

OPTICAL COMMUNICATION FOR SMALL- AND CUBESATS IN AN END-2-END APPROACH

²PHILIPP BILLER, ¹CHRISTOPHER SCHMIDT, ¹CHRISTIAN FUCHS, ²HERWIG ZECH, ²MATTHIAS MOTZIGEMBA

¹GERMAN AEROSPACE CENTER (DLR), INSTITUTE OF COMMUNICATIONS AND NAVIGATION, MUENCHNER STRASSE 20, 82234 WESSLING

²TESAT-SPACECOM GMBH & CO. KG, GERBERSTRASSE 49, 71522 BACKNANG

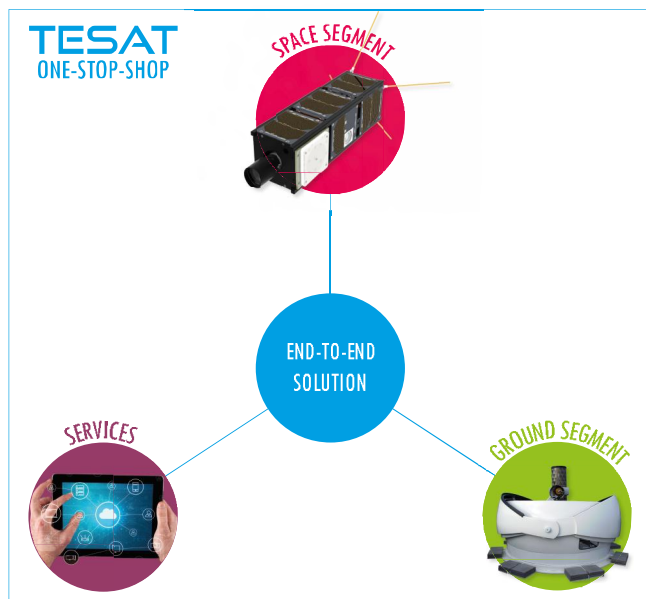
The demand for increasing bandwidth for the downlink on small satellites (< 500kg) is unbroken. Driven by new sensor capabilities for small and cube satellite applications with higher spatial and hyperspectral resolution and a rising demand of this kind of data for the end users.

This development has shifted the bottleneck towards the downlink. Optical downlink technology can solve these issues and can be an alternative to the today usually used radio frequency downlinks.

At first, optical downlink technology can deliver much higher data rates already today and has even more promising prospects up to several 100 Gbps in the next years. Furthermore, optical links are, due to the

physical properties of a laser beam, not ITU regulated and thus there is no need to apply for frequencies bands. Another important aspect is security. Optical links are robust, interference-free and robust against eavesdropping and in addition the medium for the upcoming technology of quantum key distribution.

The Institute of Communications and Navigation (IKN) of the German Aerospace Center (DLR) is working on the development of highly compact and ultra lightweight optical communication payloads for small satellites. Since 2017, TESAT is the industrial partner for this technology and the first products based on this technology are available on the market.



SPACE SEGEMENT

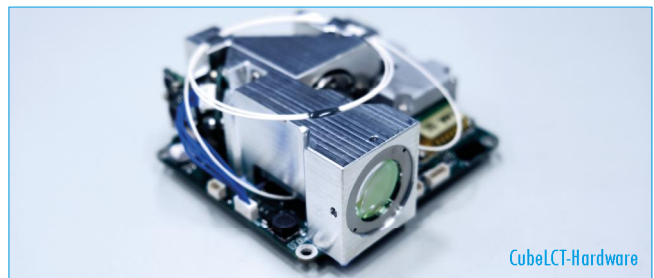
CubeLCT and TOSIRIS are laser communication terminals for direct-to-Earth communications. The 100 Mbps CubeLCT is the CubeSat derivative of this product family. With a mass of below 400g, 1/3U volume and 10W peak power it is the smallest industrialized terminal on the market. On the upper limit of this product family there is the TOSIRIS laser communication terminal with a raw channel rate of 10 Gbps but still very compact in size, weight and power.

Therefore, TESAT has setup a modern production line for this products featuring paper- and drawingless production.

able easy access to optical ground stations for all missions and customers using TESAT terminals.

To reach this, TESAT offers three solutions: First is the dedicated single-site optical ground station, the OGS 600T, which can be procured directly from TESAT. Second is to support the leading optical ground network operators, e.g. KSAT, to include optical downlinks in their service portfolio. Third is to support the upgrade of existing optical ground stations to receive data from TESAT optical terminals.

The goal is to have operational ground segments by end of 2020 and the OGS-600T ready by mid 2020.



CubeLCT-Hardware

GROUND SEGEMENT

While the development of optical space terminals is advanced and the technology already mature, the accessibility of optical ground segment is not as good as it could be. Thus, TESAT has formulated the goal to enable

SERVICES

This end-2-end responsibility is complemented by the introduction of new services, e.g. link planning of optical links, commissioning of the laser terminal, optical ground station check-out with TESAT space asset and generation of maintenance reports for constellation health status supervision.

NEXT MISSIONS

First mission making use of the compact CubeLCT is the mission PixL (Photo Imager cross Laser) onboard of a 3U Gomspace CubeSat platform. The flight readiness review is scheduled for later this year and the availability of the optical ground station check-out service for second quarter of 2020. The mission will be operated by the German Space Operation Center (GSOC) in Oberpfaffenhofen.

Next to this CubeSat mission laser communication is going to the ISS, hosted on the Airbus Bartolomeo platform. This mission is scheduled for mid 2020 and will be the first mission using a commercial optical ground network for optical direct-to-Earth links.