Many processors make light work of calculations

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Solving complicated calculations has never been easy, but a new European computing grid means researchers can number crunch their data faster than ever before.

Personal computers may be getting faster, but the increasing amount of processing power is still not able to keep pace with what researchers need. The techniques used by researchers in physics, medicine, space, energy, and environmental science are generating more and more detailed data, which means that crunching these numbers down to get a definite answer is not getting any shorter despite technological advances.

The EU-funded Interactive European Grid (Int.eu.grid) tackles this problem by allowing researchers to access a grid or network of computers at ten sites in seven European countries – Spain, Portugal,

Germany, Poland, Austria, Ireland, and Slovakia. The Int.eu.grid joins the computers locally, and at a European level through the existing high-speed Géant research network.

The researchers focused on providing EU researchers with a transparent way to simulate, process and store large volumes of data. By making more computing power available to researchers, the grid will help them make groundbreaking advances in such fields as biomedicine, astronomy, the environment, and physics.

Combining the power of many

Grid technology is a means of combining the power of many computers, which may be widely scattered over different organisations or locations, through a network. These computers are harnessed to work together as a single computing system, allowing a user to draw on the available processing power of any computer on the network to perform complex tasks.

"Exploiting the fact that local users do not use all local power at the same time, sharing the resources allows us to optimise the use of the grid," says Jesus Marco, coordinator of Int.eu.grid. "This also provides more resources than what a user could get at his or her site at any given time, and that is [definitely] adequate to solve the problems in less time. Sharing time is a well-known mechanism in large computers, and here the idea is globally similar."

The Int.eu.grid technology gives European-based researchers access to the aggregation of processing power from the networked centres to achieve a processing speed up to 10,000 megabytes per second.

Researchers can interactively steer their calculations, and are supported by video streaming. And if the 200 or so current users need help, they

can get it at all stages, from the initial setup of a processing job to the final discussion of results.

The ability to process data faster is already helping doctors in the detection of breast cancer. Physicists have also used the grid to visualise the trajectories of particles, and environmental scientists have harnessed its power to gain additional insight into the operations of watersheds in the north of Spain.

"Int.eu.grid has provided a more transparent and powerful framework for researchers to execute interactive applications," says Marco, who works at The Institute of Physics of Cantabria in Spain.

He adds: "In this way, a complex task taking ten hours on a single computer can now be interactively executed in a few minutes, and the researcher can accelerate the results of simulations or new analyses."

The researchers developed the grid to make the user feel like he or she is running software programs on a single computer and not on a dispersed grid. Local resources are easier to access and execute than remote resources.

The grid also employs an application, called ‘Migrating Desktop’, which allows users to interact with the grid infrastructure like they were on a single computer. The application also allows users to prepare and send out tasks to the grid, store results and files, and visualise other applications running on the grid.

Collective processing for all

"The consortium has worked in close collaboration with the largest European infrastructure, EGEE, to integrate the achievements and make them available to a wider scientific community," says Marco.

European researchers have been using the grid for over a year. Access is open to any European research group that requires large and interactive computing power, he adds.

For example, astrophysicists working on the ESA's Planck Mission have made use of the grid to simulate the operation of the Planck satellite, calculations that will prove critical when they launch it in October 2008.

Bringing the focus back to earth, Spanish researchers are using their access to the grid to study the environmental properties of several watersheds in the north of Spain.

Meanwhile a company in Slovakia is using the grid to simulate the behaviour of pollution clouds over the course of a week by inputting weather and meteorological data. The company developed a complete model suite that can do the calculations in a matter of minutes over the grid, generating valuable information on air quality across Member States.

Physicists are also using the grid to study how particles move inside a 'stellarator' fusion reactor. Fusion researchers can use such high-value data to design more efficient future reactors.

Healthy contributions

In the medical field, access to the grid could offer significant potential for public health. For example, applying the grid's processing power to data produced by a new ultrasound imaging technique could lead to significant faster 3-D imaging for this new method of detecting breast cancer.

One measurement using the ultrasound technique produces about 20GB of data. A single workstation would require about ten days to reconstruct

a 3-D image based on 100 slices of ultrasound imaging, each one megapixel in size. Access to Int.eu.grid means such calculations can be done in a mere fraction of this time.

Similar results can be achieved for the visualisation and annotation of brain images. The grid allows researchers to use new algorithms to process large volumes of data faster.

The grid is geared towards enhancing the ease and speed of performing complicated calculations. Gaining access to the grid is also straightforward, says Marco, and starts with an applicant sending a simple email to the Int.eu.grid office.

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Source: ICT Results