ISSN 2319 - 6629
Volume 3, No.2, February – March 2014
International Journal of Wireless Communications and Networking Technologies
Available Online at http://warse.org/pdfs/2014/ijwcnt04322014.pdf

Investigating the impact of Node Traversal Time on the Performance DYMO in MANETs

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ABSTRACT

Mobile Ad hoc Network is an emerging area in the present mobile world. Its standards are defined by IETF. MANETs presents several desirable properties like dynamic topology, Easy of deployment and robustness, are qualify them as an attractive topic for the research community finding feasible QoS routes is a challenging issue in MANETs. The choice of the stable values in protocol configuration will affect correctness of protocol. In Mobile ad hoc networks DYMO protocol suggests that the Node Traversal Time (NTT) should be a constant value, but does not refer to how this value to be adjusted with network size. This paper investigates the impact of NTT value on the performance of DYMO routing protocol. Experimental results suggest that impact of NTT shows significant progress on the performance of DYMO. This paper demonstrates that in a dynamic environment we are not supposed to use constant values like NTT in protocol configuration and suggests that the Node Traversal Time should be a suitable value with the network size.

Keywords: MANET, IETF, NTT, DYMO, AODV

1. INTRODUCTION

Mobile Ad hoc Network is a type of ad hoc network and consists of collection of independent mobile nodes communicate each other without any aid of centralized management. These networks are self generated, self organized and self handled. Every node in the network will acts as both node as well as router. All the nodes are frequently moving around the network region. MANETs have several desirable properties like dynamic topology, Easy of deployment, high mobility and these properties are qualifying them as an attractive topic for the research community [3]. Routing and QoS are the two major issues in mantes out of several challenging issues.

Routing is the act of moving information from a source to a destination in an internetwork. At least one intermediate node within the internetwork is encountered during the transfer of information [1] [13]. Routing Protocols plays crucial role in MANETS. Routing protocol for ad-hoc network can be categorized in to three categories. The three classifications of routing algorithms are Reactive, Proactive and Hybrid routing protocols. Pro-active routing is also called Table driven routing where as re-active routing is called On-demand & dynamic routing. Reactive routing protocols are popular in MANETs because they are more scalable and less overhead on the network. AODV, DSR and DYMO are popular reactive routing protocols [8].

2. AODV ND DYMO ROUTING PROTOCOLS

2.1 AODV

Ad hoc on-demand distance vector is a reactive routing protocol, i.e, in AODV routes are established only based on need. Routing decisions are made using distance vectors with number of hops. AODV supports unicast, multicast and broadcast. In AODV each node maintains a sequence number and it will be used to decide the freshness of routes. Two major phases in AODV routing. These are (i) route discovery and (ii) route maintenance [2] [3]. There are three types of routing packets in AODV. AODV uses three types of packets for establishing and maintain routes. These are Route Request (RREQ), Route Reply (RREP) are used under route discovery phase. Route Error (RRER) packet is used under route discovery phase. The major drawback of AODV is its scalability [6] [7]. AODV works well for smaller networks, however for larger networks its performance was gradually decreases.

2.2 DYMO

DYMO stands for dynamic Mobile ad hoc network organization protocol. It is latest version of AODV, i.e, AODVv2. The DYMO routing protocol is a recently proposed protocol defined in Internet Engineering Task Force (IETF) Internet-Draft. DYMO borrows "Path Accumulation" from Dynamic Source Routing and removes unnecessary Route Reply (RREP), precursor lists and Hello messages (Route exploration messages), thus simplifying AODV [12]. It retains sequence numbers, hop count and Route Error (RERR) messages from AODV. DYMO has two basic operations - route discovery and route management. The core of the route maintenance is based on IETF Internet-Draft DYMO specification. As per the DYMO Route table timeouts, "During normal operation, DYMO does not require any explicit timeouts to manage the lifetime of a route. However, the route table entry MUST be examined be before using it to forward a packet. A route MUST be wipe out if Current Time >= Route-Expiration Time" AODVv2 uses path accumulation, i.e. every intermediate node adds information about itself. DYMO uses sequence numbers to ensure loop freedom [4].

DYMO protocols are designed for mobile ad hoc networks since DYMO is capable of handling dynamically altering mobile network patters. The routes between the source and destination are hence determined only when a route was required to be established. Being capable of handling on-demand routes discovery and maintenance, DYMO can also adapt to wide ranging traffic patterns. DYMO can be typically utilized in a large mobile network consisting of large number of nodes where only a part of the nodes communicate with each other [14]. DYMO is also memory efficient since it maintains very little routing information. In DYMO, only routing information that are pertinent to all active sources and destinations is maintained where as other protocols require entire routing information of all nodes with in a network. The major limitation of DYMO is it will not work efficiently for smaller networks and networks with low mobility.

3. RELATED WORK

A large number of studies have analyzed the performance of various reactive routing protocols in Mobile ad hoc networks. We summarize representative samples of the existing work. Several studies have utilized QoS measurements like throughput, jitter and end-to-end delay. The primary focus of these studies is to analyze the impact of Node traversal time on the performance of various reactive routing protocols. Narasimha raju and Prof.SP Setty analyzed the impact of NNT on the performance of AODV and they developed new protocol called FBNTTAODV, which gives better performance than AODV [5]. Sarch edenhofer published his paper titled rigorous analysis on DYMO by comparing AODv and AODVv2 (DYMO) [4]. Text book proceedings on Network and Parallel Computing: IFIP International Conference, NPC 2008, edited by Jian Cao, Minglu Li, Min-You Wu, Jinjun Chen , defined the importance of NTT and how the NTT is defined and calculated. NTT is a conservative estimate of the average one hop traversal time for packets and it includes queuing delays, interrupt processing times and transfer times [10].

Table 1 : Simulation Scenario Parameters

4. METHODOLOGY

Routing Protocol	DYMO
Simulation Time	300s
Area (sq.m)	1500 x 1500sqm.
Propagation Model	Two Ray
Traffic	CBR
Packet Size	512 bytes
Nodes	20, 40,60,80
Antenna Type	Omni directional
Transmission range	250m
Receiver range	250m
Pause time	0 sec
Min &Max speed	1 m/s to 10 m/s
Maximum number of buffered packets	100
Mobility Model	Random Waypoint
TTL Start, TTL Increment and TTL Threshold values	1, 2, 7
Node Traversal Time	20,40,90.

As per the IETF draft the timing parameters for DYMO (AODVv2) should be administratively configurable. Ideally, for networks with frequent topology changes the DYMO parameters should be adjusted using either experimentally determined values or dynamic adaptation. For example, the default value of NTT for DYMO routing protocol in Qualnet simulator is 90 mille seconds. NTT value plays a vital role in calculation of Net Traversal Time; the value the sender waits for route reply (RREP) to determine route lifetime and time-out values. The default NTT value for DYMO is 90 mille seconds but it does not disclose how this value is optimal for networks with different size.

NTT is a conservative estimate of the average one hop traversal time for packets and it includes queuing delays, interrupt processing times and transfer times. NTT is one of the important protocol parameter. In Qualnet simulator, which is the commercial version of the scalable and open source simulator called GloMoSim, the NTT value is set to fixed 90ms. But in a dynamic topology we are not supposed to take fixed values, because of mobility and different network sizes. This paper evaluates the performance of DYMO routing protocol by varying the NTT values from 20 to 90ms under different network sizes. Initially the performance of DYMO was tested with a default stable value i.e., NTT 90 is mille seconds. Later we modified the default NTT value from 90 to 40 and then 40 to 20.

4.1 Simulation Environment

QualNet is a fast, scalable and hi-fidelity network modeling software. This is the scalable version of the open source simulator GloMoSim. It enables very efficient and cost-effective development of new network technologies. The key advantages of Qualnet are speed and scalability. QualNet can support real-time and faster than real-time simulation speed, which enables software-in-the-loop, network emulation, hardware-in-the-loop, and human-in-the-loop exercises. QualNet supports thousands of nodes. It can also take advantage of parallel computing architectures to support more network nodes and faster modeling. Speed and scalability are not mutually exclusive with QualNet[9].

In the simulation experiment, routing protocol used is DYMO. Simulation time 300 sec, terrain region 1500 x 1500 sqm. Propagation model used is Two ray, traffic type is CBR, minimum and maximum speed is 1 and 10 mps. Pause time is set to 0, which indicates high mobility. Mobility model used is Random way point. Node Traversal Time is 20, 40 and 90 mille seconds. The MAC layer protocol used is 802.11.

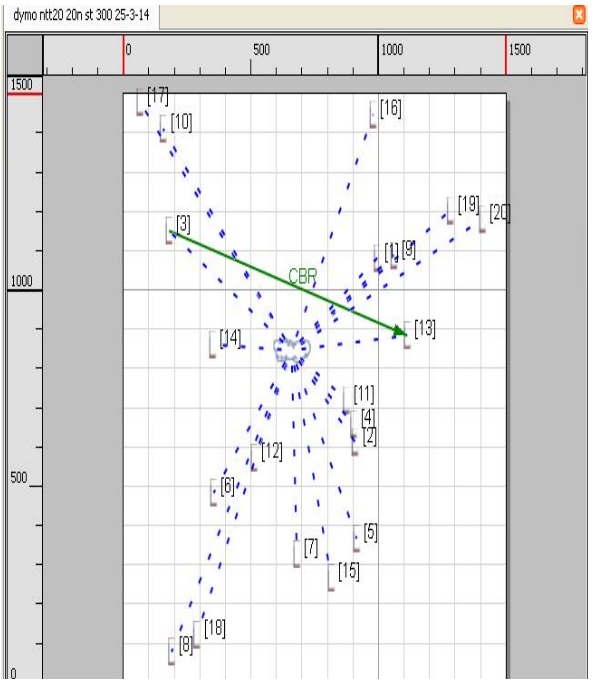

Figure 1 Simulation Scenario with Network size 20

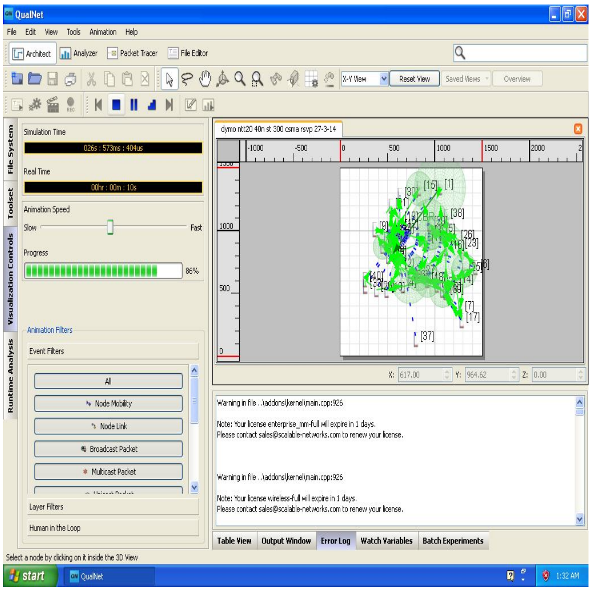

Figure 2: Simulation Scenario during Run time

5 RESULTS AND DISCUSSIONS

Different performance metrics are used in the evaluation of routing protocols. They represent different characteristics of the overall network performance in terms of QoS. In this paper, we described different metrics used in performance evaluation of DYMO with varying NTT values. These metrics are Throughput, Average End-to-End delay, Average Jitter and First packet received.

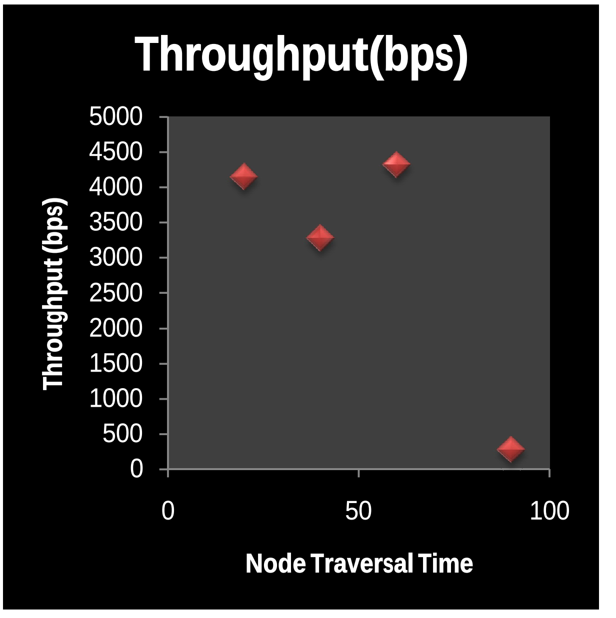

Figure 3 Variance of throughput with NTT

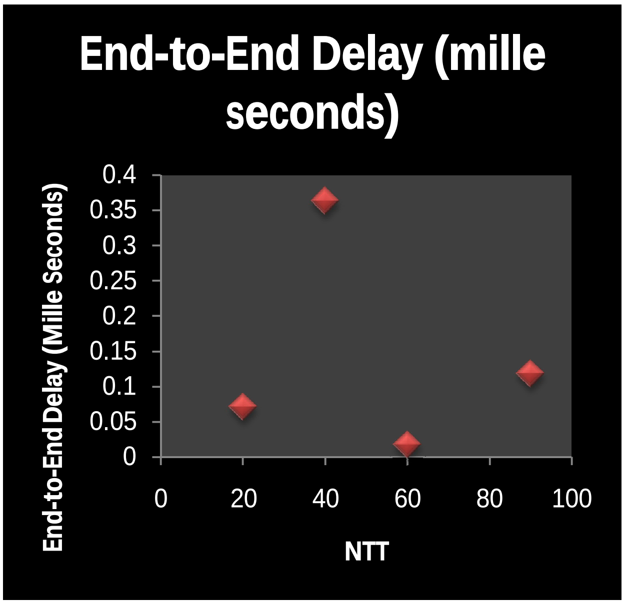

Figure 4 Variance of Delay with NTT

Throughput: It is the average rate of *successful* packets delivered over a communication channel (or) the ratio of the total amount of data that reaches a receiver from a sender to the time it takes for the receiver to get the last packet is referred to as throughput. It is expressed in bits per second or packets per second. Network with high throughput is desirable. Results of throughput with different NTT values are shown in figure 3. From experimental results we found that impact of NTT shows significant changes in throughput. For example when the network size is 20 and NTT is 90ms, the throughput is 278bps. Whereas for the same scenario by varying NTT values from 90 to 20, 40 and 60 we observed better results for throughput. The throughput for NTT 60 is 4319 bps whereas throughput for NTT 20 is 4145bps.

End-to-End Delay: The packet end-to-end delay is the average time that packets take to traverse the network. This is the time from the generation of the packet by the sender up to their reception at the destination's application layer and is expressed in seconds. It therefore includes all the delays in the network such as buffer queues, transmission time and delays induced by routing activities and MAC control exchanges. For better performance the delay should be minimum. Results of end-to-end delay with different NTT values are shown in figure 4. From experimental results we found that delay is low at NTT value 60 i.e., 0.01743ms

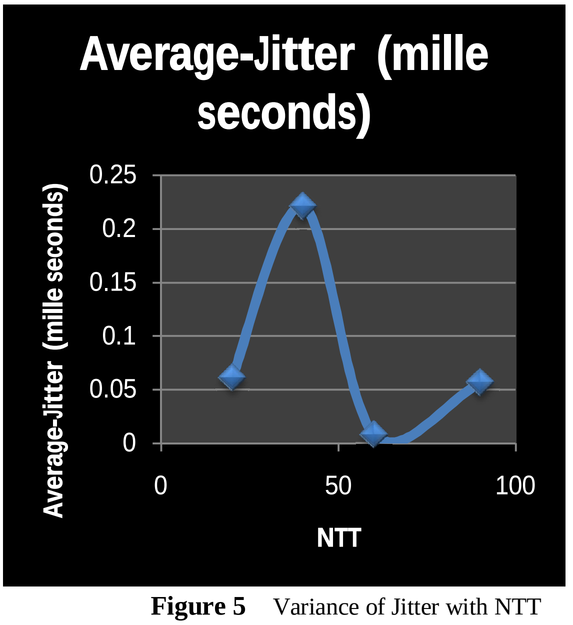

Figure 5 Variance of Jitter with NTT

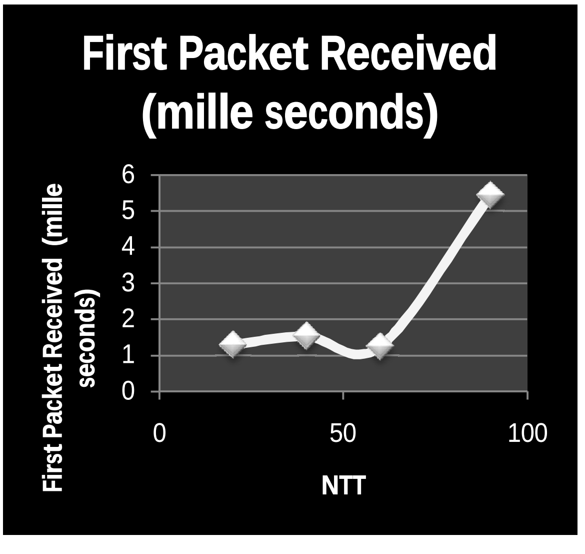

Figure 6 Variance of FPR with NTT

Average Jitter: Jitter is the variation in delay as measured in the variability over time of the packet latency across a network. A network with constant latency has no variation or jitter. Jitter is an important QoS_factor in assessment of network performance and it should be zero for real time applications. Results of average jitter with different NTT values are shown in figure 5. From experimental results we found that the value of jitter is low at NTT value 60 i.e., 0.008363ms and jitter is high at NTT 40 i.e., 0.363378ms.

First Packet Received: This is expressed in time, i.e. after sending the first packet from sender how much time it will take to reach the receiver. It is an important metric to evaluate the performance of the network. Results of first packet received with different NTT values are shown in figure 6. From experimental results we found that FPR time is minimum at NTT 60 i.e., 1.24653 ms and FPR time is maximum at NTT 90ms i.e., 5.4402 ms.

6. CONCLUSIONS

This paper analyzes the impact of Node traversal time on the performance of reactive routing protocol DYMO. Experiments are conducted using QualNet Simulator. The fixed NTT parameter value for DYMO is 90ms. In this paper we investigated the impact of NTT value on the performance of DYMO routing protocol. In our experimentation we modified the NTT values from 90 to 20, 40 and 60. The experimental results proved that impact of Node traversal time shows significant changes in QoS metrics of DYMO protocol. The QoS metrics used in performance analysis are Throughput, Average End-to-End delay, Average Jitter and First packet received. The performance of DYMO is enhanced by reducing the standard NTT value 90. For example when the network size is 20 and NTT is 90ms, the throughput is 278bps. Whereas for the same scenario by varying NTT values from 90 to 20, 40 and 60 we observed better results for throughput. The throughput for NTT 60 is 4319 bps whereas throughput for NTT 20 is 4145bps. When we reduce the NTT value from 90, the other parameters delay, jitter and first packet received also shows better results. This work can be extending to other reactive routing protocols in MANETs.

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