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A HYBRID APPROACH TO IMPROVE FAIRNESS AND SECURITY OF SHORT TERM TCP FLOWS IN WLAN

Prof. Rama Prabha K P[*1] and Prof. Jayanthi R[2]

[*1]Assistant Professor, VIT University.

[2]Assistant Professor (Jr), VIT University.

ABSTRACT

Inside wireless LAN, access point always sends long term TCP packets first followed by short term TCP packets. Due to this, there is unfairness for short term packets. In this paper, we come up with a novel approach to address this issue using a priority based scheme and URG (urgent) flag in TCP header. At the same time round robin mechanism is used for non-priority based short term TCP packets which not only improves throughput of the network and provides fairness but also avoids TCP from implementing the slow-start and congestion avoidance strategy assuming the loss of packets inside wireless networks.

Keywords: *Long term packets, short term packets, unfairness, URG flag, throughput.*

I. INTRODUCTION

Wireless network is proved to be one of the greatest assert for today's world. It allows the user to be mobile and it doesn't affect the throughput of the network. Wireless networks help the user to get rid of huge connection lines. Wireless network uses the 802.11 protocol for its communication and thus uses IP (internet Protocol) as its major network layer protocols. For the transportation of data in the form of packets the wireless networks uses TCP (Transport Layer Protocol) for smooth and reliable transmissions.

TCP with its feature like end to end semantics allows the user to transmit data in a reliable fashion without any interrupts. Features like retransmission and ACK (acknowledgement) mechanisms makes it trustworthy for sending the data. TCP generally has two types of connections that is long term connection and another is short term connections. Short-term connections are those connections in which the connection is made to the server for a shorter period of time that is accessing a website for some kind of search e.g. document, images etc. over the web. Whereas long term connection are those connections which establishes connections with server for longer period of time and a resulting in channels to be busy for a longer duration of time like file transfer. As the channels are busy for longer duration of time the short term connections faces a fairness problems. Infrastructure based WLAN consists of access point (AP) through which the short term and long term TCP packets are sent as shown in figure 1.

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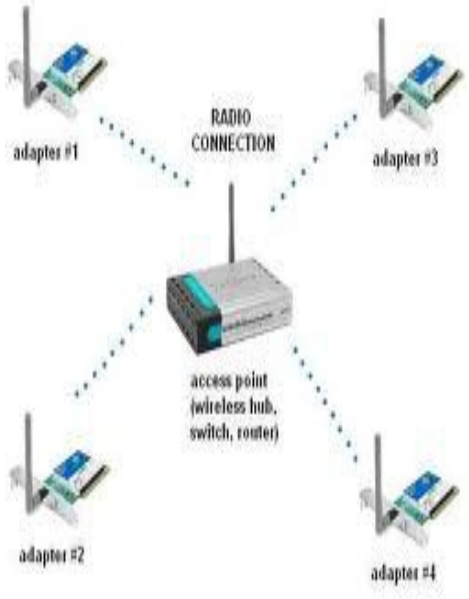

Figure 1 Infrastructure based WLAN

In this paper, Section II provides the various methodologies touched upon till now to address different fairness and congestion issues occurring in TCP flow of WLAN. Section III focuses on the new approach put forth to improve fairness on short term TCP packets followed by its advantages. At the end we provide the conclusions in Section IV on the proposed strategy.

II. LITERATURE SURVEY

TCP applications generally assume that congestion has occurred whenever any packet loss happens in network. Eventually they reduce window size and enter slow-start phase [13] followed by fast retransmit procedure. But for short connections which have small window sizes, it detects a loss only after a timeout or when all data has been already sent to the network. Hence, timeouts with short connections are ineffective in stabilizing the network and curbing the overall traffic [11]. On the other side, by reducing the delay by order of one second may turn significant improvement for short term transactions [12]. Although the high speed TCP algorithm provides various ways to serve TCP packet flows still there is room to improve performance of this algorithm due to few loopholes. [1] Traditional TCP congestion window rate of growth rate is much slower than the incremental rate of high speed TCP. The hot area of research is the fairness scheme implemented during TCP congestion control.

Few TCP versions focus on other metric like RTT-fairness [2,3] and inter-protocol friendliness among the TCP versions [4]. Fair throughput is provided to multiple flows having different RTTs in RTT-fairness scheme. Also a different approach was proposed by using RTT-fair TCP congestion control called HRF (Hybrid RTT-Fair) TCP [2], where the idea of TCP-Libra [3] is extended into a hybrid TCP framework. The HRF TCP will implement RTT-fair congestion control where they change the window increase rate depending on the RTT of a competing flow.

TCP versions can be categorized into three ways depending on the congestion control mechanisms: loss-based [5], delay-based [6] and hybrid [7]-[10]. In this paper they have commonly focus on two major metrics: friendliness and throughput efficiency classical TCP-Reno version. In the TCP-Reno friendliness, both the modes i.e. the friendly mode and throughput efficiency mode are prepared and they are switched depending on the observed and simulation parameters which are affected by network conditions like RTT (Round-Trip Time) while in the throughput efficiency metric, there is proper utilization done of packet loss for small window decrease and fast window increase. TCP-Westwood [14] and Im-TCP [15] estimate parameters like available bandwidth by observing the ACK arrival intervals of TCP packets.

However, there is still the need to achieve better fairness when it comes to short term packets inside WLAN which was not really addressed by the previous proposals made so far. Whenever the short term TCP packets and long term TCP packets arrive at AP, short term packets are queued up inside AP buffer and have to wait until entire transmission of long term packets is done through the AP. This leads severe starvation and hence many times the TCP packets are resend assuming packet loss or congestion inside network due to the timeout caused by retransmission timer resulting into the TCP entering slow-start phase and congestion avoidance scheme to reset the congestion window.

III. PROPOSED APPROACH

In order to reduce the unfairness with the short term flows of TCP, we have proposed a novel hybrid approach where we will make use of the URG (urgent) pointer in TCP header. TCP header is 32bits (8 bytes) where URG pointer is used when there is a need to send urgent data at the destination even before data (payload) information is read. When the TCP packet is sent with URG pointer set to bit 1 (ON) it is sent urgently across the network. Short-term TCP flow packets will make use of URG pointer in order to reduce their waiting time inside network. If the AP (access point) receives a short-term packet with URG pointer as set, it will give priority to such packet and send them immediately. Also the non-priority short term TCP packet with URG set as OFF, will be served using scheduling mechanisms. To achieve better throughput we are using round-robin technique wherein packets will be sent in round robin fashion serving each packet turn by turn and providing fairness to short term packets. Thus, here short term packets with URG pointer will get priority and non-priority nodes will get fair chance due to round –robin mechanism.

Following types of TCP packets will be addressed by AP at different scenarios inside network:-

a) Short term packet with URG flag (S-URG)

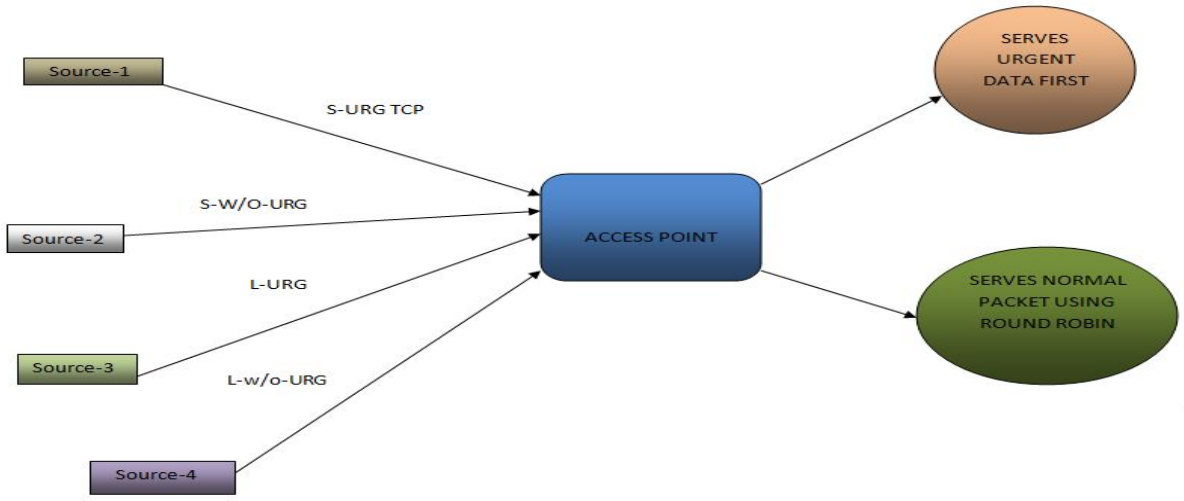

Figure 2 Proposed approach

b) Short term packet without URG flag (S-W/O-URG)
c) Long term packet with URG flag (L-URG)
d) Long term packet without URG flag (L-W/O-URG)

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The highest preference to send the packet inside the network will be given to L-URG type. The next priority will be given to S-URG type of packet followed by S-W/O-URG type packets scheduled in round-robin way. This priority mechanism does not affect the fairness of long term TCP packets but it does affect and provide favorable fairness to short
term TCP packets. Therefore, we achieve better throughput by avoiding starvation of short term TCP packets without affecting the fairness of long term TCP packets. Figure 2 shows the proposed approach and the scenarios which AP will come across.

A. Advantages:

i. Better fairness achieved for short term TCP packets belonging to S-URG type.
ii. Avoiding starvation for non-priority short term TCP packets belonging to S-W/O-URG type with the usage of round-robin mechanism.
iii. New approach does not affect the existing fairness provided to long term TCP packet.
iv. It achieves better throughput and efficiency of TCP packets.
v. Avoids resending of TCP packets due to expiry of retransmission timer and entering the slow-start and congestion avoidance phase.

B. Limitations:

i. The nodes which are buffered can be made more effective by using better scheduling schemes.
ii. Packets carrying URG pointer are vulnerable to attack and security scheme need to be addressed for them.

IV. CONCLUSION

The usage of URG flag ensures that short term packets are given fair chance by the access point. Also the short term packets which are not urgent will be sent in round-robin fashion to achieve better throughput and reduce starvation due to long term TCP packets. The model here used is infrastructure wireless network and the proposed scheme is briefer and more efficient than other windows-based algorithms.

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