



GRID AND HPC WORKSHOP V  
IPM TEHRAN, IRAN

# DISTRIBUTED SYSTEM

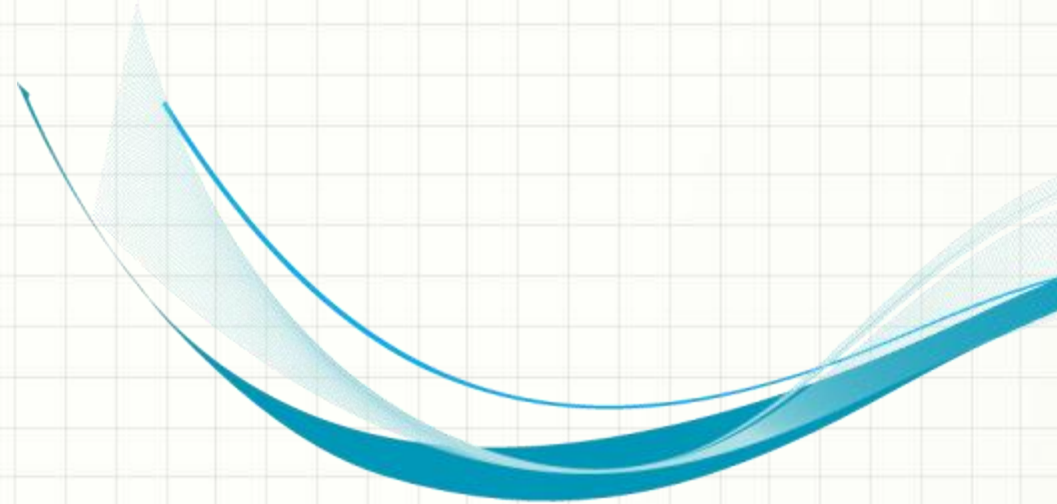
**Mohammad Reza Gerami**  
Institute for Research in Fundamental Sciences  
[gerami@ipm.ir](mailto:gerami@ipm.ir)

# Agenda

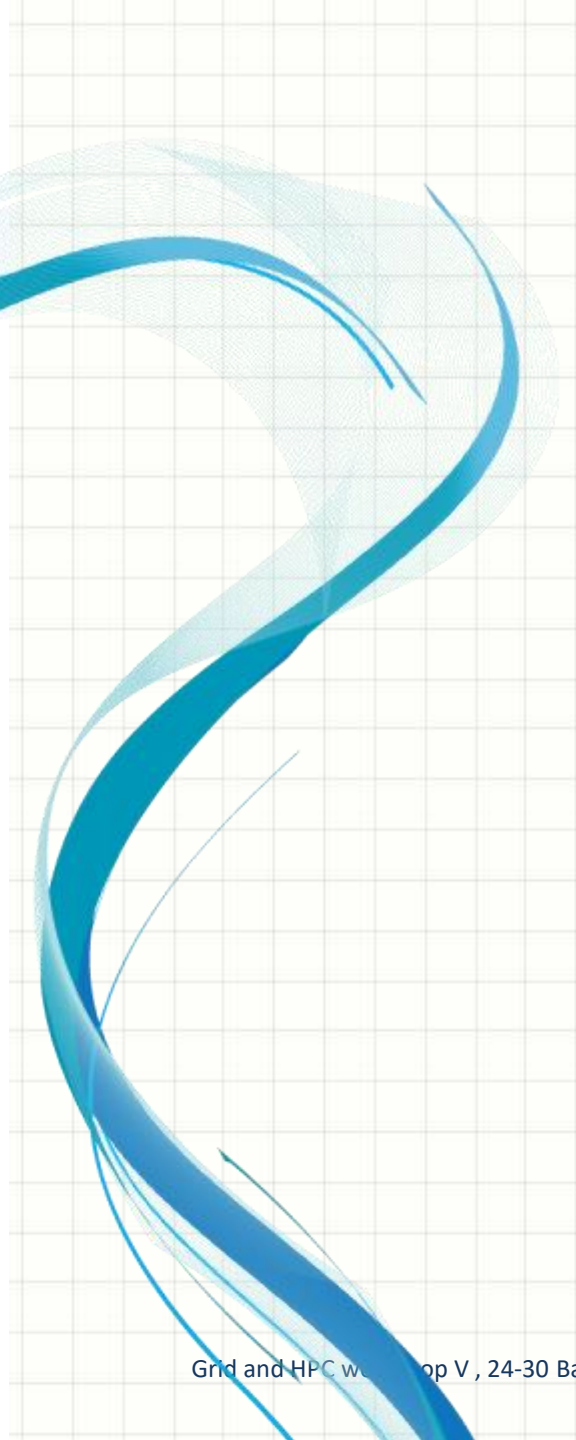
- Introduction
  - ✓ Definition of a Distributed systems
  - ✓ Goals
  - ✓ Grid Computing Systems

# Agenda

- Resource Management
- Information Systems
- Security
- Grid Middlewares
  - gLite

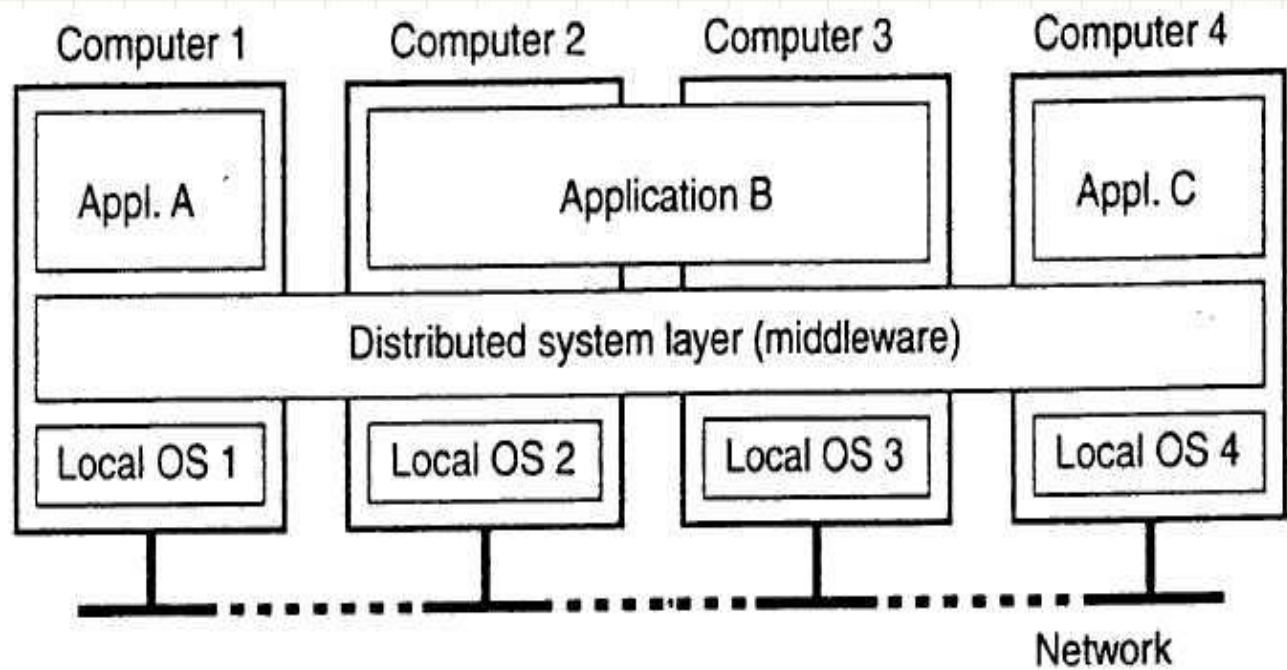


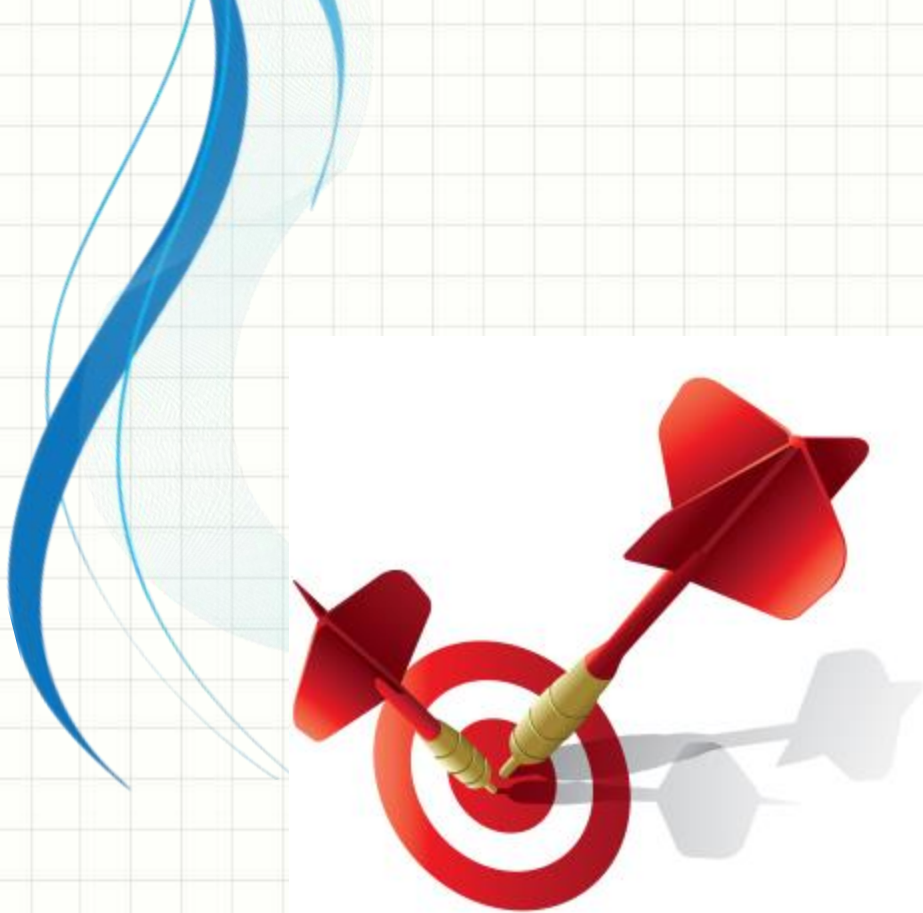
# Introduction Distributed systems



*A distributed system is a  
collection of  
independent computers  
that  
appears to its users as a  
single coherent system*







# Goals

# Goals

1

- Making Resources Accessible

2

- Distribution Transparency

3

- Openness

4

- Scalability

5

- Pitfalls



# Goals => Distribution Transparency

Transparency	Description
Access	Hide differences in data representation and how a resource is accessed
Location	Hide where a resource is located
Migration	Hide that a resource may move to another location
Relocation	Hide that a resource may be moved to another location while in use
Replication	Hide that a resource is replicated
Concurrency	Hide that a resource may be shared by several competitive users
Failure	Hide the failure and recovery of a resource

# Goals => Openness

An **open distributed** system is  
a system that offers services according to standard  
rules that describe the syntax and semantics of those  
services.

# Goals => Scalability

Worldwide connectivity through the Internet is rapidly becoming as common as being able to send a postcard to **anyone anywhere** around the world. With this in mind, scalability is one of the most important design goals for developers of distributed systems.

# Goals => Scalability

## ❖ Problems

- ✓ Size
- ✓ Geography
- ✓ Administration

Concept	Example
Centralized services	A single server for all users
Centralized data	A single on-line telephone book
Centralized algorithms	Doing routing based on complete information

# Goals => Pitfalls

- ✓ The network is reliable
- ✓ The network is secure
- ✓ The network is homogenous
- ✓ Latency is zero
- ✓ Bandwidth is infinite





# GRID BASICS

# Resources management

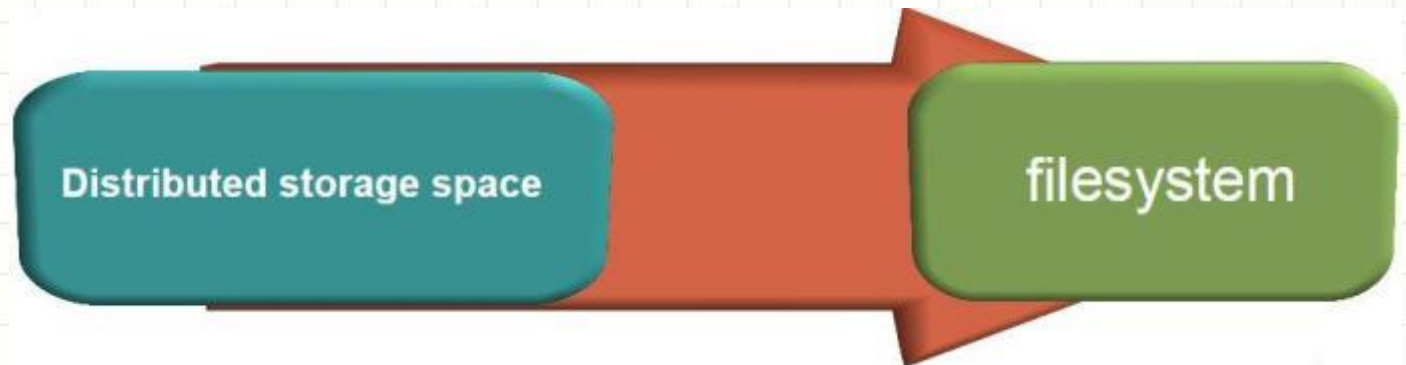
- Everything (or anything) is a resource
  - Physical or logical (single computer, cluster, parallel, data storage, an application...)
- Each site must be autonomous (local system administration policy)
- Job management:
  - Cooperation infrastructure for WAN distributed resources:
    - Locate, book and use the “right” resource
    - Scheduling service
    - Job description language

# Information system

- Which resources are available?
  - Where are them?
  - What is their status?
  - How can I optimize their use?
- We need a general information infrastructure:  
Information System
- Maintains information about hardware, software, services and people participating in a Virtual Organization
  - Should scale with the Grid's growth
- “Find a computer with at least 2 free CPUs and with 10GB of free disk space...”

# Data management (1)

- Where are data/files?
  - Which data/file exist?
  - How can I reach it?
  - Are they accessible by others?
  - ex. LFC file catalogue



# Data management (2)

- Data access and transfer
  - Simple, automatic multi-protocol file transfer tools: Integrated with Resource Management service
  - Move data from/to local machine to remote machine, where the job is executed (staging – stageout)
  - Redirect stdin to a remote location
  - Redirect stdout and stderr to the local computer
  - Pull executable from a remote location
- To have a secure, high-performance, reliable file transfer over modern WANs: e.g. GridFTP



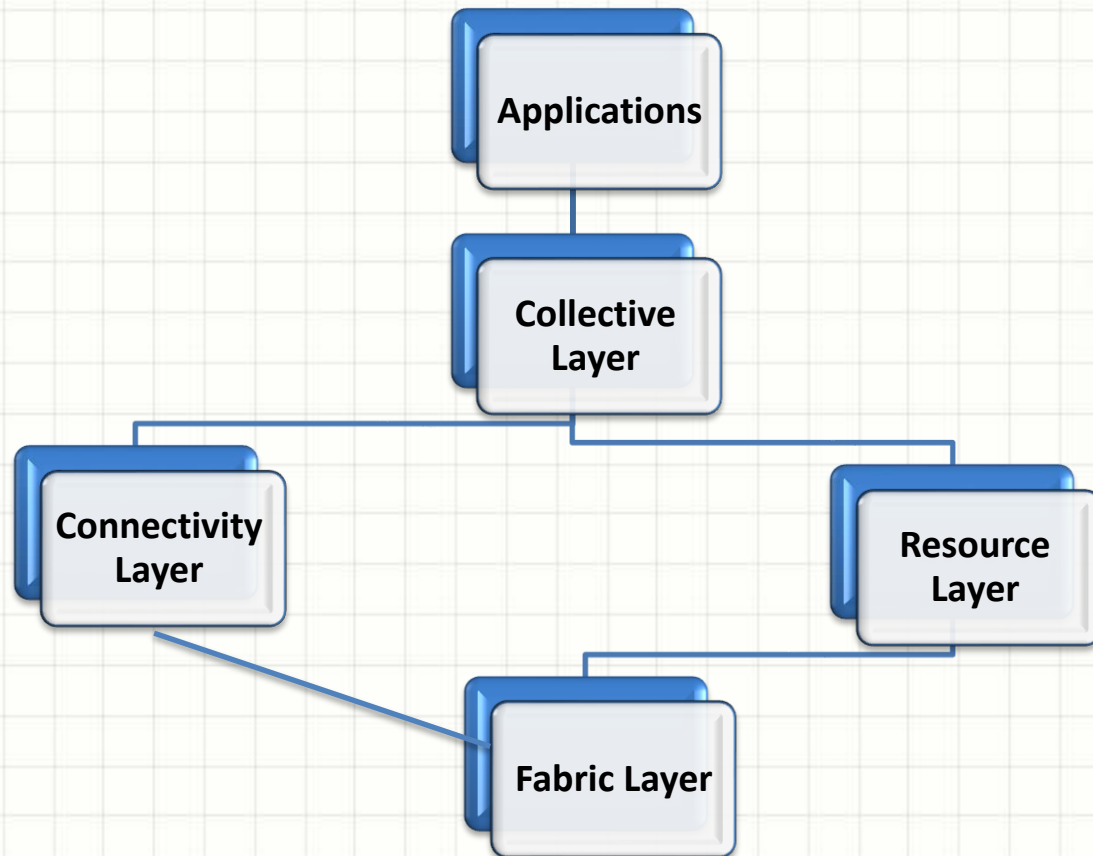
# Security (1)

- Grid is a highly complex system
  - Authentication: Who we are on the Grid?
  - Authorization: Do we have access to a resource/service?
  - Protection: Data integrity and confidentiality
- There are thousands of resources over different administration domains

# Security (2)

- Users point of view
  - Easy to use, transparent, single-sign on, no password sharing
- Administrators point of view
  - Define local access control
  - Define local police
- Grid Security Infrastructure (GSI)
- Grid credentials: digital certificate and private key
  - Based on PKI X.509 standard
  - CA signs certificates. Trust relationship

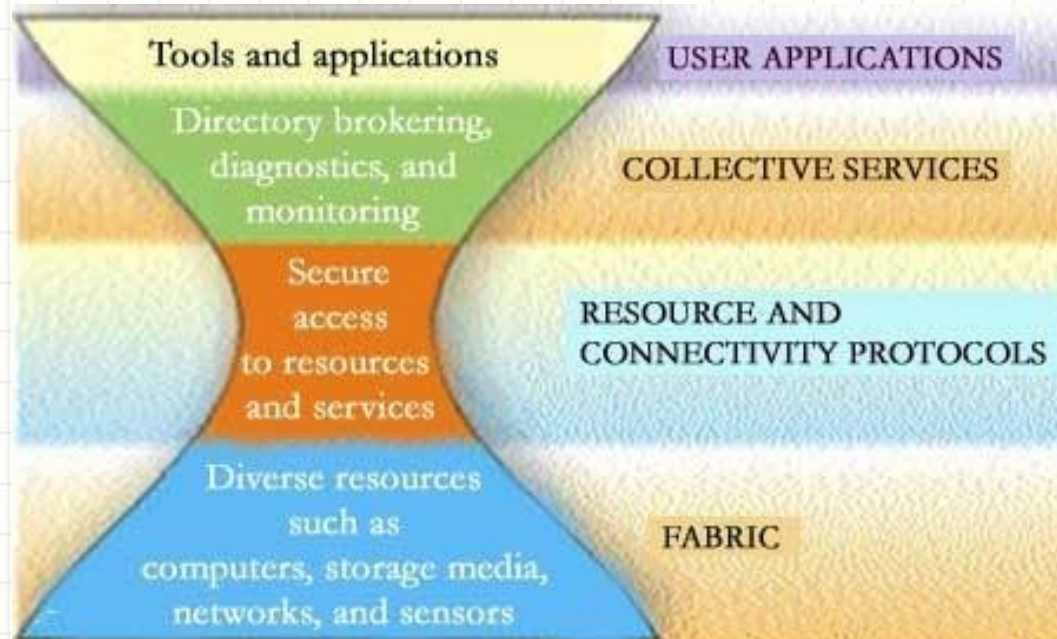
# The Grid Middleware



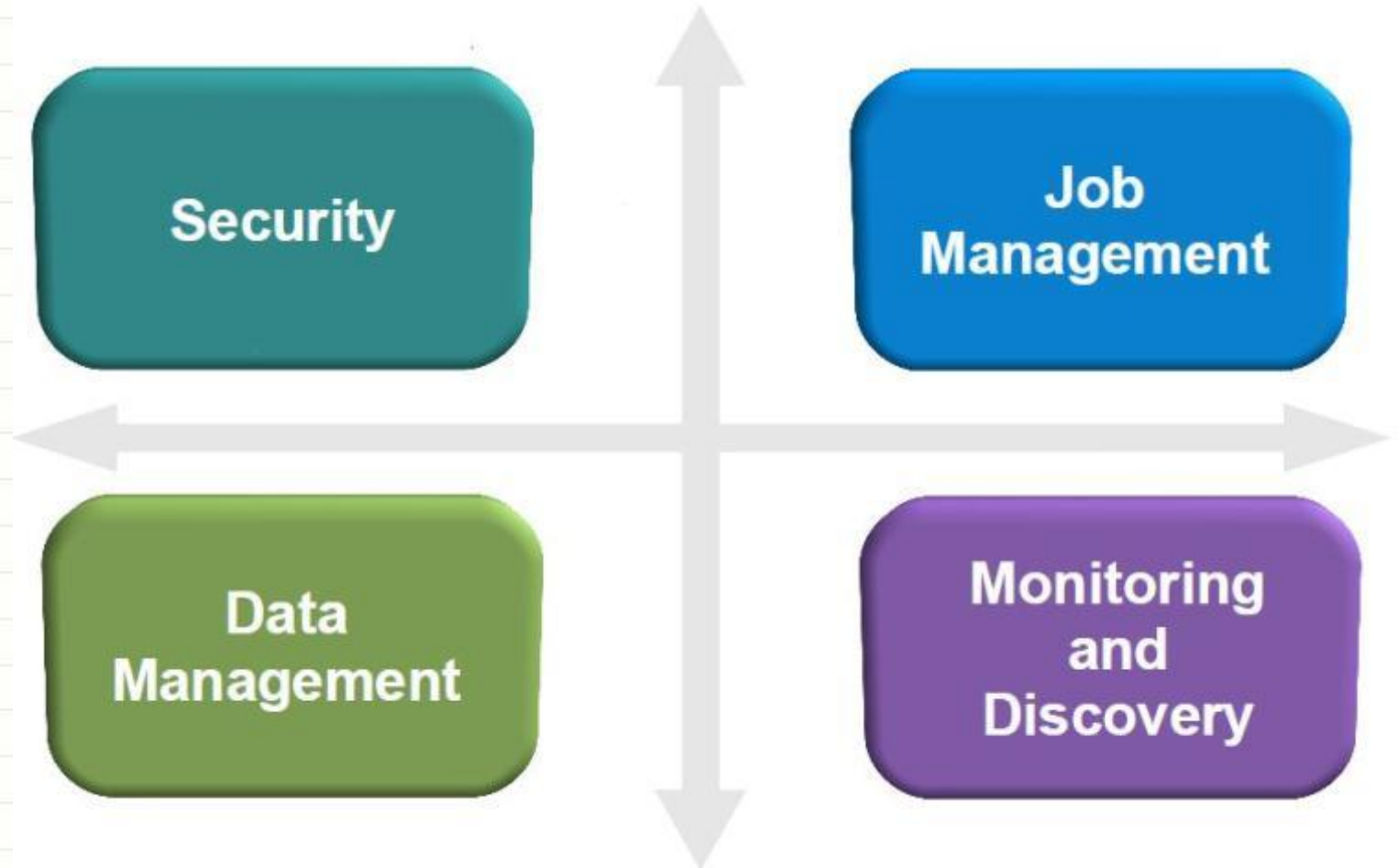
A layered architecture for grid computing systems

# The Grid Middleware

- It is the software layer that glue all the resources
- Everything that lies between the OS and the application



# Middleware generic services





# Most used middlewares

- ❖ gLite
- ❖ Globus alliance (Globus Toolkit)
- ❖ UNICORE
- ❖ ARC

# gLite (1)

- “(pronounced "gee-lite") is the next generation middleware for grid computing. Born from the collaborative efforts of more than 80 people in 12 different academic and industrial research centers as part of the EGEE Project, gLite provides a framework for building grid applications tapping into the power of distributed computing and storage resources across the Internet” - as defined at <http://glite.cern.ch/>

# gLite (2)

- The gLite distribution is an integrated set of components designed to enable resource sharing. In other words, this is middleware for building a grid.
- The gLite middleware was produced by the [EGEE](#) project
- Currently being developed by the [EMI](#) project ([European Middleware Initiative](#)) with EGI as the major customer and source of requirements for EMI
- Releases:
  - 3.1
  - 3.2
  - EMI-1 release

# gLite (3)

European Middleware Initiative (**EMI**) is a software platform for high performance distributed computing.

# gLite (4)

Release	Code Name	Release Date	End of Full Support	End of Standard Updates	End of Security Updates and Support
<a href="#">EMI 1</a>	Kebnekaise	May 12, 2011	April 30, 2012	October 31, 2012	April 30, 2013
<a href="#">EMI 2</a>	Matterhorn	May 21, 2012	April 30, 2013	October 31, 2013*	April 30, 2014*
EMI 3	Monte Bianco	February 28, 2013	April 30, 2014*	October 31, 2014	April 30, 2015*



# ARC

- The Advanced Resource Connector (ARC) middleware,
- Introduced by NorduGrid ([www.nordugrid.org](http://www.nordugrid.org))
- An open source software solution enabling production quality computational and data Grids
- Based on Globus Toolkit libraries
- Part of EMI-1



# UNICORE

- UNICORE - Uniform Interface to Computing Resources
- Grid computing technology that provides seamless, secure, and intuitive access to distributed Grid resources such as supercomputers or cluster systems and information stored in databases
- UNICORE is used in daily production at several supercomputer centers worldwide.
- UNICORE was developed in two projects funded by the German ministry for education and research (BMBF).
- In addition to CLI there is UNICORE Client, a Graphical User Interface (GUI) that exploits all services offered by the underlying server tiers
- UNICORE is part of the European Middleware Initiative



# Globus Toolkit



- The Globus Toolkit is an open source toolkit for building computing grids developed and provided by the Globus Alliance.
- The toolkit includes software services and libraries for resource monitoring, discovery, and management, plus security and file management.
- Serve as basis for many other Grid middleware's
- The Initiative for Globus in Europe (IGE) is an EU FP7 project to coordinate European Globus activities

# Ongoing Grid projects

- National
  - IRAN-GRID (Iran)
  - AEGIS (Serbia)
  - GridPP (UK)
  - CNGrid (China)
  - France Grilles (France)
  - D-Grid (German)
  - Open Science Grid (USA)
  - TeraGrid (USA)
  - ...

# Ongoing Grid projects

- International
  - EGI-InSPIRE Project (EU, Global)
  - High Performance and Grid Computing Research Group (US)
  - World Community Grid (Global)
  - OurGrid (Brazil)
  - ...