Applying the Reference Architecture for Space Data Systems

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Focus Issues:

- Architectural representation and analysis
- Standards and interoperability
- Space and ground communication architectures
- Applying the reference architecture

ABSTRACT

Architectures for data systems that are built and managed by a single organization are inherently complex. In order to understand a large scale space data system architecture, and to judge its applicability for its nominal task, a description must be produced that exposes a number of distinct viewpoints. Such descriptions will typically cover the uses that are to be made of the system, the functions that the system performs, the elements that compose the system, the information that flows among these elements, and the specific technologies that are integrated into the system.

There are a variety of approaches that can be used to describe such system architectures and to capture these various viewpoints and their relationships. A standard called Reference Model for Open Distributed Processing (RM-ODP) has been developed within ISO and ITU to provide a common way to describe large, multi-organization systems. This modeling approach provides views on a system that go from the organizational (Enterprise) to the abstract (informational, computational), to the more concrete (Engineering, Technology).

Within the CCSDS Architecture Working Group we have adapted RM-ODP to describe large, multi-national, space data systems. These systems exhibit all of the complexities of typical terrestrial systems, but are frequently compounded by involvement of several space agencies, some unusual organizational cross-support arrangements, and use of contractors in a number or roles. We also must deal with the complexities of operating systems in space, including all of the physical constraints and challenges that that environment brings. The most fundamental challenge is the physical space environment (motion, obscuration, long round trip light times, episodic connectivity, low signal strength, asymmetric data paths) which constrains how these systems are engineered and operated, and often requires different protocols for communications than those that can be used terrestrially.

We have produced a methodology, based upon RM-ODP, which provides the necessary concepts and notation for describing these complex space data systems. The reference architecture is intended for use by two different, but related, user communities: the system users and the system and standards developers. The approach is intended to be general enough to permit description of civilian, military, and commercial space data systems, the spacecraft, ground systems, processing and communications resources, and organizational arrangements. There is related work to identify means to capture these architectures and the behavior of the described elements in a machinable way, such that we can reason about the completeness and accuracy of the system as described. As a way of assessing performance and exploring design trades we hope to eventually be able to simulate at least the coarse grained overall behavior of such systems based upon their descriptions.

This paper will describe the Reference Architecture for Space Data Systems (RA-SDS) and show how it can be applied to an analysis of the trade space, issues, and possible approaches to deploying a distributed information infrastructure in support of autonomous space exploration.