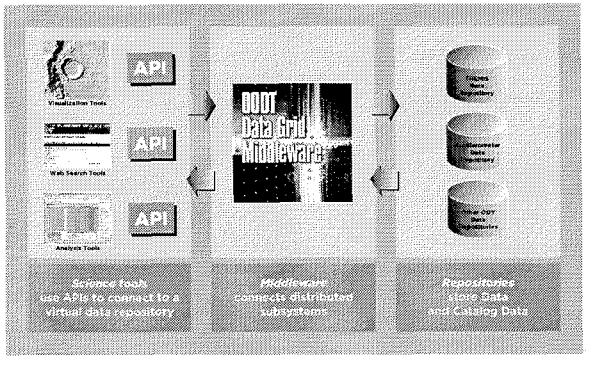
Packaging Data Products Using Data Grid Middleware for Deep Space Mission Systems

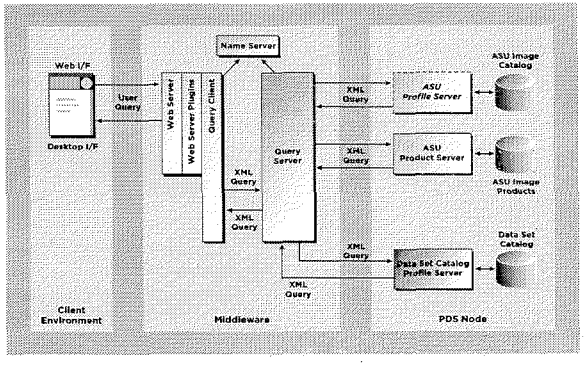
U00A-0000

Object Oriented Data Technology

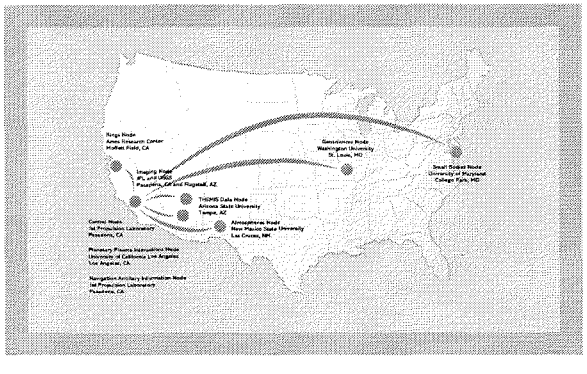
Distributed Systems Infrastructure



Component Architecture



Distributed Planetary Science Archive



Information Infrastructure Goals

- Foster an inclusive collaboration among space scientists
- Establish a knowledge system for seamless search and retrieval across multiple data repositories
- Support scientific analysis across multiple planetary science data systems
- Support the discovery of new techniques for discovery of planetary phenomena including validation and correlation of planetary science data

ABSTRACT

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Deep Space Mission Systems (DSMS) lack the capability to provide end to end tracing of mission data products. These data products are simple products such as telemetry data, processing history, and uplink data. Additionally, there is a need to create Complex products (packages) which can contain one or more of the simple products, along with descriptive information about the package itself. The ability to track both types of these data products is crucial for providing visibility of in-process status along the data product pipeline between space and ground. Other applications of this information include measuring performance of the space-to-ground data product pipeline and the timeliness of operational activities, which are key metrics in mission-critical, large-scale embedded systems that exist in multi-node space-toground missions. In order to facilitate this tracing, information about the product format and the observation (metadata) can be defined, captured, and cataloged per data product in the pipeline. Science teams can then use the cataloged metadata to discover the location and format of data products currently in the pipeline to engage in work earlier, and with a better understanding of the data products themselves.

There are certain challenges; however, in producing a system that can meet these requirements, namely (1) The distributed nature of the mission data products makes it very difficult to catalog and trace along their respective lifecycle in the space to ground pipeline. (2) Both the data product formats, and the system interfaces which expose the data products are heterogeneous in nature and thus very difficult to integrate. (3) No clear methodology or standard exists to describe a process for data product packaging, including the format of the package, and what metadata should be stored about the package itself.

At the National Aeronautics and Space Administration's Jet Propulsion Laboratory, we are addressing this very problem. We are investigating a distributed computing infrastructure for releasing science products out of the mission pipeline. We are creating a DSMS Product Service and DSMS Data Packaging Service based on the OODT middleware, a Data Grid middleware technology that has proven successful in providing access to heterogeneous, disparate data, and federating that data using a common data model. We seek to provide the capability to (1) Package the distributed data products returned from nodes in the DSMS pipeline (nodes can be spacecraft, satellite, ground stations, etc.), and create package metadata attached to the product package itself (2) Conform our data product model to a packaging standard, such as the one proposed by CCSDS and (3) Catalog Products in the DSMS pipeline so that they can be retrieved, and packaged. Early results from this work suggest that it is a feasible approach to address the challenges described above.

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