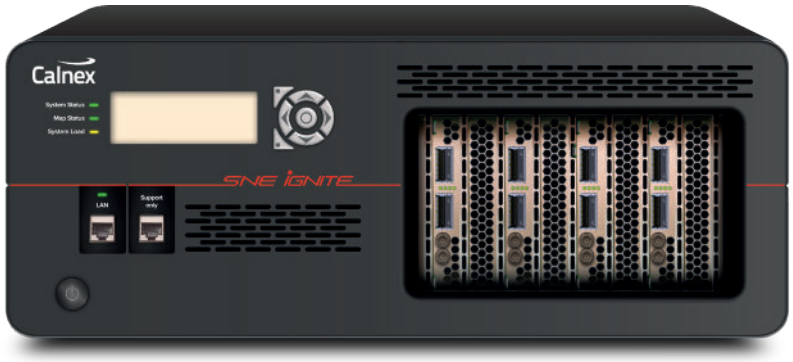
Calnex SNE **Ignite MX**

High Precision Network Emulation

Test 5G O-RAN with real-world network conditions in your lab

The SNE Ignite MX is a multi-port FPGA based, high precision Network Emulator designed to meet the stringent requirements associated with precision applications such as O-RAN Fronthaul testing. The Network Emulator supports 100GbE, 50GbE (PAM4), 40GbE, 25GbE and 10GbE Ethernet network impairments. The SNE Ignite MX is designed with:

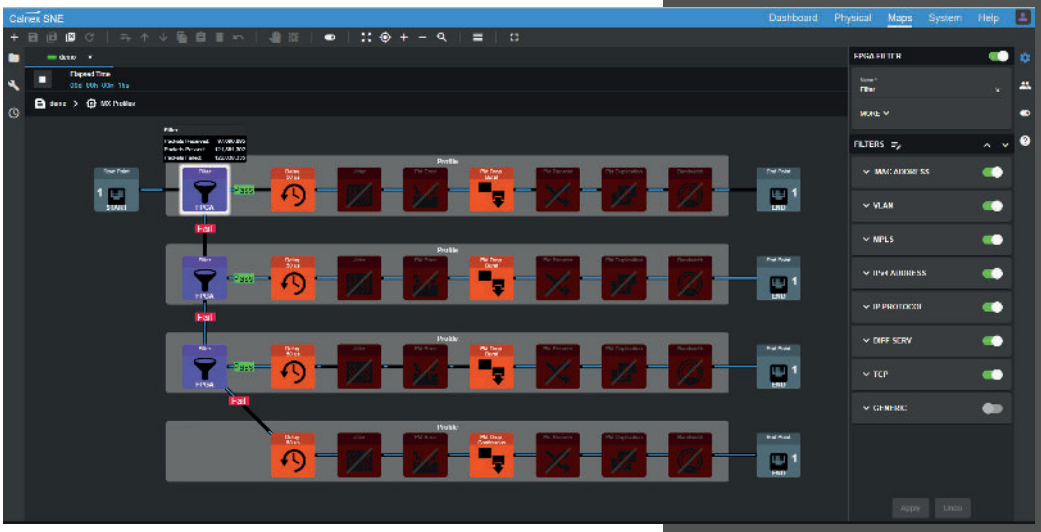
- **Low Intrinsic Latency:** many Fronthaul links, depending on O-RAN device classification, are intolerant to delays as low as 8µs
- **Low PDV/Low MTIE LPF:** many O-RU devices are intolerant to PDV
- **PTP Transparent Clock:** the SNE Ignite MX has an integral Transparent Clock (TC) to ensure that high priority O-RAN S-plane traffic is not affected by large User-Plane packets such as jumbo packets
- **ns Accuracy:** means accurate, repeatable testing
- **SyncE and External Clock Input:** enabling physical layer synchronization between devices such O-RAN Fronthaul DU to RU connections
- **Multi-port:** enabling testing of multiple devices or links simultaneously; supports up to 8 100GbE ports



Key Highlights

- **Full Line-Rate Network Emulation:** prove 100GbE, 50GbE, 40GbE, 25GbE and 10GbE device and infrastructure performance with full line-rate network simulation
- **Ultra High Precision Emulation:** nanosecond accuracy and repeatability means you emulate precisely what you think you're emulating
- **Full Line-Rate Delay:** of up to 320ms at 100GbE with extended delay option and up to 64 seconds at reduced bandwidth with extended delay option
- **SyncE Pass-Thru Mode:** maintains SyncE clock link between devices
- **PTP Transparent Clock:** ensures that high priority O-RAN S-plane traffic is not affected by large User-Plane packets
- **50GbE PAM4:** supports 50GbE SFP56 PAM4 interfaces. O-RAN Fronthaul connections are increasing in speed from 25GbE to 50GbE PAM4
- **Upgradeable:** the SNE Ignite MX provides a 50GbE PAM4 software option and a 100GbE software option. Simply add the 50GbE PAM4 option or 100GbE option when needed – protecting your investment

SNE Ignite MX user interface leverages the SNE's graphical map based WebUI.



Applications

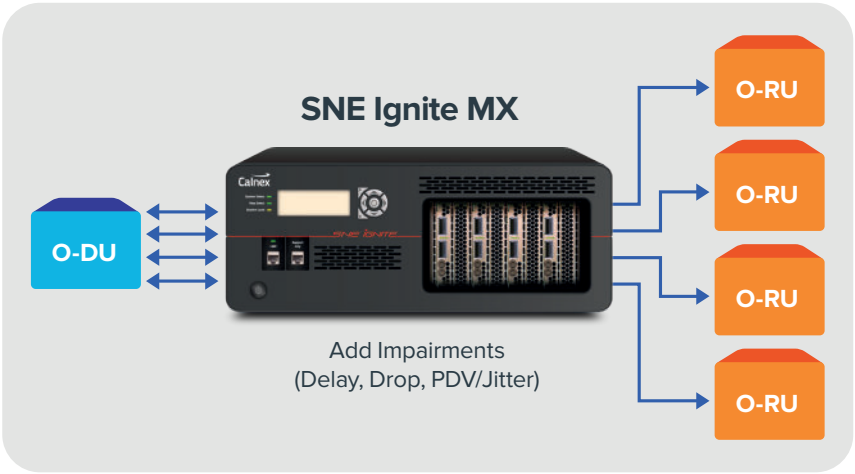
The SNE Ignite MX is a total solution to the problem of real-world Ethernet testing. It combines comprehensive and highly-accurate network emulation for:

- O-RAN Fronthaul (DU to RU) Test
- O-RAN Midhaul (CU to DU) Test
- 5G Mobile Edge Computing (MEC)
- 5G Core
- 5G Longhaul
- 5G Backhaul
- 5G Services (Video, AR/VR)
- Data Center – Interconnect, Migration
- Cloud Migration Planning
- Telecom/Federal Applications
- Defense Applications
- Customer Proof of Concept
- SLA Verification
- IPTV, Video

Features

The SNE Ignite MX is available with the following:

- Introduce Dropped, Re-ordered and Corrupted packets
- Add Duplicated packets
- Extensive and powerful set of filters to configure and inject impairments
- Web-based UI and graphical user interface
- FPGA architecture for high accuracy and throughput
- RESTful API



Technical Specifications	
Ports	
Optical Interfaces	100GbE: QSFP28 (LR4/SR4) – 2, 4, 6 or 8 ports (optional) 50GbE: SFP56 PAM4 (LR/SR) – 2, 4, 6 or 8ports (optional) 40GbE: QSFP+ (LR4/SR4) – 2, 4, 6 or 8 ports (optional) 25GbE: SFP28 (SR/LR) – 2, 4, 6 or 8 ports (optional) 10GbE: SFP+ (SR/LR) – 2, 4, 6 or 8 ports (optional) At least one of the 100GbE or 50GbE or 25GbE options **must** be ordered Optical Adaptors are provided to convert QSFP to SFP for 50GbE, 25GbE and 10GbE
Forward Error Correction	100GbE NRZ: RS(528,514) KR4 50GbE PAM-4: RS(544,514) KP4 25GbE NRZ: RS(528,514) KR4
Tx Line Rate Adjust	Supported via external reference clock input
External Ref. Clock Input	10MHz
SyncE Pass Thru	MX ports can sync to recovered clock and from external clock
Flows	
Impairment Profiles	Standard product includes 16 profiles allowing 8 flows of impaired packets in each direction. Each profile can be configured individually
Filtering	Powerful user-configurable filters including ranges and wildcards: • MAC Source and Destination Address, Length/Type • VLAN (Priority, VLAN ID & Type), CustomVLAN • CustomVLAN Length, Offset, Mask, Value • MPLS Label, CustomMPLS • CustomMPLS Length, Offset, Mask, Value • IPv4 Source and Destination Address • IPv4 Version No, DiffServ/ToS, Protocol • IPv6 Source and Destination Address • CustomL3 Length, Offset, Mask, Value • UDP/TCP Source port, Destination port • CustomL4 Length, Offset, Mask, Value
GTPv2	Targeted GTPv2 control message impairments (e.g. create session request, modify bearer request, etc.) • GTPv2 Version, Type, Tunnel EndPoint ID
eCPRI Filter	Targeted eCPRI impairments • eCPRI Revision, Concatenation Indicator, Message Type
RoE Filter	Targeted RoE (Radio over Ethernet) impairments • RoE Subtype
Custom L5 Filter	Length, Offset, Mask, Value
PTP Transparent Clock	1 Step Transparent Clock. • The residence time is measured and placed in the PTP event message correction field
General	
Web Browser User Interface	Drag and Drop User Interface Simple user interface allowing user to draw out their target network on screen, drop impairments as required and visualize the network-under-test
Remote Control	RESTful API for Test Automation
Smart Start-up	Automatically launch previous map on boot
Multi-user Support	Multiple users, share maps, assign ports to individual users

Technical Specifications (cont'd)	
Impairments	
Packet Corruption	• Corrupted packets: Corruption modes: burst (1–10,000), rate (0.00001 to 100%) Continuous or On/Off/Repeat based on time or number of packets • Dropped packets: Corruption modes: burst (1–10,000), rate (0.00001 to 100%) Continuous or On/Off/Repeat based on time or number of packets • Duplicated packets: Corruption modes: burst (1–10,000), rate (0.00001 to 100%) Continuous or On/Off/Repeat based on time or number of packets • Re-ordered packets: Corruption modes: burst (1–10,000), rate (0.00001 to 100%) Continuous or On/Off/Repeat based on time or number of packets
Latency/Delay and PDV/Jitter	• Gaussian distribution of delay • Gamma (internet) distribution of delay • Uniform distribution of delay • Step distribution of delay • Import from an external file • Jitter range from 1 µs to 400 ms; step size is 1 ns • Add independent delay/jitter distribution to each profile simultaneously • Readout of Max, Min Jitter and Max Delay for the applied distribution
Timeline	Easy automation via the Web UI without scripting or the need to learn Remote Control commands. This (auto-change) feature allows the user to easily automate emulation and schedule changes to emulation settings via the user interface with no manual intervention required. Users can loop the timeline for continuous playback
Minimum Delay Emulation (Intrinsic Delay)	• 6.8 µs at 10GbE • 6.8 µs at 25GbE • 8.2 µs at 10GbE (Jumbo Frame Mode) • 8.85 µs at 25GbE (Jumbo Frame Mode)
Maximum Delay Emulation	Line rate delay: Full line-rate delay of • 80 ms at 100GbE • 160 ms at 50GbE • 200 ms at 40GbE • 320 ms at 25GbE • 800 ms at 10GbE Delay Resolution 1 ns
Maximum Extended Delay Emulation	Delay Boost extends full line-rate delay to • 320 ms at 100GbE • 640 ms at 50GbE • 800 ms at 40GbE • 1280 ms at 25GbE • 3200 ms at 10GbE Extended delay up to 32s (all rates at 1G reduced bandwidth) Extended delay up to 64s (all rates at 500M reduced bandwidth) Delay Resolution 1 ns
Link Flap	Enables the ports to be cycled off/on to simulate Link Flapping
Timing accuracy	5ns

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