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IMPLEMENTATION OF ADAPTIVE FUZZY ROUTING MODEL TO ACHIEVE EFFICIENT ROUTING SERVICES FOR IMPROVING NETWORK COMMUNICATION

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Abstract

Now are days Network activity is going on and increasing day to day business that produces many challenges in routing the information efficiently to manage information properly , one need to design a model that provides efficient working compare to the traditional one , author of the paper concentrate on the primary requirement of network where network has been evaluated by increasing number of node at the same network scenario that affect network performance , after implementing the "Adaptive Fuzzy Routing " network performance has been getting much better result as compare to the traditional AODV,DSR,ABR and all existing one. Here author provides efficient routing that provides quality of communication factors to get reduces data loss problem and also improving throughput and system response time.

Keywords: AFR routing, AODV, DSR, ABR.

1. Introduction

Today is the time of internet where Routing plays an important role for the delivery of data from one end to other end where accuracy takes an important consideration for the reliable communication scenario, because the accuracy of information and destination is must for quality and reliable service architecture. Therefore one can define "Routing is the process of moving information from one node to other node", along the way, at least one intermediate node typically is encountered, It is also been considering as the factor of selecting route from many over which the data packets has been send. Routing is some time conflicted with bridging technique which sometimes might look same for the casual observer. One of the main differences between this two is that bridging working at layer2 (Data Link Layer in OSI Model) on the other hand routing is the functioning of Network layer of OSI Model at takes place at layer 3[3], In order to understand the actual thing between this two is routing is just address the solution for choosing correct path for the required destination that which output line will be good for the transmission i.e. the question “what should be the next intermediate node for the completion the data transmission task”. The technique for getting the correct path routing protocols fallows metric approach to evaluate which route will be the best route for complete the transition ,metric formulation is the stander measurement technique , it also used for the measurement of bandwidth, throughput , reliability, channel capacity etc. it also used for the calculation of determining optimal path , with the help of this technique one can manage routing table easily by the implementation of measurement in routing algorithm [12,13,14]. Routing algorithm managing routing information by filling the node interface address in which it includes destination, next node addresses such kind of associations tell a router that a particular destination can be reached optimally by sending the packet to a particular node representing the "next hop" on the way to the final destination. In the process of routing when any router receive and data packet first it checks the destination address and integrate it with intermediate node and next node address. Few algorithm also more efficient in working where routing is completing the accurate transmission in more complex scenario where routing are facing multiple next node addresses to reaching the data packet to its correct destination, [5, 6, 7].

In the below figure 1 describes a small network scenario packet destines for node “D” , begins from router R1, and from the calculation of router metric for the evaluation of shortest path has been forwarded to intermediate router R2. This sanded to the final destination. Here Routing table has maintained other information like data about the desirability of a path. Routers compare metrics to determine optimal routes and these metrics differ depending on the design of the routing algorithm used. Routers are getting node information by having chat with each other through the transmission of many messages that normally related to full network or a portion of that so that router can be able to analyze updated routing information from other nodes , Now a router can manage detailed topology of the network, to understand this one can have link state protocol which is one of the best example of message send between routers, informs other routers of the state of input source link , with the help of this link information one can design complete network topology to enable router to determine best route to destination end.

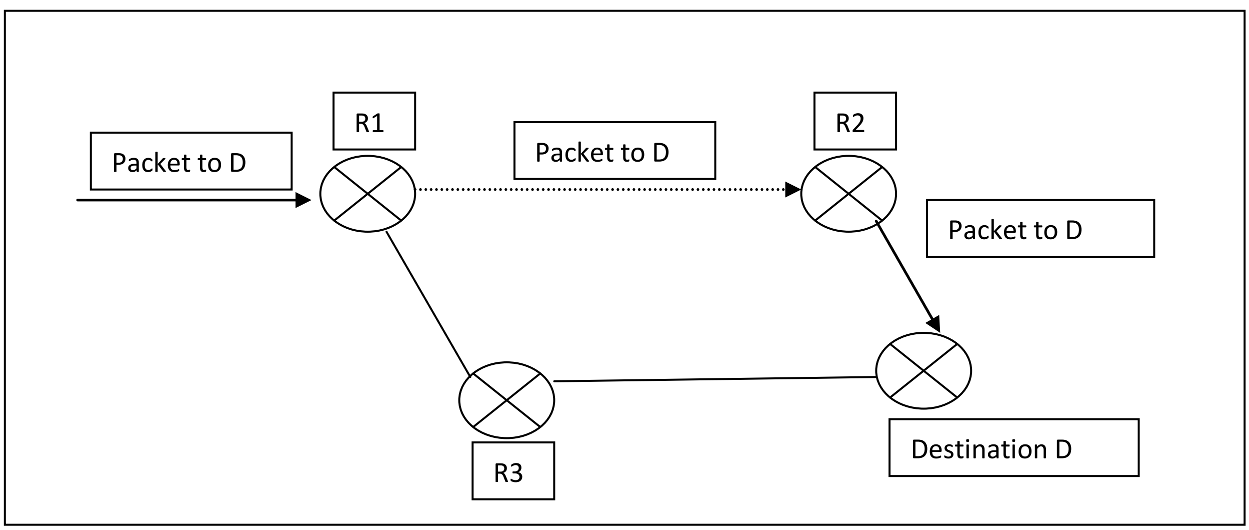

Figure 1 Routing in a small Network

2. Fuzzy Set Theory

The concept of the fuzzy set is only an extension of the concept of a classical or crisp set. The fuzzy set is actually a fundamentally broader set compared with the classical or crisp set. The classical set only considers a limited number of degrees of membership such as '0' or '1', or a range of data with limited degrees of membership. For instance, temperature depends on the membership function [7,8]. This means that the fuzzy set uses a universe of discourse as its base and it considers an infinite number of degrees of membership in a set. In this way, the classical or crisp set can be considered as a subset of the fuzzy set. one assume to create a faculty set or a faculty collection *F* with ten-faculty members *x1, x2…… x10*, in a college:

$$F = \{ x1, x2, x3, x4, x5, x6, x7, x8, x9, x10\}$$

In general, the entire object of discussion *F* is called a universe of discourse, and each member *xi* is called an element. Assuming that elements *x1 ~ x4* belong to the department of computer science, which can be considered as another set *A*. The elements *x1 ~ x3* are under age 40, which can be considered as a set *B*. Therefore the following relations exist:

$$X \rightarrow F$$
$$A = \{x1, x2, x3, x4\} \rightarrow F$$
$$B = \{x1, x2, x3\} \rightarrow A$$

It can be seen that all elements in set *B* belong to set *A*, or the set *A* contains set *B*. In this case, set *B* can be considered as a subset of set *A* and can be expressed as $B \rightarrow A$.

2. Adaptive Fuzzy Routing Algorithm

AFR provides the special function in order to achieve efficient utilization of available resources, if in case when network gets heavier load of traffic they need to be optimize first so that node can be easily recover from the last position , that leads the services of making efficient utilization of available channel capacity , and improving the delay error with data loss problem so that network can provides QoS communication even when network are getting troubled due to heavy load in the following way network gets the strategy to manage the network node efficiently and optimize buffer dynamically.

Initialization:

1. Choose a *penalty parameter* $v > 0$ and a *barrier parameter* $\mu > 0$.
2. Initialize trust region radius $R > 0$ and Lagrange multipliers λ.
3. Set an appropriate initial value for peak rate and burstiness of flows for reducing delay and improving throughput denoted as $pR(0)$, $\sigma R(0)$.
4. Specify an appropriate value for R ´ (´*R* denote value of expectable reduction in merit function).
5 . *Loop* 1: Do until
$(\max | pR(t + 1) - pR(t) | <)\&(\max | \sigma R(t + 1) - \sigma R(t) | <)$
6. Set an appropriate initial value for peak rate and burstiness of flows and slack variables for barrier problem (35) denoted as $\acute{}pR(0)$, $\acute{}\sigma R(0)$, $s(0)$.
7. *Loop* 2: Do until
$(\max | \acute{}pR(k + 1) - \acute{}pR(k) | <)\&(\max | \acute{}\sigma R(k + 1) - \acute{}\sigma R(k) | <)$
8. *Loop* 2: Do until
$(\max | \acute{}pR(k + 1) - \acute{}pR(k) | <)\&(\max | \acute{}\sigma R(k + 1) - \acute{}\sigma R(k) | <)$

9. Calculate d based on *CG Step.*
10. $ptemp = ´pR(k) + dpR$;
11. $\sigma temp = ´\sigma R(k) + d\sigma R$;
12. $stemp = ´s(k) + ds$
13.1 Calculate $\varphi(k + 1)$ by substituting $ptemp$, $\sigma temp$, $stemp$ in merit .
13.2. if $(\varphi(k + 1) - \varphi(k) \geq ´)$
13.3. Decrease R;
14. Go to 4;
15. $pR(k + 1) = ptemp$; $\sigma R(k + 1) = \sigma temp$; $s(k + 1) = stemp$
16. Compute new Lagrange multipliers λ.
17. End of loop 2.
18. Decrease *barrier parameter* μ.
19. End of loop 1.

3. Observation and Simulation of Proposed Model

The simulations performed using Network Simulator GNS3, particularly popular in the networking community. The traffic sources are CBR (continuous bit –rate). The source-destination pairs are spread randomly over the network [2,4]. The mobility model uses ‘random waypoint model’ in a rectangular filed of 500m x 500m with 50 nodes. During the simulation, each node starts its journey from a random spot to a random chosen destination. Once the destination is reached, the node takes a rest period of time in second and another random destination is chosen after that pause time. This process repeats throughout the simulation, causing continuous changes in the topology of the underlying network. Different network scenario for different number of nodes and pause times are generated. The model parameters that have been used in the following experiments are summarized in Table 1.

Table 1 Simulations Parameters

Parameters	**Values**
Simulation	GNS3
Protocol Studied	AODV, DSR and AFR
Simulation Time	200 sec
Simulation Area	200,400,600,800,1000 or 500 *500
Transmission Range	250m
Node Movement Model	Dynamic Way Point
Bandwidth	2mbps
Traffic Type	UDP
Data Payload	Bytes/Packets
Number of Nodes	10,20,30,40

4. Packet Delivery Fraction (PDF)

The ratio of the data packets delivered to the destinations to those generated by the sources. Mathematically, it can be ex pressed as:

$$P = \frac{1}{C}\sum_{f=1}^{e}\frac{R_f}{N_f} \qquad (1)$$

Where P is the fraction of successfully delivered packets, C is the total number of flow or connections, f is the unique flow id serving as index, R_f is the count of packets received from flow f and N_f is the count of packets transmitted to f.

5. Average end-to-end delay

This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times. It can be defined as:

$$D = \frac{1}{N}\sum_{i=1}^{s}(r_i - s_i) \qquad (2)$$

Where N is the number of successfully received packets, i is unique packet identifier, r_i is time at which a packet with unique id i is received, s_i is time at which a packet with unique id i is sent and D is measured in ms. It should be less for high performance.

6. Simulation Result and Observation

Figure 2 describes the actual story of all incoming and outgoing traffic scenario where one found that there is the statistics of all achieved node address based on the computation by GNS3 ,one found that all the packets has been received successfully, no packet has been marked for acknowledgement. The simulation results are shown in the following section in the form of line Figure 3-6 graphs. Graphs show comparison between the three protocols by varying different numbers of sources on the basis of the above-mentioned metrics (Table 1) as a function of pause time.

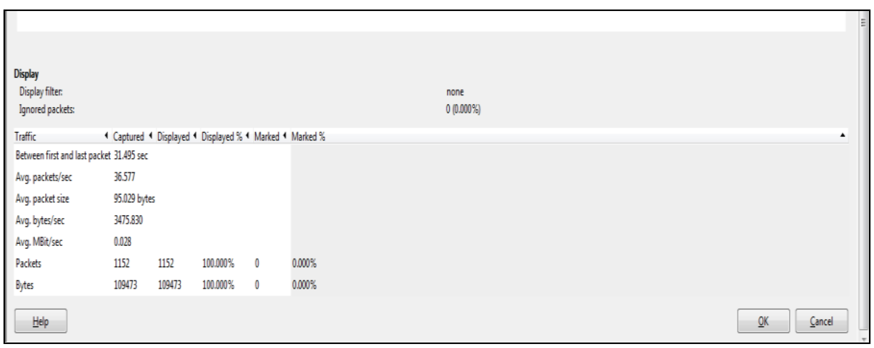

Figure 2 Cauterization of all incoming and outgoing packet over AFR routing algorithm

7. Packet Delivery Fraction (PDF) or Throughput

Figure 3-5. Shows a comparison a comparison between the routing protocols on the basis of packet delivery ratio as a function of pause time and using different number of traffic sources. Throughput describes the loss rate as seen by the transport layer. It reflects the completeness and accuracy of the routing protocol. According to the graphs, it is clear that throughput decrease with increase in mobility. As the packet drop at such a high load traffic is much high. The given graph shows that AFR ,CBRP and DSR performs better in delivering packets which is 90% and 88% but AODV shows an average PDR equals to 80% . Between DSR and CBRP, CBRP gives slightly better throughput for a larger network size and better scalability comes from its largely reduced flooding for route discovery.

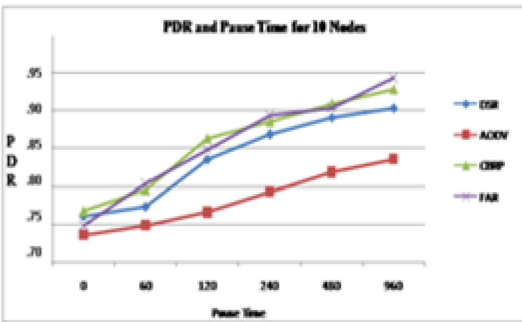

Figure 3 PDA VS Pause Time For 10 Nodes

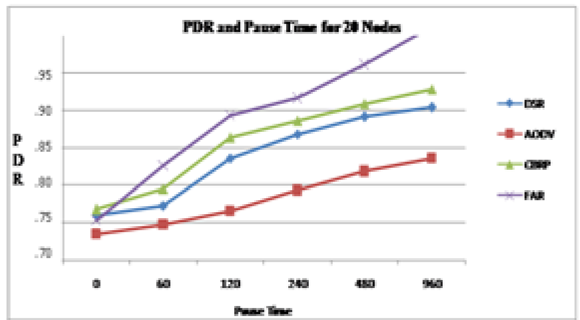

Figure 4 PDA VS Time PAuse For 20 Nodes

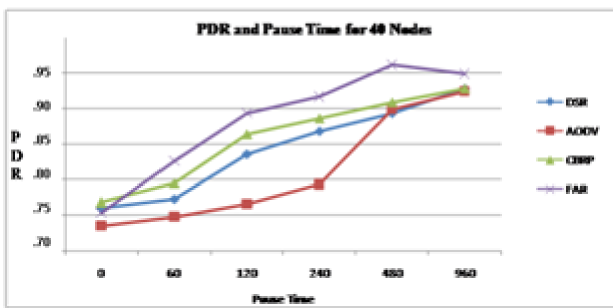

Figure 5 PDA Vs Pause Time For 40 Nodes

Figure 3 to 5, shows a comparison between the routing protocols on the basis of packet delivery fraction as a function of pause time and using different number of traffic sources. Throughput describes the loss rate as seen by the transport layer. It reflects the completeness and accuracy of the routing protocol. From these graphs it is clear that throughput decrease with increase in mobility. As the packet drop at such a high load traffic is much high.

AFR performs better at high mobility but in other cases it shows to have a excellent throughput. AODV in our simulation experiment shows to have the best overall performance. On-demand protocols (DSR and AODV) drop a considerable number of packets during the route discovery phase, as route acquisition takes time proportional to the distance between the source and destination. The situation is similar with AFR. Packet drops are fewer with proactive protocols as alternate routing table entries can always be assigned in response to link failures. AFR can be quite sensitive to the loss of routing packets compared to the other protocols. Buffering of data packets while route discovery in progress, has a great potential of improving DSR, AODV and AFR performances. AODV has a slightly loner packet delivery performance than DSR because of higher drop rates. AODV uses route expiry, dropping some packets when a route expires and a new route must be found [8].

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8. Average End to End Delay

Figure 6-8, shows the graphs for end-to-end delay Vs pause time. From these graphs one see that the average packet delay increase for increase in number of nodes waiting in the interface queue while routing protocols try to find valid route to the destination. Besides the actual delivery of data packets, the delay time is also affected by route discovery, which is the first step to begin a communication session. The source routing protocols have a longer delay because their route discovery takes more time as every intermediate node tries to extract information before forwarding the reply. The same thing happens when a data packet is forwarded hop by hop. Hence, while source routing makes route discovery more profitable, it slows down the transmission of packets.

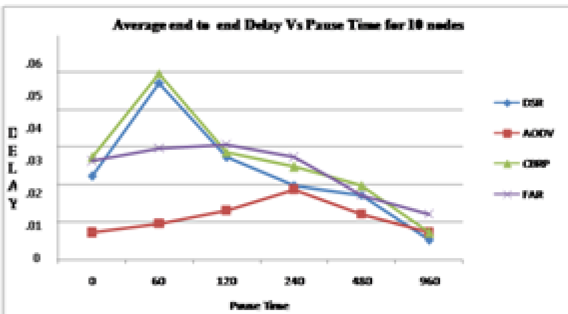

Figure 6 Average End To End Delay For 10 Nodes

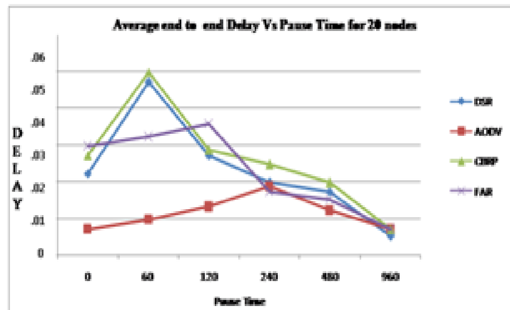

Figure 7 Average End To End Delay For 20 Nodes

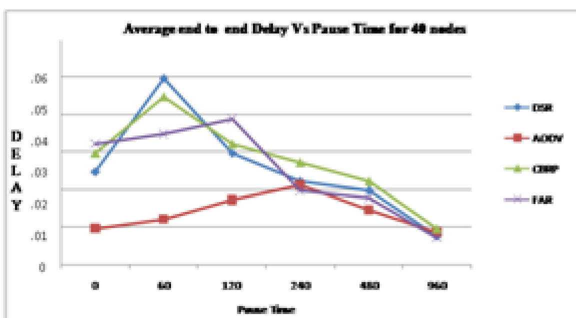

Figure 8 Average End To End Delay For 40 Nodes

Out of the four routing protocols, AODV has the shortest average end-to-end delay (0.0077sec). AFR, CBRP and DSR have average end-to-end delay of 0.0227 and 0.035 sec resp. besides the actual delivery of data packets, the delay time is also affected by route discovery. CBRP is even more time consuming because of its two-phase route discovery. The task of maintaining cluster structure also takes a piece of host CPU's time, in this way AFR performing good as end to end node communication compare to other.

Figure 9-11 shows the performance of AFR, CBRP, AODV and DSR by evaluating Normalized packet overhead with varying pause time for 10, 20 and 40 number of nodes. Average packet overhead per packet received is 0.289, 1.67 and 2.75 for DSR, AODV and CBRP respectively. In most cases, both the packet overhead and the byte overhead of CBRP and one-ninth of AODV's overhead. On the other hand FAR Showing less overhead then CBRP and AODV protocols, Due to smaller flooding range of CBRP, the number of outs route requests and replies is very less than that of DSR. But its hello messages out neigh this gain. The size of hello messages of CBRP can be larger than the size of the HELLO message of DSR. Hence, its byte overhead is more than DSR.

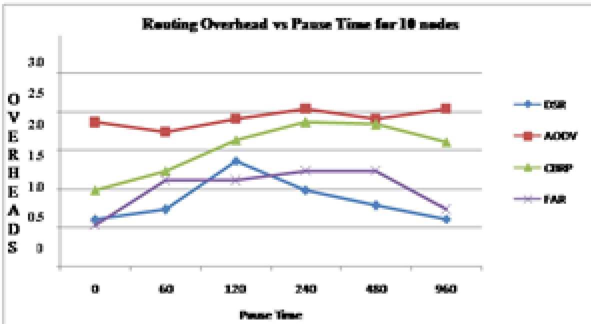

Figure 9 RoutingOberhead Vs Pause Time For 10 Nodes

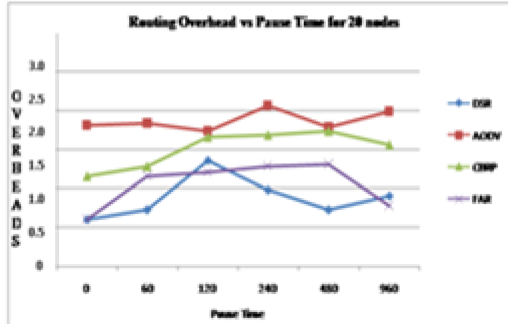

Figure 10 Routing Overhead Vs Pause Time For 20 Nodes

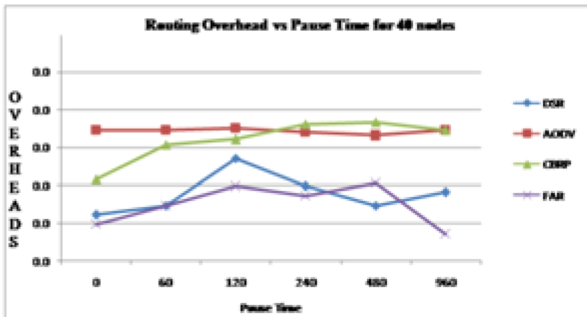

Figure 11 Routing Vs Overhead Vs PauseTIme For 40 Nodes

9. Conclusion

The goal of this performance evaluation is a comparison of a MANET between AODV, DSR and AFR routing protocols. AODV in our simulation experiment shows to have the overall best performance. It has an improvement of DSR and DSDV and has advantages of both of them. AFR performs better at high speed high mobility and has a high throughput as compared to AODV and DSR. It often serves as the underlying protocol for light on eight adaptive multicast algorithms. Whereas DSR suits for network in which mobiles move at moderate speed. It has a significant overhead as the packet size is large carrying full routing information. Table 2 shows a numerical comparison of the four protocols, “1” for the best up to “4” for the worst

Table 2 Numerical Comparison of Routing Protocols

Metrics	AODV	DSR	AFR
Scalability	2	3	1
Delay	3	2	2
Routing Overhead	2	1	1
Drop Packets	1	2	0
Throughput	1	2	3
Dynamic Adaptability	2	3	1
Energy Conservation	2	1	2

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