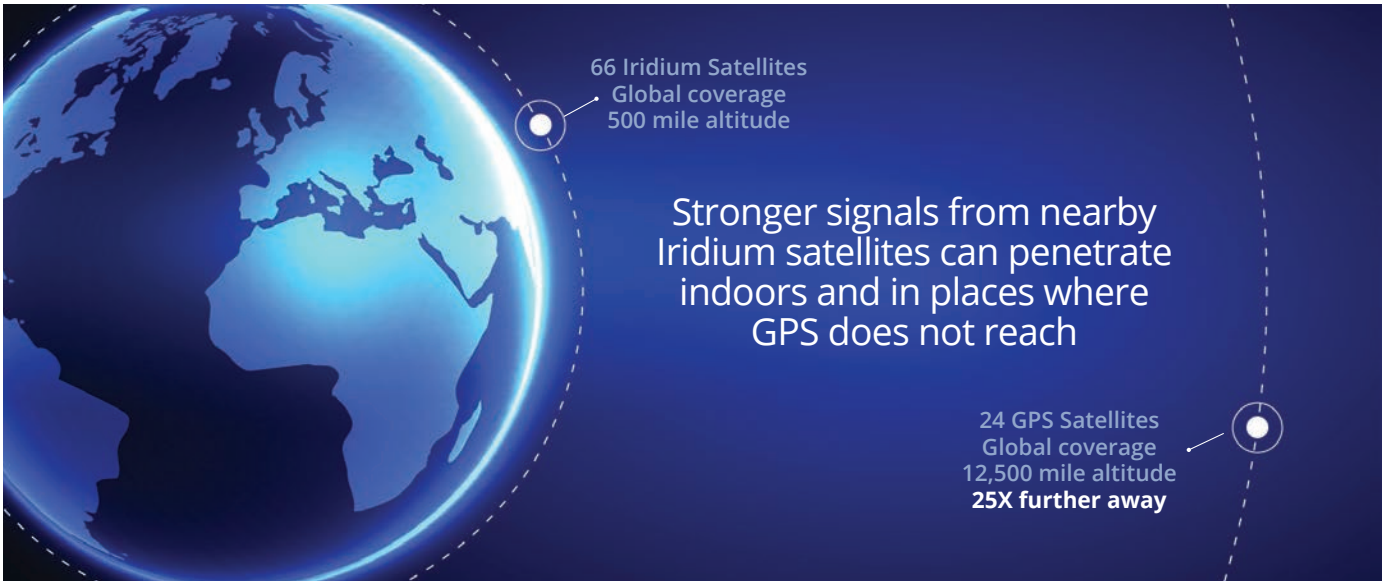

Satelles
SATELLITE TIME &
LOCATION SIGNALS
1000 times
stronger than GPS

Since the introduction of GPS in 1991, the need for location technology has expanded to personal navigation, asset tracking, geo-fencing, location-based services, and global time synchronization. Many of these applications are hindered by the poor performance of GPS within indoor environments, occluded scenarios like urban canyons, and signal jamming. Both GPS and Global Navigation Satellite Signals (GNSS) are often unavailable in these environments, because these low-power signals are unable to penetrate various obstructions between the satellite sources and the user.

Satelles has partnered with Iridium® to solve this problem, developing the Satellite Time and Location (STL) system. STL uses Iridium's low-Earth-orbit (LEO) satellite constellation to transmit signals that penetrate the densest indoor environments. In addition, STL leverages modern cryptographic techniques to deliver a secure, trusted time and location capability that is impervious to spoofing. As the exclusive provider of this revolutionary capability, Satelles delivers secure time and location signals worldwide, across a wide range of industries and applications.



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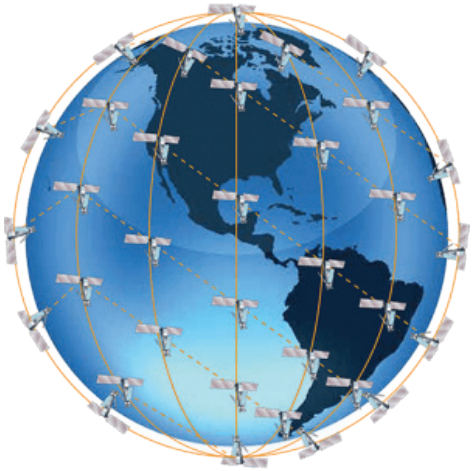
Unique value derived from Iridium

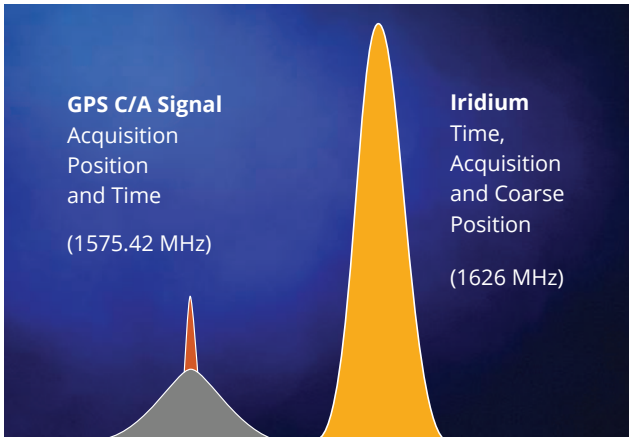


The Iridium satellite constellation is unlike any other in orbit and is the only communications network with pole-to-pole coverage of the entire planet, 24/7. It is comprised of six polar orbiting planes, each containing 11 crosslinked satellites totaling 66 in the operational constellation, creating a web of coverage around the Earth.

Iridium satellites travel at speeds of about 7500 m/s, resulting in variations of up to +/- 40 kHz from the nominal carrier frequency due to Doppler effects. Compared to GNSS signals, Iridium signals have much higher raw signal power (300 ~ 2400x) as seen by a receiver on Earth, making them attractive for use in time and location applications where GNSS is obstructed.

THE STL SYSTEM

STL leverages Iridium's satellite infrastructure to broadcast signals specifically designed to enable precision time and frequency measurements. These measurements can be used by a receiver for a variety of purposes, including 1) computing position fixes directly, independent of GNSS; 2) transferring sub-microsecond timing to a user or device; 3) aiding GNSS acquisition; or 4) augmenting GNSS measurements when not enough GNSS satellites are in view.



Custom signals provide secure time transfer and location capabilities

Worldwide Coverage	- No local infrastructure
High Power Broadcasts	- Signals penetrate buildings - Raw signal power 300-2400x stronger than GPS
Localized Spot Beams	- Enables proof location

STL signal bursts are received by a receiver about once every second. Precise time can be calculated by processing a single burst, typically in under two seconds. The precise time and frequency information derived from a single STL burst can be used to support various industry needs as well as assist weak-signal GNSS acquisitions. Since the STL signal is more robust than GNSS, precise assistance is provided to acquire GNSS signals as weak as -160 dBm, assuming that the STL and GNSS signals are attenuated similarly by path occlusions.

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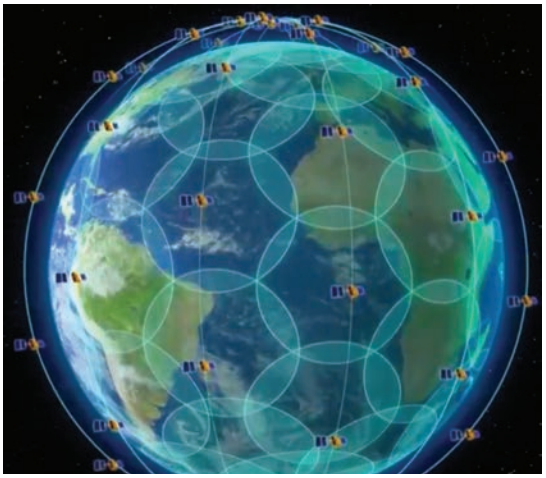
The STL system allows a receiver to decode the bursts and perform precise Doppler and range measurements at attenuations of up to 39 dB relative to unobstructed reception. This is sufficient to penetrate buildings and other occlusions, providing coverage in most deep indoor and urban canyon environments.



In environments where both GNSS and STL time and location fixes are possible, the GNSS fixes will generally be more accurate. The key advantage of STL is its ability to provide time and position fixes under conditions where GNSS is not available. In this respect, GNSS and STL can be seen as complementary technologies, and receivers supporting both are ideal. The complex, overlapping beam pattern of STL combined with random content that changes once per second (in each beam) can also be authenticated by a Satelles server to help ensure the trustworthiness of those measurements.

STL APPLICATIONS

Many positioning and timing applications achieve superior robustness through the use of STL. In particular, applications that are subject to spoofing or signal attenuation resulting from obstructions or jamming make excellent candidates. Such applications include:

- Critical infrastructure time synchronization
- Emergency services (police, fire and medical)
- Power and utility companies
- Communication industries
- Transportation (air, maritime, rail and road)
- Financial markets and transaction security
- Urban canyon positioning
- Indoor positioning
- Femtocell time and location
- Shipping container tracking
- Network security
- Data center timing
- First responder / personnel tracking
- Parolee tracking
- High value asset tracking
- Software license geofencing
- Digital rights management geofencing
- E911

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SYSTEM INTEGRATION AND RECEIVER TECHNOLOGY

STL user equipment can be implemented in various ways depending on the application. Options include:

- A stand-alone circuit board, provided by Satelles
- A small, low-power, low-cost GNSS chipset to track and leverage the STL signal. A reference design is provided by Satelles
- Firmware upgrades to existing equipment that already supports GNSS

PERFORMANCE

Satelles positioning consistently measures 20 meter or better accuracy for stationary users. Accuracy for dynamic users is dependent and several factors but applications for vehicles and pedestrian users have been proven. Timing accuracies between 50 to 500 nanoseconds have been achieved based on the timing references used by receivers, such as a Temperature Compensated Crystal Oscillator (TCXO), Oven-Controlled Crystal Oscillator (OCXO), or atomic clocks.

CLOSING

Satelles offers a worldwide position, navigation, and time solution TODAY that provides a unique capability to deliver accurate geolocation and sub-microsecond timing in GPS/GNSS-denied environments. The STL signal structure and system design is impervious to spoofing and can be used to calculate time and location. In applications where position and time assurance is critical, this is the system that users can trust.

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