

Formal Establishment of the IGS LEO-PNT Pilot Project

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Reference Documents

Ref. ID	Reference
RF01	Policy for the establishment and governance of IGS Working Groups, Pilot Projects and Committees (2024)
RF02	FrontierSI, State of the Market Report, Low Earth Orbit Positioning Navigation and Timing – v1.1 (25-Jan-2025)

Work Plan and Milestones

This LEO-PNT Pilot Project follows a phased approach, including milestones that define the conclusion of each phase (see Table below).

Phase	Milestones	Focus Area
Exploration	MS1	Impact assessment across IGS domains and coordination with providers.
Exploitation	MS2	Consolidation of standards*, collection of testing datasets, and preliminary testing.
Handover & Operations	MS3	Transition from validation to operational readiness and knowledge transfer.

Due to the evolving LEO-PNT landscape, specific due dates will be assigned as the situation clarifies during the first Exploration phase activities. A short description of each phase, including an **expected contribution to IGS Annual Technical Report**, has been provided below.

LEO-PNT is a new, fast-moving, yet-unexplored technology within the IGS. A schedule of the milestones provided here shall be considered preliminary and will possibly need to be adapted in the course of the activities.

Milestones	Milestone completion
MS1	T0+12months
MS2	T0+36months
MS3	T0+48months

*Definition of *Standards*, although part of MS2, will be addressed at an earlier stage (from the beginning), targeting a coordinated standardization approach of the various LEO-PNT signals, to ensure and facilitate smooth integration in the following phases.

Phase 1: Exploration

Exploration within IGS

A comprehensive assessment of the impact of LEO-PNT across multiple IGS domains will be conducted in collaboration with the various IGS committees. Benefits and challenges will be identified and examined to identify possible solutions. Interactions will involve the following committees for the following aspects (i.e. preliminary assessment):

- **Antenna:** Coordination for inclusion of LEO-PNT satellite and ground-station receivers and satellite transmitter antenna model: compatibility of LEO-PNT and GNSS antenna types, calibration strategies, and consistency with ITRF.
- **BAR:** Coordination for inclusion of the LEO-PNT to GNSS data, to investigate and provide biases, characterize their time stability and other temperature-related variations, along with enabling ambiguity resolution for LEO-PNT users.
- **Clock:** Assessment of the possibility of including LEO-PNT for both time and frequency transfer operations within IGS, i.e. ensuring consistency, quality, and performance in line with the current products.
- **Ionosphere:** Coordination for the inclusion of LEO-PNT on-board data (as well as for possibly current signals tracked by LEO missions) for the remote sensing and investigate the impact on the process chain and resulting products.
- **Infrastructure:** Assessment of the possibility of extending the IGS network of stations to track (or co-track) LEO-PNT signals along with legacy GNSS ones.
- **Real-Time:** Assessment of the possibility of integrating the current real-time capabilities with LEO-PNT data.
- **RINEX:** definition and promotion of standardization of LEO-PNT data, aimed at a optimal solution to ensure compatibility with current GNSS standards.
- **Reference Frame:** assessment of the impact of adding LEO-PNT into current IGS-based reference frame products, while assessing the feasibility of including LEO-PNT in future ITRF realizations.
- **Satellite Vehicle Orbit Dynamics:** promotion of the publication of LEO-PNT metadata and attitude information, along with the support to the development of accurate satellite dynamical models in low Earth orbit.
- **Troposphere:** Coordination for the inclusion of LEO-PNT satellites' data (i.e., transmitted signals) for the remote sensing, so investigating impact onto troposphere products.

Additional coordination is expected with the following IGS bodies:

- **IGS-ACs:** assessment of benefits and issues, along with an identification of capabilities and limitations for the integration of LEO-PNT into the current GNSS-related products.
- **IGS-ACC:** identification of a suitable strategy to combine ACs' products, including LEO-PNT, ensuring that accuracy and performance of products is maintained (or improved).

Exploration outside IGS (e.g. LEO-PNT Service Providers)

Coordinate with LEO-PNT providers to gather current or forthcoming information, metadata, and inputs in view of their possible future integration. This shall enable a comprehensive understanding of available resources, facilitate the evaluation of interoperability options, and support seamless incorporation into existing systems.

Definition of Guidelines

It is anticipated that PP guidelines will be essential to ensure an effective and consistent integration of LEO-PNT data with the existing IGS activities.

Two distinct sets of guidelines will be established:

- The first set, intended for the LEO-PNT providers, shall define eligibility requirements, ensuring compliance with open data accessibility, conformity to standards, signal protocols, metadata specifications, and other key performance criteria.
- The second set, for IGS internal usage, will offer guidance and recommendations for various committees, along with ACs and ACCs in order to facilitate a coordinated and seamless integration of LEO-PNT systems.

Within this pilot project, efforts will be directed toward promoting the adoption of an open data policy and advancing international standardization initiatives.

Phase 2: Exploitation

The exploitation phase has the goal of consolidating the standards and collecting an initial LEO-PNT dataset for testing, familiarizing with new dataset and potentially understanding hands-on benefits and issues that may derive from integrating these data with the traditional GNSS ones.

This phase will consist of (at least) the following elements:

- Consolidation and publication of standards and proposed guidelines for the LEO-PNT service providers.
- Collection of LEO-PNT testing dataset compliant with the proposed guidelines, making sure they are open accessible to the scientific community.
- Preliminary testing of the LEO-PNT integration within IGS in coordination with IGS committees and ACs/ACC, i.e., to identify potential issues and resolutions.
- Establish routine non-operational processes to gather and utilize LEO-PNT data together with GNSS, either through the establishment of dedicated task forces in this Pilot Project, or directly within the relevant committees.

This list will be extended also based on the outcome of Phase 1 activities.

Phase 3: Handover and Operations

This is the transition phase from testing and validation into operational readiness. This will require the transfer of knowledge from the Pilot Project to the relevant committees and shall ensure that the LEO-PNT technology can be smoothly integrated into the current operational IGS activities (at committee level).

Further details of Phase 3 activities and work plan will be defined in future iterations.

Call for participation

SUBJECT: Call for Participation – IGS LEO-PNT Pilot Project (PP)

1. Introduction

The International GNSS Service (IGS) is formally establishing a Pilot Project to investigate the integration of Low Earth Orbit Positioning, Navigation, and Timing (LEO-PNT) technology into the future IGS product portfolio. As LEO constellations begin transmitting GNSS-like signals, the IGS aims to leverage these to enhance existing GNSS-based operations and products.

2. Membership Opportunities

Membership is open to all IGS Associate Members, meanwhile we are seeking participants from the following areas:

- **Analysis Centres (ACs):** To assess capabilities and limitations for integrating LEO-PNT into current products.
- **Technology Providers:** Major LEO-PNT providers interested in coordinating on open data policies and metadata standards.
- **Technical Experts:** Specialists to support Working Group activities in areas such as Antenna Calibration, Clock modelling, Troposphere and Ionosphere remote sensing, along with RINEX, ANTEX, and other format standardization.

3. Commitment

Members are expected to contribute to the Exploration and Exploitation phases, attending meetings and supporting the development of preliminary datasets and standards.

4. How to Join

Please submit your expression of interest, area of expertise, and a brief description of planned contributions, to the Co-Chairs: Dr. Francesco Gini and Dr. Lotfi Massarweh.

Transition Plan

In accordance with IGS policy, the Pilot Project aims for a more definitive operational phase. The project will be reviewed by the Governing Board every two years. It may be transitioned into a committee if an ongoing operational product or service is required or adjourned once the main innovations are integrated into an existing operational service.

Candidate for chairpersons

We propose to have the LEO-PNT Pilot Project co-chaired by:

- **Dr. Francesco Gini**, *Navigation Support Office at ESA/ESOC, Darmstadt, Germany.*
- **Dr. Lotfi Massarweh**, *Delft University of Technology, Delft, The Netherlands.*

Draft of an IGS-mail

Dear IGS Community,

We are pleased to announce the formal establishment of the IGS LEO-PNT Pilot Project, as approved during the IGS Governing Board 73rd meeting.

As the LEO-PNT landscape evolves with numerous planned constellations, this Pilot Project will explore how this emerging technology might be optimally integrated into IGS operational activities. Therefore, this pilot project will focus on:

- Assessing the impact of LEO-PNT across all IGS technical domains.
- Defining eligibility criteria and propose future standards for LEO-PNT data.
- Developing combined GNSS and LEO-PNT products for testing and validation.

The pilot project will be co-chaired by

- **Dr. Francesco Gini** (ESA/ESOC), and
- **Dr. Lotfi Massarweh** (Delft University of Technology)

A formal [Call for Participation](#) is now open to all the Associate Members, so we encourage interested parties to review the Pilot Project Charter and join this effort to shape the future of LEO-enhanced navigation products.