**OSIRIS4CubeSat – System Engineering with New Space approach from the development of a high data-rate Optical Communication payload to the demonstrator in a quasi-operational mission**

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1. **Introduction**

Modern satellite missions like CubeSat-missions are characterized by extremely short development time and significant low resource requirements. This can only be reached by reducing classical standards to necessary levels, tailored down for the respective mission. It leads to a rethinking of system engineering in modern space missions following the new space approach, which tailors down the standard processes to a minimum but reasonable level.

The Optical Communication Systems Group (OCS) of DLR develops solutions to break the bottleneck caused by limited data-rates of traditional RF-communication systems with Free-Space-Optics (FSO) technologies for earth orbiting platforms. Therefore DLR started 10 years ago the OSIRIS (Optical Space InfraRed downlInk System) program which concentrates on research and development of laser communication terminals for Low-Earth-Orbit (LEO) satellites. The development speed in laser communication accelerated in the last years due to the availability of compact and low-cost flying platforms like pico- and nanosatellites. Therefore OCS follows the new space approach to shorten development times and finish projects much earlier compared to traditional space missions.

The OSIRIS4CubeSat (O4C) project has the goal to develop a high data-rate optical communication payload for CubeSats and demonstrates it in a quasi-operational scenario. The development of the payload is in close collaboration with Tesat-Spacecom who sells O4C under the name “CubeLCT” as a commercial product. Beside the payload development, the functionality of O4C will be demonstrated in a direct to earth downlink from a CubeSat to an Optical Ground Station. Thus, the payload will fly in the PIXL-1 mission on a 3U CubeSat built by GomSpace. After the Launch and Early Operational Phase (LEOP) the satellite will be hand over to German Space Operation Center (GSOC) to demonstrate for the first a time a commanding of a CubeSat by a professional Ground System.

The ambitious path from the development of the payload, which started from scratch, to a quasi-operational mission, shows the necessity of a working system engineering to observe all requirements, coordinate the different teams and manage the interfaces to the stakeholder. This paper describes the system engineering based on the new space approach for a modern CubeSat mission. In the beginning of the project the overall requirements for the whole project were defined. This includes the technical requirements for the payload, to ensure the functionality depending on the extreme environmental conditions in space and the requirements for the satellite. Furthermore the operational requirements were defined. Additionally to the internal requirements the needs of the commercialization partner and the possible launch opportunities had to be considered.

Beside the requirements, the single work packages were defined to distinguish the several tasks and visualise the interfaces and connections in a work breakdown structure (WBS). Based on the WBS the technical teams for the development were formed. During the concept development and the integration of the payload, the system engineering had to monitor the requirements and coordinate the different technical teams with all their interfaces. Even though the teams were separated in optics, mechanics, electronics and software, their tasks were strongly connected. Beside the internal interface coordination the system engineering had to coordinate the communication on technical level to the external stakeholders like contractee (Tesat), satellite manufacturer (GomSpace), launch provider and operator (GSOC).

This paper gives an overview over the processes in the OSIRIS4CubeSat project which represents modern system engineering following the new space approach.