

IGS LEO-PNT Pilot Project Charter

Dr. Francesco Gini, *Navigation Support Office at ESA/ESOC, Darmstadt, Germany*

Dr. Lotfi Massarweh, *Delft University of Technology, Delft, The Netherlands*

The Need

A new class of space-based Positioning, Navigation and Timing (PNT) systems is emerging in low Earth orbit (LEO), involving constellations of satellites transmitting GNSS-like signals to support ground user positioning and timing services. Several initiatives from private industry, space agencies, and institutional actors are expected to deploy these LEO-PNT missions in the coming years. According to the latest Frontier SI's [State of the Market Report 2024](#), most planned constellations will comprise several hundred satellites and are expected to transmit signals that are compatible, and potentially interoperable, with existing GNSS signals.

The widespread availability of new signals has also the potential to expand and complement current IGS products, datasets, and formats. It is therefore essential for the IGS to actively prepare for LEO-PNT, thus investigating whether and how this emerging technology can be optimally integrated into its operational activities for the benefit of its products' portfolio.

The Goals

The primary goal of the Pilot Project is to investigate the feasibility of integrating LEO-PNT technology into the IGS. This examination aims to determine the benefits and disadvantages of LEO-PNT for existing GNSS-based operations and products within IGS.

Therefore, should this integration of LEO-PNT into IGS activities be deemed feasible, the Pilot Project will pursue the following objectives:

- **Assessment and Coordination:** analyze specific impacts in each area with relevant IGS committees.
- **Guidance:** provide consultancy regarding products, standards, data, and metadata.
- **Preliminary Products:** create combined GNSS and LEO-PNT datasets for testing and validation, along with a preliminary assessment of performance.
- **Industry Engagement:** advocate for open-data policies and standard adoption with major LEO-PNT providers, thus raising awareness of user needs in space geodesy and PNT applications.
- **Public Awareness:** facilitate access to relevant information and increase awareness of LEO-PNT work.
- **Criteria Definition:** define eligibility criteria (e.g. accuracy, performance, availability) for integration of LEO-PNT constellation into existing IGS activities.
- **Comprehensive Integration:** the focus is on incorporating LEO-PNT data into IGS operational products, data, and standards.

The Topics

The LEO-PNT Pilot Project will address several critical technical and operational domains to ensure a seamless integration of LEO data with existing GNSS infrastructure. This data will concern on-board LEO receivers, as well as on-ground tracked signals from LEO.

The proposed topics (to be extended) include:

Technical challenges and opportunities

- Satellite and antenna Modeling, Ambiguity Resolution and Signal Biases, Satellite Orbit & Clock Products, Atmospheric Remote Sensing, and impact onto Reference Frame.

Standardization and Infrastructure

- Data Formats, including the definition and promotion of standardized LEO-PNT data formats compatible with or evolving current GNSS standards.
- Network Expansion, assessing the feasibility of extending IGS network capability to track LEO-PNT signals alongside legacy GNSS signals.
- Real-time Capabilities, aiming at enhancing current IGS real-time data streams and monitoring capabilities.

Governance and Data Policy

- Open Data Advocacy, promoting the adoption of open data policies and metadata publication among private and institutional LEO-PNT providers.
- Eligibility Criteria, defining the performance, accuracy, and availability requirements LEO-PNT providers must meet for IGS integration

The Structure

The LEO-PNT Pilot Project will have two co-chairs who will oversee the group activities. Per IGS policy, the Chairs are ex-officio members of the Governing Board with voting rights.

Moreover,

- **Task Forces** may be established ad hoc to evaluate specific issues or requirements with IGS committees and LEO-PNT providers.
- **Membership** is open to all Associate Members (AMs); observers may be invited at the discretion of the Chairs.
- **Project's structure** will be refined later based on early findings and needs.