Part 1 of 4 Consecutive Instalments

The Global Positioning System, the world's first global utility, has become a proven innovation and a marvel of modern technology. Over a few short years, GPS has changed many of the traditional ways we do things and in a growing number of ways, has changed human kind forever. GPS is now such an integral part of many otherwise 'ordinary' everyday maritime situations, that we are already starting to take this extraordinary satellite-based system for granted. But according to GPS systems analyst Kerry Matthews, the best is yet to come.

GPS

Navigation In The 21st Century

Part One: What It Is, & How It All Began

From precise timing for telephone and Internet networks through to Geocaching (modern day hi-tech hide and seek) to fully automated landing of FA-18 jet fighters onto an aircraft carrier's deck, the Global Positioning System provides diversity and opportunity in many applications, and it all started with Elvis.

No, Not THAT Elvis, Elvis the satellite. Yes, GPS satellite#1 was called Elvis. Actually satellite#2 was Janis (Joplin) and #3? Well, it was simply #3.

As GPS progressed from the early 1980's, continued development through the 90's saw the system become fully operational, then reached some milestones and countered issues that not many ever expected to see reached.

Referring to the Global Positioning System (GPS), one American military official made the comment that "people's lives depend on this system and people are depending on the system far beyond expectations".

Many of the GPS incident reports unfortunately highlight a type of "appliance" approach, where safety with consideration to the system specifications and operation, have in some cases been tragically taken for granted.

GPS is an extremely complex system, yet available to users as a very simple device. By understanding and using GPS within its specifications, this revolutionary navigation, timing and ranging system will leave the world wondering what we ever did without it.

In this GPS series, we will look at GPS in its entirety, how it works, how to use it, how to understand some of the navigation terminology (like in the owner's manual), what GPS modernization might mean to us boaties and fishermen with respect to accuracy - as well as current and future plans for GPS and other planned navigation systems.

Research & Report by Kerry Matthews** For F&B
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In the Beginning

Man presumably navigated from the visible surrounding geographical features. Early mariners followed the coastline and were more "pilots" than navigators. The principle of a magnetised needle was widely known, which, when combined with ancient speed and distance measuring methods allowed sailors to navigate by "deduced" (or "dead") reckoning.

Many of Columbus's voyages relied on dead reckoning and by the end of the fifteenth century celestial navigation was in an early stage of development.

The Flemish cartographer Mercator developed his now famous first map of the world in 1569. Even more interesting was the fact that much of the mathematics, logarithms and calculus that we require today had not yet been invented.

Even though sailors today still use Mercator charts, being a sailor in those times was a very dangerous business.

The development of the Quadrant in the early 1700's, the predecessor to the modern day sextant, allowed better accuracy in determining Latitude (north and south).

However, determining Longitude (east or west) still eluded the navigator and it wasn't until Englishman John Harrison had spent almost his entire life dedicated to developing his "Timepieces" that the issue of longitude was finally resolved.

This "invention", the earliest version of the modern marine chronometer started the rudiments of modern day navigation and charting, as we know it today. From our own history, Captain James Cook became recognised as one of the great navigators of modern history. In the late 1700's, Cook produced many of the world's first "modern" British Admiralty charts with such accuracy and skill they were used until quite modern times. Much of Cook's navigation excellence relied on a "Harrison Timepiece".

"Electric" ground based radio-navigation systems were developed as far back as the early 1900's, but had limited coverage and accuracy. However, despite the vast technological leaps that were made in the many fields during the two great wars 1914-1918 and 1939-1945, offshore or aerial navigation remained the province of the sextant and chronometer, with localised assistance from various RDF (Radio Direction Finding) equipment stations around airports and major ports.

Land based "hyperbolic" navigation systems of the time, such as DECCA, OMEGA, LORAN, GEE, OMEGA and others were also limited in coverage and accuracy. Even with these "state of the art" systems, professional navigators were still taking sights from the stars right through to the late 1970's and 1980's.

The first space based satellite navigational system was the U.S Navy's Transit system, which became operational in 1964. However usage was limited to certain times of the day and being only a two dimensional system basically eliminated it for aviation use and severely limited land applications.

In 1972 the satellite based TIMATION system was developed, which was to provide time and frequency transfer; time being a critical requirement for the existing land based navigation systems such as LORAN-C and OMEGA.

The third TIMATION satellite acted as a GPS technology demonstrator and hence the real start of the NAVSTAR GPS concept. This concept was for a system of radio transmitters in space that would cover the entire world, and so, instead of looking at the stars with a sextant, we would be able to listen to a man-made constellation of "stars". A group of 24 satellites plus spares that orbit the earth transmitting radio-navigating data 24 hours a day, in all weather to a 3 dimensional precision, accuracy and capability far exceeding any previous radio-navigation system.

The Iraq conflict drew close attention to the GPS system, not only because of its ability to guide precise munitions to targets, but also because the Iraqis tried to jam it. And the irony was, those GPS jammers were taken out with GPS guided weapons.

The Global Positioning System, more correctly referred to as NAVSTAR GPS (**NAV**igation **S**atellite **T**iming **A**nd **R**anging Global Positioning System) but more commonly known simply as GPS, has unlimited navigation capabilities in many fields.

Even though GPS was primarily developed as a military system, GPS as well as remaining an extremely important system for the modern NAVWAR fighter is a dual-use system surpassing all expectations in developing a wide range of peaceful civilian applications worldwide.

These applications cover a wide range of leisure activities including pleasure boating, hiking, geocaching and orienteering to car navigation, emergency rescue, farming, surveying, maritime, aviation, fleet management, surveillance, meteorology, time synchronisation, safety-of-life applications and much more.

The decision to discontinue the intentional signal degradation (Selective Availability) by President Clinton on May 1, 2000 (see inset on Page 49) was in direct response to the importance of GPS to the ever increasing number of civil and commercial users worldwide and the first step in future modernization plans.

The military success of GPS was first cited in the 1990/91 Gulf war as a key to the Desert Storm victory. This was even well before the system was fully or even partially declared operational, with only 16 operational satellites. These 16 satellites at that time were unable to provide full 24 hour navigation capabilities.

During operation Iraq Freedom, the system showed its full potential as a fully operational system. While Cruise missiles were being delivered with extremely high precision on very selective targets, the same system continued to provide a worldwide navigation service without the effects of intentional degradation for a wide range of peaceful civilian purposes.

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Background History

GPS evolved from the foresight and determination of two gentlemen, Dr. Ivan A. Getting who, in the 1950's, envisioned a system that would use satellite transmitters to pinpoint with extreme accuracy locations anywhere on Earth and Dr. Bradford W. Parkinson then Department of Defence program director. It was Dr. Getting's sustained and tireless effort that

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