IBM

IBM Departmental Supercomputing Solutions

Now, with the recent introduction of densely packaged rack-optimized servers and blades along with advances in software technology that make it easier to manage and exploit resources, it is possible to extend the benefits of clustered computing to individuals and small departments.

Highlights

■ *Complete High Performance Computing (HPC) solutions with pre-tested, densely packaged clustered servers deliver high performance at a modest price*

■ *Includes innovative software tools making cluster systems management easy while reducing the time it takes to use the solution productively*

■ *Choice to run either Linux or Microsoft® Windows® environments for enhanced flexibility*

Affordable Supercomputing for HPC Departmental Users

Scientists, engineers and researchers have long chosen clustered servers as the preferred solution for large, complex and computational- and data-intensive problems. Clusters have also proven to be a cost-effective method for managing mixed HPC workloads. It is common today for clusters to be used by large corporations, universities and government labs to solve problems in life sciences, petroleum exploration, structural design, high-energy physics, finance and securities, and more.

With the IBM Departmental Supercomputing Solutions, barriers to deploying clustered servers—high price, complexity, floor-space requirements, power consumption levels— have been overcome. Clients with smaller budgets and staff but with challenging problems to solve can now leverage the same supercomputing technology used by large organizations and prestigious labs.

IBM Departmental Supercomputing Solutions are offered in a variety of packaged, pre-tested clustered configurations. Clients have the flexibility

to choose configurations with 1U (1.75 inches high) servers or blades in reduced-sized racks and with Intel® Xeon™ or AMD Opteron™ processors. Clients can choose to run Linux or Microsoft Windows operating systems. Clients have access to information about software products from IBM vendor partners that can help them choose the right tools to enhance their productivity and help them acquire trial or permanent license versions of software. And, IBM offers optional implementation and technical support services and attractive leasing and financing options.

- *Do you or your organization have workloads that have become too complex to solve in a reasonable amount of time or with the required precision on your current computing system?*

- *Have you determined that a clustered solution would be the best approach to handle workloads but have not deployed one because of lack of budget, skills or physical space?*
- *Are you concerned that your organization's competitiveness is threatened because your HPC system can't expand with the growth of workloads?*

IBM Departmental Supercomputing Solutions may be the ideal choice.

Clustering for Performance and Growth

Clustering of servers has become a popular approach to solving large, complex HPC problems because very high levels of sustained performance can be delivered in a cost-effective manner. Clusters are also popular because workloads can be partitioned and managed flexibly, resources can be balanced against the available workload, and systems can be expanded incrementally as workload increases.

But despite all the advantages of clustering, users should be aware that clusters can be difficult to construct from scratch. There are many technical alternatives to consider, and slight mismatches between components in a cluster can result in poor performance, lowered reliability and administration nightmares.

IBM Departmental Supercomputing Solutions are comprehensive cluster packages offered in a variety of configurations to suit the needs of most smaller organizations. Each cluster consists of compute servers devoted to running applications, a management server in place for administering the cluster resources, and a network interconnect to allow communications to and among the compute servers. (See table for a list of cluster configuration choices.)

Choosing the right compute servers is the key to successful cluster deployment. IBM Departmental Supercomputing Solutions offer the following choices:

- **IBM @server® BladeCenter™ HS20**—*Up to 14 dual Intel Xeon processor blade servers in a 7U chassis*

  BladeCenter modular design gathers computing resources into cost-effective, high-density enclosures that support hot-swappable, high-performance 2-way Intel processor-based blade servers. The BladeCenter design addresses most serious issues: space constraints, manageability, scalability, capacity, performance, cooling and power. BladeCenter servers are designed to take less time to install, fewer people to maintain and cost less than a traditional server solution, helping reduce IT infrastructure costs. BladeCenter technology features deliver an effective scale-out architecture that makes adding capacity simple and affordable.

- **IBM @server xSeries® 335**—*Dual Intel Xeon processor server in a 1U rack-optimized form-factor*

  With dual high-speed Intel Xeon processors, the x335 delivers maximum xSeries performance density in a flexible server package. The x335 helps deliver the performance that businesses need to succeed, the manageability to unburden IT staff, and reliability to provide peace of mind.

- **IBM @server 325**—*Dual AMD Opteron processor server in a 1U rack-optimized form-factor*

  Designed for HPC, the e325 is ideal for customers who need leading 32-bit performance with an easy migration path to 64-bit computing at an affordable price. The AMD64™ architecture uses an integrated memory controller and innovative HyperTransport™ technology to provide memory access and substantial I/O bandwidth at the speed of the processor. In addition to delivering outstanding 64-bit price/performance, the e325 enables clients to run both 32- and 64-bit applications simultaneously. This feature gives clients the flexibility to run existing applications and operating systems at peak performance today—while also providing a 64-bit migration path for future applications to grow as your business needs grow.

Single point of control simplifies management

These compute servers are combined with the powerful **IBM @server xSeries 345** management server which is the single point of administration for all cluster resources. The x345 communicates with every compute server in the cluster over a highly secure Ethernet virtual LAN (VLAN). Each IBM Departmental Supercomputing Solution also includes a separate Gigabit Ethernet VLAN interconnecting all compute servers for application internode communications, and a terminal server network for remote console capability.

The IBM Departmental Supercomputing Solutions are packaged in economical and space-saving 11U and 25U cabinets along with the larger 42U cabinet. All configurations have been optimized for balanced performance, efficient cabling, proper cooling—and each system is packaged and tested *as a cluster* in the factory before being shipped to clients.

High Performance Computing

IBM Departmental Supercomputing Solutions—Cluster Configuration Choices

4-node cluster featuring 1U xSeries 335 compute nodes in 11U rack
A small-scale, 4-node, expandable cluster ideal for high availability, infrastructure, or departmental workloads that utilizes dual Intel Xeon processor x335 servers for compute nodes and the powerful dual Intel Xeon processor x345 for cluster management node.

4-node cluster featuring 1U eServer 325 compute nodes in 11U rack
A small-scale, 4-node, expandable cluster ideal for high performance 32-bit and/or 64-bit departmental workloads that utilizes dual AMD Opteron processor e325 servers for compute nodes and the powerful dual Intel Xeon processor x345 for cluster management node.

8- and 16-node clusters featuring 1U xSeries 335 compute nodes in 25U rack
These 8- and 16-node clusters feature dual Intel Xeon processor x335 1U servers for compute nodes and the powerful dual Intel Xeon processor x345 for the cluster management node.

8- and 16-node clusters featuring 1U eServer 325 compute nodes in 25U rack
These 8- and 16-node clusters feature dual AMD Opteron processor e325 1U servers for compute nodes and the powerful dual Intel Xeon processor x345 for the cluster management node.

14- and 28-node clusters featuring IBM @server BladeCenter in 25U Rack
These 14- and 28-node clusters feature our IBM @server BladeCenter HS20 for compute nodes and the powerful dual Intel Xeon processor x345 for cluster management node. The 14-node cluster utilizes the BladeCenter chassis with 14 dual processor HS20 blade servers sharing redundant resources such as power supplies and cooling fans. The 28-node cluster configuration utilizes two chassis with 14 blade servers installed in each.

32-node clusters featuring xSeries 335 compute nodes in 42U enterprise rack
This powerful 32-node Cluster 1350 features dual Intel Xeon processor x335 1U servers for compute nodes and the powerful dual Intel Xeon processor x345 for the cluster management node. The 42U enterprise rack includes all required cabling as well as a 17" flat panel monitor. This design is readily expandable, and can be configured to your individual needs if necessary.

32-node clusters featuring eServer 325 compute nodes in 42U enterprise rack
This powerful 32-node Cluster 1350 features dual AMD Opteron processor e325 1U servers for compute nodes and the powerful dual Intel Xeon processor x345 for the cluster management node. The 42U enterprise rack includes all required cabling as well as a 17" flat panel monitor. This design is readily expandable, and can be configured to your individual needs if necessary.

Table 1.

Innovative Software Brings the Cluster to Life

Software is what turns a collection of interconnected servers into a powerful yet manageable cluster for high performance and scalable computing. The IBM Departmental Supercomputing Solutions are delivered with cluster management software from IBM. Downloadable trial versions of software tools from IBM partners are available. The Linux or Microsoft Windows operating system is provided by the client. The collection of software helps derive maximum performance and utility from the cluster as well as ease systems management and enable rapid time-to-productivity.

Software components

- **IBM Cluster Systems Management (CSM)**
  CSM is advanced systems management software that allows a cluster of supported Intel and/or AMD Opteron processor-based servers running Linux to be managed from a single point of control.

This capability simplifies the management of the cluster and easily scales with the cluster to improve the efficiency of the person running the system. The administrator can monitor hardware and software events and CSM can trigger automated recovery actions when appropriate. Using CSM, the administrator can perform software installations and updates on nodes, run distributed commands, and synchronize files across the cluster. CSM can be used to automate security configuration and administration and perform diagnostics. The administrator can learn the status of each server in the cluster at any time, and remotely power on and off any server. By providing a single point of control with robust cluster management capabilities, CSM can simplify total systems management and help increase cluster availability.

- **IBM Linux Cluster Install Tool (LCIT)**
  LCIT is a utility and diagnostic tool for Linux users who prefer to have more direct involvement in the setup of the cluster. The IBM Departmental Supercomputing solutions include a unique and comprehensive application to assist in the deployment and management of Linux clusters. LCIT provides clients and service personnel a utility program designed to assist with the initial setup and information gathering of the cluster. LCIT processes this information into a suitable format for use with CSM.

The LCIT function results in a more automated and error-free installation. By using this tool, the administrator will see measurable time savings, efficiencies in setup and in management capabilities.

High Performance Computing

- **IBM Director**

  IBM Director gives administrators comprehensive remote management of individual servers from a single graphical console. IBM Director automates and simplifies IT tasks, boosting administrator productivity and reducing skill level requirements. IBM Director tools provide clients with flexible capabilities to realize maximum system availability and lower IT costs. With IBM Director, IT administrators can view and track the hardware configuration of remote systems in detail and monitor the usage and performance of critical components, such as processors, disks, and memory.

- **Absoft® compilers and debugger**

  Since 1980 Absoft has provided compilers, debuggers, and development tools, and now specializes in Fortran-related products for desktops, workstations, and high-performance computers and clusters for a wide variety of 32-bit and 64-bit architectures running Linux, Windows, and Macintosh operating systems. Absoft's Cray-derived

Fortran compilers (ANSI F95, F90, and F77) are source-compatible optimizing compilers which generate robust, reliable, high-performance code. The Absoft Fx2 Debugger™ is a Fortran debugging tool (and also supports C/C++ and assembler), can be used in scalar, parallel workstation and cluster configurations, and can be configured with various graphical user interfaces.

For more information, visit www.absoft.com.

- **Critical Software WMPI II™ message passing middleware**

  Critical Software has a worldwide commercial implementation of the Message Passing Interface (MPI) version 2 standard for Windows-based clusters.

  WMPI II™ is the high-end member of Critical Software's line of middleware products for high performance computing clusters providing a comprehensive implementation of version 2 of the MPI standard. Key features of WMPI II are:

  - MPI-2 standard compliant
  - Heterogeneous cluster support

- Thread-safe, OpenMP™ ready
- Internally multithreaded, no polling
- Extensive C++ & Fortran compiler support
- Remote distributed installation and automatic configuration

For more information, visit www.criticalsoftware.com/hpc.

- **Engineered Intelligence CxC® parallel programming tool**

  EI's CxC language and development environment is a simple parallel development system that allows customers to prototype parallel algorithms without system administrator knowledge regarding the operating system or cluster hardware. Customers can develop parallel programs, or parallelize existing C, C++ or Fortran code, without spending years and system time becoming a parallel programming specialist - no MPI/OpenMP knowledge required. EI's Desktop Supercomputing solution consists of a parallel development environment (Paralab™, or Parallel Laboratory) and parallel execution

run-time environment. Engineers and scientists can create, prototype and run parallel algorithms on a desktop or laptop computer, then, when ready run the same unchanged CxC executable on the supercomputing cluster with linear speedup and unlimited scalability.

For more information, visit goparallel.com/ibm.

- **Etnus TotalView® debugger**
  TotalView is an advanced 32- and 64-bit graphical debugger that gives software engineers control over and insight into threaded and parallel applications written in C, C++ or Fortran. It supports many parallel models, including MPI and OpenMP. TotalView is equally effective debugging shared memory or distributed programs, on shared memory or distributed memory/ clustered machines. Some of these advanced features include heap allocation debugging, sophisticated data analysis, and STLView for simplified viewing of C++ standard template library code.

  For more information, visit www.etnus.com.

- **PathScale™ compilers**
  The PathScale Compiler Suite represents one of the industry's highest performance 64-bit compilers for the IBM e325 server. This highly optimized suite consists of C, C++ and Fortran 77/9x compilers. It is feature rich and has full compatibility with GNU/gcc tool chain and debuggers. When performance matters, use PathScale.

  For more information, visit www.pathscale/IBM-PathScale.html.

- **PGI compilers**
  The PGI® CDK™ Fortran, C and C++ compilers and tools for Linux clusters allow multiple users to compile, debug and profile serial, OpenMP-parallel, and MPI-parallel science and engineering applications. The PGI compilers are highly optimized for both IA32 and AMD64 architecture-based systems. Executables can be deployed on any compatible system regardless of whether the PGI compilers and tools are

installed. Outstanding single-processor performance, uncommon reliability, support for most common extensions, and automatic or user-directed parallelization for shared-memory parallel systems add up to compilers that "just work" for users migrating from RISC/UNIX workstations and servers to 32-bit x86 or 64-bit AMD64 architecture-based systems.

For more information, visit www.pgroup.com.

- **Scientific Computing Associates TCP Linda™ parallelization tool**
  TCP Linda gives users without any special expertise or training in parallel programming the ability to build new parallel applications or to "parallelize" existing sequential applications easily and intuitively. TCP Linda provides a simple, yet complete command set which enables process creation, synchronization and communication. Every Linda software system employs powerful application optimization techniques and carefully tuned,

architecture-specific run-time systems. Any program written in C, C++, or Fortran can be parallelized using just four simple TCP Linda operations. The result is high performance computing through the use of clusters such as an IBM BladeCenter. TCP Linda technology is embedded in versions of Gaussian '03, the heavily-used computational chemistry program, and is used in diverse other settings such as the financial services and petroleum industries.

For more information, visit www.lindaspaces.com.

- **Scali MPI Connect™ interconnect management**
  Scali MPI Connect is a fully integrated message passing interface that allows companies to take advantage of leading interconnects—Gigabit Ethernet, Myrinet, SCI, InfiniBand or a combination thereof—through a single MPI implementation. Scali's MPI delivers flexibility, scalability and high bandwidth, low-latency performance for applications designed for parallelism and portability.

  For more information, visit www.scali.com.

- **Visual Numerics Inc. IMSL™ math libraries and PV-WAVE® visual data analysis**
  Visual Numerics' software products help users understand complex data from a variety of sources and build business-critical applications. Visual Numerics has provided technical software solutions for numerical analysis and visualization for over 30 years.

  Visual Numerics has two product families: the IMSL Numerical Libraries and PV-WAVE, Visual Data Analysis you can trust. The IMSL Numerical Libraries, which are available in C, Fortran and Java™, deliver breadth and depth of core algorithms allowing for the rapid development of any program needed to analyze problems of all sizes. The PV-WAVE Family of products can be used in conjunction with the IMSL Libraries to render sophisticated visualizations of your data.

  For more information, visit www.vni.com.

Flexibility of Choosing Linux or Microsoft Windows

Selected cluster configurations are able to run either the Linux or Microsoft Windows operating systems.

This flexibility enhances the value of choosing IBM Departmental Supercomputing Solutions. The specific operating system versions supported are:

For x335 and BladeCenter HS20:

- *SUSE® Linux Enterprise Server 8 (SLES 8)*
- *Red Hat® Enterprise Linux (RHEL) 3.0 ES and WS; RHEL 2.1 AS*
- *Red Hat 9 (32 bit)*
- *Microsoft Windows 2000 Server for Computational Servers*
- *Microsoft Windows 2003 Standard Edition for Computational Servers*

For e325:

- *SUSE Linux Enterprise Server 8 (SLES 8)/AMD-64 (64-bit)*
- *Red Hat Enterprise Linux (RHEL) 3.0 AS/AMD-64 and WS/AMD-64*
- *Red Hat 9 (32 bit)*

Software Platform Support

ISV	Functional Area	Solution	Intel/Linux (x335, BC HS20)	Intel/Windows (x335, BC HS20)	AMD Opteron/Linux (e325)
IBM	Cluster Systems Management	CSM	X	X	X
IBM	Cluster Installation	LCIT	X	X	X
IBM	Server Management	IBM Director	X	X	X
Absoft	Compilers	Compilers, Fx2 Debugger	X	X	X
Critical Software	Message Passing	WMPI II	X	X	X
Engineered Intelligence	Parallelization	CxC, Paralab	X	X	X
Etnus	Debugger	TotalView	X	X	X
PathScale	Compilers	Compilers			X
PGI	Compilers	Compilers	X	X	X
SCA	Parallelization	TCP Linda	X	X	X
Scali	Interconnect Management	MPI Connect	X		X
Visual Numerics	Math Libraries, Visual Data Analysis	IMSL, PV-WAVE	X	X	X

Backed by IBM

IBM Departmental Supercomputing Solutions are backed by worldwide service and support from IBM. When you purchase or lease this solution, you receive component level warranty service with IBM acting as a single point-of-contact and as the service provider for all components—IBM and Original Equipment Manufacturer (OEM). The warranty period is three years and standard warranty service is IBM on-site repair, 9 hours per day Mon. through Fri. excluding holidays, with next business day response. Warranty and maintenance services upgrade options are available for an additional charge.

Warranty terms and conditions may be different in some countries. Please consult your local IBM marketing representative or IBM Business Partner for country-specific terms and conditions.

Optional Services and Financing Available

IBM and IBM Business Partners offer optional installation services to clients of the IBM Departmental Supercomputing Solutions who may need customization assistance or who may want to integrate them with other existing systems.

IBM Support Line for Linux Clusters is an optional fee service staffed by experts who understand the entire cluster environment, not just the individual components. It is available to help optimize your staff's productivity, simplify integration and maintenance, and reduce problem resolution time. With Support Line for Linux Clusters, IBM will serve as a single source for comprehensive technical support for your Linux cluster. Telephone support includes troubleshooting problems, software defect support and answering questions regarding installation, usage, compatibility, upgrade planning, interoperability, product documentation, and diagnostic information. Support Line is available either 9 hours per day Mon. through Fri. or 24 hours per day 7 days per week.

To further simplify the deployment effort, IBM can provide project management support to help coordinate all aspects of delivery and installation, including hardware and software setup services. Attractive financing and leasing terms are also available. IBM Global Financing offers competitive financing to credit-qualified clients and Business Partners to assist them in acquiring IT solutions. Offerings include financing for IT acquisition, including hardware, software and services, as well as commercial financing (revolving lines of credit, terms loans, acquisition facilities and inventory financing credit lines) for Business Partners.

Feature	Benefits
Choice of several configurations based on server clustering design	• Yields affordable solutions that can be incrementally expanded as workloads grow • Comes with many choices of the number and type of server, offering an ideal solution for smaller organizations • Available in space-saving cabinets, for flexible use within departmental environments
Integrated and tested hardware supported by IBM	• Provides validated configuration with a single point of contact for continuing support • Helps speed time-to-productivity
Advanced IBM @server hardware	• Unique IBM Enterprise X-Architecture™ delivers powerful, scalable and reliable Intel processor-based servers • Revolutionary BladeCenter design delivers the optimal combination of performance density and integration • AMD Opteron processor-based systems optimized for both HPC application environments and for clients desiring an affordable, simplified environment for 32-bit to 64-bit migration
Innovative Software	• Includes useful cluster system management software tools from IBM to help improve productivity and drive higher levels of utility from the cluster • Includes access to useful software productivity tools from IBM vendor partners to help yield high performance, improve ease-of-use, and drive higher levels of utility from the cluster
Choice of Linux or Microsoft Windows	• Allows flexibility to match clients' preferences

Summary

Computationally-intensive workloads can be found within companies and organizations of all sizes. Smaller organizations with limited budgets have been unable to deploy clustered supercomputing techniques against their most challenging problems. Until recently, the cost of the system, the skills needed to install and manage it, and the space and power consumed by a cluster have been significant barriers for departmental level users. With the introduction of the IBM Departmental Supercomputing Solutions, smaller organizations can now acquire affordable, pre-tested and integrated clusters based on high-performance, space-saving technology that is easy to manage and use. Clients can become productive more quickly with the IBM Departmental Supercomputing Solutions and can take advantage of clustered supercomputing with reduced staffing requirements for highly-skilled systems administrators.

The benefits of clustered supercomputing that have provided competitive advantage for large enterprises and research labs are now available to the smallest organization—even the individual scientist or engineer.

For more information?

To learn more about IBM Departmental Supercomputing Solutions, contact IBM or an IBM authorized reseller.

World Wide Web

ibm.com/servers/deepcomputing

Reseller locator and general information

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