Performance of QoS Parameters in MANET Application Traffics in Large Scale Scenarios

Vahid Ayatollahi Tafti, Abolfazl Gandomi

***Abstract*—**A mobile Ad-hoc network consists of wireless nodes communicating without the need for a centralized administration. 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 DSR, OLSR and AODV. This paper presents a study on the QoS parameters for MANET application traffics in large-scale scenarios with 50 and 120 nodes. The application traffics analyzed in this study is File Transfer Protocol (FTP). In large scale networks (120 nodes) OLSR shows better performance and in smaller scale networks (50 nodes)AODV shows less packet drop rate and OLSR shows better throughput.

***Keywords*—**aodv, dsr, manet , olsr , qos.

I. Introduction

MOBILE ad hoc networks (MANETs) are made up of mobile devices that use wireless transmission for communication. They can be set up anywhere and at any time because they require neither infrastructure nor central administration. As in a wired network, application flows in a MANET have different characteristics (e.g. type and volume of information exchanged, lifetime of the interaction, packet interarrival time, with or without burst) and also different Quality of Service (QoS) requirements (e.g. delay, throughput, high priority processing). Hence, a uniform packet processing is not adequate and a QoS support taking into account various QoS requirements is needed[1][2]. The overall routing protocol types responsible for transmission of packets between different mobile hosts in ad-hoc network falls into three broad categories (as in Fig.1)

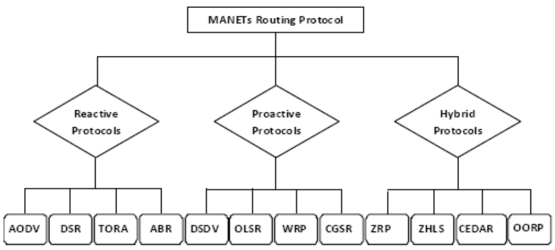

Figure 1. MANET Routing Categories and Protocols

Fig.1 MANET Routing Categories and Protocols

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[3] paper evaluated QoS with MANET routing protocols. The paper focused on three main protocols AODV, OLSR and TORA. Their work focused on routing performance with lower network congestion and with fixed number of nodes. They argued that OLSR is the most favourite proactive protocol and AODV is the most effective on-demand protocol within their environment.[4],[5] also looked into analysing performance of MANET routing protocols. Their study involved comparison of OLSR, DSR and AODV with self similar traffic like CBR, Pareto, and Exponential. They argued that DSR performance was better for packet delivery ratio and OLSR performance degraded in situations where high mobility and network load exist. On the other hand, it was argued that AODV provides the most average performance amongst all.

The research is carried out using software known as OPNET Modeler version 14. It is one of the most widely used commercial simulators based on Microsoft Windows platform and incorporates more MANET routing parameter as compared to other commercial simulator available. It not only supports MANET routing but also provides a parallel kernel to support the increase in stability and mobility in the network. The simulation focussed on the performance of routing protocols. The nodes were randomly placed within certain gap from each other in 1000 x 1000 m environment for 50 and 120 nodes. File Transfer Protocol (FTP) was generated in the network i.e. user defined via Application and Profile Configuration. Every scenario in the network was configured to execute AODV, DSR and OLSR. The simulation time was set to 300s.

II. Ad Hoc Routing Protocols

A. DSR(Dynamic Source Routing)

DSR [6] 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.

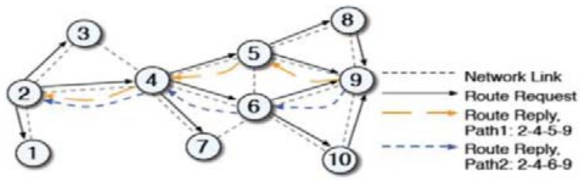

Fig. 2 DSR routing protocol[7]

B. AODV(Ad Hoc On-demand Distance-Vector Protocol)

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[8].

C. Optimized Link State Routing Protocol (OLSR)

This protocol works in collaboration with other nodes through the exchange of topology information. This exchange of information is done periodically. To avoid the broadcast of unnecessary packet re-transmissions, this protocol uses multipoint relays. In a network, a node broadcasts a message periodically to its neighboring nodes. This is done to compute the multipoint relay set as well as the exchange of information about the neighborhoods. From the information about the neighborhood this node calculates the minimum set of one hop relay point that is needed to reach the two hop neighbors and this set is called the Multipoint relay set. OLSR differs from link state protocols in two factors based on the dissemination of routing information. First is by construction i.e. only the multipoint relay nodes of a node A need to forward updates about link state that are issued by A. Secondly the size of the link state update of a node A is reduced because it only consists of those neighbors that selected node A as their multipoint relay node. Thus we can conclude that OLSR reduces the Link state protocol. It is used in a network where nodes are densely deployed; the OLSR calculates the shortest path in such networks to an arbitrary destination [9].

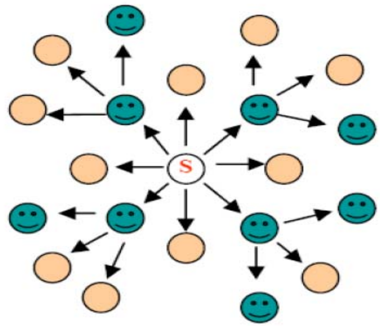

Fig. 3 The MPR flooding mechanism[10]

III. Performance Metrics

We evaluated key performance metrics for three different applications using DSR, AODV, and OLSR protocols. We used the following parameters for evaluating the effect of variation on different protocols: delay, packet drop and throughput.

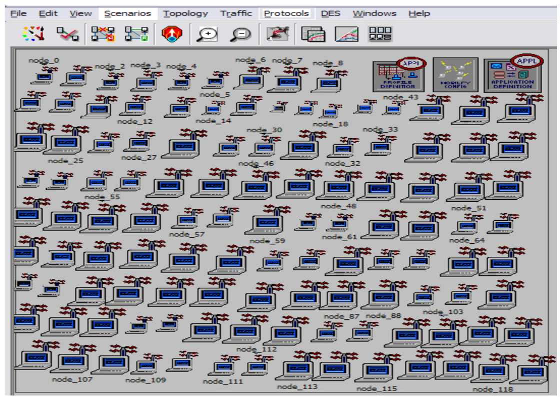

Fig. 4. A proposed model of MANET

The network designed consists of basic network entities with the simulation parameters presented in table 1.

TABLE I
PARAMETERS OF SIMULATION

Simulation time	300 s
Simulation area	1000*1000 m
Number of nodes	50 ,120
Application traffic	FTP server
File size	5000000 bytes
Data rate(bps)	11 mbps
Mobility algorithm	Random waypoint
Routing protocols	Aodv, Olsr,Dsr
Performance parameter	Throughput,delay,Drop

IV SIMULATION AND DISCUSSION

Our protocol evaluations are based on the simulation using OPNET simulator[11]. The scale up network model consists of 50 , 120 nodes distributed randomly in a space of 1000m X 1000m.

A Throughput

Fig. 4,5 show the throughput for each protocol. AODV and OLSR experienced higher throughput compared to DSR and it shows that the OLSR protocol performs better than the other two.For 50 nodes network, throughput of OLSR is about 7,000,000 bits/sec , in AODV is about 5,500,000 bits/sec and in DSR protocol is about 3,000,000 bits/sec. For 120 nodes network, throughput of OLSR is about 20,000,000 bits/sec , in AODV is about 10,000,000 bits/sec and in DSR protocol is about 2,500,000 bits/sec.

The reason could be that the OLSR maintains cluster of nodes in the topology by dividing them into different node sets. Dividing the sets into one hop and two hop neighbours makes OLSR more efficient in link process without having all nodes taking part in this. AODV performs better than DSR , With the increase in the number of traffic sources, problems of congestion and network degradation come more into effect. The protocols start to react differently due to these problems to the varying conditions and delay becomes an important factor in determining the network throughput. We observe that the performance of the AODV improves and is better than DSR. From the observations it is concluded that AODV performs better and had a higher throughput.

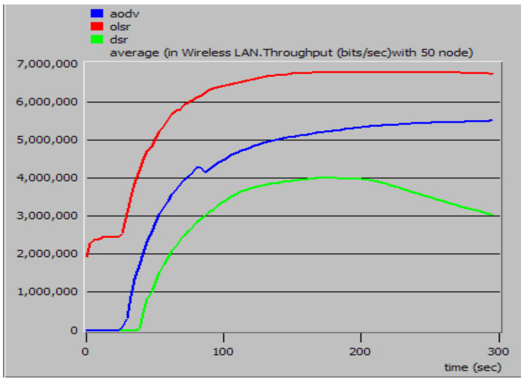

Fig. 4 throughput for 50 nodes

Figs. 6 and 7 show the end-to-end delay for each protocol. AODV and OLSR have lower delay compared to DSR and it shows that the DSR protocol has higher delay.

The end-to-end delay response of the DSR is more consistent and larger than AODV and OLSR with the growth of the network. The routing protocol DSR uses cached routes and more often, sending of traffic onto stale routes, causes retransmissions and leads to excessive delays. In networks with high traffic sources the increased number of cached routes worsens the delay.

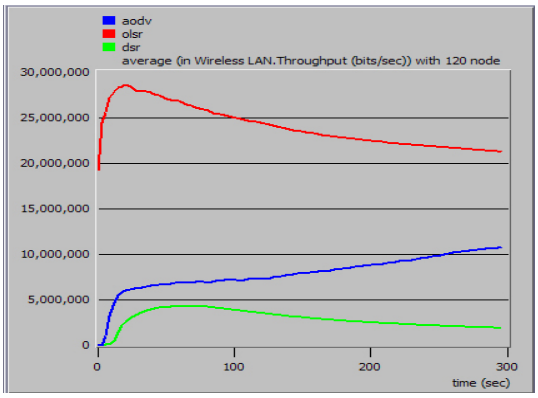

Fig.5 throughput for 120 nodes

B Delay

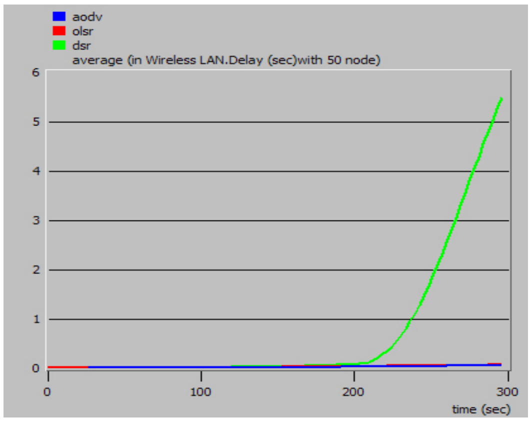

Fig.6 delay for 50 nodes

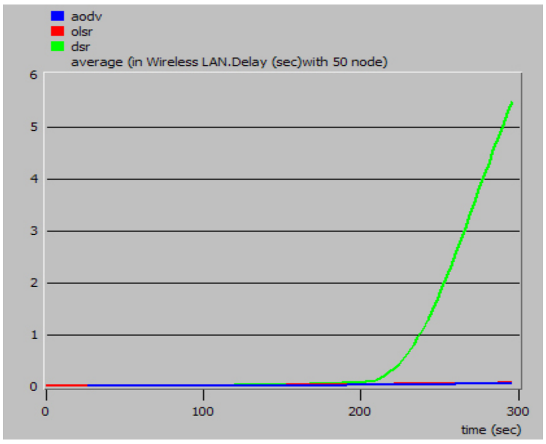

Fig.7 delay for 120 nodes

Figs. 6 and 7 show lower delay for AODV and OLSR. For AODV this is due to, frequent broadcasting of RREQ and route re-initialisation messages to find an optimal freshet path. In addition, the use of Destination Sequence Number for every RREQ increases the efficiency of the link without needing to execute the large routing table every time. Therefore, the response is quick. OLSR on other hand maintains one hop and two hop neighbours that makes OLSR more efficient in link update process without having all nodes taking part in this. In addition, maintaining “Neighbour Table” and keeping track of other nodes available via one and two hop neighbours leads to less end to end delay in OLSR.

C *Packet Drop*

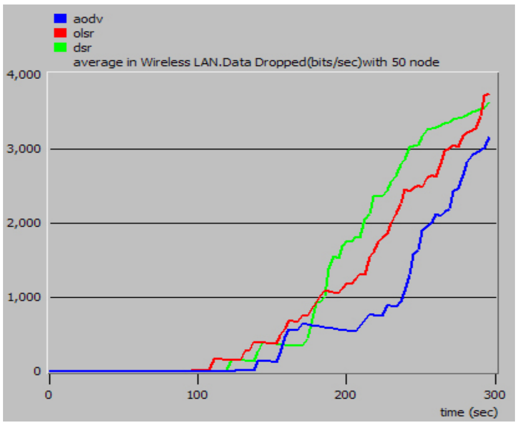

Fig. 8. packet drop rate for 50 nodes

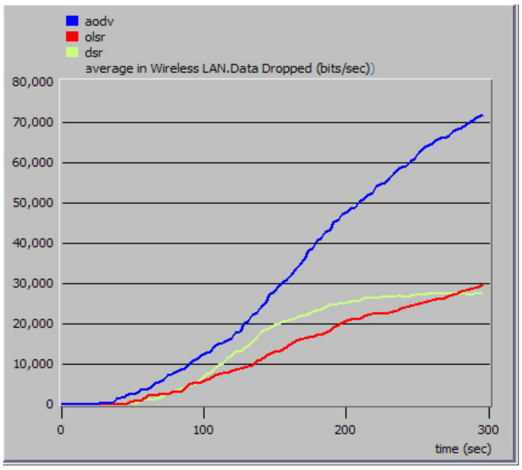

Fig. 9. packet drop rate for 120 nodes

Figs. 8 and 9 show the packet drop rate for each protocol. AODV has lower packet drop compared to DSR and OLSR for 50 nodes and OLSR and DSR have lower packet drop rate compared to AODV for 120 nodes.

The reason for 120 nodes could be that OLSR minimises the traversal of control messages by multipoint relays and reduces the end-to-end delay and packet drop rate compared to AODV.

V. Conclusion

In this paper, performance of AODV, OLSR and DSR was analysed using OPNET modeler 14. The protocols were tested using the same parameters with FTP traffic flow and random mobility. Performance of protocols with respect to scalability has also analysed with QoS parameters. Results showed that, with 50 nodes OLSR experienced higher throughput compared to AODV and DSR.This was due to maintaing cluster of nodes in the topology by dividing them into different node sets. Dividing the sets into one hop and two hop neighbours and AODV experienced lower drop rate compared to OLSR and DSR. End-to –End delay of DSR is very high, this was due to DSR algorithm that uses cached routes,sending of traffic onto stale routes, causes retransmissions and leads to excessive delays. With 120 nodes OLSR experienced higher throughput and lower delay compared to AODV and DSR because multipoint relays reduces the end-to-end delay and packet drop rate and increase throughput.Delay of DSR with 120 nodes is very high also, this was due to DSR algorithm that uses cached routes,sending of traffic onto stale routes, causes retransmissions and leads to excessive delays in large scale networks.

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