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A Survey on Knowing the Challenges of Quality of Services in Mobile Ad Hoc Networks

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ABSTRACT: I A Mobile Adhoc Network (MANET) is a group of self- organized wireless mobile nodes that form a wireless network independently. The nodes in the adhoc network are independent to move and thus have no established structure. Due to this bandwidth limited, resource constraint and dynamic topology of Adhoc Networks, rendering Quality of Service (QoS) in MANET is a hard and challenging task. In this survey paper we examine the current researches on MANET on providing QoS.

KEYWORDS: MANET, Quality of service, QoS Models, Inserv, DiffServ, FQMM.

I. INTRODUCTION

A MANET is a distributed network that does not require centralized administration, and every host works not only as a source and a sink but also as a router. Adhoc networks are especially useful for military communications or for emergency operations, where an infrastructure cannot be maintained. However with the evolution of the multimedia and video on demand technologies, the commercial interest of companies to reach wide amount of civilian applications made QoS in MANETs an great area of interest. But rendering QoS in MANET becomes very hard and challenging task because of limited network bandwidth is shared among various neighbouring nodes and the constant alteration of network topology with the node mobility.

It has been observed that Maximizing accuracy, Minimizing overhead, Maintaining route, Reserving resources, reducing power utilization, reliability are hard and challenging issues. This study is helpful for designing new routing protocols with improved QoS in MANETs.

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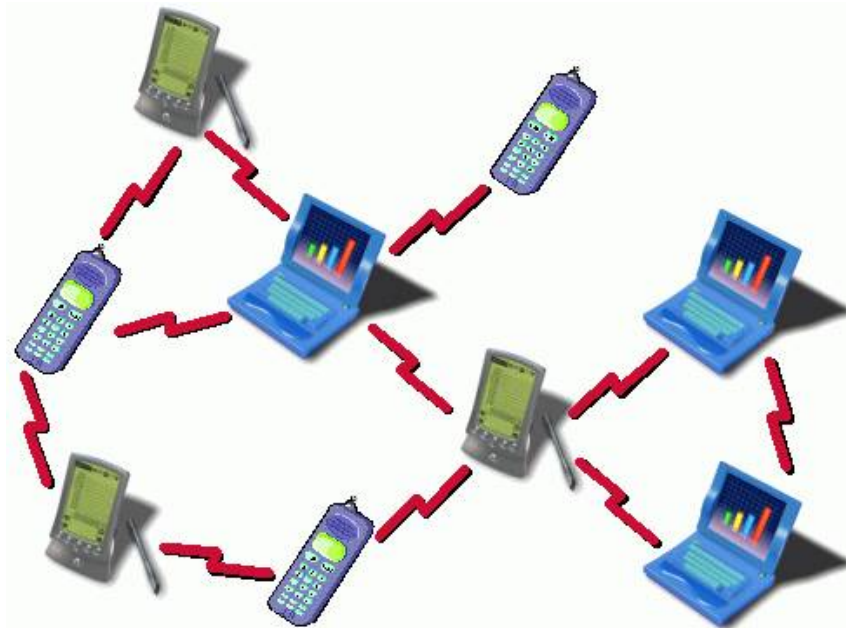


Fig. 1 Mobile Ad hoc Network

II. QUALITY OF SERVICE

QoS is the performance level of a service tendered by the network to the user. In other terms the QoS means that the network should provide some kind of guarantee about the grade of service provided to an application in terms of delay, packet loss, bandwidth, and so on.

III. QOS MODEL

QoS model defines an architecture using which some kind of services could be provided in MANETs. The model includes QoS resources reservation signalling, QoS routing and QoS Medium Access Control (MAC) as shown in Fig.2.

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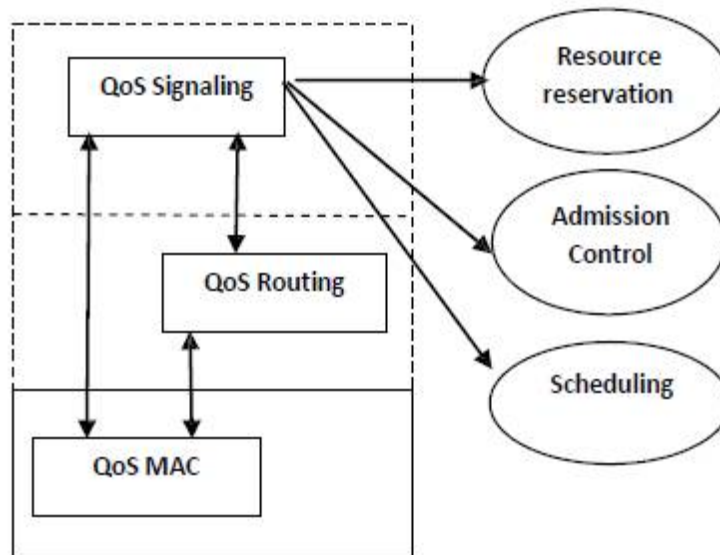


Fig. 2: QoS Model

The main requirements for a QoS Model for MANETs are as follows:-

- a) Minimal overhead:** In a wireless multi-hop network, the wireless link capacity, battery and computational resources are quite limited. Thus a QoS model for MANET should minimize the signaling overhead as well as the overhead implied in purveying of QoS.
- b) Robustness:** QoS models should be able to handle frequent route failures due to dynamic network topology. A QoS model should have mechanisms to adapt to the changing topology without creating bottlenecks, in a fast and efficient manner.
- c) Fairness:** The QoS resources should be shared in a fair and efficient manner among the wireless clients, and misbehaving nodes should not be allowed to make use of the network's resources without relaying packets for other nodes.

Some of the QoS Models are:

1. Integrated Service (IntServ) Model

The basic idea of Integrated Service (IntServ) Model is that the flow specific states are kept in every IntServ enable router [1]. A flow is an application session between a source and a destination. A flow specific state should include the information about bandwidth requirement, delay bound and cost etc. IntServ defines two types of service classes pertaining with integration along with Best-effort services. These are Guaranteed Service and the Controlled Load Service.

- i. Guaranteed Service: is used for applications requiring fixed delay bound.
- ii. Controlled Load Service: is used for applications requiring reliable and enhanced best effort service.

In an IntServ enabled router, IntServ is implemented with four basic components

- a) The signalling Protocol
- b) The admission Control routine

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c) The Classifier

d) The packet Scheduler

Other components such as the routing agent and management agent are the original mechanisms of the routers can be kept unchanged.

2. Differentiated Service (DiffServ) Model

Ad hoc networks will necessarily have a need to communicate with fixed networks, for example access to the Internet, hence there is a need for QoS between these two domains. DiffServ is a QoS architecture, which combines each flow into a defined class, and treats all packets on a per-hop basis based on which class the packets' flow belongs to. DiffServ fixes the problem of scalability present in the IntServ architecture [2]. IntServ is a flow-aware architecture that does not scale if the number of source-receiver pairs becomes too high. The DiffServ architecture uses a 6-bit Differentiated Service Code Point (DSCP), which is in the Type of Service (ToS) field in the IP header, to define a packet's treatment in the network. This treatment gives the per-hop behavior (PHB) in each intermediate node that belongs to the network domain.

Packets having similar forwarding behavior belong to the same PHB class – or DiffServ class. The differentiation among the classes is typically given by the buffer capacity, buffer drop probability and packet scheduling technique. DiffServ defines one Expedited Forwarding (EF) class, twelve Assured Forwarding (AF) classes (i.e. four classes, each with three drop probabilities) and one Best-Effort (BE) class.

3. Flexible QoS Model for MANET (FQMM)

FQMM combines the advantages of IntServ and DiffServ where only the highest prioritized classes may use IntServ because of its per-flow guarantee and lack of scalability. FQMM provides three key features : dynamic roles of nodes, hybrid provisioning and adaptive conditioning.

FQMM model provides per flow QoS guarantees for the high priority flows while lower priority flows are aggregated in to a set of service classes.

4. Stateless Wireless Ad hoc Network (SWAN)

SWAN is a class based approach that uses probing for admission control of the real-time packets, and rate control for the best-effort packets.

The SWAN model contains a number of mechanisms used to support rate regulation of best-effort (BE) traffic and admission control regulation of real-time (RT) traffic. It uses feedback based control mechanisms to regulate real-time traffic at the time of congestion in the network[3].

IV. ISSUE AND CHALLENGES WHILE PROVIDING QOS IN AD - HOC NETWORKS

The major challenges that are faced while providing the QoS in MANET are as follows:

1. Security: The wireless environments, along with the nature of the routing protocols in MANETs, which require each node to participate actively in the routing process, introduce many security vulnerabilities. Thus a routing protocol, that is adopted should effectively and efficiently support security mechanisms to address these vulnerabilities.

2. Average end-to-end delay: End-to-end delay includes all possible delays in the network caused by route discovery latency, retransmission by the intermediate nodes, processing delays, queuing delays, and propagation delays. To average the end-to-end delay we add every delay for each successful data packet delivery and divide that sum by the number of successfully received data packets. This metric is important in delay sensitive applications such as video and voice transmission. All the factors which contribute in end- to end delay play their role in making it difficult to provide QoS in MANET.

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3. Route maintenance: The nodes in the MANET may also need to perform the function of dynamic establishment of routing paths among themselves as they move around. The established routing path may be broken at any time even during the process of data transfer. Thus, the need arises of routing paths with minimal overhead and delay.

4. Lack of centralized control: The major advantage of an ad hoc network is that it may be setup spontaneously, without planning and its members can change dynamically. This makes it difficult to provide any form of centralized control.

5. Limited bandwidth: Wireless links have significantly lower capacity than infrastructure networks. In addition, the realized throughput of wireless communication after accounting for the effect of multiple access, fading, noise, and interference conditions, etc., is often much less than a radio's maximum transmission rate.

6. Hidden terminal problem: The hidden terminal problem refers to the collision of packets at a receiving node due to the simultaneous transmission of those nodes that are not within the direct transmission range of the sender, but are within the transmission range of the receiver. It necessitates retransmission of packets, which may not be acceptable for flows that have strict QoS requirements. Some control packet exchange mechanisms [4, 7] reduce the hidden terminal problem only to a certain extent.

7. Limited device resources : The nodes in a MANET have limited memory capacity and limited battery power which limits the amount of QoS state that can be stored. On the other hand, transmission and processing required during routing involve expenditure of substantial amount of energy causing the batteries to get drained out rapidly, unless the routing protocols are carefully designed.

8. Node Mobility: Since the nodes in a MANET may move independently and randomly. So the network topology must be updated frequently to allow data packets to be routed to their destinations. [5].

V. CONCLUSION

QoS is a wide area for research. Many protocols and techniques are developed in this field. In this paper we have presented a comprehensive issues and challenges involved in providing QoS in MANETs. The major challenge involved in providing the QoS in mobile ad hoc networks is how to tackle changes in the topology of the network. Another challenge in case of MANETs is that the resources of participating nodes are limited. Therefore, a protocol for providing QoS in ad hoc networks should be able to utilize the scarce resources in an efficient and effective manner.

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