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IMPROVING THE QUALITY OF SERVICE DELIVERY IN A TELECOMMUNICATION COMPANY IN NIGERIA: AN INTELLIGENT AGENT APPROACH

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ABSTRACT

The majority of telecommunications firms were unable to promise an entirely free and high-quality communication network service. Undesirable service delivery had recently occurred, and this issue may be attributed to the lack of a free, high-quality network that developed as a result of failing to monitor when there was a high bit error rate. The issue has been raised, and in this research, an intelligent agent device-based real-time evaluation and monitoring of GSM quality of service was proposed as a potential solution. This was done by first figuring out the channel capacity for a GSM quality network, getting the bit error rate for that capacity, designing an intelligent GSM rule to watch over and minimize high bit error rates for quality service, and finally designing a Simulink model for real-time monitoring and evaluation of GSM quality of service using intelligent agents. When compared to using traditional methods or techniques like hierarchical or proportional integral derivative, the result was 10% better (PID). Other traditional approaches are preferred to real-time monitoring and evaluation of GSM quality of service employing intelligent agents since they can ensure a flawless and unrestricted network in our communication network

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Keywords- Real time monitoring and evaluation of GSM quality of service, intelligent agent

INTRODUCTION

Modern concepts and technologies have enhanced how IT services deliver, manage, and control their services to end users. To achieve the tremendous implications of this new trend, telecommunications networks and equipment must operate. The evolutionary tendency has an impact on network components ranging from low resource devices to big scale distributed applications. The way service providers manage and use the various IT services is changing as a result of new technology and concepts in the data and telecommunications industries. Despite the impacts of this technical advancement that was included into the network, management systems must guarantee the delivery of high-quality services. There are now many different network components being used in competition, ranging from modest resource devices to massive distributed applications. Reduced quality of service happens when a network node or link is carrying more data than it can manage, which is referred to as network congestion in data networking and queuing theory. Queueing delays, packet losses,

or eventually the blocking of new connections are the unfavorable effects.

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AIM OF THE STUDY

This paper is aimed at improving the quality of service delivery in a Telecommunication Company with the introduction of an Intelligent Agent
1.3 Objectives of Study
Congestion on the network has been brought on by the increased demand for mobile phones and data service applications. Consequently, the goals of this work were to i. ascertain the GSM Quality Network's channel capacity. ii. Determine the capacity and assess the bit error rate iii. Create an intelligent GSM rule that will track and reduce high bit error rates for high-quality service.
Create a SIMULINK model utilizing an intelligent agent for real-time monitoring and assessment of GSM quality of service.

REVIEWS

The scope of prior work

Numerous research on GSM monitoring for high-quality service have been conducted. Using Intelligent Mobile-Agent based Scalable Network Management Architecture for Large-Scale Enterprise Systems was the focus of a study conducted by Sharma and Mishra [1]. They used Mobile Agents to distribute and delegate management activities in their study to examine the scalability and flexibility issues of centralized (SNMP or CMIP management models) models. The issues affecting the GSM Quality network [2][3] were not addressed by this. The complexity of their own framing and protocol architecture or structures has increased as a result of several technologies, including SONET, ATM, Ethernet, and DWDM, to name a few, that are offered at various tiers of the Access, Metro, and Core (long haul) sectors of the network. As a result, managing and controlling the traffic in these networks had become difficult. The Internet Engineering Task Force (IETFsimple)'s network management protocol (SNMP) for data networks has dominated it [4]. Commonly created using a centralized architecture, the OSI Common Management Information Protocol (CMIP) for telecommunication networks [5] suffers from a lack of distribution, a lack of flexibility, low scalability, and fault tolerance. [6][7]. These require network operators at the NMS level to improve real-time judgments and manually choose fixes for the myriad network issues. The data collection and reporting processes handled by these network management systems involve a large amount of data, which uses up a lot of bandwidth and adds to the overall computing load. According to [8], it can significantly strain the network and clog up traffic at the manager host. Besides The competence of these centralized management duties may be constrained since some of their tasks, such as upfront judgment, forecasting, data analysis, and making sincere efforts to maintain service quality, may be challenging. Network management based on mobile agents [9] and [10] allows agents to deliver requests to controlled devices/objects after moving close to them by providing them with network management intelligence. The focal point of this article is real-time monitoring and evaluation of GSM quality of service using intelligent agents. It is commonly known that wireless mobile communication systems have developed from the first generation (1G) analogue system through the second generation (2G) digital system to the third generation (3G) high-speed systems, which are constantly improving. Artificial intelligence was the inspiration for the idea of agent- and multi-agent-based technologies [11, 12]. An interconnected network troubleshooter or solution provider known as a multi-agent based system works together to tackle technical difficulties or issues that are beyond the scope of a single agent [13]. As a result, the idea's roots can be traced back to the first application of artificial intelligence (AI) seventy years ago. Software agents are thought of as covert software detectives who offer a generic computing platform for carrying out tasks like information gathering, information filtering, and information searching. Software agents were originally intended to be a classified technology only for security reasons. This technology was used for personal assistants and online commerce. Agent attributes and multi-agent system properties both have several benefits [14, 15], including adaptability, autonomy, proactivity, and dependability. Prior to other business sectors, the military was the first to use the technology. The main area of interest in [16] was the crucial security management issue of intrusion detection. It created a multi-agent system for network security management.

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The goal of [17] was to create a multi-agent system implementation based on the SNMP Protocol for network administration. The goal of the multi-agent system, which consists of a number of agents, is to increase the effort of network administration in line with the defined policies. The research project described here focuses on the improvement quality of service deliverey[18]. It is recommended that players in the mobile telecommunications industry should strive to raise the level of customer satisfaction by focusing on courtesy and upgrading of their operational facilities in order to widen their coverage[19],[20],[21]. People now have easier access to learning alternatives outside of regular schooling thanks to technological advancements [22]. "Today, all you really need is a computer, smartphone, and an Internet connection to do a lot of things. Telecommunication infrastructure in your communities provides the essential services that support Internet access to these devices, so we, the subscribers, are expected to protect the infrastructure, while the service provider has a duty to deliver high-quality services that are dependable and affordable to the subscribers [23]. Therefore, the Global System for Mobile Communication (GSMC), a digital mobile network utilized in Europe and other areas of the world, is proposed to be monitored and evaluated using intelligent agents in this study.

MATERIALS AND METHODS

3.1 Estimating Bit Error Rate (BER)

First, the bit error rate in the channel capacity at frequency diversity was assessed in order to establish the channel capacity for the GSM quality network. Finally, a mathematical model for observing the network's behavior was put out. This made it easier to evaluate the system's performance.

What is the channel capacity for a tele printer channel with a100Hz,200Hz 300Hz, 400 Hz,500Hz and 600Hz bandwidth and a signal-to-noise ratio of 3 dB?

Solution:

Using Shannon's equation: C = B log2(1 + SNR) we have

B = 100 Hz and SNR =3dB   1

Therefore, SNR = 10^0.3   2

C1 = 4.76Bps

To calculate the capacity when the frequency is 200Hz

C2 = 200log2 (2.995)

C2 = 10^2*0.476

C2 = 47.6bps

To find the value of the capacity when the frequency is 300Hz

B = 300 Hz and SNR (in dB) = 3,

Therefore, SNR = 100.3

C3 = 300 log2 (1 + 100.3)

C3 = 476 bps

To evaluate the channel capacity when the frequency is 400Hz

C4 = 400log2(2.995)

C4 = 4760bps

To solve for the channel capacity when the frequency is 500Hz

C5 = 500log2(2.995)

C5 = 47600bps

To calculate the channel capacity when the frequency is 600Hz

C6 = 600log2 (2.995)

C6 = 476000bps

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A bit, two bits, three bits, four bits, five bits, six bits, seven bits, and eight bits could be wrongly received after 1,000 bits have been transferred as a result of interference between the transmitter and receiver. As a result, we will be able to assess the bit error rate for the given capacity.

In this example, BER is determined by dividing the total number of transmitted bits by the number of error bits.

$$\text{BER} = \frac{1}{1000} \quad 0.001$$

To find BER at 2 bit error rate

$$\frac{2}{1000000} = 0.000002$$

To find BER at 3 bit error rate

$$\text{BER} = \frac{\text{Error bits received}}{\text{Total number of bits}}$$

$$\text{BER} = \frac{3}{1000} \quad 0.003$$

To find BER at 4 bit error rate

$$\text{BER} = \frac{\text{Error bits received}}{\text{Total number of bits}}$$

$$\text{BER} = \frac{4}{1000} = 0.004$$

3.2 To design an intelligent GSM rule that will monitor and reduce the high bit error rate for quality service

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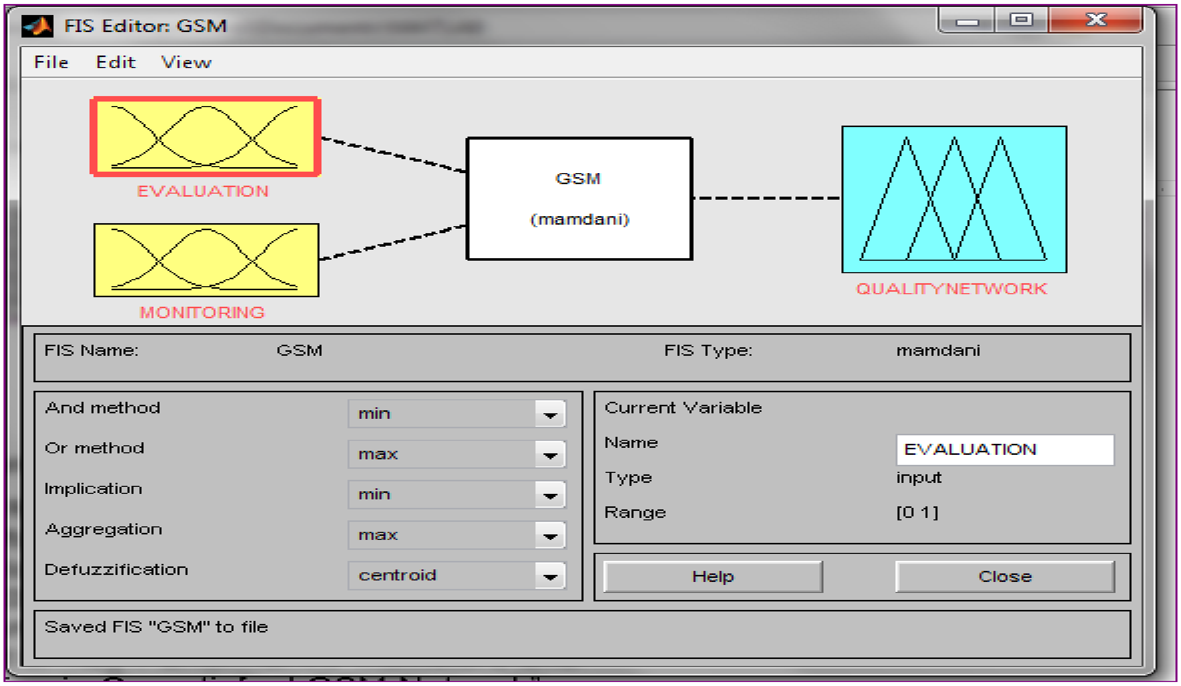

Fig 1 Fuzzy inference system editor for GSM

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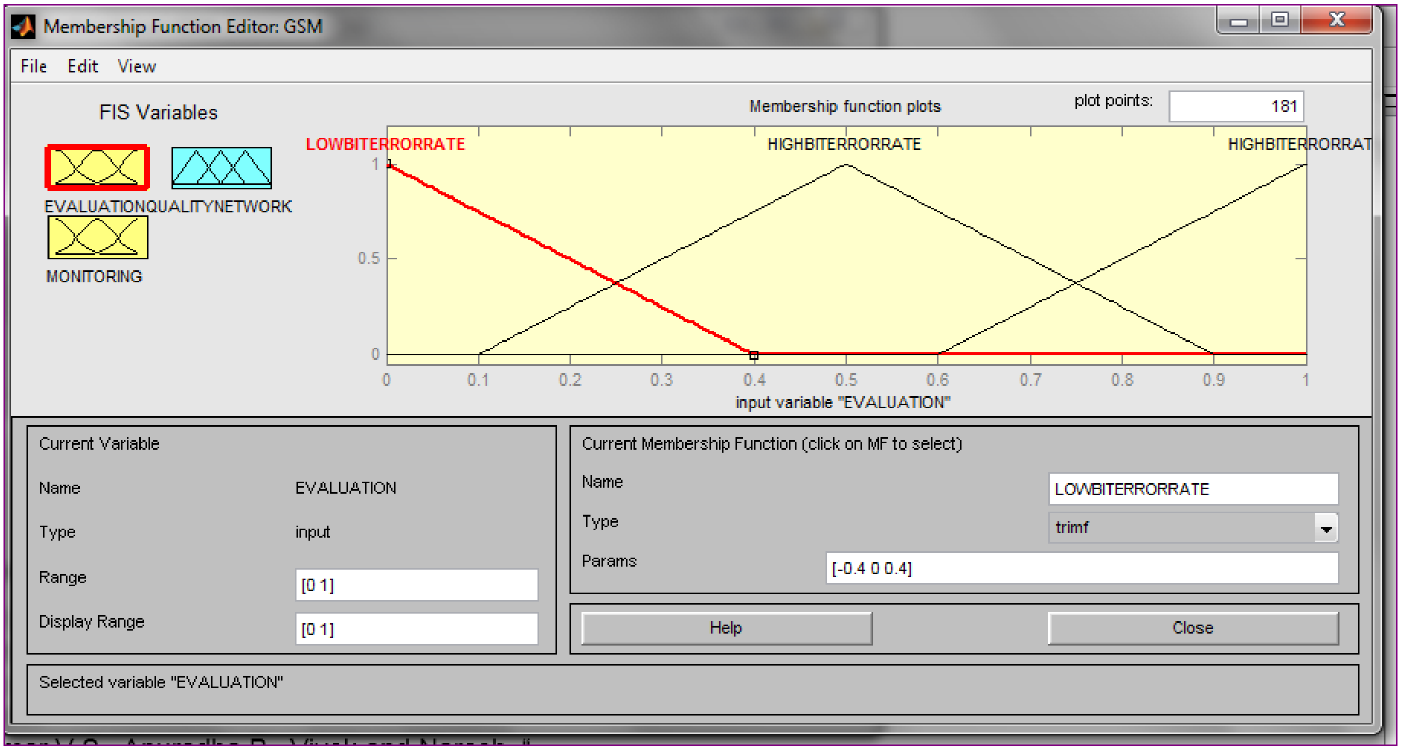

Fig 2 Membership function for GSM evaluation.

Fig 2 shows membership function for GSM evaluation that analysis the bit error rate.

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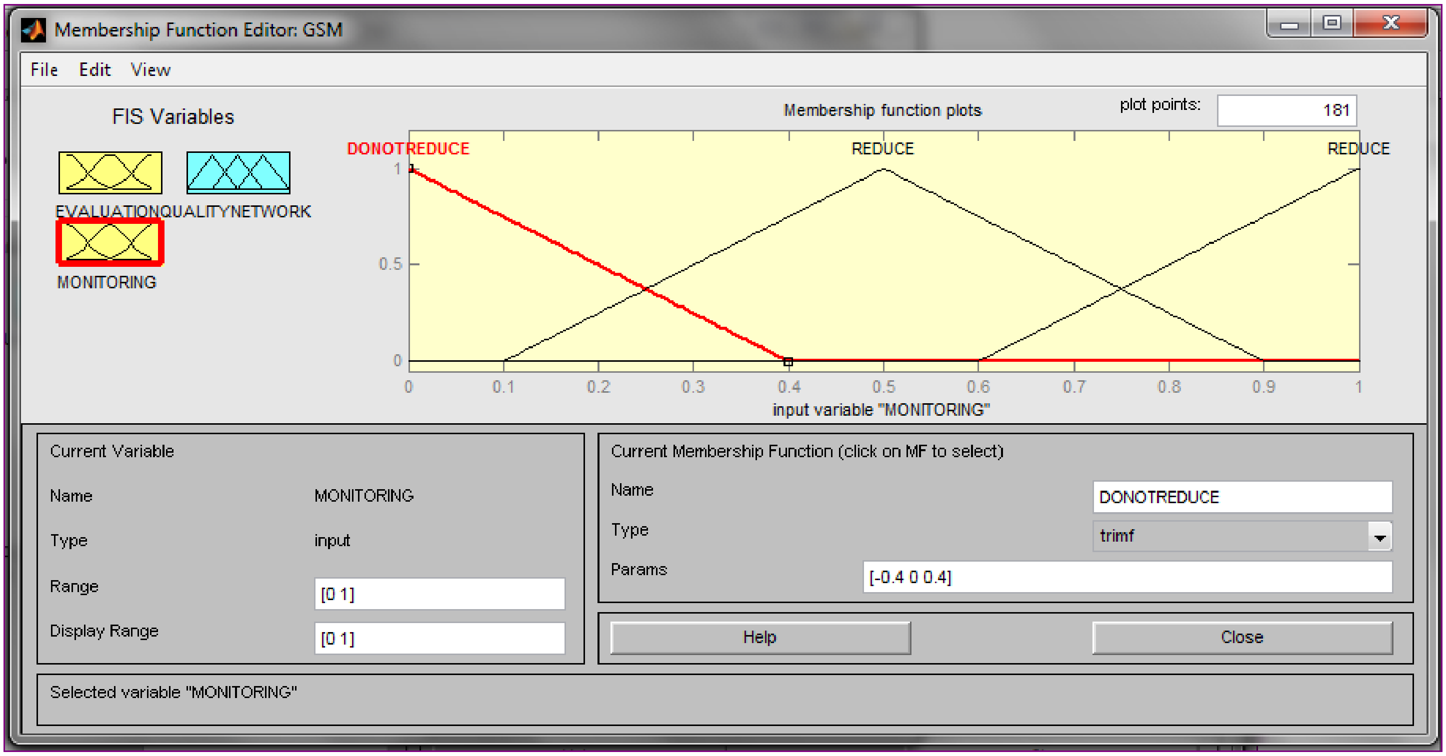

Fig 3 Membership function editor for monitoring

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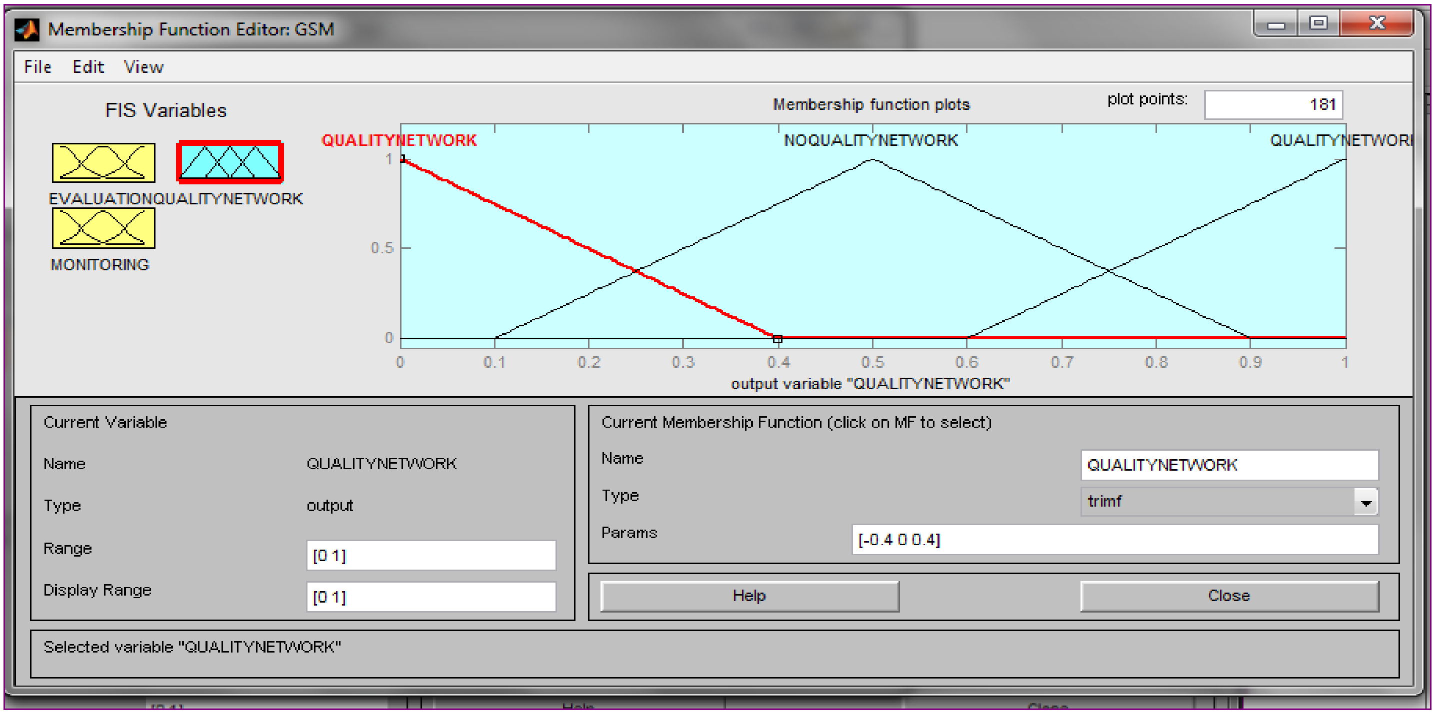

Fig 4 Membership function for quality network

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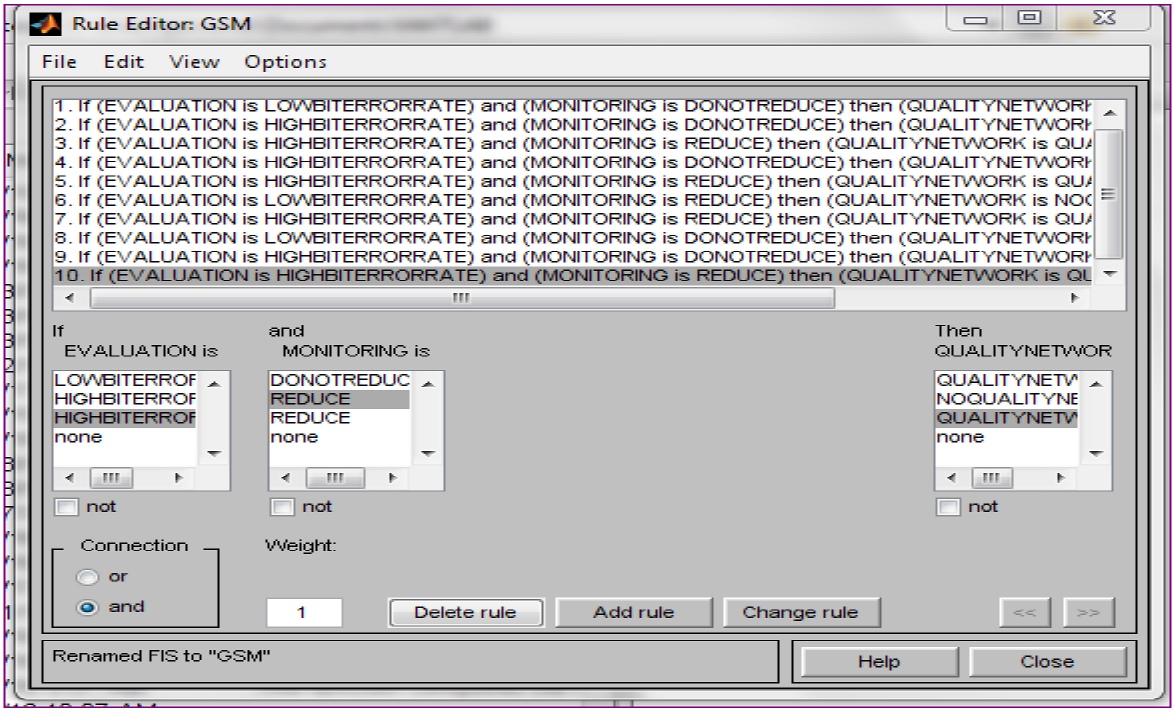

Fig 5 Rule editor for GSM network

Fig 5 Shows rule editor for GSM network that is strictly trained to stick to the rule of reducing the bit error rate when it is high for an efficient and quality network.

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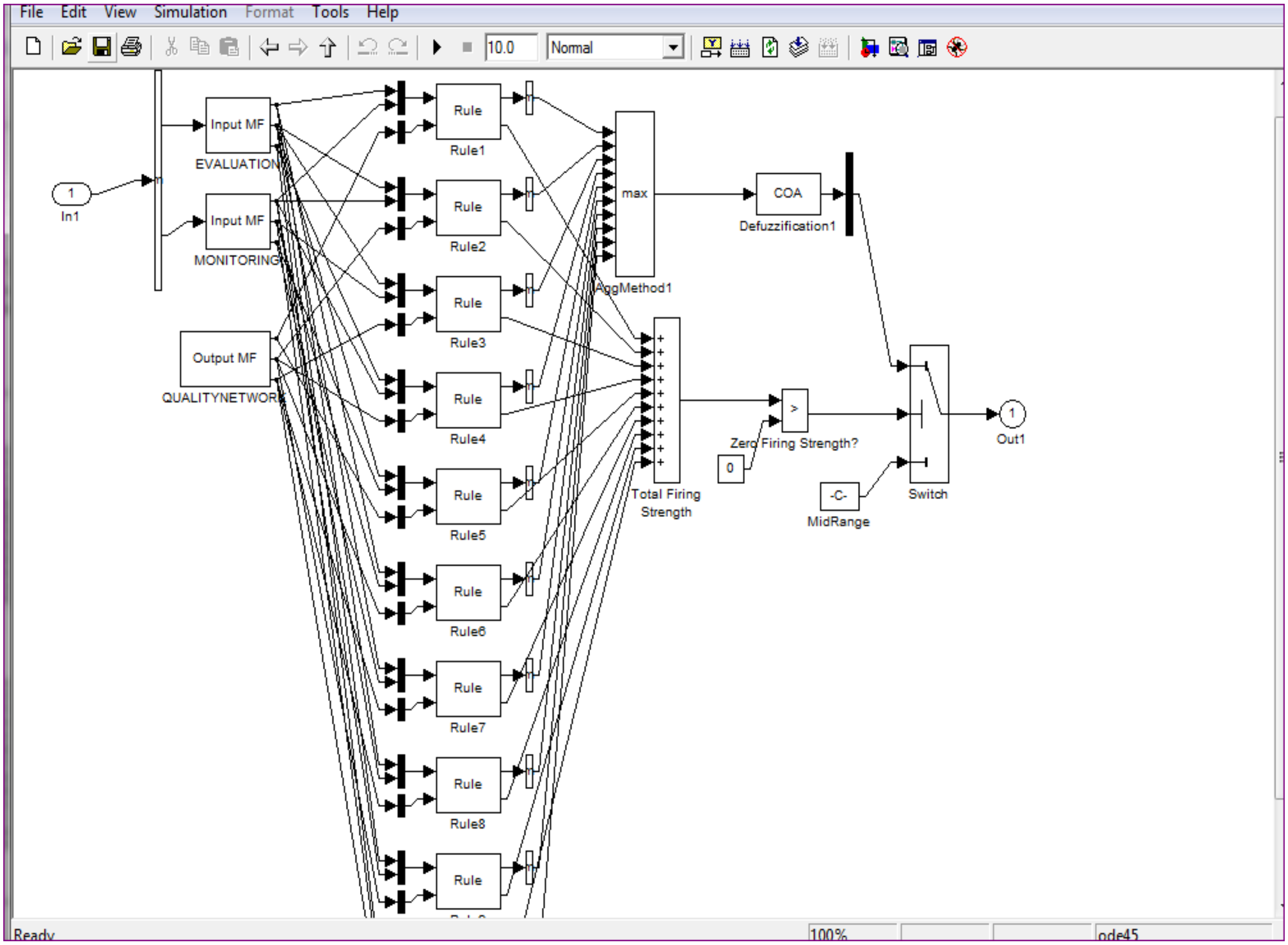

Fig 6 Imbibed rules in the fuzzy logic block

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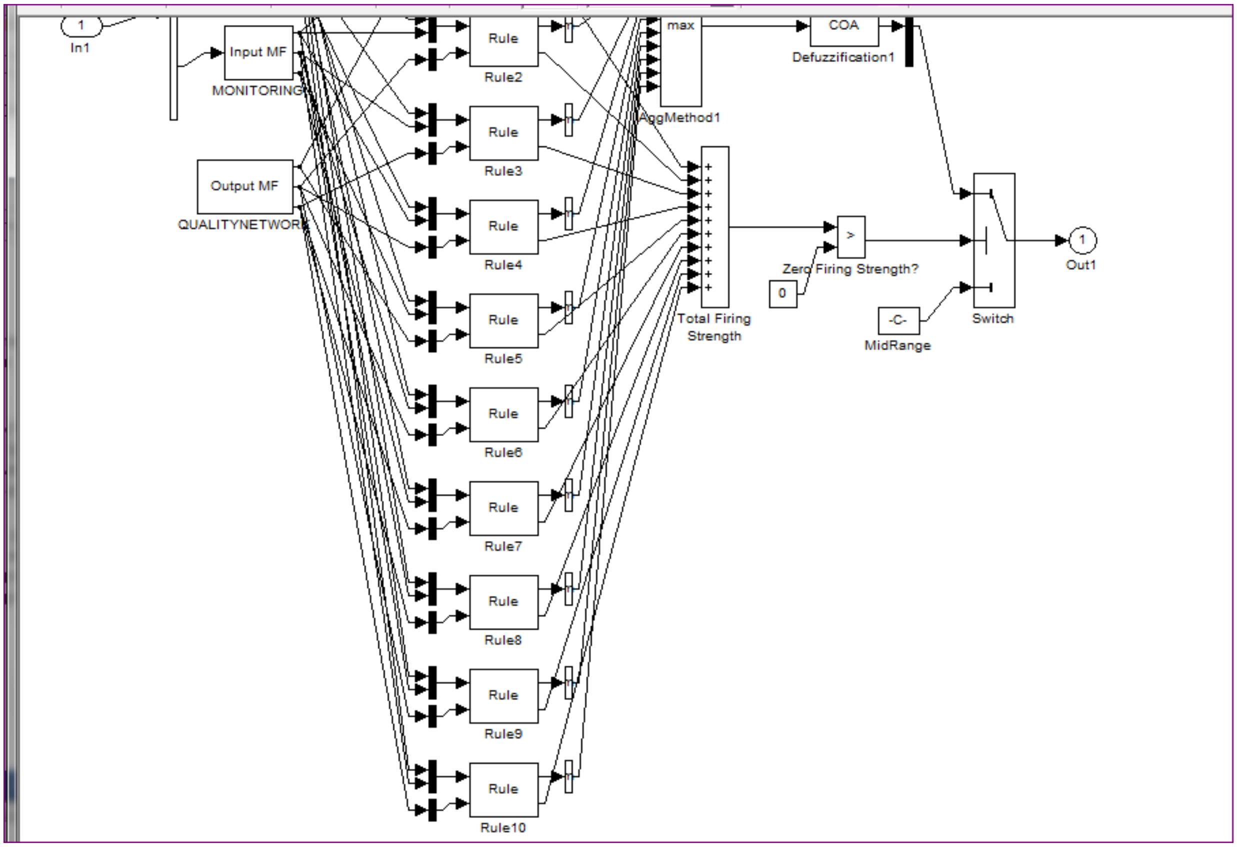

Fig 7 Imbibed GSM rules in the fuzzy logic block

Figures 6 and 7 Show the ten rules of GSM network imbibed in the intelligent agent fuzzy logic control block that enhance the reduction of high bit error rate for an effective and quality network.

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3.3 Designing a Simulink model for real time monitoring and evaluation of GSM quality of service using intelligent agent

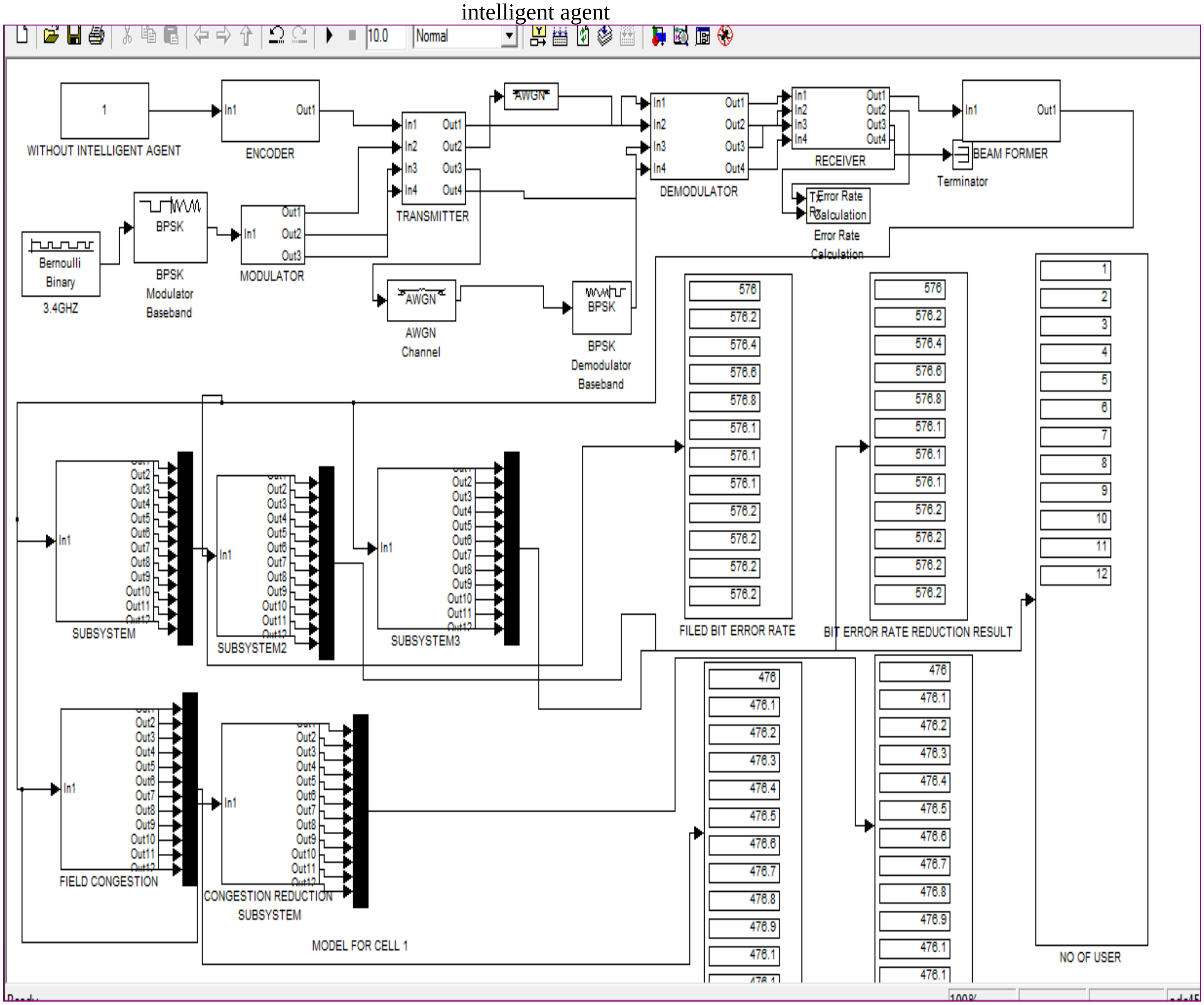

Figure 8. Designed Simulink model for real time monitoring and evaluation of GSM quality of service without using intelligent agent

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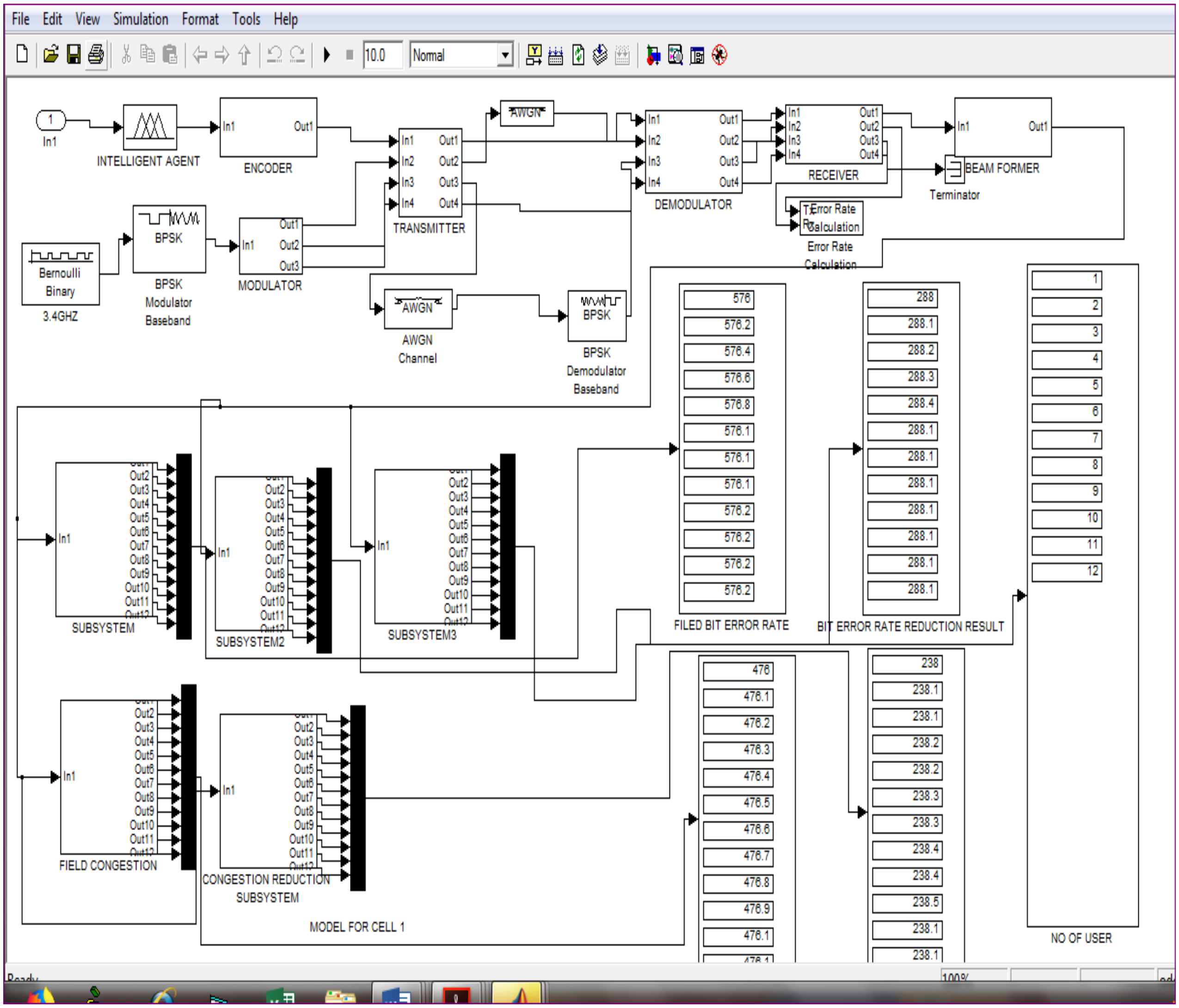

Fig 9 Designed Simulink model for real time monitoring and evaluation of GSM quality of Service with Intelligent Agent.

RESULTS AND DISCUSSION

Here, the method's results and stated goals are discussed;

The fuzzy inference system editor for GSM, which has two inputs—monitor and evaluation—is shown in Figure 1. Additionally, it produces a high-quality network.

Figure 2 illustrates the GSM evaluation's membership function, which examines the bit error rate.

The membership function editor for monitoring is shown in Figure 3. This keeps track of the communication network, determines when it is high, and gives instructions to lower it.

Figure 4 illustrates a membership function for a quality network that determines whether or not the network is free.

Figure 5 depicts a rule editor for a GSM network that has been rigorously trained to adhere to the rule of lowering the bit error rate when it is high for a reliable and effective network.

The 10 GSM network rules that are incorporated into the intelligent agent fuzzy logic control block in Figures 6 and 7 help to lower the high bit error rate for a reliable and efficient network.

Figure 8 illustrates a Simulink model that was developed without the use of an intelligent agent for real-time monitoring and evaluation of GSM quality of service. As shown in Figure 8, a high bit error rate causes the communication network to become more congested, resulting in a low-quality or unreliable network where no service will be received. Figure 9 displays a Simulink model that was created for real-time GSM quality of service monitoring and evaluation utilizing intelligent agents.

Figure 9 demonstrates how an intelligent agent reduces the high bit error rate and congestion simultaneously to improve the quality and free network in a communication system when it detects an increase in bit error rate that could make the network not be free.

A comparison of the bit error rate with and without intelligent real-time monitoring and evaluation of GSM quality of service is shown in Figure 10. It demonstrates how the incorporation of an intelligent agent lowers the high bit error rate, improving the subscribers' access to a high-quality free communication network. On the other hand, when an intelligent agent is not added to the system, there is no free communication network, leading to a poor network.

Figure 11 compares congestion in real-time monitoring and evaluation of GSM quality of service with and without an intelligent agent. In contrast to when an intelligent agent is not incorporated in the system, Fig. 11 demonstrates that there is a reduction in congestion when an intelligent agent is added to the system, improving the quality of the communication network.

The bit error rate was first computed once the channel capacity for the GSM quality network had been established. Finally, a Simulink model for real-time monitoring and assessment of GSM quality of service using intelligent agents was built. This model uses intelligent agents to monitor and minimize the high bit error rate for quality service. When compared to employing traditional methods or techniques like hierarchical or proportional integral derivative, the result was 10% better (PID). Other traditional approaches are preferred to real-time monitoring and evaluation of GSM quality of service employing intelligent agents since they can ensure a flawless and unrestricted network in our communication network.Table 1 compares bit error rates for GSM quality of service with and without sophisticated real-time monitoring. Table 2 compares the levels of congestion with and without sophisticated real-time GSM quality of service monitoring and evaluation. When compared to employing traditional methods or techniques like hierarchical or proportional integral derivative, the result was 10% better (PID).

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Table 1 contrasts bit error rates for GSM quality of service with and without sophisticated, real-time monitoring and evaluation.

Bit Error Rate Without Intelligent Agent	Bit Error Rate With Intelligent Agent	Time
576	288	1
576.2	288.1	2
576.4	288.2	3
576.6	288.3	4
576.8	288.4	5
576.10	288.1	6
576.12	288.1	7
576.14	288.1	8
576.16	288.1	9
576.18	288.1	10
576.20	288.1	11
576.22	288.1	12

Table 2 Comparing congestion without and with intelligent in real time monitoring and evaluation of GSM quality of service

CONGESTION WITHOUT INTELLIGENT AGENT	CONGESTION WITH INTELLIGENT AGENT	TIME
476	238	1
476.1	238.1	2
476.2	238.1	3
476.3	238.2	4
476.4	238.2	5
476.5	238.3	6
476.6	238.3	7
476.7	238.4	8
476.8	238.4	9
476.9	238.1	10
476.10	238.1	11
476.12	238.1	12

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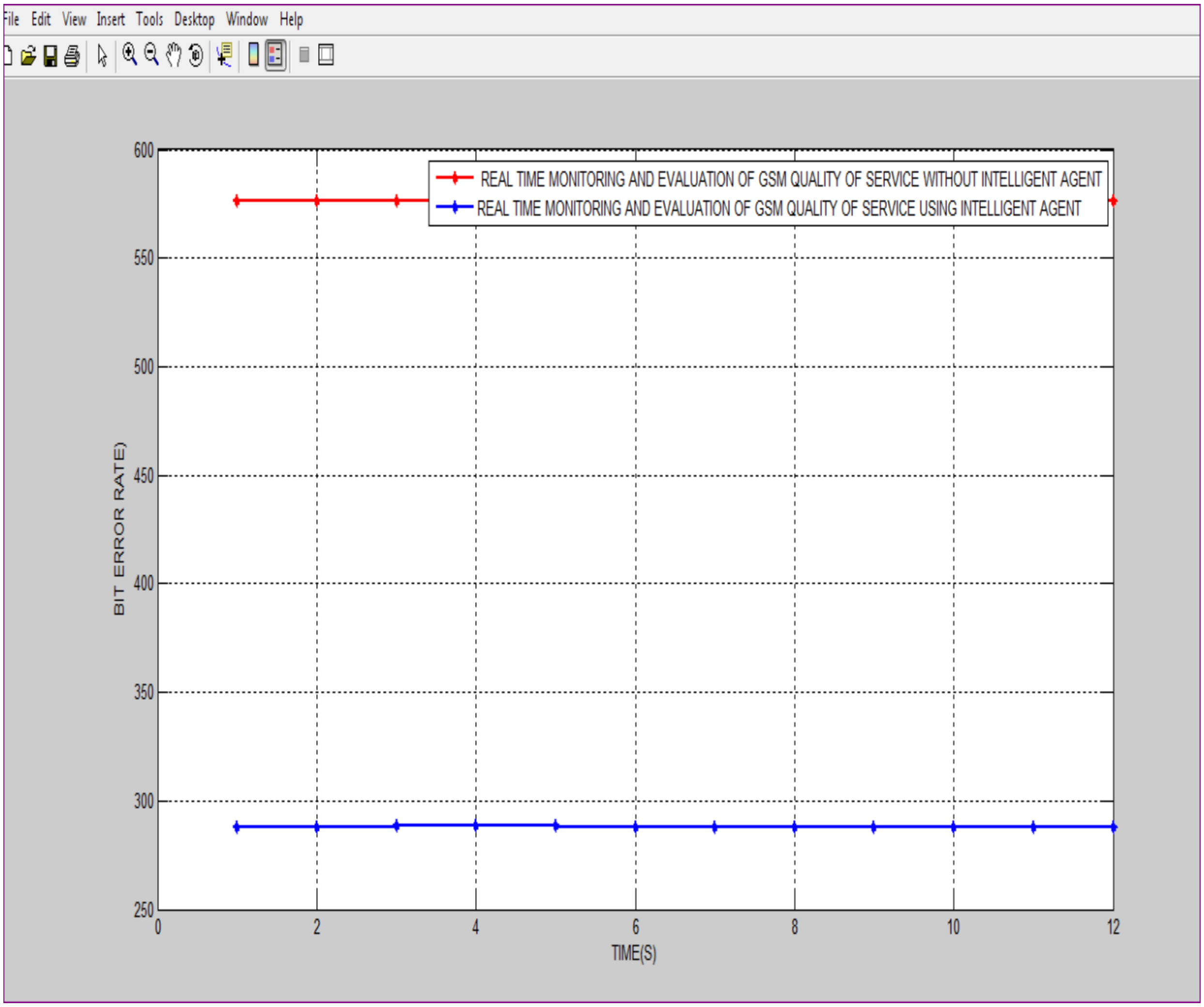

Figure 10 shows a comparison of bit error rate without and with intelligent in real time monitoring and evaluation of GSM quality of service.

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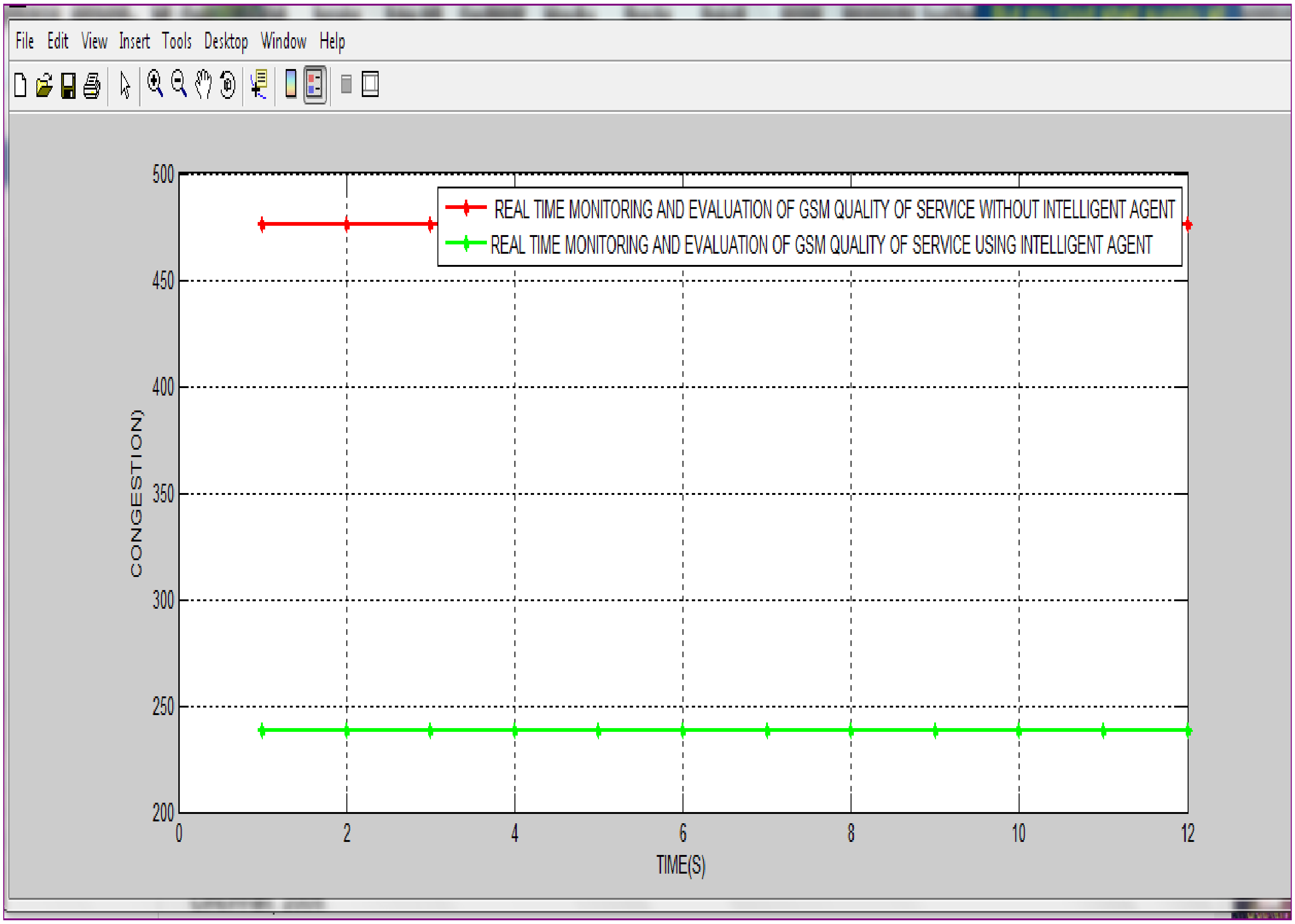

Figure 11. Comparing congestion without and with intelligent agent in real time monitoring and evaluation of GSM quality of service

CONCLUSION

The issue of our communication network's lack of a free, high-quality network can be solved by deploying intelligent agents to monitor and assess the quality of service delivery in real time. In order to do this, it is possible to calculate the channel capacity for a GSM quality network, the bit error rate for that capacity, design an intelligent GSM rule to monitor and lower the high bit error rate for quality service, and create a Simulink model for real-time monitoring and evaluation of GSM quality of service using intelligent agents. A free, high-quality communication network is the end outcome.

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REFERENCES

[1] Mani Subramanian,“Network Management: Principles and Practice”, 2008 Edition, Pearson Education
[2] Makki, S., Wunnava, S., 2008. Next Generation Networks and Code Mobility. ISAST Transactions on Communication and Networking, No.1, Vol 2
[3] “Agent based computing: A booklet for executing”, http://www.eurescom.de/
[4] Stallings, W., 1999. SNMP, SNMPv2, SNMPv3 and RMON 1 and 2, third ed. Addison Wesley
[5] Yemini, Y., 1993. “The OSI Network Management Model”, IEEE Communications Magazine, vol.31, no.5, pp.20-29. May.
[6] Stephan, R., Ray, P., Paramesh, N., 2004. Network management platform based on mobile agents. International Journal of Network Management 14, 59–73.
[7] Liotta, A., Pavlou, G. Knight, G., 2002. “Exploiting agent mobility for large-scale network monitoring”, IEEE Networks, 16:7-15.
[8] Rubinstein, M.G., Duarte, O., Pujolie, G., 2002. “Scalability of a network management application based on mobile agents”, Journal of Communication and Networks, 5:240-248.
[9] Manvi, S.S., Venkataram, P., 2006. Agent based subsystem for multimedia communications. IEEE Proceedings Software Journal 153 (1), 38–48.
[10] Mydhili K Nair, Gopalakrishna V, 2011, Applying Web Services with Mobile Agents For Computer Network Management, International Journal of Computer Networks and Communications (IJCNC), Vol. 3, No. 2, pp 125-144, March.
[11] Weiss (1999) Multi-Agent Systems, MIT Press
[12] Wooldridge, M. (2002) An Introduction tomulti-agent systems. John Wiley & Sons Limited England, ISBN: 0-471-49691-X
[13] Jennings, N. R., and Wooldridge, M. J. (1998). Application of Intelligent Agent: Foundations, Applications and Markets, pp. 3-28, Secaucus, NJ, Springer-Verlag, Berlin.
[14] Chang, Y. S., Yang, C. T., and Luo, Y. C. (2011) An Ontology based Agent Generation for Information Retrieval on Cloud Environment. J. UCS, 17(8): p. 1135-1160.
[15] Guessoum, Z. andBriot, J. P.(1999).From Active Object to Autonomous Agents", IEEE Concurrency, Volume 7(3), pp. 68-78, July/September.
[16 Boudaoud, K. and Zahia, G. (2000). A Multi-agents System for Network Security Management. Sixth IFIP Conference on Intelligence in Networks (SmartNet'2000), Vienna, Austria, September 18 – 22.
[17] Aneke,N.E., Ngang,N.B.(2021).Reduction of Power system losses in Transmission Network using Optimization method. International Journal of Engineering Science Invention(IJESI),Vol.10,issue4,pages58-66
[18] Okedu,K..E.,Uhunmwangho,R., Ngang,N.B.(2015 and John, R.A.(2015). Optimization of Hybrid Energy Efficiency in Electrical power systems design. IntechOpen-Energy Efficient Improvements in Smart Grid Components,Vol.7,pages171-191
[19] Ngang,N.B.(2020).Hydro Power Generator Speed Control Using Fuzzy Software Tool. International Journal of Emerging Trends in Engineering and Development,Vol.3,issue10,pages16-22.
[20] Ngang,N.B.,Nnamere,.E.Aneke(2021).Enhanced Voltage Stability of the Nigerian 330kV Transmission Network Using ANN Controller. American Journal of Applied Sciences and Engineering(AJASE),vol.2.,No.4,pages1-9.
[21] Ude, K. et al (2021): Reducing Costs and Pollutant Emissions using Renewable Energy sources in Eket town,Nigeria. International Journal of Sciences and Applied Research.(IJSAR).Vol.8.issue 7.pages11-2
[22] Okedu,K.E.,Uhunmwangho,R.,Ngang,N.B.(2015). Comparative Study of on and off grid tied integrated diesel/Solar PV Battery Generation System. International Journal of Engineering Technologies,vol.1 issue.1,pages19-25.
[23] Ngang,N.B.,Aneke,N.E.(2021).Improving the Efficacy of the Nigerian Electric Power Transmission Network Using Static Synchronous Compensator(STATCOM),;Journal of Information Engineering and Applications (JIEA),Vol.11,No.2,pages no.7-16.