A Grid Service for Interactive Dataset Analysis

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Specialized System for Parallel Data Analysis

- In high energy physics parallelism is straightforward because data is a collection of many files which are a set of independent events. Community is distributed
- Useful analysis is complex and researchers need feedback, thus interactivity is desirable
- Java Analysis Studio (JAS) is a combination IDE and graphical tool -- powerful single file analysis capability.
- Project described here is a Phase II Small Business Innovative Research (SBIR) grant from the Office of Science/HEP of DOE.

Project Goal and Driving Ideas

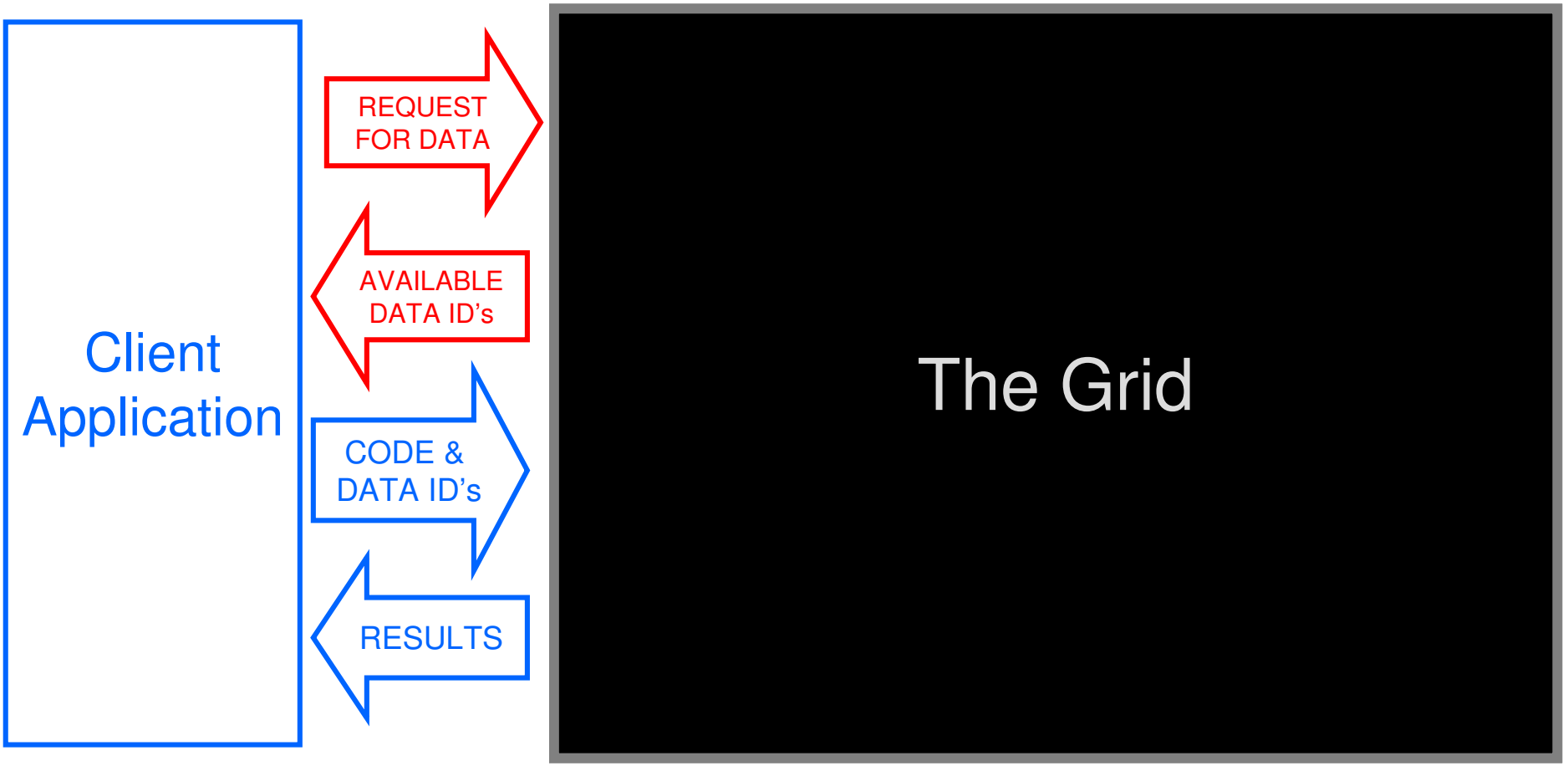
- Goal is to create a set of Grid services for clients like JAS to analyzing large data sets. Important ideas are:

  - **Interactive not batch processing**
    - Users write own analysis code to be run on many large virtual datasets while they develop the code.
    - Visualizations fill while analysis job is executing. Results appear in time scales of less than a second.
    - Can pause, alter, and restart analysis job at any time.

  - **Grid Service Infrastructure**
    - Access security provided (X509 Certificates)
    - Component structure easier to develop and flexible to connect
    - Provides interconnectivity between different implementations through well-defined interfaces and is independent of language (Client applications from different authors can use same service, visa-versa)

  - **Standardization of Common Interfaces into Grid Services**
    - Work through ***Particle Physic Data Grid (PPDG)*** interactive data analysis working group

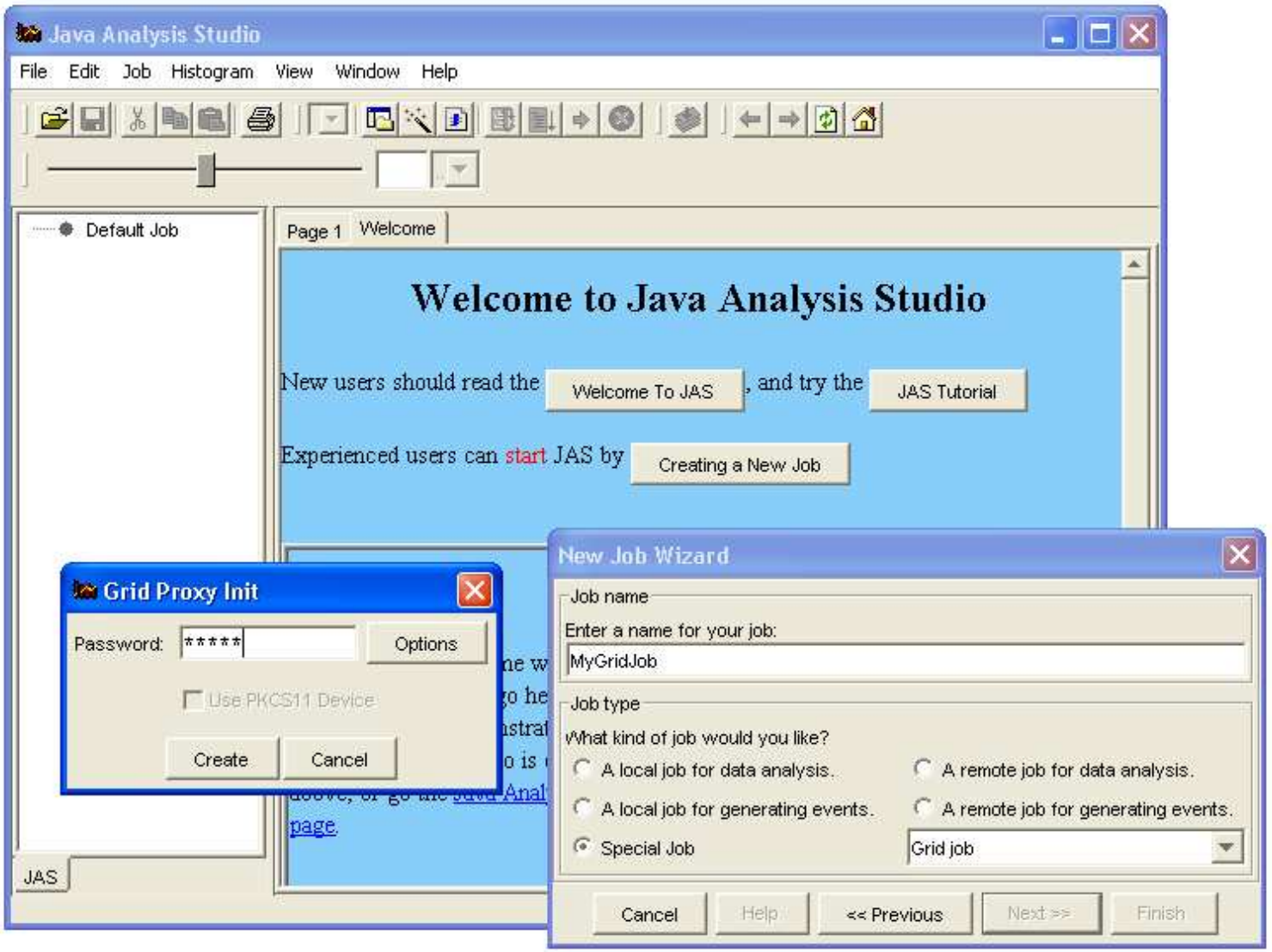
Client Deals with Dataset ID and Analysis Code

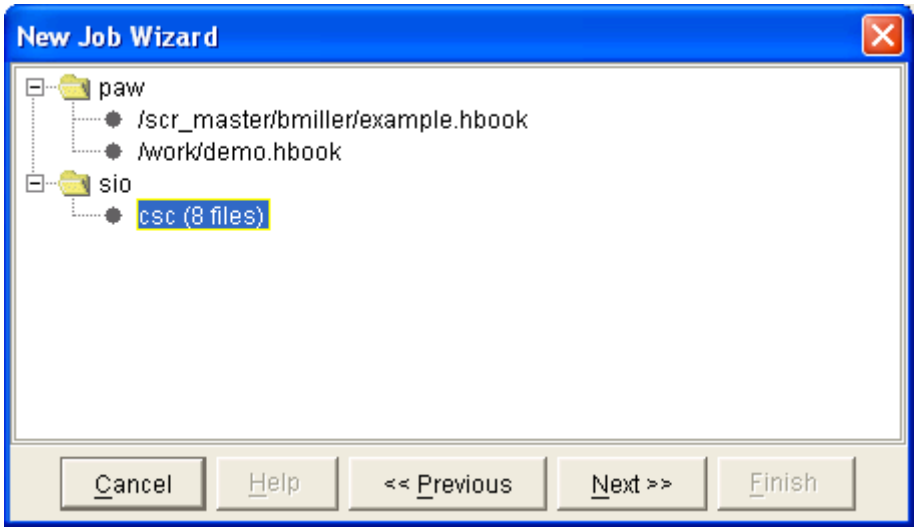


This Talk is About Prototype and Planned Work

- Grid Prototype System working
  - Demonstrates concept with pre-Grid-services Globus Toolkit GT2
  - Uses JAS version 2, distributed model
  - Uses Java Remote Method Invocation (RMI) as the communication mechanism.
- GT3-based system designed and in progress
  - Current effort underway to define Grid service interfaces with PPDG & we have a reference implementation of a dataset catalog service

Prototype has Grid Job



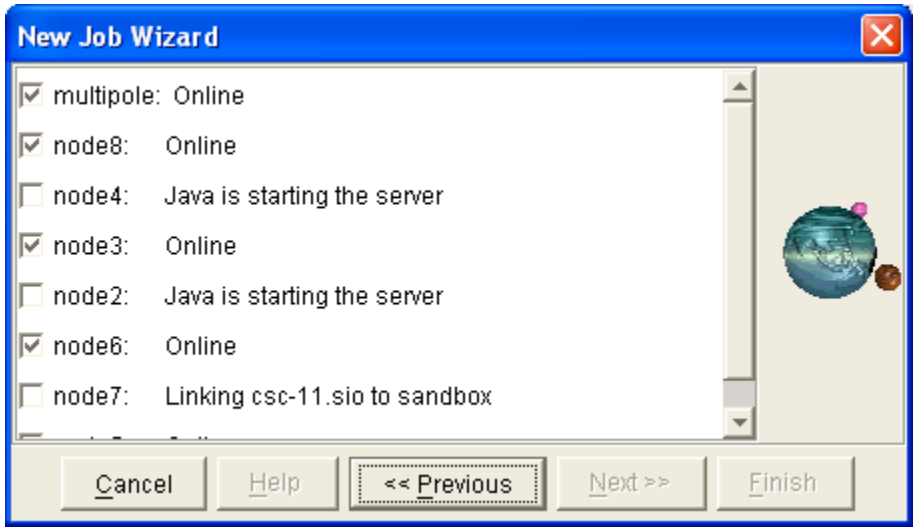


data selection

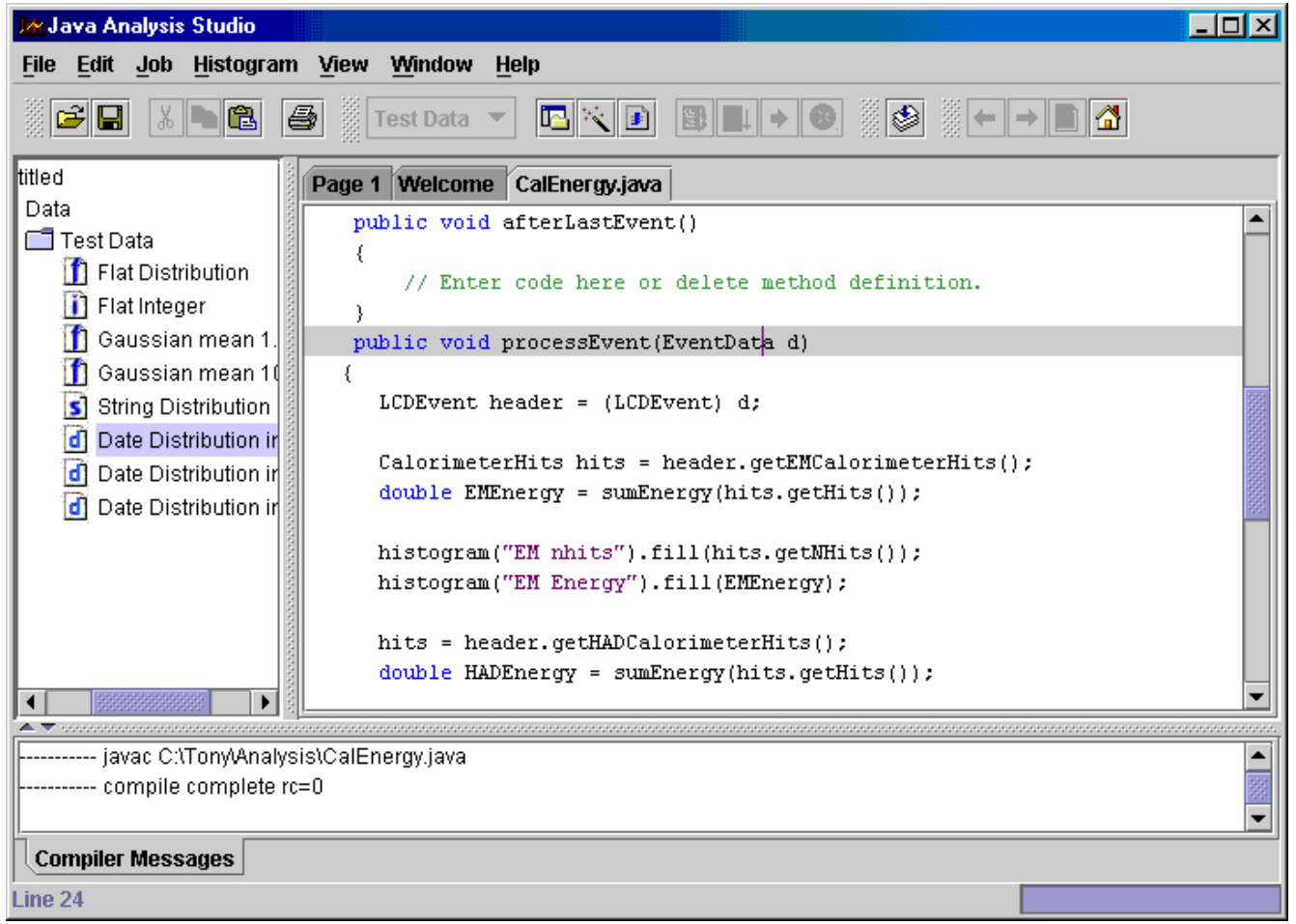
- Checks which data files are available to user
- System decides on which slave nodes to use.

grid enabled deployment

- Framework code is uploaded to slave nodes
- Data is moved or if on a mounted file system a link is created.
- Slave servers register with master server.

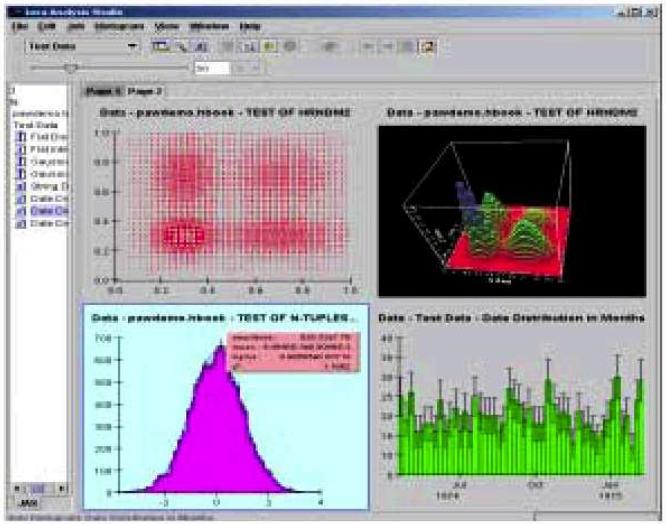


JAS client has Analysis Code Development Environment



All JAS graphics capability can be use on grid jobs

- Rich histogram tools
- Re-binning slider
- Printing & Saving capabilities for publishing

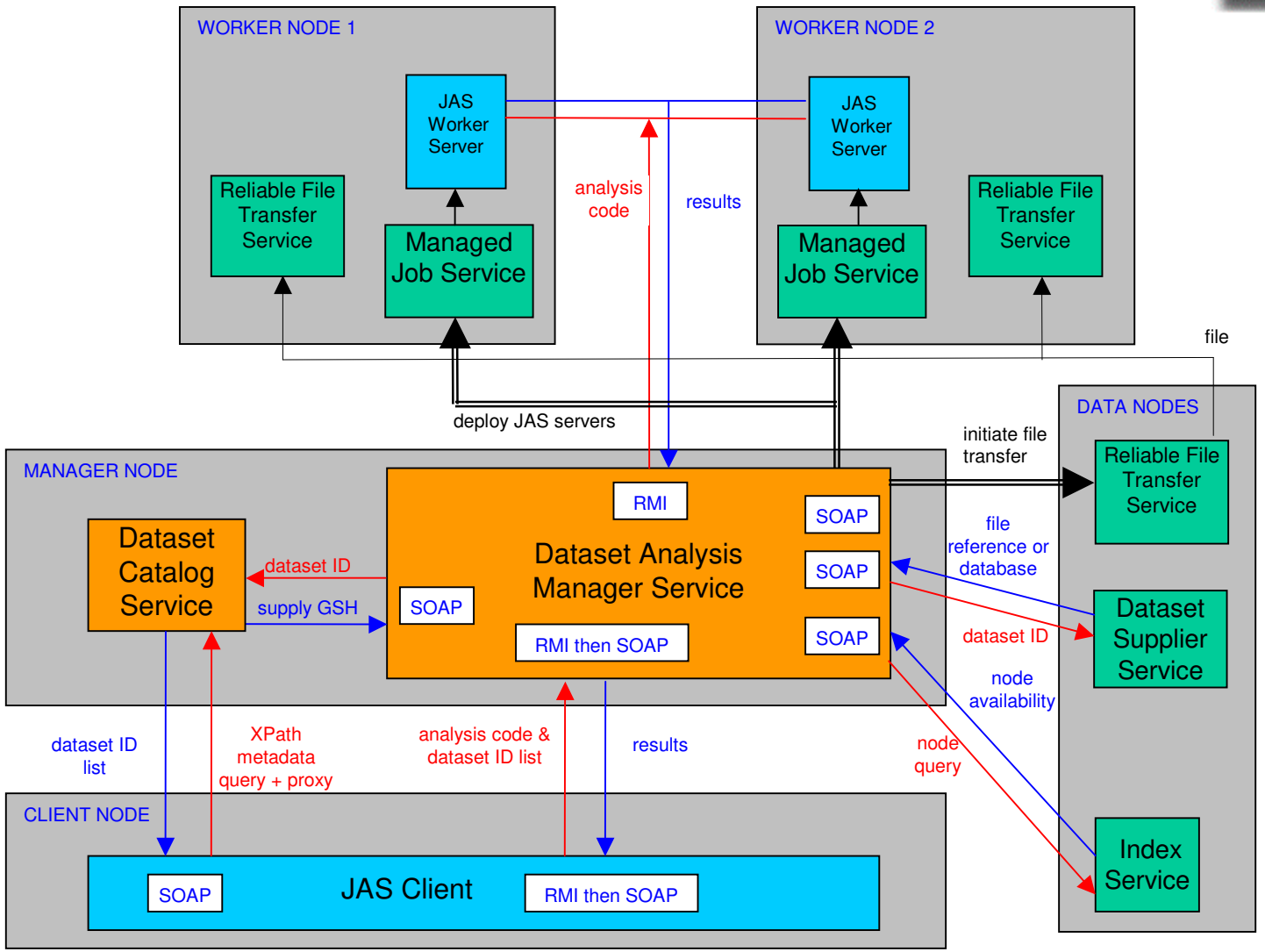


Prototype was demonstrated at SC2003 from a Windows PC in the Phoenix Exhibit that connected to 16 nodes at SLAC.

Phase II Design Goals

- Implements interfaces developed in Particle Physics Data Grid (PPDG) working group.
- Based as much as possible on OGSA style Grid services and to the maximum extent possible should use existing GT3 core services
  - Performance-critical parts may remain as Java-RMI connections
- Client will interact with a few key services which may connect to many back-end services.

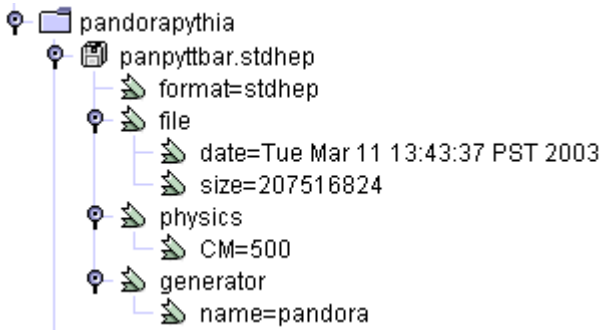
Service and Communication Model for Phase II



We are Implementing PPDG Interfaces

- PPDG use case document written
- Collaborating with many PPDG members to facilitate interface reuse
- We will provide reference implementation
- Started with ***Dataset Catalog Service*** interface, meta-data can be browsed and searched

Dataset Catalog Service: Meta-Data and XPath

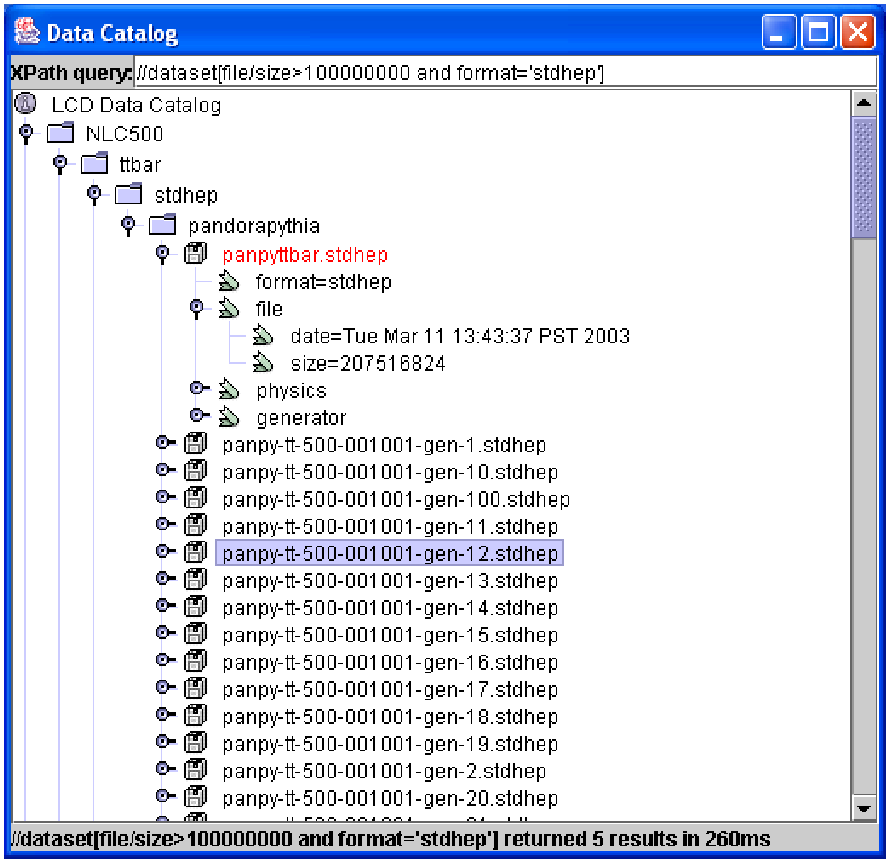


- Meta-Data
  - No limitations on type or content of meta-data
    - At least initially meta-data is not typed (string)
    - Meta-data can be arranged into a hierarchy

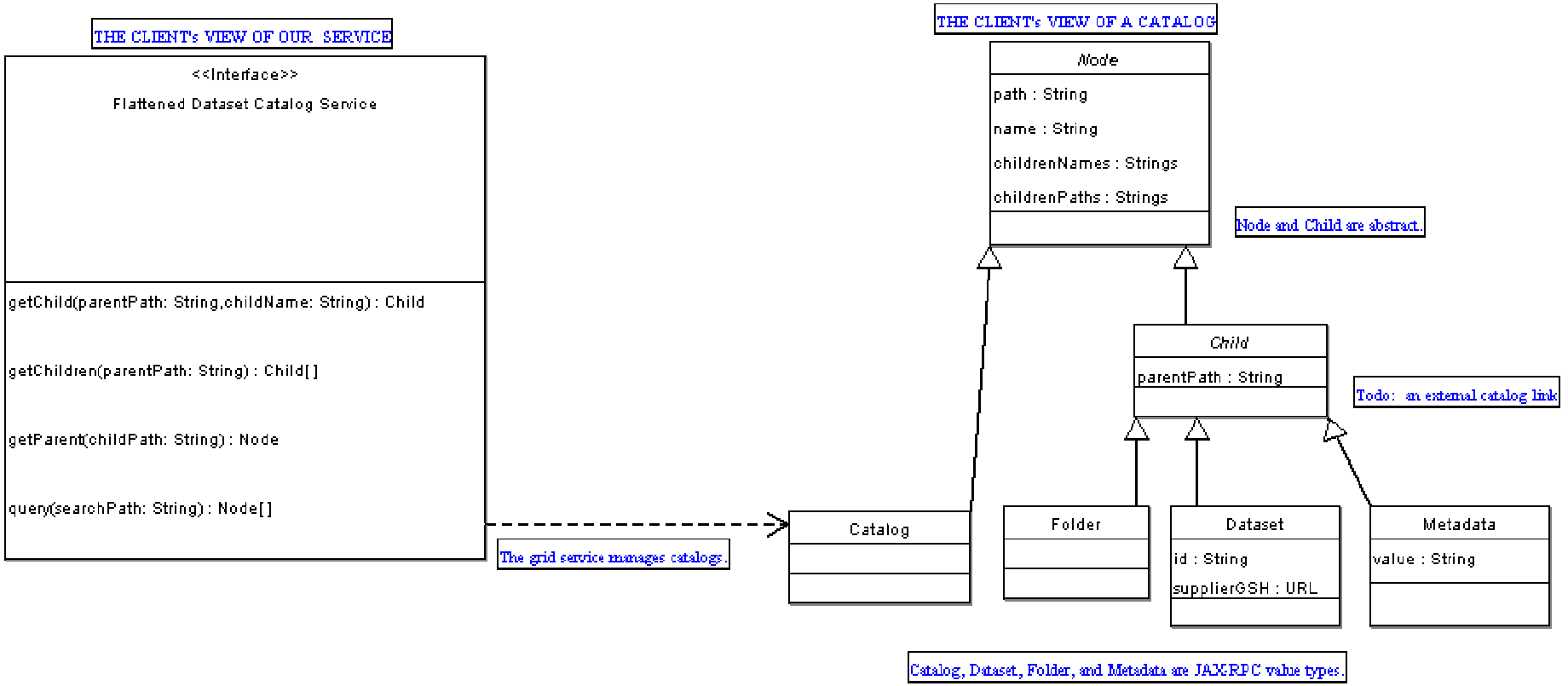
- XPath Query Language
  - XPath = language for querying hierarchical data structures.
    - Initially targeted at XML, but can be applied to any hierarchical data structure.
    - XPath = W3C standard, many implementations exist.
  - Example Query:
    - //dataset[file/size>100000000 and format='stdhep']

Dataset Catalog Service: Reference Implementation

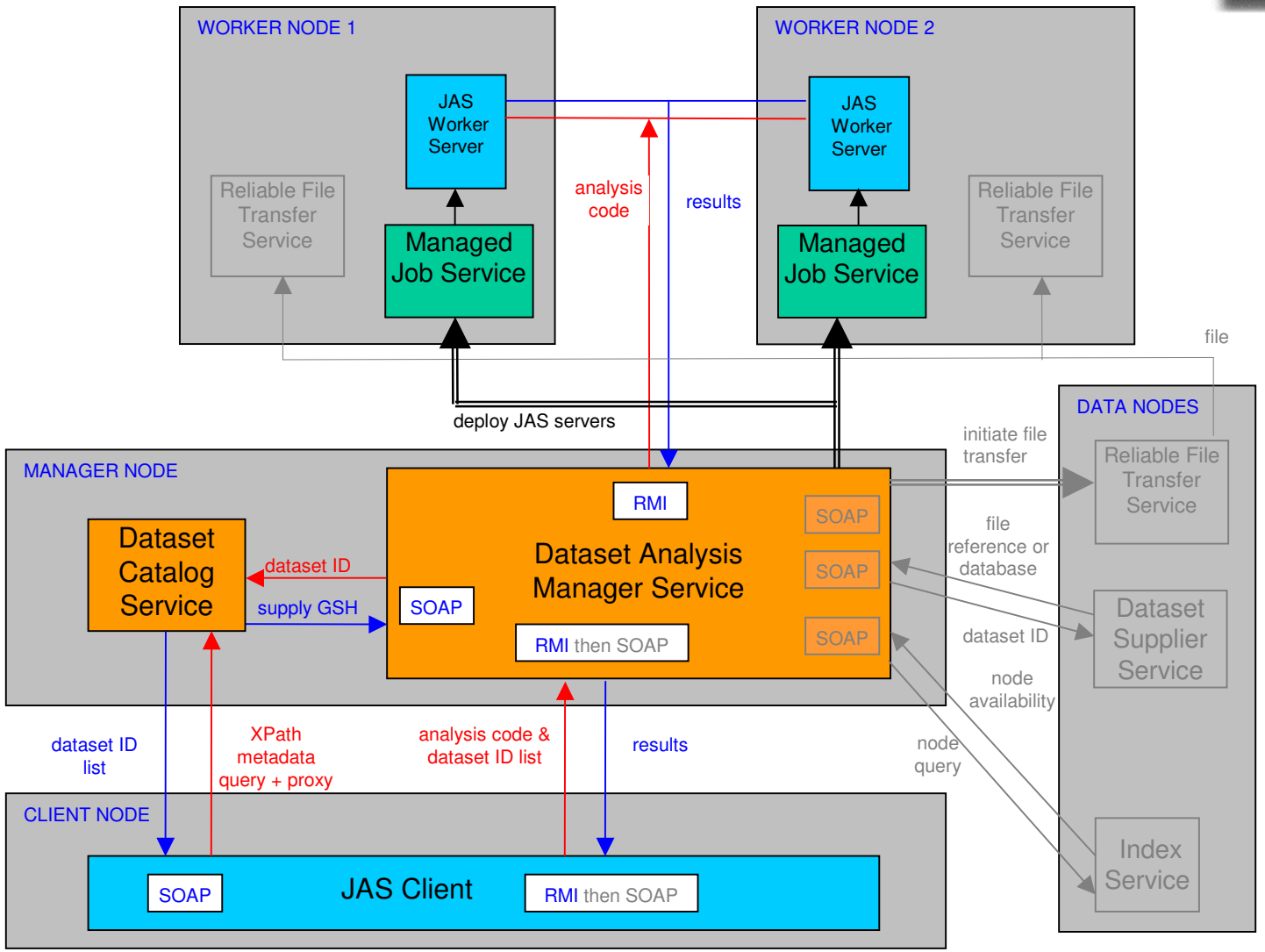
- Interface has been approved by PPDG
- Ref. implementation is only one possible implementation, could be implemented on top of any existing data catalog system.



Dataset Catalog Service interface UML

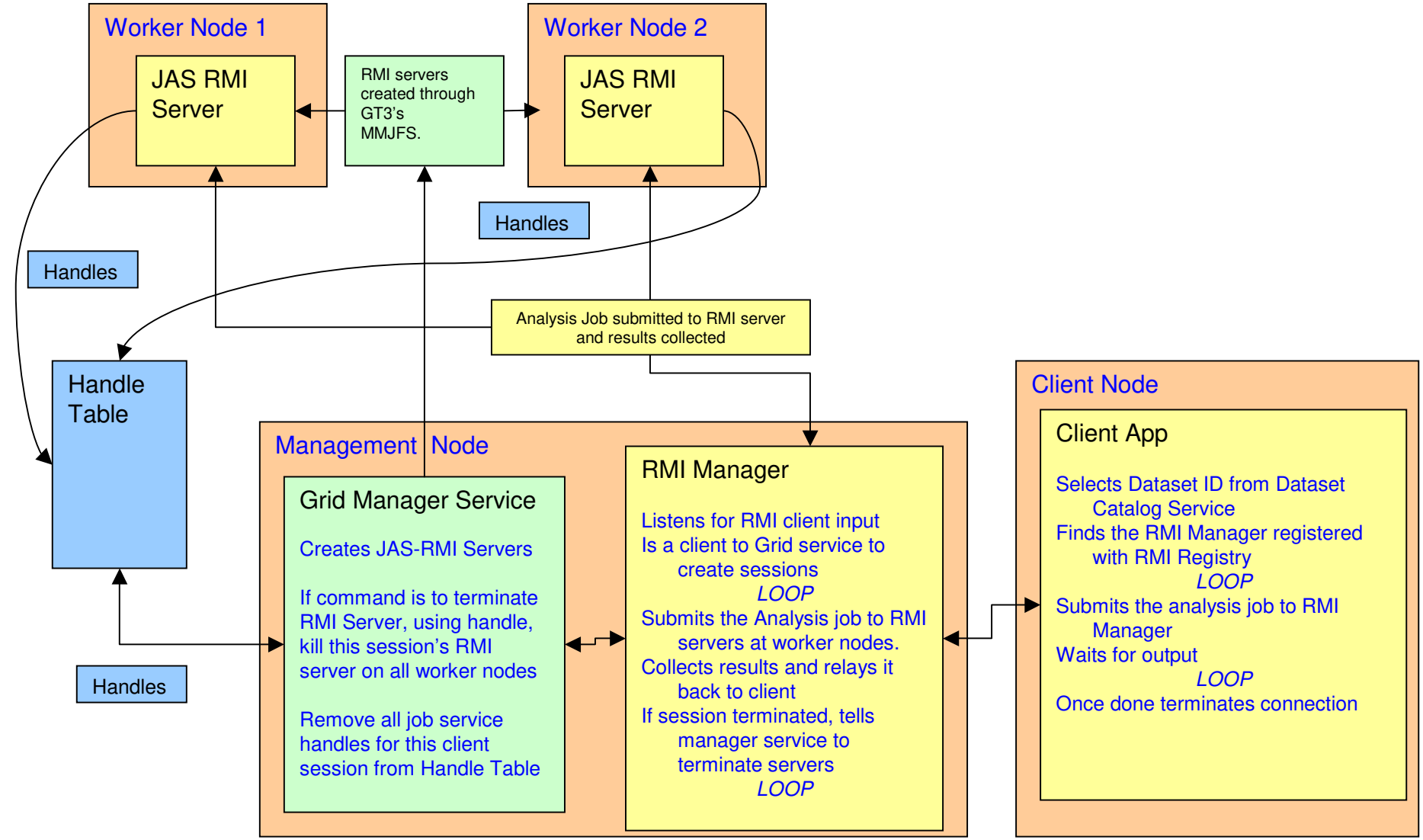


Summary: Existing Implementation



Next Steps for Project

- Working on release version of system with Grid service (GT3) deployment
- Working currently with PPDG on Job Submission interface
- Add code to use RFT file transfer service when manager recognizes that data is not on mounted file system
- Move client from having RMI connection to using Grid service

http://grid.txcorp.com

Existing System Summary