

Configuring ISL Trunks on Cisco Routers

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Introduction

This document discusses the configuration of Inter-Switch Link Protocol (ISL) trunks on external Cisco routers like the 7500/7000, 3600, 4500, or 2500 series. This document does not discuss the configuration of ISL trunks on Layer 2 (L2)/Layer 3 (L3) switches like the Cisco Catalyst 6500 or 4500.

For information on configuring ISL and 802.1Q trunks between Catalyst L2 and L3 switches that run Catalyst OS (CatOS) or Cisco IOS® Software, refer to either of these:

- The Related Information section of this document
- The LAN Product Support Pages

Prerequisites

Requirements

Readers of this document should have knowledge of these topics:

- ISL support on Catalyst switches

ISL support is hardware-dependent for Catalyst switches. When you connect an external router to a Catalyst 6500/6000, 5500/5000 or 4500/4000 switch, use one of these commands to determine the encapsulation support per module:

- ◆ CatOS **show port capabilities**
- ◆ Cisco IOS Software **show interfaces capabilities**
- ISL support on Cisco routers

In Cisco IOS Software Release 11.2 and later, only a Plus feature set is necessary. The Plus feature set is either IP Plus or Desktop Plus. Any Fast Ethernet or Gigabit Ethernet interface on the routers supports ISL VLAN trunking.

In Cisco IOS Software Release 11.3 and earlier, only IP and Internetwork Packet Exchange (IPX) with an IEEE 802.3 (Novell-Ether) encapsulation have support over ISL. Cisco IOS Software Release 11.3 added additional encapsulations and protocols.

Components Used

This document is not restricted to specific software and hardware versions.

Conventions

For more information on document conventions, refer to the Cisco Technical Tips Conventions.

Background Information

A VLAN is a logical broadcast domain. In order to allow data to traverse between two VLANs, or broadcast domains, you must use an L3 device to route between the VLANs. The seven-layer Open System Interconnection (OSI) model defines this rule. Any of these devices can accomplish this routing:

- An external router, such as the 2500, 4000, or 7000
- An internal router, such as a Multilayer Switch Feature Card (MSFC)
- An external device with routing software, like a UNIX host that runs routed or gated

The original method was to connect a different physical port on the router to each individual VLAN. This method becomes very expensive as the number of VLANs increases. But there is a better method. The network administrators can decide to use VLAN trunking to assign multiple VLANs to a single routed interface instead. Only routers with 100 MB or faster Ethernet ports can do VLAN trunking.

VLAN trunking allows 100 MB Fast Ethernet or 1000 MB Gigabit Ethernet interfaces to place a tag on the packet that identifies the VLAN to which the packet belongs. When the other end of the ISL trunk receives this tagged packet, the ISL trunk places the packet in the correct VLAN. The ISL tag is a 30-byte header that is added around the Fast Ethernet frame. Therefore, ISL is a point-to-point technology and only works between two Cisco switches or routers that support ISL on the 100 MB Fast Ethernet or 1000 MB Gigabit Ethernet interfaces.

This figure provides a visual description of ISL trunks:


```

!
!
interface FastEthernet0

!--- Only Layer 1 is configured here.

no ip address
full-duplex
!
interface FastEthernet0.1

!--- All L2 and L3 are on subinterfaces.

encapsulation isl 1

!--- This defines ISL encapsulation and the VLAN number.

ip address 10.6.1.220 255.255.255.0
no ip redirects
appletalk cable-range 100-100 100.149
appletalk zone cisco
ipx network ABC encapsulation SAP
!
interface FastEthernet0.2
encapsulation isl 2
ip address 10.7.1.220 255.255.255.0
no ip redirects
appletalk cable-range 200-200 200.135
appletalk zone cisco1
ipx network DEADBEEF encapsulation ARPA
!
interface FastEthernet0.3
encapsulation isl 3
ip address 10.8.1.220 255.255.255.0
no ip redirects
appletalk cable-range 300-300 300.69
appletalk zone cisco2
ipx network 1234 encapsulation SNAP
!
ip classless
!
line con 0
line aux 0
line vty 0 4
password cisco
login
!
end

```

You need to configure the **encapsulation isl** *vlan#* command before you configure any other L2 or L3 information. The subinterface does not have to match the VLAN ID number. However, a match makes the administration and troubleshooting of VLAN issues easier.

You must use subinterfaces to avoid a violation of the split-horizon rule. The split horizon rule prohibits the advertisement of a route by a router through an interface that the router itself is using to reach the destination. This approach is very similar to use of point-to-point subinterfaces with Frame Relay in a WAN environment.

Debug and Troubleshoot

Once you have verified that your configuration, Cisco IOS Software, and hardware platform are correct, you need to verify that things work correctly. Use the commands in this section to verify operation and

troubleshoot problems.

Note: Certain **show** commands are supported by the Output Interpreter Tool [🔗](#) (registered customers only), which allows you to view an analysis of **show** command output.

Note: Before issuing **debug** commands, refer to Important Information on Debug Commands.

- **show vlan** This command tells you what L2 or L3 information is configured for each VLAN.

```
lt-4500-static# show vlan
Virtual LAN ID: 1 (Inter Switch Link Encapsulation)
vLAN Trunk Interface: FastEthernet0.1
  Protocols Configured: Address: Received: Transmitted:
    IP 10.6.1.220 0 0
    IPX (SAP) ABC.0000.0c0b.f2f5 0 8
    AppleTalk 100.149 0 22
Virtual LAN ID: 2 (Inter Switch Link Encapsulation)
vLAN Trunk Interface: FastEthernet0.2
  Protocols Configured: Address: Received: Transmitted:
    IP 10.7.1.220 0 0
    IPX (ARPA) DEADBEEF.0000.0c0b.f2f5 0 8
    AppleTalk 200.135 0 22
Virtual LAN ID: 3 (Inter Switch Link Encapsulation)
vLAN Trunk Interface: FastEthernet0.3
  Protocols Configured: Address: Received: Transmitted:
    IP 10.8.1.220 0 0
    IPX (SNAP) 1234.0000.0c0b.f2f5 0 9
    AppleTalk 300.69 0 23
```

- **show interface** This command tells you the state of the interface and subinterfaces, as well as the VLAN color of the subinterfaces. The VLAN color is the same as the VLAN number.

```
lt-4500-static# show interface
FastEthernet0 is up, line protocol is up
  Hardware is DEC21140, address is 0000.0c0b.f2f5 (bia 0000.0c0b.f2f5)
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set, keepalive set (10 sec)
  Full-duplex, 100Mb/s, 100BaseTX/FX
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output 00:00:03, output hang never
  Last clearing of "show interface" counters 00:04:25
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 1 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    415 packets input, 25392 bytes, 0 no buffer
    Received 415 broadcasts, 0 runts, 0 giants, 0 throttles
    0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
    0 watchdog, 0 multicast
    0 input packets with dribble condition detected
    137 packets output, 12378 bytes, 0 underruns
    0 output errors, 0 collisions, 0 interface resets
    0 babbles, 0 late collision, 0 deferred
    0 lost carrier, 0 no carrier
    0 output buffer failures, 0 output buffers swapped out
FastEthernet0.1 is up, line protocol is up
  Hardware is DEC21140, address is 0000.0c0b.f2f5 (bia 0000.0c0b.f2f5)
  Internet address is 10.6.1.220/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec, rely 255/255, load 1/255
  Encapsulation ISL Virtual LAN, Color 1.
  ARP type: ARPA, ARP Timeout 04:00:00
FastEthernet0.2 is up, line protocol is up
  Hardware is DEC21140, address is 0000.0c0b.f2f5 (bia 0000.0c0b.f2f5)
  Internet address is 10.7.1.220/24
  MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec, rely 255/255, load 1/255
```

```

Encapsulation ISL Virtual LAN, Color 2.
ARP type: ARPA, ARP Timeout 04:00:00
FastEthernet0.3 is up, line protocol is up
Hardware is DEC21140, address is 0000.0c0b.f2f5 (bia 0000.0c0b.f2f5)
Internet address is 10.8.1.220/24
MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec, rely 255/255, load 1/255
Encapsulation ISL Virtual LAN, Color 3.
ARP type: ARPA, ARP Timeout 04:00:00

```

- **show {ip | ipx | appletalk} route** This command tells you that the correct ISL subinterface is learning or sending the routing information.

```

lt-4500-static# 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, * - candidate default
       U - per-user static route, o - ODR
Gateway of last resort is not set
 10.0.0.0/24 is subnetted, 3 subnets
C       10.8.1.0 is directly connected, FastEthernet0.3
C       10.7.1.0 is directly connected, FastEthernet0.2
C       10.6.1.0 is directly connected, FastEthernet0.1

```

```

lt-4500-static# show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static P - proxy
3 routes in internet
The first zone listed for each entry is its default (primary) zone.
C Net 100-100 directly connected, Fa0.1, zone cisco
C Net 200-200 directly connected, Fa0.2, zone cisco1
C Net 300-300 directly connected, Fa0.3, zone cisco2

```

```

lt-4500-static# show ipx route
Codes: C - Connected primary network, c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses, U - Per-user static
3 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.
No default route known.
C       ABC (ISL vLAN), Fa0.1
C       1234 (ISL vLAN), Fa0.3
C       DEADBEEF (ISL vLAN), Fa0.2

```

- **debug vlan packet** This command tells you if there is a misconfiguration of the packets on the ISL trunk or if the wrong ISL subinterface is sending or receiving the packets.



Caution: Always be careful when you use any **debug** command. The **debug** commands can cause severe performance issues on the router. To disable debugging, issue the **undebg all** command.

```

lt-4500-static# debug vlan packet
Virtual LAN packet information debugging is on
lt-4500-static#
vLAN: Received ISL encapsulated UNKNOWN packet bearing colour ID 2
       on interface FastEthernet0.2 which is not configured to
       route or bridge this packet type.
vLAN: Received ISL encapsulated UNKNOWN packet bearing colour ID 1
       on interface FastEthernet0.1 which is not configured to
       route or bridge this packet type.
vLAN: Received ISL encapsulated UNKNOWN packet bearing colour ID 3
       on interface FastEthernet0.3 which is not configured to
       route or bridge this packet type.
vLAN: ISL packet received bearing colour ID 4 on FastEthernet0

```

which has no subinterface configured to route or bridge ID 4.
vLAN: ISL packet received bearing colour ID 5 on FastEthernet0
which has no subinterface configured to route or bridge ID 5.
vLAN: Received ISL encapsulated UNKNOWN packet bearing colour ID 1
on interface FastEthernet0.1 which is not configured to
route or bridge this packet type.
vLAN: Received ISL encapsulated UNKNOWN packet bearing colour ID 2
on interface FastEthernet0.2 which is not configured to
route or bridge this packet type.

Related Information

- [Configuring ISL Trunking on Catalyst 5500/5000 and 6500/6000 Family Switches](#)
 - [Configuring ISL Trunking Between Catalyst 5000/6000 Switches Running CatOS](#)
 - [Configuring ISL Trunking Between Catalyst Switches Running CatOS and Cisco IOS System Software](#)
 - [Configuring ISL and 802.1q Trunking Between a CatOS Switch and an External Router \(InterVLAN Routing\)](#)
 - [Configuring InterVLAN Routing and ISL/802.1Q Trunking on a Catalyst 2900XL/3500XL/2950 Switch Using an External Router](#)
 - [LAN Product Support Pages](#)
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