White Paper

Quality of Service (QoS)

Cisco Catalyst Instant Access Solution

Contents

Overview

Typically, networks operate on a best-effort delivery basis, which means that all traffic has equal priority and an equal chance of being delivered in a timely manner. When congestion occurs, all traffic has an equal chance of being dropped. When you configure quality of service (QoS), you can select specific network traffic, prioritize it according to its relative importance, and use congestion-management and congestion-avoidance techniques to give preferential treatment. Implementing QoS in your network makes network performance more predictable and bandwidth utilization more effective. This document will attempt to provide a high-level overview of the QoS features found on Cisco Catalyst® Instant Access switches.

Pre-Requisites for QoS

Before configuring standard QoS, you must have a thorough understanding of these items:

- The types of applications used and the traffic patterns on your network
- Traffic characteristics and needs of your network. For example, is the traffic on your network burst? Do you need to reserve bandwidth for voice and video streams?
- Bandwidth requirements and speed of the network
- Location of congestion points in the network

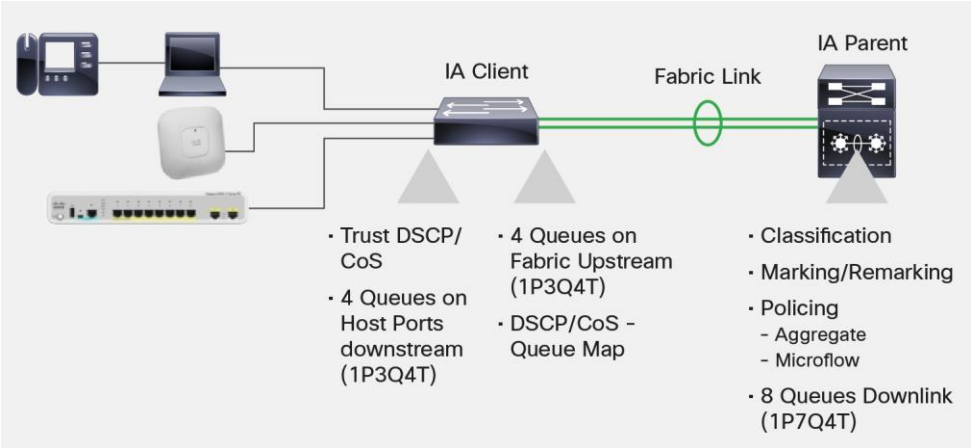
Quality of Service

Cisco® Catalyst Instant Access is a solution that allows customers to dramatically simplify campus network operations. It simplifies operation through a single point of operation and management for campus access and backbone. The solution is composed of Cisco Catalyst 6500 or 6800 Series backbone switches and Cisco Catalyst 6800ia Series Switches (Instant Access). The Cisco Catalyst 6800ia Series Switches operate like remote line cards and are physically connected by fex-fabric uplinks to the Cisco Catalyst 6500 or 6800. An Instant Access switch can provide enterprise campus features such as Power over Ethernet (PoE/PoE+), Security Group Tag (SGT), Multiprotocol Label Switching (MPLS), Easy Virtual Network (EVN), stacking, and other premium Catalyst 6800 features in the access layer network.

Since Instant Access supports stacking up to five stack members, QoS implementation may need to factor in the campus network depending on the number of fex-fabric uplinks used in this particular stack of switches. With a stack of three switches, the Instant Access solution provides up to 60 Gbps of fex-fabric uplink connectivity per stack (of three Instant Access clients) to the virtual switching system (VSS) pair, offering the subscription ratio of 2.4 to 1. With the Cisco IOS® Software Release 15.2(1)SY train, the stacking capability is increased to five. So, the Instant Access solution can provide up to 80 Gbps of fex-fabric uplink connectivity and the subscription ratio becomes 3 to 1.

The Instant Access client host ports and fex-fabric links (upstream to the Instant Access parent) support four queues (1P3Q3T), with one priority queue and three standard queues. The fex-fabric links on the Instant Access parent support eight (1P7Q4T) queues with one priority and seven standard queues on the fex-fabric link (Figure 1).

Figure 1. Queues at the Instant Access Client and Parent



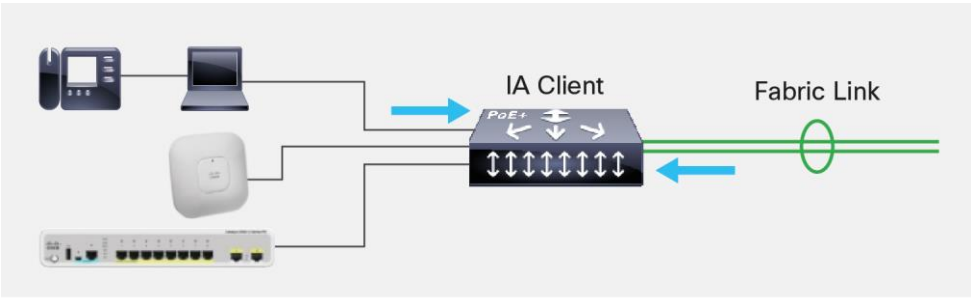
QoS on the Instant Access Client

Ingress Traffic Flow

The method of operation on Instant Access host ports is to trust the QoS value in incoming packets. So, every incoming packet on the host ports will trust the Differentiated Services Code Point (DSCP) (default) or Class of Service (COS) value. Ingress queuing on Instant Access client host ports and fex-fabric uplinks is not available (Figure 2).

However, Policy Feature Card (PFC) and Distributed Forwarding Card (DFC)-based classification, marking, and policing are available for host ports ingress packets. Refer to the white paper, “Understanding Quality of Service on the Catalyst 6500 Switch,” for PFC and DFC-based QoS features: http://www.cisco.com/c/en/us/products/collateral/switches/catalyst-6500-series-switches/white_paper_c11_538840.html

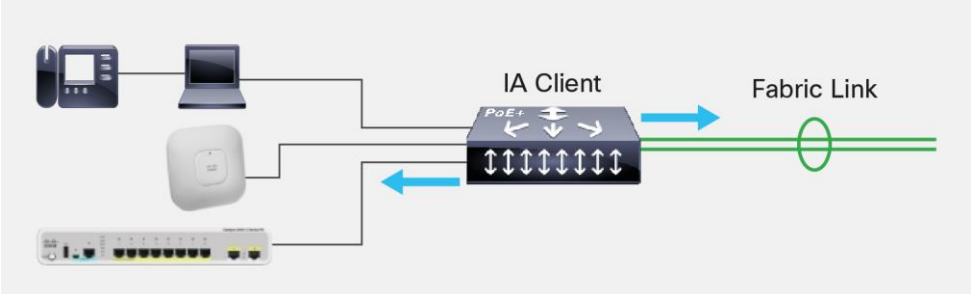
Figure 2. Ingress Flow on the Instant Access Client Switch



Egress Traffic Flow

Egress queuing on Instant Access host ports is enabled by default with a default queuing configuration (Figure 3).

Figure 3. Egress Flow on the Instant Access Client Switch



Prior to Cisco IOS 15.1(2)SY5 and 15.2(1)SY1 software releases, there was no way to change the queuing configuration on these host ports. DSCP values (32, 33, 40, 41, 42, 43, 44, 45, 46, 47) are considered priority traffic and will not drop when there is traffic congestion, as shown in the following output:

```
6880-VSS#show queueing int gig 108/1/0/1
Interface GigabitEthernet108/1/0/1 queueing strategy:  Weighted Round-Robin

  Port QoS is enabled globally
  Queueing on Gi108/1/0/1: Tx Enabled Rx Disabled

Trust boundary disabled

  Trust state: trust DSCP
  Trust state in queueing: trust DSCP
  Default COS is 0
    Queueing Mode In Tx direction: mode-dscp
    Transmit queues [type = 1p3q3t]:
    Queue Id    Scheduling  Num of thresholds
    -----------------------------------------
       1         Priority            3
       2         WRR                 3
       3         WRR                 3
       4         WRR                 3

    WRR bandwidth ratios:  100[queue 1] 100[queue 2] 100[queue 3]   100[queue 4]
    queue-limit ratios:     15[Pri Queue]  25[queue 2]  40[queue 3]  20[queue 4]

    queue thresh dscp-map
    ----------------------------------------
    1     1      32 33 40 41 42 43 44 45 46 47
    1     2
    1     3
```

```
2       1       16 17 18 19 20 21 22 23 26 27 28 29 30 31 34 35 36 37 38 39
2       2       24
2       3       48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63
3       1       25
3       2
3       3       0 1 2 3 4 5 6 7
4       1       8 9 11 13 15
4       2       10 12 14
4       3
```

Note: Instant Access control traffic is sent over the priority queue to ensure the communication between the Instant Access parent and client is not lost due to congestion.

However, with Cisco IOS 15.1(2)SY5, 15.2(1)SY1, and later software releases, the queuing configuration (for egress flow) on Instant Access host ports can be modified. In these software releases, the following features are configurable on Instant Access host ports by using the Cisco Modular QoS CLI (MQC) policy maps of the type, “lan-queuing”:

- Priority queuing
- Queue bandwidth
- DSCP-to-queue map
- Queue limit/buffer

Note: Modifying the queuing configuration on Instant Access is supported in DSCP mode only. Neither the 15.1 train, nor 15.2 train will support modifying “COS to queue mapping.” Instant Access will always use “DSCP to queue mapping“ on the Instant Access egress ports.

A service-policy configured on one of the host ports will propagate to all host ports on the Instant Access switch. So, all host ports on Instant Access will have the same queuing configuration and will overwrite the previous queuing configuration or policy present on other interfaces. The same configuration will be applicable in a stacked environment and the queuing configuration will be synchronized to other members of the stack. In other words, there will be one service policy for all host ports on each associated fabric extension (FEX).

Configuring QoS on the Instant Access Client

There are two types of service-policy configurations in QoS. They are:

- PFC QoS, which is the “service-policy”. It includes classification, marking, and policing.
- Port QoS, which is “service-policy type lan-queuing”. It includes DSCP/COS to queue mapping, bandwidth, queue limit, queue buffers, and shaping. Port QoS can be applied only on the physical interface, and not on logical interfaces.

Instant Access queuing features are configurable through “service-policy type lan-queuing” policies. They do not support any legacy Cisco Catalyst 6500 and 6800 Series queuing commands. All of the configurations and show commands originate from the Instant parent switch and will follow the native Cisco Catalyst 6500 and 6800 switches style for configuration and display format. The “service-policy type lan-queuing” policy will be the only option for modifying the Instant Access queuing configuration. Follow the steps below to configure QoS features on Instant Access host ports.

Step 1. Create Class Maps

A class map is a mechanism you use to name a specific traffic flow (or class) and to isolate it from all other traffic. The class map defines the criteria used to match against a specific traffic flow to further classify it. If you have more than one type of traffic that you want to classify, you can create another class map and use a different name. After a packet is matched against the class-map criteria, you further classify it through the use of a policy map.

```
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#class-map type lan-queuing data
6880-VSS(config-cmap)#match ?
  cos            IEEE 802.1Q/ISL class of service/user priority values
  discard-class  Discard behavior identifier
  dscp           Match DSCP in IPv4 and IPv6 packets
  precedence     Match Precedence in IPv4 and IPv6 packets

6880-VSS(config-cmap)#match dscp ?
  <0-63>   Differentiated services codepoint value
  af11     Match packets with AF11 dscp (001010)
  af12     Match packets with AF12 dscp (001100)
  af13     Match packets with AF13 dscp (001110)
  af21     Match packets with AF21 dscp (010010)
  af22     Match packets with AF22 dscp (010100)
  af23     Match packets with AF23 dscp (010110)
  af31     Match packets with AF31 dscp (011010)
  af32     Match packets with AF32 dscp (011100)
  af33     Match packets with AF33 dscp (011110)
  af41     Match packets with AF41 dscp (100010)
  af42     Match packets with AF42 dscp (100100)
  af43     Match packets with AF43 dscp (100110)
  cs1      Match packets with CS1(precedence 1) dscp (001000)
  cs2      Match packets with CS2(precedence 2) dscp (010000)
  cs3      Match packets with CS3(precedence 3) dscp (011000)
  cs4      Match packets with CS4(precedence 4) dscp (100000)
  cs5      Match packets with CS5(precedence 5) dscp (101000)
  cs6      Match packets with CS6(precedence 6) dscp (110000)
  cs7      Match packets with CS7(precedence 7) dscp (111000)
  default  Match packets with default dscp (000000)
  ef       Match packets with EF dscp (101110)

6880-VSS(config-cmap)#match dscp cs1
6880-VSS(config-cmap)#end
6880-VSS#wr
```

Step 2. Create Policy Maps

A policy map specifies which traffic class to act upon. Actions can include setting a specific DSCP value in the traffic class, and specifying the traffic bandwidth limitations. Before a policy map can be effective, you must attach it to a port.

```
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#policy-map type lan-queuing test
6880-VSS(config-pmap)#class video
6880-VSS(config-pmap-c)#priority ?
  <1-40000000>  Kilo Bits per second
  level         Multi-Level Priority Queue
  percent       % of total bandwidth
  <cr>

6880-VSS(config-pmap-c)#priority
6880-VSS(config-pmap-c)#end
6880-VSS#
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#policy-map type lan-queuing test
6880-VSS(config-pmap)#class data
6880-VSS(config-pmap-c)#?
Policy-map class configuration commands:
  bandwidth       Bandwidth
  exit            Exit from class action configuration mode
  no              Negate or set default values of a command
  priority        Strict Scheduling Priority for this Class
  queue-buffers   queue buffer
  queue-limit     Queue Max Threshold for Tail Drop
  random-detect   Enable Random Early Detection as drop policy
  service-policy  Configure QoS Service Policy
  shape           Traffic Shaping

6880-VSS(config-pmap-c)#bandwidth ?
  <1-2000000>  Kilo Bits per second
  percent      % of total Bandwidth
  remaining    % of the remaining bandwidth

6880-VSS(config-pmap-c)#bandwidth remaining percent ?
  <1-100>  Percentage

6880-VSS(config-pmap-c)#bandwidth remaining percent 30
6880-VSS(config-pmap-c)#queue-buffers ratio ?
  <0-100>  Queue-buffers ratio limit
```

```
6880-VSS(config-pmap-c)#queue-buffers ratio 30
6880-VSS(config-pmap-c)#exit
```

Step 3. Verify Class Maps and Policy Maps

```
6880-VSS#show class-map type lan-queuing
 Class Map type lan-queuing match-all video (id 4)
   Match   dscp cs1 (8)
 Class Map type lan-queuing match-any data (id 33)
   Match   dscp cs4 (32) cs5 (40)

6880-VSS#show policy-map type lan-queuing
  Policy Map type lan-queuing test
  Policy Map type lan-queuing test-1
```

Step 4. Apply a Policy Map on Instant Access Host Ports

```
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#int gig 108/1/0/1
6880-VSS(config-if)#no shut
6880-VSS(config-if)#service-policy ?
  input   Assign policy-map to the input of an interface
  output  Assign policy-map to the output of an interface
  type    Configure CPL Service Policy
```

Note: Policy will apply on the interface for egress traffic flow only.

```
6880-VSS(config-if)#service-policy type lan-queuing output test
Propagating [attach] lan queueing policy "test" to Gi108/1/0/2 Gi108/1/0/3
Gi108/1/0/4 Gi108/1/0/5 Gi108/1/0/6 Gi108/1/0/7 Gi108/1/0/8 Gi108/1/0/9
Gi108/1/0/10 Gi108/1/0/11 Gi108/1/0/12 Gi108/1/0/13 Gi108/1/0/14 Gi108/1/0/15
Gi108/1/0/16 Gi108/1/0/17 Gi108/1/0/18 Gi108/1/0/19 Gi108/1/0/20 Gi108/1/0/21
Gi108/1/0/22 Gi108/1/0/23 Gi108/1/0/24 Gi108/1/0/25 Gi108/1/0/26 Gi108/1/0/27
Gi108/1/0/28 Gi108/1/0/29 Gi108/1/0/30 Gi108/1/0/31 Gi108/1/0/32 Gi108/1/0/33
Gi108/1/0/34 Gi108/1/0/35 Gi108/1/0/36 Gi108/1/0/37 Gi108/1/0/38 Gi108/1/0/39
Gi108/1/0/40 Gi108/1/0/41 Gi108/1/0/42 Gi108/1/0/43 Gi108/1/0/44 Gi108/1/0/45
Gi108/1/0/46 Gi108/1/0/47 Gi108/1/0/48
Propagating [attach] lan queueing policy "test" to Gi108/3/0/1 Gi108/3/0/2
Gi108/3/0/3 Gi108/3/0/4 Gi108/3/0/5 Gi108/3/0/6 Gi108/3/0/7 Gi108/3/0/8
Gi108/3/0/9 Gi108/3/0/10 Gi108/3/0/11 Gi108/3/0/12 Gi108/3/0/13 Gi108/3/0/14
Gi108/3/0/15 Gi108/3/0/16 Gi108/3/0/17 Gi108/3/0/18 Gi108/3/0/19 Gi108/3/0/20
Gi108/3/0/21 Gi108/3/0/22 Gi108/3/0/23 Gi108/3/0/24 Gi108/3/0/25 Gi108/3/0/26
Gi108/3/0/27 Gi108/3/0/28 Gi108/3/0/29 Gi108/3/0/30 Gi108/3/0/31 Gi108/3/0/32
Gi108/3/0/33 Gi108/3/0/34 Gi108/3/0/35 Gi108/3/0/36 Gi108/3/0/37 Gi108/3/0/38
Gi108/3/0/39 Gi108/3/0/40 Gi108/3/0/41 Gi108/3/0/42 Gi108/3/0/43 Gi108/3/0/44
Gi108/3/0/45 Gi108/3/0/46 Gi108/3/0/47 Gi108/3/0/48
Propagating [attach] lan queueing policy "test" to Gi108/2/0/1 Gi108/2/0/2
Gi108/2/0/3 Gi108/2/0/4 Gi108/2/0/5 Gi108/2/0/6 Gi108/2/0/7 Gi108/2/0/8
Gi108/2/0/9 Gi108/2/0/10 Gi108/2/0/11 Gi108/2/0/12 Gi108/2/0/13 Gi108/2/0/14
Gi108/2/0/15 Gi108/2/0/16 Gi108/2/0/17 Gi108/2/0/18 Gi108/2/0/19 Gi108/2/0/20
Gi108/2/0/21 Gi108/2/0/22 Gi108/2/0/23 Gi108/2/0/24 Gi108/2/0/25 Gi108/2/0/26
Gi108/2/0/27 Gi108/2/0/28 Gi108/2/0/29 Gi108/2/0/30 Gi108/2/0/31 Gi108/2/0/32
```

```
Gi108/2/0/33 Gi108/2/0/34 Gi108/2/0/35 Gi108/2/0/36 Gi108/2/0/37 Gi108/2/0/38
Gi108/2/0/39 Gi108/2/0/40 Gi108/2/0/41 Gi108/2/0/42 Gi108/2/0/43 Gi108/2/0/44
Gi108/2/0/45 Gi108/2/0/46 Gi108/2/0/47 Gi108/2/0/48
6880-VSS(config-if)#end
6880-VSS#
```

Note: A service-policy configured on one of the ports will propagate to all host ports on the Instant Access switch.

Step 5. Verify the Modified QoS Configuration on the Instant Access Host Port

```
6880-VSS#show queueing interface gig 108/1/0/1
Interface GigabitEthernet108/1/0/1 queueing strategy:  Weighted Round-Robin

  Port QoS is enabled globally
  Queueing on Gi108/1/0/1: Tx Enabled Rx Disabled

Trust boundary disabled

  Trust state: trust DSCP
  Trust state in queueing: trust DSCP
  Default COS is 0
    Class-map to Queue in Tx direction
    Class-map           Queue Id
    ---------------------------
    video                    1
    data                     4
    class-default            2

    Queueing Mode In Tx direction: mode-dscp
    Transmit queues [type = 1p3q3t]:
    Queue Id    Scheduling  Num of thresholds
    ----------------------------------------
       1         Priority            3
       2         WRR                 3
       3         WRR                 3
       4         WRR                 3

    WRR bandwidth ratios:   70[queue 2]   0[queue 3]  30[queue 4]
    queue-limit ratios:  15[Pri Queue] 100[queue 2]   0[queue 3]  100[queue 4]

    queue thresh dscp-map
    ---------------------------------------
    1     1      8
    1     2
    1     3
```

```
    2      1       0 1 2 3 4 5 6 7 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 33 34 35 36 37 38 39 41 42 43 44 45 46 47 48 49 50 51 52 53
54 55 56 57 58 59 60 61 62 63
    2      2
    2      3
    3      1
    3      2
    3      3
    4      1       32 40
    4      2
    4      3
```

How to Remove the QoS Configuration from Instant Access

The QoS configuration on an Instant Access host port can be easily removed by simply detaching the service policy from an interface.

Note: Upon detaching the service policy, the default queuing configuration will apply to all host ports on the associated FEX.

```
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#int gig 108/1/0/1
6880-VSS(config-if)#no service-policy type lan-queuing ?
  input   Assign policy-map to the input of an interface
  output  Assign policy-map to the output of an interface
```

```
6880-VSS(config-if)#no service-policy type lan-queuing output test
Propagating [remove] lan queueing policy "test" to Gi108/1/0/2 Gi108/1/0/3
Gi108/1/0/4 Gi108/1/0/5 Gi108/1/0/6 Gi108/1/0/7 Gi108/1/0/8 Gi108/1/0/9
Gi108/1/0/10 Gi108/1/0/11 Gi108/1/0/12 Gi108/1/0/13 Gi108/1/0/14 Gi108/1/0/15
Gi108/1/0/16 Gi108/1/0/17 Gi108/1/0/18 Gi108/1/0/19 Gi108/1/0/20 Gi108/1/0/21
Gi108/1/0/22 Gi108/1/0/23 Gi108/1/0/24 Gi108/1/0/25 Gi108/1/0/26 Gi108/1/0/27
Gi108/1/0/28 Gi108/1/0/29 Gi108/1/0/30 Gi108/1/0/31 Gi108/1/0/32 Gi108/1/0/33
Gi108/1/0/34 Gi108/1/0/35 Gi108/1/0/36 Gi108/1/0/37 Gi108/1/0/38 Gi108/1/0/39
Gi108/1/0/40 Gi108/1/0/41 Gi108/1/0/42 Gi108/1/0/43 Gi108/1/0/44 Gi108/1/0/45
Gi108/1/0/46 Gi108/1/0/47 Gi108/1/0/48
Propagating [remove] lan queueing policy "test" to Gi108/3/0/1 Gi108/3/0/2
Gi108/3/0/3 Gi108/3/0/4 Gi108/3/0/5 Gi108/3/0/6 Gi108/3/0/7 Gi108/3/0/8
Gi108/3/0/9 Gi108/3/0/10 Gi108/3/0/11 Gi108/3/0/12 Gi108/3/0/13 Gi108/3/0/14
Gi108/3/0/15 Gi108/3/0/16 Gi108/3/0/17 Gi108/3/0/18 Gi108/3/0/19 Gi108/3/0/20
Gi108/3/0/21 Gi108/3/0/22 Gi108/3/0/23 Gi108/3/0/24 Gi108/3/0/25 Gi108/3/0/26
Gi108/3/0/27 Gi108/3/0/28 Gi108/3/0/29 Gi108/3/0/30 Gi108/3/0/31 Gi108/3/0/32
Gi108/3/0/33 Gi108/3/0/34 Gi108/3/0/35 Gi108/3/0/36 Gi108/3/0/37 Gi108/3/0/38
Gi108/3/0/39 Gi108/3/0/40 Gi108/3/0/41 Gi108/3/0/42 Gi108/3/0/43 Gi108/3/0/44
Gi108/3/0/45 Gi108/3/0/46 Gi108/3/0/47 Gi108/3/0/48
Propagating [remove] lan queueing policy "test" to Gi108/2/0/1 Gi108/2/0/2
Gi108/2/0/3 Gi108/2/0/4 Gi108/2/0/5 Gi108/2/0/6 Gi108/2/0/7 Gi108/2/0/8
Gi108/2/0/9 Gi108/2/0/10 Gi108/2/0/11 Gi108/2/0/12 Gi108/2/0/13 Gi108/2/0/14
Gi108/2/0/15 Gi108/2/0/16 Gi108/2/0/17 Gi108/2/0/18 Gi108/2/0/19 Gi108/2/0/20
Gi108/2/0/21 Gi108/2/0/22 Gi108/2/0/23 Gi108/2/0/24 Gi108/2/0/25 Gi108/2/0/26
Gi108/2/0/27 Gi108/2/0/28 Gi108/2/0/29 Gi108/2/0/30 Gi108/2/0/31 Gi108/2/0/32
Gi108/2/0/33 Gi108/2/0/34 Gi108/2/0/35 Gi108/2/0/36 Gi108/2/0/37 Gi108/2/0/38
```

```
Gi108/2/0/39 Gi108/2/0/40 Gi108/2/0/41 Gi108/2/0/42 Gi108/2/0/43 Gi108/2/0/44
Gi108/2/0/45 Gi108/2/0/46 Gi108/2/0/47 Gi108/2/0/48
6880-VSS(config-if)#
```

Deleting the policy map will also remove the QoS configuration from the interface. However, all interfaces that are associated with the deleted policy map will be affected and the default queuing configuration will apply to all effective host ports as shown in the following output:

```
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#no policy-map type lan-queuing ?
  WORD  policy-map name
```

```
6880-VSS(config)#no policy-map type lan-queuing test
Propagating [remove] lan queueing policy "test" to Gi108/1/0/1 Gi108/1/0/3
Gi108/1/0/4 Gi108/1/0/5 Gi108/1/0/6 Gi108/1/0/7 Gi108/1/0/8 Gi108/1/0/9
Gi108/1/0/10 Gi108/1/0/11 Gi108/1/0/12 Gi108/1/0/13 Gi108/1/0/14 Gi108/1/0/15
Gi108/1/0/16 Gi108/1/0/17 Gi108/1/0/18 Gi108/1/0/19 Gi108/1/0/20 Gi108/1/0/21
Gi108/1/0/22 Gi108/1/0/23 Gi108/1/0/24 Gi108/1/0/25 Gi108/1/0/26 Gi108/1/0/27
Gi108/1/0/28 Gi108/1/0/29 Gi108/1/0/30 Gi108/1/0/31 Gi108/1/0/32 Gi108/1/0/33
Gi108/1/0/34 Gi108/1/0/35 Gi108/1/0/36 Gi108/1/0/37 Gi108/1/0/38 Gi108/1/0/39
Gi108/1/0/40 Gi108/1/0/41 Gi108/1/0/42 Gi108/1/0/43 Gi108/1/0/44 Gi108/1/0/45
Gi108/1/0/46 Gi108/1/0/47 Gi108/1/0/48
Propagating [remove] lan queueing policy "test" to Gi108/2/0/1 Gi108/2/0/2
Gi108/2/0/3 Gi108/2/0/4 Gi108/2/0/5 Gi108/2/0/6 Gi108/2/0/7 Gi108/2/0/8
Gi108/2/0/9 Gi108/2/0/10 Gi108/2/0/11 Gi108/2/0/12 Gi108/2/0/13 Gi108/2/0/14
Gi108/2/0/15 Gi108/2/0/16 Gi108/2/0/17 Gi108/2/0/18 Gi108/2/0/19 Gi108/2/0/20
Gi108/2/0/21 Gi108/2/0/22 Gi108/2/0/23 Gi108/2/0/24 Gi108/2/0/25 Gi108/2/0/26
Gi108/2/0/27 Gi108/2/0/28 Gi108/2/0/29 Gi108/2/0/30 Gi108/2/0/31 Gi108/2/0/32
Gi108/2/0/33 Gi108/2/0/34 Gi108/2/0/35 Gi108/2/0/36 Gi108/2/0/37 Gi108/2/0/38
Gi108/2/0/39 Gi108/2/0/40 Gi108/2/0/41 Gi108/2/0/42 Gi108/2/0/43 Gi108/2/0/44
Gi108/2/0/45 Gi108/2/0/46 Gi108/2/0/47 Gi108/2/0/48
Propagating [remove] lan queueing policy "test" to Gi108/3/0/1 Gi108/3/0/2
Gi108/3/0/3 Gi108/3/0/4 Gi108/3/0/5 Gi108/3/0/6 Gi108/3/0/7 Gi108/3/0/8
Gi108/3/0/9 Gi108/3/0/10 Gi108/3/0/11 Gi108/3/0/12 Gi108/3/0/13 Gi108/3/0/14
Gi108/3/0/15 Gi108/3/0/16 Gi108/3/0/17 Gi108/3/0/18 Gi108/3/0/19 Gi108/3/0/20
Gi108/3/0/21 Gi108/3/0/22 Gi108/3/0/23 Gi108/3/0/24 Gi108/3/0/25 Gi108/3/0/26
Gi108/3/0/27 Gi108/3/0/28 Gi108/3/0/29 Gi108/3/0/30 Gi108/3/0/31 Gi108/3/0/32
Gi108/3/0/33 Gi108/3/0/34 Gi108/3/0/35 Gi108/3/0/36 Gi108/3/0/37 Gi108/3/0/38
Gi108/3/0/39 Gi108/3/0/40 Gi108/3/0/41 Gi108/3/0/42 Gi108/3/0/43 Gi108/3/0/44
Gi108/3/0/45 Gi108/3/0/46 Gi108/3/0/47 Gi108/3/0/48
Propagating [remove] lan queueing policy "test" to Gi107/1/0/2 Gi107/1/0/3
Gi107/1/0/4 Gi107/1/0/5 Gi107/1/0/6 Gi107/1/0/7 Gi107/1/0/8 Gi107/1/0/9
Gi107/1/0/10 Gi107/1/0/11 Gi107/1/0/12 Gi107/1/0/13 Gi107/1/0/14 Gi107/1/0/15
Gi107/1/0/16 Gi107/1/0/17 Gi107/1/0/18 Gi107/1/0/19 Gi107/1/0/20 Gi107/1/0/21
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Gi107/1/0/28 Gi107/1/0/29 Gi107/1/0/30 Gi107/1/0/31 Gi107/1/0/32 Gi107/1/0/33
Gi107/1/0/34 Gi107/1/0/35 Gi107/1/0/36 Gi107/1/0/37 Gi107/1/0/38 Gi107/1/0/39
Gi107/1/0/40 Gi107/1/0/41 Gi107/1/0/42 Gi107/1/0/43 Gi107/1/0/44 Gi107/1/0/45
Gi107/1/0/46 Gi107/1/0/47 Gi107/1/0/48
Propagating [remove] lan queueing policy "test" to Gi107/2/0/1 Gi107/2/0/2
Gi107/2/0/3 Gi107/2/0/4 Gi107/2/0/5 Gi107/2/0/6 Gi107/2/0/7 Gi107/2/0/8
Gi107/2/0/9 Gi107/2/0/10 Gi107/2/0/11 Gi107/2/0/12 Gi107/2/0/13 Gi107/2/0/14
Gi107/2/0/15 Gi107/2/0/16 Gi107/2/0/17 Gi107/2/0/18 Gi107/2/0/19 Gi107/2/0/20
Gi107/2/0/21 Gi107/2/0/22 Gi107/2/0/23 Gi107/2/0/24 Gi107/2/0/25 Gi107/2/0/26
Gi107/2/0/27 Gi107/2/0/28 Gi107/2/0/29 Gi107/2/0/30 Gi107/2/0/31 Gi107/2/0/32
Gi107/2/0/33 Gi107/2/0/34 Gi107/2/0/35 Gi107/2/0/36 Gi107/2/0/37 Gi107/2/0/38
```

```
Gi107/2/0/39 Gi107/2/0/40 Gi107/2/0/41 Gi107/2/0/42 Gi107/2/0/43 Gi107/2/0/44
Gi107/2/0/45 Gi107/2/0/46 Gi107/2/0/47 Gi107/2/0/48

Propagating [remove] lan queueing policy "test" to Gi107/3/0/1 Gi107/3/0/2
Gi107/3/0/3 Gi107/3/0/4 Gi107/3/0/5 Gi107/3/0/6 Gi107/3/0/7 Gi107/3/0/8
Gi107/3/0/9 Gi107/3/0/10 Gi107/3/0/11 Gi107/3/0/12 Gi107/3/0/13 Gi107/3/0/14
Gi107/3/0/15 Gi107/3/0/16 Gi107/3/0/17 Gi107/3/0/18 Gi107/3/0/19 Gi107/3/0/20
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Gi107/3/0/27 Gi107/3/0/28 Gi107/3/0/29 Gi107/3/0/30 Gi107/3/0/31 Gi107/3/0/32
Gi107/3/0/33 Gi107/3/0/34 Gi107/3/0/35 Gi107/3/0/36 Gi107/3/0/37 Gi107/3/0/38
Gi107/3/0/39 Gi107/3/0/40 Gi107/3/0/41 Gi107/3/0/42 Gi107/3/0/43 Gi107/3/0/44
Gi107/3/0/45 Gi107/3/0/46 Gi107/3/0/47 Gi107/3/0/48

6880-VSS(config)#end
```

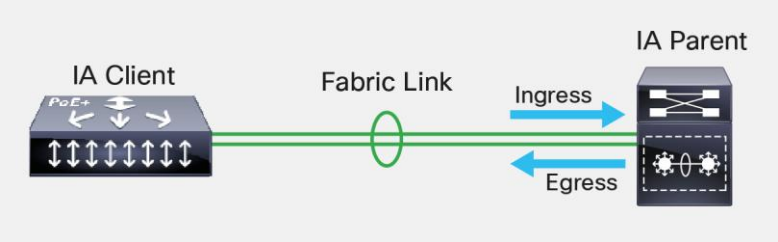
QoS on the Instant Access Fex-Fabric Link

QoS over the fex-fabric link is strictly based on the DSCP and CoS values of the packets. The Instant Access parent and client maintain a default DSCP-to-queue map and CoS-to-queue map, which is the basis of queuing packets appropriately over a priority or standard queue on fex-fabric interfaces.

Once IP packets arrive at the Instant Access parent, they can be marked, re-marked, classified, or policed. Refer to policy-based queuing in the Release 15.2SY Supervisor Engine 2T Software Configuration Guide for more details: http://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst6500/ios/15-2SY/config_guide/sup2T/15_2_sy_swcg_2T/qos_policy_based_queueing.html#pgfId-1009155

Prior to 15.1(2)SY5 and 15.2(1)SY1 software releases, both ingress and egress traffic flow on fex-fabric links used default DSCP and COS to queue maps and traffic in the appropriate queue (Figure 4).

Figure 4. Traffic Flow on Instant Access Fex-Fabric Links



However, the queuing configuration on the fex-fabric link can be modified with 15.1(2)SY5 and 15.2(1)SY1 or later software releases. The queuing configuration is supported in the both ingress and egress direction. In these software releases, we can modify “DSCP to queue mappings”, “priority queuing”, “queue bandwidth”, “queue limit/buffers”, and “traffic shaping”. However, traffic shaping is supported on egress traffic only.

Note: Modifying the queuing configuration on the fex-fabric link is supported only in DSCP mode. Neither the 15.1 train, nor 15.2 train will support configuring “COS to queue mapping”.

Configuring QoS on the Fex-Fabric Link

The following steps explain how to configure QoS on the Instant Access Fex-Fabric link.

Step 1. Create Class Maps

```
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#class-map type lan-queuing non_priority
6880-VSS(config-cmap)#match dscp cs2
6880-VSS(config-cmap)#end
```

Step 2. Create Policy Maps

```
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#policy-map type lan-queuing RSL_Fabric
6880-VSS(config-pmap)#class type lan-queuing ?
  WORD            class-map name
  class-default   System default class matching otherwise unclassified packets

6880-VSS(config-pmap)#class type lan-queuing video
6880-VSS(config-pmap-c)#priority level 1
6880-VSS(config-pmap-c)#exit
6880-VSS(config-pmap)#class type lan-queuing data
6880-VSS(config-pmap-c)#bandwidth remaining percent 40
6880-VSS(config-pmap-c)#shape average ?
  <8000-40000000000>  Target Bit Rate (bits/sec). (postfix k, m, g optional;
                      decimal point allowed)
  percent             % of interface bandwidth for Committed information rate

6880-VSS(config-pmap-c)#shape average 200000000
6880-VSS(config-pmap-c)#exit
6880-VSS(config-pmap)#class type lan-queuing non-priority
6880-VSS(config-pmap-c)#bandwidth remaining percent 20
6880-VSS(config-pmap-c)#shape average percent 1
6880-VSS(config-pmap-c)#exit
6880-VSS(config-pmap)#exit
6880-VSS(config)#exit
6880-VSS#
```

Note: Shaping is supported on the egress traffic flow only.

Step 3. Verify Class Maps and Policy Maps

```
6880-VSS#show policy-map type lan-queuing
  Policy Map type lan-queuing RSL_Fabric
    Class video
      priority 1 (kbps)
    Class data
```

```
      bandwidth remaining 40 (%)
      Average Rate Traffic Shaping
      cir 200000000 (bps)
    Class non_priority
      bandwidth remaining 20 (%)
      Average Rate Traffic Shaping
      cir 1%
6880-VSS#show class-map type lan-queuing
 Class Map type lan-queuing match-any data (id 4)
   Match   dscp af11 (10) af12 (12)
   Match   dscp cs1 (8)

 Class Map type lan-queuing match-all non_priority (id 41)
   Match   dscp cs2 (16)

 Class Map type lan-queuing match-all video (id 33)
   Match   dscp cs5 (40) ef (46)
```

Step 4. Check Fex-Fabric Link Ports

```
6880-VSS#show fex 105
FEX: 105  Description: FEX0105       state: online
  FEX version: 15.2(3m)E1
  Extender Model: C6800IA-48TD, Extender Serial: FCW1838B3U9
  FCP ready: yes
  Image Version Check: enforced
  Fabric Portchannel Ports: 2
  Fabric port for control traffic: Te1/5/5
  Fabric interface state:
    Po105      - Interface Up.
    Te1/5/5    - Interface Up.      state: bound
    Te2/5/5    - Interface Up.      state: bound

6880-VSS#show run int te 1/5/5
Building configuration...

Current configuration : 108 bytes
!
interface TenGigabitEthernet1/5/5
 switchport
 switchport mode fex-fabric
 channel-group 105 mode on
end
```

Step 5. Remove the Interface from the Port Channel

Port QoS can apply only on physical interfaces, not on logical interfaces. So, interface needs to be removed from the fex-fabric link port channel before applying the policy map to the interface.

```
6880-VSS#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
6880-VSS(config)#default interface te 1/5/5

000393: *Jul 10 23:09:20.178: %SATMGR-SW1-3-ERR_DUAL_ACTIVE_DETECT_INCAPABLE:
channel group 105 is no longer dual-active detection capable
Interface TenGigabitEthernet1/5/5 set to default configuration
6880-VSS(config)#
000394:  10 23:09:21.446: %LINEPROTO-5-UPDOWN: Line protocol on Interface
TenGigabitEthernet1/0/1, changed state to down (FEX-105)
6880-VSS(config)#
000395:  10 23:09:25.455: %LINEPROTO-5-UPDOWN: Line protocol on Interface
TenGigabitEthernet1/0/1, changed state to up (FEX-105)
6880-VSS(config)#
```

Step 6. Apply the Policy Map to the Interface and Bundle It into the Port Channel

```
6880-VSS(config)#int te 1/5/5
6880-VSS(config-if)#service-policy type lan-queuing output RSL_Fabric
6880-VSS(config-if)#switchport
6880-VSS(config-if)#switchport mode fex-fabric
All extraneous configs removed from interface TenGigabitEthernet1/5/5!

6880-VSS(config-if)#channel-group 105 mode on
6880-VSS(config-if)#
000390: *Jul 10 23:08:10.138: %SATMGR-SW1-5-FABRIC_PORT_UP: SDP up on interface
Te1/5/5, connected to FEX 105, uplink 220
000391: *Jul 10 23:08:10.138: %SATMGR-SW1-5-DUAL_ACTIVE_DETECT_CAPABLE: channel
group 105 is now dual-active detection capable
6880-VSS(config-if)#end
6880-VSS#
```

Note: A policy map that has shaping configuration can apply on interface for egress direction only.

Step 7. Verify Fex-Fabric Link Ports

```
6880-VSS#sh fex 105
FEX: 105  Description: FEX0105       state: online
  FEX version: 15.2(3m)E1
  Extender Model: C6800IA-48TD, Extender Serial: FCW1838B3U9
  FCP ready: yes
  Image Version Check: enforced
  Fabric Portchannel Ports: 2
  Fabric port for control traffic: Te2/5/5
  Fabric interface state:
```

```
Po105       - Interface Up.
Te1/5/5     - Interface Up.       state: bound
Te2/5/5     - Interface Up.       state: bound
```

Note: The policy map should be applied to all interfaces on the fex-fabric link port-channel even if only one interface controls the traffic.

Step 8. Apply a Policy Map to the Remaining Interfaces of the Fex-Fabric Link

Repeat steps 5 to 7 for the remaining interfaces from the fex- fabric link port channel.

QoS on the Instant Access Compact Switch

With Cisco Catalyst IOS Release 15.2(1)SY, Cisco Catalyst 3560CX compact switch “WS-C3560CX-12PD-S” was added to the Instant Access portfolio. Moreover, Cisco Catalyst 3560CX compact switch ”WS-C3560CX-8XPD-S” was also added to the portfolio with Cisco Catalyst IOS Release 15.2(1)SY1. Both switches can operate either as a standalone switch or as an Instant Access client (Figure 5).

Figure 5. Instant Access-Capable Compact Switch

Neither WS-C3560CX-12PD-S and WS-C3560CX-8XPD-S support stacking. They do provide up to two 10-Gb uplinks to the Instant Access parent. QoS functionality and implementation on the Instant Access-capable compact switch is exactly the same as 6800IA switches, even though the number of ports is different.

Review appendix A and B for buffers, and queues on Instant Access parents and clients.

Conclusion

Cisco Catalyst Instant Access brings fabric extension (also known as FEX) technology, with high availability and operational simplicity, to a Catalyst campus Ethernet switching line. This technology creates a single configuration and management environment across both distribution and access-layer switches. The technology has been specifically tailored to meet the needs of campus and enterprise network deployments, including QoS features.

For More Information

For more information, refer to the Cisco Catalyst Instant Access website.

Appendix A: Buffers and Queues Structure on Instant Access Parents

	Number of Port ASICs on the Line Card or Chassis	Number of Physical Ports Per Port ASIC	Buffer on the Receive Side	Buffer on the Transmit Side	Receive Queue Structure Per Port	Transmit Queue Structure Per Port
WS-X6904-40G-2T (Oversubscribed mode)	2	8 x 10 Gb	1.25 MB per 10-GE port	22 MB per 10-GE port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
WS-X6904-40G-2T (Performance mode)	2	4x10 Gb	2.5 MB per 10-GE port	44 MB per 10-GE port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6800-32P10G (Oversubscribed mode)	4	32 x 10 Gb	1.2 MB per port	250 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6800-32P10G (Performance mode)	4	16 x 10 Gb	2.5 MB per port	500 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6800-16P10G (Oversubscribed mode)	2	16 x 10 Gb	1.2 MB per port	250 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6800-16P10G (Performance mode)	2	8 x 10 Gb	2.5 MB per port	500 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6800-8P10G	2	8 x 10 Gb	2.5 MB per port	500 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6880-X (Oversubscribed mode)	2	16 x 10G	1.25 MB per port	24 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6880-X (Performance mode)	2	8 x 10 Gb	2.5 MB per port	48 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6880-X-16P10G (Oversubscribed mode)	2	16 x 10 Gb	1.25 MB per port	24 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6880-X-16P10G (Performance mode)	2	8 x 10 Gb	2.5 MB per port	48 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6816-X-LE (Oversubscribed mode)	2	16 x 10 Gb	1.25 MB per port	250 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6816-X-LE (Performance mode)	2	8 x 10 Gb	2.5 MB per port	500 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6832-X-LE (Oversubscribed mode)	4	32 x 10 Gb	1.25 MB per port	250 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6832-X-LE (Performance mode)	4	16 x 10 Gb	2.5 MB per port	500 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6824-X-LE (Oversubscribed mode)	4	24 x 10 Gb 32 X 10 Gb (with 4 SFP 10 Gb breakout)	1.25 MB per port	250 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6824-X-LE (Performance mode)	4	12 x 10 Gb 16 X 10 Gb (with 4 SFP 10 Gb breakout)	2.5 MB per port	500 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)

	Number of Port ASICs on the Line Card or Chassis	Number of Physical Ports Per Port ASIC	Buffer on the Receive Side	Buffer on the Transmit Side	Receive Queue Structure Per Port	Transmit Queue Structure Per Port
C6840-X-LE (Oversubscribed mode)	6	40 x 10 Gb 48 X 10 Gb (with 4 SFP 10 Gb breakout)	1.25 MB per port	250 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)
C6840-X-LE (Performance mode)	6	20 x 10 Gb 24 x10 Gb (with 4 SFP 10 Gb breakout)	2.5 MB per port	500 MB per port	1p7q4t (default) 2p6q4t (configurable)	1p7q4t (default) 2p6q4t (configurable)

Appendix B: Buffers and Queues Structure on Instant Access Clients

	Number of Port ASICs	Number of Physical Ports Per Port ASIC	Buffer on Receive/Transmit	Receive Queue Structure Per Port	Transmit Queue Structure Per Port
6800IA-TD/FPD/FPDR	2	24 x 1 Gb	4 MB (shared)	1p3q4t	1p3q4t
WS-C3560CX-12PD-S	1	12 x 1 Gb	4 MB (shared)	1p3q4t	1p3q4t
WS-C3560CX-8XPD-S	1	6 x 1 Gb 2 x mGig	4 MB (shared)	1p3q4t	1p3q4t

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