Interactive Multimedia File Sharing Using Bluetooth

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INTRODUCTION

In the past few years, industry has introduced cellular phones with increasing processing capabilities and powerful wireless communication technologies. These wireless technologies provide the user with mechanisms to easily access services, enabling file sharing among devices with the same technology interfaces (Mallick, 2003). In the context of electronic commerce, which demands new techniques and technologies to attract consumers, these wireless technologies aim to simplify the shopping process and provide up-to-date information about available products.

In order to exemplify the application of mobile and wireless technologies to satisfy these new commerce functionalities and needs, we present in this article the interactive multimedia system (IMS). IMS is a system for sharing multimedia files between servers running on PCs, and client applications running on mobile devices. The system was conceived initially to be deployed in CDs/DVDs and rental stores to make available product information in a simple and interactive way.

In a general way, the system allows a user to obtain information about available products through a mobile device. Then, a user can listen or watch parts (stretches) of available videos or songs. For that, the user needs to enter the store, choose a product in the store shelf, and type its identity code in the mobile device, choosing which music (or video) to listen to (or watch).

The IMS system has a client/server architecture, where the server was developed in C++ for the Windows operating system and the client application was developed in C++ for the Symbian operating system, which is a mobile device operating system mainly used in smart phones. Client/server communication is performed based on Bluetooth wireless technology. Bluetooth is suitable for this kind of application because it has a satisfactory transmission rate with enough range, and it is also supported by more than 500 million mobile devices (Bluetooth Official Website, 2006).

The rest of this article is organized as follows. In next section we present a background of the main technologies used in this project. We then present the architecture of the proposed system and describe how the system works, before discussing future trends of mobile multimedia systems and offering final remarks.

BACKGROUND

This section provides an overview of the main technologies used in the IMS development. More specifically, we outline the Bluetooth wireless technology and the programming language used with the Symbian Operational System.

Bluetooth

To provide communication between devices, the IMS client/server architecture uses the Bluetooth wireless technology. Bluetooth is a short-range wireless technology present in a large number of smart phones of the Symbian OS Series 60 platform. It is suitable for fast file exchange, including text files, photo files, and short video files. Bluetooth technology covers a distance of about 10 meters for class 2 devices (most common devices), and each server (or master) can be connected to up to seven slaves in its coverage area (Mallick, 2003). Another important feature of Bluetooth is its lower power consumption, around 2.5 mW at most, which reinforces its use in embedded devices.

With Bluetooth, it is possible to use two kinds of connections: ACL (asynchronous connectionless) and SCO (synchronous connection oriented) (Andersson, 2001). ACL links are defined for data transmission, supporting sym-

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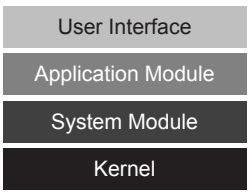
Figure 1. Symbian OS architecture



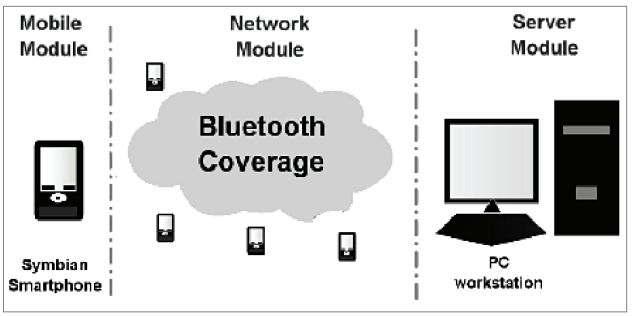
metrical and asymmetrical packet-switched connections. In this mode, the maximum data rate could be 723 kbps in one direction and 57.6 kbps in the other direction, and these rates are controlled by the master of a cell. SCO links support only a symmetrical, circuit-switched, point-to-point connection for primarily voice traffic. The data rate for SCO links is limited to 64 kbps, and the number of devices connected at the same time with the master is restricted to three devices.

In the Bluetooth protocol stack, some profiles that implement some kind of particular communication partner are defined. The general profiles in Bluetooth stack are: GAP (generic access profile), SDAP (service discovery application profile), SPP (serial port profile), and GOEXP (generic object exchange profile) (Forum Nokia, 2003). GAP defines generic procedures related to discovery of Bluetooth devices and links management aspects of connecting Bluetooth devices. SDAP defines features and procedures to allow an application in a Bluetooth device to discover services of another Bluetooth device. With SPP used in ACL links, it is possible to emulate serial cable connections using RFCOMM (RS232 Serial Cable Emulation Profile) between two peer devices. RFCOMM emulates RS-232 (Serial Cable Interface Specification) signals and can thus be used in applications that are formerly implemented with a serial cable. The GOEXP profile defines protocols and procedures that should be used by applications requiring object exchange capabilities.

Symbian

Symbian is an operating system specifically designed for mobile devices with limited resources, such as memory and processor performance. The programming language C++ for Symbian provides a specific API (application program interface), with new features for the programmer that allow access to services such as telephony and messaging (Stichbury, 2004). Also, the Symbian C++ API enables programmers to efficient deal with multitasking and memory functions. These functions reduce memory-intensive operations. Symbian OS is event driven rather than multi-thread. Although multi-thread operations are possible, they potentially create kilobytes of overhead per thread. Services in Symbian OS are provided by servers through client/server architectures. For developing applications, Symbian offers an application framework, which constitutes a set of core classes that are the basis and structure of all applications.

Figure 2. IMS general view



The Symbian OS architecture can be described by a layered approach, as illustrated in Figure 1.

The layers can be defined as follows:

- **User Interface (UI):** Can be specifically defined per vendor or per family of mobile devices, such as Series 60 platform devices;
- **Application Module:** Allows access to applications' built-in functionality concerned with data processing and not how it is presented for the user;
- **System Module:** Contains the set of OS APIs; and
- **Kernel:** The core of the operational system and cannot be directly accessed by user programs.

The mobile application was implemented using a Series 60 platform (Series 60 Website, 2006; Edwards & Barker, 2004). Series 60 is a complete smart phone-based UI design reference. It completes the Symbian OS architecture with a configurable graphical user interface library and a suite of applications, besides other general-purpose engines.

SYSTEM ARCHITECTURE

This section presents the IMS architecture. As introduced earlier, the IMS system has a client/server architecture, where the server was developed in C++ for the Microsoft Windows OS and the client application was developed in C++ for Symbian OS. Client/server communication is performed based on Bluetooth wireless technology, which can provide connection to up to seven users at the same time. Figure 2 illustrates a general system view.

According to this general view, the system can be divided into three specific modules: mobile, network, and server. The mobile module is composed of the software running on mobile devices, such as smart phones. It offers a friendly and intuitive user interface, which is responsible

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