



# Testing Confirms Resilient Timing Success

## *Underground and Indoors with SecureSync® and STL*



### Background

GMV, a global technology corporation, produces WANTime, a time service for the city of Madrid, Spain. This service is distributed using the White Rabbit network protocol over optical fiber. The Madrid Stock Exchange (Bolsa de Madrid) is currently piloting their service by connecting to GMV's datacenter via a network link of around 50 kilometers.

Accurate and resilient timing is essential for critical applications worldwide. Timing is the fundamental requirement to synchronize operations. Yet it can be challenging to establish and maintain accurate timing in multiple locations and in GNSS-compromised environments.

To meet this challenge, GMV tested an Orolia SecureSync time and frequency reference system paired with the Satellite Time and Location (STL) alternative signal from Satelles.

### Solution

The test was conducted at GMV offices in Tres Cantos, near Madrid, Spain, where a UTC timescale is maintained based on two highly stable atomic clocks, which served as truth reference for the test. The clocks are steered to UTC by means of GNSS common-view time transfer to UTC(PTB), which is the national version of UTC in Germany. PTB stands for Physikalisch-Technische Bundesanstalt, and is maintained in Braunschweig, Germany.

The GNSS receiver chains used for time transfer between GMV and PTB were fully calibrated to account for signal delays from the GNSS antenna, the antenna cable and the receiver itself. This maintained GMV's UTC realization in very close alignment with true UTC, with deviations of just a few nanoseconds as verified from BIPM's Circular T.

The atomic clocks were installed in a rack in the basement one level below the ground floor and close to the north-facing external walls of the building. The indoor conditions at the rack location had marginal availability of GNSS signals and cellular phone service.

To test STL capabilities in these conditions, a SecureSync was installed in the rack and connected to an Iridium patch antenna placed on top of the rack, as shown in the photo.

To measure the deviation of STL from UTC, the 1PPS signal from the SecureSync was compared to the 1PPS from GMV's UTC timescale, using a Time Interval Counter (TIC). The 1PPS time differences were recorded over a four-day period from November 21-25, 2019, as shown in Figure 1. Maximum deviations from UTC were below 1.5 microseconds.

After an initial settling period, the STL UTC time had an RMS noise of -300 nanoseconds (ns) with a -1000 ns offset. The offset can be calibrated out to deliver even better performance.

## Results

The combination of Orolia's SecureSync time server and the STL signal provided by Satelles delivered extremely accurate timing indoors and underground, as compared to Coordinated Universal Time (UTC). This solution for resilient timing is available for commercial and civil government applications worldwide, to help protect national critical infrastructure and to deliver precise timing in GNSS-challenged environments.

In addition to using the STL signal as an alternative reference, the Orolia SecureSync can also provide resilient timing in these ways:

- High-quality OCXO and atomic internal holdover oscillators to maintain precise time and frequency during long periods of GNSS outage
- Anti-jam and anti-spoofing antennas, DSP filters and Interference Detection and Mitigation (IDM) software

Although it is less accurate than GNSS, STL has complementary advantages:

- It is much harder to disrupt. Transmitted from Low Earth Orbit (LEO) satellites 800 km above the earth, the signal is over 30 dB stronger than all the GNSS signals that are transmitted from 20,000 km
- STL can be used indoors, and does not require rooftop access -- an advantage over most antenna solutions
- STL is protected by modern cryptographic techniques and therefore more resistant to cyberattacks
- Its indoor operation greatly simplifies installation and brings UTC synchronization to locations where it was previously impractical to install
- UTC traceability is maintained by Satelles via redundant ground stations and monitoring around the globe

This indoor, underground test demonstrated that the combination of Orolia's SecureSync time server and STL service from Satelles can deliver extremely accurate timing as compared to Coordinated Universal Time (UTC). This combined solution is available for commercial and civil government applications worldwide, to help protect critical infrastructure and deliver precise timing in GNSS-challenged environments.

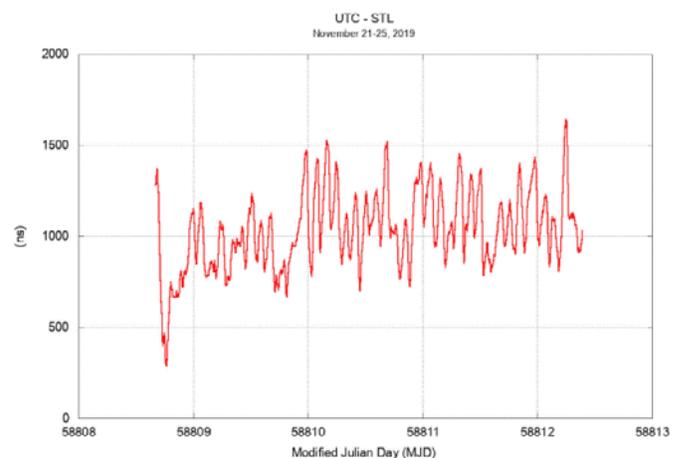


Figure 1