Chapter V

Dynamically Generated Web Content:
Research and Technology Practices

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Abstract

This chapter takes a tutorial approach to present the Web-related technologies and content middleware that attempt to accelerate the generation and optimize the delivery of dynamic content. It covers the historical aspects of dynamic content and presents the reasoning behind its introduction while discussing early content middleware such as the CGI and FastCGI. It then presents the evolution of content middleware along the lines of contacted research. The discussion focuses on popular techniques that mostly include content caching and content fragmentation. It also discusses a variety of other research efforts such as hardware and low-level acceleration techniques, active caching, and delta encoding. Finally, the authors
hope that this chapter will serve as an introductory tutorial to students and researchers in the field of dynamic Web content technology.

Introduction

The personalization and customization of Web services that increase user satisfaction require the delivery of dynamic rather than static Web documents or pages. This means that the content of such Web pages is generated on demand and tailored to a particular Web user (e.g., e-banking) or group of users (e.g., the delivery of local online sport results). Specifically, the term dynamically generated Web content, otherwise known as dynamic Web content or simply dynamic content, refers to chunks of HTML (hypertext markup language) or XML (extensible markup language) code or media that are generated and combined on the fly to build a requested Web page.

Currently, dynamic content constitutes more than 40% of Internet traffic despite the fact that generating Web pages on the fly incurs a major overhead on server resources and increases the response time of the Web servers (Feldmann, Caceres, Douglis, Glass, & Rabinovich, 1999). This percentage of Internet traffic associated with dynamic content is expected to keep increasing, especially with the improvement of dynamic-content technologies and content middleware such as application servers, client-side proxies, and server-side caches.

In this chapter, we take a tutorial approach to present the Web-related technologies and content middleware that attempt to accelerate the generation and optimize the delivery of dynamic content. We begin the chapter by covering the historical aspects of dynamic content and presenting the reasoning behind its introduction while discussing early content middleware such as the CGI (common gateway interface) and FastCGI that enable the execution of external programs and scripts. We then present the evolution of content middleware along the lines of contacted research. Our discussion focuses on popular techniques that mostly include content caching and content fragmentation at different levels along the communication path from the Web client, through any intermediate proxies, and to the Web server and back-end database servers. We also discuss a variety of other research efforts such as hardware and low-level acceleration techniques, active caching, and delta encoding.

We conclude the chapter with a discussion on the interplay between the quality of service (QoS), such as the response time or user-perceived latency, and the quality of data (QoD), such as freshness. We consider various proposals that attempt to strike a balance between user-perceived latency and the freshness of delivered documents, which can be broadly classified as client driven or data driven. Finally, motivated by growing Web user needs, we discuss future trends of dynamic-content technology.

Historical Aspects

In order to better understand the semantics of dynamic content, we first review the basics of static content. Static content emerged along with the introduction of the World Wide Web
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