Chapter VI
Buffer Control Techniques for QoS Provisioning in Wireless Networks

Michael M. Markou
University of Cyprus, Cyprus

Christos G. Panayiotou
University of Cyprus, Cyprus

ABSTRACT

This chapter introduces the network buffer control techniques as a mean to provide QoS. This problem has been extensively studied in the context of wirelined networks; however, the proliferation of wireless networks and the introduction of multimedia applications has significantly changed the characteristics of the traffic mix that flows on the network. The objective of this chapter is to create a new methodology for automatically adapting the various buffer thresholds such that the network exhibits optimal or near optimal performance even as network conditions change. The behavior of the network (generally a discrete event system—DES) is approximated by that of a stochastic fluid model (SFM); then using infinitesimal perturbation analysis (IPA) we obtain sensitivity estimators of the performance measure(s) of interest with respect to the control parameter. These estimators are easy to compute using data observed from the DES's sample path. Finally, the computed estimators are used in stochastic approximation algorithms to adjust the thresholds.

INTRODUCTION

The emergence of advanced multimedia and other real-time applications has increased the demand for better than best effort services thus increasing the pressure on network providers to provide quality of service (QoS) guarantees. As a result, providers need to find ways to configure the parameters of their networks such that the application requirements are met. Over the past

few years, QoS provisioning has been an active area of research resulting in the standardization of several architectures and protocols. Most of the past research assumed wirelined networks and that the dominant network traffic is based on the TCP (transport control protocol). However, the situation with current networks is changing. Wireless networks are becoming more popular and there is an increase of the UDP (user datagram protocol) based traffic (e.g., real-time protocol (RTP) for voice over IP). Thus, there is a need for new protocols and architectures that adopt the characteristics of the wireless channels and of the new traffic mix to provide the required QoS guarantees.

Management of different types of services such as video, voice, file transfer and email while provisioning at the same time the QoS level that each service demands is a challenging task; the analysis of large scale networks is excessively difficult and queuing theory is largely based in the Poisson assumption that does not capture the bursty nature of the realistic traffic. Furthermore, any proposed solution has to be scalable and easy to implement, adding the least possible overhead to the system's operation.

Integrated services (IntServ) is a proposed architecture for delivering QoS guarantees. In IntServ every application that requires some level of QoS guarantees has to make a resource reservation at each intermediate node along the path of the flow. The underlying protocol used for signaling to dynamically allocate resources in IntServ is the resource reservation protocol (RSVP), described by Braden et al. (1997). In this architecture, communication between a sender and a receiver is established only when every node (router) in the intermediate path between them has the necessary resources to support the QoS requirements of the new flow without affecting the QoS delivered to existing flows. A major drawback of this approach is that each router that supports a flow has to maintain information about it, making it difficult to keep track of all flows

when the network scales up. Furthermore, the overhead caused due to RSVP signaling reduces the utilization efficiency.

Differentiated services architecture (DiffServ) solves the problem by providing a framework for classification of the traffic and differentiation between the levels of service that each class will receive. In DiffServ each data packet is classified as belonging to one of a finite number of traffic classes (Blake et al., 1998). Routers in the network treat each incoming packet according to its class, enabling the protection of higher priority traffic against the lower priority, providing a more efficient and scalable traffic management mechanism. The treatment of each packet is achieved by mapping its traffic class to a per-hop behavior (PHB), which defines how a packet will be forwarded. The four available standard PHBs are: default, class-selector (Nichols et al., 1998), assured forwarding (Heinanen, Baker et al. 1999), and expedited forwarding (Jacobson et al., 1999). However, DiffServ architecture has also some disadvantages. DiffServ mechanism cannot provide individual connection QoS guarantees. Moreover, there are no clear incentives for applications to voluntarily mark their packets with a priority other than the highest. Policing mechanisms that downgrade an application's packets if it exceeds its allocated bandwidth exist however, for example, see (Heinanen & Guérin 1999; Heinanen & Guérin 1999).

In the last years, some researchers tried to combine the advantages of the two architectures and achieve an improved mechanism. A framework to apply IntServ over DiffServ was proposed by Bernet et al. (2000), whereas Zhang and Mouftah (2001) developed a sender-initiated resource reservation mechanism over a DiffServ network to offer end-to-end QoS. In addition, other frameworks that are more appropriate for wireless ad-hoc networks have been proposed, for example, flexible QoS model for mobile ad hoc networks (FQMM). FQMM is a hybrid service model that takes advantage of the per-flow

Related Content

Development of a Novel Deep Convolutional Neural Network Model for Early Detection of Brain Stroke Using CT Scan Images

Tariq Ahmad, Sadique Ahmad, Asif Rahimand Neelofar Shah (2023). *Recent Advancements in Multimedia Data Processing and Security: Issues, Challenges, and Techniques (pp. 197-229).*

www.irma-international.org/chapter/development-of-a-novel-deep-convolutional-neural-network-model-for-early-detection-of-brain-stroke-using-ct-scan-images/331443

Movie Video Summarization- Generating Personalized Summaries Using Spatiotemporal Salient Region Detection

Rajkumar Kannan, Sridhar Swaminathan, Gheorghita Ghinea, Frederic Andresand Kalaiarasi Sonai Muthu Anbananthen (2019). *International Journal of Multimedia Data Engineering and Management (pp. 1-26).*

www.irma-international.org/article/movie-video-summarization--generating-personalized-summaries-using-spatiotemporal-salient-region-detection/245751

Client-Side Relevance Feedback Approach for Image Retrieval in Mobile Environment

Ning Yu, Kien A. Huaand Danzhou Liu (2011). *International Journal of Multimedia Data Engineering and Management (pp. 42-53).*

www.irma-international.org/article/client-side-relevance-feedback-approach/54461

Multimedia for Direct Marketing

Ralf Wagnerand Martin Meißner (2009). *Encyclopedia of Multimedia Technology and Networking, Second Edition (pp. 978-985).*

www.irma-international.org/chapter/multimedia-direct-marketing/17507

Brain Neuron Network Extraction and Analysis of Live Mice from Imaging Videos

Ruichi Yu, Jui-Hsin (Larry) Lai, Shun-Xuan Wangand Ching-Yung Lin (2017). *International Journal of Multimedia Data Engineering and Management (pp. 1-20).*

www.irma-international.org/article/brain-neuron-network-extraction-and-analysis-of-live-mice-from-imaging-videos/182648