case study

Revolutionising GNSS connectivity for hyperscale data centers

Delivering sub-microsecond timing accuracy while cutting deployment complexity

Application	**Timing synchronisation**
Technology	**RF-over-Fiber & Power-over-Fiber**
Solution	**SYNCRO Max**
Customer	**Hyperscale data center**

Key results up front

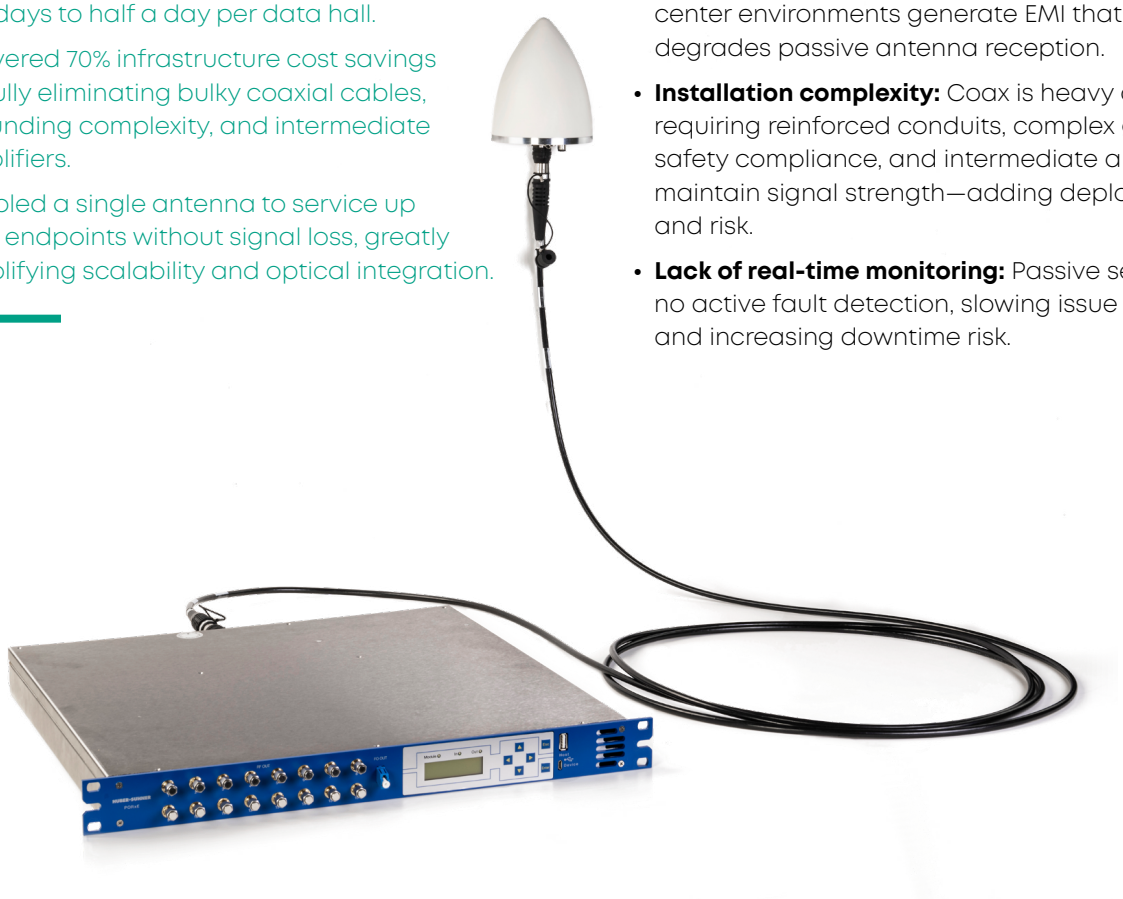
- Enabled sub-microsecond Precision Time Protocol (PTP) synchronization across a global hyperscale data center footprint with signal stability better than legacy coax setups.
- Achieved up to 10 dB improvement in GNSS carrier-to-noise ratio (C/No), improving positional accuracy to 1–2 meters.
- Reduced GNSS infrastructure installation effort by 80%, cutting typical deployment time from 2–3 days to half a day per data hall.
- Delivered 70% infrastructure cost savings by fully eliminating bulky coaxial cables, grounding complexity, and intermediate amplifiers.
- Enabled a single antenna to service up to 16 endpoints without signal loss, greatly simplifying scalability and optical integration.

Background: The challenge with legacy GNSS connectivity

Hyperscale data centers require precise, reliable timing for AI workloads, global synchronization, and high-speed data processing. While PTP provides sub-µs accuracy in theory, its effectiveness depends heavily on the quality and integrity of the GNSS signals acting as the UTC reference.

Legacy GNSS infrastructures rely on passive antennas connected via coaxial cables with external lightning arrestors. This architecture faces critical limitations:

- **Signal degradation:** Coax cables lose roughly 0.2–0.3 dB/meter, weakening GNSS signals over long runs and reducing timing accuracy.
- **Electromagnetic interference (EMI):** Dense data center environments generate EMI that further degrades passive antenna reception.
- **Installation complexity:** Coax is heavy and rigid, requiring reinforced conduits, complex grounding for safety compliance, and intermediate amplifiers to maintain signal strength—adding deployment time and risk.
- **Lack of real-time monitoring:** Passive setups provide no active fault detection, slowing issue resolution and increasing downtime risk.



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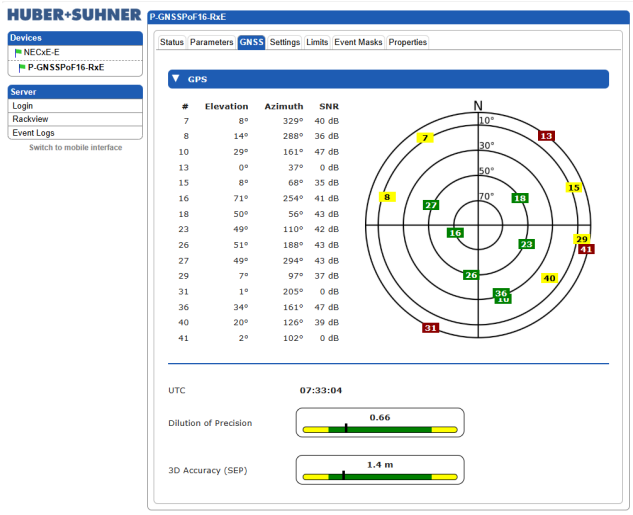
Solution: SYNCRO Max Fiber-enhanced GNSS connectivity

To overcome these issues, HUBER+SUHNER partnered with the customer to deploy SYNCRO Max, the industry's first fully copper-free GNSS connectivity solution across their hyperscale data centers. The system integrates:

- **Radio Frequency over Fiber (RFoF):** Converts GNSS signals to optical form for transmission over single-mode fiber with negligible attenuation (≤0.3 dB/km), maintaining signal strength cleanly across multiple data halls spanning kilometers.
- **Power-over-Fiber (PoF):** Supplies remote antenna and amplifier components via optical fiber, eliminating the need for local power sources and heavy coaxial cables.
- **Advanced GNSS receiver module:** Tracks multiple satellite constellations and dynamically selects the best signals based on real-time signal-to-noise ratio (SNR), supported by 60+ dB L1/L5 bandpass filtering to reject out-of-band interference.
- **Remote monitoring and management:** Web GUI, SNMP, and RestConf interfaces provide instant visibility into signal health and component status, enabling rapid fault detection and proactive maintenance.



GNSS (GPS) signal quality monitoring via inbuilt WebGUI

- **Scalable architecture:** One antenna supports up to 16 endpoints without signal loss, enabling flexible and future-proof deployment with streamlined optical infrastructure.

Technology overview: The block diagram below provides an overview of the underlying concept.

Antenna with integrated RFoF (O-E), lightning protection, and photocell for optical-to-electrical power conversion

Base unit with dual power feed, monitoring, and optical-to-electrical converter for GNSS signal extraction

Lessons learned and deployment notes

- Initial ops team hesitations around switching from familiar coax to fiber were mitigated through extensive side-by-side performance demos highlighting clear SNR gains and reduced installation risks such as cable breakage in bends.
- Lightning protection and grounding compliance were simplified, removing a major historical pain point requiring costly site-specific engineering.
- Monitoring dashboards proved essential; early visibility of signal degradations allowed preemptive fixes before any impact on downstream PTP sync.
- The reusable, standards-aligned design enabled rapid rollouts across varied regional data centers without customization.

Conclusion: Elevating hyperscale data centers

By removing coax entirely and converting to SYNCRO Max, the customer eliminated EMI risk, cut installation time by 80%, and achieved stable sub-µs sync accuracy across with 16 endpoints per antenna and further expandable.

For the customer, this became a repeatable global rollout template. Every new site now standardises on SYNCRO Max, reducing both deployment risk and ops overhead.

More to explore

Explore the HUBER+SUHNER SYNCRO solutions to discover how you can achieve reliable, cost-effective, and scalable time synchronisation for your next data center project.

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