



National Aeronautics and Space Administration



NASA's Efforts to Pursue Commercial Communication Services for Missions in Near Space

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Ka and Broadband
Communications Conference
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Commercial Engagement: **Foundation for Success**



Artemis 1 One-way partner tracking data was combined with DSN two-way events and assessed against JSC telemetry

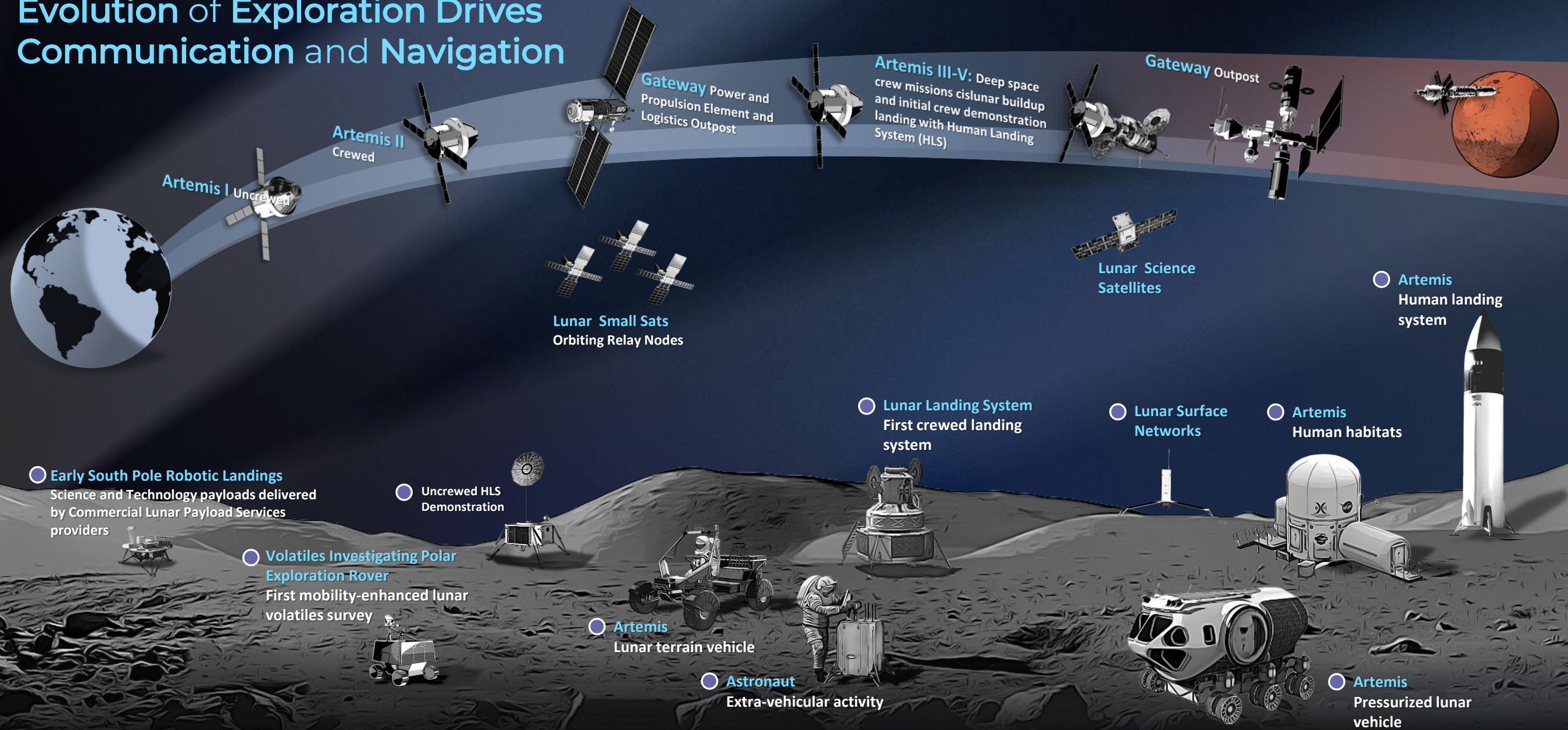
CIS's Near Earth Approach

- SCaN formed the Commercial Innovation and Synergies (CIS) Office to foster industry dialogue
- CIS engages with vendors to shape RFPs, track capabilities and promote space service market
- Outreach via RFIs, one-on-one "Uplink Sessions", open "OneLink Sessions" and "CIS Launch Pad" briefings

Industry Engagement for the Moon

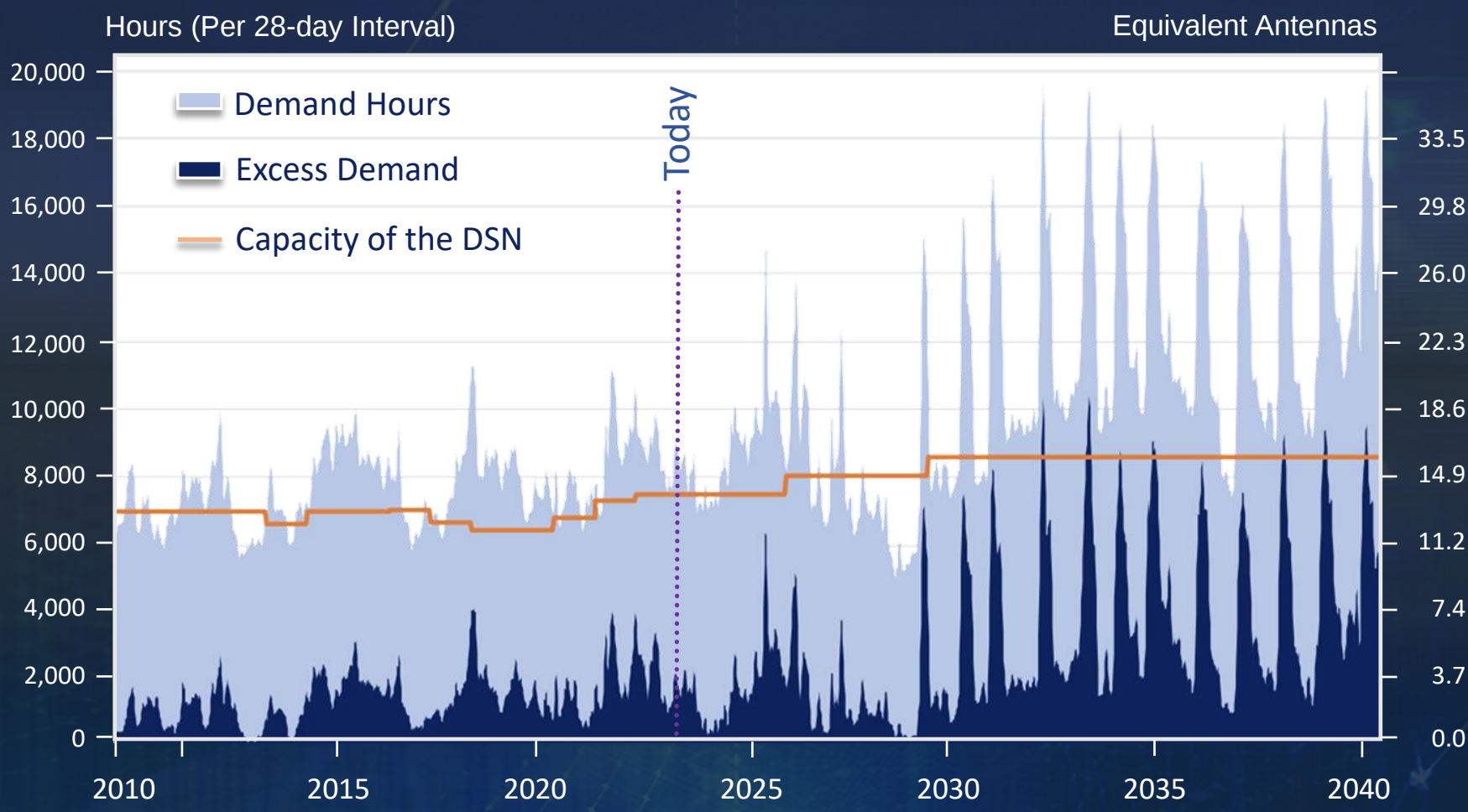
- Artemis I Doppler Tracking RFI received 20 responses—10 participated just months later
- LunaNet Interoperability Specification and draft service requirements for Lunar relay capability have been released for public comment
- SCaN efforts are consistent with the Agency's wider industry engagement on Moon-to-Mars Objectives

Evolution of Exploration Drives Communication and Navigation



Deep Space Network Alone **Cannot Meet Lunar User Needs**

Supply and Demand Challenge



- Growth in deep space and future Mars missions is an already significant demand on the Deep Space Network (DSN)
- NASA and International partners have planned lunar missions that will create a new level of network demand
- Resolution will rely on combination of international partners and leveraging commercial industry

Circa ARTEMIS V

Crewed Missions and Lunar Exploration

 Commercial Services

In Space Assets

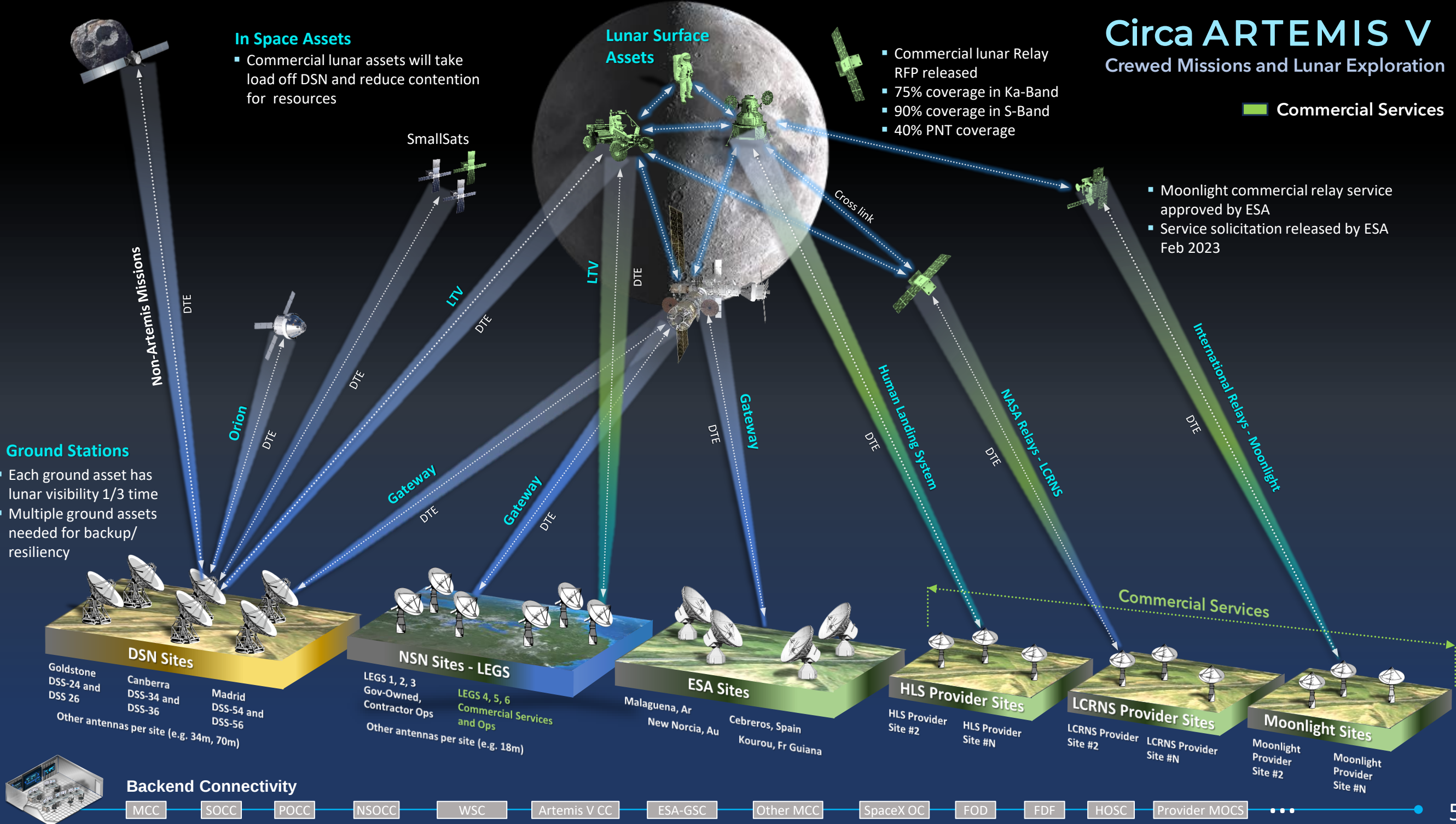
- Commercial lunar assets will take load off DSN and reduce contention for resources

Lunar Surface Assets

- Commercial lunar Relay RFP released
- 75% coverage in Ka-Band
- 90% coverage in S-Band
- 40% PNT coverage

Ground Stations

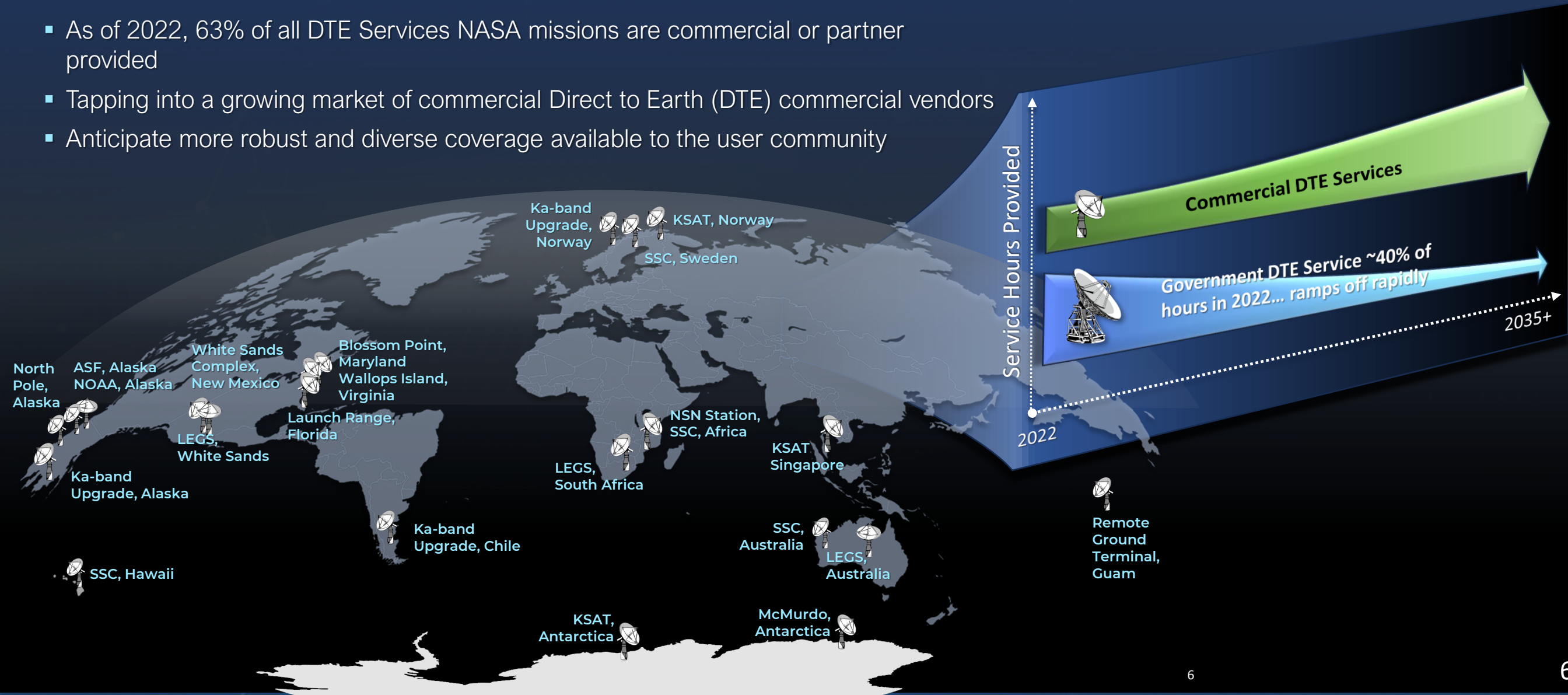
- Each ground asset has lunar visibility 1/3 time
- Multiple ground assets needed for backup/resiliency



Progress in Commercial Near Earth DTE

Request for Proposals (RFP) released in 2023 with goal to expand level of commercial services to near 100% in the near term

- As of 2022, 63% of all DTE Services NASA missions are commercial or partner provided
- Tapping into a growing market of commercial Direct to Earth (DTE) commercial vendors
- Anticipate more robust and diverse coverage available to the user community



Near Earth Lessons: **Commercial Lunar DTE Procurement**

Lessons from near Earth DTE

- In the late 90's NASA seeded the market for eventual Near Space Network services by partnering on antennas

LEGS for Lunar DTE

- Cislunar DTE is at an initial stage of growth, mirroring the 1990's era near Earth service market
- LEGS 1 to 3 will replicate the successful partner approach used for first near-Earth DTE services
- LEGS 4+ will be commercially provisioned – proposals currently being evaluated

Lunar Exploration Ground Segment (LEGS) sites will provide DTE capacity to support Artemis



- Representative/potential commercial locations that may be proposed in response to the NSN procurement to add LEGS 4+ capability with S, X, Ka band services
- Locations of government-led (contractor operated) locations for LEGS 1, 2, and 3

Progress in Near Earth Commercial Relay

Pioneering the Future of NASA's Near-Earth Space Communications

- Commercial GRO **L-band** relay network
- Low-rate SATCOM services
- Support to routine missions, contingency operations, launch, ascent, and early operations



- **Optical** LEO network
- High and low-rate services
- Supporting routine, contingency, and early operations



- GEO network with **C-band and Ka-band**
- High and low-rate services
- Supporting routine, contingency, launch and ascent, and early operations



- **Optical** LEO network
- High and low-rate services
- Routine, contingency, launch and ascent, and early operations support



- RF relay networks offering **C-band and Ka-band** services for high and low-rate communications
- Support to routine missions



- GEO **Ka-band** relay network
- High and low-rate communications services
- Routine launch and mission support



NASA announced on April 20, 2022, the Communications Services Project (CSP) awards

Totaling **\$278.5 million**,

to test how commercial satellites in both low Earth orbit and geostationary orbit could support NASA missions.

FSAA is funding vendor demos, seeding a market for commercial SATCOM that will supplant use of the Tracking and Data Relay Satellite System (TDRSS) for future NASA missions.

Six providers are matching / exceeding the awards with their own funds. Estimated total investment of

\$1.5 billion over five years

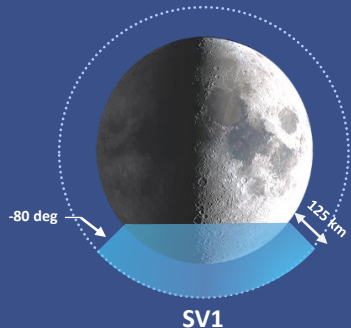
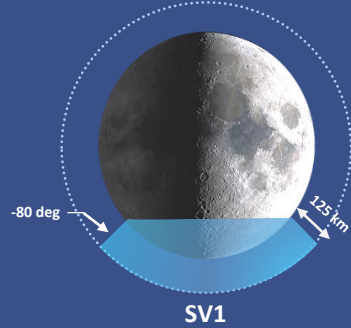
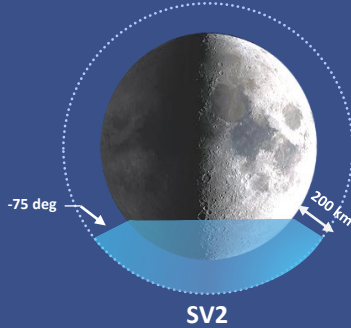
Near Earth Lessons: Commercial Lunar Relay

Lessons from near Earth DTE

- Following vendor demos, an additional required validation step may delay procurement of services by NASA missions
- As one of many buyers, NASA time to operationalize should have minimal commercial business impact

Approaches to Lunar Relay

- NASA needs lunar relay services to provide coverage to crewed and robotic south pole landings
- RFP for lunar relay services incorporates a phased approach-provide rapid access to real, in situ, users as part of validation task orders
- Vendors need confidence to invest in lunar relay with NASA as *initial* anchor tenant; procurement offers minimum service guarantee
- NASA focusing on service requirements; vendor responsible for *how* services are provided

Validation Task Order Increment	Increment Alpha	Increment Bravo	Increment Charlie
Service Volume	 SV1	 SV1	 SV2
Capabilities	• Communication support • 75% nominal service availability / critical service availability NA • % Coverage of Earth Day – 70% (all bands) • RF and waveform compatibility with LunaNet Interoperability Specification • Single augmented forward signal (AFS) (position, navigation and timing (PNT))	• Enhanced communication support • 85% nominal service availability / 85% critical • % Coverage – 75% Ka-band, 90% S-band, 70% AFS (2 links) • RF and waveform compatibility with LunaNet Interoperability Specification • Multiple augmented forward signal (PNT)	• 95% nominal service availability / 98% critical • % Coverage - 75% Ka-band, 90% S-band, 40% AFS (4 links, max spatial GDOP<6) • Full set Lunar Communications Relay and Navigation Services (LCRNS) Services Requirements Document (SRD) and Initial Operating Capability (IOC) requirements

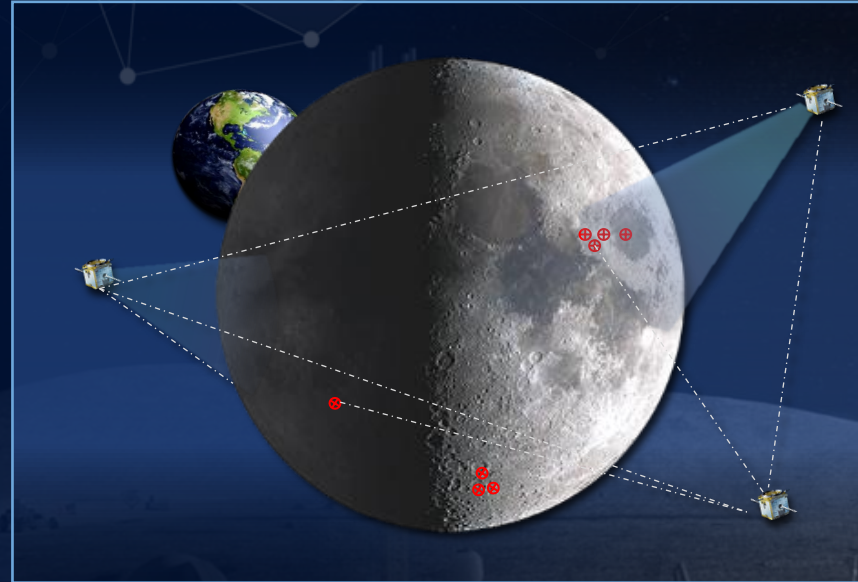
Interoperability: Lunar's "Green Field" Advantage

Lessons from Near Earth

- NASA seeks interoperability to reduce risk of vendor lock-in and access robust services
- No commercially-led standards consortium focused on space communications
- Agency is pursuing multilingual, wideband, user terminals as a near term solution
- Engaged in 3GPP to advocate for longer-term standards-based solution

LunaNet: Interoperability from the start

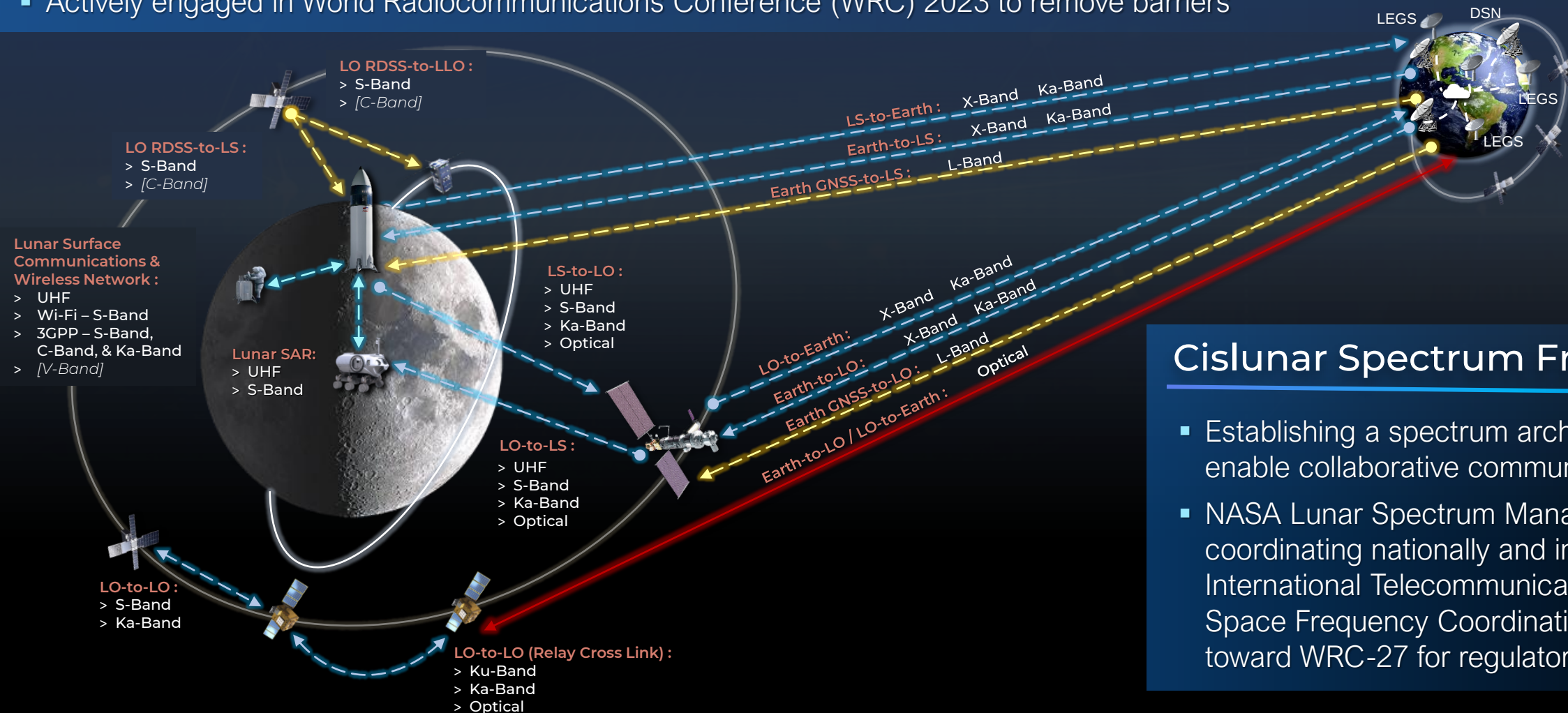
- Cislunar space offers NASA a "green field" opportunity to require vendors to use the "LunaNet Interoperability Specification" (LNIS)
- Vision is for government stakeholders to reduce their role and lunar interoperability to be led by commercial providers



Near Earth Lessons: Spectrum Framework for Cislunar Space

Lessons from near Earth

- NASA mission spectrum use has historically been S- and X-band
- Complication of mix of commercial and government services in near-Earth has presented regulatory challenges – burden needs to be reduced to lower barrier to entry for service providers
- Actively engaged in World Radiocommunications Conference (WRC) 2023 to remove barriers



Cislunar Spectrum Framework

- Establishing a spectrum architecture up-front to enable collaborative communications
- NASA Lunar Spectrum Manager engaged and coordinating nationally and internationally with International Telecommunications Union, and Space Frequency Coordination Group; working toward WRC-27 for regulatory approvals

Conclusion

- Lessons from near Earth DTE, SATCOM and interoperability are facilitating the effective use of commercial partners to meet cislunar communication needs.
- Two-way dialogues with industry are critical to convey NASA user needs, but we must avoid creating an Agency-dependent market that stifles disruptive innovation.
- Commercial services are already here. SCan's efforts can serve as a model as NASA continues developing best practices for collaborations with industry.

SCaN

Space Communications and Navigation

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Space Administration



Exploration, Enabled.

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