Ethernet Routing Switch

8600, 8300, 5x00, 4500, 2500

Engineering

RSTP/MSTP Technical Configuration Guide

Avaya Data Solutions

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Abstract

This document provides an overview of Rapid Spanning Tree Protocol (RSTP) and Multiple Spanning Tree Protocol (MSTP).

Revision Control

No	Date	Version	Revised by	Remarks
1	06/02/2009	2.0	ESE	Modifications to Software Baseline section

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Document Updates

July 2010

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 Avaya 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. Overview: RSTP/MSTP

The original IEEE 802.1D Spanning Tree Protocol (hereby referred to as STP) standard (802.1D-1998 clause 8) provides loop protection and recovery, but, it is slow to respond to a topology change in the network (for example, a dysfunctional link in a network).

The Rapid Spanning Tree protocol (RSTP or IEEE 802.1w / 802.1D-2004 clause 17) reduces the recovery time after a network break down. It also maintains a backward compatibility with the original IEEE 802.1D STP standard which was the Spanning Tree implementation prior to RSTP. Typically, the recovery time of RSTP is within a second compared to STP which can take upwards of 30-50 seconds to recover.

RSTP also reduces the amount of flooding in the network by enhancing the way the Topology Change Notification (TCN) packet is generated.

The Multiple Spanning Tree Protocol (MSTP or IEEE 802.1s / 802.1Q-2005 clause 13) is an extension to RSTP allowing for multiple Spanning Tree instances on the same switch. Both 802.1D and 802.1w spanning tree protocols operate without any regards to a network's VLAN configuration whereas 802.1s maps VLANs to multiple spanning tree instances. This allows the switch to use different paths in the network to effectively load balance or distribute VLANs evenly where each Spanning Tree instance will block the appropriate port(s) within its own instance.

When configuring MSTP, one or more VLANs are assigned to an MST instance (MSTI) and each switch is assigned to an MSTP MST region. Hence, each MST region consists of one or more MSTP switches where each switch must be configured with the same VLANs, at least one MST instance, and the same MST region name. A Common Spanning Tree (CST), base instance 0, is used to interconnect individual MST regions or MST regions with RSTP or STP LANs. MSTP connects all switches and LANs together with a single common and internal spanning tree (CIST) where one single CIST root bridge is elected and one CIST regional root bridge is elected per MST region. In summary, MSTI instances provide loop free switching within a region for VLANs whereas CIST provides loop free switching between regions with no regards to VLANs.

As noted above, MSTP is backwards compatible with both RSTP and STP likewise RSTP with STP. MSTP effectively uses the RSTP BPDUs extended to include region information and MSTI instance messages. These constitute the MSTP BPDU which, like both RSTP and STP BPDUs, are always untagged.

If an MSTP bridge detects that a neighboring bridge is operating in RSTP mode, the interconnecting interface on the MSTP bridge will downgrade to RSTP operation, whereby only RSTP BPDUs are generated on that interface. Likewise if an RSTP or MSTP bridge detects that a neighboring bridge is operating in STP mode, the interconnecting interface on the MSTP/RSTP bridge will downgrade to STP operation, whereby only STP BPDUs are generated on that interface. If a number of MSTP bridges forming an MST Region are interconnected to RSTP/STP switches, the RSTP/STP domain will see the MSTP region as one hop.

RSTP and MSTP achieve rapid convergence by enhancing the Port Role Transition state machine with regards to Forwarding transitions. Whenever a failure in the network occurs and a link or node in the active topology is broken/lost, one or more Forward transitions on some other links, previously Discarding, are required to restore connectivity. In the original STP protocol, a Forwarding transition was only possible after expiry of the Listening and Learning timers (30 seconds in total) which would guarantee enough delay for every bridge in the STP domain to receive and converge on the new topology information. With RSTP/MSTP Forward transition delays can be dramatically reduced via the Proposal & Agreement exchanges whereby every bridge wanting to perform a Forward transition on a Designated port can propose such a change to it's downstream peer bridge and can do so as soon as agreed by it's

peer (without having to wait for timers to expire). This process ripples throughout the RSTP/MSTP instance domain, away from the root bridge, until all switches in the domain have converged on the new topology.

This fast Forward transition mechanism allows RSTP/MSTP to reconverge in about 1 or 2 seconds, depending on the number of bridges participating in the RSTP/MSTP instance and on the type of failure.

However, fast Forwarding transitions are only possible under certain conditions. The port which needs to transition into Forwarding state must (a) be operating in Full Duplex mode and (b) there must be an MSTP/RSTP bridge at the other end of that link.

Hence, in the presence of legacy half-duplex links (where a hub segment could result in more than one bridge neighbor) RSTP/MSTP will fall back on the legacy STP timers. Also in the case of switch ports where end stations are directly connected condition (b) is not satisfied and again legacy STP timers are used (in this case, to obtain fast Forwarding transitions, the port needs to be configured as an Edge Port as discussed later).

Failure of the Root bridge for the RSTP/MSTP instance, while still an improvement on STP, can also result in higher convergence times. Typically a root bridge failure where its immediate neighbors detect a link loss on their interfaces will result in a 2 seconds reconverge time. However if the root bridge fails and its immediate neighbors do not detect this via loss of link (for instance, a software failure on the root device), then the reconverge time occurs after 2 consecutive BPDUs are missed i.e. 6 seconds

Overall, RSTP and MSTP enable the switch to achieve the following:

- Reduce convergence time from 30-50 seconds to less than 1 or 2 seconds under most (but not all) failure conditions
- Eliminate unnecessary flushing of the MAC database and flooding of traffic to the network, with a new enhanced Topology Change mechanism whereby only a fraction of the MAC tables need to be flushed and re-learnt
- Backward compatibility with other switches that are running legacy 802.1D STP or Avaya MSTG (STP group 1 only).

The user can configure an Avaya switch to run Avaya STP, RSTP (802.1w), or MSTP (802.1s) configuration.

1.1 Interoperability with Legacy STP

RSTP provides a new parameter ForceVersion for backward compatibility with legacy STP. You can configure a port in either STP compatible mode or RSTP mode.

- An STP compatible port transmits and receives only STP BPDUs. Any RSTP BPDU that the port receives in this mode will be discarded.
- An RSTP port transmits and receives only RSTP BPDUs. If an RSTP port receives an STP BPDU it becomes an STP port. User intervention is required to bring this port back to RSTP mode. This process is called Port Protocol Migration.

Normally an RSTP or MSTP bridge will automatically detect the STP version type of a neighboring bridge and automatically adapt to that STP version without having to use the ForceVersion parameter.

1.2 Differences in Port Roles

RSTP is an enhanced version of STP. These two protocols have almost the same set of parameters.

Table 1 lists the differences in port roles for STP and RSTP. STP supports 2 port roles while RSTP supports four port roles. MSTP adds an extra role for MSTI instances only.

Table 1 Difference in Port Roles for STP and RSTP

Port Role	STP	RSTP	MSTP	Description
Root	Yes	Yes	Yes	On a non-root bridge, this port is receiving BPDUs with the lowest root path cost, i.e. this port is the best path to reach the Root bridge in the STP/RSTP domain or in the CIST or MSTI instance for MSTP. The Root port is always in Forwarding state.
Designated	Yes	Yes	Yes	The bridge owning this port (Designated Bridge) has the lowest root path cost towards the Root bridge for this segment and, in case of a tie, best Bridge priority and Port priority. This port will generate BPDUs every 2 seconds on the segment and will transition in Forwarding state.
Backup	No	Yes	Yes	A bridge port that is not Root port or Designated port is a Backup port if the same bridge is already the Designated Bridge for the same segment (via a different port). A Backup port is always in Discarding state.
Alternate	No	Yes	Yes	A bridge port that is not Root port or Designated port or Backup port is an Alternate port. An Alternate port is always in Discarding state.
Master	No	No	Yes	On an MSTP MSTI instance only, this port is on an MST region boundary and has the lowest root path cost towards the CIST Root bridge (CIST Regional Root)

1.3 Edge Port

Edge port is a new parameter that is supported by RSTP/MSTP. When a port is connected to a non-switch device such as a PC or a workstation, it must be configured as an Edge port or else it will take 30 seconds to transition into a Forwarding state. An active Edge port is similar to the STP FastStart feature in that the port can go directly into Forwarding state without any delay. An Edge port always generates BPDUs but immediately becomes a non Edge port if it receives a BPDU.

1.4 Path Cost Values

RSTP and MSTP recommend new path cost values that support a wide range of link speeds. Table 2 lists the recommended path cost values.

Table 2 Recommended Path Cost Values

Link speed	Recommended value
Less than or equal 100Kb/s 1 Mb/s 10 Mb/s 100 Mb/s	200,000,000 20,000,000 2,000,000 200,000
1 Gb/s 10 Gb/s 100 Gb/s	20,000 2,000 200
1 Tb/s 10 Tb/s	20 2

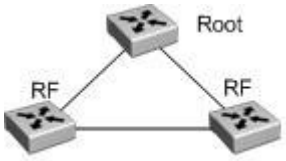
1.5 Root Bridge

Just as in STP, with RSTP and MSTP instances, the root bridge is always the bridge with the lowest Bridge ID within the Spanning Tree instance. The Bridge ID is made up by pre-pending the bridge priority (2 bytes) with the Bridge MAC address (6 bytes) forming an 8 byte long Bridge ID. Hence if multiple bridges are configured with the same bridge priority, the bridge MAC address will act as a tie breaker and uniquely determine the Root bridge.

In a Spanning Tree design, always ensure that a Core node acts as the Root Bridge.

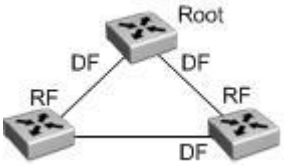
1.6 Port Roles

Root Forwarding Port



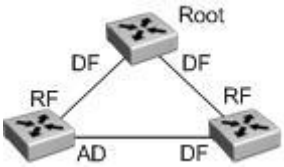
A port receiving the best BPDU on the switch is the root port and is referred to as a Root Forwarding (RF) port. This is the port that is the closest to the root bridge in terms of path cost. The spanning tree algorithm elects a single root bridge in a bridged network per spanning tree instance. The root bridge is the only bridge in a network that does not have root ports; all ports on a root bridge are normally Designated Forwarding (DF). There can only be one path towards a root bridge on a given segment otherwise there will be loops.

Designated Forwarding Port



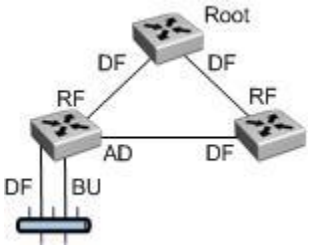
All bridges connected on a given segment listen to each other's BPDUs and agree on the bridge sending the best BPDU as the designated bridge for the segment. The corresponding port on the bridge is referred to as a Designated Forwarding (DF) Port.

Alternate Discarding Port



An Alternate Discarding port is defined as a port which is not the Root port, not a Designated port and not a Backup port. An Alternate Discarding (AD) port is a port that is blocked by receiving more useful BPDUs from another bridge.

Backup Discarding Port



A Backup Discarding (BU) port is defined as a port that is blocked by receiving more useful BPDUs from the bridge itself on a shared segment.

1.7 Rapid Convergence

In RSTP and MSTP, the designated port can ask its peer for permission for going to the Forwarding State. If the peer agrees, then the designated port moves to the Forwarding State without any delay. This procedure is called the Negotiation Process.

RSTP and MSTP also allow information received on a new Root port to be forwarded downstream immediately if the original Root port becomes dysfunctional instead of waiting for the Maximum Age time (20 seconds timer). Also a new Root port can transition to Forwarding immediately provided that any previous Root ports are in a Discarding state.

The example in Figure 1 illustrates how an RSTP port state moves rapidly to Forwarding state without the risk of creating a loop in the network.

- Switch A: ports 1 and 2 are in full duplex. Port 2 is an Edge port
- Switch B: ports 1, 2 and 3 are in full duplex. Port 2 is an Edge port
- Switch C: ports 1 and 2 are in full duplex. Port 2 is an Edge port
- Switch A is the Root

1.8 Negotiation Process

After power up, all ports assume the role as Designated ports. All ports are in the Discarding state except Edge ports. Edge ports go directly to Forwarding state without delay.

Switch A port 1 and switch B port 1 exchange BPDUs and switch A knows that it is the Root bridge and switch A port 1 is the Designated port for that segment. Switch B learns that switch A has the lowest cost to reach the Root. Switch B port 1 becomes Root port and since there is no other previous Root port active on Switch B it can transition into Forwarding state. Switch A port 1 is still in Discarding state at this point.

Switch A starts the negotiation process by sending a BPDU with proposal bit set on its port 1 to Switch B.

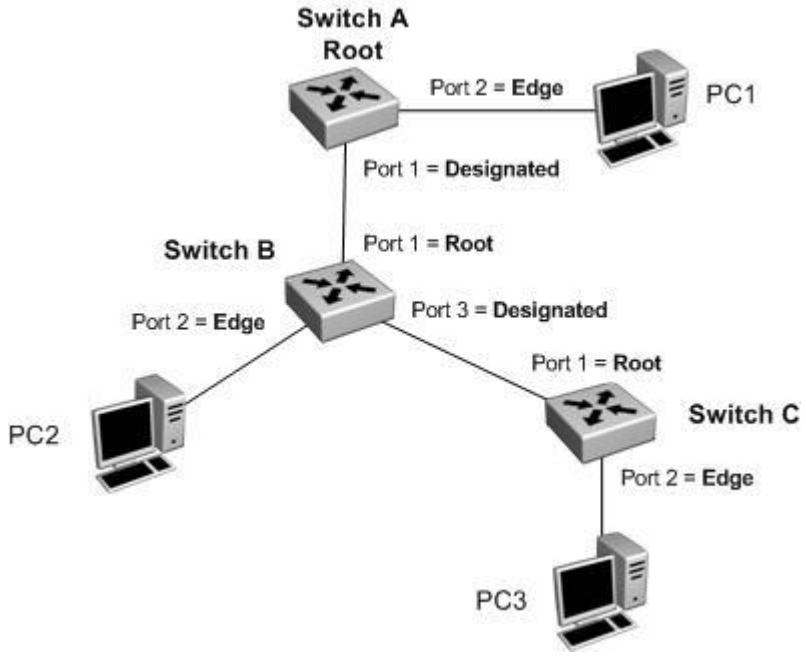
Switch B receives proposal BPDU and this will force it to enter the sync process whereby all its Designated non-Edge ports (in this case only port 3 to Switch C) are put in Discarding state and in turn a negotiation process for them is triggered downstream

Switch B can now send a BPDU with the agreement bit set back to switch A.

Switch A can now transition port 1 into Forwarding state. PC 1 and PC 2 can talk to each other.

- In the meantime the negotiation process also moved down to switch B port 3 and its partner port on Switch C.
- PC 3 cannot talk to either PC 1 or PC 2 until the negotiation process between switch B and switch C is complete.

Figure 1 Negotiation Process



The RSTP convergence time depends on how quickly the switch can exchange BPDUs during the Negotiation process, and the number of switches in the network. The convergence time depends on the hardware platform and number of active applications running on the switch.

1.9 MSTP MST Region Configuration

One of the more complex aspects of MSTP is the MST Region configuration. In order for a number of MSTP bridges to share multiple MSTI instances (and therefore achieve some level of traffic load balancing across VLANs belonging to different MSTI instances) they must first be all members of the same MST Region. If that is not the case, then any MSTI instance configured will never extend beyond the local bridge and it's forwarding topology will simply be collapsed onto the CIST forwarding topology (i.e. no per VLAN load balancing will ever be possible). The CIST base instance of MSTP will however work whether or not any MST Regions exist.

To belong to the same MST Region, MSTP bridges must have an identical MST Configuration Identifier (MCID). The MCID contains the following components:

- The MCID Format Selector version: A single byte of value 0 in the current MSTP specification; on the Avaya ERS products this value is exposed and configurable however it should be left at default value 0.
- The Region name: A variable length text string which must be manually configured to be the same across all MSTP bridges which need to operate in the same region.
- The Region Revision Level or Version: A 2 byte field which should either be left at default value 0 or configured to be the same across all MSTP bridges which need to operate in the same region.
- The VLAN MSTI membership Configuration Digest: This is a hash signature of the mapping of every possible vlan-id (1-4095) to an MSTI/CIST instance. This component is not directly user configurable but is automatically generated by the MSTP bridge based upon what VLANs are created and to which MSTI or CIST instance they are assigned.

Hence, note that simply configuring the same Region Name and Region Version on all MSTP bridges is not sufficient to make them belong to the same MST Region. It is also necessary for them to have the same exact VLANs configured and these VLANs need to be assigned to exactly the same CIST/MSTI instances across all MSTP bridges.

To confirm whether an MSTP bridge belongs to the desired MST Region, the MSTP standard defines the role of the CIST Regional root which identifies the bridge within the MST Region with the lowest external Root path cost, on a Region boundary port, towards the CIST Root. If the CIST Root exists within the MST Region, then the CIST Regional root is the CIST Root bridge.

Once a number of MSTP bridges agree on a same CIST Regional root, they are actively part of the same MSTP Region and can now share MSTI instances.

1.10 Spanning Tree interoperability between Avaya 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 Avaya switches offered today. In regards to the ERS8600 only, it also supports the older PVST+ Spanning Tree mode of operation.

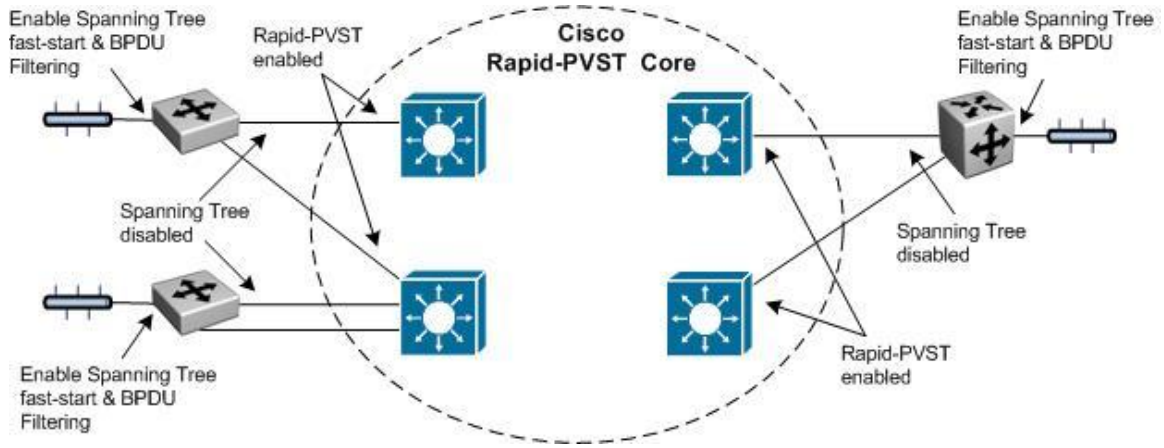
By default, Cisco comes enabled with Rapid-PVST. This proprietary protocol combines the functionality of RSTP with PVST creating an RSTP (802.1w) instance per VLAN. The Cisco implementation also defines a concept of “native” VLAN whereby BPDUs generated for the native vlan are standard compliant (802.1w 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 Avaya switches.

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

If the Avaya 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 Avaya 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 Avaya 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 Avaya 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.

Figure 2: Cisco R-PVST Interoperability with Avaya



1.11 RSTP/MSTP Definitions

As per the IEEE 802.1s (MSTP) [integrated in IEEE 802.1Q-2005] and IEEE 802.1w (RSTP) [integrated in IEEE 802.1D-2004] standards:

Boundary Port: A Bridge Port attaching an MST Bridge to a LAN that is not in the same region.

Common and Internal Spanning Tree (CIST): The single Spanning Tree calculated by STP and RSTP together with the logical continuation of that connectivity through MST Bridges and regions, calculated by MSTP to ensure that all LANs in the Bridged Local Area Network are simply and fully connected.

Common Spanning Tree (CST): The single Spanning Tree calculated by STP and RSTP, and by MSTP to connect MST Regions.

Internal Spanning Tree (IST): An internal Spanning Tree that runs in a given MST Region. Within a MST region, multiple Spanning Instances may be configured. Instance 0 within a region is known as the Internal Spanning Tree (IST).

Multiple Spanning Tree (MST) Configuration Identifier: A name for revision level, and a summary of a given allocation of VLANs to Spanning Trees.

NOTE - Each MST Bridge uses a single MST Configuration Table and Configuration Identifier.

MST Configuration Table: A configurable table that allocates each and every possible VLAN to the Common Spanning Tree or a specific Multiple Spanning Tree Instance.

Multiple Spanning Tree Algorithm and Protocol (MSTP): The Multiple Spanning Tree Algorithm and Protocol.

MST Bridge: A Bridge capable of supporting the CST, and one or more MSTIs and of selectively mapping frames classified in any given VLAN to the CST or a given MSTI.

MST Region: A set of LANs and MST Bridges physically connected via Ports on those MST Bridges, where each LAN's CIST Designated Bridge is an MST Bridge, and each Port is either the Designated Port on one of the LANs, or else a non-Designated Port of an MST Bridge that is connected to one of the LANs, whose MST Configuration Identifier (MCID) matches exactly the MCID of the Designated Bridge of that LAN.

NOTE - It follows from this definition that the MCID is the same for all LANs and Ports in the Region and that the set of MST Bridges in the region are interconnected by the LANs.

Multiple Spanning Tree Bridge Protocol Data Unit (MST BPDU): The MST BPDU specified.

Multiple Spanning Tree Instance (MSTI): One of a number of Spanning Trees calculated by MSTP within an MST Region, to provide a simply and fully connected active topology for frames classified as belonging to a VLAN that is mapped to the MSTI by the MST Configuration Table used by the MST Bridges of that MST Region.

Rapid Spanning Tree Algorithm and Protocol (RSTP): The Rapid Spanning Tree Algorithm and Protocol.

Rapid Spanning Tree Bridge Protocol Data Unit (RST BPDU): The RST BPDU specified.

Single Spanning Tree (SST) Bridge: A Bridge capable of supporting only a single spanning tree, the CST. The single spanning tree may be supported by the Spanning Tree Algorithm and Protocol (STP) defined in IEEE Std 802.1D, 1998 Edition, or by the Rapid Spanning Tree Algorithm and Protocol (RSTP), defined in IEEE Std 802.1w-2001.

Spanning Tree: A simple, fully connected active topology formed from the arbitrary physical topology of connected Bridged Local Area Network components by relaying frames through selected bridge ports and not through others. The protocol parameters and states used and exchanged to facilitate the calculation of that active topology and to control the bridge relay function.

Spanning Tree Algorithm and Protocol (STP): The Spanning Tree Algorithm and Protocol described in Clause 8 of IEEE Std 802.1D, 1998 Edition.

Spanning Tree Bridge Protocol Data Unit (ST BPDU): A Bridge Protocol Data Unit specified for use by the Spanning Tree Algorithm and Protocol, i.e. a Configuration or Topology Change Notification BPDU as described in Clause 9 of IEEE Std 802.1D, 1998 Edition.

Abbreviations

CIST	Common and Internal Spanning Tree
CST	Common Spanning Tree
IST	Internal Spanning Tree
MCID	MST Configuration Identifier
MST	Multiple Spanning Tree
MST BPDU	Multiple Spanning Tree Bridge Protocol Data Unit
MSTI	Multiple Spanning Tree Instance
MSTP	Multiple Spanning Tree Protocol
RST BPDU	Rapid Spanning Tree Bridge Protocol Data Unit
RSTP	Rapid Spanning Tree Protocol
SST	Single Spanning Tree
ST BPDU	Spanning Tree Bridge Protocol Data Unit
STP	Spanning Tree Protocol

2. RSTP Configuration Example

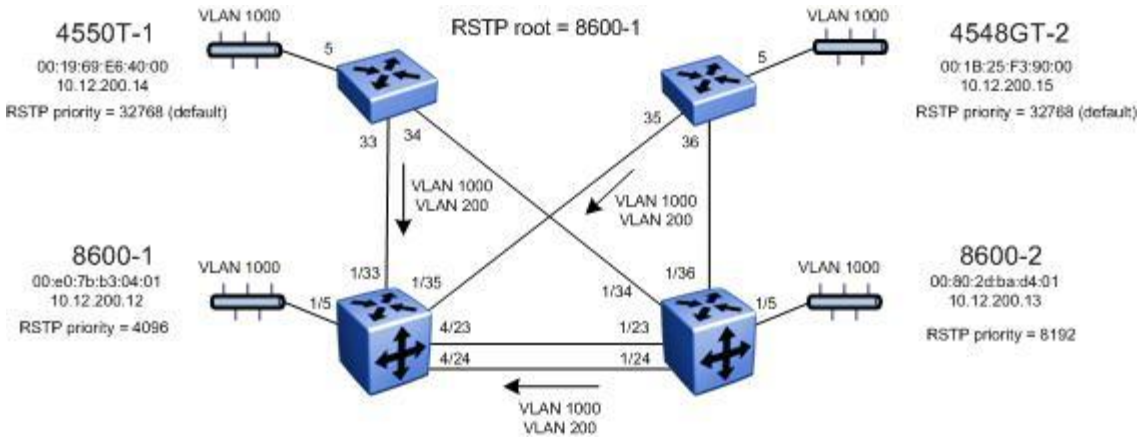


Figure 3: RSTP Configuration Example

In this configuration example, we will accomplish the following:

- Configure the bridge priority as shown in Figure 3. This will result in 8600-1 becoming the RSTP Root Bridge. If 8600-1 should fail, then 8600-2 should become the Root Bridge based on priority settings.
- Two VLANs will be configured, a management VLAN (VLAN 200) and a end user VLAN (VLAN 1000)
- 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
- As an option, we can set the RSTP port priority on 8600-1 to influence the link taken between 8600-1 and 8600-2. The default port priority simply has to be changed to a lower value on 8600-1 from the default setting of 128
- The port priority setting is configured in increments of 16 from 0 to 240

After all the switches have been configured using the above settings, traffic should flow as that shown in the following diagram.

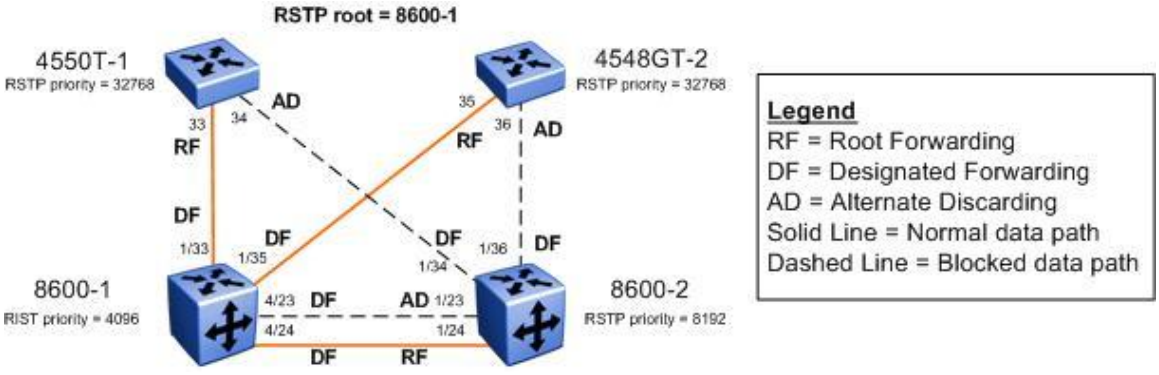


Figure 4: RSTP Example – Normal Data Flow

2.1 Configuration

For this configuration example, 8600-1 will be configured using ACLI while 8600-2 will be configured using PPCLI.

2.1.1 Set Spanning Tree Mode to RSTP

ERS8600-1: Step 1 – Set the bootconfig Spanning Tree mode to RSTP

```
ERS-8610:5(config)# boot config flags spanning-tree-mode rstp
ERS-8610:5(config)# save bootconfig
ERS-8610:5(config)# boot -y
|
ERS-8610:5(config)#sys name ERS8600-1
```

ERS8600-2: Step 1 – Set the bootconfig Spanning Tree mode to RSTP

```
ERS-8610:5# config bootconfig flags spanning-tree-mode rstp
ERS-8610:5# save bootconfig
ERS-8610:5# boot -y
|
ERS-8610:5# config sys set name ERS8600-2
```

ERS4550T-1: Step 1 – Set Spanning Tree Operation mode to RSTP

```
4550T(config)# spanning-tree op-mode rstp
4550T(config)# write memory
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 RSTP

```
4548GT#(config)# spanning-tree op-mode rstp
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
```

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

```
ERS8600-1:5(config)# vlan create 200 name mgmt type port-mstprstp 0
ERS8600-1:5(config)# vlan create 1000 type port-mstprstp 0
ERS8600-1:5(config)# vlan ports 4/23,4/24,1/33,1/35 tagging tagAll
ERS8600-1:5(config)# vlan members remove 1 1/5,4/23,4/24,1/33,1/35
ERS8600-1:5(config)# vlan members add 200 4/23,4/24,1/33,1/35
ERS8600-1:5(config)# vlan members add 1000 1/5,4/23,4/24,1/33,1/35
```

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

```
ERS8600-2:5# config vlan 200 create byport-mstprstp 0 name mgmt
ERS8600-2:5# config vlan 1000 create byport-mstprstp 0
ERS8600-2:5# config ethernet 1/23,1/24,1/34,1/36 perform-tagging enable
ERS8600-2:5# config vlan 1 ports remove 1/5,1/23,1/24,1/34,1/36
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
```

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

```
4550T-1(config)# vlan create 200 name mgmt type port
4550T-1(config)# vlan create 1000 type port
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 remove 1 5,33,34
```

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

```
4548GT-2(config)# vlan create 200 name mgmt type port
4548GT-2(config)# vlan create 1000 type port
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 remove 1 5,35,36
```

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
```

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.

2.1.2 RSTP Configuration

For this example, we will change the RSTP priority to make 8600-1 the root bridge and 8600-2 the backup root bridge. We will leave both 4550T-1 and 4548GT-2 with the default bridge priority setting of 32768.

ERS8600-1: Step 1 – Change RSTP priority to make this switch root

```
ERS8600-1:5(config)# spanning-tree rstp priority 4096
```

ERS8600-2: Step 1 – Change RSTP priority to make this switch backup root

```
ERS8600-2:5# config rstp priority 8192
```

ERS8600-1: Step 2 – Configure RSTP Edge Ports

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

ERS8600-2: Step 2 – Configure RSTP Edge Ports

```
ERS8600-2:5# config ethernet 1/5 rstp edge-port true
```

ERS4550T-1: Step 2 – Configure RSTP Edge Ports

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

ERS4528GT-2: Step 2 – Configure RSTP Edge Ports

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

2.1.3 Optional RSTP Port Priority Configuration

If we wish to influence the forwarding path when there is more than one link between two switches, the default RSTP port priority setting can be changed from the default setting of 128 to a lower value in increments of 16. For example, since 8600-1 is the root bridge and has two links available to 8600-2, if we wish to use port 4/24, we can simply change the port priority from the default setting of 128 to 16 as shown below.

ERS8600-1: Step 1 – Change port priority setting on port 4/24

```
ERS8600-1:5(config)# interface fastEthernet 4/24
ERS8600-1:5(config-if)# spanning-tree rstp priority 16
ERS8600-1:5(config-if)# exit
```

2.2 Verify Operations

2.2.1 Verify RSTP Configuration and Root Bridge

Step 1 – Verify that the RSTP is enabled and priority is set to 4096 on 8600-1 and 8192 on 8600-2 to make 8600-1 the root bridge and 8600-2 the backup root bridge

```
ERS8600-1:5# show spanning-tree rstp config
```

Result:

```
=====================================================
                              RSTP Configuration
=====================================================
Rstp Module Status            : Enabled
Priority                      : 4096 (0x1000)
Stp Version                   : rstp Mode
Bridge Max Age                : 20 seconds
Bridge Hello Time             : 2 seconds
```

```
        Bridge Forward Delay Time     : 15 seconds
        Tx Hold Count                 : 3
        PathCost Default Type         : 32-bit
```

ERS8600-2:5# ***show rstp config***

Result:

```
        ======================================================
                                    RSTP Configuration
        ======================================================
        Rstp Module Status            : Enabled
        Priority                      : 8192 (0x2000)
        Stp Version                   : rstp Mode
        Bridge Max Age                : 20 seconds
        Bridge Hello Time             : 2 seconds
        Bridge Forward Delay Time     : 15 seconds
        Tx Hold Count                 : 3
        PathCost Default Type         : 32-bit
```

4550T-1# ***show spanning-tree rstp config***

Result:

```
        Stp Priority (hex):        8000
        Stp Version:               Rstp Mode
        Bridge Max Age Time:       20 seconds
        Bridge Hello Time:         2 seconds
        Bridge Forward Delay Time: 15 seconds
        Tx Hold Count:             3
        Path Cost Default Type:    32-bit
        STP Traps:                 Enabled
```

4548GT-2# ***show spanning-tree rstp config***

Result:

```
        Stp Priority (hex):        8000
        Stp Version:               Rstp Mode
        Bridge Max Age Time:       20 seconds
        Bridge Hello Time:         2 seconds
        Bridge Forward Delay Time: 15 seconds
        Tx Hold Count:             3
        Path Cost Default Type:    32-bit
```

```
        STP Traps:                  Enabled
```

Step 2 – Verify that the RSTP root is 8600-1:

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

Result:

```
        ================================================================
                                  RSTP Status Information
        ================================================================
        Designated Root                 : 10:00:00:e0:7b:b3:04:01
        Stp Root Cost                   : 0
        Stp Root Port                   : cpp
        Stp Max Age                     : 20 seconds
        Stp Hello Time                  : 2 seconds
        Stp Forward Delay Time          : 15 seconds
```

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

Result:

```
        ================================================================
                                  RSTP Status Information
        ================================================================
        Designated Root                 : 10:00:00:e0:7b:b3:04:01
        Stp Root Cost                   : 200000
        Stp Root Port                   : 1/24
        Stp Max Age                     : 20 seconds
        Stp Hello Time                  : 2 seconds
        Stp Forward Delay Time          : 15 seconds
```

```
4550T-1# show spanning-tree rstp status
```

Result:

```
        Designated Root:        10:00:00:E0:7B:B3:04:01
        Stp Root Cost:          200000
        Stp Root Port:          33
        Stp Max Age:            20 seconds
        Stp Hello Time:         2 seconds
        Stp Forward Delay Time: 15 seconds
```

```
4548GT-2# show spanning-tree rstp status
```

Result:

```
Designated Root:        10:00:00:E0:7B:B3:04:01
Stp Root Cost:          200000
Stp Root Port:          35
Stp Max Age:            20 seconds
Stp Hello Time:         2 seconds
Stp Forward Delay Time: 15 seconds
```

To verify the base MAC on an ERS4500 or ERS8600 using ACLI, enter the command *show sys-info*. On an ERS8600 using PPCLI, enter the command *show sys info.*

On each switch, verify the following information:

Option	Verify
Root	Verify that the RSTP root bridge is 8600-1 whose address is ***00:E0:7B:B3:04:01.***
Root Port	Verify that under normal operations that the correct port to the Root is used: • ERS8600-2: Port ***1/24*** (assuming RSTP port priority on 8600-1 port 4/24 changed from default setting of 128 to 16) • ERS4550T-1: Port ***33*** • ERS4548GT-2: Port ***35***

2.2.2 Verify port forwarding state

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

```
ERS8600-1:5# show spanning-tree rstp port role 4/23,4/24,1/33,1/35
```

Result:

```
=============================================================================
                            RSTP Port Roles and States
=============================================================================

Port-Index  Port-Role    Port-State   PortSTPStatus  PortOperStatus
-----------------------------------------------------------------------------
1/33        Designated  Forwarding      Enabled        Enabled
1/35        Designated  Forwarding      Enabled        Enabled
4/23        Designated  Forwarding      Enabled        Enabled
```

```
        4/24        Designated  Forwarding      Enabled        Enabled
```

```
ERS8600-2:5# show port info rstp role port 1/23,1/24,1/34,1/36
```

Result:

```
        ================================================================
                                RSTP Port Roles and States
        ================================================================

        Port-Index  Port-Role    Port-State   PortSTPStatus  PortOperStatus
        ----------------------------------------------------------------
        1/23        Alternate   Discarding      Enabled        Enabled
        1/24        Root        Forwarding      Enabled        Enabled
        1/34        Designated  Forwarding      Enabled        Enabled
        1/36        Designated  Forwarding      Enabled        Enabled
```

```
4550T-1# show spanning-tree rstp port role 33,34
```

Result:

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

```
4548GT-2# show spanning-tree rstp port role 35,36
```

Result:

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

On each switch, verify the following information:

Option	Verify
RSTP Root Port	Verify that under normal operations that the correct port to the RSTP root bridge is used: • 8600-2: Port ***1/24*** (assuming RSTP port priority on 8600-1 port 4/24 changed from default setting of 128 to 16) • 4550T-1: Port ***33*** • 4548GT-2: Port ***35***

3. MSTP Configuration Example – One Region

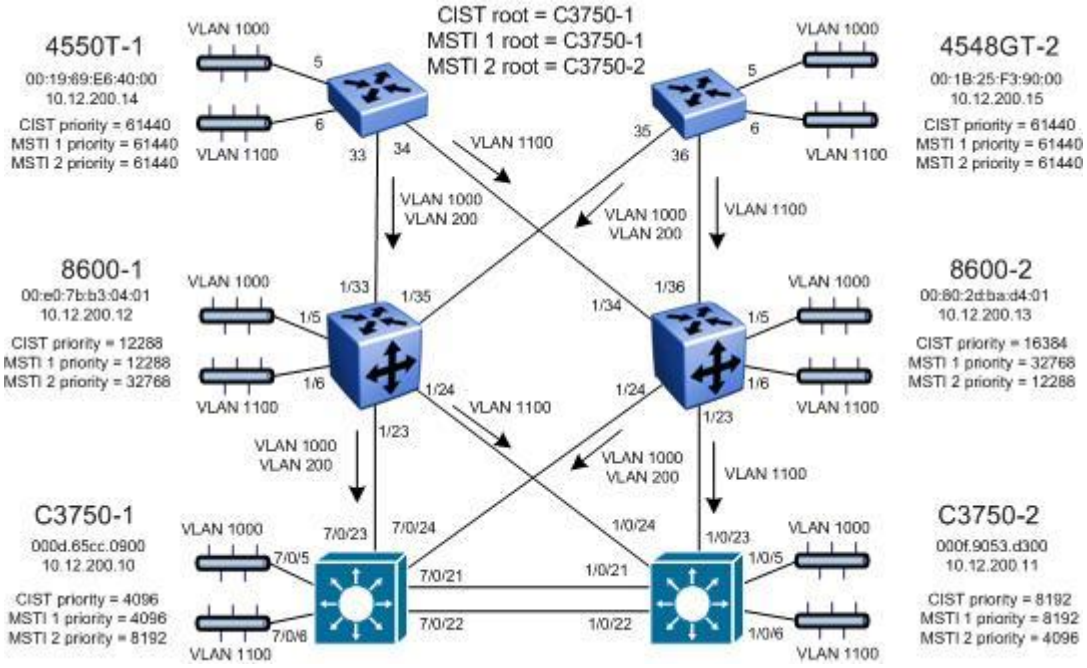


Figure 5: MSTP Example with One Region

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.

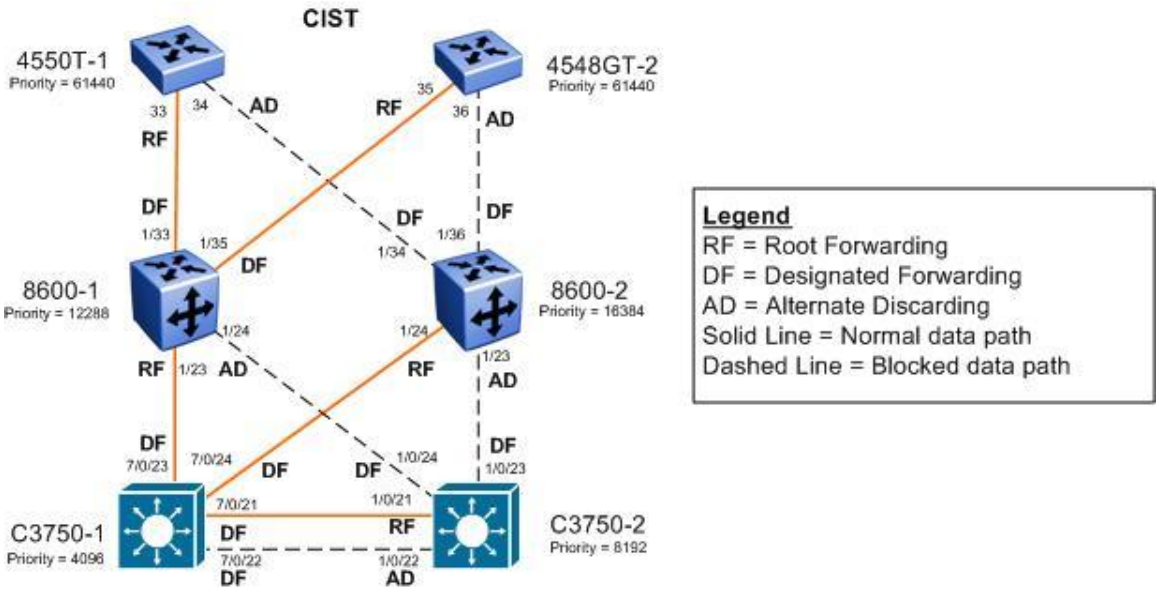


Figure 6: MSTP Example with One Region – CIST Instance 0 Data Flow

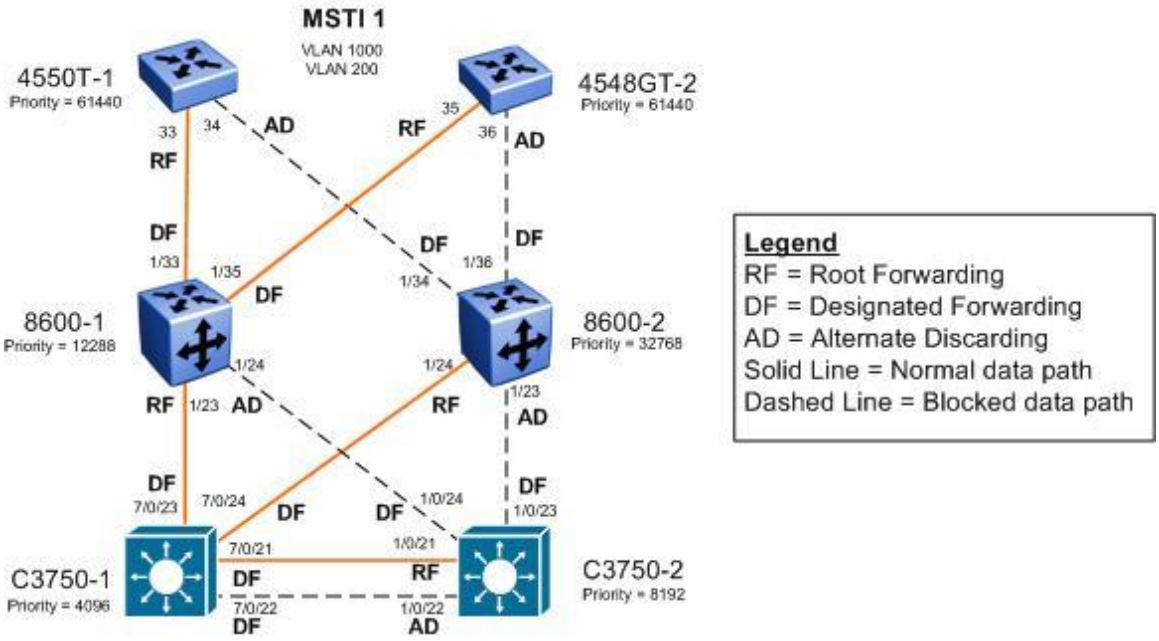


Figure 7: MSTP Example with One Region – MSTI 1 Data Flow

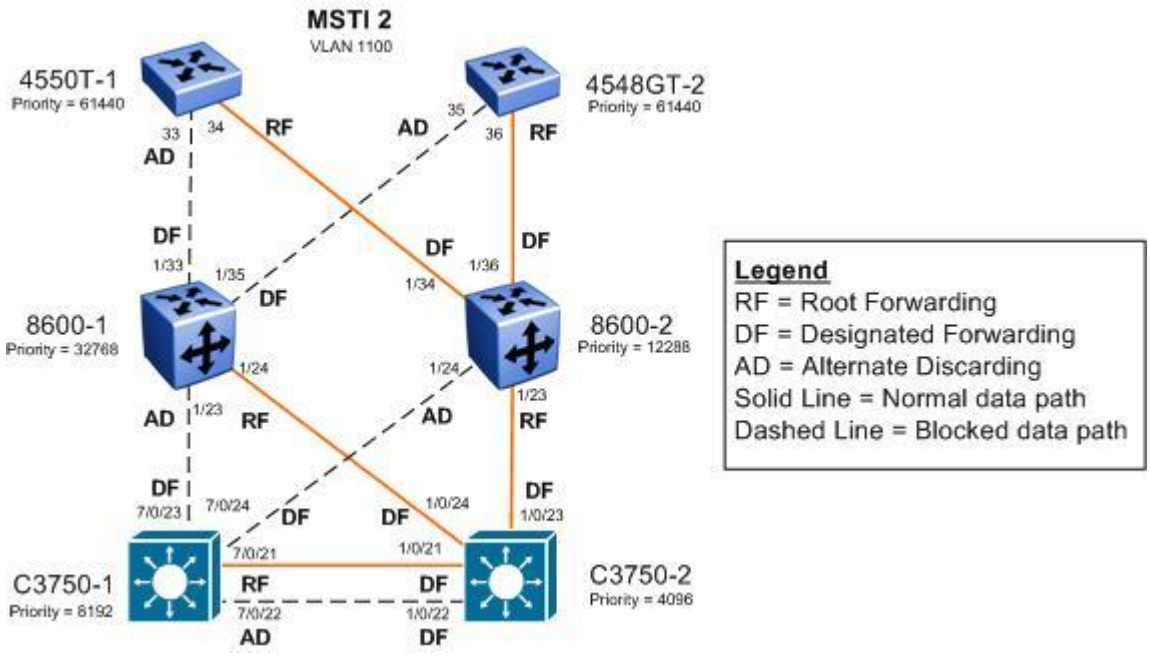


Figure 8: MSTP Example with One Region – MSTI 2 Data Flow

3.1 Configuration

3.1.1 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
ERS-8610:5(config)# save bootconfig
ERS-8610:5(config)# boot -y
|
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
ERS-8610:5# save bootconfig
ERS-8610:5# boot -y
|
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
4550T(config)# write memory
```

```
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
```

3.1.2 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.

3.1.3 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.

3.1.4 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
```

3.2 Verify Operations

3.2.1 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: • 8600-1: Port ***1/23*** • 8600-2: Port ***1/24*** • 4550T-1: Port ***33*** • 4548GT-2: Port ***35*** • C3750-2: Either port ***1/0/21*** or ***1/0/22***

3.2.2 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: • 8600-1: Port ***1/23*** • 8600-2: Port ***1/24*** • 4550T-1: Port ***33*** • 4548GT-2: Port ***35*** • 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.

3.2.3 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: • 8600-1: Port ***1/24*** • 8600-2: Port ***1/23*** • 4550T-1: Port ***34*** • 4548GT-2: Port ***36*** • 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.

4. MSTP Configuration Example - Two Regions

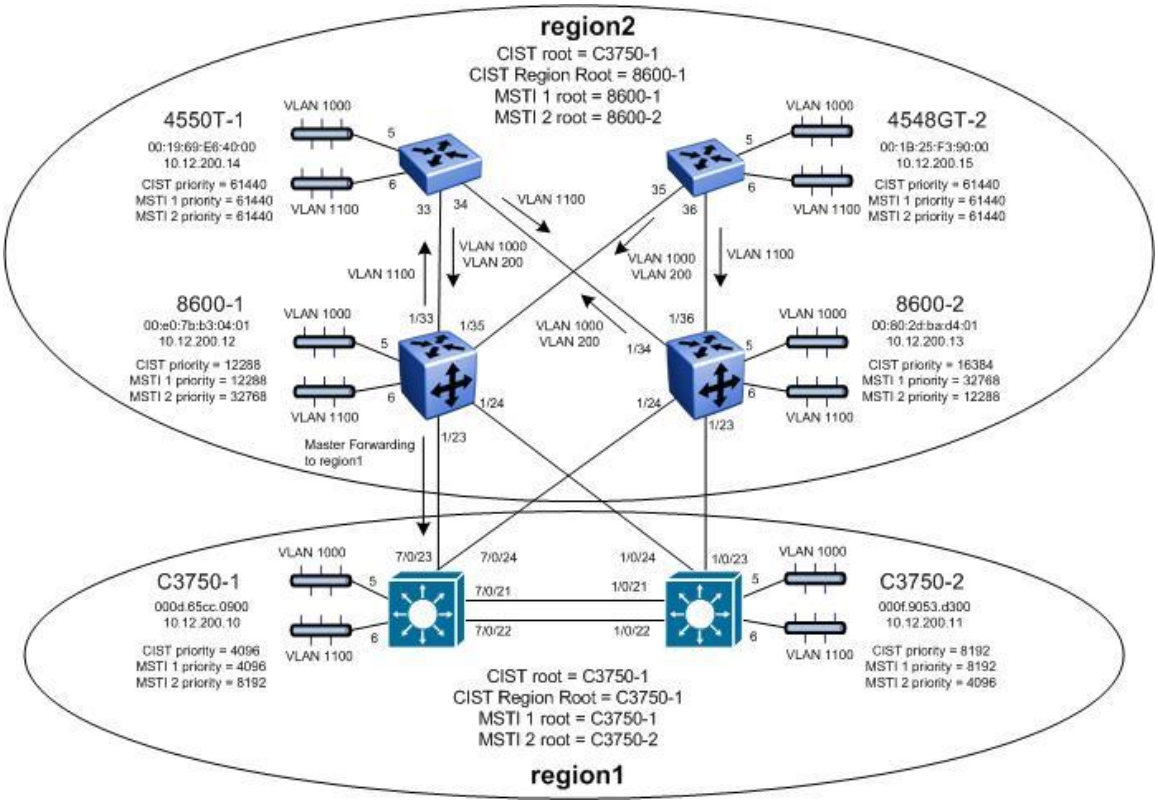


Figure 9: MSTP Example with Two Regions

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.

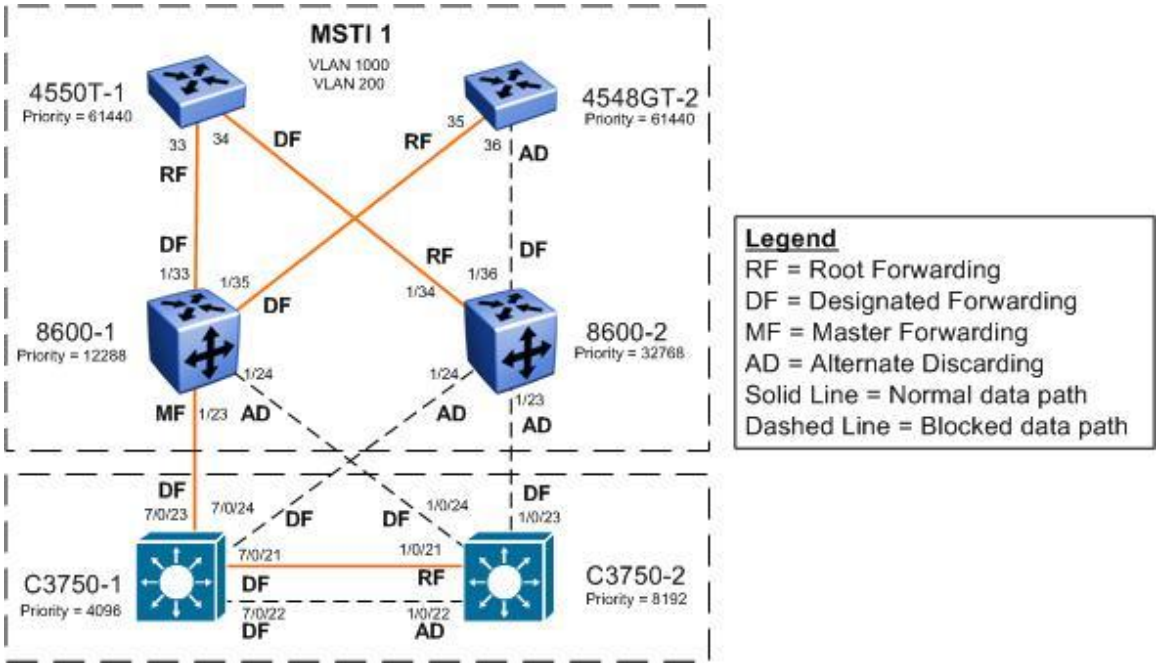


Figure 10: MSTP Example with Two Regions – MSTI 1 Data Flow

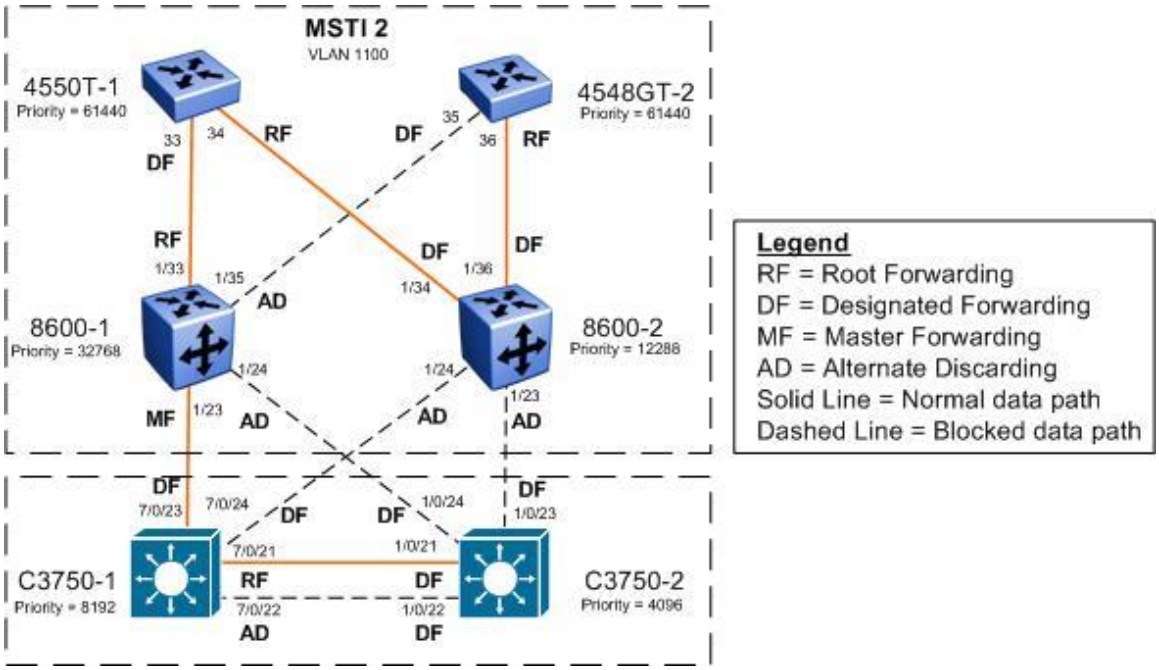


Figure 11: MSTP Example with Two Regions – MSTI 2 Data Flow

4.1 Configuration

Please note that the exact same configuration is used in this example from Section 3 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
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
```

4.2 Verify Operations

4.2.1 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: • 8600-1: Port ***1/23*** • 8600-2: Port ***1/34*** • 4550T-1: Port ***33*** • 4548GT-2: Port ***35*** • C3750-2: Either port ***1/0/21*** or ***1/0/22***

4.2.2 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: • 8600-1: Port ***1/23*** (Master Forwarding to “region1”) • 8600-2: Port ***1/34*** • 4550T-1: Port ***33*** • 4548GT-2: Port ***35*** • 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.

4.2.3 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: • 8600-1: Port ***1/33*** Port ***1/24*** (Master Forwarding to "region1") • 4550T-1: Port ***34*** • 4548GT-2: Port ***36*** • 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. Software Baseline

The software levels used in the document are based on the following:

- **ERS 4500**
  - Release 5.3
- **ERS 8600**
  - Release 5.1
- **Cisco 3750**
  - Must be at least 12.2(25)SEC or greater

6. Reference Documentation

Document Title	Publication Number	Description
Configuration — VLANs, Spanning Tree, and Link Aggregation	NN47200-502	Avaya Ethernet Routing Switch 5000 Series
Configuration — VLANs, Spanning Tree, and MultiLink Trunking	NN47205-501	Avaya Ethernet Routing Switch 4500 Series
Configuration — VLANs, Spanning Tree, and MultiLink Trunking	NN47215-501	Avaya Ethernet Routing Switch 2500 Series
Configuration — VLANs and Spanning Tree	NN46205-517	Avaya Ethernet Routing Switch 8600
Configuration - VLANs and Spanning Tree	NN46200-516	Avaya Ethernet Routing Switch 8300

7. Customer service

Visit the Avaya Web site to access the complete range of services and support that Avaya provides. Go to www.avaya.com or go to one of the pages listed in the following sections.

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