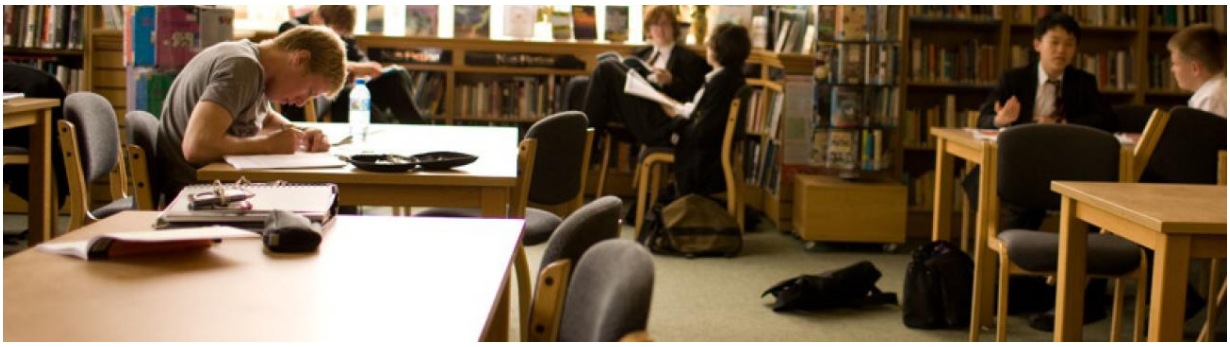
White Paper

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.

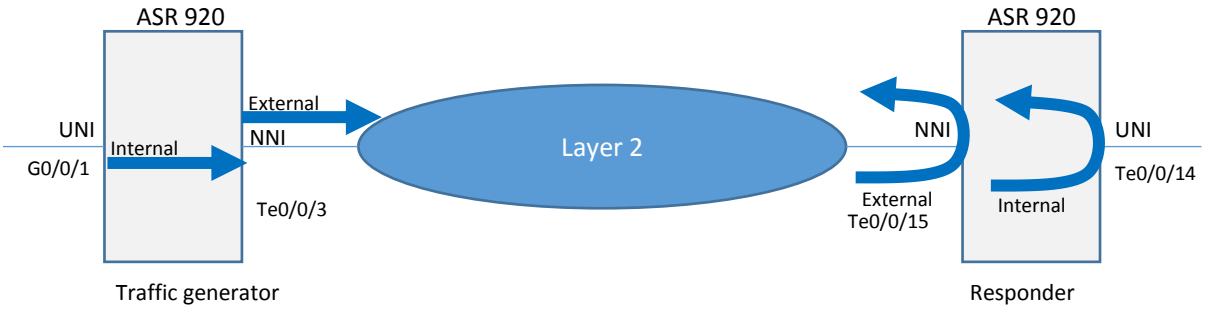
In the passive measurement mode, the router measures the traffic received on an interface. This mode is used to measure the traffic received at the remote node in order to validate that the service has been configured correctly in that particular direction. In this mode ASR920 can measure traffic sent 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

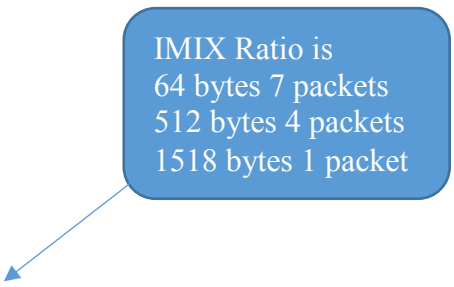
iii. Outer-cos

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:

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)

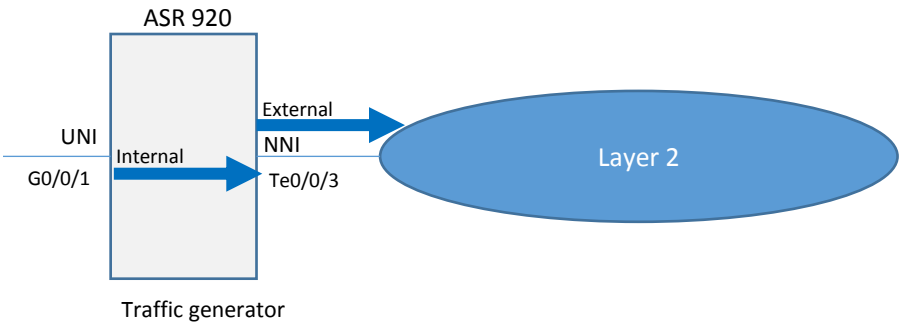
iii. IP SLA activation or Test activation

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
```

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 bridge-domain for internal traffic generation.

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

```
ip sla 1
 service-performance type ethernet dest-mac-addr 00ab.cdef.1234 bridge-domain 10
  profile packet
   outer-vlan 10
  profile traffic direction internal
   rate-step kbps 100000
ip sla schedule 1 start-time now

UNI Interface
interface GigabitEthernet0/0/1
 service instance 1 ethernet
  encapsulation dot1q 10
  bridge-domain 10

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

For Target-type bridge-domain only internal traffic generation is supported.

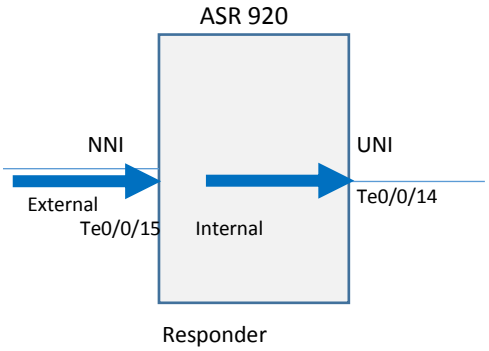
IP SLA Activation

```
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
```

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

IP SLA Activation

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

IP SLA Verification

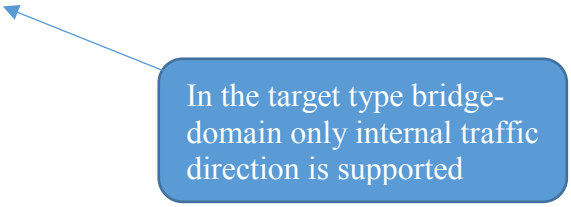
```
#sh ip sla statistics
IPSLAs Latest Operation Statistics

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-                                addr
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
```

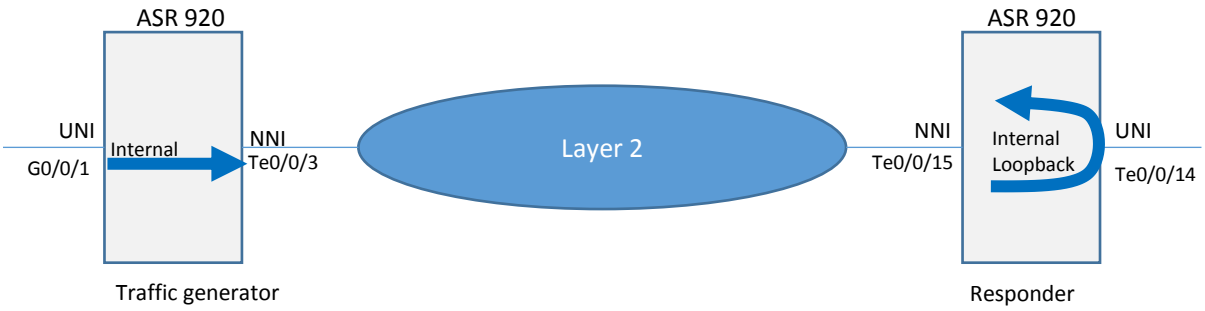
IP SLA Statistics

```
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
```

```
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

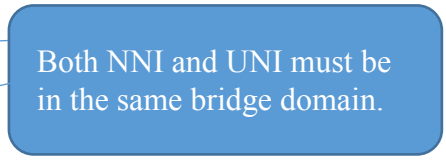
```
interface GigabitEthernet0/0/1
service instance 1 ethernet
  encapsulation dot1q 10
  bridge-domain 10

interface TenGigabitEthernet0/0/3
service instance 1 ethernet
  encapsulation dot1q 10
  bridge-domain 10
ip sla 1
 service-performance type ethernet dest-mac-addr 0011.1111.1111 interface
GigabitEthernet0/0/1
service instance 1
  frequency iteration 2 delay 1
  measurement-type direction internal
   delay
   jitter
   loss
   receive
   throughput
  profile packet
   outer-vlan 10
  profile traffic direction internal
   rate-step kbps 10000
  duration time 100
```

Both NNI and UNI must be in the same bridge domain

Traffic direction must match the measurement-type direction.

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
```



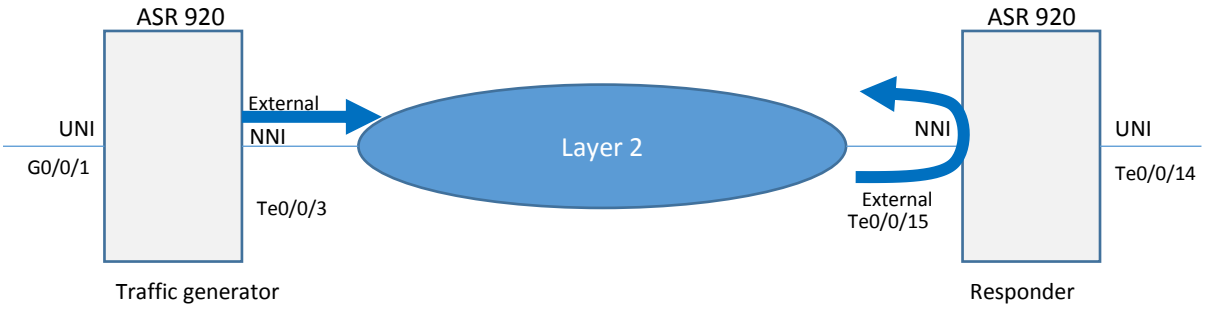
Loopback Activation

```
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

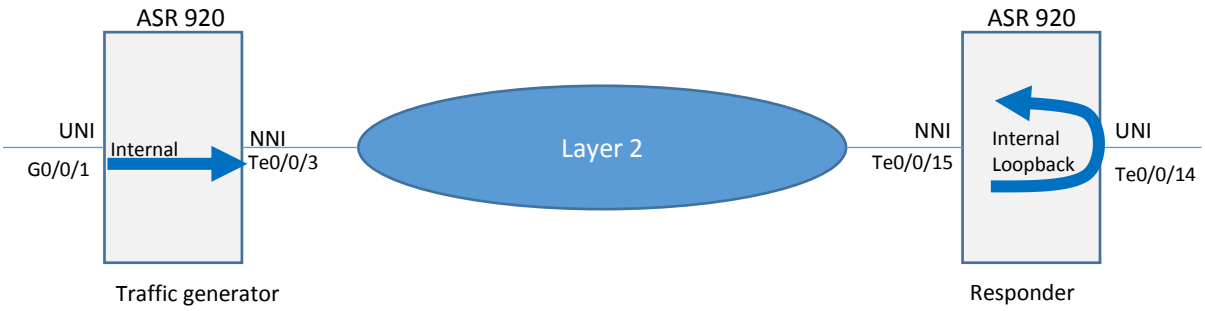
```
interface TenGigabitEthernet0/0/15
service instance 1 ethernet
  encapsulation dot1q 10
  bridge-domain 10
  ethernet loopback permit external
```

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

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

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

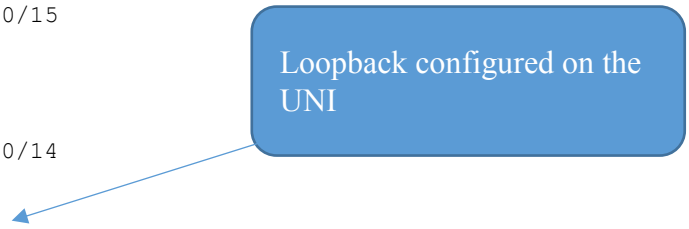
Both NNI and UNI must be in the same bridge-domain.

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
service instance 1 ethernet
  encapsulation dot1q 10
  bridge-domain 10
  ethernet loopback permit internal
```



Loopback Activation

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

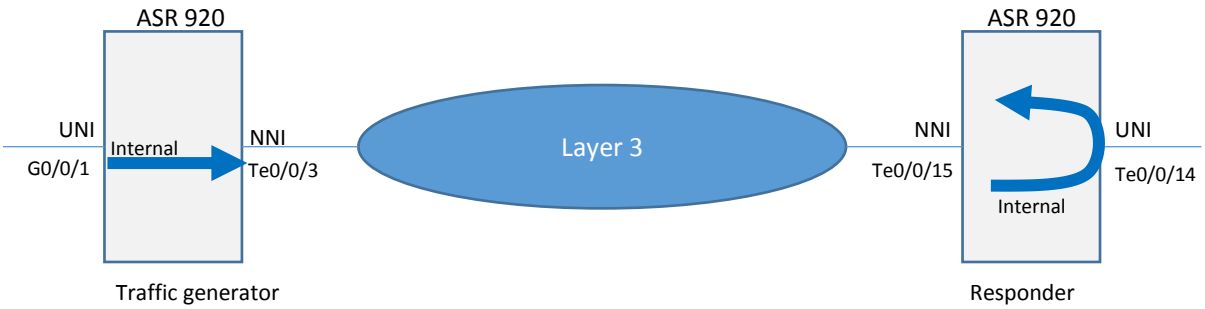
IP SLA Statistics

```
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:
IR(kbps)  FL          FLR      Avail    FTD Min/Avg/Max
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
   jitter
   loss
   receive
   throughput
  profile packet
   source-ip-addr 30.1.1.1
   outer-vlan 10
  profile traffic direction internal
   rate-step kbps 10000
  duration time 100
```

Same source-ip and destination-ip must be used in the responder IP SLA configuration

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 dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 10

interface BDI10
 ip address 30.1.1.1 255.255.255.0
interface BDI11
 ip address 192.168.1.2 255.255.255.0
```

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

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
```

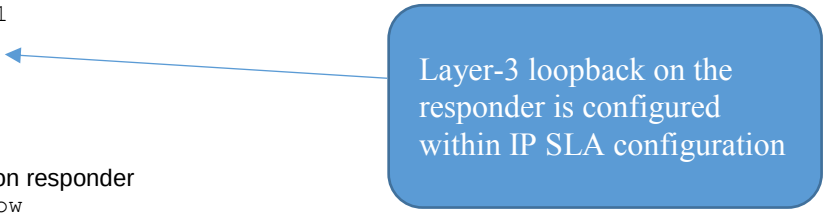
UNI Interface

```
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:
```

```
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           0.00%     100.00%   28.96us/58.09us/61.12us   80ns/839ns/31.84us
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

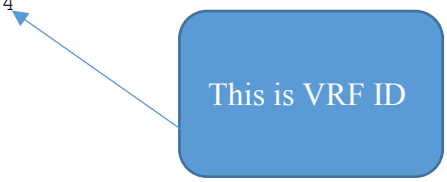
```
sh ip sla statistics
IPSLAs Latest Operation Statistics
IPSLA operation id: 1
Test mode: Two-way Measurement
Steps Tested (kbps): 10000
Test duration: 100 seconds
Latest measurement:  *11:12:05.192 UTC Thu Aug 25 2016
Latest return code:  Oper End of Life
Overall Throughput: 9654 kbps
Step 1 (10000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



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
```

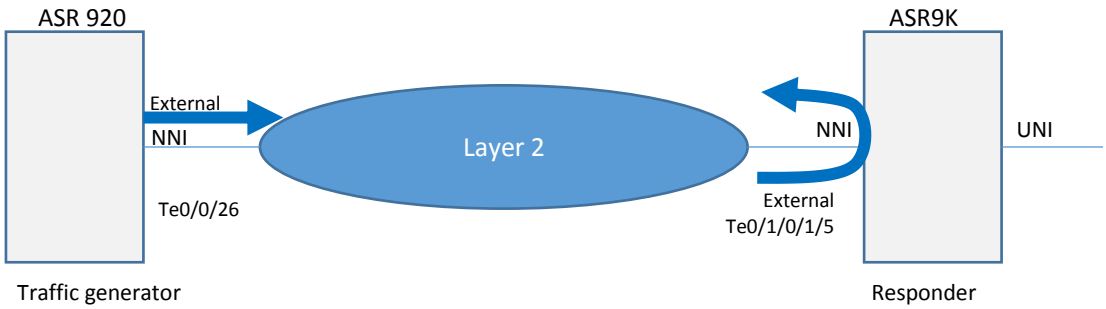
IP SLA Statistics

```
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
   jitter
   loss
   receive
   throughput
  profile packet
   outer-vlan 10
   src-mac-addr 5897.bd26.b39a
  profile traffic direction external
   rate-step kbps 100000
  duration time 100
```

The dest-mac-addr and src-mac-addr must match the NNI interface of the generator. In this case Te0/0/26

IP SLA Activation

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

Interface Configuration

```
interface TenGigabitEthernet0/0/26
```

```
 service instance 1 ethernet
  encapsulation dot1q 10
  bridge-domain 10
```

Responder

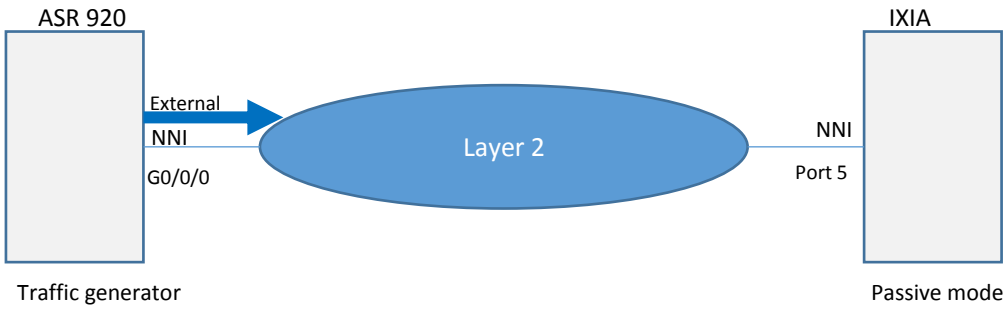
```
interface TenGigE0/1/0/1/5
loopback line
```

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.



Traffic Generator

IP SLA Configuration

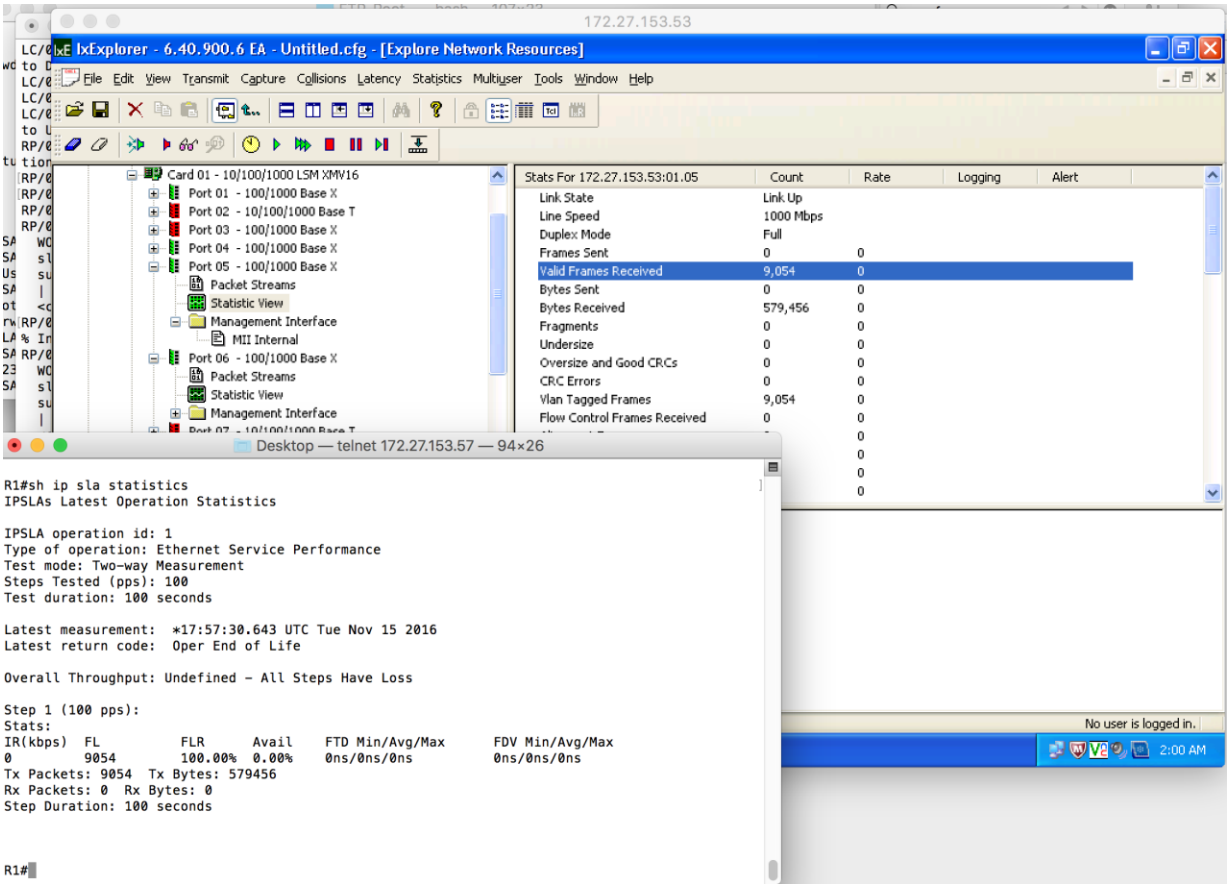
```
ip sla 1
 service-performance type ethernet dest-mac-addr 0011.1111.1111 interface
GigabitEthernet0/0/0 service instance 1
  frequency iteration 1 delay 1
  measurement-type direction external
   delay
```

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

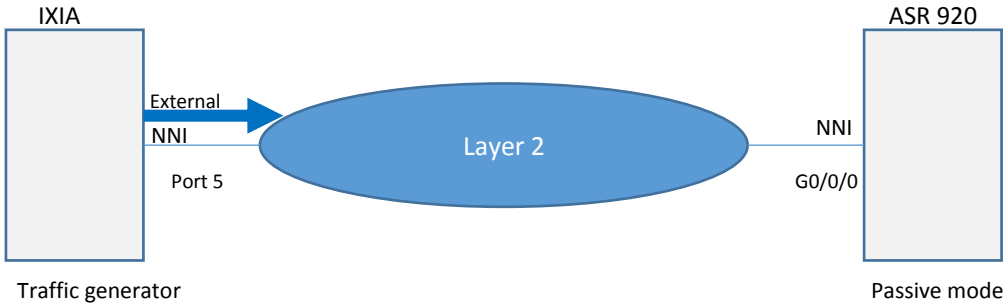
IP SLA Activation

```
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.



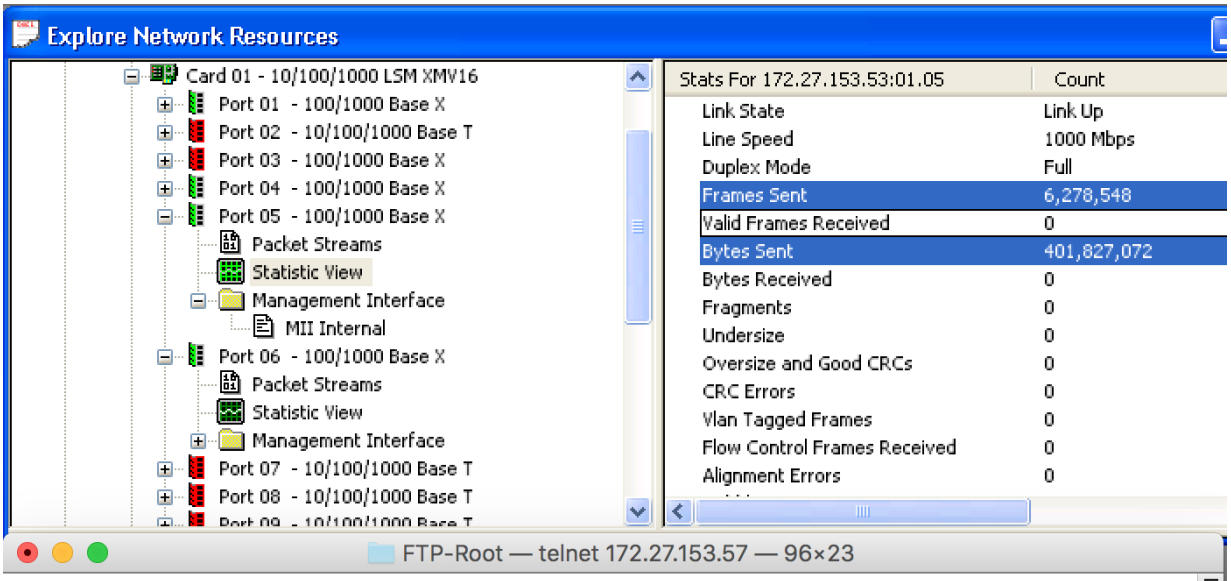
ASR920 Passive mode

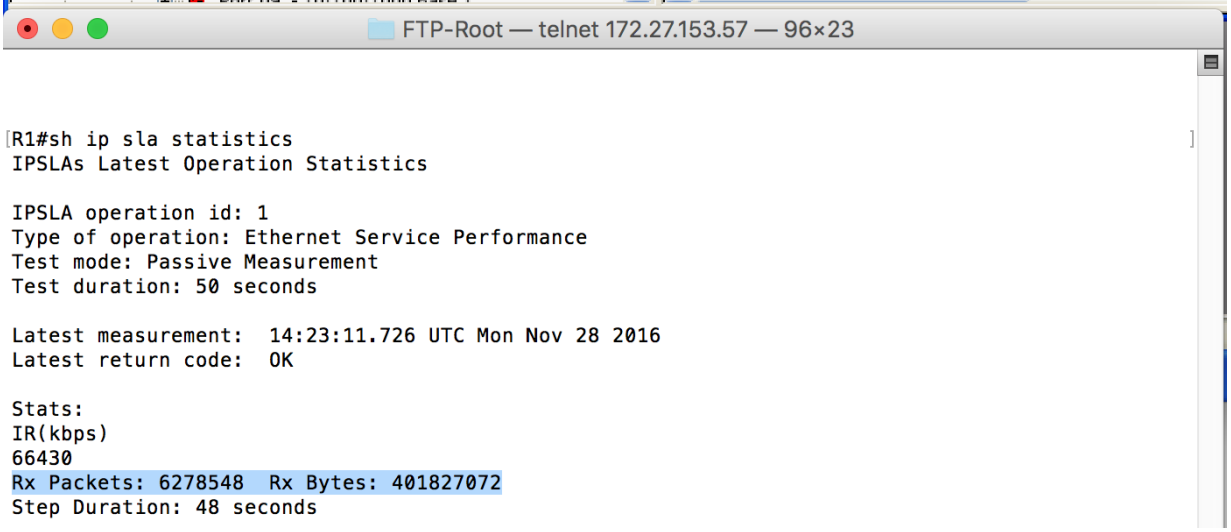
```
ip sla 1
 service-performance type ethernet dest-mac-addr 00ab.cdef.1234 bridge-domain 10
  measurement-type direction internal
   receive
  duration time 50
```

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.





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
   throughput
  profile packet
   outer-vlan 10
   packet-size 1518
  profile traffic direction internal
   cir 100000
   eir 50000
   rate-step kbps 200000
   conform-color set-cos-transmit 4
   exceed-color set-cos-transmit 5
  duration time 100
```

The commands in the bold are used to configure the color aware mode in the IP SLA configuration.

UNI Interface

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

NNI Interface

```
interface TenGigabitEthernet0/0/3
 service instance 1 ethernet
  encapsulation dot1q 10
  rewrite ingress tag pop 1 symmetric
  bridge-domain 10
```

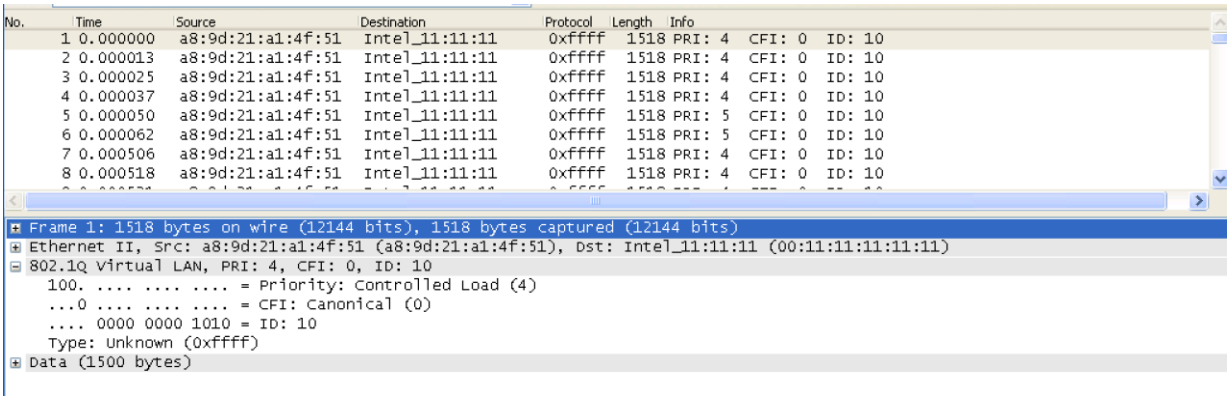
IP SLA Activation

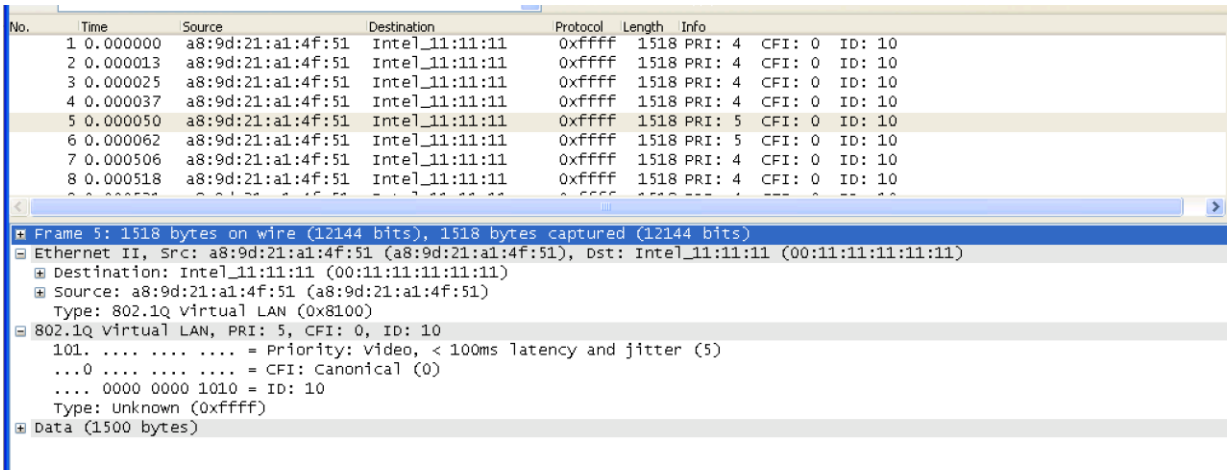
```
ip sla schedule 1 start-time now
```

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          FLR      Avail    FTD Min/Avg/Max
99822     0           0.00%    100.00%  137.12us/163.44us/223.36us
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.





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
   throughput
  profile packet
   source-ip-addr 30.1.1.1
  profile traffic direction internal
   cir 200000
   eir 200000
   rate-step kbps 400000
   conform-color set-dscp-transmit ef
   exceed-color set-dscp-transmit af11
  duration time 100
```

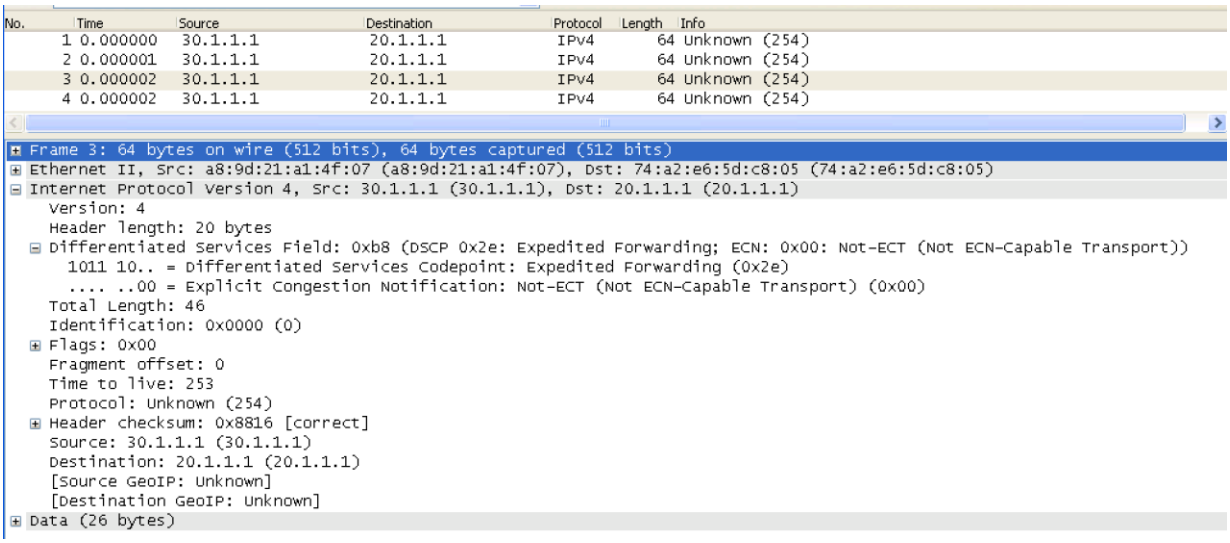
The only difference from the color blind mode are the commands in bold.

IP SLA Statistics

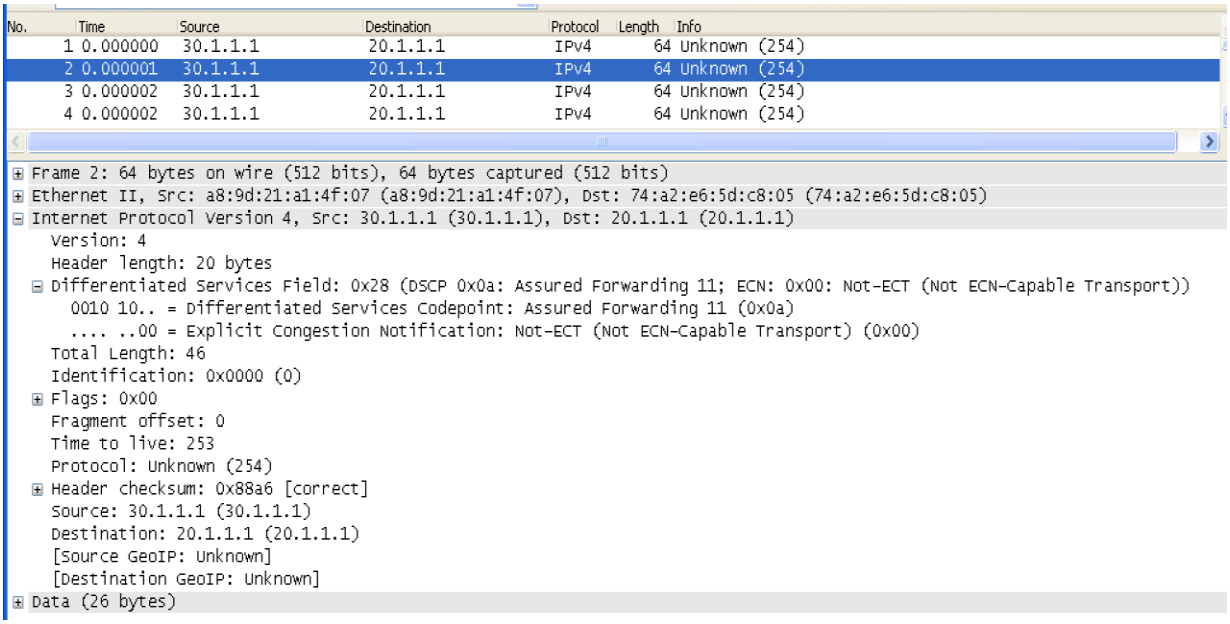
```
#sh ip sla statistics
IPSLAs Latest Operation Statistics

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:
IR(kbps)   FL          FLR       Avail     FTD Min/Avg/Max       FDV Min/Avg/Max
199644     0           0.00%     100.00%   28.96us/140.03us/144.72us
0ns/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          FLR       Avail     FTD Min/Avg/Max       FDV Min/Avg/Max
0          0           0.00%     0.00%     0ns/0ns/0ns           0ns/0ns/0ns
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.



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



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-3s-book-asr920_chapter_0110.html