Computer Science Department

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Satellite Image Processing Applications in MedioGRID

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Outline

- Introduction
- MODIS Satellite Imagery
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  - Data Management System
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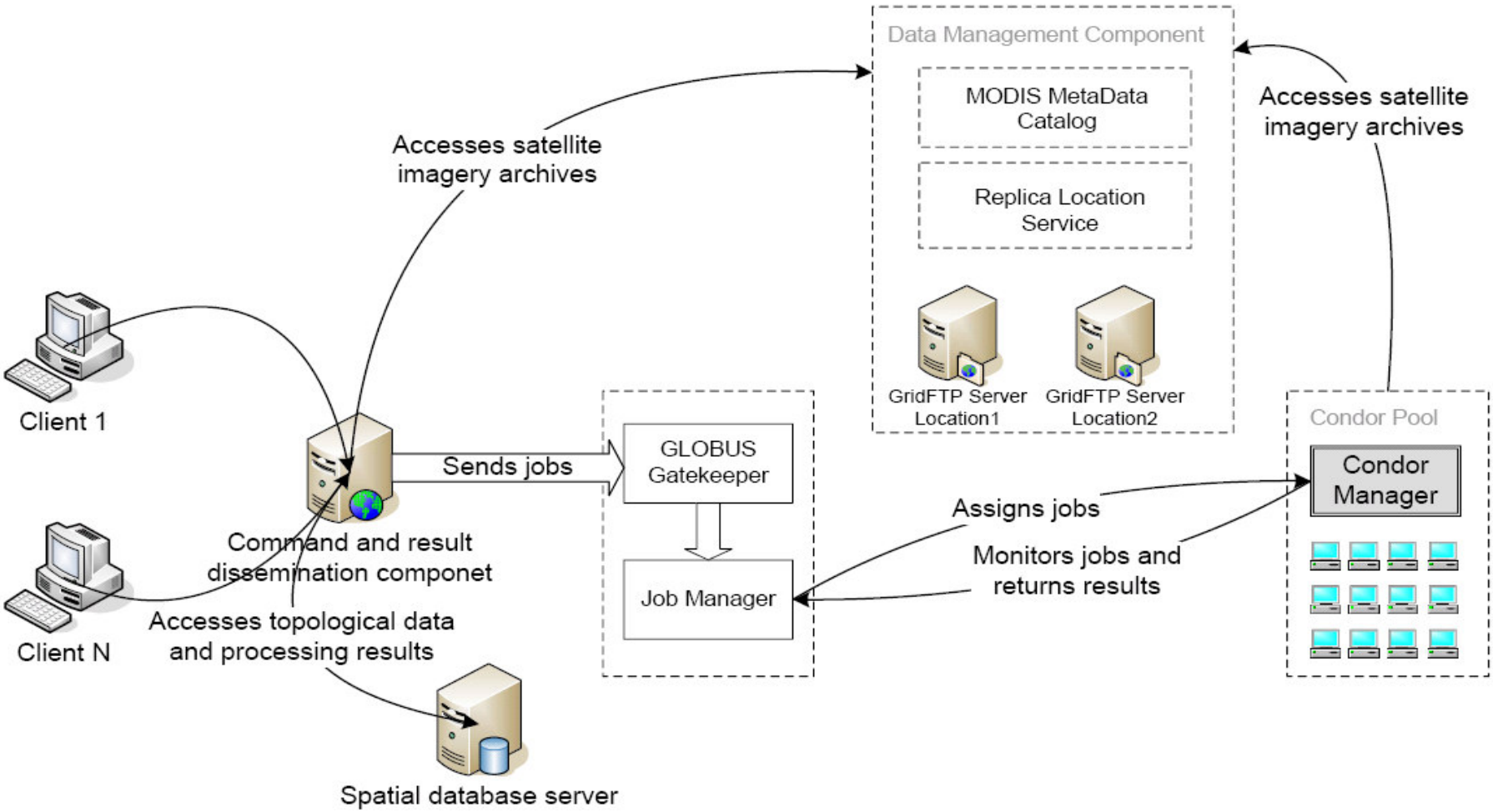
Introduction

- Objectives
  - Provide a general purpose satellite image processing system for extracting relevant environmental and meteorological parameters
  - Use GRID computing resources and real-time MODIS satellite imagery
  - Implement fire detection and water coverage detection (used for flooded area extent estimation)
  - Modular architecture
- Research institutions:
  - Universitatea Tehnică Cluj-Napoca (UTCN)
  - Universitatea Politehnica Bucureşti (UPB)
  - Universitatea Politehnica Timişoara (UPT)
  - Universitatea de Vest Timişoara (UVT)
  - iQuest Technologies (iQuest)
  - Universitatea Babeş-Bolyai Cluj-Napoca (UBB)
  - Administrația Națională de Meteorologie R.A. (ANM)

MODIS Satellite Imagery

- Produced by sensors onboard the Terra and Aqua satellites
- Covers the entire surface of the Earth
- 36 observational channels
- 250m to 1km spatial resolution
- Data distributed by the NASA DAAC

Grid Image Processing in MedioGRID – General Architecture



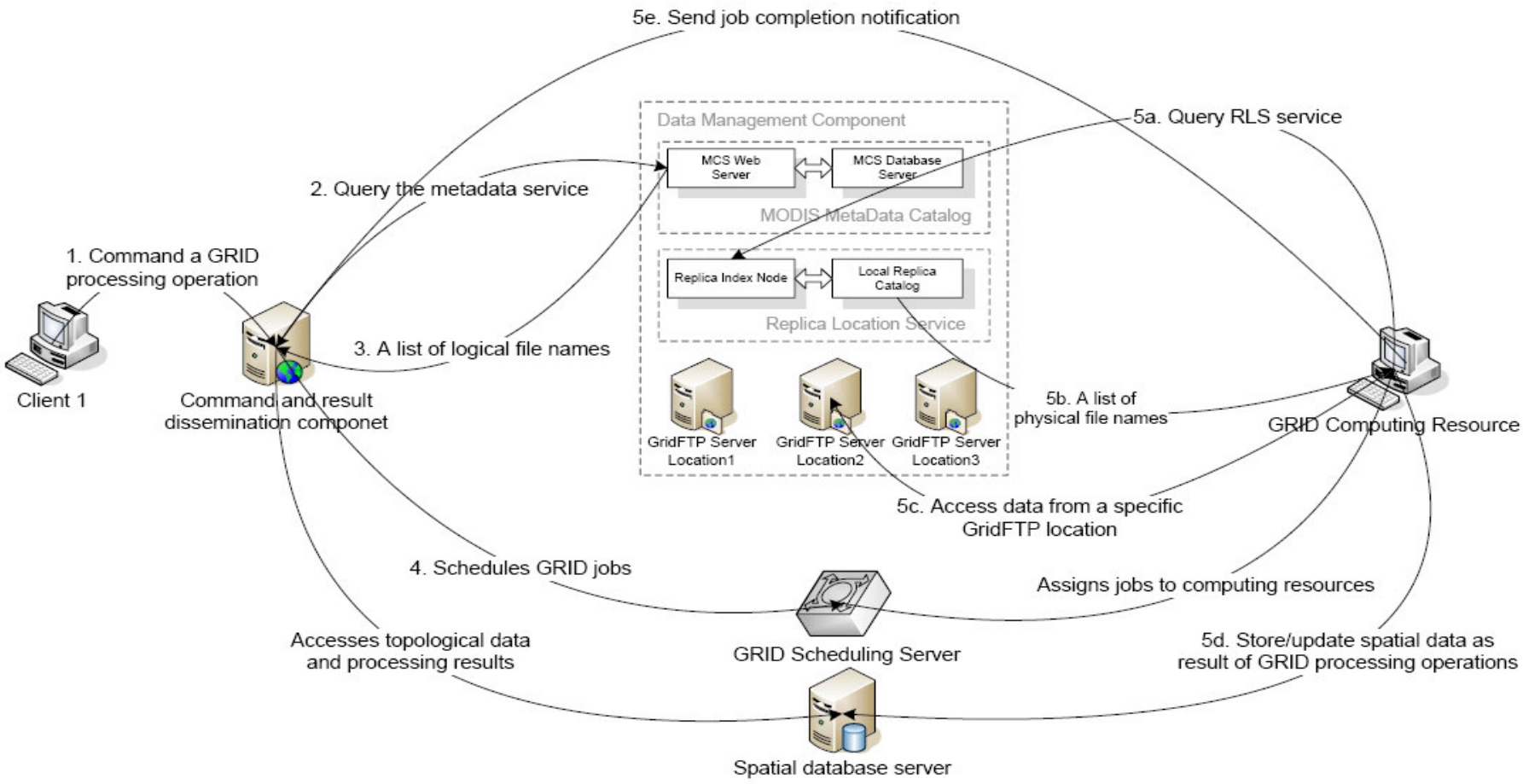
Data Management System

- Requirements
  - Robustness
  - Efficiency
  - Transparency
- Components
  - Data Mirroring and Indexing Component
    - Realtime fetching and inxexing of MODIS data
    - Data processing operations
      - Split data granules into the composing spectral bands
      - Index associated XML data
      - Generate full color JPEG images
  - Metadata Catalog Service
    - On top of the Replica Location Service
    - Answers data queries
    - Uses OGSA-DAI
  - Data Access Component
    - Provides separate access to the MODIS data layers

Command and result dissemination component

- Integrated system for commanding GRID processing operations and result dissemination
- Creates the interface between the user and the GRID computing resources
- Should include a GIS component:
  - Integrates both topology and satellite imagery data
  - Realtime display of processing results

Communication and data flow



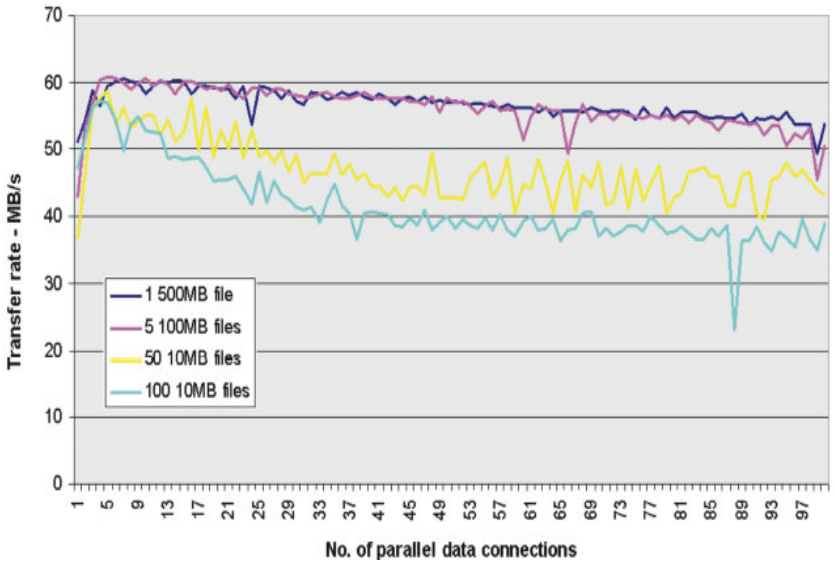
Grid Monitoring Solutions

- **GridICE**: different aggregations and partitions of monitoring data are provided with a different abstraction level of a Grid:
  - the Virtual Organization level,
  - the Grid Operation Center level,
  - the Site Administration level and
  - the End-User level.
- **R-GMA** (Relational Grid monitoring Architecture):
  - three components: Consumers, Producers and directory service
  - part of the ”Enabling Grids for E-science in Europe”
- **Ganglia:** toolkit for monitoring clusters and hierarchical aggregations of clusters
  - collects system status information and makes it available via a web interface.
  - Ganglia status can be subscribed to and aggregated across multiple systems.
- **Mon*ALISA*** (**MONitoring Agents using a Large Integrated Services Architecture**)
  - designed as an ensemble of autonomous multi-threaded, self-describing agent based subsystems which are registered as dynamic services, and are able to collaborate and cooperate in performing a wide range of information gathering and processing tasks.

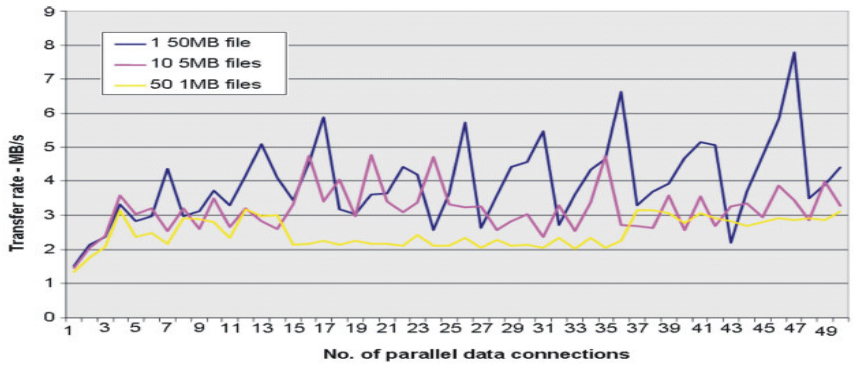
MedioGrid Monitoring Solutions

- Ganglia
  - access to each node in MedioGRID cluster and
  - request information about state of node: load, CPU usage, etc.
- Mon*ALISA*
  - Agent based support for collecting system and job data from each node in MedioGRID network.
  - Centralize date and view it in Client and/or Repository.
- ApMon
  - APIs in C, C++, Java, Python, Perl
  - Library for collect dinamic (and complet) information about jobs and systems and send it to a MonALISA database.
  - Used in MedioGRID to create a “check-point” mechanism for Satellite Image Processing Applications

Experimental Results



GridFTP - LAN data transfer performance



GridFTP - WAN data transfer performance

- The optimal performance is achieved when using 3 to 15 GridFTP parallel data streams.
- Depending on the file size, larger values for the number of parallel connections offer better performance when transferring data over the WAN links.
- Data transfer performance is directly influenced by the number of parallel data streams.

Conclusions

- Proposed a high-level architecture for grid-based satellite image processing
- Studied the GridFTP LAN and WAN transfer characteristics
- Development directions
  - Integrate the system with a powerful GIS engine for efficient result dissemination
  - Implement specialized GIS tool providing for the evaluation of flood and fire evolution over time