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ABSTRACT

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CLOUD COMPUTING

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- *Cloud Computing represents a computing paradigm shift in which users store, access, and utilize data remotely using the Internet. It can be used to augment and/or replace on-site computing resources. The “cloud” is a network of data centers providing commoditized computing power—software, hardware, and services—to end users in a highly scalable fashion similar to the provision of electricity or water.*
- *The characteristics underlying cloud computing place heightened pressure on Congress and the courts. Cloud computing providers and the companies that rely on them can easily move their base of operations to other countries that develop better legal frameworks. Comparatively poor cloud computing policy will drive skilled technical jobs and the companies that rely on them overseas.*

Background: Cloud computing represents a sea change in how organizations and the public utilize and think about computing resources. It represents a paradigm shift where users can remotely access high-powered computing resources (both infrastructure and software/services) contained in off-site data centers from modest end-user systems via a broadband connection. This added level of specialization cuts costs for users who need not build large on-site IT systems. By commoditizing IT infrastructure and software, providers of cloud services rely on economies of scale to build massive IT resources that can be portioned to clients on an as-needed basis. This shift allows for the more efficient use of computer resources and information technology, and allows individuals and small companies access to vast amounts of computing resources they would not have had the means to access in the past. However, the complexity, ubiquity and power of the “cloud” will put pressure on our existing legal regimes.

Innovative Trends Enabled by Cloud Computing:

- **Work product can “follow the sun”:** By storing resources remotely, companies can enable greater productivity and efficiency by allowing users around the world to collaborate on projects. For multinational companies, when a project team in the United States goes home for the day workers in Europe and Asia can seamlessly pick up where the other team left off.
- **Workloads can “follow the moon”:** Conversely, the actual storage and computation of data can move to locations that require the least energy usage. Computers and servers, especially high-end ones, generate significant amounts of heat and require vast amounts of energy to keep their hardware cool. Having workloads “follow the moon” (i.e., migrate to data centers where it is currently night) means reduced energy consumption and expenditure.

- **Workloads can “follow the law”:** The ease of moving data online allows workloads to be located where the regulatory and legal landscape is best suited for the task at hand. This dynamic places a heightened importance on policy makers in countries seeking to derive the benefits (and profits) associated with cloud computing.

Policy Considerations:

Free Flow of Data

To an even greater extent than ever before, cloud computing defies international borders. Information flows seamlessly between data centers around the world and, from a technical perspective, where data is stored is often arbitrary. Therefore, harmonizing the patchwork quilt of laws and regulations that govern information depending upon its physical location is essential. Information discrimination represents not just a human rights issue, but a non-tariff trade barrier. Microsoft’s General Counsel Brad Smith summed up the problem in a Brookings Institute speech:

“Ultimately cloud computing will benefit the most if governments can establish a multilateral framework that provides legal clarity in the form of a new treaty or similar international agreement. We need a free trade agreement for data and information. While a multilateral framework would require substantial diplomatic, leadership, and resources, it is definitely a cause worth embracing.”

Cyber Security

Effective domestic and international cyber security policies are necessary for cloud services to flourish. Users must trust that their critical information is secure even though it is stored off site and transits over the Internet. Policymakers should consider results based standards that allow sufficient flexibility in implementation and preserve industry-led innovation while still achieving a baseline level of security. The current course of collaborating with industry to reform domestic cyber security policy (through legislation and agency action) while also proactively working with international governments and supranational bodies should be maintained.

Broadband Coverage

Quality, high-speed broadband connections are essential to cloud computing because broadband provides the link between the purveyors of cloud computing services and their clients. As major corporations tap into cloud computing to lower their costs and raise productivity, companies without access to quality broadband will be at a competitive disadvantage. An important component of the broadband deployment debate is wireless spectrum policy. In many ways, wireless spectrum holds the key to achieving truly ubiquitous Internet access, which is necessary for maximum utilization of the cloud. The FCC and NTIA should prioritize policy changes that help wireless broadband proliferate.

Liability Rules

Online services such as cloud computing receive frequent demands by various interests to bar problematic third party content under threat of liability for the user’s action. The 1996 Telecommunications Act and the 1998 Digital Millennium Copyright Act contain crucial limitations on whether Internet and e-commerce businesses may be held liable for a user’s misconduct because these services (many of which deal in petabytes of data each day) lack the control that brick-and-mortar businesses have over individual content. Ensuring that existing statutory protections for online service providers are applied equally to cloud computing services

is essential to the future health of the industry.

Nondiscrimination

The basic infrastructure of the cloud (including broadband access) should not discriminate or provide unfair advantages to certain users. As with the Internet, the best ideas and companies will have the greatest ability to succeed if chokepoints are eliminated and market power in key areas of the underlying infrastructure is constrained.

User confidence

Cloud computing depends on storage of data by third parties. As a result, the cloud must achieve high levels of privacy and security if it is to fully realize its potential. Not only must the infrastructure be designed in such a way as to combat hackers, but policies and design must also discourage improper surveillance by foreign and domestic authorities. If privacy protections are eviscerated by political demands, data will migrate to more principled jurisdictions taking economic activity and jobs with it.

Interoperability

Competition and innovation are key to the growth of cloud computing. Ensuring (and protecting) interoperable environments and underlying frameworks is crucial in allowing the proliferation of new applications and services. As the cloud evolves, policymakers must carefully guard against “lock-in” and encourage consumer choice by preventing the inappropriate exercise of market power. Consumers should be free to migrate to any platform, software, or service as they deem fit. The construction of unnecessary barriers to prevent easy migration must be actively discouraged.

Key Players:

The categories below are designed to give an overview of the key players and services being offered in the cloud, but their boundaries are not easily defined, nor are they mutually exclusive.

Software-as-a-Service (SaaS)

One obvious and early example of the potential of cloud computing is online email. Google, Yahoo!, and Microsoft are among the companies that provide robust online email applications. For the most part, these services are free or offered for very low cost, and provide near limitless storage and remote access from any computer or device with an Internet connection. Other offerings such as mint.com and salesforce.com provide personal finance and sales lead generating software that utilize the resources of the cloud not only to lower the price of providing the software, but also use the reach of the Internet to greatly enhance the functionality of the underlying product.

Platform-as-a-Service (PaaS)

PaaS is the delivery of a computing platform and software stack over the Internet. It gives programmers and IT professionals the resources they need to develop and deploy applications without the added cost and complexity of managing their own hardware and software layers on-site. Major players in this arena include the Google App Engine, the Yahoo! Developer Network and Microsoft’s Azure Web Services.

Infrastructure-as-a-Service (IaaS)

IaaS represents full-service virtual infrastructure stacks that are sometimes referred to as “everything-as-a-service.” The goal of these services is to replace a company’s entire server

room and network through virtualization technology. These offerings are designed to cut costs and improve flexibility. This can be useful to large organizations seeking to improve margins, as well as smaller companies who have difficulty affording the large up-front and service costs associated with operating their own servers and networks. Major players in this space include Amazon Web Services, Rackspace, Savvis, HP, IBM, Verizon and AT&T.

Current Status: Cloud computing has experienced rapid growth in recent years. While mainly the result of rapid technological innovation and increased high-speed broadband offerings, the recent financial crisis has accelerated deployment as companies seek to trim the large overhead costs associated with in-house IT. Cloud computing puts pressure on many different areas of policy, and action is necessary to create the optimal environment for innovation and growth. Broadband deployment, privacy, security, competition policy, and intellectual property reform are just a few areas that must be addressed to foster rapid innovation and adoption of cloud computing. The very nature of cloud computing raises the stakes for policymakers; providers of cloud services will relocate to the countries and regions that create the optimal legal frameworks for it to thrive. If the U.S. hopes to remain the world's innovation leader long into the future, considerable time and care should be invested in passing laws and regulations that are significantly forward looking and take into account the needs of businesses and governments who will come to rely on the cloud.