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Research Paper

Comparative Analysis of Signal Strengths of Some Cellular Networks in Umuahia Eastern Nigeria

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ABSTRACT:- *As the erratic nature of the services of cellular networks become increasingly worrisome, the signal strengths of six cellular networks operational in Umuahia Eastern Nigeria are compared to ascertain the network with a better signal strength. Measurements of Signal strengths (SS) and quality of service (QS) at particular time intervals were made for all the six cellular networks. Results show that the network with the highest values of signal strength has the best quality of service. This network was found to be Network A (with mean signal strength of -86 dBμV/m and mean quality of service of 41.83%), which uses the GSM cellular network technology. Network C shows a smaller range in signal strength, thereby maintaining a more stable signal with average signal strength of -91dBμ/m. The study also shows that the type of network technology used does not affect the pattern in which signal strength varies with distance and around obstacles. Network congestion is not influenced by signal strength; rather it is influenced by bandwidth and number of users. This research also shows that CDMA networks maintain more stable signals while GSM networks have signals of better strength.*

KEYWORDS:- *CDMA, GSM, Quality of signal, Signal strength*

I. INTRODUCTION

Cellular phones have become an indispensible part of our everyday life. We continuously make use of them in voice calls, sending of short message services (SMS), sending of e-mails, in e-commerce, e-banking, e-learning and watching movies. These cellular phones operate through cellular networks which are responsible for generating and distributing of radio signals that are used by cellular phones over wide geographic areas [1]. In recent times, the service rendered by these cellular networks has been epileptic and this has been attributed to the weakness in the strengths of their signals [5]. This research compares the signal strengths of these cellular networks, in which case the quality of their signals is analyzed with a view to determining the network with better signal quality and at what period of the day the signal strength is strongest.

II. MATERIALS AND METHODS

The signal strengths and quality of signals of Network A, Network B, Network C, Network D, Network E and Network F were subjected to investigation with detailed summary as illustrated by [4]; using computer software called GSM/CDMA Signal Monitor installed in a Samsung GT-S5300 mobile phone. The GT-S5300 was connected to a computer system as explained by [5]. The software automatically measures the signal strength of the networks in decibel micro volt per metre (dBμV/m). This setup was done for the six available networks and measurements taken simultaneously at 30 minutes intervals for 24 hours. Matlab was used in generating graphs of the measured quantities against time to find out the lowest and the peak values and their effect on the network; while SPSS was used in analyzing the measured quantities.

III. RESULTS

The signal strength (SS) of Network A according to figure 1 varied between -77dBμV/m and -99dBμV/m while its quality of signal (QOS) varied between 58% and 12%. The average SS was -79dBμV/m at 7:00 hours corresponding to an average QOS of 56%. A regression coefficient of 0.972 was found between its SS and QOS. Network A also recorded a consistency period between the hours of 14:00 and 16:00.

Figure 2 shows that for Network B, the maximum SS was -83dBμV/m at 14:00, 15:00 and 21:00 hours while the minimum SS was -103dBμv/m at 9:00 and 23:00 hours. These corresponded to a maximum QOS of

50% at 14:00, 15:00 and 21:00 hours, and minimum QOS of 10% at 9:00 and 23:00 hours. A regression coefficient of 0.986 was calculated between the SS and QOS.

Figure 3 shows the measurements for Network C. It has a maximum SS of -79dBμV/m at 11:00 and 12:00 hours and minimum SS of -103dBμV/m at 14:00 and 16:00 hours; these corresponds to a maximum QOS of 56% at 11:00 and 12:00 hours and minimum QOS of 10% at 14:00 and 16:00 hour. A regression coefficient of 0.981 was found between the SS and QOS. The figure also shows a consistency period between 6:00 – 7:00 hours and 11:00 – 12:00 hours.

Figure 4 shows the measurements of Network D . It reveals a maximum SS of -83dBμV/m at 4:00 hours and a minimum SS of -110dBμv/m at 9:00 hours; corresponding to a maximum QOS of 50% at 4:00 hours and minimum QOS of 6% at 9:00 hours. A regression coefficient of 0.981 was found between the SS and QOS. The figure also shows a consistency period between the hours of 21:00 and 22:00.

Figure 5 shows the measured parameters of Network E. It has a maximum SS of -80dBμV/m at 11:00 hours and minimum SS of -109dBμV/m at 16:00 hours; corresponding to a maximum QOS of 57% at 11:00 hours and a minimum QOS of 6.1% at 16:00 hour. A regression coefficient of 0.975 was found between the SS and QOS. The figure also shows a consistency period between the hours of 5:00 and 6:00.

The measured parameters of Network F are shown in figure 6. The maximum SS was -85dBμV/m at 4:00 and 20:00 hours while the minimum SS was -107dBμV/m at 13:00 hours; corresponding to a maximum QOS of 50% at 20:00 hours, and minimum QOS of 7% at 13:00 hours. A regression coefficient of 0.969 was found between the SS and QOS. The figure also shows a consistency period between the hours of 6:00 and 7:00.

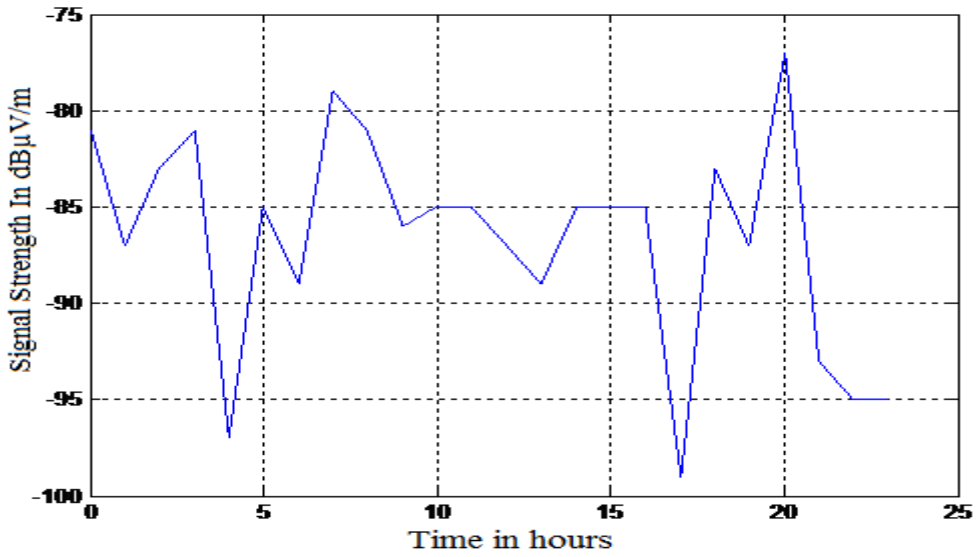

Figure 1: Signal strength variation with time for Network A

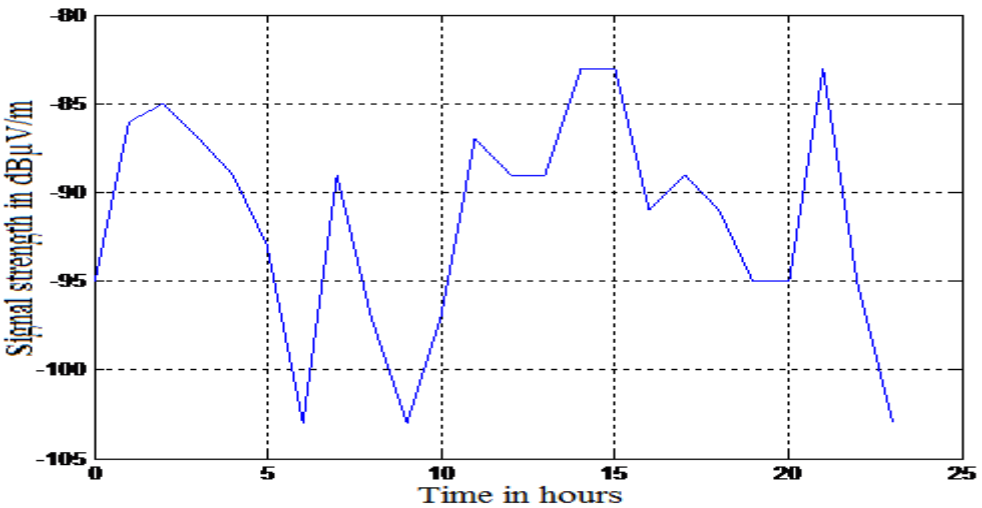

Figure 2: Signal strength variation with time for Network B

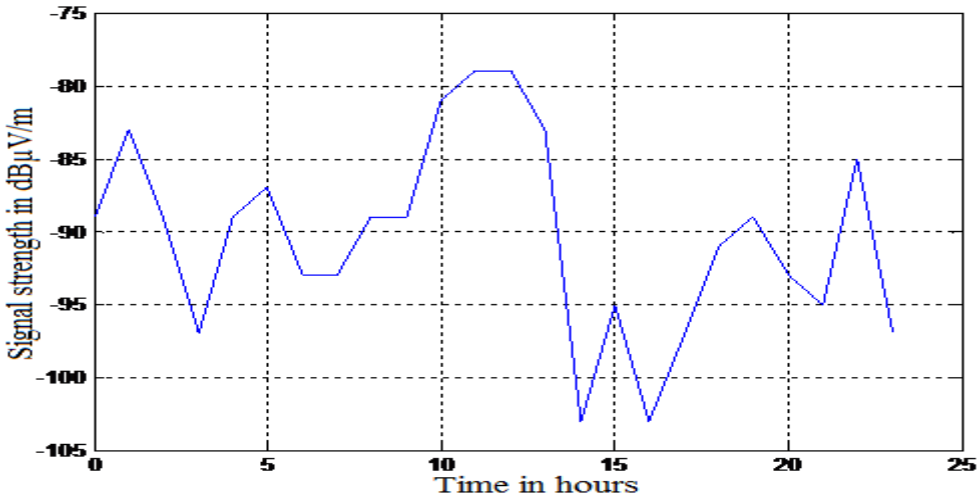

Figure 3: Signal strength variation with time for Network C

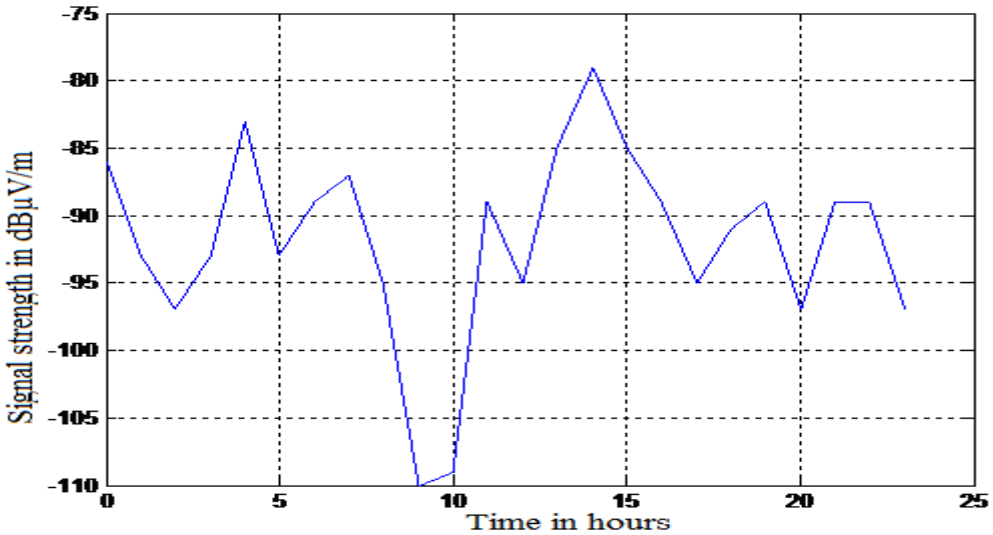

Figure 4: Signal strength variation with time for Network D

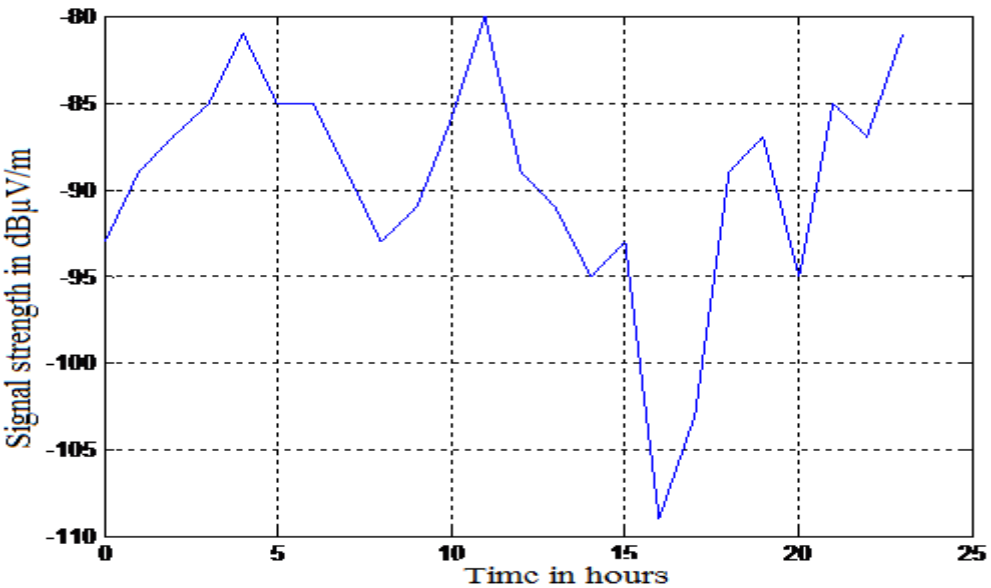

Figure 5: Signal strength variation with time for Network E

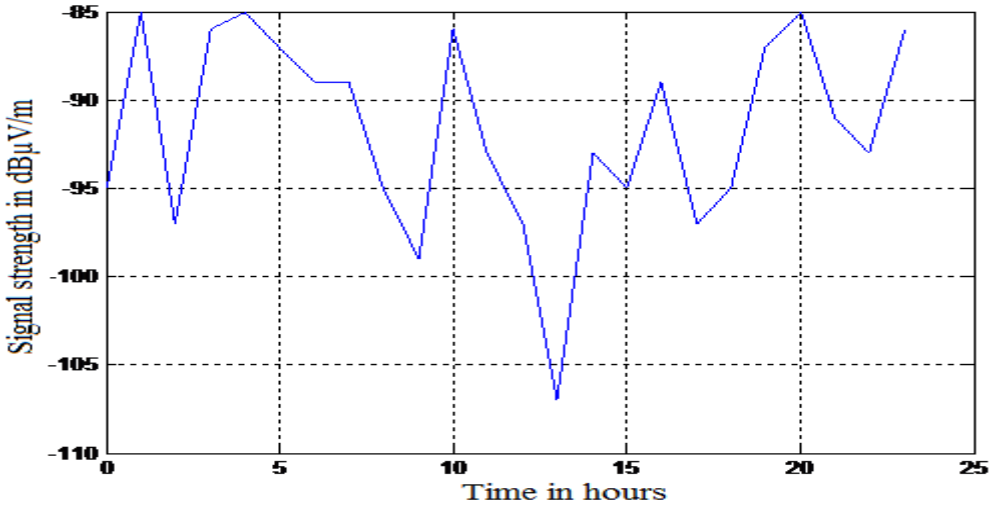

Figure 6: Signal strength variation with time for Network F

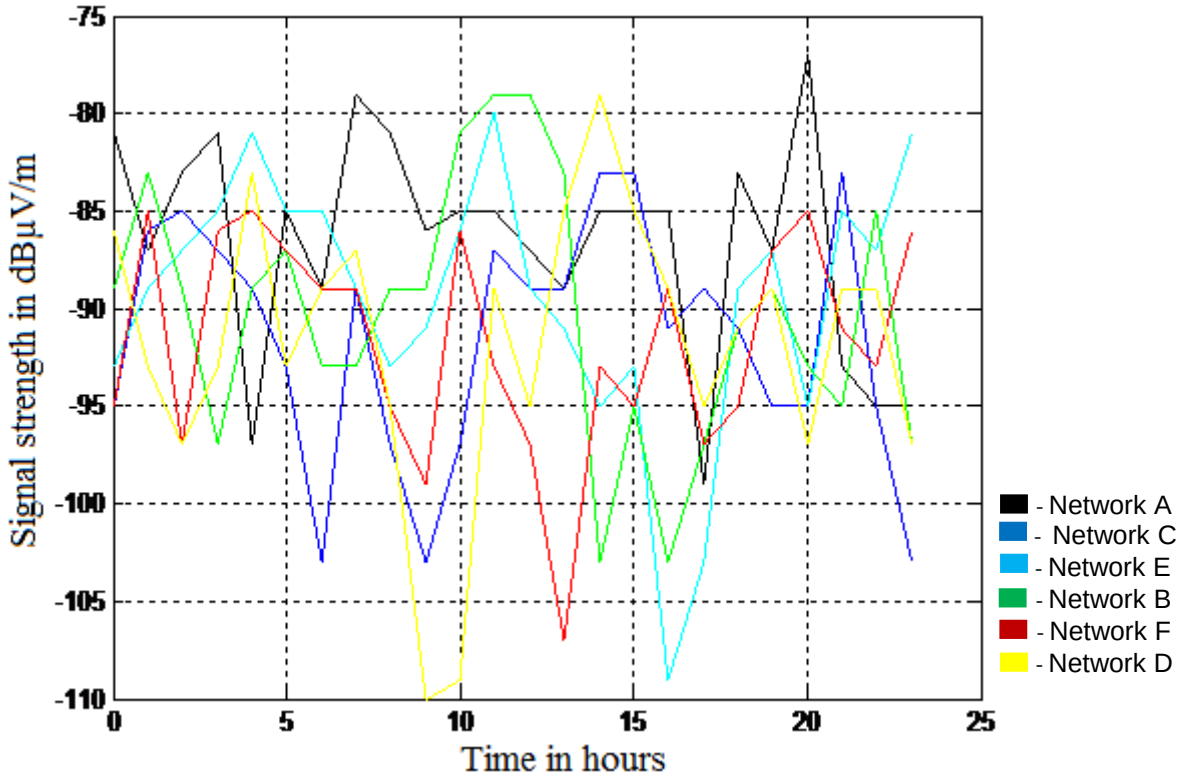

Figure 7: Signal strength variation with time for the six networks

IV. DISCUSSION

The signal strength across the networks varies in the same manner (Figs.1, 2, 3, 4, 5 and 6). The figures depict that the network technology used has no influence on the signal strength. The reason is because signal strengths are influenced by distance from base transmitting stations and obstacles not the network technology used [3]. For instance, Figs.1, 2, 3 and 5 represent signal strengths of GSM networks, yet they are not similar in any way and when compared with Figs. 4 and 6, which are the signal strengths of CDMA networks, it will be noticed that they all vary randomly in such a way that one cannot distinguish GSM signals from CDMA signals. This is in agreement with [5] who conducted a wide range of surveys on signal strengths of cellular networks and discovered that those of GSM networks are of higher values when compared with those of CDMA networks but fluctuate more rapidly while those of CDMA networks tend to be more stable. This is clearly seen in Fig. 7. From Fig.7. there is no distinction in the way signal strength varies with time in the day and at night. This shows that day time factors such as network congestion do not affect the signal strength rather they may affect data

transmission within the network [3]. However, to achieve a better signal strength in areas with poor signal strength, it is recommended that external antenna, signal booster and signal repeaters should be used. These equipments increase signal strengths tremendously [2].

V. SUMMARY

It has been clearly seen that Network A has the best signal strength with better stability when compared with other operational networks in Umuahia. The CDMA networks however show smaller range in their signal strengths thereby maintaining more stable signals than the GSM networks. This means that the spread spectrum approach of cellular transmission is more stable than the digital time division multiple access approach.
A closer look also reveals that the GSM networks record higher values of signal strengths which imply that the digital time division multiple access approach of cellular transmission travels farther than the spread spectrum approach.

VI. CONCLUSION

It is shown from this study that the cellular network technology used has no effect on the signal strength. The factors affecting signal strengths such as distance from base transmitting stations and obstacles affect both technologies in the same manner.

Traffic congestion does not have any direct effect on the signal strength. This is evident from the fact that there is no distinction in signal strength pattern between hours of heavy traffic (peak hours) and hours of low traffic (off peak hours).

In choosing a cellular network, the signal strength should be considered seriously since the quality of signal provided by a network is a function of the signal strength of that network.

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