

iRODS - Rule Oriented Data System

- **Developers:**
 - Reagan Moore (moore@sdsc.edu)
 - Arcot Rajasekar (sekar@sdsc.edu)
 - Mike Wan (mwan@sdsc.edu)
 - Wayne Schroeder(schroede@sdsc.edu)
- **Goals:**
 - Integration of server-side workflows with distributed data management
- **Collaborators:**
 - NVO - replication of sky surveys onto Teragrid resources
 - Astrogrid - integration of distributed data management with processing pipelines
 - **SHAMAN - Sustaining Heritage Access through Multivalent ArchiviNg**
 - UK e-Science data grid
 - IN2P3
 - CASPAR - Cultural, Artistic and Scientific knowledge for Preservation, Access and Retrieval
 - NCRIS - National Collaborative Research Infrastructure Strategy
 - PLANETS - Preservation and Long-term Access through Networked Services
 - MIT - DSpace digital library
 - NARA Transcontinental Persistent Archive Prototype

Intellectual Property Policy

- I acknowledge that participation in OGF23 is subject to the OGF Intellectual Property Policy.
- Intellectual Property Notices Note Well: All statements related to the activities of the OGF and addressed to the OGF are subject to all provisions of Section 17 of GFD-C.1 (.pdf), which grants to the OGF and its participants certain licenses and rights in such statements. Such statements include verbal statements in OGF meetings, as well as written and electronic communications made at any time or place, which are addressed to: the OGF plenary session,
 - any OGF working group or portion thereof,
 - the GFSG, or any member thereof on behalf of the GFSG,
 - the GFAC, or any member thereof on behalf of the GFAC,
 - any OGF mailing list, including any working group or research group list, or any other list functioning under OGF auspices,
 - the GFD Editor or the GWD process
- Statements made outside of a OGF meeting, mailing list or other function, that are clearly not intended to be input to an OGF activity, group or function, are not subject to these provisions.
- Excerpt from Section 17 of GFD-C.1 Where the GFSG knows of rights, or claimed rights, the OGF secretariat shall attempt to obtain from the claimant of such rights, a written assurance that upon approval by the GFSG of the relevant OGF document(s), any party will be able to obtain the right to implement, use and distribute the technology or works when implementing, using or distributing technology based upon the specific specification(s) under openly specified, reasonable, non-discriminatory terms. The working group or research group proposing the use of the technology with respect to which the proprietary rights are claimed may assist the OGF secretariat in this effort. The results of this procedure shall not affect advancement of document, except that the GFSG may defer approval where a delay may facilitate the obtaining of such assurances. The results will, however, be recorded by the OGF Secretariat, and made available. The GFSG may also direct that a summary of the results be included in any GFD published containing the specification.

OGF Intellectual Property Policies are adapted from the IETF Intellectual Property Policies that support the Internet Standards Process.

VOSpace Interface

- **Data access interface, ported on top of iRODS data grid**
 - Two implementations
- **Observatoire de Strasbourg**
 - Created a first implementation of VOSpace and iRODS: it has been done with a small test bed
 - Schaaff@astro.u-strasbg.fr
- **National Virtual Observatory**
 - PHP based system - Rick Wagner (UCSD)

iRODS

- **Serves as back-end distributed storage environment**
 - Files can be stored across multiple storage systems, in different administrative domains
 - Organizes files into shared collections
- **Implements management policies and server-side workflows**
 - Can define policies that automate the extraction of FITS header file information and register attributes into a searchable database
 - Can define policies that specify where files are stored, replicated
 - Can define policies for retention and disposition
 - Can define time-dependent access controls
 - Can define policies for controlling files stored at multiple sites
 - Load leveling

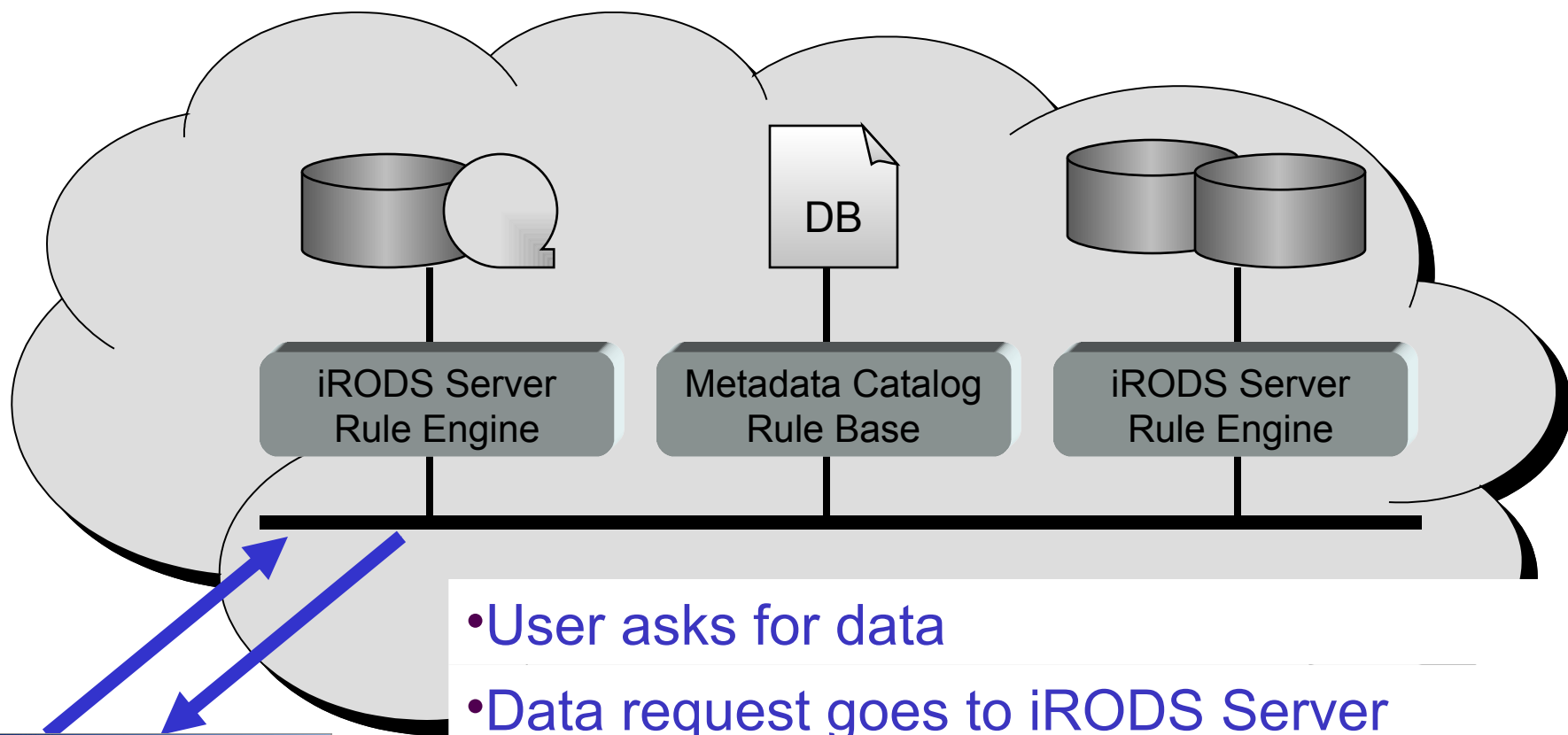
Motivation

- **Integrate server-side workflows into data management**
 - Automate ingestion processing steps
 - Metadata extraction
 - Registration
 - Automate administrative tasks
 - Integrity validation
 - Retention and disposition
 - Distribution and replication
 - Automate post-processing steps
 - Formatting
 - Derived product generation

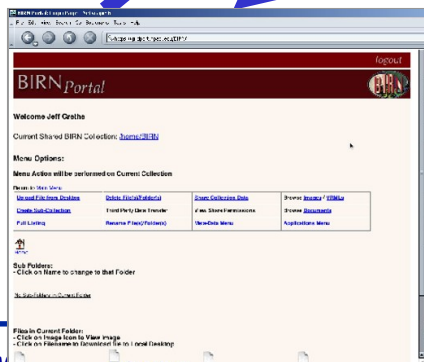
What is iRODS?

- It is a data grid – data virtualization
 - A distributed file system, based on a client-server architecture.
 - Allows users to access files seamlessly across a distributed environment, based upon their attributes rather than just their names or physical locations.
 - It replicates, syncs and archives data, connecting heterogeneous resources in a logical and abstracted manner.
- It is a distributed workflow system – policy virtualization
 - Policy can be coded as functions (micro-services)
 - Remote micro-services can be chained
 - The chains (workflows) are interpreted at run-time
 - The chains can be triggered on an event and condition (rules)
 - They can also be recursive.
 - Micro-services communicate through parameters, shared contexts, and out-of-band message queues.

Using a Data Grid - *Details*



- User asks for data
- Data request goes to iRODS Server
- Server looks up information in catalog
- Catalog tells which iRODS server has data
- 1st server asks 2nd for data
- The 2nd iRODS server applies rules



Policy Virtualization with iRODS

Micro-Services

Functions with well-defined semantics

Transactional - recovery

Context of application

Message Queues

Rules

Triggered by events

Conditional execution of
alternative rule declarations

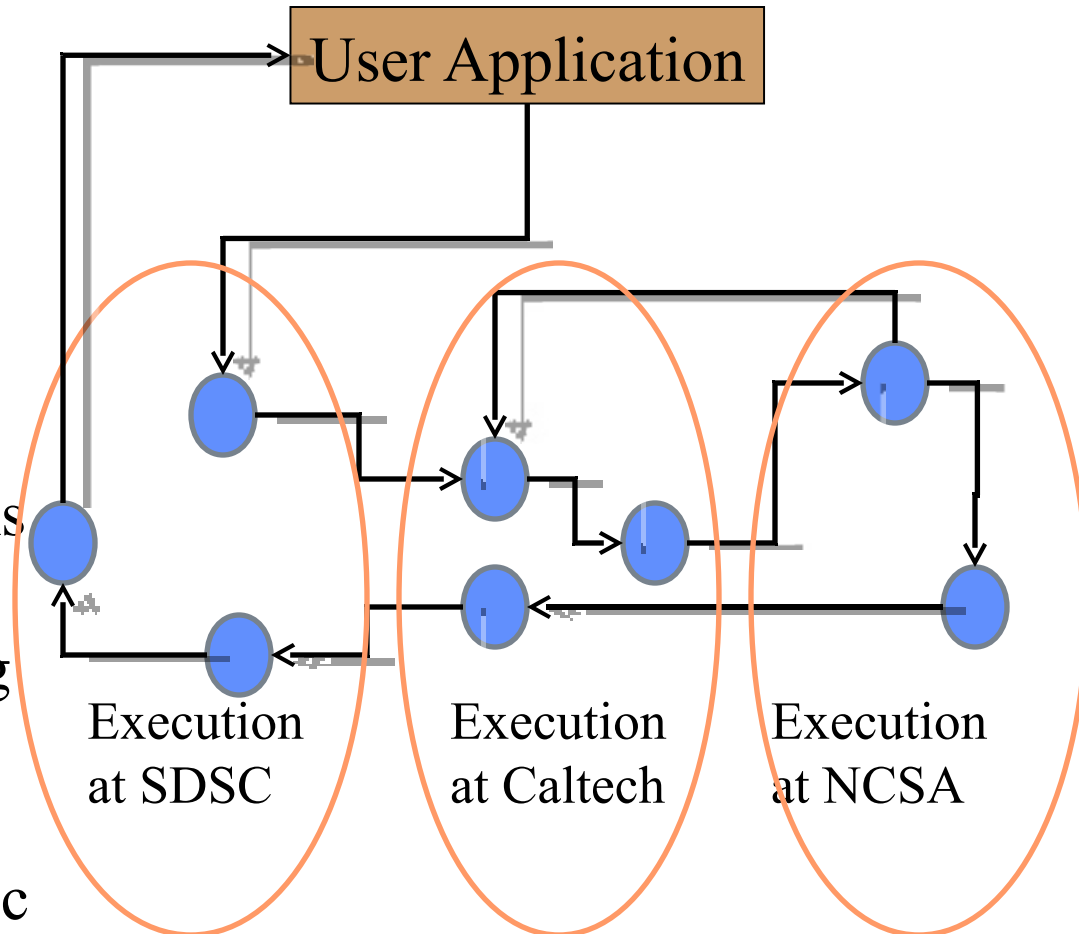
System constructs:

loops, recursion, branching

Workflows

Distributed Execution

Immediate, Deferred, Periodic



Data Virtualization

Access Interface

Standard Micro-services

Data Grid

Standard Operations

Storage Protocol

Storage System

Map from the actions requested by the access method to a standard set of micro-services. The standard micro-services are mapped to the operations supported by the storage system

Automation of Management Tasks

- **integrated Rule-Oriented Data System - iRODS**
- **Express management policies as rules that control the execution of micro-services**
 - Micro-service is a standard operation performed on a remote storage system
- **Manage persistent state information that describes outcome of the micro-service**
 - Persistent Metadata catalog stores state information
- **Virtualize the management policies**
 - Logical name space for rules
 - Logical name space for micro-services
 - Logical name space for state information

iRODS Rules

- **Each rule defines**
 - Event
 - Condition
 - Action sets (micro-services and rules)
 - Recovery sets
- **Rule types**
 - Atomic, applied immediately
 - Deferred, support deferred consistent constraints
 - Periodic, typically used to validate assertions

Management Virtualization

- **Examples of management policies**
 - **Integrity**
 - Validation of checksums
 - Synchronization of replicas
 - Data distribution
 - Data retention
 - Access controls
 - **Authenticity**
 - Chain of custody - audit trails
 - Track required preservation metadata - templates
 - Generation of Archival Information Packages

Rule-based Data Management

- **Administrator-controlled rules to implement management policies**
 - Administrative - adding / deleting users, resources
 - Data ingestion - pre-processing, post-processing
 - Data transport / deletion - parallel I/O streams, disposition
 - Data retention policies – expiration, over-writes, versions
 - Data Reliability Policies – copies, formats, migration, checking,...
- **Associate rules with combinations of name spaces**
 - Rule set for a particular collection
 - Rule set for a particular user group
 - Rule set for a particular user group when accessing a particular collection
 - Rule set for a particular storage system
 - Rule set for a particular micro-service
 - Generic rules based on SRB operations

Sample Rules

ingestObject(*F)

createFile(*F), registerFile(*F).

ingestObject(*F)

\$userDept == sdsc OR \$userDept == ncsa

createFile(*F), registerFile(*F),

computeChkSum(*F),

findBackUpRsrc(*F, *R), replicateFile(*F, *R),

computeChecksum(*F, *R),

compareChecksum(*F).

ingestObject(*F)

\$dataType == FITS Image

createFile(*F), registerFile(*F),

extractFITSMetadata(*F).

Server-side Workflows

- **Each set of operations is encapsulated in a micro-service**
 - Operations performed directly at the remote storage location
- **Can chain execution of micro-services together**
 - Server-side workflow
 - Automatic application of recovery procedures
- **Can issue periodic rules that validate assertions about the shared collection**
 - Assessment criteria
 - Integrity
 - Authenticity
- **Can invoke remote web services through a micro-service**

NVO iRODS Rules

- **getObjPositionByName.ir**
 - Executes the micro-service: msiObjByName
 - Shows as output
 - RA, Dec and Type
- **getCutOutByPosition.ir**
 - Executes the micro-service: msiSdssImgCutout_GetJpeg
 - Stores the Image Cutout as a file in iRODS.
 - Uses other iRODS system micro-services
- **getCutOutByObjName.ir**
 - Chains the two micro-services
 - Chaining of two web-services from two service providers
 - Takes an Object Name, Cutout Parameters and stores an image cutout in an irods File
- **With other NVO and image manipulating micro-services, with similar or different functionalities, one can write complex (and alternate) irods rules.**

NVO Micro-Services

- **msiObjByName**
 - Accesses the NASA/IPAC Extragalactic Database (NED)
 - Uses Web-Service provided by:
 - <http://voservices.net/ned>
 - Given an object name returns
 - RA, Dec and Type
- **msiSdssImgCutout_GetJpeg**
 - Accesses SDSS
 - Uses Web-Service provided by:
 - <http://skyserver.sdss.org/>
 - Given RA and Dec, and a cut-out size returns
 - Image Cutout file in a buffer

For More Information

Reagan W. Moore
San Diego Supercomputer Center
moore@sdsc.edu

<http://www.sdsc.edu/srb/>
<http://irods.sdsc.edu/>