

GPS AND SELECTIVE AVAILABILITY TALKING POINTS

GPS:

- The Global Positioning System (GPS) is a dual-use system providing highly accurate positioning and timing data for both military and civil users.
- GPS is a global utility that the U.S. has committed to provide free of direct user charges worldwide. Both the President and Congress documented this commitment in the Presidential Decision Directive issued in 1996, U.S. Public Law in the 1998 National Defense Authorization Act, and our pledge to international organizations such as the International Civil Aviation Organization and International Maritime Organization.
- GPS is a satellite constellation that transmits timing and location information. Developed by the Department of Defense as a military navigation system, the dual use nature of the system has found widespread applications in the civil, commercial and scientific communities throughout the globe.
- GPS has brought significant benefits to users in the U.S. and around the world, in diverse applications including air, road, rail and marine navigation, precision agriculture and mining, oil exploration, environmental research and management, telecommunications, electronic data transfer, construction, recreation and emergency response. There are many, many more.
- More than 4,000,000 GPS receivers are thought to be in use. The market for GPS applications has been growing dynamically and is expected to reach \$8 Billion in 2000 and \$16 Billion in 2003. The U.S. and world economies are increasingly dependent on GPS.

Differential GPS:

- DGPS is a technique where GPS signals at a reference station are compared to idealized signals based on a known reference station position. Based on the discrepancy, GPS signal correctors are broadcast, and used by suitably equipped GPS receivers to remove the common error sources. DGPS accuracy depends upon many factors, including distance from the reference station, and provides 1 to 7 meter positioning.
- The discontinuation of Selective Availability will not eliminate the need for DGPS systems. The decision whether to use unaugmented GPS or DGPS depends upon an individual user's application and requirements for accurate positioning. For example, Federally-operated DGPS systems provide integrity monitoring and alerts, and support many applications involving safety of life, such as aviation and maritime transportation.

GPS Modernization:

- Last year, Vice President Gore announced that the fiscal year 2000 budget would include funding for new civil and military capabilities on GPS. The new civil features include two

new GPS signals. The first of the two new signals is similar to the existing GPS civil signal but will be transmitted at 1227MHz. Using two signals will enable civilian user equipment to compensate for signal transmission errors that occur as GPS signals propagate through the atmosphere.

- For many applications, the new signal at 1227MHz will provide significant benefit; however, to meet the demands of safety-of-life applications, a third, more robust signal will be introduced that has been specifically designed for aviation applications. This signal will be located in the Aeronautical Radionavigation Service (ARNS) band, providing additional protection from interference.
- The new signal structure will offer opportunities for development of new applications and new user equipment in an area where US industry is the world leader.
- Along with the improvements that the public will have access to, the satellites will be modernized to provide additional protection for military users of the GPS system. These improvements will make it much more difficult to interfere with military users of GPS.
- Based on current satellite replacement predictions, the first satellite with modernized features will most likely launch in 2003.

GPS Management and Budget:

- An Interagency GPS Executive Board, co-chaired by the Department of Transportation and the Department of Defense with representatives from across the government, manages GPS and its commitments as a national asset. This board oversees implementation of GPS policy as well as modernization.
- The President's 2001 budget requests a total of \$0.5 billion in FY 2001 for Global Positioning System maintenance and modernization. This continues the modernization that was approved last year and further advances modernization by incorporating some of the new features on up to 18 additional satellites that are awaiting launch or are in production.
- In this year's budget we consolidated funding for civil and military GPS modernization in the Department of Defense budget request. Civil interests will still be protected through the IGEB processes and a new Memorandum of Agreement between DOT and DOD. The MoA will define the process by which the civil community will work with the Department of Defense to ensure that unique civil, commercial and scientific aspects of GPS will be assessed, approved, and funded.
- Some aspects of the modernization program are still being defined, because we want to be very sure we can sustain the constellation while we modernize, and that we bring the new military capabilities into GPS in the smartest way. However, we do not expect near term changes to the strategy for implementing the new civil signals.

GPS Global Implications:

- Our modernization plans for GPS have worldwide applicability, but also require worldwide support. One of the new signals will be a second safety of life signal, for which we will be seeking an allocation at the World Radio Conference later this year. This signal will be particularly useful for air navigation and safety, in particular for areas of the world that do not have extensive ground based navigation systems.
- We believe that all users, and their governments, have a stake in the future of GPS. We are working for international support to ensure GPS signals will be protected from interference and available to all users who rely on them.

Selective Availability (SA):

- SA is a technique to reduce the accuracy of unaugmented, single-receiver GPS measurements. This is accomplished by altering (or "dithering") the GPS satellite clock signals, and by modifying orbital elements of the broadcast navigation message. These alterations are done in a coded fashion, and could be removed by authorized users. This alteration causes horizontal positional errors on the order of 100 meters (95%), and varies in a manner that prevents rapid averaging of positional data. [Selective Availability is the intentional degradation of the civilian signal.]
- SA was implemented on March 25, 1990 on all GPS Block II satellites. The level of SA is adjustable. SA was set to zero in September 1990 in support of Operation Desert Storm, and was returned to standard level on July 1, 1991. With minor exceptions, SA has been in place since these dates.

Discontinuation of SA:

- The 1996 Presidential Decision Directive, U.S. Global Positioning System Policy, stated the President's intention to discontinue SA by 2006. The directive mandated yearly reports to the President, beginning in 2000, regarding the continued use of SA. To support this determination, the Secretary of Defense, in cooperation with the Secretaries of State, Transportation, and Commerce, and the Director of Central Intelligence, along with the heads of other appropriate departments and agencies, provided an assessment and recommendation on continued SA use.
- The first report has been forwarded to the President through the NSC and OSTP. After careful examination the President has decided to discontinue Selective Availability at midnight GMT on May 1, 2000. This decision will provide the highest unaugmented accuracy possible with the existing GPS constellation to all civil users of GPS.
- Discontinuing the use of SA is expected to improve the accuracy of GPS for civilian users from hundreds of feet to tens of feet. This performance boost will enable GPS to be applied in its most basic form to a variety of civilian activities -- land, sea, air, and space -- where it could not previously. The performance will vary depending upon the particular receiver and the level of solar disturbance of the ionosphere.

- The increased performance of GPS, which is broadcast free of charge to the entire world, is expected to accelerate its acceptance and use by businesses, governments, and private individuals around the globe. This should lead to increases in productivity, efficiency, safety, scientific knowledge, and quality of life. It should also fuel the continued growth of the global GPS market, currently estimated at over \$8 billion, as well as the market for geographic information services in general.
- The elimination of Selective Availability will not eliminate the need for Differential GPS systems. DGPS systems, such as the U.S. Coast Guard's maritime beacon system and the FAA's Wide Area Augmentation System (WAAS), will continue to provide accuracy enhancements to the civil GPS services which will exceed the performances available from the basic GPS civil service without SA. These DGPS systems also provide other enhancements to the basic GPS such as system Integrity. These services are especially applicable to safety of life applications such as maritime and aviation transportation applications.
- It is not the intent of the US to ever use SA on the civil signal again. To ensure that potential adversaries do not use GPS, the military is dedicated to the development and deployment of regional denial capabilities in lieu of global degradation through SA.

Listed below are several examples of the civilian benefits derived from discontinuing SA:

Transportation Benefits

- *Car Navigation:* Previously, a GPS-based car navigation system could drift off course by one or two blocks, leading to erroneous guidance and directions. In areas where multiple highways run in parallel, SA made it difficult to determine which one the car was on. Terminating SA will eliminate such problems, leading to greater consumer confidence in the technology and higher adoption rates. It will also simplify the design of many value-added systems, lowering their retail cost.
- *Fleet Management:* Companies managing fleets of vehicles such as taxicabs, buses, commercial trucks, and rental cars will enjoy increases in efficiency as their ability to track and route individual vehicles improves. This will be especially important in crowded parking lots and railroad yards, where SA previously made it impossible to identify specific vehicles, tractor-trailers, or boxcars using GPS alone.
- *Package Delivery:* Message courier services and package and cargo companies will also benefit from better real-time tracking and management of assets. Basic GPS will give couriers and even pizza delivery services the ability to navigate all the way to a person's door on a building with multiple entrances.
- *Aviation:* The removal of SA will improve navigational accuracy for general aviation (non-commercial) pilots using unaugmented GPS receivers. This increased accuracy improves safety by aligning pilots more closely with the runway during instrument approaches, and

improving the accuracy of terrain awareness and warning systems and moving map displays that provide situational awareness to the pilot.

- *Fisheries Enforcement:* The U.S. commercial fishing fleet currently relies on the Loran-C Navigation system because of its excellent repeatable accuracy and because it provides greater coverage than the maritime DGPS network. The improved basic GPS will provide commercial fishermen with an even better repeatable accuracy over an unlimited area. In addition, both fisherman and law enforcement agencies will share a common, higher accuracy navigation system, possibly leading to reduced violations of fisheries boundaries, exclusive economic zone issues, customs, etc.
- *Highway/Waterway Maintenance:* For the first time, many state and federal transportation authorities and the Army Corp of Engineers will have access to high-accuracy, cost-effective basic GPS receivers for highway and waterway maintenance and management.
- *Nationwide DGPS:* In remote locations where establishing Nationwide Differential GPS services is neither required nor cost effective, the improved performance of basic GPS may serve many user functions that would otherwise need DGPS coverage. This flexibility allows for a more cost-effective network for the government and the nation.

Emergency Response Benefits

- *Firefighter/Police/Ambulance Dispatch:* Reducing the positioning error from 100 meters to nearly 10 meters will significantly improve the ability to pinpoint the location of fires, crime scenes, and accident victims and route emergency crews to the scene. In such life-threatening situations, every second saved counts.
- *E-911:* The FCC will soon require that all new cellular phones be equipped with location determination technology to facilitate “911” call responses. With the removal of SA, GPS may become the method of choice for implementing the E-911 requirement. A GPS based solution might be simpler and more economical than alternative techniques such as radio tower triangulation, leading to lower consumer costs.
- *Search and Rescue:* With SA turned off, GPS will become a more powerful and compelling tool that will help rescue teams search for individuals lost at sea, on mountains or ski slopes, in deserts, and in wilderness environments.
- *Roadside Assistance:* Disabled cars equipped with integrated GPS systems will be able to more accurately transmit their location, speeding response times for tow trucks and other services. With SA zeroed, the car’s GPS signal will identify which side of the road the car is on – an extremely important distinction the local road, or interstate freeway, is divided by a concrete divider.
- *Emergency Preparedness:* Relief agencies such as the Federal Emergency Management Agency (FEMA) will be able to use basic, standalone GPS receivers to map out geographical

features such as flood plain boundaries, levees, and drainage ditches -- a task that previously required expensive and labor intensive GPS augmentation techniques.

Land Benefits

- *Mineral and Resource Exploration:* In many cases, removal of SA will eliminate the need for costly differential correction equipment and services as companies explore remote, uncharted geographic regions for minerals, oil, coal, and other natural resources.
- *Resource Management:* Agencies such as the Bureau of Land Management and the Forest Service will be able to apply basic GPS to the management of wetlands, forests, and other natural resources without the use of costly augmentation systems or, in some cases, tightly controlled, highly burdensome military receivers. This should reduce government costs and increase productivity. Similarly, paper and lumber companies may be able to use basic GPS to identify and manage individual trees in a forest without costly differential correction equipment and services.
- *Wildlife Tracking:* Scientists and other individuals seeking to observe and/or tag animals in the wild will have a more powerful positioning and tracking tool at their disposal. This includes zoologists, ecologists, marine biologists, birdwatchers, and communities seeking to safeguard themselves from animal threats (e.g., wolves).

Space Benefits

- *Satellite Tracking:* NASA satellites using GPS receivers will be able to determine their orbit positions more accurately. For example, satellites using GPS Standard Positioning Service signals, orbiting at around 700km altitude, will be able to go from the present 100m level of accuracy for orbit position determination to about 10m accuracy in near real time. This will enable improvements in science observations and satellite operations.
- *Satellite Data Processing:* The processing of science data using differential GPS techniques, such as is done in the rapid production of El Nino weather maps, can be accomplished more economically. The increased accuracy of the signals received at NASA's Global GPS Network will allow reduction in the rate of data collection thus reducing communication cost for data used to generate science results from satellites such as TOPEX/Poseidon.
- *Future Space Station Operations:* Among the many benefits that may be realized by space users of GPS in the future will be simplification of systems supporting critical rendezvous operations and navigation of "Free Fliers" near the International Space Station. The elimination of Selective Availability may enable the performance of early satellite rendezvous operations to be greatly simplified and may significantly enhance the performance of relative GPS during close in maneuvering operations.

Recreation Benefits

- *Hiking, Camping, and Hunting:* With up to 10 meter accuracy, hikers, campers, and hunters will be able to navigate their way through unmarked wilderness terrain with greater confidence and safety. And for the first time, users will find that the accuracy of GPS exceeds that of the commonly used U.S. Geological Survey (USGS) quad maps.
- *Boating and Fishing:* Recreational boaters without DGPS equipment will enjoy safer, more accurate navigation around sandbars, rocks, and other obstacles. Fishermen will be able to more precisely locate their favorite spot on a lake or river. Lobster fishermen will be able to find and recover their traps more quickly and efficiently.

Timing Benefits

- *Increased Adoption of GPS Time:* In addition to position information, the accuracy of the time data broadcast by GPS will improve to within 20-30 billionths of a second. This increased level of precision may encourage continued adoption of GPS as a preferred means of acquiring Universal Coordinated Time (UTC) and for synchronizing everything from electrical power grids and cellular phone towers to telecommunications networks and the Internet. Using GPS as a time source is far less costly than purchasing and maintaining high precision atomic clocks.

Need for Higher Accuracy

- Even with SA turned off, GPS alone will not meet all users needs. For users with higher accuracy, availability, and integrity requirements, such as commercial airlines, ships navigating within harbors, railroads performing precise train control, and surveyors, GPS will still need to be augmented with high-fidelity error correction systems based on differential GPS (DGPS) technology. But for the many other users listed above, the elimination of SA will enable the most inexpensive, standalone GPS receivers to meet their needs.