The Future of Software R&D for Network-Centric Systems

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Workshop on New Visions for Software Design and Productivity

The Future: All Software is Network-Centric

- What's new
  - We don't build or buy computers anymore, we borrow or lease them (when I walk into a room, need to solve a problem, need to communicate)
  - A "computer" is a dynamically, often collaboratively constructed collection of processors, data sources, sensors, networks (similar observations apply for software!)
- And thus
  - Reduced barriers to access mean that we do much more computing, and more interesting computing, than today => Many more components (& services); massive parallelism
  - All resources are owned by others => Sharing (for fun or profit) is fundamental; trust, policy, negotiation, payment
  - All computing is performed on unfamiliar systems => Dynamic behaviors, discovery, adaptivity, failure

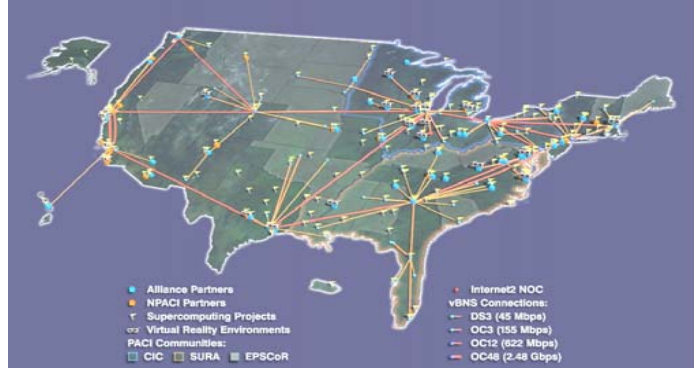
Observations

We've made significant progress already

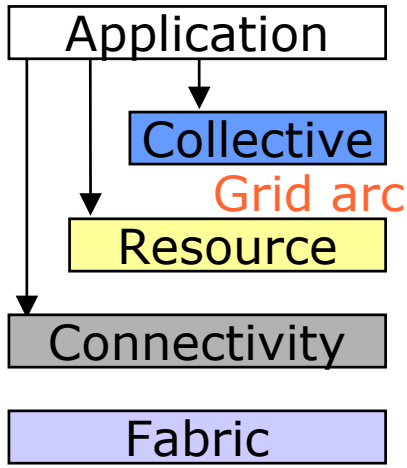
- E.g., Grid community attacking extreme science and engineering problems
- Terascale parallel and Internet computing
- Protocol and service architectures

Programmers also face new problems

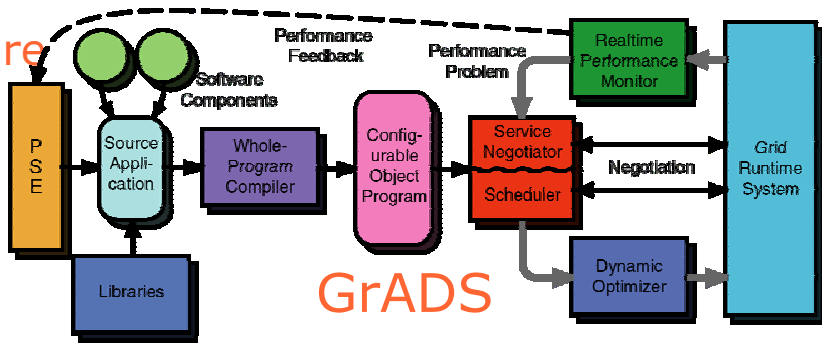
- Discovery, access, management, authorization on a massive scale => Entirely new methods and services
- Massive parallelism => New regimes wrt failure, composition, performance
- New concerns: policy, security, discovery => New methods for representation, encapsulation, manipulation
- Predictable behaviors in fundamentally unpredictable systems => New analysis, debugging systems; open up, reinvent software development cycle



National Technology Grid



Grid architecture



GrADS

A Cross-Agency Research Program: Some Specific Perspectives

- Address fundamental issues of parallelism & scalability
- Whole-system simulation as a fundamental tool
- Essential to create spaces that attract both the best computer scientists and people with wonderful problems
  - Forge connections between aggressive application communities and computer scientists
  - Build large-scale testbeds: networks and systems
  - Expeditions to the future: network computing equivalent of "grand challenges"?
- Don't forget international scale and scope of many motivating science and engineering applications
- Support the tools needed for progress
  - Open architecture, open source code base has advantages (we're establishing a Consortium for Open Grid Software)