GRID Computing

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Brief Overview

- What is the GRID
  - Definitions, checklist, major concepts and elements
- Benefits to scientists and researchers
  - Resources, collaboration and organizations
- Current trends
  - Research/scientific, private and public sector involvements, S.O.A
- Future trends
  - The computer is the network
- Conclusion

GRIDs - A first definitions

- *A computational grid is a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational capabilities.*
  - Carl Kesselman,Ian Foster in "The Grid: Blueprint for a New Computing Infrastructure" 1998
- *Grid computing is coordinated resource sharing and problem solving in dynamic, multi-institutional virtual organizations"*
  - Carl Kesselman,Ian Foster in "the anatomy of the grid" 2000

A GRID checklist (Ian Foster 2002)

- a Grid is a system that:

  1) coordinates resources that are not subject to centralized control ...

     (Otherwise, we are dealing with a local management system.)

  2)..using standard, open, general-purpose protocols and interfaces...

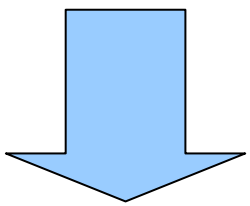
     (Otherwise, we are dealing with an application specific system.)

  3) ...to deliver nontrivial qualities of service.

     (It should meet complex user demands, so that the utility of the combined system is significantly greater than that of the sum of its parts.)

Why the name GRID ?

- metaphor for making computer power as easy to access as an electric power Grid..



Ability to access computing power (CPUs), software applications and research data in a “on-demand” fashion.

A few concepts in GRID COMPUTING

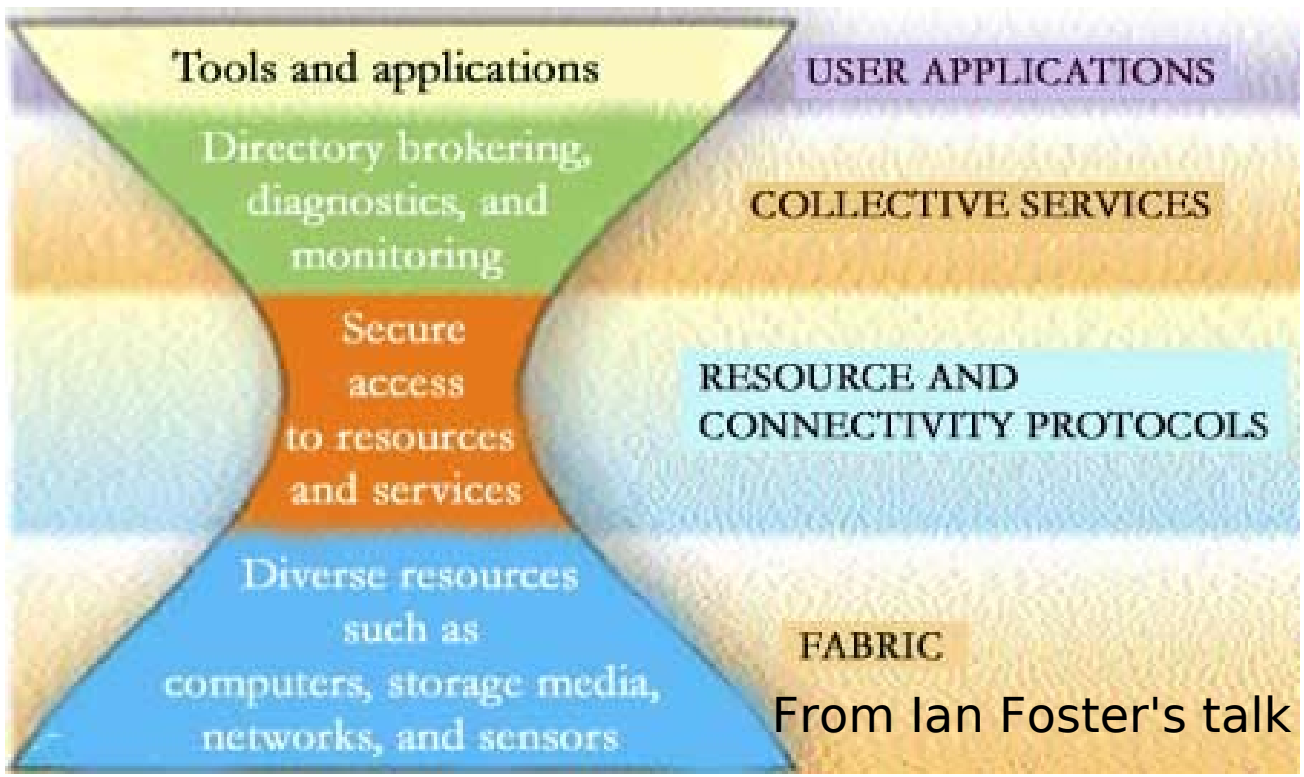
- Resources are locally managed and controlled
- Different resources can have different policies and mechanism
  - Computing resources managed by different batch system
  - Different storage system on different node
  - Different policies granted to the same user on different resources on the GRID
- Dynamic nature:
  - Resources and users can change frequently
- Collaborative environments for e-communities

The elements of a GRID infrastructure

- Hardware/Resources
  - Made available from different sites geographically distributed
  - CPU/Storage/Instruments, etc..
- Software:
  - Something that links together all these resources: the middleware
  - Some applications to use the computational resources made available
- People:
  - Who maintain the Grid
  - Who use the GRID

GRID middleware

- Middleware is “the software layer that lies between the operating system and the applications ”

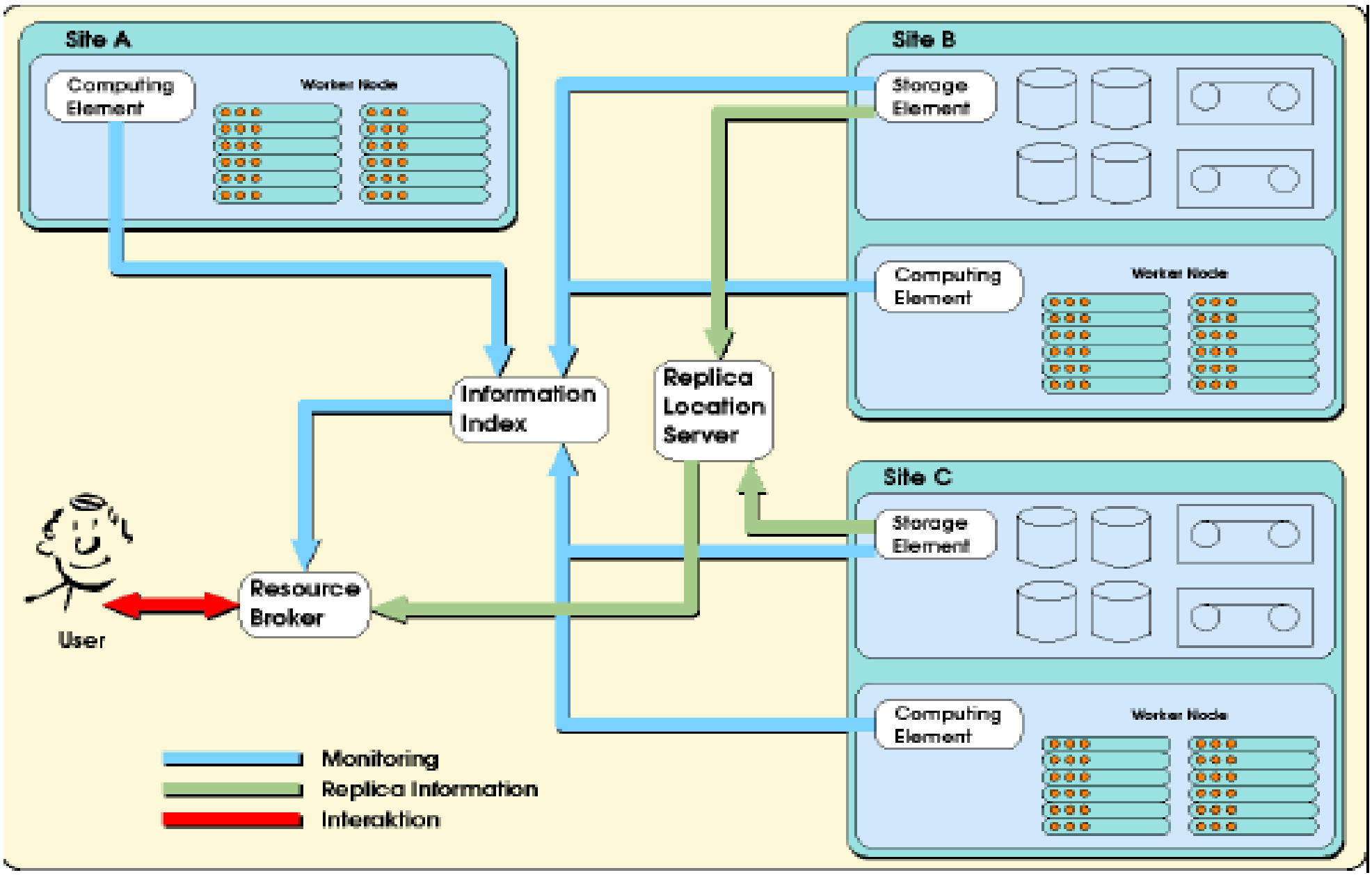


From Ian Foster's talk

grid middleware:

- Basic elements
  - Security
  - Resource management
  - Data management
  - Information Services
- Available solutions
  - Globus Toolkit (Argonne+ISI)
  - LCG/Glite (from EU projects)
  - Gridbus (Melbourne)
  - Unicore... (Germany)
  - And many other...

The grid from user's point of view

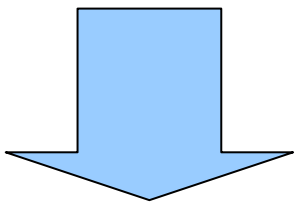


Benefits - Generic

- Multiplication of resources
  - *Resource pool of CPUs and storage available when idle*
- Faster and Bigger
  - *Simulations and problem solving computing could run faster and cover bigger domains.*
- Software and applications
  - *pool of standard applications and libraries*
  - *Access to different models and tools*
  - *Better research methodology*
- Data
  - *Access to global data sources*
  - *Better research results*

Benefits – enhanced collaborations

The size and/or complexity of the problem requires that people in several organizations collaborate and share computing resources, data, instruments



VIRTUAL ORGANIZATIONS

Benefits - Virtual Organization

- Distributed resources and people
- Linked by networks, crossing admin domains
- Sharing resources, common goals
- Dynamic
- Fault Tolerant..
- No Geographic boundaries
    - No VISA problems as no travel is required

Current trends

- Once was a public research network
  - For scientists and researchers, EGEE, GEANT, etc
- Much more involvement from financial institutions (Banks, etc).
  - Newer financial applications are now written to be GRID aware or usable on the GRID.
- No longer just computational now also services

Current trends

- Service Oriented Architecture
  - Encapsulation of a set of applications/services as a single interface that could be reconfigured based on end-user needs.
  - Standards for data management
- Cloud Computing
  - Ability to deploy or deliver services/resources as needed.

Future Trends

- Towards distributed applications that interact with one another and/or offer dynamic integration one with another.
- Everything from O.S to software application/service delivery on demand, where and when the end user needs it.
  - No need to install, update..
- The network is the computer...
  - Your desktop is how you want it, where you want it and when you want it.

Conclusions

- Africa and Africans via GRID networks can participate as active partners in the process of developing and advancing research and/or technology.
- Using GRID technology offers a great opportunity for Africa as Africans (researchers and scientists) are best placed to choose the special features of grid computing that best meets the needs of Africa and also to decide on how grid computing is implemented in Africa.

Conclusions - Grid in Africa: the problems

- Lack of network inter-connectivity !
  - sites need to be interconnected
- Bandwidth could be a limiting factor.
  - Grid is a network demanding infrastructure
  - However:
    - There are Applications which do not require too much bandwidth
    - Peripheral site (User nodes only) could deal well with limited bandwidth (~ 1Mb)
    - Isolated campus GRID/ metropolitan GRID can be an option

Towards an Africa GRID

- ICTP is ready to help African research groups in evaluating the GRID technology for their computational requirements:
  - Training activities
  - Cooperation in installing/integrating existing African resources in GRID testbed
  - Cooperation in porting/validating scientific application of African research groups
- Your role as an African:
  - identify needs/ create a first network of contacts
  - Identify resources (both HW and human ones)
  - Create well-defined VO's in specific research fields (including of course not only African countries)