Navstar key to U.S. nuclear sub defense

by Marsha Freeman

A new satellite navigational system currently under development, the Navstar Global Positioning System, could dramatically expand U.S. strategic war-fighting capabilities in the immediate months ahead, provided the Defense Department gives the go-ahead for accelerated production.

U.S. Trident I submarine-launched ballistic missiles do not have the accuracy to strike and destroy hardened military targets such as missile silos in the Soviet Union. U.S. land-based missiles are also limited in their ability to hit such targets, leaving the United States at a strategic disadvantage, against an adversary who probably already has the capability for a disabling first strike against the United States.

The Navstar program could be made sufficiently operational in the next few months to remedy this. It has the potential to provide 24-hour, all-weather navigational information to troops in the field, aircraft, and submarines. The system will increase the accuracy of the delivery of nuclear weapons five-fold by giving a submarine, for example, its position within an error range of only a few feet before firing.

The Navstar system was originally planned to be fully operational by 1984, but budget cuts under the Carter administration set the timetable back by four years. With some acceleration it is still possible to have a partially effective system in place this year. Since 1977, the Department of Defense has been deploying first-generation Navstar navigational satellites on a test basis. Over the next few months, the remainder of these Block I satellites could be launched, providing partial coverage, though not for the full 24-hour day. For the submarine forces, access to precision navigational data even once a week would significently increase weapons delivery accuracy. The production schedule of the more advanced Block II satellites can also be accelerated, so that the entire system of 18 satellites could be operational earlier than the current target of 1988.

Accurate navigation

In 1973 the Defense Department decided to design and plan a global navigational system for all of the military services to replace existing systems, which only provide for particular needs with limited coverage and accuracy.

The Navstar satellites make use of atomic clocks to provide each user—which could be a soldier in the field, an aircraft, or submarine—precise time information. For a three-dimensional fix, the user would receive data simultaneously from four separate satellites within view at the same time. This would give him the ability to compute his latitude, longitude, and altitude.

Each satellite emits two radio signals at all times. One is a crude positional signal, and the second is a coded signal which contains the navigational information. Only users with the proper equipment will be able to access the second signal's data.

The user equipment will measure the amount of time the signals from each of the four satellites take to reach it. It will also have stored the precise orbital data for the satellites, so their exact positions can be determined.

By computing the distance from each of the four satellites, whose positions are known, the user can pinpoint his location to within a few feet. The satellites will also send the user any changes in the ionosphere, weather, or other factors that could affect the travel time for radio signals.

Navstar will allow users to compute the navigational fix in about 90 seconds. For the existing technology, such as the Navy Transit system used for submarines, it can take 30 minutes to determine a less accurate position. For submarines, which have to come closer to the surface to pick up the Navstar signal, thus exposing themselves to detection, this time reduction is crucial.

The operational Navstar system will consist of 18 satellites in six orbits and three on-orbit spares. They will be in an orbit nearly 10,000 miles above the Earth, out of range of current-generation Soviet anti-satellite systems.

The second-generation Block II satellites will also be hardened against electromagnetic pulses from nuclear explosions and limited laser attack. They will be part of the Integrated Operations Nuclear Detonation Detection System and will contain sensors to detect a nuclear blast on or near the Earth or in space.

Using Navstar

The Block II satellites will have limited cross-link capabilities which means they will be able to "talk" to each other. They will, therefore, be able to cross-check any data on nuclear detonations and estimate the yield of the weapons.

This cross-link capability will also be important in a war-fighting situation, since the advanced satellites will be able to operate autonomously from ground control for a week at a time, if necessary. Military experts estimate that this could be the most important safeguard against the system being rendered inoperative, as the ground control centers are the most vulnerable segment in the Navstar system.

Survivability of the space segment, the satellites, is based on both their high orbits and the redundancy in the number of satellites. If a handful of Navstar satellites were knocked out, the system is designed to "degrade gracefully," that is, the on-orbit spares would become operational, and since there are multiple satellites in each orbit, total navigational capability is not lost even if the net number is reduced.

Navigational accuracy will provide an enhanced capability for many military missions. Navstar will be applicable to reconnaisance, mapping and targeting, helicopter operations, Navy mine-sweeping and mine-laying, anti-submarine warfare, and field artillery applications.

The equipment required for various uses differs in its complexity.

Military users which are moving quickly, like aircraft, or which need extremely precise information, such as submarines, use equipment which has five channels and can receive and process the signals from four satellites simultaneously. In either case, the weight of the receiver and computer equipment is inconsequential, and therefore the most complex and sophisticated equipment is used. Such a "high dynamic" set might weigh over 60 pounds.

In the case of ground forces, which are not moving quickly and where weight is a limitation, less complicated single channel equipment might be used where the weight might be under 15 pounds.

This "low dynamic" user set would consist of an antenna to receive the signals, a control display unit and could be battery powered. It could be used on a vehicle or as a manpack weighing as little as 14 pounds.

In addition to increased positional accuracy, Navstar will give each military user a precise reading on his own speed to an accuracy of .3 feet per second, and the correct time accurate to within millionths of a second. With this data, he will know where he will be in a given unit of time in the future. With this information, the user can determine more precisely where his weapons would hit, if unloaded.

It is also possible to place equipment on a missile or warhead itself which will give it its precise position as it heads toward its target. In the case of a missile or warhead, weight is clearly a factor. Therefore a partial system containing about 30 pounds of instruments, which would be able to receive the Navstar signals and deliver that information to the missile's guidance system, is being tested.

The basic satellite positional data and changes in the satellite ephemeris would be tracked and stored by ground control, and fed into the missile system just before launch. The accuracy of the Navstar-configured warhead would transform today's "dumb" bombs into the next-generation "smart" bombs.

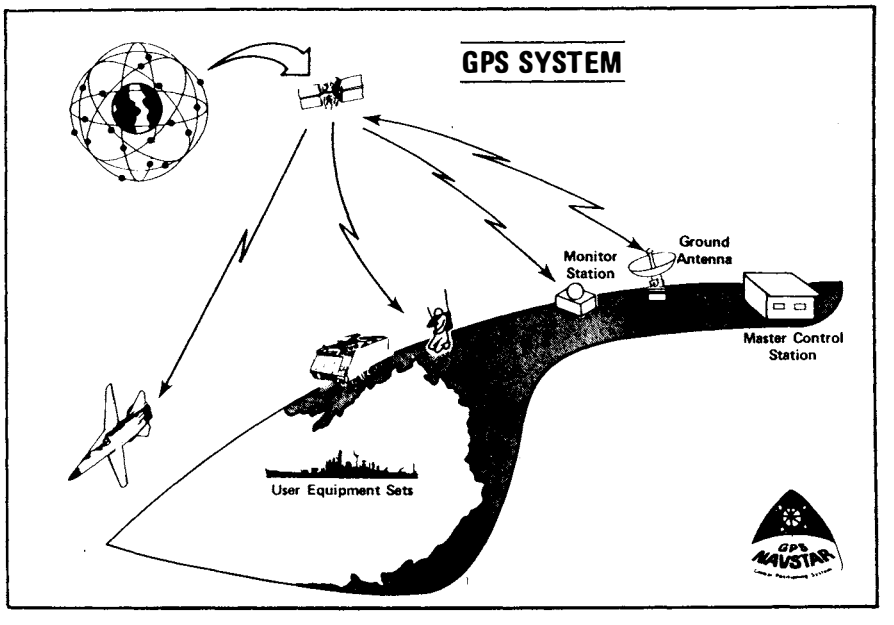
If the U.S. Minuteman III nuclear weapons were outfitted with these partial Navstar sets, it is estimated that their accuracy could be increased five-fold. Today's Minuteman II warheads fall within an approximate 600-foot circular error of probability (CEP). This means than about half of the warheads will fall within a circle having a 600 foot diameter. Military experts estimate that this would mean that over 30 percent of Soviet military targets would be "safe" from attack, since many are hardened and therefore require a much more accurate near- or direct-hit to be destroyed.

With Navstar accuracy, this CEP is reduced to 120 feet, which would place a high percentage of warheads in the range to destroy hardened targets.

Today's Trident I missiles, which are launched from submarines, have a CEP of about 1,500 feet. This poor accuracy has eliminated submarine-launched ballistic missiles (SLBMs) as weapons that could destroy hardened military targets such as missile silos in the Soviet Union.

Navstar will help solve a serious problem for submarines, that of identifying their own precise location. With Navstar, the submarines would have a more exact navigational fix, and their missiles could also be outfitted directly with the partial user sets.

A CEP of only 300 feet would be possible using the Navstar Global Positioning System. This would qualify U.S. submarine-launched missiles as part of a counterforce capability to knock out Soviet military targets.



The Navstar Global Positioning System uses satellites that will allow submarines and other users to get a highly accurate reading of their own locations, crucial for the accuracy of submarine-launched ballistic missiles.