Intelligent Agents for Source Decision Making Process in MANET

Rambabu Yerajana
Dept of Electronics and Computer Engineering
Indian Institute of Technology Roorkee
Roorkee, India
rambabuwhy@gmail.com

A.K. Sarje
Dept of Electronics and Computer Engineering
Indian Institute of Technology Roorkee
Roorkee, India.
rambabuwhy@gmail.com

Abstract—in this paper, we propose a new Intelligent Agent based Multipath routing protocol for ad hoc wireless networks, which is based on the DSR (Dynamic Source Routing)-On demand Routing Protocol. Congestion is the main reason for packet loss in mobile ad hoc networks. If the workload is distributed among the nodes in the system, based on the congestion of the paths, the average execution time can be minimized and the lifetime of the nodes can be maximized. We propose a scheme to distribute load between multiple paths according to the congestion status of the path. This protocol uses intelligent agent to obtain the congestion status of the nodes. Our simulation results confirm that the proposed protocol-IASR improves the throughput and reduces the number of collisions in the network.

Keywords- Ad hoc networks, Congestion Control, Intelligent Agent, routing protocols.

I. INTRODUCTION

A Mobile Ad Hoc Networks (MANET) is a collection of mobile nodes that can communicate with each other using multi hop wireless links without utilizing any fixed based-station infrastructure and centralized management. Each mobile node in the network acts as both a host generating flows or being destination of flows and a router forwarding flows directed to other nodes. In this case a network is formed dynamically through the cooperation of an arbitrary set of independent nodes. There is no prearrangement regarding the specific role each node should assume .Instead, each node makes its decision independently, based on the network situation, without using a preexisting network infrastructure. Routing protocols for Ad hoc networks can be classified into three categories: proactive, on-demand also called reactive, and hybrid protocols [7, 8]. The primary characteristic of proactive approaches is that each node in the network maintains a route to every other node in the network at all times. In Reactive routing techniques, also called on-demand routing, routes are only discovered when they are actually needed. When a source node needs to send data packets to some destination, it checks its route table to determine whether it has a route to that destination. If no route exists, it performs a route discovery procedure to find a path to the destination. Hence, route discovery becomes on-demand. Dynamic Source Routing (DSR) and Ad hoc On-demand Distance Vector (AODV) routing protocols are on demand routing protocols our proposed protocol is based on DSR protocol.

The rest of this paper is organized as follows. Section 2 gives a brief introduction to DSR protocol and our proposed routing protocol IASR. In section 3**,** the performance comparisons between IASR and DSR are discussed. Section 4 concludes the routing algorithm.

II. DYNAMIC SOURCE ROUTING PROTOCOL

In this basic protocol, if a node has a packet to transmit to another node, it checks its Route Cache for a source route to the destination [1, 6, 7 and 8]. If there is already an available route, then the source node will just use that route immediately. If there is more than one source route, the source node will choose the route with the shortest hop-count, 'Source Route' at the source node includes list of all intermediate traversing nodes in the packet header , when it desires to send the packet to destination in an ad hoc network. Source node initiates route discovery, if there are no routes in its cache. Each route request may discover multiple routes and all routes are cached at the source node.

The Route Reply packet is sent back by the destination to the source by reversing the received node list accumulated in the Route Request packet. The reversed node list forms the 'Source Route' for the Route Reply packet. DSR design includes loop free discovery of routes and discovering multiple paths in DSR is possible because paths are stored in cache [6, 8]. Due to the dynamic topology of Ad hoc networks, the single path is easily broken and needs to perform a route discovery process again. In Ad hoc networks multipath routing is better suited than single path in stability and load balance. IA protocol improves the performance than DSR and explained in section 3.

III. INTELLIGENT AGENT SOURCE ROUTING PROTOCOL

Our motivation is that congestion is a dominant cause for packet loss in MANETs. Unlike well-established networks such as the Internet, in a dynamic network like a MANET, it is expensive, in terms of time and overhead, to recover from congestion. Our proposed IASR protocol tries to prevent congestion from occurring in the first place. IASR uses congestion status of the whole path (Congestion Status of the all nodes participated in route path) and source node maintains the table called Congestion Status table (Cst) contains the congestion status of the every path from source node to destination node. This information is automatically filled by Intelligent Agent. IA is a software or program module which traverses across the network and calculates the congestion status. If it finds about status and it is high it updates in source node congestion state table.

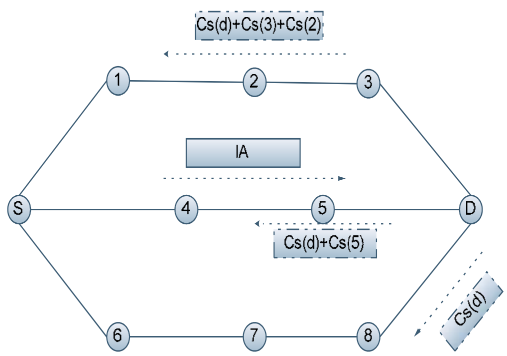

Figure 1 using IA Packets

A simplified example is illustrated in Fig. 1. Three possible routes S->1-> 2->D, S->5->D and S->3->4>D are multipaths routes between source node S to the destination node D. Source node S maintains a special table called Congestion Status Table, which stores the congestion status of the every path, remember that here we are calculating the congestion status not for the single node rather all nodes of the path (cumulative congestion status).

A. *Load Distribution*

In IASR, Destination will send Cumulative congestion status packets (Ccsp) packets towards the source node with response packets. Source node after receiving the Ccsp packets it will update the Cst Table. According to the Cst table Source node will distribute the packets such that more packet towards the path with less congestion status and sends less packets to the path with more congestion status in the Cst table. The Congestion Status of the path will be calculated as,

Cs (A): indicates Congestion status of the node A.

Ccs(B):indicates Cumulative Congestion Status of the node B. calculated using the congestion status of the node B plus congestion status of its previous nodes.

Here Congestion Status of the particular node will be calculated using available buffer size or queue length and number of packets, the ratio of data to the available queue length will give the congestion status of the particular node.

Ccs (D): Cumulative Congestion Status of the node D of the path {S, 1, 2, D}
=Congestion Status of the node D

Ccs (1): Cumulative Congestion Status of the node 1 of the path {S, 1, 2, D).
=Congestion Status of the node D + Congestion Status of the node 1
= Cs (D) + Cs (1).

Ccs (3): Cumulative Congestion Status of the node 3 of the path {S, 3, 4, D}.
=Cs (D) + Cs (4) + Cs (3).

B. *Congestion State Table*

The typical Cst table of the source node S is shown in the table 1, where pathID indicates the nodes involved in routing and Congestion Status indicates the cumulative congestion status of all nodes involved in the route path. After updating the latest congestion status source node will choose the path and distribute the packets.

Table 1 Cst Table

Path ID	Congestion Status
{S,1,2,D}	Cs(S+1+2+D)
{S,5,D}	Cs(S+5+D)
{S,3,4,D}	Cs(S+3+4+D)
……… ……….	………..… ………..

Congestion state table is updated whenever IA packets give alerts about network situation to originating node.

C. *Intelligent Agent*

This is automatically executed at the nodes and updates information of congestion status. Intelligent Agent is a mobile Agent which traverses across the network. Whenever IA finds the high load at a node it informs the status to its source node. It uses the remote procedure calls to connect to the remote system. Different IA's can be used for different sources for its own use. IA calculates the congestion status using the formula given below and it automatically updates this information in source nodes Congestion Status Table.

Q_Size: indicates the local memory size of the node A
T_Packets: gives the total packets available at local memory of the node A
The congestion at a node A = Q_Size / T_Packets.

Whenever an originating node sends IA node if required to know about congestion status of the neighborhood nodes. Then, the Timer will start and if timeout occurs, the originating node resends the IA packet. IA packet is runtime dynamic protocol which travels and calculates the congestion status of required limit and it will inform the originating node about network situation. The advantage of this protocol is packet delivery ratio is increased but the processing of IA protocol at the node is the limitation.

IV. SIMULATION

IASR protocol was simulated in GloMoSim Network Simulator. Number of nodes present in the network was varied from 20 to 60. Nodes moved in an area of (1000x300) m2 in accordance with random waypoint mobility model, with a velocity of 20 m/s and a pause time of 0 second. Simulation time was set as 700 seconds.

We considered the following important metrics for the evaluation: Packet delivery ratio, number of collisions and end-to end delay. Data Throughput (kilobits per second – Kbps) - describes the average number of bits received successfully at the destination per unit time (second). This metric was chosen to measure the resulting network capacity in the experiments.

End-to-end delay (seconds) – This is an average of the sum of delays (including latency), at each destination node during the route discovery from the source to destination. The performance of the IASR protocol gives better result in terms of delay and throughput than DSR and AODV. As shown in figure 2 and 3 we have compared the result with DSR and in figure 4 and 5 we have compared the proposed protocol result with AODV as a result of that, end-to-end delay of the DSR and AODV suffers the worst delay, this is because of high load congestion in the network nodes and absence of the load balancing mechanism. The simulation shows 5 to 25 percentage improvement in packet delivery ratio and delay.

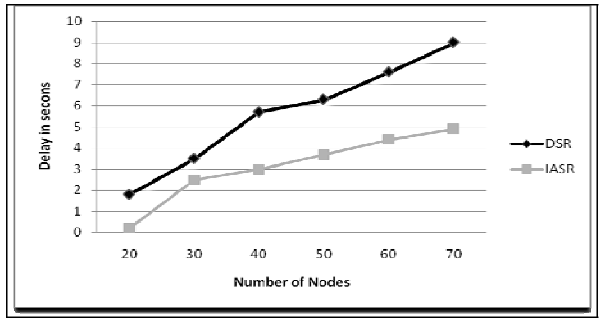

Figure 2 DSR-IASR Delays

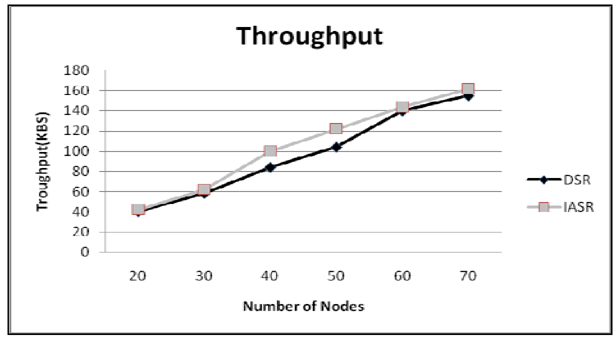

Figure 3 DSR-IASR Throughput

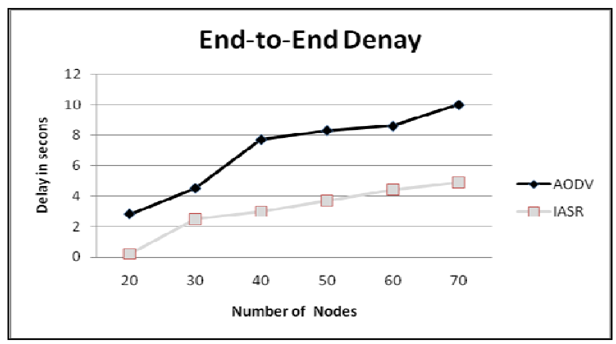

Figure 4 AODV-IASR Delays

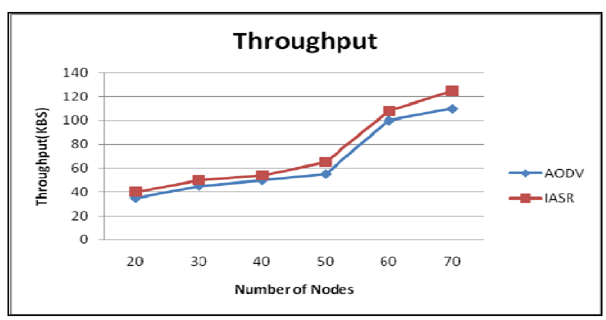

Figure 5 AODV-IASR Throughputs

V. Conclusion

In this paper, we propose IASR to improve the performance of Multipath routing protocol for ad hoc wireless networks. IASR uses cumulative congestion status of the path rather than congestion status of the neighborhood .according to the status of the congestions source node will distribute the packets such that more packets to paths with less congestion. Intelligent Agent is used for updating the information in source node's congestion state table. It is evident from simulation results that IASR outperforms both AODV and DSR because it balances the load according to the situation of the network.

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