GRIDS

LECTURE A
GRID APPLICATIONS

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Example: Rapid Atmospheric Modeling System, ColoState U

- Hurricane Georges, 17 days in Sept 1998
  - “RAMS modeled the mesoscale convective complex that dropped so much rain, in good agreement with recorded data”
  - Used 5 km spacing instead of the usual 10 km
  - Ran on 256+ processors
- Computation-intensive computing (or HPC = High Performance Computing)
- *Can one run such a program without access to a supercomputer?*
Distributed Computing Resources

MIT

Wisconsin

NCSA
An Application Coded by a Physicist/Biologist/Meteorologist

Jobs 1 and 2 can be concurrent
An Application Coded by a Physicist/Biologist/Meteorologist

Several GBs

May take several hours/days
4 stages of a job
  Init
  Stage in
  Execute
  Stage out
  Publish

Computation Intensive, so Massively Parallel

Output files of Job 0
Input to Job 2

Job 2

Output files of Job 2
Input to Job 3
Next: Scheduling Problem
GRID INFRASTRUCTURE

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Scheduling Problem

Wisconsin

MIT

NCSA

Job 0

Job 1

Job 2

Job 3

Allocation?  Scheduling?
2-level Scheduling Infrastructure

Wisconsin

HTCondor Protocol

Job 0

Job 1

Job 2

Job 3

MIT

Globus Protocol

NCSA

Some other Intra-site Protocol
Condor (now HTCondor)

• High-throughput computing system from U. Wisconsin Madison
• Belongs to a class of Cycle-scavenging systems

Such systems
• Run on a lot of workstations
• When workstation is free, ask site’s central server (or Globus) for tasks
• If user hits a keystroke or mouse click, stop task
  • Either kill task or ask server to reschedule task
• Can also run on dedicated machines
Inter-site Protocol

Internal structure of different sites may be transparent (invisible) to Globus

Globus Protocol

External Allocation & Scheduling
Stage in & Stage out of Files
Globus

- Globus Alliance involves universities, national US research labs, and some companies
- Standardized several things, especially software tools
- Separately, but related: Open Grid Forum
- Globus Alliance has developed the Globus Toolkit

http://toolkit.globus.org/toolkit/
Globus Toolkit

- Open-source
- Consists of several components
  - **GridFTP**: Wide-area transfer of bulk data
  - **GRAM5** (Grid Resource Allocation Manager): submit, locate, cancel, and manage jobs
    - Not a scheduler
    - Globus communicates with the schedulers in intra-site protocols like HTCondor or Portable Batch System (PBS)
  - **RLS** (Replica Location Service): Naming service that translates from a file/dir name to a target location (or another file/dir name)
  - Libraries like **XIO** to provide a standard API for all Grid IO functionalities
  - Grid Security Infrastructure (**GSI**)
Security Issues

- Important in Grids because they are federated, i.e., no single entity controls the entire infrastructure

- Single sign-on: collective job set should require once-only user authentication

- Mapping to local security mechanisms: some sites use Kerberos, others using Unix

- Delegation: credentials to access resources inherited by subcomputations, e.g., job 0 to job 1

- Community authorization: e.g., third-party authentication

- These are also important in clouds, but less so because clouds are typically run under a central control

- In clouds the focus is on failures, scale, on-demand nature
Summary

- Grid computing focuses on computation-intensive computing (HPC)
- Though often federated, architecture and key concepts have a lot in common with that of clouds
- Are Grids/HPC converging towards clouds?
  - E.g., Compare OpenStack and Globus