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The Effect of Weather and Fading rate in Television Transmission and Reception

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Abstract: The effect of weather and fading rate in television transmission and reception was invested and analysed. From the data obtained and the graph plotted, it was noticed that fading in television occur more at the pick of heavy dry and heavy rainy seasons. Nigerian television stations in Nigeria should go into digitalization and mini- dishes, built-in heater dishes and yearly maintenance of the dishes can go a long way in reducing fading in television.

Key word: Fade rate · Television · Weather · Transmission · Reception · Signal

INTRODUCTION

Fading is referred as the distortion that a carrier modulated telecommunication signal experiences over certain propagation media. In wireless communication, fading is referred to variation or the attenuation of a signal with time, geographical position and radio frequency [1-3]. Fading may either be due to multipath propagation, otherwise known as multipath induced fading, weather (particularly rain) or shadows from obstacle affecting the wave propagation. Fading can cause poor performance in a communication system because it can result in a loss of signal power without reducing the power of the noise [1-5].

The adverse weather has been observed to affect the quality of satellite TV signal reception. In extreme cases, reception of TV transmission can be effectively disrupted. To many users of television, they believe that heavy rain can attenuate signal enough to result in reasonable degradation of image quality. However, signal attenuation is caused mainly by wave absorption by the rain drops. Also, there is some signal scattering due to refraction and diffraction of electromagnetic wave in and around rain drops in television transmission [2-4]. Weather variation occurs because of differences in temperature, which causes density changes in air and water [6-8].

Moreover, very heavy snow can also result to bad signal quality during transmission and reception of television. The quality of reception of television can also be affected by water or snow or ice that accumulates over the surface of dish receptor. This can cause scatter and less efficient focusing of the satellite signal after its reflection from the dish surface, which results to poor reception. Rain along the transmission path is the major weather effect on satellite communication. Rain attenuation is the weakening of signals as it passes through rain drops. Rain drops absorbs and scatter radio wave energy which degrades the reliability and performance of communication links [1, 2, 3, 4].

Fading can be slow or fast depending on the coherence time. Coherence time is a measure of the minimum time required for the magnitude change or phase change of the channel to become uncorrelated from its previous value. Slowing fading takes place when the coherence time of the channel is large relative to the delay requirement of the application. in this case, the amplitude and phase change by the channel can be considered roughly constant over a period of time. Slow fading can be caused by shadowing; resulting to obstruction like hills or large building blocks the main path between the transmitter and the receiver. The fast fading results when the coherence time of the channel is small relative to the delayed requirement of the application. And in such situation, the amplitude and phase change imposed by the channel varies considerably over a period of usage. However, the coherence time of the channel is related to the Doppler spread of the channel. In this case, when a user or reflector in its environment is moving, the user's velocity causes a shift in the frequency of the signal transmitted along each signal path, resulting to a phenomenon known as Doppler shift [1, 2, 4, 6, 7].

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Mathematically, coherence time is inversely related to Doppler spread as

$$T_c = \frac{1}{D_s}$$

where T_c is the coherence time, D_s is the Doppler spread.

Weather related interference occurs mostly in the summer months when periods of high pressure can cause radio waves from distant transmitter to travel further than normal which can result in interference. During the period of very hot weather, TV reception has been interrupted by season ducting, in which case the signal from transmitter travel much farther than the normal, causing interference to another service [1-4, 7-9].

Hence, this research paper is on the investigation of the weather effect and fading rate in television transmission and reception.

Collection of Data: The collections of data for this research were done at Nigerian Television authority, NTA Abakaliki, Ebonyi State, Nigeria for two prominent seasons in Nigeria, which were dry season and rainy seasons. The period under study was between October, 2015 and November, 2016.

RESULTS AND DISCUSSION

Table 1 and Table 2 shows fading rate for moderate and heavy dry season and Table 3 and Table 4 shows the fading rate for the moderate and heavy rainy seasons in Nigeria. Figure 1 and Figure 2 shows the graph of the fading rate for dry seasons and rainy seasons. From the table and the graph, it was observed that fading rate in television is more prominent during heavy dry seasons (summer) and heavy rainy seasons (winter) in Nigeria than moderate seasons. Also from Figure 1, it showed that

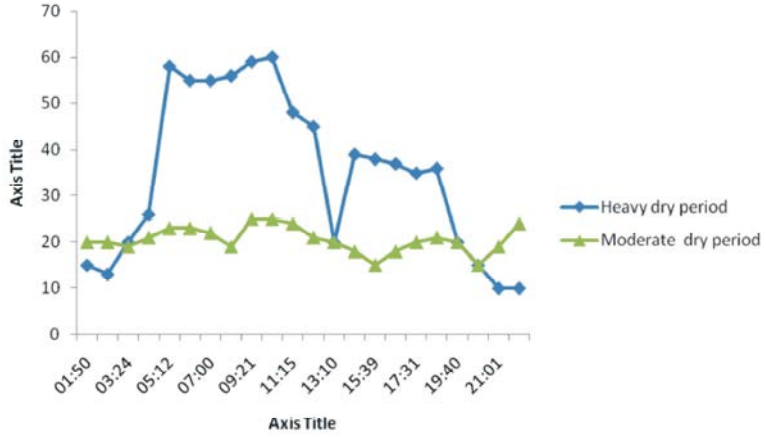

Fig. 1: Graph of fade rate in television for moderate and heavy rainy period in Nigeria

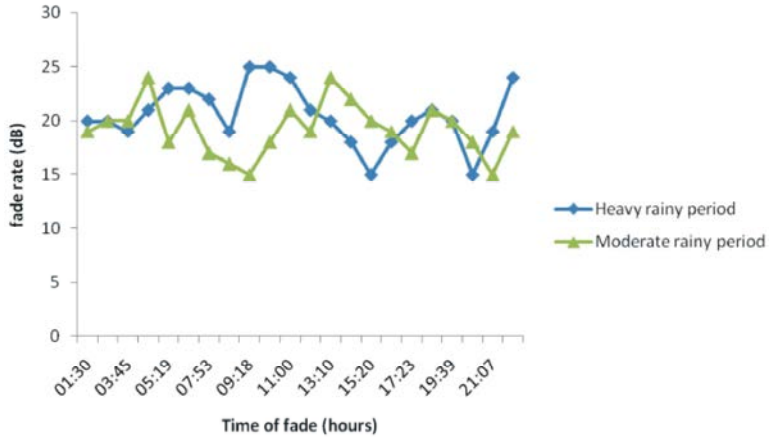

Fig. 2: Graph of fade rate in television for moderate and heavy dry period in Nigeria

Table 1: Fade rate in television for heavy dry season in Nigeria

s/n	Fade rate (dB)	month	Time (hrs)
1	15	December	01:50
2	13	December	02:15
3	20	December	03:24
4	26	December	04:10
5	58	January	05:12
6	55	January	06:17
7	55	January	07:00
8	56	January	08:47
9	59	January	09:21
10	60	February	10:11
11	48	February	11:15
12	45	February	12:19
13	20	February	13:10
14	39	March	14:42
15	38	March	15:39
16	37	March	16:58
17	35	March	17:31
18	36	March	18:00
19	20	March	19:40
20	15	March	20:22
21	10	March	21:01
22	10	March	22:14

Table 2: Fade rate in television for moderate dry season

s/n	Fade rate (dB)	month	Time (hrs)
1	20	April	01:08
2	20	April	02:11
3	19	April	03:15
4	21	April	04:07
5	23	April	05:28
6	23	April	06:23
7	22	April	07:30
8	19	April	08:41
9	25	April	09:18
10	25	April	10:12
11	24	April	11:29
12	21	April	12:20
13	20	April	13:25
14	18	April	14:19
15	15	April	15:52
16	18	May	16:00
17	20	May	17:01
18	21	May	18:32
19	20	May	19:27
20	15	May	20:01
21	19	May	21:49
22	24	May	22:56

Table 3: Fade rate for heavy rainy period in Television signal transmission

s/n	Fade rate (dB)	month	Time (hrs)
1	20	June	01:30
2	20	June	02:02
3	19	June	03:45
4	21	June	04:21
5	23	July	05:19
6	23	July	06:28
7	22	July	07:53
8	19	July	08:49
9	25	July	09:18
10	25	July	10:15
11	24	August	11:00
12	21	August	12:27
13	20	September	13:10
14	18	September	14:42
15	15	September	15:20
16	18	September	16:12
17	20	September	17:23
18	21	September	18:17
19	20	September	19:39
20	15	September	20:16
21	19	September	21:07
22	24	September	22:07

Table 4: Fade rate for moderate rainy period in Television signal transmission

s/n	Fade rate (dB)	month	Time (hrs)
1	19	October	01:13
2	20	October	02:41
3	20	October	03:38
4	24	October	04:18
5	18	October	05:15
6	21	October	06:29
7	17	October	07:40
8	16	October	08:17
9	15	October	09:00
10	18	November	10:31
11	21	November	11:02
12	19	November	12:19
13	24	November	13:25
14	22	November	14:42
15	20	November	15:34
16	19	November	16:17
17	17	November	17:01
18	21	November	18:57
19	20	November	19:00
20	18	November	20:44
21	15	November	21:51
22	19	November	22:02

fading rate in television is more prominent in heavy dry period of the season than the heavy period of the rainy period of the same season. The receptions of television pictures were greatly affected and even sometimes, images were not clearly viewed. Heavy rains and cloudy conditions can affect the television signals resulting to noticeable degradation of image quality. Hence, TV reception is badly affected during heavy dry seasons where the air is very hot, with very high harmattan which results to dusty and cloudy environment and during heavy rain.

In Nigeria, fading rate is always the other of the day. Most of the television stations were not digitalized; most of the equipments were obsolete and cannot withstand harsh weather conditions. Heavy rain and heavy dry season is always at the extreme as compared to some other part of Africa. Hence, government and private owners of various television transmissions stations should adhere to the deadline given for the television and radio stations in the world to change to digital transmission. Moreover, not all satellite signals were affected equally. The longer radio wave, the less affected by the rain fade. Therefore, transmission through the longer C-band wavelength is significantly less susceptible than the one transmitted with shorter Ku-band (i.e. used in DSTV) or Ka-band. Also most often, maintenance of the dish by qualified maintenance personnel will reduce the accumulation of water, ice/snow or dust on it thereby reducing fading. Finally, in temperate regions of the world (i.e. very cold region), a special dish with built-in heater is used prevent accumulation of water, ice and snow. Satellite mini-dishes are recommended to be used to minimize the effect of adverse weather effect which results to rain fading.

CONCLUSION

Weather effect and rain fading in television transmission and reception were invested. From the data and graph plotted, it was observed that adverse and harsh weather conditions result to fading in television. The more the weather is adverse, the more the fading. The fading is more prominent at the pick of dry season and raining seasons in Nigeria.

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