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United Nations/United States of America Second Regional Workshop on the Use and Applications of Global Navigation Satellite Systems

(Vienna, 26-30 November 2001)

Contents

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I. Introduction

A. Background and objectives

1. Global navigation satellite systems (GNSS), with their extremely high accuracy, global coverage, all-weather operation and usefulness at high velocities, are a new global utility that increasingly improve people's daily lives. Benefits of GNSS applications are growing in such areas as aviation, maritime and land transportation, mapping and surveying, agriculture, power and telecommunications networks, and disaster warning and emergency response. Particularly for developing countries, GNSS applications offer cost-effective solutions to pursuing economic growth without compromising the present and future need to preserve the environment, thus promoting sustainable development.

2. At the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), participating States stressed the social and economic benefits of GNSS. In order to help developing countries benefit from GNSS applications, the United Nations Office for Outer Space Affairs, within the United Nations Programme on Space Applications, proposed in a plan of action to implement the recommendations of UNISPACE III to organize a series of Workshops or seminars focusing on capacity-building in the use of GNSS in various areas of applications. The proposal was endorsed by the Committee on the Peaceful Uses of Outer Space, and the General Assembly, in its resolution 55/122 of 8 December 2000, paragraph 29, requested the Secretary-General to begin implementing activities in the plan.

3. In 2001, the Office for Outer Space Affairs, within the framework of the United Nations Programme on Space Applications and with the sponsorship of the United States of America, began a series of regional Workshops on the use and applications of GNSS. The first regional Workshop was held in Kuala Lumpur in August 2001 for the benefit of countries in Asia and the Pacific.

4. The present report concerns the second regional Workshop, held in Vienna from 26 to 30 November 2001 for the benefit of countries in Eastern Europe. The Government of Austria and the Austrian Space Agency hosted the Workshop.

5. The Workshop focused on issues of common concern and interest to the region, such as those addressed at the Regional Preparatory Conference for UNISPACE III for Eastern Europe. The objectives of the Workshop were: (a) to bring the benefits of the availability and use of the GNSS signals to the awareness of decision makers and technical personnel from potential user institutions and service providers in the private sector, particularly those in countries with economies in transition, in the region; and (b) to identify actions to be taken and partnerships to be established by potential users in the region to integrate the use of GNSS signals in practical applications to protect the environment and to promote sustainable development. The short- to medium-term results of the Workshop would be the launch of pilot and demonstration projects by Governments, research institutions and the industry that would benefit from the introduction of the technology. The long-term result would be the expansion of the user base of GNSS technologies.

B. Programme

6. At the opening of the Workshop, keynote addresses were delivered by I. Schädler, Federal Ministry of Austria for Transport, Innovation and Technology; K. Brill, Permanent Representative of the United States of America to the United Nations (Vienna); P. Jankowitsch, Chair of the Supervisory Board of the Austrian Space Agency; and the Director of the Office for Outer Space Affairs. The Workshop included the following nine technical sessions: (a) status and developments of the Global Positioning System (GPS), the Global Navigation Satellite System (GLONASS) and Galileo; (b) applications in the Eastern European region; (c) differential system development; (d) GNSS applications for environmental monitoring and disaster management; (e) GNSS applications for natural resource management; (f) GNSS applications for surveying, mapping and Earth sciences; (g) GNSS applications in air transportation; (h) GNSS applications in support of maritime and land transportation and precision timing; and (i) GNSS industry: markets and opportunities. Two discussion panels were convened to address: (a) development of GNSS plans and policy; and (b) implementation issues and challenges. In total, 42 presentations were made.

7. The programme was developed by the Office for Outer Space Affairs and the United States Department of State in cooperation with the Austrian Space Agency and the International Subcommittee of the Civil GPS Service Interface Committee (CGSIC). The Office was also assisted by the CGSIC International Subcommittee in publicizing the Workshop. A small exhibit was organized with the participation of the United States Government and Omnistar.

8. On 26 November 2001 the United Nations Information Service of the United Nations Office at Vienna organized a press conference. The speakers included K. Brill; P. Jankowitsch; M. Shaw, Director, Radionavigation and Positioning, United States Department of Transportation; and F. Vejražka, Vice-Rector and Head of the Department of Radio Engineering, Czech Technical University. The Director of the Office for Outer Space Affairs served as the moderator.

C. Attendance

9. Participants at the Workshop came from the following countries: Austria, Azerbaijan, Bulgaria, Brazil, Canada, Chile, Croatia, Czech Republic, Georgia, Germany, Greece, Hungary, Iran (Islamic Republic of), Italy, Japan, Kazakhstan, Lithuania, Macedonia, Netherlands, Poland, Portugal, Republic of Korea, Romania, Russian Federation, Slovakia, Sweden, Syrian Arab Republic, Tajikistan, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, United States and Uzbekistan. The International Telecommunication Union, the International Atomic Energy Agency, the European Commission, the European Space Agency, the International Hydrographic Organization, the North Atlantic Treaty Organization and the Office for Outer Space Affairs were also represented.

10. Funds allocated by the United States were used to defray the costs of air travel and/or daily subsistence allowance of 38 participants from 11 countries, use of conference facilities and salaries of conference service officers and security staff, supplies and expendable materials and travel and salaries of a consultant. The

Government of Austria covered the cost of using conference rooms. The Austrian Space Agency covered the cost of refreshments provided to the participants. The European Commission defrayed the cost of air travel and per diem to 12 participants from 10 countries.

II. Observations and recommendations

11. Electronic versions of the presentations submitted to the Office for Outer Space Affairs are available on the web site of the Office at the following address: http://www.oosa.unvienna.org/SAP/act2001/gnss2/presentations/index.html

12. The observations and recommendations of the Workshop, which are based on reports submitted by the chairpersons of the technical sessions and panel discussions, are summarized below.

A. Existing and future GNSS systems and their applications

13. Satellite navigation builds upon terrestrial-based radio navigation that has been used by aviation and shipping over the past 100 years. Navigation satellites broadcast signals that are used by a receiver to determine exactly the receiver's position, velocity and precise time worldwide. User receivers of satellite navigation signals measure the distance of the receiver equipment to the satellite using a technique called "passive ranging". In this technique, the distance to each satellite is derived from the measurement of the time the navigation signal needs to travel from the satellite to the receiver. The three-dimensional position of the receiver can be calculated if signals from at least three satellites are available, the signal from a fourth satellite is used to avoid the need for a precise atomic clock at the receiver.

14. Standard GNSS signal processing provides around 100-metre accuracy at the location of the receiver, while precision signal processing provides around 20-metre accuracy. If, in addition to the signals from the satellites, a user receiver also receives the signal of a ground-based reference station, the accuracy at the location of the user receiver is around one metre. Reference stations make differential GNSS (DGNSS) services possible.

15. The session on the existing and future GNSS systems and their applications addressed the status and development of GPS, GLONASS and Galileo, as well as GNSS activities in the Eastern European region, including those relating to differential system development.

Observations

16. The Workshop noted that GPS, a dual-use system implemented by the United States was fully operational and provided an open, civil navigation service free of direct user fees. The space segment of GPS consisted of 28 operating satellites, in order to ensure that there were 24 operating satellites on 6 orbital planes, with 4 operating satellites per plane, at any given time. The Workshop was briefed on civil benefits of GPS modernization and noted that the setting of selective availability to zero was a first step in that process. Efforts were being made to receive user feedback through various channels and methods. The policy of the

United States on GPS had been consistent, even during and after events such as the Gulf War and the terrorist attacks of 11 September 2001. Outreach activities and international cooperation, such as those with the Russian Federation, Europe and Japan, remained an important part of the policy of the United States. The principles for cooperation included no direct user fees, open signal structure, open market-driven environment and protection of the current radio-navigation spectrum.

17. The Workshop was briefed on the status of GLONASS, a dual-use system implemented by the Russian Federation. A federal programme had been approved by the Government of the Russian Federation in August 2001 to re-establish the GLONASS constellation. The constellation was to consist of 24 operating satellites on 3 orbital planes, with 8 operating satellites per plane. At the time of the Workshop, there were 6 operating satellites. The main programme goals included the guaranteed provision of service for international users. The main programme tasks included the strengthening of international cooperation, development of equipment for users that would be competitive on the international market, creation of a new geodesy network and development of scientific and technological basis for further satellite navigation development. The service would continue to be provided free of charge to civilian users.

18. The Workshop was briefed on an initiative by European countries known as Galileo, a civilian programme involving the European Commission, which was responsible for policy development, and the European Space Agency, which was responsible for the technical development programme. Galileo was planned to be operational from the year 2008. The motivation of the European Union for the initiative included achieving sovereignty, autonomy and a guarantee of service for European countries; benefits to industry; certifiable safety of life applications; and availability of complementary and backup systems to GPS and GLONASS. Galileo would provide a variety of global services free of charge to all users, while value-added services would be provided at a cost. The Workshop noted that Europe was implementing the European Geostationary Navigation Overlay Service (EGNOS) System, which was an integral part of the three current interregional systems to enhance the capability of GPS and that EGNOS was planned to be operational in 2004.

19. The Workshop was briefed on the ongoing negotiations among the United States, the European Union and the Russian Federation to achieve system interoperability and compatibility between Galileo and GPS and Galileo and GLONASS, respectively.

20. The Workshop addressed the issues of compatibility and interoperability among existing and future GNSS. Compatibility implied that neither system would harm the other. The Workshop noted that, if combined, the outputs of several interoperable systems would provide improved performance that could not be achieved by a single system. Such performance improvement was expected in availability, accuracy, continuity and integrity.

21. The Workshop was briefed on a wide range of activities with the use and applications of GNSS in Central and Eastern Europe, including those relating to differential GNSS system development.

22. The Workshop noted that the challenges ahead in expanding the use of GNSS included the need for improving the infrastructure, limited appreciation of the

benefits of advanced technology, the limited number of experts and insufficient funding. In the area of geodesy, the lack of both an accurate geoid model and redundancy of measurements presented obstacles.

23. The Workshop noted that currently GPS was the only fully operational GNSS system, although after the year 2010, three systems could be operational. It recognized that involvement in the initiative to establish a unified European reference frame (EUREF) as base system for geodetic measurements in Europe was a key for countries in the region to benefit from GNSS. EUREF created the necessary structure for several institutes to cooperate, share resources, develop and pursue standards, and make tracking and auxiliary data, as well as products of various kinds, publicly available. However, limited resources continued to present obstacles in obtaining optimal benefits.

24. The Workshop noted efforts being made by various countries in the region regarding differential system development and noted that DGNSS could significantly improve accuracy, even under circumstances where there was no selective availability or where the selective availability was set to zero.

Recommendations

25. The Workshop recommended that each country in the region develop an implementation strategy, ensure adequate funding in the use and applications of GNSS and enhance coordination and cooperation within and across the borders. Each country should develop a strategic national plan, with the involvement of users, to address funding, cooperation at all levels and user needs and requirements.

26. At the regional level, it was recommended that pilot projects should be implemented to demonstrate the benefits of GNSS. Such projects could be designed bearing in mind the need to increase consolidation of efforts in the applications of GNSS. Priority applications areas could include safety and management of transportation, with a focus on road transportation. In order for DGNSS to be fully implemented, efforts should be strengthened to increase the awareness of policy makers of the benefits, to establish appropriate national and regional infrastructure, to ensure compatibility in geodetics reference systems within Europe and to secure funding for the implementation of DGNSS through establishing partnerships.

B. GNSS applications to promote sustainable development

1. GNSS applications for environmental monitoring and disaster management

Observations

27. The Workshop noted a wide range of uses and applications of GNSS in such areas as monitoring and surveying of land and water bodies, including accurate monitoring of water level, assessment of environmental impact, mapping of flooded areas and pollution assessment.

28. In order to expand the uses and applications of GNSS in those areas, the Workshop noted the need for simple hardware and software products for users who did not have a high-level technical background and training for potential customers in the use of GNSS-equipped products. The Workshop also noted that decision

makers in general had not been convinced of the need to invest in long-term monitoring projects with the use of GNSS.

Recommendations

29. The Workshop recommended that long-term trials and case studies, using a combination of GPS, GLONASS and Galileo, to integrate the use of GNSS into environmental monitoring and disaster management as well as into hydrological and flood prediction systems. The Workshop also stressed the need for cooperation and exchange of experiences as well as the need to address such issues as cost and power suppliers.

2. GNSS applications for agriculture and fisheries

Observations

30. The Workshop noted that there was a wide range of uses of GNSS in agriculture, including crop and soil monitoring, management of chemical and fertilizer application, irrigation management and the benefits of the use of GNSS for farmers. The Workshop also noted benefits of the use of GNSS in fisheries.

31. While the use of GNSS could offer economically feasible and environmentally sound solutions for increasing productivity in agriculture, the usefulness and benefits of GNSS were not necessarily fully appreciated by farmers. The Workshop noted that it would be useful to have more demonstrations of the practical use of GNSS for farmers. An informal exchange of information between the GNSS experts and farmers could also help farmers understand and increase their appreciation of the benefits of GNSS.

Recommendations

32. The Workshop recommended that, on the basis of user requirements as identified by individual farmers, a comprehensive test-bed procedure should be developed to cover technical, economical and legal aspects of precision farming with the use of GNSS. The Workshop also recommended including value-added services by integrating GNSS data with thematic cartography in a GIS for selected test-bed installations.

33. The Workshop further recommended that a monitoring system should be installed for validation and control of technology acceptance in the context of precision farming.

34. Regarding the role of the United Nations in expanding the use of GNSS technology in agriculture, it was recommended that the United Nations should consider:

(a) The need to increase public understanding of the concept of precision farming and benefits of space-based systems;

(b) Ways for developing countries to apply GNSS technologies;

(c) Specific examples of methods and steps to integrate such technologies into agricultural practices.

3. GNSS applications for surveying, mapping and Earth sciences

Observations

35. The Workshop noted the experiences of countries in Central and Eastern Europe in a wide range of GNSS applications, including such areas as mining and geology, State border control and management, climatology and geoecology. It also noted the successful regional cooperation in geodetic and geodynamics programmes initiated and coordinated by the Central European Initiative, involving 17 countries. Such programmes included the Central Europe Regional Geodynamics Project (CERGOP), which is to be continued in the form of the Central European GPS Geodynamic Reference Network, as well as unification of gravity systems in Central and Eastern Europe. CERGOP had made important contributions to the monitoring and development of EUREF.

36. The Workshop noted that, owing to the accuracy and precision that it offered, GPS revolutionized the way in which the measurement of tectonic deformations was conducted as well as how a precise global terrestrial reference frame was defined and controlled.

37. The Workshop also noted that the basis for all GNSS related scientific analyses was provided by two services of the International Association of Geodesy (IAG), namely the International GPS Service (IGS) and the International Earth Rotation Service (IERS). With the participation of about 100 organizations, IGS aimed to provide a service to support geodetic and geophysical research activities through GPS data and their products.

38. The Workshop noted that in some countries in the region the current national reference frame was not accurate enough. The Workshop also noted that the new European Terrestrial Reference System was unified and homogenous. The present measuring technique with the use of GPS was more precise and provided better coverage than traditional methods. Transformation methods were available to make GPS-derived values compatible with those in national systems.

39. In the fields of climatology and geoecology, the Workshop noted that aerial photos and remote sensed data could be used for mapping.

Recommendations

40. The Workshop recommended the establishment of infrastructure that could be upgraded at a later stage in order to support and exploit new uses of GNSS in scientific research.

41. The Workshop recommended that the European Terrestrial Reference System should be the common reference for State border inventory in all countries. Further initiatives and changes would, however, be necessary in legal regulations.

4. GNSS applications in air, marine and land transportation

Observations

42. The Workshop noted that GPS had significantly raised the platform of aviation safety. Together with the satellite-based augmentation system (SBAS), GPS had made possible more direct en route flight paths, new precision approach services and cost savings from simplified equipment on board aircraft.

43. The Workshop noted that, while the basic GPS had many advantages over conventional navigation aids, such as distance-measuring equipment stations, radio navigation systems, and LORAN C, it still had some limitations. The advantages provided by GPS included fairly uniform accuracy worldwide, three-dimensional position and velocity, and capability to support an unlimited number of users. Some of the limitations of the basic GPS related to the integrity of the service. The notification time was 15 minutes or greater, which was not sufficient for civil aviation.

44. The Workshop noted that GNSS as defined by the International Civil Aviation Organization (ICAO) included: GPS, GLONASS SBAS, ground-based augmentation systems (GBAS), aircraft-based augmentation systems (ABAS) and ground-based regional augmentation systems (GRAS). The Workshop was briefed on the GPS augmentation systems and their benefits. As GPS alone did not meet civil aviation requirements, augmentations had been developed to reinforce integrity, accuracy, continuity and availability of GPS signals, to further improve safety of flight for all operations. While ABAS was the principal augmentation to GPS today, several other augmentations to GPS were under development. Examples of SBAS included the wide-area augmentation system (WAAS), EGNOS, and the Multifunctional Satellite-Based Augmentation System (MSAS). An example of GBAS was the local-area augmentation system (LAAS).

45. The Workshop was briefed on the practical requirements for GPS use, operational procedures, certification criteria and certified airplane systems. The Workshop was also briefed on the certified public use signal in space and the work of ICAO in completing GNSS standards and recommended practices.

46. The Workshop noted that, while GNSS had much potential value, current applications were limited by availability of augmentation systems to meet the level of integrity required by civil aviation. Future augmentations should overcome that limitation. It was also noted that technology that had not been technologically proven would not be allowed to be introduced in the aviation.

47. The Workshop noted that the integration of GPS in civil aviation might need to be pursued in an incremental manner. It also noted that, where there was a political will to improve safety in aviation, such as in areas with a high rate of aviation accidents, there would be more support by the authorities involved in air transportation for the integration of GPS.

48. The Workshop noted that a global strategy might be desirable for SBAS implementation.

49. The Workshop noted that on-board GPS application would depend on the regulations established by the authorities in each country and by airline companies involved. The Workshop noted that research supported new concepts of GNSS applications in aviation.

50. In the field of marine transportation, the Workshop noted the benefits brought by GPS, providing mariners with position-fixing capability for all stages of a voyage under any conditions. The ability to locate mariners in distress within about 100 metres was considered a major breakthrough in search and rescue. The use of DGPS with greater accuracy in electronic charting, surveying, automatic identification systems and high-precision navigation and manoeuvring had allowed

mariners to move to a level of automation and integration of equipment that had previously not been considered possible.

51. The Workshop noted that safety in marine transportation would be ensured by combining the use of GPS and other means to aid navigation.

52. In land transportation, the Workshop noted the use of GPS in surveying and mapping of roads, railways and any linear objects. Benefits of using GPS included high accuracy and cost-effectiveness compared to the use of conventional means of measurements.

53. The Workshop noted that GPS had significantly improved navigation for air, marine and land transportation. Although GPS was a reliable technology, the Workshop noted that the risk of malfunction and technological errors should be borne in mind.

Recommendation

54. The Workshop recommended that methods should be identified for improving the reliability or integrity of GNSS with augmentation by appropriate sensors and equipment, such as compasses, gyroscopes and odometers, and by SBAS, for example, WAAS, EGNOS and MSAS.

5. GNSS applications for timing

Observations

55. The Workshop noted that GPS had become the tool for international time transfer and played an important role in the establishment of the International Atomic Time Scale and thus for the establishment of Universal Coordinated Time.

56. Several relativity effects were corrected in the present GPS. Future systems would require new corrections at the 10-pico-second level as well as corrections of relativistic effects similar to the present ones in order to cover cross-link ranging and interoperability across GNSS systems.

57. The Workshop noted new methods for measuring the time difference of two events that could achieve precision in the order of 10 pico (10^{-12}) seconds, which would achieve better precision than the 1-nano-second precision achieved through the method currently used.

58. The Workshop noted that the greater the number of time laboratories, the better the stability of the time scale. It would be useful to coordinate the work of European time laboratories and to enhance cooperation with laboratories in Africa and America.

59. The Workshop also noted that the control elements and software of some instruments for precision position measurement were not user-friendly.

Recommendations

60. The Workshop recommended that the modernization of GPS should include new requirements for clocks on board satellites.

6. GPS satellite interference

Observations

61. The Workshop was briefed on the GPS satellite interference experienced in Hungary. The Workshop noted that, according to ITU regulations, the frequency band of 1559-1610 MHz was primarily allocated to aeronautical radio-navigation and Space-Earth radio-navigation satellite services; 1550-1645.5 MHz was also allocated to fixed services in specific countries. Thus, the frequency required for the L1 GPS signal was not protected in several countries. The Workshop noted that electromagnetic interference was posing an increasing threat to various GNSS applications.

Recommendations

62. In order to reduce the level of interference, the Workshop recommended using shielded hardware and software and monitoring and mapping the signal environment. The Workshop also recommended that action should be taken through ITU and national frequency regulations to protect the GNSS frequency spectrum. The enforcement of regulations to protect the GNSS frequency spectrum by national communications authorities would also be necessary. The Workshop further recommended that efforts should be coordinated on the matter at regional level.

C. GNSS industry: markets and opportunities

Observations

63. The Workshop noted the views of commercial entities involved in GNSS industry and considered the deployment of GNSS and its impact on all players in upstream and downstream industries, i.e. manufacturers of space-segment infrastructure and supporting group-segment equipment and providers of receiving equipment and value-added services.

64. The Workshop was briefed on the differential GPS service in Japan. The service was provided and paid for by the manufacturers of car navigation equipment. The Workshop was briefed on the use of GPS in rescue services following a major landslide and the subsequent civil engineering work. The Workshop noted that the private sector might not necessarily invest in services related to public safety as it was considered that the cost should be covered by the public sector.

65. The Workshop was presented with a cost-benefit analysis of the deployment of Galileo. Taking a macro-economic approach, the analysis concluded that accumulated total benefits resulting from Galileo by 2020 were estimated to be worth €74 billion with an estimated cost of €6 billion. It was anticipated that the largest user group would be users of personal sets for integrated navigation and communications. Revenues for Galileo-derived services would take off at that point,

and industry would need to ensure that investment profiles were established in anticipation of that event.

Recommendations

66. The Workshop recommended that the States that lacked the resources to participate in regional GNSS projects might consider delegating the responsibility for coordinating the development of relevant national navigation infrastructure to existing service providers.

D. Implementation and management of GNSS technologies

67. The Workshop, through discussion panels, addressed the development of plans and policies as well as implementation and challenges.

Observations

68. The Workshop noted the ongoing efforts to coordinate between GPS, GLONASS and future Galileo. As the use of GNSS increased, coordination among those systems was considered essential in order to maximize benefits from such a unique global technology.

69. It might be useful for some countries to have a coordination body for the use of GNSS within the country. However, the establishment of such coordination body would require a critical mass of users in the country concerned.

70. In order to promote the use of GNSS, each country should endeavour to increase the awareness of the benefits of GNSS among potential users and decision makers. Coordination among government agencies in the country must begin first. In Europe, the European Union could provide top-down influence to promote the use of GNSS, while small countries could work together towards achieving regional coordination. International organizations such as the United Nations could serve as facilitators in promoting cooperation and coordination between countries in the use of GNSS. Coordination with users would also be important, as the users could influence the course of action taken by Governments in developing policies and plans.

71. Resources and funding were being made available by Governments, regional bodies, international organizations and private commercial entities for GNSS related activities. However, additional sources of funding were required to enable developing countries in particular to take advantage of GNSS technology. The World Bank and private banks could be considered as possible sources of additional funding.

72. Attention should be paid to the ground infrastructure needs. Infrastructure that could be used for GPS, GLONASS and Galileo applications would reduce costs.

73. It was noted that consideration could be given to the possibility of eliminating augmentation systems, which would reduce the number of regional systems, and of having one system to cover all regions. It was, however, pointed out that European countries considered reliance on one system to be a high risk.

74. As for replacing infrastructure, it was not considered realistic to phase out existing infrastructure just for the purpose of upgrading. The question of redundancy and cost savings was another major issue to be considered. The deployment of new equipment or services without demand should be avoided.

75. The Workshop considered that public funding should be included in establishing and maintaining infrastructure. Operational requirements developed for and approved by potential operators and customers should become the basis for relevant technical requirements and specifications for user-defined applications. Investment, acquisition and procurement plans should be completed after the market potential had been clearly defined.

76. In addressing implementation issues and challenges, the Workshop considered various ways and means to provide the support required for implementing GNSS programmes, such as increasing awareness and education, standardization and interoperability as well as system procurement.

77. Standardization was noted as a key element in establishing geodetic reference systems. In that regard, the Workshop noted the importance of EUREF.

78. In order to effectively address the question of frequency interference and to ensure spectrum protection for GNSS activities, coordination among governmental entities that were involved in the use of GNSS was considered crucial.

Recommendations

79. The Workshop recommended that efforts should be strengthened to increase awareness among decision makers in Governments and managers in the business community of the importance and usefulness of GNSS technology and its applications. In that connection, space agencies could act as centres of knowledge dissemination.

80. As a way of increasing awareness, national coordinating bodies should consider demonstration projects using GNSS to address region-specific needs. The organization of additional Workshops on GNSS would also contribute to increasing awareness.

81. The Workshop recommended that satellite navigation providers should have a good understanding of the user base and user requirements. Launching a sophisticated system without users would be doomed to fail, as was the case with the Iridium company in the satellite communications industry.

82. The Workshop recommended that, particularly for the benefit of countries that were candidates for membership in the European Union and that were, therefore, sensitive to the European position, a very clear, strong position on satellite navigation should be made by the European Community.

83. The Workshop stressed the importance of coordination at national, regional and international levels in order to further expand and facilitate the use and applications of GNSS.

84. The Workshop recommended that the completion of the unified geodetic reference frame throughout Eastern Europe should be promoted. In that connection, a suggestion was made that some countries of the former Union of Soviet Socialist Republics might consider participating in the implementation of EUREF.

85. In addition to the recommendations on GPS satellite interference (see para. 62), the Workshop recommended that absolute priority should be given to the protection of GNSS from frequency interference. The Workshop recommended that a mechanism should be established for GNSS users to report on interference.