WAP 과 Bluetooth 의 결합을 통한 홈 기기 제어

안혜환*, 윤희용*, 고재진**, 정혜동**
*성균관대학교 정보통신공학부
**전자부품연구원 정보시스템 연구센터
e-mail : *{hyehwan,youn}@ece.skku.ac.kr
**{jaejini,Hudson}@keti.re.kr

Integration of WAP with Bluetooth for Controlling Home Appliances

*Hye-Hwan Ahn,*Hee Yong Youn
Jaejin Ko,Hyedong Jung
*School of Information and Communication Engineering
SungKyunKwan University
**KETI (Korea Electronics Technology Institute)

Abstract

This paper proposes to integrate WAP(Wireless Application Protocol) with Bluetooth to implement a home automation system. One of the most important benefits of the proposed approach is the elimination of the problem of limited distance of Bluetooth as less than 10 meter. With WAP providing a data link between the Internet and a mobile phone and embedded WEB camera through Bluetooth, we can control various home appliances whenever and wherever we want. The hardware and software design issues for implementing such system are discussed and a pilot home automation system is implemented.

Key words: Bluetooth , WAP, embedded WEB camera, live streaming , home automation

1. Introduction

From 1896 when wireless communication started by Marconi who demonstrated wireless telegraphy by sending and receiving Morse code using high-power transmitters to 3G wireless systems based on CDMA technologies[1][3][4][5] , wireless systems are being developed and deployed with so much data and voice communications integrated together. Wireless communications continue to evolve exponentially in the cellular telephony, wireless Internet, and wireless home networking arenas. Nowadays, we have developed high technology wireless communication applications such as ad-hoc system with Bluetooth[3].

The existing home appliances are directly controlled by human so far[1]. Most of them have no brain and they are simple working machines. Even though WAP-based wireless technology has been recognized to have some drawbacks for wireless Internet solution, we can provide abundant wireless services if we use it as a remote controller of home appliances. In this paper we propose a home automation system where the home appliances are controlled by using WAP and embedded WEB camera through Bluetooth.

The rest of the paper is organized as follows. Section 2 reviews WAP and Bluetooth[3][6] , and Section 3 describes the proposed design for home appliance control. Section 4 presents the implementation of the proposed system, and Section 5 concludes the paper.

2. Review WAP and Bluetooth

2.1 Architecture of WAP

WAP consists of several protocol layers to effectively provide data services for small mobile terminals in wireless environment. It is designed in a layered fashion in order to be extensible, flexible, and scalable. With the Open System Interconnection (OSI) model, the WAP stack is basically divided into five layers as shown in Figure 1.
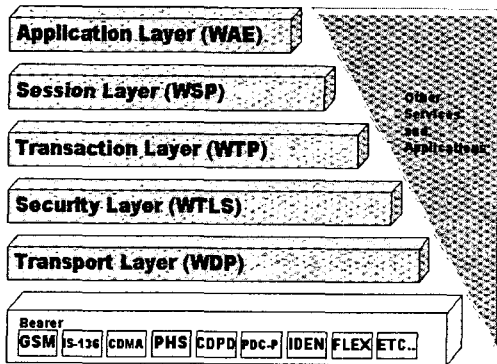

Figure 1. The structure of WAP.

● WAE (Wireless Application Environment):
  Defines content composition between mobile terminals and server.
● WSP (Wireless Session Protocol):
  Takes care of handling actual requests for pages. Sessions are used to optimize the bandwidth usage.
● WTP (Wireless Transaction Protocol):
  Implements a single request-response pair between phone and gateway. The request may be for a new page something related to the higher level protocols.
● WTLS (Wireless Transport Layer Security):
  Protocol layer for the communication security between terminals.
● WDP (Wire Datagram Protocol):
  It is a general datagram service offering a consistent service to the upper layer protocols and communicating transparently over one of the available underlying bearer services. The consistency is provided by a set of adaptations to specific features of the bearers. This thus provides a common interface to the upper layers that are then able to function independently of the services of the wireless network.

The key features offered by WAP are
● A programming model similar to the Internet
● Wireless Markup Language (WML)
● WMLScript
● Wireless Telephony Application (WTA)

● Optimized protocol stack

2.2 Architecture of Bluetooth

Figure 2 shows the Bluetooth protocol architecture. Bluetooth technology was designed and optimized for the use of mobile devices. Mobile computers, cellular handsets, network access points, printers, PDA's, desktops, keyboards, joysticks and virtually any other devices can have short range Bluetooth radios operating in the free 2.4GHz Industrial-Scientific-Medical (ISM) band integrated into them (single chip). It uses Frequency Hop (FH) spread spectrum, which divides the frequency band into a number of hop channels. Bluetooth radios use tiny radio-frequency transmitters no larger than 1.0 by 0.5 inches that can run on a watch battery for months. Power considerations are always important for battery-powered mobile devices, and Bluetooth's low power modes meet those requirements with less than 0.1W active power. Also, since Bluetooth was designed for both computing and communication applications, it supports high quality simultaneous voice and data with robust data transfer rates of up to 721 Kbps. It provides both synchronous and asynchronous services and easy integration of TCP/IP for networking purposes.
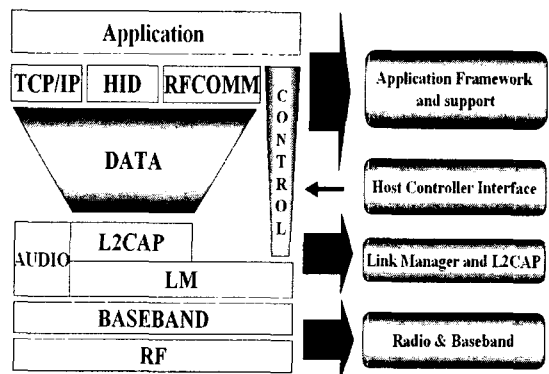

Figure 2. The structure of Bluetooth

The complete Bluetooth protocol stack of Figure 3 has been designed to include the existing protocols as much as possible (like TCP, UDP, OBEX) as well as Bluetooth specific protocols like LMP and L2CAP. The protocol reuse ensures smooth interoperability between existing applications and hardware. The specification is also open, thereby allowing vendors to build proprietary applications. Although different applications may run over different protocol stacks, they all use the Bluetooth data link and physical layer. The Application Layer lies on top of the vCard (internal object representation convention) layer.

2.3 Bluetooth with WAP

Bluetooth and WAP technology fundamentally address

different problems. Mobile users with wireless devices use WAP to access and interact with information and services over the Internet instantly. The WAP architecture was designed to enable standard off-the-shelf Internet servers to provide services to wireless devices. In addition, when communicating with wireless devices, WAP uses many Internet standards such as XML, UDP and IP. The WAP wireless protocols are based on Internet standards such as HTTP and TLS but have been optimized for the unique constraints of the wireless environment. Bluetooth on the other hand is a local area low power radio link between devices. Many of the usage scenarios for Bluetooth also involve one of the devices communicating over the air using WAP.
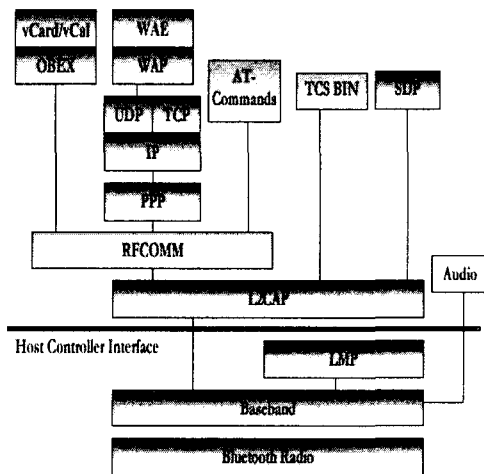

Figure 3. The Bluetooth protocol stack.

3. The Proposed Design Combining WAP with Bluetooth

3.1 The Integrated Structure of WAP and Bluetooth

The WAP is an open, global specification that enables users easily and instantaneously to access and interact with information and services through mobile wireless devices. In the work described in this paper we use it for ling range communication between a user at a remote location and a Bluetooth network in the user's home by leveraging on the Internet revolution, as well as the possibilities for remote operation of routine home processes such as gardening and pet feeding. Home automation involves the use of microprocessor-based intelligence to integrate or control electronic products and systems in the home. These products and systems include floodlight, power On/Off TV, cooking with a toaster and so on. Figure 4 shows the integrated structure of Bluetooh with WAP. We can visually control several appliances by using live streaming service.
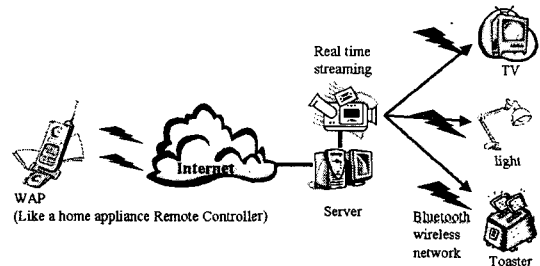

Figure 4. The integrated structure of WAP with Bluetooth.

3.2 Software Architecture

The software architecture is shown in Figure 5. It is essentially made up of two subsystems which interact with each other through WAP. It controls the Bluetooth-based home appliances while seeing the appliances by using an embedded WEB camera over RTP. The graphical user interface is implemented using Wireless Markup Language, a markup language based on XML. The official WML specification is developed and maintained by the WAP Forum. The user interface allows user input from phone keypads using input fields and presents data in the form of static text, tables, hyperlinks and monochrome images.

In a typical Bluetooth network or piconet, RF connections are established between a master device controlling the network and active slave devices up to a maximum of seven communicating with the master when permitted. The slave devices do not communicate with one another directly. The master device in the proposed piconet is a personal computer that functions as a server and has a Bluetooth module wired to it via a serial cable. It provides critical information related to services that are active on the Bluetooth devices. Essentially, it handles all connections from the client Bluetooth devices and acts as a bridge for communication between individual Bluetooth devices.
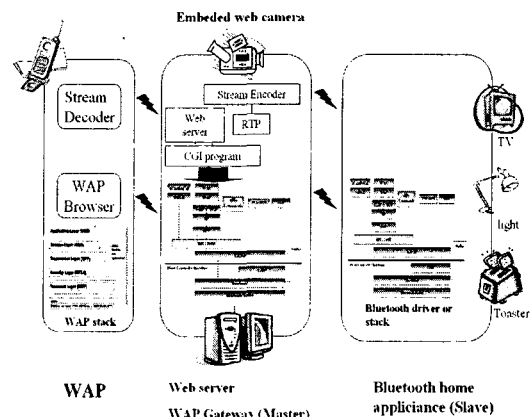

Figure 5. The software structure.

1445

4. Implementation

We implement an intelligent home using the proposed approach. Many people insist that WAP has been replaced by other good wireless solutions, but we expect that a very intelligent home can be built if we use WAP as a remote controller which can solve the small distance problem of bluetooth. Figure 6 shows a prototype intelligent home implemented by combining Bluetooth with WAP. Here the home appliances are virtual devices since we do not have real ones.
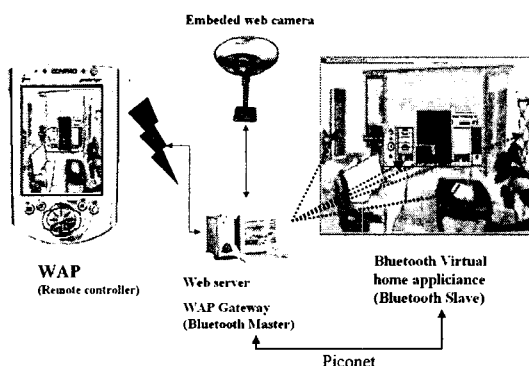
Embeded web camera

WAP
(Remote controller)

Web server
WAP Gateway
(Bluetooth Master)

Bluetooth Virtual
home appliciance
(Bluetooth Slave)

Piconet

Figure 6. An implementation of intelligent home.

5. Conclusion

This paper has presented the development of a Web based home appliances that provides simple on/off control and monitoring by using the live streaming and WEB camera over RTP from a remote location. Here the WAP client works as a remote controller. For this, we have integrated Bluetooth with WAP. With the proposed approach, our home is equipped with intelligent appliances controllable whenever and also wherever we want. The connection of appliances to the Internet will provide us with many creative ways of enhancing the quality of our lives through convenient and flexible control and co-ordination of the appliances. We anticipate that our system will be able to work in conjunction with other existing technologies in the near future.

References

[1] Internet home control system using blutooth over WAP control/communications
by K.K. Tan and C.Y.Soh

[2] HARTWIG, S., RAUTENBERG, T., SIMMER, M., TEMOVIC, D., and VAN BEBBER, A. ; 'WAP over bluetooth: technology and applications'. Proc. ICCE Int. Conf. On Consumer Electronics, Los Angels, CA, USA 19th- 21th june 2001, pp 12-13 (IEEE,2001)

[3] Bluetooth Special Interest Group, "Bluetooth core" Specification of the Bluetooth System, Version 1.1, February 22.2001

[4] Wireless Communications and Networking: An Overview "Ramiro Jordan and Chaouki T. Abdallah"

[5] Next Generation Networks "Matthew N.O. Sadiku and Tan H.Nguyen"

[6] Design and Implementation of the WAP gateway based on CDMA Environment "hye-hwan,Ahn and H Y Youn" e-mail: hyehwan@ece.skku.ac.kr

[7] Wireless Application Protocol Architecture WAP Specification 1.0, WAP Forum April 30[th,] 1998.
URL: http://www.wapforum.org

[8] Wireless Application Protocol WAP 2.0 Technical White Paper January 2002
URL: http://www.wapforum.org

[9] Linux based WAP Gateway open source
URL: http://www.kannel.3glab.org

[10] Phone.com UP SDK 4.1
URL: http://www.phone.com

[11] Professional WAP "Charles Arehart " published by WROX Press

[12] Design and Implementation of a WAP Gateway "Lars Wizenius" e-mail: liw@wapit.com

[13] Technological composition and development direction of the radio internet. "sangchoi, choi" from ETRI e-mail: sangchoi@etri.re.kr
URL: http://www.etri.re.kr

[14] WAP: Wireless Application Protocol – Wireless Wave of the Future "Slavatore P.savino"
Cap Gemni Ernst and Young, Telecom Media and Networks, 100 Walnut Avenue Clark, New Jersey 07066 USA

[15] Building the Wireless Internet "CHIP ELLIOTT" BBN Technologies, A Part of Verizon

[16] Mpeg4 live streaming service internet web site http://www.mpeg4ip.net

[17] "Third generation mobile telephony." http://www.ericsson.com/technology/3Gs.html