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Effect of Precipitation on Call Quality (Signal Quality) of Global System for Mobile Communication (GSM) Network Services in Gombi, Adamawa State Nigeria

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Abstract: The desire in this research is justify the effect of precipitation on signal quality of GSM network services in Gombi town. Fifteen average calls were made during rainfall in 6 months May to October, 2008 and another 15 average calls were made under ideal condition in the months of January, February, March, April, November and December 2008 to check the signal quality of the GSM network services in Gombi town. The study revealed that approximately, average of 25% of the signal quality was affected by precipitation; this means that precipitation has significant effect on signal quality of GSM network services in Gombi, which may also be applicable to the other parts of the entire country.

Key words: Precipitation (rainfall), signal quality, network services, GSM atmosphere, propagation

INTRODUCTION

The fundamental aim of any GSM operator is to deliver sufficient signal quality from source to destination without losing any meaningful information (Seidel and Rappaport, 1994; CCIR, 1990). GSM signal is transmitted through a transmission medium called atmosphere; the signal is geographically disperse over wide area and it may not be hitch free from transmission impairment (Andersen *et al*., 2002; Frank, 2001) due to the fact that signal may be subjected to many outdoor activities, which consequently interfere s with the signal quality, however this may lead to poor signal quality that could affect the end user of the GSM phones.

There are some other factors that affects GSM signal quality these include free space loss, fresnel zone clearance, frequency, wave length, antenna gain, antenna beam width, reflection, refraction, diffraction and vegetation but this research put on more emphasis on precipitation loss (CCIR, 1991; Hall *et al*., 1996).

In this research precipitation affects the propagation of signal quality by approximately, 25% of its original signal quality this slow down the performance of the signal quality.

MATERIALS AND METHODS

The measurements (call) were conducted in Gombi town at any part of the town in the North Eastern part of Nigeria. The call made used of two NOKIA handsets; NOKIA 1200 type RH-99 and NOKIA 1650 type RM-305 each with SIM card of the three major operators in Gombi town viz ZAIN Network communication (Operator A), MTN Network communication (Operator B) and GLOBAL Network communication (Operator C). Average of 15 calls in a month were made to other GSM mobile users during rainfall for a period of 6 moths from May to October 2008 and also another average of 15 calls were made under normal situation in the remaining 6 months of the year. The data gathered for the assessment includes call hold successful under normal situation and call hold successful under the influence of precipitation.

Method of data analysis: Data were collected during dry and rainy season from January to December 2008. During the period of the investigation total calls of 180 were made altogether round the town with average calls of 90 calls in the rainy season and 90 calls in the dry season; this data were transformed using the expression of Eq. 1 and 2, the date were further analyzed using Bar charts to describe the call information graphically.

Let Q_{sc} denote the signal quality under normal situation, Q_{scp} denote the signal quality under the influence of precipitation, N_{sc} be the number of successful call hold in a month under normal situation, N_{scp} be the number of successful call hold under the influence of precipitation and N be the total number of calls in a month, the Eq. 1 and 2 are given by Emabgetere and Edeko (2007):

$$Q_{SC}(\%) = \frac{N_{SC}}{N} \quad (1)$$

$$Q_{SCP}(\%) = \frac{N_{SCP}}{N} \quad (2)$$

RESULTS AND DISCUSSION

Table 1 presents signal quality of all the GSM operators under normal situation and precipitation influence. Under normal situation the signal quality of Operator (A) was above 79% from the month of January to April 2008, in the month of May 2008 the signal quality decay by 14.13% at the beginning of rainy season, it continues to decay with significant percentage from the month of June 2008 through July, August, September 2008, in the month of August and September the signal quality decay drastically this is the time Gombi experience very heavy rainfall. The signal quality rose by 9.74% in the month of October 2008 when the rainy season was beginning to set out, during that time the intensity of the rainfall was reduced.

For Operator (B) the signal quality under nornal condition was above 70% from the month of January to April 2008, the signal quality then decay by 13.33% less that of Operator (A) by 0.8%, from then the signal quality continuous to decay by an average of 25% to the month of October 2008. From the month of November 2008 the signal quality rose by 5.33% when the rainfall was set out.

For Operator (C) the signal quality under normal condition was above 65% from January to April 2008; in the month of May 2008 the signal quality decay by 10.21% less that of Operator (A) by 3.93% and that of Operator (B) by 3.12% although the signal quality of Operator (C) was the least. The signal quality also decay in the month June, July, August, September, October 2008 when the rainfall was at it peak and regenerates again in the month of November 2008 when the rainfall had set out.

In general, in the month of May, June, August, September and October 2008 the signal quality was reduced approximately by an average of 25% of its original quality depending the varying densities of the rainfall.

Table 1 also presents an average signal quality of all the GSM operators in a year, Operator (A) seems to have best signal quality better than that of Operator (B) with 4.26% and that of operator (C) with 10.4% whereas signal quality of Operator (B) is also better that of Operator (C) with 6.19%. Operator (C) has the least signal quality under all conditions.

Table 1: Present signal quality of all calls under normal condition and influence of precipitation

Months (2008)	Operator A (%)	Operator B (%)	Operator C (%)
January	100.00	93.33	80.00
February	86.67	80.00	86.67
March	86.67	80.00	73.33
April	80.00	73.33	66.67
May	65.87	60.00	56.46
June	65.00	59.20	49.34
July	59.20	55.73	53.46
August	52.67	48.00	40.00
September	54.26	55.00	45.60
October	64.00	60.00	53.33
November	66.67	65.33	60.00
December	73.33	73.73	64.14
Overall	71.20	66.94	60.75

Operator (A) is the ZAIN Network communication; Operator (B) is the MTN Network communication; Operator (C) is the GLOBAL Network communication

CONCLUSION

The aim of this study is to find out whether precipitation has influence over call quality of GSM network services in Gombi town. This study justify that precipitation has a considerable effects on call quality of GSM network services and also shows that precipitation reduced GSM call quality by approximately 25% of its original quality. I hope this study has touch the technical content of GSM service which needs to be addressed to meet up with the customers requirement in Gombi town.

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