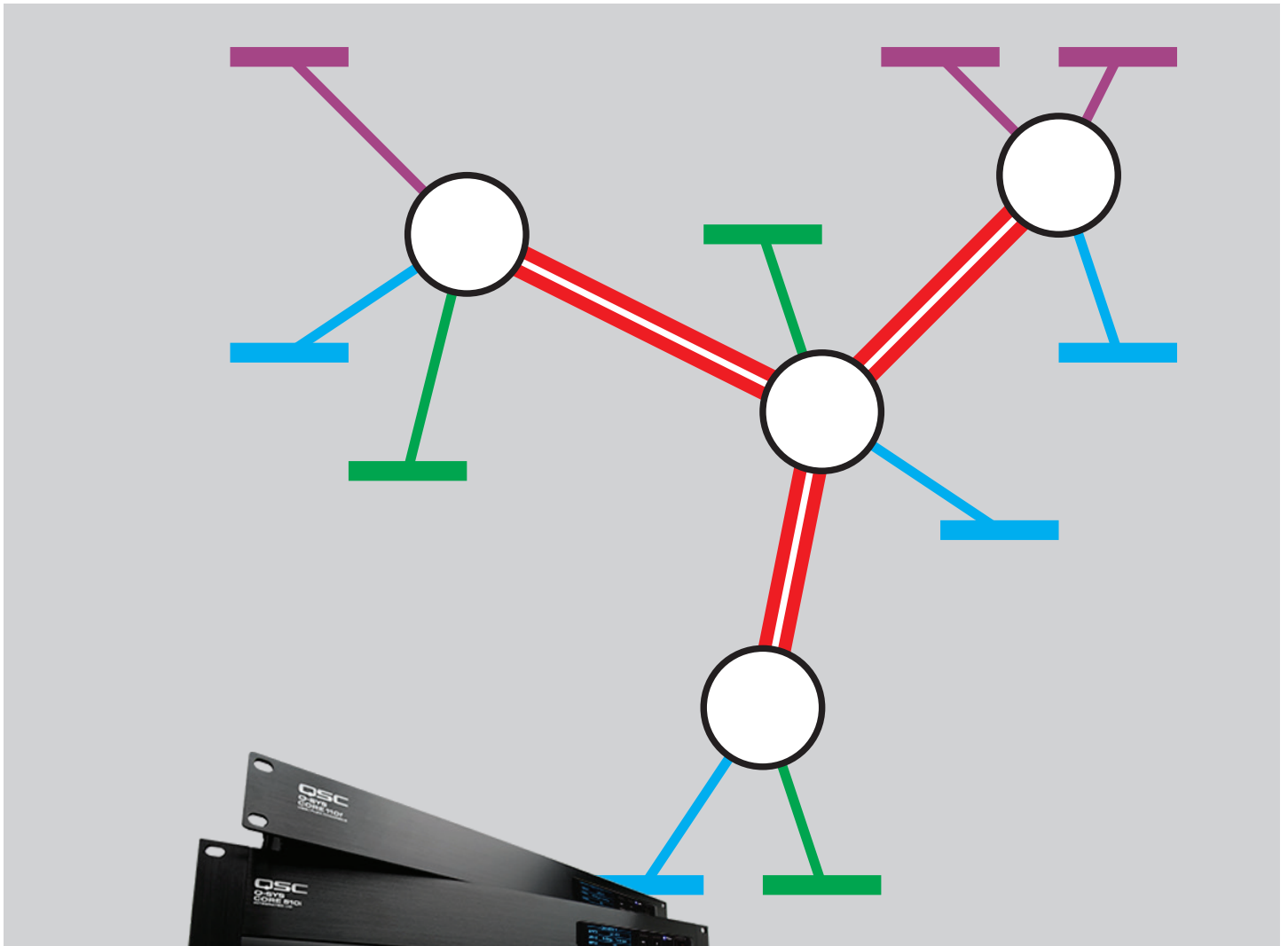


QSC

Application Guide

VLANs for improved Q-SYS performance



AET Application Engineering Team

OPTIMIZE Q-SYS PERFORMANCE: CREATE DEDICATED VLANS.

One way to greatly ensure the reliability and performance of a Q-SYS network is putting Q-SYS traffic on one or more dedicated virtual local area networks, or VLANs. This would eliminate conflicts with other network traffic and allow the Q-SYS hardware to deliver media data without delay or glitches.

A VLAN is just like a regular local area network (LAN), except that it shares network switch hardware and cabling with one or more other VLANs, allowing you to keep costs of the physical plant lower than if everything had to be separate. What makes a VLAN virtual is that you set it up within the switch or switches so that it or they create a virtual divide between each VLAN and the others.

These are some design strategies and goals for constructing VLANs:

- Keep multicast traffic and unicast traffic on separate VLANs.
- Keep QLAN and Dante traffic on separate VLANs.
- Use the RFC 1918 standard for for allocating IP addresses in private networks.
- You still have to set up QoS on the switches.
- For best results use a netmask of 255.255.255.0 (or /24). If necessary you can enlarge it to 255.255.254.0 (or /23), but we don't recommend going any larger than that.
- Depending on the model, a Q-SYS core processor will have two, three, or four network interfaces, but only one of them may have a default gateway for reaching a remote IP network or subnet.
- Set up one VLAN separately for network management.
- Each transition of data through a network switch is called a "hop." Too many switch hops may introduce timing errors in a Q-SYS network. Ideally, keep the number of switch hops to three or fewer across any span of the network (Figure 1), and do not allow more than five.

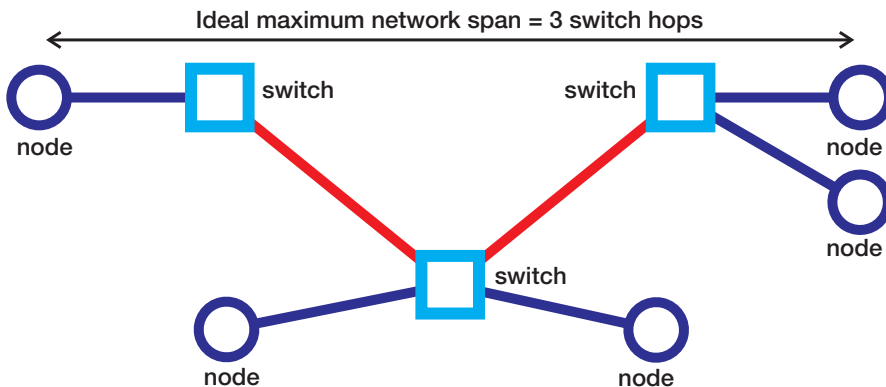


Figure 1.

CREATING VLANS

Create VLANs by setting up in the switches when you configure them. Assign a certain function or type of traffic to each VLAN and also designate each one's IP subnet. On each switch you will also assign ports to the VLANs for physical connection to the devices that will reside on them. Each VLAN will be isolated from the others, as if they were physically separate networks, even though they share switch hardware and cabling between switches.

For example, Figure 2 below shows a Q-SYS enterprise core processor that has four network connections available: LAN A, LAN B, AUX A, and AUX B. The system also needs a VLAN for network management so the switches can be accessed and managed. This calls for a total of five VLANs, which we'll call VLAN1 through VLAN5 as in Table 1.

To allow each VLAN full bandwidth throughout the expanse of the network, the switches are connected together using Link Aggregation Control Protocol, or LACP. In LACP, multiple ports (typically in pairs) on one switch connect to multiple ports on the next, and so forth, forming parallel data paths and allowing data rates that are multiples of a single 1 Gbps link.

On each switch, allocate to each VLAN as many ports as needed.

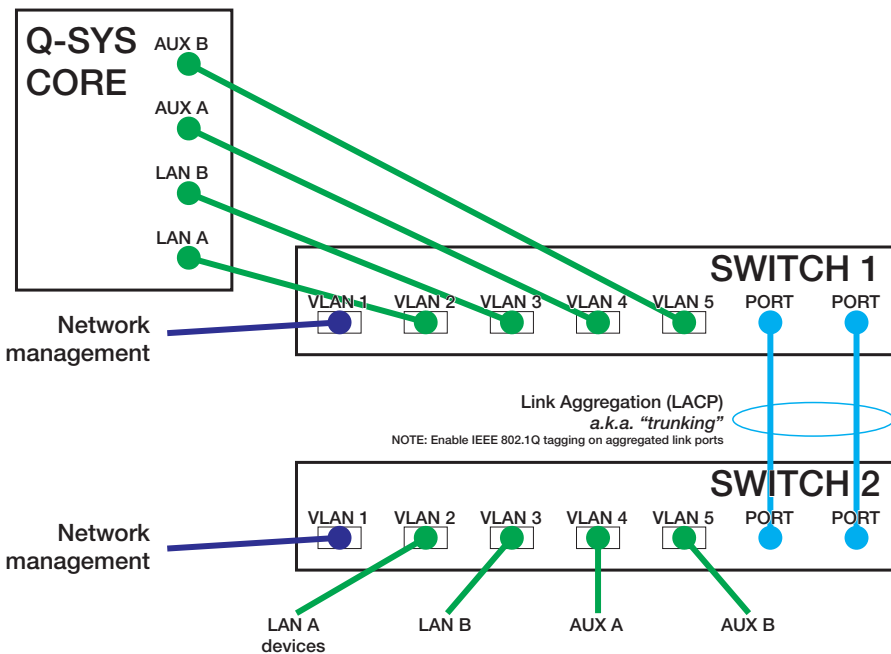
In the switch setup, enable IEEE 802.1Q tagging (VLAN tagging) on the ports used for link aggregation but do not enable it on any ports connected to Q-SYS components.

VLAN1 is for network management. We've given it an IP domain of 192.168.1.x /24 (" /24" means a subnet mask of 255.255.255.0, or 24 "1" bits followed by eight "0" bits). It does not connect to the Q-SYS core processor or other Q-SYS devices, but it does connect to all switches, routers, and gateways. The amount of traffic on this VLAN will be very low.

LAN A from the Q-SYS core processor is on 192.168.2.x /24. This will be the primary Q-SYS network and may carry media data.

Table 1. Example of VLAN assignments in a Q-SYS network

LAN	Assigned	IP and subnet
Network management	VLAN1	192.168.1.x /24 (255.255.255.0)
LAN A	VLAN2	192.168.2.x /24 (255.255.255.0)
LAN B	VLAN3	192.168.3.x /24 (255.255.255.0)
AUX A	VLAN4	192.168.4.x /24 (255.255.255.0)
AUX B	VLAN5	192.168.5.x /24 (255.255.255.0)



LAN B is on 192.168.3.x /24. This will be the backup Q-SYS network.

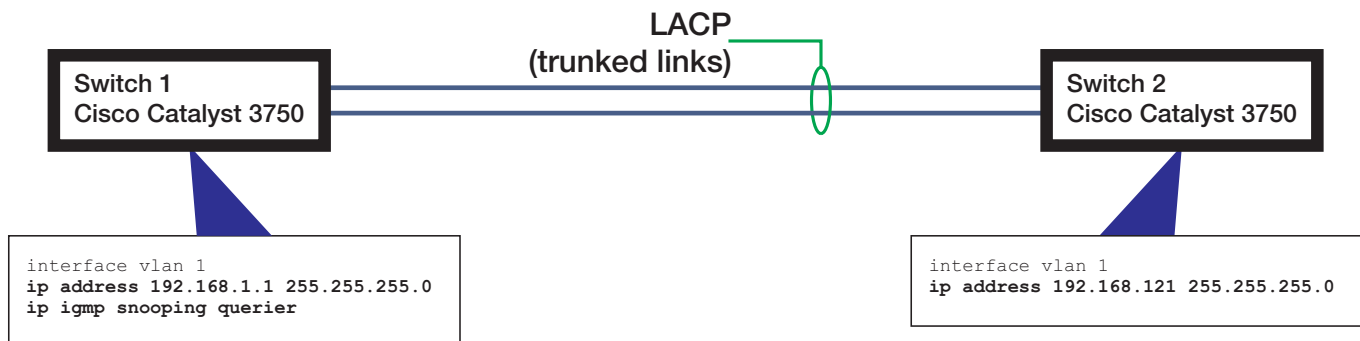
AUX A is on 192.168.4x /24 and AUX B is on 192.168.5.x /24. Multicast and broadcast data packets will reside on these.

Figure 2.

APPENDIX: CREATING AND OPTIMIZING VLANS USING CISCO NETWORK SWITCHES

This appendix details VLAN configurations for Q-SYS on Cisco Catalyst Series network switches. It will be of particular use to users who have Cisco Certified Network Associate (CCNA) certification or training.

Network Management VLAN Configuration



IGMP snooping filters multicast traffic from links that do not need it. It accomplishes this by basing Layer 2 forwarding decisions on information found by “snooping” the Layer 3 control plane packets. It is enabled by default setting in Cisco IOS.

If there is no multicast router to generate queries, IGMP snooping requires that one switch on the VLAN be designated to do so. To enable the querier function on the switch, use this configuration command:

```
ip igmp snooping querier
```

To disable IGMP snooping in a switch, use this configuration command:

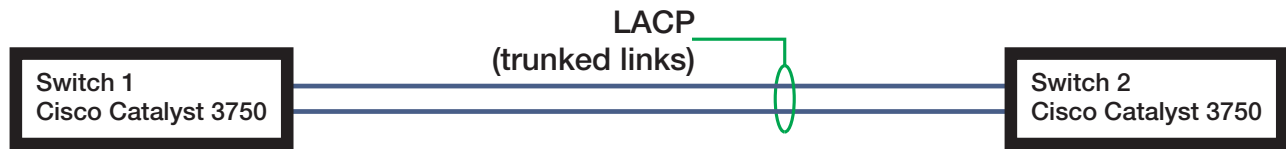
```
no ip igmp snooping
```

The IGMP snooping querier should be enabled on only one switch. Enterprise-class switches, however, typically can arbitrate and elect a querier if more than one has the querier function enabled.

Notes:

- **Multicast Catalyst Switches Support Matrix**
https://www.cisco.com/c/en/us/support/docs/ip/ip-multicast/29480-167.html?referring_site=bodynav
- **Understanding IGMP Snooping**
https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3750/software/release/12-2_52_se/configuration/guide/3750scg/swigmp.html

VTP and VLAN Configuration



VLAN Trunking Protocol (VTP) is a proprietary Cisco protocol. It provides VLAN information to all the switches in a VTP domain.

Configure switches for *VTP mode transparent*. They will pass VTP information through but not generate it themselves, which reduces the risk of making unwanted changes to other switches by mistake.

Also add VLANs 2, 3, 4, and 5 to the switches.

```
vtp mode transparent
spanning-tree mode pvst
spanning-tree extend system-id

vlan 2
name MyVLAN2

vlan 3
name MyVLAN3

vlan 4
name MyVLAN4

vlan 5
name MyVLAN5
```

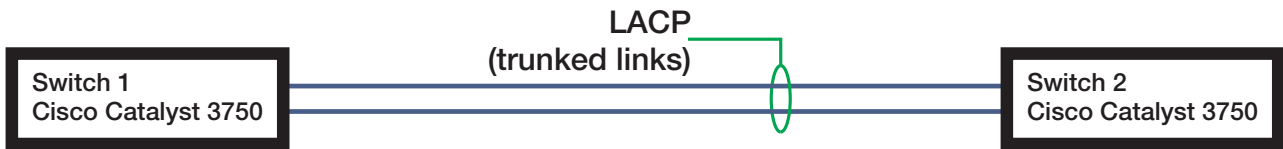
VLAN concept:

Q-SYS LAN A	VLAN2
Q-SYS LAN B	VLAN3
Q-SYS AUX A	VLAN4
Q-SYS AUX B	VLAN5

Notes:

- For information on configuring VTP mode see: https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3750/software/release/12-2_55_se/configuration/guide/scg3750/swvtp.pdf
- For more information on configuring STP see: https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3750/software/release/12-2_55_se/configuration/guide/scg3750/swstp.html

LACP and 802.1q Configuration



Configure 802.1q (“dot1q”) and trunk mode (“mode trunk”) on port channel 1.

Add port channel group 1 to the interfaces. Also configure 802.1q and trunk mode.

```
interface Port-channel1
switchport trunk encapsulation dot1q
switchport mode trunk

interface GigabitEthernet1/0/1
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 1 mode active

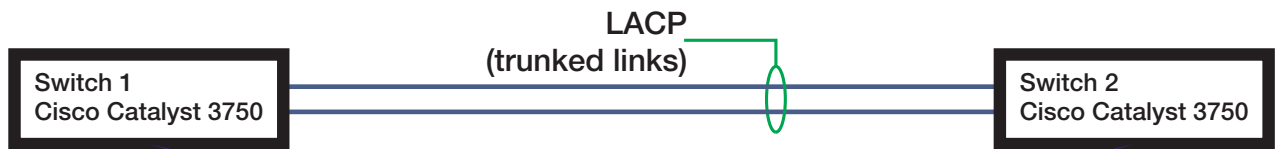
interface GigabitEthernet1/0/2
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 1 mode active
```

Link Aggregation Control Protocol (LACP) permits the bundling of several physical ports together to form a single logical channel.

Notes:

- Make sure the trunk modes on all the network switches match or are compatible with each other.
- In this example, ports g1/0/1 and g1/0/2 are uplink ports between switches.
- The Cisco link aggregation feature is called EtherChannel. For more information on configuring an EtherChannel see: https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3750x_3560x/software/release/12-2_55_se/configuration/guide/3750xscg/swthchl.pdf

Switch Port VLAN Configuration



Assign specific ports to VLANs

```
interface Gigabit Ethernet1/0/5
switchport access vlan 2

interface Gigabit Ethernet1/0/6
switchport access vlan 2

interface Gigabit Ethernet1/0/7
switchport access vlan 2

interface Gigabit Ethernet1/0/8
switchport access vlan 2

interface Gigabit Ethernet1/0/9
switchport access vlan 2

interface Gigabit Ethernet1/0/10
switchport access vlan 3

interface Gigabit Ethernet1/0/11
switchport access vlan 3

interface Gigabit Ethernet1/0/12
switchport access vlan 3

interface Gigabit Ethernet1/0/13
switchport access vlan 3

interface Gigabit Ethernet1/0/14
switchport access vlan 3

interface Gigabit Ethernet1/0/15
switchport access vlan 4

interface Gigabit Ethernet1/0/16
switchport access vlan 4

interface Gigabit Ethernet1/0/17
switchport access vlan 4

interface Gigabit Ethernet1/0/18
switchport access vlan 4

interface Gigabit Ethernet1/0/19
switchport access vlan 4

interface Gigabit Ethernet1/0/20
switchport access vlan 5

interface Gigabit Ethernet1/0/21
switchport access vlan 5

interface Gigabit Ethernet1/0/22
switchport access vlan 5

interface Gigabit Ethernet1/0/23
switchport access vlan 5

interface Gigabit Ethernet1/0/24
switchport access vlan 5
```

Desired port assignments:

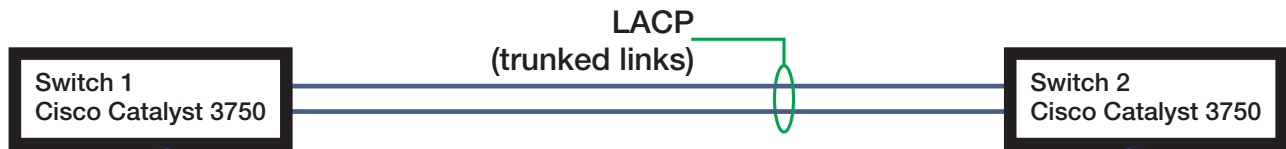
VLAN 2
1/0/5–1/0/9

VLAN 3
1/0/10–1/0/14

VLAN 4
1/0/15–1/0/19

VLAN 5
1/0/20–1/0/24

Show Interface Status



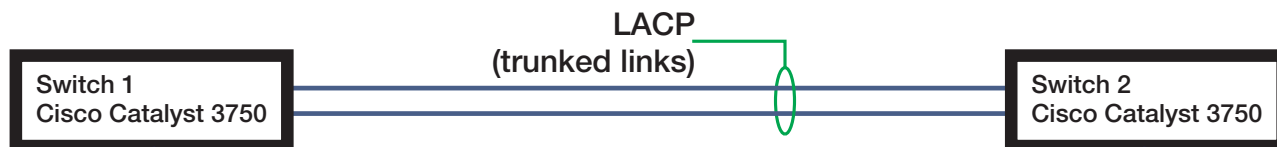
Use `show int status` to check these:

- Switch port VLAN assignments
- Switch port status (up or down)
- Switch port duplex status
- Switch port speed
- Switch port type

```
show int status
```

Port Name	Status	Vlan	Duplex	Speed	Type
Gil/0/1	connected	trunk	a-full	a-1000	10/100/1000baseTX
Gil/0/2	connected	trunk	a-full	a-1000	10/100/1000baseTX
Gil/0/3	notconnect	1	auto	auto	10/100/1000baseTX
Gil/0/4	notconnect	1	auto	auto	10/100/1000baseTX
Gil/0/5	notconnect	2	auto	auto	10/100/1000baseTX
Gil/0/6	notconnect	2	auto	auto	10/100/1000baseTX
Gil/0/7	notconnect	2	auto	auto	10/100/1000baseTX
Gil/0/8	notconnect	2	auto	auto	10/100/1000baseTX
Gil/0/9	notconnect	2	auto	auto	10/100/1000baseTX
Gil/0/10	notconnect	3	auto	auto	10/100/1000baseTX
Gil/0/11	notconnect	3	auto	auto	10/100/1000baseTX
Gil/0/12	notconnect	3	auto	auto	10/100/1000baseTX
Gil/0/13	notconnect	3	auto	auto	10/100/1000baseTX
Gil/0/14	notconnect	3	auto	auto	10/100/1000baseTX
Gil/0/15	notconnect	4	auto	auto	10/100/1000baseTX
Gil/0/16	notconnect	4	auto	auto	10/100/1000baseTX
Gil/0/17	notconnect	4	auto	auto	10/100/1000baseTX
Gil/0/18	notconnect	4	auto	auto	10/100/1000baseTX
Gil/0/19	notconnect	4	auto	auto	10/100/1000baseTX
Gil/0/20	connected	5	a-full	a-1000	10/100/1000BaseTX
Gil/0/21	notconnect	5	auto	auto	10/100/1000baseTX
Gil/0/22	notconnect	5	auto	auto	10/100/1000baseTX
Gil/0/23	notconnect	5	auto	auto	10/100/1000baseTX
Gil/0/24	notconnect	5	auto	auto	10/100/1000baseTX
Gil/0/25	notconnect	1	auto	auto	Not Present
Pol	connected	trunk	a-full	a-1000	

Show IP Interface Brief



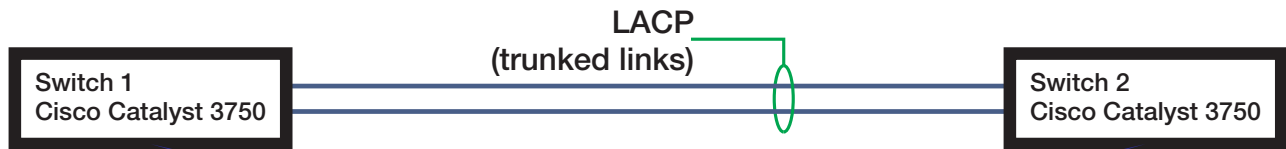
Use `show int brief` to check these:

- Switch port IP address assignments; L2 will show unassigned status
- Switch port status (up or down)
- Switch port protocol status (up or down)

```
show ip int brief
```

Interface	IP-Address	OK?	Method	Status	Protocol
Vlan 1	unassigned	YES	unset administratively	down	down
GigabitEthernet1/0/1	unassigned	YES	unset	up	up
GigabitEthernet1/0/2	unassigned	YES	unset	up	up
GigabitEthernet1/0/3	unassigned	YES	unset	down	down
GigabitEthernet1/0/4	unassigned	YES	unset	down	down
GigabitEthernet1/0/5	unassigned	YES	unset	down	down
GigabitEthernet1/0/6	unassigned	YES	unset	down	down
GigabitEthernet1/0/7	unassigned	YES	unset	down	down
GigabitEthernet1/0/8	unassigned	YES	unset	down	down
GigabitEthernet1/0/9	unassigned	YES	unset	down	down
GigabitEthernet1/0/10	unassigned	YES	unset	down	down
GigabitEthernet1/0/11	unassigned	YES	unset	down	down
GigabitEthernet1/0/12	unassigned	YES	unset	down	down
GigabitEthernet1/0/13	unassigned	YES	unset	down	down
GigabitEthernet1/0/14	unassigned	YES	unset	down	down
GigabitEthernet1/0/15	unassigned	YES	unset	down	down
GigabitEthernet1/0/16	unassigned	YES	unset	down	down
GigabitEthernet1/0/17	unassigned	YES	unset	down	down
GigabitEthernet1/0/18	unassigned	YES	unset	down	down
GigabitEthernet1/0/19	unassigned	YES	unset	down	down
GigabitEthernet1/0/20	unassigned	YES	unset	down	down
GigabitEthernet1/0/21	unassigned	YES	unset	up	up
GigabitEthernet1/0/22	unassigned	YES	unset	down	down
GigabitEthernet1/0/23	unassigned	YES	unset	down	down
GigabitEthernet1/0/24	unassigned	YES	unset	down	down
Port-channell	unassigned	YES	unset	up	up

Show IP IGMP Snooping



Use `show ip igmp snooping groups` to check these:

- Multicast groups in each VLAN
- IGMP version
- Port list

Use `show ip igmp snooping querier` to check these:

- If querier is enabled
- IGMP version

```

Switch 1: show ip igmp snooping groups
Vlan  Group                Type   Version  Port List
-----
2     224.0.1.129             igmp   v2       Gi2/0/6, Po1
2     224.0.23.175            igmp   v2       Gi2/0/6, Po1
2     239.255.255.255         igmp   v2       Gi2/0/6, Po1
3     244.0.1.129             igmp   v2       Gi2/0/11, Po1
3     224.0.23.175            igmp   v2       Gi2/0/11, Po1
3     239.255.255.255         igmp   v2       Gi2/0/11, Po1
4     224.0.1.129             igmp   v2       Gi2/0/17, Po1
4     224.0.23.175            igmp   v2       Gi2/0/17, Po1
4     239.255.255.255         igmp   v2       Gi2/0/17, Po1
5     224.0.1.129             igmp   v2       Gi2/0/24, Po1
5     224.0.23.175            igmp   v2       Gi2/0/24, Po1
5     239.255.255.255         igmp   v2       Gi2/0/24, Po1

Switch 2: show ip igmp snooping querier
Vlan  IP Address      IGMP Version  Port
-----
1     192.168.1.1    v2            Po1
2     192.168.1.1    v2            Po1
3     192.168.1.1    v2            Po1
4     192.168.1.1    v2            Po1
5     192.168.1.1    v2            Po1
    
```

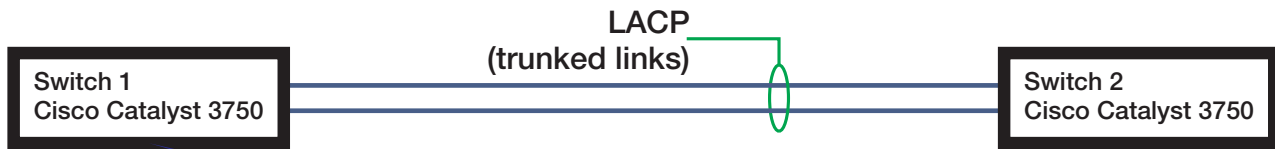
The IGMP snooping querier requires that an IP address be configured on a VLAN. In this example, VLAN 1 is configured with an IP address for network management.

For more information on the IGMP snooping querier, see the switch manufacturer's documentation.

Notes:

- For more information on configuring IGMP Snooping and Multicast VLAN Registration (MVR) see: https://www.cisco.com/c/en/us/td/docs/switches/lan/catalyst3750/software/release/12-2_52_se/configuration/guide/3750scg/swigmp.html

Show VTP Status



Use `show vtp status` to check these:

- VTP version supported
- VTP version number
- VTP domain name
- VTP pruning mode
- VTP trap generation setting
- Device ID
- Time of last configuration change
- VTP operation mode
- Maximum number of VLANs supported by local switch.

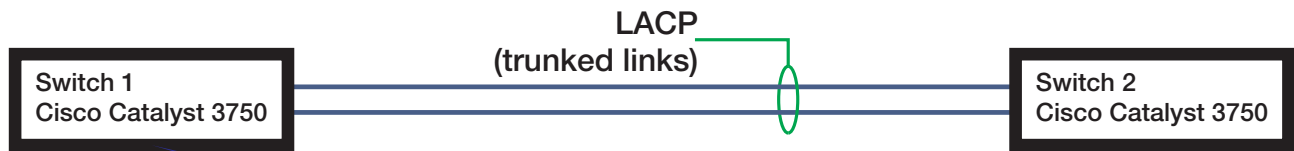
```
Switch 1: show vtp status
VTP Version Capable   :1 to 3
VTP Version Running   :1
VTP Domain Name       :
VTP Pruning Mode      :Disabled
VTP Traps Generation  :Disabled
Device ID              :00.15.fa.3f.9c.00
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00

Feature VLAN:
-----
VTP Operating Mode     :Transparent
Maximum VLANs supported locally :1005
Number of existing VLANs :9
Configuration Revision :0
MD5 digest             :0x76 0x2D 0x7B 0xE3 0x9E 0x7F 0x51 0xEA
                       :0x86 0x61 0x15 0xC8 0x36 0xDC 0x37 0x90
```

Notes:

- For more about VLAN Trunk Protocol (VTP) see: <https://www.cisco.com/c/en/us/support/docs/lan-switching/vtp/10558-21.html>

Show Interfaces Port-Channel



Use `show int port-channel 1` to check these:

- Status of port channel
- Reliability
- TxLoad and RxLoad
- Duplex, speed, and media type
- Flow control status
- Channel group members
- ARP timer
- Hang status
- Various statistics that can help with troubleshooting network issues

Switch 1: show interfaces port-channel1

```
Port-channel1 is up, line protocol is up (connected)
Hardware is EtherChannel, address is 0015.fa3f.9c01 (bia 0015.fa3f.9c01)
MTU 1500 bytes, BW 2000000 Kbit, DLY 10 usec,
  reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, loopback not set
Keepalive set (10 sec)
Full-duplex, 1000Mb/s, link type is auto, media type is unknown
input flow-control is off, output flow-control is unsupported
Members in this channel: Gi1/0/1 Gi1/0/2
ARP type: ARPA, ARP Timeout 04:00:00
Last input 00:24:37, output 00:00:00, output hang never
Last clearing of "show interface" counters never
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: fifo
Output queue: 0/40 (size/max)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 2000 bits/sec, 3 packets/sec
 4150 packets input, 389286 bytes, 0 no buffer
  Received 1020 broadcasts (831 multicasts)
   0 runts, 0 giants, 0 throttles
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
   0 watchdog, 831 multicast, 0 pause input
   0 input packets with dribble condition detected
15547 packets output, 1221576 bytes, 0 underruns
   0 output errors, 0 collisions, 1 interface resets
   0 babbles, 0 late collision, 0 deferred
   0 lost carrier, 0 no carrier, 0 PAUSE output
   0 output buffer failures, 0 output buffers swapped out
```

Show LACP

LACP
(trunked links)

Switch 1
Cisco Catalyst 3750

Switch 2
Cisco Catalyst 3750

There are three different commands for checking LACP status and statistics.

```

Switch 1: show lacp 1 counters
-----
Port          LACPDU's      Marker      Response     LACPDU's
      Sent      Recv      Sent      Recv      Sent      Recv      Pkts Err
-----
Channel group: 1
Gi1/0/1      146      148        0        0         0        0         0
Gi1/0/2      133      132        0        0         0        0         0

Switch 1: show lacp 1 internal
Flags: S Device is requesting Slow LACPDU's
      F Device is requesting Fast LACPDU's
      A Device is in Active mode
      P Device is in Passive mode

Channel group: 1
Port          LACP port      Admin      Oper      Port      Port
      Flags      State      Priority      Key      Key      Number      State
Gi1/0/1      SA      bnd1      32768      0x1      0x1      0x102      0x3D
Gi1/0/2      SA      bnd1      32768      0x1      0x1      0x103      0x3D

Switch 1: show lacp 1 neighbor
Flags: S Device is requesting Slow LACPDU's
      F Device is requesting Fast LACPDU's
      A Device is in Active mode
      P Device is in Passive mode

Channel group 1 neighbors

Partner's information
Channel group: 1
Port          LACP port      Admin      Oper      Port      Port
      Flags      Priority      Dev ID      Age      Key      Key      Number      State
Gi1/0/1      SA      32768      00.1e.49.88.1f.80 15s      0x0      0x1      0x202      0x3D
Gi1/0/2      SA      32768      00.1e.49.88.1f.80 21s      0x0      0x1      0x203      0x3D
    
```



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