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A Survey on Quality of Service (Qos) for Ad Hoc Networks

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Abstract: The Qos is the performance evaluation of the computer network particularly the performance seen by the users of the network. To measure the Qos various metrics are considered, like bandwidth, throughput, transmission delay, availability, scalability etc. This paper tells about the comparison of various metrics that are evolved in giving the quality of services for higher performance in the network.

Keywords: Quality of service (Qos), mobile adhoc networks, time division multiple access, Qos routing, reliability, efficiency, sensor networks, overhead, scalability.

I. INTRODUCTION

The quality of service is the overall measurement of the performance in the network. The budding real-time applications and the wide spread use of wireless and mobile devices has generated the need to provide quality-of-service (QoS) support in wireless and mobile networking environments. The Qos cannot be given cent percentage but the better performance can be provided with the consideration of the metrics. Recent wireless networks support wireless access for mobile communications devices by providing a wireless interface between the mobile devices and a fixed network of limited range base-stations (BS). On the basis of the infrastructure model for wireless communications, the air-interface consists of a single data-link terminating on a BS. Communication from that point is routed across a fixed network to its destination. Mobility is managed by allocating a limited set of communications frequency channels to each BS, and dynamically assigning a mobile device to a local channel as it moves from the coverage area of one BS to another. While providing QoS in an infrastructured environment is difficult, supporting QoS in mobile ad hoc networks, which do not depend on a BS for communications, is even more difficult. Essentially, a mobile ad hoc network is a network of mobile routers.

II. MOBILE AD HOC NETWORKS

Mobile ad hoc networks are composed of wireless nodes that self-organize to form a network without the aid of any established infrastructure. All the nodes are free to move and dynamically connect in an arbitrary manner. The ad hoc networks are self-organizing, rapidly deployable and have no fixed infrastructure. They are composed of wireless mobile nodes that can be deployed anywhere, and must cooperate in order to establish communications dynamically using limited network management and administration. Ad hoc network nodes may be highly mobile, or stationary, and may also vary widely in terms of their uses and capabilities. They may operated by connecting to the Internet. The environments in which ad hoc networks are initially expected to play an important role include instant infrastructure scenarios, particularly where mobile access to a wired network is either ineffective or impossible. Because of their inherent flexibility, ad hoc networks have the potential to serve as a ubiquitous wireless infrastructure capable of interconnecting thousands of devices, and supporting a wide range of networking applications.

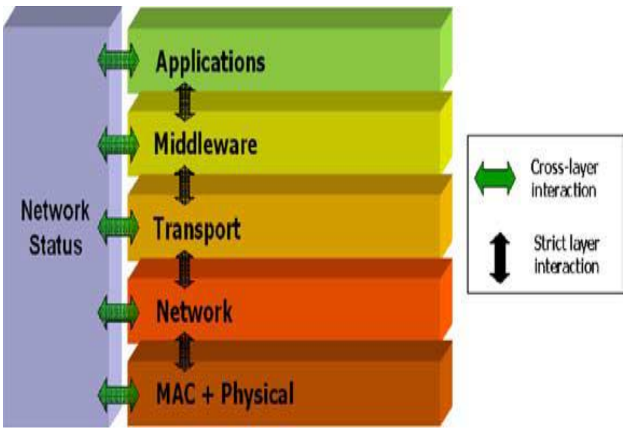

Fig. 1. Cross-layer architecture for ad hoc nodes.

III. MMSPEED

The paper [1], proposes a novel packet delivery mechanism called MMSPEED for wireless sensor networks to provide service differentiation and probabilistic QoS guarantees in the timeliness and reliability domains. For the timeliness domain, multiple network-wide speed option is provided so that various traffic types can dynamically choose the proper speed options for their packets depending on their end-to-end deadlines. For the reliability domain, probabilistic multipath forwarding is used to control the number of packet delivery paths depending on the required end-to-end reaching probability. These methods are implemented

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in a localized way with dynamic compensation to compensate for the inaccuracies of local decisions as packets progress towards their destinations.

The two important goals of the protocols,

1. Localized packet routing decision without global network state update and
2. Providing differentiated QoS options in timeliness and reliability domains.

For this localized packet routing without end-to-end path setup and maintenance, the geographic routing mechanism is adopted based on location awareness. Initially assume that the destination of the packet is specified by a geographic location rather than node ID. And sensor node is assumed to be aware of its geographical location using GPS (geographic positioning system). The location information can be exchanged with the immediate neighbors with periodic location updating packets. Thus each node is aware of its neighbor's location and radio range. Using this information the packets can be send from the source to the destination. For on-time packet delivery with different end-to-end deadlines, MMSPEED provides multiple delivery speed options that are guaranteed network-widely. For this, the idea of SPEED protocol is used which can guarantee a single network-wide speed. These are in the timeliness domain and here Mac protocols are used with the CTS/RTS request to the nodes and the acknowledgment is also received.

In a dense sensor network, there exist multiple redundant paths to the final destination even though they may not be the shortest paths. A nonshortest path is acceptable as long as it can deliver a packet within the end-to-end deadline. But our MMSPEED protocol take advantage of such inherent redundancies to probabilistically guarantee the essential end-to-end reliability level of a packet. The probability of the packet that reaches its final destination grows when the number of paths utilized to deliver a packet increases, regardless of packet drops, node failures, and errors on wireless links. Thus, by controlling the number of forwarding paths depending on the required reliability level, the service differentiation in the reliability domain is provided. Here the power consumption is the constraint.

As a result, MMSPEED can appreciably improve the effective capacity of a sensor network in terms of number of flows meeting both reliability and timeliness requirements. The qos here considerably increased but the higher performance can be obtained by considering other metrics.

IV. A QOD PROTOCOL

The paper [2], considers a hybrid wireless network i.e. an infrastructure based network and MANET. Here by directly implementing resource reservation-based QoS routing, hybrids networks take over invalid reservation and race condition problems in MANETs. Here a QoS-Oriented Distributed routing protocol (QOD) is proposed to enhance the QoS support capability in hybrid networks. QOD can afford high QoS performance in terms of overhead, transmission delay, mobility-resilience, and scalability. This protocol consists of five algorithms,

a)A QoS-guaranteed neighbor selection algorithm.
b)A distributed packet scheduling algorithm.
c)A mobility-based segment resizing algorithm.
d) A traffic redundant elimination algorithm.
e)A data redundancy elimination-based transmission algorithm.

QOD is the first work for QoS routing in hybrid networks. This paper makes five contributions.

- QoS-guaranteed neighbor selection algorithm. This algorithm selects qualified neighbors and employs deadline-driven scheduling mechanism to guarantee QoS routing.
- Distributed packet scheduling algorithm. After qualified neighbors are selected, this algorithm schedules packet routing. It allocates earlier generated packets with higher queuing delays to forwarders, then assigns more recently generated packets to forwarders delays to decrease total transmission delay with lower queuing.
- Mobility-based segment resizing algorithm. The source node resizes each packet in its packet stream for each neighbor node according to the neighbor's mobility in order to increase the scheduling feasibility of the packets from the source node.
- Soft-deadline based forwarding scheduling algorithm. In this algorithm, there is an intermediate node which first forwards the packet with the least time allowed to wait before being forwarded to achieve fairness in packet forwarding.
- Data redundancy elimination based transmission. The access points and mobile nodes can overhear and cache packet due to the broadcasting feature of the wireless networks. This algorithm improves the QoS of the packet transmission by eliminating the redundant data.

In QOD, a source node directly transmits packets to an AP if the direct transmission can guarantee the QoS of the traffic. Otherwise, the source node schedules the packets to a number of qualified neighbor nodes. The intermediate nodes forward the packet to the destination nodes. Here the metrics mobility-resilience, scalability, and contention reductions achieved high and to be implemented in test bed for the better qos to be obtained. And the other metrices can also be considered for the better performance.

V. RELIABLE AND EFFICIENT FORWARDING IN AD HOC NETWORKS

The paper [3] packet forwarding in ad hoc networks are focused and proposes a new approach to improve

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performance of nodes communication. A mechanism for REliable and Efficient Forwarding (REEF), is given which alleviate the effects of undesirable situations caused by cooperation misbehavior or network fault conditions. It makes use of nodes local knowledge to estimate route reliability, and multi-path routing to forward packets on the most reliable route. This REEF mechanism, which addresses performance problems of the forwarding function, caused by several factors such as nodes selfishness, malice, and fault conditions. This paper explains REEF as TCP traffic based mechanism. In case of UDP packets, no acknowledgment is given for packets that are send. Therefore, to estimate the reliability of routing a mechanism is introduced to determine if packets reach the destination. A solution in this direction is given in [5], where overlapping sub-packets are dispersed on different routes, and are assembled at destination, which ultimately sends back an acknowledgment to confirm that the packets are reached. Packet acknowledgments regard pieces of packets that have been successfully received, and are dispersed as well. The introduction of an acknowledgment for every UDP packet makes the mechanism look like a TCP service. Thus, an alternative solution can be the introduction of a increasing acknowledgment on UDP traffic. In particular, the destination may at times send an acknowledgment to inform a set of received packets. The acknowledgment can be used for updating the reliability of routes through which packets were sent. The simplest way to estimate the nodes reliability involves each node to keep a probability index for each neighbor, representing the reliability level of the link between the node and the specified neighbor. If there are multiple routes available for packet forwarding to a destination node, the source node can choose one of them according to a certain criteria. Some of the ad hoc policies consider the shorter or fresher paths than others. Selfishness is a new problem evolved with the ad hoc network, and set apart a class of self-interested behavior. A selfishness model for routing and forwarding functions has been defined in [6]. In this model, behavior of nodes depends on their energy level. When the energy level of the nodes goes below a predefined threshold then the nodes can stop forwarding others packets, but still participating to the routing protocol. When the energy level goes down and falls below a lower threshold, the routing function can be disabled so that it does not to appear in other routing tables, and thus need not to forward packets. Thus, nodes energy is used only for its own communications. To motivate nodes cooperation a simple forwarding mechanism based on priority treatment is used. The main goal is to differentiate the quality of service toward different nodes, providing preferential or unfavorable service, according to the way they behave with others. In this way, packets coming from reliable neighbors are forwarded with higher priority than packets coming from neighbors with a lower reliability value. The main goal of REEF is to improve network throughput and balance network utilization at the same time.

The results show the performance problems are addressed with selfish nodes with the retrieving the nodes local information. The network throughput and balance network utilization is improved with the reliability, but the misbehaving nodes estimation can be further refined and the global evolution of this can be done and the effectives must be improved for the better qos.

VI. BANDWIDTH RESERVATION PROTOCOL FOR QOS ROUTING

This paper [4] describes the comparison and analysis of the bandwidth reservation problem in a mobile ad hoc network to support QoS (quality-of-service) routing. The problem is approached by assuming a common channel that is shared by all hosts under a TDMA (Time Division Multiple Access) channel model**.** A protocol that can reserve routes by addressing both the hidden-terminal and exposed-terminal problems is implemented here. The protocol can give accurate bandwidth calculation while performing route discovery.

Providing QoS is more difficult for MANET due to two reasons. First, unlike wired networks, radios have broadcast nature. Thus, each link's bandwidth will be affected by the transmission/receiving activities of its neighboring links. Second, unlike cellular networks, where only one-hop wireless communication is involved, a MANET needs to guarantee QoS on a multi-hop wireless path. Now , a simpler TDMA model on a single common channel shared by all hosts is assumed. So it is inevitable to take the radio interference problems into consideration. The bandwidth reservation problem in such environment is measured. A route discovery protocol is proposed, which is able to find a route with a given bandwidth (represented by number of slots). When making reservation, both the hidden-terminal and exposed-terminal problems will be taken into consideration.

Issues related to QoS transmission in MANET have received attention recently. a ticket-based protocol is proposed to support QoS routing. A CDMA-over- TDMA channel model is assumed. The code used by a host should be different from that used by any of its two-hop neighbors. So a code assignment protocol should be supported this can be regarded as an independent problem. The bandwidth requirement is realized by reserving time slots on links. Based on such assumption, this paper shows how to allocate time slots on each link of a path such that no two adjacent links share a common time slot. This paper is concerned with QoS routing in a MANET.

Different from the above referenced works, a simpler TDMA-based channel model is assumed. One single common channel is assumed to be shared by all hosts in the MANET. The channel is time-framed. One interesting point is that our protocol can take the difficult hidden terminal. and exposed-terminal problems into account when establishing a route. So more accurate route bandwidth can be calculated and the precious wireless bandwidth can be better utilized.

Finally, the bandwidth reservation protocol takes the hidden terminal and exposed terminal problem that for establishing the route that can be reliable but the accurate bandwidth can be calculated and thus the quality of service metrics considered can be done better.

VII. CONCLUSION

The paper describes about the analysis of quality of service in the adhoc networks and the performance measurement. In MMSPEED the novel packet delivery mechanism for the reliability and timeliness is achieved. In the qos oriented distributed routing protocol the scalability, time resilience, overhead is considered for better qos achievement. Reliable and efficient forwarding in adhoc networks the reliability and efficiency metrics are considered for the higher performance. In the bandwidth reservation protocol the bandwidth and throughput is calculated. This comparison tells that Qos cannot be still a fulfilled one to give in a network. By considering the metric availability the Qos can be improved in one more higher level. With the data aggregation and packet aggregation mechanism the performance can be enhanced by forming the clusters with the cluster head.

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