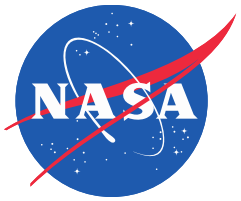

Jet Propulsion Laboratory
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Joint CSA/ESA/JAXA/NASA ISS Increments 3&38 Science Symposium May 28-29, 2013

Optical PAyload for Lasercom Science

OPALS

Abhijit Biswas
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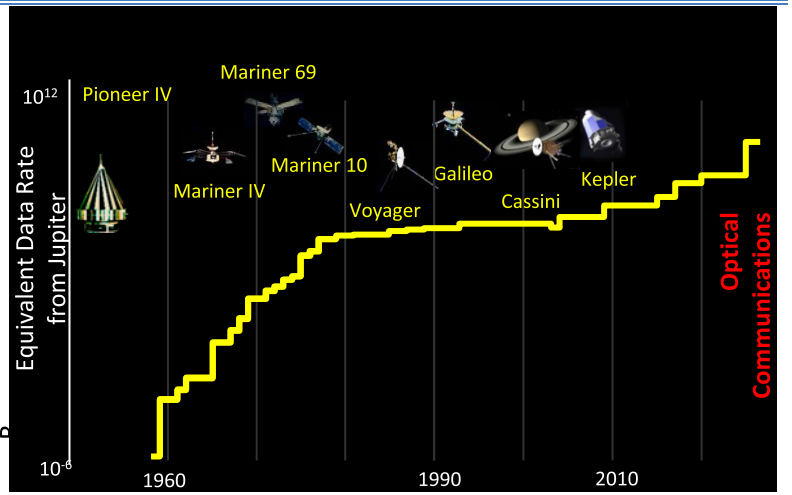
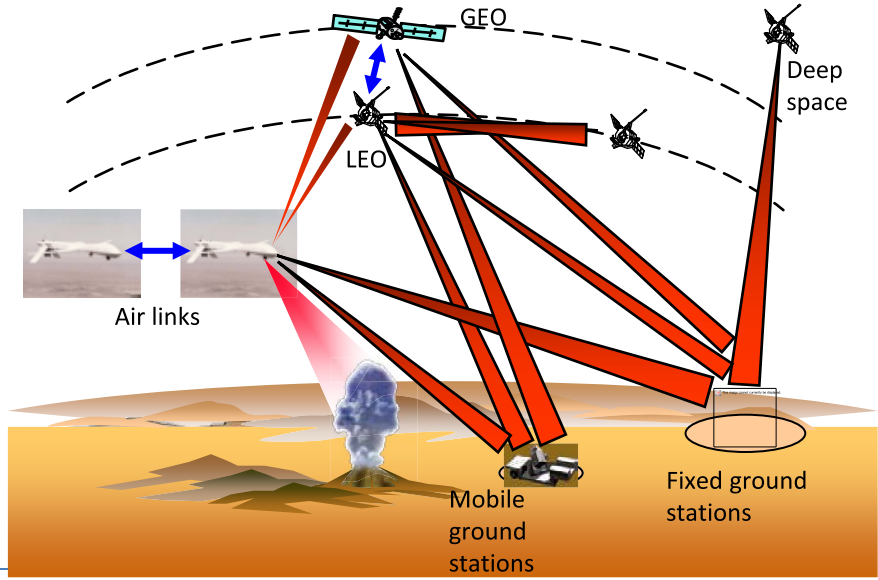
Laser Communication

Jet Propulsion Laboratory
California Institute of Technology

- **Ever-growing demand for data rate and data volume in space exploration**
  - Increase in science return from interplanetary missions
  - Connectivity via high-bandwidth terrestrial near-earth networks
  - Earth science via high-resolution remote sensing and imaging instruments
  - Time-of-flight for high precision ranging





Investigation Objective

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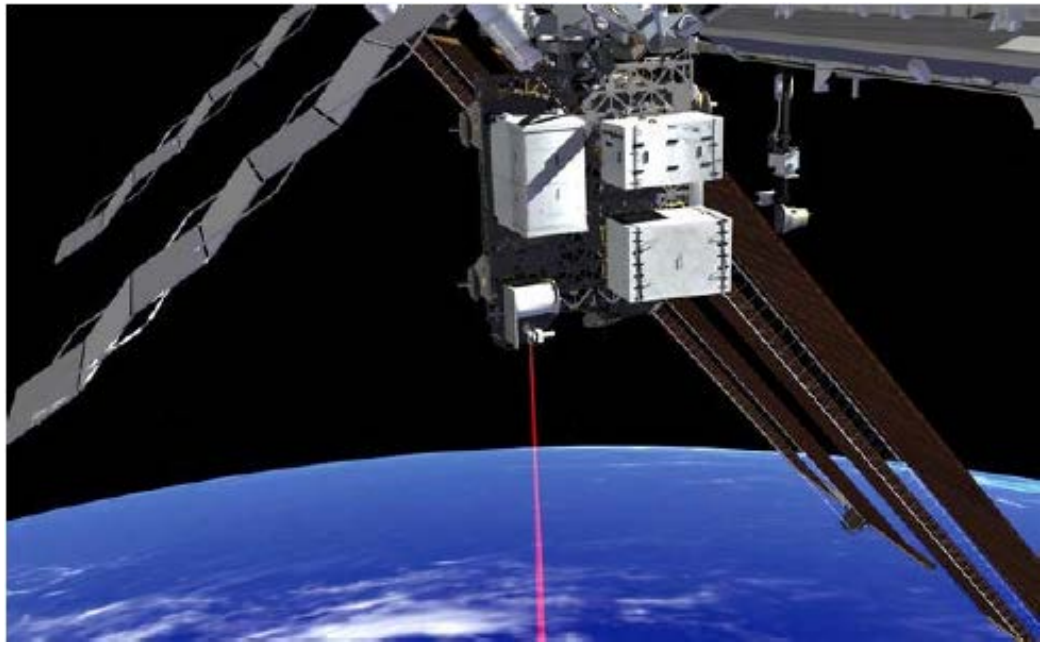
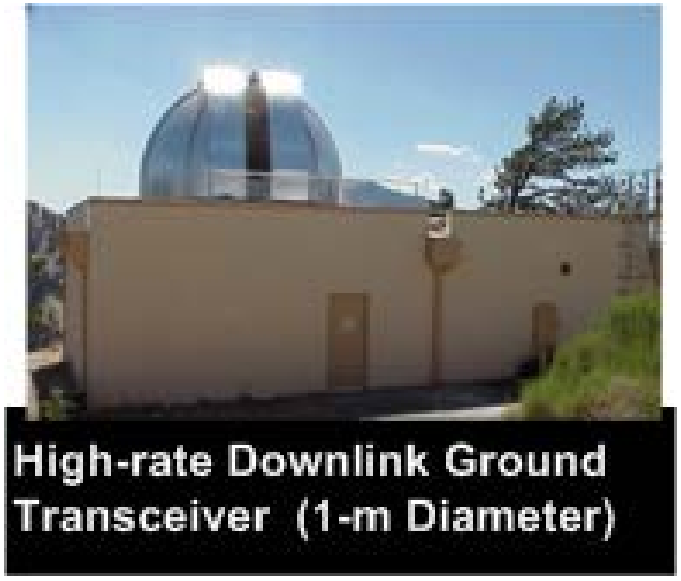
- Demonstrate the downlink of a video from ISS to ground terminal via an optical communications link





High-rate Downlink Ground Transceiver (1-m Diameter)

- ❑JPL Phaeton/Early Career Hire (ECH) training project
- ❑Implemented as Class-D payload
- ❑Downlink at ~30 – 50 Mb/s

OPALS Architecture

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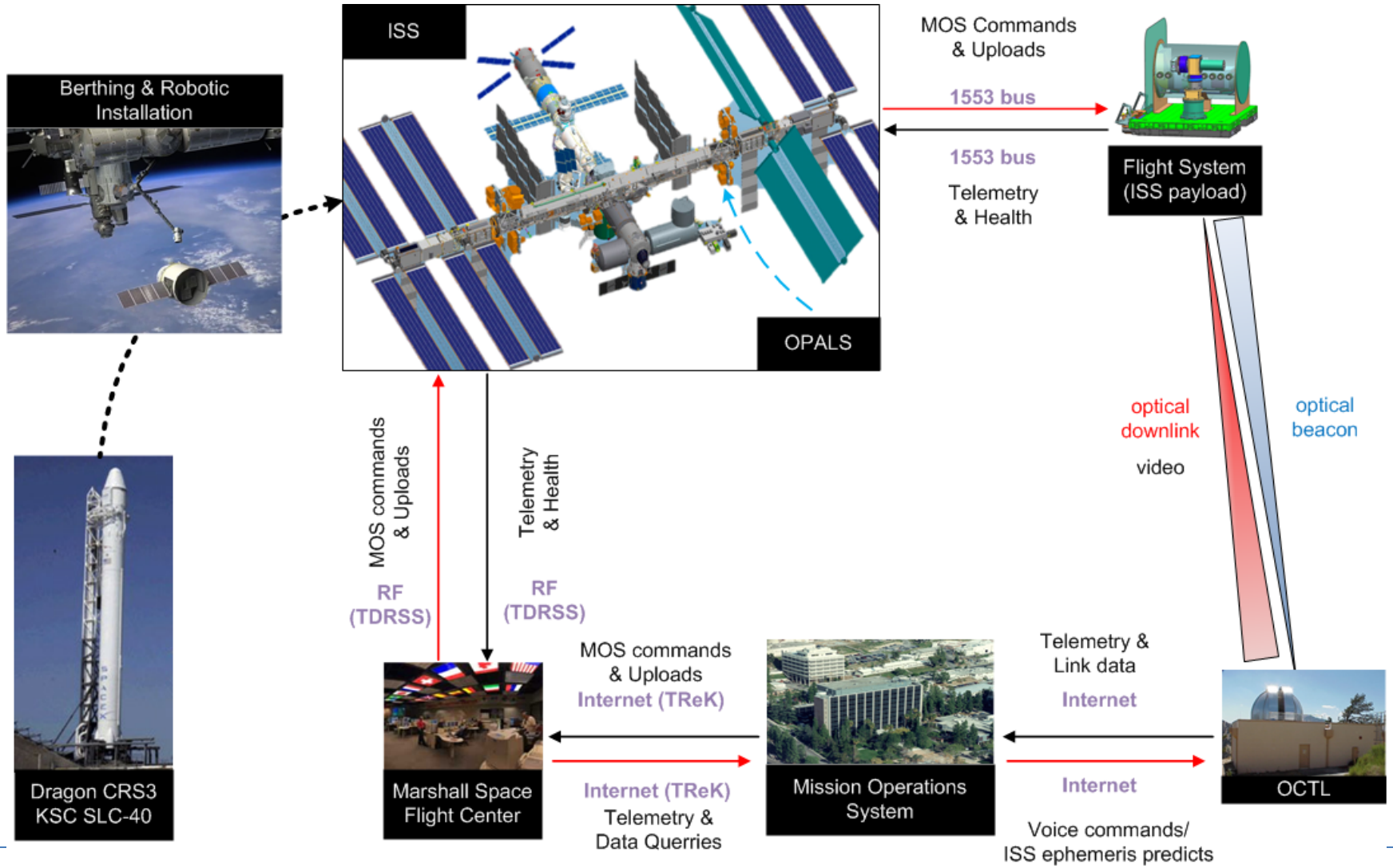

Investigation Approach

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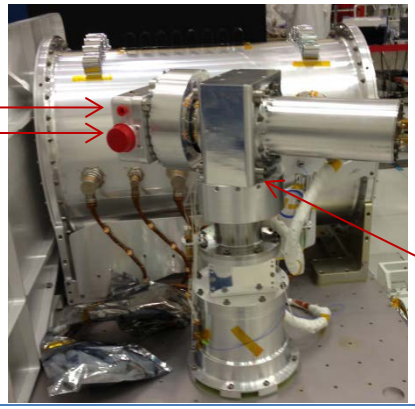
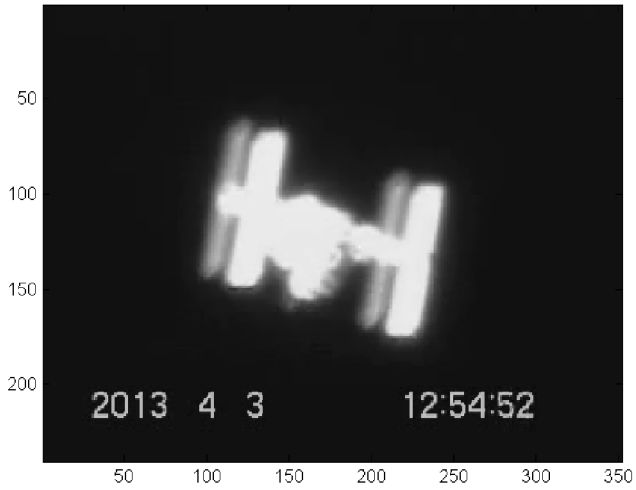
- Ground station illuminates rising ISS (Elevation > 20°)
  - Use updated ISS ephemeris to blind point laser beacon to ISS
- OPALS flight system (FS) camera acquires and locks on laser beacon (976 nm)
- FS initiates downlink for duration of ISS pass
- Ground receives and stores downlink to extract video with post-processing





Frame of Sunlit ISS Tracked from OPALS GS

Importance Reason for ISS

- **ISS is an accessible low-Earth orbiting platform ideally suited for preliminary verification of lasercom**
  - **Representative LEO slew-rates**
  - **Space environment including disturbance**
  - **Frequent ground contacts with varying link geometry**
  - **Relatively low cost for validation of acquisition and pointing i.e. the physical optical link**
  - **Provides ground operational experience with variances in atmospherics and weather**

Expected Outcome

- Multiple successful acquisition/tracking and downlink will verify link predictions
  - Measure performance correlated to prevalent atmospheric conditions
  - Evaluation of platform disturbance and its effect on design of future laser communication systems
  - Allow LEO missions to evaluate suitability for high-rate downlink on data-intensive missions
  - Provide insights for inter-satellite laser communications

Earth Benefits/Spin-off

- Streaming video and high-definition imagery from space
  - Education and public outreach
  - Engaging students
  - Atmospheric characterization from space
- High-precision ranging from LEO platforms
  - Use of transponding mode
- Promoting concept of optical node above Earth atmosphere for communication/light-science with near-Earth and deep-space spacecraft