

Gateway – a Communications Platform for Lunar Exploration



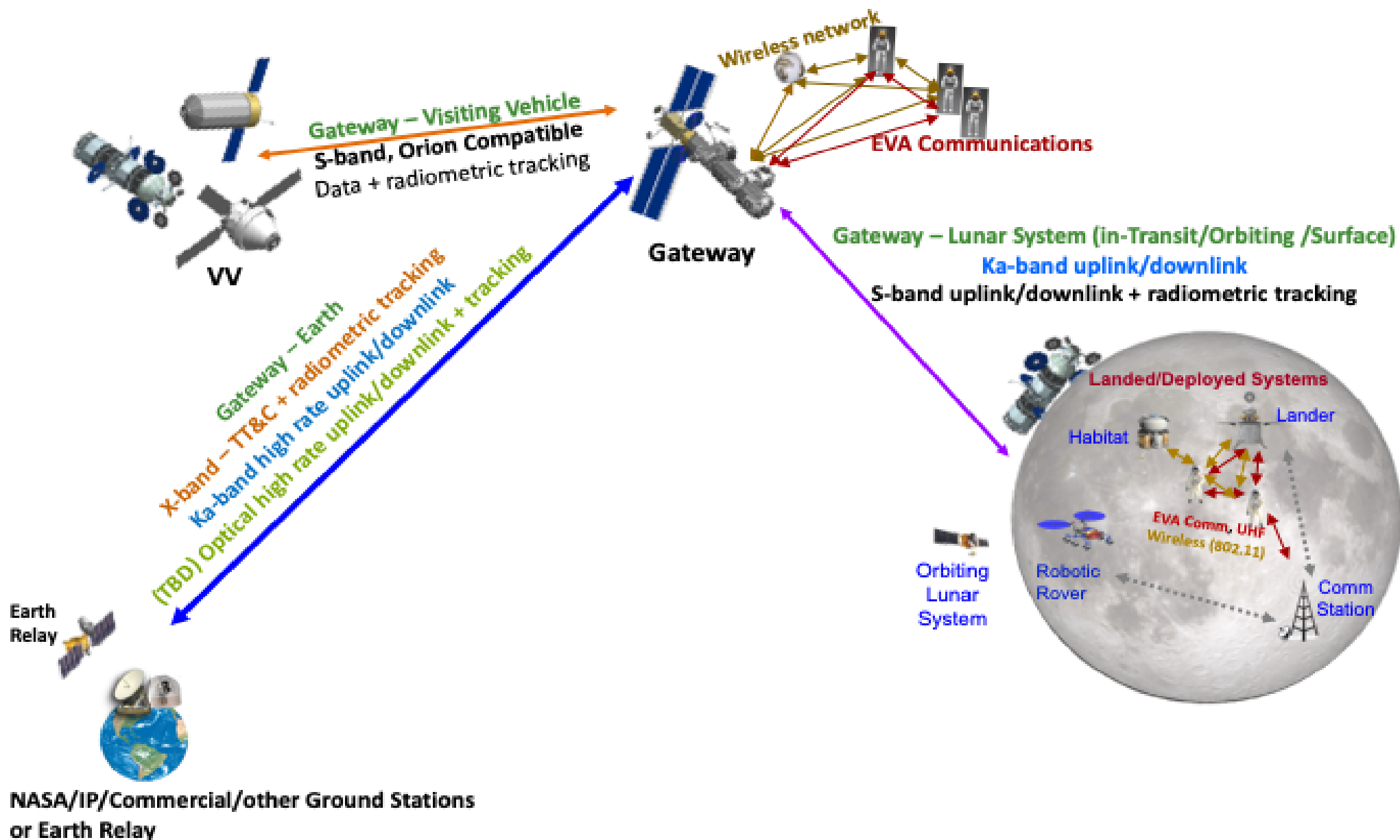
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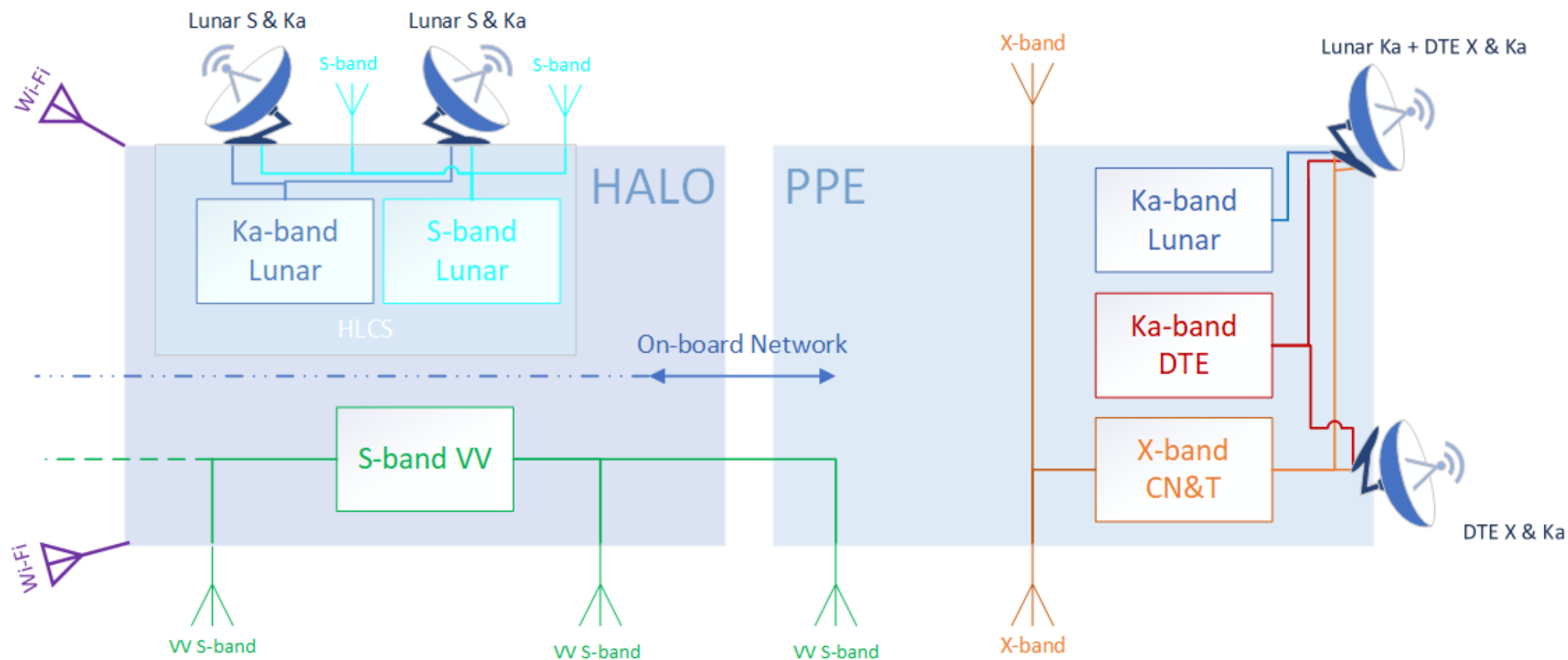


- **Introduction**
- **Architecture & System Description**
 - Mission – Phases & Orbits
 - Ranging
 - Concept of Operations
- **Key Drivers**
 - Data rates
- **Interoperability**
- **Challenges & Forward Work**
 - Upgradeability
- **Conclusions**

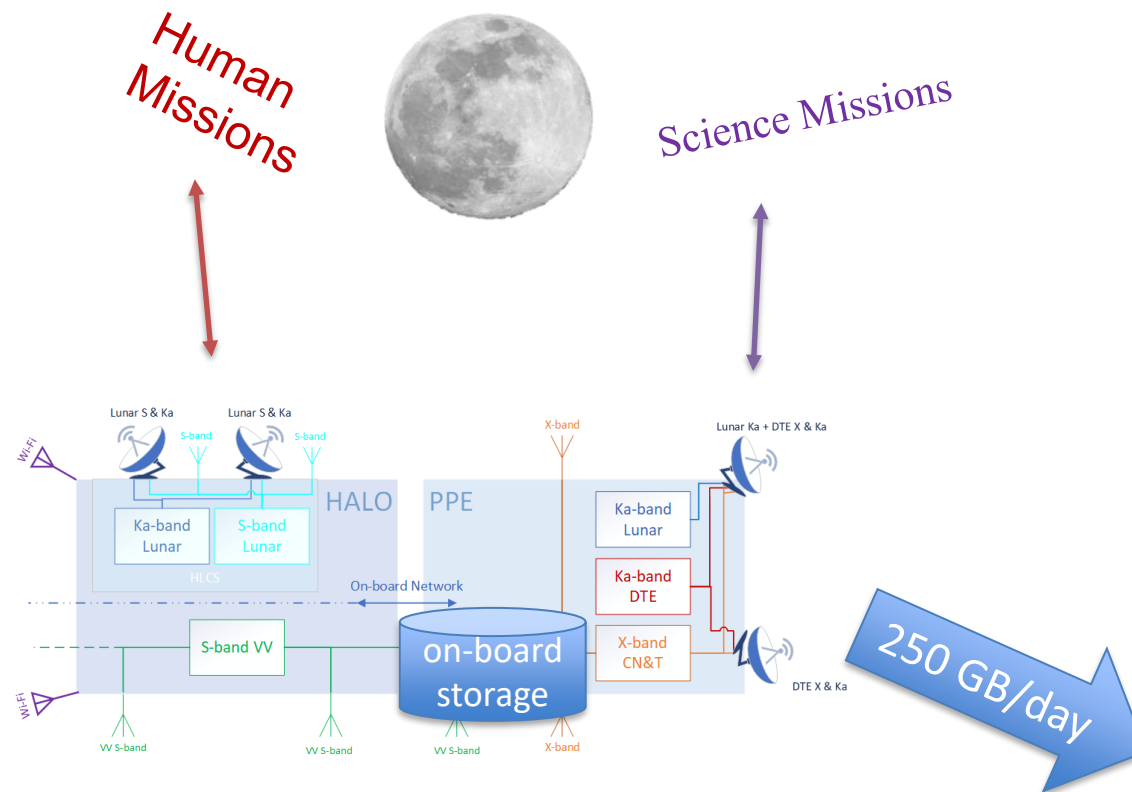




Initial Gateway System



1. Transfer and relay data from diverse set of spacecraft
2. Real-time and non-real time data:
 - imagery
 - audio
 - surface HD video relay
 - file transfers



Gateway Link Data Rates – initial capability

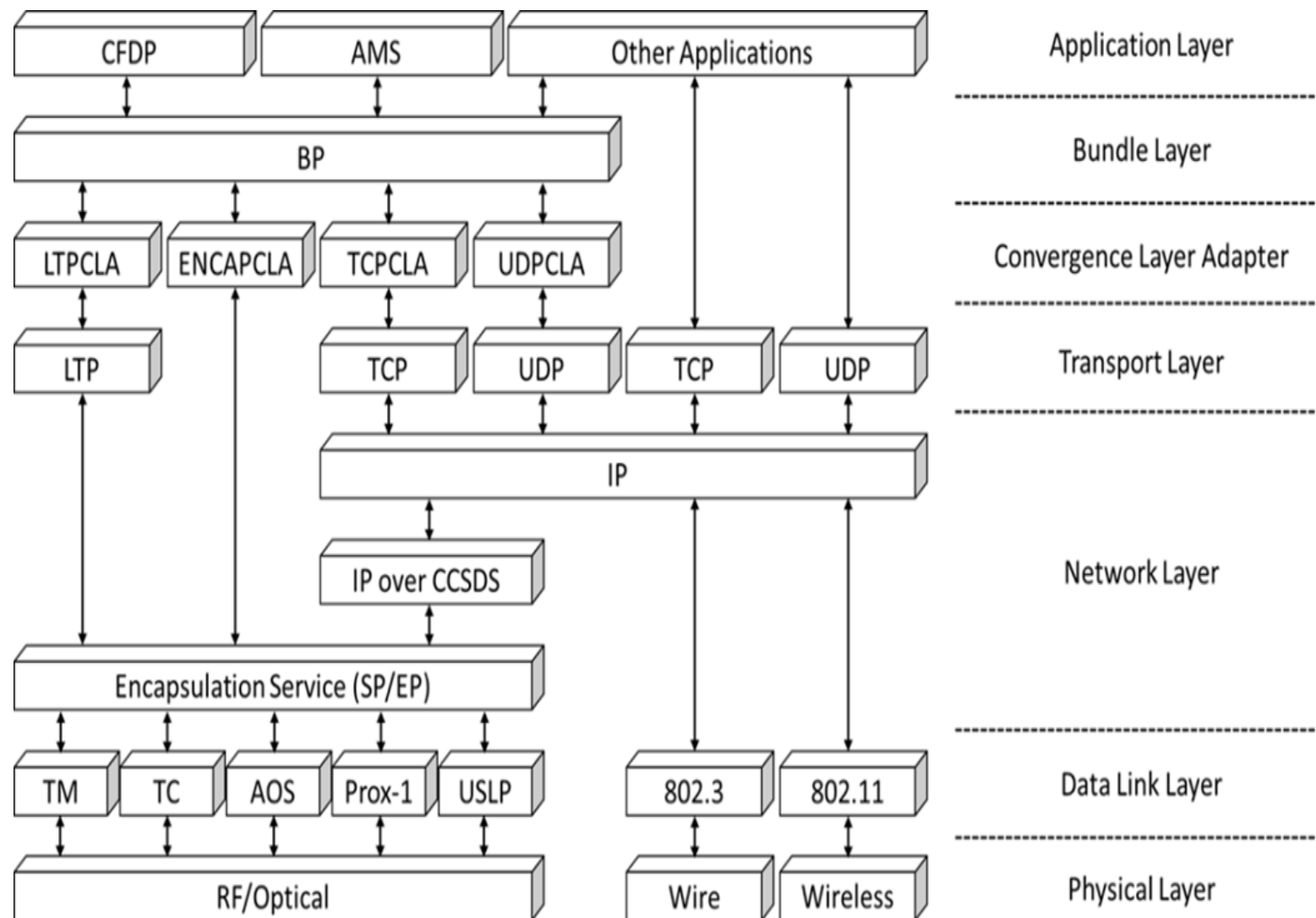
Link	Band	Max. Data Rates (Mbps)*	
		Up	Down
Earth command, telemetry	X	5	2
with Ranging	X	1	1
Earth high-rate data	Ka	20	100
Lunar Systems		Forward	Return
w/HALO	Ka	16	40
w/PPE	Ka	1	10

* User data rates, with ½ rate forward error correction



International Communications Systems Interoperability Standard (ICSIS)

- Specifies standards for all layers of communications
- Consistent with IOAG, SFCG, and CCSDS
- Evolving for needs of future deep space human exploration



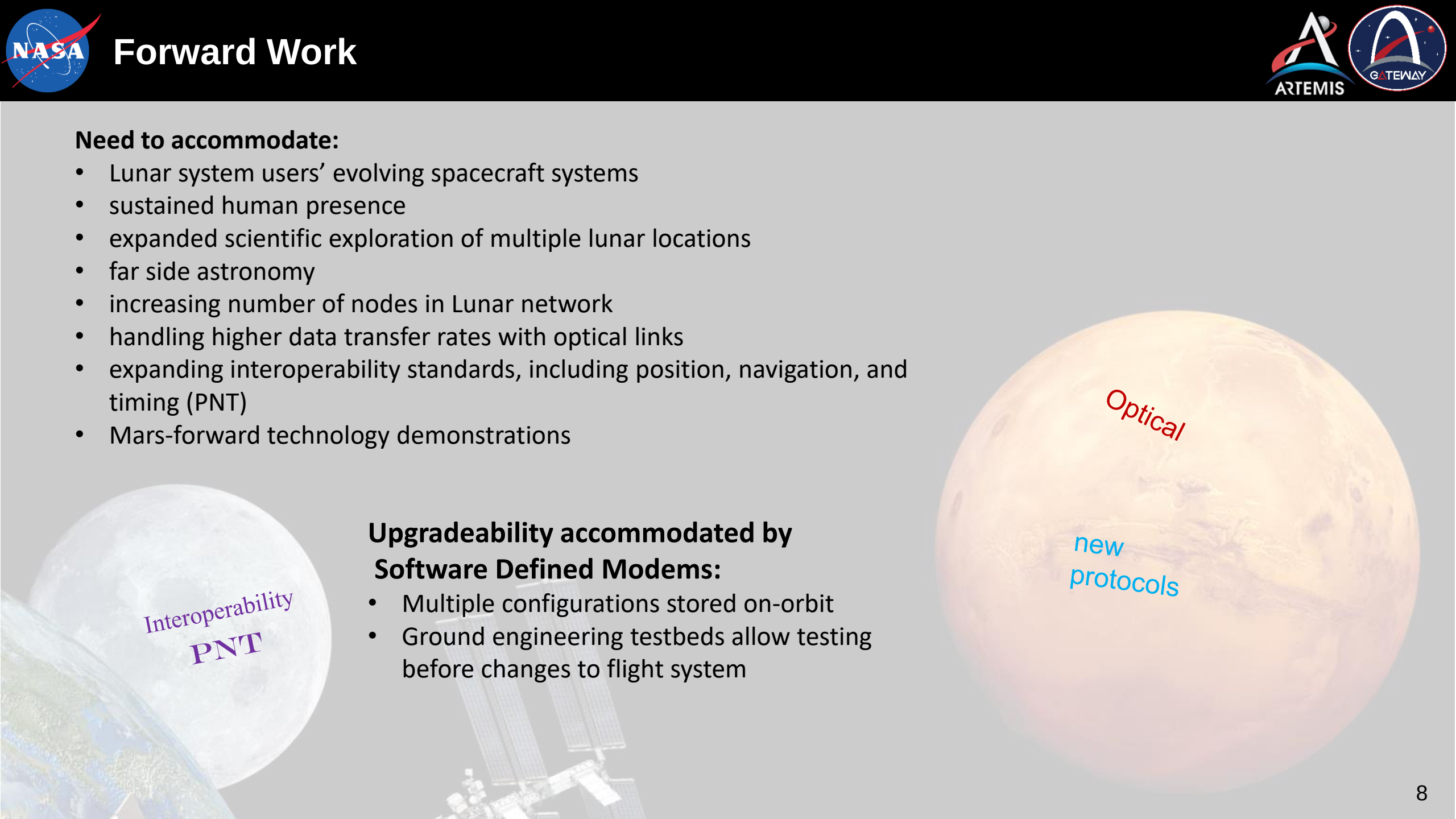
from ICSIS, Rev. A, September 2020

Need to accommodate:

- Lunar system users' evolving spacecraft systems
- sustained human presence
- expanded scientific exploration of multiple lunar locations
- far side astronomy
- increasing number of nodes in Lunar network
- handling higher data transfer rates with optical links
- expanding interoperability standards, including position, navigation, and timing (PNT)
- Mars-forward technology demonstrations

Upgradeability accommodated by Software Defined Modems:

- Multiple configurations stored on-orbit
- Ground engineering testbeds allow testing before changes to flight system



Interoperability
PNT

Optical
new
protocols



Conclusions



- The Gateway communication system:
 - embedded flexibility and adaptability to enable lunar exploration for the next 15+ years.
 - Multiple frequencies, data rates, and code rates enable communication with systems with a range of capabilities from small science systems to large crewed spacecraft.
 - Additional capability enabled with upgrades
- Interoperability is a key enabler for exploration missions
 - Coordination across all NASA and international partner missions is critical.
 - Interoperability standards must evolve as needed with support from all missions involved in Moon and Mars exploration.

