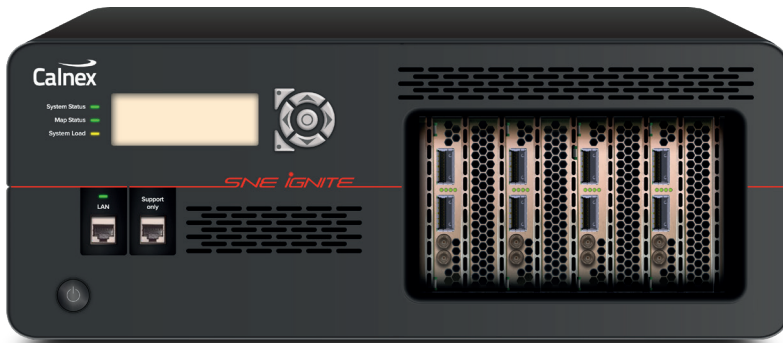


# High Precision Network Emulation

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

The SNE Ignite 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 is designed with:

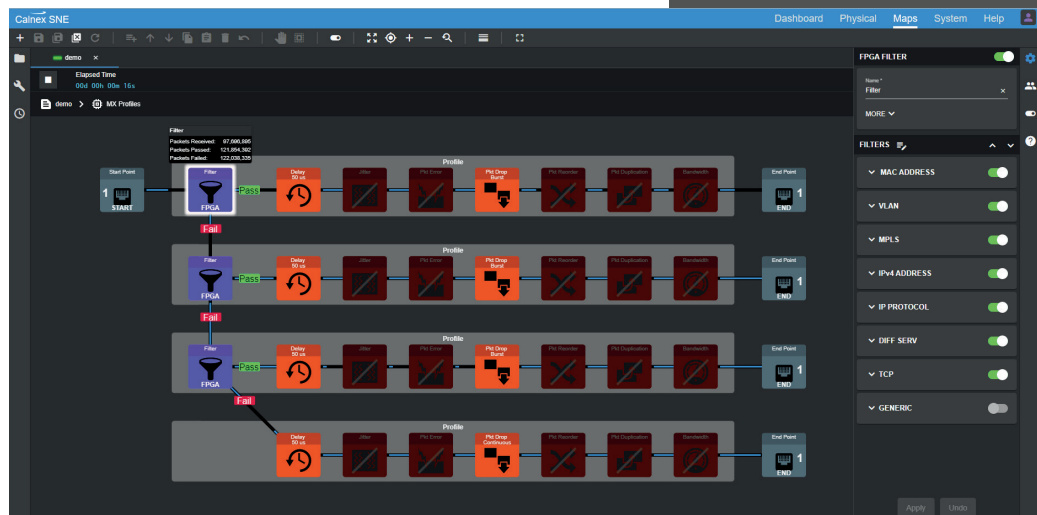
- **Low Intrinsic Latency:** many Fronthaul links, depending on O-RAN device classification, are intolerant to delays as low as 8 μs
- **Low PDV/Low MTIE LPF:** many O-RU devices are intolerant to PDV
- **PTP Transparent Clock:** the SNE Ignite has an integral Transparent Clock (TC) to ensure that high priority O-RAN S-plane traffic is not affected by large User-Plane packets such as jumbo packets
- **Nano-second 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 eight 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 42 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 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's user interface leverages the SNE's graphical map based WebUI.



## Applications

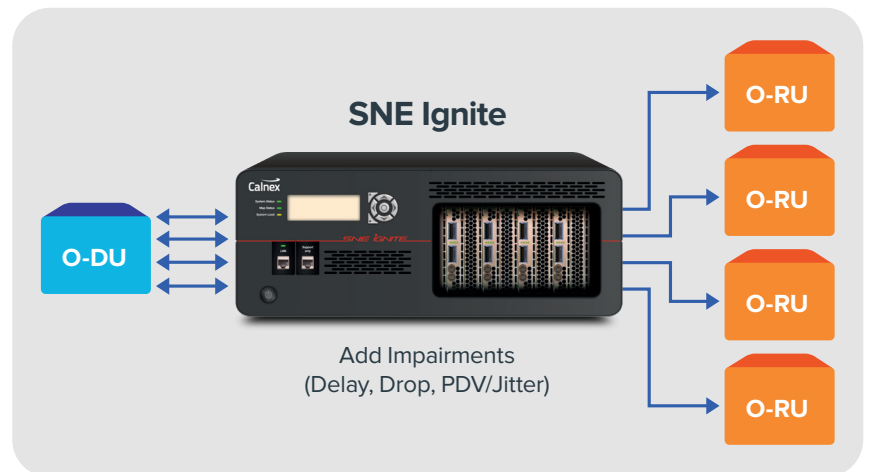
The SNE Ignite is a total solution to the problem of real-world Ethernet testing. It combines comprehensive and highly-accurate network emulation for:

- 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 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

<b>Optical Interfaces</b>	<p>100GbE: QSFP28 (LR4/SR4) – 2, 4, 6 or 8 ports (optional)</p> <p>50GbE: SFP56 PAM4 (LR/SR) – 2, 4, 6 or 8 ports (optional)</p> <p>40GbE: QSFP+ (LR4/SR4) – 2, 4, 6 or 8 ports (optional)</p> <p>25GbE: SFP28 (SR/LR) – 2, 4, 6 or 8 ports (optional)</p> <p>10GbE: SFP+ (SR/LR) – 2, 4, 6 or 8 ports (optional)</p> <p>At least one of the 100GbE or 50GbE or 25GbE options <b>must</b> be ordered</p> <p>Optical Adaptors are provided to convert QSFP to SFP for 50GbE, 25GbE and 10GbE</p>
<b>Forward Error Correction</b>	<p>100GbE NRZ: RS(528,514) KR4</p> <p>50GbE PAM-4: RS(544,514) KP4</p> <p>25GbE NRZ: RS(528,514) KR4</p>
<b>Tx Line Rate Adjust</b>	Supported via external reference clock input
<b>External Ref. Clock Input</b>	10 MHz
<b>SyncE Pass Thru</b>	MX ports can sync to recovered clock and from external clock

### Flows

<b>Impairment Profiles</b>	<p>25GbE/10GbE: Standard product includes 16 profiles allowing 8 flows of impaired packets in each direction. Each profile can be configured individually.</p> <p>Other Rates: Exact number of profiles still to be finalized. Standard product includes a number of profiles allowing a number of flows of impaired packets in each direction. Each profile can be configured individually.</p>
<b>Filtering</b>	<p>Powerful user-configurable filters including ranges and wildcards:</p> <ul style="list-style-type: none"> <li>• MAC Source and Destination Address, Length/Type</li> <li>• VLAN (Priority, VLAN ID &amp; Type), CustomVLAN</li> <li>• CustomVLAN Length, Offset, Mask, Value</li> <li>• MPLS Label, CustomMPLS</li> <li>• CustomMPLS Length, Offset, Mask, Value</li> <li>• IPv4 Source and Destination Address</li> <li>• IPv4 Version No, DiffServ/ToS, Protocol</li> <li>• IPv6 Source and Destination Address</li> <li>• CustomL3 Length, Offset, Mask, Value</li> <li>• UDP/TCP Source port, Destination port</li> <li>• CustomL4 Length, Offset, Mask, Value</li> </ul>
<b>GTPv2</b>	<p>Targeted GTPv2 control message impairments (e.g. create session request, modify bearer request, etc.)</p> <ul style="list-style-type: none"> <li>• GTPv2 Version, Type, Tunnel EndPoint ID</li> </ul>
<b>eCPRI Filter</b>	<p>Targeted eCPRI impairments</p> <ul style="list-style-type: none"> <li>• eCPRI Revision, Concatenation Indicator, Message Type</li> </ul>
<b>RoE Filter</b>	<p>Targeted RoE (Radio over Ethernet) impairments</p> <ul style="list-style-type: none"> <li>• RoE Subtype</li> </ul>
<b>Custom L5 Filter</b>	Length, Offset, Mask, Value
<b>PTP Transparent Clock</b>	<p>1-Step Transparent Clock</p> <ul style="list-style-type: none"> <li>• The residence time is measured and placed in the PTP event message correction field</li> </ul>

### General

<b>Web Browser User Interface</b>	<p>Drag and Drop User Interface</p> <p>Simple user interface allowing user to draw out their target network on screen, drop impairments as required and visualize the network-under-test</p>
<b>Remote Control</b>	RESTful API for Test Automation
<b>Smart Start-up</b>	Automatically launch previous map on boot
<b>Multi-user Support</b>	Multiple users, share maps, assign ports to individual users

## Technical Specifications (cont'd)

### Impairments

<b>Packet Corruption</b>	<ul style="list-style-type: none"> <li>• 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</li> <li>• 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</li> <li>• 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</li> <li>• 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</li> </ul> <p>* Available in an upcoming software release</p>
<b>Latency/Delay and PDV/Jitter</b>	<ul style="list-style-type: none"> <li>• Gaussian distribution of delay</li> <li>• Gamma (internet) distribution of delay</li> <li>• Uniform distribution of delay</li> <li>• Step distribution of delay</li> <li>• Import from an external file</li> <li>• Jitter range from 1 <math>\mu</math>s to 400 ms; step size is 1 ns</li> <li>• Add independent delay/jitter distribution to each profile simultaneously</li> <li>• Readout of Max, Min Jitter and Max Delay for the applied distribution</li> </ul>
<b>Timeline</b>	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
<b>Minimum Delay Emulation (Intrinsic Delay)</b>	<ul style="list-style-type: none"> <li>• 6.8 <math>\mu</math>s at 10GbE</li> <li>• 6.8 <math>\mu</math>s at 25GbE</li> <li>• 8.2 <math>\mu</math>s at 10GbE (Jumbo Frame Mode)</li> <li>• 8.85 <math>\mu</math>s at 25GbE (Jumbo Frame Mode)</li> </ul>
<b>Maximum Delay Emulation</b>	<p>Line rate delay: Full line-rate delay of</p> <ul style="list-style-type: none"> <li>• 80 ms at 100GbE</li> <li>• 160 ms at 50GbE</li> <li>• 200 ms at 40GbE</li> <li>• 320 ms at 25GbE</li> <li>• 750 ms at 10GbE</li> </ul> <p>Delay Resolution 1 ns</p>
<b>Maximum Extended Delay Emulation</b>	<p>Delay Boost extends full line-rate delay to</p> <ul style="list-style-type: none"> <li>• 320 ms at 100GbE</li> <li>• 640 ms at 50GbE</li> <li>• 800 ms at 40GbE</li> <li>• 1280 ms at 25GbE</li> <li>• 3200 ms at 10GbE</li> </ul> <p>Extended delay up to 22 s (all rates at 1G reduced bandwidth) Extended delay up to 42 s (all rates at 500M reduced bandwidth) Delay Resolution 1 ns</p>
<b>Link Flap</b>	Enables the ports to be cycled off/on to simulate Link Flapping
<b>Timing accuracy</b>	5 ns

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