CLOUD COMPUTING INFLUENCE ON OPERATING SYSTEM

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ABSTRACT**:** *In last decade internet usage has increased tremendously. Internet subsequently the Web has changed the way how people think about using computers in their daily life. This enormous shift towards the Web is made possible by many internet enable electronic gadgets which provide access virtually from anywhere to the Web. In this paper, we have studied different Web operating systems in terms of designs, architecture, and functionalities. A positive association has been found how cloud computing affects the traditional desktop operating system and shifting it to the cloud, Web, and mobile. To consolidate our arguments, we have presented case studies of different cloud operating systems like Windows Azure, Chrome OS, Eye OS, and you OS. However, cloud based operating system would be main focus in future with involvement of intelligent agents.*

Keywords: Cloud computing, Mobile computing, Traditional operating system, Web OS

1. INTRODUCTION

Web is the most emerging platform of this era. It's a chain of interlinked hypertext documents placed on Internet, which may contains various information in the form of text, images, videos, and various other resources. Web and Internet are two different terms that are often mistakenly used together. Internet is a global network of interconnected computers that uses TCP/IP protocol suite and Web is actually something that is available by internet, just like e-mail and many other services. Fast speed emerging Web technologies have provided a way to access distinct architectures and helped a lot to migrate towards Web-based hypermedia systems [11].

Operating systems (OS) are experiencing great changes with rapid technology advancements. Initially operating systems were design to meet basic requirement of users but as time passes user requirements have changed and are not limited to local system base programs or services. In order to fulfill user needs, operating system has evolved to meet the latest challenges.

Formerly, OS was developed to use on single system for single user, but with development of latest technologies it adopts the flexibility of performing multiple tasks for different people at a time, and hence OS expanded itself in a way that it can be accessed by people over the internet subsequently through Web to either share data or to execute any program. This is where concept of Web OS came up.

A Web operating system (WOS) is an interface for users that provide access to different programs and applications that resides completely or partially on the Web. It may looks like the same conventional operating system but it doesn't interact directly with hardware of system. Users must have traditional OS on their computers in order to have access to cloud or Web based operating system. In Web OS, services are provided to users through an Internet connection. Web OS can be accessed using a software or Web browser, it can provide access to practically any kind of program that could be run on computer's desktop. Applications that can be accessed using the Web OS are Emails, calendars, games, chat messengers; file management, video, audio, and other kind of programs as well. Web OS are currently available and in development phase. The most popular approaches used to develop Web operating system rely on Asynchronous JavaScript and XML (AJAX) and flash technologies.

In last decade internet usage has increased from 9.7% to 34.3% of total world population [9]. Internet subsequently the Web has revolutionized the way information is transferred and has change the traditional ways of communication and information sharing. Internet has become one of the primary sources of information for millions of user at home, work or at any place. This huge shift towards Web is due to various ranges of internet-enabled devices, which provide access to Web. Usage of Web and internet has increased to such a level that people are now depending on it a lot. This is because people now access and use Web everywhere, on mobile devices, notebook PCs, E-pads, etc., and it has become an inseparable part of their lives [10].

With the advancements in internet technologies the concept of cloud computing is emerging very fast. With cloud computing user can access data and applications via Web browser by sitting at any place with any device over the internet. Cloud computing can help in collaboration of devices and minimizing the dependency on platform compatibility. The massive moves towards Cloud computing and Web-enabled mobile devices have influenced the traditional operating systems in many important ways.

Operating systems are no more dependent on hardware; concept of virtualization has mitigated the limitations of hardware requirement for operating systems. The technologies like Hyper V, VMware and Virtual PC has made possible to deploy multiple instances of different operating systems concurrently at one platform. These advancements at operating system level are done in order to accommodate the ongoing needs of Internet and essentially to satisfy the Web user needs.

According to [7], with latest innovations and developments in mobile computing, cloud computing, and virtualization, it is essential that OS must be developed in such a way that the devices on a network can be utilized by same OS frame work and common set of applications can be maintained as well.

Cloud computing is rising as a medium for information

storage and sharing on a large scale. In this era of technology most users just do not have the desktop computers only, but also many electronic gadgets like Notebook, Mobile phones, I pad's, PDA's and these all gadgets are linked with internet. Though there are a lot of advancements in area of internet and gadget technology but yet there is no standard framework to access and save data from other gadgets. We believe that the increasing cloud popularity will help in making it the only platform for applications and in future Web based operating systems with the help of cloud services may provide that standard framework to all gadgets [5].

It is expected that most of the functionality that is provided by conventional operating system will be taken over by Web browser, for normal computer users internet browser will be complete OS and most of the services and applications required by user will be available on cloud [1]. The growing use of internet subsequently the Web has dramatically changed the development of an application, it is expected that in future most of the applications will developed for Web rather than traditional platform or architecture such as applications specific to OS, hardware or processor. Unlike traditional applications that used to be installed on system, Web based applications live on the cloud as a service and can be used at any part of the world without the need of installing them first.

In this paper, we discuss in detail in how operating system behavior changes from traditional towards Web based computing, cloud, and mobile computing and how it affects the architectural changes in operating systems with point in focus Web has positively influence on operating system.

The structure of rest of the paper is as follows. Section no 2 reviews key literature in detail focusing especially on the influence of Web on OS, and cloud computing. In Section 3, we discuss the pros and cons of Web OS and presented the solution for challenges faced by traditional OS and Web OS. To justify our idea, we present the case study on different popular Web OS in Section no 4. Furthermore, statistical analysis is shown in Section 5. Finally, Section 6 concludes the paper along with future directions.

2. LITERATURE REVIEW

The increase in use of internet subsequently the Web has changed the traditional view of operating system. K. G. Srinivas et al, in their paper, mentioned that with excessive use of internet and with advancements in technology, operating system also changes [1]. The key concept is to move the operating system to Web without dependency of platform and device so that the users can access it easily from anywhere giving rise to concept of Web OS [2]. One driving force to move towards Web OS is the use of Web applications massively like remote access of file systems, emails, Web based processing, and communication means.

According to George Lawton, Web OS is much like traditional operating system as Web applications are accessed by Web browsers which uses it as an interface [2]. It can be remotely accessed via browser through URL based file system from any location unlike traditional operating systems that can be access from only one machine. Web OS is platform independent operating system which removes compatibility issues of Web applications and traditional desktop operating systems. The same operating system runs on windows, Mac, or Linux with internet and Web access and does not require any hardware drivers. Web OS has variations in the same architecture. The SGD uses 3-tier architecture in which one is application server that is used to host virtual machines responsible for running programs and pushing them to presentation server that manages client connection. The thin client is responsible for running application and then response back to application server. Similarly, eyeOS uses 2-tier architecture combining application and presentation server. Nabil Abdennadher, Gilbert Gabin and Peter Krofp mentions that Web OS provides users to request service without knowing about which kind of request they are requesting and fulfilled user's desired goals showing that these are open access [4]. Open Access and versatility make the Web OS an interactive environment for Meta computing

Lucid OS is an advance form of Web OS. According to Kapil Garge et al, Lucid OS provides basic services of operating system for distributed, scalable, and dynamic Web applications [3]. Lucid OS is based on Web application, browser, and server. In this OS, Web browser is the primary interface for user views, content, managing services and data on local machine. Web server is necessary part as it is responsible for displaying data and content on browser from local server. This Web server is locally installed on Web applications and is highly optimized for its services. Lucid OS is based on PHP, XML, and MySql technologies.

As time passes, the usage of Web applications rises and it increases the demand for data and applications to be stored on cloud. According K. G. Srinivasa et al, MeghaOS, allows the users to save and access data on clouds [1]. As MeghaOS allows the user access through Web, so it also has high security risks involved. Due to which, an authentication is required via digital signatures that was not part of traditional desktop operating systems. MeghaOS is totally based on HTML, CSS, JavaScript and XMLHTTP. In future, MeghaOS also involves local cache feature of HTML5 in it.

David Geer writes in his paper, that the three new approaches virtualization, cloud computing, and application development changes the importance of traditional operating system [8]. The effect of virtualization on operating system is that now user is not dependent of a single operating system rather than it, they can use multiple operating systems according to their choice. The effect of cloud computing on operating system is that cloud base users, access the applications via browser. They have no need of operating system just have to run the browser. Memory, disc space, and other resources are shared by cloud system. Virtualization technology allows a PC or a server to run multiple operating system or multiple sessions of single operating system at the same time. This allows users to put number of applications running even those who are on different operating system. That's why this approach is used in business to optimize the use of hardware. This enables us to use many operating systems on a single machine.

With advancement in operating systems from start, Reed reported in his survey "The Future of the OS for Internet

Applications", that with passage of time and with new emerging Web technologies, it becomes the need of time to move OS towards Web by allowing remote access of applications [6]. The operating system becomes more scalable, reliable and platform independent due to fulfilling needs of Web. Their performance improved as one can see different improved versions of operating system for desktop as well as for Web.

3. Web OS ARCHITECTURE

Web OS has features much more than traditional operating system, having capabilities of traditional operating system and web based functionalities. Traditional operating system capabilities includes file systems, file management, productivity and communication applications. Web OS features include; functioning across platforms from any device with only internet access. Web OS comprises of traditional operating system with some variations in it. The SGD uses 3-tier architecture for security and virtualization. The application server hosts virtual machines that run programs and push them to presentation server, which manages client connection. The thin client runs the application and passes user input back to application server. As web OS moved to browser and across platforms, it eliminated hardware dependency and compatibility issues between applications as one can remotely access them from anywhere [2]. There is no doubt that Web OS removes hardware and platform dependency, but there is still a need of traditional operating system in order to access web OS on the cloud [12]. A simplified basic architecture of Web OS is shown in Figure 1.

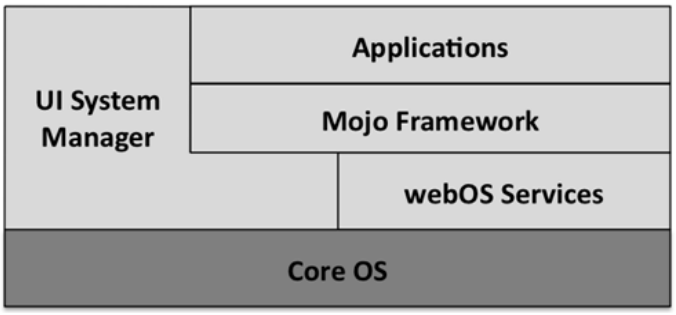

Fig 1: Basic Web OS Architecture

3.1 Advantages of WEB OS

Following are some of the advantages of Web OS.

- Web operating system can run on any device or computer that has an internet connection. This helps those people who don't have any personal computer or device and they can work from offices, colleges and internet cafes.
- In Web OS user can work from any available computer, need of dependency on one physical computer is ended.
- Web OS can run on different computers, so this results in collaboration among multiple work stations.
- In Web OS users store and manage their files, services and applications on provider's web servers rather than on their local machines, this prevents loss of data and theft of data at user end as data is being maintained at server level with much better security and storage capacity.
- Web OS users don't have to take backup of their data as it is being done at web server.
- In Web OS most of the heavy processing is done at server end, this results in user long term computer and device cost reduction.
- One of the most important features of Web OS is that it operates across platform, this eliminates the compatibility issues of operating system and applications and same Web OS can be run on Mac, Windows or Linux machine.
- In Web OS application is developed once only and can be used on all Web OS, unlike traditional operating system where application is developed for each Operating system separately. Also in web OS application is once deployed at server end and then distributed to users accordingly.
- Data and applications in Web OS are store on server at one central location which can be monitored and secured from one point, this helps in better malware protection.
- In web based operating system multiple users can work on one file at the same time rather than organizing several copies of the same file and then incorporating them in the end.
- Web Operating system booting time is very less, it boots up in just few seconds and it also supports resume enable.

3.2 Disadvantages

Though Web OS has many advantages over traditional operating system yet there are also some flaws in Web OS which are as follows.

- Web OS face network related problems like bandwidth limitations and latency constraints that traditional operating system do not have.
- As Web OS operates on web browser that runs on host machine operating system so this requires extra overhead like power demands and additional processing of keyboard, mouse, audio and video devices.
- Incase web user caches the data locally they are working with, than web browser will have access to data and security can be compromised as if hacker access the browser.
- Generally there is very limited number of applications developed for web based operating systems as compared to traditional.
- Varieties of applications of Web OS do not contain features that users like in traditional operating systems.
- Web based OS does not offer as much functionality as traditional OS like access to system drivers.
- Many people don't want to put their data in hands of third party, as they don't trust them and won't like to use servers for their personal data.
- As user must be online to access the Web OS so one must have a good internet connection all the time to work on web based operating system.

3.3 Solution for Challenges faced by WEB OS

Web based operating system can be based on distributed set of servers instead of single server , this can provide

redundancy to cope with any problem that arises in the server and also helps greatly in moving applications closer to users which results in reducing latency problems. Beside this more and more applications should be developed for Web operating system so that users can feel comfortable with Web OS. Developers should be encouraged to develop applications for Web OS and this could be achieved by making Web OS platform open source. Moreover, in order to adopt Web OS at wide level high performance network connectivity should be maintained so that users don't feel any problem to connect Web servers. Moreover providers of Web OS should make their users feel more secure and they should develop the trust of users by making strong policies regarding confidentiality of data stored on Web servers.

4. Case Studies

Windows 8

Windows 8 introduces significant changes in traditional operating system's graphical user interface and platform, such as new designed language codenamed "Metro", new start screen, windows Xbox store and touch feature for use on personal computer's, laptops and tablets. The "Metro" user interface consists of "Start Screen" made up of "Live Tiles", linked to applications and features that are dynamic and update real in time. Users would be able to switch between applications by swiping across the screen [13]. Windows 8 also provides a secure boot feature with UEFI firmware that requires the operating system to be digitally signed to protect the malware from infecting boot process [14]. Windows 8 has speedy boot time compared to its predecessors due to better resource allocation in applications and system. It uses technique of hibernating system "kernel", it does a partial hibernation on shut down. When system reboots, the memory of previous session gets reinitialized quickly [15].

EyeOS

Eye OS is based on the idea that whole system lives in the web browser. It is built on client server architecture in which web browser acts as client having access to all applications, files and documents. It is written in PHP, XML and JavaScript and acts as a platform for web applications with just internet access from anywhere in the world. It is also available for mobiles. It ties to remove compatibility issues between applications and operating system. Also, eye OS provides us with resource sharing and access from different centers without any hardware, platform and browser dependency. It also provides access to extensive applications like office applications, multimedia, networking and chat application through browser [16]. Eye OS is micro-kernel based platform, the kernel is supposed to unify the system services. Eye OS has many services for specific tasks and the kernel is responsible for its communication and location [17]. It provides us with good and wide usage of operating system on cloud but this operating system is not recommended and considered as failed due to load and latency on server through communication from client. It can be used with some restrictions like low bandwidth, networking delays and limited usage of applications.

Chrome Operating System (Chrome OS)

The architecture of chrome operating system consists of windows manager, browser, firmware, user land and system-level software. Firmware increases boot time by probing hardware, like floppy disk which are not commonly used on a computer. It verifies every step during the boot process and increases security. Windows manager manages the interaction of users with more than one client. System-level software includes Linux kernel which increases boot performance [18][19]. Chrome operating system utilizes less system resources and frees up those resources preventing the system from being slow. It stores in very small locality. There is no need to install anti-virus as secure data is transferred. It automatically updates the system and stores everything on the clouds. Chrome OS is mostly used in notebooks, tablets and laptops [20].

Windows Azure

Window azure is cloud based and is launched by Microsoft. Three services are provided in window azure named as Compute, Storage and Management. There is no need to buy expensive software and hardware for application. Fabric controller is responsible for managing applications. Whenever there is possibility of a crash, fabric controller identifies the problem and manages it [21][22]. Windows azure is designed in such a way that it needs at least two instances to run for each role to handle load-balancing between the instances which may interrupt state full applications [23].

You Operating System (YouOS)

You operating system tries to bring together conventional and web operating system to form a shared virtual computer. YouOS and its application runs inside the browser but have a look and feel of desktop applications. The code of the application and the data resides on servers remotely but their execution is done at client side locally, due to this user is free to do editing of word file at home and can access the same edited file at office or other place for further use. Everything in youOS is built upon a set of open restful server APIs. The default YouOS client implementation is based on (AJAX), the developer portal, the IDE and open XML - everything is built on simple and is accessible through the http protocol. It means that anyone can write a code of his own. Administering and delivering applications within YouOS is very easy. As a developer, one can control who can develop and release apps. And when it comes time to release, it's as simple as clicking a button before the app is immediately available for execution.

Comparison of Web OS Features

We have created a simple comparison table of the most interesting Web OS available by providing detailed information of their features. While reviewing these Web OS we have selected the following fifteen features as comparison criteria.

1. **Open source:** Possibility of contribution of users and developers to contribute by developing applications.
2. **Integrated Apps:** Applications of the web operating system by default.

Features	Cloudo	EyeOS	Ghost	Glide	Lucid	Icloud	JoliCloud	Xindesk	YouOs
Open Source	Yes	Yes	No	No	Yes	No	No	Yes	Yes
Integrated Apps	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Audio\Video Player	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No
Email Client	No	No	No	Yes	No	Yes	Yes	Yes	No
Instant Messaging	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Calendar	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No
Collaboration support	yes	Yes	Yes	No	No	No	No	No	No
Virtual Space	No	No	5Gb	30Gb	25Mb	3Gb	No	No	No
Offline Mode	No	Yes	No	No	Yes	No	Yes	No	No
Multilanguage	No	Yes	No	No	Yes	Yes	No	No	No
Mobile Support	Yes	No	No	Yes	No	Yes	Yes	Yes	No
App Manager	Yes	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Developer Tools	Yes	Yes	No	No	Yes	Yes	No	Yes	No
Games	Yes	No	No	No	No	No	No	Yes	Yes
Widgets Support	Yes	No	No	No	Yes	Yes	No	No	Yes

Table 1: Comparison between different Cloud Operating

3. **Audio\Video Player:** Presence of Media Player within the Web OS.
4. **Email Client:** Availability of Email Client in Web OS.
5. **Instant Messaging:** Presence of integrated messenger.
6. **Calendar:** Existence of Calendar
7. **Collaboration Support:** To allow multiple users to access and work on web applications.
8. **Virtual space:** Space available to users.
9. **Offline Mode:** To work On Web OS even if the internet connection is not available.
10. **Multilanguage:** Support of different languages.
11. **Mobile support:** If the users can work on OS from there mobiles.
12. **App Manager:** Permission to users to add or remove applications.
13. **Developer Tools:** Availability of tools for developers to develop applications themselves.
14. **Games:** Availability of games on Web OS.
15. **Widgets Support:** Support of widgets.

system featuresThe given Table 1 can help users in making a decision that which Web OS suits their needs the most and on the basis of their favorite Web features they can select any of the available Web OS. Furthermore Table 1 also helps us in knowing deeply about the type of features they are offering.

5. STATISTICAL ANALYSIS

Based on all the collected data and the statistics methods that are used we have come to the point that not only the architecture of operating system has changed with the evolvement of the web but it also has greatly influenced the way user interacts with system. The Web has positively influenced the operating system by making it more friendly and resourceful as now enhanced features of web are also included in web operating systems in the form of services, applications and utilities. Beyond the analysis of effect of Web on operating systems we also analyze the Web OS features so that we can characterize the future of Web operating system by their main attributes like hardware and platform independency, ease of remote access, high security and storage capacity.

In the last decade internet usage has increased from 9.7% to 34.3% of total world population [9]. It is also believed that the usage of internet on mobile devices such as handhelds, PDA's tablets, personal assistants, netbooks or laptops has increased rapidly from under 1% of total internet traffic in 2009 to more than 10% in 2012. The mobile internet is expected to exceed desktop internet by 2014, as shown in Graph No 1.

6. CONCLUSION

With the passage of time, as Web grows, it leads to architectural changes in operating systems and hence shifted the operating system to Web, cloud and mobile from traditional operating systems, minimizing the platform dependency and virtualization of resources. One can easily remote access browser via internet available. This makes the traditional operating system almost obsolete. We have presented case studies of different Web operating systems like windows 8, windows Azure, Chrome OS, Eye OS and youOS.

One thing is for certain and that is our reliance on the cloud will not be lessened by this evolution, but rather tightened, hopefully making a less painless computing experience for everyone. With excellent results and positive feedback, cloud computing is really set to shape our future.

In future, one can use different intelligent agents or knowledge based discovery rules to automate the selection of Web based Cloud operating systems.

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