A STUDY ON QUALITY-OF-SERVICE ROUTING PROTOCOLS IN MOBILE AD HOC NETWORKS

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Abstract- **Wireless networks like mobile ad hoc network provides communication not including the help of any base station. In other words, it is an infrastructure-less networks. The nonexistence of any base station makes complex routing in comparison to the cellular networks. Since the last few decades research work is going to improve Quality-of-Service (QoS) in Mobile Ad hoc Networks (MANET), to achieve high QoS in MANET is a difficult task and is an open challenge to all. This paper will provide a basic idea about QoS in MANET, QoS issues, various QoS parameters, and QoS frameworks.**

Keywords- **Mobile ad hoc network, QoS, Bandwidth, Delay, Throughput.**

I. INTRODUCTION

The ad hoc networks are defined as the wireless networks that make use of radio through the air and are proficient of working exclusive of the help of any base station. An increment of frugal, smaller and more potent devices makes MANET a rapid growing network. The nature of ad hoc network is self-furnishing and adaptive .The ad hoc networks could be classified into three generations. The third-generation systems are the present ad hoc networks e.g. Bluetooth. The first generation was called PRNET (Packet Radio Networks) and it emerged in 1972 and was used for different military scenarios, whereas the second generation came into view from the 1980s' to the mid 1990's.The second generation focused on further development of the formerly build ad hoc network structure.

In ad hoc network base station is not required whereas in cellular network base station is required that makes routing and resource management simpler and easier if we compare to the ad hoc network. In an ad hoc network, data forwarding done from one host to other and resource is managed by disseminated way that makes it complex and difficult. The ad hoc wireless network has several application domains which include battle fields, emergency operations, and collaborative computing.

QoS is defined as the performance intensity of a job that a network provides. The purpose of providing better QoS is to attain a settled network performance, as a result of that the information approved by a network can out bring in an improved way and network assets can be utilized proficiently [1]. To hold up QoS, the parameters such as cost, jitter, minimum bandwidth, maximum delay, and maximum packet loss rate should be available and manageable.

Throughout the duration of the flow the network has to ensure that the link state information are met as per agreement, i.e. the network has to grant QoS to the user which is not that simple and easy because ad hoc network has active unstable network topology, mobility of nodes, lack of essential synchronization, limited availability of resources.

A. QoS parameters

The stage of QoS service and the connected QoS parameters varies in various applications since different applications have different necessities. For example, parameters like bandwidth and delay are used for multimedia application, whereas in military applications in addition to bandwidth and delay, security and reliability are also used as the QoS parameters. Similarly, availability is the key QoS parameter for search-and-rescue operations [1].

B. QoS Routing

The QoS routing protocols help in admission control. That is, routing protocols yields a route to target as well as it computes the QoS. The accumulation of QoS parameters is the first step in a QoS routing protocol. With the help of these QoS parameters a loop free path is determined. Delay, throughput, jitter, packet loss rate, bit error rate, packet delivery ratio and path loss are the parameters that are used for QoS routing. If a valid path from one host to another is detected by meeting the QoS requirements of desired services, then only it accepts a new connection request, or else the connection request is discarded.

QoS parameters that have been used for a particular routing is defined based on the application used and the underlying network have to meet it. For example, in an application where bandwidth is the QoS parameter, then routing protocol utilizes link to select a path with necessary bandwidth.

This paper will provide the review of various routing protocols. It would be beneficial to the students and researchers for understanding the basics about Quality-of-Services (QoS).

The remaining paper is ordered as: In Section II a review of various routing protocols in MANETs is discussed. In Section III we discussed about characteristics of various routing protocols. Sections IV, presents the frameworks for QoS and Section V gives the conclusion of the paper

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II. LITERATURE SURVEY

Nowadays, Mobile Ad Hoc Networks (MANET) is becoming a major emerging technology in mobile computing. MANET has some unique characteristics which makes it complex. Due to these complex characteristics providing QoS in an ad hoc network is not so easy. Large numbers of research are going on in providing QoS support in MANET. Some of the works have been listed below in table1.

III. CHARACTERISTICS OF AD HOC WIRELESS NETWORK

Nowadays extensive research is going on for the improvement of Quality-of-Services. The exceptional characteristics of ad hoc wireless network has led to numerous difficulties in providing QoS. Some of the characteristics and their effects on an ad hoc wireless network is as follows.

A. *Network topology*

In ad hoc wireless network, nodes are mobile most of the time, which leads to active changes in the network topology which in turn leads to frequent path or a link breaks thereby requiring alternate or new path.

B. *Imprecise state information*

Due to dynamically varying network topology state information that has been transmitted from one node to the other may become imprecise and out of date which leads to a wrong routing decision.

C. *Lack of central coordinator*

In ad hoc network basically there does not exist any base station unlike cellular network thus makes difficult to provide Quality of Services.

D. *Hidden terminal problem*

In hidden terminal problem, when two or more sources which are not aware of each other tries to transmit to the common destination, then a collision occurs due to which retransmission of packets has to be done which makes complex to provide QoS hold in an ad hoc wireless network.

E. *Lack of secure medium*

Communication via wireless media is extremely timid due to the way messages are broadcast. Security is a very necessary concern in ad hoc wireless networks, mostly for military applications. It is very complicated to provide protected transmission without any efficient secure mechanism.

F. *Limited resource availability*

Resources like storage space, bandwidth, data rate, battery life, processing capacity are inadequate in an ad hoc network. Therefore, the rare accessibility of these resources makes difficult to improve the QoS in MANET.

IV. FRAMEWORKS FOR QOS

A framework for QoS is the whole method that seeks to give essential services to the user. The primary element of a QoS framework is a QoS service model [1].

A. *QoS Resource Reservation*

QoS resource reservation is a significant mechanism of any QoS framework. It is categorized into two types:

1) *Hard state resource reservation scheme:* In this scheme, throughout the QoS session resources is kept at all the intermediary nodes until the source received an acknowledgement from the required destination which in turn wastes much time and resources and further leads to additional control overhead in case of a path or link break or failure.

2) *Soft state resource reservation:* In order to overcome the difficulty faced by hard state resource reservation scheme, soft state resource reservation scheme is used, where resources are reserved for a small interval of time i.e. a timer is activated and will be updated in a permanent manner.

B. *QoS models*

In a wired network, QoS model can be classified into two types based on their essential operations. They are as follows:

1) *Integrated services (Int-Serv):* It is a fine-grained approach that provides the expected behaviour of the network for applications. It provides various services like to grant service, controlled load service and best effort service that contain multiple QoS requirements. It is implemented by using the Resource Reservation protocol (RSVP. This model is not flexible for internet but is flexible for small sized ad hoc wireless network.

2) *Differentiated services (Diff-Serv):* It is a coarsed-grained approach which gives various levels of service that satisfies inconsistent QoS requirements. This model is developed with the intention to overcome the trouble faced by the Int-Serv model. Flows are amalgamated into a confined numeral job classes where each flow is associated to one of the Diff-Serv classes of jobs. This solves the scalability problem faced by the Int-Serv model [1].

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TABLE I
LITERATURE SURVEY OF VARIOUS ROUTING PROTOCOLS

Sl. No.	Various Routing Protocols: Proposed Model/Protocol	Parameters	Findings
1	Bandwidth Routing Protocol [2].	a)Packet loss rate b) End-to-end bandwidth c) Delay	i) This QoS routing protocol comprises of bandwidth allocation and end-to-end bandwidth calculation. ii) It enables more proficient call admission control. iii) High mobility results in retransmission and increases packet loss rate. iv) QoS1 has the maximum packet loss rate amongst the entire traffic flows.. v) QoS4 has the biggest throughput, and QoS1 has more hop delay.
2	**FQMM** Model [3].	a)Throughput b) Bandwidth allocation	i) It's a hybrid approach. ii) FQMM gains improved performance in terms of throughput with raise by 23.8% than the best effort model.
3	Predictive Preemptive Local Route Repair Strategy [8].	a) end-to-end packet delay b) Packet delivery ratio	i) It increases the packet delivery ratio and decreases end-to-end packet delay. ii) It avoids unnecessary warning messages and reduces control overhead.
4	Multi-Algorithm Routing Mechanism for Acquiring High Quality of Service (**MARMAQS)** protocol [6].	a)End-to-end delay b) Packet delivery ratio c) Throughput, route reliability d) Routing overhead	i) It is very efficient in achieving high QoS in term of highly increased packet delivery ratio, transmission's reliability, network's lifetime, throughput, and decreased routing overhead and end-to-end delay's. ii) It is a complex protocol consisting of Routing, Packet scheduling, and Intrusion monitoring mechanisms which makes this scheme very robust as it achieves a high QoS's provision in MANETS.
5	Enhanced Random Early Detection **(ERED)**[10]	a) Average queue length b)Packets drop Probability	i)Packet Delivery Ratio (PDR) of RED is consistent, i.e around 92 and ERED is having PDR around 98 to 100 approximately. ii)PDR and throughput is consistently higher in ERED than RED.

TABLE I
CONTINUED…

Sl. No	Various Routing Protocols: Proposed Model/Protocol	Parameters	Findings
			iii)For 5,10,15,20 nodes throughput for RED is 659.4, 669.41, 654.99, 672.57 and for ERED is 681.01, 683.18, 681.58, 680.27 respectively.
6	QoS AODV[4]	a)Throughput b) Transmission delay	i)QoS AODV is compared with traditional AODV. ii)Average throughput of QoS AODV protocol is higher than basic AODV. iii) QoS AODV reduces much more transmission delay for real time data packets in compared to traditional AODV.
7	**EDNR** protocol [5].	a)Energy drain rate b) The relative mobility estimation rate.	i) EDNR is compared with existing protocols DSR and LPR where it outperforms than the existing protocol. ii) EDNR provides much better packet delivery ratio in compared to DSR and LPR. iii) EDNR has lesser packet loss ratio in compare to DSR and LPR. iv) It provides decreased overhead when compared to DSR and LPR. v) It has better throughput in compare to the DSR and LPR.
8	Efficient Power Aware Routing **(EPAR)** protocol [7].	a)Number of dropped packets b)End-to-end delay c) Packet delivery ratio d)The overall network lifetime	i)EPAR is compared with DSR and DSDV. ii) For the small networks, these three protocols does not have any major differences. For medium and large MANETs, EPAR outperforms other protocols.
9	Power and Delay aware Multipath Routing Protocol **(PDMRP)** [9].	a)Throughput b) End-to-end delay c) Loss rate.	i)This protocol gives the highest throughput. ii) PDMRP protocol gives lowest loss rate and end-to-end delay when compared to MAODV and OPR protocols.

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V. CONCLUSION AND FUTURE WORKS

In this paper, we reviewed various QoS routing protocols. We also discussed the challenges and QoS frameworks for providing QoS in MANETs. Although every routing protocol has some unique characteristics, but sometimes, guaranteeing QoS may be not possible if the nodes are too mobile. Due to the increased computational load network size becomes a concern. So, we need to select an appropriate routing protocol based on the network environment. Mobile ad hoc networks have created an immense evocation for the developers because of varying topology and security threats, and research is going on all across the world. We hope that this paper would be helpful for students and researchers to achieve basic knowledge about QoS.

A hopeful direction of future research is the performance analysis of various routing protocols based on the QoS metrics. One can also go for the design of an efficient routing protocol for providing QoS in MANET.

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