

IBM
Thought Leadership
February 2009



Dynamic Infrastructure[®] Helping Build a Smarter Planet

Delivering Superior Business and IT Services with Agility and Speed



Table of contents

	<u>3</u>
Introduction	<u>5</u>
Challenges in today's market and beyond	<u>7</u>
Addressing today's challenges to seize tomorrow's opportunities	<u>9</u>
A dynamic infrastructure can propel the world forward	<u>10</u>
Building a dynamic infrastructure	<u>12</u>
IBM's solution strategy is aligned with the needs of a dynamic infrastructure	<u>17</u>
Why IBM?	<u>19</u>
Conclusion	

Introduction

The world is getting smaller and flatter – but it must also get smarter. Every day, the world is becoming more instrumented, interconnected and intelligent, creating new opportunities at both a societal and organizational level. By harnessing our increasingly digitized world, we can solve intractable social problems, bring organizations closer to customers, and vastly shrink decision windows that help executives achieve competitive advantage.

Key challenges for today's organizations are to:

- Achieve superior, differentiated service delivery
- Reduce costs and optimize return on investment of all business assets
- Manage and mitigate business risk
- Act with agility and speed

Meeting any one of these challenges – let alone all of them – requires a high degree of flexibility and responsiveness within an organization's underlying business and IT infrastructure. Unfortunately, many of the assets that comprise today's infrastructure are rigid, siloed and outdated, driving cost and complexity to unsustainable levels while hampering organizational maneuverability. Today's infrastructure is not prepared for tomorrow's challenges. For many organizations – *change is imperative*.

Change is possible, the tools exist, and the mission is clear. It is necessary but not sufficient to solve today's problems – we must also seize tomorrow's opportunities. To achieve both, it's time to start thinking *differently* about infrastructure.

IBM has developed a strategy for a dynamic infrastructure that will help organizations address higher service expectations, rising cost pressures and new risks and threats, while also laying a foundation for breakthrough productivity, accelerated value creation and the increased velocity needed to achieve the faster pace that business and society demand.

In this smarter world, we need our infrastructure to propel us forward, not hold us back. This infrastructure becomes instrumented, interconnected and intelligent to bring together the business and IT infrastructure to create new possibilities across the business.



Smart is: CLS

Created the world's first and only global system for real-time simultaneous and irrevocable settlement of payment instructions and foreign exchange transactions, peaking at \$5.4 trillion a day and growing.

How do we build a more *dynamic infrastructure*?

- Address today's operational challenges to free up resources for new investments.
- Converge business and IT infrastructure to work in concert, achieving breakthrough productivity and greater business value.
- Utilize alternative sourcing approaches, like cloud computing, to deliver new services with agility and speed.

This paper outlines IBM's strategy for a dynamic infrastructure. Our pioneering new approach spans physical and digital assets, data center systems, distributed computing resources, business processes, and software solutions to address both today's and tomorrow's business imperatives. Through innovative offerings, flexible sourcing options, and effective collaboration, IBM can help you define the path and achieve meaningful progress toward developing a dynamic infrastructure.

Challenges in today's market and beyond

Smart is: Bharti Airtel
Infrastructure integrates channel and customer facing processes – enabling a seamless customer experience, higher customer satisfaction – more profitable growth in the highly competitive mobile communications market in India.

The current global financial downturn and energy crisis – occurring in tandem with exploding levels of information and proliferating risks – are forcing many organizations to change their operating model. In fact, these conspiring forces are changing the nature of work itself. Increased global integration, with its attendant challenges and opportunities, is compelling many organizations to assess their current operating infrastructure and define what that infrastructure needs to be in the future. In almost all cases, this means a business and IT infrastructure that will support and sustain competitive advantage while also delivering significant cost efficiencies.

The question is, how should such an infrastructure be designed? A key characteristic of any next-generation infrastructure will be its ability to harness and leverage the increased instrumentation, interconnectedness and intelligence of the world's devices, assets, systems, and networks. But many organizations still find themselves in unfamiliar territory in this digitally-aware, 'always-on' world. Leading organizations must quickly learn to embrace this world and design business and IT infrastructure accordingly. Sustainable competitive advantage will go to those who deeply comprehend and know how to exploit the world's emerging potential for connectedness, collaboration and quantum leaps in efficiency.

Today's business and IT assets are broadly distributed, sometimes poorly managed and often in disrepair. Merely having a broad set of assets is no longer sufficient to sustain the competitive differentiation they once delivered. In today's digitally connected world, the key is to *interconnect* all of these business and IT assets to transform service delivery and achieve superior business outcomes.



Achieving business progress in the face of so much internal complexity and environmental change may seem daunting and overwhelming. But the enablers of success are within arm's reach. The technology is available and affordable – it just takes thinking about infrastructure in a new way.

Examples of how the world is changing:

The world is becoming more **instrumented**: We now have the ability to measure, sense and see the exact condition of most everything. Consider:

- By 2010 there will be 1 billion transistors per human.¹
- By 2010 there may be 30 billion Radio Frequency Identification (RFID) tags produced globally, embedded in products, passports, buildings – even animals.²
- Nearly 4 million RFID transactions are emitted daily.³
- Nearly one-half of all sensors in transportation, facilities and production equipment are smart sensors.

The world is becoming more **interconnected**: People, systems and objects can communicate and interact with each other in entirely new ways. For example:

- We are heading toward one trillion connected objects – comprising “the Internet of things.”⁴
- Worldwide mobile telephone subscriptions reached 3.3 billion in 2007 – one for every two people on the planet.⁵
- 1/3 of the world's population (approx. 2 billion) will be on the Web by 2011.⁶

The world is becoming more **intelligent**: We can respond to changes quickly, accurately and securely, predicting and optimizing for future events. Some proof points:

- Hundreds of satellites are in orbit – generating terabytes of data every day.
- 15 petabytes of new information is generated every day (8x more than the information in all U.S. libraries).⁷
- 64 billion credit card transactions were processed in 2008, up 35% from 2007.⁸

Addressing today's challenges to seize tomorrow's opportunities

Smart is: DTE Energy Company
Projects US\$75M in annual operating cost savings by undertaking a massive consolidation of business systems and standardization across all business units.

With new economies and industries unfolding around decades-old companies with traditional business models, companies are being forced to become more responsive to address a wide range of challenges.

- **Higher Service Expectations:** Increasingly savvy customers and employees demand continuous service availability and high-quality experience across an expanding range of assets, applications and services
 - The average cost per hour of unplanned downtime is \$42,000 per 1,000 transactions⁹
 - The average new application can take up to six to nine months to deploy
 - The digital economy cannot sustain power outages or unreliable power
- **Rising Cost Pressures:** Complexity and inefficiency drive up costs and stifle innovation.
 - 40% – 70% of electrical energy is lost due to inefficiencies in the grid¹⁰
 - In distributed computing environments, up to 85% of computing capacity can sit idle¹¹
 - On average, for every 100 units of energy piped into a data center, only three units are used for actual computing¹²
- **New Risks and Threats:** Unprecedented security, resiliency and compliance challenges are created by the accelerating pace of business change.
 - Weather-related events inflicted one trillion dollars in damage from 1980-2003¹³
 - Since 2006, the U.S., alone, has experienced a 158% increase in cyber attacks¹⁴
 - 30% worldwide increase in cyber attacks over the second half of 2008¹⁵
 - 33% of consumers notified of a security breach will terminate their relationship with the company they perceive as responsible¹⁶



Smart is: SKY
Network and service assurance solution monitoring 1000s of network devices and application services at over 1,200 exchanges, 24x7 availability to more than 1.6 million broadband customers.

In addition to addressing the challenges of today, organizations need to lay a foundation for the enablers of growth and success for the future. Expectations include:

- **Breakthrough productivity:** Since almost any person, object or service can become digitally aware and connected, executives and customers will expect greater possibilities for access and availability of resources.
- **Accelerated value creation:** Companies will begin to utilize more adaptive capabilities like cloud computing to create new opportunities.
- **Increased velocity:** The faster pace of business and society demands a more responsive, agile infrastructure that drives down costs, provides greater security, and propels insight and information across the organization.

In order to achieve these objectives, it's time to start thinking differently about infrastructure. It's time to build a more dynamic infrastructure that:

- Creates linkages between physical and digital resources across the organization
- Enables businesses to adapt to changing conditions for competitive advantage
- Aligns and manages all assets to address business requirements

Even in the face of global uncertainty, it's the infrastructure that continues to enable commerce and communications – the roads, networks, utilities and technologies connecting and differentiating organizations, competitors and customers. These public and private resources vary in value, condition and status, but all have two commonalities – they bring companies and countries together, and they are themselves connected. Millions of chips, sensors and RFID tags are in the roads, vehicles and machinery that power and connect our world, all interconnected, making the world smaller, flatter – *and smarter*.

Our ability to leverage and utilize this information and intelligence is within our reach. Embracing this opportunity can enable faster, better management of a wider range of devices and systems than ever before. Businesses can now focus on delivering superior business and IT services with agility and speed while also keeping a keen eye on improving service, bringing down costs and managing risk in this new environment.

Smart is: BP Angola
Improves production efficiency through improved uptime, improves employee and environmental safety, to position BP for maximum efficiency and safety; shorter time to investment recovery.

A dynamic infrastructure can propel the world forward

Global organizations already have the foundation for a dynamic infrastructure. Most business and IT assets are becoming instrumented, interconnected and intelligent. A dynamic infrastructure will bring together business and IT to create new possibilities. For example:

- Transportation companies can optimize their vehicles routes leveraging GPS and traffic information.
- Facilities organizations can secure access to locations and track the movement of assets leveraging RFID technology.
- Production environments can monitor and manage presses, valves and assembly equipment through embedded electronics.
- Technology systems can be optimized for energy efficiency, managing spikes in demand, and disaster recovery readiness.
- Communications companies can better monitor usage by location, user or function and optimize routing to enhance user experience.
- Utility companies can reduce energy usage with a “smart grid.”

A dynamic infrastructure is designed to help transform physical and digital assets into more valued services. A dynamic infrastructure is highly optimized to achieve greater results with improved management, and leverages new technologies and strategies to reduce costs and deliver superior business and IT services with agility and speed.

A dynamic infrastructure can deliver three distinct benefits across the entire organization while also laying the foundation for the future:

- **Improve service:** Internal and external customers and employees expect superior service – not only regarding the high availability and quality of existing services, but also have rising expectations for real-time, dynamic access to innovative new services.
- **Reduce cost:** Bottom-line cost reduction is important, but a dynamic infrastructure can also help achieve breakthroughs in productivity gains through virtualization, optimization, energy stewardship and flexible sourcing.
- **Manage risk:** Security, resiliency and compliance are already expectations in today’s environment. Dynamic organizations need to prepare for the new risks posed by an even more connected and collaborative world.



Building a dynamic infrastructure

The breadth of a dynamic infrastructure goes far beyond the “walls and wires” of a data center to the “pipes and wires,” e.g. the roadways, bridges, equipment, facilities and networks, of physical infrastructure. And as instrumentation and interconnectivity accelerate, expectations for greater accessibility and availability will be higher than ever before.

As business environments evolve, the business and IT infrastructure will need to move beyond its current, siloed formation to create a more secure, responsive and resilient approach to serving the needs of customers, employees, partners and users around the world.

Efficient cloud-based computing requires a dynamic infrastructure

Much is being written and spoken about cloud computing, by IT analysts, industry and business leaders and others. Some believe it is a disruptive trend representing the next stage in the evolution of the Internet. Others believe it is hype, as it uses long established computing technologies.

So, what is cloud computing? From a user perspective, cloud computing provides a means of acquiring computing services without requiring understanding of the underlying technology. From an organizational perspective, cloud computing delivers services for consumer and business needs in a simplified way, providing unbounded scale and differentiated quality of service to foster rapid innovation and decision making. It is a service acquisition and delivery model for IT resources and, if properly used within an overall IT strategy, can help improve business performance and control the costs of delivering IT resources to the organization.

Smart is: University of Pittsburgh Medical Center
Reduces capital and operating costs by up to \$30M, improves energy efficiency by reducing floor space 40% and physical servers 67%.

How do we go about building a more dynamic infrastructure?

• **Address today's operational challenges to free up resources for new investments:**

Organizations are under pressure to drive efficiencies and optimize their processes to achieve more with less. Efficiency of business and IT assets comes from integrating virtualization, energy efficiency, standardization and automation to free up operational budget for new investment. In addition, with the vast number of connected objects across the organization and the world, a dynamic infrastructure must meet the rapidly changing security and availability requirements to grow and succeed.

• **Converge business and IT infrastructure to work in concert, achieving breakthrough productivity and greater business value:** Instrumentation of physical infrastructure resources is enabling more dynamic measurement, allocation and management to support innovation, transformation and differentiation. This transforms assets into valued services through common processes and systems that improve preventive and predictive maintenance and resource allocation to increase overall business performance.

• **Utilize alternative sourcing approaches, like cloud computing, to deliver new services with agility and speed:** Companies with a dynamic infrastructure quickly realize direct business benefits from easily blending services and information across customers and third-party providers across the value chain. They can address the explosion of information and respond to business requirements while reducing capital and operational costs associated with delivery of services.



IBM's solution strategy is aligned with the needs of a dynamic infrastructure

Smart is: Bank of Russia
Improvements in operational and energy efficiency are saving approximately \$400 million per year and allows dynamic response to business needs.

IBM recognizes that existing business and IT assets have tremendous value to offer and can be leveraged to drive new services. Therefore the ability to manage them via “sense and respond” devices and management systems is of critical importance. The management of these assets – once managed as part of traditional enterprise asset management – will need to be integrated as IT and operations are becoming more interdependent. The integrated management of physical and digital assets will help achieve optimal efficiency and cost control across the business.

A dynamic infrastructure can unite business and IT, creating a single set of assets to leverage across an organization, delivering seamless access to IT services and resources and cohesively integrating and managing the continually exploding volume of information regardless of source.

As part of IBM's strategy for creating a dynamic infrastructure, our unique approach helps improve service, reduce cost and manage risk by:

- Enabling visibility, control and automation across all business and IT assets
- Transforming these assets into higher valued services
- Optimizing the supporting infrastructure to help achieve more with less
- Addressing the information challenge
- Leveraging flexible sourcing, such as cloud computing
- Managing and mitigating risks

Smart is: Australian Open
Securely, resiliently provides scalable resources 100x normal scalability, real-time analysis and prevention of attacks and achieves 23% reduction in energy consumption, with 100% website availability.

Initiatives to consider when creating a dynamic infrastructure

In IBM's view, there are seven interrelated initiatives to evaluate and consider on the journey to a dynamic infrastructure:

- **Service Management:** Siloed management capabilities inhibit the flow of information required to manage a dynamic infrastructure. Service management provides the visibility, control and automation that helps organizations manage across all business and IT assets to deliver higher value services.

Service management delivers the solutions and expertise needed to design, build and manage a dynamic infrastructure that leverages and integrates physical and digital assets to deliver next generation services. Through real-time infrastructure management, monitoring, process automation and security, service management helps organizations fully leverage their dynamic infrastructure.

- **Asset Management:** Achieving the highest “return on assets” is a balancing act. Asset managers must optimize four major drivers: achieve highest reliability and lowest cost within a compliance framework and with limited resource. Asset management helps maximize the value of critical assets over their lifecycle with powerful workflows that enforce best practices that yield the highest benefits of all types of assets, including transportation, production, delivery, facilities, communications and IT assets. This is especially true in the asset intensive industries: utilities, oil, gas, chemicals, mining, manufacturing and other process industries.

For example, electric power utilities are moving to “smart meters” – devices that are part of an intelligent two-way communication network between customers on the grid and the central office. These new meters send readings every 15 minutes, allowing customers to control energy usage and enabling the power company to make smart business decisions with respect to newer power plant construction and the reduction of environmental impacts.



Smart is: Bank of Montreal
Providing a recovery point of zero and a recovery time of 2 hours helps reduce operational risk, increases client trust, improves availability, and meets stringent regulatory compliance requirements.

- **Virtualization:** Consolidating resources through virtualization can increase utilization far beyond the inefficient 10-15% utilization often seen in data centers today. Advances in the technology, along with higher degrees of automation, offer more opportunities for consolidation than ever before. Getting to a highly virtualized and shared infrastructure provides a foundation for automated and rapid service delivery with the benefits of economies of scale.

Virtualizing an infrastructure can help enable the flexible and dynamic delivery of shared IT resources as services. Increased utilization of IT resources, along with highly virtualized systems, helps give customers improved service delivery speed, TCO, resiliency and flexibility.

- **Energy Efficiency:** Issues and opportunities around energy, the environment and sustainability impact every individual and every business, worldwide. Every boardroom faces a dilemma on how to generate more business, lower costs and demonstrate environmentally responsible practices to their customers and stakeholders.

Optimizing the energy efficiency of the business and IT infrastructure can demonstrate the value in “green.” To meet the needs of the business, a holistic approach is required that encompasses energy management, virtualization, IT and data center facility services, and server and storage products that are designed to be green. Energy efficient dynamic infrastructures can reduce costs, resolve space, power and cooling constraints that impact growth, improve flexibility and responsiveness, and achieve Green strategy objectives.

- **Business Resiliency:** Maintaining continuous business operations while rapidly adapting and responding to risks and opportunities has elevated to the C-level suite the need to ensure a resilient and recoverable business environment. An infrastructure that has agility, is resilient to risks, allows the business to respond quickly to demands and meets compliance requirements, ensures not only that

Smart is: Ecole Polytechnique
Developing a model that will complete – in a few seconds – what would have taken days in wet lab research; advancing research in neurological and psychological disorders.

the business can continue operations, but helps the IT infrastructure become more integrated and responsive to business needs.

While each organization will have unique resiliency requirements, resilient infrastructures need to include strategies for facilities, technology, applications and data, processes, and the needs of the organization to provide the correct level of resilience for each business process and meet increasing end user demands for 24/7/365 availability.

- **Security:** Globalization has required organizations to take an end-to-end, business-driven, approach to security, compliance and risk management in alignment with an IT governance framework. The vast interconnectivity of resources brings access and collaboration, but also opens additional risks and exposures to loss and theft.

An integrated security strategy within a dynamic infrastructure can empower organizations to monitor and quantify security risks to better understand threats and vulnerabilities in terms of business impact, to better respond to security events with security controls that optimize business results, and to better quantify and prioritize their security investments.

- **Information Infrastructure:** Today, information has become the lifeline for business sustainability, and firms of all size are searching for practical ways to manage and utilize their information. Without a cohesive information management strategy, organizations will find themselves facing higher IT operational costs and greater exposure to business risk.



Smart is: Exa
Doubled their business every year for five years by utilizing Computing on Demand resources – growing from a small, local company to a global enterprise; set themselves up for a strong competitive advantage and is able to adapt rapidly and flexibly.

A dynamic infrastructure helps address the specific challenges of ensuring information availability, securing information, addressing compliance regulations, and efficiently retaining information throughout its lifecycle.

Most enterprises have started their own initiatives along one or more of these paths, and each path can contribute to the success of another. For example, virtualization can be seen as an engine for a more energy efficient and flexible data center. Service management delivers resources more efficiently from virtualized systems. As businesses adopt higher levels of automation and new innovative methods of delivery, they have to be confident all of this can be done securely, and applications are available, quickly recovering and adjusting to any failures or outages.

But organizations need to reach beyond their systems to provide intelligent access to information and manage corporate assets from all types of devices and all kinds of places – from cash registers to trucks to servers. As business and IT assets converge, and the business resources are instrumented with features like RFID tags, information about them can be tracked and managed in a dynamic infrastructure, improving optimization and cost savings not only for IT, but across the business.

Flexible sourcing options produce quicker business benefits

Creating a flexible sourcing strategy is an important part of establishing a dynamic infrastructure. Many organizations employ a mix of sourcing options to create the most effective solution to meet their needs. Much can be accomplished on-site, with the right tools, technologies and skills. Some functions can be managed remotely. Some functions or business processes may be more effectively outsourced altogether. And a rapidly emerging option, cloud computing, opens up entirely new opportunities.

The underlying technologies associated with cloud computing can be focused on creation of a more dynamic infrastructure, as applications and the services they provide are no longer locked to a fixed, underlying infrastructure and can adjust quickly to change. Cloud computing can provide access to needed, standardized IT resources to rapidly deploy new applications, services or computing resources without re-engineering the entire infrastructure – or, in some cases, without having to have an infrastructure at all.

Why IBM?

IBM has a long history of helping clients transform their businesses and integrate their business and IT environments. IBM's leadership in industry and business solutions has helped organizations better align their corporate assets with their strategic initiatives and achieve their requirements to improve service, reduce cost and manage risk. There are many important considerations when building a dynamic infrastructure:

- **Understand how to get started:** IBM can help assess the potential benefits of a dynamic infrastructure through proven tools, assessments and workshops by key initiatives to measure business impact. In addition, IBM will collaborate with you to build the right blueprint for success. Our deep business architecture knowledge, strategy and change and data center strategy expertise coupled with our open standards based approach with a supporting ecosystem of partners ensures you'll benefit from our experience from thousands of client engagements.

IBM offers a structured architecture approach based on industry best practices and our award-winning implementation blueprints and patterns. Only IBM can deliver the broadest systems, storage, software and services portfolio in the industry to find the right fit for your business, along with an unparalleled research organization and extensive patent leadership.

- **Leverage flexible sourcing options:** IBM leads the industry in innovative tools, technologies and project-based services to help you build an effective and responsive infrastructure. Our Managed Services portfolio offers the widest array of remote managed services, on site managed services and hosting services. In addition, our Outsourcing Services can increase speed and certainty of business driven IT and process change, by leveraging our value-enhancing, cost efficient Business Process, IT and Integration Services. And as an industry leader in cloud and cloud-like services and technologies, IBM can help you build private clouds, leverage public cloud delivery approaches or outsource portions of your IT to cloud environments.



- **Collaborate with our experts:** IBM's business domain expertise is across all industries and spans the spectrum from ideation to implementation. With tens of thousands of professionals focused on security and privacy, mainframe and open systems, ITIL, networking and SOA, only IBM can offer such extensive experience advising clients on business transformation, application, and service management processes. IBM's Worldwide Client Centers include access to experts, strategies and technologies that help bring ideas and innovation to your organization.

Dynamic Infrastructure: IBM's own transformation

As a global enterprise, IBM had a vast array of business and IT assets, and faced many of the same issues as its largest customers, including server sprawl, a multitude of data centers, systems and applications all previously being managed by more than 125 CIOs. From 2002 through 2007, IBM's own IT investments delivered a cumulative benefit yield of approximately \$4 billion. For every dollar invested, we saw a \$4 cumulative benefit.¹⁷

Through its "Project Big Green" initiative, IBM is on target to double its compute capacity by 2010 with no planned increase in consumption or environmental impact. And as it moves toward a fully dynamic infrastructure, IBM anticipates continued improvements of service delivery, real-time integration of data analytics and information, and the true delivery of IT as a business service.

In addition, the implementation of Tivoli identity and access management solutions reduced costs of centralized security management with systems that automate the administration of identities, passwords and access rights across the IBM infrastructure and enterprise applications.



Conclusion

Organizational leaders from every industry face unique challenges and competition related to how they exploit business and IT assets across a smarter planet. IBM's strategy for a dynamic infrastructure offers a new model to leverage innovation and tightly integrate IT and physical assets to efficiently deliver value to internal and external customers. Through its skills, partners and experience, IBM can provide the roadmap, tools and support to accelerate an organization's evolution toward implementing a dynamic infrastructure.

IBM offers many ways to get started, ranging from in-depth briefings by key initiative area, to collaborative workshops and assessments, to Proof of Concept centers for testing out new ideas and approaches. Regardless of where you are today in your journey to a more dynamic infrastructure, IBM and our Business Partners stand ready to help.

ibm.com/dynamicinfrastructure



-
- 1 Smart Objects: IBM Global Technology Outlook 2005
 - 2 Smart Objects: IBM Global Technology Outlook 2005
 - 3 Smart Objects: IBM Global Technology Outlook 2005
 - 4 From Autonomous to Cooperative," ERCIM Workshop on eMobility.
 - 5 International Telecommunication Union
 - 6 Computer Industry Almanac
 - 7 GSM Association Fact Sheet 2007
 - 8 2007 Nilson Report: Issue 889
 - 9 Alinen ROI Report
 - 10 U.S. Department of Energy, May 18, 2007
 - 11 U.S. Department of Energy , May 18, 2007
 - 12 IBM
 - 13 IBM
 - 14 US Department of Homeland Security
 - 15 IBM Internet Security Systems X-Force
 - 16 Ponemon Institute, 2007
 - 17 IBM case study

© Copyright IBM Corporation 2009

IBM Global Services
Route 100
Somers, NY 10589
U.S.A.

Produced in the United States of America
2-09
All Rights Reserved

IBM, the IBM logo, AIX, BladeCenter, Cool Blue, i5/OS, POWER, POWER6, IBM System Director Active Energy Manager, System i, System p, System p5, System x, System z, Tivoli and X-Architecture are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries or both. Dynamic Infrastructure is a registered trademark of International Business Machines Corporation in the United States.

Cell Broadband Engine is a trademark of Sony Computer Entertainment, Inc. in the United States, other countries or both and is used under license therefrom.

Intel is a trademark or registered trademark of Intel Corporation or its subsidiaries in the United States and other countries.

Linux is a registered trademark of Linus Torvalds in the United States, other countries or both.

Microsoft and Windows are trademarks of Microsoft Corporation in the United States, other countries or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Other company, product and service names may be trademarks or service marks of others.

References in this publication to IBM products or services do not imply that IBM intends to make them available in all countries in which IBM operates.