

# 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

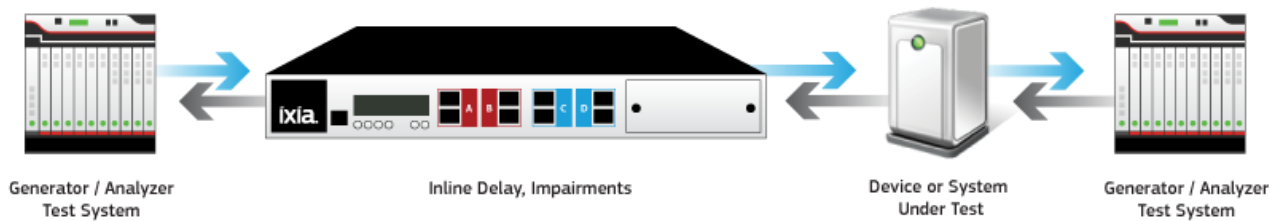
### Emulate real-world networks in the lab

- 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+ mode enables IP Fragmentation

## 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
<b>Ports</b>	<ul style="list-style-type: none"> <li>• 8 FPGA ports, divided into two banks of 4 ports each</li> <li>• All ports support 10GE, 1GE, and 100MbE</li> <li>• All ports support Fibre Channel with additional licensing</li> <li>• Each bank may run a different speed and choice of Ethernet or Fibre Channel protocol</li> <li>• License only what is needed, allowing for efficient cost</li> <li>• Flexible Resource Management provides performance when you need it               <ul style="list-style-type: none"> <li>○ Full 100% line-rate support for 8 ports of 1G</li> <li>○ Full 100% line-rate support for 4 ports of 10G (2 ports per bank)</li> <li>○ Full 100% line-rate support for 4 ports of 10G and 4 ports of 1G (each bank must run 2 ports of each speed)</li> <li>○ 8 ports of 10GE can be used when sharing bandwidth of 11G per bank</li> </ul> </li> </ul> <p>Note: Each line to be impaired requires 2 ports</p>
<b>Traffic Selection</b>	<ul style="list-style-type: none"> <li>• Classifier pattern matching allows selection of specific traffic               <ul style="list-style-type: none"> <li>○ Standard filters available such as MAC, IP, and VLAN</li> <li>○ Custom Byte Offset</li> <li>○ Up to 32 bytes for matching</li> </ul> </li> </ul>
<b>32 Classifier Profiles Per Bank with Flexible Allocation</b>	<ul style="list-style-type: none"> <li>• Flexible Resource Management provides ability to allocate resources in the required manner. Flexible Resource Management has two modes: ETHERNET and ETHERNET+. IP Fragmentation requires ETHERNET+ mode.</li> <li>• Each line to be impaired requires a port pair</li> <li>• Ports 1&amp;2, 3&amp;4, 5&amp;6, 7&amp;8 are paired and traffic flow is between port pairs</li> <li>• Flexible Resource Management allows Profiles to be configured from the Profile Pool as needed, allowing for the most efficient use of system resources</li> </ul>

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	<ul style="list-style-type: none"> <li>○ 32 Profiles per bank allocated as needed by the user or 16 in Ethernet+ mode</li> <li>○ 1 default profile is allocated to each port</li> <li>○ 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.</li> <li>○ In Ethernet+ mode the above profile pool is up to 7 profiles per port, per traffic direction allowing 15 profiles per bidirectional traffic flow.</li> <li>● FPGA hardware-driven implementation ensures accuracy and repeatable testing</li> <li>● Network Profiles support emulating multiple “network clouds” per interface: emulate different paths through a network or different classes of service               <ul style="list-style-type: none"> <li>○ 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</li> <li>○ Define bandwidth, delay, and impairments per profile</li> </ul> </li> <li>● Classify up to any 32 bytes within an Ethernet frame</li> </ul>																
<p><b>Delay</b></p>	<ul style="list-style-type: none"> <li>● Emulate delay occurring during transmission through an Ethernet network</li> <li>● Fully transparent pass-through operation for fiber where delayed output is logically identical to input signal</li> <li>● Delay at 100% line rate</li> </ul> <table border="1"> <thead> <tr> <th></th> <th>10GE</th> <th>1GE</th> <th>100MBE</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>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</p>		10GE	1GE	100MBE	Max Delay at Line Rate	2 seconds	20 seconds	30 seconds	Max Delay at Limited Line Rate	30 seconds	30 seconds	30 seconds	Resolution (Min Delay Increment)	6.4 ns	64 ns	640 ns
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<p><b>Packet Delay Variation</b></p>	<ul style="list-style-type: none"> <li>● Introduce frame or packet delay variation (jitter)</li> <li>● Impairment distribution: Gaussian, Periodic, Uniform, or Custom</li> <li>● Timing transparent pass-through operation: Physical medium clock is maintained between ingress and egress port</li> </ul>																

FEATURE	DETAILS
<b>Packet Drop</b>	<ul style="list-style-type: none"> <li>• Packet Drop impairment allowing single or multiple packets to be dropped</li> <li>• Variable by Periodic, Poisson, Uniform, and Gaussian distributions</li> </ul>
<b>Packet Duplication</b>	<ul style="list-style-type: none"> <li>• Packet Duplication impairment allows single or multiple packets to be duplicated</li> <li>• Variable by Periodic, Poisson, Uniform, and Gaussian distributions</li> </ul>
<b>Packet Reorder</b>	<ul style="list-style-type: none"> <li>• Packet Reorder impairment allows the reorder of single or multiple packets as specified by the options</li> <li>• Variable by Periodic, Poisson, Uniform, and Gaussian distributions</li> </ul>
<b>Packet Accumulate-Burst</b>	<ul style="list-style-type: none"> <li>• 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</li> </ul>
<b>Packet Modification</b>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>
<b>Checksum Correction</b>	<ul style="list-style-type: none"> <li>• Checksum correction is also available and can optionally be enabled to ensure that modified packets are valid and not dropped</li> </ul>
<b>IP Fragmentation</b>	<ul style="list-style-type: none"> <li>• IP Fragmentation allows the fragmentation of packets according to RFC791</li> </ul>
<b>Line BER</b>	<ul style="list-style-type: none"> <li>• Capable of injecting bit-errors at rates <math>5 \times 10^{-4}</math> to <math>5 \times 10^{-17}</math>, which allow errors from one in every 1000 bits to once every several years</li> <li>• Error distributions of Periodic, Uniform, Gaussian, and Poisson</li> <li>• 1-bit to 64K-bit error burst – invert, PRBS, all ones, or all zeros</li> </ul>
<b>Laser Impair</b>	<ul style="list-style-type: none"> <li>• Emulate loss of signal, loss of frame under user, or program control</li> </ul>
<b>Rate Limiting &amp; Shaping</b>	<ul style="list-style-type: none"> <li>• Line Policing added in the 3.0 product version <ul style="list-style-type: none"> <li>○ MEF10-compliant algorithm to limit traffic flow through the Network Emulator</li> <li>○ Robust configuration allows for configuration of Burst Tolerance, Rate Coupling, and Flow Control</li> <li>○ Can be applied at the line or profile level</li> </ul> </li> <li>• Line Shaping added in the 3.1 product version <ul style="list-style-type: none"> <li>○ Controls outgoing traffic to prevent buffer overflow and reduces the burstiness of traffic.</li> <li>○ Can be applied at the line or profile level</li> </ul> </li> </ul>
<b>Statistics</b>	<ul style="list-style-type: none"> <li>• Robust statistics support with customizable flow based overview</li> </ul>

FEATURE	DETAILS
<b>Filter Libraries</b>	<ul style="list-style-type: none"> <li>• Filter Libraries allow you to customize the emulator for your specific protocol requirements <ul style="list-style-type: none"> <li>○ Advanced Protocol Filter Suite provides a growing list of filters including PPP, PTP, RSVP, IP, FCoE, FIP, OSPF, MPEG, and many others</li> <li>○ Customer Byte Offset functionality allows</li> </ul> </li> </ul>
<b>User Interface</b>	<ul style="list-style-type: none"> <li>• Remote monitoring and control via 10/100/1000 RJ45 Ethernet port</li> <li>• Intuitive and interactive web GUI interface</li> <li>• Multiple user accounts and account management (12 concurrent users maximum)</li> <li>• Display-only accounts</li> <li>• RESTful API allows test automation and complete control of all functionality</li> <li>• The following browsers and versions are supported <ul style="list-style-type: none"> <li>○ Internet Explorer version 9 or higher</li> <li>○ Mozilla Firefox version 24 or higher</li> </ul> </li> </ul>

## NETWORK EMULATOR II SYSTEM SPECIFICATIONS

FEATURE	DETAILS
<b>Chassis</b>	<ul style="list-style-type: none"> <li>• Rack mount and desktop mounting hardware included</li> <li>• 1U rack-mountable</li> <li>• Dimensions: 1U - 1.73 x 17.3 x 10" (4.6 x 43.9 x 25.4 cm)</li> <li>• Weight: 9 lb. (4.08 kg)</li> <li>• Thermal <ul style="list-style-type: none"> <li>○ Operating temperature: 0° to 40° C (32 to 104° F)</li> <li>○ Operating humidity: 10 to 85% (RH), non-condensing</li> <li>○ Storage temperature: -40°C to 70°C (-40 to 158 F)</li> <li>○ Storage humidity: 5 to 95% (RH), non-condensing</li> </ul> </li> <li>• Input power (internal AC/DC converter) <ul style="list-style-type: none"> <li>○ Input voltage: 100-240VAC</li> <li>○ Input frequency: 47-63Hz</li> </ul> </li> <li>• Max. power consumption: 100W (typical), 175 (max)</li> </ul>

FEATURE	DETAILS
<b>Regulatory Approvals</b>	<ul style="list-style-type: none"> <li>• CE</li> <li>• UL 60950-1, 2nd Edition</li> <li>• FCC Class A</li> <li>• ROHS compliant</li> <li>• UL File #: E255262</li> </ul>
<b>Transceivers supported</b>	<ul style="list-style-type: none"> <li>• SFP and SFP+ form factors</li> <li>• Copper SFP</li> </ul>

## PRODUCT ORDERING INFORMATION

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