert

Executing the GET call using the API below (also under Device Config & Operations) gives the remote node's telemetry mode status. This also indicates how many seconds remain before the remote node stops sending alignment data.

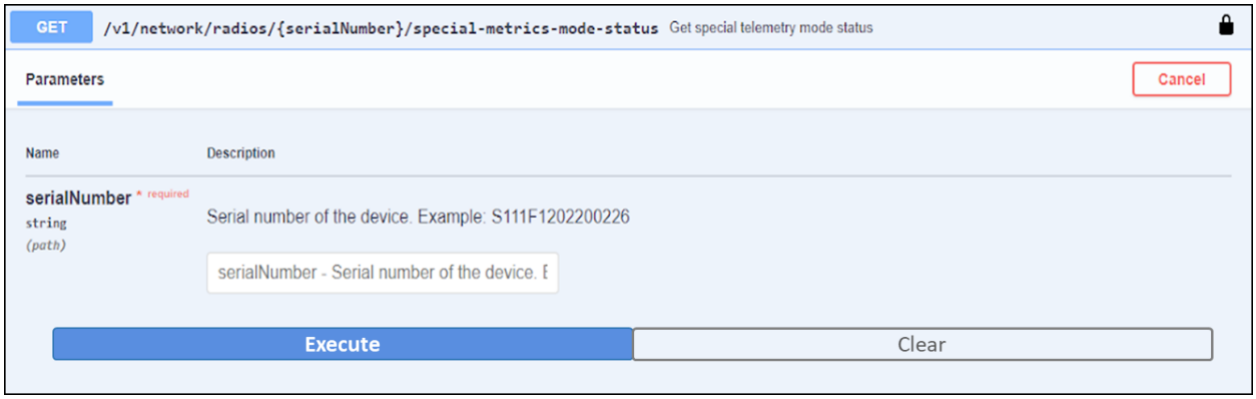


Figure 11 Getting the Remote Node Telemetry Mode Status

If the remote node disconnects for any reason, it stops sending the fast telemetry data. The stream will resume after reconnection provided the 30-minute timer has not expired.

To stop the fast telemetry stream on a particular remote node (serial number) before the 30-minute timer expires, the following POST API is used (also under Device Config & Operations).

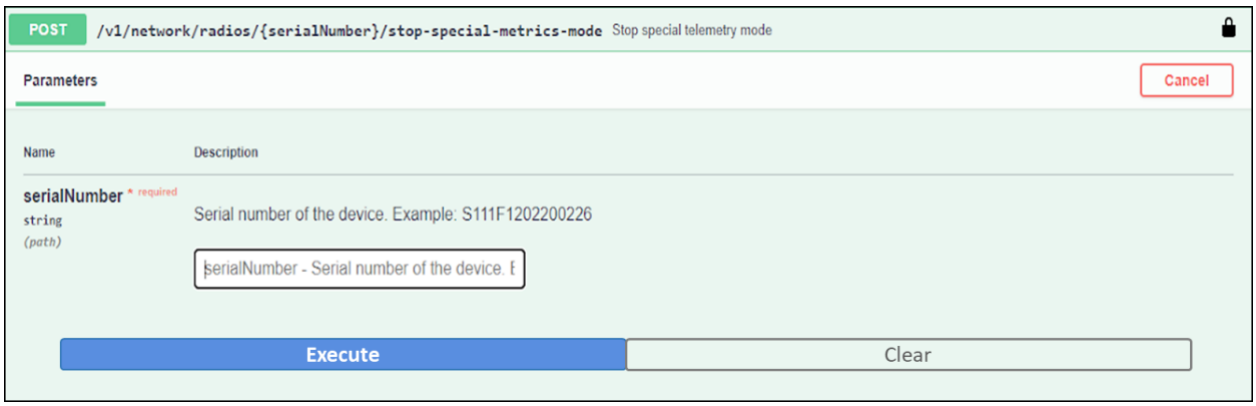


Figure 12 Stopping the Fast Telemetry Stream

Streamed Alignment Metrics

YANG Path	Units	Name	Description
/connections/connection/state/path-loss	dB	Path Loss	Refers to the attenuation of the RF signal, in dB, between the base node antenna and the remote node antenna, excluding antenna gains.
/connections/connection/state/rf-range	meters	RF Range	The distance the signal travels between sending and receiving devices, which can include reflections and diffractions.
/connections/connection/state/alignment-metric/instant	dB	Alignment Metric	Refers to the instantaneous value of the device's alignment metric.
/connections/connection/state/counters/dl-rate	Kbps	DL Rate	Refers to the latest downlink rate, in Kbps.
/connections/connection/state/counters/ul-rate	Kbps	UL Rate	Refers to the latest uplink rate, in Kbps.
/connections/connection/state/dl-cce-snr/instant	dB	DL CCE SNR	Refers to the instantaneous SNR of the DL control channel.
/connections/connection/state/ul-cce-snr/instant	dB	UL CCE SNR	Refers to the instantaneous SNR of the UL control channel.
/connections/connection/radios/radio[id][frequency]/state/interference-noise-ratio/instant	dB	Intf. Noise Ratio Instant Carrier "x"	Refers to the instant interference-to-noise ratio, in dB, detected in the carrier frequency.
/connections/connection/state/wideband-base-snr/dl/instant	dB	DL Wideband Base SNR	Refers to the instant wideband SNR in DL.
/connections/connection/state/wideband-base-snr/ul/instant	dB	UL Wideband Base SNR	Refers to the instant wideband SNR in UL.
/connections/connection/radios/radio/state/counters/rssi	dB	Received Signal strength	Refers to received signal strength.
/connections/connection/state/dl-reference-snr/instant	dB	DL Reference SNR	Refers to the instant reference signal SNR in DL.
/connections/connection/state/ul-reference-snr/instant	dB	UL Reference SNR	Refers to the instant reference signal SNR in UL.

Key Points of the Fast Telemetry Feature

- This feature is only supported if the base node and remote node are on software version 1.600.003.00 or higher.
- A maximum of 5 remote nodes can have fast telemetry mode enabled at any point in time on a particular base node.
- Telemetry streaming is enabled.
- When the link between remote node and base node is impaired, e.g., when remote node is in constrained mode, only a subset of the metrics from the table above is streamed. The following is the list of metrics reported when the remote node is in constrained mode:
    - Wideband base SNR DL
    - Wideband base SNR UL
    - DL Reference SNR
    - UL Reference SNR
    - DL rate
    - UL CCE SNR
    - Pathloss

Streamed Telemetry Metrics

System (Base Node)

System (Base Node)	Units	Range	Name	Description	Minimum Software Version
state/uptime	milli seconds		Sys Uptime	Time since the device last booted.	0.997
state/boot-time	nano seconds		Boot Time	Duration of boot time.	0.997
state/hostname			Hostname	Refers to an identifier used to distinguish the device on a network. By default, the hostname is the device's serial number.	0.997
cpus/cpu[index=0]/state/total/instant	%	0-100	CPU Utilization	The average CPU Utilization of the device.	0.997
software/state/boot-reason			Boot Reason	Reason for the last boot of the device.	0.997
software/state/reboot-message			Reboot Message		0.997
software/state/upgrade-message			Upgrade Message		0.997
software/state/download-progress			Download Progress	Provides status for software download.	0.997
software/state/upgrade-status			Upgrade Progress	Provides status for software upgrade.	0.997
clock/state/gps/number-of-satellites			Number of Satellites		0.997
clock/state/gps/lock-status			GPS Lock Status	Indicates if the base node has successfully acquired enough satellites to determine its location.	0.997
clock/state/gps/average-snr	dB		GPS SINR	Indicates quality of link to satellites. A "good" signal is 30+ dB, below 25 dB is weak.	0.997
clock/state/gps/fix-time			GPS Fix Time		0.997
clock/state/status				Indicates if the GPS has a lock to satellites.	0.997
install/state/latitude			Latitude	Latitude of the device as reported by the GPS module.	0.997
install/state/longitude			Longitude	Longitude of the device as reported by the GPS module.	0.997
install/state/tilt	degrees	-90-90	Tilt	Tilt of the device as input by the installer.	0.997
install/state/azimuth	degrees	0-359	Azimuth	Azimuth of the device as input by the installer.	0.997
install/state/height-agl			Height (AGL)	Height above ground level of the device as input by the installer.	0.997

System (Base Node)	Units	Range	Name	Description	Minimum Software Version
clock/state/gps/available			GPS Available	Indicates whether GPS device is available	3.0

Platform (Base Node)

Platform (Base Node)	Units	Range	Name	Description	Minimum Software Version
component[name=sys]/state/name					0.997
component[name=sys]/state/description					0.997
component[name=sys]/state/software-version			Software Version	Refers to the software version number running on the device.	0.997
component[name=sys]/state/serial-no			Serial Number	Refers to the serial number of the device.	0.997
component[name=sys]/state/temperature/avg	Celsius	up to 95 Celsius	Temperature	The internal temperature reported by the device.	0.997
component[name=sys]/state/memory/utilized	%	0-100	Memory Utilization	Refers to the percentage of memory currently in use.	0.997
component[name=sys]/power-supply/state/output-voltage	volts	44-58	Voltage	Voltage as measured at the base node's power connector.	0.997
component[name=sys]/power-supply/state/output-power	watts		Power	Power as measured at the base node's power connector.	0.997
component[name=digboard]/state/mac-address			MAC Address	Refers to the physical hardware address of the device.	0.997
component[name=digboard]/power-supply/state/output-power	Watts			Output power at the digboard.	3.0
component[name=digboard]/state/description					3.0
component[name=digboard]/state/name					3.0
component[name=digboard]/state/serial-no				System-assigned serial number of the component.	3.0
component[name=digboard]/state/temperature/avg	Celsius				3.0
component[name=rfboard]/power-	Watts			Output power at the rfboard.	3.0

Platform (Base Node)	Units	Range	Name	Description	Minimum Software Version
supply/state/output-power					
component[name=rf board]/power-supply/state/output-voltage	Volts			Output voltage supplied by the power supply.	3.0
component[name=rf board]/state/description					3.0
component[name=rf board]/state/name					3.0
component[name=rf board]/state/serial-no					3.0
component[name=rf board]/state/temperature/avg	Celsius				3.0

Radios (Base Node)

Radios (Base Node)	Units	Range	Name	Description	Minimum Software Version
operating-frequency	kHz		Frequency	Refers to the administrator-selected operating center frequency of the carrier.	0.997
channel-width	MHz		Bandwidth	Refers to the amount of operational spectrum, in MHz, available for use by a sector or link.	0.997
enabled				Refers to the enabled state of the radio.	0.997
sensitivity-loss/ave	dBm			Refers to the loss in sensitivity in dB on a carrier typically due to a very high received signal strength.	0.997
status		1-99			0.997
interference-noise-ratio/max	dB	5-55	Intf. Noise Ratio Max	Refers to the maximum interference-to-noise ratio detected over a 30 second interval.	0.997
rx-signal-level/max	dBm		Rx Signal Level	Refers to the received signal strength for a carrier measured in dBm.	0.997
sensitivity-loss/ave	dBm	0-28	Sensitivity Loss	Refers to the loss in sensitivity in dB on a carrier typically due to a very high received signal strength.	0.997
target-rxsi	dBm	-127/-57		BN carrier target RXSI in dBm. default -85 dBm	3.0

Radios (Base Node)	Units	Range	Name	Description	Minimum Software Version
transmit-expire-time	Seconds	300-86400		This is the time delay (in seconds) for how long the carrier can continue to transmit after the last authorization. The carrier will stop transmitting after this time has expired	3.0
carrier-down/last-reason				Reason for the last carrier-down.	3.0
carrier-down/last-reason-message				Detailed message describing the reason for the last carrier-down.	3.0

Interfaces (Base Node)

Interfaces (Base Node)	Units	Range	Name	Description	Minimum Software Version
interface[name=gi1]/state/description			Data3 - 1G	The copper Ethernet data port on the base node.	0.997
interface[name=gi1]/state/enabled		TRUE/FALSE		Enabled state of the copper Ethernet data port on the base node.	0.997
interface[name=gi1]/state/admin-status			Admin Status	Enabled admin status of the copper Ethernet data port on the base node.	0.997
interface[name=gi1]/state/oper-status		1-7	Operational Status	The operational status of the copper Ethernet data port on the base node.	0.997
interface[name=gi1]/state/data-vlan		0-4091	Data VLAN	VLAN number of the data VLAN used on the base node's copper Ethernet data port.	0.997
interface[name=gi1]/state/data-enabled		TRUE/FALSE	Data Status	Enabled data status of the base node's copper Ethernet data port.	0.997
interface[name=gi1]/state/counters/in-pkts			Packets (In)	Number of ingressed packets to the base node's copper Ethernet data port.	0.997
interface[name=gi1]/state/counters/in-discards				Number of ingress discards from the base node's copper Ethernet data port.	0.997
interface[name=gi1]/state/counters/in-errors			Errors (In)	Number of ingress errors to the base node's copper Ethernet data port.	0.997
interface[name=gi1]/state/counters/in-fcs-errors				Number of ingress FCS errors to the base node's copper Ethernet data port.	0.997
interface[name=gi1]/state/counters/out-pkts			Packets (Out)	Number of egressed packets from the base node N's copper Ethernet data port.	0.997

Interfaces (Base Node)	Units	Range	Name	Description	Minimum Software Version
interface[name=gi1]/state/counters/out-unicast-pkts			Unicast (Out)	Number of egressed unicast packets from the base node's copper Ethernet data port.	0.997
interface[name=gi1]/state/counters/out-discards				Number of egress discards from the base node's copper Ethernet data port.	0.997
interface[name=gi1]/state/counters/out-errors				Number of egress errors from the base node's copper Ethernet data port.	0.997
interface[name=ex2]/state/description			Data2 - 10G	The "Data2" 10 gigabit fiber data port on the base node.	0.997
interface[name=ex2]/state/enabled		TRUE/FALSE		Enabled state of the "Data2" 10 gigabit fiber data port on the base node.	0.997
interface[name=ex2]/state/admin-status			Admin Status	Enabled admin status of the "Data2" 10 gigabit fiber data port on the base node.	0.997
interface[name=ex2]/state/oper-status		1-7	Operational Status	The operational status of the "Data2" 10 gigabit fiber data port on the base node.	0.997
interface[name=ex2]/state/data-vlan		0-4091	VLAN	VLAN number of the data VLAN used on the base node's "Data2" 10 gigabit fiber data port.	0.997
interface[name=ex2]/state/data-enabled		TRUE/FALSE	Data Status	Enabled data status of the base node's "Data2" 10 gigabit fiber data port.	0.997
interface[name=ex2]/state/counters/in-pkts			Packets (In)	Number of ingressed packets to the base node's "Data2" 10 gigabit fiber data port.	0.997
interface[name=ex2]/state/counters/in-discards				Number of ingress discards from the base nodes "Data 2" 10 gigabit fiber data port.	0.997
interface[name=ex2]/state/counters/in-errors			Errors (In)	Number of ingress errors to the base node's "Data2" 10 gigabit fiber data port.	0.997
interface[name=ex2]/state/counters/in-fcs-errors				Number of ingress FCS errors to the base node's "Data2" 10 gigabit fiber data port.	0.997
interface[name=ex2]/state/counters/out-pkts			Packets (Out)	Number of egressed packets from the base node's "Data2" 10 gigabit fiber data port.	0.997
interface[name=ex2]/state/counters/out-discards				Number of egress discards from the base node's "Data 2" 10 gigabit fiber data port.	0.997
interface[name=ex2]/state/counters/out-errors				Number of egress errors from the base node's "Data2" 10 gigabit fiber data port.	0.997

Interfaces (Base Node)	Units	Range	Name	Description	Minimum Software Version
interface[name=ex1]/state/description			Data1 - 10G	The “Data1” 10 gigabit fiber data port on the base node.	0.997
interface[name=ex1]/state/enabled		TRUE/FALSE		Enabled state of the “Data1” 10 gigabit fiber data port on the base node.	0.997
interface[name=ex1]/state/admin-status			Admin Status	Enabled admin status of the “Data1” 10 gigabit fiber data port on the base node.	0.997
interface[name=ex1]/state/oper-status		1-7	Operational Status	The operational status of the “Data1” 10 gigabit fiber data port on the base node.	0.997
interface[name=ex1]/state/data-vlan		0-4091	VLAN	VLAN number of the data VLAN used on the base node’s “Data1” 10 gigabit fiber data port.	0.997
interface[name=ex1]/state/data-enabled		TRUE/FALSE	Data Status	Enabled data status of the base node’s “Data1” 10 gigabit fiber data port.	0.997
interface[name=ex1]/state/counters/in-pkts			Packets (In)	Number of ingressed packets to the base node’s “Data1” 10 gigabit fiber data port.	0.997
interface[name=ex1]/state/counters/in-discards				Number of ingress discards from the base node’s “Data 1” 10 gigabit fiber data port.	0.997
interface[name=ex1]/state/counters/in-errors			Errors (In)	Number of ingress errors to the base node’s “Data1” 10 gigabit fiber data port.	0.997
interface[name=ex1]/state/counters/in-fcs-errors				Number of ingress FCS errors to the base node’s “Data1” 10 gigabit fiber data port.	0.997
interface[name=ex1]/state/counters/out-pkts			Packets (Out)	Number of egressed packets from the base node’s “Data1” 10 gigabit fiber data port.	0.997
interface[name=ex1]/state/counters/out-discards				Number of egress discards from the base node’s “Data 1” 10 gigabit fiber data port.	0.997
interface[name=ex1]/state/counters/out-errors				Number of egress errors from the base node’s “Data1” 10 gigabit fiber data port.	0.997

Connections (Remote Node)

Connections (Remote Node)	Units	Range	Name	Description	Minimum Software Version
state/status		1-11	Status		0.997
state/last-change-reason			Last Change Reason		0.997

Connections (Remote Node)	Units	Range	Name	Description	Minimum Software Version
state/last-change-reason-message			Last Change Reason Message		0.997
state/data-vlan		0-4091	Data VLAN	The outer (if applicable) tag of the data VLAN configured on the device.	0.997
state/sla-profile			SLA Profile	The built-in SLA profile configured on the device. For custom SLA, see sla/state/name.	0.997
state/uptime	milli seconds		Link Uptime	The duration of time the connection has been up.	0.997
state/rf-range	meters		RF Range	The distance the signal travels between sending and receiving devices, which can include reflections and diffractions.	0.997
state/path-loss	dB		Path Loss	Refers to the attenuation of the RF signal, in dB, between the base node antenna and the remote node antenna, excluding antenna gains.	0.997
state/dl-snr	dB		DL SNR	Refers to the average downlink signal-to-noise (SNR), in dB, for a link. This value is measured at the time traffic is transmitted.	0.997
state/ul-snr	dB		UL SNR	Refers to the average uplink signal-to-noise (SNR), in dB, for a link. This value is measured at the time traffic is transmitted.	0.997
state/dl-interference-signal-ratio/avg	dB		DL SINR	Refers to the average downlink signal-to-interference and-noise ratio (SINR), in dB, for a link.	0.997
state/ul-interference-signal-ratio/avg	dB		UL SINR	Refers to the average downlink signal-to-interference and-noise ratio (SINR), in dB, for a link.	0.997
state/dl-cce-snr/instant	dB		DL CCE SNR	Refers to the instantaneous SNR value of the DL control channel.	0.997
state/ul-cce-snr/instant	dB		UL CCE SNR	Refers to the instantaneous SNR value of the UL control channel.	0.997
state/counters/dl-rate	Kbps		DL Rate	Refers to the latest downlink rate, in Kbps, as sampled once every 30 seconds.	0.997

Connections (Remote Node)	Units	Range	Name	Description	Minimum Software Version
state/counters/dl-peak-rate	Kbps		DL Peak Rate	Refers to the highest DL throughput recorded in the last 150 seconds.	0.997
state/counters/dl-bytes	Bytes		Bytes (In)	The number of bytes ingressed in the downlink direction.	0.997
state/counters/dl-packet-error-rate		0-1	DL PER	Refers to the downlink packet error rate after accounting for ARQ retransmissions.	0.997
state/counters/ul-rate	Kbps		UL Rate	Refers to the latest uplink rate, in Kbps, as sampled once every 30 seconds.	0.997
state/counters/ul-peak-rate	Kbps		UL Peak Rate	Refers to the highest UL sector throughput recorded in the last 150 seconds.	0.997
state/counters/ul-bytes	Bytes		Bytes (Out)	The number of bytes egressed in the uplink direction.	0.997
state/counters/ul-packet-error-rate		0-1	UL PER	Refers to the uplink packet error rate after accounting for ARQ retransmissions.	0.997
state/alignment-metric/instant	dB		Alignment Metric	Refers to the instantaneous value of the device's alignment metric.	0.997
state/network-entry/timing/total-time	milliseconds		Network Entry Time	Refers to the time taken for network entry.	0.997
system/software/state/boot-reason			Boot Reason	Reported by the device for the most recent reboot. Possible reasons include a cold reboot due to power loss, a warm reboot prompted by the software, and a watchdog reboot initiated when the system detects an unrecoverable condition.	0.997
system/state/hostname			Hostname	Refers to an identifier used to distinguish the device on a network. By default, the hostname is the device's serial number.	0.997
system/clock/state/gps/available				Indicates if a sufficient GPS signal is seen by the device.	0.997
system/cpus/cpu[index=0]/state/total/avg				Indicates average CPU usage.	0.997
platform/state/software-version	The active s/w version		Software Version	Refers to the current version of the running device software.	0.997

Connections (Remote Node)	Units	Range	Name	Description	Minimum Software Version
platform/state/serial-no			Serial Number	A unique device identifier.	0.997
platform/state/temperature/avg	Celsius		Temperature	Refers to the internal temperature reported by the device.	0.997
platform/state/memory/utilized	%	0-100	Memory Utilization	Refers to the percentage of memory currently in use.	0.997
platform/state/mac-address			MAC Address	Refers to the physical hardware address of the device.	0.997
radios/radio[id][frequency]/state/operating-frequency	kHz			Refers to the administrator-selected operating center frequency of the carrier.	0.997
radios/radio[id][frequency]/state/channel-width	MHz		Bandwidth	Refers to the amount of operational spectrum, in MHz, available for use by a sector or link.	0.997
radios/radio[id][frequency]/state/enabled		TRUE/ FALSE	Radio Up		0.997
radios/radio[frequency][id]/state/sensitivity-loss/avg	dB		Sensitivity Loss Avg Carrier "x" (dB)	Refers to the average loss in sensitivity in dB on a carrier, typically due to very high received signal strength.	0.997
radios/radio[frequency][id]/state/rx-signal-level/avg	dBm		Rx Signal Carrier "x" (dBm)	Refers to the average received signal strength for a carrier measured in dBm.	0.997
radios/radio[id][frequency]/state/interference-noise-ratio/max	dB		Intf. Noise Ratio Max Carrier "x"	Refers to the maximum interference-to-noise ratio, in dB, detected in the carrier frequency over a 30 second interval.	0.997
interfaces/interface[name=gi1]/state/enabled		TRUE/ FALSE		Enabled state of the Ethernet data port on the remote node.	0.997
interfaces/interface[name=gi1]/state/description				Described state of the Ethernet data port on the remote node.	0.997
interfaces/interface[name=gi1]/state/oper-status		1-7	Operational Status	The operational status of the Ethernet data port on the remote node.	0.997
interfaces/interface[name=gi1]/state/admin-status			Admin Status	Enabled admin status of the Ethernet data port on the remote node.	0.997
interfaces/interface[name=gi1]/state/counters/in-pkts			Packets (In)	Number of ingressed packets to the remote node's Ethernet data port.	0.997
interfaces/interface[name=gi1]/state/counters/in-discards			Discards (In)	Number of ingressed discards to the remote node's Ethernet data port.	0.997

Connections (Remote Node)	Units	Range	Name	Description	Minimum Software Version
interfaces/interface[name=gi1]/state/counters/out-discards			Discards (In)	Number of egressed discards to the remote node's Ethernet data port.	0.997
interfaces/interface[name=gi1]/state/counters/in-errors			Errors (In)	Number of ingress errors to the remote node's Ethernet data port.	0.997
interfaces/interface[name=gi1]/state/counters/in-fcs-errors			FCS Errors (In)	Number of ingress FCS errors to the remote node's Ethernet data port.	0.997
interfaces/interface[name=gi1]/state/counters/out-pkts			Packets (Out)	Number of egressed packets from the remote node's Ethernet data port.	0.997
interfaces/interface[name=gi1]/state/counters/out-errors			Errors (Out)	Number of egress errors from the remote node's Ethernet data port.	0.997
system/install/state/latitude	degrees	-90 - +90	Latitude	Latitude of the device.	0.997
system/install/state/longitude	degrees	-180 - +180	Longitude	Longitude of the device.	0.997
system/install/state/tilt	degrees	-180 - +180	Tilt	Tilt of the device.	0.997
system/install/state/azimuth	degrees	0 - 360	Azimuth	The horizontal angle, measured clockwise from true north.	0.997
system/install/state/height-agl	meters	0 - 1000	Height (AGL)	Installation height, in meters, above ground level.	0.997
radios/global/config/primary-network-id				Refers to the Network ID of the remote node.	0.997
network/mac-table				Refers to the MAC table of the remote node.	0.997
path-loss/instant				Path-loss measured in dB.	3.0
counters/rssi	dBm			RSSI measured in dBm.	3.0
sla/state/dl-peak-rate	Mbps			Downlink sustained rate configuration for the connection.	3.0
sla/state/name				Custom SLA profile name for the connection. For built-in SLA, see state/sla-profile.	3.0
sla/state/ul-peak-rate	Mbps			Uplink sustained rate configuration for the connection	3.0
dl-reference-snr/instant	dB			The instantaneous value of the statistic.	3.0
ul-reference-snr/instant	dB			The instantaneous value of the statistic.	3.0
wideband-base-snr/dl/instant	dB			The instantaneous value of the statistic.	3.0
wideband-base-snr/ul/instant	dB			The instantaneous value of the statistic.	3.0
state/reboot-message				Description of the system reboot reason	3.0

Connections (Remote Node)	Units	Range	Name	Description	Minimum Software Version
state/boot-time				This timestamp indicates the time that the system was last restarted. The value is the timestamp in nanoseconds relative to the Unix Epoch (Jan 1, 1970 00:00:00 UTC).	3.0
negotiated-duplex-mode		FULL/ HALF		When auto-negotiate is set to TRUE, and the interface has completed auto-negotiation with the remote peer, this value shows the duplex mode that has been negotiated.	3.0
negotiated-port-speed				When auto-negotiate is set to TRUE, and the interface has completed auto-negotiation with the remote peer, this value shows the interface speed that has been negotiated.	3.0
state/description				System-supplied description of the component	3.0
disconnect/reason/count				Count for a particular type of disconnect	3.0
negotiated-duplex-mode		FULL/ HALF		When auto-negotiate is set to TRUE, and the interface has completed auto-negotiation with the remote peer, this value shows the duplex mode that has been negotiated.	3.0

Connections (Global)

Connections (Global)	Units	Range	Name	Description	Minimum Software Version
resource-utilization/avg	%	0-100	RF Utilization	The number of available resource blocks that are consumed by traffic, including management, control, and data traffic, expressed as a percentage.	0.997
ul-subscriber-rate	Kbps			Refers to the latest aggregate uplink rate of all connections, in Kbps.	0.997
dl-subscriber-rate	Kbps			Refers to the latest aggregate downlink rate of all connections, in Kbps.	0.997
active-connections			Active Connections	The number of currently-connected remote nodes.	0.997

Appendix A Sample Configuration File (Secure Mode)

Sample configuration file for gNMIc using secure mode:

```
# This YAML configuration file is provided by Tarana Wireless for setting up the
telemetry streaming.
# Please refer to the 'Telemetry Streaming App Note' on instructions on how to
configure this feature.
# For additional details on gNMIc client please visit https://gnmic.kmrd.dev/
# This code is provided on an as is basis without any warranties of any kind.

# Enable one or more of the following outputs based on your specific requirements. We
have included 3 examples. More details available on the gNMIc User guide.
# output1 - streaming to standard output stream in 'string' format
# output2 - streaming to file in 'json' format
# output3 - streaming to InfluxDB time series database

#private key path
tls-key: "test.pem"
#Certificate path
tls-cert: "test.crt"
#tls-ca: "ca.pem"

# key which user is going to configure on tcs and in the file
access-key: "test12345"

outputs:
  output0:
    type: file
    format: json
    filename: "test_json.log"
  output1:
    type: file
    format: protojson
    filename: "test_protojson.log"
  output2:
    # required
    type: influxdb
    # influxDB server address
    url: http://x.x.x.x:8088
    # empty if using influxdb1.8.x
    org: "Tarana"
    # string in the form database/retention-policy. Skip retention policy for the
default on
    bucket: "Tarana"
    token: xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    # number of points to buffer before writing to the server
    batch-size: 10000
    # flush period after which the buffer is written to the server whether the
batch_size is reached or not
    flush-timer: 10s
    use-gzip: true
    enable-tls: false
```

Appendix B Sample Configuration File (Non-Secure Mode)

Sample configuration file for gNMIc using non-secure mode:

```
# This YAML configuration file is provided by Tarana Wireless for setting up the
telemetry streaming.
# Please refer to the 'Telemetry Streaming App Note' on instructions on how to
configure this feature.
# For additional details on gNMIc client please visit https://gnmic.kmrd.dev/
# This code is provided on an as is basis without any warranties of any kind.

# Enable one or more of the following outputs based on your specific requirements. We
have included 3 examples. More details available on the gNMIc User guide.
# output1 - streaming to standard output stream in 'string' format
# output2 - streaming to file in 'json' format
# output3 - streaming to InfluxDB time series database

outputs:
  output1:
    type: file
    file-type: stdout
    format: string
  # output2:
    # type: file
    # filename: streaming_output.log
    # format: json
  # output3:
    # type: influxdb
    # url: http://<SERVER_IP>:<INFLUXDB_PORT>
    # org: <ORGANIZATION_NAME>
    # bucket: <DATA_BUCKET>
    # token: <API_TOKEN>
```

About Tarana

Tarana Wireless, Inc. is the performance leader in next-generation fixed wireless access network solutions, powered by a number of industry-first and well-proven breakthroughs in perfect, multidimensional optimization of radio signals. Its Gigabit 1 fixed access system overcomes previously insurmountable network economics challenges for service providers in both mainstream broadband and underserved markets, using free unlicensed spectrum. The company is headquartered in Milpitas, California, with additional research and development in Pune, India. For more information, visit taranawireless.com.