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Committee on the Peaceful Uses of Outer Space

Fifth Meeting of the International Committee on Global Navigation Satellite Systems

Note by the Secretariat

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I. Introduction

A. Background

1. The International Committee on Global Navigation Satellite Systems (ICG), established in 2005, promotes international cooperation on issues of mutual interest related to civil satellite-based positioning, navigation, timing and value-added services. The ultimate goal of ICG is to achieve the compatibility and interoperability of global navigation satellite systems (GNSS), thereby saving costs through international cooperation, and make positioning, navigation and timing available globally for the benefit of society, including by monitoring all aspects of the environment.

2. The United States of America's Global Positioning System (GPS), the Russian Federation's Global Navigation Satellite System (GLONASS), Europe's Galileo satellite navigation system and China's BeiDou satellite navigation system are designed to comprise a constellation of 24 or more satellites, ensuring that signals from at least four satellites are available at any location. In addition, there are the GPS-aided GEO-Augmented Navigation System (GAGAN) of India and the Quasi-Zenith Satellite System (QZSS) of Japan, which are regional navigation satellite systems.

3. In its resolution 64/86, the General Assembly welcomed the progress made by ICG towards achieving compatibility and interoperability among global and regional space-based positioning, navigation and timing systems and in the promotion of the use of global navigation satellite systems and their integration into national infrastructure, particularly in developing countries, and noted with appreciation that the African regional centres for space science and technology education in the French and English languages, located in Morocco and Nigeria, respectively, as well as the Centre for Space Science and Technology Education in Asia and the Pacific, located in India, and the Regional Centre for Space Science and Technology Education for Latin America and the Caribbean, located in Brazil and Mexico, would serve as ICG information centres.

4. The Committee on the Peaceful Uses of Outer Space, at its fifty-third session, in 2010, noted with appreciation the activities conducted and/or planned in the framework of the ICG workplan focusing on building capacity, specifically in deploying instruments for the International Space Weather Initiative, developing a GNSS education curriculum, utilizing regional reference frames and the application of GNSS in various areas to support sustainable development.¹

5. Pursuant to General Assembly resolution 64/86 and as part of the United Nations Programme on Space Applications, the Office for Outer Space Affairs of the Secretariat held the United Nations/Republic of Moldova/United States of America Workshop on Applications of Global Navigation Satellite Systems in Chisinau from 17 to 21 May 2010 (A/AC.105/974), the twentieth United Nations/International Astronautical Federation Workshop on GNSS applications for human benefit and development in Prague on 24 and 25 September 2010 (A/AC.105/984) and the

¹ *Official Records of the General Assembly, Sixty-fifth Session, Supplement No. 20 (A/65/20)*, para. 124.

United Nations/Japan Aerospace Exploration Agency/National Aeronautics and Space Administration Workshop on the International Space Weather Initiative in Helwan, Egypt, from 6 to 10 November 2010 (A/AC.105/998). These workshops were co-sponsored by the United States through ICG.

6. In accordance with paragraph 19 of General Assembly resolution 64/86, the Office for Outer Space Affairs continued to serve as the executive secretariat of ICG and its Providers' Forum. In its role as executive secretariat of ICG, the Office dealt with matters relating to the organization of the annual meetings of ICG, interim planning and working group activities.

7. The Office for Outer Space Affairs organized and hosted the First Meeting of ICG in Vienna on 1 and 2 November 2006 (A/AC.105/879). The Second Meeting of ICG was held in Bangalore, India, from 4 to 7 September 2007 (A/AC.105/901). The Third Meeting of ICG was held in Pasadena, California, United States, from 8 to 12 December 2008 (A/AC.105/928). The Fourth Meeting of ICG was held in Saint Petersburg, Russian Federation, from 14 to 18 September 2009 (A/AC.105/948).

8. The Fifth Meeting of ICG was held in Turin, Italy, from 18 to 22 October 2010 under the chairmanship of Italy and the European Commission on behalf of the European Union.

B. Structure and programme of the Meeting

9. The programme of the Fifth Meeting of ICG included three plenary sessions and working group meetings. At the first plenary session of the Meeting, held on 18 October 2010, GNSS service providers and augmentation system providers made presentations on the status of their systems and future plans. The presentations made by associate members and observers outlined recent developments with regard to GNSS services, applications, and educational and capacity-building activities at the global, regional and national levels.

10. In accordance with the workplan of ICG, four working group meetings, held on 19 and 20 October 2010, focused on the following issues: compatibility and interoperability (led by the Russian Federation and the United States); enhancement of performance of GNSS services (led by India and the European Space Agency); information dissemination and capacity-building (led by Italy and the Office for Outer Space Affairs); and reference frames, timing and applications (led by the International Federation of Surveyors, the International Association of Geodesy and the International GNSS Service).

11. At its plenary sessions held on 21 and 22 October, ICG considered the implementation of the recommendations of the working groups and plans to address the current and future work of each working group.

12. After considering the various items before it, ICG adopted the joint statement summarized in section III below.

13. In conjunction with the Fifth Meeting of ICG, the Providers' Forum held its sixth meeting in Turin, Italy, on 17, 19 and 22 October 2010 under the chairmanship of the European Commission and the United States (see section IV below).

C. Attendance

14. Representatives of the following States participated in the Fifth Meeting of ICG: China, India, Italy, Japan, Malaysia, Nigeria, Russian Federation, United Arab Emirates and United States. The European Union was also represented.

15. The following United Nations entities were represented at the Meeting: the Office for Outer Space Affairs and the International Telecommunication Union.

16. The following intergovernmental and non-governmental organizations dealing with GNSS services and applications were represented at the Meeting: Civil Global Positioning System Service Interface Committee, Committee on Space Research, European Space Agency, European Position Determination System, International Association of Geodesy (IAG) and IAG Reference Frame Sub-Commission for Europe, International Bureau of Weights and Measures, International Earth Rotation and Reference Systems Service, International Federation of Surveyors, and International GNSS Service.

17. Observers for the African Regional Centre for Space Science and Technology Education — in English language and the Space Generation Advisory Council were invited, at their request, to participate in an expert capacity in the work of ICG and to address it as appropriate.

18. A list of States Members of the United Nations and governmental, intergovernmental and non-governmental organizations participating in ICG is contained in annex I.

D. Scientific session and industry round table

19. Two scientific sessions, entitled “GNSS technology in the era of multi-systems receivers” and “GNSS technology in the era of multi-systems: the impact of GNSS interoperability on timing and other user applications”, were held as part of the Meeting on 18 and 20 October 2010 respectively. Representatives of industrial entities and academic institutions made presentations outlining opportunities in user applications and GNSS technology for consideration by ICG and its working groups.

20. At the session entitled “GNSS technology in the era of multi-systems receivers”, the importance of maintaining compatibility and interoperability for multi-GNSS receivers was highlighted. Presentations illustrated the substantial availability of improvements made possible by the use of additional satellites through various combinations of constellations, regional systems and augmentation systems. These improvements were especially evident in areas with a restricted view of the sky. Several speakers discussed the progress made on multi-GNSS and multi-frequency receiver simulations, prototypes and planning for emerging products. New applications that were expected to be developed for those capabilities were also discussed. Vulnerability to increasing radio-frequency interference, including through the use of low-cost jammers, and the need for both operational and technical mitigations were identified as key enablers for both current and future receivers.

21. It was noted that multi-GNSS simulators and chipsets were currently available for use by developers. The consumer market for multi-frequency capability receivers had emerged for lower-cost products as well as previously available high-end receivers. Developments in the following areas were identified as facilitators to receiver developer and manufacturer inclusion of multi-GNSS/multi-frequency features: stability in signals planning and deployment, antenna and filter technology development, improved synchronization of timing measurements and availability of inter-system and inter-frequency biases.

22. Presentations at the session on “GNSS technology in the era of multi-systems: the impact of GNSS interoperability on timing and other user applications” covered the following topics: a concept of GNSS based on time meteorology, time systems and applications of current and planned global and regional navigation satellite systems and their augmentation systems; interoperability in multi-system time receivers; and the impact of multi-GNSS on international timekeeping. A problem of proliferation of pseudo-time scales and related reformulation of Coordinated Universal Time (UTC) was also discussed.

23. On 21 October 2010, the Italian Space Agency organized a round table of those industries involved in satellite navigation activities to discuss the wide range of benefits that GNSS would bring to society. The following topics were discussed: effective use of energy and other resources, including time; support to disaster management through warning and rapid response mechanisms; protection of natural resources; improvements in emergency, search and rescue operations; improvements in maritime situational awareness; and seamless transportation systems.

E. Documentation

24. A list of the documents of the Fifth Meeting is contained in annex II. The documents and further information on the Meeting programme, background materials and presentations are available from the ICG information portal (www.icgsecretariat.org).

II. Recommendations and decisions

25. ICG took note with appreciation of the reports of its working groups and its Providers’ Forum, which contained the results of their deliberations in accordance with their respective workplans.

26. ICG agreed that, through its work in the working groups and the Providers’ Forum, it continued to make significant progress towards further elaborating and implementing measures to increase compatibility and interoperability among global and regional space-based positioning, navigation and timing systems.

27. ICG agreed that Working Group D on interaction with national and regional authorities and relevant international organizations should be referred to as Working Group D on reference frames, timing and applications, in order to better reflect the nature of the activities carried out by that Working Group.

28. ICG endorsed the decisions and recommendations of the working groups with regard to the implementation of the actions contained in its workplan.

29. ICG agreed on a tentative schedule for the informal preparatory meetings for its Sixth Meeting, to be held in 2011, during the forty-eighth session of the Scientific and Technical Subcommittee and the fifty-fourth session of the Committee on the Peaceful Uses of Outer Space. It was noted that the Office for Outer Space Affairs, as the executive secretariat of the ICG and its Providers' Forum, would assist in the preparation of those meetings and the working groups' activities.

III. Joint statement

30. ICG adopted by consensus the following joint statement:

1. The Fifth Meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Turin, Italy, from 18 to 22 October 2010, to continue reviewing and discussing developments in global navigation satellite systems (GNSS) and to allow ICG members, associate members and observers to consider matters of interest. ICG also addressed GNSS technology in the era of multi-system receivers and the impact of GNSS interoperability on timing and other user applications. Representatives from industry, academia and Governments shared views on GNSS compatibility and interoperability.

2. The Meeting was jointly hosted by Italy and the European Commission on behalf of the European Union. Representatives of China, India, Italy, Japan, Malaysia, Nigeria, the Russian Federation, the United Arab Emirates and the United States, as well as of the European Union, attended the Meeting. Representatives of the following intergovernmental and non-governmental organizations also attended: Civil Global Positioning System Service Interface Committee, Committee on Space Research, European Space Agency, European Position Determination System, International Federation of Surveyors, International Association of Geodesy (IAG) and IAG Reference Frame Sub-Commission for Europe, International Bureau of Weights and Measures, International Earth Rotation and Reference Systems Service, International GNSS Service. Representatives of the Office for Outer Space Affairs of the Secretariat and the International Telecommunication Union also participated.

3. ICG recalled that the General Assembly, in its resolution 64/86 endorsed the recommendation of the Committee on the Peaceful Uses of Outer Space that the Office for Outer Space Affairs should continue to serve as the executive secretariat of ICG; welcomed the progress made by ICG towards achieving compatibility and interoperability among global and regional space-based positioning, navigation and timing systems and in the promotion of the use of global navigation satellite systems and their integration into national infrastructure, particularly in developing countries; and noted with satisfaction that ICG had held its Fourth Meeting in Saint Petersburg, Russian Federation, from 14 to 18 September 2009.

4. ICG noted that the working groups focused on the following issues: compatibility and interoperability; enhancement of the performance of GNSS services; information dissemination and capacity-building; and reference frames, timing and applications. It also noted the substantive progress made in

furthering the workplans of ICG and the Providers' Forum that had been approved at previous meetings of ICG.

5. ICG also noted the achievements of the ICG Providers' Forum, as reflected in the publication entitled *Current and Planned Global and Regional Navigation Satellite Systems and Satellite-based Augmentation Systems* (ST/SPACE/50).

6. ICG further noted that Working Group A on compatibility and interoperability had continued to explore the issue of GNSS interoperability from the perspective of users. ICG took note of the results of a workshop focused on compatibility involving system providers. Working Group A addressed further aspects of its workplan as revised at the Fourth Meeting of ICG, including spectrum protection and interference detection and mitigation. Working Group A called on interested members to focus on proposals for addressing interference detection and mitigation, and to draft a plan for consideration by ICG.

7. Working Group B on enhancement of the performance of GNSS services discussed aspects of user position integrity with a briefing on the outcomes of a special meeting of the Working Group held on 8 March 2010 and a presentation on plans on GNSS and augmentation systems. Several recommendations were made on how to proceed on the issue of integrity for users in the aviation and non-aviation sectors, as a particular effort was needed to make such users aware of the benefits arising from the development of multiple GNSS systems. A new item on techniques for radio-frequency interference mitigation and detection in the GNSS bands was added to the workplan.

8. Working Group C on information dissemination and capacity-building had continued to develop a programme on GNSS applications and reiterated the importance of deploying instruments for the International Space Weather Initiative, developing a GNSS curriculum and applying GNSS in support of sustainable development. In that respect, the ICG information centres established at the regional centres for space science and technology education, affiliated to the United Nations, would play a relevant role.

9. Working Group D on reference frames, timing and applications noted excellent progress in the work of its two task forces with regard to standard descriptions of geodetic and timing references for existing and planned systems. Working Group D agreed on an updated workplan. Recommendations were proposed and adopted by ICG on several matters of relevance to the coordination of geodetic and time references. Working Group D reiterated its support for a multi-GNSS demonstration campaign. An important new development was the agreement reached by system providers to liaise with relevant international bodies to ensure that receiver output formats for future GNSS signals would be unambiguously defined.

10. ICG accepted the offer of Japan to host the Sixth Meeting of ICG in Tokyo, from 5 to 9 September 2011. The Office for Outer Space Affairs, as the executive secretariat of ICG and its Providers' Forum, will assist in the preparations for the meeting and for interim planning meetings and working

group activities. ICG noted the expression of interest by China to host the Seventh Meeting of ICG in 2012.

IV. Providers' Forum

31. The sixth meeting of the Providers' Forum, co-chaired by the United States and the European Commission, was held in conjunction with the Fifth Meeting of ICG in Turin, Italy. The meeting consisted of three sessions, held on 17, 19 and 22 October 2010. China, India, Japan, the Russian Federation and the United States, as well as the European Union, were represented at the meeting.

32. After consideration of the items on its agenda, the Providers' Forum adopted the report on the meeting containing the recommendations and decisions set out below.

A. Summary of discussions and recommendations

1. Promotion of compatibility and interoperability

1. A presentation entitled "Position, navigation and timing (PNT) improvement supported by BeiDou" was provided by a representative of China. The presentation provided the simulation results of improvements to the dilution of precision values obtained by adding the BeiDou constellation to GPS, Galileo and GLONASS constellations. A conclusion of the presenter was that BeiDou would improve the quality of position, navigation and timing services.

Review of principles on compatibility and interoperability

2. The results of the interoperability survey conducted by Working Group A were presented by the co-chair of the Working Group. It was noted that the current definition of interoperability appears not to need any further modification. Based on the results of a compatibility workshop held on 7 June 2010, it was also noted that the current definition of compatibility does not require modification either.

Status of the consolidated report on planned and operating systems based on member input consistent with the template for information-sharing

3. The Providers' Forum noted that its achievements were reflected in the publication entitled *Current and Planned Global and Regional Navigation Satellite Systems and Satellite-based Augmentation Systems (ST/SPACE/50)*, which had been produced by the Office for Outer Space Affairs in its capacity as the executive secretariat of ICG, on the basis of reports submitted by the members of the Forum on their planned or existing systems and on the policies and procedures that govern the service they provide.

Report on user and manufacturer workshops

4. The Providers' Forum took note of two workshops on compatibility and interoperability held by Working Group A in 2009 to obtain input from experts

from all over the world with regard to factors that would aid or hinder interoperability. In that regard, the Providers' Forum noted that 20 responses to a questionnaire on GNSS interoperability had been reviewed and that Working Group A would continue to organize workshops and solicit additional responses to the questionnaire. The Providers' Forum noted that Working Group A would continue to focus on organizing workshops on interoperability.

2. Open service information dissemination

5. The representative of the United States gave a presentation entitled "Enabling multi-constellation advanced receiver autonomous integrity monitoring (ARAIM)". It was noted that in the framework of the GNSS Evolutionary Architecture Study the use of dual frequency and advanced receiver autonomous integrity monitoring was recommended in order to get benefits for aviation. Some important performance parameters were being investigated for possible inclusion in future performance standards. It was also recommended that other service providers consider including those parameters in developing their performance standards, once the definitions had been finalized.

6. The representative of the United States also made a presentation entitled "Template for GNSS service performance commitments", at the end of which it was proposed that other system providers should consider using the GPS Standard Positioning Service Performance Standard as a template for developing their own performance standard.

3. Service performance monitoring

7. A presentation on the United States Patriot Watch Program entitled "GPS Interference Detection and Mitigation (IDM)" provided information on the actions being taken by the United States to mitigate and detect signal interference through the Program. It was noted that the topic of signal interference was in the ICG workplan and that progress on the topic within ICG had been limited. It was suggested that a workshop be organized or multi-disciplinary ICG task force be established to make progress on the topic.

B. Other matters

1. Report on a multi-GNSS demonstration project

8. The representative of Japan made a presentation entitled "A multi-GNSS demonstration project in the Asia/Oceania region". It was noted that four discussion groups had been established at the Asia Oceania Regional Workshop on GNSS held in Bangkok on 25 and 26 January 2010. It was proposed that ICG become more involved in the multi-GNSS demonstration project by frequently producing reports and inviting the co-chairs of Working Group A and Working Group D to be members of the steering committee of the project. The Providers' Forum noted that a meeting would take place on 21 and 22 November 2010 in Melbourne, Australia. A request was made for other providers to contribute to the project.

2. ICG information centres

9. The Providers' Forum took note of a programme on GNSS applications focusing on building capacity, specifically by deploying instruments for the International Space Weather Initiative, developing a GNSS curriculum, utilizing regional reference frames and applying GNSS in various areas to support sustainable development. It was noted that the ICG information centres established at the regional centres for space science and technology education, affiliated to the United Nations, could play a relevant role.

3. Glossary of terms related to the work of the ICG and its Providers' Forum

10. The Providers' Forum noted the need for a glossary and that a draft of such a glossary containing undefined terms, acronyms and glossary definitions had been produced by the executive secretariat of ICG. It was also noted that the United States had made a presentation on the ICG glossary of GNSS terms at a meeting of Working Group C, in 2008. Once finalized, the glossary would serve both as a consolidated report on GNSS and as a resource for use within and outside ICG. It was proposed that each member provide a point of contact and participate in a working group in order to finalize the glossary before the next ICG meeting.

4. Document consolidating decisions and conclusions

11. The Providers' Forum noted that the document in which the decisions and conclusions of ICG and its Providers' Forum had been consolidated could be used (a) to inform policy outside the framework of ICG and (b) as a resource guide for the work of ICG. Further discussion would be required to agree on how the document would be used.

5. Joint GNSS outreach activities

12. The Providers' Forum noted that two joint GNSS outreach events had been planned. The first event was the Forum's panel at the conference of the Institute of Navigation to be held from 20 to 23 September 2011 in Portland, Oregon, United States. The second event was the Fifth International Satellite Navigation Forum, to be held on 1 and 2 June 2011 in Moscow. It was also noted that the Second China Satellite Navigation Conference, to be held in 2011, might provide another opportunity for carrying out joint GNSS outreach activities. China, the Russian Federation and the United States requested a point of contact to be identified from each provider to facilitate preparations ahead of each conference.

6. Review and discussion of presented ICG working group reports

13. The co-chairs of the ICG Working Groups presented and submitted, for consideration by the Providers' Forum, the recommendations contained in the reports of the working groups. Working Group A on compatibility and interoperability submitted six recommendations; Working Group B on enhancement of the performance of GNSS services submitted seven recommendations; Working Group C on information dissemination and

capacity-building submitted two recommendations; Working Group D on reference frames, timing and applications submitted five recommendations.

7. Chair and next meeting of the Providers' Forum

14. The Provider's Forum agreed that Japan and the United States would co-chair the Forum's next meeting, to take place at the United Nations Office at Vienna on 31 May 2011, immediately before the fifty-fourth session of the Committee on the Peaceful Uses of Outer Space, to be held from 1 to 10 June 2011.

Annex I

List of States Members of the United Nations and governmental, intergovernmental and non-governmental organizations participating in the International Committee on Global Navigation Satellite Systems

China
India
Italy
Japan
Malaysia
Nigeria
Russian Federation
United Arab Emirates
United States of America
European Union
Civil Global Positioning System Service Interface Committee
Committee on Space Research
European Space Agency
International Association of Geodesy
International Association of Geodesy Reference Frame Sub-Commission for Europe
International Association of Institutes of Navigation
International Bureau of Weights and Measures
International Cartographic Association
International Earth Rotation and Reference Systems Service
International Federation of Surveyors
International Global Navigation Satellite System Service
International Society for Photogrammetry and Remote Sensing
International Steering Committee of the European Position Determination System
International Telecommunication Union
International Union of Radio Science
Office for Outer Space Affairs of the Secretariat

Annex II

Documents of the Fifth Meeting of the International Committee on Global Navigation Satellite Systems

<i>Symbol</i>	<i>Title or description</i>
ICG/WGA/2010	Report of the Working Group on Compatibility and Interoperability
ICG/WGB/2010	Report of the Working Group on Enhancement of the Performance of Global Navigation Satellite Systems Services
ICG/WGC/2010	Report of the Working Group on Information Dissemination and Capacity-Building
ICG/WGD/2010	Report of the Working Group D on Reference Frames, Timing and Applications
