Approaches for Enhancing Performance of Mobile TCP by Congestion Control over Wireless Link

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ABSTRACT: TCP/IP (Transmission control protocol/Internet protocol) is dominant transport protocol which is used in internet application like telnet, WWW, FTP and email for data transmission.TCP provides a connection orientation, reliable data delivery and end to end mechanism. There are many variants can be developed for improving performance, fast retransmission and recovery of multiple lost packets.TCP variants are Tahoe, Reno, New Reno, Vegas, Sack and many more. In this paper, performance comparative of all the variants using network simulator (NS2.35) has been reported. New Reno shows better performance than other variants in throughput and end to end. New Reno has higher throughput and less end to end delay compared to all the other variants.

KEYWORDS

TCP/IP, TCP New Reno, Throughput, End to end delay, Congestion control.

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1. INTRODUCTION

Today internet is a wide network. It is different network from single network because of different topologies, packet sizes, bandwidth delay and other parameters.TCP/IP protocol is widely used in internet.TCP provides connection orientation, reliable connection between two host. Reason behind good reliability and ordered packet delivery is that sender does not send another packet unless sender does not receive acknowledgement of previous packet from receiving side. Due to these good qualities 90% of the data traffic carried by TCP in wired and wireless network [2] .TCP is used in telnet, WWW, FTP and email [2].TCP have many variants like Tahoe, Reno, New Reno, Sack , Vegas and many more. In this paper, we compare all the variants using simulator NS 2.35 and conclude that TCP New Reno has higher throughput and less end to end delay.TCP is used in wired and wireless link. In wired link; packet loss is due to congestion and in wireless link; packet loss is due to congestion or bit error. Losses are occurs due to congestion, bit error, fading, handoff, multipath reflection, interference and noise. In this paper, we use mobile nodes or vibrant nodes.

Rest of the paper is organized as follows section II describes variants of TCP, section III describes literature survey and limitation, section IV describes simulation graph, section V describes conclusion.

2. TCP VARIANTS.

2.1. TCP Tahoe

TCP Tahoe consist three intertwined algorithms which are slow start, congestion avoidance and fast retransmit. It takes complete timeout interval for detect packet loss. Some time it takes longer because of normal grain timeout so it is not suitable for high bandwidth links. Whenever timeout is occur so congestion window is reset to 1 after congestion avoidance algorithm started and after some time again it is starting with slow start.TCP Tahoe is slow because of transmission flow is decreases.

2.2. TCP Reno

It is updated variant of TCP Tahoe. Fast recovery algorithm is introduced in TCP Reno. Fast recovery is entering after fast retransmit.TCP Reno maintains the clocking of new data and duplicate ACKs very effectively compare to TCP Tahoe. Whenever congestion or timeout is occur so size of congestion window is half after congestion avoidance algorithm and enter in fast retransmit. After it will be enter in fast recovery algorithm. When single packet is lost from window of data so TCP Reno is maintain by fast recovery.

If two packets are lost so it will act like TCP Tahoe. This variant is not useful when two packets are lost from frame of data.TCP Reno handles multiple packets loss very poorly.

2.3. TCP New Reno

It is updated variant of TCP Reno. Slightly different in fast recovery algorithm in TCP New Reno compares to TCP Reno. Whenever two packets are lost from frame of data so it is maintain. Like TCP Reno whenever multiple packet losses detect so TCP New Reno enter in fast retransmit. Different between TCP Reno and TCP New Reno is when multiple duplicate acknowledgements are detected so TCP New Reno does not exit from fast recovery like TCP Reno.TCP New Reno is exits from fast recovery when all the data in the window is acknowledged.

TCP New Reno problem is that it takes one round trip time for detects each packet loss. When acknowledgement of first retransmitted packet is received only then other packet is lost. Another limitation is TCP New Reno does not deduce packet loss is occurring is due to bit error or congestion. Whenever bit error occurs so unnecessary cut down the size of congestion window.

2.4. TCP Sack

It is improved version of TCP Reno and TCP New Reno with selective acknowledgements. Detection of multiple packets and retransmission of multiple lost packets per round trip time can be solved by TCP Sack. When loss is detects so it enter in fast retransmit and it exists when all the data in the window is acknowledged like TCP New Reno.

Sack cannot distinguish between loss is occur due to bit error or congestion. Whenever bit error occurs so unnecessary cut down the size of congestion window.

3. LITERATURE SURVEY AND LIMITATION

3.1. Literature Survey

In literature survey, there are some papers based on TCP New Reno for improving performance.

In paper [1], it is based on improve performance of TCP New Reno by compute the ratio of Ti / Td where Ti is current estimates of retransmission timer's timeout interval and Td is time difference between two events. If ratio is high (>0.25) so packet is lost due to congestion otherwise it is lost by bit error. Limitation of TCP New Reno can be solved by this approach. Throughput is improved by comparing updated TCP New Reno with TCP New Reno and Westwood using NS2.35 simulator.

In paper [2], it is based on improve performance of TCP New Reno using bottleneck and drop tail queuing method. Bottleneck algorithm is use for congestion control. The queue size is bounded to limit of 4, above the packets of bounding limit which are to be discarded by drop tail queuing algorithm and calculate the round trip time. If (current time-packet transmission time) > RTT. If it is then it immediately retransmit the packet without waiting for 3 Duplicate packets or timeout so fast retransmission can be improved. Parameters of received packets, dropped packets, throughput, and average acknowledgement are improved by comparing updated New Reno with Reno and New Reno using simulator NS 2.35.

In paper [3], it is based on enhancing performance of TCP using estimates the RTT by calculating the time needed to get acknowledgement from the receiver. Whenever a duplicate acknowledgement is received then it immediately retransmits the packet without waiting for 3 duplicate acknowledgements .Fast retransmission can be improved. Parameters of received packets, packet loss, PDF and end to end delay are improve by comparing updated TCP New Reno with Reno and New Reno using simulator NS 2.35.

In paper [4], it is based on improve performance of TCP congestion control using an approach. In this approach, count the no. of timeout and no. of three duplicates packets and compute the ratio of no. of timeouts to the no. of 3-dupacks.If ratio is very small (in between 0.01 to 0.2) so event caused by bit error otherwise it caused by congestion. By this approach, parameters of throughput and error rate (%) are improved.

In paper [5], it is based on enhancing performance of TCP in hybrid network. In this paper ECN (explicit congestion notification) bit is use for distinguish between wireless loss and congestion loss. If ECN bit is set when out of order sequence segment is received so it deduce that loss was in wired network and immediately send duplicate acknowledgements (like normal TCP). If ECN bit is not set so loss was in wireless network. In this case, hold duplicate acknowledgements and wait for local recovery. By this approach, throughput is improved.

In paper [6], it is based on improve wireless TCP performance by bandwidth estimation and setting the congestion window and threshold value. Bottleneck bandwidth is use for bandwidth estimation. Next step is RTT calculation. Next step is setting the congestion window and threshold value. In this approach, Performance of modified New Reno is better compare to TCP New Reno.

In paper [7], it is based on TCP NCE (non congestion event): improve performance of TCP by using an approach. In this approach measure queue length (l) and define threshold based on buffer size (90%). If buffer size is greater than 90% then received three duplicate packets is due to congestion otherwise bit error. Throughput is improved by comparing TCP NCE with Reno, New Reno, Tahoe, Vegas using simulator NS2.35.

In paper [8], it is based on improve performance of TCP which is TCP SAC. In this algorithm, calculate the outstanding packets and set the value of slow start threshold based on half of the difference between maximum data packets send and last acknowledgements received at sender side. In this approach, use the difference for minimizes retransmission timeouts caused by retransmission loss. Parameters of throughput, packet loss rate and fairness are improved by comparing TCP SAC with TCP New Reno, Sack, Vegas and Reno using simulator NS 2.35.

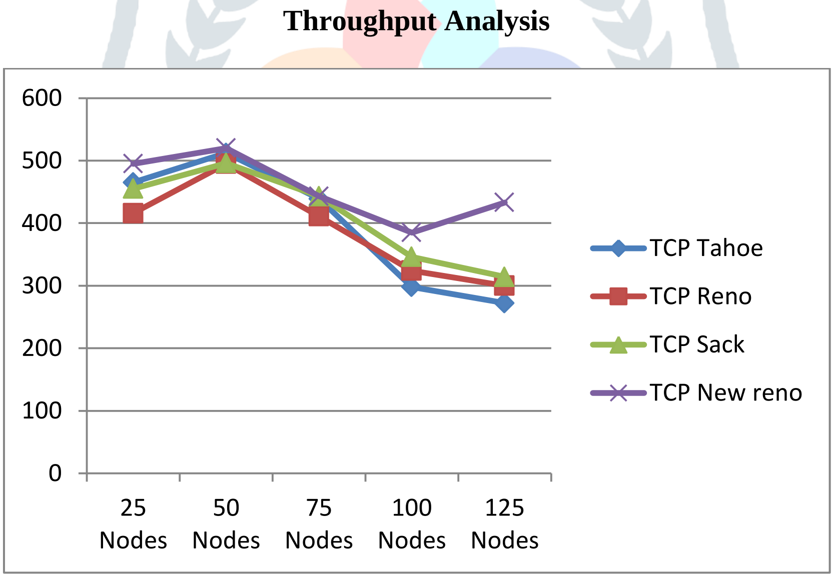
3.2. Limitation

By study many papers of TCP, limitation of TCP New Reno that is it cannot deduce whether packet loss is due to congestion loss or bit error in wireless link. If packet loss is due to congestion so size of the congestion window is half. If packet loss is due to bit error so unnecessary to cut down the size of congestion window is half so performance of TCP New Reno is degraded.[1]

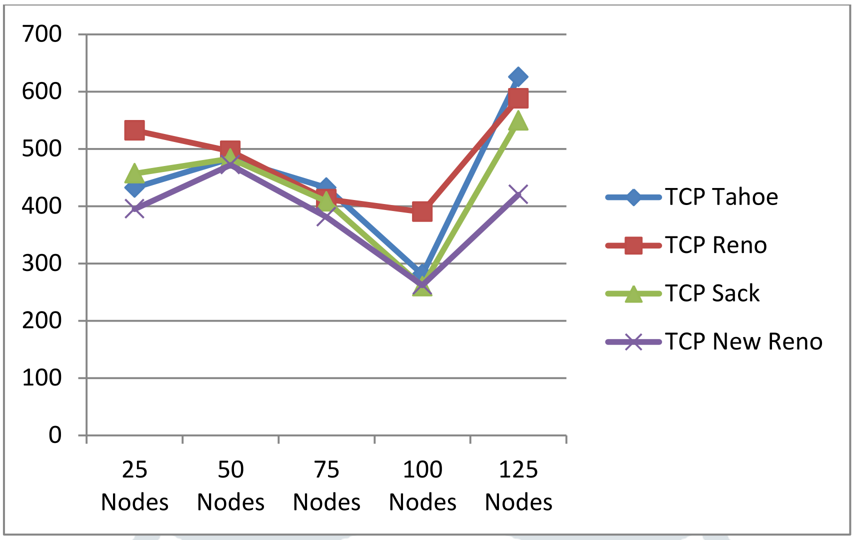
4. SIMULATION GRAPH AND RESULTS

In this study, we compare TCP Tahoe, TCP Reno, TCP New Reno, TCP Sack and TCP Vegas by using simulator NS2.35. We use many parameters are as under follows.

Parameters	Value
Traffic time	TCP
Simulation time (sec)	100
Simulation area	500 x 500
Simulation model	Two ray ground
MAC type	802.11
No of nodes	25,50,75,100
Connection	10,25
Queue length	50
Routing protocol	AODV
Link layer type	LL
Antenna	Omni antenna



Graph 1: Number of Nodes Vs Throughput (kbps)



End to End Delay analysis

Graph 2: Number of Nodes Vs End to End delay (ms)

5. CONCLUSION

In this paper, we study all the variants of TCP like TCP Tahoe, TCP Reno, TCP New Reno and TCP Sack and compared with each other by using network simulator (NS2.35). Parameters are throughput, end to end delay, and number of dropped packets and packet delivery fraction to be compared. After compared all the parameters, we conclude that TCP New Reno has higher throughput and less end to end delay.

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