

Unicore Summit, Sophia Antipolis Oct 11 – 12, 2005

Grid Computing In Research and Business

Status and Direction

Wolfgang Gentzsch, D-Grid and RENCi



Topics of the Day

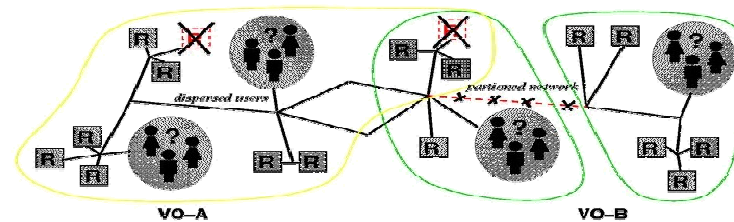
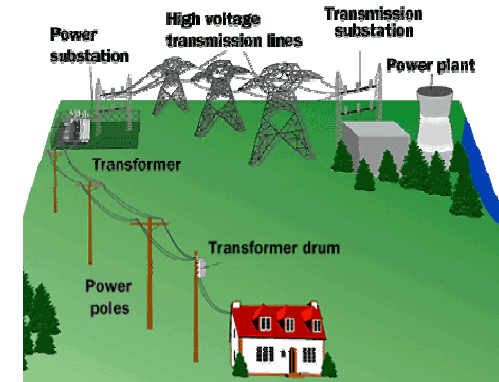
- What is a Grid ?
- Why should we care about Grid ?
- Grid Examples: Research, Industry, Community
- 12 good reasons why grids are ready for research and early adopters in business
- Grid challenges and opportunities in business
- The future of Grid Computing



What is a Grid ?

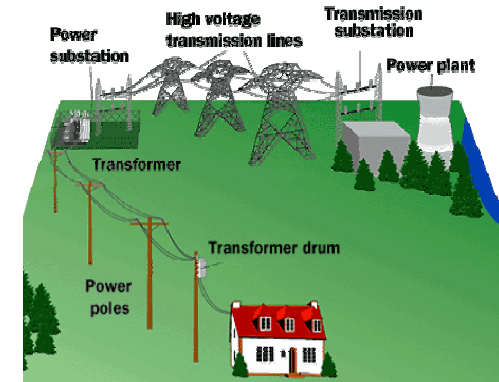
1001 Definitions

- ❖ Distributed, networked computing & data resources
- ❖ Networking and computing infrastructure for utility computing
- ❖ Distributed platform for sharing scientific experiments and instruments
- ❖ The next generation of enterprise IT architecture
- ❖ The next generation of the Internet and the WWW
- ❖ Computing from the wall socket
- ❖ The Advanced Network
- ❖ ...and 994 more...

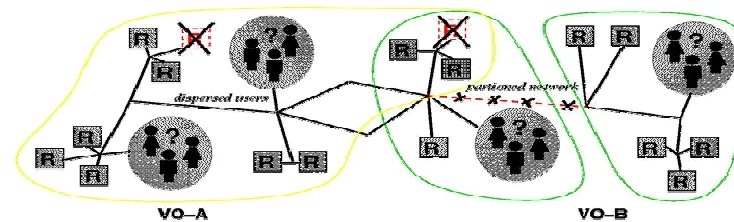


What is a Grid ?

1001 Definitions



**It's all about
distributed, networked,
shared resources
in (virtual) organizations**



Industry is on a Journey

Old World

Static

Silo

Physical

Manual

Application



New World

Dynamic

Shared

Virtual

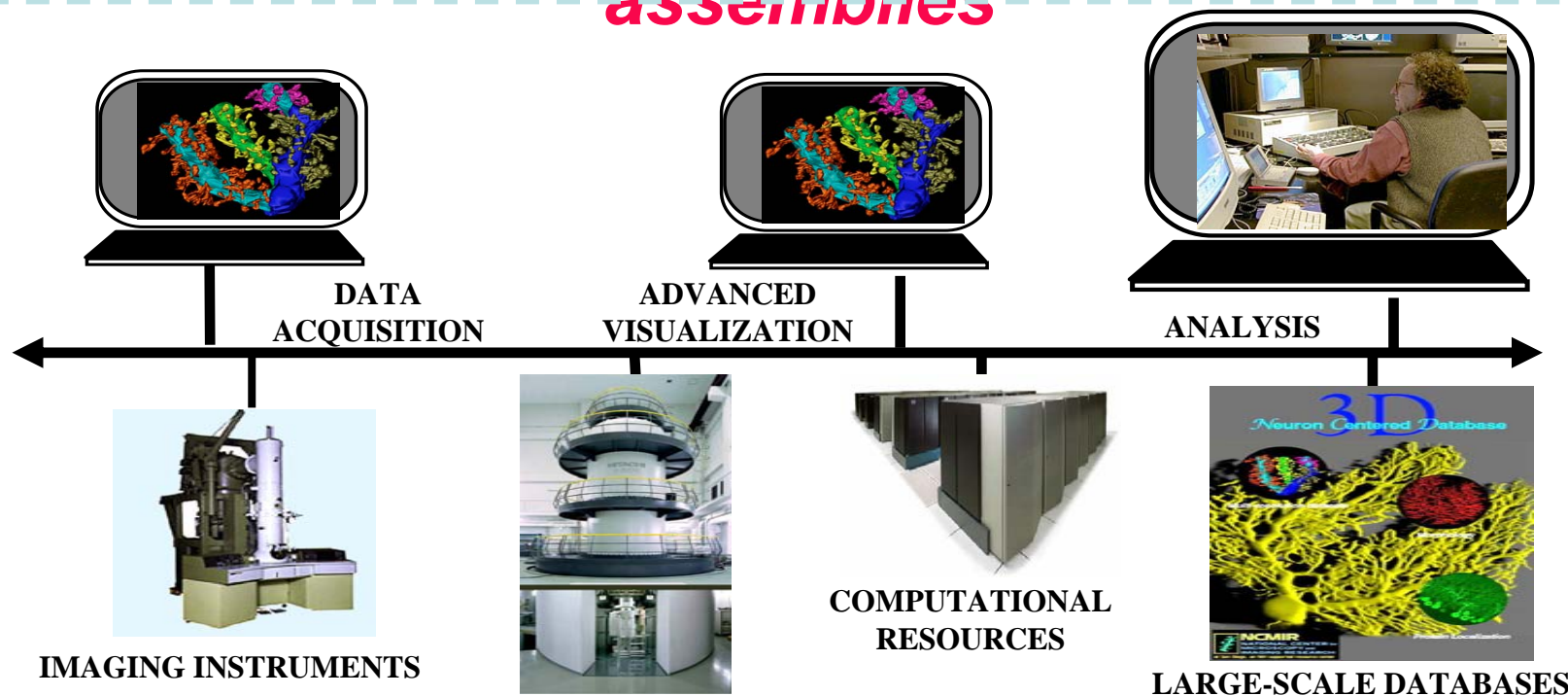
Automated

Service

Transitioning from **Silo Oriented Architecture**
to
Service Oriented Architecture

Example: Tele-Science Grid

*coordinated problem solving
on dynamic and heterogeneous resource
assemblies*



Courtesy of Ellisman & Berman /UCSD&NPACI

Why should we care about Grids ?

Three Examples

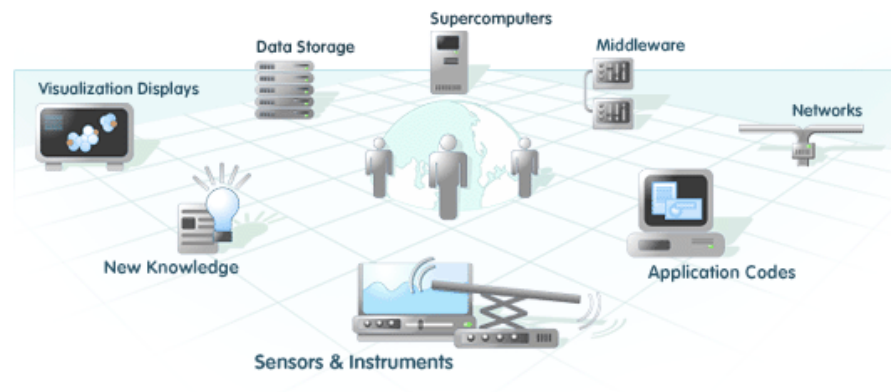
Research Grid
Industry Grid
Community Grid



Grids for Research:

NEES, Network for Earthquake Engineering Simulation

NEESgrid links earthquake researchers across the U.S. with leading-edge computing resources and research equipment, allowing collaborative teams to plan, perform, and publish their experiments.



NEESgrid enables:

- tele-observation and tele-operation
- access computational resources
- access collaborative tools

Grids for the Industry:

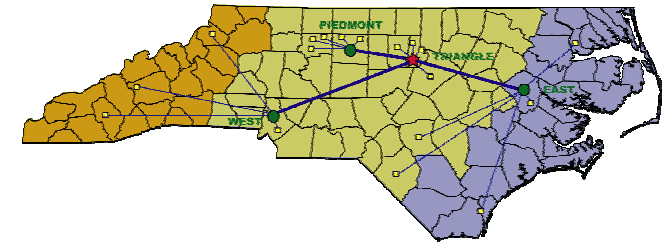


DAME is an e-Science pilot project, demonstrating the use of the GRID to implement a distributed decision support system for deployment in maintenance applications

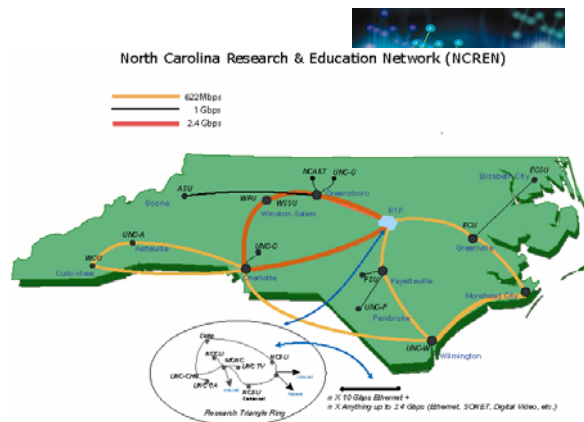
Partners: Universities of York, Leeds, Sheffield, Oxford and Rolls Royce

A Grid for the Community

Example: North Carolina



**NC Statewide Grid Initiative
2004 - 2006**



**MCNC Enterprise Grid
2003**

**MCNC Grid Service Provider
& the North Carolina
Statewide Grid**

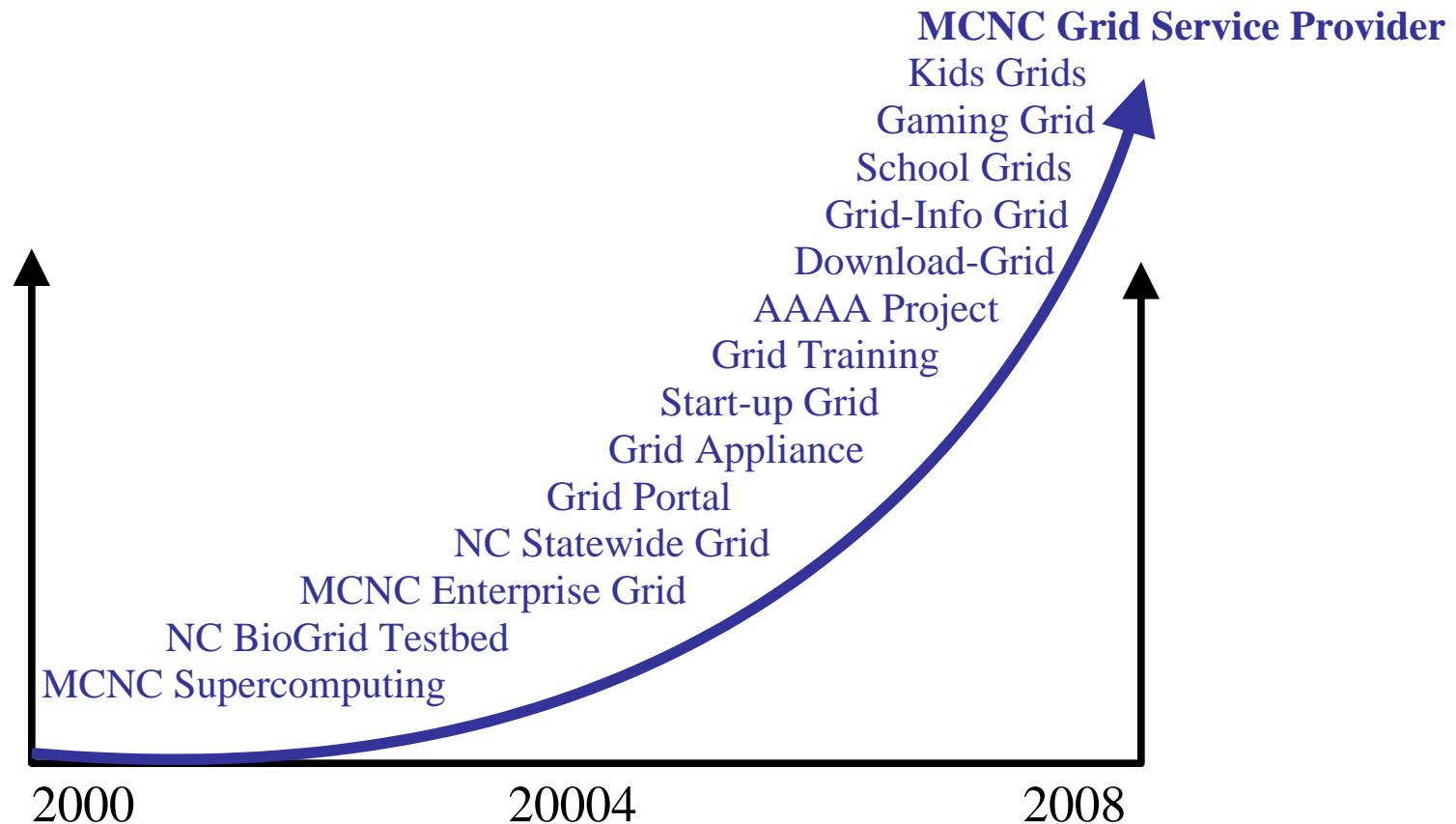
**NCREN
North Carolina Research & Education Network**

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Projects Driving Grid Adoption in North Carolina



12 Good reasons why Grids are ready, IMHO, for the research community and for early adopters in industry



#1: Grid Benefits for Department, Enterprise, Global Grids

- **Resource Utilization:** increase from 20% to 80+%
- **Productivity:** more work done in shorter time
- **Business Agility:** flexible actions and re-actions
- **On Demand:** get resources, when you need them
- **Easy Access:** transparent, remote, secure
- **Sharing:** enable collaboration over the network
- **Failover:** migrate/restart applications automatically
- **Resource Virtualization:** access compute services, not servers
- **Heterogeneity:** platforms, OSs, devices, software
- **Virtual Organizations:** build & dismantle on the fly

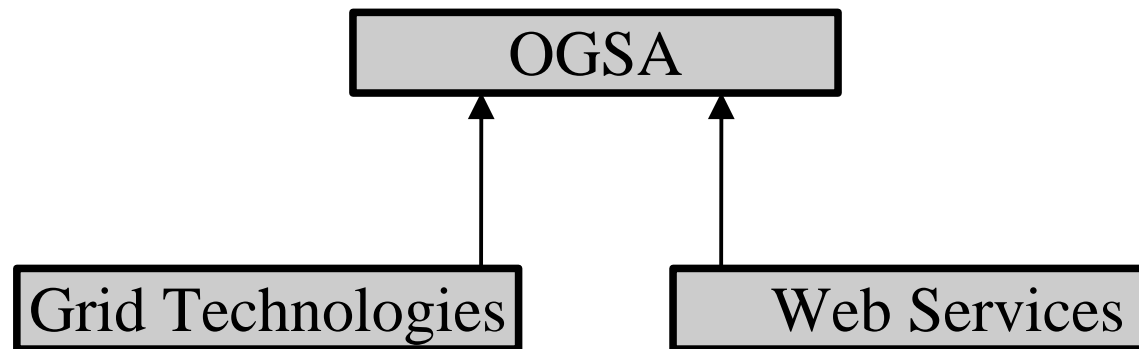


#2: We have a large Grid Community represented by GGF (Global Grid Forum)

- Community-driven set of working groups that are developing standards and best practices for distributed computing efforts
- Three primary functions: community, standards, and operations
- Standards Areas: Infrastructure, Data, Compute, Architecture, Applications, Management, Security, and Liaison
- Community Areas: Research Applications, Industry Applications, Grid Operations, Technology Innovations, and Major Grid Projects
- Community Advisory Board will represent the different communities and provide input and feedback to GGF



#3: We have ONE Open Grid Services Architecture



OGSA Open Grid Service Architecture

Integrates grid technologies with Web Services (OGSA => WS-RF)

Defines the key components of the grid

OGSA enables the integration of services and resources across distributed, heterogeneous, dynamic, virtual organizations – whether within a single enterprise or extending to external resource-sharing and service-provider relationships.”

Example:

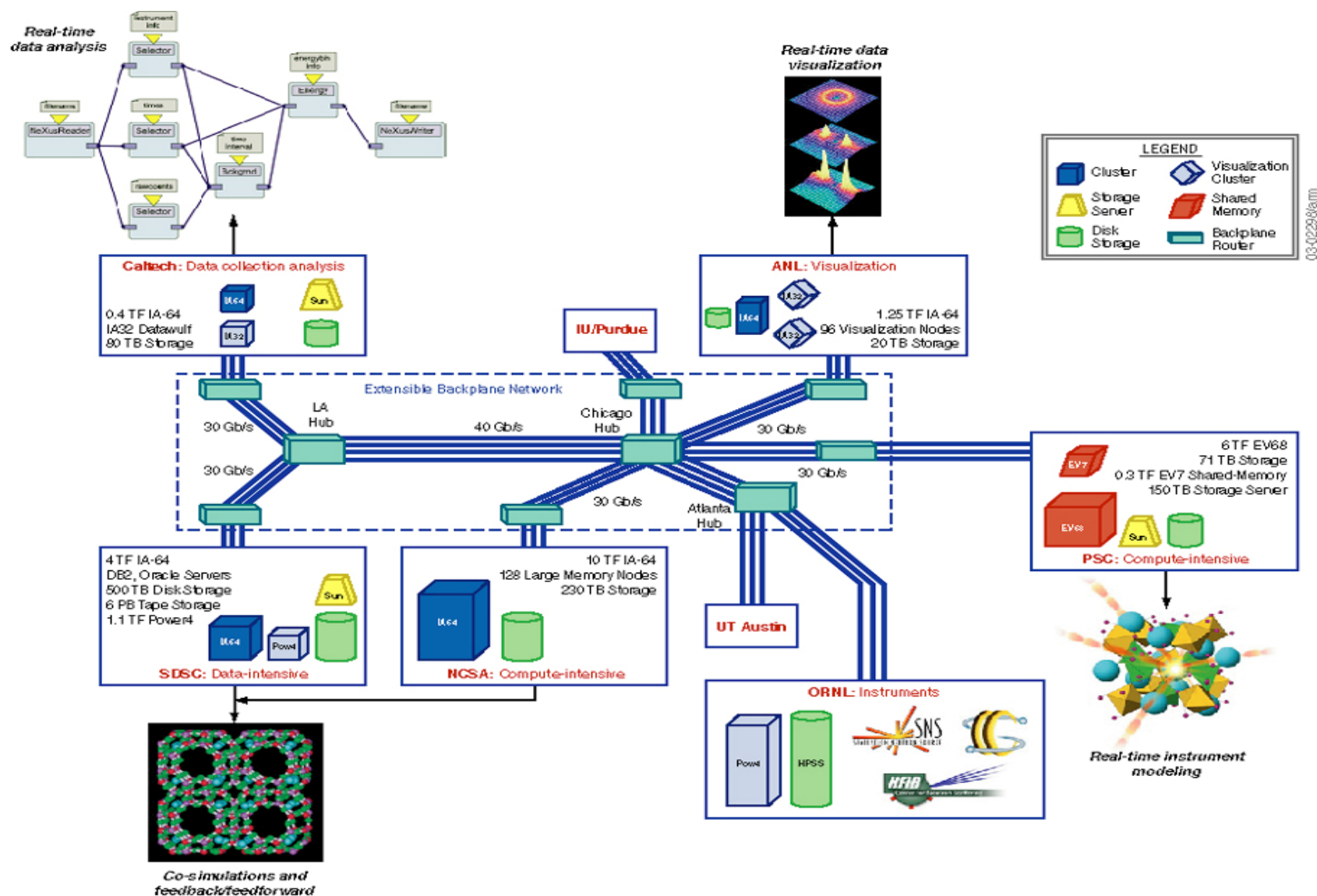


- TeraGrid is a national cyberinfrastructure for world-class computational research
- TeraGrid includes many types of resources for knowledge discovery
- TeraGrid is a partnership among leading US institutions and researchers
- ANL, Caltech, NCSA, ORNL, PSC, Purdue, SDSC, UT Austin, and others
- \$150 M so far



Neutron Science TeraGrid Gateway

John Cobb, ORNL



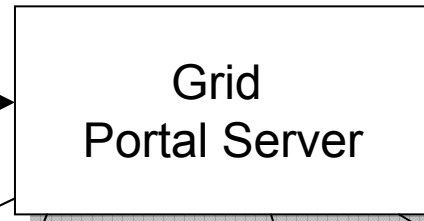
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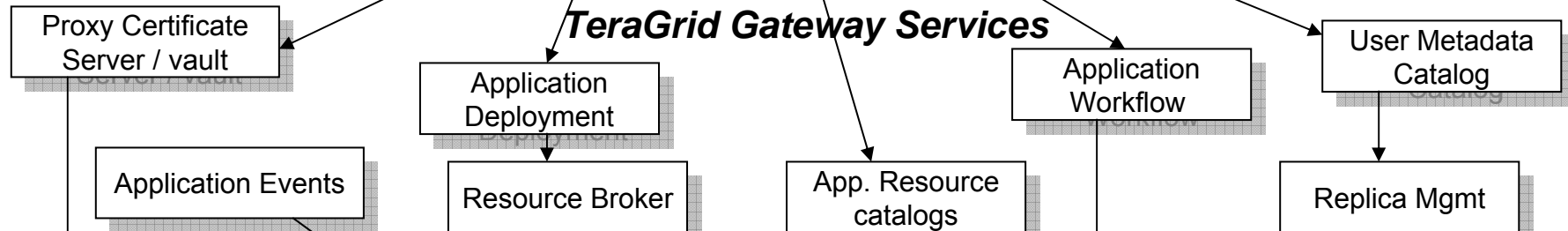


The Architecture of Gateway Services

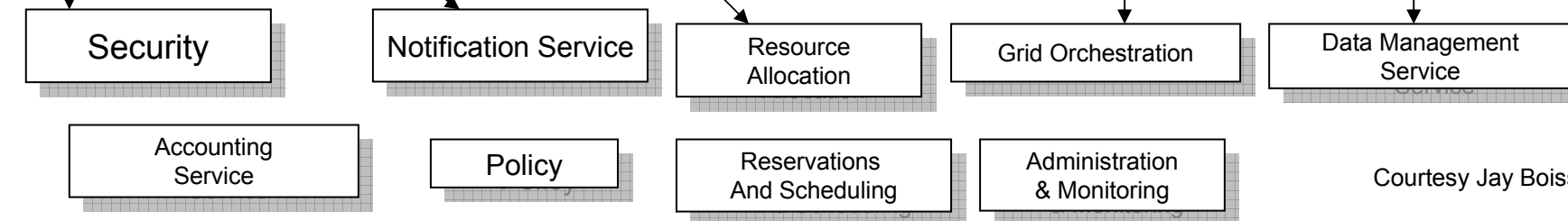
The Users Desktop



TeraGrid Gateway Services

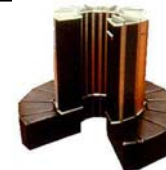
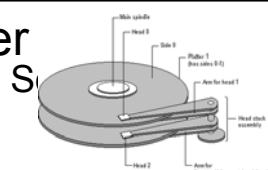


Core Grid Services



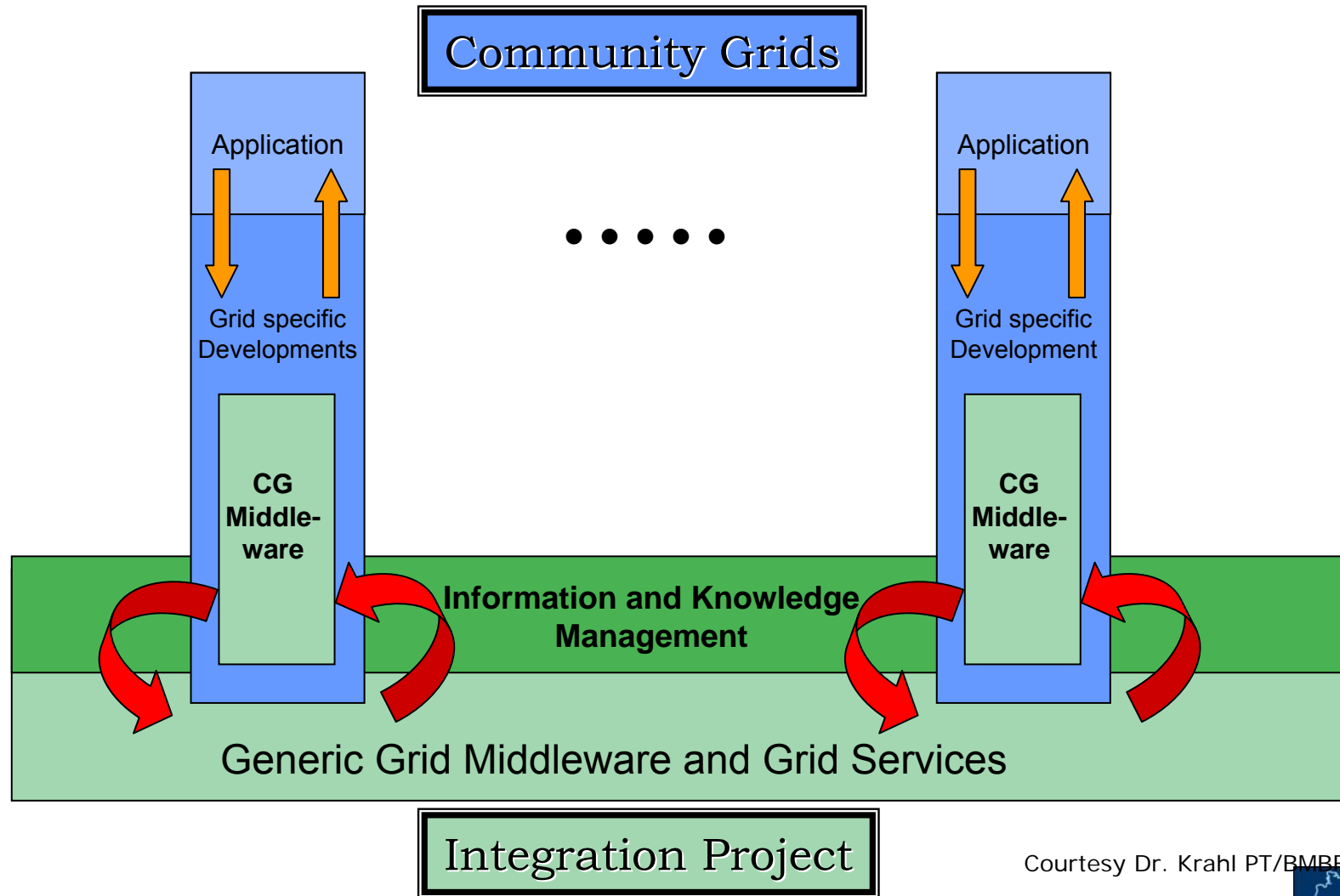
Web Services Resource Framework - Web Services Notification

Physical Resource Layer



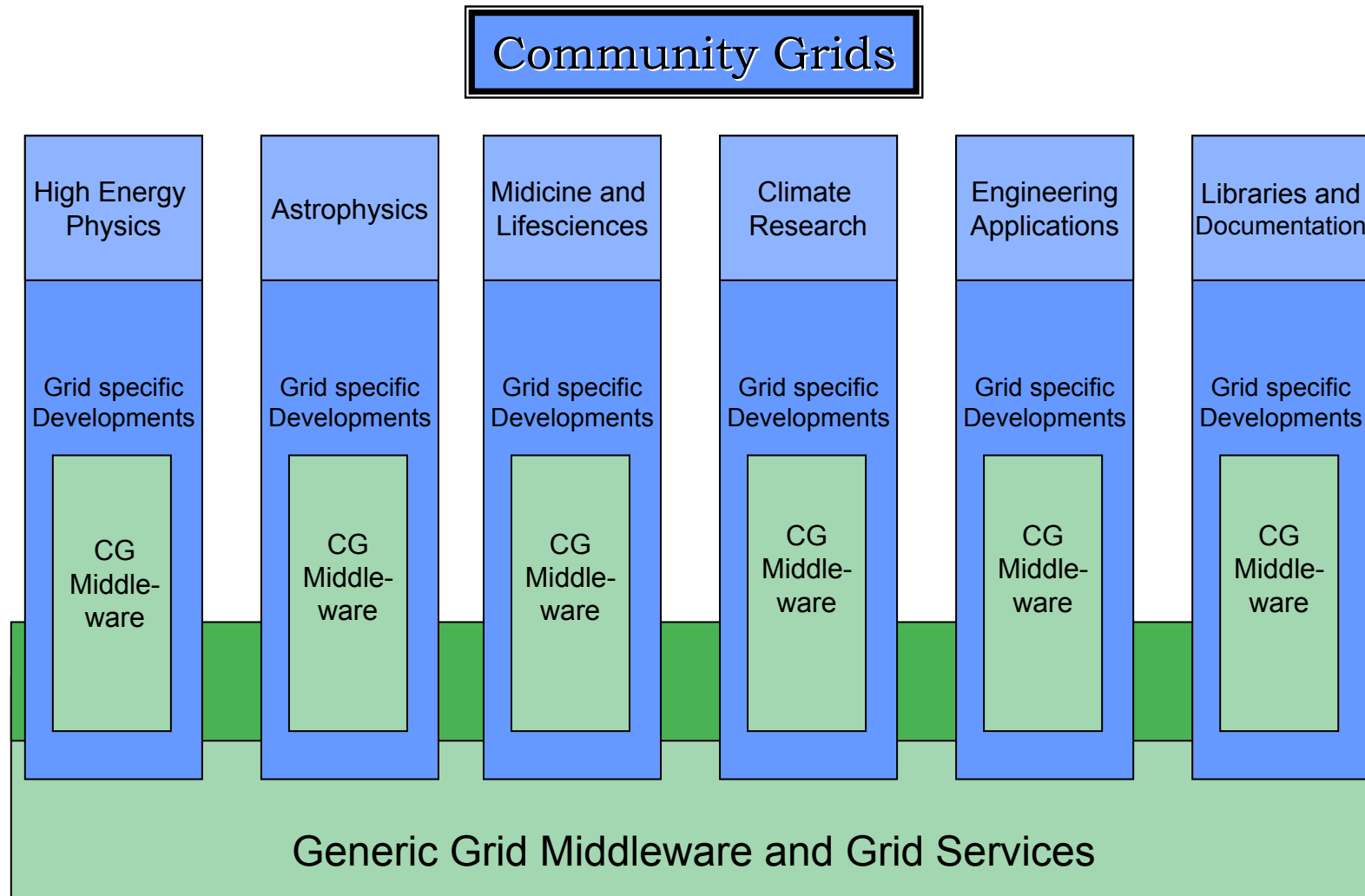
Courtesy Jay Boisseau

German D-Grid Initiative

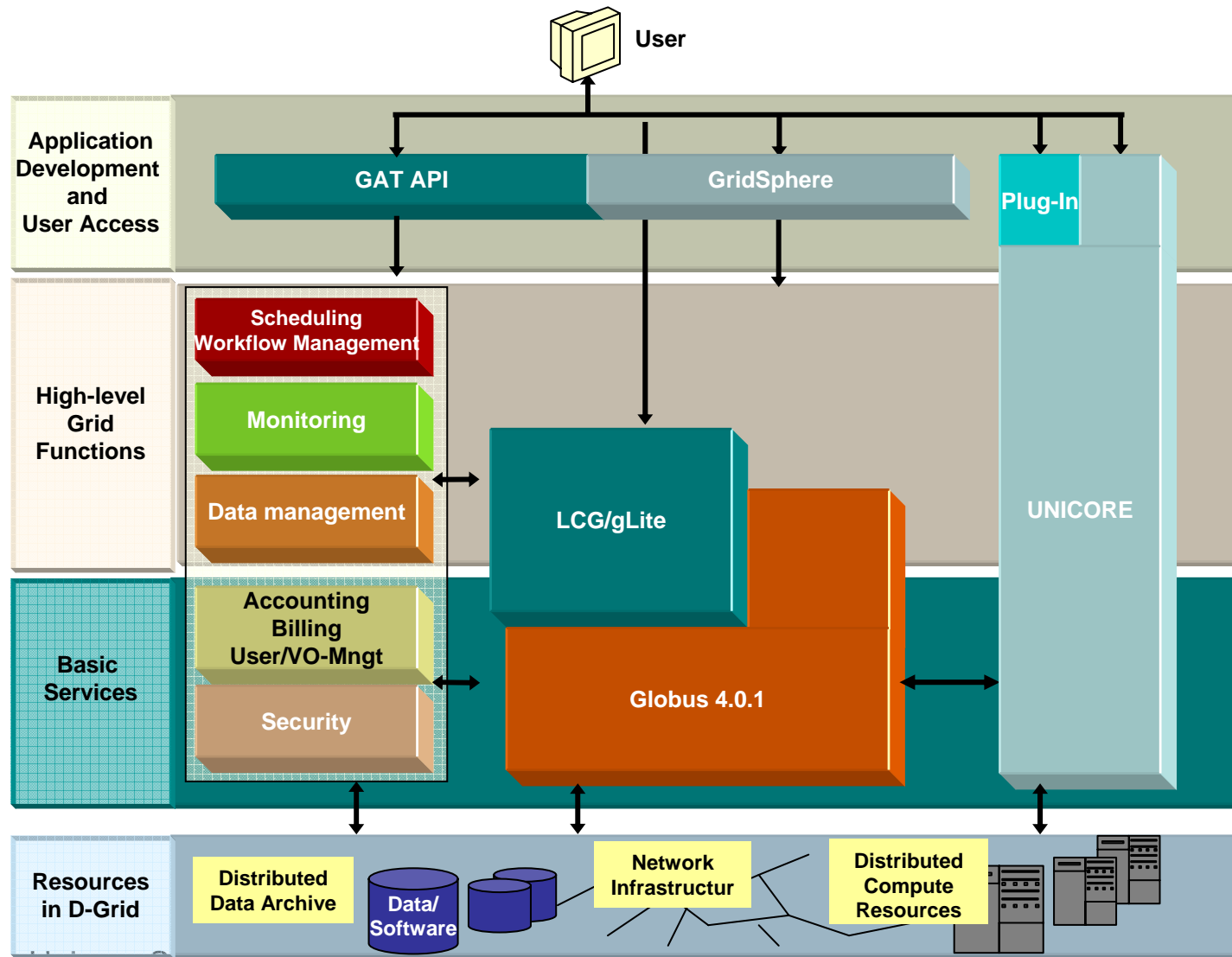


Courtesy Dr. KrahI PT/BMBF

D-Grid Components



D-Grid Middleware



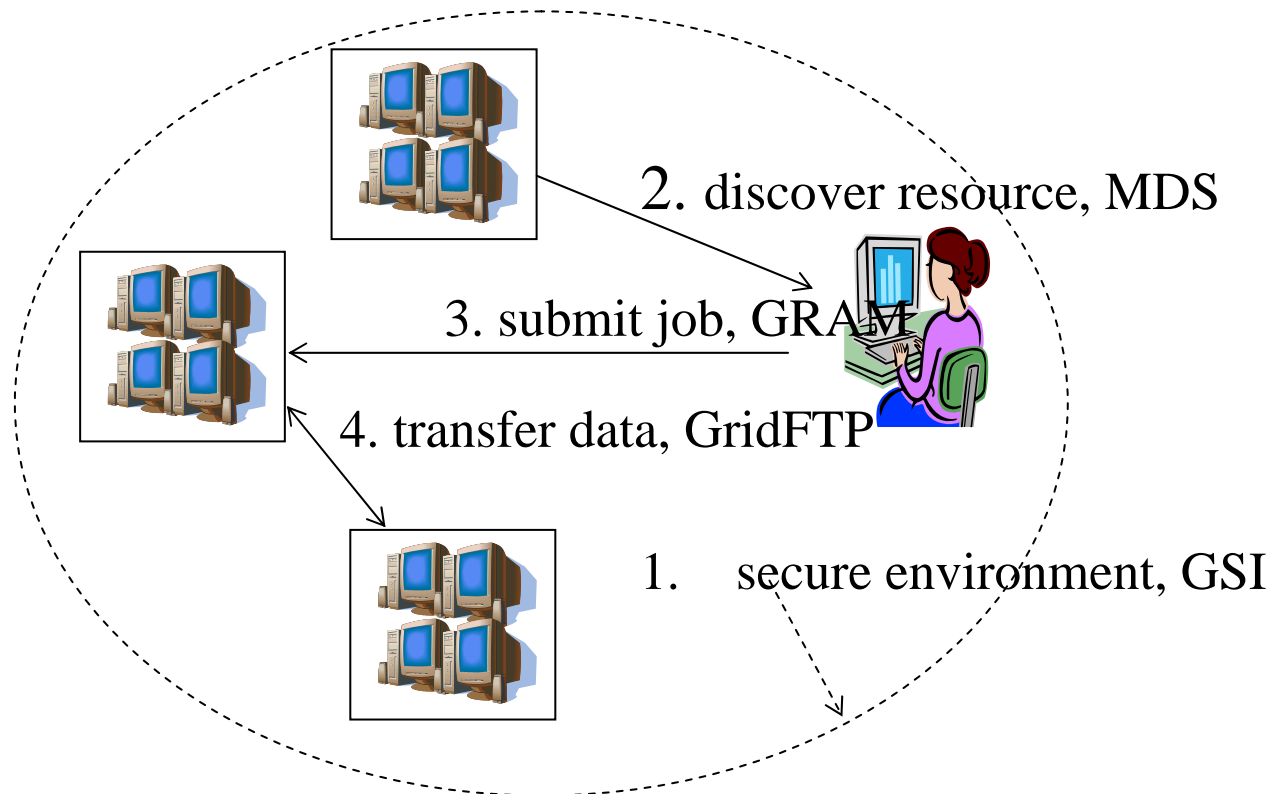
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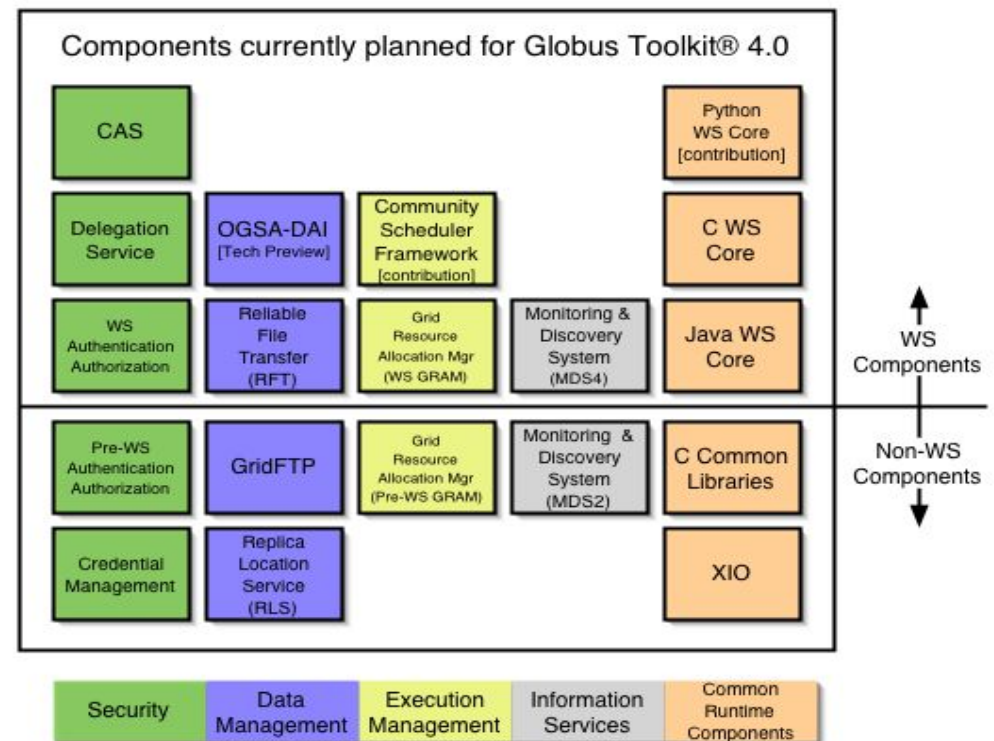
#4: We have Grid Software, like the Globus Toolkit

- Globus Toolkit provides four major functions for building grids



Globus Toolkit 4 Summary

- There are four groups of services in Globus 4, plus common libraries
- WS components are Web services talking SOAP
- Non-WS components use other protocols

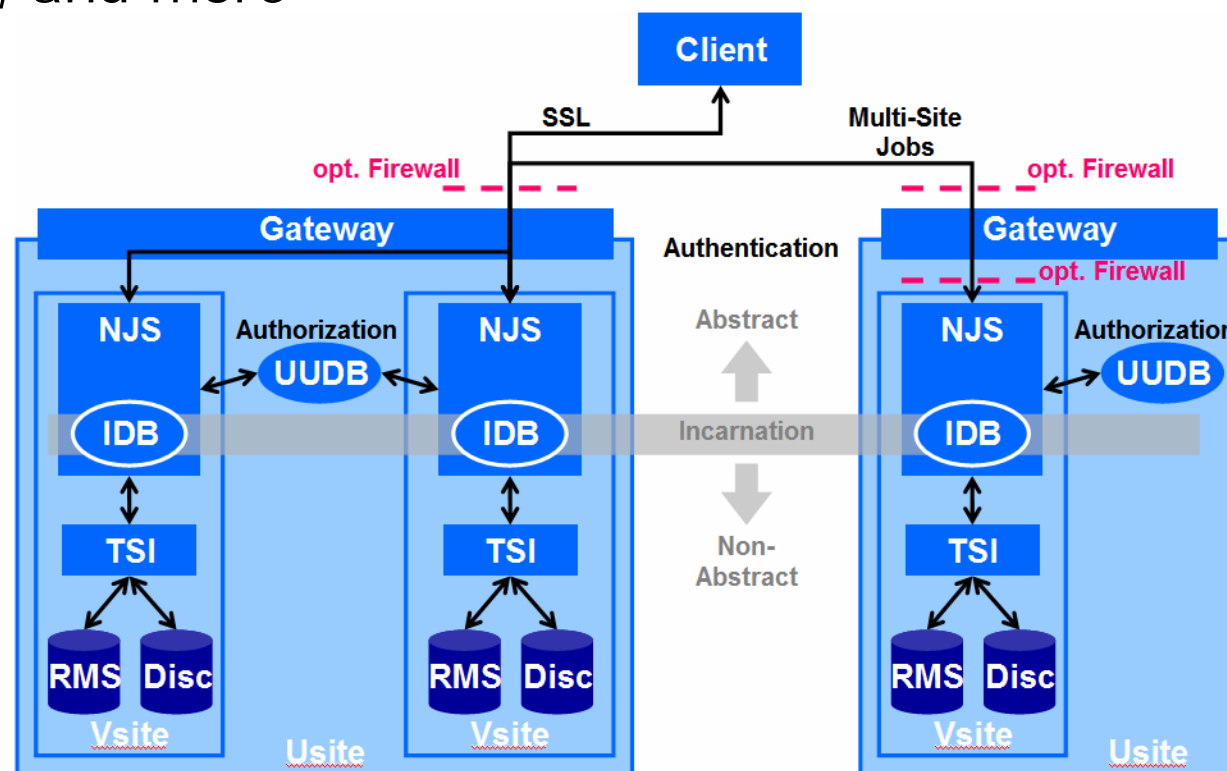


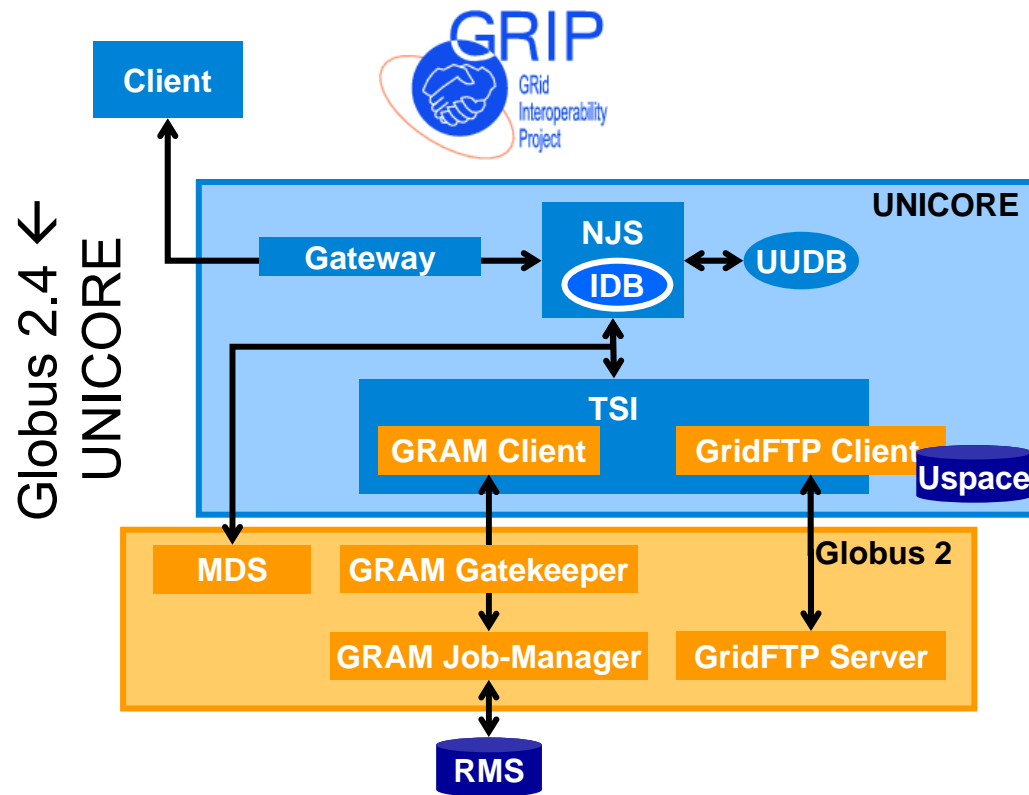
Courtesy Gridwise Technologies



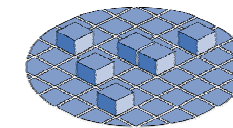
We have Grid Software, like **UNICORE**

- Seamless, secure, intuitive access to distributed resources & data
- Available as Open Source
- Features: intuitive GUI with single sign-on, X.509 certificates for AA, workflow engine for multi-site, multi-step workflows, job monitoring, application support, secure data transfer, resource management, and more
- In production

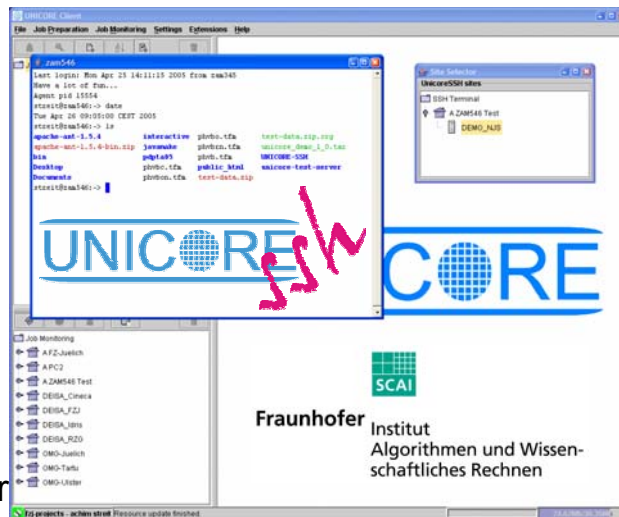
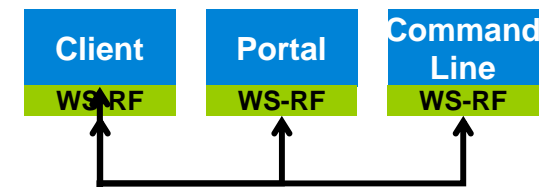




WS-Resource based
Resource Management
Framework for
dynamic resource information and
resource negotiation



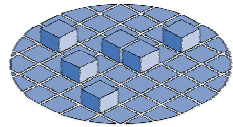
UniGrids



Unicon

Antipolis, Oc

Courtesy: Achim Streit, FZJ



UniGrids

Funded by EC grant IST-2002-004279

- Development of Next-Gen UNICORE
- WS-RF compliant UNICORE/GS
- Development of atomic and higher level services (visualization & steering, access remote devices)



- UNICORE as basic middleware for R&D
- Dvlpmt of UNICONDORE interoperability layer (UNICORE ↔ CONDOR)
- Access to 3000 CPUs with 17 TFlops peak in the NaReGI testbed



Funded by EC grant IST-508830

UNICORE



Forschungszentrum Jülich

SARA Computing and Networking Services, The Netherlands

Rechenzentrum Garching of the Max Planck Society, Germany

CSC Finnish Information Technology Centre for Science, Finland

Edinburgh Parallel Computing Centre, UK

European Centre for Medium-Range Weather Forecasts, UK

Institut du Développement et des Ressources en Informatique Scientifique, France

Consorzio Interuniversitario, Italy



- **Deployment and operation of a persistent, production ready, heterogeneous, multi-terascale European supercomputing environment based on UNICORE**
- **Access to about 11.000 CPUs with 110 TFlops**

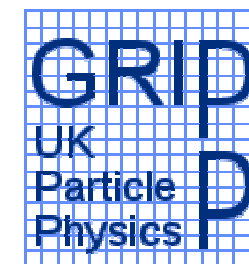
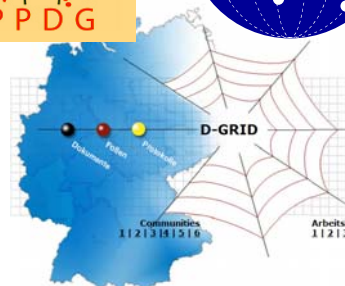
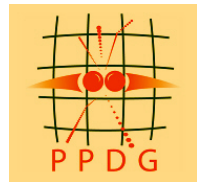
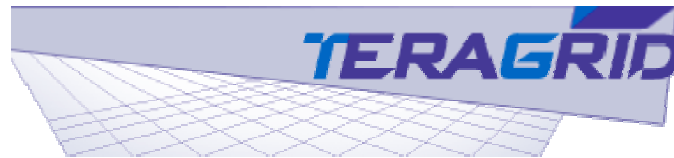
Courtesy: Achim Streit, FZJ



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#5: Global Grid Community:



#6: Projects/Initiatives Testbeds Companies

- BIRN
- Condor-G
- Daisa
- Dame
- EGA
- EnterTheGrid
- GGF
- Globus
- Globus Alliance
- GridBus
- GridLab
- GridPortal
- GRIDtoday
- GriPhyN
- I-WAY
- Knowledge Grid
- Legion
- MyGrid
- NMI
- OGCE
- OGSA
- OMII
- PPDG
- Semantic Grid
- TheGridReport
- UK eScience
- Unicore
- ...

- CO Grid
- Compute-against-Cancer
- D-Grid
- DeskGrid
- DOE Science Grid
- EEGE
- EuroGrid
- European DataGrid
- FightAIDS@home
- Folding@home
- GRIP
- NASA IPG
- NC BioGrid
- NC Startup Grid
- NC Statewide Grid
- NEESgrid
- NextGrid
- Nimrod
- Ninf
- NRC-BioGrid
- OpenMolGrid
- OptIPuter
- Progress
- SETI@home
- TeraGrid
- UniGrids
- Virginia Grid
- WestGrid
- White Rose Grid
- ...

- Altair
- Avaki
- Axceleon
- Cassatt
- Datasynapse
- Egenera
- Entropia
- eXludus
- GridFrastructure
- GridIron
- GridSystems
- Gridwise
- GridXpert
- HP Utility Data Center
- IBM Grid Toolbox
- Kontiki
- Metalogic
- Noemix
- Oracle 10g
- Parabon
- Platform
- Popular Power
- Powerllel/Aspeed
- Proxima
- Softricity
- Sun N1
- TurboWorx
- United Devices
- Univa
- ...

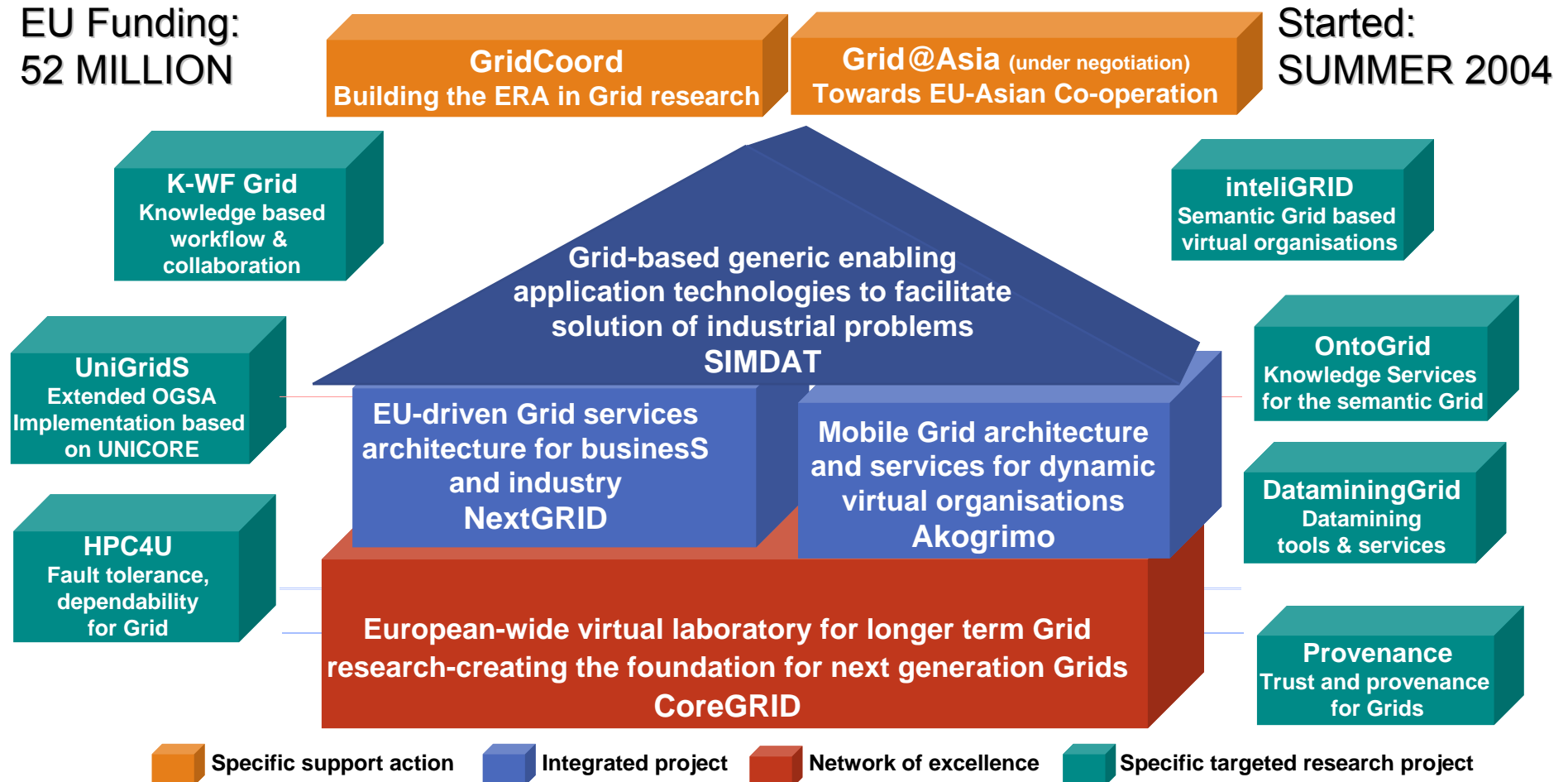


7: Funding:

Example: Grid Research Projects in EU FP6

EU Funding:
52 MILLION

Started:
SUMMER 2004

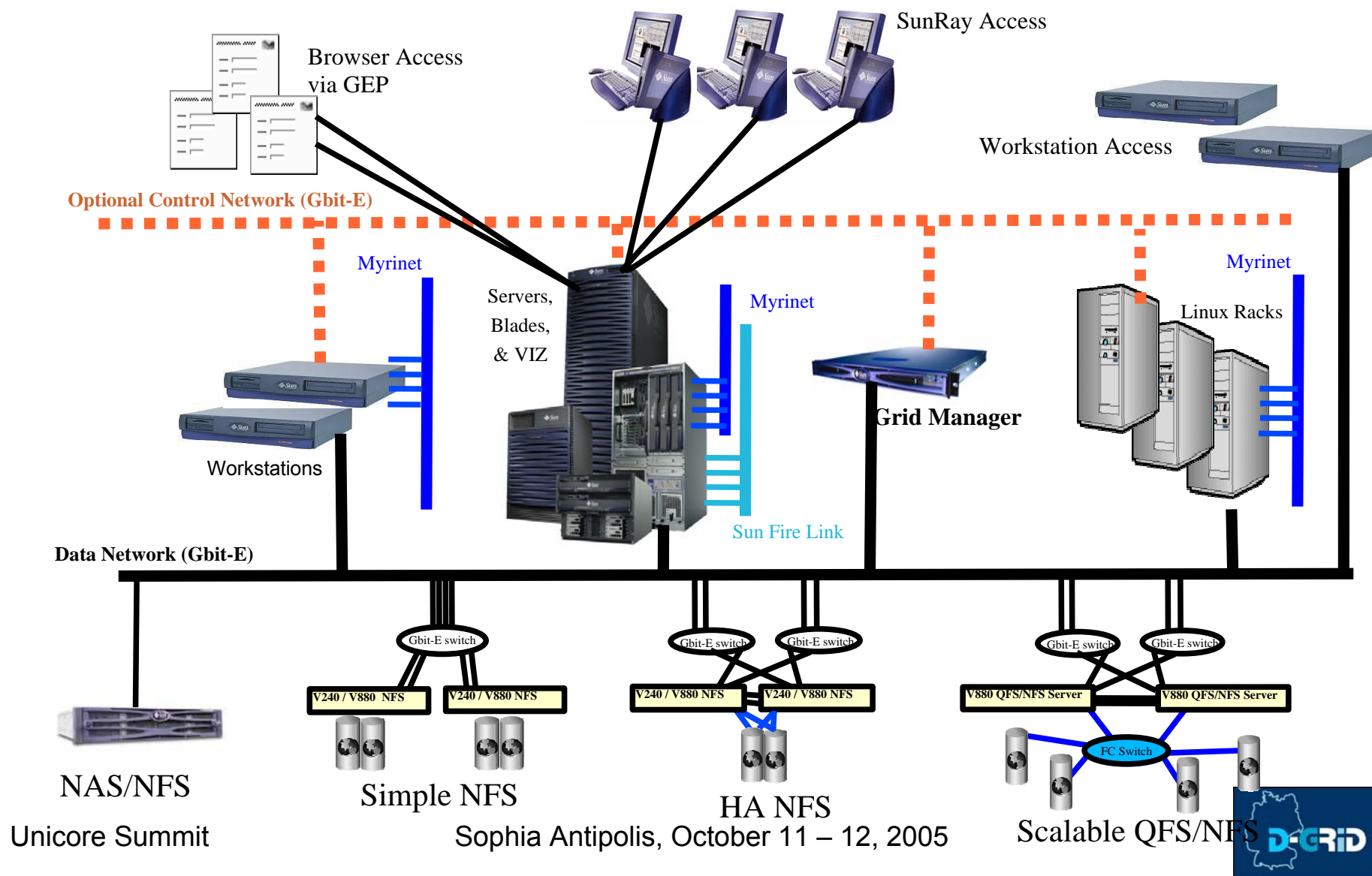


#8: EGA, Enterprise Grid Alliance, Founded in April 2004

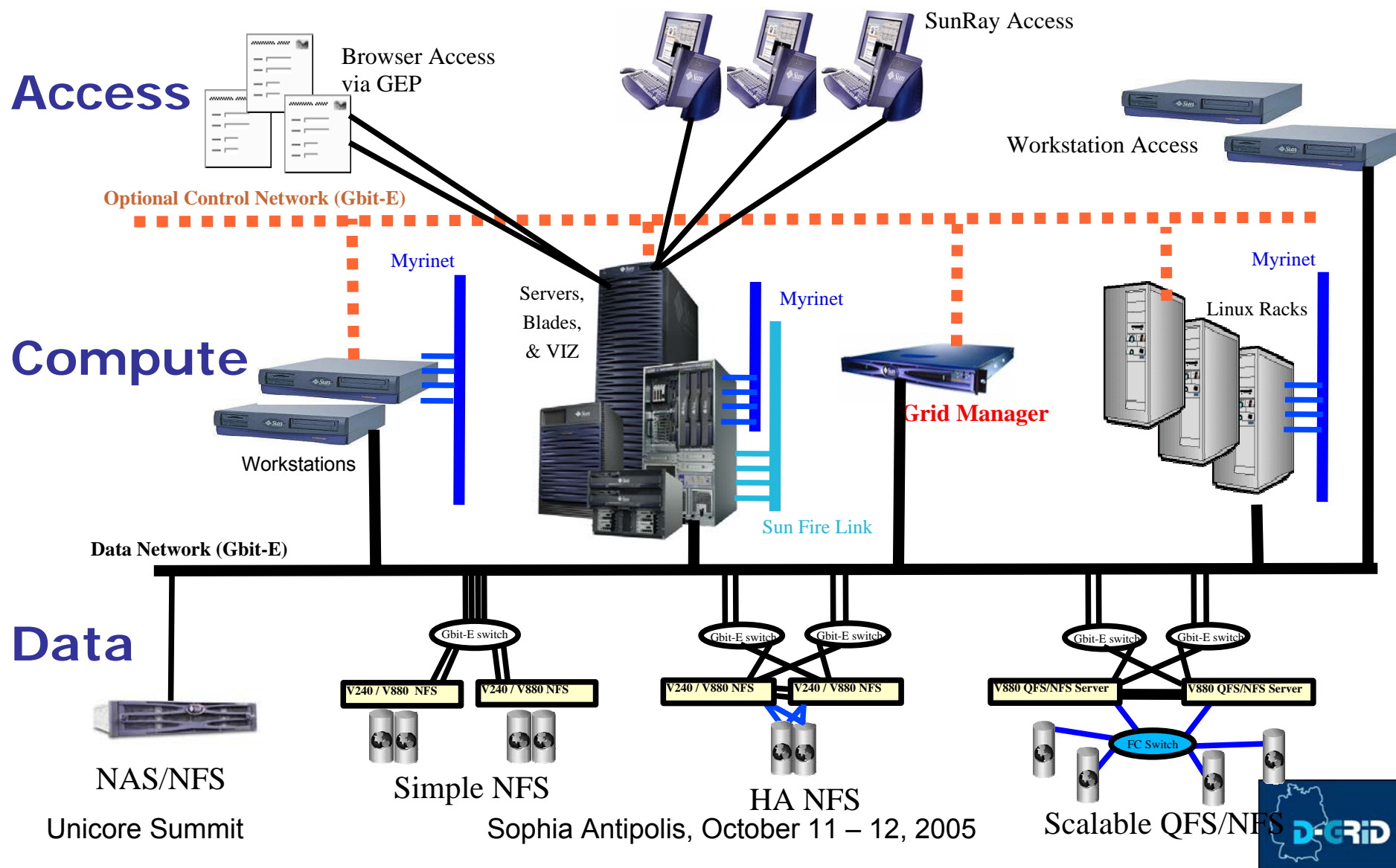
- Industry-driven consortium to implement standards in industry products and make them interoperable
- Founding members: EMC, Fujitsu Siemens Computers, HP, NEC, Network Appliance, Oracle and Sun, plus 20+ Associate Members
- First deliverable May 11, 2005:
Enterprise Grid Reference Model v1.0



Enterprise Grid Reference Architecture



Enterprise Grid Reference Architecture



#9: Globus Consortium, Founded in Jan 2005

- To advance Globus Toolkit that brings an open standards building block for enterprise grids
- Founding members: HP, IBM, Intel, Sun, Univa
- Providing resources and direction on the technology roadmap for the Globus Toolkit by defining specifications and requirements



#10: 1000s of Grids in Research and Industry

• Life Sciences

- Startup and cost efficient
- Custom research or limited use applications
- Multi-day application runs (BLAST)
- Exponential Combinations
- Limited administrative staff
- Complementary techniques

• Electronic Design

- Time to Market
- Fastest platforms, largest Grids
- License Management
- Well established application suite
- Large legacy investment
- Platform Ownership issues

• Financial Services

- Market simulations
- Time IS Money
- Proprietary applications
- Multiple Platforms
- Multiple scenario execution
- Need instant results & analysis tools

• High Performance Computing

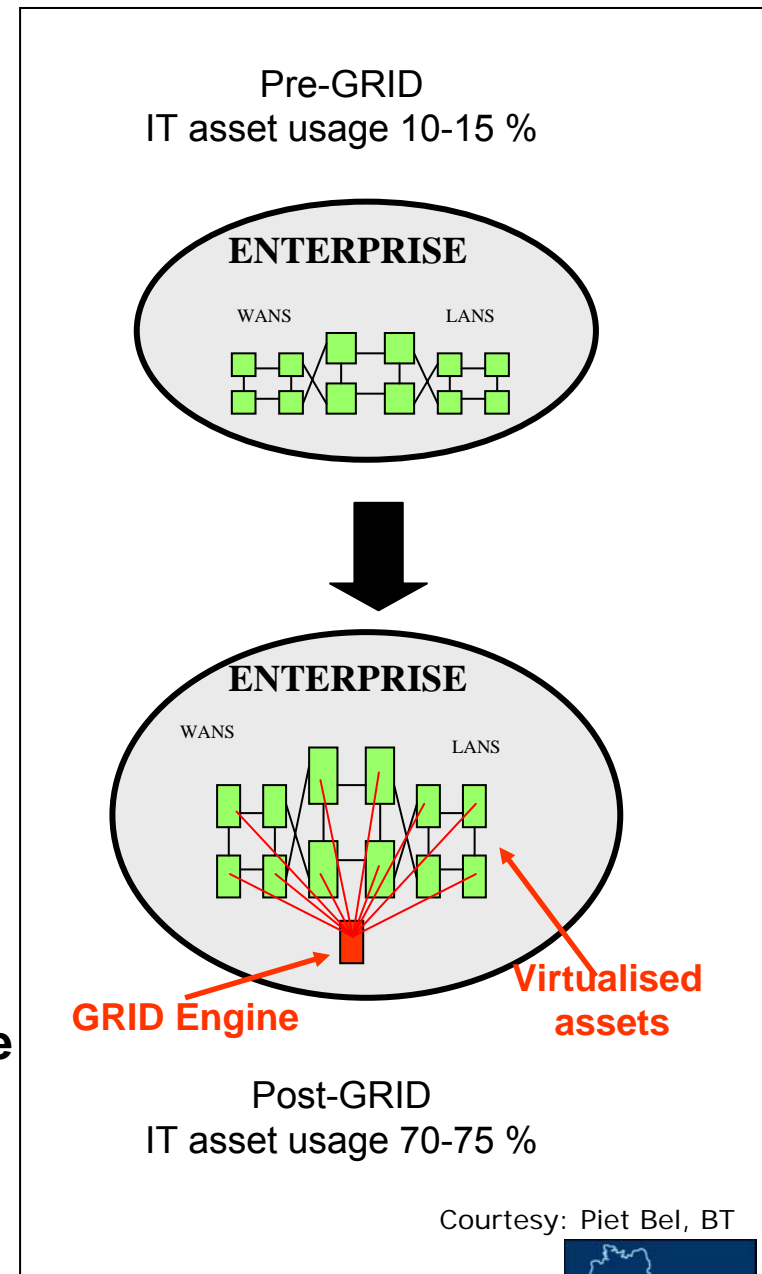
- Parallel Reservoir Simulations
- Geophysical Ray Tracing
- Custom in-house codes
- Large scale, multi-platform execution

#11: Grid Service Provider, BT

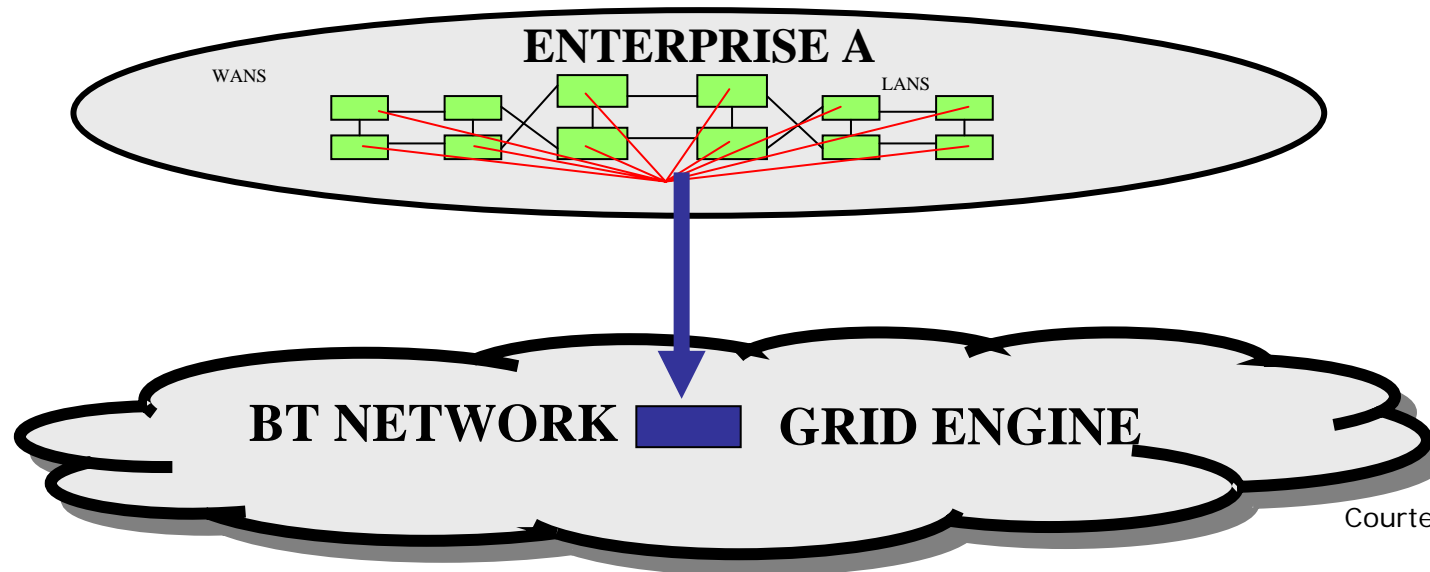
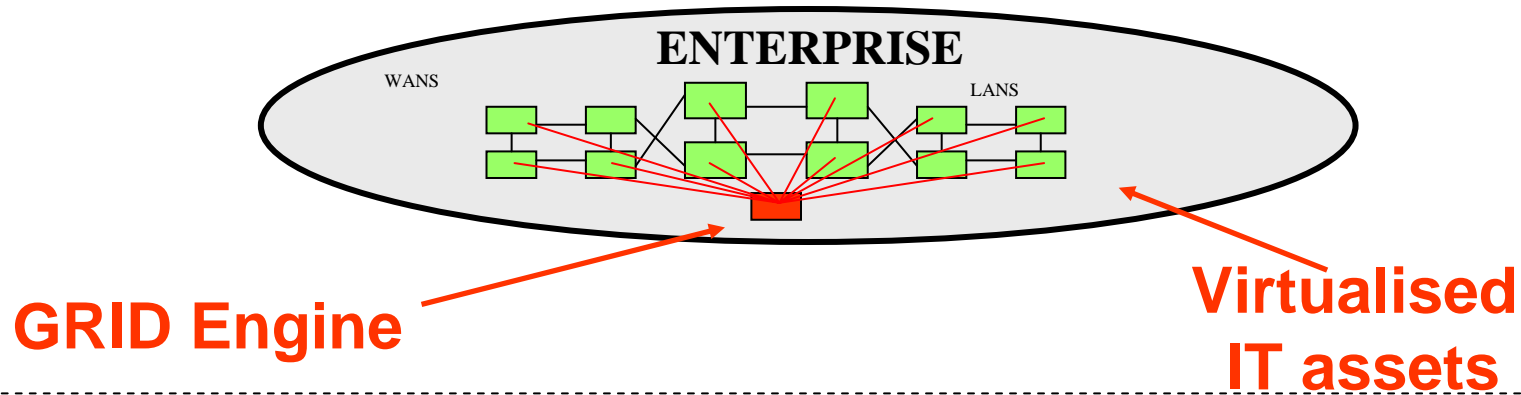
- Inside data center, within Firewall
- Virtual use of own IT assets
- The GRID virtualiser engine inside Firewall:
 - Opens up under-used ICT assets
 - improves TCO, ROI and Apps performance

BUT

- Intra-enterprise GRID is self limiting
 - **Pool of virtualised assets is restricted by firewall**
 - **Does not support Inter-Enterprise usage**
- BT is focussing on managed Grid solution



BT's Virtual Private Grid (VPG)



Courtesy: Piet Bel, BT

#12: Worldwide IT Spending, 2005 -2010 (\$Billions)

2005	2006	2007	2008	2009	2010	CAGR
\$962.5	\$1,017.9	\$1,078.9	\$1,143.7	\$1,212.3	\$1,285.0	5.9%

Note: Changes to least significant digit across the tables in this chapter are due to rounding.

Worldwide Grid Spending, 2005 -2010 (\$ Billions)

2005	2006	2007	2008	2009	2010	CAGR
\$0.714	\$1.839	\$3.893	\$8.510	\$12.216	\$19.277	93%

Note: Grid Industry segmentations include: Healthcare, Construction, Retail Trade, Wholesale Trade, Education, Soc. Svcs & Member Org., Finance, Insurance and Real Estate, Prof. Business Svcs, Hotel & Lodging, Transportation, Communications, Utilities, Entertainment and Media, Durable Manufacturing, Non-durable Manufacturing and Other.



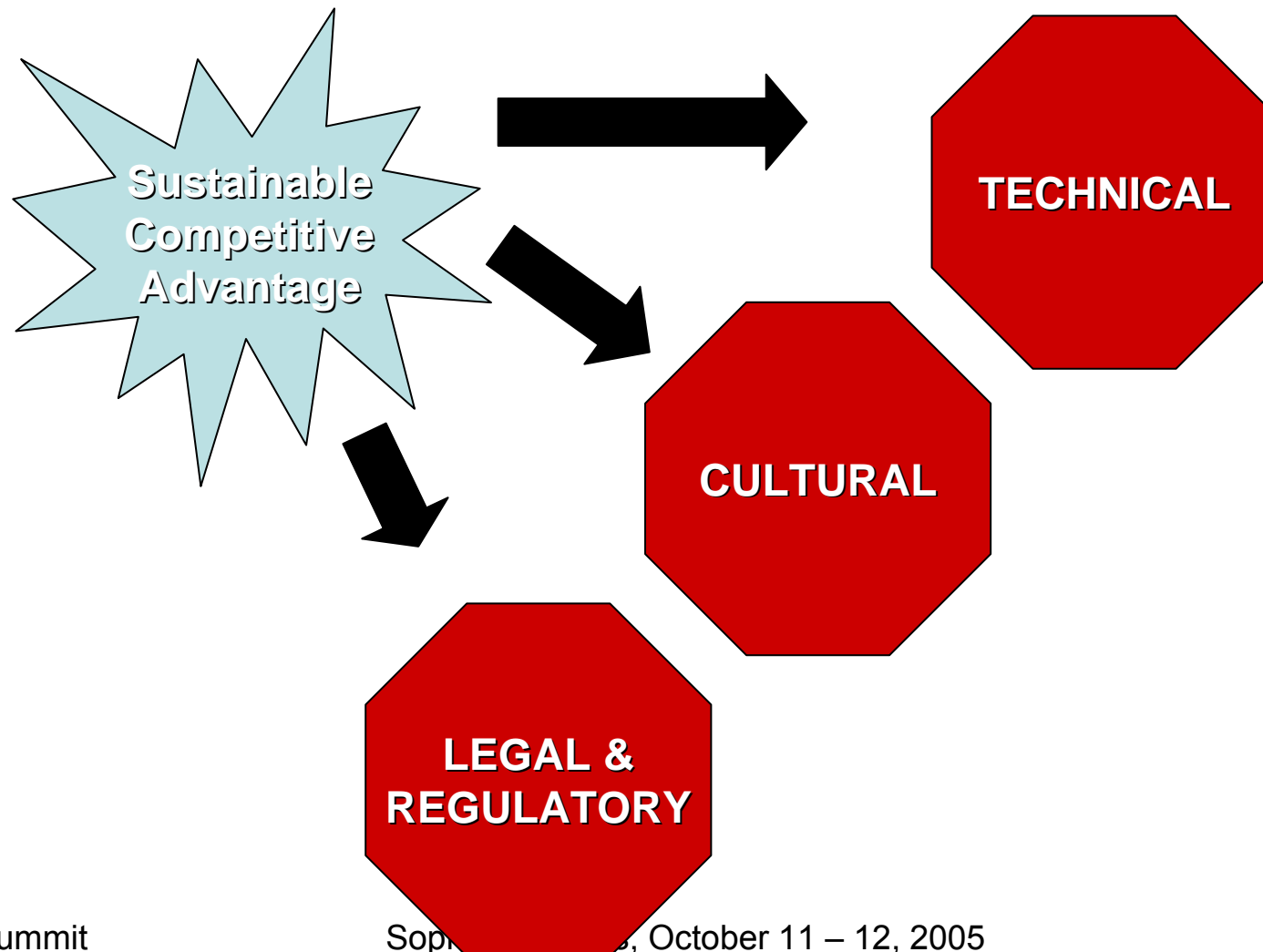
www.insight-corp.com



Business Challenges and Potential Grid Solutions



Some Grid Challenges Ahead



Business Challenges, Potential Grid Inhibitors

- Difficult to differentiate reality from hype
- Sensitive data, sensitive applications (medical patient records)
- Different organizations have different ROI
- Accounting, who pays for what (sharing!)
- Security policies: consistent and enforced across the grid !
- Lack of standards prevent interoperability of components
- 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)



Business Challenges, Potential Grid Inhibitors

- Difficult to differentiate reality from **hype**
- **Sensitive data**, sensitive applications (medical patient records)
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- SLAs based on open source (**liability**?)
- “Static” **licensing** model don’t embrace grid
- Protection of **intellectual property**
- **Legal** issues (FDA, HIPAA, multi-country grids)



Grid Adoption in Business

- ❑ Think big, start small (be a visionary and a realist)
- ❑ Grid is a good opportunity to revisit existing IT infrastructure
- ❑ Look for comparable success stories and use case analyses
- ❑ Identify gaps, problems, concerns, ... Can grids help ?
- ❑ Find out in talking/listening to your users / customers !
- ❑ Build YOUR list of grid business benefits and inhibitors
- ❑ Create awareness -> training -> testbed (6 wks – 6 months)
- ❑ Get help from Grid Service Providers
- ❑ Get buy-in from upper management
- ❑ Eventually, evolve from testbed into production



Grid Vision

The next 5 years...



Industry is on a Journey

Old World

Static

Silo

Physical

Manual

Application



New World

Dynamic

Shared

Virtual

Automated

Service

Transitioning from **Silo Oriented Architecture**
to
Service Oriented Architecture

The Vision :

The Three Waves of Grid Computing

2000



The Research Wave

**Technology, Prototypes
Virtual Organizations
Standards
GGF, IETF, OASIS**

GCNS: "Awareness Creation"

2005



The Industry Wave

**Grid-Enabled Products
Enterprise Solutions
Interoperability
GGF, EGA, IETF, OASIS**

GCNS: "Easy Access"

2010



The Consumer Wave

**Commodity
IT Utility
Integration
Legal, Ethical, Political Orgs**

GCNS: "Grid Service Provider"

Finally: Anyone, anywhere, anytime, any device, connected to The Grid



- Integration of new devices, data and information sources: e.g. Cell phones, PDAs, smart sensors, sensor arrays, health monitors
- Devices embedded in cars, engines, roads, bridges, clothes,...
- Handle huge amount of data for real-time analysis
- Policies, grid economy, to maintain stability and efficiency
- Bridges political, organizational, societal boundaries

Finally:
Anyone, anywhere,
anytime, any device,
connected to The Grid



**...enabling 'equal opportunity' for our fellow citizens
in urban and rural areas alike, all over the world**

**Improve education
Reduce poverty
Create jobs**

Thank You !

