Recommendations for Workshop on Free Space Optical Networks

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1 Enabling Space-based Remote Sensing of Earth

FSO systems have size, weight, and power advantages over RF that are particularly advantageous for space-based platforms. FSO also has an advantage with the significant amount of unallocated and currently uncontested and unregulated bandwidth available for use (coordination with the Laser Clearing House and FAA still recommended).

The miniaturization and improvement in capabilities of space platforms such as nanosatellites (CubeSats) and their ease of access to space is leading to large constellations of compact space-based sensors (hundreds to thousands of nodes) that can collect terabytes to petabytes of remote sensing data daily (e.g. hyperspectral imagery, video). High rate FSO downlinks and crosslinks enable getting data from the instruments to ground as well as enabling intelligent, autonomous onboard processing and utilization of the observations. The remote sensing application benefits from near real time operation but can tolerate some latency.

Development of compact, power-efficient, low-cost components for space-based crosslink and downlink terminals are needed, leveraging technologies such as photonic integrated circuits. Optimization of pointing and tracking systems, incorporating mechanism-free approaches (such as optical phased arrays for scanning) are needed. Networking coordination including scheduling, planning and routing of data-collecting "feeder" FSO links to "trunk" links are also needed.

2 Atmospheric Channel Characterization

FSO systems can be tailored to provide useful information about the composition and thermal structure of the atmospheric channel. High fidelity orbit determination of the transmit and receive space terminals along with attitude determination have the potential to enable laser occultation and direct recovery of the bending angle (used in calculating atmospheric temperature and pressure profiles) as a function of altitude at high vertical resolution. Multi-wavelength systems can be employed to measure atmospheric composition with wavelengths near both absorption features and the continuum of species of interest. These systems could be advanced toward onboard retrieval of these physical parameters quickly enough to operate in a closed-loop manner such that transceivers could characterize the channel in which they are operating in near real time and adapt to improve their mode of operation given the measured conditions.