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Enhancement of Data Network Robustness in Nigeria, Using Adaptive Modulation Technique.

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ABSTRACT: Passing information or transfer of data from one point to the other has become a chronic problem in our communication industry. This can be overcome by improving the robustness of data network using adaptive modulation technique. Wireless communication technology transmits information over the air using electromagnetic waves like Infrared, Radio Frequency, and satellite. Recall that GPS, Wi-Fi, satellite television, wireless computer parts, wireless phones that include 3G and 4G networks, and Bluetooth are typical examples. Adaptive Modulation is a technique which allows a radio to change its modulation rate or speed as conditions in the radio network change. Interference from outside sources, such as changes in the environment (temperature, tree foliage, moving objects usually affect radio coverage. Therefore, the physical layer mode is usually adapted to the worst case link condition, however, Adaptive method would improve the robustness of the Network. This is done in this manner**,** Designing a Simulink model of the network of study and use it to study the extent of robustness of data in the network, determining the bit error rate, evaluating the behavior of packets in the channel network, designing an adaptive modulation scheme to reduce high bit error rate, congestion and interference thereby improving robustness in the data network and designing a model for improving the robustness of data network using adaptive modulation. The result obtained is four times reduction of robustness in data network using adaptive modulation which thereby enhances the efficiency oftransfering data from one point to the other without stress.

Key words: Robustness, Data Network, Modulation

I. INTRODUCTION.

Utilization ofmultiple input multiple output (MIMO) system has demonstrated a great improvement on the systems that use a single antenna.The cause of the network not withstanding stress has arisen as a result of not having free communication network caused by high bit error rate, interference and congestion, The communication network not being free has made some communication companies to lose some of their subscribers. This will make the concerned networks to sack some of their staff because they cannot meet to paying them salaries. These staff that were sacked might be the pillar of their respective families financially. On the other hand, investors will not have the urge to invest because of poor communication network. If these problem of not having free communication network is solved by improving the robustness of data network using adaptive modulation technique these human agony like sacking staff mentioned herein will be minimized.The cause of poor communication network is because of high bit error rate that cause interference, congestion, thereby causing a big stress from transmitting packet from one point to the other.The technique used is improving the robustness of data network using adaptive modulation technique. Designing a Simulink model of the network of study and use it to study the extent of robustness of data in the network, determining the bit error rate, evaluating the behavior of packets in the channel network, designing an adaptive modulation scheme to reduce high bit error rate, congestion and interference thereby improving robustness in the data network and designing a model for improving the robustness of data network using adaptive modulation

1.1 Aim of the Study

The study is aimed at improving the Robustness of Data Network using Adaptive Modulation Technique

1.2 Objectives of Study

The cause of poor communication Network due to high bit error rate has caused interference and congestion with a resultant high

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stress from transmitting packet from one point to the other. Therefore the objectives of this research work is to

- Collect data from the characterized area under study.
- Design a Simulink model of the network of study and use it to study the extent of robustness of data in the network,
- Determine the bit error rate,
- evaluate the behavior of packets in the channel network,
- Design an adaptive modulation scheme to reduce high bit error rate, congestion and interference thereby improving robustness in the data network and finally
- Design a model for improving the robustness of data network using adaptive modulation

II. EXTENT OF PAST RELATED WORK

One of the promising techniques with the appearance of next generation broadband wireless communications is represented by combining the technology of MIMO wireless and the IEEE 802.16m standard[1]. So, WiMAX adopts the MIMO antenna technique which represents important enhancements in terms of the spectral efficiency and link reliability. Also, the function of the modulation and coding scheme (MCS) can be executed by applying link adaptation based on the 'got channel' condition which represents an effective method to improve the execution of the throughput in a cellular system [2]. Hence, a large increase in throughput for the Mobile WiMAX system can be obtained by a combination of the link adaptation method with the MIMO technique. The idea of the AMC is to adapt the modulation and coding scheme (MCS) to th e channel conditions to attain the highest spectral efficiency at all times. AMC is the standard approach which has lately been formulated in wireless standards, which include WiMax [3]. Another dimension for modulation and coding is the space dimension, such as multiple antenna techniques, whereby this technique is utilized to improve the execution of the bit error rate (BER) in wireless systems, and to increase the data rate transmitted by spatial multiplexing (SM).WiMAX has two forms based on multiple antenna profiles for utilization in the downlink (DL) and uplink (UL), but the execution of these profiles is only optional for the uplink (UL). Therefore, one of them is dependent on the space time code (STC) which is suggested through the work of Altamonte for transmit diversitywhile the other will be a 2x2 spatial multiplexing scheme.

(SMS) [4].There is no difference when using the adaptive modulation (AM) and adaptive coding (AC) together or just the AM alone. However, under favorable channel conditions the mobile WiMAX system uses the highest levels of modulation and the highest rates of channel coding, while it utilizes lower levels of modulation and lower rates of channel coding whenever the channel condition is comparatively harsh. It is expected that the results of the performance will be enhanced when the AM and AC are combined together. Furthermore, considering the modulation schemes (QPSK, 16 QAM and 64-QAM), there are four coding rates that can be applied in this case, which are 1/2, 2/3, 3/4 and 5/6[5]The non-consistence of free network that has emanated as a result of the network notwithstanding the stress that has arisen as a result of high bit error rate; this caused congestion and interference thereby reducing the rate of transporting data from one point to the other in the communication net,cwork. This has lured the researcher to source for a means of overcoming this uncertainty.

III. METHODOLOGY

The collection of required data for analysis in order to study the extent of robustness of data in the network was undertaken. This process was done in this manner characterizing the Network under studyCollect data from the characterized area under study.Designing a Simulink model of the network of study and use it to study the extent of robustness of data in the network, Determining the bit error rate, evaluating the behavior of packets in the channel network, designing an adaptive modulation scheme to reduce high bit error rate, congestion and interference thereby improving robustness in the data network and finallyDesigning a model for improving the robustness of data network using adaptive modulation.

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3.1. Designing a Simulink model of the network of study and use it to study the extent of robustness of data in the network

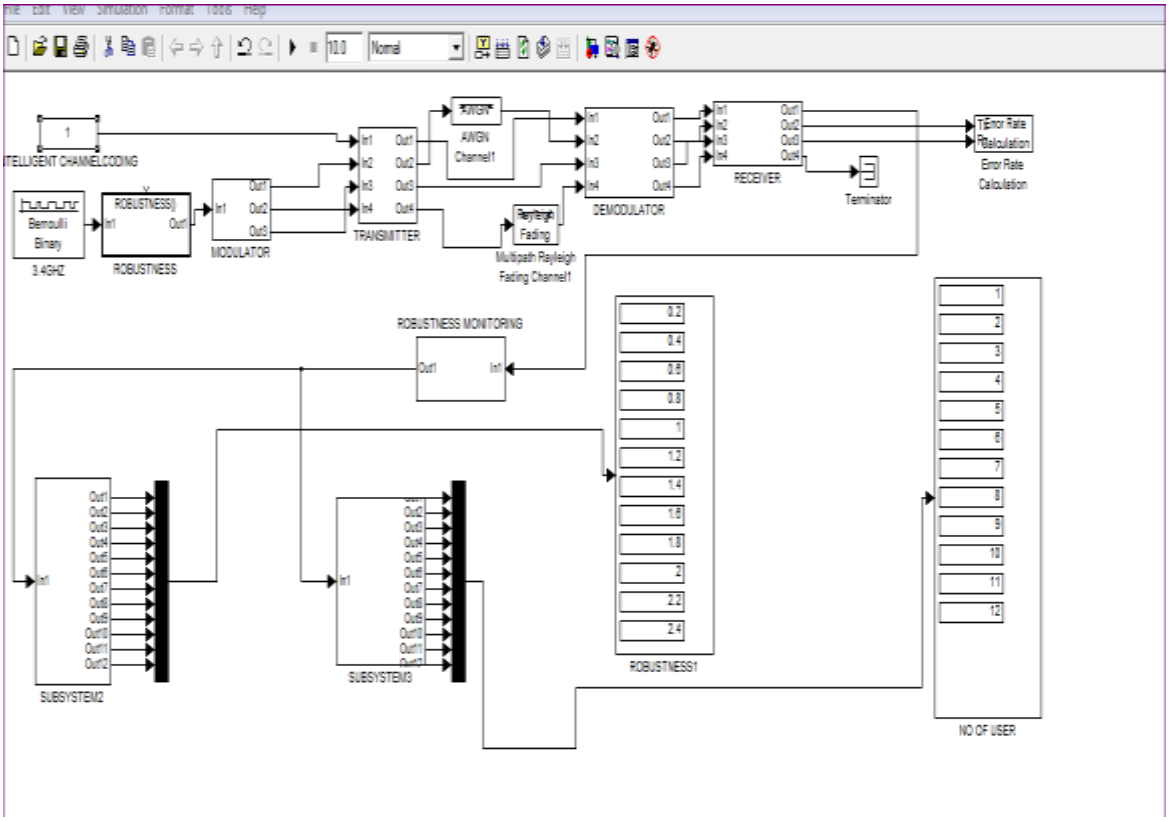

Fig. 1 Designed Simulink model of the network of study and use it to study the extent of robustness of data in the network

3.2. Determination of bit error rate

In a communication network 100,000 bits are transmitted, and a bit, 2 bits, 3 bits, 4 bits and 5bits received are error because of some kind of interference between the transmitter and receiver. Calculate the high bit error rate that cause interference thereby increasing robustness in the network.

BER = Error bit/ Transmitted bit
BER1 = 1/100000 = 0.00001
BER2 = 2/100000 = 0.00002
BER3 = 3/100000 = 0.00003
BER4 = 4/100000 = 0.00004
BER5 = 5/100000 = 0.00005

Evaluating the behavior of packets in the channel network,

This is done by computing the packet bit error rate in the network

Solving the packet error rate (PER) when BER1 = 0.00001

Recalling formula to find packet error rate
$PER = 1 – (1- BER)^N$
Where
PER is packet error rate
BER is bit error rate
N is a constant of 2
PER1 = 1- (1 – 0.00001)
$PER1 = 1 –(0.99999)^2 = 1 – 0.99998 = 0.00002$
To find PER2 = 1 – (1 – 0.00002)
$PER2 = 1 – (0.99998)^2 = 1 – 0.99996 = 0.00004$
$PER3 = 1 – (1 – 0.00003)^2 = 1 – 0.9997^2 = 1 – 0.9994 = 0.0006$
$PER4 = 1 – (1 – 0.00004)^2 = 1 – 0.99996^2 = 1 – 0.99992 = 0.00008$
$PER5 = 1- (1 – 0.00005)^2 = 1 – 0.99995^2 = 1 – 0.9999 = 0.0001$

Since the packet error is high it means that the robustness or stress isbig; and it will make the communication network to have a low quality.

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3.3. Designing an adaptive Modulation Scheme to reduce high bit error rate, congestion and interference Without Modulation.

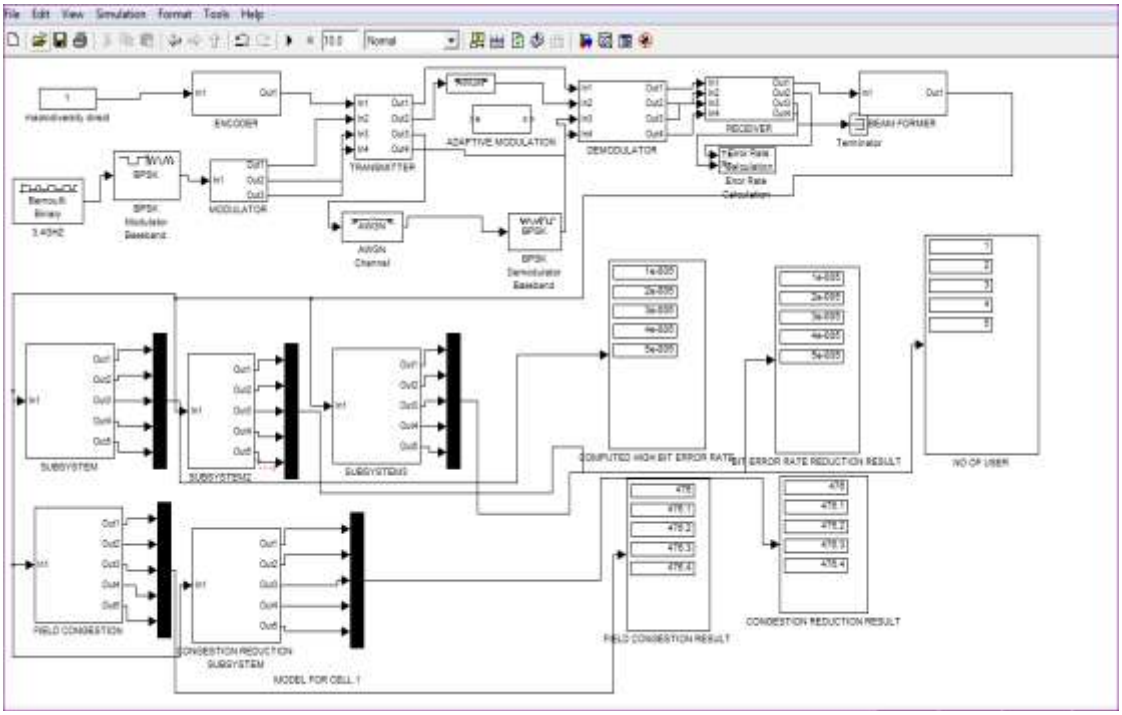

Fig.2 Designed adaptive modulation scheme to reduce high bit error rate, congestion and interference without modulation

3.4. The design of adaptive modulation scheme to reduce high bit error rate, congestion and interference when adaptive modulation is incorporated

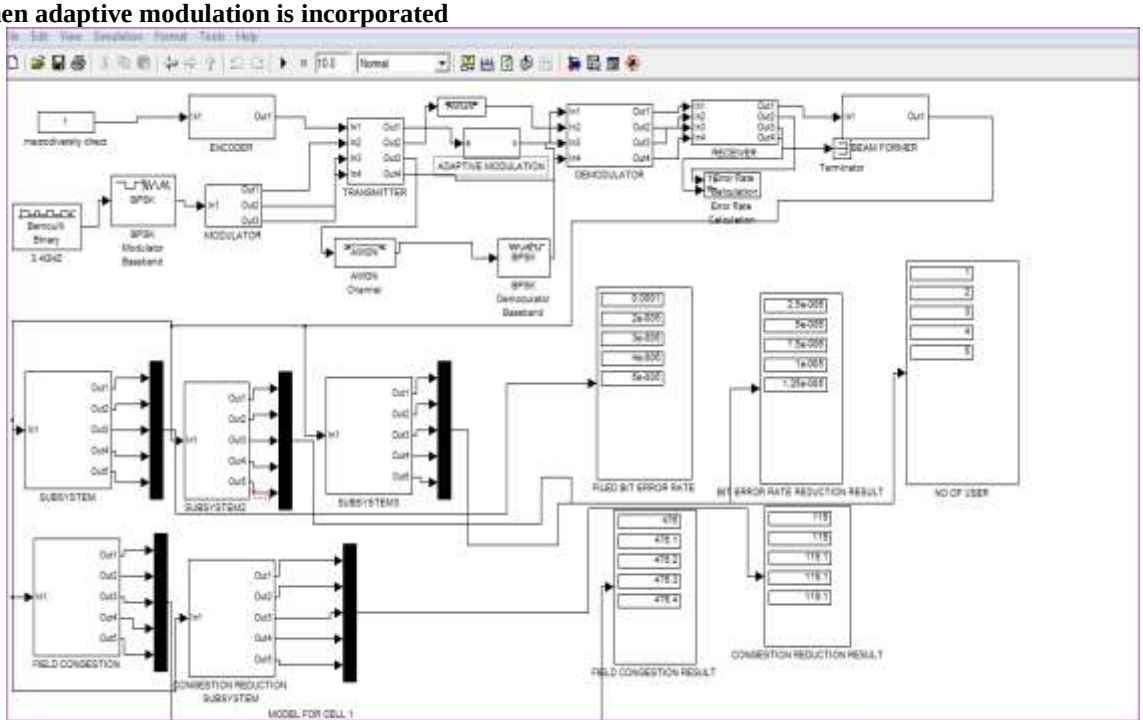

Fig. 3 Designed adaptive modulation scheme to reduce high bit error rate, congestion and interference when adaptive modulation is incorporated.

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3.5. To design a model for improving the robustness of data network using adaptive modulation

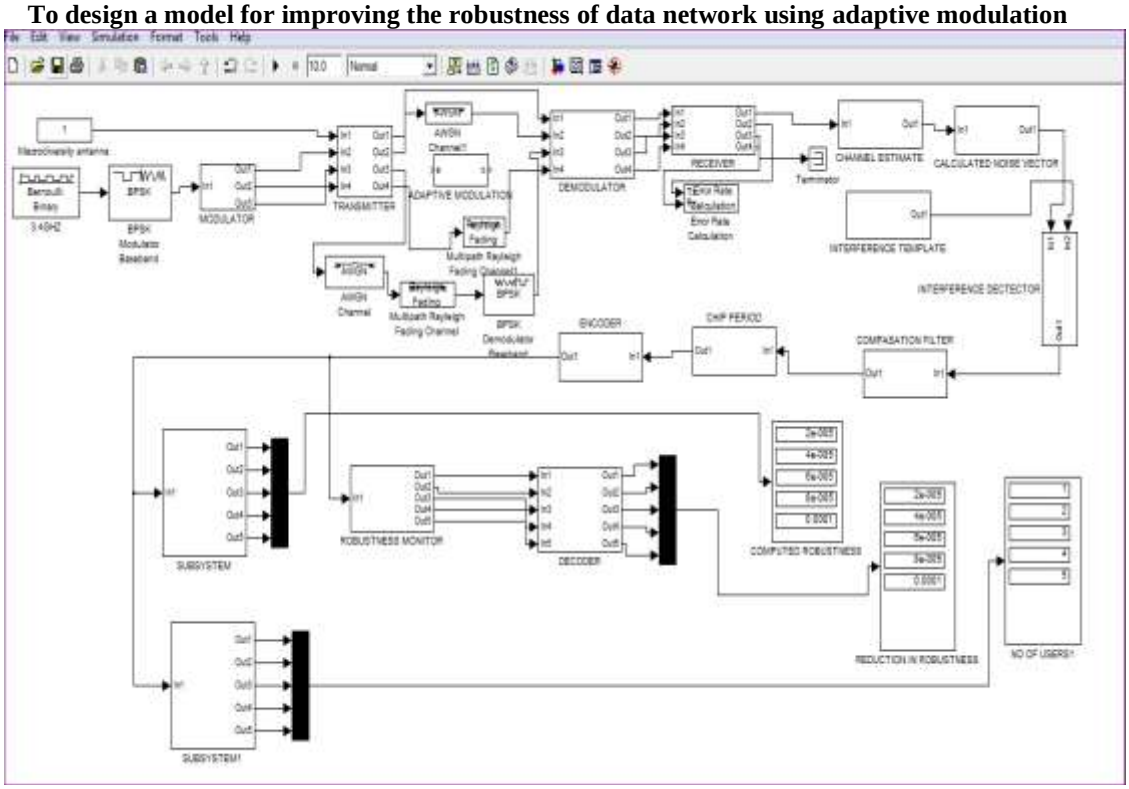

Fig. 4 Designed model for improving the robustness of data network without using adaptive modulation

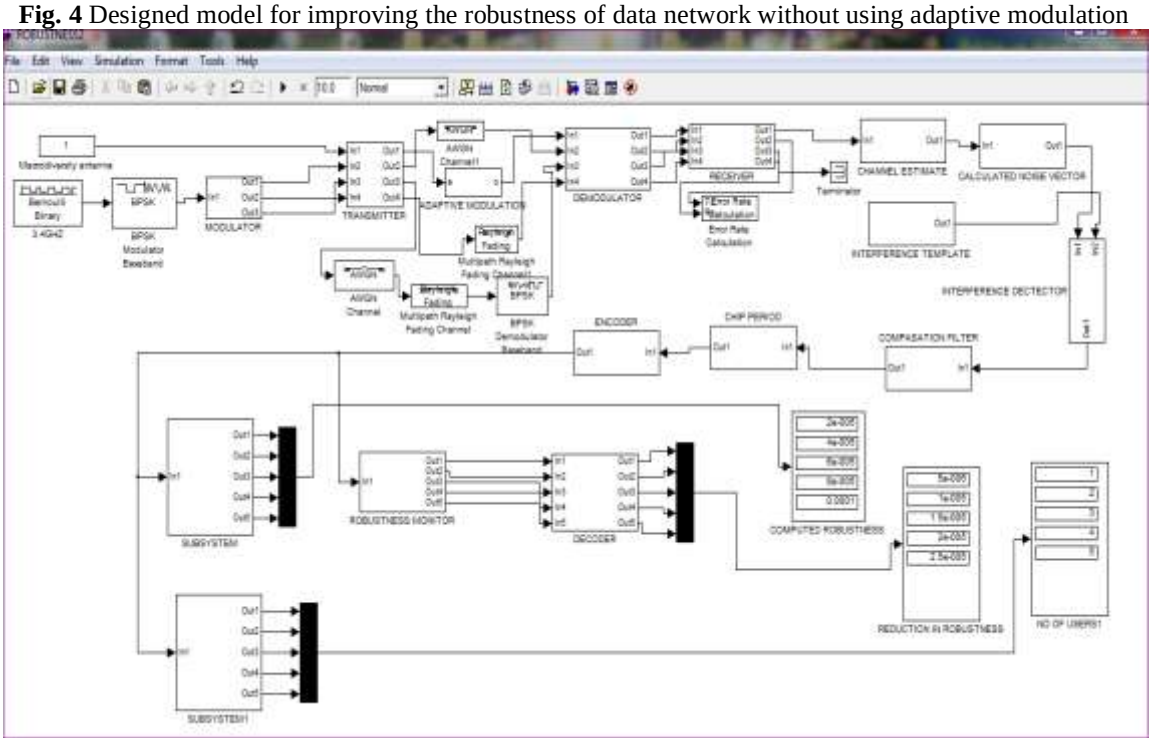

Fig. 5 Designed model for improving the robustness of data network using adaptive modulation

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IV. RESULTS AND DISCUSSION

The results obtained from the stated objectives in this study are discussed here.Figure 1 shows designed Simulink model of the network of study; it is used to study the extent of robustness of data in the network. Figure 2 shows designed adaptive modulation scheme to reduce high bit error rate, congestion and interference without incorporating adaptive modulation; this also shows that there were high bit error rate and congestion when adaptive modulation was not incorporated as shown in tables 1 and 2. Figure 3 shows adaptive modulation scheme to reduce high bit error rate, congestion and interference when adaptive modulation is incorporated, this Figure shows that the results obtained are reduction in bit error rate and congestion as shown in tables 1 and 2. Figure 4 shows designed model for improving the robustness of data network without using adaptive modulation. Figure 4 shows that there is increase in robustness when adaptive modulation is not incorporated as shown in Table 3. Figure 5 is the designed model for improving the robustness of data network using adaptive modulation technique; the Figure shows that there is decrease in robustness when adaptive modulation is imbibed in the model. This will equally increase the rate of packet arrival process thereby enhancing the rate of the communication network. Figure 6 is the comparison between the computed bit error rate and bit error rate when adaptive modulation isincorporated. Figure 6 shows that bit error rate reduces when adaptive modulation is incorporated thereby interference and stress equally reduced concurrently in the communication network. Figure 7 shows comparison between the rate of congestion with and without adaptive modulation. Figure 7 shows reduction in congestion when adaptive modulation is incorporated in the system while there is increase in congestion when adaptive modulation is not incorporated in the system. Figure 8 shows the comparison between the rate of robustness with and without adaptive modulation. Figure 8 shows that there is reduction of robustness when adaptive modulation is incorporated. Figure 8 shows that the passage of piece of information from source to sink is fast when adaptive modulation is incorporated

Table1: Comparing computed bit error rate and bit error rate when adaptive modulation is incorporated

COMPUTATED BIT ERROR RATE	BIT ERROR RATE WHEN ADAPTIVE MODULATION IS INCOORPORATED	NO OF USERS
0.00001	**0.0000025**	**1**
0.00002	**0.000005**	**2**
0.00003	**0.0000075**	**3**
0.00004	**0.00001**	**4**
0.00005	**0.0000125**	**5**

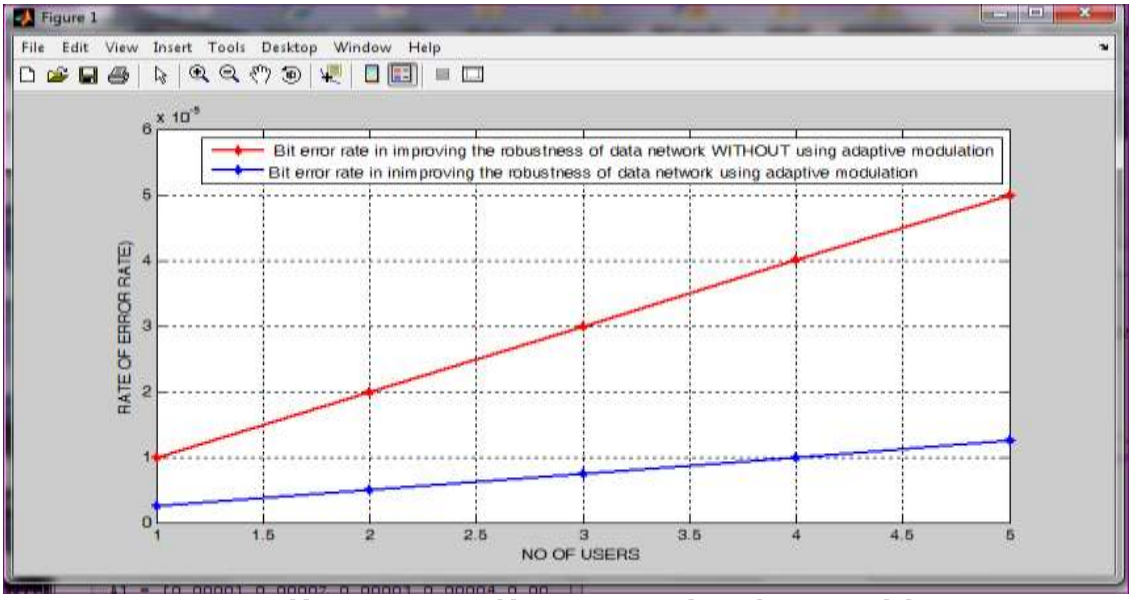

Fig. 6 Comparing computed bit error rate and bit error rate when adaptive modulation is incorporated

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Table 2: comparing the rate of congestion with and without adaptive modulation

CONGESTION WITHOUT ADAPTIVE MODULATION	CONGESTION WHEN ADAPTIVE MODULATION IS INCOORPORATED	NO OF USERS
476	119	1
476.1	119.025	2
476.2	119.05	3
476.3	119.075	4
476.4	119.1	5

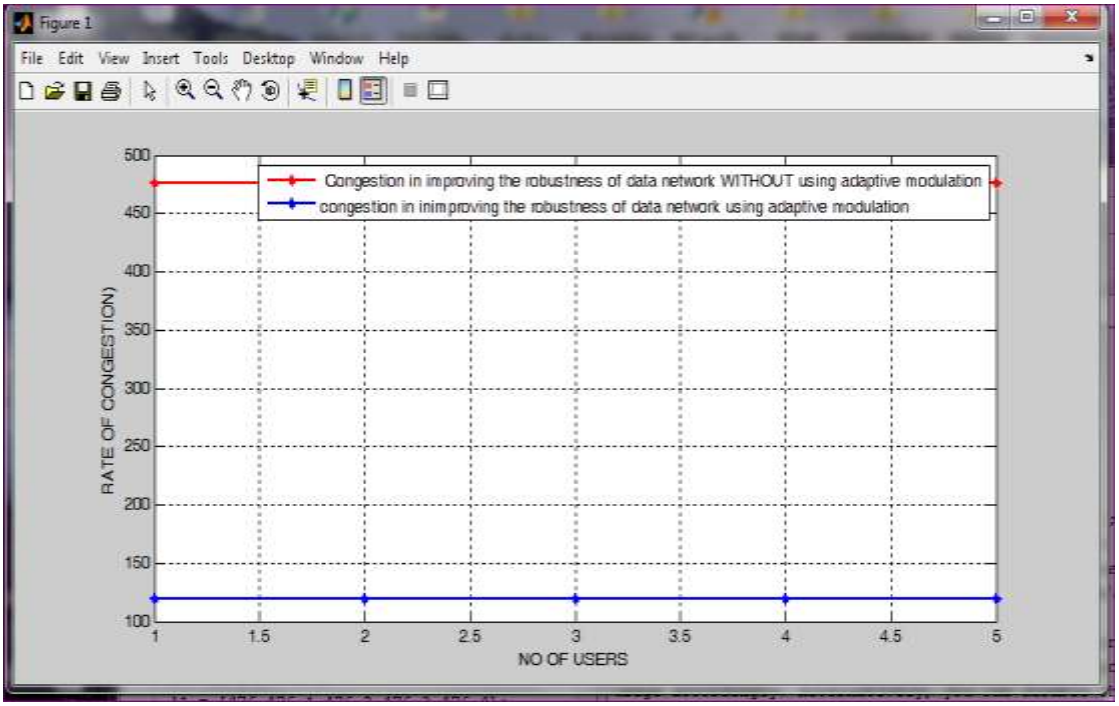

Fig. 7 comparison between the rate of congestion with and without adaptive modulation

Table 3: comparing the rate of robustness with and without adaptive modulation

ROBUSTNESS WITHOUT ADAPTIVE MODULATION	ROBUSTNESS WHEN ADAPTIVE MODULATION IS INCOORPORAEED	NO OF USERS
0.00002	0.000005	1
0.00004	0.00001	2
0.00006	0.000015	3
0.00008	0.00002	4
0.0001	0.000025	5

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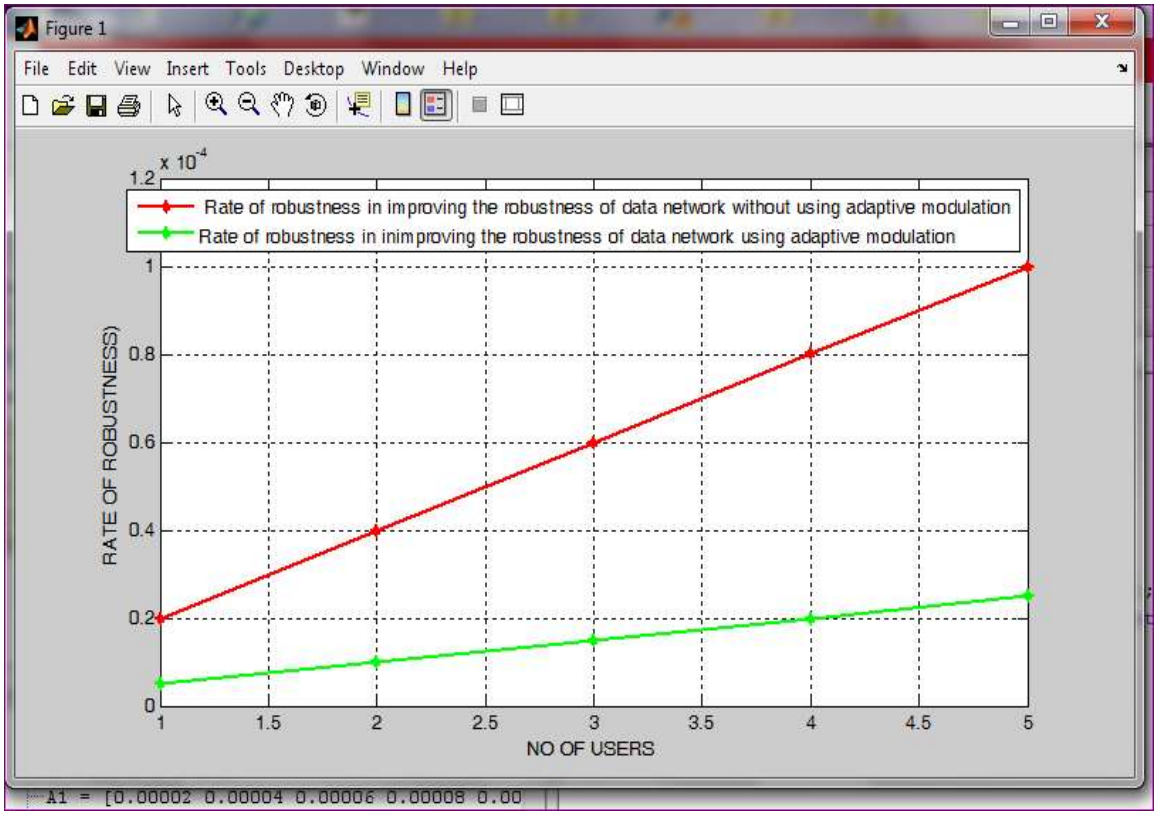

Fig. 8 Comparison between the rate of robustness with and without adaptive modulation

IV. CONCLUSION

To reduce the difficulties found in the passing of piece of information from source to sink or transfer of data from one point to the other this is achieved by improving the robustness of data network using adaptive modulation technique. This is done in this manner, Designing a Simulink model of the network of study and use it to study the extent of robustness of data in the network, determining the bit error rate, evaluating the behavior of packets in the channel network, designing an adaptive modulation scheme to reduce high bit error rate, congestion and interference thereby improving robustness in the data network and designing a model for improving the robustness of data network using adaptive modulation.

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