Agilent N2X

Bidirectional Forwarding Detection (BFD) Protocol Emulation Software

N5583A

Technical Data Sheet

The most comprehensive and scalable tool to verify the operation, performance and scalability of Bidirectional Forwarding Detection (BFD) protocol implementations; measure detection and recovery time and QoS during link failures; ensure the high availability of IP/MPLS devices and networks.

Agilent Technologies

Key Features

- **Emulate thousands of BFD sessions to characterize scalability**
- **Up to 20ms detect times and 10ms transmit/receive intervals on XS-2 cards**
- **Fully integrated – works with Graceful Restart and MPLS Fast Reroute**
- **Quantify recovery time from BFD session-down**
- **Test interoperability using non-standard BFD control packets**
- **Supports all test interfaces – Ethernet, POS, ATM, FR**
- **Verify three-way handshake, Echo initiator and responder, Poll sequence, and multihop paths**

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 N5583A N2X Bidirectional Forwarding Detection (BFD) Protocol Emulation Software offers the most comprehensive and scalable solution available for testing Bidirectional Forwarding Detection, which is a protocol used to rapidly detect faults between two forwarding engines, enabling faster recovery from faults and increased network availability. N2X accurately emulates BFD including the three-way handshake, Echo initiator and Echo responder, Poll sequence, and multihop paths over all interface types – enabling you to comprehensively verify BFD implementations.

In a carrier network, one BFD instance typically exists for each OSPF and IS-IS adjacency and BGP-4 routing peer. In MPLS networks, LSR neighbors may establish a separate BFD session for each of multiple established LSP tunnels. It is not practical to test BFD scalability using real network equipment. N2X allows users to configure thousands of BFD emulations quickly and cost-effectively, with multiple sessions per adjacency, to verify ultimate capacity and stability of a device under real network conditions.

Mechanisms such as Graceful Restart and MPLS Fast Reroute help ensure rapid recovery from faults. BFD works in tandem with routing and MPLS protocols by accelerating the detection of faults. The N2X BFD emulation is fully integrated into the Packets and Protocols application, enabling testing of BFD together with routing and signaling protocols such as OSPF, IS-IS, BGP-4, RSVP-TE, and LDP. This integration permits testing of multi-protocol Graceful Restart and MPLS Fast Reroute simultaneously, with hundreds of thousands of BFD sessions running between real and emulated network peers, to ensure network reliability under extreme conditions.

Service providers typically deploy equipment from a mix of different vendors. This makes it critical to verify that BFD-enabled devices from different vendors interoperate. In addition, network equipment may fail when receiving non-standard or errored BFD control packets. Using the N2X XML-based PDU builder and traffic generator, you can send customized BFD control packets with incorrectly formatted fields to the device under test, to ensure network stability and performance under adverse or abnormal conditions.

Product Features

Emulate thousands of BFD sessions to characterize scalability

Today's carrier networks contain thousands of devices running multiple routing and signalling protocols over thousands of physical links and MPLS tunnels, many of which will use BFD to detect failure. If there are problems with a BFD implementation, they are most likely to show up under extreme conditions, when network devices are fully stressed with data plane and control plane loads. It is only possible to reproduce these conditions realistically using a sophisticated test tool.

Using N2X, many hundreds or thousands of BFD sessions can be created and managed easily. The second-generation emulation model and graphical user interface are designed to make the management of large numbers of emulations intuitive for a user by summarizing the key operational states. Problems in scaled scenarios can be quickly identified, and detailed information can be easily obtained to diagnose the root cause of almost any problem. The BFD emulation has the flexibility to simulate multiple sessions per peer in Multi-hop mode to test realistic topologies.

BFD state information, real-time BFD measurements, and post-capture analysis of decoded BFD protocol messages lead to rapid time to insight.

Up to 20ms detect times and 10ms transmit/receive intervals on XS-2 cards

With support for up to 64 ports of 10/100 Ethernet or 8 ports of OC-48c POS in 2U of rack space, the Agilent N2X chassis provides a dense port arrangement.

The N2X chassis will scale to provide hundreds of ports of connectivity to your system under test (SUT), providing a powerful large-scale test solution.

Transmit/receive interval times for other N2X test cards are available in the technical specifications section of this document.

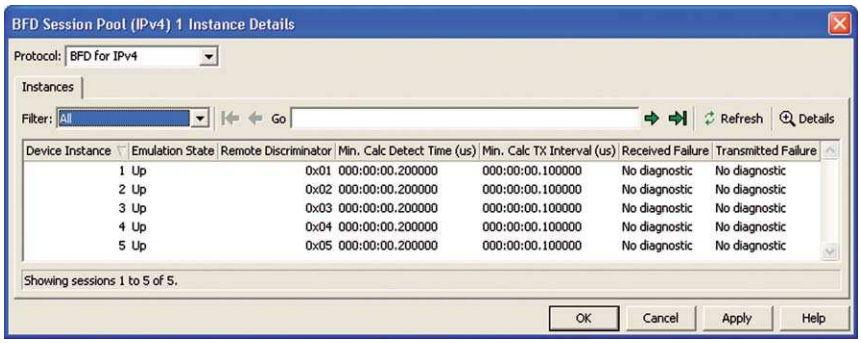

Figure 1: Emulate thousands of BFD sessions and multiple sessions per peer to characterize scalability and verify session demultiplexing

Fully integrated – works with Graceful Restart and MPLS Fast Reroute

To ensure rapid fault recovery in carrier networks, BFD is used in conjunction with different High Availability mechanisms including

- Routing protocol Graceful Restart (BGP-4, OSPF and IS-IS)
- MPLS (RSVP) protocol Graceful Restart
- MPLS (RSVP) Fast Reroute

Verification of these mechanisms – and measurement of downtime – require simultaneous emulation of BFD, routing, MPLS, and potentially other protocols.

The N2X BFD emulation operates in IPv4 and IPv6 modes alongside all existing N2X protocols. BFD can be used to simulate a forwarding-plane failure, which can be used to trigger an IP re-route or a graceful restart. BFD can also be used in MPLS Fast Reroute scenarios to trigger the reroute. This enables comprehensive verification of multiple network fault recovery mechanisms at the same time.

Quantify recovery time from BFD session-down

BFD provides a mechanism to accelerate detection of network faults and thereby accelerate recovery times and reduce outages. Accurate measurement of network recovery requires accurate timestamping of BFD Down events. The accuracy of traditional software-based measurement techniques, as used by many legacy and home-grown test tools, is insufficient and can actually become worse when the test equipment is stressed – such as during a high-scale test scenario.

The N2X BFD emulation provides hardware-synchronised timestamps to accurately measure the BFD Down and BFD Up event times. This enables reroute or restart scenarios to be precisely tested to comprehensively verify network equipment.

Test interoperability using non-standard BFD control packets

The N2X flexible PDU builder can be used to create non-standard BFD control packets. These packets can then be injected into a device or network to test the resiliency of a BFD implementation in the presence of malformed packets containing undefined or abnormal payload or header field values.

N2X can also send unexpected BFD control packets to test a device's protocol state machine. Packets can be sent to the device when the device is not expecting them to ensure correct state machine behaviour and to verify device robustness.

Supports all test interfaces – Ethernet, POS, ATM, and Frame Relay

N2X emulates BFD fully for both IPv4 and IPv6 protocol stacks on all Ethernet, POS, ATM, and Frame Relay routing interfaces. Support for stacked VLANs is also provided. This allows a device to be comprehensively tested easily in complex configurations involving multiple interface types and sub-interfaces.

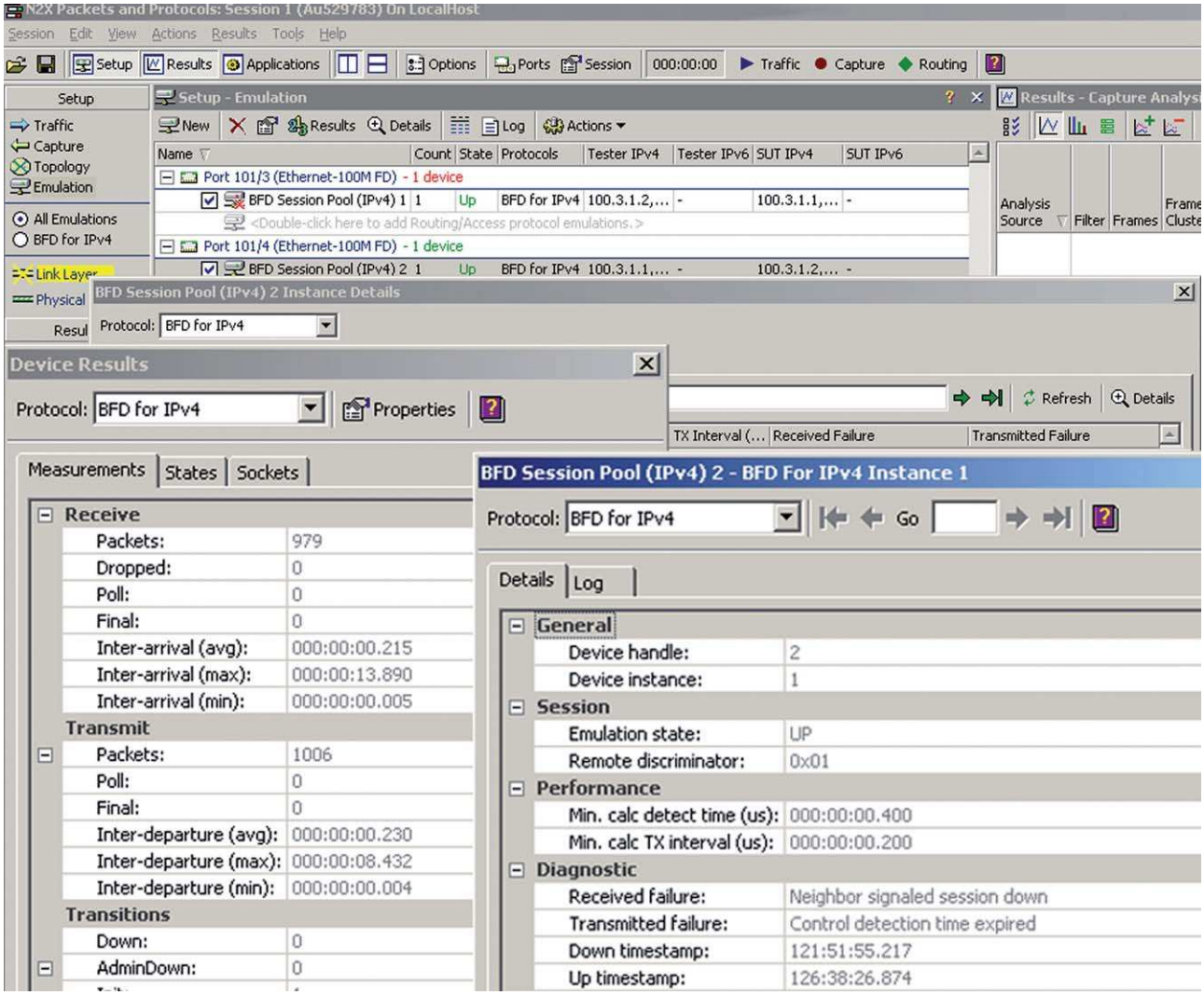

Figure 2: BFD emulation is fully integrated, enabling testing of Graceful Restart and MPLS Fast Reroute

Verify three-way handshake, Echo initiator and responder, Poll sequence, and multihop paths

N2X accurately emulates the BFD protocol including the BFD three way handshake, the Echo initiator and Echo responder, initiation of Poll sequences, and both Single and Multihop modes. This enables comprehensive verification of a device's BFD protocol implementation, and accurately supports more complex test scenarios involving multiple devices, multiple protocols, and simulated traffic.

Emulate BFD with full parameter control and state display

The N5583A software provides a comprehensive, stateful emulation of the Bidirectional Forwarding Protocol to validate network devices under realistic, simulated traffic conditions under a wide range of scenarios. BFD emulation parameters (such as Discriminator, Echo initiator and Echo responder, and C-bit) are fully configurable. A port's BFD state can be changed from BFD Up to BFD Down interactively, while continuing to generate traffic, to trigger routing convergence or MPLS fast reroute.

BFD emulation states and statistics are displayed in real time. System behaviour can be measured during testing, aiding rapid detection of faults and isolation of performance problems. For example, the status of the SUT interfaces can be filtered for a specific session state (BFD Up or BFD Down) and detection times can be displayed during the test to resolve interoperability problems.

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 router and network behavior. These automated tests have been developed to reflect the Test Plans published in the Journal of Internet Test Methodologies.

The N2X QuickTests include scripts that automate key test scenarios for verifying the functionality and performance of the Bidirectional Forwarding Detection protocol.

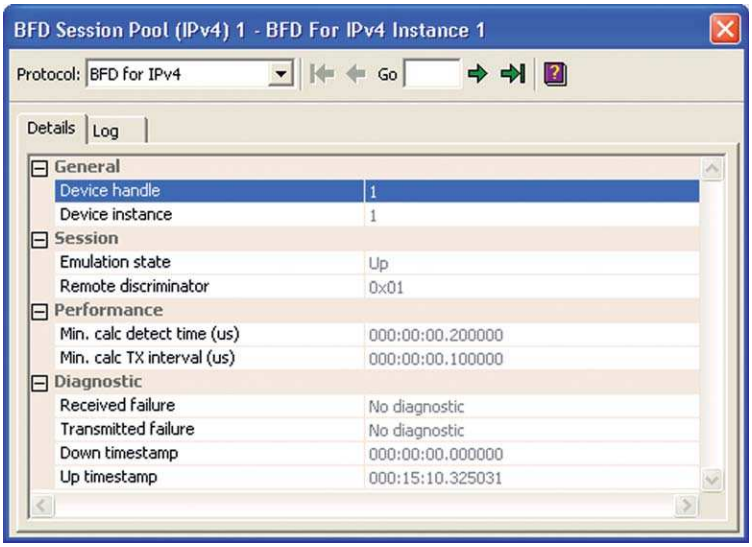

Figure 3: BFD states, detection performance and statistics can be displayed while the test is running

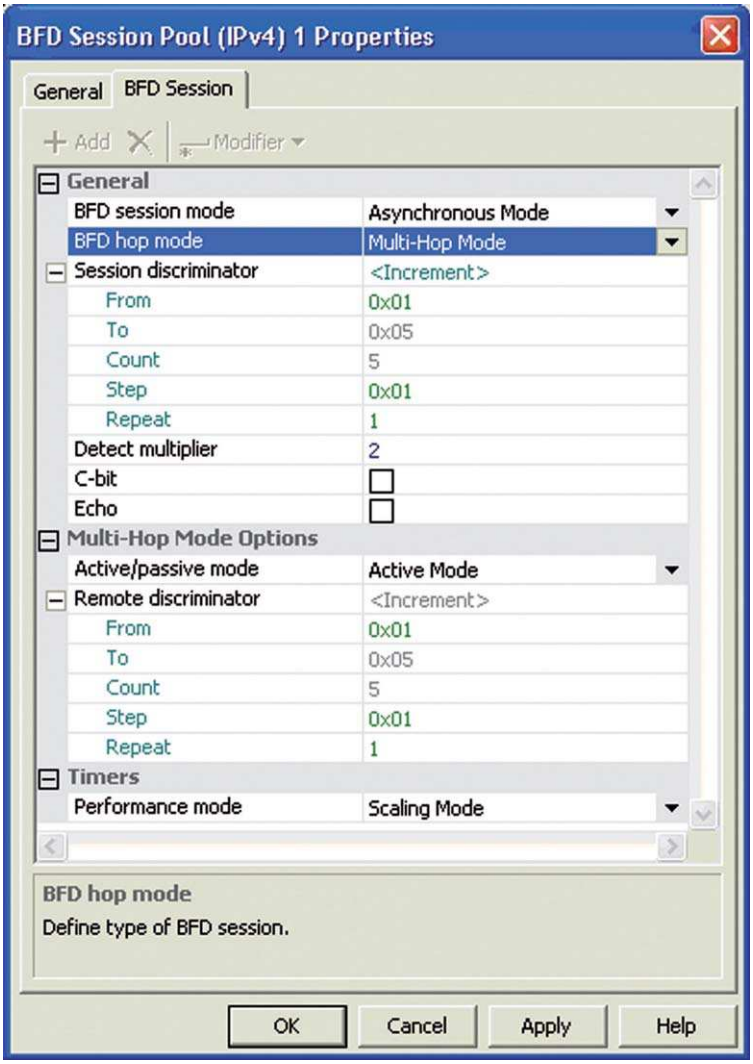

Figure 4: Comprehensively control BFD parameters including Discriminators, Echo, C-bit and timers

Technical Specifications.

Asynchronous Single-Hop and Multi-Hop support for both IPv4 and IPv6. POS, ATM, Frame Relay and Ethernet (with Stacked VLANs) support.

Configuration Parameters

Session Discriminator

Multi-Hop mode options
- Remote Discriminator
- Active or Passive Mode

Detect Multiplier

Control Plane Independent flag

Timer modes
- Scaling - Optimizes the timer values to achieve the maximum number of sessions
- Small Interval - Optimizes the timers to the smallest supported intervals
- Manual - Allows the timer values to be manually specified
  - Desired Minimum Transmit Interval (microseconds)
  - Desired Minimum Receive Interval (microseconds)

Echo mode
- Responder-min RX Echo interval
- Initiator-Global IP address
- Initiator-maximum round-trip-time
- Initiator-Desired min TX Echo interval

Statistics

Receive
- Packets
- Dropped
- Poll
- Final
- Minimum, Average, Maximum Inter-arrival time (microseconds)

Transmit
- Packets
- Poll
- Final
- Minimum, Average, Maximum Inter-departure time (microseconds)

Transitions
- Down
- AdminDown
- Init
- Up

Echo Reflect
- Reflected
- Minimum, Average, Maximum inter-arrival

Echo Initiator
- Echo initiated
- Echo recieved
- Minimum, Average, Maximum inter-arrival
- Minimum, Average, Maximum inter-departure
- Minimum, Average, Maximum round-trip-time

Minimum Transmit/Receive Interval Detect Times

XS-2	10ms
XR-2	100ms
XR	200ms
XS	200ms

Emulation Status (per-instance)

Emulation State (AdminDown, Down, Init, Up)

Remote Discriminator

Minimum Calculated Detect Time - (microseconds)

Minimum Calculated Transmit Interval - (microseconds)

Minimum Calculated Echo TX Interval

Last Received Failure Code

Last Transmitted Failure Code

Last Down Timestamp - (microseconds)

Last Up Timestamp - (microseconds)

Remote Multiplier
- Minimum FX interval
- Minimum RX interval
- Minimum Echo RX interval

Applicable Standards

- IETF draft-ietf-bfd-base-06.txt, "Bidirectional Forwarding Detection", March 2007
- IETF draft-ietf-bfd-v4v6-1hop-06.txt, "BFD for IPv4 and IPv6 (Single Hop)", March 2007
- IETF draft-ietf-bfd-multihop-05.txt, "BFD for Multihop Paths", March 2007

Configuration

To use the N5583A Bidirectional Forwarding Detection (BFD) Protocol Emulation software, the following Agilent N2X hardware and software are required.

Hardware

A N2X system is required with:

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

The N5583A Bidirectional Forwarding Detection (BFD) Protocol Emulation software is supported on all N2X XR, XR-2, XS and XS-2 Ethernet test cards.

The N5583A software is NOT supported on N2X XP or XP-2 test cards.

Software

Required software packages:

- E7881B Packets and Protocols Application Software

Recommended software packages to enable testing of BFD together with MPLS Fast Reroute (FRR) and Graceful Restart:

- E7882A IPv4 Routing Emulation Software
- E7883A MPLS Signaling Emulation Software

Optional software packages for testing Carrier Ethernet services and infrastructure:

- N5719A BFD Conformance Test Software

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.

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

Canada:
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2660 Matheson Blvd. E
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