What is a Grid?

Dave Berry
Deputy Director, Research & E-infrastructure Development
National e-Science Centre, UK
Computing as a Commodity

- From hand-built research computers...
- From individual computers...
- From specialist supercomputers...
- From proprietary formats...
- From individual servers...
- From applications...
- From ownership...
- From silos...
- to PC’s, PDAs and mobile phones
- to the Internet and the WWW
- to clusters and cycle-scavenging
- to standards and ontologies
- to virtualised, dynamically provisioned server farms
- to services
- to computing-on-demand
- to Grids
A grid is a system consisting of
- Distributed but connected resources and
- Software and/or hardware that provides and manages logically seamless access to those resources to meet desired objectives
Grids vs. Distributed Computing

- Existing distributed applications:
  - Tend to be *specialised systems*
  - Intended for a single purpose or user group

- Grids go further and take into account:
  - Different kinds of *resources*
  - Different kinds of *interactions*
  - *Dynamic* nature
Ideas and Forms

- Key ideas
  - Virtualised resources
  - Secure access
  - Dynamic provisioning

- Many forms
  - Cycle stealing
  - Linked supercomputers
  - Distributed data management
  - Commercial data centres
  - Utility computing
  - Collaboration Grids
Grids In Use: E-Science Examples

- **Data sharing and integration**
  - Life sciences, sharing standard data-sets, combining collaborative data-sets
  - Medical informatics, integrating hospital information systems for better care and better science
  - Sciences, high-energy physics

- **Simulation-based science and engineering**
  - Earthquake simulation

- **Capability computing**
  - Life sciences, molecular modeling, tomography
  - Engineering, materials science
  - Sciences, astronomy, physics

- **High-throughput, capacity computing for**
  - Life sciences: BLAST, CHARMM, drug screening
  - Engineering: aircraft design, materials, biomedical
  - Sciences: high-energy physics, economic modeling

Slide from Hiro Kishimoto’s GGF17 Keynote
climatemodelprediction.net and GENIE

- Largest climate model ensemble
- >45,000 users, >1,000,000 model years

Response of Atlantic circulation to freshwater forcing
Large Hadron Collider

- The most powerful instrument ever built to investigate elementary particle physics

- 10 Petabytes/year of data

- Simulation, reconstruction, analysis:
  - Requires computing power equivalent to ~100,000 of today's fastest PC processors
Grids In Use: E-Business Examples

- High-throughput computing
  - Aircraft design
  - Drug discovery
  - Electronic design automation

- Financial services
  - Portfolio modeling
  - Data integration

- Enterprise Information Integration (EII)
  - Banking
  - Drug discovery
  - Collaborative engineering

- Large-scale collaboration
  - Aircraft design
  - Automobile design

Slide from Hiro Kishimoto’s GGF17 Keynote
Leading Grid Application Domains

Sources: IDC
Grids straddle disciplines

- A company working on the placement of a new factory needs financial forecasting combined with mining of proprietary historical data.

- An industrial consortium works on the feasibility study for a new airliner.

- A crisis management team reacts to a chemical spill using soil and weather models, demographic information, and productivity tools for emergency teams.

Sources: Anatomy of the Grid, Foster et al.
Key Middleware Requirements

- Secure authorization, role and access privileges
- Execute and manage jobs/services
- Resource discovery, monitoring & control
- Data access, transfer and management
- Information about applications & resources
Collaboration Grids

- Key concept:
  - The ability to negotiate resource-sharing arrangements among a set of participating parties and then to use the resulting resource pool for some purpose. (Ian Foster)

- Virtual organisations:
  - Combining people and resources from different organisations to address a given problem
  - Enabled by Grid technology
Defining a Collaboration Grid

Three aspects:

1. Coordinating on-demand, secure access to distributed and heterogeneous resources (cpu, storage, bandwidth ...)
2. Using standard, open, general-purpose protocols and interfaces
3. To deliver non-trivial qualities of service
SOA & Web Services

SOA

• Flexible
  – Locate services on any server
  – Relocate as necessary
  – Prospective clients find services using registries

• Scalable
  – Add & remove services as demand varies

• Replaceable
  – Update implementations without disruption to users

• Fault-tolerant
  – On failure, clients query registry for alternate services

Web Services

• Interoperable
  – Growing number of industry standards

• Strong industry support

• Reduce time-to-value
  – Harness robust development tools for Web services
  – Decrease learning & implementation time

• Embrace and extend
  – Leverage effort in developing and driving consensus on standards
  – Focus limited resources on augmenting & adding standards as needed
SOA & SOI

Responsiveness to Market

Business Strategy
Automation & Execution

End-to-End,
Dynamic
Management

IT Operations
Automation & Management

Operational Efficiency

Service
Oriented
Architecture
Software As A Service

Service
Oriented
Infrastructure
Infrastructure As A Service
Example: Procure to Pay Process

Change: Customer Order Entry
Change: Serviced Marketing, Billing, Receivables
Change: Supplier Handles Inventory
Change: Shipping by External Company
Change: Collections Outsourced
Change: Process Optimization

ITU-T/OGF Workshop on Next Generation Networks and Grids
Geneva, 23-24 October 2006
Motivations for Grids

- Scale up computing and/or data sets
- Reduce costs via capex/opex efficiencies
- Reduce time-to-results
- Provide reliability, availability
- Support heterogeneous systems & realities
- Enable collaborations
- Support a market in software services
Questions?

0 Credits:

• Hiro Kishimoto, Fujitsu & OGF
• Dave Snelling, Fujitsu & OGF
• Franco Travostino, Nortel & OGF
• Angus McCann, IBM
• Ian Osborne, Grid Computing Now!
• Ian Foster, ANL/Globus
• IDC