Facilitating Distributed Algorithm Execution in a Grid Framework
ISP AI Forum Talk

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Introduction

1. General motivation and the Grid

Job Distribution

2. Distributing computational load

Algorithm Distribution

3. Distributing analytical software

Discussion

4. Conclusions about algorithm distribution
   - Conclusions about job distribution

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Facilitating Distributed Algorithm Execution in a Grid Framework
Motivation

- Biomedical applications
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  - Biosurveillance
  - Outbreak detection
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- Multiple organizations
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  - Data collection
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- Multiple organizations
  - Data collection – hospitals, health-care providers
  - Data aggregation – health departments
  - Data analysis – researchers in health departments and universities
General motivation and the Grid

What is the Grid?

- Coordinated sharing of data and computational resources
- Collaboration between multiple institution
- Non-centralized (each institution maintains autonomous control over its own resources)

“The real and specific problem that underlies the Grid concept is coordinated resource sharing and problem solving in dynamic, multi-institutional virtual organizations.”

I. Foster, C. Kesselman, S. Tuecke.

The Anatomy of the Grid: Enabling Scalable Virtual Organizations.

Applications

- **Computation-driven Grids**
  - Teragrid
  - Enabling Grids for E-sciencE (EGEE)
  - Open Science Grid (OSG)

- **Data-driven Grids**
  - caGrid
  - MedGrid
General motivation and the Grid

Grid Middleware

Various solutions

- Globus
- gLite
- UNICORE
- VDT
Grid Middleware

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The Globus Toolkit
- **WebServices**: Standardized interfaces for data queries and analytical services.
- **WS-GRAM**: Grid Resource Allocation Manager
- **MDS**: Monitoring and Discovery Service
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Distributing computational load

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Why distribute jobs?

Computational challenges

- Outbreak detection algorithms are required to process ever-increasing amounts of data
- Information is time-sensitive
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Computational challenges

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- Decrease computation time by using distributed algorithms
- Take advantage of the Grid framework
  - Secure data sharing
  - Secure sharing of computational resources
Distributing computational load

Job Distribution

Typical setup

- Client
- Grid node
- Grid node (Gateway)
- Scheduler

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Job Distribution

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Grid-driven setup

Client
Grid node

Grid node (Manager)

Grid node
Grid node
Grid node

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Thanks

Previous Work

Previous approach by Tsai et. al.

- Developed ADMS
- Job division performed explicitly by the management service specified before jobs are sent for execution
- Simple and has little overhead
- Have to know information about available resources
- Algorithm must be set up on computation machines

Our approach

- Used existing software (Condor-Glidein)
- Queue-based
- Utilizes a full-blown job scheduler
- Flexible, allows adding and removing resources during execution
- Can take advantage of staging

Ming-Chi Tsai, Fu-Chiang Tsui, Michael M. Wagner

An Evaluation of Biosurveillance Grid – Dynamic Algorithm Distribution Across Multiple Computer Nodes


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Facilitating Distributed Algorithm Execution in a Grid Framework
Job Scheduling

Job Schedulers

- Distribute jobs to computational units
- Monitor jobs
- Pause/resume jobs
- Cancel jobs
- Staging and cleanup
- Manage input and output

Various solutions that are officially supported by GRAM:

- Portable Batch System (PBS)
- Condor High-Throughput Computing System
- Platform LSF

Another option is the Sun Grid Engine
Distributing computational load

Job Scheduling

Job Schedulers

We use Condor

- Support for major platforms
- Supports heterogeneous pools of machines
- Highly configurable at the
  - Pool level
  - Machine level
  - Job level
- Can manage dedicated machines, cycle scavenge, or a mixture of both.
- Glidein – a means of adding Grid resources to a pool.

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- Operates by temporarily setting up Condor daemons on the remote Globus resource.
- Can be configured to only allow use by the user who invoked Glidein, or by everyone using the pool.
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   - Distributing computational load

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   - Distributing analytical software

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**Facilitating Distributed Algorithm Execution in a Grid Framework**

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Software Distribution (Motivation)

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- Information about where to get algorithms is external to the Grid.
Issues

Information

The algorithm to process the data exists, but researchers don’t know where to get it.
Distributing analytical software

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Security

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**Security**
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More generally, issues of colocation.
Approach to the information issue

We present an information service that allows Grid users to publish and discover information about the location of algorithms and software using a Grid webservice.
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A Grid WebService to

- Present a list of available algorithms
  - Identifying information
  - Description of algorithms
  - Execution information
  - URI(s) of the software
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A Grid WebService to

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- Allow for a hierarchy or network of information services
Downloadable Algorithm Information Service

Data queries

- List all algorithms
- List algorithms with a set of attributes matching a set of values
- List algorithms with a keyword appearing in a set of attributes
Downloadable Algorithm Information Service

**Data queries**
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**Administrative operations**
- Add an algorithm
- Remove an algorithm
- Add this information node as a subnode of another node
- Remove this information subnode
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Downloadable Algorithm Information Service: Future Applications

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Downloadable Algorithm Information Service: Future Applications

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- Integrate with workflow services to include algorithm download and execution in a workflow.
Implications for the security issue

Recall the security concerns

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Directly enabled by the information service:

- Get the algorithms to the party with the data.
- Use Grid security to only allow certain parties to see certain information.
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  - Instructional labs in universities
Questions?

Thank you for your attention.

This work is supported by CDC grant 1U38HK000063-01
Workflows

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