Performance Evaluation of Routing Metrics for Wireless Mesh Networks

S.L. Nxumalo[1, 2], N. Ntlatlapa[2], P. Mudali[1, 2], M.O. Adigun[1]
Department of Computer Science, University of Zululand, KwaDlangezwa, South Africa[1] and Meraka Institute, Pretoria, South Africa[2]
University of Zululand, P.O. Box X1001, KwaDlangezwa 3886, slnxumalo@gmail.com, Phone: + 27359026706/+27359026012 Fax: +27359026569

Abstract—A routing metric is a measure used by a routing protocol to select a best path, without a routing metric a protocol will not know which path to use to send a packet. A number of routing metrics exist for WMN, but routing still remains a problem for WMN. The routing metrics have not been compared with QoS parameters. This paper is a work in progress of our project in which we want to compare the performance of different routing metrics in WMN using a wireless test bed. We selected four routing metrics to be evaluated. Evaluation will reveal the best routing metric for WMN, if there is none, it will help us recommend design criteria for an optimal routing metric for WMN.

Index Terms— node, routing metric, routing protocol, WMN.

I.INTRODUCTION

WMN is a collection of communication devices (nodes) that wish to communicate, but have no fixed infrastructure available, and have no pre-defined organization of available links. WMN have emerged as a key technology for next-generation wireless networking [1].

WMN can be used in community networks, enterprise networks, home networks, and local area networks (LAN) for hotels, parks and trains. It be used as well in metropolitan area networks. It can as well be used in ad hoc deployment of LAN such as public safety, rescue and recovery operation.

There are challenges that still face WMN, one of them being the provision of Quality of Service (QoS) functionalities to the network. QoS is the collective effect of service performance which determines the degree of satisfaction of a user of the service [7].

The process of selecting the optimal path through which to send a packet is called routing. Routing is performed in each and every relay node so as to find the next hop for the packet. A routing metric is simply a measure used for selecting the best path.

There is a need to find out which routing metric is best for WMN among the existing routing metrics. The existing routing metrics have not been compared with QoS parameters, therefore they need to be compared and find out if they can work in WMN if so which one works best. If they can work in WMN, they will solve the routing problem in WMN. If these routing metrics does not work for WMN, there will still be a need for a new routing metric that will work well in WMN.

Ad hoc and mesh networking research has mostly been carried out using simulation rather than test bed but many recent studies [2] have revealed the inherent limitations of simulation in modeling the physical layer and aspects of the MAC layer [3]. The results from a simulation tool only give a rough estimate of performance [3] and results of the same routing protocol simulated on different simulation packages are not consistent and can lead to confusion and unreliability [3].

II.Literature Review

After reviewing the literature on different routing metrics, we grouped them together based on the performance metrics that are being optimized. Table 1 shows our grouping of the routing metric. From the resulting groups, we chose four routing metrics (one routing metric from each group) to use to evaluate the performance of routing metrics in WMN.

The chosen routing metrics were HOP, RTT, EETT and a routing metric for BATMAN and their performance will be evaluated on a wireless test bed using a wireless test bed.

Shortest path	Packet loss rate	Delay	Interference
HOP	ETX	PktPair	WCETT
	mETX	RTT	MIC
	ENT	ETT	iAWARE
	iETT	MCR	EETT
	MM	PPTT	ILA
		AETD	
		Airtime link metric	
		WCETT-LB	

Table 1 groups of routing metrics

1) Hop Count (HOP*)*

Hop Count [6] routing metric routes packets through a path with minimum number of hops. The link quality for this metric is a binary concept; either the link exists or it does not. The advantage of this routing metric is that it is very simple, once the topology is known; it is easy to compute and minimize the hop count.

The disadvantage of HOP is that it does not take packet loss or bandwidth into account. The route that minimizes the hop count does not necessarily maximize the throughput of a flow.

2) Round Trip Time (RTT)

RTT [4] measures the round trip delay seen by unicast probes between neighbouring nodes. It measures several facets of link quality. RTT metric is designed to avoid highly loaded or lossy links.

3) *Exclusive Expected Ttransmission Time (EETT)*

EETT [5] gives a better evaluation of a multi-channel path. EETT of a link *l* represents the busy degree of the channel used by link *l*. If there are many neighbouring links on the same channel with link *l*, link *l* may have to wait a longer period to do the transmission on that channel. A path with a larger EETT indicates that, it has more severe interference and needs more time to finish the transmission over all links within the path. EETT is calculates as: $EETT_l = \sum_{link\ i \in IS(l)} ETT_i$ (1)

4) *Routing metric for BATMAN*

This is a link metric that is used by BATMAN routing protocol [3]. The purpose of this routing metric is to maximize the probability of delivering a message. It does not check the quality of the link but rather its existence. The links are compared in terms of originator messages received within the current sliding window. *Algorithm*

i. Consider routing message *m* from source *s* to destination d on network *g*. Eliminate all links $(s, i)\ \forall i \neq$ to reduce the graph.
ii. Associate each link with weight w_{si} where w_{si} is the number of originator messages received from the destination through neighbour node *i* within the current sliding window.
iii. Find the link with largest weight w_{si} in the sub-graph and send m along the link (s,*i*).
iv. If *i* *d* repeat step 1 to 4 for routing message from *i* to d in the sub-graph *S*.
v. K is a set of one-hop neighbours for each node $i \in N$, while *N* is a set of nodes.

All the original authors of the routing metric simulated them except the routing metric for BATMAN that was implemented on a wireless test bed.

III. Proposed Research

We want to compare the performance of the routing metrics on a test bed. We conducted a survey of relevant literature on routing metrics using a framework that we came up with. We used the knowledge gathered from the survey to select representative sample of routing metrics. We grouped the routing metrics in four different groups (see table one). We then selected one routing metric from each group after comparing the routing metrics among themselves within a group. We are now left with test bed evaluation of the performance of the selected routing metrics and then recommending the design criteria for an optimal routing metric for WMN.

Performance evaluation of the selected routing metrics will be done on a wireless test bed. We are going to set up a test bed of fifteen nodes. We will evaluate the performance of the routing metrics using four QoS parameters which are: delay, packet loss ratio, packet error rate and delay jitter.

Conclusion

It has been proven that test bed results are better than simulation results [2]. This method is preferred because it shows the real life environment because of the real factors that are considered rather than assumption. What also prompts use to use the test bed is that ad hoc and mesh networking research has mostly been carried out using simulation rather than test bed [3]. We have selected routing metrics to evaluate, what is left is to implement them on the test bed. Evaluation of the routing metrics will help find out a routing metric that works best for WMN, if no routing metrics works, and then recommend design criteria.

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BIBIOGRAPHY

Siphamandla L. Nxumalo is an MSc student in University of Zululand. His main research interest is in wireless networks and his master's project is in routing metrics. He also did his honours degree in University of Zululand in 2007.