Agilent N2X Packets and Protocols

Measuring Network Convergence

Application Note

Test your network's re-convergence time with Agilent's multi-port Packets and Protocols Application.

A variety of network resiliency mechanisms are available to ensure that today's networks are highly reliable. These technologies have been developed to enable protection of links and nodes through fast and automatic switching in the event of failures on primary paths. Resiliency technologies minimize traffic loss and expedite recovery time during network failure.

Agilent N2X simplifies the testing of resiliencies technologies including Automatic Protection Switching, (APS), Spanning and Rapid Spanning Tree Protocols (STP/RSTP), Virtual Router Redundancy Protocol (VRRP) and Fast Re-Route (FRR).

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SONET/SDH Automatic Protection Switching (APS) is a layer-1 mechanism for protection of links against fiber cuts and other physical-layer failures. In this mechanism, traffic is routed around failures through the use of redundant fibers and line switching. N2X can be used to measure APS recovery times, as well as to set SONET/SDH K1and K2 overhead bits to signal failover and restoration in APS.

The IEEE's **Spanning Tree Protocol (STP)** and its faster performing **Rapid Spanning Tree Protocol (RSTP)** are mechanisms used to detect failures in links between layer-2 switches. Through the exchange of Bridge Protocol Data Units (BPDUs), STP builds a loop-free network when redundant paths are present. N2X can be used to test and simulate STP and RSTP.

Unlike APS and STP, the **Virtual Router Redundancy Protocol (VRRP)** provides a resiliency mechanism at the IP layer. This IETF standard makes a group of routers appear as a single router. If one router in the group fails, another will take over as the primary router. This protocol eliminates the single point of failure that is typically present when using static default routes. N2X supports the transmission of VRRP packets to simulate a VRRP topology.

Similar to APS, **Fast Re-Route (FRR)** uses MPLS traffic engineering to avoid traffic disruption and packet loss. FRR pre-determines a backup Label Switch Path (LSP) before a network failure or congestion occurs. The N2X MPLS protocol emulation can also be used to simulate a FRR fail-over.

This application note details how to use Agilent N2X to measure the operation of any of the reliability mechanisms listed above.

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.

Network Convergence Time Test

The following test summary describes how to measure network reconvergence time.

As shown in Figure 1 below, a source test port sends traffic into a system of switches and/or routers. A failure is introduced into the network that should cause the high-availability protocol to forward traffic over a redundant link or path. The destination test port will then measure the network re-convergence time and frame/packet loss.

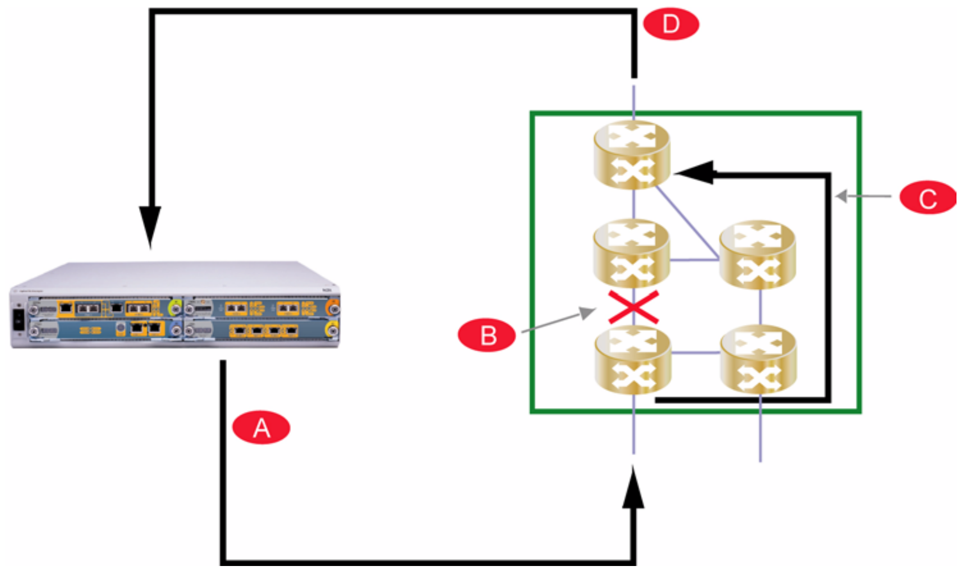

Figure 1: Network convergence test configuration

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 chosen protocol should detect the failure and forward the traffic over an alternate link.

D. Measure frame/packet loss and convergence time using N2X.

Test Details

The user creates a traffic stream from the source tester port with the test payload inserted into the frames generated. The N2X test payload defines 20 bytes of the frame to contain instrumented test information such as a timestamp with **20ns resolution** and a sequence number.

At the destination test port, packet loss will be monitored through the use of the Sequence Error statistic. As soon as a Sequence Error (i.e. dropped packet) is detected, the capture system will automatically trigger a capture so that the detailed timestamps can be examined. The packet that caused the Sequence Error (i.e. the first packet received after the network re-convergence) and the last valid packet will be examined. To determine the network re-convergence time, the delta between the received timestamps will be calculated. The delta between the sequence errors will be used to determine frame/packet loss.

N2X provides a new QuickTest to automate the above measurement procedure. Through the use of the PostFaultConvergenceTime test, repeated measurements can be made. Network re-convergence results of a single packet loss and nanosecond re-convergence time can be measured accurately.

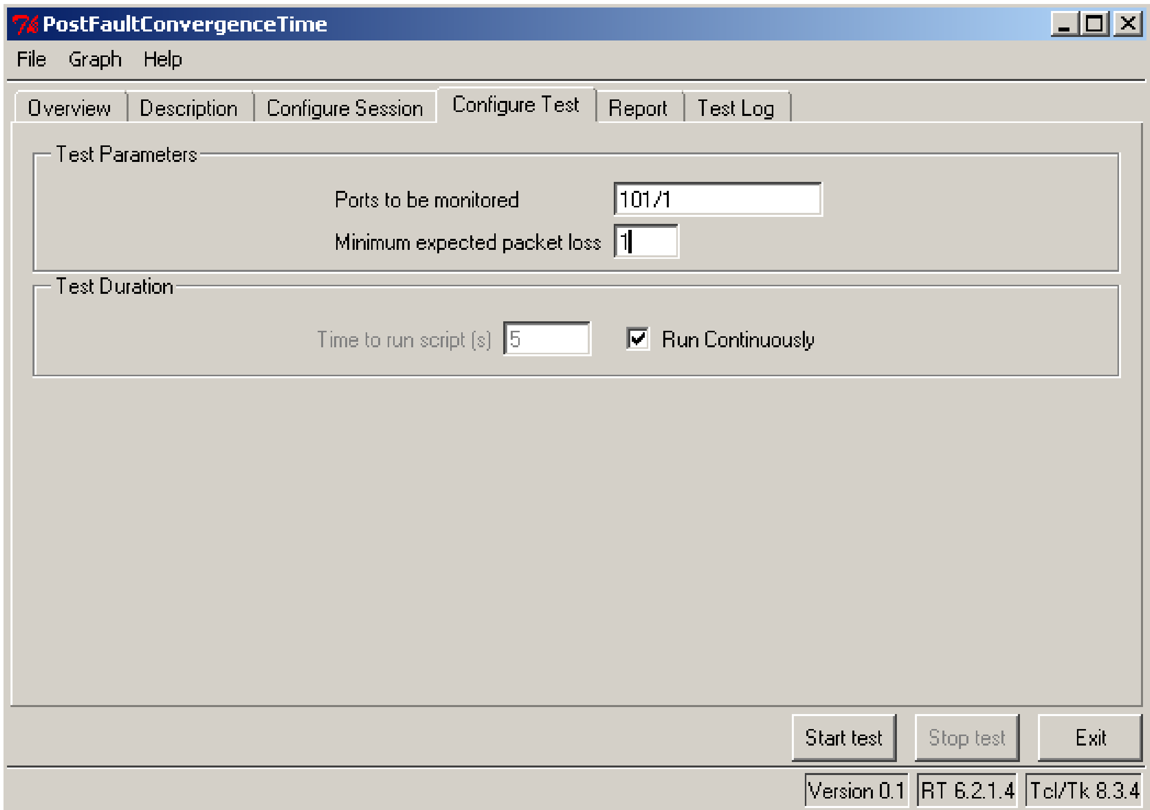

Figure 2: PostFaultConvergenceTime QuickTest on N2X

Conclusion

As highlighted in this application note, there are a variety of network resiliency mechanisms that are available to ensure that today's networks are highly reliable. These technologies have been developed to enable protection of links and nodes through fast and automatic switching in the event of failures on primary paths.

Using Agilent's N2X solution, users can simply and effectively test Network Convergence time.

Agilent's N2X solution set addresses the evolving test needs of enterprise, metro/edge and core routing and switching devices, with simple testing procedures for resiliency technologies, including Automatic Protection Switching, (APS), Spanning and Rapid Spanning Tree Protocol (STP/RSTP), Virtual Router Redundancy Protocol (VRRP) and Fast Re-Route (FRR).

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June 21, 2004
5989-0819EN, Rev B

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