

LunaNet Interoperability Updates for PNT Services

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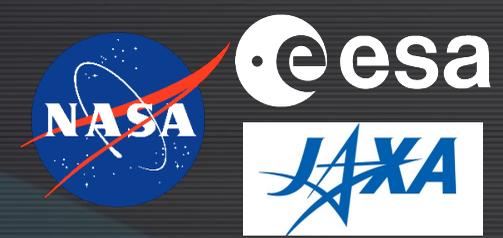
ICG Cislunar PNT Workshop

10 February, 2026

Vienna, Austria



Outline



- LunaNet 1.0 PNT Services
- Applicable Document 1: Volume A, LunaNet Signal in Space, Augmented Forward Signal
- Other Applicable Documents
- LNIS Document Release Schedule



PNT Services in the LunaNet Interoperability Specification, LunaNet 1.0

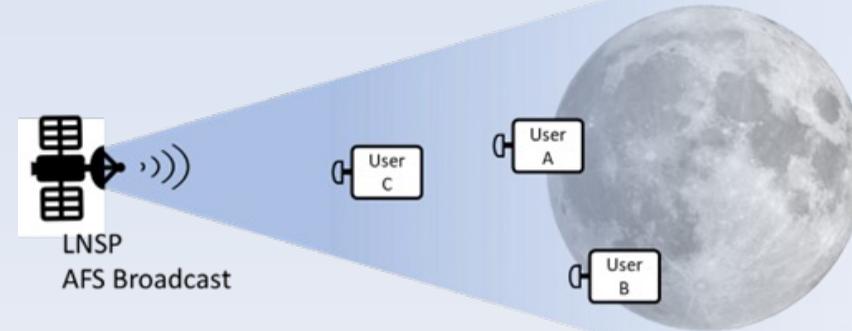


- Augmented Forward Signal (AFS), Broadcast
 - A. Specifications per LNIS AD1 Vol-A, LunaNet Signal In Space Recommended Standard for AFS
 - B. Modulations, spreading codes, data encoding, power levels, etc.
 - C. Performance requirements per respective LNSP Requirements Document
 - D. Similar to GNSS open service

- Point-to-Point (P2P) PNT Services
 - A. 2-Way Measurements, including Range and Doppler
 - B. 1-Way Doppler Reference Signals

- Information over Messages
 - A. Constellation almanac
 - B. Precise ephemeris
 - C. P2P Observables
 - D. Transformations

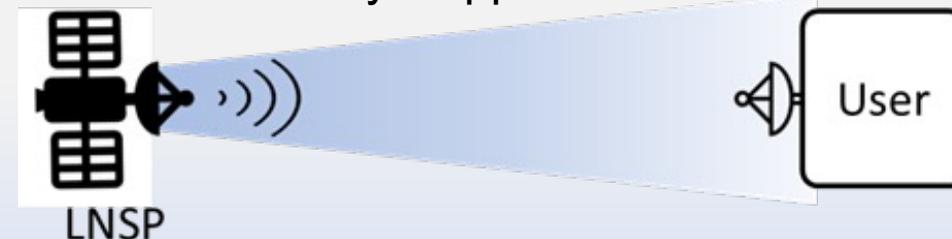
Augmented Forward Signal



P2P 2-Way Measurements



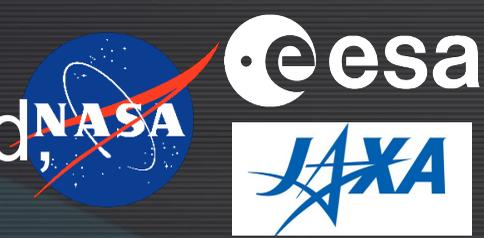
P2P 1-Way Doppler Reference





Expected Updates to AD1 Vol A:

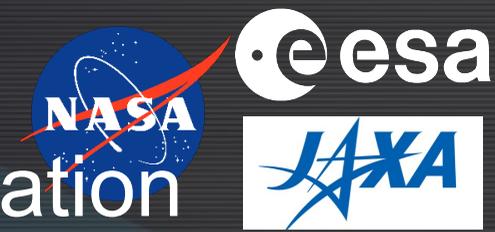
LunaNet Signal in Space Recommended Standard, Augmented Forward Signal



1. v2 will confirm most TBC's
2. SISE, including predictive
3. Power on Surface (min/max, and limits outside of service volume)
4. Updated PN Codes
5. Unwanted Emissions guidance based on ITU regulations
6. Consistency within Subframe 2
7. MSG-G4, Clock and Ephemeris Data
8. User algorithms to derive LNSP Center of Phase position, velocity
9. Example link budget



AD3: Detailed Message Definition & AD8: LunaNet Interoperability Security Specification



AD1 Volume B: LunaNet Signal in Space, Point-to-Point Signals

Establishing sessions for Two-Way Measurement services

AD2: LunaNet Measurement Schema and Parameters

Information to interpret PNT data from LNSPs

AD3: LunaNet Detailed Message Definition

Identifies Messages used generally by LunaNet.

Messages needed by PNT Broadcast, e.g. AFS, will be defined in AD1 Volume A.

AD3 will include definitions for messages sent over the P2P or DWE links, such as MSG-G13 Observations from P2P link

AD6: LunaNet Data Services

Encapsulation of Messages for P2P links

AD8: LunaNet Interoperability Security Specification

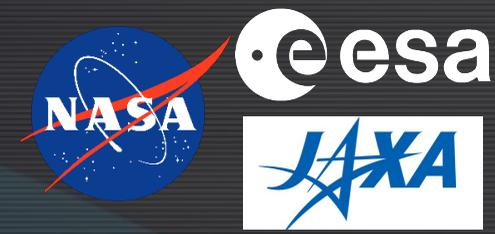
Flexibility to evolve with updates to cybersecurity requirements

Authentication on AFS

Message authentication on P2P, e.g. MSG-G13 Observations



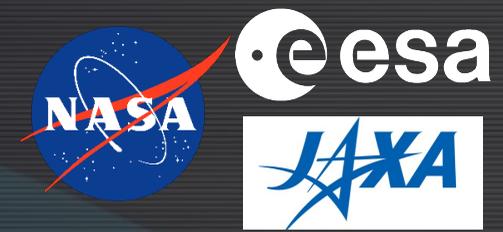
AD5: Lunar Reference Systems and LunaNet Reference Time System Standard



- SISE as the bounding parameter for interoperability
- International Lunar Reference Frame (ILuRF) as the basis
- LunaNet Reference Time (LRT), and transforms wrt LNSP SV Node Time (NT) and LNSP System Time (LST)
- Traceability of LRT to UTC
- Transform to other agreed upon Reference Frames, e.g. DE421_ME, Moon Centered Inertial
- Error Contributors



LNIS Document Schedule



2026

2027

March

April

May

June

Sept

Nov

March

May

LNIS v6
Vendor
Review

LNIS v6
Published

LNIS v7
Vendor
Review

LNIS v7
Published

LNIS v8
Vendor
Review

LNIS v8
Published

Main Document v6
AD1 VoIA v2
AD1 VoIB, v0.1 draft

AD5, v0.1 draft
AD6, v0.1 draft
AD8, v0.1 draft

Main Document v7
AD1 VoIA v3
AD1 VoIB, v1
AD2, v0.1 draft
AD3, v0.1 draft
AD5, v1
AD6, v1
AD8, v1
Concept of Ops, v0.1 draft

Main Document v8
AD1 VoIA v4 (opt)
AD1 VoIB, v2 (opt)
AD2, v1
AD3, v1
AD5, v2
AD6, v2
AD8, v2 (opt)
Concept of Ops, v1

NOTE: Draft documents are not publicly available