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PLANNING LASER LINKS FOR A DATA RELAY SYSTEM: THE GROUND SYSTEM DESIGN OF TDP-1

Abstract

The TDP-1 program ("Technology Demonstration Payload No.1") is the proof-of-concept for the European Data Relay System EDRS. The idea of these relay systems is to solve two big problems of todays observation satellite missions: First, the quantity and duration of ground station contacts and thus the downlink capacity is limited. Second, the time span between the data take and the next ground station contact might be quite high, e.g. 12 hours, which can be unfortunate for missions with an utmost interest in up-to-date data. By the usage of a geostationary relay satellite (GEO), the communication window for low-orbit observation satellites (LEOs) covers practically half of earths surface, thus strongly reducing the extents of the two described problems.

Proving this concept of data transfer between a LEO and a ground station via a GEO in between the communication chain, is the goal of the quasi-operational technology demonstration payload TDP-1. This detour is performed by using Laser Communication Terminals (LCTs) on board the observation as well as the communication satellite, from which the data is immediately downlinked via Ka-Band. This Laser Technology is perfectly suited for these kind of Inter-Satellite Communication and allows for a transmission speed of 1.8 Gbps.

Up to today, the program involves LCTs on board three satellites in orbit: The two LEOs Sentinel-1a and Sentinel-2a (operated by ESOC and part of EUs Copernicus program) and the GEO Alphasat (operated by Inmarsat). The data is downlinked to a Ka-Band ground station of the Deutsches Fernerkundungsdatenzentrum (DFD) in Oberpfaffenhofen, Germany.

The project is a collaboration of DLR, ESA, and TESAT-Spacecom. The development of the LCTs is lead by the Space Administration of DLR, funded by the Federal Ministry for Economic Affairs and Energy, and performed by TESAT Spacecom GmbH. Copernicus is a program of the European Commission, organized and executed by ESA.

The operational concept, which will in detail be described in the paper at hand, has been developed by DLR GSOC as TDP1 Mission Control Center. The concept is based on the precursor programs TerraSAR-X and NFIRE and performs all necessary tasks and steps fully automated. This includes calculation of feasible link slots based on satellite orbit and availability data, scheduling of customer link requests, and generation of operational products for the involved spacecrafts to execute the links.