CLOUD COMPUTING TECHNOLOGY

(WITH BPOS AND WINDOWS AZURE)

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We see cloud computing offerings today that are suitable to host enterprise architectures. But while these offerings provide clear benefits to corporations by providing capabilities complementary to what they have, the fact that they can help to elastically scale enterprise architectures should not be understood to also mean that simply scaling in this way will meet twenty-first-century computing requirements.
The architecture requirements of large platforms like social networks are radically different from the requirements of a healthcare platform in which geographically and corporately distributed care providers, medical devices, patients, insurance providers, clinics, coders, and billing staff contribute information to patient charts according to care programs, quality of service, and HIPAA constraints. The requirements for both of these are very different than those that provision straight-through processing services common in the financial services industry. Clouds will have to accommodate differences in architecture requirements like those implied here, as well as those relating to characteristics we subsequently discuss.


I. INTRODUCTION

Cloud Computing is frequently taken to be a term that simply renames common technologies and techniques that we have come to know in IT. It may be interpreted to mean data center hosting and then subsequently dismissed without catching the improvements to hosting called utility computing that permit near real-time, policy-based control of computing resources. Or it may be interpreted to mean only data center hosting rather than understood to be the significant shift in Internet application architecture that it is. Cloud computing represents a different way to architect and remotely manage computing resources. One has only to establish an account with Microsoft, Amazon or Google to begin building and deploying application systems into a cloud. These systems can be, but certainly are not restricted to being, simplistic. They can be Web applications that require only http services. They might require a relational database. They might require Web service infrastructure and message queues. There might be need to interoperate with CRM or e-commerce application services, necessitating construction of a custom technology stack to deploy into the cloud if these services are not already provided there. They might require the use of new types of persistent storage that might never have to be replicated because the new storage technologies build in required reliability. They might require the remote hosting and use of custom or third-party software systems. And they might require the capability to programatically increase or decrease computing resources as a function of business intelligence about resource demand using virtualization. While not all of these capabilities exist in today’s clouds, nor are all that do exist fully automated; a good portion of them can be provisioned.

In simple terms:
• Delegate your headache to someone else out there
• Focus on what you really want
• Pay only for what you use
• Scale up/down your resources dynamically on demand

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In this paper, we want to revisit autonomic computing, which defines a set of architectural characteristics to manage systems in which complexity is increasing but must be managed without increasing costs or the size of the management team, in which a system must be quickly adaptable to new tech-
nologies integrated to it, and in which a system must be extensible from within a corporation out to the broader ecosystem and vice versa. The primary goal of autonomic computing is that "systems manage themselves according to an administrator’s goals. New components integrate ... effortlessly ...". Autonomic computing per se may have been viewed negatively in the past years — possibly due to its biological metaphor or the AI or magic-happens-here feel of most autonomic initiatives. But innovations in cloud computing in the areas of virtualization and fine-grained, container-based management interfaces, as well as those in hardware and software, are demonstrating that the goals of autonomic computing can be realized to a practical degree and that they could be useful in developing cloud architectures capable of sustaining and supporting ecosystem-scaled use.

Taking an autonomic approach permits us to identify core components of an autonomic computing architecture that cloud computing instantiations have thus far placed little emphasis on:

- An architecture style (or styles) that should be used when implementing cloud-based services.
- External user and access-control management that enables roles and related responsibilities serving as interface definitions that control access to and orchestrate across business functionality.
- An interaction container that encapsulates the infrastructure services and policy management necessary to provision interactions.
- An externalized policy-management engine that ensures that interactions conform to regulatory, business partner, and infrastructure policy constraints.

Utility computing capabilities necessary to manage and scale cloud oriented platforms:

0. Architecture state: no systems management

1. Systems and resources must be identifiable

2. System and resources must be manageable

3. Policy-driven secured access to the system and managed resources must be provided

4. System must reallocate managed resources on failures as a function of policy

5. System must reallocate managed resources on various system-level conditions by policy

6. System must be managed lights-out in a single data center context

7. Systems management capability must scale across clouds of the same type

8. Systems management capability must scale across clouds of different types; these clouds must be managed uniformly while maintaining separate cloud identities

9. System must reallocate managed resources on various system-level conditions as a function of policy to accommodate real-time and business-oriented usage patterns

10. Systems management policies are harmonized across cloud boundaries

11. It must be possible to integrate management policies of different clouds

12. Monolithic applications and traditional application integrations exist/are sufficient

13. Application platform must be service-oriented

14. Applications are replaced with business services

15. Business services have secured access

16. An interaction container must be used as application container in a single-tenant environment

17. Policies must be consolidated and managed using a single (possibly federated) policy engine

18. System must reallocate managed business services on various business-level conditions by policy to accommodate real-time/batch-usage patterns

19. An interaction container must be used as application container in a multi-tenant environment

20. Business service and systems management policies are integrated

21. Architecture state: positioned as an autonomic architecture platform for virtual organization-oriented application systems

22. Architecture state: additional structural and business constraints positioning architecture platform as a service grid
II. THE CLOUD COMPUTING ARCHITECTURE

The architecture of the software systems involved in the delivery of cloud computing typically involves multiple cloud components communicating with each other over loose coupling mechanism such as messaging queue.

III. LAYERS

Once an internet protocol connection is established among several computers, it is possible to share services within any one of the following layers.

1) Client

A cloud client consists of computer hardware and/or computer software that relies on cloud computing for application delivery and that is, in essence, useless without it. Examples include some computers, phones and other devices, operating systems, and browsers.[10][11][12]

2) Application

Cloud application services or “Software as a Service (SaaS)” deliver software as a service over the Internet, eliminating the need to install and run the application on the customer’s own computers and simplifying maintenance and support.

3) Platform

Cloud platform services, also known as Platform as a Service (PaaS), deliver a computing platform and/or solution stack as a service, often consuming cloud infrastructure and sustaining cloud applications.[33] It facilitates deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers.[11][12]

4) Infrastructure

Cloud infrastructure services, also known as Infrastructure as a Service (IaaS), deliver computer infrastructure – typically a platform virtualization environment – as a service, along with raw (block) storage and networking. Rather than purchasing servers, software, data-center space, or network equipment, clients buy those resources as a fully outsourced service. Suppliers typically bill such services on a utility computing basis; the amount of resources consumed (and therefore the cost) will typically reflect the level of activity.[10]

5) Server

The server’s layer consists of computer hardware and/or computer software products that are specifically designed for the delivery of cloud services, including multi-core processors, cloud-specific operating systems, and combined offerings.[7][8][9][10]

IV. CHARACTERISTICS

Cloud computing exhibits the following key characteristics:

• Agility improves with users’ ability to re-provision technological infrastructure resources.
• Application Programming Interface (API) provides accessibility to software that enables machines to interact with cloud software in the same way the user interface facilitates interaction between humans and computers. Cloud computing systems typically use REST-based APIs.
• Cost is claimed to be reduced, and in a public cloud delivery model, capital expenditure is converted to operational expenditure.[12] This is purported to lower barriers to entry, as infrastructure is typically provided by a third-party and does not need to be purchased for one-time or infrequent intensive computing tasks. Pricing on a utility-computing basis is fine-grained with usage-based options, and fewer IT skills are required for implementation (in-house).[13]
• Device and location independence [14] enable users to access systems using a Web browser regardless of their location or what device they are using (e.g., PC, mobile phone). As infrastructure is off-site (typically provided by a third-party) and accessed via the Internet, users can connect from anywhere.[13]
• Multi-tenancy enables sharing of resources and costs across a large pool of users thus allowing for:
» Centralization of infrastructure in locations with lower costs (such as real estate, electricity, etc.)
» Peak-load capacity increases (users need not engineer for highest possible load-levels)
» Utilization and efficiency improvements for systems that are often only 10–20% utilized[15]

• Reliability is improved if multiple redundant sites are used, which makes well-designed cloud computing suitable for business continuity and disaster recovery.[16]

• Scalability and Elasticity via dynamic (“on-demand”) provisioning of resources on a fine-grained, self-service basis near real-time, without users having to engineer for peak loads. [17]

• Performance is monitored and consistent, and loosely coupled architectures are constructed using Web services as the system interface.[13]

• Security could improve due to centralization of data, increased security-focused resources, etc., but concerns can persist about loss of control over certain sensitive data, and the lack of security for stored kernels.[18] Security is often as good as or better than that of traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford.[19] However, the complexity of security is greatly increased when data is distributed over a wider area or greater number of devices and in multi-tenant systems that are being shared by unrelated users. In addition, user access to security audit logs may be difficult or impossible. Private cloud installations are in part motivated by users’ desire to retain control over the infrastructure and avoid losing control of information security.

• Maintenance of cloud computing applications is easier because they do not need to be installed on each user’s computer. They are easier to support and to improve, as the changes reach the clients instantly.

• Collaboration on documents, sharing knowledge, and managing information allows SharePoint Online to bring together the familiar SharePoint collaboration platform now delivered as an online service, making the power of the cloud work for your business; AND SharePoint Online provides a single, integrated location where employees can efficiently collaborate with team members, share knowledge, and find organizational resources and information.

V. WINDOWS AZURE

Windows Azure is a cloud services operating system that serves as the development, service hosting, and service management environment for the Windows Azure platform. Windows Azure provides developers with on-demand compute and storage to host, scale, and manage web applications on the Internet through Microsoft datacenters.

Windows Azure supports multiple languages and integrates with your existing on-premises environment. To build applications and services on Windows Azure, developers can use their existing Microsoft Visual Studio expertise. In addition, Windows Azure supports popular standards, protocols, and languages including SOAP, REST, XML, Java, PHP and Ruby. Windows Azure is now commercially available in 40 countries.
WHAT ARE THE BENEFITS OF WINDOWS AZURE?

- **Agility**: take advantage of development tools, automated service management, and global datacenter presence to respond faster to customer needs, focus on your competitive differentiators, and reach new markets.

- **Efficiency**: Windows Azure improves productivity and increases operational efficiency by lowering up-front capital costs. Customers and partners can realize a reduction in total cost of operations of some workloads by up to 30 – 40 percent over a three-year period. The consumption-based pricing, packages, and discounts for partners lower the barrier to entry for cloud services adoption and ensure a predictable IT spend. (See Windows Azure pricing.)

- **Focus**: focus on delivering services and value to your customers – and not on managing technology infrastructure. Windows Azure enables you to spend less time on operational hurdles and more time focusing on your competitive differentiators.

- **Simplicity**: Utilize your existing skills in familiar languages such as .NET, Java, and PHP to create and manage Web applications and services.

- **Trustworthy**: enterprise class service is backed by reliable service-level agreements and a rich online services experience.

You now get more time to do what you really enjoy doing rather than spending time on maintenance and troubleshooting!

ACCESS MANAGEMENT IN AZURE [SECURITY CONTINUED]

How do I get started?


2. Create your first Windows Azure local application: Learn how to create a simple ASP.NET application in Visual Studio for Windows Azure.

3. Get a paid account: Sign up for Windows Azure to set up your account and access the online portal.

4. Deploy and run your Windows Azure application: Learn how to deploy and run your sample application in Windows Azure.
VI. THE FUTURE OF CLOUD COMPUTING

A solid majority of technology experts and stakeholders participating in the fourth “Future of the Internet” survey expect that by 2020, most people will access software applications online and share and access information through the use of remote server networks, rather than depending primarily on tools and information housed on their individual, personal computers. They say that cloud computing will become more dominant than the desktop in the next decade. In other words, most users will perform most computing and communicating activities through connections to servers operated by outside firms.

Among the most popular cloud services now are social networking sites (the 500 million people using Facebook are socializing in the cloud), Webmail services like Hotmail and Yahoo mail, micro blogging and blogging services such as Twitter and WordPress, video-sharing sites such as YouTube, picture-sharing sites such as Flicker, document and applications sites like Google Docs, social-bookmarking sites like Delicious, business sites like eBay, and rating, ranking and commenting sites such as Yelp and TripAdvisor.

This does not mean, however, that most of these experts think the desktop computer will disappear soon. The majority sees a hybrid life in the next decade, as some computing functions move toward the cloud, and others remain based on personal computers.

The highly engaged, diverse set of respondents to an online, opt-in survey included 895 technology stakeholders and critics. The study was fielded by the Pew Research Center’s Internet & American Life Project and Elon University’s Imagining the Internet Center. Some 71 percent agreed with the statement:

“By 2020, most people won’t do their work with software running on a general-purpose PC. Instead, they will work in Internet-based applications such as Google Docs, and in applications run from smart phones. Aspiring application developers will develop for Smartphone vendors and companies that provide Internet-based applications, because most innovative work will be done in that domain, instead of designing applications that run on a PC operating system.”

Some 27 percent agreed with the opposite statement, which posited:

“By 2020, most people will still do their work with software running on a general-purpose PC. Internet-based applications like Google Docs and applications run from smart phones will have some functionality, but the most innovative and important applications will run on (and spring from) a PC operating system. Aspiring application designers will write mostly for PCs.”

Most of those surveyed noted that cloud computing will continue to expand and come to dominate information transactions because it offers many advantages, allowing users to have easy, instant, and individualized access to tools and information they need wherever they are, locatable from any networked device. Some experts noted that people in technology-rich environments will have access to sophisticated—yet affordable—local networks that allow them to “have the cloud in their homes.”

Most of the experts noted that people want to be able to use many different devices to access data and applications, and - in addition to the many mentions of smart phones driving the move to the cloud - some referred to a future featuring many more different types of networked appliances. A few mentioned the “internet of things” - or a world in which everyday objects have their own IP addresses and can be tied together in the same way that people are now tied together by the Internet. So, for instance, if you misplace your TV remote, you can find it because it is tagged and locatable through the Internet.

Some experts in this survey said that for many individuals the switch to mostly cloud-based work has already occurred, especially through the use of browsers and social networking applications. They point out that many people today are primarily using smart phones, laptops, and desktop computers to network with remote servers and carry out tasks such as working in Google Docs, following Web-based RSS (really simple syndication) feeds, uploading photos to Flicker and videos to YouTube, doing remote banking, buying, selling, and rating items at Amazon.com, visiting with friends on Facebook, updating their Twitter accounts and blogging on WordPress.

Many of the people who agreed with the statement that cloud computing will expand as the Internet evolves said the desktop will not die out but it will be used in new, improved ways in tandem with remote computing. Some survey participants said they expect that a more sophisticated desktop-cloud hybrid will be people’s primary interface with information. They predicted the desktop and individual, private networks will be able to provide most of the same conveniences as the cloud but with better functionality, overall efficiency, and speed. Some noted that general-purpose, in-home PC servers can do much of the work locally via a connection.
to the cloud to tap into resources for computing-intensive tasks.

Among the defenses for a continuing domination of the desktop, many said that small, portable devices have limited appeal as a user interface, and they are less than ideal for doing work. They also expressed concern about the security of information stored in the “cloud” (on other institutions’ servers), the willingness of cloud operators to handle personal information in a trustworthy way, and other problems related to control over data when it is stored in the cloud, rather than on personally-controlled devices.

Some respondents observed that putting all or most of faith in remotely accessible tools and data puts a lot of trust in the humans and devices controlling the clouds and exercising gate keeping functions over access to that data. They expressed concerns that cloud dominance by a small number of large firms may constrict the Internet’s openness and its capacity to inspire innovation—that people are giving up some degree of choice and control in exchange for streamlined simplicity.

A number of people said cloud computing presents difficult security problems and further exposes private information to governments, corporations, thieves, opportunists, and human and machine error.

Survey participants noted that there are also quality of service and compatibility hurdles that must be crossed successfully before cloud computing gains more adopters. Among the other limiting factors the expert respondents mentioned were the lack of broadband spectrum to handle the load if everyone is using the cloud; the variability of cost and access in different parts of the world and the difficulties that lie ahead before they can reach the ideal of affordable access anywhere, anytime; and complex legal issues, including cross-border intellectual property and privacy conflicts.

Among the other observations made by those taking the survey were that large businesses are far less likely to put most of their work “in the cloud” anytime soon because of control and security issues; most people are not able to discern the difference between accessing data and applications on their desktop and in the cloud; low-income people in least-developed areas of the world are most likely to use the cloud, accessing it through connection by phone.

VII. CONCLUSION

Cloud computing is the fastest growing part of IT with tremendous benefits to customers all sizes. Cloud services are simpler to acquire and scale up or down. Key opportunities present themseleves for applications and infrastructure for vendors. Public clouds work great for some, but not all, applications. Private clouds offer many benefits for internal applications. Public and private clouds can be used in combination.