Recommendation 1 for Committee Decision

Prepared by: Working Group B (WG-B), Space Use Subgroup (SUSG)
(Working Group, or individual Members or Associate Members)
Date of Submission: October 10, 2024
Issue Title: New Working Group Establishment: Working Group L (Lunar Positioning, Navigation, and Timing (PNT)) (WG-L)

Background/Brief Description of the Issue:

The International Committee on Global Navigation Satellite Systems (ICG) Working Group B Space Use Subgroup Work Plan 4 (WP-4) was formed in 2021 to understand how the GNSS Space Service Volume could be used in concert with future Lunar PNT systems to support lunar operations. Since that time, through active execution of its work plan, WP-4 has gained significant insight into the scope, breadth, and depth of such PNT systems and use cases that are under development, as well as the meaningful role Global Navigation Satellite Systems (GNSS) will serve in lunar PNT, particularly for vehicles in transit between the Earth and Moon. After the successful organization of multiple ICG joint working group sessions on lunar PNT, WG-B recognizes the need for ongoing coordination within the ICG in a dedicated centralized working group.

Discussion/Analyses:

Dedicated PNT systems in lunar orbit, on the lunar surface, and elsewhere in cislunar space are under active development by organizations from multiple nations with planned deployment before the end of this decade. Such systems (referred to as lunar PNT systems) may provide services to users in cislunar space, including in lunar orbit, on the lunar surface, orbiting the Earth-Moon Lagrange points, and in transit between the Earth and Moon.

Lessons learned from GNSS coordination within the ICG clearly show the vital need for compatibility, interoperability and signal availability among PNT systems and services. To support this coordination among lunar PNT systems and with GNSS, and to allow continued focus of existing ICG working groups on their existing work plans, it is recommended that a new ICG Working Group be established, which will have the autonomy to propose changes to its name, scope, and work plan, as necessary, in line with the ICG Terms of Reference. This recommendation represents a specific action from the more general recommendation approved at the 16th Annual Meeting of the ICG (ICG-16) (ICG/REC/2022) entitled "Coordination of GNSS and Lunar PNT systems for lunar operations."

Recommendation of Committee Action:

WG-B recommends that the ICG establishes Working GroupL (Lunar PNT) as a new working group within the ICG at the earliest date with the attached initial workplan for WG-L reference.

Members Consensus Reached_____; **No Consensus Reached_____**
Chairperson Signature: **_____ Date: _____**

Work Plan

International Committee on Global Navigation Satellite Systems (ICG)

Working Group L: Lunar PNT

PREAMBLE

1. Lunar exploration has become a top space exploration priority across the world. A burgeoning number of national space agencies are engaged in aspects of lunar exploration. These initiatives are being developed in an increasingly diverse and collaborative way.
2. To maximize lunar exploration efficiencies and reduce mission and human spaceflight risk, organizations from multiple nations are deploying systems in lunar orbits, on the lunar surface, and elsewhere in cislunar space to provide Positioning, Navigation and Timing (PNT) services. Such systems (referred to as lunar PNT systems) may provide services to users in cislunar space, including in lunar orbit, on the lunar surface, orbiting the Earth-Moon Lagrange points, and in transit between the Earth and Moon.
3. GNSS in Earth orbit (referred to as "GNSS") will serve a meaningful role in Lunar PNT, particularly for vehicles in transit between the Earth and Moon. GNSS can also supplement lunar PNT services in the lunar vicinity.
4. At a minimum, all lunar PNT systems must be compatible with each other and with other radio-based systems, including GNSS. To the maximum extent possible, Lunar PNT systems should be interoperable, in order to maximize PNT service availability and utility for lunar space users.
5. The Working Group must coordinate, as needed, with other ICG Working Groups and with external international organizations, such as the Bureau International des Poids et Mesures (BIPM), the Consultive Committee on Space Data Systems (CCSDS), the International Association of Geodesy (IAG), the International Astronomical Union (IAU), the Interagency Operations Advisory Group (IOAG), the International Space Exploration Coordination Group (ISECG), the Space Frequency Coordination Group (SFCG), and the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) Action Team on Lunar Activities Consultation (ATLAC).
6. To ensure reliable PNT services that meet user needs, the Working Group will generate recommendations to coordinate lunar PNT system development and to ensure these systems will operate in concert with GNSS. Overall, the intent is to provide guidance to providers and users to ensure that these lunar PNT systems are available, compatible, and interoperable for peaceful purposes for all.
7. It is important that Lunar PNT service providers offer a sufficient level of transparency necessary for effective coordination of compatible and interoperable lunar PNT systems.

TASKS AND SCOPE OF WORK

The ICG Working Group L (Lunar PNT) will coordinate and organize activities to:

(1) Serve as a mechanism to better understand the scope, depth, users, and status of lunar PNT systems being developed.

(2) Propose recommendations that may be taken up by the international lunar PNT community.

(3) Facilitate development of interoperable, compatible, and available lunar PNT systems.

The scope of WG-L efforts is focused on achieving reliable PNT solutions derived from radiometric signals available in the cislunar space, including GNSS. The WG-L will accomplish this by coordinating with current and emerging lunar PNT service providers, ICG working groups and Providers' Forum, and international organizations relevant to lunar PNT systems and services.

WG-L tasks include:

1) **Lunar PNT systems**: Collect and document the scope, plan, and status of lunar PNT systems being developed. These include details of the systems, signals, and services from initial deployment through full operational capability.
2) **Lunar PNT signal compatibility**: Coordinate with the Space Frequency Coordination Group (SFCG) and ICG Working Group S to ensure compliance with the International Telecommunication Union (ITU) radio regulations, signal compatibility and avoidance of harmful interference to and among lunar PNT systems and GNSS. This encompasses spectrum compatibility and coordinated selection of signal parameters such as frequencies, modulations, and codes.
3) **Lunar PNT applications**: Collect and document current and future lunar PNT applications, use cases, and user needs.
4) **Lunar PNT flight experiments**: Encourage flight experiments employing lunar PNT systems and/or GNSS, to gain an understanding of the benefits and limitations of these systems and their use in the lunar environment. Encourage dissemination of results and lessons learned.
5) **Lunar reference frames**: Coordinate with appropriate international organizations and ICG Working Group D to support standardization of lunar reference frames and their relationships.
6) **Lunar time systems:** Coordinate with appropriate international organizations and ICG Working Group D to support standardization of lunar time with traceability to Coordinated Universal Time (UTC).

7) **Lunar PNT international cooperation models:** Work with appropriate international organizations to investigate and recommend international cooperation models that enable sustainable development and operations of lunar PNT systems.

METHOD OF WORK

1. The working group will conduct at least one meeting each year between the previous and next meeting of the ICG in order to develop draft conclusions and recommendations for Committee consideration.
2. If necessary, the working group will establish ad hoc task forces to implement concrete tasks and reach objectives.
3. This work plan will be reviewed at least every two years and revised as necessary in order to address important issues that require the attention and focus of lunar PNT users and service providers.