

Session C

Tools and Programming Environments

Dr. Domenico Laforenza

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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



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Tools and Programming Environments

State of the Art

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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

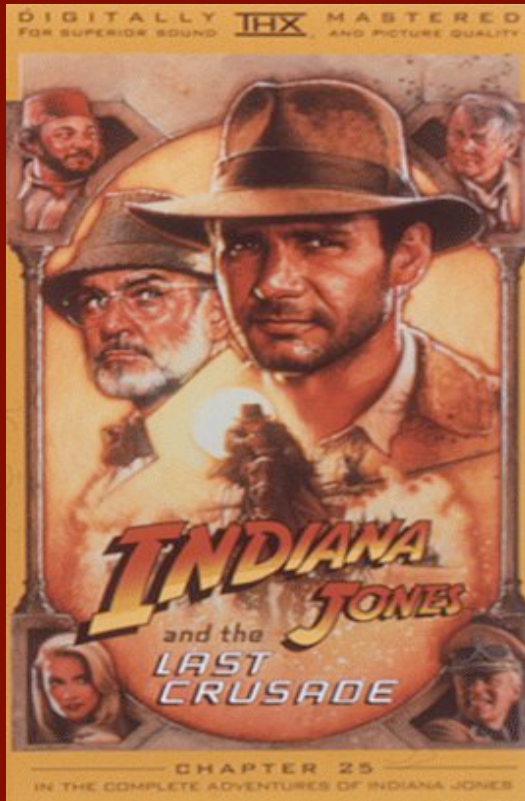
- **High-level environment, tools and methodology: the programmer has a very abstract view of the Grid**

- ☐ Resource management and service utilization: mainly at the responsibility of the environment tools

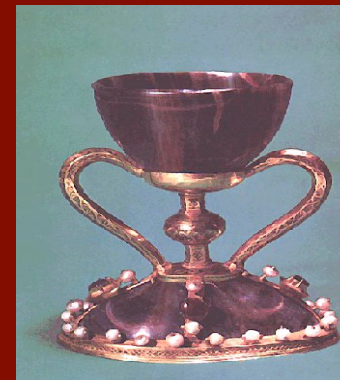
- **High-performance**

- ☐ Grid-computing vs parallel-distributed computing
- ☐ Methodologies and technologies: new vs revisited

Programming High Performance Applications in Grid Environments



.... Searching for the Holy Grail...



Grid programming: some indications where we are headed

D. Laforenza, Italian National Research Council, Pisa, Italy

Parallel Computing, Volume 28 , Issue 12 (December 2002)

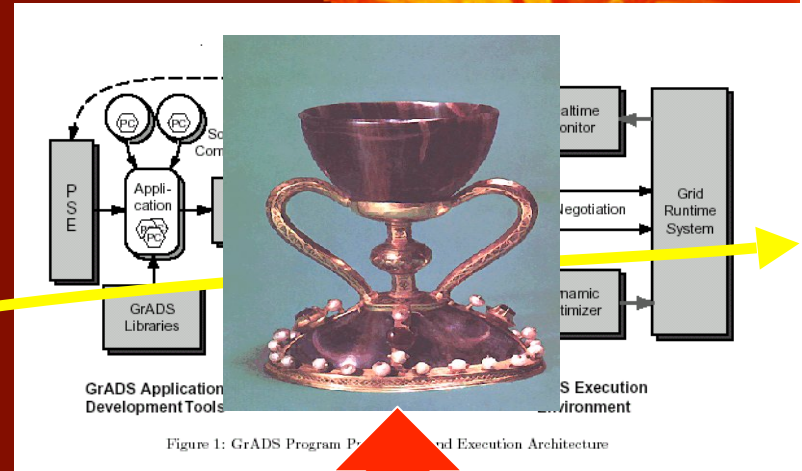
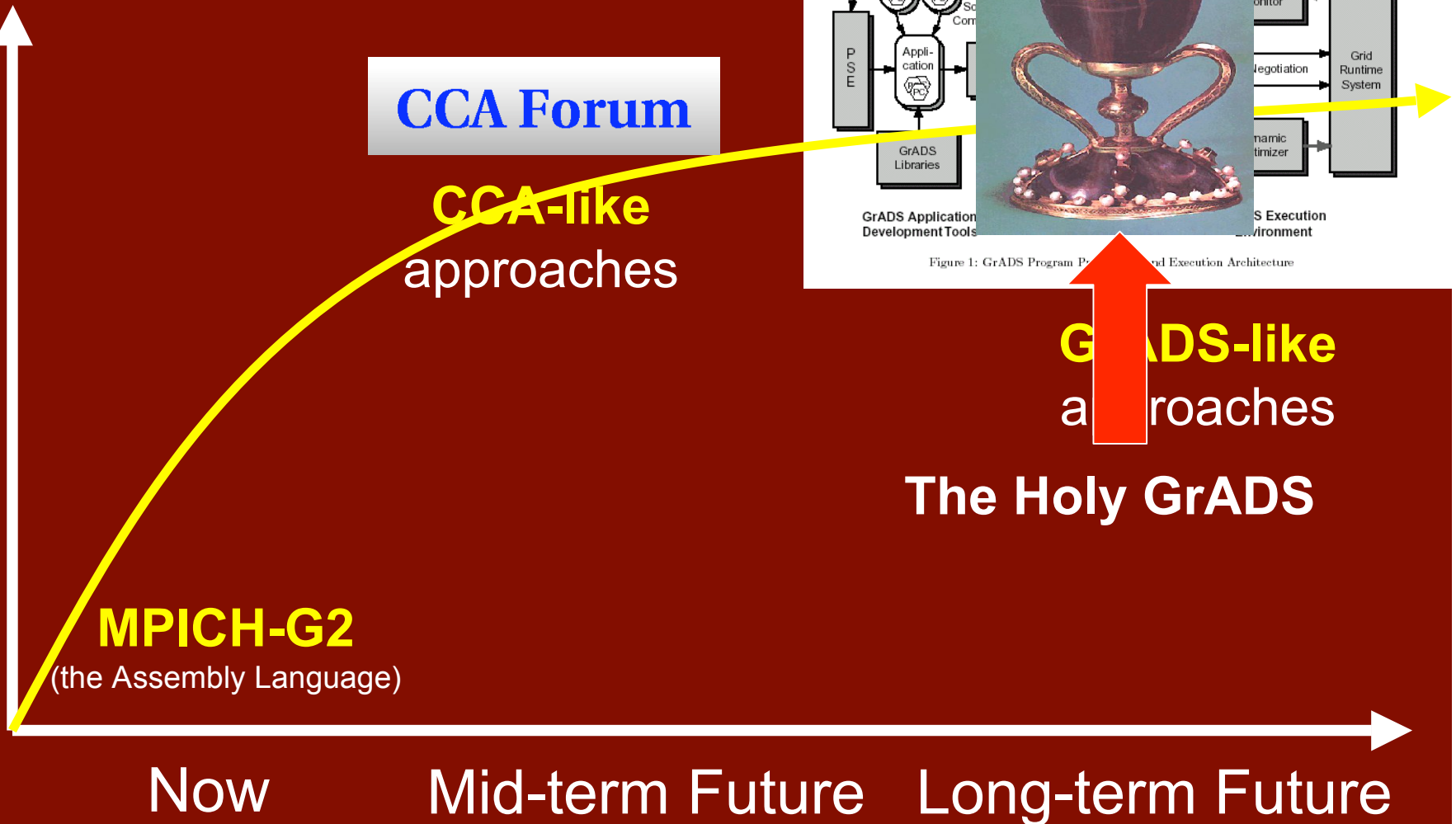
Special issue: Advanced environments for parallel and distributed computing

Pages: 1733 - 1752 Year 2002, ISSN:0167-8191, Elsevier Science Publishers



My 2-cents forecast (2002)

Degree of Automation



Workshop on Grid Applications and Programming Tools (GGF8, June 25, 2003, Seattle, USA)

“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.”

Thilo Kielmann, Vrije Universiteit, Amsterdam, Editor
(APPS-RG and UPDT-RG, Revisited December 2004)



OVERVIEW
COMPLETED WG/RG
WORKSHOPS

[ABOUT GGF](#) | [UNDERSTANDING GRIDS](#) | [GGF EVENTS](#) | [DOCUMENTS](#) | [AREAS/GROUPS](#)
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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 repogle@ggf.org.

View the [proposed Area/Group structure](#) that takes effect at GGF14.

Area	Working Groups	Research Groups
Applications and Programming Models Environments (APME)	<ul style="list-style-type: none"> Grid Checkpoint Recovery (GridCPR-WG) Grid Remote Procedure Call (GridRPC-WG) 	<ul style="list-style-type: none"> 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)



- ☐ 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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CoreGRID Technical Report
 Number TR-0002
 April 8, 2005

Institute on Programming Model

CoreGRID - Network of Excellence
 URL: <http://www.coregrid.net>

CoreGRID is a Network of Excellence funded by the European Commission under the Sixth Framework Programme

Project no. FP6-004265



Optimization Techniques for Implementing Parallel Skeletons in Distributed Environments

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CoreGRID Technical Report
 Number TR-0001
 January 21, 2005

Institute on Programming Model

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 URL: <http://www.coregrid.net>

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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

Programming the Grid - Workflow Papers

<http://dps.uibk.ac.at/index.pl/grid>

Prof. Dr. Thomas Fahringer

- ☐ 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

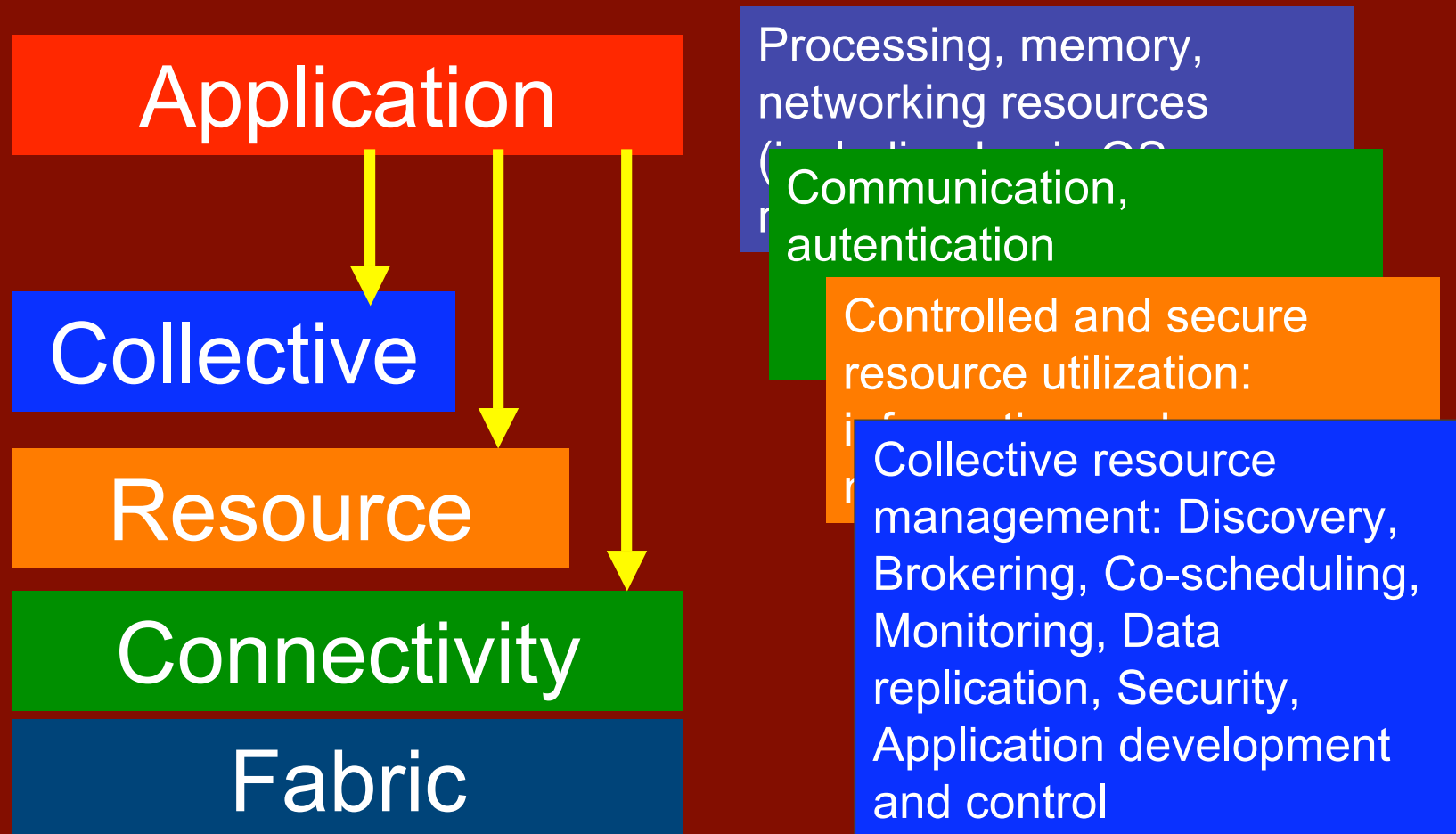
Grid Platforms

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

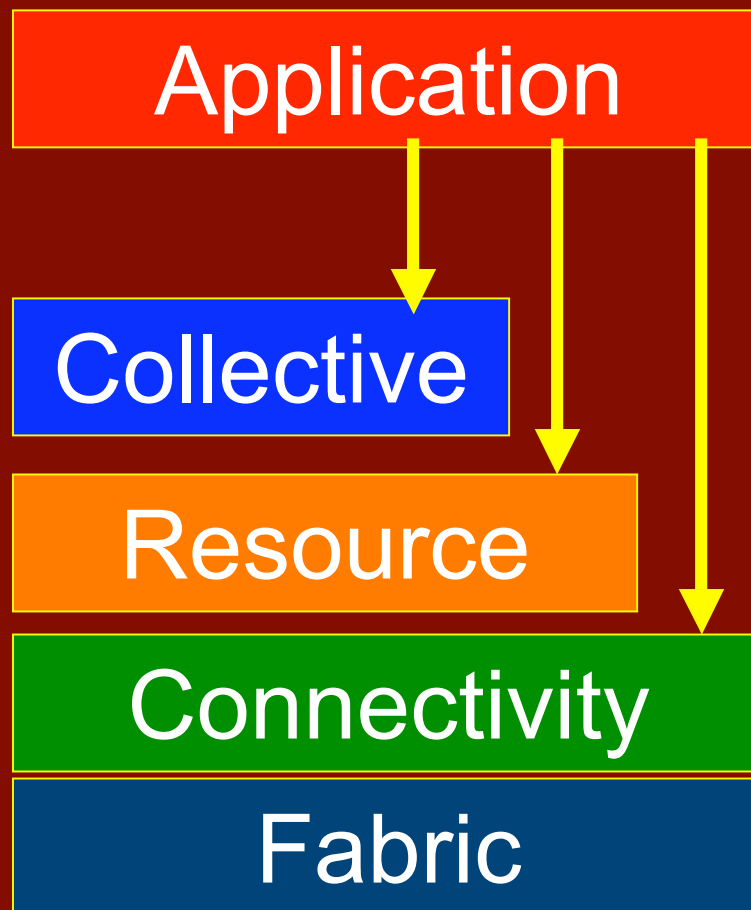
w.r.t. distributed-parallel platforms:

□ an advancement, not a replacement

Current view of Grid applications (1)



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 !

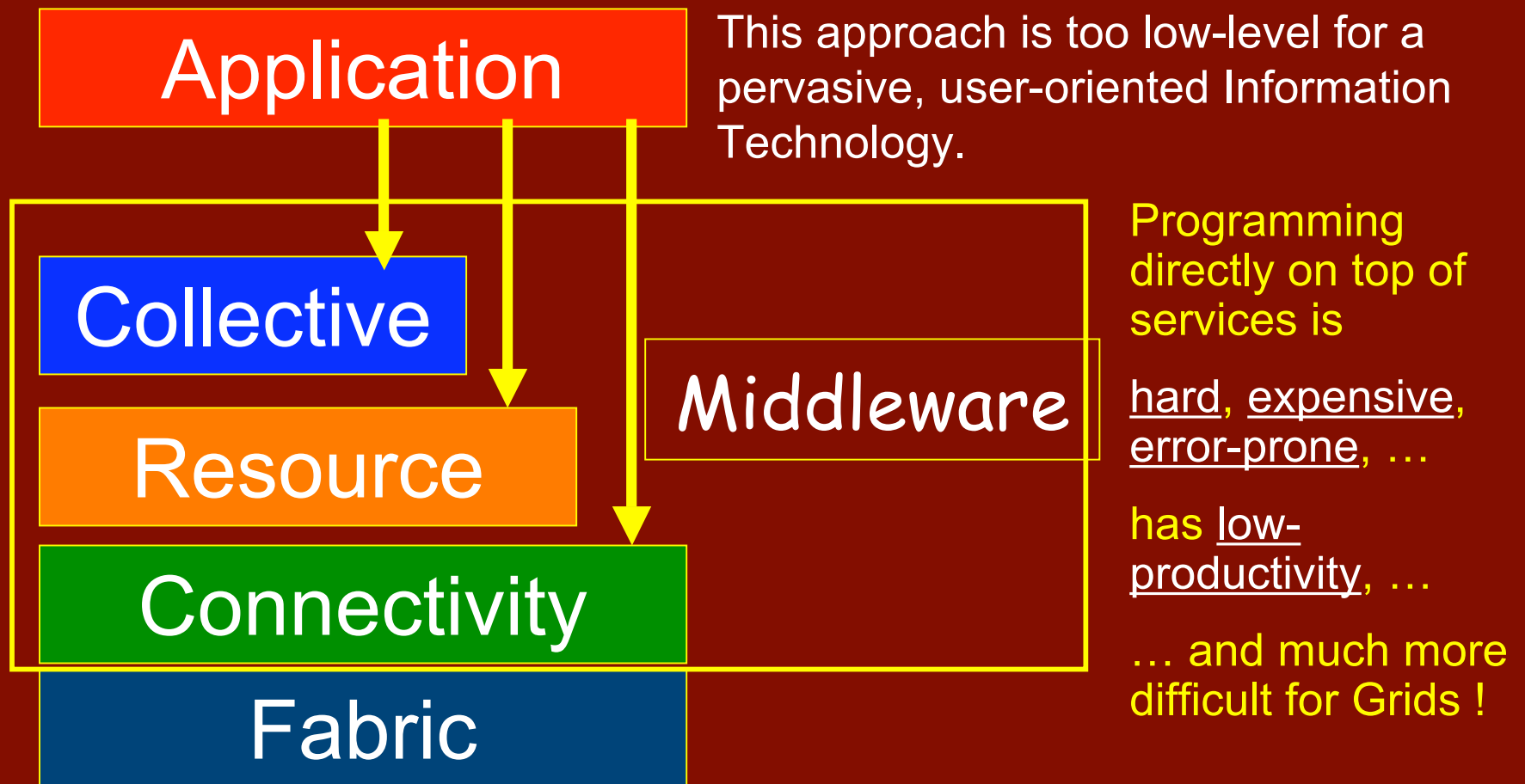
Application management: collective resource control, dynamic allocation

Resource management by process servers and their composition

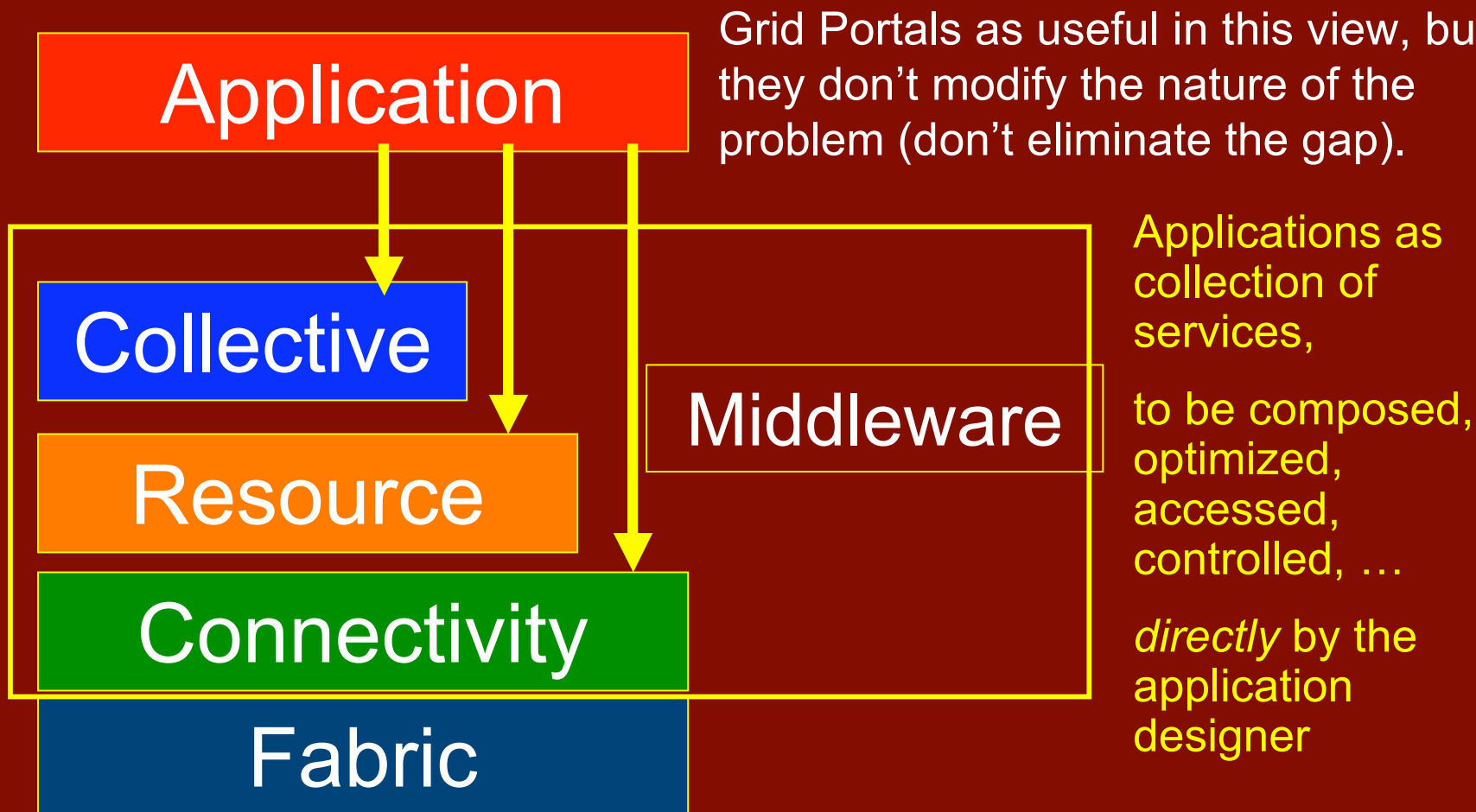
(Micro-)kernel: interprocess communication, protection, ...

Basic HW + SW

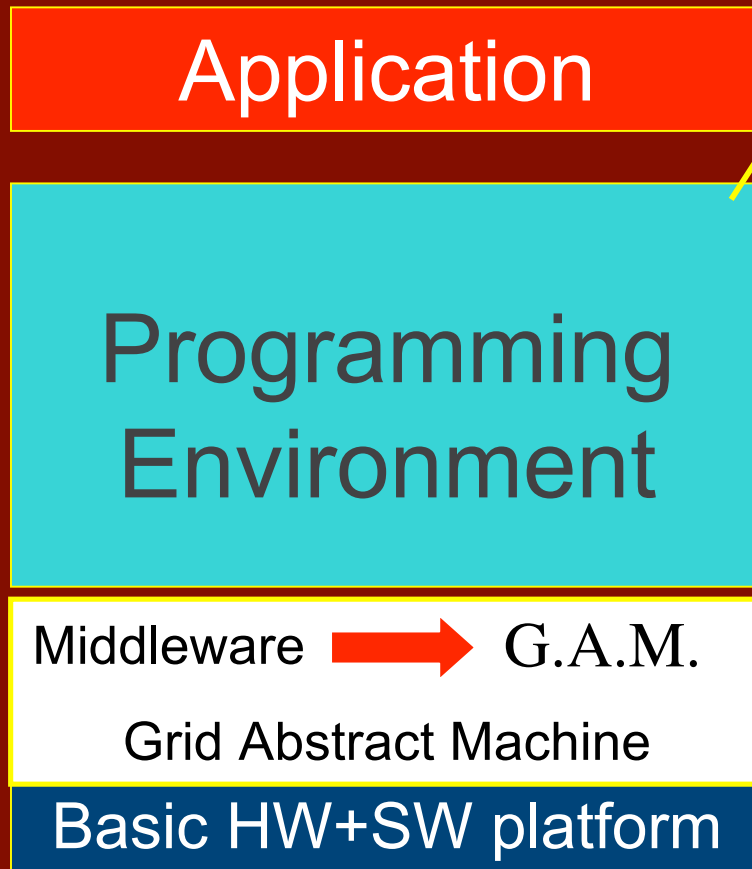
Current view of Grid applications (3)



Current view of Grid applications (4)



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

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

谢谢