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Space-Data Routers: Enhancing Deep Space communications for scientific data transmission and exploitation from Mars through Space Internetworking

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Dissemination and exploitation of data from Deep Space missions, such as planetary missions, face two major impediments: limited access capabilities due to narrow connectivity window via satellites (thus, resulting to confined scientific capacity) and lack of sufficient communication and dissemination mechanisms between deep space missions such the current missions to Mars, space data receiving centers, space-data collection centers and the end-user community. Although large quantities of data have to be transferred from deep space to the operation centers and then to the academic foundations and research centers, due to the aforementioned impediments more and more stored space data volumes remain unexploited, until they become obsolete or useless and are consequently removed. In the near future, these constraints on space and ground segment resources will rapidly increase due to the launch of new missions.

The Space-Data Routers (SDR) project aims into boosting collaboration and competitiveness between the European Space Agency, the European Space Industry and the European Academic Institutions towards meeting these new challenges through Space Internetworking. Space internetworking gradually replaces or assists traditional telecommunication protocols. Future deep space operations, such as those to Mars, are scheduled to be more dynamic and flexible; many of the procedures, which are now human-operated, will become automated, interoperable and collaborative. As a consequence, space internetworking will bring a revolution in space communications.

For this purpose, one of the main scientific objectives of the project is, through the examination of a specific scenario, the enhanced transmission and dissemination of Deep Space data from Mars, through unified communication channels. Specifically, the scenario involves enhanced data transmission acquired by the OMEGA sensor on-board ESA's Mars Express satellite. We consider two separate issues considering the capabilities of SDR in terms of (i) augmenting the data volume received from the Mars Express, through the increase of the spacecraft's connectivity with the Earth ground receiving stations and in terms of (ii) increasing the user's access speed to the OMEGA scientific data. Especially for the first, we test alternative scenarios for augmenting the data volume received specifically from OMEGA, through the enhancement of the spacecraft's connectivity with ground receiving stations. Simulation results have proven the potential of SDR in efficiently meeting the new enhanced challenges in future robotic and human missions to Mars in terms of data transmission and data handling.

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