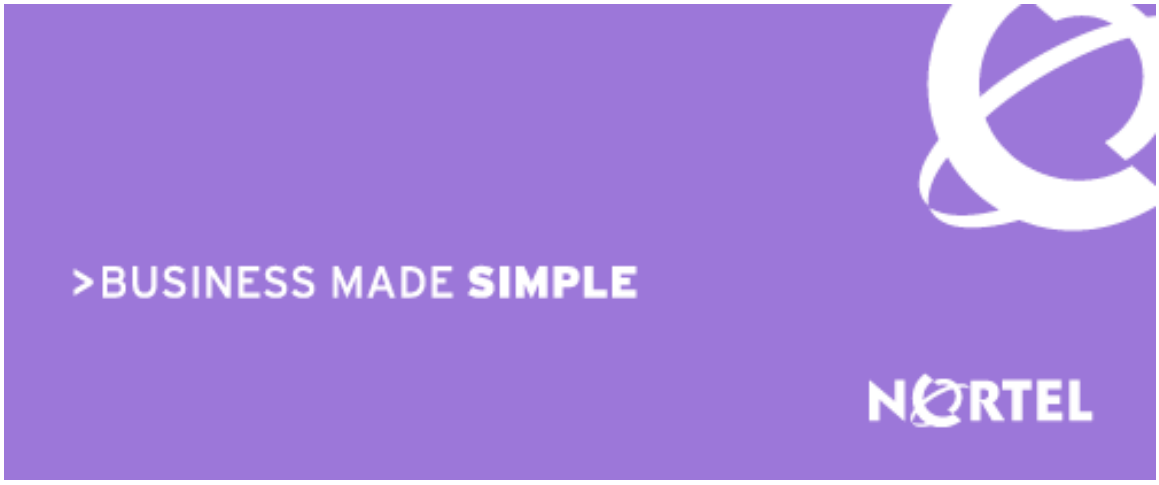


**Ethernet Routing Switch**
**Nortel IP Phones**
Engineering

# > Nortel / Cisco Interoperability Technical Configuration Guide

Enterprise Networking Solutions
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# Abstract

The purpose of this TCG is to show some of the more common configurations for the interoperability of Nortel and Cisco products.

# Revision Control

| No | Date | Version | Revised by | Remarks |
|---|---|---|---|---|
| 1 | 9/30/2009 | 1.0 | ENS | Initial Document |
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# Document Updates

# Conventions

This section describes the text, image, and command conventions used in this document.

### Symbols:

Tip – Highlights a configuration or technical tip.

Note – Highlights important information to the reader.

Warning – Highlights important information about an action that may result in equipment damage, configuration or data loss.

### Text:

**Bold** text indicates emphasis.

***Italic*** text in a Courier New font indicates text the user must enter or select in a menu item, button or command:

ERS5520-48T# ***show running-config***

Output examples from Nortel devices are displayed in a Lucinda Console font:

ERS5520-48T# ***show running-config***

```
! Embedded ASCII Configuration Generator Script
! Model = Ethernet Routing Switch 5520-24T-PWR
! Software version = v5.0.0.011
enable
configure terminal
```

# 1. Cisco Trunk Interface and Native VLAN

When a Cisco switch is configured as a trunk interface, by default, traffic becoming to the native VLAN (VLAN 1) is not trunk encapsulated. Cisco uses the native VLAN for such proprietary protocols such as CDP, PAgP, and VTP. To tag the native VLAN, the Cisco global *vlan dot1q tag native* command must be used where, unless you change the native VLAN identifier at an interface level, VLAN 1 will be tagged. At an interface level, the switchport *trunk native vlan <1-4094>* command can be used to change the VLAN identifier of the native VLAN. For example, the following configuration enables native VLAN tagging using VLAN 1050 as the native VLAN on port 1/0/18 on a Cisco 3750.

```
!
vlan internal allocation policy ascending
vlan dot1q tag native
!
interface GigabitEthernet1/0/18
 switchport trunk encapsulation dot1q
 switchport trunk native vlan 1050
 switchport trunk allowed vlan 1000,1100
 switchport mode trunk
 priority-queue out
 mls qos trust dscp
!
```

If you have an older Cisco switch that does not support native VLAN tagging and you need to pass the native VLAN traffic via a Nortel switched network, the Nortel switch can be configured to support an untagged default VLAN. Although Nortel also uses VLAN 1 as the default VLAN, any VLAN number can be used as the default VLAN. The following shows a configuration example for both an ERS8600 and an ERS5000 switch using VLAN 1050 as the default untagged VLAN.

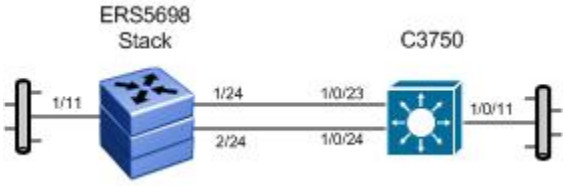
a) ERS8600 Configuration

```
#
# PORT CONFIGURATION - PHASE I
#

ethernet 3/2 perform-tagging enable

#
# PORT CONFIGURATION - PHASE II
#

ethernet 3/2 default-vlan-id 1050
ethernet 3/2 untag-port-default-vlan enable
```

b) ERS5500 Configuration

```
!
! *** VLAN ***
!
vlan create 1050 name "default-native" type port
vlan ports 1/3 tagging unTagPvidOnly  filter-untagged-frame disable
filter-unregistered-frames disable priority 0
vlan members 1050 1/3
vlan ports 1/3 pvid 1050
```

# 2. Basic Cisco EtherChannel to Nortel MLT without Spanning Tree




For this example, we will configure the following:

- MLT 2 with port member 1/24 and 2/24 on the Nortel 5698 stack
- EtherChannel on the Cisco 3750 using ports 1/0/23 and 1/0/24
- Enable 802.1Q tagging between the Nortel and Cisco switch with VLAN 300

## 2.1 Configuration Steps

### 2.1.1 ERS5698 Configuration

#### 2.1.1.1 Create VLAN

**5698TFD-1-PWR: Step 1 – Create VLAN 300**

```
5698TFD-1-PWR(config)#vlan create 300 name services type port
5698TFD-1-PWR(config)#vlan configcontrol automatic
5698TFD-1-PWR(config)#vlan ports 1/24,2/24 tagging tagall
5698TFD-1-PWR(config)#vlan members add 300 1/11,1/24,2/24
5698TFD-1-PWR(config)#vlan members remove 1 1/11,1/24,2/24
```

#### 2.1.1.2 Create MLT

**5698TFD-1-PWR: Step 1 – Create MLT 2**

```
5698TFD-1-PWR(config)# mlt 2 name cisco_ether enable member 1/24,2/24 learning
disable
```

#### 2.1.1.3 Enable Spanning Tree Fast Start and BPDU filtering on all Access Ports

**5698TFD-1-PWR: Step 1 – Enable STP Fast Start and BPDU Filtering**

```
5698TFD-1-PWR(config)#interface fastEthernet 1/11
5698TFD-1-PWR(config-if)#spanning-tree learning fast
5698TFD-1-PWR(config-if)#spanning-tree bpdu-filtering timeout 0
5698TFD-1-PWR(config-if)#spanning-tree bpdu-filtering enable
5698TFD-1-PWR(config-if)#exit
```

### 2.1.2 Cisco 3750 Configuration

The following is the configuration used on the Cisco 3750 used for this example.

```
!
aaa session-id common
switch 7 provision ws-c3750g-24t
system mtu routing 1500
vtp mode transparent
ip subnet-zero
ip routing
ip domain-name mydomain.com
!
vlan 300
 name services
!
interface Port-channel1
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 300
 switchport mode trunk
 spanning-tree bpdufilter enable
!
interface GigabitEthernet1/0/11
 switchport access vlan 300
 switchport trunk encapsulation dot1q
 switchport mode access
 spanning-tree portfast
 spanning-tree bpduguard enable
!
interface GigabitEthernet1/0/23
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 300
 switchport mode trunk
 no cdp enable
 channel-group 1 mode on
!
interface GigabitEthernet1/0/24
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 300
 switchport mode trunk
 no cdp enable
 channel-group 1 mode on
!
```

## 2.2 Verification

### 2.2.1 Verify MLT on Nortel 5698 stack

**Step 1** – Verify that the MLT instance and MLT VLAN members is configured correctly by issuing the following commands:

```
5698TFD-1-PWR#show mlt 2
```

**Result:**

```
        Id Name                 Members               Bpdu   Mode          Status
        -- -------------------- --------------------- ------ ------------- -------
        2  cisco_ether          1/24,2/24             All    Basic         Enabled
```

```
5698TFD-1-PWR#show vlan interface vids 1/24,2/24
```

Result:

```
        Unit/Port VLAN VLAN Name         VLAN VLAN Name         VLAN VLAN Name
        --------- ---- ----------------  ---- ----------------  ---- ----------------
        1/24      300  services
        --------- ---- ----------------  ---- ----------------  ---- ----------------
        2/24      300  services
        --------- ---- ----------------  ---- ----------------  ---- ----------------
```

Verify the following information:

| Option | Verify |
|---|---|
| Members<br>VLAN | Verify that the MLT is enabled and assigned to VLAN 300<br>• MLT 2: Member of VLANs ***300*** with port members ***1/24*** and ***2/24*** |
| Status | Displays as ***Enabled***. |
| Mode | Displays as ***Basic*** which is the default setting for MLT load balancing using MAC hashing. A setting of *advance* provides MLT load balancing using IP hashing and is configurable using the CLI command *mlt 2 loadbalance <advance\|basic>* |

## 2.2.2 Verify EtherChannel on Cisco 3750 switch

**Step 1** – Verify that the MLT instance and MLT VLAN members are configured correctly by issuing the following commands:

```
C3750-1# show etherchannel 1 port-channel
```

**Result:**

```
                      Port-channels in the group:
                      ---------------------------

        Port-channel: Po1
        ------------

        Age of the Port-channel   = 11d:23h:32m:14s
        Logical slot/port   = 10/1          Number of ports = 2
        GC                  = 0x00000000      HotStandBy port = null
        Port state          = Port-channel Ag-Inuse
        Protocol            =    -
        Port security       = Disabled

        Ports in the Port-channel:

        Index   Load   Port     EC state        No of bits
        ------+------+------+------------------+-----------
          0     00     Gi1/0/23 On                 0
          0     00     Gi1/0/24 On                 0

        Time since last port bundled:    0d:00h:59m:25s    Gi1/0/24
        Time since last port Un-bundled: 0d:00h:59m:40s    Gi1/0/24
```

C3750-1#***show interfaces port-channel 1***

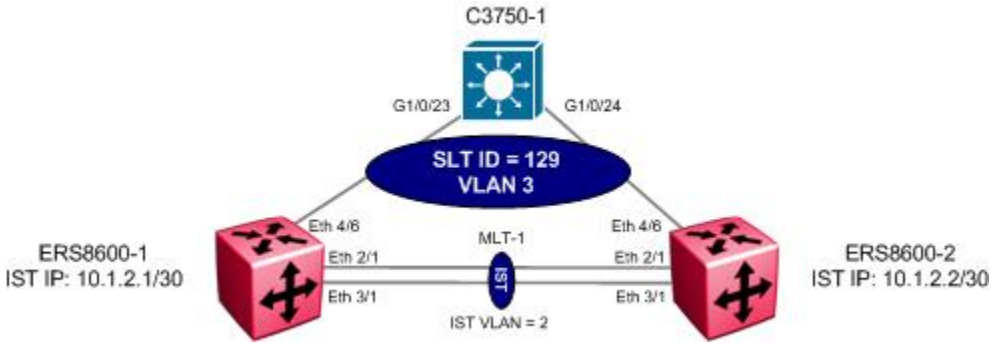
Result:

```
Port-channel1 is up, line protocol is up (connected)
  Hardware is EtherChannel, address is 000d.65cc.0917 (bia 000d.65cc.0917)
  MTU 1500 bytes, BW 2000000 Kbit, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 0/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Full-duplex, 1000Mb/s, link type is auto, media type is unknown
  input flow-control is off, output flow-control is unsupported
  Members in this channel: Gi7/0/23 Gi7/0/24
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 01:43:59, output 6d02h, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     724558882 packets input, 49268190185 bytes, 0 no buffer
     Received 622359 broadcasts (618700 multicasts)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored
     0 watchdog, 618700 multicast, 0 pause input
     0 input packets with dribble condition detected
     720546813 packets output, 49009901404 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 0 deferred
     0 lost carrier, 0 no carrier, 0 PAUSE output
     0 output buffer failures, 0 output buffers swapped out
```

Verify the following information:

| **Option** | **Verify** |
|---|---|
| Port<br>EC state | Verify that the EtherChannel running with the correct port member :<br>• Port-channel 1 with port members ***1/0/23*** and ***1/0/24***<br>• EC State is ***On*** |
| Port State | Displays as ***Port-channel Ag-inuse***. Otherwise, it would be displayed as ***Ag-Not-Inuse***. If not operational, use the *show interfaces port-channel 1* command and verify that the port-channel is up and the line protocol is up (connected) as shown above. If not, ensure that the interface speeds are the same on both the Nortel and Cisco switches and that the interfaces are configured as tagged trunk ports |

# 3. Cisco EtherChannel to Nortel Switch Cluster




For this configuration example, a Cisco 3750 switch is used at the SMLT access layer using EtherChannel to connect to the ERS8600 Switch Cluster. Note that any local proprietary load-balance mechanism or 802.3ad can be used to connect to an Switch Cluster. Overall, we will configure the following items:

- IST using MLT 1 with port members 2/1 and 3/1 and IP subnet 10.1.2.0/30
- SLT 129 for the Cisco 3750 Edge switch with VLAN 3
- Enable EtherChannel on the Cisco 3750 with tagged port members 1/0/23 and 1/0/24

It is recommended to use the same MLT ID's between the two SMLT clusters for ease in configuration and trouble-shooting.

It is recommended to use a unique IP subnet between the SMLT Cluster.

Well, if you need an OSPF adjacency between the IST peers, you have to create a separate IP subnet on the IST, since we do not recommend enabling routing protocols over the IST IP

As illustrated in the diagram above, the SMLT or SLT ID is local to an SMLT Cluster. The ERS8600 support up to 128 SMLT ID's using ID's 1 to 128. The SLT ID's can be any value from 1 to 512, however, it is recommended to use a SLT ID greater than the maximum possible SMLT ID so as to not use up a possible SMLT instance. Hence the reason we are using SLT-129 in Switch Cluster. Please note that this is not a requirement; it just illustrates the flexibility of the solution. Also note that the SMLT ID or SLT ID used on each peer in the Switch Cluster must be the same.

## 3.1.1 Switch Cluster

### 3.1.1.1 Create VLANs

The following port based VLANs will be configured on the Switch cluster

- VLAN 2 to be used by the Inter Switch Trunk (IST)
- VLAN 3 to be used at Layer 2 for the C3750-1 users.

**ERS8600-1: Step 1 – Create VLANs 2 and 3**

```
ERS8600-1:5# config vlan 2 create byport 1 name IST
ERS8600-1:5# config vlan 3 create byport 1 name Services
```

**ERS8600-2: Step 1 – Create VLAN 2 and 3**

```
ERS8600-2:5# config vlan 2 create byport 1 name IST
ERS8600-2:5# config vlan 3 create byport 1 name Services
```

### 3.1.1.2 Change fdb aging timer for VLAN 3

**ERS8600-1: Step 1 – Change fdb aging timer for VLAN 3**

```
ERS8600-1:5# config vlan 3 fdb-entry aging-time 21601
```

**ERS8600-2: Step 1 – Change fdb aging timer for VLAN 3**

```
ERS8600-2:5# config vlan 3 fdb-entry aging-time 21601
```

### 3.1.1.3 Create IST

Multilink Trunking 1 (MLT 1) will be used for the IST with 802.1Q tagged port members 2/1 and 3/1. Spanning Tree will be disabled on all IST port members by default. We will enable VLACP will on the IST port members.

**ERS8600-1: Step 1 – Create MLT 1 for IST**

```
ERS8600-1:5# config mlt 1 create
ERS8600-1:5# config mlt 1 name IST
ERS8600-1:5# config mlt 1 add port 2/1,3/1
ERS8600-1:5# config vlan 2 add-mlt 1
```

**ERS8600-2: Step 1 – Create MLT 1 for IST**

```
ERS8600-2:5# config mlt 1 create
ERS8600-2:5# config mlt 1 name IST
ERS8600-2:5# config mlt 1 add port 2/1,3/1
ERS8600-2:5# config vlan 2 add-mlt 1
```

**ERS8600-1: Step 2 – Create IST**

```
ERS8600-1:5# config vlan 2 ip create 10.1.2.1/30
ERS8600-1:5# config mlt 1 ist create ip 10.1.2.2 vlan-id 2
ERS8600-1:5# config mlt 1 ist enable
```

**ERS8600-2: Step 2 – Create IST**

```
ERS8600-2:5# config vlan 2 ip create 10.1.2.2/30
ERS8600-2:5# config mlt 1 ist create ip 10.1.2.1 vlan-id 2
ERS8600-2:5# config mlt 1 ist enable
```

**ERS8600-1: Step 3 – Enable VLACP**

```
ERS8600-1:5# ethernet 2/1,3/1 vlacp macaddress 01:80:c2:00:00:0f
ERS8600-1:5# ethernet 2/1,3/1 vlacp slow-periodic-time 10000
ERS8600-1:5# ethernet 2/1,3/1 vlacp enable
ERS8600-1:5# config vlacp enable
```

**ERS8600-2: Step 3 – Enable VLACP**

```
ERS8600-2:5# ethernet 2/1,3/1 vlacp macaddress 01:80:c2:00:00:0f
ERS8600-2:5# ethernet 2/1,3/1 vlacp slow-periodic-time 10000
ERS8600-2:5# ethernet 2/1,3/1 vlacp enable
ERS8600-2:5# config vlacp enable
```

It is recommended to use the reserved multicast MAC address of 01:80:c2:00:00:0f for the VLACP MAC address.

#### 3.1.1.4 Add VLAN 3 to IST

**ERS8600-1: Step 1 – Add VLAN 3 to IST MLT**

```
ERS8600-1:5# config vlan 3 add-mlt 1
```

**ERS8600-2: Step 1 – Add VLAN 3 to IST MLT**

```
ERS8600-2:5# config vlan 3 add-mlt 1
```

#### 3.1.1.5 SLT-129 to C3750-1

**ERS8600-1: Step 1 – Create SLT-129**

```
ERS8600-1:5# config ethernet 4/6 perform-tagging enable
ERS8600-1:5# config vlan 1 ports remove 4/6
ERS8600-1:5# config vlan 3 ports add 4/6
```

```
ERS8600-1:5# config ethernet 4/6 smlt 129 create
```

**ERS8600-2: Step 1 – Create SLT-129**

```
ERS8600-2:5# config ethernet 4/6 perform-tagging enable
ERS8600-2:5# config vlan 1 ports remove 4/6
ERS8600-2:5# config vlan 3 ports add 4/6
ERS8600-2:5# config ethernet 4/6 smlt 129 create
```

#### 3.1.1.6 CP Limit – SMLT port members

CP Limit will be enabled on all the SLT Access port members. For this example, we will select the moderate recommendations for CP-Limit.

**ERS8600-1: Step 1 – CP Limit for SLT Access ports**

```
ERS8600-1:5# config ethernet 4/6 cp-limit enable multicast-limit 2500
broadcast-limit 2500
```

**ERS8600-2: Step 1 – CP Limit for SLT Access ports**

```
ERS8600-2:5# config ethernet 4/6 cp-limit enable multicast-limit 2500
broadcast-limit 2500
```

#### 3.1.1.7 SLPP

For this example, we will pick ERS8600-1 as the primary switch for the switch cluster. SLPP will be enabled globally and on the SLT access port 4/6 on the switch cluster. On the SLT primary switch, we will set the SLPP packet-rx-threshold to 5 while on the SLT secondary switch, we will set the SLPP packet-rx-threshold to 50 for the access ports.

SLPP should only be enabled on the SMLT access or core ports and not on the IST port members.

**ERS8600-1: Step 1 – Enable SLPP and in regards to the core port on the primary switch only, set the SLPP Rx-Threshold with a value of 5**

```
ERS8600-1:5# config slpp add 3
ERS8600-1:5# config slpp operation enable
ERS8600-1:5# config ethernet 4/6 slpp packet-rx enable
ERS8600-1:5# config ethernet 4/6 slpp packet-rx-threshold 5
```

**ERS8600-2: Step 1 – Enable SLPP**

```
ERS8600-2:5# config slpp add 3
ERS8600-2:5# config slpp operation enable
ERS8600-2:5# ethernet 4/6 slpp packet-rx enable
ERS8600-2:5# ethernet 4/6 slpp packet-rx-threshold 50
```

#### 3.1.1.8 Ext-CP Limit

Ext-CP Limit will be enable globally and on the SMLT access ports in the SMLT switch cluster. The SoftDown option will be used with the bandwidth utilization threshold set to 10%.

| **ERS8600-1: Step 1 – Enable EXT-CP-Limit** |
|---|
| ERS8600-1:5# ***config sys ext-cp-limit extcplimit enable*** |
| ERS8600-1:5# ***config sys ext-cp-limit max-ports-to-check 5*** |
| ERS8600-1:5# ***config sys ext-cp-limit trap-level Normal*** |
| ERS8600-1:5# ***config ethernet 4/6 ext-cp-limit SoftDown threshold-util-rate 10*** |
| **ERS8600-2: Step 2 – Enable EXT-CP-Limit** |
| ERS8600-2:5# ***config sys ext-cp-limit extcplimit enable*** |
| ERS8600-2:5# ***config sys ext-cp-limit max-ports-to-check 5*** |
| ERS8600-2:5# ***config sys ext-cp-limit trap-level Normal*** |
| ERS8600-2:5# ***config ethernet 4/6 ext-cp-limit SoftDown threshold-util-rate 10*** |

#### 3.1.1.9 Discard Untagged Frames

It is recommended to enable discard untagged frames on all IST and SMLT ports.

| **ERS8600-1: Step 1 – Enable Discard Untagged Frames** |
|---|
| ERS8600-1:5# ***config ethernet 2/1,3/1,4/6 untagged-frames-discard enable*** |
| **ERS8600-2: Step 1 – Enable Discard Untagged Frames** |
| ERS8600-2:5# ***config ethernet 2/1,3/1,4/6 untagged-frames-discard enable*** |

### 3.1.2 Configuration - Edge Switch

Spanning Tree, PVST+, is enabled by default on a Cisco switch. Spanning Tree should be left enabled on all user ports and set for portfast, but disabled on the trunk EtherChannel ports. This can be accomplished on the Port-channel ports using the command 'spanning-tree bpdufilter enable' command.

The EtherChannel load balance method can be changed from the default setting by using the command *port-channel load-balance <dst-ip|dist-mac|src-dst-ip|src-dst-mac|src-ip|src-mac>.*

#### 3.1.2.1 C3750

```
!
no aaa new-model
switch 1 provision ws-c3750g-24ts
system mtu routing 1500
vtp mode transparent
ip subnet-zero
ip routing
!
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan 3
!
interface Port-channel1
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 3
 switchport mode trunk
  spanning-tree bpdufilter enable
!
interface GigabitEthernet1/0/3
 switchport access vlan 3
 switchport mode access
!
interface GigabitEthernet1/0/4
 switchport access vlan 3
 switchport mode access
!
interface GigabitEthernet1/0/23
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 3
 switchport mode trunk
 channel-group 1 mode on
!
interface GigabitEthernet1/0/24
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 3
 switchport mode trunk
 channel-group 1 mode on
!
no cdp run
!
```

If the EtherChannel is not coming up and you notice the Interface line protocol is down by using the *show interfaces gigabitEthernet <port>*, check to see if auto trunk encapsulation is enabled by issuing the command *show etherchannel detail*.

For example:

Problem: Interface line protocol is down

C3750-2#***show interfaces gigabitEthernet 1/0/24***
GigabitEthernet1/0/24 is up, line protocol is **down (suspended)**

Entering the following command to look at the EtherChannel details:

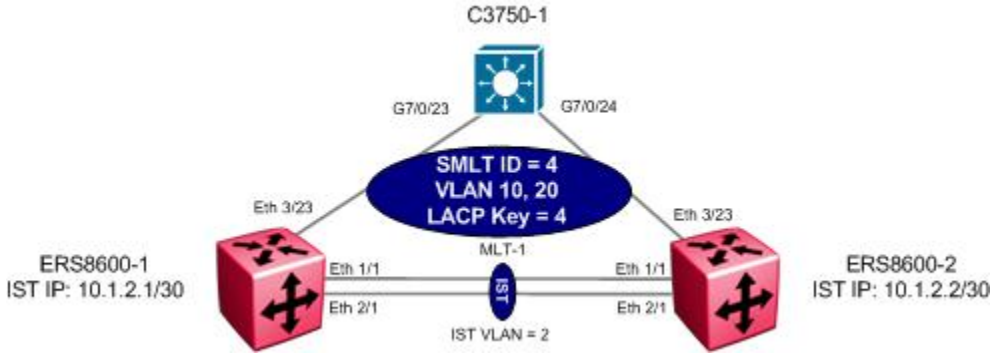
C3750-2# ***show etherchannel detail***
|
Probable reason: trunk encap of Gi1/0/24 is **auto**, Po1 is dot1q
Port-channels in the group:
---

This tells us we should disable auto trunk encapsulation on this interface

To fix this problem, enter the following commands:

C3750-2(config)#***interface range gigabitEthernet 1/0/23 - 24***
C3750-2(config-if-range)#***switchport trunk encapsulation dot1q***
C3750-2(config-if-range)#***do show int gig 1/0/23***
GigabitEthernet1/0/23 is up, line protocol is **up (connected)**

# 4. LACP Interoperability between a ERS8600 Switch Cluster and Cisco 3750




For this example, we will configure the following:

- A Link Aggregation Group (LAG) is configured between the ERS8600 triangle topology and a Cisco 3750.
  - VLANs 10 and 20 will be tagged across the LAG
  - LACP key = 4
  - MLT ID = 4
  - SMLT ID = 4
  - LACP Timeout = Long
- Use MLT 1, VLAN 2 for the IST with port members 1/1 and 2/1 using IP Subnet 10.1.2.0/30
- For this application to work, we will need to configure the SMLT System Identifier so that LACP global identifier is the same on both ERS8600-1 and ERS8600-2. Although you can use any MAC address, we will simple use the LACP identifier from ERS8600-1 to avoid any possible duplicate addresses.

Please note that Cisco does not support LACP short timer

Please note that in order for LACP to work all links must be operating at the same speed. If LACP does not come up, please check that the interfaces on both ERS8600 switches in the Switch Cluster are operating at the same speed. For example, if port 3/23 on ERS8600-1 is using a legacy module 8648TX and port 3/23 on ERS8600-2 is using an R-module 8648GTR, by default port 1/23 on ERS8600-1 will connect at 100Mbps and port 3/23 on ERS8600-2 will connect at 1000Mbps. To solve this issue, either set the speed to a fixed rate or set the auto-negotiation advertisements.

# 4.1 Configuration Steps

## 4.1.1 Switch Cluster Configuration

### 4.1.1.1 Create IST VLAN

Create VLAN 2 to be used by the Inter Switch Trunk (IST)

| **ERS8600-1: Step 1 – VLAN 2** |
|---|
| ERS8600-1# ***config vlan 2 create byport 1 name IST*** |
| **ERS8600-2: Step 1 – Create 2** |
| ERS8600-2# ***config vlan 2 create byport 1 name IST*** |

### 4.1.1.2 Create IST

Multilink Trunking 1 (MLT 1) will be used for the IST with port members 1/1 and 2/1. 802.1Q tagging will be enabled on all IST port members and Spanning Tree will be disabled on all IST port members by default. VLACP will be enabled on the IST trunk.

| **ERS8600-1: Step 1 – Create MLT 1 for IST** |
|---|
| ERS8600-1# ***config mlt 1 create***<br>ERS8600-1# ***config mlt 1 name IST***<br>ERS8600-1# ***config mlt 1 add port 1/1,2/1***<br>ERS8600-1# ***config vlan 2 add-mlt 1*** |
| **ERS8600-2: Step 1 – Create MLT 1 for IST** |
| ERS8600-2# ***config mlt 1 create***<br>ERS8600-2# ***config mlt 1 name IST***<br>ERS8600-2# ***config mlt 1 add port 1/1,2/1***<br>ERS8600-2# ***config vlan 2 add-mlt 1*** |
| **ERS8600-1: Step 2 – Create IST** |
| ERS8600-1# ***config vlan 2 ip create 10.1.2.1/30***<br>ERS8600-1# ***config mlt 1 ist create ip 10.1.2.2 vlan-id 2***<br>ERS8600-1# ***config mlt 1 ist enable*** |
| **ERS8600-2: Step 2 – Create IST** |
| ERS8600-2# ***config vlan 2 ip create 10.1.2.2/30***<br>ERS8600-2# ***config mlt 1 ist create ip 10.1.2.1 vlan-id 2***<br>ERS8600-2# ***config mlt 1 ist enable*** |

**ERS8600-1: Step 3 – Enable VLACP**

```
ERS8600-1# config ethernet 1/1,2/1 vlacp macaddress 01:80:c2:00:00:0f
ERS8600-1# config ethernet 1/1,2/1 vlacp slow-periodic-time 10000
ERS8600-1# config ethernet 1/1,2/1 vlacp enable
ERS8600-1# config vlacp enable
```

**ERS8600-2: Step 3 – Enable VLACP**

```
ERS8600-2# config ethernet 1/1,2/1 vlacp macaddress 01:80:c2:00:00:0f
ERS8600-2# config ethernet 1/1,2/1 vlacp slow-periodic-time 10000
ERS8600-2# config ethernet 1/1,2/1 vlacp enable
ERS8600-2# config vlacp enable
```

It is recommended to use the reserved multicast MAC address of 01:80:c2:00:00:0f for the VLACP MAC address with a long timeout value of 5.

#### 4.1.1.3 Create MLT with LACP Key

Create MLT 4 using key 4.

**ERS8600-1: Step 1 – Create MLT 4 using LACP key 4**

```
ERS8600-1# config mlt 4 create
ERS8600-1# config mlt 4 name c3750_lacp
ERS8600-1# config mlt 4 lacp key 4
ERS8600-1# config mlt 4 lacp enable
```

**ERS8600-2: Step 1 – Create MLT 4 using LACP key 4**

```
ERS8600-2# config mlt 4 create
ERS8600-2# config mlt 4 name c3750_lacp
ERS8600-2# config mlt 4 lacp key 4
ERS8600-2# config mlt 4 lacp enable
```

#### 4.1.1.4 Create Access VLANs

**ERS8600-1 Step 1 – Configure VLANs 10 and 20**

```
ERS8600-1# config ethernet 3/23 perform-tagging enable
ERS8600-1# config vlan 1 ports remove 3/23
ERS8600-1# config vlan 10 create byport 1
ERS8600-1# config vlan 10 ports add 3/23
ERS8600-1# config vlan 20 create byport 1
ERS8600-1# config vlan 20 ports add 3/23
```

**ERS8600-2 Step 1 – Configure VLANs 10 and 20**

```
ERS8600-2# config ethernet 3/23 perform-tagging enable
ERS8600-2# config vlan 1 ports remove 3/23
ERS8600-2# config vlan 10 create byport 1
ERS8600-2# config vlan 10 ports add 3/23
ERS8600-2# config vlan 20 create byport 1
ERS8600-2# config vlan 20 ports add 3/23
```

#### 4.1.1.5 Change fdb aging timer for VLAN 10 and 20

**ERS8600-1 Step 1 – Change fdb aging timer for VLAN 10 and 20**

```
ERS8600-1# config vlan 10 fdb-entry aging-time 21601
ERS8600-1# config vlan 20 fdb-entry aging-time 21601
```

**ERS8600-2 Step 1 – Change fdb aging timer for VLAN 10 and 20**

```
ERS8600-2# config vlan 10 fdb-entry aging-time 21601
ERS8600-2# config vlan 20 fdb-entry aging-time 21601
```

#### 4.1.1.6 Configure LACP on Aggregation Ports

**ERS8600-1 Step 1 – Enable LACP on each port and globally and add SMLT System ID of ERS8600-1**

```
ERS8600-1# config ethernet 3/23 lacp enable
ERS8600-1# config ethernet 3/23 lacp key 4
ERS8600-1# config ethernet 3/23 lacp aggregation true
ERS8600-1# config lacp smlt-sys-id 00:01:81:28:84:00
ERS8600-1# config lacp enable
```

**ERS8600-2 Step 1 – Enable LACP on each port and globally and add SMLT System ID of ERS8600-1**

```
ERS8600-2# config ethernet 3/23 lacp enable
ERS8600-2# config ethernet 3/23 lacp key 4
ERS8600-2# config ethernet 3/23 lacp aggregation true
ERS8600-2# config lacp smlt-sys-id 00:01:81:28:84:00
ERS8600-2# config lacp enable
```

To view the global LACP System ID, enter the following command

- ERS8600-1# ***show lacp info***

```
================================================
                          Lacp Global Information
================================================
               SystemId: 00:01:81:28:84:00
           SmltSystemId: 00:01:81:28:84:00
                   Lacp: enable
      system-priority: 32768
              timeout-admin: 3
    fast-periodic-time-admin: 1000
    slow-periodic-time-admin: 30000
        aggr-wait-time-admin: 2000
              timeout-oper: 3
    fast-periodic-time-oper: 1000
    slow-periodic-time-oper: 30000
        aggr-wait-time-oper: 2000
```

#### 4.1.1.7 Create SMLT-4 to C3750

| **ERS8600-1: Step 1 – Create SMLT-4 and add VLANs 10 and 20 to the IST MLT 1** |
|---|
| ERS8600-1# ***config mlt 4 smlt create smlt-id 4*** |
| ERS8600-1# ***config vlan 10 add-mlt 1*** |
| ERS8600-1# ***config vlan 20 add-mlt 1*** |
| **ERS8600-2: Step 1 – Create SMLT-4 and add VLANs 10 and 20 to the IST MLT 1** |
| ERS8600-2# ***config mlt 4 smlt create smlt-id 4*** |
| ERS8600-2# ***config vlan 10 add-mlt 1*** |
| ERS8600-2# ***config vlan 20 add-mlt 1*** |

#### 4.1.1.8 CP Limit – SMLT Port Members

CP Limit will be enabled on all the SMLT Access port members. For this example, we will select the moderate recommendations for CP-Limit.

| **ERS8600-1: Step 1 – CP Limit** |
|---|
| ERS8600-1# ***config ethernet 3/23 cp-limit enable multicast-limit 2500 broadcast-limit 2500*** |
| **ERS8600-2: Step 1 – CP Limit** |
| ERS8600-2# ***config ethernet 3/23 cp-limit enable multicast-limit 2500 broadcast-limit 2500*** |

#### 4.1.1.9 SLPP

SLPP will be enabled globally and only on the SMLT access port 3/23 for VLAN 10 and 20. On the SMLT primary switch we will set the SLPP packet-rx-threshold to 5, while on the SMLT secondary switch we will set the SLPP packet-rx-threshold to 50. For this example, we will pick ERS8600-1 as the primary switch.

The recommended SLPP receive threshold value for the primary switch is 5 and 50 for the secondary switch in an SMLT cluster.

SLPP should only be enabled on the SMLT access ports and not on the IST port members.

| **ERS8600-1: Step 1 – Enable SLPP** |
|---|
| ERS8600-1# ***config slpp add 10,20*** |
| ERS8600-1# ***config slpp operation enable*** |
| ERS8600-1# ***config ethernet 3/23 slpp packet-rx-threshold 5*** |
| ERS8600-1# ***config ethernet 3/23 slpp packet-rx enable*** |
| **ERS8600-2: Step 1 – Enable SLPP** |
| ERS8600-2# ***config slpp add 10,20*** |
| ERS8600-2# ***config slpp operation enable*** |
| ERS8600-2# ***config ethernet 3/23 slpp packet-rx-threshold 50*** |
| ERS8600-2# ***config ethernet 3/23 slpp packet-rx enable*** |

#### 4.1.1.10 Ext-CP Limit

Enable Extended CP-Limit globally with trap set to normal. Also enable Extended CP-Limit with SoftDown option on port 3/23. Since the port is a 100Mbps Ethernet interface, we will set the threshold to 80%.

| **ERS8600-1: Step 1 – Enable EXT-CP-Limit** |
|---|
| ERS8600-1# ***config sys ext-cp-limit extcplimit enable*** |
| ERS8600-1# ***config sys ext-cp-limit max-ports-to-check 5*** |
| ERS8600-1# ***config sys ext-cp-limit trap-level Normal*** |
| ERS8600-1# ***config ethernet 3/23 ext-cp-limit SoftDown threshold-util-rate 80*** |
| **ERS8600-2: Step 1 – Enable EXT-CP-Limit** |
| ERS8600-2# ***config sys ext-cp-limit extcplimit enable*** |
| ERS8600-2# ***config sys ext-cp-limit max-ports-to-check 5*** |
| ERS8600-2# ***config sys ext-cp-limit trap-level Normal*** |
| ERS8600-2# ***config ethernet 3/23 ext-cp-limit SoftDown threshold-util-*** |

```
rate 80
```

#### 4.1.1.11 Discard Untagged Frames

It is recommended to enable discard untagged frames on all IST and SMLT ports.

| **ERS8600-1: Step 1 – Enable Discard Untagged Frames** |
|---|
| ERS8600-1# ***config ethernet 3/23,1/1,2/1 untagged-frames-discard enable*** |
| **ERS8600-2: Step 1 – Enable Discard Untagged Frames** |
| ERS8600-2# ***config ethernet 3/23,1/1,2/1 untagged-frames-discard enable*** |

### 4.1.2 Cisco C3750 Configuration

The configuration configures port-channel 4 with the port-channel load-balance set for src-dst-mac. Note, when configuring port-channel on Cisco, you must configure this item first under the interface level prior to configuring the switchport settings. Also, all the access ports are configured for Spanning Tree portfast and multicast/broadcast rate limiting set to a limit of 10%.

```
!
hostname C3750-1
!
no aaa new-model
switch 1 provision ws-c3750g-24ts
system mtu routing 1500
vtp mode transparent
ip subnet-zero
ip routing
!
vlan 10
!
vlan 20
!
port-channel load-balance src-dst-mac
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id
!
!
interface Port-channel4
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 10,20
 switchport mode trunk
 switchport nonegotiate
 spanning-tree bpdufilter enable
!
!
interface GigabitEthernet7/0/3
 switchport access vlan 10
 switchport mode access
 storm-control broadcast level 10.00
 storm-control multicast level 10.00
 storm-control action trap
 spanning-tree portfast
!
```

```
interface GigabitEthernet7/0/4
 switchport access vlan 10
 switchport mode access
 storm-control broadcast level 10.00
 storm-control multicast level 10.00
 storm-control action trap
 spanning-tree portfast
!
interface GigabitEthernet7/0/5
 switchport access vlan 10
 switchport mode access
 storm-control broadcast level 10.00
 storm-control multicast level 10.00
 storm-control action trap
 spanning-tree portfast
!
interface GigabitEthernet7/0/6
!
interface GigabitEthernet7/0/7
 switchport access vlan 20
 switchport mode access
 storm-control broadcast level 10.00
 storm-control multicast level 10.00
 storm-control action trap
 spanning-tree portfast
!
interface GigabitEthernet7/0/8
 switchport access vlan 20
 switchport mode access
 storm-control broadcast level 10.00
 storm-control multicast level 10.00
 storm-control action trap
 spanning-tree portfast
!
interface GigabitEthernet7/0/9
 switchport access vlan 20
 switchport mode access
 storm-control broadcast level 10.00
 storm-control multicast level 10.00
 storm-control action trap
 spanning-tree portfast
!
interface GigabitEthernet7/0/23
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 10,20
 switchport mode trunk
 no cdp enable
 channel-group 4 mode active
 spanning-tree bpdufilter enable
!
interface GigabitEthernet7/0/24
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 10,20
 switchport mode trunk
 no cdp enable
 channel-group 4 mode active
 spanning-tree bpdufilter enable
!
no cdp run
!
```

In order for LACP to come up between a Nortel and Cisco switch, Cisco DTP (Dynamic Trunking Protocol) and native VLAN encapsulation should be disabled. Use the *show interface gigibitEthernet <port number> switchport* command to verify if DTP is enabled or not. If it is, enter the command *switchport nonegotiate* command at the port-channel and interface level. Also, disable tagging of the native VLAN (VLAN 1 by default) by issuing the CLI command *no vlan dot1q tag native*. In addition, the Cisco switch VTP (VLAN Trunking Protocol) should be set for transparent and CDP (Cisco Discovery Protocol) should be disabled.

# 4.2 Verification

## 4.2.1 SMLT Cluster

### 4.2.1.1 Verify MLT Configuration

**Step 1** – Verify that the MLT instances are configured correctly and are functioning by issuing the following command:

```
ERS8600-1# show mlt info
```

**Result:**

```
================================================================================
                              Mlt Info
================================================================================
                           PORT    SVLAN  MLT   MLT        PORT         VLAN
MLTID IFINDEX NAME         TYPE    TYPE  ADMIN CURRENT    MEMBERS      IDS
--------------------------------------------------------------------------------
1   4096  IST          trunk   normal ist    ist      1/1,2/1           2 10 20
4   4099  c3750_lacp   trunk   normal smlt   smlt     3/23              10 20

                MULTICAST             DESIGNATED   LACP      LACP
MLTID IFINDEX   DISTRIBUTION  NT-STG  PORTS        ADMIN     OPER
--------------------------------------------------------------------------
1      6144     enable       enable   null       disable   down
9      6152     disable      disable  null       enable    up
```

On each ERS8600 in the switch cluster verify the following information:

| Option | Verify |
|---|---|
| PORT MEMBERS<br>VLAN IDS | Verify that the VLAN ids assigned to the IST and SMLT MLT are correct:<br>• IST MLT 1: Member of VLANs ***10, 20*** & ***2*** with port members ***1/1*** and ***2/1***<br>• MLT 4: Member of VLAN ***10 & 20*** with port member ***3/23*** |
| MLT Admin<br>MLT CURRENT | Displays as ***smlt*** or ***ist***. The value ***normal*** under MLT CURRENT indicates that the IST or SMLT is not operational. |
| PORT TYPE | Displays as ***trunk*** for all IST and SMLT ports and will pass tagged frames. The value ***access*** indicates that the port will pass untagged frames. |

| | |
|---|---|
| LACP ADMIN<br>LACP OPER | LACP Admin should be displayed as ***enable*** and LACP OPER should be displayed as ***up***. |

#### 4.2.1.2 Verify LACP Operations

**Step 1a** – The following command is used to verify the global VLACP System ID on 8600-1

```
ERS8600-1# show lacp info
```

**Result:**

```
================================================
                        Lacp Global Information
================================================
               SystemId: 00:01:81:28:84:00
           SmltSystemId: 00:01:81:28:84:00
                   Lacp: enable
      system-priority: 32768
                timeout-admin: 3
    fast-periodic-time-admin: 1000
    slow-periodic-time-admin: 30000
        aggr-wait-time-admin: 2000
                timeout-oper: 3
    fast-periodic-time-oper: 1000
    slow-periodic-time-oper: 30000
        aggr-wait-time-oper: 2000
```

**Step 1b** – The following command is used to verify the global VLACP System ID on 8600-2

```
ERS8600-2# show lacp info
```

**Result:**

```
================================================
                           Lacp Global Information
================================================
               SystemId: 00:e0:7b:bc:20:00
           SmltSystemId: 00:01:81:28:84:00
                   Lacp: enable
      system-priority: 32768
                timeout-admin: 3
    fast-periodic-time-admin: 1000
    slow-periodic-time-admin: 30000
        aggr-wait-time-admin: 2000
                timeout-oper: 3
    fast-periodic-time-oper: 1000
    slow-periodic-time-oper: 30000
        aggr-wait-time-oper: 2000
```

**Step 2** – Verify LACP operation on the SMLT ports

```
ERS8600-1# show port info lacp actor-admin port 3/23
```

**Result:**

```
================================================================================
                          Actor Admin
================================================================================
INDEX SYS   SYS               KEY   PORT  PORT  STATE
      PRIO  ID                            PRIO
--------------------------------------------------------------------------------
3/23  32768 00:01:81:28:84:00 4     0x56    32768 act        long aggr
```

**Step 3** – Verify far end LACP operation on the SMLT ports

```
ERS8600-1# show port info lacp partner-oper port 3/23
```

**Result:**

```
================================================================================
                              Partner Operational
================================================================================
INDEX SYS   SYS               KEY   PORT  PORT  STATE
      PRIO  ID                          PRIO
--------------------------------------------------------------------------------
3/23  32768 00:0d:65:cc:09:00 4     0x17    32768 act        long aggr sync col dis
```

On ERS8600-2 in the switch cluster verify the following information:

| Option | Verify |
|---|---|
| SystemId | In an SMLT configuration, both switches in an SMLT cluster must use the same System ID. You can use the System ID from either switch. This is to ensure proper LACP operation at the edge switch in case of a SMLT cluster switch failure. This will ensure the edge always sees the same ID from the LACP packets from both switch in the cluster in case if one of the switches should fail |
| SYS ID | For this example, the value of ***00:01:81:28:84:00*** should be displayed when using the LACP actor-admin command via either switch in the SMLT cluster and also via the Cisco switch.<br>The LACP partner value will be the value send by the Cisco switch and verified by using the command "*show lacp sys-id'* on the C3750. For this example, the value is ***00:0d:65:cc:09:00.*** |
| STATE | When the LACP aggregation is up and running the following states should display on local interfaces (Actor) and far end interfaces (Partner):<br>• short OR long : Negotiated timer type<br>• aggr : Aggregation enabled<br>• sync : Port is synchronized with far end<br>• col : Port is collecting frames (receiving traffic)<br>• dis : Port is distributing frames (transmitting traffic) |

## 4.2.2 C3750

### 4.2.2.1 Verify LACP Operations

**Step 1** – The following command is used to view the global LACP System ID

```
C3750#show lacp sys-id
```

**Result:**

```
          32768, 000d.65cc.0900
```

**Step 2** – The following command is used to verify the interface level LACP operation

```
C3750# show interfaces port-channel 4 etherchannel
```

**Result:**

```
          Port-channel4   (Primary aggregator)

          Age of the Port-channel   = 00d:02h:11m:03s
          Logical slot/port   = 10/4          Number of ports = 2
          HotStandBy port = null
          Port state          = Port-channel Ag-Inuse
          Protocol            =   LACP

          Ports in the Port-channel:

          Index   Load   Port     EC state        No of bits
          ------+------+------+------------------+-----------
            0     00     Gi7/0/23 Active             0
            0     00     Gi7/0/24 Active             0

          Time since last port bundled:    00d:00h:23m:40s    Gi7/0/24
          Time since last port Un-bundled: 00d:00h:25m:53s    Gi7/0/24
```

**Step 3** – The following command is used to verify local LACP operation and key

```
C3750# show lacp 4 internal
```

**Result:**

```
          Flags:  S - Device is requesting Slow LACPDUs
                  F - Device is requesting Fast LACPDUs
                  A - Device is in Active mode       P - Device is in Passive mode

          Channel group 4
                                       LACP port     Admin     Oper    Port     Port
          Port      Flags   State      Priority      Key       Key     Number   State
          Gi7/0/23  SA      bndl       32768         0x4       0x4     0x14F    0x3D
          Gi7/0/24  SA      bndl       32768         0x4       0x4     0x150    0x3D
```

**Step 4** – The following command is used to view the LACP partner values

```
C3750# show lacp 4 neighbor
```

**Result:**

```
          Flags:  S - Device is requesting Slow LACPDUs
                  F - Device is requesting Fast LACPDUs
                  A - Device is in Active mode       P - Device is in Passive mode

          Channel group 4 neighbors
```

```
          Partner's information:

                                LACP port                          Oper     Port     Port
          Port      Flags       Priority  Dev ID          Age      Key      Number   State
          Gi7/0/23  SA          32768     0001.8128.8400  17s      0x4      0x56     0x3D
          Gi7/0/24  SA          32768     0001.8128.8400  19s      0x4      0xD7     0x3D
```

# 5. Spanning Tree interoperability between Nortel and Cisco

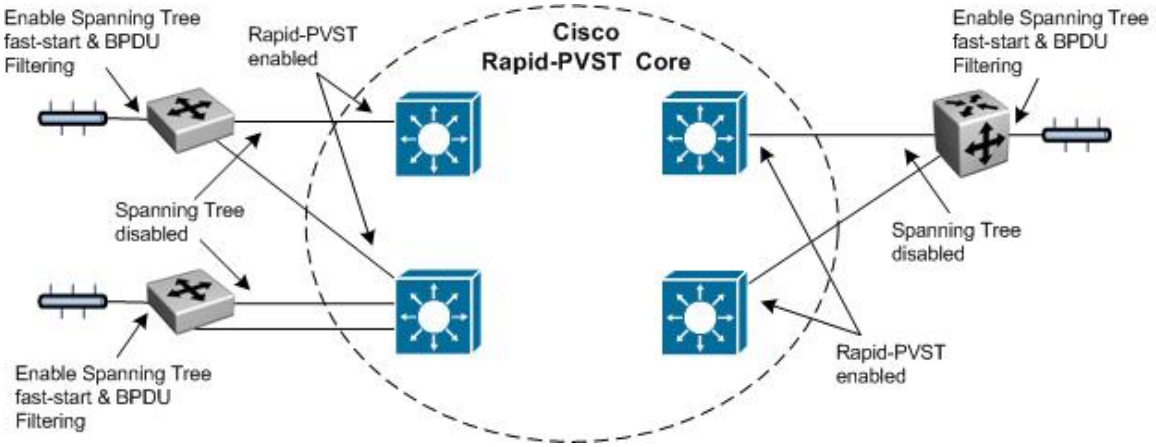
Cisco supports three Spanning Tree modes of operation, PVST+, Rapid-PVST, and MST. Of the three, only MST support standards based 802.1s which can interoperate with any of Nortel switches offered today. In regards to the ERS8600 only, it also supports the older PVST+ Spanning Tree mode of operation.

By default, Cisco comes enabled with Rapid-PVST. This proprietary protocol combines the functionality of RSTP with PVST creating an RSTP (802.1w) instance per VLAN. The Cisco implementation also defines a concept of “native” VLAN whereby BPDUs generated for the native vlan are standard compliant (802.1w for Rapid-PVST) whereas BPDUs generated for all other VLANs are modified with a Cisco multicast MAC address and are q-tagged with the vlan-id they belong to, thus rendering them incompatible with the standard.

It is therefore highly recommended to avoid Cisco’s proprietary Rapid-PVST and enable instead MST on Cisco and MSTP on the Nortel switches.

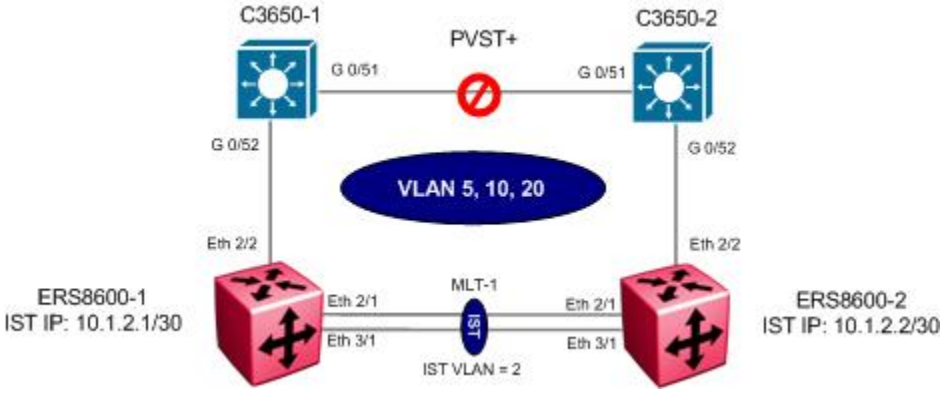
It is still possible to make the Rapid-PVST protocol interoperate with Nortel standards based 802.1w (RSTP) by letting Cisco’s native VLAN instance interoperate with Nortel single RSTP instance and allowing the other Cisco Spanning Tree instances to be flooded transparently across the Nortel switches. The native VLAN by default is set to VLAN 1. This method will work providing the native RSTP instance on a Nortel switch never blocks any interface. Hence, it can get a little difficult setting up a network.

If the Nortel switches are being deployed as edge switches onto a Cisco Core using Rapid-PVST an even better approach is to simply disable Spanning Tree on the Nortel switch uplink ports to the Cisco core and let the Cisco core take care of any loops. This is illustrated in Figure 2. The proprietary BPDUs generated by the Cisco Core will simply be re-flooded in the vlan by the Nortel edge switch and thus one of the Cisco’s will block one of the uplinks. Note that in this design only non-native VLANs must be tagged on the uplinks to the Nortel switches. The native VLAN on the Cisco Core needs to be set to some unused vlan; for instance left configured at default VLAN 1 which should never be used.



# 5.1 Cisco PVST+ to Nortel Switch Cluster Configuration Example




For this configuration example, two Cisco 3650 switches are used at the access layer and configured with PVST+ to connect to an ERS8600 Switch Cluster. The Cisco Switches could be seen as the Distribution Layer of a large Network or just as a couple of cascaded switches at the edge of a network where configuring Etherchannel is not possible because of the Cascade implementation.

This type of configuration is useful when transitioning from a Spanning Tree Solution (older L2 deployments) to a Nortel Switch Cluster Solution.

At this particular point in time, there is no elegant way to implement any flavor of Spanning Tree across a Switch Cluster Core. By design, the IST in a switch Cluster does not allow BPDU packets between the core switches.

In this particular configuration, we take advantage of the fact that PVST+ BPDUs are used in every VLAN except for the Default VLAN. PVST+ BPDUs uses a L2 Multicast Destination Address (01:00:0C:CC:CC:CD) which in turn make things simple when leaving via a tagged interface (802.1q) as the BPDUs are tagged with their corresponding VLAN ID.

The individual switches of a Nortel Switch Cluster do not recognize these Multicast addresses as BPDUs so they just flood these multicast frames on their appropriate VLANs (even across the IST).

This means that the Nortel Switch Cluster is completely transparent to PVST+ and the two Cisco Switches will go through their normal Spanning tree process of preventing a loop by eventually blocking a link. Depending on PVST+ configuration of the Cisco Switches, the blocked link will either be the link between the 2 Cisco Switches (as shown in the diagram) or one of the Cisco-Nortel links.

The configuration is very simple especially when considering that PVST+ is the default on Cisco Switches.

Note that in this scenario, the Nortel Switch Cluster is transparently passing the PVST+ BPDUs across the IST therefore allowing the Cisco Switches to detect a loop and eventually preventing any problem arising from such a loop by blocking a port on the specific VLAN. The Switch Cluster is not participating in any way to Spanning tree and therefore could never become a root bridge or ever block a link to prevent a loop from occurring nor will it fast age MAC addresses following a PVST+ active topology change.

In summary, we will configure the following:

- IST configured as normal using VLAN 2, MLT 1 with port members 2/1 and 3/1, and IP subnet 10.1.2.0/30
- Three VLANs will be configured with management VLAN 5 and VLANs 10 and 20 for end user access
- Since the Cisco switches will be using PVST+ to manage the dual homing to the Nortel Core, the Switch Cluster will not need to have a SMLT or an SLT link setup for the Cisco Switches. The only requirement is to have the correct VLANs set on the individual ports on each Core switch and for the VLAN to be crossing the IST of course.
- It will be possible of course to setup SMLT/SLT to other distributions or edges that support link Aggregation back to our switch Cluster.

The use of the default VLAN (VLAN 1) is not recommended in most cases, but in this particular scenario even more so. Even in PVST+ mode, the Default VLAN always sends its BPDUs to the IEEE STP MAC address (0180.c200.0000) in untagged frames. This could vary from inconvenient, when the BPDUs are dropped by the receiving port on the Switch Cluster, to potentially dangerous as there could be no way of detecting a loop on the Default VLAN. For that reason alone, the Default VLAN should not be used in this scenario.

In addition, it is also recommended not to use the Native VLAN setting on trunk ports used to interconnect to a Switch Cluster. The Native VLAN on a Trunk port (802.1Q) would be sent out as untagged frames and, according to Cisco documentation, the native VLAN would also send out BPDUs to the IEEE STP MAC address (0180.c200.0000) in untagged frames.

To keep things simple, do not use the Default VLAN (VLAN 1) and do not use the Native Vlan option on the trunk ports connecting to the Switch Cluster.

## 5.1.1 Configuation

### 5.1.1.1 Create VLANs

The following port based VLANs will be configured on the SMLT Switch cluster

- VLAN 2 to be used by the Inter Switch Trunk (IST)
- VLAN 5 to be used as Management VLAN for this Network
- VLAN 10 and 20 to be used as User VLANs out to the Cisco Switches

**ERS8600-1: Step 1 – Create VLANs**

```
ERS8600-1:5# config vlan 2 create byport 1 name IST
ERS8600-1:5# config vlan 5 create byport 1 name Mgmt
ERS8600-1:5# config vlan 10 create byport 1 name Data10
ERS8600-1:5# config vlan 20 create byport 1 name Data20
```

**ERS8600-2: Step 1 – Create VLANs**

```
ERS8600-2:5# config vlan 2 create byport 1 name IST
ERS8600-2:5# config vlan 5 create byport 1 name Mgmt
ERS8600-2:5# config vlan 10 create byport 1 name Data10
ERS8600-2:5# config vlan 20 create byport 1 name Data20
```

### 5.1.1.2 Change fdb aging timer for Management and User VLANs

**ERS8600-1: Step 1 – Change fdb aging timer for VLAN 5,10 and 20**

```
ERS8600-1:5# config vlan 5 fdb-entry aging-time 21601
ERS8600-1:5# config vlan 10 fdb-entry aging-time 21601
ERS8600-1:5# config vlan 20 fdb-entry aging-time 21601
```

**ERS8600-2: Step 1 – Change fdb aging timer for VLAN 5,10 and 20**

```
ERS8600-2:5# config vlan 5 fdb-entry aging-time 21601
ERS8600-2:5# config vlan 10 fdb-entry aging-time 21601
ERS8600-2:5# config vlan 20 fdb-entry aging-time 21601
```

#### 5.1.1.3 Create IST

Multilink Trunking 1 (MLT 1) will be used for the IST with 802.1Q tagged port members 2/1 and 3/1. Spanning Tree will be disabled on all IST port members by default. We will enable VLACP on the IST port members.

It is recommended to use the reserved multicast MAC address of 01:80:c2:00:00:0f for the VLACP MAC address.

**ERS8600-1: Step 1 – Create MLT 1 for IST**

```
ERS8600-1:5# config mlt 1 create
ERS8600-1:5# config mlt 1 name IST
ERS8600-1:5# config mlt 1 add port 2/1,3/1
ERS8600-1:5# config vlan 2 add-mlt 1
```

**ERS8600-2: Step 1 – Create MLT 1 for IST**

```
ERS8600-2:5# config mlt 1 create
ERS8600-2:5# config mlt 1 name IST
ERS8600-2:5# config mlt 1 add port 2/1,3/1
ERS8600-2:5# config vlan 2 add-mlt 1
```

**ERS8600-1: Step 2 – Create IST**

```
ERS8600-1:5# config vlan 2 ip create 10.1.2.1/30
ERS8600-1:5# config mlt 1 ist create ip 10.1.2.2 vlan-id 2
ERS8600-1:5# config mlt 1 ist enable
```

**ERS8600-2: Step 2 – Create IST**

```
ERS8600-2:5# config vlan 2 ip create 10.1.2.2/30
ERS8600-2:5# config mlt 1 ist create ip 10.1.2.1 vlan-id 2
ERS8600-2:5# config mlt 1 ist enable
```

**ERS8600-1: Step 3 – Enable VLACP**

```
ERS8600-1:5# config ethernet 2/1,3/1 vlacp macaddress 01:80:c2:00:00:0f
ERS8600-1:5# config ethernet 2/1,3/1 vlacp slow-periodic-time 10000
ERS8600-1:5# config ethernet 2/1,3/1 vlacp enable
ERS8600-1:5# config vlacp enable
```

**ERS8600-2: Step 3 – Enable VLACP**

```
ERS8600-2:5# ethernet 2/1,3/1 vlacp macaddress 01:80:c2:00:00:0f
ERS8600-2:5# ethernet 2/1,3/1 vlacp slow-periodic-time 10000
ERS8600-2:5# ethernet 2/1,3/1 vlacp enable
ERS8600-2:5# config vlacp enable
```

#### 5.1.1.4 Add Management and User VLANs to IST

**ERS8600-1: Step 1 – Add VLANs 5, 10, and 20 to IST MLT**

```
ERS8600-1:5# config vlan 5 add-mlt 1
ERS8600-1:5# config vlan 10 add-mlt 1
ERS8600-1:5# config vlan 20 add-mlt 1
```

**ERS8600-2: Step 1 – Add VLANs 5, 10, and 20 to IST MLT**

```
ERS8600-2:5# config vlan 5 add-mlt 1
ERS8600-2:5# config vlan 10 add-mlt 1
ERS8600-2:5# config vlan 20 add-mlt 1
```

#### 5.1.1.5 Add VLAN port members to C3650 switch

**ERS8600-1: Step 1 – Add VLAN port members**

```
ERS8600-1:5# config ethernet 2/2 perform-tagging enable
ERS8600-1:5# config vlan 1 ports remove 2/2
ERS8600-1:5# config vlan 5 ports add 2/2
ERS8600-1:5# config vlan 10 ports add 2/2
ERS8600-1:5# config vlan 20 ports add 2/2
```

**ERS8600-2: Step 1 – Add VLAN port members**

```
ERS8600-2:5# config ethernet 2/2 perform-tagging enable
ERS8600-2:5# config vlan 1 ports remove 2/2
ERS8600-2:5# config vlan 5 ports add 2/2
ERS8600-2:5# config vlan 10 ports add 2/2
ERS8600-2:5# config vlan 20 ports add 2/2
```

#### 5.1.1.6 CP Limit – on ports used for inter-switch connections

CP Limit will be enabled on all ports used for inter-switch connections. For this example, we will select the moderate recommendations for CP-Limit.

| **ERS8600-1: Step 1 – CP Limit** |
|---|
| ERS8600-1:5# ***config ethernet 2/2 cp-limit enable multicast-limit 2500 broadcast-limit 2500*** |
| **ERS8600-2: Step 1 – CP Limit** |
| ERS8600-2:5# ***config ethernet 2/2 cp-limit enable multicast-limit 2500 broadcast-limit 2500*** |

#### 5.1.1.7 SLPP

To be extra safe, we will configure SLPP on the ports connecting to the Cisco Switches on the VLANs used on the Cisco Switches. This is to make sure that if a configuration error occurs on the Cisco Switches, the Nortel Switch Cluster will still be able to detect and prevent a loop from occurring

For this example, we will select ERS8600-1 as the primary switch for the switch cluster. SLPP will be enabled globally and on the ports used to connect to the Cisco Switches. On the primary switch, we will set the SLPP packet-rx-threshold to 5 while on the secondary switch; we will set the SLPP packet-rx-threshold to 50.

SLPP should not be enabled on the IST port members.

| **ERS8600-1: Step 1 – Enable SLPP** |
|---|
| ERS8600-1:5# ***config slpp add 5,10,20***<br>ERS8600-1:5# ***config slpp operation enable***<br>ERS8600-1:5# ***config ethernet 2/2 slpp packet-rx enable***<br>ERS8600-1:5# ***config ethernet 2/2 slpp packet-rx-threshold 5*** |
| **ERS8600-2: Step 1 – Enable SLPP** |
| ERS8600-2:5# ***config slpp add 5,10,20***<br>ERS8600-2:5# ***config slpp operation enable***<br>ERS8600-2:5# ***ethernet 2/2 slpp packet-rx enable***<br>ERS8600-2:5# ***ethernet 2/2 slpp packet-rx-threshold 50*** |

#### 5.1.1.8 Ext-CP Limit

Ext-CP Limit will be enabled globally and on the ports used for inter-switch connections. The SoftDown option will be used with the bandwidth utilization threshold set to 10%.

| **ERS8600-1: Step 1 – Enable EXT-CP-Limit** |
|---|
| ERS8600-1:5# ***config sys ext-cp-limit extcplimit enable*** |
| ERS8600-1:5# ***config sys ext-cp-limit max-ports-to-check 5*** |
| ERS8600-1:5# ***config sys ext-cp-limit trap-level Normal*** |
| ERS8600-1:5# ***config ethernet 2/2 ext-cp-limit SoftDown threshold-util-rate 10*** |
| **ERS8600-2: Step 2 – Enable EXT-CP-Limit** |
| ERS8600-2:5# ***config sys ext-cp-limit extcplimit enable*** |
| ERS8600-2:5# ***config sys ext-cp-limit max-ports-to-check 5*** |
| ERS8600-2:5# ***config sys ext-cp-limit trap-level Normal*** |
| ERS8600-2:5# ***config ethernet 2/2 ext-cp-limit SoftDown threshold-util-rate 10*** |

#### 5.1.1.9 Discard Untagged Frames

It is recommended to enable discard untagged frames on all IST and inter-switch connecting ports

| **ERS8600-1: Step 1 – Enable Discard Untagged Frames** |
|---|
| ERS8600-1:5# ***config ethernet 2/1,3/1,2/2 untagged-frames-discard enable*** |
| **ERS8600-2: Step 1 – Enable Discard Untagged Frames** |
| ERS8600-2:5# ***config ethernet 2/1,3/1,2/2 untagged-frames-discard enable*** |

### 5.1.2 Configuration – Cisco Edge Switches

The Configuration of the two Cisco switches will be very basic considering that PVST+ on the Cisco Switches is enabled by default

The two switches will be basically identical except for the Management IP address the Configurations are shown below in summarized form.

#### 5.1.2.1 C3650-1 Configuration

```
!
version 12.2

no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Switch
!
!
no aaa new-model
system mtu routing 1500
ip subnet-zero
!
!
!
!
no file verify auto
!
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
interface GigabitEthernet0/1
 switchport access vlan 10
 spanning-tree portfast
!

.
.
.

interface GigabitEthernet0/24
 switchport access vlan 10
 spanning-tree portfast
!
interface GigabitEthernet0/25
 switchport access vlan 20
 spanning-tree portfast
!

.
```

```
.

interface GigabitEthernet0/48
 switchport access vlan 20
 spanning-tree portfast
!
interface GigabitEthernet0/49
!
interface GigabitEthernet0/50
!
interface GigabitEthernet0/51
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 5,10,20
 switchport mode trunk
!
interface GigabitEthernet0/52
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 5,10,20
 switchport mode trunk
!
interface Vlan1
 no ip address
 shutdown
!
interface Vlan5
 ip address 10.1.5.11 255.255.255.0
!
ip default-gateway 10.1.5.1
ip classless
ip http server
!
!
control-plane
!
!
line con 0
line vty 0 4
 login
line vty 5 15
 login
!
end
```

#### 5.1.2.2 C3650-2 Configuration

```
!
version 12.2
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Switch
!
!
no aaa new-model
system mtu routing 1500
ip subnet-zero
!
!
!
!
no file verify auto
!
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
interface GigabitEthernet0/1
 switchport access vlan 10
 spanning-tree portfast
!

.
.
.

interface GigabitEthernet0/24
 switchport access vlan 10
 spanning-tree portfast
!
interface GigabitEthernet0/25
 switchport access vlan 20
 spanning-tree portfast
!

.
.

interface GigabitEthernet0/48
 switchport access vlan 20
 spanning-tree portfast
!
interface GigabitEthernet0/49
!
interface GigabitEthernet0/50
!
```

```
interface GigabitEthernet0/51
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 5,10,20
 switchport mode trunk
!
interface GigabitEthernet0/52
 switchport trunk encapsulation dot1q
 switchport trunk allowed vlan 5,10,20
 switchport mode trunk
!
interface Vlan1
 no ip address
         shutdown
!
interface Vlan5
 ip address 10.1.5.12 255.255.255.0
!
interface Vlan10
 no ip address
 spanning-tree port-priority 16
!
ip default-gateway 10.1.5.1
ip classless
ip http server
!
!
control-plane
!
!
line con 0
line vty 0 4
 login
line vty 5 15
 login
!
End
```

### 5.1.3 Verify Operations

### 5.1.4 Cisco

To verify the Cisco Switches in this configuration are working as expected, enter the CLI command *show spanning-tree* on of each switch and ensure that each VLAN has a blocking port on the switch which is not the Root Bridge for that VLAN.

**Step 1** – Enter the CLI command *show spanning-tree* to view the operational state for each interface on all VLANs on C3650-1

```
C3650-1#show spanning-tree
```

**Result:**

```
        VLAN0005
          Spanning tree enabled protocol ieee
          Root ID    Priority    32773
                     Address     0011.939e.8000
                     Cost        4
                     Port        52 (GigabitEthernet0/52)
                     Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

          Bridge ID  Priority    32773  (priority 32768 sys-id-ext 5)
                     Address     0022.0c40.cb80
                     Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
                     Aging Time 300

        Interface        Role Sts Cost      Prio.Nbr Type
        ---------------- ---- --- --------- -------- --------------------------------
        Gi0/51           Altn BLK 19        128.51   P2p
        Gi0/52           Root FWD 4         128.52   P2p


        VLAN0010
          Spanning tree enabled protocol ieee
          Root ID    Priority    32778
                     Address     0011.939e.8000
                     Cost        4
                     Port        52 (GigabitEthernet0/52)
                     Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

          Bridge ID  Priority    32778  (priority 32768 sys-id-ext 10)
                     Address     0022.0c40.cb80
                     Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
                     Aging Time 300

        Interface        Role Sts Cost      Prio.Nbr Type
        ---------------- ---- --- --------- -------- --------------------------------
        Gi0/51           Altn BLK 19        128.51   P2p
        Gi0/52           Root FWD 4         128.52   P2p

        VLAN0020
          Spanning tree enabled protocol ieee
          Root ID    Priority    4116
                     Address     0011.939e.8000
                     Cost        4
                     Port        52 (GigabitEthernet0/52)
                     Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

          Bridge ID  Priority    32788  (priority 32768 sys-id-ext 20)
                     Address     0022.0c40.cb80
                     Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
                     Aging Time 300
```

```
Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi0/51           Altn BLK 19        128.51   P2p
Gi0/52           Root FWD 4         128.52   P2p
```

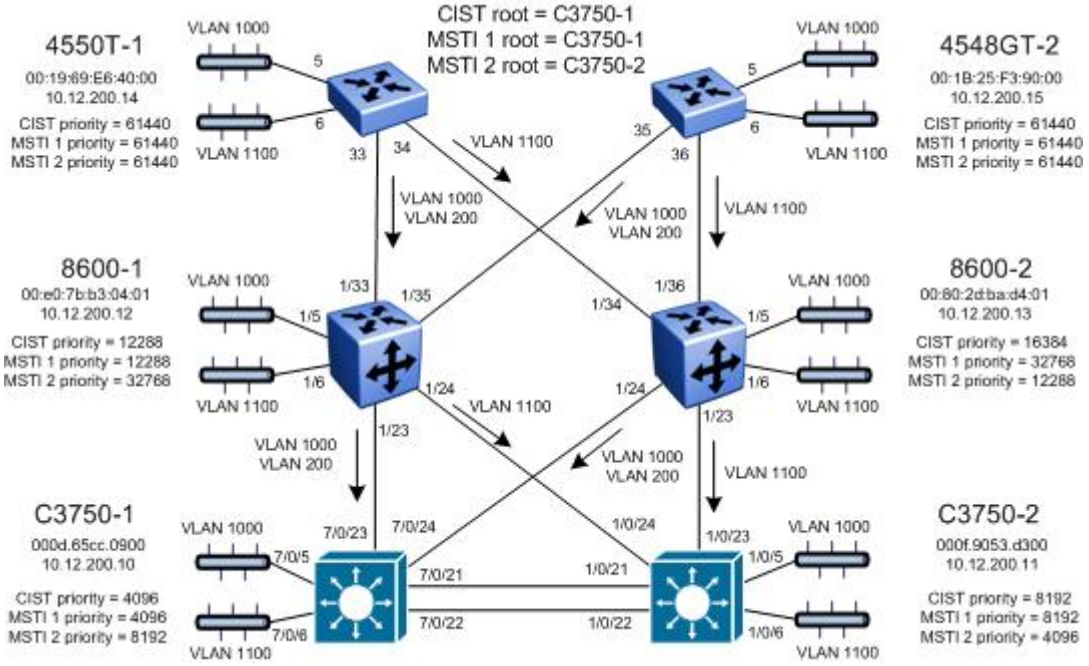
**Step 1** – Enter the CLI command *show spanning-tree* to view the operational state for each interface on all VLANs on C3650-2

```
C3650-2#show spanning-tree
```

**Result:**

```
VLAN0005
  Spanning tree enabled protocol ieee
  Root ID    Priority    32773
             Address     0011.939e.8000
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32773  (priority 32768 sys-id-ext 5)
             Address     0011.939e.8000
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi0/51           Desg FWD 19        128.51   P2p
Gi0/52           Desg FWD 19        128.52   P2p


VLAN0010
  Spanning tree enabled protocol ieee
  Root ID    Priority    32778
             Address     0011.939e.8000
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32778  (priority 32768 sys-id-ext 10)
             Address     0011.939e.8000
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi0/51           Desg FWD 19        128.51   P2p
Gi0/52           Desg FWD 19        128.52   P2p


VLAN0020
  Spanning tree enabled protocol ieee
  Root ID    Priority    32788
             Address     0011.939e.8000
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32788  (priority 32768 sys-id-ext 20)
             Address     0011.939e.8000
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi0/51           Desg FWD 19        128.51   P2p
Gi0/52           Desg FWD 19        128.52   P2p
```

## 5.2 MSTP Configuration Example – One Region




For this configuration example, we will configure the following:

- All switches are configured in the same region named *region1* and using *revision 1*
- C3750-1 will be configured so that it will become the CIST Root by configuring the lowest CIST Priority of 4096.
- C3750-2 will be configured so that it will become the CIST backup by configuring the next highest CIST Priority of 8192.
- Three VLANs will be configured, VLAN 200 for management and VLANs 1000 and 1100 for end user access
- For the management VLAN 200, we will configure a management IP address as shown in the diagram above – for this example, no routes are configured for the management as it is a simple Layer 2 network
- We will configure two MSTI instances; MSTI 1 for VLAN 200 and 1000, and MSTI 2 for VLAN 1100 to load balance traffic as illustrated in the diagram above
- C3750-1 will be configured as the root bridge for MSTI 1 and backup root for MSTI 2
- C3750-2 will be configured as the root bridge for MSTI 2 and backup root for MSTI 1
- 8600-1 will be configured with a CIST and MSTI 1 priority of 12288 so that will become both CIST and MSTI 1 root if both C3750-1 and C3750-2 should fail
- 8600-2 will be configured with a CIST priority of 16384 so that it will become CIST root if C3750-1, C3750-2, and 8600-1 should fail
- 8600-2 will be configured with a MSTI 2 priority of 12288 so that it will become MSTI 2 root if both C3750-1 and C3750-2 should fail

After all the switches have been configured using the above settings, the traffic flow for each MSTI instance and CIST should be as that shown in the following diagrams.

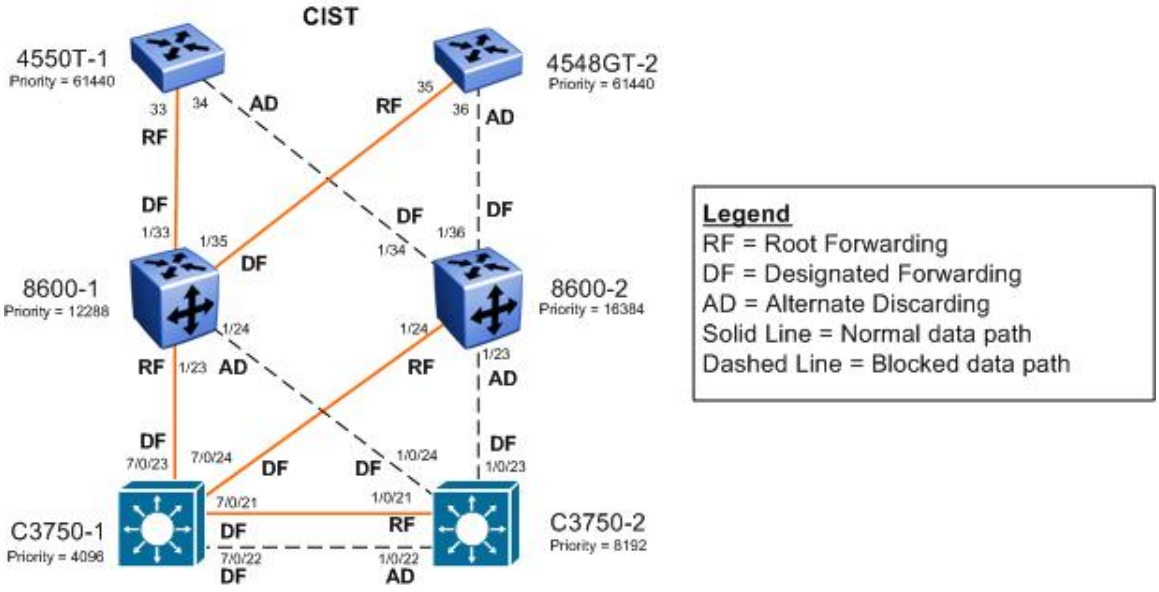



**Figure 1: MSTP Example with One Region – CIST Instance 0 Data Flow**

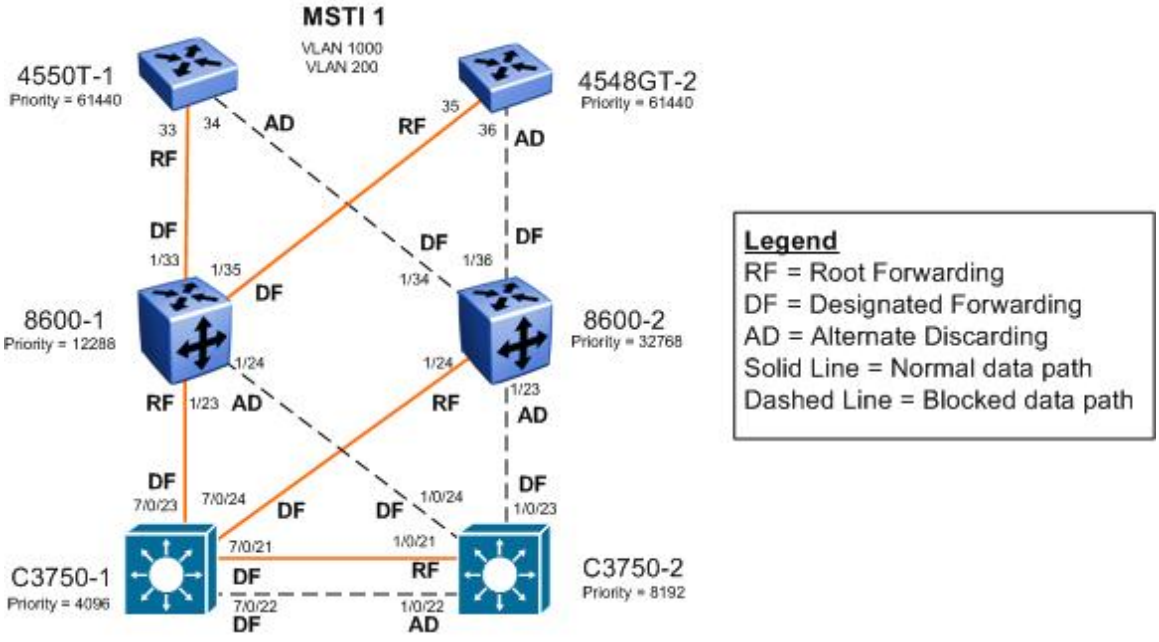



**Figure 2: MSTP Example with One Region – MSTI 1 Data Flow**

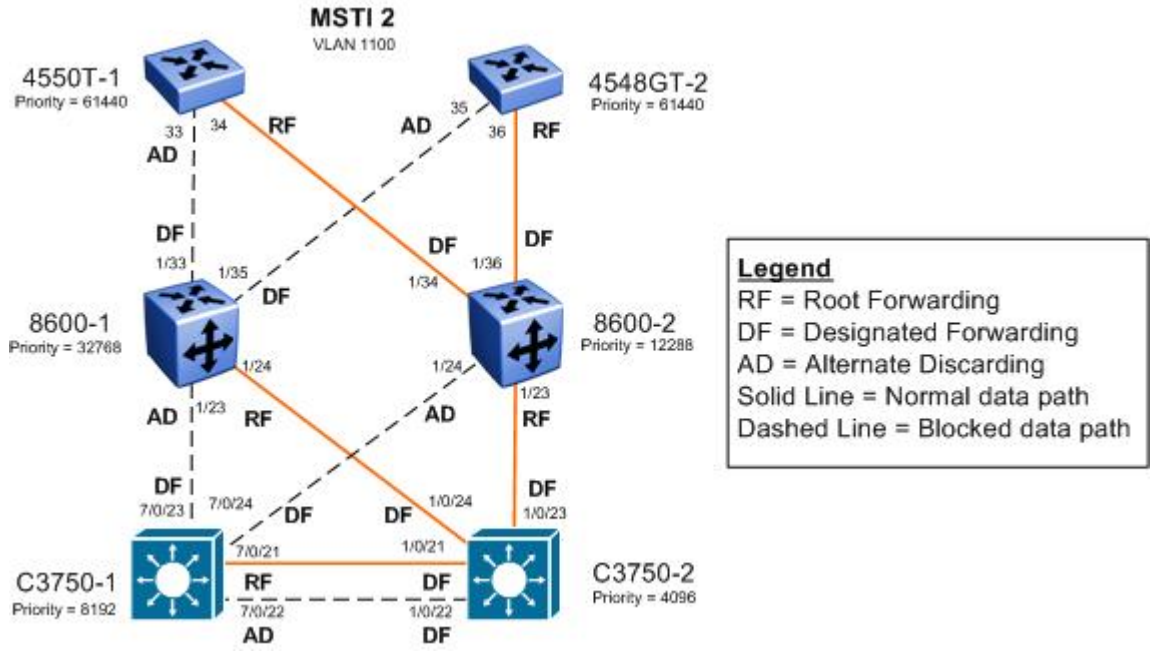



**Figure 3: MSTP Example with One Region – MSTI 2 Data Flow**

## 5.2.1 Configuration

In this configuration example, NNCLI will be used on 8600-1 while CLI will be used on 8600-2.

### 5.2.1.1 Set Spanning Tree Mode to MSTP

| **ERS8600-1: Step 1 – Set the bootconfig Spanning Tree mode to MSTP** |
|---|
| ERS-8610:5(config)#***boot config flags spanning-tree-mode mstp***<br>ERS-8610:5(config)#***save bootconfig***<br>ERS-8610:5(config)#***boot –y***<br>ERS-8610:5(config)#***sys name ERS8600-1*** |
| **ERS8600-2: Step 1 – Set the bootconfig Spanning Tree mode to MSTP** |
| ERS-8610:5# ***config bootconfig flags spanning-tree-mode mstp***<br>ERS-8610:5# ***save bootconfig***<br>ERS-8610:5# ***boot –y***<br>ERS-8610:5# ***config sys set name ERS8600-2*** |
| **ERS4550T-1: Step 1 – Set Spanning Tree Operation mode to MSTP** |
| 4550T(config)#***spanning-tree op-mode mstp***<br>4550T(config)#***write memory***<br>4550T(config)#***boot*** |

```
Reboot the unit(s) (y/n) ? y
4550T(config)#snmp-server name 4550T-1
4550T-1(config)#banner disabled
```

**ERS4528GT-2: Step 1 – Set Spanning Tree Operation mode to MSTP**

```
4548GT#(config)#spanning-tree op-mode mstp
4548GT#(config)#write memory
4548GT#(config)#boot
Reboot the unit(s) (y/n) ? y
4548GT(config)#snmp-server name 4548GT-2
4548GT(config)#banner disabled
```

**C3750-1: Step 1 – Set Spanning Tree mode to MSTP**

```
C3750(config)#spanning-tree mode mst
C3750(config)#hostname C3750-1
```

**C3750-2: Step 1 – Set Spanning Tree mode to MSTP**

```
C3750(config)#spanning-tree mode mst
C3750(config)#hostname C3750-2
```

#### 5.2.1.2 Create VLANs

**ERS8600-1: Step 1 – Create VLANs 200, 1000, and 1100 and add port members**

```
ERS8600-1:5(config)#vlan create 200 name mgmt type port-mstprstp 1
ERS8600-1:5(config)# vlan create 1000 type port-mstprstp 1
ERS8600-1:5(config)#vlan create 1100 type port-mstprstp 2
ERS8600-1:5(config)#vlan ports 1/23,1/24,1/33,1/35 tagging tagAll
ERS8600-1:5(config)#vlan members remove 1 1/5,1/6,1/23,1/24,1/33,1/35
ERS8600-1:5(config)#vlan members add 200 1/23,1/24,1/33,1/35
ERS8600-1:5(config)#vlan members add 1000 1/5,1/23,1/24,1/33,1/35
ERS8600-1:5(config)#vlan members add 1100 1/6,1/23,1/24,1/33,1/35
```

**ERS8600-2: Step 1 – Create VLANs 200, 1000, and 1100 and add port members**

```
ERS8600-2:5# config vlan 200 create byport-mstprstp 1 name mgmt
ERS8600-2:5# config vlan 1000 create byport-mstprstp 1
ERS8600-2:5# config vlan 1100 create byport-mstprstp 2
ERS8600-2:5# config ethernet 1/23,1/24,1/34,1/36 perform-tagging enable
ERS8600-2:5# config vlan 1 ports remove 1/5,1/6,1/23,1/24,1/34,1/36
ERS8600-2:5# config vlan 200 ports add 1/23,1/24,1/34,1/36
```

```
ERS8600-2:5# config vlan 1000 ports add 1/5,1/23,1/24,1/34,1/36
ERS8600-2:5# config vlan 1100 ports add 1/6,1/23,1/24,1/34,1/36
```

**ERS4550T-1: Step 1 – Create VLANs 200, 1000, and 1100 and add port members**

```
4550T-1(config)#spanning-tree mstp msti 1
4550T-1(config)#spanning-tree mstp msti 2
4550T-1(config)#vlan create 200 name mgmt type port msti 1
4550T-1(config)#vlan create 1000 type port msti 1
4550T-1(config)#vlan create 1100 type port msti 2
4550T-1(config)#vlan configcontrol automatic
4550T-1(config)#vlan ports 33,34 tagging tagall
4550T-1(config)#vlan members add 200 33,34
4550T-1(config)#vlan members add 1000 5,33,34
4550T-1(config)#vlan members add 1100 6,33,34
4550T-1(config)#vlan members remove 1 5,6,33,34
```

**ERS4528GT-2: Step 1 – Create VLANs 200, 1000, and 1100 and add port members**

```
4548GT-2(config)#spanning-tree mstp msti 1
4548GT-2(config)#spanning-tree mstp msti 2
4548GT-2(config)#vlan create 200 name mgmt type port msti 1
4548GT-2(config)#vlan create 1000 type port msti 1
4548GT-2(config)#vlan create 1100 type port msti 2
4548GT-2(config)#vlan configcontrol automatic
4548GT-2(config)#vlan ports 35,36 tagging tagall
4548GT-2(config)#vlan members add 200 35,36
4548GT-2(config)#vlan members add 1000 5,35,36
4548GT-2(config)#vlan members add 1100 6,35,36
4548GT-2(config)#vlan members remove 1 5,6,35,36
```

**C3750-1: Step 1 – Create VLANs 200, 1000, and 1100 and add port members**

```
C3750-1(config)#vtp mode transparent
C3750-1(config)#vlan 200
C3750-1(config-vlan)#name mgmt
C3750-1(config-vlan)#vlan 1000
C3750-1(config-vlan)#vlan 1100
C3750-1(config-vlan)#exit
C3750-1(config)#interface range gigabitEthernet 7/0/21 – 24
C3750-1(config-if-range)#switchport trunk encapsulation dot1q
```

```
C3750-1(config-if-range)#switchport mode trunk
C3750-1(config-if-range)#switchport trunk allowed vlan 200,1000,1100
C3750-1(config-if-range)#exit
C3750-1(config)#interface gigabitEthernet 7/0/5
C3750-1(config-if)#switchport mode access
C3750-1(config-if)#switchport access vlan 1000
C3750-1(config-if)#exit
C3750-1(config)#interface gigabitEthernet 7/0/6
C3750-1(config-if)#switchport mode access
C3750-1(config-if)#switchport access vlan 1100
C3750-1(config-if)#exit
```

**C3750-2: Step 1 – Create VLANs 200, 1000, and 1100 and add port members**

```
C3750-2(config)#vtp mode transparent
C3750-2(config)#vlan 200
C3750-2(config-vlan)#name mgmt
C3750-2(config-vlan)#vlan 1000
C3750-2(config-vlan)#vlan 1100
C3750-2(config-vlan)#exit
C3750-2(config)#interface range gigabitEthernet 1/0/21 – 24
C3750-2(config-if-range)#switchport trunk encapsulation dot1q
C3750-2(config-if-range)#switchport mode trunk
C3750-2(config-if-range)#switchport trunk allowed vlan 200,1000,1100
C3750-2(config-if-range)#exit
C3750-2(config)#interface gigabitEthernet 1/0/5
C3750-2(config-if)#switchport mode access
C3750-2(config-if)#switchport access vlan 1000
C3750-2(config-if)#exit
C3750-2(config)#interface gigabitEthernet 1/0/6
C3750-2(config-if)#switchport mode access
C3750-2(config-if)#switchport access vlan 1100
C3750-2(config-if)#exit
```

On the ERS4500, if a port is removed from the default VLAN (VLAN 1) prior to adding the port as a port member to a different VLAN, STP participation is disabled for this port. Hence, at an interface level, Spanning Tree Port must be re-enabled for each removed port. This inconvenience can be avoided if the port or ports are removed from the default VLAN after the port or ports are added to a different VLAN.

#### 5.2.1.3 MSTP Configuration

**ERS8600-1: Step 1 – Add MSTP configuration**

```
ERS8600-1:5(config)#spanning-tree mstp region region-name region1 region-version 1
ERS8600-1:5(config)#spanning-tree mstp priority 12288
ERS8600-1:5(config)#spanning-tree mstp msti 1 priority 12288
```

**ERS8600-2: Step 1 – Add MSTP configuration**

```
ERS8600-2:5# config mstp region name region1
ERS8600-2:5# config mstp region revision 1
ERS8600-2:5# config mstp cist priority 16384
ERS8600-2:5# config mstp msti 2 priority 12288
```

**ERS4550T-1: Step 1 – Add MSTP configuration**

```
4550T-1(config)#spanning-tree mstp region region-name region1 region-version 1
4550T-1(config)#spanning-tree mstp msti 1 enable
4550T-1(config)#spanning-tree mstp msti 2 enable
4550T-1(config)#spanning-tree mstp priority f000
4550T-1(config)#spanning-tree mstp msti 1 priority f000
4550T-1(config)#spanning-tree mstp msti 2 priority f000
```

**ERS4528GT-2: Step 1 – Add MSTP configuration**

```
4548GT-2(config)#spanning-tree mstp region region-name region1 region-version 1
4548GT-2(config)#spanning-tree mstp msti 1 enable
4548GT-2(config)#spanning-tree mstp msti 2 enable
4548GT-2(config)#spanning-tree mstp priority f000
4548GT-2(config)#spanning-tree mstp msti 1 priority f000
4548GT-2(config)#spanning-tree mstp msti 2 priority f000
```

**C3750-1: Step 1 – Add MSTP configuration**

```
C3750-1(config)#spanning-tree mst configuration
C3750-1(config-mst)#name region1
C3750-1(config-mst)#revision 1
C3750-1(config-mst)#instance 1 vlan 200,1000
C3750-1(config-mst)# instance 2 vlan 1100
C3750-1(config-mst)#exit
C3750-1(config)#spanning-tree mst 0,1 priority 4096
C3750-1(config)#spanning-tree mst 2 priority 8192
```

**C3750-2: Step 1 – Add MSTP configuration**

```
C3750-2(config)#spanning-tree mst configuration
C3750-2(config-mst)#name region1
C3750-2(config-mst)#revision 1
C3750-2(config-mst)#instance 1 vlan 200,1000
C3750-2(config-mst)#instance 2 vlan 1100
C3750-2(config-mst)#exit
C3750-2(config)#spanning-tree mst 0,1 priority 8192
C3750-2(config)#spanning-tree mst 2 priority 4096
```

**ERS8600-1: Step 2 – Configure access ports as Edge Port**

```
ERS8600-1:5(config)#interface fastEthernet 1/5,1/6
ERS8600-1:5(config-if)#spanning-tree mstp edge-port true
ERS8600-1:5(config-if)#exit
```

**ERS8600-2: Step 2 – Configure access ports as Edge Port**

```
ERS8600-2:5# config ethernet 1/5,1/6 mstp cist edge-port true
```

**ERS4550T-1: Step 2 – Configure access ports as Edge Port**

```
4550T-1(config)#interface fastEthernet 5,6
4550T-1(config-if)#spanning-tree mstp edge-port true
4550T-1(config-if)#exit
```

**ERS4528GT-2: Step 2 – Configure access ports as Edge Port**

```
4548GT-2(config)#interface fastEthernet 5,6
4548GT-2(config-if)#spanning-tree mstp edge-port true
4548GT-2(config-if)#exit
```

Note that Cisco does not have a MSTP Edge Port configurable parameter, but, it is activated with the portfast command.

#### 5.2.1.4 Management VLAN Configuration

**ERS8600-1: Step 2 – Add management IP address and add port members**

```
ERS8600-1:5(config)#interface vlan 200
ERS8600-1:5(config-if)#ip address 10.12.200.12 255.255.255.0
ERS8600-1:5(config-if)#exit
```

**ERS8600-2: Step 2 – Add management IP address**

```
ERS8600-2:5# config vlan 200 ip create 10.12.200.13/24
```

**ERS4550T-1: Step 2 – Add management IP address**

```
4550T-1(config)#vlan mgmt 200
4550T-1(config)#ip address 10.12.200.14 netmask 255.255.255.0
```

**ERS4528GT-2: Step 2 – Add management IP address**

```
4548GT-2(config)#vlan mgmt 200
4548GT-2(config)#ip address 10.12.200.15 netmask 255.255.255.0
```

**C3750-1: Step 2 – Add management IP address**

```
C3750-1(config)#interface vlan 200
C3750-1(config-if)#ip address 10.12.200.10 255.255.255.0
C3750-1(config-if)#exit
```

**C3750-2: Step 2 – Add management IP address**

```
C3750-2(config)#interface vlan 200
C3750-2(config-if)#ip address 10.12.200.11 255.255.255.0
C3750-2(config-if)#exit
```

## 5.2.2 Verify Operations

### 5.2.2.1 Verify CIST Root

**Step 1** – Verify that the CIST root and CIST Regional root is C3750-1:

```
ERS8600-1:5#show spanning-tree mstp status
```

**Result:**

```
================================================================
                                  MSTP Status
================================================================
----------------------------------------------------------------
Bridge Address                : 00:e0:7b:b3:04:01
Cist Root                     : 10:00:00:0d:65:cc:09:00
Cist Regional Root            : 10:00:00:0d:65:cc:09:00
Cist Root Port                : 1/23
Cist Root Cost                : 0
Cist Regional Root Cost       : 200000
Cist Instance Vlan Mapped     : 1-199,201-999,1001-1024
Cist Instance Vlan Mapped2k   : 1025-1099,1101-2048
Cist Instance Vlan Mapped3k   : 2049-3072
Cist Instance Vlan Mapped4k   : 3073-4094
Cist Max Age                  : 20 seconds
Cist Forward Delay            : 15 seconds
```

```
ERS8600-2:5# show mstp status
```

**Result:**

```
============================================================
                              MSTP Status
============================================================
------------------------------------------------------------
Bridge Address               : 00:80:2d:ba:d4:01
Cist Root                    : 10:00:00:0d:65:cc:09:00
Cist Regional Root           : 10:00:00:0d:65:cc:09:00
Cist Root Port               : 1/24
Cist Root Cost               : 0
Cist Regional Root Cost      : 200000
Cist Instance Vlan Mapped    : 1-199,201-999,1001-1024
Cist Instance Vlan Mapped2k  : 1025-1099,1101-2048
Cist Instance Vlan Mapped3k  : 2049-3072
Cist Instance Vlan Mapped4k  : 3073-4094
Cist Max Age                 : 20 seconds
Cist Forward Delay           : 15 seconds
```

4550T-1#***show spanning-tree mstp status***

**Result:**

```
Bridge Address:          00:19:69:E6:40:00
Cist Root:               10:00:00:0D:65:CC:09:00
Cist Regional Root:      10:00:00:0D:65:CC:09:00
Cist Root Port:          33
Cist Root Cost:          0
Cist Regional Root Cost: 400000
Cist Max Age:            20 seconds
Cist Forward Delay:      15 seconds
```

C3750-2#***show spanning-tree mst 0***

**Result:**

```
##### MST0    vlans mapped:   1-199,201-999,1001-1099,1101-4094
Bridge        address 000f.9053.d300  priority      8192  (8192 sysid 0)
Root          address 000d.65cc.0900  priority      4096  (4096 sysid 0)
              port    Gi1/0/21        path cost     0
Regional Root address 000d.65cc.0900  priority      4096  (4096 sysid 0)
                                      internal cost 20000     rem hops 19
Operational   hello time 2 , forward delay 15, max age 20, txholdcount 6
Configured    hello time 2 , forward delay 15, max age 20, max hops    20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi1/0/1          Desg FWD 200000    128.1    P2p
Gi1/0/21         Root FWD 20000     128.21   P2p
Gi1/0/22         Altn BLK 20000     128.22   P2p
Gi1/0/23         Desg FWD 200000    128.23   P2p
Gi1/0/24         Desg FWD 200000    128.24   P2p
```

On each switch, verify the following information:

| Option | Verify |
|---|---|
| CIST Root | Verify that the CIST root bridge is C3750-1 whose address is ***000d.65cc.0900***. |
| CIST Regional Root | Verify that all switches recognize the same CIST Regional root; this indicates that all switches are in the same MST Region; in this case the CIST Regional root matches the CIST Root |

| | |
|---|---|
| Root Port | Verify that under normal operations that the correct port to the CIST root is used:<br>• 8600-1: Port ***1/23***<br>• 8600-2: Port ***1/24***<br>• 4550T-1: Port ***33***<br>• 4548GT-2: Port ***35***<br>• C3750-2: Either port ***1/0/21*** or ***1/0/22*** |

### 5.2.2.2 Verify MSTI 1 Root and port forwarding state

**Step 1** – Verify that the MSTI 1 root is C3750-1:

```
ERS8600-1:5#show spanning-tree mstp msti config 1
```

**Result:**

```
        ============================================================
                                   MSTP Instance Status
        ============================================================
        Instance Id                      : 1
        Msti Bridge Regional Root        : 10:00:00:0d:65:cc:09:00
        Msti Bridge Priority             : 32768 (0x8000)
        Msti Root Cost                   : 200000
        Msti Root Port                   : 1/23
        Msti Instance Vlan Mapped        : 200,1000
        Msti Instance Vlan Mapped2k      :
        Msti Instance Vlan Mapped3k      :
        Msti Instance Vlan Mapped4k      :
```

```
ERS8600-2:5# show mstp instance 1
```

**Result:**

```
        ============================================================
                                   MSTP Instance Status
        ============================================================
        Instance Id                      : 1
        Msti Bridge Regional Root        : 10:00:00:0d:65:cc:09:00
        Msti Bridge Priority             : 32768 (0x8000)
        Msti Root Cost                   : 200000
        Msti Root Port                   : 1/24
        Msti Instance Vlan Mapped        : 200,1000
        Msti Instance Vlan Mapped2k      :
        Msti Instance Vlan Mapped3k      :
        Msti Instance Vlan Mapped4k      :
```

```
4550T-1# show spanning-tree mstp msti config 1
```

**Result:**

```
        Msti Bridge Regional Root:  10:00:00:0D:65:CC:09:00
        Msti Bridge Priority (hex): F000
        Msti Root Cost:             400000
        Msti Root Port:             33
        Msti State:                 Enabled

        VLAN members
        ------ ------ ------ ------ ------ ------ ------ ------
        200    1000
```

```
4548GT-2#show spanning-tree mstp msti config 1
```

**Result:**

```
        Msti Bridge Regional Root:  10:00:00:0D:65:CC:09:00
        Msti Bridge Priority (hex): F000
        Msti Root Cost:             400000
        Msti Root Port:             35
        Msti State:                 Enabled

        VLAN members
        ------ ------ ------ ------ ------ ------ ------ ------
```

```
200    1000
```

C3750-1#***show spanning-tree mst 1***

**Result:**

```
##### MST1    vlans mapped:   200,1000
Bridge        address 000d.65cc.0900  priority      4097  (4096 sysid 1)
Root          this switch for MST1

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi7/0/21         Desg FWD 20000     128.345  P2p
Gi7/0/22         Desg FWD 20000     128.346  P2p
Gi7/0/23         Desg FWD 200000    128.347  P2p
Gi7/0/24         Desg FWD 200000    128.348  P2p
```

C3750-2#***show spanning-tree mst 1***

**Result:**

```
##### MST1    vlans mapped:   200,1000
Bridge        address 000f.9053.d300  priority      8193  (8192 sysid 1)
Root          address 000d.65cc.0900  priority      4097  (4096 sysid 1)
              port    Gi1/0/21        cost          20000     rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi1/0/21         Root FWD 20000     128.21   P2p
Gi1/0/22         Altn BLK 20000     128.22   P2p
Gi1/0/23         Desg FWD 200000    128.23   P2p
Gi1/0/24         Desg FWD 200000    128.24   P2p
```

**Step 2** – Verify that MSTI 1 port state:

ERS8600-1:5#***show spanning-tree mstp msti port role 1/23,1/24,1/33,1/35***

**Result:**

```
================================================================================
                            MSTI Port Roles and States
================================================================================

Port-Index   Instance-Id   Port-Role   Port-State   Port-STP     Port-Oper
--------------------------------------------------------------------------------
1/23         1             Root        Forwarding      Enabled        Enabled
1/23         2             Alternate   Discarding      Enabled        Enabled
1/24         1             Alternate   Discarding      Enabled        Enabled
1/24         2             Root        Forwarding      Enabled        Enabled
1/33         1             Designated  Forwarding      Enabled        Enabled
1/33         2             Designated  Forwarding      Enabled        Enabled
1/35         1             Designated  Forwarding      Enabled        Enabled
1/35         2             Designated  Forwarding      Enabled        Enabled
```

ERS8600-2:5# ***show port info mstp mstirole port 1/23,1/24,1/34,1/36***

**Result:**

```
================================================================================
                            MSTI Port Roles and States
================================================================================

Port-Index   Instance-Id   Port-Role   Port-State   Port-STP     Port-Oper
--------------------------------------------------------------------------------
1/23         1             Alternate   Discarding      Enabled        Enabled
```

```
        1/23        2           Root        Forwarding      Enabled         Enabled
        1/24        1           Root        Forwarding      Enabled         Enabled
        1/24        2           Alternate   Discarding      Enabled         Enabled
        1/34        1           Designated  Forwarding      Enabled         Enabled
        1/34        2           Designated  Forwarding      Enabled         Enabled
        1/36        1           Designated  Forwarding      Enabled         Enabled
        1/36        2           Designated  Forwarding      Enabled         Enabled
```

4550T-1#***show spanning-tree mstp msti port role 1***

**Result:**

```
        Port     Role       State     STP Status  Oper Status
        ----  ----------  ----------  ----------  -----------
        5     Disabled    Discarding  Enabled     Disabled
        33    Root        Forwarding  Enabled     Enabled
        34    Alternate   Discarding  Enabled     Enabled
```

4548GT-2#***show spanning-tree mstp msti port role 1***

**Result:**

```
        Port     Role       State     STP Status  Oper Status
        ----  ----------  ----------  ----------  -----------
        5     Disabled    Discarding  Enabled     Disabled
        35    Root        Forwarding  Enabled     Enabled
        36    Alternate   Discarding  Enabled     Enabled
```

On each switch, verify the following information:

| Option | Verify |
|---|---|
| Root | Verify that the MIST 1 root bridge is C3750-1 whose address is ***000d.65cc.0900***. |
| MSTI 1 Root Port | Verify that under normal operations that the correct port to the MIST 1 root bridge is used:<br>• 8600-1: Port ***1/23***<br>• 8600-2: Port ***1/24***<br>• 4550T-1: Port ***33***<br>• 4548GT-2: Port ***35***<br>• C3750-2: Either port ***1/0/21*** or ***1/0/22*** |
| VLANs | Verify that only VLANs 200 and 1000 are configured for MSTI 1. If not, the MSTI instance will not come up on the corresponding switch. |

### 5.2.2.3 Verify MSTI 2 Root and port forwarding state

**Step 1** – Verify that the MSTI 2 root is C3750-2:

ERS8600-1:5#***show spanning-tree mstp msti config 2***

**Result:**

```
============================================================
                              MSTP Instance Status
============================================================
Instance Id                     : 2
Msti Bridge Regional Root       : 10:00:00:0f:90:53:d3:00
Msti Bridge Priority            : 32768 (0x8000)
Msti Root Cost                  : 200000
Msti Root Port                  : 1/24
Msti Instance Vlan Mapped       :
Msti Instance Vlan Mapped2k     : 1100
Msti Instance Vlan Mapped3k     :
Msti Instance Vlan Mapped4k     :
```

ERS8600-2:5# ***show mstp instance 2***

**Result:**

```
============================================================
                              MSTP Instance Status
============================================================
Instance Id                     : 2
Msti Bridge Regional Root       : 10:00:00:0f:90:53:d3:00
Msti Bridge Priority            : 12288 (0x3000)
Msti Root Cost                  : 200000
Msti Root Port                  : 1/23
Msti Instance Vlan Mapped       :
Msti Instance Vlan Mapped2k     : 1100
Msti Instance Vlan Mapped3k     :
Msti Instance Vlan Mapped4k     :
```

4550T-1#***show spanning-tree mstp msti config 2***

**Result:**

```
Msti Bridge Regional Root:  10:00:00:0F:90:53:D3:00
Msti Bridge Priority (hex): F000
Msti Root Cost:             400000
Msti Root Port:             34
Msti State:                 Enabled

VLAN members
------ ------ ------ ------ ------ ------ ------ ------
1100
```

4548GT-2#***show spanning-tree mstp msti config 2***

**Result:**

```
Msti Bridge Regional Root:  10:00:00:0F:90:53:D3:00
Msti Bridge Priority (hex): F000
Msti Root Cost:             400000
Msti Root Port:             36
Msti State:                 Enabled

VLAN members
------ ------ ------ ------ ------ ------ ------ ------
```

```
1100
```

C3750-1#***show spanning-tree mst 2***

**Result:**

```
##### MST2    vlans mapped:   1100
Bridge        address 000d.65cc.0900  priority      28674 (28672 sysid 2)
Root          address 000f.9053.d300  priority      4098  (4096 sysid 2)
              port    Gi7/0/21        cost          20000     rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi7/0/21         Root FWD 20000     128.345  P2p
Gi7/0/22         Altn BLK 20000     128.346  P2p
Gi7/0/23         Desg FWD 200000    128.347  P2p
Gi7/0/24         Desg FWD 200000    128.348  P2p
```

C3750-2#***show spanning-tree mst 2***

**Result:**

```
##### MST2    vlans mapped:   1100
Bridge        address 000f.9053.d300  priority      4098  (4096 sysid 2)
Root          this switch for MST2

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------
Gi1/0/21         Desg FWD 20000     128.21   P2p
Gi1/0/22         Desg FWD 20000     128.22   P2p
Gi1/0/23         Desg FWD 200000    128.23   P2p
Gi1/0/24         Desg FWD 200000    128.24   P2p
```

**Step 2** – Verify that the MSTI 2 port state:

ERS8600-1:5#***show spanning-tree mstp msti port role 1/23,1/24,1/33,1/35***

**Result:**

```
================================================================================
                            MSTI Port Roles and States
================================================================================

Port-Index   Instance-Id   Port-Role   Port-State   Port-STP     Port-Oper
--------------------------------------------------------------------------------
1/23         1             Root        Forwarding      Enabled        Enabled
1/23         2             Alternate   Discarding      Enabled        Enabled
1/24         1             Alternate   Discarding      Enabled        Enabled
1/24         2             Root        Forwarding      Enabled        Enabled
1/33         1             Designated  Forwarding      Enabled        Enabled
1/33         2             Designated  Forwarding      Enabled        Enabled
1/35         1             Designated  Forwarding      Enabled        Enabled
1/35         2             Designated  Forwarding      Enabled        Enabled
```

ERS8600-2:5# ***show port info mstp mstirole port 1/23,1/24,1/34,1/36***

**Result:**

```
================================================================================
                            MSTI Port Roles and States
================================================================================

Port-Index   Instance-Id   Port-Role   Port-State   Port-STP     Port-Oper
--------------------------------------------------------------------------------
1/23         1             Alternate   Discarding      Enabled        Enabled
```

```
1/23        2           Root        Forwarding      Enabled      Enabled
1/24        1           Root        Forwarding      Enabled      Enabled
1/24        2           Alternate   Discarding      Enabled      Enabled
1/34        1           Designated  Forwarding      Enabled      Enabled
1/34        2           Designated  Forwarding      Enabled      Enabled
1/36        1           Designated  Forwarding      Enabled      Enabled
1/36        2           Designated  Forwarding      Enabled      Enabled
```

4550T-1#***show spanning-tree mstp msti port role 2***

**Result:**

```
Port     Role       State     STP Status  Oper Status
----  ----------  ----------  ----------  -----------
6     Disabled    Discarding  Enabled     Disabled
33    Alternate   Discarding  Enabled     Enabled
34    Root        Forwarding  Enabled     Enabled
```

4548GT-2#***show spanning-tree mstp msti port role 2***

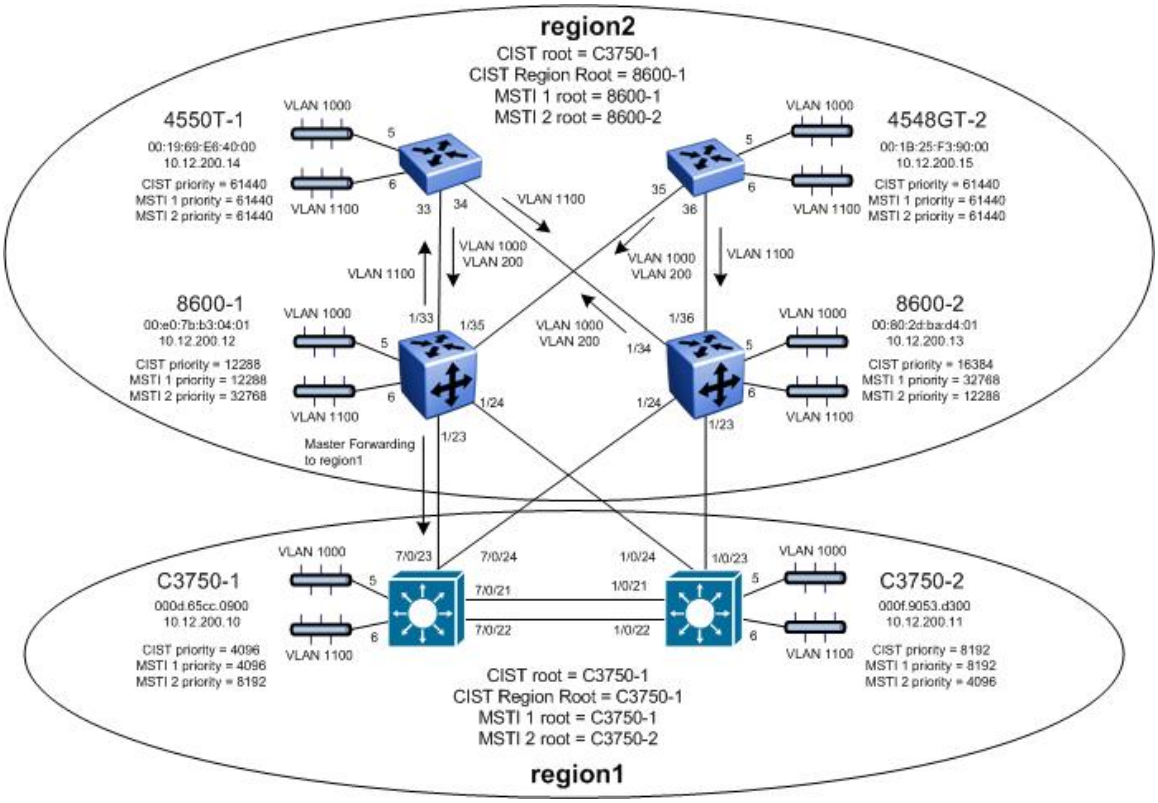
**Result:**

```
Port     Role       State     STP Status  Oper Status
----  ----------  ----------  ----------  -----------
6     Disabled    Discarding  Enabled     Disabled
35    Alternate   Discarding  Enabled     Enabled
36    Root        Forwarding  Enabled     Enabled
```

On each switch, verify the following information:

| Option | Verify |
|---|---|
| Root | Verify that the MIST 2 root bridge is C3750-2 whose address is ***000f.9053.d300***. |
| MSTI 2 Root Port | Verify that under normal operations that the correct port to the MIST 2 root bridge is used:<br>• 8600-1: Port ***1/24***<br>• 8600-2: Port ***1/23***<br>• 4550T-1: Port ***34***<br>• 4548GT-2: Port ***36***<br>• C3750-2: Either port ***1/0/21*** or ***1/0/22*** |
| VLANs | Verify that only VLAN 1100 is configured for MSTI 2. If not, the MSTI instance will not come up on the corresponding switch. |

## 5.3 MSTP Configuration Example - Two Regions




In this configuration example, we take the exact same configuration used in Section 3 with the exception of creating a second region with switches 8600-1, 8600-2, 4550T-1, and 4548GT-2. All the same CIST and MSTI priorities will be used. The only configuration change will be the MSTP region name as illustrated in the diagram above. This will result in only one forwarding port between the two regions via 8600-1 port 1/23. In the region named “region2”, 8600-1 will become the root bridge for MSTI 1 while 8600-2 will become the root bridge for MSTI 2. 8600-1 will also become the CIST Regional Root for the region named “region2” based on the priority settings configured.

After all the switches have been configured using the above settings, the traffic flow for each MSTI instance should as that shown in the following diagrams.

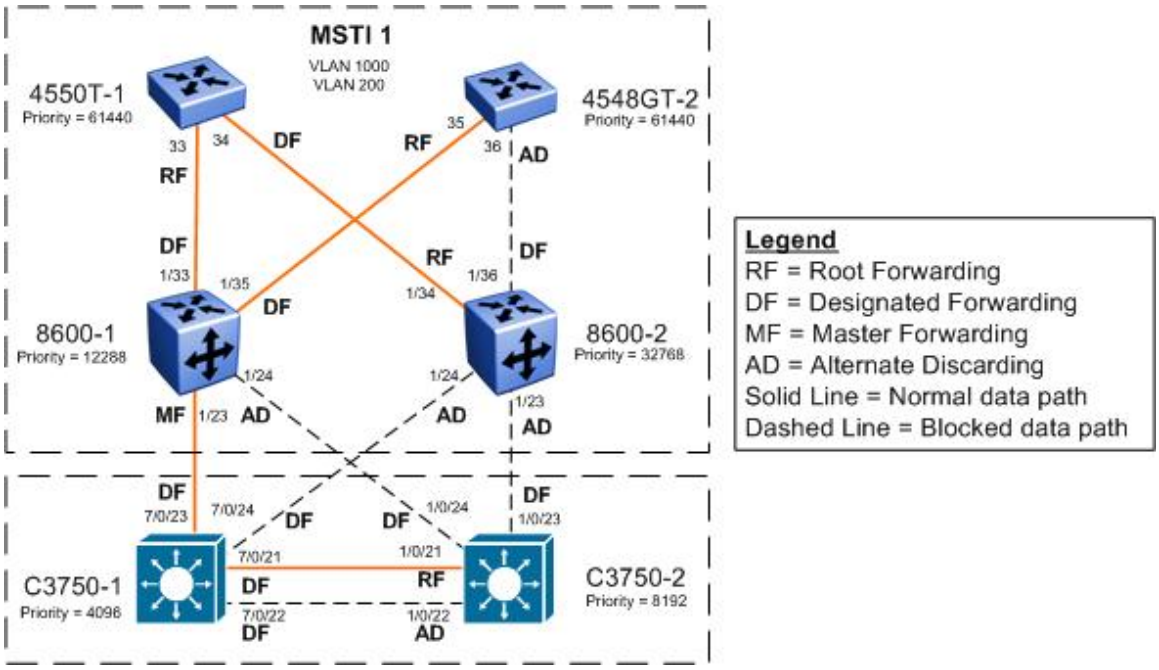



**Figure 4: MSTP Example with Two Regions – MSTI 1 Data Flow**

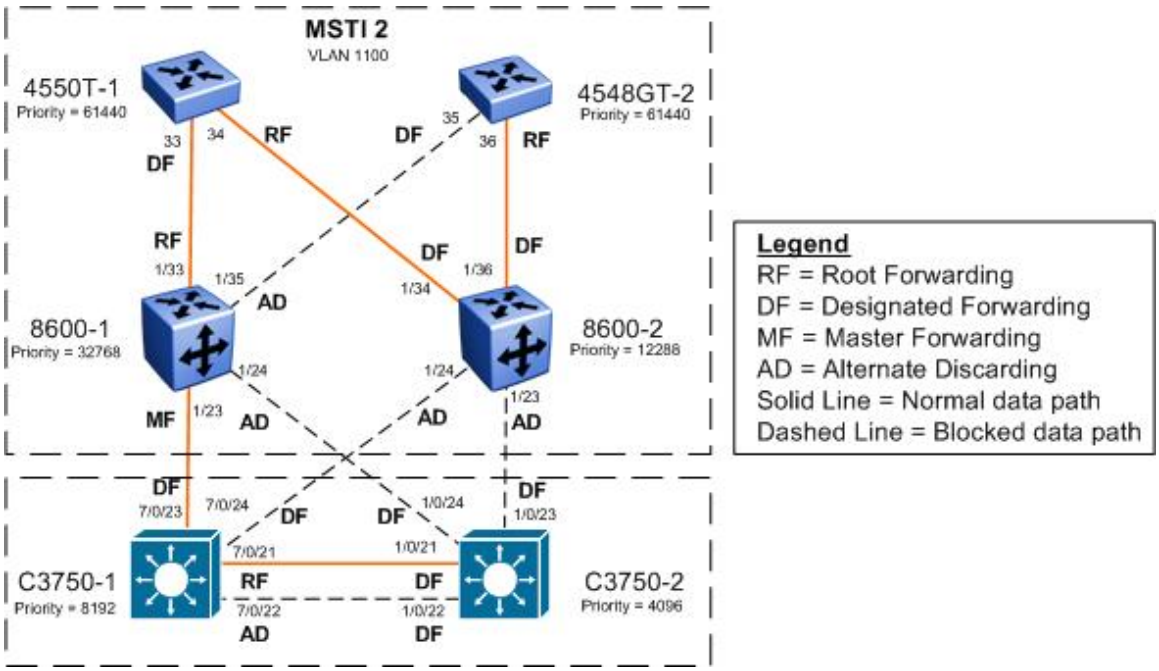



**Figure 5: MSTP Example with Two Regions – MSTI 2 Data Flow**

## 5.3.1 Configuration

### 5.3.1.1 MSTP Configuration

Please note that the exact same configuration is used in this example from Section 4.1 with the exception of changing the MSTP region name for switches 8600-1, 8600-2, 4550T-1, and 4548GT-2.

| **ERS8600-1: Step 1 – Add MSTP configuration** |
|---|
| ERS8600-1:5(config)#***spanning-tree mstp region region-name region2 region-version 1*** |
| **ERS8600-2: Step 1 – Add MSTP configuration** |
| ERS8600-2:5# ***config mstp region name region2***<br>ERS8600-2:5# ***config mstp region revision 1*** |
| **ERS4550T-1: Step 1 – Add MSTP configuration** |
| 4550T-1(config)#***spanning-tree mstp region region-name region2 region-version 1*** |
| **ERS4528GT-2: Step 1 – Add MSTP configuration** |
| 4548GT-2(config)#***spanning-tree mstp region region-name region2 region-version 1*** |

## 5.3.2 Verify Operations

### 5.3.2.1 Verify CIST Root and Regional Root

**Step 1** – Verify that the CIST root bridge is C3750-1. Verify that the regional root bridge is C3750-1 for the region named “region1” and 8600-2 for the region named “region2”. There should only be one forwarding port between the regions which should be via port 1/23 on 8600-1.

ERS8600-1:5#***show spanning-tree mstp status***

**Result:**

```
============================================================
                                MSTP Status
============================================================
------------------------------------------------------------
Bridge Address                : 00:e0:7b:b3:04:01
Cist Root                     : 10:00:00:0d:65:cc:09:00
Cist Regional Root            : 30:00:00:e0:7b:b3:04:01
Cist Root Port                : 1/23
Cist Root Cost                : 200000
Cist Regional Root Cost       : 0
Cist Instance Vlan Mapped     : 1-199,201-999,1001-1024
Cist Instance Vlan Mapped2k   : 1025-1099,1101-2048
Cist Instance Vlan Mapped3k   : 2049-3072
Cist Instance Vlan Mapped4k   : 3073-4094
Cist Max Age                  : 20 seconds
Cist Forward Delay            : 15 seconds
```

ERS8600-2:5# ***show mstp status***

**Result:**

```
============================================================
                                MSTP Status
============================================================
------------------------------------------------------------
Bridge Address                : 00:80:2d:ba:d4:01
Cist Root                     : 10:00:00:0d:65:cc:09:00
Cist Regional Root            : 30:00:00:e0:7b:b3:04:01
Cist Root Port                : 1/34
Cist Root Cost                : 200000
Cist Regional Root Cost       : 400000
Cist Instance Vlan Mapped     : 1-199,201-999,1001-1024
Cist Instance Vlan Mapped2k   : 1025-1099,1101-2048
Cist Instance Vlan Mapped3k   : 2049-3072
Cist Instance Vlan Mapped4k   : 3073-4094
Cist Max Age                  : 20 seconds
Cist Forward Delay            : 15 seconds
```

4550T-1#***show spanning-tree mstp status***

**Result:**

```
Bridge Address:          00:19:69:E6:40:00
Cist Root:               10:00:00:0D:65:CC:09:00
Cist Regional Root:      30:00:00:E0:7B:B3:04:01
Cist Root Port:          33
Cist Root Cost:          200000
Cist Regional Root Cost: 200000
Cist Max Age:            20 seconds
Cist Forward Delay:      15 seconds
```

4548GT-2#***show spanning-tree mstp status***

**Result:**

```
Bridge Address:          00:1B:25:F3:90:00
Cist Root:               10:00:00:0D:65:CC:09:00
Cist Regional Root:      30:00:00:E0:7B:B3:04:01
Cist Root Port:          35
Cist Root Cost:          200000
Cist Regional Root Cost: 200000
Cist Max Age:            20 seconds
Cist Forward Delay:      15 seconds
```

C3750-1#***show spanning-tree mst 0***

**Result:**

```
##### MST0    vlans mapped:   1-199,201-999,1001-1099,1101-4094
Bridge        address 000d.65cc.0900  priority      4096  (4096 sysid 0)
Root          this switch for the CIST
Operational   hello time 2 , forward delay 15, max age 20, txholdcount 6
Configured    hello time 2 , forward delay 15, max age 20, max hops    20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi7/0/1          Desg FWD 200000    128.325  P2p
Gi7/0/21         Desg FWD 20000     128.345  P2p
Gi7/0/22         Desg FWD 20000     128.346  P2p
Gi7/0/23         Desg FWD 200000    128.347  P2p
Gi7/0/24         Desg FWD 200000    128.348  P2p
```

C3750-2#***show spanning-tree mst 0***

**Result:**

```
##### MST0    vlans mapped:   1-199,201-999,1001-1099,1101-4094
Bridge        address 000f.9053.d300  priority      8192  (8192 sysid 0)
Root          address 000d.65cc.0900  priority      4096  (4096 sysid 0)
              port    Gi1/0/21        path cost     0
Regional Root address 000d.65cc.0900  priority      4096  (4096 sysid 0)
                                      internal cost 20000     rem hops 19
Operational   hello time 2 , forward delay 15, max age 20, txholdcount 6
Configured    hello time 2 , forward delay 15, max age 20, max hops    20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi1/0/1          Desg FWD 200000    128.1    P2p
Gi1/0/21         Root FWD 20000     128.21   P2p
Gi1/0/22         Altn BLK 20000     128.22   P2p
Gi1/0/23         Desg FWD 200000    128.23   P2p
Gi1/0/24         Desg FWD 200000    128.24   P2p
```

On each switch, verify the following information:

| Option | Verify |
|---|---|
| CIST Root | Verify that the CIST root bridge is C3750-1 whose address is ***000d.65cc.0900.*** |
| CIST Regional Root | Verify that the regional root bridge is C3750-1 for the region named “region1” and 8600-1 for the region named “region2” whose address is ***00:E0:7B:B3:04:01*** |

| | |
|---|---|
| Root Port | Verify that under normal operations that the correct port to the CIST root is used:<br>• 8600-1: Port ***1/23***<br>• 8600-2: Port ***1/34***<br>• 4550T-1: Port ***33***<br>• 4548GT-2: Port ***35***<br>• C3750-2: Either port ***1/0/21*** or ***1/0/22*** |

#### 5.3.2.2 Verify MSTI 1 Root and port forwarding state

**Step 1** – Verify that the MSTI 1 root is 8600-1 for the region named “region2” and C3750-1 is the MSTI 1 root for the region named “region1”:

```
ERS8600-1:5#show spanning-tree mstp msti config 1
```

**Result:**

```
============================================================
                            MSTP Instance Status
============================================================
Instance Id                    : 1
Msti Bridge Regional Root      : 30:00:00:e0:7b:b3:04:01
Msti Bridge Priority           : 12288 (0x3000)
Msti Root Cost                 : 0
Msti Root Port                 : cpp
Msti Instance Vlan Mapped      : 200,1000
Msti Instance Vlan Mapped2k    :
Msti Instance Vlan Mapped3k    :
Msti Instance Vlan Mapped4k    :
```

```
ERS8600-2:5# show mstp instance 1
```

**Result:**

```
============================================================
============================================================
                            MSTP Instance Status
============================================================
Instance Id                    : 1
Msti Bridge Regional Root      : 30:00:00:e0:7b:b3:04:01
Msti Bridge Priority           : 32768 (0x8000)
Msti Root Cost                 : 400000
Msti Root Port                 : 1/34
Msti Instance Vlan Mapped      : 200,1000
Msti Instance Vlan Mapped2k    :
Msti Instance Vlan Mapped3k    :
Msti Instance Vlan Mapped4k    :
```

```
4550T-1#show spanning-tree mstp msti config 1
```

**Result:**

```
Msti Bridge Regional Root:  30:00:00:E0:7B:B3:04:01
Msti Bridge Priority (hex): F000
Msti Root Cost:             200000
Msti Root Port:             33
Msti State:                 Enabled
```

```
VLAN members
------ ------ ------ ------ ------ ------ ------ ------
200    1000
```

4548GT-2#***show spanning-tree mstp msti config 1***

**Result:**

```
Msti Bridge Regional Root:  30:00:00:E0:7B:B3:04:01
Msti Bridge Priority (hex): F000
Msti Root Cost:             200000
Msti Root Port:             35
Msti State:                 Enabled

VLAN members
------ ------ ------ ------ ------ ------ ------ ------
200    1000
```

C3750-1#***show spanning-tree mst 1***

**Result:**

```
##### MST1    vlans mapped:   200,1000
Bridge        address 000d.65cc.0900  priority      4097  (4096 sysid 1)
Root          this switch for MST1

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi7/0/21         Desg FWD 20000     128.345  P2p
Gi7/0/22         Desg FWD 20000     128.346  P2p
Gi7/0/23         Desg FWD 200000    128.347  P2p
Gi7/0/24         Desg FWD 200000    128.348  P2p
```

C3750-2#***show spanning-tree mst 1***

**Result:**

```
##### MST1    vlans mapped:   200,1000
Bridge        address 000f.9053.d300  priority      8193  (8192 sysid 1)
Root          address 000d.65cc.0900  priority      4097  (4096 sysid 1)
              port    Gi1/0/21        cost          20000     rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi1/0/21         Root FWD 20000     128.21   P2p
Gi1/0/22         Altn BLK 20000     128.22   P2p
Gi1/0/23         Desg FWD 200000    128.23   P2p
Gi1/0/24         Desg FWD 200000    128.24   P2p
```

**Step 2** – Verify that the MSTI 1 port state.

ERS8600-1:5#***show spanning-tree mstp msti port role***

**Result:**

```
================================================================================
                           MSTI Port Roles and States
================================================================================

Port-Index   Instance-Id   Port-Role   Port-State   Port-STP     Port-Oper
--------------------------------------------------------------------------------
1/5          1             Disabled    Discarding      Enabled        Disabled
1/6          2             Disabled    Discarding      Enabled        Disabled
1/23         1             Master      Forwarding      Enabled        Enabled
1/23         2             Master      Forwarding      Enabled        Enabled
1/24         1             Alternate   Discarding      Enabled        Enabled
1/24         2             Alternate   Discarding      Enabled        Enabled
```

```
        1/33          1             Designated  Forwarding      Enabled         Enabled
        1/33          2             Root        Forwarding      Enabled         Enabled
        1/35          1             Designated  Forwarding      Enabled         Enabled
        1/35          2             Alternate   Discarding      Enabled         Enabled
```

ERS8600-2:5# ***show port info mstp mstirole port 1/23,1/24,1/34,1/36***

**Result:**

```
        ================================================================================
                                  MSTI Port Roles and States
        ================================================================================

        Port-Index    Instance-Id   Port-Role   Port-State   Port-STP     Port-Oper
        --------------------------------------------------------------------------------
        1/23          1             Alternate   Discarding      Enabled         Enabled
        1/23          2             Alternate   Discarding      Enabled         Enabled
        1/24          1             Alternate   Discarding      Enabled         Enabled
        1/24          2             Alternate   Discarding      Enabled         Enabled
        1/34          1             Root        Forwarding      Enabled         Enabled
        1/34          2             Designated  Forwarding      Enabled         Enabled
        1/36          1             Designated  Forwarding      Enabled         Enabled
        1/36          2             Designated  Forwarding      Enabled         Enabled
```

4550T-1#***show spanning-tree mstp msti port role 1***

**Result:**

```
        Port     Role       State     STP Status  Oper Status
        ----  ----------  ----------  ----------  -----------
        5     Disabled    Discarding  Enabled     Disabled
        33    Root        Forwarding  Enabled     Enabled
        34    Designated  Forwarding  Enabled     Enabled
```

4548GT-2#***show spanning-tree mstp msti port role 1***

**Result:**

```
        Port     Role       State     STP Status  Oper Status
        ----  ----------  ----------  ----------  -----------
        5     Disabled    Discarding  Enabled     Disabled
        35    Root        Forwarding  Enabled     Enabled
        36    Alternate   Discarding  Enabled     Enabled
```

On each switch, verify the following information:

| Option | Verify |
|---|---|
| Root | Verify that the MIST 1 root bridge is C3750-1 for region named “region1” whose address is ***000d.65cc.0900.*** Verify that the MSTI 1 root bridge is 8600-1 for region named “region2” whose address is ***00:E0:7B:B3:04:01***. |
| MSTI 1 Root Port | Verify that under normal operations that the correct port to the MIST 1 root bridge is used:<br>• 8600-1: Port ***1/23*** (Master Forwarding to “region1”)<br>• 8600-2: Port ***1/34***<br>• 4550T-1: Port ***33*** |

| | |
|---|---|
| | • 4548GT-2: Port ***35***<br>• C3750-2: Either port ***1/0/21*** or ***1/0/22*** |
| VLANs | Verify that only VLANs 200 and 1000 are configured for MSTI 1. If not, the MSTI instance will not come up on the corresponding switch. |

#### 5.3.2.3 Verify MSTI 2 Root and port forwarding state

**Step 1** – Verify that the MSTI 2 root is C3750-2 for region named “region1” and the MSTI 2 root is 8600-2 for region named “region2”:

```
ERS8600-1:5#show spanning-tree mstp msti config 2
```

**Result:**

```
============================================================
                            MSTP Instance Status
============================================================
Instance Id                    : 2
Msti Bridge Regional Root      : 30:00:00:80:2d:ba:d4:01
Msti Bridge Priority           : 32768 (0x8000)
Msti Root Cost                 : 400000
Msti Root Port                 : 1/33
Msti Instance Vlan Mapped      :
Msti Instance Vlan Mapped2k    : 1100
Msti Instance Vlan Mapped3k    :
Msti Instance Vlan Mapped4k    :
```

```
ERS8600-2:5# show mstp instance 2
```

**Result:**

```
============================================================
                            MSTP Instance Status
============================================================
Instance Id                    : 2
Msti Bridge Regional Root      : 30:00:00:80:2d:ba:d4:01
Msti Bridge Priority           : 12288 (0x3000)
Msti Root Cost                 : 0
Msti Root Port                 : cpp
Msti Instance Vlan Mapped      :
Msti Instance Vlan Mapped2k    : 1100
Msti Instance Vlan Mapped3k    :
Msti Instance Vlan Mapped4k    :
```

```
4550T-1#show spanning-tree mstp msti config 2
```

**Result:**

```
Msti Bridge Regional Root:  10:00:00:80:2D:BA:D4:01
Msti Bridge Priority (hex): F000
Msti Root Cost:             200000
Msti Root Port:             34
Msti State:                 Enabled

VLAN members
------ ------ ------ ------ ------ ------ ------ ------
1100
```

```
4548GT-2#show spanning-tree mstp msti config 2
```

**Result:**

```
Msti Bridge Regional Root:  30:00:00:80:2D:BA:D4:01
Msti Bridge Priority (hex): F000
Msti Root Cost:             200000
Msti Root Port:             36
Msti State:                 Enabled

VLAN members
------ ------ ------ ------ ------ ------ ------ ------
1100
```

C3750-1#***show spanning-tree mst 2***

**Result:**

```
##### MST2    vlans mapped:   1100
Bridge        address 000d.65cc.0900  priority      28674 (28672 sysid 2)
Root          address 000f.9053.d300  priority      4098  (4096 sysid 2)
              port    Gi7/0/21        cost          20000     rem hops 19

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Gi7/0/21         Root FWD 20000     128.345  P2p
Gi7/0/22         Altn BLK 20000     128.346  P2p
Gi7/0/23         Desg FWD 200000    128.347  P2p
Gi7/0/24         Desg FWD 200000    128.348  P2p
```

C3750-2#***show spanning-tree mst 2***

**Result:**

```
##### MST2    vlans mapped:   1100
Bridge        address 000f.9053.d300  priority      4098  (4096 sysid 2)
Root          this switch for MST2

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- ----------------------------
Gi1/0/21         Desg FWD 20000     128.21   P2p
Gi1/0/22         Desg FWD 20000     128.22   P2p
Gi1/0/23         Desg FWD 200000    128.23   P2p
Gi1/0/24         Desg FWD 200000    128.24   P2p
```

**Step 2** – Verify that the MSTI 2 port state:

ERS8600-1:5#***show spanning-tree mstp msti port role***

**Result:**

```
================================================================================
                            MSTI Port Roles and States
================================================================================

Port-Index   Instance-Id   Port-Role   Port-State   Port-STP     Port-Oper
--------------------------------------------------------------------------------
1/5          1             Disabled    Discarding      Enabled        Disabled
1/6          2             Disabled    Discarding      Enabled        Disabled
1/23         1             Master      Forwarding      Enabled        Enabled
1/23         2             Master      Forwarding      Enabled        Enabled
1/24         1             Alternate   Discarding      Enabled        Enabled
1/24         2             Alternate   Discarding      Enabled        Enabled
1/33         1             Designated  Forwarding      Enabled        Enabled
1/33         2             Root        Forwarding      Enabled        Enabled
1/35         1             Designated  Forwarding      Enabled        Enabled
1/35         2             Alternate   Discarding      Enabled        Enabled
```

ERS8600-2:5# ***show port info mstp mstirole port 1/23,1/24,1/34,1/36***

**Result:**

```
================================================================================
                            MSTI Port Roles and States
================================================================================

Port-Index   Instance-Id   Port-Role   Port-State   Port-STP     Port-Oper
--------------------------------------------------------------------------------
1/23         1             Alternate   Discarding      Enabled        Enabled
1/23         2             Alternate   Discarding      Enabled        Enabled
1/24         1             Alternate   Discarding      Enabled        Enabled
1/24         2             Alternate   Discarding      Enabled        Enabled
1/34         1             Root        Forwarding      Enabled        Enabled
1/34         2             Designated  Forwarding      Enabled        Enabled
1/36         1             Designated  Forwarding      Enabled        Enabled
1/36         2             Designated  Forwarding      Enabled        Enabled
```

4550T-1#***show spanning-tree mstp msti port role 2***

**Result:**

```
Port     Role       State     STP Status  Oper Status
----  ----------  ----------  ----------  -----------
6     Disabled    Discarding  Enabled     Disabled
33    Designated  Forwarding  Enabled     Enabled
34    Root        Forwarding  Enabled     Enabled
```

4548GT-2#***show spanning-tree mstp msti port role 2***

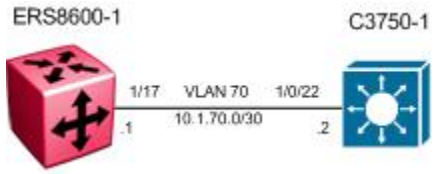
**Result:**

```
Port     Role       State     STP Status  Oper Status
----  ----------  ----------  ----------  -----------
6     Disabled    Discarding  Enabled     Disabled
35    Designated  Forwarding  Enabled     Enabled
36    Root        Forwarding  Enabled     Enabled
```

On each switch, verify the following information:

| Option | Verify |
|---|---|
| Root | Verify that the MIST 2 root bridge is C3750-2 whose address is ***000f.9053.d300***. Verify that the MSTI 2 root bridge is 8600-2 for region named “region2” whose address is ***00:80:2d:ba:d4:01*** |
| MSTI 2 Root Port | Verify that under normal operations that the correct port to the MIST 2 root bridge is used:<br>• 8600-1: Port ***1/33***<br>Port ***1/24*** (Master Forwarding to “region1”)<br>• 4550T-1: Port ***34***<br>• 4548GT-2: Port ***36***<br>• C3750-2: Either port ***1/0/21*** or ***1/0/22*** |
| VLANs | Verify that only VLAN 1100 is configured for MSTI 2 If not, the MSTI instance will not come up on the corresponding switch. |

# 6. OSPF MD5 Authentication




For this example, we will configure the following:

- MD5 OSPF authentication between a Nortel ERS8600 switch and a Cisco 3750 switch
- We will set the MD5 password to *norteltocisco*

Note that Cisco will send OSPF hello messages with LLS (Link-Local Signaling). The Nortel ERS8600 does not accept LLS and thus will never form an OSPF neighbor if LLS is left enabled.

## 6.1 Configuration Steps

### 6.1.1 Enable MD5

| **ERS8600-1: Step 1 – Add and enable MD5 message key** |
|---|
| ERS8600-1# ***config ip ospf interface 10.1.70.1 add-message-digest-key 1 md5-key norteltocisco*** |
| ERS8600-1# ***config ip ospf interface 10.1.70.1 authentication-type message-digest*** |
| **C3750-1: Step 1 – Add and enable MD5 message key** |
| C3750-1(config)#***interface vlan 70*** |
| C3750-1(config-if)#***ip ospf authentication message-digest*** |
| C3750-1(config-if)#***ip ospf message-digest-key 1 md5 norteltocisco*** |
| C3750-1(config-if)# ***ip ospf lls disable*** |
| C3750-1(config-if)#***exit*** |

# 6.2 Verify Operations

## 6.2.1 ERS8600

**Step 1** – Verify that MD5 message-digest is configured on the appropriate interface

```
ERS8600-8:5# show ip ospf int-auth
```

**Result:**

```
==========================================================================
                     OSPF Interface AuthKey - GlobalRouter
==========================================================================
INTERFACE       AUTHTYPE AUTHKEY
--------------------------------------------------------------------------
10.1.70.1       message-digest
```

**Step 1** – Verify that the Cisco switch is an OSPF neighbor:

```
ERS8600-8:5# show ip ospf neighbors
```

**Result:**

```
================================================================================
                          OSPF Neighbors - GlobalRouter
================================================================================
INTERFACE       NBRROUTERID     NBRIPADDR       PRIO_STATE    RTXQLEN PERMANENCE
--------------------------------------------------------------------------------
10.1.70.1       10.1.1.2        10.1.70.2       1    Full     0       Dynamic

Total ospf neighbors: 1
```

**Step 3** – Verify that the MLT MD5 key is configured:

```
ERS8600-8:5# config ip ospf interface 10.1.70.1 info
```

**Result:**

```
Sub-Context: clear config dump monitor mplsping mplstrace peer show switchover t
est trace wsm asfm sam
Current Context:

                admin-status : enabled
              interface-type : broadcast
                        area : 0.0.0.0
          authentication-key :
         authentication-type : message-digest
               dead-interval : 40
              hello-interval : 10
    add-message-digest-key :
                                     - 1
                               md5-key - *****
                                     - PRIMARY KEY

    change-primary-md5-key : N/A
 delete-message-digest-key : N/A
                    metric : 10
                mtu-ignore : disable
             poll-interval : 120
```

```
                        priority : 1
                retransmit-interval : 5
                      transit-delay : 1
                         bfd-enable : disabled
```

Verify the following information:

| Option | Verify |
|---|---|
| AUTHTYPE<br>AUTHKEY | Should be displayed as ***message-digest***. This just indicates that message digest has been configured and enabled for the shown interface. Use the command *config ip ospf interface 10.1.70.1 info* as shown above to verify that a MD5 key has been added. |
| STATE | If everything is working, the Cisco switch neighbor state should be displayed as ***Full***. |

### 6.2.2 Cisco 3750

**Step 1** – Verify that MD5 message-digest is configured on the appropriate interface, the line protocol is up, and that LLS is disabled

C3750-1#***show ip ospf interface vlan 70***

**Result:**

```
Vlan70 is up, line protocol is up
  Internet Address 10.1.70.2/30, Area 0
  Process ID 1, Router ID 47.133.58.137, Network Type BROADCAST, Cost: 1
  Transmit Delay is 1 sec, State BDR, Priority 1
  Designated Router (ID) 10.12.1.2, Interface address 10.1.70.1
  Backup Designated router (ID) 47.133.58.137, Interface address 10.1.70.2
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    oob-resync timeout 40
    Hello due in 00:00:09
  Does not support Link-local Signaling (LLS)
  Cisco NSF helper support disabled
  IETF NSF helper support enabled
  Index 1/1, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 10.12.1.2  (Designated Router)
  Suppress hello for 0 neighbor(s)
  Message digest authentication enabled
    Youngest key id is 1
```

**Step 1** – Verify that the Nortel switch is an OSPF neighbor:

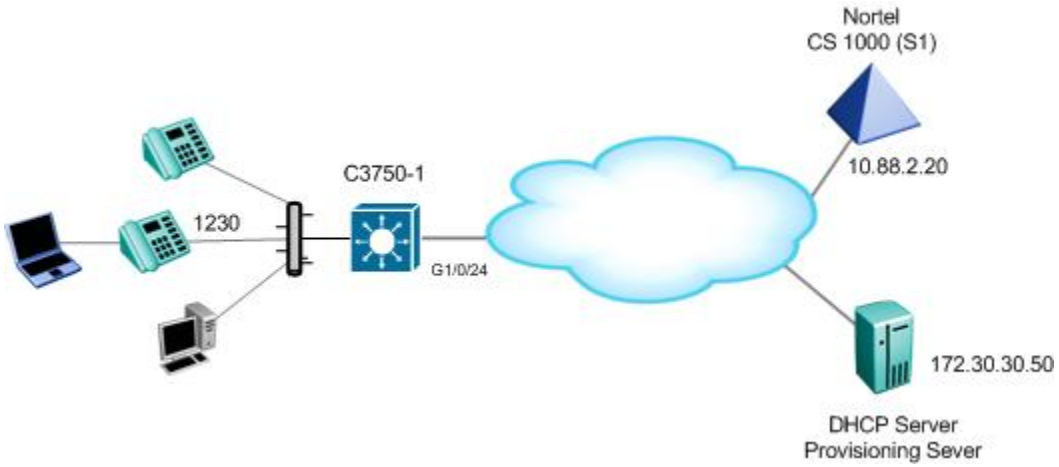
C3750-1#***show ip ospf neighbor***

**Result:**

```
Neighbor ID     Pri   State           Dead Time   Address         Interface
10.12.1.2         1   FULL/DR         00:00:32    10.1.70.1       Vlan70
```

# 7. Nortel IP Phone to Cisco Switch




The following configuration example covers various methods for configuring a Cisco 3750 to support both voice and data on the same port with a Nortel IP Phone.

The access ports will be configured to allow untagged data traffic and tagged voice traffic using VLAN 1000 for the Data VLAN and VLAN 600 for the Voice VLAN. The Nortel IP Phone can either use double DHCP to get the Voice VLAN ID from a DHCP request on the data VLAN or the Cisco 3750 switch could be configured for LLDP-MED to tell the Nortel IP Phone what the voice VLAN ID is.

For QoS, the Cisco 3750 can either be configured to trust the layer 2 p-bit value or layer 3 DSCP value. At a layer 2 level, the switch can be setup to only trust only the tagged voice VLAN 802.1p value and remark all untagged traffic with a DSCP value of 0. At a layer 3 level, the switch can be configured to trust the DSCP values from both the voice and data VLANs without a policy-map configured, or only trust the DSCP value from the voice VLAN and remark the data VLAN with a policy-map defined.

## 7.1 Config Steps

### 7.1.1 PoE

By default, on a Cisco 3750, the switch automatically detects and supplies power if the connected device requires it. If you wish, use the following interface commands to set the desired PoE settings:

interface gigabitEthernet <interface number>
- power inline auto (default setting and preferred for Nortel IP Phones)
- power inline auto max <4000-15400> milli-watts (To limit the power in auto mode)
- power inline static (To turn on power to the port even if there is no PoE device detected)
- power inline static max <4000-15400> milli-watts (To limit the power in static mode)
- power inline never (To turn off power to the port)
- power inline consumption <4000-15400> milli-watts (To set the amount of power consumption)

### 7.1.2 Nortel IP Phone default DSCP values when used with a Cisco Switch

The Nortel IP Phones uses a p-bit value of 6 and DSCP value of 46 for Voice Media. For Voice Signaling, the Nortel IP Phone uses a p-bit value of 5 and DSCP value of 40. The following command displays the default DSCP mappings on a Cisco switch.

C3750-2#***show mls qos maps cos-dscp***

```
Cos-dscp map:
     cos:   0  1  2  3  4  5  6  7
   --------------------------------
     dscp:   0  8 16 24 32 40 48 56
```

In order to support Nortel IP Phones on the Cisco switch, we need to change CoS value 6 with a DSCP value of 46. The can be accomplished by using issuing the following commands:

```
C3750-2(config)#mls qos map cos-dscp 0 8 16 24 32 40 46 56
C3750-2(config)#mls qos (enter this command to enable QoS)
C3750-2(config)#do show mls qos maps cos-dscp
   Cos-dscp map:
        cos:   0  1  2  3  4  5  6  7
      --------------------------------
        dscp:   0  8 16 24 32 40 46 56
```

### 7.1.3 QoS at Layer 2 Option

If we configure the Cisco switch, as in this example, to support untagged data traffic and tagged voice traffic, the switch can be setup to trust only the 802.1p (p-bit) values from the tagged voice VLAN. All untagged traffic will be remarked with a DSCP value of 0. This can be accomplished with the *mls qos trust cos* interface level command.

Overall, the configuration should look like the configuration shown below to trust only the p-bit values from the tagged voice VLAN. We will also change the cos-dscp 6 value from the default DSCP value of 48 to a DSCP value of 46.

**C3750-1 - Trust CoS Configuration Example for Nortel IP Phones: Trust only the tagged traffic and remark the untagged traffic with DSCP value of 0**

```
!
vtp mode transparent
!
!
mls qos map cos-dscp 0 8 16 24 32 40 46 56
mls qos
!
vlan 600
 name voice
!
vlan 1000
 name data
!
interface GigabitEthernet1/0/17
 switchport access vlan 1000
 switchport mode access
 switchport voice vlan 600
 priority-queue out
 mls qos trust cos
 spanning-tree portfast
!
```

If you wish, you can also add a default CoS value for the untagged data VLAN traffic. By default, all the data traffic is remarked with a DSCP value of 0. If you set the **mls qos cos <0-7>** on a port, the switch will set the CoS value of all frames from the untagged data VLAN to the configured CoS value. The following shows a configuration changing default CoS value of 0 to 2 which in turn will remark all the untagged data traffic with a DSCP value of 16.

**C3750-1: Trust CoS Configuration Example for Nortel IP Phones: Trust the tagged traffic and remark the untagged traffic with a default DSCP value of 16**

```
!
vtp mode transparent
!
!
mls qos map cos-dscp 0 8 16 24 32 40 46 56
mls qos
!
vlan 600
 name voice
!
vlan 1000
 name data
!
interface GigabitEthernet1/0/17
 switchport access vlan 1000
 switchport mode access
 switchport voice vlan 600
 priority-queue out
 mls qos cos 2
 mls qos trust cos
 spanning-tree portfast
!
```

### 7.1.4 QoS at Layer 3 Option

The following is a configuration example of configuring the Cisco switch to trust the DSCP value instead of the p-bit value. Please see Section 7.1.2 regarding changing the default CoS mappings to support Nortel IP phone.

**C3750-1 - Trust DSCP Configuration Example for Nortel IP Phones: Trust DSCP value from both tagged voice VLAN and untagged data VLAN**

```
!
vtp mode transparent
!
mls qos map cos-dscp 0 8 16 24 32 40 46 56
mls qos
!
vlan 600
 name voice
!
vlan 1000
 name data
!
interface GigabitEthernet1/0/17
 switchport access vlan 1000
 switchport mode access
 switchport voice vlan 600
 priority-queue out
 mls qos trust dscp
 spanning-tree portfast
```

```
!
```

The above configuration will trust all traffic both from the untagged data VLAN and the tagged voice VLAN. In some cases, you may not want to trust the data VLAN. If this is the case, a policy-map can be created to pass the voice VLAN traffic as-is and remark the data VLAN traffic. Assuming the data VLAN uses a subnet of 192.168.100.0/24 and the voice VLAN uses a subnet of 192.168.60.0/24, the following configuration will pass the CoS traffic from the voice VLAN as-is and remark the data VLAN traffic to a DSCP value of AF11.

**C3750-1 - Trust DSCP Configuration Example for Nortel IP Phones: Trust DSCP value from tagged voice VLAN IP subnet and remark untagged data VLAN IP subnet with default DSCP value of 16 using a policy-map**

```
!
vtp mode transparent
!
mls qos map cos-dscp 0 8 16 24 32 40 46 56
mls qos
!
vlan 600
 name voice
!
vlan 1000
 name data
!
class-map match-all data-1
 match access-group name data-subnet
class-map match-all voice-1
 match access-group name voice-subnet
!
!
policy-map policy-1
 class voice-1
  trust cos
 class data-1
  set dscp af11
!
interface GigabitEthernet1/0/17
 switchport access vlan 1000
 switchport mode access
 switchport voice vlan 600
 priority-queue out
 mls qos trust dscp
 spanning-tree portfast
 service-policy input policy-1
!
ip access-list extended data-subnet
 permit ip 192.168.100.0 0.0.0.255 any
ip access-list extended voice-subnet
 permit ip 192.168.60.0 0.0.0.255 any
!
```

### 7.1.5 LLDP-MED

To enable LLDP-MED, you simple have to enter the command *lldp run*. The interface level *switchport voice vlan <1-4094>* command determines the voice VLAN ID sent by the switch. By default, LLDP transmit, receive and policy will be enabled at an interface level.

**C3750-1 – LLDP-MED configuration**

```
!
vtp mode transparent
!
!
mls qos map cos-dscp 0 8 16 24 32 40 46 56
mls qos
!
vlan 600
 name voice
!
vlan 1000
 name data
lldp run
!
!
interface GigabitEthernet1/0/17
 switchport access vlan 1000
 switchport mode access
 switchport voice vlan 600
 priority-queue out
 mls qos trust dscp
 spanning-tree portfast
!
```

### 7.1.6 LLDP-MED : Verify the local attached Nortel IP Phone

**Step 1** – Verify that the Nortel IP phone using LLDP-MED assuming a Nortel IP Phone model 1230 is connected via port 1/0/15 on the Cisco 3750 switch

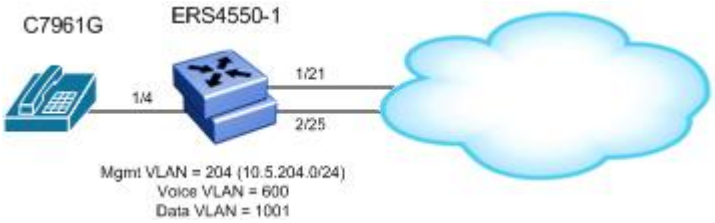
C3750-2#***show lldp neighbors gigabitEthernet 1/0/15 detail***

**Result:**

```
        Chassis id: 192.168.60.20
        Port id: 0024.000d.8dcd
        Port Description: Nortel IP Phone
        System Name - not advertised

        System Description:
        Nortel IP Telephone 1230, Firmware:062AC6R

        Time remaining: 179 seconds
        System Capabilities: B,T
        Enabled Capabilities: B,T
        Management Addresses - not advertised
        Auto Negotiation - supported, enabled
        Physical media capabilities:
            100base-TX(FD)
            100base-TX(HD)
            10base-T(FD)
            10base-T(HD)
        Media Attachment Unit type: 16

        MED Information:
```

```
          MED Codes:
                (NP) Network Policy, (LI) Location Identification
                (PS) Power Source Entity, (PD) Power Device
                (IN) Inventory

          F/W revision: 062AC6R
          Manufacturer: Nortel-05
          Model: IP Phone 1230
          Capabilities: NP, LI, PD, IN
          Device type: Endpoint Class III
          Network Policy(Voice): VLAN 600, tagged, Layer-2 priority: 0, DSCP: 0
          PD device, Power source: Unknown, Power Priority: High, Wattage: 6.0
      ------------------------------------------------
```

# 8. Cisco Phone to Nortel Switch




For this configuration example, we will configure the following

- Configure ERS4550-1 as a Layer 2 switch
- Add management VLAN 204, data VLAN 1001, and voice VLAN 600
- Configure MLT 1 using ports 1/21 and 2/25 for the uplink to the core network
- Enable ports 1/4 as untagPvidOnly to allow untagged data VLAN (PVID = 1001) and tagged voice VLAN (PVID = 600)
    - Enable LLDP-MED on port 1/4 and configure the LLDP-MED using ADAC
- Set the PoE priority level to high on port 1/4 for the IP Phone set

## 8.1 4500-1 Configuration

### 8.1.1 Go to configuration mode.

**ERS4550-1 Step 1 - Enter configuration mode**

```
4550-PWR>enable
4550-PWR#configure terminal
4550-1-PWR(config)#banner disable
4550-1-PWR(config)#snmp-server name 4550-1-PWR
```

### 8.1.2 Add MLT

**ERS4550-1 Step 1 – Add MLT with port members 1/21 and 2/25 and enable port tagging**

```
4550-1-PWR(config)#vlan ports 1/21,2/25 tagging tagall
4550-1-PWR(config)#mlt 1 enable member 1/21,2/25 learning disable
```

### 8.1.3 Enable ADAC Globally

**ERS4550-1 Step 1 – Enable ADAC using VLAN 600, set the operation mode to tagged-frames, and add one of the uplink port member, i.e. port 1/21**

```
4550-1-PWR(config)#adac voice-vlan 600
4550-1-PWR(config)#adac op-mode tagged-frames
4550-1-PWR(config)#adac uplink-port 1/21
4550-1-PWR(config)#adac enable
```

### 8.1.4 Add data and management VLANs and port members

**ERS4550-1 Step 1 – Add data and management VLANs**

```
4550-1-PWR(config)# vlan configcontrol automatic
4550-1-PWR(config)#vlan create 1001 name data type port
4550-1-PWR(config)#vlan create 204 name mgmt type port
4550-1-PWR(config)#vlan members add 1001 1/4,1/21,2/25
4550-1-PWR(config)#vlan members add 204 1/21,2/25
```

### 8.1.5 Enable ADAC at interface level

**ERS4550-1 Step 1 – Enable ADAC on port member 1/4, set the ADAC detection to LLDP only, and enable the ADAC tag mode to tagged frames and untag the default VLAN**

```
4550-1-PWR(config)#interface fastEthernet 1/4
4550-1-PWR(config-if)#adac detection lldp
4550-1-PWR(config-if)#no adac detection mac
4550-1-PWR(config-if)#adac tagged-frames-tagging untag-pvid-only
4550-1-PWR(config-if)#adac enable
4550-1-PWR(config-if)#exit
```

Note that by default, ADAC detection for MAC and LLDP is enabled. Hence, the command *adac detection lldp* is not required and only used in this example to show that there is a command to enable or disable the detection type.

### 8.1.6 Enable LLDP-MED

**ERS4550-1 Step 1 – Enable LLDP-MED on port 1/4**

```
4550-1-PWR(config)#interface fastEthernet 1/4
4550-1-PWR(config-if)#lldp tx-tlv local-mgmt-addr port-desc sys-cap sys-desc sys-name
4550-1-PWR(config-if)#lldp status txAndRx config-notification
4550-1-PWR(config-if)#lldp tx-tlv med extendedPSE med-capabilities network-policy
4550-1-PWR(config-if)#exit
```

### 8.1.7 Configure PoE levels

**ERS4550-1 Step 1 – Set PoE Power level high on all VoIP ports**

```
5520-1(config)#interface fastEthernet 1/4
5520-1 (config-if)#poe poe-priority high
5520-1 (config-if)#exit
```

### 8.1.8 Set Management VLAN

**ERS4550-1 Step 1 – Configure VLAN 204 as the management VLAN and set the management IP address**

```
4550-1-PWR(config)#vlan mgmt 204
4550-1-PWR(config)#ip address switch 10.5.204.5 netmask 255.255.255.0 default-gateway 10.5.204.1
```

### 8.1.9 Enable SNMP Management

**ERS4550-1 Step 1 – If you wish, enable SNMP management by entering the following command**

```
4550-1-PWR(config)#snmp-server enable
```

### 8.1.10 Enable IP DHCP Snooping and ARP Inspection

The following commands are optional and only used if DHCP is used.

**ERS4550-1 Step 1 – Enable IP DHCP Snooping for voice VLAN 600 and data VLAN 1001**

```
4550-1-PWR(config)#ip dhcp-snooping vlan 600
4550-1-PWR(config)#ip dhcp-snooping vlan 1001
4550-1-PWR(config)#ip dhcp-snooping enable
```

**ERS4550-1 Step 2 – Enable IP Arp Inspection for voice VLAN 600 and data VLAN 1001**

```
4550-1-PWR(config)#ip arp-inspection vlan 600
4550-1-PWR(config)#ip arp-inspection vlan 1001
```

**ERS4550-1 Step 3 – Enable core ports 1/21 and 2/25 as a trusted ports**

```
4550-1-PWR(config)#interface fastEthernet 1/21,2/25
4550-1-PWR(config-if)#ip dhcp-snooping trusted
4550-1-PWR(config-if)#ip arp-inspection trusted
4550-1-PWR(config-if)#exit
```

### 8.1.11 Enable Spanning Tree Fast Start and BPDU filtering on access ports

**ERS4550-1 Step 3 – Enable STP Fast Start and BPDU filtering on access port 1/4**

```
4550-1-PWR(config)# interface fastEthernet 1/4
4550-1-PWR(config-if)# spanning-tree learning fast
4550-1-PWR(config-if)# spanning-tree bpdu-filtering timeout 0
4550-1-PWR(config-if)#spanning-tree bpdu-filtering enable
4550-1-PWR(config-if)#exit
```

### 8.1.12 Remove port members from default VLAN (VLAN 1)

**ERS4550-1 Step 3 – Remove port member from the default VLAN**

```
4550-1-PWR(config)#vlan members remove 1 1/4,1/21,2/25
```

## 8.2 Cisco Phone Configuration

The Cisco phone used for this example is based on software version SCCP41.8-3-4SR1S in SCCP mode. A remote Cisco call server (CUCM) was set up to recognize and register the phone when contacted.

Note that the Cisco phone is required to support LLDP-MED in order to inter-operate with the ERS 4500. Support for LLDP-MED was introduced in release 8.3(3) on most, but not all, phone models. Please consult release notes.

**C7961G Step 1 – Confirm the Cisco phone supports LLDP-MED**

- Press the "Settings" button
- Select "3 – Device Configuration"
- Select "9 – Network Configuration"
- Ensure that "LLDP: PC Port" is set to "Enabled"
- Ensure that "LLDP-MED: SW Port" is set to "Enabled"
- Press "Exit" twice to return to the main "Settings" menu.

**C7961G Step 2 – Confirm that the Voice VLAN Id is not statically configured and DHCP is enabled**

- Select "2 – Network Configuration"
- Verify that the parameter "21 - Admin. VLAN Id" is set to a null value (i.e. should be blank, no value). The Voice VLAN Id should not be statically configured because it will be advertised by the ERS 4500 via LLDP-MED. If this needs to be changed press "**#" to unlock the configuration and make the change.
- Verify that "22 – DHCP" is set to "Yes"
- Press "Exit" twice to exit the "Settings" menu.

# 8.3 Verify Operations

## 8.3.1 Verify LLDP Neighbors

**Step 1** – Verify the LLDP neighbor using the following commands:

```
4550-1-PWR# show lldp neighbor
```

**Result:**

```
-------------------------------------------------------------------------------
                            lldp neighbor
-------------------------------------------------------------------------------
Port: 1/4   Index: 12                Time: 19 days, 02:04:16
        ChassisId: Network address    IPv4  10.1.60.66
        PortId:    Locally assigned   001E4A34C6AB:P1
        SysName:   SEP001E4A34C6AB.cisco.com
        SysCap:    TB / TB            (Supported/Enabled)
        PortDesc:  SW PORT
        SysDescr:  Cisco IP Phone CP-7961G,V2, SCCP41.8-3-4SR1S

-------------------------------------------------------------------------------
Sys capability: O-Other; R-Repeater; B-Bridge; W-WLAN accesspoint; r-Router;
T-Telephone; D-DOCSIS cable device; S-Station only.
Total neighbors: 1
```

```
4550-1-PWR#show lldp neighbor-mgmt-addr
```

**Result:**

```
-------------------------------------------------------------------------------
                         lldp neighbor-mgmt-addr
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
Port: 1/4   Index: 12                Time: 19 days, 02:04:16
        ChassisId: Network address    IPv4  10.1.60.66
        PortId:    Locally assigned   001E4A34C6AB:P1
        MgmtAddr:  IPv4  10.1.60.66
        MgmtOID:   0.0
        Interface: type-unknown, number:0
```

## 8.3.2 Verify ADAC Operation and correct VLAN is used

**Step 1** – Verify the Cisco IP phone is detected via ADAC using the following command:

```
4550-1-PWR#show adac interface 1/4
```

**Result:**

```
Unit/        Auto       Oper      Auto
Port   Type  Detection  State     Configuration  T-F PVID   T-F Tagging
-----  ----  ---------  --------  -------------  ---------  ---------------
1/4    T     Enabled    Enabled   Applied        No Change  Untag PVID Only
```

**Step 2** – Verify the voice VLAN is used on port 1/4:

```
4550-1-PWR# show vlan vid 600
```

**Result:**

```
        Id  Name                 Type     Protocol         User PID Active IVL/SVL Mgmt
        --- -------------------- -------- ---------------- -------- ------ ------- ----
        600 Voice_VLAN           Port     None             0x0000   Yes    IVL     No
                Port Members: 1/4,1/21,2/25
```

### 8.3.3 Verify Cisco Phone operations

Once the phone learns the Voice VLAN via LLDP-MED it sends a DHCP Discovery/Request. The DHCP Server returned an IP address, default gateway, DNS Server, DNS Domain Name, and DHCP option 150 – "TFTP Server IP Address" so that the phone can reach its Call Server. Note that there are multiple methods in which the Cisco phone can learn of its Call Server:

- Static IP address
- Option 150 (single IP address)
- Option 66 (first IP address or Domain Name System [DNS] name)
- Lookup CiscoCM1.your.domain

To verify that the Cisco phone learned the Voice VLAN:

- Press the "Settings" button
- Select "2 – Network Configuration"

Verify that the parameter "20 – Operational VLAN Id" is set to the Voice VLAN Id.

### Contact us

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If you purchased a Nortel Networks service program, contact Nortel Technical Support. To obtain contact information online, go to www.nortel.com/contactus.

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