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Chapter VIII

Adaptivity for Improving Web Streaming Application Performance

Julie A. McCann
Imperial College of Science, Technology and Medicine, UK

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This chapter introduces adaptivity and Internet applications. Its focus is on streaming media, i.e., in particular, the streaming of audio over the web. It argues that to achieve good quality end-to-end performance (between client and server), adaptive architectures provide a better solution in terms of scaleability and network fairness than that of reservation techniques. However, this is at the cost of reducing the 100% end-to-end performance guarantee. The Kendra adaptive content delivery architecture is discussed as a proof of concept highlighting the parameters that most affected performance. Kendra is then critiqued in terms of alternative solutions showing where future research in this area could lie.

INTRODUCTION

We are seeing a rapid growth in multimedia applications that use the Internet. Examples of these are video on demand, videoconferencing, and Internet telephony and radio, all requiring a high level of bandwidth. The ability to achieve high quality

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broadcast to users regardless of their numbers or location is becoming a challenge that many in industry and research are wishing to address. The aim is to provide a basic level of service that satisfies the receiver. For example audio and video applications serve their purpose and interactive applications' data streams (e.g. voice with video) are synchronized. These impose quality of service (QoS) requirements on the networks in terms of throughput, packet loss, delays and jitter.

Without any form of QoS support, fluctuation in network performance can badly affect a multimedia application's performance and therefore its usefulness. These applications typically use the UDP transport protocol, which does not perform congestion control to better share resources. This means that it is possible for a resource-hungry application to overload the network, starving other applications using the TCP protocol (which aims to share resources better). On the other hand there are also many problems caused by the TCP's congestion control mechanism, as it is not designed for streaming media.

There have been two main approaches to achieve better Internet performance: *guaranteed service* and *best effort* [1]. Traditional techniques to improve bandwidth through reservation (i.e., a guaranteed level of service) are now seen as being too costly, bandwidth wasting and non-scalable. Therefore, adaptivity is an alternative solution that provides a best-effort service, making use of intelligent network packet routing to intelligent application architectures rather than simply reserving an end-to-end channel. Adaptivity has the disadvantage in that it is not guaranteeing a level of service; rather it is providing a service as close to the requested level as possible. Further, in terms of overall network traffic and scalability, etc. this is a better and fairer solution. Here, the QoS mechanism sits on top of the basic network synchronisation layers adapting application level functionality to suit what the network can provide. This chapter will discuss differing types of adaptive Web systems, presenting our Kendra system as an example. Initially we classify adaptive systems and their architecture. We then introduce Kendra and summarise some of our performance results. We will then critique Kendra based on other adaptive systems and discuss further work in this area.

BACKGROUND–IMPROVING WEB APPLICATION PERFORMANCE

Providing content from a single point to the user over the Internet is increasingly a nonviable activity. The bandwidth costs alone are one aspect which have limited the growth of the Internet as a broadcast medium. When a content provider wishes to distribute their multimedia product, this raw video or audio is compressed using predetermined compression algorithms. This is the first technique used to improve

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