

# Paragon-X

## Ethernet Sync and OAM



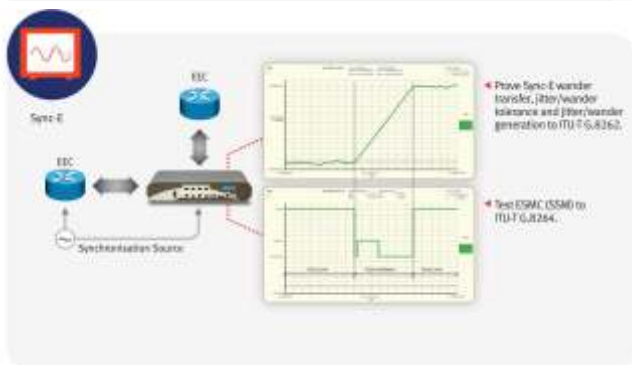
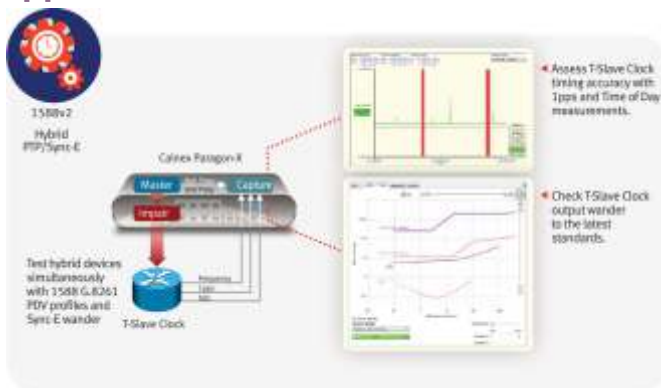
### Complete Analysis of Mobile Backhaul Devices and Networks

For Technologies up to 10Gbps, Spirent Paragon-X provides direct insights into actual device and service behavior, in a one-box test solution for Sync-E, PTP, and NTP synchronization mechanisms, as well as E1/T1/ToD sync interfaces and Ethernet OAM. Moreover, the Paragon-X brings together all the measurements you need for the design and verification of Ethernet synchronization devices and networks. With the Paragon-X, proving synchronization performance and quality is now seamless and effortless.

### All the measurements you need in one box

As Ethernet sweeps in to address the huge capacity expansion requirements of modern networking it brings with it completely new methods of synchronization. Today, network performance depends on proving overall synchronization quality and probing its underlying packet-layer and physical layer mechanisms.

### Applications



### Key Features & Benefits

#### PTP performance

- One-box testing for Main Clock, Subordinate Clock, Boundary Clock and Transparent Clock devices
- Emulate two PTP mains for BMCA and G.8265 conformance test
- Capture and replay PDV stress profiles
- Run G.826x/7x and MEF-18 test cases
- Test conformance to Utility, Industrial, Automotive, Cable and Broadcast profiles

#### Sync-E Performance

- Measure Sync-E Jitter and Wander to G.8262
- MTIE/TDEV Pass/Fail evaluation
- One nanosecond accuracy
- ESMC (SSM) message testing and verifying G.8264
- Full hybrid Sync-E/PTP test suite

#### Ethernet OAM Performance

- Prove Connectivity Fault Management (CFM) and Performance Monitoring (PM) for Y.1731, 802.1ag and 802.3ah
- Add latency, jitter, errors, dropped packets to prove OAM implementation
- Verify G.8031 Ethernet Linear Protection and G.8032 Ethernet Ring Protection
- Support for thousands of MEGs

## Paragon-X Product Specifications

PTP (1588) - options 25x and 201, option PFV	
Main/Subordinate Emulation (Option 25x)	<ul style="list-style-type: none"> <li>• Emulate up to two 1588 mains with full parametric control and Time Error/PDV/protocol anomaly impairment functions.</li> <li>• Each main can have up to 8 attached subordinates.</li> <li>• Emulate 1588 subordinate; calculate and display: PTP Time Error, 1 pps Time Error/ToD accuracy, TC CorrectionField accuracy, BC Time Error.</li> </ul>
Additional features for End-to-End (Option 250/253)	Additional features for End-to-End (Option 250/253)
Additional features for Peer-to-Peer (Option 252/253)	Automatic configuration for e.g. IEEE 802.1AS gPTP, Turnaround Time and Rate Ratio metrics
Header Capture and Alarms	MessageType, TransportSpecific, VersionPTP, MessageLength, DomainNo, Flags, CorrectionField, SourcePortIdentity, SequenceID (errors highlighted), ControlField, LogMessageInterval, OriginTimestamp.
Graphs Displayed (Calnex Analysis Tool, CAT)	<ul style="list-style-type: none"> <li>• PTP Time Error (dTE, cTE, Max TE ), Transparent Clock accuracy, latency.</li> <li>• Packet Delay Distribution.</li> <li>• PacketMTIE/TDEV, MAFE, MATIE.</li> <li>• Sync PDV (Main-to-Subordinate PDV), Delay_Req PDV (Subordinate-to-Main PDV), Subordinate Clock Wander (T3), Follow-up PDV, Delay_Resp PDV, PDelay_Req PDV, PDelay_Resp PDV, Delay Distribution Curve/Histogram</li> </ul>
Standards Supported	ITU-T G.826x/7x, MEF-18, IEEE/IEC 61850-9-3, IEEE C 37 238, IEEE 802.1AS
PTP Field Verifier (PFV)	<ul style="list-style-type: none"> <li>• Decode and display PTP Fields.</li> <li>• Display Pass/Fail to standards-based or user-defined rules.</li> <li>• Report Generation capability.</li> </ul>
PDV Editor Suite	<ul style="list-style-type: none"> <li>• Edit any PDV file from the graphs.</li> <li>• Profile Edits: Extract, Repeat, Copy, Paste (Replace or Insert); Modulate, Scale (%), Banding (Deplete or Concentrate); Adjust Delay Floor</li> </ul>
Measurement Accuracy	5 ns.

## Paragon-X Product Specifications (cont'd)

SyncE (options 213, 207, 208, 223)	
Jitter/Wander Measurement	<ul style="list-style-type: none"> <li>To ITU-T G.8262 and O.174 – jitter/wander generation, wander transfer, jitter/wander tolerance, phase transient.</li> <li>Built-in frequency offset plus sinusoidal, MTIE and TDEV wander generation.</li> </ul>
MTIE/TDEV Analysis	Built-in Calnex Analysis Tool (CAT) software with ITU-T and masks with Pass/Fail indication.
SyncE Main	Accuracy traceable to Reference source used (refer to Reference Clocks).
Measurement Accuracy	1 ns.
ESMC (SSM) Features	<ul style="list-style-type: none"> <li>Decode ESMC messages to ITU-T G.8264 and plot Quality Level (QL) changes graphically (bi-directional).</li> <li>Qls: PRS, PRC, INV3, SSU-A/TNC, INV5, INV6, ST2, SSU-B, INV9, EEC2/ST3, EEC1/SEC, SMC, ST3E, PROV, STU/UKN, DNU/DUS.</li> <li>Overwrite ESMC Message to change QL status.</li> <li>Support for ESMC Decode and SyncE in 1588 mode (for concurrent SyncE and 1588 implementations).</li> <li>Integrated display in Calnex Analysis Tool (CAT).</li> </ul>
ESMC Generation	<ul style="list-style-type: none"> <li>Generate ESMC (SSM) packets per ITU-T G.8264</li> <li>Qls: PRS, PRC, INV3, SSU-A/TNC, INV5, INV6, ST2, SSU-B, INV9, EEC2/ST3, EEC1/SEC, SMC, ST3E, PROV, STU/UKN, DNU/DUS.</li> <li>Generate ESMC messages, change QL value and measure impact on wander.</li> </ul>
Ethernet OAM (option 301)	
Capture and Decode	Packet Number, Arrival Time, Ethernet Destination Address, Ethernet Source Address, OAM Message Type, MEP ID, RDI, Period fps, TransID, TxFCf, RxFCf, TxFCb, Tx Timestamp(f), Rx Timestamp(f), Tx Timestamp(b), Rx Timestamp(b), Maintenance Domain Length, Maintenance Domain Name, Short MA Name Format, Short MA Name Length, Short MA Name, Time To Live, Origin MAC, Target MAC, Relay Action, OUI, TLV Offset, TLVs.
Round-trip Delay	Based on DMM/DMR messages. Displayed in table and graph. MEF and ITU-T delay methods supported
View Filtering	MAC addresses and OAM Message types.
Standards Supported	ITU-T Y.1731, IEEE 802.1ag, IEEE 802.3ah, ITU-T G.8031, ITU-T G.8032
Message Filters for Corruption and Delay	CCM, LBM, LBR, LTM, LTR, AIS, LCK, TST, APS, MCC, LMM, LMR, 1DM, DMM, DMR, EXM, EXR, VSM, VSR. Any combination of above messages. CCM at 1 s and 3.33 ms both supported.
Impairments and Delay	Lost, Misordered, Repeated, Errored, AIS/LCK/RDI Generation, Fixed Delay, Variable Delay.
Header Overwrite	Ethernet Header or OAM Header – overwrite any bit (first 128 bytes) with hex or binary value or invert.
Multi-MEG Mode	Capture information for 1000s of MEGs including Eth Dest, Eth Src, SVID, CVID, MEL, MEP ID, OAM Message Count, AIS, RDI, CCM, CCM fps, etc.

## Paragon-X Product Specifications (cont'd)

NTP (option 404) and CES (option 202)		
	NTP	CES
Packet Sync Rates	Any packet rate.	T1, E1, T3, E3 or Any.
Protocols	NTP (up to v4).	SAToP, CESoPSN, TDMoIP.
Header Capture and Alarms	Version, Mode, Stratum, Poll, Precision, Root Delay, Root Dispersion, ReferenceId, Reference Time, Origin, Receive, Transmit.	L, R, M, FRG, Length and Sequence # (errors highlighted). L, R, M Alarm Injection.
Graphs Displayed	Inter-Packet (Reserved_0, Sim_Active, Sim_Passive, Client, Server, Broadcast, Control, Reserved_7, all), Client PDV (Client-to-Server PDV), Server PDV (Server-to-Client PDV), RTD Variation. Delay Distribution Curve/Histogram.	TIE vs Nominal, TIE vs Measured Average, Delay vs Packet #, Inter-packet Time (vs Time and vs Packet #), Delay Distribution Curve/Histogram
Standards Supported	G.8261 (Test Cases 1 – 17), G.8273.2 and MEF-18.	
PDV Editor Suite	<ul style="list-style-type: none"> <li>Edit any PDV file from the graphs.</li> <li>Profile Edits: Extract, Repeat, Copy, Paste (Replace or Insert); Modulate, Scale (%), Banding (Deplete or Concentrate); Adjust Delay Floor.</li> </ul>	
Advanced Time of Day (option 230)		
Time of Day (ToD) Emulation	Generate ToD messages to CCSA, NMEA and ITU-T standards. Control Fields/Values: Event Message: TimeSource Type, TimeSource Status, TimeSource Alarms. Information Message: Leap Seconds, PPS Status, TAcc.	
Time of Day Measurement	Decode and display ToD fields. Highlight errors e.g. CRC, Second jumps. Validate ToD alignment to 1 pps. Compare ToD and PTP message and status.	
Measurement Accuracy	1 ns.	
Wander Measurement on Other Frequencies (option 205)		
Software Option 205	For E1/T1/2 MHz Wander measurement including TIE/MTIE/TDEV and ITU-T Masks	
Software Option 206	For 1 pps Time Error measurement (1 pps accuracy) in nanoseconds – measure 1 pps Time Error relative to 1 pps reference.	
Network Emulation (options 708, 709, 710)		
Selection of flow from multi-flow environment	<ul style="list-style-type: none"> <li>Automatic detection of flows and filter setup using Flow Wizard.</li> <li>Filters: any 1 to 64 bytes within the first 256 bytes of the frame.</li> <li>Integrated Wireshark decode.</li> </ul>	
Impairment Profiles	Select at time of purchase – 4, 8 or 16 Profiles (optional) <ul style="list-style-type: none"> <li>4 Profiles allows all impairments to be configured individually for up to 4 Flows (up to 2 bi-directional profiles).</li> <li>8 Profiles allows all impairments to be configured individually for up to 8 Flows (up to 4 bi-directional profiles).</li> <li>16 Profiles allows all impairments to be configured individually</li> </ul>	
Packet Corruption	Errored packets, Lost packets, Repeated packets (1 to 10000), Mis-ordered packets (1 to 32). Corruption modes: single, burst, rate (%), ratio (xE-y), constant	
Latency/Delay and PDV/Jitter	(a) Step waveform profile. (b) Gamma distribution of delays. (c) Gaussian distribution of delays. (d) Apply fixed delay to the filtered packets.	
Maximum Delay	8 seconds at 1 G (100 M: 80 s, 10 G: 0.8 s)	
Bandwidth Control	<ul style="list-style-type: none"> <li>Control bandwidth throttle and buffer depth per profile.</li> <li>Preset and user-defined bandwidths.</li> <li>Basic mode and advanced policing and shaping mode.</li> </ul>	

## Paragon-X Product Specifications (cont'd)

General	
Physical Interfaces	<ul style="list-style-type: none"> <li>Ethernet</li> <li>100 M Electrical (RJ45), 100 M Optical – SGMII*.</li> <li>1 G Electrical (RJ45), 1 G Optical – SFP.</li> <li>10 G Optical (if option 111 fitted) – XFP or SFP+ (LAN-PHY).</li> </ul> *PTP PDV, NTP, CES, Services
Reference Clocks	<ul style="list-style-type: none"> <li>Lock internal timing reference to external reference. Reference Lock soft LED indication.</li> <li>External reference inputs: 64 kHz, 2.048 MHz, 10 MHz; T1 BITS clock; E1 MTS, SyncE.</li> <li>Internal reference Stratum-3, <math>\pm 4.6</math> ppm.</li> </ul>
PC Control Interface	Any standard PC or laptop running Windows 8 or 10. RJ45 LAN connection to instrument.
TCP/IP Settings	TCP Port, IP Address and Gateway settable.
Automatic Flowselection in Multi-flow Environment	Automatic filter setting for 1588 in Main/Subordinate Emulation mode. Automatic detection of OAM (MEGs), 1588, CES and other flows and filter setup using FlowWizard. Filter (1 to 64 bytes): Setup messages for capture and replay. Select OAM type within a MEG flow. Select 1588 Message type(s) or groups. Integrated decode using industry-standard tool, Wireshark. Additional PTP analysis capability with PFV.
Packet Capture	Capture complete packet and display contents. The filters can specify the packet types to be captured.
Memory	Internal (2 Gb) or External (via USB).
Graph Manipulation	Zoom in (X and Y), Zoom out (X and Y), Marker 1, Marker 2, Min/Max display in nanoseconds.
Impairments - Fixed Delay	6 $\mu$ s to 10 s
Impairments - Variable Delays	Gaussian, Gamma, User Defined – stored PDV profiles or captures from networks, G.8261 and MEF-18 Test Cases, Sawtooth – Systematic, Beating (F) and Beating (S), Step Function, Latency Ramp
1588 Delays applied to:	Packet Sending Time, CorrectionField or Both.
Impairments – Corruption	Misordered, Lost, Repeated or Errored Packets
Control	Single, Burst (1 to 10000), Duration (0.1 s to 10 s), Rate (0.00001% to 99.99999%), Ratio ( $1 \times 10^{-7}$ to $9 \times 10^{-1}$ ) or Constant.
Overwrite Header	Any bytes with any value in first 128 bytes.
Switch Simulation	Independently set: Latency, Buffer Depth (1 byte to 256 kbytes), Bandwidth (0% to 100%).
Timing Measurements	E1/T1 wander – TIE, MTIE, TDEV analysis with ITU-T masks - sample rate 0.1 Hz to 100 Hz. 1 pps accuracy – recovered subordinate clock 1 pps vs reference. ToD analysis.
Simultaneous Measurements	Chosen packet measurements can be performed simultaneously with all timing measurements (SyncE and Clock wander, 1pps Accuracy, ToD analysis)
Remote Control	Scripting via TCL, Perl and Python
Operation and Regulatory	CE and EMC (incl. EN-61010, EN-61326, etc.) certified. Voltage 85 - 246 VAC, 100 - 240 VAC (Nominal) @ 50/60 Hz.
GPS Antenna, Receiver and Rb Ref. (Option 132)	PRS/Stratum 1 (GPS-locked): typical $1 \times 10^{-12}$ Outputs: 10 MHz, 1 pps.