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Chapter I

Push and Pull Systems

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Abstract

Data broadcasting has emerged as an efficient way for the dissemination of information over asymmetric wireless environments where the needs of the various users of the data items are usually overlapping. In such environments, data broadcasting stands to be an efficient solution since the broadcast of a single information item is likely to satisfy a possibly large number of users. Communications asymmetry is due to a number of facts, the most important being equipment, network, and application asymmetry. This chapter starts with a discussion of preliminary issues and terminology for asymmetric environments for data broadcasting. The chapter then discusses broadcast schedule construction for systems employing a single broadcast channel, schedule construction for systems employing multiple broadcast channels, and schedule construction for systems that take into account the effect of reception errors. It then presents an

algorithm that tries to provide better support for clients whose access patterns deviate a lot form the overall access pattern of the client population. It also presents algorithms for environments where item requests by clients are dropped if not served in a certain time period. Brief comments on issues that affect performance of the discussed data broadcasting methods are also made.

Introduction

Push and pull data delivery systems are members of a family of systems known as data broadcasting or information dissemination systems. Such systems have emerged as efficient ways for the dissemination of information over asymmetric wireless environments where the needs of the various users of the data items are usually overlapping. Examples of such applications are information retrieval ones, like weather and traffic information systems. For example, a traffic information system in an airport could be of much benefit to waiting passengers. A user coming to the airport will want information regarding departure of his flight (e.g., exact time of departure, possible delays, etc.). A broadcast server could deliver such data for all flights in the near future. Sometimes, demand for some flights is likely to be higher than for others (either due to more passengers for that flight or due to this flight departing in the very near future). Thus, one can see that client needs for data items are usually overlapping and, consequently, data broadcasting stands to be an efficient solution since the broadcast of a single information item is likely to satisfy a possibly large number of users.

Communications asymmetry is due to a number of facts, the most important being equipment, network, and application asymmetry. Equipment asymmetry is caused by the fact that a broadcast server usually has transceivers that are not subject to power limitations, whereas client transceivers are usually hindered due to finite battery life. Moreover, it is desirable to keep the mobile clients' cost low, which sometimes results in the lack of client transmission capability. Network asymmetry is due to the fact that, in many cases, the available bandwidth for transmission from the server to the clients (downlink transmission) is much more than that in the opposite direction (uplink transmission). Furthermore, there exist extreme network asymmetry cases where the clients have no available uplink channel (back channel). Even in the case of back-channel existence, however, the latter is subject to becoming a bottleneck in the presence of a very large client population. Application asymmetry concerns the pattern of information flow. Since most information retrieval applications are of client-server nature, the flow of traffic from the server to the clients is usually much higher than that in the opposite direction. Furthermore, application asymmetry concerns the pattern of accessing the broadcast information items. This is because, in many cases, the majority of the clients are interested only in a subset of the server's information items. Thus, some items tend to be a lot more "popular" than others and consequently, the environment is characterized by a "skewed" demand pattern.

So far, two major approaches have appeared for designing broadcast schedules. These are the pull (also known as on-demand) and the push approaches. In pull systems, the