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Implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III)

Implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III): final report of the Action Team on Global Navigation Satellite Systems

Note by the Secretariat

I. Introduction

1. Global navigation satellite systems (GNSS) constitute one of the most promising space applications that can be used to implement the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III).[1] Positioning and timing capabilities based on GNSS space technologies are generating extensive emerging markets for new services and advanced applications when used either as stand-alone systems or in synergy with other systems. In recent years, the use of satellites for navigation, positioning and timing has become an increasingly significant economic activity, with industry revenues projected to grow from over $10 billion in 2002 to $15 billion in 2004.

2. User communities worldwide involved in, for example, disaster management, environmental monitoring, geomatics, precision agriculture, resource conservation, surveying, mapping, transport and timing are becoming increasingly convinced of the need to develop GNSS that provide a safer, more reliable navigation and

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positioning service for civil use. This implies improving the performance of the current service in terms of accuracy, integrity, continuity and reliability.

3. International cooperation at both the political and the technical level is needed for successful implementation of satellite navigation, positioning and timing technology. System provider entities, potential contributor and end-user States, as well as users from industry, service providers and international organizations, need to cooperate closely to ensure the provision of a safe, seamless global satellite navigation, positioning and timing system.

4. Since it is universally accepted that differences in the pace of development around the world should not lead to incompatibility between the elements of navigation and positioning systems, it is desirable for the providers of GNSS to achieve full compatibility and interoperability of regional satellite navigation systems throughout the implementation process.

II. Background

5. UNISPACE III adopted a strategy to address global challenges in the future through space activities. The strategy, contained in "The Space Millennium: Vienna Declaration on Space and Human Development,"[2] included a few key actions to use space applications for human security, development and welfare. One such action was to improve the efficiency and security of transport, search and rescue, geodesy and other activities by promoting the enhancement of, universal access to and compatibility of space-based navigation and positioning systems.

6. In 2001, Member States accorded high priority to a limited number of selected recommendations of UNISPACE III. The Committee on the Peaceful Uses of Outer Space established action teams under the voluntary leadership of member States to implement those priority recommendations. The Action Team on Global Navigation Satellite Systems was established under the leadership of the United States of America and Italy to carry out the recommendation relating to GNSS.

7. The Action Team reported to the Committee and its Scientific and Technical Subcommittee in 2001 concerning its objectives, work plan and final product. The terms of reference of the Action Team, including the purpose, membership, work plan and product, are contained in annex I.

III. Findings and conclusions

8. Satellite navigation builds upon terrestrial-based radio navigation, which has been used by the aviation and shipping communities 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 from the receiver equipment to the satellite using a technique called "passive ranging", by means of which the distance to each satellite is derived from the measurement of the time that 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.

9. Standard GNSS signal processing provides around 13-metre accuracy at the location of the receiver. 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.

10. The global positioning system (GPS), a dual-use system implemented by the United States, is fully operational and provides an open, civil navigation service free of direct user fees. The space segment of GPS consists of 24 operating satellites on 6 orbital planes, with 4 operating satellites per plane, at any given time. Outreach activities and international cooperation, such as those with Japan, the Russian Federation and European countries, remain an important part of the policy of the United States. The principles for cooperation include no direct user fees, an open signal structure, an open market-driven environment and protection of the current radio-navigation spectrum.

11. The global navigation satellite system GLONASS is a dual-use system operated by the Russian Federation. Operational with limitations at present, the constellation will consist of 24 operating satellites on 3 orbital planes, with 8 operating satellites per plane. The main goals of the GLONASS programme include the guaranteed provision of service for international users, strengthening 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 bases for further satellite navigation development.

12. European countries, through the European Union and the European Space Agency (ESA), are developing a system known as GALILEO, which is expected to be operational from the year 2008. GALILEO will provide a set of globally available services designed specifically for civilian users. Those services range from an open service free of direct user fees to a safety of life service, commercial services and a secured, public-regulated service. GALILEO will add to the reliability and continuity of GNSS services through, inter alia, interoperability and compatibility with GPS and GLONASS.

13. In addition to the primary systems, current and planned, there are a number of augmentations operating or in the development stages. Augmentation systems have been and are being developed to reinforce the integrity, accuracy, continuity and availability of GNSS signals. Examples of satellite-based augmentation systems (SBAS) include the Wide Area Augmentation System (WAAS) of the United States, the European Geostationary Navigation Overlay Service (EGNOS) of Europe, the Multifunctional Transport Satellite (MTSAT) Satellite-based Augmentation System (MSAS) and the Quasi-Zenith Satellite System (QZSS) of Japan, the GPS and Geo Augmented Navigation system (GAGAN) of India, and planned SBAS on a Nigerian communications satellite.

A. Needs and concerns of developing countries

14. The Action Team recognized that GNSS applications and user needs in the industrialized world were well understood. Consequently, it focused on what should be done to promote the use of GNSS in developing countries.

15. GNSS is an extremely valuable tool across a broad range of applications and requirements. GNSS technology provides an opportunity for developing countries to take advantage of applications that improve the quality of life, contribute to social and economic progress and support priorities for sustainable development. The technical advances in GNSS over the last 20 years have resulted in streamlined processes, software, instrumentation and relatively inexpensive basic user equipment.

16. However, the benefits of GNSS are not fully recognized or taken advantage of, in particular in developing countries, for a variety of reasons. In order to help developing countries benefit from GNSS applications, the Office for Outer Space Affairs organized, within the framework of the United Nations Programme on Space Applications, a series of workshops focusing on capacity-building in the use of GNSS in various areas of applications. Four regional workshops (Kuala Lumpur, August 2001; Vienna, November 2001; Santiago de Chile, April 2002; and Lusaka, July 2002) and two international meetings (Vienna, November 2002 and December 2003) were organized with the technical and financial support of the United States Government. Co-sponsorship was also provided by ESA.

17. The regional workshops provided an opportunity for outreach and assessment of the particular needs of developing countries. A questionnaire was developed and circulated to participants by the Office and the results were made available to the meeting of experts in November 2002. That information, along with communications with various workshop participants, assisted the Action Team in the identification of key areas of interest and the challenges facing people wishing to integrate GNSS into their field of work or application.

18. The needs of developing countries are concentrated in the following areas:

(a) *Institutional needs*:

(i) Education of decision and policy makers to support application efforts; government support for GNSS technology; and increasing the level of interest in and awareness of new ways of doing things;

(ii) Capacity-building;

(iii) Dissemination of reports and recommendations via United Nations channels to Governments of all countries involved; and highlighting the benefits of GNSS technology and applications to policy and decision makers in order to increase financial and political support;

(iv) Exploring the feasibility of establishing an international GNSS mechanism to promote and foster technology and applications;

(v) Continuation of the United Nations workshops and implementation of resulting recommendations, which are seen as highly valuable in building capacity and enhancing understanding, as well as providing a network of professionals, educators and students;

(b) *Technical needs*:

(i) Understanding of the ionospheric effect on integrity, continuity, availability and accuracy of GNSS applications as a matter of priority especially in equatorial areas;

(ii) Clear and regular communication with developing countries so that they have an opportunity to assess the likely impact of future developments of GPS/GALILEO and various augmentations;

(c) *Resources and financial needs*

The required instrumentation, ancillary equipment, computer and software are still costly for developing countries given their economic levels, in spite of the decline in costs in general, and it is difficult to obtain resources to cover maintenance and recurrent costs;

(d) *Training and education needs*

(i) Development of advanced training programmes by the United Nations to cover various applications, such as civil aviation, precision measurements and remote sensing, and to cover all aspects, including observations, analysis and implementation;

(ii) Overcoming the limited education and training opportunities as well as the limited access to qualified people and information; this is complicated by the lack of experts in the various areas noted above.

B. Institutional models for international cooperation

19. As future components of the overall GNSS architecture develop worldwide, the need for an international framework to support operational coordination and exchange of information among system designers and operators and national and international user communities will be increasingly important. The focus should no longer be on explaining the basic principles of GNSS or on trying to educate the general public, the scientific community at large or policy makers about the benefits of GNSS. System operators of GNSS and their augmentations must move beyond simple outreach. The assumption is that current and future system operators will soon move from a strictly competitive to a more collaborative mode where there is a shared interest in the universal use of GNSS services regardless of the system. If this is to be the case, then the real challenge now is to provide assistance and information for those countries seeking to integrate GNSS and its augmentations into their basic infrastructure at all levels (i.e. commercial, scientific and governmental).

20. The framework to be discussed will be most favourable to service-providing Governments if flexible mechanisms are put in place and the focus of those mechanisms is providing improved service to users.

21. The following categories of international cooperation in providing GNSS services are offered for consideration:

(a) *Coordination*: (i) among core GNSS service and augmentation providers; and (ii) national and/or regional planning;

(b) *Dissemination* of information on GNSS to users and provision of technical assistance for the integration of GNSS into national infrastructures;

(c) *Identification* of users' needs and desires regarding GNSS.

1. Coordination

(a) Coordination among GNSS service providers

22. On the basis of work conducted at the United Nations workshops and meetings of the Action Team, the following objectives for international GNSS cooperation have been identified with respect to GNSS development and the provision of basic GNSS services:

(a) To reduce the complexity and cost of user equipment, GNSS providers should pursue greater compatibility and interoperability among all future systems (such as GPS III, GLONASS K, GALILEO and augmentations) in terms of signal structures, time and geodetic reference standards;

(b) To protect the investment of the current user base, GNSS providers should ensure that current services are continued for existing user equipment on a free and non-discriminatory basis for a reasonable time frame (e.g. existing user equipment life time);

(c) To ensure continuity and integrity of GNSS services and augmentations, operators should take steps with national administrations to protect against interference with national and regional infrastructures (e.g. satellites or ground stations);

(d) To ensure continuous reception of GNSS services, all nations should consider, as a matter of priority, the protection of the radio spectrum allocated for GNSS services from interference, both domestically and internationally;

(e) Mechanisms to receive feedback from users should be enhanced.

23. In order to collectively discuss each of these recommendations and to identify actions for implementation, the establishment of a service provider cooperation mechanism, such as an international committee on GNSS, could be established. This would be achieved through a multilateral arrangement between the Governments and/or organizations that currently provide or plan to provide global GNSS services and maintain corresponding infrastructure, that is, the Russian Federation, the United States and the European Union. Proposed terms of reference are contained in annex II for consideration by potential members of the international committee.

24. The international committee could also include current and future providers of regional augmentation systems. In addition to the above objectives, the international committee should look into ways of optimizing compatibility, interoperability, availability and reliability of the core systems. Among other things, it could facilitate information exchanges among GNSS providers on system modernization/development to ensure compatibility and interoperability. The international committee should also identify mechanisms for and implementation of measures to protect the reliability and integrity of signals at the national, regional and global levels; and coordinate modernization/development activities to meet user needs, in particular in the developing world.

25. Since compatibility and interoperability are highly dependent on the establishment of standards for service provision and user equipment, standard- setting will be another topic that the international committee would need to address. However, it should avoid efforts to set standards itself and should instead look for applications where no standards currently exist, such as land transport, and recommend possible organizations that could appropriately set new standards. Consultation with existing standard-setting bodies such as the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO), the International Telecommunication Union (ITU) and the International Organization for Standardization (ISO) will also be required. In addition, the Office for Outer Space Affairs through the United Nations Programme on Space Applications, could play a useful role in demonstrating to developing countries the practical benefits of GNSS and assisting the international committee in integrating GNSS into infrastructures of developing countries.

26. Such a committee would provide a mechanism for coordination among service providers and could in turn establish a mechanism to receive user feedback through coordination of activities and plans of system modernization and development:

(a) To ensure compatibility and interoperability in terms of signal structure, time and geodetic reference standards;

(b) To establish standards for service provision and user equipment;

(c) To reduce the complexity and cost of user equipment;

(d) To ensure continuity of existing services for a reasonable period of time to protect the investment of the current user base;

(e) To maintain the use of systems on a free and non-discriminatory basis;

(f) To advocate long-term protection of the spectrum reserved for GNSS.

27. The following membership could be envisaged for the international committee:

(a) Core GNSS system providers and developers/customers of GPS, GLONASS and GALILEO;

(b) Global user organizations such as the International GPS Service, the World Meteorological Organization, the United Nations Environment Programme and the secretariat for International Strategy for Disaster Reduction;

(c) Providers of augmentation systems such as WAAS, EGNOS, MSAS and QZSS.

(b) National and regional planning and governance

28. Establishing national and/or regional planning groups for GNSS that would address regulations, user needs and so on is clearly an important objective. Many countries are searching for an organizational model to use at the national level for coordinating and governing use of GNSS. The existing GNSS service providers or new entities could be used as such coordinating bodies. In some cases, various science and transport authorities (e.g. air navigation service providers) could lead the coordinating bodies.

29. The regional centres for space science and technology education affiliated with the United Nations are possible entities that could be given the task, in conjunction with the proposed international committee on GNSS, of GNSS planning and organization at the regional level. However, owing to lack of resources, some Governments might have to consider delegating the responsibility of coordinating the development of relevant national navigation infrastructure to existing service providers

2. User support and dissemination of information

30. The need for a link between users, equipment manufacturers, service providers and core system providers was highlighted in several of the regional workshop reports and in the deliberations that occurred during the international expert meetings on GNSS held in Vienna in 2002 and 2003. The objective is to increase awareness among users, provide information that is critical to users with respect to provision of GNSS services and to ensure that core system providers take into account user feedback.

31. The type of information that needs to be relayed from service providers to users includes, but is not limited to the following:

(a) Dissemination of GNSS system status information such as satellite health and satellite maintenance and testing schedules. Satellite outages within the core GNSS architecture have a direct impact on the level of service that is available for a given GNSS application. Predictive tools exist in some application sectors such as aviation that can allow users to determine when poor service availability is likely and then plan accordingly;

(b) Provision of timely notification of service denial or degradation through intentional or unintentional interference is critical. The dependency of users on GNSS is comparable to, if not greater than, other familiar services and utilities such as telecommunication and electrical services.

Implementation mechanism

32. User information centres should be established by each individual service provider. The maintenance of a globally focused web site would be a major task of such centres.

33. For GPS, the Navigation Information Service managed by the United States Coast Guard Navigation Center is the primary means of disseminating information to civil users. This is accomplished mainly through a web site that includes links to many sources of GPS information. For GLONASS, similar web sites exist that are managed by the Russian military and the Russian Aviation and Space Agency (Rosaviakosmos). Similarly, the European Commission also provides a web-based portal for the GALILEO project. Regionally focused web pages would be the responsibility of selected regional or national points of contact.

34. Dissemination of information among users can also be improved by organizing national GNSS user groups as providers of input to the consolidated web site. Existing user groups with government sponsorship include the United States Civil GPS Service Interface Committee. Industry groups include the United States GPS Industry Council, the Japan GPS Council and the Scandinavian GNSS Industry Council. The federated web-based information system of the International GPS

Service serves the scientific and research community, as well as high-accuracy users of any category.

35. This web-based information resource should probably take advantage of existing web sites, such as those previously mentioned, to the maximum extent possible. However, since the resource will be used by all nations of the world and their GNSS user communities, great care will need to be taken to ensure that the information available is easy to access for all. This will require web site design or redesign that includes options for text only to allow usable access to those with low data transmission rates. Translation of as many documents and materials as possible included in the nested set of web sites should also be considered.

36. The Office for Outer Space Affairs could combine all the web sites into a single site to act as a portal for any user of any GNSS service or regional component of a service.

3. Identification of users' needs and desires regarding GNSS

37. Collection of information from the user community could be implemented by the following means:

(a) With help of information exchange based on an international GNSS user information centre;

(b) Through regional workshops with participation by representatives of the international committee.

IV. Recommendations

38. A number of sources provided a series of recommendations for promoting a more efficient use of GNSS technology around the world. The four regional workshops held in 2001 and 2002, the international expert meetings on GNSS held in late 2002 and 2003, responses to questionnaires sent to experts, participants and service providers at those meetings as well as inputs from members of the Action Team on Global Navigation Satellite Systems are just a few of the sources. The recommendations are summarized below.

A. Recommendations regarding an institutional framework addressed to service providers

1. Creation of an international committee on global navigation satellite systems

39. An international committee on GNSS would provide a mechanism for coordination among service providers to address, among other things, coordination of activities and plans for system modernization and development:

(a) To encourage compatibility and interoperability in terms of signal structure, time and geodetic reference standards;

(b) To establish standards for service provision and user equipment;

(c) To reduce the complexity and cost of user equipment;

(d) To ensure continuity of existing services to protect the investment of the current user base;

(e) To maintain the use of the systems on a free and non-discriminatory basis;

(f) To advocate long-term protection of the spectrum reserved for GNSS.

40. The international committee could be established through a multilateral agreement among providers of GNSS and regional augmentations systems and might be modelled on the Committee on Earth Observation Satellites (see www.ceos.org/pages/overview.html), with secretariat responsibility rotating among its members on an annual basis. This possibility could be examined further. The Office for Outer Space Affairs and ICAO could be affiliated at some level in order to provide an exchange of information on user needs and to support the broader objective of integrating GNSS and its augmentations into the basic infrastructures of developing countries.

2. Development of user information centres and web sites

41. Each GNSS and/or regional augmentation provider should establish user information centres. Maintenance of a web site would be a major task for such centres. The United Nations, the international committee or another international body should combine all the web sites into a single site to act as a portal for any user of GNSS and/or their augmentations. Such a portal could become part of the web site of the Office for Outer Space Affairs, to be maintained by the Office in cooperation with the international committee.

B. Recommendations regarding an institutional framework addressed to the Office for Outer Space Affairs

Recommendation 1. The United Nations should continue to hold regional workshops.

42. The series of United Nations regional workshops has been helpful to service providers as a means of collecting input from users. It was also useful as a means of promoting the use of GNSS and their augmentations in developing countries. The workshops should therefore continue in the same manner with a focus on user input. Conducting workshops in connection with well-attended international GNSS meetings may also be desirable.

Recommendation 2. Support should be given for the establishment of national (and perhaps even regional) GNSS planning and coordination groups.

43. Appropriate organizational models and best practices should also be provided.

Recommendation 3. An assessment of current institutional models should be commissioned.

44. This activity would include the assessment of international cooperation and coordination as well as identification of models with potential applicability to evolving GNSS systems and services. Careful consideration should be given to flexible, informal mechanisms and existing organizations that already attempt to provide informational services for GNSS users.

45. At the national level, there is loose organization with regard to provider-user coordination and there is no one single organization that assumes end-to-end responsibility for GNSS. Applications are often fragmented. Developments are underfunded. There is a lack of knowledge and understanding at high decision-making levels on how to utilize the new technology and incorporate appropriate processes at the organizational level. Clearly, there is a need to improve communications between service providers and those decision makers to demonstrate the cost-effectiveness of GNSS technology by showing examples of applications and solutions to problems.

46. The main difficulty is to find common interest with specialists in various fields, such as aeronautics, marine and land navigation and mobile robots. Efforts are required to unify an approach to navigation and positioning in order to optimize synergy that will include many diverse applications and users.

Recommendation 4. Support should be provided for capacity-building for GNSS education and training.

47. The regional conferences have identified the fact that there are very few experts in the new technology, in particular in least developed countries. This underscores the need:

(a) To develop skills and knowledge of university educators, researchers and scientists through theory, research, field exercises and pilot projects;

(b) To have the regional centres for space science and technology education, affiliated with the United Nations, consider the inclusion of GNSS programmes in their training activities;

(c) To train the final users in the multiple GNSS applications to create a critical mass of trained personnel at the regional and national levels.

48. It was also noted that there was a need for publication of GNSS-related materials in languages other than English.

Recommendation 5. Help should be given in promoting the use of GNSS.

49. The reports of the United Nations/United States regional workshops on GNSS (A/AC.105/771, A/AC.105/776, A/AC.105/785 and Corr.1 and A/AC.105/795) should be distributed through official United Nations channels, in particular among Governments of developing countries.

C. Recommendations specific to global navigation satellite system applications

1. Aviation

Recommendation 1. Research should be encouraged into the development of ionospheric models, including measurements related to GNSS, as also the exchange of related information.

50. GNSS signals have been available for many years. However, such parameters as GNSS integrity, continuity, availability and accuracy still do not meet the more stringent requirements that are expected for certain applications, for example,

aviation. Region-specific phenomena such as the geomagnetic equatorial anomaly have a significant impact on determining regional solutions for equatorial regions and the southern hemisphere rather than the northern hemisphere. Collecting and analysing ionospheric data to determine optimal algorithms for ionospheric models of the region will be a challenge finding a solution to which would increase international understanding for sharing information among independent GPS augmentation systems and encourage the shared use of communication satellites.

Recommendation 2. The feasibility of implementing a "One African Sky" concept in the upper en-route similar to the "Single European Sky" initiative currently under way in Europe should be considered.

51. Successful implementation of GNSS in other parts of the world shows that the utilization of the technology and reaping the associated benefits will make it necessary for institutions that were built around ground-based aviation to change in order to fully exploit the technology. They must also allow for the expansion of air travel and the resulting expansion of African economies. The establishment of the new African Union allows the opportunity for a fresh look at these structures and processes.

Recommendation 3. The Office for Outer Space Affairs and ICAO should continue to encourage adoption of GNSS on the African continent.

52. To that end, it is recommended that the United Nations and ICAO host, within a short period of time, an executive-level session on GNSS with all African directors-general of civil aviation in order to begin to address the challenges mentioned above in accordance with the three-phase GNSS implementation strategy approved by the African-Indian Ocean Planning and Implementation Regional Group of ICAO at its fourteenth meeting, in June 2003.

53. Specific actions for the session could be:

(a) To agree on a small number of regions;

(b) To set up a task force within each region to begin to harmonize structures;

(c) To participate actively in the GNSS Africa Implementation Task Force set up by the African-Indian Ocean Planning and Implementation Regional Group;

(d) To establish cross-regional mechanisms so as to solve cross-regional problems once standardized procedures are adopted;

(e) To establish a uniform model for cost recovery;

(f) To have an existing higher education institution develop an academic programme to support the implementation of GNSS under the leadership of the regional "advocates".

2. Surveying, mapping and Earth science

Recommendation 1. A continental reference for Africa, or African reference frame, consistent with the International Terrestrial Reference Frame, should be established.

54. A uniform coordinate reference system is fundamental to any project, application, service or product that requires some form of georeferencing. Many developing countries, in particular African countries, would benefit greatly from a modern GNSS-based reference system that could be used for national surveying, mapping, photogrammetry, remote sensing, spatial data infrastructure (SDI), geographical information systems (GIS), development programmes, and hazard mitigation (studies and monitoring of earthquakes, fault motion, volcanoes and severe storms). Many existing national coordinate systems are based on reference figures of the Earth that are generally outdated and are restricted to a particular country, making cross-border or regional mapping, development and project planning very difficult. A continental reference system for Africa should be organized through an international project, with common goals and objectives throughout Africa, and with the commitment of African countries and the support of international partners. The benefits of GNSS technology cut across applications and across countries. It is further emphasized that the importance of simultaneous development of information and communication technology and related infrastructure is necessary for sustainable use of GNSS. Policy and decision makers should be made aware of the critical importance of information and communication technology to the successful utilization of GNSS.

Recommendation 2. The development of integrated DGNSS "full-scale accuracy" infrastructure with well-defined unified standards at regional levels (i.e. the European Position Determination System (EUPOS) in Europe should be expanded.

55. A subject of further discussion within the framework of the United Nations/United States regional workshops on GNSS could be problems relating to multifunctional DGNSS applications in Central and Eastern Europe, for example, EUPOS, its development for all of Europe and eventually as an element of GALILEO and EGNOS. Similar DGNSS systems can be developed for other regions in the world.

Recommendation 3. The density of the Continuous Operating Reference Station (CORS) should be increased for the areas of the Geocentric Reference System for the Americas (SIRGAS) of Latin America and the Caribbean in order to promote the use of GNSS and CORS (covering all of the Americas).

56. In spite of the existence of the SIRGAS structure, these activities are facing serious financial difficulties, which are impeding the development of GNSS applications.

Other recommendations

57. Other recommendations in the area of surveying, mapping and Earth sciences include: (a) ensuring that SDI will be based on a consistent geodetic reference frame enabled by GNSS and other space techniques; (b) monitoring of GNSS frequencies

for interference at the local and national levels; and (c) the development of accurate geoid models.

3. Management of natural resources, environment and disasters

58. Precision agriculture has attracted many new users to GNSS for the management of natural resources and protection of the environment. The rising numbers of GNSS users in those areas is expected to increase, as seen from the four United Nations/United States regional workshops on GNSS. Other sources of funding should be explored to implement the establishment of a global information exchange network related to precision agriculture and GNSS applications in the management of the environment and natural disasters. Many suggestions and recommendations were made in those areas at all four regional workshops. The significance of GNSS in the area of disaster preparedness and management was highlighted in particular.

59. Management of the environment and natural disasters is of major concern in Africa and other parts of the world. However, the plight of the African region is such that the two initiatives recommended below have been selected for priority attention on the part of the international community.

Recommendation 1. Demonstration projects should be set up in the area of agriculture and health to convince and attract the attention of government policy and decision makers in Africa.

60. Agriculture is the mainstay of the economies of most African countries. However, there is a lack of knowledge of the economic, political and professional benefits of effective use of GNSS in agricultural development and diversification (in areas such as crop production, processing and planning, animal health and production and fisheries).

Recommendation 2. International donors should support disease vector mapping projects in Africa using GNSS.

61. This will enhance understanding of the spread of killer epidemics such as the acquired immune deficiency syndrome (AIDS) and malaria prevalent in Africa. Governments do not appreciate the impact that the technology of GNSS can have in enhancing management of health resources and disease control.

D. Conclusion

62. These recommendations were selected from among a large number of proposals and recommendations made at the four United Nations/United States regional workshops and the two international meetings of experts. Many of them included additional information and suggestions as to whom and how they should be carried out. Reference should be made to the individual reports of the workshops (see para. 49) and the meetings (A/AC.105/801 and A/AC.105/821).

Notes

[1] *Report of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, 19-30 July 1999* (United Nations publications, Sales No. E.00.I.3).

[2] Ibid., chap. I. resolution 1.

Annex I

Terms of Reference of the Action Team on Global Navigation Satellite Systems

A. Purposes

1. The purpose of the Action Team on Global Navigation Satellite Systems are:

(a) To survey current international and regional efforts to achieve a seamless multi-modal satellite-based navigation and positioning system throughout the world;

(b) To assess institutional models of international cooperation and coordination systems and services and GNSS users' interests;

(c) To propose specific recommendations for the United Nations and other international organizations on actions that should be taken;

(d) To promote GNSS user interests and to increase the level of awareness, improve the quality and facilitate utilization of GNSS services, in particular in developing countries;

(e) To propose specific recommendations on global coordination and cooperation.

B. Membership

2. Membership of the Action Team is open to any interested Member States of the United Nations as well as to entities of the United Nations system and other intergovernmental and non-governmental entities.

3. The following States and organizations are members of the Action Team:

States

Australia, Austria, Belarus, Brazil, Bulgaria, Canada, Chile, China, Colombia, Czech Republic, Egypt, France, Germany, Hungary, India, Iran (Islamic Republic of), Iraq, Italy, Japan, Lebanon, Malaysia, Mexico, Mongolia, Morocco, Nigeria, Pakistan, Philippines, Poland, Portugal, Republic of Korea, Romania, Russian Federation, Saudi Arabia, Syrian Arab Republic, Turkey, Ukraine, United States of America, Zambia

Organizations

Economic and Social Commission for Asia and the Pacific, International Civil Aviation Organization, International Telecommunication Union, Bureau international des poids et mesures, European Commission , European Space Agency, European Organisation for the Safety of Air Navigation, American Institute of Aeronautics and Astronautics, Civil GPS Service Interface Committee, European Association for the International Space Year, International Association of Geodesy, International Association of Institutes of Navigation, International Cartographic Association, International Federation of Surveyors, International GPS Service.

C. Work Plan

4. The work plan of the Action Team is as follows:

(a) To compile information on national and international outreach activities designed to promote the use of GNSS for sustainable development, economic growth and scientific research;

(b) To compile information on the level of awareness and capacity of developing countries to use GNSS services and applications;

(c) To conduct an inventory of requirements of developing countries for GNSS services and applications and identify gaps in meeting those requirements;

(d) To consider ways in which entities of the United Nations system, non-governmental entities and international organizations and Member States of the United Nations could play a role in filling those gaps;

(e) To request other entities of the United Nations, through the Office for Outer Space Affairs, to report on their use of GNSS to meet their respective mandates;

(f) To evaluate the results of the series of United Nations regional workshops on GNSS organized within the framework of the United Nations Programme on Space Applications, with a view to identifying common themes.

D. Product

5. The product of the work of the Action Team is a report with information on relevant national and international activities on promoting use, access to and quality of GNSS services. The report includes proposals for specific recommendations to the Committee on the Peaceful Uses of Outer Space and other relevant United Nations bodies, non-governmental entities, Member States of the United Nations and international organizations concerning development, coordination and increased use of GNSS, in particular for the benefit of developing countries.

E. Meetings

6. The Action Team held eight meetings during the annual sessions of the Committee on the Peaceful Uses of Outer Space and its Scientific and Technical Subcommittee, as well as in conjunction with activities organized by the Office for Outer Space Affairs, as follows:

(a) First meeting (Vienna, 30 November 2001), in conjunction with the Second United Nations/United States of America Regional Workshop on the Use and Applications of Global Navigation Satellite Systems;

(b) Second meeting (Rome, 25 January 2002), in conjunction with the twenty-second session of the Inter-Agency Meeting on Outer Space Activities;

(c) Third meeting (Vienna, 27 February 2002), during the thirty-ninth session of the Subcommittee;

(d) Fourth meeting (Vienna, 4 June 2002), in conjunction with the forty-fifth session of the Committee;

(e) Fifth meeting (Vienna, 15 November 2002), in conjunction with the United Nations/United States of America International Meeting of Experts on the Use and Applications of Global Navigation Satellite Systems;

(f) Sixth meeting (Vienna, 18 February 2003), during the fortieth session of the Subcommittee;

(g) Seventh meeting (Vienna, 10 June 2003), during the forty-sixth session of the Committee;

(h) Eighth meeting (Vienna, 11 December 2003), in conjunction with the United Nations/United States of America International Workshop on the Use and Applications of Global Navigation Satellite Systems.

Annex II

Draft terms of reference of a proposed international committee on global navigation satellite systems

Preamble

Global navigation satellite systems (GNSS) have evolved from an early period of limited programmes to a point where a number of systems and their augmentations are under way or planned. In the future, a number of international and national programmes will operate simultaneously and support a broad range of interdisciplinary and international activities. Discussions taking place at the national, regional and international levels have underscored the value of GNSS for a variety of applications. The emergence of new GNSS and regional augmentations has focused attention on the need for the coordination of programme plans among current and future operators in order to enhance the utility of GNSS services.

The representatives of GNSS system providers, GNSS system augmentation providers and the international organizations primarily associated with the use of GNSS,

Aware of the overlap of GNSS mission objectives and of the interdisciplinary applications of GNSS services,

Recognizing the advantages of ongoing communication and cooperation among operators of GNSS and their augmentations,

Recognizing also the need to protect the investment of the current user base of GNSS services through the continuation of existing[a] services,

Aware that the complexity and cost of user equipment should be reduced whenever possible,

Convinced that GNSS providers should pursue greater compatibility and interoperability among all current and future systems in terms of signal structures, time and geodetic reference standards to the maximum extent possible,

Desiring to promote the international growth and potential benefits of GNSS,

Have agreed to establish the International Committee on Global Navigation Satellite Systems for the purpose of promoting the use and application of GNSS.

The aim of the Committee is to facilitate the exchange of information among users and providers of GNSS services with the view to promoting GNSS applications on a global basis, without prejudice to the roles and functions of GNSS service providers and intergovernmental bodies such as the International Telecommunication Union, the International Civil Aviation Organization and the International Maritime Organization.

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[a] While users may wish to have services continue as long as possible, service providers could continue services only for a reasonable time period as they would continue to improve their systems.

Objectives

The objectives of the Committee are:

(a) To benefit users of navigation services through consultations among members of the Committee;

(b) To encourage coordination among providers of GNSS core systems and augmentations in order to ensure greater compatibility and interoperability;

(c) To encourage and promote the introduction and utilization of satellite navigation services, in particular in the developing countries, through assistance with the integration of GNSS services into their infrastructures;

(d) To assist both the members of the Committee and the international user community by, inter alia, serving as the focal point for the international exchange of information related to GNSS activities;

(e) To better address future user needs in the GNSS development plans and applications.

Members and observers [b, c]

National or international entities that are responsible for GNSS and their augmentations or are involved in promoting GNSS services and applications and that are eligible for membership or observer status in the Committee are:

(a) *GNSS system providers*. GPS (United States), GLONASS (Russian Federation) and GALILEO (European Union);

(b) *GNSS augmentation system providers*. GAGAN (India), EGNOS (European Union), WAAS (United States of America) and MSAS (Japan) and other compatible systems;

(c) International organizations and associations dealing with global GNSS service and applications may participate as members or observers. Potential members or observers[d] could include the Office for Outer Space Affairs, the International Civil Aviation Organization, the International Maritime Organization, the International Telecommunication Union, the Civil GPS Service Interface Committee, the International Association of Geodesy, the International Association of Institutes of Navigation, the International Cartographic Association, the

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[b] The terms of reference of the international committee would need to specify the roles of "members" and "observers". While "members" would participate in the decision-making process of the Committee, "observers may not participate in the decision-making and would provide advice when requested, monitor the work of the Committee and report back to their legislative bodies. "Observers" would not be expected to assume the secretariat role, host meetings and provide support to a permanent secretariat that might be established. There should be, however, a meaningful role for "observers". The definitions of "members" and "observers" should be further examined, taking into account the experience of other international bodies, such as the Committee on Earth Observation Satellites.

[c] Consideration could be given to establishing a "Providers' Board" within the Committee, to take decisions among system providers.

[d] Regional coordination bodies, if any, could be included as observers.

International GPS Service, the International Society for Photogrammetry and Remote Sensing and the International Federation of Surveyors.

The addition of members will be with the consensus of current members of the Committee.

Organization of work

The Committee will convene at least once every year in plenary session. Meetings of the Committee will be organized and chaired by the designated host organization. Each member should designate its principal and its point of contact. Any change in the principals or points of contact should be communicated to the Chairperson of the Committee.

The Committee may establish, as mutually agreed and on an ad hoc basis, special temporary working groups to investigate specific areas of interest, cooperation and coordination and to report at subsequent plenary meetings. Continuation of each ad hoc working group requires confirmation at each plenary session.

Conclusions resulting from the plenary sessions, or the findings and recommendations of ad hoc working groups, will be decided upon on the basis of consensus. Decisions are recommendations and do not create legal obligations.

It is understood that members of the Committee would ultimately determine their activities. However, the Committee may consider undertaking the following activities:

(a) Since compatibility and interoperability are highly dependent on the establishment of standards for service provision and user equipment, adoption of and adherence to common standards could be a topic that the Committee might need to address. However, the Committee itself would not set standards and should instead identify applications where no standards currently exist, such as land transport use of GNSS, and recommend possible organizations that could appropriately set new standards. Consultation with existing standard-setting bodies such as the International Civil Aviation Organization, the International Maritime Organization, the International Telecommunication Union and the International Organization for Standardization would also be required;

(b) The Committee could consider the establishment of user information centres by GNSS providers. The maintenance of a globally focused web site would be a major task of those centres. The United Nations, through its Office for Outer Space Affairs, could combine all the web sites into a single site to act as a portal for any user of any GNSS service;

(c) The Committee could organize and sponsor regional workshops and other types of activity in order to achieve the objectives of the Committee;

(d) The Committee could establish links with national and regional authorities, in particular in developing countries. This could include establishing mechanisms to identify and eliminate sources of electromagnetic interference that can degrade signals from GNSS and their augmentations as well as other infrastructure issues;

(e) The Committee could consider and may make recommendations and agree on actions to promote appropriate coordination across GNSS programmes. Furthermore, the Committee could encourage its members to maintain communication as appropriate with other groups and other organizations involved in GNSS activities and applications through the relevant channels within their respective Governments or organizations.

Structure of the international committee [*to be refined*]

Chairperson

Member Board

Executive secretariat

Ad hoc working groups

Financing [to be clarified]

Value of contribution of each member for (a) permanent work of the secretariat; and (b) implementation of recommendations.