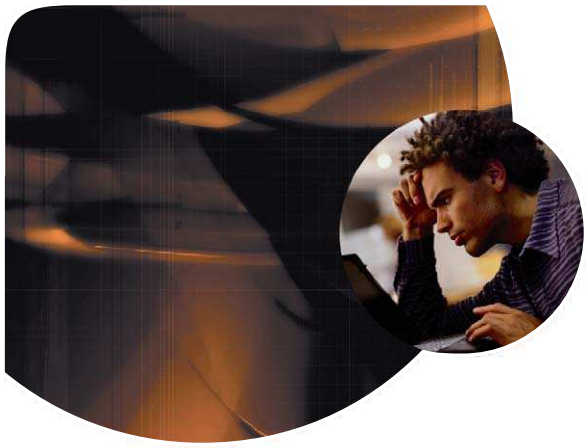

Agilent N2X

IPv4 Routing Emulation Software

E7882A
Technical Data Sheet

Agilent N2X IPv4 Routing Emulation Software integrates the most scalable BGP-4, OSPF, IS-IS and RIP routing protocol emulations available to deliver unparalleled protocol verification and stress testing of data networking devices.

Agilent Technologies

Key Features

- Verify routing protocol implementations
- Run emulations over LACP bundles
- Determine routing scalability limitations
- Test multi-protocol topologies
- Realistic internet scale routing
- Rapid test configuration
- Script powerful customized tests
- Integrated IPv4 routing and traffic configuration

BGP-4

- Verify BGP/MPLS VPN signaling function
- Stress and Verify BGP-4 and BGP/MPLS VPN implementations
- Dynamically flap routes to simulate network instability
- Advertise IPv6 routes and verify BGP-4+ signaling functions

OSPF

- Verify and stress OSPF implementations
- Support for Type 1-5,9-11 LSAs and TLV encoded Opaque LSA
- TE extensions for OSPF

IS-IS

- Verify and stress IS-IS implementations
- IS-IS Traffic Engineering
- Reliable LSP flooding

RIP

- Verify and stress RIP implementations
- Determine route convergence times

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 IPv4 Routing Emulation software features comprehensive coverage of the routing protocols used to build and manage evolving network topologies. This powerful software integrates the most scalable BGP-4, OSPF, IS-IS and RIP routing protocol emulations available to deliver unparalleled protocol verification and stress testing on your router, switch or network.

Routing protocols can be emulated individually, or concurrently to simulate extremely large and dynamic networks, and measure how well your router, switch or network manages unstable, multi-protocol network topologies inherent in the Internet today.

Agilent's IPv4 Routing Emulation Software integrates powerful BGP-4, OSPF, IS-IS and RIP protocol emulations into a single, cost-effective solution that provides coverage of the routing protocols used in today's networks.
Routing protocols can be emulated independently to deliver protocol interoperability, functional and stress testing, or can concurrently measure how well your router, switch or network manages complex and dynamic multi-protocol network topologies.

BGP-4, OSPF, IS-IS and RIP emulations are supported on all interface technologies (Ethernet, ATM, POS) and also operate over subinterfaces (VLAN's & ATM/FR PVC's). A unique feature is the ability to run these emulations over LACP bundles emulated by N2X.

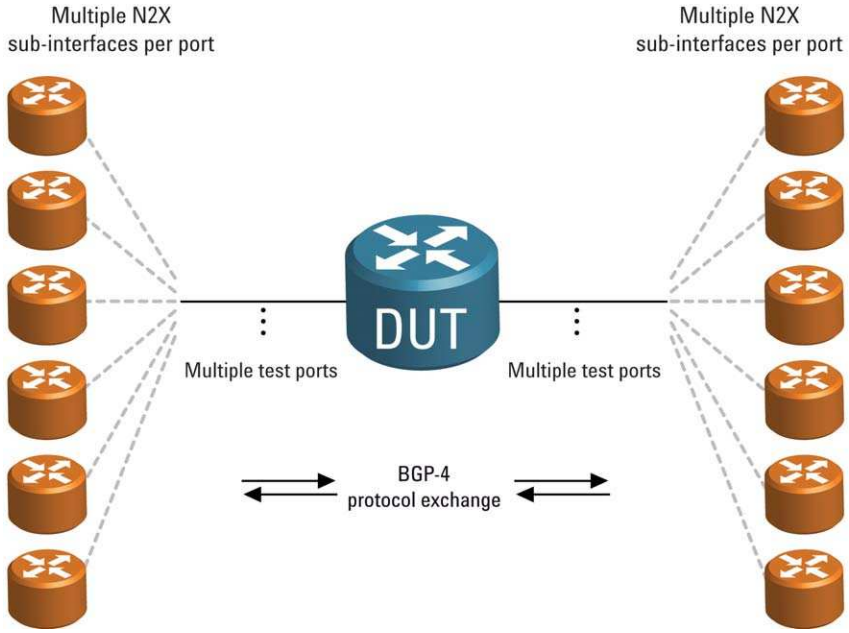

Figure 1: BGP4 Peer Scalability

BGP-4 Overview

Agilent N2X IPv4 Routing Emulation software provides a comprehensive set of capabilities for testing BGP-4 implementations. This software provides the ability to emulate and measure the impact of dynamic route changes on the forwarding performance of routers, switches and networks. By emulating both internal and external BGP-4 sessions, the BGP-4 emulation capabilities build a realistic 'network cloud' around the switch or router under test. Any number of routes with a flexible range of attributes can be advertised into the switch, router (or network) under test, building immense and complex forwarding tables within these devices. Routes and sessions can be added 'on the fly' without stopping the routing engine.

A typical test scenario is described below:

- The protocol software builds a realistic 'network cloud' around the router under test.
- The router installs the routes into tables and then uses BGP to advertise the new routes to a neighbor.
- IPv6, VPN-IPv4, as well as IPv4 routes are then injected into the router's IPv6, IPv4 routing and VPN VRF tables.
- The corresponding traffic can then be sent to verify that the router is forwarding appropriately.

BGP-4 Features

Advanced Routing GUI for powerful and rapid configuration of high-scale tests.

The N2X Advanced Routing GUI allows a user to rapidly set up and run complex BPG test scenarios with only a handful of mouse clicks:

- Minimal mouse clicks for large scale edits - no scripting is necessary to generate scaled multi-protocol topologies. The parametric GUI is easy to learn, enabling faster completion of tests.
- Rapid and comprehensive real-time system feedback, giving the user instant information on protocol state, measurements and test status. This reduces frustration and shortens test cycles.
- Industry's highest protocol scalability. The device or system under test can be pushed to its real limits, creating total confidence in the test results.
- Flexibility to interactively change simulated topologies without stopping the test. System behaviour can be rapidly compared using different network parameters, enabling real-time optimisation.

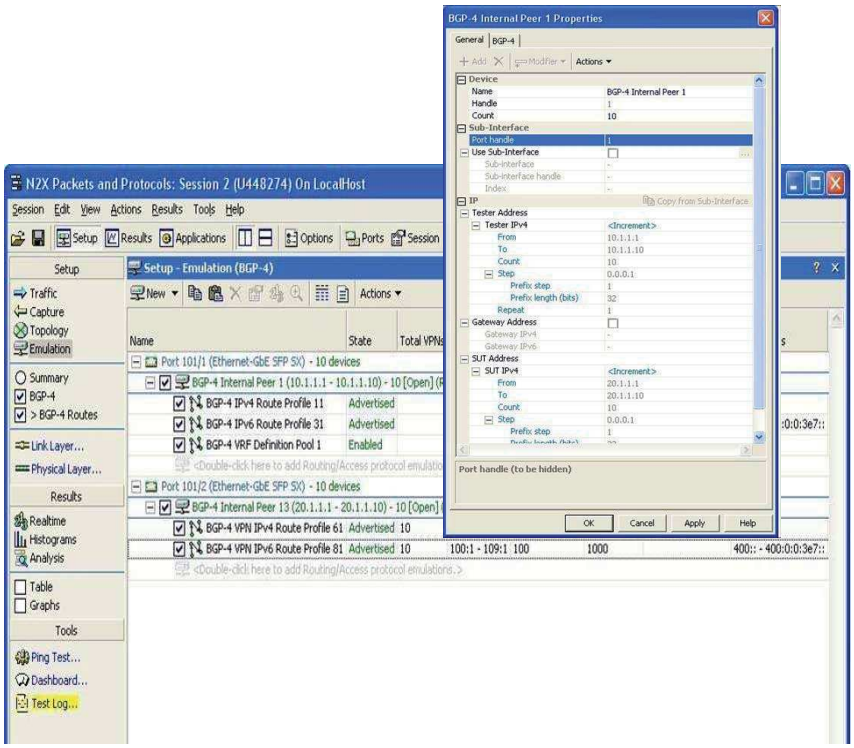

Figure 2: Parametric GUI, Optimised for Large-scale Edits – Rapidly Configure and Run Highly Scaled Tests

Compared to similar tester offerings, the Agilent N2X Advanced Routing GUI allows a user to typically halve the time it takes to emulate and test complex scaled topologies, thereby saving significant costs on a typical test run. These savings grow as test complexity increases.

Transmit any BGP Message

Craft any BGP PDU and send it over an existing session. Auto transmit a list of pre-crafted PDU's over a session, when the session opens.
Craft new capabilities to be inserted into the OPEN message, such as ORF (Outbound Route Filtering).
This powerful feature is XML based, allowing any customer to rapidly and easily extend the PDU definitions.

Verify Multi-Protocol Graceful Restart Scenarios

Emulate a 'Helper' (cooperating neighbour) to a restarting router, or emulate a restarting router itself to test 'Helper' functionality. Validate that traffic continues to flow uninterrupted during a restart. Validate proper operation under scaled conditions. Test with multiple protocols (BGP-4, OSPF and IS-IS) to verify stability and check for unwanted interactions

Verify BGP/MPLS VPN Signaling Function

The BGP-4 emulation provides the multi-protocol extensions to BGP, which includes the capability to advertise VPN IPv4 routes, Route Targets and the BGP VPN labels and verify the receipt of this information from the device being tested.

Advertise IPv6 routes and verify BGP4+ signaling function

The multi-protocol extensions to BGP include the capability to advertise, withdraw and flap IPv6 routes. I-BGP4+ and E-BGP4+ are running over an IPv4 protocol stack, injecting IPv6 routes to the router, switch or network under test.

Stress and Verify BGP-4 and BGP/MPLS VPN Implementations

Comprehensive coverage of the applicable IETF RFCs provides confidence that your implementation works properly. Stress the implementation by simulating intense periods of route updates, withdrawals and route flaps.

Support for multiple tunnel labels and labeled Route Support (RFC 3107) enables inter-AS VPN's and hierarchical CSC VPN scenarios. Flexible support for arbitrary tunnelling mechanisms (non-MPLS) such as GRE and L2TPv3 is also included

Emulate real-world multi-protocol environments

By offering a comprehensive range of control protocols, the Agilent N2X enables you to simulate many protocols simultaneously on single or multiple ports. MPLS Traffic Extensions are included to allow full multi-protocol routing and switching across hundreds of nodes, fully simulating a multi-protocol environment.

Dynamically flap routes to simulate network instabilities

A single IPv4, IPv6, or VPN IPv4 route or a pool of routes can be advertised or withdrawn continuously to simulate network instabilities, rigorously stressing the ability of a switch or router to forward packets during route changes.

BGP-4 Technical Specifications

This section contains the BGP-4 features of the IPv4 Routing Emulation software that are accessible using the GUI and Tcl/TK scripting environment. Simple point and click actions enable you to dynamically change the environment being tested.

Emulation Parameters

Peering Sessions	IBGP, EBGP & Multihop
Messages Supported	Open Update Notification KeepAlive Route Refresh

Connection Initiation

Customize connection initiation with the following control parameters. The BGP-4 connection (using an OPEN message) supports both Active and Passive connections.

BGP Identifier	<Any IP address>
AS Number Range	0 to 65,535 (2 Byte) 0.0 to 65,535.65,535 (4 Byte)
Hold Timer	0 and 3 to 65,535 seconds
Connection Retry	10 to 300 Seconds
Route Update	0 to the maximum number of NLRI routes up to the maximum UPDATE message size of 4,096 bytes
Authentication Code	0 to 255
Authentication Data	<Variable length data>
Inter Update Delay	1 - 10,000ms
KEEPALIVE Timer Value	User defined in ms units between 0 and 65,535 seconds Option to negotiate to be 1/3 of the hold time.

IPv4 Route Generation

An arbitrary number of routes can be updated for each BGP-4 peer. The entire IPV4 address space may be used. Each UPDATE message may contain and arbitrary number of NLRIs or withdrawn routes, up to a maximum UPDATE message size of 4,096 bytes.

Maximum Update Message Size	4,096 bytes
Prefix Range	2-32
Route Profiles	Abstraction allows a large number of routes to be advertised, withdrawn and flapped across multiple BGP-4 peers.
Attributes	AS_PATH including AS_SEQUENCE AS_SET CONFED_SET CONFED_SEQUENCE ORIGIN NEXT_HOP MULTI_EXIT_DISC LOCAL_PREF COMMUNITIES ATOMIC_AGGREGATE AGGREGATOR CLUSTER_LIST ORIGINATOR_ID MP_REACH_NLRI MP_UNREACH_NLRI EXT_COMMUNITIES AS4_PATH AS4_AGGREGATOR

Notification

Configure the following Notification Message Fields.

Error Code	User-defined, 0-255
Error Subcode	User-defined, 0-255

Route Flapping

Configure your route flapping tests. Advertise and withdraw information dynamically to measure the performance and verify ability to forward packets during network changes.

Advertise to withdraw delay	1ms to 120 seconds
Withdraw to advertise delay	1ms to 120 seconds
Inter-Update delay	0 to 10,000ms

Multi-Protocol Route Generation

IPv6 Route Profile	Automatically encoded into MP_REACH_NLRI and MP_UNREACH_NLRI attributes
VPN, IPV4 and IPv6 Route Profiles	Automatically encoded into MP_REACH_NLRI and MP_UNREACH_NLRI attributes. Includes Route Distinguisher/s, MPLS Label/s, Route Target/s.

Statistics

Statistics are collected over the duration of the BGP-4 peer session. These statistics are updated as packets are transmitted and received. The statistics are not subject to the sampling interval and measurement interval processing associated with the real-time forwarding statistics. Numerical, graphical and snapshot save-to-file representations are available.

Notification Received	Number of Notification messages received
NLRI Received	Number of NLRI messages received Includes multi-protocol routes in MP_REACH_NLRI attribute
NLRI Transmitted	Number of NLRI messages transmitted. Includes multi-protocol routes in MP_REACH_NLRI attribute

OPEN Received	Number of OPEN messages received
KEEPALIVE Received	Number of KEEPALIVE messages received
UPDATE Received	Number of UPDATE messages received
OPEN Transmitted	Number of OPEN messages transmitted
KEEPALIVE Transmitted	Number of KEEPALIVE messages transmitted
UPDATE Transmitted	Number of UPDATE messages transmitted
NOTIFICATION Transmitted	Number of NOTIFICATION messages transmitted
ROUTE REFRESH Transmitted	Number of ROUTE REFRESH messages transmitted
ROUTE REFRESH Received	Number of ROUTE REFRESH messages received
Flow Control Event	Number of times TCP flow control occurred while attempting to send update messages
Total Flow Time	Duration in ms the TCP window was closed while attempting to send update messages
Unfeasible (withdrawn routes) Received	Number of Unfeasible routes received. Includes multi-protocol routes in MP_ UNREACH_NLRI attribute
Unfeasible (withdrawn routes) Transmitted	Number of Unfeasible routes transmitted. Includes multi-protocol routes in MP_ UNREACH_NLRI attribute
Duration	Length of time the connection has been up
IP Header Checksum Errors	The number of IP packets that contained an IP header checksum error
UDP/TCP Checksum Errors	The number of received IP packets that encapsulated a TCP or UDP packet that contained a TCP or UDP header checksum error
Fragmentation	The number of received packets that were fragmented

Applicable BGP-4 Standards

- VPNs, RFC 2547
- Multiprotocol Extensions for BGP, RFC 4760
- Carrying Label Information in BGP4, RFC 3107
- Capabilities Advertisement with BGP-4, RFC 5492
- BGP Extended Communities Attribute, RFC 4360
- BGP Route Reflection - An Alternative to Full Mesh IBGP, RFC 4456
- Four byte ASN L3VPN emulation support, RFC 4893
- Autonomous System Confederations for BGP, RFC 5065
- BGP Communities Attribute, RFC 1997
- A Border Gateway Protocol, RFC 4271
- Graceful Restart Mechanism for BGP, RFC 4724
- Route Refresh Capability for BGP-4, RFC 2918
- Cooperative Route filtering Capability for BGP-4, RFC 5291
- Protection of BGP Sessions via the TCP MD5 Signature Option, RFC 2385

OSPF Overview

Agilent N2X IPv4 Routing Emulation software provides a comprehensive set of capabilities for testing OSPF implementations. From every N2X port, OSPF networks can be simulated and link state changes can be flooded into the switch, router or network under test.

This provides a means of verifying capabilities such as scalability, conformance, convergence time and forwarding performance while network instabilities are occurring. Any number of Link States with a flexible range of attributes can be flooded into the switch, router or network under test, building immense and complex forwarding tables within these devices. Add routes and sessions 'on the fly' without stopping the routing engine.

OSPF Features

Simulate real world environments

The OSPF emulation can be used in combination with the BGP-4 emulation capabilities to verify proper generation and processing of external reachability information and associated routing functions. Using the IPv4 Routing Emulation Software, the test system can simulate BGP-4, OSPF, IS-IS & RIP connections. When used with the RSVP capabilities of the MPLS Signaling Emulation Software, TE (traffic engineering) & GMPLS link information can be flooded into the router, switch or network under test

Realistic Internet-scale routing simulation

Hundreds of OSPF nodes can be simulated behind every port at the same time as sending and receiving traffic, allowing you to automatically establish and maintain adjacencies for a large number of neighboring nodes on a broadcast sub-network. Define complex OSPF router topologies using predefined patterns, such as a Grid, Star, Ring, Tree or Mesh.

Verify and stress OSPF Implementations

The OSPF emulation can be used to stress single switch, router or network of switches/routers. By using the Graphical User Interface an arbitrarily large network topology can be created and routes may be generated to simulate real-world routing conditions. LSAs can be inserted and withdrawn to simulate dynamic topology changes. This presents rapidly changing routing criteria to the system under test, allowing you to examine the ability of the router, switch or network to calculate routing and forwarding tables under high stress conditions. Also, using a combination of multiple interface cards, the BGP-4, OSPF, ISIS, RIP and MPLS emulations can be configured to simulate complex real-world conditions

Rapid configuration of Link State Databases through easy to use GUI

Using the graphical user interface you are able to configure many simulated switches or routers, areas and LSAs. Simulated routers can be configured to continuously flood LSAs to simulate network instabilities and rigorously stress the ability of a router to forward packets during link state changes

Verify Multi-Protocol Graceful Restart Scenarios

Emulate a 'Helper' (cooperating neighbour) to a restarting router, or emulate a restarting router itself to test 'Helper' functionality. Validate that traffic continues to flow uninterrupted during a restart. Validate proper operation under scaled conditions. Test with multiple protocols (BGP-4, OSPF and IS-IS) to verify stability and check for unwanted interactions.

OSPF Technical Specifications

This section contains the OSPF features of the IPv4 Routing Emulation software that are accessible using the GUI and Tcl/TK scripting environment. Simple point and click actions enable you to dynamically change the environment being tested.

Emulation

LSAs Supported	Type 1, 2, 3, 4, 5, 7 Router, Network, Summary3, Summary4, AS-External; Type 7 (NSSA) Type 9 through 11; Opaque Link Local, Opaque Area Local, Opaque AS Wide
Router Types Supported	Inter-Area Routers Area Border Routers AS Border Routers
Network Type Supported	Point-to-Point, Point-to-Multipoint, Broadcast, NBMA
Authentication Supported	ClearText MD5
Messages Supported	Hello Database Description Link State Request Link State Update Link State Acknowledgement
Tunneling	IP-in-IP GRE
TE Extensions	Yes

User-defined Router - Type 1 LSA Fields

Link State ID	IP Address
Advertising Router	IP Address
Number of Links	User Defined
Link ID	IP Address
Link Data	IP Address
Link Type	PTOP | TRANSIT | STUB | VIRTUAL_LINK |
Metrics	<1 - 65,535>

User-defined Network - Type 2 LSA Fields

Link State ID	IP Address
Advertising Router	IP Address
Network Mask	IP Address
Attached Router	IP Address

User-defined Summary - Type 3 LSA Fields

Link State ID - First Address	IP Address
Link State ID - Network Mask	IP Address
Link State ID Num. Address	IP Address
Advertising Router	IP Address
Network Mask	User-defined, 0-255
Metric	<1 - 65,535>

User-defined ASBR-Summary - Type 4 LSA Fields

Link State ID	IP Address
Advertising Router	IP Address
Metric	<1 - 65,535>

User-defined External - Type 5 LSA Fields

Link State ID - First Address	IP Address
Link State ID - Network Mask	IP Address
Link State ID - Num. Address	IP Address
Advertising Router	IP Address
Ebit	Optional, default zero
Metric	<1-65,535>
Forwarding Address	IP Address
External Route Tag	User-defined value

User-defined NSSA Summary - Type 7 LSA Fields

Link State ID	IP Address
Advertising Router	IP Address
Metric	<1 - 65,535>

User-defined Opaque - Type 9,10,11 LSA Fields

Link State ID	IP Address
Advertising Router	IP Address
TLV Types	User-defined, TE router address, TE link
Type of value	IPv4 Address, Long (1-2-3-4 octets), Float, Float List, Hex List
TLV Value	IP Address

OSPF Topology through the GUI

The OSPF emulation supports an intelligent GUI topology builder. Multi-select and multi-add features in the topology builder allow the user to build up a scaled topology of network elements such as routers, networks, areas etc and describe the connections between the elements.

The emulation software will then create and advertise the required OSPF LSAs. This enables users with limited OSPF expertise to quickly and easily define a valid OSPF topology. Building a topology from raw LSAs is time consuming and error-prone; the N2X OSPF emulation software takes away the guess work.

Enable traffic engineering (TE) on a particular router pattern, individual router or link. This will result in the automatic generation of the required traffic engineering LSAs.

Router Patterns

The OSPF emulation supports the simulation of different router patterns:

- Grid
- Star
- Ring
- Mesh
- Tree

Create large and complex simulated OSPF topologies quickly and easily by connecting multiple router patterns.

Topology Objects

The user will be able to add/edit/remove the following topology objects to an adjacency:

- OSPF Router Patterns
- OSPF Router
- OSPF Network
- OSPF Summary Routes
- OSPF External Routes
- OSPF ASBR Summary

Two topology objects can be connected together to form a link.
The following objects can be connected:

- Router to Router
- Router to Network
- Summary Routes to Router (ABR)
- External Routes to Router (ASBR or ABR)
- ASBR Summary to Router (ABR)

Connections between objects can be made across different OSPF adjacencies to connect together disjoint topologies behind two test ports to create a larger common topology without needing to advertise the same LSAs from both adjacencies.
Once a topology object has been added the corresponding LSAs will be available in the list of simulated LSAs. These automatically generated LSAs will be locked for removal and will not be directly editable.

State Verification

Interface States

- Loopback
- Waiting
- Point to Point
- DR Other
- Backup
- DR

Neighbor State

- Down
- Attempt
- Init
- 2-Way
- ExStart
- Exchange
- Loading
- Full

OSPF statistics collected for each OSPF session

Number of OSPF HELLO messages received

Number of OSPF HELLO messages sent

Number of OSPF DB DESCRIPTION messages received

Number of OSPF DB DESCRIPTION messages sent

Number of OSPF LINK STATE REQUEST messages received

Number of OSPF LINK STATE REQUEST messages sent

Number of OSPF LINK STATE UPDATE messages received

Number of OSPF LINK STATE UPDATE messages sent

Number of OSPF LSAs received

Number of OSPF LSAs sent

Number of OSPF LINK STATE ACK messages received

Number of OSPF LINK STATE ACK messages sent

Applicable OSPF Standards

Applicable OSPF Standards

- OSPF Version 2, RFC 2328
- OSPF Opaque LSA Option, RFC 5250
- OSPFv2 Graceful Restart, RFC 3623
- Traffic Engineering Extensions to OSPF, RFC 3630
- The OSPF NSSA Option, RFC 3101
- Routing Extensions in Support for GMPLS, draft-ietf-ccamp-gmpls-routing-05
- OSPF Extensions in Support for GMPLS, draft-ietf-ccamp-ospf-gmpls-extensions-09
- IP-in-IP emulation support, RFC 1853 and RFC 2003

IS-IS Overview

Agilent N2X IPv4 Routing Emulation Software provides a comprehensive set of capabilities for testing IS-IS implementations. This software enables you to emulate and measure the impact of dynamically flooded Link State changes on the forwarding performance of a switch or router. The IS-IS Traffic engineering extensions are also supported for MPLS testing; this enables you to propagate traffic engineering information into your network.

By emulating IS-IS sessions, the IS-IS emulation functionality builds a realistic autonomous system around the router or network under test. Any number of Link States with a flexible range of attributes can be flooded into the switch, router (or network) under test, building immense and complex forwarding tables within these devices. Add routes and sessions 'on the fly' without stopping the routing engine.

A typical test scenario is described below.

- Network topologies are simulated behind ports A & B
- LSPs are sent from Router A into the router under test
- Router B verifies that the router under test correctly floods the routes to Router B
- Router A can send information destined for a point behind Router B. It is then possible to test that the router under test has learned the new routing information.
- With Agilent N2X you are able to verify forwarding capabilities. You can also follow this test up with sending traffic at wire speed and can measure the forwarding performance including throughput, latency and loss.

IS-IS Features

IS-IS Traffic Engineering

The IS-IS emulation functionality includes the IS-IS extensions for Traffic Engineering to work within your MPLS domain. This enables you to run the tests to ensure that the traffic engineering attributes, generated by your simulated router, are being propagated throughout your network correctly and efficiently.

Reliable LSP flooding

A single LSP or a complete LSP database can be continuously flooded to simulate network instabilities, rigorously stressing the ability of a router to forward packets during link state changes.

Topologies can be updated and expectations set up to verify that appropriate routes are selected based on the applied stimulus. Failures or successes can be reported for a series of test scenarios. Proper interaction of Level-1 and Level-2 routers, generation of reachable address information and associated routing may be exercised and verified.

Realistic Internet-scale routing simulation

Thousands of IS-IS nodes can be simulated behind every port at the same time as sending and receiving traffic, allowing you to automatically establish and maintain adjacencies for a large number of neighboring nodes on a broadcast sub-network.

Verify Multi-Protocol Graceful Restart Scenarios

Emulate a 'Helper' (cooperating neighbour) to a restarting router, or emulate a restarting router itself to test 'Helper' functionality. Validate that traffic continues to flow uninterrupted during a restart. Validate proper operation under scaled conditions. Test with multiple protocols (BGP-4, OSPF and IS-IS) to verify stability and check for unwanted interactions.

MT-ISIS Support

Flexible topology creation is possible by selectively enabling MT-ISIS support on an emulated router or router grid.

IS-IS Technical Specifications

This section contains the IS-IS features of the IPv4 Routing Emulation software that are accessible using the GUI and Tcl/TK scripting environment. Simple point and click actions enable you to dynamically change the environment being tested.

Emulation

Adjacency Capacity	Up to 700 adjacencies per port
Router types	Supported Level-1, Level 1/2 and Level 2 Only
Messages Supported	IIH (LAN and Point-to-Point), CSNP, PSNP, LSP, ISH
Network Type Supported	Point-to-Point, Broadcast and NBMA (MT-ISIS supported)
TE Extensions	Yes

IS-IS Topology through the GUI

The IS-IS emulation supports an intelligent GUI topology builder. Multi-select and multi-add features in the topology builder allow the user to build up a scaled topology of network elements such as routers, networks, areas etc and describe the connections between the elements. The emulation software will then create and advertise the required Is-IS LSPs. This enables users with limited IS-IS expertise to quickly and easily define a valid IS-IS topology. Building a topology from raw LSPs is time consuming and error-prone; the N2X IS-IS emulation software takes away the guess work.

User Defined header generation (IIH, CSNP, PSNP, LSP, ISH)

IS-IS Packet Headers are generated automatically for each simulated router. The user for the automatically generated packets may assign the following parameters.

Area list	Hex String
System ID	6 bytes or IP Address
Local circuit ID	Optional, <0-255> default 255
Priority	Optional, <0-127> default 0
Metrics	Optional default metrics; delay, expense, and error <0-63>, default value 1 for default metrics, 0 for all other metrics
Max Area Addresses	Optional, <0-255> default 0
Adjacency Hold Time	Optional, <0-255> default 20 seconds
Maximum LSP Age	Optional, <0-65,535> default 1200 seconds
Protocols Supported	Optional, hex string, default absent
Area Authentication	Optional, default absent
Domain Authentication	Optional, default absent

Adjacency Initiation

IS-IS adjacencies are established and maintained with the following control parameters. All fields are optional, with the indicated defaults. All fields are optional, with the indicated defaults.

Capability	L1, L2, L1/L2 (default)
IIH Interval	0-255, default 5 seconds
Designated router IIH Interval	0-255, default 1 second
Minimum LSP generation interval	Default 30 seconds
Maximum LSP generation interval	Default 900 seconds
LSP transmit interval	Default 5000 ms
CSNP interval	Default 10,000 ms
PSNP interval	Default 2 seconds
Zero age duration	Default 60 seconds

LSP Insertion/Verification Variable Length Fields

Verification of variable length fields can take advantage of LSP aggregation according to the Key Fields (defined in the table above) in the LSP Header. In this manner, the aggregate LSP database of a system under test can be examined via the Capture Analysis Application.

Area List	Optional, hex string, default absent
L2 designated IS	Optional, 6 bytes or IP Address, default absent
IS neighbor list	Optional, list of 6 byte ID's or IP Address, default absent
ES neighbor list	Optional, list of 6 byte ID's of IP Address, default absent
Prefix neighbor list	Optional
Protocols supported	Optional, hex string, default absent
IP address list	Optional, code, type, password, default absent
Authentication information	Optional, code, type, password, default absent
Internal Reachability Information	Optional, IP Address List, default absent
External Reachability Information	Optional, IP Address List, default absent
Inter-domain routing information	Optional, hex string, default absent
TLV Field	Optional, repeated expression, default absent
Router ID TLV	Type 134
Extended IP Reachability	Type 135
Extended IS Reachability	Type 22

Dynamic Capabilities

The following parameters can be changed at run time to dynamically alter the characteristics of an established adjacency or to keep a given entry in the LSP database alive.

IIH Interval
Circuit Type
Area address assignment
MAC address assignment
Priority
Auto LSP generation enable
Auto update inserted LSP
Set database overload limit

State Verification

The following adjacency states may be verified for both the IS-IS Protocol Module State Machine or for a given neighbor.

Down
Initializing
Wait Designated Router
Wait normal
Up Designated Router
Up Normal

Connection Statistics

Statistics can be displayed and saved for running sessions independently for Level 1 and Level 2 connections. Update intervals can be specified in seconds, with a minimum of one second. Numerical, graphical and snapshot save to file representations are available.

Inbound / Outbound Statistics

Circuit Type	Broadcast or Point-to-Point
Status	Current Link State (down, init, wait DR, wait normal, up DR, up normal)
Hello PDU Count	Number of Hellos
LSP In/Out Count	Number of Router LSP transactions
CSNP In/Out Count	Number of CSNP transactions
PSNP In/Out Count	Number of PSNP transaction

Global Statistics

LSP Database Size	Number of currently stored LSPs

LSP Statistics

Statistics can be displayed and saved for all types of LSPs of a running session. Update intervals can be specified in seconds, with a minimum of one second. Numerical, graphical, and snapshot save to file representations are available.

Inbound / Outbound Statistics

Circuit Type	Broadcast or Point-to-Point
Status	Current Link State (down, init, wait DR, wait normal, up DR, up normal)
IP Address	Router IP Address
Hello Count	Number of Hellos
LSP In/Out	CountNumber of Router LSP transactions

Global Statistics

LSP Database Size	Number of currently stored LSPs

Applicable IS-IS Standards

- IS-IS Intra Domain Routing Protocol, ISO/IEC 10589
- Use of OSI IS-IS for routing in TCP/IP and Dual Environments, RFC 1195
- Restart Signaling for Intermediate System to Intermediate System (IS-IS), RFC 3847
- Intermediate System to Intermediate System (IS-IS) Extensions for Traffic Engineering (TE), RFC 3784
- M-ISIS: Multi Topology (MT) Routing in IS-IS, draft-ietf-isis-wg-multi-topology-06
- LSP Hierarchy with MPLS TE, draft-ietf-mpls-lsp-hierarchy-02
- A Policy Control Mechanism in IS-IS Using Administrative Tags, RFC 5130IS

RIP Overview

Agilent N2X IPv4 Routing Emulation Software provides a comprehensive set of capabilities for testing RIP implementations. This software enables you to emulate and measure the impact of dynamic route changes on the forwarding performance of switches and routers.

By emulating RIP behavior, the RIP emulation functionality builds a realistic RIP network cloud, where the simulated switches, routers and the system under test participate in the protocol to build a common representation of the network. The routing table of the switch or router under test can be built with any number of routes, creating immense and complex forwarding tables within these devices. Add routes and sessions 'on the fly' without stopping the routing engine.

A typical test scenario is described below.

- Network topologies are simulated behind ports A and B
- Routers A and B exchange routing information with the router under test to build its routing table
- Routers A and B may exchange information directly to one another, bypassing the router under test
- The router under test calculates the best route by working with routers A and B. The correct value can be verified by sending traffic or looking in the router under test's routing table
- Using Agilent N2X, you are able to verify forwarding capabilities. You can follow this test up with sending traffic at wire-rate and can measure the forwarding performance including throughput, latency, and loss.

RIP Features

Verify and Stress RIP Implementations

Complete test capabilities derived from the applicable IETF RFCs ensure confidence that your implementation reacts properly. Stress the implementation by simulating intense periods of route changes, and quiet periods where only periodic responses are generated.

Determine Router Convergence Times

Precisely measure the ability of a switch, router or network to withstand routing instabilities and to converge new routes. How much user data is lost when a route changes? Agilent N2X enables you to benchmark a network, switch or router with realistic, "real-life" tests to gauge its performance when deployed in the real world.

RIP Technical Specifications.

Emulation

Router ID	Required unique IP address
Metric	Value 1 to 6
Version	2
Garbage Collection Interval	Default 120,000ms
Route Expiration Interval	Default 180,000ms

Routing Table

INSERT	Insert or change a route into the routing table
REMOVE	Remove an existing route from the routing table
METRIC	Default is 1
ROUTE_TAG	Default is 0
ADDRESS_FAMILY	Default is 2
NEXT_HOP	<IP Address>
ROUTE_MODIFIER	Default is 1
TOTAL ROUTES	Default is 1

Simulated Interfaces

Optional Attributes	Net mask Metric (default -1) Version (2) Triggered Interval (default - 5,000ms) Update Interval (default - 30,000ms Horizon Control No Horizon Control Split Horizon Poison Reverse (default)

RIP Operations

Disable/Enable Session	Stop/Start RIP activity
Advertise/Withdraw Route Pool	Add/Remove a RIP route pool to the RIP database for advertisement
Flap Route Pool	Cyclically advertise and withdraw a route pool

Statistics

Statistics are collected over the duration of the RIP session. These statistics are updated as packets are transmitted and received. The statistics are not subject to the sampling interval and measurement interval processing associated with the real-time forwarding statistics. Numerical, graphical, and snapshot “save to file” representations are available.

Inputs and Outputs

Response Messages	The number of messages sent or received
Request Messages	The number of request messages sent or received
Unfeasible Neighbors	The number of withdrawn routes placed in or taken to send from the routing table by the neighbors
Unfeasible Simulated	Number of withdrawn routes simulated, placed in, or taken to send from the routing table (simulated router)
Neighbor Routes	The number of advertised routes placed in or taken to send from the routing table by the neighbor
Simulated Routes	Number of simulated routes placed in or taken to send from the routing table (simulated router)

Applicable RIP Standards

- RFC 2453, RIP Version 2

Additional N2X Features

Easy to use Graphical User Interface

The graphical user interface provides simple point and click features to dynamically define your sessions and generate routes and peers, quickly emulating a BGP-4, OSPF, IS-IS or RIP environment.

Flexible, powerful scripting

Automated scripts are quickly created using the Tcl/Tk scripting environment. With only a few lines of code, thousands of networks are easily advertised from simulated peers on any or all ports.

Online Help

An extensive online help system provides complete descriptions and detailed usage instructions. Dialog-level context-sensitive help provides rapid access to the relevant sections of the online help. A technology reference section provides a complete library of background information pertaining to router and switch performance testing.

Determine router convergence times

Precisely measure the ability of a router to withstand route flap "storms" as well as the time it takes for a router to converge new routes. How much user data is lost when a route changes? Agilent N2X enables you to benchmark a network or router with realistic 'real-life' tests to gauge its performance when deployed in the real world.

Generate wire speed traffic

With N2X Packets and Protocols application's wire speed traffic capability you can generate a complex, real-world mix of traffic whilst simultaneously testing the routing functionality. For example, the data forwarding performance of a router can be measured while simultaneously flooding OSPF Link States to it. The ability of a router to withstand Link State flooding as well as the time it takes for a router to converge on new routes can be precisely measured.

Configuration and Ordering Details

To use the E7882A IPv4 Routing Emulation software, Agilent N2X hardware and software is required

Hardware

A N2X system is required with:

- System controller
- Chassis
- Interface cards

E7882A IPv4 Routing Emulation software is supported on all N2X XR cards and XS cards. The N2X XS cards offer up to 2 times the protocol scalability of the XR cards.

E7882A IPv4 Routing Emulation software is NOT supported on N2X XP cards.

Software

Required software packages are as follows:

- E7880A Packets Application Software
- E7881A Packets and Protocols Application Software

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

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.

Software and Support Agreement

To protect your investment in the Agilent N2X, every new system includes an initial 12-month comprehensive system-based warranty and Software and Support Agreement (SSA).

Renewing Agilent support services ensures uninterrupted technical support and software upgrades, giving you confidence in N2X throughout the life of your system.

The N2X technical support portion of your SSA includes assistance with product operation and measurements, and verification that the N2X equipment is in correct working order.

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.

Ordering Information

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

Sales, Service and Support

N2X must be serviced by an approved Agilent Technologies service centre, please contact us for more information.

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

1-800-829-4444

Canada:
Agilent Technologies Canada Inc.
2660 Matheson Blvd. E
Mississauga, Ontario
L4W 5M2
1-877-894-4414

Europe:
Agilent Technologies
European Marketing Organisation
P.O. Box 999
1180 AZ Amstelveen
The Netherlands
(31 20) 547-2323

United Kingdom
07004 666666

Japan:
Agilent Technologies Japan Ltd.
Measurement Assistance Center
9-1, Takakura-Cho, Hachioji-Shi,
Tokyo 192-8510, Japan
Tel: (81) 426-56-7832
Fax: (81) 426-56-7840

Latin America:
Agilent Technologies
Latin American Region Headquarters
5200 Blue Lagoon Drive, Suite #950
Miami, Florida 33126
U.S.A.
Tel: (305) 269-7500
Fax: (305) 267-4286

Asia Pacific:
Agilent Technologies
19/F, Cityplaza One, 1111 King's Road,
Taikoo Shing, Hong Kong, SAR
Tel: (852) 3197-7777
Fax: (852) 2506-9233

Australia/New Zealand:
Agilent Technologies Australia Pty Ltd
347 Burwood Highway
Forest Hill, Victoria 3131
Tel: 1-800-629-485 (Australia)
Fax: (61-3) 9272-0749
Tel: 0-800-738-378 (New Zealand)
Fax: (64-4) 802-6881

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