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Analysis QoS Parameters for Mobile Ad-Hoc Network Routing Protocols: Under Group Mobility Model

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Abstract. A Mobile Ad-Hoc Network (MANET) is a decentralized network of autonomous mobile nodes able to communicate with each other over wireless links. Routing protocols for mobile ad hoc networks has limitations such as frequent topology changes, limited battery power, bandwidth constraint, hidden and exposed node problem, high Bit Error Rate (BER) are major problems. Both proactive and reactive routing protocols prove to be inefficient in MANET. Protocol performance is compared with proactive and reactive protocols. We have used the NS-2 network simulator for simulating routing protocols using group mobility model, and present the results of simulations.

Keywords: Routing, Wireless, Mobile, DSDV, AODV, Group Mobility, Simulation.

1. Introduction

The world is under revolution in information and communication technology. Wireless communication has tremendous growth in the communication world. The Transmission Control Protocol (TCP) is one of the most widely used end-to-end transport layer protocol in the Internet today. The TCP ensure reliable data transfer over unreliable networks.

At present, traditional wired network are being replaced by wireless networks. The main reasons may be the tremendous technical growth in the wireless communication area and the reducing cost of wireless devices . Now-a-days in every home we can see people using more cell phones rather than wired phones.

The TCP is a complex protocol, it performs congestion and flow control algorithms. The TCP establishes a connection between two applications and once connection is established between two applications, it provides many useful services to the application layer such as reliable delivery of data packets, end-to-end connection. The sender writes stream of bytes in the connection and receiver reads from connection. And now TCP/IP has emerged as the global Internet-working protocol. The TCP performs three major tasks a) Connection Establishment b) Data Transfer c) Connection Termination. Major problems of TCP degradation in mobile networks are mobility, high bit error rate, hidden and exposed node problem, Scalability, etc. Impact of mobility for TCP performance may by observed in terms of a) Route Failure b) Route Reconfiguration c) Network Partition

Cellular and ad hoc networks: Cellular network consists of collection of wireless mobile nodes coordinated by central coordination entity base station. In ad hoc networks, mobile hosts establish a network without any infrastructure. The source and destination communicate with each other through single or multi-hop paths. All mobile nodes are cooperative in nature and each node acts as the host as well as router so that

they can forward packets for other nodes. Original motivation of MANET started for military application. In battlefield, military cannot rely on access to a fixed infrastructure. In battlefield military moves in groups, and they communicate inside the group as well as outside the group (inter group communication). Due to dynamic topology MANET may not use the traditional wired routing algorithms. Therefore, it requires specialized routing[5, 7] algorithms, which are classified into three categories based on topology update: a) Table driven, b) On-demand, c) Hybrid routing protocols. The table driven routing protocol is also known as proactive routing protocol. In this protocol route to every node in the network is maintained in the routing table. Even if route is not required each node maintains the route to other nodes in the network. In case of reactive routing protocol source discovers the route to the destination only if it has some data to send. In hybrid it combines the best features of proactive and reactive routing protocol.

The protocol evaluation presented in this paper is based on the simulation using Network Simulator (NS)-2 and the graphs are generated using Matlab. The NS-2 [1, 2] is a discrete event driven simulator developed as part of the VINT project at LBL, Xerox PARC, UCB, and USC/ISI.

The layout of the paper is as follows: Section 2 describes the routing protocols. Section 3 describes the simulation environment. Section 4 describes the conclusion

2. ROUTING PROTOCOLS FOR MANETs

Destination Sequenced Distance Vector (DSDV): The DSDV Routing Algorithm is based on classical Bellman-Ford Routing Algorithm. This is proactive [5] routing protocol and routes are always available. In DSDV periodically each node advertises its own routing table to its immediate neighbors. Every node maintains a routing table that stores all available destinations, the number of hops to reach destination and the sequence number assigned by the destination. The routing table updates can be sent in two ways: a full dump or an incremental update. A full dump sends the full routing table to its neighbors, but in case of incremental update only the changed information since the last full dump is sent. Whenever the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. Routes with more recent sequence numbers are always preferred as the basis for making forwarding decisions, but not necessarily advertised. If two or more routes have the same sequence number, then it selects route with the smallest metric. All routes are loop free and hello messages are periodically exchanged to know new members.

Ad-Hoc On-Demand Distance Vector Routing (AODV): The AODV is a reactive [3, 4] protocol derived from Dynamic Source Routing and DSDV [7], and DSR. It combines the advantages of both protocols. Its route discovery procedure is similar to DSR. When a node has a packet to send to a particular destination and if it does not know a valid route, it broadcasts a route request packet by specifying the destination address. The neighbors without a valid route to the destination establish a reverse route and rebroadcast route request packet. Destination on reception of route request sends the route reply to the source. The route maintenance is done by exchanging beacon packets at regular intervals. This protocol adapts to highly dynamic topology and provides single route for communication. The major dis advantage is large delay for large networks.

Problem formulation: The objective of the work is to compare the performance of two routing protocols namely DSDV and AODV against the two quality of Service (QoS) parameters i.e packet delivery ratio and average end-to-end delay. We also analyze these routing protocols with respect to routing overhead. This study has been carried out under group mobility model which is a very common phenomena in the battle field operation or disaster recovery operations.

3. SIMULATION ENVIRONMENT

We used open source NS-2 simulator tool running on Open SUSE 11. It is a discreet event simulator mostly used for network simulation. To support multi-hop wireless networks & mobile extensions in NS-2, complete physical [2, 7], data link layer MAC protocols are developed by monarch research [8] group developed at Carnegie Mellon University. This simulation is carried out for 900 seconds, using group mobility model. For generating group mobility, we used IMPORTANT[6] tool developed by USC. It uses 802.11 DCF MAC protocol and File Transfer Protocol (FTP) traffic.

Performance Metrics: We used the following metrics for evaluating the performance of various MANET routing protocols:

Packet Delivery Ratio (PDR): It is the number of data packets received at the destination to the number of data packets sent by the source.

Routing Overhead: The total number of routing packets transmitted during the simulation. This does not include MAC, and ARP packets.

Average End-to-End Delay: The average time required for transmitting a data packet from source node IP layer to the destination IP layer, including transmission, propagation and queuing delay.

All the above metrics are calculated from the trace file generated when the simulation is done. After getting the above metrics, graphs are plotted using Matlab.

Simulation Parameters: We experimented for different offered loads (FTP traffic) by varying the no of source-destination pairs 1, 5, 10, 15, 20 and mobility varied up to 60 m/s. Keeping the packet size constant, we simulated 40 mobile wireless nodes forming ad hoc network moving over 1000x1000 flat space with max speed of 60m/s. The movement of the nodes was based on the Reference Point Group Mobility (RPGM) model. We considered Speed Deviation Ratio(SDR)=0.1 and Angle Deviation Ratio (ADR)= 0.1.

Other simulation parameters are shown in Table 1.

Table 1.

Parameter	Value
Simulator	ns-2.33
Wireless MAC	802.11
Channel bandwidth	10 Mbps
Transport protocol	TCP
Mobility model	Group Mobility
Groups	1, 4
Node speed	1-60 m/s

Results and Discussion:

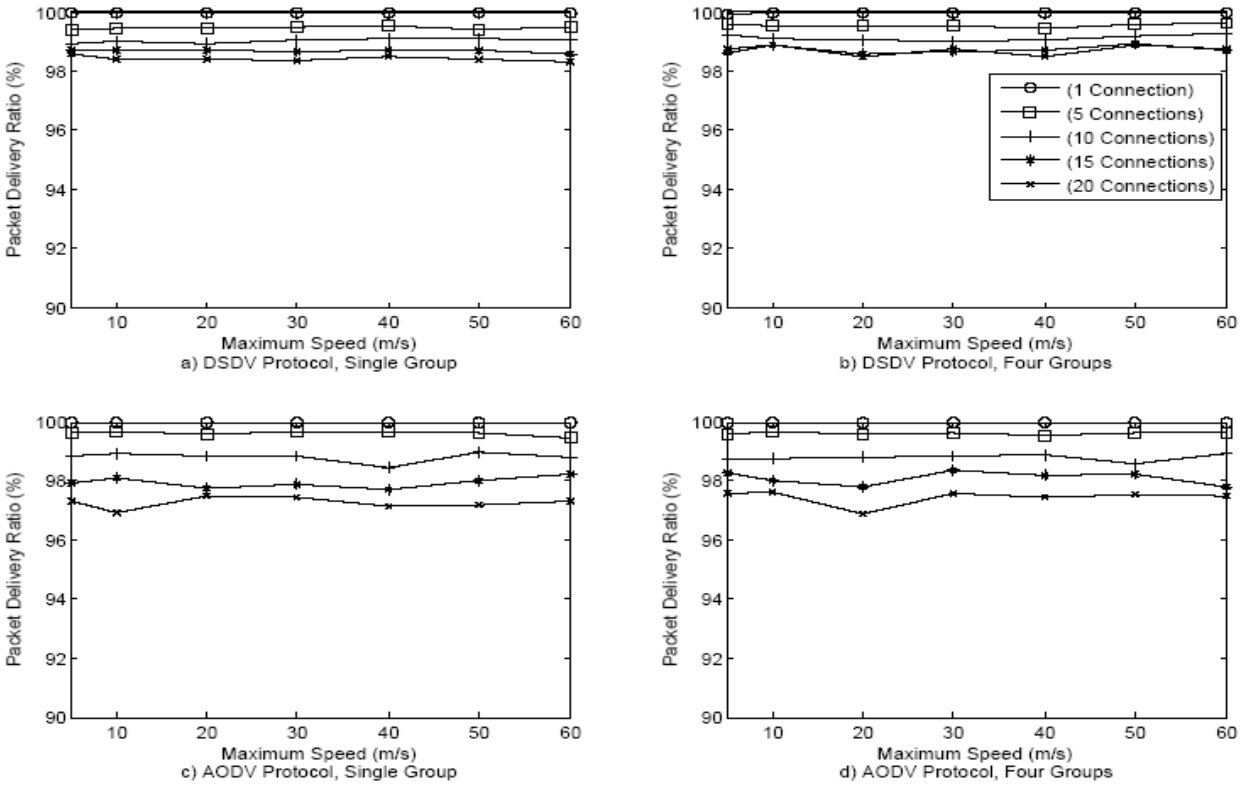

Figure 1. Comparison between the two routing (DSDV and AODV) protocols (the packet delivered as a function of node speed)

Packet Delivery Ratio: In this experiment we analyze how the increasing node speed and traffic load influences the performance of routing protocols. Figure 1 shows PDR with different speeds, lower traffic load achieved a higher packet deliver ratio than higher traffic load . Only traffic is affecting the PDR, but mobility has no impact on it. In both the scenarios DSDV performs better than AODV (up to 4%), as the traffic increases PDR reduces and mobility has very low or no impact on the routing performance . Only in case of single connection in AODV the highest performance is achieved.

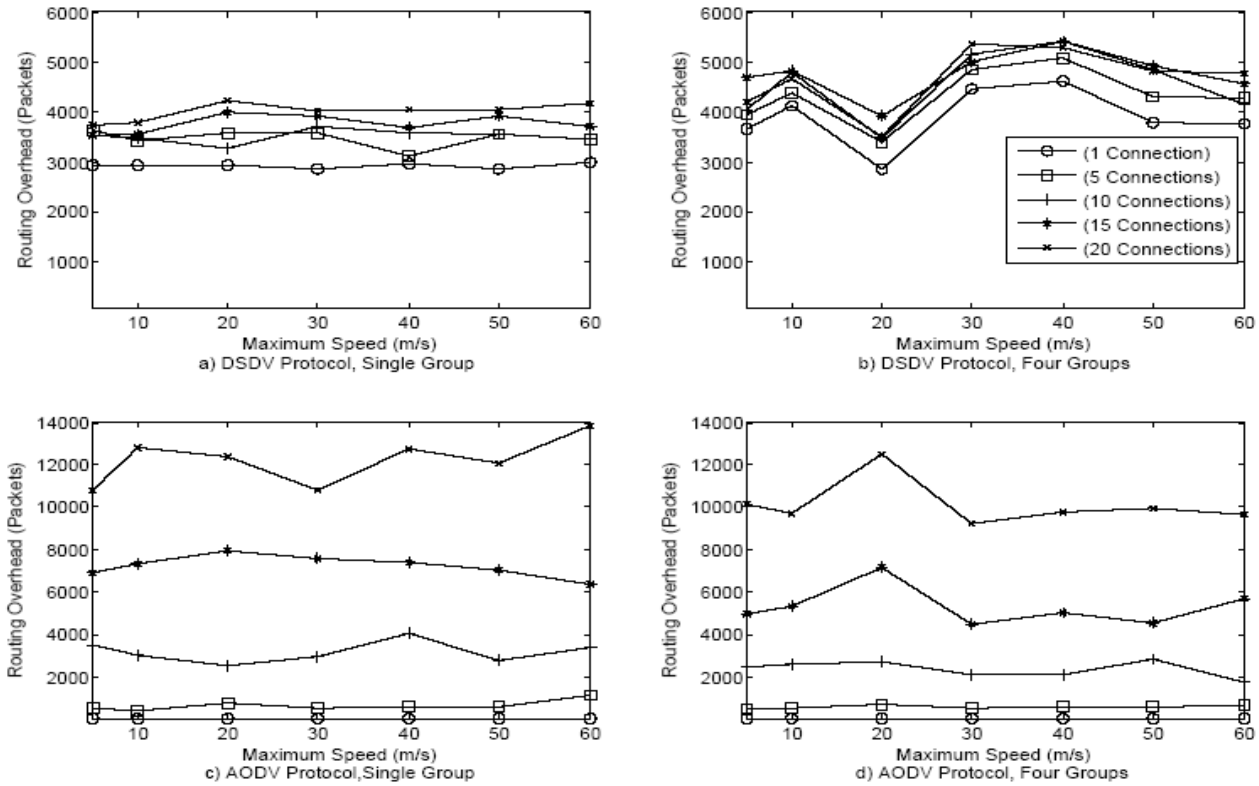

Figure 2. Comparison between the two routing (DSDV and AODV) protocols (the number of routing packets as a function of number of node speed)

Routing Overhead: In case of DSDV single group mobility model, routing overhead is lower than DSDV four group mobility model. The nodes mobility is not much influencing the routing overhead, it is almost constant as shown in Figure 2. Mainly traffic is influencing control overhead. Overall DSDV is performing better than AODV in single and four groups mobility model. DSDV generated less control traffic than AODV. In case of low traffic AODV performs better. The routing protocol that generates less control traffic uses less energy and is scalable.

Average End-to-End Delay: As the traffic increase in all four cases, delay also increases, Figure 3 shows the average end to end packet delay. Mobility has very little or no impact and the average delay is all most constant. But network traffic influences a lot on average delay (up to 30 Seconds). Overall AODV performs better than DSDV in both group mobility. Reactive protocols average delays are less than 80s, and DSDV delay are greater than 80s in almost all cases.

4. CONCLUSION

In this paper, we analyze the MANET popular routing protocols namely DSDV and AODV. The PDR is almost same in both routing protocol. Average delay is less in AODV compared to DSDV. But control overhead of AODV is much higher than DSDV. Overall we conclude that under group mobility model,

node's velocity has little impact, but number of TCP connections (traffic) has significant impact on the performance of the routing (DSDV and AODV) protocols from QoS perspective.

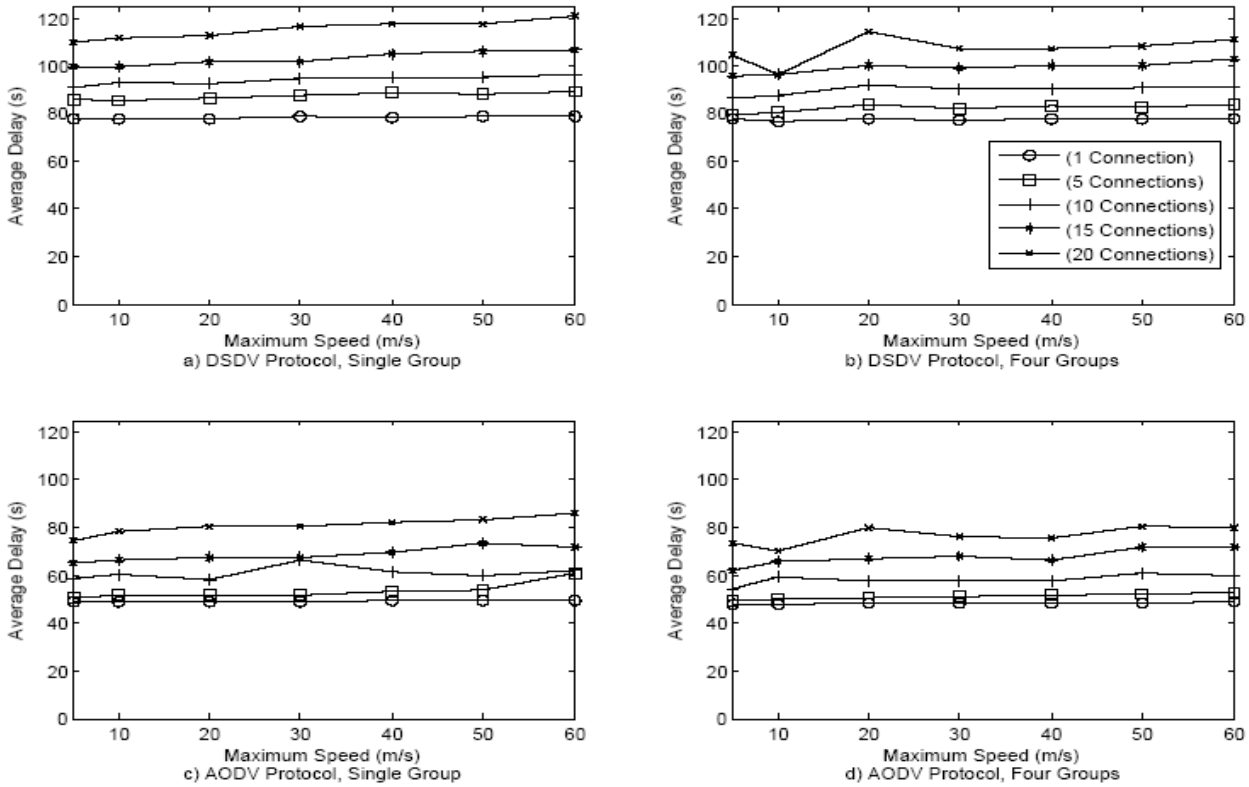

Figure 3. Comparison between the two routing (DSDV and AODV) protocols (the average end-to-end delay as a function of number of nodes speed)

5. Acknowledgements

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