National Aeronautics and Space Administration

NASA

ESC Exploration & SPACE Communications

More than you ever imagined...

LunaNet: NASA's Communications and Navigation Architectural Framework for the Moon

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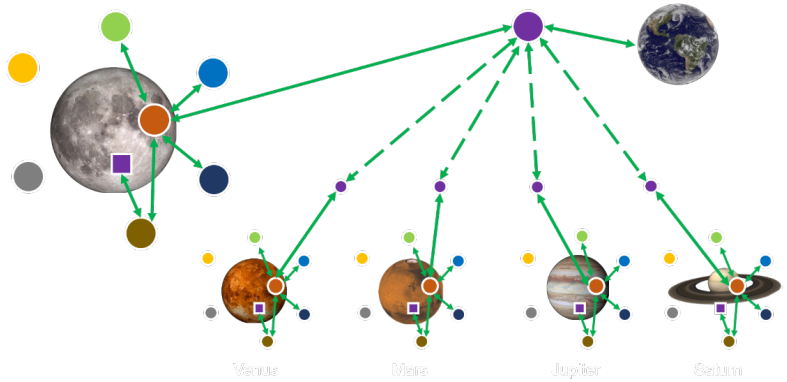
LUNANET
STATUS: ONLINE
1000.456.3.C
-210°C
NAVIGATION
SHOEMAKER
EVA-1
LRV 1
SHACKLETON
CURRENT SPACE WEATHER CONDITIONS:
Solar Wind Speed: 421 km/sec
Noon: 10.7 cm
Solar Wind Magnetic Fields:
Radio Flux: 74 sfu
SOLAR FLARE MONITOR
SOLAR FLARE PROBABILITY = 1%
PREDICTION HORIZON: 24 HR
All Clear [M & X]
SOLAR FLARE MONITOR
SOHO: EIT 171
NO SUNSPOTS DETECTED
2019-05-15 16:37 UTC
SOLAR X-RAY FLUX (1-minute dat
May 13
May 14
May 15
UNIVERSAL TIME
X-RAY FLUX
PROTON FLUX

Introduction to the Lunar Network, *LunaNet*

- LunaNet is envisioned as a framework of standards, protocols, and interfaces to support a scalable, interoperable communications and navigation network-of-networks with nodes provided by NASA, commercial, and international partners.
- LunaNet is open and scalable similar to the terrestrial internet
  - It can be introduced with early robotic missions and expanded as new spacecraft and missions come online.
- Its service-oriented architecture provides data transmission, sharing of position, navigation and timing (PNT), and situational awareness information.
- The LunaNet concept is applicable to any planetary body and offers even greater advantages as the distance from Earth increases. *LunaNet will demonstrate many capabilities needed for Mars exploration and mirrors the architecture of the future MarsNet.*



There is broad interest in developing and implementing lunar communications relay services among industry (US and foreign), international partners, and NASA Centers.

LunaNet Services

Networked Communication Services

- Critical data transmitted in real time.
- Data aggregated and transmitted in store-and-forward mode from orbiting and surface relays.
- Data exchanged among lunar users with no need for transfer to and from Earth
- Data sent on demand by user or scheduled to better manage Earth stations loading & spectrum use

PNT Services

- Precise position, velocity and time for autonomous nav and collision avoidance
- Fusion of multiple data types including radiometrics, optimetrics, celestial nav, optical nav, terrain relative nav, & GNSS
- Broadcast service supplies time transfer and metric tracking to synchronize users

Detection and Information Services

- Alerts for events such as space weather, collision avoidance, & surface impact predictions sent to all LunaNet subscribers
- Mission sensors for space weather and other measurements distribute information services to other users via LunaNet information services

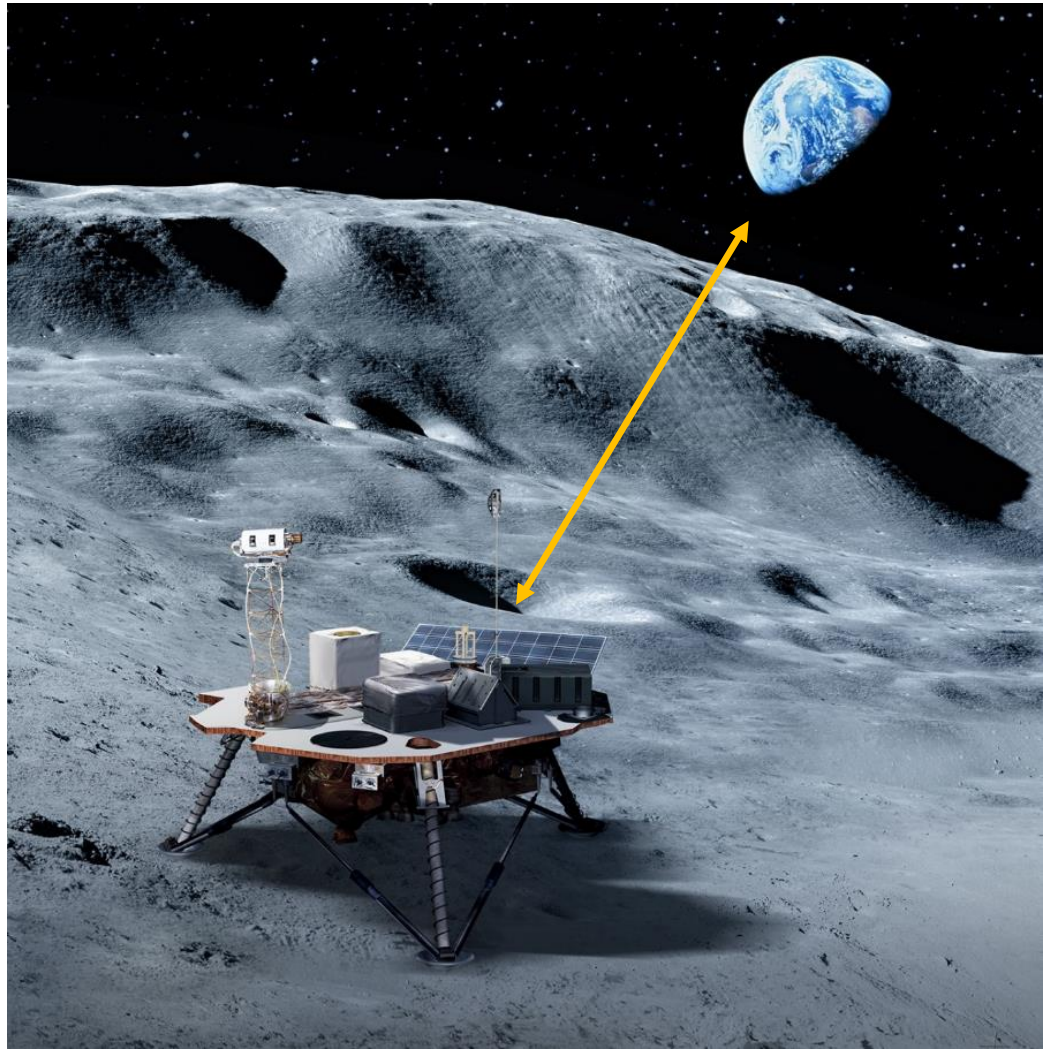
Science Services

- Use RF & optical assets (part of) as scientific instruments
- Supports Radio & Radar Sciences, Radio Astronomy / Very Long Baseline Interferometry (VLBI) & other space sciences

Any Link Provides LunaNet Access – Lunar Surface Direct with Earth

A lunar surface mission connects to the LunaNet through links directly with Earth

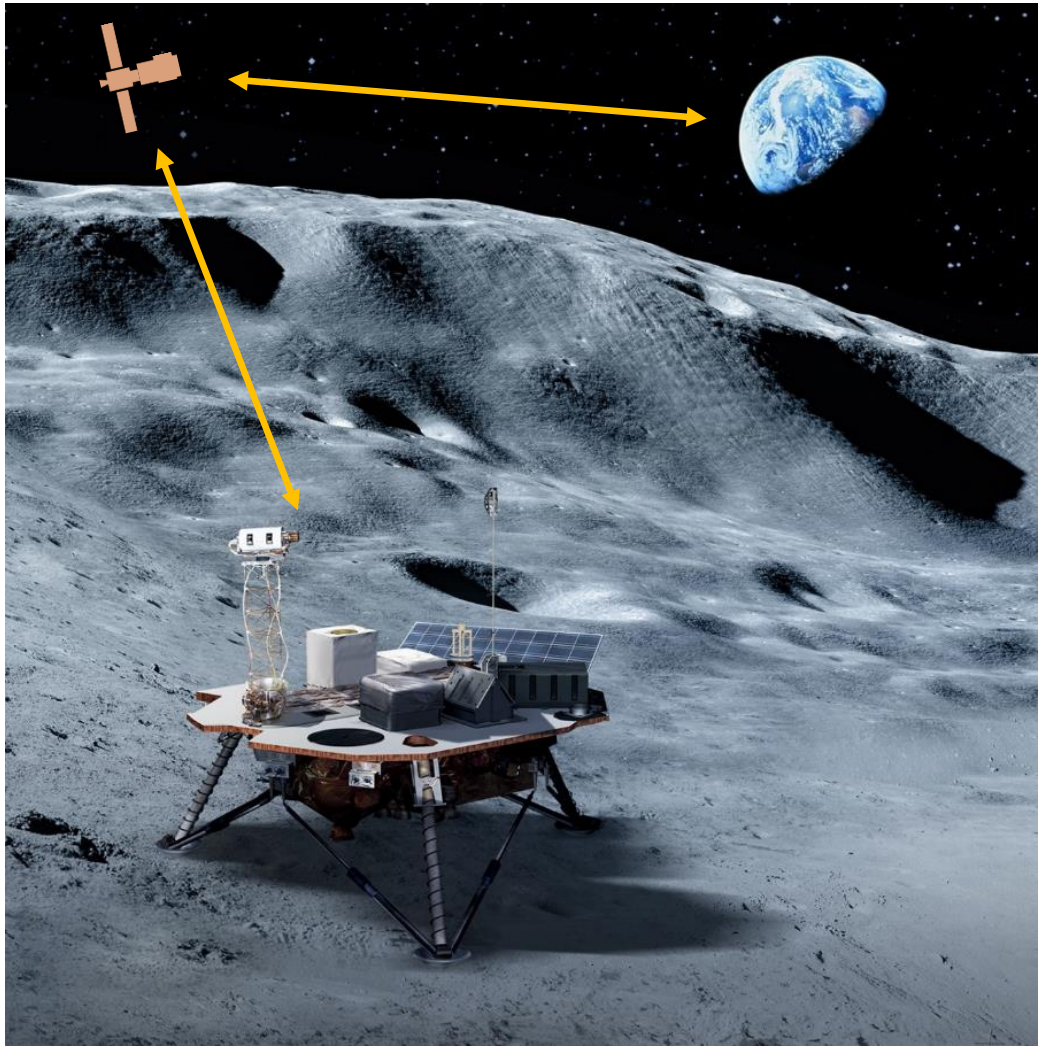
Data may still be routed to and from Earth destinations or back to lunar destinations



Any Link Provides LunaNet Access – Gateway as Access Point

The Gateway provides relay between lunar surface and Earth or other lunar users, either real-time or store-and-forward.

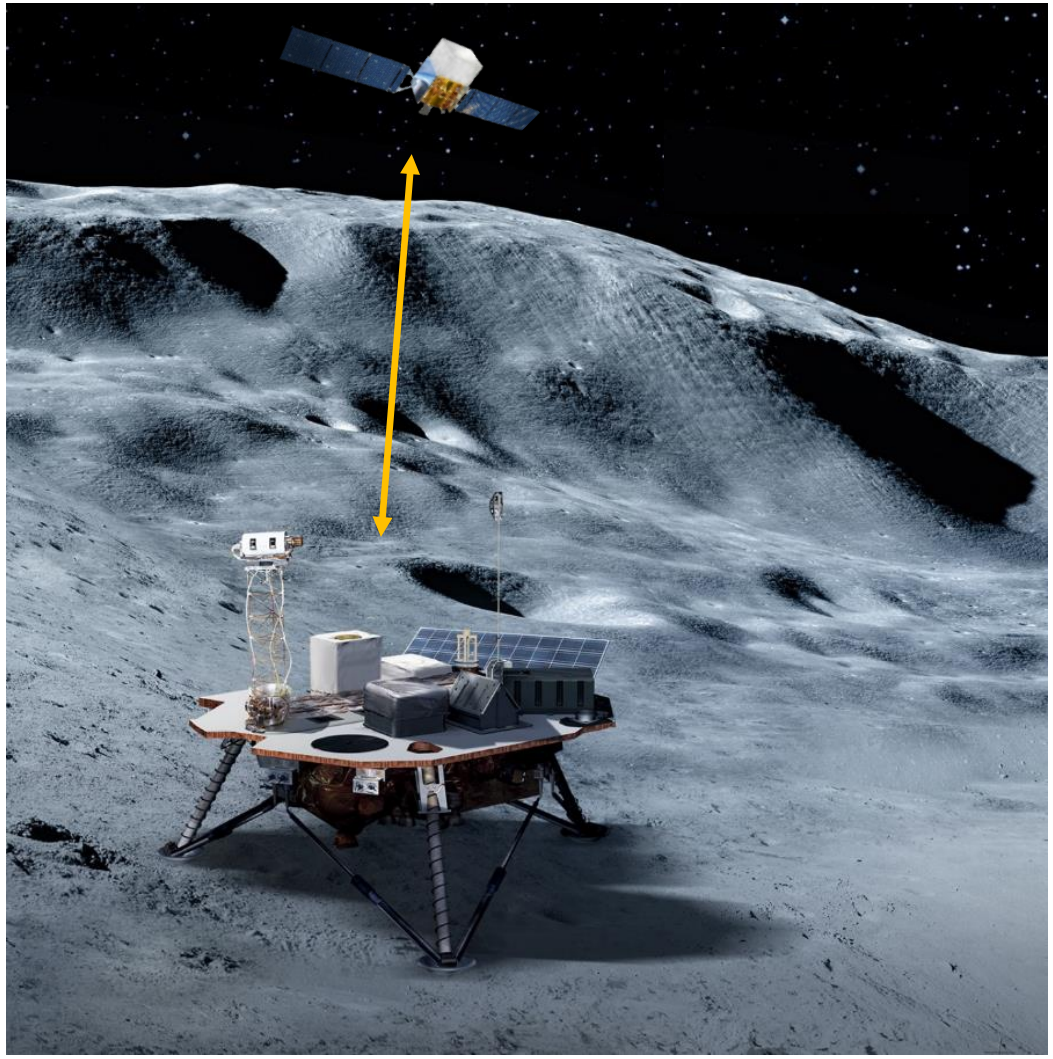
Data is still formatted the same and routed to final destinations as in the DTE case.



Any Link Provides LunaNet Access – Store and Forward Relay

Lunar surface user exchanges data with other LunaNet users through relay, even when other users are not connected to relay.

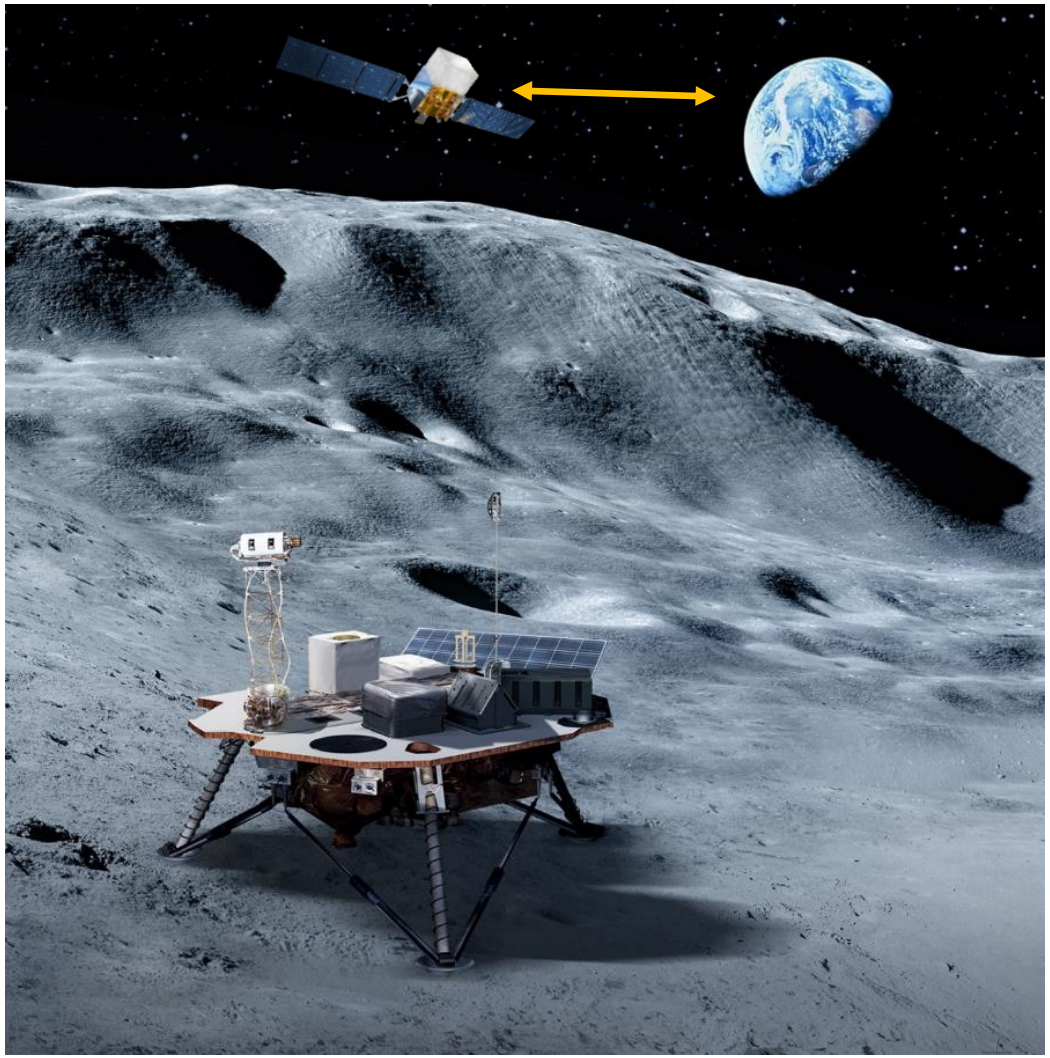
Lunar surface user may also receive position, navigation, and timing services and situational alerts when out of contact with Earth.



Any Link Provides LunaNet Access – Store and Forward Relay

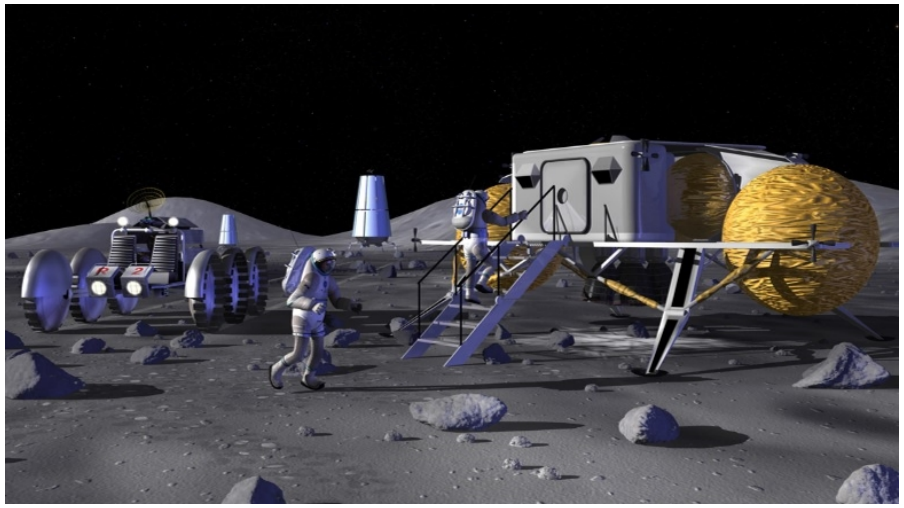
Relay forwards data to the network when Earth is in view

Relay receives data for other lunar users not in view of Earth



Conclusion

1. LunaNet is a flexible and scalable architecture for the provision of Network, PNT, and Detection & Information Services at the Moon.
2. The infrastructure can be built up over time as mission requirements and operations concepts evolve.
3. Satellites can be providers or users of the LunaNet architecture.
4. Infrastructure nodes can be provided by any combination of NASA, commercial, or other partner systems.
5. The LunaNet architectural approach is applicable to any planetary body to establish the solar system internet, such as MarsNet.



Questions?