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 enabling 10G on 4 ports at line rate or 8 ports sharing bandwidth of 11G per bank
  - Configuration of any port to either Ethernet or Fibre Channel (with additional licenses) and speed supported
- 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

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

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>DETAILS</th>
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</table>
| 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  
• 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
- Profiles can be configured from the Profile Pool as needed, allowing for the most efficient use of system resources.
  - 32 Profiles per bank allocated as needed by the user.
  - 1 default profile is allocated to each port.
  - Flexible Resource Management allows allocation from the Profile Pool enabling up to 15 profiles per port, per traffic direction allowing 30 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.

### Delay
- 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>
<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 s</td>
<td>20 s</td>
<td>30 s</td>
</tr>
<tr>
<td>Max Delay at Limited Line Rate</td>
<td>30 s</td>
<td>30 s</td>
<td>30 s</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>

**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.
<table>
<thead>
<tr>
<th>FEATURE</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packet Delay Variation</td>
<td>• Introduce frame or packet delay variation (jitter)</td>
</tr>
<tr>
<td></td>
<td>• Impairment distribution: Gaussian, Periodic, Uniform, or Custom</td>
</tr>
<tr>
<td></td>
<td>• Timing transparent pass-through operation: Physical medium clock is maintained between ingress and egress port</td>
</tr>
<tr>
<td>Packet Drop</td>
<td>• Packet Drop impairment allowing single or multiple packets to be dropped</td>
</tr>
<tr>
<td></td>
<td>• Variable by Periodic, Poisson, Uniform, and Gaussian distributions</td>
</tr>
<tr>
<td>Packet Duplication</td>
<td>• Packet Duplication impairment allows single or multiple packets to be duplicated</td>
</tr>
<tr>
<td></td>
<td>• Variable by Periodic, Poisson, Uniform, and Gaussian distributions</td>
</tr>
<tr>
<td>Packet Reorder</td>
<td>• Packet Reorder impairment allows the reorder of single or multiple packets as specified by the options</td>
</tr>
<tr>
<td></td>
<td>• Variable by Periodic, Poisson, Uniform, and Gaussian distributions</td>
</tr>
<tr>
<td>Packet Accumulate-Burst</td>
<td>• 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</td>
</tr>
<tr>
<td>Packet Modification</td>
<td>• 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.</td>
</tr>
<tr>
<td>Checksum Correction</td>
<td>• Checksum correction is also available and can optionally be enabled to ensure that modified packets are valid and not dropped</td>
</tr>
<tr>
<td>Line BER</td>
<td>• 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</td>
</tr>
<tr>
<td></td>
<td>• Error distributions of Periodic, Uniform, Gaussian, and Poisson</td>
</tr>
<tr>
<td></td>
<td>• 1-bit to 64K-bit error burst – invert, PRBS, all ones, or all zeros</td>
</tr>
<tr>
<td>Laser Impair</td>
<td>• Emulate loss of signal, loss of frame under user, or program control</td>
</tr>
<tr>
<td>Rate Limiting &amp; Shaping</td>
<td>• Line Policing added in the 3.0 product version</td>
</tr>
<tr>
<td></td>
<td>o MEM10-compliant algorithm to limit traffic flow through the Network Emulator</td>
</tr>
<tr>
<td></td>
<td>o Robust configuration allows for configuration of Burst Tolerance, Rate Coupling, and Flow Control</td>
</tr>
<tr>
<td></td>
<td>o Can be applied at the line or profile level</td>
</tr>
<tr>
<td></td>
<td>• Line Shaping added in the 3.1 product version</td>
</tr>
<tr>
<td></td>
<td>o Controls outgoing traffic to prevent buffer overflow and reduces the burstiness of traffic.</td>
</tr>
<tr>
<td></td>
<td>o Can be applied at the line or profile level</td>
</tr>
</tbody>
</table>
# NETWORK EMULATOR II SYSTEM SPECIFICATIONS

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>DETAILS</th>
</tr>
</thead>
</table>
| 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  
  o Operating temperature: 0° to 40° C (32 to 104° F)  
  o Operating humidity: 10 to 85% (RH), non-condensing  
  o Storage temperature: −40°C to 70°C (-40 to 158 F)  
  o Storage humidity: 5 to 95% (RH), non-condensing  
• Input power (internal AC/DC converter)  
  o Input voltage: 100-240VAC  
  o Input frequency: 47-63Hz  
• Max. power consumption: 100W (typical), 175 (max) |

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**DATA SHEET**

**FEATURE** | **DETAILS**
---|---
Statistics | • Robust statistics support with customizable flow based overview
Filter Libraries | • Filter Libraries allow you to customize the emulator for your specific protocol requirements  
  o Advanced Protocol Filter Suite provides a growing list of filters including PPP, PTP, RSVP, IP, FCoE, FIP, OSPF, MPEG, and many others  
  o Customer Byte Offset functionality allows
User Interface | • Remote monitoring and control via 10/100/1000 RJ45 Ethernet port  
• Intuitive and interactive web GUI interface  
• RESTful API allows test automation and complete control of all functionality  
• The following browsers and versions are supported  
  o Internet Explorer version 9 or higher  
  o Mozilla Firefox version 24 or higher
### 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

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>946-0070</td>
<td>Network Emulator II: Rack mountable 1U 8 port emulator (requires 1 license below)</td>
</tr>
<tr>
<td>930-2700</td>
<td>Network Emulator II: Ethernet 10GE, 1GE &amp; 100MbE Network Emulator Software and 8 Port License Bundle</td>
</tr>
<tr>
<td>930-2701</td>
<td>Network Emulator II: Ethernet 10GE, 1GE &amp; 100MbE Network Emulator Software and 2 Port License</td>
</tr>
<tr>
<td>930-2702</td>
<td>Network Emulator II: Ethernet 1GE &amp; 100MbE Network Emulator Software and 2 Port License</td>
</tr>
<tr>
<td>930-2703</td>
<td>Network Emulator II Upgrade: Ethernet 10GE, 1GE &amp; 100MbE Network Emulator Software and 2 Port License Upgrade</td>
</tr>
<tr>
<td>930-2704</td>
<td>Network Emulator II Upgrade: Ethernet 1GE &amp; 100MbE Network Emulator Software and 2 Port License Upgrade</td>
</tr>
<tr>
<td>930-2705</td>
<td>Network Emulator II: Ethernet 1GE &amp; 100MbE Network Emulator Software and 8 Port License Bundle</td>
</tr>
</tbody>
</table>
## Supported Transceivers

<table>
<thead>
<tr>
<th>Ethernet Transceivers</th>
<th>10G</th>
<th>1G</th>
<th>Copper</th>
<th>Mode/NM</th>
</tr>
</thead>
<tbody>
<tr>
<td>958-0053</td>
<td>✓</td>
<td></td>
<td></td>
<td>Multi/850</td>
</tr>
<tr>
<td>958-0054</td>
<td>✓</td>
<td></td>
<td></td>
<td>Single/1310</td>
</tr>
<tr>
<td>958-0030</td>
<td></td>
<td>✓</td>
<td></td>
<td>Multi/850</td>
</tr>
<tr>
<td>958-0031</td>
<td></td>
<td>✓</td>
<td></td>
<td>Single/1310</td>
</tr>
<tr>
<td>958-0036</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>RJ45</td>
</tr>
<tr>
<td>988-0011</td>
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<td>✓</td>
<td></td>
<td>Multi/850</td>
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