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Comparison Analysis of New Routing Protocol based on Reward Based Technique in AODV with other Routing Protocols

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ABSTRACT: Wireless mobile ad-hoc networks are characterized as networks without any physical connections. In these networks there is no fixed topology due to the mobility of nodes, interference, mulitpath propagation and path loss. Hence a dynamic routing protocol is needed for these networks to function properly. In this paper, various routing protocols i.e. Reward based method , other routing protocols & Reputation based methods for routing has been compared in MANET. In the end it will be analyzed that which algorithm is best suited for routing as per the parameters such as mobility of nodes, overall throughput of the network, total number of hops to reach the destination, total Bandwidth of the network and many more.

KEYWORDS: Routing, MANET, Routing protocols, Reward based method, Reputation based method.

I. INTRODUCTION

Ad hoc network is the network that consists of the access points and routers in dynamic manner. In addition to transmitting the packets in the network, wireless devices also aimed to route the data packets in determined manner [1]. In MANET the nodes has limited batter as well as power supply. So for proper routing, they have to share resources with each other for forwarding of the packets. In case nodes are selfish and do not cooperate with each other, the network will be unable to transmit multi-hop data packets [2]. Even if only a few nodes are willing to forward, multi-hop transmission will be limited, and the system will unfairly use up the power of these cooperative nodes for forwarding. Various cooperation enforcement approaches have been proposed for nodes to cooperate in sharing out their battery power for forwarding [3]. These may be classified as:

- Reputation-based,
- Reward-based or
- Behavioral-based systems.

Nodes in these systems are made to play a game of decision making (of whether to forward or not) that will also affect their self-transmissions. While encouraging forwarding, a balance must be maintained between forwarding and self-transmissions.

Routing algorithms must be robust, which means that they should perform correctly in the face of unusual or unforeseen circumstances, such as hardware failures, high load conditions, and incorrect implementations. Because routers are located at network junction points, they can cause considerable problems when they fail. The best routing algorithms are often those that have withstood the test of time and that have proven stable under a variety of network conditions [4, 5, 6].

In this paper, we propose comparison analysis based on reward-based approach with reputation based method to encourage forwarding, and a forwarding rule that increases self-transmission in system.

Below figure shows the routing process in MANET. It has been shown that how ipv4 routing protocol works in the IP network [7].

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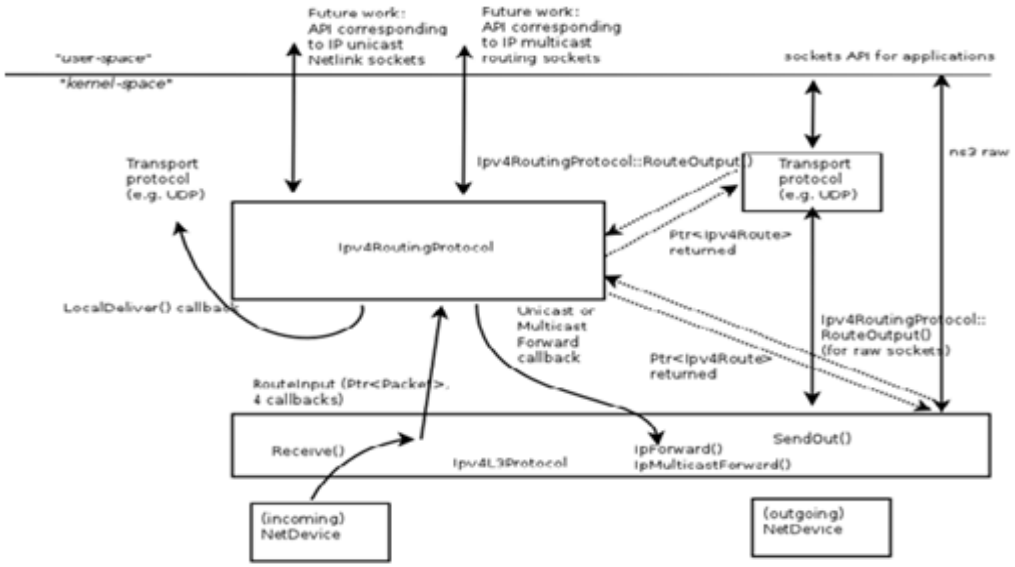

Figure.1 Routing Architecture[7]

II. ROUTING PROTOCOLS

Routing protocols determine a few policies which often governs the particular destination of communication packets by supply in order to destination spot in the network. Within MANET, you can find several types of routing protocols every one of them is employed based on the network situation. Figure.2 demonstrate principle classification from the routing protocols in MANET [15].

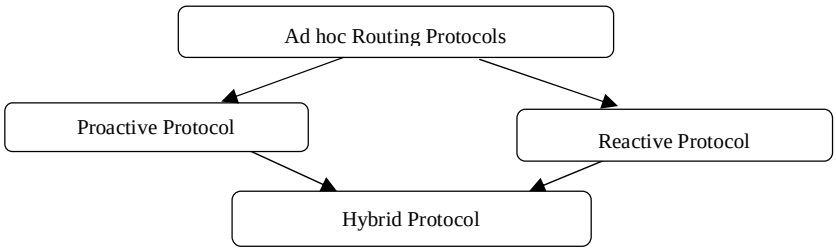

Figure.2 Routing Protocols

A. Proactive Routing Protocols

Proactive routing protocols will also be termed while table motivated routing protocols. On this every node preserve routing table which often is made up of specifics of the particular network topology also devoid of needing it. This characteristic while a good choice for datagram targeted traffic, incurs substantial signaling targeted traffic and energy usage. Your routing furniture are updated regularly every time the particular network topology improvements. Proactive protocols are certainly not made for huge networks while they must preserve node records for each and every node from the routing table of each and every node. These protocols preserve diverse quantity of routing furniture various by protocol in order to protocol. There are numerous well-known proactive routing protocols. Illustration: DSDV, OLSR, WRP etc [16].

i. Dynamic Destination-Sequenced Distance-Vector (DSDV)

DSDV is produced judging by Bellman–Ford routing algorithm together with several changes. On this routing protocol, every single mobile node from the network keeps some sort of routing table. Each one of the routing table

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contains the set of just about all accessible locations and the quantity of hops in order to every single. Each and every table gain access to be marked using a collection quantity, and that is started from the destination spot node. Routine transmissions of updates from the routing furniture help preserving the particular topology details from the network. If you experience any new major change for that routing details, the particular updates are transmitted instantly. So, the particular routing details updates may both always be routine as well as affair motivated. DSDV protocol calls for every single mobile node from the network in promoting a routing table in order to its latest neighborhood neighbors [17]. Your advertising is done both by simply broadcasting as well as by simply multicasting. With the advertisements, the particular neighboring nodes can easily be familiar with any change which includes took place from the network a result of the actions of nodes. Your routing updates could possibly be sent in two routes: is termed some sort of "full dump" and one more is "incremental". In case of entire eliminate, the full routing table is provided for the particular neighborhood neighbors, where as in case of incremental replace, simply the particular records that want improvements are sent.

B. Reactive Routing Protocols

Reactive routing protocol is also known as on demand routing protocol. On this protocol route is identified every time it can be desired Nodes start route breakthrough upon requirement foundation. Supply node recognizes its route cache for that accessible route by supply in order to destination spot in the event the route is not accessible subsequently that initiates route breakthrough process. The on- requirement routing protocols possess two important ingredients [21]:

Route discovery: In this phase source node initiates route breakthrough upon requirement foundation. Source nodes consults it's route cache for that accessible route by source in order to destination spot in any other case in the event the route is not provide that initiates route breakthrough. The origin node, from the packet, contains the particular destination spot deal with from the node too deal with from the second time beginners nodes towards the destination spot.

Route maintenance: Due to dynamic topology from the network circumstances from the route inability relating to the nodes occurs due to link the break point and so on, and so route maintenance is done. Reactive protocols possess acknowledgement system due to which often route maintenance is achievable [22].

Reactive protocols add latency towards the network a result of the route breakthrough system. Each and every second time beginners node mixed up in route breakthrough process gives latency. These protocols decrease the particular routing cost although with the cost of elevated latency from the network. That's why most of these protocols are appropriate from the conditions where reduced routing cost is essential. There are numerous well-known reactive routing protocols contained in MANET for instance DSR, AODV, TORA and LMR.

i. Adhoc On Demand distance vector (AODV)

AODV routing protocol was presented based on DSDV and the improvement for on-demand routing mechanism in DSR. It hasn't only the advantages of DSDV and DSR, but also its own characteristics, which makes it become a widely used routing protocol. In fact, if the network has light load, AODV routing protocol runs effectively. However, its performance becomes worse sharply in the case of high load. This is because when choosing a route, AODV routing protocol only pays attention to the path that is the shortest without considering the energy and load of the nodes. So when AODV routing protocol chooses the routes, it is very necessary to considerthe residual energy and the load situation of the nodes.

C. Hybrid Routing Protocol

There is a trade-off among proactive and reactive protocols. Proactive protocols possess huge overhead and a smaller amount latency whilst reactive protocols possess a smaller amount overhead and much more latency. So some sort of Hybrid protocol is introduced in order to get over the particular weak points of both proactive and reactive routing protocols. Hybrid routing protocol is mix off both proactive and reactive routing protocol. This makes use of the particular *route* breakthrough system of reactive protocol and also the table maintenance system of proactive protocol to be able to stay clear of latency and overhead issues from the network. Hybrid car protocol would work for huge network where large numbers of nodes exist. On this huge network is divided straight into number of specific

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zones where routing in the sector is performed by utilizing reactive tactic and outside the sector routing is done utilizing reactive tactic. There are numerous well-known hybrid routing protocols for MANET similar to ZRP, SHARP [23].

i. Zone Routing Protocol (ZRP)

ZRP would work for wide variety of MANETs, specifically the particular sites together with huge span and assorted mobility designs. On this protocol, every single node proactively maintains avenues within a local spot, and that is termed as routing sector. Path formation is done by using a query-reply system. Pertaining to developing diverse specific zones from the circle, some sort of node first has to know who it'sneighbours are. Some sort of neighbour pertains to some sort of node together with whom primary connection could be established, that is, within one hop transmission choice of some sort of node. Neighbour breakthrough details can be used as a foundation for Intra-zone Routing Protocol (IARP). As an alternative to blind broadcasting, ZRP utilizes a query command system to cut back *route* query traffic by simply pointing query messages outward through the query source and far from protected routing specific zones. Some sort of protected node is a node which often belongs to the routing sector of a node which includes acquired some sort of *route* query. Over the forwarding from the query packet, some sort of node pinpoints whether it be originating from its neighbour as well as certainly not. In the event that sure, subsequently that marks every one of its regarded neighbouring nodes in its similar sector while protected. Your query is as a result relayed right up until that extends to the particular destination spot. Your destination spot in turn communicates back again a reply communication via the particular reverse course and makes the particular route [24].

III. REWARD BASED SYSTEMS

Reward-based systems reward a node with credits that forwards for other nodes, so it can use the credits to pay other nodes for its multi-hop self- transmission. One implementation is the use of a nuglet counter maintained at each node, where nuglet is a virtual currency [8]. When a node needs to transmit a self-generated data packet, its nuglet counter will be decremented. But the counter can be incremented again when this node forwards data packets for other nodes. When the nuglet counter goes to zero, which means a node has transmitted more self-generated packets than forwarded packets, it will not be allowed to transmit any more self-generated packets until it has earned enough credits by forwarding packets for others. The Nuglet system focuses only on developing a packet forwarding strategy. Routing strategies like route discovery and route maintenance processes of on-demand routing protocols have not been addressed. To prevent misuse and cheating, a trusted and tamper resistant hardware module must be present in each node [25].

Consider the following forwarding strategy for a reward-based approach in a simple system. In our cost–credit game model, each 'player' or node will be given CI cost–credit units (CCUs) and B battery units (BUs) initially. There are two 'strategies' that a node can play when a transit packet reaches it: either to forward or not to forward. If the node forwards a transit packet, it will earn c CCUs but loses b BUs. If it does not forward then it will neither earn any CCUs nor lose any BUs. Here, nodes will definitely need to forward and earn credits at some point in time because of these two conditions imposed [9, 10]:

(i) CI is not large compared to B and has only a nominal value to get transmissions started,

(ii) if a node wants to transmit a self-generated packet, it needs to pay a cost of cr CCUs, on top of losing b BUs.

Let c(t) and b(t) be the respective CCUs and BUs available at a node at time slot t. This leads to a transmission rule (TR) [11]:

'If c(t) >cr and b(t) > b transmit a self-generated packet, else do not transmit'. In this simple model, c <cr, and cr, c and b are constant. Due to the self-regulatory nature, choosing a particular strategy (either to forward or not to forward) will directly affect a node's 'payout' that reflects how many self-generated packets it can transmit. Consider a node which has already forwarded NF packets at time t. At time t, after forwarding NF packets, the total number of self-generated packets that it can potentially transmit is constrained either by the amount of cost–credit units it has (ac = (CI + NFc)/cr) or by the number of battery units it can allocate for self-transmission (ab = (B/b) NF), whichever is less. We can therefore define our payout function to be:

Wt = (min ac, ab) (1)

The best strategy for a node is to always forward a packet for others if this does not decrease its overall payout function. In other words, for a nominally time slotted system with unit slots, a node should forward at time slot t if its payout function will not decrease at time slot (t + 1) as a result of this, i.e. it should forward a packet at time slot t if w(t + 1) P w(t). A node may encounter three distinct situations at time slot t 'needs to be made:

Ab< ac (2)

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Ac+1> ab (3)
Ab> ac + 1 (4)

If it forwards under situations (a) and (b), we will get w(t + 1) < w(t). However, if it forwards in (c), then w(t + 1) P w(t). Therefore, a node should forward only if (c) holds, which is

$\frac{B}{b}$- Nf>$\frac{c1+Nfc}{Cr}$ + 1 (5)

Let NT be the number of self-generated packets transmitted by the node until time slot t. We will find that c(t) = CI + NFcNTcr and b(t) = B (NF + NT)b, so substituting into will give

$\frac{Ct}{Cr}$<$\frac{B\ t}{b}$– 1 (6)

In this simple system, if a node knows its current cost–credit and battery levels, by evaluating (3), it can make a good forwarding decision. Based on this packet forwarding strategy, we can formulate a forwarding rule (FR) for this system as: 'If $\frac{Ct}{Cr}$<$\frac{B\ t}{b}$– 1 (7)
forward a packet, else do not forward [12].

e.g.Q Learning Routing

It relies on a forward probabilistic exploration method. The ACK packet carries the maximum future reward (Q-value) as well as the timestamp needed to calculate the delay. When a node receives an ACK, it performs these steps:

1- Compute end-to-end delay using timestamps.
2- Calculate the reward
3- Update the Q-value
4- Get its maximum Q-value and attach it to ACK
5- Forward the ACK to next node.

This algorithm is performed K times, which is the number of nodes along the path. The "Get Max Q-value" procedure is executed m times, which is the number of neighbors to the node. Thus the total time complexity of the learning (update) algorithm for Q-CPN is O(K x m). The Goal Function of the routing process is a common goal for all agents (nodes) in the network. The goal is to minimize a combination of the delay and the node's Associativity Ratio [25].

IV. REPUTATION BASED SYSTEMS

Every node estimates how well another nodes behavesregarding the forwarding of messages. We call reputation(R) such an estimation. The range of R is [0, 1]. The lowerR, the higher the probability that the node is a blackhole. R is a local notion because it is calculated by each nodeon the basis of its own network experience. In other words,there is no global consensus on the reputation of a givennode. This is in order to save the node energy and avoidboth the traffic overhead and the technical complicationsdue to the achievement of such a consensus. By Rij we denotethe reputation of node i calculated by node j. Everynode j calculates the reputation Rij of every node i it meets,as described below [13].

Let Ui be the Utility Function of i and Rij be the reputation of node i at node j,then the Local Utility Function, Lij, is given by:

Lij = Rij * Uij (8)

Intuitively Lij represents how capable of forwardingmessages node j considers node i. Node j uses the local utilityfunction to choose a node. In practice, it chooses thenode i having the highest value of Lij as the forwarder ofa message. The rational basis of this choice is the following.Assume that a node i is a blackhole. Thus node j assigns alow reputation value to node i, i.e., Rij⇒0. It follows that the value of Lij⇒0 and thus j does not select i as a forwardingnode.

More formally, let D be the event ''node i delivers a message''and B the event ''node i is not blackhole''. The probabilityof successful message delivery P(D) is given by [14] theBayes theorem:

P (D) = $\frac{P\ (B)P(D|B)}{P\ (B|D)}$ (9)

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Where P(D|B) = Ui,
Where Ui is the Utility Function of node i.

This is because if a node is not blackhole (event P(B) = 1),the event D happens with a probability given by thechances of the node to forward a message (i.e. Ui). Furthermore, P(B) = Rij, where Rij is the reputation given by thenode j to the node i. This is because a node is not blackhole with a probability equal to its reputation. Thus we have:

$$P(D) = \frac{Rij\ U\ ij}{P(B|D)} \qquad (10)$$

but P(Bj,D) = 1 because if i forwards messages, i is not blackhole.

V. CONCLUSION

There are large number of packet forwarding methods like reward based, behavioural based, reputation based. But Reward based is best one. While encouraging forwarding, a balance must be maintained between forwarding and self-transmissions. Reward-based systems reward a node with credits that forwards for other nodes, so it can use the credits to pay other nodes for its multi-hop self-transmission. Also as reward-based systems can cope with any kind of observable misbehavior, they are useful in protecting a system. Reputation and trust-based systems enable nodes to make informed decisions on prospective transaction partners. Researchers have been steadily making efforts to successfully model WSNs and MANETs as reward based systems. One implementation is the use of a counter maintained at each node, where counter is a virtual currency. When a node needs to transmit a self-generated data packet, its counter will be decremented.

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