



# ***LEO PNT: International Perspective***

**National Space-Based Positioning Navigation and  
Timing (PNT) Advisory Board: 29th Meeting**

Houston, TX

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***December 6, 2023***



# *LEO PNT From a GNSS Provider Perspective*

## **Why Do We Care?**

- Rapid Evolution – Transparency!
- System Use
  - What types of services will be provided?
  - Who are the users?
  - Will LEO Systems be competing with or complementing traditional GNSS?
- Technical Issues
  - Spectrum use and compatibility/interference
  - Interoperability
    - Performance Standards – standardization/consistency
    - System time offsets
    - Time/coordinate reference conventions
    - System monitoring
    - Orbits (determination, dissemination, etc.)



# *International Committee on GNSS (ICG)*

- First discussed during ICG-16 in 2022
  - How should ICG interact with purely commercial systems?
  - Should ICG include LEO PNT providers in discussions about standardization of GNSS performance standards?
- ICG LEO PNT Workshop held in June 2023
  - Objectives:
    - Understand current status/intent
    - Establish a two-way information exchange
    - Determine interest from commercial service providers about future ICG engagement
  - Five providers participated/presented – China (1), EU (1), and U.S. (3)
    - Other providers identified but unable to participate – outreach/engagement continues



# ICG Workshop Summary: CENTISPACE (China)



## Presenters:

DU Xiaodong & MU Xucheng  
Beijing Future Navigation Tech

- Commercial LEO service
  - HAS (dm/cm - level)
  - Integrity (3s TTA, 99.99% avail.)
  - Monitoring (space-based, global coverage, RT SV cross-links)
- Three-part constellation
  - 975 km @ 55°
  - 1100 km @ 87.4° [polar]
  - 1100 km @ 30.0° [low latitude]
- L1, L5 @ -157 dBW
- 5 SVs on orbit [testing], planned 190 [operational]



# ICG Workshop Summary: FutureNAV (ESA)



## Presenters:

Marco ANGHILERI & Lionel RIES  
European Space Agency

- Evolution toward multi-layer PNT
  - MEO/GEO/IGSO [existing]
  - **LEO PNT**, VDES, 5G
  - 5G/6G local hotspots
- PNT-2030 vision
  - Performance to dm- and ns-level
  - Integrity
  - Resilience
- Multiple system concepts
  - Purpose-built LEO PNT
  - Fused PNT + satellite comms
  - Signals Of Opportunity



# ICG Workshop Summary: TrustPoint (U.S.)



## Presenters:

Chris DEMAY & Paul ANDERSON

- Commercial LEO service
  - Bi-directional (space ↔ ground)
  - GNSS augmentation
  - Secure synchronization, positioning, timing
- C-band (*not* L-band)
- Performance
  - High accuracy (m-level → dm-level)
  - Similar power to existing GNSS
- 1 SV on orbit [April 2023], planned 288 [operational]



# ICG Workshop Summary: Xona Space Systems (U.S.)



Presenter:  
Christina YOUN

- Commercial LEO service
  - GNSS augmentation, integrity, authentication/security, robustness
  - Compatible & interoperable with existing GNSS (L-band)
  - Distributed clock architecture
- Performance
  - High accuracy (cm-level ranging)
  - Similar power to existing GNSS
- 1 SV on orbit [May 2022], planned 258 [operational]



# ICG Workshop Summary: Satelles (U.S.)



Presenter:  
Christina RILEY

- Commercial LEO service
- Global network time synch
- System architecture
  - Exclusive partnership w/ Iridium
  - L-band, higher power than existing GNSS
  - SV cross-links
  - Cryptographical authentication
- Performance w.r.t. UTC
  - $\leq 50\text{ns}$  @  $1\sigma$  [typ.]
  - $< 200\text{ns}$  [max.]
- 66 SVs on orbit [2023]





## *ICG Next Steps*

- Further discussions within ICG to determine most appropriate way to integrate commercial/emerging providers
- Continue outreach to LEO PNT system providers with invitation to ICG meetings and relevant activities
- Organize another workshop focused on both interoperability and compatibility issues
  - U.S., ESA and China will lead the organization effort