Calnex Sentry

Calnex
Insight and Innovation

The dedicated synchronization monitor

- Verify Phase, Time and Frequency synchronization
- Monitor PTP and NTP performance and diagnose synchronization issues on Ethernet and clock signals
- Test at 100M to 100G rates
- Redundant hot-swappable power supplies for added reliability

PERFORMANCE AT-A-GLANCE

Sentry provides a comprehensive measurement suite including:

- **Time Error (TE)**
- **Time Interval Error (TIE)**
- **MTIE**
- **TDEV**
- **ESMC Quality Levels**
- **2wayTE**
- **Dynamic Time error**
- **High and low pass filtered 2wayTE**
- **Packet Selected 2WayTE**
- **Packet Delay Variation (PDV)**
- **Floor Packet Percentage (FPP)**
- **Frequency Error**

Flexible network connection options:

- **As a pseudo T-TSC to measure upstream network synchronization**
- **As a network monitor measuring live network PDV and TE**

Clear Pass/Fail Metrics for easy analysis:

- **ITU-T specified masks**
- **ITU-T, standards-based, vendor-specific limits**
- **Detailed measurement report in pdf format**

Calnex Solutions is recognized in the industry as a leader in the measurement of synchronization accuracy. As such, Calnex Sentry comes from a lineage of expertise and experience in the measurement of network appliances and complete networks to the demanding standards of modern communications systems. In short, it's a measurement solution you can trust.

Synchronization in data centers

Accurate time synchronization is mandatory in data centers. While traditional NTP may still provide adequate synchronization in some legacy applications, in most emerging technologies and use cases, highly accurate synchronization, such as provided by PTP, is required. AI, Time as a Service, virtualized 5G and algorithmic trading are just a few of the cases where µs accurate timing provides benefits, enables the technology or is required by standards and regulatory bodies. Some of the benefits of accurate synchronization include the following:

Distributed System Coordination:

Many applications require the coordination of activities in multiple servers. Time uncertainty between these machines can often only be handled by using long inefficient wait cycles. Distributed databases are an example of this. Hyperscalers have demonstrated that moving from NTP to PTP can massively improve the efficiency of database management. A 30% reduction in the processing power required has been demonstrated.

Security:

Authentication mechanisms (like Kerberos) rely on timestamps to prevent replay attacks. Without synchronization, authentication may fail or become vulnerable to attacks due to time discrepancies.

Network Management and Performance Monitoring:

Network events and performance metrics need to be timestamped accurately to analyze latency, throughput, and failures.
Without synchronization performance data becomes unreliable, making optimization and troubleshooting difficult.

Regulatory Requirements and SLAs:

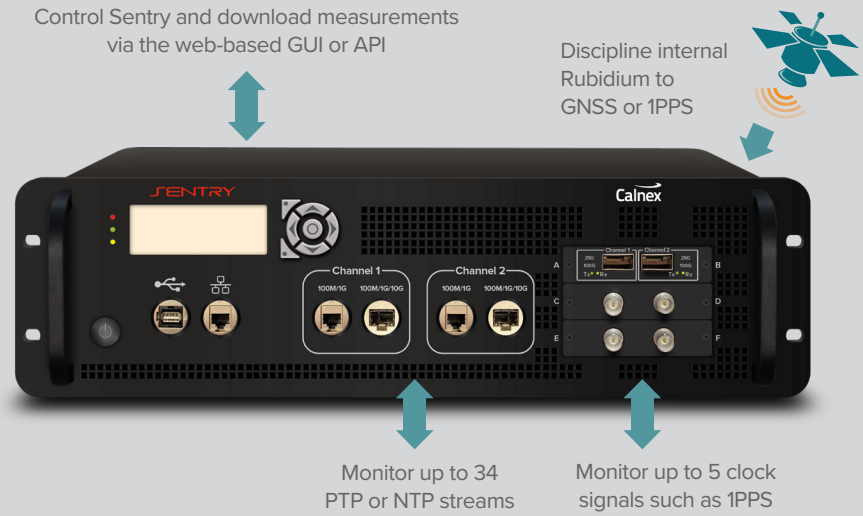
In industries like finance, precise timestamping is required. Failure to maintain accurate network synchronization can result in failed audits or legal consequences. Time-as-a-Service is a way CoLos can generate revenue. However, clients expect accurate time..

Data center synchronization assured

The new Calnex Sentry is a data center native measurement solution providing independent verification that your data center's synchronization accuracy is being maintained 24/7.

It is capable of simultaneously monitoring multiple PTP, 1PPS and NTP signals to ensure the improved synchronization capability that you've invested in – and are relying upon – is working just as you expect. It will also allow you to spot any trends in performance before they become an issue.

Sentry can test at rates up to 100GbE, and time error measurement data is available over an Application Programming Interface (API) for integration into your network management system. Plus, in the event of a loss of GNSS or other reference time within your facility, the onboard, high-stability Rubidium oscillator will continue to monitor your network synchronization while in holdover mode giving you peace of mind that your network is still in sync.



Measure up to 34 PTP/NTP streams

Sentry can be configured to have up to two Ethernet inputs (physical channels) with interfaces for rates up to 100GbE. One PTP or NTP stream will be measured on each physical channel and metrics and will be available to view on the web-based GUI. This allows detailed analysis without downloading the data.

Sentry can also be configured to measure up to 32 additional NTP/PTP streams on the physical channels. This time error measurement is available over the API for immediate evaluation or can be downloaded to the Calnex Analysis Tool (CAT) for in-depth analysis.

Continuous monitoring

To deliver the fast, stable services your customers expect means that continuous monitoring is essential to ensure optimal network performance. Sentry will make measurements continuously and store results to be downloaded over the API. Data can be downloaded at short intervals when close control of synchronization is vital, or stored on the instrument for up to 24 hours before downloading. Downloaded data can be fully analyzed to uncover subtle issues in network performance to keep the network operating flawlessly.

Remote operation

Sentry can be controlled remotely either through the web-based GUI or the API. When controlled over the web-based GUI, you get the benefit of Sentry's onboard analytics and graphing functions. These allow you to try out different network configurations or make spot-checks on the network enabling your engineers to locate under-performing services quickly.

For integration into network management systems, and where greater data security is required, Sentry is equipped with an API allowing full automation of setup and measurement downloads for maximum efficiency.

Archive network performance data

Archive the data you have downloaded from Sentry for later analysis and verification of the network synchronization performance. Archived data can be used, for example, as evidence for compliance to service level agreements where timing is provided to tenants, and invaluable in verifying compliance to regulations such as MIFID II for financial trading venues.

Highly stable internal reference

Sentry contains both a highly stable Rubidium (Rb) reference oscillator and a GNSS receiver. Combining the long term stability of GNSS with the short term stability of the Rb clock provides the ideal internal UTC reference for measurements. And if there is any disruption of GNSS, the internal reference delivers robust holdover performance allowing you to continue to make valid synchronization measurements for several hours.

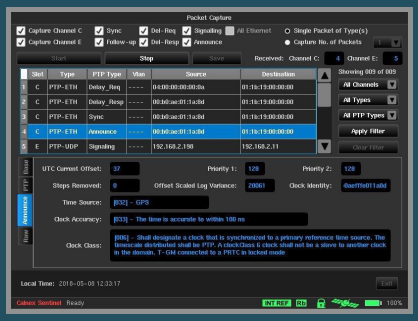
Automatic reboot with Watchdog

Uptime is paramount in data centers. Calnex Sentry units have been in service in Data Centers for hundreds of thousands of hours and have proven to be very reliable but instrument glitches can still happen. Often a simple hardware reset is all that is required, but sending an engineer out to perform a simple reset is not the best use of resources in terms of time and cost. If Sentry freezes and is unable to report results, its internal hardware watchdog resets the instrument and restarts measurements immediately so that data loss and downtime are minimal.

Redundant power supplies

Data centers often operate with two separate power circuits. To allow a power circuit to be de-energized without interrupting the critical monitoring, Sentry has redundant hot-swappable power supplies. The status of these supplies can be read through the API.

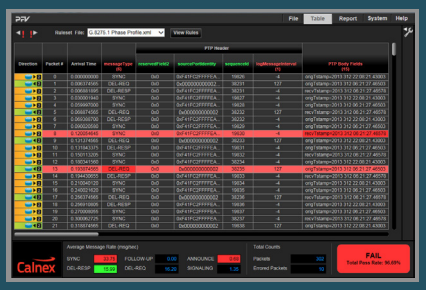
For detailed PTP Protocol Analysis, download data to Sentry's on-board Packet Capture feature or by downloading data to the PTP Field Verifier (PFV) software.



Packet Capture and Decode

Capture and decode Signaling, Sync, Del-Req, Del-Resp and Announce messages to help identify:

- **Configuration issues – such as mismatch domain number configured for Master Clock and Subordinate Clock**
- **Protocol Implementation issues – such as the log interval of Del-Resp does not reflect the real packet rate as expected in multicast mode**
- **Protocol Signaling issues – such as signaling messages do not repeat after the negotiated contract period**
- **Capture and decode Announce messages – provides detailed information about the PTP GM which is fundamental to build up the Master-Subordinate clock hierarchy**



PTP Field Verifier

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**
- **Check transmitted PTP messages for compliance with ITU-T, IEEE and user-defined standards and rules – areas of non-conformance immediately visible**
- **Flexible XML rules allow full customization of pass criteria**
- **Full report generation capability**

Related Products

Calnex Sentinel

The same performance is available in the transportable Sentinel sync analyzer. It uses the same user interface as Sentry displays through the web-based GUI. Sentinel also has a highly-stable Rubidium clock and battery so that you can take UTC with you as you carry Sentinel throughout the facility to isolate sync issues.

Calnex Paragon-X

- **Test PTP (1588), SyncE, NTP, CES and OAM up to 10GbE**
- **Stress-test equipment with real network profiles from field tests to debug network issues**
- **Complete standards compliance testing to ITU-T G.826x/827x**
- **Test PTP Ordinary Clocks, Boundary Clocks and Transparent Clocks**

Calnex Paragon-neo

- **Industry-leading Time Error solution delivering sub-nanosecond accuracy – essential for validating new, high accuracy 5G network devices.**
- **Addresses all 5G and ORAN Enhanced Time requirements at rates up to 400GbE.**
- **Capture and decode PTP packets for analysis and Time Error testing**
- **Prove SyncE jitter and 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**
- **Control ESMC (SSM) message generation for testing to ITU-T G.8264**

Get greater measurement insight with the Calnex Analysis Tool (CAT)

The 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.

Enhanced graphics makes it easy to evaluate ITU-T metrics such as Time Error (cTE, dTE), MTIE and TDEV against predefined masks. While the customizable multi-graph window lets you rapidly select measurements and channels for detailed analysis.

CAT also provides one button generation of reports in PDF format including Pass/Fail statistics and details of failures. This allows you to share captures and results with vendors for fast, efficient and accurate troubleshooting.

Ordering Information

Calnex Sentry synchronization monitor with built-in GNSS receiver. Needs minimum of one measurement option.

Included with shipment: Calnex Analysis Tool (CAT), PTP Field Verifier Tool (PFV), user manual on USB, line power cord, 1-year warranty and support.

Measurement Options

- Option 610: Clock module 1PPS/E1/T1, any clock from 0.5 Hz up to 200 MHz with 0.5 Hz step. (maximum two per instrument)
- Option 615: 100M/1G packet port (PTP/NTP). Can order maximum of 2 x Option 615. (maximum two – Option 615 and/or Option 616 per instrument)
- Option 616: 100M/1G/10G packet port (PTP/NTP). Can order maximum of 2 x Option 616. (maximum two – Option 615 and/or Option 616 per instrument)
- Option 618: 100G Interface ordered at same time as Sentry mainframe or software upgrade enabling second 100G port
- Option 622: 25G Interface ordered at same time as Sentry mainframe or software upgrade enabling second 25G port

Additional Options

- Option 620: PTP and NTP PDV measurement software (one license per instrument).
- Option 621: 32 additional virtual NTP/PTP measurements.
- Option 812: One year extension of product warranty.
- Option 813: Two years extension of product warranty.

Calnex Sentry Specifications

	Ethernet Specifications
PTP (1588) and NTP	**Main Channels** PTP (1588): Layer 2 Multicast and Layer 3 (UDP/IPv4, UDP/IPv6) Multicast/Unicast. NTP: Layer 3 (UDP/IPv4/IPv6) Multicast/Unicast. **Virtual Channels** PTP (1588): Layer 3 (UDP/IPv4, UDP/IPv6) Unicast. NTP: Layer 3 (UDP/IPv4, UDP/IPv6) Unicast.
Measurement Channels	Maximum of two channels. Each channel can be configured with multiple line rates. Only line rate per channel will be active for a measurement. **Connectors:** ↳ RJ45 for 100/1000 Base-T. ↳ SFP/SFP+ for 100M/1G/10G Optical. ↳ QSFP28 for 100G Optical. ↳ SFP28 for 25G Optical (QSFP28 to SFP28 adapter supplied with 25G option). (Optical transceivers not supplied.)
Accuracy	PTP/NTP constant TE measurement accuracy with reference to GNSS ±75 ns.
Packet Rate	128 packets/sec if only two Main Channels are used decreasing to 1 packet/sec if two Main and 32 Virtual Channels are active.
	Main Ethernet Channels
	Sentry fully analyzes one PTP stream on each measurement channel. These are referred to as the Main Channels. The analysis is available on the web-based GUI. Alternatively, the measurement data can be downloaded and fully analyzed by the Calnex Analysis Tool (CAT).
Onboard Analysis	↳ Masks or test limits can be applied to TE, 2wayTE, pktSelected 2wayTE, 2wayTEL, 2wayTEH, TIE, MTIE, and TDEV graphs PRC/SSU/SEC: Masks for G.811/G.812/G.813-clocks (ETSI 300 462-3). ↳ Networks: According to G.823/G.824/G.8261/G.8261.1/G.8271.1/G.8271.2
Web-based GUI Display	↳ Display modes: TE, 2wayTE, pktSelected 2wayTE, TIE, MTIE, TDEV, Path Delay, PDV, 2wayTEL, 2wayTEH, Distribution of PDV Selected PDV, Floor Packet Percentage, Maximum Average Frequency Error. ↳ Number of graphs: Up to 6 graphs of the same type can be over-laid on screen. Color coded. ↳ Masks on screen: Up to 6 MTIE and TDEV masks according to selected test mode. Pass/Fail result available for each mask.
	Virtual Channels
	If Option 621 Multiple Measurement capability is enabled, 2wayTE can be measured on a total of 32 additional PTP or NTP streams (Virtual Channels). Virtual Channels must be Unicast and differentiated by IP address.
Data Capture and Visualization	Measured data is be downloaded over API in CSV format for further analysis. The time error data for these Virtual Channels is also saved by Sentry and can be downloaded for analysis by the Calnex Analysis Tool (CAT).
Data available over API	Main PTP/NTP Channel: TIE, 2wayTE, Path delay, fwdPDV, revPDV, ESMC. Virtual channels: 2wayTE, Path delay, fwdPDV, revPDV.
	Clock Module Specifications
Pre-defined Signal/Clock Types	• 1PPS (PTP Subordinate recovered clock). ↳ 8 kHz (frame clock). ↳ 64 kHz/64 kb/s (E0/DS0). ↳ 1.544 MHz/1.544 Mb/s (T1/DS1 clock/data). ↳ 2.048 MHz/2.048 Mb/s (E1 clock/data). ↳ 5 MHz/10 MHz (frequency reference). ↳ 25 MHz/125 MHz/156.25 MHz (SyncE clock rate). ↳ 34 Mb/s (E3), 45 Mb/s (DS3). ↳ 155.52 MHz/155 Mb/s (STM-1/STS-3 clock/data).
User-defined Clock Types	From 0.5 Hz to 200 MHz in 0.5 Hz steps. Note: symmetrical, unipolar clock signals.
Measurement Ports	↳ Number of Ports: 2 per module. ↳ Connector: BNC. ↳ Impedance: 75 Ω, VSWR <2:1 or 1 MΩ. ↳ Voltage Range: ±5.00 V. ↳ Sensitivity: min input voltage 60 mVpp, Signal Check voltages are for indication only. ↳ Signal Type: Symmetrical pulse (clock signal); Unsymmetrical repetitive pulse (clock signal); HDB3-coded data (data signal); AMI B8ZS, B3ZS (data signal). ↳ Frequency Measurement: TIE accuracy 1 ns. ↳ 1PPS: Constant TE measurement accuracy with reference to GNSS ±75 ns.

Specifications *continued*

	Clock Module Specifications *continued*
Relative Time Error	The accuracy with which Sentry measures the phase difference between any two clock inputs. rTE ≤ 5ns.
	Internal Rb Clock
Reference Clock	Built-in Rubidium reference.
Stability	Output frequency accuracy (7 mins to warmup): 1×10^{-9} Ageing (1 day): $<1 \times 10^{-12}$ Ageing (1 year): $<5 \times 10^{-10}$
	GNSS
Built-in GNSS Module	12 channels, GPS L1, Galileo E1, GLONASS G1 and BeiDou B1 bands (not compatible with B1C).
Time Accuracy	±15 ns at 1σ after 24 hours lock.
Frequency Accuracy	2×10^{-12} averaged over 24 hours.
GNSS Disciplining Modes	Always disciplining, always in holdover, disciplining only between measurements. Requires 6 hours discipling if disconnected from GNSS for <1 week; 12 hours if >1 week. Requires 1 hour disciplining if using Cs quality 1PPS (from any state).
	External References
External 1PPS Timing Input	Voltage Range: 0 V to 0.8 V (Low), 2 V to 3.3 V (High) into 50 Ω. Required Accuracy: ±100 ns to UTC.
GNSS Timing Reference	Antenna Input: type N connector. DC-feed: +5 V on center pin to active GNSS antenna.
	Reference Output
Reference Frequency Output	Reference Frequency: 10 MHz sine-wave. Output Levels: 1 Vrms in 50 Ω. Impedance: Approx. 50 Ω.
1PPS Output	Source: Internal Rubidium oscillator. Output Logic Levels: TTL levels in 50 Ω.
	Additional
USB Host Port	Connector: Std USB type A. USB Version: 2.0 Maximum Supply Current: 400 mA.
LAN/Management Port	Communication Port: RJ45, 10/100/1000 Base-T. Protocol: HTTP, HTTPS, DHCP or fixed IP (IPv4 or IPv6), FTP, web-based GUI (http/https) with authentication if required, WebDav. Supports VLAN.
Data Storage	Internal: Up to 32G; External: USB memory stick.
System Watchdog	Automatic power cycle under fault conditions. Remote manual power cycle via API.
	Environmental Data
Operating Temperature	0°C to 40°C.
Storage	Temperature from 0 to 50°C and humidity up to 90% non-condensing.
Safety	EN61010:2010 +A1:2019
EMC	EN61326-1:2021
Power Supplies	Line Voltage: 100 to 240 Vac ± 10%, 50 to 60 Hz ± 3 Hz. Instrument power consumption <100 W. Instrument will operate on one power supply but it is recommended that both are used.
	Mechanical Data
Dimensions	3U cabinet designed for 19” rack. Depth 17.3” (439 mm).
Weight	8.4 kg (max.)

Specification is subject to change without notice.

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