Tuning in to the virtues of virtual labs

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(PhysOrg.com) -- The grid's huge communication and computation capacities could let scientists gather data and run remote experiments anywhere in the world. European researchers have now mapped out how that can be done.

Two years ago, researchers in the European-funded project RINGRID - Remote Instrumentation in Next-generation Grids - took on the challenge of mapping out how scientists round the world can efficiently carry out remote research using the 'grid'.

The GRID is the emerging next-generation internet. It uses fibre-optic cables and advanced routers to carry torrents of data some 10,000 times faster than broadband and to connect thousands of computers and supercomputers worldwide.

The researchers at RINGRID view the grid as a rich new environment in which - with the right tools - scientists anywhere in the world can collaborate, control instruments, run experiments, and tap into the grid's vast computing power.

Marcin Lawenda, deputy coordinator of the RINGRID project, sees great potential for remote research using the grid in the not-too-distant future.

"Then, almost all rare and expensive laboratory devices will be accessible to the worldwide science community via virtual laboratories," he says. "Thanks to remote access and collaboration tools, data could be

easily shared and scholars from different countries or continents will be able to work together."

Blueprints for virtual labs

From the start, the RINGRID researchers knew that they needed to help scientists access the grid's capabilities as simply and consistently as possible. If it was feasible, they wanted to design interfaces and protocols that could be used to set up and control many different kinds of experiments using different kinds of instruments and generating different kinds of data.

"We analysed the general aspects of remote instrumentation," says Lawenda. "Many scientific communities were taken into consideration, along with their needs in terms of scientific devices and the requirements of those devices."

RINGRID researchers worked with more than 50 scientists in a wide range of disciplines in order to learn what kind of equipment they use and how they carry out their research.

By identifying the most general and universal steps involved in setting up and carrying out almost any kind of experiment, the RINGRID team were able to develop coherent guidelines for developing practical, user-friendly interfaces and protocols for remote research - in effect, blueprints for building virtual laboratories.

They detailed those guidelines in their White Paper on Remote Instrumentation, published in July of this year. The white paper details every step in the remote research process, from the kinds of physical instruments that can be used, through the process of representing the devices in a virtual interface, and on through experimentation and data collection, distribution, visualisation, and analysis.

Trans-Atlantic trials

To test the concepts and methods they had developed, RINGRID partners carried out two remote research trials.

In the first experiment, researchers in Mexico were able to study the effects of noise and fading on a video transmission in Italy. The researchers used a virtual research platform called GRIDCC, developed by a separate European-funded research group working in co-operation with RINGRID.

In a second trial, researchers in Chile used a different virtual-lab platform called VLab, developed at the Poznan Supercomputing and Networking Centre, to perform nuclear magnetic resonance spectroscopic measurements in Poland. Polish researchers then used a Chilean system called UCRAV to perform similar measurements in Chile.

These experiments allowed the RINGRID researchers to note and respond to real-world challenges as well as technical and scientific issues.

“Many unexpected problems appeared,” says Lawenda, “for example communication delays, security issues, and transferring data via many administrative domains.”

However, Lawenda believes that the biggest remaining obstacles are neither technical nor practical, but educational. Most scientists and laboratory administrators are simply not aware of the potential for remote experimentation via grid computing.

“The most surprising issue in our research was low levels of awareness about remote instrumentation among device owners - institutes and laboratories,” says Lawenda. “In most cases, the owners of scientific

instruments and their users are not aware that it is possible to put their resources into the grid environment and make them remotely available for research."

Lawenda hopes that RINGRID's white paper and other publications and presentations will spur the scientific community to link their labs to the grid, and design and carry out much more collaborative and remote experimentation.

Two other European-funded research projects, DORII and EXPReS, are building on RINGRID's roadmap to push this process forward. The RINGRID project received funding from the Sixth Framework Programme for research.

Lawenda expects that the necessary grid infrastructure and fully functional systems for remote experimentation will be in place within five to seven years.

The challenge is to use that time to educate the scientific community to the many virtues of virtual laboratories on the grid.

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