# An Overview of QoS in MANETs Along with its Qualities, Special Issues & Difficulties

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## ABSTRACT

In the next generation of wireless communication systems, there will be a need for the rapid deployment of independent mobile users. Significant examples include establishing survivable, efficient, dynamic communication for emergency/rescue operations, disaster relief efforts, and military networks. Such network scenarios cannot rely on centralized and organized connectivity, and can be conceived as applications of Mobile Ad Hoc Networks. A MANET is an autonomous collection of mobile users that communicate over relatively bandwidth constrained wireless links. The quality of service (QoS) refers to several related aspects of telephony and computer networks that allow thetransport of traffic with special requirements. In the field of telephony, quality of service was defined by the ITU in 1994. Quality of service comprises requirements on all the aspects of a connection, such as service response time, loss, signal-to-noise ratio, crosstalk, echo, interrupts, frequency response, loudness levels, and so on. A subset of telephony QoS is grade of service (GoS) requirements, which comprises aspects of a connection relating to capacity and coverage of a network. In this paper we have described the qualities of QoS, special issues with all difficulties in respect of MANETs.

***Keywords--*** QoS, throughput, latency etc.

## I. AN INTRODUCTION TO MOBILE AD HOC NETWORKS

A mobile ad hoc network is a concept that has received attention in scientific research since the 1970s. A clear picture of what exactly is meant by an ad hoc network is difficult to pinpoint. In today's literature the term is used in many different ways. The Internet Engineering Task Force (IETF), the body responsible for guiding the evolution of the Internet, provides the definition as given below [23]:

A mobile ad hoc network (MANET) is an autonomous system of mobile routers (and associated hosts) connected by wireless links. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably.

Such a network may operate in a stand-alone fashion, or may be connected to the larger Internet

MANETs are useful in many applications because they do not need any infrastructure support. Collaborative computing and communications in smaller areas (building organizations, conferences, etc.) can be set up using MANETS. Communications in battlefields and disaster recovery areas are further examples of application environments. With the evolution of Multimedia Technology, Quality of Service in MANETs became an area of great interest. Besides the problems that exist for QoS in wire-based networks, MANETS impose new constraints. This is due the dynamic behaviour and the limited resources of such networks.

## II. AN OVERVIEW OF QoS

**Quality of service** (**QoS**) is the overall performance of a telephony or computer network, particularly the performance seen by the users of the network.

To quantitatively measure quality of service, several related aspects of the network service are often considered, such as error rates, bandwidth, throughput, transmission delay, availability, jitter, etc.

Quality of service is particularly important for the transport of traffic with special requirements. In particular, much technology has been developed to allow computer networks to become as useful as telephone networks for audio conversations, as well as supporting new applications with even stricter service demands.

In the field of telephony, quality of service was defined by the ITU in 1994.[1] Quality of service comprises requirements on all the aspects of a connection, such as service response time, loss, signal-to-noise ratio, crosstalk, echo, interrupts, frequency response, loudness levels, and so on. A subset of telephony QoS is grade of service (GoS) requirements, which comprises aspects of a connection relating to capacity and coverage of a network, for example guaranteed maximum blocking probability and outage probability.[2]

In the field of computer networking and other packet-switched telecommunication networks, the traffic engineering term refers to resource reservation control mechanisms rather than the achieved service quality. Quality of service is the ability to provide different priority to different applications, users, or data flows, or to guarantee a certain level of performance to a data flow. For example, a required bit rate, delay, jitter, packet dropping probability and/or bit error rate may be guaranteed. Quality of service guarantees are important if the network capacity is insufficient, especially for real-time streaming multimedia applications such as voice over IP, online games and IP-TV, since these often require fixed bit rate and are delay sensitive, and in networks where the capacity is a limited resource, for example in cellular data communication.

A network or protocol that supports QoS may agree on a traffic contract with the application software and reserve capacity in the network nodes, for example during a session establishment phase. During the session it may monitor the achieved level of performance, for example the data rate and delay, and dynamically control scheduling priorities in the network nodes. It may release the reserved capacity during a tear down phase.

A best-effort network or service does not support quality of service. An alternative to complex QoS control mechanisms is to provide high quality communication over a best-effort network by over-provisioning the capacity so that it is sufficient for the expected peak traffic load. The resulting absence of network congestion eliminates the need for QoS mechanisms.

QoS is sometimes used as a quality measure, with many alternative definitions, rather than referring to the ability to reserve resources. Quality of service sometimes refers to the level of quality of service, i.e. the guaranteed service quality. High QoS is often confused with a high level of performance or achieved service quality, for example high bit rate, low latency and low bit error probability.

An alternative and disputable definition of QoS, used especially in application layer services such as telephony and streaming video, is requirements on a metric that reflects or predicts the subjectively experienced quality. In this context, QoS is the acceptable cumulative effect on subscriber satisfaction of all imperfections affecting the service. Other terms with similar meaning are the quality of experience (QoE) subjective business concept, the required "user perceived performance",[3] the required "degree of satisfaction of the user" or the targeted "number of happy customers". Examples of measures and measurement methods are Mean Opinion Score (MOS), Perceptual Speech Quality Measure (PSQM) and Perceptual Evaluation of Video Quality (PEVQ). See also subjective video quality.

QoS is usually defined as a set of service requirements that needs to be met by the network while transporting a packet stream from a source to its destination. The network needs are governed by the service requirements of end user applications. The network is expected to guarantee a set of measurable prespecified service attributes to the users in terms of end-to-end performance, such as delay, bandwidth, probability of packet loss, delay variance (jitter), etc. Power consumption is another QoS attribute which is more specific to MANETs. In the literature, the research on QoS support in MANETs spans over all the layers in the network:

*QoS models:* specify an architecture in which some kinds of services could be provided. It is the system goal that has to be implemented.

*QoS Adaptation:* hides all environment-related features from awareness of the multimedia-application above and provides an interface for applications to interact with QoS control. □ Above the network layer *QoS signaling* acts as a control center in QoS support. The functionality of QoS signaling is determined by the QoS model.

*QoS routing:* is part of the network layer and searches for a path with enough resources but does not reserve resources.

*QoS MAC:* protocols are essential components in QoS for MANETs. QoS supporting components at upper layers, such as QoS signaling or QoS routing assume the existence of aMAC protocol, which solves the problems of medium contention, supports reliable communication, and provides resource reservation. This document does not treat *QoS MAC* and *QoS routing* any further and instead focuses on upper layers like QoS models and signaling.

# III. QUALITIES OF A GOOD TRAFFIC

In packet-switched networks, quality of service is affected by various factors, which can be divided into "human" and "technical" factors. Human factors include: stability of service, availability of service, delays, user information. Technical factors include: reliability, scalability, effectiveness, maintainability, grade of service, etc.[4]

Many things can happen to packets as they travel from origin to destination, resulting in the following problems as seen from the point of view of the sender and receiver:

*Low throughput:*
Due to varying load from disparate users sharing the same network resources, the bit rate (the maximum throughput) that can be provided to a certain data stream may be too low for realtime multimedia services if all data streams get the same scheduling priority.

*Dropped packets*
The routers might fail to deliver (*drop*) some packets if their data is corrupted or they arrive when their buffers are already full. The receiving application may ask for this information to be retransmitted, possibly causing severe delays in the overall transmission.

*Errors*
Sometimes packets are corrupted due to bit errors caused by noise and interference, especially in wireless communications and long copper wires. The receiver has

to detect this and, just as if the packet was dropped, may ask for this information to be retransmitted.

### Latency

It might take a long time for each packet to reach its destination, because it gets held up in long queues, or takes a less direct route to avoid congestion. This is different from throughput, as the delay can build up over time, even if the throughput is almost normal. In some cases, excessive latency can render an application such as VoIP or online gaming unusable.

### Jitter

Packets from the source will reach the destination with different delays. A packet's delay varies with its position in the queues of the routers along the path between source and destination and this position can vary unpredictably. This variation in delay is known as jitter and can seriously affect the quality of streaming audio and/or video.

### Out-of-order delivery

When a collection of related packets is routed through a network, different packets may take different routes, each resulting in a different delay. The result is that the packets arrive in a different order than they were sent. This problem requires special additional protocols responsible for rearranging out-of-order packets to an isochronous state once they reach their destination. This is especially important for video and VoIP streams where quality is dramatically affected by both latency and lack of sequence.

## IV.     QUALITY OF SERVICE IN MANETs

This section discusses unique issues and difficulties for supporting QoS in a MANET environment and ends up showing the major drawbacks of each of the two QoS architectures described above with respect to these characteristics.

### Special Issues and Difficulties in MANETs

MANETs differ from the traditional wired Internet infrastructures. The differences introduce difficulties for achieving Quality of Service in such networks. The following list itemizes some of the problems:

### Dynamic topologies & Delay

Nodes are free to move arbitrarily; thus, the network topology - which is typically multihop - may change randomly and rapidly at unpredictable times, and may consist of both bidirectional and unidirectional links.

### Bandwidth-constrained, variable capacity links

Wireless links will continue to have significantly lower capacity than their hardwired counterparts. In addition, the realized throughput of wireless communications - after accounting for the effects of multiple access, fading, noise, and interference conditions, etc.- is often much less than a radio's maximum transmission rate. One effect of the relatively low to moderate link capacities is that congestion is typically the norm rather than the exception, i.e. aggregate application demand will likely approach or exceed network capacity frequently. As the mobile network is often simply an extension of the fixed network infrastructure, mobile ad hoc users will demand similar services. These demands will continue to increase as multimedia computing and collaborative networking applications rise.

### Energy-constrained operation

Some or all of the nodes in a MANET may rely on batteries or other exhaustible means for their energy. For these nodes, the most important system design criteria for optimization may be energy conservation.

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