Indian Journal of Science and Technology, *Vol 9(36), DOI: 10.17485/ijst/2016/v9i36/97935, September 2016*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Collisionless Data Transmission to Improve Throughput Using Additive Links On-line Hawaii Area Technique With Timeslot Communication

S. Ismail Kalilulah[1*], B. Justus Rabi[2] and Kuldeep Chouhan[3]

[1]Department of Computer Science and Engineering, St. Peter's University, Chennai - 600054, Tamil Nadu, India; ismailkalilulah125@gmail.com

[2]Department of Computer Science and Engineering, Shri Andal Alagar College of Engineering, Chennai - 603111, Tamil Nadu, India; bennisrobi@rediffmail.com

[3] Department of Computer Science and Engineering, St. Mary's Group of Institutions Hyderabad - 508284, Telangana, India; kuldeep0009@gmail.com

Abstract

The wireless sensor network forms a topology and transmits data reverse to the information collectors. **Objectives:** The cost and performance are optimized to check the throughput rate that should improve the data transmission rate. Based on the information flow tracking, the data dependencies among information objects should be reduced. Tags should be associated with input nodes and elevate the processing on output node data. **Methods:** The method is presented in this paper: the individual nodes communicate with the server in collision free mode and improve the strength of data transmission rate with reliable and compatible data. The network topology control is to uphold the data propagation and improve the network connectivity to provide reliable service. **Findings:** The network system is evaluated for altering the statistics arrival rate (as percentage) of the server node that arrive each second, and the number of requests waiting in the buffer as demonstrated in graphical presentation. **Improvements:** ALOHA mechanism is competent technique to synchronize the node intermediate access among the contending nodes in the network.

Keywords: ALOHA, Collision-less Data, Network Encoding, Throughput Improvement, Timeslot Communication (TSC)

1. Introduction

TSC involve a cluster of nodes communicate in precise timeslots with a node station. In this context, the node topology has issues to maintain the network capacity to attract a bundle of attention. A set of communication links between node pairs used by routing mechanisms, where a network controls the parameters[1]. The source node disseminates a message to reachable node where retransmits every message to the nodes[2]. Every node range requires only one transmission to deliver significance to all the nodes in the communication. Conventionally, when a node has a failure, it is usually discarded and the reorganized with faultless nodes to continue with the operation without a transaction with the functional coverage of the networks.

The Additive Links On-line Hawaii Area (ALOHA) protocol is an instance of a MAC protocol of the contention which established the Ethernet as presented[3]. It allows to distributed stations to communicate over radio channel and the nodes are used a frequency band for their packet transmissions[4]. It presented the receipt of a packet at the network broadcast makes no collision between a packet from a node and other packet to arrive at the network[5]. Each packet has the address of the destination node that address of the resource device, where a sending node does not available with a reasonable time an acknowledgement for a frame it sent up, that assumes a collision occurred

*Author for correspondence

and retransmits the frame after some random delay. Thus, ALOHA depends on the node ability to distinguish a conflict in the network[6]. An additional mechanism enables without acknowledgement node packets from the satellite to observe the frequency band for its frame being re-broadcast by the broadcasting. When a frame acquired to the satellite without collision and the satellite ignores frames which are received corrupted by errors due to collisions/overlaps[7].

1.1 ALOHA Technique

ALOHA is a standard that transmits data from one node to another where a collision occurs in network and retransmits the data immediate that show the way to degraded path utilization[17], even though many nodes may possibly transmit the data. The finite state mechanism for this protocol is given in insert Figure 1.

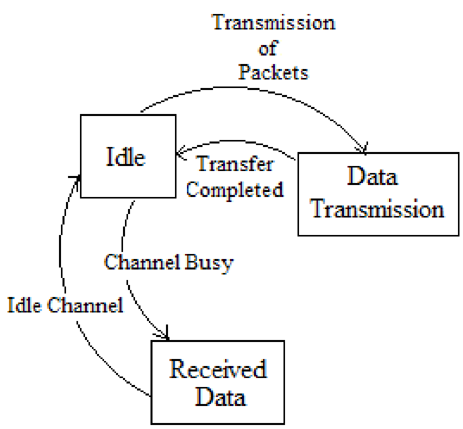

Figure 1. Finite state mechanism protocol for network.

Slotted Aloha in which time is alienated into distinct timeslots where a node transmit in the commencement of the timeslots and facilitate to reduce collisions.

1.2 Efficiency and Throughput for ALOHA

The network protocol is used effectively by the nodes, when the network is heavily loaded by many nodes using ALOHA mechanism. The efficiency method of $h_{s\text{-aloha}}$ for the slotted ALOHA scheme is obtained some assumptions directed to a numerical model of the network traffic on the intermediate by the nodes. The effectiveness of slotted ALOHA is,

$$h_{s\text{-aloha}} = S_{max}$$

where, 'S' is the average fraction of time that represent the nodes are effectively using the channel.

2. Previous Work

LAN where the network is formed with a finite number of active stations is presented[8]. The distributed algorithm which is enables the stations to tune its back-off at runtime where a considerable improvement in the throughput of the network[9]. The vibrant network is the nodes may join and leave the network at any time due to mobility of nodes in network is proposed[10]. The delay optimizing contention window sizes are resultant as a function of the contending nodes[11] is reported. The throughput analyzed mathematically that considered the network is saturated and deduced an expression for the maximum throughput[12]. It represented[13] the optimum transmission uses by node stations from the traffic conditions and increase the throughput[13]. The random access control mechanism is based on the slotted ALOHA and ensures the system throughput is reserved constant[14]. The collisions are avoided by the control wait time have differences than the predefined limit of the time[15] is reported. The computation of the throughput in a CR network using the slotted aloha technique[16]. The reported work presented[17] an efficient neighbor discovery and ALOHA which is based on the collision detection and correction in VANET. It presented[18] to analyze the stabilize random-access protocols by controlling the access probability according to the traffic load. In [19] reported that a novel power control protocol and improve the cumulative throughput of the network. The arrival of the packets in the queue is controlled to improve the throughput performance is reported[20]. The analysis and enhancement of speed in public key cryptography is using message encoding algorithm[21] have been reported. The throughput-optimal scheduling takes the error probability in decision and maximizes throughput[22]. The effects of contention and packets are on the energy efficiency of wireless LAN[23] is reported.

3. Encoding for Data Transmission

The data transmission is pursued either circuit switching or packet switching includes some computational task. The transmission of data from node to station via server in a network is shown in Figure 2.

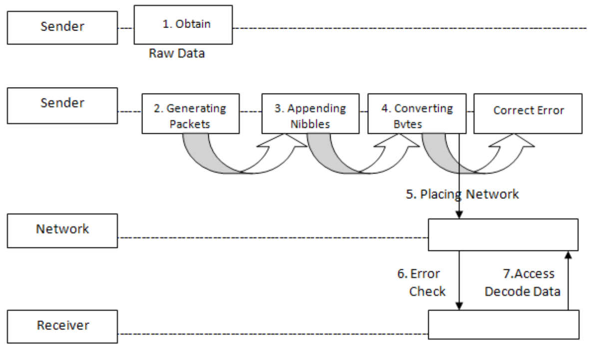

Figure 2. Sender to receiver process as sequential diagram.

The data transmission sequence of a data encoded packet is transmitted from a node in TSC, shown in Figure 3 along with the data encoding process as a flow chart in Figure 4.

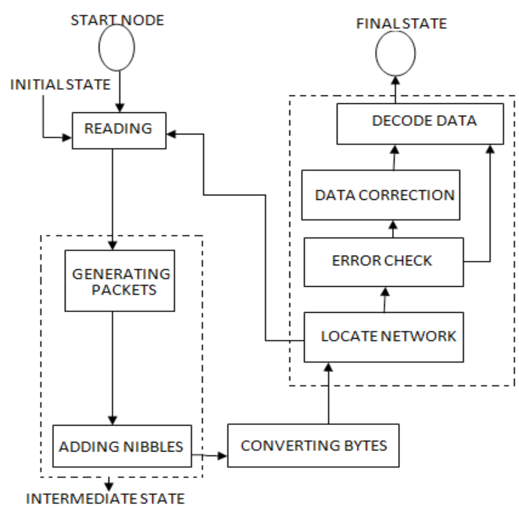

Figure 3. Data transmission sequence in encoded packets.

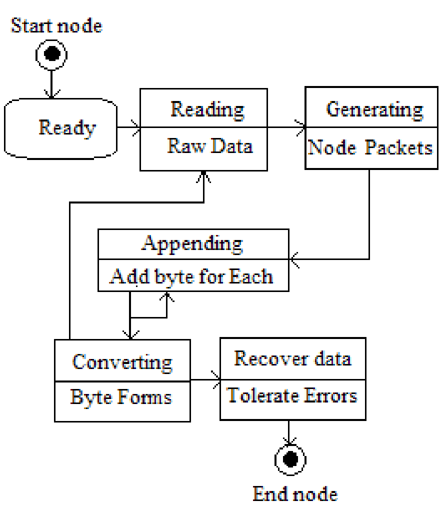

Figure 4. Data encoding process as flow chart.

4. Timeslot Communication Models and Metrics

A typical TSC uses a time switch construct, where a pipelined architecture is used to perform concurrent read and write operations on a single shared memory. The size of the memory is M_1+M_2,

where, M_1 = space to store arrival frame, and

M_2 = space to store control sequence.

In this work, $M_2 = [(log_2 N + 1) \times p]$ / (timeslot duration).

4.1 Memory Access Peak Rate

The peak rate for read/write with respect to switch memory M_1 is optimized to N slots 'x' k bits/slot 'x' 1/(slot duration) = N_k/(slot duration) bits. The typical values chosen in this work are,

(i) Slot duration =125microsec.
(ii) N=32
(iii) k=8
(iv) packets in a frame p=32

Therefore, the peak rate for reading/writing is 32×8/125 = 2.048 mbit/s regarding 4 mbit/s of I/O bandwidth. Similarly, the memory required to store the control sequence is, $[(log_2 32 + 1) \times 32]/(125\text{microsec})$ bits = 1.536 mbit/s, totally about 3 mbit/s of I/O bandwidth.

4.2 Throughput and Packet Loss

It considers $N \times N$ switch, without buffers, where the synchronous process at most one packet is transferred for each timeslot from each input, which output presented by Jung *et al.*, (2005). The traffic is uniform and 'q' is the arrival probability of a packet at an input during one timeslot. During output contention, just one packet (at random) is transferred to the output whereas the other nodes are missing, where each lost packets is for each timeslot and the restrictive throughput is calculated.

4.2.1 Packet Loss

'G' is the random variable is equivalent to the number of node packets onset and target to output as W.

i. Input link does not transmit any packet with probability 1 – q,
ii. Transmit a node packet to W with probability q/N, and

iii. Sends to another output with probability (N −1) q/N.

Hence, the probability that given N inputs and exist 'm' packets destined to W is:

$$P(G=r)=\binom{N}{m}\left(\frac{q}{N}\right)^{2}\left(1-\frac{q}{N}\right)^{N-m}$$ for m= 0, . . . , N.

If G = 0, no packet loss occurs, if G≥1, then G − 1 packets are vanished, even though merely one packet is provided. Therefore, if 'Z' is the number of lost packet directed to W, with Z = max (0, G − 1), then the average number of lost packets are given as eqn. [1],

$$E[Z]=\sum_{m=2}^{N}(m-1)\binom{N}{m}\left(\frac{q}{N}\right)^{m}\left(1-\frac{q}{N}\right)^{N-m} \quad (1)$$

It considered the packets lost between 1 and N-1. E[Z] can be computed for the allocation with parameters (r, N) and 0$\leq r \leq$ 1, which grasp is given the eqn. [2],

$$\sum_{m=0}^{N}\binom{N}{m}r^{m}(1-r)^{N-m}=1 \quad \sum_{m=0}^{N}m\binom{N}{m}r^{m}(1-r)^{N-m}=Nr \quad (2)$$

After simple calculations, output is given as eqn. [3],

$$E[Z]=\left(1-\frac{q}{N}\right)^{N}-(1-r) \quad (3)$$

Average number of nodes mislaid in the network is given as eqn. [4],

$$NE[Z]=N\left(\left(1-\frac{q}{N}\right)^{N}-(1-q)\right) \quad (4)$$

given in Table 1. For the limiting case $N\rightarrow\infty$, gives NE[Z] = N[e^{-q}-(1-q)].

Table 1. Average number of lost nodes NE[Y

N	p = 0.1	p = 0.5	p = 1.0
8	0.034	0.77	2.74
16	0.073	1.63	5.70
256	1.24	27.2	94.0

4.2.2 Throughput

The single port throughput is identical to the probability that an output is served M(G$\geq$ 1) as given in eqn. [5],

$$M(G\geq 1)=1-M(G=0)=1-\left(1-\frac{q}{N}\right)^{N} \quad (5)$$

The packets are assumed to arrive at 1gbps as given in Table 2 where the limiting throughput for each single node is,

$$\lim_{N\rightarrow\infty} 1-\left(1-\frac{q}{N}\right)^{N}=1-e^{-q}=1-e^{-1}=63\%$$

For q = 1.0 the limiting throughput is achieved and this value is slightly less in the input queued node switch with a single queue per input.

Table 2. Maximum throughput for 1Gbps ports node switch

N	Max. throughput	Max. port speed
8	0.656	656 Mbit/s
16	0.644	644 Mbit/s
256	0.633	633 Mbit/s
1	0.632	632 Mbit/s

4.3 Inference

In this research work, depending on the node switch size, the output contention problem is handled and one packet at random is transferred across the switching node. Typically the arrival process is being $\rho \in$ [0, 1] the normalized average load at an input and is related as shown in point when the traffic is uniformly distributed diagonally all the inputs and outputs.

(i) For M < N, it should be ρ < M/N, and for M $\geq$ N it should be $\rho \leq$ 1.

(ii) Observed that ρ /M is the probability that an output receives a packet during a generic timeslot. Let, X be the number of packets arrived for a specific output as given in eqn. [6],

$$P(X=0)=\left(1-\frac{\rho}{M}\right)^{N} \quad (6)$$

The throughput T is given as eqn. [7],

$$T=P(X\geq 1)=1-P(X=0)=1-1\left(1-\frac{\rho}{M}\right)^{N} \quad (7)$$

(iii) If N = φM

$$T=1-\left(1-\frac{\rho}{M}\right)^{\varphi M}\rightarrow 1-e^{-\rho\varphi}$$

If N < M (i.e. φ <1), the maximum admissible load is ρ = 1 and $T \rightarrow 1 - e^{-a}$. If $N \geq M$ (i.e. $\varphi \geq 1$), the maximum admissible load is $\rho = \frac{1}{\varphi}$ and $T \rightarrow 1 - e^{-1} \approx 0.63$. Thus, contentions among packets directed to the same output are solved at random.

4.3.1 Improvement in Packet Loss Rate

When a packet ρ arrives at input 1 and is destined to output 1 and for comparison study ρ is evaluated with the packet at input 2. The probability input 2 has a packet for the same output is ρ /3. In such case, the probability that '*p*' is lost is 1/2, and the probability that 'p' is not lost is $1-\rho/6$. Similarly, comparing '*p*' with the packet at input 3, the final probability that 'p' is not lost is $1-\rho/6$. As a consequence, the final probability that '*p*' is not lost is $(1-\rho/6)^2$ and the loss probability is $1 - (1-\rho/6)^2$. Analogously, the loss probability for a packet destined to output 3 is $1 - (1-\rho/12)^2$.

4.3.2 Fixed Delay and Packet Length for Throughput

In this scenario assumed a file in the memory where the packets are transferred to the client and the packet length and the delay are fixed for the transfer size. It infers the throughput becomes diminutive as the data size increases. The transmitted packets, received packets and the increased transmission time (throughput) as the node data size increment demonstrated as shown in Figure 5.

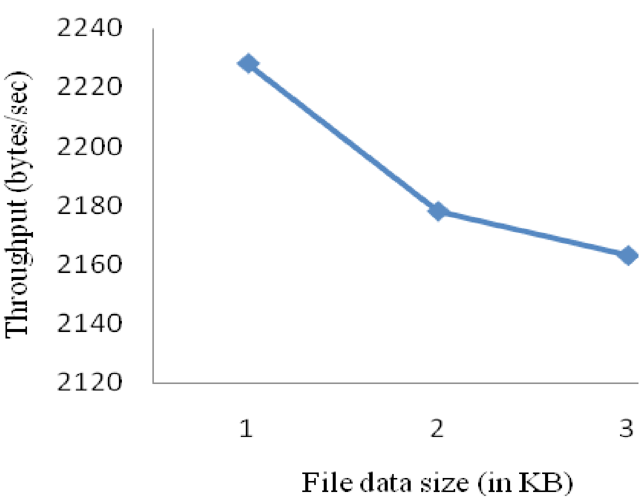

Figure 5. File data size (KB) Vs throughput (bytes/sec).

5. Timeslot Communication Implementation with Network Emulator

5.1 Slotted ALOHA User Interface Module

The slotted ALOHA initiated distinct timeslots and improved the maximum throughput where a node location sends at the creation of a timeslot, and reduced the collision. The slotted ALOHA technique using the network channels and performs the transformation, sharing and control of node data. The slotted ALOHA interface module is shown in Figure 6.

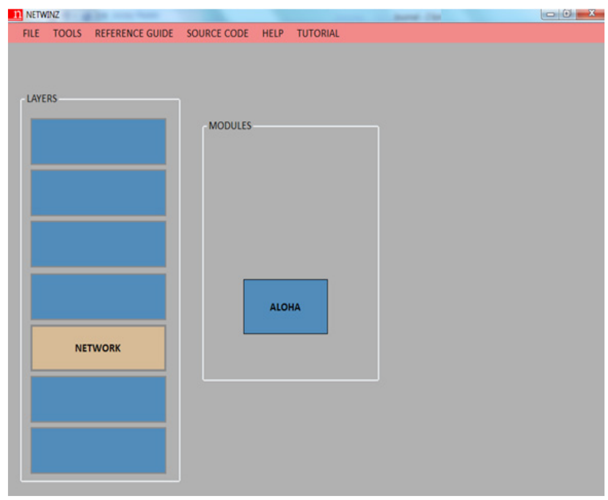

Figure 6. Slotted ALOHA interface module.

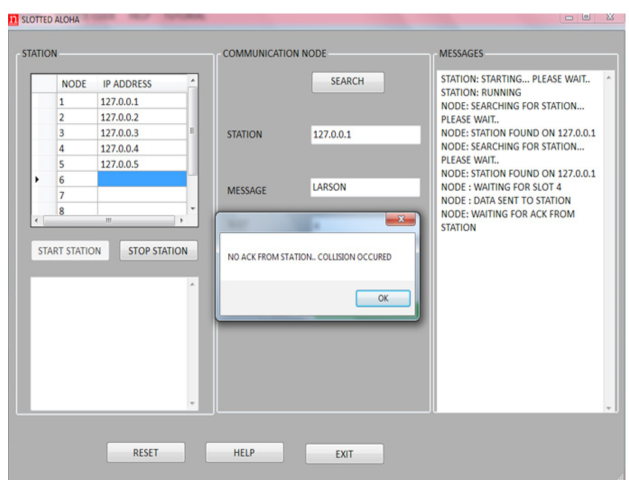

Figure 7. Slotted ALOHA unable to find out node station and collision occur (as snapshot).

5.2 Slotted ALOHA Node Communication Module

The node communications search the node address to communicate, but unable to follow an appropriate station, hence, the collision occurred as shown in Figure 7 (where, the IP addresses are assumed while experimented with two different nodes communicated with each other).

The communication node searches the slot number to spread the data to the appropriate destination as shown in Figure 8.

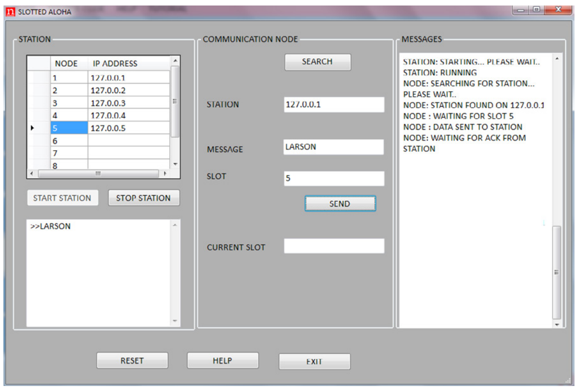

Figure 8. Snapshot of slotted ALOHA to search slot for node station for data transmission.

The communication nodes send the acknowledgement and reach to the current slot as shown in Figure 9.

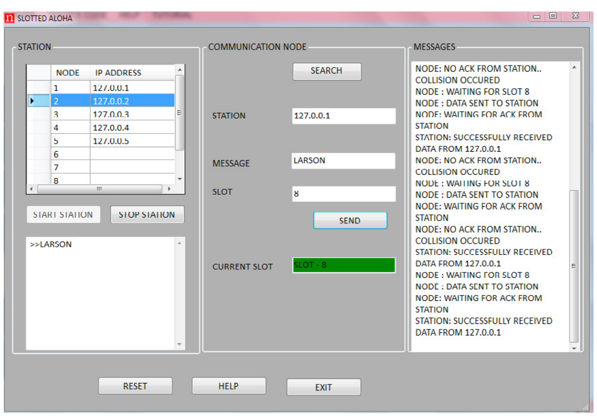

Figure 9. Message transmitted to the station and received acknowledgement from station.

5.3 Improved Throughput in Network Emulator

The throughput module of network emulator shows the data transmission rate (byte/sec) which is shown in Figure 10.

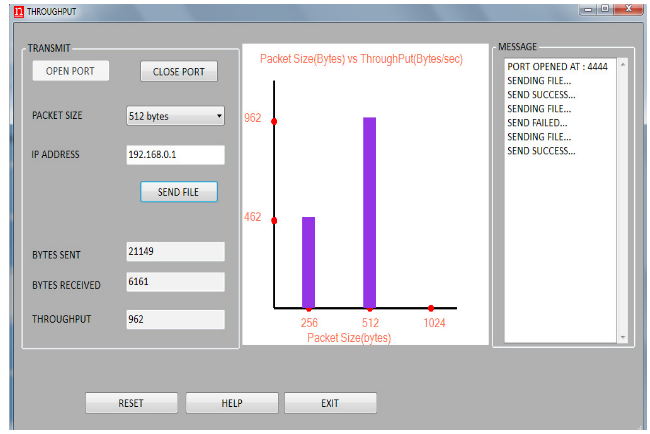

Figure 10. Packet transmission (byte/sec) in graphical view (using 512 byes).

The throughput module of network emulator shows the data transmission rate (byte/sec) which is shown in Figure 11.

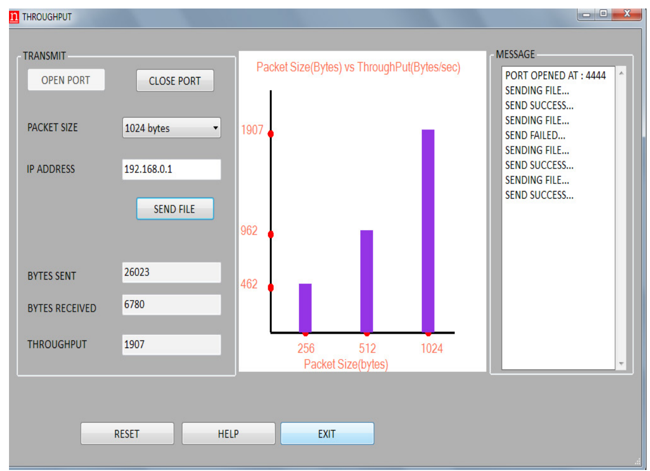

Figure 11. Packet transmission (byte/sec) in snapshot (using 1024 byes).

6. Results and Discussion

6.1 Network Performance for Improved Throughput Rates (byte/sec)

The behaviour of the network system is analysed for varying values of data arrival rate (as percentage (%)) of the server requests/sec. The arrival rates are considered, where graphical plots of node requests (*i.e.* arrive each second, the number of requests served during the second, and the number of outstanding requests waiting) in the buffer at the end of seconds are obtained in Figures 12, 13 and 14 shows the input, output and buffer content for throughput rate in server capacity requests/sec.

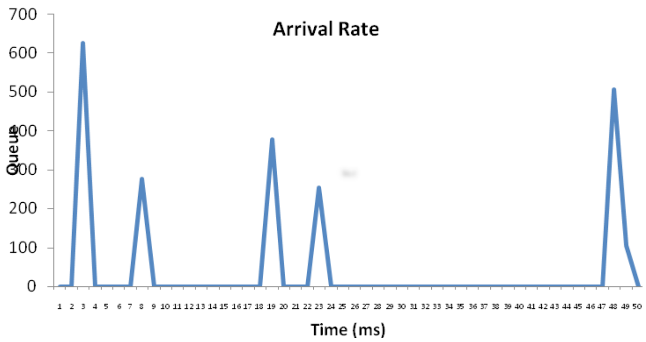

Figure 12. Time vs Buffer contents for the (in %) arrival rate.

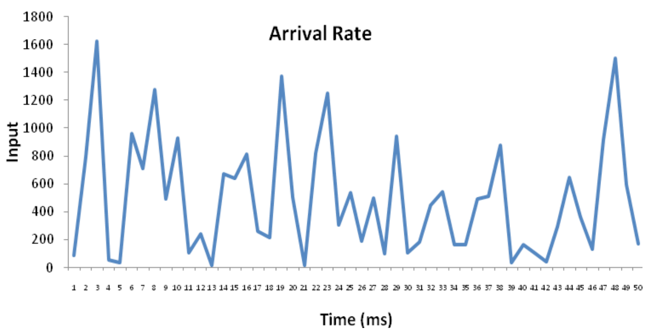

Figure 13. Time vs Input contents for the (in %) arrival rate.

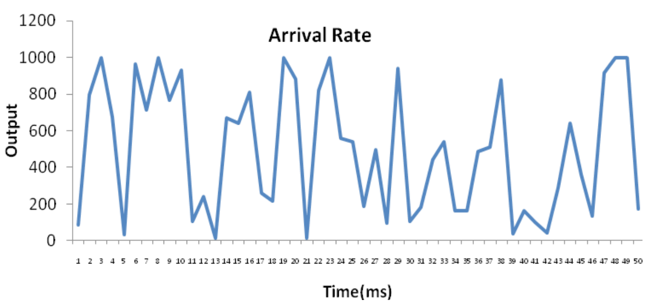

Figure 14. Time Vs Output contents for the (in %) arrival rate.

7. Conclusion

In this work, the collisionless data transmission in timeslot communication network using relevant metrics and comparative statistical has been performed. In this paper, a practical extension of slotted Aloha improved by an approach which is used Network Emulator in OSI layer model is proposed. It allowed analyzing the various performance parameters such as throughput, anticipated delay and a typical number of unintended packets. The emulator performance is used to study in a qualitative method the steadiness of the network procedure and quantitatively increase in throughput and transmit low delay. The standards of arrival rates are plotted as graphical analysis that requests the arrival rate/second, waiting in the buffer at the end are attained. This solution is supplementary proficient and accomplished of sustaining realtime appliances for the network in future.

7. Acknowledgement

I acknowledge the facilitates and amenities offered by my supervisor Professor, Dr. B. Justus Rabi and research work cooperated by Associate Professor, Dr. Kuldeep Chouhan are to be carry out to do the experimental work that provided the features in Network Emulator.

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