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GLOBAL POSITIONING SYSTEM IN THE ADF

As an example of a system that has become pervasive in next to no time at all, the US NAVSTAR Global Positioning System (GPS) is hard to beat. The ability to accurately determine time and position, without the use of expensive and complex systems, has revolutionised the way the world functions. So successful has this system been, that the GPS has become a utility—something that is assumed to be constantly available.

The NAVSTAR system has its origins in research conducted by the US Army, Navy and Air Force on competing designs for satellite-supported timing and positioning. A Navigation Satellite Executive Group (NSEG) was formed in 1968 to take a more holistic approach to space-based timing and navigation issues. Five years later, following a recommendation from the NSEG, the US Air Force was given the lead in developing a Defence satellite system. What followed was an initial testing period between 1974 and 1979—the tests being conducted using two US Navy Timation satellites, which placed the first atomic clocks in space. These tests were followed by the launch of 11 GPS Block I satellites between 1978 and 1985. Combined with ground-based transmitters that simulated a GPS signal, these satellites validated the concept of time-based-ranging using precise timing from space-based clocks.

Block II GPS Satellite

Authorisation for full-scale development of the GPS system was given in 1979, but almost immediately the program received a 30 per cent budget cut, requiring a reduction in scope and the number of operational satellites. Like many space-based systems, NSEG had difficulties 'selling' its capabilities and benefits to operational users; although it had a wide variety of applications and users, none of them wished to bear the full cost of the system. This issue was finally addressed and the Block II satellites funded, but the program was again delayed by the loss of the Shuttle *Challenger*—the only planned launch vehicle for this class of satellites. Block IIs were eventually launched aboard Delta II boosters in 1989. Initial Operating Capability (IOC) was declared in 1993 when the system was able to sustain continuous positional accuracy of 100 metres, which was a joint a requirement of the US Departments of Defense and Commerce. Full Operational Capability was declared in 1995, once all 24 Block II satellites were in orbit and fully functional.

Given the dual civil/military applications of the GPS signal, it is not surprising that the system is configured for the two customer bases; the Standard Positioning Service (SPS) provided for civilian users and the Precise Positioning System (PPS), available to designated military/government users.

SPS is the freely available, unencrypted signal that is available to all GPS receivers. While possessing the same general qualities of accuracy as PPS, the SPS signal was originally degraded through the implementation of Selective Availability. Selective Availability enabled the accuracy of a SPS receiver to be controlled by the GPS operations centre. Given the overwhelming adoption of, and dependence on, GPS by the commercial and civilian communities, then-President Clinton directed the discontinuation of this feature.

PPS is designed to provide approved users with a signal capable of operating in an electronic warfare

environment. The PPS signal characteristics are designed to enable its acquisition in a cluttered electromagnetic spectrum, to provide a measure of resilience to jamming and spoofing, and to indicate to an operator when such events occur. These characteristics are achieved through a second encrypted signal transmitted by each GPS satellite and an appropriately encrypted receiver. The PPS is available only to military-grade receivers loaded with the appropriate cryptographic key, without which a military-grade receiver effectively operates only as a SPS receiver.

Is that GPS position from SPS or PPS?

It is difficult to find an ADF project or capability that does not depend in some way on the GPS signal. Employment ranges from hand-held receivers (the vast majority of ADF receivers exist within Army), through to integration into vehicles, aircraft and ships, along with usage in an increasing number of weapons and munitions.

An often overlooked element of GPS is the realm of computer network coordination and timing. The majority of computer networks rely on precise timing to ensure the smooth passage of data between nodes. While alternative systems exist, they are expensive to implement and operate, especially compared to a 'free' signal from space. As such, many ADF and civilian networks are heavily reliant on the GPS timing signal. Such dependencies are difficult to quantify; similar to the Y2K issue, the impact of losing GPS can only be properly measured after the event.

While at face value it may appear that an SPS receiver will perform as well as its military-grade counterpart, this is only in benign environments. With the proliferation of electronic warfare equipment, and doctrine concerning the importance of controlling access to timing and navigation signals, the chances that the ADF will continue to operate in such a benign environment are increasingly slim. Indeed, it should be noted that the US DoD has a Navigation Warfare policy that includes denying access to non-PPS navigation signals—such an act would also impact on all SPS users in a theatre, whether or not they are allied with the US.

Given the near-global adoption of the GPS by Defence and supporting agencies outside of Defence, the impact of the loss of, or interference with, the GPS should be of concern to all users. From an ADF perspective, the best means of assuring our access to the GPS is through the use of appropriately endorsed PPS-capable receivers, keyed with crypto. If only a commercial-grade GPS receiver is available, commanders must recognise the inherent risks in using such a device; particularly, the impact that erroneous position data could have on the effective employment of military forces.

- *Both military and civilian activities have become highly dependent on the position, navigation and timing signals provided by the GPS system.*
- *Use of a commercial GPS receiver relies on a benign operating environment.*
- *The best means of assuring access to the GPS signal is through use of a PPS-capable receiver loaded with the appropriate cryptographic key.*

'Our strategic capability advantage depends on our ability to access space, gain the benefits of space-based systems and protect ourselves from foreign exploitation by space-based capabilities.'

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