



Configure Model-driven Telemetry

Model-driven Telemetry (MDT) provides a mechanism to stream data from an MDT-capable device to a destination. The data to be streamed is defined through subscription.

The data to be streamed is subscribed from a data set in a YANG model. The data from the subscribed data set is streamed out to the destination either at a configured periodic interval or only when an event occurs. This behavior is based on whether MDT is configured for cadence-based telemetry .

The following YANG models are used to configure and monitor MDT:

- **Cisco-IOS-XR-telemetry-model-driven-cfg.yang** and **openconfig-telemetry.yang**: configure MDT using NETCONF or merge-config over grpc.
- **Cisco-IOS-XR-telemetry-model-driven-oper.yang**: get the operational information about MDT.

The process of streaming MDT data uses these components:

- **Destination**: specifies one or more destinations to collect the streamed data.
- **Sensor path**: specifies the YANG path from which data has to be streamed.
- **Subscription**: binds one or more sensor-paths to destinations, and specifies the criteria to stream data. In cadence-based telemetry, data is streamed continuously at a configured frequency.
- **Transport and encoding**: represents the delivery mechanism of telemetry data.

For more information about the core components, see [Core Components of Model-driven Telemetry Streaming](#).

The options to initialize a telemetry session between the router and destination is based on two modes:

- Dial-out mode: The router initiates a session to the destinations based on the subscription.
- Dial-in mode: The destination initiates a session to the router and subscribes to data to be streamed.



Note Dial-in mode is supported only over gRPC.



Important

From Release 6.1.1 onwards, Cisco introduces support for the 64-bit Linux-based IOS XR operating system. The 64-bit platforms, such as NCS5500, NCS5000, ASR9000 support gRPC, UDP and TCP protocols. All 32-bit IOS XR platforms, such as CRS and legacy ASR9000, support only TCP protocol.

Streaming model-driven telemetry data to the intended receiver involves these tasks:

- [Configure Dial-out Mode, on page 2](#)
- [Configure Dial-in Mode, on page 8](#)

Configure Dial-out Mode

In a dial-out mode, the router initiates a session to the destinations based on the subscription.

All 64-bit IOS XR platforms (except for NCS 6000 series routers) support gRPC and TCP protocols. All 32-bit IOS XR platforms support only TCP.

For more information about the dial-out mode, see [Dial-out Mode](#).

The process to configure a dial-out mode involves:

Create a Destination Group

The destination group specifies the destination address, port, encoding and transport that the router uses to send out telemetry data.

1. Identify the destination address, port, transport, and encoding format.
2. Create a destination group.

```
Router(config)#telemetry model-driven
Router(config-model-driven)#destination-group <group-name>

Router(config-model-driven-dest)#address family ipv4 <IP-address> port <port-number>
Router(config-model-driven-dest-addr)#encoding <encoding-format>
Router(config-model-driven-dest-addr)#protocol <transport>
Router(config-model-driven-dest-addr)#commit
```

Example: Destination Group for TCP Dial-out

The following example shows a destination group `DGroup1` created for TCP dial-out configuration with key-value Google Protocol Buffers (also called self-describing-gpb) encoding:

```
Router(config)#telemetry model-driven
Router(config-model-driven)#destination-group DGroup1
Router(config-model-driven-dest)#address family ipv4 172.0.0.0 port 5432
Router(config-model-driven-dest-addr)#encoding self-describing-gpb
Router(config-model-driven-dest-addr)#protocol tcp
Router(config-model-driven-dest-addr)#commit
```

Example: Destination Group for gRPC Dial-out



Note gRPC is supported in only 64-bit platforms.

gRPC protocol supports TLS and model-driven telemetry uses TLS to dial-out by default. The certificate must be copied to `/misc/config/grpc/dialout/`. To by-pass the TLS option, use `protocol grpc no-tls`.

The following is an example of a certificate to which the server certificate is connected:

```
RP/0/RP0/CPU0:ios#run
Wed Aug 24 05:05:46.206 UTC
[xr-vm_node0_RP0_CPU0:~]$ls -l /misc/config/grpc/dialout/
total 4
-rw-r--r-- 1 root root 4017 Aug 19 19:17 dialout.pem
[xr-vm_node0_RP0_CPU0:~]$
```

The CN (CommonName) used in the certificate must be configured as `protocol grpc tls-hostname <>`.

The following example shows a destination group `DGroup2` created for gRPC dial-out configuration with key-value GPB encoding, and with tls disabled:

```
Router(config)#telemetry model-driven
Router(config-model-driven)#destination-group DGroup2
Router(config-model-driven-dest)#address family ipv4 172.0.0.0 port 57500
Router(config-model-driven-dest-addr)#encoding self-describing-gpb
Router(config-model-driven-dest-addr)#protocol grpc no-tls
Router(config-model-driven-dest-addr)#commit
```

The following example shows a destination group `DGroup2` created for gRPC dial-out configuration with key-value GPB encoding, and with tls hostname:

```
Configuration with tls-hostname:
Router(config)#telemetry model-driven
Router(config-model-driven)#destination-group DGroup2
Router(config-model-driven-dest)#address family ipv4 172.0.0.0 port 57500
Router(config-model-driven-dest-addr)#encoding self-describing-gpb
Router(config-model-driven-dest-addr)#protocol grpc tls-hostname hostname.com
Router(config-model-driven-dest-addr)#commit
```



Note If only the **protocol grpc** is configured without `tls` option, `tls` is enabled by default and `tls-hostname` defaults to the IP address of the destination.

What to Do Next:

Create a sensor group.

Create a Sensor Group

The `sensor-group` specifies a list of YANG models that are to be streamed.

1. Identify the sensor path for XR YANG model.
2. Create a sensor group.

```
Router(config)#telemetry model-driven
Router(config-model-driven)#sensor-group <group-name>
Router(config-model-driven-snsr-grp)# sensor-path <XR YANG model>
Router(config-model-driven-snsr-grp)# commit
```

Example: Sensor Group for Dial-out

Note gRPC is supported in only 64-bit platforms.

The following example shows a sensor group `SGroup1` created for dial-out configuration with the YANG model for interface statistics:

```
Router(config)#telemetry model-driven
Router(config-model-driven)#sensor-group SGroup1
Router(config-model-driven-snsr-grp)# sensor-path
Cisco-IOS-XR-infra-statsd-oper:infra-statistics/interfaces/interface/latest/generic-counters
Router(config-model-driven-snsr-grp)# commit
```

What to Do Next:

Create a subscription.

Create a Subscription

The subscription associates a destination-group with a sensor-group and sets the streaming method.

A source interface in the subscription group specifies the interface that will be used for establishing the session to stream data to the destination. If both VRF and source interface are configured, the source interface must be in the same VRF as the one specified under destination group for the session to be established.

```
Router(config)#telemetry model-driven
Router(config-model-driven)#subscription <subscription-name>
Router(config-model-driven-subs)#sensor-group-id <sensor-group> sample-interval <interval>

Router(config-model-driven-subs)#destination-id <destination-group>
Router(config-model-driven-subs)#source-interface <source-interface>
Router(config-mdt-subscription)#commit
```

Example: Subscription for Cadence-based Dial-out Configuration

The following example shows a subscription `Sub1` that is created to associate the sensor-group and destination-group, and configure an interval of 30 seconds to stream data:

```
Router(config)#telemetry model-driven
Router(config-model-driven)#subscription Sub1
Router(config-model-driven-subs)#sensor-group-id SGroup1 sample-interval 30000
Router(config-model-driven-subs)#destination-id DGroup1
Router(config-mdt-subscription)# commit
```

Validate Dial-out Configuration

Use the following command to verify that you have correctly configured the router for dial-out.

```
Router#show telemetry model-driven subscription <subscription-group-name>
```

Example: Validation for TCP Dial-out

```
Router#show telemetry model-driven subscription Sub1
Thu Jul 21 15:42:27.751 UTC
Subscription: Sub1                               State: ACTIVE
-----
Sensor groups:
  Id          Interval(ms)    State
  SGroup1     30000             Resolved

Destination Groups:
  Id          Encoding          Transport  State  Port  IP
  DGroup1     self-describing-gpb tcp        Active  5432  172.0.0.0
```

Example: Validation for gRPC Dial-out

Note gRPC is supported in only 64-bit platforms.

```
Router#show telemetry model-driven subscription Sub2
Thu Jul 21 21:14:08.636 UTC
Subscription: Sub2                               State: ACTIVE
-----
Sensor groups:
  Id          Interval(ms)    State
  SGroup2     30000             Resolved

Destination Groups:
  Id          Encoding          Transport  State  Port  IP
  DGroup2     self-describing-gpb grpc        ACTIVE  57500  172.0.0.0
```

The telemetry data starts steaming out of the router to the destination.

Example: Configure model-driven telemetry with different sensor groups

```
RP/0/RP0/CPU0:ios#sh run telemetry model-driven

Wed Aug 24 04:49:19.309 UTC

telemetry model-driven
destination-group 1
  address family ipv4 1.1.1.1 port 1111
  protocol grpc
  !
!

destination-group 2
  address family ipv4 2.2.2.2 port 2222
  !
!

destination-group test
  address family ipv4 172.0.0.0 port 8801
  encoding self-describing-gpb
  protocol grpc no-tls
  !
  address family ipv4 172.0.0.0 port 8901
  encoding self-describing-gpb
  protocol grpc tls-hostname chkpt1.com
```

```

!
!
sensor-group 1
  sensor-path Cisco-IOS-XR-plat-chas-invmgr-oper:platform-inventory/racks/rack
!

sensor-group mdt
  sensor-path Cisco-IOS-XR-telemetry-model-driven-oper:telemetry-model-driven
!

sensor-group generic
  sensor-path
Cisco-IOS-XR-infra-statsd-oper:infra-statistics/interfaces/interface/latest/generic-counters
!

sensor-group if-oper
  sensor-path Cisco-IOS-XR-pfi-im-cmd-oper:interfaces/interface-xr/interface
!

subscription mdt
  sensor-group-id mdt sample-interval 10000
!

subscription generic
  sensor-group-id generic sample-interval 10000
!

subscription if-oper
  sensor-group-id if-oper sample-interval 10000
  destination-id test
!
!

```

A sample output from the destination with TLS certificate chkpt1.com:

```
RP/0/RP0/CPU0:ios#sh telemetry model-driven dest
```

```
Wed Aug 24 04:49:25.030 UTC
Group Id      IP          Port    Encoding      Transport      State
-----
1             1.1.1.1    1111    none          grpc          ACTIVE
  TLS:1.1.1.1
2             2.2.2.2    2222    none          grpc          ACTIVE
  TLS:2.2.2.2
test         172.0.0.0  8801    self-describing-gpb grpc          Active
test         172.0.0.0  8901    self-describing-gpb grpc          Active
  TLS:chkpt1.com
```

A sample output from the subscription:

```
RP/0/RP0/CPU0:ios#sh telemetry model-driven subscription
```

```
Wed Aug 24 04:49:48.002 UTC
Subscription:  mdt                      State: ACTIVE
-----
Sensor groups:
  Id          Interval(ms)  State
  mdt         10000        Resolved

Subscription:  generic                  State: ACTIVE
```

```

-----
Sensor groups:
Id          Interval(ms)    State
generic     10000           Resolved

Subscription: if-oper          State: ACTIVE
-----
Sensor groups:
Id          Interval(ms)    State
if-oper     10000           Resolved

Destination Groups:
Id          Encoding        Transport    State    Port    IP
test       self-describing-gpb  grpc        ACTIVE  8801    172.0.0.0

No TLS :

test       self-describing-gpb  grpc        Active  8901    172.0.0.0
TLS :      chkptl.com

RP/0/RP0/CPU0:ios#sh telemetry model-driven subscription if-oper

Wed Aug 24 04:50:02.295 UTC
Subscription: if-oper
-----
State:      ACTIVE
Sensor groups:
Id: if-oper
Sample Interval: 10000 ms
Sensor Path:    Cisco-IOS-XR-pfi-im-cmd-oper:interfaces/interface-xr/interface
Sensor Path State: Resolved

Destination Groups:
Group Id: test
Destination IP: 172.0.0.0
Destination Port: 8801
Encoding: self-describing-gpb
Transport: grpc
State: ACTIVE
No TLS
Destination IP: 172.0.0.0
Destination Port: 8901
Encoding: self-describing-gpb
Transport: grpc
State: ACTIVE
TLS : chkptl.com
Total bytes sent: 120703
Total packets sent: 11
Last Sent time: 2016-08-24 04:49:53.52169253 +0000

Collection Groups:
-----
Id: 1
Sample Interval: 10000 ms
Encoding: self-describing-gpb
Num of collection: 11
Collection time:  Min: 69 ms Max: 82 ms
Total time:      Min: 69 ms Avg: 76 ms Max: 83 ms
Total Deferred: 0
Total Send Errors: 0
Total Send Drops: 0
Total Other Errors: 0
Last Collection Start:2016-08-24 04:49:53.52086253 +0000

```

Last Collection End: 2016-08-24 04:49:53.52169253 +0000
Sensor Path: Cisco-IOS-XR-pfi-im-cmd-oper:interfaces/interface-xr/interface

Configure Dial-in Mode

In a dial-in mode, the destination initiates a session to the router and subscribes to data to be streamed.



Note Dial-in mode is supported over gRPC in only 64-bit platforms.

For more information about dial-in mode, see *Dial-in Mode*.

The process to configure a dial-in mode involves these tasks:

- Enable gRPC
- Create a sensor group
- Create a subscription
- Validate the configuration

Enable gRPC

Configure the gRPC server on the router to accept incoming connections from the collector.

1. Enable gRPC over an HTTP/2 connection.

```
Router# configure
Router (config)# grpc
```

2. Enable access to a specified port number.

```
Router (config-grpc)# port <port-number>
```

The <port-number> range is from 57344 to 57999. If a port number is unavailable, an error is displayed.

3. In the configuration mode, set the session parameters.

```
Router (config)# grpc{ address-family | dscp | max-request-per-user | max-request-total
| max-streams | max-streams-per-user | no-tls | service-layer | tls-cipher | tls-mutual
| tls-trustpoint | vrf }
```

where:

- **address-family:** set the address family identifier type
- **dscp:** set QoS marking DSCP on transmitted gRPC
- **max-request-per-user:** set the maximum concurrent requests per user
- **max-request-total:** set the maximum concurrent requests in total
- **max-streams:** set the maximum number of concurrent gRPC requests. The maximum subscription limit is 128 requests. The default is 32 requests

- **max-streams-per-user:** set the maximum concurrent gRPC requests for each user. The maximum subscription limit is 128 requests. The default is 32 requests
- **no-tls:** disable transport layer security (TLS). The TLS is enabled by default.
- **service-layer:** enable the grpc service layer configuration
- **tls-cipher:** enable the gRPC TLS cipher suites
- **tls-mutual:** set the mutual authentication
- **tls-trustpoint:** configure trustpoint
- **server-vrf:** enable server vrf

4. Commit the configuration.

```
Router(config-grpc)#commit
```

The following example shows the output of `show grpc` command. The sample output displays the gRPC configuration when TLS is enabled on the router.

```
Router#show grpc
```

```
Address family           : ipv4
Port                     : 57300
VRF                      : global-vrf
TLS                      : enabled
TLS mutual               : disabled
Trustpoint               : none
Maximum requests        : 128
Maximum requests per user : 10
Maximum streams         : 32
Maximum streams per user : 32

TLS cipher suites
  Default                 : none
  Enable                  : none
  Disable                  : none

Operational enable      : ecdhe-rsa-chacha20-poly1305
                        : ecdhe-ecdsa-chacha20-poly1305
                        : ecdhe-rsa-aes128-gcm-sha256
                        : ecdhe-ecdsa-aes128-gcm-sha256
                        : ecdhe-rsa-aes256-gcm-sha384
                        : ecdhe-ecdsa-aes256-gcm-sha384
                        : ecdhe-rsa-aes128-sha
                        : ecdhe-ecdsa-aes128-sha
                        : ecdhe-rsa-aes256-sha
                        : ecdhe-ecdsa-aes256-sha
                        : aes128-gcm-sha256
                        : aes256-gcm-sha384
                        : aes128-sha
                        : aes256-sha

Operational disable    : none
```

What to Do Next:

Create a sensor group.

Create a Sensor Group

The sensor group specifies a list of YANG models that are to be streamed.

1. Identify the sensor path for XR YANG model.
2. Create a sensor group.

```
Router(config)#telemetry model-driven
Router(config-model-driven)#sensor-group <group-name>
Router(config-model-driven-snsr-grp)# sensor-path <XR YANG model>
Router(config-model-driven-snsr-grp)# commit
```

Example: Sensor Group for gRPC Dial-in

The following example shows a sensor group `SGroup3` created for gRPC dial-in configuration with the YANG model for interfaces:

```
Router(config)#telemetry model-driven
Router(config-model-driven)#sensor-group SGroup3
Router(config-model-driven-snsr-grp)# sensor-path openconfig-interfaces:interfaces/interface

Router(config-model-driven-snsr-grp)# commit
```

What to Do Next:

Create a subscription.

Create a Subscription

The subscription associates a sensor-group with a streaming interval. The collector requests the subscription to the sensor paths when it establishes a connection with the router.

```
Router(config)#telemetry model-driven
Router(config-model-driven)#subscription <subscription-name>
Router(config-model-driven-subs)#sensor-group-id <sensor-group> sample-interval <interval>

Router(config-model-driven-subs)#destination-id <destination-group>
Router(config-mdt-subscription)#commit
```

Example: Subscription for gRPC Dial-in

The following example shows a subscription `Sub3` that is created to associate the sensor-group with an interval of 30 seconds to stream data:

```
Router(config)telemetry model-driven
Router(config-model-driven)#subscription Sub3
Router(config-model-driven-subs)#sensor-group-id SGroup3 sample-interval 30000
Router(config-mdt-subscription)#commit
```

What to Do Next:

Validate the configuration.

Validate Dial-in Configuration

Use the following command to verify that you have correctly configured the router for gRPC dial-in.

```
Router#show telemetry model-driven subscription
```

Example: Validation for gRPC Dial-in

```
RP/0/RP0/CPU0:SunC#show telemetry model-driven subscription Sub3
Thu Jul 21 21:32:45.365 UTC
Subscription: Sub3
-----
State:          ACTIVE
Sensor groups:
Id: SGroup3
  Sample Interval:      30000 ms
  Sensor Path:         openconfig-interfaces:interfaces/interface
  Sensor Path State:   Resolved

Destination Groups:
Group Id: DialIn_1002
  Destination IP:      172.30.8.4
  Destination Port:   44841
  Encoding:           self-describing-gpb
  Transport:         dialin
  State:             Active
  Total bytes sent:   13909
  Total packets sent: 14
  Last Sent time:    2016-07-21 21:32:25.231964501 +0000

Collection Groups:
-----
Id: 2
Sample Interval:      30000 ms
Encoding:           self-describing-gpb
Num of collection:   7
Collection time:     Min:    32 ms Max:    39 ms
Total time:         Min:    34 ms Avg:    37 ms Max:    40 ms
Total Deferred:     0
Total Send Errors:  0
Total Send Drops:   0
Total Other Errors: 0
Last Collection Start:2016-07-21 21:32:25.231930501 +0000
Last Collection End: 2016-07-21 21:32:25.231969501 +0000
Sensor Path:         openconfig-interfaces:interfaces/interface
```

