GRID POWERED NETWORKING

Grid technology in action at new facility for the National Center for Supercomputing Applications

from The Projection Connection, an email newsletter from Sharp Electronics

Imagine a network that shares computational power much like the electric power grid shares electricity. Plug in anywhere and put 100 computers or 1000 to work on your problem with massive parallel processing, using clusters made up of computers and supercomputers scattered across the country.

Imagine a videoconferencing network that uses this same network grid, able to link up to 40 sites at once, each with multiple camera views displayed on a 2560 x 2048 resolution display wall.

Imagine an alliance of thousands of scientists striving to bring this kind of network power into your home and your office, to run common consumer items similar to, but much more powerful than your telephone or television set.

Think all of this is imaginary? Think again. I'm describing the Computational Grid and the Access Grid, technologies up and running today, designed by members of the National Computational Science Alliance and showcased at TRECC, an advanced collaborative facility in West Chicago, Illinois.

The Computational Grid –and Access Grid videoconferencing

One of the issues that scientists face today is the raw amount of data that they can collect. For example, experiments planned for the European Laboratory for Particle Physics in Switzerland are expected to generate several petabytes of data each year. A petabyte is a thousand trillion bytes, more data than any computer in the world can handle. Researchers in atmospheric modeling, biomedical research, aerospace engineering and several other disciplines also have to deal with very large data sets. The only way to handle these kinds of problems is by pooling computer resources.

Such pooling is well under way. The National Computational Science Alliance, a nationwide partnership of more than 50 academic, government and business organizations led by the University of Illinois, has built a computational grid, known simply as the Grid, that links supercomputers, virtual environments, scientific instruments, large databases and research teams.

The idea of the Grid came from the network of power grids that bring us our electricity. When we plug a lamp into a wall socket, the power we're using could have been generated at any number of plants across the country. We don't know exactly where it's coming from and we don't care. In the same way, when a scientist submits a job to the Grid, he doesn't need to know where the processing will be done as long as the system keeps track of available resources, routes his work to a computer or combination of computers that can handle it, then returns the results to him.

According to Jonas Talandis, the U of I researcher most responsible for technology deployment at TRECC, "this technology is very much like the Internet 15 years ago, with a few specialists using it but tremendous potential for almost anyone. Distributed computing could be done person to person or device to device, meaning your telephone, your television and other common everyday consumer items could be using grid technology in the next decade or so."

A specialized offshoot of this system

The demo area with its four-screen display

is the Access Grid, a high-bandwidth videoconferencing system that runs on the network that makes up the Grid. The Access Grid is used for distributed meetings, remote visualization, and distance education.

"What really makes the Access Grid different," says Talandis, "is that it's designed for group-to-group collaboration. For one thing, there are typically three to four video streams from each node, so you get a spatial sense of each group's surroundings and environment. In a typical session you would start with a wide shot of the audience. You would have one camera trained on your display set, so I can see what you're seeing. You would have a close-up of whoever is holding the floor. The fourth stream could be a long shot of that presenter, or we might reserve it for data."

There's more involved than a lot of video. Talandis says "the tech should be as transparent as possible. The whole idea is that you and I can sit around and chat amicably, as if we were standing around a water cooler and not necessarily in a studio. We have a number of pan tilt zoom cameras in each room, and the microphones are either tabletop ambient or ceiling mics, but they're out of the way."

In addition to requiring specially fitted sites, Access Grid connections can take a lot of bandwidth. Talandis says a typical site will have DS3 capability, or 44 megabits per second, though many participate with less. Right now TRECC is using an OC3 line running at 155 mbps, but they expect to upgrade to an OC28 soon. They use this bandwidth for many purposes beyond the Access Grid connection.

TRECC and its purposes

TRECC, the DuPage Technology Research, Education and Commercialization Center, is a program of the University of Illinois at Urbana-Champaign, funded by the Office of Naval Research and administered by the National Center for Supercomputing Applications. According to Gail Tate, director of the facility, the TRECC mission is to:

- Showcase and demonstrate University of Illinois technology research, from both the Chicago and Urbana-Champaign campuses. TRECC currently showcases several leading-edge technologies, including 3D visualization, a new graphics cluster, their own grid-enabled computational cluster (which is a supercomputer made up of 24 smaller Linux systems harnessed together) and advanced data mining and search capability projects.
- Develop new educational applications and learning systems for small business owners, educational administrators and teachers.
- Accelerate technology transfer and commercialization of emerging technologies of interest to government sponsors.

TRECC's functions as a showcase vary with the client. For example, staff have been working recently with engineers from the Center for Asymmetric Warfare in California. Talandis says this offshoot of the Department of the Navy is interested in applying Access Grid technology to some of their laboratory and systems communications. "We've given them," says Talandis, "demonstrations of the Access Grid and we're helping them spec hardware and software that they can experiment with. We're showing them the basic technology, and then they will do the value-add needed to make the application work for them."

The training area with its three-screen display

The Battelle Memorial Institute, a subcontractor on the TRECC project, has been running quite a bit of small business training in the facility. Battelle seeks entrepreneurs capable of developing technologies that meet some need of the Navy or Department of Defense, but these small businesses often need consulting help. Battelle may find engineers, for example, able to build a product based on some advance useful in the war on terrorism, but who have little knowledge of finance or of working with the government. So they bring them to TRECC for training and to put them together with DOD researchers and managers. These meetings are usually face to face but may use the Access Grid or one of TRECC's more

standard videoconferencing systems.

The AV systems at TRECC

The TRECC facility consists of staff offices plus five meeting areas, each with AV systems designed and installed by Sound Vision, Inc., of Elgin, Illinois. The largest meeting room is particularly interesting, dominated by two 14' x 18' rear projection screens served by seven Sharp XG-V10 series projectors. This room is configured in a unique triangular layout, with the screens defining a rear projection room.

One side of this room is usually set up for training. It uses three Sharp XG-V10X XGA-resolution projectors in a 1 x 3 array. The other side, served by four XG-V10W SXGA projectors in a 2 x 2 array, is typically set up theater style for demonstrating technologies or for multi-site Access Grid sessions. Meeting participants can tie into the computational cluster and other computer resources using laptops linked by a WiFi network. In addition to the projectors, Sound Vision installed eight Sony pan-tilt cameras, a sound system that includes eight Shure hanging choir mics, and a switching system that can route any signal to any display anywhere in the facility. An AMX Netlinx system controls all five meeting rooms, each of can serve as an Access Grid node.

Top of page: an Access Grid session in progress
Directly above: the projection room at TRECC

According to Tom Allison of Sound Vision, the biggest challenge the firm faced in designing these systems was a lack of space in the projection room. "The client wanted to use this area for computer repairs as well as rear projection, and the physical space was not really large enough for both simultaneously. We were able to facilitate their needs by using a custom tower with mirror assemblies for two of the projectors. This freed up quite a bit of space on one side." Allison and manager John Miles specified the Sharp projectors for a combination of reasons, including brightness, resolution, the availability of appropriate lenses and cost. "We were looking," says Miles, "at projectors that cost three or four times what the Sharp did, but these did not fit the client's budget." "The Sharp product" says Allison, "became the only one that was going to work with all the constraints that we had in the rear projection area."

TRECC became operational in September 2003, and it continues to grow and change with the technologies it showcases. NSCA recently installed, for example, a computer graphics display cluster, which consists of a 16-node Linux cluster driving a 5 x 3 matrix of 18" XGA-resolution LCD displays. TRECC is expecting to add additional projectors to make the 1 x 3 projection display in the training area into a 2 x 3 display. He has 3D imaging at work in a smaller demonstration room but would like to see it in the main areas as well. Given the rapid development of grid technology and TRECC's mission to showcase it, almost anything is possible.

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soundvision

1450 DAVIS ROAD, ELGIN, ILLINOIS 60123
847.742.6000 • WWW.SVI-AVSYSTEMS.COM