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NAVSTAR:
GPS SATELLITE NAVIGATION

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The Global Positioning System (GPS) has become well known for its civilian uses. Hunters can find their way around the woods with its help, and it plays an important function in search-and-rescue operations. Even automobiles come equipped with GPS navigation, for a hefty extra premium. What is not well enough understood is that GPS was developed for military purposes and it has sinister military applications.

GPS has already been incorporated into naval ships, submarines, and military aircraft -- virtually every vessel and vehicle of war. It has also been put on cruise missiles (21 inches in diameter) and has been designed for use in 155-millimeter artillery shells (six inches diameter). Some GPS receivers are as small as cigarette packages, so space and weight are not problems for any application.

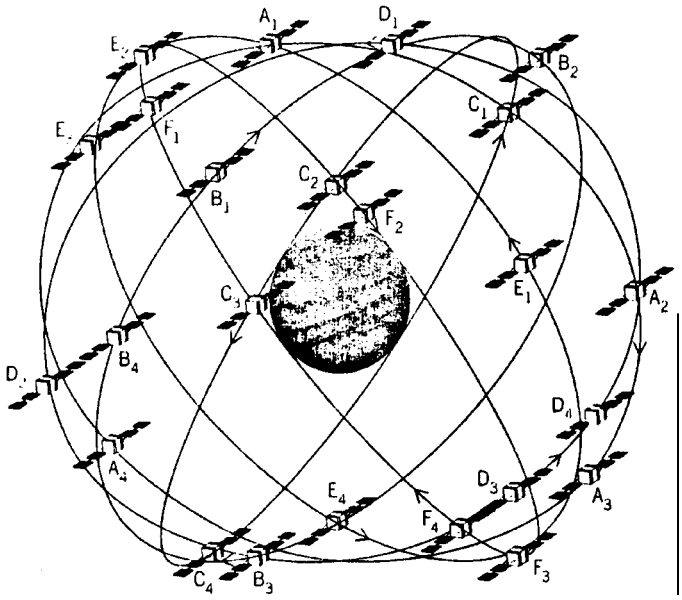
NAVSTAR GPS Satellite
Source: Boeing

DESCRIPTION

In *First Strike*[1], the history and function of the NAVigation System Timing And Ranging (NAVSTAR) Global Positioning System is outlined. NAVSTAR GPS is now available at any time, in any weather, and at any place on or above the earth. A 30-second fix will give the receiver's position within at least 10 meters (33 feet) in all three dimensions, and velocity (speed and direction) within a fraction of a mile per hour. NAVSTAR also provides precise time within a millionth of a second to synchronize the atomic clocks used in various military applications.

The full NAVSTAR constellation consists of 24 operational satellites plus spares in orbit. They are

[1]Aldridge, pp. 118-125.



Full NAVSTAR Constellation
Source: Unknown

divided equally into six equally-spaced polar-orbital planes. These orbits are half of geosynchronous altitude (10,898 nautical miles above the earth), which means each satellite completes two trips per day around the globe. With this full constellation there will always be six satellites in view anywhere on earth almost 100 percent of the time.

Obtaining the navigation fixes from the NAVSTAR GPS system is a sophisticated exercise in trigonometry. Extremely precise atomic clocks time the intervals between transmission and receiving of radio signals from each of the satellites in view. A computer then solves five or six simultaneous equations to obtain the receiver's position. Subsequent readings provide speed and direction.

Existing satellites transmit on two navigation frequencies: L1 for either military or civilian users and the very precise L2 for military only. The L1 frequency will only provide positional fixes of 100 meters (330 feet) accuracy in three dimensions. But on 1 May 2000 the Clinton administration ordered that selective availability of GPS be turned off. This for the first time gave civilian users access to the L2 frequency and the same accuracy as the military.

Future satellites will have a dedicated civilian safety-of-life frequency known as L5. They will also have an L3 frequency for nuclear detection and an L4 for some undisclosed purpose.

A more accurate application of NAVSTAR is available in certain critical locations. Called Differential NAVSTAR, it provides three-dimensional accuracy within 2 meters (6.6 feet). To accomplish this, a receiver of precisely known location receives the NAVSTAR signals, calculates the error, and then broadcasts a correction factor for that locality. Raytheon is also working on ways to make NAVSTAR GPS more accurate for civilian uses -- the Wide Area Augmentation System and the Local Area Augmentation System.

THE SATELLITES

The first NAVSTAR launch was in 1978. Early Block-1 satellites were put into orbit using Atlas missiles. The first Block-2 operational satellite was launched on 14 February 1989 by a Delta-2 booster. Delta-2 rockets have been used ever since to launch GPS satellites into orbit from Cape Canaveral. All Block-2 and Block-2A satellites, built by Rockwell Space Systems Division (now owned by Boeing) are now in orbit. These satellites were designed for a 7-year service life but experience in orbit has extended that life of Block-2A satellites to 10.6 years. Falcon Air Force Base in Colorado is the master control station for NAVSTAR.

1. GPS Block-2R Spacecraft.

In 1989 the US Air Force awarded a $800-million contract for 21 replenishment satellites designated Block-2R. Lockheed Martin Space Systems Company (LMSSC -- Sunnyvale California)

delivered the first of these in 1996. The Block-2Rs are less dependent on ground controls for corrections and are claimed to have an accuracy of one meter. They are designed for a lifespan of 7.5 years but are expected to last more than ten years. The first launch attempt on 17 January 1997 failed when the Delta-2 rocket blew up in mid-flight, destroying the $40-million satellite. The first Block-2R was put into orbit by the second launch on 22 July 1997. Orbit of the second satellite (third launch) took place on _____, the third was put into orbit on 11 May 2000, and the fourth in July 2000. There are 16 more to go by 2005.

In 2000 LMSSC received Air Force approval to improve the last 12 Block-2R satellites, which are to be designated Block-2R "Modernized." These will make military accuracy available to civilians by creating a civilian access (C/A) signal on the L2 frequency. They will also incorporate new military signals called the M-Code -- presumably the L3 and L4 frequencies -- which includes a more powerful "spot beam," a means of focusing the signal so it is not easily disrupted or jammed. A $110,170,885 contract was awarded on 30 March 2001 for this modification, about a third of it already obligated for work done up until this time.

2. GPS Block-2F Spacecraft.

On 22 April 1997, Rockwell Space Systems Division (now Boeing) won an initial contract of $382 million to design and develop six follow-on NAVSTAR satellites designated Block-2F. They are expected to have a service life of at least 12.7 years. The Air Force wants 33 of these new spacecraft by 2012 with a potential contract value of $1.3 billion.

These first six are further designated Block-2F "Lite" and will have the civilian "safety-of-life" signal (L5). Launches are to start in 2005.

Satellites subsequent to the first six will be known as Block-2F "Fully Modernized." In 2000, at the same time LMSSC was given a contract for Block-2R modernization, Boeing Space and Communications Group (Seal Beach, California) was awarded a contract to build 12 additional Block-2Fs which will have the L1,the L2 with C/A addition, and the L5 frequencies as well as the M-Code with the anti-jam spot beam.

3. GPS Block-3 Spacecraft.

In November 2000, Lockheed Martin and Boeing were each awarded a $16-million, 12-month study contract by the Air Force to conceptualize the next generation GPS satellite, which will be known as GPS Block-3.

NAVSTAR GPS SUPPORTS A FIRST-STRIKE CAPABILITY

Submarines, like missiles, have an inertial navigation system comprised of instruments which sense every movement of the vessel as well as tides and currents. By keeping track of all this relative motion the navigation system provides a pretty fair location of the submarine. But the margin of error increases with time and the sub needs a navigational "fix" to update its exact location. Then the corrected inertial system continues for another increment of time. Prior to the 1990s, submarines relied on land-based Omega and Loran-C signals, and Transit navigation satellites for these periodic positional fixes. Now the NAVSTAR GPS is taking over. Submarines also get a GPS fix just prior to launching missiles, thus giving them, for the first time in history, an accuracy equal to fixed land-based missiles in silos.

NAVSTAR GPS, by giving the exact position of launch for the submarine, is the answer to Trident missile accuracy, thus making it the ultimate first-strike weapon. It also seems obvious that NAVSTAR receivers are in the missiles, themselves, to provide in-flight guidance updates for even greater precision. Both Trident-1 and Trident-2 missiles have received NAVSTAR GPS signals during test flights, purportedly to calibrate the on-board navigation system. But millions of dollars have been spent to integrate NAVSTAR GPS fixes with inertial navigation packages and it would be no great effort to do that for Trident.

NAVSTAR GPS SUPPORTS REGIONAL WARS

NAVSTAR GPS was extensively used during the Persian Gulf war as a means to navigate the featureless Arabian desert. And it was during that war that cruise missiles with their radar-based TERCOM guidance system were found to be grossly unreliable. GPS receivers were then installed on Tomahawk and Air-Launched cruise missiles and have been used in every subsequent regional conflict.

During the attacks on Yugoslavia over the Kosovo crisis, a different set of circumstances was encountered. The frequent fog and the mountainous terrain made inoperable many munitions which depend on video and laser guidance. GPS receivers were subsequently installed on more weapons.

GPS was added to the Joint Direct Attack Munitions. This is an attachment to dumb bombs -- such as the 1,000-pound and 2,000-pound gravity bombs -- which contains a guidance package and has control fins for directional changes.

GBU-15 glide bombs are also getting GPS control, as are the AGM-130 video-guided weapon. GPS allows the latter to maneuver for a vertical dive into the target for deeper penetration.

Paveway-3 is another kit attached to dumb bombs for greater accuracy. It is laser guided but is now being updated to use GPS navigation. Steadily and certainly the instruments of regional wars are being made smarter with NAVSTAR GPS.

CONCLUSION

NAVSTAR GPS has become an important element in America's warmaking capability, from strategic to tactical, from nuclear to conventional. Every improvement makes it more deadly. All in all, it allows the US to be even more cavalier about throwing its military might around the world. GPS is a system that should be systematically and persistently opposed.

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GLOSSARY

C/A	Civilian Access.
GPS	Global Positioning System.
LMSSC	Lockheed Martin Space Systems Company.
NAVSTAR	NAVigation System Timing And Ranging.
TERCOM	TERrain COntour Matching.