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Comparative study on Congestion Control Techniques in WLAN-A Literature Review

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ABSTRACT

WLAN is a network which is established without making use of wires.The main benefit of wireless networks is to access the applications from anywhere and anytime.Due to low cost, ease of deployment and very high speed as compared to cellular network it is widely used in both offices and home environments. But congestion is the major problem for online and on demand network applications.Congestion is the traffic jam in communication networks,which may occur if the load on the network exceeds beyond the capacity of the network. Congestion control for on demand data as well as streamed media traffic over network is a challenge.This challenge has motivated the researchers to develop a congestion control mechanisms and techniques.This paper gives brief survey about basic congestion control techniques i.e., TCP Tahoe,TCP Reno, TCP New Reno and TCP SACK.Further we make comparison among these mechanisms.

I. INTRODUCTION

A Wireless Local Network (WLAN) is a network used to communicate between two or more users.It support huge number of network application like web,email,media download,web browsing and file sharing to voice calls. Due to low cost ,ease of deployment and very high speed as compared to cellular network it is widely used in both office and home environment.As there exists huge variety of network applications built on its capability of streaming media on demand such as video streaming and conferencing,voice over IP[1] and video on demand(VoD).The number of users for these network applications is continuously increasing and hence resulting in congestion.Congestion occurs when amount of data sent to the network exceeds the available capacity,the routes are unable to cope up the demand and hence in result the packet loss. Due to very high traffic rate the performance become poor or collapse completely and almost no packets are delivered.TCP Tahoe,TCP Reno,TCP New Reno and TCP SACK are basic mechanisms[2] to control congestion and improve the TCP performance.In this paper we include five sections In section 1 we have given brief introduction about WLAN,congestion and basic congestion control mechanisms. Section 2 briefs the literature review.In section 3 we will discuss various congestion control techniques.Insection 4 we shall be providing the comparison of congestion control techniques. In section 5 we will present conclusions.

II. LITERATURE SURVEY

Tomar p. et al (2011)[3]presented a paper on performance analysis and comparison of TCPVariants to identify best TCP variant in network.According to that TCP Reno is better than otherTCP variants.Comparisons are performed on the basis of parameters such as packetloss,byte received,throughput and pause time.

Dr.NeerajBhargava et al(2013) [4] performed analysis of congestion control and advance algorithms.Compared TCP Tahoe,TCP Reno,TCP SACK and each one of them was evaluated under high and low mobility.

B.Subramaniet al (2014)[1] Presented a survey on current trends and advancements of Area of TCP-friendly congestion control, further discussed the congestion control algorithms(Drop Tail ,Random Early Detection, CHOKe Algorithm, BLUE Algorithm) based on network awareness.

SatoshiUtsumietal(2014)[5]Proposed congestion control mechanism called WFCC(Wireless Friendly Congestion Control) .It is (i) friendly with TCP New Reno (ii) free from dedicate operational parameters (iii) roubust against link errors under wide range of network buffer space.Further simulations and emulation show that WFCCcan yield a throughput performance improvement compared to conventional TCP NewReno) and friendly with TCP NewReno over wireless links.

C.Socrateset al(2014) [6] Focused on the study of congestion control and elaborates various issues related with it.Further concentrates on avoidance of congestion. This scheme allows a network to operate in the region of low delay and high throughput. Comparisons among the RED,FRED,BLUEandA-CHOKe algorithms are done on the basis advantages and disadvantages.

K.P.Vijayetal(2014)[7] Investigate and proposed a newcongestion avoidance mechanism coupled with authenticated mode of data transfer. This congestion avoidance mechanism give a feedback between routers at borders of a network in order to detect and restrict unresponsive traffic flows before they enter the network and to transmit the data securely by employing cryptographic technique. It helps to audit packets that are received or send in local area network. It also ensures data security by applying cryptographic methods.

SaleemUlllah et al (2014)[8] Proposed a scheme that improving the network efficiency by making the modification in congestion control constraints and by selecting appropriate congestion window size and proactive avoidance.Simulation was done with ns-2 simulator and result are compared with TCP NewReno.The performance of proposed mechanism is better than TCP NewReno.

BhupinderKaur et al (2015)[9]Discussed various congestion control technique like CBRRT , CA-AODV ,CFR, LSRP, CARP, AODV-I,ABCC etc. further compared these congestion control techniques ,based on different simulator parameters like packet drop,packet delivery ratio,End to End Delay.

III. CONGESTION CONTROL TECHNIQUES

There has been flurry of recent works on improving TCP performance over wireless networks. The basic proposed mechanisms(TCP-Tahoe, TCP-Reno, TCP-New Reno, and TCP-SACK TCP) to improve TCP performance in wireless networks, have been chosen in the present work, and are explained below:

3.1TCP Tahoe

TCP Tahoe is one of the congestion control algorithms described adds some new and enhance the earlier TCP implementations including Slow Start, Congestion Avoidance and Fast Retransmit [2]. During slow start, the congestion window increases exponentially until it reaches the slow start threshold, and during congestion avoidance the congestion window increases linearly by one per RTT. During fast retransmit, the sender retransmits the lost segment and enters into the slow start phase by setting the congestion window to 1 and slow start threshold to half of congestion window[10].

3.2TCP Reno

TCP Reno is similar to TCP Tahoe except that in addition to fast retransmit, it also includes fast recovery mechanism for single segment loss. When TCP sender receives number of duplicate acknowledgements, instead of switching to slow start after fast retransmit, TCP Reno enters into fast recovery. During fast recovery sender sets slow start threshold to the half of congestion window and the new congestion window to the new slow start threshold plus the number of duplicate acknowledgements received. TCP Reno remains in fast recovery until the lost segment that triggered the fast retransmit has been acknowledged. When sender receives the new acknowledgement (s), it exits fast recovery, reset the congestion window to slow start threshold, and thereby moves into the congestion avoidance [2][3].

In case of congestion loss, the fast recovery mechanism keeps the average congestion window size high resulting in better throughput performance compared to TCP Tahoe. During fast recovery, each new duplicate acknowledgement increases the congestion window size by one. Although TCP Reno work fine for single loss, in case of multiple losses from thesame transmission window the performance suffers since it exits fast recovery and enters into it again in a repeated fashion or goes to timeout[10].

3.3 TCP New Reno

TCP New-Reno uses an augmented fast recovery mechanism where, unlike TCP Reno, fast recovery continues until all the segments which were outstanding during the start of the fast recovery, have been acknowledged. This strategy helps to combat multiple losses without entering into fast recovery multiple times or causing timeout. In this case, a partial acknowledgement is consider as an indication that the segment following the acknowledged one has been dropped from the same transmission window, and therefore TCP New-Reno immediately retransmit the other lost segment indicated by the partial acknowledgement and remain in fast recovery. It takes the one round trip time to detect each lost segment and to retransmit it [10].

3.4 TCP SACK

In TCP SACK, the receiver sends acknowledgment with SACK (Selective Acknowledgement) option when it receives out of order segments due to loss or out of order delivery. The SACK option field contains a number of SACK blocks, where each SACK blocks reports a non- contiguous set of data that has been received and queued. The first block in SACK options reports the most recently received block. The TCP SACK sender is an intelligent extension of that in TCP Reno. It only modifies the fast recovery mechanism of TCP Reno keeping the other mechanism unchanged. TCP SACK maintains a variable called pipe to keep track of the number of outstanding segment[10],[11].

IV. COMPARISON OF CONGESTION CONTROL TECHNIQUES

TCP Tahoe is the simplest one out of the four variants. In TCP Tahoe packet loss is detected after the whole timeout interval. When the packet loss is detected, TCP Tahoe's performance becomes slow.It doesn't have fast recovery. During congestion avoidance phase, congestion window goes above the threshold value at that time congestion window grows linearly by one per RTT.

TCP Reno differs from TCP Tahoe at congestion avoidance. When triple duplicate ACKs are received, it will halve the congestion window, perform a fast retransmit, and enters fast recovery. If a timeout event occurs, it will enter slow-start, same as TCP Tahoe. TCP Reno works fine and very effective for single loss, in case of multiple losses from the same transmission windowits performance suffers and become poor.

TCP NewRenois reafine version of TCP Reno, it improves the TCP Reno's performance when a burst of packets are lost by modifying the fast recovery algorithm. In TCP NewReno, a new data ACK is not enough to take TCP out of fast recovery to congestion avoidance. Instead it requires all the packets outstanding at the start of the fast recovery period are acknowledged.

TCP NewReno works by assuming that the packet that immediately follows the partial ACK received at fast recovery is lost, and retransmit the packet. However, this might not be true and it affects the performance of TCP. SACK TCP adds a number of SACK blocks in TCP packet, where each SACK block acknowledges a non-contiguous set of data has been received and queued. The TCP SACK and TCP Reno are differ from each otherin the behaviour at the time when multiple packets are dropped from one window of data. It only modifies the fast recovery mechanism of TCP Reno keeping the other mechanism unchanged. TCP SACK maintains a variable called pipe to keep track of the number of outstanding segment. SACK sender maintains the information which packets is missed at receiver and only retransmits these packets. When all the outstanding packets at the start of fast recovery are acknowledged, SACK exits fast recovery and enters congestion avoidance.

Actually the four variants of TCP only differ when there is a packet loss. If all packets reach the destination successfully, the four variants behave the same. The comparison[4][12] is shown in the Table1 and Table 2 as given below:

Basic TCP Variants	**Behaviours**
TCP Tahoe	Slow Start+Fast Retransmission
TCP Reno	Fast Retransmission+Fast Recovery(for single packet loss)
TCP New Reno	Fast Retransmission+Fast Recovery(for multiple packet loss)
TCP SACK	Fast Retransmission+Fast Recovery(in case of re-transmission of more than one packet loss)

Table 1: Congestion Control Methods

Algorithm TCP Variant	TCP Tahoe	TCP Reno	TCP New Reno	TCP SACK
Slow Start	Yes	Yes	Yes	Yes
Congestion Avoidance	Yes	Yes	Yes	Yes
Fast Retransmit	Yes	Yes	Yes	Yes
Fast Recovery	No	Yes	E V	E V
Retransmission Mechanism	N	N	N	N
Congestion Control Mechanism	N	N	N	N
Selective ACK mechanism	No	No	No	Yes

Table 2:TCP Variant Evaluation on basis of Algoriths

(N=Normal, EV=Enhanced Version)

V. CONCLUSION

In this paper we briefed about what congestion is and basic congestion control techniques(TCP Tahoe,TCP Reno,TCP NewReno and TCP SACK).In this paper we conclude that congestion is main issue among various TCP variants.To reduce or overcome congestion a set of mechanisms is implemented by TCP is called congestion control.Further we made comparison among these TCP variants.We have shown that the main drawback in TCP Tahoe is that packet loss is detected after the whole timeout interval. When the packet loss is detected, TCP Tahoe's performance becomes slow. Although TCP Reno work fine for single loss, in case of multiple losses from the same transmission window the performance suffers. It conclude that fast recovery mechanism introduced by TCP Reno handle multiple losses poorly.New Reno is limited to detecting and resending at most one lost segment per round trip time .When multiple packets are dropped from one window of data TCP SACK and TCP Reno differ in behaviour.This paper briefly surveys various congestion control mechanism but it seems that there is no single mechanism that control or reduce congestion in network.More research work is needed in this direction.

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