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A COMPARISON OF FIXED CELLULAR AND GSM TELECOMMUNICATION NETWORKS

Oluyemisi Ajibose
West African Bioethics Training Programme,
Center for Bioethics,
P.O.Box 29822,
Secretariat Post Office,
Ibadan, Oyo State,
Nigeria
Email: yemisiaji@yahoo.com

&

Dele Oluwade*
P.O. Box 20253, U.I.P.O.,
Ibadan, OYO 200005,
Nigeria
Email: deleoluwade@yahoo.com
(*Present institutional address : Department of Library and Information Technology, Federal University of Technology, Minna, Niger State, Nigeria)

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ABSTRACT

The economic development of any nation is affected by the type of telecommunication networks available. Until recently, the market share of telecommunications infrastructure in Africa is dominated by fixed cellular network. With the popularity of GSM network, it becomes necessary to examine features of its architecture. This paper presents a comparison of the fixed cellular network and GSM network available in Nigeria based on certain factors such as deployment difficulty, complexity of telephone sets, grade of service for intra-village call traffic, flexibility, co channel interference and complexity of RSUs. It is observed that deployment of wireless telecommunication services is easier and more flexible than the wired services. However, the wired network offers a better grade of service. Hardware infrastructures in GSM networks which are equivalent to those in wireless/wireline networks are also highlighted.

KEYWORDS AND PHRASES: Fixed wired network, Fixed wireless network, GSM network.

I. INTRODUCTION

The function of the telecommunication sector of any nation is to provide an efficient and affordable information transmission service from one point to another. Transmission of telecommunication services can be through wired (copper, fiber) or wireless means.

The fixed cellular network consists of wired and wireless architectures. GSM architecture is a wireless architecture that enables mobility of users. The fixed wireless is simply an alternative to wired communications, it does not need mobility, instead users are provided with cost effective telecommunications from fixed locations. Until recently, the market share of telecommunications infrastructure in developing countries and Africa is dominated by fixed cellular architecture. Among the countries of Africa, Nigeria is currently the fastest growing telecommunication environment, and the eighth fastest growing environment in the world [5]. Some of the past and present network operators in Nigeria are: NITEL (which provide fixed wired services); MTN, ZAIN(formerly known as Vmobile/Econet), Globacom, M-tel and Etisalat provide GSM services while Multilinks, Starcom and MTS provide fixed wireless services. In particular, MTN-which is one of the first telecommunication companies to be licensed in 2001-is regarded to be the largest telecommunication company in Nigeria. There exists a total of 57 million subscribers connected to all the five GSM networks in Nigeria .

There are many factors that impede the practical deployment of telecommunication technology in developing countries. Some of the major deployment difficulties have been identified as [3] : high initial capital costs, incompatibility of equipment, obsolescence of affordable equipment, different service quality requirement, and inadequate spectrum availability. Considering their ease of deployment and cost effectiveness for thin call traffic situations, wireless technologies appear to be an alternative choice for small communities in short time [1]. However, wired technology is well proven and cost effective for the higher subscriber densities.

Generally, the poisson , exponential and erlang distributions are frequently used to analyze telecommunication architectures. The poisson is widely used to measure the call arrival, the erlang to determine the traffic in a network while the exponential determines the call holding time [3].

In [3], a comparison of fixed wired and fixed wireless architectures was presented. In the present paper, this comparison is extended to GSM architecture based on the same factors described in [3]. In addition, hardware infrastructures in GSM network which are equivalent to those in wireless/wireline cellular networks are highlighted.

II. FIXED CELLULAR NETWORK ARCHITECTURE

Fixed Cellular Network refers to a system or devices that are situated in a fixed location such as an office or home [6]. Fixed networks can be categorized into two viz: fixed wired architecture and fixed wireless architecture. In fixed wired architecture, cables are used as physical connection between the terminals and the switch center. In fixed wireless there is no physical connection between the devices. Fixed wireless devices normally derive their electrical power from utility mains in which point–to-point signal transmissions occur through the air over a terrestrial microwave platform rather than through copper or fiber cables. The advantages of fixed wireless include the ability to connect with users in remote areas without the need for laying

cables and the capacity for broad bandwidth that is not impeded by fiber or cable capacity.

Fixed cellular network architecture consists of several neighbouring areas that are grouped to form a macrocell which has single base station (BS) [3]. The base stations are linked through high-speed wireline or wireless trunks or through links to a satellite. The subscribers within an area are connected to the remote switching unit (RSU) which manages all the intra-village call traffic. The RSUS are linked to the base station through wireless links. The macrocells are often widely separated from each other and the coverage of the BSs and RSUs do not overlap. A high degree of frequency reuse is possible leading to high spectrum utilization efficiency.

In the wired architecture, the subscribers are connected through traditional wired links. The subscriber equipment is just the conventional telephone set which is powered from a central battery in the RSU. An advantage of this architecture is that intra-village call traffic does not use up any radio spectrum. Also, intra-village calls are not blocked. However, inter-village and long distance call still requires a wireless channel between the RSU and the BS.

For the wireless architecture, there exist wireless links between BS and RSUs and between RSUs and subscribers. This architecture has the advantage of ease of deployment but has the limitations of higher complexity and cost of subscriber equipment, higher call blocking and lower grade of service for inter-village calls when intra-village call traffic is high. As the telephone sets in the architecture are to be powered locally their maintenance cost are higher, and if powered from a.c. power source, the telephone service is affected during power failures [3].

III. GSM NETWORK ARCHITECTURE

GSM is the first digital mobile communication system to enable international roaming and ISDN service characteristics [4]. GSM is an open standard for services, infrastructure and communication independent of the individual countries, network operators and producers, and flexible to the requirements of the individual user.

The GSM architecture consists of the Mobile Station (MS), Base Station Subsystem (BSS) and the Network Subsystem (NSS). The mobile station (MS) is carried by the subscriber, specifically; the MSs are connected to the BSS and the BSS to the NSS through wireless links. This implies that communication from one unit to another unit in GSM is wireless. The telephone set used in GSM is called mobile phone. The mobile station is made up of the mobile equipment (ME) which is carried by the mobile station; it is anonymous and consists of the physical equipment such as the radio transceivers, display and digital signal processors. It also contains the subscriber identity module (SIM) which stores the subscriber's information. The MS contains a battery that can be recharged.

The Base station subsystem is composed of two parts viz: the Base Transceiver Station (BTS) and the Base Station Controller (BSC); these communicate across the standard Abis interface. The Base transceiver station houses the radio transceivers that define a cell and handle the radio link protocols with the mobile station. The Base Station Controller manages the radio resources for one or more BTSs. It handles radio-channel setup, frequency hopping, and handovers. The BSC is the connection between the mobile station and the NSS. The NSS has the Mobile Switching Center as the central component. The A

interface is between the BSS and the MSC. The A interface manages allocation of suitable radio resources to the MSs and mobility management. The BTSs, whose coverage overlap, are widely separated from each other. Transmission over Air interface is digital.

GSM has the advantage of subscriber mobility, open interface, unique services like Short Message Service (SMS), web browsing, email and Multimedia Messaging Service (MMS).

IV COMPARISON OF FIXED CELLULAR NETWORK AND GSM NETWORK ARCHITECTURES

Table 1 below shows a comparison of fixed cellular network and GSM network architectures in terms of certain factors.

	Factor	Fixed Wired	Fixed Wireless	GSM
1	Deployment Difficulty	High	Low	Lower
2	Complexity of telephone sets	Low	High	Higher
3	Grade of service for intra-village call traffic	Very Good	Fair	Good
4	Overall grade of service	Good	Fair	Fair
5	Flexibility	Poor	Good	Better
6	Co channel interference	Low	Medium	Medium
7	Complexity of RSUs	Medium	High	Higher

Table 1: Comparison of fixed cellular and GSM network architectures

The above can be interpreted as follows: there is lower ease of deployment difficulty in GSM. Also, the complexity of GSM telephone set is more enhanced than the fixed cellular telephone set. There is no intra-village call traffic in GSM but communication exists between the different components. The over all grade of service in GSM can be assumed to be fair compared with fixed wireless (almost the same grade of service). To guarantee flexibility, open interfaces are specified in GSM between particular network elements. This way, network operators can be supplied by different producers. Nevertheless, the interfaces' functionality is very well specified, to guarantee a smooth data transmission. GSM architecture is designed to accommodate minimal co-channel interference. Minimizing co-channel interference is a goal in any cellular system, since it allows better service for a given cell size, or the use of smaller cells, thus increasing the overall capacity of the system. GSM does not use the term Remote Switching Unit(RSU), however it is a MOBILE Switching Centre (MSC) which acts like a normal switching node of the normal telephones of the landlines and in addition provides all the functionality needed to handle a mobile subscriber. Table 2 shows some hardware infrastructures in rural wireless/wireline architecture and the equivalent infrastructures in GSM architecture.

HARDWARE CONCEPTS IN RURAL WIRELESS/WIRE-LINE ARCHITECTURE	EQUIVALENT CONCEPTS IN GSM ARCHITECTURE
*Village subscribers(VS) *Base station(BS) *Macrocell *Remote switching unit(RSU)	*Mobile station(MS) *Base station controller(BSC) of the BS subsystem *MS,Um interface & BSS *Mobile service switching centre(MSC)

Table 2: Equivalent Hardware Infrastructures in Wireless/Wireline and GSM Architecture

V CONCLUSION

In this paper a comparative study of two telecommunication network architectures namely fixed cellular (wireless and wired) architecture and GSM architecture has been carried out. The fixed wireless and GSM network architectures are easily de ployed to any area. On the other hand, the fi xe d wired network architecture has a better grade of service compared to the other two.

POSTSCRIPT

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