Cloud Computing: In Respect to Grid and Cloud Approaches

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ABSTRACT
Cloud Computing, the long-held dream of computing as a utility, has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Developers with innovative ideas for new Internet services no longer require the large capital outlays in hardware to deploy their service or the human expense to operate it. They need not be concerned about over provisioning for a service whose popularity does not meet their predictions, thus wasting costly resources, or under provisioning for one that becomes wildly popular, thus missing potential customers and revenue.
Cloud computing refers to the use of Internet ("cloud") based computer technology for a variety of services. It is a computing model in which virtualized resources are provided as a service over the Internet. The concept incorporates infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS) that have the common theme for satisfying the computing needs of the users. Cloud computing services usually provide common business applications online that are accessed from a web browser. This paper pays much attention to the Grid paradigm, as it is often confused with Cloud technologies. We also de- scribe the relationships and distinctions between the Grid and Cloud approaches.

Keywords: Incorporates infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS), Cloud Computing, Cloud Definition, Grid paradigm

1. INTRODUCTION
Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The datacenter hardware and software is what we will call a Cloud. When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud; the service being sold is Utility Computing. We use the term Private Cloud to refer to internal datacenters of a business or other organization, not made available to the general public. Thus, Cloud Computing is the sum of SaaS and Utility Computing, but does not include Private Clouds. People can be users or providers of SaaS, or users or providers of Utility Computing. We focus on SaaS providers (Cloud Users) and Cloud Providers, which have received less attention than SaaS Users.
Cloud Computing is associated with a new paradigm for the provision of computing infrastructure. This paradigm shifts the location of this infrastructure to the network to reduce the costs associated with the management of hardware and software resources [1]. The Cloud is drawing the attention from the Information and Communication Technology (ICT) community, thanks to the appearance of a set of services with common characteristics, provided by important industry players.

2. TYPES OF CLOUD SYSTEMS AND ACTORS
This section tries to distinguish the kind of systems where Clouds are used and the actors involved in those deployments.

2.1 Actors
Many activities use software services as their business basis. These Service Providers (SPs) make services accessible to the Service Users through Internet-based interfaces. Clouds aim to outsource the provision of the computing infrastructure required to host services. This infrastructure is offered ‘as a service’ by Infrastructure Providers (IPs), moving computing resources from the SPs to the IPs, so to the SPs can gain in flexibility and reduce costs Depending on the type of provided capability, there are three scenarios where Clouds are used.

2.2 Infrastructure as a Service
IPs manages a large set of computing resources, such as storing and processing capacity. Through virtualization, they are able to split, assign and dynamically resize these resources to build ad-hoc systems as demanded by customers, the SPs. They deploy the software stacks that run their services. This is the Infrastructure as a Service (IaaS) scenario.

2.3 Platform as a Service
Cloud systems can offer an additional abstraction level instead of supplying a virtualized infrastructure, they can provide the software platform where systems run on. The sizing of the hardware resources demanded by the execution of the services is made in a transparent manner. This is denoted as Platform as a Service (PaaS). A well-known example is the Google Apps Engine [2].

2.4 Software as a Service
Finally, there are services of potential interest to a wide variety of users hosted in Cloud systems. This is an alternative to locally run applications. An example of this is the online alternatives of typical office applications such as word processors. This scenario is called Software as a Service (SaaS).

3. CLOUD COMPUTING IS
Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS), so we use

that term. The datacenter hardware and software is what we will call a Cloud.
The advantages of SaaS to both end users and service providers are well understood. Service providers enjoy greatly simplified software installation and maintenance and centralized control over versioning; end users can access the service "anytime, anywhere", share data and collaborate more easily, and keep their data stored safely in the infrastructure. Cloud Computing does not change these arguments, but it does give more application providers the choice of deploying their product as SaaS without provisioning a datacenter, Cloud Computing allows, deploying SaaS and scaling on demand without building or provisioning a datacenter.

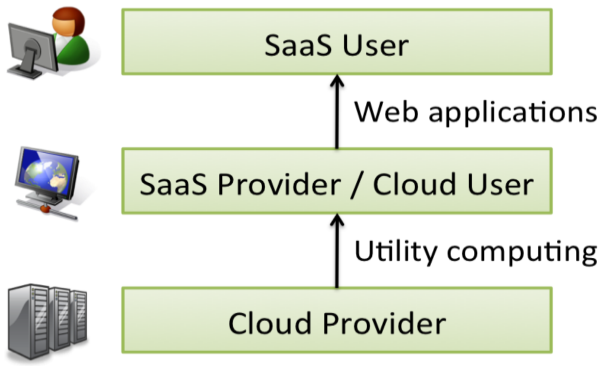

Figure 1

Figure 1: Users and Providers of Cloud Computing. The benefits of SaaS to both SaaS users and SaaS providers are well documented, so we focus on Cloud Computing effects on Cloud Providers and SaaS Providers/Cloud users. The top level can be recursive, in that SaaS providers can also be SaaS users. For example, a mash-up provider of rental maps might be a user of the Craigslist and Google maps services.

4. FACTORS TO BECOME CLOUD COMPUTING PROVIDERS:

4.1 Leverage existing investment
Adding Cloud Computing services on top of existing infrastructure provides a new revenue stream at (ideally) low incremental cost, helping to amortize the large investments of datacenters. Indeed, according to Werner Vogels, Amazon's CTO, many Amazon Web Services technologies were initially developed for Amazon's internal operations [3].

4.2 Defend a franchise
As conventional server and enterprise applications embrace Cloud Computing, vendors with an established franchise in those applications would be motivated to provide a cloud option of their own. For example, Microsoft Azure provides an immediate path for migrating existing customers of Micro soft enterprise applications to a cloud environment.

Technology	**Cost in Medium sized DC**	**Cost in Very Large DC**	**Ratio**
Network	$95 per Mbit/sec/month	$13 per Mbit/sec/month	7.1
Storage	$2.20 per GByte / month	$0.40 per GByte / month	5.7
Administration	~140 Servers / Administrator	>1000 Servers / Administrator	7.1

Table 1

Table 1: Economies of scale in 2006 for medium-sized datacenter (1000 servers) vs. very large datacenter (~50,000 servers). [4]

4.3 Attack an incumbent
A company with the requisite datacenter and software resources might want to establish a beachhead in this space before a single "800 pound gorilla" emerges. Google AppEngine provides an alternative path to cloud deployment whose appeal lies in its automation of many of the scalability and load balancing features that developers might otherwise have to build for themselves.

5. NEW APPLICATION OPPORTUNITIES
When Jim Gray examined technological trends in 2003 [5], he concluded that economic necessity mandates putting the data near the application, since the cost of wide-area networking has fallen more slowly (and remains relatively higher) than all other IT hardware costs. Although hardware costs have changed since Gray's analysis, his idea of this "breakeven point" has not.

5.1 Mobile interactive applications.
Its believable that "the future belongs to services that respond in real time to information provided either by their users or by nonhuman sensors." [6] Such services will be attracted to the cloud not only because they must be highly available, but also because these services generally rely on large datasets that are most conveniently hosted in large datacenters. This is especially the case for services that combine two or more data sources or other services, e.g., mash-ups. While not all mobile devices enjoy connectivity to the cloud 100% of the time, the challenge of disconnected operation has been addressed successfully in specific application domains, so we do not see this as a significant obstacle to the appeal of mobile applications.

5.2 The rise of analytics.
A special case of compute-intensive batch processing is business analytics. While the large database industry was originally dominated by transaction processing, that demand is leveling off. A growing share of computing resources is now spent on understanding customers, supply chains, buying habits, ranking, and so on. Hence, while online transaction volumes will continue to grow

slowly, decision support is growing rapidly, shifting the resource balance in database processing from transactions to business analytics.

5.3 Extension of compute-intensive desktop applications.

The latest versions of the mathematics software packages Matlab and Mathematica are capable of using Cloud Computing to perform expensive evaluations. Other desktop applications might similarly Benet from seamless extension into the cloud. Again, a reasonable test is comparing the cost of computing in the Cloud plus the cost of moving data in and out of the Cloud to the time savings from using the Cloud. Symbolic mathematics involves a great deal of computing per unit of data, making it a domain worth investigating. An interesting alternative model might be to keep the data in the cloud and rely on having sufficient bandwidth to enable suitable visualization and a responsive GUI back to the human user. Offline image rendering or 3D animation might be a similar example: given a compact description of the objects in a 3D scene and the characteristics of the lighting sources, rendering the image is an embarrassingly parallel task with a high computation-to-bytes ratio.

6. CLOUDS AND GRIDS COMPARISON

A source of confusion around the Cloud concept is its relation with Grid Computing [7]. The distinctions are not clear maybe because Clouds and grids share similar visions: reduce computing costs and increase flexibility and reliability by using third-party operated hardware.

6.1 A Grid Definition

Although the essential principles of grids have not changed much in the last decade, there are still different conceptions about what a Grid really is. In 2002, Ian Foster [8] pro-posed a definition of the Grid as “a system that coordinates resources which are not subject to centralized control, using standard, open, general-purpose protocols and interfaces to deliver nontrivial qualities of service”. More recent definitions emphasize the ability to combine resources from different organizations for a common goal [9]). In fact, is this divergence of conceptions about the Grid what this work aims to avoid for Clouds.

6.2 Feature Comparison:

6.2.1 Resource Sharing

Grids enhance fair share of resources across organizations, whereas Clouds provide the resources that the SP requires on demand, giving the impression of a single dedicated re-source. Hence, there is no actual sharing of resources due to the isolation provided through virtualization.

6.2.2 Heterogeneity

Both models support the aggregation of heterogeneous hardware and software resources.

6.2.3 Virtualization

Grid services are provided with interfaces that hide the heterogeneity of the underlying resources. Therefore, a Grid provides the ability to virtualizes the sum of parts into a singular wide-area resource pool. Virtualization overs both, data (flat files, databases etc.) and computing resources [10]. Cloud Computing adds the virtualization of hardware resources too.

6.2.4 Security

Virtualization is related to security since it enables the isolation of environments. While in Clouds each user has unique access to its individual virtualized environment, Grids often do not deal with end user security. Thus, some authors argue that security has not been seriously explored [11].

6.2.5 Scalability and Self-Management

Both grids and Clouds free programmers of dealing with scalability issues [8]. Grid scalability is mainly enabled by increasing the number of working nodes; Clouds offer the automatic resizing of virtualized hardware resources. Scalability requires dynamic reconfiguration as the system scales it needs to be reconfigured in an automated manner. Scalability and self-management is simpler in a single administrative domain, but many problems can be found across organizational frontiers. In grids, many difficulties lay exactly in not having a single owner of the whole system [12].

6.2.6 Usability

Clouds are easily usable, hiding the deployment details from the user [13]. This reduced entry point is a longstanding, yet unaccomplished, requirement of Grids [24]. Comparing a complex, invasive, and management-intensive vs. a simple and externally managed environment helps to explain the attention paid to Clouds.

7. CONCLUSION

Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The datacenter hardware and software is what we will call a Cloud. When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud. It is the long-held dream of computing as a utility, has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as

Software as a Service (SaaS).Clouds do not have a clear and complete definition in the literature yet, which is an important task that will help to determine the areas of research and explore new application domains for the usage of the Clouds.

To tackle this problem, the main available definitions extracted from the literature have been analyzed to provide both an integrative and an essential Cloud definition. Although our encompassing definition is overlapped with many grid concepts, our common denominator definition highlights the major features of

Clouds that make them different to Grids. Virtualization is the key enabler technology of Clouds, as it is the basis for features such as, on demand sharing of resources, security by isolation, etc. Usability is also an important property of Clouds. Also, security enhancements are needed so that enterprises could rely sensitive data on the Cloud infrastructure.

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