This subtopic seeks innovative technologies for long-range optical telecommunications supporting the needs of space missions. Proposals are sought in the following areas:

- Space-qualifiable, efficient (greater than 25% wall plug), lightweight, variable repetition-rate (1 - 60 MHz), tunable (± 0.1 nm) pulsed 1064 nm transmitter sources (diode-pumped fiber amplifier or bulk crystal laser/amplifier) with greater than 1 kW of peak power per pulse (over the entire pulse-repetition rate), and greater than 10 W of average power, and narrow (Space-qualifiable, high-peak power (> 1.2 W), average-power (> 300 mW), operating wavelength less than 1000 nm single-mode-fiber pigtalled laser diode transmitters (includes necessary modulator; internal or external driver) with narrow spectral width (25%);

- Space-qualifiable, photon counting 1064 nm and/or 1550 nm detectors at a temperature of 220 K or greater, with the gain greater than 3000, detection efficiency greater than 50%, dark rate 2 active area, > 0.2 mm in active area diameter, bandwidth greater than 500 MHz, saturation levels > 50 Mcounts/s and non-gated (continuous operation), and lifetime > 3 years at 100 Mega photons/sec continuous photon flux;

- Lightweight, compact, high precision (less than 0.1 micro-radian), high bandwidth (0-2 kHz), inertial reference sensors (angle sensors, gyros) for use onboard spacecraft;

- Novel schemes for stray-light control and sunlight mitigation, especially for large (> 5 m) ground-based optical telescopes that must operate when pointed to within a few (about 3) degrees of the Sun;

- Lightweight, high precision (one micro-radian accuracy) star-trackers for spaceflight application that can be integrated with an optical communications terminal;

- Novel techniques and technologies that will enable very low cost, large aperture (> 5 m equivalent aperture diameter) telescopes for ground or space-borne use;

- High power ground-based, relatively low-cost diode-pumped laser technology capable of reaching 100 kW average power levels in a TEM$_{00}$ mode, for uplink to spacecraft;

- Artificial laser guide-star and beam compensation techniques capable of removing all significant atmospheric turbulence distortions (tilt and higher-order components) on an uplink laser beam;
• Novel techniques to reduce the development cost and risk of future space-borne optical communications transceivers (e.g., automatic focusing or alignment techniques); and

• Systems and technologies relating to sub-microradian pointing, acquisition, and spacecraft vibration.

Research should be conducted to demonstrate technical feasibility during Phase 1 and show a path toward a Phase 2 hardware demonstration that will, when appropriate, deliver a demonstration unit for testing at the completion of the Phase 2 contract.