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A COMPARATIVELY ANALYSIS OF VARIOUS MANET BASED THROUGHPUT ENHACEMENT TECHNIQUES

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ABSTRACT

The advent of ubiquitous computing and the proliferation of portable computing devices have raised the importance of mobile and wireless networking. A mobile ad hoc network is an autonomous collection of mobile nodes forming a dynamic network and communicating over wireless links [Figure 1.1]. Ad hoc communication concept allows users to communicate with each other in a multi-hop fashion without any fixed infrastructure and centralized administration. Due to their capability of handling node failures and fast topology changes, such networks are needed in situations where temporary network connectivity is required, such as in battlefields, disaster areas, and large meeting places. Such networks provide mobile users with ubiquitous communication capability and information access regardless of location.

I. INTRODUCTION

TCP has gained its place as the most popular transmission protocol due to its wide compatibility to almost all today's applications. However, TCP as it exists nowadays may not well fit in mobile ad hoc networks since it was designed for wire-line networks where the channel Bit Error Rate (BER) is very low and network congestion is the primary cause of packet loss. On the contrary of wired links, wireless radio channels are affected by many factors that may lead to different levels of BER.

In addition to wireless channel behaviour, one of the most prominent features of Ad Hoc networks is mobility of nodes. Thus, since the devices of such a network are battery operated, they need to be energy conserving so that battery life is maximized. In the last few years, lot of research efforts have been undertaken in order to design ad hoc networking protocols that takes into consideration energy consumption aspects. Among them, a set of routing protocols [1] that have been proposed in the last few years in order to ensure network connectivity when minimizing energy consumption of mobile nodes at the same time. In the mean time, only few works dealing with energy efficiency of TCP variants have been undertaken. The objective of our work is, first, to study the performance of these TCP variants and their impact on the energy consumed by mobile nodes. Then, our second objective is to study the effect of IETF MANET routing protocols on TCP energy consumption. The result of this work can then be used, in a near future, as a guideline to design new energy-efficient TCP variant for ad hoc networks.

II. MOTIVATION

In the last few years, many researchers have studied TCP performance in terms of energy consumption and average good put within wireless mobile networks [2][3][4]. Due to the specific issues related to wireless ad hoc networks, it is expected that the performance of TCP will be affected considerably in these environments. In wireless ad hoc networks, reasons for packet losses are more sophisticated than traditional wireless (cellular) networks. Those reasons include the unpredictable wireless channel characteristics due to fading and interference (implying a high BER), the vulnerable shared media access due to random access collision, the hidden and exposed terminal problems, path asymmetry, multi-path routing, and so on. Undoubtedly, all of these pose great challenges on TCP to provide reliable end-to-end communications in such environment.

III. ISSUES OF OLD ARTICLES

This section describes the study about the environment, different research efforts and improvements over MANET technology that are simulate the problems and issues of MANET. In addition of that a part of summarizing the previous contribution is also added for further work for performance improvement on network.

Paper Reviewed

Prashanti. S, Sang-Hwa Chung atel we have discuss the problem of congestion control over MANET. Transmission Control Protocol (TCP) is the most popular connection oriented transport layer protocol used in the current internet. However, when TCP operates in WMNs, the throughput of TCP degrades drastically due to its inability to distinguish non-congestion events such as non-congestion losses and packet reordering from network congestion. In addition, when non-congestion loss and packet reordering are co-existed the number of unnecessary retransmission increases and will have adverse effects on TCP and its congestion control mechanism which deteriorate the poor performance of TCP. Several loss differentiation algorithms have been proposed for distinguishing the non-congestion events from network congestion.

YassineDoug, at el presents a new approach that tries to adapt the Transmission Control Protocol (TCP) for use in Wireless ad-hoc networks (MANET). In the proposed protocol called Hybrid TCP or H-TCP, we have made some modifications using a cross layer solution to the legacy IEEE 802.11 and TCP. In H-TCP we show that we can obtain better connections on the wireless links, while maintaining the advantages of TCP on the wired networks at the same time. This new outlook confers on TCP a good feature of adapting to wired and wireless environments. We evaluated our approach via simulation with NS3 and compared the results of H-TCP with standard TCP-Reno scheme and a recent improvement of TCP performed on the basis of the signal strength.

R. BrittoPradeep at el we have simulated different networks with differing parameters to analyze the behavior of the most common protocols DSDV and AODV with different variants of TCP. By creating different networks in MATLAB simulator, we could deeply analyze the behavior of the protocols with these TCP variants in the basis of the amount of packet drops in each case. The lesser the amount of drops the better the algorithm. This paper implicitly analyses which TCP variant has lesser drop rates with which routing protocol. To compare the performances of different TCP variants like TCP, TCP Reno, TCP NewReno, TCP Vegas and TCP Tahoe with the routing protocols DSDV and AODV.

V.Jacobson at el. we shall discuss how the different mechanism affect the through put and efficiency of TCP and how they compare with TCP Vegas in terms of performance. Cause it is much more robust in the face of lost packets. It can detect and retransmit lost packet much sooner than timeouts in Tahoe. It also has fewer re-transmissions since it doesn't empty the whole pipe whenever it loses packets. It is better at congestion avoidance and its modified congestion avoidance and slow start algorithms measure incipient congestion and very accurately measures the available bandwidth available and therefore use network resources efficiently and don't contribute to congestion. 2) Reno: More than half of the coarse-grained timeouts of Reno are prevented by Vegas as it detects and re-transmits more than one lost packet before timeout occurs. It doesn't have to always wait for 3 duplicate packets so it can retransmit sooner.

Mohit P. Tahiliani: The performance of high-speed TCP variants in multi-hop wireless networks in terms of network throughput. Another metric, expected throughput is used for comparison of throughput when nodes are mobile. Through simulations we have studied the behavior of high-speed TCP variants in multi-hop wireless networks by varying the routing protocols such as Destination Sequenced Distance Vector (DSDV), Ad hoc On demand Distance Vector (AODV) and Dynamic Source Routing (DSR) routing protocols. We have evaluated the performance of high-speed TCP variants in terms of throughput for static as well as mobile topologies.

Manish DevendraChawhan: The effects of unidirectional and bidirectional networks on various TCP variants. The effect of application of SNOOP and ECN on the performance enhancement of TCP along with TCP variants is assessed, improving the performance of TCP over wireless network by implementing cross layer design protocol (Snoop). ECN is used to avoid congestion and Snoop aims at retransmitting the lost packets from base station, avoiding retransmission from the transmitter. The performance of different TCP variants such as TCP Tahoe, Vegas, Reno, New Reno, Sack are analyzed on Wi-Fi scenario. These results can be analysed from throughput and congestion window plots in the paper. The simulator used for implementation in (MATLAB). The analysis of the result shows improvement in throughput of Vegas and E-Vegas with and without snoop with respect to other TCP Variants ie Reno, Newreno, Sack, and Tahoe.

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PoonamTomar at el compares TCP variants specifically TCP Tahoe, Reno and Lite based on different parameters such as number of nodes received with error, packet loss, byte received, and throughput and pause time. A table is then drawn which shows the comparison results. Congestion Control is a significant issue in Mobile Ad hoc Networks. The objectives listed in the problem statement have been carried out properly.

David B. Johnson et al. presentsProtocol for routing in ad hoc networks that uses dynamic source routing. The protocol adapts instantly to routing changes when host action is frequent, yet requires little or no overhead during periods in which hosts move less intermittently.

Christian Lochert et al. analyze a position-based routing approach which was geographic (GSR) that makes use of the navigational systems of vehicles. By means of simulation we compare this way with non-position-based ad hoc routing strategies (Dynamic Source Routing and Ad Hoc On-Demand Distance Vector Routing) [2].

Naigende Duncan: Proposed EEDSR, an extension of DSR that reduces routing overhead by limiting the number of route discovery and maintenance packets in the MANET. The scheme involves bigger packet headers for the source route discovery packets since they contain information about the energy levels of the nodes in the route cache. In EEDSR, since the RREQ packets are flooded once for each communication period, routing overhead is minimized.

IV. CONGESTION CONTROL ALGORITHMS

TCP is known as a full duplex protocol meaning each TCP connection provides a pair of byte streams in both directions. TCP implements the congestion control mechanism with each of these byte streams so that the receiver can limit the sender from transmitting more data in the network [5].

This section discusses about four intertwined congestion control mechanisms: slow start, congestion avoidance, fast retransmit and fast recovery. A TCP must not be more aggressive in sending data than these four algorithms allow.

Slow Start and Congestion Avoidance

The TCP sender employs the slow start and congestion avoidance algorithms to avoid more data to be sent in the network than it is capable of. For implementing these algorithms, two flow control variables, namely, the congestion window and the advertised window are included in each TCP connection state. The TCP sender imposes the congestion window while the receiver imposes the advertised window. The minimum of the congestion window and the advertised window regulates the data transmission. Besides, The slow start threshold (ssthresh), known as a state variable, is used to decide which one is to be used among the slow start or congestion avoidance algorithms for controlling the data transmission. During the beginning of the transmission, there are many unfamiliar conditions present in the network; therefore TCP needs to gradually discover the network by assessing the bandwidth and determining the available capacity [6]. This will eventually prevent the network from being congested with large bursts of data.

TCP Performance in MANETs

Even though TCP ensures reliable end-to-end message transmission over wired networks, a number of existing researches have showed that TCP performance can be substantially degraded in mobile ad-hoc network [5, 6]. Along with the traditional difficulties of wireless environment, the mobile ad-hoc network includes further challenges to TCP. In particular, challenges like route failures and network partitioning are to be taken into consideration. Furthermore, MANET experiences several types of delays and losses which may not be related to congestions, though TCP considers these losses as a congestion signal. These non-congestion losses or delays mostly occur due to the inability of TCP's adaptation to such mobile network. Appropriate cares have to be taken for assessing such losses and also to distinguish them from congestion losses so that TCP can be sensitive while invoking the congestion control mechanism.

The next subsections present an analysis of different types of constraints influencing the TCP performance in MANET environment.

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High BER

High Bit Error Rate (BER) is caused due to multipath fading, Doppler shift and signal attenuation. This causes TCP data segments to be lost and thereby the congestion control mechanisms are triggered unnecessarily by the TCP sender.

Route Failures

In MANET, the mobility of the node is considered as the major reason for the route failure and the route reestablishment is needed instantly in case of route failure. However, it is likely that a new route establishment may experience longer duration than the RTO of the sender. In consequence of that, the TCP sender will unnecessary deploy congestion control mechanism.

Path Asymmetry Impact

The network topology is changed very frequently and arbitrarily within MANETs, which leads to the creation of an asymmetric path. This path formation negatively influences the TCP performance since TCP is highly dependent on time responsive feedback information. The sender starts transmitting data in a burst when a number of ACKs are received together, which causes the packet to be lost. In MANETs, path asymmetry can be grouped into different forms such as loss rate asymmetry, bandwidth asymmetry and route asymmetry.

Network Partitioning

A network partition takes place when a node departs from the network, resulting in an isolation of some parts of a mobile ad-hoc network. These fragmented portions are defined as partitions. In a MANET environment, TCP considers network partitioning as one of the most imperative challenges which is mainly caused due to mobility or energy-constrained (limited battery power) operation of nodes. When the source and the destination of a TCP connection lie in different parts of the network, all transmitting packets are found to be dropped by the network. As a result, the congestion control algorithm will be invoked instantly by the TCP sender.

Again, the serial timeouts at the TCP sender can be generated in case of frequent disconnections in the network. This may trigger a longer idle period for the network through which the connection can be re-established. However, the TCP does not found to move from the back off state. An ideal example is illustrated in Figure 4.1:

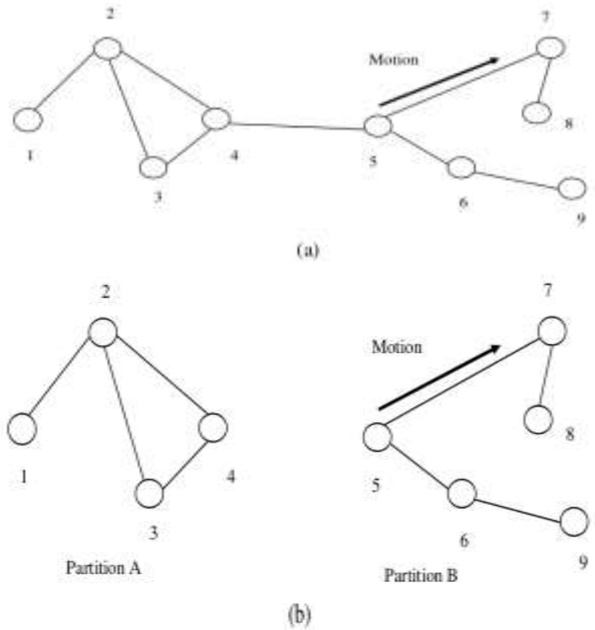

Figure4.1:-Partition impact (a) before movement (b) after movement.

In Figure 4.1a, when node 5 goes away from node 4, this causes a fragmentation of the network into two parts. The network fragmentation is depicted in Figure 4.1b. If the disconnection continues for longer period than the RTO, the exponential back-off algorithm will be activated automatically by the TCP . This mechanism doubles

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the RTO value as soon as the timeout expires and continues doubling the RTO until the maximum timeout value of 64 sec is reached.

Power Scarcity

Each mobile node carries batteries which have limited power supply; hence the network suffers the node lifetime problem. Each node in MANET works as a router and an end system, therefore needless retransmissions of the packet cause the consumption of this limited energy resource. As a result, an inefficiency of the available power is utilized.

Multipath Routing

In order to reduce the frequency of route re-computation, some routing protocols preserve multiple routes between the sender and the receiver. However, this may result in the arrival of a huge number of out-of-sequence packets to the receiver. Consequently, it causes the receiver to generate duplicate ACKs and the sender to employ the congestion control mechanisms [9].

Interaction between MAC Protocol and TCP

In a MANET environment, the intercommunication between the TCP mechanisms and 802.11 MAC protocol may lead to unexpected severe challenges such as link capture effect, instability, and hop unfairness. The causes of these problems include the hidden station and exposed station problems of the 802.11 MAC protocols [2].

Hidden and Exposed Node Impact

A typical hidden node condition where packet transmission starts from node A to node E. Since, node B cannot sense node D, node B assumes the channel as an idle channel and therefore initiates its transmission by dispatching a Request to Send (RTS) to node C. However, transmitting RTS unexpectedly introduces collisions because node C is found in the interference range of node D. This problem is termed as "Hidden Node" impact where node D is called the hidden node with respect to node B.

V. PROBLEMSTATEMENT

TCP/IP protocol was designed for wired networks which provides end to end reliable communication between nodes and assures ordered delivery of packets. It also provides flow control and error control mechanisms. As it is still a successful protocol in wired networks, losses are mainly due to congestion. But in case of ad hoc networks packet losses are due to congestion in the network and due to frequent link failures. so when network adapt TCP to ad hoc networks it misinterprets the packet losses due to link failure as packet losses due to congestion and in the instance of a timeout, backing-off its retransmission timeout (RTO).This results in unnecessary reduction of transmission rate because of which throughput of the whole network degrades. Therefore, route changes due to host mobility can have a detrimental impact on TCP performance. Therefore a new strategy is required for providing the more reliable MANET.

Problem Identified

TCP is considered as the most popular reliable transport protocol today. It is compatible with almost all other Internet protocols and applications. However, TCP as it exists now-a-days may not well fit in wireless ad hoc networks since it was designed for wired networks where network congestion is the primary cause of data packet losses. On the contrary of wired links, wireless radio channels are affected by many factors that may lead to different levels of channel errors. Wireless channel behaviour cannot be predictable, but in many cases, such channels have high channel errors that cannot be neglected when studying light-infrastructure networks such as wireless ad hoc networks.

VI. SIMULATION

What is simulation

Simulation is widely-used in system modelling for applications ranging from engineering research, business analysis, manufacturing planning, and biological science experimentation, just to name a few. Compared to analytical modeling, simulation usually requires less abstraction in the model (i.e., fewer simplifying assumptions) since almost every possible detail of the specifications of the system can be put into the simulation model to best describe the actual system. When the system is rather large and complex, a straightforward

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mathematical formulation may not be feasible. In this case, the simulation approach is usually preferred to the analytical approach.

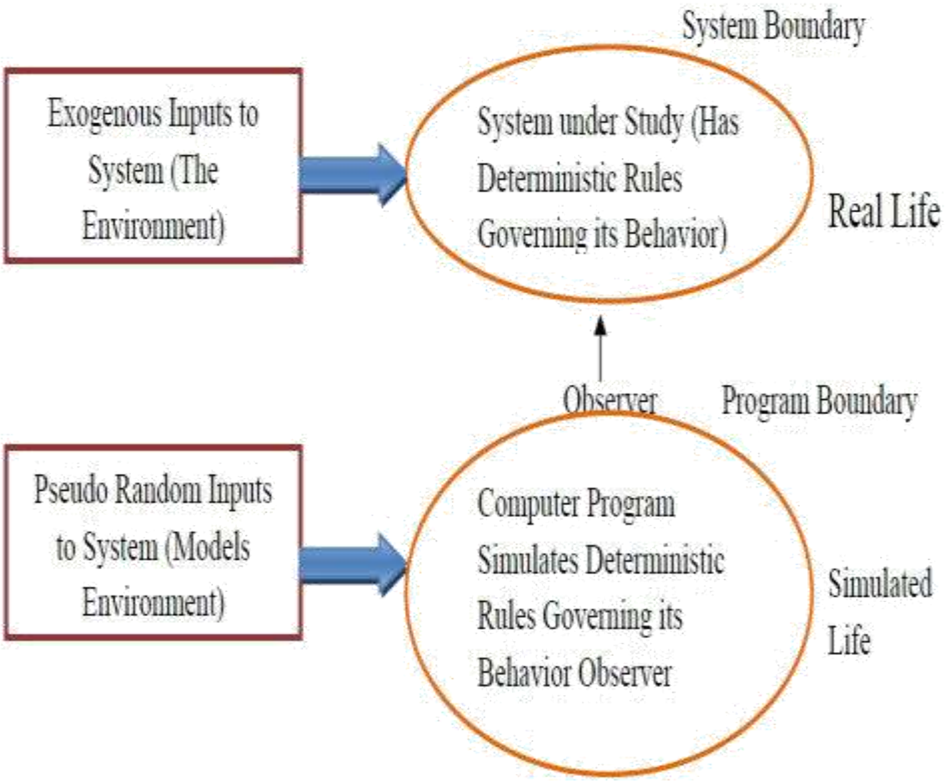

Figure6.1:-Partition impact analytical approach.

Figure 6.1: Simulation

Simulation Tool	NS-2.35
IEEE Scenario	802.11
Propagation	Two Ray Ground
Number of nodes	100 nodes
Traffic Type	TCP
Antenna	Omni directional antenna
MAC Type	IEEE 802.11
Routing Protocol	DSR
Queue limit	50 Packets
Simulation area (in metre)	2 KM
Queue type	Droptail
Channel	Wireless Channel
Simulation time	30 sec.
TCP variants	NEWRENO, SACK, TCP

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1. Packet Delivery Ratio
2. End to End Delay
3. Residual Energy
4. Throughput

A Detailed analysis of above mentioned matrices are as follows.

Packet Delivery Ratio

This is the fraction of the data packets generated by the TCP sources to those delivered to the destination. This evaluates the ability of the protocol to discover routes.

Packet Delivery Ratio for various connections:-Figure 6.7 shows the PDR under various TCP variants i.e. NEW Reno, SACK, TCP and Hybrid TCP.

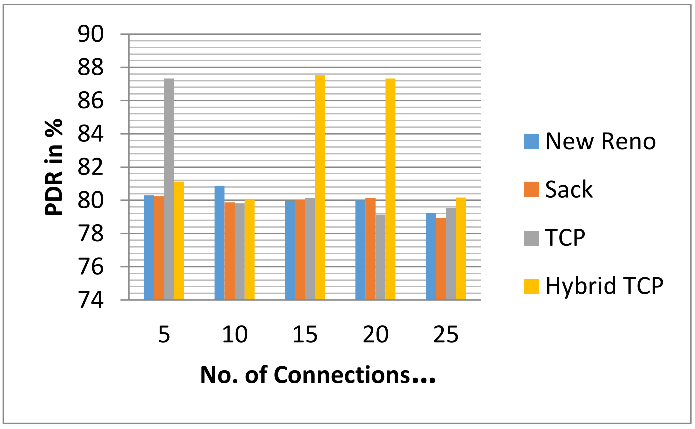

Figure 6.1Packet Delivery Ratio for various transmission connections

VII. CONCLUSION

This work carried out the detailed analysis of New Reno, SACK, TCP and Hybrid TCP variants of TCP with DSR routing protocol theoretically and through simulation by NS-2 for MANET on the basis of different performance metrics viz. packet delivery ratio, end to end to end delay, residual energy, and average throughput. These performance metrics are analyzed for the three four variants by varying the node density for static number of nodes. Simulation of variants provides the facility to select a good environment for routing and gives the knowledge how to use variant algorithm schemes in static network. Simulation results show that, as the node density increases in the network, the performance of the variants decreases. Nodes density affects the performance of variants most as frequent path break increases with the low node density. According to simulation results as the density of nodes increases, the packet drop and overheads of routing protocol increases whereas throughput and packet delivery ratio decreases.

VIII. FUTURE WORK

In wireless network community MANET received attention of many researchers due to its unique nature. Although amount of research has been thoughtful to the various routing issues in MANET but still there are some areas that need more scrutiny. Due to time constraint, we only focused on variants of TCP for ad hoc routing with various node densities with DSR protocols but still there are some areas in these routing protocols that need more attentions.

- Other performance metric such as jitter etc can be measured for all topologies in MANET.
- Secure routing is one of the challenging fields. Due to the insecure and ad hoc nature of MANET, it is prone to several security attacks that may lead to devastating consequences. So security attacks may be checked with respect to different attacks in MANET.

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