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Design of a Remote Control Application Using Mobile Phone with WPAN Platform

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ABSTRACT

In this paper, we design a mobile phone based remote control system for PC using SKT WPAN platform and compare the presented platform with that of Windows Mobile. The usability of WPAN is one of the main issues which should be considered for the ubiquitous services. For easy development and easy use of the WPAN applications, SKT WPAN platform provides abstract WPAN APIs and WPAN Application Manager for ubiquitous services. In this paper, we implement a remote control application using the WPAN platform and show the validity of the platform comparing with other platforms. In the implemented application, we use WPAN abstract APIs on the mobile phone side and a general Bluetooth APIs on the PC for a connection between phone and PC. Through the implementation and comparison, we show that the WPAN application can be easily developed with WPAN platform.

Key words: WPAN Platform, Bluetooth, Remote Control, Abstract API

1. INTRODUCTION

According to the development of mobile phone and wireless networks, various network technologies are being adopted in mobile phones. Especially, Bluetooth [1,2] is essential for mobile phone. However, since the main objective of the WPAN [1-4] is to connect devices without cables, the usage of WPAN technologies in mobile phone is somewhat restrictive when it comes to ubiquitous network services [5]. Also, it is not so easy to develop various WPAN applications and utilize the WPAN applications in the user's aspect. Considering these facts, WPAN platform has been proposed for the development process and usability of WPAN applications in mobile phone [6-8].

The SKT WPAN platform consists of a WPAN handset platform, a WPAN connection scheme, and a WPAN server platform. WPAN handset platform provides Abstract APIs for the application development in order to integrate the cellular network and the WPAN in mobile handsets. The WPAN server platform takes control of the services and devices connected to the handset. Also, for the convenience of the user, a WPAN connection scheme is utilized.

In this paper, we design and implement a mobile phone based remote control system for PC using WPAN platform. We extend the result in [9] and show that the WPAN application can be easily developed using WPAN platform. The user can control the PC applications with the presented system

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through Bluetooth network. For the Bluetooth programming in mobile phone, we use WPAN APIs of WPAN platform and show that the application is easily developed using those APIs comparing with other API sets.

The remainder of this paper is organized as follows. In Section II, related work is briefly introduced. In Section III and Section IV, we discuss the application design with API sets and comparison with the Bluetooth APIs in Windows Mobile, respectively. In Section V, service implementations are described and the conclusion follows in Section VI.

2. RELATED WORKS

Since WPAN is widely used in mobile handsets, there are many researches and various standards for the integration of WPAN. In this section, we introduce related works for the integration of WPAN in handset. Until now, the integration of WPAN in handset is generally focused on the WPAN functions in the handset. However, little consideration has been given to the development of converged network services.

2.1 JSR-82 [10-13]

JSR-82 (JavaTM APIs for Bluetooth) is a standard of JCP (Java Community Process), which provides Bluetooth APIs for the J2ME environment. There are standard APIs for the SDP (Service Discovery Profile), GAP (Generic Access Profile), SPP (Serial Port Profile), L2CAP (Logical Link Control Access Profile), and OBEX (OBject EXchange) functions of Bluetooth technology. Using JSR-82, WPAN functions can be supported in handsets. JSR-82 supports only Bluetooth APIs and there still remain other platform components for converged network services. Fig. 1 shows the overall structure of JSR-82.

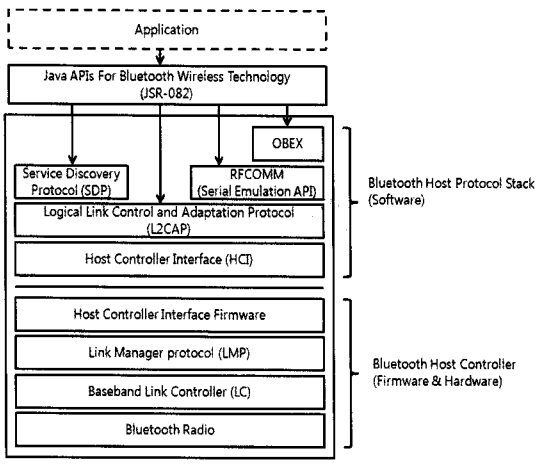

Fig. 1. JSR-82 Bluetooth protocol stack.

2.2 SKT WPAN Platform

For the convenience of developers and users, WPAN platform is designed on the mobile phone by SK Telecom and WPAN alliance. The WPAN platform consists of abstract API set for WPAN, easy connection schemes considering user scenario, WPAN manager handling WPAN applications and WPAN server platform.

Fig. 2 shows the basic architecture of WPAN APIs. The abstract WPAN APIs are provided in WPAN core level. With the abstract APIs in WPAN core level, we can make L2CAP link in Bluetooth and develop Bluetooth Applications. WPAN application manager deals with the overall application management and connection setup.

Using WPAN APIs, we can develop WPAN application easily. Table 1 shows the list of WPAN Core APIs. As shown in Table 1, WPAN Core APIs

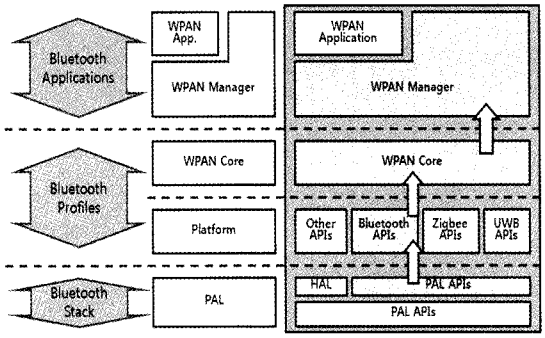

Fig. 2. WPAN Platform architecture.

Table 1. WPAN API

API	Descriptions
WPAN_ONOFF()	Turn on/off the hardware module for the WPAN (Bluetooth, ZigBee, UWB, etc.) in the WPAN handset.
WPAN_Create()	In the server mode of WPAN handset, get the file descriptor making a serial port channel, and then remain in the listen state.
WPAN_GetPairedList()	Get the list of devices that were connected before.
WPAN_Connect()	In the client mode of the WPAN handset, connect to the server and get the fd for the connected serial port channel.
WPAN_Disconnect()	Disconnect the serial port connection between the server and the client.
WPAN_Remove()	In the server mode of the WPAN handset, release the listen state of the serial port channel
WPAN_SdpClose()	Close the SDP before WPAN is excuted
WPAN_SppClose()	Close the connected serial port channel.
WPAN_SendData()	Send data to the connected serial port channel.
WPAN_RecvData()	Receive data from the connected serial port channel.

are independent of WPAN technologies.

3. APPLICATION DESIGN FOR PC-TO-PHONE CONNECTION

In this section, we discuss the PC-to-phone application design using Bluetooth. Fig. 3 shows the converged network services using PC-phone connection. Although PC to phone connections are widely used already, we present a connection implementation using the WPAN platform in order to show that the remote control application is easily developed using the WPAN platform. As shown in Fig. 3, various services can be developed through the converged networks, i. e, Bluetooth connection between PC and mobile phone, internet and 3G network.

For the implementation, we use Bluetooth network between PC and mobile phone with WPAN platform. We can make a connection using SPP

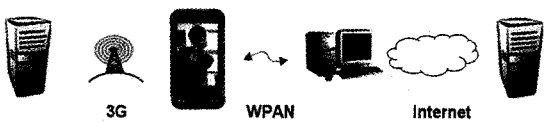

Fig. 3. Converged network service using PC to phone connection.

APIs of Bluetooth dongle in PC and WPAN core APIs in WPAN platform. The WIPI application in mobile phone controls PC with Bluetooth. In case of WPAN platform, the connection process can be summarized as the following sequences.

1. Turn on the Bluetooth module. (WPAN_ONOFF())
2. Invoke WPAN manager and search WPAN devices. Then, exchange PIN code and make authentication. (with WPAN Manager)
3. Get the list of the searched devices. (WPAN_GetPairedList())
4. Request connection and make the connection. (WPAN_Connection())
5. Exchange data between PC and phone. (WPAN_SendData(), WPAN_RecvData())

4. COMPARISON WITH OTHER BLUETOOTH APIS

The SKT WPAN platform is designed for convenience of development. In this section, we compare the flow of APIs and show the validity of the platform. Fig. 4 shows the application process for Bluetooth connection and Fig. 5 and Fig. 6 show the connection flow for WPAN platform and MS

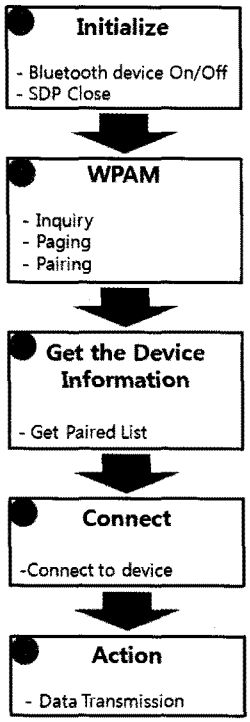

Fig. 4. WPAN platform connection process.

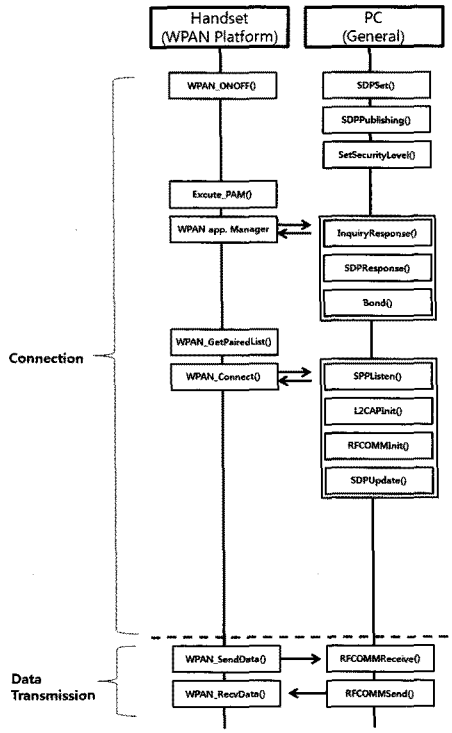

Fig. 5. Connection flow of APIs using WPAN Platform.

Bluetooth stack, respectively.

As shown in Fig. 5, we can develop the WPAN applications easily using WPAN APIs rather than using MS stack APIs as shown in Fig. 6. The number of API calls in WPAN platform is smaller than that of Windows Mobile. Also, different from other existing WPAN API sets, we can handle the WPAN connection and variation of user context, manage the applications for the user interface, and administrate the authentication, easily.

5. IMPLEMENTATION OF REMOTE CONTROL SYSTEM

Fig. 7 shows the figures of applications for PC and mobile phone. When the user gives an input in handset, the input value is transmitted through Bluetooth and the application analyzes the value. We can control the PC using mobile phone as an input device like a mouse or a keyboard.

PC application is implemented using MFC based

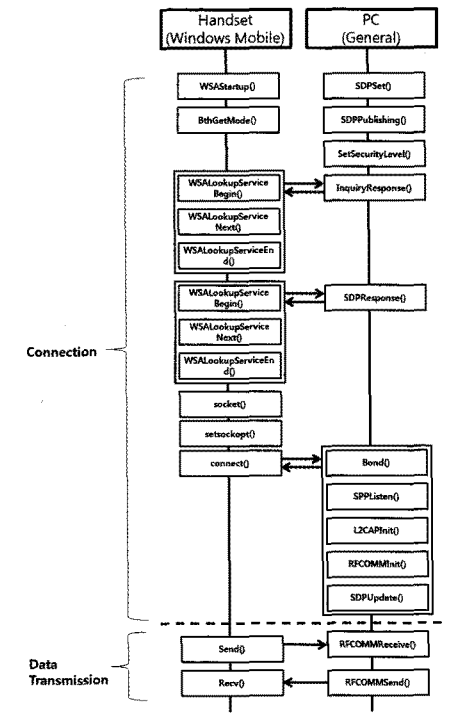

Fig. 6. Connection flow of APIs using Windows Mobile.

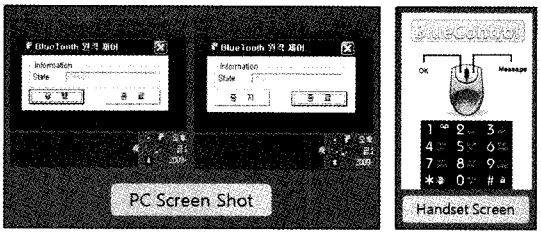

Fig. 7. Applications for PC and mobile phone.

on Windows XP. It analyses the data from the mobile phone and controls the PC keyboard. The keypad for mobile phone is defined in Fig. 8 and PC is controlled with the key input from the mobile phone. The direction key handles the movement. OK key and SMS key play a role in the button of mouse.

Fig. 9 shows an example of the remote key input application using mobile phone. We can execute a PC application with the input key value from mobile phone.

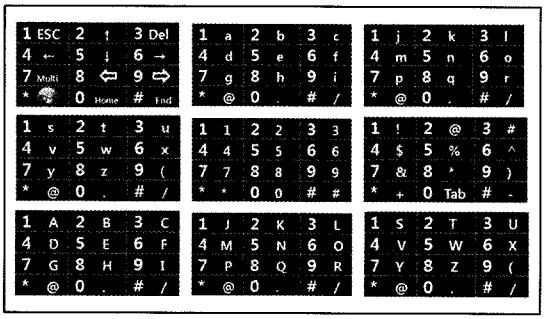

Fig. 8. Key pad for the application.

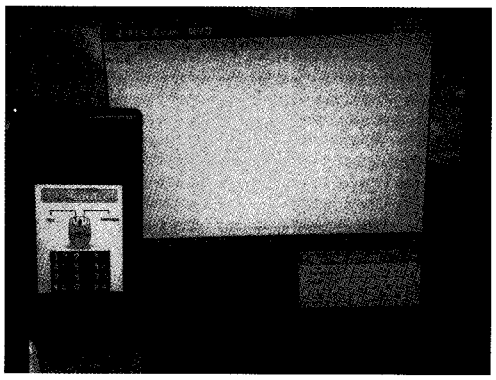

Fig. 9. An example of example of the remote key input.

6. CONCLUSIONS

In this paper, we have presented a remote control system using mobile phone for PC using SKT WPAN platform and have shown the applicability of the presented platform. In the remote control system, the user can control PC using the input of mobile phone. We utilize WPAN core APIs for the mobile phone side and general Bluetooth API for the PC side. From the comparison to other existing Bluetooth API sets, we have shown that the WPAN application can be easily developed using WPAN platform.

Nowadays, various services are being provided based on the connection to PC and contents server. Mobile applications such as game, contents download, etc. based on the described system remain future work.

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