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INTEROPERABILITY AND INTERDEPENDENCE THROUGH COORDINATED TECHNOLOGY DEVELOPMENT AND INTEGRATED TESTING

Abstract

The International Space Station (ISS) can be considered a major success from both a technical and programmatic perspective when considering that its completion required the successful integration and operation of hardware, software, major elements and crew and cargo spacecraft from the United States, Russia, Canada, Japan, Italy, and the European Space Agency. Not only that, but the on-orbit elements and systems were integrated and evolved over 12 years of crewed operation in Low Earth Orbit (LEO). To achieve this success, standards, interfaces, and integration sequences and operations were defined and agreed upon early in the program and rigidly maintained. In May 2007, the International Space Exploration Coordination Group (ISECG) involving fourteen international space agencies, created the "Global Exploration Strategy (GES): The Framework for Coordination" document as a vision for achieving future coordinated robotic and human space exploration through a voluntary, non-binding international coordination mechanism. The GES was further refined with the release of the Reference Architecture for Human Lunar Exploration in June 2010 and Global Exploration Roadmap in September 2011. These documents provide a coordinated strategy that helps space agencies with shared objectives to engage in joint projects that can maximize their return on investment. To achieve the goals and possible mission architectures defined in the GES exploration roadmaps, space agencies will need to define and develop technologies and mission elements as well as standards and interfaces in cooperation with other participants. This coordination will be difficult to achieve through a voluntary, non-binding international coordination mechanism. One approach that has been implemented and has been evolving over the last several years between NASA and CSA that meets the spirit of the GES is surface system interoperability through joint technology/system development and demonstration through integrated testing. The knowledge gained and lessons learned from two three integrated analogue field tests can be evolved to further encourage coordinated technology and system development, remove barriers for integration, and minimize the risk of multiple partner by building trust and data exchange capabilities in advance of future missions. This paper will review the approach, results, and lessons-learned from joint NASA-CSA development and integrated testing performed to date, and propose how this approach can be expanded to identify and coordinate technologies of strategic importance to each partner, examine and evolve interfaces and standards, utilize an 'Open Architecture' approach for surface exploration, and perform integration and testing to provide visual milestones and successes on an as-available evolvable basis.