

THE CHANGING PARADIGM OF COMPUTING & THE NEED FOR NEW BUSINESS MODELS TO LEVERAGE THE CHANGE

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Abstract

This paper discusses the most promising trend in computing “The Cloud Computing [1]”. This trend is a result of ever increasing participation of more and more users in computing. The consumers are showing a major participation in the way computing systems will evolve, blogging, P2P computing, Social & Job Networking, Online Gaming and other such applications are defining how the computing systems of the future shall be. For public sector the participation is through inter-agency collaboration, adoption of open offices, health care networks, political campaigning etc. Web as primary computing platform provides a major market for software developers because of a large number of applications like email, online shopping, travel reservations, instant messaging, social networking, internet phone, map search etc that it provides to consumers. This massive need for computing needs huge IT infrastructure and therefore major investments of money. This calls for development of new business model to cope up with the evolving computing systems. Cloud computing allows avoiding the purchase of new infrastructure and instead to leverage the existing but no-in-use resources by sharing, leasing or renting existing unused infrastructure.

Key Words: Cloud Computing, IT Industry, SaaS, PaaS, IaaS.

The Cloud Computing Paradigm

A paradigm shift is taking place in the IT industry. Whereas customers who wanted to support their business processes with IT used to face having to buy all the necessary hardware, operating systems and other components and decide on a software platform, there is now the realistic vision of obtaining the functionality they require under a pure leasing model where they merely pay for what they use. IT will be delivered as a service in future. It will no longer be paid for by means of initial investment in hardware, upgrades and software licenses and by fixed maintenance fees, but on the basis of usage under “pay-as-you-go” models[2]. The basis for this paradigm shift is the Internet as an IT platform that is now available everywhere, emerging virtualization technologies, hardware commoditization, the trend

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toward IT standardization and open source software, and pressure to cut costs at IT departments. Companies that were not previously associated with conventional IT services like outsourcing now offer on-demand services such as e-mail services, virtualized infrastructures, etc. The success of Google, Amazon and Microsoft thus acts as a major catalyst in development of the market and also as the technological foundation for cloud computing. The struggle between pure Internet players like Amazon [3], Google, Salesforce and SuccessFactors and traditional enterprise vendors has only just begun. Vendors such as SAP and Oracle are coming under particular pressure and making huge attempts to “transform” their on-premise offerings and provide them in the form of cloud computing. The desire by customers to break down monolithic IT structures and so reduce one-sided dependency on software vendors also furthers the chances of cloud computing. The components of cloud computing include dynamic delivery of IT services in the form of applications (Software as a Service), platform services (Platform as a Service) and infrastructure services (virtual infrastructure as a Service)

Cloud computing is staking a growing presence on the market with innovative, feasible business models and solutions that pose a threat to the business model of established IT vendors. Leading market analysts such as Forrester or Gartner estimate that by 2013 approximately 25% [4] of all IT services will be delivered in the form of cloud computing solutions. Ray Ozzie, Chief Software Designer of Microsoft, a major driver of cloud computing, has described the transition from the PC age to utility computing (and so cloud computing) as follows: “Microsoft’s mainstream business customers are increasingly considering what services-based economies of scale might do to help them reduce infrastructure costs or deploy solutions as-needed and on [a] subscription basis.” (The Big Switch, by Nicolas Carr, 2009, Norton & Company Inc.) IT services are being industrialized on the basis of highly standardized applications. The key drivers are pressure to cut costs and standardization. A major aspect is the interaction between technological and economic forces).

Amazon EC2[2] is an example of cloud based computing service. An EC2 instance looks much like physical hardware, and users can control nearly the

entire software stack, from the kernel upwards. Other examples are Google AppEngine[3] & Microsoft’s Azure[4]. Elastic Compute Cloud (EC2) from Amazon Web Services (AWS) sells 1.0-GHz x86 ISA “slices” for 10 cents per hour, and a new “slice”, or instance, can be added in 2 to 5 minutes. Amazon’s Scalable Storage Service (S3) charges \$0.12 to \$0.15 per gigabyte-month, with additional bandwidth charges of \$0.10 to \$0.15 per gigabyte to move data in to and out of AWS over the Internet.

Key Aspects of Cloud Computing Business Models

An analysis of cloud computing as an innovative IT service delivery model provides the framework for discussing its value chains and associated business models. The following key aspects are influencing developments on the vendor and service procurer sides:

- Cloud computing shifts users’ costs away from capital expense toward operating expense and harbors a general cost-cutting potential. Investment in IT infrastructure is almost only required by the service provider [5].
- Cloud computing increases the application landscape’s complexity. Additional partners must be integrated with the on-premise solutions – at the technical, administrative and business process levels.
- Cloud computing is a dynamically evolving field: It is foreseeable that solutions will develop in rapid succession into platforms for on-demand infrastructure services, cloud-based development systems and Software as a Service (SaaS) applications enablement, something that will have implications for version migration and integration.

Critical Success Factors for Cloud Computing Business Models are:

- Multi-tenant capable Web applications and customized software parameterization.
- Interoperability and integratability with custom software and non-standard interfaces.
- Operation on the basis of virtual servers and a shared infrastructure.
- Usage-based service billing models (billing by subscription, by units of consumption).
- Load-dependent scaling within the data center infrastructure (elastic cloud concepts).
- High degree of automation in delivery of

infrastructure services (dynamic services concepts).

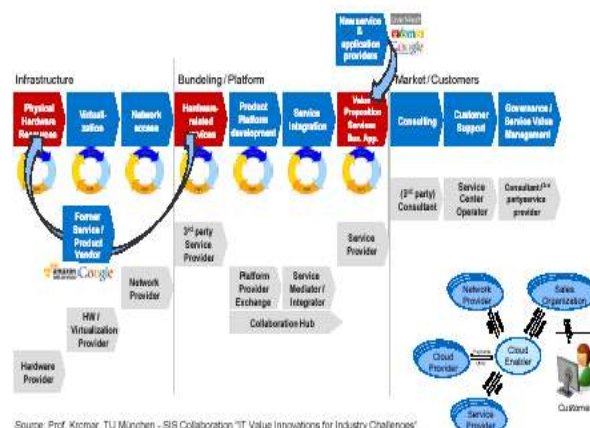
- Service level agreements (SLAs) at the application and business process levels.[6]

At present, the business model [2] of cloud computing providers is mainly based on economies of scale and service automation. Yet that is just one aspect of cloud computing. The basis for successful cloud computing business models is partnership relationships founded on trust and security in networks. In addition, parts of cloud services can be provided and procured from different clouds (public versus private versus hybrid cloud). That means growing requirements as regards the ability to manage and orchestrate a wide range of different applications and infrastructure components on the basis of billing by consumption. From the technical point of view, integration is simpler thanks to Web standards; in contrast, there is growing complexity when it comes to process integration and service management. Traditional system integrators and IT consulting firms will therefore still face challenges, albeit no longer for all types of IT service and to the same extent. Basically, customers will demand SaaS subscription models with business SLAs.

Cloud Computing Eco System:

Transaction costs are reduced as a result of cloud computing's new price and service models at some points of transition in the stages of the value chain, which may result in the value chain being broken up there. One example is operation of IT infrastructures and independent monitoring of SLAs[5] and general availability by third parties. The much lower entry costs for using a professional IT infrastructure in the cloud give rise to a large number of small, innovative enterprises that can launch new IT service offerings on the market with minimal capital commitment and flexible operating costs. The result is a cloud computing eco system of IT service providers. This eco system, such as Amazon in particular promotes by providing easy-to-use basic IT services and middleware components as Web services, will necessitate new stages in the value chain, such as service brokering and aggregation, trust and reputation assessments.

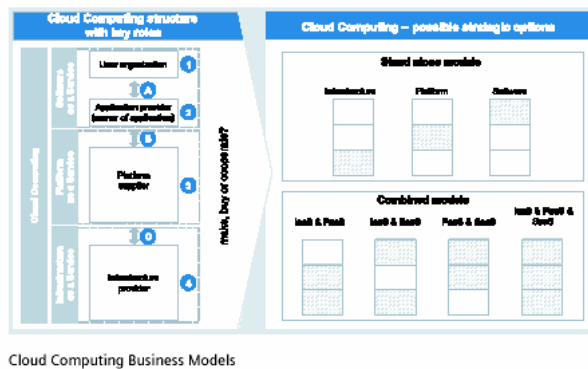
Figure: Cloud Computing Eco System (Image Courtesy: Siemens IT Solutions)



Cloud Computing Eco System

The success factors for providers of services in and out of the cloud and the features that distinguish them will become differentiated. Generic cloud computing aspects, such as a low price and flexible contractual models, will be supplemented by other factors, which will differ depending on the particular link in the value chain. Relevant factors in SaaS are best-of-breed support for the company processes that are mapped, the provider's economic reliability, integration and migration interfaces, references and flexible price models. In the case of Platform as a Service (PaaS) providers,[6] the key aspects are the size of the community entrusted with developing the technology in question, simplicity of service deployment and architecture frameworks that support automatic scaling. In contrast, leveraging economies of scale, i.e. above all advantages in price/performance ratio, as well as availability, security and the network connection's bandwidth, are important for Infrastructure as a Service (IaaS) providers. The starting point for developing feasible cloud computing business models is the fundamental cloud computing structure with the elements SaaS, PaaS and IaaS. The result is seven basic business model variants.

Figure: Cloud Computing Business Models (Image Courtesy: Seimens IT Solutions)



Cloud Computing Business Models

These business models can be classified and assessed by means of a maturity models and the value chain. The maturity model has different service level development stages in SaaS, PaaS and IaaS.

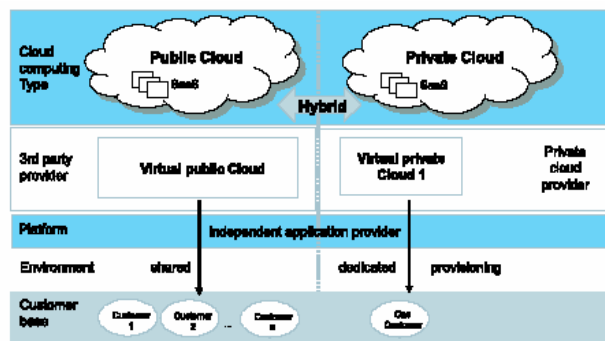
For **Software as a Service (SaaS)**, there are business model variants based on pure SaaS solutions, with independent architectures. In addition, it is possible for existing on-premise models to be transferred to an SaaS model or hybrid solutions to be offered. The Internet browser plays a key part. The browser becomes part [7] of the SaaS applications and acts as the user interface. The SaaS services can be reached via a standard Internet browser, which supports device independence and access anywhere, anytime.

In the case of **Platform as a Service (PaaS)**, the business model variants are based on the service development stages of software provisioning, software delivery platform and full scope Platform as a Service. Practice shows that SaaS application providers at least integrate software delivery platform functionalities additionally in their business model. Other business model variants focus among other things on self-contained logical units, such as mailing and collaboration platforms. Enterprises are already going over to offering largish business-critical applications from the public cloud or in a private, protected cloud (also enterprise cloud). All PaaS solutions are based on integration of SaaS applications in the underlying infrastructure via a cloud-capable PaaS development environment. The largest variant involves extensive middleware components. A further aspect of PaaS will give rise to further business model variants: billing,

metering and monitoring functionalities. These decide what the features of the pay-as-you-use component are. Creation of full-service platform[8] solutions means that independent software vendors (ISVs) and IT departments of system integrators can develop and deliver applications online using third-party infrastructure services.

Infrastructure as a Service (IaaS) business model variants comprise three different types: public, private and hybrid cloud models. Hybrid cloud models [9] enable a choice between on-premise solutions, solutions managed by a partner or solutions hosted by a third party.

Figure: Cloud Computing Hosting Models (Image Courtesy: Seimens IT Solutions)



A common feature of all IaaS models is virtualization of infrastructure services and so a sharp reduction in the cost of procuring these services. For their part, infrastructure service providers are making huge investments in expanding large, virtualized server farms. All IaaS models result in industrialization and commoditization of infrastructure services. A vital prerequisite is a high degree of automation in providing virtualized infrastructure services (dynamic services). It is also conceivable for bundling containing additional IT services to be offered on the market in addition to pure infrastructure offerings. The additional IT services include middleware components [10] , in each case with or without a license for them being provided. One aspect that must be especially emphasized is the programmability of infrastructure services. In a public cloud, the applications of different customers are hosted in a shared environment. Public cloud business models enable significant economies of scale. These solutions

are currently preferable for non-business-critical applications that relate only to a few core processes of an enterprise. The private cloud solution is suitable for larger medium-sized companies and groups where aspects such as data security and service level agreements (SLA) play an important role. Private cloud solutions [11] also have the advantages of public cloud solutions –elasticity, dynamic provisioning, multiplexing –, enable maintenance of resource control (security), compliance with corporate or regulatory requirements (governance) and can also be expanded into public cloud solutions. Private cloud business models focus on the factor of quality of service and address dedicated customer requirements relating to availability, performance, anonymity and avoidance of risks. In the regard, the ability to ensure end-to-end SLAs is of central importance. That is because reliability and the quality of services obtained from the cloud are vital to all enterprises. This also includes defining possible contract penalties if services are not available. Yet end-to-end SLAs are hardly widespread to date. However, enterprises want to establish private clouds in order to leverage the economic advantages of resource pools and drive standardization of their development and deployment processes. Hybrid Infrastructure as a Service models combine public and private cloud models. Non-critical functions can be outsourced with hybrid models. Enterprises that prefer hybrid models should remember that – at least to start with – this option is only suitable for simple applications that do not require complex databases or synchronization [12].

Interdependencies between SaaS, PaaS and IaaS

The three blocks – SaaS, PaaS and IaaS – should not be looked at in isolation: they have mutual interrelationships that have to be taken into account in forming business models. The aspect of mutual interrelationships indicates that finding a role for established on-premise providers is a challenge. It is also often the case that SaaS application providers deliver their own professional services and integration cycles [13] are dramatically shortened. The share of customizing services in the cloud computing business models that are being formed is being increasingly replaced by the possibility of configuring highly standardized applications. This makes it clear that there are basically many ways of developing cloud computing business models. All the players in

the cloud computing market who do not cater for the entire value chain must always take these interdependencies into account when occupying a niche in one of the areas SaaS, PaaS and IaaS. Providers of SaaS applications, for example, must implicitly take into account the necessary additional PaaS and IaaS services (which can be provided by third parties or the customer itself) in orientation of the business model. As a result, the new possibilities and new players in the market force established providers to review rethink their position in the value chain and the services that are perceived and rewarded by customers. The value chain, which has been perceived as essentially linear to date, is being transformed into a complex and dynamic value added network in which the best-of-breed approach from the .com era is experiencing a renaissance, enhanced by a least-cost distribution model for commodity IT services. In the media industry, it would now be realistic to choose different cloud providers for Web hosting, transcoding, archiving and content distribution, for example [14]. Apart from a number of technical and legal requirements, the feasibility of the business models will essentially determine what concepts become established on the market.

Enterprise customers should pay special attention to the following factors when selecting cloud computing solutions and providers:

- Data security (how the data in a third-party environment is protected against dishonest access)
- Compliance and governance
- Integration of the cloud computing solution in the customer's existing
- IT landscapes
- Existing processes for procuring cloud solutions
- Availability of business SLAs: Service level agreements
- TCO analysis (2-year period; 5-year period)

Independent consulting can help adequately weight the various aspects and factors so that an economically realistic and technically feasible solution can be conceived.

Conclusion

The computers of tomorrow will not be desktop machines they will be replaced by a cloud residing somewhere in the world. We need a lot of research to define and successfully apply new business models

to take advantage of cloud computing paradigm.

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