



Grid Computing: An Industry View

Vision, Strategy, Software, Examples

Wolfgang Gentzsch

Director Grid Computing

Sun Microsystems Inc



We make the net work.

Agenda

- **Grid Computing: Vision & Strategy**
- **Architecture Building Blocks**
- **Examples: Grids & Partner Projects**
- **N1, the Network Operating System**
- **The Big Picture: Grid - N1 - Web Services**

Our Vision: The Grid: Computing as a Utility

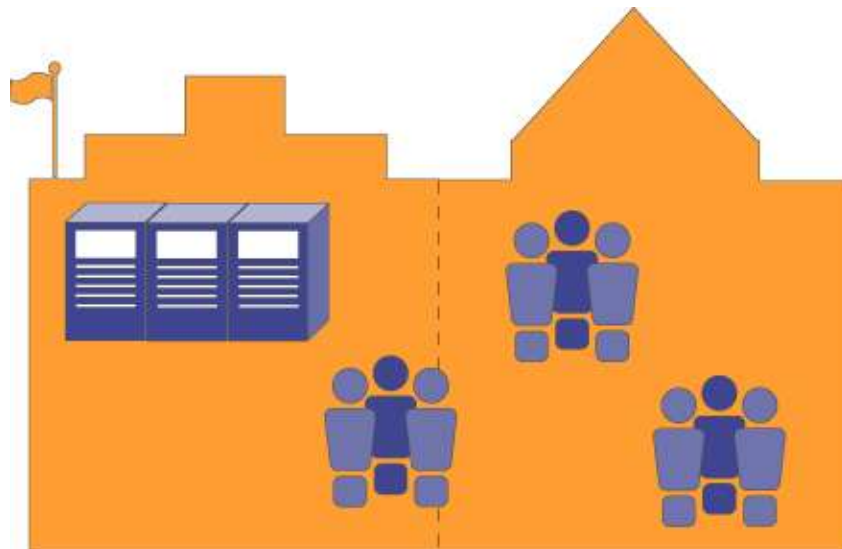
**Electricity, Water, Telephony,
Computing** What's a Utility?

- **You get what you need, when you need it**
- **You don't care where it comes from, and how**
- **You pay as you go, for what you used**

How Grids Help

- **Access:** seamless, transparent, remote, secure, wireless access to computing, data, sensors, experiments, instruments . . .
- **Virtualization:** access to compute/data services, not servers
- **On Demand:** get resources you need, when you need them
- **Sharing:** enable collaboration over the network
- **Failover:** migrate and restart applications automatically
- **Heterogeneity:** platforms, operating systems, devices, software
- **Utilization:** increase resource utilization, from 20% to 80+%
- **... and more !**

HPC Grids vs Commercial Grids



HPC Research & Engng Grids

- High Performance
- High Performance
- High Performance
- Collaboration
- Communication

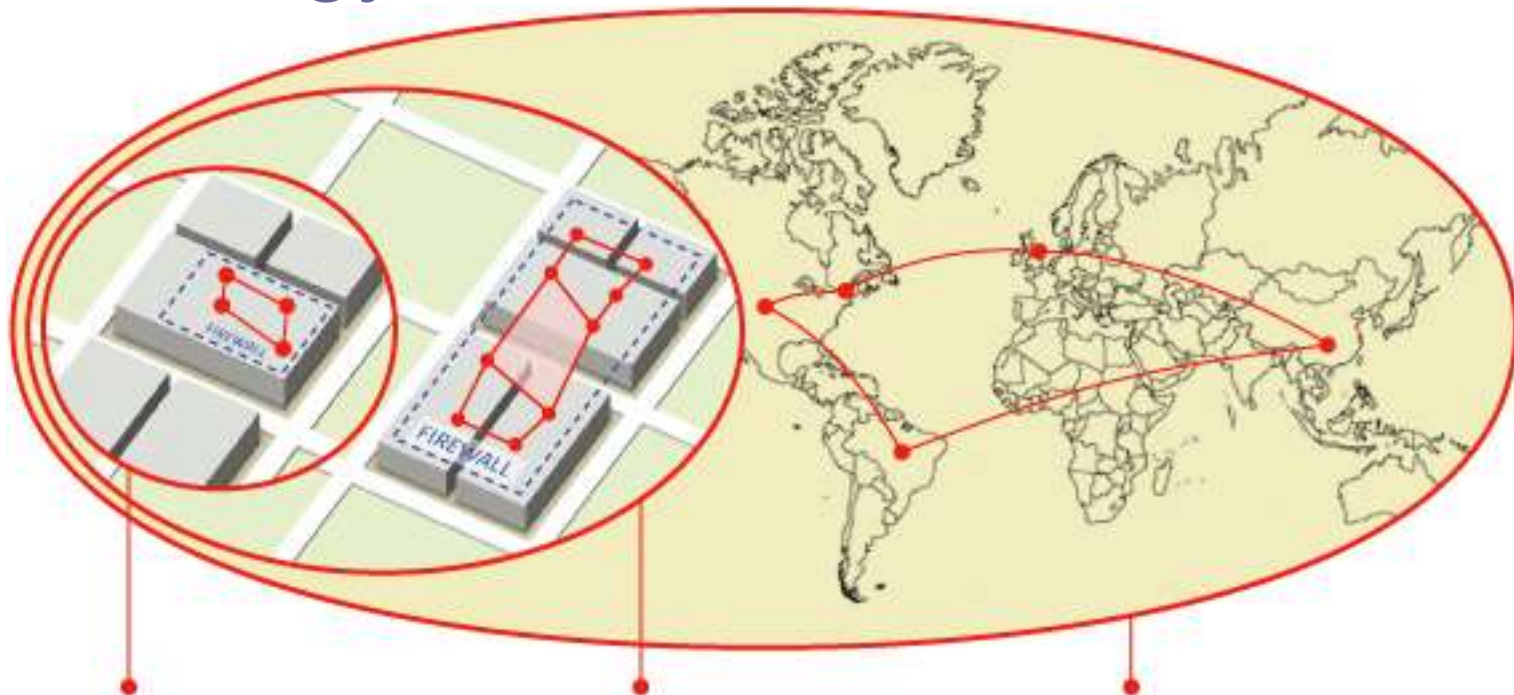
Commercial Grids

- ...
 - Scalability
 - Manageability
 - Availability
 - Reliability
 - Transparency
- | > SMART

Technical vs Commercial Grids

- raw performance
- downtime acceptable
- proprietary solutions
- low integration
- focus on computation
- software niche players
- no strict economics constraints
- mature market
- Performance, robustness, manageability, availability
- downtime unacceptable
- purchased applications, standardized solutions
- tightly integrated with other enterprise systems
- focus on databases and transactions
- enterprise software
- demands quantifiable ROI
- market mostly unknown, on the verge of strong growth

Our Evolutionary Grid Strategy



Cluster Grid Departmental Computing

- Simplest Grid deployment
- Maximum utilization of departmental resources
- Resources allocated based on priorities

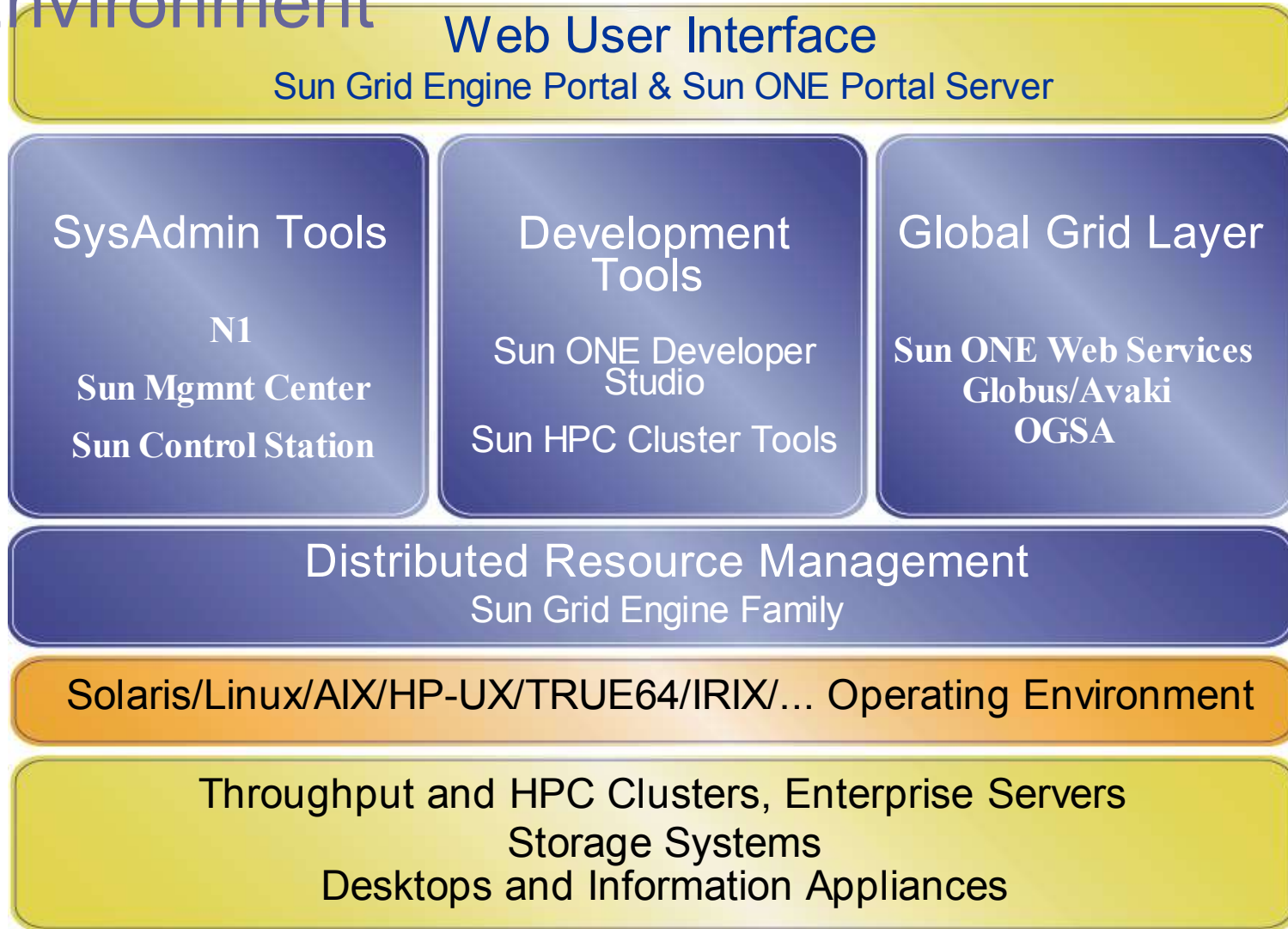
Enterprise Grid Enterprise Computing

- Resources shared within the enterprise
- Policies ensure computing on demand
- Gives multiple groups seamless access to enterprise resources

Global Grid Internet Computing

- Resources shared over the Internet
- Global view of distributed datasets
- Growth path for enterprise Grids

Example: Sun Grid Services Environment



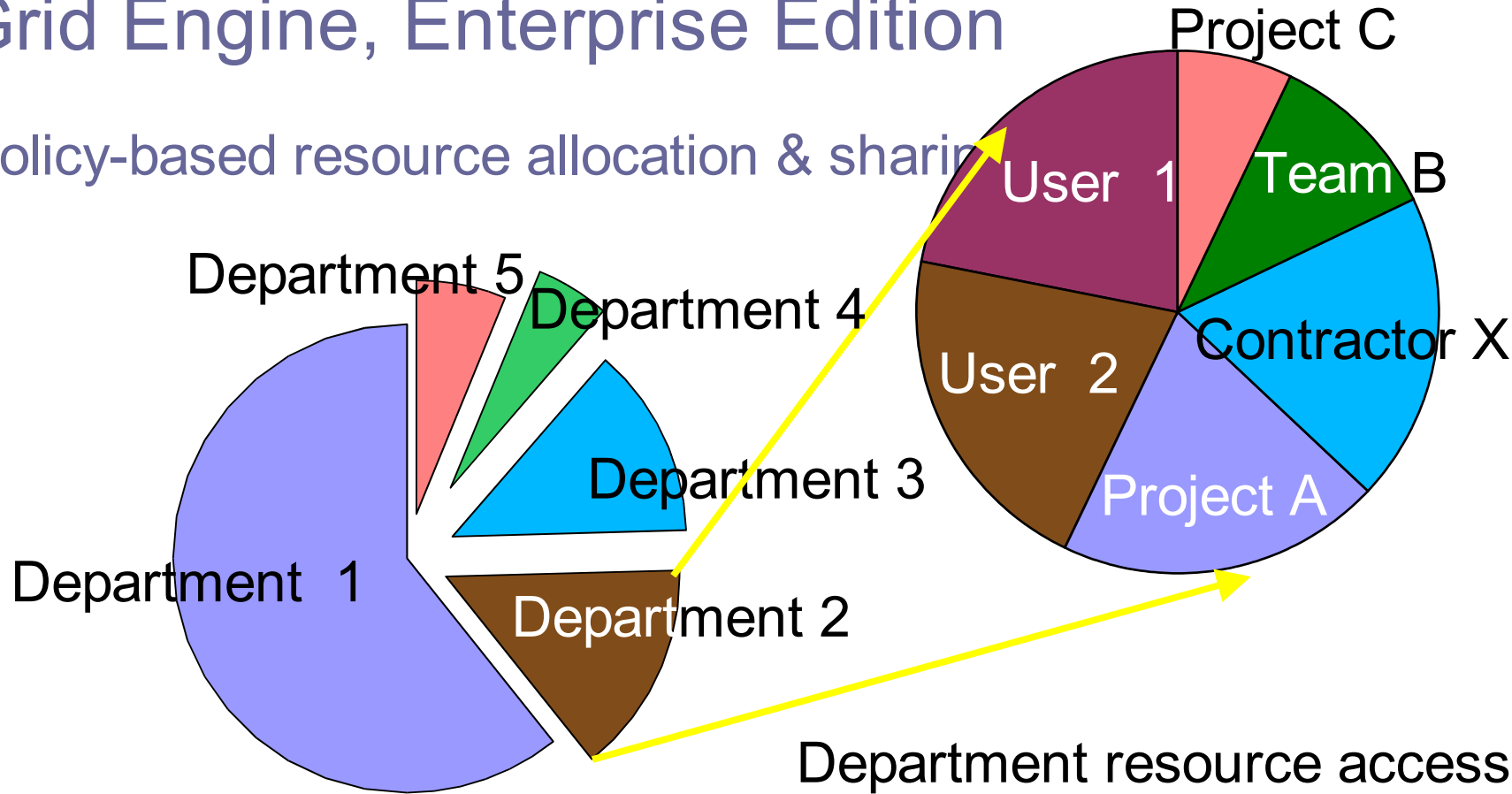
Sun Grid Engine Family

Distributed Resource Management in Cluster & Enterprise Grids

- **Multi-platform, open source, standards**
 - 7000+ grids today (departmental, enterprise, global grids), 51% Solaris, 25% Linux, 24% Mix
- Sun Grid Engine, **SGE**, free Web downloads for Solaris & Linux
 - **Identifies** best-suited, least loaded resource for your work
 - Queuing, prioritizing, scheduling
- Sun Grid Engine, Enterprise Edition
 - Equitable, enforceable **sharing** between groups and projects
 - Alignment of resources with business goals via **policies**

Managing Grid Resources: Grid Engine, Enterprise Edition

Policy-based resource allocation & sharing



Campus wide resource demand

The Portal: Access to Grid and Web Services

Key Services...

Aggregated for...

Targeted Communities



Employees

Suppliers

Partners

Customers

Portal prototype
"open source"

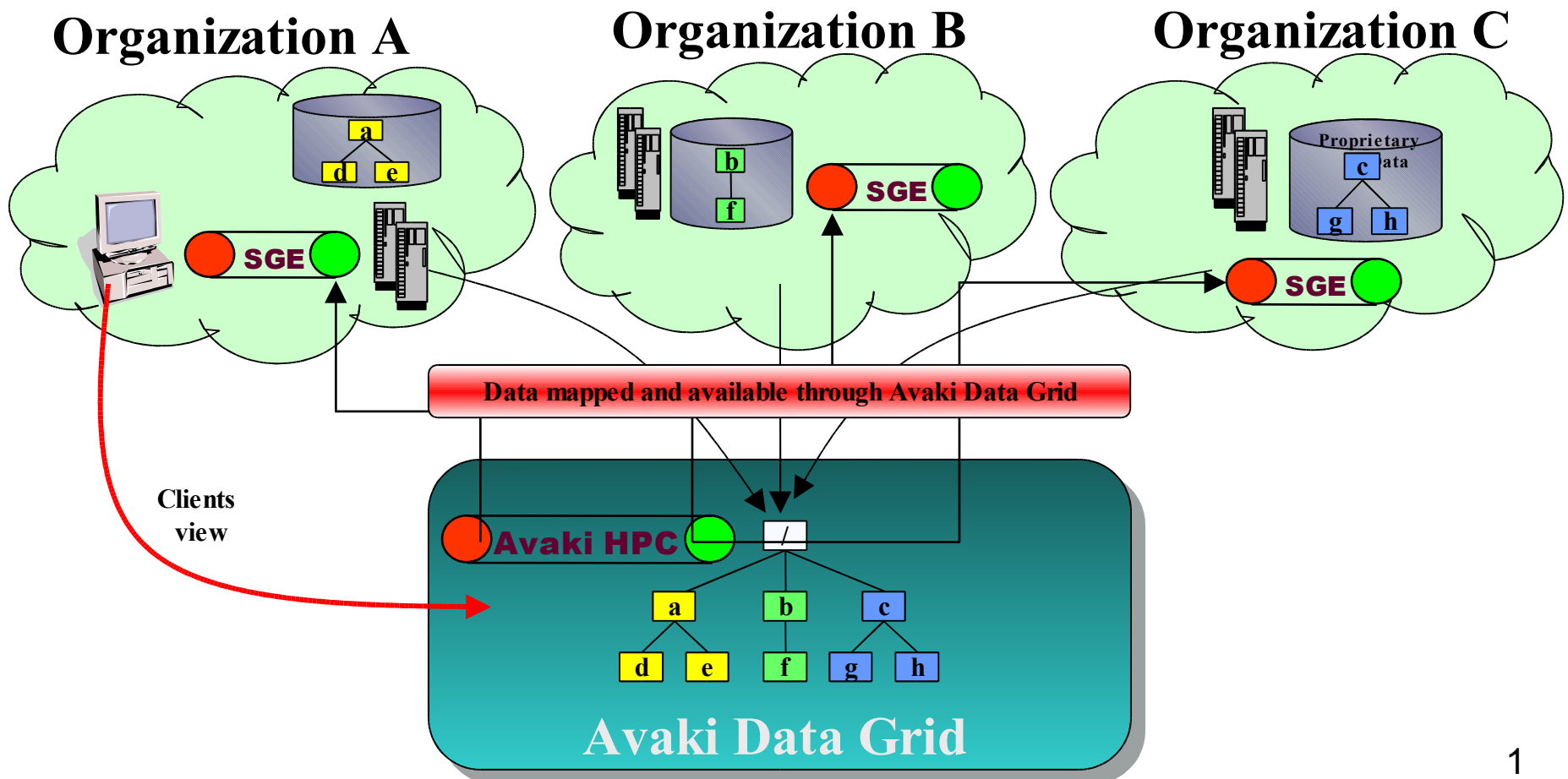


**Sun ONE
Portal
Server**

Globus & Avaki over multiple Grid Engine Clusters



- 1 SGE cluster mgmnt within an admin domain & file system area
- 2 Globus/Avaki knits together resources, handles files, binary management, and high level resource selection



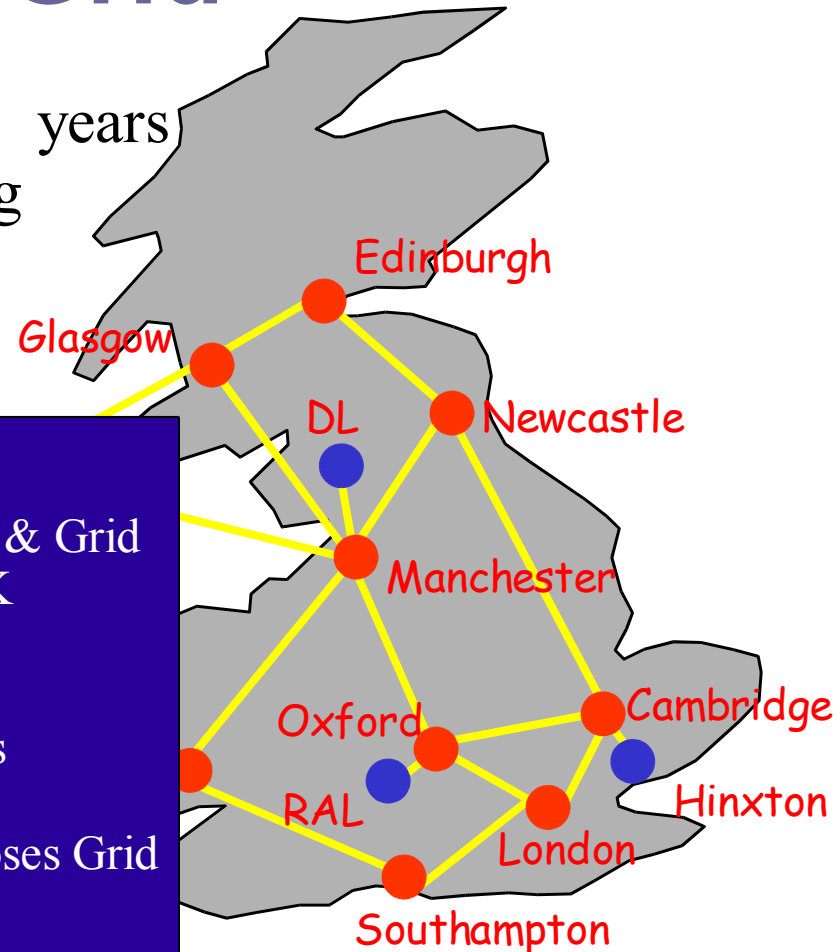
UK e-Science Grid

\$ 180 & 180 Mio in 3 & 3 years
for science and engineering

Our Grid Centers in UK:

Edinburgh EPCC, Sun CoE HPC & Grid
Cambridge, 2TeraFlops 10 SF15K
Oxford, Computational Finance
London IC, Sun CoE e-Science
London UCL, Sun CoE Networks
Manchester, MyGrid (BioGrid)
Leeds, Sheffield, York: White Roses Grid
Durham: Cosmology Engine Grid

....



Applications for The Grid

- **Single-CPU Jobs:** jobmix, many users, many serial applications, suitable for grid (e.g in universities and research centers)
- **Array Jobs:** 100s/1000s of jobs, one user, one serial application, varying input parameters, suitable for grid (e.g. parameter studies in Optimization, CAE, Genomics, Finance)
- **Massively Parallel Jobs:** one job, one user, one parallel application, no/low communication, scalable, fine-tune for grid (time-explicit algorithms, film rendering, pattern recognition)
- **Parallel Jobs:** one job, one user, one parallel application, high interprocs communication, not suitable for distribution over the grid, but for parallel system in the grid (time-implicit algorithms, direct solvers, large linear algebra equation systems)

Example: White Rose Grid in England

- Leeds, York + Sheffield Universities
- Deliver stable, well-managed HPC resources supporting multi-disciplinary research
- Deliver a Metropolitan Grid across the Universities



UNIVERSITY OF
LEEDS

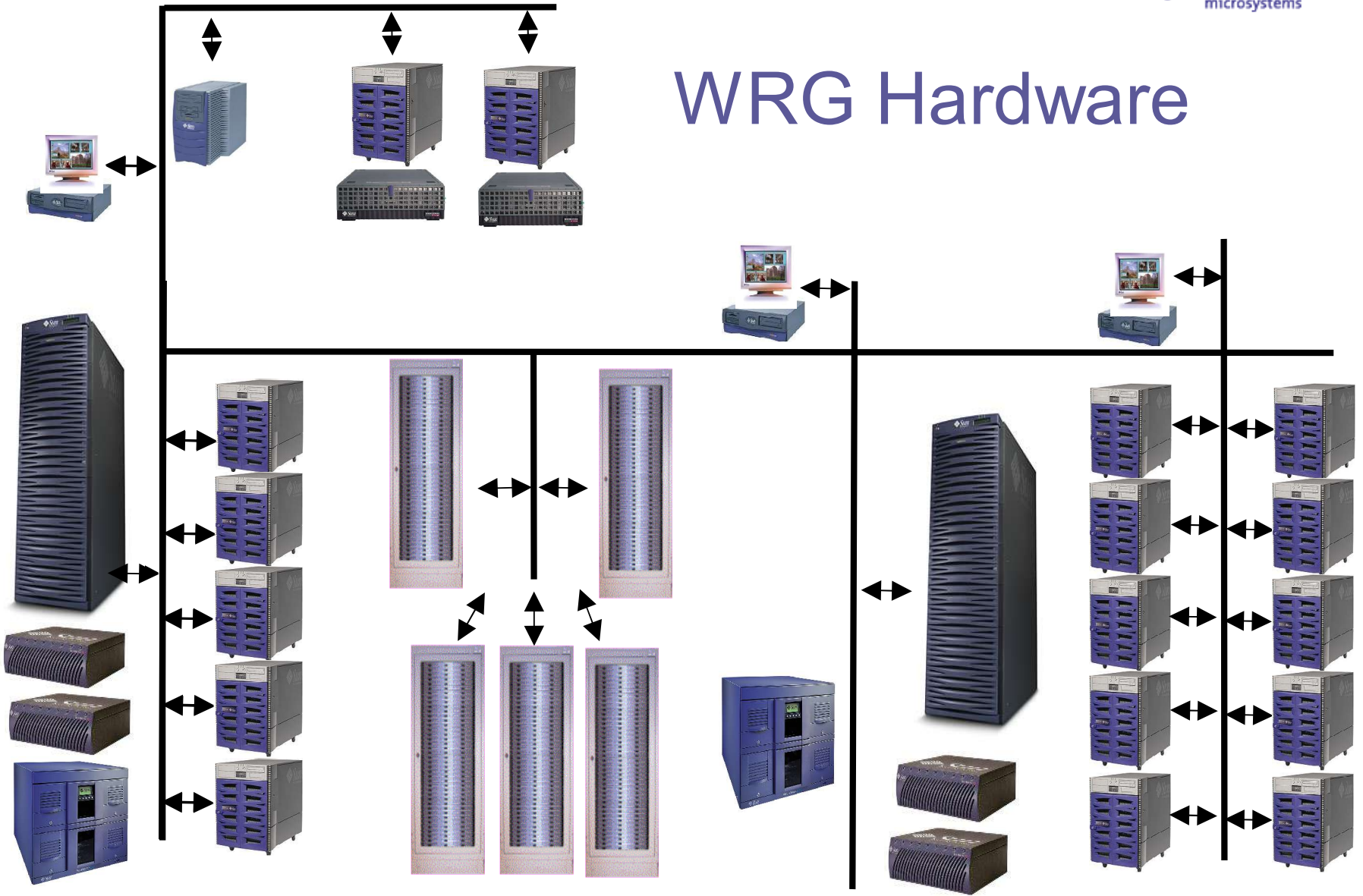


UNIVERSITY OF
SHEFFIELD



UNIVERSITY OF
YORK

WRG Hardware



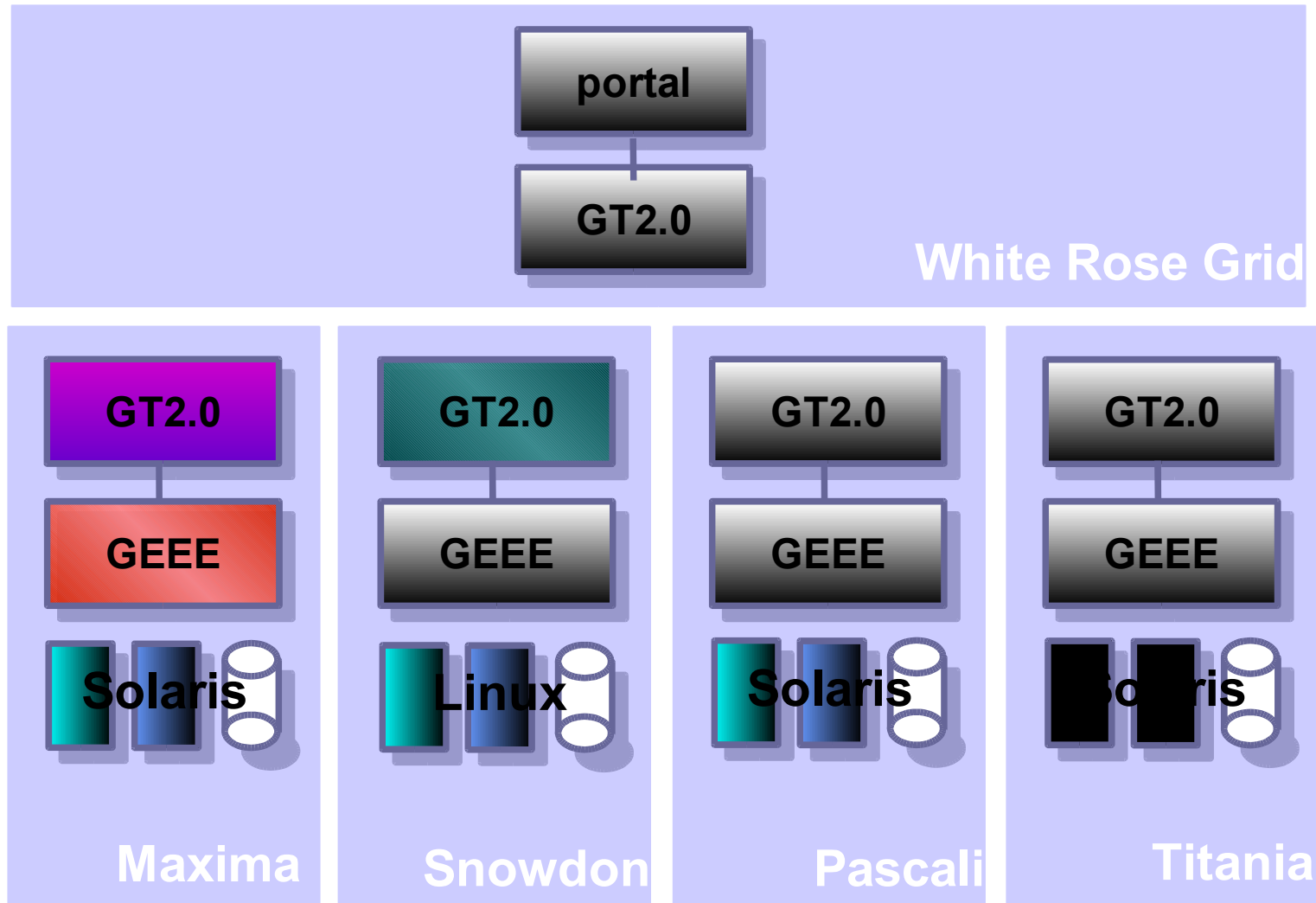
Maxima

Snowdon

Pascali

Titania

WRG Architecture Overview



WRG Key Components

- **Globus Toolkit 2.0**

Provides a **secure** means for inter-campus actions

- Transferring jobs
- Moving data
- Gathering information about resources

- **Grid Engine Enterprise Edition**

Manages the campus grid compute resources

- Delivers a single interface for a heterogeneous grid
- Guarantees a share of campus resource for grid and local users

WRG Key Components

- **Grid Portal Development Kit**

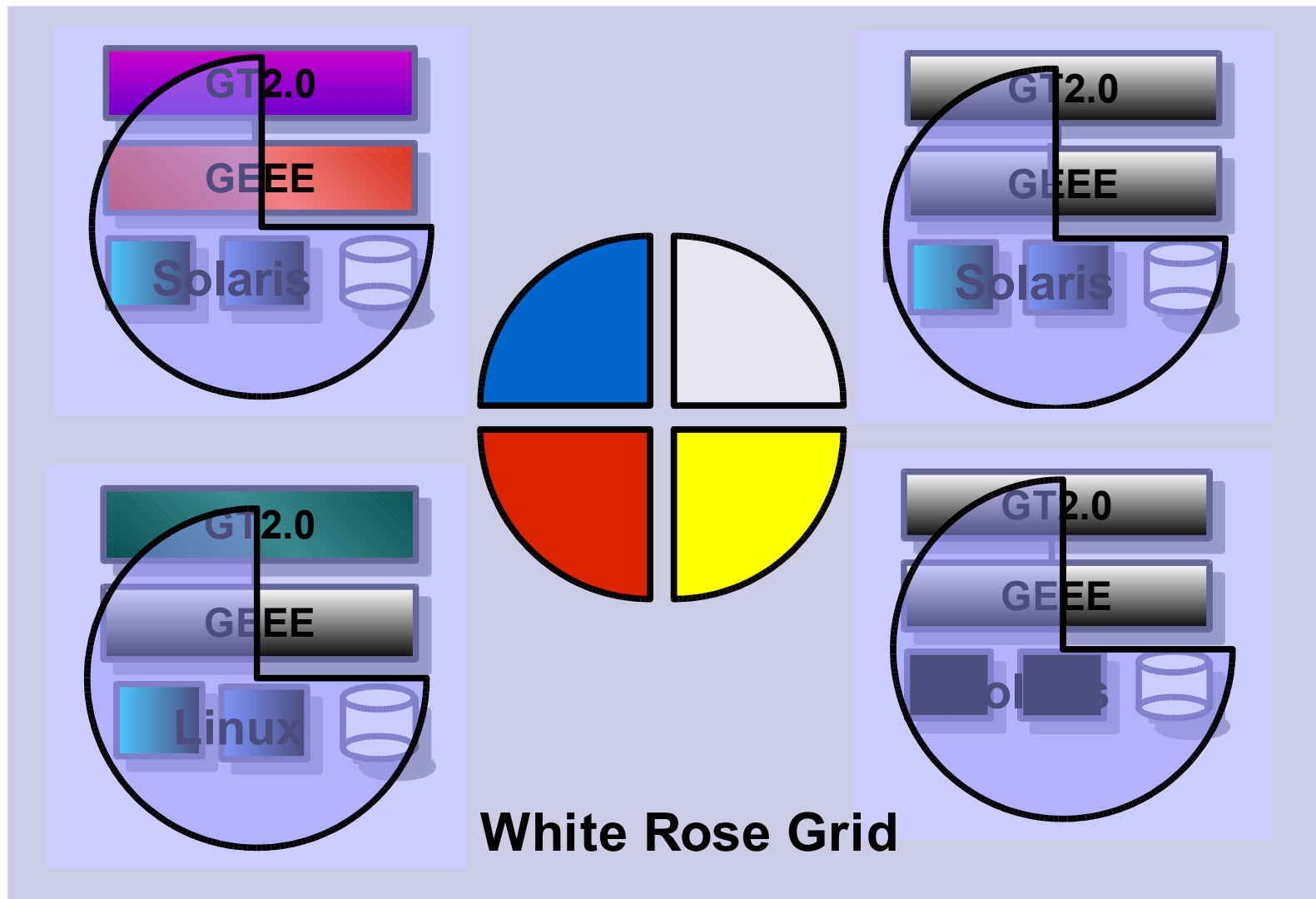
Provides a portal interface into Globus Toolkit

- Transferring jobs
- Moving data
- Gathering information about resources

- **MyProxy**

MyProxy provides a server with client-side utilities to store and retrieve delegated X.509 credentials via the Grid Security Infrastructure (GSI).

Grid Engine Enterprise Edition, Share Policies



Our Grid Partner Projects, Examples

- **ICENI**, Imperial College e-Science Netw. Infrastructure, London
- **GRIDS**, Grid Computing & Distributed Systems Lab, Melbourne
- **EZ-Grid**, Sun Center of Excellence for Grid Computing, Houston
- **White Rose Grid**, Universities of Leeds, Sheffield, York, UK
- **NCSV**, Nanyang Center for Supercomp.& Visualization, Singapore
- **EPCC** Edinburgh Sun Data & Compute Grid Project
- **HPCVL** Canada, Secure innovative HPC/Grid environment
- **GridLab** European Project for Grid Application Infrastructure
- **myGrid** Infrastructure for an e-Biologist Workbench, Manchester
- **OSC Grid**, Sun Center of Excellence for BioInformatics, Ohio
- **AIST** Advanced Industrial Science & Technology Institute, Tokyo
- and . . .
- many . . .
- more . . .

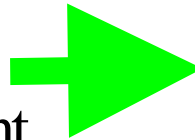
The Grid increases Complexity !

What we did inside
the F15K box...



Solaris

- Domains
- Interdomain resource mgmt
- Routing
- “Soft cabling” within the box



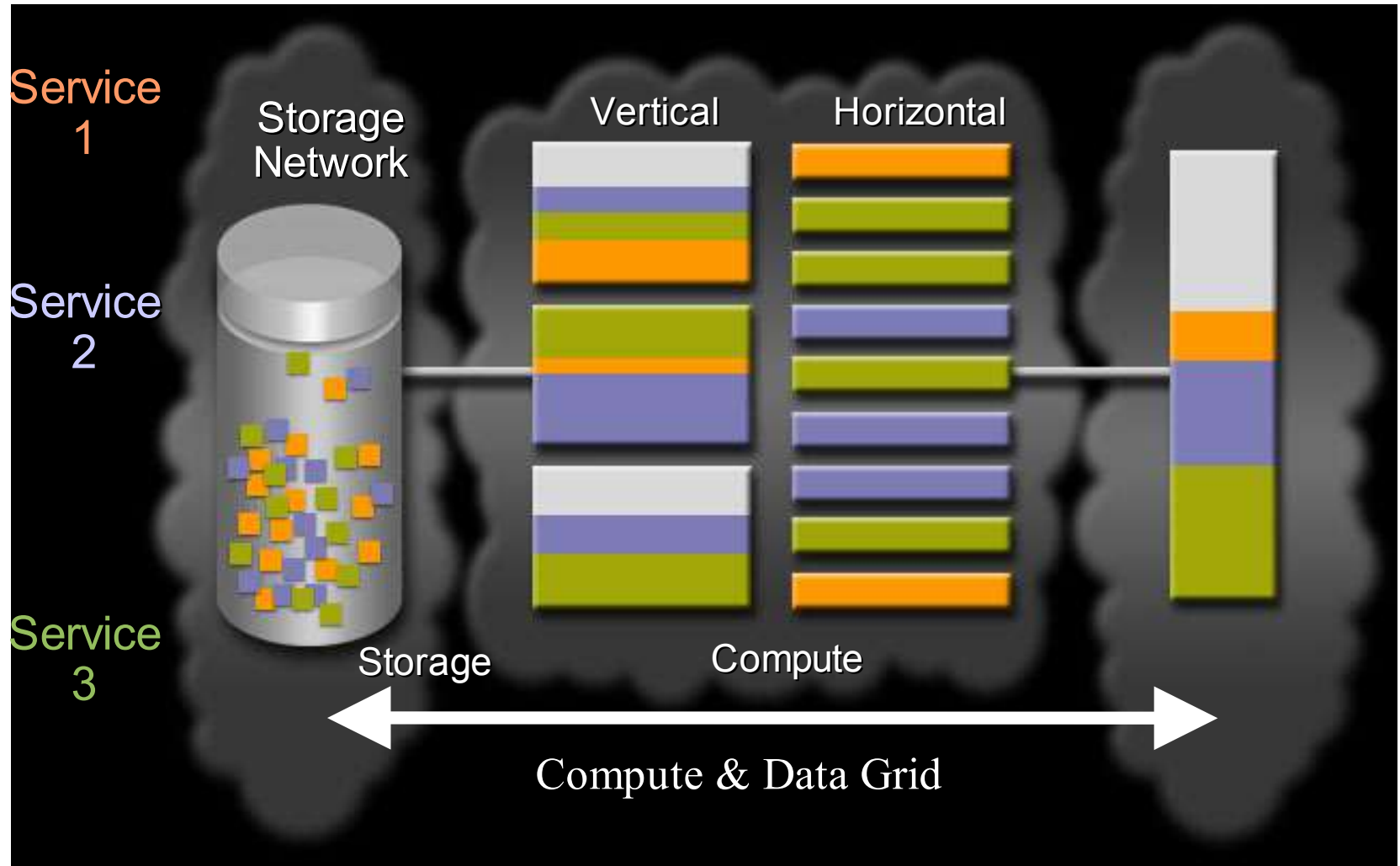
...we are now doing
to the network



N1

**N1: The Network Operating System
For The Datacenter**

Virtualization of Resources

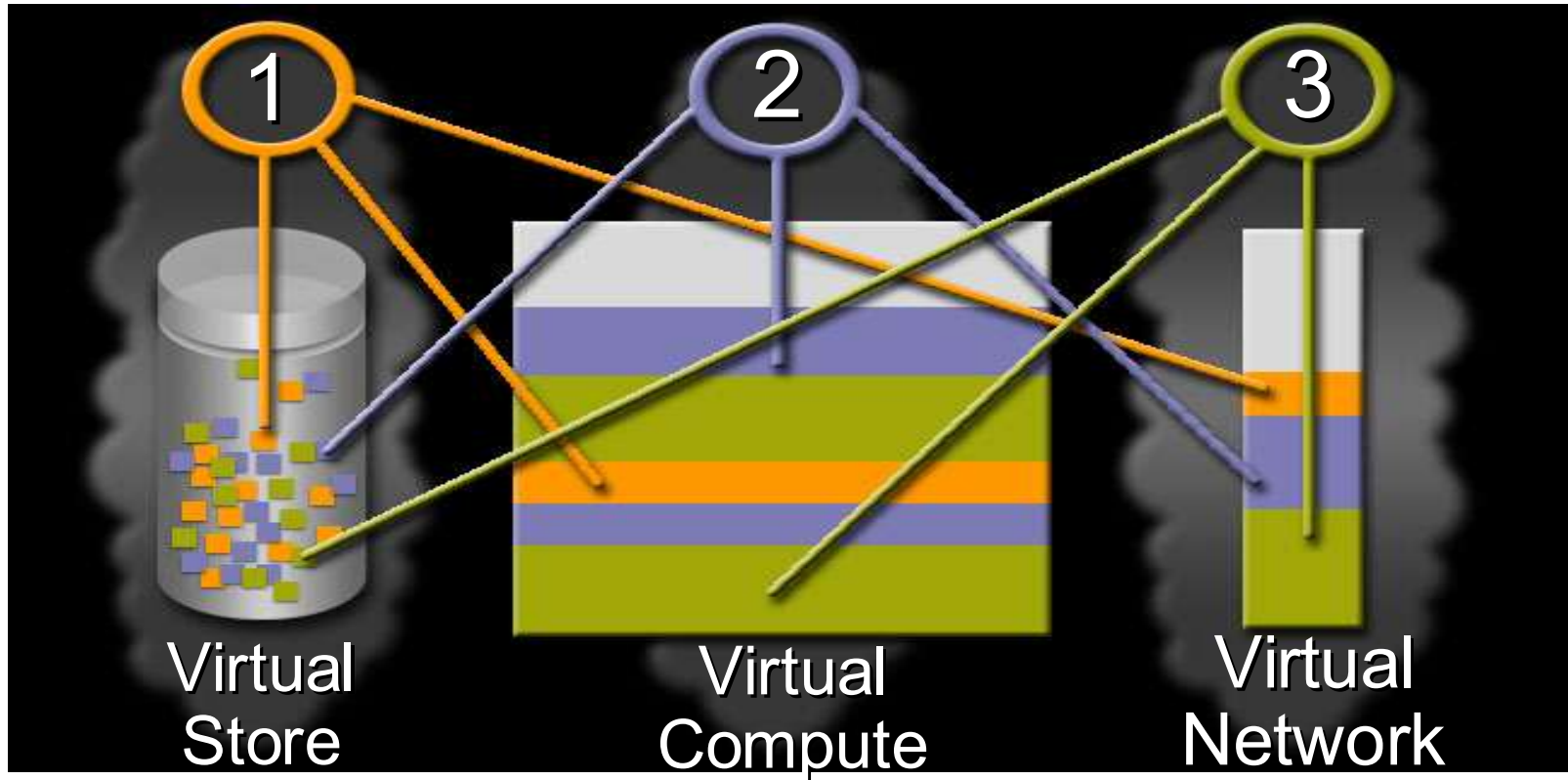


Services sharing resources

Services

Services

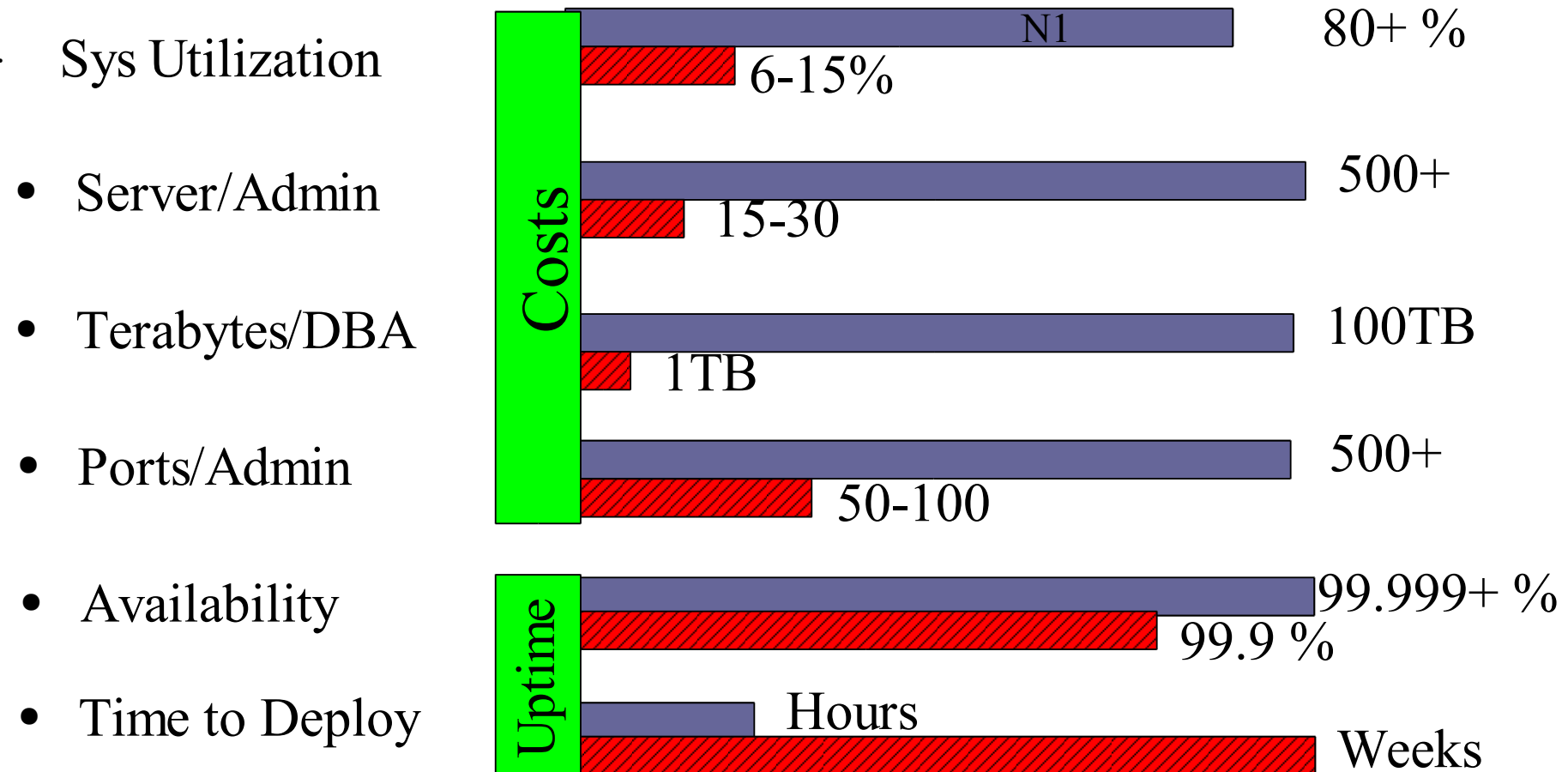
Services



N1: managing services, not servers

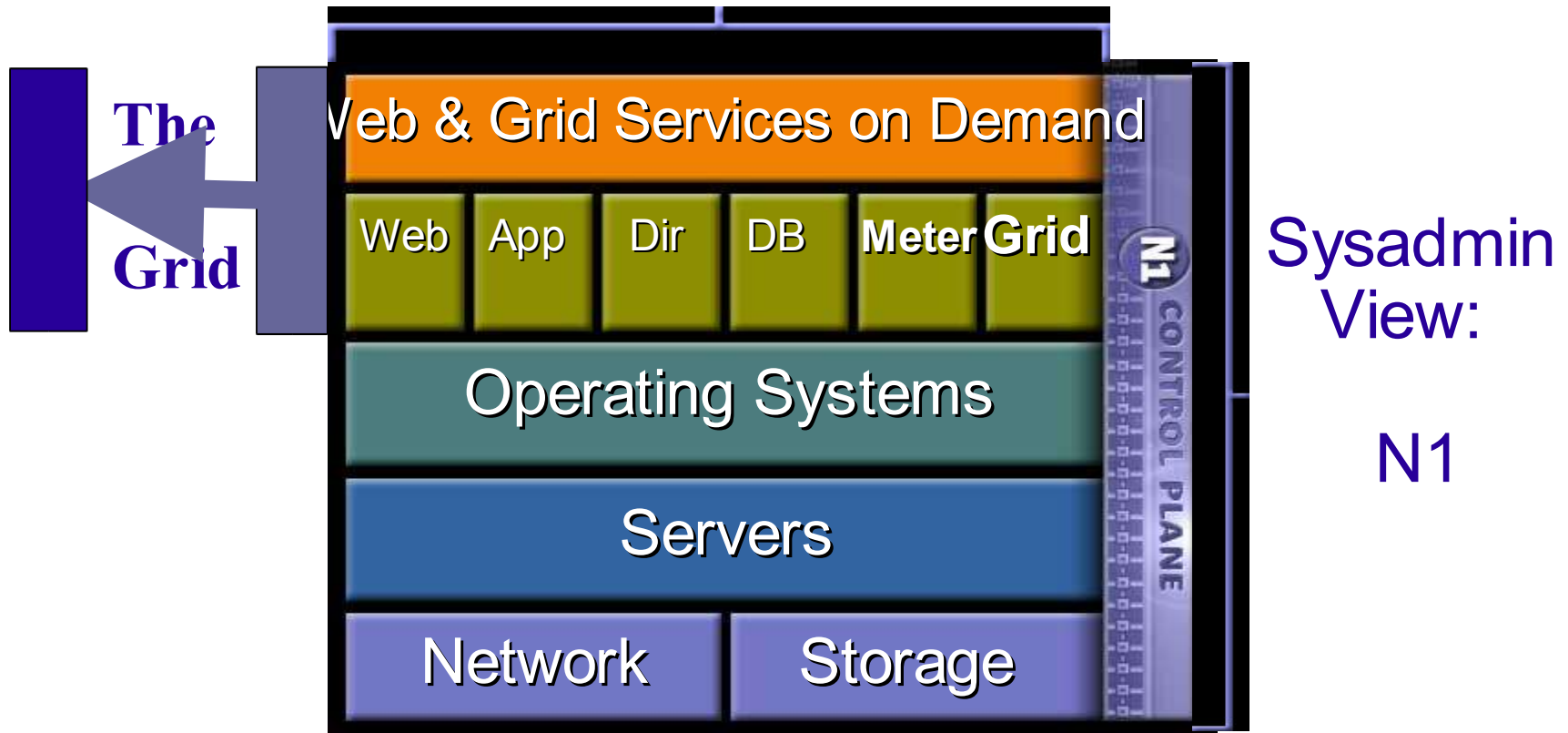
The N1 Effect on Efficiency

Radical improvement in costs & uptime



Grid & Web Services & N1

Developers & Users View: Sun ONE





Thank You !

Wolfgang.Gentzsch@sun.com

www.sun.com/grid
www.sun.com/n1
www.sun.com/security



We make the net work.