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UDP OVER VARIOUS ROUTING PROTOCOLS FOR MOBILE AD HOC NETWORKS

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ABSTRACT

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A dynamic routing protocol is needed for one node to exchange data with another to cope with the dynamic nature of mobile ad hoc networks. In this paper we have investigated the performance of UDP as a transport protocol over various routing protocols in ad hoc networks. For this investigation we have chosen three routing schemes, DSDV, DSR and AODV in different network scenarios where nodes are mobile with various speeds. Results are produced by evaluating throughput and end to end packet delay over the UDP connection through simulation experiments by considering node mobility and network density. Our results suggest that the performance of UDP is highly affected by the table-driven and demand-driven natures of routing protocols. Moreover, the number of nodes in the network has an impact on the operations of routing protocols as well as on UDP performance.

Key words: *Mobile Ad Hoc Network, UDP, Routing, Node Mobility*

INTRODUCTION

Mobile Ad Hoc Network (MANET) (Fordigh *et al.* 2000) is one of the great innovations of modern technology. In such network each mobile node operates not only as a host but also as a router and does not rely on any pre-established or centralized infrastructure.

Both UDP and TCP are responsible for hooking up the programs that are communicating with each other, whereas the underlying IP is simply responsible for getting the packets from machine to machine. The Transmission Control Protocol (TCP) is a connection oriented, reliable transport layer protocol. On the other hand the User Datagram Protocol (UDP) is a connectionless, less complex and unreliable protocol. This protocol is used in place of TCP when a reliable delivery is not required and when we want fast data transmission. For example, UDP is used for real-time audio and video traffic where lost packets are simply ignored. However, support from upper layer, such as check packet sequence, error control etc, is a must if reliable delivery using UDP is required.

Because nodes in mobile ad hoc networks (MANETs) are forwarding packets for each other, some sort of routing protocols is necessary to make the routing decisions. Although a number of studies have been conducted, improving and analyzing UDP performance in MANETs is still an active area of research and also a challenging task.

The reminder of this paper is organized as follows: Section 2 depicts the related works; mechanisms of routing protocols are shown in Section 3. We define the simulation model in Section 4 and present our analytical results in Section 5. The conclusion and future work follow in Section 6.

RELATED WORKS

Since UDP is fast and less complex protocol used in internet for real time transmissions, its performance in MANET has become an interesting and active area of research. (Rohner *et al.* 2005) have studied the effects on a low rate multihop UDP flow from a competing TCP flow. The results of this study indicated that TCP's congestion control does not seem efficient enough to only have marginal impact on the other traffic in the network. When the two data flows do not share common links, they observed increased packet interspacing in the UDP flow, caused by jitter and to some extent packet loss. In the case where UDP and TCP share a common link, contention is significantly higher resulting in increased UDP packet loss and more significant TCP interruptions. (Connolly and Sreenan, 2008) examined the performance of the Bluetooth protocol. Their paper presents an assessment of the performance of UDP over the Bluetooth protocol.

As stated above, most related earlier works focus on measuring performance of UDP with various protocols. But there is no absolute performance measurement of UDP as transport layer protocol for MANET. In this paper for real time transmission we evaluated the performance of UDP over DSDV, AODV and DSR routing protocols in terms of matrices such as throughput and end–to-end packet delay. Thus our work compliments previous work and can be combined to help UDP achieve better performance in mobile ad hoc networks.

ROUTING PROTOCOLS IN MANET

This section describes three prominent ad hoc routing protocols in the ad hoc networking community today.

Destination Sequenced Distance Vector (DSDV)

DSDV (Perkins and Bhagwat, 1994) is a proactive or table-driven routing protocol. In DSDV, each node maintains a routing table that has an entry for each destination in the network. The attributes for each destination are the next hop ID, hop count metric and a sequence number which is originated by the destination node. DSDV uses both periodic and triggered routing updates and guarantees loop freedom. Upon receiving a route update packet, each node compares it to the existing information regarding the route. Routes with old sequence numbers are simply discarded.

Dynamic Source Routing Protocol (DSR)

The Dynamic Source Routing (DSR) (Johnson and Maltz, 1996) protocol is an on-demand routing protocol based on source routing. In the source routing technique, a sender determines the exact sequence of nodes through which to propagate a packet. The list of intermediate nodes for routing is explicitly contained in the packet's header. In DSR, every mobile node in the network needs to maintain a route cache where it caches source routes that it has learned. When a host wants to send a packet to some other host, it first checks its route cache for a source route to the destination. In the case a route is found, the sender uses this route to propagate the packet. Otherwise the source node initiates the route discovery process. In route discovery, the source floods a query packet through the ad-hoc network, and the reply is returned by either the destination or another host that can complete the query from its route cache. Upon reception of a query packet, if a node has already seen this ID (i.e. it is a duplicate) or if it finds its own address already recorded in the list, it discards the copy and stops flooding; otherwise, it appends its own address to the list and broadcasts the query to its neighbors. For route maintenance when a route failure is detected the node detecting the failure sends an error packet to the source, which then uses the route discovery protocol to find a new route.

Ad hoc on-demand Distance Vector Routing (AODV)

The AODV (Perkins and Royer, 2002) is a reactive protocol, which combines both DSR and DSDV characteristics. AODV borrows the basic route discovery and route-maintenance of DSR as well as hop-by-hop routing, sequence numbers and beacons of DSDV. When a source node desires to establish a communication session, it initiates a route discovery process by generating a route request (RREQ) message, which might be replied by the intermediate nodes in the path to destination or the destination node itself with the route reply (RREP) message contains the whole path to destination. Failure of a link can be detected via hello messages. Failure to receive three consecutive HELLO messages from a neighbor is taken as an indication that the link to the neighbor in question is down.

SIMULATION MODEL

We used the discrete event Network simulator 2(NS2) (Fall 2005) from Berkley for analysis and comparison of the ad hoc routing protocols. The network simulations carried out for our study are based in 500 x 500 meter flat grid topography. We have considered four network scenarios of 4,8,16 and 32 nodes in which we have varied the speed of nodes. The mobility model uses the *random waypoint model* in a rectangular field. Each movement simulation lasted for a period of 200s. For this measurement, we have used the same traffic model that has maximum connection of 2, 4, 8 and 16 CBR (*Constant Bit Rate*) sources in four networks of 4,8,16 and 32 nodes respectively. The transmission rate of each node is 4 packets per second where each packet size fixed at 512 bytes.

PERFORMANCE RESULT

In this section we analyze the performance of UDP over AODV, DSDV and DSR based on two parameters such as mobility speed (m/s) and number of nodes considering throughput and average end to end delay for data packet delivery.

Throughput Performance

Figure 1 shows the relative throughput performance of three routing protocols for various node mobility. It can be seen that the UDP throughput for DSDV is low in all network scenarios. In DSDV, each node maintains routing information for all other nodes. Collecting such information requires substantial amount of time. That means, when network topology changes due to nodes movement, each node has to update its routing table. At those moments, sources fail to deliver data packets to the destination due to lack of routing information. Moreover, DSDV uses stale routing table entry that causes data packets to be forwarded over a broken link.

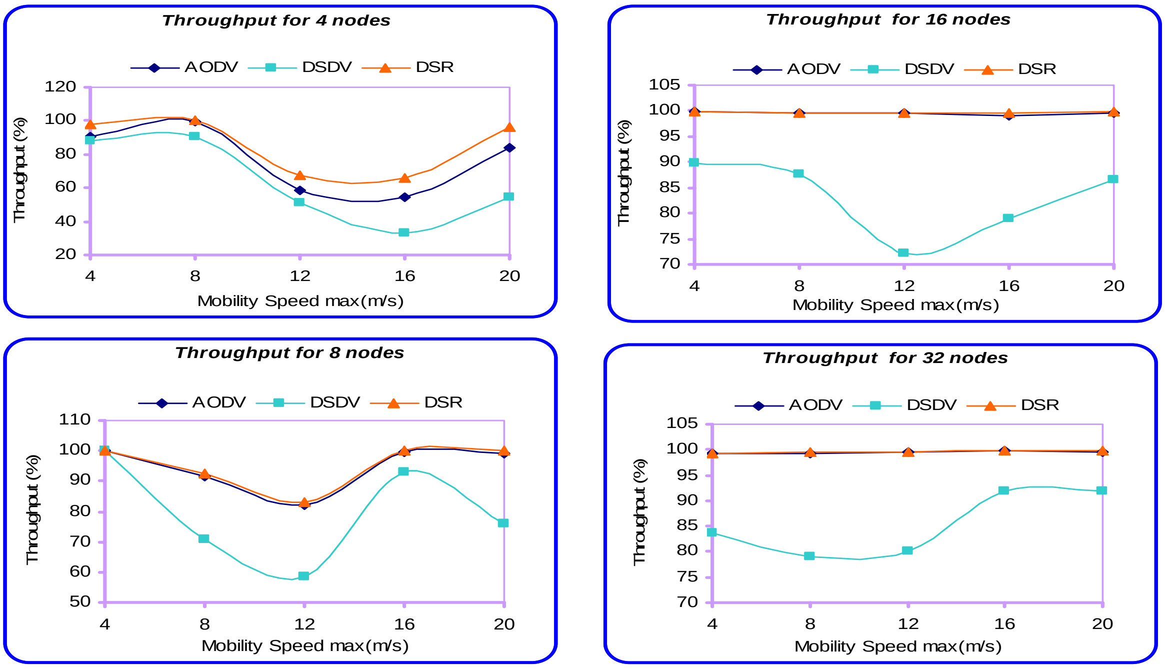

Fig. 1. UDP Throughput for various nodes with various node movement speeds

But DSR and AODV are reactive routing protocols. They force the nodes to maintain routing information as "on demand" basis. So throughput of AODV and DSR are greater than DSDV. In the network scenarios of 4 and 8 nodes DSR and AODV fails to converge their performance due to limited routing traffic. As the number of nodes increases, more routing traffic generates. So DSR and AODV performs almost 100% throughput in the network of 16 and 32 nodes even with high mobility.

Average End-to-End Delay Performance

In figure 2 DSDV shows the lowest end to end delay for UDP transmission than AODV and DSR. Because in order to discover routs DSDV takes routing information from its stale routing table that is build by periodic broadcasting. But AODV and DSR take more time to complete their route discovery processes for their on demand characteristic.

In DSR only the source takes the responsibility to store the route information in the packet header. So when a link breaks the source must need to know about the link breakage information and another new route. But in AODV not only the source but also the neighbor nodes can transmit packet through new routes after route maintenance. This is the cause of high end to end delay of DSR than that of AODV.

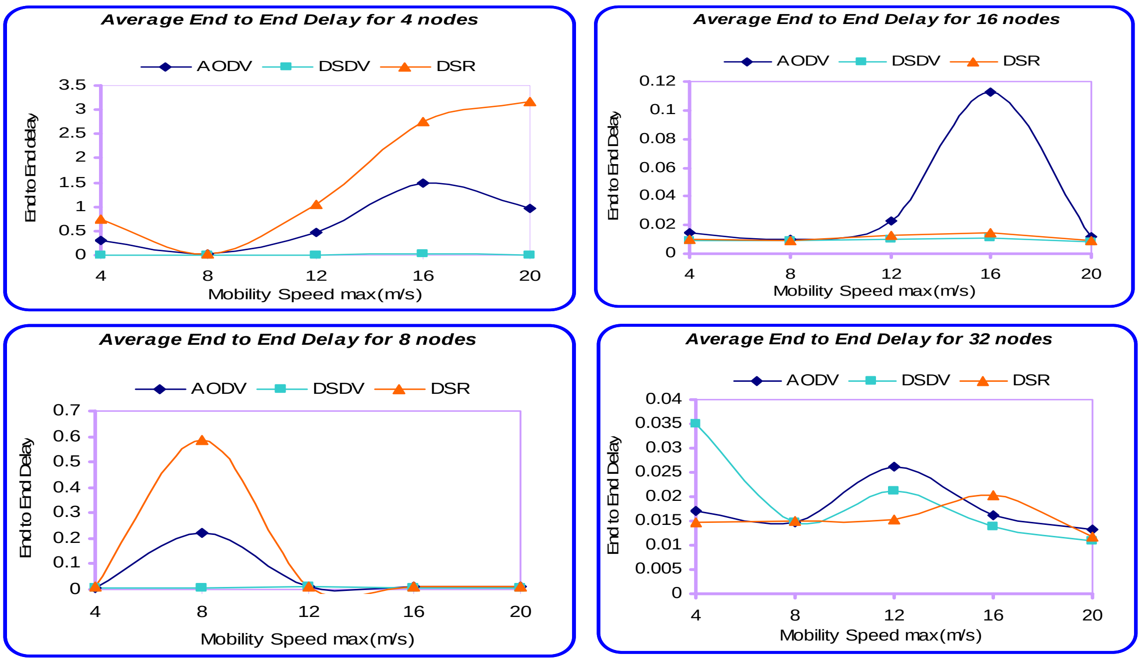

Fig. 2. UDP average End to End Delay various nodes with various node movement speeds

Additional Measurements: From figure 3 we have seen an important thing that every protocols throughput increased with the number of nodes increased as the topology is dense and the connectivity is rich.

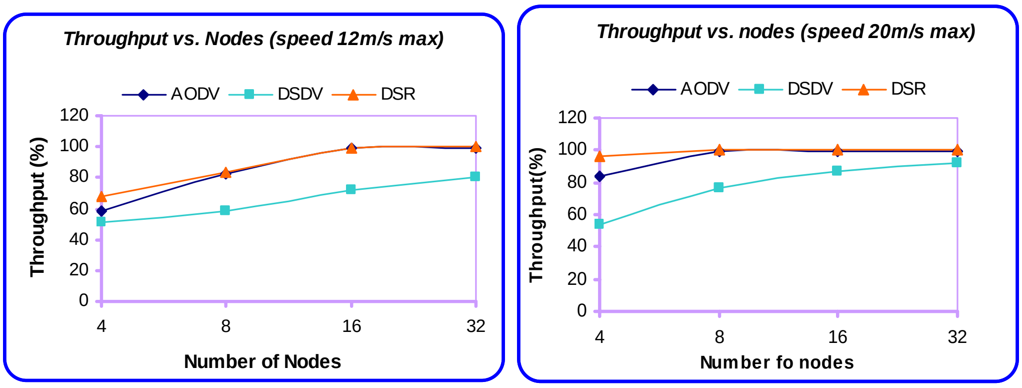

Fig. 3. Throughputs in speeds 12m/s and 20m/s with respect to the number of nodes

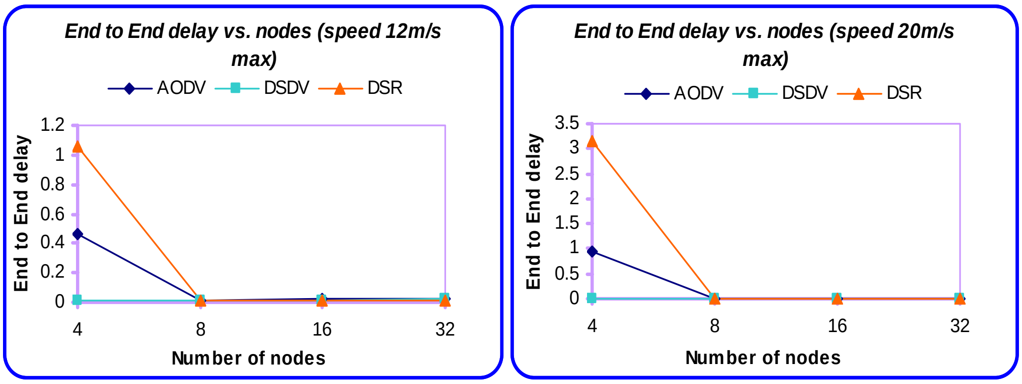

Fig. 4. End to end delay in speeds 12m/s and 20m/s with respect to the number of nodes

Moreover, when the number of node is small such as 4 then the end to end delay of DSR and AODV are high but after increasing the nodes such as 8, 16 and 32 the end to delay almost zero. They can reestablish connections quickly at the time of link breakage due to neighbor nodes availability, as the number of nodes increases network is going to be denser.

CONCLUSION & FUTURE WORK

In this paper, we have investigated the performance of UDP over DSDV, DSR and AODV protocols using simulation in ns-2 for a range of node mobility. The performance metrics that we considered includes throughput, end-to-end packet delay.

We observed from the results of simulations for four network scenarios of 4, 8, 16 and 32 nodes that UDP performance (throughput) increases with the node number increases. The UDP throughput is largest over the DSR routing protocol. For AODV the throughput is almost same but DSDV degrades the performance for the largest routing overload.

We also observed that DSDV shows the lowest end-to-end packet delay for UDP transmission than AODV and DSR because for its table-driven characteristics.

UDP is a fast transport layer protocol compared to TCP. When it is used over DSDV then it become more faster, as we see DSDV is quicker than DSR and AODV. But the UDP source is able to deliver fewer packets. On the other hand, DSR is slower than DSDV, but its end to end delay performance is tolerable. Moreover, Source will able to deliver more packets successfully to the destination using DSR protocol, which fulfill our requirements. Thus accordingly to our observation, DSR is best suited for MANET when considering UDP as a transport layer protocol.

Because ad-hoc networks are formed without centralized control, security must be handled in a distributed fashion. Moreover, routing protocols are prime targets for impersonation attacks. Next, we plan to consider the security features of routing protocols for ad hoc networks.

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