Grid and Mesh Technologies

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Content

Differences between Grid and Mesh

The present and future of the computer industry relies on these technologies. In lots of articles they are said to be the same, but in fact they aren't. They are complementary.

Grid Computing

It is a form of distributed computing that instead of having a super computer with a cluster of closed computers, it relies on thousands of them distributed all around the world thanks to the benefits of the network. The advantage is the price and the escalability. Grid Computing is being used in computationally-intensive scientific, mathematical, and academic problems.

Mesh Networking

It is a way to route data, voice and instructions between nodes. It totally acts like a mesh, allowing for continuous connections and reconfiguration around broken or blocked paths by "hopping" from node to node until the destination is reached. The advantage is the flexibility against the traditional closed "tubes". Wireless mesh networks are the most topical application of mesh architectures.

Grid Computing

Grids versus conventional supercomputers

Grid computing is a type of parallel computing which relies on lots of computers connected to a network. In contrast, supercomputers have many processors connected by a local high-speed computer bus.

The main advantage of distributed computing is the price. Thanks to the economy of scale, buying “normal” computers is much cheaper that buying processors for supercomputers. Combining the power of hundreds or thousand of “normal” computers, you get the same or better results, but at lower cost. The high-end scalability is another of its strenghts, allowing dozens of thousands of computers all around Internet to work on the same problem.

However it’s not suited for all kind of applications. The main disadvantage is that computers do not have high-speed connections, so applications that need to communicate intermediate results between processors can’t rely on this technology. Also, the programming and deployment technologies are differents so they need special solutions (custom operating system, technology to solve concurrency issues).

There are another considerations that have to be looked at. Due to the lack of control, the results of an individual computer are not trustworthy (it can be altered), there is no way to guarantee that nodes will not drop out of the network at random times. They must be taken in consideration when designing the grid.

Current applications

Grid computing is being used in several fields like mathematics, medicine, molecular biology, climatology, and astrophysics.

BOINC (Berkeley Open Infrastructure for Network Computing) is a non-commercial system for volunteer and grid computing. Its origin was the SETI@home project. Nowadays it's used as a platform for many other distributed applications. The purpouse of BOINC is to make it possible for researchers to tap into the enormous processing power of personal computers around the world. BOINC has more than 565,000 active computers worldwide processing on average 1.2 PFLOPS (July 2008), storing 12 Petabytes of data. BOINC is funded by the National Science Foundation. Some of the projects that are being solved are:

- **SETI@home**: *Search for Extra-Terrestrial Intelligence*. It was the first project of BOINC, trying to detect intelligent life outside Earth, provided by the Arecibo radio telescope. While the project hasn't reached the goal of finding extraterrestrial intelligence, it has proved that Grid Computing can succeed as a viable analysis tool, and even beat the largest supercomputers.
- **Rosetta@Home**: Determine the 3-dimensional shapes of proteins to fight diseases like HIV, Malaria, Cancer and Alzheimer.
- **PrimeGrid**: Determine the highest prime number so it can be used to improve computer cryptography.
- **Ibercivis**: Spanish project to support Spanish research in several areas like physics, material science and biomedicine.
- **Climateprediction**: Investigate the aproximations that have to be made in the actual climate models.
- **Einstein@home**: Search fo spinning neutron stars using data from the LIGO and GEO gravitational wave detectors. It's a World Year of Physics 2005 project.

Folding@home is a distributed computing project designed to perform computationally intensive simulations of protein folding and other molecular dynamics (MD). Since its launch on October 2000 by Stanford University's chemistry department, it has become in the most powerful distributed computing cluster in the world. As in BOINC, the primary contributors to the Folding@home project are many hundreds of thousands of personal computer users who have installed a small client program. In October 2008, the project has reached over 4.1 PFLOPS from over 340,000 active machines, and it has received computational results from over 3.3 million devices. Thanks to the results more than fifty scientific research papers have been published and it has improved the research results by more than thousands of times. Sony is helping this project through the Play Station 3. They have developed a folding client that runs on the PS3 while the user is not playing. By April 2007, the console accounts for around 40% of all teraFLOPS at an approximate ratio of 35½ PS3 clients per teraFLOPS.

World Community Grid is an IBM philanthropic initiative which aims to create the largest public computing grid benefiting humanity. It utilizes the BOINC platform. Fighting AIDS, Dengue drugs, Cancer or predicting the protein structures of rice in order to help rice breeders create more abundant, resilient and nutritious harvests; are some of their projects.

EGEE (*Enabling Grids for E-sciencE*) is a Grid Computing European Union project, it is the largest multi-disciplinary grid infrastructure in the world. One of its main applications is the LHC Computing Grid, that will help CERN Large Hadron Collider to handle huge amounts of data, several gigabytes per second (15 petabytes per year).

Mesh Networking

Fundamentals of Mesh networks

Mesh Networking is a way to route data, voice and instructions between nodes. The main advantage against normal conexions is that it allows for reconfiguration around broken or blocked paths by “hopping” from node to node until the destination is reached. All the component parts can all connect to each other via multiple hops.

Mesh networks can be seen as one type of ad hoc network. If the nodes are mobile, they also have to deal with the problems introduced by the mobility of them. Thanks to this connected network, the network can still operate even when a node breaks down. This solution brings a very reliable network.

Current Applications

The most typical application is wireless mesh networks. Their origin was military, with secret projects; but thanks to the low cost of radios and lot of research, there has been a significant evolution in the past decade. Radio products started to support more radios per mesh node , and the mesh node design became more modular (multiple radio cards on one box).

The famous **XO-1 laptop or "OLPC"** (the $100 portable computer) uses mesh networking to create a robust and inexpensive infrastructure in places where there are few conexions to the Internet or letting users to connect with each other. For example they achieved to offer email services to 1000 schoolchildren in Cambodia with only one conexion to the Internet.

Meraki is a company that provides hardware and software for wireless community networks. It creates a wireless network that coordinates with Meraki servers to distribute its user-volunteered Internet bandwidth. In 2007 Meraki launched a mini wireless mesh router, providing coverage over 250 meters, that let computers to surf up to 50 megabits per second. In July 2008, Meraki claimed 100,000 people using its mesh network in the city of San Francisco. In the initial phase they were working on Roofnet, an experimental mesh network under development at MIT that tries to provide better performance and new protocols which take advantage of radio's unique properties.

Another interesting project is **SolarMESH**. They try to combine the potential of mesh networks with solar power and rechargeable batteries. It's in phase of development because it's not clear it could work with the current WiFI specification.

In Monterrey, California, The **Naval Postgraduate School** built a wireless mesh network for controlling border security. They launched balloons with aerial cameras which provide real time high resolution video via a mesh network. Mesh networking was also used in **Cambridge** (UK) to run mobile live television, radio and internet services to 80,000 people.

Business Idea

Commercial Grid Computing

Mostly all the grid projects explained before are promoted to solve scientific problems from important research centers. However the grid technology can be used by any company which require a high computacional power to solve their problems. Some of them could be the aerospacial, the automobile, the pharma or the financial industry among many others.

Using the software developed by Berkeley (BOINC), it's possible to develop a grid network with thousand of computers all around the world that will help to solve non-commercial AND commercial problems. We can integrate both worlds, if it is non-commercial the user is a volunteer (like now with mostly all the grids) but if it is commercial, the user will be paid for his help.

This incentive will bring more users to the grid community. It's a way of helping solving problems and at the same time earning money for the next computer. Currently there are more than 1 billion computers worldwide, which only 1 million are currently helping in the grid community. There is many space to grow. This is only the beginning.

Welcome to CGC!

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