SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
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Author: Dr. Andreas Rathke
Airbus DS GmbH, Germany

Mr. Thomas Dreischer
beyondgravity, Switzerland
Mr. Mariano Sánchez Nogales
Deimos Space S.L., Spain
Mr. Alberto Torre
INSA, Spain
Dr. Manfred Wittig
European Space Agency (ESA) retired, The Netherlands

A TECHNOLOGY ROADMAP FOR INTERPLANETARY COMMUNICATIONS

Abstract

Data transmission to Earth is a notorious bottleneck of interplanetary science and exploration missions. This situation is likely to intensify in the future because the next generation of scientific instruments will generate even higher data rates. In order to address this challenge, ESA has placed an industrial study that shall analyse the telecommunication needs of future interplanetary missions and propose a roadmap to develop the required communication technologies.

The study considers the time frame beyond those missions that are currently under implementation. Particular emphasis is put on the decade from 2017 to 2027 but also the long-term evolution up to 2040 is considered. The full range of scenarios that shapes the requirements for future interplanetary communications systems is taken into account, comprising lunar missions, telescopes at L2, Mars missions and missions to other planets and small bodies. Both, robotic and human missions, are considered. For these mission classes the required telecommunication systems are analysed in all aspects, encompassing the overall communication architecture, ground-segment technologies, space-segment technologies, communication protocols and navigation functionality.

While most targets of interplanetary missions are visited only infrequently, Lunar or Mars missions are likely to be undertaken regularly and justify a communication infrastructure at these targets. The establishment of a single dedicated relay at the Earth-Moon-L2 or in orbit around Mars enables significant advances in the telecommunications capabilities for missions to these targets. A relay could provide larger resources for the long-haul link with Earth and allow the implementation of high-power, large-antenna radio-communication systems or of high-power large-aperture laser-communication systems. For such communication systems, but also for the short-haul links between the relay and landers or orbiters, the present-day technologies are analysed with respect to their suitability and for all elements of the telecommunications system the technology gaps are identified. To close the gaps a technology development roadmap is drafted. Care is taken that the selected technology options are versatile enough to also provide considerable benefit for telescope missions at L2 and robotic outer-planet missions. The technology roadmap comprises in particular a realistic schedule for the required near-term and medium-term activities and considers also the cost of the technology programme. The roadmap could hence contribute to the basis for the programmatic planning of telecommunications technology development for future ESA interplanetary missions.