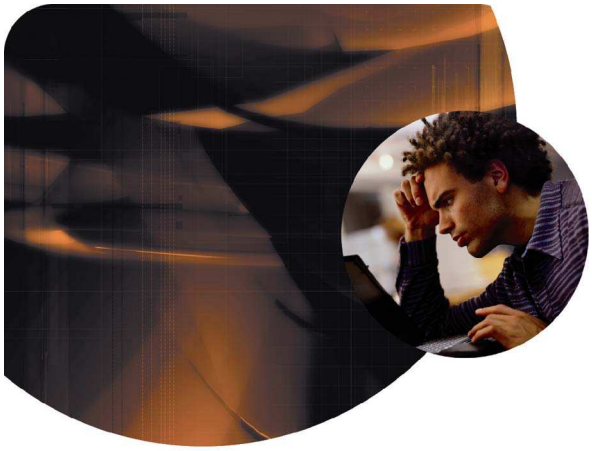

Agilent N2X

Spanning Tree Protocol (STP, RSTP & MSTP) Emulation Software

N5580A

Technical Data Sheet

The most comprehensive and scalable tool to verify the operation, performance, and scalability of spanning tree implementations; measure protocol reconvergence time during topology changes and determine the impact of link failures on QoS.

Agilent Technologies

Key Features

- **Control all emulation parameters and display protocol state**
- **Validate STP, RSTP, and MSTP interoperability**
- **Verify the Root Bridge Election process**
- **Measure convergence following Topology Change Notifications**
- **Test MST load balancing and failover**
- **Emulate thousands of bridges to characterize scalability**
- **Reduce test time using automated QuickTests**

Product Overview

Agilent N2X is the industry's most comprehensive test solution for testing the development and deployment of network services for converging network infrastructures. Service providers, network equipment manufacturers (NEMs), and component manufacturers can verify service attributes of entire networks end-to-end, while also isolating problems down to individual networking devices and subsystems. Agilent N2X delivers unparalleled test realism to verify the ultimate performance, scalability and resilience of carrier grade services and infrastructure.

The N5580A N2X Spanning Tree Protocol Emulation Software offers the most comprehensive and scalable solution available for testing Spanning Tree protocols. These protocols are used to ensure loop-free layer-2 frame forwarding within Ethernet networks. N2X emulates carrier-scale topologies using the Spanning Tree Protocol (STP), Rapid Spanning Tree Protocol (RSTP), and Multiple Spanning Tree Protocol (MSTP), enabling the user to test legacy and next-generation switching devices with VLANs.

By emulating one or more of the Spanning Tree protocols, N2X can simulate complex LAN topologies and verify interoperability between protocol versions. N2X can also generate realistic traffic at the same time, to accurately verify the functionality and performance of Spanning Tree implementations.

Today's Ethernet devices introduce QoS mechanisms for prioritizing real-time voice, video, and data traffic. Reconvergence of the Spanning Tree protocols following topology changes can adversely impact fairness and QoS – especially during oversubscribed network conditions. N2X enables thorough verification of traffic forwarding engines and QoS mechanisms while simulating Spanning Tree disruptions to validate device and network behavior.

Product Features

Control all emulation parameters and display protocol state

The N5580A software provides a comprehensive, stateful emulation of the Spanning Tree protocols to validate Ethernet devices under realistic, simulated traffic conditions in a wide range of scenarios. STP, RSTP, and MSTP configuration and emulation parameters (such as bridge identifiers, port priorities, and message age times) are under full user control. For example, path costs to the emulated root can be modified interactively, to trigger spanning tree recalculation, while continuing to generate traffic, Test Engineers can interactively change the configuration (such as bridge port MAC addresses), while the test is running, to determine the dynamic behavior of the System Under Test.

Spanning Tree emulation states and statistics are displayed in real time. System Under Test (SUT) behavior can be measured during testing, thereby accelerating detection of faults and isolation of performance problems. For example, the status of the SUT interfaces can be filtered for a specific state (such as learning or discarding), during the test, to resolve interoperability problems.

Validate STP, RSTP, and MSTP interoperability

In carrier networks, STP, RSTP, and MSTP may co-exist. N2X emulates STP, RSTP, and MSTP at the same time, enabling testing between protocols. By emulating STP on one or more N2X interfaces and RSTP or MSTP on other interfaces, the SUT is forced to interoperate between the two layer-2 protocols and create a single spanning tree. This enables verification of the lowest common denominator operation of STP and RSTP or MSTP.

In real networks, Ethernet devices from multiple vendors are often interconnected. Although the Spanning Tree Protocols are documented in IEEE standards, it is possible that different manufacturers have interpreted the standards slightly differently. Also, the IEEE documents do not specify implementation mechanisms, thereby allowing vendors to differentiate their products. Both of these variables can lead to interoperability problems that may only manifest under specific configurations or scenarios. Because N2X emulates real Ethernet bridges using the Spanning Tree Protocols, testing against N2X increases confidence that network devices will interoperate with equipment from different vendors.

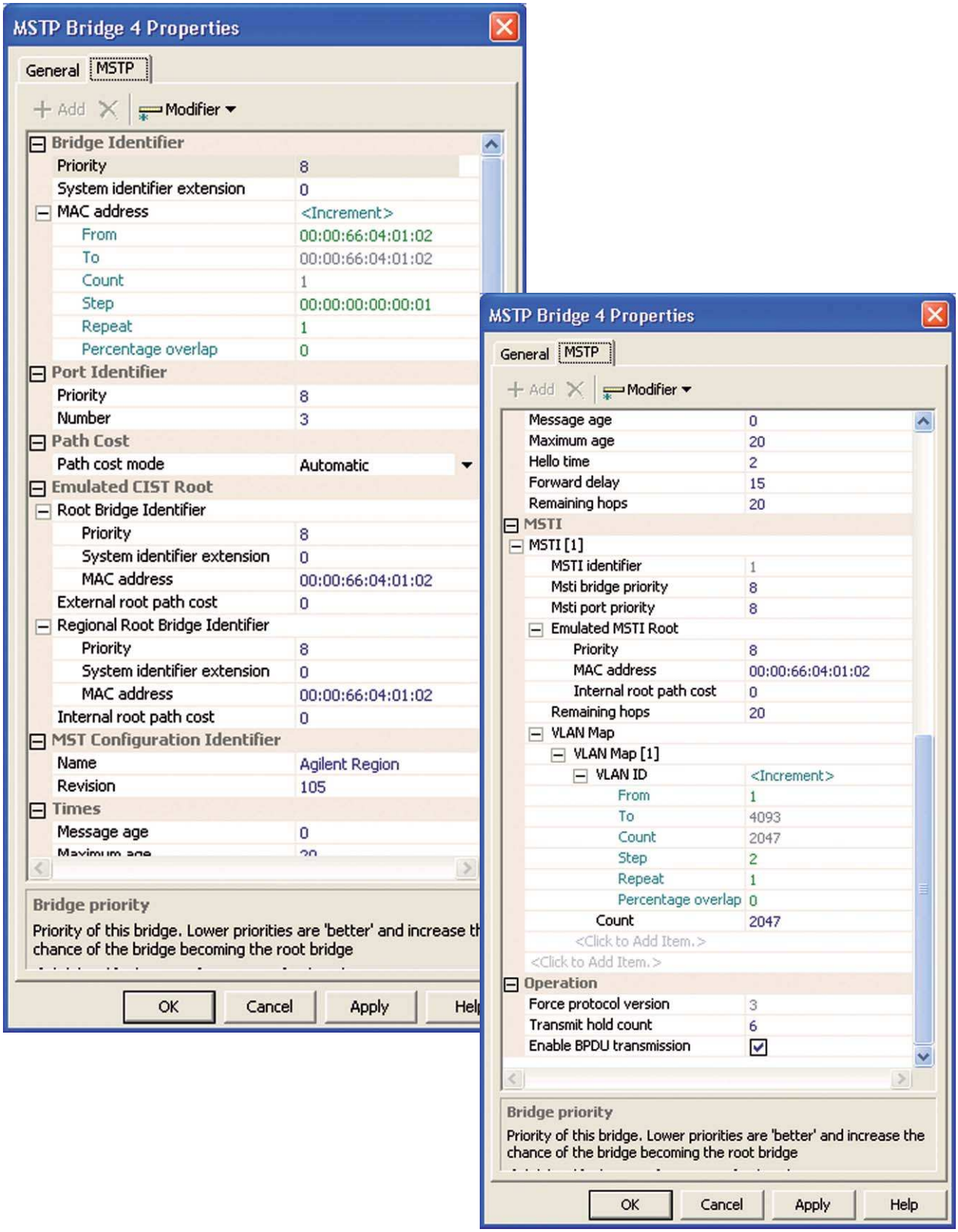

Figure 1: STP, RSTP and MSTP emulations offer full parameter control

Verify the Root Bridge Election process

Root Bridge Election ensures that a single Ethernet device will be quickly elected to the role as root of the spanning tree. Where Multiple Spanning Tree Protocol is used, there may be a different root bridge for each Multiple Spanning Tree Instance (MSTI).

N2X fully emulates the root bridge election process for STP, RSTP, and MSTP protocols. For each emulated bridge, a user can set bridge port MAC addresses and priorities to influence the election process. Almost any conceivable test scenario can be configured. N2X reports the elected root bridge identifier, the elected root path cost, neighbor bridge and neighbor port identifiers, port roles, timer values, and many other statistics.

More complex topologies involving MSTP and regional roots can be easily configured to verify regional root and region border operation.

Measure convergence following Topology Change Notifications

Following a link failure, Ethernet devices must recalculate and reconverge on a new Spanning Tree topology. N2X can characterize the impact of reconvergence on subscriber traffic by measuring failover time and packet loss. STP, RSTP, and MSTP BPDUs and simulated traffic can be captured, decoded, and analyzed to detect and isolate faults and to aid performance tuning.

Failover tests are easily scaled up, using multiple test interfaces, multiple emulated devices, multiple STP/RSTP/MSTP emulations per interface, and multiple MSTIs, to gauge recovery performance under worst-case load conditions and measure the impact of faults on subscriber traffic.

When the network topology changes, Topology Change Notifications (TCNs) trigger Spanning Tree recalculation and reconvergence. N2X can simulate TCNs to enable automated verification of reconvergence times and measurement of packet loss. A user can also modify path costs to force a topology change and measure the time for the topology to re-stabilize.

Test MST load balancing and failover

The Multiple Spanning Tree Protocol (MSTP) is typically used to perform network load balancing. Multiple Spanning Tree Instances (MSTI) can be configured to have different topologies for different VLANs. This allows high-priority voice traffic on one set of VLAN's to take a different path compared to lower-priority data traffic on another set.

With N2X, up to 64 MSTIs can be configured for different ranges of VLANs so that traffic is balanced between N2X ports. The paths taken by traffic on each VLAN can be verified, and link failures can be initiated to verify MST reconvergence. Load balancing configurations can be simulated and modified to optimize QoS and make the best use of link bandwidths, providing a valuable tool for device optimization, network design, and network performance tuning.

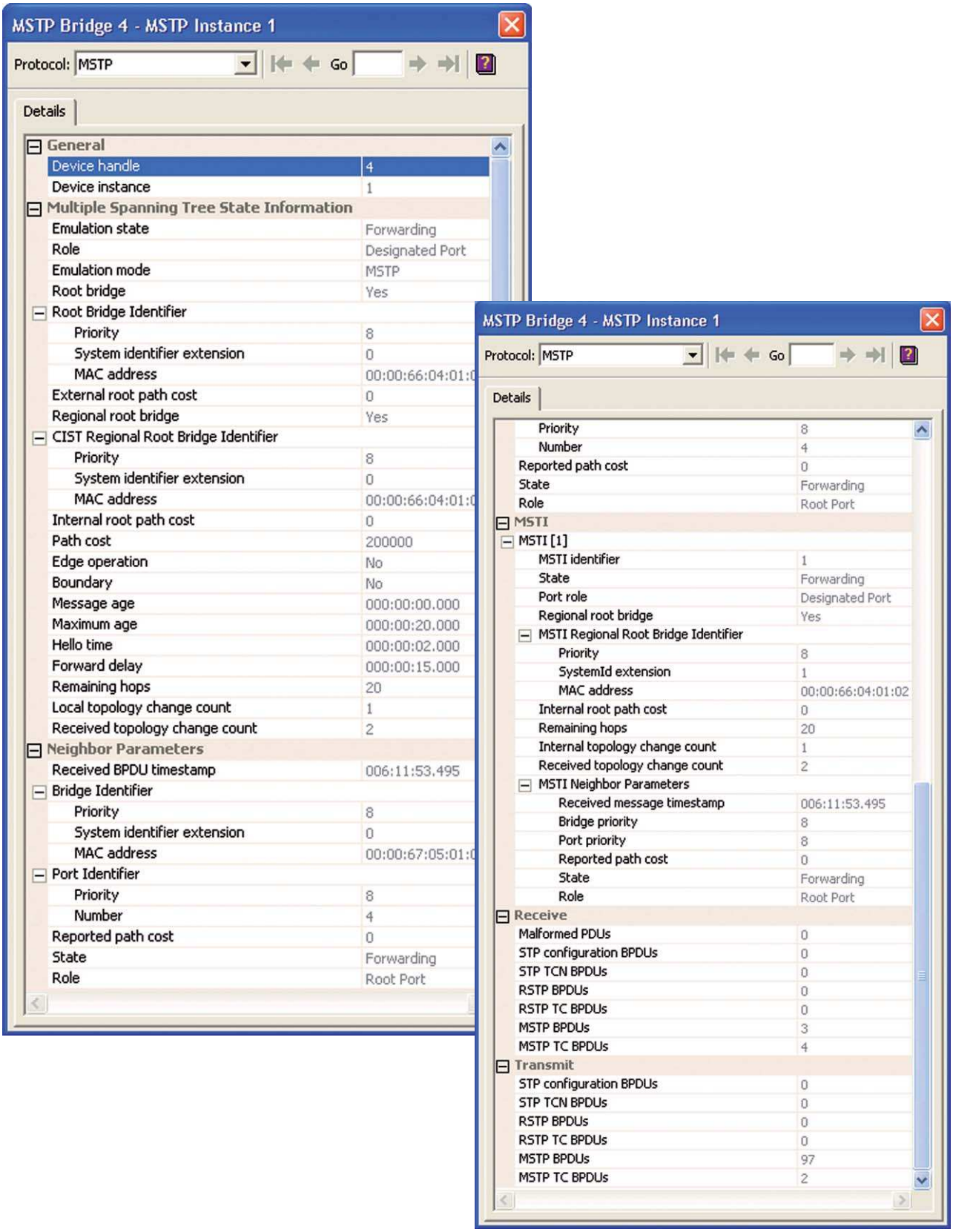

Figure 2: SUT port states and measurements can be displayed while the test is running.

Emulate thousands of bridges to characterize scalability

Ethernet device reliability must be tested under extreme load conditions. N2X can emulate up to many thousands of bridges running Spanning Tree protocols to verify device stability in large simulated networks with thousands of VLANs, under extreme traffic loads and large-scale topology changes.

To characterize MSTP scalability, N2X can be configured with a Common Internal Spanning Tree (CIST) and 64 MSTIs for each MSTP emulation. The full range of 4,094 VLAN IDs can be mapped arbitrarily across the 64 MSTIs, and multiple MSTP emulations can be configured on each test interface. Traffic can then be generated on each VLAN to verify the performance under load and the ultimate scalability of the device under test.

Failover tests are also easily scaled up, using multiple interfaces, multiple emulated devices, multiple STP/RSTP/MSTP emulations per interface and multiple MSTIs, to gauge recovery performance under worst-case conditions and measure the impact of faults on subscriber traffic.

By accurately emulating thousands of bridge devices, N2X replaces the need for large testbeds of costly network equipment for characterizing device performance.

Reduce test time using automated QuickTests

Agilent's QuickTest Script Library is a comprehensive set of tools and scripts that simplify and automate the testing of devices and networks using Agilent N2X test ports. The software runs on either Windows or UNIX client platforms.

The QuickTest library includes a wide range of predefined scripts that automate functional and performance testing across the full spectrum of bridge, router and network behavior. These automated tests have been developed to reflect the Test Plans published in the Journal of Internet Test Methodologies - http://advanced.comms.agilent.com/n2x/docs/journal/index.htm.

The N2X QuickTests include scripts that automate common (and generally complex) test scenarios for verifying the functionality and performance of the Spanning Tree protocols. These predefined tests harness many years of collective testing experience and thus benefit the test engineer by reducing the need for time-consuming test plan development, thereby accelerating the testing process.

Technical Specifications

Configuration Parameters

STP and RSTP

Bridge Identifier	• Bridge Priority • Bridge System Identifier Extension • Bridge MAC Address
Port Identifier	• Port Priority • Port Number
Path Cost Parameters	• Path Cost mode (Manual/Automatic) • Path Cost (Manual Path Cost mode)
Emulated Root Bridge Identifier	• Root Bridge Priority • Root Bridge System Identifier Extension • Root Bridge MAC Address
Emulated Root Path Cost	
Times	• Message Age (seconds) • Maximum Age (seconds) • Hello Time (seconds) • Forward Delay (seconds)
Operational Parameters	• Force Protocol Version • Transmit Hold Count • Enable/Disable BPDU transmission

MSTP

Bridge Identifier	• Bridge Priority • Bridge System Identifier Extension • Bridge MAC Address
Port Identifier	• Port Priority • Port Number
Path Cost Parameters	• Path Cost mode (Manual/Automatic) • Path Cost (Manual Path Cost mode)
Emulated Root Bridge Identifier	• Root Bridge Priority • Root Bridge System Identifier Extension • Root Bridge MAC Address
Emulated CIST Regional Root Bridge Identifier	• CIST Regional Root Bridge Priority • CIST Regional Root Bridge System Identifier Extension • CIST Regional Root Bridge MAC Address
Emulated Root Path Costs	• External Root Path Cost • Internal Root Path Cost
Times	• Message Age (seconds) • Maximum Age (seconds) • Hello Time (seconds) • Forward Delay (seconds)
Operational Parameters	• Force Protocol Version • Transmit Hold Count • Enable/Disable BPDU transmission
MST Configuration Identifier	• Name • Revision • Digest (automatically calculated from VLAN to MSTI mapping)
MSTI(1-64) Parameters	• MSTI Identifier • Bridge Priority • Port Priority • Regional Root Bridge Priority • Regional Root Bridge MAC Address • Internal Root Path Cost • Remaining Hops • VLAN Map (support for 4094 VLANs [1-4094])

Statistics

Receive	• Malformed BPDUs • STP configuration BPDUs • STP TCN BPDUs • RSTP BPDUs • RSTP BPDUs with TC flag set • MSTP BPDUs • MSTP BPDUs with TC flag set
Transmit	• STP configuration BPDUs • STP TCN BPDUs • RSTP BPDUs • RSTP BPDUs with TC flag set • MSTP BPDUs • MSTP BPDUs with TC flag set
Topology Changes	• Local topology change count • Received topology change count
Per-MSTI statistics (MSTP only)	• Local topology change count • Received topology change count

Emulation Status

STP/RSTP Emulation Status (per emulation instance)

Emulation State (Disabled, Learning, Forwarding, Discarding)

Port Role (Disabled, Root, Designated, Alternate, Backup)

Emulation Mode (STP, RSTP)

Root Bridge (Yes, No)

Root Bridge Identifier
- Root Bridge Priority
- Root Bridge System Identifier Extension
- Root Bridge MAC Address

Root Bridge System Identifier Extension

Root Bridge MAC Address

Root Path Cost

Path Cost

Edge Operation (Yes, No)

Times
- Message Age (milliseconds)
- Maximum Age (milliseconds)
- Hello Time (milliseconds)
- Forward Delay (milliseconds)

Neighbor Parameters
- Received BPDU timestamp (milliseconds)
- Bridge Priority
- Bridge System Identifier Extension
- Bridge MAC Address
- Port Priority
- Port Number
- Reported Path Cost
- RSTP Emulation State (Disabled, Learning, Forwarding, Discarding)
- RSTP Port Role (Disabled, Root, Designated, Alternate, Backup)
- Received Topology Change Count

MSTP Emulation Status (per emulation instance)

Emulation State (Disabled, Learning, Forwarding, Discarding)

Port Role (Disabled, Root, Designated, Alternate, Backup)

Emulation Mode (STP, RSTP, MSTP)

Root Bridge (Yes, No)

Root Bridge Identifier
- Root Bridge Priority
- Root Bridge System Identifier Extension
- Root Bridge MAC Address

CIST Regional Root Bridge (Yes, No)

CIST Regional Root Bridge Identifier
- CIST Regional Root Bridge Priority
- CIST Regional Root Bridge System Identifier Extension
- CIST Regional Root Bridge MAC Address

Root Path Costs
- External Root Path Cost
- Internal Root Path Cost

Times
- Message Age (milliseconds)
- Maximum Age (milliseconds)
- Hello Time (milliseconds)
- Forward Delay (milliseconds)

Path Cost

Edge Operation (Yes, No)

Boundary (Yes, No)

Neighbor Parameters
- Received BPDU timestamp (milliseconds)
- Bridge Priority
- Bridge System Identifier Extension
- Bridge MAC Address
- Port Priority
- Port Number
- Reported Path Cost
- Emulation State (Disabled, Learning, Forwarding, Discarding)
- Port Role (Disabled, Root, Designated, Alternate, Backup)

Per MSTI(1-64)
- Emulation State (Disabled, Learning, Forwarding, Discarding)
- Port Role (Disabled, Root, Designated, Alternate, Backup, Master)
- Regional Root Bridge (Yes, No)
- Regional Root Bridge Priority
- Regional Root Bridge System Identifier Extension
- Regional Root Bridge MAC Address
- Internal Root Path Cost
- Remaining Hops
- Local Topology Change Count
- Received Topology Change Count
- MSTI Neighbor Parameters
  - Received Message Timestamp (milliseconds)
  - Bridge Priority
  - Port Priority
  - Reported Path Cost
  - Emulation State (Disabled, Learning, Forwarding, Discarding)
  - Port Role (Disabled, Root, Designated, Alternate, Backup)

Applicable Standards

- IEEE 802.1D-1998 Spanning Tree Protocol
- IEEE 802.1D-2004 Rapid Spanning Tree Protocol
- IEEE 802.1Q-2005 Multiple Spanning Tree Protocol

Configuration and Ordering Details

To use the N5580A Spanning Tree Protocol (STP, RSTP & MSTP) Emulation software, the following Agilent N2X hardware and software are required.

Hardware

An N2X system is required with:

- System controller
- Chassis
- One or more Ethernet test cards

The N5580A Spanning Tree Protocol (STP, RSTP, & MSTP) Emulation software is supported on all N2X XR, XR-2, XS, and XS-2 Ethernet test cards.

The N5580A software is NOT supported on N2X XP or XP-2 test cards.

Software

Required software packages:

- E7881B Packets and Protocols Application Software

Optional software packages:

- N5712A STP Conformance Test Suite
- N5713A RSTP Conformance Test Suite
- N5714A MSTP Conformance Test Suite

Your local Agilent field engineer can provide more details on how to order and configure a test system.

Online Help

An extensive online help system provides complete descriptions and detailed usage instructions for every component of N2X. Dialog-level, context-sensitive help provides rapid access to the relevant sections of the online help.

Related Products

Agilent Network Tester

The Agilent Network Tester is a highly scalable and flexible solution for performance testing of Layer 4-7 devices. As a companion to N2X, the NetworkTester provides real-world, stateful application layer traffic generation over PPP sessions, enabling developers to verify the end-user experience and performance of applications running over a broadband network. It also supports 802.1x, IPsec and IPsecv6 access protocols.

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www.agilent.com/find/n2x

Agilent N2X

Agilent's N2X multi-service tester combines leading-edge services with carrier grade infrastructure testing and emulation. The N2X solution set allows network equipment manufacturers and service providers to more comprehensively test new services end-to-end, resulting in higher quality of service and lower network operating costs.

Warranty and Support

Hardware Warranty

All N2X hardware is warranted against defects in materials and workmanship for a period of 1 year from the date of shipment.

Software Warranty

All N2X software is warranted for a period of 90 days. The applications are warranted to execute and install properly from the media provided.
This warranty only covers physical defects in the media, whereby the media is replaced at no charge during the warranty period.

Software Updates

With the purchase of any new system controller, Agilent will provide 1 year of complimentary software updates. At the end of the first year, you can enroll into the Software and Support Agreement (SSA) contract for continuing software product enhancements.

Support

Technical support is available throughout the support life of the product. Support is available to verify that the equipment works properly, to help with product operation, and to provide basic measurement assistance for the use of the specified capabilities, at no extra cost, upon request.

Ordering Information

To order and configure the test system consult your local Agilent field engineer.

Sales, Service and Support

United States:
Agilent Technologies
Test and Measurement Call Center
P.O. Box 4026
Englewood, CO 80155-4026
1-800-452-4844

Canada:
Agilent Technologies Canada Inc.
2660 Matheson Blvd. E
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L4W 5M2
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