Role of Grid Computing in Indian Education

Dr. Ditu Soni

Head, Computer Science & Application

Guru Nanak Girls College, Santpura

Yamuna nagar, Haryana

India - 135001

Mrs. Jyotsna Sharma

Lecturer, Computer Science & Applications

Maharaja Agrasen Institute of Information & Technology,

Jagadhri,Yamuna nagar, Haryana

India – 135001

Abstract : A grid is a collection of distributed computing resources available over a local or wide area network that appear to an end user or application as one large virtual computing system. Grid computing has serious social consequences and is going revolutionize the world of computing. Education is one domain that can be benefited the most from grid computing. The focus on leveraging technologies and products from academic institutions around the world in the areas of e-learning, front-end portals, library automation and digital asset management to promote the sharing and collaboration in the use of technologies, developing content, defining standards and building best-of-breed pedagogical practices is the new upcoming trend. With a lot of work going on in this emerging domain , internationally, India too has joined the bandwagon to contribute to the development in this discipline, This paper aims to present the state-of-the-art of grid computing and attempts to survey India's efforts in developing this upcoming technology. By allowing anyone, anywhere, anytime to easily access supercomputer level processing power and knowledge resources, grids are underpining progress in Indian Education.

Keywords: Grid Computing, Seamless Scalable Computing ,Global Computing ,Distributed Computing,Web based Education, Metacomputing, Grids.

Introduction

Just as the World Wide Web evolved to satisfy the need for information sharing

globally; Grid Computing has evolved to satisfy the need for sharing computer power and data storage globally. Just as an Internet user views a unified instance of content via the Web, a grid user essentially sees a single, large virtual computer(IBM n.d.). This analogy extends to the evolution pace too. The web evolved slowly but as soon as solid standards and tools appeared there was a tremendous growth. Similarly, though grid computing is presently at a fairly nascent stage, it is seen as a cutting edge technology .

Grid computing is an approach to distributed computing that spans not only locations but also organizations, machine architectures and software boundaries to provide unlimited power, collaboration and information access to everyone connected to a grid (Foster & Kesselman, 2003). The distributed computing resources available over a local or wide area network appear to an end user or application as one large virtual computing system. Almost all scientific or technical problems require a great number of computer processing cycles. They may also need access to large amounts of data .Such problems may require a variety of heterogeneous resources not available on a single computer. The solution lies with grid computing where the resources of many computers in a network can be applied to a single problem at the same time.

There are a variety of applications that can benefit from the grid infrastructure, including collaborative engineering, data exploration, high throughput computing, and of course distributed supercomputing. Education, particularly distance education & higher education stand to reap significant benefits from grid computing by creating environments that expose students to the various aspects of their discipline. For example, for a science student, rather than using mock or historical data from an observatory, a grid could let students at different geographical locations to actually use those facilities and collect their own data. Learning experiences become far richer, providing opportunities that otherwise would be impossible or would require travel. The access that grid computing offers to particular resources can allow institutions to deepen, and in some cases broaden, the scope of their educational programs.

Leveraging Grid Computing in Education: Major Indian Initiatives

a) Garuda India : The National Grid Computing Initiative

The Center for Development of Advanced Computing (C-DAC) has been funded by the Department of Information Technology (DIT),India to deploy the nation-wide computational grid 'GARUDA'. Grid Computing has been identified by C-DAC as a major thrust area for the future.The "Proof Of Concept (PoC) phase of National Grid Computing Initiative: Garuda, involving high speed communications fabric; aggregation of geographically distributed resources (computing, data, storage, software and scientific instruments); architecture, standards, research and technology development; and end-to-end applications development and demonstration has been initiated.

GARUDA aims at strengthening and advancing scientific and technological excellence in the area of Grid and Peer-to-Peer technologies. To achieve its objective, GARUDA brings together a critical mass of well-established researchers, from 45 research laboratories and academic institutions from 17 cities across the country, who have constructed an ambitious program of activities. The 45

research and academic institutions being networked, comprise of 11 C-DAC (Centre for Development of Advanced Computing) centers, ERNET (India's Research and Education Network) and 36 academic and research organizations including all the Indian Institutes of Technology(IITs) and The Indian Institute of Science(IISc.),Bangalore.

The Grid monitoring Centre of Garuda is at Bangalore,India GARUDA will create the foundation for the next generation grids by addressing long term research issues in the strategic areas of knowledge and data management, programming models, architectures, grid management and monitoring, problem solving environments, tools and grid services.

A grid portal managed by C-DAC is used to access the GARUDA network and resources wherein, the users will have the option to choose from a fastest response to their task requests or deploying as many available computational nodes to their tasks or simply submitting job requests on a best effort mode of operation. The fabric component is set-up in partnership with Education and Research Network(ERNET). The GARUDA network is a Layer 2/3 MPLS Virtual Private Network (VPN) connecting select institutions at 10/ 100 Mbps with stringent quality and Service Level Agreements. This Grid is a pre-cursor to the next generation Gigabit speed Wide Area Network nationwide with high performance computing resources and scientific instruments for seamless collaborative research and experiments.

Garuda aims at researching applications characterized by intensive computing and data access requirements like Natural Disaster Management ,Bio-informatics applications and applications of national importance that require aggregation of geographically distributed resources .C-DAC, in association with the Space Applications Centre, which conducts space application research and development in satellite communication and remote sensing, will mine data from a network of sensors deployed over vast disaster prone regions and upload it to Garuda as input to forecast models for disaster management. The initiative will make dynamic sharing of resources and virtual collaborations possible among various research institutions of the country thereby, expectedly, giving a push to Indian education science, engineering and business. (Garuda India 2007).

Figure 1 : GARUDA Network Connectivity

b) BIOGRID

BIOGRID is a high speed and high bandwidth virtual public network (VPN) established by The Department of Biotechnology, Govt of India. It is envisioned that the BIOGRID will span all the 60+ Bioinformatics centers of the Department of Biotechnology with Gbps bandwidth and 10+ Teraflops of

computational power. Eleven nodes have been established in the first phase, which are actively pursuing bio informatics activities such as human resource development and R&D in bioinformatics besides, dissemination of biotechnology information to researchers in the country. The nodes are interconnected through 2mbps dedicated leased circuit line at each location and4Mbps Internet bandwidth shared from the central server by al the nodes. The BIOGRID allows exchange of database& software, which have been created/acquired by the individual centers/nodes of BTIS (Biotechnology Information System). This resource sharing helps in enhancing the value and usefulness of the BTIS.

The Department is supporting long-term teaching programs on bioinformatics and BIOGRID will be useful in sharing teaching materials, to deliver lectures through video conferencing-virtual classrooms besides synergizing research in biotechnology and bioinformatics. In the second and third phase the remaining centers and DBT institutions will be covered under the faster network. The mirror sites of internationally recognized genomic databases such as GDB, Protein Databank (PDB),Plant Genome Data Banks, and Databases of European Bioinformatics institute (EBI) .Public domain bioinformatics software packages are also available on the BIOGRID. The advantage of mirroring these databases in India is to provide unhindered mining of high quality data from well established primary and secondary information sources. Commercial software essential to carry out research & training in bioinformatics will also be made available through BIOGRID. The network will act as a knowledge pathway for discoveries in biotechnology and bioinformatics.

c) Kerala Education Grid

The Kerala Education Grid Project is an initiative undertaken by the Government of Kerala to provide quality education to all the students of higher education in the State of Kerala (India). The Kerala Education Grid provides web based course content as well as various collaboration tools such as message board, discussion boards, shared web space, Chats, asynchronous interaction between students or between students and teachers. The digital content includes streamed videos, technical and scientific journals and publications etc. (Kerala 2007)

Figure 2:The Kerala Education Grid Education Server and its Services

d) Other Indian Initiatives

To accelerate India's drive to turn its substantial research investment into tangible economic benefits ,there are many other initiatives .

Many other institutions in India have started active programs in Grid computing.

a. Sun Microsystems Inc has named Indian Institute of Information Technology and Management-Kerala (IIITM-K) as a Sun

Regional Center of Excellence (COE) for E-Learning. The first regional COE selected in India, IIITM-K becomes one of the four universities in the world to be recognized by Sun and the academic community as leading edge researchers in e-learning technologies.

b. IIT Kanpur is deploying Grid Computing hardware and software from Sun India, for its computer centre. The installation will make it the largest AMD Opteron HPTC (High Performance Technical Computing) cluster in the education segment in India. These companies used Grid Computing effectively to achieve considerable cost and productivity advantages. Here's a look at how some of the international leaders harnessed the technology to gain higher efficiencies and bottom line benefits:

c. The efforts of Anna University's Madras Institute of Technologies (MIT), who partnered with C-DAC in developing Grid technologies and applications are worth mentioning as they are also making Grids interfaces available in Indian languages. One of their effort was the development of Tamil (a language spoken in the south Indian state of Tamil Nadu) interface for their Grid Market Directory (GMD) user-interface. They also developed a Linux shell UI in Tamil.This is probably the world's first Grid technology with non-English language interface .

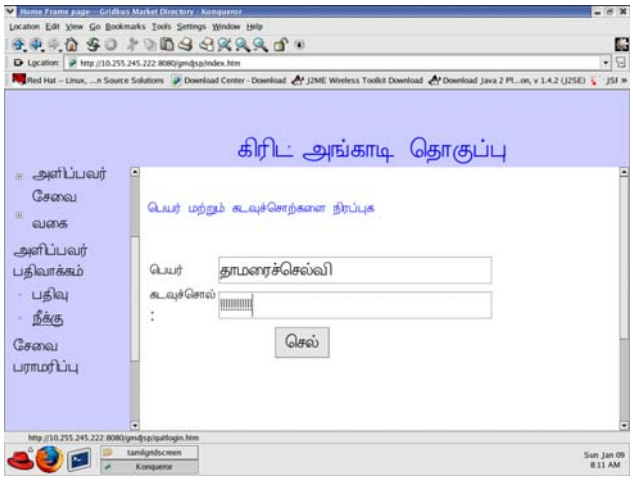

Figure 3 :Tamil(Indian Regional Language) Grid Interface

FUTURE TRENDS

Larry Smarr in (Foster 1999) observes that the effects of computational grids are going to change the world so quickly that mankind will struggle to react and change in the face of the challenges and issues they present..While challenges still lie in the path of large-scale adoption of Grid Computing on account of lack of standards, immature solutions, and lack of skills and experience at the vendor level, low awareness among users and the cost of initial investment in equipment and software, the technology is expected to proliferate by 2020.

The importance of international cooperation in grid technologies to benefit collaborative team science is now widely recognized and accepted. Most grids for scientific research are national in nature (e.g., TeraGrid in the U.S.,Garuda in India), and their software applications and middleware are tailored to run on the specific country's infrastructure. To make the infrastructure usable on a routine basis, in future, more work is expected to be done for the interconnection of the national grids.

CONCLUSION

Worldwide a great number of scientific and commercial applications have started harnessing the power of grid computing and India is not far behind.The Govt. of India and many key Indian companies are making efforts to move it beyond scientific applications into mainstream IT infrastructure. The efforts at international level ,national level and even state level projects ,promise a bright future for Grids.

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