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HIGH-DATA-RATE OPTICAL COMMUNICATION AND QKD CAPABILITIES FOR LEO-SATELLITES

Abstract

Companies involved in commercial spacecraft and satellite development have made massive investments to find solutions to the great limitation of the data download on the satellite-ground downlink. Although there are already commercial RF-based solutions that provide data transfer speeds over 200 Mbps, these are expensive and sometimes difficult to integrate into certain platforms. Finally, QKD is key to enable quantum communications, particularly important for securing message transmissions.

Many communication links of the downstream channel for LEO satellites are based on UHF or S-band systems, which offer data download capabilities per day much less than 1 Gb and have throughput and maximum transmitted power limitations at those frequencies. The development of an alternative solution based on optical systems could offer a much more efficient solution in terms of size, weight and power (SWaP). Furthermore, optical communications bands, unlike RF frequencies, are not currently subject to any frequency coordination process in the ITU. The maximum data rate achieved by the analyzed small satellite-based missions is 320 Mbps. The most common data rate for small satellites is 160 Mbps. The X-band is the most used band in this range of frequencies for small satellites; moreover, the S-band is still common in nano and micro-satellites.

Although these transmitters have been developed for some years now, and they are nowadays commercially available, they present their own challenges, including their relatively higher cost, the higher energy consumption, and the challenging pointing requirements for the directional antennas. Taking into

account these ideas, a communications subsystem that achieves data rates in the range of 10 Gbps and being compact enough to fit in a microsatellite (mass below 10

The present research addresses those issues and offers a solution as a highly flexible, miniaturized, secured communications system using a portable telescope. This subsystem accommodates, in a single box, a pointing-tracking-alignment (PAT) system, an integrated photonics circuit (PIC) with a high bit-rate communication link and all the data handling components that were traditionally belonging to separate units, including QKD capabilities. The communications subsystem is designed to meet the constrained mass and size requirements of a portable telescope, minimizing the integration complexity of essential components. The number of interfaces and connections between these essential components are streamlined, reducing the mass, volume, and manufacturing costs of the IPQKD communications subsystem.