A Posteriori Perusal of Mobile Computing

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Abstract: The breakthrough in wireless networking has prompted a new concept of computing, called mobile computing in which users tote portable devices have access to a shared infrastructure, independent of their physical location. Mobile computing is becoming increasingly vital due to the increase in the number of portable computers and the aspiration to have continuous network connectivity to the Internet irrespective of the physical location of the node. Mobile computing systems are computing systems that may be readily moved physically and whose computing ability may be used while they are being moved. Mobile computing has rapidly become a vital new example in today's real world of networked computing systems. It includes software, hardware and mobile communication. Ranging from wireless laptops to cellular phones and WiFi/Bluetooth- enabled PDA's to wireless sensor networks; mobile computing has become ubiquitous in its influence on our quotidian lives. In this paper various types of mobile devices are talking and they are inquiring into in details and existing operation systems that are most famed for mentioned devices are talking. Another aim of this paper is to point out some of the characteristics, applications, limitations, and issues of mobile computing.

Keywords: Mobile Computing, Mobile Devices, Mobile Computing Security, Cache Management, Mobile Operating Systems, Mobile Limitations.

1. INTRODUCTION

Mobile computing refers to technologies that employ small portable devices and wireless communication networks that allow user mobility by providing access to data anytime, anywhere. Mobile computing systems are computing systems that may be easily moved physically and whose computing capabilities may be used while they are being moved. Examples are laptops, [1] personal digital assistants (PDAs), and mobile phones. Mobile computing technology improves healthcare in a number of ways, such as by providing healthcare professionals access to reference information and electronic medical records and improving communication among them. Mobile computing is associated with the mobility of hardware, data and software in computer applications. Respectively, mobile software deals with the requirements of mobile applications. Also, hardware includes the components and devices which are needed for mobility. Communication issues include ad-hoc and infrastructure networks, protocols, communication properties, data encryption and concrete technologies. Mobile computing means being able to use a computing device while changes location properties. The study of this new area of computing has prompted the need to rethink carefully about the way in [2] which mobile network and systems are conceived. Mobile phones are one of the most ubiquitously used devices around. With different brands like the Android, Windows Mobile, and the iPhone, mobile phones have revolutionized the way we look at computing. There are thousands of applications such as social networking and games that have cropped up on mobile phones. With the help of cloud services, even sophisticated applications such as multi-player games, image processing, and speech processing has become feasible.

2. A HISTORY OF MOBILE COMPUTING

Mobile computing is the discipline for creating an information management platform, which is free from spatial and temporal constraints. The freedom from these constraints allows its users to access and process desired information from anywhere in the space. In the figure 1shows a timeline of mobile computing development. One of the very first computing machines, [3] the abacus, which was used as far back as 500 B.C., was, in effect, a mobile computing system because of its small size and portability. As technology progressed, the abacus evolved into the modern calculator. A mobile computing system, as with any other type of computing system, can be connected to a network. Connectivity to the network, however, is not a prerequisite for being a mobile computing system. The late 1960s, networking allows computers to talk to each other. Networking two or more computers together requires some medium that allows the signals to be exchanged among them. This was typically achieved through wired networks. By the 1970s, communication satellites began to be commercialized. With the new communication satellites, the quality of service and reliability improved enormously. Still, satellites are expensive to build, launch, and maintain. So the available bandwidth provided by a series of satellites was limited. In the 1980s, cellular telephony technologies became commercially viable and the exciting world of mobile computing is only in existence since the 1990s. Since then, the devices have been developed for mobile computing has taken over the wireless industry. This new type of communication is a very powerful tool for business and private purposes. Mobile computing is defined as the ability to use technology that is not physically connected to the static network [4]. He really used for a radio transmitter on a stable, most often with the help of a large antenna. Mobile computing has evolved from a two-way radio that use large

antennas to communicate a simple message, to three inches of personal computers that can do almost everything a normal computer does. Today, most laptops and personal digital assistants all have wireless cards or Bluetooth interface built them for convenient mobile Internet access. Mobile solutions are right under your nose all day, and connectivity has never been easier.
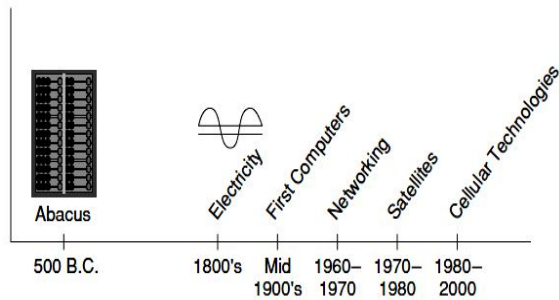

Figure 1. A Timeline of Mobile Computing

3. THE CHARACTERISTICS OF MOBILE COMPUTING

Mobile computing is accomplished using a combination of computer hardware, system and applications software and some form of communications medium. Mobile hardware includes mobile devices or device components that receive or access the service of mobility. They would range from Portable laptops, Smart phones, Tablet Pc's, Personal Digital Assistants. These devices will have receptor medium that is capable of sending and receiving signals. These devices are configured to operate in full-duplex, whereby they are capable of sending and receiving signals at the same time. They don't have to wait until one device has finished communicating for the [2] other device to initiate communications. The characteristics of mobile computing hardware are defined by the size and form factor, weight, microprocessor, primary storage, secondary storage, screen size and type, means of input, means of output, battery life, communications capabilities, expandability and durability of the device. Mobile computers make use of a wide variety of system and application software. The most common system software and operating environments used in mobile computers includes MSDOS, Symbian, Windows 3.1/3.11/95/98/NT, UNIX, android, a specialized OS like Blackberry shows in figure 2.

Figure 2. The Symbol of Most Common Operating Environments

Mobile software is the actual program that runs on the mobile hardware. It deals with the characteristics and requirements of mobile applications. This is the engine of that mobile device. In other terms, it is the operating system of that appliance. It's the [5] essential component that makes the mobile device operate. Since portability is the main factor, this type of computing ensures that users are not tied or pinned to a single physical location, but are able to operate from anywhere. It will incorporate all aspects of wireless communications. Finally, the most useful software - end user application like messaging, sales force automation, public query, data collection, etc.

The last few years have witnessed a phenomenal growth in the wireless industry, both in terms of mobile technology and its subscribers. A mobile radio communication system by definition consists of telecommunication infrastructure serving users that are on the move (i.e., mobile). The communication between the users and the infrastructure is done over a wireless medium known as a radio channel. Telecommunication systems have [6] several physical components such as: user terminal/equipment, transmission and switching/routing equipment, etc. There has been a clear shift from fixed to mobile cellular telephony, especially since the turn of the century. By the end of 2010, there were over four times more mobile cellular subscriptions than fixed telephone lines. Both the mobile network operators and vendors have felt the importance of efficient networks with equally efficient design.

Many more designing scenarios have developed with not only 2G networks, but also with the evolution of 2G to 2.5G or even to 3G networks. Along with this, interoperability of the networks has to be considered. 1G refers to analog cellular technologies; it became available [7] in the 1980s. 2G denotes initial digital systems, introducing services such as short messaging and lower speed data. CDMA2000 1xRTT and GSM are the primary 2G technologies, although CDMA2000 1xRTT is sometimes called a 3G technology because it meets the 144 kbps mobile throughput requirement. EDGE, however, also meets this requirement. 2G technologies became [8] available in the 1990s. 3G requirements were specified by the ITU as part of the International Mobile Telephone 2000 (IMT-2000) project, in which digital networks had to provide 144 kbps of throughput at mobile speeds, 384 kbps at pedestrian speeds, and 2 Mbps in indoor environments. UMTS-HSPA and CDMA2000 EV-DO are the primary 3G technologies, although recently WiMAX was also designated as an official 3G technology. 3G technologies began to be deployed last decade. The ITU [9] has recently issued requirements for IMT-Advanced, which constitutes the official definition of 4G. Requirements include operation in up-to-40 MHz radio channels and extremely high spectral efficiency. The ITU recommends operation in upto-100 MHz radio channels and peak spectral efficiency of 15 bps/Hz, resulting in a theoretical throughput rate of 1.5Gbps. The Fourth generation (4G) will provide access [10] to a wide range of telecommunication services, including advanced mobile services, supported by mobile and fixed networks, which are increasingly packet based, along with a support for low to high mobility applications and a wide range of data rates, in accordance with service demands in multi-user environment. There are many communications technologies available today that enable mobile computers to communicate.

4. MOBILE COMPUTING DEVICES

Mobile computing is not limited to, Mobile Phones only, but also there are various gadgets available in the market helping mobile computing. Example for personal digital assistant/enterprise digital assistant, smart phone, tablet computer, ultra-mobile PC, and wearable computer. They are usually classified in the following categories.

4.1 Personal Digital Assistant (PDA)

The main purpose of this device was to act as an electronic organizer or day planner that is portable, easy to use and capable of sharing information with you with a computer system. The PDA was an extension of the PC, not a replacement. These systems were capable of sharing information with a computer system through a process or service known as synchronization. Where both devices will access each other to check for changes or updates in the individual devices. The use of infrared and Bluetooth [11] connections enabled these devices to always be synchronized. With

PDA devices, a user could; browsers the internet, listen to audio clips, watch video clips, edit and modify office documents, and many more services. They had a stylus and a touch sensitive screen for input and output purposes.

Figure 3. Personal Digital Assistant (PDA)

4.2 Smart Phones

This kind of phone combines the features of a PDA with that of a mobile phone or camera phone. It has a superior edge over other kinds of mobile phones. The smart phone has the capability to run multiple programs concurrently. These phones include high-resolution touch enabled screens, web browsers that can access and properly display standard web pages rather than just mobile-optimized sites, and high-speed data access via Wi-Fi and high speed cellular broadband. The most common [12] mobile operating systems (OS) used by modern Smart phones include Google's Android, Apple's iOS, Nokia's Symbian, RIM's Blackberry OS, Samsung's Bada, Microsoft's Windows Phone, and embedded Linux distributions such as Maemo and MeeGo. Such operating systems can be installed on many different phone models, and typically each device can receive multiple OS software updates over its lifetime.

Figure 4. Smart Phone

4.3 Tablet PC and I-Pads

This mobile device is larger than a mobile phone or a personal Digital Assistant and integrates into a touch screen and operated using touch sensitive motions on the screen. They are often controlled by a pen or touch of a finger. They are usually in slate form and are light in weight. Examples would include; Ipads, Galaxy Tabs, Blackberry Playbooks etc.

Figure 5. Tablet PC and I-Pads

They offer the same functionality as portable computers. They support mobile computing in a far superior way and have enormous processing horse power [13]. User can edit and modify documents, files, access high speed intern1et, stream video and audio data, receive and send e-mails, perform lectures and presentations among very many other functions. They have an excellent screen resolution and clarity.

4.4 Ultra-Mobile PC

An ultra-mobile PC (ultra-mobile personal computer or UMPC) is a small form factor version of a pen computer, a class of laptop whose specifications were launched by Microsoft and Intel in spring 2006. Sony with its Vaio U series had manufactured the first attempt in this direction in 2004, which was however only sold in Asia. UMPCs are smaller than sub notebooks operated like tablet PCs, with a TFT display measuring (diagonally) about 12.7 to 17.8 cm, and a touch screen or a stylus. There is no distinct boundary between sub notebooks and ultra-mobile PCs. The first-generation UMPCs were just simple PCs with Linux or an adapted version of Microsoft's tablet PC operating system. With the announcement of the UMPC, Microsoft dropped the licensing requirement that tablet PCs must support proximity sensing of the stylus, which Microsoft termed "hovering". Second-generation UMPCs use less electricity and can therefore be used longer (up to five hours) and also support Windows Vista. Originally codenamed Project Origami, the project was launched in 2006 as a collaboration between Microsoft, Intel, Samsung, and a few others. Despite predictions of the demise of UMPC device category, according to CNET the UMPC category appears to continue to be in existence, however, it has largely been supplanted by tablet computers as evidenced by the introduction of Apple iPad, Google Android, Blackberry Tablet OS, and Nokia's MeeGo.

Figure 6. Ultra-Mobile PC

4.5 Wearable Computers

Wearable computers, also known as body-borne computers are miniature electronic devices that are worn by the bearer under, with or on top of clothing. This class of wearable technology has been developed for general or special purpose information technologies and media development. Wearable computers are especially useful for applications That require more complex computational support than just hardware coded logics. Figure 5 shows a wearable computer sample. One of the main features of a wearable computer is consistency [14]. There is a constant interaction between the computer and user, i.e. There is no need to turn the device on or off. Another feature is the ability to multi-task. It is not necessary to stop what you are doing to use the device; it is augmented into all other actions. These devices can be incorporated the user to act like a prosthetic. It can therefore be an extension of the user's mind and/or body. Many issues are common to the wearable as with mobile computing, ambient intelligence and ubiquitous computing research communities, including power management and heat

dissipation, software architectures, wireless and personal area networks. The International Symposium on Wearable Computers is the longest-running academic conference on the subject of wearable computers.

Figure 7. Wearable Computer Sample

4.6 E-Reader

An e-reader, also called an e-book reader, is designed primarily for the purpose of reading digital electronic books, magazines, and newspapers. Books from certain book sellers such as Amazon and others are available to be downloaded to the e-reader. E-readers usually have a seven inch screen, are designed with a longer battery life, and show text that can be read in the sunlight. Most recently, however, they have been designed to also connect to the Internet and have email capabilities. The older models do not use touch screens, but the newer ones do use them. They all have special operating systems designed just for them.
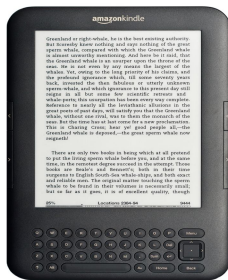

Figure 8. E-Reader

5. MOBILE OPERATING SYSTEM

A mobile operating system, also called a mobile OS, is an operating system that is specifically designed to run on mobile devices such as mobile phones, smart phones, PDAs, tablet computers and other handheld devices. The mobile operating system is the software platform on top of which other programs, called application programs, can run on mobile devices.

5.1 Symbian

Symbian OS is officially the property of Nokia. It means that any other company will have to take permission from Nokia before using this operating system. Nokia has remained a giant in low-end mobile market, so after Java, Symbian was the most used in the mobile phones till a couple of years ago. Still Symbian is widely used in low-end phones, but the demand rate has [15] continuously decreasing. By upgrading the Symbian mobile OS, Nokia has made it capable to run smartphones efficiently. Symbian ANNA and BELLE are the two latest updates which are currently used in Nokia's smartphones. Overall, the Symbian OS is excellently designed and is very user-friendly. Unfortunately, the Symbian OS graph is going downwards nowadays due to the immense

popularity of Android and iOS. Some of the phones currently running on Symbian OS are Nokia C6-0, Nokia 700, Nokia 808 Pure View, Nokia E6 (ANNA) and Nokia 701 (BELLE). Symbian is a popular choice among nokia dual sim mobile phones as well. In February 2011, Nokia announced that it would replace Symbian with Windows Phone [16] as the operating system on all of its future smartphones. This transition was completed in October 2011, when Nokia announced its first line of Windows Phone 7.5 smartphones, Nokia Lumia 710 and Nokia Lumia 800. Nokia committed to support its Symbian based smartphones until 2016, by releasing further OS improvements, like Nokia Belle and Nokia Belle FP1, and new devices, like the Nokia 808 pure views.

5.2 Android

In September 20th 2008 was the date when Google released the first Android OS by the name of 'Astro'. After some time next upgrade versions 'Bender' and 'Cupcake' were also released. Google then adopted the trend of naming android versions after any dessert or a sweet in alphabetical order. The other releases are [17] Donut, Éclair, Froyo, Gingerbread, Honeycomb, Ice Cream Sandwich and Jelly Bean. Jelly Bean is so far the latest android version of google. Since the platform is not closed like IOS, there are too many great Android apps built by developers. Just after stepping into the smart phone and the tablet market, Android gained immense popularity due to its beautiful appearance and efficient working. Many new features were introduced which played a significant role in Android's success. Google Play is an official app market, which contains millions of different apps for android [18] devices. Samsung, HTC, Motorola and other top manufacturers are using Android in their devices. Currently, Android is one of the top operating systems and is considered a serious threat to the iPhone.

The system architecture consists of

• A modified Linux Kernel.

•Open source Libraries coded in C and C++.

• The Android Runtime, which considers core libraries that disposals the most core functions of Java. As virtual machines it uses Dalvin, which enables to execute Java applications.

• An Application Framework, which disposals services and libraries coded in Java for the application development.

• The Applications, which operate on it.

In an execution environment, local code is executed with full permission and has access to important system resources. On the other hand, application code is executed inside restricted areas called a sandbox. This restriction affects some specified operations such as: local file system access or invoking applications on the local system. Sandboxing enforces fixed security policies for the execution of an application. Some of the smartphones operating on the Android are HTC Desire, Samsung Galaxy Gio, Motorola Droid Razr, Samsung Galaxy S3, S4, S5 and HTC Wilfire.

5.3 Windows OS

All of you will be familiar with Windows OS because it is used in computers all over the world. Windows OS has been also been used in mobile phones, but normal mobile phone users find it a bit

difficult to operate it, but at the same time it was very popular among people who were used to it. This was the case until Nokia and Microsoft joined hands to work together. The latest Windows release by Microsoft is known as Windows 7 which has gained immense popularity among all kinds of users. With its colorful and user friendly interface it has given Windows OS a new life and is currently in demand all over the world [19]. Another reason behind its success is that this latest OS is used in very powerful devices made by Nokia. The computer like look has totally vanished from the windows phones with the release of Windows 7. Samsung and HTC also released some Windows based phones, but they could not much place in the market.

Nokia Lumia series is completely windows based. Some of the latest Windows Phones are Nokia Lumia 800, Nokia Lumia 900, Samsung Focus and HTC Titan 2. If you are not on windows mobile OS and using windows for your pc, this is how you can run .jar games on your pc. Windows Phone uses technologies and tools, which are also, used in the station based application development, like the development environment Visual Studio and the Frameworks Silverlight, XNA and .NET Compact. Furthermore, Windows Phone considers a complete integration with the Microsoft Services Windows Live, Zune, Xbox Live and Bing. For sandboxing Windows Phone uses the same model like Android and iOS.

5.4 Apple iOS

The iOS was introduced in 29th June 2007 when the first iPhone was developed. Since then iOS has been under gone many upgrades and currently the latest one is the iOS 6. Apple has still not allowed any other manufacturer to lay hands on its operating system. Unlike Android, Apple has more concentrated on the performance rather than appearance. This is the reason that the basic appearance of iOS is almost the same as it was in 2007 [20]. Overall, it is very user-friendly and is one of the best operating systems in the world. So far iOS has been used in iPhone, iPhone 2G, iPhone 3G, iPhone 4 and iPhone 4S, not to mention their tablet pc's branded as iPad 3, iPad 2 and iPad [21].

The system architecture is identical to the MacOSX architecture and consists of the following components

• Core OS: The kernel of the operating system.

• Core Services: Fundamental system-services, which are subdivided in different frameworks and based on C and Objective C. For example, offers the CF Network Framework the functionality to work with known network protocols.

• Media: Considers the high-level frameworks, which are responsible for using graphic, audio and video technologies.

• Coca Touch: Includes the UIKIT, which is an Objective C based framework and provides a number of functionalities, which are necessary for the development of an iOS Application like the User Interface Management Like in the Android section mentioned, iOS uses a similar sandboxing model.

5.5 Blackberry OS

Blackberry OS is the property of RIM (Research In Motion) and was first released in 1999. RIM has developed this operating system for its Blackberry line of smartphones. Blackberry is much

different from other operating systems. The interface style as well as the smart phone design is also different having a trackball for moving on the menu and a qwerty keyboard. Like Apple, Blackberry [22] OS is a close source OS and is not available from any other manufacturer. Currently the latest release of this operating system is Blackberry OS 7.1 which was introduced in May 2011 and is used in Blackberry Bold 9930. It is a very reliable OS and is immune to almost all the viruses. Some of the smartphones operating on Blackberry OS are Blackberry Bold, Blackberry Curve, Blackberry Torch and Blackberry 8520. The Blackberry OS uses an older model for application sandboxing. It uses different trust roles for assignments and applications have full [23] access to the complete device and data. It is also required to sign an application via Certificate Authorities (CA) or generated (self signed) certificate to run code on the device. Furthermore the signature provides information about the privileges for an application, which is necessary because applications have full access to Blackberry devices, because of its sandboxing model.

5.6 BADA

Like others Samsung also owns an operating system which is known as BADA. It is designed for mid range and high end smartphones. Bada is a quiet user friendly and efficient operating system, much like Android but unfortunately Samsung did not use Bada on a large scale for unknown reasons. The latest version Bada 2.0.5 was released on March 15th 2012. There are only 3 phones which are operating on Bada. These three smartphones are Samsung Wave, Samsung Wave 2 and Samsung Wave 3. I believe that Bada would have achieved much greater success if Samsung had promoted it properly. Read out how you can use Picasa on Bada mobiles [24].

Bada provides various UI controls to developers: It provides assorted basic UI controls such as List box, Color Picker and Tab, has a web browser control based on the open-source WebKit, and features Adobe Flash, supporting Flash 9, 10 or 11 (Flash Lite 4 with ActionScript 3.0 support) in Bada 2.0. Both the WebKit and Flash can be embedded inside native Bada applications. Bada supports OpenGL ES 2.0 3D graphics API and offers interactive mapping with point of interest (POI) features, which can also be embedded inside native applications. It supports pinch-to-zoom, tabbed browsing and cut, copy, and paste features. Bada supports many mechanisms to enhance interaction, which can be incorporated into applications. These include various sensors such as motion sensing, vibration control, face detection, accelerometer, magnetometer, tilt, Global Positioning System (GPS), and multi-touch. Native applications are developed in C++ with the Bada SDK, and the Eclipse based integrated development environment (IDE). GNU-based tool chains are used for building and debugging applications. The IDE also contains UI Builder, with which developers can easily design the interface of their applications by dragging and dropping UI controls into forms. For testing and debugging, the IDE contains an emulator which can run apps.

5.7 Palm OS (Garnet OS)

Palm OS was developed by Palm Inc in 1996 especially for PDAs (Personal Digital Assistance). Palm OS was basically designed to work on touch screen GUI. Some Years later it was upgraded and was able to support smartphones. Unfortunately, it could not make a mark on the market and currently is not being used in any of the latest top devices. It has been 5 and half years since we saw the latest update of Palm OS in 2007. Palm OS was used by many

companies including Lenovo, Legend Group, Janam, Kyocera and IBM [25].

The key features of the current Palm OS Garnet are

• Simple, single-tasking environment to allow launching of full screen applications with a basic, common GUI set.

• Monochrome or color screens with resolutions up to 480x320 pixels.

• Handwriting recognition input system called Graffiti 2.

• HotSync technology for data synchronization with desktop computers.

• Sound playback and record capabilities.

• Simple security model: Device can be locked by password, arbitrary application records can be made private.

• TCP/IP network access.

• Serial port/USB, infrared, Bluetooth and Wi-Fi connections.

• Expansion memory card support.
• Defined standard data format for personal information management applications to store calendar, address, and task and note entries, accessible by third-party application.
.
• Included with the OS is also a set of standard applications, with the most relevant ones for the four mentioned PIM operations.

5.8 MeeGo

MeeGo was basically called a mobile platform, but it was actually designed to run multiple electronic devices including handhelds, in car devices, television sets and net books. All the devices on which MeeGo can run have the same core but the user interface is entirely different according to the device. In 2010 Moorestown Tablet PC was introduces at COMPUTEX Taipei which was also a MeeGo powered device. Most of you will have heard the name Nokia N9, but you will not be aware of the fact that this large selling device is operating in MeeGo [26] .

5.9 Maemo

Nokia and Maemo Community joined hands to produce an operating system for smartphones and internet tablets, known as Maemo. Like other devices the user interface of Maemo also comprised of a menu from which the user can go to any location. Like today's Android the home screen is divided into multiple sections which show Internet Search bar, different shortcut icons, RSS Feed and other such things. Later in 2010 at the MWC (Mobile World Congress) it was revealed that now Maemo project will be merged with Mobil in to create a fresh operating system known as MeeGo [27].

5.10 Open WebOS

Open WebOS also known as Hp WebOS or just WebOS, which was basically developed by Palm Inc but after some years it became the property of Hewlett Packard. WebOS was launched in

2009 and was used in number of smartphones and tablets. Hp promoted WebOS at a very high level by using it in high end smartphones and tablets. The latest device working on WebOS was the Hp Touch Pad. With the introduction of Android in the market sales of Hp WebOS based tablets got very less. At last Hp announced to discontinue WebOS based devices, but the existing users were assured that they will get regular updates of the operating system [28].

6. THE LIMITATIONS OF MOBILE COMPUTING

There are some general limitations for mobile computing devices. They are nominated and described in brief in follow:

6.1 Power Consumption

Power consumption plays a major part in the limitations of mobile computing, as it deals with the wireless networks battery back up are very poor in certain networks .When a power outlet is not available, mobile computers must rely entirely on battery power and most of the batteries have a back up of a few hours and need to but plugged in for future usage.

6.2 Insufficient Bandwidth

Wireless access is generally slower than the wired connection. This is mainly due to the band with allocation, mostly in developing countries. The most recent discovery in a wireless network is the 3G network where you can actually do a video conferencing. These networks are actually available within the range of near by cell phone towers; once you are out of your network access area you can't be using the latest discovery even though you have it with you. Users will be limited by the service providers .Transmission interferences also play a major role in bandwidth allocation. Connectivity in tunnels, certain buildings and in rural areas are often poor. The other major drawback chooses the network, for instance, certain phones are designed to work with CDMA and the same can't be used to using a GSM network. You need to have two different phones using both these networks. Then comes the Pay as You Go on which you can sign on a contract for one network and you get the handset to that particular network and the phone cannot be put aside to another network.

6.3 Health Hazards

Most occurrences of accidents are due to drivers who are using some form of mobile computers, most of them having a chat in their mobile phones. This occurred worldwide and many safety measures and instructions were given to the drivers regarding it and many awareness programs were conducted on it. There are allegations that the radiations from the phones cause serious health problems. World Health Organization's [29] study in 13 countries confirms radiations from the phone increases the risk of brain tumor. This is mainly due to the people who are exposed to microwaves that are emitted out from a cordless phone. Scientists have discovered that the chances of developing a glioma tumor are for people who use mobile phones for ten years. Even a normal user who uses a mobile phone for a short call will have adverse effects. Hungarian scientists have found out that 30% sperm decrease in intensive mobile phone users.

6.4 Human Interface with Device

The Screens and keyboards tend to be small, which may make them hard to use. Alternate input methods such as speech or handwriting recognition require training.

6.5 Transmission Interferences

Weather, terrain, and the range from the nearest signal point can all interfere with signal reception. Reception in tunnels, some buildings, and rural areas is often poor.

6.6 External Defects

There are various external defects, screen resolutions in some phones are poor and they don't suit to be used well on a bright sunny day, certain batteries are sensitive to high temperatures and need to be developed for charging at any condition. Touch screen plays a [30] great role with the upcoming mobile phones and it has its own drawbacks, care should be taken not to be dropped down, certain cases users need to wipe their hands dry before using their phones.

6.7 Security Standards

When working mobile, one is dependent on public networks, requiring careful use of VPN. Security is a major concern while concerning the mobile computing standards on the fleet. One can easily attack the VPN through a huge number of networks interconnected through the line.

7. APPLICATIONS OF MOBILE COMPUTING

Some of the applications of mobile computing are education and research, healthcare sector, pollution monitoring, tourism industries, airlines and railway industries, transportation industry, manufacturing and mining industries, banking and financial institutions, insurance and financial planning, hospitality industry etc. Mobile working infrastructure can deliver real time business benefits, companies of all sizes are walking up to the fact that they can improve productivity and increase profits by giving employees remote access to mission critical corporate IT system. The internet can be accessible from business, homes, and hot spots cyber cafes, available on cell phones. It is a critical business requirement, such as the oceanic fiber cuts that may result in loss of revenue and severe disruptions in networks. The required speeds have moved from supporting simple text terminals to email, the web, audio and video, requiring orders of magnitude increases in performance. It is no longer to a salesman come door to door for selling shelves full of dictionaries and encyclopedias. Rather, one can use the search engines such as Google, online dictionaries, Wikipedia etc. The written word is increasingly enhanced and replaced with graphical images, sound clips and videos. New software technology allows cell phone and PDA users to download their medical records, making them quickly accessible in case of emergency, creating room for accessing the information about the status of an airline or railway tickets. The new software to be available in years to come which can even display animated 3D scans. The computer scientists predict that the technology will also enable students to do research using their portable devices. Social networking has also taken off with applications such as Facebook, Twitter and so on. The freedom of information via Google, blogs, photos, video (You Tube), Twitter, and Wikileaks are some good examples, or police brutality is often reported first by individuals. Intellectual property,

e.g. The music industry's protective stand, or how much does say Facebook or Google know about you, who your friends are, where

you live, where you work, for searches made, or mining all the emails etc. The smart phones bring mobility to the internet user.

8. ISSUES IN MOBILE COMPUTING

Mobile computing is a broad area that describes a computing environment where the devices are not restricted to a single place. It is the ability of computing and communicating while on the move. Wireless networks help in the transfer of information between a computing device and a data source without a physical connection between them. In this paper I will discuss the two new issues first security issues and second issues cache management issues introduced by mobile computing.

8.1 Mobile Computing Security Issues

So some of the new security issues introduced in mobile computing are originated from the security issues of wireless networks and distributed computing systems. In addition, poorly managed mobile devices introduce new security issues involving information exposure and compromise, especially when these devices like laptops, PDAs, iPhones, Blackberries, and others are loaded with sensitive information and are stolen or fallen into the hands of an unauthorized person. Hence the new types of threats and security challenges introduced by mobile computing. Wireless networks have their own [31] security issues and challenges. This is mainly due to the fact that they use radio signals that travel through the air where they can be intercepted by location-less hacker that is difficult to track down. In addition, most wireless networks are dependent on other private networks, owned and managed by others, and in a public-shared infrastructure where you have much less control of, and knowledge about, the implemented security measures. I will discuss the main mobile computing security issues introduced by the use of wireless networks.

• **Denial of Service**

This attack is characterized by an explicit attempt by attackers to prevent legitimate users of a service from using that service. DOS attacks are common in all kinds of networks, but they are particularly threatening in the wireless context. This is because, the attacker does not require any physical infrastructure and he gets the necessary anonymity in the wireless environment [32]. The attacker floods the communication server or access point with a large number of connection requests so that the server keeps responding to the attacker alone hindering legitimate users from connecting and receiving the normal service.

• **Pull Attacks**

The attacker controls the device as a source of propriety data and control information. Data can be obtained from the device itself through the data export interfaces, a synchronized desktop, mobile applications running on the device, or the intranet servers.

• **Push Attacks**

The attacker uses the mobile device to plant a malicious code and spread it to infect other elements of the network. Once the mobile device inside a secure network is compromised, it could be used for attacks against other devices in the network.

• **Mobility and Roaming**

The mobility of users and data that they carry introduces security issues related to the presence and location of a user, the secrecy

and authenticity of the data exchanged, and the privacy of user profile. To allow roaming, certain parameters and user profiles should be replicated at different locations so that when a user roams across different zones, she or he should not experience any degradation in the access and latency times. However, by replicating sensitive data across several sites, the number of points of attack is increased and hence the security risks are also increased.

• **Disconnections**

The frequent disconnections caused by hand-offs that occur when mobile devices across different introduce new security and integrity issues. The transition from one level of disconnection to another may present an opportunity for an attacker to masquerade either the mobile unit or the mobile support station.

• **Traffic Analysis**

The attacker can monitor the transmission of data, measure the load on the wireless communication channel, capture packets, and reads the source and destination fields. In order to do this, the attacker only needs to have a device with a wireless card and listen to the traffic flowing through the channel. By doing such things, the attacker can locate and trace communicating users and gain access to private information that can be subject to malicious use.

• **Eavesdropping**

This is a well known security issue in wireless networks. If the network is not secure enough and the transmitted information is not encrypted then an attacker can log on to the network and get access to sensitive data, as long as he or she is within range of the access point.

• **Session Interception and Messages Modification**

The attacker can intercept a session and alter the transmitted messages of the session. Another possible scenario by an attacker is to intercept the session by inserting a malicious host between the access point and the end host to form what is called man-in-the-middle. In this case all communications and data transmissions will go via the attacker's host.

• **Captured and Retransmitted Messages**

The attacker can capture a full message that has the full credential of a legitimate user and replay it with some minor but crucial modification to the same destination or to another one to gain unauthorized access and privileged to the certain computing facilities and network services.

• **Information Leakage**

This potential security issue lies in the possibility of information leakage, through the inference made by an attacker masquerading as a mobile support station. The attacker may issue a number of queries to the database at the user's home node or to database at other nodes, with the aim of deducing parts of the user's profile containing the patterns and history of the user's movements.

• **Forced De-authentication**

The attacker transmits packets intended to convince a mobile endpoint to drop its network connection and reacquire a new signal, and then inserts a crook device between a mobile device and the genuine network.

• **Multi-protocol Communication**

This security issue is the result of the ability of many mobile devices to operate using multiple protocols, e.g. One of the 802.11 family protocols, a cellular provider's network protocol, and other protocols which may have well-known security loopholes. Although these types of protocols aren't in active usage, many mobile devices have these interfaces set "active" by default. Attackers can take advantage of this vulnerability and connect to the device, allowing them access to extract information from it or use its services.

• **Delegation**

The attacker can hijack mobile session during the delegation process. A delegation is a powerful mechanism to provide flexible and dynamic access control decisions. It is a temporary permit issued by the delegator and given to the delegate who becomes limited authorized to act on the delegator's behalf. Mobile [33] devices have to switch connections between different types of networks as they move and some kind of delegation has to be issues with different network access points. Delegations may be issued and revoked frequently as mobile device detach and reattach to different parts of the network system.

• **Spoofing**

The attacker may hijack a session and impersonate as an authorized legitimate user to gain access to unauthorized information and services.

8.2 Cache Management Issues in Mobile Computing

Mobile Computing environments are normally known as slow wireless links and relatively underprivileged hosts with limited battery powers, are prone to frequent disconnections. Caching data [34] at the hosts in a mobile computing environment can solve the problems which are associated with slow, limited bandwidth wireless links, by reducing latency and conserving bandwidth [35]. Cache replacement, Cache Consistency, Cache Invalid action is the most frequent technique used for data management in wireless networks.

• **Cache Replacement**

Caching the frequently data items is considered as an effective mechanism for improving the system performance. Cache replacement algorithms are providing the solution for finding a suitable group of items from the cache [36]. Most of the cache replacement existing algorithm is based on the time since last access ,entry time of the item in the cache, hit ratio, the expiration time of the item in the cache, location etc. Most of the time cache replacement algorithm has designed in the context of [37] operating system virtual memory management and database buffer management.

• **Cache Invalidation**

Frequently needed data items in the database server are cached to improve transaction throughput. It is necessary to maintain the data in the cache. It must be properly invalidated, for ensuring the consistency of data. Cache Invalidation strategies permit the

mobile user to re-establish the cache state from invalid stage to valid stage. The even Cache validation algorithm should consider the scarce bandwidth and limited the resources [38]. For this technique most of the time the database server involved is cache

invalidation, by sending Invalidation report (IR) to all the mobile clients. It is necessary to develop the effective cache invalidation strategies that ensure the consistency between the cached data in the mobile clients and the original data stored in the database server [39].

• **Cache Consistency**

Caching frequently accessed data objects in the local buffer of a mobile user (MU) can significantly improve the performance of mobile wireless networks. Marinating the cache consistency in a mobile environment [40] is a challenging task due to frequent disconnections and mobility of MUs. Several cache consistency maintenance schemes have been [41] proposed for the for mobile wireless environments. The goals of these schemes and algorithms are to ensure valid data objects in the cache to enhance their availability and minimize overhead due to consistency maintenance [42].

9. CONCLUSION

Mobile computing is dramatically changing our day-to-day lives, especially with the popularity of small devices such as personal digital assistants (PDAs) and with the embedding of substantial processing capabilities in devices such as telephones and cameras. Mobile computing offers significant benefits for organizations that choose to integrate the technology into their fixed organizational information system. Mobile computing is made possible by portable computer hardware, software, and communications systems that interact with a non-mobile organizational information system while away from the normal, fixed workplace. Mobile computing may be implemented using many combinations of hardware, software, and communications technologies. It offers a lot of benefits for everyone, especially the end users; however, it requires high security measures. In this paper, we have discussed about some of the challenging issues, applications of mobile computing along with a few of the characteristics of Mobile computing. Here in this paper we have introduced new security issues and challenges. Data management issues exhibit new challenges for both global and local. The caching techniques reduce bandwidth consumption and data access delay. Finally the computational power will be available everywhere through mobile and stationary devices that will dynamically connect and coordinate to smoothly help users in accomplishing their tasks.

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