

# Spirent Network Emulator

Get Predictable Infrastructure Performance with Industry's Highest Port Density

## Key Highlights

- Multi-user
- Multi-port – best-in-class port density with up to 16 ports 1GbE, up to 12 ports 10GbE, and up to 4 ports 25GbE
- 1GbE, 10GbE and 25GbE interfaces supported
- Network simulation – create complex multi-hop networks using virtual routers for cloud, data-center, customer and WAN simulation
- Connect any-port to any-port without limitations
- Delay emulation up to 10 seconds
- Over 55+ impairments and tools
- Audio and video modification and corruption
- Packet fragmentation and reordering
- Includes generic full packet inspection and filtering
- Packet modification; change any bits or bytes of any packet
- Load generators
- Non-volatile capture and replay
- RESTful API
- Link flapping

## Test with Real-world Network Conditions in Your Lab

Real-life networks are a complex system of changing conditions, flexible routes and competing applications. And the only way to get predictable infrastructure performance is to test before deployment.

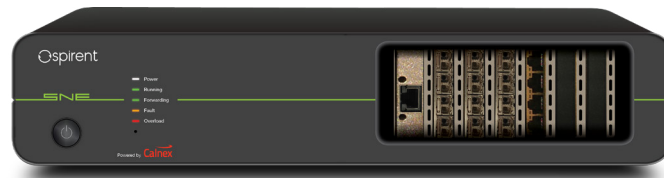
The Spirent Network Emulator provides industry-leading flexibility in building and modelling these complex real-life systems enabling you to simulate networks and emulate the real world conditions under which applications and platforms need to perform.

## Extreme Flexibility – Multi-port and Multi-user

Spirent Network Emulator is a highly flexible solution for both network emulation and network simulation. Whether you want to emulate point-to-point links, simulate complex data-centers with multiple gateways or extract out analytical information on video systems, with the Spirent Network Emulator you can build your network in seconds.

And because every network and project requirement is different – depending on factors such as location, connectivity, quality of service, number of services and the applications being used across it – reaching beyond simple delay, jitter and bandwidth emulation is essential for any business.

Further, Network Emulator offers a multi-user, multi-port environment. Each user can be allocated a pair of ports, or a number of ports, and can password protect these ports for their own exclusive use. This ensures a very cost effective and flexible means of providing test resources to a team or department.



Spirent Network Emulator is available with multiple hardware options, including:

- Multi-port – market leading port density with up to 16 ports 1GbE, up to 12 ports 10GbE, and up to 4 ports 25GbE
- Flexible configuration—mix and match interface cards to meet your needs
- Flexible interfaces; RJ-45, SFP+ or SFP28 (or a mixture)
- Wireshark integration
- Easy automation via remote control using RESTful API
- Flow packets between any port, no limitations
- Up to 12 minutes of storage for wire-rate recording at 10Gbps
- Delay emulation up to 4 seconds at 10GbE/1GbE
- Fast visual emulation design creates networks in seconds

## Emulate Real Network Conditions

- Busy peak times
- Long distance
- Jittery connections
- Duplication of data
- Fragmentation of data
- Traffic re-routing
- Limited bandwidth
- Packet corruption
- De-sequencing of data
- Network traffic bursts
- Partial or total outage
- Back-up switchovers

## Applications

Spirent Network Emulator is a total solution to the problem of real-world Ethernet testing. It combines comprehensive and highly-accurate network emulation to enable you to:

**Troubleshoot** – Investigate reported problems and test resolutions without disrupting production traffic. Moreover, test specific scenarios and gain insight and data about where and when problems arise to identify effective resolutions before they become live issues.

**Design Networks** – Create ‘what if?’ scenarios to evaluate network changes; evaluate different topologies and technologies before expensive implementation. For example, evaluate WAN Acceleration Technology by determining how different WAN optimization products will perform under the best/average/worst conditions of your network.

**Test Application Performance** – Determine how your software will perform for the end user on their network before deployment; troubleshoot and resolve issues before the need for re-work, release delay or failure.

**Optimize Performance** – Adjust application and software settings under replicated network characteristics to optimize performance for different user groups.

### Use Network Emulator to test:

- Video/voice applications (IPTV, VoIP, etc.)
- Mobile subscriber networks (VoLTE, eMBMS, etc.)
- Content delivery networks
- Cloud computing/migration
- CoS/QoS levels
- WAN acceleration/network optimization
- LAN/WAN enterprise networks
- ADSL/FTTH
- SLA verification
- ITU-T Y.1731/IEEE 802.1ag operations and maintenance
- Satellite links
- Storage networks
- Telecom/Federal network applications
- Carrier Wi-Fi
- Cable/broadband networks
- SD-WAN
- Broadcast quality video networks

## Visual Design

Using Network Emulator's unique visual design to build emulations, you take control by linking together impairments in the order you require while directly controlling the flow of packets around your simulated network.

The user interface (UI) provides a fast and responsive graphical environment for you to build emulations. The flexible UI enables you to drag and drop from the extensive list of impairments into your network to create specific scenarios to meet your testing needs.



## Features

**Wire Rate** – The Spirent Network Emulator supports wire rate performance. All 10GbE ports are dual rate, supporting 10GbE and 1GbE operation. All 25GbE ports are multi-rate, supporting 25GbE, 10GbE and 1GbE operation. This makes the Network Emulator very flexible and can be tailored to your individual throughput needs.

**"Any Port to Any Port"™ Capabilities** – Network Emulator comes with true "Any Port to Any Port"™ capabilities. Whether you are using 4, 8 or 16 ports they will all communicate with each other without limitation.

Many emulate products may state you are buying a '4 port emulator' but often what you actually get is two 'emulators' each with two ports inside a single box. There may be four ports on the outside, but the reality is that you have two independent emulators and you won't be able to send packets between each. So effectively you have got two emulators with two ports, not the four ports you need.

**Fragmentation and Reordering** – When packets cross network boundaries they can become fragmented. Network Emulator can fragment packets to simulate MTU changes down to 64 bytes. Packets can also be reordered either by displacing the packets "X" number of frames or time into the future.

**Automation Ready** – We understand that everyone's automation environments are different. Network Emulator can be controlled externally through a variety of methods. A RESTful API is provided offering powerful and efficient web-based automation. In addition, a Timeline (auto-change) feature allows you to easily automate emulation via the GUI. Developers can also directly issue XML requests to the emulator to gain deeper and full control of its operation.

## Use the Spirent Network Emulator to accurately simulate:

- SD-WAN
- Broadcast quality video networks
- VoIP
- Microwave
- Wi-Fi and WiMAX
- Satellite
- RoIP
- Cloud
- 3G and 4G
- GPRS
- Dial Up
- DSL, ADSL and XDSL

## Features (cont'd)

**Load Generation** – Very few networks are silent as there is always a certain amount of background traffic. Whether it is file servers, printers or other devices generating traffic, it is important to model it correctly.

Network Emulator provides a number of ways of generating this traffic including background traffic generation (contention), TCP load generators, PCAP file replay, etc.

**Switchover and Back-up Circuits** – Built on top of our powerful filtering system, you can easily simulate multiple paths in any network and switch between them in real-time (or using an external trigger). This allows you to model a 'good' and 'poor' network and switch between them in real time, plus you can create an unlimited number of paths.

**Video and Audio** – Dedicated impairments allow smart degradation of video (H.264), audio streaming, RTP, RTCP and much more. Understand how robust your AV equipment is to corruption of video or audio framing, and view analytics information on video format internals.

**Impairments** – Network Emulator provides all the common impairments including delay, jitter, throttle, and so on. Furthermore, it also provides advanced impairments including fragmentation, video corruption, BER corruption, reordering and many more.

**Comprehensive Settings** – Not only do you get 55+ impairments, but each one of those impairments has extensive options and settings to uniquely control their operation. This gives you an unparalleled level of fine tuning such as buffer and burst management on bandwidth throttles, or affecting only B-Frames in H.264 video streams.

**Filtering** – It's very important to be able to identify and target certain streams of data on an emulated network. Network Emulator provides a host of built-in filters to identify packets for impairment or analysis. Moreover, you can join filters together to create more complex filters (for example, you could find HTTP traffic going to Port 8080 on VLAN ID 90 with only two filters).

**Flexible UI with Wizards and Easy Licensing** – The Windows user interface provides a fast and responsive environment for you to build emulations. We've included some handy wizards to help you quickly create example networks and which don't lock you down to restrictive licensing (plus, install them on as many machines as you want).

**Virtual Routers** – Routers typically sit at the edge of most networks; they provide your ADSL connection in your business or accessibility to a cloud server through an ISP backbone.

Network Emulator contains full Virtual Router simulation, providing a method for simulating multi-hop WAN networks. These Virtual Routers provide DHCP or Static IP address assignment, automatic and manual routing table and multiple virtual interfaces. They will respond to both local and WAN pings and provide detailed analysis on packets received.

They also include OSPF to allow for the simulation of complex ring, double ring and double star topology networks with the ability to self-heal when injected faults are detected.

Technical Specifications	PRODUCT RANGE		
	1G	10G	25G
<b>Physical</b>			
<b>Network Interfaces</b>	up to 16	up to 12	up to 4
<b>Standard Network Interfaces</b>	GbE Copper	SFP+	SFP28
<b>Optional Network Interfaces</b>	RJ45	SFP+	SFP28
<b>Max. Packet Rate Per Port (bi-directional)</b>	2.96 million	29.6 million	33.5 million
<b>Dimensions</b>	2u Rack	2u Rack	2u Rack
<b>Intrinsic Latency</b>	<20µs	<20µs	<20µs
<b>Max. Frame Size</b> – Jumbo Mode 9219 bytes; Non-jumbo Mode 1542 bytes	✓	✓	✓
<b>General</b>			
<b>Timing Precision</b>	10µs	10µs	10µs
<b>Any Port to Any Port</b> <sup>™</sup> 4, 8, 16 ports – packets can be sent between any port for complete flexibility	✓	✓	✓
<b>Live Changes</b> – Real-time modification of any impairment setting or network map	✓	✓	✓
<b>Traffic Capture and Replay with Looping Option</b> Volatile Storage (4G RAM) Non-volatile Storage (1TB SSD)	✓ optional	✓ optional	✓ optional
<b>Bi-directional, Independent Emulations</b>	✓	✓	✓
<b>Timeline</b> – Schedule changes to emulation settings with no manual intervention required. Option: loop timeline for continuous playback	✓	✓	✓
<b>Link Flap</b>	✓	✓	✓
<b>Modes of Operation</b>			
<b>Virtual Routing (Simulate routers / ADSL Gateways)</b> Protocols – DHCP, ARP, ICMP, IGMP, etc DHCP – Enable / Disable Routing Table – Auto generate, manual Multiple WAN Links	✓	✓	✓
<b>Cloud / Data-center Simulation</b> – Simulate multi-hop routed networks; OSPF support for self healing and internet simulation	✓	✓	✓
<b>Bridged Mode</b> – Option to impair all traffic sent and received (protocol filtering available)	✓	✓	✓
<b>Delay Emulation</b> – up to 4s at 25GbE; up to 4s at 10GbE; up to 10s at 1GbE			
1GbE Delay Emulation – up to 1.25secs	✓	✓	✓
10GbE Delay Emulation – up to 0.5secs	n/a	✓	✓
25GbE Delay Emulation – up to 0.5secs	n/a	n/a	✓
1GbE Extended Delay Emulation – up to 10secs	optional	optional	optional
10GbE Extended Delay Emulation – up to 4secs	n/a	optional	optional
25GbE Extended Delay Emulation – up to 4secs	n/a	n/a	optional
<b>Fixed Latency</b>	✓	✓	✓
<b>Variable Latency</b>	✓	✓	✓
<b>Ramp</b>	✓	✓	✓
<b>Normal / Gaussian</b>	✓	✓	✓
<b>Sinusoidal Wave</b>	✓	✓	✓
<b>Jitter</b> – 0.1ms to 100ms or 0.1 to 100% of constant delay	✓	✓	✓
<b>Timing Constraints</b> (specify start and duration of impairments activity) Start / Duration 0.1ms to 360,000ms (in 0.1ms increments)	✓	✓	✓

Technical Specifications (cont'd)	PRODUCT RANGE		
	1G	10G	25G
<b>Bandwidth Emulation</b>			
<b>Constant Throttle</b>	500bps to 1Gbps	500bps to 10Gbps	500bps to 10Gbps
<b>Random Range</b> (min to max with time constraints)	500bps to 1Gbps	500bps to 10Gbps	500bps to 10Gbps
<b>Random Range Duration</b> – 1000ms to 60 minutes (in 0.1ms increments)	✓	✓	✓
<b>Background Traffic Generation</b>			
<b>Fixed Data Rate:</b> 500bps to 10Gbps Percentage of available link: 1 to 99% Generate broadcast packets Range (min to max with time constraints)	500bps to 1Gbps	500bps to 10Gbps	500bps to 10Gbps
<b>Range Duration</b> 0.1ms to 360,000ms (in 0.1ms increments)	✓	✓	✓
<b>Reordering</b>			
<b>Time Based Re-order</b> Displace packet from 0.1ms to 500 ms	✓	✓	✓
<b>Position Base Re-order</b> Displace packet up to 1,000,000 places	✓	✓	✓
<b>Corruption</b>			
<b>Bitflips</b> Start and end position (first byte to last byte), 1 to 100%	✓	✓	✓
<b>Byte Overwrites</b> Start and end position (first byte to last byte), 1 to 100%	✓	✓	✓
<b>Ethernet Fragmentation</b> MTU: 128 to 1580	✓	✓	✓
<b>Bit Error Rate (Per) Simulation</b> x bits in y received (1 bit to IE-14)	✓	✓	✓
<b>Enable/Disable FCS</b>	✓	✓	✓
<b>Duplication</b>			
<b>Simple</b> (single duplication) Packets received on link will be immediately duplicated once	✓	✓	✓
<b>Timed</b> (duplicated every x seconds) Single duplication after specified delay (1ms to 1,000ms)	✓	✓	✓
<b>Complex</b> (multiple, timed duplication) Specified multiple duplications after specified time delay (1ms to 1,000ms)	✓	✓	✓
<b>Loss</b>			
<b>Standard</b> – Drop x packets in y received	✓	✓	✓
<b>Percentage</b> – Drop 1% to 100% (in increments of 1%)	✓	✓	✓
<b>Outage</b> – Drop all packets received on specified link	✓	✓	✓
<b>Drop Evenly</b> – Packets will be dropped regularly throughout emulation	✓	✓	✓
<b>Drops in Bursts</b> – Packets will be dropped in continuous groups	✓	✓	✓
<b>Timing Constraints</b> – Start / Duration 0.1ms to 360,000ms (in 0.1ms increments)	✓	✓	✓

Technical Specifications (cont'd)	PRODUCT RANGE		
	1G	10G	25G
<b>Modification</b>			
<b>Generic Packet Modifier</b> Modify up to 6 bit / byte sections per packet	✓	✓	✓
<b>TAP (Test Access Point) Devices</b> (Extract analysis information from any part of the emulation)			
<b>Bandwidth Graph</b> Show bandwidth utilization – export, clipboard, peak and averaging, etc.	✓	✓	✓
<b>Packet Rates</b> Show packet utilization, Inter Packet Gap	✓	✓	✓
<b>RTP Analyser</b> Output detailed information on RTP streams	optional	optional	optional
<b>RTCP Analyser</b> Output detailed information on RTCP streams	optional	optional	optional
<b>Stateless load generation with multiple load distribution models</b>			
<b>Generic / RAW Load Generator</b> Generic any type of load with extensive stream options	optional	optional	optional
<b>TCP Client</b> Simulate clients with data streams	optional	optional	optional
<b>TCP Server</b> Simulate servers with data streams	optional	optional	optional
<b>DDOS Simulation</b> Simulate extremely stressful DDOS environments	optional	optional	optional
<b>Audio Visual (AV) Pack</b>			
<b>RTP Filter</b>	optional	optional	optional
<b>MPEG H.264 Filter</b>	optional	optional	optional
<b>MPEG H.264 Corruptor</b>	optional	optional	optional
<b>G.1050 Wizard (TIA-921)</b>	✓	✓	✓
<b>Management</b>			
<b>Drag and Drop User Interface</b> Simple User Interface, allowing user to draw out their target network on screen, drop impairments as required and visualise the network-under-test	✓	✓	✓
<b>Open XML for Test Automation</b> Easy integration with test environments to schedule, run and report on emulations without recourse to user interface	✓	✓	✓
<b>RESTful API for Test Automation</b>	✓	✓	✓
<b>SNMP</b> Operational based SNMP traps and alerts	✓	✓	✓
<b>Smart Start-up</b> Automatically launch previous map on boot	✓	✓	✓
<b>Multi-user Support</b> Unlimited users / GUI instances, share maps, admin password control, assign ports to individual users	✓	✓	✓
<b>Hardware NTP / PTPv2 Time Stamping</b> Lock hardware and packet timings to accurate internal / external clocks	✓	✓	✓

Technical Specifications (cont'd)	PRODUCT RANGE		
	1G	10G	25G
<b>Filtering (UDP, TCP, Packet count)</b>			
<b>Maximum Filter</b> – Connect multiple filters in any way to create complex filter rules	unlimited	unlimited	unlimited
<b>IP Source / destination address filtering (impair specific traffic flows)</b>	✓	✓	✓
<b>TCP</b> – Advanced: Source and destination port filtering (including range) TCP Packet length filtering	✓	✓	✓
<b>UDP</b> – Advanced: Source and destination port filtering (including range) TCP Packet length filtering	✓	✓	✓
<b>MAC Address</b> – Src / Dst single or range	✓	✓	✓
<b>Ethernet Payload</b>	✓	✓	✓
<b>Packet Counting</b> – Fail or Pass filters based on packet count or percentage	✓	✓	✓
<b>Advanced Filtering</b>			
<b>Generic Filter</b> – Filter on multiple bit / byte values with logic operations	✓	✓	✓
<b>IP Protocol</b> – Payload Type and Value	✓	✓	✓
<b>MPLS</b> – MPLS Label, QoS Value, TTL Value	✓	✓	✓
<b>VLAN</b> – VLAN ID, User Priority	✓	✓	✓
<b>MPEG Video</b>	optional	optional	optional
<b>RTP A/V</b>	optional	optional	optional
<b>Flow Control (simulation link switching)</b>			
<b>Output Switcher</b> – Up to 4 available outputs	✓	✓	✓
<b>Input Switcher</b> – Up to 4 available inputs	✓	✓	✓
<b>Merge Tool</b>	✓	✓	✓
<b>Instancers (create unique impairments for hundreds of streams)</b>			
<b>VLAN Instancer</b>	✓	✓	✓
<b>MPLS Instancer</b>	✓	✓	✓
<b>Reporting</b>			
<b>Live Monitoring</b> – Bandwidth monitoring, packets per second, export to CSV max / average values, etc.	✓	✓	✓
<b>Wireshark Integration</b> (on up to 200 protocols) Allows for live traffic capture and root cause analysis; replay third-party traffic streams under impairments, record traffic and replay at a later date	✓	✓	✓



## Port Configuration and Performance:

1. Select the number of SNE ports required at each interface rate
2. The standard specification performance is labelled 'STD' in the configuration table below
3. The high port count specifications is labelled 'HPC' in the configuration table below.

## 10GbE Configuration Table

10GbE/1GbE Optical Ports (SFP+)								
	No. of Ports	0	2	4	6	8	10	12
<b>1GbE Electrical Ports (RJ45)</b>	0		STD	STD	STD	STD	HPC	HPC
	2	STD	STD	STD	STD	HPC	HPC	HPC
	4	STD	STD	STD	STD	HPC	HPC	HPC
	6	STD	STD	STD	HPC	HPC		
	8	STD	STD	STD	HPC	HPC		
	10	STD	STD	HPC				
	12	STD	STD	HPC				
	14	STD						
	16	STD						

## 25GbE (2 Ports) Configuration Table

2 ports of 25GbE SFP28 and see line below for number of 10GbE SFP+ Optical Ports					
	No. of Ports	0	2	4	6
<b>1GbE Electrical Ports (RJ45)</b>	0		STD	STD	STD
	2	STD	STD	STD	
	4	STD	STD	STD	
	6	STD	STD		
	8	STD	STD		
	10	STD			
	12	STD			

## 25GbE (4 Ports) Configuration Table

4 ports of 25GbE SFP28 and see line below for number of 10GbE SFP+ Optical Ports

	No. of Ports	0	2	4
<b>1GbE Electrical Ports (RJ45)</b>	0		STD	STD
	2	STD	STD	
	4	STD	STD	
	6	STD		
	8	STD		

STD	Combination of 2-port 10G modules and 4-port 1G modules – “Standard” performance specification
HPC	Combination of 4-port 10G modules and 4-port 1G modules – “High Port Count” performance specification

### STD (10GbE/1GbE Standard Specification)

- Wire Rate with 128 byte traffic on all ports (up to eight 10GbE ports)
- Wire Rate with 64 byte traffic on any four 10GbE ports or all 1GbE ports

### HPC (10GbE/1GbE High Port Count Performance)

- Wire Rate with iMix traffic on all ports (up to twelve 10GbE ports)
- Wire Rate with 64 byte traffic on any two 10GbE ports or all 1GbE ports

### 25GbE Specification

- 90% Wire Rate with iMix traffic on all 25GbE ports (up to four 25GbE ports)
- 97% Wire Rate with 512 byte traffic on all 25GbE ports (up to four 25GbE ports)

NOTE: DOES NOT INCLUDE mixing 4 port 10G modules and 2 port 10G modules – NOT CURRENTLY PERMITTED

## Contact Us

For more information, call your Spirent sales representative or visit us on the web at [www.spirent.com/ContactSpirent](http://www.spirent.com/ContactSpirent).

[www.spirent.com](http://www.spirent.com)

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