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Performance Comparison of AODV and DSDV Routing Protocols in Mobile Ad Hoc Networks

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Abstract-

Mobile ad hoc networks have wireless links and work independently of fixed infrastructure. They are self-organizing and self-configuring. The wireless nodes operate both as communication end-points as well as routers, enabling multi-hop wireless communication. The wireless devices imply limited power resources and bandwidth. Network topology may change rapidly due to mobility, interference, physical obstacles on the path, and so forth. Application areas range from conference hall networks to ad hoc networks for emergency and rescue operations and military tactical use. The wireless and dynamic nature of mobile ad hoc networks (MANETs) leaves them more vulnerable to security attacks than their wired counterparts. The nodes act both as routers and as communication end points. This makes the network layer more prone to security attacks. A main challenge is to judge whether or not a routing message originates from a trustworthy node. Amongst the most popular ones are Dynamic Source Routing (DSR), Ad-hoc On-demand Distance Vector (AODV), Temporally Ordered Routing Algorithm (TORA) and Destination-Sequenced Distance Vector (DSDV)routing protocol. The performance of AODV and DSDV routing protocol have been evaluated for Mobile Ad-hoc Networks (MANETs)in terms of throughput, the average end to end delay, jitter and drop etc .The performance of the AODV is better than the performance of the DSDV routing protocol. The performance differentials based on network load, mobility, and network size have been analyzed.

Keywords: MANET, DSDV, AODV

I. Introduction

Mobile Ad Hoc Network (MANET) is a collection of communication devices or nodes that wish to communicate without any fixed infrastructure and pre-determined organization of available links. The nodes in MANET themselves are responsible for dynamically discovering other nodes to communicate. It is a self-configuring network of mobile nodes connected by wireless links the union of which forms an arbitrary topology. The nodes are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Routing is a core problem in networks for sending data from one node to another. Wireless Ad Hoc networks are also called Mobile Ad Hoc multi-hop wireless networks is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration. Mobile Ad Hoc Networks (MANETs) are characterized by a dynamic ,multi-hop, rapid changing topology. Such networks are aimed to provide communication capabilities to areas where limited or no communication infrastructures exist.
MANET's can also be deployed to allow the communication devices to form a dynamic and temporary network among them. A mobile Ad Hoc network (MANET) is receiving attention due to many potential military and civilian applications. MANETs have several salient characteristics:
1) Dynamic topologies
2) Bandwidth-constrained, links
3) Energy constrained operation
4) Limited physical security.

Therefore the routing protocols for wired networks cannot be directly used for wireless networks. Some examples of the possible uses of ad hoc networking include students using laptop computers to participate in an interactive lecture, business associates sharing information during a meeting, soldiers relaying information for situational awareness on the battlefield and emergency disaster relief personnel coordinating efforts after a hurricane or earthquake. A MANET uses multi-hop routing instead of a static network infrastructure to provide network connectivity. Several routing protocols have been proposed for mobile Ad Hoc networks. In this paper we present a number of ways of classification or categorization of these routing protocols and did the performance comparison of an AODV and DSDV routing protocols.
The main goal of Ad Hoc routing is to send data packets among nodes distributed randomly in the network. Since mobile ad hoc networks have random topology, routing in such networks is a tough task. There is so much work has been done on routing in ad hoc networks.Routing is the process of finding a path from a source to destination. The broadcasting is usual and a common operation in ad-hoc network. It consists of diffusing a message from a source node

to all the nodes in the network. Broadcast can be used to diffuse information to the whole network. It is also used for route discovery protocols in ad-hoc networks. The routing protocols are classified as follows:-

1) Proactive (Table-Driven) Routing Protocol
2) Reactive (On-Demand) Routing Protocol
3) Hierarchical Routing Protocol
4) Hybrid Routing Protocol

- **Proactive (or Table-driven) routing protocols** maintain routing information about each node in the network. The information is updated throughout the network periodically or when topology changes. Each node requires storing their routing in-formation. For example: Destination sequenced Distance vector routing (DSDV) .
- **Reactive or On-demand routing protocols** look for the routes and are created as and when required. When a source wants to send to a destination, it invokes the route discovery mechanisms to find the path to the destination. For example: Ad-Hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR).
- In **Hierarchical routing protocol** Nodes are organized in clusters, Cluster head "controls" cluster, one or multiple levels of hierarchy.
- In **Hybrid routing protocol**, Proactive for neighbourhood, Reactive for far away (Zone Routing Protocol), for Proactive for long distance, reactive neighbourhood.

II. Destination-Sequenced Distance Vector Routing(DSDV)

Destination-Sequenced Distance-Vector Routing (DSDV) is a table-driven routing scheme for ad hoc mobile networks based on the Bellman-Ford algorithm. The improvement made to the Bellman-Ford algorithm includes freedom from loops in routing tables by using sequence numbers. It was developed by C. Perkins and P. Bagwig in 1994. The DSDV protocol can be used in mobile ad hoc networking environments by assuming that each participating node acts as a router. Each node must maintain a table that consists of all the possible destinations. In this routing protocol, an entry of the table contains the address identifier of a destination, the shortest known distance metric to that destination measured in hop counts and the address identifier of the node that is the first hop on the shortest path to the destination. Each mobile node in the system maintains a routing table in which all the possible destinations and the number of hops to them in the network are recorded. A sequence number is also associated with each route/path to the destination. The route labelled with the highest sequence number is always used. This also helps in identifying the stale routes from the new ones, thereby avoiding the formation of loops. Also, to minimize the traffic generated, there are two types of packets in the system. One is known as "full dump", which is a packet that carries all the Information about a change. However, at the time of occasional movement, another type of Packet called "incremental" will be used, which will carry just the changes, thereby, increasing the overall efficiency of the system. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not suitable for highly dynamic networks.

Advantages of DSDV

1. DSDV protocol guarantees loop free paths.
2. Count to infinity problem is reduced in DSDV.
3. We can avoid extra traffic with incremental updates instead of full dump updates.

Path Selection: DSDV maintains only the best path instead of maintaining multiple paths to every destination. With this, the amount of space in routing table is reduced.

Limitations of DSDV

Wastage of bandwidth due to unnecessary advertising of routing information even if there is no change in the network topology.

1. DSDV doesn't support Multi path Routing.
2. It is difficult to determine a time delay for the advertisement of routes.
3. It is difficult to maintain the routing table's advertisement for larger network. Each and every host in the network should maintain a routing table for advertising. But for larger network this would lead to overhead, which consumes more bandwidth.

III. Ad hoc On-demand Distance Vector(AODV)

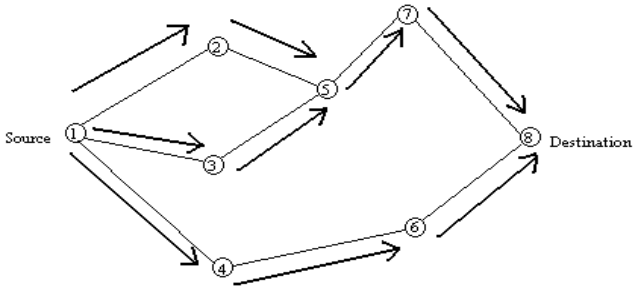
Ad hoc On-demand Distance Vector is essentially a combination of both DSR and DSDV. It borrows the basic on demand mechanism of Route Discovery and Route Maintenance from DSR, plus the use of hop-by-hop routing, sequence numbers, and periodic beacons from DSDV. It uses destination sequence numbers to ensure loop freedom at all times and by avoiding the Bellman-Ford count-to-infinity problem offers quick convergence when the ad hoc network topology changes. In this research paper we attempt to present an overview of two main categories of mobile ad-hoc routing protocols and performance comparison of both the protocols by simulation of three routing protocols (DSR, DSDV and AODV) focusing on the differences in their dynamic behaviour that can lead to performance differences. AODV enables "dynamic, self-starting, multi-hop routing between mobile nodes wishing to establish and maintain an ad hoc network.

AODV allows for the construction of routes to specific destinations and does not require that nodes keep these routes when they are not in active communication. AODV avoids the "counting to infinity" problem by using destination sequence numbers. This makes AODV loop-free. The AODV protocol is only used when two endpoints do not have a valid active route to each other. Nodes keep a "precursor list" that contains the IP address for each of its neighbours that are likely to use it for a next hop in their routing table. Route table information must be kept for all routes even short-lived routes.

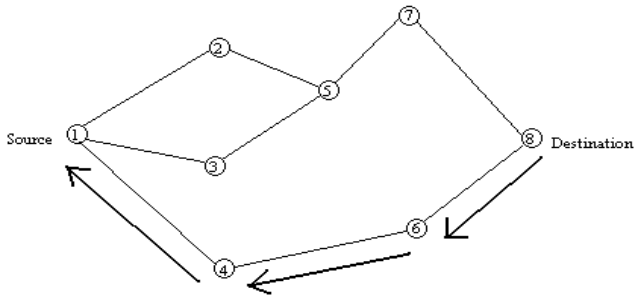
AODV defines 3 message types:

1. Route Requests (RREQs)
2. Route Replies (RREPs)
3. Route Errors (RERRs)

- RREQ messages are used to initiate the route finding process.
- RREP messages are used to finalize the routes.
- RERR messages are used to notify the network of a link breakage in an active route.



(a) Propogation of Route Request (RREQ) Packet



(b) Path taken by the Route Reply (RREP) Packet

Advanced Uses of AODV

1. Because of its reactive nature, AODV can handle highly dynamic behaviour of Vehicle Ad-hoc networks.
2. Used for both unicasts and multicasts using the 'J' (Join multicast group) flag in the packets.

Limitations of AODV

1. Requirement on broadcast medium: The algorithm expects/requires that the nodes in the broadcast medium can detect each others' broadcasts.
2. Overhead on the bandwidth: Overhead on bandwidth will be occurred compared to DSR, when an RREQ travels from node to node in the process of discovering the route info on demand, it sets up the reverse path in itself with the addresses of all the nodes through which it is passing and it carries all this info all its way.
3. No reuse of routing info: AODV lacks an efficient route maintenance technique.
4. The routing info is always obtained on demand, including for common cause traffic.

IV. Performance Comparison of AODV and DSDV Routing Protocols in Mobile Ad hoc Networks

The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks. AODV is capable of both unicasts and multicast routing. It is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources. Additionally, AODV forms trees which connect multicast group members. The trees are composed of the group members and the nodes needed to connect the members. AODV uses sequence numbers to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes. The AODV protocol uses route request (RREQ) messages flooded through the network in order to discover the paths required by a source node. An intermediate node that receives a RREQ replies to it using a route reply message only if it has a route to the destination whose

corresponding destination sequence number is greater or equal to the one contained in the RREQ. The RREQ also contains the most recent sequence number for the destination of which the source node is aware. A node receiving the RREQ may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that back to the source. Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it. As the RREP propagates back to the source nodes set up forward pointers to the destination. Once the source node receives the RREP, it may begin to forward data packets to the destination. If the source later receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop count, it may update its routing information for that destination and begin using the better route. As long as the route remains active, it will continue to be maintained. A route is considered active as long as there are data packets periodically travelling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the now unreachable destination(s)

V. Conclusion

As expected, reactive routing protocol AODV performance is the best considering its ability to maintain
Connection by periodic exchange of information, which is required for TCP, based traffic. AODV performs predictably.
Delivered virtually all packets at low node mobility, and failing to converge as node mobility increases.DSDV still requires the transmission of many routing overhead packets. At higher rates of node mobility it's actually more expensive. Compared the On-Demand (DSR and AODV) and Table-Driven (DSDV) routing protocols by varying the number of nodes and measured the metrics like end-end delay, dropped packets, As far as packet delay and dropped packets ratio are concerned, AODV performs better than DSDV with large number of nodes. Hence for real time traffic AODV is preferred over DSR and DSDV. For less number of nodes and less mobility, DSDV's performance is superior.

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