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COMMUNICATION INTEROPERABILITY FOR LUNAR MISSIONS

**Abstract**

Extending human presence into cislunar space is the next step in human spaceflight. Rather than independent missions, the approach for lunar exploration is an innovative and sustainable program of exploration with commercial and international partnership. Interoperable, cross-supportable, and compatible communications between space vehicles and systems, ground infrastructure, and lunar assets is critical to the success of human exploration. It enables use of NASA, international partner, and commercial assets interchangeably, decreases development and procurement costs and reduces operational and training complexity.

NASA, along with the International Space Station membership, have been collaborating to establish the International Communication System Interoperability Standard (ICSIS). The ICSIS provides interoperable and compatible communications terminology, interfaces, and techniques to facilitate collaborative endeavors of space exploration in cislunar and deep space environments. Some key challenges to a communication system as humans venture further out into space include the ability to operate over different mission phases and be compatible with multiple interfaces, longer latencies, an evolving architecture, system integration across multiple levels, and forward compatibility, extensibility, and scalability. A common set of standards and interfaces at the different layers of the protocol stack is essential to addressing the above challenges while addressing size, weight, and power constraints and highly reliable operations. Interoperability also enables partners to assist each other in emergency or contingency situations that can occur during Exploration. The focus of the current version of the ICSIS is a space vehicle/platform used for human exploration in cislunar space, a Cislunar Space Platform (CSP) used for human exploration, and its interfaces.

The Gateway, which includes U.S. and international partnership, is central to advancing and sustaining human space exploration goals, and is the unifying single stepping off point in the architecture for human cislunar operations, lunar surface access, and missions to Mars. Gateway, which will nominally operate in the Near Rectilinear Halo Orbit, will provide for multiple links to the Earth, visiting vehicles, and Lunar systems. Gateway is the first Cislunar Space Platform (CSP) to require the use of the standard.

This paper summarizes the development approach for the ICSIS and technologies considered. The status of the current standard is discussed, along with considerations for future revisions. The current Gateway communication concept of operations and requirements are summarized, along with the communication and navigation system on the first Gateway element – the Power and Propulsion Element (PPE).