Data Management in the Mission Data System

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Abstract - *As spacecraft evolve from simple embedded devices to become more sophisticated computing platforms with complex behaviors it is increasingly necessary to model and manage the flow of data, and to provide uniform models for managing data that promote adaptability, yet pay heed to the physical limitations of the embedded and space environments. The Mission Data System defines a software architecture in which both control theory and end-to-end data management provide the primary guiding principles.*

Keywords: data management, resource management, mission data system, MDS.

1 Introduction

As space missions become more complex with ever greater demand for automation, increasingly tight interoperability requirements between robotic vehicles, and unprecedented levels of human-robot interaction, the size and complexity of the data systems needed to manage them must also evolve. However, unbounded expansion in many different directions of a software system is a recipe for disaster. The narrowly-focused and highly customized solutions of the past quickly begin to show their limitations in the form of unexpectedly inflated costs and slipped schedules.

The Mission Data System (MDS) defines a software system architecture for remotely operated embedded control systems. Based in control theory, it defines entities and relationships needed for state estimation and control. As the name implies, providing a robust and flexible framework for data management was one of the key objectives of the MDS. Software architectures are intended to provide high-level design guidelines that can guide the design decisions that must be made during the design of a real system.

An embedded control system, and particularly one that is remotely-controlled has two primary responsibilities: to effectively translate the intent of remote operators into actions, and to return information describing what happened. For scientific spacecraft, this can be summed up in a single statement: make good science observations, and return the results to where we can use them. While control theory is central to this process, it is equally a problem of data management. It is a problem of producing and storing data, processing it to convert to more usable forms, moving it across space and time and keeping track of it in the process, and managing limited storage resources.

Moving data between systems is usually referred to as telemetry, though modern telecommunications capabilities are a far cry from what this term implied only a few decades ago. Early spacecraft were extremely simple remote sensing devices with sensors directly modulating radio signals. The introduction of more advanced onboard computers and storage devices has enabled a much greater range of sensing and control, autonomous operations, onboard analysis of data, and complex interactions between spacecraft, including routing data through other spacecraft. The pressure to advance these capabilities to provide more information, and more useful information is intense, but is severely constrained by the physical limitations of operating in space.

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Figure 1. Fusion data flow

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3 Conclusions

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