The Planetary Data System (PDS) faces new challenges in managing and providing access to its increasingly large network of heterogeneous and geographically distributed subsystems. The PDS is exploring Object-Oriented Data Technology to support cross-discipline data access using a software component framework and a metadata driven implementation. This approach allows customers to locate data and access subsystems based on existing metadata descriptions. It also allows additional links between subsystems to be developed as data models evolve.
A Model Driven Architecture for Distributed Data Management

Steve Hughes
PDS System Engineer

http://pds.jpl.nasa.gov
Problem Statement

- Distributed Data Management and Access
  - PDS needs an integrated view of all data in the PDS
  - Users need integrated spatial/temporal access to data distributed at geographically dispersed sites
  - Scientists need infrastructure support for science analysis and knowledge discovery
Independent Access to PDS Archives (e.g. Mars)

- MOC Interface
- MOLA Interface
- TES Interface
- Viking Interface
- Odyssey Interfaces

Mars Global Surveyor
- MGS MOC
- MGS TES
- MGS MOLA

Viking
- Viking MDIM
- Viking EDR

Ancillary Files
- DOCUMENTS & ANCILLARY FILES

Mars Odyssey
- THEMIS EDR ASU
- MARIE EDR PDS PPI
- GRS RDR PDS GEO
- GRS EDR UofA
Current Approach (circa 1998)

- PDS Distributed Inventory System (DIS)
  - Identified all resources available across the PDS
  - Used Object Description Language (keyword/value) labels to describe data and non-data resources
  - Included URL/FTP links to all online resources
  - Used cgi-script engine to search label database
  - Displayed results in an HTML page
DIS Label

OBJECT = DATA_SET;
DATA_SET_NAME = VO1/VO2 MARS VISUAL IMAGING SUBSYSTEM DIGITAL IMAGING MODEL;
DATA_SET_ID = VO1/VO2-M-VIS-5-DIM-V1.0;
DATA_SET_DESC = http://pds.jpl.nasa.gov/cgi-bin/remote.pl?ds:VO1/VO2%2BMARS%;
DATA_SET_TERSE_DESC = http://pds.jpl.nasa.gov/cgi-bin/remote.pl?ds:VO1/VO2%2BMARS%;
DATA_SET_RELEASE_DATE = 1991;
ARCHIVE_STATUS = ARCHIVED;
ARCHIVE_STATUS_NOTE = Passed peer review with all liens resolved. Available through PDS and NSSDC;
ARCHIVE_SCHEDULE_NOTE = 1999-08-18:ARCHIVED;
DATA_OBJECT_TYPE = IMAGE;
START_TIME = N/A;
STOP_TIME = N/A;
NODE_NAME = IMAGING;
CURATING_NODE_ID = IMAGING;
DATA_ENGINEER_ID = N/A;
TARGET_NAME = MARS;
TARGET_TYPE = PLANET;
MISSION_NAME = VIKING;
INSTRUMENT_HOST_NAME = VIKING ORBITER 1, VIKING ORBITER 2;
INSTRUMENT_HOST_TYPE = SPACECRAFT;
INSTRUMENT_NAME = VISUAL IMAGING SUBSYSTEM - CAMERA A, VISUAL IMAGING SUBSYSTEM - CAMERA B;
INSTRUMENT_TYPE = VIDICON CAMERA;
NSSDC_DATA_SET_ID = 75-075A-01F, 75-083A-01C;
VOLUME_ID = VO_2001, VO_2002, ...;
KEYVALUES = CAMERA, DIGITAL, DIM, IMAGING, MARS, MODEL, ORBITER, PLANET, SPACECRAFT, SUBSYSTEM,
            TABLE, VIDICON, VIKING, VIS, VISUAL, VO1, VO2, VO_2001, VO_2002, ...
LABEL_REVISION_NOTE = 2000-09-19 C:CN S:CN LN:AY:DN;
END_OBJECT;
DIS Links to Mars Archives

Mars Global Surveyor
- MGS MOC
- MGS TES
- MGS MOLA

Viking
- Viking MDM
- Viking EDR

Ancillary Files
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Data Catalogs
Lessons Learned

- Identified metadata as key to the solution
  - Identifies and describes data and resources
  - Provides search attributes
  - Helps determine whether query can be resolved by resource

- However
  - ODL is not a universal interchange language
  - Resource heterogeneity is still visible
  - Navigation and access is limited to http links
  - System interoperability is not supported
Next Generation DIS
XML/JAVA/CORBA (OODT)

• Use common interchange language
• Hide heterogeneity using encapsulation
• Allow communication between all components using message passing protocol
• Maintain system location independence
• Provide scaleable and extensible solution
XML Profile Example – Data Set

<profile>
  <profAttributes>
    <profId>1.3.6.1.4.1.1306.2.102</profId>
    <profType>profile</profType>
  </profAttributes>
  <resAttributes>
    <Identifier>VO1/VO2-M-VIS-5-DIM-V1.0</Identifier>
    <Title>VO1/VO2_MARS_VISUAL_IMAGING_SUBSYSTEM_DIGITAL...</Title>
    <Format>text/html</Format>
    <resContext>NASA.PDS</resContext>
    <resClass>data.dataSet</resClass>
    <resLocation>http://pdsproto.jpl.nasa.gov/catalog/dataset/Resultsds.CFM?...</resLocation>
  </resAttributes>
</profile>
<profElement>
    <elemName>MISSION_NAME</elemName>
    <elemType>ENUMERATION</elemType>
    <elemValue>VIKING</elemValue>
</profElement>

<profElement>
    <elemName>TARGET_NAME</elemName>
    <elemType>ENUMERATION</elemType>
    <elemValue>MARS</elemValue>
</profElement>

<profElement>
    <elemName>MAXIMUM_LATITUDE</elemName>
    <elemType>REAL</elemType>
    <elemMinValue>-87.50000</elemMinValue>
    <elemMaxValue>90.00000</elemMaxValue>
</profElement>
XML Profile Example – Product Server

<profile>
  <profAttributes>
    <profId>1.3.6.1.4.1.1306.2.54</profId>
    <profDataDictId>1.3.6.1.4.1.1306.2.10</profDataDictId>
  </profAttributes>
  <resAttributes>
    <Identifier>PDS Product Server</Identifier>
    <Title>PDS Product Server</Title>
    <Format>image/pds</Format>
    <Language>en</Language>
    <resContext>PDS</resContext>
    <resAggregation>data.granule</resAggregation>
    <resClass>system.productServer</resClass>
    <resLocation>iiop://JPL.PDS.Product_Server</resLocation>
  </resAttributes>
</profile>
Next Generation DIS

Browser Interfaces

Data Mining & Visualization

Data Catalogs

OODT Middleware

Product Servers

Product Servers

MGS MOC

MGS TES

MGS MOLA

Viking MDIM

Viking EDR

DOCUMENTS & ANCILLARY FILES

THEMIS EDR ASU

MARIE EDR PDS PPI

GRS EDR UofA

GRS RDR PDS GEO
MGS Coverage Plot
# OODT Collaborations

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Papers

- OODT Papers ([http://oodt/doc/papers](http://oodt/doc/papers))