

# Dell Campus Networking Interoperability with Cisco Catalyst 1.1

Dell Networking Solutions Engineering  
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## Revisions

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# Introduction

Dell Networking provides customers with the most efficient use of current networking equipment at the lowest cost while still providing today's new technologies focused around the explosive data growth in the industry. Increased reliance on Voice over IP (VoIP), instant messaging clients, streaming video and larger email attachments, as well as the emergence of virtual machines, virtual desktop infrastructure and very large databases have driven the need for increased bandwidth, lower latency and converged infrastructure. Figure 1 presents some of the technologies involved with today's networks.

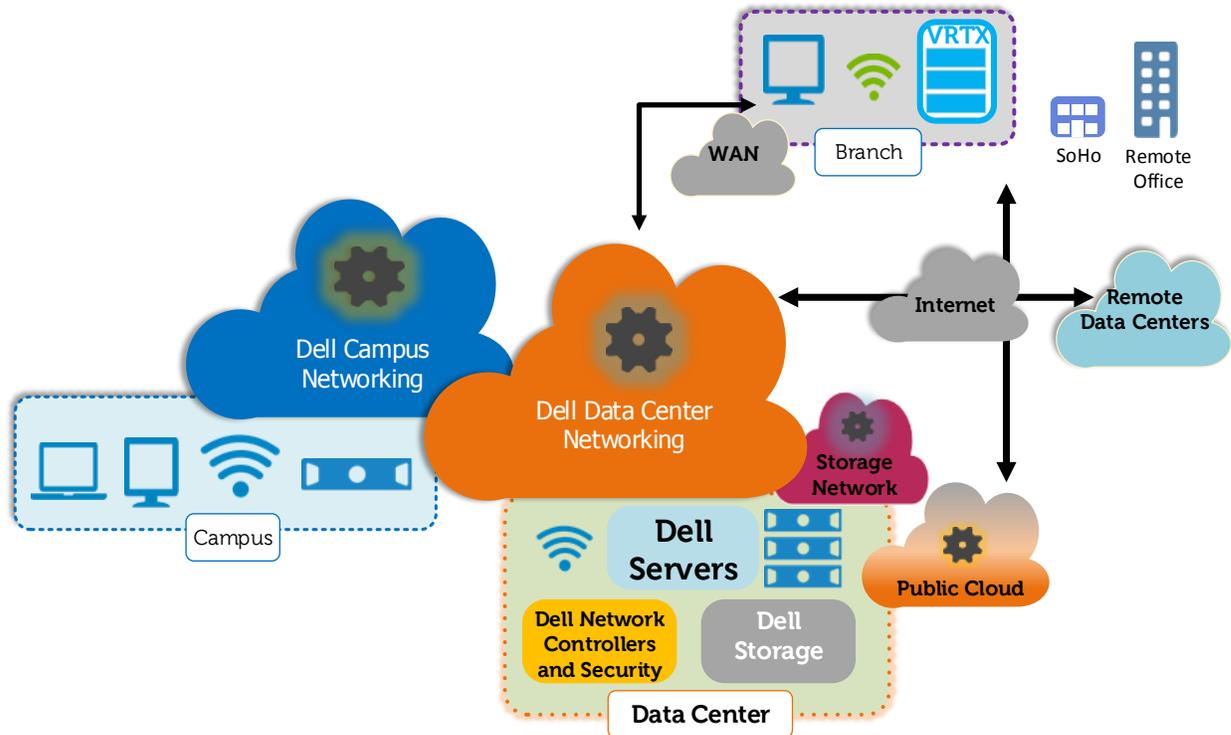


Figure 1 Networking Architecture Overview

While Dell EMC provides complete solutions for any size network, regardless of complexity, we also recognize that customers must choose the best solutions that fit the diverse requirements of their businesses and users. For example, Dell EMC supports open and heterogeneous networking and interoperability in the Campus network (Figure 2) when constructed on standards. Cisco switches, for instance, can work seamlessly in a Dell N-Series switch environment when properly configured.

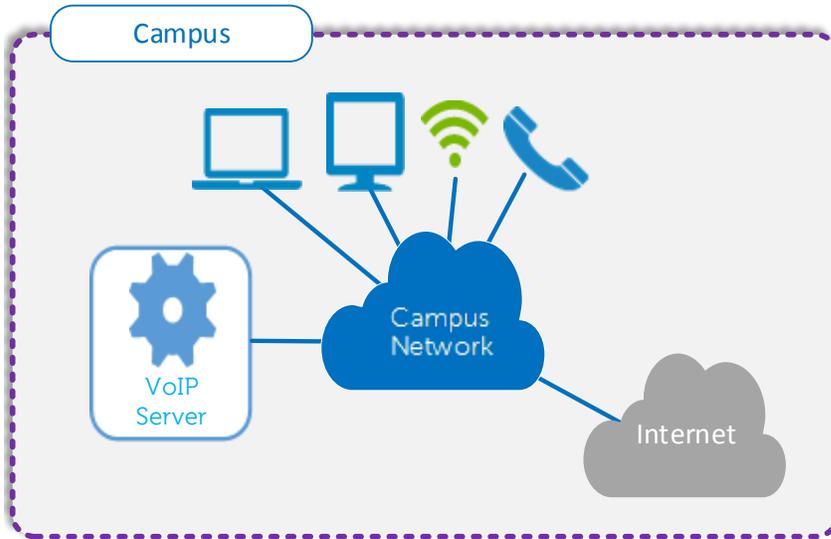


Figure 2 Logical Topology of a Campus Network

The goal of this paper is to show exactly how to configure Dell N-Series and Cisco Catalyst switches to directly attach and work together in a heterogeneous network. While the examples presented in this document use Dell N3024 switches, the same commands can be used to configure any of the N-Series switches listed below.

N1524	N2024	N3024	N4032
N1524P	N2024P	N3024P	N4032F
N1548	N2048	N3024F	N4064
N1548P	N2048P	N3048	N4064F
		N3048P	

The Dell N-Series is a family of energy efficient, PoE+ capable, high performance 1GbE and 10GbE switches designed for modernizing and scaling the Campus Network Infrastructure. N-Series switches utilize comprehensive Enterprise-Class feature sets, deliver consistent, simplified management and allow high availability network designs.

This guide enables network administrators to avoid the most common pitfalls when connecting a Cisco switch to an existing Dell EMC environment, or an N-Series switch to an existing Cisco environment, including dealing with Cisco proprietary protocols, spanning tree and link aggregation between switches.

# 1 Overview

Connecting a Dell Networking N-Series switch to a Cisco Catalyst switch is a straightforward process; minimal effort is required to integrate the N-Series switch into an existing network. This guide is designed as a supplement to the N-Series User's Guide, to help users successfully interconnect N-Series switches into a Campus Network. It provides easy-to-use steps to configure Dell Networking N-Series switches to work seamlessly with Cisco Catalyst switches.

In the examples presented in this document, Dell Networking N3000 Series switches are connected with a Cisco Catalyst 6504 switch with a WS-X6708-10GE module in slot two for 10GbE connectivity between all switches (Figure 3). Though N3000 Series switches are used for this example, the commands in this paper can be used on any of the Dell N-Series switches listed in the introduction to connect to a Cisco Catalyst switch.

**Note:** While the Cisco Catalyst 6504 is used for the examples in this document, similar test scenarios were performed and validated in Dell EMC Labs on additional Cisco models such as the Cisco Catalyst 3750, Cisco Catalyst 4500 and Cisco Catalyst 4900.

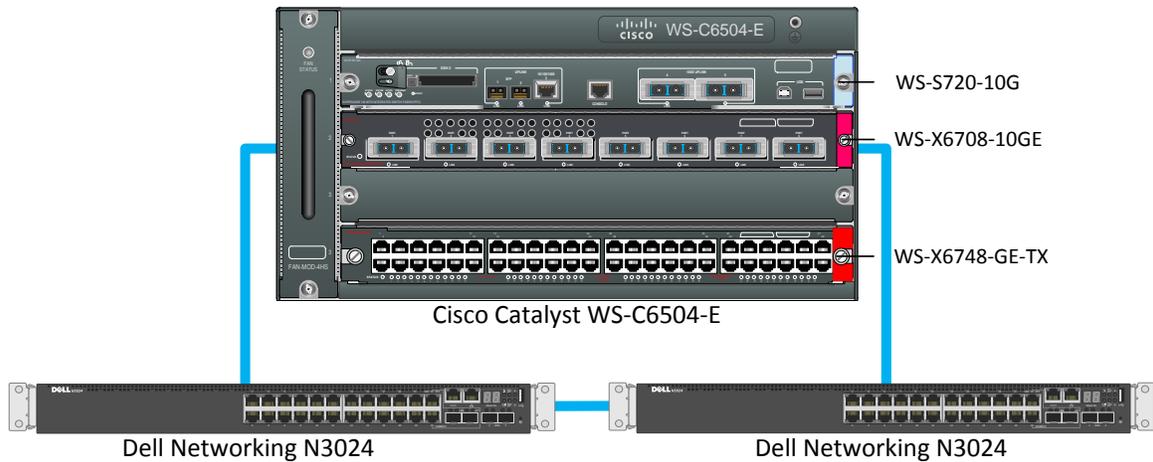


Figure 3 Logical Topology Connecting Two Dell N3024 Switches to a Cisco Catalyst

## 2 Deployment Scenarios

In the sections that follow, a variety of network deployment scenarios are discussed along with step-by-step instructions and commands required to build each setup.

### 2.1 Virtual LANs

A Virtual Local Area Network (VLAN) is an implementation of IEEE specification 802.1Q. Operating at layer 2 of the OSI reference model, a VLAN is a means of parsing a single network into logical groups of users or organizations as if they physically resided on their own dedicated LAN segment. VLANs allow a network to be logically segmented without regard to the physical locations of devices in the network. VLANs also reduce the size of broadcast domains by limiting the number of hosts receiving ARP requests.

In Figure 4, VLAN 30 is comprised of ports on both the Dell N3024 and Cisco 6504 switches.

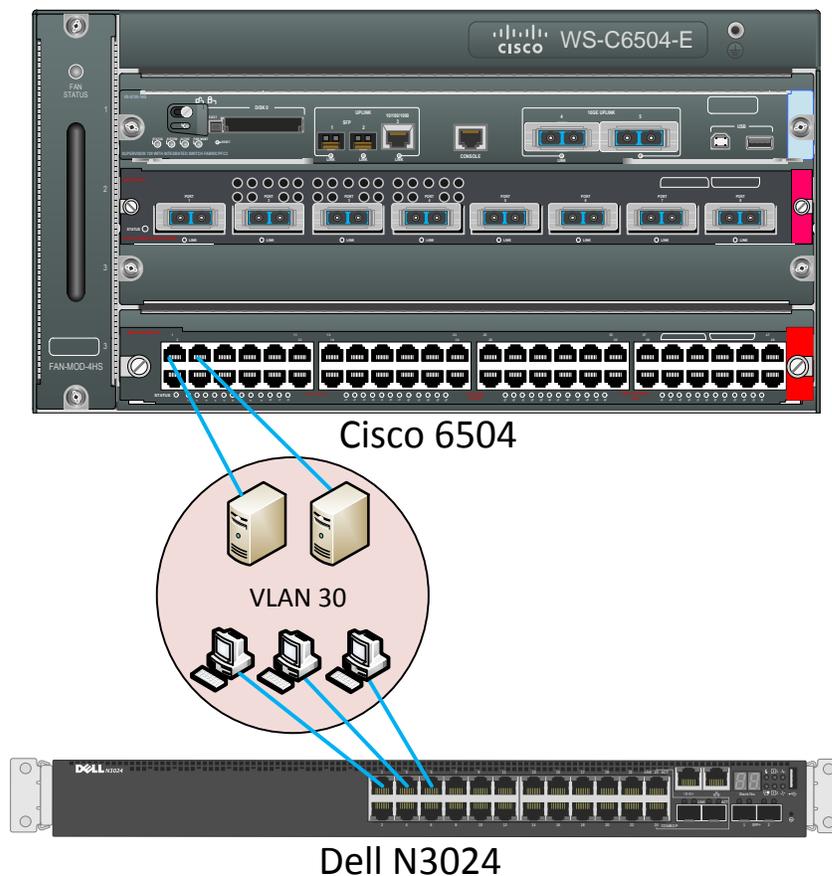


Figure 4 VLAN 30 on a Cisco and Dell N-Series Switch

## 2.1.1 Configuring VLANS — Dell N-Series

To configure a VLAN on the Dell N-Series, the command `vlan 30` is issued in configuration mode and the name "Management" is assigned to the VLAN. Configuration mode is then exited and the `show vlan` command is issued to verify creation of the VLAN.

```
N3024#configure
N3024(config)#vlan 30
N3024(config-vlan30)#name Management
N3024(config-vlan30)#end
N3024#show vlan
```

VLAN	Name	Ports	Type
30	Management		Static

### Adding ports to the VLAN

Creating a VLAN with the preceding commands only creates the framework of the VLAN. Not until one or more physical or logical ports are assigned to participate in the VLAN does it effectively serve the purpose of a virtual LAN. Use the following commands to assign physical interfaces to the VLAN.

```
N3024#configure
N3024(config)#interface Gi1/0/1
N3024(config-if-Gi1/0/1)#Description "Management"
N3024(config-if-Gi1/0/1)#switchport mode access
N3024(config-if-Gi1/0/1)#switchport access vlan 30
N3024(config-if-Gi1/0/1)#end
N3024#show vlan
```

VLAN	Name	Ports	Type
30	Management	Gi1/0/1	Static

**Note:** When assigned to a VLAN, ports can be in Access, General or Trunk mode. Consult the User's Guide for your switch to determine which mode should be used in each case.

## 2.1.2 Configuring VLANS — Cisco Catalyst

To configure a VLAN on the Cisco Catalyst, the command `vlan 30` is issued in configuration mode and the name "Management" is assigned to the VLAN. Configuration mode is then exited and the `show vlan` command is issued to verify creation of the VLAN.

```
C6504#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
```

```

C6504(config)#vlan 30
C6504(config-vlan)#name Management
% Applying VLAN changes may take few minutes. Please wait...
C6504(config-vlan)#end
C6504#show vlan brief
VLAN Name                               Status    Ports
-----
30    Management                             active

```

### Adding ports to the VLAN

Creating a VLAN with the preceding commands only creates the framework of the VLAN. Not until one or more ports are assigned to the VLAN does it effectively serve the purpose of a virtual LAN. Use the following commands to assign ports to the VLAN.

```

C6504#configure terminal
C6504(config)#interface gigabitEthernet 4/1
C6504(config-if)#switchport
C6504(config-if)#switchport mode access
C6504(config-if)#switchport access vlan 30
C6504(config-if)#end
C6504#show vlan brief
VLAN Name                               Status    Ports
-----
30    Management                             active    Gi4/1

```

## 2.2 Multiple Virtual LANs

Configuring multiple VLANs on a switch to allow several broadcast domains within the switch or with other switches is typically desired. Figure 5 shows how multiple ports from each switch can be assigned to the same VLAN, allowing end devices attached to these ports to only communicate with each other via layer 2 switching.

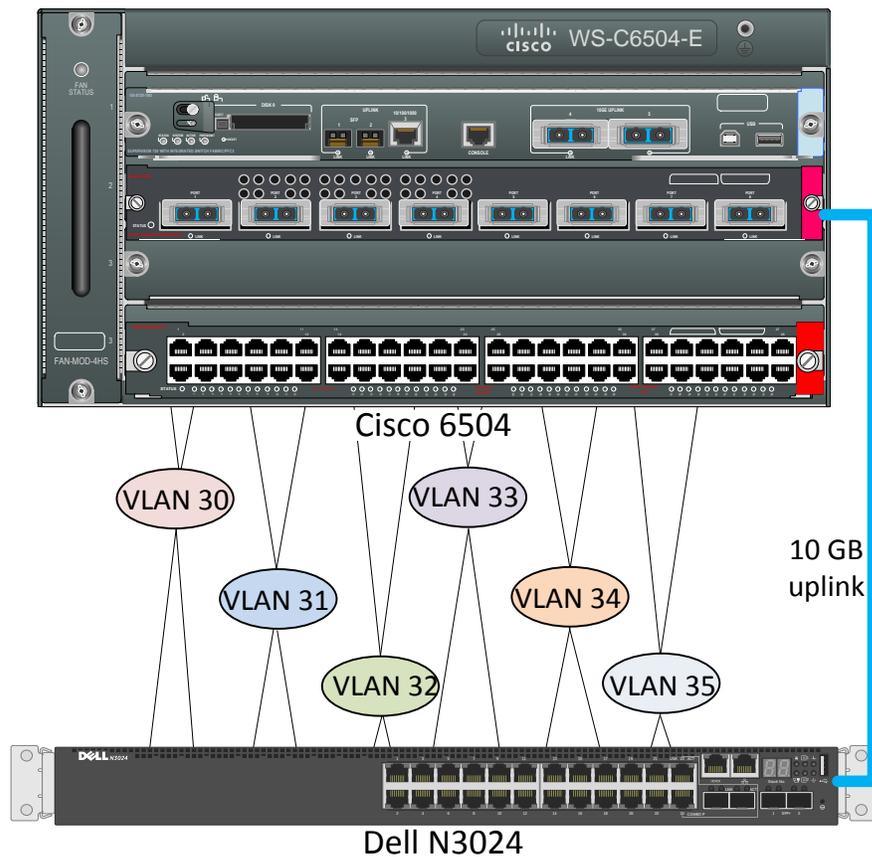


Figure 5 Multiple VLANs configured, with both switches assigning various ports to each VLAN

Use the following CLI examples to create multiple VLANs on both the Dell N-Series switches and Cisco Catalyst switches and assign ports to the VLANs.

### 2.2.1 Configuring Multiple VLANs — Dell N-Series

The following commands illustrate how to create multiple VLANs on the Dell N-Series switches. First, the switch is put in configuration mode, then the `vlan 31-35` command is issued to create VLANs 31 through 35. Optionally, names can be given to each VLAN to help identify them. Configuration mode is then exited and the `show vlan` command is issued to verify the creation of the VLANs.

```
N3024#configure
N3024(config)#vlan 31-35
```

```

N3024(config-vlan31-35)#vlan 31
N3024(config-vlan31)#name Public
N3024(config-vlan31)#vlan 33
N3024(config-vlan32)#name Guest
N3024(config-vlan32)#end
N3024#show vlan

```

VLAN	Name	Ports	Type
30	Management	Gi1/0/1	Static
31	Public		Static
32	VLAN0032		Static
33	Guest		Static
34	VLAN0034		Static
35	VLAN0035		Static

### Adding ports to a VLAN

Once the VLANs are created, use the following commands to assign ports to each VLAN.

```

N3024#configure
N3024(config)#interface GigabitEthernet 1/0/2
N3024(config-if-Gi1/0/2)#description "Management"
N3024(config-if-Gi1/0/2)#switchport mode access
N3024(config-if-Gi1/0/2)#switchport access vlan 30
N3024(config-if-Gi1/0/2)#interface range Gi1/0/3-6
N3024(config-if)#description "Public"
N3024(config-if)#switchport mode access
N3024(config-if)#switchport access vlan 31
N3024(config-if)#interface range Gi1/0/11-14
N3024(config-if)#description "Guest"
N3024(config-if)#switchport mode access
N3024(config-if)#switchport access vlan 33
N3024(config-if)#end
N3024#show vlan

```

VLAN	Name	Ports	Type
30	Management	Gi1/0/1-2	Static
31	Public	Gi1/0/3-6	Static
32	VLAN0032		Static
33	Guest	Gi1/0/11-14	Static
34	VLAN0034		Static
35	VLAN0035		Static

**Note:** When assigned to a VLAN, ports can be in Access, General or Trunk mode. Consult the User's Guide for your switch to determine which mode should be used for each case.

## 2.2.2 Configuring Multiple VLANs — Cisco Catalyst

The following commands illustrate how to create multiple VLANs on the Cisco Catalyst. First, the switch is put in configuration mode, then the `vlan 30-35` command is issued to create VLANs 30 through 35. Optionally, names can be given to each VLAN to help identify them. Configuration mode is then exited and the `show vlan brief` command is issued to verify the creation of the VLANs.

```
C6504#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
C6504(config)#vlan 31-35
% Applying VLAN changes may take few minutes. Please wait...
C6504(config-vlan)#vlan 31
% Applying VLAN changes may take few minutes. Please wait...
C6504(config-vlan)#name Public
C6504(config-vlan)#vlan 32
% Applying VLAN changes may take few minutes. Please wait...
C6504(config-vlan)#name Guest
C6504(config-vlan)#end
C6504#show vlan brief
```

VLAN	Name	Status	Ports
1	default	active	
30	Management	active	Gi4/1
31	Public	active	
32	VLAN0032	active	
33	Guest	active	
34	VLAN0034	active	
35	VLAN0035	active	

### Adding ports to a VLAN

Once the VLANs are created, use the following commands to assign ports to each VLAN.

```
C6504(config)#interface gigabitEthernet 4/2
C6504(config-if)#description "Management"
C6504(config-if)#switchport
C6504(config-if)#switchport mode access
C6504(config-if)#switchport access vlan 30
C6504(config-if)#interface range gi4/3-6
C6504(config-if-range)#description "Public"
C6504(config-if-range)#switchport
C6504(config-if-range)#switchport mode access
C6504(config-if-range)#switchport access vlan 31
C6504(config-if-range)#interface range gi4/7-10
C6504(config-if-range)#description "Guest"
C6504(config-if-range)#switchport
C6504(config-if-range)#switchport mode access
C6504(config-if-range)#switchport access vlan 33
```

```
C6504(config-if-range)#end
C6504#show vlan brief
```

VLAN	Name	Status	Ports
1	default	active	
30	Management	active	Gi4/1, Gi4/2
31	Public	active	Gi4/3, Gi4/4, Gi4/5, Gi4/6
32	VLAN0032	active	
33	Guest	active	Gi4/7, Gi4/8, Gi4/9, Gi4/10
34	VLAN0034	active	
35	VLAN0035	active	

Repeat the commands above to assign ports to each VLAN.

## 2.3 Link Aggregation Groups

Link Aggregation Group (LAG) enables the bonding of up to eight physical Ethernet links into a single logical link with an aggregate bandwidth of all the physical links used. For example, if a LAG is composed of four 1 Gbps links, it would have the cumulative total bandwidth of 4 Gbps. However, the default behavior of a port channel is to assign one of the physical links to each packet that transverses the LAG. Figure 6 shows a simple LAG consisting of two physical links.

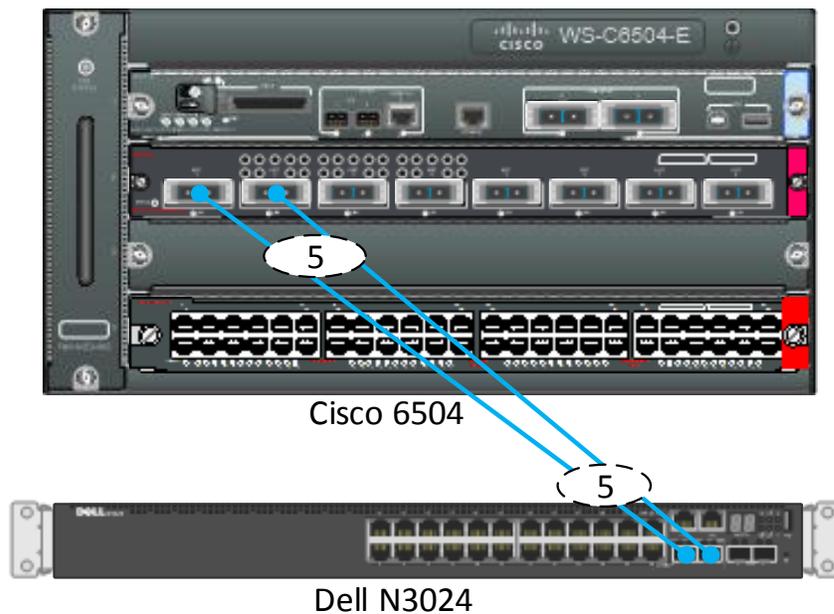


Figure 6 Link Aggregation Group

**Note:** The terms *LAG*, *port-channel*, and *channel-group* all have the same meaning. Cisco references this technology as Etherchannel. Though all four are often used in conversation and documentation, *port-channel* is used exclusively in the command for creating a LAG, and *channel-group* is used exclusively as

part of the command for assigning ports to the LAG. In the configurations in this section, for example, channel-group 5 refers to port-channel 5 as well as LAG 5.

Figure 6 and the example commands below show both switches using *LAG 5*. Though it is not required that adjacent switches sharing a LAG use the same number for the LAG, this is considered a best practice since it makes it easier to remember, troubleshoot, and manage, especially when there are multiple LAGs on a switch going to multiple devices (switches, servers, storage, etc.).

Use the following commands to configure a LAG between a Dell N-Series switch and Cisco Catalyst.

### 2.3.1 Configuring LAGs — Dell N-Series

The commands below are used to configure port channel 5 and enable the port as a trunk. As a best practice, a description is then placed on the port. The 10 Gbps Ethernet ports te1/0/1 and te1/0/2 are assigned to the LAG (port channel). These ports are joined to port channel 5 and Link Aggregation Control Protocol (LACP) is enabled through the use of the `active` parameter. The `show` command is used to verify port participation.

```
N3024#configure
N3024(config)#interface port-channel 5
N3024(config-if-Po5)#switchport mode trunk
N3024(config-if-Po5)#description "LAG to Cisco C6504"
N3024(config-if-Po5)#exit
N3024(config)#interface range tengigabitethernet 1/0/1-2
N3024(config-if)#channel-group 5 mode active
N3024(config-if)#no shutdown
N3024(config-if)#end
N3024#show interfaces port-channel 5
```

Channel	Ports	Ch-Type	Hash Type	Min-links	Local Prf
Po5	Active: Te1/0/1, Te1/0/2	Dynamic	7	1	Disabled

Hash Algorithm Type

- 1 - Source MAC, VLAN, EtherType, source module and port Id
- 2 - Destination MAC, VLAN, EtherType, source module and port Id
- 3 - Source IP and source TCP/UDP port
- 4 - Destination IP and destination TCP/UDP port
- 5 - Source/Destination MAC, VLAN, EtherType, source MODID/port
- 6 - Source/Destination IP and source/destination TCP/UDP port
- 7 - Enhanced hashing mode

**Note:** The matching LAG on the Cisco Catalyst 6504 must be created before the `show interfaces port-channel 5` command will show as active.

### 2.3.2 Configuring LAGs — Cisco Catalyst

This section covers configuring a port channel on the Cisco 6504-E to connect to the port channel on the Dell N-Series switch.

First, interface port channel 5 is configured and a description is added. The port is activated as a switchport and switchport trunking encapsulation dot1Q is enabled. The port channel is then removed from an administrative shutdown state. The interface range 2/1 and 2/2 are enabled as switchports. Next, the ports are added to port channel 5 and LACP negotiation is enabled unconditionally by using active. The ports are then removed from an administrative shutdown state. Finally, the command **show etherchannel summary** is issued in enabled mode to verify the port channel is configured properly.

```
C6504 #configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
C6504(config)#interface range tenGigabitEthernet 2/1-2
C6504(config-if-range)#switchport
C6504(config-if-range)#channel-group 5 mode active
C6504(config-if-range)#no shutdown
C6504(config-if-range)#exit
C6504(config)#interface port-channel 5
C6504(config-if)#description "LAG to Dell N3024"
C6504(config-if)#switchport
C6504(config-if)#switchport trunk encapsulation dot1q
C6504(config-if)#switchport mode trunk
C6504(config-if)#no shutdown
C6504(config-if)#end
C6504#show etherchannel 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       N - not in use, no aggregation
        f - failed to allocate aggregator
        M - not in use, no aggregation due to minimum links not met
        m - not in use, port not aggregated due to minimum links not met
        u - unsuitable for bundling
        d - default port
        w - waiting to be aggregated
Number of channel-groups in use: 1
Number of aggregators:          1
Group  Port-channel  Protocol    Ports
-----+-----+-----+-----+-----
5      Po5(SU)           LACP       Te2/1(P)   Te2/2(P)
Last applied Hash Distribution Algorithm: Fixed
```

## 2.4 Multiple Link Aggregation Groups

Multiple LAGs can be created to allow the three switches to be connected in a loop with redundant Ethernet links. The diagram in Figure 7 shows the completed topology. The numbers labeled in the diagram represent the port channel numbers specified during configuration.

Before connecting switches in a loop, it is highly recommended that spanning tree be enabled on all switches. This guide provides examples and commands for configuring spanning tree on the N-Series switches when connecting to a Cisco Catalyst. Refer to the spanning tree sections of this document or consult the User's Guide for each switch for more information on configuring spanning tree.

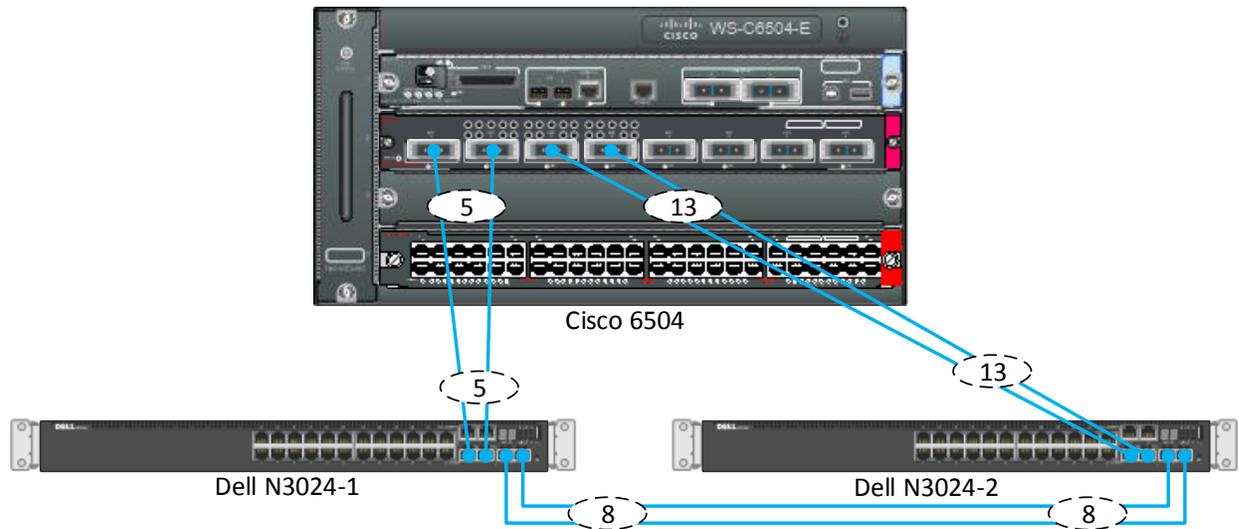


Figure 7 Multiple Link Aggregation Groups

## 2.4.1 Configuring Multiple LAGs — Dell N-Series

This section covers setting up an additional port channel on an N3024 switch. The commands below can be used on either N3024 switch in the above topology to configure port channel 8 as a trunk going between each Dell N-Series switch. As a best practice, a description is then placed on the port. The 10 Gbps Ethernet ports te1/0/3 and te1/0/4 are joined to port channel 8 and LACP is enabled through the use of `active`. A `show` command is used to show the status of the port channel and verify interface participation.

```
N3024#configure
N3024(config)#interface port-channel 8
N3024(config-if-Po8)#switchport mode trunk
N3024(config-if-Po8)#description "LAG to Dell N3024-2"
N3024(config-if-Po8)#exit
N3024(config)#interface range tengigabitethernet 1/0/3-4
N3024(config-if)#channel-group 8 mode active
N3024(config-if)#end
N3024#show interfaces port-channel 8
```

Channel	Ports	Ch-Type	Hash	Type	Min-links	Local Prf
Po8	Active: Te1/0/3, Te1/0/4	Dynamic	7		1	Disabled

Hash Algorithm Type  
1 - Source MAC, VLAN, EtherType, source module and port Id

- 2 - Destination MAC, VLAN, EtherType, source module and port Id
- 3 - Source IP and source TCP/UDP port
- 4 - Destination IP and destination TCP/UDP port
- 5 - Source/Destination MAC, VLAN, EtherType, source MODID/port
- 6 - Source/Destination IP and source/destination TCP/UDP port
- 7 - Enhanced hashing mode

All configured port channels on the switch can be seen by using the **show interfaces port-channel** command.

**Note:** Enhanced hashing mode offers excellent load balancing performance. It is the default (and recommended) hash type for N2000, N3000 and N4000 Series switches (i.e. all the N-Series switches except the N1500 series). Consult the N-Series User Guide for more information on each type of hash algorithm listed above.

## 2.4.2 Configuring Multiple LAGs — Cisco Catalyst

This section covers setting up an additional port channel on the Cisco 6504-E. The interface port-channel 13 is configured and a description added. Then, the port is activated as a switchport trunk with encapsulation dot1Q enabled. The port channel is then removed from the administrative shutdown state.

The 10 Gbps ports 2/3 and 2/4 are configured as switchports to port channel 13 and LACP is enabled. The ports are then removed from the shutdown state. A **show** command is used to verify Ethernet port participation.

```
C6504#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
C6504(config)#interface range tenGigabitEthernet 2/3-4
C6504(config-if-range)#switchport
C6504(config-if-range)#channel-group 13 mode active
C6504(config-if-range)#no shutdown
C6504(config-if-range)#exit
C6504(config)#interface port-channel 13
C6504(config-if)#description "LAG to Dell N3024-2"
C6504(config-if)#switchport
C6504(config-if)#switchport trunk encapsulation dot1q
C6504(config-if)#switchport mode trunk
C6504(config-if)#no shutdown
C6504(config-if)#end
C6504#show etherchannel 13 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          N - not in use, no aggregation
f - failed to allocate aggregator
M - not in use, no aggregation due to minimum links not met
m - not in use, port not aggregated due to minimum links not met
u - unsuitable for bundling
d - default port

w - waiting to be aggregated
Number of channel-groups in use: 1
Number of aggregators:          1
Group Port-channel Protocol Ports
-----+-----+-----+-----+-----
13    Po13(SU)          LACP    Te2/3(P)    Te2/4(P)
Last applied Hash Distribution Algorithm: Fixed

```

All configured port channels on the switch can be seen by using the **show etherchannel summary** command.

## 2.5 LACP Standby

When LACP is configured, the protocol attempts to configure the maximum number of compatible ports in the port channel, typically a maximum of eight ports per port channel. This default is generally the desired behavior. It is possible, however, to configure a LACP enabled LAG to limit the number of active ports through the use of the interface command, **lacp max-bundle**. Once the max bundles are set, participating links can be given priority to determine active links and standby links. To do this, issue the interface command **lacp port-priority** against the links participating in the port channel. A value from 1 to 65535 can be used. Ports are assigned to the LAG in increasing numerical order from 1 to 65535 until the max-bundle value is met, all ports after this value are set to a standby state.

When no priorities are defined for participating ports, an algorithm is used to automatically assign them. The criteria used, in order of high to low, are LACP system priority, System ID (a combination of the LACP system priority and the switch MAC address), LACP port priority and finally, the port number.

In Figure 8, two links are used for each port channel. The max-bundle command is set to 1 and the participating links in the bundles are set to a lacp port-priority value of 1 and 65635. This results in one link being active (solid line) and the other link being in a standby state (dashed line).

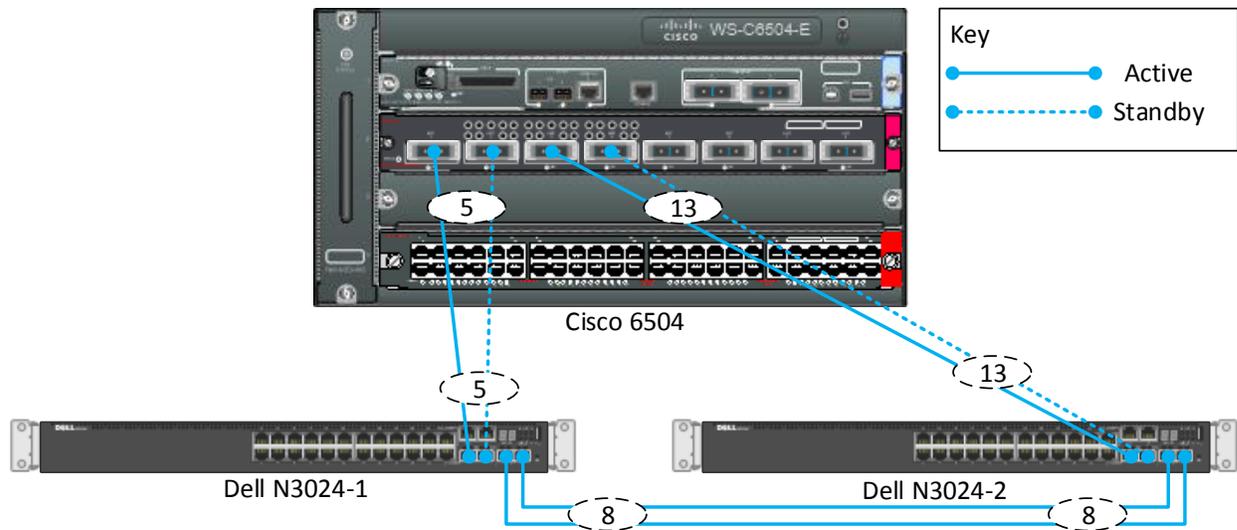


Figure 8 LACP Standby

## 2.5.1 Configuring LACP Standby — Dell N-Series

There is no specific configuration required for Dell N-Series switches. For hot-standby LACP links to work, one switch in the LAG needs to support the `max-bundle interface` command. The Dell switches must be configured to participate in the LAG and LACP must be enabled. To ensure LACP is enabled on each participating Ethernet port the command `show lacp` can be used. The command below shows port `te1/0/2` as being configured as the hot-standby for port channel 5 on the Dell N3024-1 switch in Figure 8. LACP Activity under the Actor and Partner sections will show **ACTIVE** when the port is in hot-standby.

```
N3024#show lacp Tengigabitethernet 1/0/2

port Te1/0/2 LACP parameters:
Actor:
  system priority:          1
  port Admin key:          0
  port oper key:           654
  port oper priority:      1
  port oper timeout:       LONG
  port Admin timeout:      LONG
  LACP Activity:           ACTIVE
  Aggregation:             AGGREGATABLE
  synchronization:        TRUE
  collecting:               FALSE
  distributing:            FALSE
  expired:                  FALSE
Partner:
  port Admin key:          0
  port oper key:           5
  port Admin priority:     0
```

```
port oper priority:          32768
port Oper timeout:          SHORT
LACP Activity:              ACTIVE
Aggregation:                AGGREGATABLE
synchronization:           FALSE
collecting:                 FALSE
distributing:               FALSE
expired:                    FALSE
port Tel1/0/2 LACP Statistics:
  LACP PDUs send:           60286
  LACP PDUs received:       2290
```

## 2.5.2 Configuring LACP Standby — Cisco Catalyst

This section covers the configuration required on the Cisco 6504-E switch to enable LACP port standby. The command `lACP max-bundle 1` is issued to both LAGs to reduce participating ports from two to one. The second Ethernet port participating in each of the two port channels have their LACP port-priority set to the maximum of 65535 to ensure that these physical ports will be in standby. Finally, the `show etherchannel summary` command is ran to verify active and standby port assignments. As shown below, the ports assigned for standby are flagged with a capital H for Hot-standby.

```
C6504#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
C6504(config)#interface port-channel 5
C6504(config-if)#lACP max-bundle 1

C6504(config)#interface tenGigabitEthernet 2/2
C6504(config-if)#lACP port-priority 65535

C6504#(config)#interface port-channel 13
C6504(config-if)#lACP max-bundle 1

C6504(config)#interface tenGigabitEthernet 2/4
C6504(config-if)#lACP port-priority 65535
C6504(config-if)#end
C6504#show etherchannel 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      N - not in use, no aggregation
       f - failed to allocate aggregator
       M - not in use, no aggregation due to minimum links not met
       m - not in use, port not aggregated due to minimum links not met
       u - unsuitable for bundling
       d - default port
       w - waiting to be aggregated

Number of channel-groups in use: 2
Number of aggregators:          2
Group  Port-channel  Protocol    Ports
-----+-----+-----+-----+-----
5      Po5 (SU)         LACP       Te2/1 (P)   Te2/2 (H)
13     Po13 (SU)        LACP       Te2/3 (P)   Te2/4 (H)
```

In this example, if a cable or port failure were to occur on ports te2/1 and te2/2 on the Cisco 6504, the **show** command would display the following:

```
C6504#show etherchannel 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       N - not in use, no aggregation
        f - failed to allocate aggregator
        M - not in use, no aggregation due to minimum links not met
        m - not in use, port not aggregated due to minimum links not met
        u - unsuitable for bundling
        d - default port
        w - waiting to be aggregated
```

```
Number of channel-groups in use: 2
```

```
Number of aggregators:          2
```

```
Group  Port-channel  Protocol  Ports
```

Group	Port-channel	Protocol	Ports
5	Po5 (SU)	LACP	Te2/1 (D) Te2/2 (P)
13	Po13 (SU)	LACP	Te2/3 (D) Te2/4 (P)

## 2.6 Spanning Tree Protocol (RSTP-PV and RPVST+)

In traditional STP and Rapid STP (802.1d and 802.1w respectively), layer 2 loops are prevented by placing certain ports in blocking (STP) or discarding (RSTP) states. The overall effect of this is half of the available Ethernet links leading back to the core of a network are not in use most of the time. By using a STP instance per VLAN, a manual load balancing method can be achieved allowing overall better utilization of available bandwidth in a network.

Rapid Per-VLAN Spanning Tree Plus (RPVST+) is a Cisco proprietary STP protocol available on the Cisco 6504. Dell Networking N-Series switches can work with RPVST+ through the use of Rapid Spanning Tree Protocol per VLAN (RSTP-PV). RPVST+ and RSTP-PV allow a direct one-to-one mapping of STP instances to VLANs. In Figure 9 below, VLANs 30 through 35 are configured on the three switches from the previous configuration sections. Using RPVST+ and RSTP-PV, six STP instances are created to allow the VLANs to be split evenly between the trunk ports connecting the Dell N-3024 switches to the Cisco 6504-E.

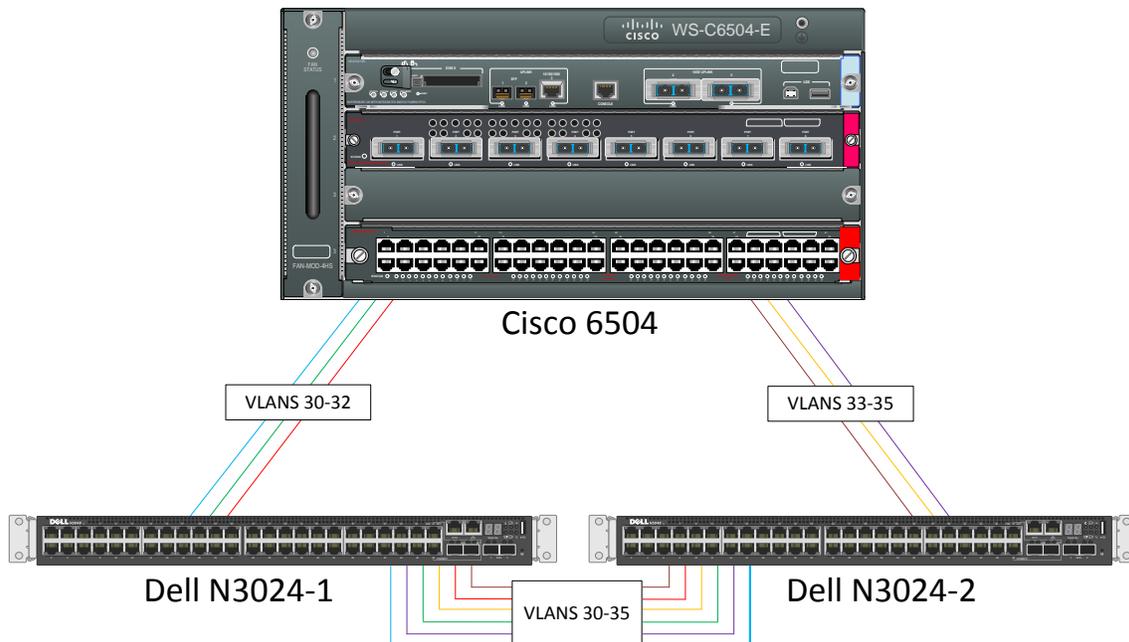


Figure 9 Per-VLAN STP Diagram

### 2.6.1 Configuring Spanning Tree Protocol — Dell N-Series

The command `spanning-tree mode rapid-pvst` enables RSTP-PV and the command `spanning-tree vlan n-n priority 1` where `n-n` represents a VLAN ID range and a priority of 1 sets a priority value to the VLAN range. This priority value is used to calculate the root bridge. Setting the priority to 1 guarantees the switch will be the root bridge for the respective VLAN STP topologies. The command `show spanning-tree summary` confirms that RSTP-PV has been enabled. Finally, the command `show`

**spanning-tree vlan n-n** is used to show that the VLANs specified have the STP root bridge running on that respective switch.

**Note:** Configuration for both switches is identical except for the VLAN range. The variable *n* is inserted in the configuration below to represent the VLAN ID. The first switch is configured for VLAN 30-32 and the second switch used VLAN 33-35.

```
N3024-1#configure
N3024-1(config)#spanning-tree mode rapid-pvst
N3024-1(config)# spanning-tree vlan 30-32 priority 1
Priority specified was converted to 0 + 30 (according to IEEE 802.1s) and
stored successfully.
Priority specified was converted to 0 + 31 (according to IEEE 802.1s) and
stored successfully.
Priority specified was converted to 0 + 32 (according to IEEE 802.1s) and
stored successfully.
N3024-1(config)#spanning-tree vlan 33-35 priority 4096
Priority specified was converted to 4096 + 33 (according to IEEE 802.1s) and
stored successfully.
Priority specified was converted to 4096 + 34 (according to IEEE 802.1s) and
stored successfully.
Priority specified was converted to 4096 + 35 (according to IEEE 802.1s) and
stored successfully.
N3024-1(config)#end
N3024-1#show spanning-tree summary

Spanning Tree Adminmode..... Enabled
Spanning Tree Version..... IEEE 802.1w
BPDU Guard Mode..... Disabled
BPDU Flood Mode..... Disabled

BPDU Filter Mode..... Disabled
Configuration Name..... 00-1E-C9-DE-D1-1A
Configuration Revision Level..... 0
Configuration Digest Key..... 0xac36177f50283cd4b83821d8ab26de62
Configuration Format Selector..... 0
N3024-1#show spanning-tree vlan 30
VLAN 30
Spanning-tree enabled protocol rpvst
RootID Priority 30
Address 001E.C9DE.D11A
Cost 0
Port This Switch is the root
Hello Time 2 Sec Max Age 20 sec Forward Delay 15 sec
BridgeID Priority 8222 (priority 8192 sys-id-ext 30)
Address 001E.C9DE.D11A
```

```

Hello Time 2 Sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300 sec

```

```

Interface Role      Sts          Cost      Prio.Nbr
-----
Po5        Designated Forwarding  2000      128.654
Po8        Designated Forwarding  1000      128.657

```

N3024-1#**show spanning-tree vlan 33**

VLAN 33

Spanning-tree enabled protocol rpvst

```

RootID      Priority      4129
Address     001E.C9DE.D11A
Cost        0
Port        This Switch is the root
Hello Time 2 Sec Max Age 20 sec Forward Delay 15 sec
BridgeID    Priority      4129 (priority 8192 sys-id-ext 30)
Address     001E.C9DE.D11A
Hello Time 2 Sec Max Age 20 sec Forward Delay 15 sec
Aging Time 300 sec

```

```

Interface Role      Sts          Cost      Prio.Nbr
-----
Po5        Designated Forwarding  2000      128.654
Po8        Designated Forwarding  1000      128.657

```

The same commands must be issued against the other N3024 (N3024-2 in Figure 9) except setting VLANs 30-32 with a priority of 4096 and VLANs 33-35 with a priority of 1. This will result in the first N3024 being the root bridge for VLANs 30 through 32 while the second switch will be the root bridge for VLANs 33-35. Below is spanning tree output for VLANs 30 and 33 on the second N3024.

N3024-2#**show spanning-tree vlan 30**

VLAN 30

Spanning Tree: Enabled Mode: rapid-pvst

```

RootID      Priority      30
Address     001E.C9E5.BA5B
Cost        1000
Port        8 (Po8 )
Hello Time: 2s Max Age: 20s Forward Delay: 15s
BridgeID    Priority      4126 (priority 4096 sys-id-ext 30)
Address     001E.C9E5.BC53
Hello Time: 2s Max Age: 20s Forward Delay: 15s
Aging Time 300 sec

```

```

Interface Role      Sts          Cost      Prio.Nbr
-----
Po8        Root          Forwarding  1000      128.217
Po13       Designated Forwarding  2000      128.222

```

```

N3024-2#show spanning-tree vlan 33
VLAN    33
Spanning Tree: Enabled Mode: rapid-pvst
RootID   Priority      33
        Address      001E.C9E5.BC53
        Cost          0
        Port          This switch is the root
        Hello Time: 2s Max Age: 20s Forward Delay: 15s
BridgeID Priority      33 (priority 0 sys-id-ext 33)
        Address      001E.C9E5.BC53
        Hello Time: 2s Max Age: 20s Forward Delay: 15s
        Aging Time 300 sec

```

Interface	Role	Sts	Cost	Prio.Nbr
Po8	Designated Forwarding		1000	128.217
Po13	Designated Forwarding		2000	128.222

**Note:** When the spanning tree mode is set to RSTP, or a variant of RSTP, users may still see MSTP instances in the running configuration if they were previously configured. There is no functional impact, and any commands used in the MSTP configuration can be removed.

## 2.6.2 Configuring Spanning Tree Protocol — Cisco Catalyst

The configuration command `spanning-tree mode rapid-pvst` enables RPVST+. No additional VLAN-specific configuration is required on the Cisco Catalyst. The `show spanning-tree vlan 30-35 summary` command is issued to confirm forwarding state on all participating interfaces. For each root bridge, these can be compared to the Dell N-Series switch output to trace the path of any given VLAN.

```

C6504#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
C6504(config)#spanning-tree mode rapid-pvst
C6504(config)#end
C6504#show spanning-tree vlan 30-35 summary
Switch is in rapid-pvst mode
Root bridge for VLAN0030 is 8222.001e.c9de.d11a.
Root bridge for VLAN0031 is 8223.001e.c9de.d11a.
Root bridge for VLAN0032 is 8224.001e.c9de.d11a.
Root bridge for VLAN0033 is 8225.001e.c9de.d142.
Root bridge for VLAN0034 is 8226.001e.c9de.d142.
Root bridge for VLAN0035 is 8227.001e.c9de.d142.
EtherChannel misconfig guard      is enabled
Extended system ID                 is enabled
Portfast Default                   is disabled
Portfast Edge BPDU Guard Default  is disabled
Portfast Edge BPDU Filter Default is disabled
Loopguard Default                  is disabled
Platform PVST Simulation           is enabled
PVST Simulation Default            is enabled but inactive in rapid-pvst mode
Bridge Assurance                   is enabled
UplinkFast                         is disabled
BackboneFast                       is disabled
Pathcost method used               is short

```

Name	Blocking	Listening	Learning	Forwarding	STP Active
VLAN0030	0	0	0	2	2
VLAN0031	0	0	0	2	2
VLAN0032	0	0	0	2	2
VLAN0033	0	0	0	2	2
VLAN0034	0	0	0	2	2
VLAN0035	0	0	0	2	2

## 2.7 Multiple Spanning Tree Protocol

Multiple Spanning Tree Protocol (MSTP, 802.1Q-2005) defines an extension to RSTP by allowing VLANs to be grouped together in MST instances. This reduces the number of STP instances found with PVSTP+ deployments, increasing available compute resources on switches participating in STP. Figure 10 shows how the previous RPVSTP+ topology can be simplified into two MST instances. MST 1 handles VLANs 30-32 and MST 2 handles VLANs 33-35 reducing the number of STP instances from six to two with each N-Series switch being the root bridge for half of the configured VLANs. This can be useful if the maximum number of RSTP instances available on a given switch are exceeded.

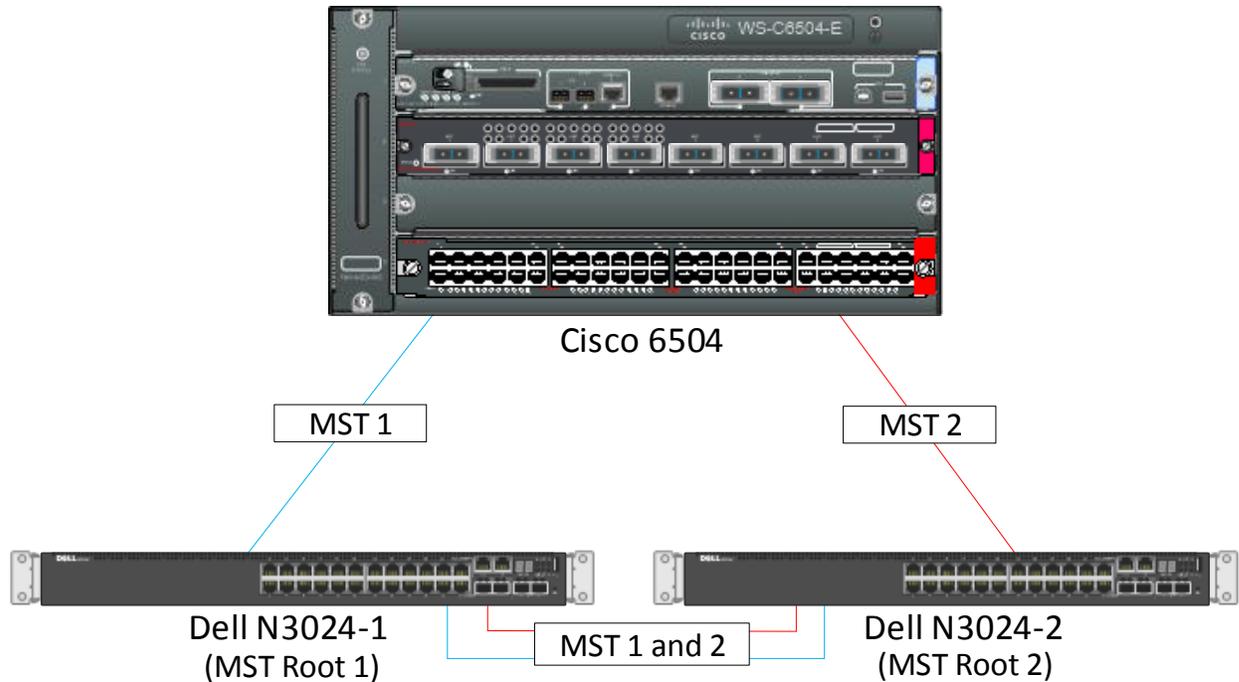


Figure 10 Multiple Spanning Tree Protocol

**Note:** All switches participating in the MSTP topology must have the same name, revision and instance mapping.

## 2.7.1 Configuring MST — Dell N-Series

The configuration below is for both Dell switches, N3024-1 and N3024-2. The *mst instance priority* value on each mst instance for each switch determines *STP root priority*, where the lower the value the higher the priority for selection. This setting ensures that the respective switch becomes the root for that MST instance. The *default* priority is 32768. For example, setting the MST 1 priority to 4096 on the first switch ensures that switch becomes the root for the MST 1 instance. Likewise, setting the MST 2 priority to 4096 on the second switch ensures that switch becomes the root for MST 2 instance. Setting the opposing MST instance priority to a value of 16384 ensures the partner switch will be the backup in the topology. MST instance VLANs, name and revision values must be identical across participating switches. Once the configuration is complete the command `show spanning-tree instance n`, where *n* represents instance ID can be issued to verify VLAN participation and port state.

```
N3024-1#configure
N3024-1 (config)#spanning-tree mst configuration
N3024-1 (config-mst)#instance 1 add vlan 30-32
N3024-1 (config-mst)#instance 2 add vlan 33-35
N3024-1 (config-mst)#name Region1
N3024-1 (config-mst)#revision 1
N3024-1 (config-mst)#exit
N3024-1 (config)#spanning-tree mst 1 priority 4096
N3024-1 (config)#spanning-tree mst 2 priority 16384
N3024-1 (config)#spanning-tree mode mst
N3024-1 (config)#exit
N3024-2#configure
N3024-2 (config)#spanning-tree mst configuration
N3024-2 (config-mst)#instance 1 add vlan 30-32
N3024-2 (config-mst)#instance 2 add vlan 33-35
N3024-2 (config-mst)#name Region1
N3024-2 (config-mst)#revision 1
N3024-2 (config-mst)#exit
N3024-2 (config)#spanning-tree mst 1 priority 16384
N3024-2 (config)#spanning-tree mst 2 priority 4096
N3024-2 (config)#spanning-tree mode mst
N3024-2 (config)#exit

N3024-1#show spanning-tree instance 1 | exclude DIS
Spanning Tree: Enabled BPDU Flooding: Disabled Portfast BPDU Filtering:
Disabled
Mode: mst
CST Regional Root:          10:00:68:EF:BD:EA:B1:80
Regional Root Path Cost:    0

##### MST 1 Vlan Mapped:    30-32
ROOT ID
          Priority          4096
          Address          001E.C9DE.D11A
```

```

          Path Cost          0
          Root Port
Bridge ID
          Priority          4096
          Address          001E.C9DE.D11A
          Hello Time 2 Sec Max Age 20 sec Forward Delay 15
Name      State      Prio.Nbr  Cost      Sts  Role  RestrictedPort
-----
Po5       Enabled   96.654   2000      FWD  Desg  No
Po8       Enabled   96.657   1000      FWD  Desg  No

```

N3024-1#**show spanning-tree instance 2 | exclude DIS**

Spanning Tree: Enabled BPDU Flooding: Disabled Portfast BPDU Filtering: Disabled

Spanning tree Enabled mode mst

CST Regional Root: 10:00:68:EF:BD:EA:B1:80

Regional Root Path Cost: 2000

##### MST 2 Vlan Mapped: 33-35

ROOT ID

```

          Priority          4096
          Address          001E.C9DE.D142
          Path Cost          1000
          Root Port          Po8
Bridge ID
          Priority          16384
          Address          001E.C9DE.D11A
          Hello Time 2 Sec Max Age 20 sec Forward Delay 15 sec
Name      State      Prio.Nbr  Cost      Sts  Role  RestrictedPort
-----
Po5       Enabled   96.654   2000      FWD  Desg  No
Po8       Enabled   96.657   1000      FWD  Root  No

```

Now the matching commands are ran on the second N3024 being sure to swap priority values. MST instance 1 has a priority of 16384 while MST instance 2 has a priority value set to 4096. In the following configuration, the spanning tree show commands are ran on the second N3024 to show that the switch is the root bridge for VLANs associated with MST instance 2.

N3024-2#**show spanning-tree instance 1 | exclude DIS**

Spanning tree Enabled mode mst

CST Regional Root: 10:00:68:EF:BD:EA:B1:80

Regional Root Path Cost: 2000

##### MST 1 Vlan Mapped: 30-32

ROOT ID

```

          Priority          4096

```

```

                Address      001E.C9DE.D11A
                Path Cost    1000
                Root Port    Po8

Bridge ID
                Priority      16384
                Address      001E.C9DE.D142
                Hello Time 2 Sec Max Age 20 sec Forward Delay 15

Name          State      Prio.Nbr  Cost      Sts  Role  RestrictedPort
-----
Po8           Enabled   96.657   1000      FWD  Root  No
Po13          Enabled   96.662   2000      FWD  Desk  No

```

N3024-2#**show spanning-tree instance 2 | exclude DIS**

```

Spanning tree Enabled mode most
CST Regional Root:      10:00:68:EF:BD:EA:B1:80
Regional Root Path Cost: 1000

```

##### MST 2 Vlan Mapped: 33-35

```

ROOT ID
                Priority      4096
                Address      001E.C9DE.D142
                Path Cost    0
                Root Port

Bridge ID
                Priority      4096
                Address      001E.C9DE.D142
                Hello Time 2 Sec Max Age 20 sec Forward Delay 15 sec

```

```

Name          State      Prio.Nbr  Cost      Sts  Role  RestrictedPort
-----
Po8           Enabled   96.657   1000      FWD  Desg  No
Po13          Enabled   96.662   2000      FWD  Desg  No

```

## 2.7.2 Configuring MST — Cisco Catalyst

In the following example, MST 0 is set to a priority of 4096. This insures that this switch will be the STP root for instance 0. MST instance 0 is actually an Internal Spanning Tree (IST) and is limited to one per region. Treat IST as a management STP instance and all non-assigned VLANs are placed in this instance by default. The `show spanning-tree mst 1, 2` command is then ran to show VLAN assignments and port participation in the STP structure.

```
C6504#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
C6504(config)#spanning-tree mode mst
C6504(config)#spanning-tree mst 0 priority 4096
C6504(config)#spanning-tree mst configuration
C6504(config-mst)#name Region1
C6504(config-mst)#revision 1
C6504(config-mst)#instance 1 vlan 30-32
C6504(config-mst)#instance 2 vlan 33-35
C6504(config-mst)#end
C6504#show spanning-tree mst 1,2

##### MST1      vlans mapped:   30-32
Bridge          address 68ef.bdea.b180  priority      32769 (32768 sysid 1)
Root           address 001e.c9de.d11a  priority      4097  (4096 sysid 1)
                port      Po5                cost          2000                rem hops 19

Interface      Role Sts Cost          Prio.Nbr Type
-----
Po5            Root FWD 2000          128.1665 P2p
Po13          Altn BLK 2000          128.1666 P2p

##### MST2      vlans mapped:   33-35
Bridge          address 68ef.bdea.b180  priority      32770 (32768 sysid 2)
Root           address 001e.c9de.d142  priority      4098  (4096 sysid 2)
                port      Po13                cost          2000                rem hops 19

Interface      Role Sts Cost          Prio.Nbr Type
-----
Po5            Altn BLK 2000          128.1665 P2p
Po13          Root FWD 2000          128.1666 P2p
```

## 2.8 Cisco Unidirectional Link Detection Interoperability

The Unidirectional Link Detection (UDLD) feature detects unidirectional links on physical ports. A unidirectional link is a forwarding anomaly in a Layer 2 communication channel in which a bi-directional link stops passing traffic in one direction. UDLD must be enabled on the both sides of the link in order to detect a unidirectional link. The UDLD protocol operates by exchanging packets containing information about neighboring devices. This feature is especially recommended when using fiber links.

### 2.8.1 Configuring UDLD — Dell N-Series

UDLD must first be enabled in global configuration mode and then on all participating physical interfaces. The **show udld** command confirms general configuration and **show udld te1/0/1** shows the UDLD state is in Bidirectional (functioning) mode.

```
N3024#configure
N3024(config)#udld enable
N3024(config)#interface range te1/0/1-4
N3024 (config-if)#udld enable
N3024(config-if)#end
N3024#show udld

Admin Mode..... Enabled
Message Interval..... 15
Timeout Interval..... 5
N3024#show udld Tengigabitethernet 1/0/1

Interface Admin Mode UDLD Mode UDLD Status
-----
Te1/0/1 Enabled Normal Bidirectional
```

### 2.8.2 Configuring UDLD — Cisco Catalyst

```
C6504#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
C6504(config)#udld enable
C6504(config)#end
C6504#show udld TenGigabitEthernet 2/1

Interface Te2/1
---
Port enable administrative configuration setting: Follows device default
Port enable operational state: Enabled
Current bidirectional state: Bidirectional
Current operational state: Advertisement - Single neighbor detected
Message interval: 15
```

Time out interval: 5

Entry 1

---

Expiration time: 37

Cache Device index: 1

Current neighbor state: Bidirectional

Device ID: 13705M1334LF

Port ID: Te1/0/1

Neighbor echo 1 device: 68EFBDEAB180

Neighbor echo 1 port: Te2/1

Message interval: 15

Time out interval: 5

CDP Device name: N3024

## 2.9 Interoperability with Cisco Discovery Protocol

Dell Networking N-Series switches participate in the Industry Standard Discovery Protocol (ISDP) and are able to both discover and be discovered by devices that support the Cisco Discovery Protocol (CDP). ISDP is a proprietary Layer 2 network protocol that inter-operates with Cisco network equipment and is used to share information between neighboring devices. ISDP is running by default and does not require any additional configuration to work with other ISDP or CDP enabled devices.

### 2.9.1 Interoperability with Cisco Discovery Protocol — Dell N-Series

The following commands show the current stats of ISDP, the neighbors currently detected and how to check and enable an interface that ISDP is disabled on.

```
N3024#show isdp
Timer..... 30
Hold Time..... 180
Version 2 Advertisements..... Enabled
Neighbors table time since last change..... 0 days 17:37:22
Device ID..... N3024
Device ID format capability..... Serial Number, Host Name
Device ID format..... Host Name

N3024#show isdp neighbors
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge,
                  S - Switch, H - Host, I - IGMP, r - Repeater

Device ID      Intf      Holdtime  Capability Platform      Port ID
-----
C6504          Tel1/0/1  158      R S I       cisco WS-C6504-E tenGiga
N3024-2        Tel1/0/3  175      R           N3024         Tel1/0/3
N3024-2        Tel1/0/4  175      R           N3024         Tel1/0/4

N3024(config)#show isdp interface Tengigabitethernet 1/0/2
Interface      Mode
-----
Tel1/0/2      Disabled

N3024#configure
N3024(config)#interface tengigabitethernet 1/0/2
N3024(config-if-Tel1/0/2)#isdp enable
N3024(config-if-Tel1/0/2)#end
```

## 2.9.2 Interoperability with Cisco Discovery Protocol — Cisco Catalyst

The following commands are similar to the Dell N-Series switches with **CDP** substituted for **ISDP**. The following shows CDP is enabled, the neighbors detected and how to verify and enable an interface where CDP has been disabled.

```
C6504#show cdp
Global CDP information:
    Sending CDP packets every 60 seconds
    Sending a holdtime value of 180 seconds
    Sending CDPv2 advertisements is enabled
C6504#show cdp neighbors

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone,
                  D - Remote, C - CVTA, M - Two-port Mac Relay

Device ID         Local Intrfce   Holdtme    Capability Platform Port ID
N3024-2           Ten 2/3        162        R          N3024   Te1/0/1
N3024-1           Ten 2/1        157        R          N3024   Te1/0/1
C6504#show cdp interface tenGigabitEthernet 2/1
TenGigabitEthernet2/1 is up, line protocol is up
  Encapsulation ARPA
  Sending CDP packets every 60 seconds
  Holdtime is 180 seconds
C6504#show cdp interface tenGigabitEthernet 2/2
C6504#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
C6504(config)#interface tenGigabitEthernet 2/2
C6504(config-if)#cdp enable
C6504(config-if)#end
```

## 2.10 Filtering Cisco Proprietary Protocols

Network Administrators often run into problems receiving multiple Cisco proprietary protocols on standards based switches, which causes unexpected results on the network. Therefore, Dell Networking has developed an easy way to block Cisco protocols when necessary. By applying built-in Access Control Lists (ACL) that block individual Cisco protocols on each port, the user can filter out unwanted packets from their network.

As one example, a switch Administrator would enter the following commands to enable automatic filtering of CDP packets on the interface:

```
N3024 (config) #interface gigabitethernet 1/0/3
N3024 (config-if) #service-acl input blockcdp
N3024 (config-if) #exit
```

**Note:** The `no service-acl input` command removes this filtering for the interface.

In the same way, administrators can block the other proprietary protocol packets individually (*cdp*, *vtp*, *dtp*, *pagp*, *udld*, *sstp*) as shown below.

```
N3024 (config) #interface gigabitethernet 1/0/3
N3024 (config-if) #service-acl input packet_type { packet_type packet_type... }
```

Where *packet\_type* is one of the following:

- blockcdp** blocks all cdp packets on this interface
- blockvtp** blocks all vtp packets on this interface
- blockdtp** blocks all dtp packets on this interface
- blockpagp** blocks all pagp packets on this interface
- blockudld** blocks all udld packets on this interface
- blocksstp** blocks all sstp packets on this interface
- blockall** blocks all Cisco proprietary protocols on this interface

Use one or more of these filters on each port by including a single or multiple packet types on a single line or use the *blockall* option to block all Cisco protocols on the port.

**Note:** These interface ACLs take precedence over any global configuration that may be active on the switch. For example, if a form of CDP is globally running on the switch, the **service-acl input blockcdp** interface option enforces the dropping of CDP packets for the ingress on this interface even if the global setting is enabled.

For more information, see the Link Local Protocol Filtering section in the *Dell Networking User Configuration Guide* for your switch.

## 2.11 Management VLAN vs Switch Virtual Interface

Management traffic is the basic messaging required to keep the network up and running. It uses BPDUs, VTP packets, CDPs and keep alives, in addition to management access traffic such as HTML, CLI, and SNMP. A Management VLAN is a VLAN specifically created for the use of managing the switch.

On a Dell Networking N3000, VLAN 1 is known as the *default VLAN* because all ports on the switch are assigned to it by default. It is also the default management VLAN on the switch. Configure this VLAN (or any other VLAN created) as the in-band management VLAN by assigning it an IP address through the console port on the switch. This, along with a configured username and password on the switch, will allow a telnet session through any port assigned to the VLAN to configure and manage the switch. This remote access provides the same commands as if attached to the OOB (Out-Of-Band) management port.

**Note:** A management VLAN is the in-band option used when there is not a separate OOB network available.

In-band management traffic is mixed in with production network traffic, and is subject to all of the filtering rules applied on a switched/routed port such as ACLs and VLAN tagging. See the Dell Networking User's Guide for your switch for more information on OOB versus Management VLAN.

The Cisco Catalyst uses a similar setting known as Switch Virtual Interface (SVI) to do remote switch management. Figure 11 shows the basic topology connecting a management VLAN and an SVI.

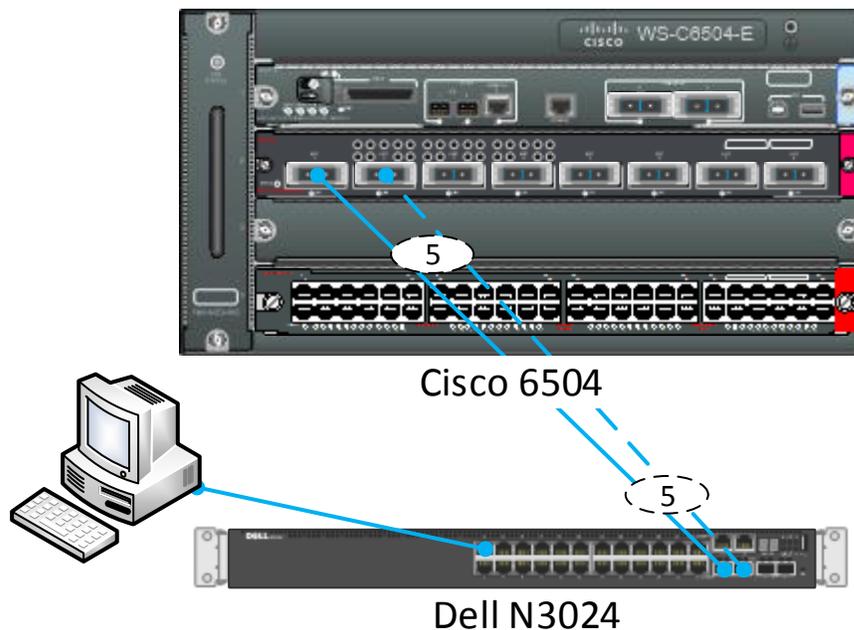


Figure 11 Management VLAN

Both switches use the port channel created earlier that was configured to allow VLANs 30 through 35. VLAN 30 is configured to carry in-band management traffic. The ports that carry switch-to-switch traffic are said to be in *trunk* mode and by default accept and pass all management traffic once a management VLAN has been

defined. To create a Management VLAN or SVI, create a VLAN interface and then add an IP address to this interface.

### 2.11.1 Configuring Management VLAN — Dell N-Series

The example below shows the commands for setting up a management VLAN on the Dell Networking N3000. After creating a username and password for remote access to the switch, create a VLAN and assign it an IP address. Assign trunk ports to be attached to the Cisco Catalyst or other switch. Finally, configure a single access port, though any number of ports may be added and used in the management VLAN.

Running the commands below on the Dell Networking N3000 switch makes vlan 30 a management VLAN, allowing in-band management to the switch.

```
N3024#configure
N3024(config)#vlan 30
N3024(config-vlan30)#name "Management"
N3024(config-vlan)#exit
N3024(config)#interface vlan 30
N3024(config-if-vlan30)#ip address 192.168.30.50 255.255.255.0
N3024(config-if-vlan30)#exit
```

A telnet session is now allowed into the Dell Networking switch through the EtherChannel 5, which is trunk enabled, to in-band management VLAN 30.

## 2.11.2 Configuring Management VLAN — Cisco Catalyst

Run the commands below on the Cisco Catalyst switch to create an SVI, which allows in-band management to the switch.

```
C6504#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
C6504(config)#vlan 30
C6504(config-vlan)#name "In-Band Management"
C6504(config-vlan)#exit
% Applying VLAN changes may take few minutes. Please wait...
C6504(config)#interface vlan 30
C6504(config-if)#ip address 192.168.30.51 255.255.255.0
C6504(config-if)#no shutdown
C6504(config-if)#end
6504#show ip interface brief | i Vlan
```

Interface	IP-Address	OK?	Method	Status	Protocol
Vlan1	unassigned	YES	unset	administratively down	down
Vlan30	192.168.30.51	YES	NVRAM	up	up

Using this configuration, it is possible to reach both switches through the in-band management VLAN 30. In this example, telnet 192.168.30.50 accesses the Dell Networking switch, and telnet 192.168.30.51 accesses the Cisco switch.

**Note:** Other basic setup configurations might be necessary for the Dell Networking N3000 or Cisco Catalyst 6504 switches, such as a DHCP option for management VLANs, enabling SSH, assigning a domain server, changing native VLANs or assigning a domain name. Configuration steps for these features on the N3000-series are found in the [Dell Networking N3000 User Configuration Guide](#).

## A Additional Resources

Support.dell.com is focused on meeting your needs with proven services and support.

DellTechCenter.com is an IT Community where you can connect with Dell EMC customers and Dell EMC employees to share knowledge, best practices and information about Dell EMC products and installations.

Referenced or recommended Dell EMC publications:

- Dell Networking Support  
<http://www.dell.com/support>
- Dell TechCenter (community forums and blogs for Dell EMC customers)  
<http://delltechcenter.com>
- Dell Networking Whitepapers  
<http://en.community.dell.com/techcenter/networking/p/guides>
- Dell Networking N1500/N2000/N3000/N4000 User's Guides and Firmware downloads  
<http://en.community.dell.com/techcenter/networking/p/guides#N-series>

## B Configuration details

The examples in this paper were verified using the following components and versions.

Component	Firmware Version
Dell Networking N2000, N30xx, N40xx	6.2.0.5
Dell Networking N15xx	6.2.5.2
Cisco Catalyst WS-C6504-E	12.2(33)SX14a

# Support and Feedback

## Contacting Technical Support

Support Contact Information

Web: <http://support.dell.com/>

Telephone: USA: 1-800-945-3355

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