Distributed
European
Infrastructure for
Supercomputing
Applications

Infrastructures and Technologies
for
Future Computing

„anyone, anything, anytime, anywhere"

Wolfgang Gentzsch

EU DEISA Project & Board of Directors of OGF
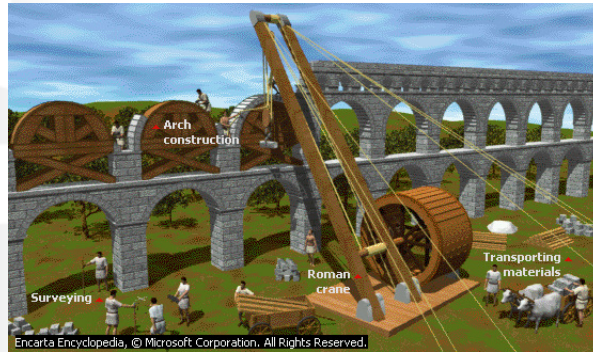
gentzsch at rzg.mpg.de

IARIA

Content

➢ History of Service Infrastructures

➢ Components: HPC Centers, Grids, Clouds, Internet, Web,...

➢ Examples of Cloud Applications

➢ Example: The DEISA Ecosystem for HPC Applications

➢ Example: The Telecoms and their potential

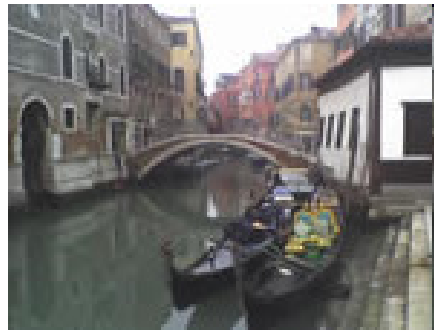➢ Next-Generation e-Infrastructure: The Digital City

We build Service Infrastructures

Ancient Rome: 10 aqueducts
150,000 m^3 of water each day
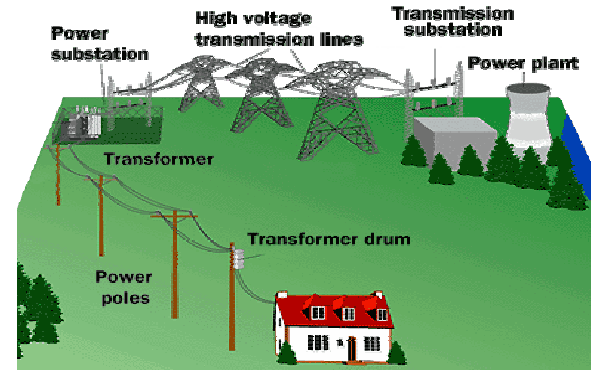
Electrical Power Grid
Infrastructure
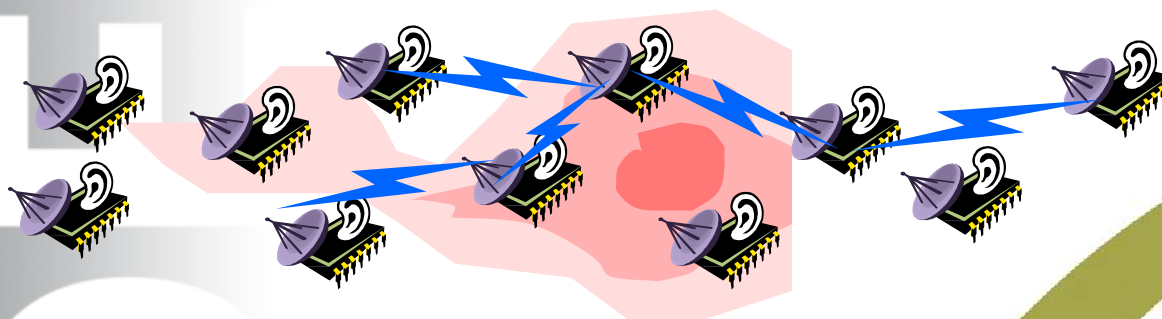
Transportation
Land, water, air

Internet
WWW, Grids, Clouds

Components of an e-Infrastructure:

Networks, Sensors, Servers, Clusters, Grids and Clouds

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Infrastructure for
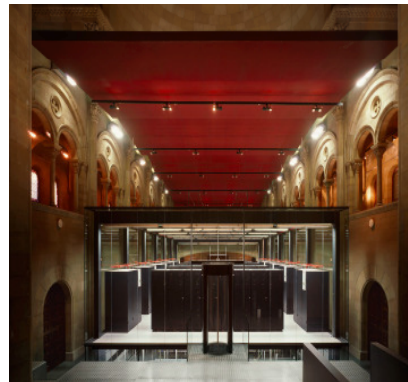**S**upercomputing
Applications

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)

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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

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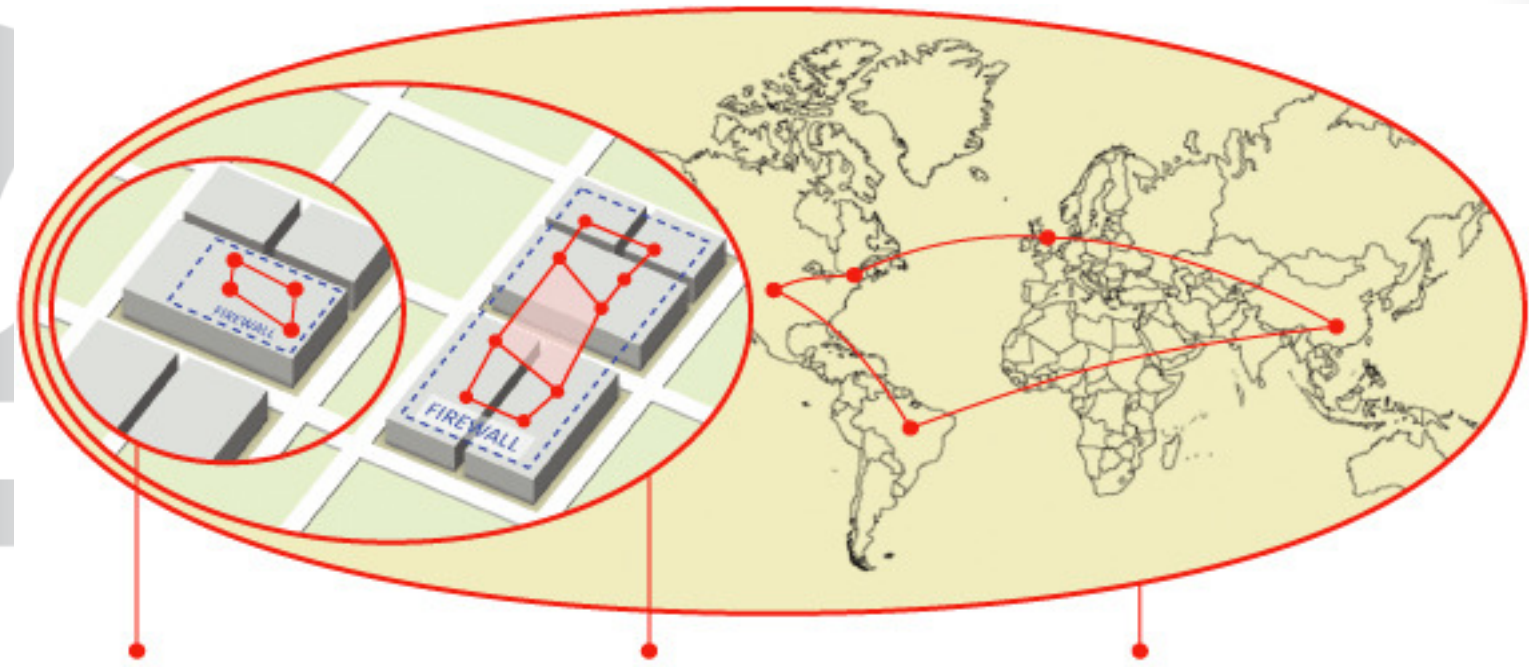
Grids

Departmental Grids

Enterprise Grids

Global Grids

Why should my App run in the Grid ?

- Closer collaboration with colleagues (VCs)
- R&D projects University - Industry
- More resources => faster/more/accurate processing
- Different architectures serve different apps
- Failover: move jobs to another system

. . . and Clouds

- No upfront cost for additional resources
- CapEx => OpEx, pay-per-use
- Elasticity, scaling up and down
- Hybrid solution (private and public cloud)

Cloud... as a Service

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

Infrastructure (IaaS)

Platform (PaaS)

Software (SaaS)

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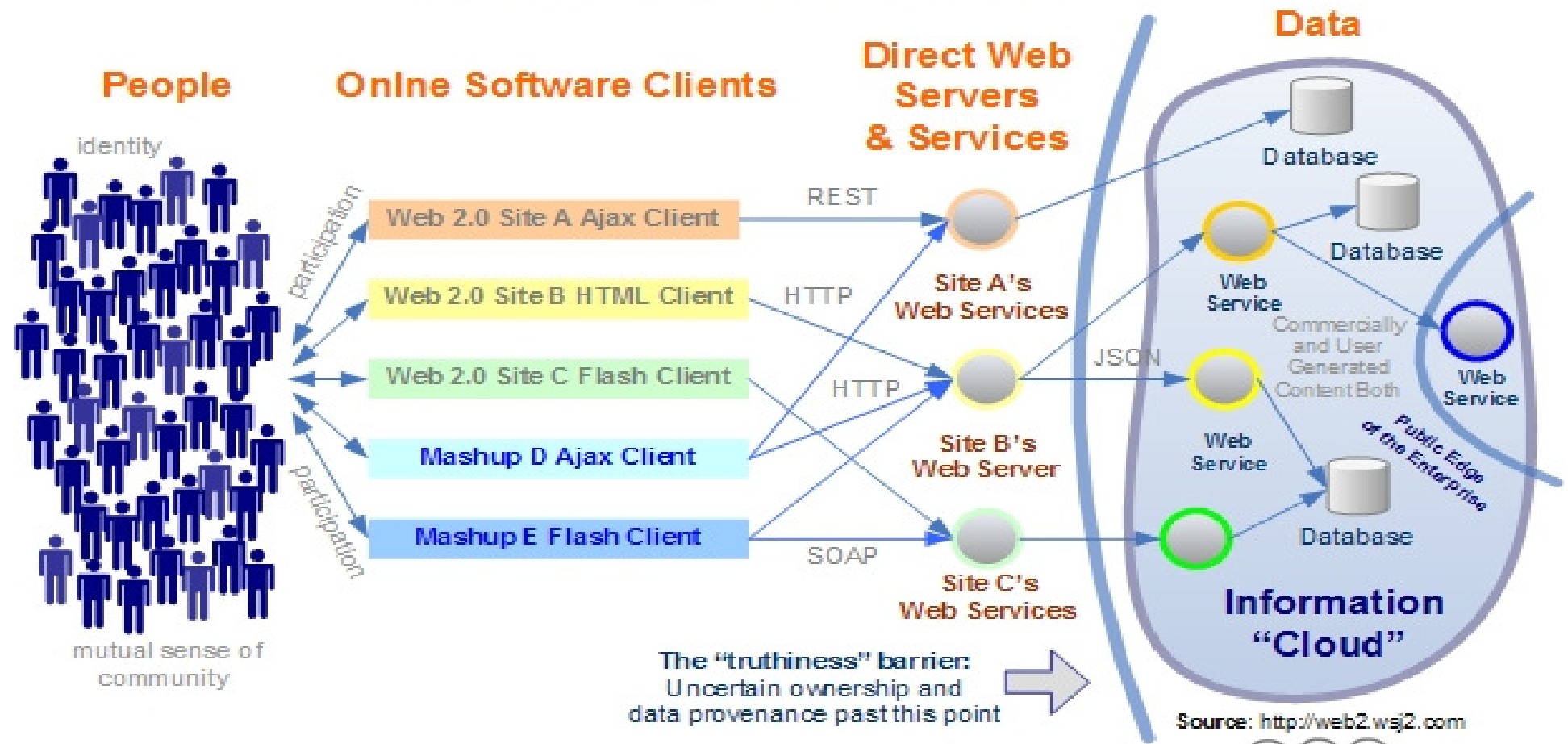- Available on demand
- Service Level Agreements
- Automated:
  - Scalability
  - Failover
  - Concurency management

Example: Web 2.0 Clouds

- Clouds drive interactive Web 2.0 sites
- enabling people to create and collaborate

The Web 2.0 Architecture of Participation:
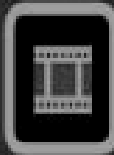### "People in the Machine Nurture the Cloud"

People — identity, participation, participation, mutual sense of community

Onlne Software Clients
- Web 2.0 Site A Ajax Client
- Web 2.0 Site B HTML Client
- Web 2.0 Site C Flash Client
- Mashup D Ajax Client
- Mashup E Flash Client

Direct Web Servers & Services
- REST → Site A's Web Services
- HTTP / HTTP → Site B's Web Server
- SOAP → Site C's Web Services

Data
- Database
- Database
- Web Service
- JSON
- Web Service
- Web Service
- Commercially and User Generated Content Both
- Database
- Web Service
- Public Edge of the Enterprise
- Information "Cloud"

The "truthiness" barrier:
Uncertain ownership and
data provenance past this point ⇨

Source: http://web2.wsj2.com

Top 15 most popular Web 2.0 Sites

eBizMBA Nov 2009

Monthly Visitors:

- YouTube: **69,110,425**
- Wikipedia: **62,228,655**
- craiglist: **45,243,526**
- twitter: **23,538,791**
- photobucket: **24,470,242**
- flickr: **23,769,885**
- WordPress: **22,147,374**
- IMDb: **21,298,399**
- digg: **33,433,760**
- eHow: **15,247,388**
- TypePad: **9,611,366**
- topix: **4,328,369**
- LiveJournal: **4,276,246**
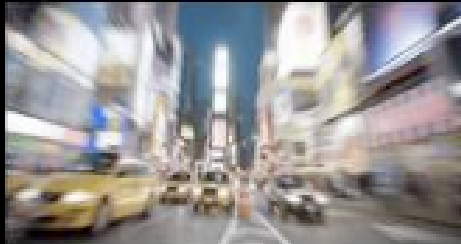- deviantART: **4,061,546**
- Technotati: **3,309,174**

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beta
ANIMOTO

1. it analyzes your
IMAGES
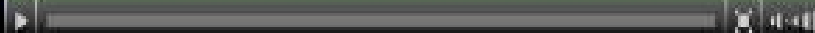
2. it feels your
MUSIC

3. it customizes a
VIDEO

FOR A **PREVIEW** CLICK HERE

Demos: 1 2

It's all automatic.

It's completely
customized to your music.

**Welcome to the
end of slideshows.**

No two videos are
ever the same.

GET STARTED ✓
create a new video

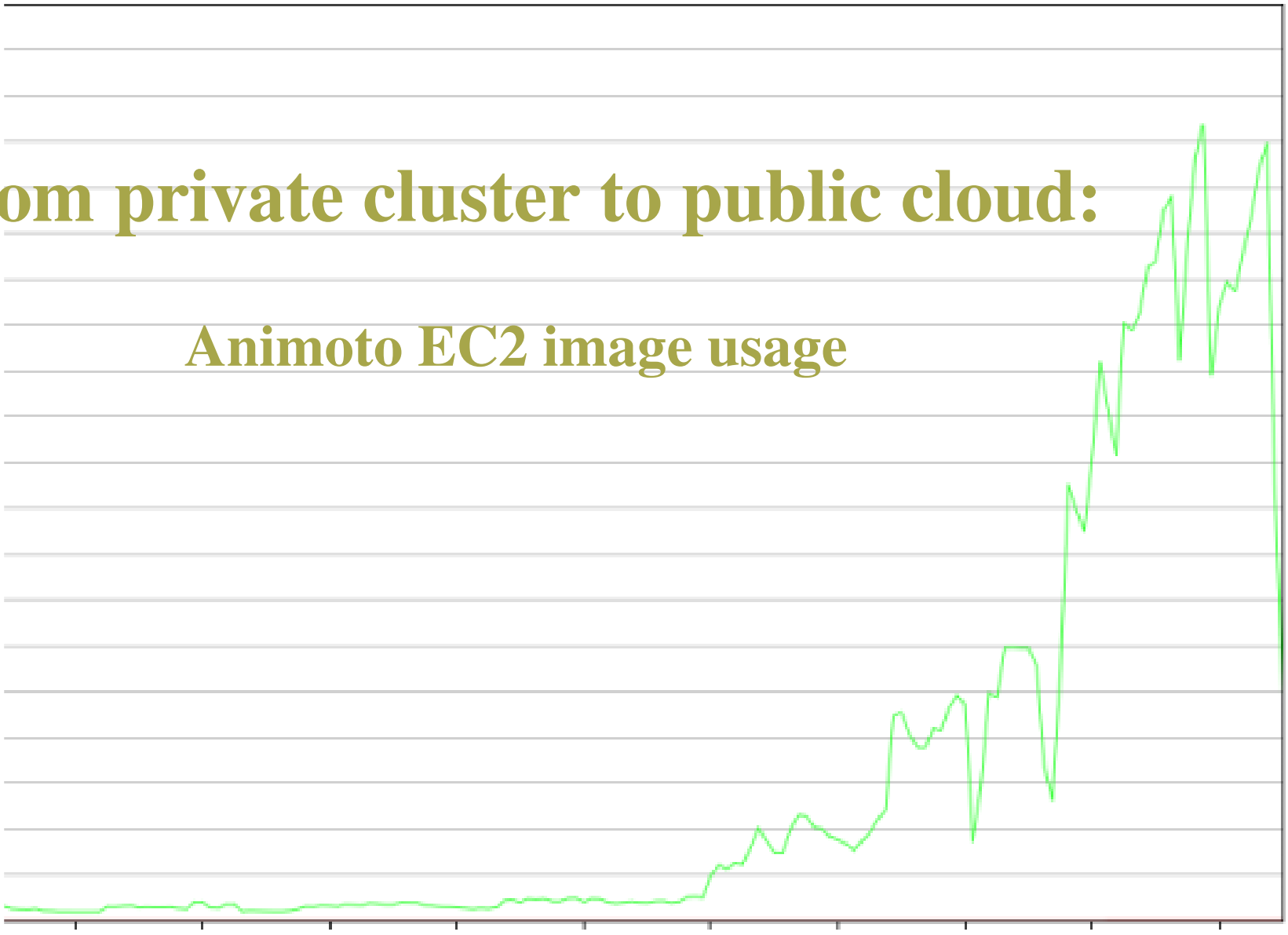**LEARN MORE** ?
watch the 60-sec video

From private cluster to public cloud:

Animoto EC2 image usage

4000

0

Day 1   Day 8

Example of an e-Infrastructure:

The DEISA Ecosystem for HPC Grand-Challenge Applications

**Distributed European Infrastructure for Supercomputing Applications**

Status and Requirements, e.g.: German Case

Scientific Field (numbers in TeraFlop/s)	2005-2007	2007-2009	2010
Climate and Earth System Research	20	50-100	>500
Geophysics	1	10-100	>1000
Nanostructure Physics	1	10-50	>200
Solid-State Physics	1	50-100	>1000
Computational Fluid Dynamics	2.5	25-100	>1000
Astrophysics	10	50-100	>500
Elementary Particle Physics and Physics of Hadrons and Nuclei	30	100	>1000
Materials Science	10	50-100	>500
Theoretical Chemistry	3	25-125	>300
Soft Matter	3	30	>200
Biophysics and Bioinformatics	3	15-80	>1000
Plasma Physics	10	50	>500

A. Bode, W. Hillebrandt, and Th. Lippert: German Scientific Case for the BMBF, 8/2005

new "petaflop" supercomputers

PRACE
petaflop supercomputers

DEISA
virtual supercomputer
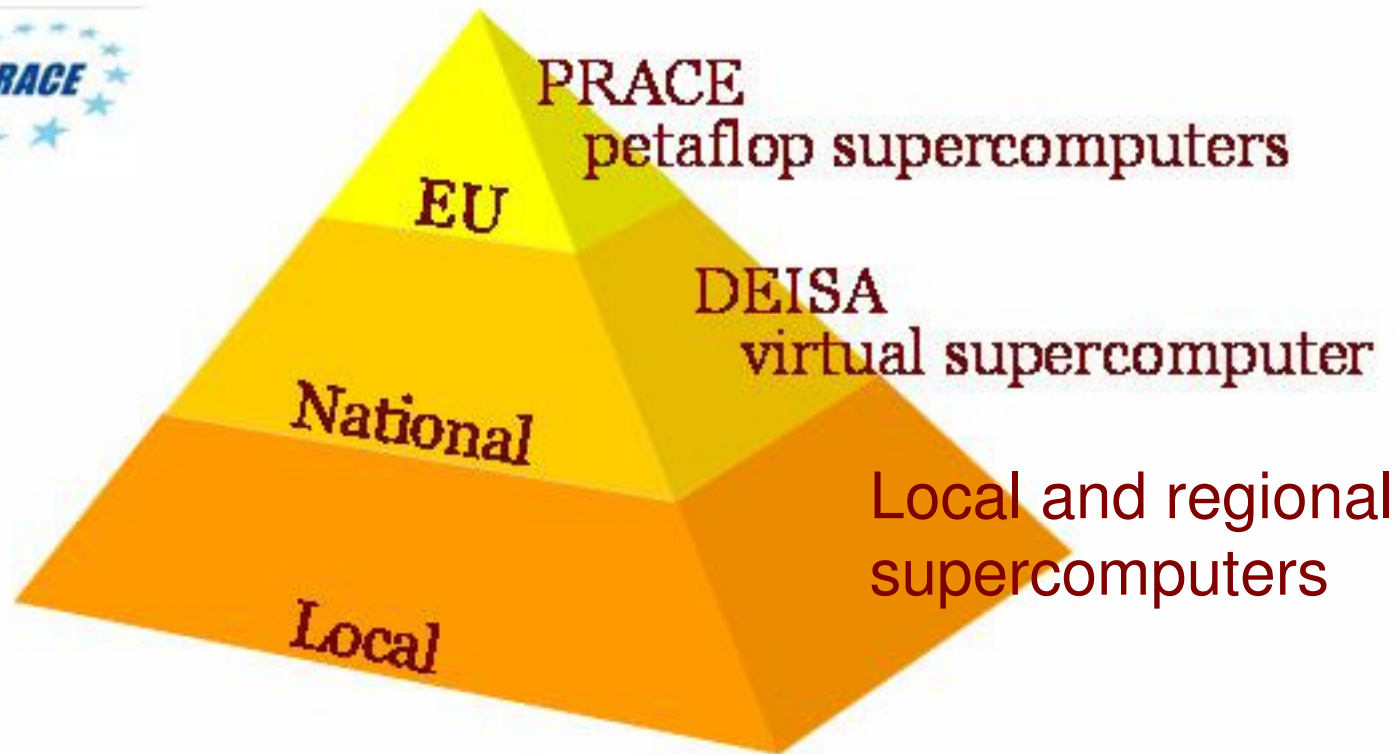
Local and regional
supercomputers

EU

National

Local

Mario Campolargo
European Commission
OGF23, June 2008

e-infrastructure

DEISA: Vision and Mission

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Applications

Vision:

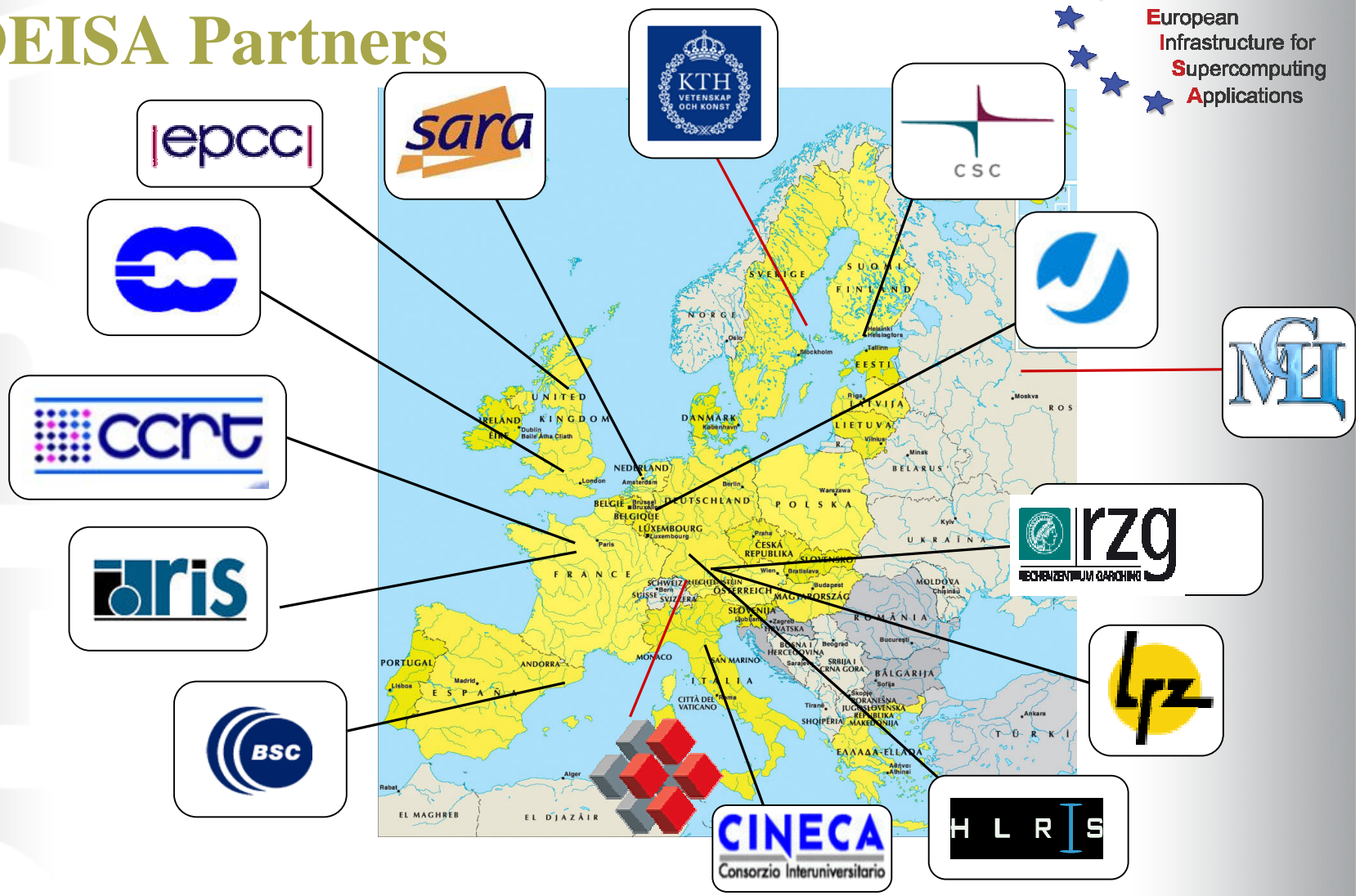Persistent European **HPC ecosystem** integrating Tier-1 (Tflop/s) centres and European Tier-0 (Pflop/s) centres.

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.
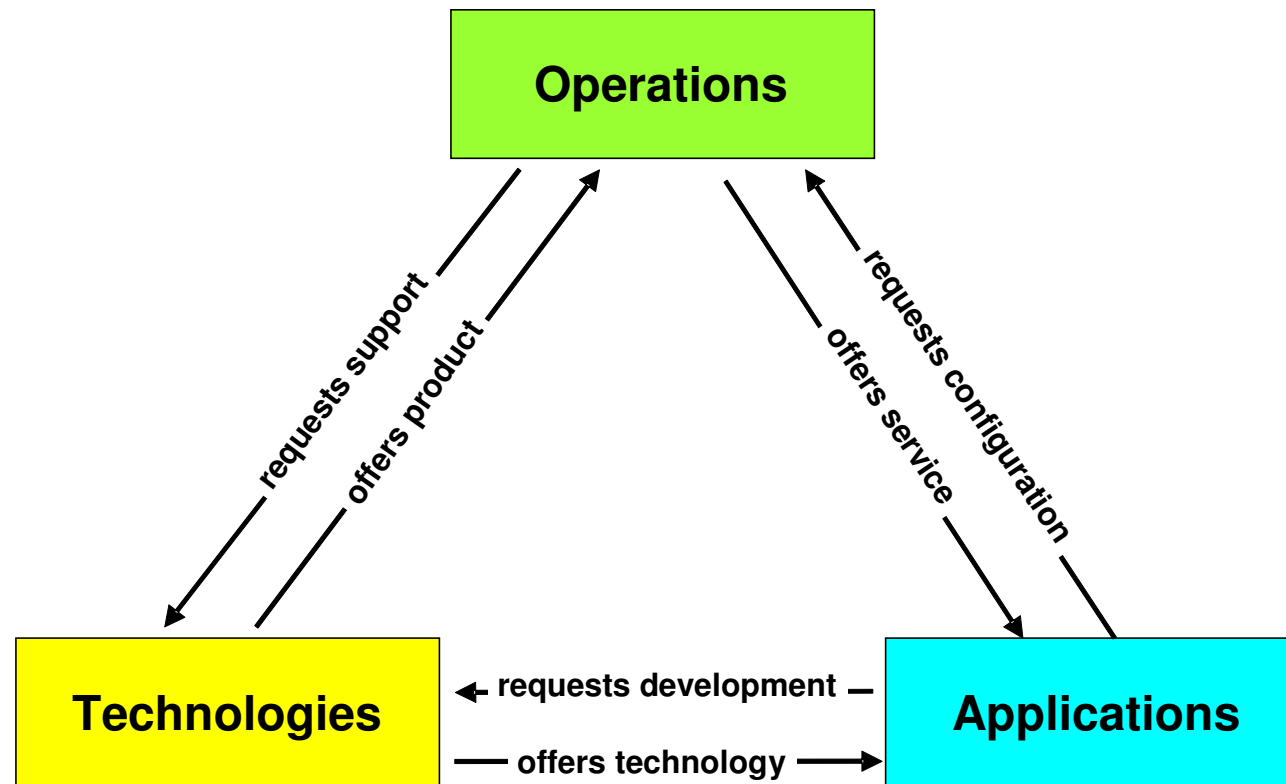
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DEISA Partners

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

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

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Categories of DEISA services

Operations

requests support

offers product

requests configuration

offers service

Technologies

← requests development —

offers technology →

Applications

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DEISA Service Layers

Distributed European Infrastructure for Supercomputing Applications

Multiple ways to access	Workflow managemnt	Common production environmnt
Single monitor system	Job rerouting	Co-reservation and co-allocation
Data staging tools	Data transfer tools	WAN shared File system
Unified AAA	DEISA Sites	Network connectivity

Presen-tation layer

Job manag. layer and monitor.

Data manag. layer

Network and AAA layers

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DEISA UNICORE Infrastructure

CINECA user

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job

LRZ user

Gateway IDRIS

Gateway FZJ

Gateway HLRS

Gateway ECMWF

Gateway HPCX

Gateway CSC

Gateway LRZ

job

Gateway CINECA

Gateway RZG

Gateway BSC

Gateway SARA

NJS IDRIS IBM P6
IDB | UUDB

NJS FZJ IBM
IDB | UUDB

NJS HLRS NEC SX8
IDB | UUDB

NJS ECMWF IBM P5
IDB | UUDB

AIX LL-MC

AIX LL-MC

Super-UX NQS II

NJS HPCX Cray XT4
IDB | UUDB

AIX LL

GridFTP

NJS CSC Cray XT4/5
IDB | UUDB

UNICOS/lc PBS Pro

UNICOS/lc PBS Pro

NJS LRZ SGI ALTIX
IDB | UUDB

LINUX PBS Pro

NJS CINECA IBM P5
IDB | UUDB

AIX LL-MC

LINUX Maui/Slurm

LINUX LL

AIX LL-MC

NJS RZG IBM
IDB | UUDB

NJS BSC IBM PPC
IDB | UUDB

NJS SARA IBM
IDB | UUDB

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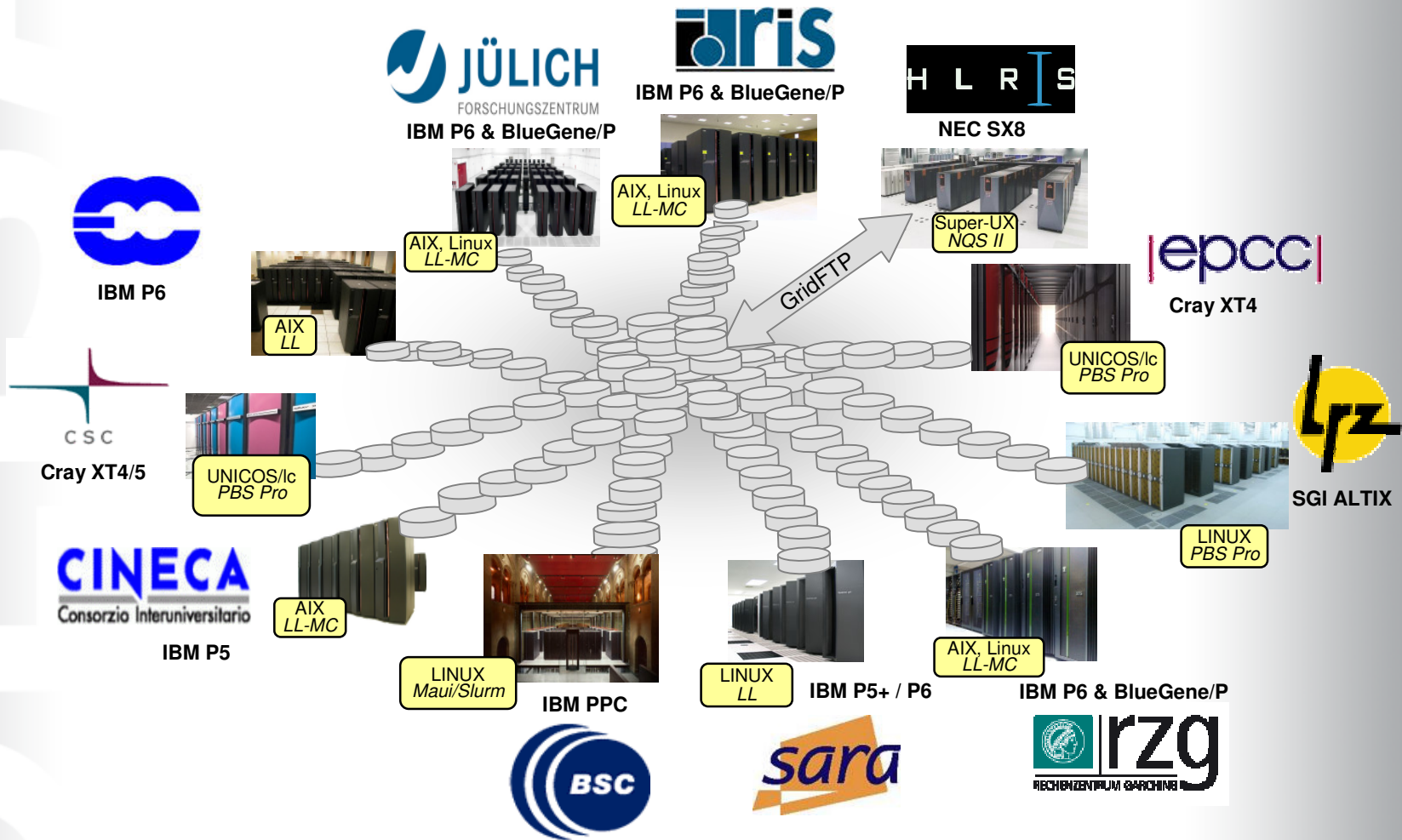
Global transparent file system based on the Multi-Cluster General Parallel File System
(MC-GPFS of IBM)

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

SARA

BSC   CINECA   CSC   ECMWF   EPCC   FZJ   HLRS   IDRIS   LRZ   RZG   SARA

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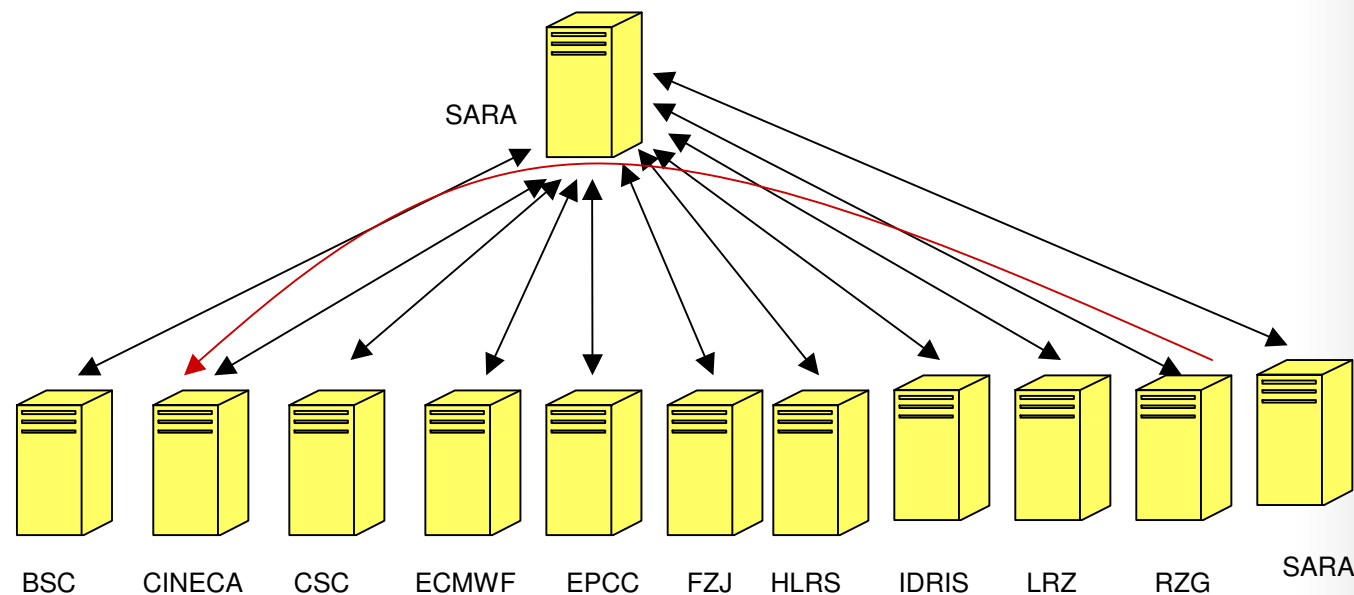
NICE EnginFrame
Cluster/Grid/Cloud Portal

Remote, interactive, transparent, and secure access to applications
and data on Intranet or Internet, or in the Cloud.
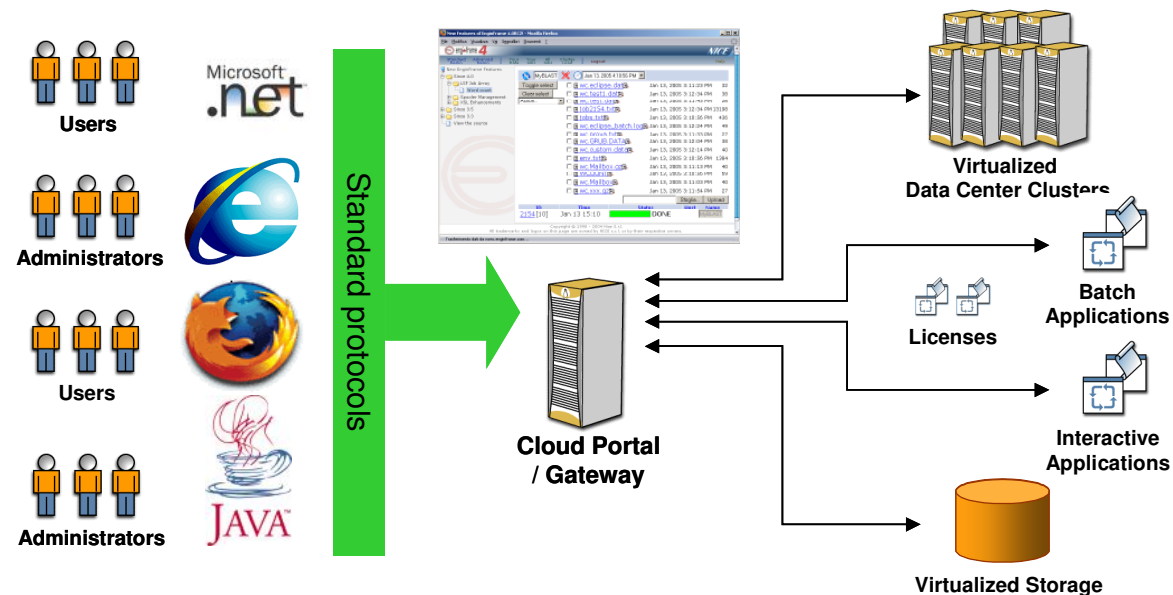
Access and control of computing resources
via an intuitive and standard Web interface
anywhere using a standard Web browser

Example:

A Next-Generation e-Infrastructure

for Telecommunications

New Powerful End-User Devices

Carry-along PCs (CAPS) , Ultra-Mobile PCs (UMPC) , Cellphones

Fujitsu UMPC

OLPC from MIT

CAPC, from Samsung, South Korea

CAPC from HTC

T83 Tablet from Asus, Taiwan,
demoed at CeBit 2007

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The Symbian Platform

(code on the device)

Application

- Location Apps
- Device Mgmt Apps
- Web Apps
- Personal Comms Apps
- Connectivity Apps
- Productivity Apps
- Multimedia Apps
- UI Apps

Middleware

- Location MW
- Connectivity MW
- Security MW
- Data Comms MW
- Personal Comms MW
- Device Mgmt MW
- Productivity MW Services
- Multimedia Middleware
- Runtimes & Web MW
- UI Middleware

OS

- OS Security
- OS Runtime and Web
- OS Location
- OS Data Comms
- OS Personal Comms
- OS Connectivity
- Multimedia
- Graphics

OS Base Services

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Example: BT Cloud

Next-Gen. e-Infrastructures
Example: Intel's Digital City Vision

Imagine a city...

That Transforms the way we Work, Live & Play...
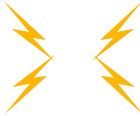
Courtesy Robert Fogel, Intel

Today's Digital Challenge

Taxes Shopping Working Banking

Multiple Identities

Wimax WiFi Wired Cellular

Incompatible Networks

Business Citizen Govt Employee

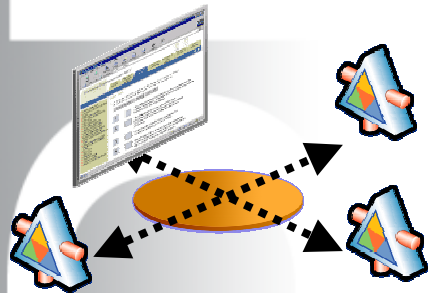Disconnected Agencies

Tomorrow's Integrated Digital City

A single, portable identity
based on strong security

One Identity
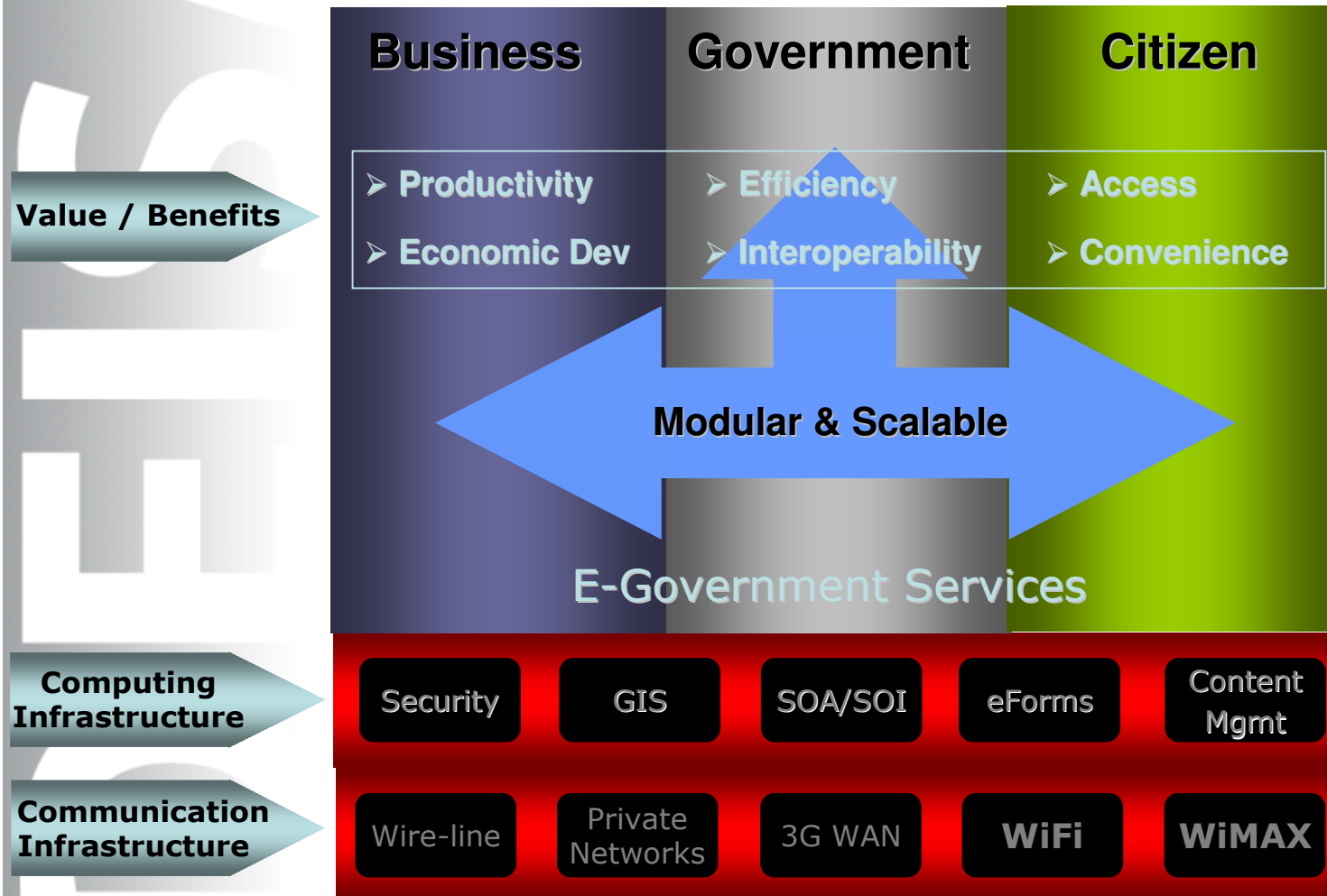
An intelligent infrastructure
supporting seamless access

One Network

A gateway to integrated e-Services
spanning multiple agencies

One Face

Building the Digital City Today

Value / Benefits

Computing Infrastructure

Communication Infrastructure

Business | **Government** | **Citizen**

- Productivity
- Economic Dev
- Efficiency
- Interoperability
- Access
- Convenience

Modular & Scalable

E-Government Services

Security | GIS | SOA/SOI | eForms | Content Mgmt

Wire-line | Private Networks | 3G WAN | WiFi | WiMAX

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Facets of the Digital City

Digital Education

Economic Vitality
(Digital Office)

Serving Citizens

Digital City

Digital Govt
GAPP Programs

Digital Healthcare

Bridging the
Digital Divide

Digital Home

Safety & Security

The Digital City is the Fabric that Connects the Community

Finally :
anyone, anywhere, anytime, any device

- Integration of devices, digital objects, ICT resources,…
- Cells, PDAs, smart sensors, sensor arrays, health monitors,…
- Devices embedded in cars, engines, roads, bridges, clothes,...
- Huge amount of data for real-time analysis
- Grid & cloud economy, policies, SLAs, QoS,…
- Support organizational and societal structures, to bridge political and social boundaries . . .

. . . very much like any other vital infrastructure, e.g. roads, telecom, water, electricity, gas, etc…

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Thank You
for your attention
Gentzsch @ rzg.mpg.de

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