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Cloud computing challenges and technologies

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Abstract
Cloud computing is the development of parallel computing, distributed computing, grid computing and virtualization technologies which define the shape of a new era. Cloud computing is an emerging model of business computing. In this paper, we explore the concept of cloud architecture and compares cloud computing with grid computing. We also address the characteristics and applications of several popular cloud computing platforms. In this paper, we aim to pinpoint the challenges and issues of cloud computing. We identified several challenges from the cloud computing adoption perspective and we also highlighted the cloud interoperability issue that deserves substantial further research and development. However, security and privacy issues present a strong barrier for users to adapt into cloud computing systems. In this paper, we investigate several cloud computing system providers about their concerns on security and privacy issues.

Keywords: cloud computing, cloud challenges, cloud technologies, review

Introduction
Cloud computing is a complete new technology. It is the development of parallel computing, distributed computing grid computing, and is the combination and evolution of Virtualization, Utility computing, Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS). Cloud is a metaphor to describe web as a space where computing has been pre installed and exist as a service; data, operating systems, applications, storage and processing power exist on the web ready to be shared. To users, cloud computing is a Pay-per-Use-On-Demand mode that can conveniently access shared IT resources through the Internet. Where the IT resources include network, server, storage, application, service and so on and they can be deployed with much quick and easy manner and least management and also interactions with service providers. Cloud computing can much improve the availability of IT resources and owns many advantages over other computing techniques. Users can use the IT infrastructure with Pay-per-Use-On-Demand mode; this would benefit and save the cost to buy the physical resources that may be vacant.

Review
This review surveyed the existing literature using a principled and systematic approach: we searched each of the major research databases for computer science, the ACM Digital Library, IEEE Xplore, Springer Link, Science Direct and Google Scholar.
Overview of the reviewed literature Category Authors General introductions Armbrust *et al*. 2009, Carr 2008, Erdogmus 2009, Foster *et al*. 2008, Pastaki Rad *et al*. 2009, Voas and Zhang 2009, Vouk 2008 Definitions Mell and Grance 2009, Vaquero *et al*. 2009, Youseff *et al*. 2008 Protocols, interfaces, and standards Bernstein *et al*. 2009, Dodda *et al*. 2009, Grossman 2009, Harmer *et al*. 2009, Keahey 2009, Lim *et al*. 2009, Matthews *et al*. 2009, Mikkilineni and Sarathy 2009, Nurmi *et al*. 2008, Ohlman *et al*. 2009, Sun *et al*. 2007 Lessons from related technologies Buyya *et al*. 2008, Chang 2006, Foster *et al*. 2008, Napper and Bientinesi 2009, Sedayao 2008, Vouk 2008, Zhang and Zhou 2009 Building clouds AbdelSalam *et al*. 2009, Buyya *et al*. 2009, Song *et al*. 2009, Sotomayor *et al*. 2009, Sriram 2009, Vishwanath *et al*. 2009 Use cases Chun and Maniatis 2009, Ganon and Zilbershtein 2009, Matthew and Spraetz 2009, Wilson 2009. The NIST definition is one of the clearest and most comprehensive definitions of cloud computing and is widely referenced in different documents and projects. This describes cloud computing as having five essential characteristics:-

On-demand self-service
Computing resources can be acquired and used at anytime without the need for human interaction with cloud service providers.

- **Computing resources:** Computing resources include processing power, storage, virtual machines etc.
- **Broad network access**: This network can be accessed over a network using heterogeneous devices such as laptops or mobiles phones.
- **Resource pooling**: Cloud service providers pool their resources that are then shared by multiple users. This is referred to as multi-tenancy where for example a physical server may host several virtual machines belonging to different users.
- **Rapid elasticity:** A user can quickly acquire more resources from the cloud by scaling out. They can scale back in by releasing those resources once they are no longer required.

Cloud Technologies
This describes technological aspects of research in cloud computing. This starts with a look at lessons to be learnt from related fields of research. In the following, standards and interfaces in cloud computing as well as interoperability between different cloud systems are explained. Then, techniques for designing and building clouds are summarized,

which include advances in management software, hardware provisioning, and simulators that have been developed to evaluate design decisions and cloud management choices. This is rounded up by presenting new use-cases that have become possible through cloud computing. Voas and Zhang identified cloud computing as the next computing paradigm that follows on from mainframes, PCs, networked computing, the internet and grid computing. These developments are likely to have similarly profound effects as the move from mainframes to PCs had on the ways in which software was developed and deployed. One of the reasons that prevented grid computing from being widely used was the lack of virtualization that resulted in jobs being dependant on the underlying infrastructure. This often resulted in unnecessary. broker that mediates between consumers and providers by buying capacities from the provider and subleasing them to the consumers. However, such resource trading requires the availability of ubiquitous cloud platforms with limited resources, and is in contrast to the desire for simple pricing models. As cloud computing delivers IT as a service, cloud researchers can also learn from service oriented architecture (SOA). In fact, the first paper that introduced PaaS described PaaS as an artefact of combining infrastructure provisioning with the principles of SaaS and SOA. Since then, no academic work has been published in the field of PaaS. We have to take our to-date understanding of PaaS from the current developments in industry, in particular from the two major vendors, Force.com and from Google App Engine. Sedayao built a monitoring tool using SOA services and principles, and describe their experience from building a robust distributed application consisting of unreliable parts and the implication for cloud computing. As design goal for distributed computing scenarios such as cloud computing they propose, “like routers in a network, any service using other cloud services needs to validate input and have hold down periods before determining that a service is down” Zhang and Zhou analyse convergence from SOA and virtualization for cloud computing and present seven architectural principles and derive ten interconnected architectural modules. These build the foundation for their IBM cloud usage model, which is proposed as Cloud Computing Open Architecture (CCOA). Vouk described cloud computing from a SOA perspective and talked about the Virtual Computing Laboratory (VCL) as an implementation of a cloud. VCL is an "open source implementation of a secure production level on-demand utility and service oriented technology for wide-area access to solutions based on virtualized resources, including computational, storage and software resources". In this respect, VCL could be categorized as an IaaS layer service. Napper and Bientinesi ran an experiment to compare the potential performance of Amazon’s cloud computing with the performance of the most powerful, purpose build, high performance computers (HPC) in the Top500 list in terms of solving scientific calculations using the LINPACK benchmark. They found that the performance of individual nodes in the cloud is similar to those in HPC, but that there is a severe loss in performance when using multiple nodes, although the used benchmark was expected to scale linearly. The AMD instances scaled significantly better than the Intel instances, but the cost for the computations were equivalent with both types. As the performance achieved decreased exponentially in the cloud and only linearly in HPC systems, Napper and Bientinesi conclude that despite the vast availability of resources in cloud computing, these offerings are not able to compete with the supercomputers in the Top500 list for scientific computations.

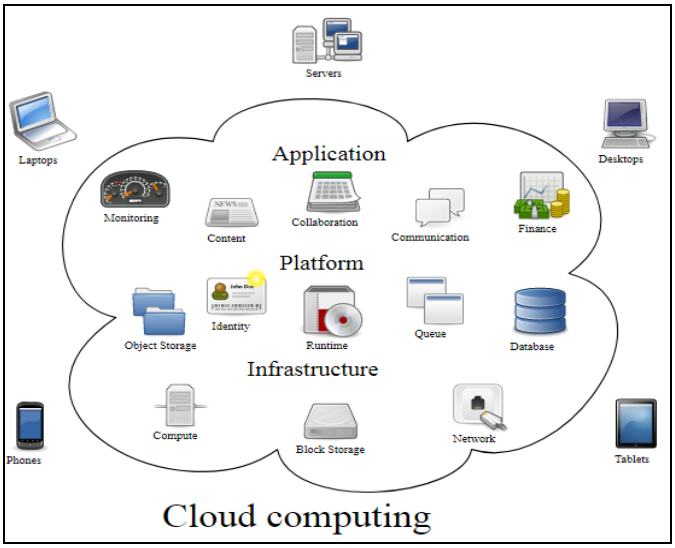

Fig 1

Cloud Computing Challenges

Challenges on cloud adoption perspective based on a survey conducted by IDC in 2008. A. Security Well-known security issues such as data loss, phishing, botnet (running remotely on a collection of machines) pose serious threats to an organization's data and software. The multi - tenancy model and the pooled computing resources on cloud computing has introduced new security challenges such as shared resources (hard disk, data, VM) on the same physical machine invites unexpected side channels between a malicious resource and a regular resource. And, the issue of “reputation fate-sharing” will severely damage the reputation of many good Cloud “citizens” who happen to, unfortunately, share the computing resources with their fellow tenant - a notorious user with a criminal mind. Since they may share the same network address, any bad conduct will be attributed to to access the system (e.g., applications, services) from anywhere. This is true for all the cloud computing systems (e.g., DaaS, SaaS, PaaS, IaaS, and etc.). Required to be accessed at any time, the cloud computing system should be severing all the time for all the users (say it is scalable for any number of users). Two strategies, say hardening and redundancy, are mainly used to enhance the availability of the cloud system or applications hosted on it. Confidentiality It means keeping users’ data secret in the cloud systems. There are two basic approaches (i.e., physical isolation and cryptography) to achieve such confidentiality, which are extensively adopted by the cloud computing vendors. Data integrity In the cloud system means to preserve information integrity (i.e., not lost or modified by unauthorized users). As data are the base for providing cloud computing services, such as Data as a Service, Software as a Service, Platform as a Service, keeping data integrity is a fundamental task. Control In the cloud system means to regulate the use of the system, including the applications, its infrastructure and the data. Audit It means to watch what happened in the cloud system. Audit ability could be added as an additional layer in the virtualized operation system (or

virtualized application environment) hosted on the virtual machine to provide facilities watching what happened in the system. It is much more secure than that is built into the applications or into the software themselves, since it is able watch the entire access duration.

Comparison between cloud and computing

A comparison between cloud and computing is to complete a specified task, such as Biology grid, Geography grid, National educational grid, while Cloud computing is designed to meet general application and there are not grid for a special field. 2) Grid emphasizes the "resource sharing" to form a virtual organization. Cloud is often owned by a single physical organization (except the community Cloud, in this case, it is owned by the community), who allocates resources to different running instances. 3) Grid aims to provide the maximum computing capacity for a huge task through resource sharing. Cloud aims to suffice as many small-to-medium tasks as possible based on users' real-time requirements. Therefore, multi-tenancy is a very important concept for Cloud computing.

Conclusion

This paper discussed popular platforms of cloud computing. It also addressed challenges and issues of cloud computing in detail. In spite of the several limitations and the need for better methodologies processes, cloud computing is becoming a hugely attractive paradigm, especially for large enterprises. Cloud Computing initiatives could affect the enterprises within two to three years as it has the potential to significantly changes.

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