Enhancements to Streaming Telemetry

This section provides an overview of the enhancements made to streaming telemetry data.

Hardware Timestamp

Table 1: Feature History Table

Feature Name	Release Information	Description
Hardware Timestamp	Release 7.3.1	Whenever periodic statistics are streamed, the collector reads the data from its internal cache, instead of fetching the data from the hardware. When the data is read from the cache, the rate at which data is processed shows spikes because the timestamp from the collector is off by several seconds. With hardware timestamping, the inconsistencies that are observed when reading data from the cache file is removed.

Whenever periodic stats are streamed, the collector reads the stats from its internal cache, instead of fetching the stats from the hardware. When the data is read from the sensor paths of Stats manager cache, the rate calculation shows spikes. This behavior is due to the timestamp from the collector that is off by several seconds. Therefore, timestamp of some other collector takes precedence because timestamps of collectors are not in synchronization with the current timestamp. This is observed when there are multiple collectors providing stats updates for the same interface.

The YANG data model for Stats manager `Cisco-IOS-XR-infra-statsd-oper.yang` is enhanced to enable the collector to read periodic stats data from the router using hardware timestamp.

The hardware timestamp is taken into account when a primary collector (for generic or proto stats) provides stats updates from the hardware to the Stats manager. With hardware timestamping in rate computation while streaming periodic stats, the spikes due to the timestamp issue is resolved.

The hardware timestamp is updated only when the collector attempts to read the counters from hardware. Else, the value remains `0`. The latest stats can be streamed at a minimum cadence of 10 seconds and periodic stats at a cadence of 30 seconds. The support is available only for physical interfaces and subinterfaces, and bundle interface and subinterfaces.

When there is no traffic flow on protocols for an interface, the hardware timestamp for the protocols is published as 0. This is due to non-synchronized timestamps sent by the collector for protocols in traffic as compared to non-traffic scenarios.

A non-zero value is published for protocols that have stats published by a primary collector for both traffic and non-traffic scenarios.

Note The hardware timestamp is supported only for primary collectors. When the hardware has no update, the timestamp will be same. However generic counters are computed for primary and non-primary collectors. The non-primary collectors show the latest stats, but not the timestamp.

When the counters are cleared for an interface using **clear counters interface** command, all counter-related data including the timestamps for the interface is cleared. After all counter values are cleared and set to `0`, the last data time is updated only when there is a request for it from a collector. For example, last data time gets updated from a collector:

```
Router#:Aug  7 09:01:08.471 UTC: statsd_manager_l[168]: Updated last data time for ifhandle
 0x02000408,
stats type 2 from collector with node 0x100, JID 250, last data time 1596790868.
INPUT: last 4294967295 updated 1596469986. OUTPUT: last 4294967295 updated 1596469986
```

All other counter values and hardware timestamp are updated when the counters are fetched from the hardware. In this case, all counters including the hardware timestamp is 0:

```
{"node_id_str":"MGBL_MTB_5504","subscription_id_str":"app_TEST_200000001",
"encoding_path":"Cisco-IOS-XR-infra-statsd-oper:infra-statistics/interfaces/interface/cache/generic-counters",
"collection_id":"7848",
"collection_start_time":"1596790879567",
"msg_timestamp":"1596790879571","data_json":
[{"timestamp":"1596790879570","keys":[{"interface-name":"FortyGigE0/1/0/11"}],
"content":{"packets-received":"0","bytes-received":"0","packets-sent":"0",
"bytes-sent":"0","multicast-packets-received":"0","broadcast-packets-received":"0",
"multicast-packets-sent":"0","broadcast-packets-sent":"0","output-drops":0,"output-queue-drops":0,
"input-drops":0,"input-queue-drops":0,"runt-packets-received":0,"giant-packets-received":0,
"throttled-packets-received":0,"parity-packets-received":0,"unknown-protocol-packets-received":0,
"input-errors":0,"crc-errors":0,"input-overruns":0,"framing-errors-received":0,"input-ignored-packets":0,
"input-aborts":0,"output-errors":0,"output-underruns":0,"output-buffer-failures":0,"output-buffers-swapped-out":0,
"applique":0,"resets":0,"carrier-transitions":0,"availability-flag":0,
"last-data-time":"1596790868","hardware-timestamp":"0",
"seconds-since-last-clear-counters":15,"last-discontinuity-time":1596469946,"seconds-since-packet-received":0,
"seconds-since-packet-sent":0}}],"collection_end_time":"1596790879571"}
```

gNMI Dial-Out via Tunnel Service

Table 2: Feature History Table

Feature Name	Release Information	Description
gNMI Dial-Out via Tunnel Service	Release 7.6.1	This feature uses the tunnel service to allow the router (tunnel client) to dial out to a collector (tunnel server). After the session is established, the server-client switch directions where a server can act as a client to request gNMI services without altering the gNMI semantics. With this feature, the management software automatically learns when a new device is introduced in the network, thus saving you the manual, offline effort required to ensure the device connects to the management software. This feature introduces the keyword **tunnel** to the **grpc** command.

Prior to Cisco IOS XR, Release 7.6.1, gNMI supports a dial-in session where a client connects to the router via gRPC server with the gNMI specification. This feature introduces support to use a tunnel service for gNMI dial-out connections based on the recommendation from OpenConfig forum.

With the gNMI dial-out through tunnel service, the router (tunnel client) dials out to a collector (tunnel server). Once the session is established, the tunnel server can act as a client and request gNMI services and gNMI Subscribe RPCs over the tunnel session. This feature allows a change in direction of session establishment and data collection without altering the gNMI semantics. Using gRPC tunnel dial-out session, the router initiates the connection to external collector so that the management software is automatically aware when a new device is introduced into the network.

For more information about gNMI dial-out via gRPC tunnel, see the Github repository.

Note Only the gNMI Subscribe RPC over the tunnel is supported.

Note The tunnel service supports only Transport Layer Security (TLS) session.

Perform the following steps to configure gNMI dial-out via tunnel service:

Step 1 Configure a third-party application (TPA) source address. This address sets a source hint for Linux applications, so that the traffic originating from the applications can be associated to any reachable IP (IPv4 or IPv6) address on the router.

Example:

```
Router(config)#tpa
Router(config)#vrf default
Router(config-vrf)#address-family ipv4
Router(config-vrf)#update-source dataports TenGigE0/6/0/0/1
```

A default route is automatically gained in the Linux shell.

Step 2 Configure the gNMI tunnel service on the router.

Example:

```
Router(config)#grpc tunnel destination ipv4
port 59510 source-interface TenGigE0/6/0/0/1 target Target-1 vrf default
```

Where—

- source-interface: Source ethernet interface
- target: Target name to register the tunnel service
- vrf: Virtual Routing and Forwarding (VRF) instance for the dial-out session. If VRF and source-interface are configured, VRF takes precedence over the source-interface.

Step 3 Verify that the gRPC tunnel configuration is successful on the router.

Example:

```
Router#show run grpc
Wed Nov 24 19:37:21.015 UTC
grpc
  port 57500
  no-tls
  tunnel
    destination 5.0.0.2 port 59510
      target Target-1
      source-interface GigabitEthernet0/0/0/1
    !
    destination 2002::1:2 port 59510
       source-interface GigabitEthernet0/0/0/0
    !
    destination 192.0.0.1 port 59500
    !
    destination 192.0.0.1 port 59600
    !
  !
!
```

Step 4 View the status of tunnel destination.

Example:

```
Router#show grpc tunnel sessions
Wed Nov 24 19:41:38.863 UTC
 5.0.0.2:59510
 Target:           Target-1
 Status:           Not connected
 Error:            Source Interface is down
 Source interface: GigabitEthernet0/0/0/1
```

```
Source address:   5.0.0.1
Source VRF:       default

[2002::1:2]:59510
Target:           Target-2
Status:           Connected
Source interface: GigabitEthernet0/0/0/0
Source address:   2002::1:1
Source VRF:       default
Last Connected:   2021-11-24 19:41:23

192.168.122.1:59500
Target:           Target-2
Status:           Connected
Last Connected:   2021-11-24 19:40:15

192.168.122.1:59600
Target:           Target-2
Status:           Not connected
Error:            cert missing /misc/config/grpc/192.0.0.1:59600.pem
Last Attempted:   2021-11-24 19:41:15
```

Step 5 Copy the public certificate for the collector to `/misc/config/grpc/<ip-addr>:<port>.pem` directory. The router uses this certificate to verify the tunnel server, and establish a dial-out session.

Step 6 Run the collector.