

Network Solution, Applications and Challenges of Mobile Computing in Africa

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ABSTRACT

Mobile Computing involves mobile services which cover new services and new application areas of existing services that are made possible based on mobility and mean increased productivity, improved adaptation and user's experience.

Mobile application cover those requirements and solutions needed from a user's perspective in order to provide required functionality based on context and user requirements, while mobile networks study and develop solutions that enable mobility by using heterogeneous network technologies, multiple connections in parallel and mobility solution in IP network scale for the requirements defined by users, services and application. By having an expository look into the mobile computing environment, electronic and communication designers and engineers can seek new, modern approaches to the existing challenges facing this environment.

ABBREVIATIONS

ACRONYM	Meaning
NMT	Nordic Mobile Telephone
AMPS	Advanced Mobile Phone Services
GSM	Global System Mobile
DCS	Digital Communication System
PCS	Personal Communication System
PSTN	Public Switched Telephone Network
BS	Base Station
MSC	Mobile Switching Centre
MS	Mobile Station
WWAN	Wireless Wide Area Network
ISDN	Integrated Services Data Network
ATM	Asynchronous Transfer Mode
PSDN	Public Switched Data Network
PCSI	Pacific Communication Systems Inc.
CS-CDPD	Circuit Switching Cellular Digital Packet Data
RF	Radio Frequency
MSK	Minimum Shift Keying
FSK	Frequency Shift Keying
MDBS	Mobile Data Base Station
MDIS	Mobile Data Intermediate Systems
DSMA-CD	Digital Sense Multiple Access with Collision Detection
CSMA-CD	Carrier Sense Multiple Access with Collision Detection
MNLP	Mobile Network Location Protocol
M-ES	Mobile End Systems
IS	Intermediate System
OSI-CLNS	Open Systems Interconnection - Connectionless Network Services

IMSI	International Mobile Subscriber Identity
HLR	Home Location Register
AUC	Authentication Centre
VLR	Visitor Location Register
POS	Point of Sale
IP	Internet Protocol
LAN	Local Area Network
CMD	Convergent Mobile Devices
ODL	Open Distance Learning
CDPD	Cellular Digital Packet Data

1.0 INTRODUCTION

The evolution of the mobile technology has made our generation become a mobile one, as with our smartphones in our pockets and thousands of mobile application on it, we can perform a wide range of information intensive activities on our mobile phones wherever we are - *Industrial Week 2013* [1], thereby making the mobile computing a human-computer interaction.

Hence, mobile computing technology is *a technology which allows the transmission of data via a computer system without being connected to a fixed physical link.*

Mobile data communication, which is a subset of the Mobile computing technology, has become a very important and rapidly evolving technology, as it allows users to transmit data from remote locations to other remote or fixed location, which proved to be the solution to the biggest problem of many business people and organizations on the move – *Mobility.*

Mobile voice communication also widely established throughout the world and has had a very rapid increase in the number of subscribers to the various cellular networks over the last few years. It is an extension of this technology that gave birth to the principle of *Mobile Computing; which is a technology that allows the transmission of data via a computer, without having to be connected to a fixed physical link i.e. across cellular network.*

2.0 THE CELLULAR NETWORK

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ARCHITECTURE

2.1 VOICE COMMUNICATION

Mobile Computing started way back to the 1980's, with the advent of the mobile telephony which took off with the introduction of cellular technology which allowed the efficient utilization of frequencies enabling the connection of a large number of users. During this period analogue technology was used.

Among the most well known systems were the NMT900 and 450 (Nordic Mobile Telephone) and the AMPS (Advanced Mobile Phone Service).

In the 1990's the digital cellular technology was introduced with GSM (Global System Mobile) being the most widely accepted system around the world. Other such systems are the DCS1800 (Digital Communication System) and the PCS1900 (Personal Communication System).

A cellular network consists of mobile units linked together to switching equipment, which interconnect the different parts of the network and allow access to the fixed Public Switched Telephone Network (PSTN). The technology is hidden from view; it's incorporated in a number of transceivers called Base Stations (BS). Every BS is located at a strategically selected place and covers a given area or **cell** - hence the name cellular communications. A number of adjacent cells grouped together form an **area** and the corresponding BSs communicate through a so called Mobile Switching Centre (MSC). The MSC is the heart of a cellular radio system. It is responsible for **routing**, or **switching**, calls from the originator to the destinator. It can be thought of managing the cell, being responsible for set-up, routing control and termination of the call, for management of inter-MSC hand over and supplementary services, and for collecting charging and accounting information. The MSC may be connected to other MSCs on the same network or to the PSTN (Koudounas and Igbal) [2].

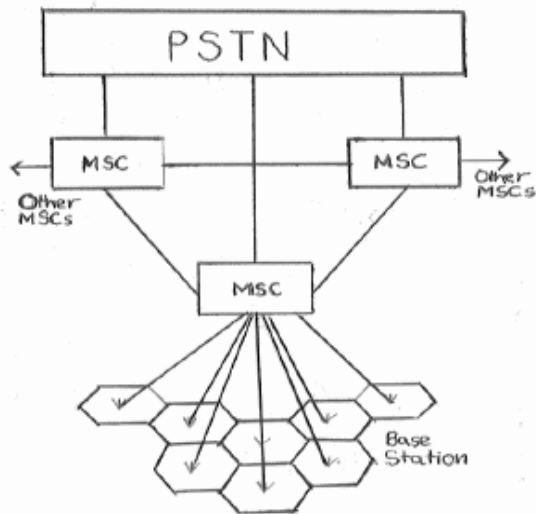


Fig. 1: Mobile Switching Centre

The frequencies used vary according to the cellular network technology implemented.

For GSM, 890 - 915 MHz range is used for transmission and 935 -960 MHz for reception.

The DCS technology uses frequencies in the 1800MHz range while PCS in the 1900MHz range. Each cell has a number of channels associated with it. These are assigned to subscribers on demand. When a Mobile Station (MS) becomes 'active' it registers with the nearest BS. The corresponding MSC stores the information about that MS and its position. This information is used to direct incoming calls to the MS. If during a call the MS moves to an adjacent cell then a change of frequency will necessarily occur - since adjacent cells never use the same channels.

This procedure is called **hand over** and is the key to Mobile communications. As the MS is approaching the edge of a cell, the BS monitors the decrease in signal power. The strength of the signal is compared with adjacent cells and the call is handed over to the cell with the strongest signal. During the switch, the line is lost for about 400ms. When the MS is going from one area to another it registers itself to the new MSC. Its location information is updated, thus allowing MSCs to be used outside their 'home' areas. (Koudounas and Igbal) [3].

2.2 DATA COMMUNICATION

Data Communications is the exchange of data using existing communication networks. The term data covers a wide range of applications including File Transfer (FT), interconnection between Wide-Area-Networks (WAN), facsimile (fax), electronic mail, access to the internet and the World Wide Web (WWW).

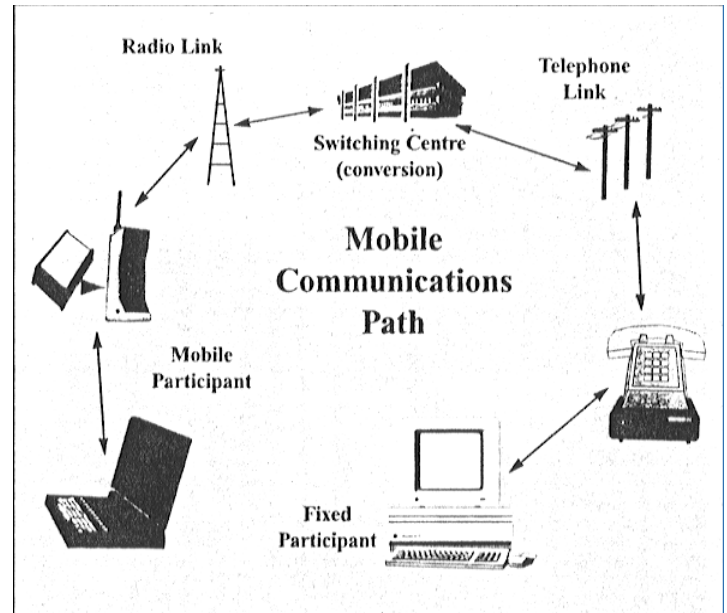


Fig. 2: An Overview of Mobile Communication

Data Communications have been achieved using a variety of networks such as PSTN, leased-lines and more recently ISDN and ATM /Frame Relay. These networks are partly or totally analogue or digital using technologies such as circuit - switching, packet - switching etc.

Circuit switching implies that data from one user (sender) to another (receiver) has to follow a prespecified path. If a link to be used is busy, the message cannot be redirected, a property which causes many delays.

Packet switching is an attempt to make better utilization of the existing network by splitting the message to be sent into packets. Each packet contains information about the sender, the receiver, the position of the packet in the message as well as part of the actual message. There are many protocols defining the way packets can be sent from the sender to the receiver.

The most widely used are the **Virtual Circuit-Switching** system, which implies that packets have to be sent through the same path, and the **Datagram** system which allows packets to be sent at various paths depending on the network availability. Packet switching requires more equipment at the receiver, where reconstruction of the message will have to be done.

The introduction of mobility in data communications required a move from the Public Switched Data Network (PSDN) to other networks like the ones used by mobile phones. PCSI has come up with an idea called CDPD technology which uses the existing mobile network (frequencies used for mobile telephony).

Mobility implemented in data communications has a significant difference compared to voice communications. Mobile phones allow the user to move around and talk at the same time; the loss of the connection for 400ms during the hand over is undetectable by the user. When it comes to data, 400ms is not only detectable but causes huge distortion to the message. Therefore data can be transmitted from a mobile station under the assumption that it remains stable or within the same cell.

3.0 NETWORK SOLUTION

Mobile Computing Network Solution provides secure, instant and anytime, anywhere access to information. Leveraging on mobile computing applications is one of the crucial deciding factors for the success of any organization in order for users to be served better, as mobile computing is becoming the de-facto standard for any IT infrastructure in the current and future system design (Sankhya 2006).

3.1 Technologies

The following technologies are used under Mobile Computing Environment which includes:

- ❖ WAP
- ❖ Messaging (SMS, MMS)
- ❖ DRM
- ❖ Bluetooth

3.2 Platforms

With Mobile solution on various kind of devices like Palm, Nokia, Compaq IPAQ etc., users can now work more efficiently on the these various OS platforms,

- ❖ Linux Mobile
- ❖ Java (J2ME)
- ❖ Microsoft Windows CE
- ❖ Symbian OS
- ❖ Palm OS

3.3 Database

Several database driven mobile applications based both on client server or stand-alone architecture are been used nowadays for different purposes. These mobile database include:

- ❖ Microsoft SQL Server CE
- ❖ Sybase SQL Anywhere
- ❖ Oracle Lite
- ❖ DB2 EveryPlace

3.4 Market Segment

Mobile computing applications reduce duplication of data inputs and provides

instant information just-in-time. Hence, with mobile computing, secure and reliable mobile applications are provided for the following verticals

- ❖ Banking and Financial Institution
- ❖ Transportation
- ❖ Hospitality Industry
- ❖ Manufacturing & Mining Industries
- ❖ Universities & other Educational Institutions

3.5 Banking and Financial Institution

- Wireless banking transactions – account balance, fund transfer, Utility bill payment from a smart phone or handheld PDA. (Example include: *Mobile Money, iMobile, iCash, Paga,*)
- ATMs wirelessly connected to handheld devices through Bluetooth.
- Credit card authorization on mobile POS terminals equipped with wireless adapters.
- Wireless e-mail, instant messaging

3.6 Transportation Industry

- Traffic Control and Monitoring
- Mobile networks to provide two-way communication between fleet drivers and their dispatch centers of home offices.
- Real-time Traffic Reporting.
- Fleet management/maintenance information

3.7 Hospitality Industry

- Hotel Reservation software
- Guest Check-in using handheld devices – PDAs, Blackberry and Cellular phones
- Mobile POS

3.8 Manufacturing & Mining Industries

- In-process Monitoring
- Industrial Controls
- Real-time Asset Management: Tools, Materials, Parts.
- Broad-spectrum networks to resolve LAN extension problems.
- Instant Purchase Verification, Delivery Confirmation and Order Tracking

3.9 Universities and other Educational Institution

- Accessing of examination results via smart phones

- Accessing of academic resource while on the move
- Registration of academic activities using smartphones and PDAs

4.0 THE CHALLENGES

Mobile computing has its fair share of security concerns as any other technology. Due to their nomadic nature, it's not easy to monitor the proper usage. User might have different intentions on how to utilize this privilege. Improper and unethical practices such as hacking, industrial espionage, pirating, online fraud and malicious destruction are some but few of the problems experienced by mobile computing.

Also, deploying and managing mobile computing in any enterprise/organization is not that simple. A typical infrastructure must support multiple types of mobile devices, software applications and network technologies. Best practices should address both technology and operational issues. But implementing the right technology, even though is essential, requires *high technical expertise* on our parts as Africans, thereby making it equally important to have the right *management personnel* in place.

5.0 SUMMARY AND CONCLUSION

Business people, corporate environments which include road warriors or marketers, branch offices, global companies on the go, and academic institutions (conventional, but most those in operating ODL) need portability and mobility, as information needs to be accessed on the go! This provides evidence that mobile devices are more strategically important to the enterprise than ever, as mobile computing services provide anytime access to computer services and information for a mobile workforce, academic staffs, students and alike, no matter where they are, in the same building or anywhere in the world.

Also, many businesses use mobile solutions to add value and increase productivity by decreasing costs, boosting revenue and improving service. This shift to mobile also means companies are deploying more **Convergent Mobile Devices** (CMDs), combinations of products such as smart phones, conventional cell phones and notebooks with Wi-Fi and embedded mobile broadband technologies.

CMDs give employees - no matter where they are located - the tools to become more productive and compete more effectively.

In its March 2008 report "Worldwide Converged Mobile Device 2008-2012 forecast research firm

IDC forecasts that shipments of CMDs will grow from 124.6 million in 2007 to 376.2 million in 2012.

This new generation of mobile devices addresses key business priorities to:

- *Enable organizations or companies to compete more effectively*
- *Increase mobile worker productivity*
- *Reduce cost and complexity*
- *Enable increased agility, efficiency and value*

Also, with the rapid technological advancements in Artificial Intelligence (A.I.), Integrated Circuitry and increase in Computer Processor speeds, the future of mobile computing looks increasingly exciting. With the emphasis increasingly on compact, small mobile computers, it may also be possible to have all the practicality of a mobile computer in the size of a hand held organizer or even smaller. The use of Artificial Intelligence may allow mobile units to be the ultimate in personal secretaries, which can receive emails and paging messages, understand what they are about, and change the individual's personal schedule according to the message. This can then be checked by the individual to plan his/her day.

The working lifestyle will change, with the majority of people working from home, as it is this motivation behind ODL rather than commuting. This may be beneficial to the environment as less transportation will be utilized. This mobility aspect may be carried further in that, even in social spheres, people will interact via mobile stations, eliminating the need to venture outside of the house.

Indeed, technologies such as *Interactive television* and *Video Image Compression* already imply a certain degree of mobility in the home, i.e. home shopping etc.

Using the mobile data communication technologies discussed, this mobility may be pushed to extreme. Hence, from this paper, I can rightly say that mobile computing environment in contemporary Nigeria *has made communication over wide physical range not just possible, but have also added value and efficiency to the kind of communication* transmitted, as presently in the country, virtually every form of information gathering and sharing over a vast geographical expanse are done using smartphones, a similar situation across the continent and the world over.

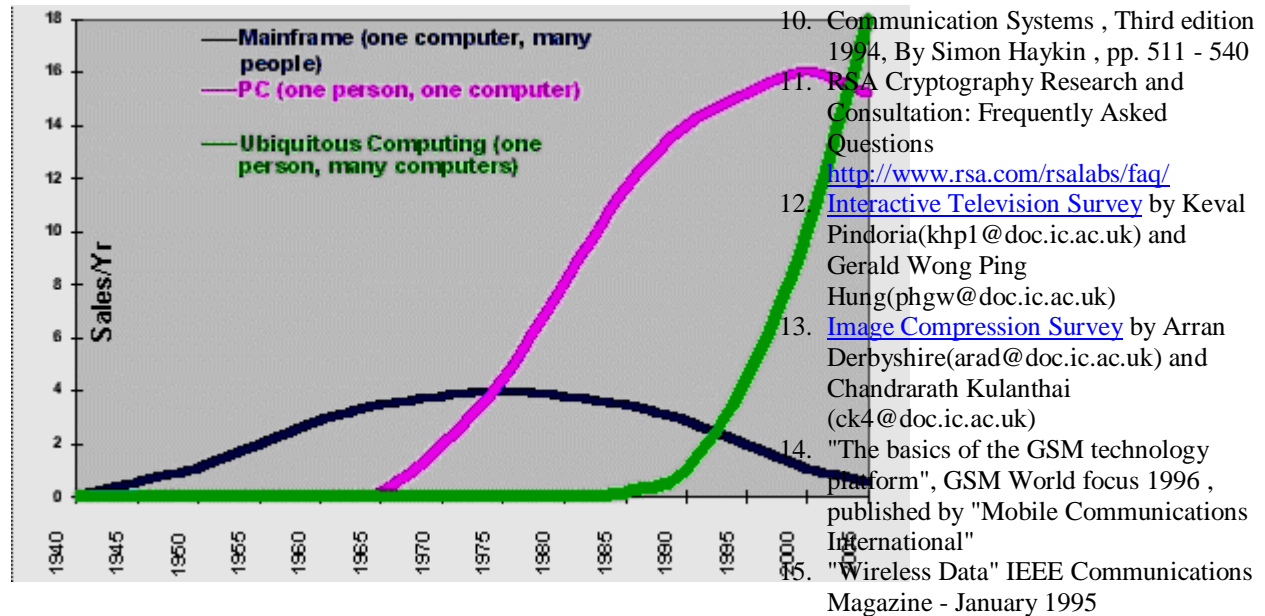


Fig 3: Major Trends in Computing

So, it is only but appropriate to say that the future of Mobile Computing is very promising indeed, although the technology behind it may go too far.

6.0

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