✚IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

AWARENESS OF WIRELESS MESH NETWORKS USING ROUTING METRICS

A. Ramakrishna[*1] & Dr. K. Subba Rao[2]
[*1]Asst.Professor, MLRITM-R.R District-Telangana-India, BVRIT-Narsapur-Medak,-India
[2]Professor, MLRITM-R.R District-Telangana-India, BVRIT-Narsapur-Medak,-India

ABSTRACT

The Wireless Mesh Network (WMN) is a key emerging technology to construct next generation wireless multi-hop network. It combines the advantages of both mobile ad-hoc network (MANET) and traditional fixed network, attracting significant industrial and academic attentions. In network layer, routing metrics are also important to the performance of communication. In this paper, we review the some of existing routing metrics like Distance routing metric, Latency Routing Metrics, Traffic Load Routing Metric, and Compositive Metrics in WMNs. Based on the findings, we also point out the open issues of routing metrics

KEYWORDS: routing metric, wireless mesh network.

I.   INTRODUCTION

The Wireless Mesh Network (WMN) is becoming a major point for the next generation wireless networks. This is mainly revaluation of using basic radio frequency physics to provide a robust, flexible, standard-based architecture. Usually, this architecture offers instant, highly flexible, and low-cost mobile broadband communications to different communities through the readily attainable multi-hop connection. In the WMNs, signals are routed optimally and nodes can automatically join and leave the network at any time. Furthermore, networks can be established instantly virtually anywhere, even in places with no fixed infrastructure. Instead of using optical fibre cable, wireless radios are applied in WMNs. They have been already deployed to build wireless broadband network in some newly developing areas worldwide and isolated islands. A WMN combines the characteristics of both fixed network and MANET. The communication inside a WMN is similar to MANET, client nodes are self-configured and self organized where the routes are selected by using certain routing algorithm and each client node has to relay other's packets. For accessing the backbone internet, the packets are forwarded through internet gateway to the fixed network by fixed cable links.

The Routing metrics are integrated in routing protocols to improve communication quality in term of bandwidth, error rate, latency, reliability, and cost. In addition, the improvement of one aspect normally results in all other aspects. For example, a good communication cost routing metric also performs well in reducing delay etc. The new routing metrics are required to examine and improve the performance of WMNs in dealing with more constraints. Because channel bandwidth is limited in wireless communication, the design of routing metrics is important. In this paper, we first review the performance of a list of existing routing metrics, *Hop-count* Round Trip Time, Traffic Load Routing Metric, Compositive Metric and so forth. We also describe the possible open issues remain in the current design of routing metrics in WMNs.

II.   NETWORK MODEL

The WMNs are a specific type of Mobile Ad-hoc Networks (MANET). A WMN consists of mesh clients, mesh routers and gateways where mesh routers and mesh clients are designed to increase the coverage of WMNs. This is by only using wireless radio while a gateway uses both wireless radios and fibre optic cable. Mesh clients connect to gateways through mesh routers, while mesh routers connect to a backbone network via gateways and gateways relay the message from internet to the mesh clients. Hence, there are three layers in a typical wireless mesh network: Internet Gateway Layer (IGW), Mesh Router Layer (MR) and Mesh Client Layer (MC) is as shown in below Figure 1. To simplify the description of the routing algorithm, we combine the MR layer and MC layer in this paper as both MR and MC are routing devices that use wireless radio and are connected to the backbone of the internet via gateways.

There are two differences between WMN and MANET are gateway and mobility. Compared to MANET, most of the traffic is expected to flow between the mesh clients and the backbone network through gateways. In the MANET, all the nodes are assumed as mobile nodes moving in the network. In other words, the MANET is most device in WMNs is stationary or with limited mobility, where only a small portion of devices such as mobile phones, are moving in the network. The characteristics of WMN are not considered in the existing routing protocols such as AODV, DSR and DSDV, and most of the existing metrics such as *HOP COUNT* and *ETX* etc. In fact, the previous protocols and metrics are designed with particular attention paid to the mobility of the nodes, i.e., supposing most of nodes are highly mobile. Therefore, both new routing protocol and metrics are required to be designed for WMNs, the old routing protocol and metrics also have to be re-engineered to satisfy requirements of WMNs.
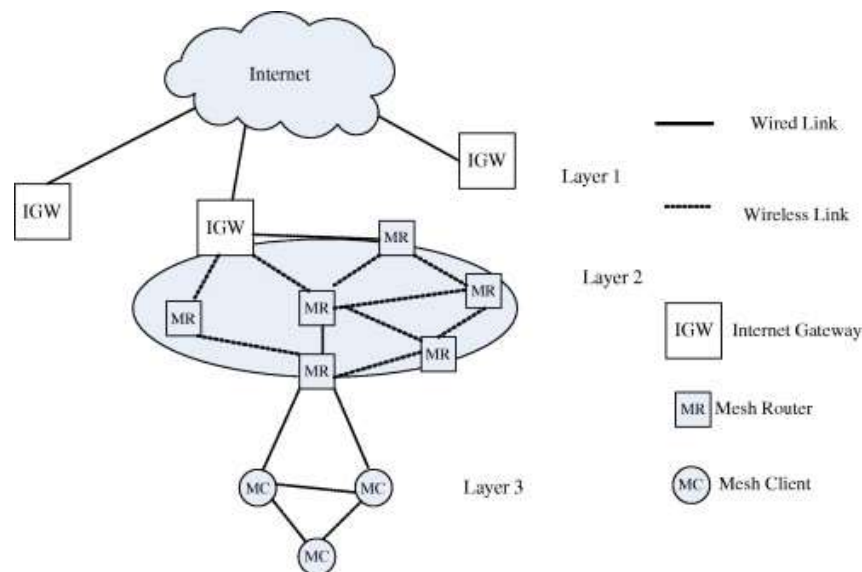

figure 1: The network structure of a typical Figure of WMN

III.   EXISTING ROUTING METRICS

The design of routing metrics is important. Existing routing metrics can be classified into following types: distance, latency, traffic load and compositive metric. The following sub-sections show typical examples of each type.

a)   Distance routing metric (*Hop-count):*
It is widely used in existing protocols such as AODV, DSR, and DSDV. A routing protocol with the Hop-count metric considers the number of hops between source and destination. Hence, it finds the path with the minimum distance. However, it does not consider other issues such as link quality, transmission rates. Since minimizing the number of hops is not usually the performance goal in WMNs, Hop-count may result in poor performance.

b)   Latency routing metrics (Pre-hop Round Trip Time):
It is designed for Multi-Radio Unification protocol. It measures the round trip delay of unicast probes between neighbours. In this metric, each node sends out a probe packet with timestamp to all neighbours. When receiving the probe packet, each neighbour may respond an acknowledgement. As sender receives the acknowledgement, it calculates the round trip time between sending probe and receiving acknowledgement. It avoids busy channel and link loss by the path selection. However, queue delay exists due to the contention among nodes for low RTT link. RTT also generates high overhead and self interference.

Per-hop Packet Pair Delay (*Packet Pair* or *PP*):
It is an improved version of round-trip time (*RTT)* by considering queue delay and transmission rates. In PacketPair, a node sends out two probe packets to each neighbour every 2 seconds. In addition, the first probe packet is small (137 bits) and the second is large (1137 bits). This tests the sensitivity of link bandwidth for packets in different sizes. Once receiving probes, each neighbour calculates the delay difference of these two packets and

RESEARCHERID
THOMSON REUTERS

ISSN: 2277-9655
[Ramakrishna * *et al.,* 7(3): March, 2018]   **Impact Factor: 5.164**
IC™ Value: 3.00   **CODEN: IJESS7**

reports the delay result to the sender. Sender keeps the delay result of each of its neighbours for future routing. Although Packet Pair eliminates the problem of queue delay, it still suffers the self interference and high overhead.

c) Traffic load routing metric (Load-count):
It is a load balancing metric for wireless networks

$$load - count = \sum_{i=l}^{n} load_i$$

where *Load i* is the traffic load on a node *i* which is normally captured by using IFQ length. The IFQ (Network Interface Queue) is a drop-tail buffer at the MAC layer of 802.11 radios, which contains outbound frames to be transmitted by the physical layer where the size of IFQ is calculated as the number of remaining packets in the buffer.

Neighbourhood Load Balancing (*NLR*):
It is the average load of each neighbourhood is measured with aim to bypass the busy neighbourhood instead of only bypassing the busy node with Load-count. Moreover, in a heavy loaded neighbourhood, extra traffic on one node influences communication of all nodes within its interference range. The transmission of packets in these nodes can be deferred, or dropped. Thus, there is a side effect caused by allowing a packet goes into heavy loaded neighbourhood. To solve the above problem, NLR is developed to check the summation value of the neighbourhood load over a path which is:

$$NLR = \sum_{i=1}^{K} \frac{load_i^n}{b_i^n}$$

$$n = \frac{tr}{d_{avg}}$$

where *n* is the interference radius of neighbourhood in hop number; *tr* denotes the transmission range (here the transmission range is assumed as same as the interference range), and *d avg* is the average distance between two one-hop nodes. *n i Load* denotes the average load of a neighbourhood of *node _i* with radius *n* hops and *n i b* is the average transmission rate of this neighbourhood. The neighbourhood size measures average transmission range of the zone with all nodes interference by the centre node. Hence, unlike existing routing metrics, NLR considers three aspects in the selection of the best path, which are IFQ length of each node, neighbourhood interference, and transmission bandwidth.

d) Compositive Metric (Weighted Cumulative ETT with Load Balancing):
It is a metric proposed, which is an improved version of *WCETT*. It considers the load balancing in the metric by involving the congestion level which is achieved by calculating the average queue length on each node. Based on the protocol layers of each metric working on, existing routing metrics can be classified into below three types: single performance parameter metric, single protocol-layer metric (for multiple performance parameters) and multi-protocol-layer metric (for multiple performance parameters). In this context, Hop-count and Load-count are network layer routing metrics. They either capture the number of hops or the traffic load along the paths. Hence, they are single performance parameter metric. IAR is a multi-protocol-layer routing metric for multiple performance parameters. It considers both data link layer and network layer to capture MAC handshake time, bandwidth and packet size, respectively. Besides above three routing metrics, all other routing metrics mentioned in this chapter are single-protocol-layer metrics for multiple performance parameters. To understand the different characteristics, routing metrics can be also divided into probe-exchange based metric and self-detection metric. Probe-exchange based metrics normally detects the routing status by sending probes in cluster, group or overall network. It normally initiates high overhead. On the contrary, self-detection metrics reduce exchange overhead by only measuring the local routing status. Besides Hop-count, Load-count and IAR, all the routing metrics in this chapter are probe exchange based metrics.

Table 1: A comparison of different routing metrics for WMNs

Routing Metrics	Layer	Communication Quality Parameter	Power Management	QoS
Hop Count	Network	No of Hops	No	No
RTT	Network	Packet loss, Delay, Contention	No	No
PacketPair	Network	Packet loss, Delay, Contention	No	No
Load Count	Network	Traffic load	No	No
WCETT	Network	Packet loss, Transmission, Contention, Bandwidth and Packet Size	No	No

IV. OPEN ISSUES

As shown in the above table 1, there are several issues in the design of routing metrics for WMNs.

1) Many existing routing metrics work ad–hoc basis. Consequently, they may only perform well for a certain type of WMN such as Client WMN.

2) Probe-exchange based metrics may cause large overhead. It performs especially badly in large scale networks.

3) Limited network parameters are considered. Critical parameters such as QoS for diverse applications are not captured in existing routing metrics.

4) Therefore, it is necessary to design new routing metrics to better optimize the routing protocol so as to achieve better performance.

V. CONCLUSION AND FUTURE WORK:

For increasing the efficient communications, routing metrics should be improved to better work in WMNs. In this paper, we review existing routing metrics for WMNs. In addition, we also describe the remaining issues on the basis of review. In our future work, we will focus on design efficient routing metrics in WMNs

VI. REFERENCES

[1] Mihail L. Sichitiu, "Wireless Mesh Networks: Opportunities And Challenges".
[2] Eduard Glatz, "Wireless Mesh Networks: Introduction" ATCN: WMN-BasicsWS0607.fm.
[3] Mojtaba Seyedzadegan, Mohamed Othman, Borhanuddin Mohd Ali and Shamala Subramaniam, "Wireless Mesh Networks: WMN Overview, WMN Architecture", 2011 International Conference on Communication Engineering and Networks, IPCSIT 19 (2011) IACSIT Press, Singapore.
[4] Yan Zhang, Jijun Luo, Honglin Hu, "Wireless Mesh Networking Architectures, Protocols and Standards", Auerbach Publications, Taylor & Francis Group, New York.
[5] Sonia Waharte, Raouf Boutaba, Youssef Iraqi, Brent Ishibashi, "Routing protocols in wireless mesh networks: challenges and design considerations", Multimed Tools Appl 29 (2006) 285–303.
[6] Jangeun Jun, Mihail L. Sichitiu, "MRP: Wireless mesh networks routing protocol", Computer Communications, (2008) .
[7] Jaydip Sen, "Secure Routing in Wireless Mesh Networks" Chapter 11, Wireless Mesh Networks.
[8] Raluca Musaloiu-Elefteri, "Practical Wireless Mesh Networks And Their Applications", A dissertation submitted to the Johns Hopkins University, Baltimore, Maryland, January, (2010).
[9] Sharma, Vinod, A. Anil Kumar, S. R. Sandeep, and M. Siddhartha Sankaran. "Providing QoS to real and data applications in WiMAX mesh networks." InWireless Communications and Networking Conference,. IEEE, (2008) 2645-2650.

[10] H. Lundgren, E. Nordstrom and C. Tschudin, "The GrayZone Problem in IEEE 802.11b based Ad hocNetworks"Proc. of. ACM Mobile Computing & Comms Review 6 (3) (2002) 104–105. R. Jurdak, "Wireless Ad Hoc and Sensor Networks: ACross-Layer Design Perspective (Signals andCommunication Technology)", Springer Publishers, Jan. (2007).

[11] H. Badis, K. Al Agha, "QOLSR multi-path routing for mobile ad hoc networks based on multiple metrics: bandwidth and delay", IEEE, 4, 2181- 218.

[12] Bo Wang and Matt Mutka, "QoS-Aware Fair Rate Allocation in Wireless Mesh Networks", Computer Communications, Volume 31 (7) (9) (2008) 1276-1289.

[13] Kaikai Chi, Xiaohong Jiang and Susumu Horiguchi, "Network coding-based reliable multicast in wireless networks", Computer Networks, 54 (11) (2010) 1823 -1836.

[14] Zheng Sihai, Li Layuan and Guo Lin, "QoS-Based Multicast Routing Protocol in MANET", International Conference on Industrial Control and Electronics Engineering, (2012) 262 - 265.

[15] [Mohammed Saghir, Tat-Chee Wan and Rahmat Budiarto, "QoS Multicast Routing Based on Bandwidth Estimation in Mobile Ad Hoc Networks", Proceedings of the International Conference on Computer and Communication Engineering, 1 (2006) 384-389.

[16] Sonika Kandari and Manoj Kr. Pandey, "QoS Multicasting in MANET", International Journal of Current Engineering and Technology, ISSN 2277 – 4106, (2014) 1854-1858.

[17] Yun-Sheng Yen, Han-Chieh Chao, Ruay-Shiung Chang and Athanasios Vasilakos, "Flooding-limited and multi-constrained QoS multicast routing based on the genetic algorithm for MANETs", Mathematical and Computer Modeling, 53 (11–12) (2011) 2238–2250.

[18] Govindaraj.E , Dr.V.P. Arunachalam and Dr.S.Karthik," A QoS Aware Robust Multi path Routing Protocol for Wireless Mesh Networks" , European Journal of Scientific Research, (2012).

[19] Ali, Amjad, and Wang Huiqiang. "Node Centric Load Balancing Routing Protocol for Mobile Ad Hoc Networks." In Proceedings of the International MultiConference of Engineers and Computer Scientists, 1(2012).

[20] Yigal Bejerano, Seung-Jae Han and Amit Kumar, "Efficient load-balancing routing for wireless mesh networks", Elsevier, (2006).

[21] Liang Ma and Mieso K. Denko, "A Routing Metric for Load-Balancing in Wireless Mesh Networks", IEEE, (2007).

[22] Siddiqui, Muhammad Shoaib; Amin, Syed Obaid; Kim, Jin Ho; Hong, Choong Seon; "MHRP: A Secure Multi-Path Hybrid Routing Protocol for Wireless Mesh Network", Proc., IEEE, military communications conference MILCOM, (2007).

CITE AN ARTICLE