AN IMPROVED NEURO FUZZY SCHEDULING BASED ROUTE DISCOVERY AND CONNECTED DOMINATING SET IN WIRELESS MESH NETWORK

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ABSTRACT

In wireless mesh network, a Connected Dominating Set (CDS) based virtual backbone plays an important role for efficient routing and broadcasting. A connected dominating set is a promising approach for broadcasting. A node in the CDS consumes more energy and depletes quickly than non-dominating nodes. Although Neuro Fuzzy based routing algorithm achieve good results in terms of the network, but we have to increase a network performance and to save the energy level on the network, a minimum size CDS does not necessarily for guarantee the optimal network performance from energy efficient point of view. If we have any jamming on the network during the data transfer from source to destination that time Neighbor Distance Discovery (NDD) method used to identify the nearby nodes on the network using CDS for choose high priority node on neighbor model. This type of CDS is priority based data transmission on the network. The existing Neuro Fuzzy based routing protocol used to avoid a traffic using neuro fuzzy logic for improving the network performances. Here proposed a connected dominating set algorithm using NDD method on the network. Simulation results in NS-2 verify that they perform better than neuro fuzzy logic routing and compare the scheduling neuro fuzzy logic routing with fuzzy logic and neuro fuzzy logic routing.

Keywords: Wireless Mesh Network, Neuro Fuzzy Logic, Access Point, Connected Dominating set, Neighbor Discovery Distance
1. INTRODUCTION

Wireless Mesh Network (WMN) is based on ad-hoc networks. WMNs consist of two types of nodes: routers and clients. Mesh routers can be implemented as dedicated equipment or on general purpose equipment (for example a PC). Mesh clients may also perform routing functions but they do not act as gateways. Examples of clients include PCs, PDAs, and IP phones. The dominant architecture in WMNs is called the Backbone Infrastructure. Mesh routers form an infrastructure or backbone to provide client connectivity. Some routers may also act as gateways, providing Internet connectivity to the mesh nodes, or integrating them with other radio networks [1]. In other architectures like the hybrid architecture known as WMN client, mesh clients may perform routing and mesh routers may or may not exist. WMNs are wireless multiple hop networks. Unlike conventional 802.11 networks, the paths in the wireless network have more than one hop [2]. This multi-hop feature is needed to extend the network coverage without reduction of communication bandwidth and also to provide connectivity between users not directly attached.

Due to their flexible architecture, facility of deployment and configuration, fault tolerant capabilities and mesh connectivity, the WMNs do not require a very large initial investment and can be deployed gradually according to need. Clients may or may not move but routers stay fixed. Power requirements depend on the type of node. Routers usually do not have strict requirements on power consumption, whereas clients would normally need power efficient protocols.

As an example, a WMN based on 802.11 technologies is compatible with 802.11 standards, i.e. with conventional WiFi clients. But WMNs also need to be compatible with other radio networks such as WiMAX, and ZigBee. The standardization of WMNs is currently undergoing at the IEEE group 802.11s. Other groups in charge of the standardization of mesh networks exist for other technologies. The IEEE 802.15.5 works on mesh networks based on Wireless Personal Area Networks (WPAN). Also a group named Mesh Ad-hoc Committee investigates the advantages of mesh networks using WiMAX (IEEE 802.16).

In WMN each node transfers data to and from source to destination on the network. These nodes are needed to be in the reach of all the nodes in the network coverage area. If there are a significant number of nodes in the network, distant nodes can transfer data with the base station in a few hops. Besides mobility, WMN have the advantages, they can work in a decentralized fashion, are cheap with minimum deal for initial communications, more dependable, scalable and provide increased coverage. They are widely used in campus networks, metropolitan area networks, transportation system, security observation system, etc. Thus, they eliminate the drawbacks predominant in a traditional network which uses a wired connectivity to a base station, where every user connects it through a point to multi point protocol.

A WMN must manage the mobility of user nodes throughout the network. As they move, user devices change their point of attachment to the network, connecting to the access point with which they have the strongest signal. Mobility raises several issues, similar to those known in both wired and cellular networks. In mobility management has been integrated into the routing process in order to cope with highly mobile nodes. In wired and cellular networks, routing and mobility management have been defined separately although complementary mechanisms.

A possible receiver node wishing to join the multicast group, broadcasts a RREQ message. If a node receives the RREQ message and is not part of the multicast on network, the node broadcasts the message in its neighborhood and also establishes the reverse path by storing the state information consisting of the group address, requesting node and the sender node information in a temporary cache. If a node receiving the RREQ message is a member of the multicast tree and has not seen the RREQ message earlier, the node waits to receive several RREQ messages and sends back a RREP message on the connected dominating set to the receiver node [3].
In our proposal to raise the level of security, the packets are routed only through more trustable nodes in the network. An adaptive Neuro fuzzy logic scheduling is used to evaluate the faith ability of each node in the network. A Neuro fuzzy system is a fuzzy system that uses a dominating algorithm consequent from or stimulated by network to determine its parameters by processing data samples [4]. A fuzzy system consists of fuzzy, inference engine, and Neuro fuzzy. Fuzzy to a linguistic variable using the membership function stored in the fuzzy knowledge base. After we get fuzzy input, we compare it against a rule base. A rule base is a set of rules that is responsible for final output.

2. RELATED WORK

In wireless mesh network IEEE 802.11 encountered scalabilty problems caused by link-level protocols, such as data processing on their network. Wired Ethernet uses carrier-sense multiple-access and the ability to detect Ethernet collisions – which cannot be done with RF signals makes the protocol more efficient. In addition, Ethernet has several orders of magnitude more bandwidth to solve this challenge. But in an all-wireless environment, there is far less bandwidth than a wired network and the AODV protocol imposes capacity limitations, especially in single-radio access points (APs). Subsequent wireless mesh solutions used separate radios for access and backhaul to mitigate the effects. Some products use multiple radios for backhaul and directional antennas to minimize self-interference, which can dramatically increase the number of collisions in large networks.

Most reactive routing approaches employ full flooding schemes to discover optimal routes. In these approaches, an active source initiates a route discovery process by broadcasting a route request packet (RREQ) to the whole network [5]. All nodes, except the source and the destination, are required to rebroadcast the first received RREQs, and/or the RREQs propagated from better routes. In most cases, only the intermediate nodes between the source and the destination are the candidates for the optimal routes, the nodes in far regions unnecessarily participate in the route discovery.

A few efficient broadcast schemes to confine packet relays to a small portion of nodes, while still maintaining the full coverage of the broadcast. For example, the scheme makes each packet sender, based on its two-hop neighbor information; derive the minimum set of relays that can reach all its two-hop neighbors [6]. These efficient broadcast schemes, when applied to RREQ transmissions, can significantly reduce redundant RREQ relays, but the route optimality is often compromised, as many nodes, especially those located between the source and the destination, are suppressed from the route inquiring.

Ad hoc network is network without any fixed communications and the network can be set up at any place and time. It is highly popular for applications where network must be built quickly or network not possible to deploy e.g. armed systems, and tragedy relief operations. The dynamic nature of mobile nodes causes recurrent route change. Due to lack of centralized management any malicious node can enter the network at any time. It is hard to detect malicious node in the network. Hence mesh is much more exposed to attack than wired network. To enlarge the level of security, the packets must be routed across the nodes that are trustable.

The packet priorities are based on the high priority node check with NDD and their delay constraints drive the selection of optimal transmission strategies at the different layers hop by hop. In order to realize the mentioned priority queuing framework for data transmission process on their network, we define the following two kinds of information feed back to a node for a connected dominating set priority model on this algorithm.

QoS routing plays an important role in providing QoS aware services in wireless mesh network. Fuzzy logic was used for QoS forecast, but correctness of the prediction depends on the shape of membership function and hence there is an error at the prediction of QoS [7]. Our proposed scheme provides optimized membership function for the estimate of QoS using Artificial Intelligent (AI) technique called ”Neuro-Fuzzy”[8]. Agents are used in this scheme for providing real-time multimedia
communication. The results have led us to conclude that substantial redesigning of protocols will be essential to make Ad Hoc Networks really useful. There are more of documentation bugs in NS2 and simulation on NS2 is somewhat unpredictable under certain conditions.

Modeling system used in this article is Neuro-Fuzzy as to detect under attack node. Selected parameters from previous stage are given to adaptive Neuro-Fuzzy system. The output of this system shows the state of the node. Furthermore, in order to an increase in accuracy and speed of training process, we normalized the input data and output data at a boundary of the model. Modeling is done in two stage training and test to detect under attack node from network. Some amount of introduction on the design of our routing protocol will be in order at this point. The aim of the protocol is to establish the most possible route within the least time possible and the appropriate approach to this problem is the use of Fuzzy Logic to deal with imprecise inputs and Algorithms to find a most favorable solution in the solution space by search and related heuristic techniques [9]. The problem therefore reduces to finding a suitable solution in an optimal sense.

3. PROPOSED APPROACH

In our proposed model we have to implement an AODV routing protocol used in ad hoc networks. In AODV, each node maintains a routing table which is used to store destination and next hop IP addresses as well as destination sequence numbers. Each entry in the routing table has a destination address, next hop, precursor nodes list, lifetime, and distance to destination [10]. It is simple with each node behaving as a router, maintaining a simple routing table, and the source node initiating path discovery request, making the network self-starting on the network.

In a network like the WMN, the various constraints like collisions, traffic level, buffer occupancy, energy, etc. need to be considered [11]. It is not enough if only one constraint is considered. This is because of the complex relationship existing between the different constraints. Multi-constrained routing is CDs to resolve their complete problem and does not have solution. It is required to use various heuristics and soft computing techniques to solve them and to using the routing algorithm for neighbor discovery distance method to set a priority based data transmission on the network [12]. We have to using an AODV routing protocol with connected dominating set constraints on the data pre processing model. We have to show the comparison of fuzzy, Neuro fuzzy and Scheduling Neuro fuzzy model on the network. It’s must to best result on Neuro method [13], so they have all the data transmission are secured and reduce data loss on their network.

In AODV with using a Scheduling Based Neuro Fuzzy Logic and then we have to Neighbor discovery distance method for checking a priority and nearby nodes on the network. CDs are using to dominating the set of nodes to collect the neighbor nodes information and send the data to destination on shortest path and reduce the energy level on their whole network performs. Recent research has started to focus on multi-path routing protocols for load balancing [14]. Multipath on-demand routing protocols tend to compute multiple paths, at both the traffic sources as well as at intermediary nodes, in a single route discovery attempt. This reduces both the route discovery latency and the control overhead as a route discovery is needed only when all the discovered paths fail. Spreading the traffic along several routes could alleviate congestion. Multi-path routing also provides a higher aggregate bandwidth and effective energy level based on scheduling as the data forwarding load can be send the data to all paths on network.

The Neighbor Distance Discovery (NDD) method used to send the information on quickly and then low latency of the network transmission on the process .In this process method to be compliant and then process on broadcasting process on the network performance on the system. The new scheme minimizes the traffic by location information to limit broadcast retransmission only to hosts near the node coverage on the network; each broadcasting node attaches a list of its selected forwarding nodes to the message before broadcasting it. So we have using the
The Connected Dominating Sets (CDS) are considered to be very efficient for broadcasting a message from one node to all the nodes in the network [15]. They have to implement with the NDD method, our existing process for CSPR routing to shortest path on the data transmission on their network. A CDS is a sub graph of a given undirected connected graph such that all nodes in the graph are included in the CDS or directly attached to a node in the CDS [16]. A Minimum Connected Dominating Set (CDS) is the smallest CDS for the entire network. For a virtual backbone-based route discovery, the smaller the size of the CDS, the smaller is the number of unnecessary retransmissions. If the RREQ packets of a broadcast route discovery process get forwarded only by the nodes in the CDS, we will have the minimum number of retransmissions [17].

3.1 SNF-Connected Dominating Set Algorithm

S-Source, D-Destination, T-Traffic, P-Packets, M-message, CD-Connected Dominating, R-Route, F-priority.

Step 1: Initialize network nodes
- Initialize the packet counter function
- Send S message to D

Step 2: If (M=true)
- S sends Packets to D

Step 3: if Else
- Get T on Network Path

Step 4: Message dropped on network
- Using NDD method

Step 5: Broadcast scheduling NEURO FUSSY-SET logic
- Enter total neighbor Route discovery

Step 6: Check if (F=0)
- Check the Neighbor list and connected set node
- Goto First Priority Node on CDs Path

Step 7: if Else (F≠0)
- Preprocess of Priority model
- Else
- Waiting on network model

Step 8: Check Available Route & Energy to Save on CDs Path

Step 9: R=0&&T=0;

Step 10: P send to S to D normally
- Packets sending to Destination
- Else
- End

Step 11: Drop the Packets P
- Exit

Step 12: Every Time update Route information

3.2 Implementation of the proposed SNF-Connected Dominating Sets routing algorithm working steps

1. The data are sending by wireless mesh network from source (S) to destination (D) on network topology.
2. Access point collects the neighbor node list and connect dominating nodes to transmit the data to destination intermediately work through from source to destination on network.
3. AP has to gather the data sending and receiving process on the network. The traffic conditions to be checked on Access Point. If have any traffic on the network intimate to the AP.
4. When data are sending from source to destination, the network has to save the energy, reduce the traffic and then quickly send the data from source to destination on the network at all.
5. Scheduling based Neuro Fuzzy-set logic is applied some conditions whenever the data loss occurred.
6. The data loss can be retrieved from the source to destination process.
7. Now the network must have to discover a...
new route for transmitting the data from source to destination.

8. Then the connected dominating routing algorithm used for a new routing processing method on the network.

9. The Scheduling based Neuro Fuzzy logic is used to set the minimum number of connected set to the destination on the network. It’s saved more energy and discovered the shortest path route on their network.

10. It reducing the packet’s delay and save the energy on their wireless mesh network. The connected set act as more efficient and scalable network on that time of the network process.

4. RESULTS AND DISCUSSIONS

The simulation studies, we used randomly generated networks on which the algorithms were executed. This ensures that the simulation results are independent of the characteristics of any particular network topology. Using randomly generated network topologies also provides the necessary flexibility to tune various network parameters such as average degree, number of nodes, and number of edges, and to study the effect of these parameters on the performance of the algorithms. The platform used for NS2 (Network Simulator version 2). NS2 is a discrete event simulator targeted at networking research. NS2 provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless networks [18]. The simulation environment is created in NS-2, a network simulator that provides support for simulating mesh wireless networks. NS-2 was written using C++ language and it uses the Object Oriented Tool Command Language (OTCL). It came as an extension of Tool Command Language (TCL).

Fuzzy Routing Decision was implemented using the Fuzzy Logic. The simulator ran with various input configuration settings and the statistics collected were analyzed in comparison with other well-known on demand routing protocol AODV. Our simulation modeled a network of nodes placed randomly within 1500 x 1500 meter area. Each node had a radio propagation range of 250 meters and channel capacity. Two-ray propagation model was used. The IEEE 802.11 distributed coordination function was used as the medium access control protocol.

A random waypoint mobility model was used: each node randomly selected a position and moves toward that location with a speed ranging from just above 0 m/s to 20 m/s. When the node reached that position, it became stationary for a programmable pause time; then it selected another position and repeated the process. The simulation was repeated with different start values. Neuro Fuzzy logic Based Connected Dominating Set Routing Algorithm with a Multiclass Scheme for generator was developed to simulate CBR (Constant Bit Rate) sources . The radio and IEEE 802.11 MAC layer models were used .The size of the data payload was 1024 bytes. Data sessions with randomly selected sources and destinations were simulated. Each source transmitted data packets at a minimum rate of packets to send the source to destination on the network. Traffic classes were randomly assigned and simulation was carried out with different bandwidth requirements.

There were no network partitions throughout the simulation. Each simulation was executed for 600 seconds of simulation time. The parameter values for simulation are shown in Table 1.
Table 1: Parameters for simulation

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version</td>
<td>Ns-allinone 2.28</td>
</tr>
<tr>
<td>Protocols</td>
<td>SNF-AODV</td>
</tr>
<tr>
<td>Propagation model</td>
<td>Free Space</td>
</tr>
<tr>
<td>Area</td>
<td>1500m x 1500m</td>
</tr>
<tr>
<td>Transmission Range</td>
<td>250 m</td>
</tr>
<tr>
<td>Traffic model</td>
<td>UDP, CBR</td>
</tr>
<tr>
<td>Packet size</td>
<td>1024 Kb</td>
</tr>
<tr>
<td>Mobility Model</td>
<td>Random Way Point</td>
</tr>
<tr>
<td>Node’s Mobility</td>
<td>0-100m/sec</td>
</tr>
</tbody>
</table>

4.1 SNF-AODV Metrics

The simulation scenario is designed as like as wireless mesh network of source to destination on their network model. The impact of network energy model of nodes are low level and reduce the energy model on the performance over a fixed topology area of 1500m x 1500m using AP identical source-destination connections. The following metrics for evaluating the performance is given in Table 2.

Table 2: Metrics for evaluating the performance

<table>
<thead>
<tr>
<th>S. No</th>
<th>No of Node</th>
<th>Protocol</th>
<th>Throughput</th>
<th>Average Delay</th>
<th>PDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>61</td>
<td>F-AODV</td>
<td>0.29</td>
<td>11.01</td>
<td>98.0</td>
</tr>
<tr>
<td>2.</td>
<td>61</td>
<td>NF-AODV</td>
<td>0.34</td>
<td>8.02</td>
<td>99.1</td>
</tr>
<tr>
<td>3.</td>
<td>61</td>
<td>SNF-AODV</td>
<td>0.45</td>
<td>5.12</td>
<td>99.6</td>
</tr>
</tbody>
</table>

4.2 Throughput Performance

They have an average throughput for using different protocols. The average throughputs show that scheduling Neuro fuzzy routing outperforms NF-AODV and traffic balancing as it always chooses the optimal path.

Throughput is the ratio of throughput performance and overall network performance. To improve network performance for maximize the packet delivery ratio and minimize the packet delay.

The performance of the throughput for Neuro Fuzzy and the proposed Scheduling Neuro fuzzy logic routing is depicted in Figure 1.

![Figure 1. Performance of Scheduling Neuro fuzzy logic](image)

The performance of Scheduling Neuro fuzzy logic based Connected Dominating sets routing throughput level is higher than fuzzy and neuro fuzzy routing of the network. It is calculating the performance of throughput level by high accuracy of the data transferring on source to destination.

4.3 Packet Delivery Fraction

Packet delivery fraction is the ratio of data packets delivered to the destination to those generated by the sources. It is calculated by dividing the number of packet received by destination through the number packet originated from source. The DeliveryRatio of Scheduling Neuro fuzzy logic is depicted in Figure 2.

\[ \text{PDF} = \left( \frac{\text{Pr}}{\text{Ps}} \right) \times 100 \]

where, \( \text{Pr} \) is total Packet received and \( \text{Ps} \) is the total Packet send.
Delivery fraction is calculating when the data transmission between the one to another node of the network. The performance of the packet delivery fraction for the proposed routing and the Neuro fuzzy logic routing based on manual calculation. Fuzzy Logic has been used for routing and management of an ad hoc wireless network. The fuzzy logic based routing algorithm takes into account input variables, delay, throughput and energy consumption. The Neuro fuzzy routing might have more routing overhead because of measuring lots of constraints at each node on the path; but the scheduling based neuro fuzz logic routing has least overhead due to routing. It is true that a lot of time is spent initially for setting up of the route. But since scheduling neuro fuzzy routing always leads to stable routes, the routes are used for a longer period.

4.4 End-to-End Delay

Average end to end delay includes all possible delay caused by buffer during route discovery latency, queuing at the interface queue, retransmission delay at the MAC, propagation and transfer time. It is defined as the time taken for a data packet to be transmitted across an MESH network from source to destination. Average end-to-end delay is written as

\[ D = (Tr - Ts) \]

Where, \( Tr \) is receive Time and \( Ts \) is sent Time.

Figure 3. Delay comparision of existing with Scheduling Neuro fuzzy logic.

The performance of delay for the proposed routing protocol with the fuzzy and neuro fuzzy logic routing on Figure 3 and also a comparison of delay for proposed scheduling neuro fuzzy based routing protocol. Delay is used to calculate the packet dropping level of the networks and then if data are dropped means the time to taken. Scheduling Neuro fuzzy logic routing delay is very low on their networks.

5. CONCLUSION

In this paper, we presented a Neuro Fuzzy scheduling based CDs and NDD method on the wireless mesh network. The performance of this scheduler was studied using NS2 and evaluated in terms of quantitative measures such as packet delivery ratio, average end-to-end delay, and throughput performance. The Scheduling based data transmission were priority based data sending and receiving process and then RREQ and RREP is an important progress on this SNF-AODV protocol model. NDD method to collect all the neighbor node information on it’s to the AP that is to set the high priority node on the network. Simulation shows that the approach is efficient, promising and applicable in wireless mesh network. A detailed comparison of several algorithm for wireless mesh network has been performed through simulation, adapting and extending the NS-2 simulator with the simulation of SNF algorithm and additional algorithms. The SNF
algorithm offers the best overall operation among the compared.

REFERENCE