

# DEISA

## Integrating European HPC Infrastructures

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GÉANT2 – a Global Leader Event

DEISA - Integrating HPC infrastructures in Europe

# Agenda

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- **A European HPC overview**
- **DEISA objectives and environment**
- **The DEISA network infrastructure**
- **Lessons learned**
- **Conclusion and Summary**

# HPC as a driving force for research



- **Scientific research is based on the three pillars:  
Theory, Experiment and Simulation**
- **The tool providing capacity for solving most challenging problems through simulations are supercomputers**
- **Access to these supercomputer systems is normally restricted to a small group of scientist having access to a national facility**
- **Providing access to these services for researchers all over Europe independent of national boundaries and with optimal resource utilization is an ongoing challenging task**

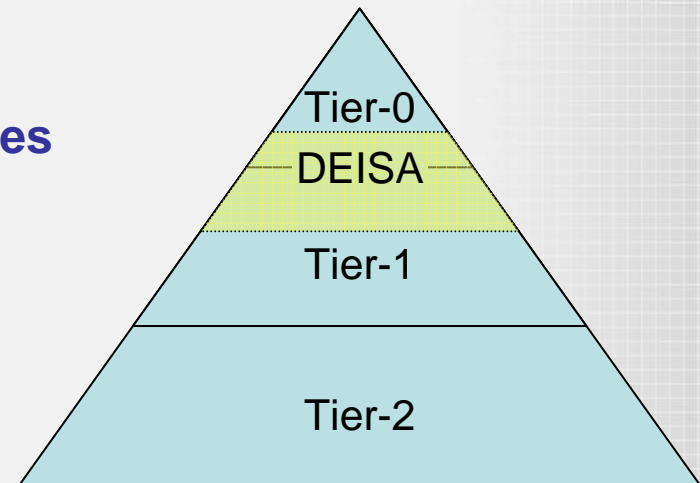
# The ESFRI vision & DEISA



## The ESFRI Vision for a European HPC service defined in 2006

- Research Infrastructures as crucial pillars for the European Research Area
- European HPC facilities as the top of an HPC provisioning pyramid having
  - Tier-0: 3-5 European facilities
  - Tier-1: National facilities
  - Tier-2: Regional/ University Centres

DEISA has started this process in 2004 already defining a virtual European supercomputing center on existing national supercomputer resources



# DEISA objectives



- contribute to a significant enhancement of capabilities and capacities of high performance computing (HPC) in Europe
  - ⇒ integration of leading national supercomputing infrastructures
- *deploy and operate a distributed multi-terascale European computing platform*, based on a strong coupling of existing national supercomputers not tied to any specific pre-established technology
  - ⇒ operate as a virtual European supercomputing center
- *contribute to the deployment of an extended, heterogeneous Grid computing environment for HPC in Europe*
  - ⇒ interfacing the DEISA research infrastructure with the rest of the European IT infrastructures.
- Enabling new science is the only criterion for success.

# DEISA objectives

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- **DEISA does not contradict the ESFRI vision for a European HPC service**
- **It defines itself as a precursor and infrastructure for future European HPC research**
- **leading the way to European HPC services and**
- **filling the gap between**
  - **existing national Tier-1 centers and**
  - **future Tier-0 facilities**

# Participating Sites



<b>BSC</b>	<i>Barcelona Supercomputing Centre</i>	<b>Spain</b>
<b>CINECA</b>	<i>Consorzio Interuniversitario per il Calcolo Automatico</i>	<b>Italy</b>
<b>CSC</b>	<i>Finnish Information Technology Centre for Science</i>	<b>Finland</b>
<b>EPCC/HPCx</b>	<i>University of Edinburgh and CCLRC</i>	<b>UK</b>
<b>ECMWF</b>	<i>European Centre for Medium-Range Weather Forecast</i>	<b>UK (int)</b>
<b>FZJ</b>	<i>Research Centre Juelich</i>	<b>Germany</b>
<b>HLRS</b>	<i>High Performance Computing Centre Stuttgart</i>	<b>Germany</b>
<b>IDRIS</b>	<i>Institut du Développement et des Ressources en Informatique Scientifique - CNRS</i>	<b>France</b>
<b>LRZ</b>	<i>Leibniz Rechenzentrum Garching</i>	<b>Germany</b>
<b>RZG</b>	<i>Rechenzentrum Garching of the Max Planck Society</i>	<b>Germany</b>
<b>SARA</b>	<i>Dutch National High Performance Computing and Networking centre</i>	<b>The Netherlands</b>

# DEISA HPC environment



23.460 processors and 205 Teraflop in March 2007, changing constantly

## IBM AIX Super-cluster

- FZJ - Juelich, 1312 processors, **8,9 teraflops peak**
- RZG - Garching, 896 processors, **4,6 teraflops peak**
- IDRIS, 1024 processors, **6,7 teraflops peak**
- CINECA, 512 processors, **2,6 teraflops peak**
- CSC, 512 processors, **2,2 teraflops peak**
- ECMWF, 2 \* 2276 processors, **33 teraflops peak**
- HPCx, 1600 processors, **12 teraflops peak**
- **BSC, IBM PowerPC Linux system (MareNostrum)**  
10240 processors, **94 teraflops peak**
- **SARA, SGI ALTIX Linux system**  
416 processors, **2,2 teraflops peak**
- **LRZ, SGI ALTIX system** 4096 processors, **26,2 teraflops peak**  
*in 2007* **> 60 teraflops peak**
- **HLRS, NEC SX8 vector system** 576 processors, **12,7 teraflops peak**

# DEISA

## service and joint research activities

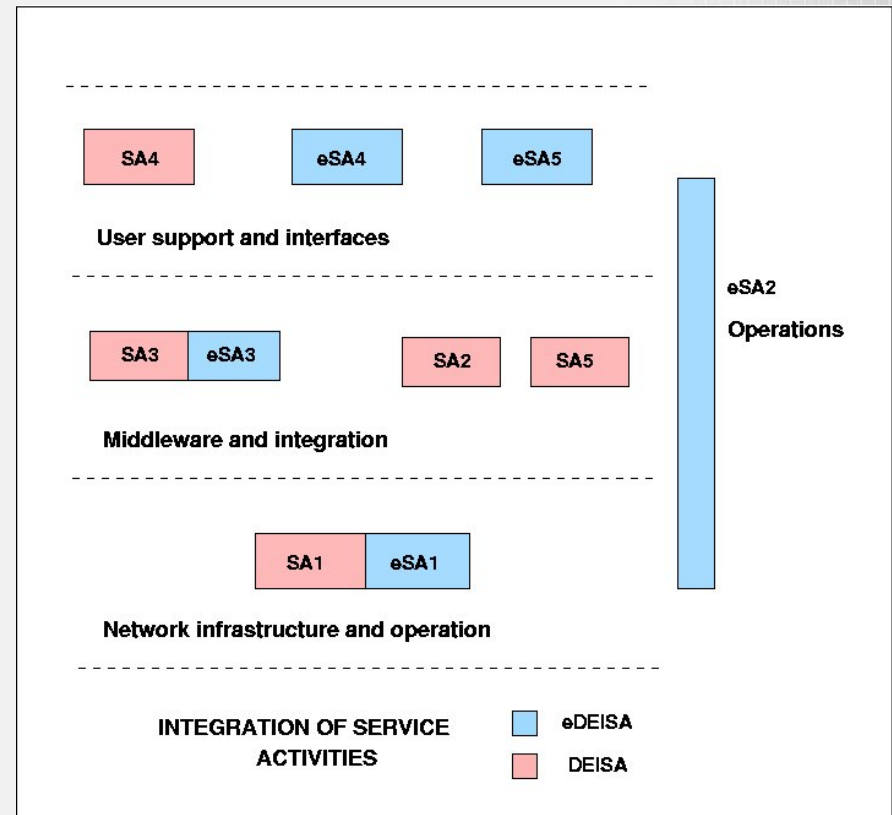


### Service Activities

- Network Infrastructure and Operation
- Operation of the Grid Infrastructure
- Data Management with GPFS
- Resource Management
- Applications and User Support
- User Interfaces
- Security

### Joint Research Activities

- Material Sciences
- Cosmology
- Plasma Physics
- Life Sciences
- Industrial CFD
- Coupled Applications
- Access to Resources in Heterogeneous Environments



# The DEISA facility

**Global distributed, high performance file system with continental scope (GPFS).**  
File transfer transparent to users.

**Dedicated bandwidth network:**  
GEANT2 and NRENs

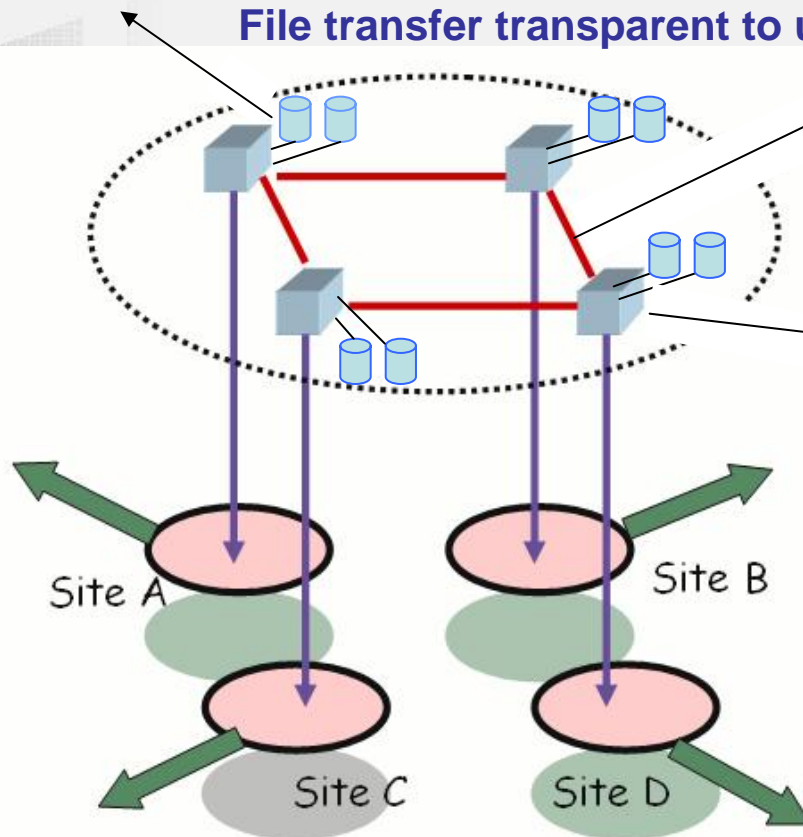
**National supercomputing platforms:**

BSC – Spain  
CINECA - Italy  
CSC - Finland  
ECMWF- UK  
EPCC - UK  
FZ-JÜLICH - Germany  
HLRS - Germany  
IDRIS - France  
LRZ- Germany  
RZG – Germany  
SARA – The Netherlands

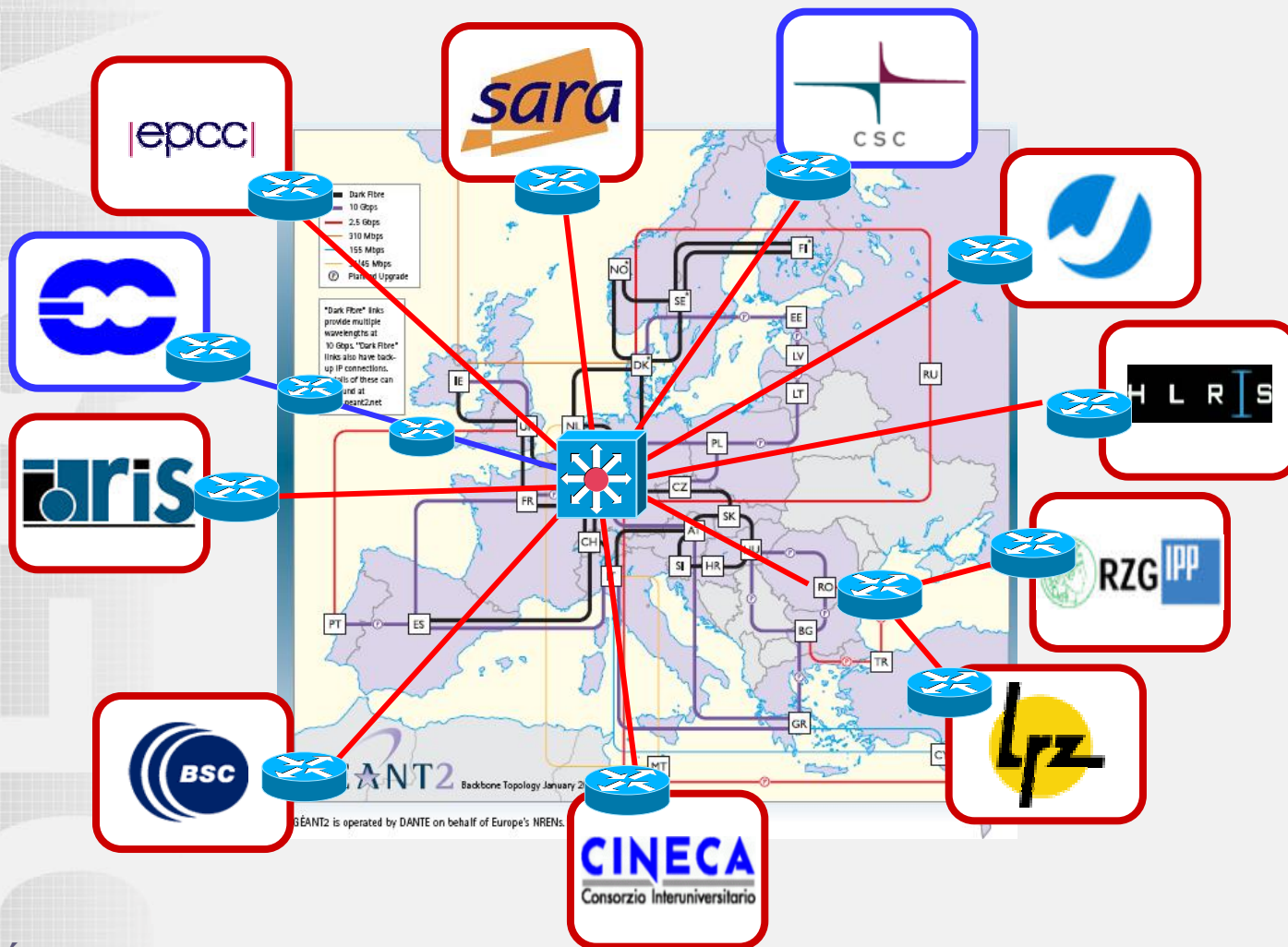
**Extended Grid services :**

Portals, Web-like services, ...  
Interfacing the core platform to other virtual organizations.

Grid-middleware used: Unicore and Globus hiding complex environments from end users



# DEISA network infrastructure



- DFN
- FUNET
- GARR
- RedIris
- RENATER
- SURFnet
- UKERNA

Dedicated  
10 Gb/s  
wavelength

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1 Gb/s LSP  
GRE-Tunnel

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# DEISA and its middleware

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Challenging task is to run bigger and more demanding applications.

“Grid enable” applications is not the right way to do (old term “metacomputing” failed because of latency problems)

DEISA uses a different strategy:

- **Load balance computational load** across national borders. Huge, demanding apps can be run because of reorganizing workload (freeing resources) by transferring smaller jobs to other sites (**MC-LoadLeveler**)
- Transparent file sharing through IBM’s **GPFS**
- **UNICORE** used for accessing the heterogeneous set of computing resources and managing workflow applications
- New middleware will be evaluated in future (e.g. **Unicore6 & GTK4**)
- **Gridftp** to access and store data on other non-DEISA storage resources
- Provide high performance access to distributed data sets  
(DB management software OGSA-DAI or grid storage software SRB)

# DEISA Extreme Computing Initiative

## enabling leading computational science



- DECI is the basic service provisioning model for scientific users
- Identification, deployment and operation of a number of « **flagship** » **applications** requiring the infrastructure services in selected areas of science and technology.
- **European Call for proposals** in May-June every year.
- **Applications selected on scientific excellence, innovation & relevance** with collaboration of HPC national evaluation committees.
- **Projects in operation: 27 (2006), 23/5 (2007), 45+ (2008)**
- **Supported by an Applications Task Force:**
  - **Enabling and deploying** the Extreme Computing **applications**
  - **Hyperscaling** of huge parallel applications, data oriented applications, Workflows and coupled applications
  - **Production of an European Benchmark Suite for HPC systems** in collaboration with the HPC-EUR initiative, to be used in future procurements of European supercomputers.

# DEISA lessons learned

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- Operation of a DEISA like production infrastructure opens new management challenges
- Staff members dealing with a problem are thousands of miles apart
- No short cuts, no office next door
- Every small software or hardware modification requires
  - agreement on all sites
  - may lead to dependencies not directly obvious
- Task scheduling, installations, maintenance, and network infrastructure changes have to be planned in advance and agreed on
- A global **operations team is mandatory** to handle all this issues and to decide on further progress in case of disagreement

## DEISA lessons learned (cont.)

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### The same applies to network issues

- Operation and monitoring of network links across several administrative domains is a challenge
- GEANT2 and the NRENs have done a good job here providing the infrastructure for DEISA ... at least so far
- But things are becoming more complicated in the future having virtual organizations building up and being suspended in even shorter time frames
- Providing network services for those upcoming and always changing grid infrastructures will become a new challenge
- Having a secure and dedicated infrastructure like DEISA allows to rest easy

### But what to improve in future?

# DEISA future network requirements

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- **Optical protection of links**
- **Bandwidth on Demand services**
- **Cross Domain link management**
- **...**

**I know most of this is already on the way**

# Conclusion

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- Four years of successful operation have shown that the concept implemented in DEISA proceeded very well
- This does not preclude that organizational structures of DEISA may change over time
- But the general idea of DEISA will sustain
- Being a central player within European HPC, DEISA intends to contribute to a global infrastructure for science and technology furthermore
- Integrating leading supercomputing platforms with Grid technologies and reinforcing capability with shared petascale systems is needed to open the way to new research dimensions
- This vision can only be achieved with fruitful participation of

**GÉANT2 – the Global Leader**



Questions ???