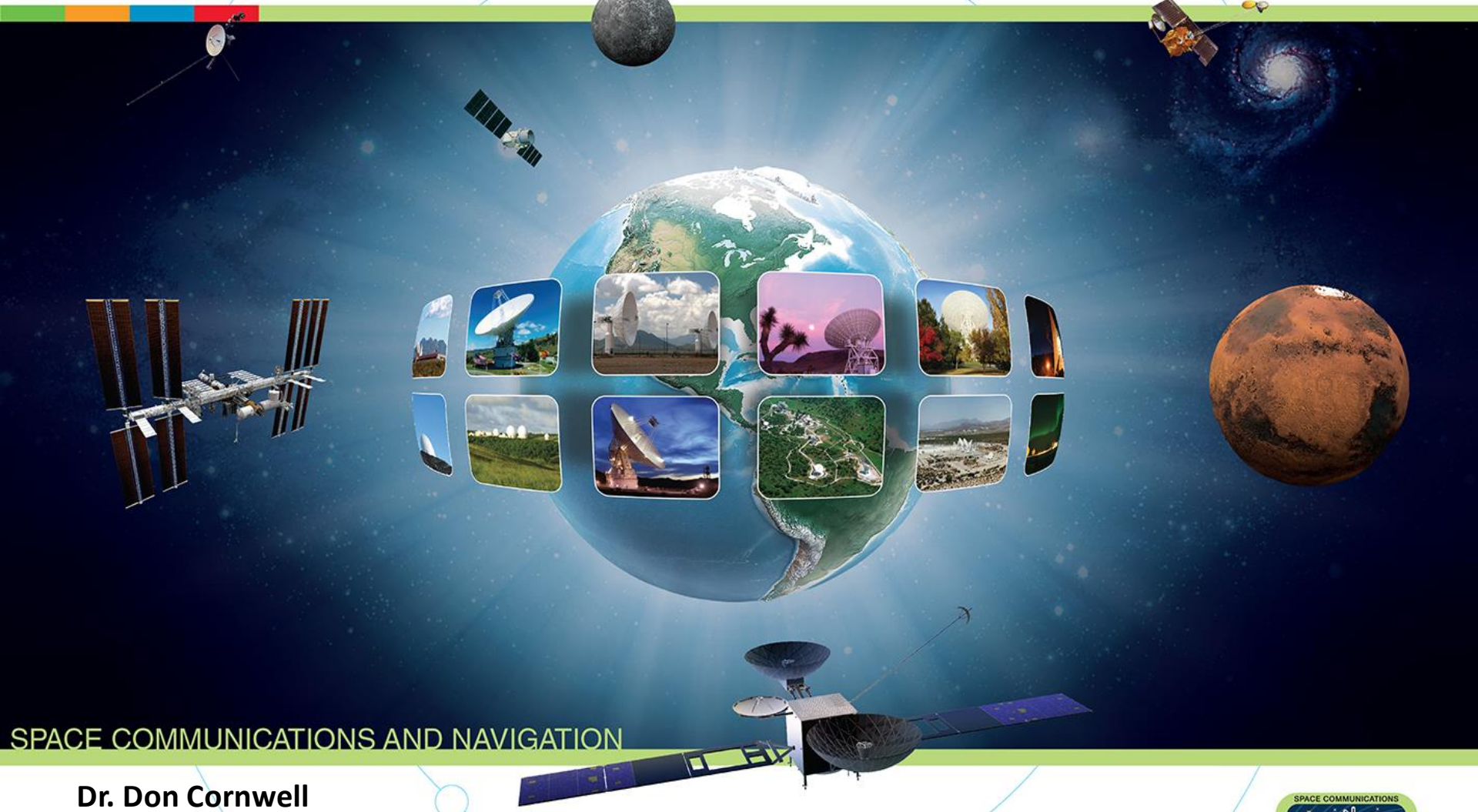
Laser Communication Relay Demonstration Overview

National Aeronautics and Space Administration



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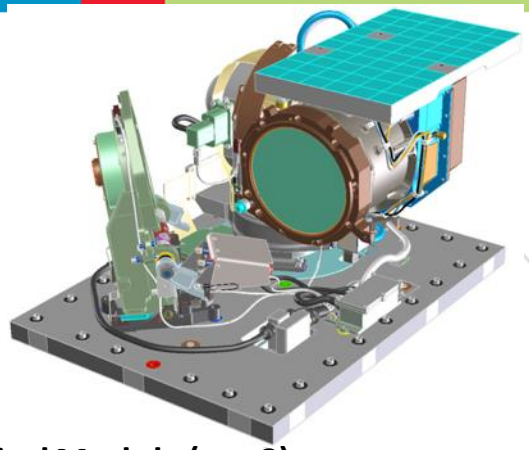
Laser Communication Relay Demonstration (LCRD) Mission for 2019

- **Joint Space Technology Mission Directorate/SCaN Mission**
- **Two to five years of mission operations**
- **Flight Payload**
  - **Two LLCD-heritage Optical Modules and Controller Electronics Modules**
  - **Two Differential Phase Shift Keying (DPSK) Modems with 2.88 Gbps data rate**
  - **New High Speed Electronics to interconnect the two terminals**
  - **RFI for "Guest Investigators" revealed significant commercial interest**
- **Key for Next-Gen TDRS (or equivalent) in 2024 timeframe**

Payload Hardware Overview

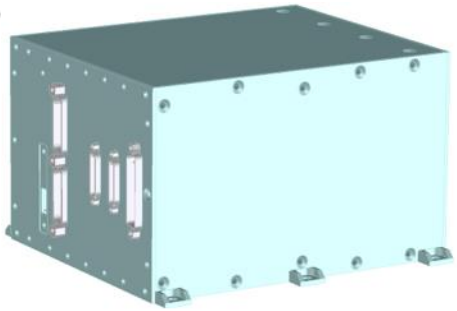


Optical Module (qty 2)

- Gimbaled telescope (elevation over azimuth)
  - 12° half-angle Field of Regard
- 10.7 cm aperture, 14.5 kg
- Local inertial sensor stabilization

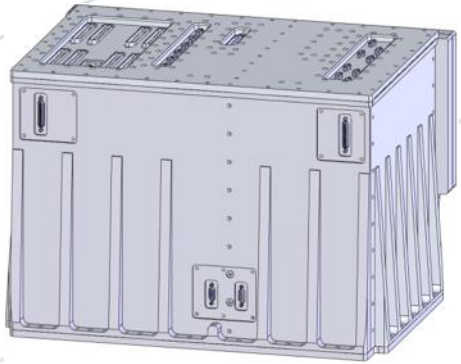
Integrated Modem (qty 2)

- 0.5 W transmitter; optically pre-amplified receiver
- DPSK and PPM modulation
- 29.2 kg, 130 W nominal operations
- Supports Tx and Rx frame processing
  - No on-board coding and interleaving



Controller Electronics (CE) (qty 2)

- OM control/monitoring
- Interface to Host Spacecraft
- 6.6 kg, 99 W peak (turn-on), 30W nominal



Space Switching Unit (qty 1)

- Flexible interconnect between modems to support independent communication links
  - High speed frame switching/routing
- Command and telemetry processor

LCRD Payload Mass

LCRD Payload	CBE Mass		MPV Mass	
	lb	kg	lb	kg
Payload Electronics				
Space Switching Unit (SSU)	64.11	29.08	70.5	32.0
Secure Host Interface Module (SHIM)	8.82	4.00	22.9	10.4
Optical Space Terminal #1 **OST Total = 55.1 kg**				
Optical Module (OM) 1	31.97	14.50	35.2	16.0
Communication Splice Box (CoSB) 1	1.87	0.85	2.1	1.0
Integrated Modem 1 Tower A	34.61	15.70	38.1	17.3
Integrated Modem 1 Tower B	29.76	13.50	32.7	14.9
Controller Electronics (CE) 1	14.53	6.59	16.0	7.2
Power Filter Unit (PFU) 1	8.82	4.00	11.5	5.2
Optical Space Terminal #2				
Optical Module (OM) 2	31.97	14.50	35.2	16.0
Communication Splice Box (CoSB) 2	1.87	0.85	2.1	1.0
Integrated Modem 2 Tower A	34.61	15.70	38.1	17.3
Integrated Modem 2 Tower B	29.76	13.50	32.7	14.9
Controller Electronics (CE) 2	14.53	6.59	16.0	7.2
Power Filter Unit (PFU) 2	8.82	4.00	11.5	5.2
Harness	22.05	10.00	25.4	11.5
Thermal	1.76	0.80	2.1	1.0
Misc HW	6.61	3.00	9.3	4.2
Total of NASA LCRD Hardware	**355.30**	**161.16**	**401.2**	**182.0**

LCRD Physical Dimensions

LCRD Payload	Dimensions (Inches)			Dimensions (Centimeters)		
	Length	Width	Height	Length	Width	Height
Payload Electronics						
Space Switching Unit (SSU)	15.110	12.420	10.370	38.379	31.547	26.340
Secure Host Interface Module (SHIM)	10.200	12.400	5.000	25.908	31.496	12.700
Optical Space Terminal #1						
Optical Module (OM) 1	19.511	13.310	12.190	49.558	33.807	30.963
Communication Splice Box (CoSB) 1	8.750	6.750	1.013	22.225	17.145	2.573
Integrated Modem 1 Tower A	15.380	12.380	6.144	39.065	31.445	15.606
Integrated Modem 1 Tower B	12.380	12.380	6.313	31.445	31.445	16.035
Controller Electronics (CE) 1	8.840	8.440	4.980	22.454	21.438	12.649
Power Filter Unit (PFU) 1	3.000	11.000	11.000	7.620	27.940	27.940
Optical Space Terminal #2						
Optical Module (OM) 2	19.511	13.310	12.190	49.558	33.807	30.963
Communication Splice Box (CoSB) 2	8.750	6.750	1.013	22.225	17.145	2.573
Integrated Modem 2 Tower A	15.380	12.380	6.144	39.065	31.445	15.606
Integrated Modem 2 Tower B	12.380	12.380	6.313	31.445	31.445	16.035
Controller Electronics (CE) 2	8.840	8.440	4.980	22.454	21.438	12.649
Power Filter Unit (PFU) 2	3.000	11.000	11.000	7.620	27.940	27.940

All dimensions exclude keep out zones for harnesses and installation GSE

LCRD Peak Payload Power

LCRD Payload	CBE Peak Input Power	CBE Dissipation to S/C Panel	MPV Peak Input Power	MPV Dissipation to S/C Panel
	Watts	Watts	Watts	Watts
Payload Electronics				
Space Switching Unit (SSU)	100.0	100.0	115.0	115.0
Secure Host Interface Module (SHIM)	18.4	18.4	23.9	23.9
Optical Space Terminal #1				
Optical Module (OM) 1	0.0	11.0 (TBR)	0.0	16.5 (TBR)
Communication Splice Box (CoSB) 1	0.0	0.0	0.0	0.0
Integrated Modem 1 Tower A	72.2	72.2	90.0	90.0
Integrated Modem 1 Tower B	39.4	39.4	50.0	50.0
Controller Electronics (CE) 1	99.1	57.8	114.0	72.7
Power Filter Unit (PFU) 1	8.7 (TBR)	8.7 (TBR)	10.0 (TBR)	10.0 (TBR)
Optical Space Terminal #2				
Optical Module (OM) 2	0.0	11.0 (TBR)	0.0	16.5 (TBR)
Communication Splice Box (CoSB) 2	0.0	0.0	0.0	0.0
Integrated Modem 2 Tower A	72.2	72.2	90.0	90.0
Integrated Modem 2 Tower B	39.4	39.4	50.0	50.0
Controller Electronics (CE) 2	99.1	57.8	114.0	72.7
Power Filter Unit (PFU) 2	8.7 (TBR)	8.7 (TBR)	10.0 (TBR)	10.0 (TBR)
Thermal	0.0	0.0	0.0	0.0
Total of NASA LCRD Hardware	**557.2**	**496.6**	**666.9**	**617.3**

Optical Module 1 Survival Heater	38.2*	0.0	50.0	0.0
Optical Module 2 Survival Heater	38.2*	0.0	50.0	0.0