



The Multiple Spanning Tree Protocol

802.1Q - 2003



Presentation Outline

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Abbreviations

- ST – Spanning Tree
- RST – Rapid Spanning Tree
- MST – Multiple Spanning Tree
- MSTP – Multiple Spanning Tree protocol
- BPDU – Bridge Protocol Data Unit
 - Types: ST BPDU, TCN BPDU, RST BPDU, MST BPDU
 - Configuration BPDU \Rightarrow ST BPDU (terminology change)



Definitions

- 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."*¹
- Common Spanning Tree (CST)
 - *"The single Spanning Tree calculated by STP and RSTP, and by MSTP to connect MST Regions."*²

1 – IEEE Std 802.1Q™-2003 sub-clause 3.2

2 – IEEE Std 802.1Q™-2003 sub-clause 3.3



Definitions (cont.)

- CIST (layman's terms)
 - A single topology connecting all Bridges (STP, RSTP, MSTP) via one active topology. CIST differs from CST, because it includes the “logical...connectivity through MST Bridges and regions”.
- CST (layman's terms)
 - The topology connecting all STP/RSTP Bridges and MSTP regions.
 - In the context of CIST, MST Regions are treated as a single RSTP Bridge.



Definitions (cont.)

- 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."*¹
 - 64 distinct MST topologies (MSTIs) are calculated and maintained by MSTP, however, not all topologies are actively used to carry traffic, as the VLANs may not all be in use.

1 – IEEE Std 802.1Q™-2003 sub-clause 3.19



Definitions (cont.)

- MST Configuration Identifier

- A parameter used to determine if a set of Bridges belongs to a single region. Consists of several values:
 - Configuration ID Format Selector – value of “0” indicates use of following fields as defined in IEEE 802.1Q™-2003.
 - Configuration Name – *“A variable length test string endoded within a fixed field of 32 octets”¹*, used to identify a MST region with a human readable name.
 - Revision Level – unsigned number in 2 octet field
 - Configuration Digest – 16 field resulting from HMAC-MD5 encoding of the MSTI column of a MSTI to VID table. *“the MST Configuration Table is considered to contain 4096 consecutive two octet elements, where each element of the table (with the exception of the first and last) contains an MSTID value encoded as a binary number, with the first octet being most significant.”²*

1 – IEEE Std 802.1Q™-2003 sub-clause 13.7

2 – IEEE Std 802.1Q™-2003 sub-clause 13.7



Definitions (cont.)

- CIST Regional Root –
 - *"The one Bridge in each Region whose minimum cost path to the Root is not through another Bridge using the same MST Configuration Identifier..."*¹

1 – IEEE Std 802.1Q™-2003 sub-clause 3.19

Protocol Design Goals

- Produce a single spanning tree active topology for any given VLAN, ensuring that there is only one data path between any two end stations for frames associated to said VLAN.
- Provide fault tolerance by automatically reconfiguring topology after Bridge or data path failures.
- Achieve stable topology in minimal amount of time.
- Predictable/reproducible active topology that may be selected by management actions.
- Operate transparent to end stations.
- Minimal overhead used by Bridges to establish topology.
- Frames for different VLANs may follow different paths.
- Provide simple and full connectivity even in administrative errors of VLAN to spanning tree allocation.
- Minimal required memory requirements and device configuration.



Forming MST Regions

- Requirements for forming MST Regions to realize performance improvements:
 - Consistent means of associating VIDs to MSTIs.
 - Agreement on Config. Name and Revision Level.
 - Assessment of data distribution in network.
 - Performance goals regarding quality of service for communication sets within MST Region.
 - Assign parameter values to Bridges within MST Region to realize performance goals.



MSTP provides...

- MST Configuration Identifier
- CIST priority vector
- MSTI priority vector
- Distributed spanning tree algorithm (CIST/MSTI)
- CIST/MSTI Port Roles



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Pieces of the topology

- One Bridge selected as CIST Root of network.
- Minimum path cost to CIST Root calculated for all Bridges and LANs.
- CIST Regional Root
- MSTI Regional Root
- Minimum path cost to MSTI Regional Root calculated for all Bridges and LANs.



CIST Port Roles

- Root Port
 - “Provides the minimum cost path from the Bridge to the CIST Root (if the Bridge is not the CIST Root) through the Regional Root (if the Bridge is not a Regional Root).”¹
- Designated Port
 - “Provides the least cost path from the attached LAN through the Bridge to the CIST Root.”²
- Alternate or Backup Ports
 - “Provide connectivity if other Bridges, Bridge Ports, or LANs fail or are removed.”³



Things to note

- Paths within a region are always preferred to paths outside a region.



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Advantages

- Transparent operation with legacy STP and RSTP implementations.
- Eliminates the need for having a separate RSTP spanning tree for each VLAN.
 - Saves processing and memory consumption on the device.
 - Much easier control when a large number of VLANs are used.
- Built on the RSTP protocol.



Design

- The design of the multiple spanning tree protocol is based on RSTP and extended to allow for different VLANs to travel along separate “instances” of spanning tree while allowing compatibility with legacy STP devices.
- An MST Instance may have a different root bridge than the CIST.

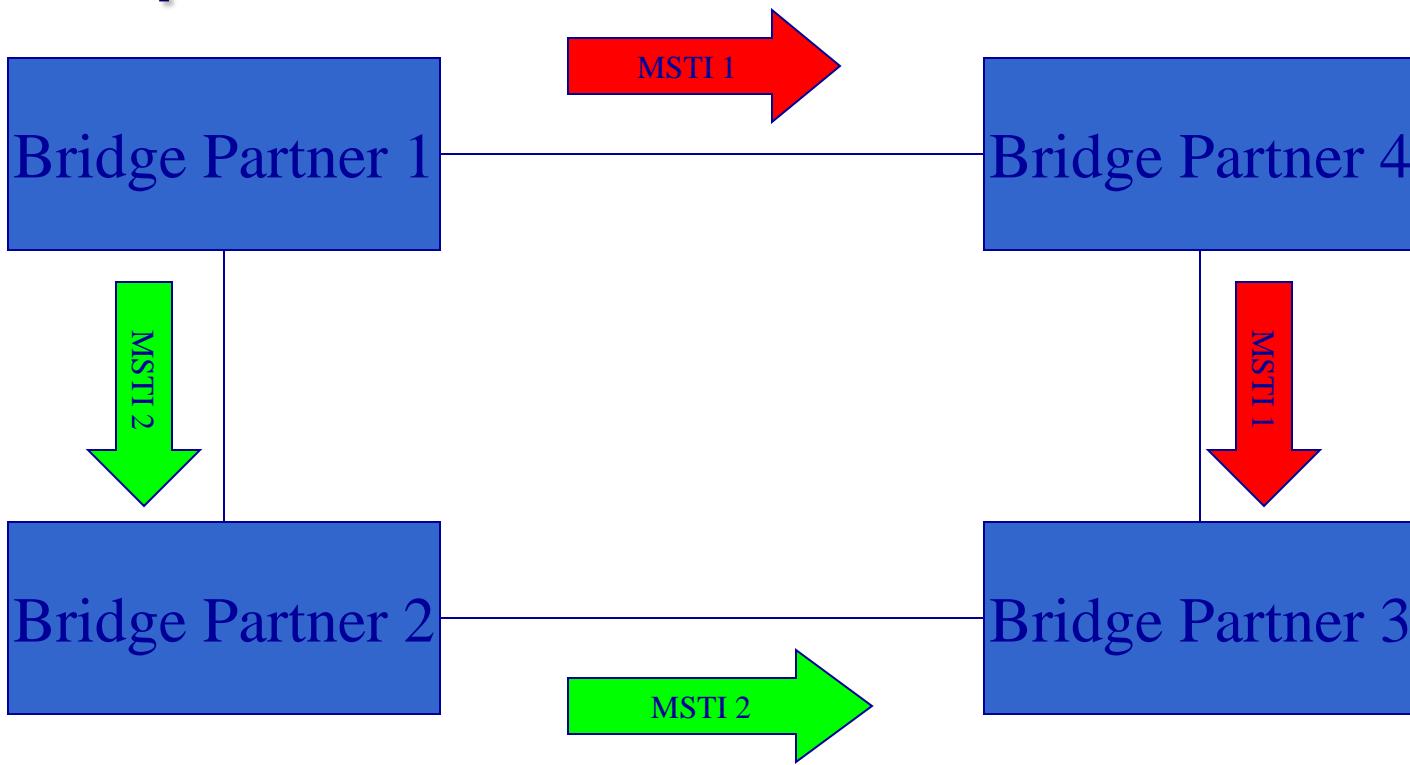


Design (cont.)

- Port priority and path cost are treated the same as classic STP but MSTP allows a port to have a different priority and path cost for the CIST and any MST instance.
 - Because of this and the fact that bridge priorities may be different depending on the instance, frames may travel a different paths in the active topology depending on what instance they are assigned to.



Example



In this example traffic moving from bridge partner (BP) 1 to bridge partner 3 travels in different paths depending on what MSTI it belongs to. In this case the port connecting BP 1 with BP 2 may have a lower priority than the port connecting BP1 with BP 4 for instance 2. For instance 1 the port with the better priority is connect to BP4 so traffic assigned to that instance will move through BP4 to get to BP3.

Questions

- 13.3 part d, #4: is this an exclusive statement
- 13.3 part e, #2: is this done for all MST Bridges in the LAN?



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