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AN INVESTIGATION ON THE EFFECT OF RAIN ON RECEIVED SIGNAL STRENGTH OF MOBILE BROADBAND

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ABSTRACT
This paper investigates the effect of rain on received signal strength of mobile broadband communications in Mubi, Adamawa State. In carrying out this investigation, received signal strength measurements and rainfall data were collected concurrently for a period of seven months during the wet (rainy) season from April 2013 to October 2013. The result indicates that rainfall did not impose any meaningful additional attenuation on the signal strength received during the period.
Keywords: *mobile, broadband, signal strength, communication, attenuation*

INTRODUCTION
Climatic factors such as rain, snow, fog and other forms of precipitation can have a significant impact on the transmission of radio frequency signals through the atmosphere. Communication systems may experience loss of signal caused by the effects of rain on a radio link. Radar systems may experience interference that distorts the amplitude of the target signal. Any remote sensing system that relies on the propagation of electromagnetic waves must therefore be designed to take these factors into account (Choi, Pyun, Noh, and Lee, 2012). The most severe impact is caused by rain. The effect of rain on radio signals becomes significant at very high frequencies. It causes severe attenuation for both terrestrial and earth-satellite systems which in turn degrades overall system performance (Mostafa, Hassan, Mandeep, Ain and Khedher, 2007).
Mobile broadband is a third-generation (3G) cell phone technology that refers to high-speed wireless Internet access delivered through cell phone towers to computers, mobile phones and other digital devices via a portable modem. It utilizes wireless radio technologies designed to broadcast radio frequency signals through the atmosphere which may not be free of climatic factors.
It has been established that the received signal by a mobile station is prone to various degrees of attenuation due to path loss and fading, notable amongst which are Rayleigh, Rice and Nakagami fading (Chia, 1996, Lee, 1998 & Richard, 2008). The attenuation is caused mainly by the environment (topography, buildings, trees and other objects) around the signal propagation path. This study focuses on the effect of climatic factors on radio frequency propagation.
In a study, on the effect of rainfall on very high frequency (VHF) radio wave propagation in a forested zone, Meng, Lee and Ng (2009) observed that the time of arrival of the direct wave traveling through the wet canopy layer can be delayed significantly. In another study, Meng, Lee and Ng (2009) investigated the dynamic property of a tropical forested channel due to weather on VHF and UHF radio wave propagation and found that wind and rain can impose an additional attenuation on the signal strength within the forest environment. The additional attenuation increases as the strength of the wind and rain increases.
Shallangwa, Abdulrazak and Jerome (2009) examined the effect of atmospheric parameters (harmattan and rainfall) on GSM call quality in Gombi, Adamawa State and found that call quality dropped by approximately 25%.
In this study, an investigation is carried out to monitor the event of received signal strength in mobile broadband, which operates on ultra high frequency (UHF) radio wave propagation under various degrees of rainfall within a year in Mubi, Adamawa State.
Mubi region has tropical wet and dry type of climate (rainy and dry season). Rainfall in Mubi town like any other part of Nigeria is controlled by the mass movement of the Inter Tropical Discontinuity (ITD); this divides the zone between the cool and dusty air mass (harmattan) and the warm and wet air mass (rain). The movement of the ITD determines the onset and cessation of rains and the weather conditions at

a particular time of the year (Adebayo, 2004). March and April are the months of transition from dry to wet season in Mubi while the months of May to October constitute the wet (rain) season.

METHOD AND PROCEDURE

Received signal strength measurements were collected using an iPhone set to field test mode in order to acquire the numerical value of received signal strength of the mobile network. This mode is available on any iPhone running iOS 4.1 and all later versions. According to Agajo, Joseph, Ezewele, and Theophilus (2011) the received signal strength indicator remains the only reliable tool for estimating signal strength in any mobile device.

The measurements were made for a period of 7 months from 10/4/2013 to 16/10/2013 during the rainy season. Rainfall data was gathered concurrently. The duration of the rainfall each time was also recorded. All signal strength measurements were made at a height of 0.9m in an open strategic position for the whole period.

The 3G mobile broadband service provider in Mubi Township is Airtel Nigeria Ltd. It has deployed four (4) base transceiver stations (BTS) located at Maiha Road, Sabon Layi, Barama and Fire Service. All the BTS have 3G antennas sectored at 120^0 for optimal coverage.

RESULTS AND DISCUSSION

The average received signal strength over time and the average rainfall over time are presented on Table 1. The generated chart contains information about the averaged signal strength for each month and the average rainfall for each month during the period under investigation. This is presented on Fig.1.

Within the period, it was observed that throughout the received signal strength was fairly stable and very good. The figure varied just slightly from the average which is –74 dBm. The slight observations made were in the months of August and September which is marked by very heavy continuous rainfall in Mubi though the signal strength is still very good for communication.

Table 1: Average signal strength received under the influence of rainfall

Month	Average Signal Strength Received (dBm)	Average rainfall (mm)
April	– 69	27
May	– 70	88
June	– 68	106
July	– 74	223
August	– 86	254
September	– 84	232
October	– 72	113

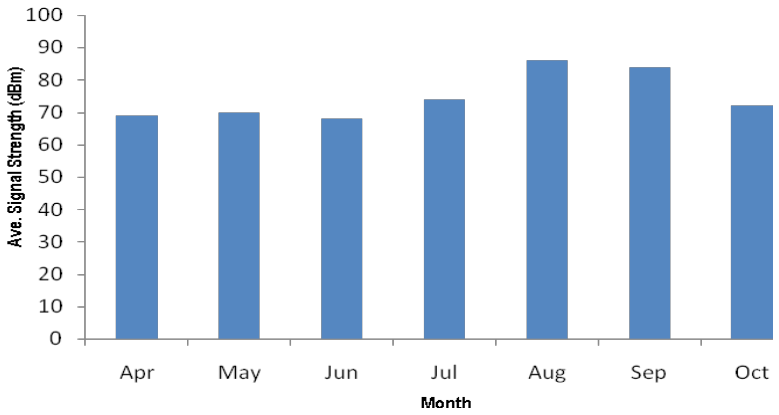

Fig.1: Bar chart of average signal strength received during the period

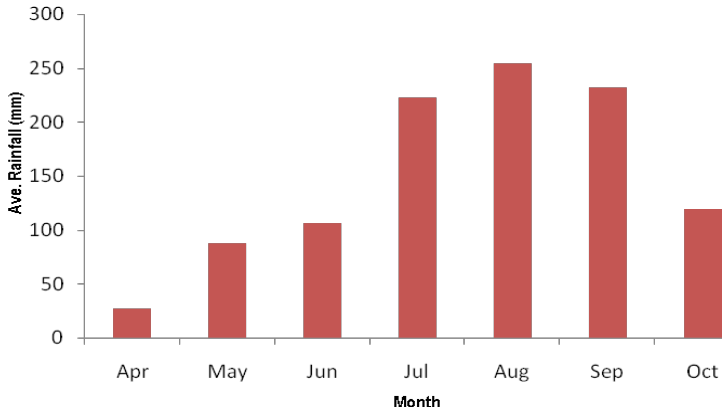

Fig.2: Bar chart of average rainfall during the period

CONCLUSION

The effect of rain on received signal strength of mobile broadband has been investigated in the paper. The experimental results indicate that rainfall did not impose any meaningful additional attenuation on the signal strength received during the period. The slight variation observed in the months of August and September might have been due to the effect of wind tilting the antenna or disturbing power supply at the base station.

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