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Y.1564 Capabilities on the ASR 920



The objective of this document is to provide an in-depth understanding of the capabilities of ASR 920 platform with respect to Y.1564 service activation. This document assumes the reader has a basic understanding of Y.1564.

Overview of Y.1564

The ITU-T recommendation Y.1564 defines an out-of-service test methodology to confirm the proper configuration and performance of an Ethernet service prior to customer delivery and covers the case of both a point-to-point and point-to-multipoint topology. This service activation acceptance testing of Ethernet-based services can be implemented as a test function inside of a network element and this is the case examined below - specifically for the Cisco ASR 920 Aggregation Services Router series of products.

Modes of Operation

There are various modes of operation for Y.1564, namely:

- Traffic generation
- Passive measurement
- Two way statistics collection

In the traffic generation mode, the ASR 920 can generate traffic and send out over the interface on which the service is to be running. With this capability there is no need for an external traffic generator to test the service since it is generated internally. In the later portion of this document we examine the range of traffic profiles possible to generate on ASR 920.

In the passive measurement mode, the router measures the traffic received on an interface. This mode is used to measure the traffic received at the remote node in order to validate that the service has been configured correctly in that particular direction. In this mode ASR920 can measure traffic sent by any other traffic generator. It does not necessarily have to be an ASR920 generating the traffic.

In the two-way statistics collection mode, all measurements are done locally on the sender. The traffic generated from the local sender is looped back from the remote node (so called "responder" node). For the responder node to

be able to return the received traffic back to the sender, a loopback has to be configured and then enabled before starting the test. There is no requirement of sync in the two-way statistics collection mode.

Traffic generation and measurement

Traffic can be generated as external or internal on ASR920. External here does not mean traffic generated from an external traffic generator. External traffic generation, also known as *facility generation*, is the traffic generation from the NNI interface configured on ASR920 towards the service provider network. It is the egress traffic generated from the interface.



Internal traffic generation also known as *terminal generation* is the traffic generation from the UNI interface configured on the ASR920 towards the service provider network on the NNI interface traversing the forwarding plane of the node. Internal traffic generation is similar to the traffic received on a UNI interface and then traversing the forwarding plane of ASR920 and then send out on the NNI interface configured on ASR920.

The traffic that arrives at the far end node can either be measured by configuring passive measurement mode at the far end node or it can be looped back by configuring and enabling the loopback at the remote node.

The measurement done at the far end node is called the passive mode. In the passive mode there are two ways to do the measurement, internal and external. External measurement is done on the NNI interface whereas internal measurement is done on the UNI interface. The traffic measured at the UNI interface with "internal" measurement-type direction traverses the forwarding plane of ASR920.

For traffic looped at the far end node measurement is done at the local sender node. The measurement direction must match the traffic generation direction in the IP SLA configuration. This traffic generation and measurement at the local sender node is called the "two-way statistics collection" mode.

Network Types and Traffic Target Types

The service running on a network could be a Layer-2 or a Layer-3 service.

Within the Layer-2 service activation testing the following traffic target types are supported:

- i) Bridge Domains
- ii) Service Instance

A traffic target type is the type of interface a UNI (User-to-Network Interface) or NNI (Network-to-Network Interface) is configured as. To explain it further, the traffic can be generated and measured on a bridge domain interface or service instance interface.

Within the Layer-3 service activation testing the following traffic target types are supported.

- i) Physical interface
- ii) Service Instance
- iii) Bridge Domains
- iv) VRF

Another term which will be used extensively in this document is the "traffic direction". Traffic direction could be internal or external. The following tables show the different traffic target types and direction supported on ASR920.

 Table 1.
 Layer 2 SLA Target Type and Traffic direction

Target Types	Traffic Direction
Service Instance	Internal and External
Bridge-domain	Internal

Table 2. Layer 3 SLA Target Type and Traffic direction

Target Types	Traffic Direction
Physical Interface	Internal
Service Instance	Internal
Bridge-domain	Internal
VRF	Internal

Traffic Profiles

The ASR920 has the flexibility to generate the traffic with custom values inside a **Layer-2** or **Layer-3** packet header.

Layer-2 traffic profile gives admin the flexibility to configure the following values:

- i. Outer-vlan
- ii. Inner-vlan
- iii. Outer-cos
- iv. Inner-cos
- v. Ether-type
- vi. Source mac-address

vii. Packet-size (64,128,256,512,1024,1280,1518,9216 and IMIX)

Layer-3 traffic profile gives the admin the flexibility to configure the following values:

IMIX Ratio is 64 bytes 7 packets 512 bytes 4 packets 1518 bytes 1 packet

- i. Outer-vlan
- ii. Source ip-address
- iii. Packet-size (64,128,256,512,1024,1280,1518,9216 and IMIX)
- iv. DSCP

Y.1564 configuration steps

The following steps are required to configure, enable and verify Y.1564 service activation testing:

- i. IP SLA configuration
- ii. Loopback configuration and activation (only for two-way statistics collection mode)
- iii. IP SLA activation or Test activation
- iv. IP SLA Statistics verification

Sample Configuration Layer-2 Traffic

Let us examine the sample configuration for Layer-2 traffic generation, measurement and two-way mode. Two target types, Service Instance and Bridge Domain, are supported on the ASR920 with color-aware and color-blind traffic generation.

Traffic generation mode, Target-type Service Instance



IP SLA Configuration

```
ip sla 1
service-performance type ethernet dest-mac-addr 0011.1111.1111 interface Te0/0/3
service instance 1
frequency iteration 2 delay 1
```

```
profile packet
outer-vlan 10
profile traffic direction external
rate-step kbps 10000
duration time 100
```

```
NNI Interface
interface TenGigabitEthernet0/0/3
service instance 1 ethernet
  encapsulation dot1q 10
  bridge-domain 10
```

IP SLA Activation

ip sla schedule 1 start-time now

IP SLA Verification

show ip sla statistics 1

IPSLAs Latest Operation Statistics

IPSLA operation id: 1 Type of operation: Ethernet Service Performance Test mode: Traffic Generator Steps Tested (kbps): 10000 Test duration: 100 seconds

Latest measurement: *09:11:13.435 UTC Mon Oct 17 2016 Latest return code: Oper End of Life Step 1 (10000 kbps): Stats: Tx Packets: 1885626 Tx Bytes: 120680064 Step Duration: 100 seconds

Traffic generation mode, Target-type Bridge-domain

IP SLA Configuration

<pre>ip sla 1 service-performance type ethernet dest-mac-addr 00ab.co profile packet outer-vlan 10 profile traffic direction internal</pre>	def.1234 bridge-domain 10
rate-step kbps 100000 ip sla schedule 1 start-time now	For Target-type bridge-
UNI Interface	domain only internal
interface GigabitEthernet0/0/1 service instance 1 ethernet encapsulation dot1q 10	traffic generation is supported.
bridge-domain 10	
NNI Interface	
interface TenGigabitEthernet0/0/3 service instance 1 ethernet encapsulation dot1q 10 bridge-domain 10	

Traffic direction external means the traffic is generated from NNI interface Te0/0/3 towards the network. For internal traffic generation use 'traffic direction internal' and interface Gi0/0/1 instead of Te0/0/3. Both UNI and NNI must be in the same bridgedomain for internal traffic generation.

IP SLA Activation

ip sla schedule 1 start-time now

IP SLA Verification

IPSLAs Latest Operation Statistics

IPSLA operation id: 1 Type of operation: Ethernet Service Performance Test mode: Traffic Generator Steps Tested (kbps): 100000 Test duration: 100 seconds

Latest measurement: *12:36:07.627 UTC Mon Oct 17 2016 Latest return code: Oper End of Life

Step 1 (100000 kbps): Stats:

```
Tx Packets: 18864018 Tx Bytes: 1207297152
Step Duration: 100 seconds
```

Passive mode, Target-type Service-instance



IP SLA Configuration

```
ip sla 1
service-performance type ethernet dest-mac-addr
0011.1111.1111 interface TenGigabitEthernet0/0/15 service
instance 1
measurement-type direction external
receive
```

interface TenGigabitEthernet0/0/15
service instance 1 ethernet
 encapsulation dot1q 10
 bridge-domain 10

IP SLA Activation

ip sla schedule 1 start-time now

IP SLA Verification

For measuring at UNI interface measurementtype direction internal is used and UNI interface Te0/0/14 is used instead of NNI Te0/0/15.

```
#sh ip sla statistics
IPSLAs Latest Operation Statistics
```

IPSLA operation id: 1 Type of operation: Ethernet Service Performance Test mode: Passive Measurement Test duration: 50 seconds

Latest measurement: *16:34:40.389 UTC Thu Sep 8 2016 Latest return code: OK

Stats: IR(kbps) 5790 Rx Packets: 565692 Rx Bytes: 36204288 Step Duration: 50 seconds

The Rx Packets value must exactly match the transmitted Packets at the generator in order to verify the service configuration and performance.

Passive mode, Target-type Bridge-domain

IP SLA Configuration

```
ip sla 1
service-performance type ethernet dest-mac-
00ab.cdef.1234 bridge-domain 10
measurement-type direction internal
receive
duration time 50
```

Interface Configuration

```
interface TenGigabitEthernet0/0/15
service instance 1 ethernet
  encapsulation dot1q 10
  bridge-domain 10
```

interface TenGigabitEthernet0/0/14
service instance 1 ethernet
 encapsulation dot1q 10
 bridge-domain 10

IP SLA Activation

ip sla schedule 1 start-time now

IP SLA Statistics

sh ip sla statistics IPSLAs Latest Operation Statistics

```
IPSLA operation id: 1
Type of operation: Ethernet Service Performance
Test mode: Passive Measurement
Test duration: 50 seconds
```

Latest measurement: *23:34:24.694 UTC Thu Sep 8 2016 Latest return code: OK

In the target type bridgedomain only internal traffic direction is supported addr

Stats: IR(kbps) 61146 **Rx Packets:** 5659188 **Rx Bytes:** 384824784 Step Duration: 50 seconds

Two-way statistics collection mode, Target-type Service Instance

In the two-way statistics collection mode both traffic generation and measurement are done in a single "ip sla" instance. Both traffic generation and measurement-type must have the same direction either internal or external.



Sample Configuration for Target-type Service Instance, Traffic direction internal, Loopback internal

Below is the sample configuration of two-way statistics collection mode for traffic generation internal and loopback internal. In this example, on the traffic generator ASR920 the generated traffic will be directed towards the service-instance (UNI interface G0/0/1) which is the Target-type and looped back at the UNI Te0/0/14 interface on the responder ASR920.

Traffic generator



Responder

```
interface TenGigabitEthernet0/0/15
service instance 1 ethernet
    encapsulation dot1q 10
    bridge-domain 10
interface TenGigabitEthernet0/0/14
service instance 1 ethernet
    encapsulation dot1q 10
    bridge-domain 10
    ethernet loopback permit internal
```

Both NNI and UNI must be in the same bridge domain.

Loopback Activation

ethernet loopback start local interface te0/0/14 service instance 1 internal dot1q 10 timeout none

IP SLA Statistics

R2#sh ip sla statistics 1 IPSLAs Latest Operation Statistics

IPSLA operation id: 1 Type of operation: Ethernet Service Performance Test mode: Two-way Measurement Steps Tested (kbps): 100000 Test duration: 100 seconds

Latest measurement: *15:22:11.517 UTC Mon Oct 17 2016 Latest return code: Oper End of Life

Overall Throughput: 99412 kbps

Step 1 (100000 kbps):
Stats:
IR(kbps) FL FLR Avail FTD Min/Avg/Max FDV Min/Avg/Max
99412 0 0.00% 100.00% 137.12us/182.36us/192.96us
10.72us/11.35us/55.76us
Tx Packets: 818613 Tx Bytes: 1242654534
Rx Packets: 818613 Rx Bytes: 1242654534
Step Duration: 100 seconds

Sample Configuration for Target-type Service Instance, Traffic direction external, Loopback external



Below is the sample configuration of two-way statistics collection mode for traffic generation external and loopback external. In this example the traffic is generated from the NNI interface Te0/0/3 on the traffic generator ASR920 and looped back at the NNI Te0/0/15 interface on the responder ASR920.

Traffic Generator

```
ip sla 1
service-performance type ethernet dest-mac-addr 0011.1111.1111 interface Te t0/0/3
service instance 1
 frequency iteration 2 delay 1
 measurement-type direction external
  delay
   jitter
   loss
  receive
  throughput
 profile packet
  outer-vlan 10
  packet-size 1518
 profile traffic direction external
  rate-step kbps 100000
  duration time 100
ip sla schedule 1 start-time now
interface TenGigabitEthernet0/0/3
service instance 1 ethernet
  encapsulation dot1q 10
 bridge-domain 10
```

Responder

```
interface TenGigabitEthernet0/0/15
service instance 1 ethernet
encapsulation dot1q 10
bridge-domain 10
ethernet loopback permit external
```

Loopback activation

ethernet loopback start local interface te0/0/15 service instance 1 external dot1q 10 timeout none

Two-way statistics collection mode, Target-type Bridge-domain

In the two-way statistics collection mode both traffic generation and measurement are done in a single "ip sla" instance. Both traffic generation and measurement-type must have the same direction either internal or external.



Sample Configuration for Target-type Bridge-domain

Below is the sample configuration of two-way statistics collection mode for traffic generation internal and loopback internal. In this example, on traffic generator ASR920 the traffic generated will be directed towards the Bridge-Domain 10 which is the Target-type and looped back at the UNI Te0/0/14 interface on the responder ASR920. Target-type bridge-domain supports only internal traffic generation.

Traffic Generator

IP SLA Configuration

```
ip sla 1
 service-performance type ethernet dest-mac-addr 00ab.cdef.1234 bridge-domain 10
  measurement-type direction internal
   delay
   jitter
   loss
   receive
   throughput
  profile packet
   outer-vlan 10
  profile traffic direction internal
   rate-step kbps 100000
Interface configuration
                                                         Both NNI and UNI must be
```

```
interface GigabitEthernet0/0/1
service instance 1 ethernet
 encapsulation dot1q 104
 bridge-domain 10
```

```
interface TenGigabitEthernet0/0/3
service instance 1 ethernet
encapsulation dot1q 10
bridge-domain 10
```

in the same bridge-domain.

IP SLA Activation

ip sla schedule 1 start-time now

Responder

```
interface TenGigabitEthernet0/0/15
service instance 1 ethernet
   encapsulation dot1q 10
   bridge-domain 10
interface TenGigabitEthernet0/0/14
```

ethernet loopback permit internal

service instance 1 ethernet encapsulation dot1q 10 bridge-domain 10 Loopback configured on the UNI

Loopback Activation

ethernet loopback start local interface te0/0/14 service instance 1 internal dot1q 10 timeout none

IP SLA Statistics

R2#sh ip sla statistics 1 details IPSLAs Latest Operation Statistics

```
IPSLA operation id: 1
Service Performance Operation
Type: ethernet
Destination
MAC Address: 0011.1111.1111
VLAN:
Interface:
Service Instance:
EVC Name:
Duration Time: 100
Interval Buckets: 1
```

Signature:

Description:

Measurement Type: throughput, delay, loss, receive Direction: internal Color Conform: COS: Not Set EXP: Not Set DSCP: Not Set Color Exceed: COS: Not Set EXP: Not Set DSCP: Not Set Color Violate: COS: Not Set EXP: Not Set DSCP: Not Set

Profile Traffic: Direction: internal CIR: 0 EIR: 0 CBS: 0 EBS: 0 Burst Size: 0 Burst Duration: 0 Inter Burst Interval: 0

```
Rate Step (kbps): 100000
Profile Packet[0] :
Inner COS: Not Set
Outer COS: Not Set
Inner VLAN: Not Set
Outer VLAN: 10
DSCP: default
Packet Size: 1518
Source MAC Address: Not Set
EtherType: default
Number of Packets: 100
Type of operation: Ethernet Service Performance
Test mode: Two-way Measurement
Steps Tested (kbps): 100000
Test duration: 100 seconds
Latest measurement: *18:48:50.849 UTC Mon Oct 17 2016
Latest return code: Oper End of Life
Overall Throughput: 99412 kbps
Step 1 (100000 kbps):
Stats:
                               Avail
                                        FTD Min/Avg/Max
IR(kbps)
         FL
                      FLR
99412
         0
                      0.00%
                               100.00% 133.68us/178.86us/190.48us
Tx Packets: 818613 Tx Bytes: 1242654534
Rx Packets: 818613 Rx Bytes: 1242654534
Step Duration: 100 seconds
```

Sample Configuration Layer-3 Traffic

Let us examine the sample configuration for Layer-3 traffic generation, measurement, and two-way mode. The four target types supported on ASR920 traffic generation are Physical interface, Service Instance, Bridge Domain and VRF. With Layer-3, only internal traffic generation and measurement are supported. Also, the loopback direction supported on the responder is internal only.



Two-way statistics collection mode, Target-type Service-instance

In the two-way statistics collection mode both traffic generation and measurement type are done in a single "ip sla" instance. Both traffic generation and measurement-type must be internal because only internal mode of traffic generation is supported in Layer-3.

Sample Configuration for Target-type Service Instance

Traffic Generator

```
IP SLA Configuration
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 interface GigabitEthernet0/0/1
service instance 1
  frequency iteration 1 delay 1
  measurement-type direction internal
   delay
                                                            Same source-ip and
   jitter
                                                            destination-ip must be used
   loss
   receive
                                                            in the responder IP SLA
   throughput
                                                            configuration
  profile packet
   source-ip-addr 30.1.1.1
   outer-vlan 10
  profile traffic direction internal
   rate-step kbps 10000
  duration time 100
Interface configuration
interface TenGigabitEthernet0/0/3
service instance 1 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
 bridge-domain 11
interface GigabitEthernet0/0/1
service instance 1 ethernet
  encapsulation dot1g 10
  rewrite ingress tag pop 1 symmetric
 bridge-domain 10
                                                            In Layer-3 mode, loopback
                                                            on the responder is
interface BDI10
                                                            configured within IP SLA
ip address 30.1.1.1 255.255.255.0
interface BDI11
                                                            configuration
 ip address 192.168.1.2 255.255.255.0
Responder
Loopback configuration
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 interface
TenGigabitEthernet0/0/14 service instance 1
  frequency iteration 1 delay 1
  loopback direction internal
    profile packet
   source-ip-addr 30.1.1.1
   outer-vlan 10
  duration time 1000
```

Interface configuration

```
interface TenGigabitEthernet0/0/15
service instance 1 ethernet
encapsulation dot1q 10
rewrite ingress tag pop 1 symmetric
bridge-domain 10
```

interface TenGigabitEthernet0/0/14
service instance 1 ethernet
 encapsulation dot1q 10
 rewrite ingress tag pop 1 symmetric
 bridge-domain 11

interface BDI10 ip address 192.168.1.1 255.255.255.0

interface BDI11 ip address 20.1.1.1 255.255.255.0

IP SLA Statistics

R2#sh ip sla statistics IPSLAs Latest Operation Statistics IPSLA operation id: 1 Test mode: Two-way Measurement Steps Tested (kbps): 100000 Test duration: 100 seconds Latest measurement: *17:51:36.214 UTC Thu Oct 13 2016 Latest return code: Oper End of Life Overall Throughput: 96583 kbps Step 1 (100000 kbps): Stats: IR(kbps) FL FLR Avail FTD Min/Avg/Max FDV Min/Avg/Max 96583 0 0.00% 100.00% 29.76us/58.66us/94.44us 160ns/890ns/64.52us Tx Packets: 18864018 Tx Bytes: 1207297152 Rx Packets: 18864018 Rx Bytes: 1207297152 Step Duration: 100 seconds

Sample Configuration for Target-type Bridge-domain

Traffic Generator

IP SLA Configuration

```
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 bridge-domain 10
frequency iteration 1 delay 1
measurement-type direction internal
delay
jitter
loss
receive
throughput
profile packet
source-ip-addr 30.1.1.1
profile traffic direction internal
rate-step kbps 100000
duration time 100
```

IP SLA Activation ip sla schedule 1 start-time now

Interface Configuration

NNI Interface

interface TenGigabitEthernet0/0/3
ip address 192.168.1.2 255.255.255.0

UNI Interface

```
interface GigabitEthernet0/0/1
service instance 1 ethernet
encapsulation dot1q 10
rewrite ingress tag pop 1 symmetric
bridge-domain 10
```

```
interface BDI10
ip address 30.1.1.1 255.255.255.0
```

Responder

Loopback configuration

```
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 bridge-domain 10
frequency iteration 1 delay 1
loopback direction internal
profile packet
source-ip-addr 30.1.1.1
duration time 1000
```

IP SLA Activation or loopback activation on responder

ip sla schedule 1 start-time now

Interface configuration

NNI Interface

```
interface TenGigabitEthernet0/0/15
ip address 192.168.1.1 255.255.255.0
```

UNI Interface

```
interface TenGigabitEthernet0/0/14
no ip address
service instance 1 ethernet
encapsulation dot1q 10
rewrite ingress tag pop 1 symmetric
bridge-domain 10
interface BDI10
ip address 20.1.1.1 255.255.255.0
```

IP SLA Statistics

```
sh ip sla statistics details
IPSLAs Latest Operation Statistics
IPSLA operation id: 1
Service Performance Operation
Type: ip
Destination
Destination address: 20.1.1.1
VLAN:
```

Layer-3 loopback on the responder is configured within IP SLA configuration

Interface: Service Instance: EVC Name: Duration Time: 100 Interval Buckets: 1 Signature: Description: Measurement Type: throughput, delay, jitter, loss, receive Direction: internal Color Conform: COS: Not Set EXP: Not Set DSCP: Not Set Color Exceed: COS: Not Set EXP: Not Set DSCP: Not Set Color Violate: COS: Not Set EXP: Not Set DSCP: Not Set Profile Traffic: Direction: internal CIR: 0 EIR: 0 CBS: 0 EBS: 0 Burst Size: 0 Burst Duration: 0 Inter Burst Interval: 0 Rate Step (kbps): 100000 Profile Packet[0] : Source IP: 30.1.1.1 Tunnel EXP: Not Set Packet Size: Not Set Outer VLAN: Not Set Number of Packets: 100 Test mode: Two-way Measurement Steps Tested (kbps): 100000 Test duration: 100 seconds Latest measurement: *22:44:22.630 UTC Thu Oct 13 2016 Latest return code: Oper End of Life Overall Throughput: 96583 kbps Step 1 (100000 kbps): Stats: IR(kbps) FL FLR Avail FTD Min/Avg/Max FDV Min/Avg/Max 96583 0.00% 100.00% 28.96us/58.09us/61.12us 80ns/839ns/31.84us 0 Tx Packets: 18864018 Tx Bytes: 1207297152 Rx Packets: 18864018 Rx Bytes: 1207297152 Step Duration: 100 seconds

Sample Configuration for Target-type Physical Interface

Traffic Generator

```
IP SLA Configuration
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 interface GigabitEthernet0/0/1
frequency iteration 1 delay 1
measurement-type direction internal
delay
jitter
loss
receive
throughput
profile packet
```

```
source-ip-addr 30.1.1.1
profile traffic direction internal
rate-step kbps 10000
duration time 100
```

IP SLA Activation

ip sla schedule 1 start-time now

Interface Configuration

```
interface TenGigabitEthernet0/0/3
ip address 192.168.1.2 255.255.255.0
```

```
interface GigabitEthernet0/0/1
ip address 30.1.1.1 255.255.255.0
```

Responder

Loopback configuration

```
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 interface
TenGigabitEthernet0/0/14
frequency iteration 1 delay 1
loopback direction internal
profile packet
source-ip-addr 30.1.1.1
duration time 1000
```

Loopback activation

```
ip sla schedule 1 start-time now
```

Interface configuration

```
interface TenGigabitEthernet0/0/15
ip address 192.168.1.1 255.255.255.0
```

```
interface TenGigabitEthernet0/0/14
ip address 20.1.1.1 255.255.255.0
```

IP SLA Statistics

```
sh ip sla statistics
IPSLAs Latest Operation Statistics
IPSLA operation id: 1
Test mode: Two-way Measurement
Steps Tested (kbps): 10000
Test duration: 100 seconds
Latest measurement: *11:12:05.192 UTC Thu Aug 25 2016
Latest return code: Oper End of Life
Overall Throughput: 9654 kbps
Step 1 (10000 kbps):
Stats:
IR(kbps) FL
                      FLR
                               Avail
                                        FTD Min/Avg/Max
                                                             FDV Min/Avg/Max
9654
                      0.00%
                               100.00% 28.96us/30.52us/67.00us
          0
240ns/1.11us/37.88us
Tx Packets: 1885626 Tx Bytes: 120680064
Rx Packets: 1885626 Rx Bytes: 120680064
Step Duration: 100 seconds
```

Sample Configuration for Target-type VRF

Traffic Generator

IP SLA Configuration

```
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 vrf 4
frequency iteration 2 delay 1
measurement-type direction internal
delay
loss
receive
throughput
profile packet
source-ip-addr 30.1.1.1
profile traffic direction internal
rate-step kbps 100000
duration time 100
```

This is VRF ID

IP SLA Activation

ip sla schedule 1 start-time now

Interface configuration

```
interface TenGigabitEthernet0/0/3
vrf forwarding 1564
ip address 192.168.1.2 255.255.255.0
interface GigabitEthernet0/0/1
vrf forwarding 1564
ip address 30.1.1.1 255.255.255.0
```

Responder

Loopback configuration

```
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 vrf 3
frequency iteration 1 delay 1
loopback direction internal
profile packet
source-ip-addr 30.1.1.1
duration time 1000
```

Loopback Activation

```
ip sla schedule 1 start-time now
```

Interface Configuration

```
interface TenGigabitEthernet0/0/15
vrf forwarding 1564
ip address 192.168.1.1 255.255.255.0
```

interface TenGigabitEthernet0/0/14
vrf forwarding 1564
ip address 20.1.1.1 255.255.255.0

IP SLA Statistics

sh ip sla statistics 1 IPSLAs Latest Operation Statistics

IPSLA operation id: 1 Test mode: Two-way Measurement Steps Tested (kbps): 100000 Test duration: 100 seconds

Latest measurement: *01:45:32.818 UTC Tue Oct 18 2016 Latest return code: Oper End of Life Overall Throughput: 96583 kbps Step 1 (100000 kbps): Stats: IR(kbps) FL FLR Avail FTD Min/Avg/Max 96583 0 0.00% 100.00% 28.96us/58.09us/61.12us Tx Packets: 18864018 Tx Bytes: 1207297152 Rx Packets: 18864018 Rx Bytes: 1207297152 Step Duration: 100 seconds

Interop with ASR9K

There could be scenarios where ASR920 is the traffic generator and ASR9K is the responder.



In this test the loopback is configured on ASR9K 8x100GE card.

Traffic Generator

```
IP SLA Configuration
ip sla 1
 service-performance type ethernet dest-mac-addr 5897.bd26.b39a interface
TenGigabitEthernet0/0/26 service instance 1
  frequency iteration 1 delay 1
  measurement-type direction external
   delay
                                                                    The dest-mac-addr
   jitter
                                                                    and src-mac-addr
   loss
   receive
                                                                    must match the
   throughput
                                                                    NNI interface of
  profile packet
                                                                    the generator. In
   outer-vlan 10
   src-mac-addr 5897.bd26.b39a
                                                                    this case Te0/0/26
  profile traffic direction external
   rate-step kbps 100000
  duration time 100
```

IP SLA Activation

ip sla schedule 1 start-time now

Interface Configuration interface TenGigabitEthernet0/0/26 service instance 1 ethernet encapsulation dotlq 10 bridge-domain 10

Responder

interface TenGigE0/1/0/1/5
loopback line

IP SLA Statistics

#sh ip sla statistics IPSLAs Latest Operation Statistics

IPSLA operation id: 1 Type of operation: Ethernet Service Performance Test mode: Two-way Measurement Steps Tested (kbps): 100000 Test duration: 100 seconds

Latest measurement: 01:30:26.895 UTC Wed Nov 16 2016 Latest return code: Oper End of Life

Overall Throughput: 96583 kbps

Step 1 (100000 kbps): Stats:

 IR (kbps)
 FL
 FLR
 Avail
 FTD Min/Avg/Max
 FDV Min/Avg/Max

 96583
 0
 0.00%
 100.00%
 9.90us/42.55us/4294.95ms

 160ns/858ns/4294.94ms
 Tx
 Packets:
 18864018
 Tx Bytes:
 1207297152

 Rx
 Packets:
 18864018
 Rx Bytes:
 1207297152

 Step Duration:
 100 seconds

Interop with a regular Traffic generator

In order to validate the traffic generator capabilities of ASR920 the traffic generated from ASR920 and received on a regular traffic generator is examined. In this example the traffic generated from an ASR920 is received on an IXIA test equipment across a Layer-2 network.



```
jitter
loss
receive
throughput
profile packet
outer-vlan 10
profile traffic direction internal
rate-step pps 100
duration time 100
```

IP SLA Activation ip sla schedule 1 start-time now



The below screen shot shows the IXIA stats matching the ip sla stats on ASR920.

In order to validate the traffic measuring capabilities of ASR920 the traffic sent from a regular traffic generator and received on an ASR920 in passive mode is examined. In this example the traffic generated from an IXIA test equipment is received on an ASR920 across a Layer-2 network.



Explore Network Resources 🚊 🕮 Card 01 - 10/100/1000 LSM XMV16 Stats For 172.27.153.53:01.05 Count 🗄 📲 Port 01 - 100/1000 Base X Link State Link Up 🛓 📲 Port 02 - 10/100/1000 Base T Line Speed 1000 Mbps 🖮 📲 Port 03 - 100/1000 Base X Duplex Mode Full 庄 📲 Port 04 - 100/1000 Base X Frames Sent 6,278,548 🚊 📲 Port 05 - 100/1000 Base X Valid Frames Received 0 副 Packet Streams 401,827,072 Bytes Sent Statistic View Bytes Received 0 🚊 💼 Management Interface 0 Fragments

Undersize

CRC Errors

FTP-Root — telnet 172.27.153.57 — 96×23

Oversize and Good CRCs

Flow Control Frames Received

Vlan Tagged Frames

Alignment Errors

0

0

0

0

0

0

The below screen shot shows the IXIA stats matching the ip sla stats on ASR920.

```
R1#sh ip sla statistics
IPSLAs Latest Operation Statistics
IPSLA operation id: 1
Type of operation: Ethernet Service Performance
Test mode: Passive Measurement
Test duration: 50 seconds
Latest measurement: 14:23:11.726 UTC Mon Nov 28 2016
Latest return code: OK
Stats:
IR(kbps)
66430
Rx Packets: 6278548 Rx Bytes: 401827072
Step Duration: 48 seconds
```

🖹 MII Internal

🗄 💼 Management Interface

💼 📲 Port 07 - 10/100/1000 Base T

Port 08 - 10/100/1000 Base T
 Port 09 - 10/100/1000 Base T

🚊 📲 Port 06 - 100/1000 Base X

🛍 Packet Streams

🔛 Statistic View

• • •

Ξ

Color-Aware Mode

The color mode allows the customer to pre-mark their traffic with a priority tag rather than letting the service provider blindly enforce the CIR/EIR/CBS/EBS algorithm on the traffic.

The ASR920 has the capability to generate color-aware traffic. For example, the traffic generated can be configured with 100Mbps CIR with priority tag 5 and 50Mbps EIR with priority tag 4 in order to validate the QoS performance and configurations for a specific service.

In the color-blind mode, the ASR920 generates the traffic without any priority tagging and the network will treat all ingress traffic equally and enforce the CIR, EIR, CBS, EBS values blindly.

Color-aware mode is supported for both Layer-2 and Layer-3 traffic generations and measurements. Only internal traffic generation and measurement are supported in color-aware mode.

Sample Configuration Layer-2 Traffic Color-Aware

Target-type Service-instance

Traffic Generator

```
ip sla 1
service-performance type ethernet dest-mac-addr 0011.1111.1111 interface
GigabitEthernet0/0/1 service instance 1
  frequency iteration 1 delay 1
  measurement-type direction internal conform-color cos 4 exceed-color cos 5
   delay
   loss
   receive
                                                        The commands in the
   throughput
                                                        bold are used to
  profile packet
                                                        configure the color
   outer-vlan 10
   packet-size 1518
                                                        aware mode in the IP
  profile traffic direction internal
                                                        SLA configuration.
   cir 100000
   eir 50000
   rate-step kbps 200000
   conform-color set-cos-transmit 4
   exceed-color set-cos-transmit 5
  duration time 100
UNI Interface
interface GigabitEthernet0/0/1
service instance 1 ethernet
  encapsulation dot1g 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 10
NNI Interface
interface TenGigabitEthernet0/0/3
 service instance 1 ethernet
  encapsulation dot1g 10
  rewrite ingress tag pop 1 symmetric
 bridge-domain 10
```

IP SLA Activation ip sla schedule 1 start-time now

IP SLA Statistics

sh ip sla statistics IPSLAs Latest Operation Statistics IPSLA operation id: 1 Type of operation: Ethernet Service Performance Test mode: Two-way Measurement Steps Tested (kbps): 200000 Test duration: 100 seconds Latest measurement: *22:43:29.685 UTC Mon Nov 7 2016 Latest return code: Oper End of Life Overall Throughput: 149733 kbps Step 1 (200000 kbps): CIR Stats: IR(kbps) FL 0.00% FLR Avail FTD Min/Avg/Max 100.00% 137.12us/163.44us/223.36us 99822 0 Tx Packets: 821992 Tx Bytes: 1247783856 Rx Packets: 821992 Rx Bytes: 1247783856 Step Duration: 100 seconds EIR Stats: IR(kbps) FL FLR Avail FTD Min/Avg/Max 49911 0 0.00% 100.00% 170.40us/189.76us/226.08us Tx Packets: 410998 Tx Bytes: 623894964 Rx Packets: 410998 Rx Bytes: 623894964 Step Duration: 100 seconds

In the below traffic captures CoS values configured in the above example are seen.

No.	Time	Source	Destination	Protocol	Length Info			~
	1 0.000000	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10	
	2 0.000013	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10	
	3 0.000025	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10	
	4 0.000037	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10	
	5 0.000050	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 5	CFI: 0	ID: 10	
	6 0.000062	a8:9d:21:a1:4f:51	Intel_11:11:11	0×ffff	1518 PRI: 5	CFI: 0	ID: 10	
	7 0.000506	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10	
	8 0.000518	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10	~
2	0 0 000504	0 0 1 00 0 00 00	7	A 6666		^		2
∎F	rame 1: 1518 b	oytes on wire (12144	i bits), 1518 bytes	captured	(12144 bits)	1		
ΞE	thernet II, Sr	<pre> a8:9d:21:a1:4f:</pre>	51 (a8:9d:21:a1:4f:	51), Dst:	Intel_11:11:	11 (00:1	1:11:11:11:11)	
Ξ 8	02.10 virtual	LAN, PRI: 4, CFI: 0), ID: 10					
	100	= Priority:	Controlled Load (4)				
	0	= CFI: Canor	nical (0)					
	0000 000	00 1010 = ID: 10						
	Type: Unknown	n (Oxffff)						
ΞC	ata (1500 byte	es)						

Ν	vo.	Time	Source	Destination	Protocol	Length Info				
Г		1 0.000000	a8:9d:21:a1:4f:51	Intel_11:11:11	0×ffff	1518 PRI: 4	CFI: 0	ID: 10		
н		2 0.000013	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10		
н		3 0.000025	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10		
н		4 0.000037	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 4	CFI: 0	ID: 10		
н		5 0.000050	a8:9d:21:a1:4f:51	Intel_11:11:11	0xffff	1518 PRI: 5	CFI: 0	ID: 10		
г		6 0.000062	a8:9d:21:a1:4f:51	Intel_11:11:11	0×ffff	1518 PRI: 5	CFI: 0	ID: 10		
н		7 0.000506	a8:9d:21:a1:4f:51	Intel_11:11:11	0×ffff	1518 PRI: 4	CFI: 0	ID: 10		
н		8 0.000518	a8:9d:21:a1:4f:51	Intel_11:11:11	0×ffff	1518 PRI: 4	CFI: 0	ID: 10		
		0 0 000504	0.01.04 4.45 54	7			^			1
										-
	🗉 Fra	ume 5: 1518 k	oytes on wire (1214	4 bits), 1518 bytes	captured	(12144 bits)				
	🖃 Etł	nernet II, Sr	rc: a8:9d:21:a1:4f:	51 (a8:9d:21:a1:4f:	51), Dst:	Intel_11:11:	11 (00:1	1:11:11:11:11	L)	
н	± [estination:	Intel_11:11:11 (00	:11:11:11:11:11)						
н	± 2	Source: a8:90	d:21:a1:4f:51 (a8:9	d:21:a1:4f:51)						
н	1	ype: 802.10	Virtual LAN (0x810	2)						
Ð	802	.10 virtual	LAN, PRI: 5, CFI:	D, ID: 10						
н	1	.01	= Priority:	video, < 100ms lat	ency and	jitter (5)				
н			= CFI: Canor	nical (0)						
н		0000 000	00 1010 = ID: 10							
н	г	ype: Unknown	n (Oxffff)							
Ð	🗄 Dat	a (1500 byte	es)							

Sample Configuration Layer-3 Traffic Color-Aware

Target-type Bridge-domain

Traffic Generator

```
ip sla 1
service-performance type ip dest-ip-addr 20.1.1.1 bridge-domain 10
  frequency iteration 1 delay 1
  measurement-type direction internal conform-color dscp ef exceed-color dscp af11
   delay
   jitter
   loss
   receive
                                                                      The only
  throughput
  profile packet
   source-ip-addr 30.1.1.1
                                                                      from the color
  profile traffic direction internal
  cir 200000
                                                                      blind mode are
   eir 200000
                                                                      the commands
  rate-step kbps 400000
                                                                      in bold.
   conform-color set-dscp-transmit ef
   exceed-color set-dscp-transmit af11
  duration time 100
IP SLA Statistics
#sh ip sla statistics
IPSLAs Latest Operation Statistics
IPSLA operation id: 1
Test mode: Two-way Measurement
Steps Tested (kbps): 400000
Test duration: 100 seconds
Latest measurement: *14:27:16.636 UTC Mon Nov 7 2016
Latest return code: Oper End of Life
Overall Throughput: 386144 kbps
Step 1 (400000 kbps):
```

CIR Stats: FLR Avail FTD Min/Avg/Max FDV Min/Avg/Max 0 00% 100 00% 28 96us/140 03us/144 72us IR(kbps) FL 100.00% 28.96us/140.03us/144.72us 199644 0 0.00% Ons/1.19us/115.68us Tx Packets: 38993114 Tx Bytes: 2495559296 Rx Packets: 38993114 Rx Bytes: 2495559296 Step Duration: 100 seconds EIR Stats: IR(kbps) FL FLR Avail FTD Min/Avg/Max FDV Min/Avg/Max 186500 0 0.00% 100.00% 62.64us/139.78us/144.96us 0ns/643ns/81.84us Tx Packets: 36425827 Tx Bytes: 2331252928 Rx Packets: 36425827 Rx Bytes: 2331252928 Step Duration: 100 seconds Above EIR Stats: IR(kbps) FL Avail FTD Min/Avg/Max FDV Min/Avg/Max FLR 0 0 0.00% 0.00% Ons/Ons/Ons Ons/Ons/Ons Tx Packets: 0 Tx Bytes: 0 Rx Packets: 0 Rx Bytes: 0 Step Duration: 100 seconds

In the below traffic capture the DSCP marking of EF can be seen.

	L							
No.	Time	Source	Destination	Protocol	Length Info			
	1 0.000000	30.1.1.1	20.1.1.1	IPv4	64 Unknown	(254)		
	2 0.000001	30.1.1.1	20.1.1.1	IPv4	64 Unknown	(254)		
	3 0.000002	30.1.1.1	20.1.1.1	IPv4	64 Unknown	(254)		
	4 0.000002	30.1.1.1	20.1.1.1	IPv4	64 Unknown	(254)		
<								>
∎ En	ame 3: 64 b∨	tes on wire (512 bits). 64 bytes capt	tured (512	(bits)			
± Et	hernet II, S	<pre>c: a8:9d:21:</pre>	a1:4f:07 (a8:9d:21:a1:4)	F:07), Dst	: 74:a2:e6:5d:d	8:05 (74:	a2:e6:5d:c8:05)	
🗆 In	ternet Proto	col version 4	, src: 30.1.1.1 (30.1.1.	1), Dst:	20.1.1.1 (20.1.	1.1)		
_	version: 4		,					
	Header lengt	h: 20 bytes						
	Differentiat	ed Services F	ield: 0xb8 (DSCP 0x2e: 0	Expedited	Forwarding; ECM	4: 0×00: N	ot-ECT (Not ECN-Capable Transpo	rt))
_	1011 10	- Differentia	ted Services Codepoint:	Expedited	Forwarding (0)	(2e)		
	00	= Explicit Co	ngestion Notification: 1	NOT-ECT (N	Not ECN-Capable	Transport) (0x00)	
	Total Length	: 46	5					
	Identificati	on: 0x0000 (0	0					
±.	Flags: 0x00	•	-					
_	Fragment off	set: O						
	Timé to live	: 253						
	Protocol: Un	(nown (254)						
±.	Header check	sum: 0x8816 [correct]					
_	Source: 30.1.1.1 (30.1.1.1)							
	Destination:	20.1.1.1 (20	.1.1.1)					
	[Source GeoI	P: UnknownÌ						
	[Destination GenTP: Unknown]							
+ Da	ta (26 bytes)	· · · · · ·					

In the below traffic capture the DSCP marking of AF11 can be seen.

No.	Time	Source	Destination	Protocol	J Length Info				
	1 0.000000	30.1.1.1	20.1.1.1	IPv4	64 Unknown (254)				
	2 0.000001	30.1.1.1	20.1.1.1	IPv4	64 Unknown (254)				
	3 0.000002	30.1.1.1	20.1.1.1	IPv4	64 Unknown (254)				
	4 0.000002	30.1.1.1	20.1.1.1	IPv4	64 Unknown (254)				
<						>			
± FI	name 2: 64 byt	tes on wire	(512 bits), 64 bytes ca	ptured (512	12 bits)				
⊞ E1	thernet II, Si	rc: a8:9d:21	L:a1:4f:07 (a8:9d:21:a1:	4f:07), Dst	st: 74:a2:e6:5d:c8:05 (74:a2:e6:5d:c8:05)				
🖃 I I	nternet Proto	col Version	4, src: 30.1.1.1 (30.1.	1.1), Dst: /	: 20.1.1.1 (20.1.1.1)				
	Version: 4								
	Header length	h: 20 bytes							
	Differentiat	ed Services	Field: 0x28 (DSCP 0x0a:	Assured Fo	Forwarding 11; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))				
	0010 10 :	= Differenti	iated Services Codepoint	: Assured F	Forwarding 11 (0x0a)				
	00 :	= Explicit C	Congestion Notification:	NOT-ECT (N	(Not ECN-Capable Transport) (0x00)				
	Total Length	: 46							
	Identificati	on: 0x0000 ((0)						
±	Flags: 0x00								
	Fragment off:	set: O							
	Time to live	: 253							
	Protocol: Un	known (254)							
±	Header check:	sum: 0x88a6	[correct]						
	Source: 30.1	.1.1 (30.1.1	1)						
	Destination:	20.1.1.1 (2	20.1.1.1)						
	[Source GeoIP: Unknown]								
	[Destination	GeoIP: Unkr	iown]						
± Da	ata (26 bytes))							

Throughput measurement for each packet size

The table below shows the maximum SLA rate supported by the ASR920 and it is independent of SLA sessions. Max Rate can be achieved in a single SLA session or combination of two or more SLA sessions.

Packet Size (Bytes)	Max Rate (kbps)
64	469848
128	638061
256	775123
512	867758
1024	922728
1280	934554
1518	942124
9216	977675
IMIX	788000

References and Further Information

ITU-T Recommendation Y.1564:

https://www.itu.int/rec/T-REC-Y.1564/en

ASR 920 Series Aggregation Services Router

http://www.cisco.com/c/en/us/products/routers/asr-920-series-aggregation-services-router/index.html

IP SLA Configuration guide

http://www.cisco.com/c/en/us/td/docs/routers/asr920/configuration/guide/ipsla/sla-xe-3s-book-asr920/sla-xe-3sbook-asr920_chapter_0110.html