Channel Utilization and performance comparison between TCP and TCP Reno Protocol in 802.11 MAC Standard

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***Abstract*--- This paper explores the comparison between the TCP protocol and the TCP Reno protocol, particularly focusing on their performance pertaining to the data transmission in the wireless networks.**

Further apart from the basic comparison between these two protocols, this paper also aims at highlighting the performance of TCP and TCP Reno when deployed in the common conditions and specifications on the same network scenario by using channelization approach. In this network scenario, the node automatically searches an appropriate channel for data transmission that minimizes the interference and congestion.

***Keywords*: Delay, Throughput, TCP, TCP Reno, Drop Ratio, Round trip time, Congestion, Orthogonal Frequency Division Multiplexing.**

I. INTRODUCTION

Wireless Networking is one of the inexpensive and effective technologies that has developed to such an extent that its implementation is riding the crest of popularity across the world. The deployment of wireless LANs are playing a vital role for communication in Offices, Corporate, Airports, public places etc. Further, its increased mobility, easier access and effective transmission have made it a powerful tool in the world of advanced networking.

A. TCP (Transmission Control Protocol)

TCP is one of the important core protocols from the family of IP Suite. It can be defined as a set of rules that works in collaboration with the Internet Protocol (IP) during data transmission. During data transmission, the message is converted into small packets to facilitate the efficient routing of the message through the internet. During this process, each individual packet of the data is tracked by TCP While the actual delivery of the data is handled by the IP.

In this process, a connection is established between the pre-determined nodes and maintained till the message or messages to be exchanged by the application programs at each end have been exchanged and for this reason TCP is known as a

Connection-oriented protocol. TCP enables the data flow in such a manner that obviates the congestion and provides smooth flow unlike in the case of IP. With the use of TCP protocol, communications between the applications are more secured over the network independently from the lower layers.

During data transmission, certain unpredictable barriers like traffic load balancing, network congestion may result in the loss of the IP packets, duplication or improper delivery. To overcome such peculiar problems, TCP rearranges out-of-order data, requests retransmission of lost data, and even helps minimize network congestion. Once, the sequence of octets is reassembled by TCP in conformance with originally transmitted, it passes them to the application program. A record of each packet is kept with the sender when it sends to the receiver. TCP messages are interpreted by the TCP at the destination. The sender maintains the logs with the help of the timer right from the initial stage and if the message is not acknowledged within the specific time frame, it retransmits the data.

B. TCP Reno Protocol

During the normal working of the system when there is no loss of the packet, TCP Reno continues to increase its window size by one during each round trip time. Whereas when it experiences a loss of data, it reduces its window size to one half of the current window size. This is called additive increase and multiplicative decrease. The congestion avoidance mechanism adopted by TCP Reno constantly modifies the window size that eventually leads to the periodic oscillation in the window size which further creates an oscillation in the round trip delay of the packets. Ultimately, this results in the frequent re-transmissions of the same packet and underutilization of the available band width.

C. IEEE 802.11 Standard

In 1997, the family of IEEE 802.x standards expanded itself with the addition 802.11 Wireless Local Area Network (WLAN) standard that consists of a series of half-duplex over–

the-air modulation techniques having the same basic protocol. As per the protocol IEEE 802.11, Physical layer specifications uses three different modulation techniques i.e. Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS) and Infrared (IR), with the maximum data transmission rate of up to 2mbps. The DSSS and FHSS Physical layers operated in the License free 2.4 GHz ISM (Industrial, Scientific and Medical) band. With the passage of time, development in original MAC remained intact while the technology continued to explore the new Physical layer specifications.

In 1999, the two enhanced Physical layer specifications 802.11b and 802.11a were released by IEEE with data transmission rates of up to 11 and 54 Mbps, respectively. Protocol IEEE 802.11a is based on (OFDM) Orthogonal Frequency Division Multiplexing) that operates in the 5 GHz band where 802.11b is DSSS based that operates in the 2.4 GHz band. In 2003, IEEE further extended its 802.x group to 802.11g Physical layer that support data transmission rates of up to 54Mbps in the 2.4 GHz band. IEEE 802.11 has been continuously intensifying the efforts on increasing transmission speeds and range, improving Quality of Service (QoS), and addi ng new capabilities. Due to its cost effectiveness, the popularity of IEEE 802.11 surged in a short time to the extent that today IEEE 802.11 has attained the position of the most widely deployed wireless network technologies in the world.[19]

II. RELATED WORK

In [1] the Authors discussed about the performance of TCP in wireless Networks. They discussed various schemes such as End to End Schemes and Handoff proposals. Handoff occurs when mobile hosts are shifting their base stations due to location change. In the mobile networking, the retransmission timeout problem occurs frequently and TCP-R used in this paper serves a robust solution to it. Experiments show that this system is significantly more effective and efficient while dealing with unreliable wireless links than normal TCP.

In this paper [2] The Generalized-Snoop also called G-Snoop is implemented at wireless gateways for enhancement of TCP protocol in wireless networks. Apart from gateways, other parts of the network remain unmodified.

The Authors [5] studied the effects of random walk mobility in k-hop clustered networks that eventually improves the energy efficiency and power delay tradeoff of the network. Further the author discussed the random walk mobility model with nontrivial velocity and the i.i.d. mobility model used in the critical transmission range for connectivity in mobile K-hop clustered networks where all nodes move. The Authors worked on the clustered networks in which it is assumed that the cluster heads are stationary where any packet from a cluster member can reach a cluster head, even though the cluster members may move. It would be interesting to study the case where cluster heads may move as well. In simple terms, study was carried out on contribution of the mobility in the improvement of network performance

In this paper [9], the authors highlighted the schemes to improve the performance of TCP in wireless networks and other lossy link networks that cause packet loss because of congestion due to bit errors and handoffs. It is also discussed that whenever TCP identifies any type of loss, it invokes congestion control and avoidance algorithm resulting in a degraded performance of wireless and lossy systems. To overcome this problem, these schemes are classified into three categories that are end-to-end protocols, where loss recovery is performed by the sender; link-layer protocols that provide local reliability; and split-connection protocols that break the end-to-end connection into two parts at the base station. The paper presents the results of the experiments conducted earlier on both LAN and WAN environments based on the throughput and good put metrics.

The result certifies that a reliable link layer protocol provides very good performance without splitting the end to end connection at Base Station. Further, The Authors investigated that in above mentioned approach; the TCP Reno improves better in case of End to End Scheme and shows better performance in LAN connection than WAN which has more connection failures and presence of lossy links.

This paper [11] proposes a new version of TCP called TCP NewZag to provide an end to end congestion control mechanism. TCP NewZag determines the random packet loss in the network that could to the poor TCP performance in wireless networks. TCP New Zag proposes two new mechanisms:

1. A new end to end loss differentiation algorithm.
2. Adjustments of TCP New Reno multiplicative decrease algorithm. In both the cases, the adjustments are required at the TCP sender side only. TCP New Zag re-designs clock unit inside the kernel to increase the estimate of three RTT relative variables. Compared with TCP New Reno TCP, New Zag achieves significant throughput improvement when the wireless random packet losses occur.

In this paper [14], the authors discussed the results related to the performance of TCP in Intermittently Connected Wireless Networks (ICWN) with epidemic routing protocol. The results shows that the multiple copies of the data packets cause duplicate acknowledgements due to which the performance of the TCP gets degraded by epidemic routing in ICWN since it reduces the transmission rate of the data. Further, A-TCP-Reno, an enhanced algorithm of TCP, is proposed to solve the said problem. Duplicate acknowledgements caused by epidemic routing that hampers the performance can be avoided by A-TCP-Reno. The result of the experiment conducted on the simulator shows that A-TCP/RENO improves throughput, gives higher delivery ratio and lowers the delay as compared to TCP/RENO.

III. CHANNEL SELECTION APPROACH

The physical layer for IEEE 802.11 is dependent upon Orthogonal Frequency Division Multiplexing (OFDM). The OFDM gives utility touch on aqueducts and minimize burst error rates on the grounds that it permits individual channels to take care of their orthogonally, or separation, to near channels. OFDM is very useful for transmitting radio signals reflected from one point to many points; leading to different channels before they eventually reach the receiver.MAC selects the particular rate to transmit the data on the wireless channel. The 802.11 mac works on a queue based technique means first in first out transmission; every station and the corresponding node chooses randomize channel for frame transmission. The channel is split into time slots wherever every slot corresponds to specific RF hop frequency. The collision probability is also less by choosing randomizes channels and if the packet drops during the transmission then it retransmit the packet and utilizes the congestion window [16].The channel supports point to multipoint transmissions.

IV. EXPERIMENTAL METHODOLOGY

Assume that n mobile nodes in a wireless networks with CBR (constant bit rate) traffic; configured TCP and TCP Reno Protocols. In this case, OFDM actually transmits radio signals from one point to other point of the similar frequency of 2.4 GHz. The frames are entirely transmitted as a whole and the hidden terminal effects are not considered. Also, it is assumed that the ACK frame is transmitted at the lowest rate so that the probability of error in the ACK frame becomes zero. The data bytes set by 1024 bytes and acknowledgments frame is set at 40 bytes. The absence of ACK frame indicates a collision among the packets during transmission. During the frame transmission if the channel is not free, a channel access with synchronization takes place. The mobile node is allowed to start the transmission and if channel losses the packet then it arbitrarily waits for next cycle to start the transmission.

V. EXPERIMENTAL SCENARIO

The transmission rate of wireless networks is 1.5 Mbps and that no transmission errors occur (if the channel is ideal).The mobile nodes configured with 802.11 support. These mobile nodes access the channel by employing the 802.11 MAC standard with following parameters: Maximum Segment Size (MSS) =1024 bytes, Distributed Coordination Function Inter-Frame Space (DIFS) =2 slots, CWmin = 31, CWmax = 1023. The proposed mechanism attains lower overall rejection probability in the TCP and TCP Reno Protocol, while for the high priority class the performance is significantly improved. The experimental scenario for both TCP and TCP Reno Protocol shown in figure 1; these protocols run on 40 nodes.

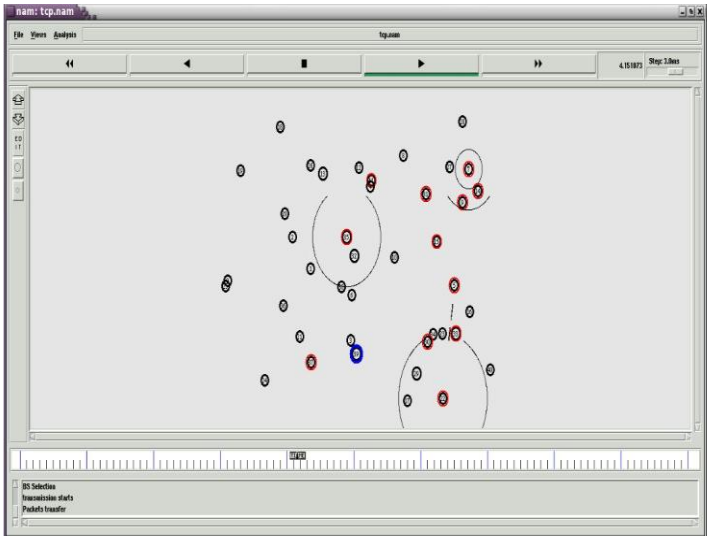

Figure 1. Experimental scenario of TCP and TCP Reno Protocol

A. *Experimental Results*

In this section, the results are referring to the comparison performance of TCP and TCP Reno Protocol. An equivalent traffic load and same state of affairs has been applying in each the protocols. The distribution of the nodes is uniform and transmission is random method way manner. We provide an end to end connectivity in between the nodes of the wireless network scenario.

1) *Throughput of TCP and TCP Reno Protocol:* It is the proportion of delivered packets over the entire packets sent within the networks. The performance model takes under consideration all traffic from nodes within the interference vary.

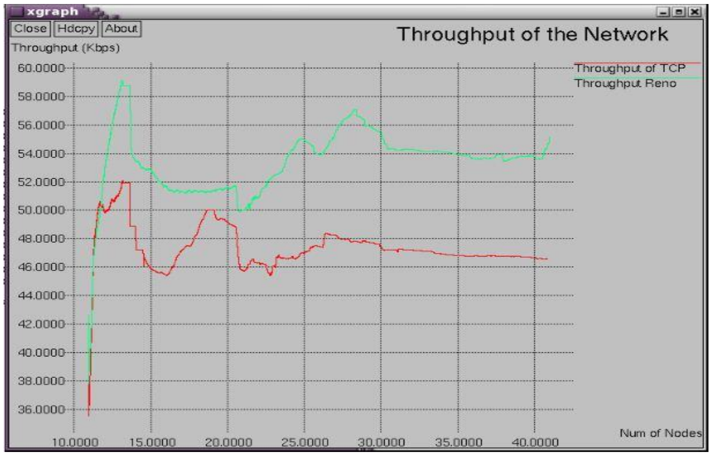

Figure 2.Throughput of TCP vs. TCP Reno Protocol

The results clearly show that TCP Reno effectively performed and utilization of channel has been better than TCP protocol. The throughput of TCP Reno Protocol is higher than of TCP Protocol.

2) *Average delay of TCP and TCP Reno Protocol:* The delay of a packet in a network is the time it takes the packet to reach the destination after it leaves the source. We take into account queuing delay at the source because we consider multi-hop transmissions and a node can be involved in different simultaneous transmissions.

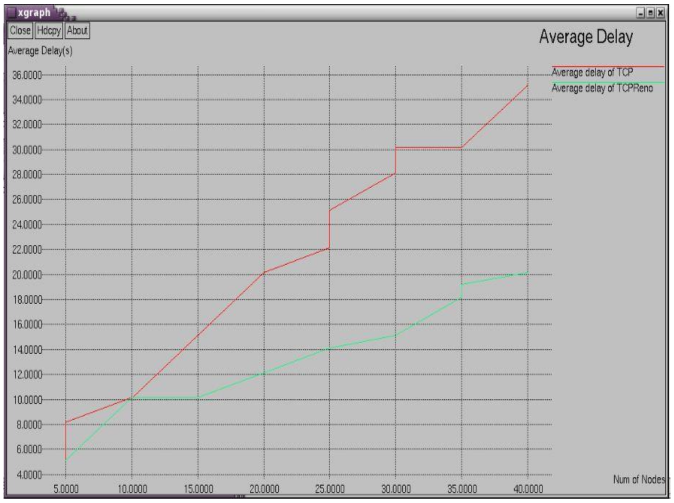

Figure 3. Average delay of TCP vs. TCP Reno Protocol

The Simulation results have been shown in above two subsections that the TCP Reno outperforms well compared to the TCP protocol. The observed Throughput of TCP Reno is high and lesser delay. The delay depends on packet transmission in between source to receiver end; if the delay is less then achievable throughput is high; this way lesser packet collision in the network.

3) *Packet Drop Ratio of TCP and TCP Reno Protocol:* The drop ratio of the packets increases due to congestion or improper data delivery and other network losses due to interference or noises. Low drop ratio manages the channels for good delivery of data in case of TCP Reno. The drop ratio increases with the number of nodes& due to this the performance of TCP Reno is better than TCP Protocol.

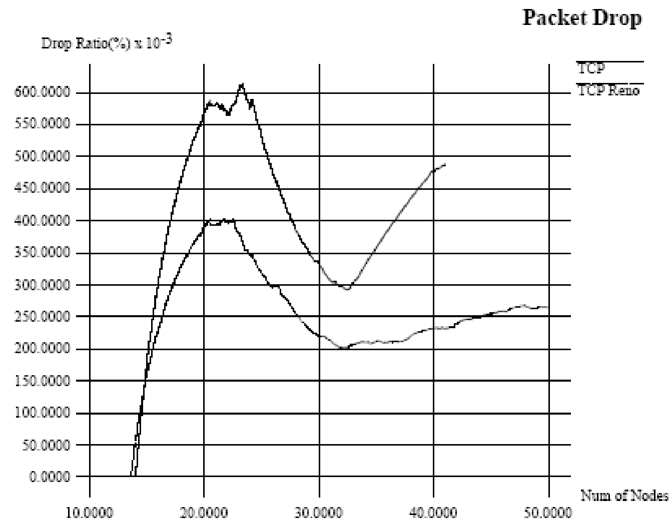

Figure 4. Packet Drop Ratio

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VI. CONCLUSION

One roguish taken hold by TCP Reno is that it has overheads that accompanied with the frame transmission that is apparently reducing its efficiency. So reducing the efficiency of the TCP Reno we uses channel selection approach with maintaining congestion window to improvement the performances of the wireless networks.

The results show that TCP Reno support seamless connectivity with influentially utilization of channels. TCP Reno works the best in small networks under the low network mobility conditions. It is also observed that multiple channel assignment in the TCP Reno protocol with minimize of interferences as of TCP protocol and enhances the reliability of the network. In the future, we will be working with the real network with deploying the real traffic and also faces channel assignment problems. The work will also be supposed to run on cross layer.