

Reducing the Cost of Spacecraft Ground Systems and Operations

In the late 1980s JPL reduced the cost of spacecraft ground systems by implementing the Space Flight Operations Center (SFOC). Over its 15-year history this system has had several names and incarnations. What it did was eliminate the practice of building each spacecraft's ground system from scratch. SFOC provided a set of services which could be customized to support each spacecraft's needs. SFOC built upon the CCSDS packet telemetry standard on packets. This allowed SFOC to provide services based on a standard.

This is an excellent strategy and should be pursued at every opportunity.

However, it is not a panacea for ground system costs and operations. In fact no single solution will reduce the costs for every spacecraft and therefore we must continue to search for alternate methods.

In this paper I will discuss how architecture when used early in the development process can help identify complexity. Architectures constrain the solution space, reduce the time spent exploring ineffective solutions and consequently architectures help contain system life cycle cost.

A common heuristic used at JPL is: "Mistakes made the first day are the most costly and difficult to correct." So it is natural to attempt to move lessons learned further back in the development cycle. However, in early phases of project development resources are limited and attention cannot be focused on all aspects of development. The goal of this paper is to encourage the early introduction of architectural principles by all participants. A single person or a small team of people can effectively apply these principles.

I will present an example of how early application of architecture in development of a part of the Cassini ground data system help identify desirable traits, and lead to early development of requirements. The architecture restricted the solution space; constrained the options available and lead to a cost effective solution. It should be noted that the solution space identified by the architecture was not fully implemented; however the key aspects of the system were.

I will also discuss areas where the solution space was not sufficiently constrained and thus cost exceeded expectation. I will discuss how application of architecture principles might have helped identify these areas.