Agilent N2X Packets and Protocols

Testing Spanning Tree Protocol

Application Note

Test your device's Spanning Tree implementation with Agilent's multi-port Packets and Protocols Application.

The Spanning Tree Protocol (STP) was developed as a method of loop prevention on LANs, as defined in the IEEE 802.1d. Through the exchange of Bridge Protocol Data Units (BPDUs) sent between the switches, STP builds a loop-free network when redundant paths are present. The STP algorithm removes switching loops by "turning off" or blocking redundant links that are not part of the STP tree. When a primary link is broken (causing a network segment to become unreachable), STP re-converges the network to a stable topology by activating a standby link over which traffic can be forwarded.

The Rapid Spanning Tree Protocol (RSTP) was further developed by the IEEE as a loop prevention method for LANs with faster network convergence, and was released in 2001. RSTP retains all the benefits of STP whilst removing the limitation of a significant convergence time.

This application note explains how to use Agilent N2X to test and simulate both STP and RSTP topologies.

Agilent Technologies

Testing with Agilent N2X

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 incorporates the strength of the RouterTester 900 to deliver unparalleled test realism to verify the ultimate performance, scalability and resilience of carrier grade services and infrastructure.

The N2X Packets and Protocols application enables N2X to verify the traffic forwarding performance, protocol scalability and services delivering capabilities of switching and routing devices across the enterprise, metro/edge and core.

A powerful and flexible PDU builder makes it easy to build streams of Layer-2 Layer-7 Protocol Data Units (PDUs) containing multiple encapsulations and even proprietary formats. With the PDU builder, you can define a packet length distribution and common header type, and then edit any field, including the payload. You can also set a field modifier to vary a header field's values, creating a separate flow or measurable stream for each one. This tool reduces the time needed to generate multi-encapsulated traffic types thereby allowing you to get more out of your testing time.

Users can also generate and analyze more streams per port than any other tester available (up to 32,768 transmit and receive streams per port), making it easy to scale your tests beyond the maximum performance parameters of your network or device. Your test can include 256 test ports per system, with 15 traffic profiles and up to 1023 - 4095 stream groups per port, depending on the port type. In total, the Traffic Generation and Analysis application can generate and measure statistics on 32,768 streams per port, using either four separate measurements over 32,768 streams or twelve measurements over 4,096 streams.

Spanning Tree Protocol Test

The following scenarios describe how to use Agilent N2X to test your Layer-2 device's Spanning Tree or Rapid Spanning Tree implementation.

Test Scenario 1 - STP/RSTP in a System Under Test

N2X can be used to measure network recovery time by measuring traffic flow while introducing a failure into the network. This is demonstrated in figure 1.
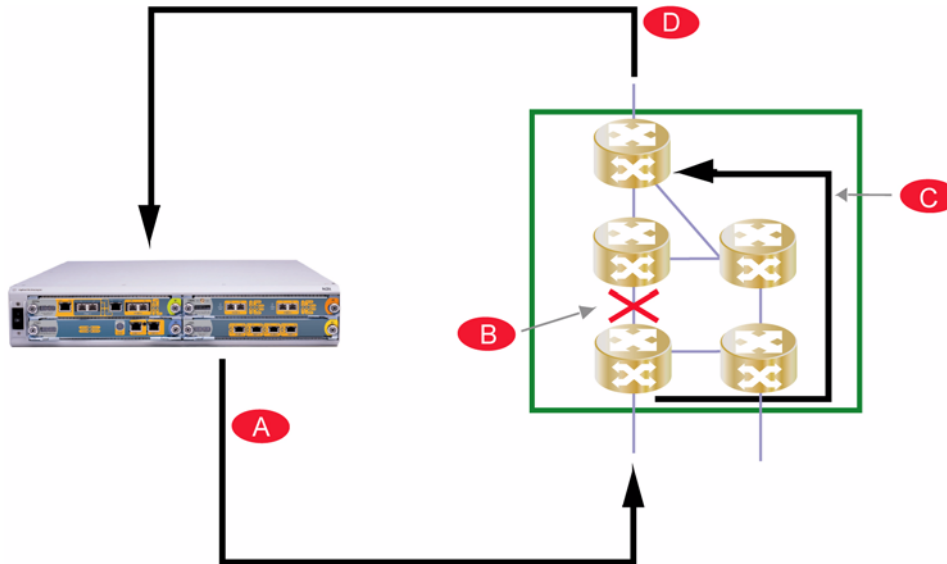

Figure 1: STP/ RSTP black-box test configuration

Test Summary

A. Load the System Under Test (SUT) by generating traffic using N2X.

B. Introduce a failure into the network (e.g. shutting down a link).

C. The STP/RSTP on the SUT should detect the failure and forward the traffic over an alternate link.

D. Measure packet loss and convergence time using N2X.

Test Scenario 2 - Simulate STP/RSTP Topology

N2X can be used to simulate an STP/RSTP topology by sending BPDU frames into a Device Under Test (DUT). Negative testing can also be performed via N2X by using the flexible PDU builder to send invalid BPDU frames.

Figure 2 demonstrates the steps performed in order to simulate an STP/RSTP topology and to measure the reconvergence time once a topology change has been introduced.
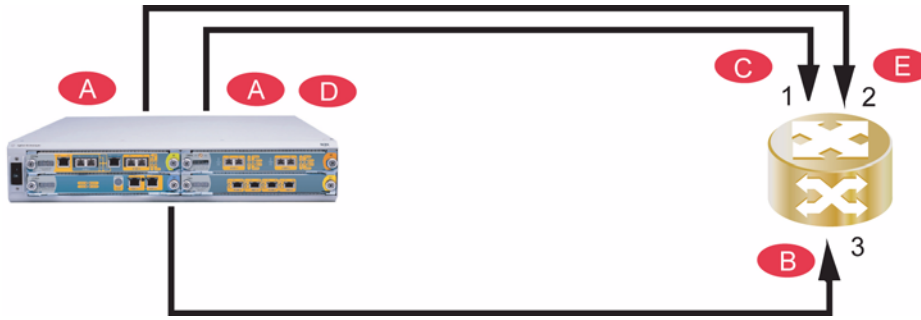

Figure 2: Configuration to test STP/RSTP directly with N2X

Test Summary

A. Generate BPDU frames to simulate the same topology behind ports 1 and 2 of N2X.

B. Send simulated traffic into the DUT.

C. Verify that the traffic is forwarded to the destination via the first port, and the redundant link (port 2) is blocked.

D. Simulate a topology change (e.g. by transmitting a BPDU with a different cost, or by stopping the sending of BPDUs on the primary link).

E. Measure the interval between the topology change and traffic arrival on port 2. This will determine the network convergence time.

BPDU Setup

The BPDU frames required to simulate the STP/RSTP topology can be easily created using the flexible PDU builder on N2X. The PDU builder hosts a collection of PDU definitions, while the intuitive GUI makes it easy to edit/error protocol fields.

Step 1: Select test modules and ports.

Configure three Ethernet test ports; two of these ports will be transmitting BPDUs, while the third port will be used for traffic.

Step 2: Specify the PDU.

Create a new Ethernet 802.3 SAP PDU. Add a SPT/RSPT BPDU.

Step 3: Set the MAC addresses.

BPDUs use a destination MAC address of 01:80:C2:00:00:00.

Step 4: Set the LLC values.

Set the DSAP and SSAP to both use 0x42.

Step 5: Configure the BPDU parameters.

All BPDU fields can be modified. Be aware that the timer values are specified in 1/256 seconds. For RSTP, the Flag field can be modified.
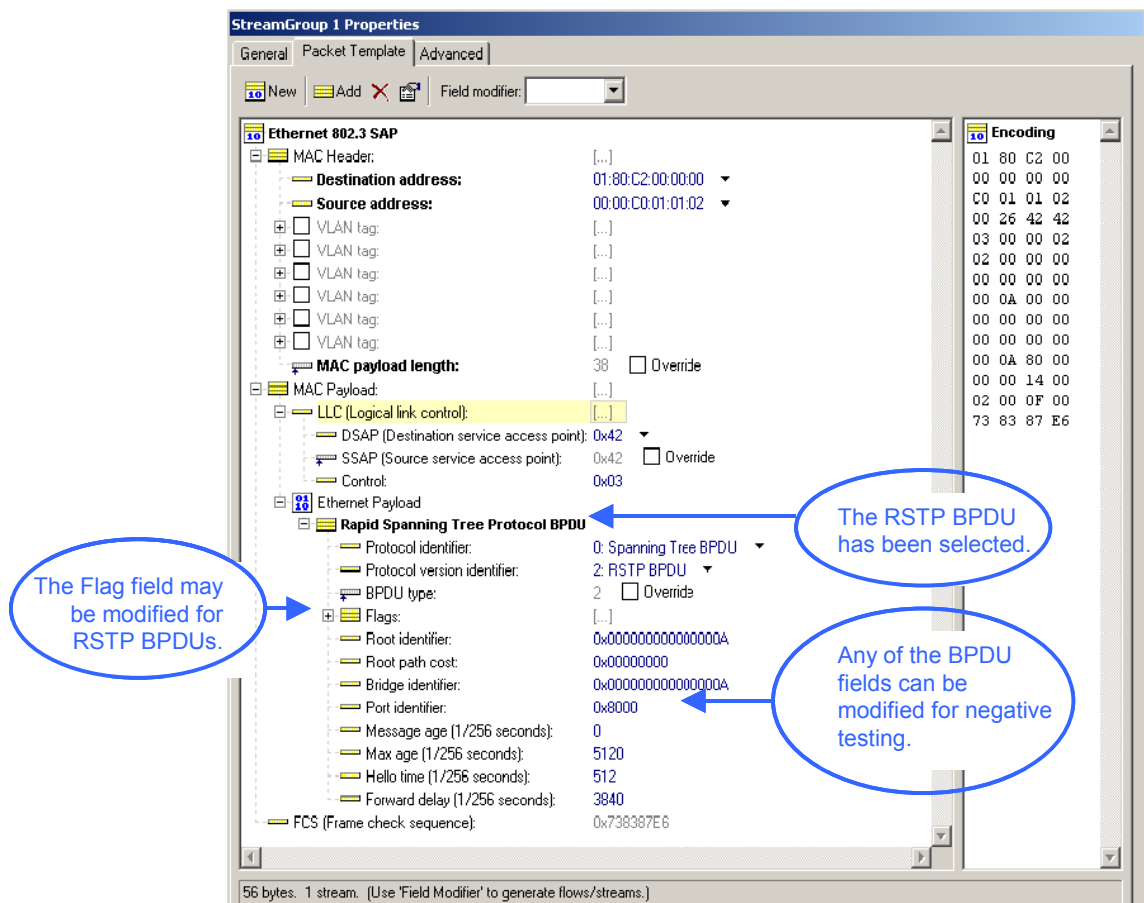
Figure 3: STP/RSTP BPDU defined with N2X PDU builder

StpConvergenceTime QuickTest

STP/RSTP testing has been made simpler with N2X. Through the use of the new QuickTest script, N2X can be configured to simulate a bridged network and provide automated measurements of STP convergence time. This is demonstrated in figure 4.
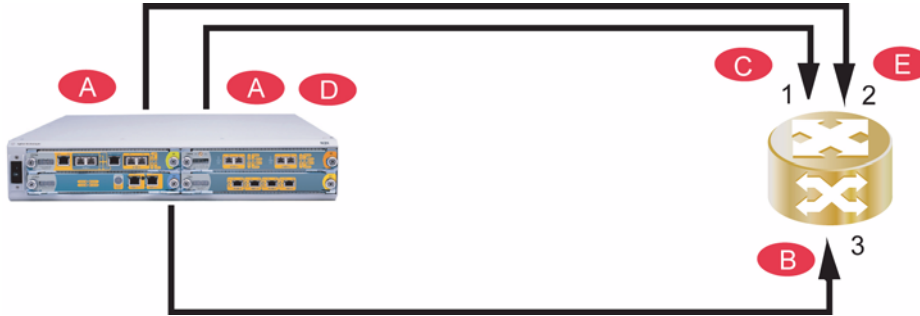

Figure 4: Configuration automated in the StpConvergenceTime QuickTest

Test Summary

A. Using the QuickTest, send BPDUs from the tester into the DUT to simulate a topology.

B. Send traffic into the DUT.

C. Verify that the traffic is forwarded to the first destination test port and blocked on the redundant link.

D. Simulate a topology change by stopping transmission of BPDUs on the primary link

E. Measure the convergence time for the traffic to arrive at the second destination test port.
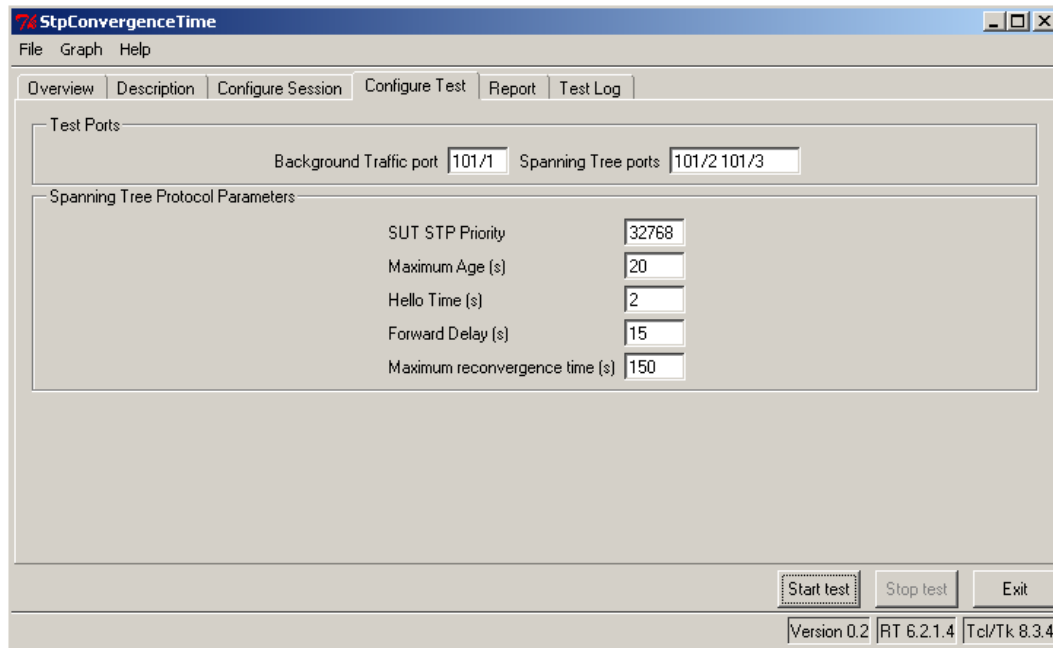
Figure 5: StpConvergenceTime QuickTest on N2X

Conclusion

Agilent's N2X solution offers a powerful and versatile test platform to address the evolving test needs of enterprise networks and devices. It's flexible PDU builder and StpConvergenceTime QuickTest enables you to verify the reliability and robustness of enterprise networks that use the Spanning Tree Protocols by measuring the downtime and impact on services during switch failure and recovery.

Agilent's N2X assists enterprise equipment manufacturers and enterprise network operators to speed the development and deployment of Ethernet switches and routers.

www.agilent.com/comms/N2X

Agilent Technologies