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Optimized Fuzzy Routing for MANET

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Abstract: *An ad-hoc network is a collection of mobile hosts with wireless network interfaces that may form a temporary network without the aid of any established infrastructure of centralized administration. In such environment, the nodes operate both as hosts as well as routers. Due to mobility, the topology of the network may change randomly, rapidly and unexpectedly.*
The objective of the work is to present effective decision algorithm that improves network performance. In the proposed technique, we defuzzyfy the values of delay, packet success rate, bandwidth and find out the threshold for these parameters for current session. In the path selection each node checks for its suitability with respect to the threshold corresponding to the parameters. If a node satisfies the condition then only it is included in the path otherwise node is omitted from the path.
Keywords: *Adhoc Network, Fuzzy Logic, AODV, Routing, MANET*

I. Introduction:

The goal of the paper is to propose a FUZZY routing in MANET by considering Bandwidth, Packet Success Rate and Energy. We propose optimized routing technique for MANET by taking routing decision using fuzzy logic". All possible paths from source to destination are obtained in multipath environment using disjoint approach. In source nodes cache, the entire path will be present. RREQ is modified by appending extra fields of bandwidth, Packet Success rate and energy. As the RREQ traverses from the intermediate nodes, they append their values in the respective fields. Source node defuzzyfies them and select the best path based on the above parameters.

i. Introduction to Mobile Ad-hoc Networking

The term MANET stands for Mobile Ad-hoc Network. This new networking concept defines simple mechanisms, which enable mobile devices to form a temporary community without any planned installation, or human intervention. The idea is to form a totally improvised network that does not require any pre-established infrastructure. But, how can we make this possible? The answer is very simple. Each node acts as a host and a router at the same time. This means that each node participating in a MANET commits itself to forward data packets from a neighboring node to another until a final destination is reached.

ii. Introduction to Fuzzy Logic

Is a form of multi-valued logic derived from fuzzy set theory to deal with reasoning that is approximate rather than precise? Just as in fuzzy set theory the set membership values can range (inclusively) between 0 and 1, in fuzzy logic the degree of truth of a statement can range between 0 and 1 and is not constrained to the two truth values {true, false} as in classic predicate logic.

II. Existing System

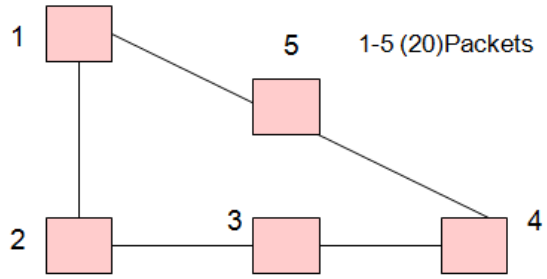
[1] Propose a QoS-aware routing protocol, which is based on residual traffic condition estimation during route set up. Propose QoS-aware routing protocol is built off AODV, in which the routing table is used to forward packets, "Hello" messages are used to detect broken routes and "Error" messages are used to inform upstream hosts about a broken route. We explore two ways to perform traffic condition estimation, and we incorporate both an adaptive feedback-based scheme and an admission control scheme.

[2] Available bandwidth estimation is a vital component of admission control for quality-of-service (QoS) in both wireline as well as wireless networks. In wireless networks, the available bandwidth undergoes fast time-scale variations due to channel fading and error from physical obstacles. These effects are not present in wireline networks, and make estimation of available bandwidth in wireless networks a challenging task. Furthermore, the wireless channel is also a shared-access medium, and the available bandwidth also varies with the number of hosts contending for the channel. Wireless last-hop networks employing the IEEE 802.11 protocol

[3] Reveals that most current multipath routing protocols do not concentrate on the uncertainty in the MANET. They choose an "optimal" multipath set by considering only single route selection parameter. Genetic fuzzy multipath routing protocol, which is a multipath routing protocol based on Fuzzy set theory and

evolutionary computing. It naturally deals with the uncertainty in MANET and adaptively constructs a set of highly reliable paths by considering the interplays among multiple route selection parameters.

III. Methodology of the Proposed System



ID	SRC	DST	HOP	TLL	BW	DELAY	PSR

Each node maintains a neighbor table comprising of neighbor information.

NODE ID	HOPS	BANDWIDTH	BUFFER

RREQ → Broadcast from source to its neighbors Their Neighbors

3. As RREQ is received by any node, it must put its BW and Buffer in RREQ & Forward.

4. When it reaches to destination. It has multiple paths. It has to decide which path? Here destination will select the path based on adaptive fuzzy routing.

If (BW_Min≥ BW_Required) && (Total_Hops ≤ Delay_Hops) && Buffer_Min ≥ Buffer_Required
{
Then select the path and store in cache
}
If (BW_Max < BW_Required)
{
Drop the Path
}
If (BW_of_Path > BW_of_all_Other_Path)
&& ((Buffer_of_Path) > Buffer_required))
{
Start transmitting through its path
}

Formation of the Routing decision

AODV Handle Message Function

If Receive packet is of type Hello packet

1. Check the node from which hello packet has arrived.
2. Check if already the node is available in the routing table or not.

If present update the information else add new node in the routing table.
If a node receive RREQ, so call handle RREQ function.

In handle RREQ

1. If this RREQ already processed discard the packet else process the packet.
2. If a node is blacklisted (low energy or bandwidth) then discard this RREQ.

So, Process RREQ like a Hello Packet.
So, If this node is destination generate the RREQ message.
If it is source node & has received RREQ, discard the packet.

RREP (Route Reply) so Handle RREP function will be called RREP will be treated as hello packet & Statement 1 & 2 of the handle hello function will be performed.
If the node neither source nor destination then forward the packet. If it is the source node then copy the path.

IV. Implementation of the Proposed System

i. Steps to implement Optimized Fuzzy Routing for MANET

Step 1: First initialize number of nodes in omnetpp.ini file.
world.dim = 15

Step 2: Decide number of source node(omnetpp) world.mobileHost[1].app.active = 6 means first 6 nodes are source

Step 3: Initialize load world.mobileHost[*].app.rate = 20 // means 20 packet/second
;pakets of 512 byte = 4096 bit
So Load= 4096*20*6=491 kb
For this load we have to develop fuzzy routing, Fuzzy routing has to minimize this

Step 4: Channel datarate(Bandwidth is **world. mobileHost[*].physic.channelDatarate = 11.04858e+6)means 11mbps) Effective bandwidth=datarate/total_neighbour;**
Total neighbor variable is present in cArray nbList , of Physical layer. **Bandwith is calculated in MAC layer from formula (dataRate/length(nbList))**

Step 5: Delay is find out once the packet is received at aodv::finish() method statistics.hopsSum / statistics.deliveredDataMsg.

Step 6: Packet Success Rate is given by dataDelivery ratio at AODV::Finish() statistics. sentDataPkt / statistics .deliveredDataMsg

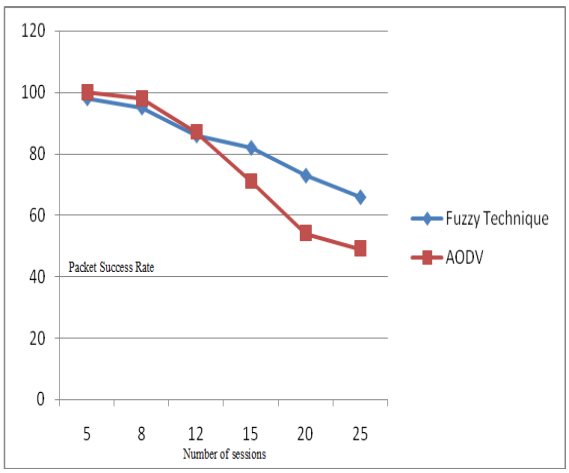
Step 7: Steps to Calculate Energy (the property of Nodes which decreases as they transmit and receive). It
is a physical Layer Property.

Step 8: E=E – Etx – Erx , if the energy is sufficient to transmit further m bits messages,
Check for the condition (value of the parameter should be between max and min)
If so forward RREQ else
Drop RREQ

ii. Fuzzy Implementation

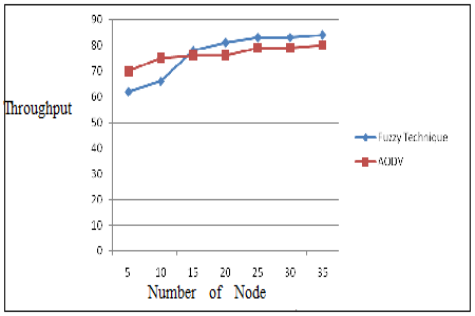
First assume the parameters corresponding to the transmission. They are packet success rate, bandwidth, energy & load. They are known as input variables. These parameters are combined to form a membership function. Hence a membership function can be considered as a domain of value of the input parameters. But we don't know how these parameters are inter-related that is what is the significance of each parameter in the regard to the whole domain. Hence this is to solve by defuzzification. "Defuzz" is a function which accept the membership function & defuzzify them into range of values as high, low and medium. This range forms a trapezoidal view with low, medium & high. Once the values are defuzzified the range is obtained. This range is imported in Ad hoc network simulation environment and used as thresholds.

V. Simulation and Results



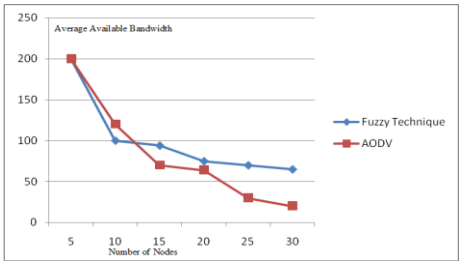
Result 1:Number of sessions v/s Packet Success Rate

The graph clearly depicts that packet delivery of ratio is better in case of proposed fuzzy based technique then the conventional AODV. This is due to the fact fuzzy selects best possible path in terms of available bandwidth rate decreases with the increase number of sessions as those is more congestion in the network.



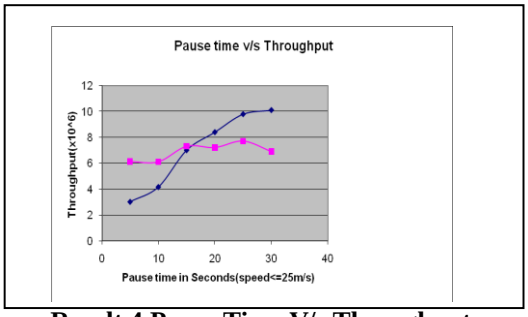
Result 2: Number of Node v/s Throughput (Load: 3 sessions, 20packets/seconds)

As number of nodes increases the through put also increase. This is due to the fact that the number of node increases there are more number of options are available for route selection.



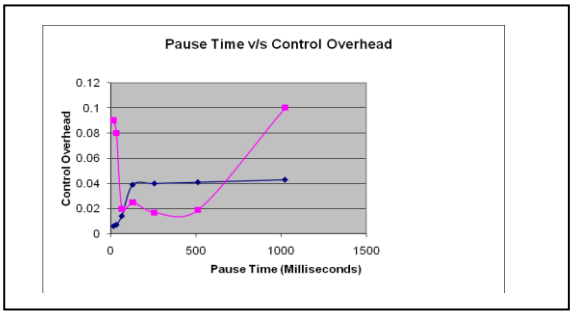
Result 3: Number of Nodes v/s Average Available Bandwidth

Result four depicts average available bandwidth based on both the techniques bandwidth is calculated as mean of residual bandwidth left in each node after every packet burst is transmitted. It shows that path selected through fuzzy has more residual bandwidth left because slection includes nodes with maximum bandwidth.



Result 4 Pause Time V/s Throughput

It shows that the proposed technique has better Throughput under low mobility. This is because of path reconfiguration.



Result 5 Pause Time V/s Control Overhead

Control overhead of proposed technique is steady with respective to AODV. This is because using the proposed technique always optimum path found.

VI. Conclusion

In this work we have adopted a multipath routing which gives the option for evaluating amongst the best paths. Fuzzy technique is used to inter-relate different parameters like bandwidth, packet success rate and energy. As the data domain of all the parameters is different, it is quite difficult to establish a relationship amongst them. Using fuzzy rule set we can optimize these parameters and thus can adoptively get the thresholds for the routes. Multipath routing also facilitates the possibility of backup routing whereby if a path fails, the source can another path from the cache. Results show that the proposed technique performs better than conventional routing like AODV when the load is very high. For mediocre load however the performance of AODV is better.

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