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Performance analysis of TCP and TCP- Fin Ad-Hoc network

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ABSTRACT
Many applications use TCP as the transport layer for reliable data transfer for wireless connections to integrate seamlessly into the Internet. Some of the assumptions made during the design of traditional TCP may not be suitable for an infrastructure-less network environment, because TCP invokes the congestion control mechanism even if the packet loss is due to the link failure. On the other hand TCP-F that is able to distinguish link failure from congestion through feedback from the intermediate nodes and takes appropriate action. This paper compares the performance of TCP-F with traditional TCP through simulation.

Introduction

TCP invokes the congestion[1][2] control mechanism even if the packet loss is due to the link failure. This results in degraded end-to-end TCP performance, largely because of the back off of the retransmit timeout and the reduction in the window size. When this happens the TCP sender waits a longer time to retransmit the lost packets and also slows down the rate of transmission of data thereby causing further increase in the completion times of data transfer leading to a decrease in end-to-end throughput.

Improving the performance [8] of TCP on ad hoc network is important because many networks use TCP as a transport protocol and integrated well-performing extended wired in to wireless networks is the ultimate goal[12]. TCP-F protocol is one of the approaches that is developed for performance improvement of TCP on ad hoc network. After receiving the feedback from the intermediate node about link failure TCP-F freezes it's window and stops retransmission and starts retransmissions after receiving the route reestablishment notification.

Over view of Mobile and Wireless Environment

Traditional TCP is initially designed in order to work in wired data networks. But now-a-days the networks include more and more wireless links [3][4]. In the following, we discuss briefly the scenario of TCP performance [5] within wireless mobile [9] network environments, and the proposed solutions to overcome these problems. The performance of TCP is affected when the infrastructure contains a wireless link [10][11]. This occurs due to channel fading and user mobility and it also leads to delayed performance in data transmission and sometimes to packet loses.

Furthermore, the possibility to handoff from one base station to another may lead to sudden and high increase of data packets delay over the connection and a burst data packet loss. In addition to data packet losses due to the wireless channel [10] inefficiencies, high fluctuations of Round Trip Time (RTT) values over the connection may lead the TCP Retransmission Time-Out to expire. This will invoke the TCP sender to trigger its congestion [1] control algorithm. This leads to TCP data packets retransmission although that the retransmitted packet is not actually lost but simply delayed. As a result, TCP decreases its congestion window size to minimum and under-utilizes the available bandwidth unnecessarily. In addition, TCP sender consumes more energy to retransmit the considered to be lost data packets without need (redundant retransmission).

Challenges

The Transmission Control Protocol (TCP) is a reliable stream oriented transmission protocol that provides a sequenced delivery of data over the communication link between the sender and the receiver. Congestion is the most common cause that leads to data packet losses. TCP deploys flow control mechanism through Slow-Start and Congestion Avoidance process.

The problem of TCP within wireless Ad-hoc [5] networks comes from its inability to distinguish between the different data packet loss models within the network. This often leads to an aggressive reaction from TCP when faced with a data packet loss that is not due to congestion. Indeed, dealing with any data packet loss as if it were due to congestion results in resource waste both at the network and nodes' levels. This waste is represented by low bandwidth utilization and higher energy consumption. Therefore, in order to enhance the performance[5][7] of TCP within wireless ad hoc [6] networks, it is obvious that TCP should be able to identify each data packet loss cause and react accordingly, triggering the most suitable loss recovery action that optimizes both the network and node's resources.

Experimental Study

The experiment was performed by comparing traditional TCP and TCP-F with the parameters namely Route Re-establishment Delay (RRD), Link Lifetime and Load. This Experiment conducted by assuming any loss on the wireless links and throughputs of both of the protocols are same and a fixed size of 200 bytes, the data transfer rate is 1.6Mbps, the source to destination varies between 5 -10 hops and each node's window size is 8Kbps.The input parameter for load and Route Reestablishment Delay (RRD) and Lifetime values are 100 to 2500 ins for fixed link lifetime of 10000 ins. The simulation is done using C programming.

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Observation Outcomes

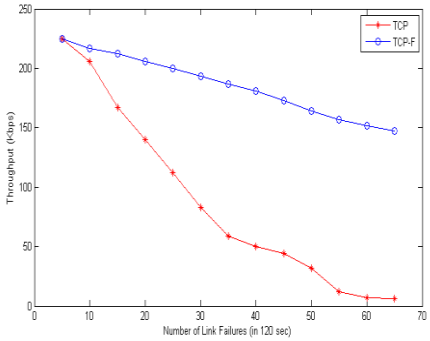

Figure: 1 Throughput versus Number of Link Failures (in 120 sec) for LIGHT Load

The results obtained can be explained better by the graphs. We present them one by one. The graph in figure1 shows degradation of throughput with increasing number of link failures during whole simulation time (120 s) for both TCP and TCP-F and when the number of link failure is 0 or 1 the throughputs for both TCP and TCP-F are same. This indicates that TCP and TCP-F in the wired link are same because of the link fails are negligible in case of wired network phenomenon.

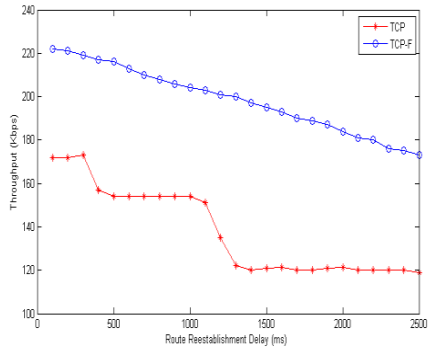

Figure 2. Throughput versus Route Reestablishment Delay for LIGHT Load

The above graph shows the degradation of throughput with route reestablishment delay for both TCP and TCP-F in case of light loading condition. This shows that TCP-F provides better outcomes than TCP as RRD is increasing. This graph is taken as average of 20 runs. During simulation time link lifetime was taken as 10000 ms.

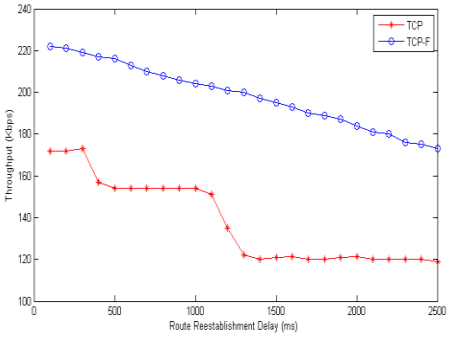

Figure 3: Throughput versus Route Reestablishment Delay for MEDIUM Load

The above graph shows the degradation of throughput with route reestablishment delay for both TCP and TCP-F in case of medium loading condition.

Conclusion

The traditional TCP is unable to distinguish the packet loss due to link failure and due to congestion and TCP switches to congestion control mechanism although the packet loss has occurred due to link failure which leads to a performance degradation. However TCP-F may improve the performance on Ad-hoc networks which is experimentally observed. To summarize, the TCP-F provides a framework to address problems caused by link failures due to mobility by performing freezing action and limiting retransmissions. This protocol preserves the end-to-end TCP semantics and is transparent to the application layer. It may be used to leverage the locality of packet loss. Some work is also needed to compute new window size after link reestablishment as a future scope. As a result it can be a function of old window size, old path length, new path length, queue length at different intermediate nodes etc., some new parameters can also be included to get the value of new window size for optimum performance. Similarly time-out period can also be recomputed after link reestablishment.

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