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

Virtual Laboratory Server

User Interface

Authorization Centre

Accounting

Monitoring

Digital Science Library

Grid Gateway

Dynamic Measurement Scenarios

Global Scheduling

Local Scheduling

Device server 1

Job Submission

Laboratory device

Device server 2

Job Submission

Laboratory device

Device server N

Job Submission

Laboratory device

Outside modules

Virtual Users Accounting System

Computational server

Visualization server

GRMS

Grid environment

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