

# Spirent Paragon-X and Paragon-100G

## Ethernet Sync and OAM

### All the measurements you need in one box

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

### Complete analysis of mobile backhaul devices and networks

For Technologies up to 10Gbps the Paragon-X offers direct insight to actual device and service behavior, the Calnex Paragon products are the definitive one-box testers for Sync-E, 1588v2 PTP and NTP synchronisation 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 backhaul synchronisation devices and networks. With the Paragon-X, proving synchronisation performance and quality is now seamless and effortless.

The Paragon-100G is the industry's first 100G SyncE test solution. It precisely measures frequency and phase synchronization in accordance with G.8262 (SyncE) and IEEE 1588 (PTP) standards, and supports wander testing at 40GbE and 100GbE speeds.

### Features & benefits

#### 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

#### 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



#### 1588v2 & CES performance

- One-box testing for Master Clock, Slave Clock, Boundary Clock and Transparent Clock devices
- Emulate two PTP masters for BMCA and G.8265 conformance test
- Capture and replay PDV stress profiles
- Run G.8261 and MEF-18 test cases

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## Applications

**1588v2 Hybrid PTP/Sync-E**

Test hybrid devices simultaneously with 1588 G.8261 PDV profiles and Sync-E wander

Calnex Paragon-X

Master (Drift Time and Freq) / Capture / Impair

T-Slave Clock

Frequency: 1000, 100

- Assess T-Slave Clock timing accuracy with 1pps and Time of Day measurements.
- Check T-Slave Clock output wander to the latest standards.

**Sync-E**

EEC

EEC

Synchronisation Source

- Prove Sync-E wander transfer, jitter/wander tolerance and jitter/wander generation to ITU-T G.8262.
- Test ESMC (SSM) to ITU-T G.8264.

## Paragon-100G product specification

### Sync-E

<b>Wander Measurement</b>	ITU-T G.8262. Wander Generation, Wander Transfer, Wander Tolerance, Phase Transient, built-in frequency offset plus sinusoidal, MTIE and TDEV wander generation	
<b>Wander Analysis</b>	<ul style="list-style-type: none"> <li>Built-in (CAT) software including industry standard ITU-T Pass/Fail Masks with clear Pass/Fail indication</li> <li>ITU-T Masks: G.813, G.823, G.824, G.8261, G.8262, G.8263, G.8261.1, GR.1244</li> <li>Clock Wander Measurements: TIE, MTIE, TDEV, clock MAFE, clock FFO</li> </ul>	
<b>ESMC (SSM) Features</b>	<ul style="list-style-type: none"> <li>Decode ESMC messages to ITU-T G.8264 and graph/plot Quality Level (QL) changes graphically (bi-directional). 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 industry standard tool, Wireshark and integrated decode using Tshark</li> </ul>	
<b>ESMC Generation</b>	<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>	
<b>SyncE Master</b>	Accuracy traceable to Reference source (refer to Reference Clocks)	
<b>Product</b>		
<b>Optical Interfaces</b>	<ul style="list-style-type: none"> <li>Ethernet (optical CXP, CFP2 and QSFP+ modules not supplied)</li> <li>100 GbE: CXP (SR10) – 2 slots (optional)</li> </ul>	<ul style="list-style-type: none"> <li>100 GbE: CFP2 (LR4/SR4) – 2 slots (optional)*</li> <li>40 GbE: QSFP+ (LR4/SR4) – 2 slots (optional)</li> </ul>
<b>External Reference Clocks</b>	<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 (1.544 Mb/s), E1 MTS (2.048 Mb/s), SyncE</li> </ul>	
<b>Internal Reference Clock</b>	Frequency Stability over Temp: +/-1.5 x 10 <sup>-7</sup>	
<b>Clock Ref. Output Ports</b>	2 x 10 MHz/2.048 MHz Reference Outputs (BNC)	
<b>Clock Measurement1</b>	<ul style="list-style-type: none"> <li>1000BT, 100BT Electrical - RJ45, 1 GbE Optical (SFP required)</li> <li>E1 (2.048 Mb/s), 10 MHz, 2.048 MHz – BNC (unbalanced)</li> </ul>	<ul style="list-style-type: none"> <li>E1 (2.048 Mb/s), T1 (1.544 Mb/s) – RJ48 (balanced)</li> </ul>
<b>Phase Measurement1</b>	<ul style="list-style-type: none"> <li>1 pps – BNC (unbalanced)</li> </ul>	<ul style="list-style-type: none"> <li>1 pps – RJ (balanced)</li> </ul>
<b>1 pps + ToD Ref. Input1</b>	<ul style="list-style-type: none"> <li>1 pps unbalanced Input (BNC), 1 pps balanced Input + ToD (RJ48C)</li> </ul>	<ul style="list-style-type: none"> <li>ToD Format: CCSA, CISCO, NTP, NMEA format</li> </ul>
<b>1 pps + ToD Ref. Output1</b>	1 pps unbalanced Output (BNC), 1 pps balanced Output + ToD (RJ48C)	

### General

<b>PC/Mac or Tablet Control Interface</b>	Web-based GUI approach with built-in controller enables use of any PC or Android Tablet with any browser with screen resolution of 1024 x 768 pixels. RJ 45 LAN connection to instrument.	
<b>TCP/IP Settings</b>	TCP Port, IP Address and Gateway settable	
<b>Remote Control</b>	<ul style="list-style-type: none"> <li>Scripting via TCL, Perl and Python</li> </ul>	<ul style="list-style-type: none"> <li>Automatic Script Recorder for TCL, Perl and Python</li> </ul>
<b>Indicator/LEDs</b>	<ul style="list-style-type: none"> <li>Power On</li> </ul>	<ul style="list-style-type: none"> <li>40 GbE QSFP+, 100 GbE CXP, 100 GbE CFP2 (if appropriate option fitted) – Integral LEDs</li> </ul>
<b>GPS Rubidium Reference</b>	<ul style="list-style-type: none"> <li>PRS/Stratum1 (GPS locked): typical 1 x 10<sup>-12</sup></li> </ul>	<ul style="list-style-type: none"> <li>Outputs: 10 MHz, 1 pps and NMEA ToD</li> </ul>

Note: \*100GbE SR4 is a future release

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**Paragon-X product specifications**

1588v2 (option 201) and CES (option 202)

	1588v2	CES
Packet Sync rates	Any packet rate	T1, E1, T3, E3 or Any
Protocols	IEEE-1588 (2008)	SAToP, CESoPSN, TDMoIP
Header capture and alarms	MessageType, TransportSpecific, VersionPTP, MessageLength, Flags, CorrectionField, SourcePortIdentity, SequenceID (errors highlighted), ControlField, LogMessageInterval, OriginTimestamp.	<ul style="list-style-type: none"> <li>■ L,R,M,FRG, Length and Sequence number (errors highlighted)</li> <li>■ L,R,M Alarm Injection</li> </ul>
Graphs displayed	Inter-Packet (SYNC, DELAY_REQ, DELAY_RESP, pDELAY_REQ, pDELAY_RESP, FOLLOW-UP, ALL), Sync PDV (Master-to-Slave PDV), Delay_Req PDV (Slave-to-Master PDV), Slave Clock Wander (T3), Follow-up PDV, Delay_Resp PDV, PDelay_Req PDV, PDelay_Resp PDV, Asymmetry Variation, RTD Variation—Include or Exclude Correction Factor in PDV Calculation, Delay Distribution Curve/Histogram	TIE vs Nominal, TIE vs Measured Average, Delay vs Packet Count, Inter-packet Time (vs Time and vs Packet Count) Delay Distribution Curve/Histogram
Standards	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>	
Measurement accuracy	5ns	
Metrics	ITU-T metrics will be implemented as ratified incl. MTIE, MAFE, ZTIE, PktMTIE, etc.	
Master/slave emulation (option 250)	<ul style="list-style-type: none"> <li>■ Emulate up to two 1588v2 masters with full parametric control and PDV/protocol anomaly addition. Each master can have up to 8 attached slaves</li> <li>■ Emulate one 1588v2 slave</li> <li>■ Calculate and display: slave wander, 1pps/ToD accuracy, TC correction field accuracy, BC time error</li> </ul>	
Master/Slave Scale emulation and Load testing (Spirent BPK-1155A, BPK-1180, BPK-1001)	<ul style="list-style-type: none"> <li>■ Load testing Boundary clocks, Transparent clocks and Hybrid clocks (1588 + SyncE)</li> <li>■ Multiple Masters and 100s of slaves with live traffic</li> </ul>	
<b>Sync-E (options 213, 207, 208, 223)</b>		
Jitter/Wander measurement	To ITU-T G.8262 and O.174 - Jitter/Wander Generation, Wander Transfer, Jitter/Wander Tolerance, Phase Transient Built-in frequency offset plus sinusoidal, MTIE and TDEV wander generation	
MTIE/TDEV analysis	Built-in software with ITU-T Masks and Pass/Fail indication	
Sync-E master	Accuracy traceable to Reference source used (refer Reference Clocks)	
Measurement accuracy	1ns	
ESMC (SSM) features to G.8264, G.781, etc	<ul style="list-style-type: none"> <li>■ Decode ESMC messages to ITU-T G.8264 and plot Quality Level (QL) changes graphically (bi-directional) 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 Sync-E in 1588 mode (for concurrent Sync-E and 1588v2 implementations)</li> <li>■ Integrated decode using industry-standard tool, Wireshark</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 Generate ESMC Messages, change QL value and measure impact on Wander</li> </ul>	
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 1s and 3.33ms both supported	
Impairments and delay	Lost, Misordered, Repeated, Errored, AIS/LCK/RDI Generation, Fixed Delay, Variable Delay	

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## Spirent services

Spirent Global Services provides a variety of professional services, support services and education services—all focused on helping customers meet their complex testing and service assurance requirements. For more information, visit the Global Services website at [www.spirent.com](http://www.spirent.com) or contact your Spirent sales representative.

### Paragon-X product specifications (continued)

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
Physical Interfaces—Ethernet	<ul style="list-style-type: none"><li>100M Electrical, 100M Optical (SGMII)*</li><li>1G Electrical (optional), 1G Optical (optional) - SFP</li><li>10G Optical (optiOnal) – XFP or SFP+ (LAN-PHY)</li></ul>
Reference clocks	Lock internal timing reference to external reference. Reference Lock soft LED indication External reference inputs: 64kHz, 2.048MHz, 10 MHz; T1 BITS clock; E1 MTS, Sync-E, GPS Internal reference Stratum-3, + 4.6 ppm
PC control interface	Any standard PC or laptop running Windows XP, Vista or 7. RJ45 LAN connection to Instrument
TCP/IP settings	TCP Port, IP Address and Gateway settable
Automatic flow-selection in multi-flow environment	Automatic detection of OAM (MEGs), 1588v2, CES and other flows and filter setup using FlowWizard Filter: (1 to 64 bytes): <ul style="list-style-type: none"><li>Setup messages for capture and replay</li><li>Select OAM type within a MEG flow</li><li>Select 1588v2 Message type(s) or groups Integrated decode using industry-standard tool, Wireshark</li></ul>
Packet capture memory	Capture complete packet and display contents. The filters can specify the packet types to be captured Internal (2Gb) 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 – delay	
Fixed delay	6µs to 10s
Variable delays	<ul style="list-style-type: none"><li>Gaussian, Gamma</li><li>User Defined – stored PDV profiles or captures from networks</li><li>G.8261 and MEF-18 Test Cases</li><li>Sawtooth – Systematic, Beating (F) and Beating (S)</li><li>Step Function</li><li>Latency Ramp</li></ul>
1588v2 delays applied to	Packet Sending Time, Correction Field or Both
Impairments - corruption	Misordered, Lost, Repeated or Errored Packets
Control	Single, Burst (1 to 10000), Duration (0.1s to 10s), Rate (0.00001% to 99.99999%), Ratio (1E-7 to 9E-1) or Constant
Overwrite header	Any bytes with any value in first 128 bytes
Switch simulation— independently set	<ul style="list-style-type: none"><li>Latency</li><li>Buffer Depth (1 byte to 256k bytes)</li><li>Bandwidth (0% to 100%)</li></ul>
Timing measurements	E1/T1 Wander – TIE, MTIE, TDEV analysis with ITU-T masks - sample rate 0.1Hz to 100Hz 1pps accuracy – recovered slave clock 1pps vs reference
Simultaneous measurements	1588v2/CES PDV & IPG, E1/T1/2.048MHz TIE/MTIE/TDEV, 1pps Wander/Accuracy
Remote control	Scripting via TCL
Operation & regulatory	Temperature 5-50°C, Humidity 0-95%, CE and EMC (incl. EN-61010, EN-61326, etc.) certified, Voltage 85- 246VAC, 100-240VAC (Nominal) @ 50/60Hz
GPS antenna, receiver and rubidium reference	<ul style="list-style-type: none"><li>PRS/Stratum 1 (GPS-locked): typical 1E-12</li><li>Outputs: 10MHz, 1pps</li></ul>

## Ordering information

Due to the wide range of available system configurations, please contact your regional Spirent sales representative for detailed ordering information.

AMERICAS 1-800-SPIRENT  
+1-800-774-7368 | [sales@spirent.com](mailto:sales@spirent.com)

EUROPE AND THE MIDDLE EAST  
+44 (0) 1293 767979 | [emeainfo@spirent.com](mailto:emeainfo@spirent.com)

ASIA AND THE PACIFIC  
+86-10-8518-2539 | [salesasia@spirent.com](mailto:salesasia@spirent.com)