Infrastructure for Mobile Computing

Wireless Communication and Information (WCI) 2005

Berlin, 14. 10. 2005

Hermann Heßling
(FHTW Berlin)
Overview

- Mobile Devices
- Grid Computing
- Mobile Grid Computing
- Simulation of Grids
- Dynamical Service Level Agreements
Mobile Devices

- Infrastructure

|~~ wireless ~>| |<====== wired ========>|

Carrier

Internet

Service-Provider
Mobile Devices

- A cellular phone is not a PC
  - network connection
    - slow
    - unreliable
    - expensive
  - small screen
  - small battery \(\Rightarrow\) limited computational power (CPU, memory)
  - keys
    - multi-valued, often too small
- PDA \(\approx\) phone + software
  \(\Rightarrow\) properties comparable to cellular phone
Mobile Devices

- Mobile Web access
  - Suffers from usability and interoperability problems.
    ⇒ The ansatz “single source creation - multiple channel production” is hard to realize.
  - How to handle the status “offline” (tunnel, train, ...)?

- W3C Mobile Web Initiative (WMI)
  - 11 May 2005 (founding sponsors: France Telecom, HP, Nokia, Vodafone …)
  - “Best practices” to support development of mobile web content that works well on mobile devices.
  - “MobileOK” trustmark for Web sites.
Grid Computing

- Architecture

```
User Application  User Application  User Application

Internet

Grid Middleware  Grid Middleware

Grid Sites
```
Grid Computing

- “Grid Computing is an accepted set of services and applications for sharing computer power and data storage over a net.”

- Central concepts
  - Virtual environment
    - All systems belong to the “pool” of resources.
    - For the user the pool seems to be a single system.
      - The technical details are hidden behind his GUI.
      - No information about the geographical distribution of the data.
  - Virtual organization
    - Cooperative use of the resources of the pool.
    - New forms of collaborations between distributed and multi-organizational environments.
Grid Computing

- Characteristic properties
  - Local resources can freely be removed from the pool (based on policies of the owner).
  - Resources may be quite heterogeneous.
  - Scalability: if an application needs more resources the Grid software finds them.
  - Selfhealing: if a resource is broken the Grid software is able to react properly.
Grid Computing

- The Global Grid Forum (GGF) defines Grid specifications.
- Grid infrastructures are developed by e.g.
  - LHC Computing Grid (LCG) project of the Large Hardron Collider (LHC) at CERN
  - Enabling Grids for E-science (EGEE) project in Europe
  - D-Grid, the German e-science project
  - NextGRID, project driven strongly by commercial organizations.
Grid Computing

- **Efficiency**
  - Grid services are much more slowly than other remote methods like Corba or JavaRMI.
  - Latency is the price to be paid for a better interoperability of distributed services on arbitrary knots.

- **Complexity**
  - Installation and running of the current (often academic) Grid systems is highly non-trivial.
  - The comfort is not comparable with current commercial B2B solutions based on Web services.

- **Improving Scalability**
  - Integration of peer-to-peer (P2P) techniques: every Grid service corresponds to a special P2P system (P2P ~ selforganizing, decentralized system for file sharing)
Grid Computing

- **Web services**
  - support the interaction between distributed computers
  - can communicate among each other (SOAP)
  - are non-transient (outlive all their clients)
  - are stateless (cannot remember previous events).

- **Problem:** A Grid has to react to dynamical changes of the infrastructure.

- **Grid Services ≈ Web services, but**
  - can be stateful and transient
  - allow a lifetime management.
  - ... Open Grid Service Infrastructure (OGSI), and Web Service Resource Framework (WSRF)
Mobile Grid Computing

- Mobile devices integrated into the Grid
  - service recipients
  - service providers
- many challenging issues, e.g.
  - intermitted connectivity
  - heterogeneity of devices
  - security, privacy
  - job scheduling
    ⇐ global-local ansatz
    (for Grids: NP-complete problem)
  - detection and selection
    of resources ⇐ Semantic Grid
    (probabilistic problem)
- Projects in Europe and Korea:
Simulation of Grids

- Planning large Grid infrastructures is a highly non-trivial task.
- Existing simulation studies are often based on simplifying assumptions that are not fulfilled in a commercial environment.
- In a joint project
  - M. Fehse, R. Schelling (T-Systems International)
  - C. Beck, H. H., D. Holzapfel (FHTW Berlin)
analyzed Grids up to 96 knots using ~ 20,000 real job data.

Main results: to minimize costs
- homogeneous Grid sites are disadvantageous
- data of “cheap” jobs should not be shifted to different Grid sites (searching the “best” site is too expensive).
Dynamical SLAs

- Service Level Agreement (SLA)
  - negotiated between customer and service provider
  - describes content and costs of a service
  - may change dynamically during a project lifetime
  - is of central importance to estimate infrastructure and costs of a commercial Grid system.

- Standardization of SLAs (⇒ XML).
**Dynamical SLAs**

- New research project
  - “Influence of Dynamical SLAs on Storage Networks”
  - Cooperation with *T·Systems*
Summary

- Grid computing is becoming increasingly important.
- Productive Grid systems exist, mainly in academia.
- Standards are evolving.
- Mobile Grid is on the agenda.
- Dynamical SLAs are of special importance for commercial Grids.

Thank you!