SPACE SYSTEMS SYMPOSIUM (D1)
Lessons Learned in Space Systems (5)

Author: Mr. Brian Muirhead
Jet Propulsion Laboratory - California Institute of Technology, United States,
brian.k.muirhead@jpl.nasa.gov

Dr. Dale Thomas
National Aeronautics and Space Administration (NASA), Marshall Space Flight Center, United States,
dale.thomas@nasa.gov

LESSONS LEARNED IN ARCHITECTING HUMAN SPACEFLIGHT PROGRAMS

Abstract

This paper discusses the fundamentals of architecting a major human spaceflight program and the lessons that can be learned from Constellation. Constellation is NASA's program to implement a new generation of human exploration missions to the moon and beyond. It is a tightly coupled program where a unique set of architectural challenges can be seen and evaluated to better understand how architecting of such systems can be done better in the future. While the specific issues discussed in this paper derive from the current Constellation architecture they share threads with previous crewed systems including Apollo and Shuttle and are likely to be common to any human exploration system or spaceflight system of significant technical and programmatic complexity.

This paper will describe the fundamentals of system architectures, as seen in the organization of a system, as embodied in its constituent elements, the relationships between elements and stakeholders, the environment and the principles governing the design and the sustainability over time. The foundation and development of the Constellation architecture will be discussed including primary architectural drivers such as crew safety, performance, risk, and programmatics. Comparisons to past human spaceflight architectures including Apollo, Shuttle and the International Space Station will be made. The paper will focus on a set of the most significant challenges to creating and sustaining a human exploration architecture. Specific recommendations for developing, communicating and implementing architectures of such complex systems will be made.