

Can PowerConnect Switches Be Used in VoIP Deployments?

This Application Notes relates to the following Dell PowerConnect™ products:

- PowerConnect 33xx
- PowerConnect 52xx

Abstract

This application note explains how to use Dell PowerConnect switches in networks that carry voice over IP (VoIP) traffic. This document describes quality of service (QOS) mechanisms and provides sample configurations for implementing QOS policies to prioritize latency-sensitive voice traffic.

Applicable Network Scenarios

Voice traffic is highly sensitive to latency and packet loss, and this presents special challenges in network design and administration.

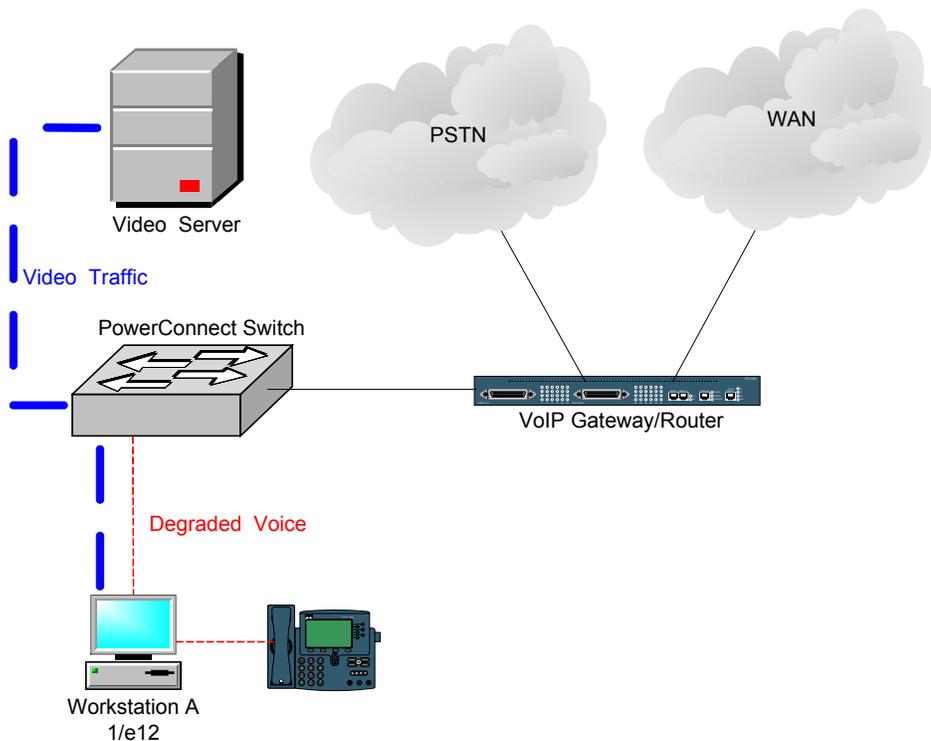
Voice traffic must compete for network bandwidth with data applications, many of which tend to send traffic in large bursts. It is easily possible for packets carrying voice traffic to be held up behind a burst of data traffic, with poor audio quality or even session loss as a result.

Given the sensitivity of voice traffic to latency and loss, it is very desirable to give voice traffic priority over data traffic. This prioritization of some classes of traffic over others is the essence of QOS.

Consider the example in the diagram below. In this scenario, voice traffic travels over the same network as data traffic, with the latter consuming the majority of bandwidth. The lack of prioritization for voice traffic can result in degraded or unusable telephony service for endpoints such as IP phones.

Workstation A and its respective IP phone (both on the same segment) are attached to a Dell PowerConnect switch that forwards data and voice traffic to an office gateway/router, which in turn forwards traffic to the corporate WAN or public switched telephone network (PSTN). A video server that streams content also is attached to the same switch. All nodes attached to the switch, including Workstation A, receive high-bandwidth video broadcasts.

Since the IP phone shares a switch connection with Workstation A, traffic from the video server will inhibit voice traffic to and from the IP phone. The resulting increases in latency and jitter (inter-packet delay variations) will degrade the quality of the voice service and IP-based voice applications.



Technology Background

VoIP services allow enterprises to provide company-wide telephony solutions over existing IP networks. Such services not only help to cut costs by placing voice and data traffic on the same network infrastructure, but can also boost productivity through applications such as conferencing and unified messaging.

Since voice services are real-time in nature, the underlying infrastructure that carries VoIP traffic must keep loss, latency, and jitter to an absolute minimum. Dell PowerConnect switches offer QoS mechanisms that can allocate bandwidth and expedite VoIP traffic on the campus network.

As a general rule, VoIP traffic should never experience more than 1 percent packet loss, 200 milliseconds of latency, or 30 milliseconds of jitter. Any measurement above these thresholds will degrade service quality.

Implementing QoS policies should ensure that PowerConnect switches service VoIP traffic first, before other classes of traffic. This is known as “strict priority.”

The Internet Engineering Task Force (IETF) has defined the differentiated services code point (DSCP), a field in the IP header of every packet, to distinguish various traffic classes. Dell PowerConnect switches can examine DSCPs to prioritize one or more classes of traffic over others. The DSCP field is 6 bits in length, allowing for the definition of up to 64 traffic classes. The DSCP field is defined in the IETF’s Request for Comments 2474 ([RFC 2474](#)) and the overall differentiated services architecture is defined in [RFC 2475](#).

DSCPs are a superset of the Type of Service (TOS) field defined in the original specification for the IP protocol [RFC 791](#). TOS classification allows a maximum of 8 traffic classes, compared with 64 classes with DSCPs. Nonetheless, a primary goal of the DSCP design is to ensure backward compatibility with TOS-capable devices.



DSCPs and IP precedence are network-layer mechanisms in that they work at the third (network) layer of seven-layer ISO stack.

IEEE standards 802.1p and 802.1Q also define a set of class of service (COS) markings to prioritize traffic at the second (link-layer) layer of the ISO (International Standards Organization) stack.

Many devices, including Dell PowerConnect switches, directly map DSCP values in IP packets onto COS values in Ethernet frames. Although the command-line syntax for Dell PowerConnect switches refers to COS values in setting up queues, the switches can understand both COS and DSCP values.

The following table shows DSCP-to-COS mappings for traffic classes commonly used in VoIP networks:

| Type of voice traffic | DSCP value | COS value |
|-----------------------|-------------------------|-----------|
| Voice bearer traffic | EF (0x2E) | 5 |
| Voice control traffic | AF ₃₁ (0x1A) | 3 |
| Videoconferencing | AF ₄₁ (0x22) | 4 |
| Streaming video | AF ₁₃ (0x0E) | 1 |

EF refers to Expedited Forwarding and AF refers to Assured Forwarding; these are differentiated services standards defined in [RFCs 3246](#) and [2597](#), respectively. The subscripts refer to priority and drop values. Drop values are a feature of differentiated services to specify how much traffic of a given class a device should discard. For example, AF₁₃ refers to a priority of 1 and a drop preference of 3.

Dell PowerConnect switches allow QOS policies that act on both DSCP and COS values. A PowerConnect 33xx switch can be placed into a “trusted” state, whereby the switch is instructed to accept the DSCP or COS value assigned by specified VoIP endpoints or streaming services. This is a useful safeguard against rogue stations or applications that attempt to mark all traffic as high priority.

33xx:

```
qos trust { cos | dscp | tcp-udp port }
```

Example:

```
console> enable
console# configure
console(config)# qos
console(config)# qos trust dscp
```

Note: This procedure is not applicable to Dell 52xx series switches.

This example configures a 33xx switch to trust the DSCP markings of incoming packets. Replacing “dscp” with “cos” would cause the switch to examine COS markings instead of DSCP values. The use of DSCP or COS depends on the application.

The network manager also must define queues for different traffic classes, and treatments for traffic in each queue. First, we define multiple queues.

33xx:

```
priority-queue out num-of-queues { queues }
```

Example:

```
console(config)# priority-queue out num-of-queues 2
```

The above example sets up two queues. The next step is to assign queue numbers (the higher the number, the higher the priority of traffic) and the COS treatment for traffic in each queue.

33xx:

```
wrr-queue cos-map { queue-id | cosn }
```



Example:

```
console(config)# wrr-queue cos-map 4 5  
console(config)# wrr-queue cos-map 3 3
```

52xx:

```
queue cos-map { queue-id | [cos1.....cosn] }
```

Example:

```
console(config-if)# queue cos-map 4 5  
console(config-if)# queue cos-map 2 3
```

The example for the 33xx sets up two high priority queues, 3 and 4, and assigns COS value 5 (highest priority) to queue 4 and COS value 3 to queue 3. The example for the 52xx assigns COS value 5 (highest priority) to queue 4 and COS value 3 to queue 2.

Proposed Solution

To prioritize latency-sensitive voice traffic, priority queues must be set up to handle traffic with COS values that indicate either voice-bearing traffic or voice control traffic.

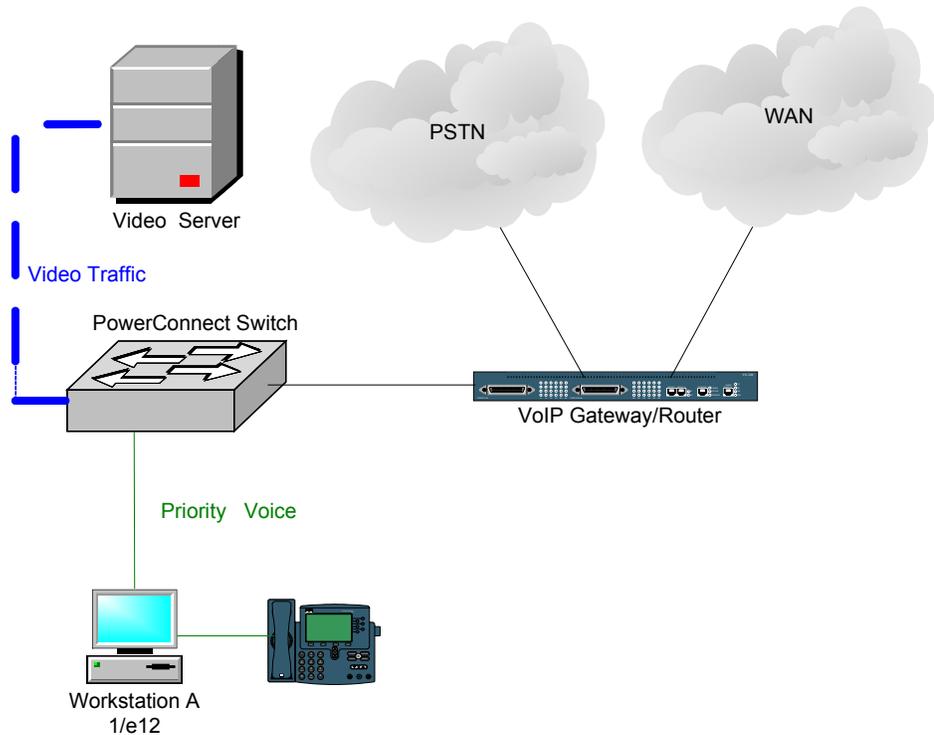
Overview

On Dell PowerConnect switches:

- 1) Enable QoS if necessary.
- 2) Define priority queues if necessary.
- 3) Associate COS values with priority queues.
- 4) Verify correct QoS operation.

Typical Network Designs

With high-priority queuing specified for voice-bearing traffic and voice control traffic, high-content video broadcasts no longer degrade voice services. The PowerConnect switch will service queues holding VoIP traffic first, regardless of the amount of other network traffic present. The result should be decreased latency, jitter, and loss, and improved VoIP application performance.



Step-By-Step Instructions

The following configuration guidelines work with any Dell PowerConnect 33xx or 52xx switch.

1. Enable QoS if necessary.

PowerConnect 33xx:

```
console# enable
console# configure
console(config)# qos
console(config)# qos trust dscp
```

2. Configure priority queues if necessary.

PowerConnect 33xx:

```
console(config)# priority-queue out num-of-queues 2
```

3. Associate COS values with priority queues.

PowerConnect 33xx:

```
console(config)# wrr-queue cos-map 4 5
console(config)# wrr-queue cos-map 3 3
console(config)# exit
console#
```

PowerConnect 52xx:

```
console(config-if)# queue cos-map 4 5
```



```
console(config-if)# queue cos-map 2 3
console(config-if)# exit
console#
```

4. Verify proper QoS operation.

PowerConnect 33xx:

```
console# show qos interface queueing
Ethernet 1/e12
wrr bandwidth weights and EF priority:
qid-weights Ef - Priority
1 - 1          dis- N/A
2 - 4          dis- N/A
3 - N/A        ena- 3
4 - N/A        ena- 4
Cos-queue map:
cos-qid
0 - 2
1 - 1
2 - 1
3 - 3
4 - 2
5 - 4
6 - 3
7 - 3
```

PowerConnect 52xx:

```
Vty-0#show queue cos-map
...
Information of Eth 1/12
Queue ID  Class of service
-----  -
0          1 2
1          0 3
2          4
3          5 6 7
```

Conclusion

Priority queuing can substantially improve the performance of IP telephony services marked with standards-based QPS values. Voice-bearer traffic and voice control traffic will be transmitted before all other frames arriving at a given interface, decreasing the likelihood of high latency, loss, and jitter.

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