QUALITY OF SERVICE IN DSDV AND AODV PROTOCOLS

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Abstract- *Mobile Ad hoc Networks due to their characteristics put some extra requirements on the routing protocols such as, distributed control management, on demand operation, energy efficient approach and limited packet size. With the development of real-time applications, incorporating Quality of Service (QoS) into the network architecture becomes essential.In this paper, we analyze and compare DSDV (proactive or Table Driven) and AODV (reactive or On Demand) routing protocols for MANETs using Network Simulator NS2. Performance evaluation of AODV and DSDV is evaluated based on three parameters of quality of service (QoS), throughput, packet loss ratio and delay. Our simulations show that AODV outperforms DSDV in terms of throughput and packet loss ratio.*

Keywords: *MANET, Quality of Servive, AODV, DSDV, NS2.*

INTRODUCTION

In recent years mobile computing has enjoyed a tremendous rise in popularity. The continued miniaturization of mobile devices and the extraordinary rise of processing power available in mobile laptop computers combine to put more and better computer based applications in the hand of growing segment of population. Mobile Ad Hoc Networks (MANET) represent complex distributed system that comprise wireless mobile nodes that can freely and dynamically self organized into arbitrary and temporary ad hoc network topologies, allowing people and devices to seamlessly internet work in area with no pre-existing communication infrastructure. Each of the nodes has a wireless interface and communicates with each other over either radio or infrared. Numerous MANET routing protocols have been proposed to address the challenges of mobile ad hoc networks. These routing protocols are divided into the following categories: Table driven, on demand, and hybrid models.
The rest of the paper is organized as follows. In Section 2, a general description of the MANET protocols is presented. A description of the AODV and the DSDV routing protocols is given in Section 3. We present our simulations and experiments in Section 4 along with some results and analysis. The conclusion of this work is given at Section 5.

METHODS

Mobile Adhoc Networks

MANETs Architecture

The architecture of an Ad Hoc network can be divided into two types: peer-to-peer structure and hierarchical structure [1].

Peer-to-peer

In this structure, each mobile node has the same status. Each node can move randomly and establish point-to-point wireless connection with each other, automatically. Information can be exchanged among the nodes directly [2].

Hierarchical

In this type, the whole network is organized into different clusters. Each cluster is a subnet and includes one cluster head with multiple cluster members [3]. The cluster head and cluster members move randomly and are self-organized, and use the same radio frequency to connect with each other. However the cluster head use another radio frequency to communicate with the other cluster heads. In the hierarchical structure, the status of the cluster head is more important than the cluster members. This cluster heads link among themselves to provide the backbone of an Ad Hoc network. The traffic flow is higher in the backbone than on the other links. Thus, some cluster members that are located far away from the backbone, do not need to participate in some of the routing processes.

MANETs routing protocols

Proactive

- Maintain routing information independently of need for communication
- Update messages send throughout the network periodically or when network topology changes.
- Low latency, suitable for real-time traffic
- Bandwidth might get wasted due to periodic updates [4].

Reactive

- Discover route only when you need it
- Saves energy and bandwidth during inactivity
- Can be bursty -> congestion during high activity
- Significant delay might occur as a result of route discovery
- Good for light loads, collapse in large loads [5].

Hybrid

- Proactive for neighborhood, Reactive for far away (Zone Routing Protocol, Haas group)
- Proactive for long distance, Reactive for neighborhood (Safari)
- Attempts to strike balance between the two [6].

Quality of Service in MANET

QoS is defined as a set of service requirements to be met by the network while transporting a packet stream from source to destination [7]. Intrinsic to the notion of QoS is an agreement or a guarantee by the network to provide a set of measurable pre-specified service attributes to the user in terms of delay, jitter, available bandwidth, packet loss, and so on. As in the Internet, mobile ad hoc networks are designed to support the best-effort service with no guarantees of associated QoS [8]. Therefore, when a packet is lost in a mobile ad hoc network, the sender simply retransmits the lost packet. This is an efficient method for applications requiring no QoS, but simple end-to-end retransmission is inadequate for real-time applications that are sensitive to packet loss, delay, bandwidth availability, etc.

QoS metrics could be defined in terms of one or a set of parameters [9]:

- delay,
- bandwidth,
- packet loss,
- Throughput,
- delay-jitter, etc.

AODV and DSDV Routing Protocols

Proactive protocols are based on periodic exchange of control messages and maintaining routing tables. In reactive protocols, a route is discovered only when it is necessary. For comparison purpose, we present two different protocols: the DSDV protocol (Destination-Sequenced Distance-Vector) and AODV protocol (Ad hoc On demand Distance Vector).

DSDV protocol

In distance vector each node only monitors the cost of its outgoing links, but instead of broadcasting this information to all nodes, it periodically broadcasts to each of its neighbors an estimate of the shortest distance to every other node in the network. The receiving nodes then use this information to recalculate the routing tables, by using a shortest path algorithm.

Definition

The destination sequenced distance vector (DSDV) routing protocol is a proactive routing protocol which is a modification of conventional Bellman-Ford routing algorithm [10]. This protocol adds a new attribute, sequence number, to each route table entry at each node. Routing table is maintained at each node and with this table; node transmits the packets to other nodes in the network. This protocol was motivated for the use of data exchange along changing and arbitrary paths of interconnection which may not be close to any base station [11].

Properties

Because DSDV is dependent on periodic broadcasts it needs some time to converge before a route can be used. This converge time can probably be considered negligible in a static wired network, where the topology is not changing so frequently. In an ad hoc network on the other hand, where the topology is expected to be very dynamic, this converge time will probably mean a lot of dropped packets before a valid route is detected. The periodic broadcasts also add a large amount of overhead into the network [10, 11].

Basic Mechanism

- DSDV is a hop-by-hop distance vector routing protocol requiring each node to periodically broadcast routing updates. It guarantees loop-freedom.
- Each DSDV node maintains a routing table listing the “next hop” for each reachable destination.
- DSDV tags each route with a sequence number and considers a route more favorable than other if R has a greater sequence number or if the two routes have equal sequence numbers but R has a lower metric.
- If a route is broken then a message with infinite metric and sequence number one greater than the sequence number of the route is advertised [10,11].

AODV protocol

The Ad hoc On-Demand Distance Vector (AODV) routing protocol is designed for mobile ad hoc networks (MANETs) and other wireless ad-hoc networks with large numbers of mobile nodes. The protocol's algorithm creates routes between nodes only when the routes are requested by the source nodes, giving the network the flexibility to allow nodes to enter and leave the network as will. Routes remain active only as long as data packets are traveling along the paths from the source to the destination. If the source stops sending packets, the path will time out and close. AODV was developed at the Nokia Research Center of University of California, Santa Barbara and University of Cincinnati by C. Perkins and S. Das [12, 13].

How AODV works

AODV utilizes routing tables to store routing information; one routing table for uncast routes as well as one for multicast routes. These tables hold information like: destination address, next-hop address, hop count, destination sequence number, and life time.

AODV discovers routes as needed and when it is necessary, which means no need to maintain routes from every node to all other nodes. And routes should be maintained as long as it's necessary. AODV nodes have four types of messages to communicate between each other:

- Route Request (RREQ)
- Route Reply (RREP)
- Route Error (RERR)
- HELLO messages
- RREQ and RREP messages are used for route discovery, whereas RERR and HELLO messages are used for route maintenance [12, 13].

Properties

a. AODV discovers routes as and when necessary. It does not maintain routes from every node to every other.
b. Routes are maintained just as long as necessary.
c. Every node maintains its monotonically increasing sequence number which increases every time the node notices change in the neighborhood topology.
d. AODV utilizes routing tables to store routing information
    - A Routing table for unicast routes
    - A Routing table for multicast routes
    - The route table stores: <destination addr, next-hop addr, destination sequence number, life_time>
e. For each destination, a node maintains a list of precursor nodes, to route through them. Precursor nodes help in route maintenance. Life-time updated every time the route is used. If route not used within its life time, it expires [12, 13].

Simulations, Results, Comparison and Analysis

This section described the simulation tool, Simulation parameters and simulation results. The QoS of proactive and reactive routing protocols is evaluated on the basis of three metrics: Throughput, Packet loss ratio, and delay. This simulation of proactive and reactive routing protocols is done by using network simulator2 (NS2) software due to its simplicity and availability. NS is a discrete event Simulator targeted at networking research. NS provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless (local and satellite) networks.

Simulation Tools

The Network Simulator 2 (NS-2) is a free computer program with a large pool of libraries, written both in Tcl/OTcl and C/C++, for the purpose of simulating networks

[14]. Those libraries include variety of protocols such as TCP, routing, multicast, MAC protocols, and architectures.

AWK programming is like any other high level programming. Since we have to only deal with reading text files and extracting relevant results, we can limit ourselves with learning simple features of the language like defining variables, reading files and displaying results. Since there are different trace formats, the same AWK code will not work for all trace files, however the basic concept is the same. AWK identifies the strings separated by tabs and spaces on a single line in the text as a single unit and accordingly designates those numbers.

RESULTS AND DISCUSSION

Using Awk, we analyze the simulation trace files then the results are represented graphically using histograms of MATLAB.
figure 1 shows the packet delay versus number of nodes over three traffic type: CBR, Pareto and Exponential.

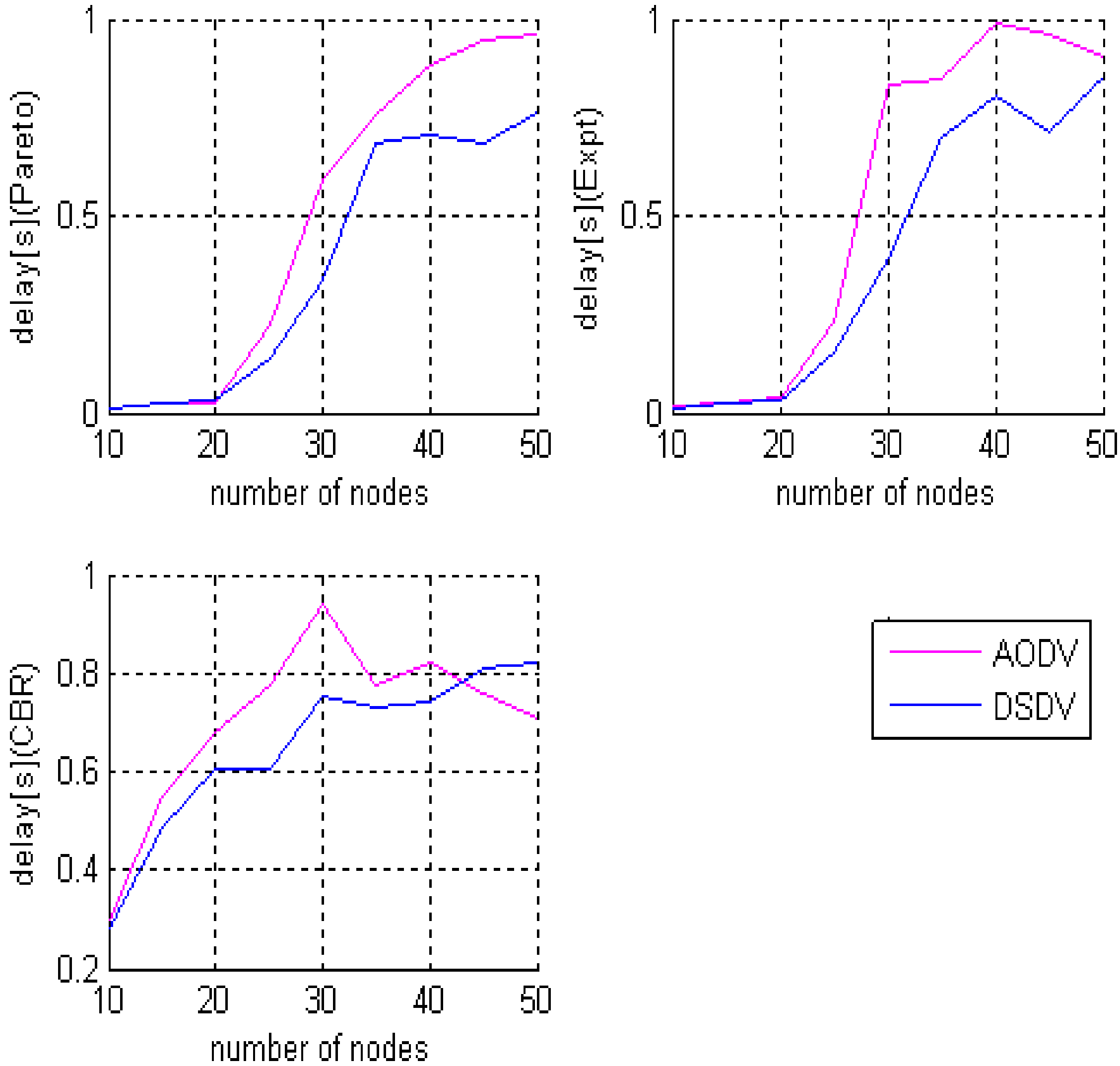

Fig. 1. Delay vs. Number of Nodes

The previous figure shows that for both protocols AODV and DSDV the delay increases when the number of nodes is increases in the three traffic types. Yet, the delay in DSDV was less than AODV.

figure 2 shows the throughput versus number of nodes over different traffic types:

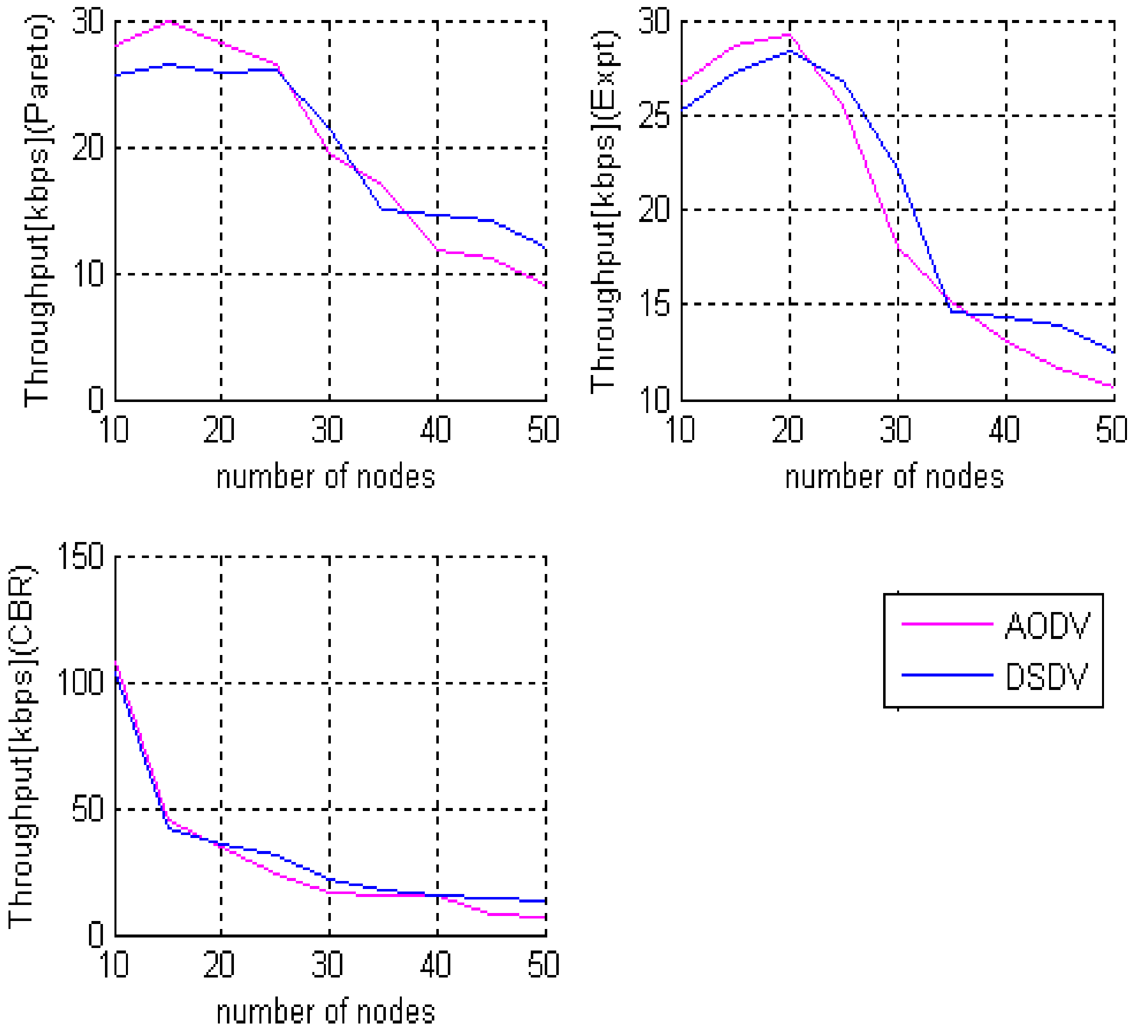

Fig. 2. Throughput vs. number of nodes

The above figure shows that the number of nodes increases when the throughput decreases for both protocols AODV and DSDV over the three traffic types. Yet, the graph shows clearly that the AODV has a higher throughput.

figure 3 shows the packet loss versus number of nodes over the three traffic types.

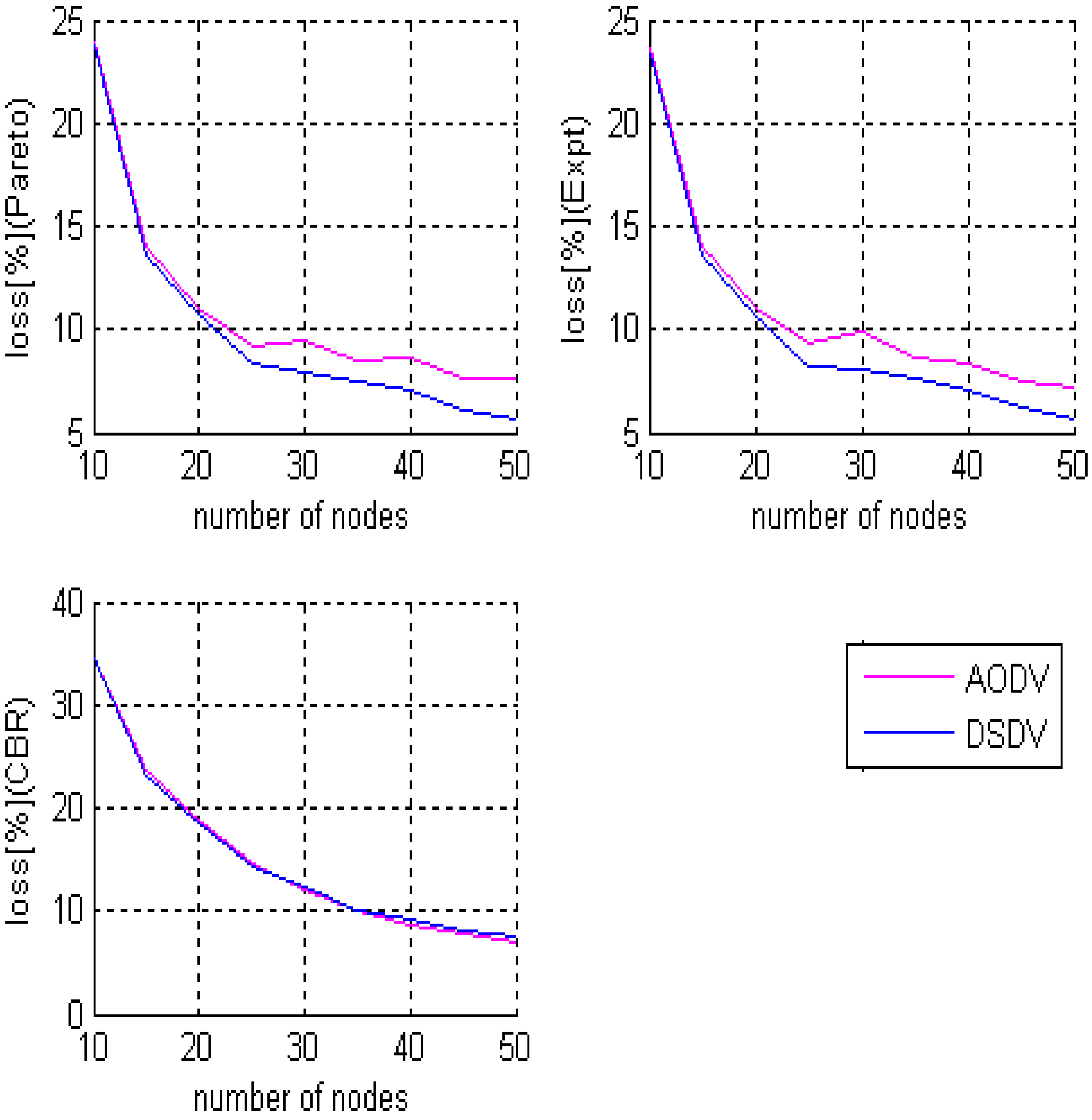

Fig. 3. Packet loss vs. number of nodes.

For both protocols AODV and DSDV, as number of nodes increases, packet loss decreases, and almost identical in the three traffic types.

CONCLUSION

In this paper, the Quality of service (QoS) of DSDV and AODV routing protocols were measured using the different performance metrics such as throughput, average end-to-end delay and packet loss ratio under three different scenarios while changing number of nodes, speed and time of simulation.

We observed that the QoS of AODV routing protocols is much higher compared to the DSDV routing protocol in terms of delay and packet loss while changing speeds and time of simulation, but DSDV was better than AODV in term of throughput while changing the number of nodes. This was due to the frequent routing information broadcasting. Both protocols showed almost the same results in some cases but it was observed that performance of AODV became much better compared to DSDV routing protocol.

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