

# A STUDY OF THE MEASURE OF SIGNAL STRENGTH OF SOME SELECTED GSM NETWORKS IN ESUT COMMUNITY AND ITS ENVIRONS

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## ABSTRACT

This paper assesses the signal strength of some selected GSM network service providers in Enugu State University of Science and Technology (ESUT). The latitude, longitude and altitude of the reference positions where the study area will be carried out were picked with global positioning system. The data used were downloaded from the Automatic Weather Station and Signal Strength Meter in the Department of Industrial Physics Enugu State University of Science and Technology. The signal strength of MTN, AIRTEL AND GLO were measured over a period of 7 Months. The data were analyzed and compared with each other to check their performances and the strength of their networks for this period. The result showed that the network with the highest signal strength has the best quality of service and this network was found to be AIRTEL with signal strength of -61dbm on the average followed by MTN -68dbm and GLO -75dbm with the lowest signal strength.

Keywords: Quality of signal, Signal strength, GSM, Networks.

## 1. INTRODUCTION

The need for good communication network service has been a subject of hot discussion overtime. From time immemorial, information and communication have fashioned the basis of human existence. We continuously use cellular phones for calls, sending of short message services (SMS), send of e-mail, in e-commerce, uploading and downloading of information and another internet service (P.K sharma and R.K singh, 2011). This desire has been a driving force inspiring people to continuously seek for a new and effective means of communication irrespective of time and distance. The first generation of cellular telephone system which was analog system was launched in 1960s before digital communication became prevalent (Popoola *et al.*, 2008,2009).

These cellular phones operate through cellular network which are responsible for generating and distribution of radio signal that are used by cellular phone over wide geographical areas. The cellular technology is by far the most widely used form of communication and entertainment technology since the very beginning of the 21st century. The cellular technology makes use of a wireless network called the cellular network that is transmitted across an area through the use antenna and amplifiers. These antennas are also known as cell towers that transmit the signals over a wider area. It is the strength of the signal transmitted via the cell tower that determines how well you can communicate via the telephone. The receiving antenna of electronic devices are wirelessly connected to the mobile network Base station (BS) transmitter. As the devices are moved about, wireless signals transmitted

from the base station transmitter are significantly affected by the nature or geography of the environment.

The distribution of radio signal depends on the prevailing weather/climate condition as dictated by atmospheric processes like temperature, relative humidity, solar radiation, cloud cover etc. These factors affect the signal strength of these networks.

The ionosphere and the neutral atmospheric induce propagation delays. In the neutral atmosphere, delays are induced by refractivity of gasses. Hydrometers and other particulates depending on their permittivity, concentration and forward scattering from hydrometer and other particulates. Change in temperature, moisture and pressure in the atmospheric column cause a change in atmospheric density which in return causes variation in the intensity of wave in both the vertical and horizontal (Olasoyi Y.O and Kolawole M.O,2010).

Propagation parameters of the cellular mobile signal transmission includes antenna height, tilt, antenna gain, transmitted frequency etc. are very vital to be considered as practical and theoretical guide to effective mobile network planning.

Radio propagation is profoundly site specific and varies considerably based on speed of mobile terminal, frequency of operation on the parameters like antenna height, antenna gain, transmitted power, path loss, other losses, and receiver sensitivity (Haykin, Simon 2001). The received signal strength depends on the path loss and the parameters of the transmitter and receiver.

Quality of call establishment is based on received signal strength. Sharma et al opined that before going for the establishment of expensive system such as wireless system, mathematical model analysis is necessary to estimate channel environment, frequency band and the desired radio coverage range. According to Celinu Kiyea (2014) Quality of Service (QS) is usually defined as a set of service requirements that need to be met by the network while transporting a packet stream from a source to its destination. The network needs are governed by the service requirements of end user applications.

For a mobile network telephony services specifically to be of quality, it has to meet up with some criteria such as Speech Quality, Call Completion Rate, Call Setup Success Ratio, Service Accessibility Telephony, Service Accessibility Short Message Service. This research tends to examine the signal strength of these networks which is a measure of their quality of service.

## **2. INSTRUMENTATION AND METHOD**

All the data used in this research was from a UHF signal strength measuring meter designed and built by the research team. The meter has a slot for three GSM slots to receive signal from three GSM networks (MTN, AIRTEL and GLO) within the study area. The signal strength of each GSM network is received by the external module of the measuring equipment and transmitted through RF to the internal module which has a data logger. The integration time was set at 2min. The data is downloaded to a dedicated computer system for analysis. The study was done using the selected three networks and the measurements were taken simultaneously at 2 minutes' interval for 24 hours in seven months. The graph of the measured signal strength against time were plotted using Microsoft Excel to determine the lowest and the peak values of the signal strength of the networks. This in turn shows the network with the best quality of service and how the signal strength varies with time.

## **3. DATA ANALYSIS**

The data collected during the research period is here by presented and analyzed for all the selected networks involved. In order to carry out the analysis a total of 720 data are collected per day and the average of the data were calculated for the different networks. Table 1 shows average signal strength of the selected network from the month of April to October 2017.

## 5.RESULTS

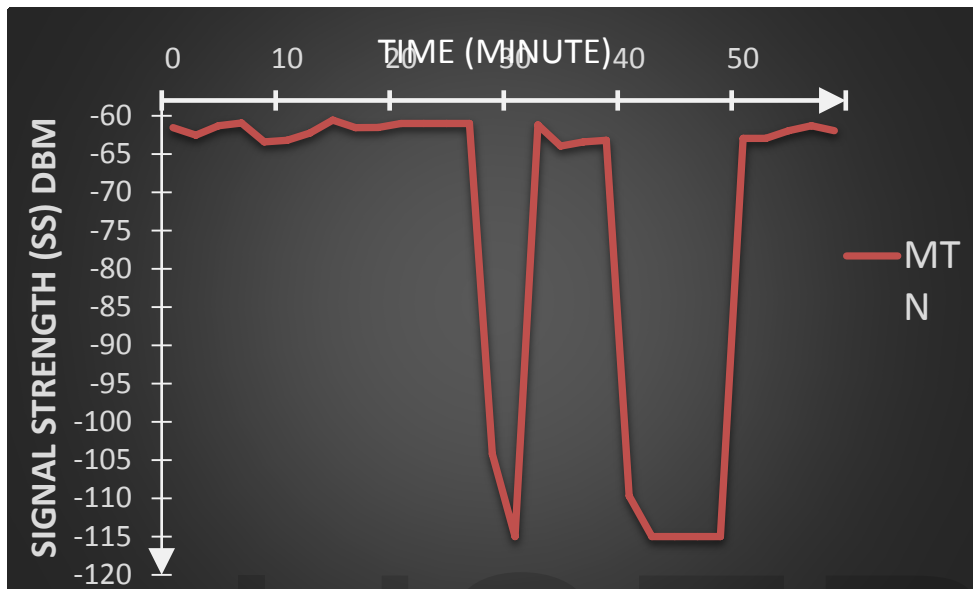


Fig. 1: Signal strength variation with time for MTN network for the month of April.

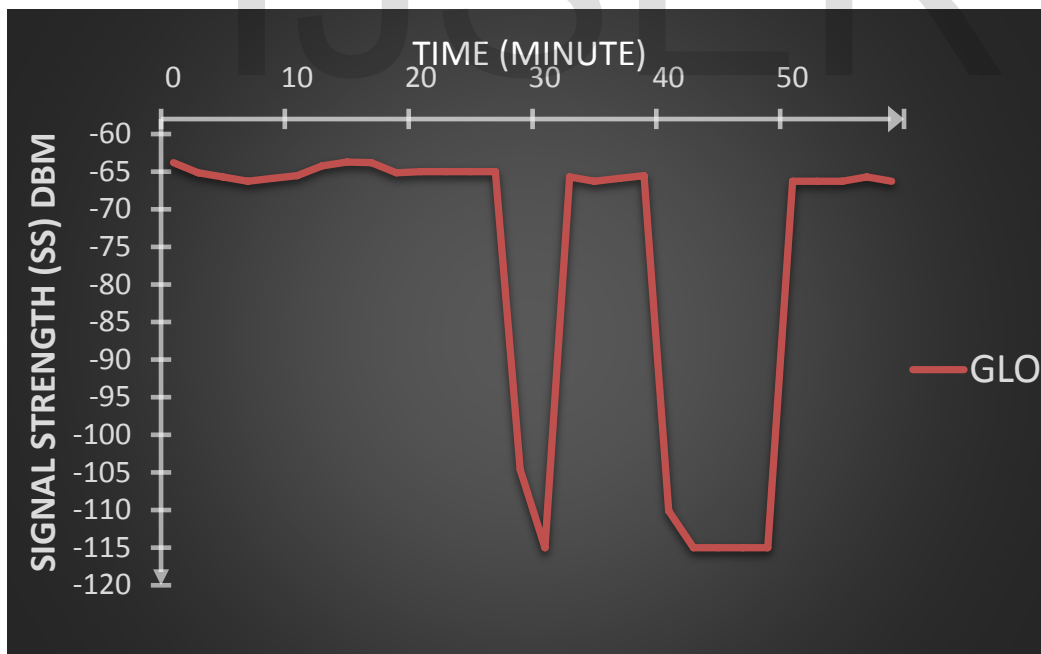


Fig. 2: Signal strength variation with time for GLO network for the month of April.

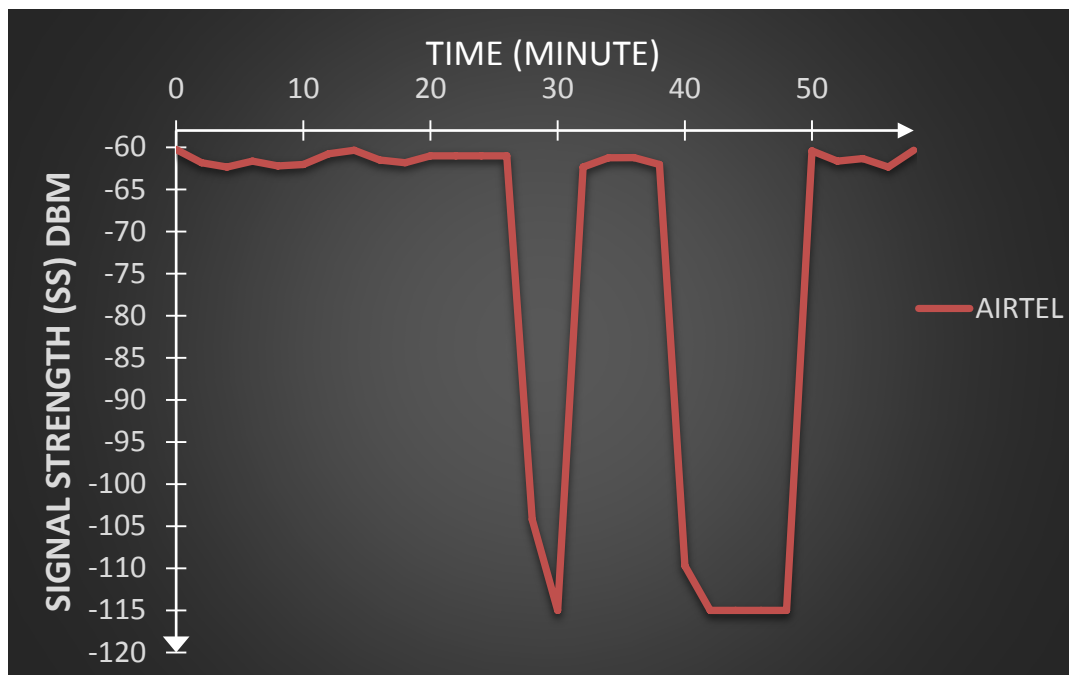


Fig3: Signal strength variation with time for Airtel network for the month of April.

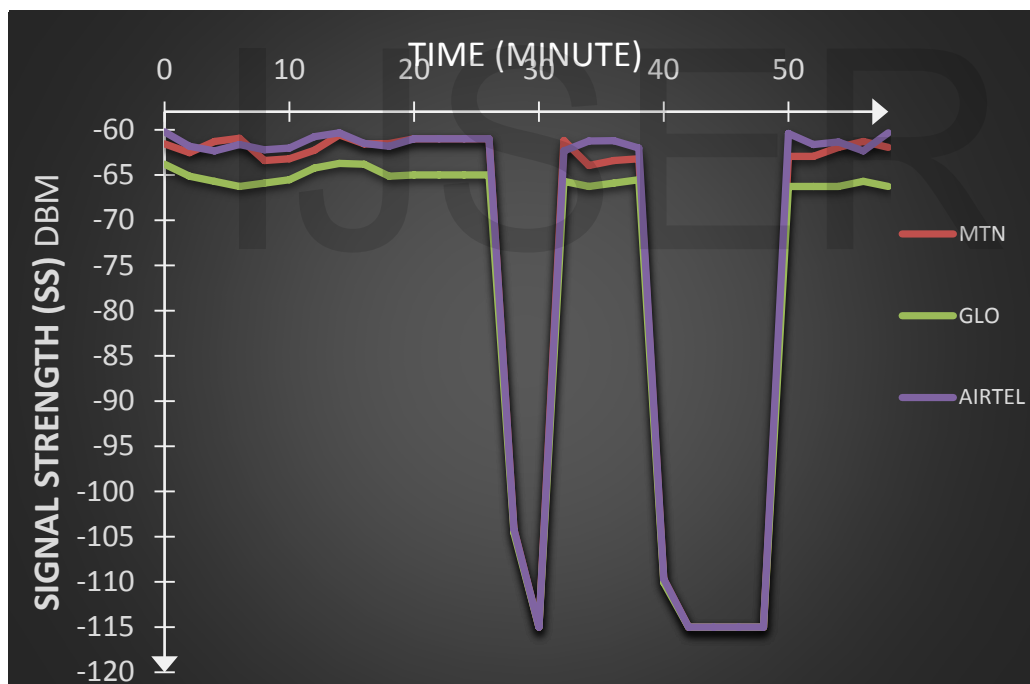


Fig.4: Signal strength variation with the Time for all the different network for the month of April.

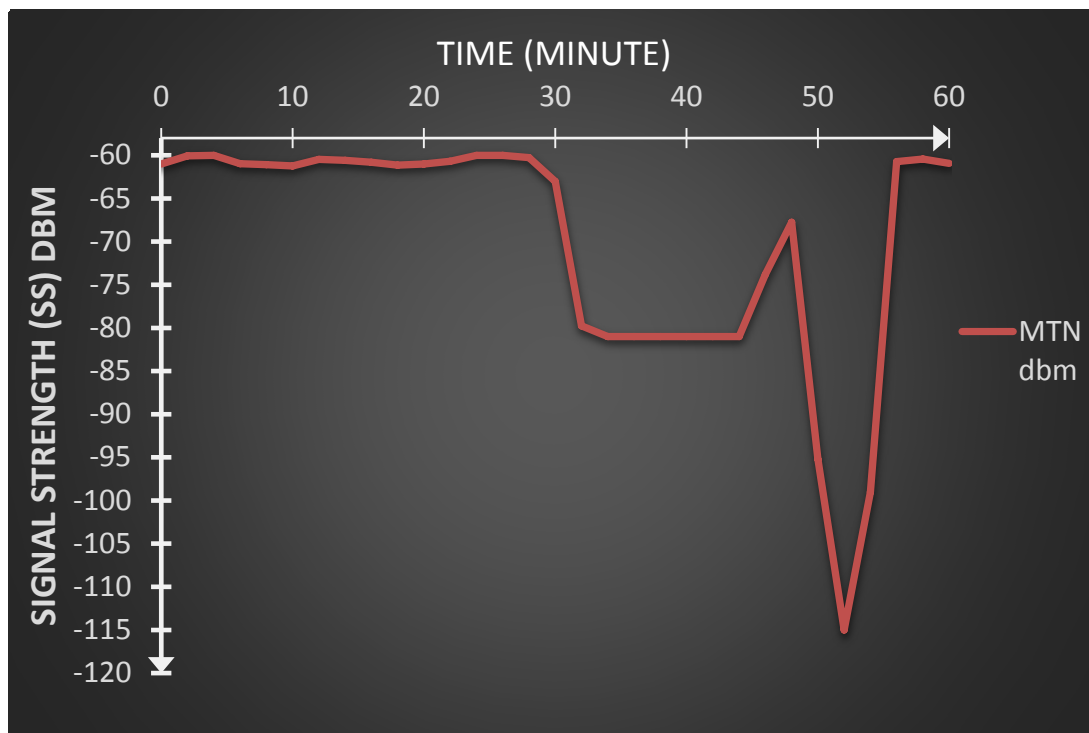


Fig. 5: Signal strength variation with time for MTN network for the month of May

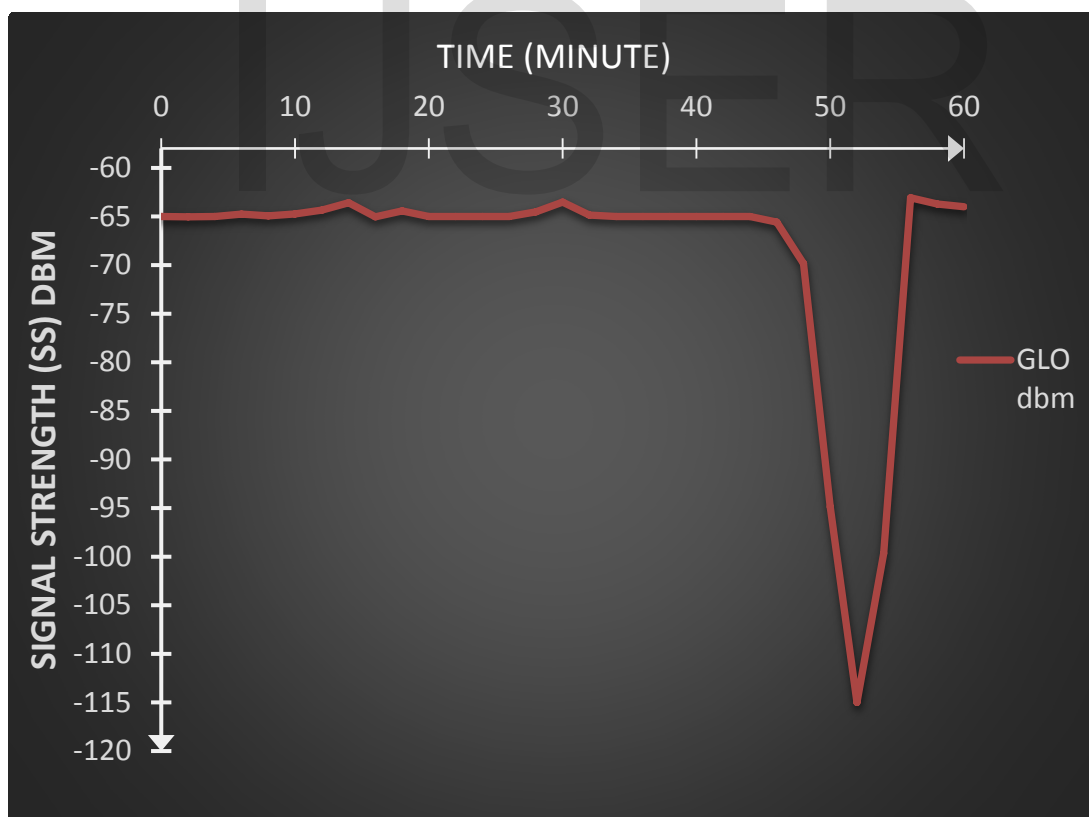


Fig. 6: Signal strength variation with time for GLO network for the month of May

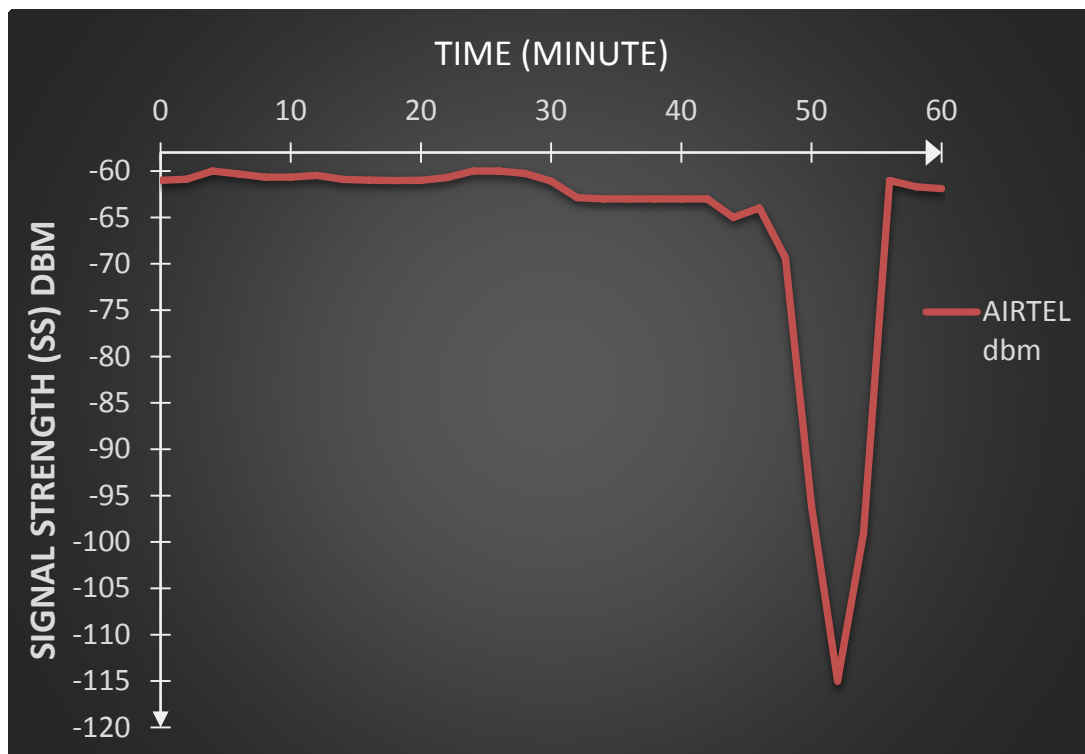


Fig.7: Signal strength variation with time for Airtel network for the month of May

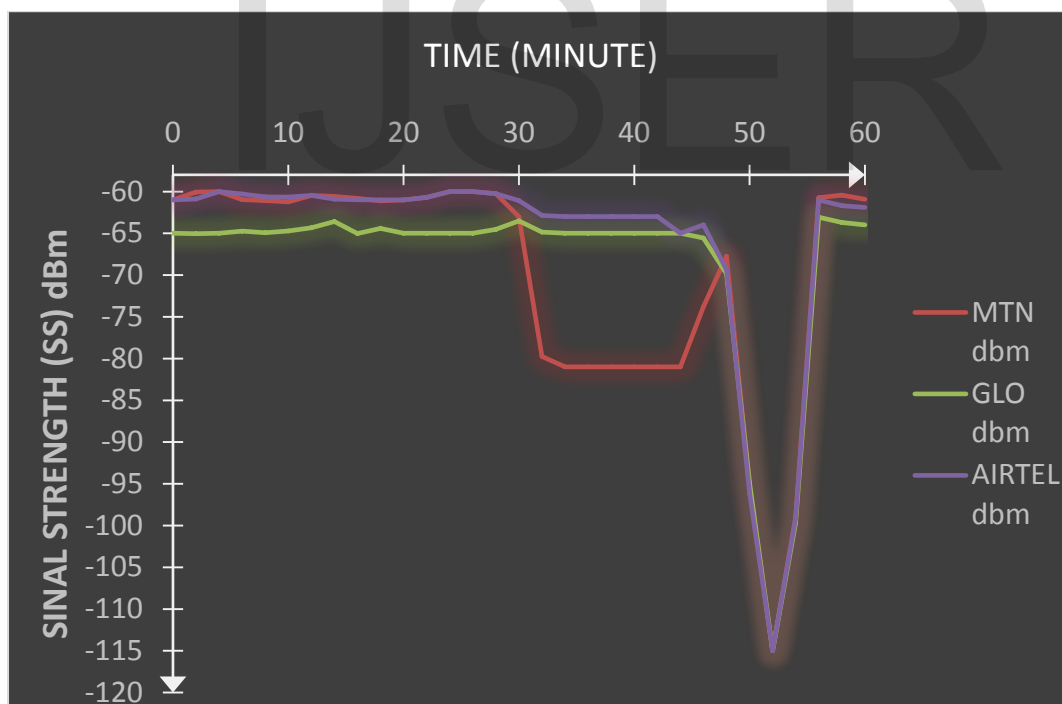


Fig.8. Signal strength variation with the Time for the different networks for the month of May

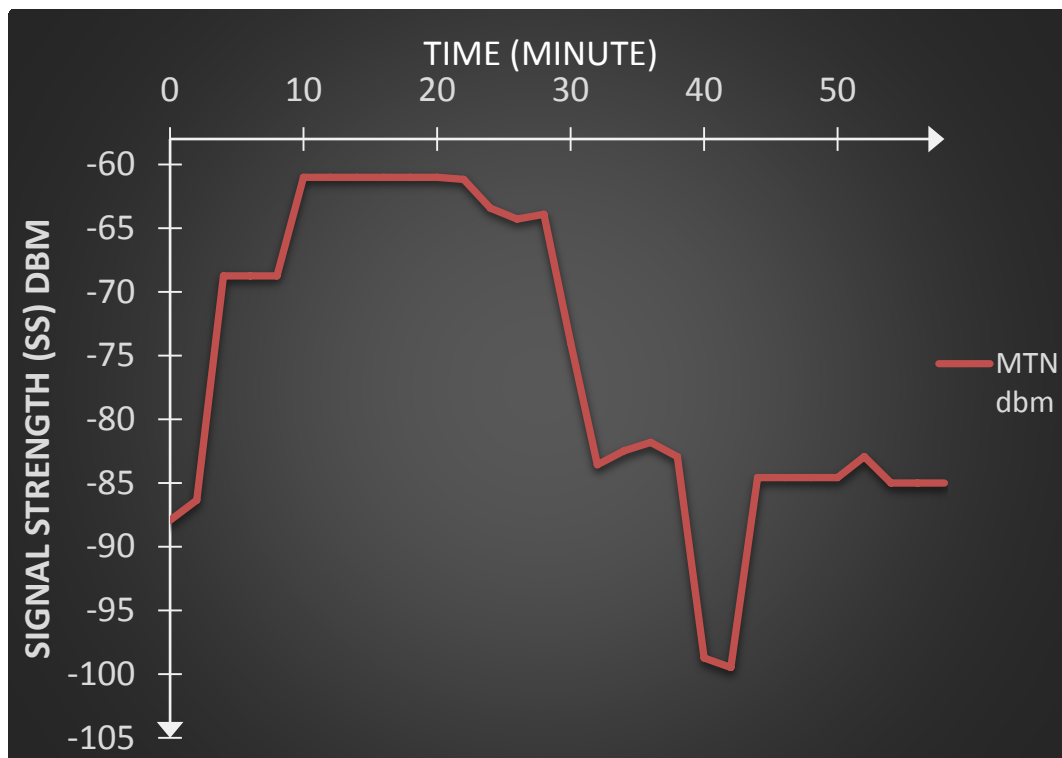


Fig.9: Signal strength variation with time for MTN network for the month of June.



Fig.10: Signal strength variation with time for GLO network for the month of June.

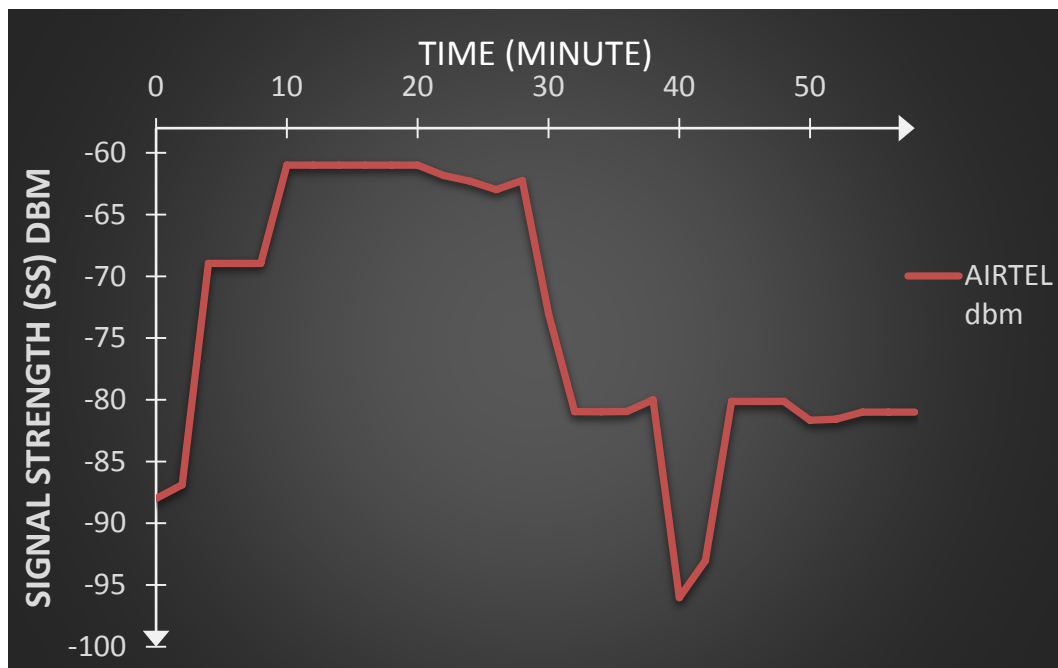


Fig. 11: Signal strength variation with time for Airtel network for the month of June.

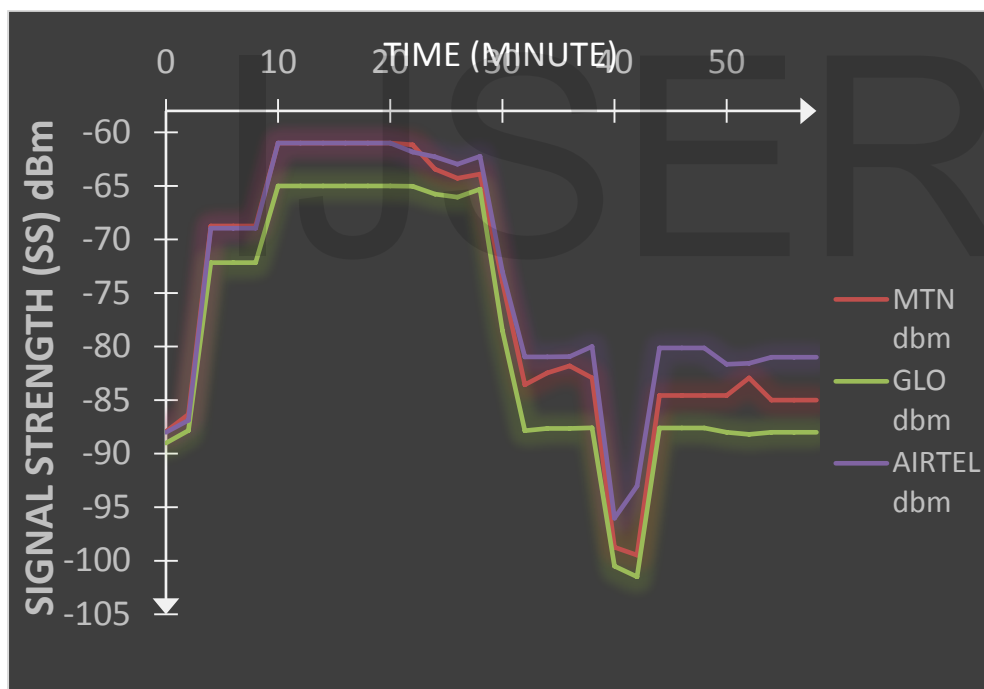


Fig. 12: Signal strength variation with the Time for all the different network for the month of June.



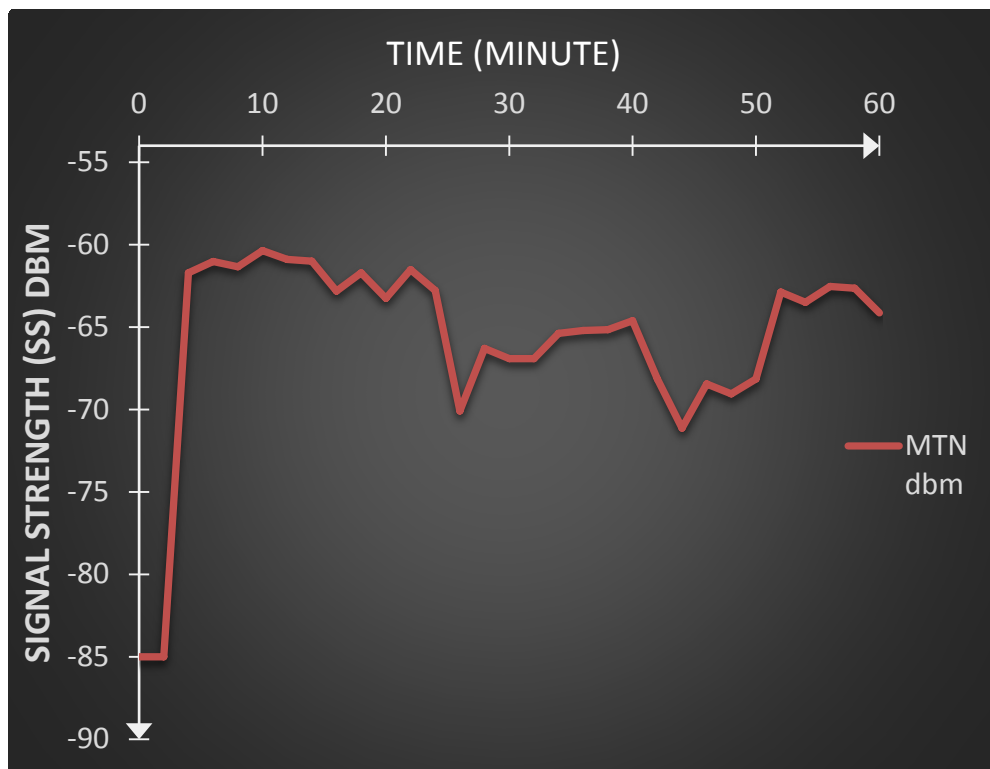


Fig. 13: Signal strength variation with time for MTN network for the month of July

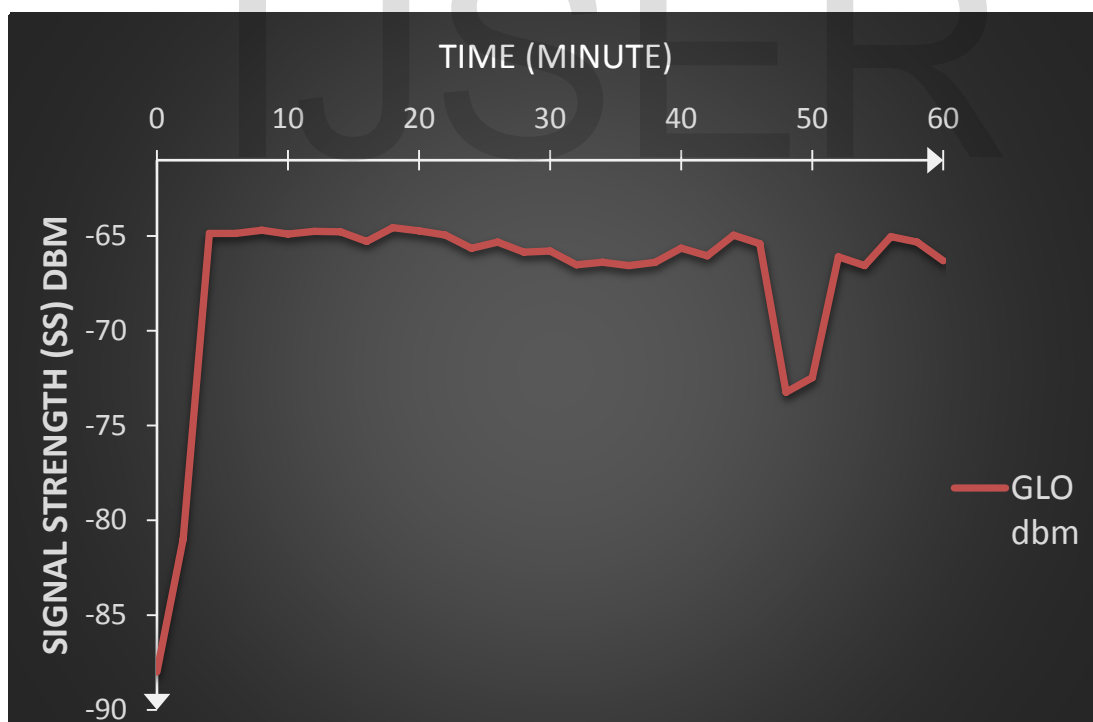


Fig. 14: Signal strength variation with time for GLO network for the month of July

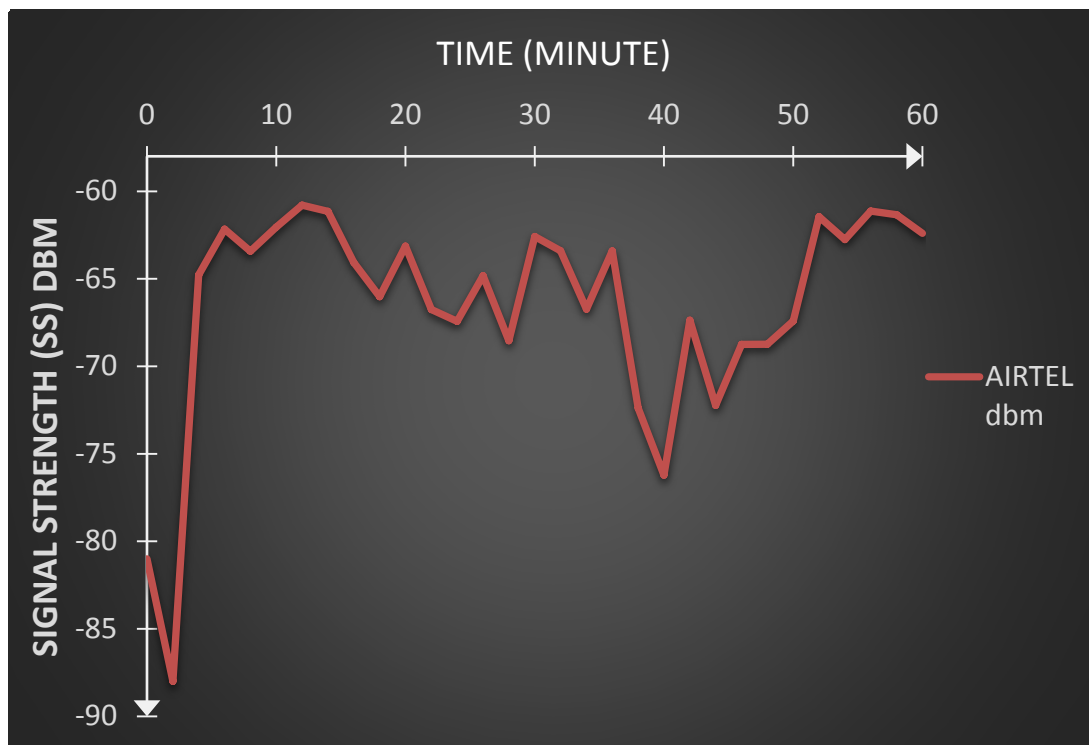


Fig. 15: Signal strength variation with time for Airtel network for the month of July

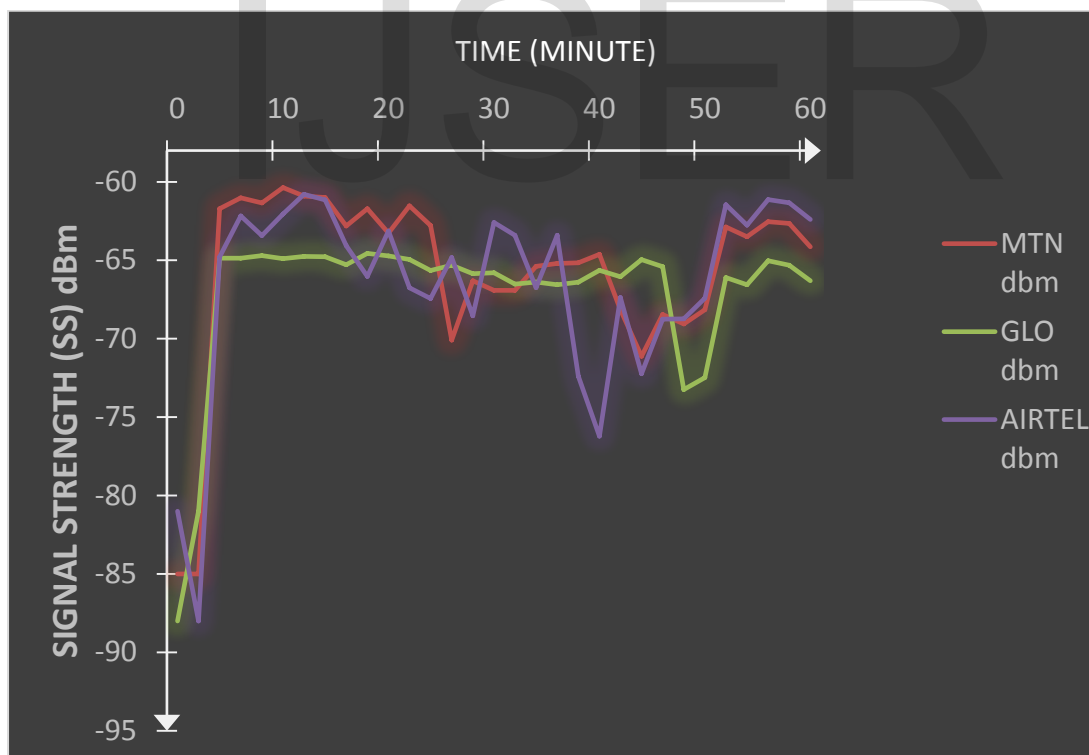


Fig.16: Signal strength variation with the Time for all the different network for the month of July.

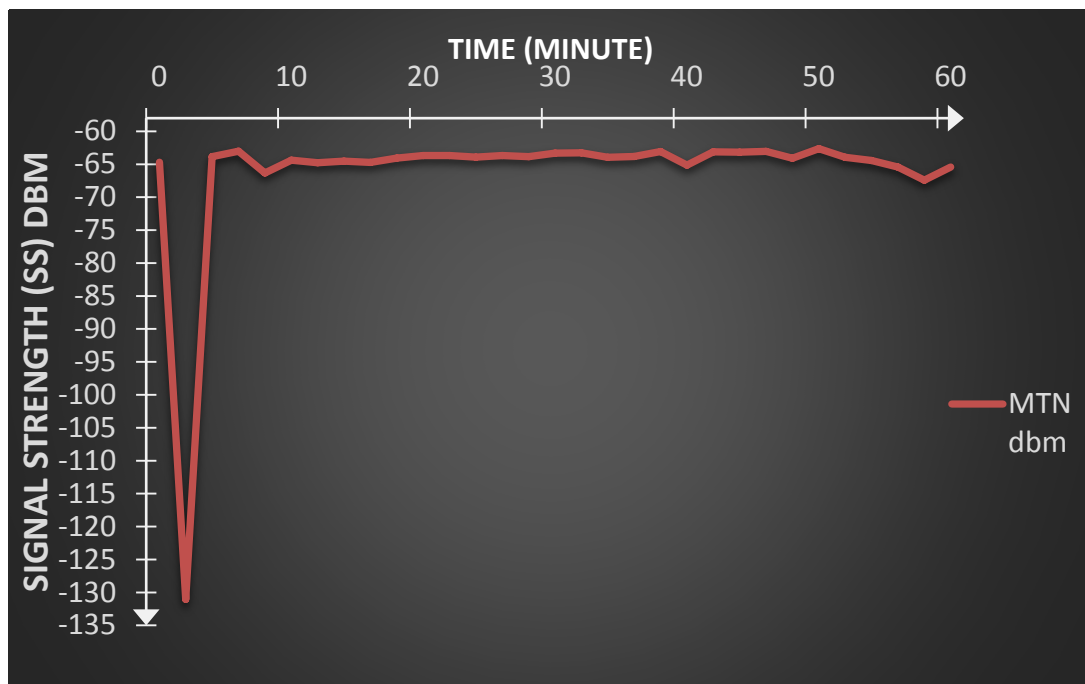


Fig.17: Signal strength variation with time for MTN network for the month of August

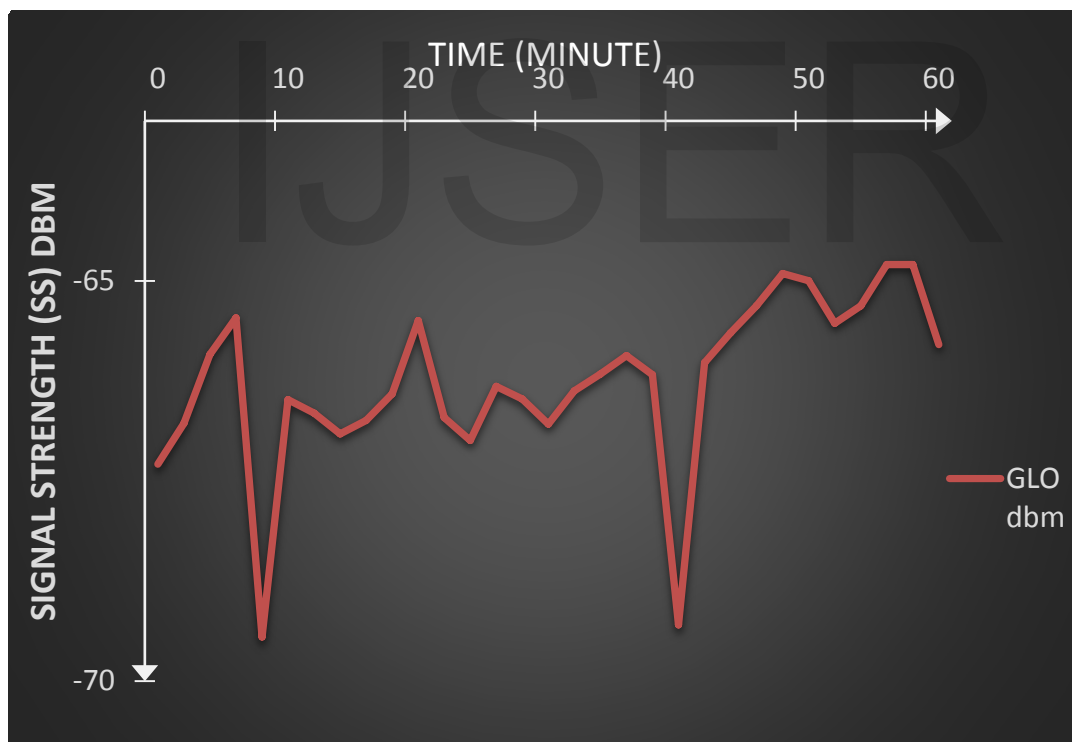


Fig. 18: Signal strength variation with time for MTN network for the month of August

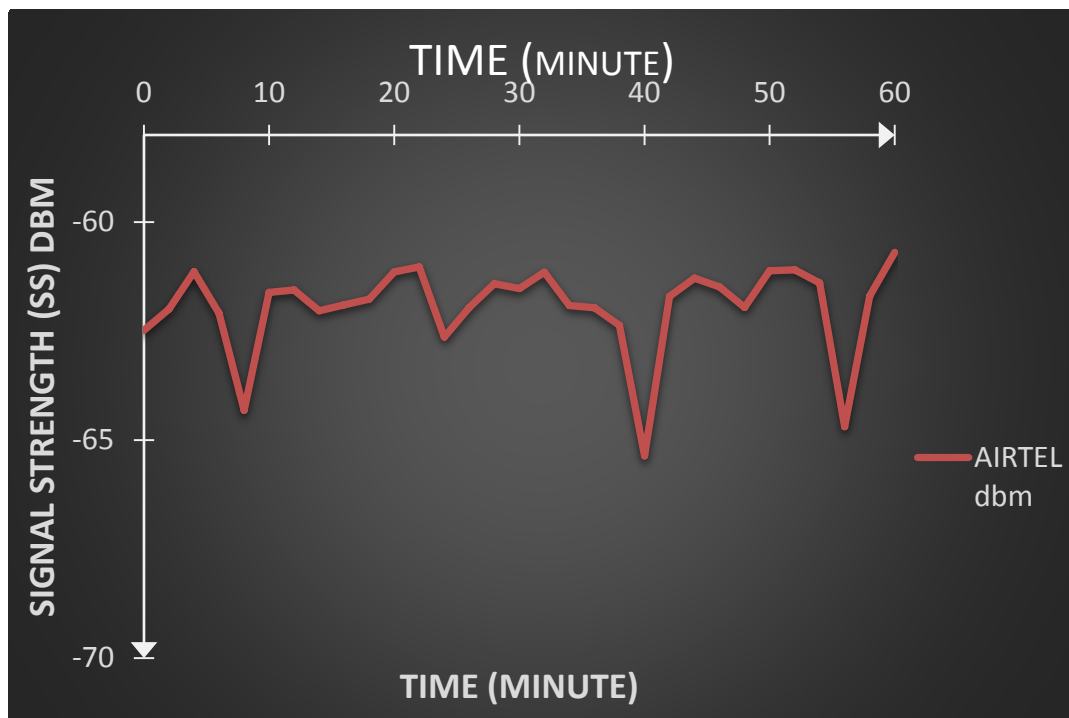


Fig. 19: Signal strength variation with time for Airtel network for the month of August.

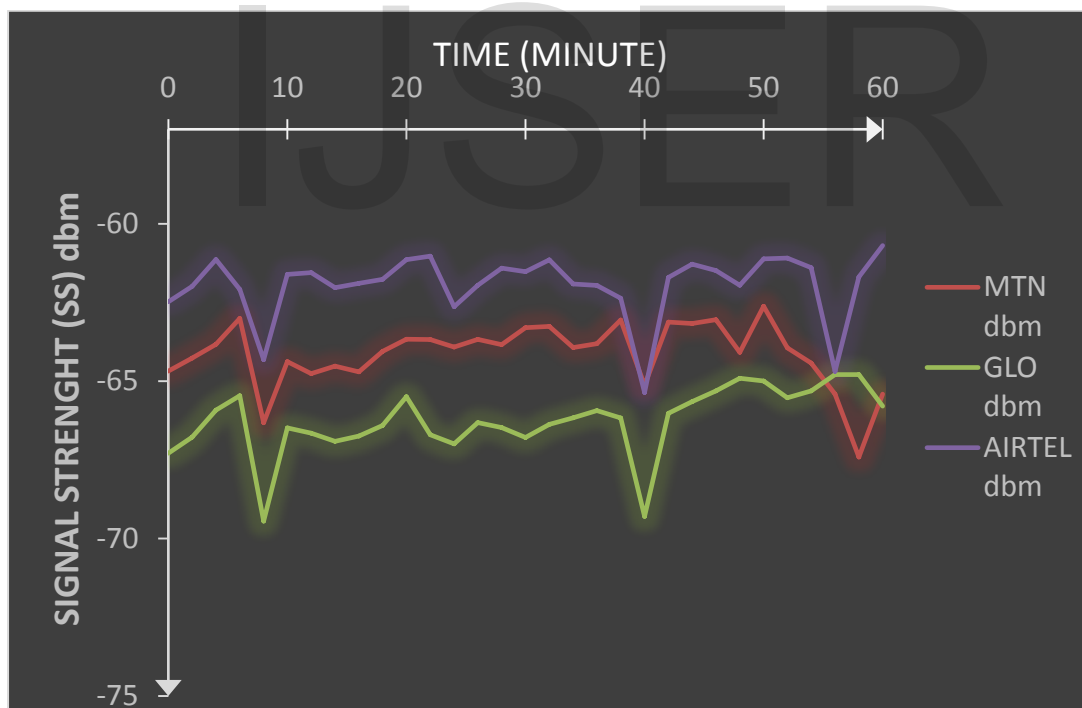


Fig. 20: Signal strength variation with the Time for all the different network for the month of August.

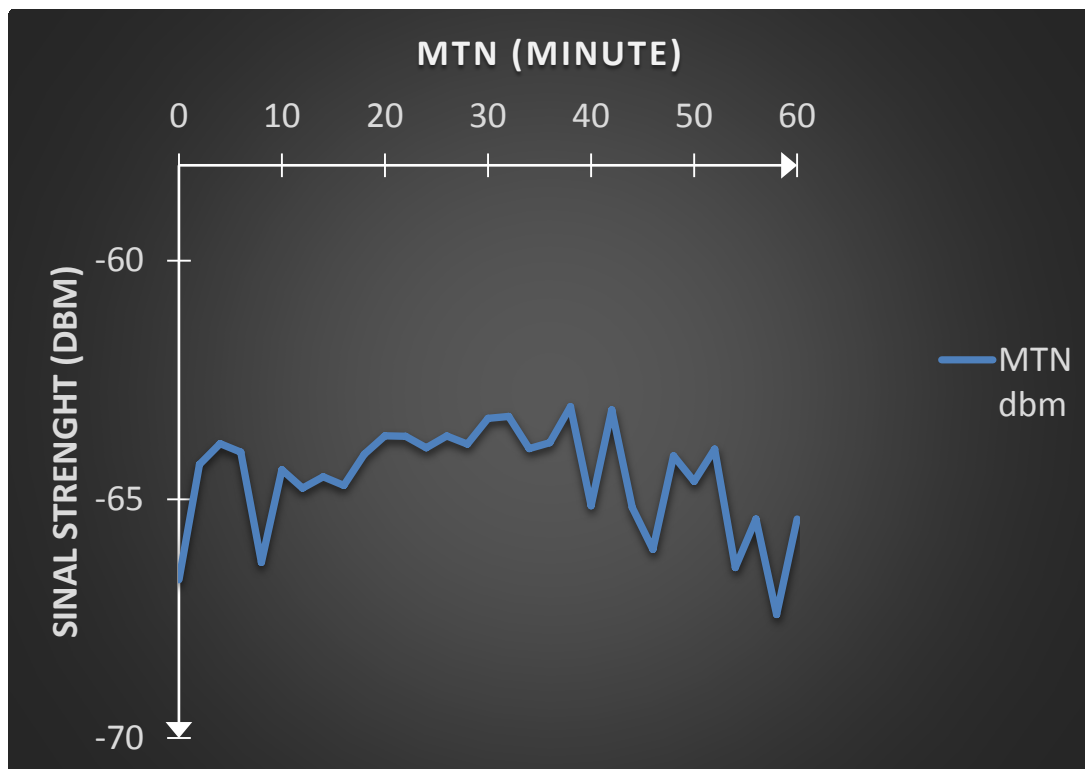


Fig. 21: Signal strength variation with time for MTN network for the month of Sept.

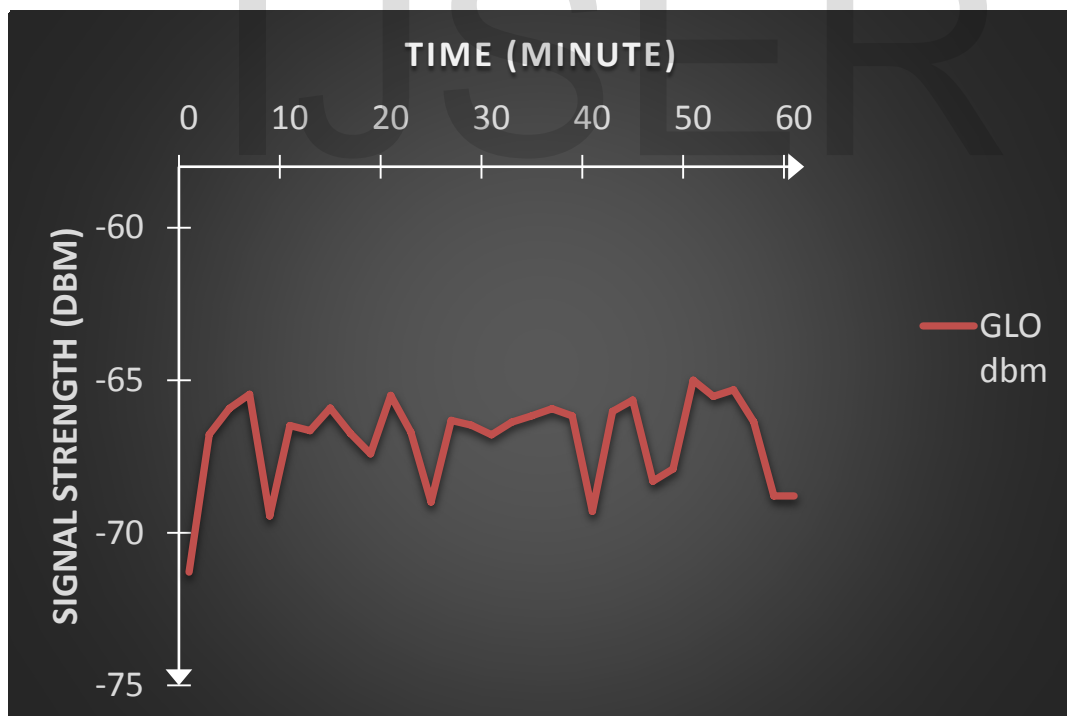


Fig. 22: Signal strength variation with time for GLO network for the month of Sept.

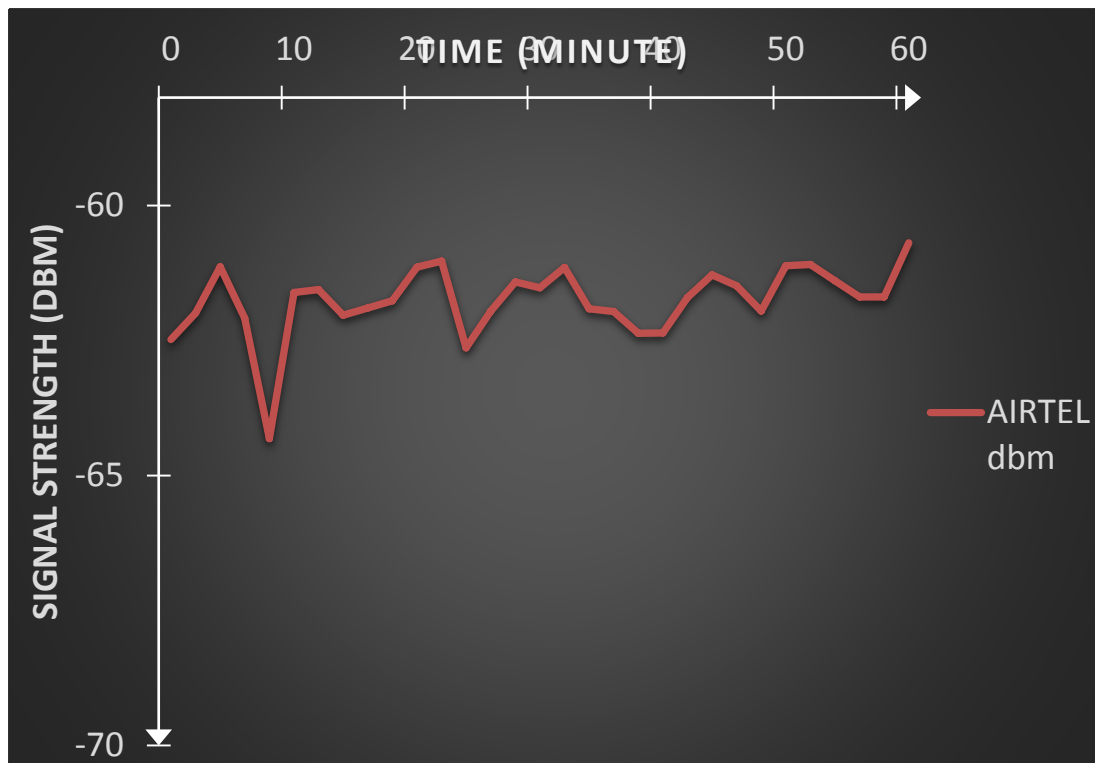


Fig. 23: Signal strength variation with time for AIRTEL network for the month of Sept.

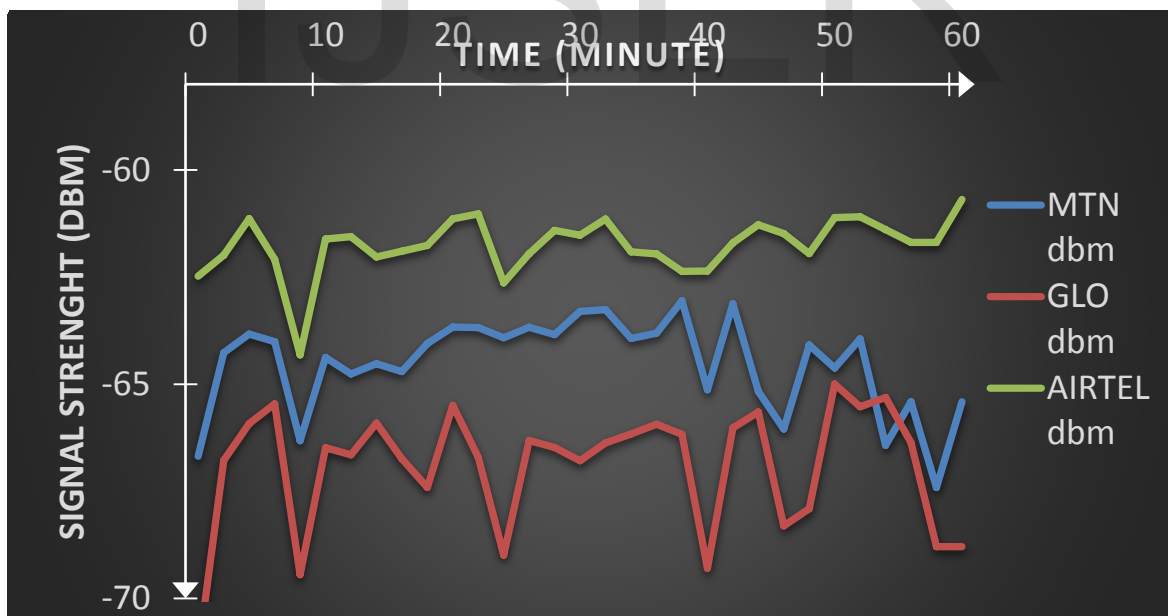


Fig. 24: Signal strength variation with the Time for all the different network for the month of Sept.

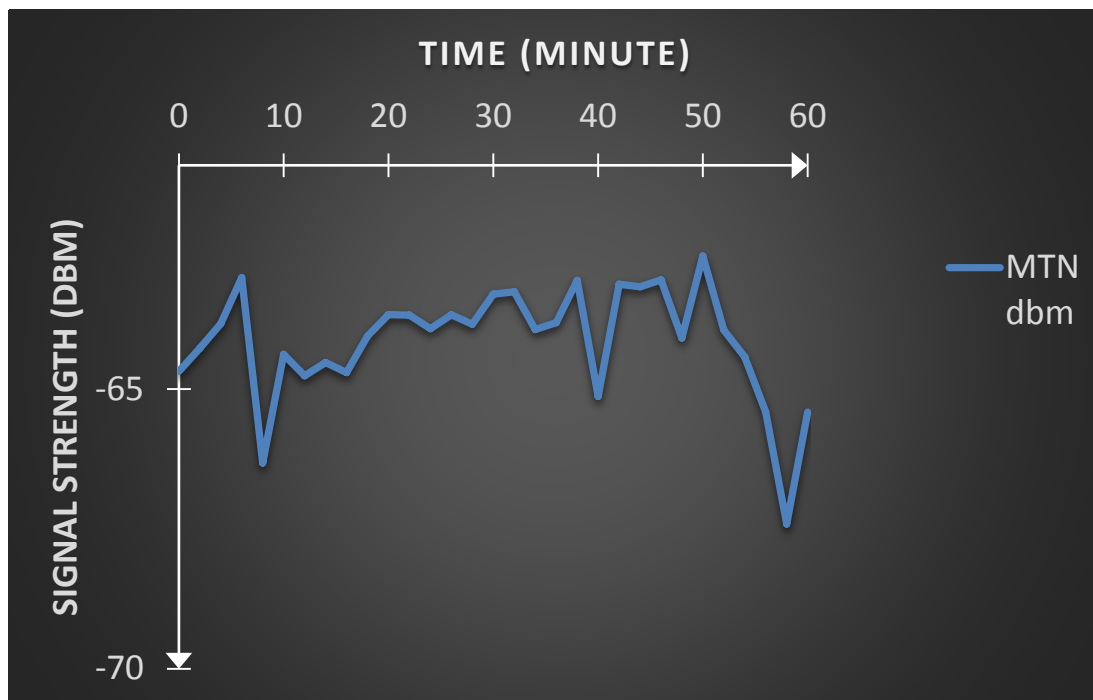


Fig. 25: Signal strength variation with time for MTN network for the month of Oct.

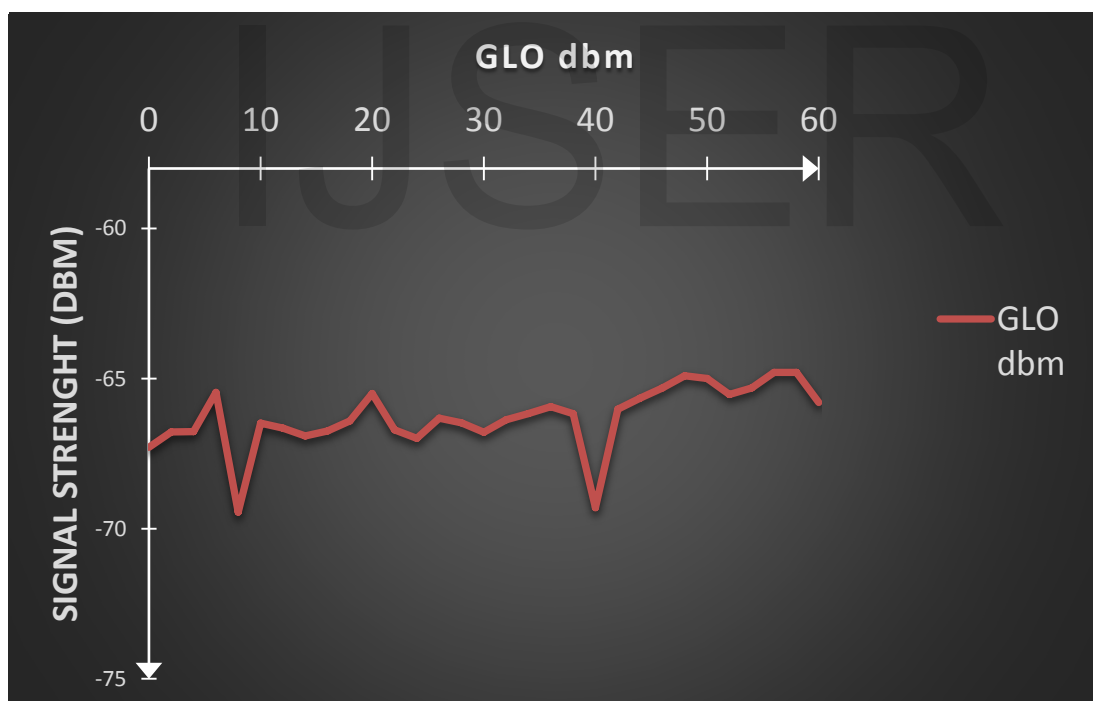


Fig. 26: Signal strength variation with time for GLO network for the month of Oct.

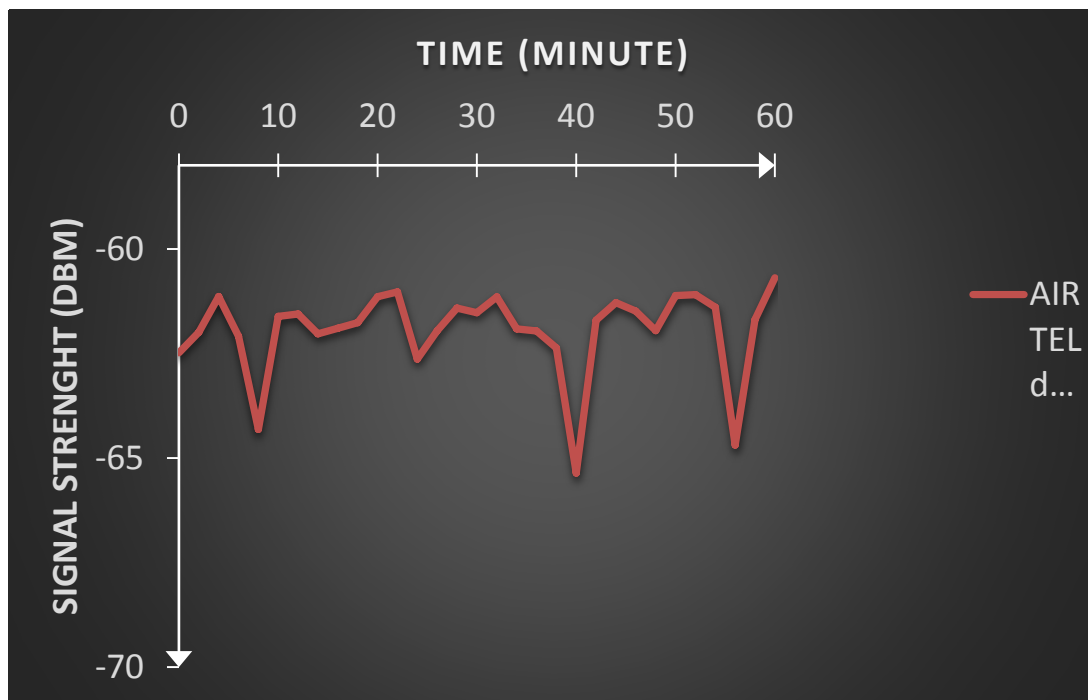


Fig. 27: Signal strength variation with time for AIRTEL network for the month of Oct.

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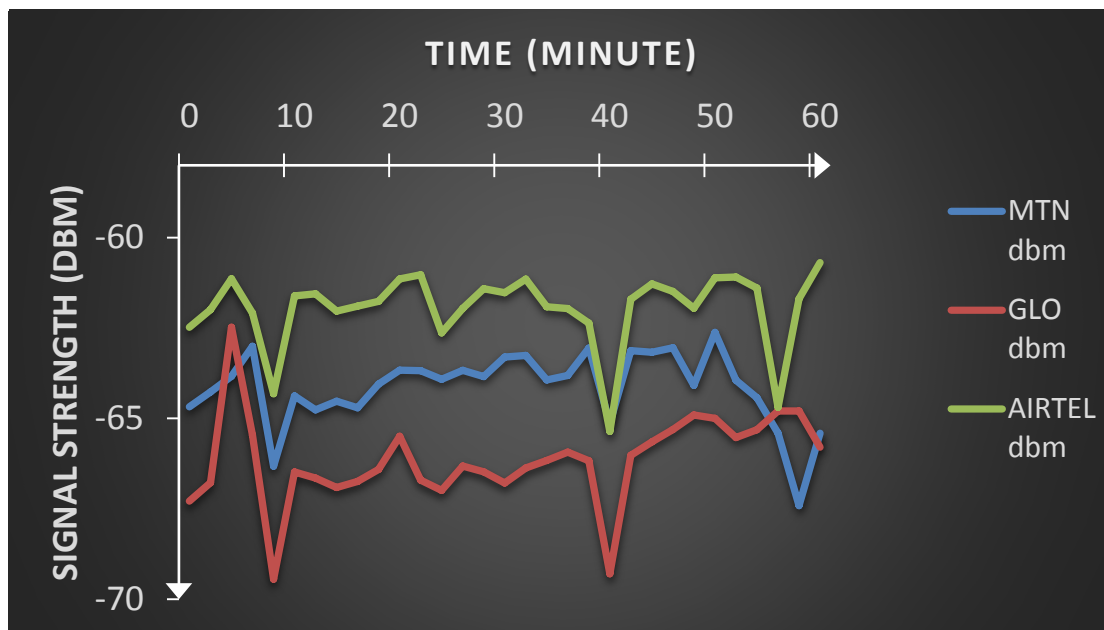


Fig. 28: Signal strength variation with the Time for all the different network for the month of Oct.

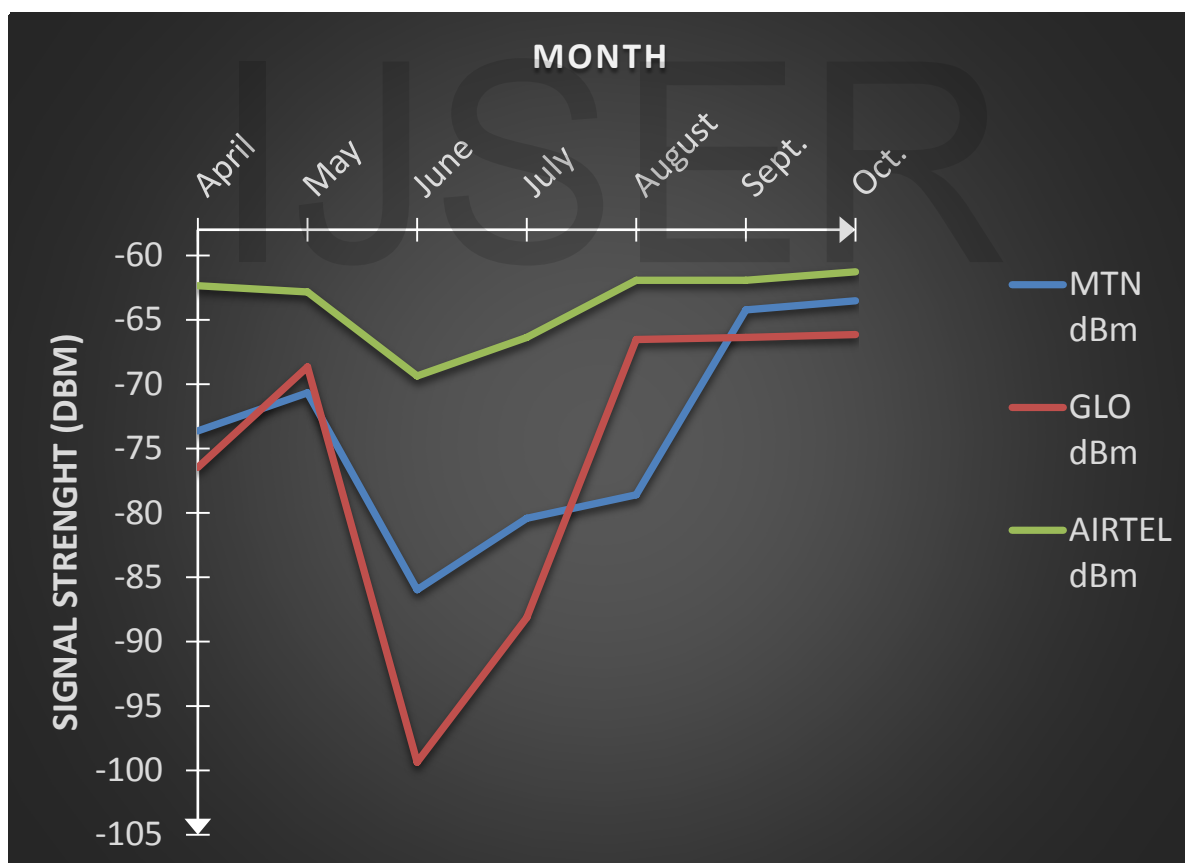


Fig. 29: Signal Strengths Variation for all the Period of Research.

## 6.DISCUSSION OF THE RESULTS

In the graph above, the trough of the line graph shows points where the signal strength is minimum and how the signal strength changes with time. Figure 1, 2 & 3 shows the graph for the variation of signal strength with time in the month of April. Figure 4, 5, & 6 for the month May, figure 7, 8 & 9 for June, figure 10, 11, & 12 for the month of July while figure 13, 14, & 15 are for the month of August.

Figure 8, 12, 16, 20, 24, 28 & 32 is a combine graph showing the variation of the SS of the selected networks with time for the seven months of research.

Furthermore, figure 33 is a graph of SS variation with time on the average of the monthly data collection during the period of research. The signal strength across the three networks varies in the same manner over time according to the figures above. The signal strength of all the networks despite the network technology used has no much effect or influence on the signal strength. Although quality of service being pick up by mobile phone depends on the technology used because newer Smartphone will have stronger antenna for the same type of signal and therefore have a better signal strength. This is because signal strength is influenced by distance from base transmitting station, obstacles and mobile phone technology not the network technology.

There is restriction in the way signal strength varies with time in the day and night. This is because received signal strength of mobile phones depends on the weather parameters such Air temperature, Rain, Wind direction, Fog and Cloud cover, Snow, Hail, Lighting, Trees, Water bodies and Physical obstructions. This shows that day time factors such as network congestion do not affect the signal strength rather they may affect data transmission with the network.

However, to achieve a better signal strength in area with poor signal strength, it is recommended that external antenna, signal booster and signal repeaters should be used. These equipment increases the signal strength tremendously

The Signal Strength of all the networks varies with time.

According to figure 33, the signal strength of MTN network varies between -72dBm to -68dBm and its quality of service (QS) is about -33.3%.

The signal strength for GLO network is maximum at -75dBm and minimum at -81dBm. The corresponding quality of service (QS) is about -34.3%.

Figure 33 also shows that the signal strength for AIRTEL network varies between -64dBm to -61dBm. And the corresponding quality of service is about -32.4%.

The figure also shows a consistency period where the individual networks have stable network and according the figure, Airtel network had always maintained stability and maximum quality of service, followed by the MTN network and then the GLO network. The correlation between the networks shows that the quality of service for Airtel is -32.4%, MTN is -33.3% and GLO is -34.3%.

**Table 1: Summary of the result found on the Average monthly data collection for each of the networks**

MONTH	MTN dBm	GLO dBm	AIRTEL dBm
April	-73.63	-76.47	-62.35
May	-70.67	-68.65	-62.84
June	-85.97	-99.37	-69.36
July	-80.42	-88.14	-66.37
August	-78.59	-66.53	-61.93
Sept.	-64.23	-66.37	-61.93
Oct.	-63.52	-66.14	-61.27

## 7. CONCLUSION

The data collected over these networks was done using the same device to ensure that there is no error due to nature of technology used. The data was collected for seven months on two-minute interval per day. All data collected was recorded and analyzed by taken the average data per day for the seven months. A series of graphs of signal strength in dBm was plotted against the time of the day in minutes for all the selected networks and a combined graph of signal strength against time for all networks was equally plotted to show how the individual networks varies time.

According to figure 33 which is a correlation graph for all the selected network for the five months of research, the signal strength of MTN network varies between -72dBm to -68dBm and its quality of service (QS) is about 60.3%.

The signal strength for GLO network is maximum at -75dBm and minimum at -81dBm. The corresponding quality of service (QS) is about 20.3%.

Figure 33 also shows that the signal strength for AIRTEL network varies between -69 dBm to -61dBm. And the corresponding quality of service is about 70.4%. This typically shows that for ESUT and its environ that Airtell has the best network followed by MTN. A closer look reveals that the signal strength for mobile phone varies with time.

In this study, it has been clearly proven from the data collected and analyzed that Airtel network has the best signal strength and quality of service when compared with other networks operating in Esut community Agbani Campus as shown in table 7. From table 7 it was shown clearly that Airtel has the best network, it falls within the range of -61.27 to -69.36 respectively unlike the other networks that keeps fluctuating especially during the raining season. In wireless communication, the quality of service is affected by weather parameters. However, receiving signal strength of mobile phone depends on the technology used and the transmitting power from the base station antenna.

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