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Chapter V

Broadcast Data Placement over Multiple Wireless Channels

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Abstract

The advances in computer and communication technologies made possible an ubiquitous computing environment were clients equipped with portable devices can send and receive data anytime and from anyplace. Due to the asymmetry in communication and the scarceness of wireless resources, data broadcast is widely employed as an effective means in delivering data to the mobile clients. For reasons like heterogeneous communication capabilities and variable quality of service offerings, we may need to divide a single wireless channel into multiple physical or logical channels. Thus, we need efficient algorithms for placing the broadcast data into these multiple channels so as to reduce the client access time. The present chapter discusses algorithms for placing broadcast data to multiple wireless channels, which cannot be

coalesced into a lesser number of high-bandwidth channels, assuming that there are no dependencies among the transmitted data. We give an algorithm for obtaining the optimal placement to the channels and explain its limitation since it is computationally very demanding and thus unfeasible. Then, we present heuristic schemes for obtaining suboptimal solutions to the problem of reporting on their implementation cost and their relative performance.

Introduction

The technological achievements in the field of computer communications and the ever-decreasing sizes of wireless devices enabled the proliferation of wireless data applications. Mobile clients equipped with laptops, palmtops, personal digital assistants (PDAs), and other portable devices are able to access a variety of information stored in the databases of servers located in fixed wireline networks. The mobile clients roam inside the coverage area of the wireless network requesting various data; types of data that may be of interest to the clients include stock quotes, weather information, traffic conditions, and airline schedules, to name a few.

There are two basic delivery methods in wireless applications: the unicast (or point-to-point) and broadcast methods. In the former, each client establishes a connection with the server and poses a request; in response, the server sends the requested data to the client using the established connection. This delivery method implements the classic client-server paradigm of communication encountered in traditional wireline networks. The broadcast delivery method (Wong, 1988) differs because all clients monitor the same channel (*broadcast channel* or *downlink channel*) in order to acquire the information transmitted by the server. The contents of the transmission are determined by the server, based either on the estimation of client preferences (pure broadcast systems; Acharya, Alonso, Franklin, & Zdonik, 1995) or on the client requests acquired through *uplink channels* (on-demand broadcast systems; Aksoy & Franklin, 1999).

Although, many current systems are based on unicast delivery, the broadcast method is increasingly appealing. Unicast delivery is a waste of resources because each datum must be transmitted for each client that requests it. Thus, the network and server load increases with every client. In contrast, broadcasting is advantageous because of its excellent scalability, that is, a single broadcast satisfies all pending requests for it. Moreover, wireless environments are characterized by the asymmetry in communication, that is, the broadcast channel capacity is much greater than the uplink channel capacity. Therefore, broadcasting is able to exploit the high bandwidth of the downlink channel. Concrete examples of broadcast delivery include the cache-satellite distribution systems (Armon & Levy, 2004), where satellites broadcast popular data, for example, Web pages, to clients (e.g., humans or proxy servers), and the mobile Infostations (Iacono & Rose, 2000).