ANALYSIS OF PATH LINK ATTENUATION BETWEEN AN AIRBORNE PLATFORM AND SPACE SATELLITES IN SELECTED LOCATIONS IN NIGERIA

BY

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SEPTEMBER, 2021

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B.Sc, Physics Electronics, Federal University of Technology, Minna.

An M.Sc DISSERTATION SUBMITTED TO THE DEPARTMENT OF PHYSICS, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (M.Sc) IN INDUSTRIAL PHYSICS (ATMOSPHERIC AND COMMUNICATION PHYSICS), COLLEGE OF SCIENCE AND TECHNOLOGY, COVENANT UNIVERSITY,OTA.

SEPTEMBER, 2021

ACCEPTANCE

This is to attest that this research work is accepted in partial fulfilment of the requirements for the award of the degree of Master of Science (M.Sc) in Industrial Physics (Atmospheric and Communication Physics) in the Department of Physics, College of Science and Technology, Covenant University, Ota, Nigeria.

Mr. John A. Philip ……

(Secretary, School of Postgraduate Studies) **Signature and Date**

Prof. Akan B. Williams ……

(Dean, School of Postgraduate Studies) **Signature and Date**

DECLARATION

I, ADEYEMI, OLUWASEUN JOSHUA (MATRIC NO: 17PCE01703) declare that this research was carried out by me under the supervision of Prof. Temidayo V. Omotosho of the Department of Physics, College of Science and Technology, Covenant University, Ota, Nigeria. I attest that the Dissertation has not been presented either wholly or partially for the award of any degree elsewhere. All sources of data and scholarly information used in this dissertation are duly acknowledged.

ADEYEMI OLUWASEUN JOSHUA ……

Signature and Date

CERTIFICATION

We certify that this Dissertation titled "**Analysis of Path Link Attenuation between an Airborne Platform and Space Satellites in Selected Locations in Nigeria**." is an original work carried out by **ADEYEMI, OLUWASEUN JOSHUA (MATRIC NO: 17PCE01703)** in the Department of Physics, College of Science and Technology, Covenant University, Ota, Nigeria under the supervision of Prof. Temidayo V. Omotosho We have examined and found this work acceptable as part of the requirements for the award of the degree of Master of Science (M.Sc) in Industrial Physics (Atmospheric and Communication Physics).

Prof. Temidayo V. Omotosho ….……

(Project Supervisor) **Signature and Date**

Prof. Mojisola R. Usikalu …….……

(Head of Department) **Signature and Date**

Prof. Elijah O. Oyeyemi ……..

(External Supervisor) **Signature and Date**

Prof. Akan B. Williams ……..

(Dean, School of Postgraduate Studies) **Signature and Date**

DEDICATION

This research is dedicated to GOD, I am grateful to Him for helping me through it all. God himself has been good to me.

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ABSTRACT

Aeronautical applications have become very important in supporting communications for in-flight entertainment and in-flight connectivity services. As the local aircraft is moving from one location to the other at higher altitudes from 6 to 8 km above the sea level, the link between airborne platform and satellite undergoes signal degradation which affects internet connection for the passenger. However, cloud and gases are major tropospheric effects that cause attenuation above rain height of 5 km for radio wave propagation most importantly microwave signals for an airborne platform to space communication in the Ku and above. Therefore, the analysis and prediction of the airborne-satellite path links of gas and cloud attenuation is essential, hence the importance of this research. An historical radiosonde data obtained from National Oceanic and Atmospheric Administration (NOAA) covering three locations in Nigeria; Abuja (2006-2008, 2016), Ikeja (1953-1973), and Kano (1972-1992) at elevation angles of 48.5˚, 44.5˚ and 48.8˚ respectively were used for this research. The results showed that the effect of gases on attenuation is a major contributor to the total attenuation on an airborne platform to satellite link. Generally, the results over the three locations revealed that at Ku and Ka band, the effect of water vapour (wet air) is more significant than oxygen. However, higher attenuation values were recorded in the V-band frequencies because at these frequencies the effect of water vapour density is very small compare to that of oxygen. The total attenuation at V-band shows both uplink and downlink frequencies following the same pattern; at Abuja station in 2007 the total attenuation is about 2.6053 dB at 50 GHz and 0.7487 dB at 40 GHz while at Ikeja station in 1961 the total attenuation is about 3.7882 dB at 50 GHz and 1.0575 dB at 40 GHz and finally at Kano station in 1990 the total attenuation is about 5.7119 dB at 50 GHz and 1.4881 dB at 40 GHz. Hence, the results can be useful for the Nigeria meteorological Agency (NIMET) and the Nigeria Civil Aviation Authority (NCAA) in planning for a more efficient airborne–space communication for aviation safety, in-flight connectivity (IFC) and in-flight entertainment (IFE).

Keywords: Attenuation, Airborne platform, Radio wave propagation, Space, Satellite