Improved AODV Based on Energy Strength and Dropping Ratio

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***Abstract*—Wireless Sensor Networks are the latest trends in the market due to the demand for communication and networking among the wireless network devices. The routing protocols are used in the Wireless Sensor Networks for efficient communication of data between sensor nodes. The designs of routing protocols in Wireless Sensor Networks are very concern because they are influenced by many challenging factors. To design the networks, the factors needed to be considered are the coverage area, mobility, energy power consumption, communication capabilities etc.. Broadcasting is an inevitable operation in the route discovery phase of AODV protocol. A probability based AODV is proposed, it uses nodes remaining energy and threshold random delay to generate the rebroadcasting of route request packet. The route request packet of AODV is modified to gather nodes remaining energy strength. The performance of probability based AODV is compared with AODV over packet delivery fraction, normalized routing overhead, delay and average acquisition latency.**

NS-2 based simulator is used to evaluate the performance of routing protocol.

Keywords: **AODV(Ad-hoc on demand vector), WSN(wireless sensor networks), RREQ(route request)**

I. INTRODUCTION

Wireless Sensor Networks have emerged as an important new area in wireless technology. A wireless network consisting of tiny devices which senses and monitor physical or environmental conditions such as temperature, pressure, motion or pollutants etc...when placed at different areas, They are self-organize and are connected with each other through wireless links .These nodes communicate with each other through multihop communication.

Features of sensor networks are self-organizing capabilities, dynamic network topology, limited power, node failures and mobility of nodes, short-range broadcast communication and multi-hop routing, and large scale of deployment. The strength of wireless sensor network lies in their flexibility and scalability. They also deployed in an ad-hoc fashion in remote location without the need of any existing infrastructure.

The basic issues of WSN like, sensing range, placement or deployment pattern, computational power, memory, battery power and the transmission capacities, the energy consumption by a node is a critical aspect, in order to increase the network life time [4]. In WSN, a sensor node may simultaneously sense, process and transmit data. In most cases it is very difficult to recharge or change the battery as it is having finite energy. Sensor nodes are useless when the batteries are drained. Thus, it is critical and challenging to design long lived WSN with the energy constraints.

Routing protocols are a key feature of any network. They enable each node to learn about the other nodes in order to find a link to their destination. Because some nodes could be mobile in wireless sensor networks (WSNs), routes between nodes change very often. Therefore, it is not possible to establish fixed paths and infrastructure between nodes. Routing in sensor networks is very challenging due to several characteristics that distinguish them from communication and wireless networks [2].

The routing protocols for Wireless networks have been classified into two categories [2]: *table-driven protocols and on-demand protocols*. They differ from each other on the way they obtain the routing information. The table driven protocols usually maintain the routing table of the whole network whereas the on-demand protocols only try to keep routes whenever it is required. A third category hybrid protocols, is also there which combines both table driven and on-demand protocol.

II. LITERATURE SURVEY

Different broadcasting protocols are designed in order to minimize the number of rebroadcast packets. In Paper[8], AODV is essentially a combination of both DSR and DSDV. It is works on *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.

In Counter-based broadcasting (CB) [7] protocol predefines a relay counter threshold (CH). After receiving a rebroadcast packet first time, the node initiates a counter C = 1 and sets a random relay delay (RRD), $0<RRD<T_{max}$. Before the RRD expires, the node increases C by one whenever it receives a redundant packet. When the RRD expires, the node would drop this packet if C CH. Otherwise, the packet is

relayed. The performance of counter-based protocol mainly depends on the selection of CH.

W. Peng et al. [9] and Lim et al. has proposed two different neighbor-knowledge-based approaches. These approaches require mobile hosts to periodically exchange HELLO messages between neighbors. Neighbor-knowledge-based approaches make rebroadcast decisions based on the available neighborhood information. Therefore, the number of rebroadcasts may be near optimal but HELLO messages themselves consume channel bandwidth.

Ni et al. [7] also discussed area-based algorithms, distance-based and location-based approaches. Area based algorithms require support from GPS or other location devices. In distance-based approach, a mobile node rebroadcast the received broadcast packet only if the distance between this node and the neighbor node is more than a threshold value.

The dynamically probability calculating protocols[10,9,12] are also proposed because predefined probability protocols[13] are not able to deliver better results. These predefined probability base protocols are not able to serve in all scenarios of network as dense and sparse network topology.

Here, an approach is proposed that combines the advantages of probabilistic and packet energy to dynamically generate rebroadcast probability to yield higher throughput, better reach ability, and lower latency.

III. AODV

Ad-hoc On-demand distance vector (AODV) discovers routes whenever it is needed by route discovery process using traditional routing tables; one entry per destination. AODV uses a broadcast route discovery algorithm and then the unicast route reply massage for finding the route[5].

Route Discovery: When a node wants to send a packet to some destination node and does not have 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 Neighbours, which then forwards the request to their neighbours and so on. Nodes generates a Route Request with destination address, Sequence number and Broadcast ID and sent it to his neighbour nodes. . Each node receiving the route request sends a route back (Forward Path) to the node.

Route Reply: 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.

Route Maintenance: A route established between source and destination pair is maintained as long as needed by the source. When a link break in an active route is detected, the broken link is invalid and a RERR message is sent to other nodes. 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.

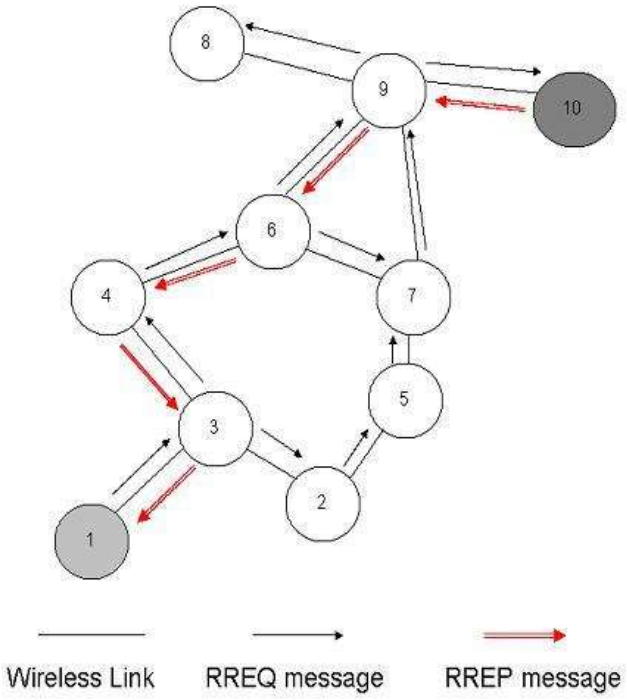

Fig 1. AODV route discovery process

IV. PROBABILITY BASED AODV

Probability based Broadcasting technique for routing protocol is proposed to trim down flooding problem. It uses node s remaining energy strength and threshold random delay to generate rebroadcast probability dynamically for the efficient broadcasting in route discovery. This technique is analyzed over reactive Adhoc On-Demand Distance Vector (AODV) protocol. The route request (RREQ) packet of AODV is modified to gather energy information of nodes. The performance of modified protocol is analyzed over broadcast packets sent and End-to-End Delay using ns2 simulator.

The objective of the Probability based Broadcasting technique is to find an efficient probabilistic based broadcasting protocol which controls the rebroadcasting of received broadcast packets. This protocol is based on the fact that the extra coverage area by the rebroadcasting of a node is inversely proportional to the number of broadcast packet it has received. This proposed protocol is implemented on the

AODV. The AODV is broadcasting route request (RREQ) packet to search the route from source to destination. In order to collect node s current remaining energy information and dropping information as two additional fields that are added in the RREQ packet format, thus the format for the RREQ packet is modified.

A. Modified RREQ Packet

The Probability based Broadcasting technique uses modified RREQ packet frame for storing nodes remaining energy strength as shown in following figure. Two field of 4 byes is added to store node energy strength S_i and dropping ratio D_i of node i. The additional memory used for this are very nominal out of 32 bytes of RREQ packet frame. This modified RREQ packet is used for broadcast in route discovery. At each intermediate node this fields will be updated for the remaining energy strength and dropping ratio at the time of rebroadcast. Packets are rebroadcasted with this probability

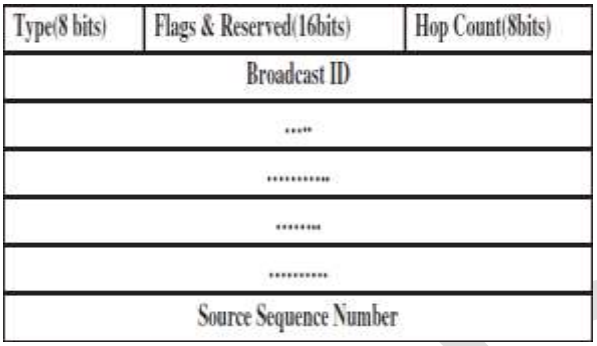

Fig. 1. Frame of AODV RREQ packet

B. Methodology of Probability Based Broadcasting Technique

Based on the number of received broadcast packets and energy strengths, the probability is calculated as follows: After receiving the broadcast packet at node i for for the first time with remaining energy strengthS0, the node sets a random relay delay [0, Tmax]. During this delay, it receives all the rebroadcast packets having energy strength more than Sth, receive energy threshold. Suppose these are another n-1 redundant packets with energy strength S1, S2, ,Sn-1, respectively. After the random delay expires, this node relays this broadcast packet with probability:

.

P =f(n)*E(S)*D(s)

where, $f(n) = \frac{1}{n}$, $E(s) = \frac{S_{min}}{S_{max}}$ *and* $D(s) = \frac{D_{max}}{D_{min}}$

$S_{max} = max(S_0, S_1, \dots, S_{n-1})$ $S_{min} = min(S_0, S_1, \dots, S_{n-1})$

$D_{max} = max(D_0, D_1, \dots, D_{n-1})$ $D_{min} = min(D_0, D_1, \dots, D_{n-1})$

Smax = max(S0,S1, , Sn-1), Smin = min(S0,S1, , Sn-1)

The f(n) and E(S) are monotonously decreasing functions and are always less than and equal to 1. The probability P is guaranteed to be less than 1 as both functions are also $f(n) \leq 1$ and $E(S) \leq 1$ always.

Type (8 bits)	Flags & Reserved (16bits)	Hop Count (8bits)
Broadcast ID		
……		
……		
……		
Source Sequence Number		
Node Remaining Energy strength Si (Added New Field)		
Dropping ratio D_i(Added New Field)		

Fig. 4. Modified frame of RREQ packet for probability based broadcasting technique

C. Algorithm for Probability Based Broadcasting Technique

Initialize Counter = 0
While (Broadcast Packets are arriving)
{
Receive Broadcast packet P
if ((Node Energy Strength of P $\geq S_{th}$)&& (Packet Drop Ratio $\leq D_{th}$))
{
if (packet P is first)
$S_{max} = S_{min}$ = Node Energy Strength of P
$D_{max} = D_{min}$ = Drop ratio of P
Counter ++
Set threshold Random Delay T [0, Tmax]
else
{ if (threshold Random Delay T is **not** expired)
{ Counter ++
if ((Node Energy Strength of P > S_{max}) && (Dropping ratio of P > D_{max}))
S_{max} = Node Energy Strength of P
else if ((Node Energy Strength of packet < S_{min}) && (Dropping ratio of P < D_{min}))
S_{min} = Node Energy Strength of P
}
else
{
n = counter
f(n) = 1/n
E(S) = S_{min}/ S_{max}
D(s)= D_{max}/D_{min}
Probability p = f(n)*E(S)*D(S)

```
                    Broadcast packet P with probability p
                    exit
                }
            }
}
else Discard packet P
```

D. Advantages of Proposed AODV

1) Controls rebroadcast packets and drops number of it based on dynamic probability that results in much less overhead
2) Proposed protocols ensure broadcasting coverage with less number of redundant RREQ packets
3) Uses minimum energy to increase network lifetime.
4) Chooses reliable path avoiding transmitting nodes that is having high drop ratio

TABLE I
SIMULATION PARAMETERS

S.No	Parameters	Values
1.	Channel	Wireless
2.	Propagation	Two Ray Ground
3.	Mac Protocol	802.11
4.	Routing Queue	Drop tail
5.	Antenna	Omni Directional
6.	Energy Model	Battery
7.	Initial energy	1J
8.	Received power	0.3J
9.	Transmitted power	0.6J
10.	Simulation area	1000*1000
11.	Number of nodes	100(fixed)
12.	Pause time	0ns
13.	Simulation stop time	100ns
14.	Mobility	20,30,40,50,60

The analysis of AODV protocol and probability based AODV is performed, where the number of parameters are set for common nodes as shown in Table I. By using these parameters both the protocols are simulated and the performance is evaluated based on the performance metrics discussed above.

V. CONCLUSION

In this paper Probability based Broadcasting technique is proposed and analysed on AODV routing protocol for Wireless Sensor Networks. The proposed protocol controls rebroadcast packets and drops number of it based on the probability that results in much less overhead than AODV. This protocol uses the minimum energy strength of nodes to calculate the broadcast probability. It is observed that the simulated results the packet delivery fraction is good for probability based AODV than AODV, but end to end delay is high in probability based AODV.

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