Enhanced Transmission Efficiency of Multimode Optic Fiber for Long Distance Data Transmission Using Ann Controller

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***Abstract*: The drastic slow in the transmission efficiency in multimedia optic fiber which has demoralized the moral of the egalitarian subscribers are as a result of congestion. This sad situation of congestion in the network is subdued by introducing enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller. It is done in this manner, characterizing the network under study, determining the causes of delay in transmission efficiency of multimode optic fiber such as congestion low throughput and much bit error rate from the characterized network, training ANN in the causes of delay in transmission network to enhance its performance and designing a SIMULINK model for enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller. The results obtained are the lowest conventional congestion occurred in 2s and is1.76 Engar while that when ANN controller is incorporated in the system at the same time is1.703Engar thereby enhancing the transmission efficiency of multimedia optic fiber and the highest conventional throughput is 8bps while the throughput when ANN controller is incorporated in the system is 8.542bps that tremendously enhanced the transmission efficiency of multimode optic fiber.**

***Keyword:* Enhanced, transmission efficiency, multimode optic fiber, artificial neural network (ANN)**

I. INTRODUCTION

It is an axiomatic that Multimode optic fiber is synonymous to transmitting data in a shorter distance, but its transmission of data to a long distance is delayed by interference, congestion, high attenuation, low throughput, low signal to noise ratio. The transmission of data through optical fiber cables over long distances in communication systems usually experience different types of dispersion and other forms of losses that have impact on transmission performance. Nonlinear characteristics of an optical fiber channel are important in determining the transmission capacity and performance of the system. In order to improve transmission range and minimize data transmission losses, optimization configuration of combinations depends on few factors such as dispersion and optical signal power. There are advantages and disadvantages of using nonlinear effects in optical fiber **(Singh, 2007)**. The advantages of using nonlinear effects in optical fiber is that it identifies when the network are experiencing the following; congestion, low throughput, low signal to noise ratio that cause bad performance of the network, while its disadvantage is that it takes longer time for it to be identified which might cause serious damage to the multimode fiber data network.

II. METHODOLOGY

The methodology employed for the study is the computer aided software engineering methodology which accommodates modeling equations to formulate solutions to modern problems like the issues of poor efficiency of multi model fiber channels for long range transmission. The method employed to develop the new solution are characterization of an optic fiber network under study, then the modeling of the proposed neural network control system to improve the efficiency of the data routing process within the fiber network. to achieve this, data of the fiber network was collected considering key routing parameters such as packet transmission size, time, attenuation using the model in equation 1 and 2 and presented the result in table 1;

Table 1: To characterize the network under study.

Yearly	YEARLY ATTENUATION	FILE SIZE	TRANSMISSION TIME (s)	PACKET TRANSFERRED DATA	PACKET RETRANSMITTED
2009	62.8	16	2	30	25
2010	62.8	20	4	28	24
2011	47.8	24	5	26	20
2012	100.5	16	3	26	18
2013	416.2	18	7	24	16
2014	236	26	6	24	14
2015	306.3	28	8	22	12
2016	287.4	18	4	22	11
2017	205.5	30	5	22	11
2018	311.1	16	4	20	12

The table 1 presented the data routed on the fiver network for 9 years and the average packet loss and congestion experienced on the network is presented in the table 2;

Table 2: Data of recorded optic network performance

Packet loss experienced yearly	Congestion experienced yearly
0.833	1.79
0.857	1.76
0.769	1.86
0.692	1.86
0.667	2.0
0.2858	3.04
0.545	2.21
0.55	2.2
0.55	2.2
0.636	2.01
0.6	2.1

To determine the causes of delay in transmission efficiency of multimode optic fiber such as congestion low throughput and much bit error rate from the characterized network.

P = 8/ 3C^2 -----------------------1

Source (Chen, 2003) transport layer III congestion control strikes back.

Where P is packet loss

W is the network congestion

Then, make C the subject formula in equation 1

The mathematical model for congestion in the network is as shown in equation 2

$P = 8/ 3C^2$

$3C^2P = 8$

$C^2 = 8/3P$

$C = \sqrt{8}/3P$---------------------------2

To find the network congestion in 2009 when the packet loss is 0.833

C1 = √ 8 / 3 x 0.833

C1 = √ 8 / 2.499

C1 = √ 3.2013

C1 = 1.79

Congestion in 2010 when packet loss is 0.857

C2 = √ 8 / 3 x 0.857

C2 = √ 8 / 2.571

C2 =√ 3.11

C2 = 1.76

Congestion in 2011 when packet loss is 0.769

C3 =√ 8 / 3 x 0.769

C3 = √ 8 / 2.307

C3 = √3.47

C3 = 1.86

Congestion in 2012 when packet loss is 0.692

C4 = √ 8 / 3 x 0.769

C4 = √ 8 / 2.307

C4 = √3.4677

C4 = 1.86

Congestion in 2013 when packet loss is 0.667

C5 = √ 8 / 3 x 0.667

C5 = √ 8 / 2.001

C5 = √ 3.998

C5 = 1.99

C5 = 2.0

Congestion in 2014 when packet loss is 0.2858

C6 = √ 8 / 3 x 0.285

C6 = √ 8 / 0.867

C6 = √9.23

C6 = 3.04

Congestion in 2015 when packet loss is 0.545

C7 = √ 8 / 3 x 0.545

C7 = √ 8 / 1.635

C7 = √4.893

C7 = 2.21

Congestion in 2016 when packet loss is 0.55

C8 = √ 8 / 3 x 0.55

C8 =√ 8 / 1.65

C8 = √ 4.85

C8 = 2.2

Congestion in 2017 when packet loss is 0.55

C9 = √ 8 / 3 x 0.55

C9 =√ 8 / 1.65

C9 = √ 4.85

C9 = 2.2

Congestion in 2018 when packet loss is 0.636

C10 = √ 8 / 3 x 0.636

C10=√ 8 / 1.908

C10 = √ 4.193

C10 = 2.01

Congestion in 2019 when packet loss is 0.6

C11= √ 8 / 3 x 0.6

C11= √ 8 / 1.8

C11 =√ 4.44

C11 = 2.1

To calculate the throughput

Throughput = file size/transmission time

Throughput1 = 16/2 = 8bps

Throughput2 = 20/4= 5bps

Throughput3 = 24/5 = 4.8bps

Throughput4 =16/3 = 5.33bps

Throughput5 =18/7 = 2.57bps

Throughput6 =26/6 = 4.33bps

Throughput7 = 28/8 = 3.5bps

Throughput8 = 18/4 = 4.5bps

Throughput9 = 30/5 =6bps

Throughput10 = 16/4 = 4bps

To determine an ideal bit error rate convenient for the characterized network

BER1 = PER/8 × MTU × 1.03125 ----4

Where MTU is 12000

BER1 = 0.833/8 x 12000 x1.03125

BER1 = 0.833/9900

BER1 = 0.0000841bits

To find the bit error rate in 2010 when the packet loss is 0.857

BER2 = 0.857/9900

BER2 = 0.0000866bits

To find the bit error rate in 2011 when the packet loss is 0.769

BER3 = 0.769/9900

BER3 = 0.0000777bits

To find the bit error rate in 2012 when the packet loss is 0.692

BER4 = 0.692/9900

BER4 = 0.0000699bits

To find the bit error rate in 2013 when the packet loss is 0.667

BER5 = 0.667/9900

BER5 = 0.0000674 bits

To find the bit error rate in 2014 when the packet loss is 0.2858

BER6 = 0.2858/9900

BER6 = 0.000030 bits

To find the bit error rate in 2015 when the packet loss is 0.545

BER7 = 0.545/9900

BER7 = 0.0000551bits

To find the bit error rate in 2016 when the packet loss is 0.545

BER8 = 0.545/9900

BER8 = 0.0000551bits

To find the bit error rate in 2017 when the packet loss is 0.636

BER9 = 0.636/9900

BER9 = 0.0000642bits

To find the bit error rate in 2018 when the packet loss is 0.636

BER10 = 0.2/9900 = 0.000020bits

To find the bit error rate in 2019 when the packet loss is 0.6

BER11 = 0.6/9900 = 0.000061bits

Table 3: Data to train Artificial Neural Network

Packet loss experienced hourly	Congestion experienced hourly	Bit error rate
0.833	1.79	0.0000841
0.857	1.76	0.0000866
0.769	1.86	0.0000777
0.692	1.86	0.0000699
0.667	2.0	0.0000674
0.2858	3.04	0.000030
0.545	2.21	0.0000551
0.55	2.2	0.0000551
0.55	2.2	0.0000642
0.636	2.01	0.000020
0.6	2.1	0.000061

Modeling of the Neural Network Control system

To develop the neural network control system, the modeling diagram in figure 1 was used to design a neural network logical data flow, showing how the data in the table 3 was feed to the neuron which has weight and bias. The data was summed and activated using nonlinear activation function and then trained with back propagation algorithm in figure 2 to generate the reference control model.

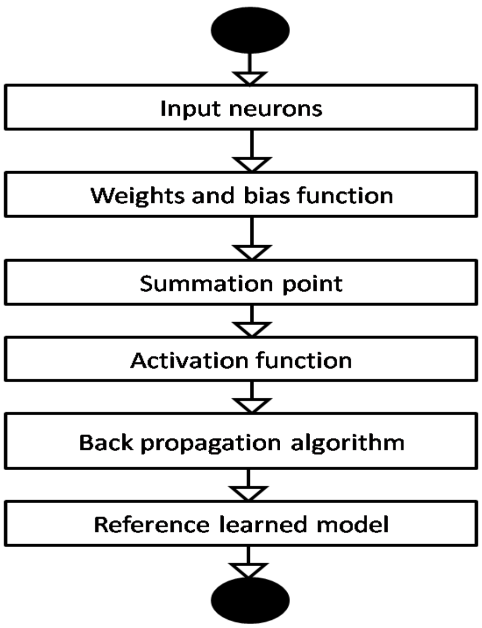

Figure 1: model of the neural network

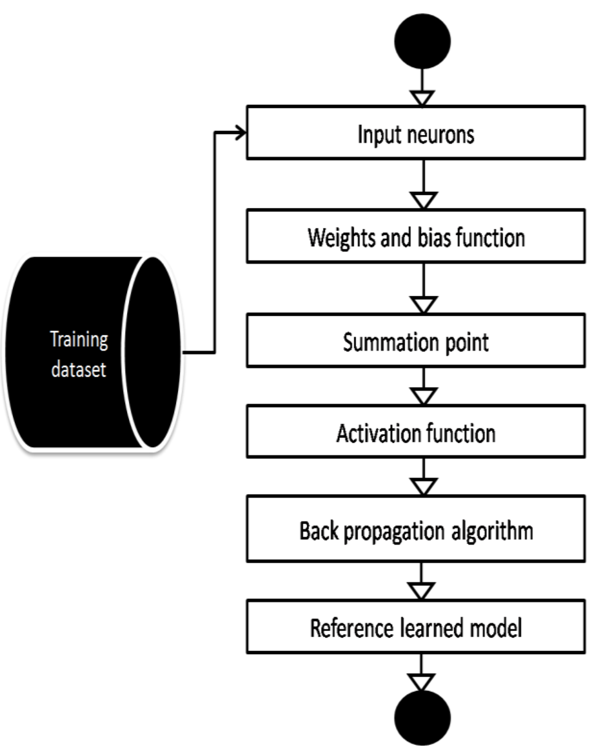

Figure 2: Neural Network with training dataset

Pseudo Code Of Training Algorithm

1. *Start*
2. *Activated Optical network feature vectors*
3. *Select feature variable*
4. *Initialize threshold for weight and bias function*
5. *Vary weight and bias iteratively*
6. *Check epoch performance*
7. *Is training ok=true*
8. *Stop*
9. *Generate reference control model*
10. *Else*
11. *Train until epoch is satisfied*
12. *End*

To train ANN in the causes of delay in transmission network to enhance its performance

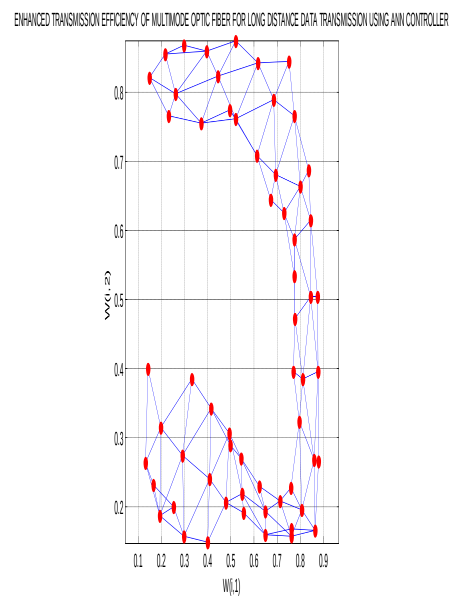

Fig 3 trained ANN in the causes of delay in transmission network to enhance its performance

Fig 3 shows trained ANN in the causes of delay in transmission network to enhance its performance. In figure 1 the tree core things that causes delay of transmission efficiency in multimode optic fiber for long distance data transmission are congestion, low throughput and much bit error rate were trained 20times to get sixty neurons that mimics human intelligence.

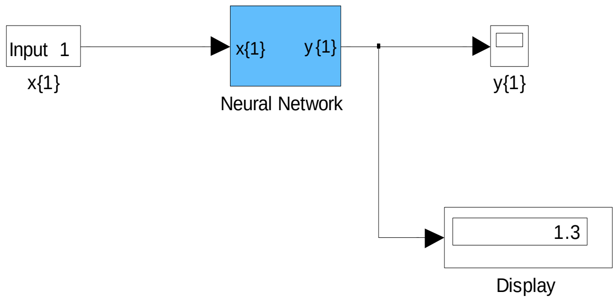

Fig 4 SIMULINK model at the course of the training to enhance transmission efficiency in multimode optic fiber

To design a SIMULINK model for enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.

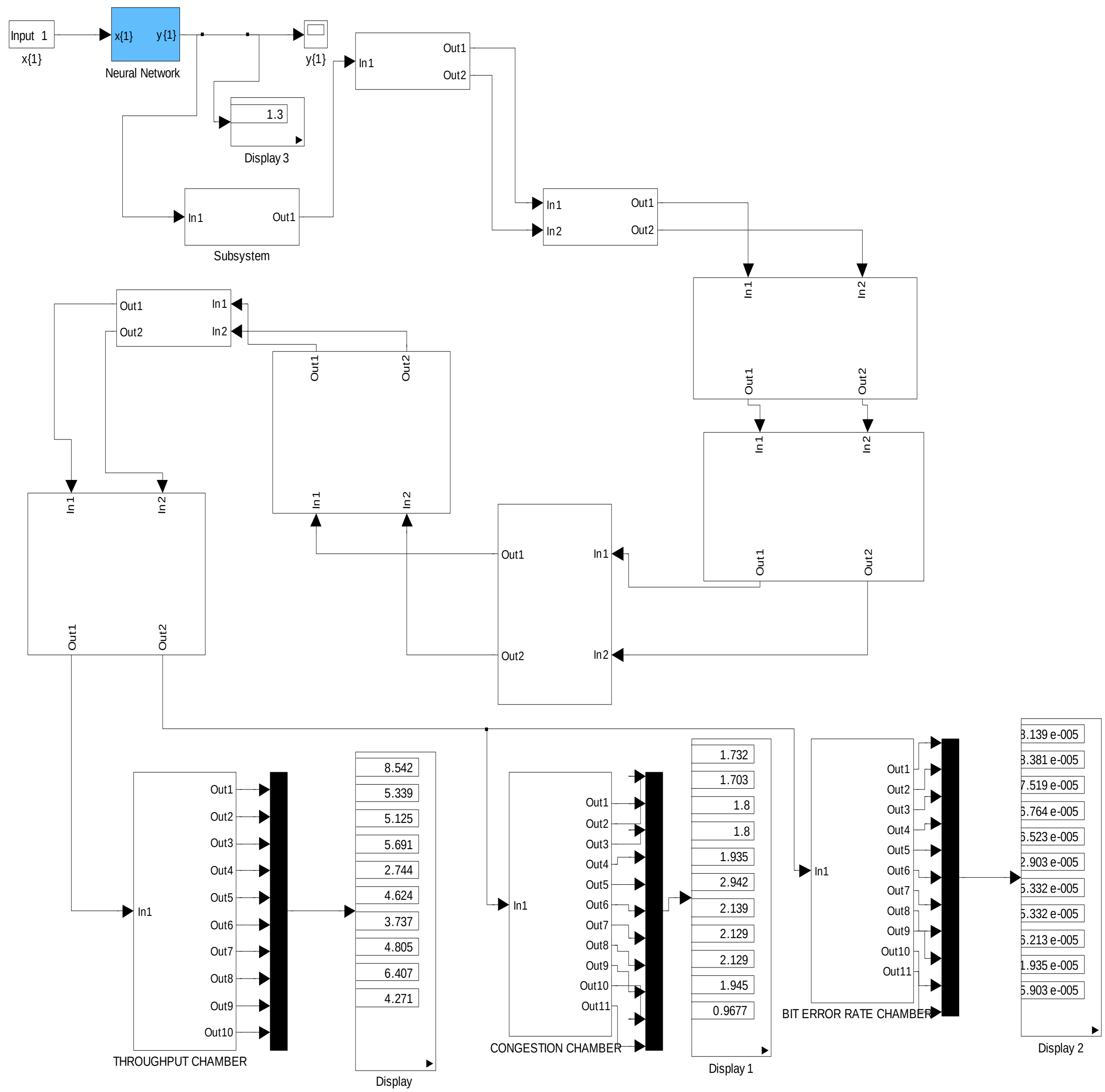

Fig 5: The simulink model

III. DISCUSSION OF RESULT

Table 4: Comparing conventional bit error rate and ANN bit error rate in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller

Time(s)	Conventional bit error rate(bits) in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.	ANN bit error rate (bits) in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.
1	0.0000841	0.00008139
2	0.0000866	0.00008381
3	0.0000777	0.00007519
4	0.0000699	0.00006764
5	0.0000674	0.00006523
6	0.000030	0.00002903
7	0.0000551	0.00005332
8	0.0000551	0.00005332
9	0.0000642	0.00006213
10	0.000020	0.000001935
11	0.000061	0.00005903

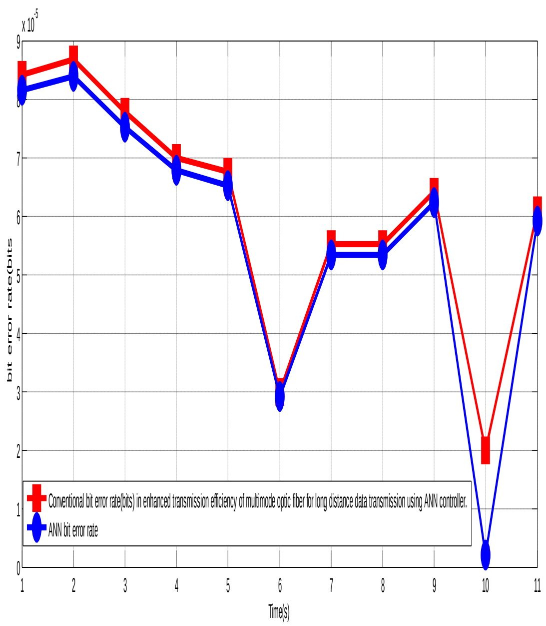

Fig 6 comparing conventional bit error rate and ANN bit error rate in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller. Fig 6 shows that the highest conventional bit error rate is 0.0000841 bits that delays the network transmission efficiency. On the other hand, the highest ANN controller bit error rate is 0.00008139bits that helps to enhance transmission efficiency in multimedia optic fiber.

Table 5: comparing conventional congestion and ANN congestion in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller

Time (s)	Conventional congestion experienced hourly in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.	ANN congestion in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.
1	1.79	1.732
2	1.76	1.703
3	1.86	1.8
4	1.86	1.8
5	2.0	1.935
6	3.04	2.942
7	2.21	2.139
8	2.2	2.129
9	2.2	2.129
10	2.01	1.945
11	2.1	1.9677

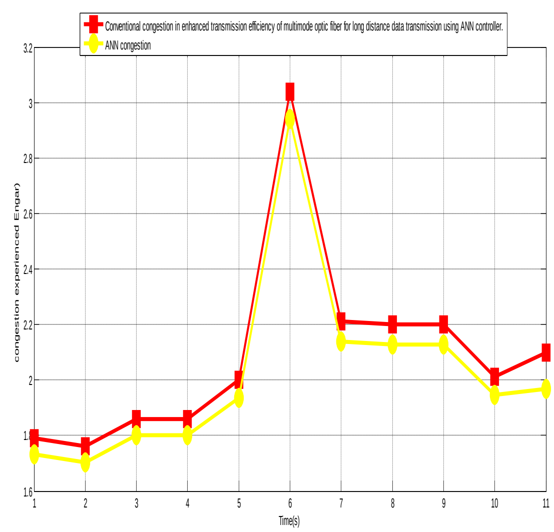

Fig 7 comparing conventional congestion and ANN congestion in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.

In fig 7 the lowest conventional congestion occurred in 2s and is1.76 Engar while that when ANN controller is incorporated in the system at the same time is1.703Engar thereby enhancing the transmission efficiency of multimedia optic fiber.

Table 6: Comparing conventional throughput and ANN throughput in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller

Time (s)	Conventional throughput experienced (bps) in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.	ANN throughput (bps) in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.
1	8	8.542
2	5	5.339
3	4.8	5.125
4	5.33	5.691
5	2.57	2.744
6	4.33	4.624
7	3.5	3.737
8	4.5	4.805
9	6	6.407
10	4	4.271

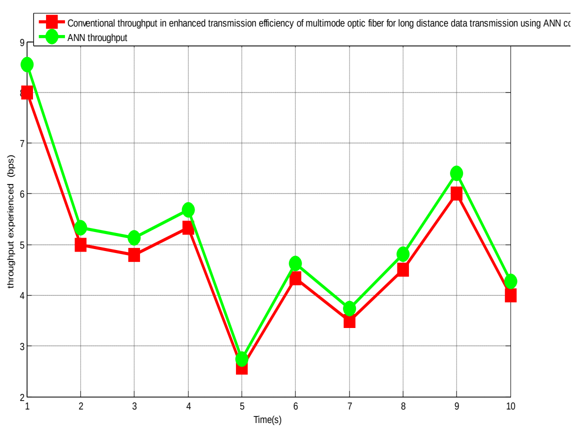

Fig 8: Comparing conventional throughput and ANN throughput in enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller.

In fig 8 the highest conventional throughput is 8bps while the throughput when ANN controller is incorporated in the system is 8.542bps that tremendously enhanced the transmission efficiency of multimode optic fiber.

IV.CONCLUSION

The slow in transmission experienced in multimode optic fiber has arisen as a result of congestion, low throughput interference to mention a few. This ugly situation of slow in transmission in multimedia optic fiber is out vied by introducing enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller. It is wittingly achieved in this manner, characterizing the network under study, determining the causes of delay in transmission efficiency of multimode optic fiber such as congestion low throughput and much bit error rate from the characterized network, training ANN in the causes of delay in transmission network to enhance its performance and designing a SIMULINK model for enhanced transmission efficiency of multimode optic fiber for long distance data transmission using ANN controller. The results obtained are the lowest conventional congestion occurred in 2s and is 1.76 Engar while that when ANN controller is incorporated in the system at the same time is1.703Engar thereby enhancing the transmission efficiency of multimedia optic fiber and the highest conventional throughput is 8bps while the throughput when ANN controller is incorporated in the system is 8.542bps that tremendously enhanced the transmission efficiency of multimode optic fiber.

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