Performance of QoS Parameter in Wireless Ad hoc Network (IEEE 802.11b)

Kumar Manoj, Parmanand, S. C. Sharma & S.P. Singh

***Abstract*— A wireless Ad-hoc network consists of wireless nodes communicating without the need for a centralized administration, in which all nodes potentially contribute to the routing process. A user can move anytime in an ad hoc scenario and, as a result, such a network needs to have routing protocols which can adopt dynamically changing topology. To accomplish this, a number of ad hoc routing protocols have been proposed and implemented, which include Dynamic Source Routing (DSR), Destination Sequenced Distance Vector (DSDV) and ad hoc on-demand distance vector (AODV) routing. In this paper, we analyze the performance differentials to compare the above-mentioned commonly used ad hoc network routing protocols. We report the simulation results of three different protocols for wireless ad hoc networks having thirty nodes. The performances of proposed networks are evaluated in terms of number of retransmission attempts, Control traffic sent, Control traffic received, Data Traffic sent, Data Traffic received and throughput with the help of OPNET simulator. Data rate 2Mbps and simulation time 20 minutes were taken. For this above simulation environment, AODV shows better performance over the other two on-demand protocols, that is, DSR and DSDV.**

***Index Terms*— aodv, dsr, dsdv, OPNET, MANET**

I. Introduction

A wireless Ad-hoc network consists of wireless nodes communicating without the need for a centralized administration. A collection of autonomous nodes or terminals that communicate with each other by forming a multihop radio network and maintaining connectivity in a decentralized manner is called an ad hoc network. There is no static infrastructure for the network, such as a server or a base station. The idea of such networking is to support robust and efficient operation in mobile wireless networks by incorporating routing functionality into mobile nodes. Fig. 1 shows an example of an ad hoc network, where there are numerous combinations of transmission areas for different nodes. From the source node to the destination node, there can be different paths of connection at a given point of time. But each node usually has a limited area of transmission as shown in Fig. 1 by the oval circle around each node. A source can only transmit data to node B but B can transmit data either to C or D. It is a challenging task to choose a really good route to establish the connection between a source and a destination so that they can roam around and transmit robust communication. There are three major ad hoc routing protocols DSDV, DSR, and AODV, all these protocols are constantly being improved by IETF [5]. As a result, a comprehensive performance evaluation is of ad hoc routing protocols essential. We evaluated all available metrics and then performed a comparative performance evaluation. Since these protocols have different characteristics, the comparison of all performance differentials is not always possible. The comparative studies of the simulation results for these parameters for different protocols have been reported.

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(i) Traffic received and sent,
(ii) Total route requests sent,
(iii) Control traffic received and sent,
(iv) Data traffic received and sent,
(v) Retransmission attempts,
(vi) Throughput,

To the best of our knowledge, very few papers have been published. In section 2, we review the mostly used wireless ad hoc protocols. In Section 3, we present the performance metrics of our simulation. Section 4 described the simulation environment, Section 5 performance comparison of the protocols. We draw our conclusions in Section 6.

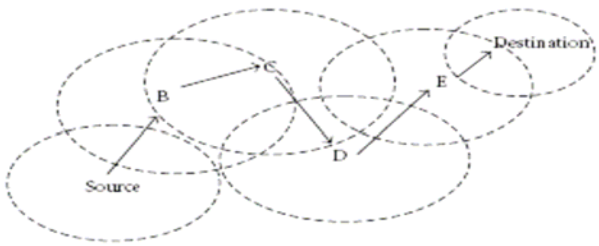

Fig. 1. Ad hoc networking model.

II. Ad Hoc Routing Protocols

A. DSDV

Destination Sequenced Distance Vector (DSDV) [1] is a Proactive routing protocol that solves the major problem associated with the Distance Vector routing of wired. The DSDV protocol requires each mobile station to advertise, to each of its current neighbours, its own routing table (for instance, by broadcasting its entries). The entries in this list may change fairly dynamically over time, so the

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advertisement must be made often enough to ensure that every mobile computer can almost always locate every other mobile computer. In addition, each mobile computer agrees to relay data packets to other computers upon request. At all instants, the DSDV protocol guarantees loop-free paths to each destination.

B. DSR

Dynamic Source Routing (DSR) [2] is a reactive protocol i.e. it doesn't use periodic advertisements. It computes the routes when necessary and then maintains them. Source routing is a routing technique in which the sender of a packet determines the complete sequence of nodes through which the packet has to pass; the sender explicitly lists this route in the packet's header, identifying each forwarding "hop" by the address of the next node to which to transmit the packet on its way to the destination host. There are two significant stages in working of DSR: Route Discovery and Route Maintenance. A host initiating a route discovery broadcasts a route request packet which may be received by those hosts within wireless transmission range of it. The route request packet identifies the host, referred to as the target of the route discovery, for which the route is requested. If the route discovery is successful the initiating host receives a route reply packet listing a sequence of network hops through which it may reach the target. In addition to the address of the original initiator of the request and the target of the request, each route request packet contains a route record, in which is accumulated a record of the sequence of hops taken by the route request packet as it is propagated through the network during this route discovery. DSR uses no periodic routing advertisement messages, thereby reducing network bandwidth overhead, particularly during periods when little or no significant host movement is taking place. DSR has a unique advantage by virtue of source routing. As the route is part of the packet itself, routing loops, either short-lived or long-lived, cannot be formed as they can be immediately detected and eliminated.

C. AODV

AODV offers low network utilization and uses destination sequence number to ensure loop freedom. It is a reactive protocol implying that it requests a route when needed and it does not maintain routes for those nodes that do not actively participate in a communication. An important feature of AODV is that it uses a destination sequence number, which corresponds to a destination node that was requested by a routing sender node. The destination itself provides the number along with the route it has to take to reach from the request sender node up to the destination. If there are multiple routes from a request sender to a destination, the sender takes the route with a higher sequence number. This ensures that the ad hoc network protocol remains loop-free.

III. Performance Metrics

We evaluated key performance metrics for three different applications using DSR, AODV, and AODV protocols. The parameters used for wireless LAN application performance evaluation include: control traffic received and sent, data traffic received and sent, throughput, and retransmission attempts. We used the following parameters for evaluating the effect of variation on different protocols: routing traffic received and sent, total traffic received and sent, and ULP traffic received and sent, throughput.

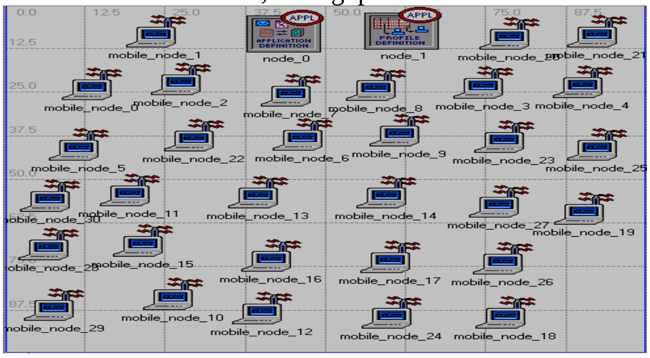

Fig. 2. A proposed model of ad hoc network.

IV. Simulation

Our protocol evaluations are based on the simulation using OPNET simulator. The scale up network model consists of thirty nodes distributed randomly in a space of 250m X 250m. The channel speed of the wireless LAN is also set to 2Mbps. The simulation parameters have been reported in Table 1. Fig. 2 is a snapshot of the proposed network model considers for simulation. In order to enable direct, fair comparisons between the protocols, it was critical to challenge the protocols with identical loads and environmental conditions. Each run of the simulator accepts as input a scenario file that describes the exact motion of each node and the exact sequence of packets originated by each node, together with the exact time at which each change in motion or packet origination is to occur. We pre-generated 35 different scenario files with varying movement patterns and traffic loads (FTP), and then ran all three routing protocols against each of these scenario files. Since each protocol was challenged in an identical fashion, we can directly compare the performance results of the three protocols. For all simulations, the same movement models were used, and the number of traffic sources was fixed at 30. Fig. 2 shows a model of nodes used to simulate different ad hoc network protocols.

V. Performance Comparison of the Protocols

Fig. 3 shows the control traffic received in bits/s for DSR, AODV, and DSDV protocols for a wireless LAN application. It shows that the AODV protocol performs better than the other two. Although DSDV does not perform well at the beginning, later it does well. DSR's performance remains average during the entire evaluation time. Fig. 4 shows the control traffic sent in bits/sec. It is obvious that AODV performs better than DSDV and DSR. Although DSR and DSDV have shown an average performance throughout the entire simulation, they show better performance compared to AODV at the end. AODV uses a fast router-finder algorithm, which is critical for AODV's better performance. Both DSR and DSDV have to go through route creation using RREQ and RREP messages. Once the routes are created, DSR and DSDV tend to do better than AODV. As a result, we observe from Figs. 3 and 4 that, near the end of simulation time, both DSDV and DSR show better performance than AODV Figs.

5 and 6 shows the data traffic received and data traffic sent in packets/sec, respectively, for DSR, DSDV, and AODV protocols. From Fig. 5, it is evident that, at the beginning of the simulation AODV appears to dominate over DSDV and DSR, but at the most of the simulation time, DSDV yields the best result. DSR shows poor performance and the traffic remains always at the lower level, whereas DSDV performs well most of the time. In Fig. 6, we observe that AODV performs well during most of the simulation time. DSDV shows consistent performance and peaks at the end of the simulation. DSR does not show any positive traffic except for the last few seconds of the simulation. Fig. 7 shows the throughput in bits/sec for DSR, AODV, and DSDV protocols, where DSDV shows significantly better performance than the other two, and AODV performs slightly better than DSR. Fig. 8 shows the retransmission attempts in packets/sec as a function of time for wireless LAN involving different protocols. It is evident from Fig. 8 that AODV requires a lot of retransmission attempts before it can successfully transmit data due to the fact that only AODV uses UPD packet. When a node first gets a QRY message for a destination, if it does not have a route for the requested destination, it broadcasts a UPD message and increases the height of the node. In this way, it tries to transmit the UPD message until it gets the destination node. DSR and DSDV have almost the same logic to find a route and show almost similar performance near the end of the simulation time.

Table 1: Simulation Environment

Area	250 X 250
Physical Characteristics	DSSS
Packet Reception Power Threshold	5.33 E-14
Buffer Size	128000
Fragmentation Threshold	512
Data Rate	2 Mbps
No. of Nodes	30

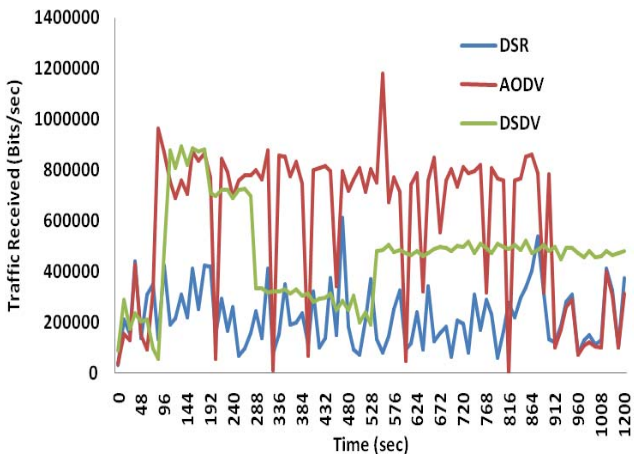

Fig. 3. Control traffic received for different protocols in wireless LAN.

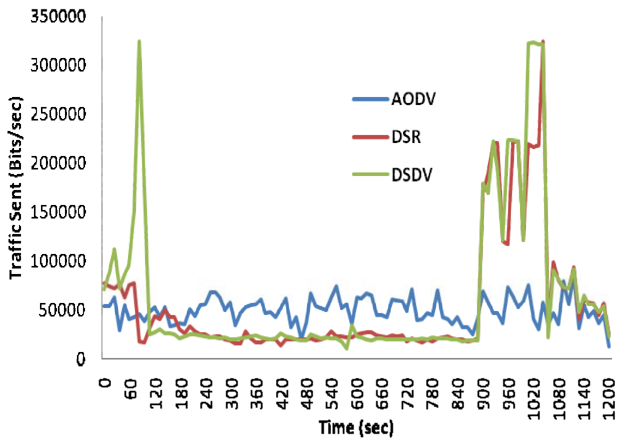

Fig. 4. Control traffic sent for different protocols in wireless LAN.

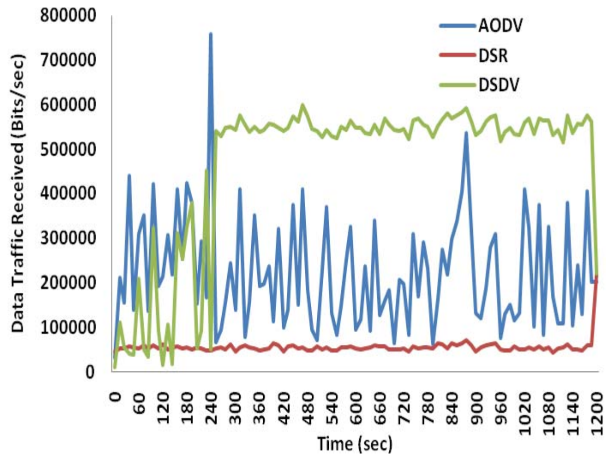

Fig. 5. Data traffic received for different protocols in wireless LAN.

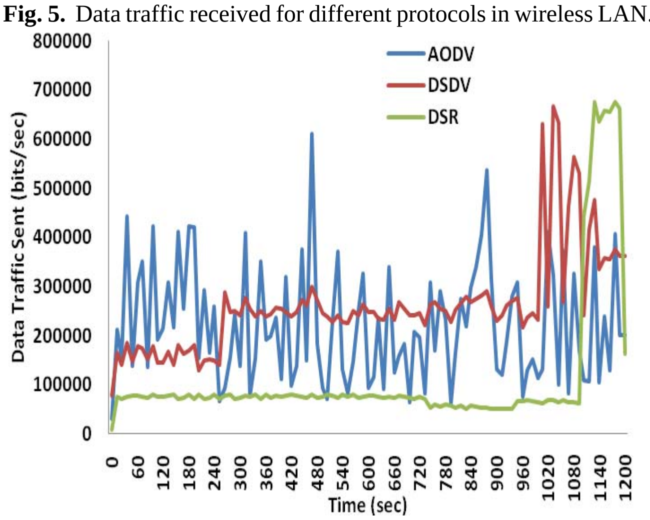

Fig. 6. Data traffic sent for different protocols in wireless LAN.

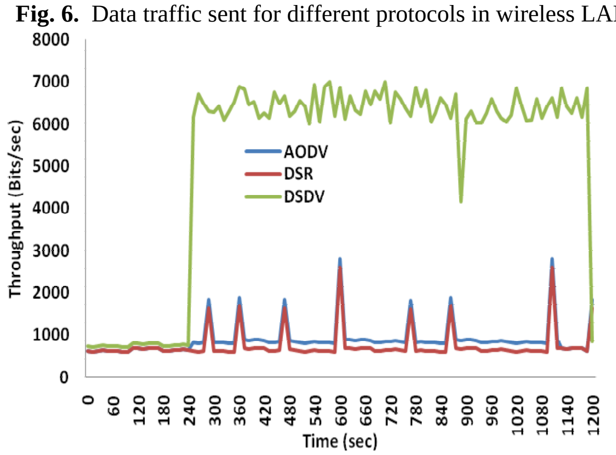

Fig. 7. Throughput of different protocols in wireless LAN.

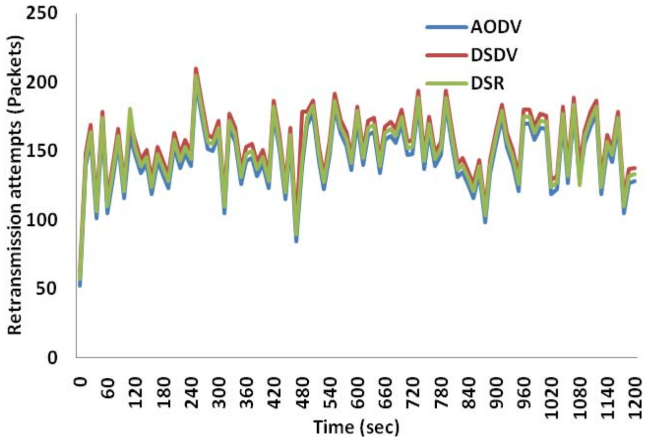

Fig. 8. Retransmission attempts for different protocols in wireless LAN.

VI. CONCLUSION

In this paper, OPNET Simulator has been used, we evaluated the performance of widely used ad hoc network routing protocols. The simulation characteristics used in this research, that is, the control traffic received and sent, data traffic received, throughput, retransmission attempts, and traffic received, are unique in nature, and are very important for performance evaluation of any networking protocol. Performance evaluation results for some ad hoc network protocols were previously reported [4,5], which primarily covered the impact of the fraction of packets delivered, end-to-end delay, routing load, successful packet delivery, and control packets overhead. In this paper, we perform a thorough analysis that includes additional parameters. For comparative performance analysis, we first simulated each protocol for ad hoc networks with 30 nodes. In case of wireless LAN, AODV shows good performance for the control traffic received, control traffic sent, and data traffic sent. However, DSDV shows better performance for data traffic received and throughput. DSR and DSDV show poor performance as compared to AODV for the control traffic sent and throughput. However, AODV and DSDV show an average level of performance for the data traffic received and data traffic sent, respectively.

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