



# Sub-Session: Standardization

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Session Co-chairs:

Jörg HAHN

Cheryl GRAMLING



Vienna, VIC, 10 Feb 2026

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# Session Agenda



• 14:00–14:10 Introduction (J. Hahn - ESA, Ch. Gramling - NASA)



• 14:10–14:25 From the Earth to the Moon: LUNEX - Lunar Unified Navigation Exchange Format  
(F. Gini - ESA, A. Hauschild - DLR)



• 14:25–14:40 Standardisation for Lunar PNT Receivers  
(S. Fantinato - Qascom)



• 14:40–14:55 Standards: the Good, the bad and the applicability  
(S. Lightman - NIST)



• 14:55–15:10 Progress on Cislunar CCSDS Standards as a Foundation for Interoperability  
(D. Fischer - ESA)



• 15:10–15:30 Room and online Q&A + Wrap-up

# Why Standardisation Now? – What is going on?

## ESA Roadmap For Lunar COMM and PNT Services



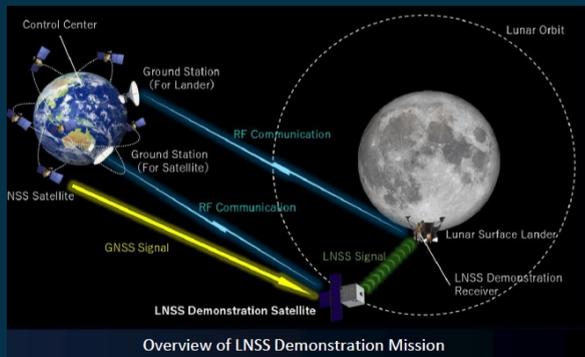
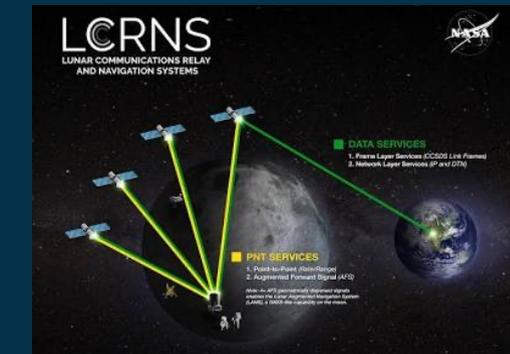
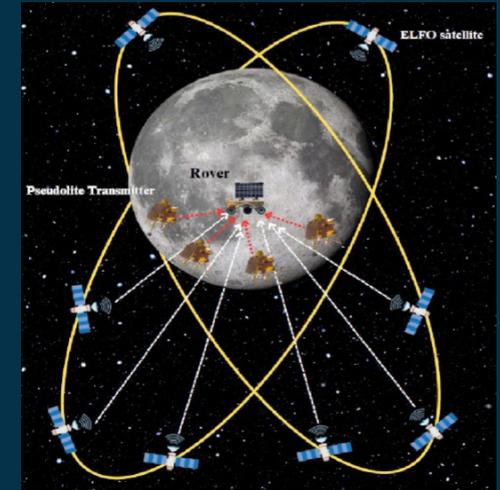
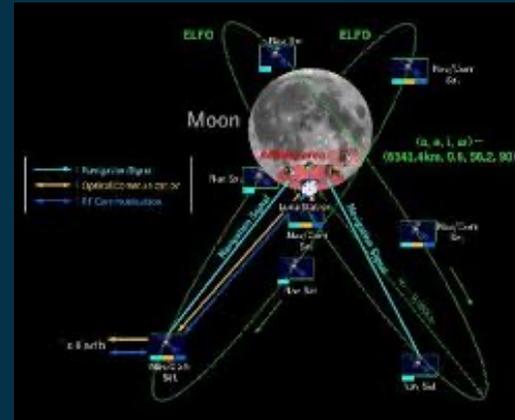
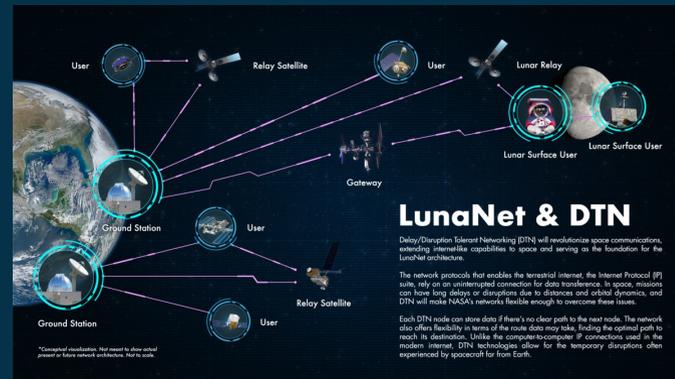
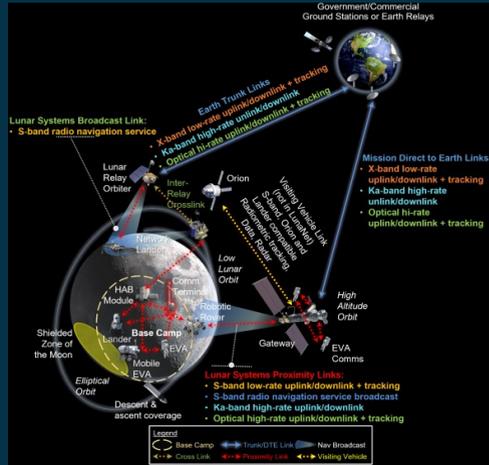
**STEP 1: LUNAR PATHFINDER**  
(Launch 2026)

**STEP 2: MOONLIGHT System**  
(Initial: 2028; Final: 2030)

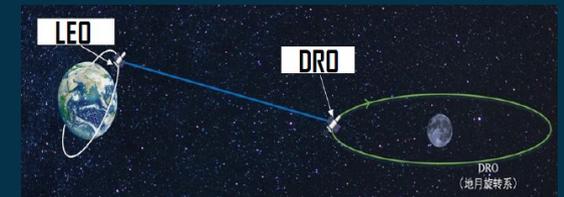
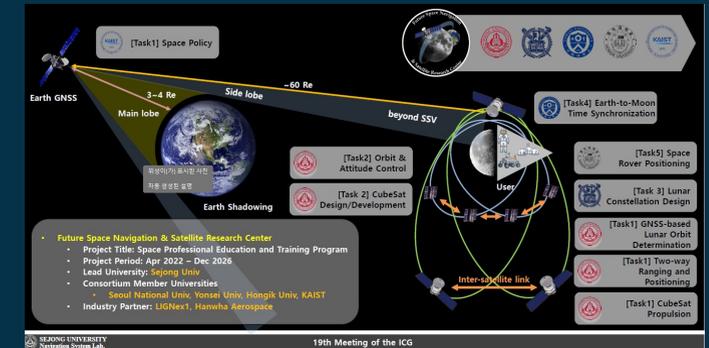
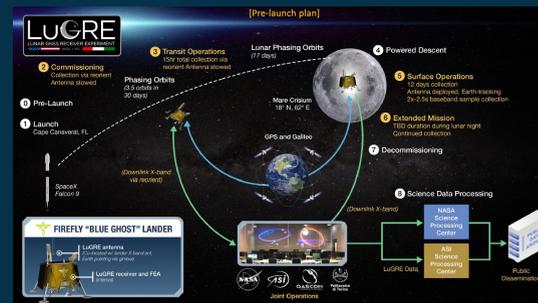
**STEP 3: NOVAMOON: Local PNT Differential Station**  
(Launch target: 2030)

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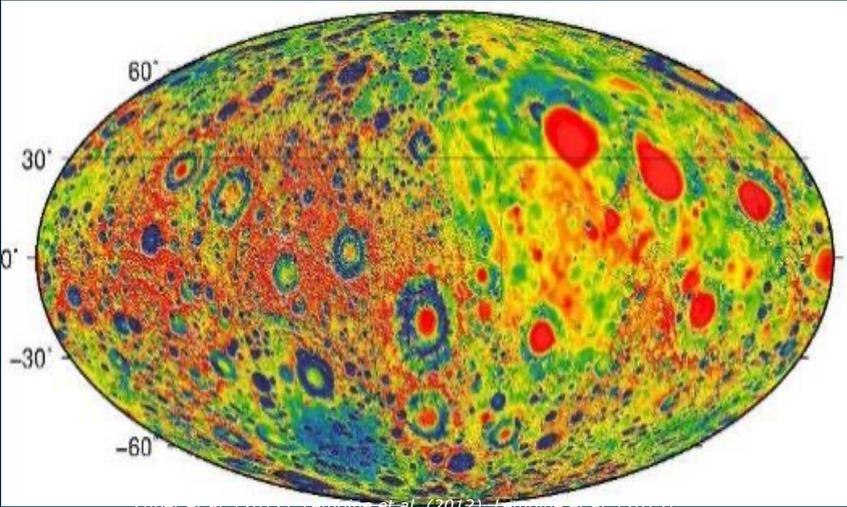
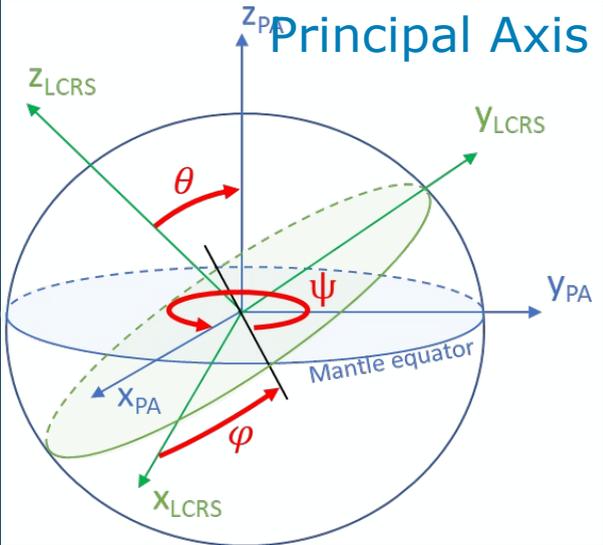
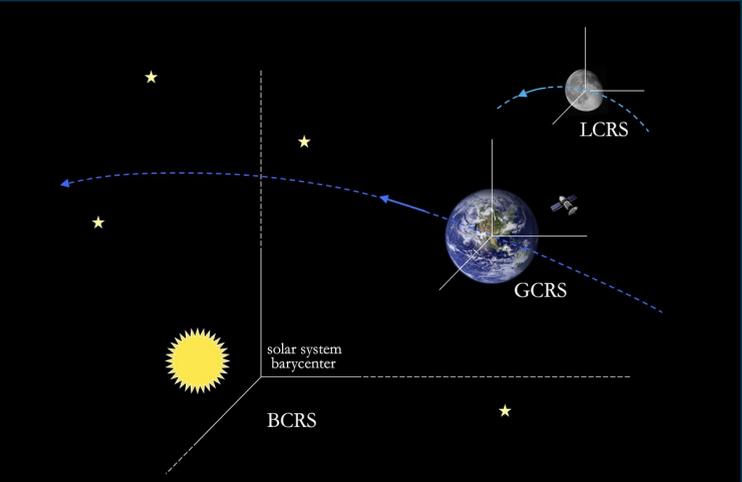


Schematic Diagram of Queqiao System

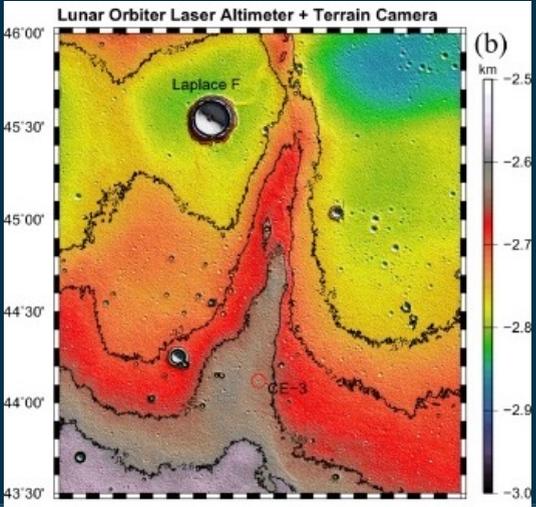
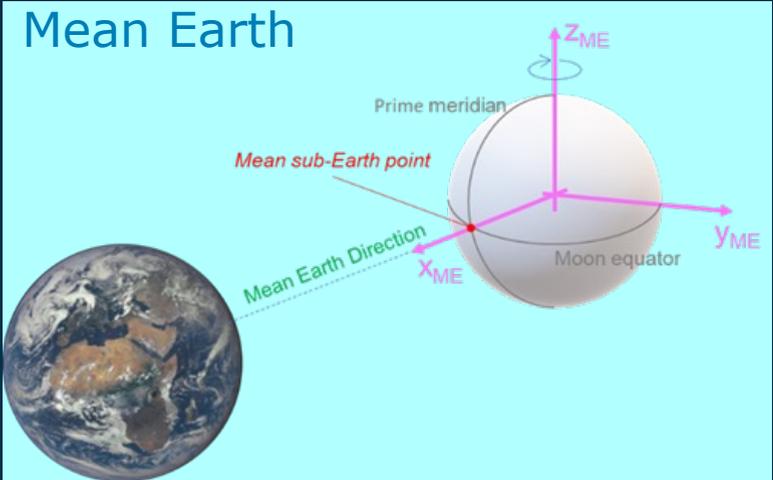


... not exhaustive!...

# Why Standardisation Now? – What is going on?



Zuber et al. (2012), Lemoine et al. (2012), Lemoine et al. (2015)



# Why Standardisation Now?



- **Rapid growth** of lunar PNT systems developments.



- Need for **early efforts to ensure Interoperability and Compatibility** to avoid fragmentation.

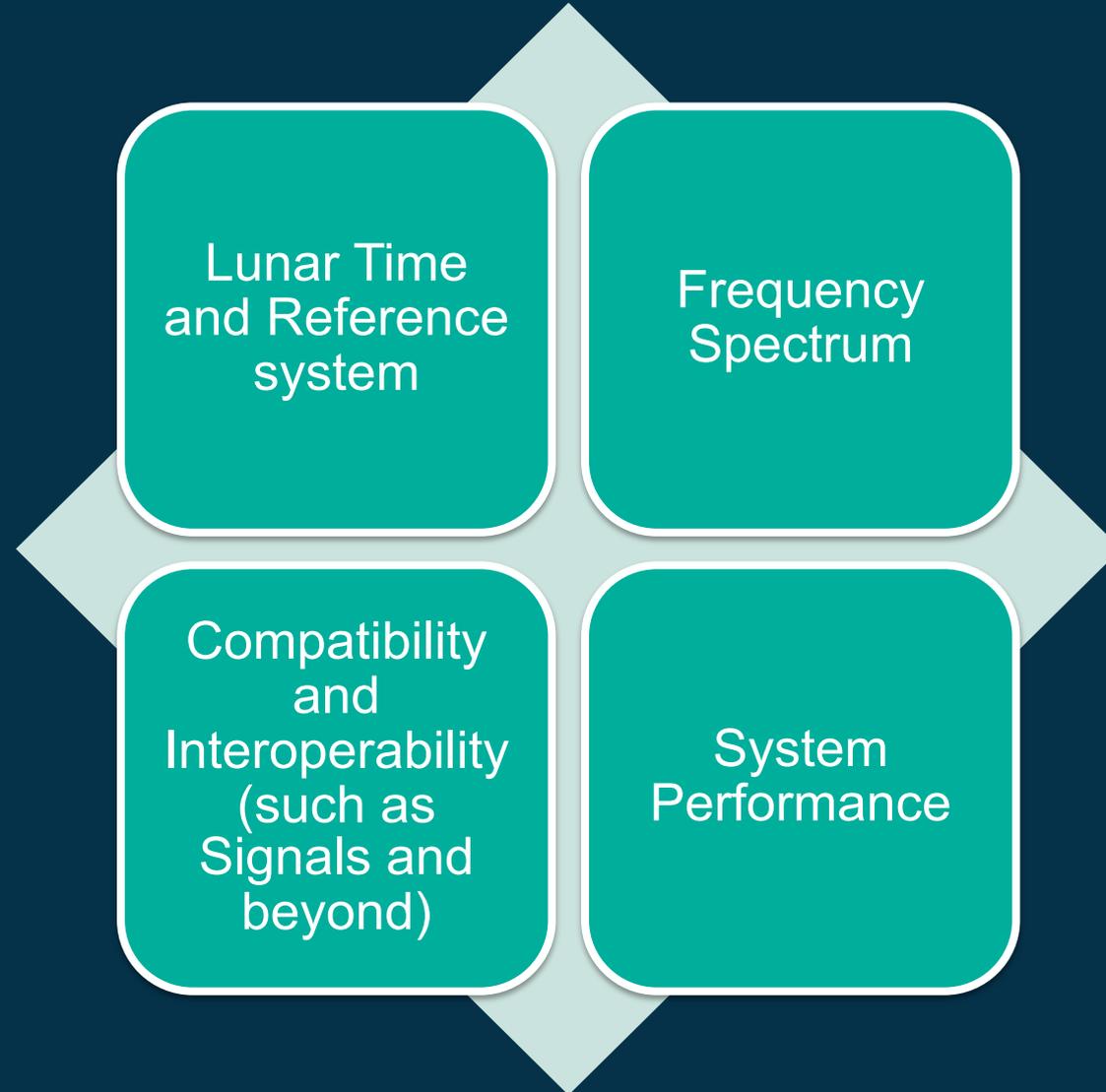


- **Intl. collaboration** (i.e. SFCG, IAU, IAG, BIPM for the foundational standards); ICG WG-L as coordinating body.



- **Lessons from GNSS:** standards must emerge before deployment.

# Why Standardisation Now? Areas for PNT and COMs



+ **Governance**  
(next sub-session)

# Why Standardisation Now? – "LunaNet" as just one example

LunaNet Orbital PNT Service Providers





**ESA Moonlight LCNS (2028-2030)**

**LNSP: Telespazio**



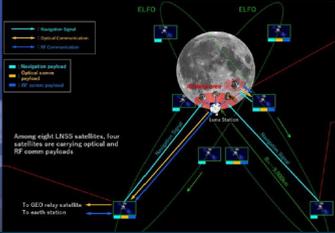
**NASA LCRNS (2026+)**

**LNSP: Intuitive Machines**



**Japan LNSS (2028/2029~)**

**LNSP: ArkEdge Space**  
※PNT only



**LCNS: Lunar Communications and Navigation Services**

**LCRNS: Lunar Communications Relay and Navigation Systems**

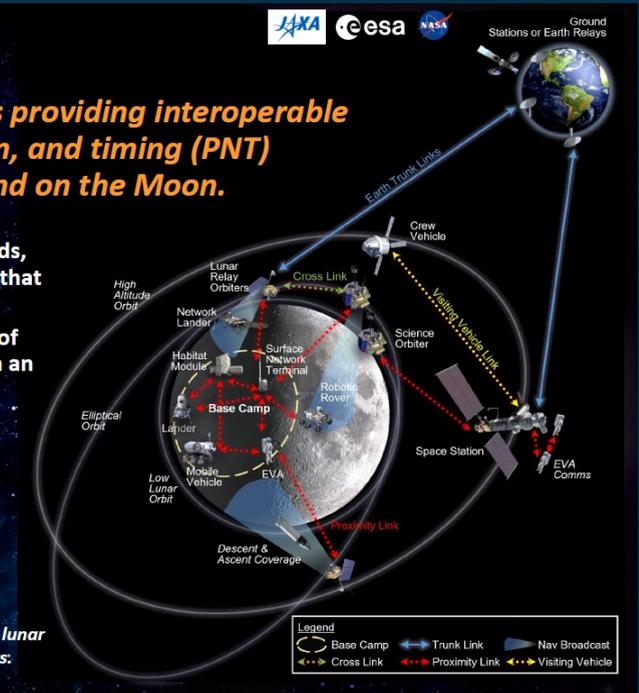
**LNSS: Lunar Navigation Satellite System**

## What is LunaNet?

*LunaNet is a set of cooperating networks providing interoperable communications and position, navigation, and timing (PNT) services for users in transit to, around, and on the Moon.*

- Based on a framework of mutually agreed-upon standards, protocols, frequency bands, and interface requirements that enable interoperability.
- Allows many lunar mission users to engage the services of diverse commercial and government service providers in an open and evolvable architecture.
  - Service-Oriented
  - Scalable
  - Open
  - Resilient
  - Secure
  - Extensible

*LunaNet consists of Earth Ground Stations (for Direct with Earth links), lunar orbital relays (lunar proximity and Earth trunk links), and surface assets.*



# Questions to be addressed. Some thoughts...

- How do we adopt standards for interoperability based on Earth analogues?
- What is the Lunar PNT / COMs “standards tree”? Is it well “configured”?
- Do we propose joint GNSS / Lunar PNT / COM’s standards and at which stage?
- Do we need to coordinate and promote the standardization within established bodies, public entities and industries?
- Should we coordinate directly with LunaNet and industrial vendors + other players?
- Should we start standardization of the ICD(s) for “recording” lunar PNT / COMs signals/observations.
- Should we standardize an ICD for user equipment for lunar PNT?
- How do the PNT systems fold into any standards for SSA, such as dissemination of a space-based conjunction data message?
- How does “standardization” flow into “governance”? How will governance enforce the standards and established rules, e.g. for spectrum?

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# 10 min / speaker + Q&A

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# Expected Sub-Session Outcomes

- Complete the list of Questions
- Find some answers to the Questions



# THANK YOU

Jörg HAHN  
[joerg.hahn@esa.int](mailto:joerg.hahn@esa.int)

Cheryl GRAMLING  
[cheryl.j.gramling@nasa.gov](mailto:cheryl.j.gramling@nasa.gov)



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