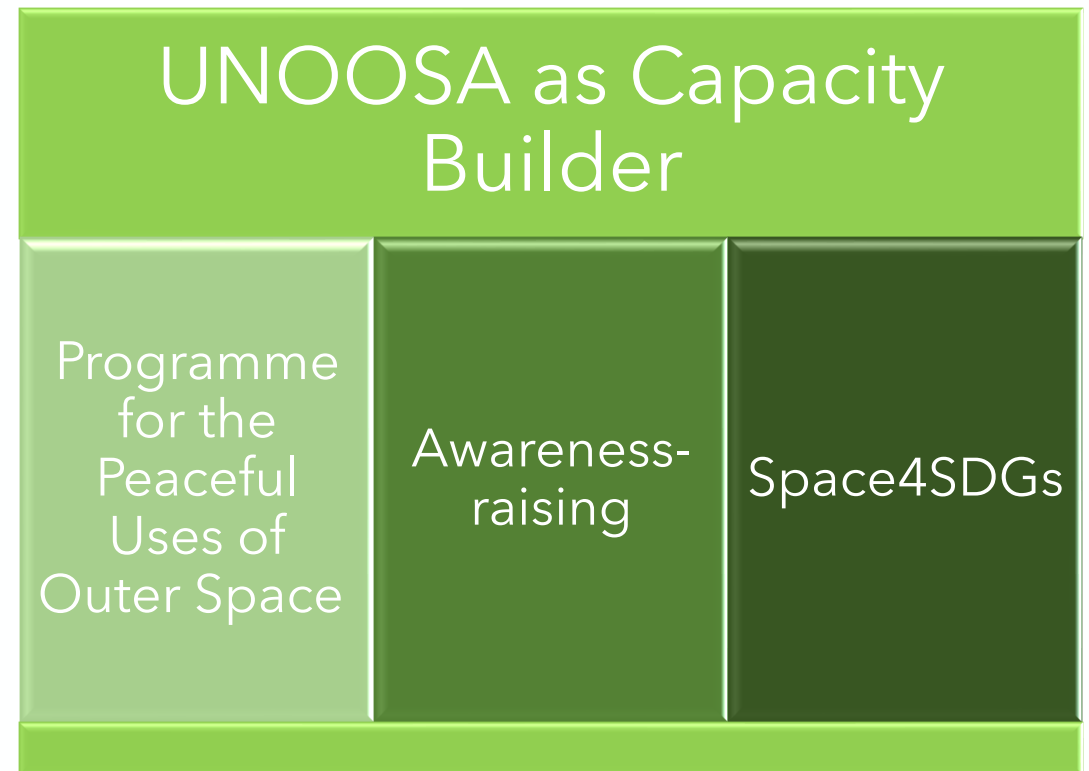
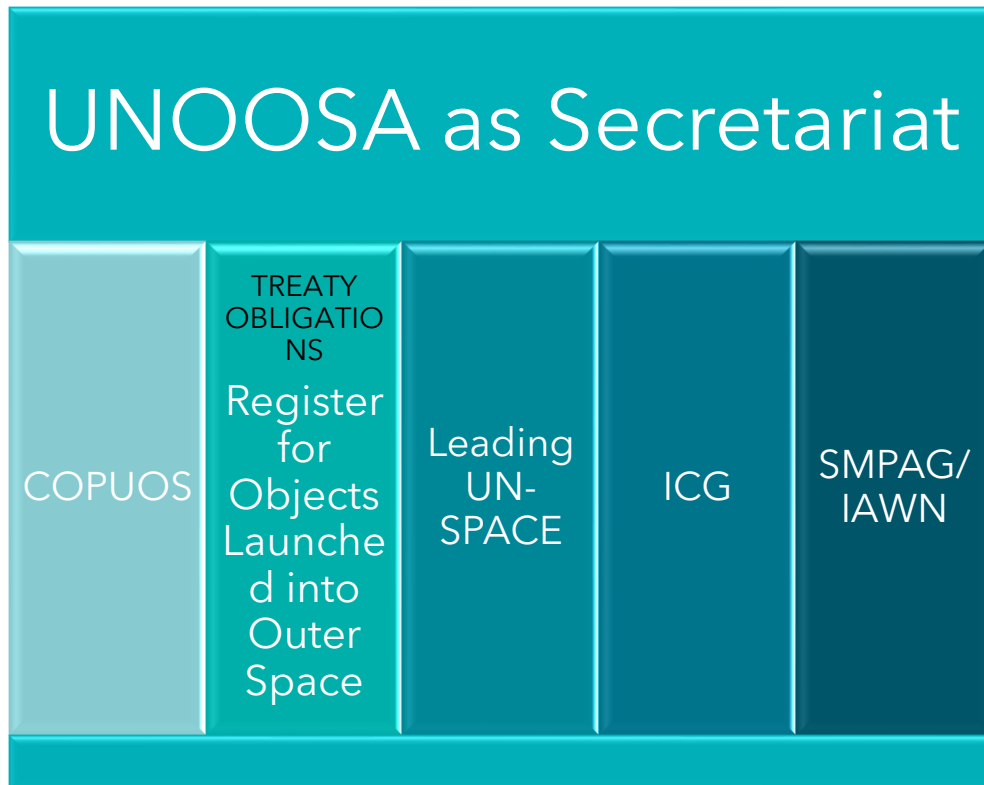


International Committee on GNSS Recent Developments





- ❑ 18th meeting of ICG, Wellington, New Zealand, October 2024
- ❑ 19th meeting of ICG, Bussan, Korea, 20 - 24 October 2025

Key responsibilities:

Executive Secretariat

Int'l Committee on GNSS (ICG) (37)

- **Est. 2005** - meets annually
- Voluntary cooperation, coordination, promoting utilization **of multiple GNSS signals**

Working Groups

- Systems, Signals, Services; Enhancement of GNSS Performance, New Services and Capabilities; *Information Dissemination & Capacity-building*; Reference Frames, Timing and Applications; *Lunar PNT*

Provider's Forum

- **Compatibility & interoperability**

ICG Membership

System Providers: Global and Regional Constellations

China (BDS, 27+3IGSO+5GEO), Russian Federation (GLONASS, 24+), United States (GPS, 24+), European Union (Galileo, 24+), India (NavIC, 7), Japan (QZSS, 7)

Services and Applications (15)

Algeria, Australia, Italy, Malaysia, New Zealand, Republic of Korea, Türkiye and United Arab Emirates

Augmentation Systems

India, Japan, *Nigeria*, Russian Federation, United States and European Space Agency

Assoc. Members + Observers: IGO, NGO, UN entities (22)

- ❑ **Systems, Signals and Services** (*United States & Russian Federation*): Compatibility and spectrum protection; interoperability and service standards; system-of-system operations
- ❑ **Enhancement of GNSS Performance, New Services and Capabilities** (*India, China & ESA*): Future & novel integrity solutions; implementation of interoperable GNSS Space Service Volume (SSV) examination of performance of atmospheric models, *establish dialogue with space weather/RS communities and its evolution*;
- ❑ **Information Dissemination and Capacity Building** (*UNOOSA*): Focused on education and training programmes, promoting GNSS for scientific exploration (incl., *space weather and its effects on GNSS*)
- ❑ **Reference Frames, Timing and Applications** (*IAG, IGS & FIG*): Focused on monitoring and reference station networks

ICG: Working Group S Recommendations

Emerging Low Earth Orbit (LEO) PNT Workshops

The WG S has conducted two workshops focused on emerging LEO PNT systems in 2023/2024. These workshops were aimed at better understanding what systems are being developed and how they might interact with GNSS

- To consider holding annual workshops focused on LEO PNT topics supported by WGS, including compatibility and interoperability

Working Group S Workshops in 2025

The WG S made good progress on the issues outlined in its workplan in 2024. At the ICG-18 meeting, the need for additional in-depts discussions on several areas of work was identified

- To organize the following workshops:
 - Timing Interoperability
 - PPP interoperability
 - IGMA and Performance Standards
 - IDM
 - LEO PNT Compatibility and Interoperability

Update to the WG S Work Plan

Updates to the work plan will include adding four new topics. These topics fit within the scope of the WG and have already been discussed on a regular basis. The updated work plan will reflect the work that is already taking place within the WG

- The detailed workplan will include the following areas of work:
 - PPP Interoperability
 - Civil Signal Authentication
 - LEO PNT Compatibility and Interoperability
 - Lunar PNT Compatibility (With GNSS/RNSS)

The workshop on ionospheric impacts on GNSS and international collaboration to meet current and future solar activity period challenges

The ionosphere is one of the key factors affecting the performance of all navigation satellite systems.

- ❑ The ICG encourages international GNSS and ionospheric space weather communities, including ICG members to:
 - ❑ work together by conducting a workshop aimed at discussing the ionospheric impacts on GNSS, and
 - ❑ Joint actions to be undertaken to mitigate the ionospheric impacts on GNSS during current and future solar activity period through international collaborations

ICG: Working Group B Recommendation

Participation in Joint ICG-IOAG Multilateral Cislunar PNT Workshop

The goal of the workshop is to provide an open international coordination forum for lunar PNT services providers, including GNSS providers, to foster interoperable, compatible, and available lunar PNT systems for the future

- ❑ Lessons learned from GNSS community will be needed to ensure compatibility and interoperability between GNSS and Lunar PNT systems and services
- ❑ Coordination on the topics of lunar spectrum management, common lunar reference frames, and lunar time systems are essential

- ❑ **Workshop on Cislunar Positioning, Navigation, and Timing (PNT), 11 – 13 February 2025, VIC, Vienna**

<https://www.unoosa.org/oosa/en/ourwork/icg/working-groups/b/CislunarPNT2025.html>

New Working Group Establishment: Working Group L

ICG WG B Space Use Subgroup Work Plan 4 was formed in 2021 to understand how the GNSS Space Service Volume could be used in content with future Lunar PNT systems to support lunar operations. Since that time, through active execution of its workplan, W P-4 has gained significant insight into the scope of such PNT systems and use cases that are under development, as well as the meaningful role GNSS will serve in lunar PNT, particularly for vehicles in transit between the Earth and Moon.

- ❑ To establish the Working Group on Lunar PNT (WG L) as a new working group within the ICG
 - Lunar PNT systems
 - Lunar PNT signal compatibility
 - Lunar PNT applications
 - Lunar PNT flight experiments
 - Lunar reference frames
 - Lunar time systems
 - Lunar PNT international cooperation models

Publication of a Policy Brief on the Uses of GNSS for Disaster Risk Reduction

The “Applications of GNSS for Disaster Risk Reduction” Task Force is exploring how GNSS technology can enhance disaster risk reduction strategies and bolster natural hazard early warning systems. Currently, TF focuses on four GNSS-based techniques, which have broad applications, spanning for instance earthquakes, tsunamis, floods and solar storms

- *Precise Point Positioning (GNSS-PPP)*
- *Reflectometry (GNSS-R)*
- *Radio Occultation (GNSS-RO)*
- *Ground based Total Electron Content (GNSS-TEC)*

❑ The policy Brief on the Uses of GNSS for Disaster Risk Reduction:

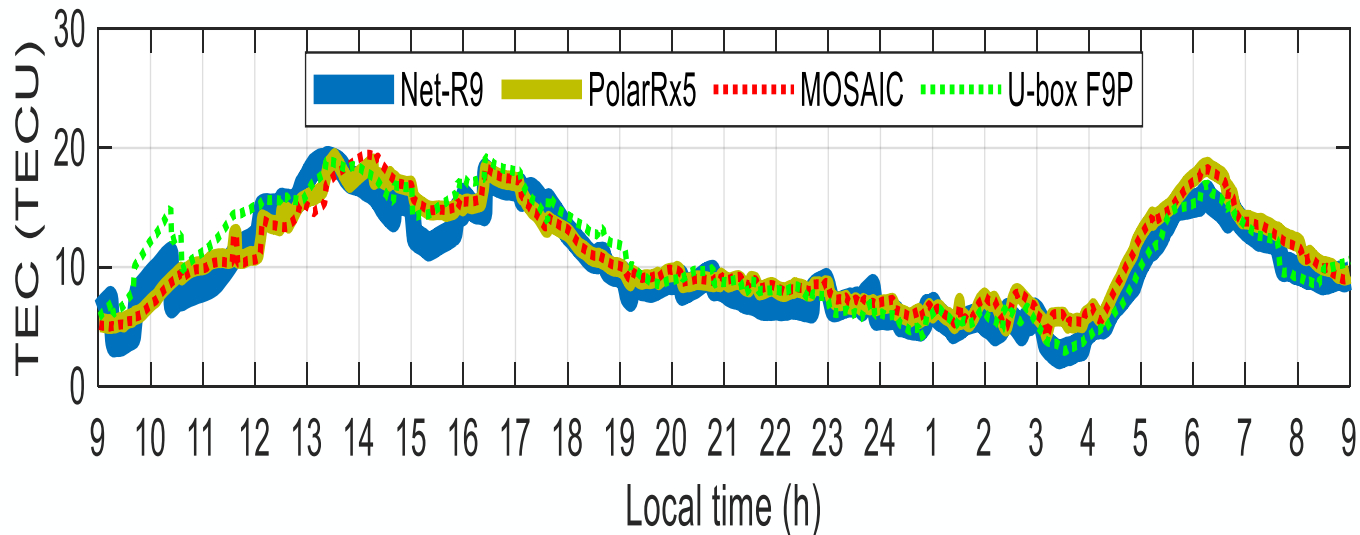
<https://www.unoosa.org/oosa/en/ourwork/icg/resources/Regl-ref.html>

- ❑ Cooperation ICG & The University of Tokyo, Japan: *To focus on GNSS data types, GNSS errors, coordinate systems and applications, and low-cost receiver system data*
- ❑ Cooperation ICG, ICTP, Italy and Boston College, US: *To enhance capacity building on GNSS for Space Weather monitoring*
- ❑ Cooperation ICG, FIG, IAG and IGS: *To focus on reference frames in general with a specific focus on UN initiatives, global and regional frames as well selected national case studies*
- ❑ Low-cost GNSS receiver system for space weather: *To focus on low-cost GNSS receiver systems for high-accuracy PNT and associated applications*

Low-cost GNSS receiver system for space weather data

- ❑ Exploring low-cost GNSS receivers that satisfies space weather needs both in terms of scintillation and total electron content (TEC)
 - *any receiver that is capable to output raw data*
 - *dual frequency receiver*
 - *cost (including antenna and data logging system)*

Comparison of TEC Results



Instrument Limitations and Challenges:

- Raw data are logged in proprietary data format
- Common raw data format, data type, and observation frequency shall be defined
- Scintillation computation is yet to be verified. It may be limited to only code-phase scintillation data
- Data processing algorithms shall be standardized

ICG: Working Group C Observations

- ❑ Training for capacity development through the international delivery of various GNSS training programmes, including in supporting developing countries through scholarships offered
- ❑ Scholarships for these GNSS training courses may be enhanced by individual countries and companies sponsoring individuals
- ❑ Balance between in-person, online and hybrid modes of training delivery, with a preference for in-person due to the benefits of networking and informal mentoring and/or the hands-on requirements of the coursework, such as fieldwork to GNSS sites or understanding receivers and devices
- ❑ **The United Nations-affiliated Regional Centres:**
 - to connect with the ICG experts to deliver training courses at the Centres
 - exploration of a train of trainers' programmes to support the development of in-region qualified trainers
 - engagement between the Regional Centres to share training materials and the exchange of lecturers.

Thank you



UNITED NATIONS
Office for Outer Space Affairs