An Optimized WRED to Improve Quality of Service in Cloud-MANET

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ABSTRACT
Weighted Random Early detection (WRED) is a mechanism that is responsible to avoid congestion in a network, by sensing the movement of nodes, on the basis of analyzed value for multiple queues of data packets. Numbers of devices always try to transmit data packets for certain time span, there would be an issue of consumed bandwidth, delay, media access delay, load in a network; and these factors can conclude to an increased queuing delay, decreased throughput, long queues, increased number of retransmissions for particular device in a network. So an optimized WRED is one of the improved mechanisms that can contribute to an increased performance of devices in a network for any communication established. To attain a comparative analysis of performance OPNET IT GURU EDUCATIONAL VERSION 14.5 Modeler is used.

Keywords
Cloud Computing, Ad-hoc Network, MANET, PPP, Digital Signal, TORA, Quality of Service, RED, WRED

1. INTRODUCTION
Cloud computing [1, 2] is one the emerging technology in present and coming era. This technology can be attained in an ease that can provide numbers of user to make use of their applications and resources in an 'anywhere and anytime' basis. Cloud computing is hence known as 'on-demand' or 'on-line' computing methodology.

This technology is adapted globally exponentially as it allows its users to access their all the resources which are shared globally, using a pool configuration. It facilitates its users with functionality that it is not necessary to keep all the database and resources with each individual user, but to make an access on on-demand basis.

Cloud computing up-fronts for numbers of enterprises and users for the following factors included: low infrastructure cost, adaptation to virtual hardware, high performance, and accessibility globally to shared resources, services at cheap cost, high computing power, scalability, and availability of resources in a pool architecture, reliability, security, and increased performance to devices, less maintenance needed, enhanced manageability, is capable enough to meet the merging fluctuating demands of numbers of enterprises.

Due to above briefed factors, cloud computing has led to an increment and implementation of such computing technology presently. Cloud computing can be maintained under two subsequent i.e. either in centralized manner, or in decentralized manner. Ad hoc network [2, 3] is one of the types of decentralized cloud computing infrastructure. Ad hoc network is a wireless network that works under a decentralized manner of operation. The network is said to be as ad hoc when it need not to maintain or manage any kind of pre-specified infrastructure to establish communication in between the connected devices.

The usefulness of ad hoc network is generally maintained by implementing Access Points (AP) [4, 5] in every autonomous segment for each grouped numbers of device. APs are responsible to make an initiative to enable or disable communication in-between the proposed scenario of devices. It is assumed that in an ad hoc network no individual station can be treated as an AP, and cannot act or permit devices to communicate at certain time span. Implementing an ad hoc network will permit every device in a network to communicate without any restrictions. Hence each and every communicating device is allowed to transmit or flood numbers of packet at anywhere-anytime functionality, and so ad hoc is formerly recognized as 'on-the fly' network.

Since every device can transfer or flood data packets in a network freely, then decision is to be taken regarding the data packet transmission to avoid unnecessary congestion in particular transmission. To accomplish this, a dynamic process is encouraged that will be responsible to take decisions that which device should communicate at which time span while communication is established. Unless, the traditional use of switches, routers, and hubs in a network, ad hoc networking stands off-clear in all the aspects.

Mobile Ad Hoc Network (MANET) [6] is one the aspect that includes a factor of mobility in all the devices that were intended to communicate in an ad hoc network primarily, along with the fact that mobility does not make any effect onto performance of the network or any of the communicating devices. Devices in MANET are able to move along a network while communicating or making access to resources and services. Unlikely to existing ad hoc network, MANET also concludes to be an infrastructure less, and self-configuring network and in a continuous manner.

Further, bifurcation of paper can include the following sections. Section 2 covers signaling scheme, ad hoc routing protocol [7], Quality of Service (QoS) [4], [6] and its schemes, Internet Protocol (IP) [2], [4], [8] compression mechanism, congestion avoidance mechanism [8], [9], routing protocols in Internet Protocol version-6 (IPv6) [2], [4], [9] environment. Section 3 underlines the proposed scenario(s), configurations to the scenario(s), proposed algorithm. Section 4 represents analysis for proposed scenario and performance of devices in a network under particular circumstances. Section 5 underlines conclusion and the resultant factors that improve the working of existing congestion avoidance mechanism; and references of the proposed work in all the sections above along with future scope.

2. USEFUL WORK

It is said that while operating in a MANET environment, each and every station is meant to communicate freely in a network, this is because every work station is allowed to set their routes for data possible data transmission. Before stations made or begin transferring data packets, certain message packets need to be exchanged. Before any communication is established, the communicating devices will be sending presence-listen acknowledgment messages so that any collision is prevented. This continuous process of exchanging the presence-listen messages along with acknowledgment messages, every device can configure the topological structure of the particular autonomous network to which the station belongs. Since, no topological structure is set or fixed for MANET, every station will be allowed to build-up their topology individually and can know their neighbour in this sense. Hence, this process helps every other station to find best routes in delivering data packet to an appropriate destined device.

In a cloud network, reliability is one of the factors that has concerned at a greater scale. When it is talked about reliability in a network, it is intended that such protocols must be used that provides reliability when a connection is established. Point-to-Point Protocol (PPP) [2], [4], [8], [10] is one of the protocols that provide some aspects of reliability in a cloud-based network.

PPP, an end-to-end protocol, is generally stacked up to the data link layer (OSI model Layer 2). PPP protocol facilitates a physical communication link to provide reliability to all the connected devices. Along with reliability [8] factor, PPP provides other factors such as: compression mechanism [2], [11], [12] for data packets, encryption of data packets travelling along the network, and authentication for every access that has made for data packet. When PPP is implemented in a cloud-based ad hoc network, it is generalised as T-carrier system [8], [13].

The system is said as T-carrier as it is intended to operate on digital signals. Digital Signal 3 (DS3) [8], [13] or 3 T-carrier is one of the types of T-carrier system. DS3 is a signalling scheme consisting 28 Digital Signal 1 (DS1) [8], [13] scheme, and a speed of 44.736 Mbps. It is made available for both wired and unwired environments.

To establish securely in any network using Internet, it is encouraged that to establish a secure communication and to provide integrity, some set of protocols need to be followed. While working in an ad hoc-based network or in MANET, certain set of protocols are provided so that an efficient communication is achieved every time. Ad hoc routing protocols are the standards set priory so that proper control can be attained while any communication or packet transfer need to be done, and stations can better take decision in maintaining topological structure, finds the best route.

Temporally Ordered Routing Algorithm (TORA) [14] is one of the algorithms that accomplish a mechanism that can help devices to route data packets along a network. With the help of TORA, every station can make their topological structure and get to know about their neighbours, best route is found out in this manner.

Out of all these factors, one factor is also encouraged to be accomplished in every communication performed in any network, i.e. QoS. QoS provides us a metrics that defines a performance analysis for a particular network. The QoS of a network is generally measured by certain factors, such as, delay while transmission, availability of bandwidth [4], [11], [15], [16] throughput, transmission speed or bit rate, and error rates or packet loss in a particular network.

Besides all these, QoS can be firmly described as a metrics that comes under resource reservation & control, prioritization of users, flows of data, prioritization of data packets, etc. When QoS need to be taken into consideration, several factors or aspects are chosen onto which the performance for any network rather than a particular device depends.

When two connected devices need to communicate in an ad hoc network, the two devices will set their topological structure using TORA algorithm. Afterwards, there might be a scenario when numbers of devices are communication in a particular time span, in this situation collisions, congestion may occur, as queues are maintained every time multiple devices try to transmit data packets using single data line or communication link. There exists a queuing mechanism under this scenario, which treats the traffic or data packets so waiting in queues to get deliver at set destined devices.

There exist several queuing schemes, out of which some can be as: First in First out (FIFO) [17], Fair Queuing (FQ) [18], Priority Queuing (PQ) [19], Weighted Fair Queuing (WFQ) [20], Weighted Round Robin (WRR) [21], Deficit WRR (DWRR) [22], Priority-based DWRR (PB-DWRR) [23].

PB-DWRR is one of the reliable and most interesting queuing schemes that can be implemented in any network. Priority based queuing can be beneficial in number of aspects, it can control the rate of data packet transmission, can set priorities to data packets to deliver in a fair time, eradicates starvation situation to occur for every engaged device in communication, and higher transmission speed can also be accomplished along with this queuing mechanism.

PB-DWRR puts both the benefits of PQ and DWRR. Every workstation is provided a fixed time slot to establish reliable communication, through this mechanism every device in a network is given an appropriate fixed time at regular intervals. In this manner, all devices communicate in a much better way following a Round Robin mechanism. Different levels are set to provide different levels of priority to each of the data packets and in that basis a continuous rotation takes place, hence making full utilization of bandwidth and isolating the congestion part in some sense.

Since, bandwidth is finite and faster communication strategy works on number of factors, such as data packet size, error rate or dropping of data packets, etc. To tackle up with the issue related to length of data packets, a compression technique need to be yet introduced. TCP/IP Header Compression [24] is a formally known compression technique that is responsible to reduce the size of data packet up-to a relevant and appropriate length. TCP/IP header compression technique is capable enough that it can precise the data packet length from 40 bytes to a level of 3-4 byte. Hence contributes towards QoS with higher transmission rate to data packets.

3. SIMULATION

This section is an experimental section that includes simulation [2], [4], [15], [25] environment under which scenarios need to be implemented to measure the performance metrics for numbers of station operating in any segment of the network. In the proposed simulation environment, cloud computing is encouraged along with ad hoc network methodology, *i.e.*, work stations operating in this environment are allowed to move freely in a network and are allowed to communicate while moving along the network.

In the proposed simulation, MANET is also introduced, so that ad hoc networking is performed by the stations that are set to mobile, i.e. includes some factors associated with moveable character. Numbers of autonomous segments each consisting of MANET methodology are inter-connected to every other autonomous segment through cloud network.

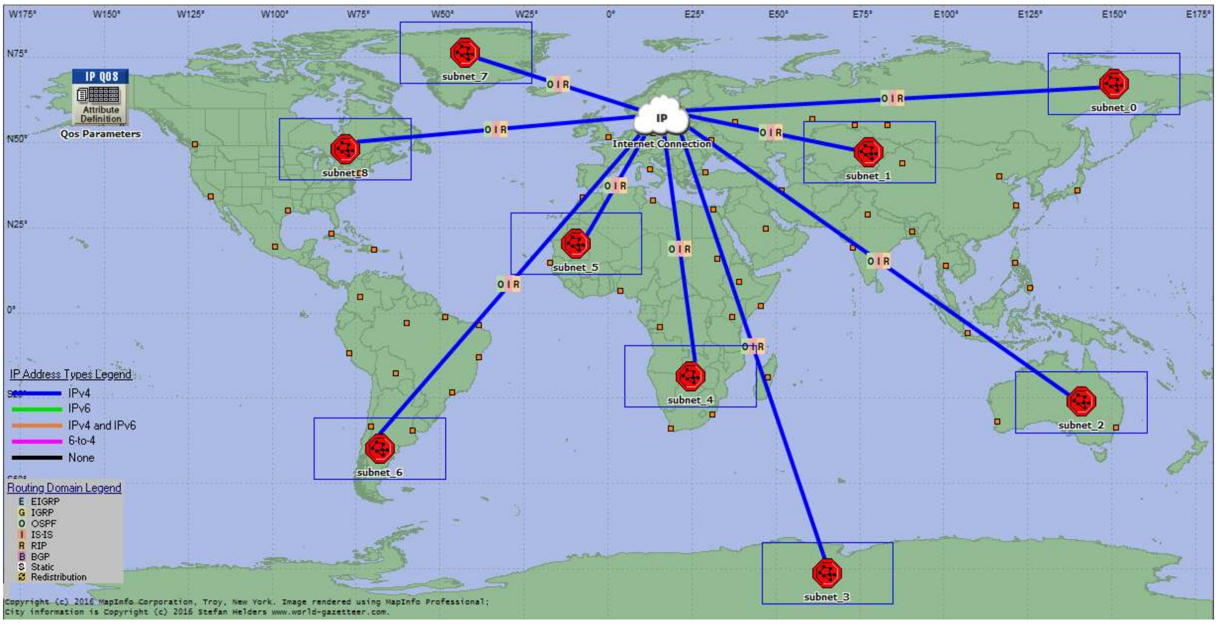

Fig 1: Cloud-based MANET

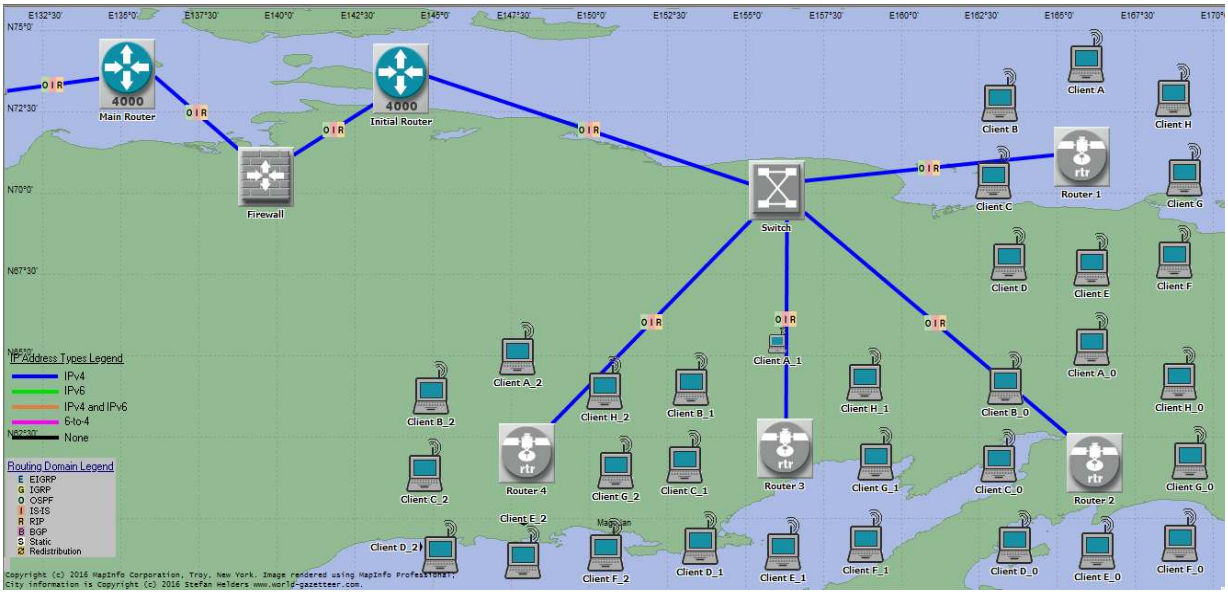

Fig 2: Simple Autonomous MANET scenario

A) *A scenario with WRED*: Under this scenario, routers are enabled with QoS parametric values, along with the mechanism enabled for congestion avoidance in a network. Simple WRED is enabled on all the routers.

B) *An improved WRED algorithm with compression*: This scenario will underline the concept of WRED in a more optimized manner. The working for basic WRED and an optimized WRED can include the numbers of factors.

Since, WRED is a mechanism that follows a queuing discipline. Multiple queues are maintained and basis for queues are maintained in accordance with the traffic classes. WRED basically works under an environment where TCP/IP is followed. Because under WRED, precedence factor is included, for that it is necessary to fulfil the criteria for possible communication in such environment.

Performance factor for WRED can consists, such as threshold of each data packet, bit rate [2], [4], buffer capacity [15], length of data packet, router's memory management [26]. QoS can be barely depend on the factors that depicts performance of WRED in a particular environment. Mathematically, relation in between these factors can ve justified as, steps would include:

1. Let '*t*' be the time factor for any data packet to travel along the network, '*exp_w*' be the exponential weight to be assigned to every data packet, '*avg_Q_size*' be the factor that depicts average queue size to be accepted for successful transmission.
2. Out of theses parametric values, following equation can be made:

$$o\_avg = avg\_Q\_size(t-1) \quad (1)$$

$$c\_avg = avg\_Q\_size \quad (2)$$

$$avg\_Q\_size\ (t) = o\_avg * (1 - (1/2)\ exp\_w) + c\_avg * (1/2)\ exp\_w \quad (3)$$

$$Optimized\_avg\_Q\_size\ (t) = o\_avg * (1 - (1/2)\ exp\_w) + c\_avg * (1/2)\ exp\_w - (b/k) \quad (4)$$

Where o_avg is the old average queue size, $avg\_Q\_size(t\text{-}1)$ is the average queue size at time t-1; c_avg is current average queue size; b is the possible bit rate to transfer a data packet; and k is the threshold value.

Equation 3 depicts the basic or traditional way of analysing the average queue size for the particular communication to be established. With the traditional WRED [27], [28] and its process of analysing queue size results in number of data losses or multiple retransmissions. But when a rational value of both threshold and bit rate are adjoined with traditional WRED, results are improved in some manner. Equation 4 denotes an optimized version of WRED mechanism.

Both the scenarios consist of a common configuration. The configuration [2], [4], [8], [29] would probably include: an ip_cloud; 9 subnets or autonomous segments each consisting of 4 sub-autonomous segments, 36 workstations, 4 normal routers, 2 CISCO 4000 series router, firewall, switch to connect all sub-autonomous segments of connect with other networks. Every work station is enabled as MANET station, and is intended to operate in an IPv6 environment, i.e. IPv6 address format will be used to identify every workstation. All the subnets are connected to every other subnet via cloud computing using DS3 communication link along with routing protocol set consisting of RIP, IGRP, OSPF, IS-IS, and EIGRP; and ad hoc routing protocol set consisting of TORA. PB-DWRR queuing scheme is implemented to better enhances performance metrics for both the scenarios.

4. ANALYSING SIMULATION

This section concentrates on the analysis for the comparison in between the existing and optimized algorithm so proposed in MANET. The performance is measured on the basis of QoS that has accomplished with each of the scenario proposed. The analysis is to be taken into consideration regarding internet connection and firewall for subnet 0 and subnet 5, by measuring queuing delay, retransmission attempts, throughput, load, multicast traffic sent/received, and traffic sent/received.

4.1 Media Access Delay

Media access delay [15] is the amount of time span that has been spent while accessing the workstation particularly in a network. This delay has been encountered for shorter time spans.

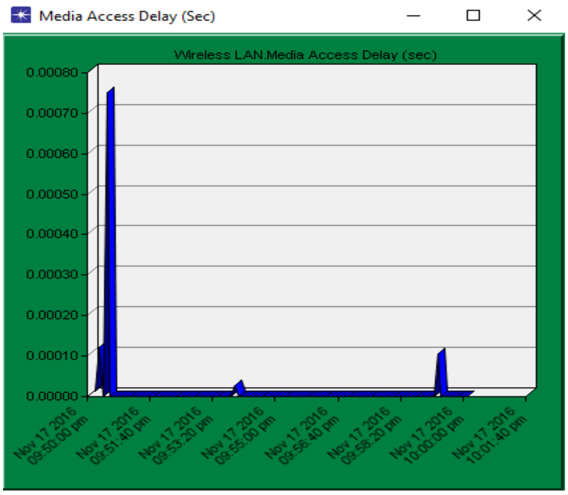

Fig 3: Media Access Delay

Figure 3 represents the media access delay that has been observed in a network, while all accesses are made by individual devices in a Wireless Local Area Network (WLAN) environment. There would be an increase in such kind of delay at the beginning of communication, but would decrease as router got to know about stations associated in a network.

4.2 Multicast Traffic Received/Sent

Multicasting [30] is a concept in which a message, or data packet is sent to a defined numbers of stations in a network, and not to all the stations. The multicast parameter can be analysed both for traffic or data packet sent, or received by an individual station.

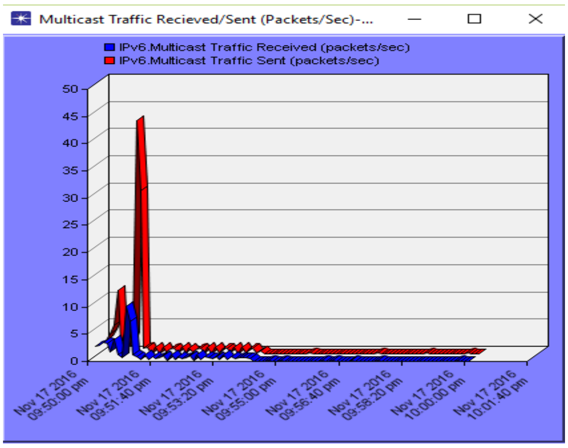

Fig 4: Internet Connection: Multicast Traffic Received/Sent

Figure 4 implies multicast traffic by the stations to other stations in Internet Connection. It is observed clearly in a graph that large numbers of data packets are multicast by the station and very few are received successfully.

4.3 Queuing Delay Received/Sent

Queuing Delay [2], [4], [8] is an amount of time spent by the data packet in a queue to reach to its destination. The time span spent by the data packet to reach its destination before time out has occurred, is referred as queuing delay.

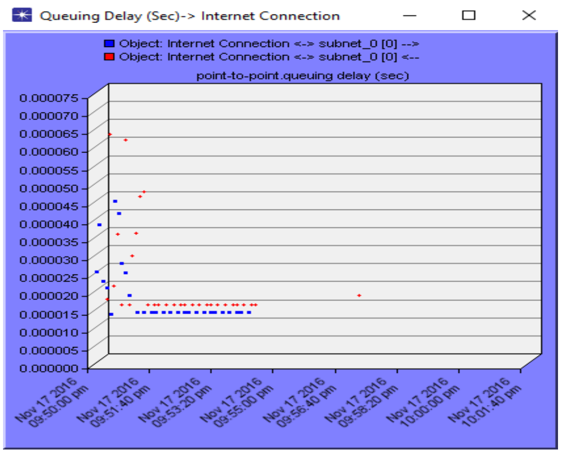

Fig 5: Internet Connection (Subnet 0): Queuing Delay Received/Sent

Figure 5 represents queuing delay occurred while traffic or data packet is either received, or sent to other devices in a network. It can be seen that delay has occurred as time passes. It can be clearly observed by the graph that at initial when communication established, delay has increased, then decreased gradually to constant.

4.4 Throughput Received/Sent

The rate at which it can be said that the data packet has been successfully delivered at the destined device respectively in a network. The rate at which successful transmissions can be attained, is formally known as throughput [2], [4], [5], [8], [15]. This parametric value can be attained for both, traffic sent or received in a network.

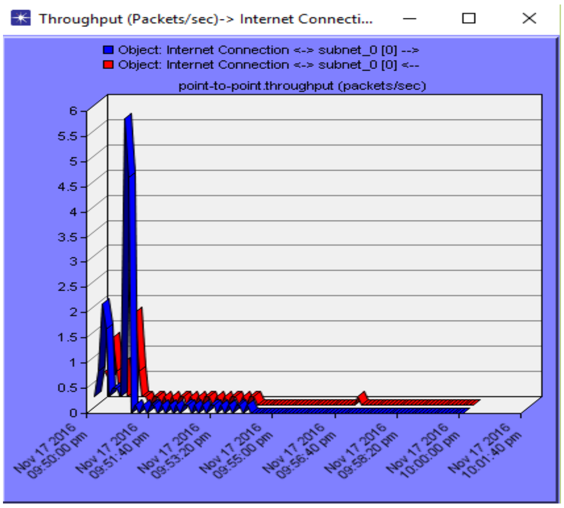

Fig 6: Internet Connection (Subnet 0): Throughput Received/Sent

Figure 6 represents the rate of successful transmission while communication is established. The graph depicts throughput rate in subnet 0 for the internet connection. It can be seen that large number of packets are sent by very few are received by the routers at subnets respectively.

4.5 Retransmission Attempts

There exists one scenario where numbers of packets are not delivered successfully by the devices. For this particular scenario, the source devices probably send data packets to their destined devices for successful delivery of data packets in a provided time span. This concept is treated as retransmission attempts [11], [31].

Figure 7 depicts retransmission attempts performed by one of the device, *i.e.*, Client A for two subnets, subnet 0 and subnet 5 in a network. For client in both the subnets, retransmissions attempted are constant in manner.

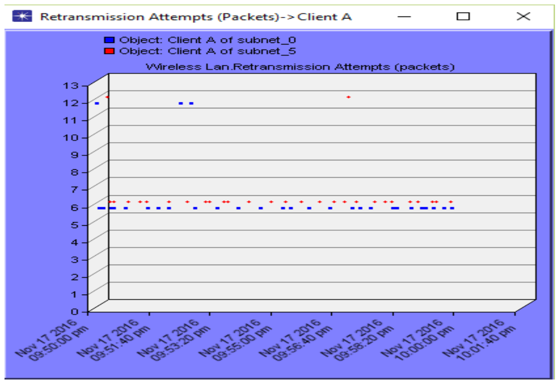

Fig 7: Client A (Subnet 0 and Subnet 5): Retransmission Attempts

4.6 Load

The parameter load [5], [15], [31] can be said in a simpler word as an obstacle that has occurred to a network. The traffic or unnecessary data packets that travel along the network, consumes bandwidth are treated as load for a particular routing path.

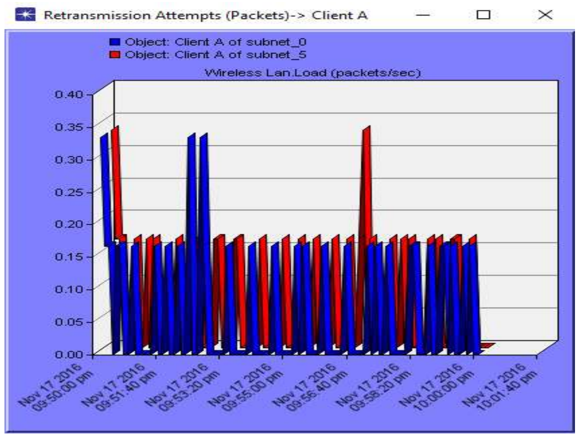

Fig 8: Client A (Subnet 0 and Subnet 5): Load

Figure 8 depicts the load factor in a network for Client A in two subnets, i.e., subnet 0 and subnet 5. At an initial level of communication, load has reached to a milestone, but hen decreases gradually to a constant segment, with not very frequent fluctuations while transmission was taking place.

5. CONCLUSION

WRED is one of the congestion avoidance mechanism that works on TCP/IP model and data packets that are TCP/IP enabled. In the paper, an analysis for traditional WRED and its performance factors are analysed. Threshold, bit rate, length of data packet, buffer size can be the possible factors which effects performance of any network. To improve existing WRED, an optimized WRED is established which proves that two factors, *i.e.*, threshold value and bit rate of each data packet. These contributes a lot to any network, and can facilitates an improved performance if are related in some way. It can be concluded that WRED can be performed more in an optimized manner by relating the queue size as in shown equation 4. Since most of the current techniques were originally designed for wired networks, many researchers are engaged in improving the old techniques, adapting the old techniques and developing new techniques that are suitable for

MANETs. To integrate a model at the appropriate layer with a suitable process model, one needs to integrate a detection engine that identifies an intruder in a generalised way instead of identifying them according to their category.

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