Grid Introduction, Part 2

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Grids in Context

- Grid as infrastructure
  - research, private market forces, government all required
  - local infrastructures (e.g., PC clusters) lead to global infrastructure – the Grid
  - capacity distributed throughout the infrastructure
    - Example is NSF Extensible Terascale Facility (ETF) – the Teragrid – 5 supernodes + regional medium-sized nodes, iwht a common software infrastructure
    - Networking also distributed and hierarchical – 40Gb/sec between supernodes, down to 56Kb/sec to homes on dialup lines

Grid Users

- Computational scientists and engineers
  - to get at remote computers easily - to compute, visualize, steer computations
- Experimental scientists
  - to attach remote instruments to supercomputers, or visualization devices
- Corporations
  - to link people and resources at multiple sites within a corporate intranet

Grid Users (cont.)

- The environment (public policy makers)
  - to solve hard, multidisciplinary problems requiring a collaborative computational framework
- Remote training and education
  - virtual lecture rooms
  - Access Grid – Internet videoconferencing
- …

Scientific Grid Users

- Data intensive applications
  - analyzing particle physics data from collider experiments – multiple petabytes per year, accessed and mined by physicists worldwide
    - NSF Grid Physics Network (GriPhyN)
    - DOE Particle Physics Data Grid (PPDG)
    - EU DataGrid
  - astronomy *digital sky surveys* – 10TB today, to petabytes soon
    - astronomers want to federate all the archive to create a single, globally distributed, repository spanning all wavelengths
    - a *virtual observatory*
    - this is happening in earth and space science too – data from satellites looking at both the earth and objects/phenomena in space

Scientific Grid Users (cont.)

- Medical imagery - MRIs, CT scans, X-rays, etc. stored online digitally – multiple terabytes coming
  - allows comparing images across time for individuals and across populations
  - federating collections enable epidemiological studies – need to mine both images and metadata
  - security and privacy issues very important

Scientific Grid Users (cont.)

- Computational science based on simulation
  - supercomputers as scientific instruments
    - e.g. Japanese Earth Simulator for Earth's climate, at 40Tflops/sec
    - DOE ASCI machines for nuclear bomb simulations
  - application areas include computational chemistry for creating and testing new compounds, life sciences for intelligent drug design, and function and structure of all known publicly available genome sequences
- Remote access to scientific instruments
  - e.g., Network for Earthquake Engineering Simulation

Industrial Grid Users

- Open Grid protocols like Internet standards
  - allow integration of technologies, applications, files, other resources
  - enable *global* sharing of the resources
  - *virtualize* the resources, to shield users from their complexity
  - eventually allow for delivery of computing services when and where needed – *on-demand*

Open Protocols

- Merger of Grid protocols with Web services is a big step forward – the Open Grid Services Architecture (OGSA)
  - merge Grid protocols with Web services, using WSDL (for defining services), UDDI (for discovering services) and SOAP (for sending messages) – all XML based
  - all this to allow *programs* to interact with other programs on the Grid

Virtualization

- To allow sharing of physical resources, and applications and data
  - e.g. virtual machines (Java), virtual memory, virtual storage
- The challenge of the Grid is to “virtualize computing resources over the Internet”
  - use open Grid protocols on top of local OS (Linux, Windows, Solaris, or whatever)

Quality of Service (QoS)

- Challenge for industry (e-business) is high QoS at a low price
  - requires end-to-end resource management
  - schedule multiple computers required for a given transaction (a path through a distributed application)
  - in the distributed, heterogeneous Grid infrastructure

On-Demand Computing

- Virtualize machines, servers (software), up to entire data center
  - so business can own its own infrastructure, or contract to an external service provider, or both
  - any authorized user can access the resources from anywhere, on demand
  - company can buy compute or data services for applications as needed, and only when needed