Routing Protocols AODV and DSDV Performance Evaluation using NS-2 in MANETS(Mobile Adhoc NETworks) and WSN(Wireless Sensing Networks)

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ABSTRACT

Two routing protocols named DSDV and AODV were evaluated and simulated using NS-2 package and were compared in terms of packet delivery ratio, end to end delay and routing overhead and throughput in different environment; varying number of nodes, speed and pause time. The performance of routing protocols were measured with respect to metrics like Packet Delivery Fraction, End to End Delay and Routing Overhead and throughput in four different scenarios using two different environment i.e. MANETS(Mobile Ad hoc Networks) and WSN(Wireless Sensor Networks).

1. INTRODUCTION

Mobile Ad hoc Networks (MANETs) as well as Wireless Sensor Networks (WSNs) suffer from various challenges like low bandwidth, overhead and velocity of nodes, random and quickly changing network topology; thus the need for a robust dynamic routing protocol that can accommodate such an environment. This research contribution is the study between MANETs and WSNs environment with respect to two routing protocols i.e AODV and DSDV using NS-2. This study investigates the routing protocols corresponding to packet delivery ratio, routing overhead, average to end-to-end delay and throughput. For MANETs, two protocols AODV and DSDV are selected and a performance study is done.. For WSNs, two protocols AODV and DSDV are selected and evaluated. WSN consist of multiple sensor nodes, which can communicate with each using wireless radio links. Each node is usually small as well as easy and cheap to produce. This makes them flexible and versatile, but also creates constraints. It consist of many small, light weight sensor nodes (SNs) called motes. Each individual node has very limited resources (memory, CPU, battery capacity) and the range of its wireless radio is considerably smaller than the diameter of the whole network deployed on the fly in large numbers to monitor the environment or a system by the measurement of physical parameters such as temperature, pressure or relative humidity. Potential WSN applications include security, traffic control, industrial and manufacturing automation, medical or animal monitoring Mobile ad hoc networks (MANET) is a network composed of mobile nodes or communication devices mainly characterized by the absence of any centralized coordination, fixed infrastructure or pre-determined organization of available links, which makes any node in the network act as a potential router means that each node in the network also acts as a router, forwarding data packets for other nodes. A Mobile Ad hoc Network (MANET) is a kind of wireless ad-hoc network, and is a self-configuring network of mobile routers (and associated hosts) connected by wireless links – the union of which forms an arbitrary topology that represent complex distributed systems that comprise wireless mobile nodes that can freely and dynamically self organize into arbitrary and temporary ad hoc network topologies. A mobile ad hoc network is a collection of nodes that is connected through a wireless medium forming rapidly changing topologies. The widely accepted existing routing protocols designed to accommodate the needs of such self-organized networks do not address possible threats aiming at the disruption of the protocol itself. To improve the packet delivery ratio of Destination-Sequenced Distance Vector (DSDV) routing protocol in mobile ad hoc networks with high mobility, a message exchange scheme for its invalid route reconstruction is being used. Two protocols AODV, DSDV were simulated using NS-2 using OTcl and C++ package and were compared in terms of packet delivery ratio, end to end delay and routing overhead in different environment; varying number of nodes. Routing protocols play decisive role for the packets as how they will reach the destination. To study the behaviour of these protocols, several attempts have been made in deploying and evaluating protocols in different network environments. Routing protocols naming AODV and DSDV been simulated to judge their performance in various different situations.

II LITERATURE REVIEW

II.i AODV Reactive (On-Demand) Protocol

Ad-hoc On-demand distance vector (AODV)[9,10] is another variant of classical distance vector routing algorithm, based on DSDV and DSR . It shares DSR's on-demand characteristics hence discovers routes whenever it is needed via a similar route discovery process. However, AODV adopts traditional routing tables; one entry per destination which is in contrast to DSR that maintains multiple route cache entries for each destination. The initial design of AODV is undertaken after the experience with DSDV routing algorithm. Like DSDV, AODV provides loop free routes while repairing link breakages but unlike DSDV, it doesn't require global periodic routing advertisements. Apart from reducing the number of broadcast resulting from a link break, AODV also has other significant features.

Whenever a route is available from source to destination, it does not add any overhead to the packets. However, route discovery process is only initiated when routes are not used and/or they expired and consequently discarded. This strategy reduces the effects of stale routes as well as the need for route maintenance for unused routes. Another distinguishing feature of AODV is the ability to provide unicast, multicast and broadcast communication. AODV uses a broadcast route discovery algorithm and then the unicast route reply massage. The following sections explain these mechanisms in more detail. [8]

Route Discovery

When a node wants to send a packet to some destination node and does not locate a valid route in its routing table for that destination, it initiates a route discovery process. Source node broadcasts a route request (RREQ) packet to its neighbors, which then forwards the request to their neighbors and so on.

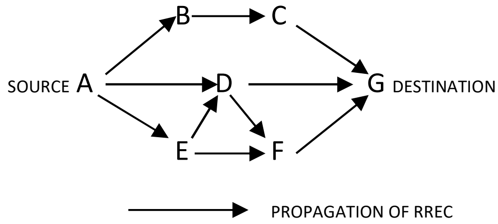


Fig. 1 indicates the broadcast of RREQ across the network

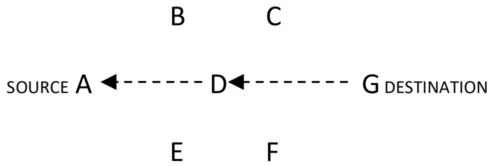


Fig 2: Route Reply through RREP Packet

To control network-wide broadcasts of RREQ packets, the source node use an expanding ring search technique. In this technique, source node starts searching the destination using some initial time to live (TTL) value. If no reply is received within the discovery period, TTL value incremented by an increment value. This process will continue until the threshold value is reached. When an intermediate node forwards the RREQ, it records the address of the neighbor from which first packet of the broadcast is received, thereby establishing a reverse path.

When the RREQ is received by a node that is either the destination node or an intermediate node with a fresh enough route to the destination, it replies by unicasting the route reply (RREP) towards the source node. As the RREP is routed back along the reverse path, intermediate nodes along this path set up forward path entries to the destination in its route table and when the RREP reaches the source node, a route from source to the destination established. Fig. 2 indicates the path of the RREP from the destination node to the source node.[8]

Route Maintenance

A route established between source and destination pair is maintained as long as needed by the source. If the source node moves during an active session, it can reinitiate route discovery to establish a new route to destination. However, if the destination or some intermediate node moves, the node upstream of the break remove the routing entry and send route error (RERR) message to the affected active upstream neighbors. These nodes in turn propagate the RERR to their precursor nodes, and so on until the source node is reached. The affected source node may then choose to either stop sending data or reinitiate route discovery for that destination by sending out a new RREQ message.

Broadcast ID+ Source IP address

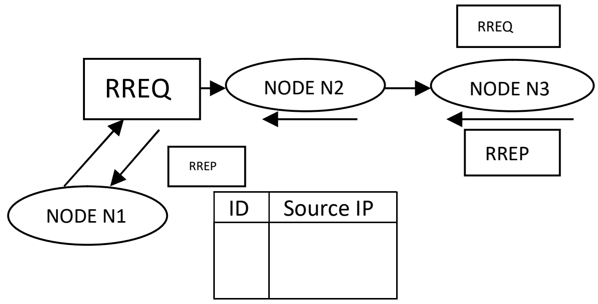
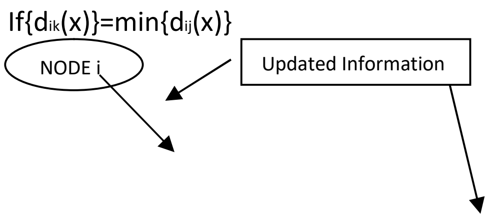


Fig 3: Illustration of AODV

II.ii DSDV Proactive (Table-Driven) Routing Protocol

Destination-Sequenced Distance-Vector Routing (DSDV) [1,11] is one of the most well known table-driven routing algorithms for MANETs. It is a distance vector protocol. In distance vector protocols, every node i maintains for each destination x a set of distances {dij(x)} for each node j that is a neighbor of i. Node i treats neighbor k as a next hop for a packet destined to x if dik(x) equals minj{dij(x)}. The succession of next hops chosen in this manner leads to x along the shortest path. In order to keep the distance estimates up to date, each node monitors the cost of its outgoing links and periodically broadcasts to all of its neighbors its current estimate of the shortest distance to every other node in the network. The distance vector which is periodically broadcasted contains one entry for each node in the network which includes the distance from the advertising node to the destination. The distance vector algorithm described above is a classical Distributed Bellman-Ford (DBF) algorithm [6][7].



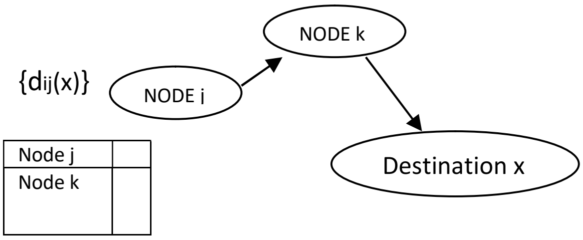


Fig 4: Illustration of DSDV

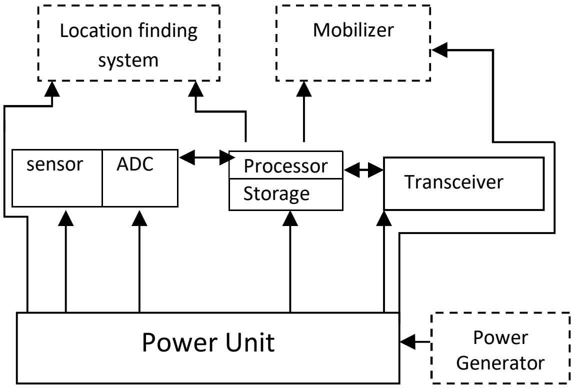


Figure 5. DSDV Routing Table

DSDV is a distance vector algorithm which uses sequence numbers originated and updated by the destination, to avoid the looping problem caused by stale routing information. In DSDV, each node maintains a routing table which is constantly and periodically updated (not on-demand) and advertised to each of the node's current neighbors. Each entry in the routing table has the last known destination sequence number. Each node periodically transmits updates, and it does so immediately when significant new information is available. In DSDV, broken link may be detected by the layer-2 protocol [2], or it may instead be inferred if no broadcasts have been received for a while from a former neighbouring node. The data broadcasted by each node will contain its new sequence number and the following information for each new route: the destination's address, the number of hops to reach the destination and the sequence number of the information received regarding that destination, as originally stamped by the destination. No assumptions about mobile hosts maintaining any sort of time synchronization or about the phase relationship of the update periods between the mobile nodes are made.

Following the traditional distance-vector routing algorithms, these update packets contain information about which nodes are accessible from each node and the number of hops necessary to reach them. Routes with more recent sequence numbers are always the preferred basis for forwarding decisions. Of the paths with the same sequence number, those with the smallest metric (number of hops to the destination) will be used. The addresses stored in the route tables will correspond to the layer at which the DSDV protocol is operated. Operation at layer 3 will use network layer addresses for the next hop and destination addresses, and operation at layer 2 will use layer-2 MAC addresses [7].

III.EXPERIMENTAL RESULT

The following metrics are used in varying scenarios to evaluate the different protocols:-

1) Packet delivery ratio - This is defined as the ratio of the number of data packets received by the destinations to those sent by the CBR sources.

2) Normalized routing load - This is defined as the number of routing packets transmitted per data packet delivered at the destination. Normalized routing load gives a measure of the efficiency of the protocol.

3) End-to-end delay of data packets - This is defined as the delay between the time at which the data packet was originated at the source and the time it reaches the destination. Data packets that get lost en route are not considered. Delays due to route discovery, queuing and retransmissions are included in the delay metric.

4) Throughput - This is defined as the ratio of the number of data packets received by the destinations to those sent by the CBR sources.

Parameter Used:

Table 1 Simulator parameter used for routing protocols

Parameter	Value
Simulator	NS-2.27
Protocols	AODV, DSDV
No. of Nodes	25,50,75,100
Environment size	500*500,500*400
Simulation time	20,50,100 seconds
Traffic type	CBR,UDP

Packet Delivery Ratio average results:

The ratio between the number of packets that are received and the number of packets sent.

Table 2 Packet Delivery Ratio of AODV, DSDV

No. of Nodes	AODV	DSDV
25	74.82	61.02
50	80.72	66.85
75	74.765	76.02
100	75.755	65.765

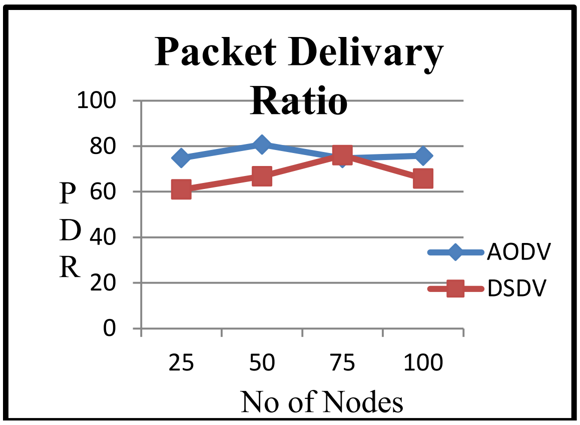


Figure 6 Performance evaluation of routing protocols average resullts

In figure 6 shows the performance metrics of PDR. When network size is 25 nodes. Packet delivery ratio of AODV is higher than DSDV. When we increase the network size at 50 nodes than packet delivery ratio of AODV is again higher than DSDV. When network size at 75 nodes packet delivery ratio of DSDV increases and PDR of AODV decreases but the ratio us almost similar at 75 nodes. When we again increases the network size with 100 nodes than PDR of DSDV again decreases and PDR OF AODV again increase and higher than DSDV. The performance of AODV is better than DSDV with no. of nodes increases (except at 75 nodes).

Average End to End delay:

This delay includes processing and queuing delay in each intermediate node i.e. the time elapsed until a demanded route is available. Unsuccessful route establishment are ignored.

Table 3 End to End Delay of AODV and DSDV routing average results

No of Nodes	AODV	DSDV
25	3606.4	10204.56
50	4031.63	5057.795
75	5762.115	7708.61
100	9075.43	7668.355

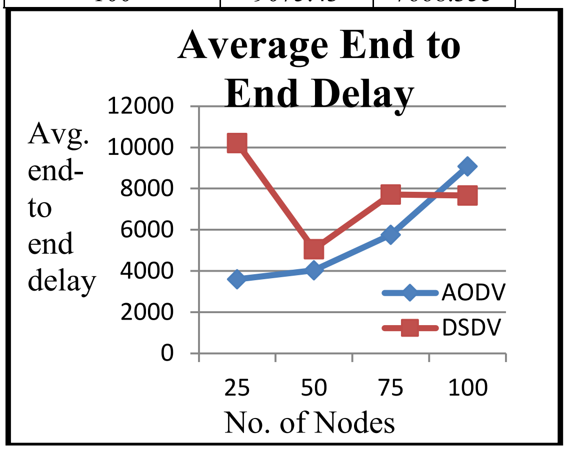


Figure 7 Performance evaluation of routing protocols average results

In figure 7 shows the performance metrics of average end to end delay. When network size is 25 nodes. Average end to end delay of DSDV is very higher than AODV. When we increase the network size at 50 nodes than Average end to end delay of DSDV is again higher than AODV but delay of DSDV now decreases and delay of AODV little bit increases. When network size at 75 nodes average end to end delay of DSDV increases and delay of AODV again increases. When the network size with 100 nodes than delay of AODV again increases and delay of AODV again increase and higher than DSDV. The performance of AODV is better than DSDV with no. of nodes increases (except with 100 nodes).

Routing Overhead:

The routing overhead measures by the total number of control packets sent divided by the number of data packets delivered successfully.

No. of Nodes	AODV	DSDV
25	1.36	1.615
50	1.255	1.435
75	1.375	1.345
100	1.395	1.61

Table 4 Routing Overhead of AODV and SDV routing protocols for WSN

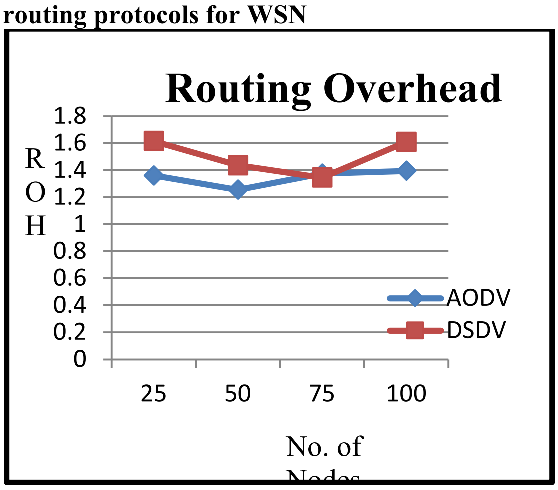


Figure 8 Performance evaluation of routing protocols average results

In figure 8 shows the performance metrics of routing overhead. When network size is 25 nodes. Routing overhead of DSDV is higher than AODV. When we increase the network size at 50 nodes than routing overhead of DSDV is again higher than AODV. When network size at 75 nodes routing overhead of DSDV decreases and overhead of AODV increases. When the network size with 100 nodes than overhead of AODV almost same routing overhead of DSDV again increase and higher than AODV.

Throughput:

Throughput is the total of all bits (or packets) successfully delivered to individual destinations over total-time / total time (or over bits-total / total time) and result is found as per KB/Sec.

No. of Nodes	AODV	DSDV
25	2.3	2.08
50	2.915	2.54
75	5.335	5.405
100	5.315	5.1

Table 5 Throughput of AODV and DSDV routing protocols average results

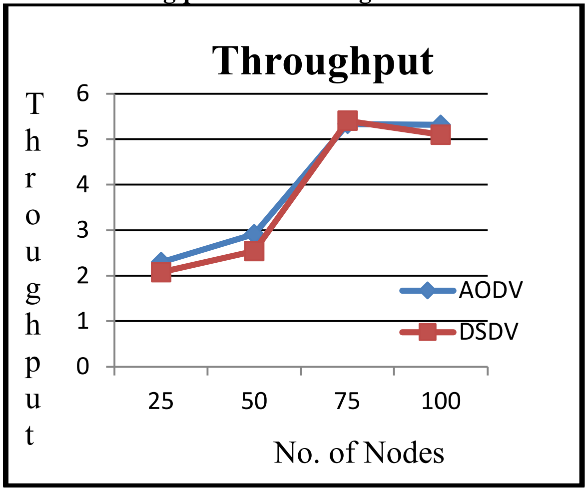


Figure 9 Performance evaluation of routing protocols average results

In figure 9 shows the performance metrics of throughput. When network size is 25 nodes. Throughput of AODV is higher than DSDV. When we increase the network size at 50 nodes than Throughput of AODV is again higher than DSDV. When network size at 75 nodes throughput of DSDV increases and throughput of AODV also increases and almost the same throughput. When the network size with 100 nodes than throughput of AODV increases and throughput of DSDV decreases.

IV.CONCLUSION

The results indicate that the performance is better especially when the number of nodes in the network is higher. Reactive routing protocol AODV performance is the best considering its ability to maintain connection by periodic exchange of information. AODV performs predictably. Delivered virtually all packets at low node mobility, and failing to converge as node mobility increases. AODV performs predictably. Delivered virtually all packets at low node mobility, and failing to converge as node mobility increases. Meanwhile DSDV was very good at all mobility rates and movement speeds. Protocols deliver a greater percentage of the originated data packets when there is little node mobility, converging to 100% delivery ration when there is no node motion. The packet delivery of AODV is almost independent of the number of sources. AODV suffers from end to end delays. DSDV packet delivery fraction is very low for high mobility scenarios. We Conclude that the AODV protocol is the ideal choice for communication.

Parameter	AODV	DSDV
Flooding	Yes	Yes
Routing loop Avoidance	Yes	Yes
Power Consumption	Medium	High
Distance Vector	Yes	Yes
Throughput	High	Medium
End-to-End Delay	Medium	High

Table 6. A Brief Comparison of AODV & DSDV

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