

Japan Lunar Navigation Satellite System (LNSS) and Its Contribution Towards 'Moon GNSS'

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# Lunar Comm&Nav (CPNT) systems by US, Europe, Japan

ESA Moonlight LCNS (2027~)



NASA LCRNS (2025~)



JAXA LNSS (2028~)



LCNS: Lunar Communications and Navigation Services

LCRNS: Lunar Communications Relay and Navigation Systems

LNSS: Lunar Navigation Satellite System

# Towards the establishment of 'Moon GNSS' called LANS

### The concept of the Moon GNSS called the Lunar Augmented Navigation Service (LANS)



### JAXA's plan

# LNSS is GPS-like satellite constellation for the Moon designed by JAXA





#### JAXA's plan

LNSS contribution towards the establishment of the LANS **※ ESA LCNS and NASA LCRNS orbits are notional in figures below** 

ELFO 3a







Our second LNSS satellite will perform the optical communications experiment between Moon and Earth

### JAXA's plan

# GNSS weak signal navigation for LNSS satellites, making the lunar PNT autonomous





# Collaboration with ESA and NASA and LunaNet Interoperability Specification (LNIS)

# ESA-NASA-JAXA collaboration ongoing on the LunaNet Interoperability Specification (LNIS) and the LANS



#### LNIS Draft Version 5 now available on the internet

# LunaNet Interoperability Specification Document

Draft Version 5 Published by NASA and ESA

**Draft Version 5 – August 2023** 

LNIS V005

The LNIS and its applicable document includes:

• <u>Concept of the LANS, message format of the</u> <u>Augmented Forward Signal (AFS), signal frequency,</u> <u>power, etc.</u>

• <u>Signal-In-Space-Error (SISE) requirement for</u> <u>LunaNet Service Providers (LNSPs)</u>

• <u>Lunar Reference System and Lunar Time System</u> <u>Standard</u>

The JAXA LNSS complies with the LNIS to become interoperable and comparable with the other LNSPs

Thanks to NASA and ESA, JAXA has joined the LNIS working group and is now working with NASA and ESA for the publication of the LNIS Version 5

# Plan of LANS interoperability and PNT demonstration mission targeting in 2028

# Launching and deploying our first LNSS satellite and LANS receivers to the moon





## Proposing the first-ever ESA-NASA-JAXA LANS interoperability and PNT demonstration





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# Takeaways

• The JAXA LNSS, ESA LCNS, NASA LCRNS will comply with the LNIS and form the LANS that becomes the 'Moon GNSS'

• ESA, JAXA, and NASA encourage the LANS interoperability demonstration mission in 2028 and are currently assessing their respective participation. The LANS receivers to be located at the South Pole region will receive all LNSPs AFSs and send them back to the Earth for the in-depth analysis

• In this mission, a laser retro-reflector (LRR) will be placed on the Moon surface as well for the precise position estimation of the LANS receiver. The laser ranging data will be also utilized for the refinement of the Lunar Reference System (LRS)