

HPDC 2009
Garching, June 9 - 13, 2009



Sustainable HPC Infrastructures

HPC Centers, Grids, and Clouds - The DEISA Experience -

- Your Research and the Big Picture -

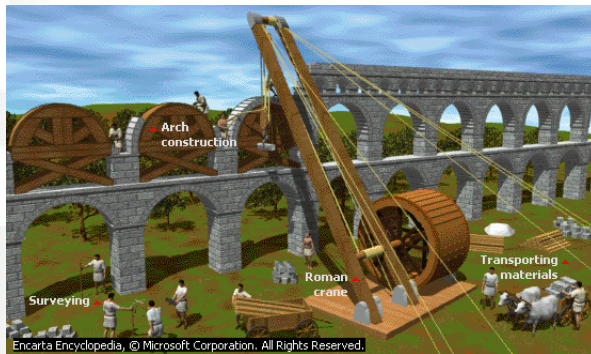
Wolfgang Gentzsch
DEISA & OGF
gentzsch at rzg.mpg.de



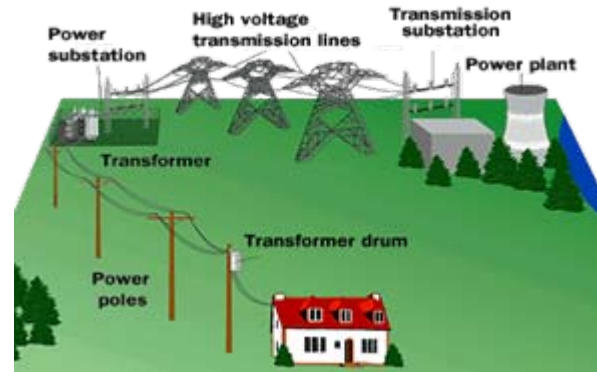
Contents

- Service Infrastructures
- Components: HPC Centers, Grids, and Clouds
- Examples: Research e-Infrastructures
- Example, Research: DEISA Ecosystem for HPC
- Example, Industry: Telecoms and the Cloud

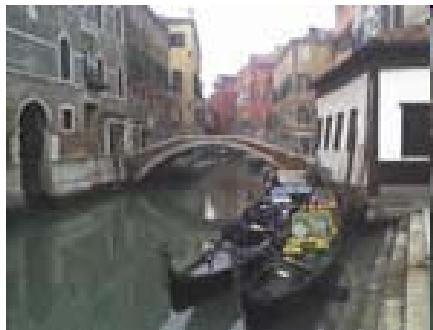
Service Infrastructures



Ancient Rome: 10 aqueducts,
150,000 m³ water each day



Electrical Power Grid
Infrastructure



Transportation
Grids



EGEE – Enabling
Grid in E-Science

HPC Centers

- HPC Centers are **service providers**, for past 35 years
- Computing, storage, applications, data, etc IT services
- Serve (local) research, education, and industry
- Very professional: to end-users, they look (almost) like Cloud services (Amazon Cloud definition: easy, secure, flexible, on demand, pay per use, self serve)



HPDC 2009



Wolfgang Gentzsch, DEISA

RoadRunner, Breaking the Petaflop/s Barrier

- 1986, Cray-2 breaking the **Gigaflop/s** barrier
- 1997, Intel ASCI Red, breaking **Teraflop/s** barrier
- **2008**, IBM RoadRunner, breaking **Petaflop/s**
 - At DOE's Los Alamos National Laboratory
 - 1.026 Linpack Petaflop/s solving 2 Mio equations
 - 6912 dual-core Opteron & 12960 IBM Cell eDP
 - #1 on Top500 of June 2008



Grids

1998: The Grid: Blueprint for a New
Computing
Infrastructure:

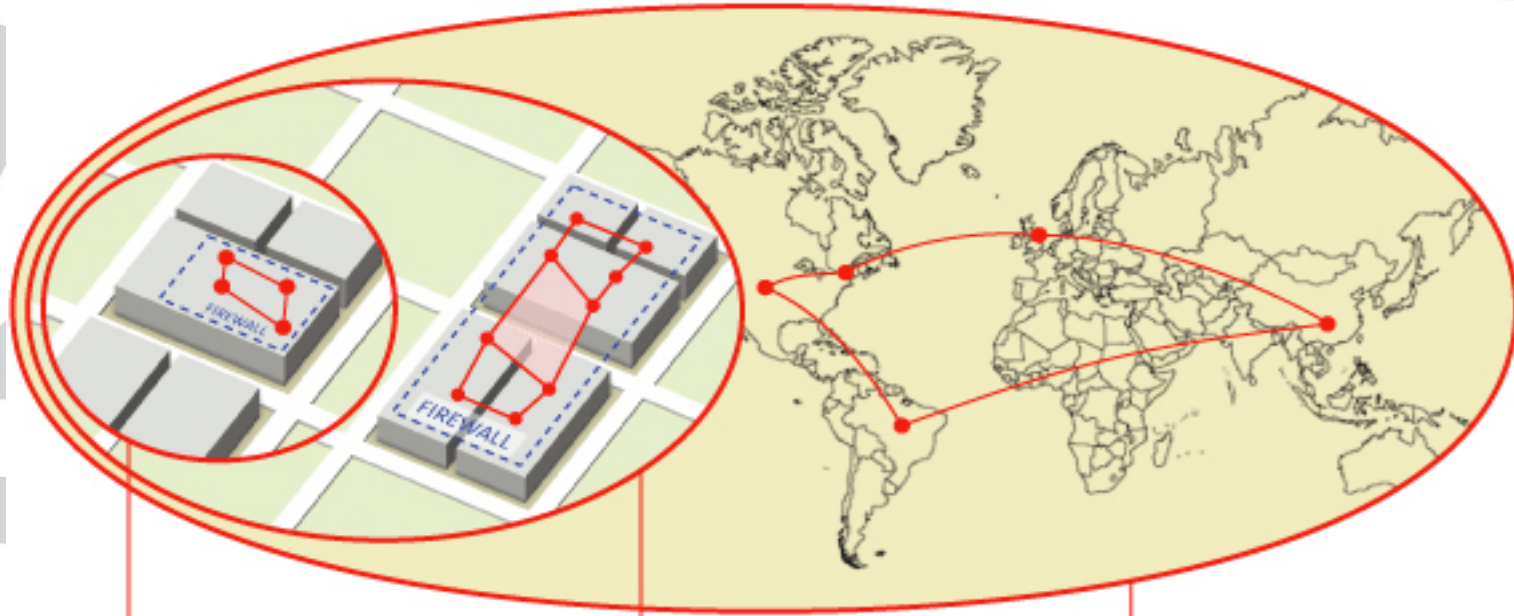
“... hardware and software infrastructure ...
dependable, consistent, pervasive,
inexpensive access to high-end computational
capabilities.”

2002: The Anatomy of the Grid:

“... coordinated resource **sharing** and problem
solving in dynamic, multi-institutional **virtual**
organizations.”

Quotes: Ian Foster, Carl Kesselman, Steve Tuecke

Grids (in 2001)



**Departmental
Grids**

**Enterprise
Grids**

**Global
Grids**

Research Grids work:

TERAGRID

Distributed European Infrastructure for

UNICORE

Distributed European Infrastructure for Supercomputing Applications



K*GRID



CERN

openlab for DataGrid applications
Developing Solutions for the Data-Intensive Science of the Large Hadron Collider



Grid5000



Enabling Grids for E-science in Europe

NAREGI

超高速コンピュータ網形成プロジェクト
National Research Grid Initiative

国立情報学研究所グリッド研究開発推進拠点 NII -The National Institute of Informatics

Grid Applications

Grid Middleware

Networking



Industry Grids work:

Johnson & Johnson

 GlaxoSmithKline
 Bristol-Myers Squibb

 Arcelor
Flat Carbon Steel

 Distributed European Infrastructure for
Schlumberger
Raytheon

 MERCK

 sanofi aventis
Because health matters

 Pfizer

 COLT

 TERRALLIANCE



BEAR STEARNS

Bank of America

 NTT WEST
The Abbey National

 BNP PARIBAS

 ATK

 CDC Ixis
Capital Markets



Caboto

ChevronTexaco

 CORUS

HSBC 

SUNGARD

 TD

WACHOVIA



 CALYON
CORPORATE AND INVESTMENT BANK



 Freddie Mac

 CIBC

 MIMOS

 Western Digital

COMMERZBANK 

Deutsche Bank 

UBS

 UniCredit

 Fidelity Investments

 JUPITER
A Time Warner Company

 bp

PHILIPS

 Algorithmics
Know Your Risk.

Genworth Financial
Built on GE Heritage

 Hewitt

 USGS
science for a changing world

 TRW
Automotive

FORTIS 

 Allstate.
You're in good hands.

BANK ONE

 NEESgrid

 MCNC
Grid Computing & Networking Services

 SAIC
An Employee-Owned Company

 Calypso
technology

 Nationwide

CREDIT SUISSE | **FIRST BOSTON** | **Goldman Sachs**

 U. PORTO

 CrossGrid

 ISI

 Northwestern Mutual
FINANCIAL NETWORK*

Cloud... X as a **Service**

Cloud: dynamically **scalable** and **virtualized** resources provided **as a service** over the Internet

Infrastructure (**IaaS**)

- Accessible online, anytime, anywhere
- Pay for what you use
- Available on demand
- Service Level Agreements
- Automated:
- Scalability
- Failover
- Concurrency management

Platform (**PaaS**)

Software (**SaaS**)

The Cloud of Cloud Companies

- 
- Amazon
 - Google
 - Salesforce
 - Microsoft
 - Sun
 - IBM
 - Oracle
 - EMC
 - Cloudera
 - Cloudsoft
 - Akamai
 - Areti Internet
 - Enki
 - Fortress ITX
 - Joyent
 - Layered Technologies
 - Rackspace
 - Terremark
 - Xcalibre
 - Manjrasoft
 -

Example: ANEKA Cloud platform

SaaS



Cloud applications
Social computing, Enterprise, ISV, Scientific, CDNs, ...

Cloud Programming Models & SDK

- Task Model
- Thread Model
- Map Reduce Model
- Workflow Model
- Third Party Models

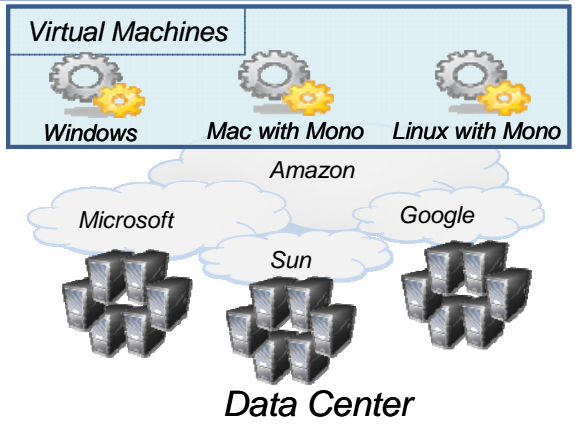
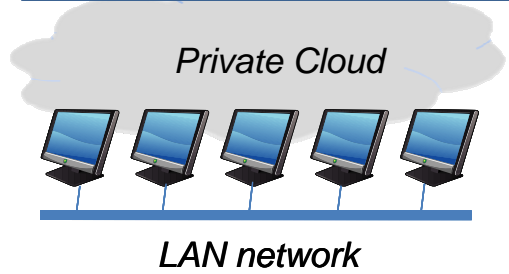
Core Cloud Services

- SLA Management
- QoS Negotiation
- Pricing
- Billing
- Metering
- Job Scheduling
- Execution Management
- Monitoring
- Admission Control
- Data Storage
- VM Management
- VM Deployment

Aneka Cloud Platform

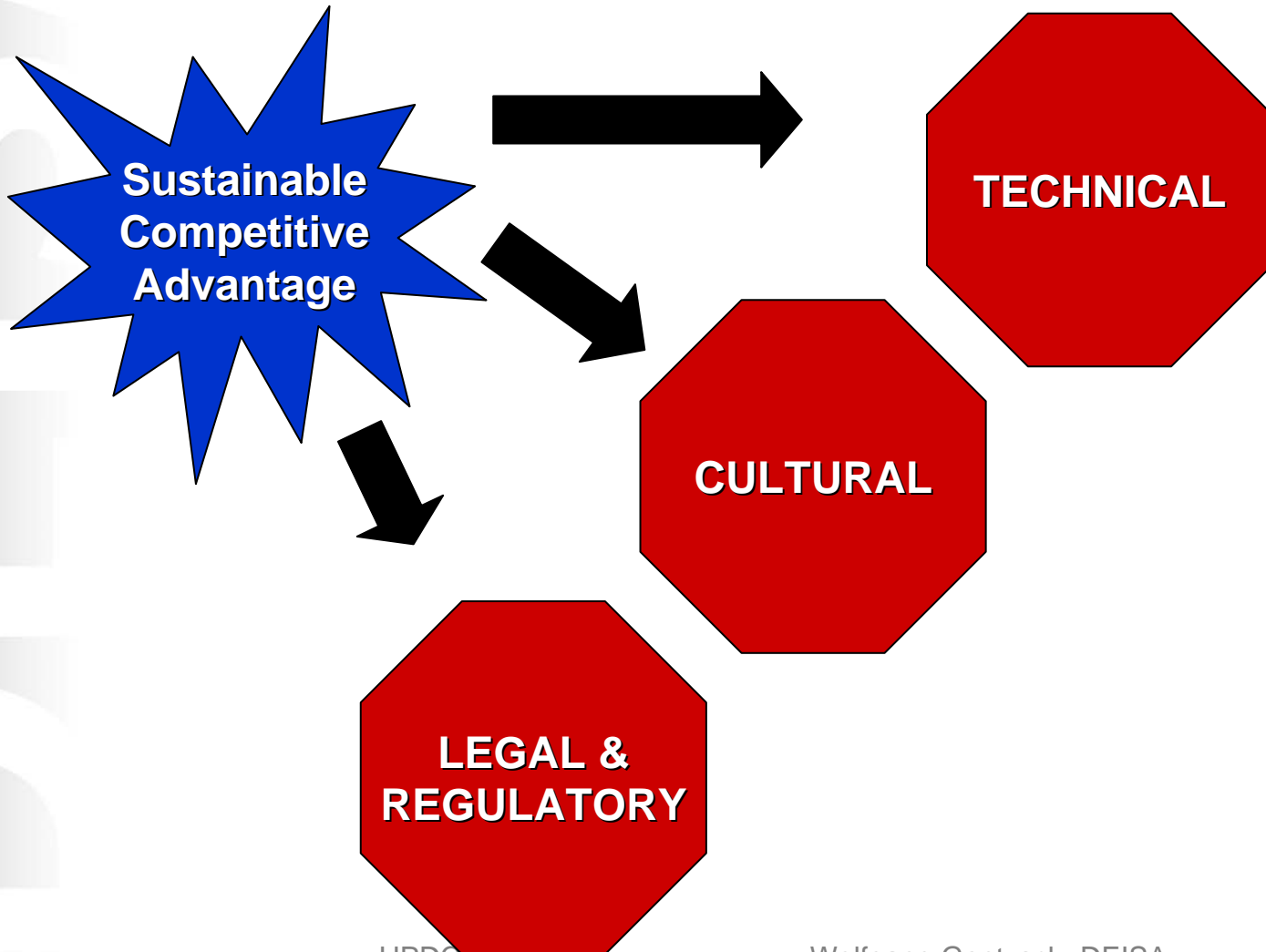
PaaS

IaaS



Courtesy: Raj Buyya Grids Lab

The Challenges for e-Infrastructures



e-Infrastructure Challenges

- **Sensitive data**, sensitive applications (med.patient records)
- Different organizations have different **ROI**
- **Accounting**, who pays for what (sharing!)
- **Security** policies: consistent and enforced across the grid !
- **Interoperability** of components and grids (standards ?)
- Current IT culture is not predisposed to **sharing** resources
- Not all applications are grid-ready or **grid-enabled**
- **Open source** is not equal open source (read the little print)
- SLAs based on open source (**liability**?)
- “Static” **licensing** model don’t embrace grid
- Protection of **intellectual property**
- **Legal** issues (FDA, HIPAA, multi-country grids)



DEFISA

Examples of a successful Research e-Infrastructures



NEESGrid

Realtime access to earthquake Shake table experiments at remote sites.



BIRN – Biomedical Information



The screenshot shows the BIRN Portal website. At the top left is the BIRN logo with the text "BIOMEDICAL INFORMATICS RESEARCH NETWORK". To the right is a login form with fields for "Username:" and "Password:" and a "login" button. Below the login form is a navigation bar with links: "Portal Home", "BIRN Website", "Account Request", "Style", and "Help".

Login Information

BIRN Portal Login

Enter your username/password

Username:

Password:

- [Request](#) a BIRN account (must be a BIRN participant)
- [Email](#) BIRN Portal admins

Portal Requirements

You must have cookies enabled to login to the BIRN Portal, in addition, Javascript is highly recommended but not required.

The latest version of Java will be required to access *some* of the applications.

For optimal browsing please use a [Mozilla](#) based browser.

Older versions of Safari will experience

Welcome to the BIRN Portal

The Biomedical Informatics Research Network (BIRN) Portal provides BIRN members with a single sign on web portal to access data grid files, computation grid resources, and a variety of collaboration tools to facilitate the scientific needs of BIRN researchers. Non-BIRN participants may access the portal through a guest registration.



BIRN Portal
Biomedical Informatics Research Network

Geological Information Grid Portal

The screenshot displays the GEONgrid Portal interface. At the top, the title "GEONgrid Portal" is shown next to the GEON logo (CYBERINFRASTRUCTURE FOR THE GEOSCIENCES). A navigation bar includes links for PortalHome, GEONsearch, myGEON, GEONscience, System, UserProfile, and MapIntegration. Below this, there are links for GEON Search, GEON Ontology, and GEON Resource Registration. The main content area is titled "GEON Search" and is divided into two columns. The left column contains search filters: "Metadata Related" with dropdowns for resource type and subjects, and "Spatial Coverage" with a text input and a "GO" button. The right column is titled "Select a Subject to Show Resources" and lists various subjects such as Biological oceanography, Chemical oceanography, and Geology. Below the subject list, there is a note about reorganization and a section titled "Resources in Geology" showing 1-5 of 17 files. The first resource listed is "Arizona Geology Map" with details on format, dataset ID, spatial coverage, temporal coverage, and description.

GEONgrid Portal

Welcome Dennis Gannon: [Logout](#)

PortalHome GEONsearch myGEON GEONscience System UserProfile MapIntegration

GEON Search GEON Ontology GEON Resource Registration

GEON Search

1 Metadata Related:

Choose resource type:
<All Resource Types>

Choose subjects:
<All Subjects>

Optional keywords:

2 Spatial Coverage:

Type a place name:
 [GO](#)

or select an area on the map:

Select a Subject to Show Resources

Biological oceanography	Chemical oceanography	Cryology
Ecology	Education	Environmental science
Forestry	Geochemistry	Geologic time
Geology	Geophysics	Human geography
Hydrology	Mineralogy or petrology	Natural hazards
Other	Paleontology	Physical geography
Physical oceanography	Soil science	Structural geology
Technology		

(These subjects will be reorganized soon by something similar to the classification from [GeoRef](#).)

Resources in Geology 1-5 of 17 files ▶

Title: Arizona Geology Map

Format: shapefile

Dataset Id: GEON-25dfb3db-e710-11d8-b226-ab22ed7681c0

Spatial Coverage: North: 37 East: -109.04 South: 31.33 West: -114.82

Temporal Coverage: any

Description: This is a geology map of Arizona in USA.

Semantic Annotations: [see details](#)

Mesoscale Meteorology



NSF LEAD project - making the tools that are needed to make accurate predictions of tornados and hurricanes.

- Data exploration and Grid workflow

Welcome to the **LEAD PORTAL** Linked Environments for Atmospheric Discovery
 Sponsored by the National Science Foundation

Portal Home | Geo GUI | Education and Outreach | Weather | Links | About LEAD | Help

Home

To view a local radar, select area of interest and click on the image below.

**RADAR REFLECTIVITY FROM RADAR CODED MESSAGES
 NATIONAL WEATHER SERVICE
 AUTOMATED EDITING APPLIED
 SEP 24, 2005 21:49 UTC**

MSG
 55 DBZ
 50 DBZ
 45 DBZ
 40 DBZ
 30 DBZ
 15 DBZ

Data provided by NOAA's National Weather Service

LEAD Home | FAQ | Privacy | Terms of use | Contact us

User Name

Password

Remember my login

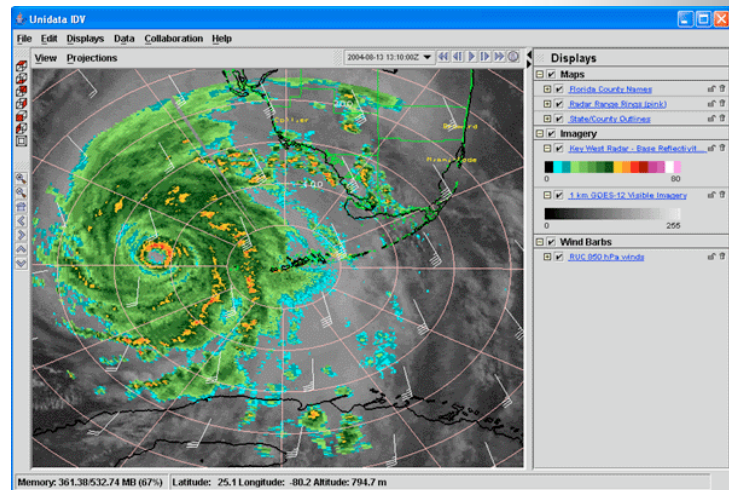
Create new account

Forgot your password?

LEAD Grid Testbed Status

Testbed	Grid Auth	GRAM	Grid
IU [chinkapin]	✓	✓	✓
NCSA [copper]	✓	✓	✓
OU [aquaman]	✓	✓	✓
UAH [frozone]	✓	✓	✓
UNC [dante0]	✗	✗	✗
Unidata [lead1]	✓	✓	✓

Last updated: Sat Sep 24 17:00:00 2005 Indiana 1



Workflow Composer

Workflow MyLead Component Monitor

Add Node Remove Node Connect/Disconnect

Component List

- System Components
- http://whitney.extreme.indiana.edu
- http://www.extreme.indiana.edu
- Adder
- Multiplier
- Divider
- decoder
- threads
- arps-trn
- arps-sfc
- ext2arps-llbc

Component Information

Service: decoder

Description:
 A service for decoding raw eta data to netcdf format

Operation: Run

Port information | Notification |

Selected Output Port

Selected Input Port

Component: Output_URL
Port: Parameter
Type: Any
Description: This port can be connected to any type.

Renci Bio Portal



Providing access to biotechnology tools running on a back-end Grid.

- leverage state-wide investment in bioinformatics
- undergraduate & graduate education, faculty research
- another portal soon:
national evolutionary synthesis center



The screenshot displays the Renci Bio Portal interface. The browser window shows the URL: https://velma.renci.unc.edu:8443/bioportal/portal/user/lavanya/js_pane/P-f0545b2177-20017?getvm=true&expert=true&vmfile=blast2.vm&frm_menusstate=151&eventSubmit_doGetvm=Get+Entry+Form. The page title is "Bioportal My Workspace: Applications - Microsoft Internet Explorer provided by Compaq". The main content area is titled "Bioinformatics Tools Menu" and "Select an application". A sidebar on the left lists various applications: banana, biosed, bl2seq, blast2, btwisted, build_icm, cai, chaos, charge, checktrans, chips, cirdna, clique, clustalw, codcmp, compseq, cons, consense, cpqplot, cpqreport, cusp, dan, deqapseq, descseq, diffseq, distmat, dnadist, dnapsars, dollop, dotmatcher, dotpath, dottup, drawgram, drawtree, dreg, emma. The main panel shows the "BLAST2: with gaps (Altschul, Madden, Schaeffer, Zhang, Miller, Lipman)" application. It includes a "Simple blast2 form" with a dropdown menu for "Blast program" set to "blastp: amino acid query / protein db". There are fields for "Sequence File" and "actual data here". The "Sequence File" field has a "Browse..." button. The "actual data here" field has a "Browse..." button. Below these fields are input boxes for "Start of required region in query sequence (-L)" and "End of required region in query sequence (-L)". There are also dropdown menus for "protein db" (set to "erw_nr: Non-redundant environmental samples from GenPept+PDB+SwissProt+PIR+PRF") and "nucleotid db" (set to "erw_nt: Environmental Samples"). The page footer shows the Windows taskbar with the start button and several open applications.

Nanohub - nanotechnology



Distributed
European
Infrastructure for
Supercomputing
Applications

X-Ray Crystallography

C.I.M.A.

Common Instrument
Middleware Architecture

Welcome to the
Crystallography Portal

Username: Login
Password:
 Remember me on this computer
[Login Help](#)

[Home](#) [Current Status](#) [Data Repository](#) [About](#)

The Purdue Chemistry Crystallography Center

The Purdue Chemistry Crystallography Center

[Disable your browser's cache to get the live stream!](#)

[IUB IUMSC](#)

[IUB Myers
Hall](#)

[Purdue
Crystallography
Center](#)

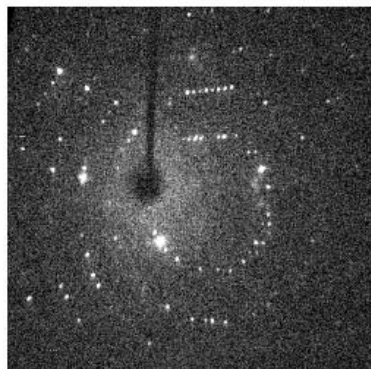
[CSAF Sydney,
Australia](#)

[Minnesota
X-ray Lab](#)

[ChemMatCARS
- Univ. of
Chicago at
APS](#)

[Other
collaborators](#)

[NCS
Southampton,
UK](#)



Data from Nonius Kappa CCD detector
(Under development!)
Total Number of jpg: 10
Frame: s01f0010.jpg
[All available jpg images](#)
[Browse the 20 latest jpg images](#)



[Streaming video from the lab showing the Nonius instrument](#)



[Streaming video from the crystal microscope on the Nonius diffractometer](#)

Local date/time: 2005-09-24 11:36:54

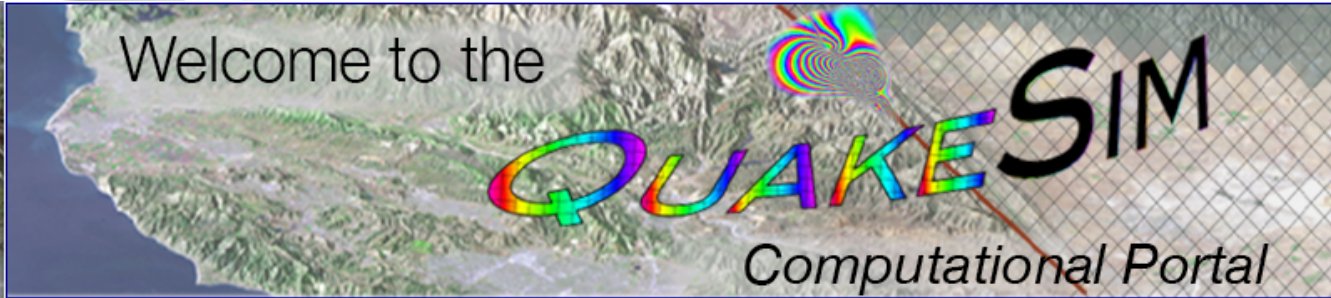
These values are updated approx. every 60 sec.

Times in UTC

LabJack U12

Instrument Enclosure Temp. & Humidity:	23.4 C Rel. Humid. 43.1 %	2005-09-24 16:35:59
Chill Water In:	16.4 C	2005-09-24 16:36:25
Chill Water Out:	19.3 C	2005-09-24 16:36:25
Generator Relay Voltage: All previous voltages	3.42 X-ray Generator is: OFF	2005-09-24 16:36:48

ServoGrid Portal



Username:

Password:

[Create New Account](#) | [Login Help](#)

[SERVOGrid](#) [FaultDB Search](#) [QuakeTables Portal](#) [Search](#)

SERVOGrid

SERVO Grid

Solid Earth Research Virtual Observatory Grid

- [QuakeSim](#) home page.
- Old GEM General Earthquake Modeling [Web Site](#)
- SLIDE Distributed [File System](#) for NASA Computational Technology Project
- [Report](#) from the Earth Science Enterprise Computational Technology Requirements Workshop April 30-May 1 2002 where SERVO concept first introduced
- Discover the Grid at the [Grid Forum](#) or at this [collection](#) of papers
- Other collected papers and presentations on SERVOGrid and related topics are available from the Community Grids Lab [publications page](#).

[QuakeSim Web Portal](#)

[User Manual](#)

[Support](#)

[Report Bugs](#)

[QuakeSim Web Site](#)

Participating Institutions:

[IU CGL](#) | [NASA JPL](#) | [UC Davis](#) | [UC Irvine](#) | [USC](#)



Belfast Gene Grid Portal



The screenshot shows the Belfast Gene Grid Portal website. At the top left is the BeSC logo (The Queen's University of Belfast Belfast e-Science Centre). In the center is the GeneGrid logo. At the top right is the Queen's University Belfast logo and a language dropdown menu set to English. Below the header is a red navigation bar with 'GridSphere' and 'Home' links. The main content area features the 'fusion antibodies' logo (from genes to proteins to antibodies) and the 'amtec' logo. A 'Login' box on the right contains fields for 'User Name' and 'Password', a 'Remember my login' checkbox, a 'Login' button, and a 'Forget your password?' link. The main text welcomes users to the GeneGrid Prototype - Release 0.6, managed by the Belfast e-Science Centre. It lists commercial partners Fusion Antibodies and Amtec Medical, and provides contact information for P.V. Jithesh (BeSC), Mark McCurley (Fusion), and Dr. Shane McKee (Amtec). It also requests users to subscribe to the GeneGrid mailing list and provides a link for more information. An important note states that current GeneGrid users should continue to use the Release 0.5 available here. The footer includes the e-science logo and a 'powered by gridsphere' badge.

MyGrid - Bioinformatics

myGrid



Navigate

- [Home](#)
- [About](#)
- [Downloads](#)
- [Components](#)
 - [Component Overview](#)
 - [Research Components](#)
- [Using myGrid](#)
- [Research Using myGrid](#)
- [Links](#)
- [Publications](#)
- [Contact](#)

Log In

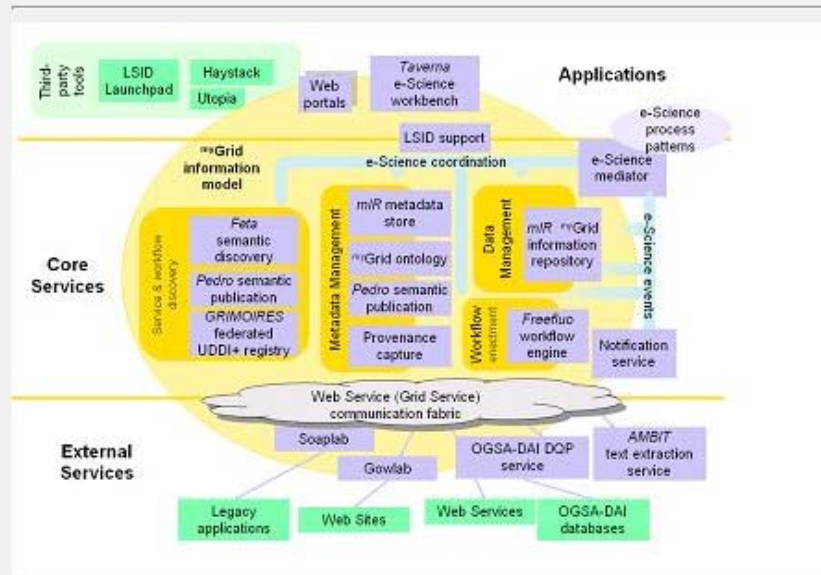
Username

Password

Log In

[New Account Signup](#)
[Forgot Password](#)

myGrid Architecture



myGrid components - overview

myGrid is a collection of services and components that allows the high level integration of biological applications. The architecture provides the infrastructure necessary, in a web service environment, to create an e-science workbench that actively supports the scientific lifecycle. Each component or service contributes to a system that allows the e-scientist to perform complex in-silico experiments across distributed bioinformatics resources.

DEISA



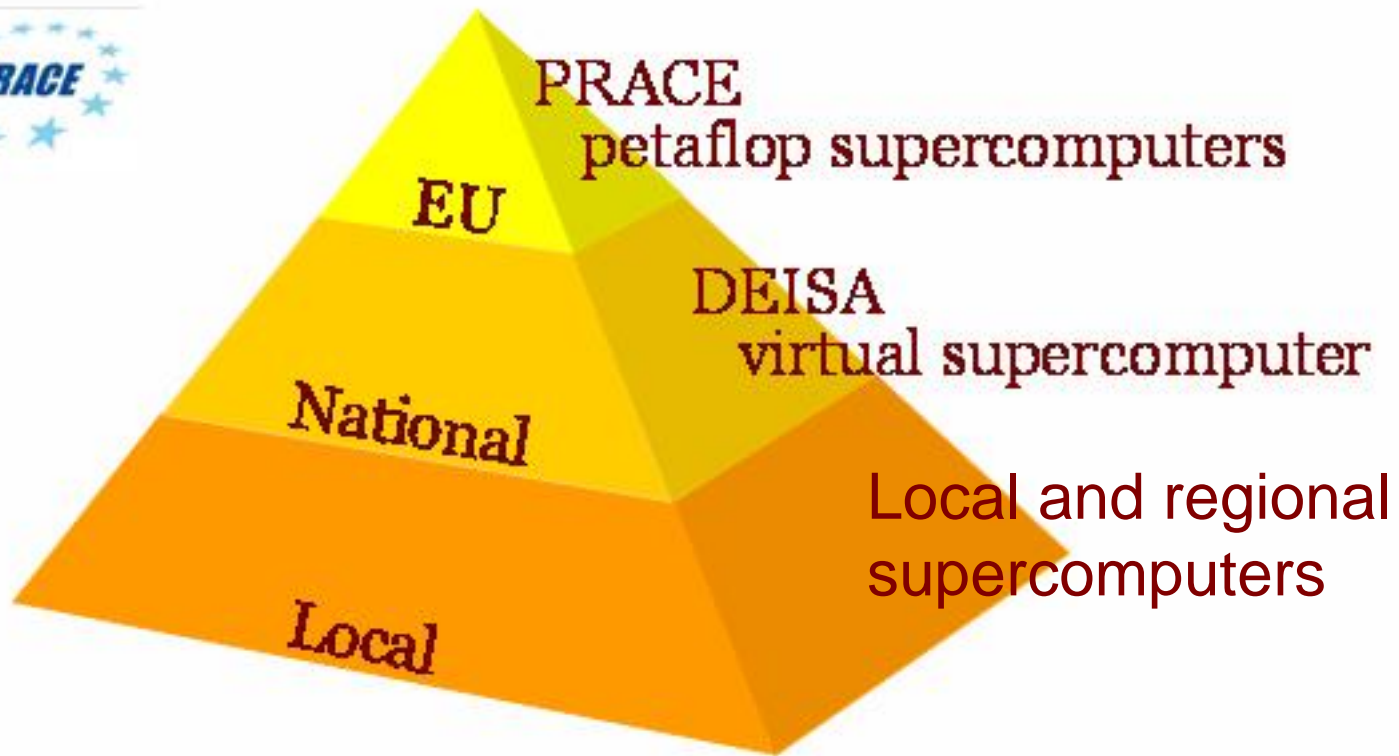
Example of a successful Research e-Infrastructure:

The DEISA Ecosystem for HPC Grand-Challenge Applications

Distributed European Infrastructure for Supercomputing Applications



new "petaflop" supercomputers



Local and regional supercomputers

*Mario Campolargo
European Commission
OGF23, June 2008*



DEISA: Vision and Mission



Vision:

Persistent European HPC ecosystem integrating Tier-1 (Tflop/s) centres and European Tier-0 (Pflop/s) centres.

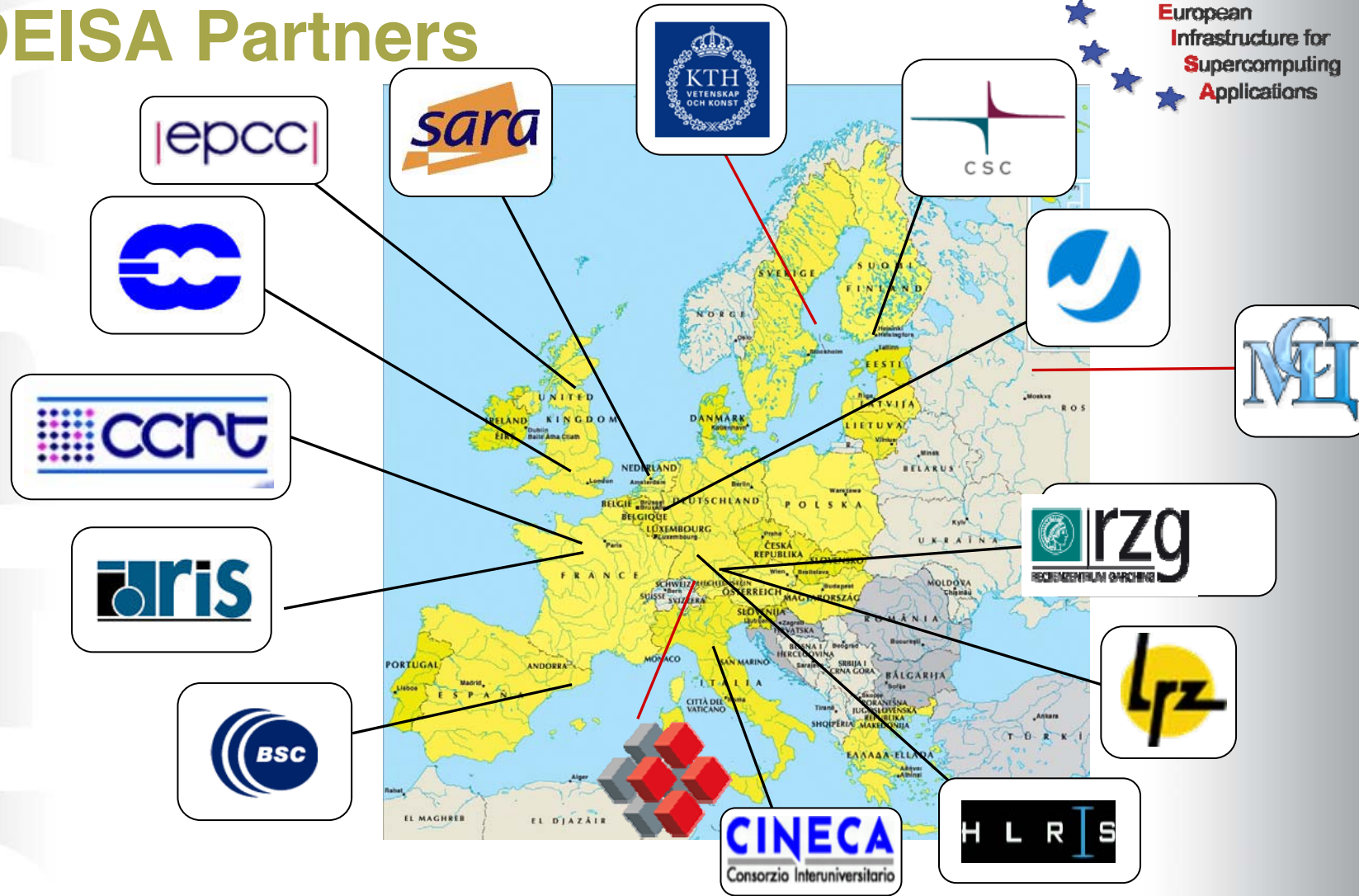
Mission:

Enhance Europe's capability in computing and science by integrating most powerful supercomputers into a European HPC e-infrastructure.

Built European Supercomputing Service on top of existing national services, based on the deployment and operation of a persistent, production quality, distributed supercomputing environment with continental scope.

DEISA Partners

Distributed
European
Infrastructure for
Supercomputing
Applications

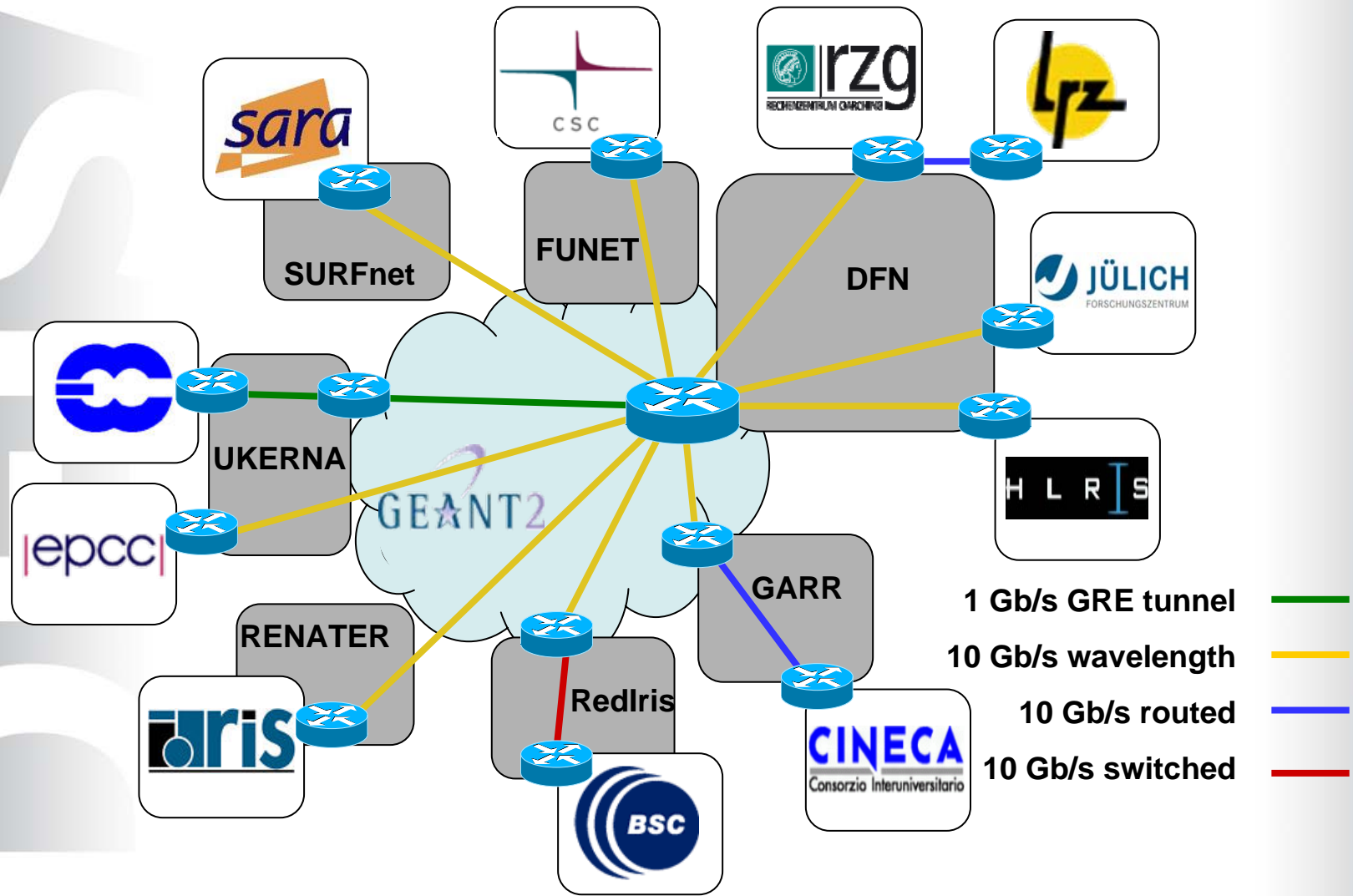


DEISA1: May 1st, 2004 – April 30th, 2008

DEISA2: May 1st, 2008 – April 30th, 2011

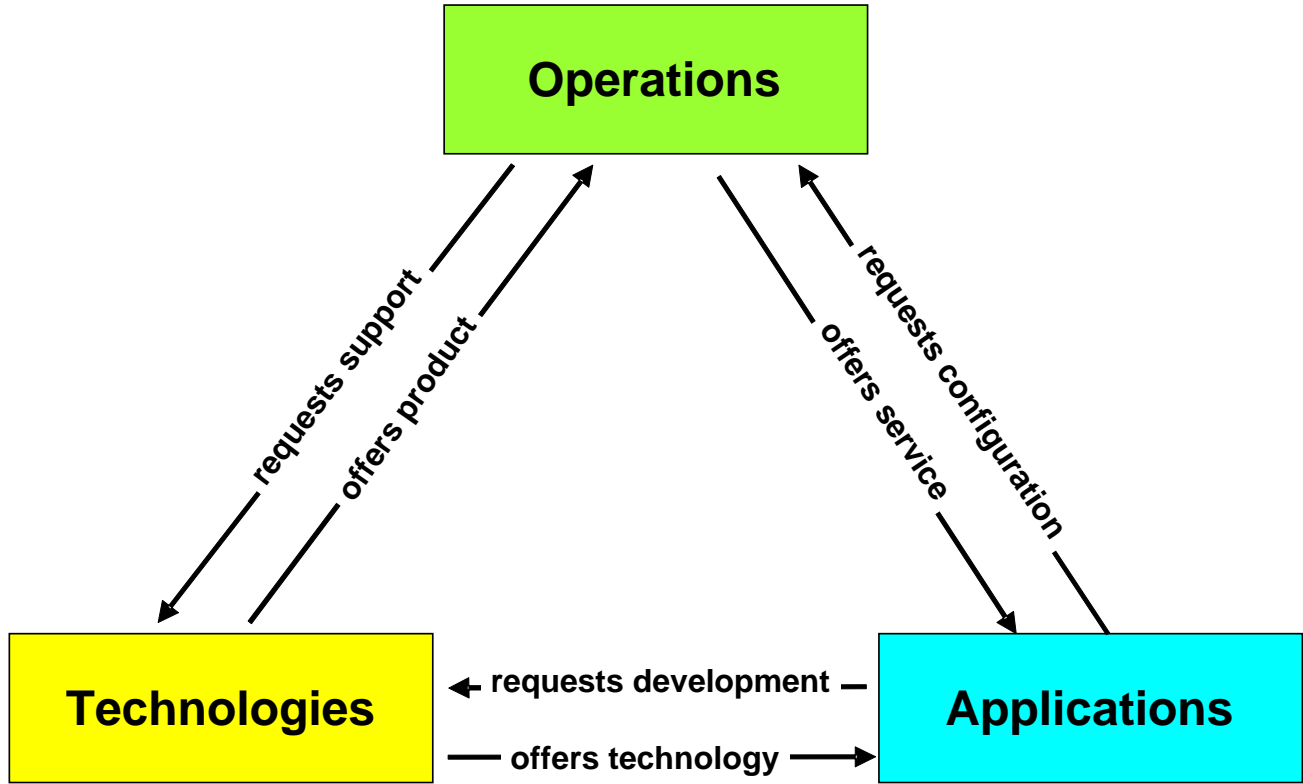


DEISA dedicated high speed network on GEANT2 and the NRENs

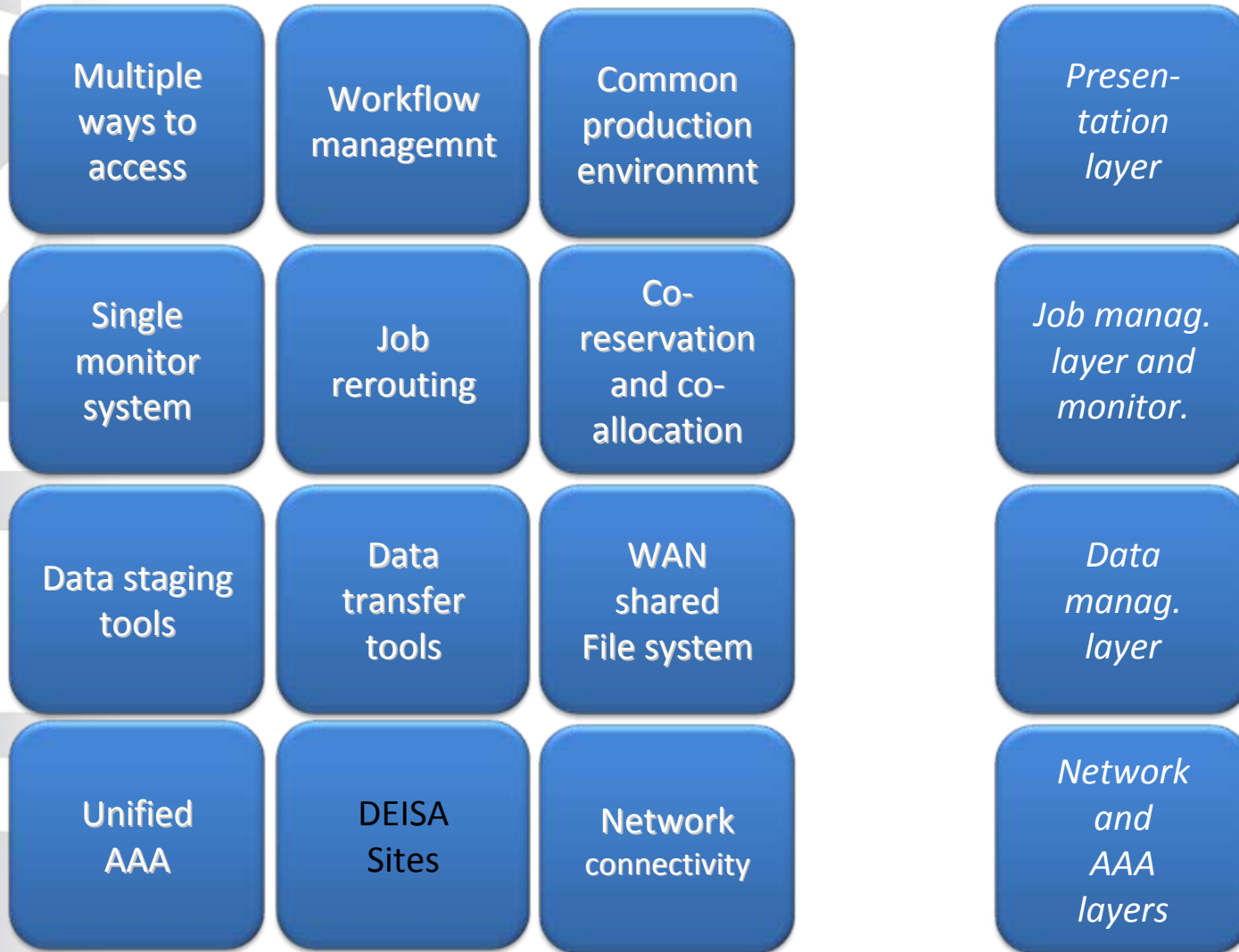


- 1 Gb/s GRE tunnel —
- 10 Gb/s wavelength —
- 10 Gb/s routed —
- 10 Gb/s switched —

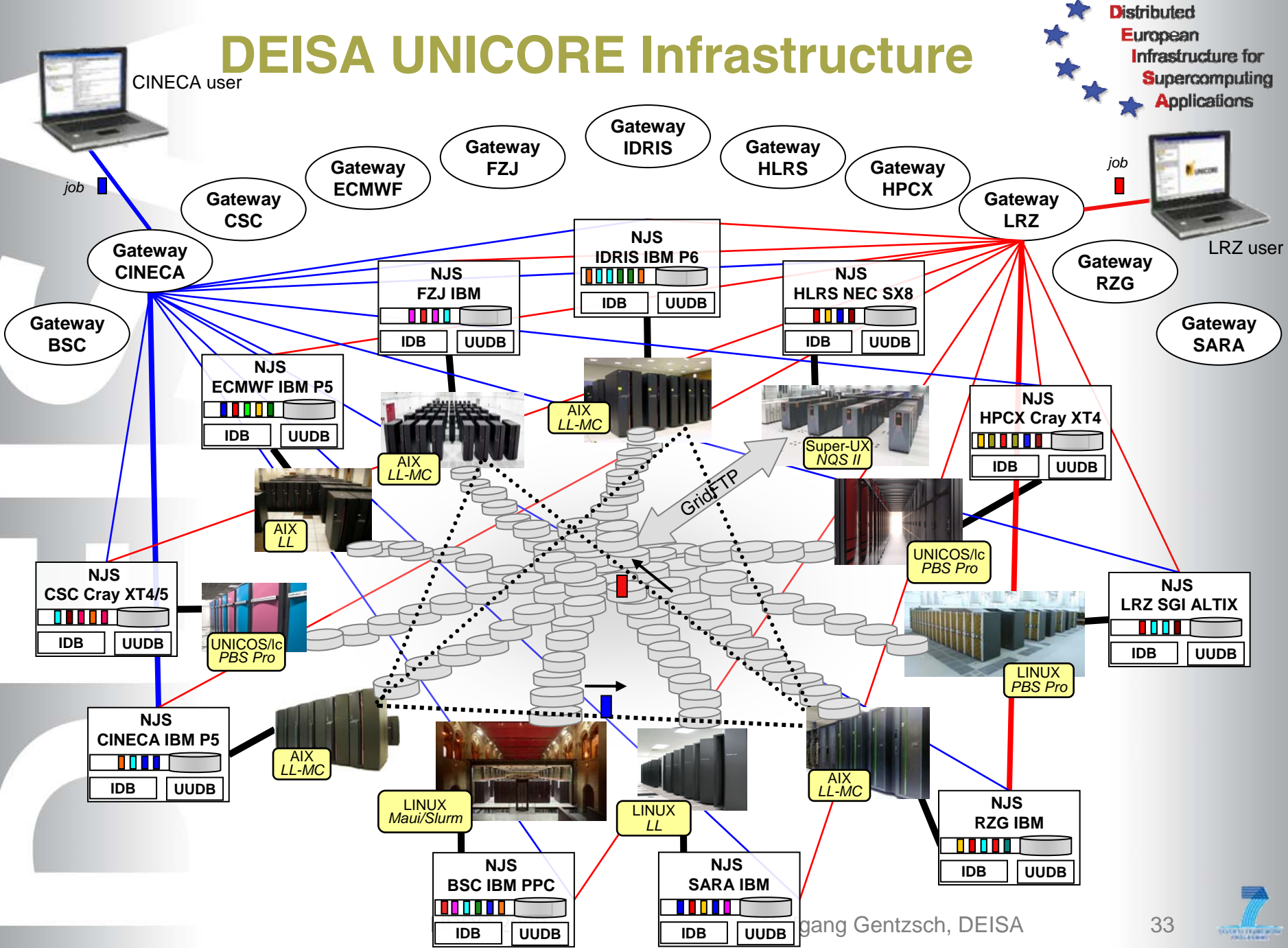
Categories of DEISA services



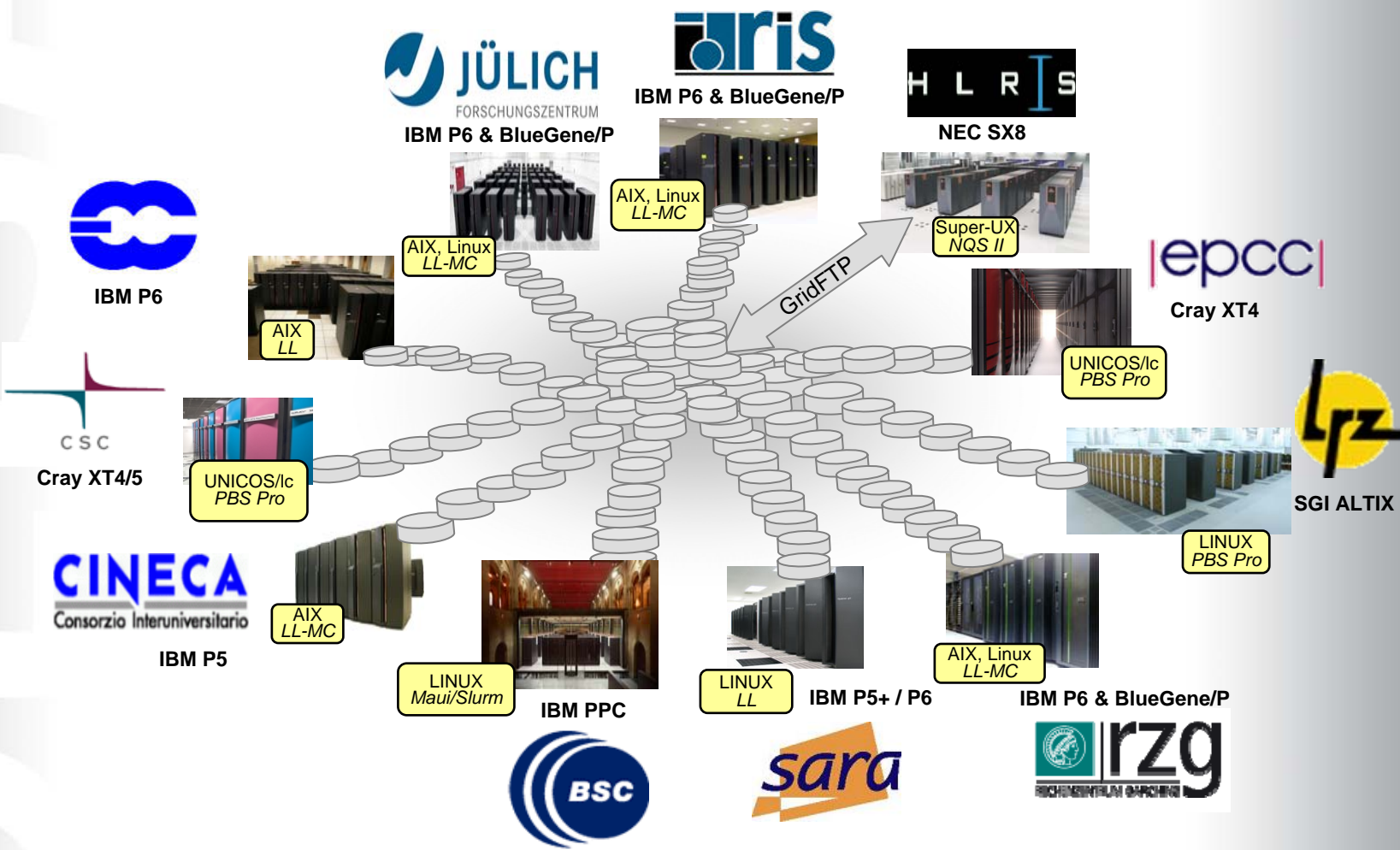
DEISA Service Layers



DEISA UNICORE Infrastructure



DEISA Global File System

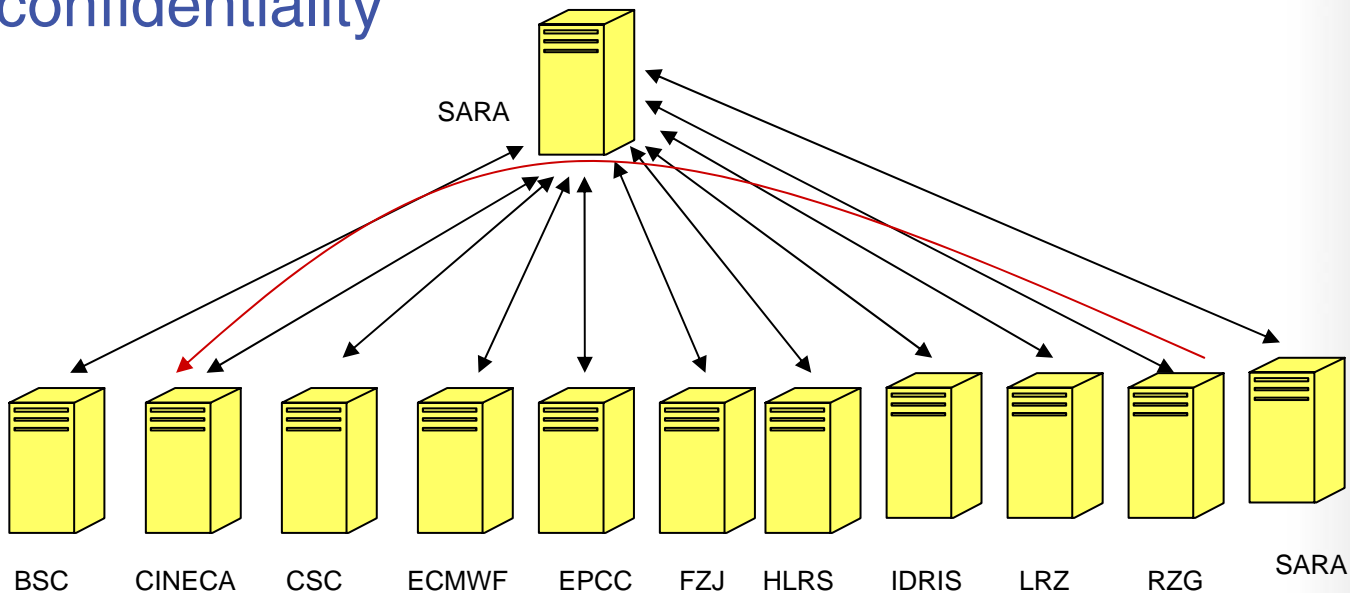


Global transparent file system based on the Multi-Cluster General Parallel File System (MC-GPFS of IBM)



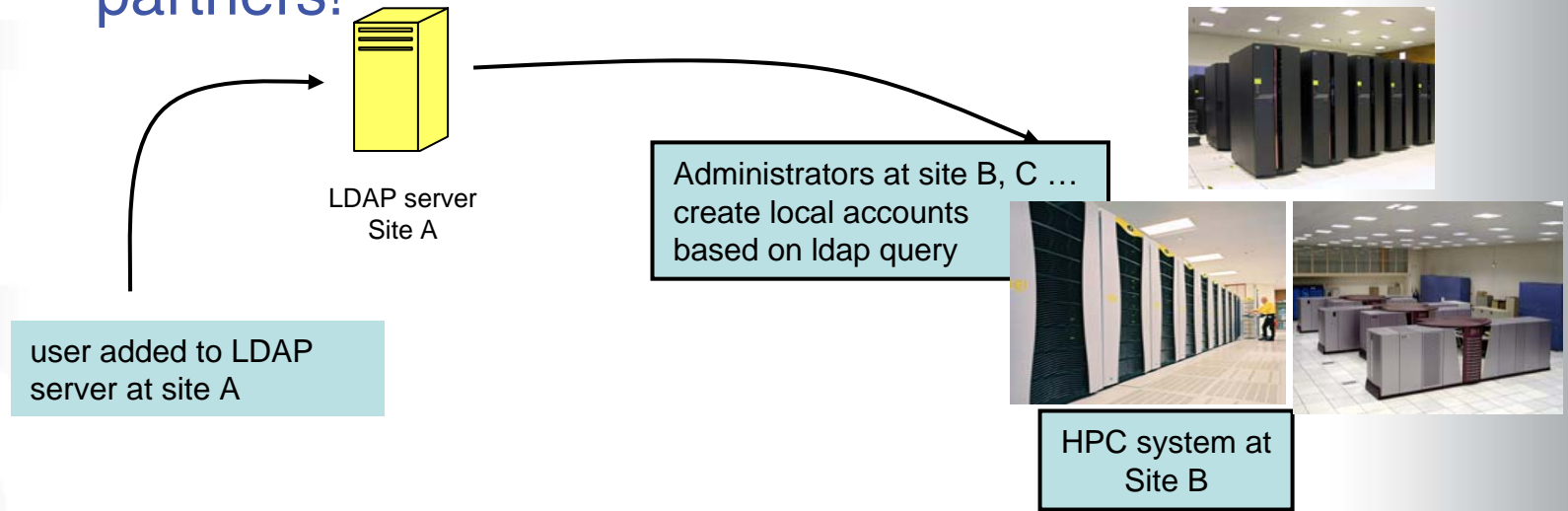
Management of users in DEISA

- A dedicated LDAP-based distributed repository administers DEISA users
- Trusted LDAP servers are authorized to access each other (based on X.509 certificates) and encrypted communication is used to maintain confidentiality



Common User Administration

- Each partner is responsible for the registration of users affiliated to the partner (home organization)
- Other partners update local user administration (LDAP, NIS, /etc/passwd) with data from other sites on a daily basis. Based on trust between partners!



DEISA Extreme Computing Initiative (DECI)



- DECI launched in 2005: complex, demanding, innovative simulations requiring the exceptional capabilities of DEISA
- Multi-national proposals encouraged
- Proposals reviewed by national evaluation committees
- Projects chosen on the basis of innovation potential, scientific excellence, relevance criteria, and national priorities
- Most powerful HPC architectures for most challenging projects
- Most appropriate supercomputer architecture selected

DEISA Extreme Computing Initiative



Calls for Proposals for challenging supercomputing projects from all areas of Science

DECI call 2005

51 proposals, 12 European countries involved, co-investigator from US)
30 mio cpu-h requested
29 proposals accepted, 12 mio cpu-h awarded (normalized to IBM P4+)

DECI call 2006

41 proposals, 12 European countries involved
co-investigators from N + S America, Asia (US, CA, AR, ISRAEL)
28 mio cpu-h requested
23 proposals accepted, 12 mio cpu-h awarded (normalized to IBM P4+)

DECI call 2007

63 proposals, 14 European countries involved, co-investigators from
N + S America, Asia, Australia (US, CA, BR, AR, ISRAEL, AUS)
70 mio cpu-h requested
45 proposals accepted, ~30 mio cpu-h awarded (normalized to IBM P4+)

DECI call 2008 (ending June 30, 2008)

66 proposals, 15 European countries involved, co-investigators from
N + S America, Asia, Australia
134 mio cpu-h requested (normalized to IBM P4+)
42 proposals accepted, 48 mio cpu-h awarded (normalized to IBM P4+)

Example of a Next-Generation e-Infrastructure in Industry Telecommunications

The silent revolution in Telecommunications:
Convergence of smart phones, broadband,
and cloud computing

New Powerful End-User Devices

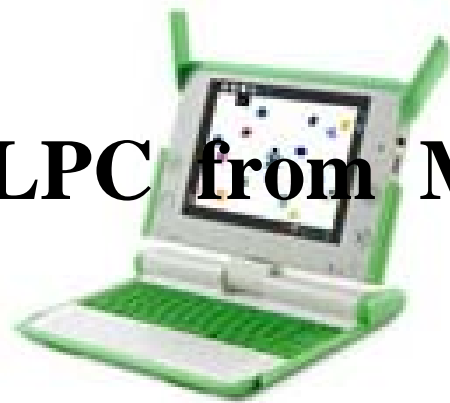
Carry-along PCs (CAPS), Ultra-Mobile PCs (UMPC), Smart mobile phones



CAPC, from Samsung, South Korea



OLPC from MIT



Fujitsu UMPC



T83 Tablet from Asus, Taiwan, demoed at CeBit 2007



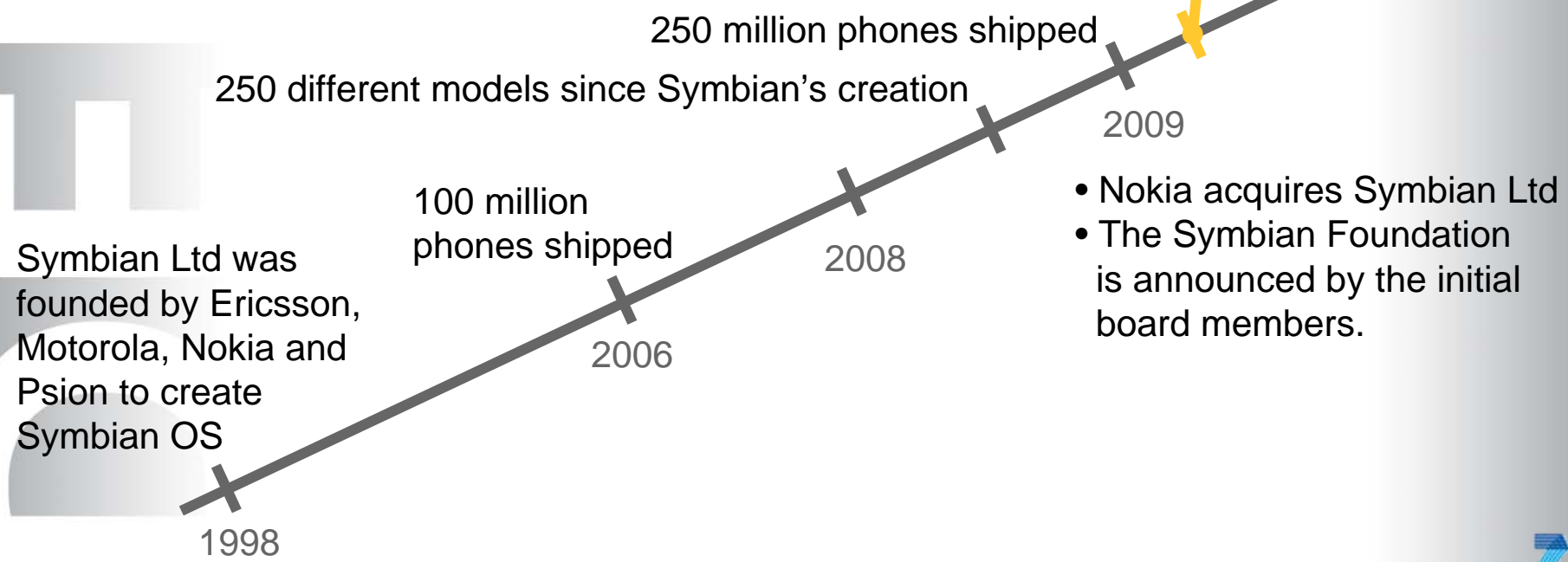
CAPC from HTC



Asus R2H

The Symbian Mobile OS

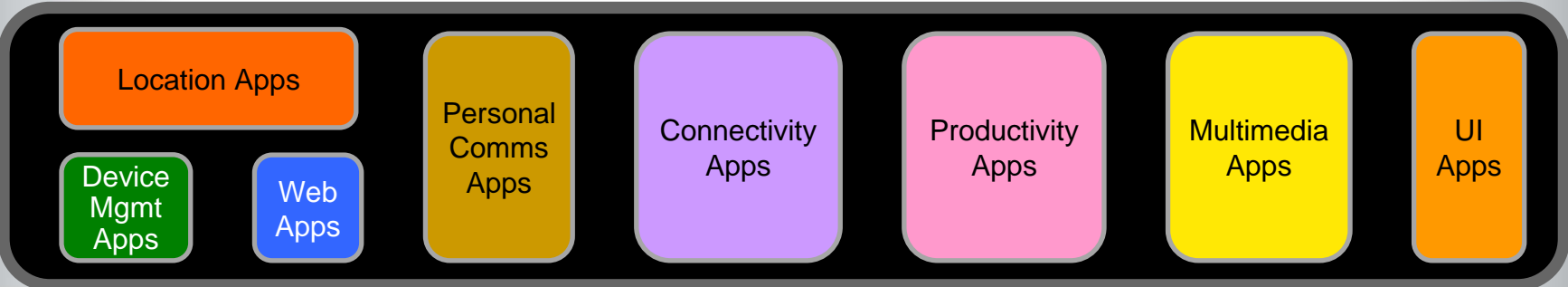
SYMBIAN FOUNDATION



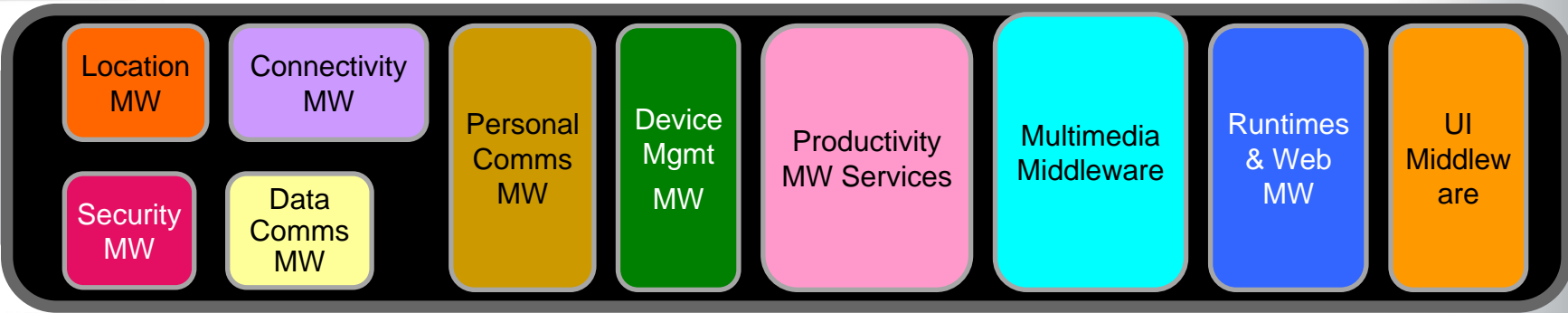
The Symbian OS

Powerful mobile platform for deep-content services

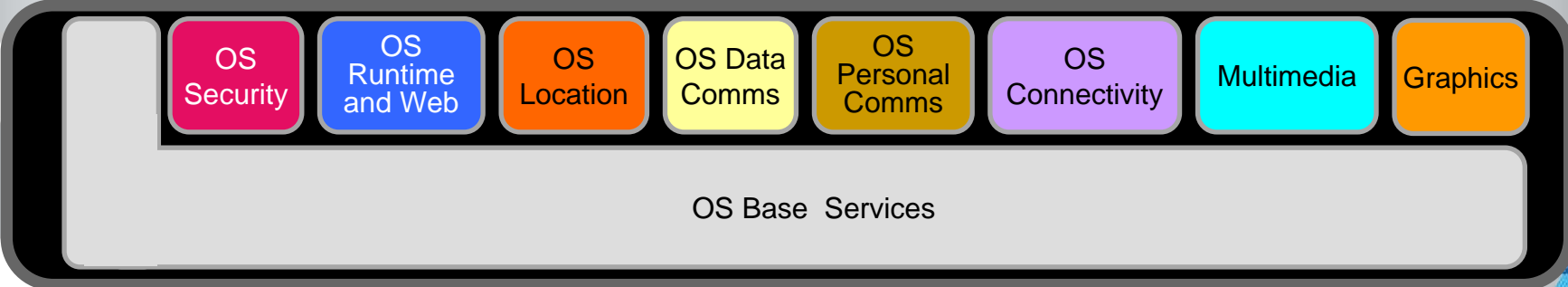
Application



Middleware

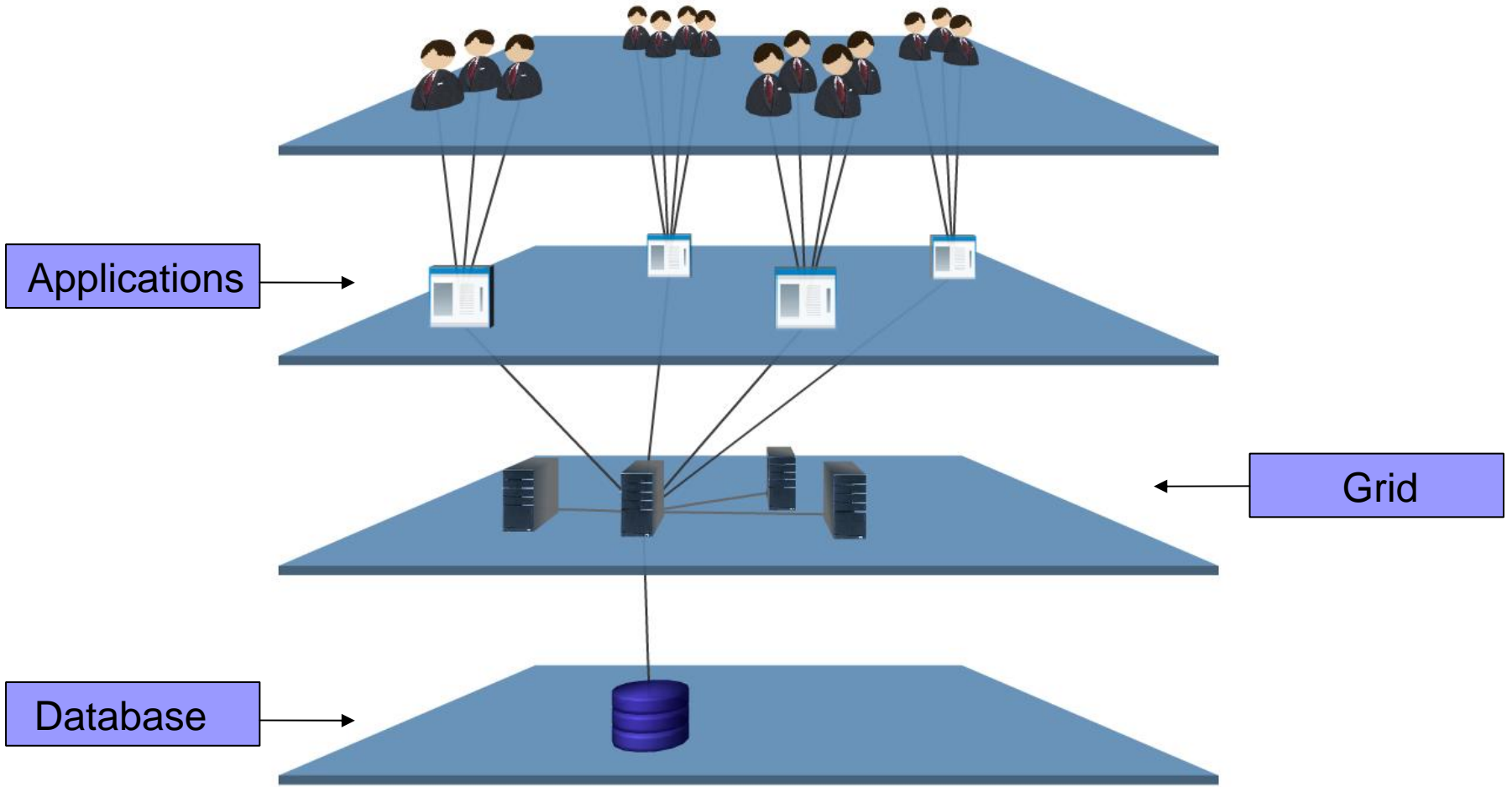


OS

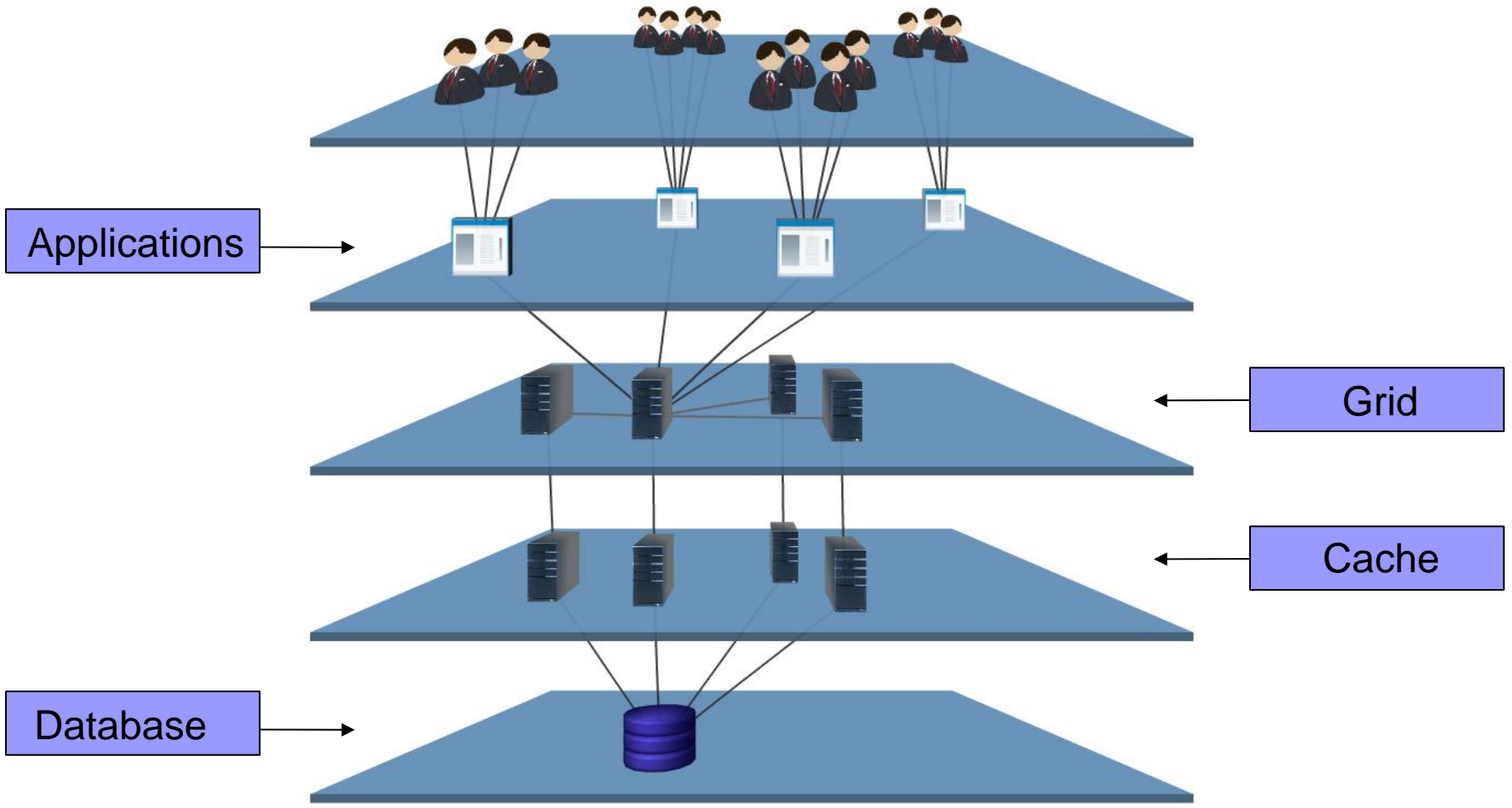


Standard Grid Concepts

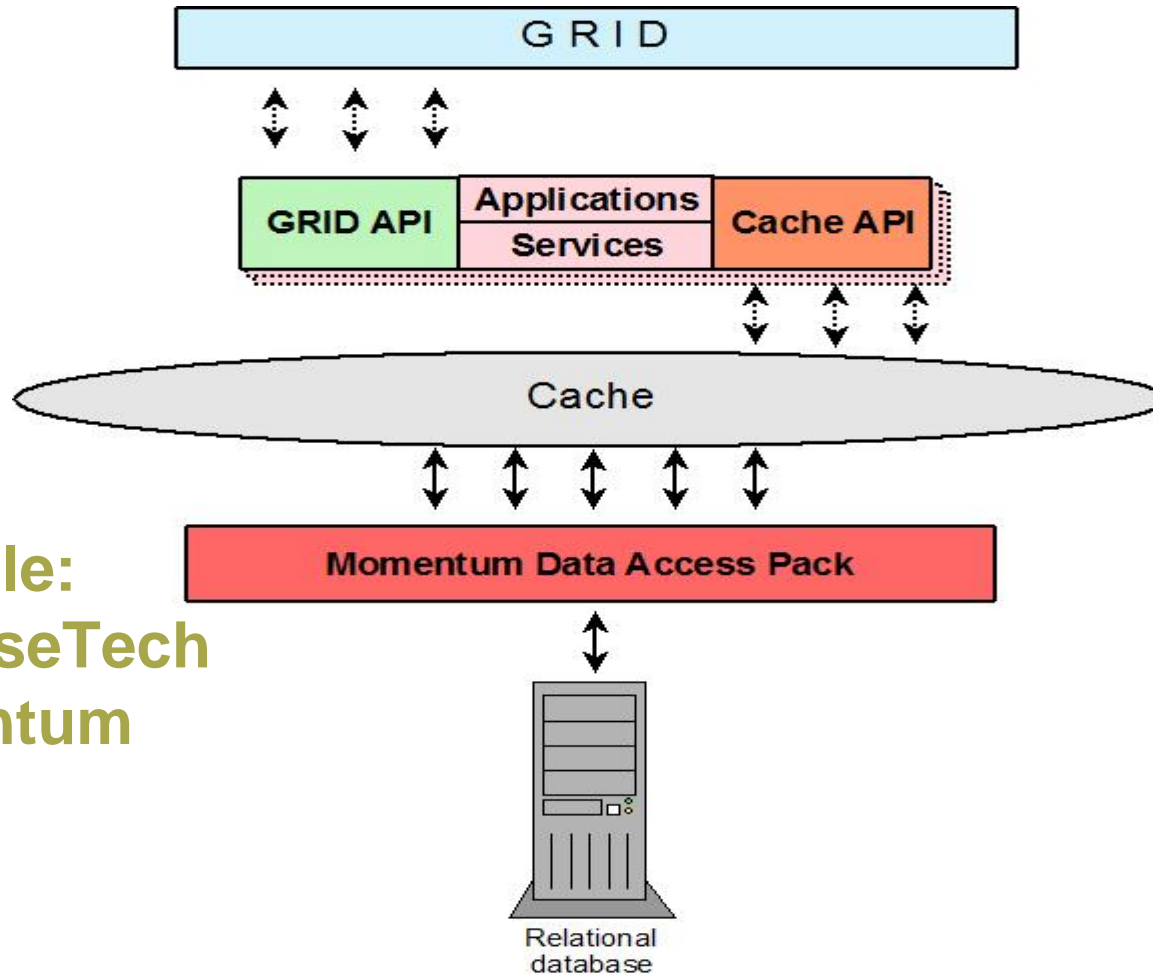
are often not scalable for millions of users



Grid and virtual cache concept



The Core: A scalable Infrastructure



Example:
GridwiseTech
Momentum

Virtualization Everywhere

- Devices like desktop, laptop, minis, smart phones, and sensors, are islands of capabilities today.
- However, with an image (or clone) in the cloud
- ... enabling deep content services not able on the device
- smart mobiles will become the primary (access) device for all communication and computing needs
- ISV's will provide a value-added service by mobilizing their application

Device-centric => Information-centric

ISV's "mobilize" their application

ISV's are providing value-added services
By developing light versions for smart phones

- Salesforce: Mobile Lite, CRM
- Omniture: SiteCatalyst, Web analysis
- Interchange: SalesNow
- Workday: HR and ERP

Business Model:

- attract new customers for their phone services
- attract new customers for their Web services

Your Digital Shadow

All your devices will have a clone
in the cloud
Sitting in a secure container
Accompanying you anywhere
As your Lifelog

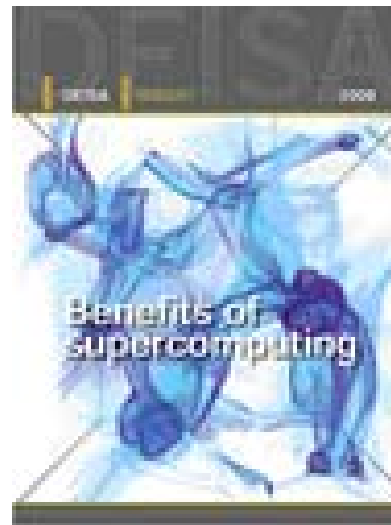


or

- Your digital shadow in the cloud -



More about DEISA in:



Thank You!

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