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United Nations/United States of America Workshop on the Use of Global Navigation Satellite Systems

Contents

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I. Introduction

A. Background and objectives

1. The present report describes the organization and outcome of the fourth in a series of regional workshops sponsored by the United Nations and the United States of America and co-sponsored by the European Space Agency (ESA), to promote the use and applications of global navigation satellite systems (GNSS). The United Nations/United States of America Workshop on the Use of Global Navigation Satellite Systems, hosted by the Government of Zambia, was held at the Mulungushi Conference Centre in Lusaka from 15 to 19 July 2002 for the benefit of countries of Africa and Western Asia.

2. The objective of the Workshop was to demonstrate how navigation and positioning technology could help solve problems of regional or global significance, given that GNSS are considered one of the key technologies in stimulating economic and social development, especially in developing countries. The Workshop was also intended to contribute to education and awareness about satellite navigation technology in user communities of Africa and Western Asia.

3. GNSS constitute one of the most promising space applications that can be used to implement the recommendations adopted during the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III).[1] The 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 $7 billion in 2000 to over $9 billion in 2002.

4. User communities worldwide (working, for example, in disaster management, monitoring of the environment, 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 positioning service for civil use. That implies improving the performance of the current service in terms of accuracy, integrity, continuity and reliability.

5. International cooperation at both the political and the technical level is needed for the successful implementation of satellite navigation and positioning 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 and positioning system.

6. 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.

7. UNISPACE III identified the need to determine precise locations on the ground for use with Earth observation images and ancillary information in geographical information systems (GIS). That location information is needed for a large number of remote sensing applications, some of which support such strategic areas for development as disaster management, monitoring and protecting the environment, management of natural resources and food production. With the availability of high-resolution images, some applications will require a location precision of the order of one metre. GNSS provide a signal that can serve that purpose and in addition could be used for a large range of other applications with economic benefits for the user.

8. The Workshop aimed to increase the awareness of participants of the intrinsic value of GNSS signals in a sustainable development context and to motivate them to make use of them in their own programmes and projects. A direct result would be an expanded user base, which would probably include a network of experienced and beginner users from governmental and academic institutions as well as from the private sector.

9. The Workshop was aimed specifically at: (a) bringing the benefits of the availability and use of GNSS signals to the awareness of decision makers and technical personnel from potential user institutions as well as to service providers in the private sector, in particular in developing countries; and (b) identifying actions that could be taken and partnerships established by potential users to increase the user base and to take advantage of the economic and social benefits that can be derived from the GNSS applications.

B. Programme

10. The programme for the Workshop was developed by the Office for Outer Space Affairs and the State Department of the United States of America in cooperation with the Ministry of Science, Technology and Vocational Training. The five-day programme consisted of presentations on GNSS systems, as well as presentations illustrating the various applications of the technology. It included a total of 33 technical presentations by speakers from 15 countries and regional organizations. Thematic group discussions of from one to three hours were also held. Five working groups established at the Workshop discussed the following: GNSS systems; GNSS applications for the management of natural resources and the environment; surveying and mapping; transportation; and education and training. Chairpersons were designated for each group and given the tasks of leading discussion on issues concerning the implementation of the GNSS technology; suggesting recommended solutions for more effective use of the technology; and preparing a short report on observations and recommendations to be presented at the final session of the Workshop.

11. Work focused on specific applications of the use of existing and future GNSS and their augmentations to further global environment objectives, sustainable development programmes and to deepen understanding of those applications in developing countries. Such global systems include the Global Positioning System (GPS) of the United States of America, the Global Navigation Satellite System

(GLONASS) of the Russian Federation and the planned Galileo project of the European Community.

12. The Workshop reviewed applications of the GNSS with special emphasis on: (a) current status and briefing on the modernization policy of GPS; current status and future developments of GLONASS and developments in the Galileo programme; (b) existing and future potential applications of those systems for sustainable development and protection of the environment of interest for States of Africa and Western Asia; and (c) promotion of regional and international cooperation.

13. An exhibition organized in conjunction with the Workshop demonstrated various types of GNSS-oriented equipment.

14. The technical documentation provided by speakers was distributed to participants in hard copy as well as on CD-ROM together with promotional materials from the private sector and international organizations. The proceedings of the Workshop are also accessible to the international community on the web site of the Office for Outer Space Affairs:

www.unvienna.org/SAP/act2002/gnss2/presentations/index.html

C. Attendance

15. Workshop participants included 208 experts from 31 countries (Algeria, Australia, Austria, Belgium, Burkina Faso, Canada, Cape Verde, Egypt, Ethiopia, France, Kenya, Madagascar, Mali, Morocco, Mozambique, Namibia, Nigeria, Republic of the Congo, Russian Federation, Rwanda, Saudi Arabia, Senegal, South Africa, Sudan, Swaziland, Sweden, Syrian Arab Republic, United Republic of Tanzania, United States, Zambia (over 100 participants) and Zimbabwe), Office for Outer Space Affairs, Economic Commission for Africa (ECA), the International Civil Aviation Organization (ICAO), the European Commission, ESA, International Air Transport Association (IATA), the Peace Parks Foundation and the Regional Centre for Mapping of Resources for Development, Participants held senior managerial positions with decision-making authority in national institutions.

16. Funds allocated by the United Nations, the United States and ESA were used to defray the cost of air travel and daily subsistence allowance of 26 participants from 18 countries, one consultant and staff of the Office for Outer Space Affairs who supervised the Workshop, as well as the cost of local transportation, interpretation and renting of conference facilities. The Government of Zambia, through the Ministry of Science, Technology and Vocational Training, provided board for all participants, local hospitality and logistical and technical support.

II. Summary of proceedings

A. Observations

17. The objectives of the Workshop were met through the information provided by the technical presentations and discussions that were held following the presentations and in the working groups.

18. Speakers brought the benefits of the diverse GNSS following applications to the awareness of the audience. The speakers came from Algeria, Australia, Austria, Burkina Faso, Canada, Egypt, Ethiopia, Kenya, Morocco, the Russian Federation, Saudi Arabia, South Africa, the United States and Zambia, as well as the Office for Outer Space Affairs, the Economic Commission for Africa, ICAO, the European Commission, ESA, IATA, the Peace Parks Foundation and the Regional Centre for Mapping of Resources for Development. They reviewed applications to agriculture, disaster warning, establishment of geodesic networks, Earth sciences, emergency services, environmental monitoring (of deforestation for example), land surveying, mining and geology, seismic activities, regional mapping, civil aviation and land transportation. Education and training in the use and applications of GNSS technologies were also discussed extensively.

B. Recommendations

19. The participants made a number of recommendations for action that could be taken to facilitate the use of GNSS signals in various applications areas that are important in Africa and Western Asia. The observations and recommendations will be considered along with similar input from workshops held in the regions of Asia and the Pacific, Eastern Europe and Latin America and the Caribbean. Those recommendations are summarized below.

1. Development of GNSS systems

20. There is a need to continue coordination of the GNSS system development process to ensure: (a) interoperability and compatibility of all GNSS systems and their augmentations; (b) spectrum allocation and protection; (c) dissemination of the information about the systems to end users; and (d) collection of users' requirements.

21. It was therefore recommended:

(a) In order to ensure continuous reception of critical GNSS services, that all nations give high priority to the protection of the radio spectrum allocated for GNSS services from interference, both domestically and internationally;

(b) In order to reduce the complexity and cost of user equipment, that GNSS providers pursue greater compatibility and interoperability among all future systems (GPS III, GLONASS K, Galileo and augmentations) in terms of signal structures, time and geodetic reference standards;

(c) In order to protect the investment of the current user base, that GNSS providers ensure that all new services are backwards compatible with existing user equipment;

(d) In order to ensure continuity of critical GNSS services, that GNSS providers take steps to enhance physical security of the GNSS infrastructure.

2. Management of natural resources and protection of the environment

22. While agriculture is the mainstay of the economies of most African nations, there is a lack of awareness of the economic, political and professional benefits of

the effective use of GNSS in agricultural development and diversification (in areas such as crop production and animal health).

23. It was therefore recommended that demonstration projects be initiated in agriculture and health in order to attract the attention of government policy and decision makers, and to convince them of the usefulness of GNSS applications in those major areas.

24. There is a lack of adequate usage of GNSS signals in disaster prevention and management especially with regard to distress signal responses for search and rescue. There are no coordinated efforts nor a standardized interface among disaster-related agencies in Africa and international agencies.

25. It was therefore recommended:

(a) That all isolated seismic stations using GNSS technology be coordinated in order to ensure prompt disaster alert;

(b) That studies be undertaken to map behaviour patterns of animals and insects in response to climate variability to assist as tools for disaster prevention and management;

(c) That the use of GNSS technology be promoted for search and rescue.

26. Governments do not appreciate the impact that GNSS technology can have in enhancing health resource management and disease control.

27. It was therefore recommended that international donors support disease-vector mapping projects using GNSS. That would enhance the understanding of the spread of killer epidemics such as malaria, which is prevalent in Africa, and of other health applications.

28. There has not been enough emphasis on GNSS applications in Africa for the management of natural resources and protection of the environment and, in the area of meteorology, there is a lack of training in GNSS technology that prevents its use in all weather- and climate-related sectors.

29. It was therefore recommended:

(a) That national, subregional, regional and international technical training be offered with emphasis on environmental resource management;

(b) That focal points be nominated who would constitute steering committees, drawn from participants of the Workshop, in the areas of natural resources and protection of the environment;

(c) That training programmes for trainers be set up at the regional level and support training at the national level on the use and benefit of GNSS technology, in particular in the area of meteorology. The persons thus trained should be helped to organize further local and national training programmes.

3. Geodesy, surveying and mapping

30. While most areas of the world have established a uniform coordinate reference system, countries of Africa have not yet done so. Such a system is critical for national surveying, mapping, photogrammetry, remote sensing and the use of cartographic and thematic data in GIS.

31. It was therefore recommended:

(a) That a continental reference system (including vertical data) be established for Africa, using GNSS as the primary tool that is fully standardized and global within the framework of the International Terrestrial Reference System;

(b) That such a reference system be organized through an international project to be known as AFREF with common goals and objectives throughout Africa and with the commitment of African nations and the support of international partners;

(c) That the AFREF project solicit resources to provide support for the use of GNSS technology.

32. Geospatial data resources (in particular GIS) are used increasingly for decision-making on economic and development issues. Those resources are organized around the concept of spatial data infrastructure (SDI). SDI components (data sets) depend on the availability of a spatial reference framework for defining locations in space. The GNSS community believes that a modern, consistent and accessible geodetic reference frame should be the foundation for SDI.

33. It was therefore recommended that the GNSS community ensure:

(a) That it is involved in the development of SDI and related activities;

(b) That proposals for SDI make provision for the establishment and maintenance of the geodetic reference frame;

(c) Core data include relevant geodetic data;

(d) That metadata include description of geodetic data sets;

(e) That the proposed permanent committee on SDI in Africa include a working group on the spatial reference framework and geodesy.

34. The benefits of GNSS technology cut across several fields and across countries. It is essential for GNSS systems and ancillary equipment to be standardized for full benefits to be reaped.

35. It is therefore recommended:

(a) That, as a global utility, all GNSS systems must operate in identical reference frames and coordinate systems;

(b) That internationally accepted standards and procedures such as those of the International Association of Geodesy, the International Terrestrial Reference Frame and the International GPS Service be followed.

36. An essential element in the application of GNSS in the field of surveying, mapping and related disciplines is sound and reliable information and communication technologies.

37. It was therefore recommended that policy and decision makers be made aware of the critical importance of information and communication technologies in the development and success for the utilization of GNSS applications in surveying, mapping and SDI.

4. Aviation applications

(a) Long-term issues

38. Successful implementation of GNSS in other parts of the world show that utilization of the technology and reaping the associated benefits will require that institutions that were built around ground-based systems to support aviation must change in order to exploit the technology fully. Existing regional aviation alliances in Africa are only marginally positioned to take full advantage of GNSS technology.

39. It was therefore recommended:

(a) That a "one African sky" concept be implemented similar to the "one European sky" initiative at present under way in Europe;

(b) That an aviation academy be established for the purpose of developing a strong aviation culture incorporated into the formal education process.

(b) Short-term issues

40. Obstacles to using GNSS to support aviation in Africa include the following:

(a) Lack of uniform governmental, regulatory or provider structures to make cohesive GNSS policy decisions;

(b) Lack of effective regional structures;

(c) Duplicative technical assistance efforts;

(d) Technical expertise developed in GNSS not being exploited on a regional or even bilateral basis;

(e) Lack of a uniform model for cost recovery of all aviation services; and

(f) Lack of centralized, institutionalized academic environment to learn about aviation policy, regulation, operations and technology.

41. It was therefore recommended:

(a) That the Office for Outer Space Affairs and ICAO continue to encourage adoption of GNSS on the African continent;

(b) That they host within a short period of time a GNSS executive-level session with all the African directors general of civil aviation to begin to address the challenges above;

(c) That at that session:

(i) A small number of regions be agreed upon;

(ii) A task force be set up in each region to begin to harmonize structures;

(iii) A GNSS "advocate" be nominated in each region to serve as a regional expert;

(iv) Cross-regional mechanisms be established so that problems are solved once and standardized procedures are adopted;

(v) A uniform model for cost recovery be established;

(vi) A database on safety statistics be established and targets for improvements implemented by means of specific projects.

5. Education and training

42. There is a lack of awareness of GNSS and other information technology infrastructure capabilities at all levels in Africa, from government decision makers to end users.

43. It was therefore recommended that the United Nations:

(a) Bring to the attention of Governments, at the highest level possible, the wide range of sustainable economic and social benefits that the use of GNSS technology can bring in finding solutions to national and regional problems;

(b) Encourage government decision makers to integrate GNSS and information technology into their respective country's long-range planning and vision;

(c) Establish or expand regional technology business centres to promote GNSS applications in various sectors;

(d) Organize GNSS technology awareness seminars.

44. There is a great need for GNSS education and training in Africa.

45. It was therefore recommended:

(a) That an inventory of GNSS capabilities of education and training institutions in Africa be drawn up, with a view to identifying resource and training needs for those institutions;

(b) That, based upon that assessment, funding for capacity-building be sought for at those institutions, where needed;

(c) That an assessment of the education and training needs be carried out in the various disciplines that may benefit from the use of GNSS;

(d) That, based upon the results of that assessment, funding be sought for the preparation of materials and modules for GNSS awareness seminars and materials and modules for short courses.

6. Implementation of GNSS

46. The cost of GNSS solutions is too high.

47. It was therefore recommended:

(a) That Governments provide financial incentives that would encourage private investment in GNSS solutions, such as favourable taxation policy on equipment, reduction of import fees and low- or no-interest loans to finance start-up costs of GNSS technology investments;

(b) That GNSS providers harmonize standards to achieve maximum interoperability, thereby reducing the complexity and cost of user equipment;

(c) That equipment, even used, be made available to users in developing countries on a lease, loan or low-cost basis so they could gain experience prior to capital investment;

(d) That partnerships be pursued between Governments, industry and academia in order to share resources and expertise.

Notes

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