

IAF SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Part 3 (2C)

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CONCEPTUAL DESIGN OF AN INTEGRATED LUNAR SURFACE COMMUNICATION SYSTEM
FOR THE PRESSURIZED ROVER “LUNAR CRUISER”**Abstract**

Since 2019, JAXA and Toyota Motor Corporation have been jointly developing a crewed pressurized rover, the Lunar Cruiser, as part of international lunar exploration initiatives. The rover is designed to support sustained crewed surface operations of approximately one month, as well as extended uncrewed missions dedicated to geological and resource exploration. Owing to this dual mode operation, the Lunar Cruiser is expected to play a key role in the Artemis program, which aims to enable sustainable human activities on the Moon. The extravehicular communication system of the Lunar Cruiser is required to provide reliable telecommand and telemetry links between the rover and ground control systems during both crewed and uncrewed operations. Communications are established via Earth based Deep Space Network (DSN) stations and Lunar Exploration Ground Sites (LEGS), in addition to lunar orbital assets such as the Gateway and Lunar Communication Relay and Navigation Systems (LCRNS). To ensure continuous connectivity under varying operational conditions, the system must flexibly secure, select, and switch among multiple frequency bands and communication links. Furthermore, given the severe bandwidth limitations of lunar–Earth communications, the system must efficiently accommodate diverse data types, including rover health and status telemetry, multiple voice channels, video streams, and remote control signals for uncrewed operations. In this study, we examine the applicability of terrestrial wireless communication technologies, such as 3GPP based systems and Wi Fi, to the lunar surface environment, with an emphasis on future scalability of lunar communication infrastructure. Considering the unique propagation characteristics and operational scenarios of the lunar environment, we propose a conceptual design of an extravehicular communication system that integrates terrestrial wireless technologies with conventional space communication systems through functional role sharing and interconnection. The proposed design approach and key findings provide insights into the effective utilization of heterogeneous communication technologies for future lunar surface missions.