atop Technologies

Precision Timing

Whitepaper

Engineered and manufactured in Taiwan

Contents

Network Timing

At its simplest, a network is a series of connections to exchange information between nodes. But although simple in theory, what today's networks underpin in practice is a vast complexity of industry and consumer activities. And as the number of consumer devices grows and industry applications become more advanced, the complexity of managing such networks is increasing.

Over several decades, different timing mechanisms have been established to synchronize devices on a network, such as Network Time Protocol (NTP) and IRIG-B. But a clear need has emerged for such mechanisms to provide better flexibility, ease of use, lower cost, and perhaps most importantly, a higher time accuracy for a range of new applications and industry demands.

A Dedicated Solution

Precision Time Protocol (PTP) is a relatively new protocol, with its specifications having been defined in 2008 in the IEEE-1588v2 standard. The protocol provides a mechanism by which to synchronize devices on a network with sub-microsecond precision, by using hardware-timestamped data packets and accumulated delay calculations. Where PTP also advances is in introduction of the concept of profiles.

Profiles allow other standards bodies to tailor PTP to particular applications, by defining a combination of options and attributing values for a given application. This is turn allows better interoperability between equipment designed for that purpose. Such profiles include ITU-T for telecoms, WIP for enterprises, and even IEEE802.1AS for audio applications. And with PTP's ability to incorporate legacy hardware and protocols, it is look set to allow the next generation of possibilities, all while including yesterday solutions to today's demands. It is a dedicated solution for precise network ting.

How PTP Works

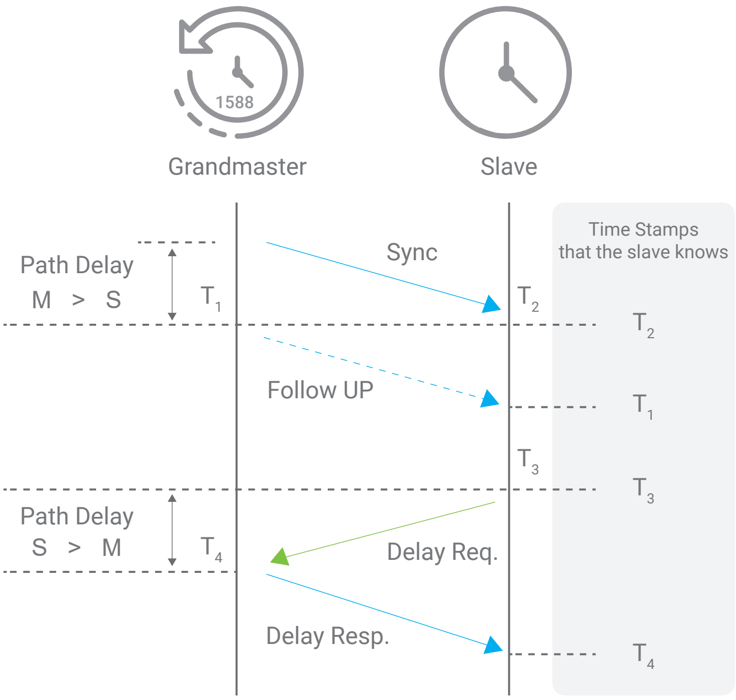
Defined in the IEEE 1588-2008 standard, Precision Time Protocol (PTP) version 2 is a two-way packet-based communications protocol designed to synchronize clocks in the sub-microsecond range, by using hardware-timestamped data packets and accumulated delay calculations.

PTP uses a master-slave hierarchy. A grandmaster clock acts as the primary time source to which all master clocks synchronize. Where PTP simplifies matters is in its use of Best Master Clock (BMC) algorithm. By continually polling for the most accurate time source, master devices automatically synchronize to the grandmaster clock; slave devices automatically synchronize to maser devices. Not only does this make the set-up process of a PTP-enabled network relatively quick, but it provides added reliability should a link or device failure occur, as devices then negotiate status and recognize the next best clock upstream.

PTP's sub-microsecond accuracy comes from the use of hardware timestamped packets. Because packets are timestamped when they enter and leave device, the inaccuracies that come from the time software processing are eliminated. Accumulated delay calculations are used to provide an accuracy with 1 µs.

With this accuracy, reliability, and relative easy of use, IEEE1588v2 is proving itself invaluable to industries such as Power Distribution, Telecommunications, and Industrial Automation. And in the emerging world of Industry 4.0 and IIoT, highly accurate timestamps will be critical for every step in processes.

PTP Sequence



Time Stamp Sequence

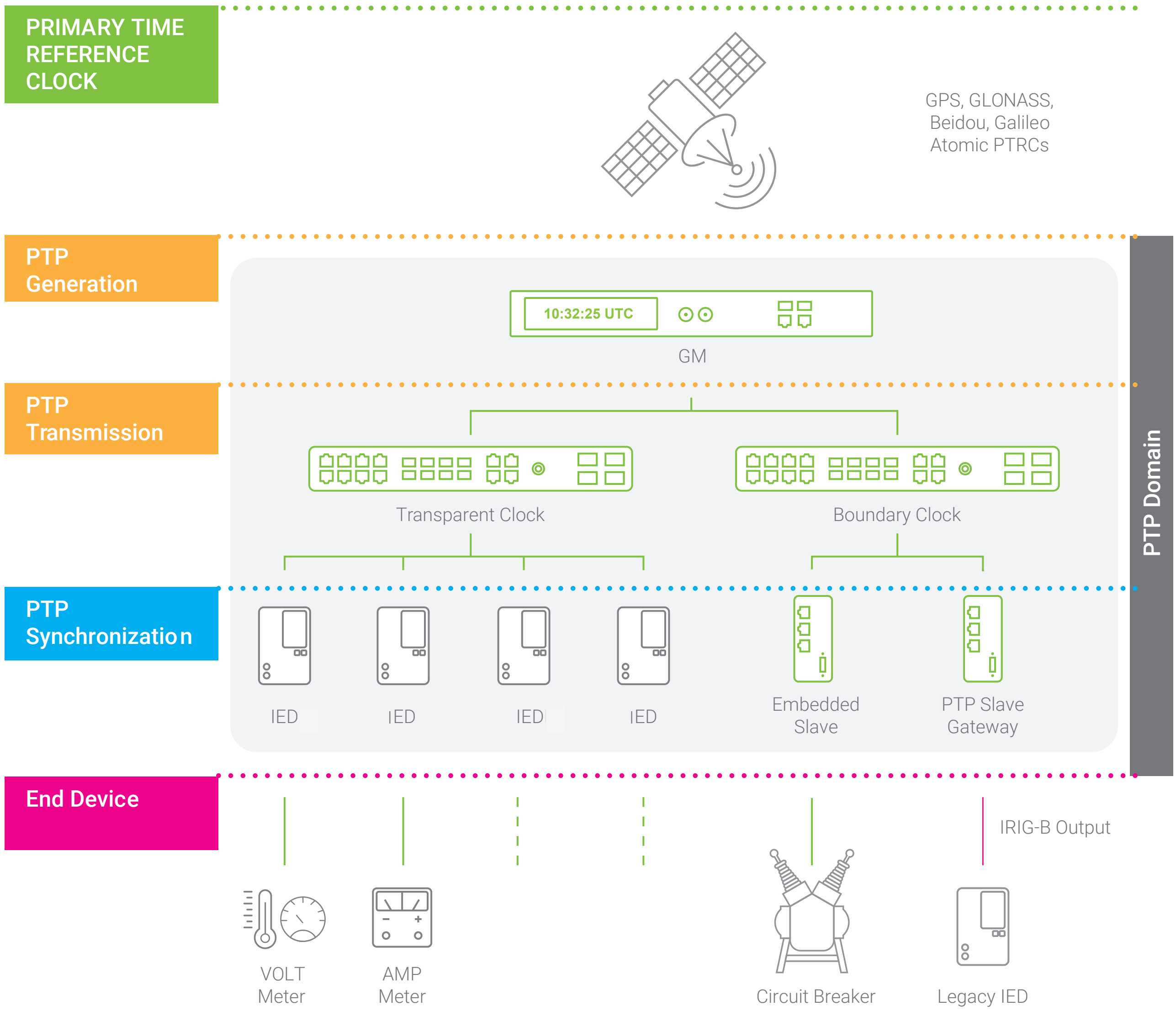
The PTP event messages are: Sync, Delay_Req, PDelay_Req and PDelay_Resp. The PTP general messages are: Follow_Up, Delay_Resp, PDelay_Resp_Follow_Up, Announce, Management and Signaling.

- Once elected Grandmaster by BMCA, the master clock sends the **Sync** message. The time that Sync messages leaves the master is the timestamped as t1. For one-step operations this can be embedded in the **Sync** message itself; for two-step operations, it can be embedded in the **Follow_Up** message.
- The slave receives the **Sync** message; t2 is the timestamp that the slave receives the in Sync message. In order to be able to compute the exact time, the slave will have to know the link delay.
- In End-to-End link-delay calculation, the slave sends the **Delay_Req** message. This as timestamped as t3 when it leaves the slave. It is then timestamped as t4 when is it received by the master. The master responds with a **Delay_Resp** message that contains the t4 timestamp.
- The Peer-to-Peer link-delay is calculated in a similar way, with different messages, but from hop to hop

By knowing timestamps t1, t2, t3, and t4, the slave is able to compute accurate timing by calculating for accumulated link delays. In Peer-to-Peer mode, the link delay is calculated between each hop by assuming that packets use the same path during transmission and that the delay is symmetric.

How PTP Delivers

Accurate Network Timing



PTP Elements

GNSS

As an external clock source, GNSS' Atomic Clock provides highly accurate absolute time to the GM.

Grandmaster

Highly accurate clock that is the ultimate source of time for network synchronization using PTP.

Boundary Clock

Upper Network Layer

Located between two or more network segments, it acts as a slave clock to devices upstream, and as a master to devices downstream.

Transparent Clock

Ethernet switch that forwards PTP packets transparently, only modifying selected fields during pass-through.

Slaves

A slave clock uses IEEE 1588 protocol to Synchronize its internal System Time to the BMC selected master clock.

PTP from ATOP

Turn to page 12 for our Industrial solutions for brining PTP to your industry.

Delivering The Next Revolution

Industry initiatives such as the Internet of Things (IoT) and Industry 4.0 have already fundamentally changed consumer behavior, with the proliferation of devices like smartphones penetrating everyday habits and providing total connectivity to an array of industry and consumer services. To maintain command and control of mission critical data and responses, Industries, too, have been developing their equivalent, with the Industrial Internet of Things (IIoT), by using greater connectivity for insights, visibility, and more intelligent automated actions, with the of ultimate goal of Industry 4.0 being the creation of the Smart Factory these interconnected devices that offer deeper insights and more control. The potential of such practices will be eliminating efficiencies and responding to individual consumer demand with the use of interconnected advanced robotics, Big Data Analytics, and Industrial Connectivity and Services.

As industries become more interconnected between consumers, suppliers, and produces, IEEE 1588 PTP will become increasingly vital for delivering accurate timestamps for every process step for the functioning of these networks, affecting industries such as manufacturing, telecommunications, power generation, finance, aerospace and defense, and the scientific enterprise itself in the field of testing and data acquisition.

Telecommunications

With the proliferation of devices like smartphones and high bandwidth cellular network technologies such as 3G and 4G the telecommunications industry has undergone a revolution. Originally conceived for communications alone, the industry has become the backbone for streaming online music and video services to providing remote access and control to wind farms. And as the industry moves towards 5G, these services will undergo more demands, as consumers begin to take advantage of faster speeds and industries develop and implement IIoT applications such as embedded Machine-to-Machine communications for use at remote locations and factory floors. This will require interconnected base stations and cells to function together with nanosecond-accurate network timing with both frequency and phase (time-of-day) synchronization.

The PTP Telecom profile was created by ITU-T for targeting accurate time and phase distribution, frequency, and signal failure – for both existing and new-build networks – and all with a target accuracy of with 1.5μs for time synchronization. So PTP is a protocol that is a must for today's cellular networks for distributing time, and for future proofing networks for tomorrow's more advanced applications that will require highly accurate timestamps for every step in processes.

Power Distribution

Past experiences such as the North American Blackout of August 2003 past show just how difficult it can be to align data with timestamps that are produced with inaccurate time references, with such blackouts or power failures incidents taking longer to align data than analysing the data itself. As an innovative protocol with hardware-based timestamps, PTP makes it much easier to align data, by reaching time resolutions in the sub-microsecond range. By contrast, NTP as a time distribution mechanism provides an accuracy only in the range of milliseconds, and although time codes like IRIG-B provide much better performance than NTP, they require the installation of additional, specialised cabling to distribute time.

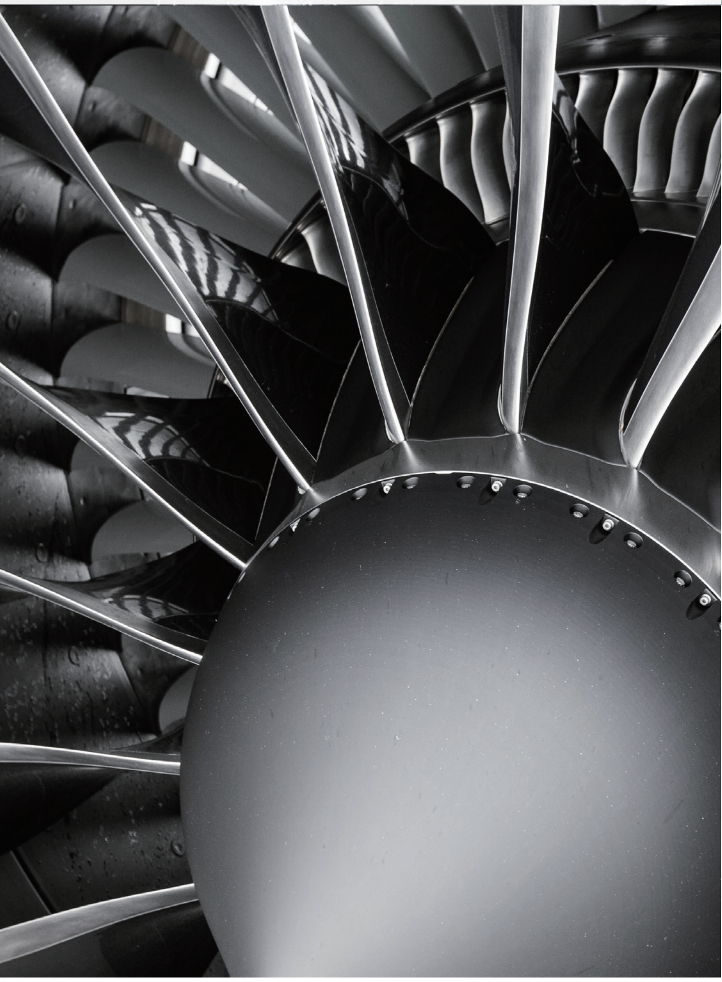
These accuracies are important to maintain. The power industry deals in one of the few commodities that has transmission speeds that are as fast as the communication speeds that control the operation. So at the substation level, every IED has to be accurately synchronized to ensure that failures are handled in a way that doesn't jeopardize the integrity of the whole grid. And the grid itself, being so interconnected, needs to keep frequency and phase of the AC power line aligned perfectly. So PTP's specific Power Profile address such issues: ensuring seamless interoperability of PTP equipment for applications in the power industry; synch accuracy not being affected by network traffic, fiber optic or twisted pair, meaning it's a matter of selecting the right Ethernet switch for port configuration.

Dedicated Industrial Precision

Industrial Automation

Real-time Industrial Automation Protocols such as Profinet, IRT, EtherCat, and Powerlink were conceived to handle the motion control of units that are act together in a series of coordinated actions, requiring frequent energy and position data. These updates can take place up to 40,000 time per second.

Traditionally, sensor signals have been used to coordinate such devices, which introduce jitter into a system. But because IEEE 1588 PTP is based on timestamps instead of sensor signal, jitter can be reduced, enabling tighter system coordination and making throughput more predictable. Also, when there are instances of fault occurrence, IEEE 1588 PTP use of timestamping makes much easier and simpler to detect where fault occurs -- such as a camera being triggered too early or a part arriving late. With IEEE 1588 PTP, the exact sequence of events can be identified.



Aerospace and Defense

GPS was originally developed by the US military for high-end military communication applications. But although GPS can deliver somewhat convenient accurate frequency, phase, and time, its setbacks stop it from being fully embraced today. GPS antennas can be cumbersome, and poor weather conditions can lead to signal degradation, not to mention poor GPS signal reception from limited sky view. And this is on top of vulnerability to jamming and spoofing. Its these setbacks in many aerospace and defense applications that has turned attention away from GPS and towards Ethernet.

Based on Ethernet, IEEE 1588 PTP has become ideal today's modern mobile military units, which utilize interconnected networked devices for reconnaissance, coordination, and the execution and deployment of weapons systems. Ethernet is faster and more flexible and offers greater functionality than the legacy systems such as serial.

Dedicated Industrial Precision

Finance

When one thinks of finance, Wall Street is an image that is not too far one's mind. But practices have shifted away from on-floor trading and the out-cry. Instead, much of today's stock, futures, and options are handled electronically over the internet. Not only has this sped up buying and selling, but it has opened up trading to more individuals and trading platforms. And so with more transactions happening ever more quickly between more users and individuals, tracking when exactly transactions has become vitally important.

Trading regulations have also caught up with high frequency trading. For instance, approved by the European parliament, MiFID II will take effect in January 2018, which stipulates a time synchronization of 100 microseconds and a timestamp resolution of 1 microsecond. And this is in world in which new payment methods like BitCoin and micropayments from devices like smartphones and even smartwatches are fast becoming common ways to purchase items online and in stores. This sort of precision is simply not offered by previous protocols like NTP over the internet, nor can they offer the same level of security as IEEE 1588 PTP.

Control and Measurement

As the world's largest and most powerful particle collider, the Large Hadron Collider (LHC) is the world's most complex experimental facility yet built. Since it went live September 10, 2008, it has generated vast quantities of data, which are streamed to laboratories around the world for distributed processing. For instance, by 2012 data from over 6 quadrillion (6 x 1015) LHC proton-proton collisions had been analysed; LHC collision data was being produced at approximately 25 petabytes per year.

The value of PTP in such high-speed, event-driven data acquisition applications is in making it much simpler to compare data sets from multiple independent systems: sample data that is synchronized to absolute time becomes much easier to analyze, which is especially important for data with time resolutions in the sub-microsecond range. Besides the performance advantages, PTP offers more practical implementations, by reducing the weight and complexity of wiring installations, which is becoming increasingly important as large systems become more commonplace.

NTS7500 - PTP

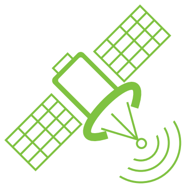
Power-Grade Industrial PTP Grandmaster Clock

FEATURED HIGHLIGHTS

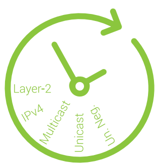
- High precision GNSS module
- Stratum 1 NTP Server, with PTP hardware-support
- supports IEEE61850-9-3 and IEEEC37.238 Power Profiles
- Holdover <30 ns/second time-drift when disconnected from GNSS
- IEC62439-3 Clause 5 Parallel Redundancy Protocol (PRP)
- Industrial fanless design for -40~85°C operation; IEC61850-3 protection
- Flexible modular configuration; 2 dedicated Output Module slots
- 2 x 10/100/1000 Mbps RJ45 and 2 x 100/1000 Mbps Combo SFP slots
- Embedded NTP/SNTP client and NTP server
- Support for Legacy Protocols: IRIG-B, BJT, BCD, ST, ST with checksum
- Redundant power input; low-Voltage DC or high-Voltage AC/DC

PRODUCT DESCRIPTION

A Powerful base for NTP and PTP
The NTS7500 1U 19" Rack-mount Modular NTP Server with additional Grandmaster Clock feature is a high-powered rugged device that offers good precision and reliability. Suitable for almost any environment and complying with the harshest Industrial EMC conditions, ATOP's device satisfies all industry requirements for Industrial-grade networking timing applications. Its modular architecture provides power-input redundancy and up to 16 different outputs for legacy time Protocols – such as IRIG-B, BCD, ST, ST with checksum.

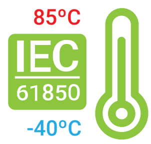


Stratum 1 NTP Server: NTS7500 embeds a high precision, multi-system GNSS module that supports GPS, GLONASS, BEIDOU and GALILEO GNSS Systems for redundancy. When disconnected from a GNSS time source, its integrated TCXO Oscillator, ensures time drift (1PPS output) does not exceed 30 ppb matching and exceeding the requirements for Power Substations. NTS7500 supports NTPv1/v2/v3/v4 Server and NTP/SNTP Client.



PTP Standard Support: On NTS7500-CPU-PTP, the possible PTP configurations are endless. NTS7500 supports Layer-2 and Layer-3 over IPv4 transport; VLAN Tagging; and Multicast, Unicast and Unicast Negotiation in both End-to-End and Peer-to-Peer delay calculation modes. NTS7500 fully supports IEEE C37.238-2017 and IEEE/IEC 61850-9-3 – 2016 Power Profiles.

Industrial and Substation Hardware : Designed to satisfy EMC requirements for Substation-Grade equipment, NTS7500 has a minimum EMC Level 4 rating and is designed to function between -40°C and 85°C with passive cooling only, allowing it to avoid the risk of having moving parts breakdown from constant operations. Also, its powerful CPU supports up to 2,000 packets per second, allowing endless applications and a large number of slaves to be supported simultaneously. Redundancy through IEC62439-3 Clause 5 PRP.



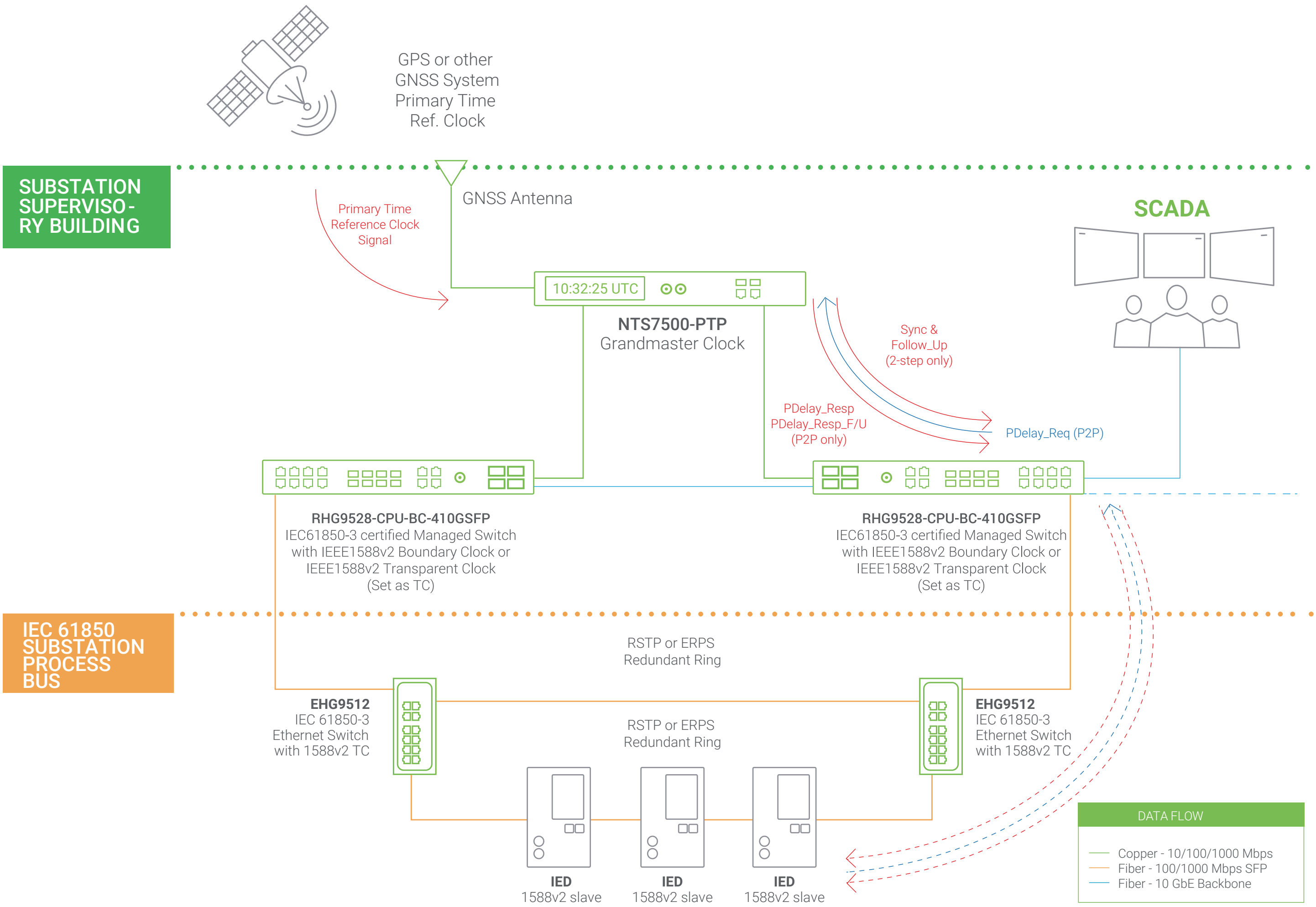
Proven design: No standardized testing procedure for PTP devices exists. So ATOP tests its products yearly in ISPCS Plugfests to demonstrate their reliability. NTS7500 was successfully tested in Stockholm 2016, Monterey 2017, Geneva 2018 and Portland 2019. More information available on www.ispcs.org.

APPLICATION CASE

IEEE1588v2 Precision Time Protocol

PTP is the only protocol that allows network time synchronization in the nanosecond-range. Current networking protocols nor legacy protocols allow such a timestamp resolution. IEEE1588-2008 (v2) derives from an earlier version issued by IEEE in 2002 that is not backward compatible. Being so exact about timestamp resolution and timekeeping, IEEE1588v2 timestamps are required to be hardware-generated, since no software could keep up with some stringent requirements, no matter the processing power. PTP is a hierarchical protocol, in which Grandmaster Clocks are directly synchronized with reference clocks such as GNSS or Atomic Clocks, with subsequent layers reaching slaves devices. PTP packets are timestamped with a nanosecond resolution.

To achieve such accuracy, PTP works best on Local Area Networks without passing through the internet: latencies and paths would introduce variables latencies that couldn't be accommodated for in the accumulated delay calculations. PTP packets should always travel the same path during each synchronization phase to preserve such high accuracy. PTP is designed to work on Ethernet transport, Layer-2 (Data-link Layer) or Layer-3 IPv4. And there are two methods to calculate link delay: in End-to-End mode, link delay is calculated from the source of the PTP packet until its destination, while in Peer-to-Peer mode, link delay is calculated as between each network node. In addition, PTP is Internet-capable, with IPv4 in unicast and unicast negotiation modes.



Application example

This network diagram shows the use of ATOP's NTS7500 in a substation environment. The GMC is usually located in the office building adjacent to the substation. On one side, it is connected to the GNSS Antenna, with the other side being the Substation backbone connection. Every switch connected to the Grandmaster should be able to handle all Precision time Protocols by hardware, in order not to affect the synchronization quality. Packets are delivered downstream through Boundary or Transparent clocks, where they'll reach PTP slaves – such as substation IEDs.

RHG9528 Series

IEC61850-3 Certified Rack-Mount High-Availability Managed Modular Gigabit Switch - PTP Boundary Clock

FEATURED HIGHLIGHTS

- Supports HSR (IEC 62439-3), PRP (IEC 62439-4) for high-availability
- IEC 61850-3 and IEEE 1613 KEMA certification (pending)
- Integrated IEEE 1588v2 hardware-based BC and TC (-BC/SB version)
- Maximum 128Gbps switching capacity, 95.24Mpps throughput
- Rugged industrial design for harsh environments between -40~85°C
- Flexible modular configuration; 3 Module-dedicated slots
- Up to 24 Gigabit ports, and 4x10 Gigabit SFP Uplink slots, 1PPS BNC
- ITU-T G.8032 ERPS Ring, RSTP, or MRP (client) redundancy
- Advanced management features such as QoS and VLAN
- Supports Synchronous Ethernet for Telecom Applications (-SB version)

PRODUCT DESCRIPTION

Flexibility: ATOP's high-density RHG9528 Rack-mounted managed switch provides the flexibility needed for your application demands. You can choose from among six different Core versions: based on power supply, uplink port configurations and embedded Hardware-Assisted Boundary Clock feature. And you can choose from six different 4- or 8-Port modules to customize your device in a very simple way.

Designed for Substations: RHG9528 supports up to **24 Gigabit ports in any 8-port multiple configuration**. Specifically designed for IEC61850 substation backbone use, it is fully certified to meet all IEC61850-3 hardware requirements – such as EMC Level 3, 4 and 5 requirements, Wide temperature range and High availability. ATOP is proud to be applying for KEMA certification, the most prestigious one in Power Utilities.

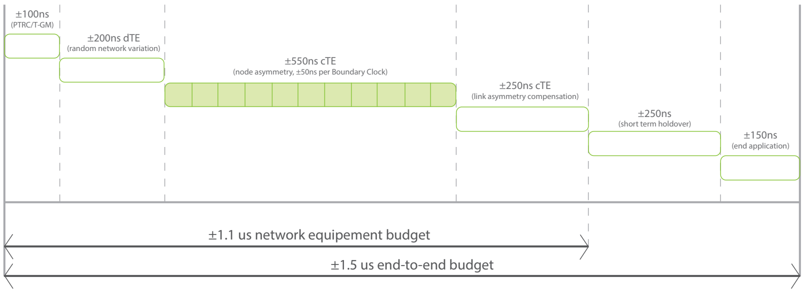
Award-winning Performance: RHG9528's IEEE1588v2 Hardware-PTP version received recognition for nanosecond-level accuracy, high-performance and an astonishing holdover performance of less than 1 Microsecond/hour. This makes RHG9528 one of the most reliable GMC backups. And being embedded with Synchronous Ethernet and with full support for PTP profiles, RHG9528 is also ideal for Telecom applications.

High-availability, versatility and power: When equipped with ***High-Availability HSR/PRP modules***, RHG9528 complies with the most stringent redundancy requirements, ensuring no packet loss and guaranteeing GOOSE packets arrive at their respective destinations. RHG9528's high performance provides a network redundant self-recovery mechanism of under 20ms on full load. This enables you to build a reliable network through almost any redundant ring topology. RHG9528 supports ITU-T G.8032 ERPS Ring, IEEE802.1D-2004 RSTP, STP, MSTP, MRP (Client), iA-Ring, iA-Chain and many other compatible ring protocols for network redundancy. With a Multifunctional web dashboard, its offers intelligent features such as Quality of service (QoS), IGMP, port mirroring, and security.
It is available in two power input variants: one for low-DC voltage (redundant 24~48VDC input) and one for the more popular High-Voltage applications in the distribution grid (redundant 90~264VAC, 24~120VDC or 120~370VDC input). Additional 4 x 10 Gigabit uplink SFP slots allow RHG9528 to be the backbone of the substation.

BOUNDARY CLOCK APPLICATION

High accuracy delivered, even in holdover mode

A boundary clock, mainly used in Telecom applications, is normally a switch that doesn't act transparently to the slaves in the network. Directly connected to the Grandmaster, large networks with thousands of slaves would overload the Grandmaster. So the need for a device that acts as a slave towards the master and as a master towards slaves is achieved with a boundary clock. ATOP's RHG9528 Boundary clock, once synchronized, achieves the 50ns precision set forth in the ITU-T G.8271.1 recommendation. And it is equipped with a high-precision OCXO to guarantee that precision in the event of a link or device failure, with a maximum time-drift of 250ns per from from GNSS time. All this can guarantee a maximum 1.5us end-to-end time deviation budget from the GNSS to the end-application, up to 10 BC hierarchies.

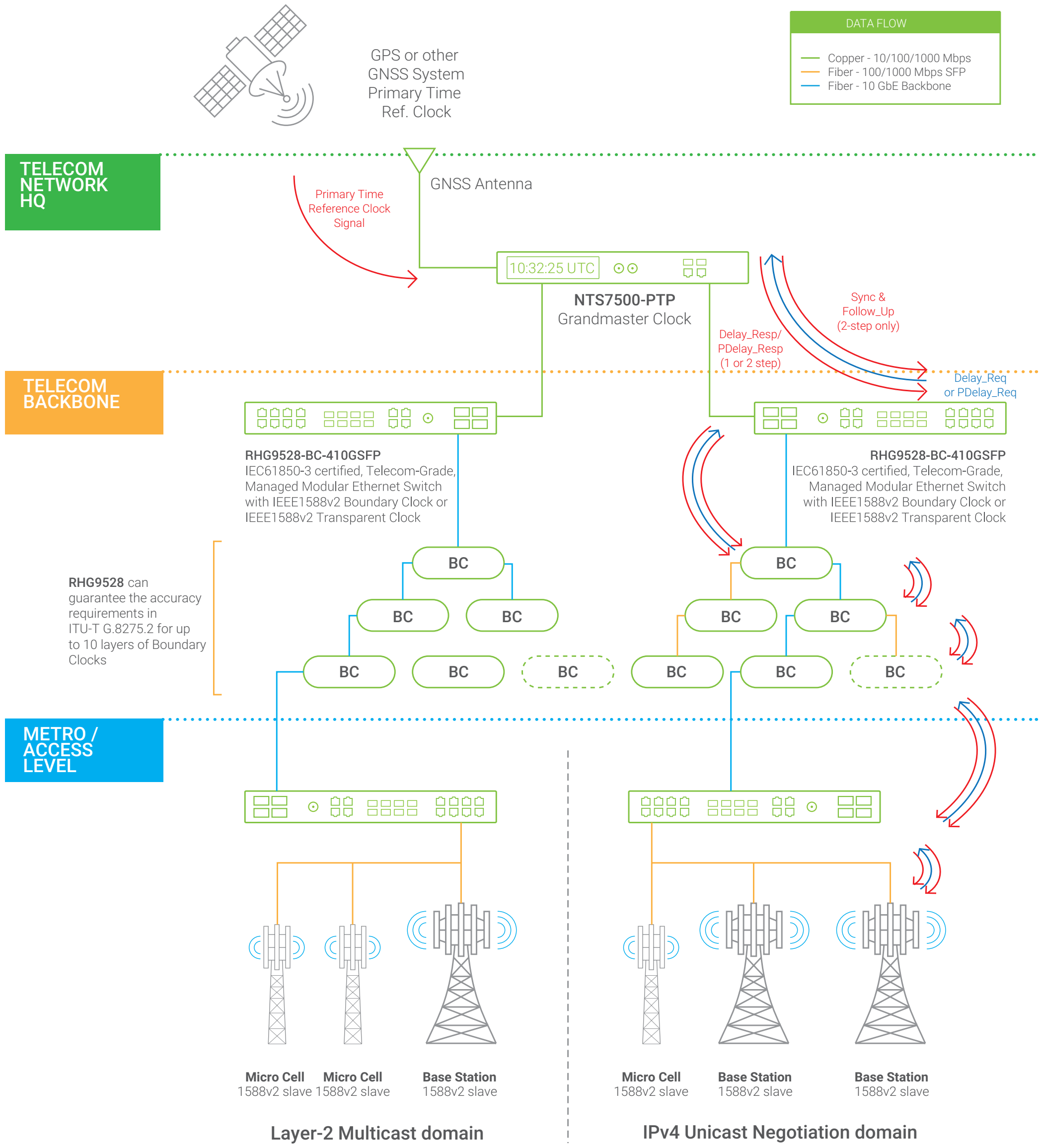


Application Example

The network diagram shows the use of ATOP's NTS7500 Grandmaster Clock and RHG9528 Boundary clock in a telecommunication application.

RHG9528 can easily function as a both Access/Aggregation switch with up to 4x1/10Gbps SFP slots and as a PTP boundary clock. Up to 28 ports can be individually configured to run different instances of IEEE1588v2. For example, the switches shown on the left hand-side will work on an L2 ITU-T G.8275.1 multicast End-to-End configuration, while the Boundary Clocks shown on the right hand-side work on IPv4 Unicast Negotiation End-to-End configuration that is fully compatible with ITU-T G.8275.2 Telecom Profile.

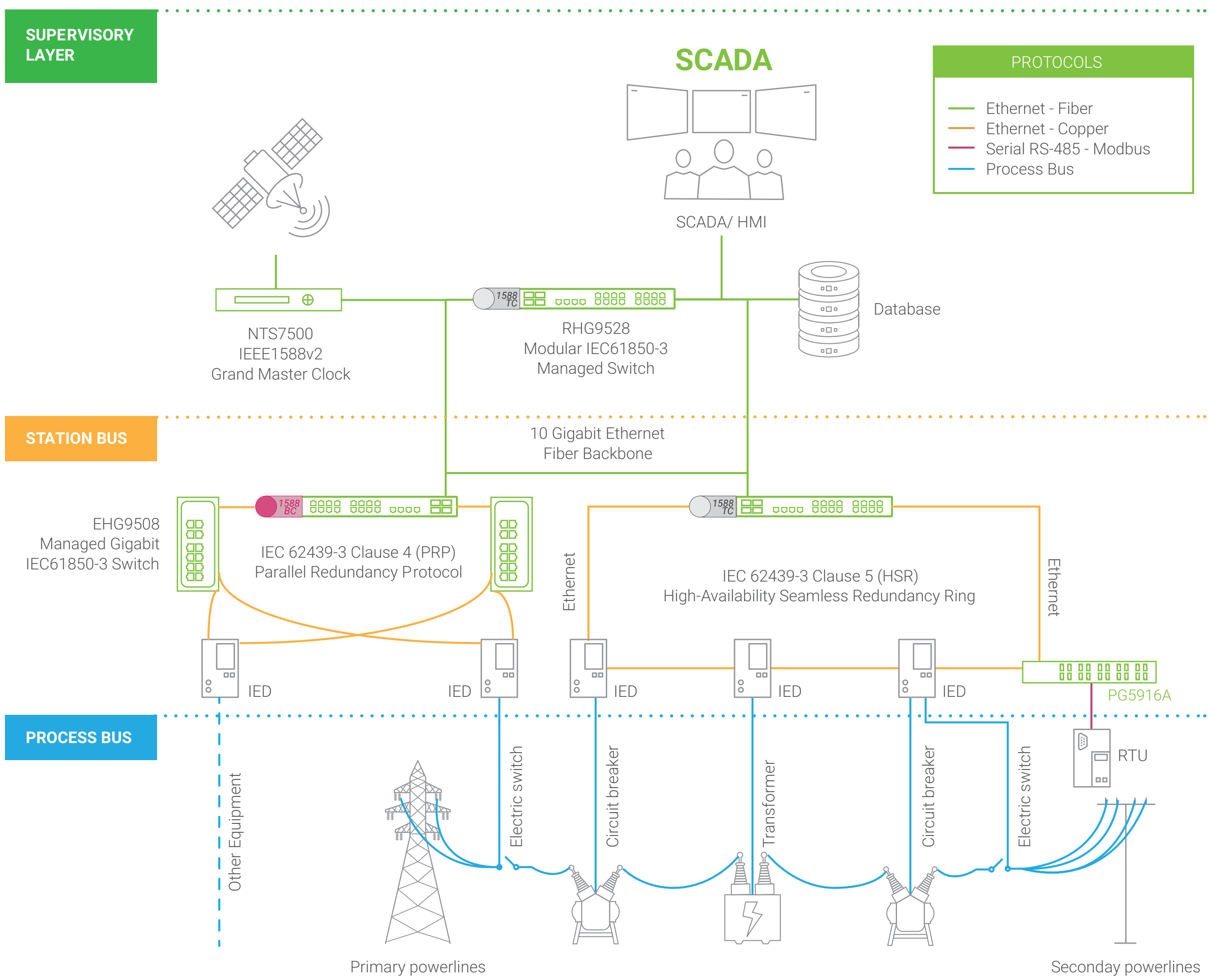
A wide variety of settings are allowed within profiles – such as the Power, Telecoms, and Enterprise profiles. RHG 9528-BS supports Synchronous Ethernet, allowing the transport of time and frequency, which is important for legacy networks such as SDH-SONET.



HIGH AVAILABILITY APPLICATION

Zero packet loss, on multiple ports

Install a 4-port Gigabit RJ45 or SFP High-Availability module in any of the module slots in RHG9528 CPU board, and you're good to go. Congratulations: your network is now fully compliant with IEC62439-3 Clause 4- 2016 (PRP) and IEC62439-3 Clause 5-2016 (HSR). Simultaneously. Though this 4-port module, You'll have a powerful quadbox at Your disposal: you can use 4 ports in HSR mode, in PRP mode or have 2 Ports working in an HSR Ring while other 2 working in PRP. This will provide you flexibility when integrating the switch in a complex topology. Through HSR/PRP technology, Atop's device will replicate the packet through 2 redundant paths and the end-application will have the risks to lose a packet almost zeroed. This is an example of a mixed HSR/PRP network, where RHG9528 is used flexibly as a Transparent or a Boundary Clock and as an HSR/PRP manager.



IEEE1588v2 PTP, IEC61850-9-3 Power Profile and HSR/PRP

RHG9528 is an advanced and flexible platform. It embeds high-bandwidth Switching fabric, Accurate hardware-based Boundary Clock or Transparent Clock, IEC61850-3 compliant hardware, and fully supports IEC/IEEE61850-9-3 - 2016 Power Profile. Also on HSR/PRP ports. When properly configured, our Switch can seamlessly provide Peer-to-Peer transparent clock and Boundary Clock on all ports, HSR/PRP ports included.

NTS7500 - NTP

Power-Grade Industrial NTP Server

FEATURED HIGHLIGHTS

- High precision GNSS module
- Stratum 1 NTP Server
- Holdover <30 ns/second time-drift when disconnected from GNSS
- IEC62439-3 Clause 5 Parallel Redundancy Protocol (PRP)
- Industrial fanless design for -40~85°C operation; IEC61850-3 protection
- Flexible modular configuration; 2 dedicated Output Module slots
- 2 x 10/100/1000 Mbps RJ45 and 2 x 100/1000 Mbps Combo SFP slots
- Embedded NTP/SNTP client and NTP server
- Support for Legacy Protocols: IRIG-B, BJT, BCD, ST, ST with checksum
- Redundant power input; low-Voltage DC or high-Voltage AC/DC

PRODUCT DESCRIPTION

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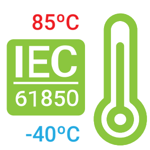
Stratum 1 NTP Server

NTS7500-NTP embeds a high precision, multi-system GNSS module that supports GPS, GLONASS, BEIDOU and GALILEO GNSS Systems for redundancy. When disconnected from a GNSS time source, its integrated TCXO Oscillator, ensures time drift (1PPS output) does not exceed 30 ppb matching and exceeding the requirements for Power Substations. NTS7500 supports NTPv1/v2/v3/v4 Server and NTP/SNTP Client.

Industrial and Substation Hardware

Designed to satisfy EMC requirements for Substation-Grade equipment, NTS7500 has a minimum EMC Level 4 rating and is designed to function between -40°C and 85°C with passive cooling only, allowing it to avoid the risk of having moving parts breakdown from constant operations. Redundancy through IEC62439-3 Clause 5 PRP.



EHG9508/9512 Series
EHG9608/9612 Series

8 or 12-Port IEC61850-3 Certified Industrial Managed or Layer-3 Gigabit Switch

FEATURE HIGHLIGHTS

- IEC61850-3 Certified, KEMA-KEUR
- Up to 6 or 8 10/100/1000 BASE-T(X) ports and 2 or 4 1000 BASE-X SFP ports
- IEEE1588v2 Precision Time Protocol support, with nanosecond-accurate Hardware-based E2E Transparent clock and Software Boundary Clock
- ERPS and Compatible Ring (recovery time < 20ms @ 40 switches), STP/RSTP/MSTP/MRP (Client) for network redundancy
- Remote management over Web browser, Telnet, Serial console, Utility
- Security features based on IEC62443-4-2
- Powerful Layer-3 Switching, supporting BGPv4, IPv4 Static, RIPv1/v2 and OSPFv2

PRODUCT DESCRIPTION

The EHG9508/12 Series & EHG9608/12 Series is a highly reliable Gigabit Managed Ethernet Switch. Its IEC61850-3 compliance allows it to be core part in the IEC 61850 network in power substations and control centers. The series is also certified by DNL.GL (former KEMA) to meet the IEC61850 applications and to support the transmission of GOOSE messages used for fast communication between IEDs.

The **IEEE1588 Precision Time Protocol capabilities allow the deployment of EHG9508/EHG9512 Series** & **EHG9608/EHG9612 Series in networks with stringent time Synchronization requirements**. It can act as hw-assisted End-to-End transparent clock providing nanosecond-accurate correction-field packet-update and as a sw-assisted boundary clock.

The device equips up to 8 10/100/1000BASE-T(X) RJ-45 ports and up to 4 1000BASE-X SFP ports. **With its high performance, it provides network redundancy self-recovery mechanisms is less than 20ms on full load that enables the user to build a reliable network through a redundant ring topology**. ERPS/STP/MSTP/RSTP/MRP (Client) and many other compatible rings are supported. With a Multifunctional web dashboard, its offers intelligent features such as Quality of service (QoS), Virtual LAN (VLAN), IGMP, IGMP Snooping, Port mirroring and security. To prevent network intrusions, it is necessary to have a good accessing control mechanism that can identify, authenticate and authorize users. EHG9508/12 support user account, password policy, and authentication interface managements functions that comply with IEC62443 standard.

The EHG9508/12 Series & EHG9608/12 Series is designed to be used in core power utilities. It provides dual redundant power inputs with Reverse Polarity Protection and two sets of relay that allow the user build up a stand-alone fault alarm system. Its wide operating temperature of -40 to 85°C and DIN-Rail mounting capacities make it suitable to be used in remote substations where harsh environment and reliability is an issue.

RHG7528
RHG7628 Series

INDUSTRIAL Rack-Mount Layer-2 or Layer-3 MANAGED Modular Gigabit Ethernet PoE SWITCH

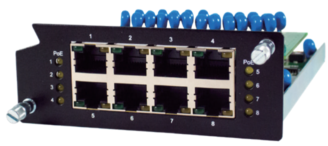
FEATURE HIGHLIGHTS

- Maximum 128Gbps switching capacity, 95.24Mpps throughput
- Rugged industrial design for -40~75°C harsh environment operation
- Flexible modular configuration, 3 Module-dedicated slots
- Up to 24 PoE ports, with maximum 720W of PoE power budget
- 4 x 1 Gigabit or 4 x 10 Gigabit SFP Uplink slots
- Up to 54 possible configurations in 4 power input versions
- ITU-T G.8032 ERPS Ring, RSTP, or MRP (client) redundancy
- RIP, OSPF, Static Routing, PIM supported Layer-3 switching
- EN50155 / EN50121-4 Certified for Railway applications

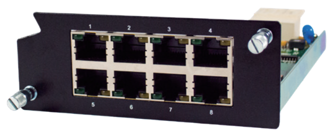
PRODUCT DESCRIPTION

Flexibility
Atop's high-density RHG7528/7628 Managed Rack-mount switch will provide you the flexibility your application needs. You will be able to choose among 8 different Layer-2/Layer-3 Routing Core versions (based on power supply and uplink port configurations) and five different 4/8-Port modules and customize your device in a very simple way.

Designed for PoE, in wide temperature
RHG7528/7628 supports up to 24 Gigabit ports in any 8 or 4-port multiple configuration.
Specifically designed for bringing power through Ethernet cable virtually anywhere, a maximum output Power over Ethernet of 720W over the 24 ports is allowed (PoE/PoE+ configuration - 802.3af/at). Available in 4 power input variants, it is EN 60950 -1:2006 certified and designed to handle the harshest environments. Its fanless design and EMC Level 3 protection guarantee operations within -40 and +75°C.



Powerul and versatile
Almost any redundant ring topology is supported, such as ITU-T G.8032 ERPS Ring, IEEE802.1D-2004 RSTP, STP,MSTP, MRP (Client), iA-Ring, iA-Chain and many compatible rings.
Also 7628 supports IPv4 Static Routing, RIPv1/v2, OSPFv2, PIM-DM, PIM-SM, PIM-SSM, DVMRP and VRRP for Routing Redundancy.



Automation and IoT ready
Conforming with v2.33 makes RHG7528/7628 the perfect candidate for being the backbone of your Industrial automation network.
The RHG7528/7628 Series is fully EN50155-certified to ensure reliable performance under a wide range of power supply conditions, and it complies with essential sections of EN50121-4 for ground equipment

Secure
The first Industrial Managed Secure Switch! Protect your LAN from Eavesdropping and impesronation through 802.1AE MACsec. With no additional latency and 100% Gigabit Throughput guarantee, dedicated modules can provide you the internal ultimate security solution

EHG7504/ EHG7508/ EHG7604/ EHG7608

4 or 8-ports Gigabit Layer-2 or Layer-3 Managed Switch

- Up to 8 10/100/1000 BASE-T(X) RJ45 ports or 1000 BASE-X SFP slots.
- Up to 8 802.3af/ 802.3at Power over Ethernet ports, with maximum 30W PoE power per port and maximum 240 W device power budget.
- Powerful Layer-3 Switching, supporting BGPv4, IPv4 Static, RIPv1/v2 and OSPFv2
- Layer-2 Redundancy, with ERPS, RSTP, STP, MRP (Client) and more.
- Profinet CC-B conformance
- EN50155 / EN50121-4 Certified for Railway applications
- IEEE 1588v2 Precision Time Protocol Hw-Based Transparent clock
- CE/FCC/UL and NEMA TS-2 Certified for Traffic Control Applications
- Operational between -20°C~70°C; up to 4,000m in elevation

EHG7512/ EHG7516/ EHG7520/ EHG76XX

12, 16 or 20-ports Gigabit Layer-2 or Layer-3 Managed Switch

- Up to 20 10/100/1000 RJ45 ports or 100/1000 BASE-X SFP slots. Plus 4 dedicated 1/10G Uplink SFP slots
- Up to 8x 802.3af/ 802.3at PoE/PoE+ Power over Ethernet ports, with maximum 30W PoE power per port and up to 240W power budget.
- Powerful Layer-3 Switching, supporting BGPv4, IPv4 Static, RIPv1/v2 and OSPFv2
- Redundancy through ITU-T G.8032 ERPS Ring, RSTP, STP, MRP (Client), compatible rings and compatible chains.
- UL 62368-1:2014, CE/FCC, NEMA TS-2 certified for traffic control
- IEEE 1588v2 Precision Time Protocol Hardware-Based End-to-End TC
- Wide temperature operations, from -40°C to 70°C

EMG8508/ EMG8510/EMG8608/ EMG8610

8 or 10-ports EN50155 IP67 Gigabit Layer-2 or Layer-3 Managed Switch

- 8 or 10 10/100/1000 BASE-T(X) ports, M12 connector
- 2 1000 Base-X SFP slots
- Up to 4 or 8 802.3af or 802.3at complaint PoE ports
- Powerful Layer-3 Switching, supporting BGPv4, IPv4 Static, RIPv1/v2 and OSPFv2
- EN50155, EN50121-4, IEC60571, EN45545-2 and UL 61010-2-201 certified
- Redundant power input, DC or High Voltage DC
- Ruggedized IP67 aluminum enclosure
- Works from -40°C~75°C
- 2x Relay outputs, 5-pin M12 A-Coding

atop Technologies

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