Investigating Quality Metrics for Multimedia Traffic in OLSR Routing Protocol

B. Prabhakara Rao, M. V. H. Bhaskara Murthy

Abstract**—**An Ad hoc wireless network comprises of mobile terminals linked and communicating with each other sans the aid of traditional infrastructure. Optimized Link State Protocol (OLSR) is a proactive routing protocol, in which routes are discovered/updated continuously so that they are available when needed. Hello messages generated by a node seeks information about its neighbor and if the latter fails to respond to a specified number of hello messages regulated by neighborhood hold time, the node is forced to assume that the neighbor is not in range. This paper proposes to evaluate OLSR routing protocol in a random mobility network having various neighborhood hold time intervals. The throughput and delivery ratio are also evaluated to learn about its efficiency for multimedia loads.

Keywords**—**Ad hoc Network, Optimized Link State Routing, Multimedia traffic

I. Introduction

MOBILE Ad hoc Network (MANET) is a group of wireless mobile nodes with dynamic changing topology that forms a temporary network without infrastructure/centralized administration [1]. Mobile Ad hoc Network is presently a research focused area in the wireless networking domain due to its intrinsic advantages including easier set up and saving in hardware costs [2]. Each node is independently multi-directionally and also acts as a communication router for nodes not within radio range. The Mobile Ad hoc Network, due to its expeditious and economically less demanding service, finds numerous applications including military, collaborative and distributed computing, emergency operations, wireless mesh networks, wireless sensor networks, hybrid wireless network architectures and educational environments. In MANET Node privacy is ensured by anonymous communication which also improves MANET security [3].

Wired network’s traditional routing protocols are ineffective for ad hoc networks because of the wireless media’s intrinsic qualities and its changing topology [4]. Most proposed routing protocols in an Ad hoc network include wired counterpart enhancement and can be split into Proactive, Reactive and Hybrid routing protocols [5]. Pro active routing protocols are also labeled table driven routing protocols which creates routing table during network formation and constantly updates it dynamically when there is a change in the topology. Examples of pro active protocols are Destination-Sequenced Distance- Vector (DSDV) [6] Optimized link state routing protocol (OLSR) [7] and Clusterhead Gateway Switch Routing Protocol (CGSR) [8].

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When network size is large, sizes of the corresponding routing tables is also large and it works against memory constraint nodes. But these issues were overcome in some pro active routing protocols including OLSR and CGSR.

Reactive routing protocols also called on demand routing protocols discover route only when data is to be forwarded between two nodes. Examples of re active protocols are Dynamic Source Routing (DSR) [9] and Ad hoc on demand Distance Vector (AODV) [10]. Usual problems in reactive routing protocols include higher latency for route discovery and network congestion caused by excessive flooding. Hybrid routing protocols combine advantages of proactive and reactive routing. Initially routes are established using proactive technique which is subsequently updated when required using reactive techniques. The choice for either method requires predetermination for typical cases. Some issues in hybrid routing protocols are high latency for new route discovery.

In this paper, the effect of tuning the neighborhood hold time in a random mobility network with multimedia traffic is extensively studied.

II. Related Works

Novatnack, et al., [11] studied three MANET routing protocols: OLSR, DSR and AODV, focusing on their effect on various QoS metrics. The study also undertook how analysis of how protocols differ in the path selection mechanisms, detect broken links, and buffer messages during link outages. Effects of differences are quantified with regard to packet delivery ratio, end-to-end hop count, end-to-end latency, and mechanism overhead. The study revealed how OLSR a proactive protocol builds paths with lower hop counts than reactive protocols, AODV and DSR, which in turn lead to reduction in end-to-end latency that assists QoS models to meet timing requirements and improve global network performance. While proactive protocol used lower paths than reactive protocols it led to lower hop paths and lower end to end latencies. OLSR without link layer feedback had the highest *link error latency*, delays in detecting broken links, and so had the lowest packet delivery ratio, thereby being unable to guarantee timely delivery.

Zougagh, et al., [12] focused on compare/analyze the performances of AODV and OLSR. The study is an attempt to find out how the performance of the mentioned protocols will affect routing and data transmission in Ad Hoc wireless network. The study revealed that while AODV protocol performed better in static traffic networks where source number and destination pairs was small for each host, it also used fewer resources when compared to OLSR as it required less bandwidth OSLV was efficient in high density networks that had sporadic traffic. Its performance improved when between many hosts as quality metrics were easy to expand.

However scalability in both protocols scalability was restricted due to their proactive or reactive characteristic. In the AODV protocol it was flooding overhead in high mobility networks whereas in OLSR protocol it was routing table size that led to topological updating of messages.

Fan Bai, et al., [13] proposed various protocol independent metrics to capture mobility characteristics, including spatial and temporal dependence and geographic restrictions in MANET routing protocols. Research on MANET protocols are simulation based as not many are deployed presently and Random Waypoint is the usual mobility model used in simulations. The study showed that this model alone was insufficient to capture mobility characteristics where MANETs might be employed. Additionally a set of parameterized mobility models including Random Waypoint, Group Mobility, Freeway and Manhattan models were introduced. Evaluation of connected routing protocols including DSR, AODV and DSDV revealed that performance varied highly across mobility models and also that their performance rankings varied with the model used, which in turn could be explained by the interaction of mobility characteristics with connectivity graph properties. The study proved that mobility pattern did influence MANET routing protocols performance though there was no clear winner. Additionally, preliminary investigation was done on the MANET routing protocols common building blocks mobility effect on them and how they influenced the protocol totally.

Huang, et al., [14] investigated the performance of differing impacts of tuning refresh interval timers on OLSR performance under various scenarios including varying node density and node speed. Simulation results with NS2, revealed that though reducing refresh intervals improved OLSR's performance, intervals for some message types specially HELLO messages had a greater impact on its performance than other message types. It was also found that interval timer impact increases with rise in network mobility and node density. Though smaller HELLO intervals can and do speed up neighbor and link failure detection, improvement is not linear and has no connection with decrease of the interval. Hence it might be possible to tune an OLSR operation dynamically, during the process through measurement of metrics presented in the study. Thus the experiments led to the conclusion that OLSR routing performance depends mainly on HELLO interval timer value. Protocol throughput improves by setting up useable routes quickly and this in turn is related to the expeditious detection of neighboring nodes.

III. Methodology

Optimized Link State Protocol (OLSR) is a proactive routing protocol where routes are always available when needed. OLSR is an optimized version of a pure link state protocol. So topological changes lead to flooding of topological information to available network hosts. To reduce network overhead the protocol uses Multi Point Relays (MPR) and the idea of the latter is reduction of broadcast flooding through reduction of the broadcast in some network regions. More MPR details are available in this chapter later. Another reduction method is through provision of the shortest path.

Time interval reduction for control messages transmission thereby brings more reactivity to topological changes [15].

OLSR uses Hello and Topology Control (TC) messages. The former are used to find information about link status and the host's neighbors. The Multipoint Relay (MPR) Selector that describes which neighbors have chosen this host to act as MPR is added to the hello message and it is from this information that the host calculates its own set of the MPRs. Hello messages are forwarded one hop away but the TC messages are broadcast throughout the network and are used for broadcasting information about its own advertised neighbors that includes the MPR Selector list at the least. TC messages are regularly broadcast with only MPR hosts having the ability to forward it [16].

Reactions to topological changes are adjusted by changing time intervals for broadcasting Hello messages or increasing neighborhood holding time that in turn determines if there is a link between a node and its neighbor. It increases protocol suitability for ad hoc network with the quick changes of both the source and destinations pairs.

The OLSR protocol also does not require the link be reliable for control messages, since they are forwarded periodically and delivery is not sequential. Due to OLSR's routing protocol simplicity to use interfaces, it is easy to integrate it in existing operating systems, without changing IP messages header format. The protocol only interacts with the host's Routing Table [17].

OLSR protocol suits applications which do not allow long delays in data packet transmission. The most suitable working environment for OLSR protocol is a dense network, where most communication is concentrated between many nodes.

IV. Experimental Setup

The simulation environment consists of 20 nodes. Each node runs a multimedia application over UDP. The data rate of each node is 11 Mbps with a transmit power of 0.005 watts. The nodes are distributed 2000 meter by 2000 meter with the trajectory of each node being random. The parameters used in the OLSR routing protocol is shown in Table I.

TABLE I
OLSR Parameters Used In Experimental Setup

Hello interval in seconds	2
TC interval in seconds	6
Neighbor hold time in seconds	4,6,8,10
Topology hold time in seconds	15
Duplicate message hold time in seconds	30
Addressing mode	IPV4

Simulations in each scenario were carried out for 6 minutes with no traffic being for the first 140 seconds. The results obtained are tabulated in figure 1, 2 and 3.

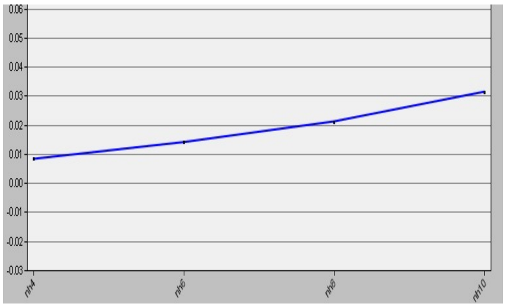

Fig. 1 Mean voice jitter in seconds

Nh4, nh6, nh8 and nh10 are the respective neighbor hold time in seconds.

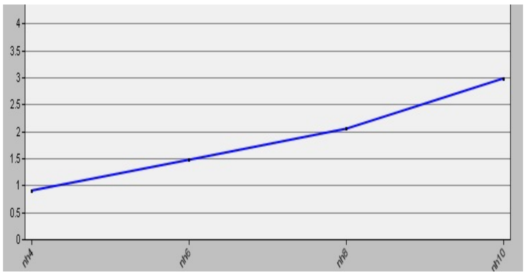

Fig. 2 Mean packet end to end delay

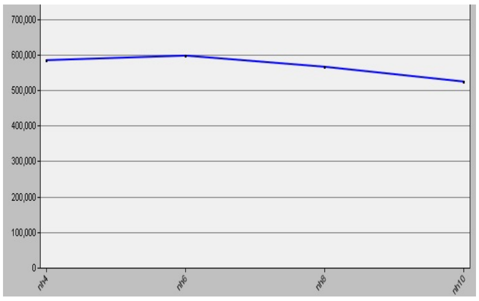

Fig. 3 Mean throughput in bits / second

From figure 1 it can be seen that the jitter increases linearly and is close to 300 ms when the neighbor hold time is 10 seconds. The jitter occurs due to route change or network congestion or time spent for route discovery. High neighbor hold times will affect the QOS especially in multimedia streaming networks. High jitter from figure 2 it is seen that the mean packet end to end delay for nh4 is 2.5 and for nh10 is close to 8 seconds which is extremely high. This again can affect the QOS as packet arrival time could be well above the data usage time. Buffering of the data can improve the QOS.

V. Conclusion

In this paper it was proposed to investigate the performance of OLSR routing protocol for multimedia intensive network with varying neighborhood hold time. The RFC for OLSR specifies the neighborhood hold time as 6 seconds. Investigations were carried out with 4, 6, 8 and 10 seconds. Though throughput remains relatively high in each scenario, the end to end delay in packet increases linearly which can affect the quality of service drastically. Further work needs to be carried out with tuning of hello messages to reduce jitter and end to end delay.

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