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Author: Ms. Shreya Santra
Skolkovo Institute of Science and Technology, Russian Federation, shreya.santra@community.isunet.edu

Ms. Divya Shankar
Skolkovo Institute of Science and Technology, Russian Federation, divya.outerspace@gmail.com
Ms. Punyapat Saksupapchon
Skolkovo Institute of Science and Technology, Russian Federation,
punyapat.saksupapchon@skolkovotech.ru
Dr. Dzmitry Tsetserukou
Skolkovo Institute of Science and Technology, Russian Federation, D.Tsetserukou@skoltech.ru

CONCEPT STUDY OF COMMUNICATION ARCHITECTURE FOR A CIS-LUNAR HUMAN-ROBOTIC MISSION

Abstract

A lunar-base is considered to be the next step in human space exploration and communication system design plays a vital role in realizing this aim. This paper presents a design goal to achieve human-robotic partnership with a space station at Earth-Moon Lagrangian point L2. A human crew is considered to be present on the space station at L2 and involved in various operations to control the robots on the lunar surface which will be deployed to build the In-Situ Research Unit (ISRU) and 3D printing facilities for the lunar base. This paper aims to illustrate a communication architecture design, requirements and constraints to establish telerobotic operations within the time frame of the lunar exploration roadmap 2020-2030. The main objective is to establish constant communication link between three nodes; a prospective lunar station in L2, a base on the Lunar surface and an Earth Station, which is a vital requirement in constructing the lunar base. This paper details various communication architectures which includes building ground terminals and have satellite constellations in the Lunar and Earth Orbits. This communication architecture is to support the teleoperations required for the lunar surface exploration and for the communication link direct to the Earth. Different communication architectures are analyzed and trade-offs are shown. These include study of space station orbit locations, number of ground segments and satellites requirements, and complexity in developing the supporting infrastructure. Based on the mission architecture evaluation and simulation result, the best architecture chosen is to have one ground station on Moon and a space station at L2 Offset point which can have near continuous field of visibility with both Moon and Earth.

This objective will pave way for future internet of things on lunar base to achieve the main goal of preparing the Moon for rigorous surface exploration and make it as an intermediate stop during interplanetary and interstellar exploration.