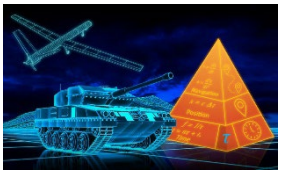
Should PNT Really Be TPN?

Critical infrastructure and defense applications can rely on precise, secure and resilient time even during GNSS denial thanks to our portfolio of precision timing devices.



Importance of Building a Resilient Future for PNT

Global Positioning System (GPS) and other Global Navigation Satellite Systems (GNSS) play critical roles in defense and civilian infrastructure. GNSS navigation loss can be catastrophic in many applications. A cruise missile losing its guidance is disastrous. An autonomous vehicle that loses GNSS without an alternative navigation method will no longer be autonomous. Cell phones, the Internet and energy distribution are examples of applications that rely on GNSS time. The vulnerabilities of the systems have become economic and national security issues. **Secure Position, Navigation and Time (PNT) solutions** seek to minimize the impact of GNSS vulnerabilities. The defense industry has been investing heavily in the sector for decades. The US Department of Homeland Defense has issued the "**Resilient Positioning, Navigation, and Timing (PNT) Conformance Framework**" that highlights the importance of "time-hardening" civilian infrastructure systems that depends on GNSS.

The Role of Time in Secure PNT

The cornerstone of any **secure PNT solution** is time. The acronym should really be rewritten as TPN (Time, Position and Navigation) to emphasize its key role. Why is time the most important of three functions? PNT systems use time to calculate position. Navigation is a series of directions from one place to another while tracking position as it changes in time.

With time established as the cornerstone of secure PNT, it is helpful to understand time's role in each facet of a PNT system.

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PNT Core: Time Creation

A PNT core is the central timing location of a PNT system, whether it is a GPS ground station or national metrology lab that transmits time over fiber. Ensembles of atomic clocks create a stable time base. Many of these ensembles contribute to Universal Coordinated Time (UTC), which is the time-of-day standard used around the world, determined by a weighted average of 589 atomic clocks.

At Microchip, we are proud that our **5071A** cesium clock primary frequency standard is the single largest contributor to UTC with 356 cesium references contributing from 53 countries. 67 of our **MHM2020** and MHM 2010 hydrogen masers also contribute, the second largest contribution. Together, these make up 72% of all clocks in the UTC ensemble.

PNT Transmission: Time Delivery

PNT delivery systems send time from the PNT core through a medium (for example, microwave signals in a GPS system) to distribution points. Our **space-grade quartz crystal oscillators** and space-grade atomic clocks play key roles in the distribution of time across PNT systems, not only by keeping time, but also by providing the stable frequency references required to transmit and receive the signals. The distribution points then transmit the time to the end user. The measured elapsed time for these transmissions is used to calculate position and time at the end user. For many applications, the time delivery from a GNSS system to a centralized node is then distributed through a terrestrial network using Network Time Protocol (NTP) or Precision Time Protocol (PTP). Our **TimeProvider® TP4100 PTP Gateway Clocks** are used in cellular networks. Our **SyncServer® S600 Time Servers** are widely deployed in data centers and by other enterprise customers while our **GridTime™ 3000 GNSS Time Server** is specifically to distribute time for the power industry.

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PNT Resilience: Time Back Up

Secure PNT requires a path between the core and the end user that is not only precise and accurate but also resilient and immune to interruptions. If the signal is interrupted, PNT resilience is achieved through local oscillators, either atomic or quartz, which are designed to provide alternate sources of time for periods of minutes to months depending on the application. Our Chip Scale Atomic Clock (**CSAC**) and Evacuated Miniature Crystal Oscillator (**EMXO**) are small form factor, low-power solutions intended for battery operation that can provide microsecond accuracy for a few hours to a day, whereas our **4310B** cesium reference can provide microsecond accuracy for months during GNSS denial.

PNT Assurance: Time Defense

PNT defense protects the time signal at the end user. The two key threats to a PNT signal are jamming (blocking of a signal) and spoofing (replacing the PNT signal with a signal containing false information). We offer our **AJ directional antenna** to help prevent jamming, and our **BlueSky™** technology hardware and software offer advanced detection and protection from spoofing.

With all facets of the PNT time stream covered by our solutions, you and your application will never have to worry about where you are and when it is again.