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   RESEARCH METHODOLOGY

   RESULTS & DISCUSSION

   FINDINGS

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SURVEY OF NEWRENO AND SACK TCP TECHNIQUES PERFORMANCE IN PRESENCE OF ERRORS FOR HIGH SPEED NETWORK

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ABSTRACT
Degradation of the performance of TCP because of errors in transmission media has always a Key area of research. In recent years, the demand for network bandwidth is growing due to increase in global population of internet and verity of application. Optical data communication has been acknowledged as the best solution to meet the present bandwidth requirement of users and supporting future network service. Optical fiber give higher throughput and bandwidth but when large network (like, internet's connection undersea over the world) and errors in transmission media at a time same congestion problem as copper wire. To solve such problem require improving TCP protocol. So, in this paper attempts to study, simulate and analyze the most improved version of TCP (SACK TCP and Newreno TCP) base on Go-Back-N and Selective Acknowledgment in Presence of Errors in High Speed Network.

KEYWORDS
TCP (Transmission Control Protocol), SACK (Selective Acknowledgement), ARQ (Automatic Repeat Request).

INTRODUCTION
TCP/IP protocol stack has been an inseparable part of Internet. Therefore, behavior and efficiency of the protocol stack significantly contribute in the performance of Internet. TCP has been modified by various add on techniques to achieve a desired performance level in heterogeneous environments. TCP is responsible for flow, error and congestion control which has a direct impact on network performance and service. Among TCP variants, SACK TCP is considered as the most stable and efficient scheme [2].

TCP provide fairness in sharing bandwidth TCP gradually traffic after connection establishment and it decreases it when any loss found for particular connection. Flow control is used for control congestion over transport layer to reduce loss of packet. If any loss found at receiver then it is responsible to inform to the sender about this loss so sender can take appropriate action for that packet regarding its retransmission and if rate of loss is high then it take some action to reduce those losses [1]. When TCP use for make a communication between sender and receiver at time, fast the sending process sends a SYN (Synchronization Sequence numbers during connection) packet to which the receiving process replica with its SYN-ACK and the sender replies with an ACK. Once this three way handshake is negotiated, the connection is established and data transmission can begin. When all data is sent, the client and the server exchange FIN (Terminate connection) and ACK in both direction and terminate connection between sender and receiver [1].

TCP use sliding window to handle flow control. The Sliding window protocol used by TCP, however, is something between the Go-Back-N and Selective Report Sliding Window [1].In G0-back-N protocol accumulative *ack* scheme is used. In Go-Back-N Automatic Repeat Request, in this protocol we can send several frames before receiving acknowledgments; we keep a copy of these frames until the acknowledgments arrive. Ssize (send window, size) for Go-Back-N = 2^{m}-1 [1]. In *sack,* is another mechanism that does not resend N frames when just one frame is damaged; it resent only the damaged frame. Ssize (send window, size) for Selective Repeat ARQ = 2^{m-1}[1].

In TCP each byte of data that is sent by client is assigned a sequence number, unique to that session. The server acknowledges receipt of each byte of the data using ACK segment. Acknowledgements of the TCP are cumulative; an ACK confirms the successful receipt of all the data bytes up to (but not including) the acknowledged sequence number. Normally, TCP does not acknowledge each byte received individually, nor does it send ACK packet every time it receives data. It waits for a certain amount of time. During this period, if more data segment arrives, these segments are acknowledged together at once ("delayed acknowledgment") or if a data segment has to be sent, the acknowledgement is "piggy backed" along with the data packet [3].

In Tahoe TCP , loss recovery depends only on time out and for retransmission it must wait for time out, during this waiting period it has to stop father TCP transmission and finally it can send less data in given time. Also, it doesn't send immediate ACK's, it sends cumulative acknowledgements, and therefore it follows a 'go back n 'approach. Thus every time a packet is lost it waits for a timeout. This offers a major cost in high band-width delay product links. Some modification is done, that is known as fast retransmit. In that we recover from loss with the help of three duplicate acknowledgments [2].

On receiving three successive duplicate acknowledgements the sender can infer that receiver has not received at least the packet immediately after the number in duplicate ack. Retransmission can be triggered without waiting for time out. This improves throughput as well as channel utilization. It returns to slow start and sets ssthresh to one half of the congestion window [1].

Every time When only one packet loss in Tahoe TCP It returns to slow start with congestion window to 1 and sets ssthresh to one half of the congestion window. Now, some of the modification is done, and that is known as Fast Recovery and it avoids slow start with congestion window to 1 [4].

Reno is improved version of TCP .It include operation of fast recovery with Tahoe TCP. Fast Recovery is entered by a TCP sender after receiving an initial threshold of dup ACKs. This threshold, is generally set to three. Once the threshold of dup ACKs is received, the sender retransmits one packet and reduces its congestion window by one half. Instead of (reduce to 1) slow-starting, as is performed by a Tahoe TCP sender [1].Reno performs very well over Tahoe TCP when the packet losses are small. But when we have multiple packet losses in one window then RENO doesn't perform too well and its performance is almost the same as Tahoe under conditions of high packet loss. Such limitations overcome by Newreno TCP. In such all three versions (Tahoe TCP, Reno, and Newreno) of TCP use Go-Back-N for the flow control. Due to that receiver cannot inform to the sender that packet is loss or it is out of order. These limitations overcome by SACK TCP.

In Section Overview of TCP Go-Back-N and Selective Acknowledgment Based Improved TCP Version we describe basic different between SACK and Newreno TCP Version. After that we describe simulation topology. In Section Result of simulation describe packet delivery v/s time and throughput v/s time base comparisons of newreno TCP and SACK TCP at different error rate.

OVERVIEW OF TCP GO-BACK-N AND SELECTIVE ACKNOWLEDGMENT BASED IMPROVED TCP VERSION

1. NEWRENO TCP

Newreno is a slight modification or improved version of TCP-Reno. A Reno sender exits fast recovery on arrival of partial acknowledgment ignoring the possibility of multiple packet losses. New Reno requires only sender side changes to allow TCP to recover from multiple losses in a window of data. It is able to detect multiple packet losses and thus is much more efficient that Reno in the event of multiple packet losses. Newreno differs from Reno in that it doesn't exit fast-recovery until all the data which was out standing at the time it entered fast-recovery is acknowledged. Thus it overcomes the problem faced by Reno of reducing the *cwnd* multiples times [2]. Newreno sends cumulative acknowledgements; therefore it follows a 'go back n 'approach. So, when packet is loss sender not get complete information about packets which are reach successfully at the destination after loss, or it is out of order. Due to this, sender may be unnecessarily retransmitting that packet [2].

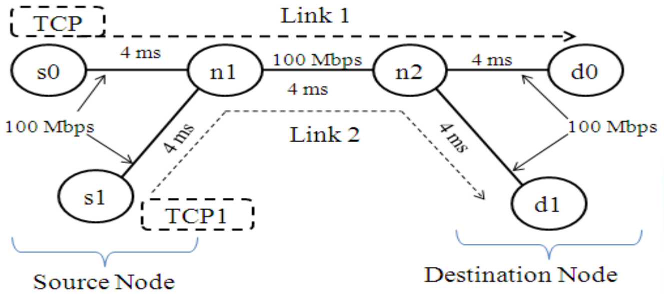
2. SACK TCP

SACK TCP, a modified version of TCP-Reno with SACK. Reno TCP use 'go back n 'approach, in that receiver cannot inform to the sender that packet is loss or it is out of order. Due to this, sender may be unnecessarily retransmitting that packet. However, these revisions are not enough to prevent TCP from attempting unnecessary retransmissions while facing multiple losses. These limitations overcome by SACK TCP [2].SACK retains the slow-start and fast-retransmit parts of RENO. SACK TCP requires that segment acknowledged cumulatively but should be acknowledged selectively. Addition of SACK option in TCP header enabled sender to determine lost segments accurately and minimize unnecessary retransmissions [5].

SIMULATION TOPOLOGY

We have used network simulator ns -2 for our experiments based on simulation. This section describes simulations for different TCP Version like Newreno, and SACK TCP in Presence of Errors in High Speed Network topology. For all simulations, traffic on two connections starts simultaneously and has same link delay. Simulation topology is shown in below figure 1.

FIG.1: SIMULATION TOPOLOGY



Experiment is done for two parallel tcp connections, two different senders (s0 and s1) connected with three different receiver (d0 and d1) using link (n1-n2) with capacity 100mbps , data arrive from two sender by two different link(s0-d0,s1-d1) these two link have capacity 100 Mbps. All link have same link delay = 4ms.

Erroneous environment is created by corrupting packets which are required to travel on link from node s0 and s1 to node d0 and d1 (the receiver) with varying different error rate. Hear in simulation we very error in reverse link and check the performance of Newreno and SACK TCP at different error rate. For packet deliver we only consider link 1 and check packet delivery variation in the network

The next section describes the results of simulation using number of packets delivered in case of Newreno and SACK TCP. Hear in simulation we compare Newreno and SACK TCP base on packet deliver v/s time and throughput v/s time.

RESULTS OF SIMULATION

1. COMPARISONS OF NEWRENO TCP AND SACK TCP BASE ON PACKET DELIVERY V/S TIME AT DIFFERENT ERROR RATE

Packet delivers v/s time for Newreno TCP and SACK TCP for different error rate shown in below figure. Hear we consider simple topology as given in figure 1 and at different error rate we compare the performance of Newreno TCP and SACK TCP. All the simulation result given in figure 2, 3, 4 and 5 are check only on link 1 because in Network two links are share same bandwidth.

In figure 2 we consider same 0.01 forward link error rates for three different reverse link error rate (0.10, 0.20, and 0.30).In figure 3 we consider 0.02 forward link error rates for three different reverse link error rate (0.10,0.20 and 0.30). As shown in figure 3 and 4, same as Newreno we check the performance for SACK TCP.

TABLE 1: DELIVERED PACKETS

Forward link Error Rate	Reverse Link Error Rate	Newreno TCP	SACK TCP
0.1	0.10	2332761	3007702
0.1	0.20	1164742	1353031
0.1	0.30	215542	1137836
0.2	0.10	848764	1729548
0.2	0.20	158137	436265
0.2	0.30	134104	183511

From figure 2 and 4, deliver packet in SACK TCP is higher compare to Newreno TCP. For error rate 0.01 forward links and 0.10 in reverse link at that time packet deliver due to SACK TCP and Newreno TCP are 30007702,2332761 respectively. So using SACK TCP we deliver 674941 number of higher packet compare to Newreno. Now for different error rate deliver packet in case of Newreno and SACK TCP shown in Table 1.

FIG. 2: DELIVER PACKET V/S TIME FOR NEWRENO TCP AT DIFFERENT ERROR RATE AT FORWARD LINK AND REVERSE LINK

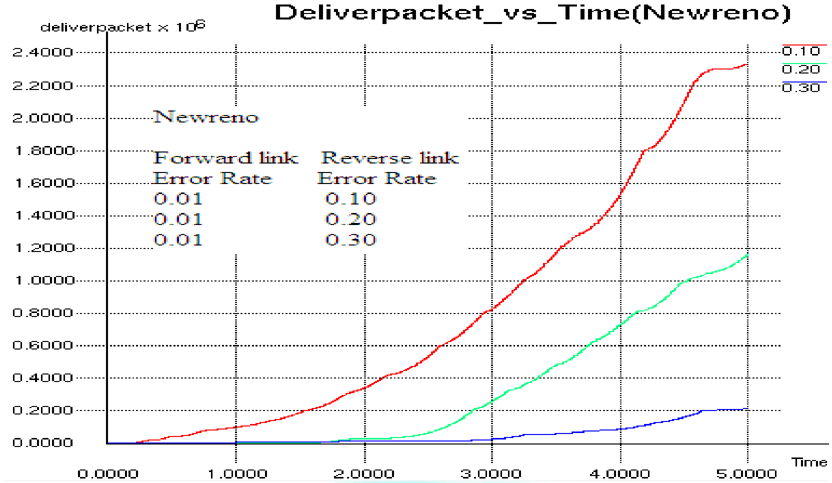


FIG. 3: DELIVER PACKET V/S TIME FOR NEWRENO TCP AT DIFFERENT ERROR RATE AT FORWARD LINK AND REVERSE LINK

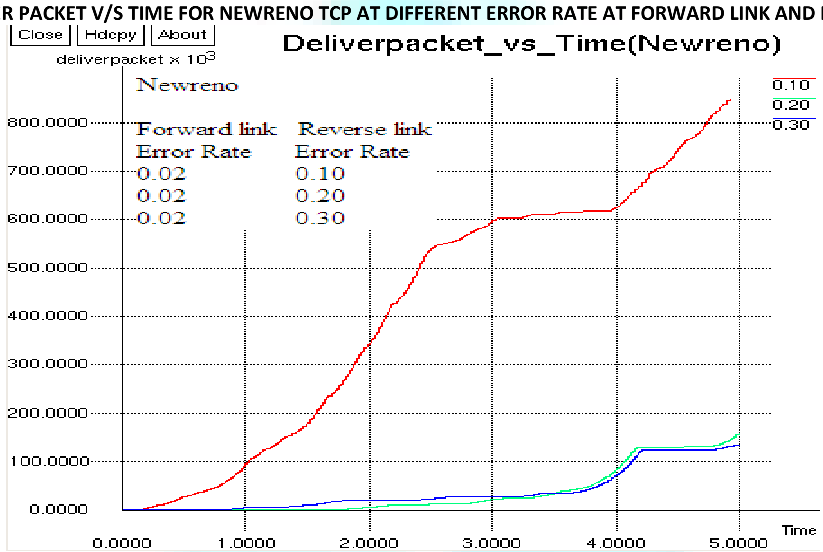


FIG. 4: DELIVER PACKET V/S TIME FOR SACK TCP AT DIFFERENT ERROR RATE AT FORWARD LINK AND REVERSE LINK

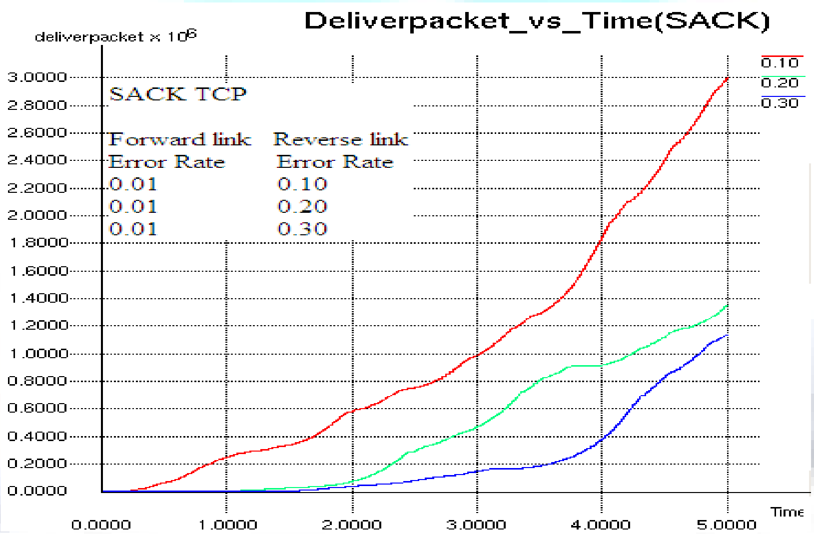


FIG. 5: DELIVER PACKET V/S TIME FOR SACK TCP AT DIFFERENT ERROR RATE AT FORWARD LINK AND REVERSE LINK

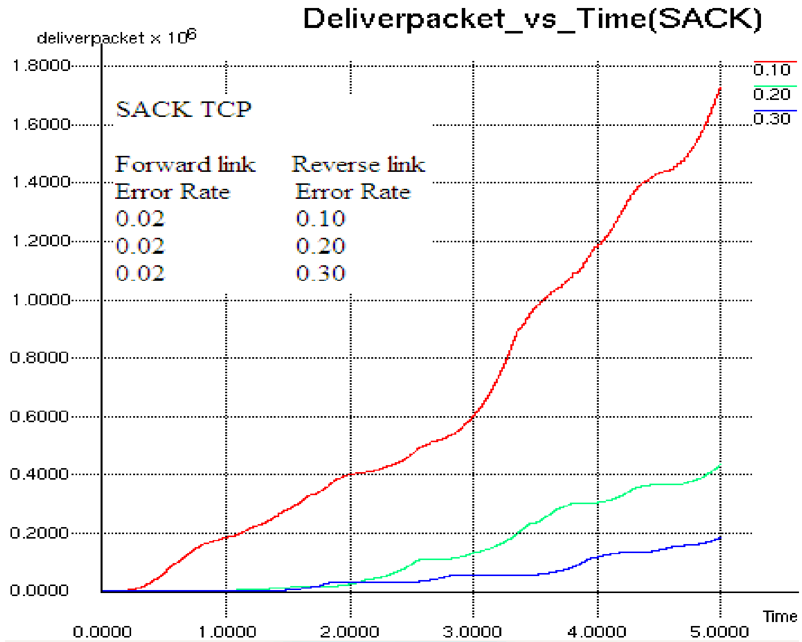
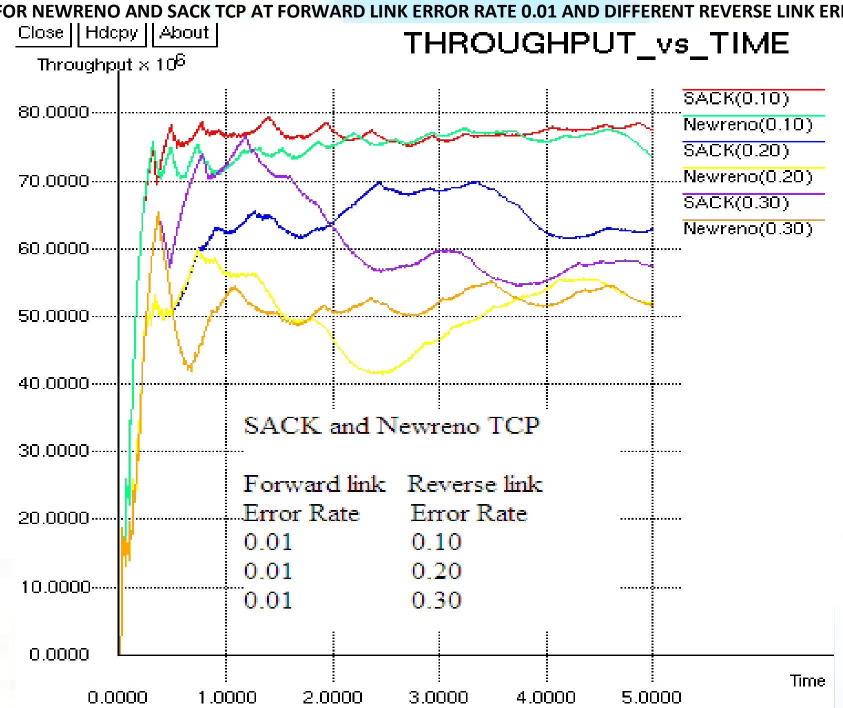


Table1. Shows number of packets delivered to receiver, d0 using Newreno and SACK TCP in presence of different error conditions in forward and reverse link between the source and destination. The table shows continuous degradation in performance of Newreno with increasing error rate in forward link. However, the performance degradation is relatively less with increase in reverse link error.

2. COMPARISONS OF NEWRENO TCP AND SACK TCP BASE ON THROUGHPUT V/S TIME AT DIFFERENT ERROR RATE

Hear above all result we check for only link 1.Now we check the performance venation in Network TCP and SACK TCP due to different error rate at forward and reverse link.

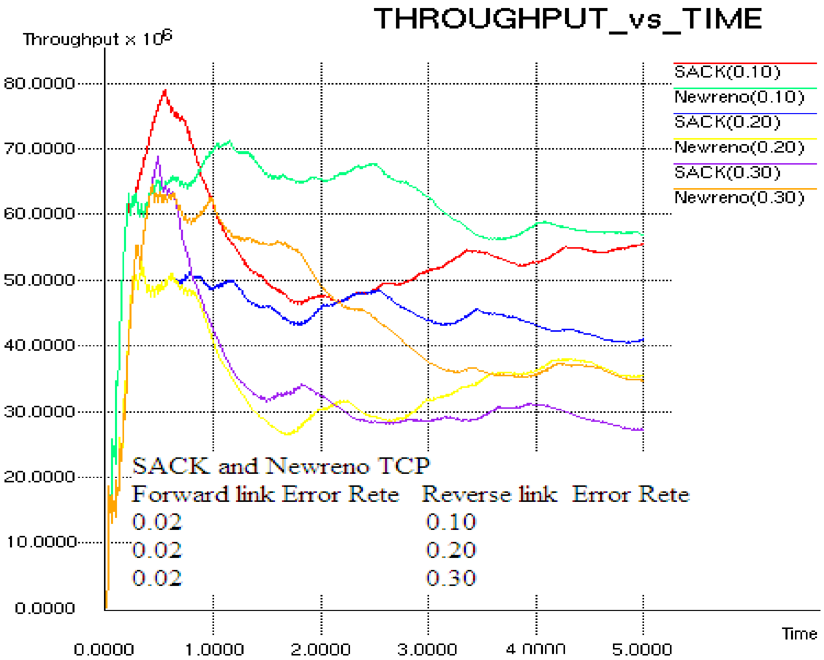
FIG.6: THROUGHPUT V/S TIME FOR NEWRENO AND SACK TCP AT FORWARD LINK ERROR RATE 0.01 AND DIFFERENT REVERSE LINK ERROR RATE (0.10, 0.20, AND 0.30)



In case of Newreno, when packet is loss sender not get complete information about packets which are reach successfully at the destination after loss, due to this, sender may be unnecessarily retransmit that packet.

This problem overcome by TCP with 'Selective Acknowledgments' is an extension of TCP Reno and it works around the problems face by TCP RENO and TCP New-Reno, namely detection of multiple lost packets, and re-transmission of more than one lost packet RTT (Round Trip Time).

FIG.7: THROUGHPUT V/S TIME FOR NEWRENO AND SACK TCP AT FORWARD LINK ERROR RATE 0.02 AND DIFFERENT REVERSE LINK ERROR RATE



As shown in above figure 5 and 6, overall network throughput v/s time of SACK TCP for High Speed network at different error rate is better compare to the Newreno. From figure 5, we set fixed forward link error rate is 0.01, and we very reverse link error rate (0.10, 0.20 and 0.30).Now when 0.01 forward link rate and 0.10, 0.20 and 0.30 reverse link error rate at that time SACK TCP Highest throughput 79Mbps (79% of total capacity) against 76Mbps (76% of total capacity) in Newreno. Same way for ever error rate SACK TCP throughput compares to Newreno is higher as shown in figure.

Now in figure 6, we change forward link error rate to 0.02, and check for same different reverse link error rate (0.10, 0.20 and 0.30) at such time also we get SACK TCP Throughput is higher compare to Newreno Throughput. So as error rate very in forward link or in reverse link in all condition SACK TCP give Better performance compare to Newreno TCP.

CONCLUSION

From the above simulation result, SACK TCP give higher Number of packet delivery v/s time at different error rate compare to Newreno TCP Because in SACK TCP use acknowledged selectively and Newreno use Go-Back-N for flow control due that at the reverse link SACK send only selectively acknowledged for the loss packet so it reduce unnecessarily retransmission packet from sender and it increase the throughput of overall network as shown in figure 6 and 7.Reno and SACK TCP in such two version making minimal changes to TCP's underlying congestion control algorithms. We assume that the addition of Selective acknowledgments to TCP will open the way to further developments of the TCP protocol.

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