



Space Communications and Navigation

Planning Activities for NASAs Future SATCOM Direction

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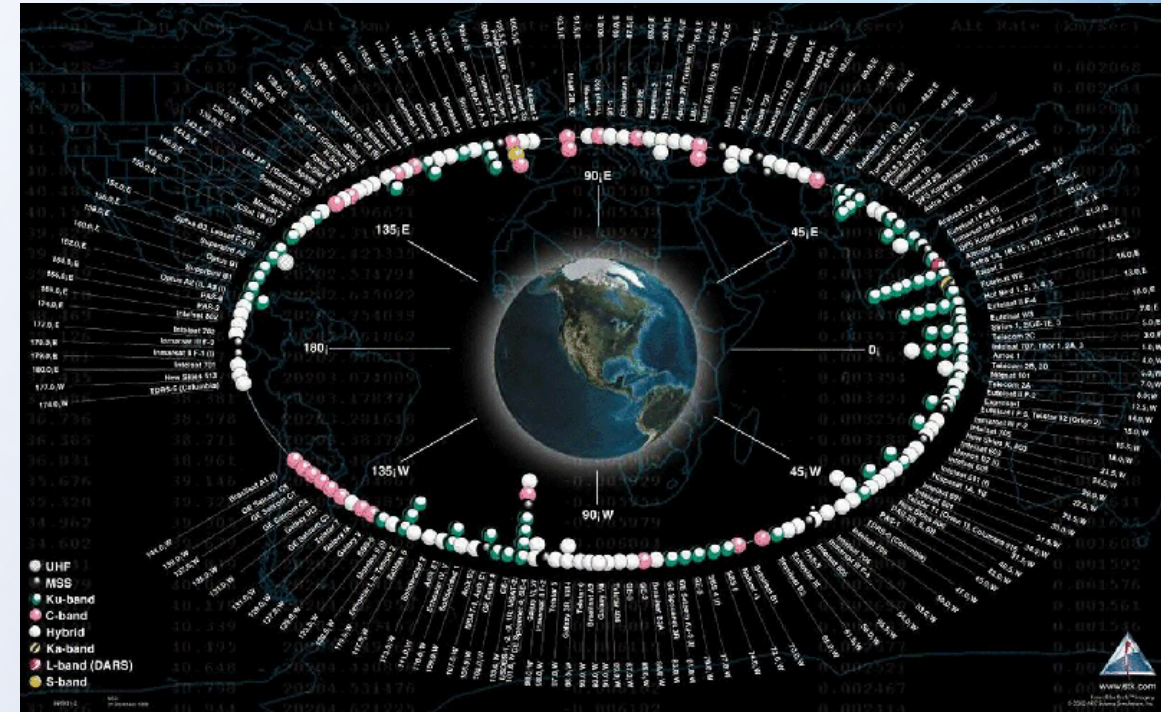
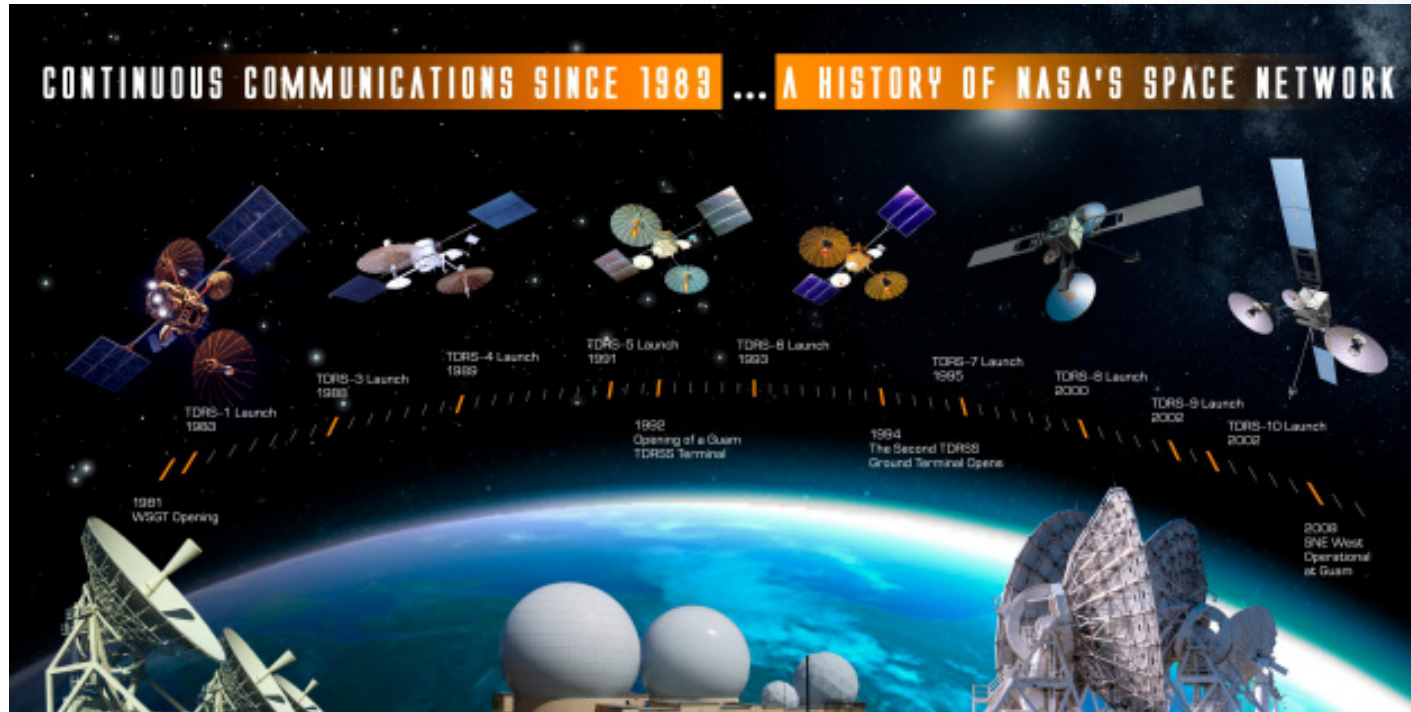
NASA GRC

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Current NASA Network Architecture



Transition Planning for End of TDRS Era...



- TDRS initiated to support launch and manned spaceflight activities in the 1980s and has provided 24/7 coverage of near earth missions to present day.
- As NASA moves human presence out of low earth orbit (i.e., ISS) and transitions to lunar space, and commercial services in near earth continue to proliferate, argument for continued TDRS support reduces.
- NASA presently desires a path to leverage commercial satellite communications services in low earth orbit to augment and potentially replace TDRS services.

Transition Planning for End of TDRS Era...

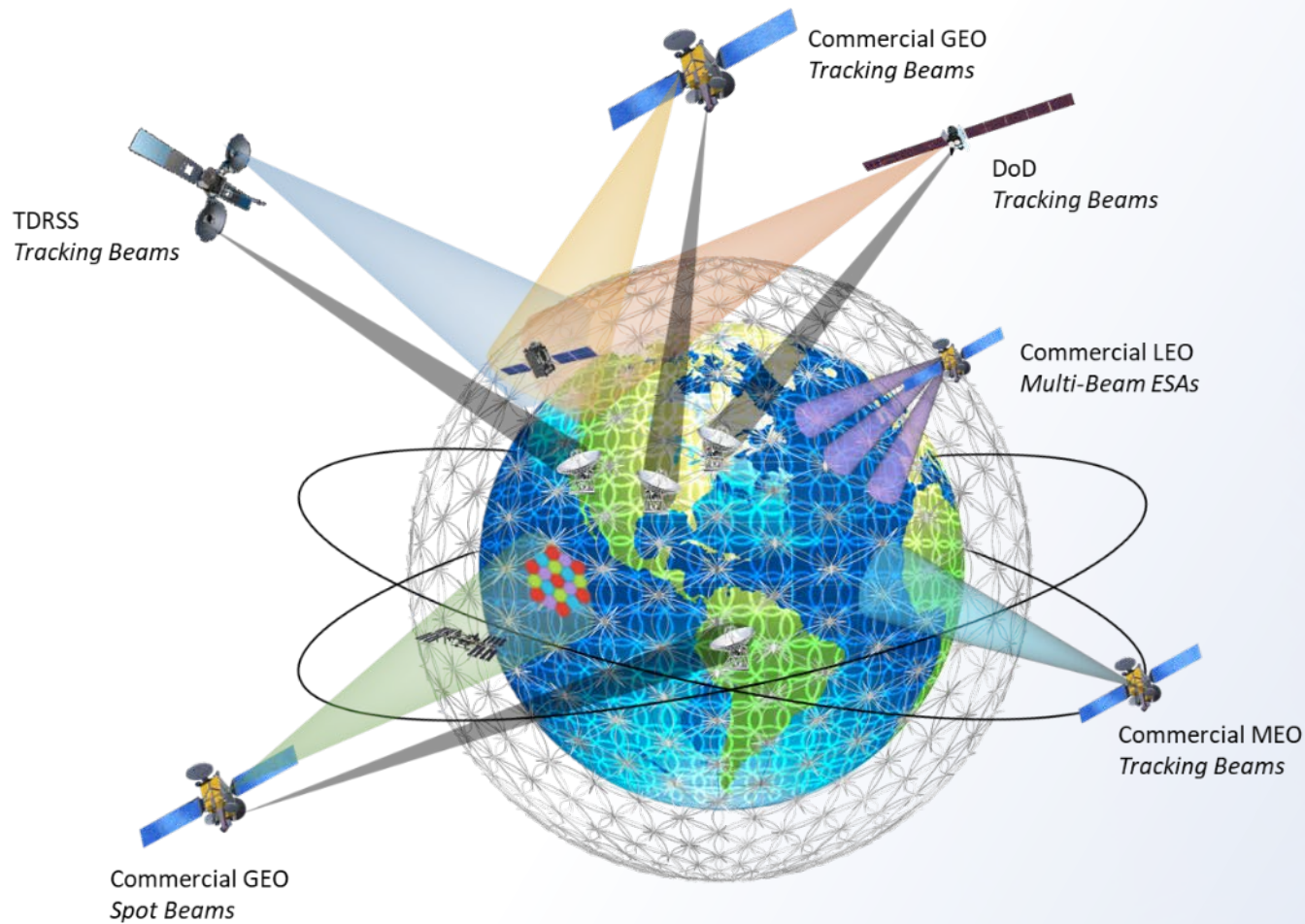
TDRS services will remain viable through ~2040

Commercial services for global SATCOM coverage exist to small degree today, but limited. Future commercial services in Ka-band and optical are being established in this decade.

Questions:

- **How do we convince risk-averse NASA missions to start transitioning for eventual lack of TDRS services?**
 - *Forced Approach vs Transition Approach*
- **How do we work with commercial SATCOM service providers to meet NASA needs?**
- **How do we develop a path toward interoperability among commercial SATCOM service providers?**
 - *Standards? Technology Development?*

Landscape of Future SATCOM Architectures



Challenges:

- Wide frequency range of operations
- Huge trade space of architectures to work with, with varying capabilities
- Mix of open standard and provider-specific proprietary waveforms
- Mix of multiple access techniques
- Unique networking protocols across individual CSPs
- Technology development/maturation of multiple subsystems required
- “One of many” approach dictates need to accommodate CSPs, not force them to accommodate us

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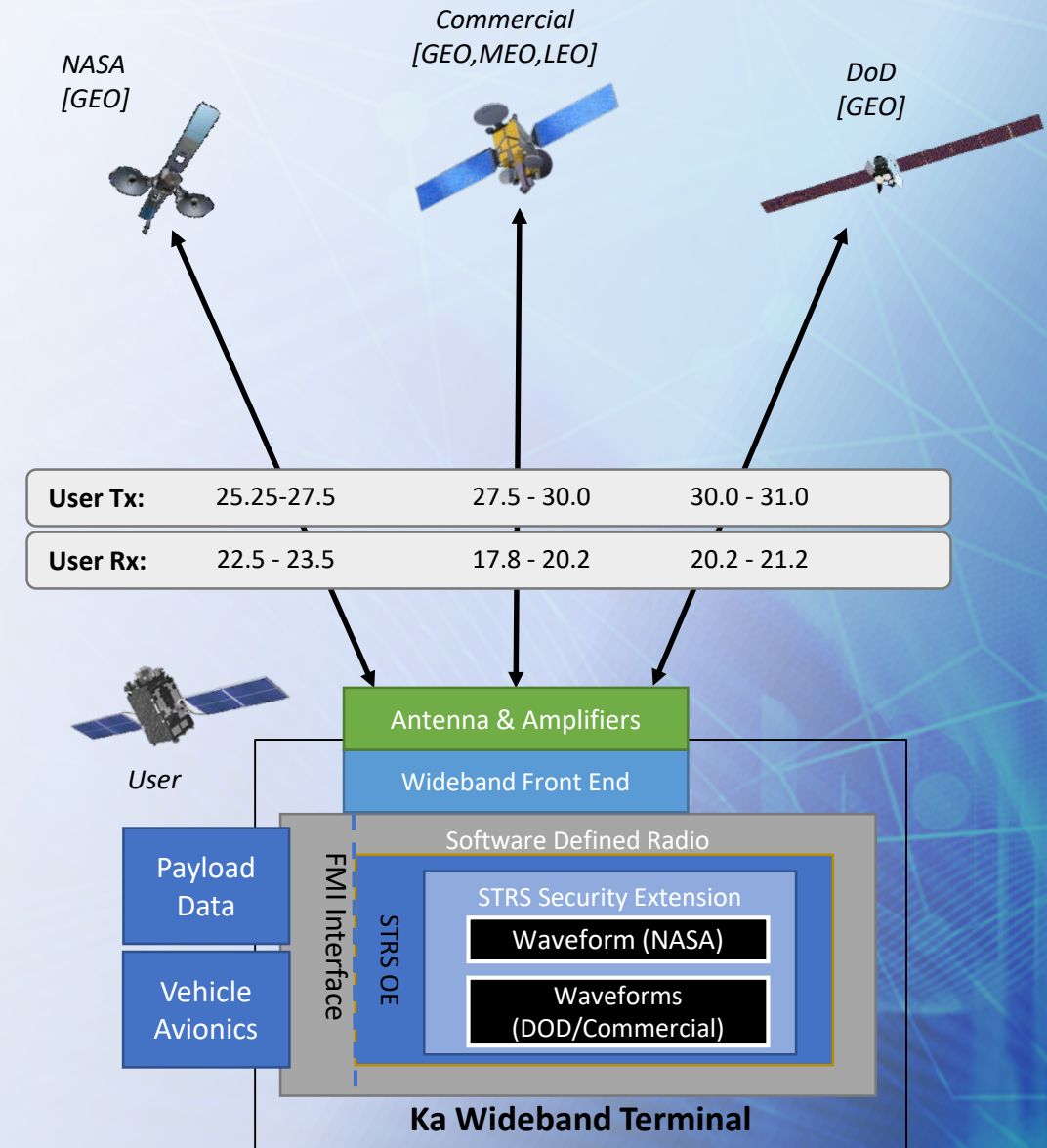
iridium

Wideband Terminal Development

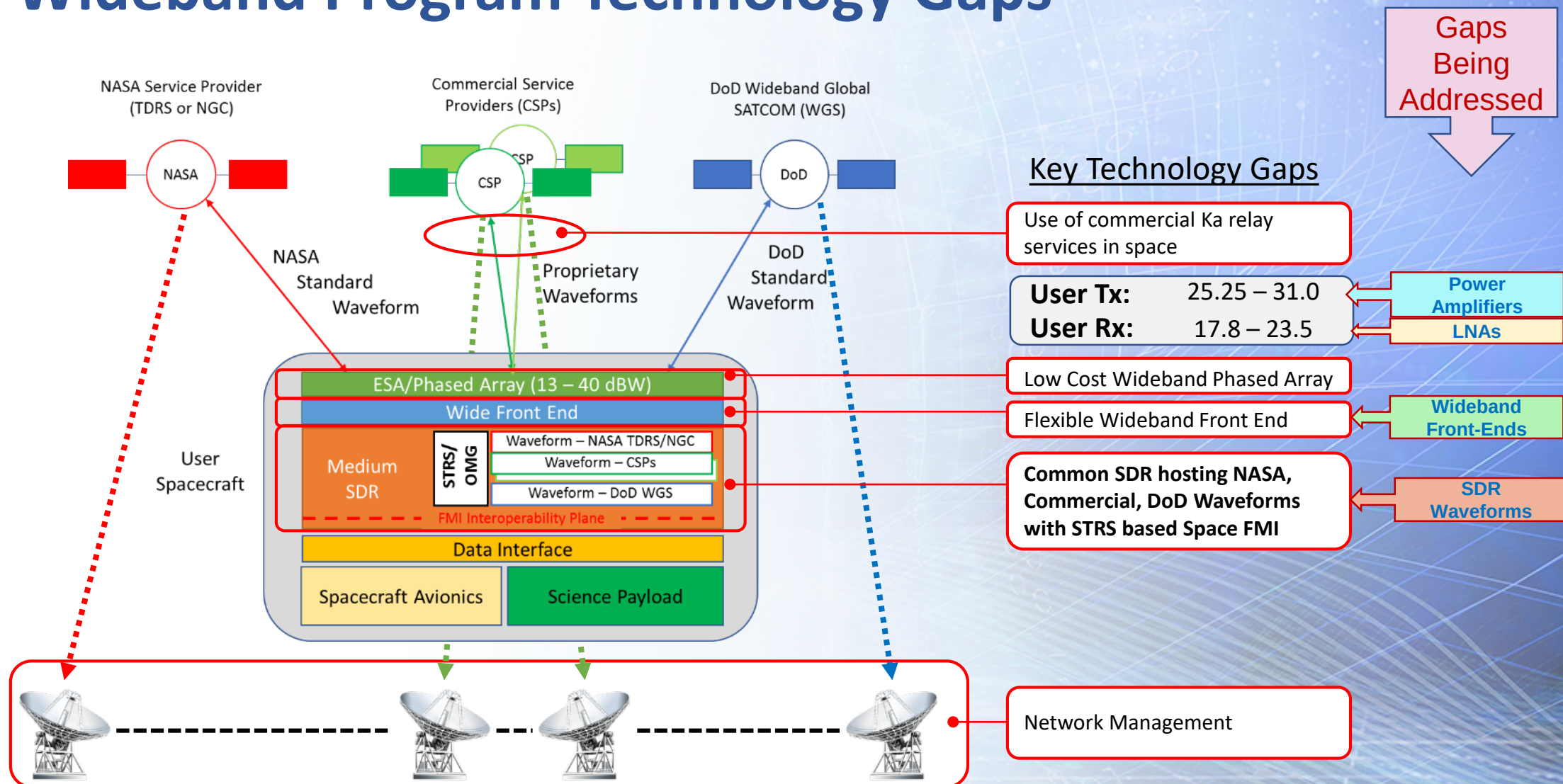
Primary Objective: Support transition of NASA missions to use of commercial space relay services

Approach:

- Develop a prototype user terminal to support low latency space relay links across NASA/Commercial/DoD assets
- Focus on integration of commercially available product lines, or, where products do not exist, development of technology gap areas toward realization of a flight product
- Conduct combination of early ground-based and space-based experiments to demonstrate proof-of-concept wideband terminal operations
- Establish path toward standardization and porting of multiple commercial waveforms to a common SDR



Wideband Program Technology Gaps



Long Term Objective/Capability: Develop a *flexible* space user terminal which can support *roaming capability* across NASA, Commercial, and DoD relay services at Ka-band.

Based on J. Schier: "SATCOM Architecture Interoperability Options"

Proposed Demonstration Plans

Staged approach to ground demonstrations

Phase 1: TDRSS Demonstrations (FY20)

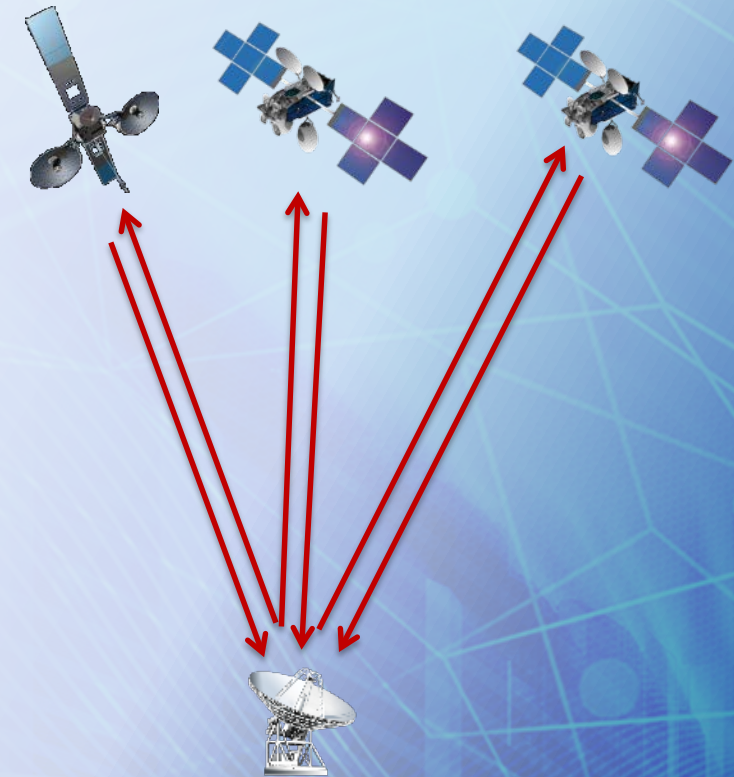
- Operate link on TDRSS Standard Service
- Operate link on TDRSS IF Service using commercial DVB-S2 waveforms
- Demonstrate service “hand-offs” on TDRSS between Standard and IF Services to demonstrate FMI CONOPS and waveform switching

Phase 2: Commercial/DoD Demonstrations (FY21)

- Demonstrate frequency compatibility using commercial bent-pipe services
- Demonstrate hand-offs between TDRSS and DOD/commercial satellite services

Phase 3: Full Wideband Demonstration (TBD)

- Work toward integration and demonstration of proprietary commercial waveforms for full wideband demonstration and demonstrate hand-offs amongst multiple CSPs/TDRSS/DoD assets





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