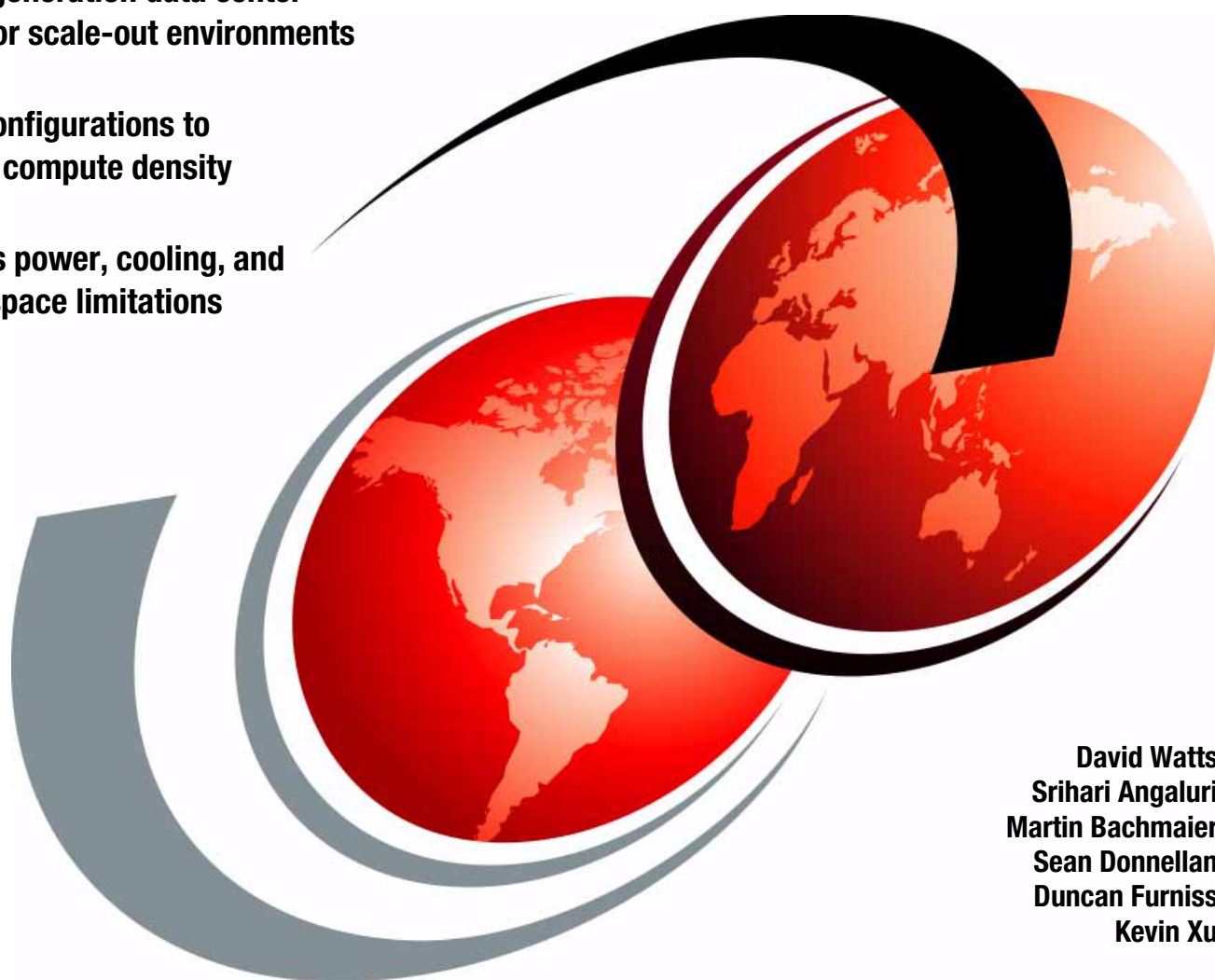# Building an Efficient Data Center with IBM iDataPlex

The next generation data center solution for scale-out environments

Custom configurations to maximize compute density

Addresses power, cooling, and physical space limitations

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Srihari Angaluri
Martin Bachmaier
Sean Donnellan
Duncan Furniss
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Redpaper

IBM

International Technical Support Organization

Building an Efficient Data Center with IBM iDataPlex

May 2008

Note: Before using this information and the product it supports, read the information in "Notices" on page v.

First Edition (May 2008)

This edition applies to the IBM System x iDataPlex solution comprising of:

IBM System x iDataPlex Rack
System x iDataPlex 2U Flex chassis
System x iDataPlex 3U chassis
System x iDataPlex dx340
Rack management appliance
System x iDataPlex Rear Door Heat eXchanger

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Preface

IBM® iDataPlex™ is a new data center solution for Web 2.0, HPC cluster and corporate batch processing customers experiencing limitations of electrical power, cooling, physical space, or a combination of these. By providing a "big picture" approach to design, iDataPlex uses innovative ways to integrate Intel®-based processing at the node, rack, and data center levels to maximize power and cooling efficiencies while providing the compute density needed.

An iDataPlex rack is built with industry standard components to create flexible configurations of servers, chassis, and networking switches that integrate easily. Using technology for flexible node configurations, iDataPlex can configure customized solutions for applications to meet specific business needs for computing power, storage intensity, and the right I/O and networking.

This IBM Redbooks® publication introduces iDataPlex and the innovations in its design. It also outlines the benefits of the iDataPlex solution: lower capital and operating costs, modular design, more efficient cooling, and greater compute density both within the rack and overall in the data center. This Redpaper also introduces the services offerings available from IBM for planning and installing an iDataPlex solution.

The team that wrote this paper

This Redpaper was produced by a team of specialists from around the world working at the International Technical Support Organization, Raleigh Center.

David Watts is a Consulting IT Specialist at the IBM ITSO Center in Raleigh. He manages residencies and produces IBM Redbooks publications on hardware and software topics related to IBM System x™ and BladeCenter® servers and associated client platforms. He has authored over 80 books, papers, and technotes. He holds a Bachelor of Engineering degree from the University of Queensland (Australia) and has worked for IBM both in the United States and Australia since 1989. He is an IBM Certified IT Specialist.

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Martin Bachmaier works as an IT Specialist in the IBM BladeCenter development lab in Boeblingen, Germany, working on the blade systems using the Cell Broadband Engine™. He has worked for IBM for almost 5 years. As part of the Open Systems Design and Development team, his current responsibilities include the architecture and management of Linux-based infrastructures, and the support of early customer installations and development teams around the world. He helped implement several IBM internal clusters, mainly with

Cell/B.E, and is also involved in the development of systems using the next generation of IBM processors. He holds a diploma in computer science from the University of Cooperative Education in Stuttgart, Germany, and a Bachelor of Science (Hons) from the Open University in London, UK. He is an IBM Certified Systems Expert.

Sean Donnellan is an IT Architect with IBM in Ehningen, Germany, and has worked in the IT industry since 1995 when he started as an enterprise firewal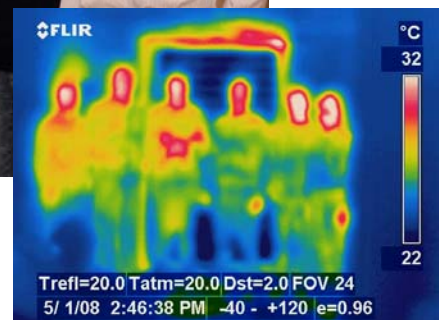l designer and an AIX® SP2 Cluster specialist. He has worked for IBM for the past 8 years. Among other IBM specialist certifications, he is an AIX Advanced Technical Expert and holds the CISSP credential. He has been involved in designing solutions for Linux on System z™, IDS design in hosting environments, designing systems management solutions, and data center and hosting design in general. He is currently architecting shared data center migrations and also architecting shared customer virtualization solutions across the entire IBM Systems family.

Duncan Furniss is a Senior Advisory IT Specialist for IBM Canada and currently provides technical sales support for System x, BladeCenter, and System Storage™ products. He co-authored four IBM Redbooks publications: *High Availability Without Clustering*, SG24-6216, *IBM eServer xSeries 440 Planning and Installation Guide*, SG24-6196, *Using Active PCI Manager*, REDP-0446, and *Using Process Control*, REDP-3637. He contributed to the IBM Redpaper *Implementing Sun Solaris on IBM BladeCenter Servers*, REDP-4269. He has designed and implemented several Linux clusters for various applications, some of which are on the Top500 list. He is an IBM Regional Designated Specialist for Linux in high-performance compute clusters and rack, power, and cooling. He is an IBM Accredited IT Specialist.

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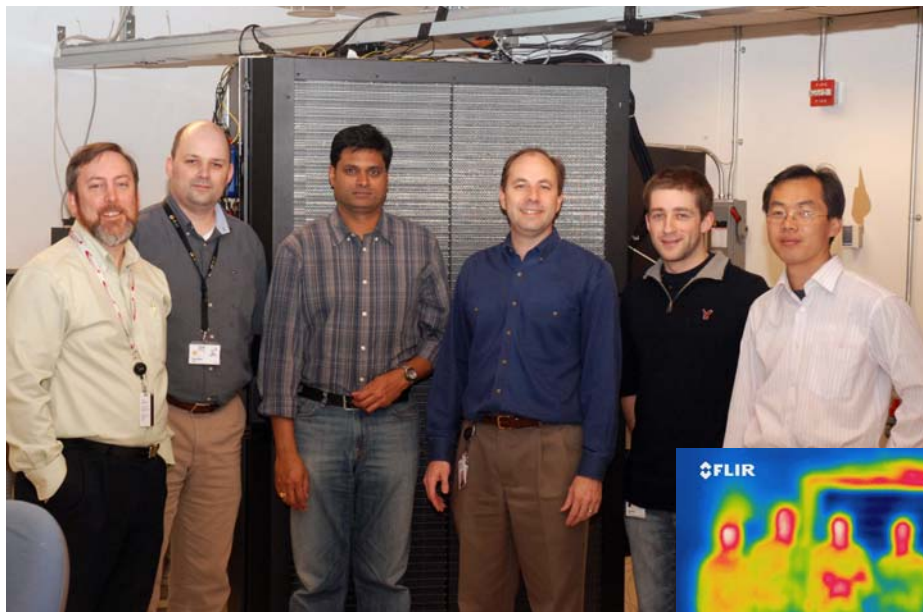
The author team (l-r): Duncan, Sean, Srihari, David, Martin, and Kevin

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Introduction

Demand for data center compute capacity has been steadily growing over the past few years with existing as well as emerging technologies such as Web 2.0, online gaming, social network analysis (SNA), real-world Web, Service Oriented Architecture (SOA), cloud computing, virtualization, and so on. These technologies, coupled with growing user demands, are pushing the envelope when it comes to the amount of raw compute power, storage, and other associated data center infrastructure requirements, which collectively contribute to the growing energy bills from data center power, and to cooling, acquisition, and on-going maintenance costs for customers.

These demands require not only the expansion of existing data centers but also the design of new massive scale-out data centers to compete in and sustain the rapid growth of markets in these areas. As data centers expand to meet these new demands, new challenges are emerging, which can be primarily categorized as follows:

- ► Increased power and cooling requirements for servers and related hardware
- ► Constraints in floor space, which mandate more compute power in a limited amount of space
- ► The need for efficient and effective manageability of massive scale-out environments
- ► The need to minimize initial acquisition costs and subsequent maintenance costs for servers and associated infrastructure

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1.1 Data center facts

A recent report from IDC, a well-known IT research firm, presents the following interesting facts about data centers:

- ▶ Data center power density is increasing by approximately 15% annually.
- ▶ Resulting power draws per rack have grown eight fold since 1996.
- ▶ Over 40% of data center customers report power demand outstripping supply.

IDC concludes "Data center infrastructure is challenged to keep pace."[1]

According to a survey by AFCOM and InterUnity Group, which was quoted in a SearchDataCenter.com report, "In two years, 44.5% of AFCOM member's data centers would be incapable of supporting business requirements due to capacity constraints."[2]

Professor Jonathan Koomey of Stanford University concludes in his paper "Estimating Total Power Consumption By Servers In The U.S. And The World" that for every kW of power used to drive servers, on average another kW of power is needed to drive infrastructure devices such as power and air conditioning.[3]

Koomey also estimates that in 2010, electricity use in data centers will be as much as 76% higher than in 2005.

1.1.1 Project Green IT

Given these alarming facts, various commercial companies, hardware manufacturers, as well as the governments of several nations have started thinking about addressing current energy issues and the plan to meet future power demands. According to the IT research firm Gartner, Inc., report on "Gartner Identifies the Top 10 Strategic Technologies for 2008," "Green IT" is ranked among the top 10.[4]

Green IT is the term coined to indicate the new paradigm shift in designing data centers to be much more efficient in power consumption and cooling as well as to reduce carbon emissions and potential environmental impacts, compared to the traditional data center designs. Gartner predicts that new government regulations have the potential to constrain companies in designing data centers to meet these new environmental requirements. In the wake of these new challenges and business requirements to stay competitive, companies are actively looking for solutions at various levels from server manufacturers and other infrastructure vendors.

1.1.2 The next generation data center model

To address the new data center challenges, a new way of thinking is essential - a new way of designing data centers and the server infrastructure that goes into the data centers. The design must encompass data center power, cooling, management, and acquisition/operating costs as the chief design goals, as opposed to just performance, cost, and scalability at the server level.

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[1] See IDC report "The Impact of Power and Cooling on Data Center Infrastructure."
http://www-03.ibm.com/systems/z/advantages/energy/index.html#analyst_rep
[2] See SearchDataCenter.com E-book, *The green Data Center: Energy-efficient computing in the 21st century.*
http://searchdatacenter.techtarget.com/general/0,295582,sid80_gci1273283,00.html
[3] See "Estimating Total US & Global Server Power Consumption" at
http://enterprise.amd.com/us-en/AMD-Business/Technology-Home/Power-Management.aspx
[4] See Gartner press release, http://www.gartner.com/it/page.jsp?id=530109

In an effort to address various critical IT challenges, IBM has developed and introduced innovative technologies to the market for several decades and established itself as the industry leader. As data center computing enters the next generation, IBM has once again focused on developing technologies that not only will address the critical data center challenges to meet Green IT goals, but also will revolutionize the data center design and computing model over the next decade.

As part of this grand vision, IBM in 2007 announced the "Project Big Green" initiative, which aims to "increase data center compute capacity by a factor of 10, while using 50 percent less power by the end of the decade - dramatically increasing performance without the need to build new data centers, conserving resources from trees to gasoline."[5]

Project Big Green will include new server designs as well as innovations in various related products to help increase power and cooling efficiencies, while reducing IT acquisition costs and simplifying management for massive scale-out data centers.

1.1.3 New philosophy

As part of the new thinking, a new philosophy emerged, which promises to deliver the Project Big Green goals:

> Don't design servers and put them in Data Centers. Instead, first design the ideal Data Center. Then design servers and racks specifically for this design.

This new philosophy is the basis for the suite of new IBM server family of products and technology targeted for data centers, called iDataPlex.

1.2 Introducing iDataPlex

To address the growing data center challenges as outlined previously, IBM has taken a new approach and designed an innovative new family of products and technology called iDataPlex.

IBM has years of experience designing server technologies for both scale-up and scale-out settings that primarily focused on performance and scalability as the fundamental requirements. However, iDataPlex focuses on a different set of new goals:

► Significantly reduce the initial hardware acquisition costs and on-going maintenance costs for data center owners

► Dramatically improve efficiency in power consumption

► Virtually eliminate data center cooling requirements

► Achieve higher server density within the same footprint as the traditional rack layout

► Simplify manageability for massive scale-out environments

► Reduce the time to deployment through pre-configuration and full integration at manufacturing

As is evident, these design goals go far beyond a single server or a single rack level - they are goals for the entire data center.

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[5] See IBM press release "IBM Premiers Project Big Green in Hollywood"
http://www.ibm.com/press/us/en/pressrelease/22891.wss

With the new philosophy and the new design, iDataPlex promises to address the data center challenges at various levels:

► An innovative new rack design that achieves higher node density within the traditional rack footprint.

► New innovative *flex node* chassis and server technology based on industry standard components.

► Shared power and cooling components improve efficiency at the node and rack level.

► An optional Rear Door Heat eXchanger virtually eliminates traditional cooling based on computer room air conditioning (CRAC) units.

► Various networking, storage, and I/O options optimized for the new rack design.

► Intelligent, centralized management through a management appliance.

Each of these innovations is described in the following sections. Subsequent chapters explain the technology and products in more detail.

1.2.1 The iDataPlex rack

The iDataPlex rack is a new cabinet design with 100 rack units (U) of space, as opposed to the traditional enterprise rack cabinet, which has 42U of space. In that sense, the iDataPlex rack is essentially two 42U racks connected together. The iDataPlex rack is show in Figure 1-1.
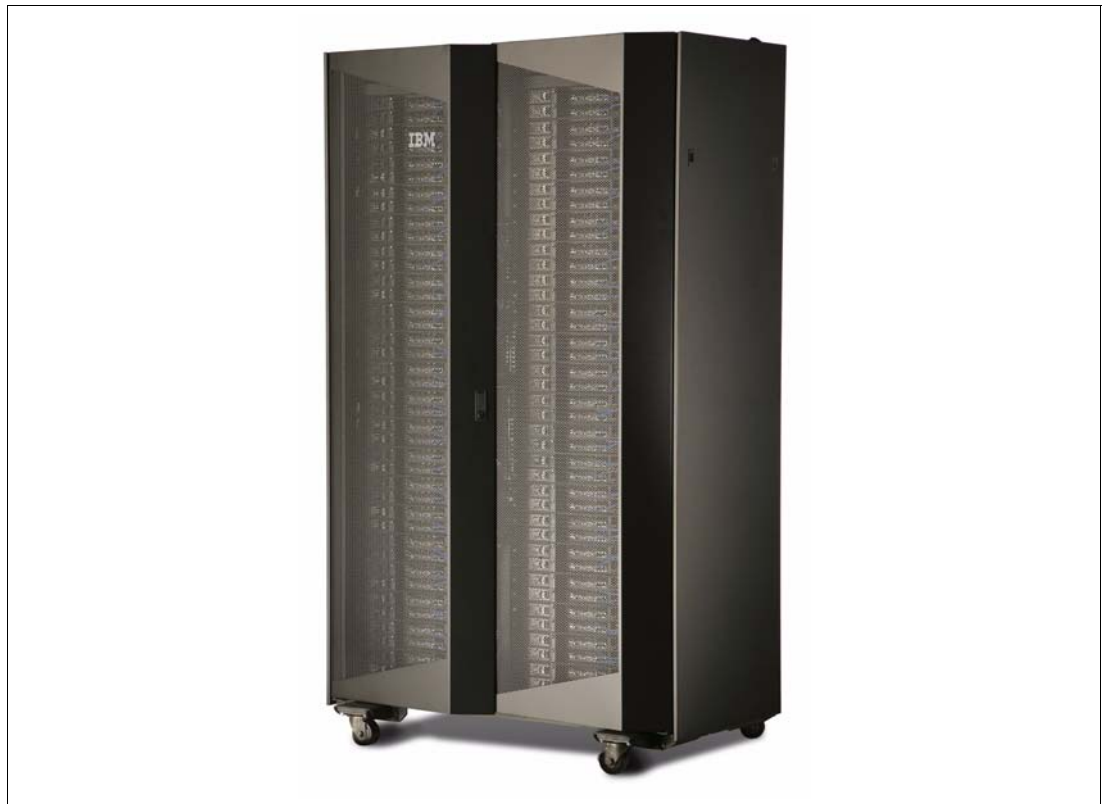

Figure 1-1   iDataPlex 100U rack

However, the iDataPlex rack is shallower in depth compared to a standard 42U server rack as shown in Figure 1-2. The shallow depth of the rack and the iDataPlex nodes is part of the reason that the cooling efficiency of iDataPlex is higher than the traditional rack design, because air travels a much shorter distance to cover the internals of the server compared to airflow in a traditional rack.

The iDataPlex rack is much shallower than a standard 19" rack, which means cooling efficiency is much higher.

One iDataPlex Rack
(Top view)

Two Standard 19" Racks
(Top view)
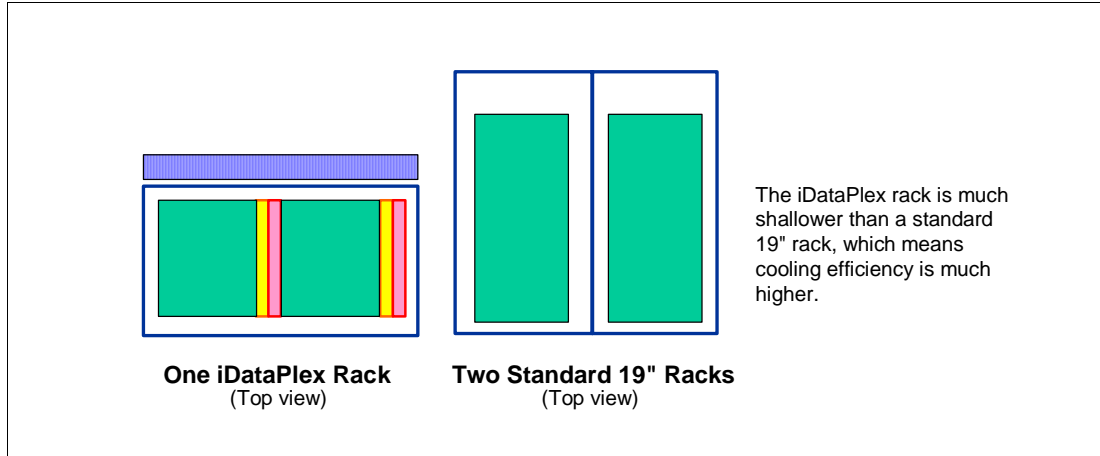
Figure 1-2   Comparison of iDataPlex with two standard 42U racks (top view)

A single iDataPlex 100U rack enclosure provides twice the compute density of a standard 42U rack enclosure within the footprint of a single 42U rack. The iDataPlex rack has 84 horizontal 1U slots for server chassis and 16 vertical slots for network switches, PDUs, and other appliances.

The rack is oriented so that servers fit in side by side on the widest dimension. For ease of serviceability, all hard drive, planar, and I/O access is from the front of the rack. There is little need to access the rear of the iDataPlex rack for any serviceability other than to service the Rear Door Heat eXchanger.

1.2.2 Rear Door Heat eXchanger

The Rear Door Heat eXchanger is a water-cooled door that is mounted on the rear of an IBM iDataPlex rack to cool the air that is heated and exhausted by devices inside the rack. A supply hose delivers chilled, conditioned water to the heat exchanger. A return hose delivers warmed water back from the heat exchanger.

For customers who are able to cool their data centers with water, the Rear Door Heat eXchanger can withdraw 100% - or, in fact, more - of the heat coming from a rack of servers to alleviate the cooling challenge that many data centers are having. By selecting the correct water inlet temperature and water flow rate, you can achieve optimal heat removal.

The Rear Door Heat eXchanger is shown in Figure 1-3. The inlet and outlet connectors are shown at the bottom of the photo.

Figure 1-3   Rear Door Heat eXchanger (rear view of the iDataPlex rack)

1.2.3 Flex Node Technology

The modular design of the iDataPlex components makes it possible for customized server solutions to meet specific business needs. The servers for iDataPlex can be configured in numerous ways using Flex Node Technology, which is a new innovative 2U modular chassis design. Figure 1-4 shows a 1U iDataPlex server. These servers are installed in the 2U chassis in the rack.

Figure 1-4   One 1U server installed in the iDataPlex 2U Flex chassis

Racks are orderable and deliverable with any combination of configured chassis in the rack up to a total of 84 nodes in 42 chassis. This provides maximum flexibility for data center solutions to incorporate a combination of configurations in a rack.

1.2.4 Management features

The iDataPlex rack can include an optional rack management appliance. The device uses the Intelligent Platform Management Interface (IPMI) Version 2.0 protocol for multiple management functions to provide an intelligent aggregated rack solution. Customers with custom solutions that depend on IPMI V2.0 will find full functionality with iDataPlex servers and be able to manage their systems at the rack level.

Each compute node has an onboard management controller that provides basic service-processor environmental monitoring functions. If an environmental condition exceeds a threshold or if a system component fails, an error log entry will be made and LEDs will help you diagnose the problem. The management controller also provides remote server management capabilities using the IPMI V2.0 protocol.

1.3 Summary

Next-generation scale-out data centers are going to be severely constrained for power, cooling, floor space, and acquisition and maintenance costs, and will be subject to various government regulations for power efficiency, carbon emissions, and environmental impact.

To address these concerns and to design the next-generation data center model, IBM announced the Project Big Green initiative. As part of the project, IBM will bring to market a series of products and technologies that address various data center-related aspects to meet

the Project Big Green objectives of building cost-effective and power-efficient "green" data centers.

iDataPlex is one such technology, which defines a new server architecture based on the new iDataPlex 100U rack cabinet, Flex Node and Chassis, Rear Door Heat eXchanger, and a rack management appliance. iDataPlex will not only help customers address the data center power, cooling, and floor space concerns, but will also do it at an attractive price point for customers.

2

Benefits of iDataPlex

This chapter describes how iDataPlex uniquely addresses data center challenges. iDataPlex is designed to be a *lean mean green computing machine* from the computing facility, to the rack level, to the individual servers. This approach addresses costs and efficiencies from procurement, through implementation, to operation. iDataPlex is a new range of systems; and much like the BladeCenter systems IBM introduced in 2002, the range will grow in numbers and evolve with technological advances.

In this chapter we introduce the iDataPlex rack and the range of systems that are currently available. We cover how this new product increases computing density at the rack level and at the room level. We also discuss how iDataPlex is procured and delivered.

Topics in this chapter are:

2.1 Acquisition and operating costs

Paramount among the development objectives for iDataplex is to address the areas of acquisition and operating costs in order to lower them and simplify the process for customers looking to build large-scale data centers.

2.1.1 Acquisition

Currently, iDataplex solutions are only acquired directly through IBM direct sales channels. Members of the IBM iDataPlex sales group have the required skills, and will involve the appropriate IBM experts, to guide an iDataPlex solution through the design, review, manufacturing, delivery, and installation of the solution.

Many options are provided by third-party vendors (including BNT, Cisco, Force10, SMC). Many of the internal components are sourced from high-volume manufacturers. When market conditions coincide with appropriate sized orders of iDataPlex, IBM will make spot purchases of components rather than building from existing inventory, taking advantage of opportunities to minimize the acquisition cost. These savings are then passed on to the customer.

iDataPlex solutions are custom built at time of order, reflecting the customer's specific requirements. Implementations of the scale iDataPlex are unlikely to proceed without planning on several fronts - for example, computational, storage, and networking needs; financial considerations; and real estate, power, cooling, and cabling provisioning. Thus if the iDataPlex solution is built while these considerations are being addressed, it can be scheduled for delivery when the data center is ready to receive it. While the exact time frame can be determined when the order is placed, at time of writing, it is estimated to be three months.

These process decisions were made to drive the acquisition cost - often referred to as *capital expense* (CapEx) - as low as possible. While price of the iDataPlex components will not be published on the Internet, it should be understood that the price of the hardware will be substantially lower than traditional "tier one" products - and will be comparable to "white box" products.

2.1.2 Operating costs

Operating expenses (OpEx) are the real estate (floor space), electrical power consumption for operation, energy used to maintain temperature and humidity, and manageability costs. These are fundamental considerations in the design of iDataPlex.

The current focus on power and cooling is indicitive of two phenomena:

► The acknowledgment of just how expensive power and cooling are in the operation of a computing facility.

► Use of a computing model that provides performance and reliability through software, computing in a scalable and fault-tolerant way on multiple servers, thus decreasing the emphasis on wringing maximum performance and creating the highest levels of reliability within individual servers.

This model enables iDataPlex engineers to improve power efficiency in many ways, also enabling them to simplify the server design, which also lends itself to greater reliability, lower cost, and higher efficiency. The power supply and fans in each chassis are optimized for efficiency in powering and cooling the nodes. The planars use chipsets that are balanced performers while having low power consumption. The overall node design is short from front

to back, and special attention is given to reducing the resistance to airflow; the easier it is for the cooling air to flow through the server, the less energy is used by the fans to move that air.

Aside from moving data centers to lower cost locations, the solution to the real estate challenge is to increase overall solution density. iDataPlex addresses this at the server level, the rack level, and the data center level.

iDataPlex nodes comply with the Intelligent Platform Management Interface (IPMI) standards, which enables integration with a broad spectrum of management methods. A wide selection of networking devices is available, so as well as being able to integrate these devices in to the overall networking environment, the investment in network management expertise can be leveraged.

2.2 Integration ready

In addition to lowering the acquisition costs, having IBM preconfigure the iDataPlex solution at the manufacturing facility reduces CapEx and OpEx further:

► Packaging that is not needed after the solution is shipped is minimized, reducing disposal requirements.

► Considerations for proper airflow for cooling, robust mechanical assembly, and in rack cabling are taken care of before the system arrives.

► Testing after final assembly will minimize, ideally eliminate, servicing that needs to be done after the equipment arrives.

iDataPlex is meant to be rolled in to the data center, extend its levelling legs, connect power, network, and optionally cooling water, and be ready to use.

2.3 Modularity and flexibility

The flexible design of iDataPlex provides cost-efficient servers in configurations to meet many needs. The node design has a common power supply and fan assembly for all models, to minimize costs and maximize the benefits of standardization.

A flexible set of configurations are created from common building blocks. These configurations are either computationally dense, I/O rich, or storage rich. This modular approach to server design keeps costs low while providing a wide range of node types.

Having IBM integrate the servers, power distribution, and networking at the manufacturing facility saves deployment time and ensures design integrity, both of which reduce solution cost. The IBM specialist who designs the custom iDataPlex solution for the customer takes into consideration the rack positioning of the nodes and the airflow requirements of all the components and provides instructions to manufacturing. iDataPlex was built to be shipped, and arrive as a complete unit. The only packaging is the crate it ships in. The crate provides protection for the unit in transit, can be moved by forklift, and provides a ramp for rolling the iDataPlex from the crate to the floor.

2.4 Rack density

The unique iDataPlex design maximizes floor space utilization by fitting as much as 100U of equipment in approximately the space occupied by a 19" enterprise rack. In the area of two data center floor tiles, there are two columns of 42U of 19-inch horizontal-mounting rack space plus a further 16U of vertical space for ancillary devices.

The rack density has the potential for an additional benefit. It is possible in some cases to reduce the number of power feeds going to the same number of servers when they are consolidated in one rack instead of two. One US-based power company was charging its customers in the range of $1,500 to $2,000 per month for each 8.6 kVA feed. One customer indicated that reducing the number of feeds per rack from four to three would save them about USD $14 million per year.

2.5 Density at the data center level

The iDataPlex design allows for increased system density in the data center. The shallow depth of the rack allows for more rows of systems in the same area. Figure 2-1 shows how the shallower racks in iDataPlex mean the rows in the data center can be closer together.
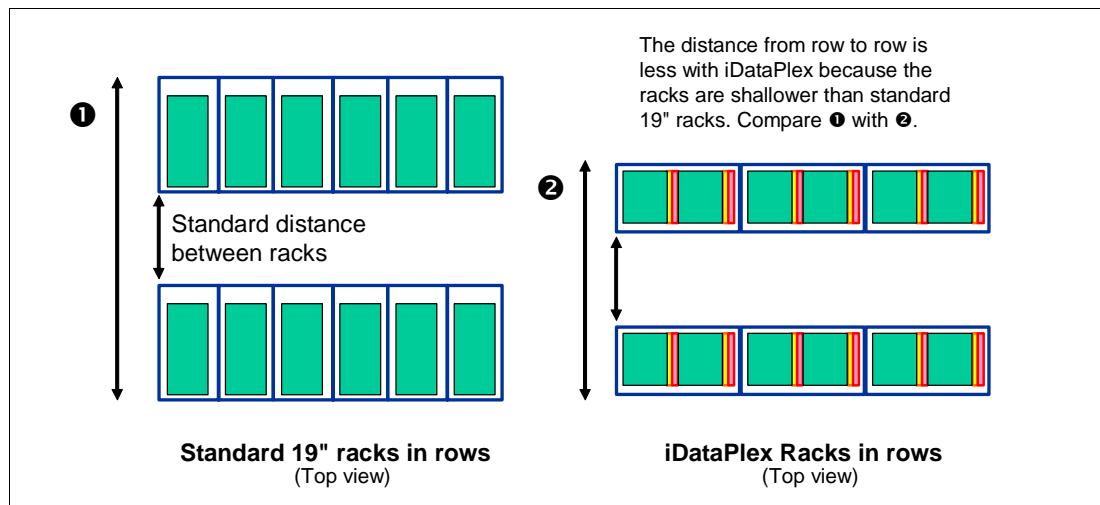
Figure 2-1   Increased density in the data center due to shallower iDataPlex racks

In addition, with 16U of vertical bay space available for power, networking, management, or other options, most iDataPlex designs can utilize all of the horizontal rack space for data processing, potentially reducing the number of racks required. The power efficiency of iDataPlex means less of the data center floor needs to be given to cooling equipment.

2.6 Rear Door Heat eXchanger

The Rear Door Heat eXchanger option for iDataPlex was developed to extract heat at its source. A water-cooled door closes behind the iDataPlex rack and provides energy savings from not having to move hot air with fans or blowers elsewhere in the computer room to be cooled, as is done with conventional computer room air conditioner (CRAC) units.

Due to the design of the iDataPlex rack, the Rear Door Heat eXchanger has large surface area for the number of servers it cools, making it very efficient. It can greatly reduce, or even eliminate the need for additional cooling in the server room, freeing space occupied by the numerous CRAC units otherwise needed.

Any data center that uses CRAC systems already has chilled water installed, so integrating this solution is not difficult. As an added benefit, hot spots in the data center, which can be problematic to address, are less likely to occur.

Figure 2-2 shows thermal images taken of an iDataPlex rack under test in the IBM Thermal Lab, with a person standing beside it, both before the heat exchanger was operational and after.

Even without water-cooling, the iDataplex solution is still at least 20% cooler than the conventional rack approach.

iDataPlex can run at room temperature - no air conditioning required - when used with the optional Rear Door Heat eXchanger.

These photos were taken in Thermal Lab at IBM, showing the iDataPlex without (top image) and with (bottom image) the Rear Door Heat eXchanger closed and operational.
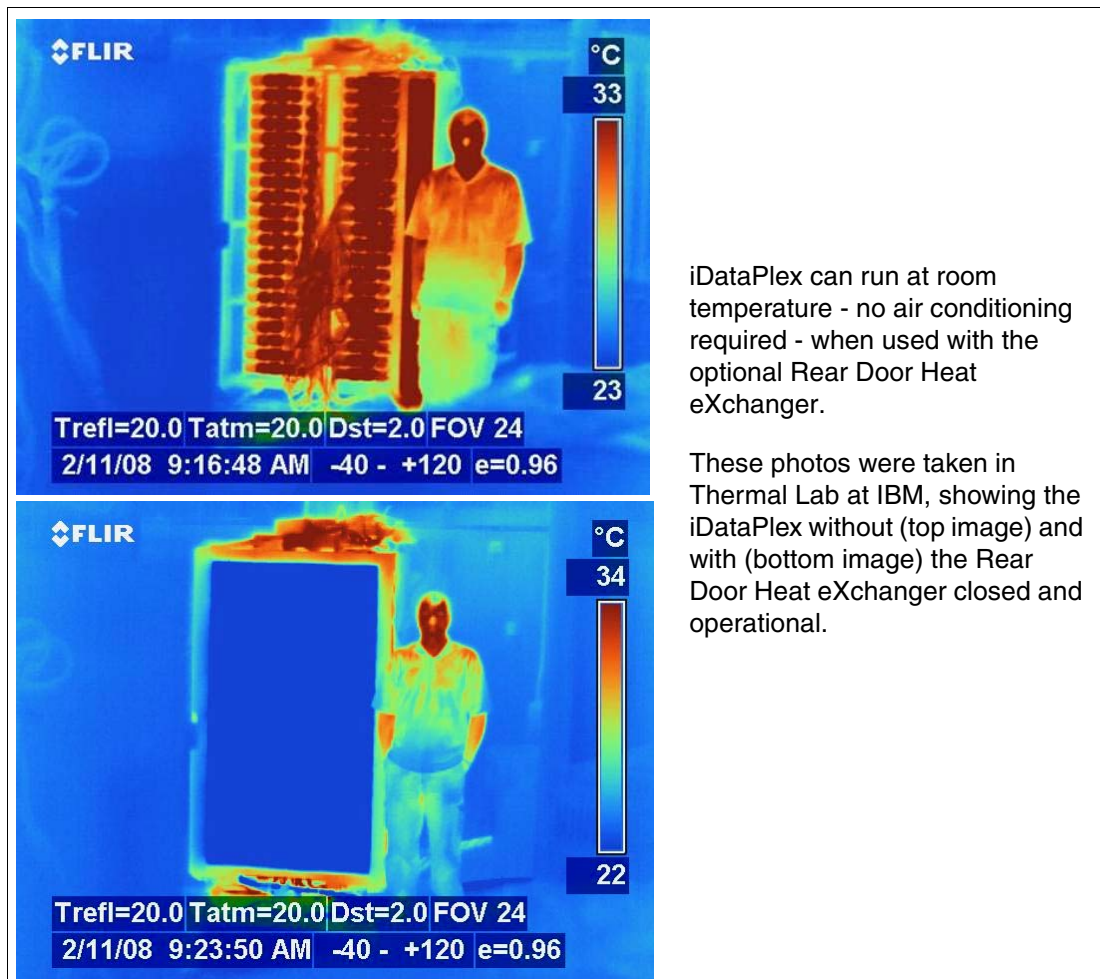
Figure 2-2   iDataPlex rack without and with the Rear Door Heat eXchanger closed and operational

3

Services offerings

To aid in the successful implementation of an iDataPlex deployment, IBM offers a variety of planning and installation services.

This chapter describes the different service offerings:

► 3.1, "Global Technology Services" on page 16
► 3.2, "IBM Systems and Technology Group Lab Services" on page 18
► 3.3, "IBM Global Financing" on page 21

For each offering, we provide a short outline on what the service provides.

3.1 Global Technology Services

Global Technology Services (GTS) offers a number of services that are relevant to iDataPlex and to site and facility services in general. The following is a selection of services that evaluate space and thermal requirements, perform airflow analysis, simulate application scenarios, and design the power and cooling for data centers.

The Web site for site and facilities is the following:

http://www-935.ibm.com/services/us/index.wss/itservice/igs/a1026000

The GTS offerings described in this section are:

- ► 3.1.1, "High-density computing data center readiness assessment" on page 16
- ► 3.1.2, "Thermal analysis for high-density computing" on page 17
- ► 3.1.3, "Data center energy efficiency assessment" on page 17
- ► 3.1.4, "Optimized airflow assessment for cabling" on page 17

3.1.1 High-density computing data center readiness assessment

The high-density computing data center readiness assessment helps clients benefit from high-density computing by assessing the capacity and capability of their existing data centers, the gaps that could jeopardize continuous operations, and the actions to resolve identified concerns.

This readiness assessment helps clients gauge their capacity to support high-density IT infrastructure components in their data center facilities. By determining the existing facility's power-supply and heat-removal capabilities and comparing them to the power and cooling requirements demanded by the new technology, the readiness assessment can identify potential gaps that could jeopardize continuous operations, and can provide an input for problem resolution.

The readiness assessment consulting methodology combines IBM technology insight and decades of experience in data center facility design and operations to help CIOs and other IT decision makers determine a data center facility's capacity to accommodate high-density technology and to operate it reliably.

The offering includes:

- ► An assessment of a facility's as-built power supply and heat-removal capabilities
- ► A comparison of existing capacity against power and cooling requirements demanded by high-density technology—existing and planned
- ► An examination of the entire interdependent power and heat-removal infrastructure
- ► The identification of gaps potentially jeopardizing continuous operations
- ► A comprehensive evaluation that forms the basis for recommendations for any necessary remedial measures

The potential benefits to a client include the following:

- ► Professional guidance in managing the growth and expense challenges associated with high-density technology
- ► Key technology insight to identify design shortfalls and capacity limitations
- ► Continuous operations
- ► Adoption of powerful computing capabilities to meet escalating customer demands

Visit the following Web site for more information:

http://www.ibm.com/in/gts/datacentre/hdcas.html

3.1.2 Thermal analysis for high-density computing

Thermal analysis for high-density computing assists clients in identifying and resolving heat-related problems within existing data centers and provides recommendations for cost savings and future expansions.

Computational fluid dynamics software tools are used to create predictive thermal models that enable clients to plan new data centers designed to satisfy current equipment cooling requirements, to support additional equipment for future IT expansion, and to isolate thermal problem areas in the data center.

The potential benefits of this offering include:

- ► Lower data center costs by helping to improve cooling efficiency and thereby reducing related power consumption
- ► Increased system uptime by helping to reduce server outages caused by high-heat conditions
- ► Provision of information you can use to better understand how to manage data center growth
- ► Effective consolidation of data center facilities
- ► Improved reliability of data center facilities

Visit the following Web site for more information:

http://www.ibm.com/in/gts/datacentre/tahdc.html

3.1.3 Data center energy efficiency assessment

The data center energy efficiency assessment provides a comprehensive assessment of the client data center and supporting physical infrastructure to identify operational cost savings and assists clients with utility rebates or LEED (Leadership in Energy and Environmental Design) certification.

This offering provides:

- ► A comprehensive, fact-based analysis of data center energy efficiency
- ► An evaluation of cooling system components, electrical systems, and other building systems
- ► A baseline metric for the data center's energy use
- ► A roadmap of cost-justified recommendations

3.1.4 Optimized airflow assessment for cabling

This offering is a solution to the issue of excess and obsolete cabling in a raised floor air delivery plenum, which identifies and removes unused cabling for the client, resulting in an energy optimized air delivery system.

This offering has the following features:

► A comprehensive review of existing cabling infrastructure

► A plan for improvements to the data center that can help increase availability and maintain a security-rich environment

► An expert analysis of the overall cabling design required to help improve data center airflow for optimized cooling

► Specific recommendations for cabling system improvements

► A report on how the new structured cabling design can help maximize airflow for cooling, which can improve efficiency and reduce power consumption

Some of the potential benefits are:

► Increased availability, improved energy efficiency, and reduced overall data center management costs

► Reduced potential for downtime through fiber connector inspection and verification

► Simpler change and growth within data centers through the documentation of cooling systems, which also helps companies organize and manage cables and trunking

3.2 IBM Systems and Technology Group Lab Services

IBM Systems and Technology Group (STG) Lab Services provides an in-depth capability for data center design and analysis that is not limited to the planning of racks, servers, chiller doors, and power. Lab Services experts have a very broad scope and a deep knowledge of every aspect of the data center.

A number of services are tailored directly for the iDataPlex, and a number of further services cover the data center as a whole. The STG Lab Services team is ideally positioned to help clients roll out or ramp up an iDataPlex installation because they have full access to the developers of the systems as well as a whole host of experts who are deeply involved in equipment and software tuning, providing detailed recommendations and reports, as well as setting industry standards worldwide.

Overview of STG Lab Services offerings:

► 3.2.1, "Data center power and cooling planning for iDataPlex" on page 19
► 3.2.2, "iDataPlex post-implementation jumpstart" on page 19
► 3.2.3, "iDataPlex management jumpstart" on page 20
► 3.2.4, "Cluster enablement team services" on page 20

Some of the solutions offered by STG include:

► Power, cooling, and I/O data center best practices

► Power sizing in the data center

► Use of virtualization to help reduce the demand for energy

► Information on the power and heat load values for specifically configured server systems

► Comparisons of IBM products with competitors based on performance/Watt, performance and SWaP (Space, Watts and Performance) metrics

► Power trends for IBM product lines

► Integration of IBM products into data centers with limitations (for example, 5 kW per rack)

► Reducing carbon emissions in line with European laws

- ► Water cooling in new data centers
- ► Planning of raised floor heights, ceiling heights, positions of CRACs, positions of cable trays, and more
- ► Using IBM system and storage device capabilities to help manage power demand and thermal load

IBM STG Lab Services is a world-wide team based in the following locations:

- ► Austin, TX, U.S.
- ► Bangalore, India
- ► Beaverton, OR, U.S.
- ► Beijing, China
- ► Kirkland, WA, U.S.
- ► LaGaude, France
- ► Mainz, Germany
- ► Poughkeepsie, NY, U.S.
- ► Raleigh, NC, U.S.
- ► Rochester, MN, U.S.
- ► Taipei, Taiwan

The Web site for IBM STG Lab Services is:

http://www.ibm.com/systems/services/labservices/solutions/labservices_datacenter.html

3.2.1 Data center power and cooling planning for iDataPlex

This offering helps clients assess air conditioning and distribution in preparation for installing one or more iDataPlex racks. Guidance for cooling is provided, as is an evaluation of the need for a Rear Door Heat eXchanger. iDataPlex power specifications are reviewed in light of the customer's PDU and hardware configuration. Electrical requirements are provided based on the findings.

The service also helps clients evaluate the need for a data center thermal analysis or measurement and optimization study and provides appropriate direction based on the sum of findings from all the performed evaluations.

3.2.2 iDataPlex post-implementation jumpstart

This services offering helps clients install and configure the iDataPlex in their own environment. This is done by providing a comprehensive overview of the system and the best practices related to it. The custom-tailored hardware and software is demonstrated and then restored to out-of-the-box settings so that the client can customize the software under supervision and with support from lab experts. This process effectively transfers the required knowledge.

Some of the topics covered are: planning sessions, cluster configuration, management node configuration, BIOS/RAID/firmware verifications and updates, operating system and cluster manager installation, network and storage configuration, cluster tests, power up/down tests, skills transfer, and assistance with the acceptance tests.

3.2.3 iDataPlex management jumpstart

This services offering takes the same approach as the other jumpstart services by first demonstrating the products and then helping the client configure them from an unconfigured state.

This offering includes such items as:

► Planning the use of and installing the appliance
► Overviews of the different command-line utilities
► Authentication methods
► Monitoring and management functions
► Integration into SNMP-based management networks
► Integration into IBM Director-based installations
► Demonstrations of the appliance that show the chassis and node provisioning process
► User management
► Remote and power management
► CLI for batch and interactive use
► Configuring the alert handling

3.2.4 Cluster enablement team services

The cluster enablement team provides clients and partners with access to IBM experts skilled in HPC cluster implementation. This includes hardware, software, and complex high-performance computing knowledge.

The service categories are divided into four components:

► **Cluster Implementation Services**

The Cluster Enablement Team provides Cluster Implementation Services for:

– Standard IBM 1350™ clusters
– Microsoft Windows® Compute Cluster Server
– DB2® Balanced Configuration Unit
– DB2 Information Integrator
– SAP® Search Engine

The Cluster Enablement Team provides roll-your-own cluster services for:

– Basic cluster installation and setup
– Roll-your-own SAP Business Intelligence Accelerator and SAP Search Engine
– Myrinet and InfiniBand® network implementation
– GPFS™ implementation

► **Cluster Support Services**

Cluster Support Services has three renewable yearly support subscription options:

– Remote support

  • Provide basic remote support via e-mail, phone, Web, and so on

  • Cluster 1350 Service provides level 1 and level 2 remote support as needed

– On-call administration support

  • Dedicated Cluster 1350 resource to provide remote cluster administration and assistance as needed (24x5, 4-hour response window, pager/e-mail notifications)

  • Optional 24x7x365 support for mission-critical customers paying higher premium

- On-site health-check support
  - Provide periodic maintenance support to ensure health of systems, perform necessary upgrades, and so on
  - Fixed number of visits per year to the customer site
  - Available for roll-your-own clusters as well as standard 1350 clusters

► **Advanced Cluster Support Services**

Advanced Cluster Support Services provides customized account-specific services that include:

- Hardware problem troubleshooting
- Cluster benchmarking assistance
- Software implementation and tuning
- Cluster administration

► **Cluster Training Services**

The Cluster Training Services offer training on cluster-related topics and have a number of standard offerings that include:

- General cluster training
- xCAT
- GPFS

Customized training is also available.

3.3 IBM Global Financing

IBM Global Financing can assist clients with competitive customized financing structures for their System x iDataPlex equipment. Leasing structures can lower total cost of ownership, minimize risk, improve accountability, and enable clients to focus on their core business strategies while still preserving their ability to make flexible equipment decisions throughout the entire technology life cycle.

Visit the following Web sites for more information:

http://www.ibm.com/financing
http://www.ibm.com/financing/us/recovery/gogreenwithibm/

IBM Global Financing offers competitive financing to credit-qualified customers and IBM Business Partners to assist them in acquiring IT solutions. The offerings include financing for IT acquisition, including hardware, software, and services, from both IBM and other manufacturers or vendors, as well as commercial financing (revolving lines of credit, term loans, acquisition facilities, and inventory financing credit lines) for Business Partners. Offerings (for all customer segments: small, medium, and large enterprise), rates, terms, and availability can vary by country.

Abbreviations and acronyms

AFCOM	Association for Computer Operation Managers
BIOS	basic input output system
BNT	Blade Network Technologies
CLI	command-line interface
CRAC	computer room air conditioning
GPFS	General Parallel File System™
GTS	Global Technology Services
HPC	high performance computing
I/O	input/output
IBM	International Business Machines
IDC	International Data Corporation
IPMI	Intelligent Platform Management Interface
IT	information technology
ITSO	International Technical Support Organization
LED	light emitting diode
LEED	Leadership in Energy and Environmental Design
PDU	power distribution unit
RAID	redundant array of independent disks
SNA	social network analysis
SOA	Service Oriented Architecture
STG	Server & Technology Group
UPS	uninterruptible power supply
USD	United States dollars

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this paper.

IBM Redbooks

You can search for, view, or download books, papers, Technotes, draft publications, and additional materials, as well as order hardcopy IBM Redbooks publications, at the IBM Redbooks publications Web site:

ibm.com/redbooks

Related IBM Redbooks and Redpaper publications:

- ► *IBM BladeCenter Products and Technology*, SG24-7523
- ► *Tuning IBM System x Servers for Performance*, SG24-5287

Online resources

These Web sites are also relevant as further information sources:

- ► IDC report "The Impact of Power and Cooling On Data Center Infrastructure"

    http://www-03.ibm.com/systems/z/advantages/energy/index.html#analyst_rep
- ► IBM press release "IBM Premiers Project Big Green in Hollywood"

    http://www.ibm.com/press/us/en/pressrelease/22891.wss
- ► IBM Systems and Technology Group Lab Services

    http://www.ibm.com/systems/services/labservices/solutions/labservices_datacenter.html
- ► IBM Financing - Global Asset Recovery Services

    http://www.ibm.com/financing/us/recovery/gogreenwithibm/
- ► Global Technology Services — Site and Facilities

    http://www-935.ibm.com/services/us/index.wss/itservice/igs/a1026000
- ► "The green data center: Energy-efficient computing in the 21st century"

    http://searchdatacenter.techtarget.com/general/0,295582,sid80_gci1273283,00.html
- ► Gartner press release "Gartner Identifies the Top 10 Strategic Technologies for 2008"

    http://www.gartner.com/it/page.jsp?id=530109

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Building an Efficient Data Center with IBM iDataPlex

The next generation data center solution for scale-out environments

Custom configurations to maximize compute density

Addresses power, cooling, and physical space limitations

IBM iDataPlex is a new data center solution for Web 2.0, HPC cluster and corporate batch processing customers experiencing limitations of electrical power, cooling, physical space, or a combination of these. By providing a "big picture" approach to design, iDataPlex uses innovative ways to integrate Intel-based processing at the node, rack, and data center levels to maximize power and cooling efficiencies while providing the compute density needed.

An iDataPlex rack is built with industry standard components to create flexible configurations of servers, chassis, and networking switches that integrate easily. Using technology for flexible node configurations, iDataPlex can configure customized solutions for applications to meet specific business needs for computing power, storage intensity, and the right I/O and networking.

This IBM Redbooks publication introduces iDataPlex and the innovations in its design. It also outlines the benefits of the iDataPlex solution: lower capital and operating costs, modular design, more efficient cooling, and greater compute density both within the rack and overall in the data center. This Redpaper also introduces the services offerings available from IBM for planning and installing an iDataPlex solution.

REDP-4418-00