Impact Analysis of Service Oriented Architecture Over Cloud Computing

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Abstract— Mobile cloud computing (MCC) which combines mobile computing and cloud computing is still at the early stage of development. There is a requirement to draw a detailed understanding of the technology in order to point out the direction of future research. This paper presents a review on the principles of mobile cloud computing and service oriented cloud computing architecture (SOCCA).A brief explanation from mobile computing to cloud computing is presented. It also discusses the eventual goal to make a uniform cloud computing architecture that will allow people to move from one cloud provider to another with ease.

Key words: SOCCA, MCC, WiMax

I. INTRODUCTION

As technology advances and more and more people have their own personal computers, cloud computing has become more popular than ever. Products like Windows 8 using cloud computing and many companies like Amazon and Google making use of cloud computing. Also advances in the field of network based computing and applications on demand have led to an unstable growth of application models such as cloud computing, software as a service, community network, web store, and so on.

In the age of the Internet, Cloud Computing has become a major research topic of the scientific and industrial communities. According to the top ten strategic technology trends for 2012 [1] provided by Gartner (a famous global analytical and consulting company), cloud computing has been on the top of the list. Smartphone's are considered as the representative for the various mobile devices as they have been connected to the Internet with the rapidly growing of wireless network technology. Ubiquity and mobility are two major features in the next generation network which provides a range of personalized network services through numerous network terminals and modes of accessing. The core technology of cloud computing is centralizing computing, services, and specific applications as a utility just like gas or electricity is sold to users.

Concepts such as service oriented cloud computing have sprung up and have set goals to achieve a uniform architecture that all cloud providers can use so that all people can interact with all cloud providers in a uniform manner. This paper will describe Service Oriented Cloud Computing Architecture (SOCCA) [2]. The basic model of mobile cloud computing, its background, key technology, current research status, and its further research perspectives as well.

II. MOBILE COMPUTING

Mobility has become a very popular word and rapidly increasing part in today's computing area. An incredible growth has appeared in the development of mobile devices such as, Smartphone, PDA, GPS Navigation and laptops with a variety of mobile computing, networking and security technologies. In addition, with the development of wireless technology like WiMax, Ad Hoc Network and WIFI, users may be surfing the Internet much easier but not limited by the cables as before. Thus, those mobile devices have been accepted by more and more people as their first choice of working and entertainment in their daily lives.

So, what is Mobile computing exactly? It is described as a form of human-computer interaction by which a computer is expected to be transported during normal usage [3]. Mobile computing is based on a collection of three major concepts: hardware, software and communication. The concepts of hardware can be considered as mobile devices, such as smartphone and laptop, or their mobile components.

Software of mobile computing is the numerous mobile applications in the devices, such as the mobile browser, anti-virus software and games. The communication issue includes the infrastructure of mobile networks, protocols and data delivery in their use. They must be transparent to end users.

A. Features:

The features of mobile computing are as follows:

1) Mobility: mobile nodes in mobile computing network can establish connection with others, even fixed nodes in wired network through Mobile Support Station (MSS) during their moving.
2) Diversity of network conditions: normally the networks using by mobile nodes are not unique, such networks can be a wired network with high-bandwidth, or a wireless Wide Area Network (WWAN) with low-bandwidth, or even in status of disconnected.
3) Frequent disconnection and consistency: as the limitation of battery power, charge of wireless communication, network conditions and so on, mobile nodes will not always keep the connection, but disconnect and consistent with the wireless network passively or actively.
4) Dis-symmetrical network communication: servers and access points and other MSS enable a strong send/receive ability, while such ability in mobile nodes is quite weak comparatively. Thus, the communication bandwidth and overhead between downlink and uplink are discrepancy.
5) Low reliability: due to signals is susceptible to interference and snooping, a mobile computing network system has to be considered from terminals, networks, database platforms, as well as applications development to address the security issue.

B. Challenges:

Compared with the traditional wired network, mobile computing network may face various problems and

challenges in different aspects, such as signal disturbance, security, hand-off delay, limited power, low computing ability, and so on. Due to the wireless environment and numerous mobile nodes. In addition, the Quality of Service (QoS) in mobile computing network is much easier to be affected by the landforms, weather and buildings.

III. CLOUD COMPUTING

In the era of PC, many users found that the PCs they bought 2 years ago cannot keep pace with the development of software nowadays; they need a higher speed CPU, a larger capacity hard disk, and a higher performance Operation System (OS).

Thus Cloud computing is the use of shared computing infrastructure to provide IT services in the form of a large pool of systems that are linked together. In essence cloud computing is a large group of computers working together to provide a service.

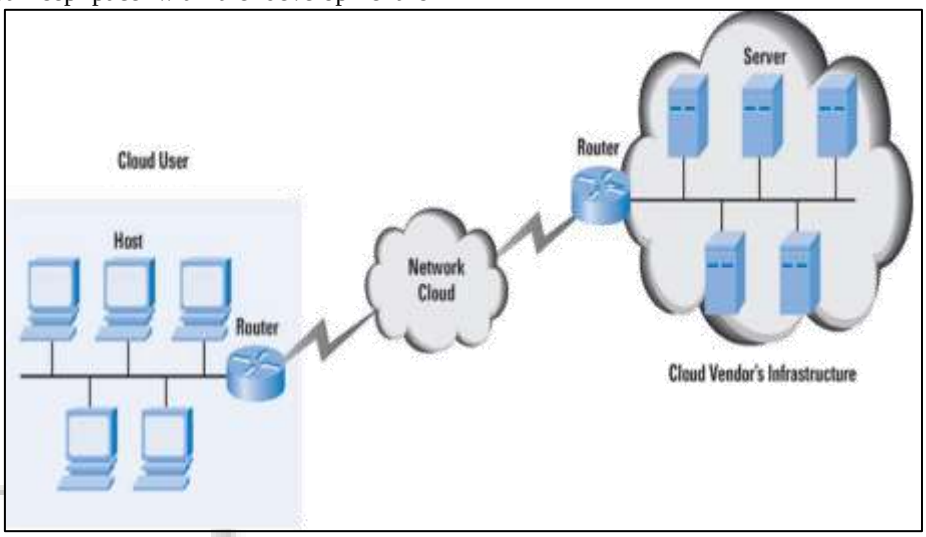

Fig. 1: Cloud Computing [6]

Cloud computing has many different characteristics that define it. Some of the most prominent characteristics are elasticity and scalability, pay-per use, on demand, resiliency, multitenancy, and workload movement. Elasticity and scalability refer to being able to expand and improve the cloud as time goes on. Pay-per use and on demand mean that users can choose when they want to use a service and only pay for it when they use it. Resiliency means the cloud will be stable when any sort of failure occurs. Multitenancy is when a provider has one instance of a program running on a server and many people connect and use the application instance at the same time.

Hewitt [4] introduces that the major function of a cloud computing system is storing data on the cloud servers, and uses of cache memory technology in the client to fetch the data. Those clients can be PCs, laptops, smart phones and so on. R. Buyya [5] gives a definition from the perspective of marking that cloud computing is a parallel and distributed computing system, which is combined by a group of virtual machines with internal links. Such systems dynamically offer computing resources from service providers to customers according to their Service level Agreement (SLA).

There are three major models of cloud computing [6]. The first is software as a service (SaaS). SaaS is providing a service through the use of the internet instead of having an individual license that a company hands out to users of that software. Examples of SaaS are yahoo mail, Google mail and Quicken Online. In some of these services users need to pay for, like Quicken Online and others are free of charge, like Gmail. All of these services are handled by the provider of the service. All software updates are handled by the provider as well. Thus in SaaS model of cloud computing user need to pay and then use the application.

The second model of cloud computing is platform as a service (PaaS). PaaS is when a provider provides a software platform that the users can use to make their own applications. Examples of PaaS are online development tools, such as Windows Azure, Google AppEngine, and Force.com. All of these products are tools that are used to develop programs online and using their infrastructure and are intended to make developing applications easier.

The third and the main cloud computing model is infrastructure as a service (IaaS). This is when a provider provides computing power and storage for their users. It is used for letting customers install their own operating systems on their portion of the cloud that they have purchased. An example of PaaS is Amazons Elastic Cloud computing cloud (EC2). Amazon rents user's disk space, CPU power and memory to run operating systems and applications on the space users have rented.

The cloud computing system is the development of parallel processing, distributed and grid computing on the Internet, which provides various guaranteed quality of services such as hardware, infrastructure, platform, software and storage to different Internet applications and users.

A. Framework:

Cloud computing systems actually can be considered as a collection of different services, thus the framework of cloud computing is divided into three layers, which are infrastructure layer, platform layer, and application layer (see Fig. 2).

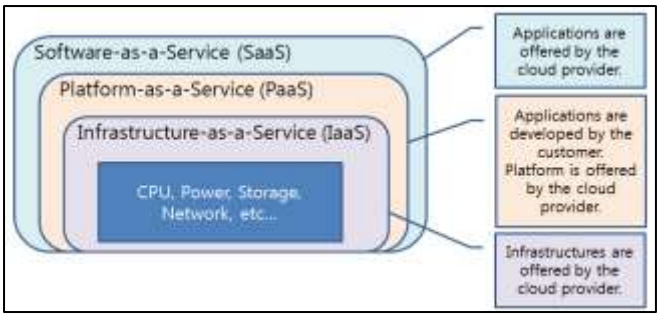

Fig. 2: The Framework of Cloud Computing [19]

1) Infrastructure layer:

It includes resources of computing and storage. In the bottom layer of the framework, physical devices and hardware, such as servers and storages are virtualized as a resource pool to provide computing storage and network services users, in order to install operation system (OS) and operate software application. Thus it is denoted as Infrastructure as a Service (IaaS). Typically services in this layer such as Elastic Computing Cloud of Amazon [7].

2) Platform layer:

This layer is considered as a core layer in the cloud computing system, which includes the environment of parallel programming design, distributed storage and management system for structured mass data, distributed file system for mass data, and other system management tools for cloud computing. Program developers are the major clients of the platform layer. All platform resources such as program testing, running and maintaining are provided by the platform directly but not to end users. Thus, this type of services in a platform layer is called Platform as a Service (PaaS). The typical services are Google App Engine [8] and Azure from Microsoft [9].

3) Application Layer:

This layer provides some simple software and applications, as well as costumer interfaces to end users. Thus we name this type of services in the application layer as Software as a Service (SaaS). Users use client software or a browser to call services from providers through the Internet, and pay costs according to the utility business model (like water or electricity) [10]. The earliest SaaS is the Customer Relationship Management (CRM) [11] from Sales force, which was developed, based on the force.com (a PaaS in Sales force).Some other services provided by Google on-line office such as documents, spreadsheets, presentations are all SaaS.

B. Features:

The features of Cloud Computing are as follows:

1) Virtualization:

The 'Cloud' can be considered as a virtual resource pool [12] where all bottom layer hardware devices is virtualized. End users access desired resources through a browser and get data from cloud computing providers without maintaining their own data centers. Furthermore, some virtual machines (VMs) are often installed in a server in order to improve the efficiency to use resources; and such VMs support load migration when there is a server over-load.

2) Reliability, Usability and Extensibility:

Cloud computing provides a safe mode to store user's data while users do not worry about the issues such as software updating, leak patching, virus attacks and data loss. If failure happens on a server or VM, the cloud computing systems transfer and backup those data to other machines, and then delete those failure nodes from the systems automatically in order to make sure the whole system has normal operation [13]. Meanwhile, cloud can be extended from horizontal and vertical [14] in a large-scale network, to process numerous requests from thousands of nodes and hosts.

3) Large-Scale:

in order to possess the capability of supercomputing and mass storage, a cloud computing system normally consists of thousands of servers and PCs. Google Cloud Computing, for example, has already controlled 2% of all servers or about 1 million servers located in two hundred different places in the world, and will move upward to 10 million servers in the next decade [15].

4) Autonomy:

A cloud system is an autonomic system, which automatically configures and allocates the resources of hardware, software and storage to client's on-demand and the management is transparent to end users.

C. Challenges:

First of all, cloud computing needs an improved mechanism to provide a safe and high efficiency service as the numerous invoked third-party software and infrastructures are implementing in computing. In addition, due to data centers of resource using a mass of electricity, efficient resource scheduling strategy and methods are required in order to save energy. Furthermore, as a Service Level Agreement (SLA) is established between users and service providers in cloud computing, so the performance and analysis of services are necessary to be monitored. Last but not least, simple and convenient application interfaces are indispensable for service providers in cloud computing, thus a uniform standard is required eagerly.

IV. MOBILE CLOUD COMPUTING

Mobile Cloud Computing represents perhaps the biggest paradigm shift in the delivery architecture of information services, since the invention of timesharing or the introduction of the client/server network.

Mobile Cloud Computing customers generally do not own the physical infrastructure, instead avoiding capital expenditure by renting usage from a third – party provider. They consume resources as a service and pay only for resources that they use. Many cloud – computing offerings employ the utility computing model, which is analogous to how traditional utility services (such as electricity) are consumed, while others bill on subscription basis.

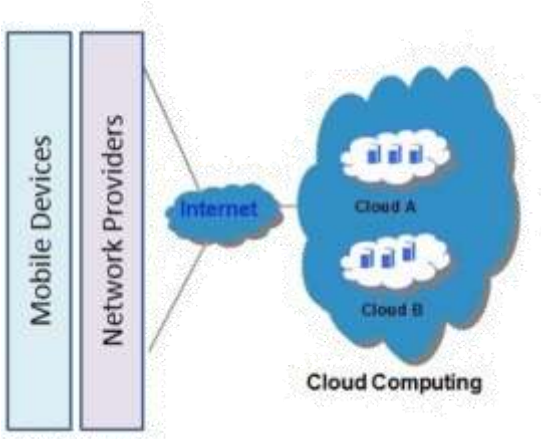

Fig. 3: Mobile Cloud Computing

The characteristics of Mobile Cloud Computing are given below:

Agility improves with users able to rapidly and economically re-provision technological infrastructure resources.

Cost is claimed to be greatly reduced and capital expenditure is converted to operational expenditure. This ostensibly lowers 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.

CLIENTS		
User Interface	Machine Interface	
Application		
Components	Services	
Platform		
Compute	Network	Storage
Infrastructure		
SERVERS		

Fig. 4: Layered Approach of Cloud computing

Devices and location independence enable users to access systems using a web browser regardless of their location or what device they are using (e.g., PC, mobile). As infrastructure is off – site (typically provided by a third party) and accessed via the Internet, users can connect from anywhere.

Multitenancy enables sharing of resources and costs across a large pool of users thus allowing for:

1) Centralization of infrastructure in locations with lower costs (such as real estate, electricity, etc.)
2) Peak – load capacity increases (users need not engineer for highest possible load – levels)
3) Utilization and efficiency improvements for systems that are often only 10 – 20% utilized.

Reliability improves through the use of multiple redundant sites, which makes cloud computing suitable for business continuity and disaster recovery. However, many major mobile cloud computing services have suffered outages, and IT and business managers can at times do little when they are affected.

1) Scalability Via Dynamic Provisioning Of Resources Fine Grained, Self:

Service basis near real – time, without users having to engineer for peak loads. Performance is monitored and consistent and loosely – coupled architectures are constructed using web services as the system interface.

2) Security typically improves due to centralization of data, increased security:

Focused resources, etc., but concerns can persist about loss of control over certain sensitive data, and lack of security for stored kernels. Security is often as good as or better than under traditional systems, in part because providers are able to devote resources to solving security issue that many customers cannot afford. Providers typically log access, but accessing the audit logs themselves can be difficult or impossible. Furthermore, the complexity of security is greatly increased when data is distributed over a wider area and / or number of devices.

Sustainability comes about through improved resources utilization, more efficient systems, and carbon neutrality. Nonetheless, computers and associated infrastructure are major consumers of energy.

A mobile client consists of mobile hardware and/ or mobile software which relies on mobile cloud computing for application delivery of cloud computing delivery, or which is specifically designed for delivery of cloud services and which, in either case, is essential useless without it.

3) Application:

A mobile cloud application leverage mobile cloud computing in software architecture, often eliminating the need to install and run the application on the customer's own computer, thus alleviating the burden of software maintenance, ongoing operation, and support.

4) Platform:

A mobile cloud platform delivers a computing and/ or solution stack as a service, generally consuming cloud infrastructure and supporting mobile cloud applications. It facilitates deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers.

5) Infrastructure:

Mobile Cloud Infrastructure is the delivery of computer infrastructure, typically a platform virtualization environment, as a service.

6) Servers:

The server layer consists of hardware and/or software products which are specifically and solely designed for the delivery of cloud services.

V. SERVICE ORIENTED ARCHITECTURE

There are many things that are in need to have a service oriented Architecture (SOA) and most of these qualities are features that we do not have in our modern architecture [16] [17]. This presents many problems for switching to SOA, but it must be done to improve current architectures and move forward to more efficient systems. The requirements for SOA are:

1) The user must be able to switch between different clouds as long as they are compatible. An example would be if a user is running an OS on an IaaS cloud. They should be able to transfer their information to the new cloud provider they want to switch to.
2) There must be a requirement to create a federation of resources. This means that even though there are many providers competing against each other;

those providers must want to create a conglomeration of resources and want to work together at providing those resources. An example would be, two cloud providers work together at providing their combined resources through the same source.

These two requirements define a truly service oriented architecture. With this knowledge in hand, is it possible to achieve service oriented architecture? What are the problems that have to be dealt with to achieve service oriented architecture? There are some problems with SOA but the main problem is that if all cloud providers can be switched between without consequence; then there is no reason for a user to stay with a company. Most companies want their customers to stay with them and if a user can leave a company without worry of loss of data or hassle there is no incentive for users to stay with a company. This implies that some companies are holding onto customers because the customer risks losing their project. An answer to this is that better providers of the same services will thrive and others will dwindle and this is incentive for confident cloud providers to use SOA.

Though SOA is the most ideal architecture that a cloud computing world could have, the concept of SOA is currently not fully implemented. So why is SOA included at all? Why talk about SOA? The concept of the perfect architecture is something that companies and programmers should make every effort for. Though as a whole SOA may not be accomplished, parts of SOA will at some point be accomplished. Being able to switch between providers with relative ease is something that could be possible. Users can move information around from one provider to another and the user just has to do it themselves. For example users can import emails from one email to another. The problem is that it is not easy as it could be. The point of SOA is to make something that is best for the customer. Though it may not all be fully achieved, there is still a goal.

A figure describing the relationship between service oriented architecture, web services, and cloud computing will torch a light on how the things may be related for better utilization of resources.

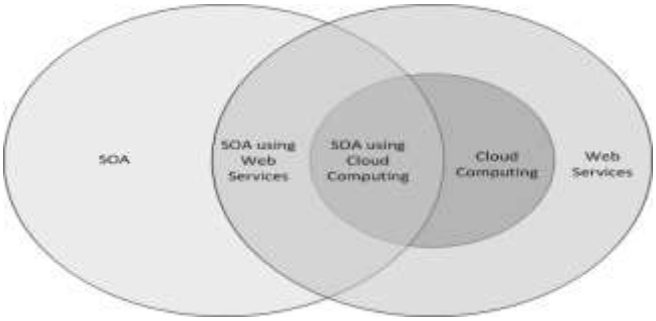

Fig. 5: Relationship between Web services SOA and Cloud Computing

VI. MULTITENANCY

Multitenancy is another property that a service oriented architecture must have. This is what a lot of current cloud computing architectures does not have. Importance of Multitenancy is because of its efficiency. Two important terms that need to be known are single tenancy and Multitenancy [18]. Single tenancy is when a provider has an application running and only one user is using it at a time.

An example of a single tenancy program would be a text editor. A user has an application on their computer and only they can run that application. Multitenancy is when a provider has one instance of a program running on a server and many people connect and use the application instance at the same time. An example of a Multitenancy program would be gmail or hotmail.

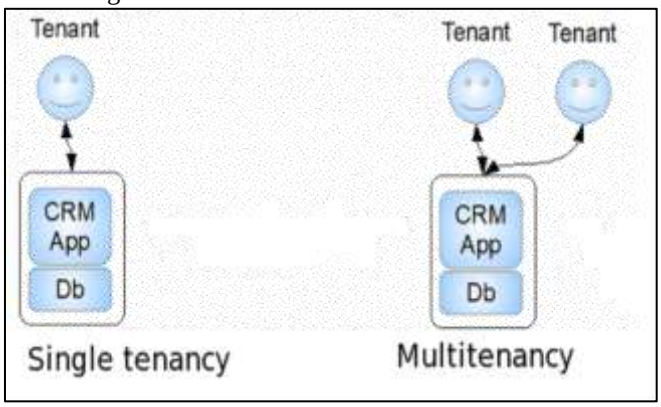

Fig. 6: Simple examples of single and multitenancy. CRM app means CRM application or just an instance of an application and db means Database. Tenants are users. [18]

There are positives and negatives to both of these options. Most of the advantages to single tenancy programs are when the program is being used on a person's personal machine and not when running on the cloud. The major downside to single tenancy programs on the cloud is that they are less efficient because for each person that uses that application there has to be a new instance and this uses a large amount of resources.

The positive part of multitenancy is that, everything is handled by the provider for the user. This includes security, backup of user data, and updates to software and hardware. The drawbacks are that you have to trust that provider is doing their job. There is never any guarantee that the company providing the service will not go out of business or make a mistake managing the user's data.

VII. SERVICE ORIENTED CLOUD COMPUTING ARCHITECTURE

Service Oriented Cloud Computing Architecture (SOCCA) [2] is the other architecture proposed by researchers. This is a theoretical architecture that is not implemented but discussed in the paper. This is another architecture that attempts to take advantage of the goals and views of SOA. SOCCA has four layers that make up its architecture.

A. Cloud Provider Layer

This is the layer at which each individual cloud provider has their own hardware and software. There are multiple providers providing services, but each provider manages their own software and hardware. In this layer all the cloud providers take care of their own resources and virtualization. Each provider has to figure out how much resources they will need and if they need to cut down on the amount that they are using or increase the amount they have.

B. Cloud Ontology Mapping Layer

The cloud ontology mapping layer is the layer of SOCCA that hopes to mask the differences between separate clouds. This layer is to help the transfer of data from one cloud to another which fulfils one of the key goals of SOA. To

achieve this goal SOCCA has three ontology systems. Ontology is generic knowledge that can be reused by different applications.

1) Storage Ontology: This ontology deals with data manipulation on the cloud. This includes data update, date insert, data delete, and data select and so on.
2) Computing Ontology: "It defines the concepts and terms related to distribute computing on the clouds."
3) Communication Ontology: "It defines the concepts and terms related Communication Schema among the clouds, such as data encoding schema, message routing."

An example of how these three ontologies are used would be the storage ontology that would handle data on the cloud. The ontologies are so that all providers have a framework to build on, but instead of each cloud provider building there cloud on that framework, each cloud provider shares information in the same way.

C. Cloud Broker Layer:

This is the layer that deals with information for each cloud provider. Information such as pricing, hardware, software, and services provided. The core components of this layer are cloud provider information. Ranking is how well each provider is rated by their customers. This involves comparing prices and reliability and reviews from people who have used that cloud.

D. SOA Layer:

This layer deals with the ideas of SOA and implementing them into the SOCCA architecture. One of the key and most important ideas of SOA is multitenancy. SOCCA hopes to utilize multitenancy to its fullest. There are two types of applications in this architecture. The first is Multiple Application instance; these are single tenancy applications. Examples of this would be, applications that like VMs that are individual operating systems that are single tenancy. The second is single application instance to multiple users. This would be multitenancy applications. Examples these applications would be Gmail.

VIII. CONCLUSION

In this paper it is analyzed that data computation in science and commerce is increasing with a great pace and thus the capacity of data processing has been considered as a strategic resource.MCC as a development and extension of mobile computing and cloud computing has inherited the features such as high mobility and scalability and thus become a very running research topic in recent years. As the main approach in MCC is quality of communication and division of application services. Using virtualization and image technology it can be addressed effectively, and immigrate task from terminal to cloud is also a good way to achieve better results. Also it is well known that the quality of communication in wired network is better than in wireless network, so reducing the proportion of data delivery in wireless environment is an effective way to improve the quality. In addition SOCCA is a promising idea and could possibly be made into service oriented architecture for mobile cloud computing. Thus the concept of Mobile Cloud Computing and Service oriented cloud computing architecture has all the best properties with it but is still far away and need more effort into it before they become a realization as a combination. Thus the two can be a good place to start.

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