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November 12, 2009

**Ex Parte**

Ms. Marlene H. Dortch, Secretary  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

*Re: GN Docket Nos. 09-47, 09-51, and 09-137*

Dear Ms. Dortch:

On November 10, 2009, Mr. Stuart McKee, Mr. Eric Wenger, and Mrs. Paula Boyd of Microsoft spoke with Mr. Eugene Huang, Mr. Kevin Bennett, and Mr. Vishal Doshi on the FCC's Broadband Team. Mr. McKee and Mr. Wenger discussed how technology can enhance government operations and services and referenced Microsoft's technologies such as Vine, Hohm, and Unified Communications.

Mr. McKee and Mr. Wenger discussed the role of the cloud in making data available and accessible while delivering efficiencies and cost savings for the government. Mr. McKee also touched on enabling a greener environment through telecommuting and discussed the energy consumption of data centers. In addition, he discussed the potential for such technologies to support the government's efforts to ensure the continuity of operations during emergencies, such as a pandemic flu.

Mr. McKee and Mr. Wenger also asserted that the government must act as a good steward for the citizen data that it holds by properly weighing the privacy and security implications of moving certain data to the cloud against the anticipated cost savings. Mr. McKee and Mr. Wenger highlighted the importance of managing identity and authentication issues as citizens interact with government via the Internet. Such considerations might include defining digital identity in limited ways in order to share only the finite information needed to obtain a particular good or service. In addition, while there are tremendous benefits in terms of innovation that will likely stem from making raw government data available to the public, care should be taken to ensure that the citizens have meaningful access to the data directly from the government as well as through third party aggregators. In the same vein, ideally it should be possible to

Ms. Marlene H. Dortch

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establish a chain of custody allowing government data to be tied back to its source---  
thereby addressing potential challenges to its authenticity.

Information outlining the top business practices for environmentally sustainable data  
centers and a document that discusses privacy and cloud computing is attached. Case  
studies that outline cost savings delivered by technology can be found at:

[http://www.microsoft.com/casestudies/Case\\_Study\\_Detail.aspx?casestudyid=400000531](http://www.microsoft.com/casestudies/Case_Study_Detail.aspx?casestudyid=400000531)  
[1 and http://www.microsoft.com/windowsserver/mainframe/casestudies.msp](http://www.microsoft.com/windowsserver/mainframe/casestudies.msp).

Pursuant to the Commission's rules, a copy of this letter is being filed electronically in  
the above-referenced dockets. Please let me know if you have any questions.

Sincerely,

*/s/ Paula Boyd*

Paula Boyd  
*Regulatory Counsel for Microsoft Corp.*

Attachments

# Trustworthy Computing



## Privacy in the Cloud Computing Era

*A Microsoft Perspective*

November 2009

The information contained in this document represents the current view of Microsoft Corp. on the issues discussed as of the date of publication. Because Microsoft must respond to changing market conditions, it should not be interpreted to be a commitment on the part of Microsoft, and Microsoft cannot guarantee the accuracy of any information presented after the date of publication.

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## Cloud Computing and Privacy

A new generation of technology is transforming the world of computing. Internet-based data storage and services—**also known as “cloud computing”**—are rapidly emerging to complement the traditional model of software running and data being stored on desktop PCs and servers. In simple terms, cloud computing is a way to enhance computing experiences by enabling users to access software applications and data that are stored at **off-site datacenters rather than on the user’s own device or PC or at an organization’s on-site datacenter.**

E-mail, instant messaging, business software, and Web content management are among the many applications that may be offered via a cloud environment. Many of these applications have been offered remotely over the Internet for a number of years, which means that cloud computing might not feel markedly different from the current Web for most users. (Technical readers will rightly cite a number of distinct attributes—including scalability, flexibility, and resource pooling—as key differentiators of the cloud. These types of technical attributes will not be addressed here because they are outside the scope of this document.)

Cloud computing does raise a number of important policy questions concerning how people, organizations, and governments handle information and interactions in this environment. However, with regard to most data privacy questions as well as the perspective of typical users, cloud computing reflects the evolution of the Internet computing experiences we have long enjoyed, rather than a revolution.

Microsoft recognizes that privacy protections are essential to building the customer trust needed for cloud computing and the Internet to reach their full potential. Customers also expect their data and applications stored in the cloud to remain private and secure. While the challenges of providing security and privacy are **evolving along with the cloud, the underlying principles haven’t changed**—and Microsoft remains committed to those principles. We work to build secure systems and datacenters that help us protect individuals’ privacy, and we adhere to clear, responsible privacy policies in our business practices—from software development through service delivery, operation, and support.

Enterprise customers typically approach cloud computing with a predefined data management strategy, and they use that strategy as a foundation to assess whether a given service offering meets their specific needs. As a result, privacy protections might vary in different business contexts. This is not new or unique to the cloud environment. Ultimately, we expect the technology industry, consumers, and governments to agree on baseline privacy practices that span industries and countries. As that consensus view evolves, Microsoft will remain an active voice in the discussion—drawing on our extensive experience and our commitment to helping create a safer, more secure Internet that enables free expression and commerce.

## The Evolution of Cloud Computing

Services that operate in the cloud often work in tandem with a client application operating on the desktop computer. For example, instant messaging and e-mail applications running on a computer rely on the cloud infrastructure for their connected features and **also require a client download. The combination of “client**

plus **cloud**” offers consumers, governments, and businesses greater choice, agility and flexibility while also greatly increasing efficiency and lowering information technology (IT) costs. It gives customers access to information, software, and services on a range of intelligent devices, at a lower cost. As a result, this next generation of computing has enormous potential to create new business opportunities and economic growth.

As with other major technological transitions, the evolution of cloud computing has drawn widespread attention and scrutiny in the news media. It has also raised policy questions concerning how people, organizations, and governments handle information and interactions in this environment. These questions are not unlike those raised during other technology-driven transitions, such as the shift from records, cassettes, and compact discs to MP3 files and from printed newspapers to online news. In these examples, the unique properties of a new medium triggered a period of adjustment that involved realigning usage practices, policies, and even regulatory approaches.

In the case of the cloud, this shift has been under way for a number of years as part of an ongoing evolution from processing information on paper and storing it in filing cabinets to storing it on computer servers outside of **the user’s** immediate physical control. A key distinction of cloud computing is that information storage and **usage need not be limited by space or geography. Indeed, cloud computing users typically don’t even need to know how many “virtual filing boxes” they will need because the available space scales to meet their needs.** Further, the cloud does far more than just store data. It also hosts applications and enables cheaper, more flexible uses of **the cloud’s** contents.

## Privacy Questions in Cloud Computing

These properties of client-plus-cloud computing raise valid questions about security and privacy, such as:

- Are hosted data and applications within the cloud protected by suitably robust privacy policies?
- **Are the cloud computing provider’s technical infrastructure, applications, and processes secure?**
- Are processes in place to support appropriate action in the event of an incident that affects privacy or security?

Security is an essential component of strong privacy safeguards in all online computing environments, but security alone is not sufficient. Consumers and businesses are willing to use online computing only if they trust that their data will remain private and secure. (See the related paper titled “[Securing Microsoft’s Cloud Infrastructure](#).”<sup>1</sup>) The ability of cloud computing providers to live up to these expectations is critical not only for the future of cloud computing but also for protecting fundamental rights of privacy and freedom of expression.

Microsoft has been examining and addressing privacy challenges in the evolving cloud computing realm for well over a decade. Our extensive experience has helped us develop well-defined business practices, privacy policies, and security measures that govern our cloud computing ecosystem. Recognizing that the cloud poses some new security and privacy challenges, we believe that our current policies and practices provide a solid foundation for addressing privacy issues and enabling greater trust in the Internet going forward.

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<sup>1</sup> [www.globalfoundationservices.com/security/documents/SecuringtheMSCloudMay09.pdf](http://www.globalfoundationservices.com/security/documents/SecuringtheMSCloudMay09.pdf)

## Consumer-Oriented Cloud Computing Today

Over the past decade, rapidly growing Internet-based services such as e-mail, blogging, social networking, search, and e-commerce have substantially redefined the way consumers communicate, access content, share information, and purchase products. Since the launch of the MSN® network in 1994, Microsoft has actively

### Microsoft Privacy Principles

- **Accountability** in handling personal information within Microsoft and with vendors and partners
- **Notice** to individuals about how we collect, use, retain, and disclose their personal information
- **Collection** of personal information from individuals only for the purposes identified in the privacy notice we provided
- **Choice and consent** for individuals regarding how we collect, use, and disclose their personal information
- **Use and retention** of personal information in accordance with the privacy notice and consent that individuals have provided
- **Disclosure or onward** transfer of personal information to vendors and partners only for purposes that are identified in the privacy notice, and in a security-enhanced manner
- **Quality assurance** steps to ensure that personal information in our records is accurate and relevant to the purposes for which it was collected
- **Access** for individuals who want to inquire about and, when appropriate, review and update their personal information in our possession
- **Enhanced security** of personal information to help protect against unauthorized access and use
- **Monitoring and enforcement** of compliance with our privacy policies, both internally and with our vendors and partners, along with established processes to address inquiries, complaints, and disputes

addressed privacy and security considerations in its online services. Today, we manage a cloud-based infrastructure and platform for more than 200 online services and Web portals for consumers, including Windows Live™ Hotmail®, Windows Live Messenger, and Bing™ search. Because Microsoft has a direct relationship with consumers for these services, we establish and directly manage the privacy policies that govern data associated with these services.

Microsoft has long maintained that in order for individuals and organizations to fully utilize the power of computers and the Internet, the overall ecosystem must be more secure and reliable. We also believe that individuals and organizations must have greater control over their information and be able to trust that this information is being used and managed appropriately.

**The foundation of Microsoft's approach to privacy and improved data protection is a commitment to empowering people to help control the collection, use, and distribution of their personal information.** Microsoft was one of the first organizations to embrace the Safe Harbor privacy principles developed by the U.S. Department of Commerce and the European Commission. These tenets provided a **framework for the development of Microsoft's own privacy principles**, which guide our use and management of customer and partner information. (See sidebar at left.)

Together, our privacy principles and corporate privacy policy govern the collection and use of all customer and partner information and provide Microsoft employees with a clear and simple framework to help ensure privacy compliance companywide.

As a part of our Trustworthy Computing initiative, Microsoft employs more than 40 full-time privacy professionals across the company, with several hundred

more employees responsible for helping to ensure that privacy policies, procedures, and technologies are **applied within the company's products, services, processes, and systems.**

Further, the Microsoft Privacy Standard for Development (MPSD) framework helps ensure that customer privacy and data protections are systematically incorporated into the development and deployment of Microsoft products and services. The MPSD includes detailed guidance on creating customer notification and consent procedures, providing sufficient data security features, maintaining data integrity, offering user access, and supplying controls when developing software products and Web sites. In an effort to share best practices with the broader technology industry and privacy community, Microsoft has publicly released a version of its [Privacy Guidelines for Developing Software Products and Services](#).<sup>2</sup>

We continually review and refine the privacy policies and codes of conduct that govern our online applications **in order to address consumers' evolving needs and expectations.**

## Cloud Computing for Governments and Businesses

Many of the same privacy policies, principles, and technologies that govern our delivery of consumer-oriented cloud computing services also apply to cloud computing for governments and businesses. Adoption of cloud computing in these sectors has accelerated as organizations have recognized its compelling potential to reduce capital and staffing costs by moving e-mail and other services into a cloud environment. Cloud-based services can also be quickly implemented and modified to meet customer demand anytime and anywhere. This allows governments and businesses to add or reduce computing capacity nearly instantaneously and pay only for the services they need. These advantages are leading organizations to put mission-critical services such as customer relationship management, enterprise resource planning, financial data management, e-mail, and document management into the cloud.

Unlike our consumer business, in which Microsoft has a direct relationship with consumers and directly controls the policies that govern their data, our cloud services for business customers defer to the policies of those customers. **In this case, Microsoft has no direct relationship with the business's employees or the customers to whom the hosted data may pertain. Policies relating to the business's handling of this data in the cloud** environment are controlled and set by that business rather than by Microsoft. Our role is to handle and process the data on behalf of the business, much like third-party telephone call centers process customer inquiries, orders, and data for their business customers.

The division of responsibility between an enterprise or government and its cloud services provider is similar to that of a company that rents physical warehouse space from a landlord for storing boxes of customer or company files. Even though someone else might own the building, access to those files and the use of information within them is still governed by the policies of the company that rents the space. These same principles should apply in the cloud environment.

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<sup>2</sup> <http://www.microsoft.com/downloads/details.aspx?FamilyId=C48CF80F-6E87-48F5-83EC-A18D1AD2FC1F&displaylang=en>

**Documents stored on an organization's own internal servers have a measure of built-in security and privacy** based on the physical boundaries and access controls that the company can impose directly. As data moves into the cloud, these natural protections no longer apply in the same way. Assurance of privacy and security will require firm policies on data access, usage, and transfer that will remain in force no matter where the data travels or how it is used. Some companies will prefer to store and manage their documents and data on their own servers, while others will prefer a cloud environment or some combination of the two approaches. Microsoft offers customers all three options, which are backed by a range of security tools to help customers protect documents and data against theft, security breaches, and other types of compromise.

To prepare for the growth of cloud computing, Microsoft has developed clear and transparent data handling processes in its hosted-services agreements with enterprise customers for Microsoft Dynamics® CRM Online, Microsoft® Business Productivity Online Standard Suite, and many other services. Microsoft also provides enterprise customers with a set of flexible management tools in its enterprise platform offerings that help to protect sensitive and confidential data and support compliance with related government guidelines.

These types of transparent policies and strong protective tools are essential for enterprises as they deal with the additional privacy and security questions that arise from their use of the cloud environment to store, organize, and share data—questions that go beyond those associated with consumer-oriented cloud computing services.

Microsoft is working closely with its enterprise customers to help address these considerations through well-defined policies governing cloud-based management, use, and protection of data. This includes making sure that as enterprises increasingly move from storing data in-house to contracting with cloud-services providers for hosted management, clear privacy guidelines define what the provider can and cannot do with data it is safeguarding.

## **Legal and Regulatory Challenges**

Cloud services can thrive when companies are able to provide these services in an efficient way and assure customers that their data will remain private and secure. But as more and more consumer and enterprise data moves into the cloud, increasing uncertainty about the legal and regulatory obligations related to that data could jeopardize the benefits of cloud computing.

To offer the full benefits of cloud computing, online computing providers must be able to operate datacenters in multiple locations and transfer data freely between them. This allows a provider to optimize efficiency and deliver the performance and reliability that customers expect. Regulations that restrict cross-border data transfers, or create uncertainty or disharmony with respect to such transfers, can hamper these benefits.

Similarly, providers can be caught in an impossible position when governments impose conflicting legal obligations and assert competing claims of jurisdiction over user data held by these providers. Divergent rules on data privacy, data retention, law enforcement access to user data, and other issues can lead to ambiguity and significant legal challenges. For instance, one country might insist that its rules regarding mandatory data retention or law enforcement access to data apply in a given context. However, this could result in a situation

where there is a direct conflict with the privacy laws of another country that also has a strong claim of jurisdiction over that same data.

While IT companies will face the brunt of these problems first, their effects will increasingly be felt across the economy. If businesses are forced to store data locally in order to mitigate these jurisdictional conflicts, the costs of investment and innovation in cloud computing will increase. As a result, many of the efficiency and performance benefits of cloud computing may be lost and the benefits to business and consumers will be reduced.

The IT industry has been working hard to address these challenges, but it cannot solve them alone. Microsoft supports efforts to develop globally consistent privacy frameworks that recognize the worldwide nature of data flows while at the same time providing strong privacy protections for the people to whom the data pertains. More generally, governments must help craft clear rules and processes to resolve these conflicting obligations in a way that protects privacy and security.

## Conclusion

Client-plus-cloud computing offers enhanced choice, flexibility, operational efficiency and cost savings for businesses and consumers. To take full advantage of these benefits, users must be given reliable assurances regarding the privacy and security of their online data. In addition, a number of regulatory, jurisdictional, and public policy issues remain to be solved in order for online computing to thrive.

Microsoft has been addressing many of these issues since 1994, when we delivered our first online services for consumers and enterprises. Our breadth of experience has shaped our **company's privacy principles, corporate privacy policy**, product and service development, and overall business practices. These components anchor our commitment to maintaining the highest standards of privacy and security in our online services and to partnering with other industry leaders, governments, and consumer organizations to develop globally consistent privacy frameworks that enable the expansion of the economic and social value of cloud-based computing.

# Microsoft's Top 10 Business Practices for Environmentally Sustainable Data Centers

How to Reduce Energy Consumption, Waste, and Costs while Increasing Efficiency and ROI

April 2009

Microsoft recognizes the tough challenges that data center managers, industry operators, and IT businesses face today as they struggle to support their businesses in the face of budget cuts and uncertainty about the future. It's natural that environmental sustainability is taking a back seat in many companies at this time. But the fact is, being "lean and green" is good for both the business and the environment, and organizations that focus their attentions accordingly will see clear benefits. Reducing energy use and waste improves a company's bottom line, and increasing the use of recycled materials is a proven way to demonstrate good corporate citizenship to your customers, employees, and the communities you do business in.

That said, it isn't always easy to know where to begin in moving to greener and more efficient operations. With that in mind—along with Microsoft's commitment to share best practices with the rest of the data center industry—this paper presents the top ten best business practices for environmentally sustainable data centers. The items in this list were submitted by senior members of Microsoft's Global Foundation Services (GFS) Infrastructure Services team. Their backgrounds include expertise in server and chip development, data center electrical and mechanical engineering, power and cooling architecture and design, research and development, and business operations and administration.

Microsoft has followed the practices below for several years now and found that in addition to helping protect the environment, they lead to optimal use of resources and help teams stay aligned with core strategies and goals.

- 1. Provide incentives that support your primary goals:** Incentives can help you achieve remarkable results in a relatively short period of time if you apply them properly. Take energy efficiency as an example. A broad range of technology improvements and best practices are already available that companies can use to improve efficiency in the data center. However, industry adoption for these advances has been relatively low. The main reason is that the wrong incentives are in place. For instance, data center managers are typically compensated based on uptime and not efficiency. Microsoft now provides specific incentives to reward managers for improving the efficiency of their operations, using metrics such as Power Usage Effectiveness (PUE), which determines the energy efficiency of a data center by dividing the amount of power entering a data center by the power used to run the computer infrastructure within it.

The current global PUE average for the data centers that Microsoft owns is 1.53 and we are working aggressively to drop this average yearly PUE below 1.2 for all new data center designs by 2010. Uptime is still an important metric, but it is now being appropriately balanced against the need to improve energy efficiency.



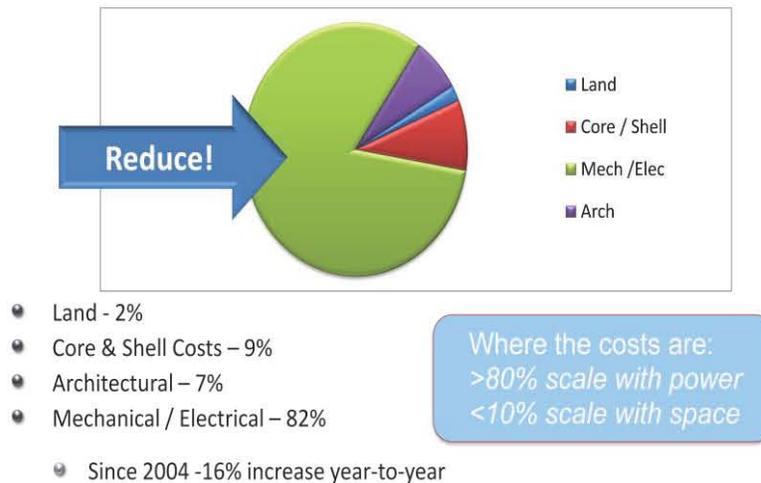
*One data center manager drove power improvements of 22 percent within three years in one of Microsoft's older facilities.*

Another outmoded incentive in the industry involves how data center hosting costs are allocated back to internal organizations. Most often these costs are allocated based on the proportion of floor space used. These incentives drive space efficiency and ultra-robust data centers, but they come at a high cost and typically are not energy efficient. Space-based allocation does not reflect the true cost of building and maintaining a data center.

Microsoft has achieved substantial efficiency gains by moving to a model that allocates costs to internal customers based on the proportion of energy their services consume. Not long after Microsoft's GFS organization implemented this change, engineers from internal groups began contacting GFS to ask how they could architect upcoming releases so they didn't use as much energy. And product groups began evaluating their server utilization data to make sure they didn't already have unused capacity before ordering more servers.

It's important to note that GFS didn't simply change its billing practices and then leave it up to the product teams to figure out how to reduce their energy use. The migration to this new process was thoughtfully rolled out with supporting data, tools, and guidance to our internal teams so they could integrate these improvements into their practices. However, without financial incentives, it is doubtful these tools would have been used to the extent and success that they were.

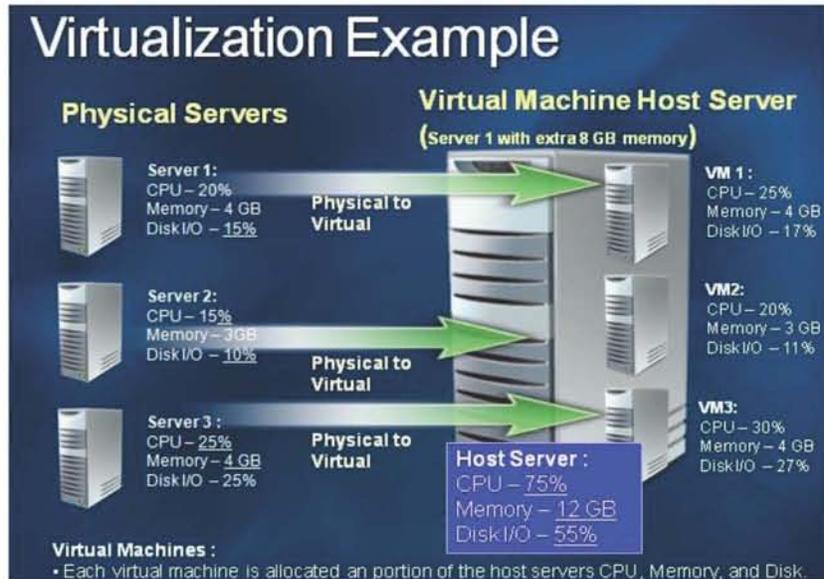
## Data Center Costs in the United States



*To significantly reduce costs, focus on mechanical and electrical expense.*

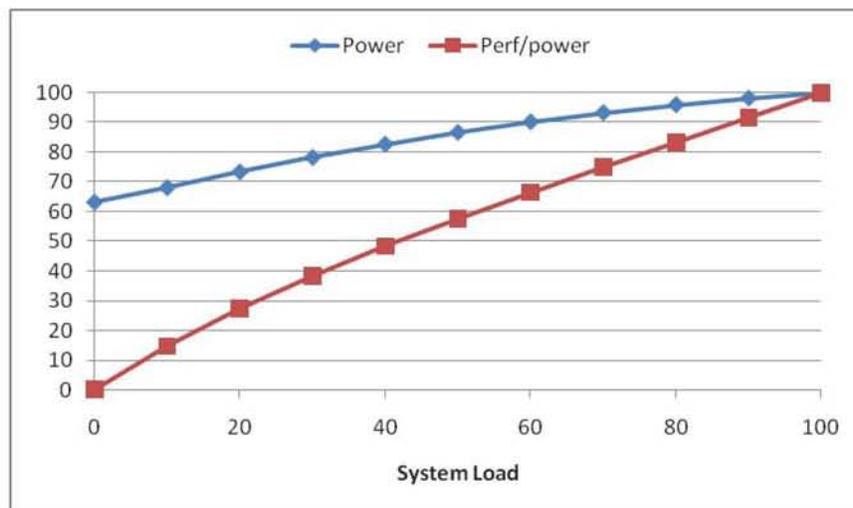
**2. Focus on effective resource utilization:** Energy efficiency is an important element in Microsoft business practices, but equally important is the effective use of resources deployed. For example, if only 50 percent of a data center's power capacity is used, then highly expensive capacity is stranded in the uninterruptible power supplies (UPSs), generators, chillers, and so on. In a typical 12 Megawatt data center this could equate to \$4-8 million annually in unused capital expenditure. In addition, there is embedded energy in the unused capacity since it takes energy to manufacture the UPSs, generators, chillers, and so on. Stranding capacity will also force organizations to build additional data centers sooner than necessary. This wouldn't happen had they fully utilized existing data center infrastructure first.

**3. Use virtualization to improve server utilization and increase operational efficiency:** As noted in the point above, underutilized servers are a major problem facing many data center operators. In today's budgetary climate, IT departments are being asked to improve efficiency, not only from a capital perspective, but also with regard to operational overhead. By migrating applications from physical to virtual machines and consolidating these applications onto shared physical hardware, Microsoft data centers are increasing utilization of server resources such as central processing unit (CPU), memory, and disk input/output. It is quite common to see several instances in data centers where server resources are under-utilized. Industry analysts have reported that utilization levels are often well below 20 percent. Microsoft is using technologies such as Hyper-V to increase virtualization and thus utilization year over year, which in turn helps increase the productivity per watt of our operations. GFS is also actively working on broad-based adoption of Microsoft's upcoming Windows Azure cloud operating system, which uses virtualization in its core. On Windows Azure, an application typically has multiple instances, each running a copy of all or part of the application's code. Each of these instances runs in its own virtual machine (VM). These VMs run 64-bit Windows Server 2008, and they're provided by a hypervisor that's specifically designed for use in the cloud.



*Consolidating virtualized applications onto shared hardware increases the utilization of server resources.*

One immediate benefit of virtual environments is improved operational efficiency. Microsoft operations teams can deploy and manage servers in a fraction of the time it would take to deploy the equivalent physical hardware or perform a physical configuration change. In a virtual environment, managing hardware failures without disrupting service is as simple as a click of a button or automated trigger, which rolls virtual machines from the affected physical host to a healthy host.



*Servers consume a significant amount of power when they are idle, typically 60 to 70 percent of their total power. As shown above, raising their utilization from 20 to 80 percent does not quadruple the power.*

A server running virtualization will often need more memory to support multiple virtual machines, and there is small software overhead for virtualization. However, the overall value proposition measured in terms of work done per cost and per watt is much better than the dedicated underutilized physical server case.

Key benefits of virtualization include:

- Reduction in capital expenditures
- Decrease in real estate, power, and cooling costs
- Faster time to market for new products and services
- Reduction in outage and maintenance windows

**4. Drive quality up through compliance:** Many data center processes are influenced by the need to meet regulatory and security requirements for availability, data integrity, and consistency. Quality and consistency are tightly linked, and can be managed through a common set of processes. Popular approaches to increasing quality are almost without exception tied to observing standards and reducing variability.

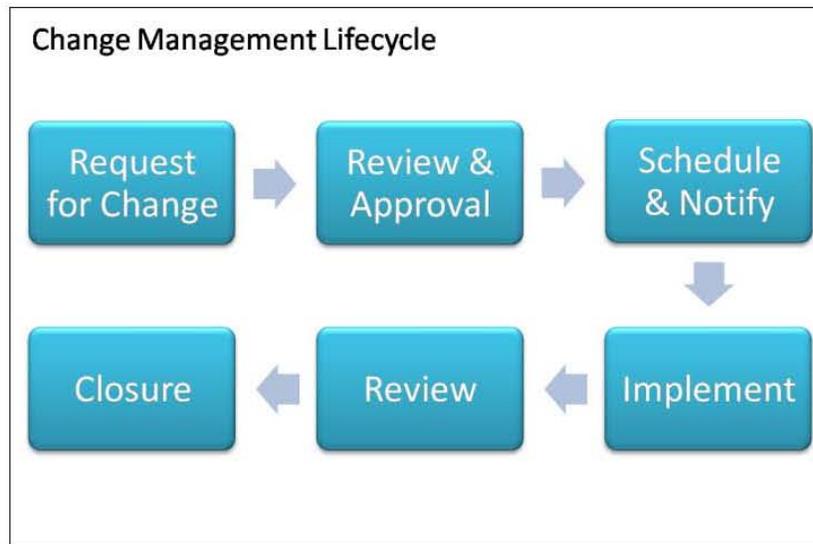
## Continuous Compliance Program



*A continuous process helps maintain the effectiveness of controls as your environment changes.*

Compliance boils down to developing a policy and then operating consistently as measured against that policy. The extended value that can be offered by standardized, consistent processes that address compliance will also help you achieve higher quality benefits. Microsoft has seen many such examples as we achieved certification to the international information security standard, ISO/IEC 27001:2005. For instance through monitoring its data center systems for policy compliance, the company has exposed processes that were causing problems, and found opportunities for improvements that benefitted multiple projects.

**5. Embrace change management:** Poorly-planned changes to the production environment can have unexpected and sometimes disastrous results, which can spill over into the planet’s environment when the impacts involve lower energy utilization and other inefficient use of resources. Changes may involve hardware, software, configuration, or process. Standardized procedures for the request, approval, coordination, and execution of changes can greatly reduce the number and severity of unplanned outages. Data center organizations should adopt and maintain repeatable, well-documented processes, where the communication of planned changes enables teams to identify risks to dependent systems and develop appropriate workarounds in advance.



*Consistent and well-documented processes help ensure smooth changes in the production environment.*

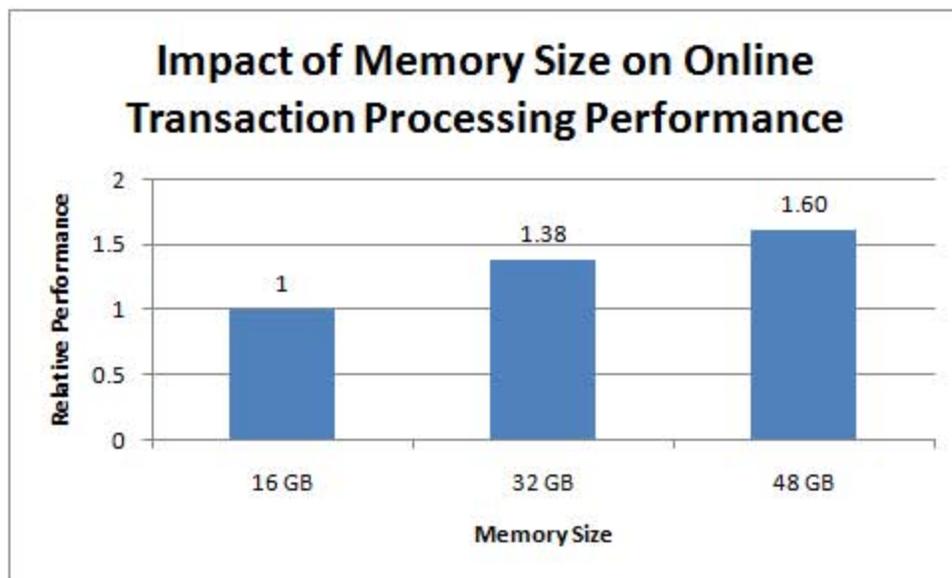
Microsoft manages changes to its data center software infrastructure through a review and planning process that is based on the Information Technology Infrastructure Library (ITIL) framework. Proposed changes are reviewed prior to approval to ensure that sufficient diligence has been applied. Additionally, planning for recovery in the case of unexpected results is crucial. Rollback plans must be scrutinized to ensure that all known contingencies have been considered.

When developing a change management program, it is important to consider the influences of people, processes, and technology. By employing the correct level of change management, Microsoft has increased customer satisfaction and improved service level performance without placing undue burden on its operations staff.

Other features that your change management process should include:

- Documented policies around communication and timeline requirements
- Standard templates for requesting, communicating, and reviewing changes
- Post-implementation review, including cases where things went well

**6. Invest in understanding your application workload and behavior:** The applications in your environment and the particulars of the traffic on your network are unique, and the better you understand them, the better positioned you'll be to make improvements. Moving forward in this regard requires hardware engineering and performance analysis expertise within your organization, so you should consider staffing up accordingly. Credible and competent in-house expertise is needed to properly evaluate new hardware, optimize your request for proposal (RFP) process for servers, experiment with new technologies, and provide meaningful feedback to your vendors. Once you start building this expertise, the first goal is to focus your team on understanding your environment, and then working with the vendor community. Make your needs known to them as early as possible. It's an approach that makes sense for any company in the data center industry that's working to increase efficiency. If you don't start with efficient servers, you're just going to pass inefficiencies down the line.



*In some cases, adding memory is an energy efficient way to improve performance.*

**7. Right-size your server platforms to meet your application requirements:** A major initiative in Microsoft data centers involves “right-sizing the platform.” This can take two forms. One is where you work closely with server manufacturers to optimize their designs and remove items you don't use, such as more memory slots and input/output (I/O) slots than you need, and focus on high efficiency power supplies and advanced power management features. With the volume of servers that Microsoft purchases, most manufacturers are open to meeting these requests as well as partner with us to drive innovation into the server space to reduce resource consumption even further.

Of course not all companies purchase servers on a scale where it makes sense for manufacturers to offer customized stock-keeping units (SKUs). That's where the second kind of right-sizing comes in. It involves being disciplined about developing the exact specifications that you need servers to meet for your needs, and then not buying machines that exceed your specifications. It's often tempting to buy the latest and greatest technology, but you should only do so after you have evaluated and quantified whether the promised gains provide an acceptable return on investment (ROI).

Remember that you may not need the latest features server vendors are selling. Understand your workload and then pick the right platform. For example, Microsoft recently replaced a high-end SQL four-socket SKU with a well engineered two-socket SKU based on the latest microprocessor technology that provided higher capacity, similar performance, and much lower power.

Conventional wisdom has been to buy something bigger than your current needs so you can protect your investment. But with today's rapid advances in technology, this can lead to rapid obsolescence. You may find that a better alternative is to buy for today's needs and then add more capacity as and when you need it. Also, look for opportunities to use a newer two-socket quad-core platform to replace an older four-socket dual-core, instead of overreaching with newer, more capable four-socket platforms with four or six cores per socket. Of course, there is no single answer. Again, analyze your needs and evaluate your alternatives.

**8. Evaluate and test servers for performance, power, and total cost of ownership:** Microsoft's procurement philosophy is built around testing. Our hardware teams run power and performance tests on all "short list" candidate servers, and then calculate the total cost of ownership, including power usage effectiveness (PUE) for energy costs. The key is to bring the testing in-house so you can evaluate performance and other criteria in your specific environment and on your workload. It's important to not rely on benchmark data, which may not be applicable to your needs and environment.



*In-house testing is the only way to verify how equipment will perform in your specific environment.*

For smaller organizations that don't have resources to do their own evaluation and testing, SPECpower\_ssj2008 (the industry-standard SPEC benchmark that evaluates the power and performance characteristics of volume server class computers) can be used in the absence of anything else to estimate workload power. In addition to doing its own tests, Microsoft requests this data from vendors in all of its RFPs. For more information visit the Standard Performance Evaluation Corp. web site at [www.spec.org/specpower](http://www.spec.org/specpower).

**9. Converge on as small a number of stock-keeping units (SKUs) as you can:** One of Microsoft's leading data center initiatives is the move to a server standards program where internal customers choose from a consolidated catalogue of servers. Narrowing the number of SKUs allows Microsoft to make larger volume buys, thereby cutting capital costs. But perhaps equally important, it helps reduce operational expenditures and complexities around installing and supporting a variety of models. Complementing this approach, Microsoft's server selection process is built around a 12- to 18-month cycle, so new models of servers aren't constantly being brought on board. This increases operational consistency and results in better pricing, as long-term orders are more attractive to vendors. Finally, it provides exchangeable or replaceable assets. For example, if the demand for one online application decreases while another increases, with fewer SKUs it is easier to reallocate servers as needed.

**10. Take advantage of competitive bids from multiple manufacturers to foster innovation and reduce costs:** Competition between manufacturers is a good thing, which Microsoft encourages through ongoing analysis of proposals from multiple companies that puts most of the weight on price, power, and performance. Microsoft develops hardware requirements, shares them with multiple manufacturers, and then works actively to develop optimized solutions. After a preliminary analysis, detailed development work continues with the company that has the best proposed design. Energy efficiency, power consumption, cost effectiveness and application performance per watt each play key roles in hardware selection. The competition motivates manufacturers to be price competitive, drive innovation, and provide the most energy efficient, lowest total cost of ownership (TCO) solutions. In many cases, online services do not fully use the available performance. Hence, it makes sense to give more weight to price and power. Remember that power impacts not only energy consumption costs but also data center capital allocation costs.

## Conclusion

Beyond the business practices listed above, Microsoft's Global Foundation Services' team is taking significant steps in four areas important to environmental sustainability:

- **Using recycled resources whenever practical:** The Microsoft data center in San Antonio, Texas, for example, uses approximately eight million gallons of recycled water a month from the city's waste water system during peak cooling months.
- **Using renewable resources whenever available:** The Microsoft data center in Quincy, Washington, uses 100 percent renewable hydropower from the Columbia Basin River. The San Antonio facility obtains its electricity from a utility that derives more than 10 percent of its peak capacity from renewable energy—including wind, solar, and landfill gas. And the Dublin, Ireland data center will use outside air for cooling, thereby reducing the need for energy-intensive coolers.
- **Reducing waste in operations:** One example of Microsoft's focus on reducing waste is the company's transition to using standard shipping containers to house thousands of servers apiece. Ordering servers by the truckload eliminates the need for large amounts of packaging and other materials previously required when servers were delivered individually or in racks.
- **Taking part in industry environmental groups:** Microsoft is a co-founder and active participant in the Climate Savers Computing Initiative and The Green Grid—industry organizations focused on improving computer systems and data center energy efficiency and establishing a firm methodology for measuring Power Usage Effectiveness (PUE) accurately and consistently. In part through these groups Microsoft is advocating that the industry move to a broader range of

operating environments that will enable data centers to run without chillers in many parts of the globe, thereby saving large amounts of power and capital expense.

Microsoft has also implemented a number of best practices and policy guidelines that drive its construction and facility operations worldwide. Examples include benchmarks for the design, construction, and operation of high performance green buildings, high efficiency electric motors for pumps and fans, electronic variable speed drives, electronic ballasts for fluorescent lamps, and occupancy dimmers. In short, GFS leaves no stone unturned in optimizing its use of power and natural resources.

Global Foundations Services' focus on the environment is consistent with Microsoft's commitments in this area. Most recently Microsoft [announced in March 2009](#) that it is taking a proactive corporate approach to reduce its carbon emissions per unit of revenue by at least 30 percent compared with 2007 levels by 2012 to help reduce the company's carbon footprint. Because data centers are a significant component of Microsoft's carbon footprint, GFS will play a vital role in Microsoft's efforts to meet this corporate goal.

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