

Configuring InterVLAN Routing with Catalyst 3750/3560/3550 Series Switches

Document ID: 41260

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Introduction

This document explains how to configure interVLAN routing with Cisco Catalyst 3750/3560/3550 series switches. The document provides a sample configuration for interVLAN routing with a Catalyst 3550 series switch that runs enhanced multilayer image (EMI) software in a typical network scenario. The document uses a Catalyst 2950 series switch and a Catalyst 2948G switch as Layer 2 (L2) closet switches that connect to the Catalyst 3550. The Catalyst 3550 configuration also has a default route for all traffic that goes to the Internet when the next hop points to a Cisco 7200VXR router. You can substitute a firewall or other routers for the Cisco 7200VXR router.

Prerequisites

Requirements

Ensure that you meet these requirements before you attempt this configuration:

- Knowledge of how to create VLANs

For more information, refer to *Creating Ethernet VLANs on Catalyst Switches*.

- Knowledge of how to create VLAN trunks

For more information, refer to the *Configuring VLAN Trunks* section of *Configuring VLANs*.

Components Used

The information in this document is based on these software and hardware versions:

- Catalyst 3550–48 that runs Cisco IOS® Software Release 12.1(12c)EA1 EMI
- Catalyst 2950G–48 that runs Cisco IOS Software Release 12.1(12c)EA1 EI
- Catalyst 2948G that runs Catalyst OS (CatOS) version 6.3(10)

Note: The configuration from the Cisco 7200VXR is not relevant, so this document does not show the configuration.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, make sure that you understand the potential impact of any command.

Related Products

This configuration can also be used with these hardware and software versions:

- Any Catalyst 3750/3560/3550 switch that runs EMI software or standard multilayer image (SMI) Cisco IOS Software Release 12.1(11)EA1 and later
- Any Catalyst 2900XL/3500XL/2950/3550 or CatOS switch model, used as the access layer switch

Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

Background Theory

In a switched network, VLANs separate devices into different collision domains and Layer 3 (L3) subnets. Devices within a VLAN can communicate with each other without the need for routing. Devices in separate VLANs require a routing device to communicate with one another.

L2-only switches require an L3 routing device. The device is either external to the switch or in another module on the same chassis. A new breed of switches incorporate routing capability within the switch. An example is the 3550. The switch receives a packet, determines that the packet belongs to another VLAN, and sends the packet to the appropriate port on the other VLAN.

A typical network design segments the network based on the group or function to which the device belongs. For example, the engineering VLAN only has devices that relate to the engineering department, and the finance VLAN only has devices that relate to finance. If you enable routing, the devices in each VLAN can talk to one another without the need for all the devices to be in the same broadcast domain. Such a VLAN design also has an additional benefit. The design allows the administrator to restrict communication between VLANs with use of access lists. In the example in this document, you can use access lists to restrict the engineering VLAN from access to devices on the finance VLAN.

The switch does not route non-IP packets between VLANs and routed ports. You can forward these non-IP packets with fallback bridging. In order to use this feature, you must have the IP services image, formerly known as the enhanced multilayer image (EMI), installed on your switch.

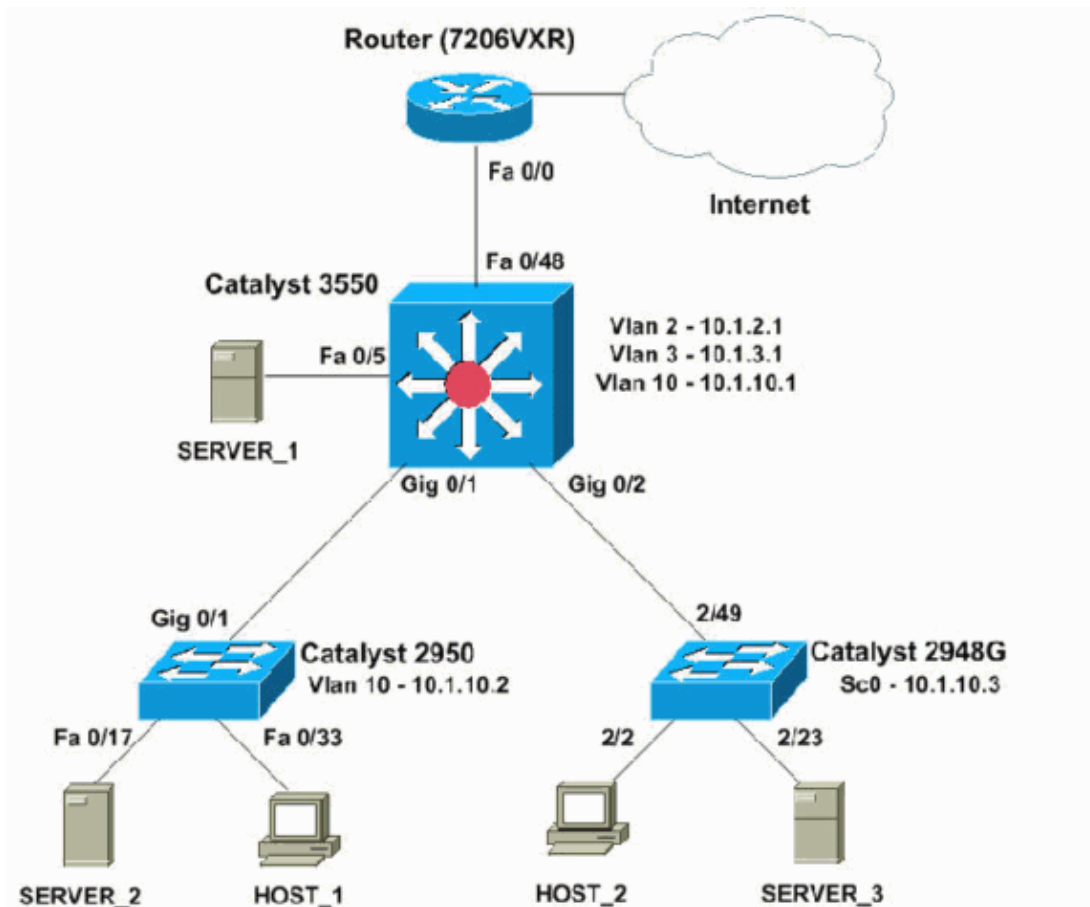
Configure

In this section, you are presented with the information to configure the features described in this document.

Note: Use the Command Lookup Tool [↗](#) (registered customers only) to find more information on the commands used in this document.

Network Diagram

This document uses this network setup:



In this diagram, a small sample network with the Catalyst 3550 provides interVLAN routing between the various segments. By default, the Catalyst 3550 switch acts as an L2 device with disablement of IP routing. In order to make the switch function as an L3 device and provide interVLAN routing, you must enable IP routing globally.

These VLANs are the three VLANs that the user defines:

- VLAN 2 user VLAN
- VLAN 3 server VLAN
- VLAN 10 management VLAN

The default gateway configuration on each server and host device must be the VLAN interface IP address that corresponds on the 3550. For example, for servers, the default gateway is 10.1.3.1. The access layer switches, which are the Catalyst 2950 and 2948G, are trunked to the Catalyst 3550 switch.

The default route for the Catalyst 3550 points to the Cisco 7200VXR router. The Catalyst 3550 uses this default route to route traffic destined for the Internet. Therefore, traffic for which the 3550 does not have a routing table entry forwards to the 7200VXR for process.

Practical Tips

- Ensure that the native VLAN for an 802.1Q trunk is the same on both ends of the trunk link. If the native VLAN on one end of the trunk is different than the native VLAN on the other end, the traffic of the native VLANs on both sides cannot be transmitted correctly on the trunk. This failure to transmit correctly can imply some connectivity issues in your network.
- Separate the management VLAN from the user or server VLAN, as in this diagram. The management VLAN is different from the user or server VLAN. With this separation, any broadcast/packet storm

that occurs in the user or server VLAN does not affect the management of switches.

- Do not use VLAN 1 for management. All ports in Catalyst switches default to VLAN 1, and any devices that connect to nonconfigured ports are in VLAN 1. The use of VLAN 1 for management can cause potential issues for the management of switches, as the second tip explains.
- Use a Layer 3 (routed) port to connect to the default gateway port. In this example, you can easily replace a Cisco 7200VXR router with a firewall that connects to the Internet gateway router.
- Do *not* run a routing protocol between the Catalyst 3550 and the Internet gateway router. This example configures a static default route on the 3550 instead. This setup is best if there is only one route to the Internet. Make sure to configure static routes, preferably summarized, on the gateway router (7200VXR) for subnets that can be reached by the Catalyst 3550. This step is very important because this configuration does not use routing protocols.
- If you have two Catalyst 3550 switches in your network, you can dual connect the access layer switches to both 3550 switches. Run Hot Standby Router Protocol (HSRP) between the switches to provide redundancy in the network. For more information on the configuration of HSRP, refer to the *Configuring HSRP* section of *Configuring IP Services*.
- If you need additional bandwidth for the uplink ports, you can configure EtherChannel. EtherChannel also provides link redundancy in the case of a link failure.

Configurations

This document uses these configurations:

- Catalyst 3550
- Catalyst 2950
- Catalyst 2948G

Catalyst 3550 (Catalyst 3550–48 Switch)

```
Cat3550#show running-config
Building configuration...

Current configuration : 3092 bytes
!
version 12.1
no service single-slot-reload-enable
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Cat3550
!
!
ip subnet-zero

!--- Enable IP routing for interVLAN routing.

ip routing
!!
!
spanning-tree extend system-id
!
!
!
interface FastEthernet0/1
 no ip address
!

!--- Output suppressed.
```

```

!
interface FastEthernet0/5
  description to SERVER_1

!--- Configure the server port to be in the server VLAN, VLAN 3.

switchport access vlan 3

!--- Configure the port to be an access port to prevent trunk negotiation delays.

  switchport mode access
  no ip address

!--- Configure PortFast for initial Spanning Tree Protocol (STP) delay. Refer to
!--- Using PortFast and Other Commands to Fix Workstation Startup Connectivity Delays
!--- for more information.

spanning-tree portfast
!

!--- Output suppressed.

!
interface FastEthernet0/48
  description To Internet_Router

!--- The port that connects to the router converts into a routed (L3) port.

no switchport

!--- Configure the IP address on this port.

ip address 200.1.1.1 255.255.255.252
!
interface GigabitEthernet0/1
  description To 2950

!--- Configure IEEE 802.1 (dot1q) trunking, with negotiation, on the L2 switch.
!--- If there is not support for Dynamic Trunking Protocol (DTP) on the far switch,
!--- issue the switchport mode trunk command to force the switch port to trunk mode.
!--- Note: The default trunking mode is dynamic auto. If you establish a trunk link
!--- with the default trunking mode, the trunk does not appear
!--- in the configuration, even though a trunk has been established on
!--- the interface. Use the show interfaces trunk command to verify the
!--- establishment of the trunk.

switchport trunk encapsulation dot1q
  no ip address
!
interface GigabitEthernet0/2
  description To 2948G
  switchport trunk encapsulation dot1q
  no ip address
!
interface Vlan1
  no ip address
  shutdown
!
interface Vlan2
  description USER_VLAN

!--- This IP address is the default gateway for users.

  ip address 10.1.2.1 255.255.255.0
!
interface Vlan3

```

```

description SERVER_VLAN

!--- This IP address is the default gateway for servers.

ip address 10.1.3.1 255.255.255.0
!
interface Vlan10
description MANAGEMENT_VLAN

!--- This IP address is the default gateway for other L2 switches.

ip address 10.1.10.1 255.255.255.0
!
ip classless

!--- This route statement allows the 3550 to send Internet traffic to
!--- the default router which, in this case, is the 7200VXR (Fe 0/0 interface).

ip route 0.0.0.0 0.0.0.0 200.1.1.2
ip http server
!
!
!
line con 0
line vty 5 15
!
end

```

Note: Since the 3550 has configuration as a VLAN Trunk Protocol (VTP) server, the switch does not display the VTP configuration. This behavior is standard. This switch uses these commands to create a VTP server with the three VLANs that the user defined from global configuration mode:

```

Cat3550(config)#vtp domain cisco
Cat3550(config)#vtp mode server
Cat3550(config)#vlan 2
Cat3550(config-vlan)#name USER_VLAN
Cat3550(config-vlan)#exit
Cat3550(config)#vlan 3
Cat3550(config-vlan)#name SERVER_VLAN
Cat3550(config-vlan)#exit
Cat3550(config)#vlan 10
Cat3550(config-vlan)#name MANAGEMENT

```

Catalyst 2950 (Catalyst 2950G-48 Switch)

```

Cat2950#show running-config
Building configuration...

Current configuration : 2883 bytes
!
version 12.1
no service single-slot-reload-enable
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Cat2950
!
!
ip subnet-zero
!
spanning-tree extend system-id
!

```

```
!  
interface FastEthernet0/1  
  no ip address  
!  
  
!--- Output suppressed.  
  
interface FastEthernet0/16  
  no ip address  
!  
interface FastEthernet0/17  
  description SERVER_2  
  switchport access vlan 3  
  switchport mode access  
  no ip address  
  spanning-tree portfast  
!  
  
!--- Output suppressed.  
  
!  
interface FastEthernet0/33  
  description HOST_1  
  
!--- Configure HOST_1 to be the user VLAN, VLAN 2.  
  
  switchport access vlan 2  
  switchport mode access  
  no ip address  
  spanning-tree portfast  
!  
  
!--- Output suppressed.  
  
interface GigabitEthernet0/1  
  switchport trunk encapsulation dot1q  
  no ip address  
!  
interface GigabitEthernet0/2  
  no ip address  
!  
interface Vlan1  
  no ip address  
  no ip route-cache  
  shutdown  
!  
interface Vlan10  
  description MANAGEMENT  
  
!--- This IP address manages this switch.  
  
ip address 10.1.10.2 255.255.255.0  
  no ip route-cache  
!  
  
!--- Configure the default gateway so that the switch is reachable from other  
!--- VLANs/subnets. The gateway points to the VLAN 10 interface on the 3550.  
  
ip default-gateway 10.1.10.1  
ip http server  
!  
!  
line con 0  
line vty 5 15  
!
```

```
end
```

Note: Since the Catalyst 2950 has configuration as a VTP client, the switch does not display the VTP configuration. This behavior is standard. The 2950 acquires the VLAN information from the VTP server, which is the 3550. This 2950 switch uses these commands to make the switch a VTP client in the VTP domain `cisco` from global configuration mode:

```
Cat2950(config)#vtp domain cisco
Cat2950(config)#vtp mode client
```

Catalyst 2948G Switch

```
Cat2948G> (enable) show config
This command shows non-default configurations only.
Use 'show config all' to show both default and non-default configurations.
.....
.....
..
begin
!
# ***** NON-DEFAULT CONFIGURATION *****
!
!
#time: Fri Jun 30 1995, 05:04:47
!
#version 6.3(10)
!
!
#system web interface version(s)
!
#test
!
#system
set system name Cat2948G
!
#frame distribution method
set port channel all distribution mac both
!
#vtp

!--- Configure the VTP domain to be the same as the 3550, the VTP server.
set vtp domain cisco

!--- Choose the VTP mode as client for this switch.
set vtp mode client
!
#ip

!--- Configure the management IP address in VLAN 10.
set interface sc0 10 10.1.10.3/255.255.255.0 10.1.10.255

set interface sl0 down
set interface me1 down

!--- Define the default route so that the switch is reachable.
set ip route 0.0.0.0/0.0.0.0 10.1.10.1
!
#set boot command
```

```

set boot config-register 0x2
set boot system flash bootflash:cat4000.6-3-10.bin
!
#module 1 : 0-port Switching Supervisor
!
#module 2 : 50-port 10/100/1000 Ethernet

!--- Configure HOST_2 and SERVER_3 ports in respective VLANs.

set vlan 2    2/2
set vlan 3    2/23
set port name    2/2  To HOST_2
set port name    2/23 to SERVER_3

!--- Configure trunk to 3550 with dot1q encapsulation.

set trunk 2/49 desirable dot1q 1-1005
end

```

Verify

This section provides information you can use to confirm your configuration works properly.

The Output Interpreter Tool [🔗](#) (registered customers only) (OIT) supports certain **show** commands. Use the OIT to view an analysis of **show** command output.

Catalyst 3550

- **show vtp status**

```

Cat3550#show vtp status
VTP Version                : 2
Configuration Revision     : 3
Maximum VLANs supported locally : 1005
Number of existing VLANs   : 8
VTP Operating Mode         : Server
VTP Domain Name            : cisco
VTP Pruning Mode           : Disabled
VTP V2 Mode                : Disabled
VTP Traps Generation       : Disabled
MD5 digest                 : 0x54 0xC0 0x4A 0xCE 0x47 0x25 0x0B 0x49
Configuration last modified by 200.1.1.1 at 3-1-93 01:06:24
Local updater ID is 10.1.2.1 on interface Vl2 (lowest numbered VLAN interface found)

```

- **show interfaces trunk**

```

Cat3550#show interfaces trunk

Port      Mode           Encapsulation  Status        Native vlan
Gi0/1     desirable     802.1q         trunking     1
Gi0/2     desirable     802.1q         trunking     1

Port      Vlans allowed on trunk
Gi0/1     1-4094
Gi0/2     1-4094

Port      Vlans allowed and active in management domain
Gi0/1     1-3,10
Gi0/2     1-3,10

Port      Vlans in spanning tree forwarding state and not pruned
Gi0/1     1-3,10

```

Gi0/2 1-3,10

• show ip route

```
Cat3550#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route
```

Gateway of last resort is 200.1.1.2 to network 0.0.0.0

```
200.1.1.0/30 is subnetted, 1 subnets
C    200.1.1.0 is directly connected, FastEthernet0/48
10.0.0.0/24 is subnetted, 3 subnets
C    10.1.10.0 is directly connected, Vlan10
C    10.1.3.0 is directly connected, Vlan3
C    10.1.2.0 is directly connected, Vlan2
S*  0.0.0.0/0 [1/0] via 200.1.1.2
```

Catalyst 2950

• show vtp status

```
Cat2950#show vtp status
VTP Version                : 2
Configuration Revision     : 3
Maximum VLANs supported locally : 250
Number of existing VLANs   : 8
VTP Operating Mode         : Client
VTP Domain Name            : cisco
VTP Pruning Mode           : Disabled
VTP V2 Mode                : Disabled
VTP Traps Generation       : Disabled
MD5 digest                 : 0x54 0xC0 0x4A 0xCE 0x47 0x25 0x0B 0x49
Configuration last modified by 200.1.1.1 at 3-1-93 01:06:24
```

• show interfaces trunk

```
Cat2950#show interfaces trunk

Port      Mode           Encapsulation  Status        Native vlan
Gi0/1     desirable     802.1q         trunking     1

Port      Vlans allowed on trunk
Gi0/1     1-4094

Port      Vlans allowed and active in management domain
Gi0/1     1-3,10

Port      Vlans in spanning tree forwarding state and not pruned
Gi0/1     1-3,10
```

Catalyst 2948G

• show vtp domain

```
Cat2948G> (enable) show vtp domain
Domain Name                Domain Index VTP Version Local Mode Password
-----
cisco                      1            2            client      -
```

```

Vlan-count Max-vlan-storage Config Revision Notifications
-----
8          1023             3             disabled

Last Updater V2 Mode Pruning PruneEligible on Vlans
-----
200.1.1.1    disabled disabled 2-1000

```

• **show trunk**

```

Cat2948G> (enable) show trunk
* - indicates vtp domain mismatch
Port      Mode           Encapsulation  Status      Native vlan
-----
2/49     desirable     dot1q          trunking    1

Port      Vlans allowed on trunk
-----
2/49     1-1005

Port      Vlans allowed and active in management domain
-----
2/49     1-3,10

Port      Vlans in spanning tree forwarding state and not pruned
-----
2/49     1-3,10

```

Troubleshoot

Use this section to troubleshoot your configuration.

Troubleshooting Procedure

Follow these instructions:

1. If you are not able to ping devices within the same VLAN, check the VLAN assignment of the source and destination ports to make sure that the source and destination are in the same VLAN.

In order to check the VLAN assignment, issue the **show port *mod/port*** command for CatOS or the **show interface status** command for Cisco IOS Software.

If the source and destination are not in the same switch, make sure that you have configured trunking properly. In order to check the configuration, issue the **show trunk** command for CatOS or the **show interfaces trunk** command for Cisco IOS Software. Also, check that the native VLAN matches on either side. Make sure that the subnet mask matches between the source and destination devices.

2. If you are not able to ping devices in different VLANs, make sure that you can ping the respective default gateway.

Note: See Step 1.

Also, make sure that the default gateway of the device points to the correct VLAN interface IP address. Make sure that the subnet mask matches.

3. If you are not able to reach the Internet, make sure that the default route on the 3550 points to the correct IP address, and that the subnet address matches the Internet gateway router.

In order to check, issue the **show ip interface *interface-id*** command and the **show ip route** command. Make sure that the Internet gateway router has routes to the Internet and the internal networks.

Related Information

- [Creating Ethernet VLANs on Catalyst Switches](#)
 - [LAN Product Support](#)
 - [LAN Switching Technology Support](#)
 - [Technical Support & Documentation – Cisco Systems](#)
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Updated: Oct 31, 2006

Document ID: 41260
