Validation of Model to Optimize QoS in Small MANETs

Muhammad Sulleman Memon, *Senior Member, IACSIT*

***Abstract*—In this piece of work, authors have given verification of their proposed Model for optimization of QoS in MANETs. Model is based on advance resource reservation on paths. This is entirely a new approach first time used for MANETs in research. OPNET Modulator version 14.0 is used for simulations and model/approach is validated by running it on different scenarios and it is proved by excellent results that proposed policies works well in a very network in which users have given different priorities according to their contract with network for which they pay. Results have been taken for end to end delay, throughput and jitter for small networks having up to 20 nodes and ranging in 300 square meters.**

***Index Terms*—Throughput, packet loss, jitter, delay, premeditated policies LP.**

I. Introduction

The frequent path breaks due to the mobility, difficulty of time synchronization that consumes bandwidth, bandwidth reservation that requires complex medium access protocol and cost of an elegant mobile host are major problems with multi hop ad hoc networks [1]. Where medium access schemes, routing, multicasting, transport layer protocol, pricing schemes [2], self-organization, security, energy management, addressing, service discovery, scalability, deployment consideration [3] and above all Quality of Services (QoS) are major solvable issues to mobile ad hoc networks [4]-[5] .

MANETs are always considered as self-governing network in which every node inherits its own properties controlled by different panels and propagate with different objectives. The literature term these nodes as selfish nodes [6] and they work underpayment based schemes [7] they will relay information or cooperate on some nature of price. These nodes work in three perspectives: (i) from sender's perspective to transmit their own packets with minimum price, (ii) from relaying perspective to earn as much as possible payment through forwarding packets for other nodes (iii) from network's designer perspective to get maximum throughput and life time of network. In context of MANETs price is always referred as way of adjudicate resource allocation [8]-[9].

In multi hop networks there exits multiple possible routes from source to destination. Here we refer to two concepts of Path diversity in which it is considered that multiple routes exists between source and destination each with different characteristics (such as no of hops, bandwidth available, time to reach etc.). The other concept is of time diversity in which it is considered that because of mobility different traffic flows routes between nodes keep changing over time. For each node to fulfill its target with definitive performance both path and time must be subjugated. With reference to routing and resource utilization in past the least cost route was selected from available routes based on auction but a very little or no work has been performed to consider QoS issues regarding the pricing with respect to the service that a source require from the network. Different types of applications require different QoS, so the price will also be different according to the facility provided [9].

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Muhammad Sulleman Memon is with Department of Computer Systems Engineering at QUEST, Nawabshah (e-mail: sullemanhalai@yahoo.com).

II. Reviews for Account of Events

To optimize QoS in MANETs, we have given a QoS Model that was developed on the basis that it will help to optimize QoS for different traffic types in network according to their priority. The priority of each traffic will be on the basis of contract that a network user will agree with network for transmission of their traffic for which user has to pay. To serve this purpose the model is featured with delay control, admission control, policy control, classification, shaping. The feedback control, scheduling, traffic control and contract enforcement modules are added as distinguishing feature of the model that serve to achieve above mentioned aim [10]. On the basis of this model, Resource Reservation policies are designed in which first time in MANETs an idea of advance resource reservation is presented on different paths. To serve this purpose of advance resource reservation a complete mechanism is given [9] and to make it feasible to implement an algorithm is also presented [10]. What type of routing protocol will match near to policies to support, a complete review is also presented and it was proposed to use any proactive routing protocol with or without little modifications to match the presented policies.

III. Assumptions

In this research few names are used for different categories of traffics with respect to their priorities and services offered to them by network. OPNET uses same type of traffics but with different names, therefore here those assumptions of names are highlighted to remove the confusion.

Table I gives summary about the proposed framework for different QoS attributes related to different categories of Traffic, their priorities with resource reservations on different routes and functions of different protocols

A. Path Finding

As proposed in [11] we have suggested finding three paths

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as Primary Path (PP), Secondary Path (SP) and Ternary Path (TP) from those resources will be reserved in advance on PP and SP [9]. As in MANETs nodes are supposed to move every time so routes breaks are common. Therefore as soon as PP will be broken SP will become PP and TP will become SP and path finding procedure will be started for TP. Due to this mechanism there will be no break in transmission and retransmission of packets and delay will be minimum. Fig. 1 shows a virtual procedure of path finding in a real scenario.

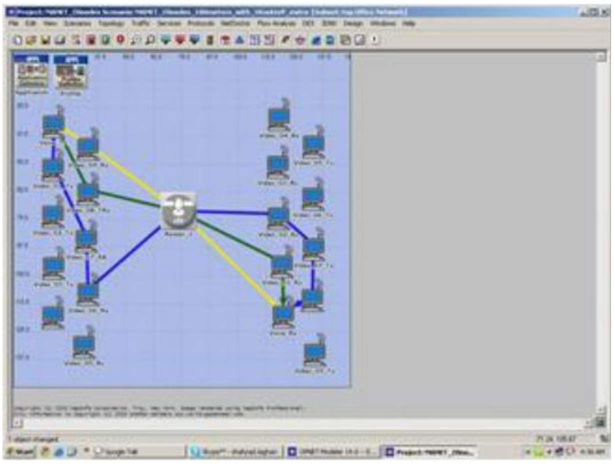

Fig. 1. Actual path finding scenario/procedure

TABLE I: COMPARISON OF ATTRIBUTES USED IN RESEARCH AND SAME FACILITATED BY OPNET AND USED POLICIES SUGGESTED IN RESEARCH

S. No	Names used	Services offered	OPNET Terminology	WFQ DSCP Profiles	Implementation on Node Nos
1	Very High Priority Traffic VHPT	Premium Service PS	Reserved Service RS	EF	1
2	High Priority Traffic HPT	Gold Service GS	Excellent Service ES	AF21	2, 3
3	Medium Priority Traffic MPT	Silver Service SS	Standard Service SS	AF33	4, 5, 6,
4	Low Priority Traffic (Best Effort) LPT	Metal Service MS (BES)	Best Effort Service BES	AF 43	7, 8, 9.10

IV. VERIFICATION AND VALIDATION

Verification of the proposed scheme is performed by simulations on OPNET (OPtimized Network Engineering Tools) Simulator 14 with Voice application transmission in small networks having 20 nodes spread over 300 m^2 area.

A. Quality of Service Types in OPNET

Types of Quality of Service are defined by Application base QoS and Quality of services in this section are divided in many parts. Starts from minimum Quality

1) Best Effort (0) < Minimum>
2) Background (1)
3) Standard (2)
4) Excellent Effort (3)
5) Streaming multimedia (4)
6) Interactive multimedia (5)
7) Interactive Voice (6)
8) Reserved (7) < Maximum>

V. SIMULATIONS

A. Scenario

Name of simulation network is Sulleman Memon MANET Network. There are 10 nodes for Transmission Voice Information in the form of PCM Quality and 10 nodes for Receiving these information. The transmission starts simultaneously after start of simulation. There are of Scenario is About 300 m2.All nodes are enabled of Ad hoc Technique called AODV. Fig 2 shows this scenario.

B. Simulating Parameters

For Small Networks we have used the following parameters for simulation shown in Table II.

TABLE II. SIMULATION PARAMETERS FOR 20 NODES AND 150 M FOR SMALL NETWORKS

PARAMETERS	VALUES
Simulation Time	180 sec
Mobility Model	Random way point
MAC protocol	802.11g
Routing Protocol	AODV
Network Scenario	20 nodes for and 300 m^2 for small
Propagation Model	Two Ray Ground
Time between Retransmitted Requests	500 ms
Timeout for non-Propagation Search	30 ms
Traffic Rate	11Mbps
Node Transmission Range	100 - 150 meters
Transmit Power	0.0058 W
Terrain Area	300 m^2
No of Nodes	20 for small network
Pause Time	10 sec
Node Placement	Random
Maximum Queue Size	Infinity
Traffic Type	CBR
Node Placement	Uniform
Bit Rate	11mbps
Wireless Propagation Model	Free Space
Antenna Type	Omni directional
Minimum Node Speed	0
PHY Layer Protocol	802.11e
DATA Link Layer Protocol	MAC 802.11e
Queuing Policy	Priority Basis
Bandwidth	11Mbps

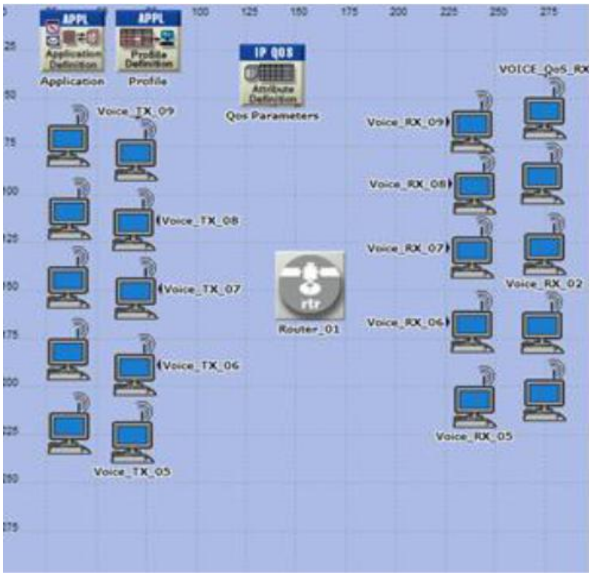

Fig. 2. Simulation scenario

VI. Performances

Performance of proposed Policies for optimizing QoS for the validation of QoS model is evaluated through very famous QoS attributes and Matrices, i.e.,

1) End to End Delay of Network
2) Jitter of Network
3) Throughput of Network
4) Packet Drop Ratio of Network

A. Delay

Delay is the time taken for transmission of a packet across the network departing from source and reaching to destination. Sometimes it is considered the time between its generation and its destruction at its destination [12]. Delay is supposed to be the result of routing, mobility, and transmission and propagation issues [13]. Delay can be varied with respect to number of nodes in network plus the size of packets and movement of hops. Due to these reasons there may be some variations in delay.

Here in results we can observe that Blue color (Reserved Services) delay of network is in very small ratio and total delay of VHPT in full 3 mints simulation is about 3 b/sec. Fig. 3 shows the simulation results.

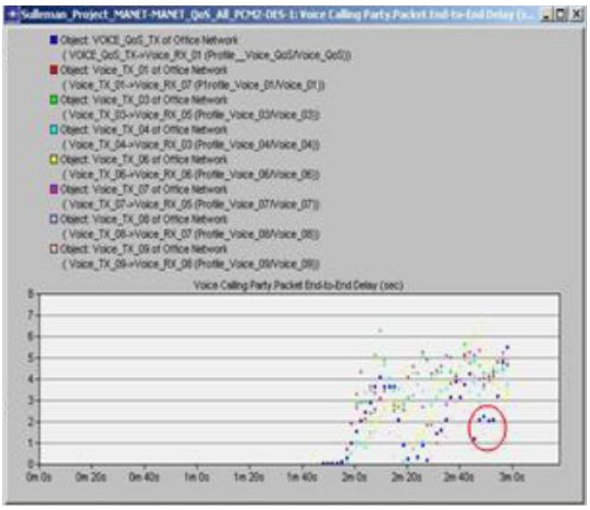

Fig. 3. Compression "packet end to end delay" for voice calling parties

B. Jitter

Jitter is measurement of differences in delay transversely in multiple packets related to an explicit passage stream released from same source [14]. Its main causes are MAC delays and queuing from the source. Therefore it is supposed that traffic congestion is the major reason for longer jitters. All transit delays, receiver buffer delays are supposed to be the average jitter.

Our results shows that jitter for Blue color (Reserved Services) is in very small variance and total jitter of VHPT is in between of -0.1 to +0.1 b/sec and much of simulation time it remained at zero. Fig.4 shows simulation scenario.

Fig.4. Jitter of calling party of all nodes

C. Throughput

Throughput is actually a ratio of successful transmission from source to destination. It includes the number of packets received at destination safely, communicated from source and it shows the ratio of success for all transmitted packets [15]. Throughput is generally supposed to be the measure of network performance and always compared with the number of delivered packets to the total number of packets sent. Packet delivery ratio and packet loss [16] ratio are also part of throughput [11].

Simulation results show that throughput for Green color a (Reserved Service) packet is very high as compared to other traffic categories and it is 58 b/sec that is almost 97 to 98% of network. Fig. 5 indicates the graphical output.

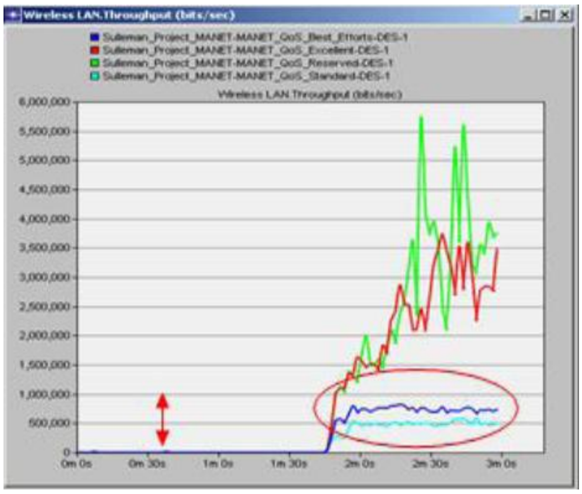

Fig. 5. Throughput in small networks

D. Packet Dropped

It is the ratio which is calculated in terms that throughout transmission what ratio of packets were lost in comparison of packets those received safely at destination.

By adopting our proposed policies it is observed that for Reserved Services it is only 1% 2% that is just negligible. Fig. 6 indicated the ratio.

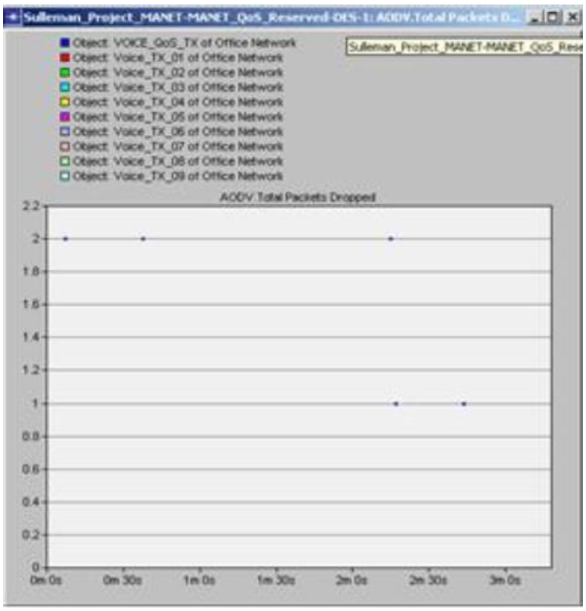

Fig. 6. Packet drop ratio in small networks

VII. Conclusion and Summary

In this piece of work implementation of already proposed premeditated policies for resource reservation for small MANETs is presented with verification and validation of supported simulation results performed on voice application in OPNET simulation environment. It is observed that policies works well and give excellent results and can also be practically implemented on CISCO routers with support of differentiated services strategies.

VIII. Future Work

In future we wish to extend same policies for large networks so that they can be used for commercial purposes.

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Muhammad Sulleman Memon is currently PhD Scholar at Quaid e Awam University of Engineering, Science and Technology, Nawabshah, PAKISTAN and working as Assistant Professor in computer Systems Engineering Department. He did his Masters in Software Engineering and Bachelor in Computer Engineering in 2004 and 1990 respectively.

He is a senior professor having more than 20 years teaching experience and author of many international papers. He has presented his work at different parts of the world. His current research is in the section of Mobile Communications and working on techniques to assure QoS in MANETs. His work and papers are cited by a large number of researchers in their research throughout the globe. He is supervising many research students.