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A Critical Survey of Personal Cloud

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ABSTRACT

From time to time, there is the need for a survey of different forms of computer services delivery. Personal Cloud computing is a technology which satisfies customers dynamic resource demands and makes the job easier to work on all platforms for the user. Cloud computing is the delivery of computing services over the Internet. Security is the main criteria when working on cloud, as the third party involvement will always be there. It is therefore recommended in this paper that secure architecture should be used to provide services through the cloud. The extensive use of virtualization in implementing cloud infrastructure brings unique security concerns for customers or tenants of a personal cloud service. It is observed that virtualization alters the relationship between the OS and underlying hardware -be it computing, storage or even networking. Hence, identified methods show how to overcome the security issues of the cloud.

Introduction

Personal cloud is the individual collection of digital content, services and applications which are seamlessly accessible from any device (Gartner Research). The personal cloud is not a tangible entity. It is a place which gives users the ability to store, synchronize, stream and share content on a relative core, moving from one platform, screen and location to another. Created on connected services and applications, it reflects and sets consumers' expectations for how the next-generation computing services will function. The four primary types of personal cloud in use today are: Online cloud, NAS device cloud, server device cloud, and home-made clouds (Sheppard 2014).

There are commercial providers such as abiquo private cloud solution, Amazon vpc, Cisco private cloud solution, IBM smartcloud foundation, microsoft private cloud, which offer personal cloud solutions from different devices. The popularity of these killer applications lies behind their easy to use built-in virtualization capabilities of windows server 12 (microsoft server 12 R2) and others. In a recent report, Forrester research forecasts a market of $12 billion in the USA in paid subscriptions to personal cloud by 2016.

However, despite the acceptability, very little is known about Qos of personal clouds. Furthermore, there is no public information about the control policies that personal clouds enforce, as well as the factors impacting on their service performance (Gracia-Tinedo et al 2013).

In this paper, we present a computer science-based approach of various personal clouds. In reference to the current year's list of top 10 cloud computing service providers, we can certainly apply the aged-old proverb: 'The more things change, the more they stay the same' because there has been a lot of change in the cloud computing arena since the previous year's top list. The advancement of new technologies delivered over the past year or two has enticed many larger IT shops to launch their first personal clouds and served to make or break the fortunes of small and large cloud competitor.

Objectives

This paper on a survey of personal cloud is set out to achieve the following objectives:

i) Examination of personal cloud from computer science approach;
ii) Review of select related work on personal cloud; and
iii) Discussion of findings with recommendations.

Types of Personal Cloud

Online Cloud

The online cloud is also sometimes referred to as public cloud. Online cloud is the cloud computing model where online resources like software and data storage are made available over the Internet by a service provider. In an online cloud model, cloud services are provided in a virtualized ecosystem, are constructed using pooled, shared physical resources and are accessed by the Internet.

Typically, an individual or organization has little control over the ecosystem in which the online cloud is hosted and the core infrastructure is shared between many individuals and organizations. The data and application on the online cloud is logically segregated so that only those authorized are allowed access. Some examples of online cloud providers include Dropbox, Box, and Google Drive.

NAS device cloud

A network-attached storage (NAS) device is a computer connected to a network that provides only file-based data storage services to other devices on the network. Though, it may technically be possible to run other software on a NAS device, it is not designed to be a general purpose server. Cloud NAS is remote storage that is accessed over the internet as if it is local.

A cloud NAS is often used for backups and archiving. One of the benefits of NAS Cloud is that data in the cloud can be accessed at anytime from anywhere. The main drawback, however, is that the speed of the transfer rate which could be only as fast as the network connection the data is accessed over and can therefore be fairly slow. An example of NAS personal cloud is the My Cloud by Western Digital, the CloudBox by Lacie, and the Central by Seagate.

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Server Device Cloud

In many ways cloud servers work in the same way as physical servers but the functions they perform can be very different. Typically, the cloud server is an on-premise device that is connected to the internet and gives users the functions available on the online cloud but with the added benefit and security of the files being in their control on their premises.

The server cloud has been historically enterprise-based deployed by businesses needing an in-house cloud. However, there are also in-house options available for individual users such as the Cloud Locker by Sto Amigo and the Nimbus project.

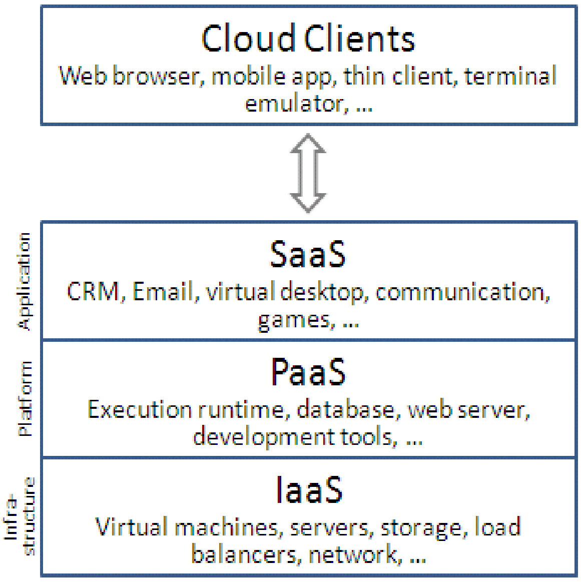
Home-Made Clouds

For the more technologically proficient user, a common solution for using a personal cloud is to create a home-made cloud system by connecting an external USB hard drive to a Wi-Fi router. This enables both wired and wireless computers to access the USB hard drive and use it for storage or for retrieving files a user needs to share on the network thereby acting like a cloud.

The challenge for the home-made cloud is that, in order to set it up, a user has to have a certain degree of skills in technology and network setup. This solution is not for novice and average consumers. If this setup is not done by a technology expert, the biggest issue will be security and leaving the files accessible to anyone with technical knowledge. It is also important to note that not every router supports this type of access and modification. Three of the biggest routers to allow this type of connection are Linksys, Netgear and Asus.

Cloud Service Delivery Models

Cloud computing providers offer their services according to several fundamental models:


Cloud Clients
Web browser, mobile app, thin client, terminal emulator, ...
SaaS
CRM, Email, virtual desktop, communication, games, ...
PaaS
Execution runtime, database, web server, development tools, ...
IaaS
Virtual machines, servers, storage, load balancers, network, ...
Application
Platform
Infra-structure

Infrastructure as a Service (IAAS)

In the most basic cloud-service model and according to the IETF (Internet Engineering Task Force), providers of IaaS offer computers – physical or (more often) virtual machines – and other resources. (A hypervisor, such as Xen, Oracle VirtualBox, KVM, VMware ESX/ESXi, or Hyper-V runs the virtual machines as guests. Pools of hypervisors within the cloud operational support-system can support large numbers of virtual machines and the ability to scale services up and down according to customers' varying requirements.) IaaS clouds often offer additional resources such as a virtual-machine disk image library, raw block storage, and file or object storage, firewalls, load balancers, IP addresses, virtual local area networks (VLANs), and software bundles (Amies et al 2012). IaaS-cloud providers supply these resources on-demand from their large pools installed in data centers. For wide-area connectivity, customers can use either the internet or carrier clouds (dedicated virtual private networks).

Platform as a Service (PAAS)

In the PaaS models, cloud providers deliver a computing platform, typically including operating system, programming language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. With some PaaS offers like Microsoft Azure and Google App Engine, the underlying computer and storage resources scale automatically to match application demand so that the cloud user does not have to allocate resources manually. The latter has also been proposed by an architecture aiming to facilitate real-time in cloud environments. Platform as a service (PaaS) provides a computing platform and a key chimney. It joins with software as a service (SaaS) and infrastructure as a service (IaaS), model of cloud computing (Hui Lin 2013).

Software as a Service (SAAS)

In the business model using software as a service (SaaS), users are provided access to application software and databases. Cloud providers manage the infrastructure and platforms that run the applications. SaaS is sometimes referred to as "on-demand software" and is usually priced on a pay-per-use basis. SaaS providers generally price applications using a subscription fee.

In the SaaS model, cloud providers install and operate application software in the cloud and cloud users access the software from cloud clients. Cloud users do not manage the cloud infrastructure and platform where the application runs. This eliminates the need to install and run the application on the cloud user's own computers, which simplifies maintenance and support. Cloud applications are different from other applications in their scalability—which can be achieved by cloning tasks onto multiple virtual machines at run-time to meet changing work demand. Load balancers distribute the work over the set of virtual machines. This process is transparent to the cloud user, who sees only a single access point. To accommodate a large number of cloud users, cloud applications can be multitenant, that is, any machine serves more than one cloud user organization. The pricing model for SaaS applications is typically a monthly or yearly flat fee per user, so price is scalable and adjustable if users are added or removed at any point.

Review of Related Work

Research on “Enabling Public Verifiability and Data Dynamics for Storage Security in Cloud Computing” in 2009 submits that “Cloud Computing has been envisioned as the next-generation architecture of IT Enterprise. It moves the application software and databases to the centralized large data centers, where the management of the data and services may not be fully trustworthy.” This unique paradigm brings about many new security challenges, which have not been well understood. This work studies the problem of ensuring the integrity of data storage in Cloud Computing. Difficulties and potential security problems of direct extensions with fully dynamic data updates from prior works are identified. It further shows how to construct an elegant verification scheme for seamless integration of these two salient features in our protocol design (Gayathri 2013).

Also in 2009, a research was conducted on “Data Management in the Cloud: Limitations and Opportunities” This focused on the limitations and opportunities of deploying data management issues on these emerging cloud computing platforms. We speculate that large scale data analysis tasks, decision support systems, and application specifically data marts are more likely to take advantage of cloud computing platforms than operational, transactional database systems (at least initially). It involves a list of features that a DBMS designed for large scale data analysis tasks running on an Amazon-style offering should contain and then further discusses some currently available open source and commercial database options that can be used to perform such analysis tasks. The work concludes that none of these options, as presently architected, match the requisite features. Hence, the need for a new DBMS, designed specifically for cloud computing environments (Abadi 2009).

Further research dwelt on “A survey on security issues in service delivery models of cloud computing” The work discusses that the architecture of cloud poses such a threat to the security of the existing technologies when deployed in a cloud environment. Hence, it is suggested that cloud service users need to be vigilant in understanding the risks of data breaches in new environment. The paper further highlights different security risks that pose a threat to the cloud due to the nature of the service delivery models of a cloud computing system (Subashini S. and V. Kavitha 2011)

In further development, a research on “Information security and cloud computing” gives a description of cloud computing followed by a general description of information security issues and solutions, and a brief description of issues linking cloud computing with information security. It is opined that security solutions must make a trade-off between the amount of security and its performance cost and impact on the end-user experiences. This is accentuated in a cloud computing environment where users desiring different levels of security share the same resources. An essential issue for cloud computing is the perception of security, which is beyond the simple technical details of security solutions. This paper includes a list of a few key information security challenges that also present significant research opportunities. Solving these key problems will encourage the widespread adoption of cloud computing.

Research Efforts on Personal Cloud

Many universities, vendors, institutes and government organizations are investing in research around the topic of cloud computing:

- In October 2007, the Academic Cloud Computing Initiative (ACCI) was announced as a multi-university project designed to enhance students' technical knowledge to address the challenges of cloud computing (Rich 2008)
- In April 2009, UC Santa Barbara released the first open source platform-as-a-service, AppScale, which is capable of running Google App Engine applications at scale on a multitude of infrastructures(StACC 2009).
- In October 2010, the TClouds (Trustworthy Clouds) project was started, funded by the European Commission's 7th Framework Programme. The project's goal is to research and inspect the legal foundation and architectural design to build a resilient and trustworthy cloud-of-cloud infrastructure on top of that. The project also develops a prototype to demonstrate its results.
- In January 2011, the IRMOS EU-funded project developed a real-time cloud platform, enabling interactive applications to be executed in cloud infrastructures.
- In July 2011, the High Performance Computing Cloud (HPCCLoud) project was kicked-off aiming at finding out the possibilities of enhancing performance on cloud environments while running the scientific applications – development of HPCCLoud Performance Analysis Toolkit which was funded by CIM-Returning Experts Programme – under the coordination of Prof. Dr. Shajulin Benedict.
- In June 2011, the Telecommunications Industry Association developed a Cloud Computing White Paper, to analyze the integration challenges and opportunities between cloud services and traditional U.S. telecommunications standards.
- In December 2011, the VISION Cloud EU-funded project proposed an architecture along with an implementation of a cloud environment for data-intensive services aiming to provide a virtualized Cloud Storage infrastructure.
- In October 2012, the Centre for Development of Advanced Computing released an open source, complete cloud service, software suite called "Meghdoot"(IEEE 2014).
- In October 2012, the ECO2Clouds EU-funded project was launched to analyze the environmental impact of applications on the cloud and to optimize their deployment and scheduling based on a monitoring infrastructure based on BonFIRE proving ecometrics.
- In February 2013, the BonFIRE project launched multi-site cloud experimentation and testing facility. The facility provides transparent access to cloud resources, with the control and observability necessary to engineer future cloud technologies, in a way that is not restricted, for example, by current business models.

Findings

Mainly, TPA Working Process has been observed as one of the effective ways of handling security related issue. TPA covers both request mode and auditing mode. The request mode gives the accessing permission from the cloud server. Auditing mode establishes the path to security page. This is used to register the login to the web server. It contains name, password, address, and host name (online), security code. The auditing security gives data dynamics, data integrity, audit report results. Data dynamics provides the whole information about the time period which is data uploaded and downloaded details, but data integrity provides the private network details. In this case, user selected the audit report option, and then it waits for audit request from server end to gather the information which was accessed (Kanchana and Dhadapani 2013).

Also, it has been observed that there is the problem of data security in cloud data storage, which is essentially a distributed storage system (Musthafa and Dora Babu 2013). To ensure the correctness of users’ data in cloud data storage, there is the need to propose an effective and flexible distributed scheme with explicit dynamic data support, including block update, delete, and append. By utilizing the homomorphic token with distributed verification of erasure coded data, the scheme achieves the integration of storage correctness insurance and data error localization. Though detailed security and performance analysis, shows that the scheme is highly efficient and resilient to Byzantine failure, malicious data modification attack. Some of the most common network attacks are described below:

- ♦ Ping of Death (PoD) – The attack involves sending a malformed or otherwise corrupted malicious ping to the host machine - this can be for example PING having size bigged that usual which can cause buffer overflow on the system that lead to a system crash.

♦ Smurf Attack – This works in the same way as Ping Flood attack with one major difference that the source IP address of the attacker host is spoofed with IP address of other legitimate non malicious computer. Such attack will cause disruption both on the attacked host (receiving large number of ICMP requests) as well as on the spoofed victim host (receiving large number of ICMP replies).

♦ Buffer Overflow Attack – In this type of attack, the victim host is being provided with traffic/data that is out of range of the processing specs of the victim host, protocols or applications - overflowing the buffer and overwriting the adjacent memory. One example can be the already mentioned Ping of Death attack - where malformed ICMP packet with size exceeding the normal value can cause the buffer overflow.

♦ Bluesnarfing - This kind of attack allows the malicious user to gain unauthorized access to information on a device through its Bluetooth connection. Any device with Bluetooth turned on and set to "discoverable" state may be prone to bluesnarfing attack.

♦ Bluejacking - This kind of attack allows the malicious user to send unsolicited (often spam) messages over Bluetooth to Bluetooth enabled devices.

♦ Bluebugging – It is a hack attack on a Bluetooth enabled device. Bluebugging enables the attacker to initiate phone calls on the victim's phone as well read through the address book, messages and eavesdrop on phone conversations.

Some other factors have also been discovered in our review of the work of Kanchana, and Dhandapan (2013) thus:

- Availability and Reliability Issues: Cloud data centers like enterprise data centers are usually safe and secure. However, outages do occur. Also, the cloud is only usable through the internet, so reliability and availability of the internet and access to it are essential
- Legal and Regulatory Issues: The virtual, international nature of cloud computing raises many legal and regulatory issues. Few of them have been sorted.
- Perimeter Security Model Broken: Many organizations use a perimeter security model with strong security at the perimeter of the enterprise network. This model has been weakening over the years with outsourcing and a highly mobile workforce. Cloud computing strikes its death knell. The cloud is certainly outside the perimeter of enterprise control, but it will now store critical data and applications.
- Integrating Provider and Customer Security Systems: A unified directory and other components of security architecture such as automated provisioning, incident detection and response are required.
- Unisys Secure Cloud Solution: Unisys Secure Cloud Solution is a managed cloud service providing comprehensive data security for multi-tenant environments, in which clients share a common IT infrastructure. Because the solution uses Stealth technology, Unisys says enterprise clients can move existing business applications—including those with secure or sensitive data, such as human resources, financial, and healthcare information—into a managed, shared cloud service, without needing to rewrite or alter applications.

Conclusion and Recommendation for further studies

As a new technology is expected to significantly reduce the cost of existing technologies, cloud computing is one of the major development trends of IT industry. For information security, there are both favorable factors and negative factors brought by personal cloud computing. The final effect depends on whether we can develop its strengths and avoid its disadvantages. Only in this way, the cloud can become a real cost savings, improving productivity efficiency and secure platform. The area of concentration of all these is security of information whether it is at rest or in transit. There are large numbers of security issues pertinent to cloud infrastructure of which most critical ones are discussed in this paper.

Our research focus is to provide a solution for the threats that are the major issue for anyone when they want to adopt cloud services for their work. For this purpose, modern frameworks should be designed for execution of data and information securely in cloud environment. This will protect users' data, messages, information against various attacks.

Furthermore, any modern framework should rely on erasure-correcting code in the file distribution preparation to provide redundancy parity, vectors and guarantee the data dependability.

For the more technologically proficient user, a common solution for using a personal cloud is to create a home-made cloud system by connecting an external USB hard drive to a Wi-Fi router. This enables both wired and wireless computers to access the USB hard drive and use it for storage or for retrieving files, a user needs to share on the network thereby acting like a cloud. The challenge for the home-made cloud is that, in order to set it up, a user has to have a certain degree of skills in technology and network setup. Without this, the files would be accessible to anyone with technical knowledge.

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