



HP User Society: IT Symposium 2007

Multiple Instance Spanning Tree

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19. April 2007

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Agenda

- Introducing STP / RSTP
- Introducing MST
- Common Pitfalls with MST
- Summary

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The need for Spanning Tree:

Requirements for a Layer-2 bridging protocol



- Provide a loop-free topology, meaning a packet should never be seen twice in a network
- Only ONE active path between two hosts
- Should activate redundant links in case of a failure
- Convergence time should be as quick as possible
- Nice to have: Utilize redundant links

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IEEE Standards



- The First IEEE standard implementation of STP is **IEEE 802.1D**. (since 1998)
- RSTP is Rapid Spanning-Tree Protocol defined by the **IEEE 802.1w**. (since 2001)
- MSTP is Multiple Spanning-Tree Protocol defined by the **IEEE 802.1s**. (since 2002/2003)



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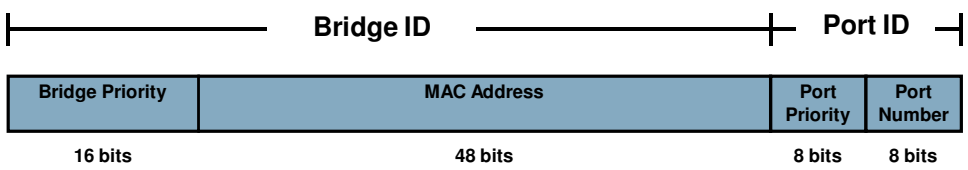
Introducing STP/RSTP (IEEE 802.1D / IEEE 802.1w)

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Spanning-Tree Identifiers

- Two identifiers play an important role in determining the active path through the bridged network
 - Bridge ID – 64-bit field comprising:
 - 16-bit user definable priority value
 - 48-bit bridge MAC address
 - Port ID – 16-bit field comprising:
 - 8-bit user definable priority value
 - 8-bit port number



Bridge ID		Port ID	
Bridge Priority	MAC Address	Port Priority	Port Number
16 bits	48 bits	8 bits	8 bits

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Spanning-Tree Election Criteria



- To build the L2 topology, STP goes through 3 elections (Root Bridge, Root Port, Designated port) using 4 criteria.
- In STP, the *best value is the lowest*

Election		Criteria
1- One Root Switch		1- Root Bridge-Id
2- One Root Port per switch except root switch	3-One Designated port per segment	2- Root Path Cost
		3- Neighbor Bridge-Id
		4- Neighbor Port-Id

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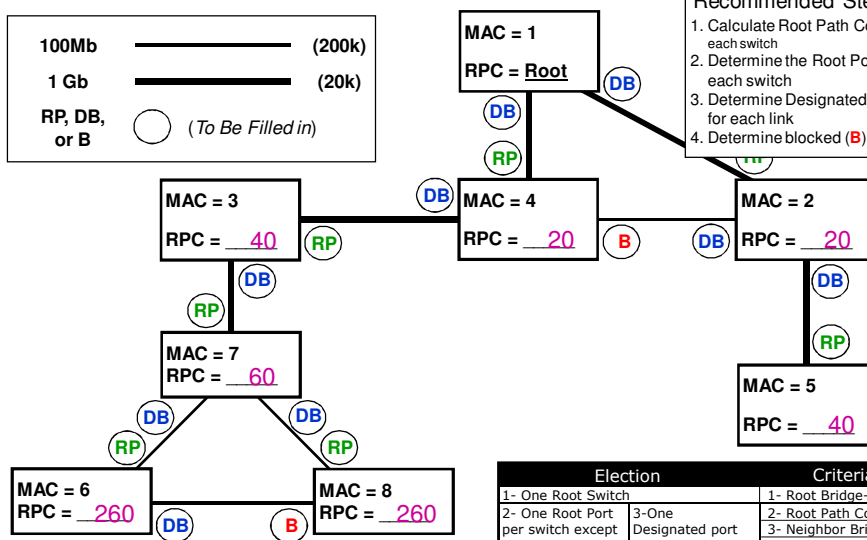
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Analyzing RSTP – Part 1



100Mb ————— (200k)
1 Gb ————— (20k)
RP, DB, or B ○ (To Be Filled in)

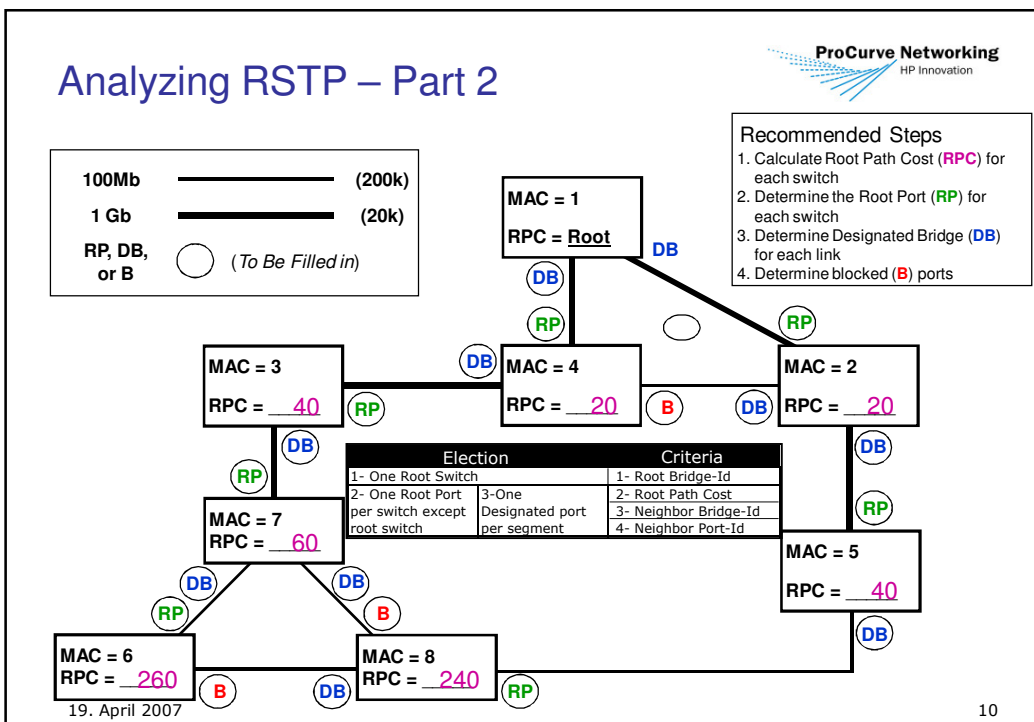
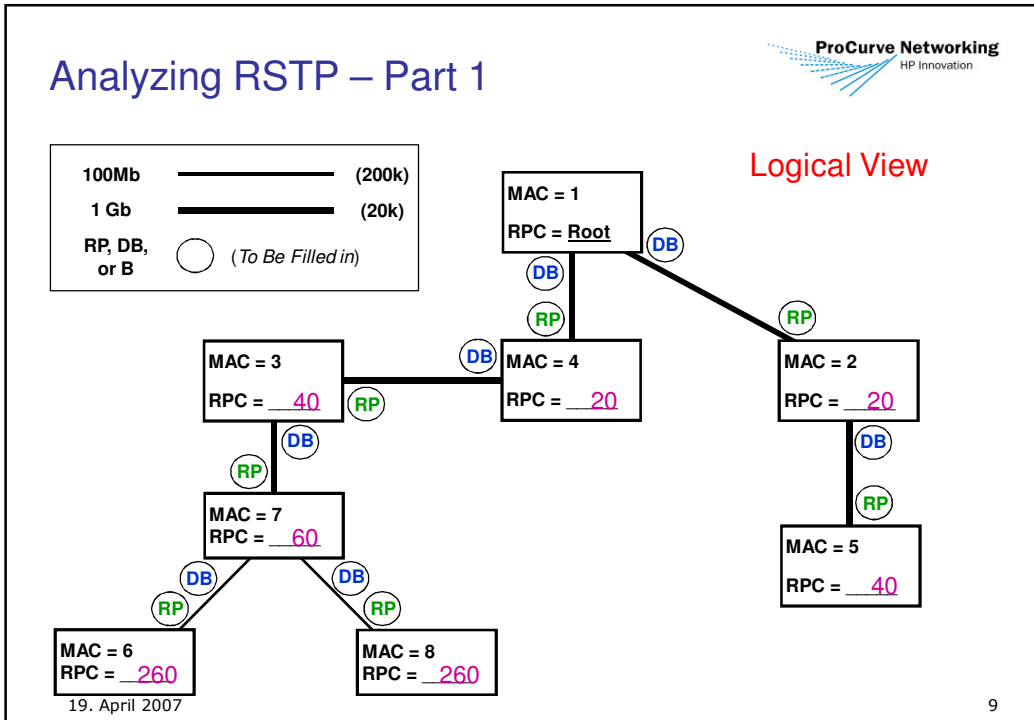
- Recommended Steps**
1. Calculate Root Path Cost (RPC) for each switch
 2. Determine the Root Port (RP) for each switch
 3. Determine Designated Bridge (DB) for each link
 4. Determine blocked (B) ports

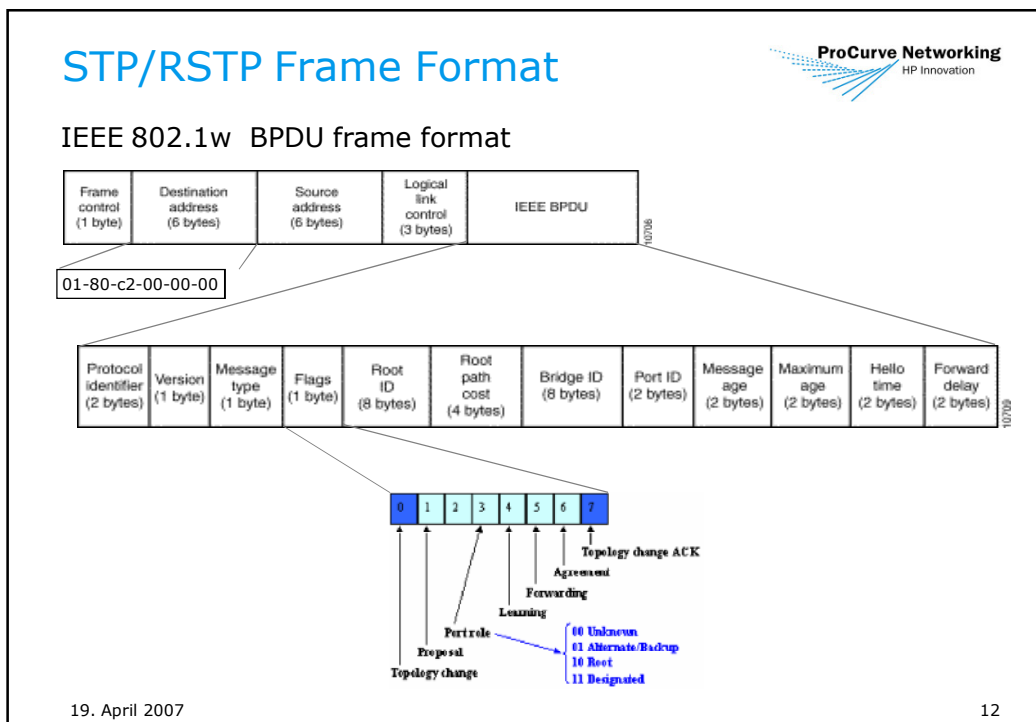
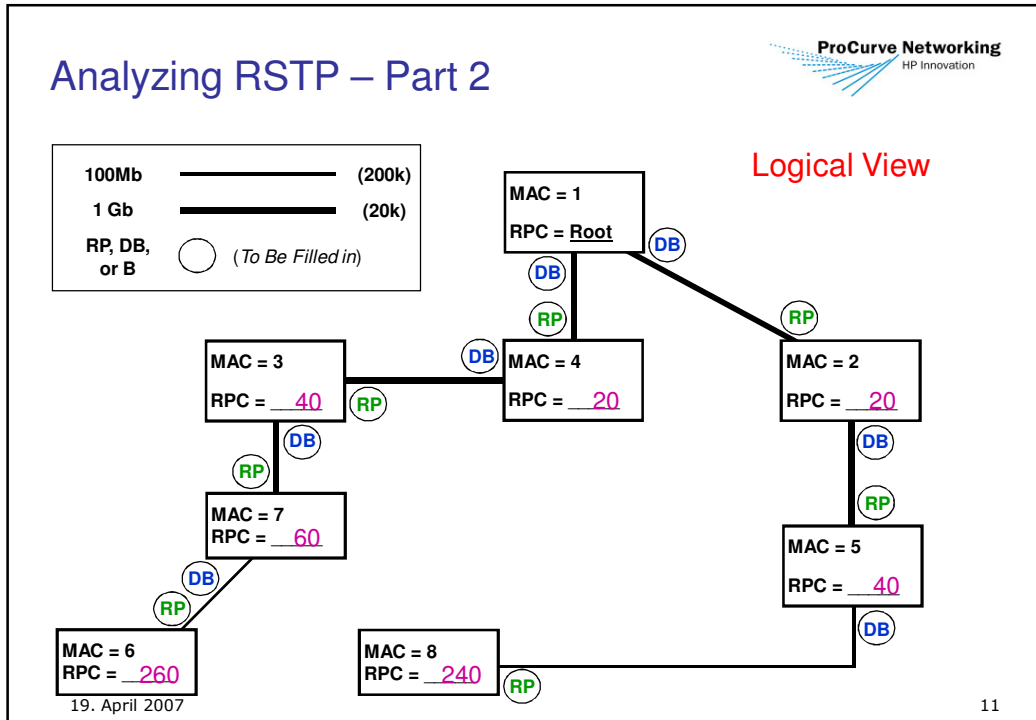



Election		Criteria
1- One Root Switch		1- Root Bridge-Id
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		4- Neighbor Port-Id

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Introducing MST (IEEE 802.1s)

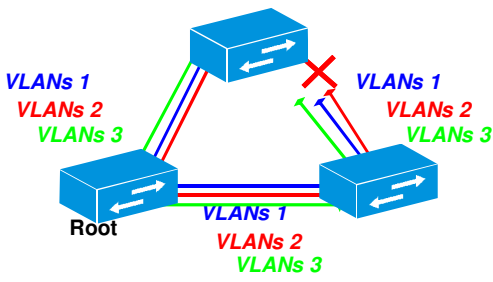


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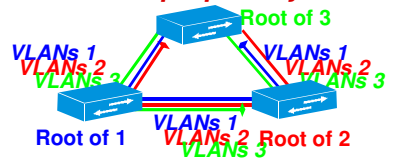
Topological Differences



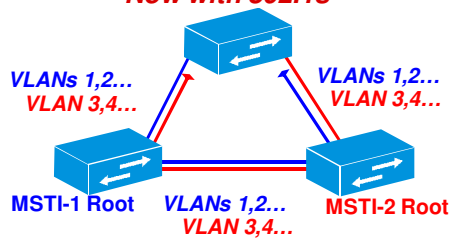
Before (with STP/RSTP)



With Cisco's proprietary PVST+



Now with 802.1s



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Introducing MST

New Terms



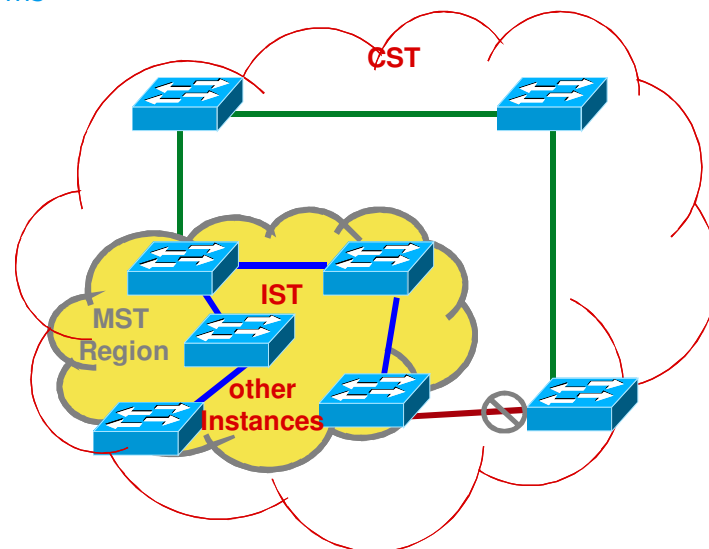
- MST Region:**
 A group of switches running 802.1s under a common set of configuration attributes.
- MST instance:**
 An entity which will calculate its own topology. Each instance can be used for one or more VLANs.
- Common Spanning Tree (CST):**
 An STP or RSTP spanning tree instance to interconnect different regions.
- Internal Spanning Tree (IST):**
 RSTP instance interconnecting CST to the region. All other VLANs that are not configured manually to a particular instance are mapped automatically to the IST (MST Instance 0).

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Introducing MST

New Terms



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Introducing MST

Defining a Region


For defining an MST Region, all switches within that region must have the following parameters in common:

1. Region Name
2. Configuration Number
3. MD5 Digest
=> which is a result of the VLAN-to-Instance mapping




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Various Spanning-Tree BPDUs




802.1D	Untagged IEEE Destination MAC: 01:80:c2:00:00:00										
802.1w	Untagged IEEE Destination MAC: 01:80:c2:00:00:00										
MST 802.1s	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 35%;">Untagged IEEE Destination MAC: 01:80:c2:00:00:00</td> <td style="width: 15%; text-align: center;">RSTP and MSTP Common</td> <td colspan="3" style="text-align: center;">MSTP Specific Parameters</td> </tr> <tr> <td style="text-align: center;">CST Information</td> <td style="text-align: center;">IST Info.</td> <td style="text-align: center;">MSTI Info.</td> <td colspan="2" style="text-align: center;">.... additional MSTI Info.</td> </tr> </table>	Untagged IEEE Destination MAC: 01:80:c2:00:00:00	RSTP and MSTP Common	MSTP Specific Parameters			CST Information	IST Info.	MSTI Info. additional MSTI Info.	
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PVST+ on Cisco Trunk ports	<table style="width: 100%;"> <tr> <td style="width: 33%; padding: 2px;"> Untagged for native VLAN <small>(only if VLAN =1 is allowed on the trunk)</small> IEEE Destination MAC: 01:80:c2:00:00:00 </td> <td style="width: 33%; padding: 2px;"> Untagged for native VLAN Cisco Destination MAC: 01:00:0c:cc:cc:cd </td> <td style="width: 33%; padding: 2px;"> Tagged Cisco Destination MAC: 01:00:0c:cc:cc:cd </td> </tr> </table>	Untagged for native VLAN <small>(only if VLAN =1 is allowed on the trunk)</small> IEEE Destination MAC: 01:80:c2:00:00:00	Untagged for native VLAN Cisco Destination MAC: 01:00:0c:cc:cc:cd	Tagged Cisco Destination MAC: 01:00:0c:cc:cc:cd							
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Common Pitfalls with MST



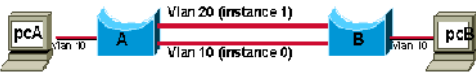
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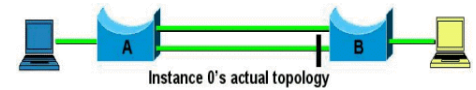
Introducing MST

Popular Misconfigurations

The rule:
All instances are active on all ports!



This configuration results in pcA's inability to send frames to pcB.




The *show* command reveals that Switch B is blocking the link to Switch A in VLAN 10.

When switches A and B exchange STP information:

An MST BPDU, containing IST (VLAN 10) informations and also Mrecord for instance 1 (VLAN 20), will be sent.

Switch B receives two BPDUs for instance 0 from switch A, one on each port.

=> It has to block one of them!




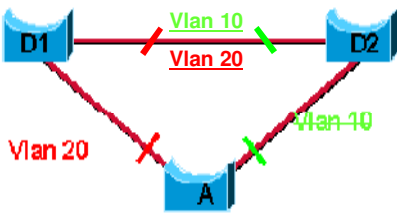
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Popular Misconfigurations

The rule:
**VLANs mapped to the same instance
 always block the same ports!**



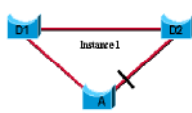


Suppose that VLANs 10 and 20 are both mapped to the same instance (instance 1).

Users in VLAN 10 have lost connectivity to the network.


VLANs 10 and 20 are both mapped to instance 1, which means there is only one logical topology for both VLANs.

VLAN 10 is only allowed on the blocked port !

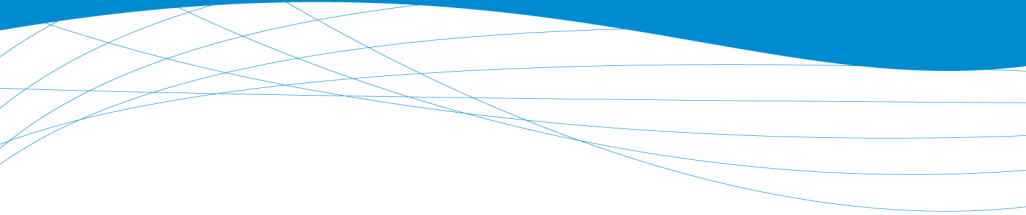


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Summary



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Summary



- There is only one standardized and interoperable multiple-instance Spanning Tree Protocol available, which allows load sharing:
 - **MST (IEEE 802.1s)**
- Watch out for potential, non-obvious misconfigurations.

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