



Exploration & **SPACE**
Communications

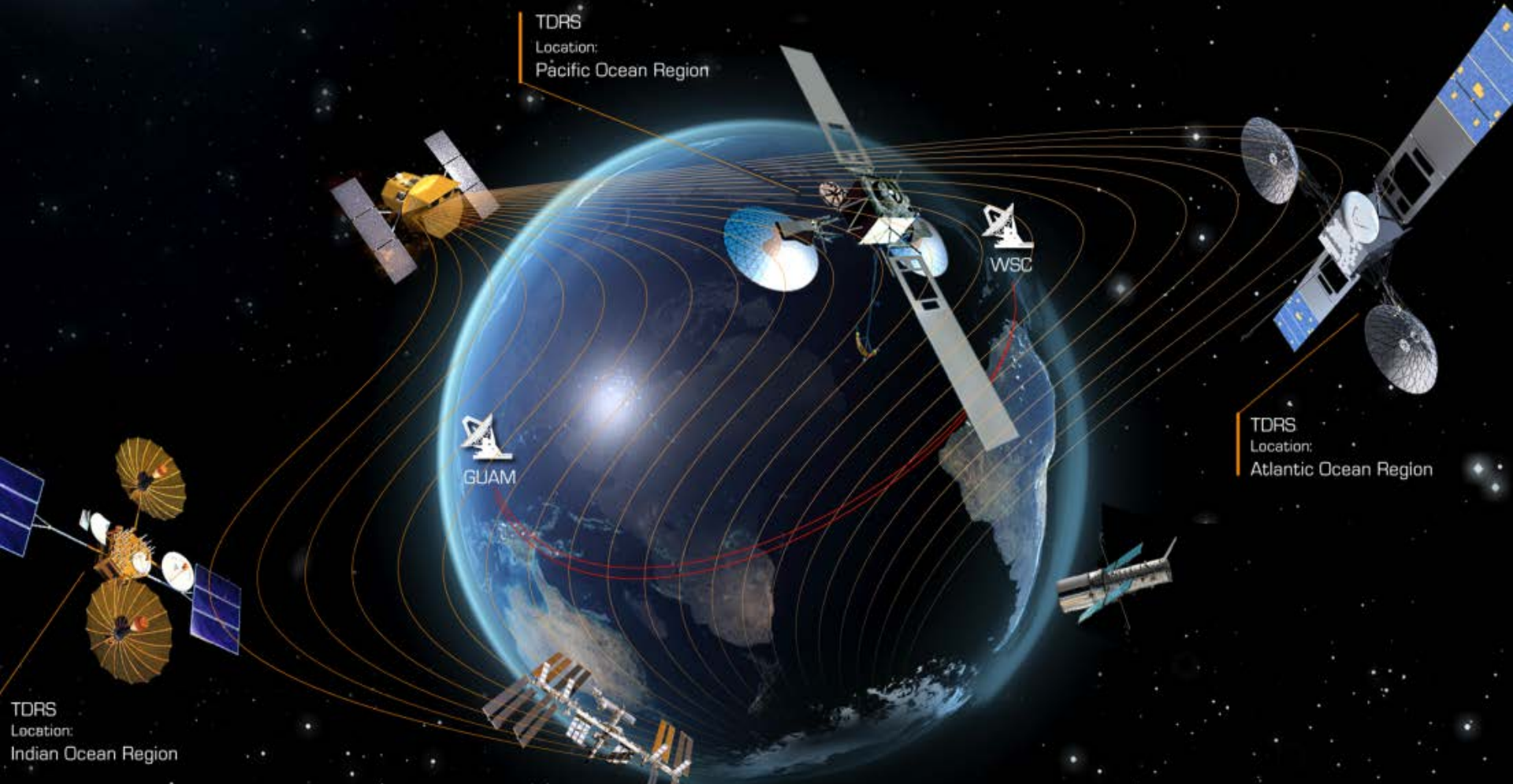
More than you ever imagined...

Next-Generation NASA Earth-Orbiting Relay Satellites: Fusing Microwave and Optical Communications

David J. Israel
March 5, 2018

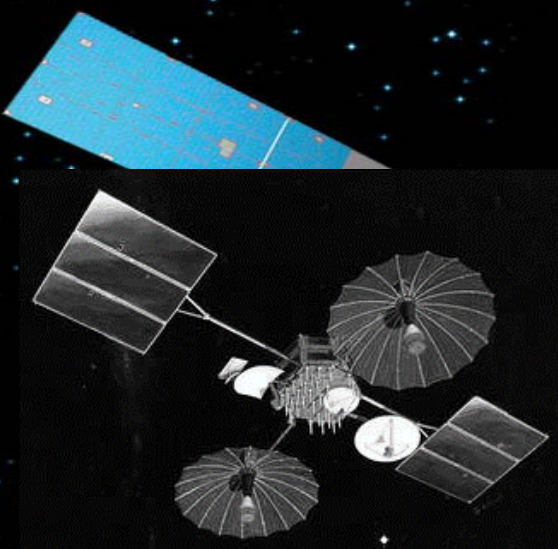


NASA Relay Satellite Communications



The Space Network provides tracking and data acquisition services to spacecraft below geosynchronous orbit, and can connect user spacecraft with 100% coverage of the user's orbit.

Generations of TDRS



First Generation
TDRS-A to TDRS-G



Second Generation
TDRS-H to TDRS-J

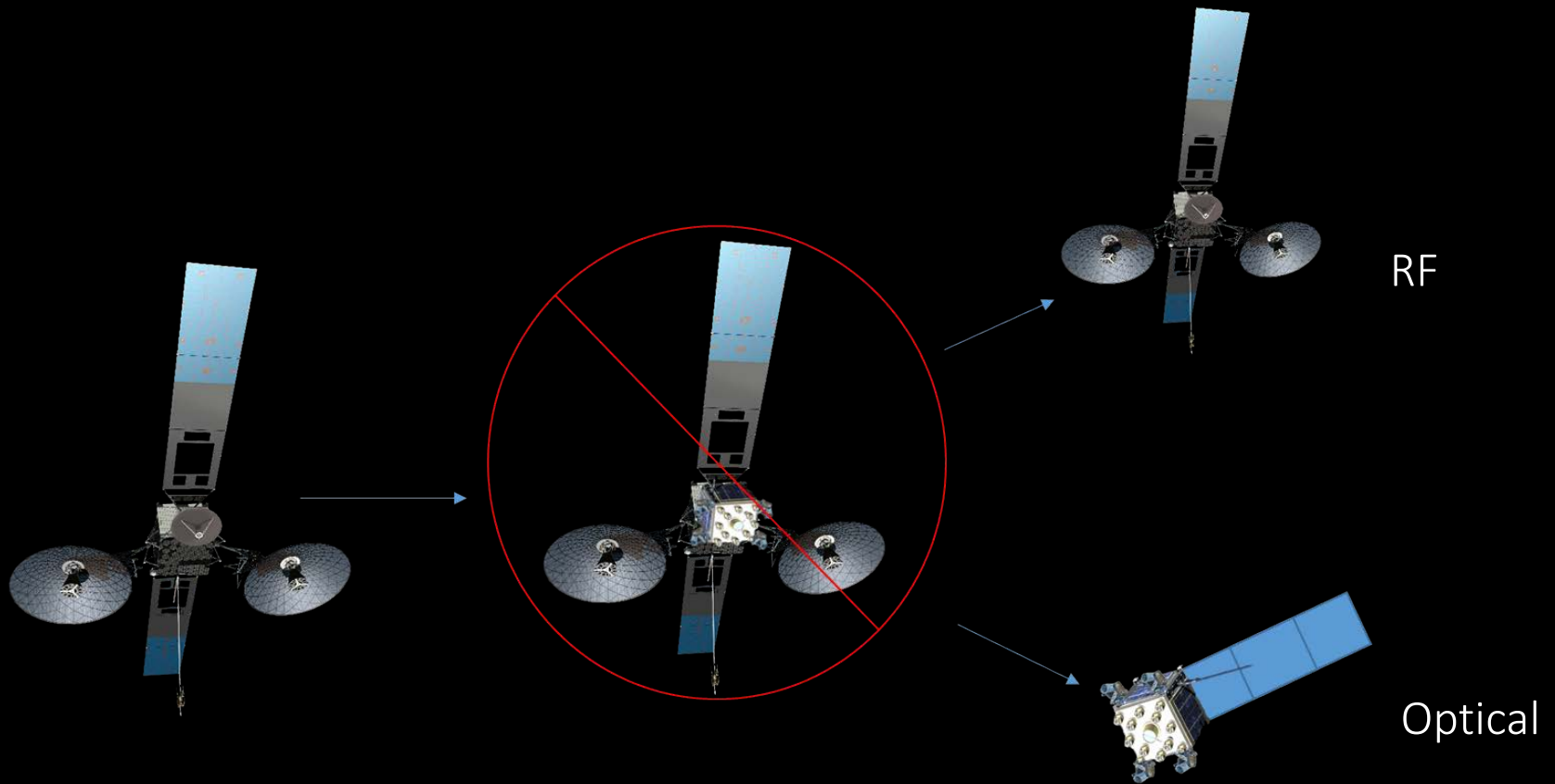


TDRS-M LAUNCH:
August 18, 2017

TDRS-13
ACCEPTANCE:
Third Generation
TDRS-K to TDRS-M
February 2018

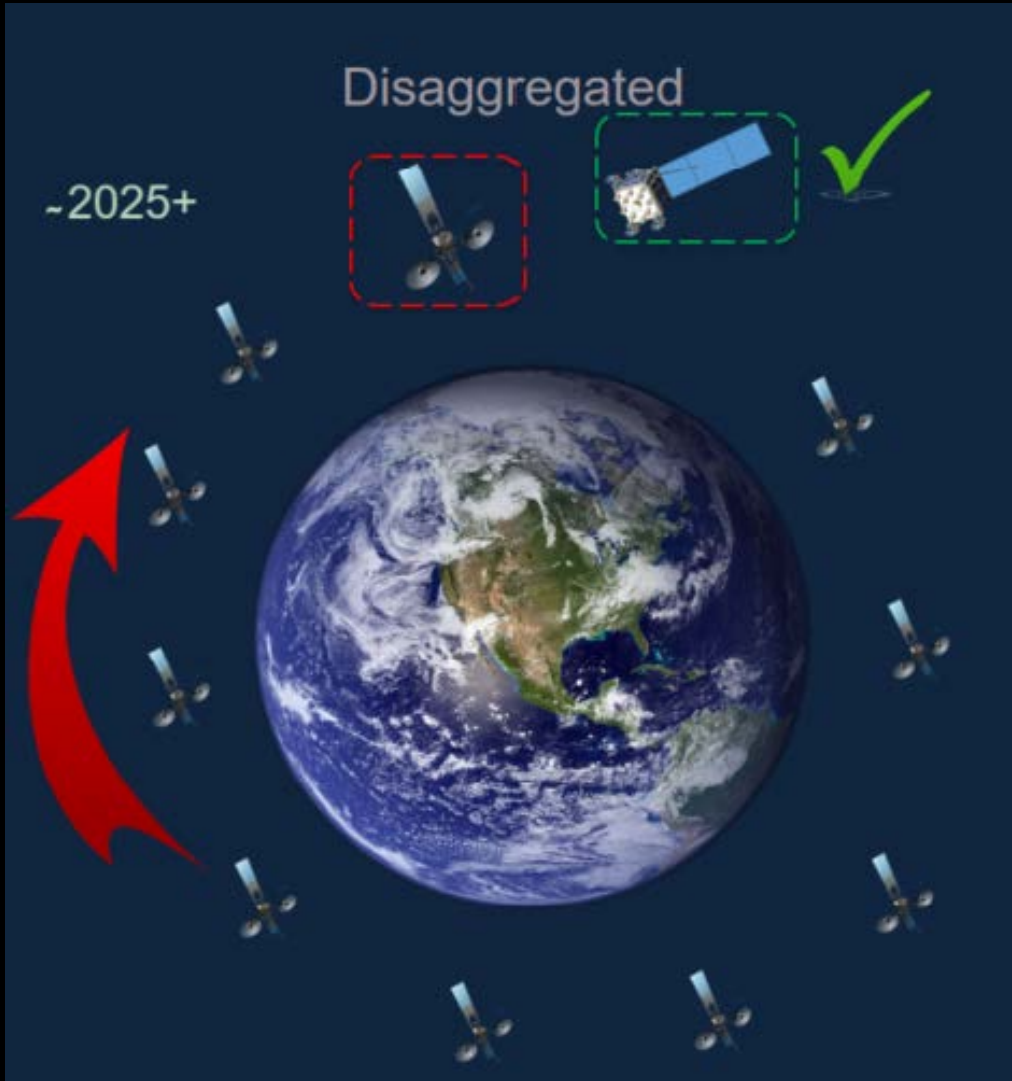
THIRD GENERATION

Disaggregated Communications



RF and optical communications are built and deployed on separate systems.

Disaggregation Benefits

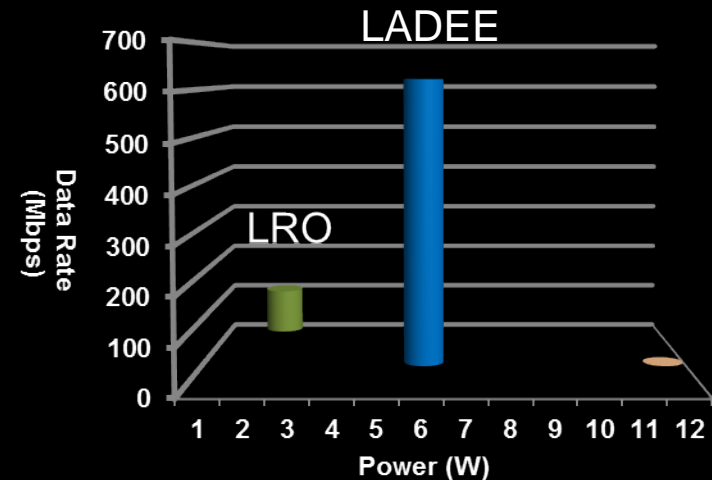


- Fleet management at individual service level
- Greater opportunity for commercialization of RF services

The Future of NASA Space Comm: Optical Communications

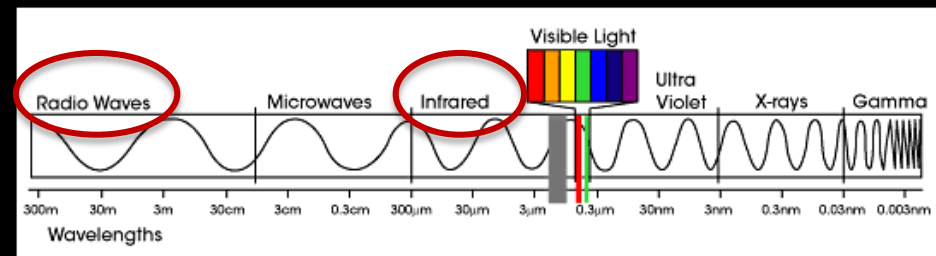


Optical communications systems are under development to enable support of **tremendous volumes of data at higher rates** with quicker response times.



Optical communications will enable:

- Speed and Volume
- Less SWaP
- Availability



Optical: State of the Technology



Lunar Laser
Communications
Demonstration
2013-2014



Laser Communications
Relay Demonstration
Launch: 2019



ILLUMA-T
Optical to Orion (EM-2)

“Proof of Concept”
COMPLETE

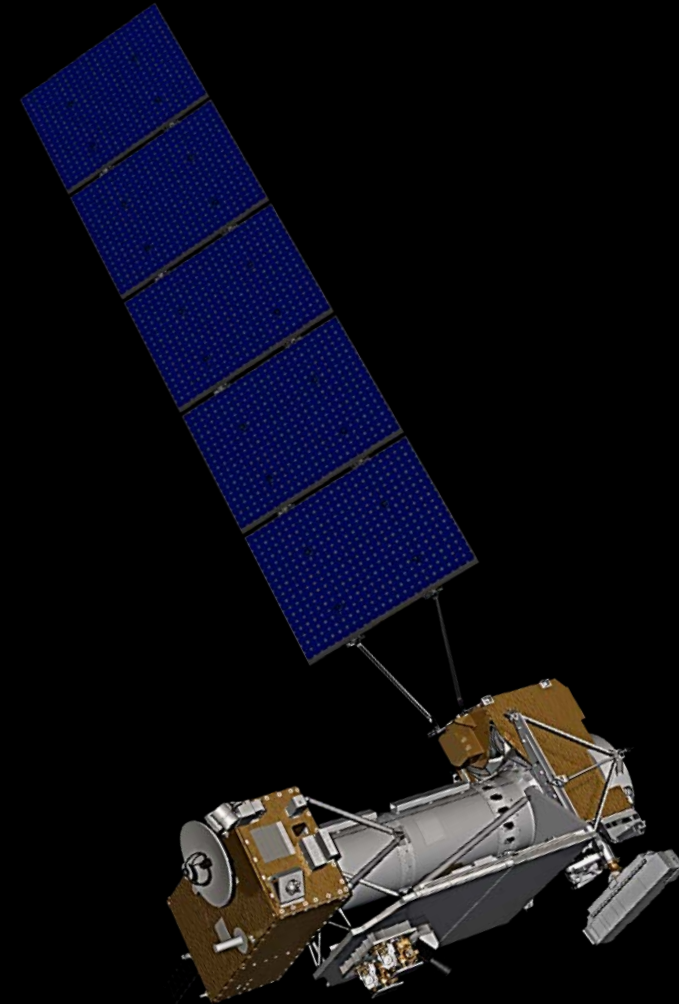
“Relay Operations
Demonstration”
UNDER DEVELOPMENT

“Mission Operations
Demonstration”
UNDER
DEVELOPMENT

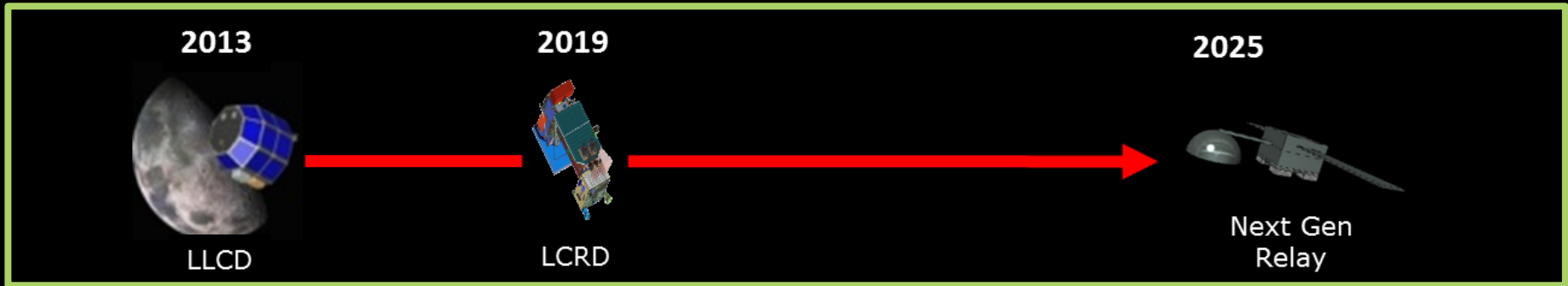
Key Features of LCRD



Subsystem	Description
Two optical modules	10.8-cm telescope, 2-axis gimbal
Laser	1550 nm at 0.5W
RF downlink	Spacecraft bus provided
Module-to-module switching	Gbps-class high-speed space switching unit
Data rates	Up to 1.244 Gbps forward and return links
Optical ground stations	Haleakala, HI Table Mountain, CA
Mission operations center	GSFC Space Network at WSC, NM

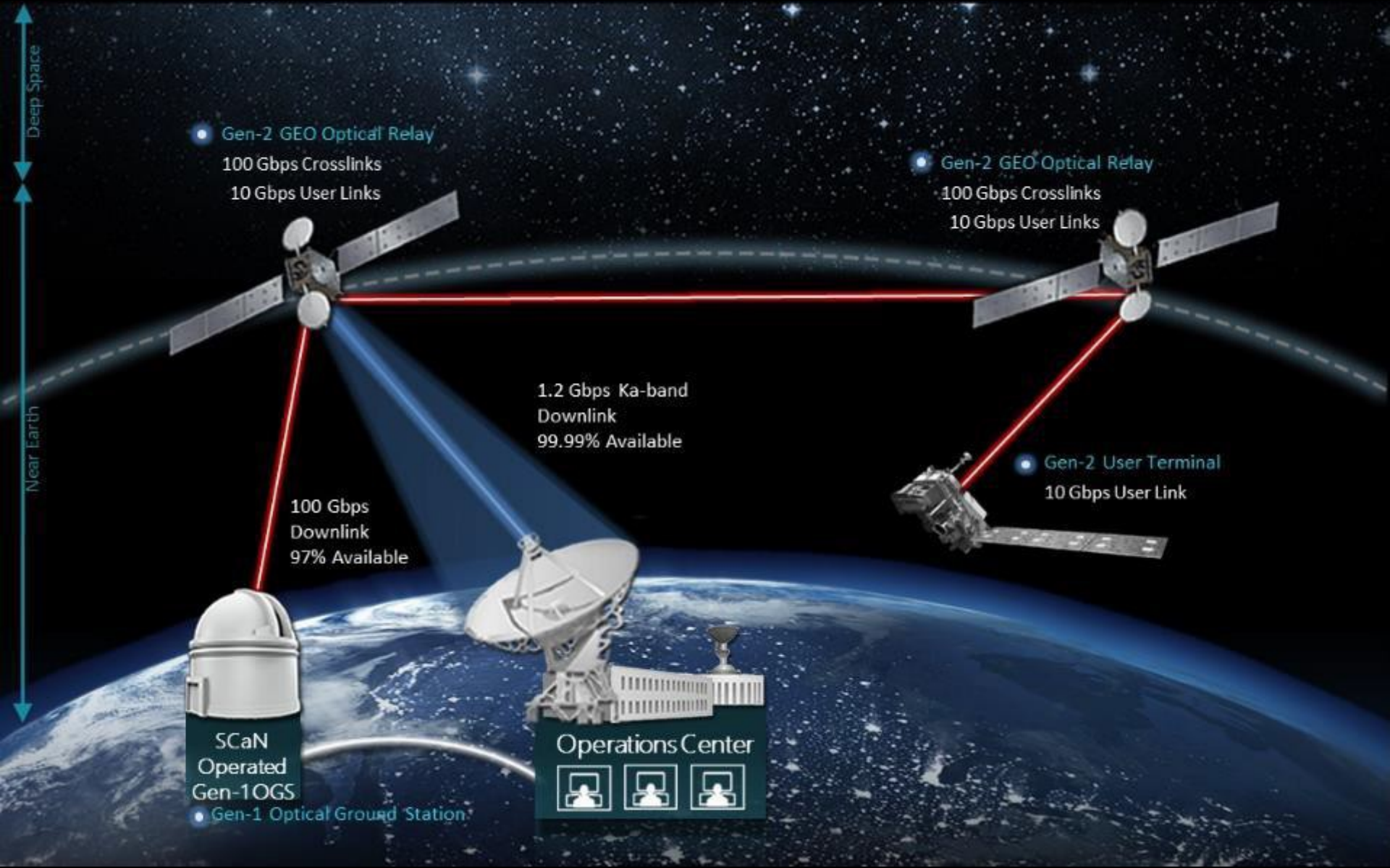


Path to Optical Relay Operations

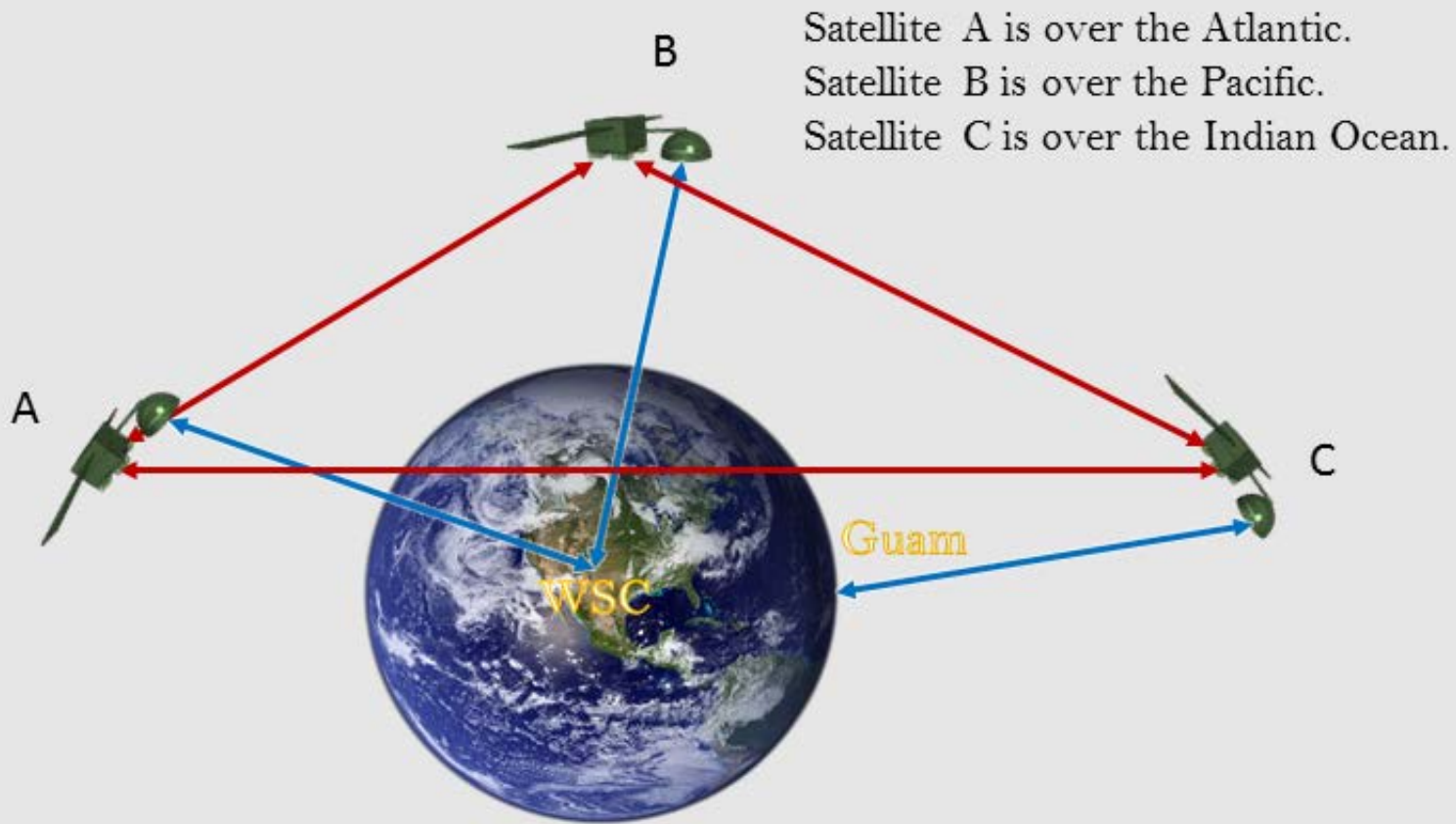


An optical relay capability is being targeted for a 2025 launch as the first node of the next-generation relay architecture. Early studies and technology developments are underway.

NASA's Next Generation Earth Relay



Next-Generation Earth Relay Concept of Operations





Spacecraft/Platform

Optical Communications Payload

Other Required Subsystems

Optical Space Terminal

Optical Module

Modem with
Beacon,
Amplifier and
CODEC

Controller
Electronics

Other Required Subsystems:

- Storage
- Data Processing
- Switch/Router
- Optical Comm Payload Controller

Conclusions



- The requirements for the first optical relay nodes continue to be refined.
- Relay nodes could be dedicated spacecraft or hosted payloads.
- Alternate acquisition strategies for the relay node are also under assessment.
 - Procure optical relay services, if commercially available
 - Form partnership with commercial entity