



17th meeting of the International Committee on Global Navigation Satellite Systems,

Madrid, Spain

16 – 20 October 2023

Joint Statement

1. The seventeenth meeting of the International Committee on Global Navigation Satellite Systems (ICG) was held in Madrid, from 16 to 20 October 2023 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 and collaborate on recent developments in their countries, organizations and associations regarding GNSS services and applications.
2. Timo Pesonen, Director General of Defence Industry and Space of European Commission and Carmen Librero Pintado, Special Commissioner for Transport, Mobility and the Urban Agenda of Spain delivered opening statements. Sharafat Gadimova of the Office for Outer Space Affairs of the United Nations Secretariat also addressed the meeting.
3. The meeting took note of a keynote presentation from Brad Parkinson of the United States on History of the Global Positioning System (GPS) on the occasion of the 50th anniversary of gaining initial approval in 1973.
4. The meeting was held with in-person and online attendance by representatives of Australia, China, India, Italy, Japan, Malaysia, New Zealand, Nigeria, the Republic of Korea, the Russian Federation, the United Arab Emirates, the United States of America and the European Union, as well as the following intergovernmental and non-governmental organizations: Asia-Pacific Space Cooperation Organization (APSCO), Civil Global Positioning System Service Interface Committee (CGSIC), Committee on Space Research (COSPAR), European Space Agency (ESA), International Bureau of Weights and Measures (BIPM), International Earth Rotation and Reference Systems Service (IERS), International Federation of Surveyors (FIG), International Association of Geodesy (IAG), International Association of Institutes of Navigation (IAIN), International GNSS Service (IGS), the International Telecommunication Union (ITU) and Radio Technical Commission for Maritime Services (RTCM). Representatives of the Office for Outer Space Affairs also participated.
5. Representatives of Algeria, Pakistan, Türkiye, the Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP, India), the Regional Centre for Space Science and Technology Education in Asia and the Pacific

(RCSSTEAP, China), International Maritime Organization (IMO) and Space Generation Advisory Council (SGAC) were invited to attend as observers.

6. Algeria and Türkiye were recognized as new members of ICG.
7. Regarding membership application of Pakistan, which was submitted at the ICG-15, ICG fails to attain consensus. ICG agreed to work towards a swift conclusion on the matter. Furthermore, a Member of ICG expresses its concern over this matter and requests ICG to bring this matter to the attention of UNCOPUOS.
8. ICG took note of the requests of Australia, New Zealand and Republic of Korea to change their description to “current and future space-based regional and augmentation system providers” as per the ICG ToR and agreed to discuss it further. ICG took note of a proposal from China to amend the ToR of ICG and agreed to discuss it further.
9. 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.
10. The Working Group on Systems, Signals and Services (Working Group S), through its subgroups and task forces, continued the work outlined in its workplan during the intersessional period between sixteenth and seventeenth 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 GNSS spectrum by reviewing relevant GNSS/Radionavigation Satellite Service (RNSS) related ITU activities. The subgroup conducted a workshop on interference detection and mitigation in December 2022, focused on utilizing of Automatic Dependent Surveillance - Broadcast (ADS-B) and the Automatic Identification System (AIS) for interference detection, and further investigating national processes for notification of interference testing. The subgroup also agreed to conduct an eleventh workshop on interference detection and mitigation, to look at the aviation and maritime sector reporting process, A potential future recommendation related to notification for GNSS testing was discussed, but no consensus was reached.
11. Under the Working Group S, the subgroup on interoperability and service provision continued to make progress on the work in its workplan, including overseeing the work of its task forces. The performance standards group led and organized a workshop on future low Earth orbit (LEO) positioning, navigation and timing (PNT) systems, including those provided by commercial industry. The performance standards group also continued to hold monthly virtual meetings combined with the international GNSS monitoring and assessment (IGMA) task force and continued its work on a “hints and tips” document. The IGMA task force held a workshop focused on reviewing the Terms of Reference for the joint ICG-IGS trial project, which resulted in a recommendation for ICG to adopt those revisions. The IGMA task force continued to make progress on calculation methodologies and data formats for

the trial project and plans to hold another workshop in 2024. The IGMA task force and performance standards groups plan to continue with combined virtual meetings on a monthly basis. Timing experts from the subgroup on interoperability and service provision held a meeting to discuss next steps, and agreed to a recommendation for working group members to reach out to industry for views on timing interoperability and conduct a workshop to share the results. Finally, the Precise Point Positioning (PPP) interoperability task force held a workshop in 2023 and continued pulling together information on planned systems through collection of information from service providers on the characteristics of their services. The PPP interoperability task force plans to hold another workshop in 2024 to continue discussing future plans and identify ways to further enhance interoperability.

12. Under the Working Group's workplan focused on system of system operations, the working group received several presentations related to open service navigation message authentication. Providers continued to provide feedback on the 2020 report from the Inter-Agency Space Debris Coordination Committee (IADC) that followed a recommendation from 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 plans to work with China to develop a response to IADC based on collection of information on orbital parameters from the providers. Under the topic of system of system operations, the working group received presentations from system providers, who are looking into methods for authentication of open civil signals. Lastly, the Working Group agreed to a recommendation supporting further inclusion of LEO PNT providers, who may also be from industry, for further engagement in ICG discussions on this topic. The working group also plans to hold another LEO PNT Workshop in 2024.
13. The Working Group on Enhancement of GNSS Performance, New Services and Capabilities (Working Group B) had progressed in its activities.
14. The Working Group B space users subgroup organized a joint working group session on Lunar PNT to provide a consolidated introduction and overview of lunar PNT activities to the ICG working groups. Presentations included (1) a condensed overview of the current status of systems being proposed, including by China, ESA, the Japan Aerospace Exploration Agency (JAXA) and the National Aeronautics and Space Administration (NASA); (2) an overview of lunar spectrum considerations and the Space Frequency Coordination Group (SFCG); (3) an introduction and status of the LunaNet Interoperability Specification and lunar reference frame and time system coordination; and (4) the introduction of a recommendation for ICG to jointly organize with the Interagency Operations Advisory Group (IOAG) a multilateral workshop on cislunar PNT. The joint working group also welcomed a presentation by the European Commission and ESA announcing upcoming public availability of transmit antenna gain patterns for Galileo Full Operational Capability (FOC) satellites. In addition, the Indian Space Research Organization (ISRO) highlighted their concept of lunar pseudolites.
15. The Working Group noted, based on discussions in the joint working group and Working Group B, that several space agencies were planning in-situ lunar services including communication, PNT, search and rescue, and more,

beginning within this decade. Working Group B also noted that the LunaNet Interoperability Specification (LNIS) working group was working to define a framework of mutually agreed standards aimed toward creating an interoperable network of compliant services, including PNT, around the Moon. Based on the experience acquired and lessons learned by ICG participants in achieving interoperability between GNSS services, and with the goal of benefiting utilisation of lunar PNT services, the Working Group B encouraged developers of lunar PNT systems to collaborate towards interoperability via open, inclusive multi-lateral mechanisms, including the LNIS.

16. Working Group B noted that the current draft of the LNIS was publicly available, and encouraged all parties to review and provide comments by 30 November 2023. The Working Group B space users subgroup work package 4 will also coordinate a review within ICG.
17. Since the fifteenth meeting of ICG, the Working Group B application subgroup has been working on an initiative entitled “GNSS applications: for present and future”. The subgroup’s current activities focus on studying cases of operational GNSS applications that are in the market or are under final development before market release.
18. The application subgroup’s activities intend to provide assistance and guidance to GNSS users, based on lessons learned. The initiative would lead to a research report entitled “GNSS applications for sustainable development: case studies”.
19. The Working Group notes that the subgroup has made significant progress on implementing the assigned initiative, supported by a team of 20+ active experts. The application subgroup actively participated in the United Nations GNSS Applications workshops and other related international conferences.
20. The work on the first Issue of the research report has been initiated, and the release is expected by early 2024.
21. The Working Group discussed the progress on MEOSAR, LunaSAR and Emergency Warning Services. The Working Group recognizes 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.
22. Separately, it was suggested including the research subject on integration of communication and navigation, with a view to improve the resiliency of PNT. The Working Group agreed to initiate the discussion as part of the intersessional meeting of the Working Group and invites interested experts of the Working Groups S and D to join the discussion.
23. The Working Group recognises the potential impact of the rising solar activities of the 25th solar cycle on GNSS services and satellites. Further discussions among experts through workshops should be conducted to understand the possible impact of space weather events and the need for alert systems. The need for the formation of a task force shall be subject of the next intersessional meeting of the Working Group (planned in June 2024).
24. The Working Group on Information Dissemination and Capacity -building (Working Group C) addressed all areas of its workplan. Representatives of China, India, Italy, Japan, Malaysia, Nigeria, Pakistan, the Republic of Korea,

the Russian Federation, the United Arab Emirates, the United States, APSCO and the European Space Agency participated in the work of the working group. Presentations were made on GNSS education programmes and projects carried out by their respective organizations. The Working Group received an update on the activities undertaken or supported by the Office for Outer Space Affairs during 2023 and the main results achieved.

25. The Working Group noted the work of the United Nations-affiliated regional centres for space science and technology education based in China and India. The Working Group would continue to collaborate with the regional centres to further develop the GNSS curriculum and provide support in carrying out seminars and training courses on GNSS and its applications.
26. The Working Group's project team on "space weather monitoring using low-cost GNSS receiver systems", consisting of experts representing the Abdus Salam International Centre for Theoretical Physics (ICTP), Boston College of the United States, The University of Tokyo of Japan, Laboratory of Plasma Physics of France, established in 2021, continued to explore the possibilities of using low-cost receiver systems for space weather monitoring and implementation of a prototype system. The Working Group noted that the preliminary comparison results between high-end and low-cost GNSS receivers showed good correlation for vertical total electron content (VTEC), rate of change of total electron content index (ROTI) and code-phase scintillation (S4).
27. The Working Group would invite other interested institutions, including the United Nations-affiliated regional centres, to join the project by collecting additional data and/or providing software in order to further perform data analysis to compute space weather related parameters.
28. The Working Group on Reference Frames, Timing and Applications (Working Group D) noted progress on the geodetic and timing references by the GNSS and radionavigation satellite service providers. The Working Group thanks the GNSS providers for their continued efforts to align their reference frames to the ITRF.
29. Working Group D thanks Russia for installing 45 new GNSS stations in the Russian national Basic Astronomical and Geodetic Network (BAGN) and following the IGS guidelines and standards.
30. Working Group D acknowledges and is thankful for the release of satellite metadata for the European Global Navigation Satellite System (Galileo), Beidou Navigation Satellite System (BDS), Quasi Zenith Satellite Systems (QZSS) and GPS constellations.
31. Working Group D noted that some templates on geodetic and timing references currently provided on the ICG website should be updated by the GNSS and RNSS providers to contain the most up-to-date information.
32. BIPM recalled that a new naming convention has been decided for the broadcast prediction of UTC by GNSS: bUTC_GNSS. The BIPM department has defined a new, more robust approach to determine UTC-bUTC_GNSS. BIPM is ready to publish the new UTC-bUTC_GNSS values in Section 4 of the Circular T for GPS, Galileo, GLONASS and BDS. BIPM will give a deadline, but also some time for all labs to adapt.

33. BIPM also recalled that Resolution 4 of the 2022 Conférence Générale des Poids et Mesures (CGPM) decided for an increased maximum value for the difference (UT1-UTC) in or before 2035. Some GNSS broadcast UT1-UTC differences will therefore go beyond 1 s, which might not have been foreseen. The possibility of a negative leap second in the next 10 years calls for a quicker implementation of the UT1-UTC tolerance increase. A task group [“Towards continuous UTC” \(CCTF-TGUTC\)](#) was created in Consultative Committee on Time and Frequency (CCTF) to prepare a draft resolution to decide on the new tolerance.
34. BIPM highlighted the work carried out by a dedicated CCTF task group on the traceability to UTC from GNSS measurements. Different kinds of users have been identified and for each of them, the traceability chain to UTC and the requested calibration have been defined. Some recommendations have been formulated for the users, GNSS receiver manufacturers and GNSS providers. The latter are invited to seek collaboration with National Metrology Institutes regarding GNSS system time realisation and monitoring, and to describe the realisation of GNSS system times and the information contained in the navigation messages following metrological practice and vocabulary.
35. The CCTF working group on GNSS time transfer presented the organisation of GNSS calibrations within the UTC community. Since 2020 all calibrations include Galileo (E1 and E5a), while the BDS calibrations (B1C and B2a) started in 2022.
36. ESA presented their activity on absolute calibration of GNSS receiver chains. ESA uses their GNSS station with absolute calibration to monitor the different UTC-bUTC_GNSS. This presentation calls for further cooperation among the various GNSS providers to better understand the observed inter-system biases.
37. Working Group D acknowledged the installation of a NavIC timing receiver at PTB (Germany), allowing the monitoring of NavIC time w.r.t. UTC(PTB) and UTC. Working Group noted the willingness of NavIC to include NavIC time in the BIPM Circular T Section 4. BIPM recommended NavIC representatives to establish contact with CCTF for that purpose.
38. The Indian delegation also presented the good performance of the Indian Rubidium Atomic Frequency Standard (IRAFS) on-board NVS-01 (navigation satellite) and the impact of a continuous UTC for NavIC. The current broadcast of UT1-UTC can go up to approximately 1 min; overall, NavIC has spare bits to represent UT1-UTC up to one hour.
39. Working Group D takes note of Working Group B’s request to collaborate with them on Lunar PNT for space and time references and for interoperability. Working Group D is willing to contribute to this effort.
40. NTSC (National Time Service Centre, China) presented a comparison between computation techniques for the GPS-Galileo Time Offset (GGTO): (a) the single-station approach and (b) taking bUTC_GNSS as pivot. Working Group D confirmed that (i) there currently exists a difference between the actual and broadcast time offset (UTC - GNSS Time) for GLONASS and BDS, and (ii) the single-station GGTO method is indeed the preferred method when satellite visibility permits.

41. Working Group D drafted a recommendation on the use of bUTC_GNSS for timing interoperability and discussed it with Working Groups B and S. The final recommendation from Working Groups B, D and S was adopted by ICG.
42. In the context of the Working Group D's task force "Applications of GNSS for Disaster Risk Reduction", IGS drafted a recommendation, which was adopted by ICG.