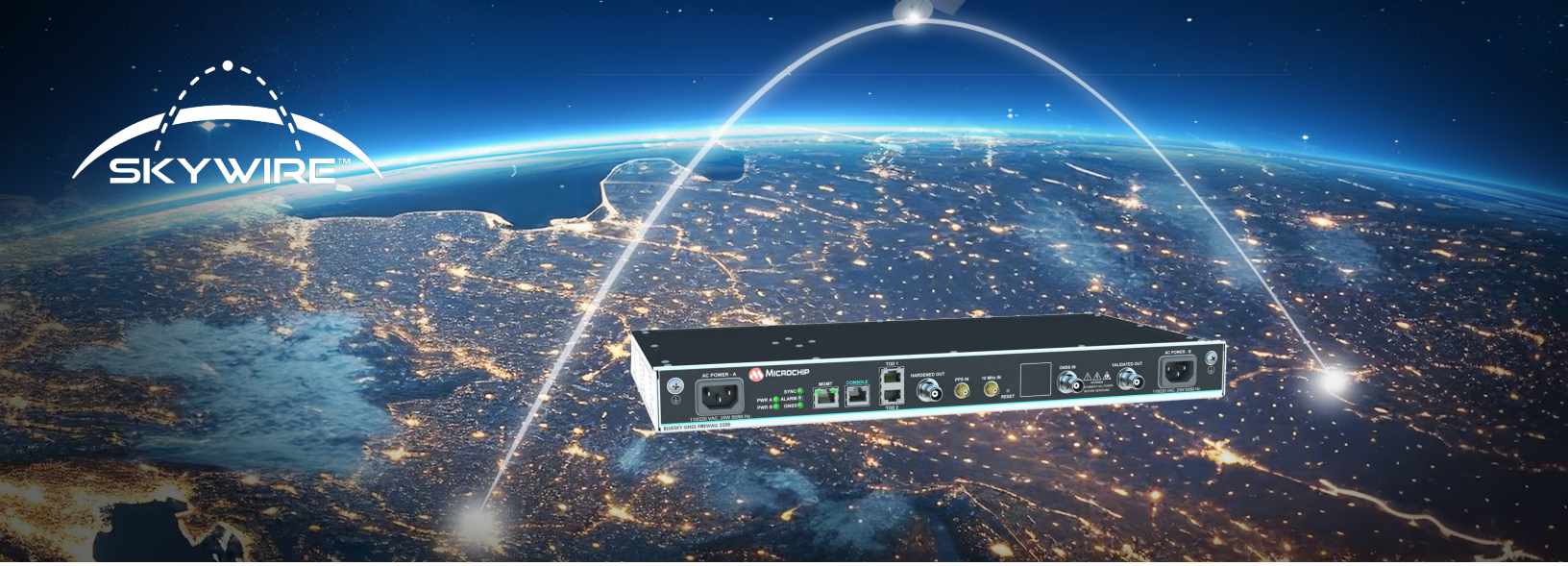


BlueSky® GNSS Firewall Release 4.0.x

Protection and Traceability of Timing for Critical Infrastructure

Summary

The BlueSky® GNSS Firewall 2200 protects against jamming and spoofing by providing a cost-effective overlay solution installed between existing GNSS antennas and GNSS systems. Similar to a network firewall, the BlueSky GNSS Firewall 2200 protects systems inside the firewall from untrusted sky-based signals outside the firewall. With the addition of embedded SkyWire™ technology, BlueSky GNSS Firewall 2200 units can compare clocks across widely dispersed geographic locations to ensure alignment, including traceability with UTC as provided by national timing laboratories.

The combination of the BlueSky GNSS Firewall's anti-jamming and spoofing protection and the SkyWire technology for clock measurement verification and alignment is all included in the software release 4.0 to provide an industry-leading solution to protect and strengthen systems against GNSS threats.

Use Cases

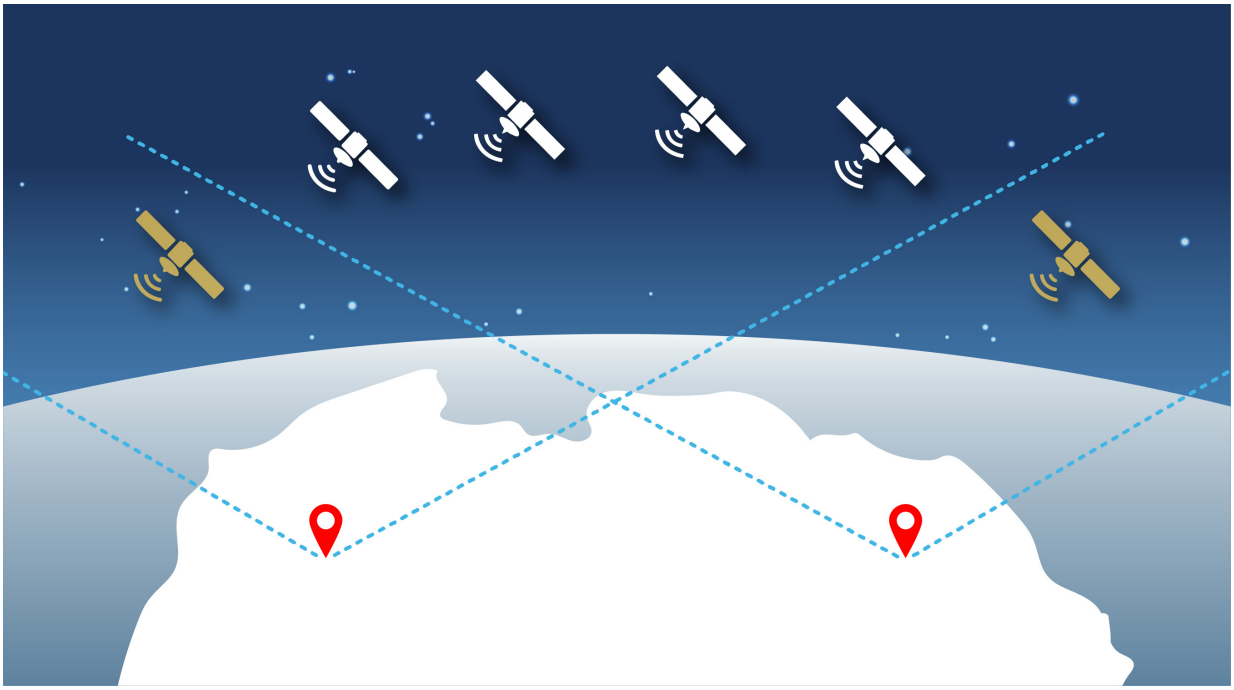
- Telecommunications networks
- Power grid synchronization
- Financial trading systems
- Traceability to UTC provided by metrology labs
- Any critical infrastructure requiring precise and secure timing

Key Features

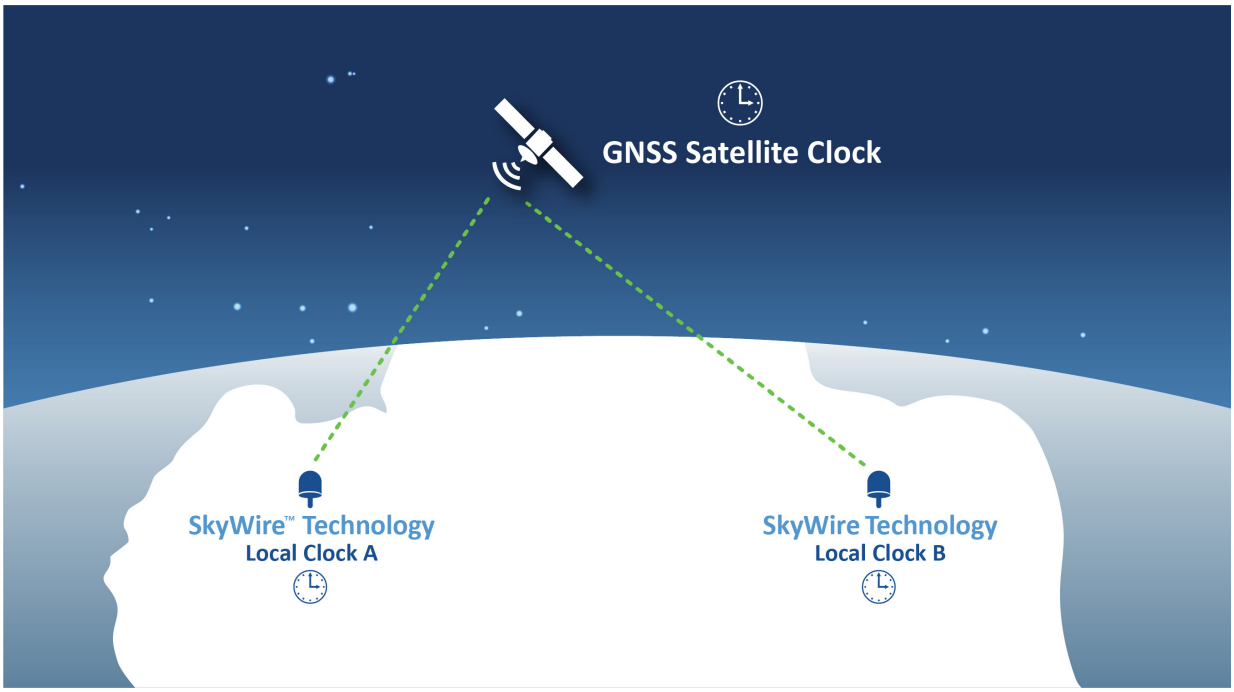
- **GNSS Firewall Functionality:** Like a traditional network firewall, the BlueSky GNSS Firewall 2200 acts as a barrier between the GNSS antenna and the GNSS receiver/system. It filters and validates incoming satellite signals, blocking those that are suspicious or potentially harmful.
- **Anti-Jamming and Anti-Spoofing:** The device detects and mitigates attempts to jam (block) or spoof (deceive) GNSS signals, ensuring that only authentic and reliable signals are passed through to the protected systems.
- **Cost-Effective Overlay:** It is designed to be easily installed as an overlay between existing GNSS antennas and systems, minimizing the need for major infrastructure changes.

SkyWire Technology (New in Software Release 4.0)

- **Clock Comparison Across Locations:** SkyWire technology enables BlueSky GNSS Firewall units to compare timing signals (clocks) across multiple, geographically dispersed sites.
- **UTC Traceability:** The system ensures that all connected sites remain synchronized and traceable to Coordinated Universal Time (UTC), as maintained by national timing laboratories.
- **Enhanced Verification:** This technology adds an extra layer of verification, ensuring that timing signals are not only protected from external threats but also remain accurate and aligned across an organization's entire network.

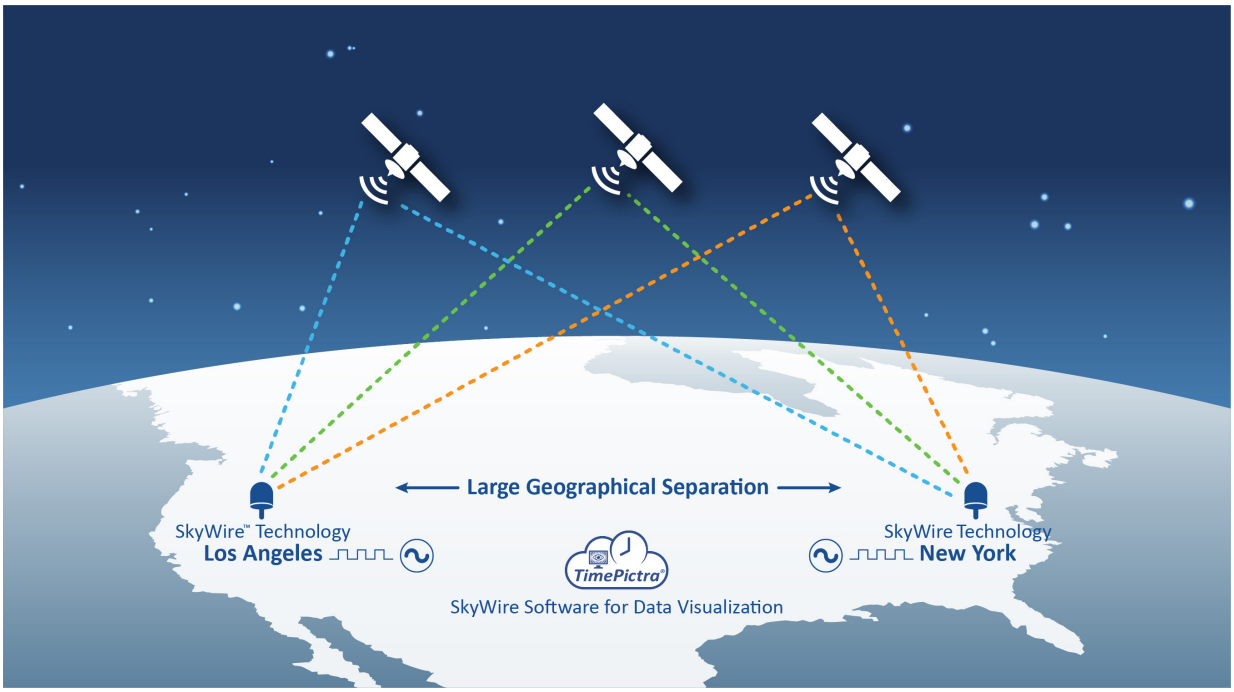


SkyWire technology leverages GNSS signals not as a direct timing source, but as a virtual wire to enable highly precise time comparisons between geographically separated locations. With SkyWire technology, two sites can achieve accurate time alignment as long as they can simultaneously track the same GNSS satellites—a concept known as common view. In this scenario, both locations observe the same set of satellites at the same time, allowing them to reference identical signals for time and frequency comparison. This shared visibility forms the foundation for precise synchronization across distributed sites, ensuring robust and reliable time transfer without relying solely on GNSS as the primary timing source.

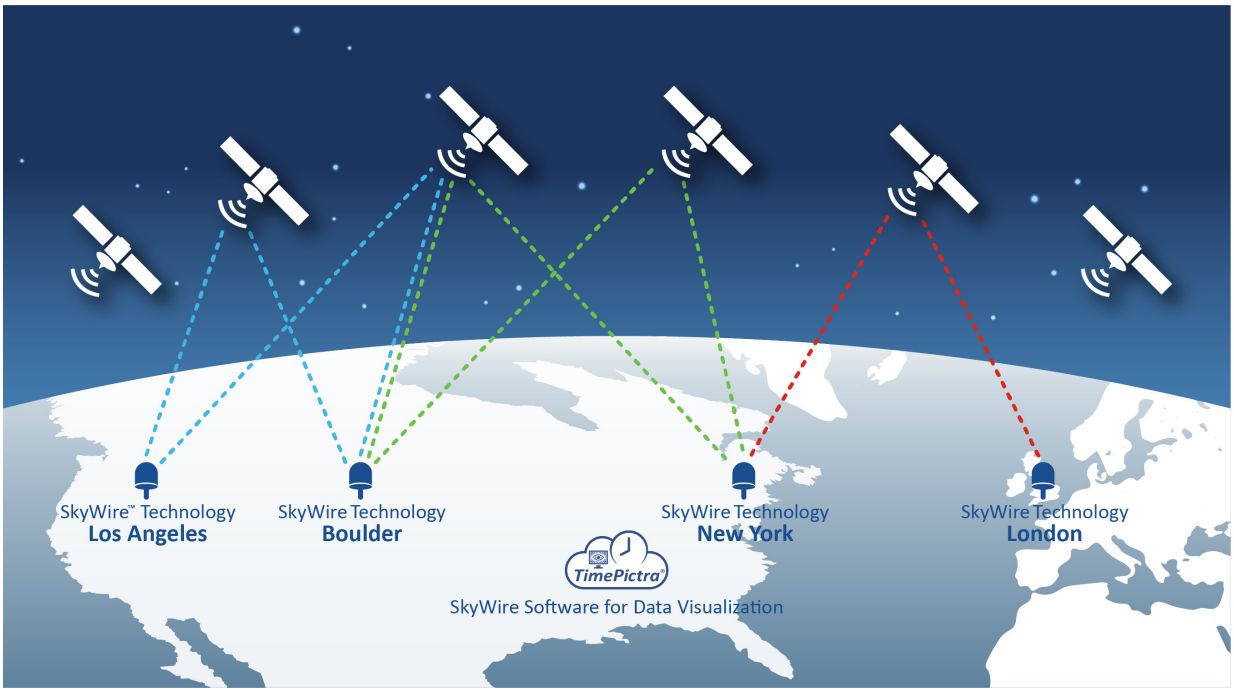


When a satellite is in common view between two locations, both sites can independently record the time of arrival of the satellite's signal. In this scenario, the GNSS satellite effectively serves as a shared reference clock for both locations. At each site, a BlueSky GNSS Firewall 2200 uses SkyWire technology to measure the local clock against the satellite's clock—Clock A versus the GNSS clock, and Clock B versus the GNSS clock. By subtracting these two measurements, you obtain the time offset between

Clock A and Clock B. The BlueSky GNSS Firewall with SkyWire technology maintains accurate knowledge of both the satellite's position and the antenna locations to ensure that signal path delays are accounted for. This enables a highly precise comparison of the two clocks.

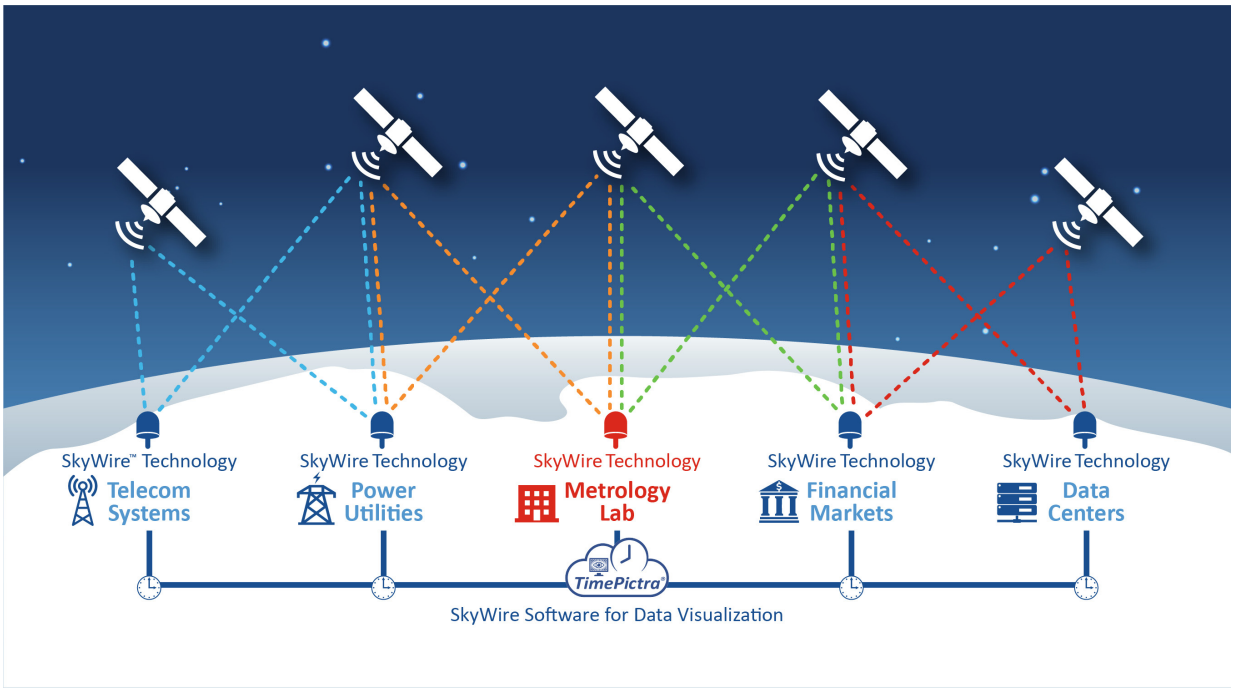


Historically, performing common view time transfer required specialized, high-end GNSS receivers. Today, however, advances in technology have made it possible to achieve very high accuracy in common view time transfer. By developing advanced techniques to mitigate Radio Frequency (RF) interference in challenging GNSS environments and leveraging real-time processing, the BlueSky GNSS Firewall with SkyWire technology provides a common view solution that can now be deployed reliably and efficiently at scale.



The BlueSky GNSS Firewall with SkyWire technology can compare clocks located at vast distances from each other. Multiple locations can simultaneously measure the same satellite(s) that are visible at the same time. The resulting measurement data is

aggregated and analyzed by the TimePictra® software suite, allowing the time differences between any and all clocks to be computed and displayed visually. This capability is optimal for operators of data centers, hyperscales and other critical infrastructure with dispersed locations that require precise time alignment for applications such as distributed database access.



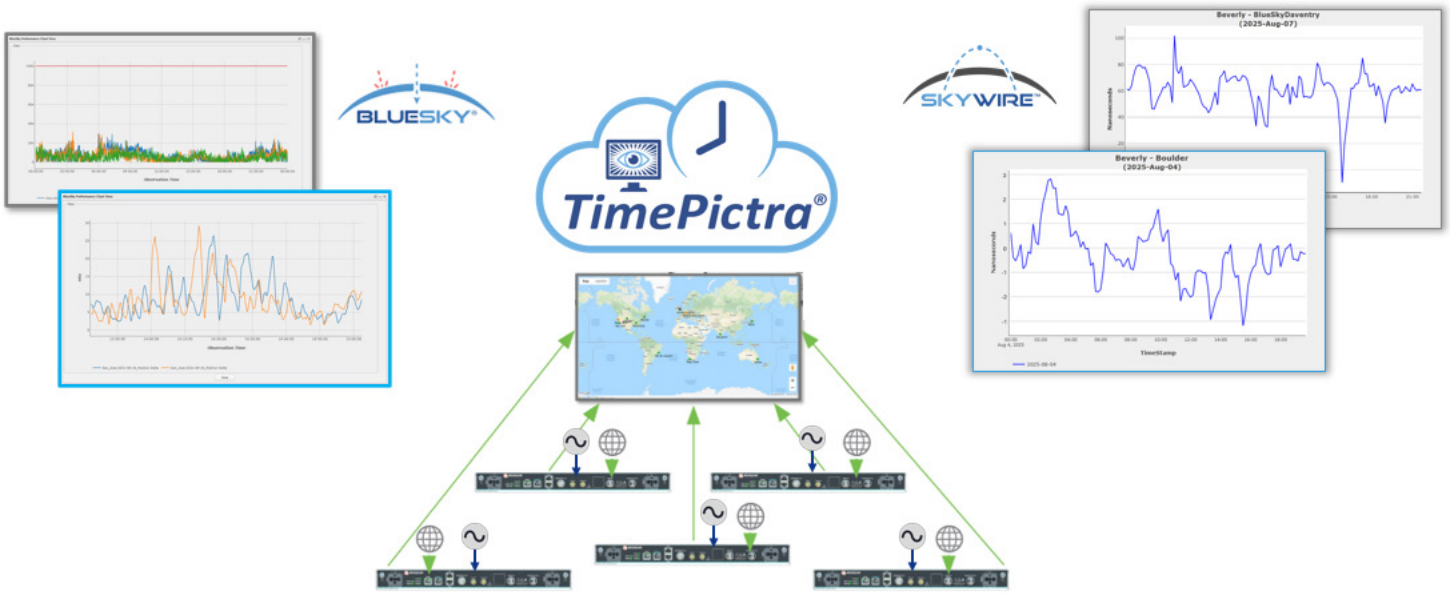
SkyWire technology enables national metrology laboratories to serve as the definitive authority for time and to provide reliable traceability services to all critical infrastructure sectors, including financial markets, data centers and power or utility companies. As countries implement alternative or multi-source Positioning, Navigation, and Timing (PNT) solutions, the ability to measure and verify traceability to the national time standard becomes increasingly crucial. Deploying the BlueSky GNSS Firewall with SkyWire technology at both metrology laboratories and at critical infrastructure sites establishes the foundation for a resilient national timing grid.

TimePictra® Software Suite Provides an Intuitive Graphical Interface for Managing Large Deployments of BlueSky GNSS Firewalls with SkyWire Technology

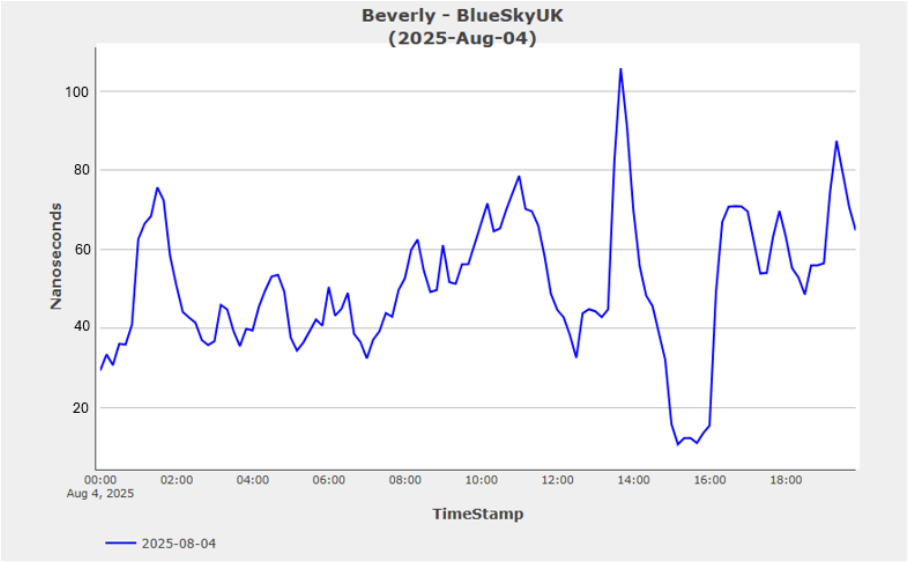
For critical infrastructure deployments, maintaining a broad geographical perspective is essential. The TimePictra software suite provides an efficient and comprehensive solution for managing these complex environments. The BlueSky GNSS Firewall with integrated SkyWire technology works seamlessly with the TimePictra platform to deliver robust protection and advanced monitoring capabilities.

The TimePictra software suite serves as a centralized platform for overseeing networks equipped with BlueSky and SkyWire technologies. BlueSky technology enables rapid identification of sites affected by GNSS anomalies, whether these issues arise simultaneously at multiple locations or recur periodically at different sites.

The TimePictra platform also allows users to visualize and efficiently compare multiple clocks across their infrastructure. Measurement data from SkyWire technology, embedded in the BlueSky GNSS Firewall, is aggregated and analyzed within the TimePictra platform, enabling direct comparison of any clocks in the network. The software computes and visually displays time differences between all clocks, ensuring precise time alignment and simplifying the management of complex timing systems.



TimePictra software suite with integrated SkyWire technology software enables clock comparison data to be efficiently collected and stored within a centralized database. Users can easily select a specific date and view the clock offset between any two locations. In the example shown to the right, Daventry, UK, and Munich, Germany, have been chosen for comparison. Over the 24-hour period, the peak-to-peak clock offset between these locations is measured at 86 nanoseconds.



Security Hardening of Network Interface

The BlueSky GNSS Firewall offers robust protection against live sky jamming and spoofing threats, along with a highly secure Trusted Time network management interface to defend against cyber threats. This ensures the security of time in compliance with the fundamental pillars of Zero Trust, which include users, devices, networks and analytics.

Configurable User Security Privileges and Authentication Protocols

The BlueSky GNSS Firewall supports two-factor authentication with RADIUS, which requires an additional login credential beyond just the username and password to access an account. TACACS+ can be utilized to manage and control device access effectively.

The BlueSky GNSS Firewall is compatible with LDAP v2 and LDAP v3, which are protocols used for authenticating users to access directory services. LDAP facilitates the centralized storage and management of user information, including usernames, passwords and groups, to streamline directory management.

Only administrators have the authority to create user roles with designated passwords and access levels. Administrators can also configure session timeouts and set password expiration periods for users. If these values are not specified by the administrator, default thresholds will be applied.

Leveraging the Latest PKI Infrastructure and TLS Hardening

The BlueSky GNSS Firewall's web GUI, which is designed for monitoring and upgrading the unit, is user-friendly yet highly secure. The interface is fortified with X.509 CA-signed certificates and employs robust TLS 1.2-based encryption to provide a very secure connection.

Secure, Web-Based Communications and Enhanced Management

Network security utilizes HTTPS to provide encrypted and secure web-based communication between the user and the device. This secure communication protocol is crucial for preserving the confidentiality and integrity of the data exchanged during the configuration and monitoring process.

The BlueSky GNSS Firewall also employs SNMP and Secure Shell (SSH) to enhance management and security. SNMP facilitates efficient network management by allowing administrators to monitor the device's performance and identify potential issues promptly.

SSH provides secure remote access to the BlueSky GNSS Firewall's command line interface. By encrypting the session, SSH ensures that administrative tasks, such as firmware updates and advanced configurations, can be performed securely to protect the system from potential cyber threats.

Remote Log Server Support

Analytics rely on network telemetry data, which includes activities such as user logoffs/logons, configuration changes and software upgrades. The BlueSky GNSS Firewall also integrates with the TimePictra management platform to monitor and verify the latest configuration changes. The TimePictra management platform provides an interface for viewing multiple BlueSky GNSS Firewalls, enabling network administrators to swiftly identify and respond to potential threats or anomalies in GNSS signals.

Secure Software Installation with Encrypted Authorization Files

The BlueSky GNSS Firewall features in-field service update capability. As attacks on GNSS systems are expected to become increasingly sophisticated, these in-field service updates enable users to stay ahead of the evolving threat landscape.

Access to the BlueSky GNSS Firewall's software downloads is restricted to authenticated and authorized users only. These downloads include encrypted authorization files that govern the software installation process. Prior to installation, the BlueSky GNSS Firewall verifies the integrity of the software to ensure its authenticity.

Security Timing Protection Using Interconnected Network BlueSky GNSS Firewalls

The BlueSky GNSS Firewall is equipped with a local console port and a dedicated network management port. The local console port provides direct user access to the BlueSky GNSS Firewall, facilitating straightforward configuration and management. The network management port enables connectivity to a centralized network management system such as the TimePictra platform. This port can also be utilized for interconnecting multiple BlueSky GNSS firewalls to perform advanced anomaly detection.

The BlueSky GNSS Firewall also features two Time-of-Day (TOD) ports, which can also be employed for anomaly detection to enhance the overall security and reliability of the system.

BlueSky GNSS Firewall Trusted Time Security Check List for Zero Trust Network

Users	RADIUS authentication and two-factor authentication
	TACACS+ support
	Administrative Security • Web session timeouts (5–1440 minutes long) • Custom login banners
	LDAP authentication (LDAP v2 and LDAP v3)

	User Settings
	• Password expiration
	• User management (creation/deletion, username, password, email)
	• Multiple user privilege levels
	  • Administrator: Can create new roles and users
	  • User: Default basic role

	SSH (allowed and denied users)
Devices	**Software Upgrades** • Available exclusively through FTS Resource Portal • Requires authenticated user access to the FTS Resource Portal • Requires authorization to download the system software file and serialized authorization file
	Alarms (extensive user-configurable alarms, notification via trap, logs)
	Hardened output provides a synthesized GPS signal isolated from the live-sky environment
	Validated output delivers a verified pass-through of the actual GNSS signal being analyzed
	HTTPS Secure management • Protocols: TLS 1.3 or higher • Session timeout: 5 to 1440 minutes • Self-signed certificate: 2048 or 4096 RSA key bit; expiration days 1–1825; customizable locality codes
	X.509 Cert/CSR: Create and download Certificate Signing Requests (CSRs) with 2048 or 4096 RSA key bits
	X.509 installation: Install multiple CA-signed X.509 certificates
	Timing Security • Anti-jam antenna • Atomic clock upgrades for timing holdover
Network	Dedicated and distinct network management port along with a local console port
	Service/system control (enable/disable HTTPS, SNMP, SSH, ToD)
	GPS Subframe Anomaly Detector compares subframes from a remote firewall to those received from the live-sky signal within the local firewall (For more information, see the BlueSky® GNSS Firewall Software-Release 3.1.1 data sheet)
	Trusted Time Anomaly Detector allows terrestrial network-based time to cross check GNSS time (For more information, see the BlueSky GNSS Firewall Software-Release 3.1.1 data sheet)
Analytics	**SNMP V3** • Secure authentication • Secure encryption
	TimePictra® platform monitoring • Tracks last configuration changes • Supports autonomous messaging • Monitors firmware versions
	Secure Syslog • X.509 authentication • TLS encryption

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