RESEARCH PAPER | Mathematics | Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

Performance Enhancement in OSI Network Model using Fuzzy Queue

KEYWORDS: OSI architecture, Buffer, multiprocessing unit, trapezoidal fuzzy number, series queue with blocking, Robust ranking technique.

B.Palpandi	Dr. G.Geetharamani	J.Arun Pandian
Assistant Professor, Department of Mathematics,Anna University,BIT Campus, Tiruchirappalli-620024, Tami Nadu, India.	HOD, Department of Mathematics, Anna University, BIT Campus, Tiruchirappalli-620024, Tami Nadu, India.	PG Scholar, Department of mobile and Pervasive Computing, Anna University, BIT Campus, Tiruchirappalli-620024,Tamil Nadu, India.

ABSTRACT *In recent communication network technology Open System Interconnects (OSI) networks play a vital role. In this paper, to improve the performance of communication in OSI network layers,series queues with blocking has been analyzed and probability of packets blocking has been evaluated. After that to get buffer-less network system, multiprocessing unit has been introduced in the MAC layer to reduce the blocking probability. In real time, the values of the parameters are vague. To overcome this ambiguity, we take the arrival rate of packets as trapezoidal fuzzy number. In this paper, measurement of the fuzzy probability of blocking of the arrival packets was suggested by using queuing theory with fuzzy arrival rate. Finally defuzzify the fuzzy probability of blocking by using robust ranking technique which is useful for system designers. Numerical analysis has been shown to check the validity of the proposal.*

1. Introduction

Networking is a process of connecting computers by means of wire or wireless. The main objective is to share information and resource among computers. Initially, the computer networks were designed with the hardware as the main part and software as its supports. But now a days network software is given more importance.

The modern computer networks are designed by the concept of layered protocols or functions. Each layer is built over another. The number of layers, the content of layers and the name of each layer differs from network to network. The OSI is one of the important network models, it supports different type of networks. In traditional networks a size of packets is quite small to be delivered from the source node to the destination node. In the case of multimedia data where a size is measured in megabyte (Mbytes), it is a big challenge to transfer the data. The bigger the data, the more computation and energy are required to deliver the packets. To overcome this problem, networks are required different routing protocols, modified communication nodes with high speed processors that could process the multimedia data.

In multimedia networks energy consumption still remains the main problem. As we increase hardware specifications, more energy will be consumed and vice versa. One of the ways to prolong the life of communication nodes is to add additional power supply such as a solar cell. However, it will increase the cost of the Communication nodes and therefore will squeeze the application areas. Regardless of the challenges mentioned above, there should be trade-off between energy consumption and resource utilization. However, service time for each arrival packets increases as the size expands, therefore, number of packets waiting in queue in the buffer are swelled. The loss of some video and voice packets might not seriously affect overall data in destination, so that remaining packet can convey the necessary message to the listener. In the case of loss of image packet, it is difficult to rearrange whole frame in order to get original picture back. In this paper probability of packets blocking has been analyzed by using fuzzy queue. In order to reduce packet blocking, multiprocessing unit has been introduced in OSI network layers.

2. System Architecture overview of OSI Network Model

A communication network consists of several Nodes that are interconnected with each others. Each network node is composed of processing unit, memory, power supply and internet connection. An internet is defined as a network of networks around the world which is the largest computer network available and it is used to transfer information through cyberspace. In 1960, Advanced Research Project Agency of USA defense department founded a project called ARPANET [7]. The aim of the project was to connect universities, computer science engineering through a computer and telephone lines. In 1989, the World Wide Web was invented for connecting the computers around the world. From 1990 the usage of internet facilities spread all over the world.

OSI networking model was developed according to the standards of International Standards Organization (ISO). This networking model is used to connect computer systems that are ready to communicate with each other. It controls the connection and data transfers.

2.1. OSI Networking Model

The OSI network model has seven well defined layers which is used to communicate among the computers [8]. Figure 1 shows the structure of the layers in OSI network model.

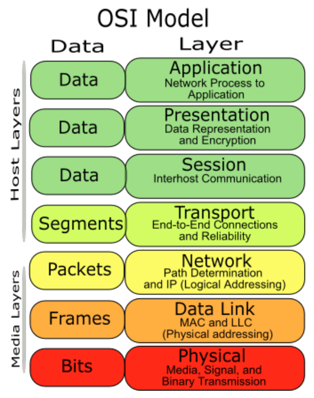

Figure 1. OSI Network Model

Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

PHYSICAL LAYER: it is the lowest layer in the OSI network model. It is responsible for establishing and deactivating a physical connection between sender and receiver. It is used for sending and receiving raw bits (0 or 1) of data between sender and receiver through communication channel.

DATA LINK LAYER: this layer is responsible for the transfer of data over the channel. It takes the raw bit of data from physical layer and transforms into error free data frames (bytes of data) and pass it to the network layer. It generates the acknowledgement frames sent by the receiver.

Data Link layer are divided into two ((Figure 2) sub-layers: 1) Upper sub layer—Logical Link Control (LLC) layer and 2) Lower layer—Medium Access Control (MAC) layer. LLC Layer acts as an interface between the MAC layer and the network layer. Mainly it provides services to the network layer protocols and to control frame synchronization, flow control and error checking. MAC Layer determines the media access controlling on hardware devices and provides data analyzing based on physical signaling requirements of the medium.

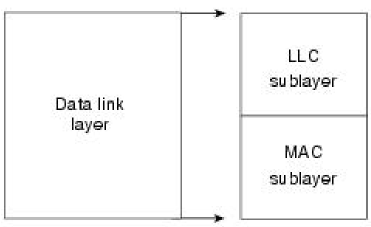

Figure 2. Data-link sub-layer

Functionalities of MAC protocol are changed depending upon the Network layer requirements, hardware specifications and network topologies [9]. Functionalities of MAC layer can be classified mainly into channel assess policies, scheduling and buffer management and error control. In this paper we addressed buffering problem in MAC layer in order to improve performance in data transmission.

NETWORK LAYER: This layer is responsible for controlling the operation of the subnet and it delivers the data packet from source to destination. It identifies the shortest route from sender to receiver and it controls the congestion of packets in the networks.

TRANSPORT LAYER: This layer is used to provide reliable and cost effective data transport from source machine to destination machine. It is independent of the network currently in use. It accepts data from session layer and split it into smaller units and passes it to network layer. It also checks whether all the piece of data are arrived at the destination.

SESSION LAYER: This layer is used to establish a meeting between users of different machines. It allows transferring file between systems. It allows the user to log into a remote time sharing system.

PRESENTATION LAYER: The important function of this layer is to provide a general syntax and meaning of the information exchanged between systems. It converts the sender dependent format of information into common general format.

APPLIATION LAYER: This layer contains number of services that are commonly needed by the users. The important functions of this layer are mail services, file transfer and access, remote login and accessing World Wide Web.

In this paper we took Physical layer and MAC sub layer together as one "service point" and remaining layers together as second "service point" to determine Performance metric based on the data queue stored in MAC layer[1]. Queuing process in the MAC layer has been extensively researched and several schemes with varying levels of complexity were proposed. Queuing process directly related to the energy consumption. So that data packet loss because of buffer overload leads to retransmission of the same packets several times, which in turn consume additional energy.

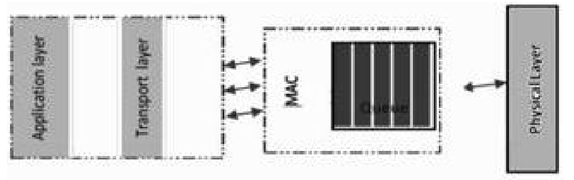

Figure 3. Queuing Process in the Processor Memory

To show an importance of queuing model in multimedia networks, we illustrated the big picture of the queuing process in Figure. As shown in the figure 3, Processor Memory is divided into logical part in order to picture the work flow distribution from the perspective of the protocol stack.

3. Queue Networks

Queue networks can be regarded as a group of 'k' inter-connected nodes, where each node represents a service facility of some kind with servers at nodes

3.1. Series queues with blocking

A series queue model or a tandem queue model is, in general, one in which (i) customers may arrive from outside the system at any node and may leave the system from any node. (ii) Customers may enter the system at some node, traverse from node to node in the system and leave the system from some node, not necessarily following the same order nodes and (iii) customers may return in the system for ever.

Series queue with blocking is a sequential queue model consisting of two service points and, at each of which there is only one server and where no queue is allowed to form at either point. An entering customer will first go to , After he gets the service completed at , he will go to if it is empty or will wait in until becomes empty This means that a potential customer will enter the system only when is empty, irrespective of whether is empty or not, since the model is a sequential model, viz., all the customers require service at and then at .

The possible states of the system are given below with their interpretation:

Table 1. State Transition Table:

State	Interpretation
(0,0)	No customers in either servile point.
(1,0)	Only one customer in S_1
(0,1)	Only one customer in S_2
(1,1)	Only one customer each S_1 and S_2
(block)	One customer each in and , but the customer in , having finished his work as , is waiting for to become free, while the customer in is being served.

Assume that potential customers arrive in accordance with a Poisson process with parameter λ and the service time at and follow exponential distributions with parameters and respectively.

Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

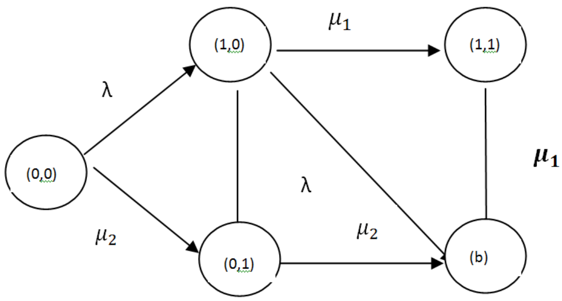

Figure 4. state transition diagram

state diagram is given based on different states as follows: (0,0), (1,0), (0,1), (1,1), (b,1) (blocking state).The state (0,0) represents the system is empty and none of the packet is received. When a packet is received and served by the first server while the second server is idle, the system becomes (1,0) state. If the packet is sent to the second server to serve, then the system will become (0,1) state. In this state the first server must be idle. Otherwise the system state will be in (1,1) state. Namely both of the servers will be busy. The state (b,1) (blocking state) happens when the first server is completed its task, but the second server is still working. If the first server is busy, then arrival packet will be dropped. Let P(x) denote steady state probability of state x.

Table 2. Balance equations table:

State	Interpretation
(0,0)	$P(0,0)\lambda=P(0,1)\mu_2$
(1,0)	$P(1,0)\mu_1=P(0,0)\lambda+P(1,1)\mu_2$
(0,1)	$P(0,1)(\lambda+\mu_2)=P(1,0)\mu_1+P(b)\mu_2$
(1,1)	$P(1,1)(\mu_1+\mu_2)=P(0,1)\lambda$
(block)	$P(b)\mu_2=P(1,1)\mu_1$

Since all 5 states are mutually exclusive and exhaustive , we have

$P(0,0)+P(0,1)+P(1,0)+P(1,1)+P(b)=1$

Solving the above balance equations, we can get the five steady-state probabilities.

3.2. Queuing management in OSI network Model

The buffers between two different layers (servers) consume much electric power and more cost (figure 4).Here to avoid buffers between layers in OSI network, series queue with blocking technique has been applied.

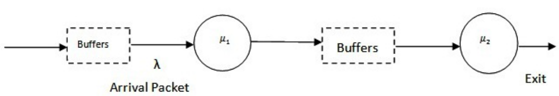

Figure 5. Structure of queuing process

From the balancing equations, the probabilities of different states are

$$P(0,0)\frac{1}{1+\frac{\lambda}{\mu_2}+\frac{\lambda}{\mu_1+\mu_2}\frac{\lambda}{\mu_2}+\frac{\mu_1}{\mu_2}\frac{\lambda}{\mu_1+\mu_2}\frac{\lambda}{\mu_2}+\frac{\lambda}{\mu_1}+\frac{\lambda}{\mu_1+\mu_2}\frac{\lambda}{\mu_1}} \quad (1)$$

$$P(0,1)=\frac{\lambda}{\mu_2}P(0,0) \quad (2)$$

$$P(1,1)=\frac{\lambda}{\mu_1+\mu_2}P(0,1) \quad (3)$$

$$P(b)=\frac{\mu_1}{\mu_2}P(1,1) \quad (4)$$

$$P(1,0)=\frac{\lambda}{\mu_1}P(0,0)+\frac{\mu_2}{\mu_1}P(1,1) \quad (5)$$

Probability of blocking

$$(PB)=P(1,0)+P(1,1)+P(b) \quad (6)$$

The traffic intensities for the entire queuing system, service point 1, service point 2 are defined as

$$\rho=\frac{\lambda}{\mu_1+\mu_2},\rho_1=\frac{\lambda}{\mu_1},\rho_2=\frac{\lambda}{\mu_2} \text{ Respectively.}$$

Assume the arrival rates are trapezoidal fuzzy numbers and calculate fuzzy probability of blocking using equations 1, 2,3,4,5 and 6 for two cases.

1) $\mu_1=\mu_2$

2) $\mu_1\neq\mu_2$

In this model Probability of blocking occurs if the first server is busy or the state is blocking.

FPB= P(1,0)+ P(1,1)+ P(b,1)

CASE 1: $\mu_1=\mu_2$

$$FPB=(\frac{3\rho^2}{2}+\rho)P(0,0),\ \text{Where } P(0,0)=(1+2\rho+\frac{3\rho^2}{2})^{-1} \quad (7)$$

CASE 2: $\mu_1\neq\mu_2$

$$FPB=[\rho\rho_2(1+\frac{\mu_1}{\mu_2})+\rho_1(1+\rho)]P(0,0),$$

$$\text{Where } P(0,0)=[1+(1+\rho)(\rho_1+\rho_2)+\frac{\mu_1}{\mu_2}\rho\rho_2]^{-1} \quad (8)$$

4. Fuzzy arithmetical operations under function principle

Zadeh [3] in 1965 first introduced Fuzzy set as a mathematical way of representing impreciseness or indistinctness in everyday life.

4.1. Definition

A fuzzy set is characterized by a membership function mapping elements of a domain space or universe of discourse X to the unit interval [0,1].(i,e)A = {(x, (x); x∈ X}, Here

: X →[0,1] is a mapping called the degree of membership function of the fuzzy set A and(x)is called the membership value of xεX in the fuzzy set A [6].These membership grades are often represented by real numbers ranging from [0,1].

4.2. Definition

A fuzzy set A of the universe of discourse X is called a normal fuzzy set implying that there exist at least one x ε X such that (x) = 1.

The fuzzy set A is convex if and only if, for any , ∈X, membership function of A satisfies the inequality

$\mu_A\{\lambda x_1+(1-\lambda)x_2\} \geq \min\{\mu_A(x_1), \mu_A(x_2)\}.\ 0\leq\lambda\leq 1.$

4.3.Definition: (α-cut of a trapezoidal fuzzy number)

The α-cut of a fuzzy number A(x) is defined as

$$\theta\ A(x) = \{\ x : \mu(x) \geq \alpha,\ \alpha \in [0,1]\}$$

4.4.Definition (Trapezoidal fuzzy number)

For a trapezoidal number A(x), it can be represented by A(a,b,c,d;1) with membership function μ(x) is given as,

$$\mu(x) = \begin{cases} \frac{x-a}{b-a}, a \leq x \leq b \\ 1, b \leq x \leq c \\ \frac{d-x}{d-c}, c \leq x \leq d \\ 0, otherwise \end{cases} \quad (9)$$

4.5.Function principle

Function principle is proposed to be as the fuzzy arithmetical operations by trapezoidal fuzzy numbers. We describe some fuzzy arithmetical operations under Function Principle as follows [5].

Suppose $\tilde{A} = (a_1, b_1, c_1, d_1)$ and $\tilde{B} = (a_2, b_2, c_2, d_2)$ are two trapezoidal fuzzy numbers. Then

Addition of two fuzzy numbers $\tilde{A}$ and $\tilde{B}$ is defined as

$$\tilde{A} \oplus \tilde{B} = (a_1 + a_2, b_1 + b_2, c_1 + c_2, d_1 + d_2)$$

where $a_1, b_1, c_1, d_1, a_2, b_2, c_2, d_2$ are any real numbers.

Multiplication of two fuzzy numbers $\tilde{A}$ and $\tilde{B}$ is defined as

$$\tilde{A} \otimes \tilde{B} = (a_3, b_3, c_3, d_3)$$

$$Where\ \ X = (a_1 a_2, a_1 d_2, d_1 a_2, d_1 d_2)$$

$$Y = (b_1 b_2, b_1 c_2, c_1 b_2, c_1 c_2)$$

$$a_3 = \min X\,, b_3 = \min Y\,, c_3 = \max Y\,, d_3 = \max X$$

where a_1, b_1, c_1, d_1,a_2, b_2, c_2, d_2 are any positive real numbers.

Division of two fuzzy numbers $\tilde{A}$ and $\tilde{B}$ is defined as

$$\tilde{A}\ \Theta \tilde{B}=(\frac{a_1}{d_2}, \frac{b_1}{c_2}, \frac{c_1}{b_2}, \frac{d_1}{a_2})$$

where a_1, b_1, c_1, d_1,a_2, b_2, c_2, d_2 are any positive real numbers.

Scalar Multiplication

Take α be any real number. Then for $\alpha \geq 0$, $\alpha\tilde{A} = (\alpha a_1, \alpha b_1, \alpha c_1, \alpha d_1)$

$\alpha < 0$, $\alpha\tilde{A} = (\alpha d_1, \alpha c_1, \alpha\ b_1, \alpha a_1)$

The inverse of a fuzzy number $\tilde{A} = (a_1, b_1, c_1, d_1)$ is defined as $\tilde{A}^{-1}= (\frac{1}{d_1}, \frac{1}{c_1}, \frac{1}{b_1}, \frac{1}{a_1})$

where a_1, b_1, c_1, d_1 are any positive real numbers.

5. Robust Ranking Technique – Algorithm

Using robust ranking technique fuzzy numbers can be converted into crisp one .Robust ranking technique which satisfies compensation, linearity, and additive properties and provides results which is consistent with human intuition. Give a convex fuzzy number ã, the Robust Ranking Index is defined by

$$R(\tilde{a}) = \int_0^1 0.5(a_\alpha{}^L + a_\alpha{}^U)d\alpha$$

Where $(a_\alpha{}^L, a_\alpha{}^U)$ is the α –level cut of the fuzzy number ã which is calculated from equation 9.

In this paper we use this method for ranking the fuzzy numbers values. The Robust ranking index R(ã) gives the representative value of the fuzzy number ã [4] .Fuzzy probability of blocking for different fuzzy arrival rates and service rates has been found using function principle and equations 7 and 8.

Finally defuzzify fuzzy probabilities using robust ranking technique and the values are tabulated given below [11]:

Table 3: Probability of Blocking When $\mu_1 = \mu_2$

Fuzzy arrival rate ($\tilde{\lambda}$)	Fuzzy Probability of Blocking When $\mu_1 = \mu_2$ $\mu_1 = 30$, $\mu_2 = 30$	Probability of Blocking When $\mu_1 = \mu_2$ $\mu_1 = 30$, $\mu_2 = 30$
(1,2,3,4)	(0.027, 0.06, 0.1, 0.149)	0.084
(6,7,8,9)	(0.149, 0.192, 0.24,0.297)	0.219
(11,12,13,14)	(0.251, 0.297,0.35,0.409)	0.326
(16,17,18,19)	(0.334,0.381,0.435,0.495)	0.411
(21,22,23,24)	(0.403,0.451,0.503,0.559)	0.479

Table 4 : Probability of Blocking When $\mu_1 > \mu_2$

Fuzzy arrival rate ($\tilde{\lambda}$)	Fuzzy Probability of Blocking When $\mu_1 \neq \mu_2$ $\mu_1 > \mu_2$ $\mu_1 = 35, \mu_2 = 30$	Probability of Blocking When $\mu_1 \neq \mu_2$ $\mu_1 = 35, \mu_2 = 30$
(1,2,3,4)	(0.023, 0.052, 0.087, 0.131)	0.073
(6,7,8,9)	(0.135,0.173, 0.217, 0.268)	0.198
(11,12,13,14)	(0.231, 0.274, 0.321, 0.377)	0.300
(16,17,18,19)	(0.277, 0.357, 0.407, 0.462)	0.375
(21,22,23,24)	(0.38, 0.427, 0.474, 0.462)	0.485

Table 5: Probability of Blocking When $\mu_1 < \mu_2$

Fuzzy arrival rate (λ)	Fuzzy Probability of Blocking When $\mu_1 < \mu_2$ $\mu_1 = 25, \mu_2 = 30$	Probability of Blocking When $\mu_1 < \mu_2$ $\mu_1 = 25, \mu_2 = 30$
(1,2,3,4)	(0.03, 0.07, 0.12, 0.153)	0.09325
(6,7,8,9)	(0.151, 0.202, 0.29,0.31)	0.24075
(11,12,13,14)	(0.271, 0.307,0.38,0.432)	0.3555
(16,17,18,19)	(0.353,0.402,0.454,0.501)	0.4275
(21,22,23,24)	(0.436,0.487,0.542,0.693)	0.5895

From the comparison of the tables 1,2,3, when $\mu_1 > \mu_2$ probability of blocking is decreased. In order to obtain the state $\mu_1 > \mu_2$Multi processing unit has been installed in the MAC layer in OSI network model.

Assume the first service point performs with S numbers of multi processing units. Then

$$\mu_1 = S\mu_1.$$

Where S = 1, 2, 3, 4…..N

Volume : 4 | Issue : 4 | Apr 2014 | ISSN - 2249-555X

when the arrival rate increases then only the value of S should be increased. Otherwise the system cannot get the optimum target. This kind of system is called multiprocessing (MP) systems [10]. These techniques are frequently employed in the class of machine called supercomputing Systems. The multiprocessing is the use of multiple processors to executes separate portions of computation truly simultaneous. Several classes of machines are generally referred to as multiprocessors, but the most popular are machines that have similar or identical processors and that share a common memory.

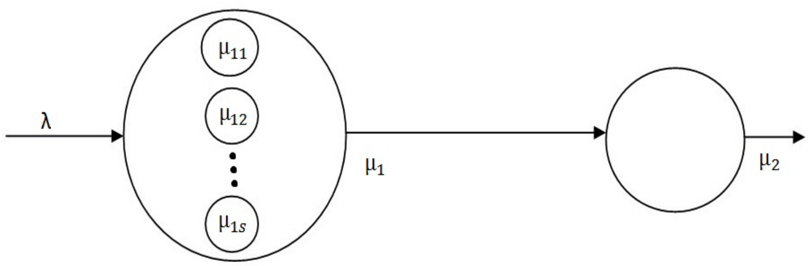

Figure 6. Structure of multiprocessing queuing process

Multiprocessor system results that it can handle a much greater flow of data, complete more tasks in a short time and deal with demands of many input and output devices. A special form of MP that uses an even number of processors is symmetric multiprocessor (SMP).

Using $\mu_1 = S\mu_1$, we get the new blocking probability equations as follows

$$P(0,0) = \frac{1}{1+\frac{\lambda}{\mu_2}+\frac{\lambda}{s\mu_1+\mu_2}\frac{\lambda}{\mu_2}+\frac{\mu_1}{\mu_2}\frac{\lambda}{s\mu_1+\mu_2}\frac{\lambda}{\mu_2}+\frac{\lambda}{s\mu_1}+\frac{\lambda}{s\mu_1+\mu_2}\frac{\lambda}{s\mu_1}} \quad (10)$$

$$P(0,1) = \frac{\lambda}{\mu_2}P(0,0) \quad (11)$$

$$P(1,1) = \frac{\lambda}{s\mu_1+\mu_2}P(0,1) \quad (12)$$

$$P(b) = \frac{s\mu_1}{\mu_2}P(1,1) \quad (13)$$

$$P(1,0) = \frac{\lambda}{s\mu_1}P(0,0) + \frac{\mu_2}{s\mu_1}P(1,1) \quad (14)$$

Probability of blocking

$$(PB) = P(1,0) + P(1,1) + P(b) \quad (15)$$

Probability of blocking plays a vital role in network performance. Probability of blocking (PB) happens when the first server is busy. When the value of S is increased in the first server (MAC layer), probability of blocking is decreased. PB for the multiprocessing units has been evaluated using equations 11, 12, 13, 14, 15 and given in the following table.

Table 6. Comparison of Probability of blocking in two different S values:

Fuzzy arrival rate (λ)	$\mu_1 = 35$, $\mu_2 = 30$, S=1		$\mu_1 = 35$, $\mu_2 = 30$, S=4	
	Fuzzy Probability of Blocking	Probabiliy of Blocking	Fuzzy Probability of Blocking	Probability of Blocking
(1,2,3,4)	(0.023, 0.052, 0.087,0.131)	0.084	(0.012, 0.024, 0.06,0.078)	0.0435
(6,7,8,9)	(0.135,0.173, 0.217, 0.268)	0.219	(0.089, 0.102, 0.119,0.132)	0.1475
(11,12,13,14)	(0.231, 0.274, 0.321,0.377)	0.326	(0.139, 0.163, 0.26, 0.312)	0.2165

From table 4, when the value of S increases Probability of blocking decreases.

6. Conclusion

Since available Performance metrics based on queuing/buffer management in wired and other wireless networks cannot be applicable in OSI because of its unique characteristics, new models are required to measure Performance metrics. In this paper multiprocessing technique has been introduced in OSI network layers to improve the performance of communication. Because of taking arrival rates are fuzzy numbers, the system is more realistic and nature. After that blocking probabilities have been established for different fuzzy arrival rates. From table 4, when S=4 Probability of blocking is very least compare with S=1 for all arrival rates. Hence we have concluded that performance of multiprocessing unit is always better than the single processing unit. Based on the proposed model it gives clear picture on how transceiver and receiver should be designed in order to reduce data loss and minimize buffer size. Since there are very less researches on this topic, proposed model is satisfactory to determine hardware configuration.

REFERENCE 1. Agassi Melikov, Anar Rustamov, "Queuing Management in Wireless Sensor Networks for QoS Measurement, Wireless Sensor Network", 4, pp. 211-218, 2012. | 2. Lilly Robert and W. Ritha, "Machine Interference Problem with Fuzzy Environment", Int. J. Contemp. Math. Sciences, 5,39, pp.1905-1912, 2010. | 3. L.A .Zadeh, "Fuzzy sets", Information and control ,8 ,pp. 338-353, 1965. | 4. R. Nagarajan and A.Solairaju, "Computing improved fuzzy optimal Hungarian assignment problems with fuzzy costs under robust ranking techniques, International Journal of Computer Applications", 6,4, pp.6-13,2010. | 5. Abhinav Bansal , "Trapezoidal Fuzzy Numbers (a,b,c,d): Arithmetic Behavior", International Journal of Physical and Mathematical Sciences,pp.39-44,2011. | 6. L.A Zadeh , "Fuzzy sets as a basis for a theory of possibility", Fuzzy Sets and Systems,1,pp.3-28, 1978. | 7. Metcalfe, R, "Computer/network interface design: lessons from Arpanet and Ethernet ", Selected Areas in Communications, IEEE Journal, 11 , 2 ,pp. 173 – 180, 1993. | 8. John D. Day and Hubert Zimmermann, "The OS1 Reference Model", proceedings of the iefj2, 71, 12, 1983. | 9. Staalhagen, L. , A comparison between the OSI reference model and the B-ISDN protocol reference model", Network, IEEE, 10, 1, pp.24 – 33, 1996 | 10. J. G. kiln and K. Koh, "An O(1) Time Deadlock Detection Scheme in Single Unit and Single Request Multiprocessor System", IEEE TENCON ,91,2, pp. 219-223,1991. | 11. B.Palpandi, G.Geetharamani, A.Sreen Fathima, "Quality of service optimization in MANET using fuzzy queues", International Journal of Application or Innovation in Engineering & Management, 2,12,pp.210-216,2013. |