CS540 - Paper Review Report # X

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Title: TCP Westwood: End-to-End Congestion Control for Wired/Wireless Networks

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Using the estimated bandwidth to properly set the cwnd and slow-start threshold (ssthresh), TCP Westwood (TCPW) , a sender-side modification of the TCP congestion window algorithm, improves the performance and utilization of TCP Reno both in wired as well as wireless networks. The improvement is most significant in wireless networks with lossy links. Compared to other wireless TCP “extensions”, TCPW does not require inspection and/or interception of TCP packets at intermediate (proxy) nodes. That is, It fully complies with the end-to-end TCP design principle.

By continuously measuring the bandwidth at the TCP sender side used by the connection (monitoring the rate of returning ACKs), TCPW computes congestion window and slow start threshold after a congestion episode (after three duplicate acknowledgments or after a timeout). The rationale of this strategy is simple: in contrast with TCP Reno which “blindly” halves the congestion window after three duplicate ACKs, TCP Westwood attempts to select a slow start threshold and a congestion window which are consistent with the effective bandwidth used at the time congestion is experienced. This mechanism is called faster recovery.

The paper discusses about TCPW basics(comparing it with other previous TCP versions),end-to-end bandwidth measurement: The ACK-based measurement procedures, bandwidth estimation techniques,and the effect of delay and cumulative ACKs on bandwidth measurement, TCPW algorithms and TCPW convergence to fair share. TCPW estimates the bandwidth by monitoring the TCP ACKs and this estimated bandwidth is used to directly control the congestion window and the slow start threshold.

Simulation based performance analysis on the basic performance behavior of TCPW, its fairness among a number of TCPW connections sharing a bottleneck link, and its friendliness to coexisting connections of other TCP variants, such as Reno, has also been done by the authors.

To show the advantage of using TCPW is a proper an end-to-end solution to error and congestion control in mixed wired and wireless networks, different scenarios: Independent loss model and/or Burst error models in round radio environment and LEO satellite model scenarios have been developed and studied.

In heterogeneous networks due to the difficulty in discriminating the wireless loss from congestion loss estimating available bandwidth is not easy. How to handle such problem? Is it applicable to real-time applications (application with no acknowledgment)?

Title: Analysis of TCP Performance over Mobile Ad Hoc Networks

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As a result of the advancement of wireless technology and the proliferation of handheld wireless terminals, recent years have witnessed an ever-increasing popularity of wireless networks. Mobile ad hoc network (MANET) is is an infrastructureless network in which a group of mobile computing devices communicate among themselves using wireless radios. Each node in a MANET is capable of moving independently and functioning as a router that discovers and maintains routes and forwards packets to other nodes. Thus, MANETs are multi-hop wireless networks by nature. Note that MANETs may be connected at the edges to the wired Internet.

For reliable end-to-end data delivery between end hosts in traditional wired or/and wireless network TCP is used as a de facto protocol. Reliability is achieved by retransmitting lost packets; that is packets will be retransmitted if the sender receives no acknowledgment(ACK) within a certain timeout interval or receives duplicate acknowledgments. Due to the inherent reliability of wired networks, there is an implicit assumption made by TCP that any packet loss is due to congestion. To reduce congestion, TCP will invoke its congestion control mechanisms whenever any packet loss is detected. However, due to the fact that wired and wireless networks have differences in terms of bandwidth, propagation delay, and link reliability, packet losses in wireless networks are no longer mainly due to network congestion; they may well be due to some wireless specific reasons. That is, in wireless LANs or cellular networks, high bit error rate in wireless channels and handoffs between two cells are causes for packet losses, while in mobile ad hoc networks, most packet losses are due to medium contention and route breakages, as well as radio channel errors.

In the paper, the authors investigated the effects that link breakage due to mobility has on TCP performance of wireless mobile ad hoc networks by presenting a simulation based [1] Performance analysis of standard TCP over mobile ad hoc networks, and [2] An analysis of the use of explicit notification techniques to counter the effects of link failures. It is observed that the characteristics of the routing protocol have a very significant impact on TCP performance and it is also noted that TCP throughput drops significantly when node movement causes link failures, due to TCP's inability to recognize the difference between link failure and congestion. While using expected throughput metric to show how the use of explicit link failure notification (ELFN) can significantly improve TCP performance, some surprising effects that route caching can have on TCP performance has been discovered.

Choice of Routing protocol's impact on the performances of MANET, especially how the protocol behaves and converges when faced with a broken link? What will be the impact of MAC failure detection (the amount of time spent before the MAC concludes a link failure) and route computation latencies over TCP Performance?