Novel Composite Approach to Reduce Broadcast Storm Problem

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***Abstract*—** Broadcasting is the fundamental operation in mobile ad hoc network (MANET). Broadcasting is a side effect of flooding where each mobile nodes in the network can transmit the redundant packets to its neighboring nodes which are in the same transmission range. When mobile nodes are increased then network become dense and it leads to the problems such as redundant rebroadcast, contention and collision. These prone the high protocol overhead and intrusion with existing data traffic . Many MANET protocols such as Ad hoc On demand distance vector (AODV) and Dynamic Source Routing (DSR), Zone Routing Protocol (ZRP), Location Aided Routing (LAR) rely on broadcasting during route discovery mechanism which causes the broadcast storm problem. The main focus of this paper to understand AODV and DSR protocols and its side effect of broadcasting and propose an algorithm to reduce the broadcast storm problem.

Keywords*- Ad-Hoc On-Demand Distance Vector, Dynamic Source Routing, Broadcast Storm Problem*

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1. Introduction

MANET is considered as self configuring and self adaptive mobile network in which each mobile node is free to move randomly and independently without any static or central governance. Each node can act as a router for other mobile nodes which is not there in their same transmission range. Due to high mobility links between these mobile are frequently changes. Thus, the efficient routing between these mobile nodes is a greater challenge. There are various protocols are available in MANET. These protocols are differentiated based on how they can store or maintain the network information [1].

These protocols are categorized as 1. Proactive protocols. 2. Reactive protocols 3. Hybrid protocols. The main advantages of reactive protocol are low overhead because mobile nodes can initiate the route discovery as and when needed. There are many reactive routing protocols are available, but mainly we focus on AODV and DSR to understand the broadcasting, its side effect into the network and introduce an approach to reduce the broadcast storm problem [1,2].

2. Related Work

Mobile nodes in the MANET are free to move randomly without static infrastructure. Each node can communicate with each other independently and also act as a router to transmit the packets to other mobile nodes. Due to rapid change in the topology reliable and efficient routing between these mobile nodes is an important goal. For routing various protocols are already introduced. This paper mainly emphasizes on reactive routing protocols such as AODV and DSR.

AD hoc On demand Distance Vector (AODV)

AODV is well known reactive routing protocol. As it a reactive routing protocol route discovery starts when there is a need of communication and keep this information up to date as long as communication lasts [2,3].Each mobile node can maintain the routing table to store the information such as destination, next hop, number of hops, destination sequence number, and active neighbors for this route and expiration time for this route table entry[3,4].

Communication starts by initiating route discovery mechanism. Routing discovery is possible by exchanging two control messages 1. Route Request (RREQ) and 2. Route Reply (RREP). RREQ contains Source address, Request ID, Source sequence number, Destination address, destination sequence number, Hop count. RREP contains the source address, destination address, destination sequence number, Hop count, TTL. Source address and Request ID together can use to identify the new route request. In response to a RREQ message destination node can generate the RREP message, provided that the incoming sequence number is greater than the destination sequence number otherwise it can broadcast the RREQ message but can no reply back. Every RREQ carries a time to live (TTL) value that specifies the number of times this message should be re-broadcasted. This value is predefined [3,4].

Due to high mobility links between these mobile nodes are changed frequently. To maintain the local connectivity between these mobile nodes, each mobile node periodically sends HELLO message to its neighboring mobile nodes to check the status for active link. When a node receives a HELLO message, it updates the lifetime of the neighbor into its routing table [2,3,4].

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Dynamic Source Routing (DSR)

DSR is also reactive routing protocol. The main feature of the reactive routing protocol is a source routing[3,4]. Source node knows complete hop by hop route to the destination node. It maintains the routing information in its route cache. Each of the intermediate mobile nodes can also maintain the route cache. When the sender wants to send the packet to the destination, it first looks into its route cache if the route is already cached then it uses the same route otherwise it starts the new route discovery by appending its

Entry and broadcast the route request (RREQ) packets.. Each intermediate node receiving a RREQ rebroadcasts it, unless it is the destination node or it has a path towards the destination in its route cache. Such a node replies to the RREQ with a route reply (RREP) packet that is routed back to the source node. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed across the network. The RREP routes itself back to the source by traversing this path backward. The source node can maintain the route carried back by RREP packet in its cache for further use. If any of the links fail, the intermediate nodes can inform the source node by sending route error (RREP) packet. After receiving the RREP packet source deletes the any route using this link from its cache.

3. Critique Of AODV And DSR

Broadcasting is the main operation in both of these protocols during the establishing the route between the source and destination. Consider the following ad hoc network

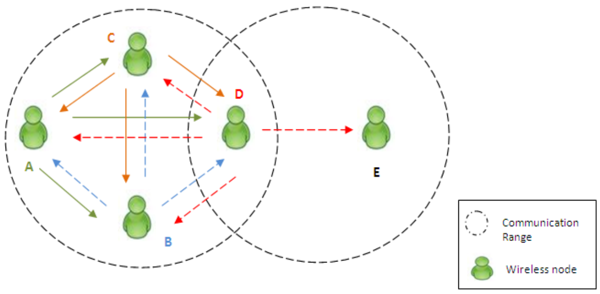

Fig. 1 A sample ad-hoc network with 5 nodes[5].

Where if node A broadcasts a packet, nodes B, C and D will receive the same packet. Nodes B, C and D will again rebroadcast the same packet and at last node E will also rebroadcast the same packet. It clearly observer that broadcast redundancy inherent with flooding. When the no of mobile nodes are increased then the network becomes dense and redundant broadcast is increasing and this leads to problems such as redundant rebroadcast, contention and collision.

4. Proposed System

To reduce the broadcast storm problem system emphasizing on boundary range estimation along with the one hop neighboring discovery approach.. The 1-hop neighbor information can be obtained by exchanging the HELLO message in MAC layer protocols [Efficient Flooding in Mobile Ad Hoc Networks Hui Zeng1] and new boundary range based mobile data transmission mechanism is used.

These boundary range estimation is used to assist manage the route of data flood of mobile data packets, The system also concentrates on path maintenance, due to the fact of mobility in the network there might be frequent link failure due to mobility, the system act more resistant to link failure. In the network every node is responsible for confirming that the next hop in the Source Route receives the packet. Also, each packet is only forwarded once by a node (hop-by-hop routing). If a packet cannot be received by a node, it is retransmitted up to some maximum number of times until a confirmation is received from the next hop. Only if retransmission results, then in a failure, a route error message is sent to the initiator that can remove that Source Route from its Route Cache. So the initiator can check his Route Cache for another route to the target. If there is no route in the cache, a route request packet is broadcasted.

5. Propose Algorithm:

The proposed algorithm combines the features of AODV and DSR protocols in establishing a route between source and destination and try to reduce the broadcast storm problem by one hop neighbor discovery mechanism and boundary range estimation.

The fields in the broadcast message (AODV) are< Source Address, HELLO-PACKET, one-hop neighbors >

The fields in the route discovery message (DSR) are< Source Address, RREQ, Destination Address >

Also, the RREP contains < Source Address, REPLY, SEQ-NO, Destination Address >

From the SEQ-NO value each node can determine the shortest route between the nodes, and then uses this location information to find the next node to reach the destination. This routing table will be updated with the determined distance between the nodes using SEQ-NO.

Each node can maintain a cache that contains the information like:< Source Address, Sequence Number, Destination Address, Broadcasted Distance, Route list {(next node$_1$,distance$_1$),(next node$_2$,distance$_2$) ……} expiration timeout >

Input packet is P, Source is S, Destination is D, Neighbor is N

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Step 1: if (D boundary is within S boundary range) S sends packet P directly to destinations Go to end.

Else

Step 2: Source S broadcast route discovery message on time slot to destination D

Step 3: Source node S determines the estimated location of destination D through broadcast .

Step 4: Source S defines the total path between itself and destination D.

Step 5: Source S determines the set of one hop neighbors (N) that are nearer to destination D.

Step 6: if (N=Φ) where Φ is busy state, which means if neighbor nodes are engaged with other routings condition S cached N and P to its queue Go to waiting state.

Else

Step 7: S selects the best neighbor and sends P to N

Step 8: if (D is neighbor of N) N sends P directly to D

Go to end

Else

Step 9: N forwards P to next neighbor N End

Waiting state:

Waiting state ends

Go to step 2

Simulation Result

Performance of the routing protocols is analyzed based on the following parameters.

Throughput It is defined as the total number of packets delivered over the total simulation time.

Packet delivery ratio: It is defined as the ratio of data packets received by the destinations to those generated from the sources. Mathematically, it can be defined as: PDR= S1÷ S2 Where, S1 is the sum of data packets received by the each destination and S2 is the sum of data packets generated by the each source.

Average Energy Consumption*:* average of the energy consumed by all the packets that originate at the source and delivered at the destination.

Drop : It is defined as the total number of packets lost during transmission from source to destination.

For simulation following parameters are defined:
Topology size is 1200*1100 meters, maximum transmission range is 150 meters, bandwidth is 95 kbps interface queue length is 50 and maximum packet size is 512 bytes.

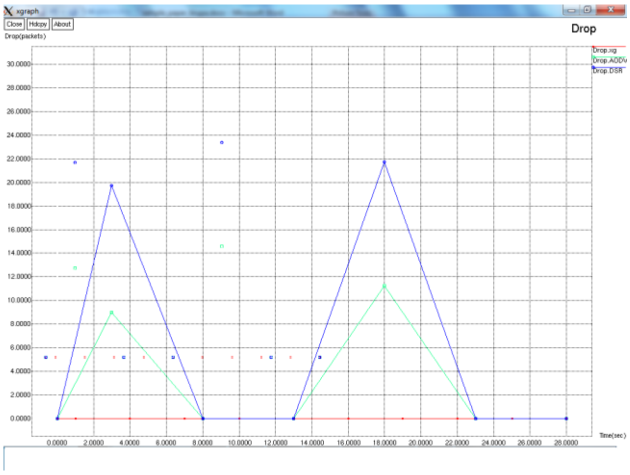

Fig 2. Drop vs. time

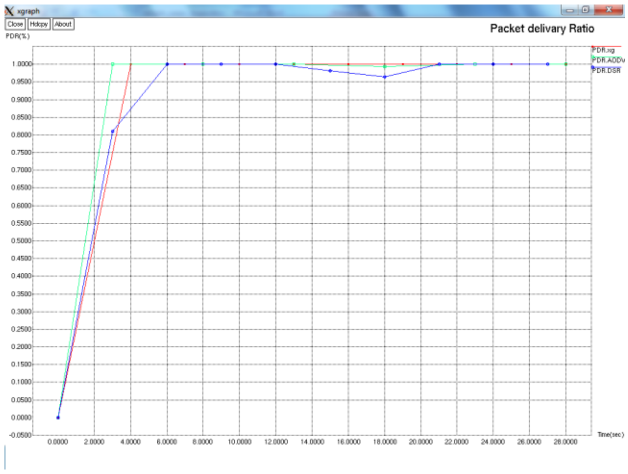

Fig 3. Packet delivery ratio vs. time.

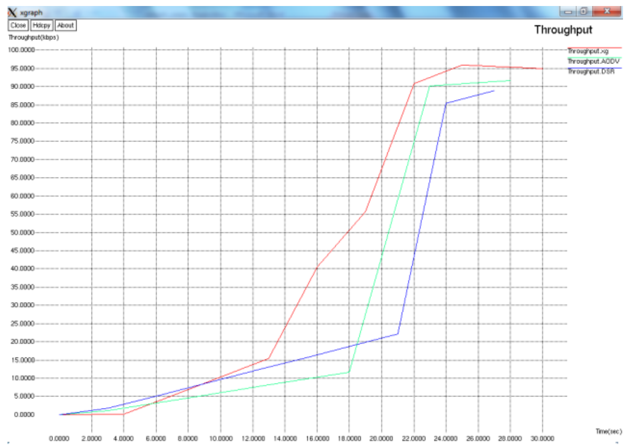

Fig 4. Throughput vs. time.

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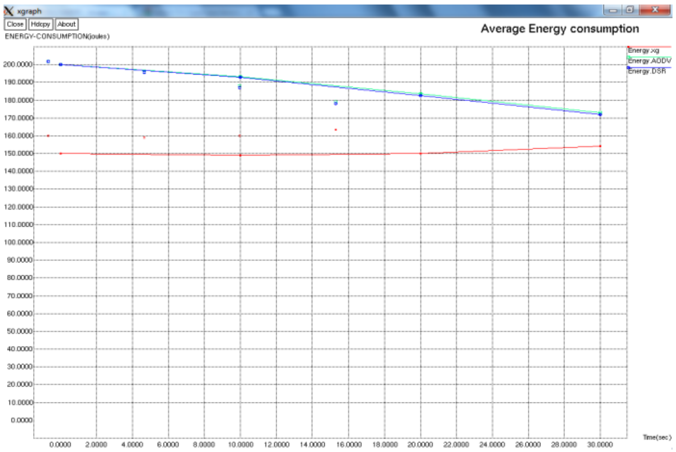

Fig 5. Average Energy Consumption vs. time

6. Conclusion

The main goal of this work is to reduce the broadcast storm problem in MANET by comparing the traditional protocols such as AODV and DSR. By observing the proposed algorithm we will get the best result in all the parameters.

Parameter	Proposed algo	AODV	DSR
PDR	99%	98%	97%
Throughput	95kbps	90kbps	88kbps
Energy level consumption	150 joules	172 joules	173 joules
Drop(packet)	0-5	11-15	20-25

From the figure 2 it is observed that the packet drop of propose system compared with aodv and dsr, from the result it is observe that the packet drop proposed system is 0-5 packets, where the aodv drop is 11-15 packets and dsr packet drop is 20-25, so the result says proposed system has lower packet drop compared to aodv and dsr. From the figure 3 it is observed that packet delivery ratio of our propose system compared with aodv and dsr, from the result we observe that packet delivery ratio of our proposed system is 99%, where the aodv pdr is 98%, and dsr pdr is 97 %, so the result says our proposed system has a higher packet delivery rate compared to aodv and dsr.
From the figure 4 it is observed that the throughput of propose system compared with aodv and dsr, from the result it is observe that the throughput proposed system is 95kbps, where the aodv throughput is 95kbps and dsr throughput is 88kbps so the result says proposed system has higher throughput compared to aodv and dsr. From the figure 5 it is observed that energy consumption of our propose system compared with aodv and dsr, from the result we observe that energy consumption of our propose system is 150 joules where the aodv energy consumption is 172 joules and dsr energy consumption is 173 joules so, the result says our proposed system has a lower energy consumption compared to aodv and dsr.

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