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SURVEY ON QUALITY OF SERVICE TECHNIQUES IN WIRELESS NETWORKS

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ABSTRACT

The advent of portable laptop computers, palmtops, and personal digital assistants with integrated communication capabilities facilitates mobile computing. With an increasing amount of audio and video being sent over public, packet-switched networks, the ability to provide quality of service (QoS) guarantees may be more important in today's networks. Therefore, supporting a high Quality of Service (QoS) in delivering voice, video and data in this context has emerged as one of the most important challenge of the new century. This paper covers the various QoS techniques for Wireless networks.

Keywords: Quality of Service (QoS), Internet Protocol, Adhoc Networks, Wireless Metropolitan Area Network (WMAN), Automatic Repeat Request (ARQ)

I. INTRODUCTION

Providing QoS guarantees to various applications is an important objective in designing the next-generation wireless networks. Different applications can have very diverse QoS requirements in terms of data rates, delay bounds, and delay bound violation probabilities, among others. For example, applications such as power plant control, demand reliable and timely delivery of control commands; hence, it is critical to guarantee that no packet is lost or delayed during the packet transmission. This type of QoS guarantees is usually called deterministic or hard guarantees. On the other hand, most multimedia applications including video telephony, multimedia streaming, and Internet gaming, do not require such stringent QoS. This is because these applications can tolerate a certain small probability of QoS violation. This type of QoS guarantees is commonly referred to as statistical or soft guarantees [1]. Providing QoS guarantees to various applications is an important objective in designing the next-generation wireless networks. Different applications can have very diverse QoS requirements in terms of data rates, delay bounds, and delay bound violation probabilities, among others. For example, applications such as power plant control, demand reliable and timely delivery of control commands; hence, it is critical to guarantee that no packet is lost or delayed during the packet transmission. This type of QoS guarantees is usually called deterministic or hard guarantees. On the other hand, most multimedia applications including video telephony, multimedia streaming, and Internet gaming, do not require such stringent QoS. This is because these applications can tolerate a certain small probability of QoS violation. This type of QoS guarantees is commonly referred to as statistical or soft guarantees. For wireless networks, since the capacity of a wireless channel varies randomly with time, an attempt to provide deterministic QoS (i.e., requiring zero QoS violation probability) will most likely result in extremely conservative guarantees. For example, in a Rayleigh or 1 Ricean fading channel, the deterministically guaranteed capacity [2].

II. TECHNIQUES TO MAINTAIN QOS IN WIRELESS NETWORKS

To support QoS guarantees, two general approaches have been proposed. The first approach is network-centric. That is, the routers, switches, and base stations in the network are required to provide QoS support to satisfy data rate, bounded delay, and packet loss requirements requested by applications (e.g., integrated services)[3] or differentiated services [4]. The second approach is solely end-system-based and does not impose any requirements on the network. In particular, the end systems employ control techniques to maximize the application-layer quality without any QoS support from the transport network.

2.1 Network-Centric QoS Provisioning

To provide QoS guarantees in wireless networks, a network architecture should contain the following six components: traffic specification, QoS routing, call admission control, wireless channel characterization, resource reservation, and packet scheduling. The network architecture is illustrated in Figure 1. First, an end system uses a traffic specification procedure to specify the source traffic characteristics and desired QoS. Then, the network employs QoS routing to find path(s) between source and destination(s) that have sufficient resources to support the requested QoS. At each network node, call admission control decides whether a connection request should be accepted or rejected, based on the requested QoS, the wired link status, and/or the statistics of wireless channels. For base stations, wireless channel characterization is needed to specify the statistical QoS measure of a wireless channel, e.g., a data rate, delay bound, and delay-bound violation probability triplet; this information is used by call admission control.

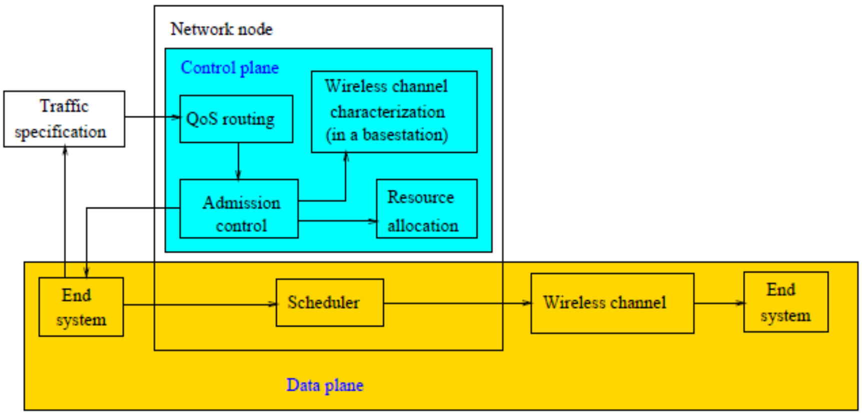

Fig.1 .Network Architecture for QoS Provision

If a connection request is accepted, resource reservation at each network node allots resources such as wireless channels, bandwidth, and buffers that are required to satisfy the QoS guarantees. During the connection life time, packet scheduling at each network node schedules packets to be transmitted according to the QoS requirements of the connections. As shown in Fig. 1, in a network node, QoS routing, call admission control, resource allocation, and wireless channel characterization, are functions on the control plane, i.e., performed to set up connections; packet scheduling is a function on the data plane, i.e., performed to transmit packets.

Currently existing wireless networks have demonstrated that it is possible to efficiently deal with data services (e.g., Internet connectivity). Therefore, there is a growing expectation that future wireless networks will efficiently deal with multimedia .This contains an overview of existing QoS solutions for multi-hop ad-hoc networks. The technique present an analysis of the QoS aspects of the physical layer because the wireless communication channel is constantly changing and inherently prone to errors. The method focus on protocols which enable traffic differentiation, solve the hidden node problem and provide fair medium access. This also deals with QoS issues at the network layer. Additionally, cross-layer solutions for QoS support in multi-hop ad-hoc networks are analyzed. Finally, the expected direction of future work and a brief summary are presented. QoS Supports in Multi-hop Ad-hoc Networks services as well. This is caused by the growing popularity of such applications as VoIP, multimedia streaming, peer-to-peer file sharing, etc. However, the nature of ad-hoc networks makes the task of serving delay sensitive or bandwidth consuming traffic with a proper QoS very complex. In comparison to wired networks, ad-hoc networks offer much smaller bandwidth and, therefore, their design requires much more attention. Additionally, such factors as mobility of devices, unpredictable channel conditions, the hidden and exposed node problems, limited battery power, and heterogeneity of devices make QoS provisioning in ad-hoc networks a very complicated challenge. The technique begin with background information regarding the challenges of QoS provisioning in multi-hop ad-hoc networks. Then, it describe QoS solutions proposed for the physical, data link and network layers. Additionally, we discuss cross-layer solutions, which combine features of the previously presented protocols. Finally, it sketch future research directions and present the most important conclusions.(5)

2.2 End-System-Based QoS

The end-system-based QoS support does not impose any requirements on the network. Such an approach is of particular significance since it does not require the participation of the networks in QoS provisioning and is applicable to both the current and future wireless Internet. Note that the current wireless Internet does not provide any QoS guarantee. End-system-based QoS support is typically application specific. In this technique, we choose real-time wireless video communication as the target application. Compared with wired links, wireless channels are typically much noisier and have both small-scale and large-scale fades [, making the bit error rate very high; the resulting bit errors could have devastating effects on the video presentation quality. Thus, robust transmission of real-time video over wireless channels is a critical problem; and this is the problem we want to investigate. To address the above problem, we introduce adaptive QoS control for video communication over wireless channels. The objective of our adaptive QoS control is to achieve good perceptual quality and utilize network resources efficiently through adaptation to time varying wireless channels. Our adaptive QoS control consists of optimal mode selection and delay-constrained hybrid automatic repeat request (ARQ). Optimal mode selection provides QoS support (i.e., error resilience) on the compression layer while delay-constrained hybrid ARQ provides QoS support (i.e., bounded delay and reliability) on the link layer (6).

2.3 Hybrid Technique for Enhancing QoS

The proposed technique support different QoS enhancement schemes. It applies the DiffServ architecture and uses the IntServ management model (Fig. 2). IntServ is not deployed here since its requirement of setting states

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in all routers along a path is not scalable. But the IntServ principles of explicit admission control and reservation are applied locally to the QoS control over the wireless access segment. The resource management at the access network level is based on functional blocks typical of IntServ model, that is, admission controller and packet (frame) classifier, with multiple queues and service disciplines used to enforce QoS guarantees given to the flows (sessions) upon admission.

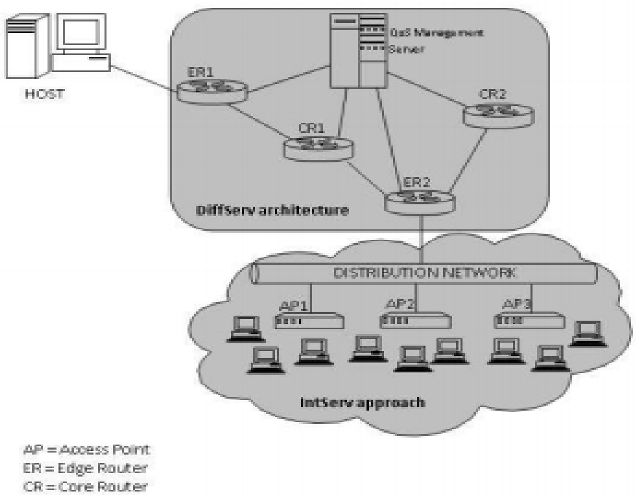

Fig.2. Hybrid Technique for QoS Enhancement

At the edge, packets are classified into flows, and the flows are conditioned to a traffic conditioning specification (TCS). In this way, more simple and effective QoS support can be built from the components during early deployments, and Internet-wide QoS can evolve into a more sophisticated structure. The IntServ QoS provision can be made using DiffServ network segments. This solution maintains the IntServ signaling, delay-based admission and the IntServ service definitions. Though QoS can be provided when PCF and DCF mode of provisioning are adapted, where DCF guarantees equal transmission opportunities for each wireless node in heavily loaded servers and the PCF supports time-bound traffic. The performance of the DCF scheme significantly degrades when there are a large number of active client stations in the network due to the more severe collision problem, while the performance of the PCF scheme significantly degrades when the number of inactive stations increases. To optimize the performance of the polling algorithm in the PC, stations need to communicate QoS requirements to the AP. But, there is no mechanism for this in PCF. Since performance optimization is not possible, neither DCF nor PCF provide sufficient facility to support traffic with QoS requirements proposed. But, EDCF introduces the concept of traffic categories. Each station has eight traffic categories, or priority levels. Using EDCF, stations try to send data after detecting the medium is idle and after waiting a period of time defined by the corresponding traffic category. HCF, which is similar to IntServ protocol, allows the AP to poll clients during CFP and allocate them a TXOP during CP at specified start time and maximum duration. The HCF offers enhanced QoS control, more efficient use of the medium when heavily loaded and fairly in channel utilization. Due to reduced overhead, HCF provide better QoS support for high priority streams while allocating enough bandwidth to lower priority streams. HCF is AP localized, creating a simple QoS mechanism [7].

2.4 Algorithm Based QoS

Algorithms used for providing QoS paths through ad hoc networks have to work with imprecise information. Saving battery power and keeping the overhead of the routing protocols are important design rules. Flooding algorithms with modifications to limit the number of routing messages generated seem to be the best solution for QoS routing in ad hoc networks. Imprecise models for delay and bandwidth calculations are necessary to provide the proper QoS metrics to the algorithms [8].

2.5 QoS Technique Proposed for 4G Networks

The requirement for higher data speed is increasing rapidly, reason being the availability of smart phones, at low cost in the market due to competition and usage of social networking websites. Constant improvement in wireless data rate is already happening. Different network technologies are integrated to provide seamless connectivity and are termed as heterogeneous network. Long Term Evolution-Advanced (LTE-A) is known as 4G and it is the solution for heterogeneous networks and wireless broadband services. International Mobile Telecommunication-Advanced (IMT-Advanced) represents a family of mobile wireless technologies, known as 4G. Network evolution is occurring throughout the globe and we are shifting toward an all-IP communications. The core of 4G network is IP and the signaling is done through advanced IPv6 itself. Internet Protocol (IP) describes the format as well as the switching technology of what is popularly called Evolved Packet Core (EPC). Basically IP was termed as a general-purpose data transport protocol in the network layer, but now extended as a carrier for voice and video communications over 4G networks. Wireless networks in the future will be heterogeneous. Different access networks such as Institute of Electrical and Electronics Engineers (IEEE) 802.15 Wireless Personal Area Network (WPAN), IEEE 802.11 Wireless Local Area Network (WLAN), IEEE 802.16 Wireless Metropolitan Area Network (WMAN), General Packet Radio Service (GPRS), Enhanced Data rate for GSM Evolution (EDGE), Wideband Code Division Multiple Access (WCDMA), Code Division Multiple Access (CDMA2000), satellite network etc are integrated. Selecting the suitable access network to meet the QoS requirements of a specific application has become a significant topic and priority is to maximize the QoS experienced by the user. QoS is the ability of a network to provide premier service to some fraction of total network traffic over specific underlying technologies. QoS metrics are delay, jitter (delay variation), service availability, bandwidth, throughput, packet loss rate. Metrics are used to indicate performance of particular scheme employed. QoS can be achieved by resource reservation (integrated services), prioritization (differentiated services). We can apply QoS according to per flow (individual, unidirectional streams) or per aggregate (two or more flows having something in common) basis. From the QoS point of view, the protocol stack is composed of upper layer protocols (transport and above), on top of IP. Applications can, in this context, be classified according to the data flows they exchange as elastic or real-time. The network layer includes IP traffic control that implements datagram policing and classification, flow shaping, and scheduling. The data link layer may also provide QoS support, by means of transmission priorities or virtual channels. QoS provision in 4G networks is challenging as they support varying bit rates from multiple users and variety of applications, hostile channel characteristics, bandwidth allocation, fault-tolerance levels, and frequent handoff among heterogeneous wireless networks. QoS support can occur at the network, transport, application, user and switching levels. To meet QoS, we should address the following issues like encryption protocols, security and "trust of information", different rates, error profiles, latencies, burstiness, dynamic optimization of scarce resources and fast handoff control. Over the past several years there have been a considerable amount of research in the field of quality-of-service support for 4G systems as it"s more challenging than previous generations. Regarding this, some research papers have presented their idea of QoS architectures across all protocol layers [9].

2.6 QoS using Distributed Routing Protocol

Here by implementing the reservation based quality of service routing, the wireless networks meets the problems like race condition as well as the invalid reservation in the mobile ad hoc networks.[4] In the QoS Oriented Distributed routing protocol (QOD) has been used to support the Qos capability in wireless networks. This protocol will offers the good QoS performance of wireless networks. The QOD helps in reducing delay in transmission of packets, scalability and mobility resilience. Protocol which is consisting of five algorithms:

- A QoS-guaranteed neighbor selection algorithm.
- A distributed packet scheduling algorithm.
- A mobility-based segment resizing algorithm.
- A traffic redundancy elimination algorithm.
- A data redundancy elimination-based transmission algorithm.

In QOD there the very first work was QoS routing for the networks of hybrid. Here we are discussing five major things. In the QoS guaranteed neighbor selection algorithm when the source node is not able to transmit the packets then it will takes the help of another node, it requests for the reliable neighbor node for the reliable routing. Then the Distributed packet scheduling algorithm will schedules the packets and transmits the packets in reliable manner. After selecting the qualified neighbor the source node then forwards the packet to the destination node with specific IP address of the node. After qualified neighbors are selected, this algorithm schedules packet routing. Then in the Mobility-based segment resizing algorithm, the source node will resizes the every packet of the specific packet stream respectively. The each neighbor node in spite of the neighbor's mobility will increases the feasibility of scheduling of packets in the source node. In Soft-deadline based forwarding scheduling algorithm, the algorithm should associated with the intermediate node which forwards packets with the least time span to achieve scalability. The redundancy of data elimination which is based on the transmission and nodes of mobile which overhears cache packet because of broadcasting feature in wireless networks. So by this algorithm we can improve QoS in transmitting the packet by eliminating data redundancy. QOD protocol can increase the capacity of network with increase in scalability of network. This will increase the life duration of network. [10].

2.7 Data Transmission Protocol

In Adhoc networks, routing is the important phase that considerably improves the QoS. There are numerous routing protocols that are in use today. AODV (Adhoc On demand Distance Vector) is the more frequently used. In this technique, a new variant is proposed which gives better results than the AODV protocol improving the QoS with respect of a set of QoS parameters and under different constraints, taking into account the limited resources of mobile environments (bandwidth, network size etc). Here we propose a QoS-oriented data transmission technique that enhances the QoS support exclusively for hybrid wireless networks. It incorporates the following algorithms:

1) Neighbour identification and best path selection for data transfer ensuring QoS,

2) Packet scheduling algorithm.

Among selected neighboring nodes to further reduce the stream transmission time. All these algorithms reduce the transmission delay of data thus supporting the QoS requirement in hybrid wireless networks [11]

2.8 Cross-Layer Techniques

In this technique, here we propose a set of building blocks for channel and application adaptive real-time wireless streaming applications. Our approach combines the flexibility and programmability of application layer adaptations, with low delay and bandwidth efficiency of link layer techniques. We propose a novel marketization scheme so that Forward Error Correction (FEC) codes can be applied within an application packet at radio link protocol (RLP) packet level rather than across different application packets and thus reduce delay at the receiver. Furthermore, a priority-based Automatic Repeat Request (ARQ), together with a scheduling algorithm, is applied at the application layer to retransmit only the corrupted RLP packets to improve the wireless bandwidth efficiency. Unlike wired packet switched networks that suffer from congestion-related loss and delay, the wireless networks have to deal with a time-varying, error-prone, physical channel that in many instances is also severely bandwidth constrained. As such, the solutions needed for wireless video streaming applications are fundamentally different from wired streaming [12].

III. CONCLUSION

To support various applications such as voice, data, and multimedia in the next-generation wireless networks, providing QoS guarantees for these applications is particularly important. In this paper, we discussed the issues and techniques in QoS for wireless networks. In the starting, we have discussed introductory point related to QoS for wireless networks. In first technique, an end system uses a traffic specification procedure to specify the source traffic characteristics and desired QoS. In next technique we introduce adaptive QoS control for video communication over wireless channels. . Hybrid Technique for Enhancing QoS applies the DiffServ architecture and uses the IntServ management model. Saving battery power and keeping the overhead of the routing protocols are important design rules under next algorithm based QoS.The use of various routing protocols and cross layer technique are other alternative approach for QoS for wireless communication. In this paper, we also explore the approach for 4G networks. Hence we can guarantee the services and security for the data that should be transmitted across the wireless networks.

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