



Switch Configuration Example for Q-SYS™ Platform

Cisco Catalyst 3650 and 3850 Series

Important Note

This switch configuration example is intended to serve as a network setup guideline for systems using Q-LAN audio and video streaming within your Q-SYS system and should be used alongside the [Q-SYS Networking Requirements](#) for deeper setup insight. Keep in mind that QSC is unable to provide live network configuration support for third-party switch configuration. To learn more about network switch qualification services and the plug-and-play Q-SYS NS Series preconfigured network switches, visit <http://www.qsys.com/switches>.

This document applies to these Cisco switches:

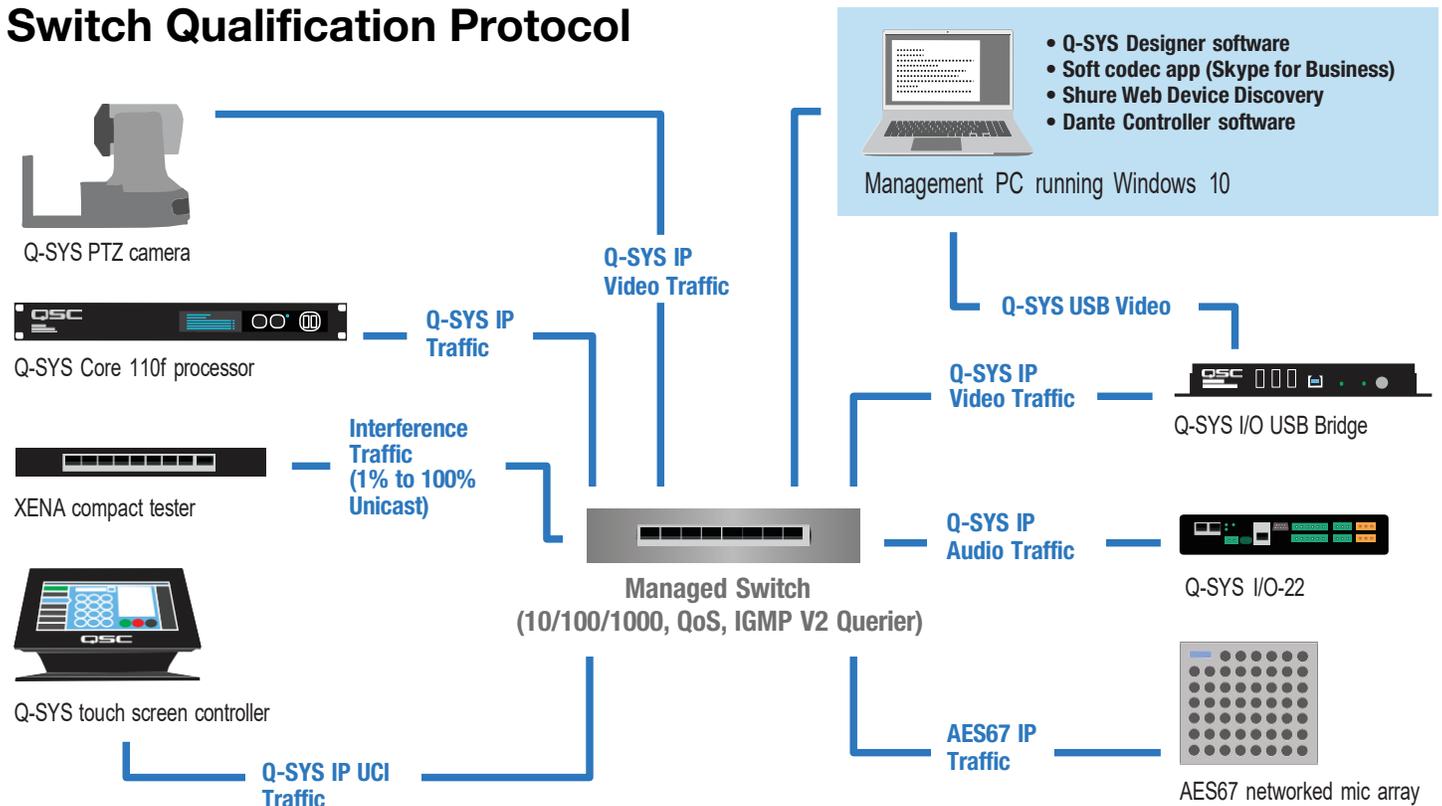
**Catalyst 3650-12X48UR | 3650-12X48UQ | 3650-12X48UZ | 3650-48FQM |
3650-8X24UQ | 3650-24PDM | 3650-48FQ | 3650-24PD | 3850-12X48U | 3850-24XU |
3850-48U | 3850-24U | 3850-48XS | 3850-24XS | 3850-NM-8-10G | 3850-NM-2-40G**

Introduction

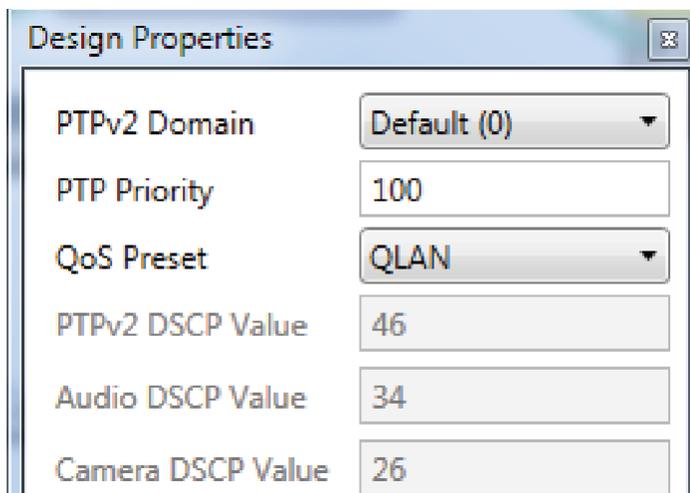
As of release 5.3.x, Q-SYS Designer software now supports AES67-standard interoperability. The AES67 standard does not prescribe a method of discovery for devices so manufacturers are free to implement one or more discovery services for their devices. In this configuration document, the process uses Bonjour as the discovery method for AES67 devices.

Q-SYS Designer now also offers a selection of Differential Services Code Point (DSCP) setting presets to optimize Quality of Service (QoS) for different types of deployment. DSCP codes are a six-bit value placed in the IP header of data packet, and they instruct a network switch to handle various types of data with defined levels of priority that ensure proper QoS.

Switch Qualification Protocol



Selecting QoS presets in a Q-SYS design file



1. In Q-SYS Designer, open the design. Make sure it is disconnected from the Core processor (press **F7** or select **File > Disconnect**).
2. Select **File > Design Properties**.
3. Select the appropriate QoS preset (See specification table below.)

Specifications

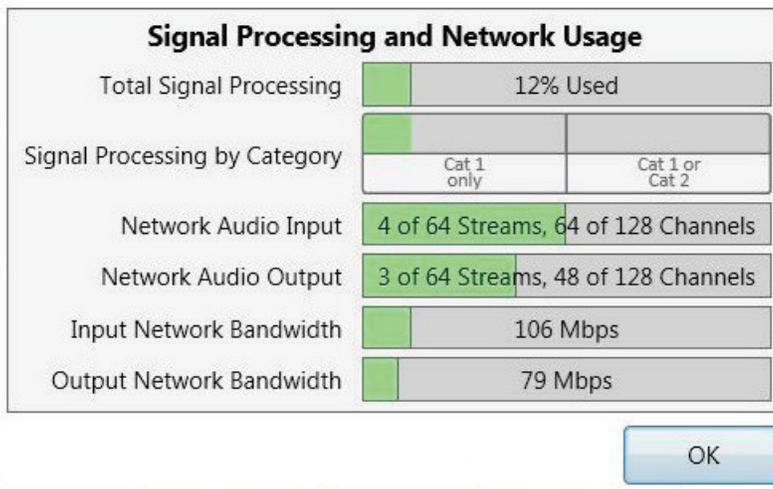
Preset	Q-LAN	Audinate	Manual
Use for:	• Q-LAN-only network	• DANTE-only network	• If custom DSCP settings are necessary
	• Q-LAN + AES67 network	• DANTE + Q-LAN network	
QoS class assigned:		• DANTE + Q-LAN + AES67 network	
	PTPv2: 46	PTPv2: 56	PTPv2: 56
	Audio: 34	Audio: 46	Audio: 46
	Camera: 26	Camera: 26	Camera: 26

4. Leave the PTPv2 Domain and PTP Priority settings at default. Click **OK**.
5. To save the settings, press **F5** or select **File > Save to Core & Run**.

Assessing network needs

Knowing your Q-SYS design’s network requirements will help you configure the Cisco Catalyst switch appropriately. To do this, open the design in Q-SYS Designer. The design does not need to be running in the core processor.

1. In Q-SYS Designer, go to **File > Check Design**. The **Signal Processing and Network Usage** window will open and display important data about the demands the design will place on a network.
2. The two bottom parameters displayed are **Input Network Bandwidth** and **Output Network Bandwidth**. Take the larger of the two quantities and add about 20% for operating headroom.



Take that figure and calculate the percentage of the port speed that will be required for the input and output network bandwidths.

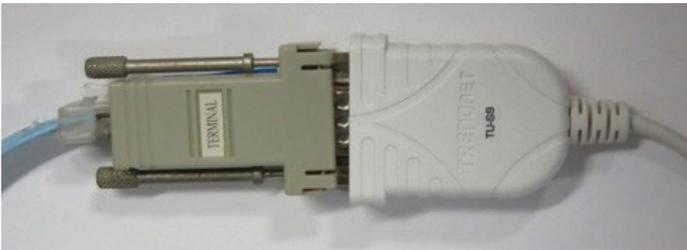
In this example, take the Input Network Bandwidth of 106 Mbps and add 20%, which comes out to 127 Mbps. If the ports all have 1 Gbps speed, this amounts to 12.7%. Round any fractional results up to the next integer value; in this case, that will be 13%.

We will use this figure during the configuration.

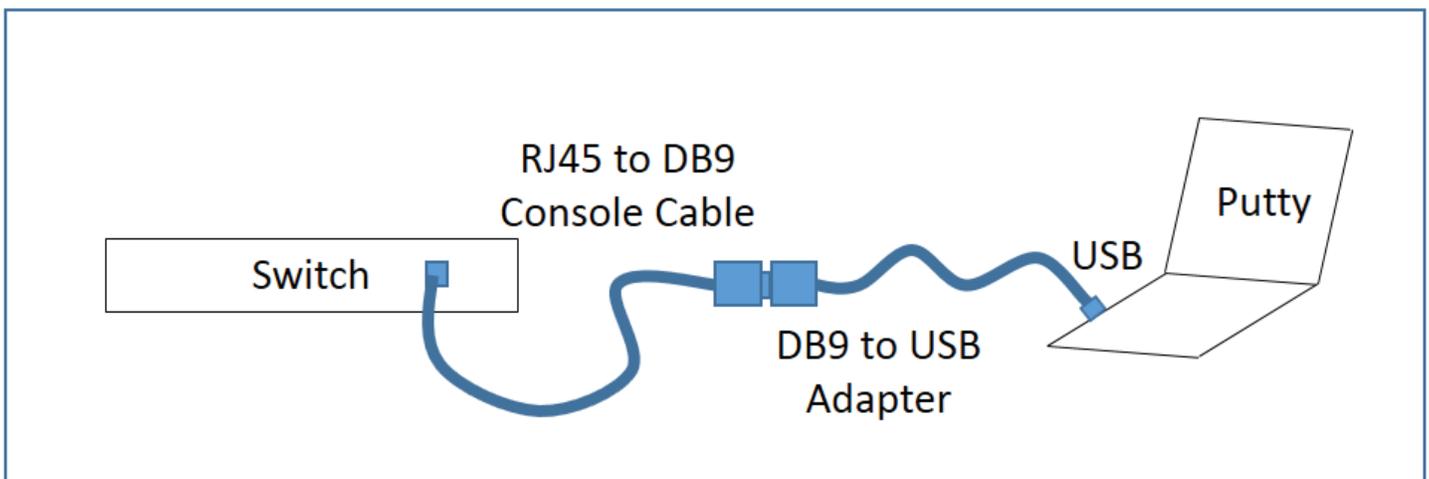
Configuring the network switch for Q-SYS

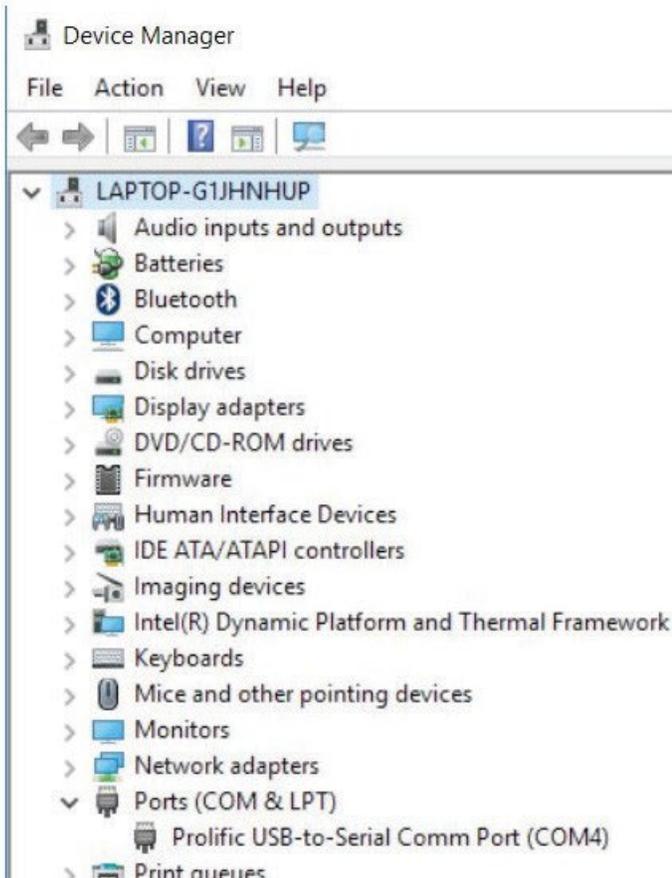
Configuring the switch requires these items:

- Computer with an available USB port
- DB9 to USB serial adapter
- Switch console cable (usually supplied with the switch)
- PuTTY terminal software (or equivalent)



Before starting, use the console cable and adaptor to connect the computer to the switch's console port.



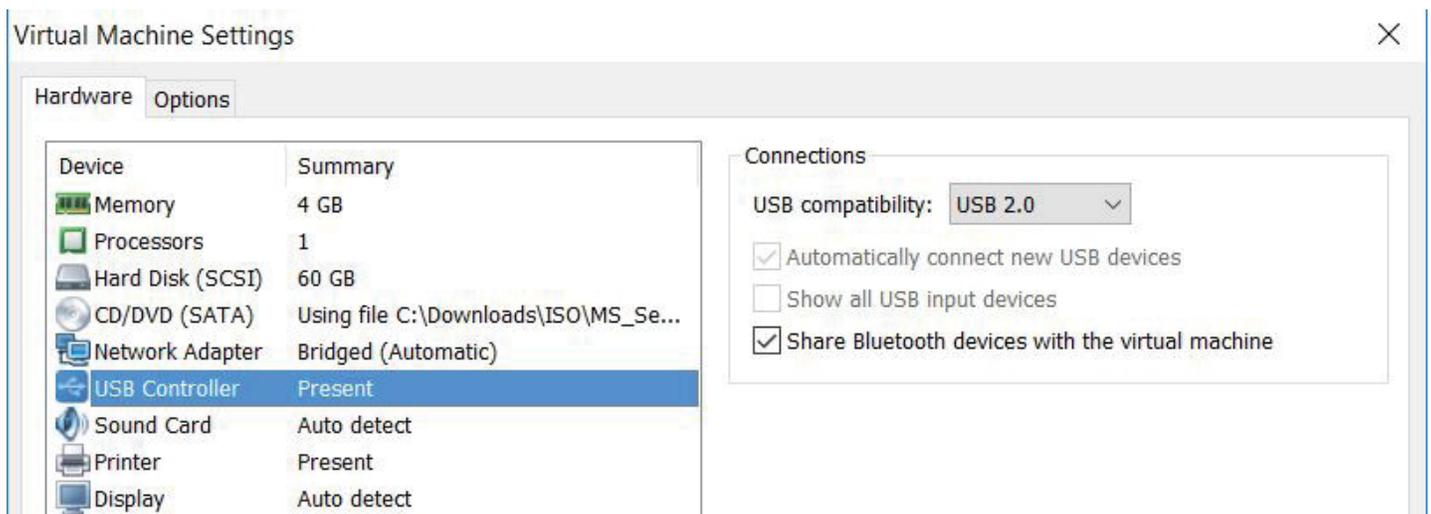


Verify that Windows recognizes the USB-to-serial adapter. In Windows, open Device Manager (In Windows 10, you can find it by typing device manager into the Cortana text box). Expand Ports (COM & LPT); the USB-to-serial comm port adapter should be listed there.

If the adapter does not appear, try these remedies:

- Plug the USB-to-serial adapter directly into the computer, to bypass any USB hubs.
- Download and install the latest drivers for the USB-to-serial adapter.

- If you are using virtualization, make sure that the USB devices are configured to connect to the virtual machine. If you still have problems with the USB connections, try running the computer without any virtualization (i.e., “bare metal”).



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- See if any Windows updates are queued. If there are, apply them and reboot the computer.
- Check security settings and any security software for issues that might prevent functioning of the USB devices.

Resetting the switch

It is good practice to start with the switch set to its factory default settings. Reset the switch using the command line interface (CLI).

1. Log into the switch.
1. At the CLI prompt, type **enable** and press **Enter**.
1. Type **delete flash: vlan.dat** and press **Enter**.
1. Type **erase startup-config** and press **Enter**.
1. Type **reload** and press **Enter**.
1. If you are asked to save the configuration, enter NO.

The Cisco web site may show other methods of resetting the switch.

Be careful when adding a Cisco IOS-based switch to a network if the switch had been used before (such as in lab testing or as a spare from another project) and was not reset to factory default settings after. Deleting the **vlan.dat** file from flash memory will reset the VLAN Trunk Protocol (VTP) configuration and the VLAN settings, and prevent a possible network-wide outage arising from an inadvertent VTP mismatch.

Current Cisco IOS software and updates

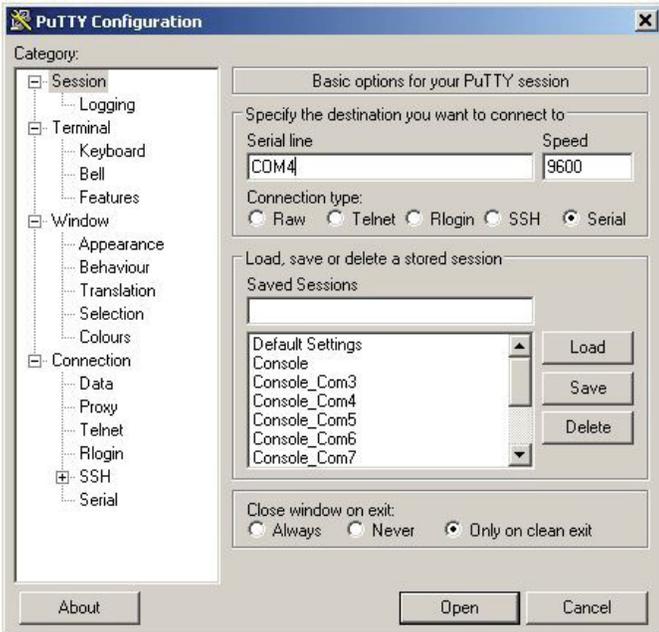
For Q-SYS qualification testing, the Cisco Catalyst 3650 Series switch used the Cisco IOS **cat3k_caa-universalk9.16.03.02.SPA.bin** and the Catalyst 3850 Series switch used **cat3k_caa-universalk9ldpe.SPA.03.06.06.E.152-2.E6.bin**. These IOS versions feature a special latency enhancement that has demonstrated optimal test results.

Before proceeding, verify that you have an active Cisco SmartNet contract for the Catalyst 3650 and Catalyst 3850 Series, with rights to download Cisco IOS software. Do a test download of the Cisco IOS software for the Catalyst 3650 or Catalyst 3850 Series switches to make sure your Cisco Connection Online (CCO) account is correctly linked to the SmartNet contract.

Upgrading a switch's IOS is not a quick process and can be lengthy if any problems arise. If you can, do the upgrade before you bring the switch to the installation site and allow enough time to complete it.

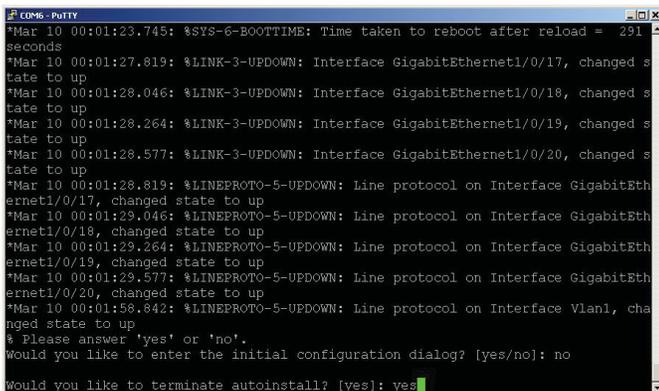
For instructions and guidance on downloading and installing Cisco IOS software into the switch, visit the web page http://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3650/software/release/3se/system_management/configuration_guide/b_sm_3se_3650_cg/b_sm_3se_3650_cg_chapter_010101.html.

Configuring the switch

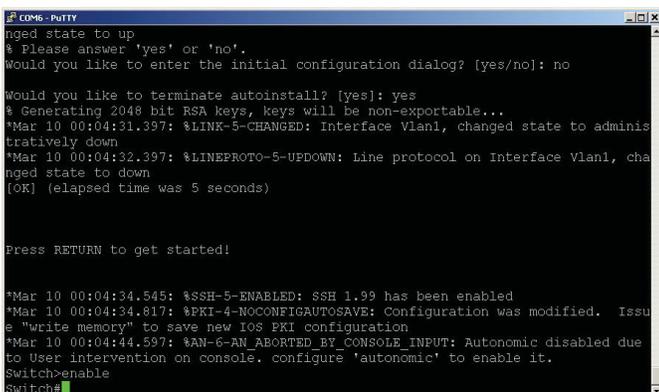


1. Start PuTTY.
2. In the PuTTY Configuration window, select these basic options:
 - Connection type: **Serial**
 - Serial line: **COM4**
 - Speed: **9600**
 - If you wish to save these settings for future use, assign a name at **Saved Sessions** and then click **Save**.
3. Click **Open**.

The PuTTY terminal session window will open.



4. At **Would you like to enter the initial configuration dialog?** type **no** and press **Enter**.
5. At **Would you like to terminate autoinstall?** type **yes** and press **Enter**.



6. At the prompt **Switch#** type **enable** and press **Enter**.

The next sequence of steps will depend on the type of network the switch will be used on: combined Audinate (Dante or AES67) and Q-SYS network or combined AES67 and Q-SYS network.

Combined Audinate (Dante or AES67) and Q-SYS network

```
COM6 - PuTTY
CAT3650#
CAT3650#
CAT3650#config t
Enter configuration commands, one per line. End with CNTL/Z.
CAT3650(config)#class-map match-any IEEE-1588
CAT3650(config-cmap)#match ip dscp cs7
CAT3650(config-cmap)#exit
CAT3650(config)#class-map match-any Q-LAN
CAT3650(config-cmap)#match ip dscp ef
CAT3650(config-cmap)#exit
CAT3650(config)#class-map match-any Q-Video
CAT3650(config-cmap)#match ip dscp af31
CAT3650(config-cmap)#match ip dscp cs1
CAT3650(config-cmap)#exit
CAT3650(config)#policy-map Q-Sys
CAT3650(config-pmap)#class IEEE-1588
CAT3650(config-pmap-c)#priority level 1 percent 5
CAT3650(config-pmap-c)#exit
CAT3650(config-pmap)#class Q-LAN
CAT3650(config-pmap-c)#priority level 2 percent 90
CAT3650(config-pmap-c)#exit
CAT3650(config-pmap)#class Q-Video
CAT3650(config-pmap-c)#bandwidth percent 5
CAT3650(config-pmap-c)#exit
CAT3650(config-pmap)#exit
CAT3650(config)#exit
CAT3650#
Mar 13 16:11:19.523: %SYS-5-CONFIG_I: Configured from console by console
CAT3650#wr mem
Building configuration...
[OK]
CAT3650#
```

1. Type **config t** and press **Enter**.
2. At the command line prompt type the following lines of text. Press **Enter** at the end of each line.

```
class-map match-any IEEE-1588
match ip dscp cs7
exit
class-map match-any Q-LAN
match ip dscp ef
exit
class-map match-any Q-Video
match ip dscp af31
match ip dscp cs1
exit
```

These commands direct the switch to identify the Q-LAN timing packets (which use the IEEE 1588 Precision Time Protocol, or PTP), the Q-LAN audio data packets, and the Q-Video data packets, and assign them certain *differentiated services code point* (DSCP) values.

3. At the command line prompt type the following lines of text. For *percentage*, enter an integer figure that represents the percentage of guaranteed bandwidth for each class of data. The total cannot exceed 100. See the explanatory text below for details. Press **Enter** at the end of each line.

```
policy-map Q-Sys
class IEEE-1588
priority level 1 percent [percentage]
exit
class Q-LAN
priority level 2 percent [percentage]
exit
class Q-Video
bandwidth percent [percentage]
exit
exit
```

These commands create a policy map called Q-Sys that assigns the highest priority to the PTP packets, though their network utilization will be quite low (less than 5%). The next highest priority is assigned to the Q-LAN audio packets, and they will have the highest need for network bandwidth. Although the example earlier requires only 13% of the ports' bandwidth, in a Q-SYS-only network it would be safe to guarantee Q-LAN data 90%; in a network with other traffic, this figure will require more detailed analysis and calculation because more bandwidth will have to be allotted to the other services. Q-Video data packets do not need priority as high as was given to PTP or Q-LAN, and because they are localized between the camera and the IO-USB Bridge device, their guaranteed percentage of bandwidth is typically about 5%.

4. Type **wr mem** and press **Enter**. This writes the settings into the switch's memory. Proceed to page 10.

Combined AES67 and Q-SYS network or Q-SYS-only network

```
COM6 - PuTTY
CAT3650#
CAT3650#
CAT3650#config t
Enter configuration commands, one per line. End with CNTL/Z.
CAT3650 (config)#class-map match-any IEEE-1588
CAT3650 (config-cmap)#match ip dscp ef
CAT3650 (config-cmap)#exit
CAT3650 (config)#class-map match-any Q-LAN
CAT3650 (config-cmap)#match ip dscp af41
CAT3650 (config-cmap)#exit
CAT3650 (config)#class-map match-any Q-Video
CAT3650 (config-cmap)#match ip dscp af31
CAT3650 (config-cmap)#exit
CAT3650 (config)#policy-map Q-Sys
CAT3650 (config-pmap)#class IEEE-1588
CAT3650 (config-pmap-c)#priority level 1 percent 5
CAT3650 (config-pmap-c)#exit
CAT3650 (config-pmap-c)#class Q-LAN
CAT3650 (config-pmap-c)#priority level 2 percent 90
CAT3650 (config-pmap-c)#exit
CAT3650 (config-pmap-c)#class Q-Video
CAT3650 (config-pmap-c)#bandwidth percent 5
CAT3650 (config-pmap-c)#exit
CAT3650 (config-pmap)#exit
CAT3650 (config)#exit
CAT3650#
*Mar 19 16:11:19.523: %SYS-5-CONFIG_I: Configured from console by console
CAT3650# mem
Building configuration...
[OK]
CAT3650#
```

1. Type **config t** and press **Enter**.
2. At the command line prompt type the following lines of text. Press **Enter** at the end of each line.

```
class-map match-any IEEE-1588
match ip dscp ef
exit
class-map match-any Q-LAN
match ip dscp af41
exit
class-map match-any Q-Video
match ip dscp af31
exit
```

These commands direct the switch to identify the Q-LAN timing packets (which use the IEEE 1588 Precision Time Protocol, or PTP), the Q-LAN audio data packets, and the Q-Video data packets, and assign them certain *differentiated services code point* (DSCP) values.

3. At the command line prompt type the following lines of text. For *percentage*, enter an integer figure that represents the percentage of guaranteed bandwidth for each class of data. The total cannot exceed 100. See the explanatory text below for details. Press **Enter** at the end of each line.

```
policy-map Q-Sys
class IEEE-1588
priority level 1 percent [percentage]
exit
class Q-LAN
priority level 2 percent [percentage]
exit
class Q-Video
bandwidth percent [percentage]
exit
exit
```

These commands create a policy map called Q-Sys that assigns the highest priority to the PTP packets, though their network utilization will be quite low (less than 5%). The next highest priority is assigned to the Q-LAN audio packets, and they will have the highest need for network bandwidth. Although the example earlier requires only 13% of the ports' bandwidth, in a Q-SYS-only network it would be safe to guarantee Q-LAN data 90%; in a network with other traffic, this figure will require more detailed analysis and calculation because more bandwidth will have to be allotted to the other services. Q-Video data packets do not need priority as high as was given to PTP or Q-LAN, and because they are localized between the camera and the IO-USB Bridge device, their guaranteed percentage of bandwidth is typically about 5%.

4. Type **wr mem** and press **Enter**. This writes the settings into the switch's memory. Proceed to page 10.

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```
COM6 - PuTTY
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#
Switch(config)#int range g1/0/1 - 24
Switch(config-if-range)#no shutdown
Switch(config-if-range)#spanning-tree portfast
$Warning: portfast should only be enabled on ports connected to a single
host. Connecting hubs, concentrators, switches, bridges, etc... to this
interface when portfast is enabled, can cause temporary bridging loops.
Use with CAUTION

$Portfast will be configured in 24 interfaces due to the range command
but will only have effect when the interfaces are in a non-trunking mode.
Switch(config-if-range)#service-policy output Q-Sys
Switch(config-if-range)#flow receive desired
Switch(config-if-range)#exit
Switch(config)#exit
*Mar 10 00:12:40.760: $SYS-5-CONFIG_I: Configured from console by console
Building configuration...
[OK]
Switch#
```

- At the command line prompt type the following lines of text. Press **Enter** at the end of each line.

```
config t
int range g1/0/1 - 24
no shutdown
spanning-tree portfast
```

These commands select all the ports, keep them enabled, and set them for spanning tree portfast protocol, which allows the ports to go into forwarding state immediately. When the commands are applied it will take about 10 seconds for the ports to update. Wait for the command prompt to reappear.

- At the command line prompt type the following lines of text. Press **Enter** at the end of each line.

```
service-policy output Q-Sys
flow receive desired
exit
```

These commands apply the QoS settings to the ports and also enable flow control receive, which under certain conditions control the amount of video traffic.

```
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int vlan 1
Switch(config-if)#no shutdown
Switch(config-if)#ip address
*Mar 10 00:14:33.216: $LINK-3-UPDOWN: Interface Vlan1, changed state to up
*Mar 10 00:14:34.216: $LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, cha
nged
Switch(config-if)#ip address 192.168.1.92 255.255.255.0
Switch(config-if)#exit
Switch(config)#exit
Switch#wr mem
```

- At the command line prompt type the following lines of text. Press **Enter** at the end of each line.

```
config t
int vlan 1
no shutdown
```

These commands establish a VLAN with an ID of 1. It will take about 10 seconds for the ports to update. Wait for the command prompt to reappear.

In the next steps you will configure the IP address and the subnet mask.

- Type the following lines of text. Press **Enter** at the end of each line.

```
ip address [ip address] [subnet mask]
exit
exit
wr mem
```

```
Switch#config t
Enter configuration commands, one per line. End with CRTL/Z.
Switch(config)#ip route 0.0.0.0 0.0.0.0 172.16.1.1 1
Switch(config)#exit
```

9. If the switch must be accessible from outside the subnet, you must configure it for the gateway's address.

Type the following lines of text. Press **Enter** at the end of each line.

```
config t
ip route 0.0.0.0 0.0.0.0 [ip address of gateway]
exit
```

Configuring the IGMP Snooping Querier

IGMP Snooping is enabled by default in the Cisco IOS. It requires an IGMP Snooping Querier on one switch in the VLAN.

If you wish to set up the querier in this switch, use these commands.

1. Type the following lines of text. Press **Enter** at the end of each line.

```
config t
ip igmp snooping querier
ip igmp snooping querier address [IP address of the VLAN SVI]
exit
wr mem
```

2. Use this command if you wish to check the IGMP Snooping Querier.

```
show ip igmp snooping querier
```

Press **Enter**.

Configuring access security, etc.

The following steps are optional but recommended to prevent unauthorized access to the switch's configuration.

```
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#enable password QSC
Switch(config)#exit
```

1. Add a password for putting the switch into configuration mode. At the command prompt type the following lines of text. Press **Enter** at the end of each line.

```
config t
enable password [password]
exit
```

```
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#line 0 4
Switch(config-line)#password QSC
Switch(config-line)#login
Switch(config-line)#exit
Switch(config)#exit
```

2. Add a password for managing the switch remotely via Telnet sessions. Type the following lines of text. Press **Enter** at the end of each line.

```
config t
line 0 4
password [password]
login
exit
```

```
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#line con 0
Switch(config-line)#password QSC
Switch(config-line)#login
Switch(config-line)#exit
Switch(config)#exit
```

- Add a password for local console management. Type the following lines of text. Press **Enter** at the end of each line.

```
config t
line con 0
password [password]
login
exit
```

```
Switch#config t
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#hostname CAT3650
CAT3650(config)#ip domain-name QsysLAN.local
CAT3650(config)#crypto key generate rsa
The name for the keys will be: CAT3650.QsysLAN.local
Choose the size of the key modulus in the range of 360 to 4096 for your
  General Purpose Keys. Choosing a key modulus greater than 512 may take
  a few minutes.
How many bits in the modulus [512]: 2048
% Generating 2048 bit RSA keys, keys will be non-exportable...
[OK] (elapsed time was 3 seconds)
CAT3650(config)#ip ssh time-out 120
CAT3650(config)#ip ssh version 2
CAT3650(config)#exit
```

3. Configure the switch for Secure Shell (SSH). Type the following lines of text. Press **Enter** at the end of each line. For *hostname*, assign a descriptive name to the switch, such as a model number, a sequential number (e.g., "SWITCH1"), etc. For domain name, assign a descriptive name for the IP domain, such as "QsysLAN.local", etc.

```
config t
hostname [hostname]
ip domain-name [domain name]
crypto key generate rsa
2048
ip ssh time-out 120
ip ssh version 2
exit
```

These commands also create a crypto key, define the key's size (2048 bytes), set the SSH time-out value, and the SSH version number.

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```
CAT3650#config t
Enter configuration commands, one per line. End with CNTL/Z.
CAT3650(config)#username qscadmin password qscadmin
CAT3650(config)#exit
```

4. Set an SSH user account for remote access. Type the following lines of text. Press **Enter** at the end of each line. For *qscadmin*, assign a user name for the account. For *qscpass*, assign a password.

```
config t
username [qscadmin] password [qscpass]
exit
```

```
CAT3650#config t
Enter configuration commands, one per line. End with CNTL/Z.
CAT3650(config)#aaa new-model
CAT3650(config)#exit
```

5. To use SSH, enable Cisco Authentication, Authorization, and Accounting (AAA). Type the following lines of text. Press **Enter** at the end of each line.

```
config t
aaa new-model
exit
```

```
CAT3650#config t
Enter configuration commands, one per line. End with CNTL/Z.
CAT3650(config)#int g0/0
CAT3650(config-if)#ip address 192.168.1.93 255.255.255.0
CAT3650(config-if)#no shutdown
CAT3650(config-if)#exit
CAT3650(config)#exit
CAT3650#wr mem
```

6. Set up out-of-band (OOB) management, then exit configuration and write the settings to the switch's memory. Type the following lines of text. Press **Enter** at the end of each line. For *ip address*, enter the OOB management IP address.

```
config t
int g0/0
ip address [ip address] 255.255.255.0
no shutdown
exit
exit
wr mem
```

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Application
Engineering
Team