



General Assembly

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Committee on the Peaceful Uses of Outer Space

Ninth meeting of the International Committee on Global Navigation Satellite Systems

Note by the Secretariat

I. Introduction

A. Background

1. The International Committee on Global Navigation Satellite Systems (ICG), established in 2005 under the umbrella of the United Nations, provides a unique forum for multilateral discussions among system operators. The primary objectives of the ICG are to encourage compatibility, that is, for global navigation satellite systems (GNSS) to be used separately or together without interference among systems, and interoperability, using satellite navigation services together to provide better capabilities than can be achieved by individual systems alone. Another significant issue before ICG is the integration of GNSS services into national infrastructure, particularly in developing nations.
2. In compliance with the ICG workplan, as adopted at its first meeting in 2006, the work of ICG is organized through four working groups, which focus on: compatibility and interoperability (Working Group A); enhancement of the performance of GNSS services (Working Group B); information dissemination and capacity-building (Working Group C); and reference frames, timing and applications (Working Group D).
3. The ICG Providers' Forum, established in 2007, provides ways and means of promoting communication among system providers on key technical issues and operational concepts such as protection of the GNSS spectrum and orbital debris and orbit de-confliction.
4. The Office for Outer Space Affairs of the Secretariat, as the executive secretariat of ICG and its Providers' Forum, handles the coordination of the planning meetings of ICG and the Providers' Forum, which are held in conjunction



with the sessions of the Committee on the Peaceful Uses of Outer Space and its subsidiary bodies. The Office also implements a programme on GNSS applications, as mandated by ICG and the Providers' Forum.

5. The Office for Outer Space Affairs organized and hosted the first meeting of ICG in Vienna in 2006 (see A/AC.105/879). The ICG meetings held from 2007 to 2013 were hosted by India (see A/AC.105/901), the United States of America (see A/AC.105/928), the Russian Federation (see A/AC.105/948), Italy (see A/AC.105/982), Japan (see A/AC.105/1000), China (see A/AC.105/1035) and the United Arab Emirates (see A/AC.105/1059).

6. The ninth meeting of ICG was held in Prague from 10 to 14 November 2014. The European Commission and the European GNSS Agency organized the meeting on behalf of the European Union.

B. Structure and programme of the meeting

7. The programme of the ninth meeting of ICG included three plenary sessions and a series of meetings of the four working groups. An update on satellite-based navigation systems in operation or under development was provided by a representative for each system at the first plenary session, on 10 November 2014. ICG members, associate members and observers, representing key GNSS user communities, gave presentations on the emergence of innovative applications in various domains. The Office for Outer Space Affairs also contributed, with a presentation entitled "Programme on GNSS applications", in which regional workshops and the work carried out through the regional centres for space science and technology education, affiliated to the United Nations, which also acted as the information centres for ICG, were described.

8. The meeting of the providers with ICG members, comprising United Nations Member States and intergovernmental and non-governmental organizations, was held on 11 November 2014. The meeting, led by the co-chairs of the ICG Providers' Forum, considered some cross-cutting issues in terms of user needs, priorities and requirements, including the actions to be taken to collect and collate user requirements.

9. In accordance with the ICG workplan, four working groups met on 11 and 12 November 2014 to review progress made in implementing the recommendations made at previous meetings and the ways and means of carrying them forward in 2015 and beyond.

10. At its second and third plenary sessions, held on 13 and 14 November 2014, ICG discussed the recommendations of the working groups and the plans to address the current and future work of each working group.

11. After considering the various items on its agenda, ICG adopted a joint statement (see section III below) and its vision statement (see annex I).

12. In conjunction with the ninth meeting of ICG, the Providers' Forum held its thirteenth meeting on 9, 11 and 13 November 2014 under the co-chairmanship of China and the European Union (see section IV below).

C. Attendance

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

14. The following United Nations entities were represented at the meeting: Office for Outer Space Affairs and International Telecommunication Union (ITU).

15. The following intergovernmental and non-governmental organizations dealing with GNSS services and applications were also represented at the meeting: Arab Institute of Navigation, Civil Global Positioning System Service Interface Committee, European Space Agency, European Space Policy Institute, Interagency Operations Advisory Group, International Aeronautical Federation, 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 Earth Rotation and Reference Systems Service, International Federation of Surveyors, International GNSS Service and International Steering Committee of the European Position Determination System.

16. ICG decided to invite, at their request, observers for Canada and the Space Generation Advisory Council to attend the ninth meeting and to address it, as appropriate, on the understanding that it would be without prejudice to further requests of that nature and that doing so would not involve any decision of ICG concerning their status. The representatives of the Asia-Pacific Space Cooperation Organization (APSCO) also attended.

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

D. Expert seminar on global navigation satellite system applications

18. An expert seminar on GNSS applications was held on 10 November 2014 as part of the ninth meeting of ICG. The seminar introduced issues and opportunities in user applications and GNSS technology for consideration by ICG and/or its working groups. Bradford Parkinson (United States), widely known as the founder of Global Positioning System (GPS), made a keynote presentation entitled “Assuring Positioning, Navigation and Timing (PNT): A PTA (protecting, toughening and augmenting) programme and recommendations of the United States PNT Advisory Board”.

19. The presentations given at the seminar included the following: “GNSS application market opportunities”, by the representative of the European GNSS Agency; “High-precision agriculture and machine control with the Global Navigation Satellite System (GLONASS), GPS and other GNSS”, by the representative of the Russian Federation; “Progress of BeiDou navigation satellite system applications”, by the representative of China; and “GNSS for train control and management systems: challenges and opportunities for global services” and “Satellite services for personal air transportation”, by the representatives of Italy.

E. Documentation

20. A list of the documents before the ninth meeting is contained in annex III. Those documents and further information on the meeting's agenda, background materials and presentations are available on the ICG information portal (www.unoosa.org/oosa/en/SAP/gnss/icg.html).

II. Observations, recommendations and decisions

21. After considering the various items before it, ICG, at its ninth meeting, made the observations, recommendations and decisions set out below.

22. In the interests of enhancing information-sharing and data dissemination among ICG members, ICG encouraged participating space-based positioning, navigation and timing system providers to consider establishing mechanisms with international representation to promote further collaboration among all emerging user groups.

23. With a focus on capacity-building and knowledge-sharing in GNSS technology development, it was noted that the experts' meetings, organized by the Office for Outer Space Affairs, provided a good platform for strengthening institutional and human capacity in utilizing GNSS technology through sharing case studies, lessons learned and experiences from different countries.

24. ICG noted that the continuation of the United Nations experts' meetings on GNSS and its applications in the future would ensure that a forum for ongoing dialogue and feedback was possible between users and system providers in order to enhance positioning, navigation and timing services worldwide.

25. ICG agreed that the discussion topics from the meeting of the providers with ICG members, associate members and observers should, in the future, be addressed in the ICG working groups, as appropriate.

26. ICG noted the results of the thirteenth meeting of the Providers' Forum, held in conjunction with the ninth meeting of ICG. It was noted that the Providers' Forum continued to work cooperatively to enable better services. It was also noted that "Debris mitigation in medium-Earth orbit" and "GNSS market access" would be topics for discussion by the providers.

27. In preparation for its tenth meeting, to be held in 2015, ICG noted that the 10th anniversary booklet would include key information about ICG membership, presenting the role of members and the benefits of participation in ICG.

28. ICG noted with satisfaction the work currently being undertaken by the executive secretariat to revitalize and improve the information portal of ICG.

29. ICG took note with appreciation of the reports of its four working groups, which contained the results of their deliberations in accordance with their respective workplans.

30. ICG endorsed the decisions and recommendations of the working groups with regard to the implementation of the actions set forth in their workplans.

31. ICG took note of the application of APSCO for membership in ICG. The Chair of the meeting summarized the letter of application and the relevant correspondence.
32. ICG heard a presentation by the representative of APSCO on the organization's plans for implementing GNSS applications, and granted APSCO the status of observer.
33. The executive secretariat was requested to amend the terms of reference of ICG to reflect the addition of the new observer.
34. ICG accepted the invitation of the United States to host the tenth meeting, to be held in 2015, and noted the offer of the Russian Federation to host the eleventh meeting, in 2016. ICG also noted the expression of interest by Japan to host the twelfth meeting, in 2017.
35. ICG agreed on a tentative schedule for the preparatory meetings for its tenth meeting, to be held during the fifty-second session of the Scientific and Technical Subcommittee and the fifty-eighth session of the Committee on the Peaceful Uses of Outer Space, both in 2015. It was noted that the Office for Outer Space Affairs, as the executive secretariat of ICG and its Providers' Forum, would assist in the preparation of those meetings and the activities of the working groups.
36. In a closing ceremony that was part of the ICG meeting, organizers and participants expressed their appreciation to the Office for Outer Space Affairs for its work in support of ICG and its Providers' Forum, including carrying out planned activities.

III. Joint statement

37. ICG adopted by consensus the following joint statement:
 1. The ninth meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Prague from 10 to 14 November 2014 to continue reviewing and discussing developments in global navigation satellite systems (GNSS) and to allow ICG members, associate members and observers to address recent developments in their organizations and associations with regard to GNSS services and applications. The Deputy Minister of Transport of the Czech Republic, the Head of the Unit for Galileo and EGNOS — Applications, Security and International Cooperation, European Commission, and the Executive Director of the European GNSS Agency delivered opening speeches on behalf of the European Union. The Director of the Office for Outer Space Affairs of the United Nations Secretariat also addressed the meeting.
 2. The European Commission and the European GNSS Agency organized the meeting on behalf of the European Union. The meeting was attended by representatives of China, India, Italy, Japan, Malaysia, the Russian Federation, the United Arab Emirates, the United States and the European Union, as well as of the following intergovernmental and non-governmental organizations: Arab Institute of Navigation, Civil Global Positioning System Service Interface Committee, European Space Agency, European Space Policy

Institute, Interagency Operations Advisory Group, International Aeronautical Federation, International Association of Geodesy and the International Association of Geodesy Reference Frame Sub-Commission for Europe, International Association of Institutes of Navigation, International Bureau of Weights and Measures, International Earth Rotation and Reference Systems Service, International Federation of Surveyors, International GNSS Service and International Steering Committee of the European Position Determination System. Representatives of the Office for Outer Space Affairs and the International Telecommunication Union (ITU) also participated. Canada was invited to attend as an observer. The representative of the Space Generation Advisory Council also attended. Representatives of the Asia-Pacific Space Cooperation Organization (APSCO) also attended. APSCO was recognized by ICG as a new observer.

3. ICG recalled that the United Nations General Assembly, in its resolution 68/75, had noted with satisfaction the continuous 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 GNSS and their integration into national infrastructure, particularly in developing countries, and noted with appreciation that ICG had held its eighth meeting in Dubai, United Arab Emirates, from 10 to 14 November 2013.

4. ICG addressed GNSS application market opportunities and applications in the areas of aviation, spatial aerial plants (e.g. cable cars), train control and management systems and high-precision agriculture. Representatives from industry, academia and Governments shared views on challenges and opportunities for GNSS services.

5. ICG noted that the working groups had 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.

6. Beginning at its intersessional meeting held in Geneva and hosted by ITU, and continuing during the ninth meeting of ICG, Working Group A, on compatibility and interoperability, addressed all four areas of its current workplan. The compatibility and performance standard subgroup reported on the status of ongoing work in those areas and updated its recommendation on compatibility between international mobile telecommunications and the radio determination satellite service and radio navigation satellite services spectrum. In addition to the intersessional meeting, the newly formed interference detection task force organized and completed the third ICG interference detection and mitigation workshop at ITU. That event and the subsequent deliberations led to three recommendations on interference detection and mitigation capabilities and the conduct of the United Nations workshops on spectrum protection and interference detection and mitigation to be organized by the Office for Outer Space Affairs on a regional basis.

7. The international GNSS monitoring and assessment task force also presented two recommendations to the Working Group, based on three meetings that had been held in 2014, including a proposal to hold an

international GNSS monitoring and assessment workshop in Xi'an, China, immediately preceding the sixth China Satellite Navigation Conference, to be held in 2015.

8. Finally, the interoperability task force reported on three workshops held in China, Japan and the Russian Federation, where inputs from industry and users on the subject of multi-GNSS interoperability had continued to be collected and analysed. The task force will continue its work in 2015, to include an interoperability workshop in Europe, leading to potential recommendations for consideration by the Working Group and the Committee at the tenth meeting of ICG.

9. Working Group B, on the enhancement of GNSS service performance, made progress in establishing an interoperable GNSS space service volume. Space service volume-relevant characteristics were presented by Global Positioning System, Global Navigation Satellite System (GLONASS), BeiDou navigation satellite system and Quazi-Zenith Satellite System. Galileo aims to release its space service volume-related characteristics in the first quarter of 2015. Members of Working Group B will develop a booklet on interoperable GNSS space service volume and will continue to work towards an interoperable GNSS space service volume. The Working Group members acknowledged the benefits of signals broadcast from satellites in non-nominal orbit or from satellites not part of the operational constellation for a wide range of users, including space service volume users.

10. Alongside the issue of space service volume, the Working Group continued to work according to its workplan. Good-quality ionospheric error compensation models were identified in order to provide single frequency users with better accuracy. Results obtained from one of those, the NeQuick Galileo model, which had demonstrated good performance, were discussed. Following the recommendation of the eighth meeting of ICG, the discussion continued on the Time To First Fix estimation methodology, leading to the identification of additional figures of merit. Interference mitigation techniques at the antenna level and at the digital signal processing level were discussed and the importance of investigating interference mitigation techniques at the user level was confirmed.

11. The application subgroup of Working Group B held dedicated meetings and continued monitoring application needs. The findings were being summarized in a report. The way forward to the tenth meeting of ICG for the Working Group and its application subgroup was defined.

12. Recognizing the present status of GNSS and the prospects for the continued development of a wide variety of applications critical to science, commerce and infrastructure, Working Group C, on information dissemination and capacity-building, recommended that more workshops and training courses should continue to be held on specific areas of interest to end users. The Working Group encouraged knowledge transfer via e-learning systems using existing web-based distance learning programmes, as well as communication and outreach to the wider community through the regional centres for space science and technology education, affiliated to the United Nations, which also acted as information centres for ICG.

13. To improve cooperation between the existing and/or developing user information centres of the providers, Working Group C recommended that all the provider and GNSS user information centres consider the development and adoption of a process for referring enquiries to each other, where appropriate.

14. Working Group D, on reference frames, timing and applications, apprised ICG of developments within the Economic and Social Council to establish the Committee of Experts on Global Geospatial Information Management, and within the Working Group on Global Geodetic Reference Frame. The Committee of Experts had noted that the services derived from GNSS technology provide a framework for all geospatial activity, as a key enabler of spatial data interoperability, disaster mitigation and sustainable development. The co-chairs of Working Group D were involved in the Working Group on Global Geodetic Reference Frame, and suggested that ICG and the United Nations Initiative on Global Geospatial Information Management explore close cooperation.

15. Working Group D noted significant continued progress on the geodetic and timing references for GNSS currently represented in ICG. Specific progress was noted in the refinement of the alignments of GNSS-associated reference frames to the latest realization of the International Terrestrial Reference (ITRF) System, in the form of ITRF2008, and in timing references in relation to rapid Coordinated Universal Time, International Bureau of Weights and Measures publications and GNSS time offsets.

16. Working Group D had contributed and would continue to contribute to the international GNSS monitoring and assessment initiative. The Group also made two recommendations: one in relation to the United Nations Initiative on Global Geospatial Information Management initiative regarding a General Assembly resolution on the global geodetic reference frame, and one on the possible provision by GNSS providers of satellite data that would improve orbit modelling and accuracy.

17. ICG adopted a Vision Statement, which is contained in annex I of the present document.

18. ICG accepted the invitation of the United States to host its tenth meeting in Boulder, Colorado, from 2 to 6 November 2015. The Office for Outer Space Affairs, in its capacity 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 to be held in 2015. ICG noted the expression of interest by the Russian Federation to host the eleventh meeting of ICG, in 2016, and by Japan to host the twelfth meeting, in 2017.

IV. Providers' Forum

38. The thirteenth meeting of the Providers' Forum, co-chaired by China and the European Union, was held in conjunction with the ninth meeting of ICG, on 9, 11 and 13 November 2014 in Prague. China, India, Japan, the Russian Federation, the United States and the European Union were represented at the meeting.

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

A. Summary of discussions and recommendations

1. Open service information dissemination

1. The United States presented an update on GNSS space service volume. The United States was very pleased with the progress made at the eighth meeting of ICG in 2013. The goal for the United States was to ensure an interoperable, sustained and quantified GNSS capability for space users. Recently released antenna patterns for the GPS IIR and IIR-M satellites were also presented. They would help space users in high-Earth orbit (i.e. geostationary orbit and geostationary transfer orbits). The United States continues to encourage GNSS and radio-navigation satellite services partners to complete the space service volume templates, develop specifications and publish constellation antenna data.
2. The United States presented background information on Medium-Earth Orbit Search and Rescue (MEOSAR) as an application for the International Satellite System for Search and Rescue (COSPAS-SARSAT). MEOSAR is the next generation of satellite-aided search and rescue to be in the testing phase. MEOSAR payloads will be on board GPS, Galileo and the Russian GLONASS satellites, and are expected to have early operational capability in 2015.
3. The European Union presented an update on the status of Galileo and noted a significant improvement in ranging accuracy over the previous year. The European Union also provided an update on Galileo satellites 5 and 6, which were in a stable condition and had been handed over to the Galileo command and control on 27 and 28 September 2014. However, the satellites were not in the expected orbits, owing to a launch anomaly. An orbit-raising manoeuvre was started for one of the satellites, and in-orbit testing was expected to be done in December 2014, after a higher target orbit had been reached. An analysis of the target orbit indicated that the signal in space could be used by most commercial receivers, but the lack of a valid almanac and navigation message (orbits, clocks) was expected. A decision about whether to use those satellites for navigation and search and rescue would be made after the in-orbit testing was complete. The European Union also noted that the possibility of a collision with other medium-Earth orbit satellites was very low, based on their output of respective analysis centres.
4. The European Union also presented information on the progress made on Galileo space service volume characterization.
5. The European Union intends to publish the Galileo characteristics related to the interoperable GNSS space service volume in early 2015.
6. During the presentation given by the United States, it was noted that the United States national space policy encouraged market access, and that bilateral discussions had been held with Japan and the European Union on that topic. The consideration of system-specific equipage mandates by GNSS providers was an area of concern for the United States, as they might not be

consistent with World Trade Organization commitments. The United States would prefer to see technology-neutral performance-based standards, which would allow manufacturers and users to identify the optimal means for meeting the requirement.

2. Service performance monitoring

7. On the topic of service performance monitoring, China noted two recommendations that had been proposed to Working Groups A, B and D for further discussion. The first was for the establishment of an information portal for international GNSS monitoring and assessment, and the second was for the international GNSS monitoring and assessment task force to hold a workshop in 2015.

3. Report on a multi-global navigation satellite systems demonstration project in Asia and Oceania

8. The secretariat of Multi-GNSS Asia provided an update on the multi-GNSS demonstration project in Asia and Oceania and noted that 42 organizations from 15 countries were currently participating. The sixth regional workshop had been held from 9 to 11 October 2014 in Phuket, Thailand. At that workshop, two proposed experiments had been endorsed by the Multi-GNSS Asia steering committee, and the formation of a new working group on capacity-building had been proposed. The results of the current multi-GNSS experiment would be reported at the next regional workshop.

4. Information centres and information portal of the International Committee on Global Navigation Satellite Systems

9. The ICG executive secretariat provided an update on recent and future activities.

10. The first nine-month postgraduate course on GNSS had been completed at the African Regional Centre for Space Science and Technology — in French Language, which was based in Rabat and was also an ICG information centre.

11. The ICG information portal was being redesigned by the Office for Outer Space Affairs and would include the addition of a web page for ICG members, associate members and observers. More information about the information portal would be presented at the Providers' Forum planning meeting to be held in February 2015.

12. The booklet was being updated for the 10-year anniversary of ICG, in 2015. The first chapter of the booklet contained information about each provider's system, and needed to be updated from the last time the booklet was published, in 2010. The goal was to have the booklet complete by June 2015, so that it could be launched at the fifty-eighth session of the Committee on the Peaceful Uses of Outer Space. Submission of the completed input template to the ICG executive secretariat was requested by the end of November 2014.

B. Other matters

13. A review of the draft vision statement was discussed. The European Union made some revisions.

14. The United States proposed debris mitigation in middle-Earth orbit and GNSS market access as topics for discussion by the providers. The providers agreed to consider that proposal at their next meeting, based on further information to be provided by the United States.

15. The providers agreed to add to the agenda of the Providers' Forum an item on review of progress in the implementation of the recommendations of the ICG Working Groups.

16. The providers agreed that the next meeting of the Providers' Forum would be held in Vienna in June 2015, in conjunction with the fifty-eighth session of the Committee on the Peaceful Uses of Outer Space.

Annex I

Vision statement of the International Committee on Global Navigation Satellite Systems

The International Committee on Global Navigation Satellite Systems strives to encourage and facilitate compatibility, interoperability and transparency between all the satellite navigation systems, to promote and protect the use of their open service applications and thereby to benefit the global community. Our vision is to ensure the best satellite-based positioning, navigation and timing for peaceful uses for everybody, anywhere, any time.

Annex II

List of States Members of the United Nations, United Nations entities 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

Arab Institute of Navigation

Asia-Pacific Space Cooperation Organization

Civil Global Positioning System Service Interface Committee

Committee on Space Research

European Space Agency

European Space Policy Institute

Interagency Operations Advisory Group

International Aeronautical Federation

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 III**Documents before the ninth meeting of the International
Committee on Global Navigation Satellite Systems**

<i>Symbol</i>	<i>Title or description</i>
ICG/WGA/2014	Report of the Working Group on Compatibility and Interoperability
ICG/WGB/2014	Report of the Working Group on Enhancement of the Performance of Global Navigation Satellite System Services
ICG/WGC/2014	Report of the Working Group on Information Dissemination and Capacity-building
ICG/WGD/2014	Report of the Working Group on Reference Frames, Timing and Applications
ICG/TOR/2014 (amended)	Terms of reference of the International Committee on Global Navigation Satellite Systems
