A BLUETOOTH BASED PROTOCOL FOR MULTIMEDIA GUIDEBOOKS ON MOBILE COMPUTING DEVICES

Experiencing Mobile Locality-Aware Multimedia in the Palm of Your Hand

Matthew D'Souza, Adam Postula, Neil Bergmann
School of Information Technology and Electrical Engineering
The University of Queensland, Brisbane, Australia

Montserrat Ros
School of Mathematics, Statistics and Computer Science
The University of New England, Armidale, Australia

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Abstract: This paper presents a Bluetooth based communications protocol used for multimedia guidebooks on mobile computing devices. Multimedia guidebooks are used in museums to allow users to access information about museum exhibits. The multimedia guidebook protocol was successfully implemented on a personal digital assistant and mobile (cell) phone platforms. The protocol overcomes some of the wireless file transfer protocol limitation issues with mobile computing devices. The protocol uses Bluetooth wireless connections as a communications medium. The protocol can be used to transfer various file formats such as image or audio files. The protocol also identifies the language content of the information file. Future work on this protocol involves expanding it to allow for other languages to be included and other user preferences such as personal interests and file download options.

1 INTRODUCTION

The widespread usage of sophisticated mobile computing technology has lead to the development of mobile multimedia and communication services such as Wireless Application Protocol (WAP) and Bluetooth. Mobile phones and personal digital assistants (PDA) are now increasingly being used to run advanced applications such as web browsing, gaming, playback of music and other applications. As mobile computing devices (MCD) applications become more advanced, the programming and communication features of the MCD also advance. This has lead to the development of variants of commonly used languages such as C, Java and Microsoft Visual Studio.Net as programming environments for mobile computing devices. However, not all the functionality of these programming languages is available for MCDs.

The functionality of application programming interfaces (API) is usually a public domain specification. However it is up to the MCD manufacturer to implement the API. For various reasons, the API for file transfer using wireless protocols may not be fully supported. This could be due to the limited computing functionality the MCD. For example file transfer functions such as file or directory browsing are commonly not supported. This is a problem for application programs that require file transfer using Bluetooth or the infrared protocols. The use of Bluetooth or infrared protocols is attractive for some applications because the transfer of information is not charged and does not require the user to have an account with a service provider as with WAP.

This paper introduces a Bluetooth based communications protocol used for the implementation of multimedia guidebooks. Multimedia guidebooks are used in museums to allow users to access information about museum exhibits. The multimedia guidebook protocol (MGP) presented in this paper, allows various formats of

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information files to be passed between a client and a server using a Bluetooth connection. The MGP is also designed to convey the language type of the transferred file contents and to be implemented on any MCD with limited computing and wireless communication capabilities.

Typical interaction between the user and the information host involves 2 main processes: the registration process, where a user is introduced to the system; and a connect-and-request process, where the user selects the item they wish to retrieve. The user experiences the items requested by way of the text, image and audio/video viewers already located on the MCD.

This paper is organized into 5 sections. Section 2 presents a review of related work. Section 3 describes the MGP architecture and implementation. Future areas of investigation are discussed in section 4 and conclusions are drawn in section 5.

2 RELATED WORK

There are two types of multimedia guidebook protocols. The first type involves the information being transferred to the MCD on request. The second type already has the information stored on the MCD. Examples are the Exploratorium (Hsi 2002), (Haneef and Ganz 2002) and the Cyberguide guidebooks (Abowd, Atkeson et al. 1997). Existing guidebooks tend to use older short-range wireless protocols such infrared communications. This is due to the widespread usage of infrared transceivers on older personal digital assistant (PDA) platforms. Infrared is not widely integrated into MCDs as Bluetooth has become. Infrared has been surpassed by Bluetooth in many applications because it does not require line of sight, supports ad-hoc networking and has more robust data communications.

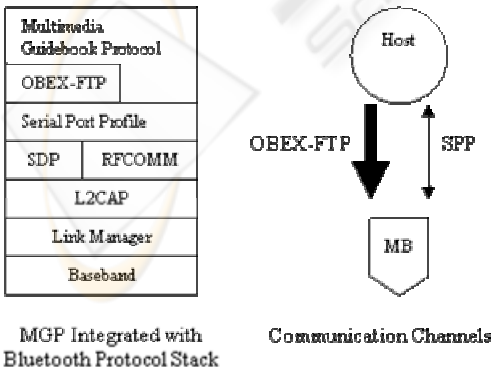

Figure 1: MGP – Bluetooth Stack Integration and Communication Channels

Bluetooth does support some legacy protocols that were developed for Infrared such as object exchange file transfer profile.

The Exploratorium guidebook deploys Radio Frequency Identification (RFID) beacons, 802.11b wireless LAN and HP Jornada PDAs. When a user with a PDA comes within range of an RFID beacon, a uniform resource locator (URL) number is sent to the PDA via infrared. The Hypertext Transfer Protocol (HTTP) is then used by the PDA to request and receive the information via the 802.11b LAN connection.

3 MULTIMEDIA GUIDEBOOK PROTOCOL ARCHITECTURE

The multimedia guidebook protocol (MGP) is a Bluetooth based protocol for use with multimedia guidebooks on mobile computing devices (MCD). The MGP was designed to be simple enough to implement on MCDs that have limited computing and wireless communication resources. The Bluetooth wireless protocol supports two basic information transfer profiles: serial port profile (SPP) and the OBEX file transfer (OBEX-FTP) profile (Bluetooth SIG). The MGP uses the SPP as a control channel and the OBEX-FTP to transfer information item files. The control channel is used to convey request and response MGP packets. Figure 1 shows the Bluetooth protocol stack (Bluetooth SIG) integrated with the MGP and the communication structure between the host device and the MCD.

3.1 Multimedia Guidebook Protocol State Machine

The MGP is designed to be a request and response protocol between a host device and a mobile computing device. The host only responds to requests from the MCD. The MGP state machine message passing sequence can be seen in Figure 3. The MGP state machine consists of 5 states: registration, connection, menu initialization, information item request and disconnection. The MGP state machine on both the host and MCD does implement a timeout to ensure that idle communication links are disconnected. During the registration phase, the MCD's Bluetooth address is registered as a user identifier (UID) in a user database that is accessed by the host. This allows the host to only accept requests from registered MCDs.

When the MGP state machine enters the connection phase, the host authenticates the MCD's UID and allows the connection if the UID is

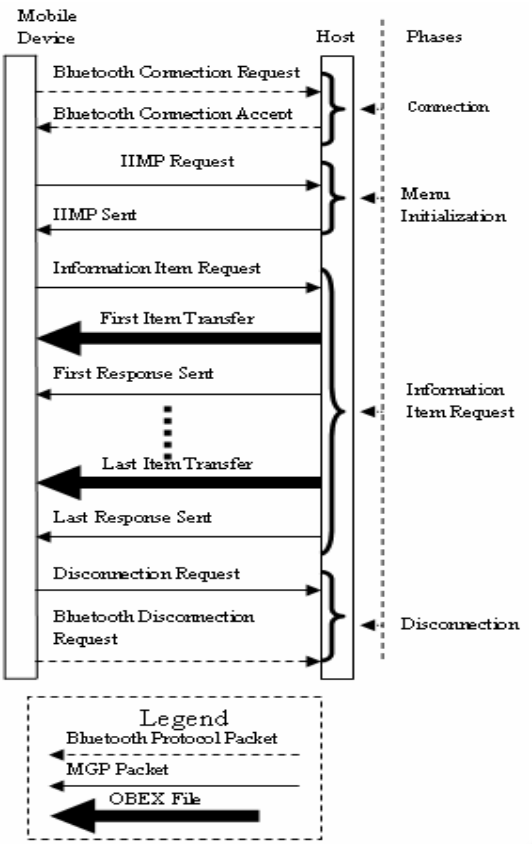

Figure 3: Multimedia Guidebook Protocol State Machine and Message Passing Sequence

registered. Once the host and MCD are connected, an item initialization menu packet (IIMP) is sent to the MCD from the host. The IIMP contains a list of information items that can be accessed from the host. Once the IIMP has been transferred, the user will see a menu of information items to select from.

When a user selects an information item to view, mobile computing device's MGP state machine enters the information item request phase. An MGP item request packet is sent to the host from the MCD. The host responds with an acknowledge packet and it also transfers the information item file to the MCD using the OBEX-FTP channel. When the user wants to disconnect their MCD from the host, the MGP state machine enters the disconnection phase and transmits an MGP disconnection packet to the host.

3.2 Multimedia Guidebook Protocol Structure

The MGP packet structures containing ASCII values can be seen in Figure 2. The packets are designed to be received and transmitted through a normal Bluetooth serial port connection. There are two types of packets: request and response packets. Each packet consists of a packet header that contains the command field and the UID field. The request packet contains the number of requested information items and the information item numbers (IIN) of the information items to be requested. The response packets contain the IIN of the information item sent as well as the number of items remaining to be sent. The IIN is described in section 3.3.

The initialize item menu packet (IIMP) payload contains the total number of accessible information items, followed by the information item fields of each information item. Delimiter characters are used to separate the information fields. The structure of the IIMP is given in Figure 4**.**

3.3 Information Item File Formats

The information items are transferred as files through the Bluetooth OBEX-FTP channel. Each information item file is assigned an information item number (IIN). The IIN is only unique to a particular host. The structure of the IIN can be seen in Figure 4, consists of an item type, language and number fields. The number field is a random number assigned by the host. The item type specifies the format of a file. Common formats such as JPG and MP3 are used. The language field contains a number that specifies what language the file content is in. A preliminary language list is given in Figure 4. The information name field contains the text that is seen by the user on their MCD. The menu type field determines if the information name field is viewed either as normal or it appears as a submenu item.

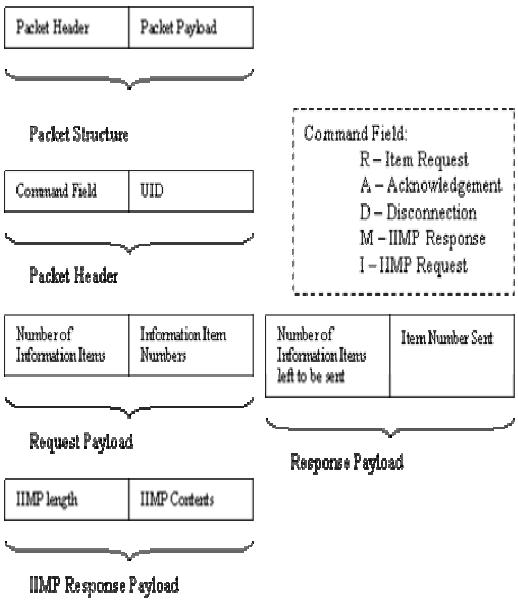

Figure 2: MGP Packet Fields

4 FUTURE WORK

Future work associated with the development of this protocol, would be to expand its facilitation of user options. In order to make this technology available to more people, further work must be done in the expansion of the current field options – for example, the inclusion of many more languages or item types. As well as fledging out the current fields, further work needs to be done on the development of other user preferences as new fields. Some suggestions include fields for file size preferences (smaller/quicker vs. larger/detailed), experience type (streaming vs. wait-until-downloaded), personal interests (historical/architectural point-of-view) as well as options for visually or hearing impaired persons (captions/Read-Aloud).

5 CONCLUSION

A protocol for a multimedia guidebook was presented in this paper. The multimedia guidebook protocol was designed to be simplistic so that it could be implemented onto any mobile computing device with limited computing and programmability capability. The MGP was also designed to overcome some of the wireless file transfer limitation issues with mobile computing devices and was implemented using a Bluetooth serial port and OBEX-FTP connections. The MGP allows the transfer of various file formats such as image or audio files and also identifies the language content of the information file. Future work on this protocol involves expanding the current field options to allow for other languages to be included and for other user preferences such as personal interests and file download options.

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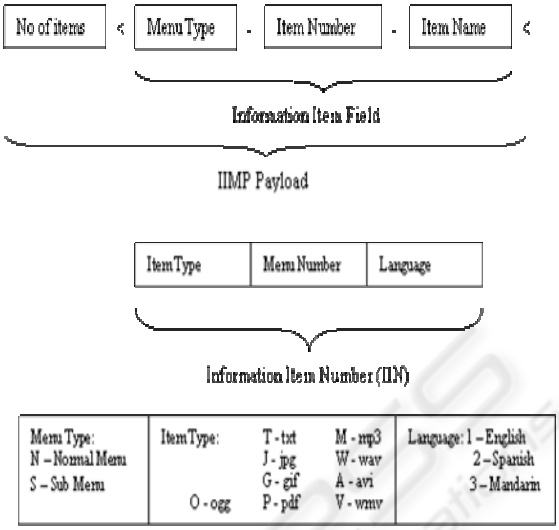

Figure 4: Structures of the Information Item

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