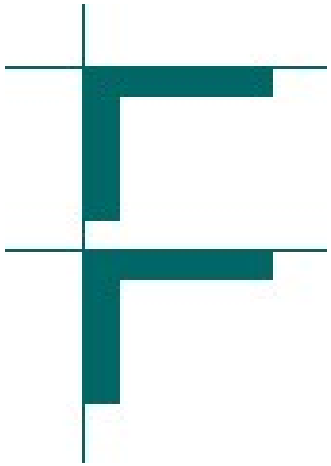
EGEE: crafting a production quality Grid environment



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Marcus Hardt, Dr. Marcel Kunze
Forschungszentrum Karlsruhe / Germany

Varna, 16.9.05

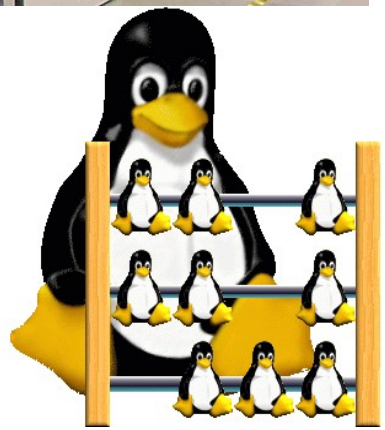
Some slides contributed by
EGEE team, FZK members

Forschungszentrum Karlsruhe

Institute for Scientific Computing (IWR)

- Part of the „Helmholtz Gemeinschaft“
- One of the largest independent German research institutions
- Many different research areas ranging from environmental studies over nano technology to Grid Computing

Tier-1 centre in LCG



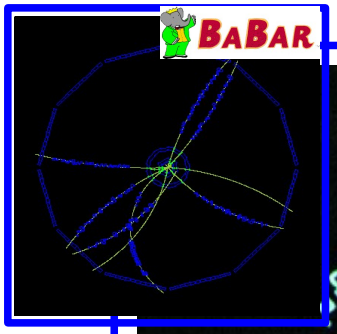
Scientific Linux

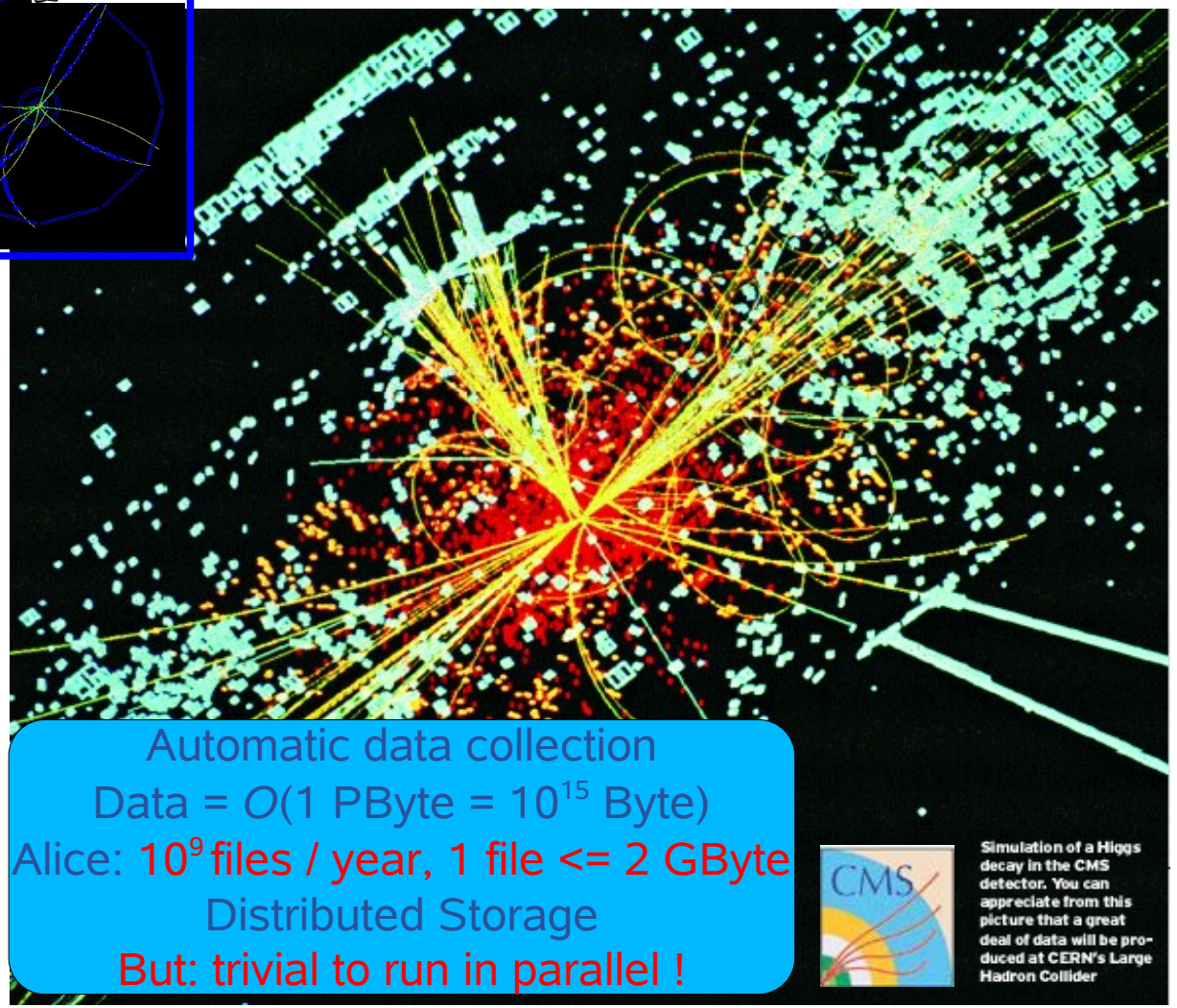
GridKa

LHC / CMS

In LHC:
Expect data rates of
10 - 40 Petabytes
for all experiments
per year.

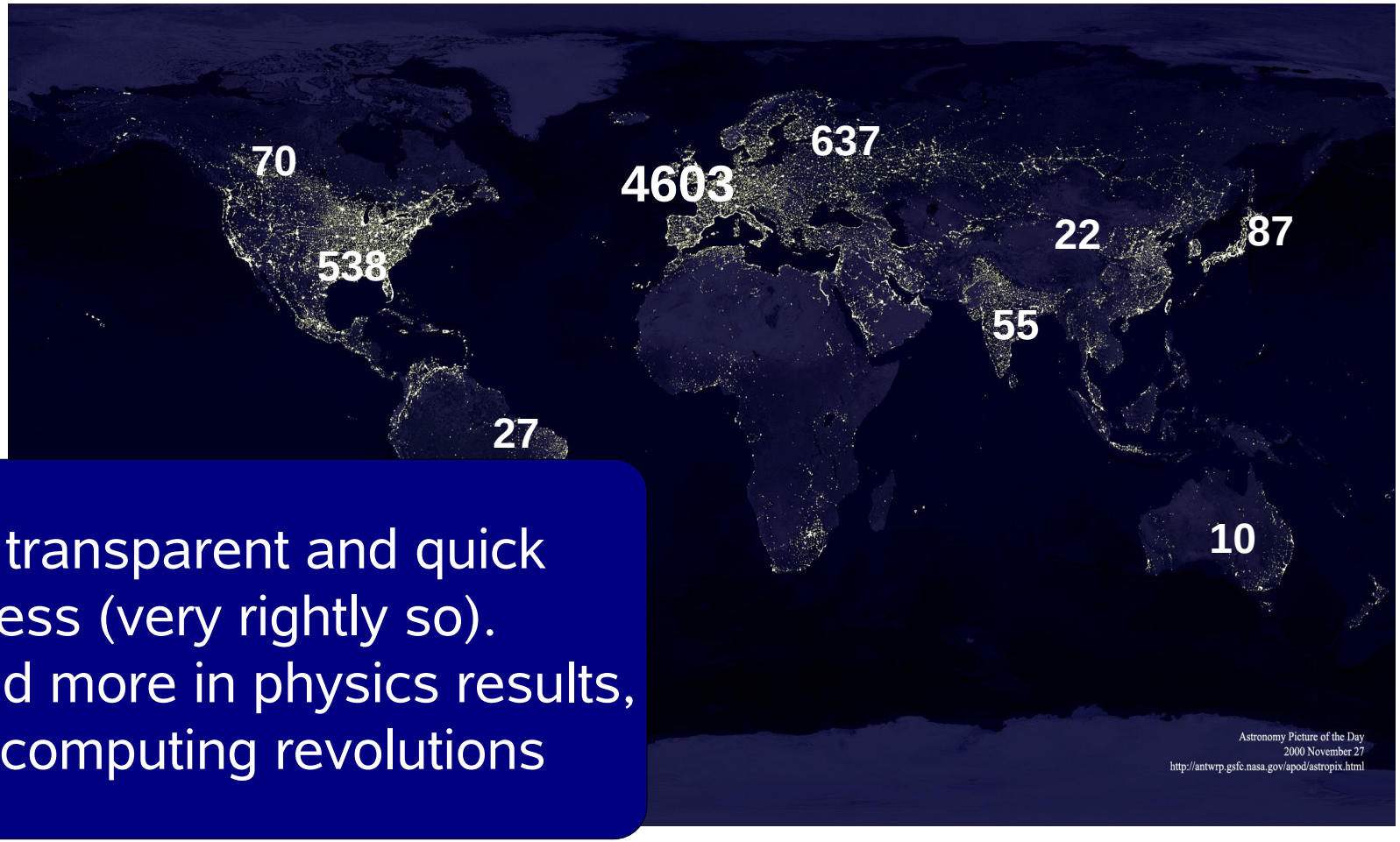
But: trivial to run in parallel ...





Automatic data collection
Data = *O*(1 PByte = 10^{15} Byte)
Alice: 10^9 files / year, 1 file <= 2 GByte
Distributed Storage
But: trivial to run in parallel !

Over 6000 LHC Scientists world wide

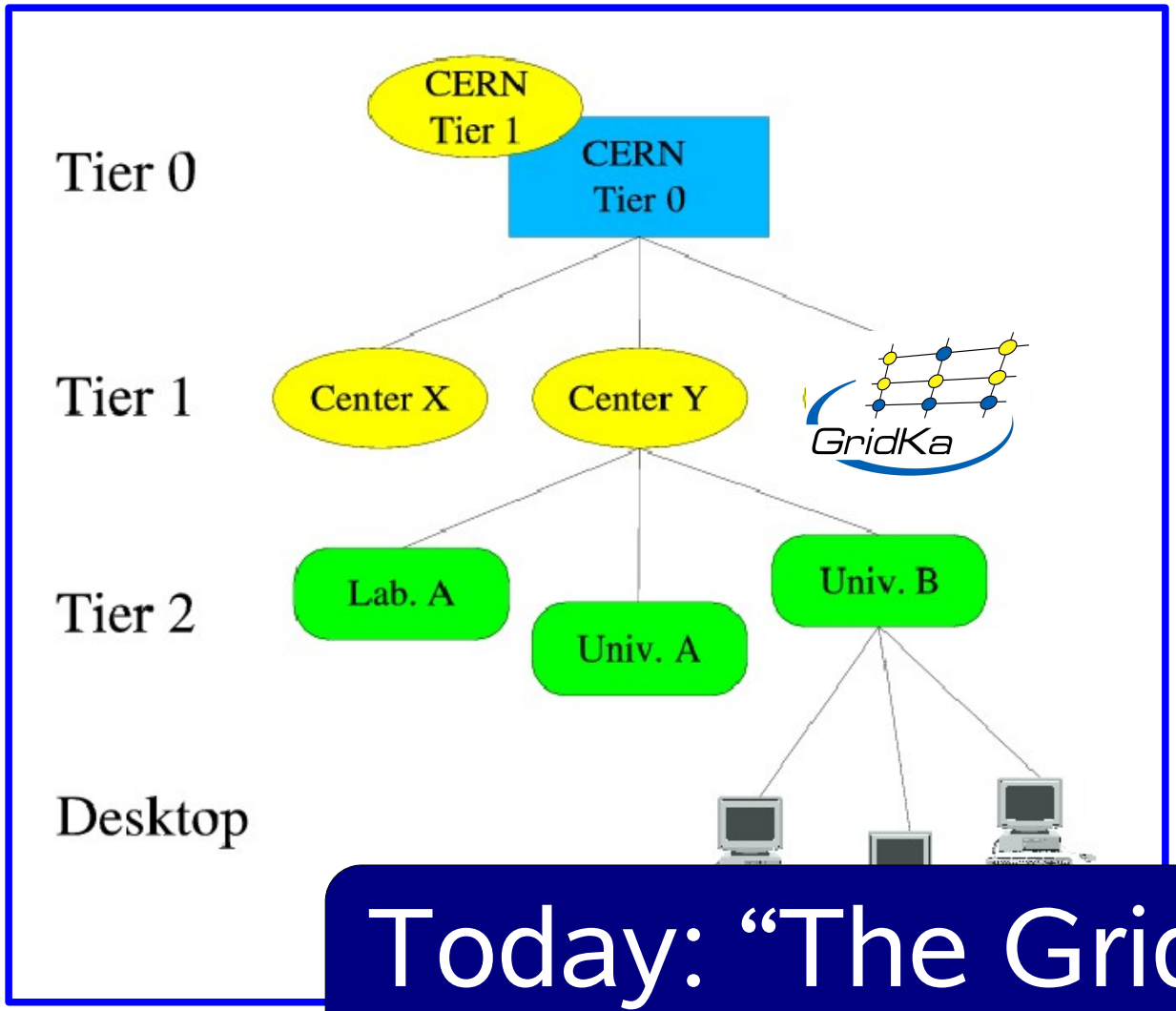


Want transparent and quick access (very rightly so). Interested more in physics results, than computing revolutions

Europe: 267 Institutes, 4603 Users
Other: 208 Institutes, 1632 Users

The MONARC* study and Tier-1 centers

- Basic idea: hierarchical distribution of tasks
- Idea accepted by the LHC Computing Grid (responsible for planning and management of LHC computing)
- Tier-0: Initial reconstruction and storage of raw events, distribution to Tier-1
- Tier-1: Data-heavy analysis, reprocessing of data, regional support
- Tier-2: Managed disk storage, simulation of PP events, computing



Today: "The Grid"
(with many meanings ...)

* **MONARC** == **M**odels **O**f **N**etworked **A**nalysis at **R**egional **C**enters

Requirements of production quality Grid

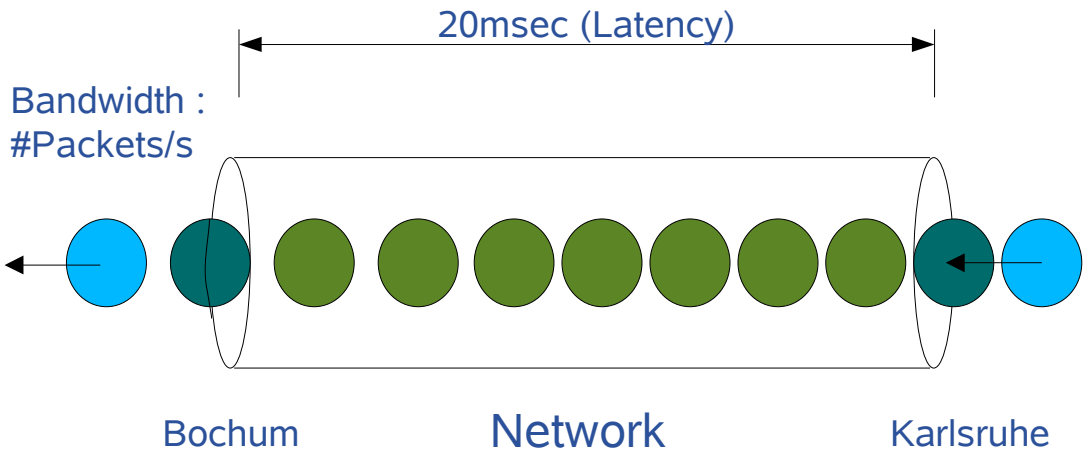
Need: (a) software layer "middleware", (b) fast networks, (c) common policies and (d) services

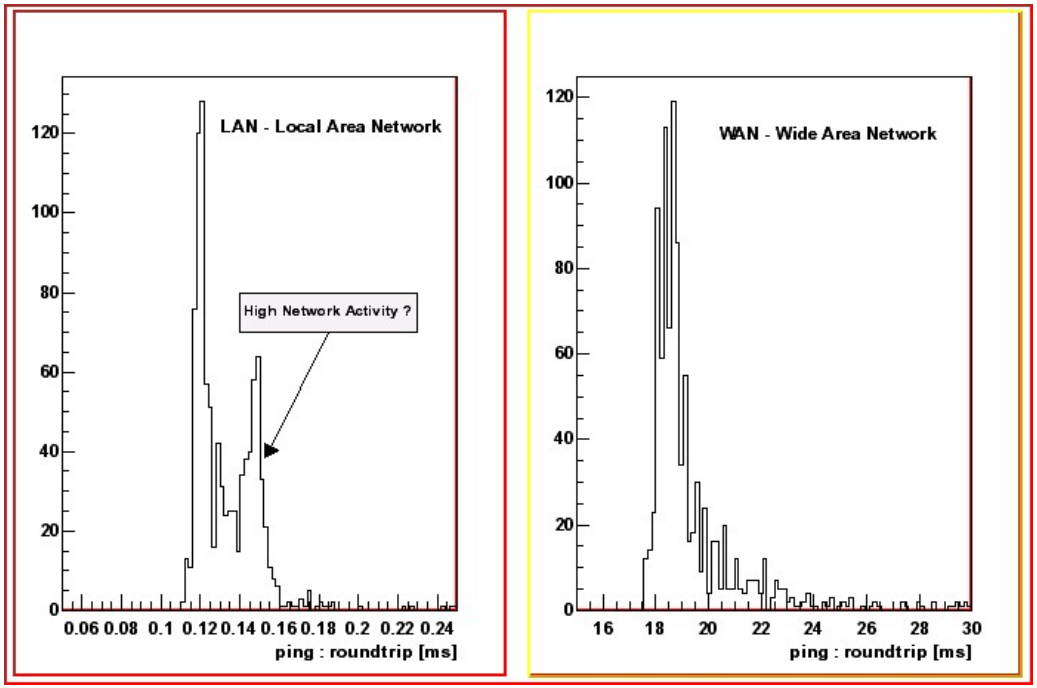
Need:

- transparent access to data
  - replication, virtualisation,
  - global filesystems, ...
- secure storage, authentication and authorisation
  - access control (Unix ...), PKI infrastructure, CA, agreed policies, VO
- accounting (computing costs money)
  - not really solved
- training, support
  - GGUS, EGEE Workpackages
- fast networks (low latency, high bandwidth)
  - Geant, DFN, ...

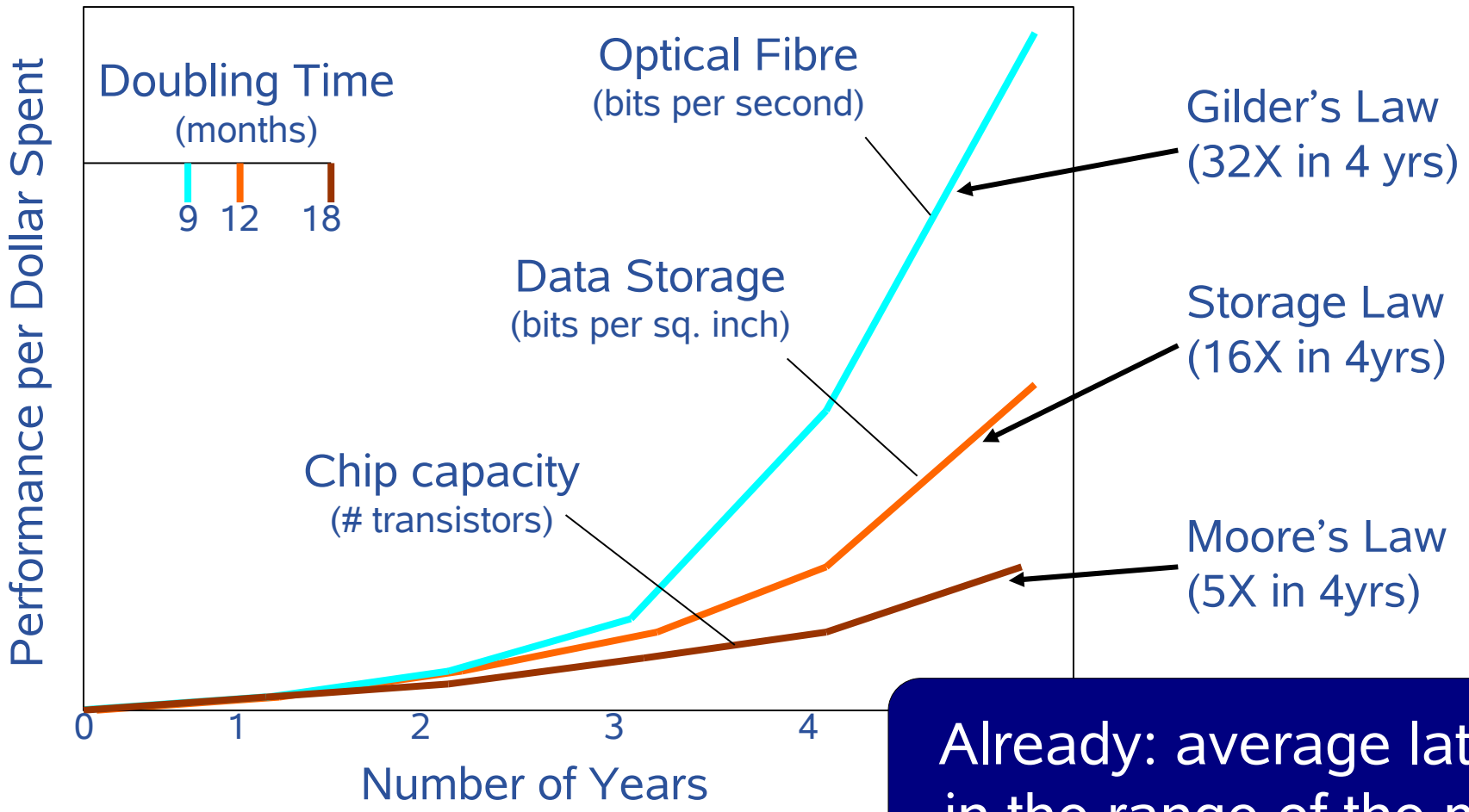
Technical Limitations

- „Speed“ of a network consists of two components
- Bandwidth (scales to any number)
- Latency (doesn't scale)
- Possible application types in a Grid are limited by latency
- But PP is not a problem
- However: applicability of our approaches not given for some Grid types !





New Opportunities Demand New Technology



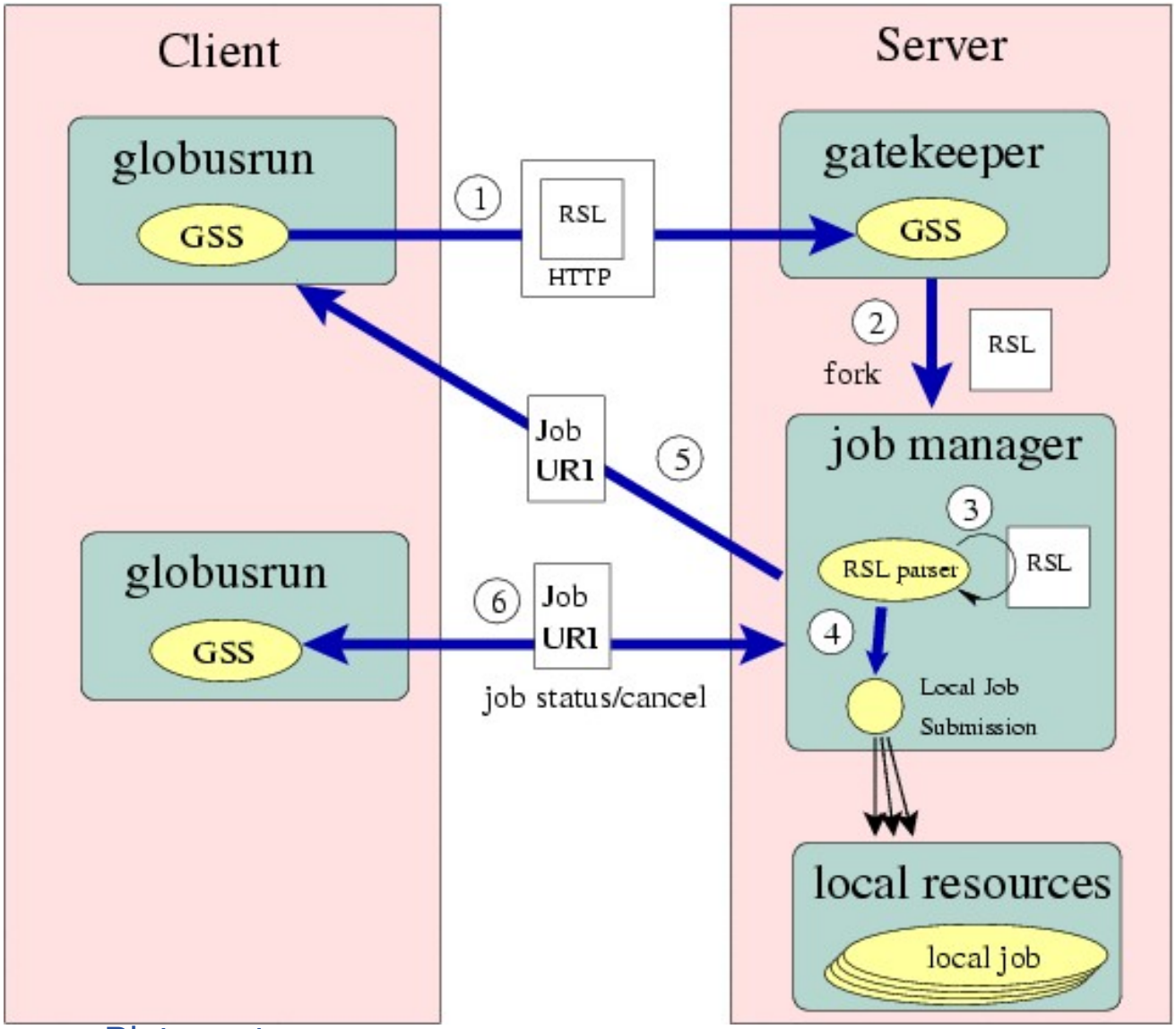
Triumph of Light – *Scientific American*. George Stix,

Already: average latency in the range of the mean access times of an old MFM harddrive !!!

Evolution of Grid Solutions (1)

Globus (Version 2)

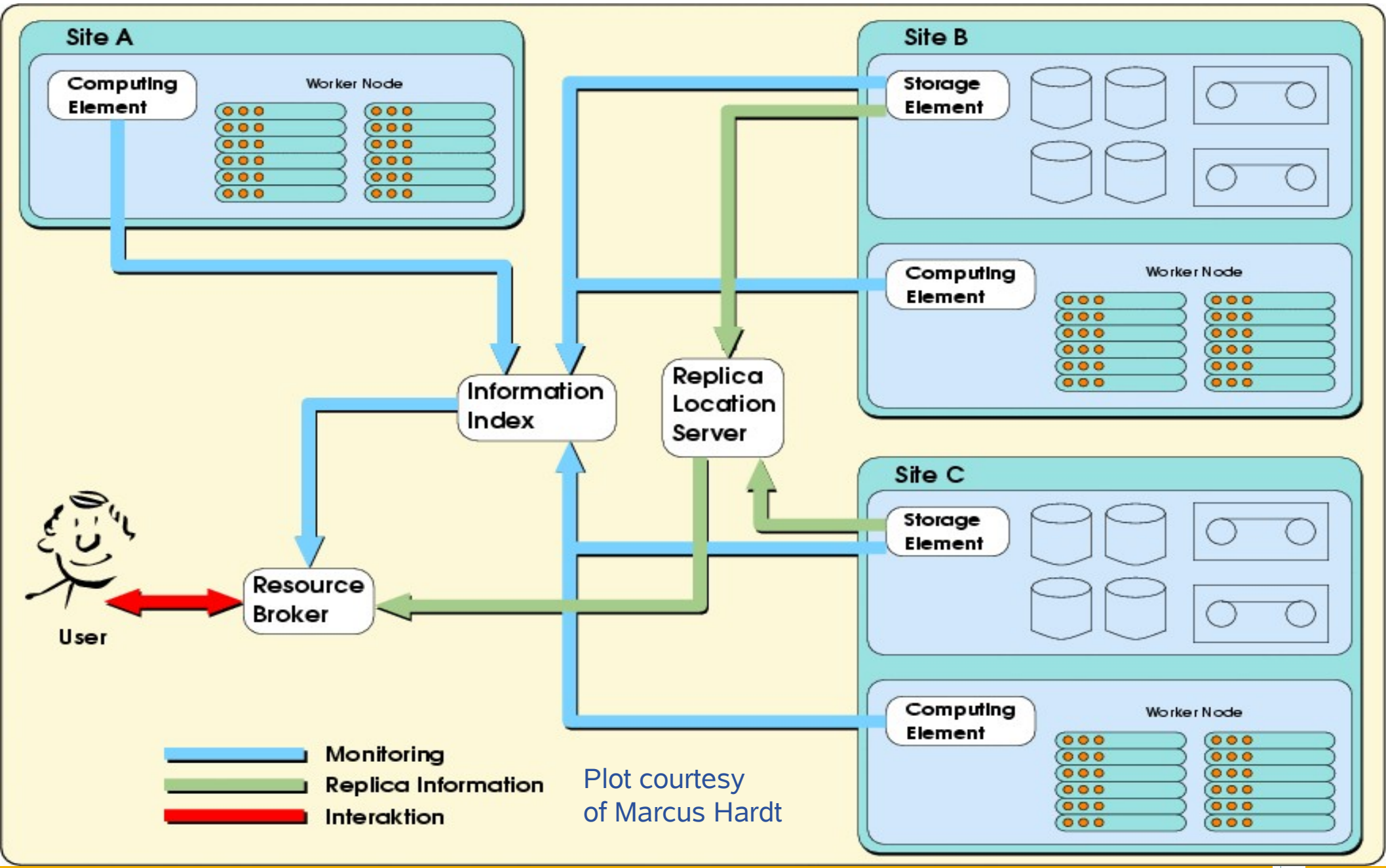
- 1.) Job transmission to server via HTTP as an RSL document
- 2.) Server forks jobmanager, hands over RSL document
- 3.) jobmanager parses RSL, checks the job requirements
- 4.) jobmanager distributes the job to local resources in cluster
- 5.) jobmanager sends a unique job id (URI) to the client
- 6.) The client ca use the URI to cancel the job, when needed, or gain status information



Plot courtesy of Marcus Hardt

Plot courtesy Dr. Harald Kornmayer

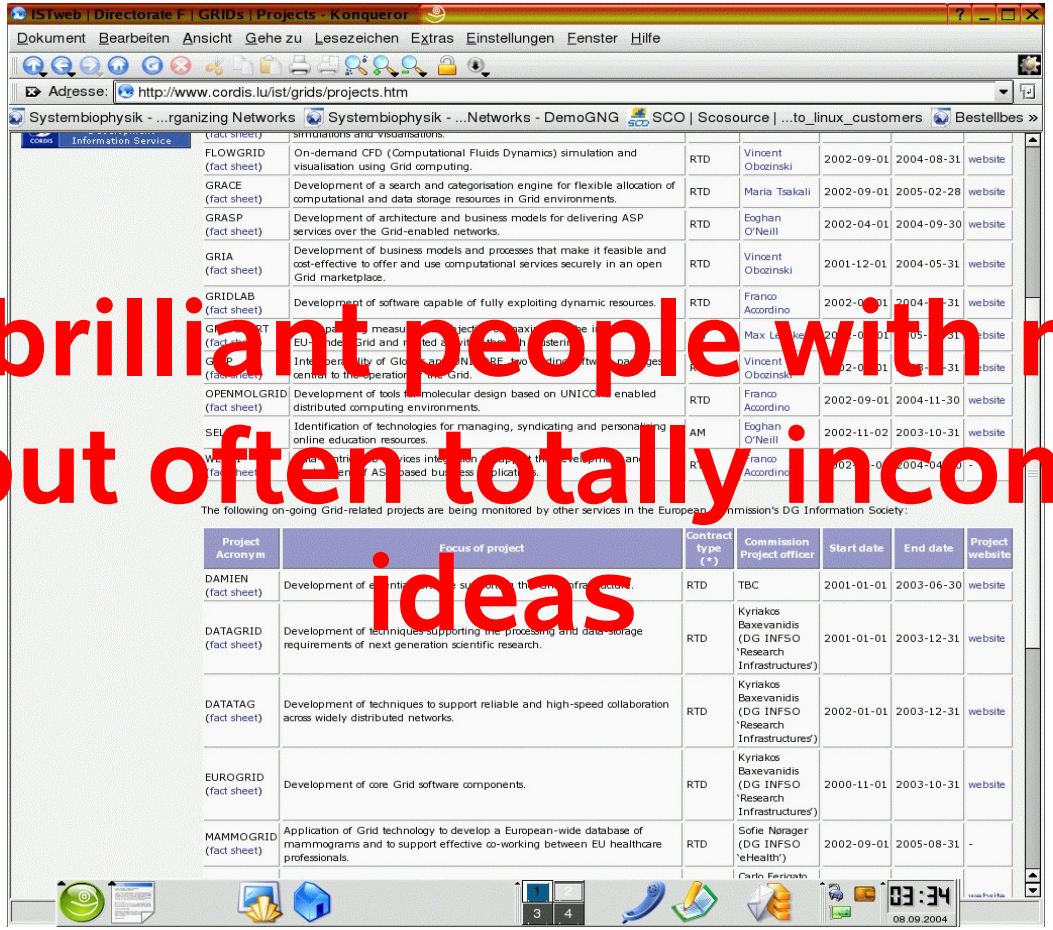
Evolution of Grid Solutions (1)



Plot courtesy of Marcus Hardt

Grid Projects

http://www.cordis.lu/ist/grids/projects.htm

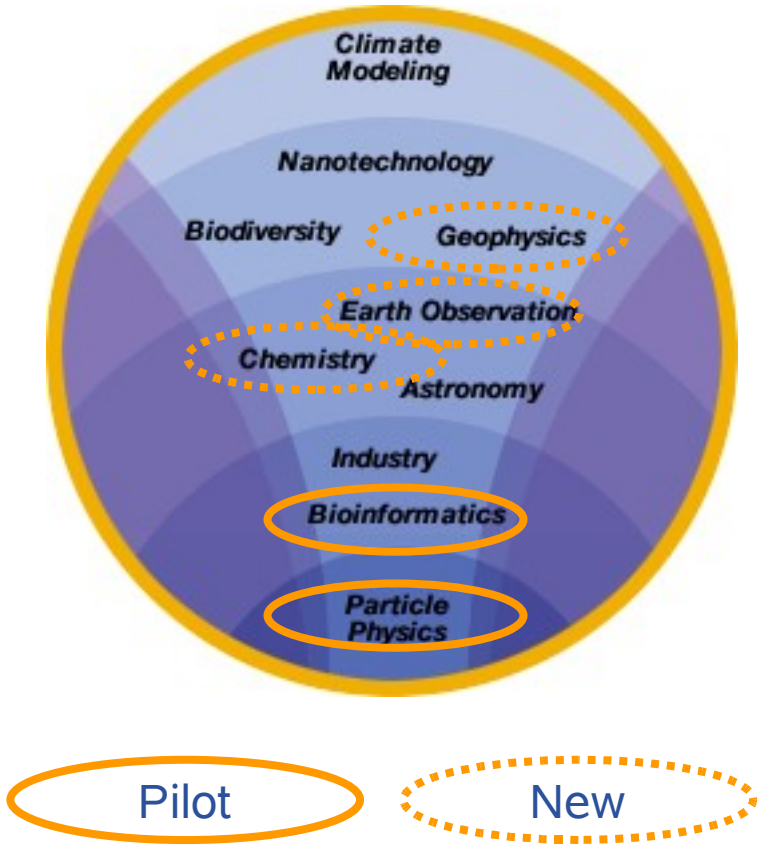


Many brilliant people with many brilliant (but often totally incompatible) ideas

EGEE: Bringing it all together

Over 2 years EGEE wanted:

- **To establish production quality sustained Grid environment**
  - 3000 users from at least 5 disciplines
  - over 8,000 CPU's, 50 sites
  - over 5 Petabytes (10^{15}) storage
- **To demonstrate a viable general process to bring other scientific communities on board**
- **To propose a second phase in mid 2005 to take over EGEE in early 2006**

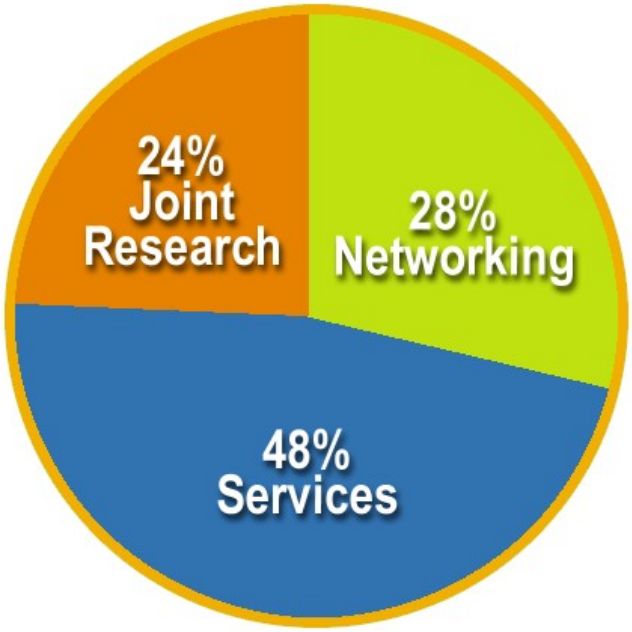


EGEE does the important step from Grid research to Grid deployment !

EGEE activities

32 Million Euros EU funding over 2 years starting 1st April 2004

- **48 % service activities (Grid Operations, Support and Management, Network Resource Provision)**
- **24 % middleware re-engineering (Quality Assurance, Security, Network Services Development)**
- **28 % networking (Management, Dissemination and Outreach, User Training and Education, Application Identification and Support, Policy and International Cooperation)**



Emphasis in EGEE is on operating a production grid and supporting the end-users

gLite – small is beautiful !

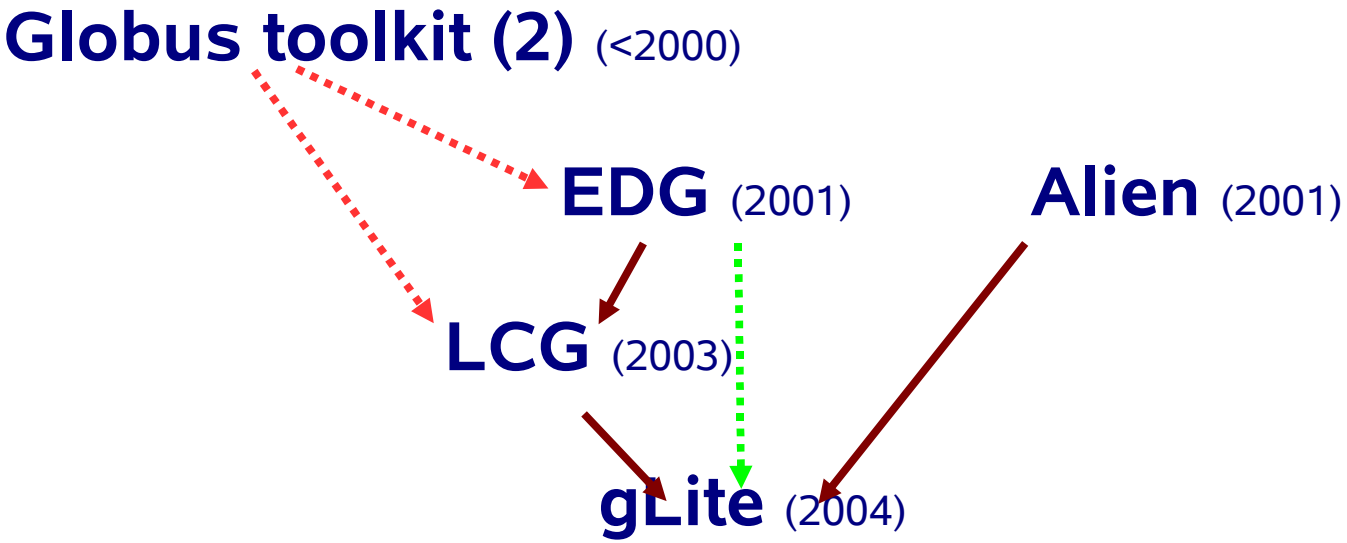
- **Lightweight (existing) services**
  - Easily and quickly deployable
  - Use existing services where possible as basis for re-engineering
- **Interoperability**
  - Allow for multiple implementations
- **Resilience and Fault Tolerance**

- **Co-existence with deployed infrastructure**
  - Reduce requirements on site components
  - Co-existence (and convergence) with LCG-2 and Grid3 are essential for the EGEE Grid service

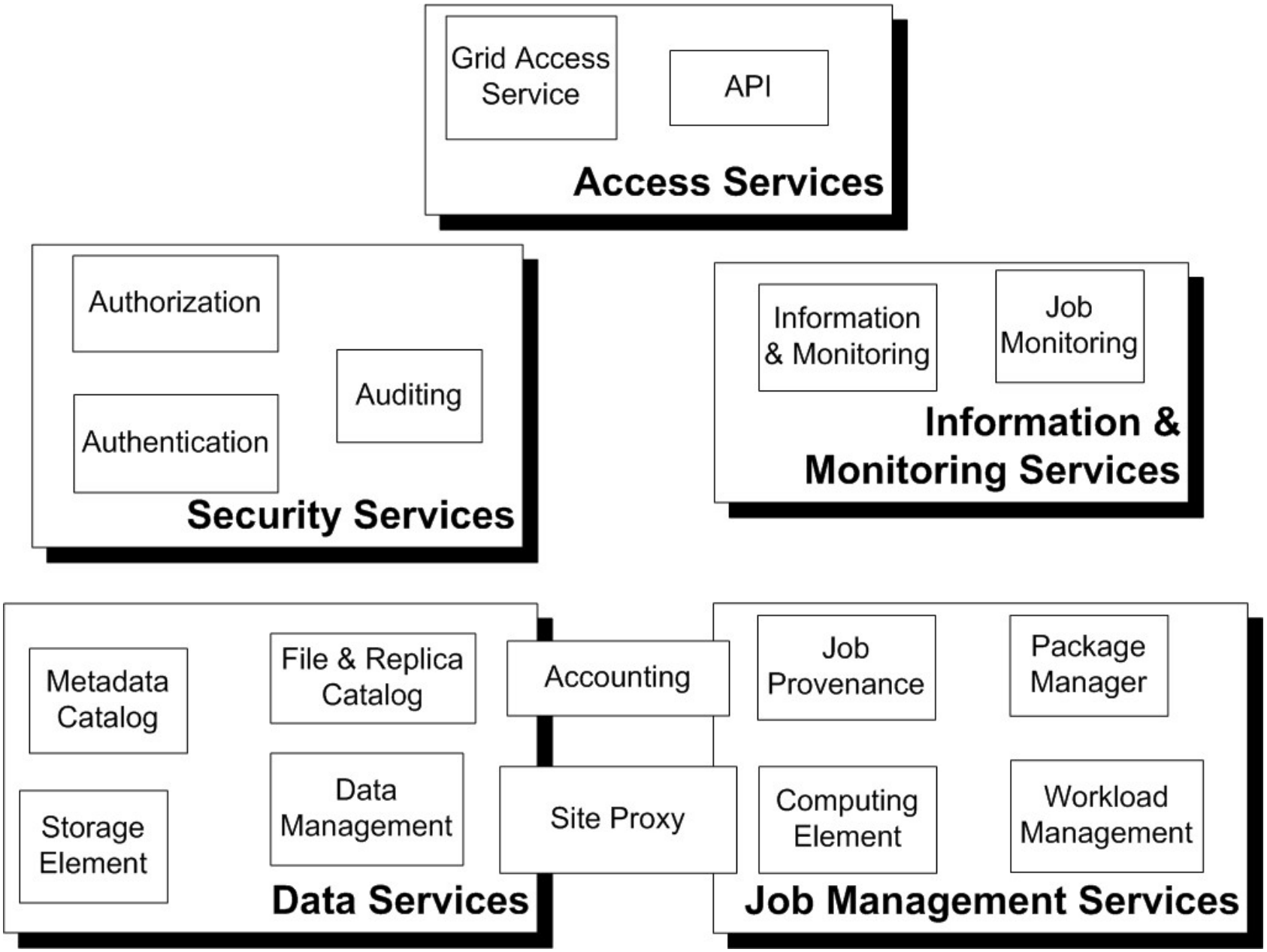
- **Service oriented approach**
  - Follow WSRF standardization
  - No mature WSRF implementations exist to date so start with plain WS (WS-I)
  - Provide framework to others so higher-level services can be developed quickly

Architecture: https://edms.cern.ch/document/476451

Evolution of Grid Solutions (2)



Evolution of Grid Solutions (2)

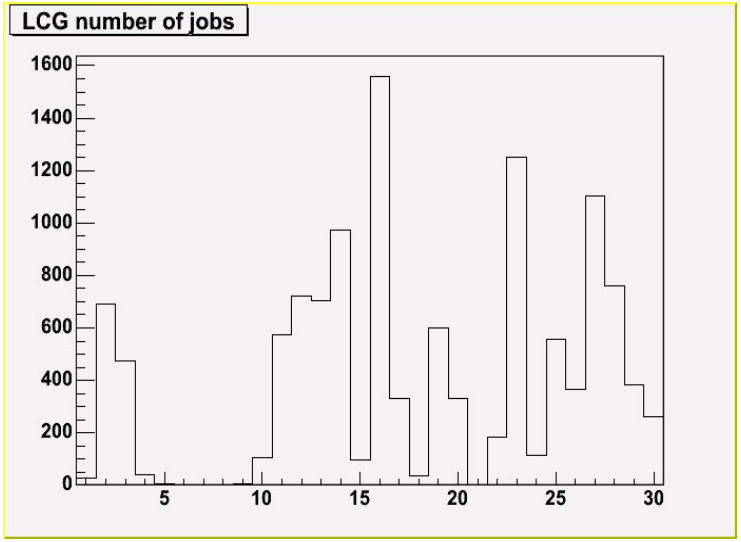


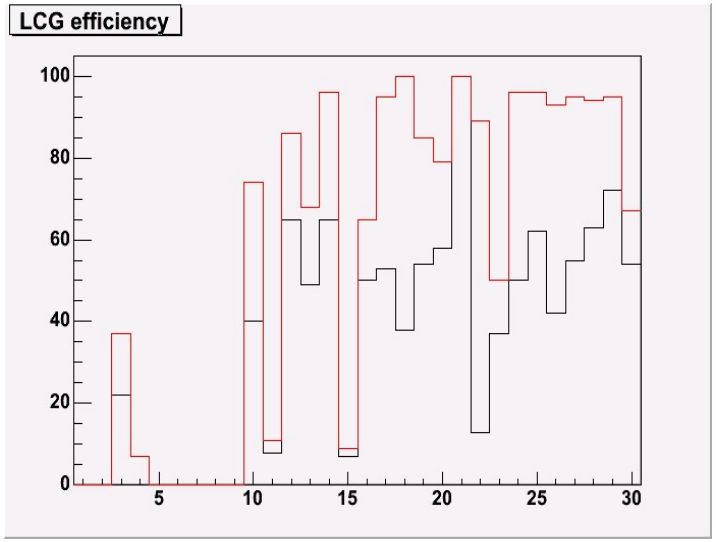
Issues and Problems with “The Grid”

- Hardware / Software issues
  - Heterogeneous hardware, software, OS are a BIG problems !
  - Example: User Interface
  - Example: floating point accuracy
  - Example: dynamic libraries
  - Example: distributed application across diffferent platforms
  - Revival of the interpreter, JIT ?
  - Security and accounting – IntraGrid vs. InterGrid
  - Submission times ???
- Political Issues
  - Different communities – different agendas / hidden agendas
  - coordination between partners
  - typical problems of large, heterogeneous organisations
  - small and dynamic vs. large and powerful organisations

Lessons learned

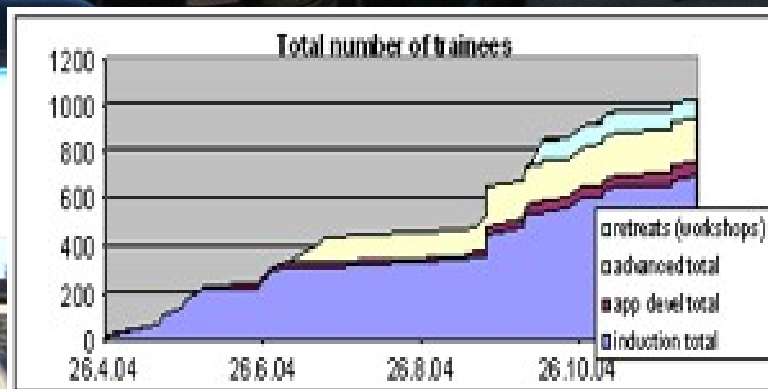
- Standardisation is an important goal but cannot always be achieved. Thus interoperability of different solutions is equally important.
- Alongside sophisticated features, a user-friendly behaviour of Grid components is important to end-users
- Research collaborations must find the right balance between development flexibility and man-power.
- Support and Training play crucial role in generating critical mass of users.
- Quality of existing solutions must be ensured by extensive testing, e.g. using data and service challenges at regular intervals in context of the LCG project.



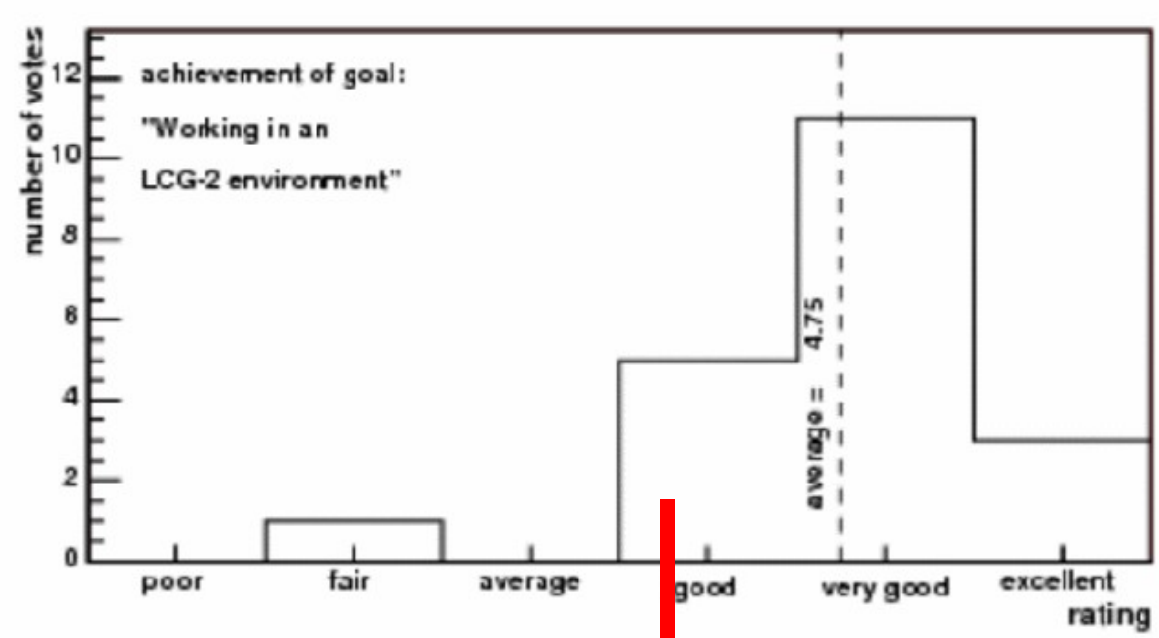


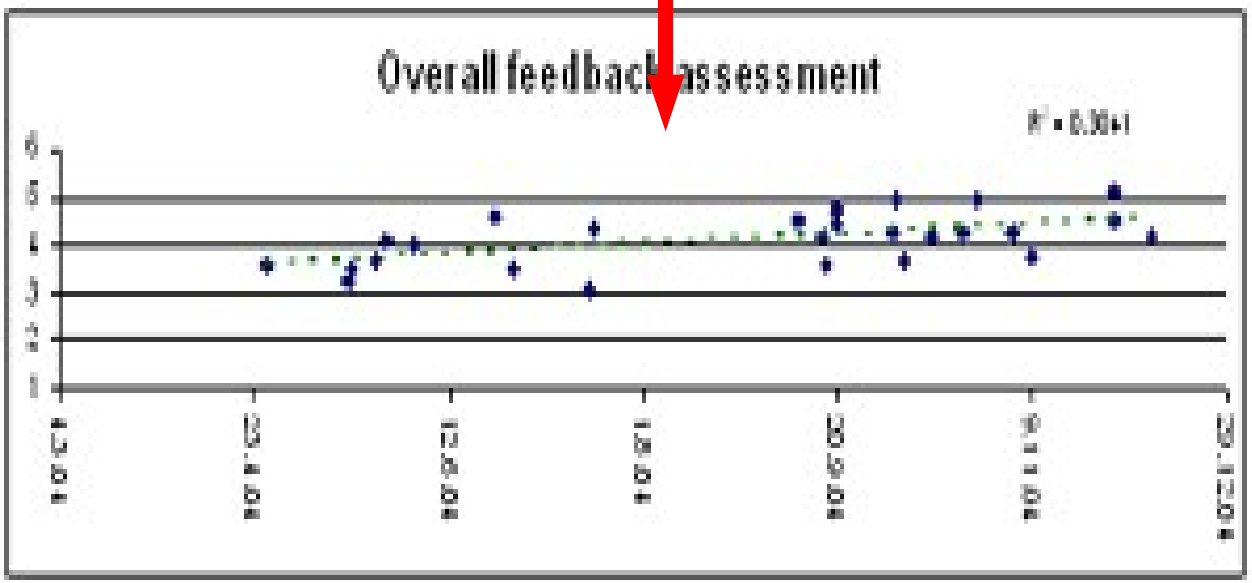
Impression from Grid Training

Picture taken at GridKa School 2004. Check out GridKa School 2005 at http://gks05.fzk.de



Quality assurance in EGEE Training





Conclusion

- The Grid is not history, but there is quite a bit of history in Grid Computing
- Standardisation is an ongoing process
- Following standards might be a better approach than inventing them
- The ultimate meaning of „The Grid“ will be defined by the applications that run on it
- EGEE is a major step in the creation of a production quality Grd infrastructure for science and industry

Thank you !

We'd like to thank the German Federal Ministry of Education and Research, BMB+F, the EGEE project and its representatives as well as Forschungszentrum Karlsruhe / Germany for their continuous interest and support !

bmb+f - Förderschwerpunkt
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