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Throughput Evaluation for QoS Measurement in Manets

M. Sulleman Memon, G. Ali, Noor Ahmed Shaikh

Department of CSE/IT Quaid e Awam Uest, Nawabshah, Sindh Pakistan
Department of Computer Science Shah A. Latif University Khairpur, Sindh Pakistan

Abstract: Measuring the factors effecting QoS in MANETs always remains a hottest issue and different type of parameters like bandwidth, delay, jitter, link capacity, link stability, packet loss ratio etc are supposed to be the metrics to effect the throughput of network that directly results in degrading the QoS performance. In this piece of work we have given a complete agenda to for these factors to be measured plus authors have bifurcated the functionalities with respect to different protocol layers so that researchers easily can extend this work.

Key words: Atlas, QoS Measurement, Metrices, Resourse Reservation, Primay Path

INTRODUCTION

Different applications have different requirements about QoS and their associated metrics regarding QoS remain also different (Sulleman, M., Manzoor, 2009). For example in mission critical and commercial applications the QoS attributes will be guaranteed link connectivity and advance recourse reservation for full duration of transmission time like fully connected and IP networks, that became very difficult in MANETs because of their nature of continues mobility of nodes due to that they change their routing topology every time(Sulleman, M., 2009) In case of multimedia applications, bandwidth, delay jitter, and delay are the key QoS metrics, whereas military applications have stringent security requirements(Hafiz M. Asif, 2008). For applications such as emergency search-and-rescue operations, availability of the network is the key QoS metric. Applications such as group communication in a conference hall require that the transmissions among nodes consume as little energy as possible; hence battery life is the key QoS metric here (Bheemarjun T., Reddy etl, 2006). In hostile environment where MANETs are deployed with limited resources, service differentiations and dynamic bandwidth management can help to avoid graceful degradation of performance and enhance the overall survivability of the network (Wenjian Shoo etl., 2005). Some of the prominent metrics that characterize MANETs are dynamic topology, Bandwidth constraints, delay, packet loss, route breaks etc (Phanse, K.S., 2003).

In particular to provide QoS and manage it is quite difficult task. Therefore, it is a big challenge but it is very necessary to give affordable solution (Akira Shirahase, 1999). In MANETs Bandwidth, delay and jitter are commonly considered as the major metrics for QoS enabled networks.

The second issue is occurrence of different types of traffic in the presence of those different traffics how one can be assured to get best service from the network, even if ready to pay extra. The most common solution to this is to classify the traffic in different categories and give certain priority levels to each type of traffic according to their service level agreement for that they pay. According to those priorities network will provide a specific type of service to that particular traffic. Further more network provide advance resource reservation for traffic type that will pay extra(Bheemarjun T., Reddy etl, 2006) and give priority routing facilities with assured bandwidth availability, minimum delay with small or negligible number of packet losses, to those prioritized traffics according to their service agreements with network(Sulleman, M., 209).

The network will prefer the most advantageous accessible criteria to support the required quality for the service; and will deny to the service request if the existing mechanisms are unable to provide the desired quality (Carlos T. Calafate,). Furthermore, the new service will also not be accepted if its introduction is expected to infringe the QoS for the on hand services. Once accepted, the fulfillment with the particular QoS properties will be continuously monitored and violations will be notified (Nityananda Sarma, 2008).

Corresponding Author: M. Sulleman Memon, Department of CSE/IT Quaid e Awam Uest, Nawabshah, Sindh Pakistan
E-mail: sullemanmemon@hotmail.com

Rest of the paper is organized as follows: Section II explains and recollects the review of accounts of events for the work conducted. Section III is about QoS metrics and section IV is to explain actual agenda about paper. Section V expresses the conclusion and future work.

Account of Events:

To optimize QoS in MANETs , authors present a QoS Model (Sulleman, M., 2008) 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 was featured with delay control, admission control, policy control, classification, shaping. The feedback control, scheduling, traffic control and contract enforcement modules were added as are distinguishing feature of the model that serve to achieve above mentioned aim. On the basis of this model, Resource Reservation policies were designed in which first time in MANETs an idea of advance resource reservation was presented on different paths. To serve this purpose of advance resource reservation a complete mechanism was given in (Sulleman, M., Manzoor, 2009) and to make it feasible to implement an algorithm was presented at (Sulleman, M., Manzoor, 2009). What type of routing protocol will match near to policies to support, a complete review was presented in (Sulleman, M., Manzoor, 2008) and it was proposed to use any proactive routing protocol from DSR and CEDAR with or without little modifications to match the presented policies. Table No 1 presents the summary all about the traffics, their specified type with priority allotted and policies for those traffic categories.

Table 1: Different path selection criteria for different priorities of traffic.

Traffic Categories	Primary Path	Secondary Path	Ternary Path
VHPT	1. Required resources are reserved on the PP for full duration of transmission. 2. Pre-emption not allowed.	1. Required resources are reserved on the SP for full duration of transmission. 2. These resources may be allocated to lower priority traffic subject to the condition of pre-emption. 3. When traffic diverted from PP to SP, SP is designated as PP. 4. The TP becomes SP and action is taken accordingly.	1. TR is found and identified but resources are not reserved.
HPT	1. Required resources are reserved on the PP for full duration of transmission. 2. Pre-emption not allowed.	1. Required resources are reserved on the SP for 25% or lower of the duration of transmission. 2. But resources may be allocated to lower priority traffic subject to the condition of pre-emption. 3. If and when PP breaks with in this initial 25% of time, it is tried to make SP as PP. If sufficient resources are not available on SP other route with sufficient resources is searched. 4. The TP becomes SP and action is taken accordingly.	1. The TP is found and identified, but resources are not reserved.
MPT	1. Required resources are reserved on the PP for full duration of transmission. 2. Pre-emption not allowed.	1. Route is identified; resources are reserved but subject to the pre-emption. 2. If and when traffic is diverted from PP to SP, the SP becomes PP. 3. The TP becomes SP and action is taken accordingly.	1. The TP is found and identified, but resources are not reserved.
LPT	1. Path is identified but no resources are reserved .	1. Path is identified but no resources are reserved.	1. Not Applicable.

Table No 2 summaries the proposed framework. for different QoS attributes related to different categories of Traffic, heir priorities with resource reservations on different routes and functions of different protocols

QoS METRICES

According to the agreement, Network must guarantee for serve QoS metrics over duration of time to provide measurable pre-specified service attributes to the user in terms of Bandwidth, end to end delay, jitter, throughput etc. Here in this section we are highlighting some key metrics.

A. Bandwidth: A Key QoS Metric:

QoS is nothing but collection of certain set of requirements to meet for assured service delivery. There are many items those come under his boundary but we are concentrating only on bandwidth. We strongly believe that if issue of BW in any network is resolved then all other metrics that are associated to optimize QoS will automatically be adjusted. Associated behaviors are like delay, jitter, throughput, packet delivery etc. Bandwidth is center point of our study and we believe that if BW will be sufficient then all other related issues to degrade QoS will be decreased but if BW will not be available in enough amount then delay, jitter etc will be increased by degrading QoS to support network requirements (Wenjian Shoo etl., 2005).

Bandwidth (BW) Estimations:

Generally in MANETs there remains no regional management of BW and its allocation because neighboring nodes share BW plus they take a part in the procedure of forwarding information ahead (Nityananda Sarma, 2008). Therefore for guaranteed availability of BW to traffic, it is required to estimate the BW accurately on the route/link or at each host.

B. Delay:

Delay is second important metrics for QoS measurement and it is the time taken for transmission of a packet across the network departing from source and reaching to destination. Some times it is considered the time between its generation and its destruction at its destination (Hafiz M. Asif, 2008). Delay is supposed to be the result of routing, mobility, transmission and propagation issues (Weverton Cordeiro, 2007). 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.

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(Nityananda Sarma, 2008). 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 ratio are also part of throughput (Manoj, B., 2003).

D. Jitter:

Jitter is measurement of differences in delay transversely in multiple packets related to an explicit passage stream released from same source (Carlos T. Calafate,). 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.

IV. Agenda for QoS Measurement Metrices:

In (Sulleman, M., 2008) authors proposed a QoS Model that was designed in such a way that different modules of model with respect to their specific function in model were placed at different protocol stacks so that it supports the effectiveness of model with respect to already tested functionalities of protocol stack. In this piece of work, we are extending the agenda for QoS metrics in the light of that model and highlight functionalities in the bounds of each layer of stack.

In proposed model the functionalities of Application and Transport layer are combined. Application layer categories the type of application and service required by it. QoS metrics are end to end delay, throughput and best effort traffic's settlement. Transport layer will take the control of admission according to the nature of service required and implement t the policies according to agreement with network.

Network Layer plays an important role in entire communication for getting optimized QoS. QoS metrics depends on routing, resource reservation and allotting priorities to traffics according to the contract.

Link layer works according the instructions passed by network layer and it responsibilities are to shape, schedule and classify the packets to route on selected paths of network layer. Delay, throughput, path stability for longer connection and hop count foe BET are main metrics.

MAC and Physical layer metrics are link bandwidth, stability, delay which will show the capacity and quality of link. All attribute of MAC have direct impact on
network QoS.

In Table No 2: we have given all t QoS measurement metrics with different functions performed by protocol layers.

Simulations:

Simulation Environment:

For Evaluation of the Model presented (Sulleman, M., 2008), the verification for the premeditated policies of resource reservation (Sulleman, M., Manzoor, 2009) and effectiveness of its algorithm(Sulleman, M., Manzoor, 2009) we perform simulations on NS-2 by using CEDAR routing protocol for finding the Throughput results with environment given in Table 3.

B. Simulation Results:

Throughput:

We use above simulation environment to find Network throughput for four different conditions:

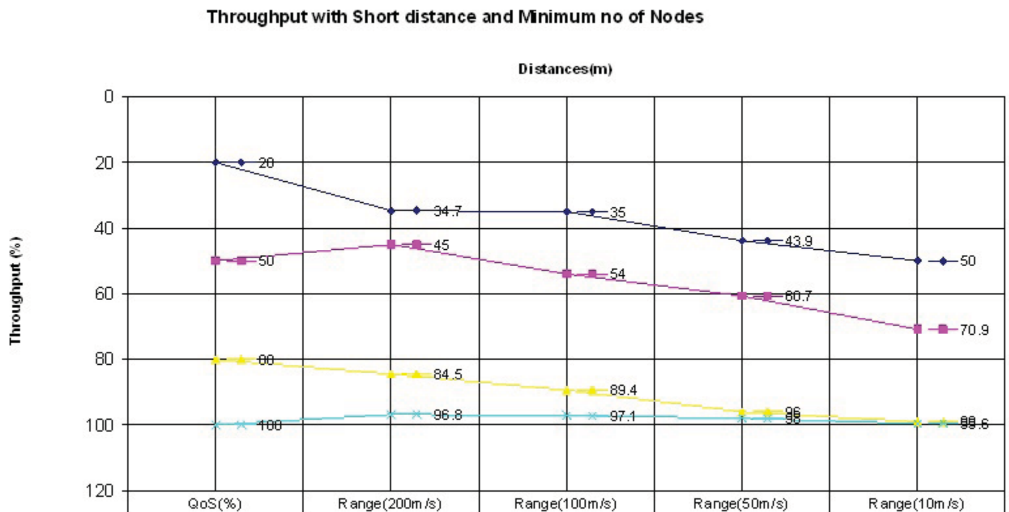
Table 2: Summary for Different QoS attributes related to different categories of Traffic, their priorities with resource reservations on different routes and functions of different protocols

QoS Type Offered	Traffic Type	QoS Level	Traffic and Policies	Applications Type	Transportation Type Required	Functions performed by Protocol layers
PS (Premium Service)	VHPT (Very High Priority Traffic)	1	PS for VHPT	Emergencies, Search and Rescue Operations, Online operation in Hospitals, Telemedicine and Earthquakes	Constant bit transfer rate	Application Layer: i. Receiving QoS enable Application
GS (Gold Service)	HPT (High Priority Traffic)	2	GS for HPT	Military Environment: Army, Navy, air Force, Fire Fighting and Policing	Constant or some variable bit transfer rate	Transport Layer: i. Admission Control, ii. Policy Control
SS (Silver Service)	MPT (Medium Priority Traffic)	3	SS for MPT	Academic and Business Environment: Video Conferencing, Online Classroom Lectures, meetings, Transmission of news, road conditions, meetings, stadiums, shopping malls and games operations	Variable bit transfer rate	Network Layer: i. Resource Reservation, ii. Priority Traffic Control, iii. Feedback Control
MS (Metal Service)	LPT (Low Priority Traffic)	4	MS for LPT	Web access, audio and file transfer operations, e mail, chat and remote access operations	Traffic behavior small, batch file transfer	Data Link Layer: i. Packet Shaping, ii. Packet Scheduling iii. Packet Classification,

Table 3: QoS measurement metrics with different functions performed by protocol layers Metrics with respect to important protocol Layers

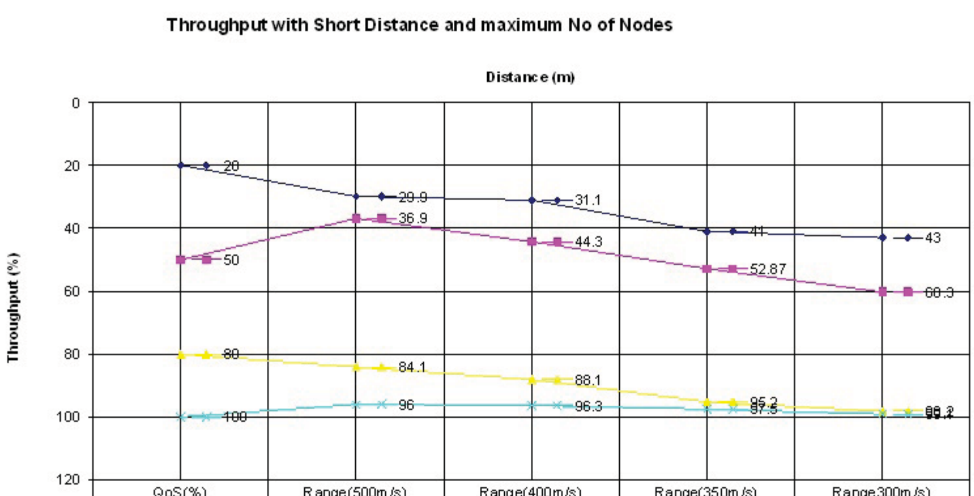
Traffic Type	QoS Level	Application Layer & Transport Layer	Network Layer & Data Link Layer	MAC layer & Physical Layer
VHPT	PS	Delay : Smaller End To End Delay Throughput: Maximum Bandwidth: Max required BW (As per Contract)	Path Delay: Smaller Path Stability: Stronger Path BW: Full availability	Delay: Smaller Link Stability: Stronger Link BW: Maximum
HPT	GS	Delay : Smaller End To End Delay Throughput: Maximum Bandwidth: Max required BW(As per Contract)	Path Delay: Smaller Path Stability: Stronger Path BW: Full availability Some Buffer Level	Delay: Smaller Link Stability: Stronger Link BW: Maximum
MPT	SS	Delay: greater than VHPT and HPT End To End Delay Throughput: On priority ranking (Moderate) Bandwidth: Available required BW (As per Contract)	Path Delay: on priority according to agreement Path Stability: Moderate Path BW: On availability according to agreement Some Buffer Level	Delay: Smaller (on priority according to agreement Link Stability: Moderate Link BW: Average (On availability according to agreement)
LPT	MS	Best Effort	Hop Count Path Stability	Best Effort (All Remaining)

1. Throughput with Small distance ranging from 50 to 200 sqr meters and minimum no of Nodes up to 25.
2. Throughput with Small distance ranging from 50 to 200 sqr meters and maximum no of Nodes up to50.
3. Throughput with Long distance ranging from 300 to 500 sqr meters and minimum no of Nodes up to 25.
4. Throughput with Long distance ranging from 300 to 500 sqr meters and maximum no of Nodes up to 50.



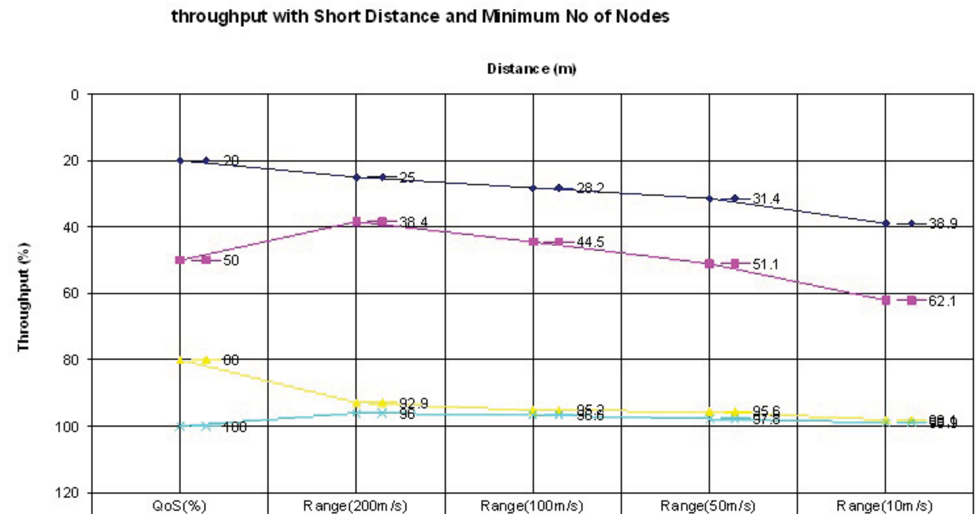
	QoS(%)	Range(200m/s)	Range(100m/s)	Range(50m/s)	Range(10m/s)
BET (with20% QoS)	20	34.7	35	43.9	50
MPT((with 50% QoS)	50	45	54	60.7	70.9
HPT((with 80% QoS)	80	84.5	89.4	96	99
VHPT((with100% QoS)	100	96.8	97.1	98	99.6

Fig. 1: Graph showing throughputs (End to End) when no of nodes are minimum (25) and distance is also short from 0 – 200 meters



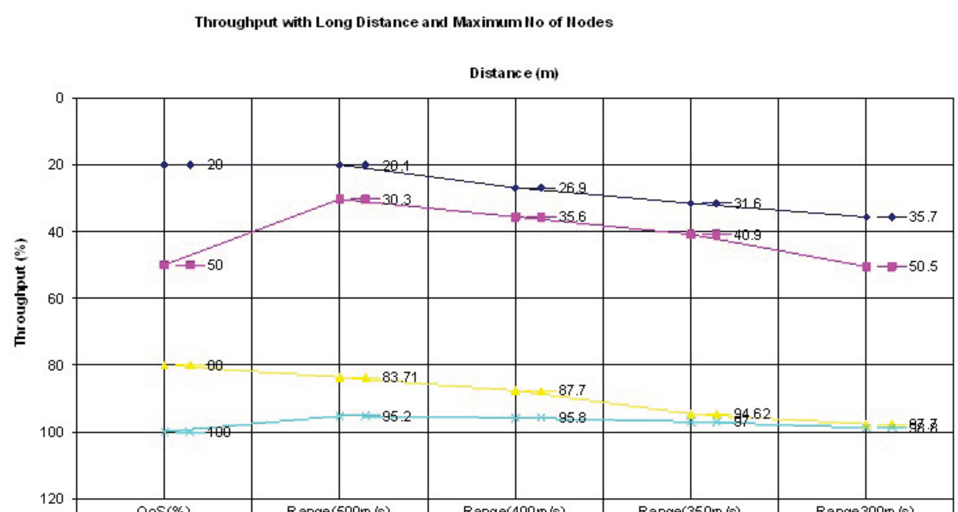
	QoS(%)	Range(500m/s)	Range(400m/s)	Range(350m/s)	Range300m/s)
BET (with20% QoS)	20	29.9	31.1	41	43
MPT((with 50% QoS)	50	36.9	44.3	52.87	60.3
HPT((with 80% QoS)	80	84.1	88.1	95.2	98.2
VHPT((with100% QoS)	100	96	96.3	97.5	99.1

Fig. 2: Graph showing throughputs (End to End) when no of nodes are maximum (50) and distance is short from 0 – 200 meters



	QoS(%)	Range(200m/s)	Range(100m/s)	Range(50m/s)	Range(10m/s)
BET (with20% QoS)	20	25	28.2	31.4	38.9
MPT((with 50% QoS)	50	38.4	44.5	51.1	62.1
HPT((with 80% QoS)	80	92.9	95.2	95.6	98.1
VHPT((with100% QoS)	100	96	96.6	97.8	98.9

Fig. 3: Graph showing throughputs (End to End) when no of nodes are minimum (25) and distance is long from 300 – 500meters



	QoS(%)	Range(500m/s)	Range(400m/s)	Range(350m/s)	Range300m/s)
BET (with20% QoS)	20	20.1	26.9	31.6	35.7
MPT((with 50% QoS)	50	30.3	35.6	40.9	50.5
HPT((with 80% QoS)	80	83.71	87.7	94.62	97.7
VHPT((with100% QoS)	100	95.2	95.8	97	98.8

Fig. 4: Graph showing throughputs (End to End) when no of nodes are maximum (50) and distance is long from 300 – 500 meters

Table 4: Simulating Parameters

PARAMETERS	VALUES
Simulation Time	120 sec
Mobility Model	Random way point
MAC protocol	802.11e
Routing Protocol	CEDAR
Network Scenario	250 nodes for small and 500 for large
Propagation Model	Two Ray Ground
Time between Retransmitted Requests	500 ms
Timeout for non Propagation Search	30 ms
Traffic Rate	1-6 Mbps
Node Transmission Range	100-200 meters
Transmit Power	1.327 W
Terrain Area	500 sqr m
No of Nodes	25 for small network and 50 long distance
Pause Time	10 sec
Node Placement	Random
Maximum Queue Size	50 Packets
Traffic Type	CBR
Node Placement	Uniform
Bit Rate	2mbps
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	2Mbps

The results in all specified scenarios shows very clearly that there is a very little impact on QoS when we reserve resources in advance on two paths as Primary and secondary or the no of nodes are even minimum or maximum because resources are reserved on priority of traffic according to agreement to network for which they pay. But performance of network is degraded for the traffic with low priority and with no resource reservations.

Fig No 1, 2, 3 and 4 shows the simulation results for four different scenarios.

As in past no such policies are given for MANETs and only multi path and load balancing techniques were used so we can't compare our results with any other technique but with respect to old traditional techniques stated above our model has given very high throughput to optimist QoS with more than 10 percent of better results.

Clusion and Future Work:

This piece of research work is in continuation of work conducted in and specifies verification and validation of proposed model and relative methods. We represent different QoS metrics with their impact on network QoS and perform simulations to get throughput of the network and find very excellent results to optimize QoS in MANETs. In future we will work to evaluate the impact of the same model and policies on Delay (End to End), Packet Loss and Error Rates. Work is in progress on same simulation scenario in which we are evaluating the remaining metrics.

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