Chapter III
Quality Models for Multimedia Delivery in a Services Oriented Architecture

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ABSTRACT

In this chapter we present an overview of research and development efforts across several different technical communities aimed at enabling efficient and standardized end-to-end delivery of multimedia content over a service-oriented architecture (SOA). We focus primarily on issues related to quality of service (QoS) specification, measurement, and enforcement for different multimedia distribution applications in this space.

INTRODUCTION

In this chapter we present an overview of research and development efforts across several different technical communities aimed at enabling efficient and standardized end-to-end delivery of multimedia content over a service oriented architecture (SOA). We focus primarily on issues related to quality of service (QoS) specification, measurement, and enforcement for different multimedia distribution applications in this space. In order to do this, we first describe state-of-the-art in multimedia delivery architectures, and standardization efforts in coding, networking, and multimedia quality modeling. We then consider the implications of building SOA-based realizations of such multimedia applications, and
identify the appropriate integrated service policies, mechanisms, architecture, and metrics that may be used to successfully design and deploy them. We not only describe the current state-of-the-art in this space, but also identify emerging trends, describe problems, discuss solutions, and most importantly, provide insights into the feasibility and applicability of these solutions to specific problem areas.

With the current availability of digital content, and underlying infrastructure improvements in network bandwidth and user devices, there is a rapidly expanding set of applications that require delivering multimedia to remote users. This includes traditional applications such as videoconferencing and video on demand, as well as several new applications enabled by enterprises, and the peer-to-peer (P2P) and gaming environments. Multimedia delivery requires orchestration across several different aspects, such as content generation, underlying infrastructure, end-user device capability, user preferences, service provider capabilities, and so forth. There is need for a standardized set of mechanisms that allow these distributed and heterogeneous components to successfully interact with each other to build an end-to-end multimedia delivery system.

A service-oriented architecture provides several mechanisms for describing precisely the capabilities of distributed components, providing directory services to locate appropriate service providers, and providing interface descriptors that allow connecting such components to compose workflows. It also provides policy mechanisms to support service level agreements (SLA), and specifies requirements on the desired QoS. Hence, there has been significant interest in using SOA-based architectures to deliver multimedia for several of these applications.

This is significantly different from the way several multimedia applications are currently constructed, as it requires traditional multimedia researchers to acknowledge the presence of a distributed infrastructure where the delivery mechanism is not under the control of any single provider. For example, a typical situation will have different providers providing content, infrastructure hosting, and end-user services. The situation is further complicated by the fact that a content provider would like to work with multiple end-user services providers. A key challenge that needs to be addressed in this space involves the development of appropriate models of end-to-end QoS for multimedia delivery. Such models are critical prerequisites for the successful deployment of any multimedia delivery application within the SOA framework. For instance, models for QoS are essential for users and service providers to be able to formulate the right SLAs and being able to enforce them. This also requires changing several of the established paradigms in prioritizing and delivering multimedia services over a tightly controlled network infrastructure. Capability negotiation, dynamic load balancing, security, privacy, and robustness of the heterogeneous environment are all very important considerations.

Traditional research in this field has often been from two distinct perspectives: the SOA side and the multimedia side. Researchers in SOA often use very simplistic QoS models for multimedia, and often ignore critical metrics relevant to the quality of the multimedia experience (e.g., user preferences, content characteristics, encoding, artifacts, etc.). On the other hand, multimedia researchers have built sophisticated models to measure multimedia quality and perform network bandwidth optimization; however, they have lacked a good mechanism to specify or enforce delivery policies that typically cover a broad spectrum of systems components. In this chapter, we bring together the established and emerging developments across both these fields, and connect these to QoS specification, measurement, and enforcement for different multimedia applications.

This chapter is organized as follows. We start, in Section 0, with an overview of multimedia delivery architectures currently used, in terms of the media formats, network protocols, and delivery mechanisms. In Section 0, we present the potential impact of the infrastructure issues (i.e., varying delivery architec-
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