Instrumentation requirements for advanced e-Infrastructure

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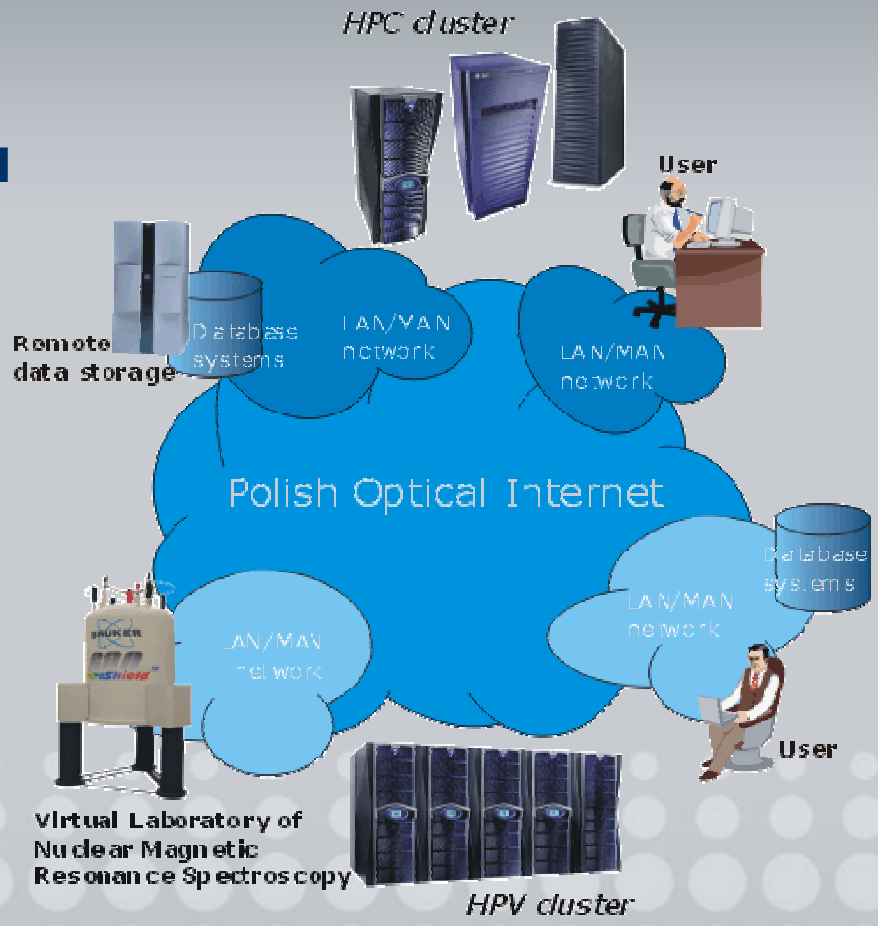
Virtual Laboratory

http://vlab.psnc.pl/

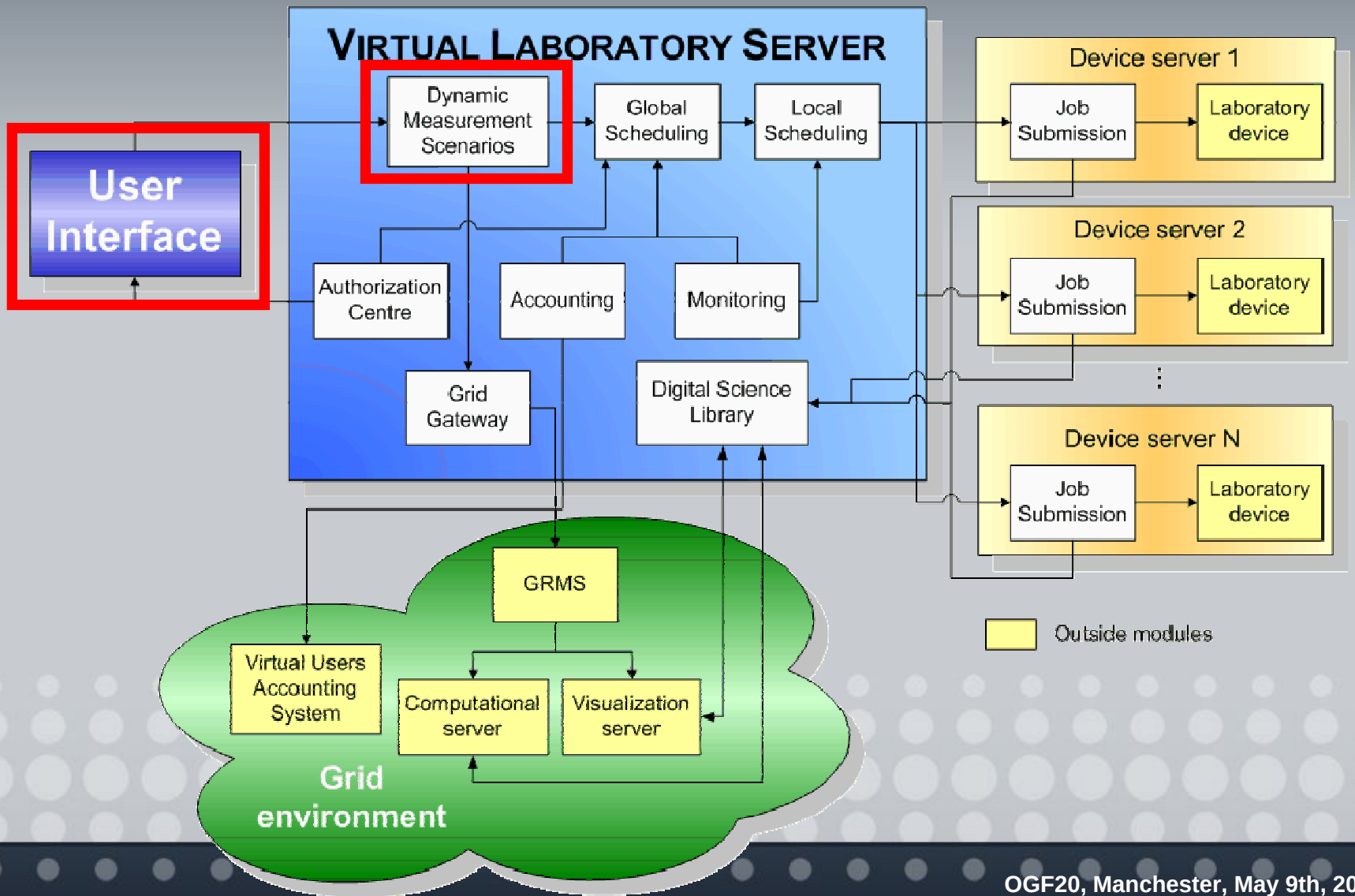
Virtual Laboratory overview

A distributed environment, providing its users with the following functionality:

- **Remote access to complex and expensive laboratory research equipment**
- **User-customized Dynamic Measurement Scenarios**
- **Digital Science Library**
- **Data storage and management**
- **Educational potential**
- **Workgroup collaboration tools**

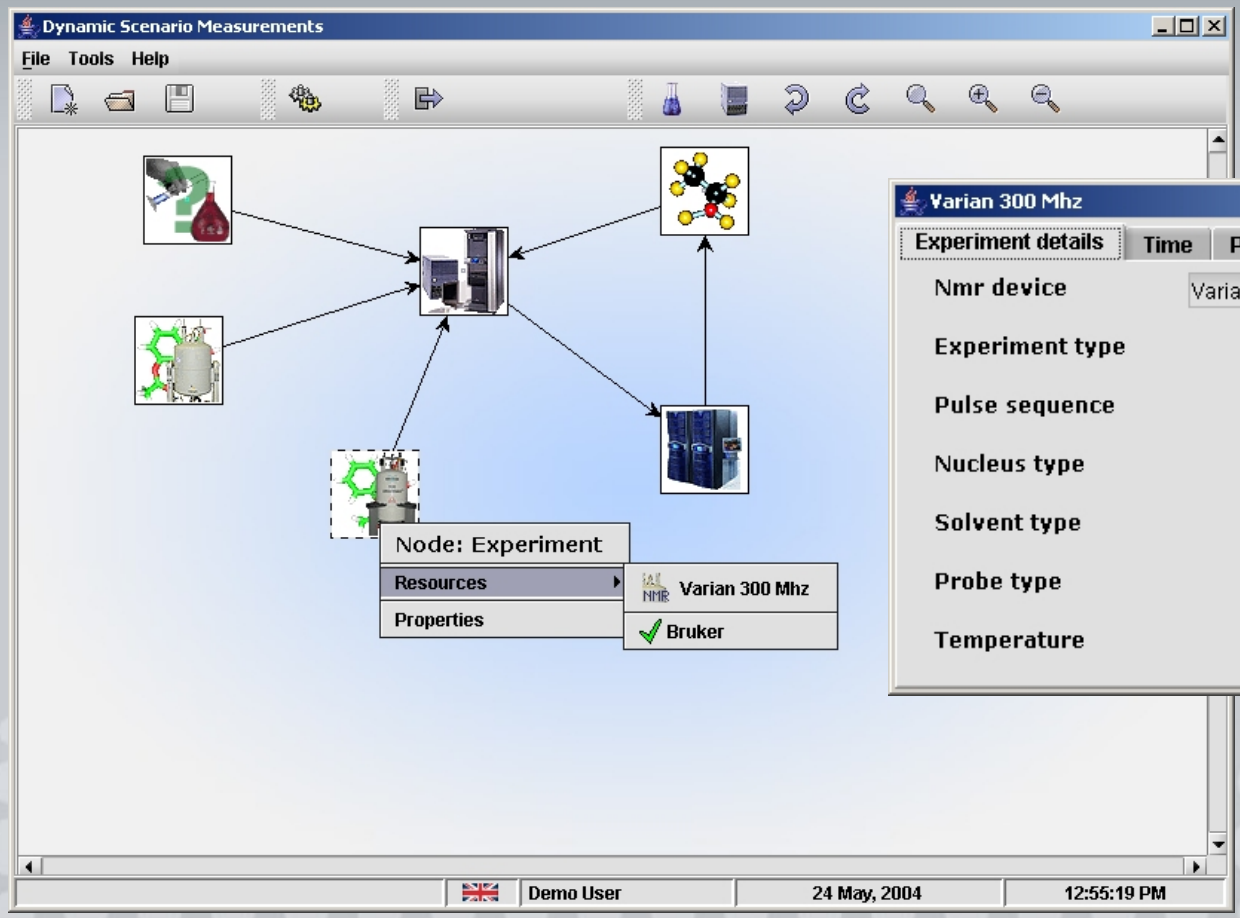


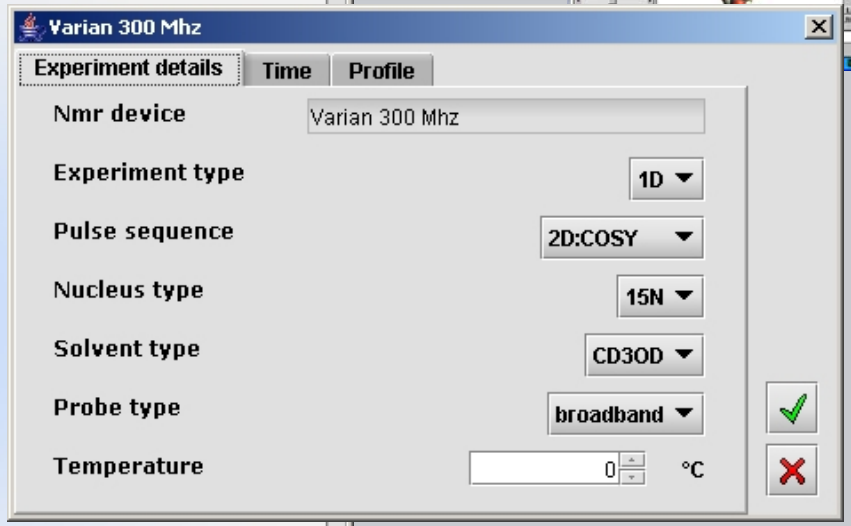
Vlab - Architecture

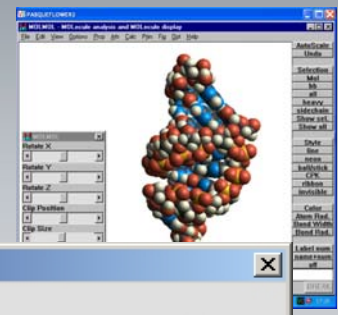


Scenario Submission Application

The user is welcome to create the measurement diagram using the Scenario Submission Application (SSA).



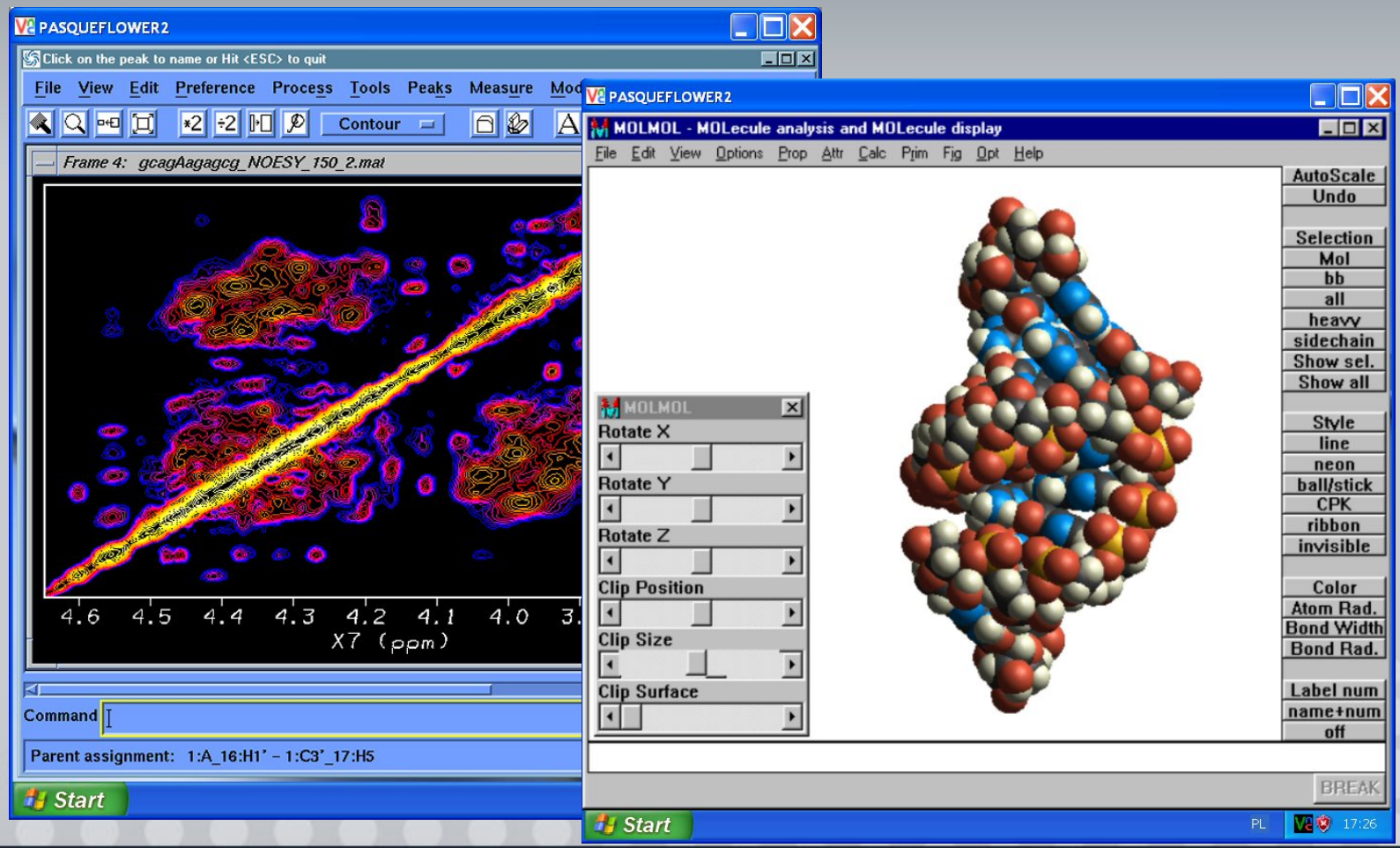




Scenario Submission Application

Visualization

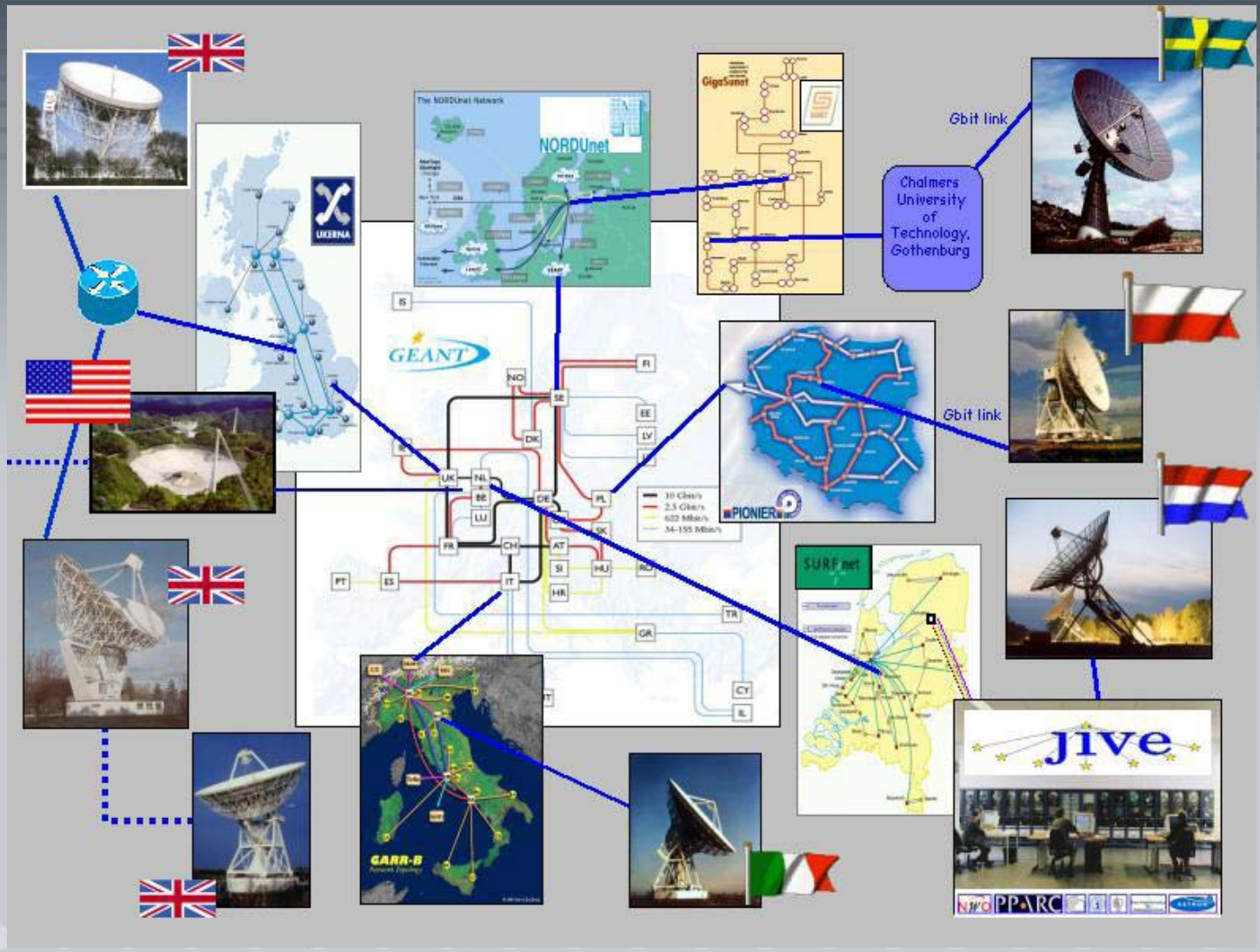
Interactive access to visualization applications from the VLab portal



Conclusions (#1)

- General framework
- Integrates labour facilities with Grid environment
- Testbed installation

- Missing
  - towards production infrastructure
  - worldwide approach
    - limited number of facilities
  - sustainability
  - enhanced architecture – vision of the future



EXPReS

e-VLBI pilot

VLBI is a technique, in which physically independent and widely separated radio telescopes observe the same region of sky simultaneously, in order to generate very high-resolution continuum and spectral-line images of cosmic radio sources

A Production Astronomy e-VLBI Infrastructure

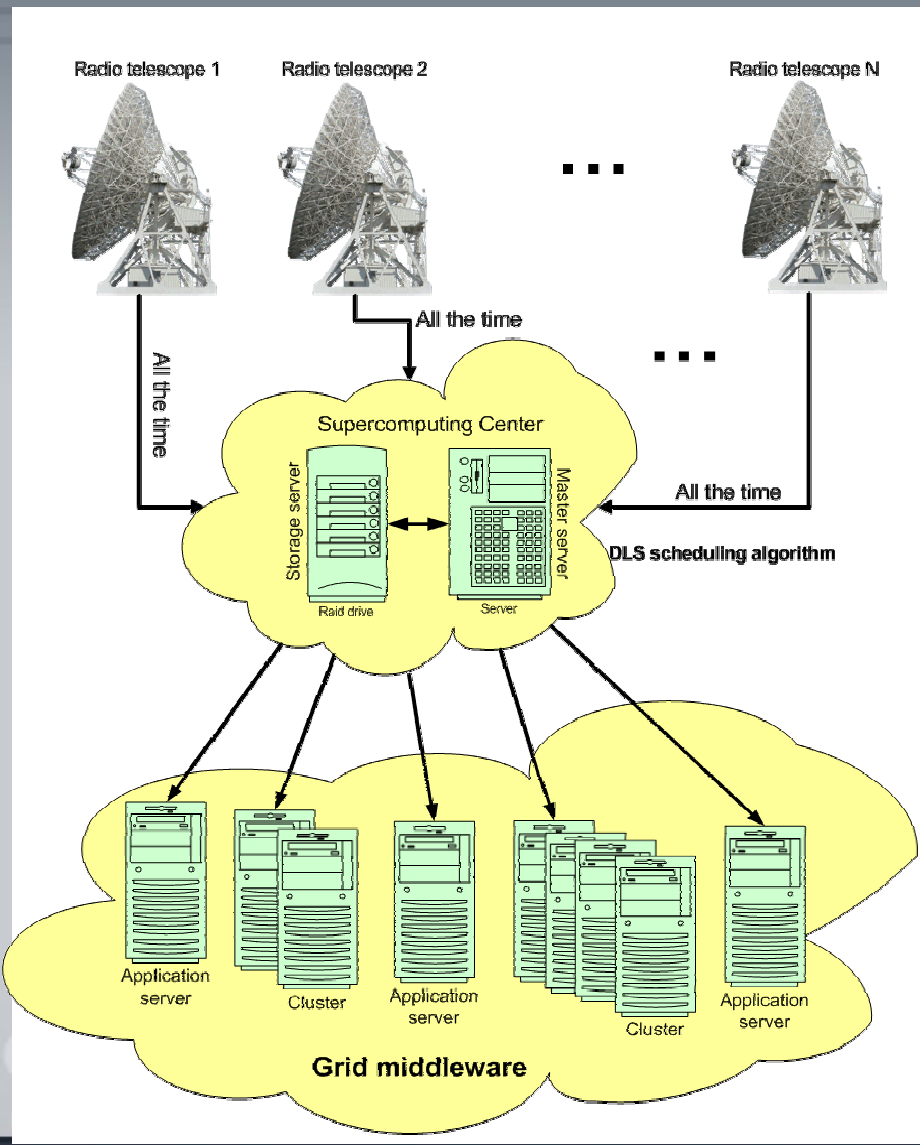
VLBI approach:

Data are sent and correlated at the central point (JIVE – Joint Institute for VLBI in Europe)

e-VLBI:

The total flow of data into the central processor is approximately 10-100 Terabytes per single observation, after processing this is reduced to 10-100 Gbytes

Distributed correlation used in Expres project, supported by grid



RINGrid

Remote Instrumentation in Next-generation Grids

- **Specific Support Action**
- **Contract no. 031891**
- **18 months: from October 2006 – March 2008**

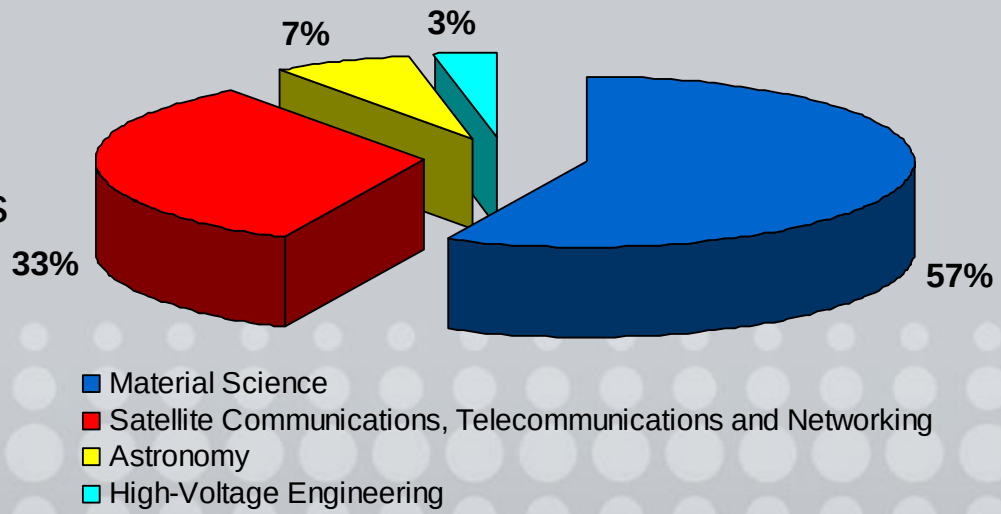
RINGrid

Objectives:

- Identification of instruments and user communities, definition of requirements
- **Synergy** between remote instrumentation and next-generation high-speed communications networks and grid infrastructures
- Trend analysis and recommendations for designing next-generation remote instrumentation services

1st Phase:

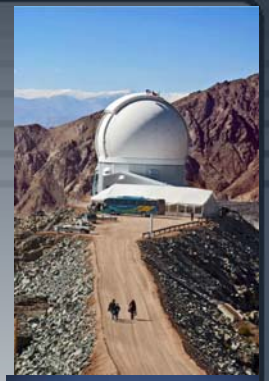
- Identified 30+ instruments representatives and requirements



Identified Instrumentation

… from labour equipment to sensors

- **Material Science**
  - Synchrotron Light Source – 11 beam lines
  - High Resolution Transmission Electron Microscope (HR-TEM)
  - Field Emission Scanning Electron Microscope (FEG-SEM)
- **Optical Astronomy at LNA (www.lna.br)**
  - 4.1 m optical telescope at Southern Astrophysical Research Telescope (SOAR)
- **Vibration spectroscopy**
  - BRUKER Tensor 37 FTIR
  - Electron spectroscopy
  - VARIAN Cary 100 UV-Vis
- **Chemistry**
  - Bruker AC – 250 P
  - Laser Scan Microscope
  - Zeiss LSM 410 Confocal Microscope
  - Diffractometer
  - Siemens D-5000(http://microlab.berkeley.edu/labmanual/chap8/8.44.html)
- **Satellite communications, telecommunication systems and networking measurement equipment**
  - Satellite network (mesh topology); 24 earth stations; audio and video multicasting
  - Vector Signal Generator Agilent ESG E4438C (250 kHz – 6 GHz, IEEE 802.11b option)
- **Food processing, chemistry, other**
  - Gas Cromatograph Varian 38000
  - Atomic Absorption Varian AA 800
  - Varian Cary 1E UV-Visible Spectrophotometer
- **Radio Astronomy**
  - 32m Radio Telescope in Piwnice, Poland




User requirements

Astronomy and Astrophysics:

- To be able to effectively interact with the telescope operator.
- To have additional information about sky conditions and other environmental information, to replace the act of walking outside to check conditions.
- Ability for controlling telescope and/or instrument as if sitting in the control room.
- Basically safety, reliability and low-cost maintenance needs

Telecommunications

- High quality videoconferences capabilities
- Dedicated broadband for specific purposes
- Open source software (compatibility)

User requirements (cont.)

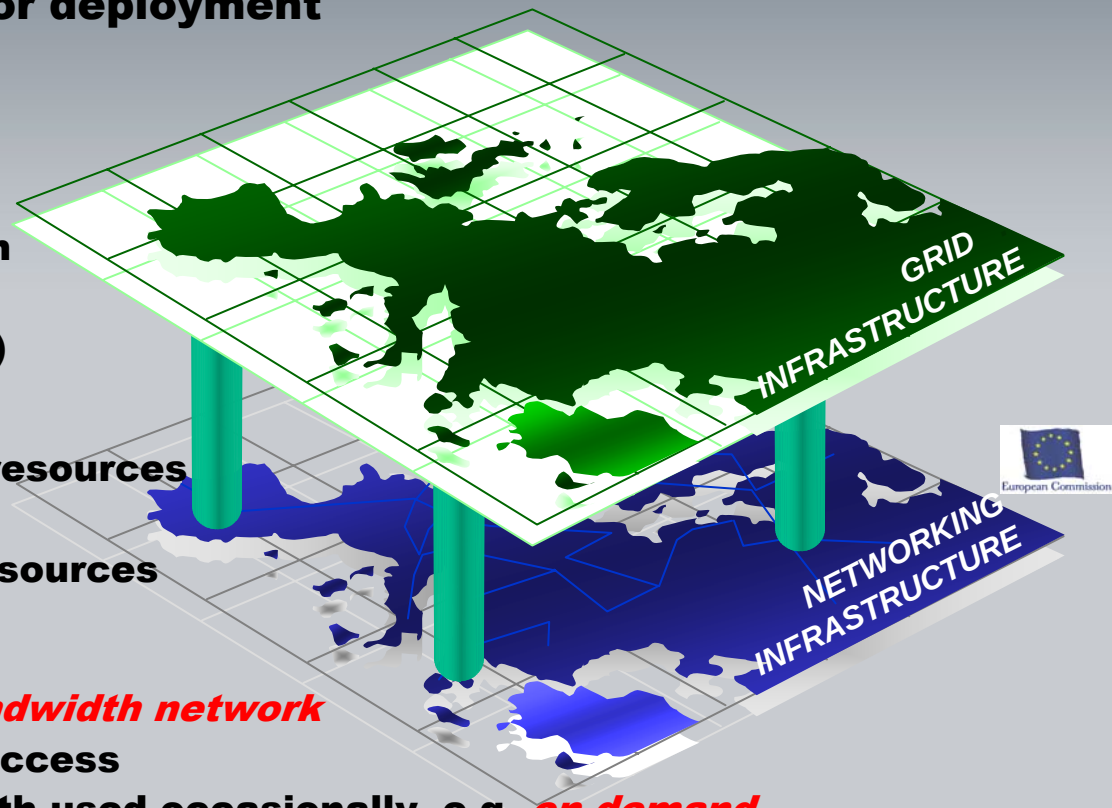
Material Science

- Remote sample changing and positioning
- Visualization of the obtained data (for some instruments)
- Preparation and treatment of samples where the experiment is carried out
- Use specific software to modelling different processes
- Possibility for changing experimental conditions.
- Possibility for preliminary training (including remote training)
- Usage of friendly interface, easy to learn and use
- Treatment of the samples
- Provide information about technical parameters of instrumentation,
- Contact with an operator during the measurement
- To have same access efficiency as conventional (not remote) use.
- Knowledge on the instrumentation type, its software and technical parameters in advance
- Instruction of sample preparation

Conclusions (#2)

Framework ready to be used for deployment
Collaborative environment

Interactivity
Visualisation
Advanced resource reservation
AAA, business models
Service Level Agreement (SLA)



Virtualisation of resources
Network buffers
Computational resources

High bandwidth network
On-line access
Bandwidth used occasionally, e.g. *on demand*
QoS, jitter
Reliability
Sustainability
Security on technology level

RinGRID - further steps

- Analysis of the scientific instrument requirements with respect to the present research network infrastructures
- Analysis of the scientific instrument requirements with respect to the present state of the art of grid middleware and other grid- enabled software
- Requirements definition of infrastructures for remote instrumentation systems
- Analysis of future trends concerning network technologies that may be used to access remote instrumentation services and virtual research laboratories
- Guidelines for the development of new software services enabling user-friendly interactions (e.g. access, control, monitor) with remote scientific devices

- Recommendations for the development of virtual research laboratories to reduce access costs and expand accessibility to top-level instruments

Summary

Networking + Grid + Instrumentation

e-Infrastructure

Software framework ready for deployment

Ecosystem

- **stable, reliable**
- **ready for deployment**

Thank YOU !

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