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Data Broadcasting Model for Mobile Video-on-Demand Systems

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Abstract—The future development of data broadcasting is expected to involve the efficient dissemination of data items in a mobile computing environment that relies on the data dissemination method to improve the scalability of systems and to indicate reliable patterns for dynamic user access. The rapid growth of time-critical information in emerging applications presents a number of challenges. There is an increasing need for the system to assist convenient data dissemination for multiple parties. This paper discusses the main challenges and techniques of mobile video broadcasting and proposes a model for mobile video systems involving time-critical on-demand data broadcasting.

Index Terms— Data broadcasting, demand systems, mobile wireless, network techniques

1 Introduction

THE current deployment of different wireless communication networks over mobile devices has brought to light the need for suitable services in terms of reliability. Moreover, a wireless communication system that is used in different environments adopts certain broadcasting elements so as to deliver information to the client. The implementation of these elements can be carried out without generating additional cost [1]. Some issues associated with the use of point-to-point services include signal response time and the conservation of power and bandwidth usage. Few studies focuses on reducing the time of delivery of broadcast data through personal digital assistant (PDA) devices [2]. The most important challenges involving the delivery of data elements through mobile devices are access efficiency and power conservation in the PDA system [3].

The required period for retrieving and representing data and the speed of performing a request must be specified to gain access efficiency. Power conservation involves reducing a mobile client's power consumption while accessing the desired data [4].

The communication structure of broadcast data could help users to create a different range of broadcast data communications. This type of action may reduce access time and power loss for mobile clients, which ranges from only a few hours to about half a day under continuous use. A number of researchers, including Dewri et al. [2] have addressed the communication behavior of such an environment by describing the access time between the moment when a query is issued and the moment when it is satisfied.

2 Issues and Challenges

To retrieve a data item in data broadcasting, a mobile client must continuously monitor the broadcast until the data item of interest arrives. For this type of action to occur, time is required to access the data sources in the server. Various solutions have been introduced to overcome this problem. The most common solution has focused on indexing the data elements so as to provide better broadcast access. One drawback of this solution is that the broadcast of any video data is lengthened as a result of the additional indexing information. Therefore, data access and access time become issues in this type of situation.

The complexity of accessing broadcast data through PDA devices in a network is exacerbated by the following three forces: the exponential growth in demand from users for richer network services, the desire of providers to utilize network resources fully, and the complexity of the interactions between advanced networking components, which are themselves becoming more complex.

3 Broadcast Video Networks

The main focus of this paper is reducing the time for broadcasting through PDA user devices. This paper follows the recommendations put forth by Chen, et al. [1] to formulate in detail how data are streamed / broadcast to users. The process of broadcasting video over networks is also adapted from the findings of Kim and Kang [10]. Based on their findings, we conclude that PDA devices have a high level of network ability to deal with different protocols. Fig. 1 presents the main components of the adopted broadcast video delivery networks.

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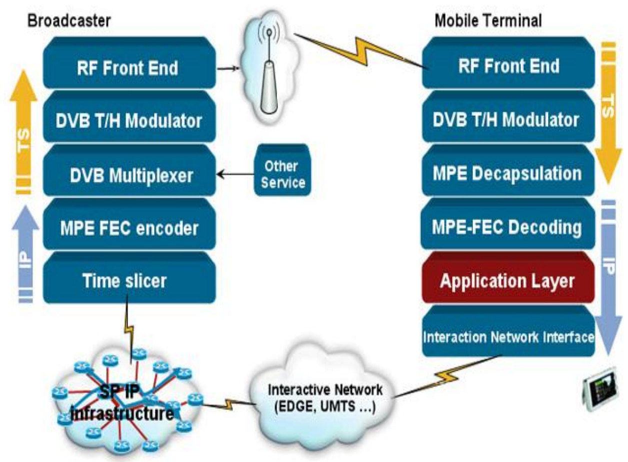

Fig. 1. Components of broadcast video delivery networks.

4 Broadcast Mobile Video Techniques

The main techniques for retrieving and delivering mobile video that significantly affect operators are reviewed in this paper. Video delivery networks can be categorized as follows:

4.1 Unicast Video Delivery Networks

This type of service requires various technologies, such as Real Time Streaming Protocol (RTSP), Hypertext Transfer Protocol (HTTP), and Adobe Flash-based streaming servers, to deliver a unique video stream to each subscriber [5].

Conklin et al. [7] and other researchers have described the importance of this type of service in the delivery of video data, which allows a service manager to limit the video access time and to provide access within a fixed range. Those researchers justified the time factor in processing the broadcast data. They found that unicast video allows a mobile operator to deliver an individual experience to the subscriber, which relies on not only technical considerations (e.g., availability of bandwidth in a cell tower and optimization of video codec) but also subscriber preference (e.g., targeted advertising) [5-6]. Fig. 2 shows how a unicast video delivery network works.

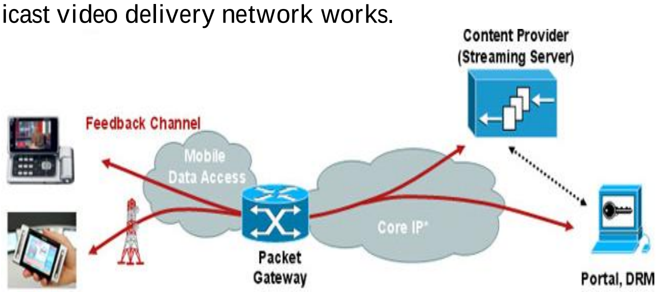

Fig. 2. Unicast video delivery network.

4.2 Multicast Video Delivery Networks

This type of video delivery network is found in the configuration of some wireless services such as Third Generation Partnership Project (3GPP), Third Generation Partnership Project 2 (3GPP2), and Worldwide Interoperability for Microwave Access (WiMAX) forum. It has not been optimized in a lot of fields for operating and facilitating data delivery over networks. Many researchers have highlighted the features of this technique, particularly how it allows a mobile operator to achieve the highest level of performance for a mobile video stream by reducing the amount of data traffic and how it consumes a great deal of operator spectrum for deployment [7-8]. Fig. 3 depicts the features of a Broadcast and Multicast Service (BCMCS).

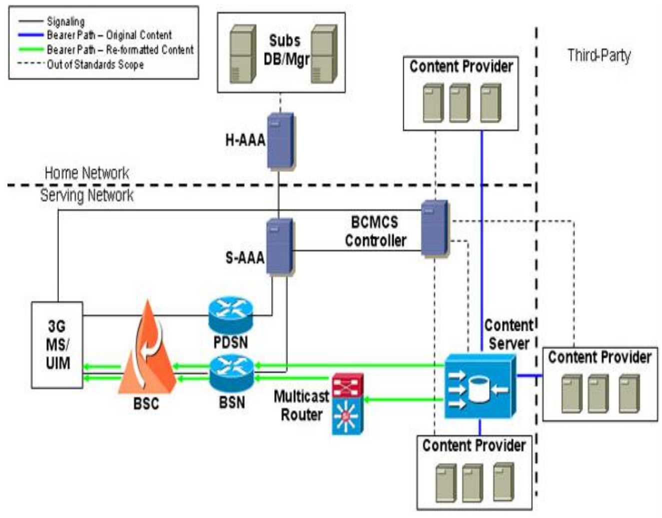

Fig. 3. Broadcast and Multicast Service (BCMCS).

4.3 Broadcast Video Delivery Networks

In their [9] study, Kim and Kang examined the reliability of this technique in delivering video components to user wireless devices based on overlay networks and a separate spectrum for the delivery of video services to devices. The main drawback of this technique is the need for specifying the data elements to be executed in video broadcasting.

Receiving a video signal in these networks requires separate radio components [9]. Therefore, with such a large number of points of presence (PoPs) (i.e., cell towers) in the mobile network, its imposed data must be broadcasted slowly. It can be shown with the Digital Video Broadcasting-Handheld (DVB-H; see Fig. 3) and Qualcomm MediaFLO.

In their 2007 study, Schierl, Stockhammer, and Wiegand [10] introduced a data representation model for video accessing (Fig. 4). Their goal was to report on the streaming media process over mobile devices and on delivery networks for video signals. They also discussed the critical issues in managing the delivery period of data in a continuous stream of packets to the mobile device [8]. Fig. 4 shows that some of these packets are delayed in routing and that some are lost during transmission.

A streaming media session may include a flow of status control for the information from the receiving device to the server and an indication of the quality of the streaming data connection. In this study, we found that obtaining such a process may allow the media server to adjust its data transmission rate so as to accommodate changing transmission characteristics.

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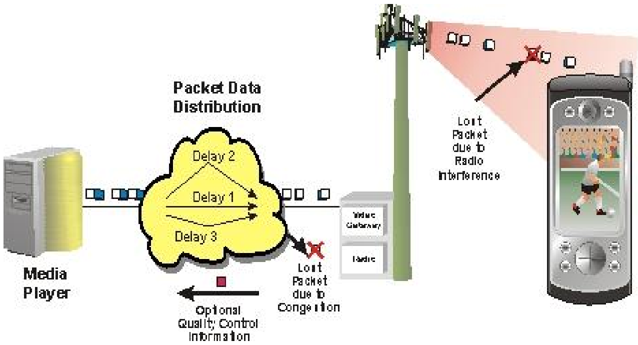

Fig. 4. Streaming media.

The issues involving data delivery have prompted many researchers to design and develop techniques that specify the main aspects of delivering video content over wireless network services. In their [11] work, Bria, Karrberg, and Andersson demonstrated this phenomenon by developing a new mobile TV business model, which comes with new dimensions [10]. They also addressed difficulties associated with the technology, market behavior, and industry strategy domains (see Fig. 5).

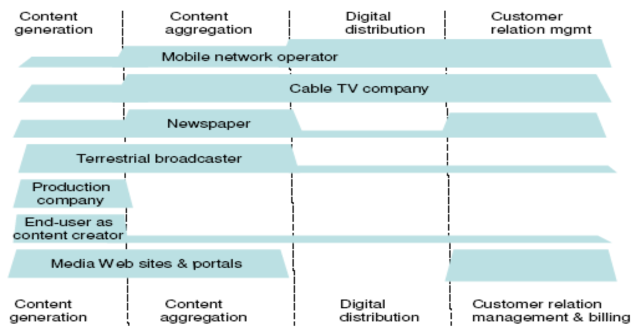

Fig. 5. On-demand architecture towards data accessing [2].

In his [12] article, Picard studied the potential of streaming audio and video services to mobile handsets from the perspective of consumer behavior. He maintained that consumer choice rather than technology or supply side activities determine the success of these services. In addition, Picard claimed that consumers who are currently using mobile audio and video services with other technologies for data delivery enhancement largely determine the demand for mobile broadcasting services [11].

5 Proposed Model

In the present study, we create a data broadcasting model for mobile video-on-demand systems based on the findings of the aforementioned research studies, particularly those of Dewri, Ray, and Whitley [2]; Chen, Chan, and Li [5]; and Kim and Kang [6]. The proposed model, which is formulated to deliver broadcast data efficiently, includes the following components: Evolution Data Optimized (EVDO), a third generation (3G) high speed wireless broadband standard; time-division multiplexing (TDM), which enables different conversions between multicast Internet Protocol Television (IPTV) and unicast (RTSP), User Datagram Protocol (UDP), and Real-time Transport Protocol (RTP); and public data networks (PDNs), which are used to organize the load balancing of resources for live and on-demand services. The proposed model is designed to meet the specific requirements of delivering broadcast data over mobile video on-demand systems or operators. This model—with its use of EVDO, TDM, and PDNs for controlling video broadcasting through a high- speed network—differs from existing techniques.

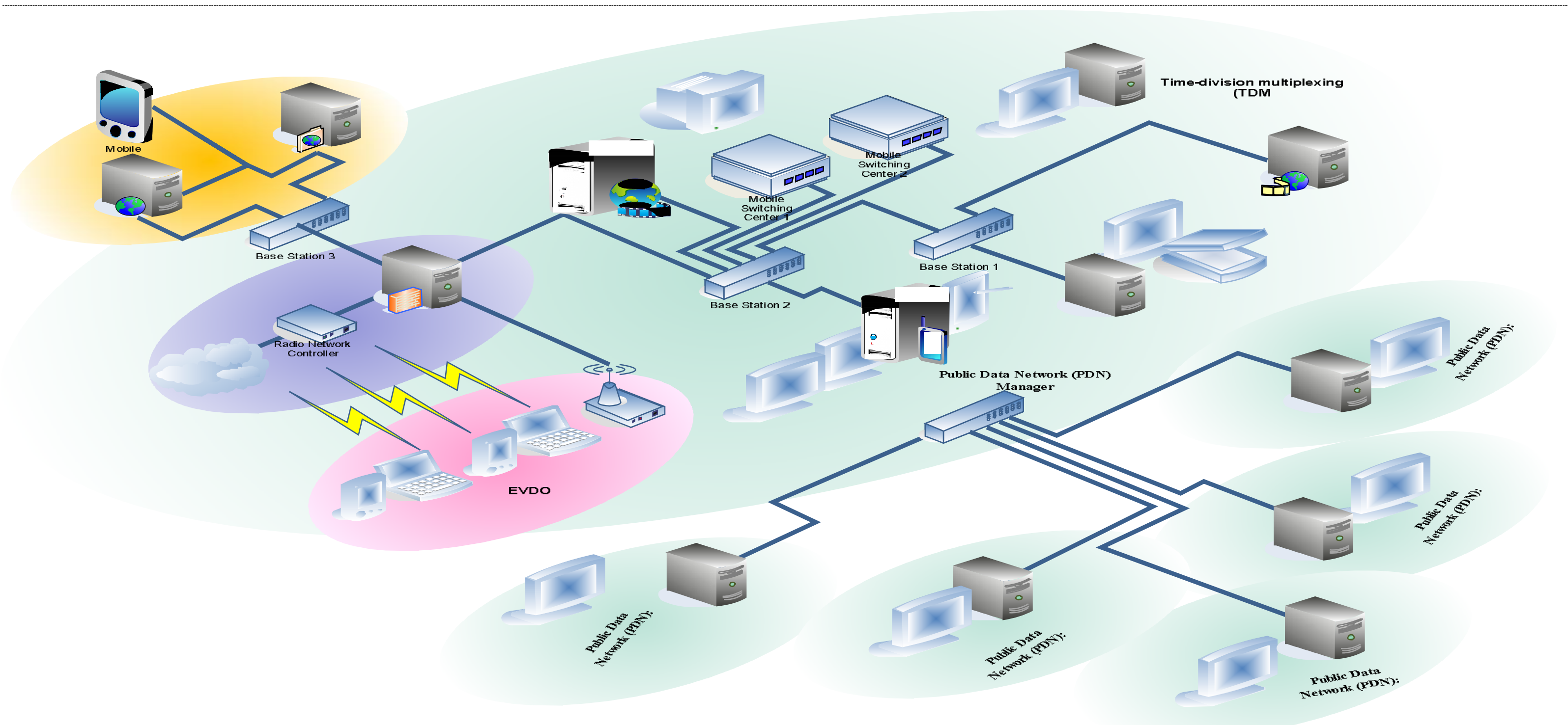

Fig. 6. Proposed data broadcasting model for mobile video on-demand systems.

6 Expected Benefits

The main objective of this paper is to decrease the broadcast time for users, based on the proposed mechanism level, which in turn could reduce the access time. Specifically, this paper investigates a new mechanism for retrieving data elements from mobile devices and for delivering data elements to mobile devices during the broadcasting process. The proposed model is formulated to reduce the time required for delivering broadcast data and to provide high quality in content delivery.

7 Conclusion

This paper reviews the current challenges in video broadcasting, with a particular focus on time-critical issues in delivering on-demand data broadcasting. The main techniques for mobile video broadcasting are also discussed. A model for data broadcasting in mobile video is introduced, based on the recommendations of the reviewed broadcasting techniques for on-demand systems. The expected advantages of the customized model are highlighted.

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