Recommendation for Committee Decision

Prepared by: **Working Group B, Space Use Subgroup (SUSG)**
(Working Group, or individual Members or Associate Members)

Date of Submission: September 15, 2022

Issue Title: Coordination of GNSS and Lunar PNT systems for lunar operations

Background/Brief Description of the Issue:

Positioning, Navigation and Timing (PNT) capabilities are being developed now by various international space agencies and other providers to support operations near and on the surface of the moon. During Earth-Moon transit and for portions of lunar operations, lunar PNT will be coupled with Earth-based GNSS to provide on-board PNT solutions. To ensure that these Earth GNSS and lunar PNT systems will be compatible and interoperable with each other and to ensure adequate availability of PNT signals in the lunar environment, GNSS providers and lunar PNT architects need to work together, internationally, and coordinate their developments—emulating the interoperability success of the ICG and GNSS SSV as models.

Discussion/Analyses:

To date, twenty nations have signed the Artemis Accords to cooperate in the exploration and use of the Moon and beyond. Also, fourteen nations are coordinating their lunar activities as members of the International Space Exploration Coordination Group (ISECG). Internationally, nations that are GNSS providers are represented in one or both of the above international coordination efforts. Both international efforts agree that the primary, first deep space target for human exploration is the moon. The ISCEG has defined several lunar PNT technology needs that members of the ICG WG-B SUSG are actively tracking and working as part of Work Package 4.

Several space agencies are actively developing PNT services at the vicinity of the Moon including the lunar surface. Under the open LunaNet framework, NASA and ESA have published draft interoperability specification documents. NASA and ESA are developing the Lunar Communications Relay and Navigation Systems (LCRNS) and Moonlight, respectively, to implement this framework. JAXA is formulating the Lunar Navigation Satellite System (LNSS). And China has announced plans to develop a Lunar Communications and PNT Constellation. Ensuring that all are interoperable, compatible, and available will be essential for successful lunar PNT operations in the future.

During Earth-Lunar transit and for portions of lunar operations, lunar PNT will be coupled with Earth-based GNSS to provide on-board PNT solutions. To ensure that these systems will be compatible and interoperable with each other and to ensure adequate availability of PNT signals, GNSS providers and lunar PNT architects must coordinate their developments. Currently, multilateral organizations, including the IOAG, are studying how they may support and foster this coordination. It is imperative

that the ICG engages immediately in these initiatives via the appropriate multilateral liaison roles to ensure interoperability, compatibility, and availability of PNT systems that will be employed from the Earth to the moon.

Recommendation of Committee Action:

The ICG encourages international GNSS providers and lunar PNT developers to work together via the appropriate multilateral fora, such as the IOAG, to ensure the future attainment of an interoperable, compatible, and available PNT system of systems that can support the world's ever-expanding human and robotic space operations around and on the surface of the moon. The collaborative efforts of the ICG, including the GNSS Space Service Volume initiative, should serve as a model for this promising international exploration initiative. The ICG will analyse planned lunar PNT systems and their interactions with GNSS and propose recommendations that may be taken up by GNSS providers and lunar PNT developers.

Members Consensus Reached_____; **No Consensus Reached**_____

Chairperson Signature: _____ **Date:** _____