A Novel Approach
to
Selective Availability Anti Spoofing Mode
(SAASM)
Introduction

In a military environment, the Global Positioning System (GPS) satellite based positioning system has become a key factor in enabling more and more sophisticated systems and strategies to insure highly successful outcomes with minimal casualties in situations of armed conflict.

Due to the power of the system and the advantage it brings however, finding ways to disable availability of the system has also become a major priority for the enemy.

One of the simplest forms of disabling key military systems based on GPS technology is "jamming" of the GPS signals. This is primarily because the signal levels are so low, that very sensitive "front end" receiver equipment is needed to detect and process the signals. Although this is the simplest method, it is not very attractive to an enemy as it is extremely obvious, and there are a number of ways to mitigate this.

A more productive approach for an enemy is to "spoof" the GPS system. This is a much more complex method of interference and involves transmission of GPS like signals that fool the GPS receivers into thinking they are somewhere/some time that they are not. Hence the importance of the military P(Y) code signal, and Selective Availability Anti Spoofing Mode (SAASM) equipment.

The P(Y) code is an encrypted signal, derived from an encrypted version of the P pseudo random noise code (PRN), and transmitted by the GPS satellites at a different frequency than the C/A (coarse acquisition) code that is broadly utilized in civilian and infrastructure applications. In order to receive and decode the P(Y) code it is necessary to have access to a decryption "key", which for obvious reasons is not readily available without the necessary military clearances!

The SAASM implementation of a GPS receiver receives the P(Y) code and has the capability to accept a decryption key which it utilizes in order to decode the received P code signal, and in turn generate accurate position and timing information.

Application

There are two primary type of SAASM receiver, the most prolific being a handheld version used by troops on the ground for navigation and positional information. The other type of equipment is the time and frequency instrumentation that uses the satellite information to generate the precision timing and frequency signals essential for military operations.

Although there are significant numbers of the time and frequency type equipment deployed, the quantities are dwarfed by the numbers of handheld devices in used, and therefore the cost of the time and frequency equipment tends to be very high compared to the cost of the handheld devices.
Novel Approach

In order to take advantage of the capabilities of the SAASM equipment for precision time and frequency applications, while minimizing the cost overhead of integrating SAASM based receiver modules and key capability into the relatively high cost time and frequency equipment, an approach has been taken that combines the capabilities of the handheld device with the specialty functions generated in a precision time and frequency instrument.

One of the capabilities of the handheld devices is that they are generally able to be programmed to output an accurate pulse once every second. Typically they also have a communications interface through which it is possible to obtain position, time and satellite signal information.

While this information by itself is insufficient to provide the necessary signals and timing for the precise timing and frequency applications, nevertheless used in conjunction with a much lower cost commercial time and frequency instrument it is sufficient to provide the basis for generating highly precise time, timing and frequency signals.

The approach taken does just this. A commercial instrument has been modified to provide an interface to a SAASM enabled handheld device. The interfacing signals comprise the precision Pulse Per Second (PPS) signal, and a communications interface from which time, position and satellite health are acquired.

The time, position and satellite health signals are utilized to control the instrument indications and outputs such as time of day, day of year, IIRG B time code and instrument health (holdover, fault etc.), while the PPS signal is incorporated into a precision control loop to give long term accuracy (disciplining) of the precision frequency signal, while short term performance (phase noise, short and medium term stability) are determined by the internal rubidium atomic clock module in the instrument itself.

The resultant system provides a highly secure (not prone to spoofing) precision time and frequency system at a fraction of the cost of a more conventional precision time and frequency instrument with integrated SAAS module.

Summary

The approach described in this paper provides a novel way of leveraging the cost/performance benefits of high volume handheld devices with a precision time and frequency instrument to generate high performance time and frequency signals at a fraction of the cost of the conventional "integrated" approach.

For more information please contact Precise Time and Frequency, Inc.