



## Y.1564 - Ethernet Service Activation Test

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## Y.1564 - Ethernet Service Activation Test

With the deployment of Ethernet in service provider networks, ethernet services have evolved significantly. Not only is ethernet found at the User Network Interface (UNI) but can also be deployed anywhere in the network, creating a Network-to-Network Interface (NNI). With the capability to prioritize traffic, high availability, and its built-in resiliency, service providers are now using this technology to deliver advanced services. In the absence of any standardized test methodologies that can measure delay, jitter, loss, and throughput at a port, the ITU-T recommendation Y.1564 addresses the gap

Y.1564 - Ethernet Service Activation Test (or performance test methodology) is a testing procedure which tests service turn-up, installation, and troubleshooting of Ethernet-based services. This test methodology was created to have a standard way of measuring Ethernet-based services in the industry.

This testing procedure is now supported on Cisco Routers that have the Cisco NCS57 line cards installed and operate in the Native mode.

On NCS 5700 Series NCS-57B1-5DSE-SYS/NCS-57B1-6D24-SYS fixed chassis, Service Activation/Deactivation Test (SAT/SADT) and its related features will not function for ETM-enabled optics controller interfaces.

Cisco implementation of ITU-T Y.1564 has three key objectives:

- To serve as a network SLA validation tool, ensuring that a service meets its guaranteed performance settings in a controlled test time.
- To ensure that all services carried by the network meet their SLA objectives at their maximum committed rate, thus proving that under maximum load, network devices and paths can support all traffic as designed.
- To perform medium-term and long-term service testing, confirming that network elements can properly carry all services while under stress during a soaking period.

The following Key Performance Indicators (KPI) metrics are collected to ensure that the configured SLAs are met for the service or stream.

- Frame Transfer Delay (FTD) or latency—Measures the round-trip time (RTT) taken by a test frame to travel through a network device, or across the network and back to the test port.
- Frame Loss Ratio (FLR)—Measures the number of packets lost from the total number of packets sent. Frame loss can be due to a number of issues such as network congestion or errors during transmissions.

### Supported Modes

The mode of operation that is supported for Y.1564 is the Two-way statistics collection mode. In the two-way mode, the sender generates the test traffic used to perform the test, which is then looped back by the remote node. The statistics are measured and collected locally on the sender.

The following encapsulations are supported by Y.1564 SADT feature:

- dot1q
- dot1q + second dot1q
- dot1ad
- dot1ad + second dot1q
- priority tagged
- untagged
- default




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**Note** Before Cisco IOS XR Software Release 24.2.1, default encapsulation is supported if there are no other subinterfaces configured with untagged encapsulation. Starting Cisco IOS XR Software Release 24.2.1, default encapsulation is supported.

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### Restrictions for Default Encapsulation for ITU-T Y.1564 Service Activation Test

The following are the restrictions for default encapsulation mode for Y.1564 Service Activation Test:

- Default encapsulation with cos value isn't supported.
- Multiple parallel sessions with default encapsulation aren't supported. Default Encapsulation packets lack VLAN priority, and the SAT engine can only differentiate sessions based on the CoS value.
- If there are subinterfaces for both encap *untagged* and *default*, then only the SAT sessions over *untagged* works. But SAT sessions over *default* encap don't work. The packets are handled by an untagged sub interface.
- If there are subinterface for both *tagged* encapsulation and *default*, then only the SAT sessions work over the *default* interface but not over the *tagged* interface. Both function only if the session over the *tagged* interface is initiated before the *default* session.
- When the *default* interface session is initiated first, the absence of VLAN priority qualifier causes tagged packets to also trigger the default PMF entry, resulting in frame loss for tagged packets.

To know more about default encapsulation refer *Configure Virtual LANs in Layer 2 VPNs* Chapter in the L2VPN Configuration Guide for NCS 5500 Series Routers.

### Usage Guideline and Limitations

- Rewrite with POP option is supported with Color Blind mode with Outer-Cos value of 0.
- Rewrite Push and Translate on Encapsulation Untagged is not supported.
- Y.1564 doesn't support L1 loopback.
- Y.1564 over bundle with members from multiple NPU is not supported.
- Y.1564 doesn't support measuring and analyzing jitter.
- When utilizing the SAT engine received bytes statistics feature, there can be potential inaccuracies in the following conditions:
  - During tests incorporating EMIX sequences that encounter packet drops.
  - When handling LMM packets originating from TGEN, Y.1731 protocols, or any unidentified sources.
- SAT supports a scale of four parallel sessions per system. However, all four sessions can not operate as color aware sessions simultaneously due to limitations in Class of Service (CoS) combinations.
- SAT over bundle interface functions by selecting one of its members for transmission. Therefore, at least one member must be in the 'UP' state to initiate an SAT session. For modular chasis, bundle member from the different LCs is not supported.
- For optimal performance, it's recommended to use the Ethernet Data Plane Loopback functionality (EDPL) on the peer side for SAT. EDPL loops back and swaps the MAC addresses of Layer 2 packets generated. If the peer node doesn't support EDPL functionality, you can configure SAT to generate Layer 2 packets with the destination MAC address equal to the source MAC address. In such cases, the peer can perform an L1 loopback.
- Packets generated by SAT with PRBS payload at certain packet sizes may have PRBS errors. When configuring GTF packet using `bcm_sat_gtf_packet_config_set`, this is verified. If the `payload_type` is `bcmSatPayloadPRBS` and packets generated at the configured `packet_length` have PRBS error, this API now returns `BCM_E_PARAM` to the caller. The user is informed about the PRBS error through the test abort reason.
  - On BCM8869X, packets have PRBS errors, if  $(\text{packet\_length} + 63) / 64$  is one of [4, 6, 10, 12, 13, 14] or  $\geq 18$ .
  - On BCM8880X, packets have PRBS errors, if  $(\text{packet\_length} + 63) / 64$  equals to 6 or  $\geq 33$ .

### Platform GTF Rate

The following table includes the GTF rate for different platforms.

Platform (PID)	Platform Name	Asic Type	XR Release	DTHO	GTF Rate
NCS540	Tortin	QAX	7.1.1	Yes	19.2 Gbps

NCS560	RSP4	QMX	7.1.2	Yes	19.2 Gbps
NCS540L	Bigbend	QAX	7.1.2	Yes	19.2 Gbps
NCS4K	Scapa	Arad	6.5.31	Yes	23 Gbps
NCS5501	Taihu	QMX	7.1.1	Yes	19.2 Gbps
NCS-5501-SE	Turin	QMX	7.1.1	Yes	19.2 Gbps
NCS55A1-48Q6H	BiFrost	Jericho+	7.1.2	Yes	23 Gbps
NCS55A2_MOD_S_SE	Peyto	Jericho+	7.1.2	Yes	23 Gbps
NCS-55A1-36H-SE-S	Old Castle	Jericho+	7.4.2	No	23 Gbps
NCS-55A1-36H-S	Old Castle CR (non-SE)	Jericho+	7.4.2	No	23 Gbps
NCS-55A1-24Q6H-S	TurinCR	Jericho+	7.1.1	No	23 Gbps
NCS-55A1-24Q6H-SS	TurinCRMAC	Jericho+	7.1.1	No	23 Gbps
NCS-55A1-24H	Pyke	Jericho+	7.1.1	No	23 Gbps
NCS-5502-SE	Zermatt	Jericho	7.1.1	No	23 Gbps
N540X-6Z18G-SYS-A	Beagle	QUX	7.3.1	No	8 Gbps
N540X-4Z14G2Q-D	Fitzroy	QUX	7.3.1	No	8 Gbps
N540X-8Z16G-SYS-D	Galapagos	QUX	7.3.1	No	8 Gbps
N540-6Z14S-SYS-D	Meerkat	QUX	7.3.1	No	8 Gbps
NCS-57C1-48Q6-SYS	Twins	Q2C	7.8.1	Yes	300 or 400 Gbps
NCS-57C3-MODS-SYS	Eyrie	Jericho2C	7.8.1	Yes	400 Gbps
NCS-57B1-5DSE-SYS	Shadow Tower	Jericho2	7.8.1	Yes	400 Gbps
N540-24Q8L2DD-SYS	Arches	Q2A	7.8.1	Yes	300 Gbps

NCS-57D2-18DD-SYS	CastleBlack	Jericho2C+	Future Release	No	400 Gbps
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## CoS DEI Support Matrix

*Table 1: Class of Service (CoS) and Discard Eligibility Identifier (DEI) Matrix*

		CoS							
		0	1	2	3	4	5	6	7
DEI	0	Ö	Ö	Ö	Ö	Ö	X	Ö	X
	1	Ö	Ö	X	X	X	X	X	X

Ö - Supported

X- Not Supported

## Supported Bandwidth Parameters

Bandwidth Parameters	Internal Direction	External Direction
Committed Information Rate	Y	Y
Exceeded Information Rate	Y	Y

## Service Activation Test Target Matrix

Target	Internal Direction	External Direction
L2 Interface over physical main/sub interfaces	Y	Y
L2 Interface over bundle main/sub interfaces	Y	Y
L2 PW VPWS over physical main/sub interfaces	Y	Y
L2 PW VPWS over bundle main/sub interfaces	Y	Y
L2 EVPN/XConnect over physical main/sub interfaces	Y	Y
L2 EVPN/XConnect over bundle main/sub interfaces	Y	Y
L2 VPLS PW	N	N

Target	Internal Direction	External Direction
L2 EVPN Bridge-Domain	N	N
L3 Interfaces	N	N

## Configuration Examples

The following example shows how to start service-activation test on an interface with external direction:

```
RP/0/RP0/CPU0:router ethernet service-activation-test start interface TenGigE 10/0/0/1
profile test destination 00ab.6009.9c3c direction external
```

The following example shows how to start service-activation test on an interface with internal direction:

```
RP/0/RP0/CPU0:router ethernet service-activation-test start interface TenGigE 10/0/0/1
profile test destination 00ab.6009.9c3c direction internal
```

The following example shows how to stop service-activation-test on an interface:

```
RP/0/RP0/CPU0:router ethernet service-activation-test stop interface TenGigE 10/0/0/1
```

The following example shows how to stop all service-activation-tests:

```
RP/0/RP0/CPU0:router ethernet service-activation-test stop all
```

## Configuring Ethernet Service Activation Test Color Profile

The following example shows how to configure a color-blind profile for ethernet service activation test:

```
RP/0/RP0/CPU0:router#configure
RP/0/RP0/CPU0:router(config)# ethernet service-activation-test
RP/0/RP0/CPU0:router(config-ethsat)#profile sattest1
RP/0/RP0/CPU0:router(config-ethsat-prf)#outer-cos 4
RP/0/RP0/CPU0:router(config-ethsat-prf)#duration 8 minutes
RP/0/RP0/CPU0:router(config-ethsat-prf)#information-rate 11800 mbps
RP/0/RP0/CPU0:router(config-ethsat-prf)#packet-size 1000
```

The following example shows how to configure a color-aware profile for ethernet service activation test:

```
RP/0/RP0/CPU0:router#configure
RP/0/RP0/CPU0:router(config)# ethernet service-activation-test
RP/0/RP0/CPU0:router(config-ethsat)#profile sattest3
RP/0/RP0/CPU0:router(config-ethsat-prf)#outer-cos 4
RP/0/RP0/CPU0:router(config-ethsat-prf)#duration 1 minutes
RP/0/RP0/CPU0:router(config-ethsat-prf)#color-aware cir 7 gbps eir-color cos 1
RP/0/RP0/CPU0:router(config-ethsat-prf)#information-rate 8 gbps
RP/0/RP0/CPU0:router(config-ethsat-prf)#packet-size 1000
```

## Verification

To verify the interfaces on which Y.1564 (ethernet service activation test) is enabled, use the **show ethernet service-activation-test brief** command. The following is a sample output of an enabled device:

```
RP/0/RP0/CPU0:router#show ethernet service-activation-test brief
Interface TenGigE0/0/0/14.1
  Service activation tests permitted (external only)
```

Test completed:  
Duration 1 minute(s)  
Information rate 1 Gbps  
Color-aware, CIR: 900 Mbps, EIR: DEI set, CoS 1  
External, Two-way, Destination 00:11:00:22:00:33  
Packet size EMIX, Sequence 'abceg', Pattern hex 0x00  
Packet format: SAT MEF-49  
Outer CoS 2

Results:  
Step 1, Information Rate 1 Gbps  
CIR packets:  
Tx packets: 11276845, bytes: 6743553310  
Rx packets: 11276845, bytes: 6743553310  
FL: 0, FLR: 0%  
FD: Min 5.144us, Mean 6.681us, Max 9.576us  
IFDV: Not supported  
Out of order packets: 0 (0%)  
Error packets: 0 (0%)  
  
EIR packets:  
Tx packets: 1252895, bytes: 749231210  
Rx packets: 1252895, bytes: 749231210  
FL: 0, FLR: 0%  
FD: Min 5.160us, Mean 6.679us, Max 8.800us  
IFDV: Not supported  
Out of order packets: 0 (0%)  
Error packets: 0 (0%)

# Optional Source MAC Address for Y.1564 Service Activation Test

Table 2: Feature History Table

Feature Name	Release Information	Feature Description
Optional Source MAC Address for Y.1564 Service Activation Test	Release 24.1.1	<p>Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers</p> <p>By specifying the source MAC address to the ITU-T Y.1564 SAT, you can ensure that the test results are relevant and applicable to the specific service configuration for use in production and before deployment for your customers.</p> <p>This feature introduces the following change:</p> <p><b>Modified CLI:</b></p> <p>The <b>source</b> keyword is added to the <b>ethernet service-activation-test</b> command.</p> <p><b>YANG DATA Model:</b></p> <ul style="list-style-type: none"> <li>New XPath for Cisco-IOS-XR-ethernet-sat-act.yang (see <a href="#">Github</a>, <a href="#">YANG Data Models Navigator</a>)</li> </ul>

Prior to Cisco IOS XR Software Release 24.1.1, the default local interface MAC address was automatically employed as the source MAC address for the test traffic. This approach lacked flexibility and customization options, as you were restricted to the default address. With the optional source MAC address extension, you can specify the exact source MAC address you wish to use in the test traffic. This functionality empowers you to tailor the test sessions according to your specific requirements and network configurations.

## Add Source MAC Address for a Y.1564 Service Activation Test

Use the **source** keyword in the **ethernet service-activation-test** command to specify a source MAC address for a Y.1564 Service Activation Test.

**Step 1** Use the **ethernet service-activation-test** command to configure a profile.

```
Router(config)#ethernet service-activation-test
Router(config-ethsat)#profile prof1
```



```
Router(config-ethsat-prf)#duration 1 minutes
Router(config-ethsat-prf)#information-rate 1 mbps
Router(config-ethsat-prf)#root
Router(config)#interface TenGigE0/0/0/1
Router(config-if)#ethernet service-activation-test
Router(config-if-ethsat)#permit all
Router(config-if-ethsat)#commit
```

**Step 2** Run the **ethernet service-activation-test** command in exec mode to specify source MAC address for an SAT:

```
Router#ethernet service-activation-test start interface TenGigE0/0/0/1 profile prof1 destination
00ab.6009.9c3c source 0000.1000.001d direction external
```

**Step 3** The **show ethernet service-activation-test in-progress** command displays the source MAC address.

```
Router#show ethernet service-activation-test in-progress
Fri Oct 21 03:50:55.658 PDT
Interface TenGigE0/0/0/1
Service activation tests permitted
Test in progress, 1 minute(s) remaining:
  Duration 1 minute(s)
  Information rate 1 Mbps
  External, Two-way, Destination 00ab.6009.9c3c, Source 0000.1000.001d
```

---

# Loopback Frames for Y.1564 Service Activation Test

Table 3: Feature History Table

Feature Name	Release Information	Feature Description
Loopback Frames for Y.1564 Service Activation Test	Release 24.1.1	<p>Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers</p> <p>This feature enables the redirection of test traffic from the destination router to the source router in loopback message (LBM) format. Loopback message enables the measurement of various parameters and performance metrics, such as frame delay, frame loss rates, and QoS settings, after the traffic has completed its round trip.</p> <p>Such comprehensive measurement helps identify issues within the network setup. You can also use it to ensure the service is running and meets the SLA.</p> <p>This feature introduces the following change:</p> <p><b>CLI:</b></p> <p>The <b>packet-format lbm</b> keyword is added to the <b>ethernet service-activation-test profile</b> command.</p> <p><b>YANG DATA Model:</b> New XPath for Cisco-IOS-XR-ethernet-sat-cfg.yang (see <a href="#">Github</a>, <a href="#">YANG Data Models Navigator</a>)</p>

In a typical Y.1564 Service Activation Test scenario, traffic flows from a source router to a destination router. However, with the inclusion of the loopback-message packet-format configuration, the traffic that reaches the destination router can be redirected back to the source router through a loopback interface. Now, the data packets are used in LBM format.

The collection of statistics start once the source router receives the test traffic from the destination.

Prior to Cisco IOS XR Software Release 24.1.1, tests were conducted independently in each direction, with traffic flowing from the source to the destination router. The data packets were used in Loss Measurement Message (LMM) format for Frame Loss (FL).

To enable this functionality, use the **packet-format lbm** keyword in the **ethernet service-activation-test profile** command. Once **packet-format lbm** is configured, data packets are used as per MEF-49.

## Configure Loopback for Test Traffic in a Y.1564 Service Activation Test

The following configuration example shows how to configure loopback frames for Y.1564 Service Activation Test.

**Step 1** Use the **ethernet service-activation-test profile** command to configure loopback for a test traffic.

```
Router(config)#ethernet service-activation-test
Router(config-ethsat)#profile p1
Router(config-ethsat-prf)#duration 2 minutes
Router(config-ethsat-prf)#information-rate 5 gbps
Router(config-ethsat-prf)#packet-format lbm
Router(config-ethsat-prf)#root
Router(config)#interface TenGigE0/0/0/12
Router(config-if)#ethernet service-activation-test
Router(config-if-ethsat)#permit all
Router(config-if-ethsat)#commit
```

Example of SAT results:

```
Results:
Step 1, Information Rate 5 Gbps
CIR packets:
Tx packets: 313509436, bytes: 160516831232
Rx packets: 313464074, bytes: 160493605888
FL: 45362, FLR: 0%
FD: Min 5.244us, Mean 6.122us, Max 8.188us
IFDV: Not supported
Out of order packets: 0 (0%)
Error packets: 0 (0%)

EIR packets:
Tx packets: 0, bytes: 0
Rx packets: 0, bytes: 0
FL: 0, FLR: 0%
FD: Min 0.000us, Mean 0.000us, Max 0.000us
IFDV: Min 0.000us, Mean 0.000us, Max 0.000us
Out of order packets: 0 (0%)
Error packets: 0 (0%)
```

**Step 2** Use the **show running-config** command for the running configuration

```
Router#show running-config
Wed Feb 14 14:37:59.418 UTC
!
ethernet service-activation-test
profile p1
duration 2 minutes
information-rate 5 gbps
packet-format lbm
!
!
interface TenGigE0/0/0/12
ethernet service-activation-test
permit all
!
```

**Step 3** The `show ethernet service-activation-test` command shows that `packet-format lbm` is configured.

```
Router#show ethernet service-activation-test
Thu Feb 29 06:38:33.435 UTC
Interface TenGigE0/0/0/19
Service activation tests permitted
Test in progress, 179 minute(s) remaining:
Duration 2 minute(s)
Information rate 5 Gbps
Color-blind
External, Two-way, Destination 0A:AA:0B:BB:0C:CC
Packet size 512, Pattern hex 0x00
Packet format: Y.1731 LBM
CoS not set
```

---

# Combined Frame Delay and Frame Loss Measurement for Y.1564 Service Activation Test

Table 4: Feature History Table

Feature Name	Release Information	Feature Description
Combined Frame Delay and Frame Loss Measurement for Y.1564 Service Activation Test	Release 24.1.1	<p>Introduced in this release on: NCS 5500 fixed port routers; NCS 5700 fixed port routers</p> <p>We have enhanced the ITU-T Y.1564 Service Activation Testing (SAT) capabilities by enabling a comprehensive service quality measurement that includes network responsiveness, congestion, and other issues degrading network performance. This feature also allows a holistic testing of the QoS SLAs, which helps identify potential issues faster and troubleshoot effectively.</p> <p>This feature introduces the following change:</p> <p><b>CLI:</b></p> <p>The <b>measurement combined</b> keyword is added to the <b>ethernet service-activation-test profile</b> command.</p> <p><b>YANG DATA Model:</b></p> <ul style="list-style-type: none"> <li>• New XPath for <code>Cisco-IOS-XR-ethernet-sat-cfg.yang</code> (see <a href="#">Github</a>, <a href="#">YANG Data Models Navigator</a>)</li> </ul>

You can configure the SAT test to measure both delay and loss simultaneously for each frame transmitted and received. This configuration allows for the consolidated calculation of both delay and loss using Frame Delay (FD) packets. By setting the Frame Loss (FL) rate to 0% in the generator function, the test focuses solely on calculating delay and loss metrics using Delay Measurement Message (DMM) frames. This means that every frame sent and received is analyzed for delay and loss characteristics.

Prior to Cisco IOS XR Software Release 24.1.1 release, either FD or FL could be measured at a time

Furthermore, the configuration treats out-of-order packets in the same manner as the transmitted packets since there is no sequence numbering on the DMM packets. This approach ensures that all frames, regardless of their order of arrival, are accounted for in the measurement of delay and loss.

## Configure Measurement Combined for a Y.1564 Service Activation Test

The following configuration example shows how to configure combined frame delay and frame loss measurements for Y.1564 Service Activation Test.

**Step 1** Use the **ethernet service-activation-test profile** command to configure **measurement combined** for a test traffic.

```
Router(config)#ethernet service-activation-test
Router(config-ethsat)#profile p1
Router(config-ethsat-prf)#duration 10 minutes
Router(config-ethsat-prf)#information-rate 1 gbps
Router(config-ethsat-prf)#measurement combined
Router(config-ethsat-prf)#root
Router(config)#interface TenGigE0/0/0/12
Router(config-if)#ethernet service-activation-test
Router(config-if-ethsat)#permit all
Router(config-if-ethsat)#commit
```

Example of SAT results:

```
Results:
Step 1, Information Rate 1 Gbps
CIR packets:
Tx packets: 2929519174, bytes: 1499913817088
Rx packets: 20696794, bytes: 10596758528
FL: 2908822380, FLR: 99%
FD: Min 5.232us, Mean 18.642us, Max 63.032us
IFDV: Not supported
Out of order packets: 0 (0%)
Error packets: 0 (0%)

EIR packets:
Tx packets: 0, bytes: 0
Rx packets: 0, bytes: 0
FL: 0, FLR: 0%
FD: Min 0.000us, Mean 0.000us, Max 0.000us
IFDV: Min 0.000us, Mean 0.000us, Max 0.000us
Out of order packets: 0 (0%)
Error packets: 0 (0%)
```

**Step 2** Use the **show running-configuration** command for the running configuration

```
Router#show running-config
Wed Feb 14 14:37:59.418 UTC
!
ethernet service-activation-test
profile p1
duration 10 minutes
information-rate 1 gbps
measurement combined
!
!
interface TenGigE0/0/0/12
ethernet service-activation-test
permit all
!
```

**Step 3** The **show ethernet service-activation-test** command shows frame loss and frame delay are measured on every frame.

```
Router#show ethernet service-activation-test in-progress
Tue Dec 14 08:18:22.981 PST
Interface TenGigE0/0/0/12
  Service activation tests permitted
  Test in progress, 10 minute(s) remaining:
    Duration 10 minute(s)
    Information rate 1 gbps
    Color-blind
    External, Two-way, Destination Source 2001:DB8:0:ABCD::1
    Packet size 1024, Pattern hex 0x00
    Packet format: SAT MEF-48
    Delay and loss measured on every frame
    CoS not set
```

---

