"A REVIEW ON IMPROVING THE PERFORMANCE OF TCP FOR WIRELESS NETWORKS"

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ABSTRACT: TCP continues to be an important transport-layer communication protocol that is typically tuned to perform well in traditional wired networks, where bit error rate (BER) is low and congestion is the primary cause of packet loss. Mobile devices face temporary and unannounced loss of network connectivity when they move. They are likely to have rare resources, and they react to frequent changes in the environment. Motion causes varying, increased delays and packet losses, while the network learns how to deliver packets to the new location of the host. TCP incorrectly interprets these delays and losses as signs of network congestion and to block its transmission rate, causing degraded end-to-end performance. This paper provides an in-depth survey of various TCP enhancements which are specifically targeted for last-hop wireless environments. The objective is to review the performance issues of TCP variations, when employed in last-hop wire-less networks, and to provide a categorized analysis of different existing solutions comparatively.

1. INTRODUCTION

Network mobility (NEMO) is an emerging area of mobile networks that facilitate all where Internet connectivity to the in-vehicle mobile hosts (MHs) for information mobility and entertainment applications (Icomera-Wireless). The MHs connect to an onboard LAN, which connects to the fixed host (FH) in the Internet via a mobile router (MR) (Fig. 1). The MR manages the Internet connectivity of the entire vehicle by exploiting any available wireless carrier networks (e.g., cellular, satellite, or even a roadside WLAN) in the background. One common feature of these systems is that their journeys mostly last for hours or even days. People riding a high-speed train or a non-stop flight (e.g., from Mumbai to New York) may want to use these long hours to read/send emails, browse the Internet, or catch up with their office intranet. The increasing necessity of in-vehicle entertainment is an impetus for research communities and governments to increase their efforts towards creating a standardized platform. The Internet Engineering Task Force (IETF) has standardized NEMO Basic Support Protocol (Devarapalli et al., 2005), an MR-based solution, for connecting any type of moving networks to the fixed Internet. Also a number of research efforts are going on to support NEMO using network based protocols such as PMIPv6 (Lee et al., 2012; Lee and Ernst, 2011).

The idea of providing Internet connectivity on transportation has attracted increasing popularity in recent years, and several commercial systems have already been implemented. In addition, the Internet Engineering Task Force (IETF) has proposed an extension of the Mobile IPv6 protocol called NEMO to support such modified communication. Generally speaking, wireless links have low bandwidth and are error prone, and using multiple wireless links simultaneously has been proposed as a potential solution to these problems. However, regular TCP are not designed for a multi-homed environment, and the performance will be seriously degraded when data from a single TCP connection is stripped and sent over multiple links.Although, some transport layer protocols, such as the Stream Control Transmission Protocol (SCTP), have been proposed to support multi-homing. They require changes in the protocol stack of the end host, which is impractical for real-world deployment. Given that currently more than 70% of Internet traffic is still TCP, it is unlikely that people will replace TCP with these new protocols. In addition, many of these protocols suffer serious degradations in performance when packet loss or out-of-order packets occur.

In the recent past, we have evidence of explosive growth in the use of Wi-Fi and 2G cellular networks. A key characteristic of these networks is that the last (or, the first) link is the only wireless link along the path from fixed host (FH) in the wired network to the wireless host (WH) (or vice versa). These networks, in general, can be termed as last-hop wireless networks. Typically, a wireless host connects to the wired network via a gateway node, called access point (AP) in Wi-Fi or base station (BS) in 2G. Proving efficient and reliable connectivity between the FH and wireless host is an important issue, and TCP obviously has to play animportant role there.

Since its inception approximately 30 years ago, the trans-mission control protocol (TCP) has grown to be one of the most important communication protocols, responsible for the stability of the Internet. Most of the applications make use of TCP as the transport-layer protocol. Since TCP's approach to error detection is based on mechanisms that only confirm that a packet is missing, the nature of the error is not detected and does not determine alternative recovery strategies.

2. THEORY RELATED TO WORK

1. Description of modified TCP

The modified TCP is a TCP-aware link layer protocol for NEMO. The objective of modified TCP is to recover wireless losses locally and keep the sender unaware of these losses. The modified TCP accomplishes this task by using agents at both BS and MR. The role of the agents is to cache TCP packets and retransmit if packet loss is detected. The modified TCP agents at BS and MR are responsible to recover wireless losses in BS–MR link. The agent at MR is also responsible to recover wireless losses in MR–MH link. In the following, we describe modified TCP in terms of the agents at BS and MR.

2. Modified TCP agent at BS

For a quick look the functionalities of modified TCP agent at BS are shown in Fig. 3. For each connection, modified TCP keeps track of incoming packet sequence numbers. When a packet arrives, it is stored in the transmission queue for transmission over the wire-less link. Once the packet is sent, a copy of it is stored in the cache for any necessary local recovery later on. The modified TCP agent at BS will receive two types of ACK packet from the modified TCP agent at MR: standard TCP ACK and selective negative ACK (SNACK). The SNACK packet uses the option field of TCP. By using SNACK packet, it is possible to provide explicit information about multiple packet losses. So, multiple packet losses can be recovered in one RTT. It is to be noted that the introduction of SNACK packet does not require any modification at the end hosts.

If the modified TCP agent at BS receives an ACK (original or duplicate), it forwards the ACK to the FH untouched and removes the corresponding packets from the buffer. However, if it receives a SNACK, it concludes that packets mentioned in the SNACK packet are lost in the BS–MR wireless link. In order to activate retransmission of the lost packets, it first checks its cache. If the packets are present in the cache, it retransmits the packets immediately. Otherwise, it concludes that the reported packets are lost in the wired network between FH and BS due to congestion or removed from the cache prematurely. In this case, if the modified TCP agent at MR continues suppressing the DUPACKs, the fast retransmission from the FH is unnecessarily delayed because the lost packets are not available in the cache of modified TCP agent at BS. So the modified TCP agent at BS sends a congestion packet to the modified TCP agent at MR. The congestion packet serves as an order for the modified TCP agent at MR to forward all DUPACKs for these lost packets to activate fast retransmission from the FH.

3. modified TCP agent at MR

For a quick look the functionalities of modified TCP agent at MR are shown in fig 2. The modified TCP agent at MR is responsible to detect packet losses in both BS–MR and MR–MH links. To detect packet losses in BS–MR link, it keeps track of the sequence number of the received packets. If it finds a gap in sequence number of the received packets, it concludes that some packets are lost in BS–MR link. To report packet losses to the agent at BS, it generates a SNACK in which it includes the sequence number of all lost packets and sends it to the agent at BS. If it receives the packets in sequence, it stores them in a cache and forwards a copy of the packets to the MH. The reason behind caching at MR is that the MHs may be connected to the MR via wireless links.

The agent at MR detects packet losses in MR–MH link using the DUPACKs. When the MH receives the packets out of order, the MH generates DUPACKs. There can be three reasons for which the MH generates these DUPACKs: the packets might have been lost (i) in the path between MR and MH, (ii) in the path between BS and MR, and (iii) in the wired network between FH and BS. When the agent at MR receives the DUPACKs, it checks its cache. If the packet is present in the cache, it retransmits the lost packets using go-back-n ARQ technique. Otherwise, it has definitely received an indication (congestion packet) from BS about this packet, i.e., the packet is lost due to congestion in the wired network. So in order to activate fast retransmission at the FH, it starts forwarding all DUPACKs for the lost packet.

4. Differences between snoop and modified TCP

The snoop and modified TCP protocols are similar in their core design aspect: both are link layer protocols, and both use local retransmission technique to recover from wireless losses. However, they differ in many other aspects. The subtle differences between the loss recovery mechanisms of snoop and modified TCP are the following:

The snoop protocol considers the entire BS–MR–MH link as a single homogeneous link whereas modified TCP considers them as independent heterogeneous links and handles them independently. So, recovery is faster in modified TCP than that in snoop. Introduction of new packets (e.g., congestion and SNACK packet) does not require any changes in the implementation of FH and MH. Whereas snoop requires changes in implementation at either FH or MH or both. In snoop, the loss detection and retransmission takes place from only one node, namely BS. In modified TCP, the loss detection and retransmission takes place from two nodes, namely BS and MR. Unlike snoop, modified TCP uses SNACK in BS–MR link and DUPACKs in MR–MH link to recover from wireless losses.

As modified TCP uses SNACK in BS–MR link, selective retransmissions (instead of go-back-n) take place in BS–MR link. When modified TCP agent at MR receives DUPACKs, it retransmits all packets starting from the lost packet in order to recover multiple packet losses in one RTT. The snoop agent retransmits only the lost packet for which the DUPACK is received.

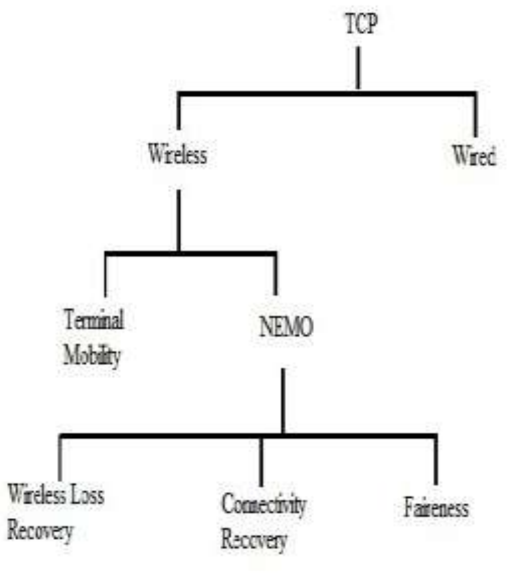
3. LITERATURE REVIEW

[1] BhaskarSardar, DebashisSaha, Mahbub Hassan:A novel enhancement of TCP for on-board IP networks with wireless cellular connectivity, Journal of Network and Computer Applications 41 (2014) 89–100:In this paper mobile router (MR) connects the moving network to the Internet by means of high-speed cellular mobile data services. Unlike terminal mobility, where the mobile hosts (MHs) connect to the cellular base station directly.

[2] Bhaskar Sardar (Wbut), Debashis Saha (Iim): A Survey of Tcp Enhancements For Last-Hop Wireless Networks: In this paper author provides an in-depth survey of various TCP enhancements which are specifically targeted for last-hop wireless environments. The objective is to review the performance issues of TCP variations, when employed in last-hop wireless networks, and to provide a categorized analysis of different existing solutions comparatively, as we all know that it is difficult to create a “one size fits all” TCP for last-hop wireless networks.

[3] K. Avrachenkov, U.sAyesta, J. Doncel, P. Jacko: Congestion control of TCP flows in Internet routers by means of index policy: In this paper This paper deals with congestion control and buffer management, two of the most classical research problems in networking. The objective of congestion control is to control the traffic injected in the network in order to avoid congestive collapse. Most traffic in the Internet is governed by TCP/IP(Transmission Control Protocol and Internet Protocol).

4. PROPOSED METHODOLOGY



Network for communication may be wired or wireless.TCP was originally designed for wired networks where congestion is the primary cause of packet loss. If congestion occurs TCP invokes congestion control procedures to give the network a chance to recover. As a result, TCP is not capable to respond effectively to packet losses not related to congestion. So the rapid increase of wireless mobile networks has enlightened the need for TCP enhancement. In wireless network there are terminal and network mobility. If a packet loss occurs in wireless network due to wireless errors or mobility of the hosts, Terminal mobility is sensed in the form of different types of acknowledgement, giving corresponding response to the response this problem will be minimized.

NEMO Basic Support Protocol, a MR-based solution, for connecting any type of moving networks to the fixed Internet. Also a number of research efforts are going on to support NEMO using network based protocols.

Here NEMO categorize the protocols in three groups: wireless loss recovery, connectivity recovery, and fairness.

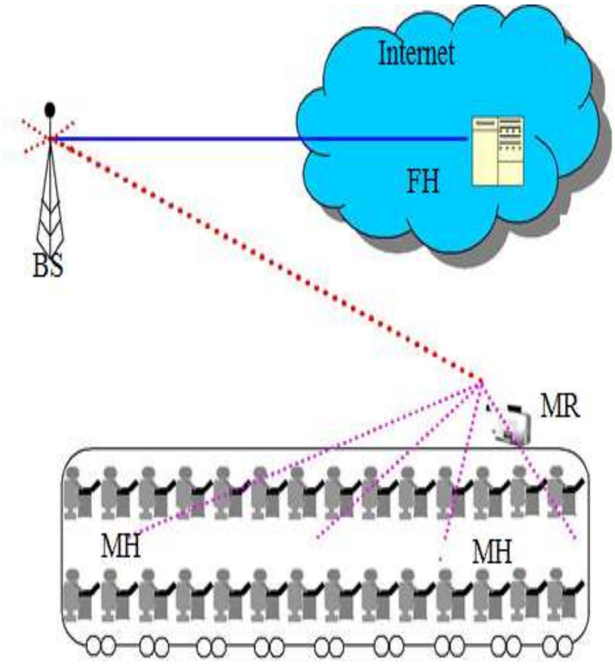


Figure 2: NEMO ConnectivityModel

TCP invokes congestion control routines, whenever there is a random packet loss on the wireless link, resulting in a very slow recovery for the lost packets. To speed up the recovery process, most classical solutions employ agents that buffer the passing TCP packets close to the MHs (say in BS) to perform local retransmissions if the packet is lost on the wireless link. These solutions are known to improve TCP performance over wireless links considerably. So, we first applied snoop in NEMO to improve TCP performance. Although NEMO benefits. From snoop agents, snoop could not provide the optimum performance enhancement for NEMO because it treats the whole BS–MR–MH path as a single link. Any packet loss in this part of the path, whether they occur in the BS–MR link or in the MR–MH link is detected and retransmitted by the agent located at the BS. Clearly, snoop ignores the presence of MR, which plays an important role in NEMO. So, we feel that there is a room for further improvement in

TCP performance in the context of NEMO by incorporating the MR into the agent design. Investigating the impact of the additional wireless link (MR–MH) on the performance of snoop, and designing mechanisms to all aviate any negative impacts may solve the problem to some extent. Thus, the objective of this paper is to extend the single point recovery mechanism to multipoint i.e. link-to-link recovery mechanism to recover wireless losses in different wireless links independently and simultaneously, thereby decreasing the loss recovery time and increasing TCP performance.

5. CONCLUSION

In this paper, we have proposed modified TCP to effectively address the wireless link related issues in NEMO. modified TCP places agents at both BS and MR to quickly recover from wireless losses. Loss recovery time analysis shows positive gain in wireless loss recovery of modified TCP over snoop for all loss probabilities and delay values. Gain in recovery time increases linearly with delay and non-linearly with loss probability in wireless links. We have used the loss recovery analysis to obtain throughput performance of snoop and modified TCP.

6. REFERENCES

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