



Panel

Communications beyond the Thinking

(spatial, terrestrial, speed, 5G/6G, streaming, high data processing, protocols, etc.)

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Extending Cost Model of Earth satellite broadband services to future commercial lunar relay service?

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Biography

Tim Pham is the Chief System Engineer of the NASA Deep Space Network. His interest is in system engineering and system development. Besides DSN system engineering work, he also supports the CCSDS activities in Cross Support Transfer Services and the ground system development at the Morehead State University.

Tim has published several papers on antenna arraying, spacecraft tracking, system modeling and performance analysis. He co-authored the book “Antenna Arraying Techniques in the Deep Space Network”. He is recipient of the NASA Exceptional Service Medal, NASA Exceptional Achievement Medal, several NASA New Technology and Space Act Awards, and the IARIA Fellow.

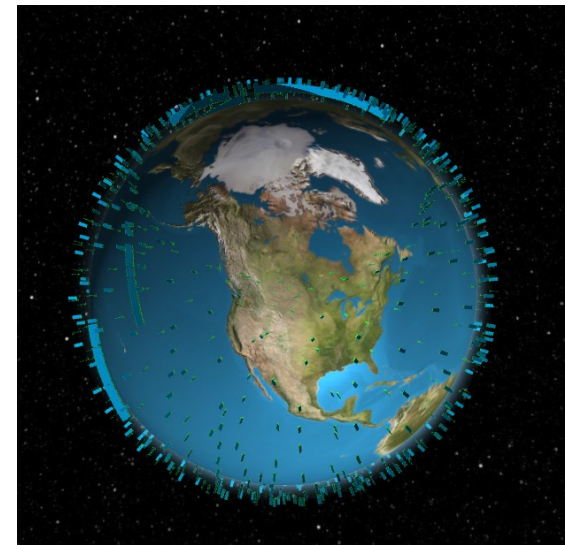
Panelist Position

Extending cost model of Earth satellite broadband services to future commercial lunar relay service?

- Commercial viability of Earth satellite broadband services
- Would such viability be extended to lunar communication services?

Earth Satellite Broadband Services

- Characteristics of low Earth orbit satellite broadband system
 - Low Earth orbit
 - Low latency and higher bandwidth compared to geosatellites
 - Large number of satellites (tens of 1000s) required for sufficient coverage
- Business model
 - Cost reduction (e.g. SpaceX) via ^[1]
 - vertical integration with launch provider
 - reusable low cost rockets
 - rideshare program offered to other payload customers
 - High revenue expected from large potential customer base
 - ~160M Americans lack of broadband access ^[2]



<https://platform.leolabs.space/visualization>

[1] <https://spacenews.com/op-ed-can-spacex-profit-on-certain-starlink-launches/>

[2] <https://blogs.microsoft.com/on-the-issues/2019/04/08/its-time-for-a-new-approach-for-mapping-broadband-data-to-better-serve-americans/>

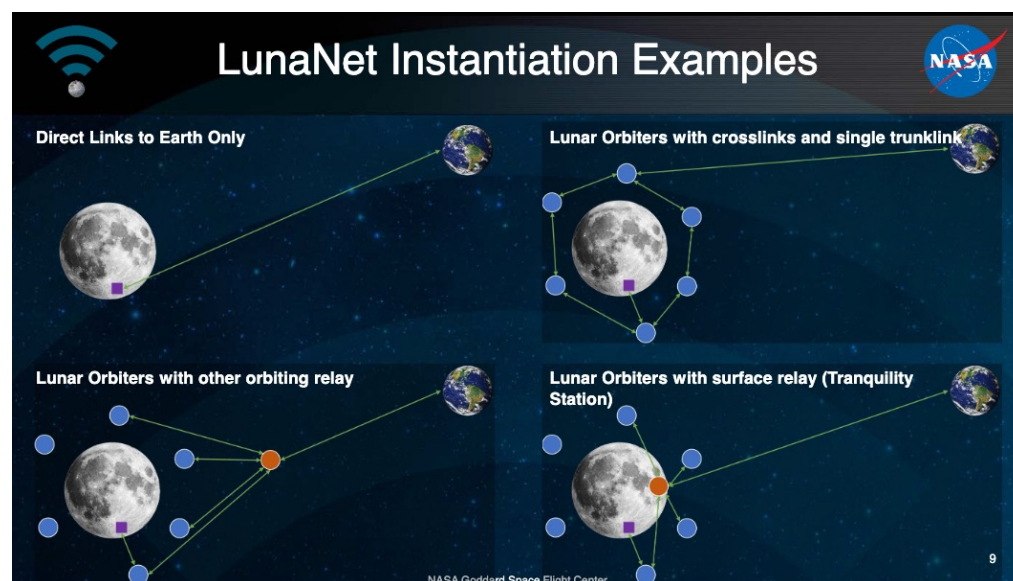
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Considerations on Future Lunar Network

- Sustaining presence on the moon requires an internet-like communications among lunar “residents” and with Earth
 - Commercial, government, international partners
 - Orbiters, rovers, astronauts, habitats
- Three key services
 - Networking
 - Position, navigation and timing
 - Science utilization

- Commercial viability requires
 - Low cost in launch and operation
 - Large customer base or good business base
- Will the future hold true?



Israel, David J., *LunaNet: A Flexible and Extensible Lunar Exploration Communication and Navigation Infrastructure*, <https://ntrs.nasa.gov/citations/20200001648>