An Interaction between SCTP and On Demand MANET Routing Protocols

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ABSTRACT

Mobile Ad hoc Network (MANET) is a wireless network of mobile nodes that has no fixed routers. In MANET, mobile nodes can communicate via the wireless interface while nodes are moving freely without using the network infrastructure. Nowadays the performance of a new existence Internet protocol technology, that is Stream Control Transportation Protocol (SCTP) in a MANET Routing Protocol still unknown. The general objective of this research is to analyze and make the comparative performance of SCTP with Ad-hoc On-demand Distance Vector (AODV) and Dynamic Source Routing protocol (DSR) using Network Simulator (NS-2). Specifically, this research is to measure the behavior of SCTP in terms of throughput and smoothness and; to determine routing protocol in Mobile Ad-hoc Network (MANET) either it has significant effect in SCTP. This research used Network Simulator 2 (NS-2), type of the traffic is Constant Bit Rate (CBR) and packet size is 1000. The data sent consists of five speeds at 5 m/s, 10 m/s, 15 m/s, 20 m/s, 25 m/s, and then these speeds are used in AODV and DSR simulation. The result, of our study suggested that the SCTP throughput over AODV is higher than DSR and the smoothness of SCTP over DSR was higher than AODV for the five types of speed. In addition, there was no significant impact on throughput between AODV and DSR as the percentage difference was small (i.e., 0 to 2.4%). Furthermore, the speed of node movement does not significant affect the smoothness.

Keywords: Routing protocols, MANET, AODV, DSR, SCTP.

I INTRODUCTION

The transport layer is responsible for dividing data into segments, providing logical connections "end-to-end" between the terminals, and providing error handling (error handling). Within the transport layer protocol is the User Datagram Protocol (UDP), the Transport Control Protocol (TCP) and the Stream Control Transmission Protocol (SCTP). SCTP combines the best features of UDP and TCP. SCTP is a message-oriented protocol because reliable SCTP messages store limits, and at the same time detect data loss, data duplication, and out-of-order data (Ahmed et al., 2003). SCTP also has congestion control and flow control mechanisms. SCTP is connection-oriented like TCP, but the difference is that SCTP can supports carrying data in multiple streams and multihoming.

The SCTP connection called an association provides novel services such as multihoming that allows the end points of single association to have multiple IP addresses, and the multistreaming allows for independent delivery among data streams (Pascal and Petre, 2005). At the same time, SCTP has many advantages such as no transfer of duplicated data, data fragmentation to conform with the maximum transmission unit (MTU) size, without error, and bundling optional user message to an SCTP packet (Jayesh et al., 2002). In addition, SCTP supports congestion control algorithms, error handling (Mcclellan and Stanley, 2003), and even to multimedia better UDP or TCP (Fang and Yie, 2008), as result, the SCTP has many features that lead it become very important protocol. For data transmission by SCTP to be mobile, it needs a wireless network that has no fixed network infra-structure.

MANET can be formed from the set of nodes that use a wireless interface; they are for communication between one node to another node. Each node can be a host or router, so the node can forward packets to the next node. Further, nodes can communicate with other nodes that are outside its scope, requiring routing protocols that have the ability to pass through a lot of nodes, so that MANET is also expected to be a network with a wider range than the radio network. Each mobile node has a wireless network interface and communicates with each other by utilizing the media. Because the transmission medium has a limited transmission power, the inter-node communication is done by passing one of several other nodes (node serves as a router or host) so that MANET can also be called a multi-hop network (Jan *et al.,* 2008).

In support communication using the network method used in MANET, the protocol can be classified into three categories. First by modifying the conventional routing protocols because they have to adapt to working in Ad hoc networks, such as DSDV (Destination Sequence Distance Vector); second, it is based on the routing discovery as needed, such as DSR (Dynamic Source Routing), or AODV (Ad hoc On-demand Distance Vector); and third, it is based on a Quality of Service (QoS) routing protocol (Chi L. & Han, 2006). There is also a hybrid approach to routing protocol that combines both types of routing protocols, proactive and reactive, for example, Zone Routing Protocol (ZRP). SCTP is the existence of a new Internet protocol technology, whereas the performance in a MANET Routing Protocol is still unknown. Therefore, this research will lead us to study the characteristics and behavior of SCTP over AODV and DSR, especially during the handover, in which the throughput and smoothness will appear and be examined. The main aim of this research is to achieve deep understanding on the performance of SCTP protocol by using different MANET routing protocols. Firstly, it has to measure the behavior of SCTP in terms of throughput and smoothness. Secondly, to determine routing protocol in MANET will have significant effect in SCTP.

II RELATED WORK

Nahm et al., (2005) analyzed TCP on multihop 802.11 networks involving inter-layer research. In this study, they investigated the effects of congestion and MAC contention on the interaction between TCP and an on-demand ad hoc routing protocol in ad hoc 802.11 network. Their study shows some problems that arise from the lack of coordination and sharing in the network. It is observed that TCP causes an overreaction in the routing protocol and damages the quality of the connection end to end. So, one important source that reduces TCP throughput lies in the TCP window mechanism itself. To fix this problem, they proposed a scheme Fractional Windows Increment for TCP to prevent excessive reaction to the on-demand routing protocol by limiting TCP's aggressive nature. The proposed scheme can be applicable to various transport protocols that use the basic mechanism of TCP.

In the simulation they used a large data rate of 2 Mbps, using a radio propagation model manifold two- ray ground with a 250 meter transmission range, a carrier sensing range of 550 meters, and a transmission range of 550 meters. The simulation used 7x7 grid topology and as much as 6-hop chain topology. To use static routing, the process of routing was prearranged; this type of routing was used to avoid the unexpected effects of dynamic routing. From the simulation results Nahm et. al. wanted to show the average correlation between large windows (W) and the packet loss rate (p). The p-value and W was calculated from 500 seconds of simulation time with a number of TCP flows using chain topologies ranging from 4 to 22 hops. From the simulation results of Nahm et. al. they concluded that the mechanism of TCP windows lost a great rate on a network with a low-bandwidth delay product.

Ashwini et al., (2004) compared the performance of SCTP vs. TCP in MANET environments. They used a scenario that consisted of 46 mobile nodes placed in a 1000m by 300m rectangle using the Random Way Point mobility model. Raw link bandwidth was 2 Mbps and the background traffic consisted of 10 CBR connections each with a data rate of 16 Kbps. One TCP connection began after all CBR connections were running. Total run time of the transport protocol was 900 seconds. Selective Acknowledgement (SACK) allows the TCP version to be used for the simulation. MTU for each link is stored in 1500 bytes. TCP segments size of 1400 bytes of data were stored in SCTP, while every piece was 700 bytes. Chunk bundling was activated for SCTP, which allows 1400 bytes in a packet of data. Initial congestion and flow control parameters for TCP and SCTP were stored together. They used AODV for the routing process. Both sets of simulations involved various network loads by varying the rate of CBR traffic. For each case in the second set of simulations, the performance metrics were an average of more than a single simulation run in 12 scenarios. Multihome endpoints had two interfaces. Goodput, Connect time, the number of retransmissions and bandwidth SACK, are the metrics used to evaluate the performance.

Simulations were performed for three combinations of multihoming cases mobility; Multihoming, Mobile, and Multihoming Stationary nodes. Results for each were similar, each showing a decrease in goodput and retransmissions increased with increased mobility, as expected. Goodput of SCTP remained slightly lower than TCP, while the bandwidth SACK shows the opposite trend. It was noticed that the SACK took command of greater bandwidth in the case of TCP SCTP. A particular trend in a case does not show the connect time graph. Simulations involving varying network loads gave expected results, with SACK goodput bandwidth and a sharp decrease in increasing background traffic, while improving time to connect line.

Khuzairi et al., (2011) measured the TCP-friendly Rate Control (TFRC) performance in terms of throughput, jitter and delay. In addition, this research also identifies whether or not MANET routing protocols have impact on TFRC. They conduct the experiment by sending multimedia streaming traffic carried by TFRC over Ad-Hoc On Demand Vector (AODV) routing protocol and Destination-Sequenced Distance Vector (DSDV) respectively. Random-Waypoint mobility model is used for both experiments. Results obtained shows that TFRC has better throughput over DSDV. As for delay and jitter, TFRC over AODV has smoother results.

III MATERIAL AND METHODS

The experiments were conducted using NS-2 and the topology as shown in Figure 1 was used to simplify the analysis. This topology consists of 16 nodes placed in a 1500m x 1500m rectangle because it uses static topology, consisting of a 4x4 metric. The initial location node 0 is (200,200), node 1 (400,200), node 2 (600,200), node 3 (800,200), node 4 (200,400), node 5 (400,400), node 6 (600,400), node 7 (800,400), node 8 (200,600), node 9 (400,600), node 10 (600,600), node 11 (800,600), node 12 (200,800), node 13 (400,800), node 14 (600,800), and node 15 (800,800). The source node is denoted as node 0, and node 15 is set as the destination node. Node 0 is moves at the time of 200 seconds in (300, 500), at the time of 400 second in (600, 500), at the time of 600 second (700, 100). The distance between nodes is 200m.

The two routing protocols are involved in the simulation. The first protocol is AODV, the second protocol is DSR. During the simulation, CBR starts at the time of 50 seconds and ends at 900 seconds. The CBR over UDP sends data by node 12 to 3, node 14 to 5, node 8 to 10, node 6 to 4, node 1 to 11, node 2 to 9 and node 7 to 13, we used CBR because to see the multimedia traffic. Node 1 to 15 sending the data using SCTP. In this research, the data sent consists of five difference speeds; 5 m/s, 10 m/s, 15 m/s, 20 m/s, 25 m/s, and then these speeds are used in both AODV and DSR simulation as show in Table 1.

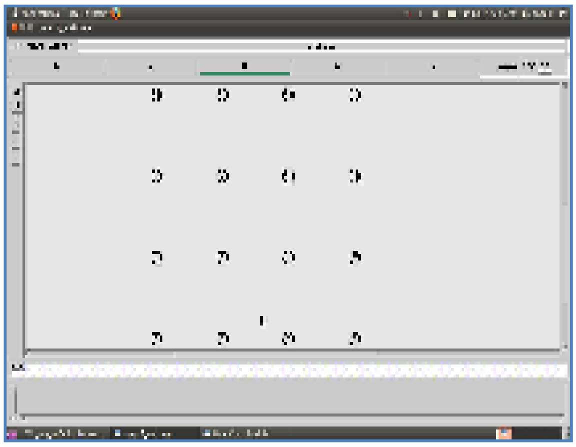

Figure 1 Simulation of the Topology

Table 1: Simulation Parameters

Parameters	Settings
Examined Protocols	AODV, DSR
MAC Protocol	802.11
Simulation Time	900 seconds
Simulation Area	1500m X 1500m
Transmission Range	200m
Number of Node	16
Traffic Type	CBR (SCTP)
NS-2 version	2.34

There are two processes for evaluating the input parameters which are; by executing the NS-2 successfully, and compare the result with other results to evaluate the performance. The first step of evaluating is to execute the simulation software by running the experimental topology. Once the simulation runs completely, the performance metrics will appear to show the results of the output of the data. Secondly, the time when the experiments indicated the data output, and the results will present the performance metrics in a graph and table format, while the results would be compared for perfect measurement of the performance. It required to run the simulation as needed many times by using different values in order to compare the results for measuring the performance.

IV RESULT AND DISCUSSION

As shown in Table 2 the highest value of differences between SCTP over AODV and DSR is only 2.4 % at speed 5 m/s. However, the result of SCTP throughput when using different routing protocols does not have any significant impact. The lowest percentage difference is 0% at speed 10 m/s whereas the highest percentage difference is 2.4% as summarized in Table 4.1. Furthermore, no conclusion can be made whether AODV or DSR is better in working with SCTP.

Figure 2 shows the average throughput of SCTP over AODV and DSR. The average value of throughput is exemplified according to speed of wireless network, as well as according to type of network protocol. The result has shown similar features and values for each simulation. Therefore it has been concluded that the behavior of both network protocols are same. There was no significant different indicated from the result.

Table 2: Average throughput of SCTP over AODV and DSR

Speed (m/s)	SCTP over AODV	SCTP over DSR	Difference (%)
5	10,79	10,53	2.4
10	10,61	10,61	0
15	10,73	10,69	0.37
20	10,61	10,41	1.89
25	10,78	10,58	1.86

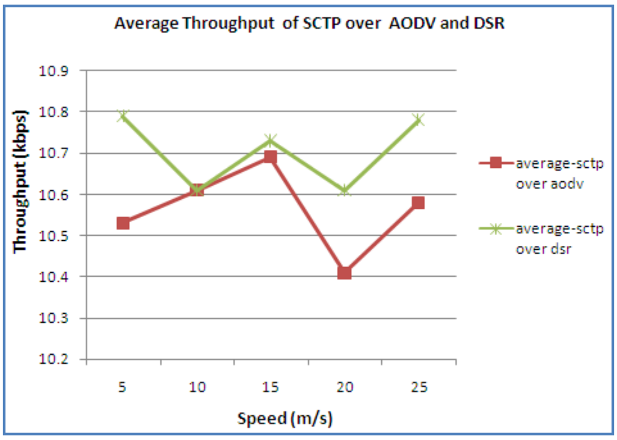

Figure 2: Average Throughput of SCTP over AODV and DSR

Table 3 and Figure 3 show the average smoothness results according to speed of wireless network, as well as based to type of protocol. As it is clearly outlined, there was no significant difference in the measurement of smoothness between AODV and DSR protocol. Furthermore, it has been concluded from the obtained values that the speed of network has not resulted any change in the smoothness value.

Table 3: Average of Smoothness

	5m/s	10m/s	15m/s	20m/s	25m/s
SCTP-AODV	0.77961	0.81235	0.70213	0.800329	0.792612
SCTP-DSR	0.744712	0.721714	0.76375	0.7799	0.778644

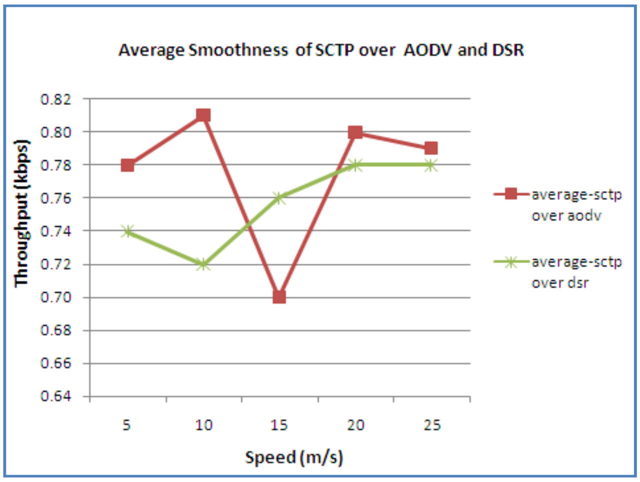

Figure 3: Average Smoothness of SCTP over AODV and DSR

V CONCLUSION

This research is focused on comparing the throughput and smoothness of SCTP over AODV and DSR routing protocols. The results obtained have provided to fulfill the objectives of this research. In other to conclude, that is no significant impact among of comparison throughput on SCTP over AODV and DSR because of the difference percentages was small between 0% to 2.4%. Furthermore, it has been concluded from the obtained values that the speed of network has not resulted any change in the smoothness value. This research is focused out successfully, however, there are several recommended areas for future work. This research has been utilizing 16 nodes, however, it is recommended to conduct simulation and research on more than 16 nodes. It is recommended to include 32 and also this research has been utilizing CBR in the simulation. As alternative, new simulation and research could be carried out with FTP protocol instead of CBR.

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