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PRINCIPLES OF CLOUD COMPUTING IMPLEMENTATION IN THE ENTERPRISE

Dimiter G. Velev
Department of Information Technologies and Communications
University of National and World Economy, Sofia, Bulgaria
e-mail: dvelev@unwe.acad.bg

Today business needs to respond in the Internet environment with new services, capabilities, and offerings to be competitive. This could be a long process of implementation actions involving storage, networking, security and other procedures. A growing number of companies and organizations are turning to cloud computing to reduce costs and shorten the time to market. While traditional corporate data centers and on-premise software are not disappearing, cloud computing will have a far-reaching impact on enterprise IT and business in large organizations.

Cloud computing is an on-demand service model for the provision of IT services based on virtualization and distributed computing technologies [1, 6, 8, 9]. The common business applications are delivered online as services which are accessed from another web service or software like a web browser, while the software and data are stored on servers. The abstraction of computing, network and storage infrastructure is the foundation of cloud computing. Cloud computing removes the traditional application silos within the data center and introduces a new level of flexibility and scalability to the IT organizations.

Cloud Computing Categories

The following cloud computing categories have been identified and defined in the process of cloud development [1, 4]:

- Infrastructure as Service (IaaS): provides virtual machines and other abstracted hardware and operating systems which may be controlled through a service Application Programming Interface (API). IaaS includes the entire infrastructure resource stack from the facilities to the hardware platforms that reside in them and it incorporates the capability to abstract resources as well as deliver physical and logical connectivity to those resources. IaaS provides a set of APIs that allow management and other forms of interaction with the infrastructure by consumers.
- Platform as a Service (PaaS): allows customers to develop new applications using APIs, implemented and operated remotely. The platforms offered include development tools, configuration management and deployment platforms. PaaS is positioned over IaaS and adds an additional layer of integration with application development frameworks and functions such as database, messaging, and queuing that allow developers to build applications for the platform with programming languages and tools are supported by the stack.
- Software as a Service (SaaS): software offered by a third party provider, available on demand, usually through a Web browser, operating in a remote manner. SaaS is built upon the underlying IaaS and PaaS stacks and provides a self-contained operating environment used to deliver the entire user experience including the content, its presentation, the applications and management capabilities.
- Multi-Tenancy: manages the need for segmentation, isolation, governance, service levels and billing models for different consumer constituencies.

Cloud Deployment Models

The cloud services can be implemented in four deployment models [1, 2, 3]:

- Public Cloud. The cloud infrastructure is made available to the general public or large industry group and is owned by an organization selling cloud services.

- Private Cloud. The cloud infrastructure is operated entirely for a single organization. It may be managed by the organization or a third party, and may exist on-premises or off-premises.
- Community Cloud. The cloud infrastructure is shared by several organizations and supports a specific community. It may be managed by the organizations or a third party, and may exist on-premises or off-premises.
- Hybrid Cloud. The cloud infrastructure is a composition of two or more clouds (private, community or public) that are bound together by standardized or proprietary technology that enables portability of data and application.

Cloud users are identified as Individual consumers, Individual businesses, Start-ups, Small and medium-size businesses and Enterprise businesses.

Aspects of the cloud computing in the enterprise

Cloud computing significantly changes many aspects of enterprise computing acquisition, operations and governance. These aspects are [8, 10, 11]:

- Reduced capital expenditures - costs are dramatically reduced since the initial computing infrastructure investments rests primarily on the cloud computing provider. Ongoing costs are also lower due to economies of scale and multi-tenancy, which allows access to the lower cost of cloud computing resources even for very infrequent tasks.
- Low barrier to entry – since it is not necessary to acquire and install hardware and software for every need and resources can be obtained on-demand in real-time, cloud computing facilitates moving existing applications into a hosted data center.
- Security - cloud computing can be more secure than traditional computing since shared costs allow larger overall investment in security processes and infrastructure. Nevertheless the problems regarding access and control over an organization's sensitive data remain.
- Scalability and performance - Cloud computing can provide access to very high levels of scale without enormous costs of traditional infrastructure. Performance of cloud computing can also be on a very good level since many providers own data centers around the world to keep the processing reasonably close to those accessing it over the network.
- Centralization - Cloud computing can be centralized or it can be highly distributed using peer-to-peer capabilities.
- Service orientation - Cloud computing is a service delivered over the network, but true service-orientation allows such services to be componentized, pluggable, composable and loosely coupled. Cloud computing transforms the Web to a global Service Oriented Architecture.

Several factors bring to the in interest in the cloud [5, 7]. From a business point of view economic conditions continue to put pressure on business spending. For organizations eager to reduce or eliminate capital spending, the pay-as-you-go model provides an attractive option. Companies also turn to cloud-based solutions as a way to counter the rising costs of licensing enterprise software. As the globalization trend continues, distributed work has become an everyday reality in large organizations. In contrast to many existing on-premise applications, Web-based productivity applications are inherently collaborative and accessible anywhere. From a technology point of view the latest IT developments have combined to make the Internet an emerging enterprise platform. At the center is the widespread adoption of Web services, allowing easy publishing, access, and integration of application functionalities and infrastructural capabilities from distributed sources. Next are the Rich Internet applications (RIAs) which support desktop-like, client-side functionality within a browser, including local persistence for offline use, complex graphics processing, integration with local devices and enhanced user In

addition, other advances such as hardware virtualization, multi-tenant architecture, parallelization engines to support for the elasticity and scalability of the cloud.

Enterprise Cloud Type Utilization

There are two options for proper cloud utilization in the enterprise [3, 7, 11]:

- Enterprise Private Clouds - This model overcomes several challenges faced in public cloud adoption. Enterprise private clouds are seen as a natural progression of initiatives like virtualization already taken up by several organizations. Enterprise private cloud solutions add capabilities like self-service, automation and charge back over the virtualized infrastructure.
- Enterprise Hybrid Clouds - Private clouds help overcome some of the challenges associated with public clouds but they are not as cost effective as public clouds. The recommended approach is to adopt a hybrid one where both public and private clouds are used for different categories of applications. This approach allows enterprises to adopt the public clouds partially, deploying only those services that are suitable for public clouds. The private cloud helps apply the cloud computing model internally as well. Thus the hybrid approach brings together the best in both worlds of public and private clouds. As technology matures, there will be better options for creating such an enterprise cloud.

Implementing Enterprise Projects in the by Cloud Computing

The infrastructure clouds provide a relatively inexpensive and flexible source of raw computing power for batch-oriented jobs with self-contained datasets. Such projects include data conversion and mining, data compression and encryption, simulation, risk modeling, etc. [2, 3, 5, 9]:

- Software development and testing - For companies with large in-house software projects, moving to a cloud based development environment makes sense since it provides more support for distributed projects and global collaboration. Because the project team can obtain development resources on the fly, it can also help minimize potential project delays.
- Research and development - R&D projects in large companies may also be suitable candidates for the cloud since they are highly iterative, demanding fast and quick scaling. Advanced product development groups may also take advantage of the cloud to shorten time to market.
- Business continuity and disaster recovery - Large providers of cloud services rely on highly distributed, robust and scalable infrastructure. They can store customer data redundantly in multiple physical locations. In case of disaster, such data will be more easily recovered than it would be in a typical enterprise data center. Thus, the cloud may also be used to back up business data in critical enterprise systems.
- Desktop productivity tools - Companies might be tempted to move commodity applications like e-mail and personal productivity tools into the cloud to save money and to meet the demands of younger employees. Desktop clouds are not yet mature enough in terms of feature sets and service levels for such heavy business use. They are best used to augment rather than replace existing productivity suites. Depending on the type and style of work, it makes sense to target select groups for such applications.
- Peak load demands - There are two broad types of peak load demands: predictable and unpredictable. A predictable peak demand comes up when IT groups have to handle the usual operations and the cloud can be used to accommodate demand. Unpredictable peak load is more complex. It requires dynamic load balancing between the applications running on in-house data centers and external clouds. Companies must plan their internal data center capacities based on stable demand instead of peak numbers. Together with the broad adoption of virtualization this could lead to drastic improvements in the utilization of data center resources.

Enterprise Cloud Computing will have a profound effect on IT infrastructure. This can become the result of implementing an internal cloud or through use of external cloud computing services or both. IT infrastructure is evolving into a service supply chain, comprised of multiple service domains integrated to better support business service goals. So the relationships between cloud service providers, both internal and external, will become important. The cloud computing model brings together four dimensions of complexity [2, 3]:

- Applications and services will further evolve from being monolithic and static toward composite and dynamic. This in turn increases the reliance on network performance as well as the separation from the traditional data center.
- IT infrastructure will continue to shift from physical to virtual dependence, complicating IT orchestration with more moving parts.
- Operational domains of control will move from single to dual toward multiple, which isolates operational decisions from management-based policy and complicates Service Level Agreements (SLA) and performance management.
- Business models move from per-instance licensing to pay-as-you-go licensing, which will require better project financial management and exploration into chargeback methods.

Conclusion

Cloud computing constitutes a major step in the continuing industrialization of IT and enabling high performance. The changing business model, underlying technologies and architecture will allow any IT professional can quickly add business value to run applications and develop software off-premise by Cloud Computing technologies. For enterprise IT users, the cloud holds great potential in terms of lower-cost services, greater IT agility, more flexibility, and better user experiences. Like any new technology platform, the cloud brings risks in the areas of data management, security and privacy, integration and service quality.

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