



white paper

## Interoperating with Cisco Systems

### Hands-On Look at Configuring D-Link® and Cisco for Seamless Savings

The best network design invariably is multi-vendor. That is even more true in an era of constrained budgets where sticking with your existing vendor brings with it not only a price premium, but also the continuation of proprietary approaches.

Cisco has long been the assumptive choice for enterprise networking equipment, in part because of its prowess in creating proprietary standards designed to address customers' needs and minimize operational issues, while at the same time having the tertiary effect of locking customers into an all-Cisco solution.

As a result, Cisco shops that wish to adopt the latest advance or the best value from a range of vendors face an integration challenge rather than an opportunity to gain a competitive edge. In a recent Core Research Note, the analysts at leading research firm Gartner recommended that organizations should add a second network vendor to save money and solidify operations. One obvious requirement in order to accomplish that high return proposition is ensuring that the second vendor's equipment interoperates with your primary vendor's gear.

Fortunately, even Cisco has yielded to the obvious customer advantage of adding support for the standards-based protocols promulgated by the IEEE and IETF.

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**D-Link®**

## D-Link Simplifies Cisco Interoperability

D-Link® makes it easy for customers to achieve interoperability with Cisco. If you follow Gartner's recommendation and begin by installing D-Link in just one building block of your network (say, the edge layer) D-Link engineers will look at the protocols running between the edge and aggregation layer to make sure there are no interoperability issues in such areas as trunking, QoS, VLANs, PoE and link layer device discovery.

The need for that diligence comes from the high proportion of proprietary protocols running in many Cisco environments. Yet it proves to be relatively easy to make a move to open standards for even the most fundamental protocols in enterprise networks, including routing.

For their routing, a great many networks still rely on Cisco's proprietary EIGRP, or Enhanced Interior Gateway Routing Protocol, which supports fast convergence from link failure, is loop-free, secure and efficient in bandwidth usage.

Despite its usefulness, EIGRP has been overtaken by OSPF, or Open Shortest Path First, developed as an open standard by the Internet Engineering Task Force (IETF). OSPF enjoys the status of being the most widely used interior gateway protocol, while EIGRP is declining in usage, largely because it is only supported by Cisco.

OSPF also appeals to enterprise network architects for its several advantages over EIGRP. OSPF supports equal-cost load balancing and can support any size network. OSPF has the capability of dividing autonomous systems (AS) into different areas, based on the topology. By partitioning ASs, network architects can build a hierarchical, scalable network. And perhaps most important for future proofing your network, OSPF supports traffic engineering, which EIGRP does not.

D-Link's approach to resolving the issue of Cisco interoperability – with respect to EIGRP as well as other proprietary protocols – echoes the recommendation of the experts at Gartner: "Migrate proprietary protocols to widely-deployed open standards." Not only does moving to open standards prevent being held hostage by a vendor, it often results in adopting a more efficient and forward looking replacement.

## Taking the First Steps Toward a Cisco/D-Link Network

According to Gartner, learning how to configure vendors to the same open standard with Command Line Interfaces (CLI) is not difficult. "From talking to clients, we would estimate that training an existing network operations resource on a second network vendor would take one to two days."

In this white paper, we show how easy it is to add high value switches from D-Link to your Cisco environment, while migrating from proprietary protocols to the open, and often more efficient equivalent, such as moving routing from EIGRP to OSPF. We'll show not only the particular CLI session, but also sessions for handling VLAN, Link Aggregation, Spanning Tree Protocol and Multiple Spanning Tree Protocol.

We'll begin with VLAN, including a quick lesson on translating Cisco's Proprietary ISL terminology to industry standard 802.1Q terms, followed by a command line session that not only establishes the interoperating configuration but also confirms that interoperability has been achieved. Where appropriate, our examples will show the topology in question.

If you initially prefer to read each session's opening description of Cisco's proprietary versus D-Link's open approach, you can skip the details of the actual command line session transcription linked to in the Appendix and move on to the next proprietary versus open example.

## VLAN Configuration

The 802.1q standard was created by IEEE to allow breaking up large networks into smaller and more manageable ones through the use of VLANs. The 802.1q standard is an alternative to Cisco's InterSwitch Link, or ISL. The IEEE 802.1q method of tagging Ethernet frames to identify which VLAN they belong to is commonly used even in Cisco-oriented network installations because ISL is only supported by Cisco.

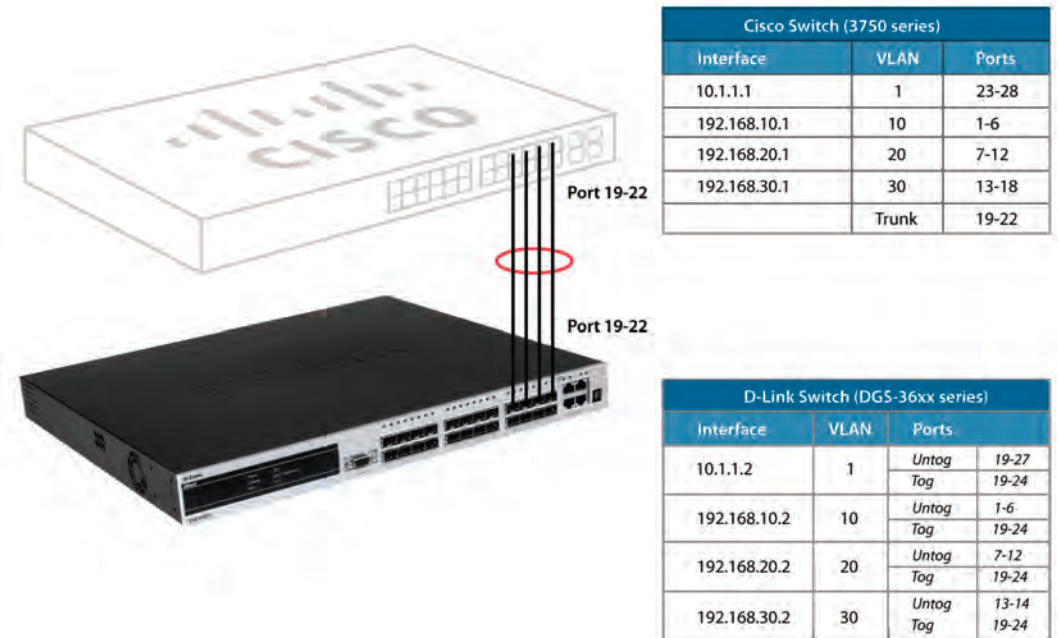
In addition to the compatibility issue, most network engineers prefer 802.1q because it has:

- \* Support of up to 4096 VLANs as opposed to the 1000 ISL supports
- \* Insertion of a 4-byte VLAN tag into the frame as opposed to ISL's 30 byte encapsulation

**Terminology.** Configuring VLANs that connect Cisco and D-Link switches involves two simple tasks. First, you must defeat Cisco's default ISL protocol with a simple command to switch to "dot1Q" mode, Cisco's abbreviation of the industry standard. Second, use the following simple mapping of Cisco's proprietary terminology (Cisco calls it "trunking") to the terminology of the relevant 802.1Q standard used by D-Link:

Cisco	D-Link	Description
Trunking Port	Tagged Port	A port carries multiple 802.1Q tagged VLANs. Usually used for uplink ports, IP phone ports.
Access Port	Untagged Port	A port which is an untagged member of a VLAN.
Native VLAN	VLAN 1	Defines the untagged VLAN of a 802.1Q - tagged port. Defaults to VLAN 1 on D-Link and Cisco.

**Sample Topology**

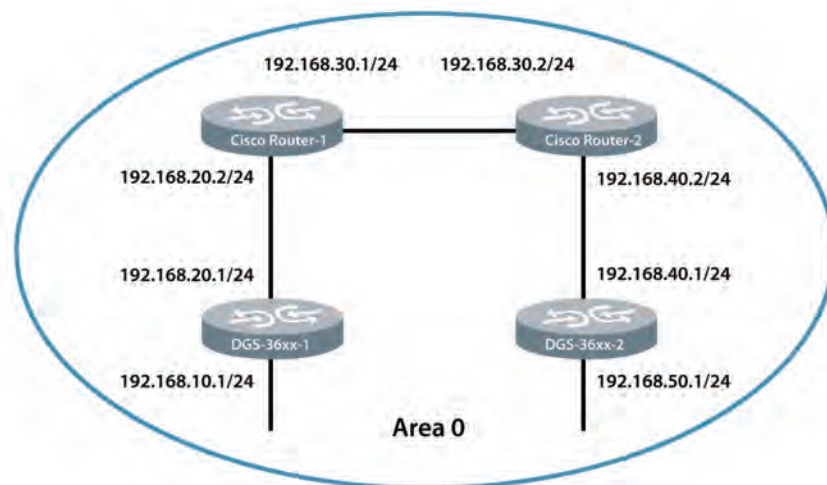


[Click this link](#) to visit a Command Line Interface (CLI) session in the appendix on configuring VLANs, or move onto the next interoperability example.

**Routing: Open Shortest Path Fast (OSPF) Configuration**

OSPF (Open Shortest Path Fast) protocol is the most widely used interior gateway protocol in large enterprise networks. Some Cisco environments still use the proprietary EIGRP (Enhanced Interior Gateway Protocol) instead, but most experts say OSPF makes for a more efficient and scalable network, and certainly more interoperable.

**Sample Topology**



Click though to the [OSPF command line interface session](#) in the appendix to explore how to achieve interoperability or move to the next example, Link Aggregation.

## Link Aggregation

Our next example covers the process of aggregating links. Link aggregation enables the parallel use of multiple network ports to increase link speed beyond the limits of any one port and to provide redundancy for higher availability. Once again, per Gartner's recommendation, it's important to transition your network off Cisco's proprietary aggregation method, called Port Aggregation Protocol (PAgP), to the standard alternative, IEEE's 802.3ad LACP function, which Cisco and D-Link switches both support.

Cisco has its own proprietary terminology, while D-Link uses the standard terminology, but mapping is simple.

Cisco	D-Link	Description
Channel-group	Group ID	ID of a port aggregation group.
Port-channel	Trunking Group	A logical port aggregation group.

The logical port defined by Cisco's link aggregation is named "port-channel" and is configured as the "Interface Port-channel x". On D-Link it is named "LACP port" and is configured as the "interface Trk#" for a static trunk or "interface Dyn#" for a dynamic trunk.

A "Static" trunk becomes an active trunk unconditional and independent of the configuration of the other side. A static trunk does not need any protocol to be created.

"Dynamic" trunks will be created if both sides agree to it. To do so, they exchange messages, either PAgP or LACP, to negotiate their status. One side is said "active" (LACP) or "desirable" (PAgP), meaning that it initiates the negotiation. The other side is said to be "passive" (LACP) or "auto" (PAgP) and forms a link aggregation automatically.

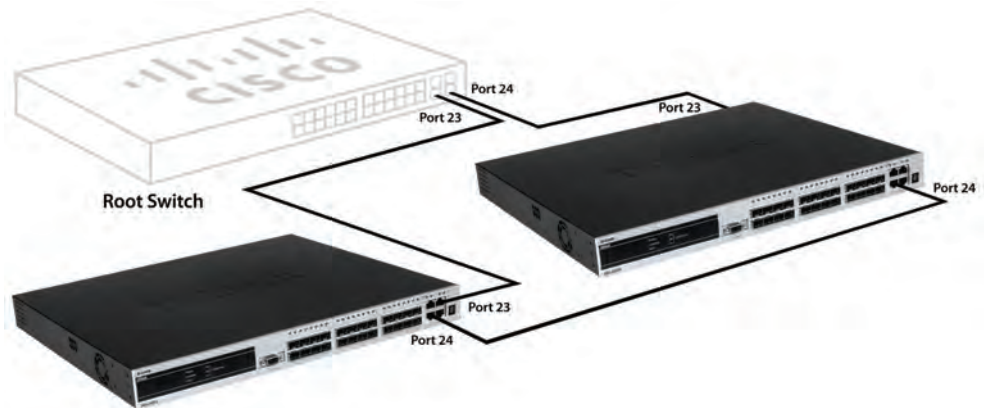
In the command line interface session that follows, we're leveraging the fact that with LACP, one or more additional links can operate as standby links that will activate only if another active link goes down. When connecting two switches with LACP, one of the switches must be "active" (send LACP frames) and another one should be "passive".

Click through to the [Link Aggregation Configuration Session](#) in the appendix to explore the command line interface session to achieve interoperability in link aggregation, or move to the next example, Spanning Tree Configuration.

## Spanning Tree Configuration

Spanning Tree Protocol prevents loops in any bridged LAN, allowing redundant links for resiliency without a resulting broadcast storm. Once again, D-Link supports the standards, which are Spanning Tree Protocol (STP) and Multiple Spanning Tree Protocol (MSTP). The potential hitch is that Cisco's default is their proprietary Rapid Per-VLAN Spanning Tree (RPVST+) protocol, which implements a different topology for each VLAN. The standards-based solution for multiple VLANs is MSTP, which has some advantages over the Cisco approach in terms of load balancing, fault tolerance and CPU load. However, the disadvantage is that you may have to pay for a Cisco software upgrade to add that feature. But if you choose to leave your Cisco switches running the proprietary protocol, here's how to interoperate with D-Link as long as the connections are all located within a VLAN.

### Sample Topology

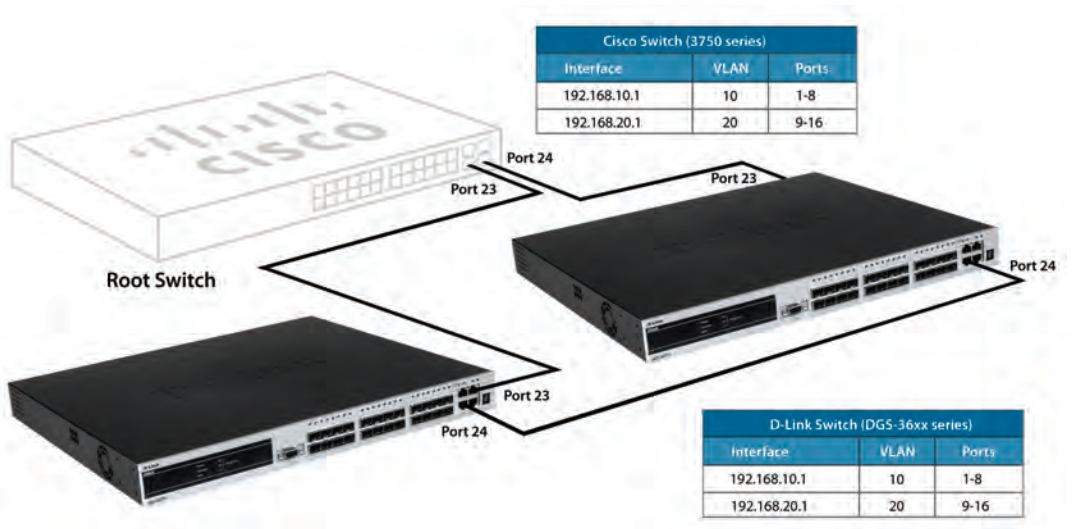


Click through to the [Spanning Tree Protocol Configuration session](#) in the appendix on linking Cisco RPVST+ and D-Link STP switches or move on to our next example, MSTP.

### Multiple Spanning Tree Configuration

Our final example applies to making D-Link and Cisco switches interoperate based on standard MSTP. You may have to acquire the appropriate software upgrade from Cisco before it supports the industry standard. Click through to the [MSTP configuration session](#) in the appendix to explore further.

### Sample Topology



## Conclusion

To maintain a competitive edge, companies must be free to invest in the best price-performance technology, confident that it will integrate into their existing network.

As long as some vendors persist in pursuing proprietary approaches, some additional complexity will result, but Gartner and other experts make clear the advantages are well worth it. D-Link published this white paper tutorial to both demonstrate and minimize the complexity. Proprietary barriers can be overcome simply by configuring equipment to follow the standards-based protocols promulgated by the IEEE and IETF. D-Link can guide you for any proprietary to standard conversion not covered in our sample command line sessions.

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# APPENDIX

## VLAN Configuration on Cisco Switch

	Command Example	Purpose
<b>Step 1</b>	<pre>Catalyst# config terminal Catalyst(config)# vlan 10,20,30 Catalyst(config-vlan)# exit</pre>	Creating VLAN 10,20,30.
<b>Step 2</b>	<pre>Catalyst(config)# interface range gigabitEthernet 1/0/1-6 Catalyst(config-if)# switchport mode access Catalyst(config-if)# switchport access vlan 10 Catalyst(config-if)# exit  Catalyst(config)# interface range gigabitEthernet 1/0/7-12 Catalyst(config-if)# switchport mode access Catalyst(config-if)# switchport access vlan 20 Catalyst(config-if)# exit  Catalyst(config)# interface range gigabitEthernet 1/0/13-18 Catalyst(config-if)# switchport mode access Catalyst(config-if)# switchport access vlan 30 Catalyst(config-if)# exit</pre>	Changing ports to access mode and assign the membership to each VLAN.
<b>Step 3</b>	<pre>Catalyst(config)# interface range gigabitEthernet 1/0/19-22 Catalyst(config-if)# switchport trunk encapsulation dot1q Catalyst(config-if)# switchport trunk allowed vlan 1,10,20,30 Catalyst(config-if)# switchport mode trunk Catalyst(config-if)# exit</pre>	Creating VLAN trunking port.

The “encapsulation” method defines how multiple VLANs are carried on Cisco Ethernet links. Their default proprietary method, ISL, is switched to and the IEEE standard 802.1Q with the command “dot1q”. By default, a Cisco “trunk” carries all VLANs. The “allowed VLAN” is used to restrict the VLANs carried to the specified VLANs. By default, a port is in “access” mode, i.e. it belongs to one VLAN only.

### ***IP Configuration on Cisco Switch***

	Command Example	Purpose
<b>Step 4</b>	<pre>Catalyst(config)# interface vlan 1 Catalyst(config-vlan)# ip address 192.168.0.1 255.255.255.0 Catalyst(config-vlan)# no shutdown Catalyst(config-vlan)# exit  Catalyst(config)# interface vlan 10 Catalyst(config-vlan)# ip address 192.168.10.1 255.255.255.0</pre>	Configuring IP address of VLAN interfaces.

```

Catalyst(config-vlan)# no shutdown
Catalyst(config-vlan)# exit

Catalyst(config)# interface vlan 20
Catalyst(config-vlan)# ip address 192.168.20.1
255.255.255.0
Catalyst(config-vlan)# no shutdown
Catalyst(config-vlan)# exit

Catalyst(config)# interface vlan 30
Catalyst(config-vlan)# ip address 192.168.30.1
255.255.255.0
Catalyst(config-vlan)# no shutdown
Catalyst(config-vlan)# exit

```

If the switch is a layer 2 switch, a unique IP address is usually defined in one VLAN for management purposes. In this case, the D-Link DGS-36xx and Cisco 3750 are both L3 switches. For testing connectivity, one IP address has been defined in each VLAN.

### ***VLAN Configuration on D-Link Switch***

	<b>Command Example</b>	<b>Purpose</b>
<b>Step 1</b>	<pre> switch# create vlan 10 tag 10 switch# create vlan 20 tag 20 switch# create vlan 30 tag 30  switch# config vlan default delete 1-18 switch# config vlan 10 add untagged 1-6 switch# config vlan 20 add untagged 7-12 switch# config vlan 30 add untagged 13-18 switch# config vlan 10 add tagged 19-24 switch# config vlan 20 add tagged 19-24 switch# config vlan 30 add tagged 19-24 </pre>	Creating VLAN 10, 20, 30 and assign port membership.

Ports 1 to 22 are removed from VLAN 1 (default VLAN) and are assigned to each VLAN.

Ports 1 to 8 are assigned to VLAN 10.

Ports 9 to 16 are assigned to VLAN 20.

Ports 17 to 22 are assigned to VLAN 30.

Port 23 (uplink) is tagged with VLAN 10, 20, 30 and belong to untagged member of VLAN 1.

### ***IP Configuration on D-Link Switch***

	<b>Command Example</b>	<b>Purpose</b>
<b>Step 2</b>	<pre> switch# config ipif System ipaddress 192.168.0.2/24 switch# create ipif 10 192.168.10.2/24 10 switch# create ipif 20 192.168.20.2/24 20 switch# create ipif 30 192.168.30.2/24 30 </pre>	Configuring IP address of VLAN interfaces.

## Checking VLANs and Ports Assignment on Cisco Switch

Checking if all VLAN interfaces were created and member ports are correct.

### Command Example

```
Catalyst# show vlan
```

VLAN	Name	Status	Ports
1	default	active	<b>Gi1/0/23, Gi1/0/24, Gi1/0/25, Gi1/0/26, Gi1/0/27, Gi1/0/28</b>
10	VLAN0010	active	<b>Gi1/0/1, Gi1/0/2, Gi1/0/3, Gi1/0/4, Gi1/0/5, Gi1/0/6</b>
20	VLAN0020	active	<b>Gi1/0/7, Gi1/0/8, Gi1/0/9, Gi1/0/10, Gi1/0/11, Gi1/0/12</b>
30	VLAN0030	active	<b>Gi1/0/13, Gi1/0/14, Gi1/0/15, Gi1/0/16, Gi1/0/17, Gi1/0/18</b>

## Checking if trunking port are set correctly

### Command Example

```
Catalyst# show interfaces gigabitEthernet 1/0/19 switchport
```

```
Name: Gi1/0/19
Switchport: Enabled
Administrative Mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q
Negotiation of Trunking: On
Access Mode VLAN: 1 (default)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk Native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk associations: none
Administrative private-vlan trunk mappings: none
Operational private-vlan: none
Trunking VLANs Enabled: 1,10,20,30
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL

Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

## Checking if the access port are set correctly

### Command Example

```
Catalyst# show interfaces gigabitEthernet 1/0/1 switchport
Name: Gi1/0/1
Switchport: Enabled
Administrative Mode: static access
Operational Mode: down
Administrative Trunking Encapsulation: negotiate
Negotiation of Trunking: Off
Access Mode VLAN: 10 (VLAN0010)
Trunking Native Mode VLAN: 1 (default)
Administrative Native VLAN tagging: enabled
Voice VLAN: none
Administrative private-vlan host-association: none
Administrative private-vlan mapping: none
Administrative private-vlan trunk native VLAN: none
Administrative private-vlan trunk Native VLAN tagging: enabled
Administrative private-vlan trunk encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk associations: none
Administrative private-vlan trunk mappings: none
Operational private-vlan: none
Trunking VLANs Enabled: ALL
Pruning VLANs Enabled: 2-1001
Capture Mode Disabled
Capture VLANs Allowed: ALL

Protected: false
Unknown unicast blocked: disabled
Unknown multicast blocked: disabled
Appliance trust: none
```

## Checking if the IP address of each VLAN interface are correct

### Command Example

```
Catalyst# show ip interface brief
```

Interface	IP-Address	OK?	Method	Status	Protocol
Vlan1	192.168.0.1	YES	manual	up	up
Vlan10	192.168.10.1	YES	manual	up	up
Vlan20	192.168.20.1	YES	manual	up	up
Vlan30	192.168.30.1	YES	manual	up	up

## Checking VLANs and ports assignment on D-Link Switch

Checking if all VLAN interfaces were created and port membership are correct.

### Command Example

```
switch# show vlan
Command: show vlan

VID                : 1                VLAN Name          : default
VLAN Type          : Static           Advertisement      : Enabled
Member Ports      : 19-27
Static Ports       : 19-27
Current Tagged Ports :
Current Untagged Ports : 19-27
Static Tagged Ports :
Static Untagged Ports : 19-27
Forbidden Ports    :
Status             : Active

VID                : 10               VLAN Name          : 10
VLAN Type          : Static           Advertisement      : Disabled
Member Ports      : 1-6,19-24
Static Ports       : 1-6,19-24
Current Tagged Ports : 19-24
Current Untagged Ports : 1-6
Static Tagged Ports : 19-24
Static Untagged Ports : 1-6
Forbidden Ports    :
Status             : Active

VID                : 20               VLAN Name          : 20
VLAN Type          : Static           Advertisement      : Disabled
Member Ports      : 7-12,19-24
Static Ports       : 7-12,19-24
Current Tagged Ports : 19-24
Current Untagged Ports : 7-12
Static Tagged Ports : 19-24
Static Untagged Ports : 7-12
Forbidden Ports    :
Status             : Active

VID                : 30               VLAN Name          : 30
VLAN Type          : Static           Advertisement      : Disabled
Member Ports      : 13-24
Static Ports       : 13-24
Current Tagged Ports : 19-24
Current Untagged Ports : 13-18
Static Tagged Ports : 19-24
Static Untagged Ports : 13-18
Forbidden Ports    :
Status             : Active

Total Entries: 4
```

## Checking if the IP address of each VLAN interface are correct

### Command Example

```
switch# show ipif
Command: show ipif

IP Interface           : 10
VLAN Name              : 10
Interface Admin state  : Enabled
DHCPv6 Client State   : Disabled
IPv4 Address           : 192.168.10.2/24 (Manual) Primary
Proxy ARP              : Disabled (Local : Disabled)
IP Directed Broadcast  : Disabled
IP MTU                 : 1500

IP Interface           : 20
VLAN Name              : 20
Interface Admin state  : Enabled
DHCPv6 Client State   : Disabled
IPv4 Address           : 192.168.20.2/24 (Manual) Primary
Proxy ARP              : Disabled (Local : Disabled)
IP Directed Broadcast  : Disabled
IP MTU                 : 1500

IP Interface           : 30
VLAN Name              : 30
Interface Admin state  : Enabled
DHCPv6 Client State   : Disabled
IPv4 Address           : 192.168.30.2/24 (Manual) Primary
Proxy ARP              : Disabled (Local : Disabled)
IP Directed Broadcast  : Disabled
IP MTU                 : 1500

IP Interface           : System
VLAN Name              : default
Interface Admin state  : Enabled
DHCPv6 Client State   : Disabled
IPv4 Address           : 10.1.1.1/24 (Manual) Primary
Proxy ARP              : Disabled (Local : Disabled)
IP Directed Broadcast  : Disabled
IP MTU                 : 1500

Total Entries         : 4
```

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## OSPF Configuration

### OSPF Configuration on Cisco Switch # 1

	Command Example	Purpose
<b>Step 1</b>	<pre>Switch#config terminal Switch(config)#interface gigabitEthernet 1/0/23 Switch(config-if)#no switchport Switch(config-if)#ip address 192.168.20.2 255.255.255.0 Switch(config-if)#no shut Switch(config-if)#exit Switch(config)#interface gigabitEthernet 1/0/22 Switch(config-if)#no switchport Switch(config-if)#ip address 192.168.30.1 255.255.255.0 Switch(config-if)#no shutdown Switch(config-if)#exit</pre>	Create two IP interfaces (192.168.20.0 / 192.168.30.0)
<b>Step 2</b>	<pre>Switch(config)#ip routing Switch(config)#router ospf 100 Switch(config-router)#router-id 192.168.20.1 Switch(config-router)#network 192.168.20.0 0.0.0.255 area 0 Switch(config-router)#network 192.168.30.0 0.0.0.255 area 0</pre>	Enable OSPF on specific interfaces and setup router ID

### OSPF Configuration on Cisco Switch # 2

	Command Example	Purpose
<b>Step 1</b>	<pre>Switch#config terminal Switch(config)#interface gigabitEthernet 1/0/23 Switch(config-if)#no switchport Switch(config-if)#ip address 192.168.40.2 255.255.255.0 Switch(config-if)#no shut Switch(config-if)#exit Switch(config)#interface gigabitEthernet 1/0/22 Switch(config-if)#no switchport Switch(config-if)#ip address 192.168.30.1 255.255.255.0 Switch(config-if)#no shutdown Switch(config-if)#exit</pre>	Create two IP interfaces (192.168.30.0 / 192.168.40.0)
<b>Step 2</b>	<pre>Switch(config)#ip routing Switch(config)#router ospf 100 Switch(config-router)#router-id 192.168.30.1 Switch(config-router)#network 192.168.30.0 0.0.0.255 area 0 Switch(config-router)#network 192.168.40.0 0.0.0.255 area 0</pre>	Enable OSPF on specific interfaces and setup router ID

### OSPF Configuration on D-Link Switch # 1

	Command Example	Purpose
<b>Step 1</b>	DGS-3627:admin#create vlan 10 tag 10 DGS-3627:admin#create vlan 20 tag 20 DGS-3627:admin#config vlan default delete 1-16 DGS-3627:admin#config vlan 10 add untagged 1-8 DGS-3627:admin#config vlan 20 add untagged 9-16,23	Create VLAN 10 and 20 and assign relative ports to each VLAN
<b>Step 2</b>	DGS-3627:admin#create ipif 10 192.168.10.1/24 10 DGS-3627:admin#create ipif 20 192.168.20.1/24 20	Create two IP interfaces on VLAN 10 and 20
<b>Step 3</b>	config ospf router_id 192.168.10.1 DGS-3627:admin#config ospf ipif 10 area 0.0.0.0 state enable DGS-3627:admin#config ospf ipif 20 area 0.0.0.0 state enable DGS-3627:admin#enable ospf	Enable OSPF on specific interfaces and setup router ID

### OSPF Configuration on D-Link Switch # 2

	Command Example	Purpose
<b>Step 1</b>	DGS-3627:admin#create vlan 40 tag 40 DGS-3627:admin#create vlan 50 tag 50 DGS-3627:admin#config vlan default delete 1-16 DGS-3627:admin#config vlan 40 add untagged 1-8,24 DGS-3627:admin#config vlan 50 add untagged 9-16	Create VLAN 40 and 50 and assign relative ports to each VLAN
<b>Step 2</b>	DGS-3627:admin#create ipif 40 192.168.10.1/24 40 DGS-3627:admin#create ipif 50 192.168.20.1/24 50	Create two IP interfaces on VLAN 40 and 50
<b>Step 3</b>	config ospf router_id 192.168.40.1 DGS-3627:admin#config ospf ipif 40 area 0.0.0.0 state enable DGS-3627:admin#config ospf ipif 50 area 0.0.0.0 state enable DGS-3627:admin#enable ospf	Enable OSPF on specific interfaces and setup router ID

### Checking OSPF information on Cisco Switch

#### Checking OSPF detail information

##### Command Example

```
Switch#show ip ospf
Routing Process "ospf 100" with ID 192.168.20.1
Start time: 00:01:21.528, Time elapsed: 00:00:52.454
Supports only single TOS(TOS0) routes
Supports opaque LSA
Supports Link-local Signaling (LLS)
```

```

Supports area transit capability
Router is not originating router-LSAs with maximum metric
Initial SPF schedule delay 5000 msec
Minimum hold time between two consecutive SPFs 10000 msec
Maximum wait time between two consecutive SPFs 10000 msec
Incremental-SPF disabled
Minimum LSA interval
*Mar  1 00:02:12.623: %OSPF-5-ADJCHG: Process 100, Nbr 192.168.30.1 on
GigabitEthernet1/0/22 from LOADING to FULL, Loading Done5 secs
Minimum LSA arrival 1000 msec
LSA group pacing timer 240 secs
Interface flood pacing timer 33 msec
Retransmission pacing timer 66 msec
Number of external LSA 0. Checksum Sum 0x000000
Number of opaque AS LSA 0. Checksum Sum 0x000000
Number of DCbitless external and opaque AS LSA 0
Number of DoNotAge external and opaque AS LSA 0
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
Number of areas transit capable is 0
External flood list length 0
IETF NSF helper support enabled
Cisco NSF helper support enabled
Reference bandwidth unit is 100 mbps
Area BACKBONE(0)
  Number of interfaces in this area is 2
  Area has no authentication
  SPF algorithm last executed 00:00:37.984 ago
  SPF algorithm executed 2 times
  Area ranges are
  Number of LSA 8. Checksum Sum 0x043353
  Number of opaque link LSA 0. Checksum Sum 0x000000
  Number of DCbitless LSA 4
  Number of indication LSA 0
  Number of DoNotAge LSA 0
  Flood list length 0

```

## Checking if the neighbors are established

### Command Example

```
Switch#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.30.1	1	FULL/DR	00:00:38	192.168.30.2	GigabitEthernet1/0/22
192.168.10.1	1	FULL/DR	00:00:36	192.168.20.1	GigabitEthernet1/0/23

## Checking if the route entries are resident in the routing table

### Command Example

```
Switch#show ip route
```

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

```
C 192.168.30.0/24 is directly connected, GigabitEthernet1/0/22
O 192.168.10.0/24 [110/2] via 192.168.20.1, 00:02:07, GigabitEthernet1/0/23
O 192.168.40.0/24 [110/2] via 192.168.30.2, 00:02:07, GigabitEthernet1/0/22
C 192.168.20.0/24 is directly connected, GigabitEthernet1/0/23
O 192.168.50.0/24 [110/3] via 192.168.30.2, 00:02:07, GigabitEthernet1/0/22
```

## Checking OSPF interface status

### Command Example

```
Switch#show ip ospf interface
GigabitEthernet1/0/22 is up, line protocol is up (connected)
  Internet Address 192.168.30.1/24, Area 0
  Process ID 100, Router ID 192.168.20.1, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 192.168.30.1, Interface address 192.168.30.2
  Backup Designated router (ID) 192.168.20.1, Interface address 192.168.30.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:01
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 192.168.30.1 (Designated Router)
  Suppress hello for 0 neighbor(s)
GigabitEthernet1/0/23 is up, line protocol is up (connected)
  Internet Address 192.168.20.2/24, Area 0
  Process ID 100, Router ID 192.168.20.1, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 192.168.10.1, Interface address 192.168.20.1
  Backup Designated router (ID) 192.168.20.1, Interface address 192.168.20.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:07
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 5
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
```

```
Adjacent with neighbor 192.168.10.1 (Designated Router)
Suppress hello for 0 neighbor(s)
```

### Checking OSPF status on D-Link Switch

#### Checking if OSPF are enabled on correct interfaces

##### Command Example

```
DGS-3627:admin#show ospf
```

```
Command: show ospf
```

```
OSPF Router ID : 192.168.10.1
```

```
State          : Enabled
```

```
OSPF Interface Settings
```

Interface	IP Address	Area ID	State	Link Status	Metric
System	10.90.90.90/8	0.0.0.0	Disabled	Link Up	1
10	192.168.10.1/24	0.0.0.0	Enabled	Link Up	1
20	192.168.20.1/24	0.0.0.0	Enabled	Link Up	1

```
Total Entries : 3
```

```
OSPF Area Settings
```

Area ID	Type	Stub	Import	Summary LSA	Stub Default	Cost	Translate
0.0.0.0	Normal	None			None		None

```
Total Entries : 1
```

```
Virtual Interface Configuration
```

Transit Area ID	Virtual Neighbor	Router	Hello Interval	Dead Interval	Authentication	Link Status
-----------------	------------------	--------	----------------	---------------	----------------	-------------

```
Total Entries : 0
```

```
OSPF Area Aggregation Settings
```

Area ID	Aggregated Network Address	LSDB Type	Advertise
---------	----------------------------	-----------	-----------

```
Total Entries : 0
```

```
OSPF Host Route Settings
```

Host Address	Metric	Area ID
--------------	--------	---------

-----  
Total Entries : 0

### Checking if OSPF neighbor is established

#### Command Example

```
DGS-3627:admin#show ospf neighbor  
Command: show ospf neighbor
```

IP Address of Neighbor	Router ID of Neighbor	Neighbor Priority	Neighbor State
192.168.20.2	192.168.20.2	1	Full

Total Entries : 1

### Checking OSPF interface information

#### Command Example

```
DGS-3627:admin#show ospf ipif 10  
Command: show ospf ipif 10
```

Interface Name: 10	IP Address: 192.168.10.1/24 (Link Up)
Network Medium Type: BROADCAST	Metric: 1
Area ID: 0.0.0.0	Administrative State: Enabled
Priority: 1	DR State: DR
DR Address: 192.168.10.1	Backup DR Address: None
Hello Interval: 10	Dead Interval: 40
Transmit Delay: 1	Retransmit Time: 5
Authentication: None	

Passive Mode: Disabled

Total Entries : 1

DGS-3627:admin#

### Checking all the route entries are resident the routing table

#### Command Example

```
DGS-3627:admin#show iproute  
Command: show iproute
```

Routing Table

IP Address/Netmask	Gateway	Interface	Cost	Protocol
10.0.0.0/8	0.0.0.0	System	1	Local
192.168.10.0/24	0.0.0.0	10	1	Local
192.168.20.0/24	0.0.0.0	20	1	Local

192.168.30.0/24	192.168.20.2	20	2	OSPF
192.168.40.0/24	192.168.20.2	20	3	OSPF
192.168.50.0/24	192.168.20.2	20	4	OSPF

Total Entries : 6

Total Entries : 1

DGS-3627:admin#

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## Link Aggregation Configuration (which Cisco calls Static Trunk Configuration) on Cisco Switch

	Command Example	Purpose
<b>Step 1</b>	<pre>Catalyst# config terminal Catalyst(config)# interface range gigabitEthernet 1/0/19-22 Catalyst(config-if)# channel-group 1 mode on</pre>	Creating channel group 1 with static mode

### Static Trunk Configuration on D-Link Switch

	Command Example	Purpose
<b>Step 1</b>	<pre>switch# create link_aggregation group_id 1 type static switch# config link_aggregation group_id 1 ports 19- 22 state enable</pre>	Creating trunk group 1 with static mode

### Checking the Static Channel Status on Cisco Switch

(Are ports of channel group and port mode set correctly)

Command Example			
<pre>Catalyst# show etherchannel 1 summary Flags: D - down          P - bundled in port-channel        I - stand-alone  s - suspended        H - Hot-standby (LACP only)        R - Layer3       S - Layer2        U - in use       f - failed to allocate aggregator         M - not in use, minimum links not met        u - unsuitable for bundling        w - waiting to be aggregated        d - default port  Number of channel-groups in use: 1 Number of aggregators:          1  Group  Port-channel  Protocol    Ports -----+-----+-----+----- 1      Po1(SU)          -           Gi1/0/19(P) Gi1/0/20(P) Gi1/0/21(P)                                       Gi1/0/22(P)</pre>			
<pre>Switch#show etherchannel 1 detail Group state = L2 Ports: 4    Maxports = 8 Port-channels: 1 Max Port-channels = 1 Protocol:   - Minimum Links: 0               Ports in the group:               ----- Port: Gi1/0/19 -----</pre>			

```
Port state      = Up Mstr In-Bndl
Channel group  = 1           Mode = On           Gcchange = -
Port-channel   = Po1        GC   = -           Pseudo port-channel = Po1
Port index     = 0           Load  = 0x00        Protocol = -
```

Age of the port in the current state: 0d:00h:04m:13s

Port: Gi1/0/20

-----

```
Port state      = Up Mstr In-Bndl
Channel group  = 1           Mode = On           Gcchange = -
Port-channel   = Po1        GC   = -           Pseudo port-channel = Po1
Port index     = 0           Load  = 0x00        Protocol = -
```

Age of the port in the current state: 0d:00h:04m:12s

Port: Gi1/0/21

-----

```
Port state      = Up Mstr In-Bndl
Channel group  = 1           Mode = On           Gcchange = -
Port-channel   = Po1        GC   = -           Pseudo port-channel = Po1
Port index     = 0           Load  = 0x00        Protocol = -
```

Age of the port in the current state: 0d:00h:04m:14s

Port: Gi1/0/22

-----

```
Port state      = Up Mstr In-Bndl
Channel group  = 1           Mode = On           Gcchange = -
Port-channel   = Po1        GC   = -           Pseudo port-channel = Po1
Port index     = 0           Load  = 0x00        Protocol = -
```

Age of the port in the current state: 0d:00h:04m:13s

Port-channels in the group:

-----

Port-channel: Po1

-----

```
Age of the Port-channel = 0d:00h:04m:17s
Logical slot/port      = 10/1           Number of ports = 4
GC                     = 0x00000000    HotStandBy port = null
Port state             = Port-channel Ag-Inuse
Protocol               = -
Port security          = Disabled
```

Ports in the Port-channel:

Index	Load	Port	EC state	No of bits
0	00	Gi1/0/19	On	0
0	00	Gi1/0/20	On	0
0	00	Gi1/0/21	On	0
0	00	Gi1/0/22	On	0

Time since last port bundled: 0d:00h:04m:14s Gi1/0/22  
(We have truncated the similar display for the other port members of the channel)

### Checking the Static Trunk Status on D-Link Switch

#### Checking if ports if channel group and port mode are set correctly

##### Command Example

```
switch# show link_aggregation
Command: show link_aggregation

Link Aggregation Algorithm = IP-Source
Group ID      : 1
Type         : TRUNK
Master Port   : 19
Member Port   : 19-22
Active Port   : 19-22
Status       : Enabled
Flooding Port : 19
```

### LACP Configuration on Cisco Switch

#### If the switch is to play an active role in a LACP trunk.

	Command Example	Purpose
<b>Step 1</b>	Catalyst# config terminal Catalyst(config)# interface range gigabitEthernet 1/0/19-22 Catalyst(config-if)# channel-group 1 mode active	Creating channel group 1 with LACP-active mode

#### If the switch is to play a passive role in a LACP trunk.

	Command Example	Purpose
<b>Step 1</b>	Catalyst# config terminal Catalyst(config)# interface range gigabitEthernet 1/0/19-22 Catalyst(config-if)# channel-group 1 mode passive	Creating channel group 1 with LACP-passive mode

### LACP Configuration on D-Link Switch

#### If the switch is to play an active role in a LACP trunk.

	Command Example	Purpose
<b>Step 1</b>	switch# create link_aggregation group_id 1 type lacp switch# config link_aggregation group_id 1 master_port 19 ports 19-22 state enable switch# config lacp_port 19-22 mode active	Creating trunk group 1 with LACP-active mode

**If the switch is to play a passive role in a LACP trunk.**

	Command Example	Purpose
<b>Step 1</b>	<pre>switch# create link_aggregation group_id 1 type lacp switch# config link_aggregation group_id 1 master_port 19 ports 19-22 state enable switch# config lacp_port 19-22 mode passive</pre>	Creating trunk group 1 with LACP-passive mode

Note: By default, D-Link switches' LACP port mode is passive.

**Checking the LACP Configuration on Cisco Switch**

**Checking if ports of channel group and port mode are set correctly**

Command Example	
<pre>Catalyst# show interfaces etherchannel ---- GigabitEthernet1/0/19: Port state      = Up Sngl-port-Bndl Mstr Not-in-Bndl Channel group   = 1                Mode = <b>Active</b>          Gchange = - Port-channel    = null             GC      = -            Pseudo port-channel = Po1 Port index      = 0                Load   = 0x00         Protocol = LACP  Flags:  S - Device is sending Slow LACPDUs   F - Device is sending fast LACPDUs.         A - Device is in active mode.         P - Device is in passive mode.  Local information: Port      Flags  State  LACP port  Admin  Oper  Port  Port           SA   indep  Priority   Key    Key   Number State Gi1/0/19 SA   indep  32768     0x1    0x1   0x13  0x7D  Age of the port in the current state: 0d:00h:00m:51s  ---- GigabitEthernet1/0/20: Port state      = Up Sngl-port-Bndl Mstr Not-in-Bndl Channel group   = 1                Mode = <b>Active</b>          Gchange = - Port-channel    = null             GC      = -            Pseudo port-channel = Po1 Port index      = 0                Load   = 0x00         Protocol = LACP  Flags:  S - Device is sending Slow LACPDUs   F - Device is sending fast LACPDUs.         A - Device is in active mode.         P - Device is in passive mode.  Local information: Port      Flags  State  LACP port  Admin  Oper  Port  Port           SA   indep  Priority   Key    Key   Number State Gi1/0/20 SA   indep  32768     0x1    0x1   0x14  0x7D  Age of the port in the current state: 0d:00h:00m:51s  ---- GigabitEthernet1/0/21: Port state      = Up Sngl-port-Bndl Mstr Not-in-Bndl</pre>	

```
Channel group = 1          Mode = Active          Gchange = -
Port-channel   = null      GC   = -              Pseudo port-channel = Po1
Port index     = 0         Load = 0x00          Protocol = LACP
```

```
Flags: S - Device is sending Slow LACPDUs   F - Device is sending fast
LACPDUs.
       A - Device is in active mode.         P - Device is in passive mode.
```

Local information:

Port	Flags	State	LACP port Priority	Admin Key	Oper Key	Port Number	Port State
Gil/0/21	SA	indep	32768	0x1	0x1	0x15	0x7D

Age of the port in the current state: 0d:00h:00m:55s

----

GigabitEthernet1/0/22:

```
Port state      = Up Sngl-port-Bndl Mstr Not-in-Bndl
Channel group = 1          Mode = Active          Gchange = -
Port-channel   = null      GC   = -              Pseudo port-channel = Po1
Port index     = 0         Load = 0x00          Protocol = LACP
```

```
Flags: S - Device is sending Slow LACPDUs   F - Device is sending fast
LACPDUs.
       A - Device is in active mode.         P - Device is in passive mode.
```

Local information:

Port	Flags	State	LACP port Priority	Admin Key	Oper Key	Port Number	Port State
Gil/0/22	SA	indep	32768	0x1	0x1	0x16	0x7D

Age of the port in the current state: 0d:00h:00m:55s

----

Port-channel1:Port-channel1 (Primary aggregator)

```
Age of the Port-channel   = 0d:01h:42m:42s
Logical slot/port        = 10/1          Number of ports = 0
HotStandBy port = null
Port state                = Port-channel Ag-Not-Inuse
Protocol                  = LACP
Port security             = Disabled
```

```
Time since last port bundled: 0d:01h:42m:38s   Gil/0/22
Time since last port Un-bundled: 0d:00h:01m:19s  Gil/0/22
```

### ***Checking LACP Configuration on D-Link Switch***

Checking if ports of trunk group are set correctly

#### **Command Example**

```
switch# show link_aggregation
Command: show link_aggregation
```

```
Link Aggregation Algorithm = IP-Source
Group ID      : 1
Type         : LACP
Master Port   : 19
Member Port   : 19-22
Active Port   : 19-22
Status       : Enabled
Flooding Port : 21
```

```
Total Entries : 1
```

### Checking if port mode are set correctly

#### Command Example

```
switch# show lacp
Command: show lacp_port
```

Port	Activity
-----	-----
1	Passive
2	Passive
3	Passive
	⋮
19	<b>Passive</b>
20	<b>Passive</b>
21	<b>Passive</b>
22	<b>Passive</b>

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## Spanning Tree Configuration on Cisco Switch

	Command Example	Purpose
Step 1	Switch#config terminal Switch(config)#spanning-tree mode rapid-pvst	Enable STP and choose rapid-pvst mode.
Step 2	Switch(config)#spanning-tree vlan 1 priority 4096	Change priority to 4096

## Spanning Tree Configuration on D-Link Switch

	Command Example	Purpose
Step 1	DGS-3627:admin#enable stp DGS-3627:admin#config stp version rstp	Enable RSTP and choose RSTP
Step 2	DGS-3627:admin#config stp ports 1-22 edge true DGS-3627:admin#config stp ports 23-24 p2p true	Assumed ports 1-22 connecting to PCs or end terminal device. It should be set edge ports. Port 23-24 both connect to switch, it should be set p2p ports.

## Checking RSTP mode and ports status on Cisco Switch

Command Example						
Switch#show span vlan 1						
VLAN0001						
Spanning tree enabled protocol <b>rstp</b>						
Root ID	Priority	<b>4097</b>				
	Address	<b>0021.56b0.5c00</b>				
This bridge is the root						
	Hello Time	2 sec	Max Age	20 sec	Forward Delay	15 sec
Bridge ID	Priority	4097	(priority 4096 sys-id-ext 1)			
	Address	0021.56b0.5c00				
	Hello Time	2 sec	Max Age	20 sec	Forward Delay	15 sec
	Aging Time	300				
Interface	Role	Sts	Cost	Prio.Nbr	Type	
-----						
--						
Gi1/0/23	<b>Desg</b>	<b>FWD</b>	4	128.23	<b>P2p</b>	
Gi1/0/24	<b>Desg</b>	<b>FWD</b>	4	128.24	<b>P2p</b>	

## Checking STP detail information

Command Example
Switch#show spanning-tree detail

```

VLAN0001 is executing the rstp compatible Spanning Tree protocol
  Bridge Identifier has priority 4096, sysid 1, address 0021.56b0.5c00
  Configured hello time 2, max age 20, forward delay 15, transmit hold-count 6
  We are the root of the spanning tree
  Topology change flag not set, detected flag not set
  Number of topology changes 4 last change occurred 00:25:48 ago
    from GigabitEthernet1/0/23
  Times: hold 1, topology change 35, notification 2
    hello 2, max age 20, forward delay 15
  Timers: hello 0, topology change 0, notification 0, aging 300

Port 23 (GigabitEthernet1/0/23) of VLAN0001 is designated forwarding
  Port path cost 4, Port priority 128, Port Identifier 128.23.
  Designated root has priority 4097, address 0021.56b0.5c00
  Designated bridge has priority 4097, address 0021.56b0.5c00
  Designated port id is 128.23, designated path cost 0
  Timers: message age 0, forward delay 0, hold 0
  Number of transitions to forwarding state: 2
  Link type is point-to-point by default
  BPDU: sent 839, received 22

Port 24 (GigabitEthernet1/0/24) of VLAN0001 is designated forwarding
  Port path cost 4, Port priority 128, Port Identifier 128.24.
  Designated root has priority 4097, address 0021.56b0.5c00
  Designated bridge has priority 4097, address 0021.56b0.5c00
  Designated port id is 128.24, designated path cost 0
  Timers: message age 0, forward delay 0, hold 0
  Number of transitions to forwarding state: 1
  Link type is point-to-point by default
  BPDU: sent 779, received 65

```

### ***Checking RSTP mode and ports status on D-Link Switch***

#### **Checking if spanning mode is RSTP and STP is enabled**

##### **Command Example**

```

DGS-3627:admin#show stp
Command: show stp

```

```

STP Bridge Global Settings
-----
STP Status           : Enabled
STP Version          : RSTP
Max Age              : 20
Hello Time           : 2
Forward Delay        : 15
Max Hops             : 20
TX Hold Count        : 6
Forwarding BPDU      : Disabled
Loopback Detection   : Enabled
LBD Recover Time     : 60
NNI BPDU Address     : dot1ad

```

## Checking Root Bridge is correct

### Command Example

```
DGS-3627:admin#show stp instance 0
Command: show stp instance 0
```

#### STP Instance Settings

```
-----
Instance Type      : CIST
Instance Status    : Enabled
Instance Priority   : 32768(Bridge Priority : 32768, SYS ID Ext : 0 )
```

#### STP Instance Operational Status

```
-----
Designated Root Bridge : 4097 /00-21-56-B0-5C-00
External Root Cost     : 20000
Regional Root Bridge   : 32768/00-19-5B-12-43-00
Internal Root Cost     : 0
Designated Bridge      : 4097 /00-21-56-B0-5C-00
Root Port              : 23
Max Age                : 20
Forward Delay          : 15
Last Topology Change   : 978
Topology Changes Count : 5
```

## Checking Root Interface is correct

### Command Example

```
DGS-3627:admin#show stp ports 23
Command: show stp ports 23
```

#### MSTP Port Information

```
-----
Port Index      : 23      , Hello Time: 2 /2 , Port STP : Enabled , LBD : No
External PathCost : Auto/20000 , Edge Port : False/No , P2P : True /Yes
Port RestrictedRole : False, Port RestrictedTCN : False
Port Forward BPDU : Disabled
```

MSTI	Designated Bridge	Internal PathCost	Prio	Status	Role
0	1001/002156B05C00	20000	128	Forwarding	Root

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## Multiple Spanning Configuration on Cisco Switch

	Command Example	Purpose
<b>Step 1</b>	Switch#config terminal Switch(config)#vlan 10,20,30	Create VLAN 10,20
<b>Step 2</b>	Switch(config)#interface range gigabitEthernet 1/0/1-8 Switch(config-if-range)#switchport access vlan 10 Switch(config-if-range)#interface range gigabitEthernet 1/0/9-16 Switch(config-if-range)#switchport access vlan 20	Assign interfaces 0/1/0-8 to VLAN 10 and assign interfaces 0/1/9-16 to VALN 20
<b>Step 3</b>	Switch(config)#interface range gigabitEthernet 1/0/23-24 Switch(config-if-range)#switchport mode trunk Switch(config-if-range)#switchport trunk allowed vlan 1,10,20 Switch(config-if-range)#switchport trunk encapsulation dot1q	Set interface 0/1/23-24 to be trunk interfaces.
<b>Step 4</b>	Switch(config)#interface vlan 10 Switch(config-if)#ip address 192.168.10.1 255.255.255.0 Switch(config)#interface vlan 20 Switch(config-if)#ip address 192.168.20.1 255.255.255.0	Create two IP interface on VLAN 10, 20
<b>Step 5</b>	Switch(config)#spanning-tree mode mst Switch(config)#spanning-tree mst configuration Switch(config-mst)#name test Switch(config-mst)#revision 1 Switch(config-mst)#instance 1 vlan 10 Switch(config-mst)#instance 2 vlan 20	Setup Multiple Spanning Tree Name/revision/instance and VLAN mapping should be the same on all switches.
<b>Step 6</b>	Switch(config)#spanning-tree mst 1 priority 4096 Switch(config)#spanning-tree mst 2 priority 4096 Switch(config)#spanning-tree mst 3 priority 4096	Set Cisco switch to be root switch

## Multiple Spanning Configuration on D-Link Switch

	Command Example	Purpose
<b>Step 1</b>	DGS-3627:admin#create vlan 10 tag 10 DGS-3627:admin#create vlan 20 tag 20 DGS-3627:admin#config vlan default delete 1-16 DGS-3627:admin#config vlan 10 add untagged 1-8 DGS-3627:admin#config vlan 10 add tagged 23-24 DGS-3627:admin#config vlan 20 add untagged 9-16 DGS-3627:admin#config vlan 20 add tagged 23-24	Create VLAN 10,20 and port assignment
<b>Step 2</b>	DGS-3627:admin#create ipif 10 192.168.10.2/24 10 DGS-3627:admin#create ipif 20 192.168.20.2/24 20	Create two IP interface on VLAN 10,20

<b>Step 3</b>	<pre>DGS-3627:admin#config stp mst_config_id name test DGS-3627:admin#config stp mst_config_id revision_level 1 DGS-3627:admin#config stp version mstp DGS-3627:admin#create stp instance_id 1 DGS-3627:admin#create stp instance_id 2 DGS-3627:admin#config stp instance_id 1 add_vlan 10 DGS-3627:admin#config stp instance_id 2 add_vlan 20 DGS-3627:admin#enable stp</pre>	<p>Setup Multiple Spanning Tree Name/revision/instance and VLAN mapping should be the same on all switches.</p>
---------------	--	---

### ***Checking MSTP mode and ports status on Cisco Switch***

#### **Checking if instance and VLAN mapping information**

##### **Command Example**

```
Switch(config-mst)#show pending
Pending MST configuration
Name      [test]
Revision  1      Instances configured 3

Instance  Vlans mapped
-----
0         1-9,11-19,21-4094
1         10
2         20
```

```
Switch#show spanning-tree mst configuration
Name      [test]
Revision  1      Instances configured 3

Instance  Vlans mapped
-----
0         1-9,11-19,21-4094
1         10
2         20
```

#### **Checking STP detail information**

##### **Command Example**

```
Switch#show spanning-tree detail

VLAN0001 is executing the rstp compatible Spanning Tree protocol
Bridge Identifier has priority 4096, sysid 1, address 0021.56b0.5c00
Configured hello time 2, max age 20, forward delay 15, transmit hold-count 6
We are the root of the spanning tree
Topology change flag not set, detected flag not set
Number of topology changes 4 last change occurred 00:25:48 ago
      from GigabitEthernet1/0/23
Times:  hold 1, topology change 35, notification 2
        hello 2, max age 20, forward delay 15
```

```
Timers: hello 0, topology change 0, notification 0, aging 300
```

```
Port 23 (GigabitEthernet1/0/23) of VLAN0001 is designated forwarding
Port path cost 4, Port priority 128, Port Identifier 128.23.
Designated root has priority 4097, address 0021.56b0.5c00
Designated bridge has priority 4097, address 0021.56b0.5c00
Designated port id is 128.23, designated path cost 0
Timers: message age 0, forward delay 0, hold 0
Number of transitions to forwarding state: 2
Link type is point-to-point by default
BPDU: sent 839, received 22
```

```
Port 24 (GigabitEthernet1/0/24) of VLAN0001 is designated forwarding
Port path cost 4, Port priority 128, Port Identifier 128.24.
Designated root has priority 4097, address 0021.56b0.5c00
Designated bridge has priority 4097, address 0021.56b0.5c00
Designated port id is 128.24, designated path cost 0
Timers: message age 0, forward delay 0, hold 0
Number of transitions to forwarding state: 1
Link type is point-to-point by default
BPDU: sent 779, received 65
```

## Checking STP detail Status

### Command Example

```
Switch#show spanning-tree
```

```
MST0
```

```
Spanning tree enabled protocol mstp
Root ID      Priority      4096
             Address      0021.56b0.5c00
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

Bridge ID    Priority      4096  (priority 4096 sys-id-ext 0)
             Address      0021.56b0.5c00
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
```

Interface	Role	Sts	Cost	Prio.Nbr	Type
-----					
--					
Gil/0/1	Desg	FWD	200000	128.1	P2p Edge
Gil/0/9	Desg	FWD	200000	128.9	P2p Edge
Gil/0/23	Desg	FWD	20000	128.23	P2p
Gil/0/24	Desg	FWD	20000	128.24	P2p

```
MST1
```

```
Spanning tree enabled protocol mstp
Root ID      Priority      4097
             Address      0021.56b0.5c00
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
```

```

Bridge ID Priority      4097  (priority 4096 sys-id-ext 1)
Address    0021.56b0.5c00
Hello Time 2 sec Max Age 20 sec Forward Delay 15 sec

Interface          Role Sts Cost      Prio.Nbr Type
-----
--
Gil/0/1            Desg FWD 200000   128.1    P2p Edge
Gil/0/23           Desg FWD 20000   128.23   P2p
Gil/0/24           Desg FWD 20000   128.24   P2p

MST2
Spanning tree enabled protocol mstp
Root ID      Priority      4098
Address      0021.56b0.5c00
This bridge is the root
Hello Time   2 sec Max Age 20 sec Forward Delay 15 sec

Bridge ID    Priority      4098  (priority 4096 sys-id-ext 2)
Address      0021.56b0.5c00
Hello Time   2 sec Max Age 20 sec Forward Delay 15 sec

Interface          Role Sts Cost      Prio.Nbr Type
-----
--
Gil/0/9            Desg FWD 200000   128.9    P2p Edge
Gil/0/23           Desg FWD 20000   128.23   P2p
Gil/0/24           Desg FWD 20000   128.24   P2p

```

## Checking MST protocol information

### Command Example

```

Switch#show spanning-tree mst

##### MST0      vlans mapped: 1-9,11-19,21-4094
Bridge          address 0021.56b0.5c00 priority      4096  (4096 sysid 0)
Root            this switch for the CIST
Operational     hello time 2 , forward delay 15, max age 20, txholdcount 6
Configured      hello time 2 , forward delay 15, max age 20, max hops 20

Interface          Role Sts Cost      Prio.Nbr Type
-----
Gil/0/1            Desg FWD 200000   128.1    P2p Edge
Gil/0/9            Desg FWD 200000   128.9    P2p Edge
Gil/0/23           Desg FWD 20000   128.23   P2p
Gil/0/24           Desg FWD 20000   128.24   P2p

##### MST1      vlans mapped: 10
Bridge          address 0021.56b0.5c00 priority      4097  (4096 sysid 1)
Root            this switch for MST1

Interface          Role Sts Cost      Prio.Nbr Type
-----

```

```

Gi1/0/1      Desg FWD 200000    128.1    P2p Edge
Gi1/0/23     Desg FWD 20000     128.23   P2p
Gi1/0/24     Desg FWD 20000     128.24   P2p

##### MST2    vlans mapped:    20
Bridge       address 0021.56b0.5c00  priority    4098  (4096 sysid 2)
Root         this switch for MST2

Interface      Role Sts Cost      Prio.Nbr Type
-----
Gi1/0/9        Desg FWD 200000    128.9    P2p Edge
Gi1/0/23       Desg FWD 20000     128.23   P2p
Gi1/0/24       Desg FWD 20000     128.24   P2p

```

### ***Checking RSTP mode and ports status on D-Link Switch***

#### **Checking if spanning mode is MSTP and STP is enabled**

##### **Command Example**

```

DGS-3627:admin#show stp
Command: show stp

```

```

STP Bridge Global Settings
-----

```

```

STP Status      : Enabled
STP Version     : MSTP
Max Age         : 20
Forward Delay   : 15
Max Hops        : 20
TX Hold Count   : 6
Forwarding BPDU : Disabled
Loopback Detection : Enabled
LBD Recover Time : 60
NNI BPDU Address : dot1ad

```

#### **Checking if spanning instance information**

##### **Command Example**

```

DGS-3627:admin#show stp instance 0
Command: show stp instance 0

```

```

STP Instance Settings
-----

```

```

Instance Type      : CIST
Instance Status    : Enabled
Instance Priority   : 32768(Bridge Priority : 32768, SYS ID Ext : 0 )

```

```

STP Instance Operational Status
-----

```

```

Designated Root Bridge : 32768/00-19-5B-12-43-00
External Root Cost     : 0
Regional Root Bridge   : 32768/00-19-5B-12-43-00
Internal Root Cost     : 0

```

```
Designated Bridge      : 32768/00-19-5B-12-43-00
Root Port              : None
Max Age                : 20
Forward Delay          : 15
Last Topology Change   : 74717
Topology Changes Count : 22
```

## Checking instance and VALN mapping

### Command Example

```
DGS-3627:admin#show stp mst_config_id
Command: show stp mst_config_id
```

```
Current MST Configuration Identification
```

```
-----
Configuration Name : test                               Revision Level :1
MSTI ID      Vid list
-----
CIST         1-9,11-19,21-4094
  1          10
  2          20
```

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