SUMMARY RECORD OF THE TWENTY-SIXTH MEETING OF THE CIVIL GP SERVICE INTERFACE COMMITTEE (CGSIC)

Sponsored by: The office of the Assistant Secretary for Transportation Policy (OST/P-7) and the United States Coast Guard (USCG) Navigation Center (NAVCEN).

Dates: September 11, 1995, Full Committee
September 12, 1995, Timing Information Subcommittee
September 12, 1995, Reference Station Information Subcommitte
September 12, 1995, International Information Subcommittee

Location: Spa Hotel, 100 North Indian Canyon Drive, Palm Springs, CA 92262.

Meeting Chair: CAPT Robert J. Wenzel, Commanding Officer, Coast Guard Navigation Center.

CGSIC Chair: George Wiggers, Office of the Assistant Secretary for Transportation Policy (OST/P-7).

Agenda: The agenda for the 26th meeting is included as Appendix A.

Attendance: One hundred twenty people preregistered for the meeting. A list of registered attendees is included as Appendix B.

MEETING CHAIR REMARKS

George Wiggers, OST/P-7.

Mr. George Wiggers introduced himself and welcomed the attendees at 0845. Mr. Wiggers introduced CAPT Robert Wenzel as the Commanding Officer of NAVCEN and Deputy Chair, CGSIC. The committee has been a vital link between the government and civil sectors. Many of the issues discussed, during the past meetings, are highly sensitive and certainly all have been important.

There were no changes to the 25th Meeting Summary Report.

GPS INTERAGENCY ADVISORY COUNCIL

CAPT Lewis Lapine, NOAA Director, National Geodetic Survey.

Captain Lapine stated that the GPS Interagency Advisory Council (GIAC) is a committee under the DOT POS/NAV Committee that concentrates on GPS Federal Sector Activities. The Council divides its interest between positioning issues, some navigation issues (although most navigation issues are within the CGSIC), and timing issues. In his role, as head of the GIAC, Captain Lapine attends the OST/P policy meetings, the CGSIC meetings, and many professional organization meetings, to understand what is going on and the potential impact, not only to federal agencies, but all of our constituents as well. The GIAC is organized parallel, in nature, to the CGSIC charter. M. K. Miles, U.S. Army Corps of Engineers, is the vice chair and convenes the executive board when necessary.

Captain Lapine stated that the GIAC is housed within the Federal Geodetic Control Subcommittee (FGCS), having its own charter, and is actually a subsection of the FGCS. The

FGCS is one subcommittee under the Federal Geographic Data Committee (FGDC), which is headed by the Department of Interior, and is chaired by Secretary Babbitt.

The GIAC has held two meetings since its initial charter formation. The charter was widely distributed mainly to federal agencies that participate directly under GIAC. Currently, in Washington, D.C., this charter was incorporated into the revised charter for the FGCS of the FGDC. It was approved by the FGDC Representative Agencies Coordination Working Group on September 12, 1995.

The first general membership coincides with the FGCS meeting, and also, will be held at the Corps of Engineers headquarters in downtown Washington, D.C. Invitations were sent to 65 individuals, representing 14 federal agencies, requesting their participation in this meeting.

The GIAC has acted on two policy issues thus far. First, the GIAC sent an accuracy policy statement to the DOT POS/NAV Committee containing its concerns on the Coast Guard's Differential GPS System advertised accuracy and integrity of 20 meters. They believe that system is operating at the 2- to 5-meter level and the accuracy level discrepancy creates a lot of confusion. Many of the users, who use these government systems, need a 2- to 5-meter statement. This is particularly important for harbor and river navigation, and for dredging and hydrographic survey operations. The second issue addressed Selective Availability (SA) concerns and whether SA should remain on or turned off. This issue was approached from a non-defense point of view by civil federal users. These two subjects will probably be presented for the first time to the DOT POS/NAV Committee Meeting, scheduled for late September, in order for policy statements to be proposed for review to all users.

In response to a question, Captain Lapine stated that the GIAC has not had any of the Department of Defense members openly participate in any of the discussions on SA.

Captain Lapine added that the GIAC makes recommendations and provides information to the DOT POS/NAV Committee. Since the GIAC is not a policy generating organization, it does not make public statements on policy. It is up the POS/NAV Committee to act on the information and set policy through DOT.

A GPS Information Exchange Workshop is planned, in early 1996, as a result of the questionnaire circulated throughout NOAA. Nearly 100 responses were received from people using GPS. Many of the things that they are doing could use the same base stations, reference stations, or standard specifications that we are promulgating for surveying and timing.

The National Weather Service (NWS), the largest component in NOAA, wants to look at GPS noise, which is the ionospheric refraction, and synchronize their signal to gather meteorological data. The NWS believes they can measure total water vapor content, for the atmosphere, which is one of the prime variables in the production of daily weather forecasts. The NWS is so sure this is going to work, they are planning to install 1,300 geodetic-quality reference receivers through the United States. The NWS believes this number of stations are needed in order to statistically sample water vapor for nationwide weather prediction. If they were to proceed with their plan, those receivers could serve many different purposes.

Captain Lapine's viewgraph is included as Appendix C.

Captain Lapine then turned the podium over to Pam Fromhertz.

Ms. Pamela J. Fromhertz, National Geodetic Survey.

The Federal Geodetic Control Subcommittee Instrument Working Group will be conducting an airborne kinematics GPS test, starting October 16th in Springfield, Ohio, over the Ohio Department of Transportation Camera Calibration Test Range. The Instrument Working Group has conducted many tests for both static and kinematics ground surveys. Since GPS data has had such an impact over the reduction of ground control, in a photogrammetric application, it was appropriate for the Instrument Working Group to begin such airborne testing.

This will be the first photogrammetric application test that the Instrument Working Group has conducted. The manufacturers will provide solutions for the camera exposure stations, which will be integrated into an aerotriangulation solution, and compared to known targets.

The test was open to all manufacturers with dual frequency capability, able to obtain centimeter accuracy, and capable of receiving the TTL signal from the camera that signifies when an exposure is taken. Data will be collected at one second intervals from a ground base station and from receivers in the aircraft and post-processed differentially. Data collection will start prior to departure and continue until the aircraft has landed and remained stationary for at least 5 minutes. Thr three manufacturers, who will be participating in this test and meet the above requirements, are Ashtech, Leica, and Trimble.

The NOAA Citation Jet II will be the operating platform with a Wild RC-30 camera. The receivers will collect data simultaneously from each antenna. An antenna splitter will be used, in the aircraft, off the FRPA II antenna, and on the ground, off of a choke ring antenna. The final flight plan will be determined tomorrow. In addition, the manufacturers, if they desire, will setup their own independent systems. For the actual test in October, the same ground configuration will be used at the airport.

Due to the complexity of the logistics, we decided to have a pre-test, which will be conducted tomorrow at the Palm Springs Airport. This will provide the manufacturers with an opportunity to examine the data and be sure there is no signal interference or degradation due to the antenna splitter or from other receiver data.

Captain Lapine added that NOAA has used this process, for over two years now, with continuous repeatability, at the subdecimeter positioning level, for the camera exposure stations. That technology requires about one third of the amount of ground control previously required. CAPT Lapine then invited the attendees to see the aircraft, which is set up for kinematics GPS photogrammetry.

Ms. Fromhertz's viewgraphs are included as Appendix D.

TIMING SUBCOMMITTEE REPORT

Mr. David W. Allen, Allen's Time.

One of the problems, with the timing system, is a way to check it when you get to the geonanosecond level. They are looking at other systems, such as time transfer and GLONASS, to compare some of the timing experiments with GPS.

They are also working with the receiver manufacturer design focusing on the critical element for timing. For navigation, the timing cancels, in the solution, inside the receiver. Unfortunately, for timing, they need to know absolute delays to the receiver which is a difficult problem.

NIST has now declared operational their primary standard, NIST7. This is now the most accurate clock in the world. Operating at a 10^{14} absolute accuracy, its stability is one part in 10 to the 15th. To compare this clock, with another one somewhere else, is extremely difficult.

In October, there will be a conference in Boston, where there will be several opportunities showing accuracy potential at 10^{15}. Some of the physics have already been done, for standards in the optical region, which has potentials for 10^{18}. GPS and other techniques just aren't accurate enough to measure this. The International Timing Community has a goal of one nanosecond working through this. There is a way to test it by going around the globe, from station A to B in a common-view, B to C and C to A and that should add up to zero. That number currently adds up to about 4 nanoseconds. So, there are systematics, of that order, they can not get rid of.

The Millisecond Pulsars People have indicated their desire to tie into the new receivers that are made for telecommunications. They are using common-view techniques and prefer to have something real-time. Common-view is calculated after the fact. That need could potentially be fulfilled very soon.

NASA JPL DSN space network has very demanding requirements for the future. GPS common-view has been used, but that needs to be improved. They have multipath problems at some of the stations, where their 64 meter antennas wave around, acting as reflectors to the GPS antennas, creating a significant problem. Experiments with them will hopefully reduce those problems.

NIST has a Global Time Service they support in the telecommunication arena, which is growing very rapidly. Enhanced GPS is valuable for telecommunications and for those people who need time now. Many receivers using this technique are being manufactured and deployed throughout the world. The power industry is still working to use GPS to coordinate power control grids.

Last Tuesday, the GPS program did some timing tests and when they came back from those tests, they could not upload successfully to PRN12, the only remaining Block I satellite. As a result, the clock drifted off as much as 3 milliseconds in a course of a few days. The satellite thought it was healthy, so the timing receivers were looking at PRN12 as a healthy satellite. Unfortunately, many of the receivers wouldn't even lock. When this was discovered, the timing community called 2SOPS, asking if they could get an upload to the satellite, declaring it unhealthy. The Air Force was very cooperative, and as soon as they could get an upload, all the receivers came back on.

Mr. Allen's viewgraphs are included as Appendix E. A paper titled "Report on Data GLONASS Common-View (Residuals) from 3S Navigation) is included as Appendix F.

Dr. Lewandowski, BIPM, France.

Dr. Lewandowski first reported on a GLONASS common-view experiement. Since June 28, 1995, three GLONASS R-100/10 time receivers, manufactured by 3S Navigation Company from Laguna Hills, California, are operating at 3S, at BIPM in Sevres, France, and USNO in Washington, D.C. First evaluation gives sigmas of about 8 ns for the three involved time links. It is slightly larger from sigmas of about 6 ns for GPS common-views (see figure in Appendix G). It can be explained by a poor modelling of ionospheric delay for GLONASS and lower quality of GLONASS broadcast ephemerides.

The second topic reported on by Dr. Lewandowski concerned Two-Way Satellite Time and Frequency Transfer (TWSTFT). An experiment using a geostationary INTELSAT satellite is in progress since January 1994. It involves 6 European and 2 U.S. time laboratories. The goal for this technique is to provide a sub-nanosecond time transfer. Present comparisons of TWSTFT technique with GPS common-view shows differences of peak to peak 20 ns (see figure in Appendex G). This is under investigation. The sensitivity of GPS time receivers to temperature is certainly one of the causes of this discrepancy.

Dr. Lewandowski's viewgraphs are included as Appendix G.

REFERENCE STATION SUBCOMMITTEE

Mr. Karl Brown, Reference Station Information Subcommittee, National Biological Service.

Mr. Brown stated that, since the last meeting, the subcommittee worked on the inventory methodology, which is published in the minutes of the March meeting. It is a nine step methodology containing the station location, integrity, station monitor, the available services, etc. The American Congress of Surveying and Mapping, an ad hoc working group, reviewed the inventory methodology for reference stations and found it to be quite complete and suitable. Mr. Brown added that being able to inventory this population seems to be a somewhat impossible task at this point.

The real reason for interest in the reference stations is the differential correction. It seems that the user groups, who want to obtain GPS services, are more interested in where they can get a good signal and a good correction, so that they can go on about their work. Contacting a reference station and getting the data from them is really just a logistical exercise. What they really want is a better position. Since the main thrust of the subcommittee is to provide worldwide information on reference stations, it might be prudent for the Reference Station Subcommittee to combine with the International Subcommittee, and to join forces for that DGPS

Information undertaking. The desire is to have this information available over the INTERNET, ideally on a web page on the World Wide Web. This will be addressed during the subcommittee meeting on the next day.

INTERNATIONAL INFORMATION SUBCOMMITTEE

Mr. George Preiss, Olsen Norway AS.

A year ago, he reported on the International Information Subcommittee (IISC), survey of European industries, to determine whether there was a desire to form a European Industry Council. The draft report, which was issued in Salt Lake City last year, was a preliminary report, because there were indications that some companies had not received or returned the survey. More completed surveys were received, but they did not significantly change the statistics. The final report will soon be delivered to the Secretariat.

Norway Industry will meet on the 22nd of September, with the possibility of going final, on the formation of a Norwegian GNSS Industry Council Foundation.

Some years ago, the IISC issued a document called the "Information Package". It was a listing of the various bulletin board services that were in existence at that time. Since then, the information super highway and the appearance of INTERNET is available to the private user. The IISC needs to examine the impact of this development on the dissemination of operational GPS information to users worldwide. One specific question is, should we continue to support the recommendation that individual nations set up their own bulletin board services, or should we change our recommendation to say they should rely on having or creating a few main INTERNET web services. These services should be recognized and authoritative, on the grounds if you have a telephone you can get into a service fairly quickly and easily. If that is to be the case, we need to consider a few standards, including reducing the number of graphics, because they take forever to download.

In December, the IISC has planned a meeting in Amsterdam. The objective is to bring what is happening in the European community, to those who cannot make it to the regular meetings. The Secretariat has issued a questionnaire, throughout Europe, to the national points of contact and has received enough positive responses to suggest that there is a requirement for such a meeting to be held.

More discussions will be held on the above points at the subcommittee meeting.

EUROPEAN COMMISSION

Mr. Luc Tytgat, Directorate-General for Transport.

Abstract

The European Commission, the Council and the Parliament have raised, in various communications and resolutions adopted in 1994, the growing importance of space technology and its civil applications. Considering that the latest means of determining positions, by satellite, form a phenomena, which will revolutionise numerous activities concerning navigation and the identification of a precise location, the European institutions will do everything necessary to ensure that Europe will not be held back in developing the crucial technological capacity for its growth, thus creating and promoting markets for new equipment and services.

In this context, a GNSS High Level Group has been set up, steered by the European Commission Transport and Telematics Directorates (DG VII and DG XIII). It is composed of representatives from national European governments, users, telecommunication operators, the relevant international organisations, particularly the European Space Agency, ICAO, EUROCONTROL, and Industry. The main task of this High Level gGoup is to ensure that activities undertaken in Europe, in the satellite navigation field, tend toward the same end. The High Level Group has also been created to assist the European Commission in initiating and supporting work for the design and the organisation of GNSS for civil use, taking into account all the institutional, legal and organisational problems including, of course, those due to the required inter-regional

cooperation (especially with non-European countries).

For the time being, three organisations are already strongly involved in the European Contribution to a GNSS:

- European Space Agency
- EUROCONTROL
- European Commission

In order to ensure coherency in their work and to benefit from their complimentary actions, they have drafted an agreement establishing cooperation between the three parties.

As the GNSS is an international concept and as part of its core tasks, the European commission places great importance on the relationship with the rest of the world. In this field, discussions have already been initiated with Russia, US, Japan, and Africa.

GNSS actions have already been undertaken by the European Commission. They concern the launch of research and development activities related to GNSS 1 as well as GNSS 2, and also some necessary support actions.

Introduction

Satellite Navigation and Positioning Systems offer many advantages over other existing systems, such as all weather operation, constant accuracy all over the world, they can be used by an unlimited number of users, and they are going to be essential in a wide spread of different kinds of applications.

They offer a simple and effective mode of navigation for all forms of transport from road and railway to maritime and civil aviation. At the same time, the positioning function is of great interest to geodesy, as well as, for many other specific applications in agriculture, fishing, off shore petroleum, gas exploration and so on.

Existing systems do not satisfy all civil requirements, this is mainly due to a lack of integrity, of accuracy, or because they are controlled nationally.

Article 129C of the European Union Treaty gives the Commission a mandate to draw out the key issues relating to the construction of a Trans-European Network. From the commission's point of view, satellite navigation and positioning services are a part of the Transport and Telecommunications Trans-European Networks.

The European "White Book" on Growth, Competitivity and Employment contains a project list, which takes into account, satellite multimodal positioning systems which are essential for air, land, and maritime traffic management constituting, undoubtedly, the most important element of the European Radionavigation Plan.

The "Sages" Report, relating to the air transport industry situation, also highlighted the necessity to "speed up" the implementation of satellite technology to contribute to the improvement of European Air Traffic Management.

Within a "Community and Space" report, the European Parliament has recently adopted a resolution on space policy for the next decade. This report specifically demands urgent action in the field of satellite navigation. It also asks the commission to build a European strategy, in such a way, to allow European industry to be involved in the implementation of a Global Navigation Satellite System and prior to that, to guarantee access to the existing satellite navigation systems.

In 1994, the European Union first launched the necessary actions to support the development of a GNSS.

GNSS Council Resolution

To draw attention to this new technology which is becoming essential in the framework of all future transport developments and more generally, in the framework of all navigation, timing, and positioning applications, the Commission passed a Communication to the Council in June 1994.

This communication suggests a European contribution to satellite navigation systems and a strategy for the implementation of a European contribution to a GNSS.

This strategy consisted of a list of actions to be considered in the context of 2 major European Union programmes:

- The Trans European Networks and the
- 4th Framework Programme.

In December 1994, convinced of the economical, political, and technical importance of Satellite Navigation and Positioning Systems, the Council welcomed the Commission's initiative in a Resolution.

This resolution invites the Commission:

- to define the requirements of all potential users and describes the resulting possibilities;
- to initiate or support work on the development and implementation of a European contribution to GNSS 1;
- to initiate and support, in parallel with GNSS 1 activities, the preparatory work needed for the design and the organisation of a GNSS 2, for civil use. This should be compatible with GNSS 1 and should be operated according to international guidelines on an independent and, if possible, private enterprise basis. This should make it possible to use the results of GNSS 1 research and development work immediately.

Morever, this Council Resolution welcomes the setting of a High Level Coordinating Group, composed of representatives from national governments, users, telecommunication operators, industries and relevant international organisations, particularly the European Space Agency, EUROCONTROL and ICAO.

GNSS High Level Group

As defined by the GNSS Council Resolution mentioned above, the GNSS High Level Group mandate is composed of 2 major tasks:

- The GNSS High Level Group will ensure that activities undertaken in Europe, in the Satellite Navigation field, move towards the same end; and, in particular, will help to establish a common approach of the international organisations dealing with GNSS.
- The GNSS High Level Group will assist the Commission in the development and updating of a GNSS Action Plan. They will indicate the different stages required, (taking into account national programmes), for the introduction of a European complement to a GNSS for civil use. This Action Plan will thus list all issues, including user requirements consolidation, as well as other legal, organisational and institutional issues.

These issues include:

- the examination of the financing possibilities and necessary resources for the implementation of this system;
- the need to cooperate closely with the relevant international organisations, and in particular ICAO, IMO, EUROCONTROL, the European Space Agency, users, industry and telecom operators;
- the examination of the possible activities and potential contributions for the private sector;
- the examination of the related legal issues.

This Action Plan will also provide a framework for all technical work that needs to be undertaken in the GNSS field in Europe.

To help the High Level Group fulfill its task effectively and efficiently, it has been structured into 3 different entities with different tasks and participants allotted to each:

- *The Senior Official Group*
- *The Conference Group*
- *The Ad Hoc Working Groups*

The *Senior Official Group*constitutes the central group of the High Level Group and offers guidance and advice. It is the core group and is positioned at governmental level with representatives from Member State Administrations and the relevant governmental organisations, particularly European Space Agency and EUROCONTROL. It holds discussions and gives advice to the High Level Group on tasking, working arrangements and tentative schedule. It also reviews and gives

critiques on documents issued by the Commission (e.g., Guidelines for the Drafting of the GNSS Action Plan).

The *Conference Group*, representing the plenary composition of the High Level Group, is composed of members representing a large variety of GNSS stakeholders, from all potential users to all potential service providers, not forgetting legal actors and regulators. It naturally, also, includes the Senior Official Group representatives.

Therefore, the attendees of the Conference Group meeting will come, as defined by the Council Resolution, from Member States as well as from international organisations, user organisations, service providers, service operators, industry, and so on. Non-EC representatives could be invited ad hoc (i.e., to discuss the issue of inter-regional cooperation).

The Conference Group will receive all information about progress and issues associated with European GNSS activities. It will offer strategic advice on the High Level Group actions that are required, and will also be responsible for the dissemination of this information.

The *Ad Hoc Working Groups* are tasked to draft a specific, thorough and exhaustive proposal intended to aid the Commission to complete the GNSS Action Plan. The Ad Hoc Working Groups will be composed of experts who are well aware of the groups task. These designated experts should have complimentary fields of competence which will guarantee the exhaustiveness of the Action Plan.

Once these experts begin participating in the Ad Hoc Working Groups, they will have to become "impartial", and should not represent a state, organisation or any other body.

Following the issues to be raised in the framework of the GNSS Action Plan, the Ad Hoc Working Groups will probably be arranged in function of the following items:

- User requirements (taking into account cost benefit issues);
- Exploitation framework (dealing with organisational issues and financial scheme);
- Inter-regional cooperation.

A target date for the Commission to deliver the GNSS Action Plan, using the Ad Hoc Working Groups contribution, and taking into account the High Level Groups recommendations, is before the end of this year or early 1996.

Tripartite Agreement

Prior to the existence of a GNSS Action Plan, working structures have been set in place and actions have been launched.

Thus, a Tripartite Agreement between the European Space Agency, EUROCONTROL and the European Commission has been drafted to instigate a legal and institutional framework. This has been set up to ensure a European contribution to GNSS and to be ready, in time, for the worldwide user community.

In practice, this concerted effort is aimed at placing Europe in a position to allow provisions for a satellite navigation service which will, as far as is practical, satisfy the present and foreseeable requirements of all civil users for operational use, independent of other means of radionavigation.

The contribution of the 3 parties may be summarised as follows:

- the main contribution of the European Commission is to provide high level political support for the required activities; consolidate and coordinate the requirements of all kinds of users; and validate the resulting system against such requirements; also sustain the implementation of the infrastructure.
- The European Space agency will be responsible for the system development and above all, will be in charge of the system operation up until 1999, when a selected service provider will replace them.
- EUROCONTROL will deliver civil aviation user requirements and, through tests and validation, will determine whether the system meets these requirements. It will also support the Joint Aviation Authorities in its campaign to certify GNSS for use in civil aviation.

External Relationships

The European element of a GNSS will be a regional contribution to a global system. To ensure effectiveness and because people need to travel over European Union frontiers (using the same navigational means), inter-operability with other relevant GNSS contributions is a strong requirement.

The coverage, of the service, offered by the European contribution to a GNSS will certainly exceed the European Union frontiers to other neighboring countries or continents. Then, it could be appropriate to place some components of the ground segment outside of the European Union. It may be interesting to extend the monitoring network of the space segment in non-European regions covered by the European contribution to a GNSS. And last but not least, the existing satellite navigation and positioning systems (from Russia and USA) will surely be a part of the GNSS.

The aspects mentioned above already demonstrate the necessity for cooperation with non-EU countries. To that end, the European Commission strongly supports the industrial cooperation, notably with Russia, on the development of combined GLONASS/GPS and CHAYKA/LORAN-C receivers. Considerations are also underway, between the European Union and Russia, to extend the GLONASS/GPS surveillance network in order to improve differential corrections and integrity information quality.

The European Union is also in contact, at a very senior level, with the USA and is pushing very hard to institute a frank cooperation at a global level, and firstly to ensure interoperability between the respective GNSS contributions.

During approval discussions (April 95) at Ministerial Level, the European Union and Japan agreed to start to cooperate in the field of GNSS, and to identify an area of cooperation.

The European Union is also in discussion with Africa and is examining the possibility of installing surveillance stations, on this continent, to improve GNSS efficiency.

Main European Instruments

Satellite Navigation and Positioning Systems constitute a natural part of Transport and Telecommunication Trans-European Networks, in accordance with article 129 of the Maastricht Treaty, respecting efficiency principals of safety and limited impact on environment.

The 4th Framework Programme on research, technological development, and demonstration is another instrument. Both these instruments will contribute to the definition of user requirements, institutional and organisational analysis, and design, development, implementation and exploitation of Global Navigation Satellite Systems.

Preparatory Actions

Preparatory actions have already been launched, in early 95, and they mainly consist of:

- A study to devise a European Radionavigation Plan;
- A study on institutional issues;
- The creation of a GNSS European Office.

The European Radionavigation Plan will enable the radionavigation systems, in use, in the areas covered by members of the European Economic Area, to be rationalised and harmonised as to provide an efficient service in a cost effective manner for both governments and users.

This study will:

- determine the extent to which radionavigation systems are used for multimodal applications;
- determine the present and anticipated multimodal user requirements;
- determine the radionavigation systems currently is use in this area, those in the process of being introduced and those which are planned;
- identify key aspects and possible actions to achieve the inter-operability of the systems for the following periods:
    - 1995 - 2000
    - 2000 - 2010
    - After 2010

- identify necessary research and development activities;
- anaylse the methods, in use, for funding radionavigation systems and recommend a method which could be applied by all members of the European Economic Area;
- recommend the extent to which private radionavigation systems should be taken into account.

The Institutional Issues Study concerns the organisational aspects, of the application, of satellite navigation systems to transport. Firstly, this study analyses the application of satellite navigation, and examines ways in which satellite navigation systems can contribute to meeting the goals of generic transport applications such as:

- Navigation and positioning
- Traffic management
- Fleet management
- Collision avoidance
- Demand management
- Transport information
- Surveillance

An assessment of technical requirements for marine navigation and land applications is due and different scenarios are being studied for the transition from the current situation to a wholly civil satellite navigation system.

Because space based systems have to be implemented under generally applicable Treaty Rules and must conform with requirements of Community Law and Objectives, institutional requirements are thoroughly examined, taking into account:

- the application of competition rules;
- the avoidance of market distortions;
- that the service has to be provided to users on a fair and equitable basis;

Finally, this study will highlight the most pressing issues and urgent actions.

Last but not least, a GNSS European Office has been set up to facilitate the European coordination of all GNSS related activities. This office has been established to provide a liaison with outside GNSS related programmes not only in Europe, but also elsewhere (e.g., Russia, USA, Japan ...), in order to achieve a position that enables the European Commission to:

- promote and lead European initiatives;
- collaborate with other partners;
- be at the forefront of the global effort for the system design;
- support the competitive position of European industry.

This naturally includes support for the High Level Group and GNSS Tripartite activities.

Actions Underway

Three major GNSS projects are already underway.

The objective of the 1st project is to develop GNSS 1 user segment prototypes and to assess their performance in terms of availability, accuracy, integrity and continuity of service through field trails involving civil land, maritime and aviation users.

The project has commenced with a first phase intended to update the user requirements, and the qualification and operation constraints that would apply to GNSS 1 users devices, leading to the definition of the validation plan.

The second phase of the project will consist of the development of GNSS 1 user segments and the set-up of a laboratory test-bed designed to stimulate GNSS 1 like signals. This test-bed will be used to verify the behavior of the user equipment.

The third phase of the project will aim at the evaluation of the performance of GNSS 1 in field trials. These trials will probably consist of upgrading the SKYFIX network with real-time wide area differential and integrity monitoring algorithms. The experiments performed, with the users, will then constitute a good validation of the user segments. Civil aviation experiments will be conducted, on an AIRBUS, to demonstrate en-route to CAT I performance. In addition, railway trails and navigation in coastal waters will be performed.

The objective of the 2nd project is to develop GNSS 1 user segments, to assess their capability to meet the most demanding requirements (particularly in terms of accuracy and integrity) and to evaluate the benefits that users can get from the integration of GNSS 1 with data links. This will be done by developing validation prototypes of GNSS 1 user segments and conducting experiments with users. Specific attention will be paid to the multimodal aspect of GNSS and multimodal solutions will be considered wherever appropriate.

The project has commenced with a first phase intended to update the user requirements and the qualification constraints that would apply to the user devices. Based on the data collected, the experiments objectives will be defined.

The second phase of the project will aim at selecting the technical solutions to be used for the validation phase. The third phase will then be dedicated to the development of the GNSS 1 user segments and local ground augmentations. These augmentations will be integrated, in a GNSS 1 test-bed used to validate the behavior of the GNSS 1 user segments, then installed on the demonstration sites.

The fourth phase will be dedicated to the demonstrations with a specific emphasis on CAT II/III landings and local ADS. Helicopter all weather operations, rail network management and narrow channel entrance will also be experimented.

Another project covers, in coordination with ESA, the design of GNSS 2. In addition, some complementary support is also envisioned to strengthen the cooperation of the activities between ESA and EU.

Other projects are expected to be launched before the end of this year (1995).

Conclusion

Member states and their industries have conducted important activities in the field of GNSS since the eighties. These activities were developed in a fragmented fashion with each country developing their own applications. Since the end of 1994, the European Council and Parliament have allowed the Commission to be strongly involved in GNSS.

The European Union has, at its disposal, all the necessary "instruments" to support the European GNSS activities. The main instruments are the European Union Programmes such as the Transport and Telematics Trans-European Networks and the 4th Framework Programme, but also the close cooperation instituted with the European Space agency and EUROCONTROL.

The organisational, legal and institutional problems are being solved with the aid of specific studies or mainly with the advice of the High Level Group.

Lastly, important technical actions have already been launched on the development of user segment prototypes, local ground augmentation, set up of a laboratory test-bed and validation trails for GNSS 1, as on the design of GNSS 2.

The European Union now has all the required skills in place to lead a perfect GNSS programme.

A summary of Mr. Luc Tytgat's presentation is included as Appendix H.

COUNTRY UPDATES

AUSTRALIA

Captain Ian Mallett, Airservices Australia.

Capt. Mallett reported that seven years ago, the Civil Aviation Authority (CAA) was corporatised while remaining fully Government owned. Because of concerns over whether an aviation service provider could also regulate the industry, the CAA was recently split into Airservices Australia (air traffic services, rescue and fire fighting, and facilities management, all funded by the industry) and the Civil Aviation Safety Authority (CASA) (partially Government funded).

Within Airservices resides the GNSS Program Office, which is responsible for the implementation of GNSS, for Australian Aviation. The Program Office is a member of the Commonwealth GPS Group, which was formed by the Australian Department of the

Prime Minster and Cabinet. This Group was formed to coordinate the Australian use of GPS and provide this service, at the least cost, to the Australian taxpayer.

Airservices also convenes the GNSS Implementation Team, which is an advisory and consultative group, consisting of Airservices, CASA, the aviation industry (i.e., airlines, airports, avionics manufacturers), research institutes, and other interested bodies. Through this group, Airservices informs the users of the proposed direction being taken for GNSS implementation and seeks their inputs and comments on the processes.

Activities currently in progress are the development of a WAAS Test-bed, GPS monitoring, and monitoring of Local Area Systems for aviation use.

The Wide Area Testbed, being developed, is a cooperative effort between Airservices and AUSLIG (the Australian Government Survey Organisation). AUSLIG has in place ground monitoring stations located around Australia. These are being connected back to Canberra via Airservices Satellite Communications Network. There are plans, in progress, to conduct joint trials, between the Australian WAAS and the U.S. WAAS, using the Pacific Ocean INMARSAT II satellite as the geostationary overlay satellite.

Captain Mallett stated that a major enroute study has just been completed in Australia, which sees Australia about to approved GPS as a primary means enroute navigation system for Australian airspace. This approval is based on the use of a TSO C129 receiver, 24 satellites being available, 7.5 degree mask angle. Given the fact that in certain areas of Australia, the only navigation system available is OMEGA; this is seen as a significant improvement in capability. Australia would be interested in any debate on this approval.

Australia is actively supporting the ICAO GNSS panel, whose focus is to produce the international aviation standards for GNSS as soon as possible. Australia believes the development of these international standards will overcome a lot of the opposition of whether this is a U.S. or Russian system. Captain Mallett also stated that he would like to see active participation at the ICAO meeting in Bangkok, on the 18 - 20th of October, on the Regional Augmentation Systems (RAS) Task Force, whose remit is the development of an Asia Pacific strategy for the implementation of augmentation systems for GPS and GLONASS.

Captain Mallet's viewgraphs are included as Appendix I.

Mr. John Manning, Mr. Martin Hendy, Australian Surveying & Land Information Group (AUSLIG)

National GPS Network

Australia currently maintains a network of 14 permanent tracking GPS receivers which provide the following functions:

- fiducial reference frame for all GPS applications,
- network for future implementation of a WADGPS System,
- network for future WAAS for aviation in Australia,
- GPS data for post processing of static GPS surveys.

Australia has used GPS to position approximately 80 sites in a 500 km GPS network for land survey users.

Differential GPS

AUSLIG is installing a network of local area DGPS base stations called AUSNAV, which use the FM radio subcarrier to broadcast an RTCM - 104 DGPS message. Currently eight stations are operating and plans are to install three more in the remaining state capital cities. Further expansion will continue in regional centres and areas of high DGPS use, as demand requires. This network maybe developed, in the future, into a WADGPS network.

Two maritime radio beacon DGPS base stations are now operational and a third is under construction. More such stations will be installed to cover the important shipping lanes around the Australian Coast.

In Australia, it is fairly easy to cover about 95% of the population with only a few stations. Aerial photogrammetry users can utilize the FM signal at 55,000 feet, at an operating distance of 600 kilometers.

The three levels of government, in Australia, are involved in setting up base stations for various uses, including vehicle tracking and surveying. The maritime authority is currently setting up a number of free-to-air radio beacon DGPS stations using marine frequencies, following very closely the recommendations of the U.S. Coast Guard. They currently have three stations operating and will implement at least 10 in the next few years to cover the major shipping lanes around Australia.

State governments in New South Wales, Victoria, and Tasmania operate GPS base stations for use with real-time and post-processing of GPS survey data.

AUSLIG is deploying a number of dual frequency GPS receivers, across the country, as the basis for a future ground based GPS integrity monitoring network. One second epoch data is being gathered and will eventually be consolidated in Canberra, in near real-time, by satellite communications. This will form the basis for legal traceability for GPS in Australia.

Two private industry companies are operating their own DGPS services on a commercial basis, using satellite communications to transmit the DGPS message. At this stage, this is an expensive service, due to the satellite communications.

Applications of GPS

- GPS is increasingly being used for navigation from hand held receivers.
- Regular processing of data from the regional sites has commenced to monitor horizontal and vertical land motion.
- The Intergovernmental Committee on Surveying and Mapping, consisting of State and Federal Governmental organisations, have approved the introduction of a new geocentric datum based on ITRF1993 at epoch 1994.0 using the GRS80 Ellipsoid, this will allow all spatial land information to be directly compatible with GPS at the ten centimetre level.
- Vehicle applications continue to grow quickly as taxi, transport companies and some rescue services introduce it into their vehicle fleets.

GPS Information

AUSLIG operates a local Bulletin Board for GPS information (+61 6 2014378), in conjunction with, the AUSLIG World Wide Web Geodesy Information Service (http://www.auslig.gov.au). The application of the WWW revolutionises the distribution of GPS information. The AUSLIG system is integrated, for users, to automatically select other WWW sites such as U.S. Coast Guard GPS Information Centre. They still maintain a bulletin board because there are a lot of people that can not connect to INTERNET.

AUSLIG supplies precise ephemerides for IGS to users, on request, but for data there are very few requests. If the demand increases, AUSLIG will put these up on a daily basis.

Mr. Manning and Mr. Hendy viewgraphs are included as Appendix J.

SWEDEN

Mr. Gunnar Hedling, National Land Survey of Sweden.

Mr. Hedling reported that the National Land Survey of Sweden will be reorganized. This new organization will start in 1996. The organization will be responsible for the Swedish Network of Permanent Reference Stations, that is called SWEPOS, and for the dissemination of information to Swedish GPS users.

The SWEPOS network has 21 stations, all operating with one or two receivers. Twelve stations provide DGPS corrections, using the RDS system, conceived by DCI. SWEPOS allows data distribution for real time data access. The data is used for navigation, surveying, and for studies.

The National Land Survey operated a BBS information service that can also be reached via INTERNET or WWW.

The Swedish network established by the National Maritime Administration Station will be operational on 1 January, 1996.

Mr. Hedling's viewgraphs are included as Appendix K. Also, a professional paper titled "SWEPOS - A Swedish Network of Reference Stations for GPS" was submitted and included as Appendix L.

CANADA

Mr. Kim Lochhead, Geodetic Survey of Canada.

Mr. Lochhead reported that the Coast Guard has received the proposals for stage one of the Canadian Marine DGPS system and is currently evaluating those proposals. It is scheduled for implementation from January to November 1996. The system includes the lower St. Lawrence river and some of their maritime Eastern providence's in Canada. They are cooperating closely with U.S. Coast Guard and it will be a similar type of system or coverage in common waters.

The Transport Canada Aviation Group is collaborating closely with the FAA to develop a WAAS system. The Satellite Operational Implementation Team conducted flight tests on the current WAAS testbed system. Currently, there are three testbed stations in Canada, with a fourth being established in Frobisher Bay. They are also involved in aviation receiver evaluations. Currently, the Transport Canada Flight Inspection Challenger Aircraft is equipped with interference detection capability, to find locations of GPS interference. The active control system, the set of reference stations across Canada, is being used for flight tests and experiments.

The Geodetic Survey Division's active control system is a partnership with the Geological Survey Division. Approximately nine tracking stations provide DGPS data, precise orbits, and satellite clocks. Precise point positioning is provided, in post processing mode, two days after collection. Orbit and clock information is provided on the INTERNET, along with software, to allow use of the information to improve single point positioning capability and accuracy. Currently, they are working on daily turnaround of the orbits and clocks. They are developing a prototype to support real-time data; real-time capabilities based on the tracking data and predicted orbits. They are actively seeking partnerships with commercial and public agencies to distribute the real-time information and other value-added products.

Questions

A question was asked about the interference detection capability and a problem in St. Louis

Mike Shaw, U.S. FAA, stated the testing was done as a cooperative effort between the U.S. FAA and Transport Canada. They identified a course of interference at the McDonald Douglas Plant in St. Louis. They had an aircraft up on a stand, and they were doing testing, specifically on GPS frequencies. There was no interference identified from TV Channels.

NORWAY

Brede Gunderson, Norwegian Mapping Authority.

Norway has inaugurated a new geodetic observatory in Tromso, which is a fundamental station. In addition, this station is an IGS and SATREF station. It was operating in test mode for the last two years and is now being upgraded with new GPS receivers and an integrity inventory. The control center is operating and is connected with 64 kbps lines from each station. The conversion to use a GPS RDS system is a government funded research project, awarded to an American firm, and is being tested now. The signals are covering 95% of the Norwegian area, or 99% of the populated area.

Norway is contributing to a GPS/DGPS project called FM/DARC, using a DARC channel off of the FM net. It is a joint project between Norwegian, French, and Swedish telecommunications companies. It is a more extended version of a Japanese system.

Due to the impact of GPS, Norway is establishing a new satellite based reference

station network in the north. Currently, there are ten reference stations transmitting GPS and DGPS data to the control center every second. Norway is looking for high integrity and reliable reference stations to broadcast directional beacon signals and SATREF data transmitted from eight radio beacons. A few more radio beacons will be started this year, so that the entire coast will be covered by the end of 1995.

Mr. Gunderson's viewgraphs are included as Appendix N. Also, he submitted the following papers, included as Appendix's O, P, and Q, respectively: "SATREF, Satellite-based Reference System", "Statens Kartverk's Strategy, Use and Experience with GPS", and "Ny-Alesund Space Geodetic Observatory".

UNITED KINGDOM

Dr. Terry Moore, University of Nottingham.

Dr. Moore stated that the UKCSG is a special interest group of the Royal Institute of Navigation (RIN) that represents equipment manufacturers, transport industry, and acts as liaison with them. They act as the point of contact for civil users. They run an information center which consists of a computer bulletin board and a fax service. The bulletin board has been running for six years. New hardware and modems are connected to GPS receivers, which provide integrity. They are integrating and automating all other services to save money. They are investigating full INTERNET access.

They also organize meetings. One of their main roles is to educate and disseminate information. They hold an annual meeting to try and educate general aviation people about GPS. They also hold meetings, aimed at 16 to 18 year old students, to introduce them to Satellite Navigation. One meeting was held in Scotland and they are planning to do the same thing next year. They will probably hold similar meetings in other countries through road shows. The RIN has also organized a two day workshop meeting, to be held in London, in October.

The UKOAA is an organization, in the UK, which is working to provide ways to standardize the quality measures for Differential GPS. Within the last year, they have developed the benchmarking procedures for Differential GPS services. The quality measures are being published and adopted by commercial service providers.

The Association of Geographic Information, Survey and Mapping Special Interest Group is also trying to incorporate a standard way of testing one service providers performance with another.

Great Britain is working on Geodetic Datums. All the mapping, off-shore charting and nautical charting is using their own datum (OSGB36). There are three networks in the UK, which have ETRF 89 coordinates. One is called SciNet 92, which is 22 GPS stations around the country linked to ETRF 89. It has been identified with the National GPS Network.

Dr. Moore's viewgraphs are included as Appendix R.

GERMANY

Mr. George Weber, Institute for Applied Geodesy.

Mr. Weber related that the German GPS Information System was not only for Germany, but also for other interested European countries.

The middle of this year, the German GPS Information System decided to switch to a service on the World Wide Web. The main reason was that everyone in Germany now has access to INTERNET free of charge, and accessing by INTERNET avoids long distance phone charges.

There are several sections within this web server. The first is GPS information. They also have information on Differential GPS, GLONASS, and timing. They provide different utilities, because the server runs on a bigger HP workstation. You can start your own programs through forms and ask for the server to coordinate transformation or some computations. Lastly, they have a miscellaneous section giving you some news.

Germany has a lot of Differential GPS information on activities, including a low frequency system at 137 kHz. The advantage of this system is you don't need 100 transmitting

stations to cover Germany. With only one transmitting station in the middle of Germany, they get an accuracy of less than 5 meters. This is working with the RDS technology. The main idea is to have a service, free-of-charge, on a quite low level. People interested in more sophisticated Differential GPS services have to access other systems. It is based on a contract between the Institut fur Angewandte Geodasie (IFAG) and Germany Telecom, which is responsible for transmitting the system.

They are currently downloading GLONASS information. It is available from the CSIC of the Scientific Information Center and from the Intergovernment Navigation and Information Center, both in Moscow. These two official sources have been in service during the course of this year. They are downloading daily from the CSIC run server.

Earth Rotation Parameters are downloaded from the International Earth Rotation Service, from the Center of Orbit Determination for Europe, and from the International GPS Geodynamic Service. They have some information about the International Terrestrial Reference Frame Sites because users are sometimes interested.

The Utilities Section is an important section on the web server. Since the elevation obtained from the GPS system is given in terms of ellipsoidal heights and not in terms of mean sea level, we need geoidal information. This section was implemented, on the server, to help with this transformation.

Information about the visibility of GPS or GLONASS satellites is available by filling out this form with the date, latitude, longitude, and height. Information about geoid heights, for a specific position in different solutions, is available by filling out a form with latitude, longitude, and downloaded after a couple of seconds or maximum of a minute, the geoidal height for a specific position.

They can also coordinate transformations from the ED50 and the DHDN system into the WGS84 system ellipsoidal coordinates.

The miscellaneous section provides GPS information, including a Newsletter, which is coming out every two months. They also have information on meetings in Europe, a bibliography section and a GPS calendar fashioned like the Coast Guard NIS. The site locator is http://gibs.leipzig.ifag.de/welcome-e.htm.

Mr. Weber's viewgraphs are included as Appendix S. Also, a pamphlet titled "GPS Information and Observation System" is included as Appendix T.

POLAND

Prof. Dr.-habil. Janusz Sledzinski, Warsaw University of Technology.

Prof. Sledzinski stated that in 1992, Poland has joined the EUREF system. One year later, 53 zero-order GPS points were established as part of the Polish/U.S. DMA project. They are now establishing two networks, one military and one civilian, each consisting of about 550 points. The work will be completed by Spring 1996.

There are three permanent GPS IGS stations. There are two receivers working, operating single telementary on station. Also, two experimental DGPS stations are operating. Complete details of Warsaw University of Technology activities are included in "GPS Projects Currently Running at the Institute of Geodesy and Geodetic Astronomy of the Warsaw University of Technology" in Appendix U.

The Central European Initiative, Section C "Geodesy" is a new organization established by the Ministers of Foreign Affairs of 15 central European countries. Complete Details are provided in Appendix V in the "GPS Activities Within the Programme of DEI Section C 'Geodesy'".

George Preiss related that Prof. Sledzinski was the coordinator of Section C.

JAPAN

Mr. Hiroshi Nishiguchi, Japan GPS Industry Council.

The Japan GPS Council was created as an industry council with the purpose of disseminating accurate information about GPS

and to provide an accurate understanding and awareness about GPS, so that the GPS will be properly utilized. Approximately 100 companies in the private sector got together to organize this Japan GPS Council.

Differential GPS is to be provided by Multiple FM in Japan. Following the success in field trials, which took place in the early part of this year, our council made a proposal about the format, in other words, the formal standard protocol of format, to a Japanese government organization called Multiple FM Committee. They were able to obtain the approval for their proposal at the end of June this year. That format is called DGPS Data Transmission Standard in Japan. For the earliest possible realization of materialization of DGPS service in Japan, preparation is underway for the establishment of a business company, with capital participation from interested parties, from among our council members.

Market Trends in Japan. At present, some 23 companies are fighting furiously with each other, in the market place, for leadership in the area of the car navigation market. The sales continue to be promising and growing on stage, and as was expected at the beginning of this year, the target sales of 450,000 - 500,000 units for fiscal 1995 is likely to be achieved. The accumulative total number of units in use would reach about one million by the end of this year.

The most prosperous are the value-added data CD-ROM or Card industries that target the car navigation display unit. These CD-ROM products are exploring, not only the car navigation applications, but also new demands in the home personal computers.

In the geodetic fields, GPS is used actively in reconstruction activities and to check the reference points that might have been affected by geographical distortions created by the earthquake disaster in Kobe-Osaka areas. In addition to that, the GPS demand has been pushed up, by allocation of a special budget by the government, for the earthquake countermeasure projects in other parts of Japan. The earthquake disaster in Kobe-Osaka area has played an important role in the propagation of GPS utilization in Japan. In precision land survey, Japan has long been importing and introducing GPS-based precision survey systems from the United States in large quantities. GPS has become an indispensable tool in this area of precision land survey in Japan.

In other applications, such as marine use and aviation use, the various government organizations have started some studies on uses of wide area augmentation.

The Japan GPS Industry Council is using seminars to spread information about GPS. They believe that they will encourage the use of GPS in Japan. They are conducting GPS seminars approximately every two months in various areas of Japan. The secretariat members and corporation representatives have been serving as speakers at such GPS seminars, in Japan. They have been able to get information services from Norway and are translating the information into Japanese, so they can disseminate the information to the Japanese corporate members of our council.

FEDERAL RADIONAVIGATION PLAN

Mr. Heywood Shire, OST/P7

Mr. Heywood Shire presented the highlights of the 1994 Federal Radionavigation Plan. His viewgraphs are included as Appendix W.

USCG DIFFERENTIAL UPDATE

LCDR Gene Schlechte, USCG Navigation Center.

The USCG Navigation Center is responsible for the operations of all U.S. Maritime Radionavigation Aids.

The Coast Guard local area differential service is a navigation service, which provides 8 - 20 meters accuracy with integrity. The service is in excess of 99%, with coverage of coastal U.S. waters, Alaska, portions of Hawaii and Puerto Rico. It's our goal to have completed installations by January 1996.

The Coast Guard service architecture includes the reference station and integrity monitor located at the remote site. The data link used for differential corrections is medium frequency radio beacons, in compliance with international

standards for marine differential service providers. It also has centralized control using two control stations. One is located on the East Coast at the Navigation Center and one on the West Coast at the Navigation Center's Detached Operations Command in Petaluma, CA. The communications network used, to link the control stations with all of the remote sites, is an X.25 packet switch service. It's available from a commercial provider through government contract.

Since the March meeting, NAVCEN has been busy doing remote site preparation needed to meet the required coverage for January 1996. LCDR Schlechte went through a series of slides showing the erection of one of the modern towers at Saginaw, Michigan. That one was erected on an Army Corps of Engineers building. A lot of progress was made by working with other federal agencies to keep the project on track.

This new tower is a higher efficiency design and helps provide the coverage with existing transmitters.

At the time of the meeting, they were approximately at the 50% point with site installation. Some sites have the full installation of first generation operational equipment, and also, have communications with the East Coast Control Station. They are not operational at this time for navigation use, but they do have integrity monitors installed. The integrity monitors are hard wire connected to the reference station, so if there is a fault detected, the user alarm broadcasts at the same time the control station is notified.

The problem at this point, with the Coast Guard declaring these sites operational for navigation, is the maintenance and support infrastructure is not totally in place. The control station software is still under final testing and some final improvements need to be made.

To quickly put this in perspective, if you count all the green sites, there are about 17 of them that are completed, and at the end of this week, we will probably see six more sites go to green. In fact, LCDR Schlechte stated that he had a phone call this morning and was told that the site in English Turn, LA, is up and communicating with the control station, as of last Friday afternoon.

Unfortunately, fifty percent of the remote sites, that are not done yet, are some of the more difficult sites, particularly in Alaska. Right now there are two sites in Alaska that are broadcasting differential corrections. Those sites are for positioning use in the Prince William Sound VTS service. They will not be operational for navigation use this year, because they will not have communications with the control station or integrity monitors. There are five additional Alaskan sites, four of which are under construction at this time. The fifth site has been delayed due to an archeological study that they have been required to pursue. If the archeologists find evidence of historical value, that site may not be completed this year. The report is expected this month.

NAVCEN has been operating the control station software, in a beta test mode, on a 24 hour basis since February 1995. The software seems to be performing quite well. There are some bugs that have been identified and that's being taken care of by the U.S. Coast Guard Engineering Center in Wildwood, NJ.

LCDR Schlechte presented a slide showing the watchstander interface screen on the control station. Two information plots have been displayed based on actual performance data from the integrity monitor at the Point Blunt, CA broadcast site.

Earlier that morning, there was a question on International Standard in the maritime field, particularly concerning the coordination of site identifiers. Also, people have been asking about a consolidated listing of international DGPS broadcast sites. IALA is working on both of these, and has come out with a draft proposal for assigning reference station ID's, as well as, broadcast ID numbers. NAVCEN has incorporated those IALA standards into their Broadcast Standard.

The USCG DGPS Broadcast Standard was issued on 3 March, 1995. This information is available through the NAV INFO Service, either electronically, by calling the watchstander, or from Fax-on-Demand.

LCDR Schlechte concluded his presentation. He finished up with one final slide and it's something that has cause us, within the USCG project, a lot of aggravation. DGPS, however it is being delivered to the user, is very addictive. Once a site begins broadcasting, whoever is controlling and providing it, it develops users immediately. In his experience, the Coast Guard will turn a signal on, and before our own installation team has called the Control Station to say they are ready to start testing, we will have users calling. These users want to know if the site is up permanently or for testing. So, DGPS is a great technology. It works, and it's going to meet the Coast Guard user needs quite nicely.

Questions

An attendee asked what version of the RTCM SC-104 standard is the USCG using in their DGPS Standard.

LCDR Schlechte responded that the Coast Guard has been operating prototype sites for years. Some of the equipment being used has software that is quite old. An example would be Galveston, TX. This particular site was using RTCM SC-104, Version 2.0, but not a full implementation. The site was not correctly using the Type Six message. Today all USCG sites have Reference Stations using RTCM SC-104, Version 2.1, the current version.

Another attendee asked what form the international community was using and if they are using RTCM SC-104, Version 2.1 or their own format.

To his knowledge, all international broadcasts utilizing the marine radio beacon band are compliant with RTCM SC-104, Version 2.0 or 2.1. If the user equipment is fully compliant with Version 2.0, it will function with 2.1.

LCDR Schlechte's viewgraphs are included as Appendix X.

NAVIGATION INFORMATION SERVICE UPDATE

Ms. Rebecca Casswell, USCG Navigation Center.

The Navigation Information Service (NIS) is the civil contact for information on the U.S. provided navigation systems. The NIS is responsible for gathering, processing, and disseminating timely system status information about GPS, DGPS, Loran-C, and Omega to domestic, as well, as international users. The NIS is staffed 24 hours a day, seven days a week.

NANUs are downloaded daily from 2SOPS. DGPS status is supplied by the control station at NAVCEN. NAVCEN only accepts information from the originator to insure validity of the information. The NIS also provides information on Loran-C and Omega.

On April 1st, NIS started a Fax-Back service. Using your Fax machine, you can get copies of status information and publications. The service has averaged approximately 100 accesses a week. The phone numbers for the service are (703) 313-5931/32.

Since the NIS established its Web Site on the INTERNET in July, it has averaged over 2500 accesses a week.

On 1 July, the NIS established its INTERNET service. The web address is http://www.navcen.uscg.mil or gopher://gopher.navcen.uscg.mil. Suggestions for improvements are encouraged.

Ms. Casswell then stated that anyone who had problems downloading the signal specifications, the problem was now fixed. The previous version required the full Microsoft word package. The suspect graphics were now converted to a PDF file, which will allow more people access.

If you have any questions or suggestions, please call the NIS watchstanders or LT John Radziszewski.

Ms. Casswell's viewgraphs are included as Appendix Y.

GIS-ISO TC211 (GPS Data Transfer)

Mr. Henry Tom, Defense Mapping Agency.

Most GIS standards are an adoption or adaptation of an information technology standard. In the severe situation, one is developed, which actually helps you to define, describe, and process the spatial data.

If you know the trends that are occurring, then you will understand why things happen in the GIS standards. They are going to anticipatory standards development. Today, technology moves so fast, that by the time you develop a standard, it's too late. So, you have to anticipate what will be needed four or five years down the road and start developing, hoping that it is in place by the time it's needed. Right now, it's the end users that are driving the standard.

Until last November, there was no GIS standards infrastructure. But, with the formation of ISO TC211, you do have that now.

Within the U.S. Federal government, Federal Information Process Standards are mandatory for all federal agencies. On the national level, there is an American National Standards Institute (ANSI) that accredits standards development. There are several International Standards Organizations which are very prolific in terms of the standards they develop.

Recently, the Federal Geographic Data Community has been very active. The National States Geographic Information Council is made up of state representatives formed from the state GIS State Coordinators. The Open GIS Consortium is made up of 50+ venders and federal agencies that want to build a huge API. It represents a horizontal integration as opposed to vertical integration. Within X301, there are four working groups. Working Group One is working on the Spatial Data Transfer Standard. Working Group Two is doing a GIS extension to SQL. Working Group Three will develop the Data Quality Standard. Working Group Four has a study on Geospatial Objects.

Internationally, there are three major organisations, ISO, IEC, and ITU. The first two are voluntary standards organizations. The ITU is done by treaty and is represented by the Department of State. The other two are represented by the National Standardization Body. In the United States, it is ANC. So, in order to come to the ISO table, you have to go through ANC. ISO, IEC JTC 1 is a committee, which is a joint committee, between ISO and IEC. ISO has over 9000 standards since they formed in 1947. In 1987, they formed JTC1, which produced over 3500 of those 9000. The United States chairs JTC 1.

ISO TC211 is a Geographic Information System. There are twenty-two countries which participate. The O-members don't participate, but receive correspondence and keep an eye on things. There are 36 O-members. Liaison within the ISO committees include TC 204, Transport Information and Control Systems. The Secretariat for this ISO TC211 is Norway.

Working Group One is charted by the United States. Two weeks ago they approved twenty work items.

Working Group two is chaired by Australia. They are Spatial Subschema, Temporal Subschema which is what they call the Yellow Data Model Game.

Working Group Three is chaired by the UK, which is concerned with Metadata and Quality.

Working Group Four is chaired by Norway, which is working on the Standard for Positioning Services. Mr. Tom's attendance was an outreach effort, within the U.S., to invite the CGSIC to participate in developing these standards. He wants to find out what needs to be promoted as a standard.

Working Group Five is chaired by Canada and is very important because what they deal with is existing defacto standards that have not been approved by a formal standardization body. They produce profiles which will be brought into the ISO standard so that they can co-exist.

Question

George Preiss asked if the RTCM 104 was going through ISO to end up as an ISO standard?

Mr. Tom stated it depends if it is proposed. There are liaisons with two groups: The International Association Geodesy and the other on FIG. They are very aware of the Rynex 2.1 and NMEA. These liaison groups can, as professional societies, formally request or

contribute to the ISO committee and ask to have a new work item created to make that an ISO standard. It has not happened yet, because they just joined as a liaison group. This one was to specifically deal with a Military Standard called "Digest". There is an International Hydrographic Standard called "DX90", otherwise known as "S57". A lot of people use this standard. Both of these standards were developed in their own user domain and were truly international. They realized that they had a big investment that many countries were already using. Working Group Five is to figure out how they can harmonize it, create profiles of a general generic international ISO standard where these things can co-exist. There is also another group called ISO TC20 which is a Space and Planetary Systems Technical Committee. Aviation standards may fall under that committee.

Mr. Tom's viewgraphs are included as Appendix Z.

GPS CONSTELLATION STATUS

Captain Rick Koon, Air Force Space Command.

Captain Koon recommended that the Navigation Information Service or the Second Space Operation Squadron be contacted for details on particular satellites. The user interface for the Second Space Operation Squadron is (719) 567-6378.

The status diagram is an overall pictorial of the current constellation status, as of 1 August, 1995. The Constellation Sustainment Assessment Team (CSAT) met, in late July, to assess the health of the constellation and determined the overall health of the constellation is good. CSAT recommended no launch in October of this year, but will meet again, before the end of this year, to make a determination for a February/March launch. Right now, it appears there will be a launch in the February/March time frame into the C-Plane. There are a couple of vehicles having some difficulties and the C-Plane is very difficult to reach. With those two considerations, the Air Force thinks there will be a launch during that time frame into the C-Plane.

Questions

In response to a question, Captain Koon stated that on SVN23 the squadron has to manually smooth the arrays four times a year. Otherwise, the arrays sit in a fixed position. This is a problem within six months to a year after launch.

Ed McGann asked if we are now at the 21 active plus three spare satellites configuration, or are we formally confirmed to a twenty-four active satellite?

Captain Koon replied that the Air Force Space Command Requirements Office does not refer to a twenty-one plus three constellation at all. We refer to a twenty-four satellite constellation. In the new ORD, there will be no reference to the number of satellites at all.

Ed McGann then asked if the Air Force is now launching on an anticipated demand rather than on demand. Captain Koon replied that was correct.

Ed McGann then stated that a change, in either philosophy, will significantly effect the down range cost of the system and he thought it raised a political problem. He added that he didn't believe that the U.S. Government has committed to 24 active satellites or to an unlimited number of satellites. He added that he didn't think Congress knew that the Air Force was launching on anticipated demand.

Captain Koon replied that the launch decision was made by the senior leadership in Air Force Space Command. As far as the constellation goes, Space Command will be required to meet certain coverage and availability thresholds, i.e., 98% coverage and 98% availability. The Air Force Material Command determines how many satellites are required to meet those requirements. They will have to take into consideration the costs. Determining requirements is a coordinated effort between DOD and DOT.

Captain Koon's viewgraphs are included as Appendix AA.

GPS OPERATIONAL REQUIREMENTS DOCUMENT

Mr. Hank Skalski, OST/P7 Representative at Air Force Space Command.

The Operational Requirements Document (ORD) is the document, in the chain of fielding or implementing the system at the United States Air Force, which identifies the operational requirements for the entire GPS system.

Attachment 5 to the Air Force ORD includes the Civil Requirements. The Air Force is going out for formal coordination of the world's civil requirements by November. Final comments will be due in January 1996.

Since Mr. Skalski briefed the CGSIC last March, the only additional comments or inputs received was a request to include a second civil frequency into the Block IIF Satellites. He then reported as of last Friday, September 8, 1996, LTGEN Patrick Karawana signed a letter to Mr. Joseph Canny of DOT, stating that they support putting the MET signal on the Block IIF satellites. LTGEN Karawana also notified the JPO to include it in the RFP for Block IIF.

The civil attachment to the ORD will be amended and be posted for comment next month. That attachment will be posted on the NIS Bulletin Board so that everybody can comment on the new requirements. It's going to be a short turnaround, approximately 30 days, so the civil comments, additions, or changes can be formally coordinated with the Air Force and into the RFP.

The second civil frequency will be an offset of L2. The exact frequency is not known yet, but he anticipates that it might be a 20.46 MHz offset. The two options in the RFP are: 1) to broadcast CA Code, only with no NAV message, at approximately -6 dB down from the present L1 power, or, 2) put a clone L1, i.e., the same CA Code, with the same power and messages, on a new frequency.

Questions

Jim Nagel from INMARSAT stated that INMARSAT is getting ready to put a navigation panel on their next generation of satellites, which will be an intermediate circuit orbit, or have GPS altitude. Currently, the payload design is to do a frequency design with the GPS L1 and L2 frequencies. He then asked how soon the civil frequency would be decided, because this would make an impact. The first Block IIF launch will be in 2003/2005 time frame. They have two options here. First, they could puton the proposed civil frequency now and have no user equipment to go ahead and use it, or go ahead as we are planning to do, in using the existing GPS L2 and then come up with new civil L2 possibility on the next generation satellites. You talked about a 30 day turn around and there is a commitment to put those on, but is there a funding requirement still to be determined, to go ahead and make sure that the civil frequency is on board.

Mr. Skalski responded that Mr. Ken Lamm would address these questions in full, but that is one area being examined. There is a cost benefit analysis, including funding options, in progress.

Mr. Nagel added that INMARSAT is looking at first time orbit date of 1998, so they need something considerably earlier, primarily for planning, to pursue their options.

Mr. Skalski replied that if the option is exercised, any satellites that happen to have this capability will be useful. How many satellites would be required or practical is being looked at right now. Hopefully, before the contract is awarded, most of those things will be answered. We will know what direction we will be going before we exercise that option.

Mr. Nagel then added that it may be worth talking to INMARSAT, because it could have that option available for the international community. Prior to that, some of those inputs could be used in the evaluation of what to put on GPS.

Mr. Skalski then thanked Headquarters, Air Force Space command, particularly Col. Cimafonte, for promoting and sustaining an excellent program of cooperation between the civil community and the Air Force, and also working with DOT to meet civil needs.

Paul Drouilhet then asked Jim Nagel if INMARSAT had funding to put those packages on INMARSAT satellites.

Mr. Nagel replied that full funding was not yet secured. The technical requirements are done, and the funding decision will be made in November of this year.

The question was then asked if the DOT has requested international input to the ORD requirements through any other sources, such as contacts between governments or with other international organizations, who have an invested interest in such things as a second frequency.

Mr. Skalski responded that inputs were solicited through the CGSIC and through NAVCEN's Bulletin Board. The Bulletin Board was updated as requirements were updated, with the notice to comment as appropriate.

Mr. Skalski's viewgraphs are included as Appendix BB.

STATUS UPDATE FOR BLOCK IIR AND BLOCK IIF

Captain Glen Catania, GPS JPO.

The Block IIR program consists of 21 satellites, built by Lockheed Martin. It's currently in production and the first satellite was delivered, in early April, with a launch on schedule for 29 August, 1996.

The first satellite was fully assembled and delivered. Testing thus far has been very successful. The first portion of the software is now being integrated with the control station. The proof of the whole system is the integration of the satellite vehicle, with control segment, which will begin in May 96. According to John Morrison, the program manager, there are no show stoppers impeding that launch.

The IIR satellites will eventually expire and have to be replaced, hence the need for Block IIF. Our current plan is to launch the first Block IIF satellite in the fourth quarter of 2001.

The President of the United States is committed to a sustained constellation, and to providing GPS service to the international community, for both military and civil use. The Air Force's long term goals are to continue providing uninterrupted navigation signals.

A major goal is to reduce system costs in the control, launch, and satellite segments. Significant savings will be realized from operations of the consolidated OCS support contract. In order to make the GPS satellite segment more affordable, they are asking to extend the life of the satellite from the current 6.5 years to 10 years or more.

They are also trying to include, into the package, a design that will allow technology to be inserted into designs, to keep the system flexible, to respond to improving technologies.

The basic contract is for six satellites, followed by a four year multi-year buy, for 15 and 12 satellites, respectively. This includes the ground control segment module, the software, operating satellites and eventually, an option to incorporate the total maintenance package, in support of OCS, by the year 2000.

The three competitors are the top three manufacturers, of satellites, in the world. They worked with these manufacturers for about 2 years to develop the Block IIF strategy. Two of these are previous GPS satellite builders.

The initial draft RFP is over 1600 pages. It had a lot of information and was a self-contained technical library. It includes five evaluation areas with thirteen factors. They went to a one page statement of objectives. One unique aspect is they put in a warranty to guarantee satellite performance.

The plan is to get the RFP out on the street by the end of September. They have to notify congress, because of the size of the acquisition ($3.6 billion dollars).

Anticipated contract award is the middle of February.

Questions

The question was asked, with the contract schedule, when does the information on the civil frequency get put in?

Captain Catania responded that the option is in the RFP. The contractors and Mr. John Clark, of Aerospace Corporation, were asked to recommend the frequency.

In response to a question, Captain Catania replied that the initial plan was to establish a very wide relationship with one single integration contractor. The initial proposal, to the Acquisition Command, is for 51 satellites. They felt they were establishing a long term relationship with a single contractor and that was limiting competition. Therefore, the RFP was reduced to 34 which equates to a full constellation of 24 plus ten.

In response to a question, Capt. Catania stated that the Block IIR contract was for only 21 satellites verses 24, which is less than a full constellation. Congress elected not to fund the options to firm up additional satellites. The Air Force is pushing the initial buy of six Block IIF satellites to make up the difference between 21 and 24. This folds the gap satellites into the IIF acquisition.

Roger Sperry, from NAPA, stated that when he was briefed "Total System Performance Requirements (TSPR)" were changed to "System Performance Requirements". Are they now going back to the original concept of the Total System Performance Responsibility?

Capt. Catania replied that they retained the "T" as their mission's ultimate goal. This is a variation of pure Total System Performance Responsibility (TSPR) than what Mr. Sperry was briefed. TSPR concerns procuring a total system package which includes all of the elements, including the booster and the ground control segments, as well as satellite. They recognized that there are current rules that prevent them from doing that, however, for the elements they do have control over, they are still shooting for a TSPR in the space vehicle and ground control segment of those two aspects.

Another attendee stated that last year Major Vaughn announced that the IIR satellites would be -6 dB down than the current constellation. He also announced that they might be able to correct that before the satellites were launched.

Captain Catania stated that the block IIF signal strength is based on the current constellation. The IIR will transmit a weaker signal strength.

Col. Cimafonte stated that the satellites are being built to meet the system specifications as they are documented. Rockwell puts out more signal strength than was documented. When the Air Force goes to a contractor, with the order from Congress to sustain the GPS constellation, we can only sustain the specifications that are documented. Lockheed Lawton is doing that. When satellites get into orbit, they may perform better; we won't know until then.

Capt. Catania's viewgraphs are included as Appendix CC.

GPS INTERFERENCE REPORTING

Lt. Daniel McGibney, GPS Joint Program Office.

With the proliferation of equipment, world wide, have come unexplained anomalies and the need to have a central point to report these anomalies.

The Joint Spectrum Interference Resolution (JSIR) is run by the Joint Spectrum Center. The JSIR is responsible for the reporting, analysis, and resolution of persistent electromagnetic interference in DOD. This group replaces MIJI or Meaconing, Intrusion, Jamming and Interference. The JSIR is structured to resolve these anomalies at the lowest level possible. MIJI used to go and find what was emitting and causing noise at a site, whether through local officials or through the FAA, and attempt to resolve the problem. Hopefully, that will continue to happen.

Lt. McGibney then showed the questionnaire, included in Appendix DD, that is available on the NAVCEN BBS, through the World Wide Web. The form is evolving, so if you have comments or there are certain things you would like to see on this worksheet, please contact Lt. McGibney or Ms. Casswell at NAVCEN.

The GPS Interference Worksheet requested the following information:

- Description of Interference (three narrative paragraphs or less)
- Duration and number of occurrences
- Date(s) and time(s) of occurrence
- Frequencies or frequency affected
- Type of user equipment
- Type of antenna
- Type of installation (plane, boat, etc.)
- Operating Mode
- Whether the problem was identified, (power plant close by, etc.)
- Did you solve the problem yourself.
- Did any operator action help
- Locations of possible interference source

Please include your name and telephone number. The investigators might need to get in touch with you to get this incident resolved.

This data base will contain both civilian and military interference reports.

Questions

What would be done if a lot of problems were related to a particular manufacturers receivers?

Lt. McGibney replied that this would, initially, just be a database. It is up the manufacturer to look and see how they compare to other manufacturers. This is just a clearinghouse to determine where the problem points are located.

The point was raised that the Air Force Space Command has tried for years to get users to post interference reports on the NIS Bulletin Board. This form is just another attempt to get users to report problems. These forms can be reviewed by the users and will be reviewed by NAVCEN and the Air Force. Nobody is going to judge the reporter. It is information to check the system. The reporting form will also be available on the Fax-Back system. If you don't have a computer, but have access to a fax machine, you can use that. If you only have a telephone, call the NIS Watchstander.

When asked how the interference form would be publicized, Lt. McGibney stated that the form would be placed in periodicals, and that he was open for suggestions.

An attendee suggested that the interference form be put in every box that includes the GPS receiver. He then asked how he could get a summary of what data is gathered, because he'd like to see that before he buys a few hundred GPS receivers.

Lt. McGibney replied that the database, without names, would be available on the NIS BBS, but the main objective is to get reports. The Coast Guard has been appointed the dissemination clearinghouse for the civilian user.

George Preiss asked if the reports, made by civil agencies, from overseas, on the bulletin board to the Coast Guard, will then be examined by DOD with a possible reply.

Lt. McGibney stated that he was going to look at the bulletin board. Whether you get a reply is dependent on the type of problem found. This will be a case by case situation. The details of how the interference report findings will be handled is not yet finalized. If it turns out that the DOD is to blame, we will let you know if there was a test going on on our program.

CAPT Wenzel added that this is a new program. The Coast Guard, on the civil side, has had a lot of experience with this over the years and it's not a trivial problem to track down those types of problems from the average user. In the past, when the problem was found, information was shared through white papers and similar things.

George Preiss then asked for an explanation of the problem in the Adriatic that was reported two years ago.

Franz Van Der Kop added that the problem was still there about two week ago.

Someone from Australia added the Civil Aviation Authority collects and receives many reports. The UK asked for reports in preparation for their meeting on interference, in October. Now the U.S. is asking for reports affecting lots of data and places. Where is it going to be coordinated and recorded, in an international sense, so that we can all see it and who is going to deal with the large number of reports?

Ms. Casswell replied that there are people who look at the reports on the bulletin board now, but there aren't many there. Space Command looks once a week. When they see a report, they do what they can to investigate it. There are other groups that do the same thing. So far, we haven't had enough reports to really worry about how we're going to handle large numbers of reports. Ms. Casswell then added that paper copies of the reports, already collected, would be accepted.

Another attendee then added the RTCA SC159 was having difficulty accumulating information on interference. His best reports come from the Aviation Station Reporting System, that is run by NASA and others from the FAA, who are also interested in aviation safety items. Out of 60,000 reports to that system, in the last seven years, only 88 had any reference to GPS. The interference turns out not to be interference in most cases. There are reports from St. Louis, Southeast Korea, the Adriatic, Northern Italy, Germany, and England. Equipment is a lot better than it used to be and that has solved a lot of problems. Cellular telephones and pagers cause major problems on their frequency, but modifying the antenna can sort this out.

Lt. McGibney added that procedures will be sorted out as the project evolves. This is not a clearinghouse to point fingers, but a way to become aware of the problems and then solve them. If the user is not willing to provide data, the problems will not be solved.

In response to a question asking if photographs or spectrum analysis sheets would be accepted as part of a report, Lt. McGibney answered if the information was provided, the Coast Guard would be more than willing to take it. The additional information would allow the investigation to go one or two steps further, depending on how much data was provided.

Lt. McGibney's viewgraphs are included as Appendix DD.

WIDE AREA AUGMENTATION SYSTEM UPDATE

Mr. Mike Shaw, Federal Aviation Administration.

The Wide Area Augmentation System (WAAS) will enable satellite navigation to become a primarily means of navigation through all phases of flight, including precision landing and approach.

The strategy calls for implementing two systems. The first system will provide the performance needed down through Category I precision approach. The local area augmentation system gives the additional performance needed for Category II and III precision approach. CAT I precision approach takes you down to approximately 200 feet above the ground, CAT II takes you down to 100 feet above the ground, and CAT III takes you all the way through autolanding.

The wide area concept calls for a ground network of wide area reference stations spread across the national airspace system. They are on survey positions and they collect the information to provide integrity and improved accuracy. That information is collected at the wide area master station. The corrected message is formatted and then forwarded to a ground station that sends it to the Geosynchronous Satellite for broadcast to the aviation user.

The contract was awarded to Wilcox as prime, but Hughes and TRW are also on the contract team. Wilcox is responsible for the system design, the integration testing and the site preparation. Hughes will do the software engineering and TRW will do the communication links for the ground network.

The contract calls for using Geosynchronous Satellites, provided through INMARSAT. Initial capability, called Initial WAAS, is scheduled for January 1998, 29 months after contract award. The WAAS progresses to In-State WAAS in the year 2001.

The Initial WAAS will consist of 24 reference stations throughout the continental United States, Alaska, Hawaii, and Puerto Rico. There will be two master stations, one on each coast, that uses a ground link that is triple redundant. There will be two ground stations in the initial system that will use straight INMARSAT communication satellites.

The first of our INMARSAT III satellites will be put up in February 1996 to cover the Indian Ocean. The following three will be launched to cover the Atlantic Ocean East, the Pacific, and then the Atlantic Ocean West, with completion in the spring of 1997. Three of those satellites have coverage over the continental or the national airspace system.

The WAAS schedule is an incremental process, progressing through the phases of flight. It moves from supplemental mode to primary means of navigation. Currently, GPS is approved as a primary means of navigation for oceanic enroute flights and as a supplemental means for domestic enroute through non-precision approach.

When approval was received for this program, the Initial WAAS was expected in 18 months. They have learned that it is difficult to set a specific date and time. Between Initial WAAS and In-State WAAS, there are three options in the contract that have not been exercised. Future considerations are the number of reference stations, and satellites to provide the full performance characteristics needed in the national airspace system. Starting in 1998, as experience is gained, you may see significant operational restrictions, in the forms of increased fuel reserves, alternate equipment, or any number of mechanisms. In 1998, the system will start providing the accuracy necessary for CAT I approaches. The FAA will then decide how many and which options to exercise in the WAAS contract, to develop the system into the In-State Wide Area Augmentation system.

The benefits derived from WAAS include more direct routing, reduced avionics onboard, and reduction/withdrawal of other pieces of ground equipment. All this has to be integrated. Substantial amounts of time is expected when there will be dual operation using GPS as a primary means with other navigation and landing aids. At some point in the future those systems will be reduced.

Questions

Ed McGann asked if it was justifiable to propose a primary means system in the center of the United States with only one satellite coverage in 1998/9. He also asked if the Cost Benefit Analysis for WAAS had been posted in the Federal register.

Mr. Shaw responded that the satellite operational implementation team very likely will authorize it with significant operational limitations. Those limitations will be between now and 1998. He did not know if the Cost Benefit Analysis was in the Federal Register.

Ed McGann then asked that now that GPS is FOC, how could you test WAAS to show that it can determine an out of specification performance.

Mr. Shaw stated that he did know that WAAS would be tested in the national testbed to verify the performance before the system is accepted.

The question was then asked if the ability to accommodate GLONASS in the U.S. National Airspace was included in the WAAS capabilities. The United States expects the world to accommodate GPS in their airspace, what is the United States doing to accommodate GLONASS in their airspace.

Mr. Shaw responded that there was enough space to do that.

Answer. Right now, what we have done to accommodate GLONASS is we feel the system, having enough margin in there, that it be the decision to include corrections to the GLONASS satellites. There is enough space available to do that. That dialogue is preceding. I don't see an active decision at this point or in the near future to include that in WAAS, but it is available and that to be the decision.

In response to a question, Mr. Shaw stated the current plan is the Wide Area Augmentation System will be unencrypted.

U.S. RAILROAD - POSITIVE TRAIN CONTROL

Mr. Dick Shamberger, Federal Railroad Administration.

The United States Congress and the National Transportation Safety Board has pressed the Federal Railroad Administration (FRA) to find a way to assist the railroad industry in developing positive train control systems which would not only enforce operating authority limits and speed restrictions, while simultaneously providing productivity improvements and economic benefits. Positive Train Control Systems (PTC), built upon an RF digital communication platform, will provide just these capabilities. High-speed passenger train operation, in already congested freight corridors, can only come about after the successful implementation of PTC.

FRA reported to Congress, in July 1994 (Radio Communications and Railroad Train Control) on the status and prospects various of technological developments expected over the next few years. The July 1994 report sparked general interest, and in June 1995, FRA delivered another report to the Appropriation Committees of Congress in response to more specific questions... "The committee supports the activities within the Department of Transportation (DOT) to utilize differential Global Positioning Systems (DGPS) as a means of promoting surface transportation safety and technology. As part of DOT's examination of the potential uses of this technology, the FRA is directed to submit a report on the benefits, costs, desirability, feasibility, and implications of using current and planned DGPS as a means of further promoting the accuracy and utility of positive train control systems." The substance of his talk examined the current state of development of these families of augmentation technologies as used in the railroad industry.

In April 1994, the Union Pacific and Burlington Northern Railroads announced the start of a joint project, in Washington and Oregon, initiating the development of a prototype system, which may well become the foundation of the next generation nationwide and interoperable train control system. Field testing will begin during the first quarter of 1996 - still unfolding! This scenario allows FRA to participate in "partnershiping" with private sector companies, the states of Washington and Oregon, and the Association of American Railroads - simultaneously achieving strategic goals set by both DOT and FRA.

Now, to the specific business of the Civil GPS Interface Committee. Positioning and navigation - that is the question; the train is on which track, moving in what direction, at what speed, and what is the safe stopping distance? GPS, even DGPS alone, cannot solve the problem, when adjacent tracks are but 11.5 feet apart. But, DGPS shows great promise for performing well as a primary part of a Location Determination System (LDS). The LADGPS, current U.S. Coast Guard Beacon System, used as a first level of augmentation, in conjunction with other augmentation techniques (computerized detailed track geometry, odometer readings, fiber-optic gyroscope), should provide us with "proof of concept". Assurance of which track is occupied must be greater than 0.99999. Because of the detailed trace geometry, and knowledge of precise switch location, speed and direction, the LDS will be able to reregister the exact location of the train every few moments. All this location information is needed to continually calculate the "safe" breaking distance algorithm.

The first generation LDS will also be proposed as the train location system for the FRA-sponsored High-Speed Passenger Train tests to be conducted in the states of Michigan and Illinois. The rail industry's acceptance of the Coast Guard's LADGPS may well play an important role in government's decision to provide differential coverage nationwide. Just as an aside, FRA, U.S. Coast Guard, and the U.S. Army Corps of Engineers have plans to fund and establish an additional radio beacon tower in the Pacific Northwest to guarantee adequate "proof of concept". The route involved in the test extends south from Blaine, WA through Seattle to Portland, Or., and then East along the Columbia River to Pasco, WA and Hinkle, OR. I guess we will all learn something more about radio signal propagation, terrain masking, and microprocessors in locomotives from this undertaking. First, quarter 1996 is not far away.....

The on-board locomotive "electronic sensor suite" will also include multi-channel UHF/VHF digital radio. It is by this means the locomotive will communicate with railroad headquarters. So you see there is a lot going on in the U.S. Railroad Industry on several fronts, so far as,

technological deployment is concerned. In my humble opinion, it will be to the mutual advantage of everyone in this room today to keep abreast of all this progress, help where you can, ask questions, and add to the effort.

Questions

An attendee asked if the FRA knew where all their railroad cars are at any time.

Mr. Shamberger replied that there is a centralized car location system, which works well. Canada and Mexico also have a powerful system. There is a point at which Positive Train Control and Integrated Service Management will fit together. There are systems that are going to make the railroad industry, in North America, a more dynamic, whirling, and viable industry.

THE SECOND CIVIL FREQUENCY FOR GPS

Mr. Prem Munjal, Aerospace.

Mr. Munjal talked about why the second civil frequency is needed, how it would be implemented, and the need for a timely decision.

The Wide Area Augmentation System has 24 ground segment stations, which have dual frequency receivers to collect data. They will collect the data and send it to the master uplink, to the INMARSAT III dual station satellites, to provide the necessary corrections. In part, these corrections remove or eliminate most of the Selective Availability effects. This also provides dual frequency ionospheric corrections.

Currently, the civilians have only single frequency information available. WAAS provides corrections every five minutes to make sure the users have information derived from the nearest grid point, which may be a few hundred kilometers away. That information is used to compensate for ionospheric errors.

The dual frequency ionospheric correction is needed for the precision approach, where more accuracy is needed than for the non-precision approach. The Initial WAAS and In-State WAAS have a set of requirements for non-precision approach and for precision approach.

With the Initial WAAS requirement, you can have up to one hour in a day outage. For In-State precision approach, the outage has to be less than 2 minutes a day. For non-precision approach, the initial requirement for outages can be no more than 2 minutes a day. For the initial WAAS and for In-State WAAS, it has to be less than a second a day.

According to the WAAS specifications, you have to meet the continued function and also account for the worst case pilot. The requirement is such that ionospheric corrections, rather than treated as a random uncoordinated information, is information on a delay and calls for treating ionospheric error as a bias. Because of the bias, it puts undo restrictions on the user potential range error and the user noise error in avionics. With a dual frequency ionospheric correction, ionospheric information does not have to be treated as a bias. You can then target more error in the receiver avionics and the user dimension error. It can also help when you have adverse ionospheric correction situations or when you have one station failure.

The bottom line is that with dual frequency ionospheric corrections you can increase your availability, not only for Initial WAAS, but for In-State WAAS. It is most critical for the precision approach. Besides availability increase, you can tolerate more satellite failure.

Only two boxes are needed on the Block IIF payload to accommodate annex dual frequency; the annex modulator and the annex HP8. Those two different components need to be designed. It is estimated that the dual frequency capability will require about 9 watts in power and approximately one percent of additional weight.

It is proposed that the dual frequency can be incorporated in all 33 Block IIF satellites. If done now, the cost will be 1/10 or 1/20 of the cost, if added later. There is a window of opportunity which exists today for Block IIF. Should that be missed, the next window of opportunity will be in 1998, but then it will only be available on 27 of the Block IIF satellites.

Questions

Jim Nagle, INMARSAT, said that GPS has two frequencies already, so why was this frequency needed?

Mr. Munjal stated that this frequency annex has been proposed by the NAPA, NRC and other organizations. There have been several studies done within DOD and the DOT POS/NAV Committee. It is not a final committed answer that it has to be twenty megahertz below the L2. The decision has to come from DOD and DOT. He was presenting the technical options of how it can be done, which will benefit DOT and DOD.

Paul Drouilhet commented that the second frequency was not an FAA concern. In fact, the emphasis on the second frequency comes from other applications of Differential GPS rather than from the FAA.

Mr. Munjal stated the dual frequency makes it much easier to meet the FAA's specification of WAAS for precision approach. It provides reliability and gives you other safety factors. With dual frequency, you can tolerate more error, because you have less ionospheric error. He then discussed the tradeoffs in the error budget. To meet the continuity of function, you are left with only a very stringent accuracy requirement, which you are placing on avionics receiver noise and also on other parts of the UDIE. Dual frequency can delete part of that, and get availability at high numbers. It's really essential for In-State WAAS. The Block IIF dual frequency fits very well with FAA In-State WAAS time lines. The benefit is extremely tremendous.

One attendee questioned using a frequency near L2, because it is susceptible to interference from pagers and cellular telephones.

Mr. Munjal said that he was only giving a snapshot. What he presented was only two weeks of activity. This has only very recently become an option. Some of the issues raised will be addressed and presented at a future meeting.

SECOND CIVIL FREQUENCY/GPS COST ALLOCATIONS

Mr. Kenneth Lamm, detailed to OST/P-7.

Mr. Lamm stated that last year, the DOD/DOT Task Force recommended a comprehensive study of GPS funding and cost allocations in order to identify a steady source of funding. This source could be from the outside or from the general fund.

Information on costs was provided from the differential providers. The Air Force supplied figures concerning the satellite costs and the operational costs.

Cost recovery could possibly come from user fees or the WAAS. It is possible that other user groups can find a way to pay for a share of its use.

There are indirect ways of obtaining these funds. The NAPA and Rand Studies suggested ways, including the general fund. It's not clear in their reports what analysis was done.

Mr. Lamm stated he needed ideas, and encouraged everybody to let him how they would like GPS to be funded. He requested the attendees to participate in surveys.

The second civil frequency project is in the planning stages of requirements analysis. Federal requirements were submitted and DOD has agreed they are sufficient to justify investigating the option. Mr. Lamm asked the membership to submit their opinions on the positives and negatives of a second civil frequency. He would like to know what effect it will have on the providers of service and equipment in dollars. The decision should be made in April.

Questions

Jim Nagel of INMARSAT asked if L2 or LX option was part of what Mr. Lamm was looking for?

Mr. Lamm responded that the current option, under examination, was part of the RFP for Block IIF. He was tasked to look at the L2/LX

frequency on GPS satellites. JPO would decide if the second satellite provider could provide that option. The purpose of the LX is to estimate the ionosphere delay from the GPS satellite to the user. So, to measure the delay, using a different satellite, the satellite would generally have to be in the same part of the sky.

Mr. Nagel stated that INMARSAT was currently working with Aerospace on the analysis to show how that can be done.

Mr. Lamm's viewgraphs are included as Appendix EE.

NATIONAL ACADEMY OF PUBLIC ADMINISTRATION (NAPA) STUDY

Mr. Roger Sperry, NAPA.

There is a NAPA Study Summary available, from NAPA, at a charge of $20.00. The Summary is a joint report of the NAPA panel, chaired by Jim Slessinger and a National Research Council (NRC) Committee, chaired by Larry Adams.

Congress charted the study in 1994, as part of the Defense Authorization Act, which asked for a joint study of the management and funding of GPS. NAPA looked at how the programming should be structured, how to maximize this dual utility, and how GPS should be funded. The issues addressed were equitable cost recovery mechanisms, if commercialization or privatization was possible, and international participation and management.

The NAPA panel included people with a variety of backgrounds including GAO, the Air Force, and a former Associate Administrator of NASA, Ed Harper, who is president of the Association of American Railroads.

Our panel decided, very early on, to look at this topic very broadly and identify, first, the forces of change that now make it a global utility and a national asset. The fact that GPS is a weapon of war and terrorism is something that must be considered, along with everything else. The rapidly growing commercial markets have changed the political dynamics of decision making. This constrained some of the options that are available to the President and others in future decisions, for improvements in technology. So, there are a number of forces driving the future of this technology.

The panel decided it was now the time to think of GPS in terms of a national perspective. They set out to put together a set of national goals for GPS, and see if there was a way that policy for GPS, in the future, could keep these goals in mind. The first objective is to protect the national security. The second is to maintain an effective dual use positioning capability. The third is to maintain U.S. leadership in the technology, by encouraging growth in commercial applications. The fourth is to maintain GPS as a global resource and establish policies governing it's availability that are stable, consistent, and workable for all users. A flexible GPS management structure is needed to adapt rapidly changing technical and international requirements. The last goal was to limit the overall burden on the U.S. taxpayer. These goals overlap to some extent and need to be in mind as we go about establishing policy.

Arnold Donahue, NAPA.

NAPA found the GPS industry had a tremendous growth potential, with an average of 38% growth annually between 1995 and 2000. It trails off a little bit after that, but it's hard to project what will happen after 2000.

The market is at two billion now and projected to grow to 11 billion by 2000 and 31 billion in 2005. Booze Allen did an in-depth market survey with 120 different market segments, based on the North American market only, and came up with similar growth rates.

The user community is projected to go from half a million to 10-20 million, based on the automobile navigation area. Military use will be at 1-2%. These are very low numbers in terms of military demand verses civilian use.

The panel made no recommendations on the commercial side. One of the reasons they wanted to go into it, though, was to do some sensitivity analysis with respect to the impact of Selective Availability. They found that Selective Availability appeared to be distinctly retarding the commercial market, because of the added cost and complexity required to use either

augmentation systems. For North America, the Booze Allen analysis determined the market could be fifty percent higher without Selective Availability. The NAPA survey determined the figure was closer to 26%. They found the impact on differential providers to be small and temporary, even for differential service providers.

They also found that Selective Availability was having a detrimental impact on foreign users and governments. It forced foreign countries to pursue foreign alternatives more aggressively.

The panel visited a number of European and Asian countries to get an idea of what the alternatives to GPS might be. GLONASS might be a real alternative, but given the Russian Government's political and economic problems, not too many people seem willing to make it an integrated basis of their navigation system for the next 25 years. It is a real alternative and it does provide an existing capability other than GPS.

INMARSAT is developing an international satellite navigation capability. It starts with INMARSAT C and moves to INMARSAT P. How much of an alternative to GPS it provides will depend a lot on what actions the U.S. takes, with respect to how it deals with GPS and the rest of the international community. Combined GPS and GLONASS, bringing in EGNOS, NTSATS and other foreign options, add to that concern.

The possible outcome is an integrated system, where GPS becomes the glue, with regionalized elements; with the WAAS in the Western Hemisphere, and the Eastern Hemisphere divided into alternative systems. The United States Government has to have a much more outgoing attitude towards bringing in the international communities concerns and interests in GPS.

In Europe, there was discussions on GPS control or ownership. The U.S. developed the system and wants to control it, but there are a lot of options for involvement in GPS. The U.S. Government considering foreign concerns in the further evolution of GPS would be healthy and beneficial for the system, the United States and the world.

Lastly, the panel looked at the national security considerations involved with GPS. Both the NAPA and NRC panels said maintaining military advantage was of the highest priority. They found and believe the reliance the Department of Defense currently puts on SA is flawed and inadequate. It was in Desert Storm and Haiti where DOD turned on SA.

On the political side, no one will want to deny or degrade the signal when a large number of commercial or civil users are dependent on it. The President will be reluctant to be responsible for train wrecks, airplane crashes, or boat wrecks.

U.S. jamming is currently not being pushed aggressively, because DOD depends upon the CA signal to acquire the P Code. Both NRC and NAPA agreed that DOD should have the capability to acquire the P Code signal without using the CA Code.

The panel found that the conservative defense approach, to adding incremental capabilities to the satellites, was potentially jeopardizing U.S. leadership. NRC recommended the second civil frequency to deal with jamming. Finally, they found that international participation in many phases of GPS, including the ground station architectures, were both compatible with U.S. national security and had the potential for seriously limiting competition to GPS.

Roger Speery, NAPA.

The general conclusion is that the current governance and management structure appears to work well, although it seems a bit cumbersome at times. The report gave high praise to DOD and the Air Force for getting to where we are right now. The panel came to the conclusion that DOD should continue to have operational responsibility for GPS. However, pressure is mounting on the current system, so the U.S. must change its current governance and management in order to meet the challenges ahead.

The panel recommended a one time statement, from the President, to establish a set of national goals and a national strategy. This could best be done by an executive order. The President

would address the national goals, and establish a GPS Executive Board which would have authority over GPS to include its augmentations, govern its policy and coordination. This statement would reassert the U.S. policy in providing a civilian GPS signal-free world wide, and announce that Selective Availability would be turned to zero immediately and deactivated after three years. The directive should provide for a review, in three to five years, of the board's operation and effectiveness.

The board should be composed of DOD, DOT, NOAA, and at a minimum, Commerce, State, and Interior. It should be Co-Chaired by designees of the Defense and Transportation Departments with a mechanism to systematically solicit use and opinions, as well as, provide an appropriate opportunity for a meaningful voice for all non-federal interest. The panel decided that the committee probably needs to be augmented by a more formal advisory committee. This would represent the international, commercial, and civil user, who needs more direct involvement, in providing information to policy makers. An executive director, tasked to carry out the boards directives, and a very small staff could be located in either DOD or DOT.

The U.S. Government should embark on an evolutionary path, toward more international involvement, in the governance and management of satellite navigation systems, possibly including the basic GPS.

GPS is an important military asset, which justifies federal support for that reason alone. The panel was reluctant to endorse any scheme that might introduce instability, based on demand, for the services of the system, or to introduce the idea of encryption for the civil side. For the present time, the best way to fund GPS is through appropriated funds for GPS and it's principal augmentations.

All of this, of course, needs to be studied again in the future. There is currently a policy review at the White House, with the hope of issuing a directive on 1 November. The ball is now in their court to consider these issues. The Senate Armed Services Committee has told the Defense Department to set a date, before the end of the decade, for SA to be terminated or disabled.

Mr. Sperry's and Mr. Donahue's viewgraphs are included as Appendix FF.

NATIONAL RESEARCH COUNCIL (NRC) STUDY

Mr. Lawrence Young, National Research Council.

The NRC portion of the study was primarily directed toward the technical aspects of the GPS systems and how it could be improved. The two main tasks were to determine if SA and AS were meeting their intended purpose and what augmentations could be made to GPS to enhance military, civilian, and commercial use of the system.

The committee was a mixture of people with a lot of experience to no experience with GPS.

The first thing examined was if civil users would benefit if AS was turned off. The committee found that it remained critically important, because it forces a potential adversary to use the CA Code. The CA Code can then be jammed, if necessary, to deny access to the signal locally, but the U.S. Military could still retain the use of the encrypted signal. AS should remain on. The Air Force should explore the necessity of upgrading their current encryption method to see if it's necessary to come up with an approved encryption system.

When examining Selective Availability, there is, currently, availability positioning with GLONASS to the GPS level of accuracy. Turning SA to zero would have an immediate positive effect on civil users. They were concerned with what would happen to suppliers of differential information, differential equipment, when Selective Availability was turned off. The results of the Booze Allen study indicated that there would be an increase in the differential equipment. Since the system works better without SA, the market overall would go up for GPS equipment and services. In particular, even systems like WAAS would benefit from Selective Availability being turned off, because you would be able to have low update rates. Again, with SA off, the military would be, more or less, forced to train troops to operate, in an environment, where they relied on

jamming the CA signal as a means of denying access to an adversary. This would require the development of direct Y Code receivers. They felt that this was not a major technological problem.

The recommendation was that SA should be turned to zero immediately and deactivated after three years time.

Another task was to recommend technical enhancements for military and civilians. This included the wider use of antennas that would automatically detect the presence of a jamming signal. The incorporation of an inertial aiding into the GPS receivers was another way of counteracting the jamming signals. The signal process improvements are described, in more detail, in the full report.

The first civilian enhancement recommendation was to gain authorization to add another L Band frequency at the earliest opportunity. This would not only provide better accuracy for calibrating ionospheric delays, but also to make the system more interference immune. If there was an accidental interference on the L1 frequency, there would likely be an available signal at the L4 frequency.

The committee did not conclude whether to recommend that the L2 signal have the same data modulation as the L1. Perhaps the higher data rate would allow more rapid differential corrections to be transmitted over the GPS satellites themselves or microprints. This would allow you to interpolate for longer periods of time, so you could tolerate very high jamming environments.

With the second civil frequency, the atmospheric error would be reduced to an overall one centimeter. This is what you get with a dual frequency correction with a residual error. The clock ephemeris errors have been observed to be about 3.6 meters.

The Interstate Committee believes if the NRC recommendations are implemented, the overall GPS performance and reliability would be greatly enhanced. The stand alone accuracy would approach 5 meters, 2 DRMS, which is 2 sigma in the horizontal plane.

The system would progress from 100 meters civil user down to the 6 meters as you turn off Selective Availability, add the LX signal, and receivers improve. The final recommendation is the improvements to the transmitted clock, in the ephemeris corrections, from the satellites.

Questions

An attendee asked if the second frequency was too close to the military frequency for jamming purposes.

Mr. Young replied that the panel felt that it was sufficiently away from L2 frequency that the military could have full benefits from their L2 signal. In fact, there is a portion of the committee that believes if the SA were in the middle of the L1 and L2, the military could still jam CA and use the Y Code.

Mr. Allan remarked that he found it disconcerting that there was no mention of timing. American business relies on GPS timing daily. Most of the telecommunication networks use GPS to time long distance calls. Timing is extremely vital.

Mr. Young stated that timing was included in the report. The reason he didn't discuss it was GPS is meeting the timing requirements, so there was no pressing need for improvements.

Mr. Young's viewgraphs are included as enclosure GG.

STATEMENT BY JULES MCNEFF, DEPARTMENT OF DEFENSE

I don't want anyone to think the Department of Defense agrees with the substance of the recommendations from the reports. The Secretary of Defense has specifically came out with a position that says, "The Department of Defense views the Selective Availability feature, of GPS, as providing a military competitive advantage for U.S. forces. Any recommendation to immediately remove Selective Availability from GPS will be to the disadvantage of the United States and the U.S. Forces".

Because of that principal recommendation, which has taken up about 80% of the discussion

this afternoon, flies in the face of national security, and if implemented, it would be dangerous for the United States Military and extremely costly to work around. The fact that SA exists today isn't, as has been stated, a crutch for the DOD, it's partly to benefit the DOD and our allies in maintaining the military competitive advantage. It could possibily be a weapon of war and terrorism, if it's not controlled.

The purpose of Selective Availability is to put a measure of control, on the extent to which the services of the satellites can be used, to effectively conduct war and terrorism. As a service provider of a positioning service, that is effective of determining targets and delivering munitions against targets, the DOD is now compelled, as it was back in the late '70's, to put a protective feature on the system that would discourage those who are not authorized to use it. By virtue of the fact that they are outside the U.S., DOD and our allied sphere, it would discourage them from using it for military purposes.

Anyone who provides a service with the precision that we are talking about here, and does so indiscriminately, needs to consider the full range of uses that service will be put to. Anyone who intends to provide a wide area, high accuracy, positioning signal over large areas of the earth, without any control on it's use, needs to consider not only the positive uses that is was designed for, but also the negative, non-peaceful uses that will be encouraged if it's not controlled. That is the basic reason for Selective Availability.

DOD is working on local area denial methods to enable our forces to operate safely in military situations around the world. Independent of what the DOD does, in that particular arena, the broader international issue of how these signals are used, for both peaceful and non-peaceful purposes, is one that still needs to be addressed in the national policy review.

Concerning the recommendations about management, the DOD and DOT have worked extensively, over the last couple of years, to come up with an effective management mechanism for the Unites States to continue operating GPS for both civil and military benefit. The DOD considers the management mechanisms, put in place by the Department of Defense and Department of Transportation Positioning and Navigation Executive Boards, the executive committees and the Joint GPS Executive Board, to be a very effective means in managing this system. That mechanism includes participation by the Department's of Commerce and Interior, and represents a good government wide means of providing the best possible service for all of the civil users, as well as, protecting the interest of the military. This gathering is a prime example of that cooperation and how that system is working. To say that something institutionalized in the bureaucracy and with some sort of vague participation by others outside the government, even outside the United States, in management and control is needed, doesn't make sense to him.

Questions

David Allen stated that to use jamming on L1, in case of conflict, would have significant impact on the timing users. The timing needs are easily met to a microsecond for a wide variety of strategic civil uses of GPS. He stated that he supported Mr. McNeff's position that SA should be left alone, and the civil sector can use either differential or some kind of filtering techniques. A whole variety of people use GPS for timing, with SA on, without any adverse effect.

Congress wanted an independent view on the issue of the future management and funding of GPS. Twenty-six or twenty-eight people came together to come up with some suggestions and recommendations for the President, Congress and DOD to consider. These groups, not NAPA or NRC, makes policies. Selective Availability, if not turned off immediately, will probably be down the road. The time has come to consider the recommendations in the light that they were given and try to come up with some solutions that will move this excellent technology forward, in ways that meet not only the needs of DOD and the national security threat, but also satisfy the needs of others. The NAPA/NRC recommendations are not the last word. They are intended to be suggestions for policy makers, to be taken in that light, which was the way they were intended

An attendee asked if the difference of opinion came from the researchers not having access to classified service information.

Mr. McNeff responded that the NAPA and NRC panels had access to a considerable amount of classified information.

Ron Haley, of DCI, commented that the NAPA Study said that turning off SA would be beneficial for differential service providers. He stated the NAPA team was told otherwise, but they chose to ignore it. He understood that the majority of manufacturers said to leave it alone.

DISCUSSION FORUM

CAPT Wenzel read a comment from Hans van der Wall of the Netherlands which is included as Appendix HH.

David Allen commented that the UTC, which is our official time for the world, uses GPS common-view, for transferring the 200 clocks to the International Bureau of Weights and Measures, and SA has no effect.

George Wiggers opened the floor to discussion on whether the 12 to 18 hour maintenance window impacts user operations.

Karen Van Dyke stated that there are many operations where this is critical in the planning. For example, the Notice to Airmen System, that we have developed in the Air Force and FAA both, have similar capabilities and having that information for pre-flight planning is critical. What tends to happen is the creditability of the information is degraded when the actual times are consistently less than the actual time the satellite is down. There are many other applications outside of aviation where people are counting on this information, for either test or research. If there was a way to forecast the outage, as close to the amount of time it actually takes, it would be beneficial to the community.

The National Geodetic Survey Advisor for the State of Minnesota stated that they are in post-processing. He would like to know why the satellite is not available and what parts of the satellite are malfunctioning when looking at the messages. In some cases, he might be able to use the data collected, if he knew why the satellite should not have been used.

George Preiss stated that he felt the forecast outages were time excessive and asked if it could possibly be reduced. He also stated that he had done information requirement surveys and the information requirements should be presented to the Coast Guard.

Another attendee suggested an education program that addresses the limitations of the system at various aspects. A forum where people can say “don’t believe this and don’t believe that”.

Captain Lisa Boland, from 2SOPS, stated that they have noted that the maintenance window probably can be reduced, but cannot say at this time how much. It depends on the satellites themselves. They are looking into reducing it.

When there were no more comments from the floor, George Wiggers adjoined the meeting.