LCRD and Lasercom

Jade P. Wang

1951–2021
70 YEARS
LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

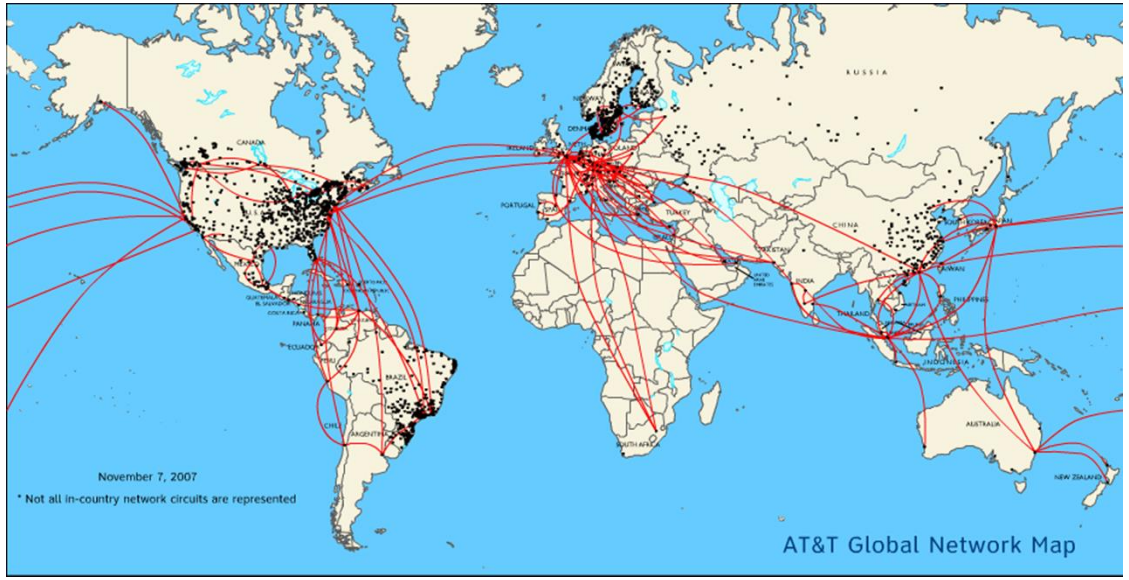
Asimov's 1964 Vision of Lunar Lasercom in 2014

"…Any number of simultaneous conversations between earth and moon can be handled by modulated laser beams, which are easy to manipulate in space. On earth, however, laser beams will have to be led through plastic pipes, to avoid material and atmospheric interference. Engineers will still be playing with that problem in 2014."

– Isaac Asimov
New York Times, 16 August 1964

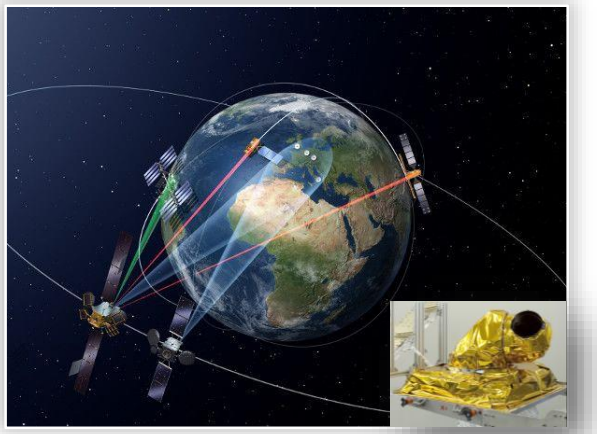
Fiber Optics & Space Optical Communications

2007



Optical Communications Today: Terrestrial and Near-Earth Proliferation

SpaceX Starlink



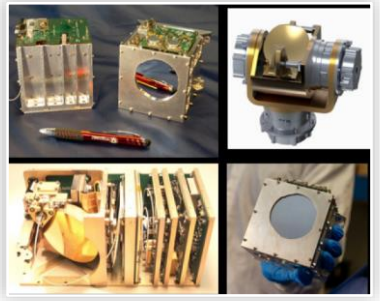
ESA EDRS

Amazon

DARPA Blackjack

Mynaric

SA Photonics



Fibertek

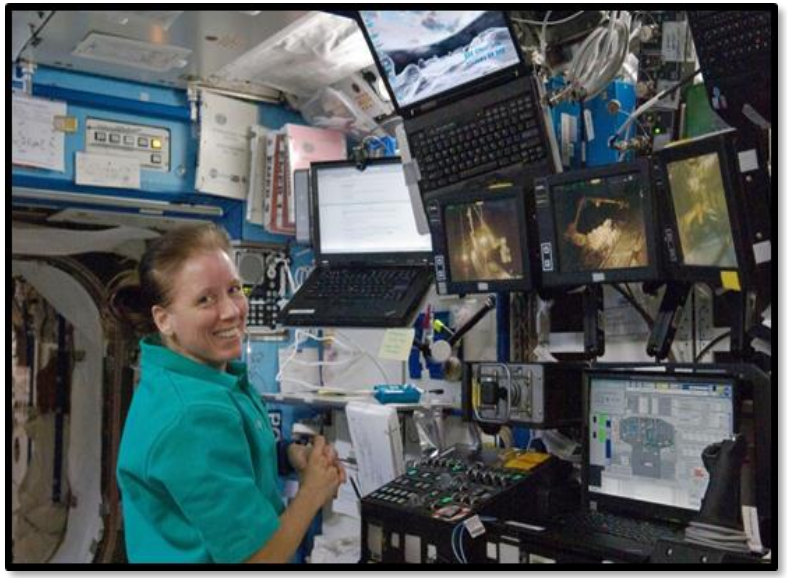
Many demonstrations planned over the next few years
Industry focused on delivering broadband to remote locations through proliferated LEO constellations

Space Exploration Comm Needs

Ultrasound scan on Canadian astronaut Chris Hadfield

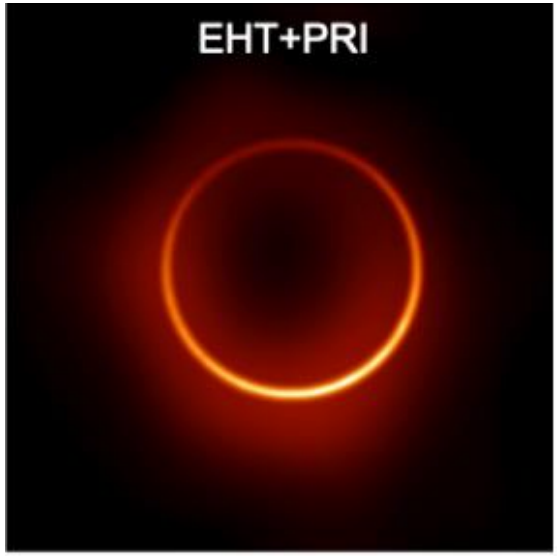
Space Medicine, Haptics, Health Monitors
(1-10 Mbps uplink/downlink)

Astronaut Shannon Walker



Software Updates, Human User Store & Forward + Real Time services
(20 Mbps uplink, 20-50 Mbps link/downlink)

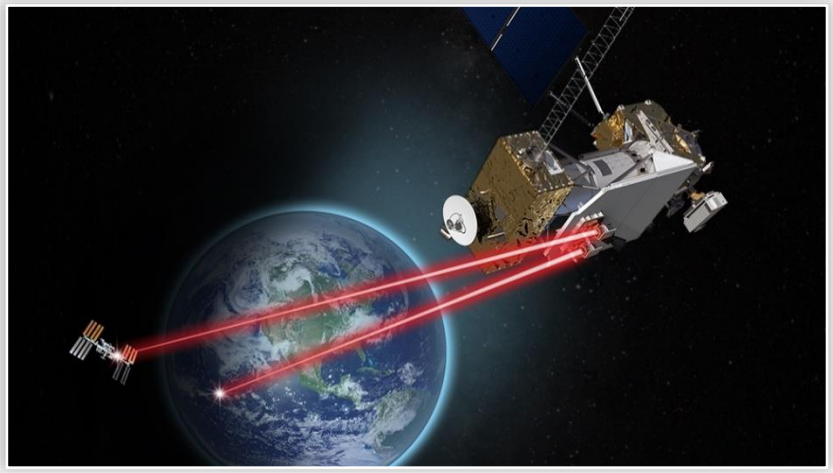
Event Horizon Telescope (Simulation)



Science data
(<1-100's Gbps)

Evolving human space exploration and science data comm needs require additional network capabilities

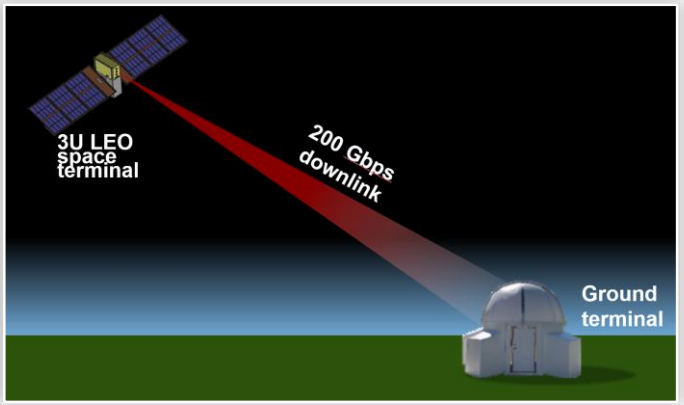
Optical Communications Today: Space Exploration



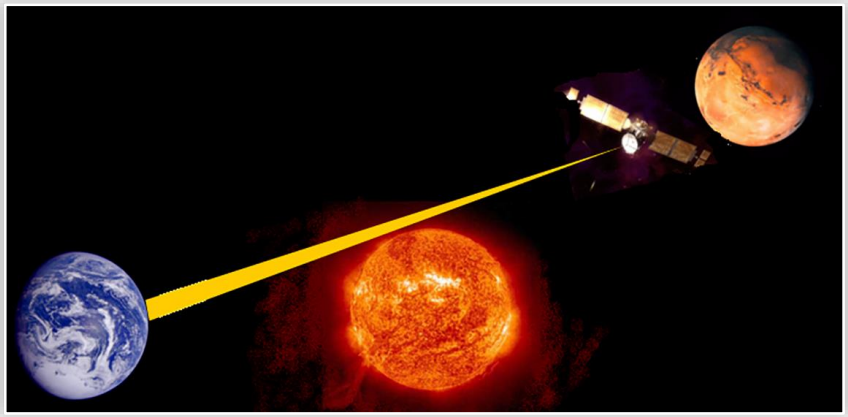
LCRD (GEO) – Launch 2021!

Artemis (Lunar) – O2O

ISS (LEO-GEO crosslinks) – ILLUMA-T

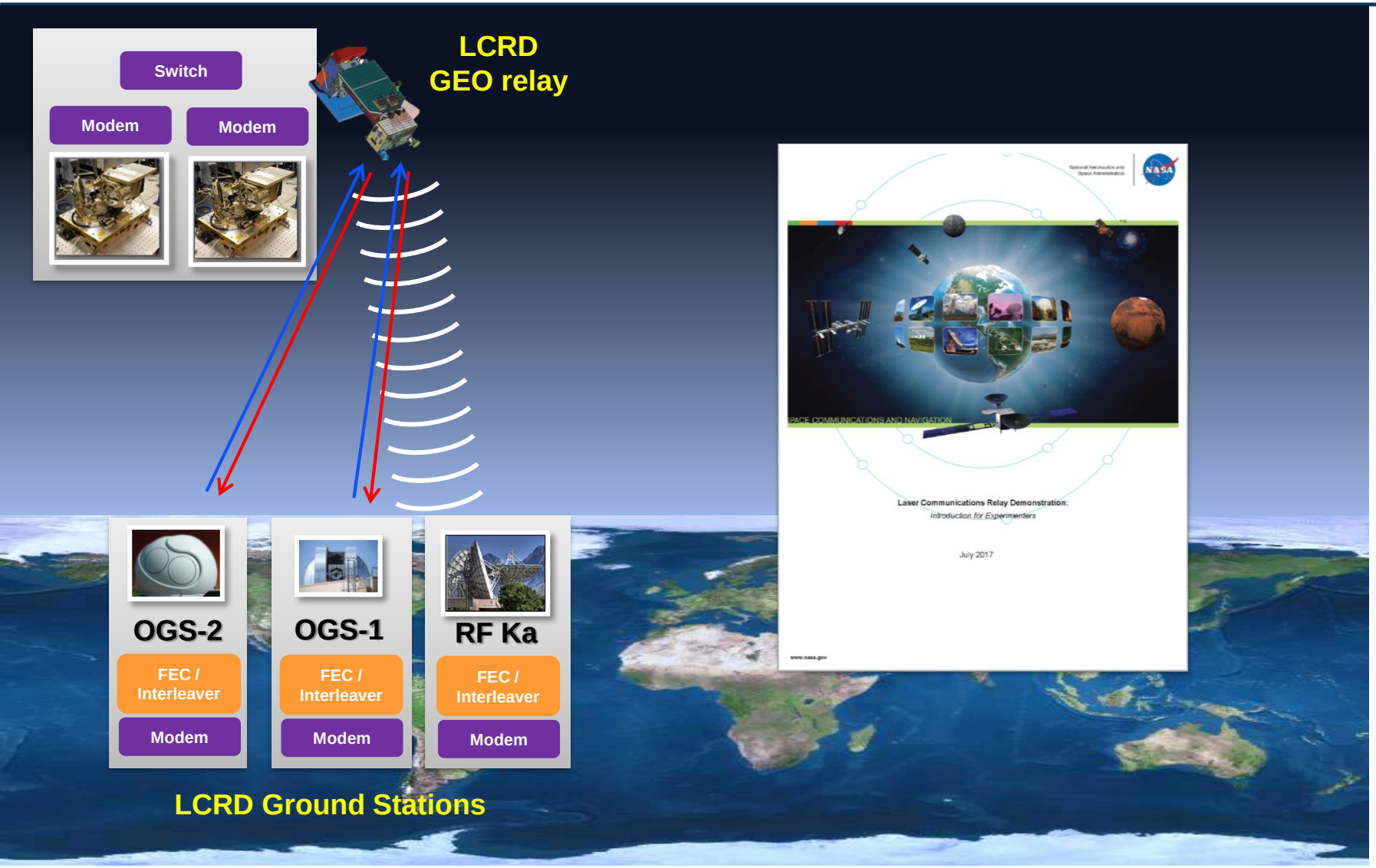


LEO - TBIRD



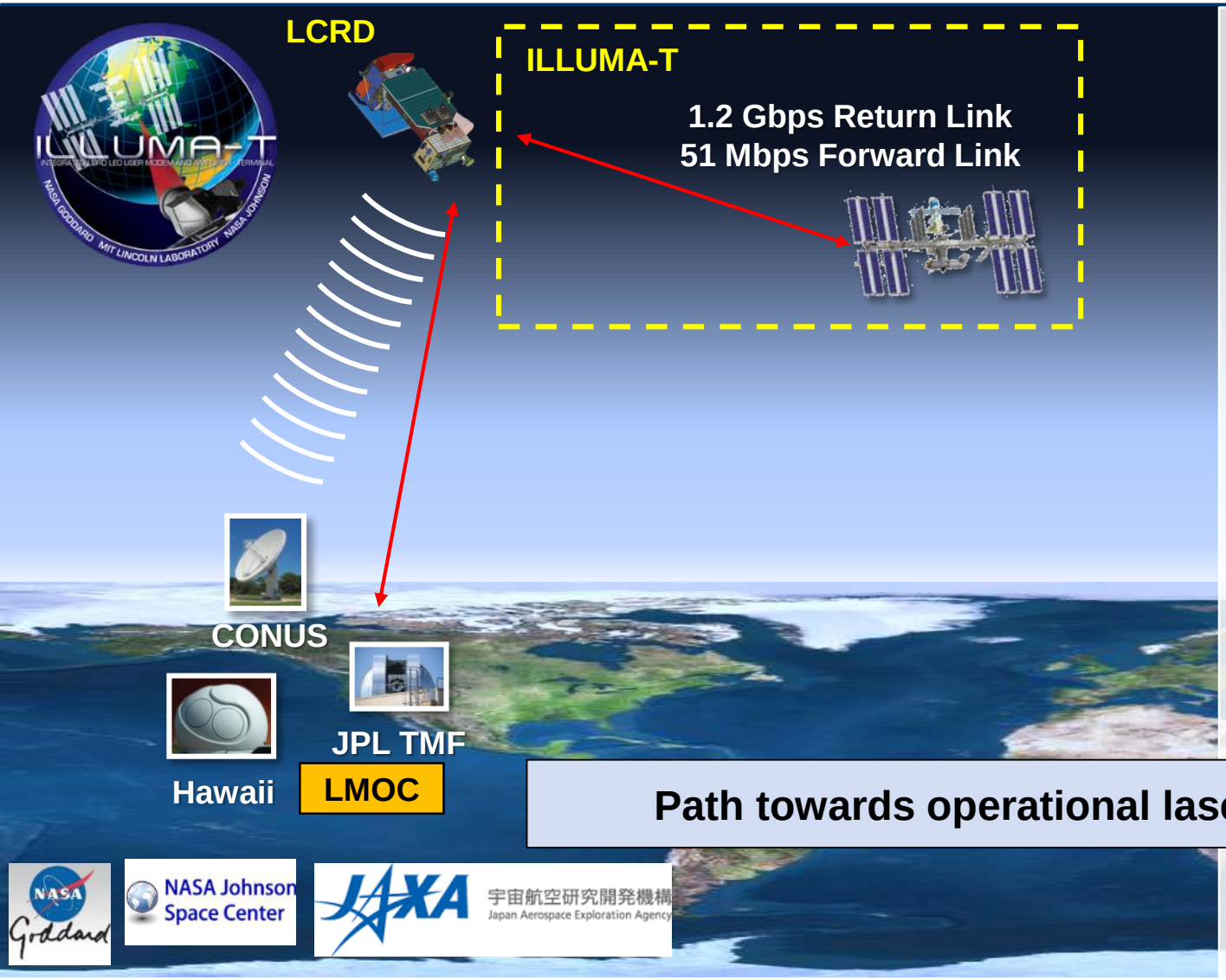
Psyche (Mars) – DSOC

LCRD Enables an On-orbit Experimentation Platform



- Tech transfer from MITLL
- Developed by Goddard
- High speed physical-layer frame switching
- "End-to-end" relay architecture
- Supports LEO & ground users
- RF or optical downlinks
- Supports "Experimenters" to leverage relay demonstration asset for future lasercom concept development

First LEO User: ILLUMA-T*

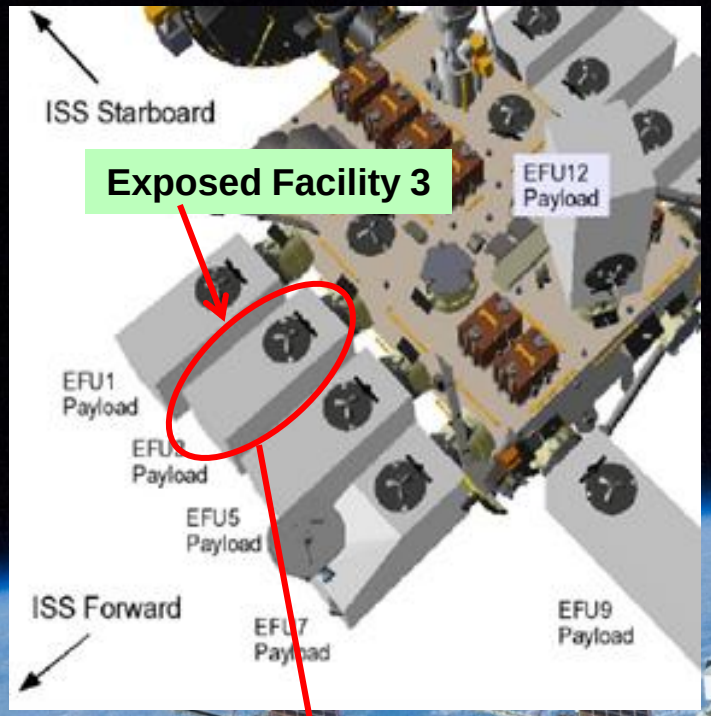


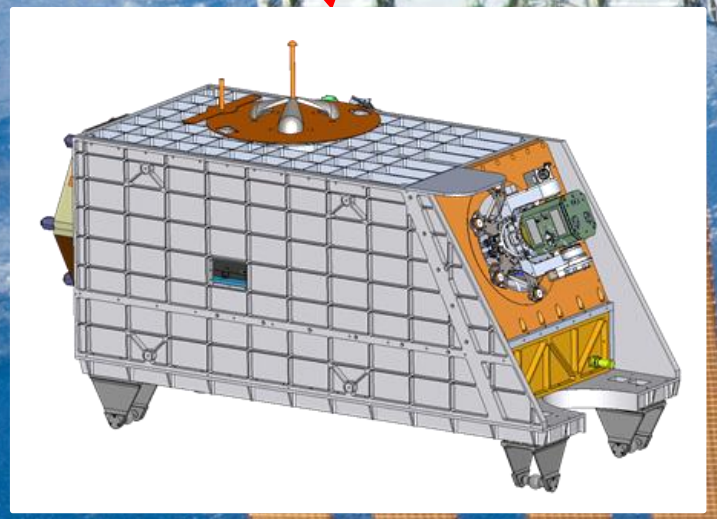
- First LEO user for LCRD
  - Demonstrate additional capability for ISS
- Industry-built proto-flight terminal
  - 10-cm MAScOT Optical Module
  - 3W DPSK modem (CACI)
- Payload to launch in 2022

Path towards operational lasercom supporting ISS

* Integrated LCRD LEO User Modem and Amplifier Terminal

ISS / ILLUMA-T Mission





“Kibo” Module

Forward Velocity Direction

Summary

- **LCRD will be a critical pathfinder and on-orbit asset for future optical communications development**
  - **Experimenter handbook available for those interested**

- **Expanding communications needs for supporting human spaceflight as well as science data will continue to drive optical communications innovation**