

# The Next Generation of Computing

*Strengthening Economies and Addressing Societal Challenges with Innovative Software and Intelligent Devices, Complemented by the Cloud*

## A New Era in Computing: "Client Plus Cloud"

We are on the verge of a new era in computing, in which innovative software applications on intelligent devices ("clients"), complemented by Internet-based data storage and services (the "cloud"), will offer individuals increased control over their information while enabling more engaging, seamless experiences across their computers, cell phones and other devices. These advances will help individuals become more productive and enable organizations of every size to become more agile, innovative and collaborative. This next generation of computing holds enormous potential to stimulate economic opportunities while empowering individuals, businesses and governments to customize computing experiences to meet their specific needs.

The infusion of intelligence and connectivity into a wide range of devices, complemented by Internet-scale services, will create a new paradigm for computing based on the concept of "client plus cloud." It will help individuals and businesses increase productivity and stimulate long-term economic growth. It will allow governments to reduce IT costs while improving citizen access to government services and making the process of governance more transparent, efficient and inclusive.

### Three technology developments are driving next-generation computing:

- Advances in hardware technology that are expanding the array of increasingly powerful, versatile, interconnected and affordable PCs, smartphones and other devices
- Innovations in operating systems and feature-rich software applications that power these devices
- Maturing of the Internet as a gateway for "cloud computing," in which remote data-centers host data and serve applications used by devices and IT systems ("cloud-based services")

### Policy Briefs from Microsoft

*A convergence of innovative software and intelligent devices, complemented by cloud-based services, will stimulate economic growth, make government more effective and benefit citizens in areas ranging from education to health-care to the environment. This policy brief is one in a series from Microsoft about next-generation computing.*

While the IT sector will lead in developing these technologies, governments will be a critical partner in showcasing the use of technology to improve efficiency. Government can also advance public policies that employ technology as a tool to advance societal goals.

As the world's largest software company, Microsoft is at the forefront of all of these technological advances, combining them in ways that create unprecedented choice and flexibility for customers. We offer a range of seamless client plus cloud solutions that combine the power of software applications with advances in hardware and Internet-based services. We call these our “Software-plus-Services” solutions.



This policy brief summarizes the technological developments driving the next generation of computing. It also examines the benefits for governments of using the cloud to complement their IT resources, as well as some of the associated policy issues that governments will want to consider.

## Powerful, Interconnected Devices

The first driving force behind next-generation computing is rapid growth in the variety and power of Internet-connected computing devices. Today, many people—particularly in developed markets—have a computer at work, another at home, and one or more computing devices that they carry around with them, such as a smartphone or digital music player. Meanwhile, advances in microprocessor, storage, communications and display technologies are enabling an explosion of diversity in computing devices. Semiconductor manufacturers such as Intel and AMD are continuing to increase computing power with a new generation of multi-core processors, which stimulate development of intelligent devices that run innovative software from Microsoft and other companies.

We already see this trend today with mobile phones featuring capabilities that nearly match those of the PC; TVs with Internet connectivity and rich user interfaces; GPS and media units in cars that respond to voice commands; electronic book readers that download books from the Internet and display them with a quality approaching that of paper; digital picture frames that grab photos and other content wirelessly over the Internet; and game consoles that serve as media hubs for the home. But this is just the beginning. In the years ahead, we'll see intelligence and connectivity woven into nearly everything in our lives, from wall-sized screens and tabletop touch-screen computers such as [Microsoft® Surface™](#) in businesses to networked sensors and displays throughout the home.

## Smarter, Easier-to-Use Software

Significant and exciting advances in operating systems and software applications that power and connect all of these devices represent a second driving force behind next-generation computing. For example, [Windows® 7](#), Microsoft's forthcoming operating system for laptop and desktop computers, will include a touch-based natural user interface that many users of mobile phones, PDAs, Tablet PCs and Microsoft Surface have recently become familiar with. This will enable programs that run on Windows to offer more intuitive touch-based user interfaces and features, making software a more integral part of our lives at work and at home. Microsoft is also investing significantly in other speech and visual recognition interfaces, all of which will spur the development of innovative new products and services by other companies and make computing devices even more versatile, powerful and easy to use.

Microsoft and other software companies will continue to develop more innovative software that will reside locally on users' computing devices, often referred to as “rich client” software. The advanced features and functionality of these programs will enable users to perform increasingly complex



computing functions such as data visualization and simulation. More innovative software will also stimulate development of the new generation of intelligent devices that provide users with flexibility to meet their computing needs anywhere, anytime.

This infusion of intelligence and connectivity into a wide range of devices complements the growth of Internet-scale services to create a new paradigm for computing based on the concept of client plus cloud. In this paradigm, data storage and processing duties are spread across intelligent and powerful clients (such as PCs, set-top boxes or mobile devices), and large-scale Internet services are hosted in vast datacenters. For customers, this means rich, seamless experiences that offer the information, entertainment and connectivity they need—at any time and on any device. For example, Microsoft's [Live Mesh](#) service lets people synchronize information and files across their devices, as well as access and run programs on computers in their mesh networks.

Rich client software is what enables the cloud's full potential to be realized. It will be essential to enabling productivity in offline computing scenarios, such as when Internet access is unavailable or where bandwidth is limited. Rich client software will enhance the cloud experience by fostering a wider array of cloud-based services and solutions and by empowering customers to select the combination of client plus cloud that best meets their needs.

## The Cloud: Complementing and Enhancing Rich Client Computing

The third driving force behind the next generation of computing is the maturing of the Internet as a gateway for Internet-based services, in which remote datacenters host data and serve applications to users' devices and to IT systems. In simple terms, the cloud will enhance client computing experiences by enabling users to access software applications and data over the Internet. The applications and data are stored at off-site datacenters rather than on the user's own device or PC or at an organization's on-site datacenter. When software and data are delivered as an online service, the installation, maintenance and support functions are centralized and streamlined, leading to greater economic efficiency.

The cloud is often associated with, and can complement, software applications that support key IT processes such as customer relationship management, video conferencing and Web content management. These are processes that many organizations and businesses are not equipped to manage on their own or have little interest in managing. The cloud enables organizations to access software applications and computer capacity on a pay-as-you-go basis, paying only for the services they use. The cloud already supports





popular consumer services such as Internet e-mail (Yahoo! Mail, Windows Live Hotmail®), online content delivery (YouTube, Flickr) and online applications (eBay, Microsoft Office Live).

The cloud complements traditional on-premises and device-based software by offering the following benefits:

**Choice and flexibility.** The cloud enables organizations to respond quickly to evolving needs by scaling their IT capacity up or down, without having to invest in new hardware or additional IT support. It also gives users more choice about where to store their data and enables organizations to customize their IT systems for their specific needs. For instance, some organizations might choose the cloud for mission-critical IT services such as maintaining customer databases and e-mail. Others might choose the cloud for more basic IT services such as data storage. Still others might choose the cloud to improve efficiency or simplify their IT infrastructure.

**Cost savings and efficiencies.** Although pricing models for cloud-based services are still evolving, the centralized architecture for cloud-based services is expected to generate efficiencies and economies of scale. For example, choices such as pay-as-you-go and subscription-based purchase of cloud-based services can allow organizations to spend their IT budgets more efficiently and devote more of their energy and resources to their core business functions.

**Access to greater computing power and the latest software.** Cloud-based services allow organizations of any size and in virtually any location to complement their core rich-client computing needs by tapping into supercomputing power and software applications that were previously available only to the largest global companies. It also facilitates “anywhere, anytime” access to data and applications, making organizations more efficient and businesses more competitive in the global marketplace.

**Earlier access to new technologies.** Cloud-based services allow software developers to roll out software updates more quickly. They can also allow organizations to “test drive” new technologies or applications before deciding whether to invest in bringing them in-house. This can greatly benefit governments and small and medium-sized businesses, which traditionally have not had the resources to access newer and more expensive technologies.

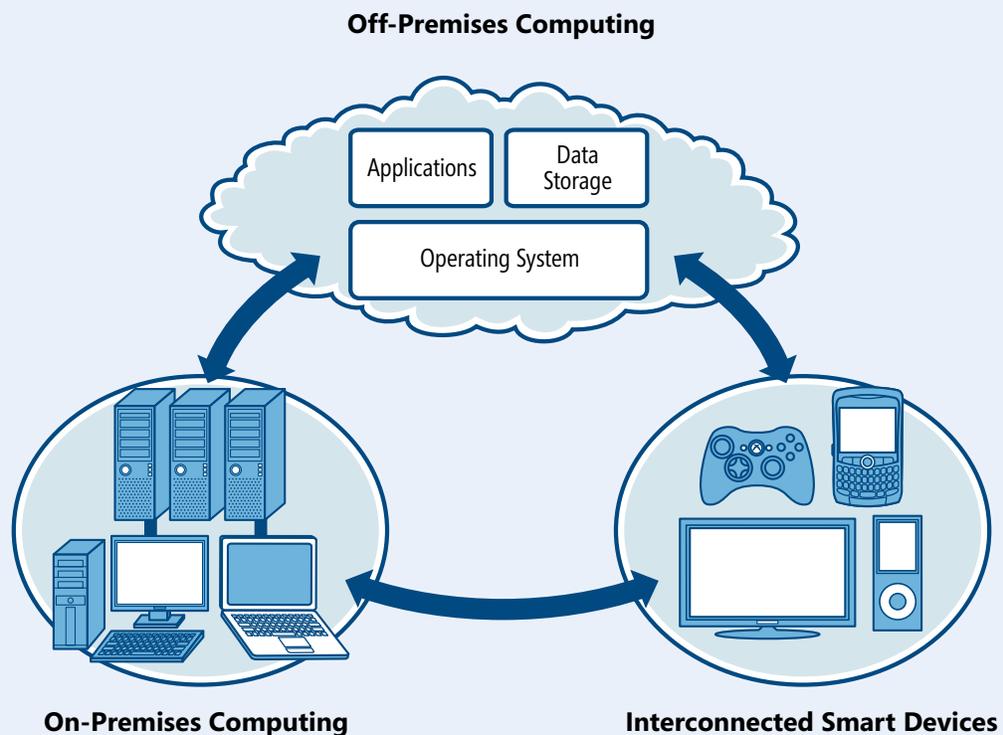


## Microsoft's Vision: Software-Plus-Services

Microsoft's [Software-plus-Services](#) vision focuses on empowering customers and offering them unprecedented flexibility in choosing client plus cloud combinations—of innovative software, intelligent and interconnected devices, and cloud-based services—that best meet their needs.

Building on our experience and success in developing many of the most popular computer operating systems, office productivity suites and other software applications, Microsoft has been a leader in the consumer cloud-based services space for years, with offerings such as Windows Live Hotmail, Messenger and Xbox LIVE®. With 13 datacenters around the world and more coming in the years ahead, we also provide a range of advanced cloud-based solutions for businesses and organizations. These offerings compete worldwide with hosted services from other leading providers, including Amazon, SAP, Salesforce.com, Google and IBM. What makes our approach unique is that it allows customers to combine our flexible cloud-based services with rich client software on intelligent, interconnected devices and in on-premises datacenters. No other company has the experience or breadth of solutions to offer this flexibility and best-of-all-worlds approach.

Microsoft recently unveiled the [Azure™ Services Platform](#) (Azure), a cloud-based services platform hosted at Microsoft datacenters that provides an operating system and a set of developer services that can be used individually or together. Azure's flexible and interoperable platform allows developers to build new applications that run from the cloud or enhance existing rich client software with cloud-based capabilities. Its open architecture can be used to build cloud-based applications; applications that run on connected devices, PCs or servers; or hybrid solutions that offer the best of online and on-premises computing. The Azure Services Platform is interoperable and supports numerous open standards such as SOAP, REST, XML and PHP. It supports Microsoft and non-Microsoft programming languages and environments, and it enables developers to use any programming language on any platform.



**Software-Plus-Services: How It Works.** Rich client software on personal computers and interconnected devices will be complemented by cloud applications. Microsoft's vision is to enable customers to choose the combination that best meets their needs.

## Benefits of the Cloud for Governments and Citizens

Just as earlier advances in computing increased the efficiency of government and improved the delivery of services to citizens, cloud-based services have the potential to help governments become significantly more efficient, transparent, accountable and accessible to citizens. Equally important, government policies that enable the widespread adoption of next-generation computing technologies can help provide the vital stimulus needed to get economies growing again.

The following examples highlight the potential benefits of the cloud for governments.

**Government agencies.** Many government agencies require additional IT capacity to accommodate periodic spikes in usage, such as in the weeks before an annual filing deadline. With cloud-based services, an agency can maintain enough on-premises servers to handle its normal workload and add capacity as needed from a cloud provider to handle occasional upsurges.

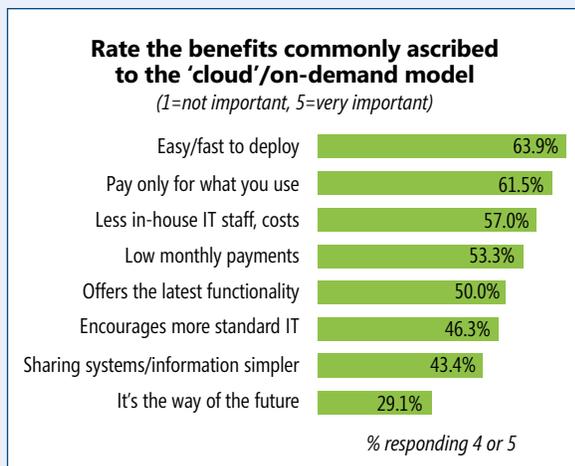
**Government research.** Many government research labs and agencies undertake major scientific research projects—in areas such as energy, healthcare, defense and infrastructure—that require massive computing power to process large volumes of data. This need for secure, high-end computing capability can impose tremendous financial burdens. Cloud-based services allow governments to pay only for the computing power they need, when they need it—thereby freeing up IT resources for further research.

**Hospitals and healthcare.** The cloud offers public and private hospitals and clinics an important tool in making the transition to a more cost-effective health IT system. Cloud-based services can also enable clinics in remote areas or with few resources to access cutting-edge health IT applications and share data easily without having to purchase new equipment or hire new IT staff.

**Education.** Schools often lack the resources or ability to take full advantage of information technology. The cloud offers a way to expand the quality and accessibility of education, particularly in remote and underserved communities. It can enable more dynamic and interactive learning experiences and allow teachers in multiple locations to collaborate more effectively. In addition, cloud-based services can offer schools the same kinds of cost savings, agility, choice and access to cutting-edge computing technologies that are available to business organizations.

**Green initiatives.** Cloud-based services can help governments advance their energy efficiency and environmental goals. For example, consolidated datacenters can be designed to reduce total energy consumption and use renewable and other environmentally friendly energy sources.

**Startups and small businesses.** Cloud-based services democratize computing power and applications, making computing resources more accessible and reducing up-front costs to organizations of all sizes. This is especially important as governments continue to encourage entrepreneurs and small businesses to innovate and thereby help strengthen their local economies.



Source: IDC eXchange, "IT Cloud Services User Survey, pt. 2: Top Benefits & Challenges," Oct. 2, 2008.



## Government Leadership to Foster the Cloud

To help nurture the development of the cloud and cloud-based services, and to spur the associated economic and social opportunities, governments will want to consider a number of public policy issues. Given the importance of the Internet to cloud-based services and to today's economy, governments have a compelling interest in ensuring that the online ecosystem evolves in ways that are healthy, competitive and sustainable. Necessary steps include ensuring that consumers' privacy and online safety are protected; maintaining incentives for creativity and protecting the intellectual property rights of online copyright owners and creators; ensuring competition, choice and interoperability among online ad platforms; and establishing rules that encourage network operators to invest in broadband infrastructure and preserve user access to content in all of its forms.

Other key public policy considerations include:

**Unrestricted flow of data across borders.** To offer the full benefits of cloud-based services, providers must be able to transfer data across multiple datacenters. When these datacenters are located abroad, the cross-border transfer of data might violate national data privacy laws. To avoid conflicting rules or legal demands in different jurisdictions and to attract datacenters to their country, governments have to work together to find practical solutions—such as agreements for greater intergovernmental coordination and cooperation and perhaps new international legal rules on transferring and accessing user data.

**Telecommunications rules.** The convergence of computing and telecommunications technologies—such as Voice-over-IP services—raises challenging questions about the application of traditional telecommunications rules to online services. Whether governments treat cloud-based services as “information” services, “telecommunications” services or something entirely new could have a substantial impact on the development of next-generation computing. Governments should work with industry on these issues to develop a regulatory framework that enables innovation and choice.

**Intellectual property.** For next-generation computing to thrive, industry must invest heavily in research and development as well as infrastructure, even during difficult economic times. Intellectual property laws—laws governing patents, copyrights, trademarks and trade secrets—must continue to provide strong incentives for these investments. Existing laws might need to be updated to appropriately limit the liability of cloud providers regarding content or software hosted on their systems that infringes intellectual property rights.

**Broadband access.** Economic incentives can encourage the expansion of broadband capacity—through fiber optic or advanced wireless technologies, for example—to support cloud-based services, particularly in remote and underserved communities.

### Government Access to Advanced Technology

For governments and citizens to gain the full benefits of the cloud, they need to be able to choose the technologies that best meet their needs. To ensure that governments have the broadest choices among IT products and services and that they are making decisions in an open and transparent manner, government procurement policies should be objective and merit based, and not discriminate based on IT business, development or licensing models.



## Microsoft's Leadership in Enabling the Cloud

For the cloud to reach its full potential, industry must take the lead in addressing important issues as they emerge. Here are several examples of what Microsoft is doing and how the industry can work with governments to make even more progress:

**Security and online safety.** Relocating data from on-site servers to remote datacenters raises security concerns for all users, from individuals to governments. Microsoft has adopted industry-leading best practices to strengthen the security of our products and to meet stringent security standards for our online services, including being the first major online service provider to earn [ISO/IEC 27001:2005 certification](#). We also collaborate with law enforcement and others to protect users, especially children, against online threats. While industry must continue to provide the first line of defense against online security threats, governments can play an important role by updating laws to address new technologies and threats, enacting procedures that make it easier for law enforcement to investigate online crimes and share information, and ensuring that their own security rules do not impose unnecessary barriers to adoption of cloud-based services and related technologies.

**Privacy.** Online privacy continues to be a major concern for users. As a leader in online privacy, Microsoft believes that all providers of online services must be transparent about their data collection and usage practices and commit to not sharing users' personal data with third parties. We encourage governments to support industry-led efforts to strengthen online privacy, including in areas such as anonymization of user information.

**Interoperability and data portability.** For next-generation computing to truly expand choice, users must be able to transfer their data easily between on-site and cloud servers, and among various cloud providers and services. Achieving this will require a strong industry commitment to interoperability and data portability. Microsoft has adopted industry-leading interoperability principles on open access, support for standards, and data portability for its high-volume products. Companies will need to work collaboratively to promote interoperability and data portability in the new cloud environment.

**Human rights and free expression.** Some governments seek to censor online content or target the speech of political dissidents. Some allow law enforcement access to user data in ways that are seen to violate human rights. Microsoft recently joined the Global Network Initiative, a multi-stakeholder group of companies, civic organizations (including human rights and press freedom groups), investors and academics that has advanced a set of voluntary guidelines in this area called the [Principles on Freedom of Expression and Privacy](#). We encourage governments to actively support such efforts and seek to resolve conflicting obligations that might arise in this area through direct, government-to-government dialogue.



## Smartphones Exemplify the Benefits of Next-Generating Computing

Smartphones such as Apple's iPhone, RIM's BlackBerry and various Windows Mobile® devices are examples of intelligent, connected computing devices that use rich client software and cloud-based services. Each device is loaded with an operating system and various applications that enable a user to easily perform tasks on the smartphone itself, such as reading a PDF, playing games or viewing photos. The devices also enable users to connect to Internet-based cloud services. For instance, users can access their personal e-mail in the cloud via Gmail or Yahoo! Mail, or access their office e-mail and contacts via Microsoft Exchange ActiveSync® on their company's cloud. They can also easily access online content and applications in the cloud, such as videos on YouTube, their Facebook page or news from the *New York Times*.

## Conclusion: Partnering to Achieve the Benefits of Next-Generation Computing

The cloud and cloud-based services for businesses and organizations are relatively new, and it remains to be seen how rapidly they will be adopted and how they will evolve. What appears certain, however, is that most users will opt to use a combination of client plus cloud. For instance, an organization might use on-premises rich clients to handle certain core computing tasks and to store sensitive or mission-critical data while using cloud-based services or the cloud for other tasks or to store less sensitive data that does not need to be immediately accessible.

Both client and cloud-based services involve tradeoffs, so users will have to balance these tradeoffs based on their own unique circumstances. Users will always have a need for smarter, more efficient and more functional software on their PCs and devices. By allowing users and organizations to seamlessly combine the best of rich client software with intelligent, interconnected devices and cloud-based services, Microsoft's Software-plus-Services approach gives users the choices they need.

Governments have an important role to play in enabling the next generation of computing and its many benefits. By facilitating cloud-based services, governments will have more choices that enable them to become more efficient and provide greater access to public services. It also will support efforts to spur economic growth that can in turn help address social challenges. Microsoft welcomes the opportunity to work closely with governments on the policy and legal issues that have emerged and will continue to emerge in this area.

[Click here for more on how Microsoft is partnering with governments.](#)

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**Software + Services?**



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