



Exploration & **SPACE**
Communications

More than you ever imagined...

Optical Communications at L2 Feasibility Study

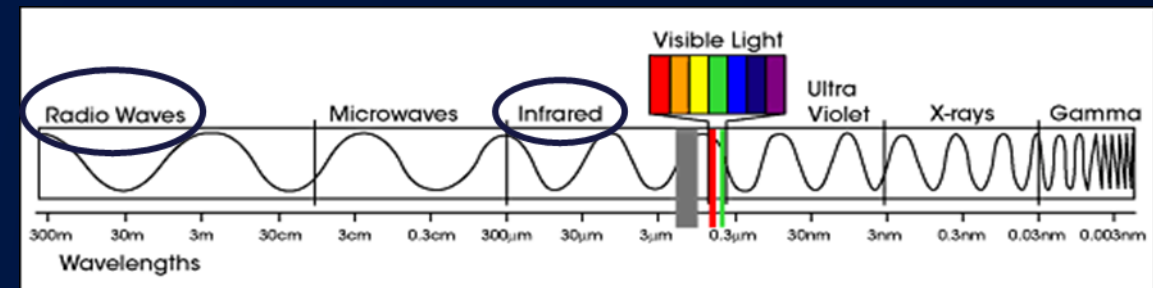


Why Optical Communications?



Optical communications will enable:

- Greater download speed and volume
- Smaller size, weight and power (SWaP) requirements
- Greater service availability





2013: LLCD
Lunar Laser Comm Demo

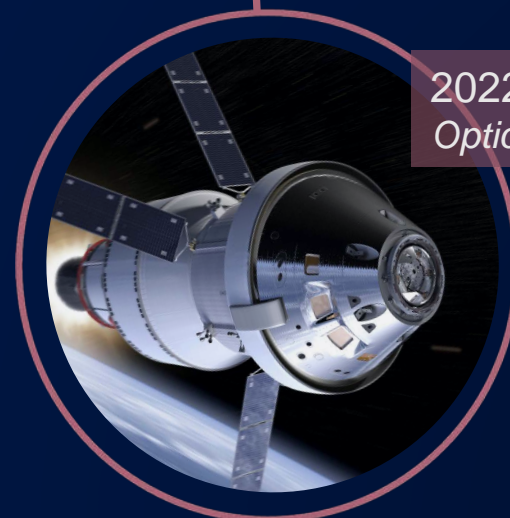


2021: ILLUMA-T
*Integrated LCRD LEO User
Modem and Amplifier-Terminal*

Heritage of Optical Communications Technology



2020: LCRD
Laser Comm Relay Demo



2022: O2O
Optical to Orion

Study Goals



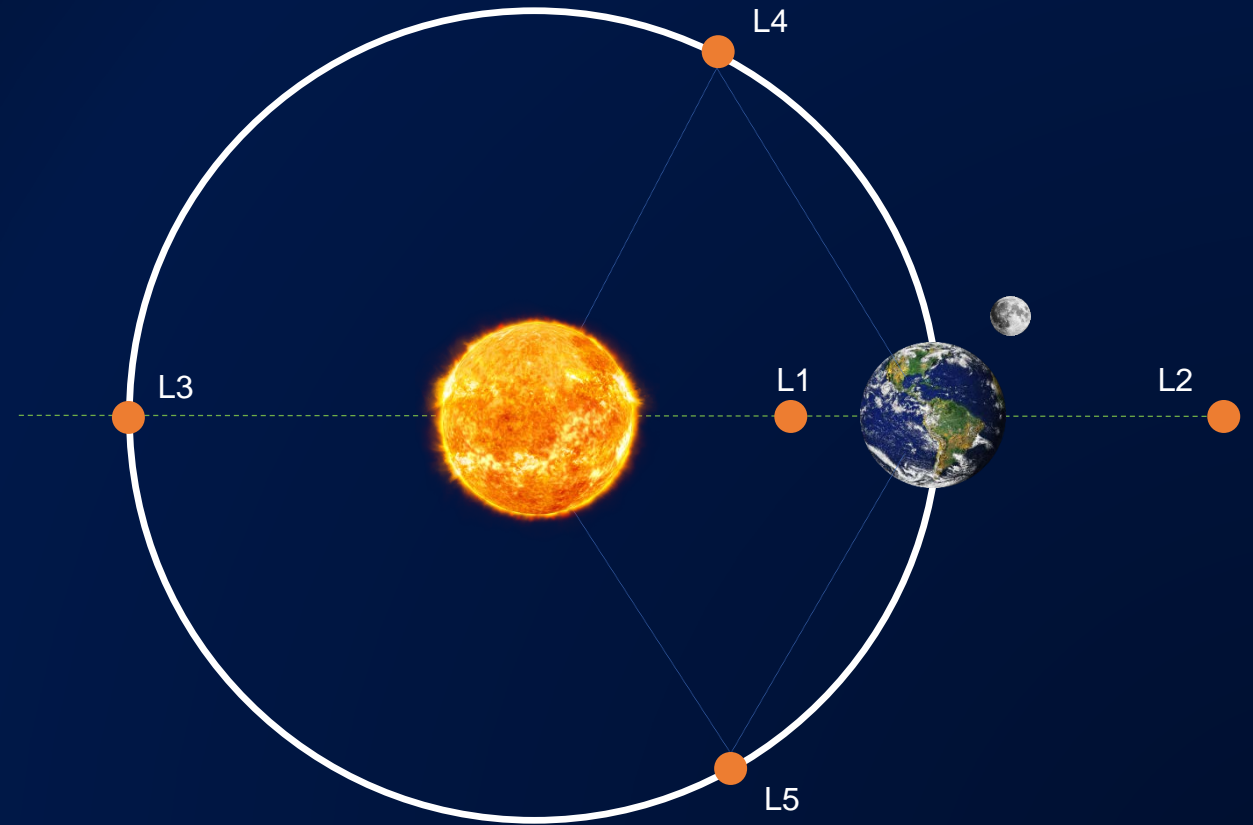
Assess the feasibility of including optical communications on a NASA science mission located at Sun-Earth Lagrange Point 2 on a non-interference basis with primary mission objectives.



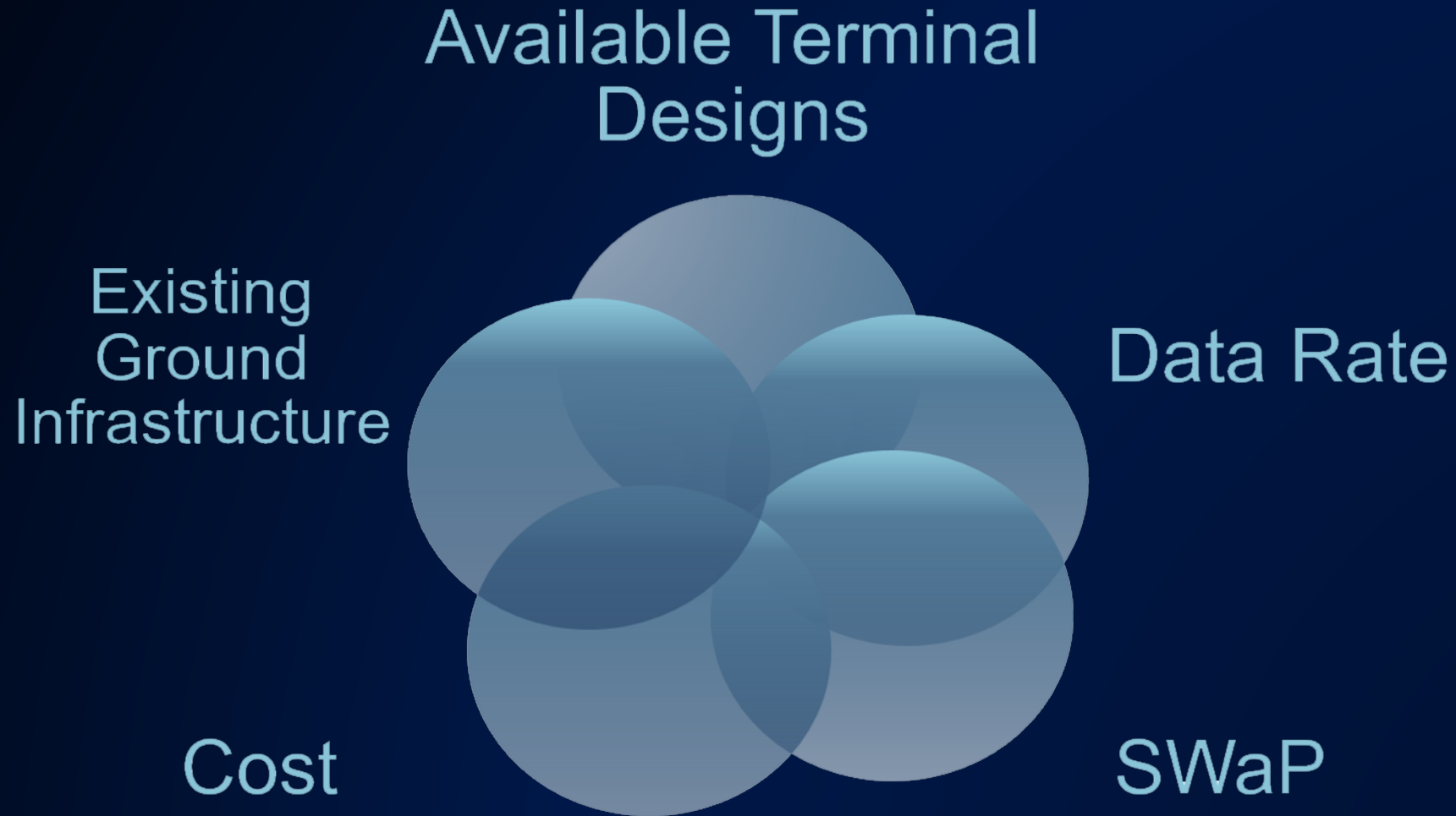
Guiding Questions:



1. Can we close the link to L2 with pulse position modulation (PPM) technologies at hundreds of megabits per second?
2. How do we interface with the mission's main data system?
3. What are the pointing, jitter and vibration environments and requirements for an optical terminal on the mission?
4. What is the use case and operations concept?
5. Will future terminal designs that provide the basis for the OCP be capable of supporting optical communications from Earth to L2 by the time of the mission's need date?



Key Trade Considerations



Summary of Trades



Flight Terminal Trades:

- Existing Terminal Designs
- Optical Module Size
- Power Level

Ground Terminal Trades:

- Ground Terminal Design Options
- Power Level
- Number of Terminals
- Ground Station Locations
- Elevation Limit for Ground Terminal
- Network / Terminal Usage

Optical Link Trades:

- Link Budget
- Encoding Scheme
- Modulation
- Data Rates

Terrestrial Connectivity Trades:

- Payload Operations Center / End-point Locations

Key Benefits



Key benefits of including optical communications on the studied mission:

1. Establishes optical communications between Earth and L2
2. Provides and demonstrates optometric ranging accurate to ~3 cm, enabling more accurate orbital determination. Much more accurate than current radiometric methods.
3. Provides data volume transfers at rates potentially higher than the RF system is capable of, enabling future missions to utilize for science data transfer needs

Study Results



Point 1:

- Optical Communications between a ground terminal on Earth and the mission at L2 is feasible using an existing optical communications terminal design that supports the current mission plan.

Point 2:

- Optical link with mission's optical communications payload (OCP) would be capable of data rates up to 97% of the mission's RF system rates using "minimum threshold" capability, but can exceed the mission's RF system rates using "ultimate goal" configuration.

Point 3:

- The OCP system can provide optometric ranging measurements in the ~3 cm range between Earth and L2.

Co-Authors



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