Grid Computing
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The Era of Grid Computing: A new standard for successful IT strategies

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Grid computing: Driving new standards for succesful IT strategies

Business today moves fast and is getting faster every day. To gain a competitive edge, respond quickly to changing economic climates and react in a flash to variations in customer and market demand, companies need to be dynamic, nimble and flexible. They need to do business "on demand."

Creating an operating environment to support business on demand presents a significant IT challenge. It requires building infrastructures that are flexible, scalable and resilient enough to respond to unexpected surges in traffic and use. It means finding ways to quickly and easily deploy new workloads and grant employees instantaneous access to the resources they need. It demands integrating distributed, heterogeneous IT resources to work seamlessly together to support this new business paradigm. And of course, it means doing more with less, thus creating realistic cost structures that enable companies to fully leverage existing technology investments and scale as they grow.

The rise of grid computing

To meet this daunting challenge, grid computing has emerged as an enabling technology to help businesses efficiently consolidate, pool, share and manage IT resources. Simply put, grid computing is a services-oriented architecture that embraces heterogeneous systems and involves distributed computing—over the Internet or any private network—via open standards.

Utilizing grid technologies, IT departments can aggregate disparate technology capabilities such as compute resources, data storage, filing systems and more to create single, unified systems. At its core, grid computing enables devices—regardless of their operating characteristics—to be virtually shared, managed and accessed across an enterprise, industry or workgroup. This virtualization of resources places all of the necessary access, data and processing power at the fingertips of those who need to rapidly solve complex business problems, conduct compute-intensive research and data analysis and engage in real-time business on demand.

Highlights

Desktop Scavenging Grids take advantage of unused computing cycles—often on idle desktops. They lend themselves in particular to highly parallelized, distributed applications such as those used in the scientific and research arenas.

By virtualizing compute resources, grid computing helps to promote the efficient utilization and management of technology resources. As a result, grid computing fosters the creation of cost-effective, resilient IT infrastructures that are adaptable to change.

A grid-enabled environment provides new options for IT organizations by:

- *Efficiently utilizing IT resources including processing, storage and data*
- *Delivering robust, reliable technology infrastructures*
- *Establishing resource integration*
- *Offering greater freedom of choice and deployment for an IT infrastructure*

Flexible architectures for every IT need

While practical grid applications typically incorporate varying combinations of each, grids generally pull from three types of resources:

Desktops

Desktop Scavenging Grids can create access to a large pool of processing capacity resources. To accomplish this task, these grids take advantage of unused desktop computing cycles. The grid is designed to run in the background on end-user machines, most commonly as "screensavers" that function only when the PC is not in use. For this reason, its presence is almost completely transparent to users. Desktop Scavenging Grids lend themselves in particular to highly parallelized, distributed applications such as those used in the scientific and research arenas.

Servers

Server Grids can be used to create access to specialized devices required to enable a specific computation or process.

Server Grids are similar to Desktop Scavenging Grids because they are also focused on taking advantage of shared resources—in this case, server resources—while they are not being fully utilized. In addition, Server Grids can be used to create access to specialized devices required to enable a specific computation or process.

Highlights

Data Grids are designed to make a single source of data available for sharing and collaboration purposes. Data Grids also can be used to create a single, virtual view of a collection of data sources for large-scale collaboration.

Data

Data Grids are designed to make a single source of data available for sharing and collaboration purposes. Data Grids also can be used to create a single, virtual view of a collection of data sources for large-scale collaboration. This process is called "data federation." For example, some Data Grids such as the National Digital Mammographic Archive (NDMA) and the eDiamond Grid in the United Kingdom are designed to make large datasets—in these cases digital x-rays and the clinical information associated with them—available to many processing sites. By coupling the availability of these massive datasets with the large processing capability of grid computing, scientists and researchers can create applications to analyze the aggregated information. Searching the information for patterns or signatures enables scientists to potentially reach new insights regarding the environmental or genetic causes of diseases.

Grid computing and business today

Grid computing techniques can be applied to many business and IT situations including:

Research and development

Research and development (R&D) activities tend to be information- and compute-intensive, involving methods such as analytics, data mining and data extraction. For this reason, IBM has developed grid computing solutions for R&D markets such as the pharmaceutical, manufacturing and electronics industries; the medical research community; and academic institutions. IBM's grid solutions are designed to harness vast capabilities in the form of compute power and database resources and place them at the disposal of R&D professionals. In this manner, grid computing can help to boost the productivity of these researchers, thereby significantly reducing cycle time and time to market.

IBM grid solutions enable the exploitation of data and database management systems that can be amassed quickly and securely for "point-in-time" data warehousing capabilities, then disassembled immediately.

In addition, IBM R&D grid offerings enable the exploitation of data and database management systems that can be amassed quickly and securely for "point-in-time" data warehousing capabilities, then disassembled immediately. This capability is particularly important in competitive market environments that demand privacy and discretion around development.

Highlights

Using IBM grid solutions, businesses can take advantage of untapped compute and processing resources to impressively accelerate analytical processes—reaching end results far more rapidly and accurately than within conventional computing environments.

Business intelligence and analysis

Business intelligence and analytical grids are generally designed to carry out heavy data mining, data intelligence and data exploitation projects that would traditionally consume a comparatively long period of time (days or weeks). Examples of such projects include seismic and reservoir analyses in the petroleum industry and derivative analysis work in the financial services industry. Using IBM grid solutions, businesses can take advantage of untapped compute resources to impressively accelerate analytical processes—reaching end results far more rapidly and accurately than within conventional computing environments. In this manner, companies can utilize IBM grid solutions to greatly increase their ability to make sound, informed business decisions in a timely fashion.

Engineering and product design

Because they have adopted an extremely collaborative approach—incorporating vast numbers of partners, original equipment manufacturers (OEMs), suppliers and assembly plants—large manufacturing businesses face a unique computing challenge when it comes to engineering and product design cycles. For example, an automotive manufacturer developing a particular model might need to collaborate with thousands of parts suppliers in order to create its desired end product. In addition, each of those partners could potentially run different operating systems, applications and databases—an integration nightmare.

By creating unified product development grids, manufacturers can not only engender collaboration across their supply chains, but they can also take advantage of augmented computing capabilities to decrease cycle time, reduce development costs and improve time to market—ulimately delivering a higher value product to end customers.

Thanks to the open standards–based architecture that is the foundation of grid computing (Open Grid Services Architecture, or OGSA), these large manufacturers can virtualize disparate, heterogeneous systems into a single, powerful computing instance. By creating unified product development grids, manufacturers can not only engender collaboration across their supply chains, but they can also take advantage of augmented computing capabilities to decrease cycle time, reduce development costs and improve time to market—ulimately delivering a higher value product to end customers.

Highlights

Through grid, IT departments can gain access to expanded, virtualized networks of resources that can operate as backup and recovery systems for improved operational resilience and reduced infrastructure investment requirements.

Using grid computing technologies, IT organizations can realize benefits that can help them meet the challenges of the on demand era.

Grid computing provides a set of horizontal integration capabilities that effectively address the challenge of cross-enterprise, cross-function IT resource integration and even extend that solution among multiple organizations.

Enterprise optimization

With IBM grid solutions, organizations can quickly link together disparate resources to optimize workloads across them, thereby provisioning compute and data resources "on the fly" across enterprise boundaries. For example, while an enterprise's Tokyo office is closed for the day, the New York office can utilize the Tokyo office's infrastructure resources to augment processing power during market trading hours. This flexibility and scalability of capacity also makes it possible for organizations to provision computing capacity to meet average—not peak—demand, taking advantage of virtualized resources to meet unexpected surges in resource requirements and improve utilization of existing IT assets.

Using IBM grid technologies, companies can take full advantage of underutilized compute resources to serve as a platform for backup and recovery. Through grid, IT departments can gain access to expanded, virtualized networks of resources that can operate as backup and recovery systems for improved operational resilience and reduced infrastructure investment requirements.

Enabling a successful IT strategy

Through the use of grid computing technologies, IT organizations can realize benefits that can help them meet the challenges of the on demand era.

- **Integrate heterogeneous devices and systems**
  Because grid techniques are based on open standards, businesses can use grids to bring together disparate resources into single, unified and centrally managed instances. Grid computing provides a set of horizontal integration capabilities that effectively address the challenge of cross-enterprise, cross-function IT resource integration and even extend that solution among multiple organizations. The heterogeneous integration facilities of grid also make it possible for companies to access specialized equipment not previously available to them. For example, a scientist participating in a research grid could gain newfound access to a unique supercomputer connected to a cyclotron in a national lab—greatly aiding the problem-solving process.

Highlights

Grid computing helps businesses build cost-effective IT infrastructures that make full use of existing technology investments and do not depend upon over-provisioned, excessively cost-bearing IT infrastructures.

Grid computing makes it much easier for IT personnel to establish, reestablish and change the parameters of a secure, resource-sharing domain as business needs require.

Grid computing helps create IT infrastructures that can quickly respond to unexpected surges in traffic and use—an advantage in the "on demand" era.

- **Improve the cost-effectiveness of operating environments**
  Through virtualizing the consolidation, pooling, sharing and management of resources across heterogeneous IT functions, grid computing helps to simplify and streamline operating environments and their management for reduced administrative overhead. In addition, because it helps to promote the efficient utilization of technology resources, grid computing helps businesses build cost-effective IT infrastructures that make full use of existing technology investments and do not depend upon over-provisioned, excessively cost-bearing IT infrastructures.
- **Create flexible, secure "virtual collaboration" domains**
  Based on closed, proprietary systems and standards, security and resource-sharing domains today tend to be inflexible and cumbersome to manage. Once they are put in place, adding and removing users and resources can present an extremely difficult challenge. Grid techniques, on the other hand, embrace the notion of flexibility, freedom of choice and open standards. Grid computing is based upon the principle that grids have no "prior knowledge" of the resources that they aggregate together. Therefore, grids must be capable of dynamically discovering and adjusting to widely differing, fluctuating IT environments. For this reason, grid computing makes it much easier for IT personnel to establish, reestablish and change the parameters of a secure, resource-sharing domain as business needs require.
- **Increase resource capacity to respond to fluctuations in demand**
  By enabling IT organizations to aggregate distributed resources and exploit unused capacity, grid techniques greatly increase the amount of available computing and data resources. Grid computing helps create IT infrastructures that can quickly respond to unexpected surges in traffic and use–an advantage particularly in the "on demand" era.
- **Boost infrastructure reliability, improve operational resiliency**
  Taking advantage of grid resources as an alternative to traditional disaster recovery scenarios, IT departments can significantly improve the reliability and availability of their technology infrastructures for improved operational resilience at a fraction of the cost of a duplicate system. In addition, the virtualization of pooled resources enables administrators to easily monitor the progress and status of jobs across a variety of heterogeneous devices as if they were one system.

Highlights

IBM is a strong supporter of grid-based architectures.

IBM and the Globus Alliance: Leading the way to grid

In its commitment to grid computing and open standards, IBM is a strong supporter of grid-based architectures and the Globus Alliance, a multi-institutional research and development effort. The goal of the Globus Alliance is to address the technical and business challenges required to make grid computing a global success.

Founded by a team of technicians and researchers, the Globus Alliance has defined an open source grid reference architecture and a set of tools to assist in the implementation of grids. IBM and Globus are also sponsors of the Global Grid Forum, whose mission is to develop industry standards for grid computing. Other members of this forum include major IT suppliers and representatives from a growing number of industries. In collaboration with the Globus Alliance, this organization is dedicated to the development of grid technologies to support the specifications and standards set forth by the Globus Alliance.

OGSA brings together industry and grid computing standards to form a common technical base for grids the world over.

The Open Grid Services Architecture

Leading the way toward widespread adoption of grid computing, IBM and the Globus Alliance have published a set of specifications and standards that leverage the combined expertise of Web services and grid computing: the Open Grid Services Architecture (OGSA). OGSA brings together industry and grid computing standards to form a common technical base for grids the world over. As the result of collaboration by some of the best architects and technical minds in the industry, OGSA specifies an open standard for grid computing protocols and interfaces, leverages Web services and is designed to enable large-scale cooperation and access to applications through the Internet. IBM is actively participating in the development of the OGSA standard.

The OGSA standard is intended to help adopters of grid:

- *Manage resources across distributed heterogeneous platforms*
- *Deliver seamless quality of service (QoS) across integrated grid resources*
- *Provide a common base for autonomic management solutions*
- *Define open, published interfaces*
- *Exploit industry-standard integration technologies*
- *Integrate with existing IT resources*

Highlights

Using the Globus Toolkit, many individuals, organizations and projects have already developed higher-level services, application frameworks and R&D and engineering grid applications.

OGSA brings together standards such as WSDL and SOAP—important to Web services—with the standards for grid computing developed by the Globus Alliance. Through OGSA, Globus and IBM (as well as several other major IT vendors) have begun to specify open standards, grid computing protocols and Web services designed to enable large-scale cooperation and access to applications over public and private networks.

The Globus Toolkit

Working with Globus, IBM has created an enhanced version of the Globus Toolkit™ called the IBM Grid Toolbox. This toolkit provides a comprehensive set of tools and software for security, information infrastructure, resource management, data management, communication, fault detection and portability across a wide array of systems. IBM in concert with Globus is also developing a reference implementation of OGSA running on the IBM WebSphere® platform.

The IBM product foundation

The IBM @server product line forms a solid platform for designing and developing grid solutions, and even managing entire grids.

In an ongoing effort to support the establishment of open industry standards, IBM is currently designing its systems to embrace grid computing. By utilizing the breadth and depth of the company's wide array of products and services, IBM is taking an integrated and comprehensive approach to this new computing era. For example, the IBM @server® product line forms a solid platform for designing and developing grid solutions, and even managing entire grids. In addition, IBM DB2® products and tools support grid computing solutions to enable the rapid, easy construction of complex data infrastructures.

Strong working relationships with the providers of grid-enabling middleware solutions, provide IBM's customers with a comprehensive set of tools and capabilities to enable commercial grid solutions.

In addition, IBM has established strong working relationships with the providers of grid infrastructure software, including Platform Computing, DataSynapse, Avaki and United Devices. These relationships help IBM to provide its customers with a comprehensive set of tools and capabilities to enable commercial grid solutions.

Highlights

Through the development and management of its intraGrid, IBM has gained valuable, firsthand experience in building and operating true commercial computing grids.

The IBM vision of autonomic computing embraces the development of intelligent, open systems that are capable of adapting to varying circumstances and preparing resources to efficiently handle the workloads placed upon them.

Solid technology experience

Currently, IBM is an industry-leading supplier of grid solutions, services and expertise to the scientific and technical communities, as well as to commercial customers. In fact, many grid projects including Charles Schwab, The European Aeronautic Defense and Space Company (EADS), NTT Data, Royal Dutch Shell and the University of Pennsylvania Mammography Grid all leverage IBM grid technology for their day-to-day operations.

In addition, IBM Research has used Globus technologies to build its own research and development grid—the IBM intraGrid—that unifies IBM R&D resources around the world and serves as a test bed for grid services and solutions. Through the development and management of the intraGrid, IBM has gained valuable, firsthand experience in building and operating true commercial computing grids.

Grid and autonomic computing

The IBM autonomic computing initiative, which is focused on making software and servers that are self-optimizing, self-configuring, self-protecting and self-healing, is closely related to grid. Much like the principles of grid computing, the IBM vision of autonomic computing embraces the development of intelligent, open systems that are capable of adapting to varying circumstances and preparing resources to efficiently handle the workloads placed upon them. In this manner, autonomic technologies will help companies more easily and cost-effectively manage their grid computing systems.

IBM is working to make the long-range vision of autonomic computing a reality with the introduction of advanced technologies in its current line of hardware and software. At the heart of autonomic and grid computing are the self-management capabilities throughout the IBM software and server product lines.

Highlights

IBM Global Services—along with key IBM Business Partners—provide a full range of grid-related services.

Backed by IBM

Leveraging the industry expertise of IBM Business Consulting Services and the deep knowledge of the On Demand Innovation Services research team, IBM Global Services can help you tackle complex problems unique to your business with IBM grid solutions.

Using proven consulting methodology, IBM Global Services can help you dive deep into your business processes and overall environment to find the opportunities for grid computing with the potential to derive the greatest value for your organization.

Grid Innovation Workshop

As part of IBM's strategic approach, with a two- or three-day session, IBM consultants work with you to prioritize your list of grid computing opportunities, develop a high-level plan and begin to develop a business case.

IBM Grid Value at Work

Determining the greatest return on investment for a project is critical to business decision making, but it can often take more time than you would like. IBM consultants can help you determine your business goals, and then rapidly map a strategy that takes into consideration the total cost of transforming your business. Using templates and simulation modeling for financial calculations, this industry-leading, patent-pending tool and methodology draws on IBM Global Services' years of customer engagements and can provide the analysis and roadmap you need to start small and grow with grid computing.

Highlights

As the e-business environment continues to expand, grid computing will serve as a key technology tool to help IT organizations deftly, efficiently and cost-effectively develop operating environments.

Grid Solution Deployment Services

IBM Integrated Technology Services professionals can help integrate your new grid computing environment—no matter how heterogeneous or complex it may be. From application porting and support services to Strategic Outsourcing, which is designed to enable you to focus on your core activities, IBM can help you align your IT infrastructure with business goals for a successful grid computing deployment.

In addition, IBM provides a wide variety of educational offerings—ranging from Web lectures to classroom courses and customer briefings—all designed to meet customers' grid-readiness needs.

Enabling a winning IT strategy

Increasingly, as companies move into the on demand era, they will turn to their IT organizations in search of operating environments to support this new business approach. They will seek technology infrastructures that move and grow alongside them, fluidly reacting to fluctuations in market and customer demand. They will look for ways to quickly enable new resources and make the most of existing ones. In short, they will turn to grid computing.

As the e-business environment continues to expand, grid computing will serve as a key technology tool to help IT organizations deftly, efficiently and cost-effectively develop operating environments to support business in this on demand era. With the help of technology leaders such as IBM and Globus, IT professionals will be one step closer to establishing successful IT strategies to meet their specific business requirements—now and in the future.

For more information on grid computing, please visit **ibm.com**/grid.

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