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A Comprehensive Analysis on Route Discovery and Maintenance Features of DSDV, AODV and IERF Ad-hoc Routing Protocols

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Abstract— MANET is a momentary network of nodes without any aid of any infrastructure and network proprietor. Each node in MANET acts as a router or host and moves in dynamic trajectory region according to applied protocol. Recent research work in MANET rise to design various novel protocols based on fundamental protocols proposed by IETF. The route discovery and maintenance feature of MANET routing is essential for its proactive, reactive or hybrid behavior. In this paper, we analyzed comprehensively route discovery and maintenance of DSDV, AODV and IERF ad-hoc routing protocol along with their basic functionality. This will facilitate for finding motive to assessment of competitive MANET routing protocols on performance metrics such as PDR, delay, throughput etc. according to their phenomenal nature. The DSDV protocol is outperformed than AODV and IERF. The IERF protocol is observed superior to AODV due to its key features such as path accumulation, node reliability pair factor and node pruning .

Keywords— MANET, DSDV, AODV, IERF, NS-2

I. INTRODUCTION

Now a day MANET is responsible for equal share in modern data communication technology as with other resources. The routing protocols use a flat network topology in which all nodes are assigned the same tasks in terms of the route discovery and maintenance process. Every node in a network with flat network must maintain a route to every possible destination in the network stored in the node's routing table (RT). As the dynamic nature of the network, nodes may reach or out from the coverage area, the size of the routing-tables increases, resulting in large numbers of control messages in the network.

DSDV (Destination Sequenced Distance Vector) [Perkins 1994] is a loop free ad hoc routing protocol in which the shortest-path calculation is based on the Bellman-Ford algorithm for finding the shortest path [1],[2]. DSDV is proactive in nature means each node is capable of maintaining a routing table that contains routes to all nodes in the network.

AODV (Ad Hoc On-Demand Distance Vector), [RFC 3561], is a reactive ad hoc routing protocol that is again based on the Bellman-Form algorithm [1],[2].

IERF (Improved Energy and Route Failure) protocol is a reactive in nature and based on AODV protocol with changes in reacting with neighbors using special features such as path accumulation, node reliability pair factor and node pruning. It uses the Route Failure and Energy bits for route discovery and maintenance process in routing. The working principle of these protocols is discussed in section 2 & simulation and results for comprehensive analysis is discussed in section 3.

II. ROUTE DISCOVERY AND MAINTENANCE

Route discovery and maintenance process of three considered protocols is discussed as:

A. *Destination Sequenced Distance Vector*

In DSDV data packets are transmitted between the nodes RT stored at each node. Each RT contains all the possible destinations from a node to any other node and also the number of hops to each destination.

Each node issues a sequence number attached to every new RT update message and uses two different types of RT updation methods: full dump and incremental dumps. Each node keeps statistical data concerning the average setting time of a message that the node receives from any neighboring node. The data is used to reduce the number of rebroadcasts of possible routing entries that may arrive at a node from different paths but with the same sequence number. DSDV uses only bidirectional links between nodes.

DSDV routing-table construction starts with the condition that every node in the network periodically exchange control messages with its neighbors to set up multihop paths to any other node in the network. Each individual route to every destination is tagged with a destination sequence number, which is issued by the destination node. Any route to a destination with a higher destination sequence number replaces the same route with a smaller destination sequence number in the node's RT. Every node immediately advertises when any significant change in its routing table. This may be due to a link failure to its neighboring node(s), but waits for a certain amount of time to advertise other changes. This time is calculated by maintaining, for every destination, a running, weighted average of the most recent updates of the routes. This advertising method used by DSDV is used to minimize the number of route updates transmitted by a node. Thus, when a node receives a route update for a destination from one of its neighboring nodes, and a few seconds later, it receives a second update from a different neighboring node for the same destination with the same destination sequence number, but a lower number of hops, the node does not immediately broadcast the change in its routing table. If this type of rule were not in place, the node would have to advertise two route updates within a short period, as a result neighboring nodes broadcast new route updates to its neighboring nodes, because each node maintains a table with the destination address, the last settling time and the average settling time of this address. The node uses this information in routing table for checking the stability of the route to a destination [1].

B. Ad Hoc On-Demand Distance Vector

AODV is a reactive routing protocol so it does not explicitly maintain a route for any possible destination in the network. However, its RT maintains routing information for any route that has been recently used within a time interval. So a node is able to send data packets to any destination that exists in its routing table without flooding the network with new Route Request (ROUTEREQUEST) messages.

When a originator node has to send data to destination node in the network, the originator looks in its routing table to find a route to the destination. If there is no such route, or the route is marked as invalid by an appropriate flag, the originator propagates a ROUTEREQUEST message to its neighboring nodes. The originator, before sending the ROUTEREQUEST message, increments by one the ROUTEREQUEST ID and the originator sequence number in the message header. Each ROUTEREQUEST message is exclusively identified by combining the above numbers with the originator IP address. Any intermediate node that receives an ROUTEREQUEST message, takes one of the following three actions: (i) the intermediate node discards the ROUTEREQUEST message if it has previously received the same ROUTEREQUEST message. (ii) if the intermediate node has a valid route to the destination node, it reverses a ROUTEREPLY message back to the originator and (iii) if the intermediate node does not have a valid route to the destination, it further broadcasts the message to its neighbor nodes. The destination node, which finally receives the ROUTEREQUEST message, increments the destination sequence number and reverses an ROUTEREPLY message back to the originator. When the originator node receives the ROUTEREPLY message, it updates its routing table with the "fresh" route. Figure 1 shows the route discovery process from source node 1 to destination node 10. All the nodes are linked with Wireless link. ROUTEREQUEST and ROUTEREPLY messages are shown arrow with black and red colors respectively.

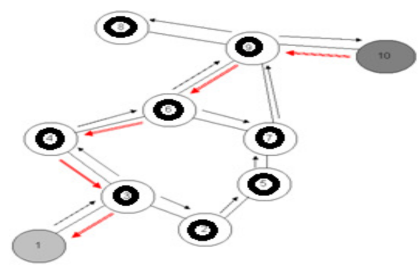

Fig 1: AODV Route Discovery Process

High routing overhead due to flooding nature can be avoided two methods: (i) involves a binary exponential back off to minimize congestion in the network and (ii) involves an expanding ring search technique in which the originator node starts broadcasting a ROUTEREQUEST message and the TTL value is set to a minimum default value. If the originator node does not receive a ROUTEREPLY message within a certain time interval, it exponentially increments the time interval and increases the diameter of the searching ring. The maximum value for the ring diameter is set by default to 35, which is, for AODV, the maximum value of the network diameter. The route maintenance process in AODV is shown in Figure 3. When the link in the path between node 1 and node 10 breaks the upstream node that is affected by the break, in this case node 4 generates and broadcasts a RERR message. The RERR message eventually ends up in source node 1 [3],[4].

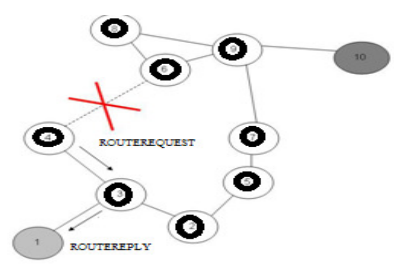

Fig 2: AODV REER Message Generation

Upon receiving the REER message, node 1 will generate a new ROUTEREQUEST message. Finally, if node 2 already has a route to node 10, it will generate a ROUTEREPLY message, as indicated in Figure 2. Otherwise, it will re-broadcast the ROUTEREQUEST, as in Figure 1.

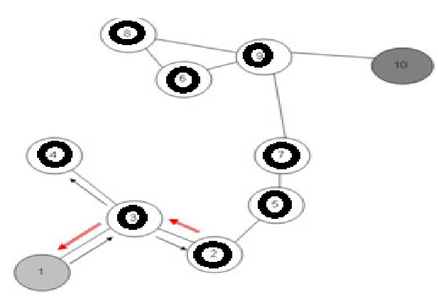

Fig 3: AODV Route Maintenance Process

A. Improved Energy and Route Failure

A source mobile node needs to send a packet to a destination mobile node when a routing table does not have any entry for the destination. A source mobile node broadcasts a route request message ROUTEREQUEST packet to all its neighbor mobile nodes. When a neighboring mobile node receives the route request message PREQ packet, it set a receive route entry to the source mobile node from which the route request message ROUTEREQUEST packet was received. This reverse route entry guides to route a route reply message ROUTEREPLY packet to the source. If the intermediate mobile node does not have a route to the destination, it will then rebroadcast the packet to all its neighbors. This process continues until the packet searches the destination. The destination sends a route reply message ROUTEREPLY packets to all mobile nodes along the path update the energy bits and route failures bits in the reserved bit field. The working of timer setting for time to live (TTL) and duplicate sequence number checking mechanism is followed similar to AODV [1],[2]. The flowchart in Figure 4 describes the flow of routing control for route discovery and route maintenance using the key features based on reliability pair factor (RPF), accumulation path (AP) and node pruning. [5].

III. SIMULATION SETUP AND RESULTS

The simulation model is developed in NS-2 (2.35) network simulator on LINUX Ubuntu 12.04 platform for analysis of DSDV, AODV and IERF protocols [6]. The different parameters used in simulation are given in Table 1:

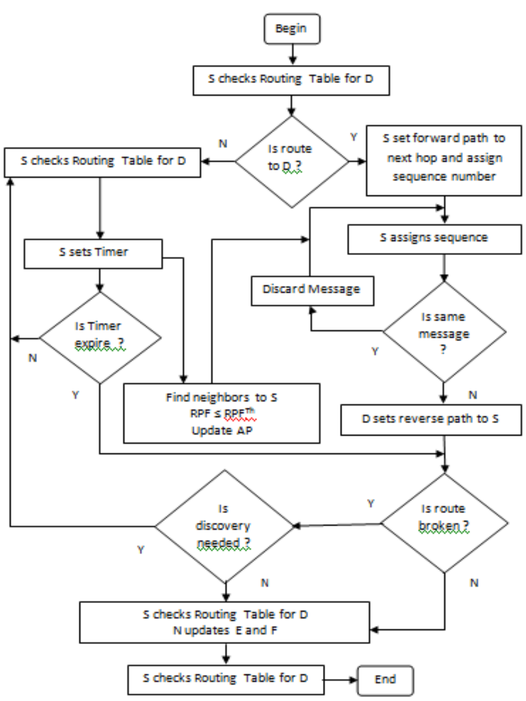

Fig 4: IERF Flow

Table1: Simulation Parameters

Protocol	DSDV, AODV, IERF
Topography Area (m2)	500 *500
Simulation Time	300 seconds
Traffic Type	UDP/CBR
Radio Propagation Model	Two Ray Ground
MAC layer Protocol	MAC IEEE 802.11
Antenna type	Omni Antenna
Number of Mobile Nodes (No)	5,10,15,20,25
Number of Traffic Connections (No)	2
Mobile Node Speed (m/sec)	50
Mobile Node Pause Time (sec)	2
Packet size (bytes)	128

The performance metrics used in simulation concerned with route discovery and maintenance are packet delivery ratio (PDR), delay, and throughput. The Figure shows this analysis.

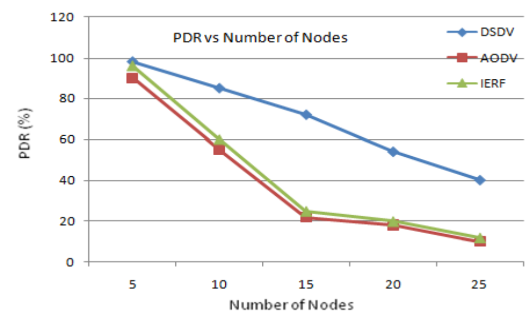

Figure 5: PDR vs. Number of Nodes

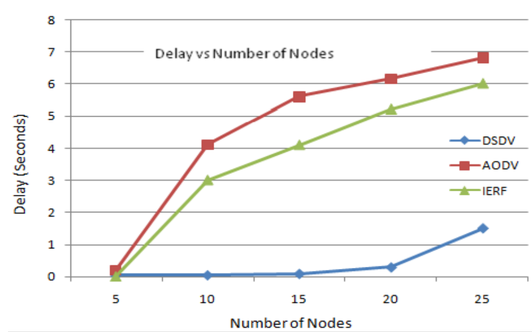

Figure 6: Average Delay vs. Number of Nodes

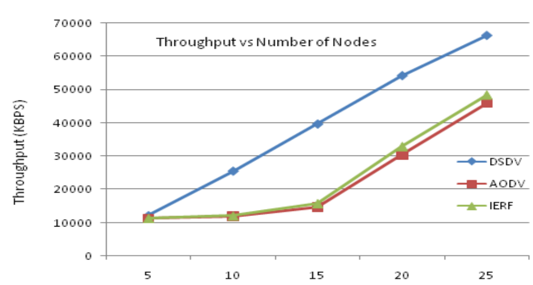

Figure 7: Throughput vs. Number of Nodes

IV. CONCLUSION

In this paper, the comprehensive analysis of route discovery and maintenance of DSDV, AODV and IERF ad hoc routing protocols are evaluated in terms of communication reliability, quality and performance using performance metrics. The performance metrics used in the analysis are PDR, delay and throughput. The communication reliability is high for DSDV as its PDR outperforms both AODV and IERF. The delay affects the quality of network which shows worst for AODV. The maximum throughput is observed with DSDV because it maintains the best path instead of maintaining multipath for every destination.

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