Broadband Network Gateway on a ToR Switch

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Background

This document serves as a guide in setting up and testing a ToR switch as a Broadband Network Gateway (BNG) running Broadcom's ICOS image.

In the topologies below, the subscribers are connected over 802.1Q VLANs with static IP addressing. Bi-directional traffic was sent and packet captures were taken to verify the integrity of the traffic at both the Internet and subscriber end points.

# Features and Limitations

- Features tested and verified
    - ToR as a hybrid Switch Router
    - 802.1Q VLANs – same VLAN tags used on multiple switchports
    - QoS
        - Policing – maps CoS with DSCP before transmit/drop action
        - Queuing – verified global and per-interface configurations
        - Traffic Shaping – verified global and per-interface configurations
    - VLAN interfaces on IP unnumbered addressing scheme
- Limitations

    The following are software (maybe HW as well) limitations that we should address to compete in the broadband aggregation market.

    - QoS
        - Queuing – Unable to verify the queues utilization via show CLI. Used '***show interfaces traffic <slot/port>***' to verify that congestion drops stopped when queuing was enabled.

- Shaping – Works on outbound traffic only and no support for inbound traffic shaping. This is a customer requirement.
- No per-subscriber support – either per-traffic class or per-port only. This is a customer requirement.
    - No QinQ (double VLAN tags) support – double-tagged traffic can't be terminated on the switch. This is a customer requirement.
    - No show CLI to display the total number of sessions (used '*show arp | include Dynamic*' command to find out the number of active sessions.
    - No show CLI to display per-subscriber statistics – subscriber tuples (MAC address, IP address, VLAN assignment, port association, etc.), packet counts, policy conformance/violation, etc. To support broadband aggregation, this should be an implicit requirement to provide granular statistics per-subscriber.
    - Ability to download configurations (IP Access Control List, QoS Policies, AAA Attributes, etc.) to dynamically effect subscriber sessions during bring-up and/or on-demand during normal operation.

Deployment Topology
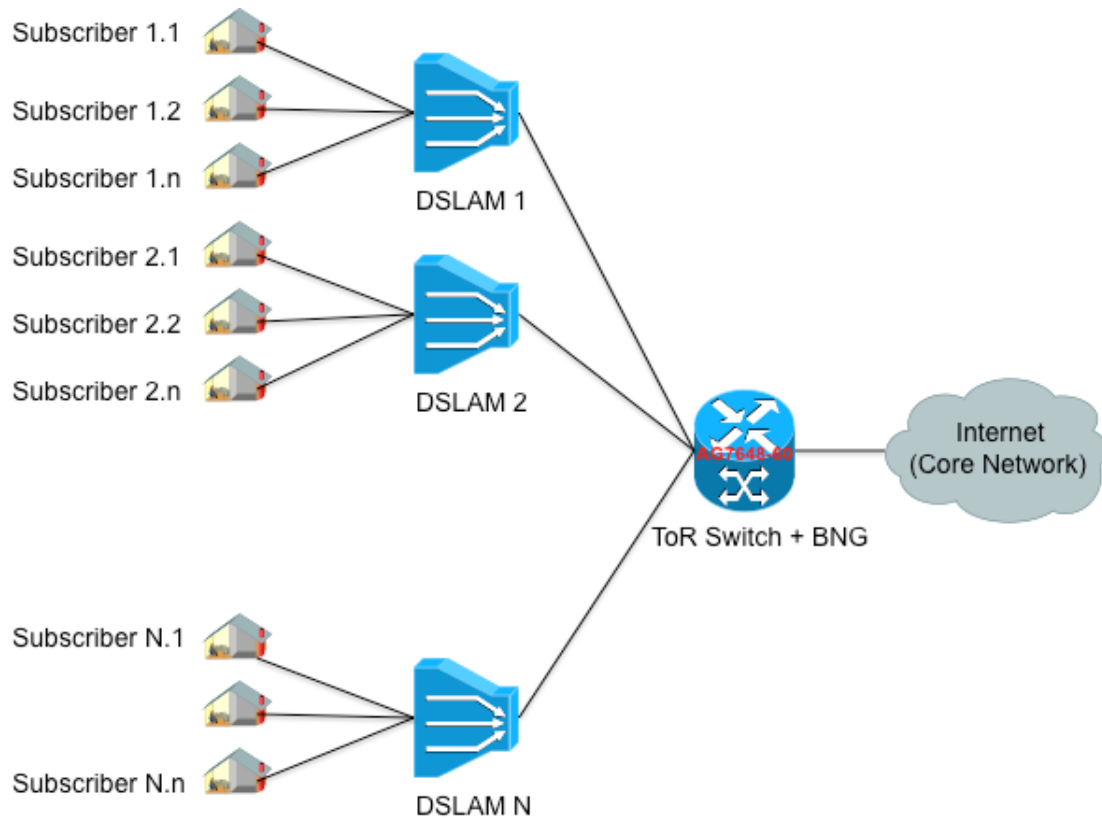
Physical Testbed Topology
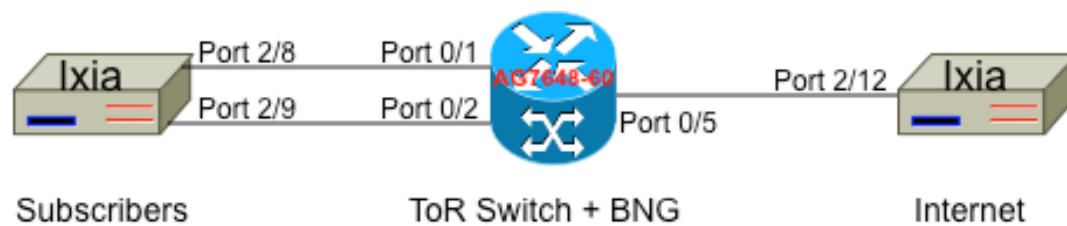
Upstream Traffic Handling

Downstream Traffic Handling

ToR Switch Configuration

Here are key configurations on enabling the ToR switch to act as BNG.

```
! Configure VLANs and add them to the routing domain
vlan database
vlan 11-20
vlan routing 11 1
vlan routing 12 2
vlan routing 13 3
vlan routing 14 4
vlan routing 15 5
vlan routing 16 6
```

```
vlan routing 17 7
vlan routing 18 8
vlan routing 19 9
vlan routing 20 10
exit
!
! Enable routing globally
ip routing
!
! Create match criteria for upstream traffic
class-map match-all C1 ipv4
match cos 1
exit
!
class-map match-all C2 ipv4
match cos 3
exit
!
! Create match criteria for downstream traffic
class-map match-all C11 ipv4
!match ip dscp 8(cs1)
match ip dscp 8
exit
!
class-map match-all C12 ipv4
!match ip dscp 24(cs3)
match ip dscp 24
exit
!
! Create policy for upstream traffic
! DSCP value of 8 will be set in packets matching class-map C1
policy-map P1 in
```

```
class C1
police-simple 3000000 128 conform-action set-dscp-transmit 8 violate-action drop
exit
!
! DSCP value of 24 will be set in packets matching class-map C2
class C2
police-simple 5000000 128 conform-action set-dscp-transmit 24 violate-action drop
exit
!
! Create policy for downstream traffic
! CoS value of 1 will be set in packets matching class-map C11
policy-map P11 in
class C11
police-simple 4000000 128 conform-action set-cos-transmit 1 violate-action drop
exit
!
! CoS value of 3 will be set in packets matching class-map C12
class C12
police-simple 4500000 128 conform-action set-cos-transmit 3 violate-action drop
exit
!
! Setup QoS Queuing globally
cos-queue min-bandwidth 35 35 5 5 5 5 5 5
! Setup QoS Shaping globally
traffic-shape 80
!
! Create a lookback interface to be used as unnumbered interface
interface loopback 0
no shutdown
ip address 170.1.1.1 255.255.255.255
exit
!
```

```
! Connected to subscribers (Ixia port 2/8)
! Configured as switchport in trunk mode and allow VLANs 11-20
! Apply inbound service policy
! Apply interface-level QoS traffic shaping
interface 0/1
load-interval 30
service-policy in P1
traffic-shape 70
no shutdown
switchport mode trunk
switchport trunk allowed vlan 11-20
exit
!
! Connected to subscribers (Ixia port 2/9)
! Configured as switchport in trunk mode and allow VLANs 11-20
! Apply inbound service policy
interface 0/2
load-interval 30
service-policy in P1
no shutdown
switchport mode trunk
switchport trunk allowed vlan 11-20
exit
!
! Connected to Internet (Ixia port 2/12)
! Configured as routed port
! Apply inbound service policy
interface 0/5
load-interval 30
service-policy in P11
no shutdown
routing
```

```
ip address 140.1.1.1 255.255.255.0
exit
!
! For all of the VLANs in routed mode, configure them to borrow loopback 0 IP
address
interface vlan 11
no shutdown
routing
ip unnumbered loopback 0
exit
!
interface vlan 12
no shutdown
routing
ip unnumbered loopback 0
exit
!
.
.
.
interface vlan 20
no shutdown
routing
ip unnumbered loopback 0
exit
```

Test Image Version

**Test platform: AG7648**

(AG7648-60) #show version

Switch: 1

System Description............................. Broadcom Trident2 56854 AG7648 System - 48
10G SFP+ and   6 40G QSFP+, 3.2.2.6, Linux 3.16.0-29-generic, 201412130048
Machine Type................................... Broadcom Trident2 56854 AG7648 System - 48
10G SFP+ and   6 40G QSFP+
Machine Model................................. BCM-56854
Serial Number................................. A766F0DL164S00013
FRU Number................................... A766F0DL164S00013
Maintenance Level............................. A
Manufacturer.................................. 0xbc00
Burned In MAC Address.......................... 00:18:23:30:C5:FB
Software Version.............................. 3.2.2.6
Operating System.............................. Linux 3.16.0-29-generic
Network Processing Device...................... BCM56854_A2
CPLD version.................................. 0x2
Additional Packages........................... BGP-4

> *QOS*
> *Multicast*
> *IPv6*
> *Routing*
> *Data Center*
> *OpEN API*
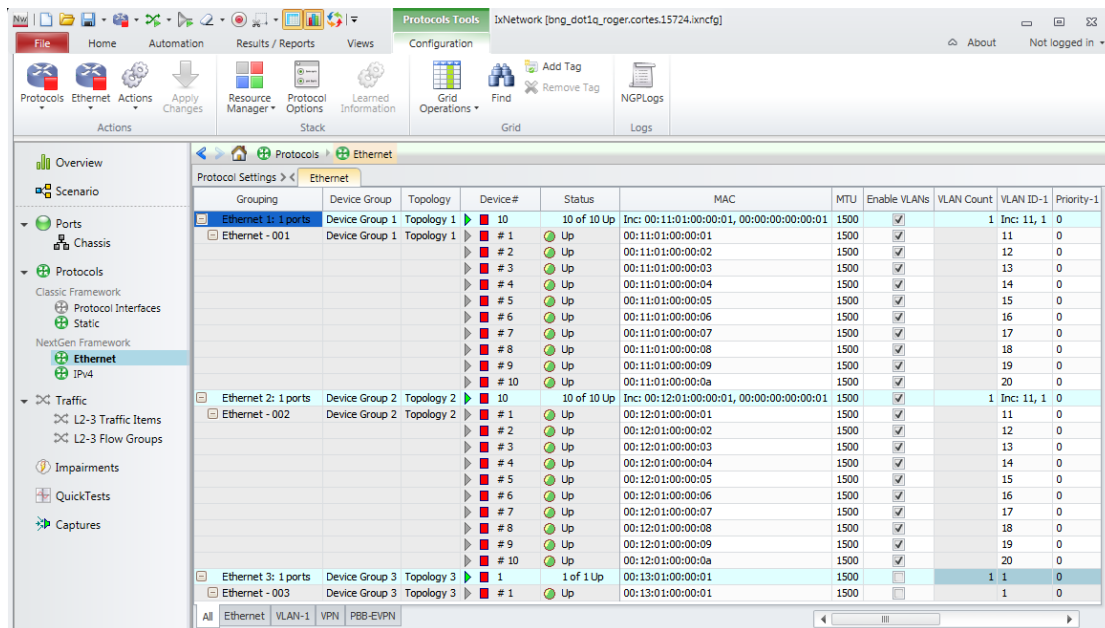> *Prototype Open API*

Ixia Setup

IxNetwork Topologies
- Topology 1 – port 2/8 (subscribers)
- Topology 2 – port 2/9 (subscribers)
- Topology 3 – port 2/12 (Internet)
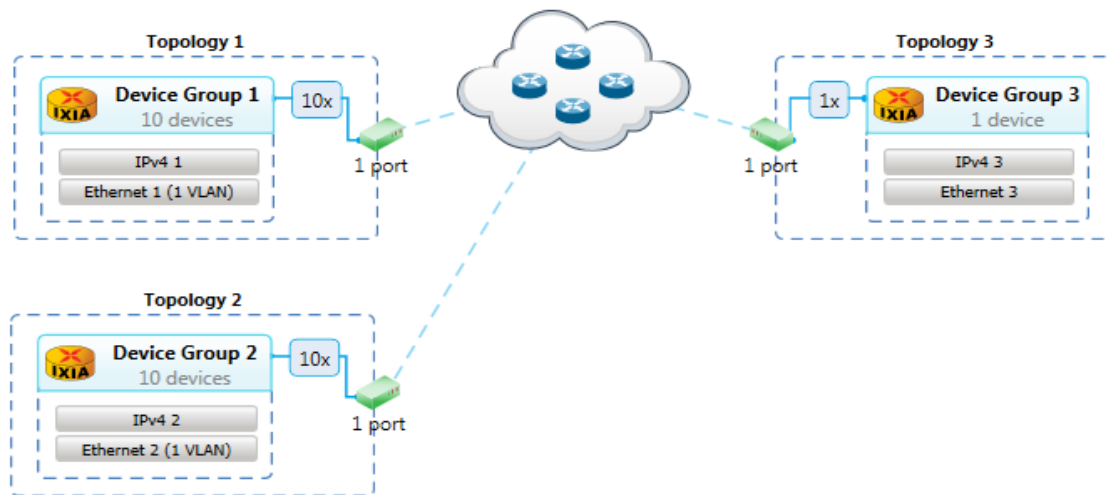
Layer 2
- Enable VLAN and setup VLANs 11 to 20 for both Topologies 1 and 2.
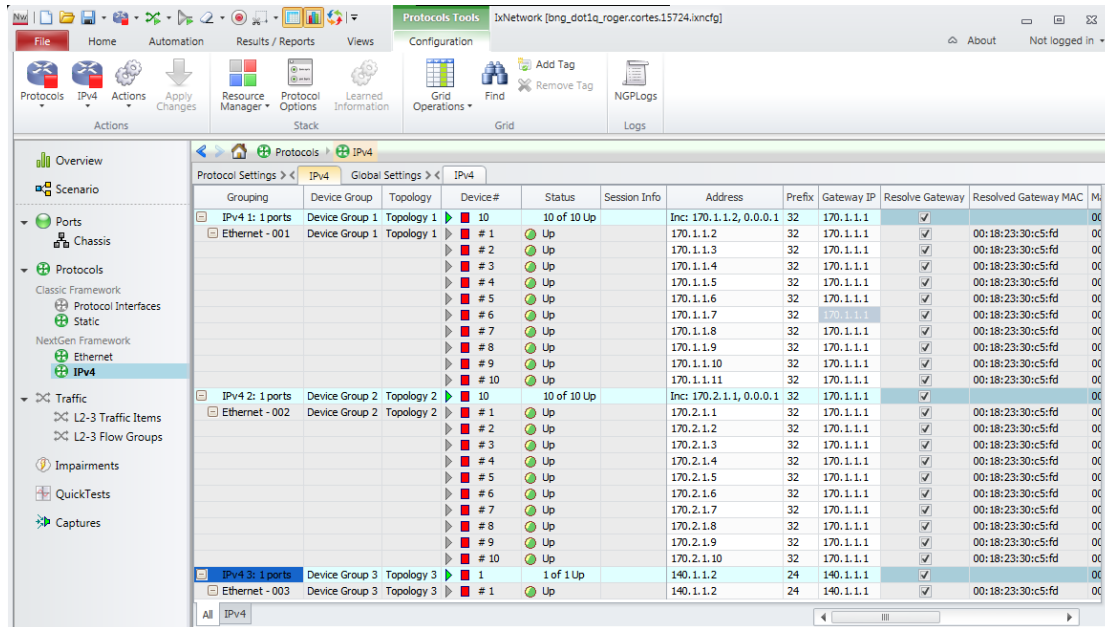- Keep without VLAN for Topology 3.

Layer 3

- Configure IP addresses in the same subnet as the loopback 0 on the Switch for the Topologies 1 (170.1.1.2 to 170.1.1.11) and 2 (170.2.1.1 to 170.2.1.10). Gateway is 170.1.1.1 and subnet mask is /32.
- Configure IP address in the same subnet as the Internet-facing interface on the Switch for topology 3 (140.1.1.2).

Create and Start Traffic Streams

- Start Protocol before creating traffic streams.
- All traffic streams are bi-directional.
- Use the Advanced Traffic Wizard to create the traffic streams.
- Setup traffic stream between Topology 1 and Topology 3.
    - Using the traffic wizard, add a traffic stream.
    - Select Per-Encapsulation option.
    - For port 2/8, update the VLAN Priority to have a value of 001 (Priority).
    - For port 2/12, update the TOS to have a value of 001 (Priority).
    - Set the traffic to be 35% of line rate for port 2/8 and 30% of line rate for port 2/12.
- Setup traffic stream between Topology 2 and Topology 3.
    - Using the traffic wizard, add a traffic stream.
    - Select Per-Encapsulation option.
    - For port 2/9, update the VLAN Priority to have a value of 011 (Flash).
    - For port 2/12, update the TOS to have a value of 011 (Flash).

- o Set the traffic to be 35% of line rate for port 2/9 and 30% of line rate for port 2/12.
- Setup traffic stream between Topologies 1 & 2 and Topology 3.
  - o Using the traffic wizard, add a traffic stream.
  - o Traffic priority is all default.
  - o Set the traffic to be 35% of line rate for ports 2/8 & 2/9 and 30% of line rate for port 2/12.
- Start Traffic Streams
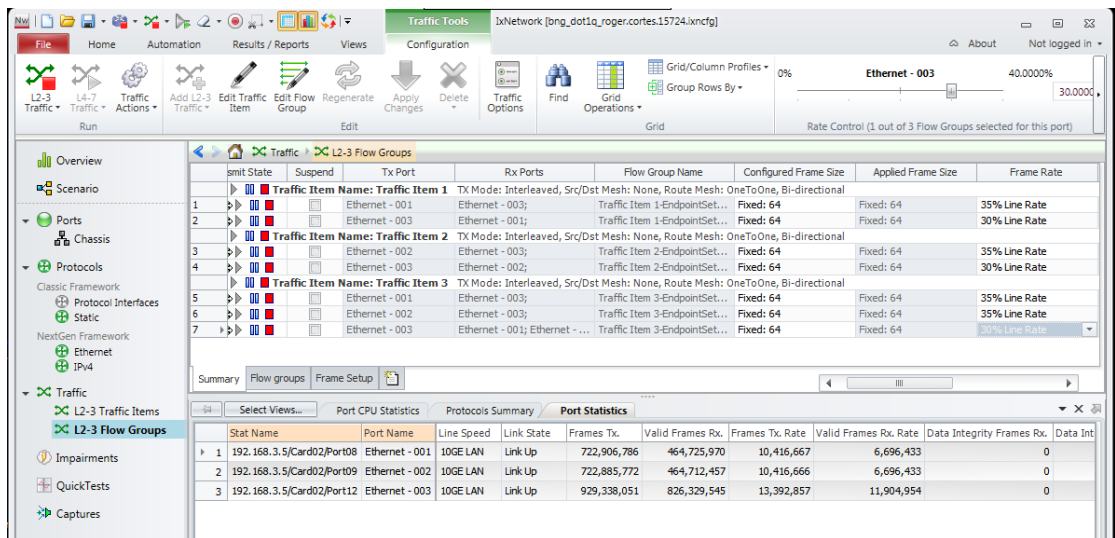
Test Results and Findings

1. On the Ixia, ensure that traffic sent/received are as expected.
2. On the Switch, verify that the number of subscribers are as expected (20 in this test setup).

(AG7648-60) #show arp | include Dynamic

Dynamic Renew Mode .... Disable

170.1.1.2   00:11:01:00:00:01   4/1   Dynamic   0h 12m 10s

170.1.1.3   00:11:01:00:00:02   4/2   Dynamic   0h 12m 10s

170.1.1.4   00:11:01:00:00:03   4/3   Dynamic   0h 12m 10s

170.1.1.5	00:11:01:00:00:04	4/4	Dynamic	0h 12m 10s
170.1.1.6	00:11:01:00:00:05	4/5	Dynamic	0h 12m 10s
170.1.1.7	00:11:01:00:00:06	4/6	Dynamic	0h 12m 10s
170.1.1.8	00:11:01:00:00:07	4/7	Dynamic	0h 12m 10s
170.1.1.9	00:11:01:00:00:08	4/8	Dynamic	0h 12m 10s
170.1.1.10	00:11:01:00:00:09	4/9	Dynamic	0h 12m 10s
170.1.1.11	00:11:01:00:00:0A	4/10	Dynamic	0h 12m 10s
170.2.1.1	00:12:01:00:00:01	4/1	Dynamic	0h 12m 10s
170.2.1.2	00:12:01:00:00:02	4/2	Dynamic	0h 12m 10s
170.2.1.3	00:12:01:00:00:03	4/3	Dynamic	0h 12m 10s
170.2.1.4	00:12:01:00:00:04	4/4	Dynamic	0h 12m 10s
170.2.1.5	00:12:01:00:00:05	4/5	Dynamic	0h 12m 10s
170.2.1.6	00:12:01:00:00:06	4/6	Dynamic	0h 12m 10s
170.2.1.7	00:12:01:00:00:07	4/7	Dynamic	0h 12m 10s
170.2.1.8	00:12:01:00:00:08	4/8	Dynamic	0h 12m 10s
170.2.1.9	00:12:01:00:00:09	4/9	Dynamic	0h 12m 10s
170.2.1.10	00:12:01:00:00:0A	4/10	Dynamic	0h 12m 10s

(AG7648-60) #

Note: There's no show CLI to display the number of sessions. This is a limitation of the software.

3. Verify QoS Policing works as expected.

   a) Upstream match criteria is enabled

```
(AG7648-60) #show class-map


                        Class L3

        Class Name          Type   Protocol Reference Class Name

------------------------------ ----- -------- -------------------------------

C1                          All    ipv4
C2                          All    ipv4
```

```
C11                                    All    ipv4
C12                                    All    ipv4


(AG7648-60) #show class-map C1


Class Name.................................... C1
Class Type.................................... All
Class Layer3 Protocol......................... ipv4


        Match Criteria                          Values
    -------------------------- ---------------------------------------
    Class of Service              1


(AG7648-60) #
(AG7648-60) #show class-map C2


Class Name.................................... C2
Class Type.................................... All
Class Layer3 Protocol......................... ipv4


        Match Criteria                          Values
    -------------------------- ---------------------------------------
    Class of Service              3


(AG7648-60) #
```

b) Downstream match criteria is enabled

```
(AG7648-60) #show class-map C11


Class Name.................................... C11
Class Type.................................... All
Class Layer3 Protocol......................... ipv4
```

```
      Match Criteria                           Values

--------------------------  ----------------------------------------

IP DSCP                          8(cs1)



(AG7648-60) #show class-map C12



Class Name.................................... C12

Class Type.................................... All

Class Layer3 Protocol......................... ipv4


      Match Criteria                           Values

--------------------------  ----------------------------------------

IP DSCP                          24(cs3)



(AG7648-60) #
```

c) Upstream policing is enabled

```
(AG7648-60) #show policy-map P1



Policy Name................................... P1

Policy Type................................... In



Class Name.................................... C1

Policing Style................................ Police Simple

Committed Rate................................ 3000000

Committed Burst Size.......................... 128

Conform Action................................ Mark IP DSCP

Conform DSCP Value............................ 8(cs1)

Non-Conform Action............................ Drop

Conform color mode............................ Blind
```

```
Class Name................................... C2

Policing Style............................... Police Simple

Committed Rate............................... 5000000

Committed Burst Size......................... 128

Conform Action............................... Mark IP DSCP

Conform DSCP Value........................... 24(cs3)

Non-Conform Action........................... Drop

Conform color mode........................... Blind


(AG7648-60) #
```

d) Downstream policing is enabled

```
(AG7648-60) #show policy-map P11


Policy Name................................... P11

Policy Type................................... In


Class Name................................... C11

Policing Style............................... Police Simple

Committed Rate............................... 4000000

Committed Burst Size......................... 128

Conform Action............................... Mark CoS

Conform COS value............................ 1

Non-Conform Action........................... Drop

Conform color mode........................... Blind




Class Name................................... C12
```

```
Policing Style................................ Police Simple

Committed Rate................................ 4500000

Committed Burst Size.......................... 128

Conform Action................................ Mark CoS

Conform COS value............................. 3

Non-Conform Action............................ Drop

Conform color mode............................ Blind


(AG7648-60) #
```

e) Disable Traffic shaping and then increase traffic rate on Ixia and ensure that policing discards packets upstream or downstream. The outbound traffic to the Internet does not exceed 8 Gbps (aggregate of policing rate limit – 3 Gbps + 5 Gbps).

```
(AG7648-60) #config

(AG7648-60) (Config)#no traffic-shape

(AG7648-60) #show policy-map interface 0/1 in


Interface..................................... 0/1


Direction..................................... In

Operational Status............................ Up

Policy Name................................... P1


Interface Summary:


Class Name.................................... C1

In Offered Packets............................ 141405000449

In Discarded Packets.......................... 1027404533


Class Name.................................... C2
```

```
In Offered Packets............................ 0

In Discarded Packets.......................... 0


(AG7648-60) #

(AG7648-60) #show interface 0/5


Packets Received Without Error................. 430436416269

Packets Received With Error.................... 0

Broadcast Packets Received..................... 6

Receive Packets Discarded...................... 0

Packets Transmitted Without Errors............. 383404830289

Transmit Packets Discarded..................... 3495355496

Transmit Packet Errors......................... 0

Collision Frames............................... 0

Number of link down events..................... 0

Load Interval.................................. 30

Bits Per Second Received....................... 7109346488

Bits Per Second Transmitted.................... 7899395112

Packets Per Second Received.................... 13885442

Packets Per Second Transmitted................. 15428506

Percent Utilization Received................... 71%

Percent Utilization Transmitted................ 78%

Time Since Counters Last Cleared............... 1 day 4 hr 1 min 31 sec


(AG7648-60) #
```

Notes:
1. The policed traffic rate can also be verified on the received traffic rate on Ixia (port 2/12).
2. There's no show CLI to display per-session QoS statistics. This is a limitation of the software.

4. Verify QoS Traffic Shaping works.

   a) Enable traffic shaping on the Internet port (port 0/5).

   b) Disable QoS Queuing before performing this test (on the Switch, configure '***no cos-queue min-bandwidth***').

```
(AG7648-60) #conf


(AG7648-60) (Config)#interface 0/5


(AG7648-60) (Interface 0/5)#traffic-shape 70


(AG7648-60) (Interface 0/5)#end

(AG7648-60) #show interfaces traffic 0/5


 Intf     Congestion   Tx Queue Rx Queue     Color Drops (Pkts)      WRED Tx

 Name     Drops (Pkts) (Cells)  (Cells)      Yellow        Red       Queue

------- ------------ -------- -------- ------------ ------------ --------

0/5       1395406920      0        0           0            0           0




(AG7648-60) #

(AG7648-60) #show interface 0/5


Packets Received Without Error................. 10921994393

Packets Received With Error.................... 0

Broadcast Packets Received..................... 1

Receive Packets Discarded...................... 0

Packets Transmitted Without Errors............. 6366221000

Transmit Packets Discarded..................... 371759110

Transmit Packet Errors......................... 0

Collision Frames............................... 0

Number of link down events..................... 0
```

```
Load Interval................................... 30

Bits Per Second Received........................ 6990633744

Bits Per Second Transmitted.................... 5257134408

Packets Per Second Received.................... 13653581

Packets Per Second Transmitted................. 10267840

Percent Utilization Received................... 69%

Percent Utilization Transmitted................ 52%

Time Since Counters Last Cleared............... 2 day 0 hr 10 min 21 sec



(AG7648-60) #
```

Notes:
1. The shaped traffic rate can also be verified on the received traffic rate on Ixia (port 2/12).
2. There's no show CLI to display per-session QoS statistics. This is a limitation of the software.

5. Verify QoS Queuing

   Congestion drops stops after configuring queuing.

```
(AG7648-60) #configure


(AG7648-60) (Config)#cos-queue min-bandwidth 35 35 5 5 5 5 5 5


(AG7648-60) (Config)#end

(AG7648-60) #show interfaces traffic 0/5
```

Intf Name	Congestion Drops (Pkts)	Tx Queue (Cells)	Rx Queue (Cells)	Color Drops (Pkts) Yellow	Red	WRED Tx Queue
0/5	14953544360	0	0	0	0	0

```
(AG7648-60) #show interfaces traffic 0/5


Intf      Congestion   Tx Queue Rx Queue      Color Drops (Pkts)      WRED Tx

Name      Drops (Pkts) (Cells)   (Cells)     Yellow        Red        Queue

------- ------------ -------- -------- ------------ ------------ --------

0/5       14953544360        0       0            0            0          0




(AG7648-60) #show interfaces traffic 0/5


Intf      Congestion   Tx Queue Rx Queue      Color Drops (Pkts)      WRED Tx

Name      Drops (Pkts) (Cells)   (Cells)     Yellow        Red        Queue

------- ------------ -------- -------- ------------ ------------ --------

0/5       14953544360        0       0            0            0          0




(AG7648-60) #
```

Note: There's no show CLI to display queuing utilization - either per
traffic class or per-session.

6. Check for data integrity
    a) Stop all traffic from Ixia.

       Start traffic between Ixia ports 2/8 and 2/12.

       Start packet capture and examine the packets.

       Upstream traffic: the **Precedence is 'priority (1)' and the DSCP is 0x08**
       (8 in decimal).

```
⊞ Frame 11466: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface 0
⊟ Ethernet II, Src: 00:18:23:30:c5:fd (00:18:23:30:c5:fd), Dst: 00:13:01:00:00:01 (00:13:01:00:00:01)
  ⊞ Destination: 00:13:01:00:00:01 (00:13:01:00:00:01)
  ⊞ Source: 00:18:23:30:c5:fd (00:18:23:30:c5:fd)
    Type: IP (0x0800)
    Padding: 130623e9
  ⊞ Frame check sequence: 0xa45da0c0 [correct]
⊟ Internet Protocol Version 4, Src: 170.1.1.2 (170.1.1.2), Dst: 140.1.1.2 (140.1.1.2)
    Version: 4
    Header length: 20 bytes
  ⊞ Differentiated Services Field: 0x20 (DSCP 0x08: Class Selector 1; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
  ⊟ Type of service: 0x20 (None)
      001. .... = Precedence: priority (1)
      ...0 .... = Delay: Normal
      .... 0... = Throughput: Normal
      .... .0.. = Reliability: Normal
      .... ..0. = Cost: Normal
      .... ...0 = MBZ: Reserved
    Total Length: 42
    Identification: 0x0000 (0)
  ⊞ Flags: 0x00
    Fragment offset: 0
    Time to live: 63
    Protocol: Any host internal protocol (61)
  ⊞ Header checksum: 0x4371 [correct]
    Source: 170.1.1.2 (170.1.1.2)
    Destination: 140.1.1.2 (140.1.1.2)
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]
⊞ Data (22 bytes)
```

Downstream traffic: the **VLAN priority is set to 1 and the DSCP is 0x08** (8 in decimal).

```
⊞ Frame 1: 68 bytes on wire (544 bits), 68 bytes captured (544 bits) on interface 0
⊞ Ethernet II, Src: 00:18:23:30:c5:fd (00:18:23:30:c5:fd), Dst: 00:11:01:00:00:09 (00:11:01:00:00:09)
⊟ 802.1Q Virtual LAN
    001. .... .... .... = Priority: 1
    ...0 .... .... .... = CFI: 0
    .... 0000 0001 0011 = ID: 19
    Type: IP (0x0800)
    Trailer: 4e06bb0c
⊟ Internet Protocol Version 4, Src: 140.1.1.2 (140.1.1.2), Dst: 170.1.1.10 (170.1.1.10)
    Version: 4
    Header length: 20 bytes
  ⊟ Differentiated Services Field: 0x20 (DSCP 0x08: Class Selector 1; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
      0010 00.. = Differentiated Services Codepoint: Class Selector 1 (0x08)
      .... ..00 = Explicit Congestion Notification: Not-ECT (Not ECN-Capable Transport) (0x00)
  ⊟ Type of service: 0x20 (None)
      001. .... = Precedence: priority (1)
      ...0 .... = Delay: Normal
      .... 0... = Throughput: Normal
      .... .0.. = Reliability: Normal
      .... ..0. = Cost: Normal
      .... ...0 = MBZ: Reserved
    Total Length: 46
    Identification: 0x0000 (0)
  ⊞ Flags: 0x00
    Fragment offset: 0
    Time to live: 63
    Protocol: Any host internal protocol (61)
  ⊞ Header checksum: 0x4365 [correct]
    Source: 140.1.1.2 (140.1.1.2)
    Destination: 170.1.1.10 (170.1.1.10)
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]
⊞ Data (26 bytes)
```

b) Stop the traffic between Ixia ports 2/8 and 2/12.
Start the traffic between Ixia ports 2/9 and 2/12.

Upstream traffic: the **Precedence is 'flash (3)' and the DSCP is 0x18** (24 in decimal).

```
⊞ Frame 11465: 64 bytes on wire (512 bits), 64 bytes captured (512 bits) on interface 0
⊟ Ethernet II, Src: 00:18:23:30:c5:fd (00:18:23:30:c5:fd), Dst: 00:13:01:00:00:01 (00:13:01:00:00:01)
   ⊞ Destination: 00:13:01:00:00:01 (00:13:01:00:00:01)
   ⊞ Source: 00:18:23:30:c5:fd (00:18:23:30:c5:fd)
     Type: IP (0x0800)
     Padding: 6c1a3354
   ⊞ Frame check sequence: 0x29784752 [correct]
⊟ Internet Protocol Version 4, Src: 170.2.1.1 (170.2.1.1), Dst: 140.1.1.2 (140.1.1.2)
     Version: 4
     Header length: 20 bytes
   ⊞ Differentiated Services Field: 0x60 (DSCP 0x18: Class Selector 3; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
   ⊟ Type of service: 0x60 (None)
       011. .... = Precedence: flash (3)
       ...0 .... = Delay: Normal
       .... 0... = Throughput: Normal
       .... .0.. = Reliability: Normal
       .... ..0. = Cost: Normal
       .... ...0 = MBZ: Reserved
     Total Length: 42
     Identification: 0x0000 (0)
   ⊞ Flags: 0x00
     Fragment offset: 0
     Time to live: 63
     Protocol: Any host internal protocol (61)
   ⊞ Header checksum: 0x4331 [correct]
     Source: 170.2.1.1 (170.2.1.1)
     Destination: 140.1.1.2 (140.1.1.2)
     [Source GeoIP: Unknown]
     [Destination GeoIP: Unknown]
⊞ Data (22 bytes)
```

Downstream traffic: the **Precedence is 'flash (3)' and the DSCP is 0x18** (24 in decimal).

```
⊞ Frame 9002: 68 bytes on wire (544 bits), 68 bytes captured (544 bits) on interface 0
⊞ Ethernet II, Src: 00:18:23:30:c5:fd (00:18:23:30:c5:fd), Dst: 00:12:01:00:00:02 (00:12:01:00:00:02)
⊟ 802.1Q Virtual LAN
     011. .... .... .... = Priority: 3
     ...0 .... .... .... = CFI: 0
     .... 0000 0000 1100 = ID: 12
     Type: IP (0x0800)
     Trailer: a1bc4340
⊟ Internet Protocol Version 4, Src: 140.1.1.2 (140.1.1.2), Dst: 170.2.1.2 (170.2.1.2)
     Version: 4
     Header length: 20 bytes
   ⊞ Differentiated Services Field: 0x60 (DSCP 0x18: Class Selector 3; ECN: 0x00: Not-ECT (Not ECN-Capable Transport))
   ⊟ Type of service: 0x60 (None)
       011. .... = Precedence: flash (3)
       ...0 .... = Delay: Normal
       .... 0... = Throughput: Normal
       .... .0.. = Reliability: Normal
       .... ..0. = Cost: Normal
       .... ...0 = MBZ: Reserved
     Total Length: 46
     Identification: 0x0000 (0)
   ⊞ Flags: 0x00
     Fragment offset: 0
     Time to live: 63
     Protocol: Any host internal protocol (61)
   ⊞ Header checksum: 0x432c [correct]
     Source: 140.1.1.2 (140.1.1.2)
     Destination: 170.2.1.2 (170.2.1.2)
     [Source GeoIP: Unknown]
     [Destination GeoIP: Unknown]
⊞ Data (26 bytes)
```