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Intelligent Routing Algorithm Using Antnet

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ABSTRACT
The delay in the transporting packets or data from one point to the other has become a big problem in communication network. This can be surmounted by characterizing a data network with a view in finding out the throughput performance, modeling a dynamic routing algorithm that provides paths that change dynamically in response to network traffic and congestion, thereby increasing network performance because data travel less congested paths, simulating the intelligence routing algorithm using Ant net; that has properties like learning, reasoning and decision making with respect to packet transmission in a data network using MATLAB/SIMULINK as a tool and comparing the performance of the model to existing routing algorithm

Keywords: *Routing, intelligent, ANTNET*

1. INTRODUCTION:

Large-scale, wide area data networks are a part of today's global communication infrastructure. Networks such as the Internet have become an integral medium of information transfer, ranging from personal communication to electronic commerce and entertainment. The importance of such networks will only increase as the electronic world becomes more prevalent. The basic function of a data network is very simple: delivering data from one network node to another. Achieving this goal requires many network components, including physical computers and links, signaling protocols between computers, and data packaging protocols. This thesis addresses one such component, routing; the process that logically connects network nodes by calculating paths between nodes so that data sent by one node traverses the calculated path to its destination.

Although many algorithms in graph and operational research literature calculate paths between nodes, the challenge in developing network routing algorithms is in dealing with the scale and distribution of the physical network. Because typical wide area networks have nodes on the order of tens of thousands, routing algorithms must be scalable. In addition, routing algorithms must be able to calculate paths in a distributed manner due to the global and distributive nature of physical networks. Moreover, because of the actual physical network, routing algorithms need to cope with events such as physical component failures and recalculate paths whenever such events occur. Finally, routing algorithms need to calculate paths to allow nodes to achieve high throughput performance.

In general, routing algorithms view a network as a weighted graph, where network links are represented as graph edges and network routers as graph vertices. Network routers are network nodes that execute routing algorithms and ensure that data travel the calculated paths. In the weighted graph, the assignment of edge weights depends on the specific routing algorithm; typically, the assignment reflects the latency and bandwidth of the link (Atul, 1999).

After a routing algorithm makes these link cost assignments, it then computes paths between nodes. Thus, the specific routing algorithm that routers execute determines the paths that data will travel in the network.

Routing algorithms in today's Internet base their implementations on the static metric single shortest pathrouting model. Single shortest path means that routing algorithms provide, at any given time, the least-cost path between nodes. Static metric refers to link cost assignments which are based on static properties of a link, such as its bandwidth or latency. As shown later, the main drawback of this model is that static metric shortest paths do not always provide good network performance.

1. Problem Statement

The general problem of routing packets in transport networks is in itself nothing new. The shortest path problem is a basic part of graph theory, with multiple solutions and countless applications in different fields. Previous implementations suffer two problems: routing instability and high routing overheads. Routing instability occurs when paths are constantly being recomputed and do not stabilize. This instability degrades network performance and increases the probability of network congestion and failures. The second problem is high routing overheads. The overheads are in terms of the CPU cycles and messages required for path re-computation.

So, one of the fast changing areas in internetwork routing is the application of intelligence into it. Among the major challenges that exist in network, the coexistence of multiple infrastructure systems and different models are some of the prime issues. The existing infrastructure lacks the intelligent awareness and coordination of numerous components and applications running on the network and it has opened up various complexities. Also, the coordination with different models needs a good understanding of the services provided by the layers. These two criteria had led the researchers to think of making the network nodes more intelligent. It is reasonable to say that intelligence in the nodes must include properties like learning, reasoning and decision making. To establish accurate results for optimal path, a network must be made aware of its environment. This can be realized by helping the network to learn, think and remember and hence making it intelligent.

2. Research Objective

This research is focused on proposing an intelligent routing algorithm for data network using path vector technique. Its main objective includes:

1. To characterize a data network with a view in finding out the throughput performance.
2. To model a dynamic routing algorithm that provides paths that change dynamically in response to network traffic and congestion, thereby increasing network performance because data travel less congested paths.
3. To simulate the intelligence routing algorithm using Antnet; that has properties like learning, reasoning and decision making with respect to packet transmission in a data network using MATLAB/SIMULINK as a tool
4. To compare the performance of the model to existing routing algorithm

3. Methodology

To characterize a data network with a view in finding out the throughput performance

Table 1 : DATA COLLECTION ON PACKET LOSS DUE TO CONGESTION WITH DATE OF DATA COLLECTION: 1th TO 8th of FEBUARY, 2018

Time	Packet Transferred Data	Packet Retransmitted	Packet Loss
12.00 AM	30	25	0.8
1.00 AM	28	24	0.833
2.00 AM	26	20	0.7
3.00 AM	26	18	0.556
4.00 AM	24	16	0.5
5.00 AM	24	14	0.2858
6.00 AM	22	12	0.167
7.00 AM	22	11	0.167
8.00 AM	22	11	0.182
9.00 AM	20	12	0.2
10.00 AM	18	13	0.6154
11.00 AM	18	14	0.7143

To calculate the efficiency in 12.00 AM

Recall

Efficiency = 100% x (transferred-retransmitted)/ Transferred

Efficiency = 100 x (30 – 25)/ 25

Efficiency = 100 x 5/25

Efficiency = 100/5 = 20

Then, to calculate the network loss in 12.00AM

Network loss or packet loss = 100 – efficiency

Network loss = 100 -20 = 80 = 0.8

To calculate the efficiency in 1.00 AM
Efficiency = 100% x (transmitted– retransmitted)/ Transmitted
Efficiency = 100 x (28 – 24)/24
Efficiency = 100 x 4 /24
Efficiency =16.7 = 0.167l

To calculate the network loss
Network loss = 100 – 16.7
Network loss = 83.3
Network loss = 0.833

To calculate the efficiency in 2.00 AM
Efficiency = 100% x (26 – 20)/20
Efficiency = 100 x 6/20 = 30
Network loss = 100 – 30 = 70 = 0.7

To calculate the efficiency in 3.00AM
Efficiency = 100% X (26 -18)/18
Efficiency = 100 x 8 /18
Efficiency = 800/18 = 44.4
Network loss = 100 – 44.4
Network loss = 55.6 = 0.556

To find the Efficiency at 4.00 AM
Efficiency = 100% X (24 - 16)/16
Efficiency = 800/16= 50
Network loss = 100 – 50 = 50 = 0.5

To find the Efficiency at 5.00 AM
Efficiency = 100 x (24 -14)/14
Efficiency = 1000/14 = 71.42
Network loss = 100 – 71.42
Network loss = 28.58 = 0.2858

To calculate the efficiency at 6.00 AM
Efficiency = 100 x (22 – 12)/12
Efficiency = 1000/12
Efficiency = 83.3
Network loss = 100 – 83.3
Network loss = 16.7 = 0.167

To calculate the efficiency at 7.00 AM
Efficiency = 100 x (22 -12)/12
Efficiency = 1000/12
Efficiency =83.3
Network loss = 100 – 83.3
Network loss = 16.7 = 0.167

To calculate the efficiency at 8.00 AM
Efficiency =100 x (20 – 11)/11
Efficiency = 900 /11
Efficiency = 81.8
Network loss = 100 -81.8 = 18.2
Network loss = 0.182

To calculate the efficiency at 9.00 AM
Efficiency = 100 x (22 – 10)/10
Efficiency = 800/10 = 80
Network loss = 100 – 80
Network loss = 20 = 0.2

To calculate the efficiency at 9.00 AM
Efficiency = 100 x (20 -12)/12
Efficiency = 800 /12 = 66.67
Network loss = 100 – 66.67
Network loss = 33.3 = 0.333

To calculate the efficiency at 10.00 AM
Efficiency = 100 x (18 – 13)/13
Efficiency = 500/13
Efficiency = 38.46
Network loss = 100 – 38.46
Network loss = 61.54 = 0.6154

To calculate the efficiency at 11.00 AM
Efficiency = 100 x (18 -14)/14
Efficiency = 400/14 = 28.57
Network loss = 100 -28.57
Network loss = 71.43 = 0.7143

Table 2: DATA COLLECTION ON PACKET LOSS DUE TO CONGESTION PER HOUR

Packet loss experienced hourly	Congestion experienced hourly
0.8	2.04
0.833	1.96
0.7	2.33
0.556	2.94
0.5	3.266
0.2858	5.67
0.167	9.78
0.167	9.78
0.182	8.97
0.2	8.17
0.6154	4.6
0.7143	2.29

To find the congestion at 12.00 AM

The mathematical model for congestion control in improving optimized real time monitoring and evaluation of GSM quality of service using intelligent agent is as shown in equation 3.2

To find the congestion at 12.00 AM

L = 8/ 3W^2 --1

Where L is packet loss

W is the network congestion

Then, make W the subject formula in equation 1

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

W = Square root of 8/3W^2-----------------------------2

To find the network congestion in 12.00 AM

W1 = square root 8/ 3 x 0.8^2

W1 = square root 8 /3 x 0.64 = 8/1.92

W1 =√ 4.17

W1 =2.04

Congestion in 1.00 AM

W2 = square root 8/3 x 0.833^2 = 8 / 3 x 0.833^2 = 8/2.081667

W2 =√ 3.84

W2 = 1.96

Congestion in 2.00 AM

W3 = Square root of 8/ 3 x 0.7^2 = 8/1.47

W3 = square root of 8/ 1.47 = 5.442

W3 = √5.442

W3 = 2.33

Congestion in 3.00 AM

W4 = Square root of 8/ 3 x0.556^2

W4 = square root of 8/ 0.927

W4 = √8.63

W4 = 2.94

W4 = 2.94

Congestion in 4 A.M

W5 = square root of 8/3 x 0.5^2

W5 = Square root of 8/ 0.75 =10.67

W5 = √10.67

W5 = 3.266

Congestion in 5 A.M

W6 = Square root 8 / 3 x 0.2858^2

W6 = Square root 8 / 0.25

W6 = √32

W6 = 5.67

Congestion in 6 A.M

W7 = Square root 8/ 3 x 0.167^2

W7 = Square root 8/ 0.0837

W7 = √95.57

W7 = 9.78

Congestion in 7A.M

W8 = 8/ 3 x 0.167^2

W8 =8/0.0837

W8 = 8/0.0837

W8 = √95.57

W8 = 9.78

Congestion in 8A.M

W8 = 8/ 3 x 0.182^2

W8 = 8/0.099372

W8 = 80.5

W8 = √80.5

W8 =8.97

Congestion in 9 A.M

W9 = 8/3 x 0.2^2

W9 = 8/0.12

W9 = √66.7

W9 = 8.167

Congestion in 10 A.M

W10 = 8/3 x 0.6154^2

W10 = 8 /0.378717

W10 =√ 21.12

W10 = 4.6

Congestion in 11 A.M

W11 = 8/3 x 0.7143^2

W11 = 8/1.53

W11 = 5.23

W11 = √5.23

W 11= 2.29

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

Taking into consideration the worst case scenario, the linear relationship between BER and packet error rate (PER) is expressed as:

PER= 8 × BER ×MTU ×66/64--------------------------3

Where the MTU is the maximum transmission unit, and using the Ethernet standards it is set to 1500 bytes for the simulations and then the MTU is increased to improve performance. A conversion from 8 bits to 1 byte is shown,

Recall 1 byte = 8bits

1500bytes = 8 x 1500 = 12000bits

MTU = 12000bits

PER is packet loss and BER is bit error rate

To evaluate the bit error rate in 12 A.M when the packet loss is 0.8

Make BER the subject formula in equation 3.3

BER1 = PER/8 × MTU × 1.03125 ---------------------4

BER1 = 0.8/8 x 12000 x1.03125

BER1 = 0.8/9900

BER1 = 0.000081bits

To find the bit error rate in 1 A.M

BER2 = **0.833/9900**

BER2 = 0.000084bits

Bit error rate in 2 A.M

BER3 = o.7/9900

BER3 = 0.000071bits

Bit error rate in 3 A.M

BER4 = 0.556/9900

BER4 = 0.0000562bits

Bit error rate in 4A.M

BER5 = 0.5/9900

BER5 = 0.000051 bits

Bit error rate in 5A.M

BER6 = 0.2858/9900

BER6 = 0.000030 bits

Bit error rate in 6A.M

BER7 = 0.167/9900

BER7 = 0.000017bits

Bit error rate in 7A.M

BER8 = 0.167/9900

BER8 = 0.000017bits

Bit error rate in 8A.M

BER9 = 0.182/9900

= 0.000018bits

Bit error rate in 9 A.M

BER10 = 0.2/9900

= 0.000020bits

Bit error rate in 10A.M

BER11 = 0.6154/9900

= 0.000062bits

Bit error rate in 11A.M

BER12 = 0.7143/9900

= 0.000072bits

Table 3: DATA COLLECTION ON PACKET LOSS DUE TO CONGESTION PER HOUR WITH BIT ERROR RATE

Packet Loss Experienced Hourly	Congestion Experienced Hourly	Bit Error Rate
0.8	2.04	0.000081bits
0.833	1.96	0.000084bits
0.7	2.33	0.000071bits
0.556	2.94	0.0000562bits
0.5	3.266	0.000051bits
0.2858	5.67	0.000030bits
0.167	9.78	0.000017bits
0.167	9.78	0.000017bits
0.182	8.97	0.000018bits
0.2	8.17	0.000020bits
0.6154	4.6	0.000062bits
0.7143	2.29	0.000072bits

To model a dynamic routing algorithm that provides paths that change dynamically in response to network traffic and congestion, thereby increasing network performance because data travel less congested paths

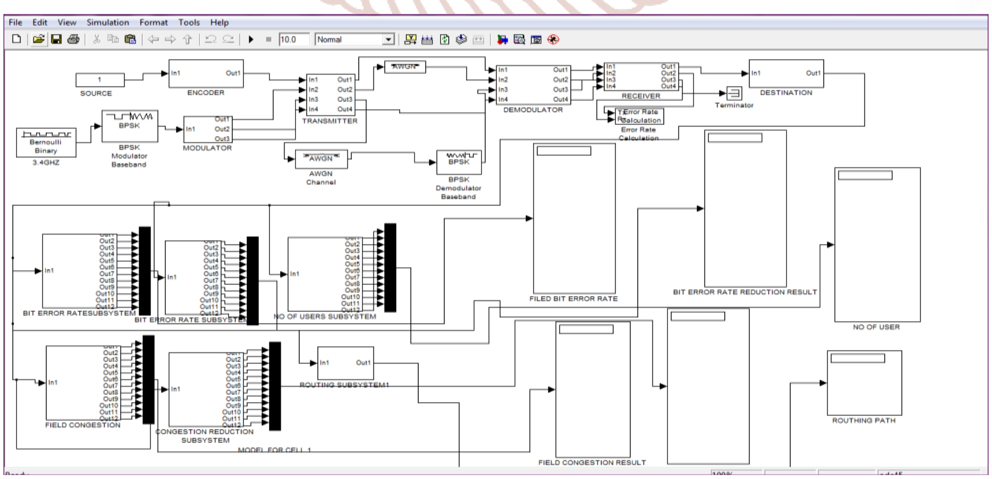

Fig 1: Designed model for a dynamic routing algorithm that provides paths that change dynamically in response to network traffic and congestion

Fig 1 shows designed model for a dynamic routing algorithm that provides paths that change dynamically in response to network traffic and congestion. In fig 1 the design was done in mat lab software with the necessary blocks like channel, scope, and transmitter. The empirical data collected from the GLO network were inserted inside the designed model.

To simulate the intelligence routing algorithm using Antnet; that has properties like learning, reasoning and decision making with respect to packet transmission in a data network using MATLAB/SIMULINK as a tool

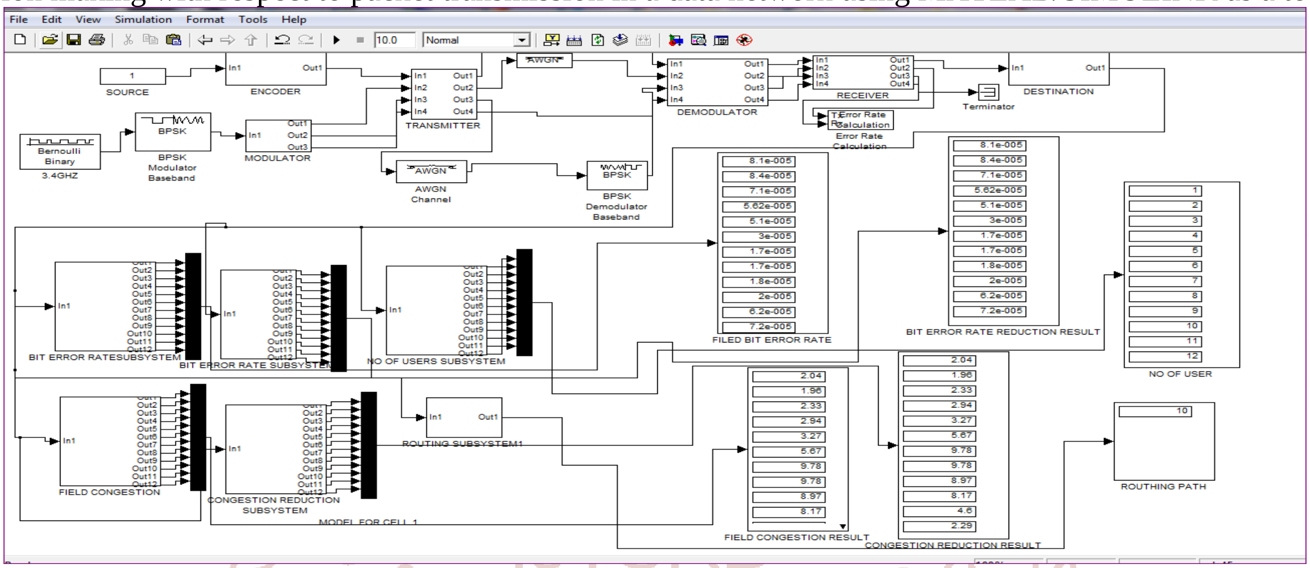

Fig 2 Simulated result of development of improving of throughput in data network without using intelligent routing.

Fig 2 shows simulated result of development of improving of throughput in data network without using intelligent routing. In fig 2 the simulated result is a high bit error rate coupled with congestion that make the network not to function effectively well.

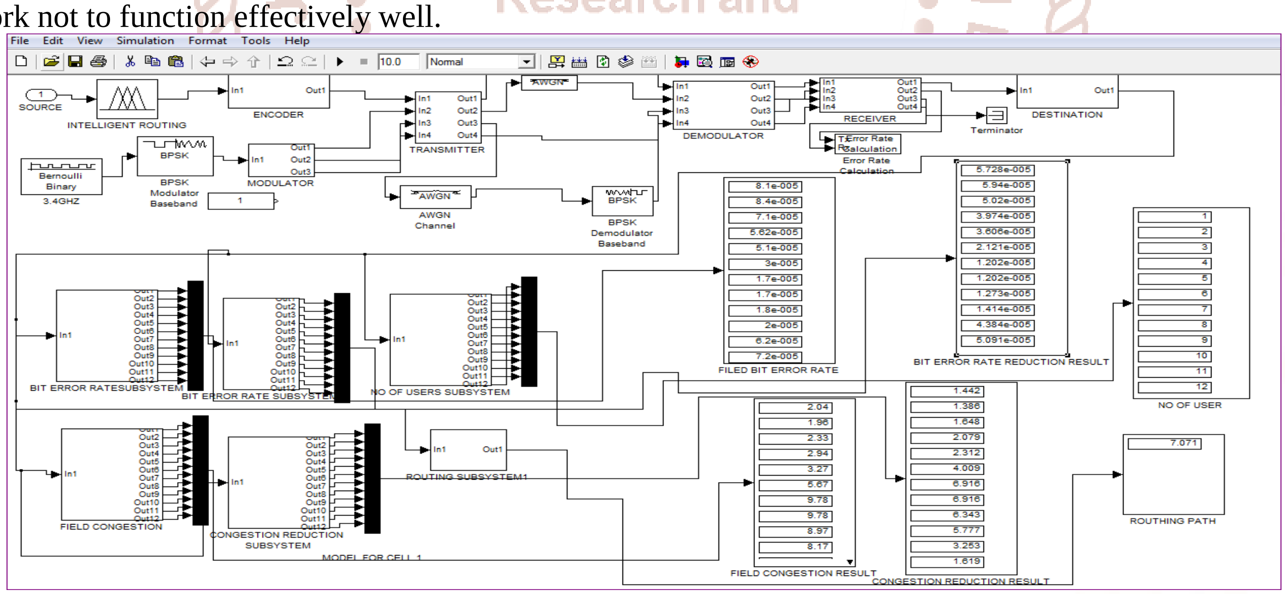

Fig 3 Simulated result of development of improving of throughput in data network using intelligent routing.

Fig 3 shows simulated result of development of improving of throughput in data network using intelligent routing. Fig 3 when simulated reduced both bit error rate and congestion concurrently thereby making the network to be free.

To compare the performance of the model to existing routing algorithm

Fig 3 gives a better result by reducing congestion and bit error rate than figure 2.

4. Result Analysis

Table 4: CONVENTIONAL CONGESTION VS NUMBER OF USERS

CONVENTIONAL CONGESTION	NUMBER OF USERS
2.06	1
1.96	2
2.33	3
2.94	4
3.27	5
5.67	6
9.78	7
9.78	8
8.97	9
8.17	10
4.60	11
2.29	12

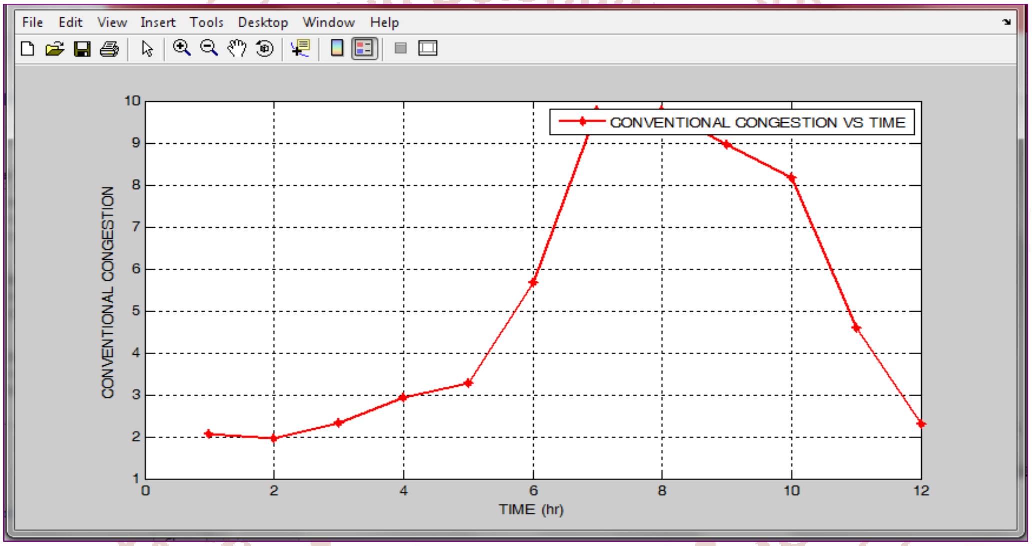

Fig 4 CONVENTIONAL CONGESTION VS NUMBER OF USERS

Fig 4 shows conventional congestion vs number of users. The lowest coordination of congestion vs number of users is (1.96, 2) while the highest coordination of congestion vs number of users (8.97,8).

Table 5: CONVENTIONAL CONGESTION VS NUMBER OF USERS USING INTELLIGENT ROUTING

CONVENTIONAL CONGESTION USING INTELLIGENT ROUTING	NUMBER OF USERS
1.442	1
1.386	2
1.648	3
2.079	4
2.312	5
4.009	6
6.916	7
6.916	8
6.343	9
5.777	10
5.253	11
1.619	12

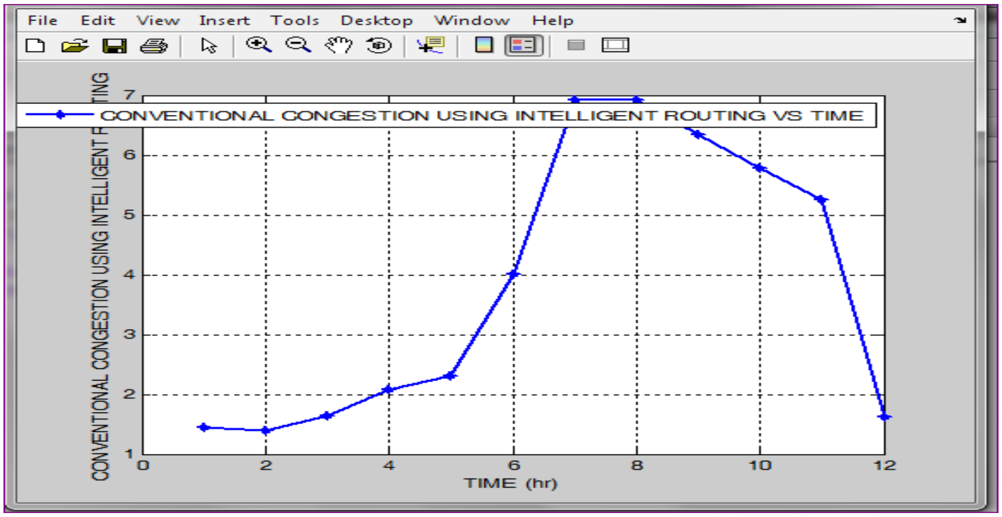

Fig 5 CONVENTIONAL CONGESTION VS NUMBER OF USERS USING INTELLIGENT ROUTING

Fig 5 shows conventional congestion vs number of users using intelligent routing. The highest coordination of congestion vs number of users is (6.916,7) and (6.916,7). The lowest coordination is (1.442, 2). This shows that there will be free communication network that its congestion is free.

Table 6: COMPARING CONVENTIONAL CONGESTION AND CONVETIONAL CONGESTION VS NUMBER OF USERS WITH INTELLIGENT ROUTING ALGORITHM

CONVENTIONAL CONGESTION	CONVENTIONAL CONGESTION USING INTELLIGENT ROUTING	NUMBER OF USERS
2.06	1.442	1
1.96	1.386	2
2.33	1.648	3
2.94	2.079	4
3.27	2.312	5
5.67	4.009	6
9.78	6.916	7
9.78	6.916	8
8.97	6.343	9
8.17	5.777	10
4.60	5.253	11
2.29	1.619	12

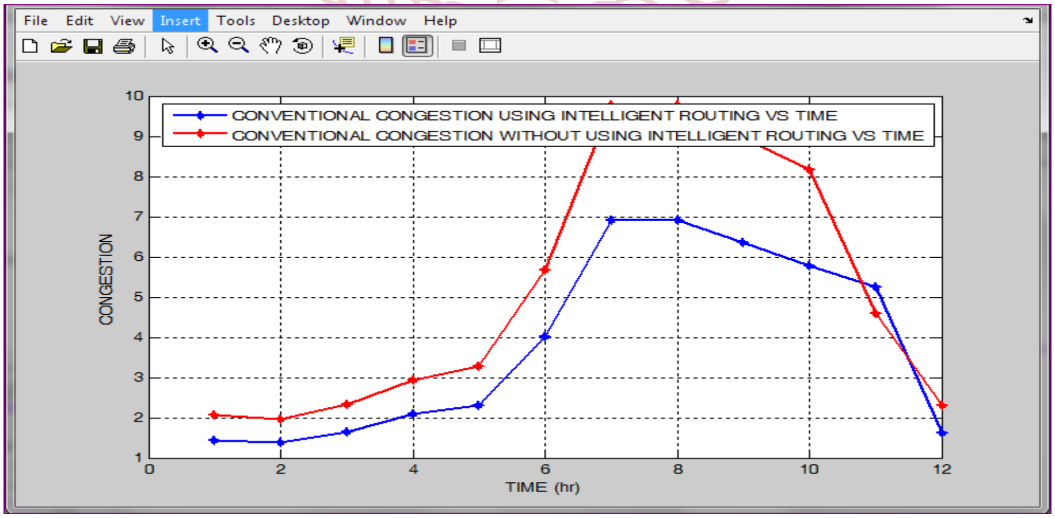

Fig 6 COMPARING CONVENTIONAL CONGESTION AND CONVETIONAL

CONGESTION VS NUMBER OF USERS WITH INTELLIGENT ROUTING ALGORITHM.

Fig 6 shows comparing conventional congestion and conventional congestion vs number of users with intelligent routing algorithm. The highest coordination of conventional approach and intelligent routing approach are(9.78,7) and (.6.916.7). This shows that there is free network in communication network when intelligent routing is used.

5. Conclusion

The manner by which free communication network is easily noticed in our communication network has arisen as a result of high bit error rate, that constitutes interference and congestion which has led to economic degradation among the subscribers that in bark in business and the country at large can be overcome by development of intelligent routing algorithm for the improvement of throughput in data network. This can be overcome in this manner. Characterizing a data network with a view in finding out the throughput performance. Modeling a dynamic routing algorithm that provides paths that change dynamically in response to network traffic and congestion, thereby increasing network performance because data travel less congested paths.

simulating the intelligence routing algorithm using Antnet; that has properties like learning, reasoning and decision making with respect to packet transmission in a data network using MATLAB/SIMULINK as a tool and comparing the performance of the model to existing routing algorithm

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