

VLAN INTEROPERABILITY OF THE DELL™ POWERCONNECT™ M6220

WITH CISCO IOS OR CISCO CATOS BASED SWITCHES

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INTRODUCTION

This paper describes how to configure the Dell PowerConnect M6220 Gigabit Ethernet switch to interoperate and connect with Cisco IOS and CatOS-based switches when using industry standard Virtual Local Area Networks (VLANs) that adhere to the IEEE 802.1Q standard. This paper discusses both static and dynamic VLANs.

The primary purpose of VLANs is to separate traffic on a network. This separation is accomplished by adding a VLAN tag to each Ethernet frame and by using switches that can recognize these tags to keep the traffic with the same tags on the necessary network segments. Using VLANs conserves network bandwidth by limiting broadcast traffic to a specified VLAN and provides a more secure network by limiting traffic across multiple VLANs.

The IEEE 802.1Q standard-based VLAN implementation on the PowerConnect M6220 is interoperable with Cisco VLANs using both static and dynamic configuration (dynamic via GVRP). Dell is a member of the University of New Hampshire Interoperability Lab (UNH-IOL), where all PowerConnect products are tested to confirm interoperability with other Consortium members' network devices. Included in the UNH-IOL tests is VLAN interoperability with other Consortium members. Additional information regarding UNH's VLAN testing can be found at:

<ftp://ftp.iol.unh.edu/pub/bfc/testsuites/vlan.io.test.suite.pdf>

VLANs can be configured as either dynamic or static. Dynamic configuration is supported using the IEEE 802.1Q standard, which is known as GARP VLAN Registration Protocol (GVRP). Static configuration is used when connecting the Dell PowerConnect M6220 Gigabit Ethernet switch to an external Gigabit Ethernet switch or a NIC that does not support GVRP. One advantage of GVRP is that the protocol enables the Gigabit Ethernet switches in the network to automatically add and remove ports from VLANs, thus minimizing network administration.

The following examples use the switch's Command Line Interface (CLI) for configuration. See the *Dell™ PowerConnect™ M6220 CLI Reference Guide* for more detailed information about the commands. The "VLAN Commands" chapter contains information about configuring VLANs by using the CLI.

If desired, any of the example configurations can be performed on the Dell PowerConnect M6220 by using the Web Based Interface (WBI) as well. See the *Dell PowerConnect M6220 User's Guide* for a description of the Dell WBI. For information about configuring VLANs by using the WBI, see the "Configuring VLANs" section in the "Configuring Switching Information" chapter.

The *Dell™ PowerConnect™ M6220 CLI Reference Guide* and the *Dell PowerConnect M6220 User's Guide* are located on the Dell support website:

<http://support.dell.com/support/edocs/network/PCM6220/en/index.htm>

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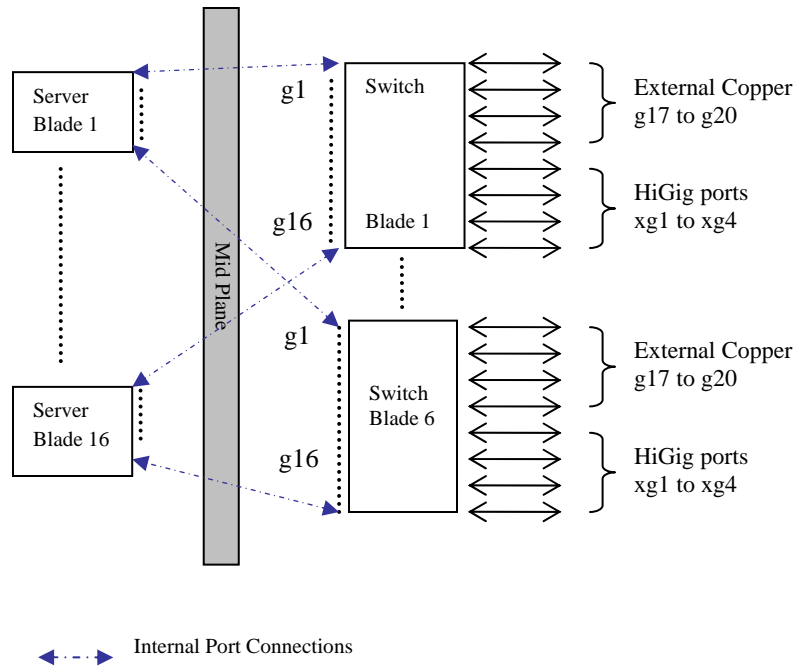


Figure 1: Dell PowerConnect M6220 Networking Architecture

NETWORK ARCHITECTURE OF THE DELL MODULAR SERVER ENCLOSURE

The internal network architecture of the Dell Modular Server Enclosure is shown in Figure 1. Each server blade has two LAN on Motherboard (LOM) Ethernet controllers integrated into its motherboard. Each server blade's LOM is connected through the chassis midplane to the chassis I/O bays in the rear. Each Ethernet switch has sixteen internal ports (one to each server blade, numbered g1-g16) and four external 1G ports (numbered g17-g20) and four optional 10G ports (numbered xg1-xg4).

CLEARING THE CONFIGURATION FOR THE DELL POWERCONNECT M6220 AND CISCO SWITCHES

The examples in this document show the minimum configurations necessary to configure VLANs between a Cisco IOS Gigabit Ethernet switch (Catalyst 3750), Cisco CatOS Ethernet switch (Catalyst 6509), and the Dell PowerConnect M6220. The commands in this example work without issue when starting from a default configuration of the switches.

To set the Dell PowerConnect M6220 to default configuration and reboot, use the following commands:

NOTE: This will erase any configuration data previously configured and reboot the switch.

```
M6220# clear config
M6220# reload
```

From the Web interface, click the **Restore Configuration Factory Default** option on the **System > File Management > Copy Files** page, and then click **Apply Changes**.

The screenshot shows a web interface titled 'System > File Management > Copy Files'. The main heading is 'Copy Files'. There are 'Print' and 'Refresh' buttons in the top right. Below the heading, there are three rows of configuration options, each with a radio button and a label:

- Copy Master Firmware: Destination is set to 'All'.
- Copy Configuration: Source is set to 'Running Configuration' and Destination is set to 'Startup Configuration'.
- Restore Configuration Factory Default: This option is selected with a green radio button.

An 'Apply Changes' button is located at the bottom center of the interface.

To set a Cisco IOS based switch to default configuration, use the following commands:

NOTE: This will erase any configuration data previously configured and reboot the switch.

```
3750# delete flash:/config.text  
3750# reload
```

To set a Cisco CatOS based switch (e.g. Catalyst 6509) to default configuration, use the following commands:

NOTE: This will erase any configuration data previously configured and reboot the switch.

```
Cat_6509 (enable) clear config all
```

Please see other sections of this paper for cases when it is impractical to reset the switches to factory defaults.

The Dell PowerConnect M6220 can support up to 1024 different VLANs. VLAN ID can be any value between 2-4093 (The default VLAN ID is 1). A VLAN tag can have a value from 2 to 4093.

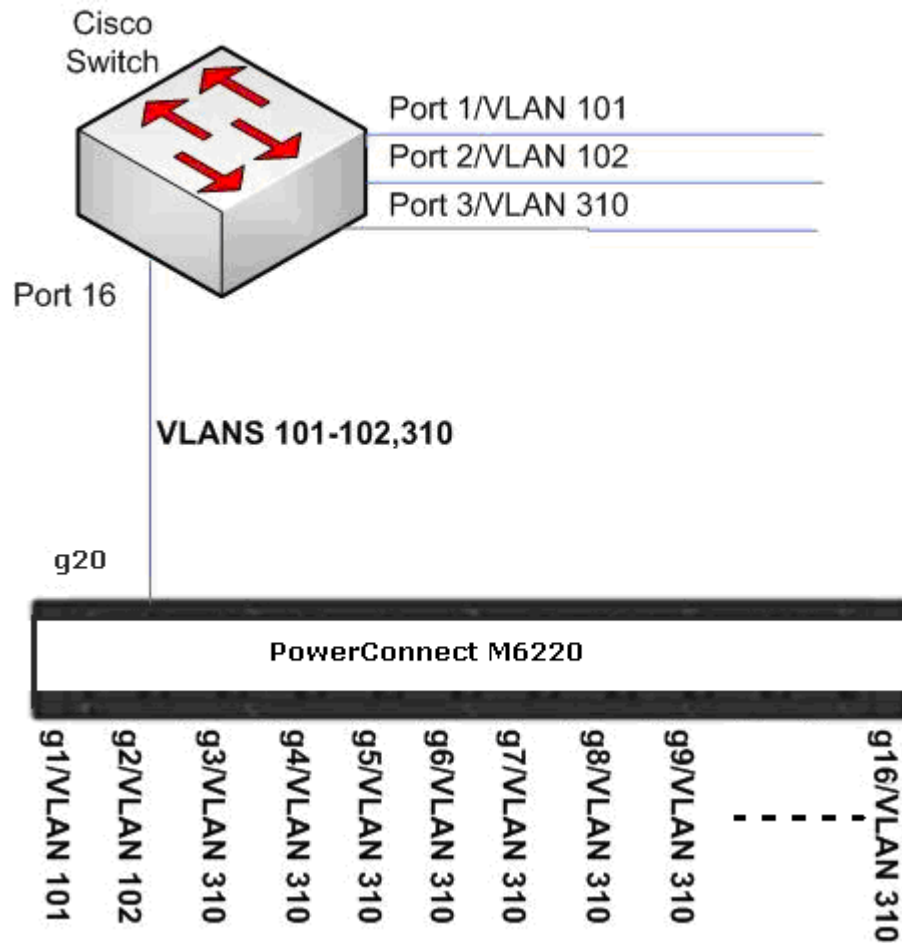


Figure 2: VLAN Example (Used for Static and GVRP Examples)

CONFIGURING THE M6220 PORTS FOR STATIC VLANS

The network scenario in Figure 2 will be used to show how to configure static VLANs (Figure 2 will also be used for the GVRP examples later in this paper). This example will show how to perform the following tasks:

- Put the server blade connected to port g1 in VLAN 101
- Put the server blade connected to port g2 in VLAN 102
- Put server blades connected to ports g3 through g16 in VLAN 310
- “Trunk” these VLANs to a Cisco IOS and a Cisco CatOS switch using static VLANs

Port g20 is used as the trunk port in the examples, but this is an arbitrary choice. Any ports from g17 to g20 could be used for this example.

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CONFIGURING THE M6220 EXTERNAL PORTS FOR STATIC VLANS

The following example shows the Dell PowerConnect M6220 Gigabit Ethernet switch CLI commands for configuring the 16 internal ports and external port g20 as shown in Figure 2.

```
M6220>enable
M6220#configure
M6220(config)#vlan database
M6220(config-vlan)#vlan 101,102,310
M6220(config-vlan)#exit

M6220(config)#interface ethernet 1/g1
M6220(config-if-1/g1)#switchport access vlan 101
M6220(config-if-1/g1)#exit
M6220(config)#interface ethernet 1/g2
M6220(config-if-1/g2)#switchport access vlan 102
M6220(config-if-1/g2)#exit

M6220(config)#interface range Ethernet 1/g3-1/g16
M6220(config-if)#switchport access vlan 310
M6220(config-if)#exit

M6220(config)#interface ethernet 1/g20
M6220(config-if-1/g20)#switchport mode general
M6220(config-if-1/g20)#switchport general allowed vlan add 101,102,310
tagged
M6220(config-if-1/g20)#switchport general pvid 4095
M6220(config-if-1/g20)#switchport general allowed vlan remove 1
M6220(config-if-1/g20)#exit
```

The following table describes the commands used in the previous example.

Command	Description
enable	Set the CLI mode to enable privilege mode
configure	Sets the CLI mode to configuration mode
vlan database	Sets the CLI mode to define the static VLANs
vlan 101,102,310	Defines the static VLANs that are used in this example
exit	Puts the CLI back into the configuration CLI mode
interface ethernet 1/g1	Sets the CLI mode to configure gigabit ethernet port 1 (referred to in the command as '1/g1') NOTE: Value '1' in "1/g1 and 1/g8" specifies the unit number, this number depends on the Stack unit number and can be between 1 to 12
switchport access vlan 101	Sets the port to an access VLAN port in VLAN 101. This means that the Ethernet traffic on this port will be untagged and all the traffic will be in VLAN 101
exit	Puts the CLI back into the configuration CLI mode
interface ethernet 1/g2	Sets the CLI mode to configure gigabit ethernet port 2 (referred to in the command as '1/g2')
switchport access vlan 102	Sets the port to an access VLAN port in VLAN 102

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Command	Description
<code>exit</code>	Puts the CLI back into the configuration CLI mode
<code>interface range ethernet 1/g3-1/g16</code>	Sets the CLI mode to configure gigabit Ethernet ports 3 through 16 (referred to in the command as '1/g3-1/g16')
<code>switchport access vlan 310</code>	Sets ports 1/g3 through 1/g16 to access ports in VLAN 310
<code>exit</code>	Puts the CLI back into the configuration CLI mode
<code>interface ethernet 1/g20</code>	Sets the CLI mode to configure gigabit Ethernet port 20 (referred to in the command as '1/g20')
<code>switchport mode general</code>	Sets the port type to an 802.1Q VLAN. An 802.1Q VLAN port will allow multiple tagged VLANs
<code>switchport general allowed vlan add 101,102,310 tagged</code>	Sets the port to allow only tagged traffic in VLANs 101, 102, and 310. Traffic with tags other than 101, 102, or 310 will be dropped
<code>switchport general pvid 4095</code>	Sets the port to put any untagged packets entering the port into VLAN 4095 (4095 is the discard VLAN. Setting the PVID to 4095 means that untagged packets are not allowed on this port)
<code>switchport general allowed vlan remove 1</code>	Used to remove the port membership from VLAN '1'. By default all the ports on the switch are members of VLAN '1'
<code>exit</code>	Puts the CLI back into the configuration CLI mode

NOTE: In this example, traffic from the server blades is untagged and put in a specific VLAN at the switch. The combined traffic from the server blades is then put on the single external trunked port as tagged traffic. The VLAN tags keep the traffic logically separated. When tagged traffic enters the external trunked port, the switch examines the tag, removes the tag and sends the traffic to the destination server blade.

To configure the external ports for static VLANs by using the Web interface, use the following steps.

1. From the **Switching > VLAN > VLAN Membership** page, click **Add**.

Switching > VLAN > VLAN Membership

VLAN Membership

Print Refresh

Add

Show VLAN 1 Default

VLAN Name (0-32 characters) Default

Status Default

Unauthenticated Users Disable

Remove VLAN

Unit	Port																								XG1XG2XG3XG4			
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
Static	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Current	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

Port

25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Static	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Current	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

Lags

2. From the **Add VLAN** page, enter 101 in the **VLAN ID** field and click **Apply Changes**.

Switching > VLAN > Add VLAN

Add VLAN

Print Refresh

VLAN ID (2 - 4093) 101

VLAN Name (0-32 characters)

Apply Changes Back

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3. Add VLANs 102 and 310.
4. From **Ports** menu on the **Switching > VLAN > Port Settings** page, select port g20.
5. Configure port g20 in General mode with a PVID of 4095 and click **Apply Changes**.

Switching > VLAN > Port Settings

Port Settings

Print Refresh

[Show All](#)

Ports	Unit 1 Port g20
Port VLAN Mode	General
PVID (1 - 4093) 4095	4095
Frame Type	Admit All
Ingress Filtering	Enable
Port Priority (0 - 7)	0

Apply Changes

6. From the **Show VLAN** menu on the **Switching > VLAN > VLAN Membership** page, select 101.
7. Click the **Static** box for port 1 so that the letter *U* (untagged) appears in the box.
8. Click the **Static** box for port 20 so that the letter *T* (tagged) appears in the box.
9. Click **Apply Changes**.

Switching > VLAN > VLAN Membership

VLAN Membership

Print Refresh

[Add](#)

Show VLAN	<input checked="" type="radio"/> 101 <input type="radio"/> Default
VLAN Name (0-32 characters)	
Status	Static
Unauthenticated Users	Disable

Remove VLAN

	Unit 1																								XG1XG2XG3XG4			
	Port																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
Static	U																			T								
Current	U																			T								

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10. Select VLAN 102 and assign port 2 to the VLAN as an untagged interface and port 20 as a tagged interface.
11. Select VLAN 310, and assign ports 3-16 to the VLAN as untagged interfaces and port 20 as a tagged interface.

Switching > VLAN > VLAN Membership

VLAN Membership

Print Refresh

Add

Show VLAN 310 Default

VLAN Name (0-32 characters)

Status Static

Unauthenticated Users Disable

Remove VLAN

Unit	Port																											
1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	XG1	XG2	XG3	XG4
Static			U	U	U	U	U	U	U	U	U	U	U	U	U	U				T								
Current																												

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12. Click **Apply Changes**.
13. Select VLAN 1, and click the Static field for port 20 until it is blank in order to remove interface 1/g20 from VLAN 1.
14. To view the VLAN Port Table, open the **Switching > VLAN > Port Settings** page, and then click **Show All**.

Switching > VLAN > VLAN Port Table

VLAN Port Table Print Refresh

Unit

Port	Port VLAN Mode	PVID	Frame Type	Ingress Filtering	Port Priority	Edit	
1	1/g1	Access	1	Admit All	Enable	0	<input type="checkbox"/>
2	1/g2	Access	102	Admit All	Enable	0	<input type="checkbox"/>
3	1/g3	Access	310	Admit All	Enable	0	<input type="checkbox"/>
4	1/g4	Access	310	Admit All	Enable	0	<input type="checkbox"/>
5	1/g5	Access	310	Admit All	Enable	0	<input type="checkbox"/>
6	1/g6	Access	310	Admit All	Enable	0	<input type="checkbox"/>
7	1/g7	Access	310	Admit All	Enable	0	<input type="checkbox"/>
8	1/g8	Access	310	Admit All	Enable	0	<input type="checkbox"/>
9	1/g9	Access	310	Admit All	Enable	0	<input type="checkbox"/>
10	1/g10	Access	310	Admit All	Enable	0	<input type="checkbox"/>
11	1/g11	Access	310	Admit All	Enable	0	<input type="checkbox"/>
12	1/g12	Access	310	Admit All	Enable	0	<input type="checkbox"/>
13	1/g13	Access	310	Admit All	Enable	0	<input type="checkbox"/>
14	1/g14	Access	310	Admit All	Enable	0	<input type="checkbox"/>
15	1/g15	Access	310	Admit All	Enable	0	<input type="checkbox"/>
16	1/g16	Access	310	Admit All	Enable	0	<input type="checkbox"/>
17	1/g17	Access	1	Admit All	Enable	0	<input type="checkbox"/>
18	1/g18	Access	1	Admit All	Enable	0	<input type="checkbox"/>
19	1/g19	Access	1	Admit All	Enable	0	<input type="checkbox"/>
20	1/g20	General	4095	Admit All	Enable	0	<input type="checkbox"/>

CONFIGURING A CISCO IOS ETHERNET SWITCH FOR STATIC VLANS

The following example shows the Cisco IOS Ethernet switch command-line interface (CLI) commands for configuring its ports as shown in Figure 2.

```
3750(config)# vtp mode transparent

3750(config)# interface GigabitEthernet 1/0/1
3750(config-if)# switchport access vlan 101
3750(config-if)# exit

3750(config)# interface GigabitEthernet 1/0/2
3750(config-if)# switchport access vlan 102
3750(config-if)# exit
```

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```
3750(config)# interface GigabitEthernet 1/0/3
3750(config-if)# switchport access vlan 310
3750(config-if)# exit

3750(config)# interface GigabitEthernet 1/0/16
3750(config-if)# switchport mode trunk
3750(config-if)# switchport trunk allowed vlan 101-102,310
3750(config-if)# switchport trunk encapsulation dot1q
3750(config-if)# exit
```

The following table describes the commands used in the example:

Command	Description
<code>vtp mode transparent</code>	Sets the switch for static VLAN configuration. This command disables the VTP protocol. NOTE: Cisco switches have the Cisco proprietary VTP (VLAN trunking protocol) enabled by default. VTP performs the same function as the IEEE standard protocol GVRP. The PowerConnect M6220 does not support the Cisco proprietary VTP and can only work with ports using IEEE 802.1Q standard GVRP protocol. Some Cisco switches also support GVRP. GVRP is discussed later in this document
<code>interface GigabitEthernet 1/0/1</code>	Sets the CLI mode to configure gigabit Ethernet port 1 (referred to in the command as 'GigabitEthernet 1/0/1')
<code>switchport access vlan 101</code>	Sets the port to an access VLAN port in VLAN 101. This means that the Ethernet traffic on this port will be untagged and all the traffic will be in VLAN 101
<code>exit</code>	Puts the CLI back into the configuration CLI mode
<code>interface GigabitEthernet 1/0/2</code>	Sets the CLI mode to configure gigabit Ethernet port 2
<code>switchport access vlan 102</code>	Sets the port to an access VLAN port in VLAN 102
<code>exit</code>	Puts the CLI back into the configuration CLI mode
<code>interface GigabitEthernet 1/0/3</code>	Sets the CLI mode to configure gigabit Ethernet port 3
<code>switchport access vlan 310</code>	Sets the port to an access VLAN port in VLAN 310
<code>exit</code>	Puts the CLI back into the configuration CLI mode
<code>interface GigabitEthernet 1/0/16</code>	Sets the CLI mode to configure gigabit Ethernet port 16 (referred to in the command as 'GigabitEthernet 1/0/16')

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Command	Description
<code>switchport mode trunk</code>	Sets the port type to a VLAN trunk. A VLAN trunk port will allow multiple tagged VLANs
<code>switchport access vlan 102</code>	Puts the CLI back into the configuration CLI mode
<code>switchport trunk allowed vlan 101-102,310</code>	Sets the port to allow only tagged traffic in VLANs 101, 102, and 310
<code>switchport trunk encapsulation dot1q</code>	Sets the port to send and receive 802.1Q tagged traffic (not the Cisco proprietary ISL tagged traffic)
<code>exit</code>	Puts the CLI back into the configuration CLI mode

CONFIGURING A CISCO CATOS ETHERNET SWITCH FOR STATIC VLANS

The following example shows the Cisco CatOS Ethernet switch command-line interface (CLI) commands for configuring its ports as shown in Figure 2.

```
6509> (enable) set vtp mode transparent

6509> (enable) set vlan 101 2/1
6509> (enable) set vlan 102 2/2
6509> (enable) set vlan 310 2/3

6509> (enable) clear trunk 2/16 1-1005,1025-4094
6509> (enable) set trunk 2/16 on dot1q 101-102,310
```

The following table describes the commands used in the previous example:

Command	Description
<code>vtp mode transparent</code>	Sets the switch for static VLAN configuration. By default, Cisco switches have the Cisco proprietary VTP (VLAN trunking protocol) enabled by default. This command disables the VTP protocol
<code>set vlan 101 2/1</code>	Sets the port to an access VLAN port in VLAN 101. This means that the Ethernet traffic on this port will be untagged and all the traffic will be in VLAN 101
<code>set vlan 102 2/2</code>	Configures port 2/2 to be an access port in VLAN 102
<code>set vlan 310 2/3</code>	Configures port 2/3 to be an access port in VLAN 310

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Command	Description
clear trunk 2/16 1-1005, 1025-4094	Disables port 2/16 from carrying all VLANs. The default VLAN settings of Cisco CatOS are to allow all VLANs on trunked ports. This is a security concern. It is good network configuration practice to remove a port from all VLANs before adding it to the desired VLANs.
set trunk 2/16 on dot1q 101-102,310	Sets port 2/16 port type to a VLAN trunk (noted by 'trunk'), sets the port to send and receive 802.1Q tagged traffic (noted by 'on') and sets the port to allow only traffic in VLANs 101, 102, and 310. A VLAN trunk port will only allow tagged packets.

CONFIRMING A SUCCESSFUL STATIC VLAN CONFIGURATION
ON THE POWERCONNECT M6220

The following M6220 command can be used to confirm the VLAN configuration:

```
M6220#show interfaces switchport ethernet 1/g1
```

```
Port: 1/g1
VLAN Membership mode:Access Mode
```

```
Operating parameters:
PVID: 101
Ingress Filtering: Enabled
Acceptable Frame Type: Untagged
Default Priority: 0
GVRP status:Enabled
Protected:Disabled
```

Port 1/g1 is member in:

VLAN	Name	Egress rule	Type
101		Untagged	Static

Static configuration:

```
PVID: 101
Ingress Filtering: Enabled
Acceptable Frame Type: Untagged
```

Port 1/g1 is statically configured to:

VLAN	Name	Egress rule	Type
101		Untagged	

Forbidden VLANs:

```
VLAN Name
---- ----
```

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The output of this command shows that port g1 'VLAN Membership Mode' is 'Access' and that the 'Port is member in' VLAN 101.

The following is the output of this command for port g20 (the port with VLANs 101,102, 310):

```
M6220#show interfaces switchport ethernet 1/g20
```

```
Port: 1/g20
VLAN Membership mode:General Mode
```

```
Operating parameters:
PVID: 4095
Ingress Filtering: Enabled
Acceptable Frame Type: Admit All
Default Priority: 0
GVRP status:Disabled
Protected:Disabled
```

Port 1/g20 is member in:

VLAN	Name	Egress rule	Type
101		Tagged	Static
102		Tagged	Static
310		Tagged	Static

```
Static configuration:
PVID: 4095
Ingress Filtering: Enabled
Acceptable Frame Type: Admit All
```

Port 1/g20 is statically configured to:

VLAN	Name	Egress rule
101		Tagged
102		Tagged
310		Tagged

```
Forbidden VLANs:
VLAN Name
-----
```

The output of this command shows that port g20 'VLAN Membership mode' is 'General and that the 'Port is member in' VLANs 101, 102, and 310. Also notice that the 'Ingress UnTagged VLAN (PVID): VLAN is 4095. VLAN 4095 is the discard VLAN and this setting means that untagged packets entering this port are dropped.

CONFIRMING A SUCCESSFUL STATIC VLAN CONFIGURATION WITH CISCO IOS

The following Cisco IOS commands can be used to confirm the VLAN configuration:

```
3750# show interfaces gigabitEthernet 1/0/1 switchport
Name: Gi1/0/1
Switchport: Enabled
Administrative Mode: dynamic auto
Operational Mode: static access
Administrative Trunking Encapsulation: negotiate
Operational Trunking Encapsulation: native
Negotiation of Trunking: On
Access Mode VLAN: 101 (VLAN0101)
. . .
```


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The output of this command shows that port 1/0/1 (Name: Gi1/0/1) is in 'Operations Mode: static access' and that is in 'Access mode VLAN: 101 (VLAN0101)'.

The following is the output of this command for port 1/0/16 (the port with VLANs 101,102, 310):

```
3750# show interfaces gigabitEthernet 1/0/16 switchport
Name: Gi1/0/16
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)
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 encapsulation: dot1q
Administrative private-vlan trunk normal VLANs: none
Administrative private-vlan trunk private VLANs: none
Operational private-vlan: none
Trunking VLANs Enabled: 101,102,310
. . .
```

The output of this command shows that port 1/0/16 (Name: Gi1/0/16) is in 'Operational Mode: trunk' and that the 'Trunking VLANs Enabled': are 101, 102, and 310. In Cisco IOS when a port is in VLAN trunk mode, all untagged packets are dropped unless the 'Trunking Native Mode VLAN' is also included as one of the 'Trunking VLANs'. In this example the 'Trunking Native Mode VLAN' is VLAN 1 but since VLAN 1 was not included in the trunk (via the `switchport trunk allowed vlan` command), all untagged traffic entering this port is dropped.

CONFIRMING A SUCCESSFUL STATIC VLAN CONFIGURATION WITH CISCO CATOS

The following CatOS commands can be used to confirm the VLAN configuration:

```
6509> (enable) show vlan
VLAN   Name                Status      IfIndex  Mod/Ports,Vlans
-----
1      default             active      6        1/1-2
                                           2/4-15,2/17-48
                                           3/1-8
                                           4/1-48
101    VLAN0101            active      116     2/1
102    VLAN0102            active      117     2/2
310    VLAN0310            active      121     2/3
1002   fddi-default        active      7
1003   token-ring-default active      10
1004   fddinet-default    active      8
1005   trnet-default      active      9
. . .
```

The output of this command shows that VLAN 101 has port 2/1 as a member port, VLAN 102 has port 2/2 as a member port, and VLAN 310 has port 2/3 as a member port.

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The following command can be used for port 2/16 (the port with VLANs 101,102, 310):

```
6509> (enable) show trunk
* - indicates vtp domain mismatch
# - indicates dot1q-all-tagged enabled on the port
Port      Mode      Encapsulation      Status      Native vlan
-----
2/16      on        dot1q                trunking    1

Port      Vlans allowed on trunk
-----
2/16      101-102,310

. . .
```

The output of this command shows that port 2/16 has an 'Encapsulation' of 'dot1q', the 'Status' is 'trunking' and that the 'VLANs allowed on the trunk' are 101, 102, and 310. In Cisco CatOS when a port is in VLAN trunk mode, all untagged packets are dropped unless the 'Native VLAN' is also included as one of the 'VLANs allowed on trunk'. In this example the 'Native VLAN' is VLAN 1 but since VLAN 1 was not included in the trunk all untagged traffic entering this port is dropped.

CONFIGURING THE M6220 EXTERNAL PORTS FOR DYNAMIC VLANS USING GVRP

NOTE: The following example assumes starting from an empty configuration.

The following example shows the Dell PowerConnect M6220 Gigabit Ethernet switch command-line interface (CLI) commands for configuring the Gigabit Ethernet switch with GVRP to match the example in Figure 2.

```
M6220(config)# vlan database
M6220(config-vlan)# vlan 101-102,310
M6220(config)# exit
M6220(config)# interface ethernet 1/g1
M6220(config-if-1/g1)# switchport access vlan 101
M6220(config-if-1/g1)# gvrp enable
M6220(config-if-1/g1)# exit
M6220(config)# interface ethernet 1/g2
M6220(config-if-1/g2)# switchport access vlan 102
M6220(config-if-1/g2)# gvrp enable
M6220(config-if-1/g2)# exit
M6220(config)# interface range ethernet 1/g3-1/g16
M6220(config-if)# switchport access vlan 310
M6220(config-if)# gvrp enable
M6220(config-if)# exit

M6220(config)# interface ethernet 1/g20
M6220(config-if-1/g20)# switchport mode general
M6220(config-if-1/g20)# switchport general pvid 4095
M6220(config-if-1/g20)# switchport general allowed vlan remove 1
M6220(config-if-1/g20)# gvrp enable

M6220(config-if-1/g20)# exit

M6220(config)# gvrp enable
```

The only addition is the `gvrp enable` command for each port. For the access ports (g1, g2, g3-10) the `gvrp enable` command configures each port to be advertised by GVRP on any ports that have GVRP enabled. Conversely VLANs that are only on access ports that do not have GVRP enabled will **not** be advertised on ports that have GVRP enabled. For port (g20), the `gvrp enable` command configures the port to advertise the VLANs from the ports that have GVRP enabled (101,102, 310) and learn new VLANs on the port via GVRP.

The last GVRP enable command enables GVRP globally.

To perform the same configuration by using the Web interface, navigate to the **Switching > VLAN > GVRP Parameters** page.

To enable GVRP on the switch Select **Enable** from the **GVRP Global Status** menu and click **Apply Changes**.

The screenshot shows the 'GVRP Parameters' configuration page. At the top, there is a breadcrumb trail: 'Switching > VLAN > GVRP Parameters'. The page title is 'GVRP Parameters'. On the right side, there are three buttons: 'Print', 'Refresh', and 'Show All'. The configuration is divided into two main sections: 'Global Parameters' and 'Port Parameters'. In the 'Global Parameters' section, there is a single row with 'GVRP Global Status' set to 'Enable'. In the 'Port Parameters' section, there are four rows: 'Interface' (set to 'Port 1' and 'g1'), 'GVRP State' (set to 'Disable'), 'Dynamic VLAN Creation' (set to 'Disable'), and 'GVRP Registration' (set to 'Disable'). At the bottom of the page, there is an 'Apply Changes' button.

To enable GVRP on the ports, use the following steps:

1. From the **GVRP Parameters** page, click **Show All**.
2. Select the **Edit** option for port 1/g1, and then select **Enable** from the **GVRP State** menu.
3. Above the port table, select the **Copy Parameters From** option and make sure port 1/g1 is selected in the Port field.
4. Select the **Copy To** option in the fields for ports 1/g2 – 1/g20 to copy the GVRP Enable setting from port 1/g1 to those ports.

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Switching > VLAN > GVRP Port Parameters Table

GVRP Port Parameters Table

Unit: 1

Copy Parameters From Unit: 1 Port: g1 LAG: ch1

	Interface	GVRP State	Dynamic VLAN Creation	GVRP Registration	Copy To	Edit
1	1/g1	Enable	Disable	Disable	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2	1/g2	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
3	1/g3	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
4	1/g4	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
5	1/g5	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
6	1/g6	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
7	1/g7	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
8	1/g8	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
9	1/g9	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
10	1/g10	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
11	1/g11	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
12	1/g12	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
13	1/g13	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
14	1/g14	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
15	1/g15	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
16	1/g16	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
17	1/g17	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
18	1/g18	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
19	1/g19	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>
20	1/g20	Disable	Disable	Disable	<input checked="" type="checkbox"/>	<input type="checkbox"/>

5. Click **Apply Changes**.

CONFIGURING A CISCO CATOS BASED ETHERNET SWITCH FOR DYNAMIC VLANS

The following example shows the Cisco CatOS Gigabit Ethernet switch command-line interface (CLI) commands for configuring the Cisco switch with GVRP to match the example in Figure 2.

```
6509> (enable) set vtp mode transparent
6509> (enable) set vlan 101 2/1
6509> (enable) set vlan 102 2/2
6509> (enable) set vlan 310 2/3
6509> (enable) set trunk 2/16 on dot1q
6509> (enable) set port gvrp 2/16 enable
6509> (enable) set gvrp dynamic-vlan-creation enable
6509> (enable) set gvrp enable
6509> (enable) clear trunk 2/16 1
```

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Command	Description
<code>set vtp mode transparent</code>	Sets the switch to ignore, but forward the Cisco proprietary VTP (VLAN Trunking Protocol). VTP is used to perform similar functions as GVRP, but it is not compatible with GVRP
<code>set vlan 101 2/1</code>	Configure port 2/1 to be an access port in VLAN 101
<code>set vlan 102 2/2</code>	Configure port 2/2 to be an access port in VLAN 102
<code>set vlan 310 2/3</code>	Configure port 2/3 to be an access port in VLAN 310
<code>set trunk 2/16 on dot1q</code>	Sets port 2/16 to use 802.1Q encapsulation for VLAN tagged traffic (not the Cisco proprietary ISL encapsulation)
<code>set port gvrp 2/16 enable</code>	Enable GVRP on port 2/16
<code>set gvrp dynamic-vlan-creation enable</code>	Configures the switch to dynamically create VLANs learned via GVRP
<code>set gvrp enable</code>	Enables GVRP on the switch globally
<code>clear trunk 2/16 1</code>	Prevents VLAN 1 from being advertised via GVRP. VLAN 1 is the default VLAN. Any ports not configured to be in a specific VLAN will be put in VLAN 1. This shows how to prevent traffic from ports left in the default state from sending traffic across the trunk

CONFIGURING A CISCO IOS ETHERNET SWITCH FOR DYNAMIC VLANS

Very few IOS based switches support GVRP. This section will be updated at a later time.

CONFIRMING A SUCCESSFUL GVRP COMMUNICATION WITH THE M6220

The following example shows how the PowerConnect M6220 `show vlan` command can be used to assure that the M6220 is learning VLAN information via GVRP.

M6220# `show vlan`

VLAN	Name	Ports	Type	Authorization
1	Default	ch1-18, 1/g3-1/g20, 1/xg1-1/xg4	Default	Required
101		1/g1	Static	Required
102		1/g2	Static	Required
310		1/g3-1/g16, 1/g20	Static	Required
VLAN	Name	Ports	Type	Authorization
1	1	g(11-15),ch(1-8)	other	Required
101	101	g1	permanent	Required
102	102	g2	permanent	Required
310	310	g(3-10,16)	permanent	Required

MSTP INTEROPERABILITY OF THE DELL™ POWERCONNECT™ 6200 SERIES SWITCHES WITH CISCO IOS AND CISCO CATOS-BASED SWITCHES

The output of this command shows that VLAN 310 contains ports g3-g16 and port g20. In the example ports g3-16 were configured statically to be members of 310. Port g20 was learned via GVRP. The configuration of the Cisco switches will not advertise the access port VLANs across port g20 unless the access port has link. So the output of the above command implies that the Cisco switch does not have link on port 1 and 2, but does have link on port 3.

CONFIRMING A SUCCESSFUL GVRP COMMUNICATION WITH CISCO CATOS

The following example shows how the Cisco CatOS `show trunk 2/16` command can be used to assure that the Cisco switch is learning VLANs via GVRP.

```
6509> (enable) show trunk 2/16
* - indicates vtp domain mismatch
# - indicates dot1q-all-tagged enabled on the port
Port      Mode      Encapsulation      Status      Native vlan
-----
2/16      on        dot1q               trunking    1

Port      Vlans allowed on trunk
-----
2/16      2-1005,1025-4094

Port      Vlans allowed and active in management domain
-----
2/16      101-102,310

Port      Vlans in spanning tree forwarding state and not pruned
-----
2/16      310
```

The output of this command shows that the trunk port 2/16 has learned VLAN 310. In the example, port 2/3 was configured statically to be a member of VLAN 310. Port 2/16 was added to VLAN 310 via GVRP. The configuration for the PowerConnect M6220 in the example will not advertise VLAN 310 unless one of the access ports g(3-10) has link. So the output of the command implies that the PowerConnect switch does not have link on port g1 and g2, but does have link on at least one of the ports g(3-10).

CONFIRMING A SUCCESSFUL GVRP VLAN CONNECTION WITH CISCO IOS

Very few IOS based switches support GVRP. This section will be updated at a later time.

CONFIGURATION LIMITATIONS

None

VLANS AND LINK AGGREGATION GROUPS

On the PowerConnect M6220, when members are added to a link aggregation group (LAG), they are removed from all existing VLAN memberships. When members are removed from a LAG, they are added back to the VLANs that they were previously members of as per the configuration file.

NOTE: A port's VLAN membership can still be configured when it is a member of a LAG; however, this configuration is only actually applied when the port leaves the LAG. Additionally, the port's GVRP configuration is overridden by the LAG's GVRP configuration. Upon leaving the LAG, the port will restore its GVRP configuration. The LAG interface can be a member of a VLAN complying with IEEE 802.1Q.

The following discussion assumes an understanding of LAGs Please see the white paper "Link Aggregation Interoperability of the Dell PowerConnect™ M6220 with Cisco IOS or Cisco CatOS based Switches" for an in-depth discussion of M6220 LAG interoperability with Cisco switches.

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When configuring a LAG to be in a VLAN, the concept for the PowerConnect M6220 is that ports are put into a LAG, and then the LAG is configured with the desired VLAN settings (not the individual ports). If the example in Figure 2 were changed slightly, where port g20 was a LAG of ports g17 and g18 instead of a single port, the M6220 static configuration would look like this (starting from an empty configuration):

```
M6220(config)# vlan database
M6220(config-vlan)# vlan 101,102,310
M6220(config-vlan)# exit

M6220(config)# interface ethernet 1/g1
M6220(config-if-1/g1)# switchport access vlan 101
M6220(config-if-1/g1)# exit
M6220(config)# interface ethernet 1/g2
M6220(config-if-1/g2)# switchport access vlan 102
M6220(config-if-1/g2)# exit

M6220(config)# interface range ethernet 1/g3-1/g10
M6220(config-if)# switchport access vlan 310
M6220(config-if)# exit

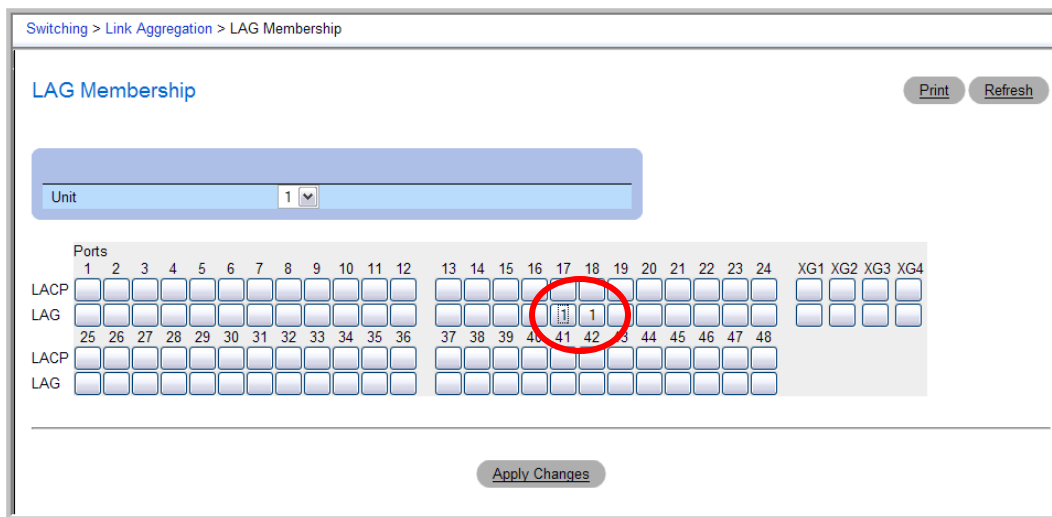
M6220(config)# interface range ethernet 1/g17-1/g18
M6220(config-if)# channel-group 1 mode on
M6220(config-if)# exit

M6220(config)# interface port-channel 1
M6220(config-if-ch1)# switchport mode general
M6220(config-if-ch1)# switchport general allowed vlan add 101,102,310 tagged
M6220(config-if-ch1)# switchport general allowed vlan remove 1
M6220(config-if-ch1)# switchport general pvid 4095
M6220(config-if-ch1)# exit
```

Only the **bold** lines were added or changed. The interface range ethernet 1/g17-1/g18 command changes the CLI mode to configure ports g17 and g18. The channel-group 1 mode on command puts ports g17 and g18 into a static LAG. The interface port-channel 1 command changes the CLI mode to configure LAG 1. All the other lines are exactly the same as the static VLAN example.

To assign ports 1/g17 and 1/g18 to LAG 1 by using the Web interface, navigate to the **Switching > Link Aggregation > LAG Membership** page.

In the **Ports** area, click the button under port 1/g17 and 1/g18 in the **LAG** row. The number 1 appears to indicate that the port belongs to LAG 1.



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To configure the VLAN membership information for LAG 1, use the following steps:

1. Navigate to the **Switching > VLAN > LAG Settings** page.
2. Set the **Port VLAN Mode** to **General**.
3. Enter 4095 in the **PVID** field.
4. Click **Apply Changes**.

Switching > VLAN > LAG Settings

LAG Settings

Print Refresh

Show All

LAG	ch1
Port VLAN Mode	General
PVID (1 - 4093) 4095	4095
Frame Type	Admit All
Ingress Filtering	Enable

Apply Changes

5. Navigate to the **Switching > VLAN > VLAN Membership** page.
6. From the **Show VLAN** menu, select 1.
7. Remove LAG 1 from the VLAN 1 membership and apply the changes.

Switching > VLAN > VLAN Membership

VLAN Membership

Print Refresh

Add

Show VLAN	1	Default
VLAN Name (0-32 characters)	Default	
Status	Default	
Unauthenticated Users	Disable	

Remove VLAN

Unit	1																												
Port	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	XG1	XG2	XG3	XG4	
Static												U	U	U	U	U	U			U		U	U	U	U	U	U	U	U
Current												U	U	U	U	U	U			U		U	U	U	U	U	U	U	U

Port	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Static	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Current	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

Lags	1																						
Static	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Current	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U

Apply Changes

8. Select the other VLANs and add LAG 1 as a tagged member.

The concept for Cisco IOS is the same as for the M6220. Ports are put into a LAG and then the LAG is configured with the desired VLAN settings. If the example in Figure 2 were changed slightly, where port 1/0/16 was a LAG of ports 1/0/11 and 1/0/12 instead of a single port, the Cisco IOS static configuration would look like this (starting from an empty configuration):

```
3750(config)# vtp mode transparent

3750(config)# interface GigabitEthernet 1/0/1
3750(config-if)# switchport access vlan 101
3750(config-if)# exit

3750(config)# interface GigabitEthernet 1/0/2
3750(config-if)# switchport access vlan 102
3750(config-if)# exit

3750(config)# interface GigabitEthernet 1/0/3
3750(config-if)# switchport access vlan 310
3750(config-if)# exit

3750(config)# interface range GigabitEthernet 1/0/11 - 12
3750(config-if)# channel-group 1 mode on
3750(config-if)# exit

3750(config)# interface Port-channel 1
3750(config-if)# switchport mode trunk
3750(config-if)# switchport trunk allowed vlan 101-102,310
3750(config-if)# switchport trunk encapsulation dot1q
3750(config-if)# exit
```

Only the **bold** lines were added or changed. The `interface range Gigabit Ethernet 1/0/11 - 12` command changes the CLI mode to configure ports 1/0/11 and 1/0/12. The `channel-group 1 mode on` command puts ports 1/0/11 and 1/0/12 into a static LAG. The `interface Port-channel 1` command changes the CLI mode to configure LAG 1. All the other lines are exactly the same as the static VLAN example.

The concept for CatOS is that all individual ports are configured for their VLAN settings and then the ports are put into a LAG. If the example in Figure 2 were changed slightly, where port 2/16 was a LAG of ports 2/11 and 2/12 instead of a single port, the Cisco IOS static configuration would look like this (starting from an empty configuration):

```
6509> (enable) set vtp mode transparent

6509> (enable) set vlan 101 2/1
6509> (enable) set vlan 102 2/2
6509> (enable) set vlan 310 2/3

6509> (enable) clear trunk 2/11,2/12 1-1005,1025-4094
6509> (enable) set trunk 2/11 on dot1q 101-102,310
6509> (enable) set trunk 2/12 on dot1q 101-102,310

6509> (enable) set port channel 2/11,2/12 mode on
```

Only the **bold** lines were added or changed. The `clear trunk 2/11,2/12 1-1005,1025-4094` command disables all undesired VLANs from being allowed on the two ports (2/11,2/12) being put into the LAG. The `set trunk 2/11 on dot1q 101-102,310` and `set trunk 2/12 on dot1q 101-102,310` commands put the two ports (2/11,2/12) being put into the LAG into VLANs 101, 102, and 310. The `set port channel 2/11,2/12 mode on` command puts ports 2/11 and 2/12 into a static LAG. All the other lines are exactly the same as the static VLAN example.

VLANS AND SPANNING TREE ON THE M6220

The PowerConnect M6220 implements a Multiple Spanning Tree Protocol instance per switch. By default the Spanning Tree Protocol is enabled (in RSTP mode) and a single instance of STP (CIST) will be active. In this case (default configuration), the user should be aware that even if the network is segmented into multiple VLANs with loops in any particular VLAN, if a physical loop exists in the network, some ports may be disabled preventing complete network connectivity. This is a well understood behavior of a single Spanning Tree Protocol instance. Please see the white paper "MSTP Interoperability of the Dell PowerConnect™ M6220 with Cisco IOS or Cisco CatOS based Switches" for an in-depth discussion of M6220 Multiple Spanning Tree (MSTP) interoperability with Cisco switches.

COMPARING ACCESS, TRUNK AND GENERAL MODES ON THE M6220

The PowerConnect M6220 supports three different VLAN modes. The modes and their definition are as follows:

- **Access mode VLAN**
 - By default sets egress to untagged
 - Supports single VLAN configuration only
 - Automatically sets PVID (native VLAN, ingress untagged) to configured VLAN
 - Will accept untagged packets or tagged packets with VLAN ID to which the port is a member - in this case the port is a member of only one VLAN.
- **Trunk mode VLAN**
 - By default sets egress to tagged
 - Supports multiple VLANs
 - Does not set PVID (native VLAN, ingress untagged)
 - Native VLAN cannot be a configured Trunk VLAN or 4095 (discard VLAN).
- **General mode VLAN**
 - By default sets egress to tagged
 - Supports multiple VLANs
 - Does not set PVID (native VLAN, ingress untagged)
 - Native VLAN can be any defined VLAN
 - Setting the PVID removes default vlan (VID=1) for that port
 - PVID can be 4095 (discard VLAN)
 - Allows mix of tagged and untagged VLANs in the egress direction.

Access and Trunk modes are short hand for configurations that can be accomplished in General mode.

The following command example shows the equivalent Access and General mode configurations:

Access Mode:

```
M6220(config)# interface ethernet 1/g1
M6220(config-if-1/g1)# switchport mode access
M6220(config-if-1/g1)# switchport access vlan 101
M6220(config-if-1/g1)# exit
```

is equivalent to the following General mode settings:

```
M6220(config)# interface ethernet 1/g1
M6220(config-if)# switchport mode general
M6220(config-if)# switchport general allowed vlan add
101 untagged
M6220(config-if)# switchport general pvid 101
M6220(config-if)# exit
```

The following shows the equivalent Trunk and General mode configurations:

Trunk mode:

```
M6220(config)# interface ethernet 1/g20
M6220(config-if-1/g20)# switchport mode trunk
M6220(config-if-1/g20)# switchport trunk allowed vlan
add 101,102,310
M6220(config-if-1/g20)# switchport trunk native 1
M6220(config-if-1/g20)# exit
```

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is equivalent to the following General mode settings:

```
M6220(config)# interface ethernet 1/g20
M6220(config-if-1/g20)# switchport mode general
M6220(config-if-1/g20)# switchport general allowed vlan
add 101,102,310 tagged
M6220(config-if-1/g20)# switchport general pvid 1
M6220(config-if-1/g20)# exit
```

The examples discussed in this document use General mode VLANs and not Trunk Mode VLANs. This is done deliberately so that the PVID could be set to 4095 (discard VLAN) to disallow untagged packets from entering port g20. Trunk mode ports to not allow the Native VLAN to be set to 4095.

CONCLUSION

The standards-based VLAN feature on the Dell PowerConnect M6220 switch interoperates easily with Cisco IOS and CatOS based switches. By understanding the differences in the Dell PowerConnect M6220 CLI and the Cisco CLIs and building on the examples shown in this article, system administrators can integrate the M6220 into their Cisco-based networks.

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