Distributed
European
Infrastructure for
Supercomputing
Applications

DEISA

An European GRID-empowered infrastructure for Science and Industry"

Pisa 11 maggio 2005
Angelo De Florio

DEISA

Distributed European Infrastructure for Supercomputing Applications

is a **project**
- partially funded by the European Commission under the **6° Framework Program**

is **a consortium**
- **of leading national supercomputing centers in Europe**

Focuses
- **deploying an innovative Grid empowered infrastructure** to enhance and reinforce High Performance Computing **(HPC) in Europe**.
- set up a **stable production infrastructure** distributed across Europe.

Its goal
- jointly building and operating a **distributed terascale supercomputing facility**
- deep **integration of high end national HPC infrastructures**
- Integrated computing power close to 30 Teraflops in 2004 (old goal, more than 4000 processors)
- Integrated computing power close to **100 Teraflops** at the end of 2005

DEISA
Target users and applications

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For European Scientists and Industries

- Researchers could use this supercomputing power and the related global data management infrastructures in a **coherent and comfortable way**

- A special focus is set on grand challenge applications from **material sciences**, **climate research**, **astrophysics**, **life sciences**, **fusion oriented energy research**, **and alike**

www.deisa.org

DEISA
strategic requirements

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The architecture of the DEISA supercomputing environment has been designed following a number of **strategic requirements**:

- Operating in a transparent and non-disruptive way as a **layer on top on the existing national services**

- **Hide complex grid technologies** from the end scientific users

- Guarantee **persistence and portability of scientific applications**, since they are an **essential part of the corporate wealth of research organizations.**

Initial Participants

CINECA
Consorzio Interuniversitario, Bologna, Italy

CSC
Finnish Information Technology Centre for Science, Espoo, Finland

ECMWF
European Centre for Medium-Range Weather Forecasts, Reading, UK

EPCC
Edinburgh Parallel Computing Centre, Edinburgh, UK

FZJ
Forschungszentrum Jülich, Jülich, Germany

IDRIS (Project leader)
Institut du Developpement et des Ressources en Informatique Scientifique, Orsay, France

RZG
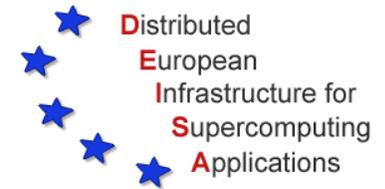Rechenzentrum Garching of the Max Planck Society, Garching, Germany

SARA
Stichting Academisch Rekenentrum Amsterdam, Amsterdam, the Netherlands

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New Partecipants
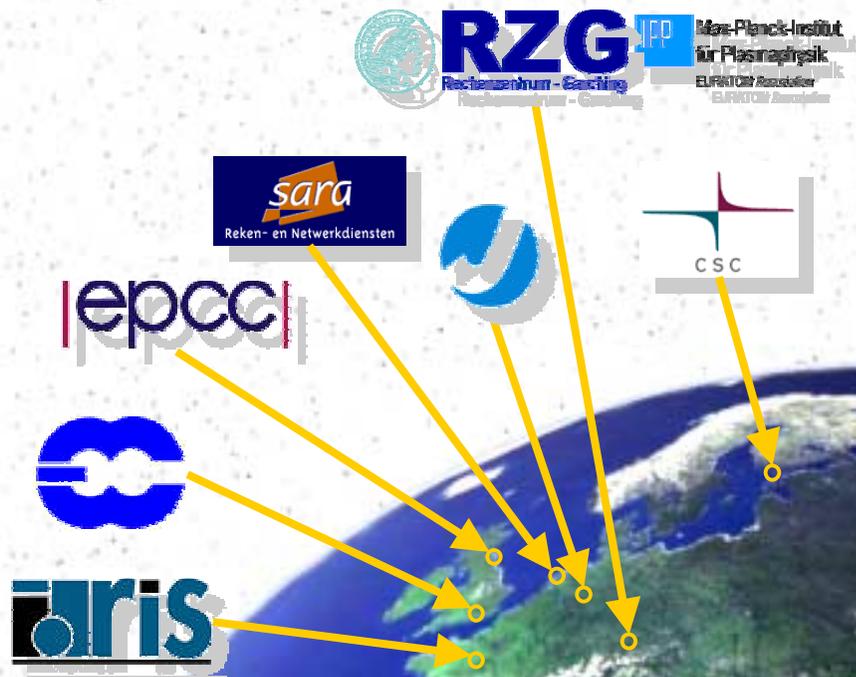
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To give access to the new 3 partners, **project has been scaled down from 5 years to 4 years** (starting date 1/5/04)

To accept **all sites** that asked to associate DEISA and to add functionalities, project will submit a *new proposal*.

HLRS
Stuttgart Supercomputing Centre, Stuggart, Germany
LRZ
Leibnitz Recherzentrum, Munich, Germany
BSC
Barcelona Supercomputing Cente, Barcelona, Spain

Sites that asked to associate to the DEISA infrastructure

University of Manchester (UoM), Manchester, UK
CASPUR, Roma, Italy
CSCS (CSCS), Manno, Switzerland
Poznan Supercomputing Center (Poznan), Poznan, Poland
And many more.

Principal Partners and Contact Persons

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Institut du Développement et des Ressources en Informatique Scientifique (IDRIS-CNRS), Orsay, France. Prof. Victor Alessandrini, Coordinator and acting Project Director

European Centre for Medium-Range Weather Forecasts (ECMWF), Reading, UK. Walter Zwieflhofer

Forschungszentrum Jülich (FZJ), Jülich, Germany. Dietmar Erwin

Leibniz Computing Centre of the Bavarian Academy of Sciences and Humanities, München, Germany Horst-Dieter Steinhoefer

Consorzio Interuniversitario (CINECA), Bologna, Italy. Sanzio Bassini

Edinburgh Parallel Computing Centre (EPCC), Edinburgh, UK David Henty

Barcelona Supercomputing Center (BSC), Barcelona, Spain Prof. Mateo Valero

Finnish Information Technology Centre for Science (CSC), Espoo, Finland. Kimmo Koski

High Performance Computing Center Stuttgart, Stuttgart, Germany. Prof. Michael Resch

SARA Computing and Networking Services , Amsterdam, The Netherlands. Axel Berg

Technology Partners

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GÉANT

Le Réseau National de Télécommunications pour la Technologie, l'Enseignement et la Recherche (Renater) , France

Deutsche Forschungsnetz (DFN), Germany

Gruppo per l'Armonizzazione delle Reti della Ricerca (GARR), Italy

Industrial Partners

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Centro Ricerche Fiat (CRF) , Società Consortile per Azioni, Obassano, Italy

DEISA ORGANIZATION
Service Activities

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SA1 – Network Operation and Support. (**FZJ leader**)
- Deployment and operation of a gigabit per second network infrastructure for an European distributed supercomputing platform. Network operation and optimization during project activity.

SA2 – Data Management with Global file systems. (**RZG leader**)
- Deployment and operation of global distributed file systems, as basic building blocks of the "inner" super-cluster, and as a way of implementing global data mlanagement in a heterogeneous Grid.

SA3 – Resource Management. (**CINECA leader**)
- Deployment and operation of global scheduling services for the European supercluster, as well as for its heterogeneous Grid extension.

SA4 – Applications and User Support. (**IDRIS leader**)
- Enabling the adoption by the scientific community of the distributed supercomputing infrastructure, as an efficient instrument for the production of leading computational science.
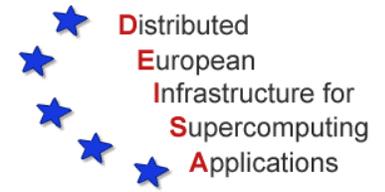
SA5 – Security. (**SARA leader**)
- Providing administration, authorization and authentication for a heterogeneous cluster of HPC systems, with special emphasis on single sign-on.

DEISA ORGANIZATION
Joint Research Activities

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■ **JRA2 – Cosmology.** (EPCC) Migration and deployment on the inner infrastructure and its outer extension, of leading applications carried out by the European project VIRGO.

■ **JRA1 – Material Sciences. (RZG)** Migration and deployment of leading applications in this scientific area.

■ **JRA3 – Plasma Physics.** (RZG) Migration and deployment of leading applications in this scientific area.

DEISA collaborates with leading European research groups from several scientific and industrial disciplines

Joint Research Activities
The first six JRAs applications JRAs addressing modern and challenging application software engineering issues, paving the way in some cases for the heterogeneous extension of the facility. They also provide strong support to early adopters of the DEISA platform, in leading scientific areas vigorously supported by the national research organizations.
The last JRA is the only Grid R&D activity supported by the project.

■ **JRA4 – Life Sciences.** (IDRIS) Migration and deployment of leading applications in Genomics and Health Sciences.

■ **JRA5 – Industry.** (CINECA) Migration and deployment of leading applications in Industrial Computational Fluid dynamics.

■ **JRA7 – Access to Resources in Heterogeneous Environments.** (EPCC) Development of a Heterogeneous Service Management software infrastructure based on OGSA standards.

■ **JRA6 – Coupled Applications.** (IDRIS) Development, migration and deployment of leading multi-physics, multi-scale coupled applications in several areas of science and technology.

Integration

Key integration technologies for the distributed super-cluster

- ✓ **Network bandwidth**, provided by the European research network GEANT and the national research networks (today DFN in Germany, RENATER in France, and GARR in Italy)

- ✓ Capability to **efficiently share data** across a wide area network, provided by a global file system (Global Parallel File System, GPFS).

Possibility of **redistributing the computational workload by migrating jobs** across national borders, in order to free huge resources for one specific application in one site.

DEISA Services

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The DEISA heterogeneous grid will provide a number of services to the scientific community:

- **workflow management** based on **UNICORE middleware** (complex applications that visit several platforms to perform a job)

- **high performance global data management** in the whole grid (sharing data between different applications, applications accessing distributed data)

- **grid applications** that run on several platforms simultaneously

- **portals and Web interfaces** to hide complex environments from end users.
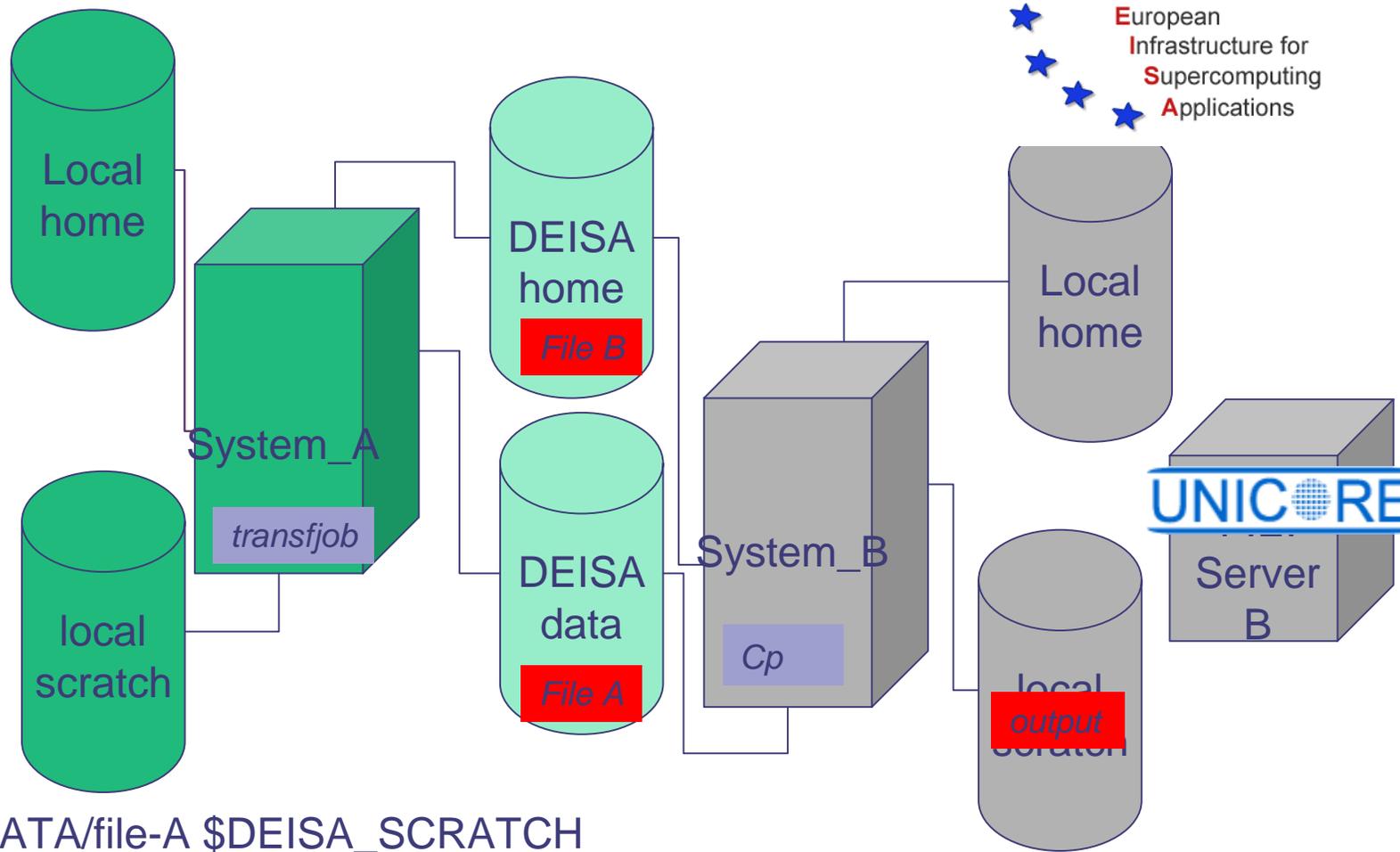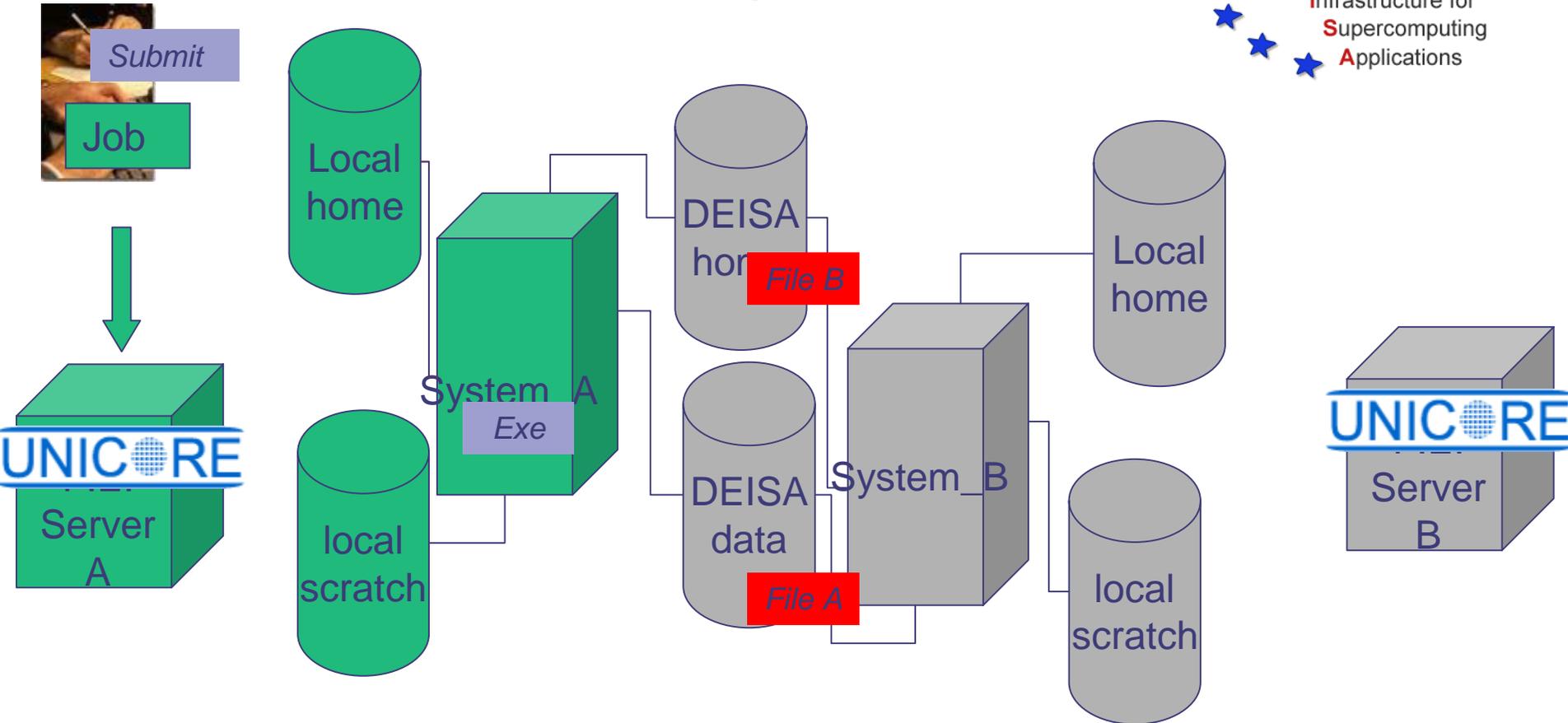
Cp $DEISA_DATA/file-A $DEISA_SCRATCH

Cp $DEISA_HOME/file-B $DEISA_SCRATCH

How a job can use **remote** data in a **transparent** manner

This kind of tests has been already performed successfully and it is going to be demonstrated at the project review meeting on the operational infrastructure.

Metascheduling functionalities

Metascheduler:

- access,
- workflow management,
- job rerouting,
- co-allocation,
- brokering,
- multiple accounting,
- data staging

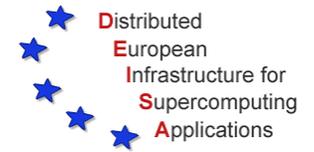Policies implementation through the scheduler (workload,advance reservation, accounting)
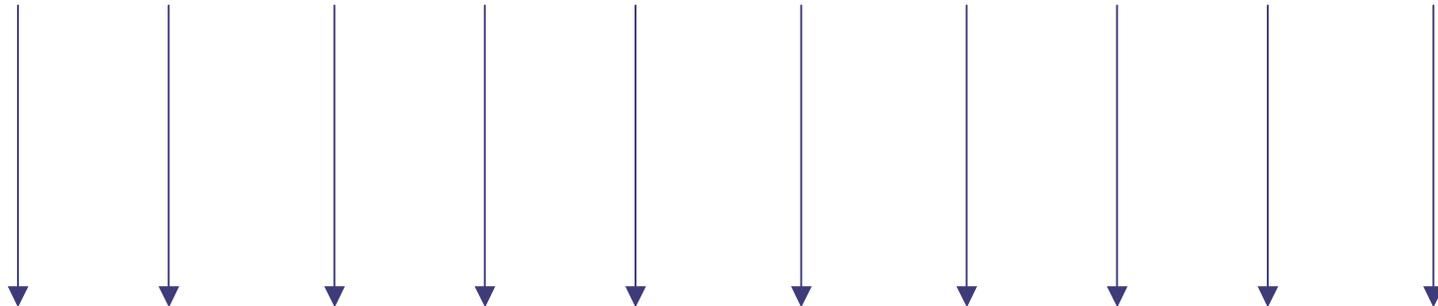
Resource manager

OS and communication

Hardware

Today – physical layout
Resource management

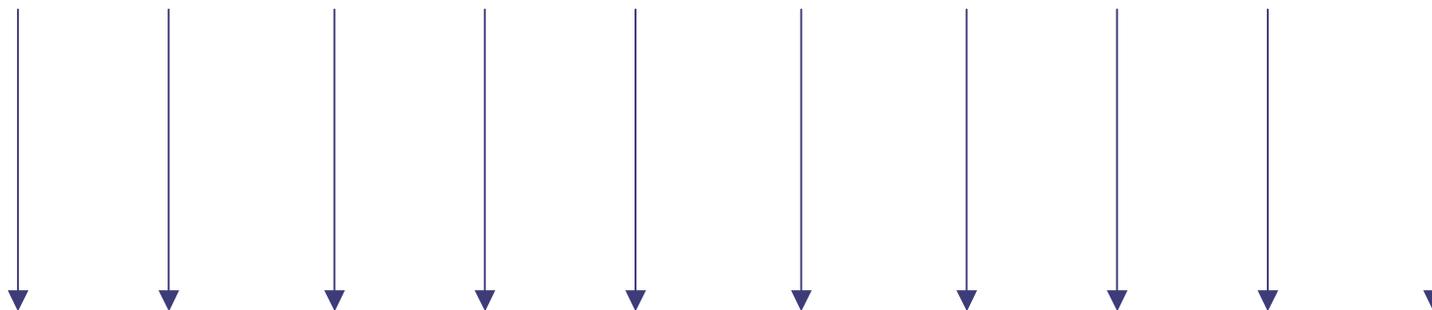| Idris	Fzj	Rzg	Cineca	Csc	Ecmwf	Sara	Lrz	Bsc	Hlrs

UNICORE

LL backfill	LL backfill	LL backfill	LL backfill	LL backfill	LL backfill	LSF HPC	SGE	LL backfill	NEC NQE
LL RM	LL RM	LL RM	LL RM	LL RM	LL RM	LSF RM	SGE RM	LL RM	NEC NQE RM
AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	RHEL+ SGI PP	RHEL+ SGI PP	SUSE	NEC OS
Power 4	Power 4	Power 4	Power 4	Power 4	Power 4	IA6 4	IA6 4	PPC	SX

Today – physical layout
Data management

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Idris	Fzj	Rzg	Cineca	Csc	Ecmwf	Sara	Lrz	Bsc	Hlrs

IBM GPFS (General Parallel File System) over WAN

Client Nativo	Client Nativo	Client Nativo	Client Nativo	Client Nativo	Client Nativo	Client Ad Hoc	Client Ad Hoc	Client Nativo	Client Ad Hoc ??
AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	RHEL+ SGI PP	RHEL+ SGI PP	SUSE	NEC OS
Power 4	Power 4	Power 4	Power 4	Power 4	Power 4	IA6 4	IA6 4	PPC	SX

Today – physical layout
Data management

AFS									
AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	AIX 5.2	RHEL+ SGI PP	RHEL+ SGI PP	SUSE	NEC OS
Power 4	Power 4	Power 4	Power 4	Power 4	Power 4	IA6 4	IA6 4	PPC	SX

CINECA IBM SP Power 5 Setup