Assured Positioning, Navigation, and Timing (A-PNT)

Simplifying Integration and Ensuring User Confidence

Read About

Using complementary sources to provide A-PNT

Overcoming complementary PNT challenges

Holistic A-PNT practices in action

Replacing One Point Solution With Another Does Not Make Sense

There is no debating the fact that Global Navigation Satellite Systems (GNSSs) are a tremendous asset to warfighters in the field. Unfortunately, there is also no debating the fact that GNSSs have become a single point of failure that puts military personnel, operations, and equipment at risk. Simply replacing a GNSS with another point solution is not the answer to the problem. No matter how sophisticated or ingenious that point solution is, the ever-increasing sophistication of adversarial tactics means it will also inevitably become just another single point of failure.

Bringing Assured Positioning, Navigation, and Timing to the Field

The availability — or lack thereof — of technologies that could replace GNSS adds to the problem. GNSS signals are being jammed and spoofed today. But, many of the technologies being touted as potential replacements are not available today, and will not be available for several years. Warfighters need a much more immediate solution to an increasingly dangerous point of vulnerability.

The reality is there is no "magic bullet" to today's systems, and there never will be. Instead, technology companies that support military organizations must focus on developing solutions that consider and combine information from a number of complementary sources to provide Assured Positioning, Navigation, and Timing (A-PNT) to warfighters in the field.

Solutions that combine information from multiple complementary PNT sources eliminate the risks associated with a single point of failure. Each complementary PNT information source contributes to the final result, but no single source can overly influence the information provided to warfighters. As a result, warfighters have a solution that provides a diversity of defenses to counter adversarial tactics and deliver a position, navigation, and timing truth they can confidently rely on.

The key when evaluating A-PNT solutions is to look for those that adequately address the many challenges associated with using complementary PNT technologies and that deliver the benefits warfighters and system integrators need most.

Developing a Holistic A-PNT Solution Is Complex

Designing and developing an A-PNT solution that relies on information from multiple complementary sources and provides the same level of performance as GPS is not an easy task. From a design and engineering perspective, there are, quite literally, a lot of moving parts to consider and combine to arrive at a PNT truth.

In addition, solutions must be easy to integrate into the existing available space on ground, airborne, and naval platforms. And they must provide reliable positioning information in GPS-degraded environments, where tall buildings, heavy foliage, and underground positions can affect signal quality, as well as in GPS-denied environments where adversaries have intervened to jam or compromise GPS signals.

The following summaries provide a brief overview of just a few of the technical challenges involved in developing effective and reliable A-PNT solutions.

Data Processing

Data from all of the available PNT sources must be processed in a way that allows accurate positioning information to be provided to warfighters and systems when needed.

This is extremely challenging. The solution must be able to process data that is received from a wide variety of sources, at different times, and in different formats. Complex data processing algorithms are required to amalgamate and process all of this information in a way that accounts for varying and disparate temporal and spatial data. And all of this processing must be completed extremely quickly so that people and systems always have access to accurate PNT information.

Data Distribution

Once the data is processed, it must be made available to a variety of other systems and clients on the platform. The data may also need to be made available to systems on associated platforms in the field and at command centers.

The main challenge here is that deployed platforms combine a variety of legacy and modern systems and clients with differing levels of sophistication, communications interfaces, and data processing requirements. Each system to which PNT information — and more importantly, *Assured* PNT information — will be distributed must be considered.

The considerations for distributing data to some types of legacy equipment can be quite involved. For example, existing GPS receivers and systems using GPS receivers must be made capable of providing A-PNT truth rather than the GPS data they were designed to provide.

Interoperability

A-PNT solutions must also be able to interoperate with existing legacy and modern systems on the deployed platform. And they must anticipate future interoperability requirements.

Hardware interoperability is challenging because it means A-PNT solutions must support the right combination of physical interfaces and pinouts to connect to legacy, modern, and future systems. Software interoperability is challenging because it means software must be easily updatable to support new capabilities and technologies as they emerge.

In short, the entire A-PNT solution must be designed to interoperate with past, present, and future hardware and software.

Security

Designing and implementing security that provides the right level of protection for the application is a major challenge in any solution. In an A-PNT solution, getting security right is even more difficult due to the factors outlined above — the need to protect information that arrives at different times and in different formats, then securely distribute that information to a variety of legacy and modern hardware and software systems and clients.

The breadth of these requirements means that A-PNT solutions must straddle all of the different security enclaves on a platform. This includes the need to securely receive and distribute changing combinations of classified and unclassified information.

Ease-Of-Use and Flexibility

A-PNT solutions must provide PNT information to warfighters in a way that is fast and easy for them to access and understand, even while they are on the move or in dangerous situations.

This is challenging because warfighters are already very familiar with GPS systems and how GPS information is provided. The transition to A-PNT information must be "invisible" so warfighters can continue to focus on mission tasks rather than struggle with unfamiliar controls and information formats. Developing A-PNT solutions that deliver an imperceptible level of change across all of the different systems involved is extremely difficult from every perspective — physical design, installation, integration, and usability.

Technology must also give warfighters the ability to be part of the solution. Warfighters must be able to manually incorporate information from additional PNT sources into the final location calculation, as well as override the PNT assessment provided to them with information they know to be more accurate for any number of reasons.

The Right Approach to A-PNT Benefits Warfighters and System Integrators

Holistic A-PNT solutions that address the challenges and requirements outlined in the previous section deliver important benefits to warfighters in the field and to system integrators.

Warfighters Gain Trusted PNT Information

With an A-PNT solution that is based on multiple complementary PNT information sources, warfighters have a far better ability to understand and respond to threats on the battlefield. They can quickly grasp the exact state of PNT signals, then use this insight in a strategic way to conduct navigation warfare (NAVWAR).

NAVWAR is extremely important for warfighters because it allows them to take defensive and offensive actions based on position, navigation, and timing information they trust to be accurate and uncompromised.

When warfighters are working with trusted PNT information from complementary sources, they no longer have to worry about the risks associated with a single point of failure. Knowing that GPS information is always at risk and that the information received may not be accurate adds considerable stress to already difficult situations. With trusted PNT information, warfighters have a higher level of trust in the information based on the knowledge that a range of defenses have been applied to protect against the possibility that inaccurate information will be provided.

Ultimately, the trust and confidence that warfighters have in A-PNT solutions is crucial. Today's warfighters have higher expectations for technology than previous generations. This new generation of digital natives grew up with easy-to-use technology at their fingertips. As a result, they expect fast and easy access to accurate and reliable information at all times. And they expect that technology and systems will "just work."

When warfighters have A-PNT systems they can rely on with full confidence, they will use those systems to the full extent of their capabilities without skepticism. This allows them to maintain complete focus on the strategic and tactical initiatives underway. In contrast, when warfighters do not have confidence in a system, they may avoid using it, or will question the information provided. Hesitation, vacillation, and doubt in the field can lead to actions, or inactions, that put people, missions, and equipment at risk.

With A-PNT solutions that are designed to seamlessly slide into the available space and provide A-PNT information just as GPS information is currently provided, it's easy for warfighters to transition from GPS to A-PNT information. They do not have to think about the technology transition or learn new ways of operating. All of the actions they take related to location information are natural and intuitive.

System Integrators Gain Simplicity, Security, Scalability

When A-PNT solutions adequately address the technical and security challenges outlined in the previous section, system integrators' tasks can be completed faster and easier to lower development costs and accelerate time to market.

Solutions are designed for the available space with size, weight, and power (SWaP) constraints in mind so they can be easily integrated into a variety of ground and air platforms. System integrators can choose the form factor that is best suited to their application and platform with no compromises to functionality. And installation is straightforward, with no need to remove other systems or struggle with masses of wires.

System integrators can also be confident that the Line Replaceable Unit (LRU) or Line Replaceable Module (LRM) they select will have the physical interfaces needed to connect to the legacy and modern equipment that is already installed on the platform. They can support new or retrofit programs with ease and avoid the costs and complexity associated with replacing additional systems to support the A-PNT solution.

Along with the ability to physically connect to any existing equipment, solutions can also share PNT data with all of the other systems that rely on positioning information. System integrators can develop solutions that combine information from classified and unclassified sources, span all security enclaves on the platform, and distribute data to legacy and modern systems.

The ability to support data from low-end and high-end PNT sources is another important benefit for system integrators. PNT sources are available in widely varying levels of sophistication and at very different price points. With a scalable solution, system integrators can design solutions that can quickly process data from sources that cost hundreds of dollars or tens of thousands of dollars to accommodate whatever equipment their end customers are already using or are about to purchase.

Holistic A-PNT Practices in Action

The Curtiss-Wright approach to A-PNT is based on multiple complementary PNT technologies that leverage proven and trusted techniques to arrive at A-PNT truth and provide a trusted solution that will protect personnel and equipment in the field.

Whether on tactical and combat vehicles, unmanned aerial vehicles (UAVs), unmanned underwater vehicles (UUVs), or aircraft, our proven hardware products with PNT capabilities can be upgraded to deliver higher performance and more sophisticated capabilities as technology evolves, ensuring warfighters always have access to the latest innovations to keep them safe and steps ahead of adversaries.

And, with the U.S. Department of Defense's tri-services memo mandating that "the use of MOSA [Modular Open Systems Approach] supporting standards should be included in all requirements, programming and development activities," our A-PNT modules and systems are designed in alignment with open standards, such as

+ The Open Group Sensor Open Systems Architecture™ (SOSA)
+ C5ISR/EW Modular Open Suite of Standards (CMOSS)
+ Vehicle Integration for C4ISR/EW Interoperability (VICTORY)

The VPX3-673 A-PNT and Radial Clock LRM

A Gold honoree at the 2020 Military & Aerospace Electronics Innovators Awards, The VPX3-673 is a specialized single board computer and timing card designed to eliminate the need for multiple in-platform boxes to field new navigational capabilities and simplify the integration of complementary PNT sources on ground vehicles.

VPX3-673 A-PNT and Radial Clock LRM

Aligned with CMOSS, the SOSA™ Technical Standard, and the OpenVPX™ Timing module standard, the SWaP-efficient VPX3-673 delivers state-of-the-art technology services, including a GPS/GNSS Receiver (M-CODE or SAASM), Chip Scale Atomic Clock (CSAC), and an on-board Inertial Measurement Unit (IMU) – all within a single slot.

The VPX3-673 is also ideal for radial clock distribution applications and can provide a server for various low-power timing services. Serving as a low-skew clock master powered by a GPS-disciplined CSAC, the module offers a variety of configurable clock reference sources and support for up to 16 synchronized clock outputs.

Enabling A-PNT in Difficult Environments

The VPX3-673's onboard 10 degree of freedom IMU makes it capable of precise motion tracking in a denied or untrusted GPS environment. Support for an onboard GB-GRAM type II GPS with SAASM or MCODE support is provided, including dedicated zeroize and keyfill functionality. An RS-232 port and RF 1 PPS input are provided for interfacing with an external RS-232 GPS sources.

Providing Server for Radial Clock Distribution Applications

The VPX3-673 is ideal for radial clock distribution applications and can provide a server for various low-power timing services. Serving as a low-skew clock master powered by a GPS-disciplined CSAC, the module offers a variety of configurable clock reference sources and support for up to 16 synchronized clock outputs.

Delivering High-Performance Capability in a 3U Footprint

The VPX3-673 offers NXP® Arm® processor technology, featuring its advanced 64-bit, four-core Layerscape LS1043A. With a high-speed DDR4 memory subsystem connected directly to the processor and supporting up to 4 GB SDRAM, the VPX3-673 is able to maximize the performance of its multiple processing cores, GPS, and associated position and timing capabilities.

The DBH-670A A-PNT Vehicle Computer and Switch

The DBH-670A is a highly integrated, multi-functional vehicle computer and Ethernet switch that combines A-PNT functionality, a powerful Gigabit Ethernet switch, and a power-efficient Arm computer in a single box.

Enabling A-PNT in Difficult Environments

The DBH-670A serves as an excellent high-performance, low-skew clock master powered by a GPS-disciplined Chip Scale Atomic Clock (CSAC), which offers a variety of configurable clock reference sources and support for up to 8 synchronized clock outputs. Its on-board 10 degree of freedom IMU delivers precise motion tracking in limited, impeded, or denied GPS/GNSS environments. The DBH-670A also supports direct connection to an external GPS receiver (NMEA, DAGR, or equivalent) for real-time GPS position and time data. It can be optionally configured with an on-board GPS Receiver (upgradeable to M-Code).

Delivers High-Performance Switching

Built around a non-blocking core fabric, the DBH-670A's 16-port Ethernet switch provides tri-speed operation (10/100/1000 Mbps) with auto-negotiation and auto MDIX. Its feature-rich networking includes support for IPv4/v6, VLANs, IGMP multicast, QoS, MSTP/RSTP, link aggregation, port mirroring, and jumbo frames. The network switch also includes full support for hardware-based Precision Time Protocol (IEEE-1588v2), enabling the network nodes to synchronize with nanoseconds of accuracy.

Built with a Modular Open Systems Approach

Curtiss-Wright designs rugged modules and systems like the DBH-670A in alignment with MOSA open standards to shorten our customers' development times, simplify technology upgrades and interoperability, and reduce solution costs.

DBH-670A Digital Beachhead

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Learn More

Products

- VPX3-673 CMOSS A-PNT & Radial Clock LRM
- DBH-670A A-PNT Vehicle Computer and Switch

Read About

- Curtiss-Wright's Proven Technology for Trusted PNT
- Modular Open Systems Approach (MOSA)
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