COMPARATIVE ANALYSIS AND STUDY OF DIFFERENT QOS PARAMETERS OF WIRELESS AD-HOC NETWORK

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ABSTRACT

A wireless Ad-hoc network is a collection of two or more wireless nodes equipped with wireless communications and networking capability. They communicate with each other without the need of centralized administration, in which all nodes potentially contribute to routing process. In Ad-hoc scenario, any node can move anytime so these types of networks need to have routing protocol with dynamically changing topology. To accomplish this, many protocols have been proposed and developed; these are ad-hoc on-demand distance vector (AODV) routing, Dynamic Source Routing (DSR) and Destination Sequenced Distance Vector (DSDV). In this work, we evaluate the performance of proposed Ad-hoc network model in terms of Control traffic received, Control traffic sent, Data traffic received, Data traffic sent, Throughput and number of retransmission attempts to compare above-mentioned commonly used routing protocols. We analyze the simulation results of three different protocols for wireless ad-hoc networks having thirty nodes. For simulation, we use OPNET (Optimized Network Engineering Tool) simulator, which is a discrete event, object-oriented and general purpose network simulator. In our simulation environment, ad-hoc on-demand distance vector (AODV) routing protocol perform better than other two protocols; Dynamic Source Routing (DSR) and Destination Sequenced Distance Vector (DSDV).

KEYWORDS: *AODV, DSR, DSDV, MANET, OPNET.*

1. INTRODUCTION

A wireless Ad-hoc network is a collection of two or more wireless nodes equipped with wireless communications and networking capability. They communicate with each other without the need of centralized administration. A wireless ad-hoc network is the collection of autonomous nodes that communicate in multihop manner to maintain connectivity [1].

This type of network does not contain any type of server or base station. The characteristics of ad-hoc networks are: Mobility, Multihopping, Self-organization, Energy conservation, Scalability and Security. An example of ad-hoc network is shown in fig. 1 and also the transmission area of each node that is denoted by oval circle around each node. Source A can transmit the data only to the node B but the node B can transmit the data either to node c or node D. Source C can transmit the data either to node D or node E. So choosing a really good route for the establishment of connection between source and destination is a very challenging task so that they can move around and transmit uninterruptable communication. The major routing protocols for ad-hoc network are: AODV, DSR and DSDV. The simulation is carried out for evaluating the performance of different protocols on the basis of different performance parameters and these parameters are:

- Traffic received and sent
- Total route requests sent
- Control traffic received and sent
- Data traffic received and sent
- Retransmission attempts
- Throughput

In section-2, we discuss and review the mostly used wireless ad-hoc protocols. The performance metrics of our simulation is presented In Section-3. Section-4 describes our simulation environment and Section-5 gives the performance comparison of the protocols. Conclusion is discussed in Section-6.

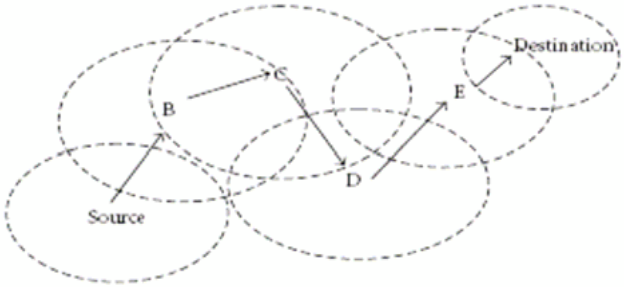

Figure 1: Ad-hoc networking model

2. AD-HOC ROUTING PROTOCOLS

DSR: Dynamic Source Routing (DSR) is a reactive protocol [2]. In this the routes are computed when required and after that they are maintained. It does not advertise periodically. In this routing technique, the source node determines the complete path (sequence of nodes) of packet, through which the packet has to pass and the source node clearly mentions this route in header of packet. Dynamic Source Routing protocol is based on the concept of source routing and it includes two operational components: Route Discovery & Route Maintenance.
This protocol also includes 3 types of route control messages:

- RREQ(Route Request)
- RREP(Route Reply)
- RERR(Route Error)

In MANET, when a node wants to send a packet but it does not have a route to destination in its route memory(cache) then it broadcast a RREQ packet to initiates route discovery process. This RREQ packet contains source node address, unique sequence no., empty route record and destination node address. When each intermediate node receives the route request first time, it checks own route cache. If it doesn't have any route to destination, then it will add own address to route record and rebroadcast RREQ packet. If it have route, then it reply back a RREP packet to source node. This reply has complete record of route from source to destination. If route request is received by destination node, then it will send RREP packet back to source and also copy route record present in route request. The discovered routes are not longer valid over the time because of node movement. The route error packets are sent to accomplish the route maintenance mechanism. In the situation of link broken, the node sends back a route error packet, when it detects link failure, to source node. When a route error message is received by each node then they removes all broken link's route from its cache. In Dynamic Source Routing, each transmitting node is responsible for confirming that packet have been received by next hop (along source route).
AODV: Ad-hoc on-demand distance vector (AODV) is a reactive protocol [3]. It also offers low network utilization. When needed, it requests a route & does not maintain routes for the nodes which do not actively participate in communication. It also uses a destination sequence number and this destination sequence number corresponds to a receiver (destination) node which was requested by a routing source node. In case of multiple routes from request source to destination, the source takes the route having highest sequence number. The destination sequence number is used to make AODV routing protocol loop free. The messages used by the nodes to communicate with each other, in AODV are: Route Request (RREQ), Route Reply (RREP), Route Error (RERR) and HELLO. Where the RREQ and RREP are used for discovery of route and remaining two are used for route maintenance. Das[4] has also proposed performance comparison of two on-demand routing protocols (DSR & AODV) for ad-hoc networks.

DSDV: Destination Sequenced Distance Vector (DSDV) is basically a Proactive routing protocol [5]. This type of protocol maintains routing information about each node in network. It solves the major problem associated with the Distance Vector routing of wired. In this protocol, each mobile station has to broadcast the entries of its routing table to each of its current neighbours. The entries in the list are updated throughout the network periodically or when the topology changes. Each node has to store their routing information. In wireless ad-hoc networks, to each destination, DSDV protocol guarantees loop-free paths.

3. PERFORMANCE METRICS

The performance metrics evaluated for three different applications using AODV, DSR and DSDV protocols. In the evaluation of wireless LAN performance, the parameters used are: control traffic received, control traffic sent, data traffic received, data traffic sent, throughput and number of retransmission attempts. The parameters used for evaluating the effect of variation[10] on different protocols are: Total traffic received, Total traffic sent, Routing traffic received, Routing traffic sent, ULP traffic received, ULP traffic sent and throughput.

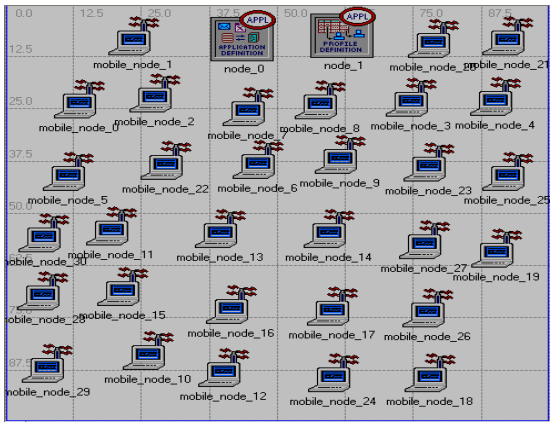

Figure 2: A proposed model of ad-hoc network

4. SIMULATION

We have use OPNET simulator [8], for simulation purpose. Our proposed network model consists of thirty nodes that are distributed randomly in area of 250m x 250m. The Data rate is set to 2Mbps. The snapshot of proposed network model used for simulation is shown in fig. 2. For enabling direct comparisons among the protocols, it was very critical to challenge these protocols with identical environmental conditions and loads. Each simulator's run accepts as input a scenario file which describes the exact packets sequence originated by each node and exact motion of each node. There are 35 different scenario files, that was pre-generated with varying traffic loads and movement patterns and then run all routing protocol against each scenario files. The performance results of these protocols can be directly compared because each protocol was challenged in identical fashion. For all simulations, the no. of traffic source was fixed to thirty & same movement models were used.

5. PERFORMANCE COMPARISON OF THE PROTOCOLS

The control traffic received for each protocol for a wireless application is shown in fig. 3. Figure shows that the performance of AODV protocol is better than DSR and DSDV routing protocol. During entire evaluation time DSR protocol performs average. The performance of DSDV protocol is not well at beginning but later it performs well. The control traffic sent (bits/sec) is shown in fig. 4. We can say that AODV performs better than other two. These both protocols give average performance throughout entire simulation but at the end they show better performance than AODV. In both DSDV and DSR, the routes are created by using RREQ and RREP massages. The thing responsible for AODV's better performance is its faster router-finding algorithm. After routes creation

both DSR & DSDV tends to perform better than AODV. As the result, near the ending of simulation, both DSR & DSDV perform better than AODV. The data traffic received and data traffic sent are shown in fig.5 & fig.6 respectively, for each protocol. Fig.5 shows, at most of the simulation time the performance of DSDV is better than other two. The performance of DSR protocol is poor; as a result the level of traffic is always low. Fig.6 shows that DSDV performs consistently and gives peak at ending of simulation and the performance of AODV is acceptable during most of the simulation time. DSR does not perform well except near the ending of simulation time. Throughput and no. of retransmission attempts are shown in fig.7 and fig.8 respectively. In case of throughput, AODV performs better than both DSR and DSDV protocols.

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
Simulation Time	20 Minutes

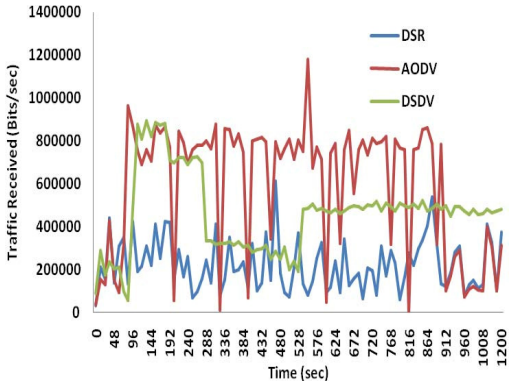

Figure 3: Control traffic received for different protocols in wireless LAN

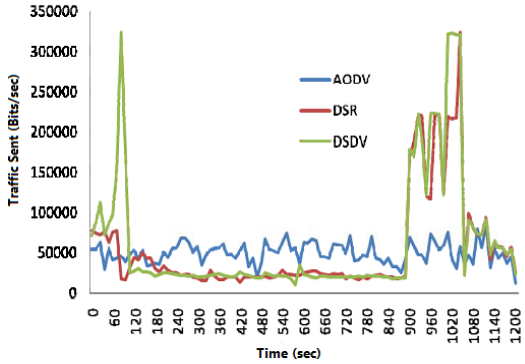

Figure 4: Control traffic sent for different protocols in wireless LAN

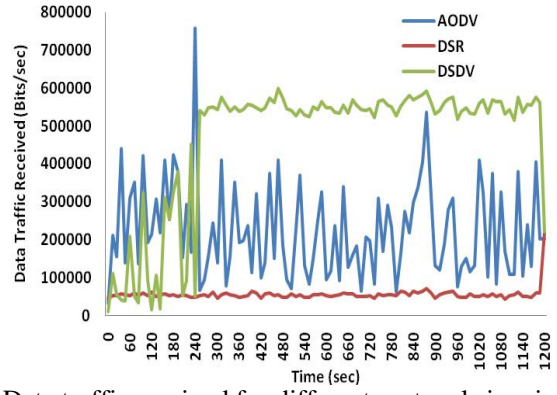

Figure 5: Data traffic received for different protocols in wireless LAN

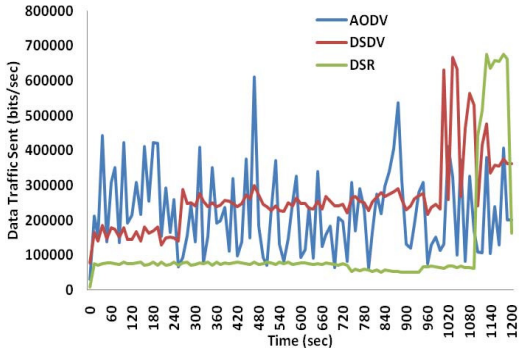

Figure 6: Data traffic sent for different protocols in wireless LAN

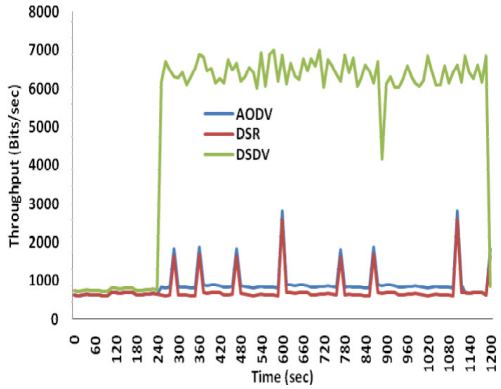

Figure 7: Throughput of different protocols in wireless LAN

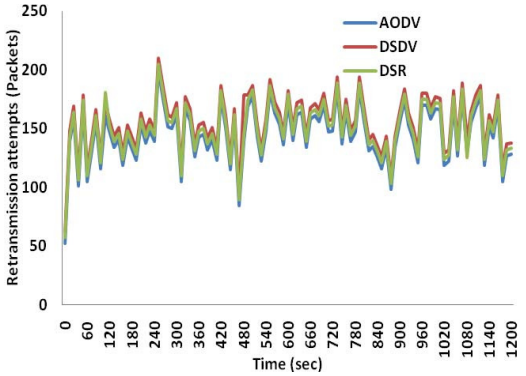

Figure 8: Retransmission attempts for different protocols in wireless LAN

6. CONCLUSION

In this work, the performance of mostly used ad-hoc network routing protocols have been evaluated by using OPNET simulator. Simulation parameters used in this work are very important for evaluating the performance of any networking protocol and also have unique nature; these are throughput, number of retransmission attempts, control traffic received, control traffic sent, data traffic received and data traffic sent. For comparative analysis of each protocol, we have taken an ad-hoc network having 30 nodes and then we simulated each protocol for that network. For wireless LAN, DSDV performs better for throughput & data traffic received and AODV performs well for data traffic sent, control traffic received and control traffic sent. For throughput and control traffic sent, AODV performs better than both DSR and DSDV protocols. However, DSDV and AODV perform average for data traffic sent and data traffic received, respectively.

7. ACKNOWLEDGEMENT

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REFERENCES

[1] Ramanathan, R., Redi, J., "A brief overview of ad hoc networks: challenges and directions," Communications Magazine, IEEE, vol.40, no.5, pp.20-22, May 2002.
[2] David B. Johnson, David A. Maltz, and Yih-Chun Hu, The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR), <draft-ietf-manet-dsr-10.txt> Internet-draft,19 July 2004.
[3] C. Perkins and S. Das, "Ad-hoc on-demand distance vector (AODV) routing," Network Working Group, RFC: 3561, July2003, http://rfc3561.x42.com.
[4] DAS, S.R., PERKINS, C.E., ROYER, E.M., 'Performance comparison of two on-demand routing protocols for ad-hoc networks', Proc. IEEE Conf. on Computer Communications (INFOCOM), March 2000, Tel Aviv, Israel, pp. 3-12.
[5] Charles E. Perkins and Pravin Bhagwat, Highly dynamic Destination-Sequenced Distance-Vector routing (DSDV) for mobile computers, Proc. of the SIGCOMM '94 Conference on Communications Architectures, Protocols and Applications, pages 234–244, August 1994.
[6] S. R. Das, R. Castaneda, J. Yan and R. Sengupta, "Comparative performance evaluation of routing protocols for mobile, ad-hoc networks," in Proceedings of 7th International Conference on Computer Communications and Networks (IC3N '98), pp. 153–161, Lafayette, La, USA, October 1998.
[7] E. Celebi, "Performance evaluation of wireless multi-hop ad-hoc network routing protocols", http~ ecelebi/esim.pdf.
[8] OPNET Technologies. Retrieved February 10, 2011, from www.opnet.com.
[9] J. Broch, D.A. Maltz, D.B. Johnson, Y.C. Hu, and J. Jetcheva, A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols, Proc. of the ACM/IEEE International Conference on Mobile Computing and Networking (MobiCom), October 1998.
[10] S. Corson, and J. Macker, Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations, RFC 2501, January 1999.

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