An Efficient Agent-Based AODV Routing Protocol in MANET

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***Abstract*—A MANET (Mobile Adhoc Network) consists of a collection of mobile nodes communicating with each other without any fixed infrastructure such as access points or base stations. MANETS are self organizing or self restoring. Network topology in MANETS is subject to continuous and precipitous (unpredictable) change. The limited bandwidth availability, energy constraints and highly dynamic topology make the routing process as exigent. The routing process in MANET relies (based) on the co-operation of individual nodes which constitute the network. In this paper, we have tried to remove the existence of misbehaving nodes that may paralyze or slows down the routing operation in MANET. This increases the efficiency of a network. Efficiency can be calculated by the parameters or factors such as transmission capacity, battery power and scalability. Here we are considering the most crucial factor named as transmission capacity of a node. In MANET, as the network size increases complexity of a network also increases. To overcome this we make network as modular. So the network becomes task specific which refer to a particular work only. This is the reason of infusing the concept of agents in an efficient network. This proposed protocol provides the most efficient and reliable route which may or may not be minimum hop count.**

Keywords- MANET, agents, network topology, AODV, secure, trusted.

I. INTRODUCTION

Mobile Adhoc Network (MANET) is collection of mobile nodes which communicate via multi hop wireless links. Therefore a distinct feature of mobile adhoc network is there reduced dependence on infrastructure. In MANET [1], all nodes are act as a router and host at the same time. The MANET networks are highly dynamic in nature (behavior). Due to which its consequences of mobility and disconnection of mobile host poses a number of problems in designing proper routing scheme for effective communication and routing between nodes. MANET routing protocols are classified into three broad categories: table driven (proactive), on-demand (reactive) and hybrid protocol [1]. It is very difficult for a node to perform routing and communication between nodes efficiently due to heavy responsibilities and dynamics nature of MANET. Structured aspect to routing protocols such as object oriented approach in software development has found a new direction. In this direction Agent Based Routing protocols are emerging, in which various processes of MANET are given as agent type structures.

Agents are task – focused entity working autonomously to perform the assigned task to achieve optimal results. Now the concept of agent is introduced to manage the node responsibilities. Also it is very challenging to make efficient communication between nodes. The protocol Efficient Agent Based- AODV (AB-AODV) uses the on-demand capability of AODV routing protocol and a distributed topology discovery mechanism using mobile agents with transmission-capacity (T-C) value. The Mobile agents have the ability to support asynchronous communication and flexible query processing. Therefore, the host node can assign the task to mobile agent and when the agent feels that there is a communication availability with the best T-C value path, then it fulfill the task successfully. In this way, a mobile node requires less communication connectivity than it would need in traditional AODV routing protocol.

In section II, we will discuss briefly an AODV protocol and its advantages. Section III describes the related work. Section IV contains the proposed protocol model that is Efficient AB-AODV. Future scope and conclusion is discussed in section V.

II. AODV ROUTING PROTOCOL

AODV routing protocol [4][3][5] is a reactive. AODV is based on-demand routing scheme which states that it (nodes) discovers a path only when the need arises. AODV requires host node to maintain only active routes. An active route is used to forward atleast one packet within the past time out period. It is free from loops, by using the concept of sequence number to ensure that chosen route is always fresh enough.

In AODV, each node maintains a routing table which contains one route entry for each destination that the node is communicating with. It has two phases: Route Discovery and Route maintenance. *Route Discovery:* when the host node needs to send a packet to destination and doesn't contain an active route to the destination node in its routing table. It broadcast a route request (RREQ) packet to its neighbors. During the process of forwarding the RREQ packet, all the intermediate nodes record, in their routing tables, the address of neighbor from which the first copy of the broadcast is received, thereby establishing the reverse path. When the RREQ reaches the destination or an intermediate node with fresh enough route, the destination/intermediate nodes responds by unicasting a route reply (RREP) packet back to the neighbor from which it first received the RREQ. The second phase for AODV is the *route maintenance*, where routes are maintained in the following manner: if a source node move, it is able to reinitiate the route discovery process to find a new route to the destination node. Also if a node along a route moves, its upstream neighbors notice the move and propagates a ink failure notification or route error message (RERR) to each of its active neighbors so that they can update their routing table.

III. RELATED WORK

Manal Abdullha and Helen Bakhsh [2] work focuses on improving the performance of the routing process by using the concept of mobile agent to make routing decision better. It proposed a new routing protocol ARPM (Agent based dynamic Routing System for MANETS. ARPM is a protocol which makes the node in the network topology aware.

Amin [10] proposed Agent-Based distance Vector Routing (ADVR). The agent-based solution is proposed in this work replaces the routing messages in the network with an active population of agents. Multiple agents communicate with each other using the synthetic pheromones. The population of agents can be changed dynamically at the run time; they can dynamically terminate themselves as a function of pheromone value detected at the node.

In **lei-chen and wendi B.Heinzelman** [11] work focuses on exploring different ways to estimate the available bandwidth, incorporating a QoS-aware scheme into the route discovery procedure and providing feedback to the application through a cross-layer design. Lei-chen and wendi use two methods for estimating bandwidth in this paper. One is for hosts to listen to the channel and estimate the available bandwidth based on the ratio of free and busy times ("Listen" bandwidth estimation). The other is for every host to disseminate information about the bandwidth it is currently using in the "Hello" messages, and for a host to estimate its available bandwidth based on the bandwidth consumption indicated in the "Hello" messages from its two-hop neighbors ("Hello" bandwidth estimation).

IV. EFFICIENT AGENT BASED – AODV ROUTING PROTOCOL

A. Agents

Agents are the software program or entities that run on a node or system to perform specific task. This task is assigned by the network architecture in the protocol. An agent manifests for distinct characteristics namely: intelligence, communication, autonomy and mobility. There are two types of agent: 1. Static agent and 2. Mobile agent.

1. ***Static Agents*** are the types of the agents that reside on the particular system or node, and then perform the assigned task to it. Static agents are permanent resident of a node which will act like interactive host .It performs the following functions:-

a. It will manage entry for each visited mobile agent with their Id in its table.

b. It will extract updated information from mobile agent table.

c. Perform the updates on the node where it is residing.

2. Mobile Agents **[6] [7]** are design to move from one node to other node in a specific manner to perform the task or function.

a. Generally the core function of the mobile agent is to make all the nodes in the network topology aware and secure communications.

b. It will compute the transmission capacity of each node in the network.

B. Description of Efficient AB – AODV Routing Protocol

In this section, we propose an innovative Efficient Agent - Based Adhoc On-Demand routing protocol (AB-AODV) for MANET. The purpose of Efficient AB-AODV selects the most efficient [8] [9], minimum overhead and may be minimum hop count route from the different possible routes. The mobile agent paradigm has attained the attention from many field of Computer Science in Wireless communication.

The proposed scheme uses mobile agent that can move in the adhoc network to discover the network topology and collects or updates the routing table. Also it will evaluate transmission capacity value for each node by a formula discussed later. This would be performing by the fusing of mobile agent at every node which computes routing information. The static agent that runs in a host node supplies the require information to the visiting mobile agent. Therefore the proposed protocol uses a Monitoring Agent System (MAS) and Routing Agent System (RAS) to achieve the required task.

MAS are responsible for monitoring the host node behavior and activities like calculating transmission capacity value of a node including in the routing process. Efficiency can be achieved by using the transmission capacity value of a node. ***RAS*** is responsible for using the already calculated transmission capacity information and finding out the most reliable and efficient route for a destination. When a mobile agent wants to find the most efficient path, it moves from one node to another node. Therefore each mobile agent should have a unique *mobile ID* and carries the briefcase which contains all the possible routing information needed during the movement of agent. Also a host node contains the routing cache which is updated by the stationary agent. Routing cache also contain the data in its storage area as shown in Fig. 1. The R (i) is a particular routing process i started by a mobile agent with unique ID.

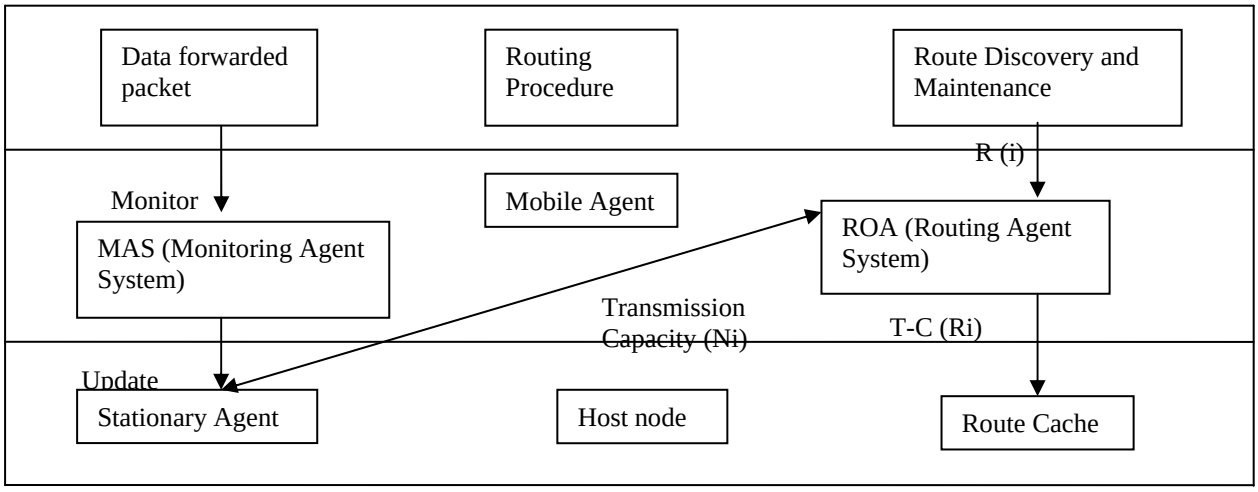

Figure 1. Node Agent System in ABT-AODV

The development of our transmission capacity value calculation is based on the Secure and Objective Reputation based Incentive (SORI) basic scheme [12]. In that scheme monitoring of neighbor node is used to collect information about the packet forwarding behavior of all the neighbors. Due to the promiscuous mode they consider, a node may be capable of overhearing the transmissions of its neighbors. Therefore with this capability, a mobile node *N* can maintain a neighbor node list (denoted by NNL_N) which contains all of its

neighbor nodes that node *N* learned by overhearing. Also, node *N* keeps track of two numbers, for each of its neighbor (denoted by *M*), define as below:

- $FN_N(M)$ *(Request-for-Forwarding):* The total number of packets that node *N* has transmitted to node *M* for forwarding.
- $FT_N(M)$ *(Has-Forwarded):* The total number of packets that have been forwarded by node *M* and noticed by node *N*.

These two numbers are updated by the following rules. When node *N* sends a packet to node *M* for forwarding, the counter *FNN (M)* is increased by one. Then node *N* listens to the wireless channel and check whether node *M* forwards the packet as expected. If node *N* detects that node *M* has forwarded the packet before a preset time-out expires, the counter $FT_N(M)$ is increased by one.

$C_N(M)$ is a metric called confidence, used to describe how confident node *N* is for its judgment on the reputation of node *M*. In SORI, $C_N(M) = FN_N(M)$; that is the more packets transmitted to node *M* for forwarding, the better estimation about how well the neighbor M does forwarding. $C_N(M)$ is used by mobile agent to take decision in efficient routing. To reflect this kind of node's selective for forwarding behavior, Efficient AB-AODV computes transmission capacity of a node M as:

$$\text{Transmission} - \text{capacity (M)} = \frac{\text{FN (M)*pkt-size (FN (M))}}{\text{FT (M)*pkt-size (FT (M))}} \qquad (1)$$

Here FN (M): total number of packets that have been forwarded by node M.

FT (M): total number of packets that all nodes have transmitted to node M for forwarding.

Pkt-size (FT (M)): total size of packet FN (M).

Pkt size (FT (M)): total size of packet FT (M)

For each arbitrary node N_i, its MAS, locally maintains a transmission capacity evaluation table with the help of T-C (M). The trust value is calculated by the above mentioned formula. Mobile agent has the duty of calculative this T-C (M) and passes this value back to the stationary agent in the host node.

C. Example of Efficient AB– AODV Routing Protocol

In this example, functioning of the proposed protocol Efficient AB - AODV is shown below:

1. Each node has two agents: static and mobile agents.

2. Static agent always resides on a node and maintains entry for each visited mobile node in its routing table.

3. A mobile agent visits to the static agent to inform the network topology updates and has a responsibility of computing the transmission capacity value for each node.

4. Static agent makes updates in the routing table of node.

5. Static agent chooses the maximum (best) transmission capacity value of node for routing to a destination node.

In the Fig. 2, node 1 (source) wants to send the data to node 6 (destination), it first check its routing table whether a route with greatest transmission capacity value of a node 6 which may or may not be minimum hop count is available or not. If efficient route is available in its routing table, it will send the data to node 6. Otherwise it will execute or call the static agent on its system for fresh enough route to a destination node 6. Here static agent waits for mobile agent to visit with updated information so that it will extract the all the updated information. It will make all the changes in its routing table and node's routing table. Mobile agent first finds all routes to node 6 and chooses best (greatest) transmission capacity value for a efficient and reliable route. In the Fig. 2, routes available for destination node 6 are: route1 is 1-2-3-6, route2 is 1-4-6, route3 is 1-5-6, route4 is 1-4-3-6, and route5 is 1-5-4-6. Mobile agent computes the transmission capacity of each node on the basis of formula described in equation (1). We assume that total no of packets that have been forwarded by node 2, 3, 4, 5 are 5, 13, 15, 10 respectively and total no of packets that all nodes have transmitted to node 2, 3, 4, 5 for forwarding are as 10, 16, 10, 12 respectively. However packet size may vary but for ease of showing we are considering the fixed packet size is 512 bytes.

Node (2) = (5*512) / (10*512) = 0.5

Node (3) = (13*512) / (16*512) =0.8

Node (4) = (15* 512) / (10* 512) = 1.5

Node (5) = (10* 512) /(12* 512) = .833

All these nodes transmission capacity value is stored in mobile agent table. Static agent takes this information and chooses the route 2 with greatest transmission capacity value 1.5 although route has minimum hop count.

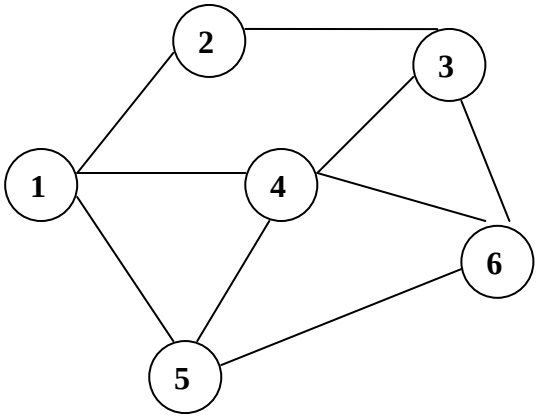

Figure 2. Mobile adhoc network

V. CONCLUSION AND FUTURE SCOPE

The infrastructure less and dynamic nature of MANET demands new set of networking analysis in order to provide diverse application in many different scenarios. So, it is possible that some application demands less overhead as well as fast processing with efficient transmission. This paper, presents the protocol being proposed which utilizes the dual cooperative mobile agents and stationary agents for routing in dynamic networks as MANET. It also provides the transmission capacity factor into the networking as MANET. Each node has its own stationary agents but number of mobile agents in the network depends on the network architecture or the protocol used. Every mobile agent computes the transmission capacity of all the nodes so that Routing Agent System (RAS) can take the decision which routing path is more efficient and reliable also. Here we have presented the analysis of proposed protocol Efficient AB – AODV and evaluation of simulation is considered in future.

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