Technical Performance Evaluation between Global System for Mobile Communications and Code Division Multiple Access Technology

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***Abstract* — This research paper is on the technical performance evaluation between Global System for Mobile Communication (GSM) and Code Division Multiple Access (CDMA) technology. GSM and CDMA are the two dominant technologies for mobile communication. Both technologies have the same goal of dividing the finite Radio Frequency (RF) spectrum between the multiple users. The technical performance evaluation of the two technologies are done based on the information obtained from research works, reports, journals, with more emphases on global reach, data transfer speed, security factors, clarity, traffic, capability, compatibility, spectrum frequencies, radiation exposure etc. GSM uses time-sharing protocol techniques, while CDMA uses spread spectrum techniques for its transmission. The outcome of this technical evaluation shows that CDMA is a better technology as compared to GSM.**

Keywords—Technical; Evaluation; GSM; CDMA; Mobile Communicatio.

I. INTRODUTION

There has been a tremendous growth in the wireless communication technology over the past decade. Global System for Mobile Communication (GSM) and Code Division Multiple Access (CDMA) are the two most prevalent mobile technologies [1]. Both of them operate on different frequencies using multiple accesses to divide finite RF spectrum between multiple users.

Global System for Mobile Communication (GSM) uses both Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA) for user and cell separation [2]. On the other hand, Code Division Multiple Access (CDMA) is based on spread spectrum technology which makes the optimal use of available bandwidth. It allows each user to transmit over the entire frequency spectrum all the time.

This research work has attempted to provide further comparison, mostly from the technical point of view, between these two systems in order to ascertain which is better.

Section **II** of this research examines a brief background review of GSM and CDMA, Section **III** surveyed the methodology, Section **IV** presents the result analysis, while section **V** summarizes and concludes the work.

II. BACKGROUND REVIEW

In today's world, most people communicate through the mobile phones. It is hard to believe that fifteen years ago cell phones were a rarity. Mobile Phones have a long and varied history.

Global System for Mobile communication (GSM) is the name of a standardization group that was established in 1982 in an effort to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900MHz[1,2]. GSM technology uses Time Division Multiple Access (TDMA) to chop up the channel into sequential slices, where each user of the channel takes turns to transmit and receive signals.

Code Division Multiple Access (CDMA) was originally known as Interim Standard 95 (IS-95). Qualcomm in United State was the first to patent this technology, and in 1993, it was adopted by the Telecommunication Industry Association (TIA). This technology was later enhanced and refined by Ericsson [3]. CDMA uses special digital modulation spread spectrum which spread the voice over very wide channel in pseudo random fashion.

The major difference between the two lies in terms of their global reach, data transfer speed, security factors, clarity, traffic, capability, compatibility, spectrum frequencies, and radiation exposure [4].

III. METHODOLOGY

Figure1 and 2 shows the network architectures of GSM and CDMA. The technical performance evaluation of the two technologies are done based on the information gained from

research works, reports, journals, with more emphases on global reach, data transfer speed, security factors, clarity, traffic, capability, compatibility, spectrum frequencies, radiation exposure.

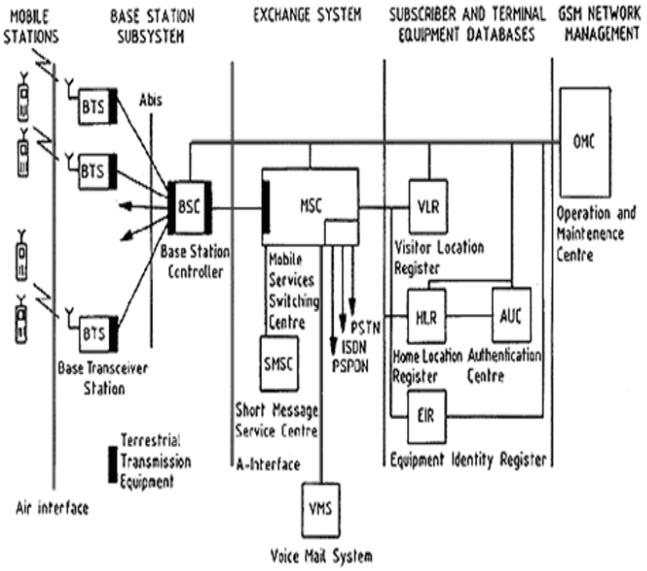

Figure 1. GSM Network Architecture

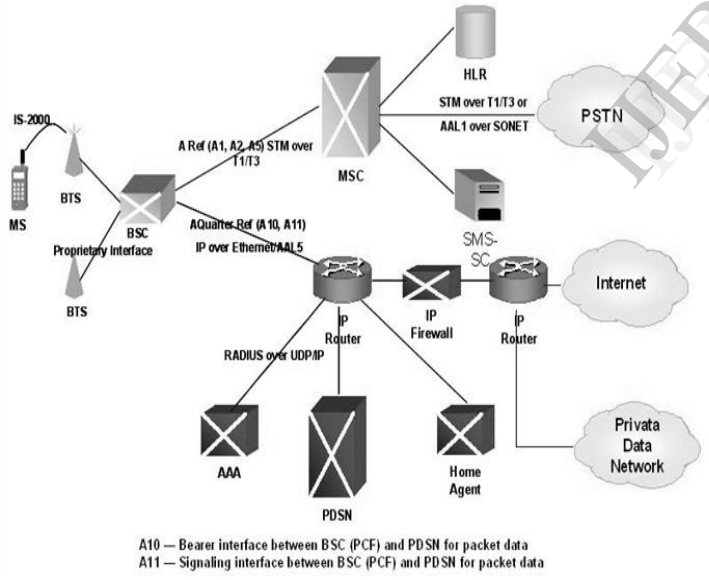

Figure 2. CDMA Network Architecture

A *Technology*

The GSM operates on the wedge spectrum called a carrier. This carrier is divided into a number of time slots and each user is assigned a different time slot so that until the ongoing call is finished, no other subscriber can have access to this. On the other hand, CDMA is based on spread spectrum technology which makes the optimal use of available bandwidth [5]. It allows each user to transmit over the entire frequency spectrum all the time.

B *Spectral Efficiency:*

CDMA has a very high spectral efficiency and can accommodate more users (Soft Capacity) per Mega Hertz (MHz) of bandwidth than the GSM. It delivers the highest voice capacity and packet data throughput using the least amount of spectrum for the lowest cost while the GSM has a less fixed capacity (hard capacity) that is easily computed since the principle of slot sharing is used.

C *Increased Battery Life:*

CDMA significantly enhances battery performance more than the GSM [6]. It saves a great amount of energy since its typical mobile transmitter power is less than 200 milli watts, while that of GSM is greater than 250 milli watts.

D *Security*

CDMA Technology is more secured as compared to the GSM technology since encryption is inbuilt in the CDMA. A unique code is provided to every user and all the conversation between two users are encoded ensuring a greater level of security for CDMA users. The signals cannot be detected easily in CDMA as compared to the signals in GSM. In terms of encryption, GSM technology has to be upgraded so as to be more secure.

E *Power Control*:

In GSM, there are five classes of mobile stations defined according to their peak transmitter power rated at 20, 8, 5, 2, and 0.8 watts. Power levels can be stepped up or down in steps of 2dB from the peak power for the class down to a minimum of 13 dB (20 milli watts). Power control in GSM is handled with care, since there is the possibility of instability. In CDMA, the power control is less, but it gradually increases with respect to distance from Base Station.

F *Relevance of Technology:*

CDMA has a clear advantage by using the entire frequency spectrum and the broadcast can happen at very high signal strength spread over a bigger radius than GSM. For a country like Nigeria, the GSM grid requires about 1,400 base stations to cover the country while CDMA requires roughly 880 base stations. So CDMA is known to cover more area with fewer towers.

G *Global Reach*

80% of the world's mobile users in over 210 countries use GSM as compared to CDMA. CDMA is almost exclusively used in the United States and some parts of Canada and Japan.

H *Data Transfer rate*

CDMA has faster data transfer rate as compared to GSM because Evaluation-Data optimized (EVDO) transfer technology is used in CDMA which offers a maximum download speed of 2mbps. EVDO read mobile phones are required to use this technology. GSM uses Enhanced Data rate for GSM Evaluation (EDGE) transfer technology that has

maximum download speed of 384kbps which is slower as compared to CDMA. For browsing the web, to watch videos and to download music, CDMA is better choice as compared to GSM.

I Radiation Exposure

GSM phones emit continuous wave pulses, so there is a large need to reduce the exposures to electromagnetic fields that is focused on cell phones. On the other hand, CDMA cell phones do not produce wave pulses. GSM phones emit about 28 times radiation on average as compared to CDMA phones [7]. Moreover, GSM phones are more biologically reactive as compared to CDMA.

J Roaming:

A major network standard in the world is the GSM MAP that supports the GSM radio interface. In CDMA systems a standard known as ANSI-41 (also called IS-41) provides roaming services for CDMA systems. The major drawbacks in GSM roaming include:

- Forwarding of GSM systems calls from the serving system, which often results in calls looping from a home system to serving system and back to the home system.
- The Authentication Center (AuC) in GSM which requires a transfer of authentication data for every call and which must perform authentication calculations. In practice, GSM carriers often avoid this, since it reduces the level of security that their systems provide. It is only a matter of time before a good hacker cracks the GSM mathematical algorithms. Just like Internet is hackable and GSM is clonable.

The implication is that somebody can recreate the SIM card codes and can make and receive calls on the subscriber's behalf. This could retard future transitional development from E-commerce (Electronic commerce) to M-commerce (Mobile commerce) in a big way via the GSM technological approach, unlike that of the CDMA technology that easily supports such development with backward compatibility, and thus does not require new standards [8].

K New Product:

New products are being developed and deployed which will further boost the capacity of CDMA networks. These include Selectable Mode Vocoder (SMV) receive diversity, and Smart Antenna technologies. SMV and receive diversity are specific to CDMA technologies.

Both are backward compatible and they do not require new standards. They are completely transparent to the end user and can be rolled out as needed over time.

L Co-Channel Inference:

In GSM, calls are interfered with by another site operating on the same physical channel and time slot. It is often observed that a signal from the other conversation can interfere with the signal that is actually received. This will result in audio dropouts and generally poor audio quality. The CDMA usually does not suffer from such interference since everyone is on the same channel. Signals only tend to degrade gradually, when there are too many signals present or too many added stations.

IV. RESULTS ANALYSIS

Stated in table 1 below are the summarized key results arising from the comparative evaluation between GSM and CDMA.

Table 1: Key technical comparative results between CDMA and GSM

COMPARATIVE TOOL	***CDMA***	***GSM***
Technology	American Digital	Pan European Digital
Roaming Capability	On Trail	Implemented
System Modulation	Binary Phase Shift Keying (BPSK)	Gaussian Minimum Shift Keying (GMSK)
Typical Mobile Transmit Power	< 200 mW	> 250 mW
Smart Card Used	Removable User Identity Module (R-UIM)	Subscriber Identity Module (SIM)
Systems Signal Jamming	Not Affected	Affected
Speech Encoding	Code Exited Liner Predictive Codec (CELP)	Regular Pulse Excited Linear Predictive Codec (RPE-LTP)
Basic CODEC used	Extended Variable Rate Coding (EVRC)	Enhance Full Rate (EFR)
Hand off	Soft hand off	Hard Hand off
Drop Calls	Rarely occurs	Occurs frequently
Large open land coverage	Works very well	Unstable audio
High Ground	Functions well	Chops audio receptions
Co-channel's effect	Avoided via site selections	Competes with the needed signals
Health Risk	Reduced	Higher (uses lots of power)
Coverage Comparison	1.7 – 3X GSM	-----
Frequency Re-use Gains	20X TDMA	3X TDMA
Service Offered	Voice, data, paging, M-commerce	Voice, data, paging, M-commerce
Eavesdropping (Security)	Highly secure (PN codes = 4.4 trillion Combinations)	Hackable (far less combinations

V. SUMMARY AND CONCLUSION

From the result in Table 1, it is evident that there are many reasons why CDMA tends to be a better choice for the next generation of digital wireless communications, products and services. These include; outstanding voice and call quality, greatest coverage per unit cost, longer battery life, fewer dropped calls, improved security and privacy, greater capacity, reduced background noise and interference, rapid deployment, faster speed, continuing technology advances, etc. CDMA evolution ground is wider, and in a few years, it will be significantly superior to GSM. In comparison, GSM and CDMA are quantity over quality scenario.

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