United Nations A/AC.105/1034

General Assembly

Distr.: General
14 December 2012

Original: English

Committee on the Peaceful Uses of Outer Space

Activities carried out in 2012 in the framework of the workplan of the International Committee on Global Navigation Satellite Systems

Report of the Secretariat

I. Introduction

1. Global navigation satellite systems (GNSS) comprise constellations of Earth-orbiting satellites that broadcast their location and time information and networks of ground control stations and receivers that calculate ground positions using trilateration. Satellite navigation-related technology supports many civil, scientific and commercial applications. GNSS is used in all forms of transportation: space stations, aviation, maritime, railroads, highways and mass transit. Positioning, navigation and timing play a critical role in, among other things, telecommunications, land surveying, law enforcement, emergency response, precision agriculture, mining, finance and scientific research. GNSS is used to control computer networks, air traffic, power grids and other activities.

2. At present, there are two fully operational global GNSS systems — the Global Positioning System (GPS) of the United States of America and the Russian Federation's Global Navigation Satellite System (GLONASS) — and the developing global and regional systems, namely, the European Satellite Navigation System (Galileo), China's COMPASS/BeiDou, the Indian Regional Navigation Satellite System (IRNSS) and Japan's Quasi-Zenith Satellite System (QZSS). Once all those global and regional systems have become fully operational, users will have access to positioning, navigation and timing signals from more than 100 satellites.

3. In its resolution 64/86, the General Assembly endorsed the recommendation of the Committee on the Peaceful Uses of Outer Space for the Office for Outer Space Affairs of the Secretariat to continue to serve as the executive secretariat of the International Committee on Global Navigation Satellite Systems (ICG) and its Providers' Forum. As such, the executive secretariat is responsible for the preparation of activities of ICG and its Providers' Forum.

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4. Additionally, the executive secretariat handles the coordination of the planning meetings of ICG and its Providers' Forum held in conjunction with the sessions of the Committee on the Peaceful Uses of Outer Space and its subsidiary bodies, and the implementation of a programme on GNSS applications as mandated by ICG and the Providers' Forum. The executive secretariat also maintains a comprehensive information portal for ICG and users of GNSS services (see www.unoosa.org/oosa/en/SAP/gnss/icg.html). The executive secretariat, in cooperation with the international GNSS community, contributes to international and regional conferences to introduce all elements of the work of ICG. The Office for Outer Space Affairs is also leading the ICG Working Group on Information Dissemination and Capacity-building.

5. The present report reflects the wide range of activities carried out in 2012 by the Office for Outer Space Affairs in its role as the executive secretariat of ICG. Detailed information on the activities can be found on the ICG information portal.

II. Activities of the International Committee on Global Navigation Satellite Systems carried out in 2012

6. Pursuant to the ICG workplan, the Office for Outer Space Affairs, through its programme on GNSS applications, concentrated its work on (a) leading the development of the education curriculum on GNSS; (b) promoting the use of GNSS technologies as tools for scientific applications, including space weather effects on GNSS; and (c) organizing regional workshops on applications of GNSS and the International Space Weather Initiative.

A. Education curriculum on global navigation satellite systems

7. The education curriculum on GNSS (ST/SPACE/59) was developed taking into account the outlines of GNSS courses taught at the university level in a number of developing and industrialized countries. The incorporation of elements of GNSS science and technology into university-level education curricula served a dual purpose: (a) to enable countries to take advantage of the benefits inherent in the new technologies, which, in many cases, are spin-offs of space science and technology; and (b) to introduce users to concepts of high technology in a practical way and help create national capacities in science and technology in general. Currently, serious efforts are being made worldwide to introduce GNSS, and its applications in the fields of science, technology and applications, as a stand-alone discipline in university-level curricula.

8. The GNSS education curriculum is different from most available in print and on the web. The GNSS education curriculum is a unique result of the deliberations of the regional workshops on GNSS applications held since 2006.

9. The curriculum will be made available to the regional centres for space science and technology education, affiliated to the United Nations. The regional centres may, as appropriate, modify and structure their actual courses by making decisions with respect to contents and the depth in which topics will be covered. The centres may also make modifications to the topics covered in order to address

issues specific to the region. The course prerequisite is a degree in electronic and communications engineering, geomatics or software and computer engineering.

10. The course will consist of nine modules, each covering specific areas of GNSS (theory, technology and applications). The duration of the course is 36 weeks, followed by one year of pilot project work in the participant's home country.

11. Regional centres have been established in India for Asia and the Pacific, in Morocco and Nigeria for Africa, in Brazil and Mexico for Latin America and the Caribbean and in Jordan for Western Asia, under the auspices of the United Nations Programme on Space Applications implemented by the Office for Outer Space Affairs. The objective of the centres is to enhance the capabilities of Member States, at the regional and international levels, in various disciplines of space science and technology that can advance their scientific, economic and social development. Each of the centres provides postgraduate education, research and application programmes with an emphasis on remote sensing, satellite communications, satellite meteorology and space science for university educators and research and application scientists.

12. An additional GNSS education curriculum will supplement the proven standard model education curricula of the regional centres that were developed through the United Nations Programme on Space Applications and which comprise the following core disciplines taught at the centres: remote sensing and geographic information systems, satellite communications, satellite meteorology and global climate, and space and atmospheric sciences.

B. Promoting the use of global navigation satellite system technologies as tools for scientific applications

1. Space weather effects on global navigation satellite systems

13. Since the last solar maximum in 2000, societal dependence on GNSS has increased substantially. Critical applications, such as railway control, highway traffic management, precision agriculture, emergency response, commercial aviation and marine navigation require GNSS services. Everyday activities such as banking, mobile phone operations and even the control of power grids are facilitated by the accurate timing provided by GNSS. As national, regional and international infrastructure, as well as the global economy, is becoming increasingly dependent on positioning, navigation and timing services, society in general is vulnerable to disruptions that can be caused by space weather or variable conditions on the Sun and in the space environment that can influence space-borne and ground-based technological systems. Just as society takes for granted that electricity, heat and clean water will always be available, it also takes for granted that GNSS will be available, reliable and accurate. GNSS is so entrenched in the daily activities of individuals, businesses and government that any loss of satellite positioning, navigation and timing services would be broadly disruptive.

14. Within the framework of the workplan of ICG, the Office for Outer Space Affairs co-organized the workshop on science applications of GNSS in developing countries, followed by a seminar on the development and use of the ionospheric NeQuick model, held in Trieste, Italy, from 11 April to 1 May 2012. The Abdus

Salam International Centre for Theoretical Physics hosted the two activities, both of which were co-sponsored by the United States through ICG.

15. The activities integrated formal lectures with hands-on practice in GNSS basics and state-of-the-art applications with emphasis on the scientific exploration of the Earth environment using GNSS. An on-site computer laboratory gave participants ample opportunities to learn about analysing atmospheric and ionospheric data obtained from GNSS measurements.

16. In addition, several participants made formal presentations on GNSS-related activities in their home institutions and countries. Those presentations demonstrated that a number of new research programmes utilizing GNSS ground- and space-based measurements to observe ionospheric and space weather phenomena had been established in recent years, particularly in Africa, with evident benefits for global knowledge about the Earth environment.

17. A total of 70 scientists, engineers and educators in the field of GNSS and space weather from 29 developing countries and countries with economies in transition from all economic regions were invited to attend the workshop and seminar. Funds provided by the United States through ICG were used to defray the costs of air travel for 10 participants.

2. Reference frames and timing

18. At the sixth meeting of ICG, held in Tokyo from 5 to 9 September 2011, ICG Working Group D on Reference Frames and Timing and Applications recommended organizing a technical seminar on reference frames to address the following issues: (a) how to deal with data analysis, (b) how to express results appropriately, and (c) how to use a multi-GNSS network (see A/AC.105/1000).

19. Within the scope of its activities as the executive secretariat of ICG and its Providers' Forum, the Office for Outer Space Affairs supported the "Reference frame in practice" seminar. The seminar was organized in cooperation with the International Association of Geodesy and the International Federation of Surveyors (FIG), and held in Rome on 4 and 5 May 2012, prior to the FIG Working Week on 6-10 May 2012.

20. The seminar consisted of six sessions providing educational and informative materials on the following topics: (a) global terrestrial reference systems and frames, (b) regional and national reference systems, (c) gravity and the World Height System, (d) the multi-GNSS environment, (e) standards and traceability of a terrestrial reference frame/GNSS, and (f) four-dimensional deformation models for terrestrial reference frames.

21. The seminar was attended by 46 participants from 21 countries. Funds provided by the United States through ICG were used to defray the costs of air travel, daily subsistence allowance and accommodation for four participants.

C. Regional workshops on global navigation satellite system applications and the International Space Weather Initiative

22. Pursuant to General Assembly resolution 66/71 and as part of the United Nations Programme on Space Applications, the Office for Outer Space Affairs organized the United Nations/Latvia Workshop on the Applications of Global Navigation Satellite Systems held in Riga from 14 to 18 May 2012 (A/AC.105/1022). The Workshop was co-sponsored by the United States (through ICG) and the European Space Agency. The Latvian Geospatial Information Agency hosted the Workshop on behalf of the Government of Latvia.

23. The specific objectives of the five-day Workshop were (a) to provide an update on ongoing activities related to the use of GNSS technology in participating countries; (b) to enhance institutional and human capacity in utilizing GNSS technology using case studies, lessons learned and experiences from other countries; (c) to identify the specific needs of ongoing individual plans and projects on GNSS at the regional and international levels for near-, medium- and long-term applications, taking into consideration the local institutional settings, including specific training and capacity-building needs; (d) to develop a regional plan of action that would contribute to the wider use of GNSS technology and its applications, including the possibility of one or more national or regional pilot projects, in which interested institutions could incorporate the use of GNSS technology; and (e) to define recommendations and findings to be forwarded as a contribution to ICG. Thus the overarching objective was to facilitate cooperation in applying GNSS solutions through the exchange of information and the scaling-up of capacities among countries in the region. A detailed programme of the Workshop and its proceedings are available on the website of the Office for Outer Space Affairs (www.unoosa.org).

24. Pursuant to General Assembly resolution 66/71, the United Nations/Ecuador Workshop on the International Space Weather Initiative was held in Quito from 8 to 12 October 2012 (see A/AC.105/1030). The Quito Astronomical Observatory of the Escuela Politécnica Nacional hosted the Workshop on behalf of the Government of Ecuador.

25. The main objective of the Workshop was to provide a forum in which participants could comprehensively review achievements of the International Space Weather Initiative, in terms of the status of deployment of low-cost, ground-based, worldwide space weather instruments, and further plans for the Initiative, as well as assess recent scientific and technical results in the field of solar-terrestrial interaction. Further, the Workshop was to recommend ways and means of updating and upgrading the website (www.iswi-secretariat.org) and newsletter of the Initiative.

III. Technical advisory services

26. To present the specific work of the Office in the framework of ICG and its programme on GNSS applications, as well as the future role of ICG in a multi-constellation GNSS, and to receive feedback from the GNSS community, the Office for Outer Space Affairs participated in and contributed to the Munich

Satellite Navigation Summit 2012, held in Munich, Germany, from 12 to 14 March 2012. The Summit included plenary discussions with invited speakers and presentations on the main activities of worldwide satellite navigation systems. Emphasizing a future trend in satellite navigation, the Summit focused on GNSS and security in the user segment. The discussions were held on the long-term plans to provide increased benefits from multiple constellations and alternate position navigation and time sources.

27. The Office for Outer Space Affairs organized the preparatory meetings for the seventh meeting of ICG and the eighth meeting of the Providers' Forum, co-chaired by China and the United States, held in Vienna on 13 February 2012 and 5 June 2012. Those preparatory meetings were held on the margins of the forty-ninth session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space and the fifty-fifth session of the Committee. At the meetings, it was emphasized that ICG should play an important role in future GNSS developments and their implications for civil use and performance. ICG member States focused on issues related to the effective functioning of ICG and its current structure as a body established to promote cooperation on matters of mutual interest related to civil satellite-based positioning, navigation timing and value-added services, as well as the compatibility and interoperability of GNSS.

28. In addition, the Office for Outer Space Affairs organized the interim meeting of ICG Working Group B on Enhancement of the Performance of GNSS Services, held in Vienna on 6 June 2012. The main objectives of the meeting were (a) to develop a template to survey the service providers on their Space Service Volume (SSV) characteristics that would help to identify an interoperable SSV for the future; and (b) to identify possible new message broadcasts for associated new services for the enhancements of existing services.

29. The Office for Outer Space Affairs also organized an ICG workshop on GNSS spectrum protection and interference detection and mitigation held in Vienna on 7 and 8 June 2012. The workshop discussed sources of interference; radio navigation satellite services (RNSS) spectrum protection; current and future information sharing, dissemination, collaboration and standardization; and concepts and techniques for interference detection.

30. In order to focus on the specific topics of the recommendations made at the United Nations International Meeting on the Applications of Global Navigation Satellite Systems, held in Vienna from 12 to 16 December 2011 (see A/AC.105/1019), a follow-up meeting was held in Jerusalem, Israel, on 19 and 20 March 2012, with the representatives of Tel Aviv University, the Israel Space Agency, the Ministry of Science and Technology and the Ministry of Foreign Affairs. Topics of discussion were (a) the use of GNSS in various areas of applications, including effects of space weather observed on GNSS applications; (b) development of training, education and awareness programmes for short-term courses on GNSS; and (c) explore the possibility of sponsoring and hosting the workshops in the context of GNSS programmes and applications. Drawing on the varied sources of information and interests, participants in the follow-up meeting made a proposal for the development of training, education and awareness programmes in the area of GNSS applications.

IV. Voluntary contributions

31. The activities of ICG in 2012 were successfully implemented thanks to the support and voluntary contributions (financial and in-kind) of member States:

(a) The Government of the United States provided $170,000 to support capacity-building and technical advisory services and arranged for experts to make technical presentations and participate in discussions during activities described in the present report;

(b) The Governments of China, Japan and the Russian Federation, the European Union and the European Space Agency provided sponsorships for experts to make technical presentations and participate in the activities carried out in the framework of the ICG workplan. Sponsorships were also provided for staff members of the Office for Outer Space Affairs to participate in the seventh meeting of ICG and the Munich Satellite Navigation Summit 2012.