Development of the Computer Network Applications using NetSIM Simulator & Python

Er. Shivali[1], Dr. Ajay Abrol[2], Dr. Sameru Sharma[3]
[1]*P.G. Student, Department of Electronics and Communication Engineering, Government College of Engineering & Technology, Jammu, India*
[2]*Associate Professor, Department of Electronics and Communication Engineering, Government College of Engineering & Technology, Jammu, India*
[3]*Professor, Department of Electronics and Communication Engineering, Government College of Engineering & Technology, Jammu, India*

Abstract-Wired and wireless networks form hybrid networks and require spectrum usage. The spectrum remains underutilized. Resource management strategy is required to address the problem. The 5G network was envisioned for designs to encounter the fundamental challenges for quality of services in existing networks, like allowing higher data rates, enhanced end-user quality, reduced end-to-end latency, lower energy consumption, and higher traffic capacity. Interconnected systems share digital information required for various applications. Network behavior changes with regards to size and type of network. In the current work, five wireless hybrid networks are simulated and applications developed using LTE and LTE-A simulation tool. Bandwidth, NSS coding rates, data rates, receiver sensitivity are analyzed. Trends in data analysis are presented. Findings of data analysis are that data rate and receiver sensitivity is showing similar fluctuations for BPSK, QPSK. For 16 QAM data rates and receiver sensitivity decreases, also throughput decreases with decrease in MSS and inter arrival time. For 64 QAM there is increasing trend for these two parameters. The Network simulator used is NetSIM v12 Academics and Research bundle and study is carried out in the Lab.

Index Terms—LTE; LTE-A; NeTSIM; Hybrid network; Python

I.INTRODUCTION

Computer Networks is a set of devices connected directly or through intermediate nodes. Network makes use of distributed processing in which computation is performed by several nodes [1]. It is projected that 5G cellular technology will achieve a mobile data volume that is one thousand times higher per unit area, a number of connecting devices that is ten to one hundred times higher, a user data rate that is five times lower, a battery life that is ten times longer, and a reduction in latency that is five times lower [2]. Complexity of current computer networks, including e.g., local networks, large structured networks, wireless sensor networks, data center backbones, requires a thorough study to perform analysis and support design. Simulation can help to encompass all the different aspects responsible for design quality and network performance including energy issues, security management etc. [3].

A considerable increase in throughput and decrease in delay is been noted by modifying the parameters in the application type, switching mode and transport layer of wired and wireless node in the current [4] for selecting network simulator, it is important to have knowledge of the tools available for desired application. It is also important to ensure that the results are valid and credible [5]. The rest of the paper is organized as follows: Section II comprises of research methodology related to simulating an enterprise network. Section III gives an overview of the NetSIM framework and analysis. Section IV describes the conclusion and future work.

II.RESEARCH METHODOLOGY

A hybrid network scenario with wireless and wired network with 20 nodes is built using NetSIM GUI. LTE & LTE-A module is selected for simulation: viewing packet animation and various network settings. The output performance metrics at multiple levels - network, sub network, link, queue is examined and applications are developed.

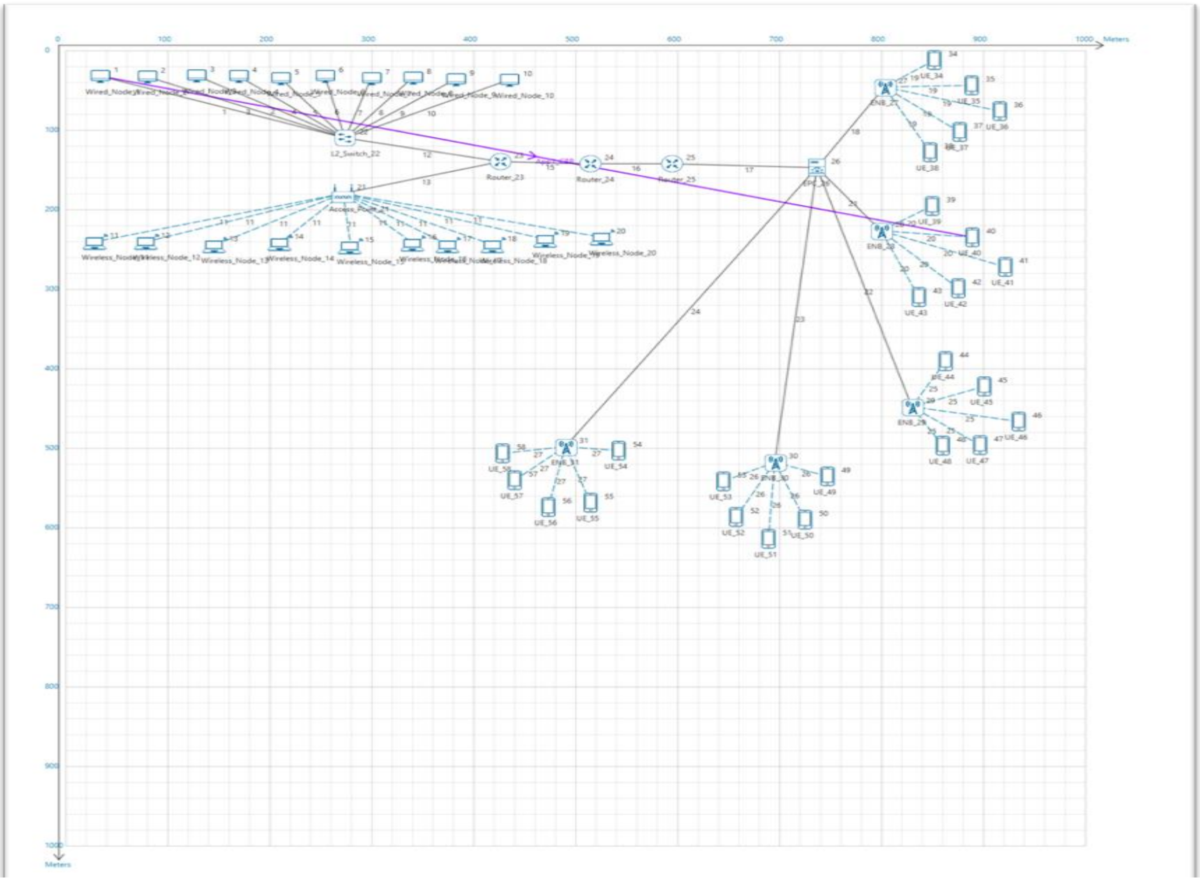

Figure 1. Network created on NetSIM workspace

For a given network model, we varied the type of modulation as BPSK, QPSK, 16-QAM, 64-QAM. Coding rates are also varied keeping bandwidth and NSS to be fixed. For wired node network is set to TCP protocol and for wireless to UDP protocol. Layer wise settings are done. Application is created to communicate between nth node of wired node and Mth node of wireless node. Simulation yield the results that are analyzed. Excel & Python are used for plotting graphs.

Table 1. WLAN DSSSP Network

Bandwidth	NSS	Modulation	Coding Rate	Data Rate	Receiver Sensitivity
20	1	BPSK	0.5	6.5	-95.621656
20	1	BPSK	0.5	7.2	-95.177656
20	1	QPSK	0.5	13	-89.601656
20	1	QPSK	0.5	14.4	-89.156656

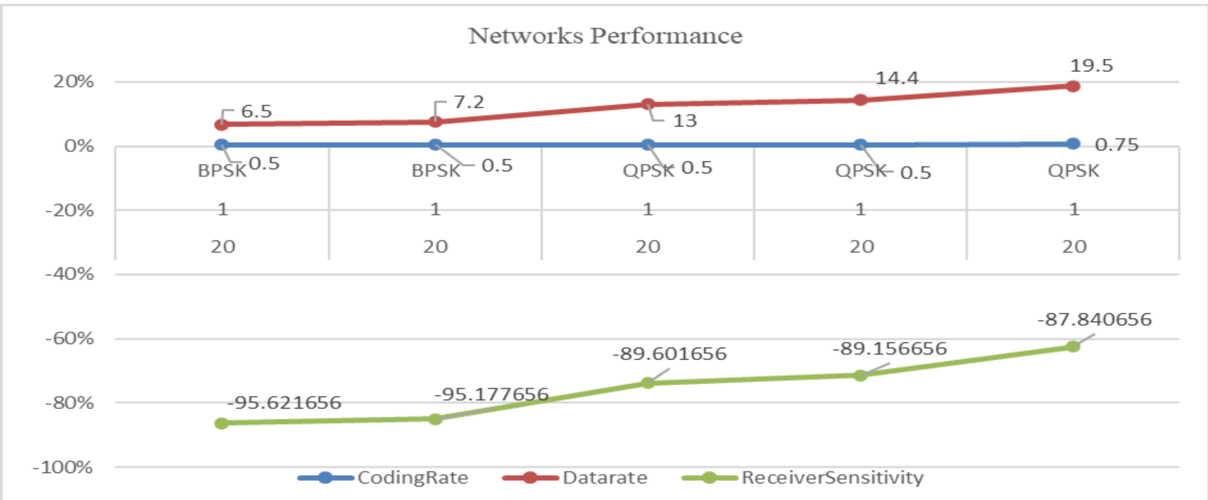

Figure 2. Collective Presentation of Data Acquired from Simulation

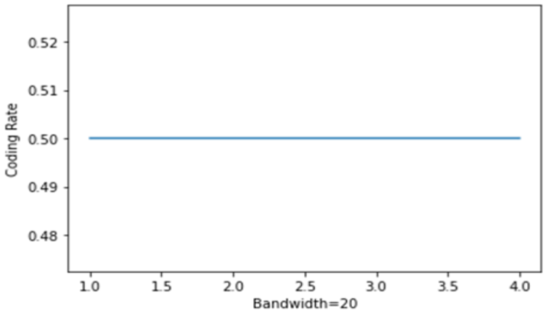

Figure 3. Bandwidth v/s coding rate

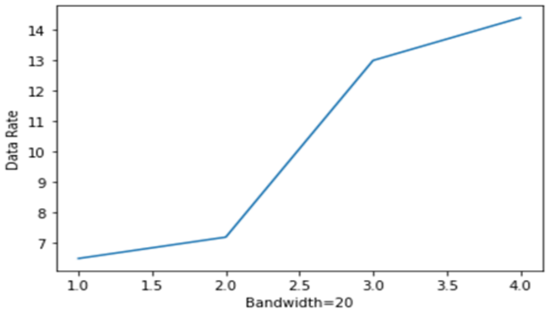

Figure 4. Bandwidth v/s Data Rate

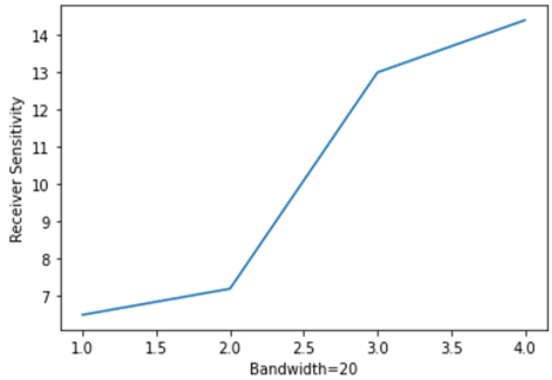

Figure 5. Bandwidth v/s Receiver Sensitivity

With same bandwidth, NSS Coding Rate, and increase in data rate, receiver sensitivity increases. Both data rates and receiver sensitivities are higher when QPSK is applied in comparison with BPSK modulation whereas coding rate remains constant.

Table 2. WLAN HTPHY

Bandwidth	NSS	Modulation	Coding Rate	Data rate	Receiver Sensitivity
20	1	16QAM	0.5	28.9	-85.072656
20	1	16QAM	0.5	26	-85.531656
20	1	16QAM	0.75	39	-83.770656
20	1	16QAM	0.75	43.3	-83.316656
20	1	64QAM	0.666667	52	-78.214656
20	1	64QAM	0.666667	57.8	-77.755656
20	1	64QAM	0.75	58.5	-77.703656
20	1	64QAM	0.75	65	-77.245656
20	1	64QAM	0.833333	72.2	-76.789656
20	1	64QAM	0.833333	65	-77.245656

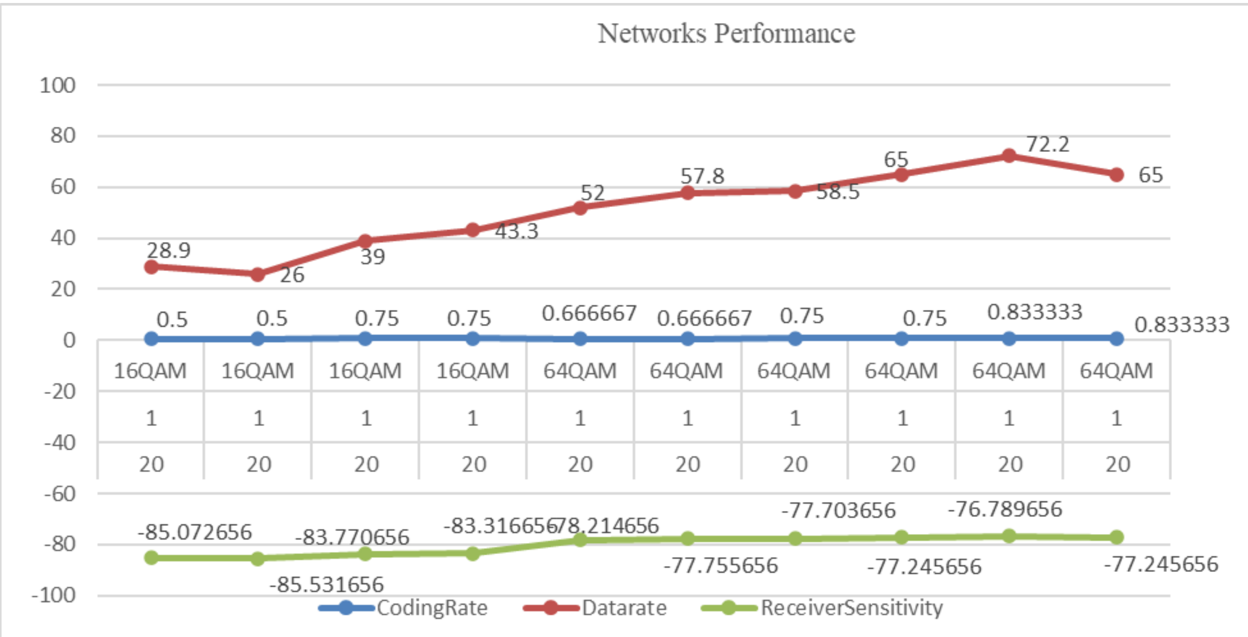

Figure 6. Collective Presentation of Data Acquired from Simulation

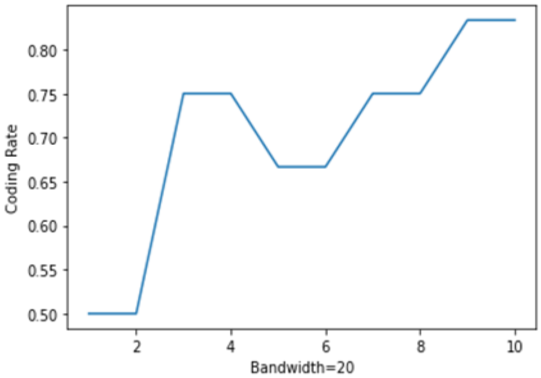

Figure 7. Bandwidth v/s Coding Rate

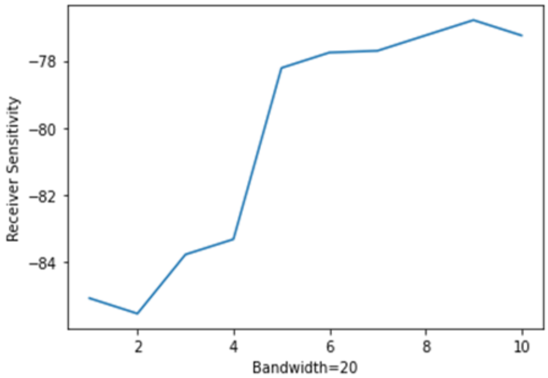

Figure 8. Bandwidth v/s Data Rate

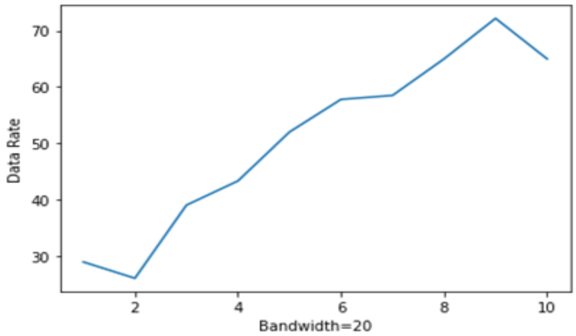

Figure 9. Bandwidth v/s Receiver Sensitivity

Table 3 WLAN OFDM PHY

Bandwidth	NSS	Modulation	Coding Rate	Data rate	Receiver Sensitivity
20	2	BPSK	0.5	13	-95.621656
20	2	BPSK	0.5	14.4	-95.177656
20	2	QPSK	0.5	28.9	-89.141656
20	2	QPSK	0.5	26	-89.601656
20	2	QPSK	0.75	43.3	-87.385656
20	2	QPSK	0.75	39	-87.840656
20	2	16QAM	0.75	86.7	-83.311656
20	2	16QAM	0.5	57.8	-85.072656
20	2	16QAM	0.5	52	-85.531656
20	2	16QAM	0.75	78	-83.770656
20	2	64QAM	0.666667	104	-78.214656
20	2	64QAM	0.75	117	-77.703656
20	2	64QAM	0.833333	130	-77.245656

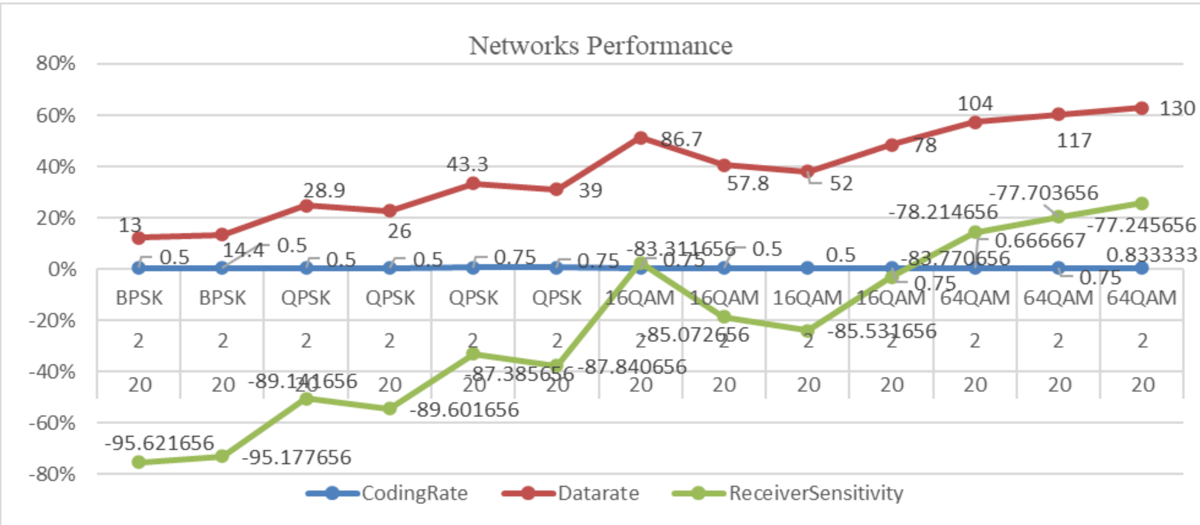

Figure 10. Collective Presentation of Data Acquired from Simulation

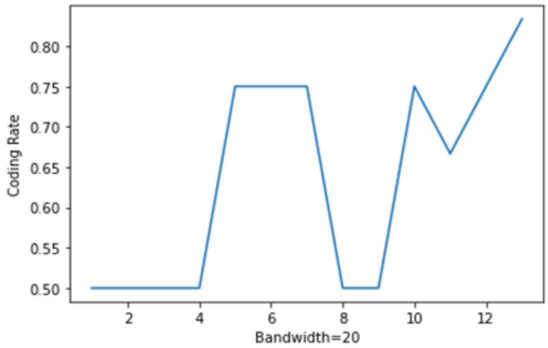

Figure 11. Bandwidth v/s coding rate

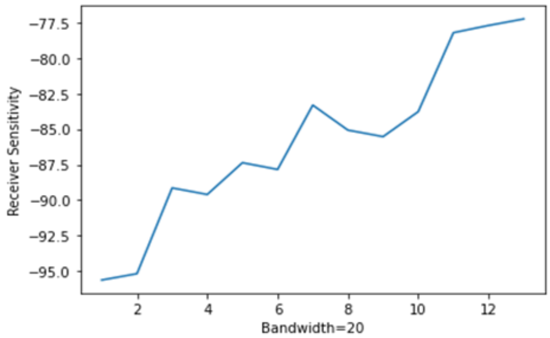

Figure 12. Bandwidth v/s Data Rate

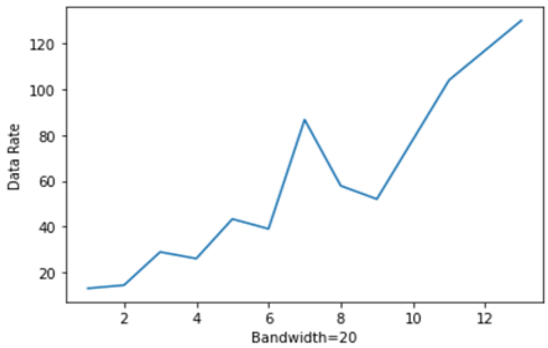

Figure 13. Bandwidth V/S Receiver Sensitivity

For a network with modulation technique using 16-QAM, network shows decrease in data rate with decrease in receiver sensitivity in first step, with decrease in sensitivity data rate increases in second step and then shows proportional performance for third and fourth reading. 64-QAM also indicates a proportional trend of receiver sensitivity and data rate except at -77.245656 where sensitivity decreases and data rate increases. In all the observations band width and NSS are same. Coding rate also shows an trend for data rates and receiver sensitivity. Data rate is lowest for BPSK, increases for QPSK, 16-QAM and is highest for 64-QAM as presented in Table 3.

III.CONCLUSION

Network simulation using NetSIM is adopted in which we simulate and implement hybrid networks including wired and wireless networks. The future scope of the simulation using various simulators is very vast and wide. The network simulation helps us to achieve proved result [6].

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[6] Soni, K. and Prakash, R., 2014. Improved survey on network simulation tools. International Journal of Engineering Research & Technology (IJERT), 3(4)]. We can measure various network issues that can describe the network behavior.