

INTRODUCTION

The Voyager central acquisition software provides users with flexible options for collecting and synchronizing sensor data. Voyager can be deployed on a dedicated central acquisition device or hosted in the cloud. In both configurations, maintaining precise time alignment across all Sentry System devices is critical for advanced structural health analysis applications, especially when using high-speed sensors like accelerometers.

IMPORTANCE OF TIME SYNCHRONIZATION

In Structural Health Analysis, data from multiple sensors are combined to detect minute changes in structural behavior. Any discrepancy in timestamp alignment can lead to incorrect correlation, misinterpretation of vibration modes, and potentially false alarms or missed events. When sampling rates reach up to 1000 samples per second (sps), even a millisecond of drift can translate to a full sample offset, severely impacting the quality of modal analysis, damage detection, and trend monitoring.

DEVICE SYNCHRONIZATION METHODS

GPS SYNCHRONIZATION

When using synchronization via GPS, Sentry System devices leverages the onboard GPS module to obtain precise time from global navigation satellite systems. The module provides 1PPS (one pulse per second) output to timestamp all acquired data synchronize. The internal clock of the GPS module maintains precision even when GPS signals are temporarily unavailable.

Parameter	Specification
Supported GNSS:	GPS, GLONASS, Galileo, BeiDou
Time Pulse (1PPS) Accuracy:	±15 ns RMS (±60ns guaranteed)
Time Pulse Frequency Stability:	±10 ppb
Time-to-First-Fix (TTFF):	Cold start: 26 s, Hot start: 0.3 s
Maximum Update Rate:	10 Hz
Timestamp Resolution:	1 μs
Interface:	Proprietary Digitex connector
Supply Voltage:	From device

SYNCHRONIZATION USING DIGISYNC PROTOCOL

DigiSync is Voyager's proprietary time synchronization protocol that operates over the same network used for data transmission between Voyager and Sentry System devices. It ensures sub-millisecond precision across all connected devices, even in GPS-denied environments, making it ideal for indoor or obstructed installations.

Parameter	Specification
Synchronization Precision:	< 1 ms
Synchronization Update Rate:	Up to 10 Hz (configurable)
Timestamp Resolution:	1 μs
Network Protocol:	TCP/IP or UDP
Drift Compensation:	Automatic between sync messages
Maximum Sampling Support:	Up to 1000 sps per device
Fall-Back Mode:	Maintains precise internal clock if network delays occur

CHOOSING THE RIGHT METHOD

- GPS Synchronization: Preferred when a clear sky view is available for reliable satellite signals.
- DigiSync Protocol: Ideal for indoor installations or when GPS antenna cabling is impractical.
- User Switching: Each device can be switch between GPS and DigiSync based on user needs to maintain continuous synchronization.

SUMMARY

Precise time synchronization is the cornerstone of reliable Structural Health Analysis using Sentry System devices. Whether leveraging the GPS module in outdoor settings or utilizing Voyager's DigiSync protocol indoors, users can ensure all data streams align with sub-millisecond accuracy, enabling advanced analytical capabilities and trustworthy monitoring results.