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Wireless Mesh Networking Routing Algorithm Based on Inference Model

Monika[1], Dr. Yashpal Singh[2]

CSE Department, Ganga Institute of Technology and Management, Kablana, Jhajjar, Haryana[1]

Associate Professor, CSE Department, Ganga Institute of Technology and Management, Kablana, Jhajjar, Haryana[2]

Abstract: With the growing demand for real time services in Wireless Networks, based routing has emerged as an interesting research topic. A Wireless Mesh Network (WMN) is based on ad-hoc networks, where each node transfers data to and from an Access Point (AP) which is connected to the Internet by a wired or wireless network. These AP need not be in the reach of all the nodes in the network. Nodes around the AP forward the packets from the faraway nodes to the AP. If there are a significant number of nodes in the network, faraway nodes can transfer data with the AP in a few hops. Besides mobility, WMN have the advantages viz., they can work in a decentralized fashion, are cheap with minimum investment for initial infrastructure, more reliable, scalable and provide increased coverage. They are widely used in campus networks, metropolitan area networks, transportation system, security surveillance system, etc.

Keywords: Wireless Mesh Network (WMN), Access Point (AP), Ad-Hoc Networks.

1. INTRODUCTION

As the development of networking technologies and the increasing popularization of network based applications, computer networks are now being widely used in scientific researches, business, education, national defense and other domains [1, 2]. In addition to this, other issues such as routing for multicast applications, scalability of routing protocols, cross-layer design between routing and MAC protocols are also under study.

2. ROUTING IN WMN

Routing protocols can be classified into proactive and reactive. Proactive protocols need to maintain routes between all node pairs all the time, while reactive routing protocols [3, 14] only build and maintain routes on demand. Studies [2, 15] have shown that reactive routing protocols perform better in terms of packet delivery ratio and incur lower routing overhead especially in the presence of high mobility. In WMN, transfer of data takes place to and from the AP. Each node sends route requests to its neighbors.

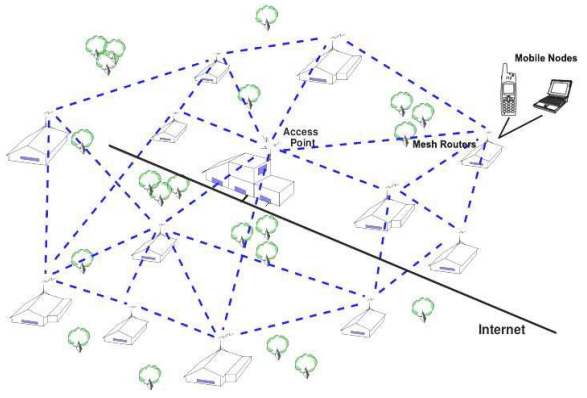

Figure1. Wireless mesh networks

When the requests reach the different APs, they send back a route reply. The sending node receives all these replies and decides which route and AP to use based on different conditions.

3. PROPOSED MULTI CONSTRAINT ROUTING USING INFERENCE MODEL

The block diagram of the proposed multi constraint routing using fuzzy logic is shown in Figure 2.

3.1. Routing with Fuzzy Logic

In this routing, the constraints first undergo fuzzification and are mapped into sets using membership functions. Then the inference engine with the help of the rule base computes the fuzzy output. This fuzzy output is sent back after defuzzification.

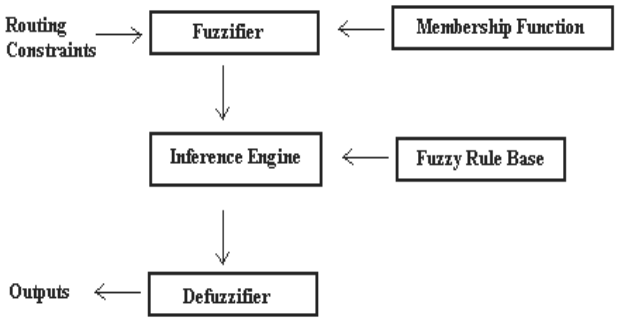

Figure 2.Fuzzy routing

The functions performed by various units in the fuzzy controller are explained as follows:

3.1.1. Fuzzifier and Membership Function

The membership function of a fuzzy set represents the degree of truth. Fuzzy truth represents membership in

vaguely defined sets, not likelihood of some event or condition. Membership functions on any fuzzy input X represent fuzzy subsets of X. In the membership function under consideration, the fuzzy inputs buffer occupancy and hop count have been divided into three fuzzy subsets - low, medium and high. Fuzzifier is the mechanism that is used to map the real-world fuzzy inputs to the range [0, 1].

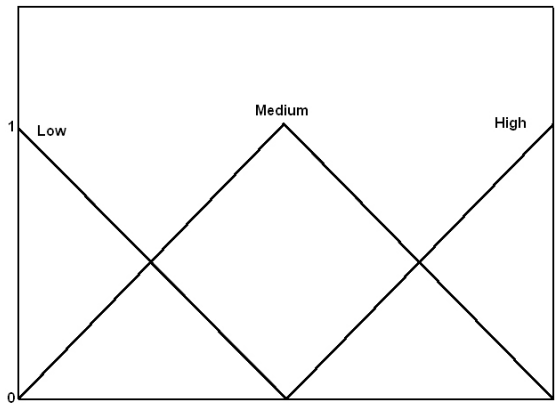

Figure 4 Triangular membership functions for buffer occupancy, residual node energy and hop count over a normalized range.

3.1.2. Inference Engine and Fuzzy Rule Base

The fuzzy inference engine takes the value of fuzzy inputs at each node and scans through the fuzzy rule base to find the appropriate entry corresponding to the fuzzy inputs to calculate the fuzzy output cost for each node.

3.1.3. Defuzzifier

Defuzzifier produces a quantifiable result in fuzzy logic. Thus, defuzzifier produces a real-world output from the fuzzy outputs which are in the range [0, 1] by using defuzzification techniques. Since the objective of our system is to choose the paths with the best fuzzy cost, it doesn't require the fuzzy outputs to be defuzzified and results can be derived by comparingthe fuzzy costs itself. As an example, consider twopaths P1 and P2.The better path can be derived as follows without further defuzzifying the fuzzy outputs:

If Fuzzy (P1) < Fuzzy (P2)
Better path 1= P1
else
Better path 2 = P2.

4. LITERATURE REVIEW

1.	INTERNATIONAL JOURNAL OF TECHNOLOGY ENHANCEMENTS AND EMERGING ENGINEERING RESEARCH, VOL 3, ISSUE 04 ISSN 2347-4289	A Reliable And Trusted Routing Scheme In Wireless Mesh Network
2.	Int. J. Mobile Communications, Vol. 9, No. 6, 2011	An interference-aware routing metric for Wireless Mesh Networks
3.	JOURNAL OF NETWORKS, VOL. 7, NO. 3, MARCH 2012	Efficient Routing Algorithm Based on Decisionmaking Sequence in Wireless Mesh Networks
4.	International Journal of Multimedia and Ubiquitous Engineering Vol.8, No.5 (2013),	A Simulation-Based Performance Analysis of a Cluster-based Routing Scheme for Wireless Mesh Networks
5.	International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization)	An Efficient Routing Protocol for Wireless Mesh Networks
6.	International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 2, Issue 10, October 2013	An Efficient Routing Protocol for Wireless Mesh Networks
7.	International Journal of Multimedia and Ubiquitous Engineering Vol.8, No.5 (2013),	Troubleshooting Wireless Mesh Networks
8.	CTRQ 2011 : The Fourth International Conference on Communication Theory, Reliability, and Quality of Service	FTAM: A Fuzzy Traffic Adaptation Model for Wireless Mesh Networks
9.	MESH 2012 : The Fifth International Conference on Advances in Mesh Networks	A Survey on QoS in Wireless Mesh Network
10.	International Journal of Computer Science and Telecommunications [Volume 3, Issue 5, May 2012]	Review on Routing Algorithms in Wireless Mesh Networks
11.	International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 2, February 2015	Real Time Routing Algorithm Based On NSGA-II in Wireless Mesh Networks
12.	The International Arab Journal of Information Technology, Vol. 9, No. 1, January 2012	Routing for Wireless Mesh Networks with Multiple Constraints Using Fuzzy Logic

13.	AR ARTICLE IN PRESS: Computer Communications xxx (2008)	MRP: Wireless mesh networks routing protocol
14.	International Journal of Computer Science and Telecommunications [Volume 3, Issue 5, May 2012]	Trajectory Inference using a Motion Sensing Network
15.	International Journal of Current Engineering and Technology Accepted 10 April 2015, **Vol.5, No.2 (April 2015)**	Routing for Wireless Mesh Networks using Agent based Scheme

5. IMPLEMENTATION OF INFERENCE MODEL ROUTING

There are 3 phases involved in the implementation of proposed multi constraint routing using Inference model:

• Phase 1: Sending requests for route: Whenever a node wants to discover a new route, it sends Route REQuest (RREQ) packets to its neighbours. It starts a time window as soon as it sends this RREQ. This is the time till which it will receive the route replies sent back from the destination node. At each node on the path, the routing constraints are measured. Then the Inference system works as follows:

1. The constraints are divided into sets of low, medium and high based on the membership function for that constraint which is decided by repeated trials and expert analysis.
2. The fuzzy inputs are then fed into the inference engine which decides the fuzzy grade of that node with the help of the rule base is given in

• Phase 2: Route reply phase
When the RREQ packets arrive at the destination node, it sends back a Route REPly Packet (RREP) to the source node, through that given route with the fuzzy grade value in its packet header.

• Phase 3: Route decision phase
The source node accepts all RREP packets which arrive within the time frame. It then compares the value of fuzzy grade to the route already available in its routing table. If the current route has a better value, then this route replaces the one present in the routing table else this RREP is simply dropped.

Simulation Tools

2.1. Main Evaluation Methods of Routing Protocols

Typically, the development process is divided into two phases: the evaluation by means of quality tools and the subsequent prototype testing in a close-to-real environment test beds. In the case of Wireless Mesh Networks, as compared to traditional wireless networks, there is an additional challenge, due to the structure of network, stationary nodes roles as well as client's mobility and roles. It is also worthwhile to mention that there are some specific characteristics of Wireless Mesh Networks that provide additional conditions for simulating them, such as

_ wireless { what implicit limited transmission rates and high loss rate;
_ multi-hop { means that track is forwarded through nodes that are not in direct range of the node that generates it;
_ redundancy { the nature of WMN implies redundant links in the wireless backbone of network;
_ mobility { while backbone nodes are mostly stationary, clients of the network should be treated in simulation models as mobile;
_ dynamics { because of the self-con_guring and selfhealing ability of WMN one should consider smooth changes in the structure of the network; the network is established in a very spontaneous way;
_ infrastructure { dual type of nodes in network should be considered - mobile clients versus stationary nodes;
_ integration { the duality of structure also in roles that nodes play in network - lightweight clients can join the WMN network without serving any routing services.

Drawbacks of the use of simulators
Advantages
_ Easy to expand network topologies due to simulation applications high scalability
_ Simulation process is easy to maintain
_ It is the most common way of developing and testing new routing protocols
_ Testing cost relatively small
_ Results have high repeatability
_ Full control of simulation process
_ Easy process of scenario preparing and data collecting

Drawbacks
_ There is no standardized simulation tool that would allow to compare simulation results between different projects
_ Results can di_er from real world because of abstracted PHY layer modelling
_ Results can depend on a particular implementation of simulation software

We need to evaluate a routing protocol or routing metric for WMN have to choose a evaluation model.
We can choose from different types of evaluation processes.

Theoretical analysis: in that process a mathematical models to evaluate network performance is used. The most commonly used mechanism is queuing theory. It is a very di_cult means of development, mathematical formulas can get very complex and, thus, can consume a large amount of time. What is more, there are no dedicated mathematical tools to provide such analyses. Nevertheless, a mathematical analysis is often the first step of the development process.

Simulations: with special tools the researcher iscapable of modeling virtual environment to help verify the general

idea, detailed parameters and solutions, or to compare proposed solutions. Simulations are particularly useful for studying highly distributed networks such as Wireless Mesh Networks or Wireless Sensor Networks. In this way one can discover behavior in such networks under a change in some parameters, while others remain _xed. Additionally, simulation base studies are very flexible with low cost.

Emulation: it is a hybrid study environment thatconsists of two parts - real and simulated. It depends on the researcher's goal which element is real and which simulated. Emulation has one important advantage: any results from such tests are more realistic as any experiment part because it is a real working part.

Virtualization: general idea of virtualization is to provide virtual environment in which hosts to conduct experiments are run. Nowadays, virtualization is becoming quite simple and inexpensive, so it becomes more and more widely used. It is actually rather easier to use existing hosts and install virtual hosts on it than to build a quite new infrastructure that consists of many physical machines. It can vary to what degree virtualization can be used: it can be full with virtual hosts, virtual operating systems and all network equipment or as virtual instances or virtualized only as a part (for example only client hosts). Virtualization can o_er good tools for evaluating communication protocols {it is possible to provide multiple virtual hosts on a single physical machine, thus the experiments cost can be minimized.

Real test-beds: it is a development process based ona prototype implementation that should produce the most realistic results. By using it, the researcher can simply transfer their ideas to the real world, though the influence from environment should be also considere as it can significantly affect conducted experiments.

6. PRESENT WORK

Routing for Wireless Mesh Networks with Multiple Constraints Using Inference model it maximize the performance of WMN, a multi constraint routing with constraints viz., buffer occupancy, residual energy and hop count, using Inference model techiniques is proposed in this paper. Our simulation results show that this Inference model based multi constraint routing outperforms the existing routing algorithms. It always chooses the optimal path for routing with minimum routing overhead, and maximizes the throughput. This is attributed to the fact that Inference routing produces routes that are optimal and stable. As such, this reduces the possibilities of congestion in the network. This work can be extended for group communication in wireless mesh networks.

7. CONCLUSION

Due to the growth in the scale of WMNs new routing algorithms come into existence. This paper has proposed a new reliable and trusted routing scheme based on node residual energy, hop count and throughput. Our proposed scheme combines three parameters to discover a reliable route between the sources to destination.
Our simulation results show that this Inference Model Routing algorithms exist.It always choose the Optimal Path solution for maximum throughput. This will reduce the traffic congestion in the various network by using Inference Model.

8. FUTURE WORK

Now a days routing is a multi constraint problem. In order to reduce congestion and make routing decisions more reliable, routing decisions should be based on more than one constraint. Inference model is a suitable tool to be applied in the wireless mesh network routing decision purposes. The research work in the present paper is to select reliable route by using certain metrics such as node residual energy, hop count and throughput. We believe that the proposed routing scheme can be further investigated based on other routing metrics in order to design better adaptive technique for wireless mesh networks.

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