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SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Future Building Blocks in Space Exploration and Development (2)

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TYCHO: DEMONSTRATOR AND OPERATIONAL SATELLITE MISSION TO EARTH-MOON-LIBRATION POINT EML-4 FOR COMMUNICATION RELAY PROVISION AS A SERVICE

Abstract

In the current wake of mission plans to the Moon and to Earth-Moon libration points (EML) by several agencies and organizations TYCHO identifies the key role of telecommunication provision for the future path of lunar exploration. It demonstrates an interesting extension to existing communication methods to the Moon and beyond by combining innovative technology with a next frontier location and the commercial space communication sector.

It is evident that all communication systems will rely on direct communication to Earth ground stations. In case of EML-2 missions around HALO orbits or bases on the far side of the Moon, it has to be extended by communication links via relay stations. The innovative approach is that TYCHO provides this relay communication to those out-of-sight lunar mission as a service. TYCHO will establish a new infrastructure for future missions and even create a new market for add-on relay services.

The TMA-0 satellite is TYCHO's first phase and a proposed demonstrator mission to the Earth-Moon libration point EML-4. It demonstrates relay services needed for automated exploratory and manned missions (Moon bases) on the rim and far side surface, to lunar orbits and even to EML-2 HALO orbits (satellites and space stations). Its main advantage is the permanent availability of communication coverage. This will provide full access to scientific and telemetry data and furthermore to crucial medical monitoring and safety. The communication subsystem is a platform for conventional communication but also a test-bed for optical communication with high data-rate LASER links to serve the future needs of manned bases and periodic burst data-transfer from lunar poles.

The operational TMA-1 satellite is a stand-alone mission integrated in existing space communication networks to provide open communication service to external lunar missions. Therefore the long-time stable libration points EML-4 and -5 are selected to guarantee an operation time of up to 10 years. It also enables measurements of the libration point environment with the scientific payloads. This includes sensors for space dust, solar and cosmic radiation activity for satellite lifetime estimation and lunar crew protection by means of early-warning system.

The paper describes the mission concept and the pre-design of the demonstrator satellite according to the operational mission requirements and advantages and benefits of this service. The concept was awarded with the Space Generation Advisory Council and OHB Scholarship in 2011 and the concept study is conducted at the Institute of Space Systems (IRS) of University of Stuttgart.