NETWORK EMULATOR II™ — ETHERNET

DATA SHEET

10GE, 1GE, AND 100MBE ETHERNET IMPAIRMENT EMULATION

PROBLEM: KNOWING HOW NETWORKS AND DEVICES WILL BEHAVE UNDER WORST-CASE CONDITIONS

Effective testing requires a real-world environment that reproduces realistic network conditions and behavior. All software and hardware should be subjected to a realistic test environment prior to deployment.

SOLUTION: REAL-WORLD NETWORK IMPAIRMENT TESTING

Network Emulator II is a precision test instrument for 10GE, 1GE, and 100MbE Ethernet impairment. The device allows users to accurately emulate the real network conditions that occur over live production LAN/WAN networks. By emulating realistic and worst-case network conditions in the lab, users can validate and test performance of new hardware, protocols, and applications to prevent failures in production networks. The Network Emulator II offers a rich feature-set to allow testing in a controlled lab environment with repeatable and predictable impairments. Network Emulator II enables user to:

- Test the effect of delay on the network and application performance
- Determine how applications will perform when distributed across data centers
- Test data center backup in a real-life environment
- Cause outage and degrade scenarios to trigger and validate fail-over protection
- Combine with IxNetwork, IxLoad, and BreakingPoint test systems to create a complete test environment that includes real-world impairments

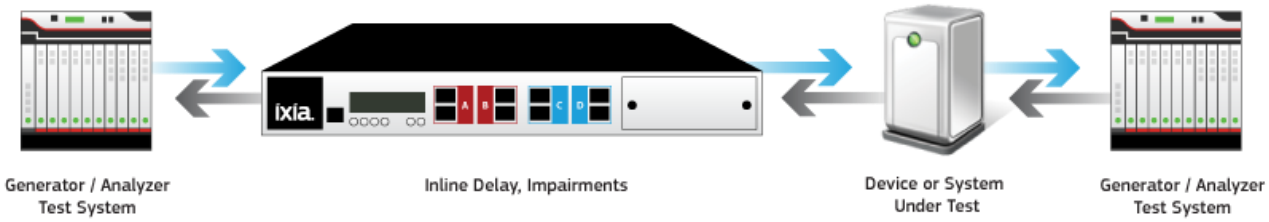
HIGHLIGHTS

Emulate real-world networks in the lab

- Enables validation, performance, and interoperability testing
- Test products and applications to characterize end user experience under real-world conditions
- Precisely reproduce and quickly resolve issues occurring in the field

Key Features

- 10GE / 1GE / 100MbE impairment emulation
- 8 Port FPGA hardware architecture allows 100% line-rate performance
- Single hardware platform for both Ethernet and Fibre Channel
- Test mixed speeds at the same time with one device
- Flexible resource management



KEY FEATURES

- Industry's highest port count Ethernet FPGA emulator with 8 Ethernet ports
- Supports 10GE, 1GE, and 100MbE Ethernet impairment
- FPGA hardware-based architecture provides maximum precision and accuracy
- Dual banks with 4 ports each and dedicated FPGA processors per bank ensures high performance
- Fibre Channel 16G, 8G, 4G, and 2G also supported with additional software licenses
- Flexible Resource Management enables allocation of resources as needed by allowing:
  - Automatic or manual memory allocation
  - Allocation of profiles
  - Bandwidth flexibility in Ethernet mode, enabling 10G on 4 ports at line rate or 8 ports sharing bandwidth of 11G per bank
- Precisely emulates delays and impairment that exist in Ethernet networks
- Stresses systems with controlled bit errors and frame drops
- Dynamically increases impairments to test failure recovery mechanisms
- Transparent to any higher-layer L2/7 protocols
- Optical media physical layer clock transparency for SyncE support
- Test automation via RESTful Web API, allowing control by TCL and languages such as Python
- ETHERNET+ features
  - IP fragmentation
  - Packet capture

PRIMARY USE CASES

- Performance testing of critical applications over Ethernet with realistic network conditions and impairments
- Combine with IxNetwork, IxLoad, and BreakingPoint test systems to create a complete real-world test environment
- Real-world interoperability and customer proof-of-concept (PoC) testing
- Corporate LAN/WAN emulation

- Business continuity and disaster recovery testing
- Server consolidation/migration
- Application cloud migration and storage extension
- Wireless/mobile delay and impairment simulation
- Satellite network delay emulation
- Reuse and build proprietary or standard-based Layer 2-7 protocol filter with the Customizable Filter Library
- Use corruption for precise functional and negative testing
- Cause outage and degrade scenarios triggering fail-over protection

NETWORK EMULATOR II SPECIFICATIONS

FEATURE	DETAILS

Ports	• 8 FPGA ports, divided into two banks of 4 ports each
	• All ports support 10GE, 1GE, and 100MbE
	• All ports support Fibre Channel with additional licensing
	• Each bank may run a different speed and choice of Ethernet or Fibre Channel protocol
	• License only what is needed, allowing for efficient cost
	• Flexible Resource Management provides performance when you need it
	  ○ Full 100% line-rate support for 8 ports of 1G
	  ○ Full 100% line-rate support for 4 ports of 10G (2 ports per bank)
	  ○ Full 100% line-rate support for 4 ports of 10G and 4 ports of 1G (each bank must run 2 ports of each speed)
	  ○ 8 ports of 10GE can be used when sharing bandwidth of 11G per bank
	Note: Each line to be impaired requires 2 ports

Traffic Selection	• Classifier pattern matching allows selection of specific traffic
	  ○ Standard filters available such as MAC, IP, and VLAN
	  ○ Custom Byte Offset
	  ○ Up to 32 bytes for matching

32 Classifier Profiles Per Bank with Flexible Allocation	• Flexible Resource Management provides ability to allocate resources in the required manner. Flexible Resource Management has two modes: ETHERNET and ETHERNET+. IP Fragmentation and Packet Capture require ETHERNET+ mode. • Each line to be impaired requires a port pair • Ports 1&2, 3&4, 5&6, 7&8 are paired and traffic flow is between port pairs • Flexible Resource Management allows Profiles to be configured from the Profile

<table>
<tr><th>FEATURE</th><th>DETAILS</th></tr>
<tr><td></td><td>
Pool as needed, allowing for the most efficient use of system resources

32 Profiles per bank allocated as needed by the user or 16 in Ethernet+ mode
1 default profile is allocated to each port
Flexible Resource Management using ETHERNET mode allows allocation from the Profile Pool enabling up to 15 profiles per port, per traffic direction allowing 30 profiles per bidirectional traffic flow.
In Ethernet+ mode the above profile pool is up to 7 profiles per port, per traffic direction allowing 15 profiles per bidirectional traffic flow.

FPGA hardware-driven implementation ensures accuracy and repeatable testing
Network Profiles support emulating multiple “network clouds” per interface: emulate different paths through a network or different classes of service

Each profile is defined by any combination of VLAN tag, MPLS label, MAC/IP address (IPv4, IPv6), TCP/UDP port, or any data within Ethernet frame
Define bandwidth, delay, and impairments per profile

Classify up to any 32 bytes within an Ethernet frame

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<tr><td>Delay</td><td>

Emulate delay occurring during transmission through an Ethernet network
Fully transparent pass-through operation for fiber where delayed output is logically identical to input signal
Delay at 100% line rate

<table>
<tr><th></th><th>10GE</th><th>1GE</th><th>100MBE</th></tr>
<tr><td>Max Delay at Line Rate</td><td>2 seconds</td><td>20 seconds</td><td>30 seconds</td></tr>
<tr><td>Max Delay at Limited Line Rate</td><td>30 seconds</td><td>30 seconds</td><td>30 seconds</td></tr>
<tr><td>Resolution (Min Delay Increment)</td><td>6.4 ns</td><td>64 ns</td><td>640 ns</td></tr>
</table>
Note: When line rate is less than 100%, delay can be increased to a maximum 30 seconds dependent on the actual line rate and memory allocation
</td></tr>
<tr><td>Packet Delay Variation</td><td>

Introduce frame or packet delay variation (jitter)
Impairment distribution: Gaussian, Periodic, Uniform, or Custom
Timing transparent pass-through operation: Physical medium clock is maintained between ingress and egress port

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</table>

FEATURE	DETAILS
Packet Drop	• Packet Drop impairment allowing single or multiple packets to be dropped • Variable by Periodic, Poisson, Uniform, and Gaussian distributions
Packet Duplication	• Packet Duplication impairment allows single or multiple packets to be duplicated • Variable by Periodic, Poisson, Uniform, and Gaussian distributions
Packet Reorder	• Packet Reorder impairment allows the reorder of single or multiple packets as specified by the options • Variable by Periodic, Poisson, Uniform, and Gaussian distributions
Packet Accumulate-Burst	• Packet Accumulate-Burst allows the accumulation of packets until the time and/or accumulation amount has been reached after which all accumulated packets will be sent
Packet Modification	• Packet Modification allows for the value within a defined location in a packet to be modified; up to 6 modification rules are available and each can modify 8 bytes.
Checksum Correction	• Checksum correction is also available and can optionally be enabled to ensure that modified packets are valid and not dropped
IP Fragmentation	• IP Fragmentation allows the fragmentation of packets according to RFC791
Line BER	• Capable of injecting bit-errors at rates 5x10-4 to 5x10-17, which allow errors from one in every 1000 bits to once every several years • Error distributions of Periodic, Uniform, Gaussian, and Poisson • 1-bit to 64K-bit error burst – invert, PRBS, all ones, or all zeros
Packet Capture	• Packet capture at line rate • Robust profile configuration options enabling selection of target traffic • Standard PCAP file format compatible with Wireshark and other decode utilities
Laser Impair	• Emulate loss of signal, loss of frame under user, or program control

Rate Limiting & Shaping	• Line Policing added in the 3.0 product version
	  ○ MEF10-compliant algorithm to limit traffic flow through the Network Emulator
	  ○ Robust configuration allows for configuration of Burst Tolerance, Rate Coupling, and Flow Control
	  ○ Can be applied at the line or profile level
	• Line Shaping added in the 3.1 product version
	  ○ Controls outgoing traffic to prevent buffer overflow and reduces the burstiness of traffic.
	  ○ Can be applied at the line or profile level

Statistics	• Robust statistics support with customizable flow based overview

FEATURE	DETAILS

Filter Libraries	• Filter Libraries allow you to customize the emulator for your specific protocol requirements
	  ○ Advanced Protocol Filter Suite provides a growing list of filters including PPP, PTP, RSVP, IP, FCoE, FIP, OSPF, MPEG, and many others
	  ○ Customer Byte Offset functionality allows

User Interface	• Remote monitoring and control via 10/100/1000 RJ45 Ethernet port
	• Intuitive and interactive web GUI interface
	• Multiple user accounts and account management (12 concurrent users maximum)
	• Display-only accounts
	• RESTful API allows test automation and complete control of all functionality
	• The following browsers and versions are supported
	  ○ Internet Explorer version 9 or higher
	  ○ Mozilla Firefox version 24 or higher

NETWORK EMULATOR II SYSTEM SPECIFICATIONS

FEATURE	DETAILS

Chassis	• Rack mount and desktop mounting hardware included
	• 1U rack-mountable
	• Dimensions: 1U - 1.73 x 17.3 x 10” (4.6 x 43.9 x 25.4 cm)
	• Weight: 9 lb. (4.08 kg)
	• Thermal
	  ○ Operating temperature: 0° to 40° C (32 to 104° F)
	  ○ Operating humidity: 10 to 85% (RH), non-condensing
	  ○ Storage temperature: –40°C to 70°C (-40 to 158 F)
	  ○ Storage humidity: 5 to 95% (RH), non-condensing
	• Input power (internal AC/DC converter)
	  ○ Input voltage: 100-240VAC
	  ○ Input frequency: 47-63Hz
	• Max. power consumption: 100W (typical), 175 (max)

FEATURE	DETAILS
Regulatory Approvals	• CE • UL 60950-1, 2nd Edition • FCC Class A • ROHS compliant • UL File #: E255262
Transceivers supported	• SFP and SFP+ form factors • Copper SFP

PRODUCT ORDERING INFORMATION

PART NUMBER	DESCRIPTION
946-0070	Network Emulator II: Rack mountable 1U 8 port emulator (requires 1 license below)
930-2700	Network Emulator II: Ethernet 10GE, 1GE & 100MbE Network Emulator Software and 8 Port License Bundle
930-2701	Network Emulator II: Ethernet 10GE, 1GE & 100MbE Network Emulator Software and 2 Port License
930-2702	Network Emulator II: Ethernet 1GE & 100MbE Network Emulator Software and 2 Port License
930-2703	Network Emulator II Upgrade: Ethernet 10GE, 1GE & 100MbE Network Emulator Software and 2 Port License Upgrade
930-2704	Network Emulator II Upgrade: Ethernet 1GE & 100MbE Network Emulator Software and 2 Port License Upgrade
930-2705	Network Emulator II: Ethernet 1GE & 100MbE Network Emulator Software and 8 Port License Bundle

SUPPORTED TRANSCEIVERS

ETHERNET TRANSCEIVERS	10G	1G	COPPER	MODE/NM
958-0053	✔			Multi/850
958-0054	✔			Single/1310
958-0030		✔		Multi/850
958-0031		✔		Single/1310
958-0036		✔	✔	RJ45
988-0011	✔	✔		Multi/850

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