## SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2) Advanced Satellite Services (4)

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CONNECTIVITY SERVICES BASED ON OPTICAL GROUND-TO-SPACE LINKS

## Abstract

Free space optical communication is characterized by some unique features hardly matched by transmission schemes based on radio frequencies: it offers high data rates at low power consumption, it does not come within the provisions of frequency regulation and it inherently maintains high physical security. Therefore, optical ground-to-space communication embodies a promising method to satisfy the upcoming demand for data relay services from remote locations with nomadic ground terminals connected to land-based, maritime or airborne data sources. In the course of current trends like Cyber-Physical Systems, the Internet-of-Things, Big Data or Cloud Computing the urge for data sovereignty becomes more and more prominent in the scientific as well as the industrial sectors. Relay systems in geostationary orbit utilizing free space optical communication offer great potential to backup, process and archive large amounts of data collected or generated at remote locations, in near-real time. In contrast to existing or upcoming global satellite communication systems, such optical GEO relays are able to provide a huge uplink (return-channel) data throughput with channel rates in the gigabit-per-second range.

One of the most critical components of such data uplinks are the optical ground terminals used to connect to the space segment. In this study we analyze the design drivers of optical ground stations for different land-based applications. In particular, the effects of atmospheric attenuation and index of refraction turbulence are investigated. Moreover, we identify requirements on pointing, acquisition and tracking imposed by potential ground terminal base motions. Our survey underpins pre-existing ventures to foster optical relay services like the European Data Relay System (EDRS). With well-designed, self-sufficient and small-sized ground terminals new user groups could be attracted, by offering alternatives to the emerging LEO mega-constellations and GEO-satellite communication systems, which operate at a low return channel data rates across-the-board.