

Calnex Paragon neo and Paragon neo-A (PAM4)

Solve the timing challenges of 5G

Providing PTP and SyncE testing of speeds up to 100GbE on Paragon neo or 400GbE (PAM4) on Paragon neo-A.

Supporting your changing environment

As the world prepares for 5G, the levels of synchronization accuracy and speed of data transfer required are increasing exponentially. In response, the ITU-T is enhancing the G.827x series of standards to cover next-generation accuracy requirements – to ensure that Ethernet systems are robust against varying transmission delays and other effects that can significantly disrupt the precise transfer of timing. These ITU-T standards also form the foundation of timing requirements for new Open Radio Access Networks, and are inherently required for O-RAN compliance.

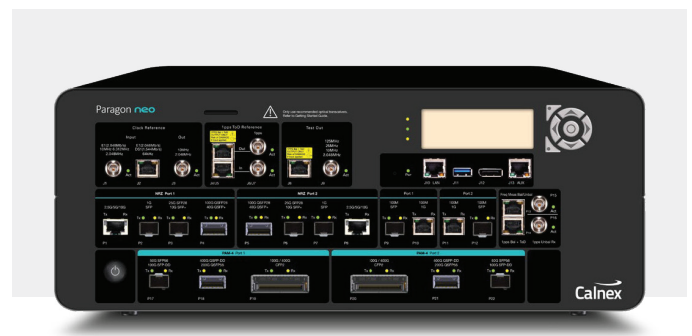
The Paragon neo is the latest platform from Calnex, providing PTP and SyncE testing of speeds up to 400GbE (Paragon neo-A (PAM4)) or 100GbE Paragon neo. It's designed to meet the stringent test requirements of NEMs who are developing, verifying and manufacturing devices against enhanced timing standards such as for ITU-T G.8273.2 Boundary Clocks, O-RAN compliant O-DU and O-RU equipment, and for those designing and deploying 5G networks and systems.

What's more, because high network efficiency and reduced data transmission costs are only possible with highly accurate timing, Paragon neo offers hardware performance and software test methodologies allowing sub-nanosecond accuracy for the entire test system.

To meet the timing challenges of 5G deployments, Calnex is committed to providing the most advanced, precise and reliable test solutions to make sure your devices and systems deliver the high quality network services of the future. In a changing world, it's good to know that some things never change.



Paragon neo



Paragon neo-A (PAM4)

Analyze PTP conformance to standards-based or user-defined profiles, with automatic indication of pass/fail (and reason for non-compliance) and report generation.

Generate SyncE wander and jitter for ITU-T G.8262.1/G.8262 testing, simultaneously measure SyncE wander and PTP Time Error, and control ESMC message generation for testing to ITU-T G.8264.

Emulate PTP clocks to maximize accuracy and repeatability of PTP test, including specific test modes for various DUTs and automatic test selection for ITU-T and O-RAN standards conformance.



PTP Field Verifier (PFV)

- Analyze PTP protocol for conformance to standards or user-defined profiles.
- Automatic pass/fail indication – check captured PTP messages against a pre-defined set of rules, with clear pass/fail alerts.

Calnex PFV

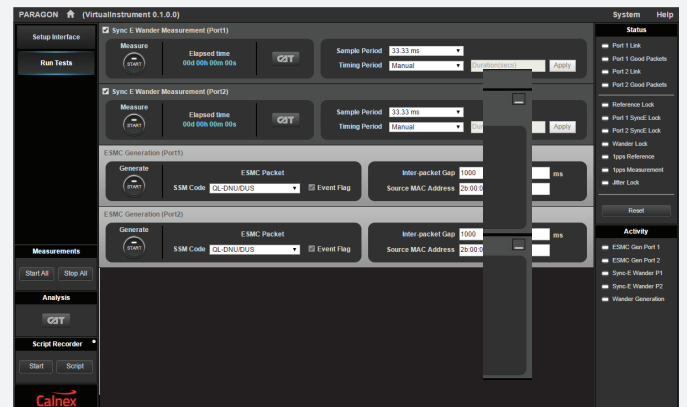
Ruleset: File: G 8275.1 Phase Profile.xml View Rules

Direction	Packet #	Arrival Time	messageType	reserved/sid2	sourcePort/identity	sequenceid	highMessageInterval (s)	PTP Body Fields
0	0.00000000	0.00000000	SYNC	0x0	0x41FC2FFFEA	19626	-4	origTimestamp-2013 312 22 08 21 43003
1	0.000374565	0.000374565	DEL-REQ	0x0	0x0000000002	38231	127	origTimestamp-2013 312 22 08 21 43003
2	0.000681095	0.000681095	DEL-RESP	0x0	0x41FC2FFFEA	38231	-4	recvTimestamp-2013 312 22 08 21 43003
3	0.000901440	0.000901440	SYNC	0x0	0x41FC2FFFEA	19627	-4	origTimestamp-2013 312 22 08 21 43003
4	0.000997000	0.000997000	DEL-REQ	0x0	0x41FC2FFFEA	19628	-4	origTimestamp-2013 312 22 08 21 43003
5	0.0009874565	0.0009874565	DEL-REQ	0x0	0x0000000002	38232	127	recvTimestamp-2013 312 22 08 21 43003
6	0.0009380700	0.0009380700	DEL-RESP	0x0	0x41FC2FFFEA	38232	-4	origTimestamp-2013 312 22 08 21 43003
7	0.000020580	0.000020580	SYNC	0x0	0x41FC2FFFEA	19629	-4	origTimestamp-2013 312 22 08 21 43003
8	0.000020580	0.000020580	DEL-REQ	0x0	0x41FC2FFFEA	19630	-4	origTimestamp-2013 312 22 08 21 43003
9	0.131374565	0.131374565	DEL-REQ	0x0	0x0000000002	38233	127	origTimestamp-2013 312 22 08 21 43003
10	0.131843375	0.131843375	DEL-RESP	0x0	0x41FC2FFFEA	19631	-4	origTimestamp-2013 312 22 08 21 43003
11	0.150112005	0.150112005	SYNC	0x0	0x41FC2FFFEA	19632	-4	origTimestamp-2013 312 22 08 21 43003
12	0.150341550	0.150341550	DEL-REQ	0x0	0x41FC2FFFEA	38234	-4	origTimestamp-2013 312 22 08 21 43003
13	0.192874565	0.192874565	DEL-REQ	0x0	0x0000000002	38235	127	origTimestamp-2013 312 22 08 21 43003
14	0.194420555	0.194420555	DEL-RESP	0x0	0x41FC2FFFEA	19633	-4	recvTimestamp-2013 312 22 08 21 43003
15	0.210040120	0.210040120	SYNC	0x0	0x41FC2FFFEA	19634	-4	origTimestamp-2013 312 22 08 21 43003
16	0.240021620	0.240021620	SYNC	0x0	0x41FC2FFFEA	19635	-4	origTimestamp-2013 312 22 08 21 43003
17	0.256374565	0.256374565	DEL-REQ	0x0	0x0000000002	38236	127	recvTimestamp-2013 312 22 08 21 43003
18	0.256603055	0.256603055	DEL-RESP	0x0	0x41FC2FFFEA	19636	-4	origTimestamp-2013 312 22 08 21 43003
19	0.270008055	0.270008055	SYNC	0x0	0x41FC2FFFEA	19637	-4	origTimestamp-2013 312 22 08 21 43003
20	0.300027225	0.300027225	DEL-REQ	0x0	0x41FC2FFFEA	38237	-4	origTimestamp-2013 312 22 08 21 43003
21	0.311874565	0.311874565	DEL-REQ	0x0	0x0000000002	19638	127	origTimestamp-2013 312 22 08 21 43003

Average Message Rate (msg/sec):
 SYNC: 0.00 FOLLOW-UP: 0.00 ANNOUNCE: 0.00
 DEL-RESP: 10.20 DEL-REQ: 10.20 SIGNALING: 1.38
 Total Counts: 302
 Error: 10
FAIL
 Total Pass Rate: 96.6%

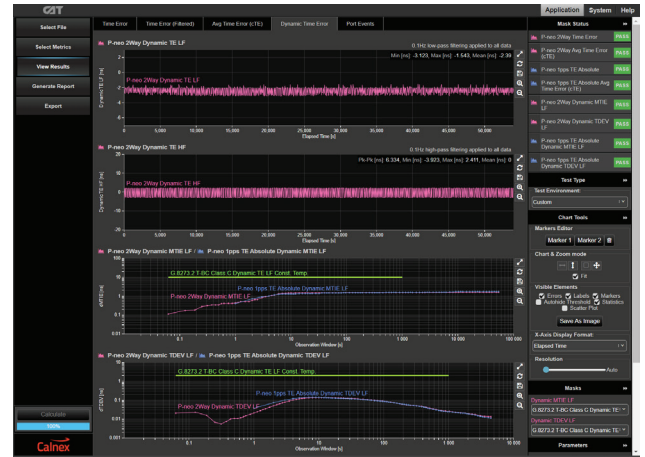
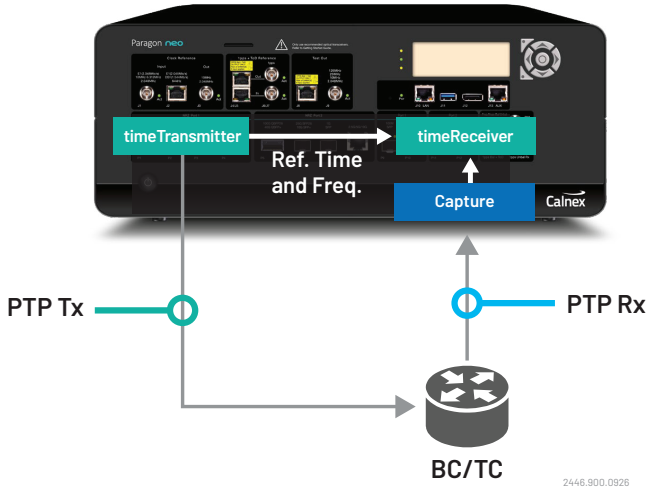
Conformance Test Application

- Start testing in seconds – just two clicks to configure crucial standards-defined test sequences.
- Automatically generates PTP and ESMC messages, Time Error and SyncE impairments, and applies filters, metrics and masks.



PTP Applications

Test hybrid devices simultaneously with PTP Time Error/SyncE wander and measure output packet timing, recovered clocks and SyncE wander with unbeatable test accuracy and repeatability.

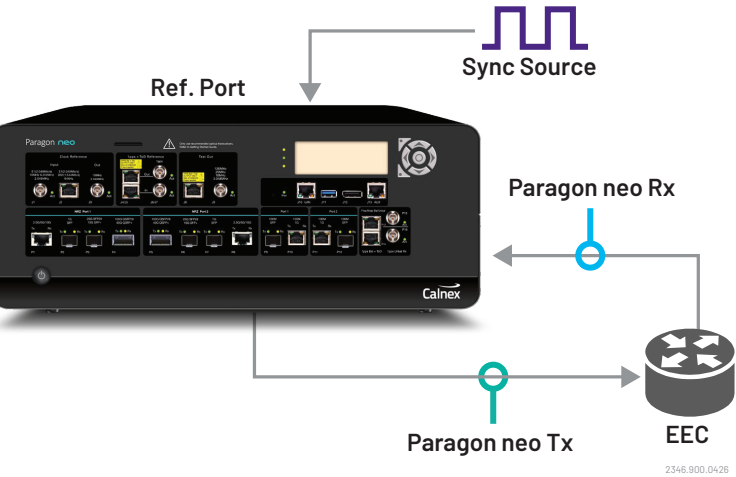


- Analyze the Time Error (TE) of, for example, T-Boundary Clocks or PRTC/TimeTransmitter Clocks
- Apply standards-defined Time Error impairments
- Combine with SyncE and ESMC for complex tests such as Phase Noise Response to SyncE Transient

Application	Standard
Boundary Clock Testing	ITU-T G.8273.2
Transparent Clock Testing	ITU-T G.8273.3
PTS and APTS Clock Testing	ITU-T G.8273.4
TimeTransmitter Clock Testing	ITU-T G.8272/8272.1
O-DU and O-RU Testing	O-RAN.WG4.CONF.0
Announce Message Delay Measurement	ITU-T G.781.1 (APP III)

SyncE Applications – ITU-T G.8262.1/G.8262 (Jitter and Wander)

The Paragon neo supports full SyncE testing to ITU-T G.8262.1/G.8262 including Wander Tolerance, Wander Transfer, Wander (Noise) generation, Pull-in, Hold-in and Pull-out ranges, Frequency Accuracy and Phase Transient, plus Jitter Tolerance and Jitter Generation.



The Calnex Analysis Tool (CAT) provides powerful insight into network and device performance. All your measurement results are now in one place, and you can view multiple graphs simultaneously for easier correlation of your results. Plus, with enhanced graphics, it's easy to evaluate metrics such as MTIE and TDEV against ITU-T and O-RAN masks.

Application	Paragon neo Tx	Paragon neo Rx
SyncE Jitter Generation	Jitter free	Measure Jitter
SyncE Jitter Tolerance	Apply Jitter	Check Test Packets
SyncE Wander (noise) Generation	Wander free	Measure Wander
SyncE Wander (noise) Tolerance	Apply Wander	Check ESMC
SyncE Wander (noise) Transfer	Apply Wander	Measure Wander
SyncE Short Term Phase Transient	Break line or set ESMC QL=DNU	SyncE TIE, MTIE

PTP Performance Summary

- Capture and decode PTP packets for analysis and Time Error testing
- PTP clock emulation, plus the Paragon neo's unique conformance test application, removes uncertainty and maximizes test repeatability – essential for validating new, highaccuracy 5G network devices
- Automatic test of PTP profile compliance for simple and reliable verification against standards-based or user-defined profile configurations

SyncE Performance Summary

- Prove SyncE wander performance to ITU-T G.8262.1/G.8262
- Evaluate MTIE/TDEV pass/fail results to ITU-T G.8262.1/G.8262 masks
- Check ESMC (SSM) messaging to ITU-T G.8264
- Test SyncE jitter performance to ITU-T G.8262.1/G.8262

Technical Specifications

Product		
Optical Interfaces (all optional)	NRZ	
	100MbE	SFP
	1GbE	SFP
	10GbE	SFP+
	25GbE	SFP28
	40GbE	QSFP+
	50GbE	QSFP28
	100GbE	QSFP28
	100GbE	QSFP28 DCO
	PAM4 56G (Paragon neo-A only)	
	50GbE	SFP56
	100GbE	SFP-DD
	200GbE	QSFP-DD
	400GbE	QSFP-DD
	Passive DAC supported on all NRZ line rate interfaces and on PAM4 56G for Paragon neo-A	
Electrical Interfaces	1000/100 BASE-T: RJ45	
External Reference Clocks	Lock internal timing reference to external reference	
	External reference inputs: 2.048 MHz, 10 MHz, T1 BITS clock (1.544 Mb/s), E1 MTS (2.048 Mb/s)	
Internal Reference Clock	Frequency stability over temperature – better than $\pm 1 \times 10^{-9}$	
	Short term phase stability – better than 500 ps	
Clock Reference Output Ports	2 x 10 MHz/2.048 MHz Reference Outputs (BNC)	
Phase Measurement	1 pps – BNC (unbalanced)	
	1 pps – RJ48 (balanced)	
Frequency Measurement	BNC (unbalanced)	
	RJ48 (balanced)	
1 pps + ToD Reference Input	1 pps Unbalanced Input (BNC), 1 pps Balanced Input + ToD (RJ48)	
	ToD format: CCSA, ITU-T, NMEA	
1 pps + ToD Reference Output	1 pps Unbalanced Output (BNC), 1 pps Balanced Output + ToD (RJ48)	
	ToD format: CCSA, ITU-T, NMEA	
Mechanical Data		
Dimensions (w x h x d)	45 x 17 x 40 cm	
Weight	13 kg	

Technical Specifications continued

General	
PC/Mac or Tablet Control Interface	Web-based GUI with built-in controller enables use of any PC or Android Tablet with any browser with screen resolution of 1024 x 768 pixels. RJ45 LAN connection to instrument
Workflow	Graphical test-case driven workflow with real-time status and results
	Stimulus/Response test configuration tool
	Detailed configuration options also available
Remote Control	Scripting via TCL, Perl and Python
	Automatic Script Recorder for TCL, Perl and Python
	Compatible with Calnex Test Sequencer (CTS) for creation/use of specific or user-defined test plans
PTP	
Standards	IEEE 1588
	G.8273.2
	G.8272
	All relevant ITU-T G.826x/827x standards
Supported Profiles	IEEE 1588V2 and ITU-T G.8275.1, G.8275.2, G.8265.1
PTP Time Error Measurement Accuracy	Better than 1 ns for NRZ optical interfaces ¹
	Better than 5 ns for PAM4 optical and electrical interfaces ²
timeTransmitter/timeReceiver Emulation	Emulate PTP timeTransmitter with full parametric control
	Emulate PTP timeReceiver
	Add Time Error patterns e.g. G.8273.2, G.8271.1, G.8271.2, G.8261, user-defined
Time Error Metrics	Built-in (CAT) software including industry-standard ITU-T pass/fail masks with clear pass/fail indication
	Time Error (2Way and 1Way) – packet selection and filtering as per ITU-T specifications cTE, dTE, etc.
PTP Packet Analysis	Decode and display PTP Fields with PFV
	Additional options with full PFV licence: Display pass/fail to standards-based or user-defined rules; report generation capability

¹Except 100 MbE: 5 ns

²Except 1 GbE (15 ns)

Technical Specifications continued

SyncE	
Jitter/Wander Measurement	ITU-T G.8262.1, G.8262 and O.174. Jitter/Wander Generation, Wander Transfer, Jitter/Wander Tolerance, Phase Transient, built-in frequency offset plus generation of sinusoidal, MTIE and TDEV Wander.
Wander Analysis	Built-in (CAT) software including industry-standard ITU-T pass/fail Masks with clear pass/fail indication
	ITU-T Masks: G.8261, G.8262, G.8262.1, G.8261.1
	Wander Measurements: TIE, MTIE, TDEV, clock FFO
ESMC (SSM) Features	Decode ESMC messages to ITU-T G.8264 and graph/plot Quality Level (QL) changes graphically (bi-directional)
	Generate ESMC (SSM) packets as per ITU-T G.8264. Enhanced SSM fully supported
Phase Wander Measurement Resolution	250 ps



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