Wireless Seminar
Massy – July, 1st

N2X Multiservices Test Solution

R&D & Lab validation of triple play infrastructure and services, from broadband access through carrier core/edge.
N2X leads Agilent’s Triple Play Solutions

N2X verifies network devices and systems, in the lab, “out-of-service”

N2X is mostly used before deployment

N2X is usually not placed in ‘live’ networks

R&D-strength testing
Where is N2X aimed?

- Core Router
- Broadband Network Gateway BNG / Broadband Remote Access Server B-RAS
- Ethernet Aggregation (L2) Switch
- Access Node (DSLAM or PON OLT)

- Home Network
- Edge / Access Router
- Ethernet Aggregation (L2) Switch
- Broadband Network Gateway BNG / Broadband Remote Access Server B-RAS
- Access Node (DSLAM or PON OLT)

- Content Servers
- VoD Server
- SoftSwitch
- Internet
- PSTN
- Encoder
- Content Router
- IP/MPLS Core
- Edge / Access
- Residential Gateway
- VoD Server
- Internet
- DSLAM
- Residential Gateway
Core IP Router

High-capacity core routers process large amounts of traffic and routing information in the core of service-provider networks. They are often situated at Internet Point-of-Presence (POP) locations and may connect to other carrier networks.

Key pain points
- **Scalability**: Ensure the router can handle huge traffic and routing loads over many high-speed interfaces
- **High Availability**: Verify that the router can maintain 99.999% availability during periods of network instability
Edge/Access router, BNG / B-RAS

An Edge/Access or Multi-Service router, Broadband Network Gateway (BNG), or Broadband Remote Access Server (B-RAS) manages subscriber services, applies policies, and can act as a PPP or DHCP server.

Key pain points
- **Multiple Services**: Validate IPTV, VoIP, data applications / TCP, multicast, and business VPN deployment scenarios
- **Access Protocols**: Measure DHCP, DHCPv6, PPPoX, and ANCP performance and scalability
- **QoS**: Verify per-flow Quality of Service and prioritization
Ethernet Aggregation (layer-2) Switch

The Ethernet Aggregation (or Ethernet Services) Switch cost-effectively aggregates traffic, and is optimized for Ethernet services.

Key pain points

• **Scalability**: Verify Ethernet and/or MPLS switching from many GbE interfaces to a few high-speed 10GbE interfaces
• **Layer-2 Protocols**: Test conformance and performance of Ethernet OAM Fault Management, Spanning Tree (xSTP), Link Aggregation (LACP), BFD, Provider Backbone Bridging, Mac-in-Mac (PBB/MiM)
• **Carrier Ethernet Services**: Validate E-Line/E-LAN services shaping & policing
Access Node / IP DSLAM / OLT

Access Nodes are also known as Access Concentrator, DSL Access Multiplexer or Optical Line Terminator (OLT).

They terminate DSL or Passive Optical Network (PON) lines, aggregate subscribers, and assist IPTV multicast services.

Key pain points
- **Traffic**: Analyze forwarding performance (latency, loss, throughput)
- **Multicast**: Verify IGMP/MLD snooping (which accelerates IPTV channel-zapping) and multicast performance
- **Access Protocols**: Gauge DHCP relay agent and PPPoE performance & scalability
The 5 key application areas

• Carrier Ethernet
  - LACP
  - MEP
  - Y.1731
  - 802.3ah
  - CFM
  - VPWS
  - VPLS
  - MDI = 0:0
  - Delay Factor (DF) & Media Loss Rate (MLR)

• Routing, MPLS and VPNs
  - BGP4, OSPF, IS-IS and RIP
  - Kompella
  - Control Plane
  - Fast re-route
  - Route flapping
  - Graceful Restart
  - G-MPLS
  - RSVP

• Traffic Generation, Analysis & QoS
  - QoS
  - SLAs
  - Packet loss, latency, throughput
  - Inter-arrival time
  - IPv6
  - W-RED

• Triple Play – IPTV, VoIP, Data
  - IPTV
  - QoE
  - SIP
  - MOS
  - Multi-Play
  - TCP

• Access Protocols and Multicast
  - DHCP/DHCPv6
  - Relay agents
  - mVPN
  - MDSP
  - L2TP
  - IGMP
  - PIM
  - PIM-SM
Fundamental Test Scenario 1 - Functional Test

"Does it work as it should?"

- Test device under normal and abnormal conditions

- Traffic (data plane) functional test
- Protocol (control plane) functional test

Test DUT functionality under expected conditions

Test stability and response to unexpected stimulus (negative testing)
Fundamental Test Scenario 2 – Packet Performance

“Does it perform?”

• Measure packet performance through a forwarding device

Send thousands streams of realistic traffic into the device

Each stream can represent a QoS level or traffic from an individual customer

Measure packets sent and received, latency, throughput, and lost and misdirected packets on each stream
Fundamental Test Scenario 3 - Protocol Emulation “Does it scale?”

- Emulate routing, signaling and other protocols simultaneously, to simulate very large attached networks

Because N2X accurately sends and responds to protocol messages, the SUT thinks N2X is actually thousands of real devices

- Measure protocol scalability
- Verify multi-protocol management
Fundamental Test Scenario 4 Integrated traffic and protocol emulation

Combine traffic generation and protocol emulation

- Measure performance during integrated traffic and protocol stress
- Measure delivery of services such as IPTV, MPLS VPNs and Carrier Ethernet OAM
Fundamental Test Scenario 5 – Conformance Test

“Does it conform to industry standards?”

- Verify protocol conformance to IETF, IEEE & MEF standards

N2X sends the DUT a message and tests for a correct and timely response.

Each N2X conformance test suite contains a hundred or hundreds of unique test cases.

Conformance helps ensure interoperability with network devices from other vendors.
Fundamental Test Scenario 6 – Restoration Time

“Does it handle failures? How fast?”

- Measure recovery from a simulated device or

- Applies to many technologies
  - MPLS Fast Re-Route
  - Routing reconvergence
  - LACP single-link failure
  - Spanning Tree reconvergence
  - Bidirectional Forwarding Detection
  - Ethernet CFM Continuity Check
N2X Product Structure

N2X System Components:

- **Chassis** – 2 slot or 4 slot
- **Controller** – laptop or 2 levels of rackmount
- **Software (3 tiers)**
  1. Packet only - including QuickTests
  2. Emulation Software
  3. Productivity Advantage – advanced pre-written tests
- **Hardware – Test Cards**
- **Support & Software Updates**

![N2X System Diagram](image)
N2X session-GUI/API model

GUI on remote desktop

API on external computer

N2X controller – local GUIs and APIs

GUIs

APIs

GUIs

APIs

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test session 1

Test session 2

...
Traffic Terminology

- N2X Packets and Protocols traffic:
  - **Traffic**: custom mix of PDUs (L2 to L7) sent through multiple ports
  - **Profile**: each has a constant or bursty load
  - **Stream Group**: each has a common PDU template
  - **Stream**: each has a unique stream ID
  - **Flow**: each has a unique header
Select traffic profile properties

Profile 1 Properties

Name: Profile 1

Profile enabled

Type

- Constant
- Burst

Mode

- Continuous
- Single shot:

<table>
<thead>
<tr>
<th>Frames</th>
<th>1000</th>
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Average Load (Layer 2)

- Percentage: 10.00
- Frames/s: 12013.2
- Mb/s: 8.076

Burst Load (Layer 2)

- Percentage: 100.00
- Frames/s: 120192.3
- Mb/s: 80.769

Frame IDT: 8320 ns
Burst IDT: 74888532 ns

Burst length: 1000 Frames

1 active Stream Group, 100 streams

New Stream Group

OK  Cancel  Help
Configuring the traffic type and length

Specify the number of times the transmitter sends each PDU in the Current stream group before moving to the next stream group in the profile.

Specify the type of PDU (layer-2 or Layer 3) and its length.

Add 20 bytes of test information to the payload and must be enabled if you want to gather statistics for the stream group.

Specify whether PDUs have a mixed length (None) or a range of incrementing, decrementing, or randomized lengths.
Step 3: Configuring the traffic type and length

Examples: Defining PDU lengths

Increment or decrement a range of PDU lengths by a specified step.

You can also create a random distribution of lengths within a defined range.
Create protocol encapsulations

- Add a new layer (encapsulation) to the existing PDU
- Add a new Protocol
- Change Encapsulation
- View Options of selected Field
- Expand to view all encapsulations and fields
- Delete the selected layer
- Hide the Encode Pane
- Packet Preview
- Field Modifier Options
- View the entire PDU in hexadecimal format
- Vary the value of a selected field of interest by adding a Field Modifier.
Edit PDU fields

- Define a fixed field value for all packets in the stream group, or apply a field modifier to vary the fields value within the PDU.
- Override a field to type an illegal value.
- Apply a field modifier to vary the value of a field of interest. Modifiers can increment, decrement, randomize a range of values. You can also create a custom list of field values.

 Indicates the number of streams defined in the stream group.
Supported PDU types - GPT
Custom PDU types: LTE/WiMax

- PDU fields and layout defined by .xml files

- User can construct packets of any type to simulate LTE protocol control plane messages

- Use profile features to send protocol packets in sequence
Packet capture in N2X
Summary

• N2X generates high-scale, high-bandwidth IP traffic for realistic testing
• Protocol emulations for a large range of routing and access protocols
• PDU builder and capture features allow testing of new protocols used in IPoWireless
• High volume IP traffic testing remains vital