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# THE COMPARATIVE ANALYSIS OF WEIBULL AND RAYLEIGH DISTRIBUTIONS UNDER STOCHASTIC APPROACH IN 4G AND 3G CELLULAR NETWORK

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The aim of this paper is to investigate and compare the stochastic parameters of the received signal in a cellular network between UMTS (3G) and LTE(4G). Drive test measurements are conducted on a street having the high rise building on both sides wherein the line of sight from the cell tower to mobile devices is not clear. Therefore, the street (120 meters long) between block-7 and block-8 (Lat: 8.3162452/8.3162767; Long: 35.559375/35.5597058) in the Mattu University (Ethiopia) has been chosen for this. Insinix hot.9 smartphones with an "Android 7+" operating system and "cell info" software were used during the observations and measurements in Ethio-telecom coverage. Collected received signal strength is used to plot the Weibull [1] and Rayleigh [2] distribution with help of Easy Fit software. Consequently, the statistical data of the random variable (received signal strength) in a stochastic behaviour like mean, variance standard deviation, coefficient of variation, and skewness will be calculated and compared.

Received signal strength indicator (RSSI) [3] in dBm reveals that the average value of RSSI in 4G and 3G are approximately around -100 dBm and -85 dBm respectively. However, the table-1 shows the actual RSSI as measured repeatedly at the place of observation.

**Table-1.** RSSI value measured at fading location

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **RSSI/4G (dBm)** | -99 | -100 | -98 | -100 | -97 | -99 | -103 | -104 |
| **RSSI/3G (dBm)** | -93 | -89 | -86 | -85 | -90 | -87 | -85 | -85 |

Statistical calculations for 4G and 3G networks are shown in table-2 and table-3.

**Table-2**. Statistical calculation for 4G

| PDF | Variance | Standard deviation | Coefficient of variance | Skewness |
|---|---|---|---|---|
| Weibull | 75.97 | 8.71 | -0.093 | 1.129 |
| Rayleigh | 61.32 | 7.83 | -0.084 | 0.631 |

**Table-3.** Statistical calculation for 3G

| PDF | Variance | Standard deviation | Coefficient of variance | Skewness |
|---|---|---|---|---|
| Weibull | 86.13 | 9.27 | -0.116 | -0.05 |
| Rayleigh | 116.69 | 10.8 | -0.134 | 0.63 |

As per the available random variable, the Probability Density Function (PDF) plot for Weibull and Rayleigh distribution in the 4G network are shown in figure 1 and figure 2 respectively. Similarly, figure 3 and figure 4 reflect the PDF plot for Weibull and the Rayleigh distribution in the 3G network.

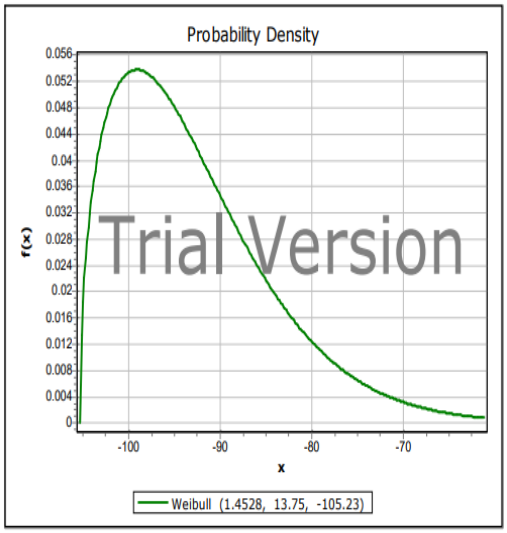


**Figure 1.** Weibull Distribution (4G)

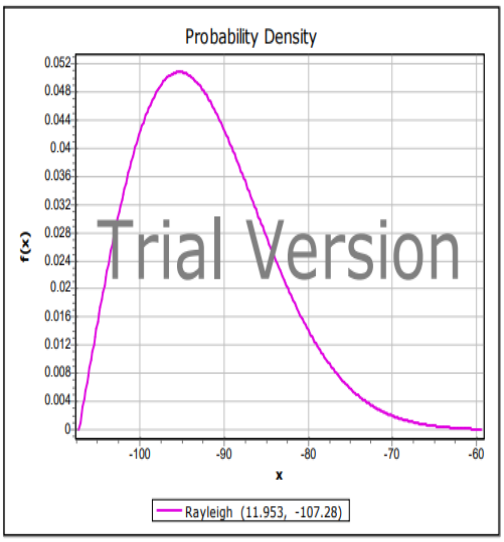


**Figure 2.** Rayleigh Distribution (4G)

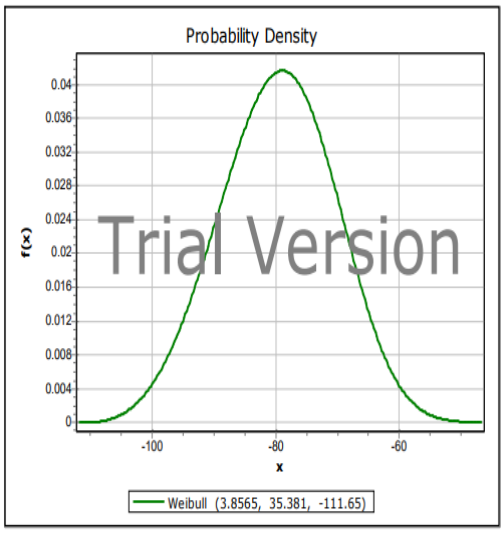


**Figure 3.** Weibull Distribution (3G)

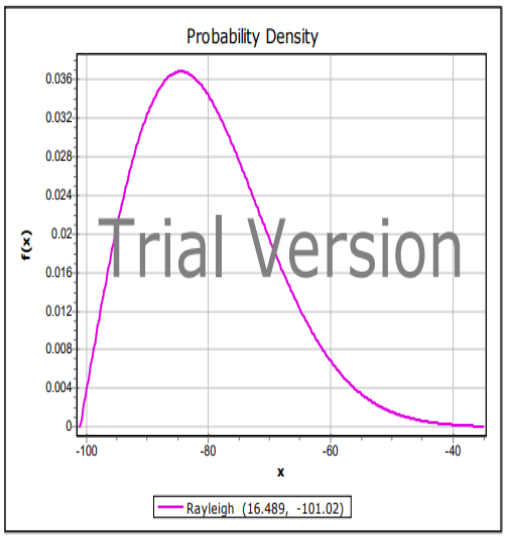


**Figure 4.** Rayleigh Distribution (3G)

By refereeing the CDF plots and table-2 for 4G, it can be concluded that the Rayleigh approximation is a better choice to study the stochastic behaviour of the 4G network at this location. But table-3 and plotted CDF strongly recommend that the Weibull approximation is a better choice to study the stochastic behaviour of the 3G network at this location.

## REFERENCES

[1]. C.G. Justus, W.R. Hargraves, A. Mikhail, D. Denise Graberet, "Methods for estimation wind speed frequency distributions," Journal of Applied Meteorology, vol. 17, no. 3, pp. 350-353, 1978.

[2]. N. Slamnik, J. Musovic, A. Okic, F. Tankovic, and I. Krijestorac, "An approach to analysis of heterogeneous networks' efficiency," In Proceedings of the 2017 XXVI International Conference on Information, Communication and Automation Technologies (ICAT), Sarajevo, Bosnia and Herzegovina, 26-28 October 2017, pp. 1-5.

[3]. Khalid Ali Khan. Measurement of 3G (WCDMA) Radio Statistics in Sub Urban Region of South-Western Ethiopia. International Journal of Science and Research (IJSR), vol. 8, no. 12, pp. 645-649, 2019.