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EVALUATION OF TRANSMISSION CONTROL PROTOCOL IN MOBILE ADHOC ROUTING PROTOCOLS ON THE ORIGIN OF PRESENTATION METRICS

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ABSTRACT:
Many protocols have been proposed for MANETs with the goal of achieving efficient routing. Most of these protocols can be classified either as source-based or table-based routing protocols with a few hybrid protocols emerging in the recent years. Some of the popular table-driven algorithms are the Destination Sequenced Distance Vector (DSDV) routing protocol the Temporally-Ordered Routing Algorithm (TORA), The Wireless Routing Protocol (WRP), Global State Routing (GSR), Fisheye State Routing (FSR), Hierarchical State Routing (HSR), Zone-based Hierarchical Link State Routing Protocol (ZHLS), Cluster-head Gateway Switch Routing (CGSR). While source-based algorithms include the Dynamic Source Routing (DSR) protocol, Ad-hoc On-demand Distance Vector (AODV) routing protocol, Cluster Based Routing protocol (CBRP), The Associatively Based Routing (ABR), Signal Stability-Based Adaptive Routing protocol (SSR). Hybrid protocols like the Zone Routing Protocol (ZRP) combine proactive and reactive approaches at different stages of the routing process.
Key words: Mobile ad-hoc Network, electromagnetic, node movement

INTRODUCTION

Many protocols have been proposed for MANETs with the goal of achieving efficient routing. Most of these protocols can be classified either as source-based or table-based routing protocols with a few hybrid protocols emerging in the recent years. Some of the popular table-driven algorithms are the Destination Sequenced Distance Vector (DSDV) routing protocol the Temporally-Ordered Routing Algorithm (TORA), The Wireless Routing Protocol (WRP), Global State Routing (GSR), Fisheye State Routing (FSR), Hierarchical State Routing (HSR), Zone-based Hierarchical Link State Routing Protocol (ZHLS), Cluster-head Gateway Switch Routing (CGSR) [1-2], [3]. While source-based algorithms include the Dynamic Source Routing (DSR) protocol, Ad-hoc On-demand Distance Vector (AODV) routing protocol, Cluster Based Routing protocol (CBRP), The Associatively Based Routing (ABR), Signal Stability-Based Adaptive Routing protocol (SSR). Hybrid protocols like the Zone Routing Protocol (ZRP) combine proactive and reactive approaches at different stages of the routing process [4], [5].

These algorithms differ in the approach used for searching a new route and/or modifying a known route when nodes move. They are similar in that insufficient network topology information is considered in their routing decisions. For example, the routing algorithms do not consider the physical location of the destination node when choosing a route. They are also not concerned about information like the density of the network, congestion at the node, movement speed and direction of the nodes. Excessive overhead packets required in discovering new route, in the event of failure to access the destination due to presence of congestion or failure in intermediate node. Consequently, these routing algorithms are slow in reacting to dynamic changes in the topology of the network resulting in reduced throughput when they occur.

MANET has been gradually exploited the world as one of the most familiar wireless communication network. This achievement makes the communication companies and many of research and development institutes to introduce many developments in MANET in an attempt to enhance the performance and put more features to this service. However, the dynamic topology of such network suggests the use and development of various routing protocols that will enhance the reliability of such advanced communication network. This is because routing protocols play an important role in the enhancement of MANET reliability. Thus different routing protocols have been proposed and have witnessed a remarkable development over the years [6]. In the development always MANET performance has been investigated for different number of nodes, different mobile speed and different traffic load and types [7, 8]. The distributed nature of the MANET and their link stability posed critical challenges in the design of routing protocols [9].

Furthermore, in the investigation of routing protocol, it is necessary to select best candidate from proactive and reactive routing protocols, such as OLSR and AODV, respectively [10]. In the performance evaluation, it is important to compute the delay and throughput metrics by using OPNET simulation. HTTP traffic uses TCP as its transport protocol, this work will investigate the impact of different variants of TCP transport layer protocol, Taho, Reno and New-Reno on the performance of MANET routing protocols [11].

REVIEW OF LITERATURE

Ad hoc networks are networks made of independent nodes connected to each other wirelessly. These connections are created and destroyed due to the changing network topology. Ad hoc networks face an extra set of problems to those encountered in traditional fixed networks or wireless cellular networks. Dynamically forming the communications infrastructure from mobile devices is the source of these complications. One way of thinking about this is to imagine the problems caused by continually moving and changing the router used to connect the local subnet to the rest of the world.

The delivery of data packets along with requirements that affect traditional routing protocols such as loop free routing, completeness and stability is to be addressed during routing in MANET. Solutions for these issues in literature focused on developing ad hoc routing protocols such as Destination Sequenced Distance Vector (DSDV) (Charles and Pravin 1994), Dynamic Source Routing (DSR) (Charles and Elizabeth 1999) and ad hoc Ondemand Distance Vector (AODV) (Perkins 2001).

Ad hoc On-demand Distance Vector (AODV) was initially set out in (Charles and Elizabeth 1999) and is defined in the IETF Draft, version 8, (Perkins, 2001). AODV is an on demand ad hoc routing protocol which supports both unicast and multicast routing. AODV does not use source routing but routing entries are dynamically created in intermediate nodes between the source and destination. AODV adopts a similar approach as DSR, in that the source wanting to send information initiates a RREQ, which is broadcast throughout the network until it reaches the destination itself, or an intermediate node which has a route to the destination. This node then propagates back a RREP to the source.

Yogesh et al (2010) focused on comparative analysis of two on demand routing protocols: Ad hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR) based on packet delivery ratio, normalized routing overhead and end-to-end delay while varying number of sources and pause time. The simulation experiments are performed using GLOMOSIM.

The traffic sources used were CBR and the source-destination pairs are spread randomly. The data packet size is 512 bytes with the performance metrics considered for evaluation were Packet Delivery Ratio (PDR), End-to-end delay, Routing overhead.

The analysis shows that routing is very important factor for evaluating the performance of the system. Traditional routing algorithms cannot fulfill the requirements of an wireless network, because of the dynamic topology and the limited bandwidth that characterize these networks. The authors evaluated and compared AODV and DSR routing algorithm using simulation. DSR outperforms AODV in terms of overhead with just 10% of overhead as compared to AODV. DSR also performs better then AODV in constraint conditions in terms of PDR which is 90.16 % as compared to 83 % of AODV. End-to-end delay of AODV is less than that of DSR. For both protocols performance improves as pause time increases.

Deepak and Yogesh (2011) proposed a new AODV-Efficient and Dynamic Probabilistic Broadcasting (EDPB) approach which is quite efficient and dynamic in nature and solves the broadcast storm problem in AODV. The simulation was done using Global Mobile Simulator (GloMoSim). Average end-to-end delay and routing overhead are considered as main performance evaluation metrics. The results show that the proposed algorithm has better performance over the conventional AODV protocol and AODV implemented with blind flooding (Lim and Kim 2001) and with fixed probabilistic flooding approaches (Cartigny and Simplot 2003; Zhang and Agrawal 2005) proposed in literature.

The proposed methodology also improves the performance of on demand routing protocols of MANETs by reducing the communication overhead incurred during the route discovery process in AODV protocol. The simulation results show that new EDPB algorithm has definitely superior performance over traditional AODV-Blind Flooding (AODV-BF) and AODV-Fixed Probability (AODV-FP). The AODV-EDPB generates much lower routing overhead and end-to-end delay, as a consequence, the packet collisions and contention in the network is reduced. The proposed algorithm determines the rebroadcast probability by taking in to account the network density. In order to improve the saved rebroadcasts, the rebroadcast probability of the low density nodes is increased and the rebroadcast probability high density nodes are decreased.

Goswami et al (2009) proposed a Fuzzy Ant Colony based routing protocol (FACO) based on fuzzy logic and swarm intelligence. The proposed protocol selected optimal path by optimization of multiple objectives based on the swarm based intelligence algorithm. They conducted experiments comparing the performance of the FACO, Ant-colony-based Routing Algorithm (ARA), Ant-AODV protocols. In these experiments, the authors used the discrete time network simulator, NS-2. Fifty mobile nodes are spread within a 1500 m by 300 m area and moves according to the random waypoint mobility model. Each node had 250m of radio range of and 2Mb/s channel capacity. Simulation results show that the proposed protocol performs better than the existing swarm intelligence based routing protocols used in MANET.

Tomar (2008) overcame flooding problem in the network by presenting an algorithm, which used selective flooding in place of broadcasting. It is proposed to lessen the number of packets within the network. This reduces the routing Packet overhead. The protocols have been simulated using NS-2 as a simulator. The protocols DSDV, DSR and AODV are simulated on NS-2 with a network with fifty mobile nodes which are moving and communicating with one another. The desired goal of the experiment was to measure the ability of the routing protocols i.e. successfully deliver data packets to destinations.

4. AD HOC NETWORKS

Ad Hoc networks do not have a certain topology or a central coordination point. Therefore, sending and receiving packets are more complicated than infrastructure networks. Figure 3.1 illustrates an Ad Hoc network.

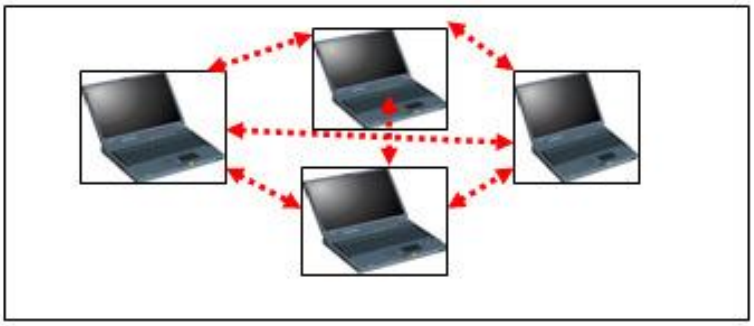

Figure 1: An Ad Hoc Network

Nowadays, with the immense growth in wireless network applications like handheld computers, PDAs and cell phones, researchers are encouraged to improve the network services and performance. One of the challenging design issues in wireless Ad Hoc networks is supporting mobility in Mobile Ad Hoc

Networks (MANETs). The mobility of nodes in MANETs increases the complexity of the routing protocols and the degree of connection's flexibility. However, the flexibility of allowing nodes to join, leave, and transfer data to the network pose security challenges.

TCP VARIANTS

TCP is transport layer is the reliable connection orientated protocol that provides reliable transfer of data between the nodes. It ensures that the data is reached the destination correctly without any loss or damage. The data is transmitted in the form of continuous stream of octets. The reliable transfer of octets is achieved through the use of a sequence number to each octet. Another aspect of TCP is the tree way handshakes mechanism to establish a connection between the nodes. Furthermore, TCP uses the port assignment as an addressing mechanism to differentiate each connection for the cases of more TCP connection between nodes are required. After the introduction of first version of TCP several different TCP variants exist. The most famous implementation of TCP called Tahoe, Reno and New-Reno [3].

TCP TAHOE

Congestion control plays an important role in flow control objective in transport layer protocol TCP. In the TCP Taho, congestion control algorithm is introduced in the original TCP with slow start, congestion avoidance and fast retransmits procedures [8]. Initially, slow-start procedure is initiated after a packet loss had been detected with the congestion window set to 1. This will work as a TCP connection starts or re-starts to avoid the initial burst and the connection might never get started. After each acknowledgment received, the congestion window CWD will be increased by 1 and the congestion condition is raised as the number of packets sent is increased exponentially. Having encountered congestion, the sending rate is decreased and the CWD is reduced to one to start over again. Thus, Tahoe can detect packet losses by time-outs. With occasionally checks for timeouts, costly repeated interrupt will be avoided. This can be used to retransmit packet before a packet loss is observed [9]. In congestion avoidance procedure Additive Increase Multiplicative Decrease will be employed. The procedure is started when congestion is noticed after packet loss is observed. In this case half of the current window will be saved as a threshold value. Next, slow start phase will be operated with CWD set to 1 until it reaches the threshold value. The CWD will be incremented linearly until it encounters a packet loss. On the receipt of 3 duplicate ACK's, a sign that the segment was lost is indicated. The segment can be retransmitted without waiting for timeout. In this case the Taho enters the fast retransmit procedure. Finally, whenever segment loss is indicated, fast retransmit procedure started. This is occurred whenever 3 duplicate ACK's received. The TCP Reno can be considered as an enhancement of the TCP Tahoe. In the enhancement fast retransmit procedure has been enhanced through the inclusion of fast recovery. TCP Reno improves the TCP Taho performance for the single packet loss within a window of data except multiple packet losses case within a window data. The congestion window size is halved and linearly increased like congestion avoidance case. The increase in transmission rate is slower than that observed in slow start adopted in Taho to relieve congestion [10]. Finally, the enhancement prevents the communication path from going empty after fast retransmit procedure. This will avoid the need for the slow start procedure.

Due to buffer overflow, packet may be lost in congested link. In this case which, the sender will receive three duplicate acknowledgments or the sender retransmission timeout (RTO) timer will be expired. In the former case, fast retransmit and recovery algorithm will be used by the sender to reduce the congestion window to half size. Next, the congestion window will be increased linearly and can assist in congestion treatment. On the other hand and for the case of single packet loss in a window, TCP Reno can improve the performance through the use of fast recovery, whereas for multiple packet loss, TCP Reno performance will be degraded [11].

TCP NEW-RENO

TCP New-Reno is a modification of the TCP Reno through the use of retransmission process. This is occurred in the fast recovery phase of the TCP Reno. In the improvement, TCP New Reno can detect multiple packet losses[12]. Furthermore, through the period the fast recovery, all unacknowledged segments received and the fast recovery phase is terminated. Having achieved this modification, several reductions in the congestion window size will be avoided in the cases of multiple packet losses occurrence. Furthermore, the congestion window size is set up to slow start threshold the congestion avoidance phase will be resumed and next segment will be retransmitted when partial acknowledgment is received [13]. It is worth to mention that, in partial acknowledgments, all outstanding packets at the onset of the fast recovery are not necessarily acknowledged [14].

PROBLEM STATEMENT

An ad hoc network is an instantly deployable wireless network that does not require the services of any networking infrastructure such as base stations or routers. A key feature of these networks is their ease of deployment that makes it ideally suitable for battlefield, search, rescue and disaster relief operations. These networks can operate on a single-hop or multi-hop basis where nodes in the network are able to act as intermediaries (routers) for communications of other nodes. Nodes in these networks operate with power limited batteries, and the bandwidth is constrained as these are wireless networks. Consequently, routing becomes a vital factor and a major challenge in such a network. This research aims to study the impact of three IETF (Internet Engineering Task Force) standardized routing protocols on MANETs and thereby comprehensively analyzes their performance under varying network sizes and node mobility rates. The three routing protocols that are considered in the analysis are Ad-hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Temporary Ordered Routing Algorithm (TORA). In addition, from a transport layer's perspective, it is necessary to consider Transmission Control Protocol (TCP) as well for MANETs because of its wide application, which enjoys the advantage of reliable data transmission in the Internet. However, the factors such as scalability and mobility cause TCP to suffer from a number of severe performance problems in an ad-hoc environment.

Problems are associated with in the MANET performance, an evaluation and optimization techniques are necessary to opt and adhere for the better execution of the transmission medium. Pledged data delivery is TCP utmost drawback in wireless networks but possible solutions are available to recognize the data transmission effects. To measure the performance of different TCP variants, simulation study has been conducted in practice. MANET utilizes TCP and UDP for data transmission and our study focus on different variants of the TCP i.e. particularly Tahoe, Reno and New Reno explicitly using AODV, DSR and TORA protocols in focus.

EVALUATION PLATFORM

The OPNET is one of the most extensively used commercial simulators based on Microsoft Windows platform, which incorporates most of the MANET routing parameters compared to other commercial simulators available [12]. OPNET has a comprehensive built-in development environment to design and simulate network models. The performance metrics such as Throughput, End-to-End Delay, Upload Response Time, Download Response Time, Retransmission Attempts, are being used to evaluate the network efficiency.

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