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INRIA Lorraine & LORIA AlGorille

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INRIA Lorraine & LORIA AlGorithmes pour la Grille

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Introduction ... and the Scientific Community Structuring applications for scalability Transparent resource management Experimental validation

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Algorithm: A concise description of a technique to solve a given problem.

Efficiency: Ensure that the resource usage of an algorithms is as low as possible.

Proof: May be a theoretical proof (*e.g* on the bound of the number of operations) or a reproducible experimental study of the behavior.

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The notion 'Grid' was introduced in 1998 by Foster & Kesselmann:



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The notion 'Grid' was introduced in 1998 by Foster & Kesselmann:

Idea: Use resources on the net

- computing power
- bandwidth
- storage

transparently, like we use electricity:

anonymous

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transparently, like we use electricity:

customer provider

anonymous

Layer model of a grid architecture:

applications
middleware
services
infrastructure

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applications
middleware
services
infrastructure

Layer model of a grid architecture:

applications		
middleware		
services		
infrastructure	soft and hardware	

A (10) × (10) × (10)

Layer model of a grid architecture:

applications
middleware
services

Layer model of a grid architecture:

applications
middleware
services

scheduling, data management...

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Layer model of a grid architecture:

Layer model of a grid architecture:

applications
middleware
services
infrastructure

assemble service into platform API

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Layer model of a grid architecture:

applications middleware services infrastructure

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Layer model of a grid architecture:



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Three Research Themes

- Structuring applications for scalability
- Transparent resource management
- Experimental validation

Software

Conclusion





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 - conceptua
 - methodological

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The Team

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Malek Cherier (SimGrid) Xavier Delaruelle (Grid5000)

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CoreGrid: EU

- GridExplorer, AGIR: national ACI
- Grid5000
- Alpage: ARA MDMSA
- RGE
- PRST Région Lorraine: MIS

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LOTIA

algorithmic

The algorithmic challenge: overcome spatial and temporal distances

Grids are distributed environments:

latency is proportional to the distance

bandwidth is restricted

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algorithmic

The algorithmic challenge: overcome spatial and temporal distances

Grids are distributed environments:

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algorithmic

The algorithmic challenge: overcome spatial and temporal distances

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We have to organize

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... and the Scientific Community **Three Challenges** conceptual Structuring applications for scalability Transparent resource management

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Three Challenges co

conceptual

The conceptual challenge: reconcile differing objectives

customer

provider

anonymous

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Three Challenges co

conceptual

The conceptual challenge: reconcile differing objectives

customer broker provider *anonymous*

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Three Challenges co

conceptual

The conceptual challenge: reconcile differing objectives

customer broker provider role anonymous

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Three Challenges con

conceptual

The conceptual challenge: reconcile differing objectives



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... and the Scientific Community **Three Challenges** methodological Structuring applications for scalability Transparent resource management

LOTIA

The methodological challenge: performance evaluation

On top of all these difficulties: the problem of performance evaluation.

- Compare different algorithms in a reliable and reproducible way.
- Thereby demonstrate the progress our solutions provide.
- We have to
 - predict
 - control
 - evaluate

the performance in a setting that is as wide as possible.

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... and the Scientific Community Three Research Themes Structuring applications for scalability Transparent resource management Experimental validation

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LOTIA

Structuring applications for scalability

Models and algorithms for large scale computations

Cellular Networks

- Matrix-based problems from Natural Science (Physics, biochemistry, ...)
- Graphs and other Dynamic Data Structures.

Structuring applications for scalability

Models and algorithms for large scale computations

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Structuring applications for scalability

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- Transparent resource management
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Three Research Themes Service Layer

Transparent Resource Management

Efficient algorithms for

• Sequential and parallel task scheduling

- Data exchange
- Distribution and redistribution of data.

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Three Research Themes Service Layer

Transparent Resource Management

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Three Research Themes Service Layer

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Outline

... and the Scientific Community Three Research Themes Structuring applications for scalability Transparent resource management Experimental validation

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Simulation ⇒ SimGrid

- Emulation => Wrekavoc
- Large Scale Experiments —> Grid5000

Pilot Applications => parXXL

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LOTIA

- Simulation \implies SimGrid
- Emulation => Wrekavoc
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Context: Irregular Applications on a Large Scale

graphs networks web graph, internet, social networks cellular networks neural networks, cristals

Large problems, some millions or billions of nodes. Complex neighborhood structure and local functionality

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LOTIS

parXXL Algorithmic toolbox and testbed for fine grained computation on coarse grained architectures.

AdOC Communication compression on the fly.

SimGrid/GRAS Grid-simulator (SimGrid) and toolbox (GRAS) for service development, simulation, evaluation and deployment.

Wrekavoc Emulation of heterogeneity.

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Why: On simulator, one develops a prototype, not an application



What: Grid Research & Development Framework

- Study on simulator, produce real-world programs seamlessly
- Two implementations of the same interface
- Running to Linux, Mac OSX, Solaris, AIX, IRIX (Windows?)
- Communication speed almost comparable to MPICH
- Allow heterogeneous communications

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Algorithms for the Grid

Layer model of a grid architecture

Experimental validation

applications	
middleware	
services	
infrastructure	

Structuring applications for scalability Transparent resource management

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A lot of Software

parXXL AdOc SimGrid Wrekavoc

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Conclusion

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Algorithms for the Grid

Layer model of a grid architecture

Experi- 🏠	applications	$ \Leftarrow$
mental	middleware	1
valida-	services	$ \Leftarrow$
tion ↓	infrastructure	1

Structuring applications for scalability Transparent resource management

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A lot of Software

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Algorithms for the Grid

Layer model of a grid architecture

Experi- ↑	applications
mental	middleware
valida-	services
tion ↓	infrastructure

 Structuring applications for scalability
 Transparent resource

(3)

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management

A lot of Software

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