Session C
Tools and Programming Environments

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Session C - Tools and Programming Environments

09:00-10:30  Session C - Tools and Programming Environments
- State of the Art - Domenico Laforenza, ISTI-CNR, Italy
- CoreGRID - the European Research Network on Foundations, Software Infrastructures and Applications for large scale distributed, GRID and Peer-to-Peer Technologies - Thierry Priol, INRIA, France
- Aggregation and Coordination of Services on Geological Application Grid - Shilong Ma, National Lab on Software Development Environment at BUAA
- Open Source Middleware for the Grid: ObjectWeb ProActive - Denis Caromel, University Nice Sophia Antipolis, France

10:30-10:45  Coffee Break

10:45-12:15  Session C - Tools and Programming Environments
- Construction Platform for Specialized Computing Grid - Ming Chen, Tsinghua University, China
- GRIDLAB - A grid application toolkit and testbed - Jarek Nabrzyski - PSNC Posnan, Poland
- General discussion
Session C
Tools and Programming Environments
State of the Art

Dr. Domenico Laforenza
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A Grid Programming Environment

- Development environment for Grid-aware applications
  - Heterogeneity, dynamicity, adaptability
  - Better programmability and productivity
  - Effective software reuse, including legacy codes
  - Grant a certain degree of QoS: performance, fault tolerance, security

- High-level environment, tools and methodology: the programmer has a very abstract view of the Grid
  - Resource management and service utilization: mainly at the responsibility of the environment tools

- High-performance
  - Gridcomputing vs parallel-distributed computing
  - Methodologies and technologies: new vs revisited
Programming High Performance Applications in Grid Environments

Grid programming: some indications where we are headed

D. Laforenza, Italian National Research Council, Pisa, Italy
Parallel Computing, Volume 28, Issue 12 (December 2002)
Special issue: Advanced environments for parallel and distributed computing
Pages: 1733 - 1752  Year 2002, ISSN:0167-8191, Elsevier Science Publishers

.... Searching for the Holy Grail...
My 2-cents forecast (2002)

- CCA Forum
- CCA-like approaches
- MPICH-G2
  (the Assembly Language)

Degree of Automation

Now
Mid-term Future
Long-term Future

Advanced Grid Research Workshops through European and Asian Co-operation
However, the submitted papers seem to reflect the status quo in Grid application development and deployment. It appears to be common that the developer teams consist of many Grid experts, who know to expect from Grid -- and thus do not spell out unbiased expectations. Furthermore, these experts develop their own suites of tools and environments, basically circumventing the weaknesses of existing Grid middleware. Seemingly, we are still far way from domain experts developing or at least Grid-enabling their applications.”
Overview

The work of GGF is accomplished primarily by standards-oriented working groups and community-building research groups. Working groups focus on a very specific technology or grid issue and develop guidelines, best practices, or specifications that lead to broadly adopted standards and interoperable software. Research groups may focus on scientific or commercial applications using grids or may do research on a particular facet of grid technology or solutions. Each group belongs in an Area, which is managed by two Area Directors (ADs). You may visit an Area or Group page by clicking on their names below. For more information, contact replogl@ggf.org.

View the proposed Area/Group structure that takes effect at GGF14.

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<td>User Program Development Tools for the Grid (UPDT-RG)</td>
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Applications and Programming Models Environments (APME)

Working Groups

- Grid Checkpoint Recovery (GridCPR-WG)
- Grid Remote Procedure Call (GridRPC-WG)
- Advanced Collaborative Environments (ACE-RG)
- Application Developers and Users (APPS-RG)
- Astronomy Applications (Astro-RG)
- Grid Computing Environments (GCE-RG)
- Grid User Services (GUS-RG)
- Humanities, Arts, and Social Science (HASS-RG)
- Life Sciences Grid (LSG-RG)
- Particle and Nuclear Physics Applications (PNPA-RG)
- Preservation Environments (PE-RG)
- Production Grid Management (PGM-RG)
- Simple API for Grid Applications (SAGA-RG)
- User Program Development Tools for the Grid (UPDT-RG)

Research Groups

A lot of research is required
- Institute on Knowledge and Data Management
- Institute on Programming Model
- Institute on System Architecture
- Institute for Grid Information and Monitoring Services
- Institute on Resource Management and Scheduling
- Institute on Problem Solving Environment, Tools and GRID Systems
Institute on Programming Model

Institute leader:

- Marco Danelutto, Dept. Computer Science, University of Pisa, Italy

The expected result of this virtual institute will be the design of an innovative component model for the GRID, perfectly suited for large-scale, heterogeneous systems such as those that are found in GRID and P2P computing.
Behavior Customization of Parallel Components for Grid Application Programming

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Optimization Techniques for Implementing Parallel Skeletons in Distributed Environments

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Programming the Grid - Some Relevant Papers
http://dps.uibk.ac.at/index.pl/grid
Prof. Dr. Thomas Fahringer

- A Grid Programming Primer (GGF Document)
- Grid Programming: some indications where we are headed
- Models and Languages for Parallel Computations
- Grid RPC, Events and Messaging
- GridRPC: A Remote Procedure Call API for Grid Computing
- GridSuperscalar: a programming paradigm for GRID applications
- Grid Application Toolkit (GAT) API (EU GridLab Project)
- Stream Programming: In Toto and Core Behavior
- What is Content-Based Routing?
- Jini Network Technology - An Executive Overview
- Project JXTA: A Technology Overview
- MPICH-G2: A Grid-Enabled Implementation of the Message Passing Interface
- OmniRPC: A Grid RPC Facility for Cluster and Global Computing in OpenMP
- Peer-to-Peer Computing
- Program Control Language: a programming language for adaptive distributed applications
- Problem Solving Environment Comparison
Workflow Management: State of the Art vs. State of the Practice
GridFlow: Workflow Management for Grid Computing
Web Services Flow Language
GSFL: A Workflow Framework for Grid Services
Grid Enabling Applications Using Triana
The Application of Petri Nets to Workflow Management
Mapping Abstract Complex Workflows onto Grid Environments
Grid Workflow: A Flexible Failure Handling Framework for the Grid
Workflow Terminology: A list of active open source workflow projects - Open Source Workflow Engines
Grid Computing Env. Research Group - Meeting GGF6, grid workflow issues, BPEL4WS,...
MyGrid IT Innovation Workflow Enactment Engine
Service Workflow Language
Business Process Execution Language for Web Services
JISGA : A Jini-based Service-oriented Grid Architecture
Grid Platforms

"Distributed computing infrastructure for coordinated resource sharing and problem solving in dynamic, multi-institutional virtual organizations”

w.r.t. distributed-parallel platforms:

- an advancement, not a replacement
Current view of Grid applications (1)

Application

Collective Resource

Connectivity Fabric

Processing, memory, networking resources (including basic OS mechanisms)
Communication, authentication
Controlled and secure resource utilization: information and data replication, Security, Application development and control

Collective resource management: Discovery, Brokering, Co-scheduling, Monitoring, Data replication, Security, Application development and control
Current view of Grid applications (2)

Conceptually, nothing new w.r.t. programming on top of OS services and mechanisms, …

… but much more difficult for Grids!

Application

Collective

Resource

Connectivity

Fabric

Application management: collective resource control, dynamic allocation

Resource management by process servers and their composition

(Micro-)kernel: interprocess communication, protection, …

Basic HW + SW
This approach is too low-level for a pervasive, user-oriented Information Technology. Programming directly on top of services is hard, expensive, error-prone, … has low-productivity, … … and much more difficult for Grids!
Current view of Grid applications (4)

Application

Collective

Resource

Connectivity

Middleware

Grid Portals as useful in this view, but they don’t modify the nature of the problem (don’t eliminate the gap).

Applications as collection of services, to be composed, optimized, accessed, controlled, …

directly by the application designer
High-level view of Grid applications

- High-level languages, compositionality, modularity and interoperability
- Compiling Tools
- Run Time Support
- Programming Model (Cost Model) for static and dynamic optimizations
- Development, loading, execution, monitoring, ..., reconfiguring tools

Application

Programming Environment

Middleware → G.A.M.

Grid Abstract Machine

Basic HW+SW platform

It is not necessarily the same Middleware as before: it should be defined and realized according to the needs of the Programming Environment
Acknowledgements

- Marco Vanneschi, Department of Computer Science, University of Pisa, Responsible for the GRID.IT Project

- CoreGrid Colleagues
  - in particular, Marco Danelutto, leader of the CoreGRid Institute on Programming Model

- Global Grid Forum (GGF) Colleagues
Thank You