Network Flow and QoS Protocol for Speed

Himani, Sunita, Arvind
Computer Science & Engineering, Maharshi Dayanand University,Rohtak, India.

Abstract – QoS is to provide preferential delivery service for the applications that need it by ensuring sufficient bandwidth, controlling latency and jitter, and reducing data loss. Network administrators can use QoS to guarantee throughput for mission-critical applications so that their transactions can be processed in an acceptable amount of time. We studied three routing protocols AODV, DSR and TORA for QOS in network. It investigates the factors affecting the performance criteria and working architecture of Ad hoc on-demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Temporally Ordered Routing Algorithm (TORA).

Index Terms – QoS,MAC,AODV,TORA,DSR.

1. INTRODUCTION

Wireless services are evolving from the traditional voice service to a wide range of multimedia services including data, voice, and video. Different multimedia services over networks have different bandwidth requirements. For example, applications like audio phone and video conference require strict end-to end performance guarantees; hence it is crucial for the networks to provide reliable and timely packet transmission. On the other hand, applications such as E-mail and file transfer can adapt their bandwidth to various network loads since they can tolerate certain delays.

QoS provisioning is crucial to future wireless networks since voice and multimedia will be among the most important applications for them, while mobility and the fluctuation of bandwidth requirement due to handoffs make it challenging to guarantee QoS in such networking environments.

QoS depends on support throughout the network. To achieve QoS from sender to receiver, all of the network elements through which a traffic flow passes — such as network interface cards, switches, routers, and bridges — must support QoS. If a network device along this path does not support QoS, the traffic flow receives the standard first-come, first-served treatment on that network segment.

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.

2. LITERATURE REVIEW

QoS guarantees for multimedia traffic in wireless networks. The scheme allocates bandwidth to a call in the cell where the call request originates and reserves bandwidth dynamically in all neighboring cells according to the network conditions. Bandwidth reservation in all neighbouring cells guarantees the QoS of handoff calls, but it often results in the underutilization of network resource as mobile user hands off to only one of the cells.

Nasser et al. [21] describes an adaptive bandwidth allocation framework which can adjust the bandwidth of ongoing calls during their stay in the cell whenever there are resource fluctuations in wireless networks. When a new or handoff call arrives to an overloaded network, the bandwidth adaptation algorithm can reduce the allocated bandwidth of ongoing calls to free some bandwidth for the new or handoff call. The bandwidth adaptation algorithm minimizes the number of calls receiving lower bandwidth than that requested. In [41], a bandwidth adaptation scheme is developed for wireless networks to guarantee the upper bound of the call degradation probability. The CAC measures the state of the network and reflects the observed system history on making call admission decisions. The adaptation algorithm adjusts the bandwidth of multimedia calls to minimize the call degradation probability. In the work of El-Kadi et al. [28], a rate-based borrowing scheme (RBBS) is provided for multimedia wireless networks. In case of insufficient bandwidth, in order not to deny service to requesting calls, bandwidth can be borrowed on a temporary basis from existing calls to accept the new or handoff call. When enough bandwidth becomes available due to call completion or outgoing handoff, the bandwidth is returned to the ongoing calls. To reduce handoff dropping probability, a fixed amount of bandwidth is reserved for handoff calls in each cell. Reference [40] proposes a borrowing-based adaptive bandwidth allocation scheme to improve the work in [28]. The scheme makes adaptive decisions for bandwidth allocation by employing attribute-measurement mechanism and service-based bandwidth borrowing policy. A dynamic time interval reservation strategy is introduced to provide QoS guarantees for handoff calls by adjusting the amount of reserved bandwidth in each cell according to the online traffic information. Compared to [38] and [39], the bandwidth adaptation schemes proposed in [40] [28] [41] and [21] provide more flexibility in bandwidth allocation since they can change the bandwidth of ongoing calls during their stay in the cell. However, these schemes have one common drawback, i.e. they have not provided any mechanism to measure the degradation of calls.

The bandwidth adaptation scheme for wireless networks described in [43] measures the bandwidth degradation of multimedia calls. Two bandwidth degradation metrics, i.e. bandwidth degradation ratio and bandwidth degrade frequency, are taken into account in the bandwidth degradation process. Similar Bandwidth degradation measurements can also be found in [42]. The bandwidth adaptation schemes introduced in [43] and [42] evaluate the application level QoS using bandwidth instead of a quantitative measure which can be perceived by end-users. Hence the consequence of bandwidth degradation, namely the decrease of the satisfaction degree of end-users, and the adaptive characteristics of the ongoing calls cannot be reflected. For example, a small portion of bandwidth degradation on a non-real-time data call may result in unnoticeable perceived QoS change on the end-user; while the same bandwidth degradation on a real-time multimedia call may cause the application to be dropped. The quantitative QoS measure is also a missing factor in other bandwidth adaptation schemes mentioned above. To address such problem, this thesis applies utility to bandwidth adaptation to provide both connection-level and application-level QoS to multimedia traffic in wireless networks. In the following chapters, the utility-based adaptive multimedia traffic model and several utility-based bandwidth adaptation schemes will be proposed.

3. RESEARCH METHODOLOGY

The major contributions of this research are summarized as follows:

- Utility functions are formulated explicitly for multimedia traffic so that they can be applied to the bandwidth adaptation in wireless networks. The advantage of using utility functions is that they can capture the adaptability of multimedia applications and empower end-users to give guidance on their perceived QoS. The thesis classifies multimedia traffic into different classes and formulates the utility function with an appropriate shape for each class of traffic according to its adaptive characteristics.
- A novel utility-maximization bandwidth adaptation scheme is proposed from the perspective of network operators. Depending on the network load, the utility-maximization scheme dynamically degrades or upgrades the allocated bandwidth of ongoing calls to maximize the total utility of all calls in the network.
- A novel utility-fair bandwidth adaptation scheme is proposed from the perspective of end-users. The scheme aims to treat end-users in a fair manner, i.e. it enables all ongoing calls in each individual cell of the network to receive fair utilities. It solves the utility unfair distribution problem caused by the utility-maximization bandwidth adaptation scheme.
- A novel utility-based multi-objective bandwidth adaptation scheme is proposed from the perceptive of both network operators and end-users. As mentioned earlier, multimedia traffic is classified into different classes according to their adaptive characteristics. It is assumed that each traffic class contains one or more groups of calls, and all calls within the same group have the same bandwidth requirements and utility function. The proposed scheme is designed to meet two objectives in the preference order:

1) All calls within the same group receive fair utilities; and

2) The total utility of all different groups of calls is maximized.

- Several new utility-based performance metrics including average cell utility, average call degradation ratio, utility fairness deviation and average intra group utility fairness deviation are introduced to evaluate the performance of the proposed bandwidth adaptation schemes.

4. QoS IN WIRELESS SENSOR NETWORK

QOS architecture, which includes all networking layers from the application layer to the MAC layer. The bold lines indicate the flow of data packets and the narrow lines indicate the flow of control packets. Each layer's features are detailed below:-

4.1Application Layer-

Applications can be categorized into real-time and non-real-time applications based on their sensitivity to packet delay. Real-time applications have strict requirements on the packet delay. Therefore, packet retransmission is not allowed. The applications that fit into this category are on-line live movies and video conferencing. Many video compression technologies, such as MPEG-4, H.263, and multiple-description coding, can compress video with different coding rates to meet different channel conditions. In addition, most of these compression schemes have error resilience features to recover the video frame, if some packets are lost.

4.2Transport Layer-

UDP and TCP are two transport layer protocols widely used in wired networks. UDP has no congestion control scheme to react to network congestion. Applications that use UDP as the underlying transport protocol to transmit packets can easily overwhelm the network with data, which results in a considerable amount of wasted energy and bandwidth in transmitting packets that will be dropped due to congestion.

4.3Network Layer-

To support QOS, the routing protocol should have an embedded scheme such as call admission or adaptive feedback that is designed to support QOS. At the same time, non-QOS-aware routing that is targeted at ending a feasible path should be offered as well. For QOS-aware routing, information about the current network status is provided to the application for performance optimization

4.4Link Layer-

The link layer needs to discriminate the different priority packets and schedule packet delivery according to priority levels. The service differentiation should be completed in the packet queue through queue management and in the MAC layer through a MAC discriminator and priority classier.

A Quality of Service connection is a connection that has an end-to-end performance requirement such as delay of bandwidth constraint. A connection is implemented at the network layer by a network path (routing channel) through which data packets are delivered, as connections with quality-of-service requirements, with delay and bandwidth constraints, are not supported. The goal of QOS routing is twofold:

1) Selecting network paths that have sufficient resources to meet the QOS requirements of all admitted connections, and

2) Achieving global efficiency in resource utilization

It is difficult to provide QOS in wireless network due to its dynamic nature. The overhead of QOS routing in wireless network is likely to be higher than that in a wireless network because the available state information is less precise, and the topology changes in an unpredicted way.

QoS depends on the following factors:-

1. **Throughput:** The rate at which the packets go through the network. Maximum rate is always preferred.

2. **Delay: This** is the time which a packet takes to travel from one end to the other. Minimum delay is always preferred.

3. **Packet Loss Rate:** The rate at which a packet is lost. This should also be as minimum as possible.

4. **Packet Error Rate:** This is the errors which are present in a packet due to corrupted bits. This should be as minimum as possible

5. **Reliability**: The availability of a connection. (Links going up/down)

Admission control and Bandwidth allocation schemes can help provide QOS guarantees in wireless networks, but in wireless networks the problem is much more complex due to bandwidth limitations and host mobility.

5. CHALLENGES

Wireless networks provide more freedom to communications than wire line networks. However, the distinctive characteristics of wireless networks present great challenges to the QoS provisioning for multimedia traffic.

- **Bandwidth Limitation**

The link bandwidth of wireless networks is much scarcer than that of wire line networks. In the past few years, with the presence of more portable devices coupled with the easy access to wireless networks, the number of mobile users has increased massively.

- **Handoff Management**

The bandwidth availability in wireless networks is highly variable due to channel fading and user mobility. Channel fading is the time variation of received signal power caused by changes in the transmission medium or paths, and user mobility means the roaming of mobile user across the cell's coverage area.

- **Measurements of QoS**

The QoS in multimedia wireless networks can be measured at two abstraction levels, i.e. Connection-level QoS and packet-level QoS, Connection-level QoS is the basic level QoS in wireless networks. It is related to connection establishment and management, which are very important in wireless networks, especially in dealing with handoff requests generated by user mobility. Connection-level

Application-level QoS is introduced as a supplement to connection-level QoS and it refers to the applications qualities that the network offers to end-users in terms of QoS parameters including bandwidth, delay/delay variation, and loss/error rate, etc.

6. CONCLUSION & FUTURE WORK

The growth of the wireless customer base and the introduction of various new data services mandate the consideration of new objectives such as throughput, delay, latency, and quality of service (QoS). Indeed, the migration to IP Multimedia Subsystems (IMS) will promote the continuous development of new services with different resource requirements, QoS demands, and traffic characteristics. Furthermore, data services introduce demand fluctuations that are intrinsically larger than they are for voice services. The multidimensional nature of demand, its temporal dependence, and its increased dynamic range render optimization strategies based on a peak (albeit composite) loading progressively less effective at efficiently allocating and managing network resources. Additionally, the demand for increasing data rates and the falling costs for network hardware will drive network architectures toward micro-cellular structures. This development will create frequent infrastructure upgrades with the demand for fast, autonomous, and inexpensive cell integration.

Feature development can be guided by the knowledge gained from the mathematical modelling and simulation stages. For example, a centralized optimization solution may be realized in a distributed form only, which allows approximating the optimum solution without excessive communication. Alternatively, good candidate algorithms can be "guessed" based on observable patterns in the optimum solution based on engineering experience.

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