



**Committee on the Peaceful
Uses of Outer Space****Sixteenth meeting of the International Committee on Global
Navigation Satellite Systems****Note by the Secretariat****I. Introduction****A. Background**

1. Global navigation satellite systems (GNSS) are a powerful tool for a better future and continue to evolve as an instrument for international cooperation. The interoperability of GNSS constellations is key, as it means more precise services for people and businesses on Earth.
2. With the participation of States Members of the United Nations, intergovernmental bodies and non-governmental organizations, significant progress continues to be made through the work of the International Committee on Global Navigation Satellite Systems (ICG). The results of this work not only promote the capabilities of GNSS to support sustainable development, but also promote new partnerships among ICG members and institutions in the broader user community, in particular in developing nations.
3. ICG divides its work among four working groups, which are currently addressing the following topics: systems, signals and services (Working Group S); enhancement of GNSS performance, new services and capabilities (Working Group B); information dissemination and capacity-building (Working Group C); and reference frames, timing and applications (Working Group D).
4. ICG held its sixteenth meeting in Abu Dhabi, from 10 to 14 October 2022, in a hybrid format. The Providers' Forum held its twenty-sixth meeting, on 9 and 13 October 2022, in conjunction with the ICG meeting. The United Arab Emirates Space Agency organized and hosted the meeting on behalf of the Government of the United Arab Emirates. 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 I.

B. Structure and programme of the meeting

5. The programme of the sixteenth meeting of ICG consisted of three plenary sessions and a series of meetings of the four working groups. The first plenary session, held on 10 October 2022, provided an opportunity for providers of GNSS, regional



systems and augmentation systems to make presentations on their programme and policy updates and exchange ideas in the field of GNSS. ICG members, associate members and observers also shared their views and perspectives on matters of interest to ICG and its working groups.

6. The ICG working groups met in four parallel sessions from 11 to 13 October 2022 to review progress made in implementing the recommendations made at previous meetings and ways and means of continuing to make progress in 2023 and beyond.

7. In addition, the working groups held joint sessions on 11 and 12 October 2022 to address the following topics: (a) open service information-sharing and service performance monitoring; (b) precise point positioning interoperability; and (c) multi-GNSS timing interoperability. The conclusions and recommendations of the working groups were presented and discussed at the ICG second plenary session, on 13 October 2022.

8. After considering the various items on its agenda, ICG adopted a joint statement (see sect. III below).

9. In conjunction with the sixteenth meeting of ICG, the Providers' Forum held its twenty-sixth meeting on 9 and 13 October 2022, chaired by the Russian Federation (see sect. IV below).

C. Attendance

10. Representatives of the following States participated in the sixteenth meeting of ICG: Australia, China, India, Italy, Japan, Malaysia, New Zealand, Republic of Korea, Russian Federation, United Arab Emirates and United States of America. The European Union was also represented.

11. The following United Nations entities and intergovernmental and non-governmental organizations dealing with GNSS services and applications were also represented at the meeting: Arab Institute of Navigation, Asia-Pacific Space Cooperation Organization, Civil Global Positioning System Service Interface Committee, Committee on Space Research, European Space Agency, Interagency Operations Advisory Group, International Aeronautical Federation, International Association of Geodesy, International Association of Institutes of Navigation, International Bureau of Weights and Measures, International Federation of Surveyors, International Global Navigation Satellite System Service, International Maritime Organization and International Telecommunication Union. Representatives of the Office for Outer Space Affairs also participated.

12. ICG invited the observers for Pakistan, Türkiye, the African Regional Centre for Space Science and Technology Education – in English language, the Centre for Space Science and Technology Education in Asia and the Pacific, the Radio Technical Commission for Maritime Services and the Regional Centre for Space Science and Technology Education in Asia and the Pacific (China), at their request, to attend the sixteenth 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.

D. Expert seminar

13. An expert seminar, entitled “Low Earth orbit positioning, navigation and timing”, was held on 10 October 2022 to raise awareness of issues and opportunities related to positioning, navigation and timing services provided through low Earth orbit satellite constellations.

14. Presentations made by China, India and the United Arab Emirates demonstrated that positioning, navigation and timing system constellations would move to a

“multilayer system of systems” approach, with medium Earth orbit signals supplemented by those from satellites in low Earth orbit, with additional inputs from terrestrial positioning, navigation and timing systems. It was noted that geometric improvement provided using satellite constellations in low and medium Earth orbit would increase positioning accuracy and improve receiver autonomous integrity monitoring.

E. Documentation

15. A list of the documents before ICG at its sixteenth meeting is contained in annex II. Those documents and further information on the agenda of the sixteenth meeting, background materials and presentations are available on the ICG information portal on the website of the Office for Outer Space Affairs (www.unoosa.org).

II. Observations, recommendations and decisions

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

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

18. ICG discussed the recommendations of the working groups with regard to the implementation of the actions set forth in their workplans. The following four recommendations were endorsed: (a) the incorporation of resilience into GNSS interference detection and mitigation; (b) the coordination of GNSS and lunar positioning, navigation and timing systems for lunar operations; (c) the inclusion and coordination of lunar search and rescue capabilities in lunar positioning, navigation and timing architecture; and (d) the creation of a Working Group D task force on the applications of GNSS for disaster risk reduction.

19. ICG took note of the schedule of the intersessional meetings and workshops of the working groups for 2023, which would be held in conjunction with space-related international conferences and symposiums.

20. The Chair of the meeting informed participants that requests for membership of ICG had been received from Pakistan (note verbale dated 4 January 2021) and the Radio Technical Commission for Maritime Services (letter dated 24 May 2022).

21. ICG took note of a presentation by the representative of Pakistan on a status update currently being developed for the Pakistan satellite-based augmentation system and discussed that country’s request for membership.

22. ICG took note of the proposal by Working Group S to hold a meeting (in virtual or hybrid format) to discuss the technical merits of the membership application made by Pakistan in the light of new information received from the country. It was noted that any outstanding questions might be submitted to the ICG executive secretariat in advance and discussed during this technical meeting. A report of the meeting could be presented to the ICG annual meeting in 2023.

23. ICG discussed the request by the Radio Technical Commission for Maritime Services for observer status. The Commission was recognized as a new observer of ICG.

24. ICG accepted the invitation extended by the European Commission to host the seventeenth meeting of ICG in 2023, and noted the offer made by Australia and New Zealand to jointly host the eighteenth meeting of ICG in New Zealand in 2024. ICG also noted the expression of interest by the Republic of Korea in hosting the meeting of ICG in 2025.

25. ICG agreed on a tentative schedule for the preparatory meetings for its seventeenth meeting, to be held during the sixtieth session of the Scientific and Technical Subcommittee and the sixty-sixth session of the Committee on the Peaceful Uses of Outer Space, in 2023. It was noted that the Office for Outer Space Affairs, as the executive secretariat of ICG and its Providers' Forum, would assist in preparations for those meetings and the activities of the working groups.

26. At the closing ceremony, participants expressed their appreciation to the United Arab Emirates Space Agency for hosting the meeting and to the Office for Outer Space Affairs for its work in support of ICG and its Providers' Forum, including the conduct of planned activities.

III. Joint statement

27. ICG adopted by consensus the following joint statement:

1. The sixteenth meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Abu Dhabi from 10 to 14 October 2022 to continue reviewing and discussing developments in the field of global navigation satellite systems (GNSS) and to allow ICG members, associate members and observers to address recent developments in their countries, organizations and associations regarding GNSS services and applications.

2. Salem Al Qubasi, Director General of the United Arab Emirates Space Agency, delivered an opening statement on behalf of the United Arab Emirates. A representative of the Office for Outer Space Affairs of the Secretariat also addressed the meeting.

3. The meeting was held with in-person and online attendance by representatives of Australia, China, India, Italy, Japan, Malaysia, New Zealand, the Republic of Korea, the Russian Federation, the United Arab Emirates, the United States and the European Union.

4. The following United Nations entities and intergovernmental and non-governmental organizations dealing with GNSS services and applications were also represented at the meeting: Arab Institute of Navigation, Asia-Pacific Space Cooperation Organization, Civil Global Positioning System Service Interface Committee, Committee on Space Research, European Space Agency, Interagency Operations Advisory Group, International Aeronautical Federation, International Association of Geodesy, International Association of Institutes of Navigation, International Bureau of Weights and Measures, International Federation of Surveyors, International Global Navigation Satellite System Service, International Maritime Organization and International Telecommunication Union. Representatives of the Office for Outer Space Affairs also participated.

5. Representatives of Pakistan, Türkiye, the African Regional Centre for Space Science and Technology Education – in English language, the Centre for Space Science and Technology Education in Asia and the Pacific, the Radio Technical Commission for Maritime Services and the Regional Centre for Space Science and Technology Education in Asia and the Pacific (China) were invited to attend as observers. The Radio Technical Commission for Maritime Services was recognized as a new observer of ICG.

6. ICG discussed the request for membership made by Pakistan dated 4 January 2021. No consensus was reached; however, no objections were received.

7. ICG conducted an expert seminar entitled “Low Earth orbit positioning, navigation and timing”. Presentations described low Earth orbit positioning, navigation and timing as a new concept whereby positioning, navigation and timing services could be offered through low Earth orbit satellite constellations.

8. ICG noted that the working groups had focused on the following issues: systems, signals and services; enhancement of GNSS performance, new services and capabilities; information dissemination and capacity-building; and reference frames, timing and applications.

9. The Working Group on Systems, Signals and Services (Working Group S), through its subgroups and task forces, had continued the work outlined in its workplan during the intersessional period between the fifteenth and sixteenth meetings of ICG. Under the leadership of the subgroup on compatibility and spectrum protection, the Working Group had continued its campaign to promote adequate protection of the GNSS spectrum by reviewing relevant GNSS and radionavigation satellite service-related International Telecommunication Union activities. The subgroup agreed to conduct a workshop on interference detection and mitigation prior to the next ICG meeting, focused on the use of Automatic Dependent Surveillance - Broadcast (ADS-B) and the Automatic Identification System (AIS) for interference detection and investigating national processes for notification of interference testing. The Working Group also finalized a recommendation regarding the resilient use of GNSS for critical infrastructure, which was adopted by ICG. A potential future recommendation related to notification for GNSS testing was discussed, but no consensus was reached.

10. The subgroup on interoperability and service standards had held a virtual meeting during the intersessional period, focused on continuing to make progress on the objectives in its workplan. The performance standards group had held monthly virtual meetings in conjunction with the international GNSS monitoring and assessment task force. The performance standards group continued work on a “hints and tips” document and agreed to organize a workshop in 2023 to examine existing and future low Earth orbit positioning, navigation and timing systems, including those provided by commercial industry. The international GNSS monitoring and assessment task force continued to make progress on calculation methodologies and data formats for the joint ICG-International Global Navigation Satellite System Service trial project and planned to hold an in-person workshop focused on addressing issues that could not be resolved through virtual meetings. The task force also planned to meet in 2022 or 2023 to review the terms of reference for the trial project. The task force and the performance standards group planned to continue to hold combined virtual meetings on a monthly basis. During a joint working group session on timing interoperability, discussion focused on the need for an in-person workshop to be held in conjunction with working groups B and D, to discuss timing interoperability in more detail. There was broad consensus that the timing needs of terrestrial users were different from the timing needs of space users. Lastly, the precise point positioning interoperability task force had continued compiling information on planned systems through the collection of information from service providers on the characteristics of their services. The task force planned to hold a meeting and workshop in 2022 or 2023 to continue discussing future plans and identify ways to further enhance interoperability.

11. Under the Working Group’s workplan, which was focused on system of system operations, the providers continued to provide feedback on the 2020 report of the Inter-Agency Space Debris Coordination Committee that followed a recommendation made at the thirteenth meeting of ICG to study the issue of debris mitigation practices relevant to the medium Earth orbit and inclined geosynchronous orbit orbital regimes used by GNSS. The Working Group intended to complete a response to the report and further discuss ways that ICG providers could work together to mitigate the risk of satellite collisions. Lastly, the Working Group received presentations from system providers, who were investigating methods of authenticating open civil signals.

12. The Working Group on Enhancement of GNSS Performance, New Services and Capabilities (Working Group B) had progressed in its activities.

13. The Working Group B space users subgroup informed the Working Group of the progress made since the fifteenth meeting of ICG. The subgroup had met 13 times in that period, including one face-to-face meeting in Vienna in June 2022. The subgroup reviewed the progress made on its workplan for the period 2021–2022, including on the five work packages. The activities of nearly all work packages had started and meetings were held on a regular basis. Good working progress had been made for all the initiated work packages.

14. The space users subgroup also gave a summary of its interactions with the Interagency Operations Advisory Group through the ICG-Interagency Operations Advisory Group liaisons. The proposed areas of coordination between the two organizations related to the development of lunar positioning, navigation and timing architecture and included establishing necessary liaison roles, documenting lunar use cases, encouraging lunar flight experiments and making recommendations to maximize the interoperability, compatibility and availability of the combined GNSS and lunar positioning, navigation and timing system of systems.

15. Since the fifteenth meeting of ICG, the Working Group B application subgroup had been working on an initiative entitled “GNSS applications: for present and future”. The subgroup’s current activities focused on studying cases of GNSS applications that were on the market or were under final development before market release. The subgroup’s activities were intended to provide assistance, lessons learned and guidance to GNSS users. The initiative would lead to a research report entitled “GNSS applications for sustainable development: case studies”.

16. The applications of GNSS in the field of disaster prevention and mitigation were an area of focus for the application subgroup. Working Group B and the subgroup recognized that the proposed study area, namely, GNSS applications for disaster risk reduction, intersected with the subgroup’s current activities and therefore supported the recommendation to study novel GNSS applications for disaster prevention systems. The Working Group and, in particular, the subgroup would actively contribute to the new joint task force of working groups D and B on applications of GNSS for disaster risk reduction.

17. Further enhancements were identified to create opportunities for greater participation and attract new contributions to the application subgroup. The subgroup intended to participate in important GNSS conferences and events to promote GNSS application development and obtain information about trends in GNSS applications in line with the new initiative. The subgroup also intended to support the workshops on the applications of GNSS organized by the Office for Outer Space Affairs.

18. The Working Group appreciated the variety of the contributions received, such as the Emergency Warning Service of the European satellite navigation system (Galileo), the BeiDou Navigation Satellite System search and rescue service, the Space Service Volume Applications and Lunar Search and Rescue (LunaSAR), illustrating the convergence of science, positioning, navigation and timing services and communication systems. The Working Group noted the efforts made in relation to the interoperability of the Emergency Warning Service. The growing importance of the scientific and commercial use of GNSS (in the agricultural sector, for example) was also noted by the Working Group.

19. The Working Group recognized the early development of lunar search and rescue capabilities and the importance of interoperability among lunar communication and navigation providers intending to offer these services. The Working Group discussed and agreed on the recommendation that developers of lunar communication and navigation services consider the integration of interoperable and easily accessible search and rescue services.

20. The Working Group recognized the potential impact that the rising solar activities of the twenty-fifth solar cycle could have on GNSS services and satellites. Further discussions among experts should be conducted through workshops to understand the possible impact of space weather events and the need for alert systems. This would be subject to further discussion at the Working Group's intersessional meeting in 2023.

21. The Working Group on Information Dissemination and Capacity-building (Working Group C) addressed all areas of its workplan. Representatives of China, India, Italy, Japan, the Russian Federation, Malaysia, Pakistan, the Republic of Korea, the United Arab Emirates, the United States and the European Space Agency participated in the work of the working group. Presentations were made on GNSS education programmes provided by their respective organizations. The Working Group received an update on the activities undertaken or supported by the Office for Outer Space Affairs during 2022 and the main results achieved.

22. The Working Group noted the work of the United Nations-affiliated regional centres for space science and technology education, which also acted as information centres for ICG. The Working Group would continue to collaborate with the regional centres to further develop the GNSS curriculum and massive open online courses, and provide support in carrying out seminars and training courses on GNSS and its applications.

23. The Working Group's project team made progress in: (a) exploring low-cost GNSS receivers that could be used to compute total electron content-related parameters; (b) exploring software that could be used to process data from low-cost GNSS receivers in order to compute total electron content; and (c) design a prototype low-cost GNSS receiver for space weather related applications.

24. The Working Group on Reference Frames, Timing and Applications (Working Group D) noted progress on geodetic and timing references by the GNSS and radionavigation satellite service providers. Specific progress was noted in relation to: (a) the release of satellite metadata for better orbit dynamic modelling; (b) the alignment of GNSS reference frames to the International Terrestrial Reference Frame; and (c) the decision to draft a recommendation on timing interoperability for ground users.

25. The Working Group noted that the templates on geodetic and timing references currently provided on the ICG website should be updated by the GNSS and radionavigation satellite service providers to contain the most current information. Moreover, the tracking of updates on the web repository should be improved.

26. The Working Group reiterated that satellite metadata information such as physical and geometrical properties related to the shape, mass, optical properties, dimensions and locations of radiating antennas permitted improved orbit modelling, which in turn increased the accuracy of satellite ephemerides and clock correction determination. This information would greatly benefit the scientific and research community. The Working Group noted that some progress had been made in the provision of satellite properties by the GNSS and radionavigation satellite service providers on the basis of recommendation 23, entitled "Improving the accuracy of multi-GNSS orbits determined by the International Global Navigation Satellite System Service", in accordance with the white paper entitled "Satellite and operations information for generation of precise GNSS orbit and clock products", issued by the International Global Navigation Satellite System Service. The Service collected and made GNSS satellite properties available to the user community. Access to satellite metadata was essential for enabling scientific applications and for high-accuracy precise positioning. The Working Group also noted that the provision of GNSS satellite phase centre offsets significantly contributed to the determination of the scale

of the GNSS/International Global Navigation Satellite System Service reference frame and allowed intercomparing with satellite laser ranging and very long baseline interferometry scales used to determine the International Terrestrial Reference Frame scale. The Working Group acknowledged the significant progress made in the release of additional satellite metadata by Galileo, the Quasi-Zenith Satellite System and the Beidou Navigation Satellite System. The Galileo phase centre offsets had been used to determine the scale of the GNSS/International Global Navigation Satellite System Service reference frame in the third ICG reprocessing campaign (Repro3) solution, contributing to the realization of the International Terrestrial Reference Frame 2020. GNSS providers were requested to continue publishing satellite metadata, including phase centre offsets.

27. The Working Group noted little progress on recommendation 12, entitled “Interoperability of geodetic references among the different GNSS systems”. Some providers were providing GNSS data from their tracking stations to the International Global Navigation Satellite System Service. The working group would continue to monitor progress (in conjunction with the international GNSS monitoring and assessment task force), demonstrate the benefits and encourage all GNSS providers to contribute. The Working Group continued to contribute to the task force’s initiative, in particular through involvement in the joint trial project.

28. In a meeting of the Working Group D task force on timing, the European Space Agency and the National Centre for Space Studies presented their work in the field of accurate multi-GNSS time monitoring, emphasizing the crucial need for the accurate calibration of multi-GNSS receiver chains.

29. The Working Group noted the progress made by the International Bureau of Weights and Measures in implementing recommendation 20, entitled “International Bureau of Weights and Measures publication of [UTC-GNSS times] and [UTC-UTC(k)_GNSS]”. Details of the procedure leading to the publication for all four GNSS had been presented. With respect to recommendation 16-A, entitled “Information on the works related to the proposed redefinition of Coordinated Universal Time”, the Bureau presented the status of the discussions on continuous, Universal Time Coordinated, noting that agreement might be achieved at the General Conference on Weights and Measures, to be held in November 2022, and at the World Radio Conference, to be held in 2023.

30. The Working Group noted the status of GNSS calibrations performed by the International Bureau of Weights and Measures for the computation of Universal Time Coordinated. The calibration performed in 2020 included Galileo and the Global Positioning System, and in 2022, BIPM will also include BDS.

31. The Working Group noted the considerable progress made by India in the development of the Indian Regional Navigation Satellite System Rubidium Atomic Frequency Standard. The country presented a scenario in which timing derived from the Indian Regional Navigation Satellite System could be applied in quantum communications experiments and the testing that was carried out using the System to support quantum communication by entanglement. India gave a presentation on International Global Navigation Satellite System Service stations, whose work was enabled by the Indian Regional Navigation Satellite System.

32. The Working Group examined developments relating to recommendation 21-B on the monitoring of offsets of GNSS times. It noted the work carried out by the Consultative Committee for Time and Frequency and its working groups and task groups, emphasizing that the current broadcast predictions of Universal Time Coordinated broadcast by GNSS through the message [bUTC_{GNSS}-GNSS time] provide a ready-to-use and robust method to determine GNSS-to-GNSS

timing offsets, in addition to existing methods. The Working Group also noted that Recommendation GNSS 1, issued by the Consultative Committee for Time and Frequency in 2021, invited receiver manufacturers to consider this possibility for interoperability.

33. The Working Group concluded that the inter-system bias could be determined using three different methods: (a) direct determination using GNSS measurements when enough satellites were in view (single-station method); (b) the use of direct broadcast GNSS-to-GNSS timing offsets; or (c) the [bUTC_{GNSS}-GNSS time] predictions currently broadcast by GNSS.

34. Studies showed that the difference between broadcast predictions of Universal Time Coordinated had negligible consequences for mass market ground users. Therefore, there was no need to create an ad hoc timescale as a common pivot for timing interoperability. The Working Group acknowledged the fact that the needs of space users might lead to different requirements. The evaluation of these space users' needs had been initiated by Working Group B. Working Group D proposed that follow-up discussions on timing interoperability for space users be held at a joint meeting with working groups B, S and D.

35. At the joint session with working groups B, D and S on timing interoperability, agreement was reached on the development of a joint recommendation that aligned with Recommendation GNSS 1 for ground users. The recommendation was expected to be ready for consideration at the seventeenth meeting of ICG, to be held in 2023.

36. The Working Group noted the recent efforts of the United Nations Committee of Experts on Global Geospatial Information Management and its Subcommittee on Geodesy, namely, the ongoing work of building and maintaining a global geodetic reference frame, as well as the plans for the establishment of a United Nations global geodetic centre of excellence at the United Nations campus in Bonn, Germany.

37. The Working Group expressed its support for the GPS Environmental and Earth Science Information System scientific programme, including its mission. By providing space ties between four different geodetic techniques, the mission had the potential to improve determination of the International Terrestrial Reference Frame and support the International Association of Geodesy and Global Geodetic Observing System requirements, in accordance with General Assembly resolution 69/266, entitled "A global geodetic reference frame for sustainable development". The mission would provide a wide range of benefits, including in relation to geodesy, precise navigation, Earth science and climate change monitoring. In addition, its focus on social benefit through technological community-building aligned closely with the spirit of international collaboration in geodesy, with global users of openly available data and products benefiting from the advances made. Furthermore, the option of advanced time transfer techniques, in addition to the primary geodetic objectives, would be very useful in order to compare ground clocks in relation to the redefinition of the International System of Units second. Therefore, Working Group D supported the GPS Environmental and Earth Science Information System project and strongly encouraged the European Space Agency to continue to carry out this fundamental mission.

38. The Working Group proposed that a joint task force on the applications of GNSS for disaster risk reduction be established under Working Group D and co-chaired by working groups B and D. The task force would focus on novel applications of GNSS data and infrastructure to support sustainable development and disaster risk reduction and would be in alignment with the Sustainable Development Goals and the Sendai Framework for Disaster Risk Reduction 2015–2030. The first application to be considered would be the use of GNSS to enhance tsunami early warning systems.

39. Working Group D, together with working groups B and S, highlighted the importance of harmonizing key aspects of system-provided precise point positioning services, in particular, the definition of precise point positioning terminology, as well as the coordinates reference frame and timing system. Working Group D reiterated that the interoperability of GNSS precise positioning required the timing and geodetic references to be consistent in order to reduce ambiguities for users with regard to the interpretation of navigation and timing solutions. The Working Group found it desirable, from the point of view of the user, to relate or align different GNSS frames to the International Terrestrial Reference Frame.

IV. Providers' Forum

28. The twenty-sixth meeting of the Providers' Forum, chaired by the Russian Federation, was held in conjunction with the sixteenth meeting of ICG, on 9 and 13 October 2022, in a hybrid format with both in-person participation in Abu Dhabi and online participation. China, India, Japan, the Russian Federation, the United States and the European Union were represented at the meeting.

29. After considering the items on its agenda, the Providers' Forum adopted the report on its twenty-sixth meeting, containing the discussions and recommendations set out below.

A. Summary of discussions and recommendations

1. Open service information dissemination

30. Presentations were made on the following topics.

(a) Lunar Search and Rescue (LunaSAR) update

31. The United States presented an update on its distress notification and tracking system for lunar exploration. LunaSAR allowed a crew member on the lunar surface to send a distress signal should they become endangered or separated from their crew members. In addition to the architecture of LunaSAR, the potential for international collaboration and cooperation, including possible interoperability with the European Space Agency Moonlight initiative, was also addressed.

(b) Galileo programme status, including system performance

32. The European Commission presented the current programme status of Galileo. The status of the Open Service Navigation Message Authentication function, High Accuracy Service, I/NAV message improvement, search and rescue, Emergency Warning Service and other upcoming services and features were also reported. In addition, an overview was provided of the Galileo second-generation satellites.

2. Service performance monitoring

33. China presented an update on its international GNSS monitoring and assessment System, including on system infrastructure and evaluation results. Monitoring and evaluation result analysis reflected the signal-in-space ranging error, availability and continuity, the Coordinated Universal Time offset error and positioning accuracy assessment results of the BeiDou Navigation Satellite System, Global Positioning System, Global Navigation Satellite System and Galileo. The system was recently updated to evaluate the BeiDou Navigation Satellite System precise point positioning service, showing the signal-in-space ranging error and positioning accuracy of precise point positioning signals. The service performance of multiple GNSS systems would be continuously evaluated and the service performance of new signals and services tracked.

3. Spectrum protection and interference detection and mitigation

34. The United States presented a report of a recent interference event. It was reported that even for this accidental interference event, the Government's inter-agency GPS interference detection and mitigation process had functioned, including by issuing a notice to air missions. As part of its resilience posture outreach efforts, the United States had developed two guidance documents, entitled "GPS interference happens" and "Time guidance for Network Operations Operators, Chief Information Officers and Chief Information Security Officers", with a view to further educating infrastructure operators.

4. Multi-GNSS demonstration project in the Asia-Oceania region

35. Japan provided an update on Multi-GNSS Asia, which promoted multi-GNSS in the Asia-Oceania region. The status of the Rapid Prototype Development Challenge 2022 was reported. The annual Multi-GNSS Asia conference was planned to be held from 31 January to 2 February 2023 in Chiang Mai, Thailand.

5. Information centres of the International Committee on Global Navigation Satellite Systems: regional centres for space science and technology education, affiliated to the United Nations

36. A representative of the executive secretariat of ICG noted that the nine-month postgraduate courses on GNSS would be held at the regional centres for space science and technology education, affiliated to the United Nations, in the academic year 2022/2023. The Regional Centre for Space Science and Technology – in French Language, in Rabat, hosted a workshop on space weather and GNSS from 9 to 13 May 2022. The workshop was co-organized by the Office for Outer Space Affairs, Boston College and the Abdus Salam International Centre for Theoretical Physics. The representative of the executive secretariat also noted that the second edition of *The Interoperable Global Navigation Satellite Systems Space Service Volume*, launched at the fifteenth meeting of ICG, had been distributed to all regional centres for space science and technology education, for educational purposes.

6. Potential areas of coordination between ICG and international organizations

37. The liaisons from the Interagency Operations Advisory Group to ICG presented an update on the Group's twenty-fifth annual meeting, held on 9 May 2022, and its first intersessional teleconference, held on 13 September 2022. At the annual meeting, the liaisons presented proposed areas of coordination with ICG and its space users subgroup in the context of lunar positioning, navigation and timing services. The Interagency Operations Advisory Group had created a lunar communications and navigation working group to study these services, which would include the ICG liaisons as members. The Advisory Group had also created an interim committee to study LunaNet governance, which would recommend a governance structure for interoperable lunar positioning, navigation and timing services under the LunaNet umbrella.

B. Other matters

1. Requests for membership of the International Committee on Global Navigation Satellite Systems

38. The providers discussed the request by Pakistan for membership status, dated 4 January 2021.

39. The providers also discussed the request by the Radio Technical Commission for Maritime Services for observer status, dated 24 May 2022. The Providers' Forum agreed that the Commission should be accepted as an observer of ICG.

2. Review of the terms of reference of the Providers' Forum

40. The providers reviewed the terms of reference and agreed on the changes to be made to the Chair rotation procedure for future Providers' Forum meetings. The terms of reference of the Providers Forum were amended accordingly.

Annex I

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

Australia
China
India
Italy
Japan
Malaysia
New Zealand
Nigeria
Republic of Korea
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
Radio Technical Commission for Maritime Services

Annex II**Documents before the sixteenth meeting of the International Committee on Global Navigation Satellite Systems**

<i>Symbol</i>	<i>Title or description</i>
ICG/REC/2022	Recommendation of the Working Group on Systems, Signals and Services
ICG/REC/2022	Recommendations of the Working Group on Enhancement of GNSS Performance, New Services and Capabilities
ICG/REC/2022	Recommendation of the Working Group on Reference Frames, Timing and Applications
ICG/TOR/2022	Terms of reference of the International Committee on Global Navigation Satellite Systems (as amended)
ICG/PF/TOR/2022	Terms of reference of the Providers' Forum (as amended)