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ANALYSIS OF TRANSMISSION CONTROL PROTOCOL IN MOBILE AD HOC NETWORK

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ABSTRACT
The transmission control protocol (TCP) is the most predominant transport layer protocol in the Internet today. It transports more than 90% percent of the traffic on the Internet. Its reliability, end-to-end congestion control mechanism, byte-stream transport mechanism, and, above all, its elegant and simple design have not only contributed to the success of the Internet, but also have made TCP an influencing protocol in the design of many of the other protocols and applications. Its adaptability to the congestion in the network has been an important feature leading to graceful degradation of the services offered by the network at times of extreme congestion. TCP in its traditional form was designed and optimized only for wired networks. The history of wireless networks started in the 1970s and the interest has been growing ever since. During the last decade, and especially at its end, the interest has almost exploded probably because of the fast growing Internet. The tremendous growth of personal computers and the handy usage of mobile computers necessitate the need to share information between computers.

KEYWORDS: *Ad hoc networks, Wireless transmission*

INTRODUCTION

Military communication on a tactical level is becoming IP-based. This allows the employment of one common communication infrastructure for multiple systems, enabling the network-based defense paradigm. With IP-based connectivity comes also a desire to interconnect wired and wireless communications systems. There is an expectation that services used in wired networks today also will be available in the wireless domain. In the wireless domain, cell-phone technology has shown users that IP-based web communication is feasible. However, this communication technology requires infrastructure in the form of a high capacity backbone1 network and one hop wireless communication between the client terminal and base stations that connect to the backbone. Current wireless communication in the military tactical domain consists mainly of point-to-point radio links and one-hop broadcast voice/Situational Awareness (SA) data. However, there is a lot of ongoing work focusing on interconnecting the various radio systems using Mobile Ad hoc NETwork (MANET) technology, to create heterogeneous MANETs. MANETs are self-configuring infrastructure-less networks that adapt dynamically to changing environments. In contrast to cell phone technology, MANETs are able to support multi-hop wireless communication over a shared medium. However, the capacity and performance of MANETs are much lower, compared to cell phone networks, and informing future users and service developers on the limitations as well as the advantages of this technology is essential for proliferation of the MANET technology.

TCP is reliable and connection oriented protocol developed in 1981. It's based on simple sliding window flow control, during the early stages congestion collapses occurred because of lack of congestion control mechanism. With the advent of Jacobson congestion algorithms for TCP as a remedy, TCP is updated to its new version known as TCP Tahoe. Now currently TCP Reno is widely used in Internet. TCP Tahoe congestion Control includes slow start, congestion avoidance and fast retransmission. While in addition to these three algorithms, TCP Reno also adds the fast recovery algorithm. TCP is design for wired network, but with the technology emerging towards wireless medium, the need to implement TCP is of great important but it faces many problems especially in an ad hoc networks. Mobile ad hoc network (MANET) is a famous ad hoc network can be utilized well for emergency situation and military applications. TCP has poor performance in MANET due to dynamic topology, shared medium, high error ratio; channel connotation and multi hop architecture.

DYNAMIC TOPOLOGY/MOBILITY

In contrast to wired network, in wireless ad hoc networks the devices are free to move which leads to frequent topology changes. Then two types of problem occurrence are possible. (a) Path loss and (b) Network Partition

Path loss leads to the path re-computation at sender side and during this phase there will be no transmission which ultimately causes throughput degradation. Another possibility during this phase is that if path re-computation take more time then may be retransmission time out (RTO) occurs. Thus there will be data retransmission, RTO is increased exponentially and CP enters to slow start phase. This affect will be more serious in high mobility environment. In case of network partition the sender and receiver remains at different network and all the packets will be dropped. In such situation multiple consecutive transmission of the same segment are possible, while the receiver will be disconnected and it is called serial time out.

MULTI-HOPING

In Ad hoc Network Environment every node is also supporting the responsibility of router to forwards packets on behalf of other nodes. Thus longer flow, in since of hops, having longer round trip time and higher packet dropping probability and high fluctuating end-to-end throughput as compare to flow having small number of hops.

DIFFERENTIATING TRANSMISSION AND CONGESTION LOSSES

Since wireless network have open medium, signal passing through the medium they have to face different blockage such as building, due to these blockages the transmission signals are reflected, diffracted and scattered and thus causes packets loss. TCP assume that this loss is occurred due to congestion and it activate its congestion control and result in congestion window reduction, which leads to low throughput and low utilization of available bandwidth. So TCP has no such mechanism to differentiate between congestion losses and transmission losses.

HIGH BIT ERRORS

In wired network the Bit Error Rate (BER) is ranging from 10-6 to 10-8, while in wireless network this range is from 10-3 to 10-1. Since due to high BER the packet losses are very frequent and TCP reaction to these losses reduces the congestion window. Thus leads to non-optimal performance.

CHANNEL CONTENTION

Another reason of TCP performance degradation is the channel contention due to increasing number of nodes. It can occur between different flows passing through the same vicinity or between different packets in the same flow. In IEEE802.11, when the number of try for channel access exceeds the predefined limit, then cause to drop the packets and the Medium Access Control (MAC) Protocol notifies (wrongly) the upper layer that the path is unavailable. In response the upper layer starts the route recovery procedure and TCP stop its transmission and the throughput drop to zero during route recovery process.

This channel contention also leads to unfairness problem. The unfairness also occurs between the nodes so that each node has or not the equal access to the medium as compare to other node. If there is no equal access to the medium for each node then the unfairness occurs between the flows passing from different nodes. This unfairness also happens among the flows passing from the same path.

HIDDEN AND EXPOSED TERMINAL PROBLEM

Due to the share medium and multi hoping capability the nodes facing the hidden and exposed node problem. Fig: 1 representing the hidden and exposed terminal problem of IEEE 802.11 standard. The circles show the transmission range of A and B, where C is in the transmission range of both A and B. Let A and B both want to transmit data to C, so there will be collision at C, because A and B do not know about the transmission of each other due to hidden node problem.

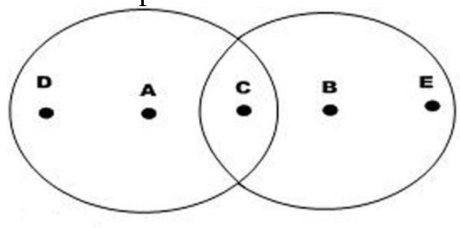

Fig. 1: Hidden and Exposed Node Terminal Problem

Now let that there is a transmission between C and B, while at the same time A wants to transmit data to D, but when A senses the medium, it find that the medium is busy due to C transmission and thus A stops its transmission. Actually in this situation A transmission for D will not going to collide with C transmission, This problem exist in IEEE802.11 standard and known as exposed terminal problem.

OUT OF ORDER PACKET

When a receiver receives out of order packets, the receiver transmits duplicate acknowledgement, after receiving three duplicate ACK the sender retransmit the packets and congestion control is activated. But the problem is that congestion control is activated wrongly most of the time, because out-of-order packet occurrence take place due to different reasons such as multipath routing protocol and rout failure and not only due to congestion.

4G AND AD HOC NETWORKING

A major goal toward the 4G Wireless evolutions is the providing of pervasive computing environments that can seamlessly and ubiquitously support users in accomplishing their tasks, in accessing-information or communicating with other users at-anytime, anywhere, and from any device. In-this environment, computers get pushed further-into background; computing power and network-connectivity are embedded in virtually every device-to bring computation to users, no matter where-they are, or under what circumstances they work. These devices personalize themselves in our presence to and the information or software we need. The new trend is to help users in the tasks of everyday life by exploiting technologies and infrastructures hidden in the environment, without-requiring any major change in the users behavior. This new philosophy is the basis of the Ambient-Intelligence concept. The objective of ambient-intelligence is the integration of digital devices and networks into the everyday environment, rendering-accessible, through easy and ‘‘natural’’ interactions, a multitude of services and applications. Ambient intelligence places the user at the center of the information society. This view heavily relies on 4G wireless and mobile communications. 4G is all-about an integrated, global network, based on an open systems approach.

Integrating deferent types-of wireless networks with wire-line backbone network seamlessly and convergence of voice, multimedia and data tra'c over a single IP-based core-network are the main foci of 4G. With the availability of ultra-high bandwidth of up to 100 Mbps, multimedia services can be supported efficiently; ubiquitous computing is enabled with enhanced system mobility and portability support, and location-based services are all expected. Fig. 1 illustrates the networks and components within 4G network architecture. In network integration, 4G networks are touted as-hybrid broadband networks that integrate different-network topologies and platforms. In Fig. 1 the overlapping of different network boundaries represents the integration of different types of networks in 4G. There are two levels of integration. First is the integration of heterogeneous wireless networks with varying transmission characteristics such as Wireless LAN, WAN, and PAN, as well as mobile ad hoc networks. At the second level we find the integration of wireless networks with the fixed-network backbone infrastructure, the Internet, and PSTN.

Much work remains to enable a seamless-integration, for example that can extend IP to-support mobile network devices. In all IP networks, 4G starts with the assumption that future networks will be entirely packet-switched, using protocols evolved from those in use in-todays Internet. An all IP-based 4G wireless-network has intrinsic advantages over its predecessors. IP is compatible with, and independent of the actual radio access technology, this means that the core 4G network can be designed and evolves independently from access networks. Using IP based core network also means the immediate tapping of the rich protocol suites and services already available, for example, voice and data-convergence, can be supported by using readily available VoIP set of protocols such as MEGACOP, MGCP, SIP, H.323, SCTP, etc. Finally the converged all IP wireless core networks will be packet based and support packetized voice and multimedia on top of data.

CONCLUSIONS

Currently congestion control, as considered in this survey, is often seen as a transport layer issue. It is therefore very often combined with reliability mechanisms, in a TCP like way. Therefore like in the Internet congestion control for unreliable, UDP like traffic is not possible. A new perspective on this problem might be to realize congestion control in the MAC or network layer. After all, it might make sense to tackle the problem where it emerges. An exeedingly high network load is a problem closely associated with medium access and packet forwarding. Some approaches already follow this direction and separate congestion control strictly from reliability measures. Here a wide spectrum is open for more fundamental research. Furthermore, new applications especially developed for MANETs need different types of protocols. As mentioned before, there are many cases where the protocols will necessarily be extremely application specific. Examples are the emerging applications for MANETs in the field of car-to-car communication: this demands very specific, nongeneric congestion control and reliability mechanisms. Warning messages need to be sent fast and it has to be assured that every car driving towards an incident will be warned. Moreover, new applications in MANETs will require communication paradigms like multicast or geocast. In wired networks multicast is used very rarely, because it is often not supported by the network. But in mobile ad hoc networks, where the network can be tailored to the application and bandwidth is especially scarce, it might in fact turn out to be vital for group communication scenarios. Congestion control for these non-unicast communication scenarios is also an open research issue.

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