Implementation of Enhanced IN Services via IP-Based Networks

Kim-Joan Chen, Hui-Kai Su, and Yuan-Sun Chu
Department of Electrical Engineering
National Chung-Cheng University,
Chia-Yi, Taiwan 621, ROC.
Tel: +886-5-2720411#23253
Email: pat@ee.ccu.edu.tw

Abstract

This paper proposes a novel framework and implement the enhanced IN (Intelligent Network) services via IP-Based Networks. Furthermore, The PC-DECT PBX System, DBMS (Database Management System), IP-Based Networks, and other telecommunication technologies are integrated into a system. We solve the issues of the service management for wired and wireless mobile subscribers, and the mobility management for wireless mobiles. Based on the architecture of integrated system, we can easily develop more novel and useful enhanced IN services which integrate the telecommunication services and IP-Based Applications.

I. Introduction

Telecommunication is a popular communication system. In the recent years, telecommunication technology makes progress faster and faster. Moreover, with the rapid growth of telecommunications, people need various, suitable and convenient services. However, developing a new service is very difficult in traditional telecommunication system. Factories must spend much money and time for new services. Therefore, telecommunication networks are evolving into INs (Intelligent Networks) that offer a lot of services whose data reside in a small number of centralized databases that can be queried by the exchanges[1][2][3][4]. Accessing to the centralized databases from switches is provided via SS7 (Signaling System 7) Networks [5][6]. In the IN architecture, the providers and manufactories only spend few cost and time to develop new services.

The infrastructure of telecommunication is hard and expensive. Every provider of telecommunication needs more finance to build their own networks which are construct of the matrix topologies of lease-lines. Furthermore, a lot of novel telecommunication systems are improved and devised constantly. It contains wired and wireless telecommunication systems. Such as: GSM, GPRS, DECT, DPRS, PACS, PHS, WCDMA, CDMA 2000, etc. The telecommunication networks become more and more complex. On the other hand, the data communication networks are prevalent in the few years. Such as: Internet increases the efficiency of networks and decrease the cost. Therefore, how to combine the novel technologies and network resources and increase the benefits are very important issues.

This paper proposes a novel framework about the implementation of enhanced IN services via IP-Based Networks. We replace SS7 Networks by IP-Based Networks and deliver the signaling of telecommunication via Internet. The integrated system provides several enhanced IN services and mobility management functions to the traditional wired and wireless subscribers, that contain the POTS (Plain Old Telephone Service) and DECT mobile subscribers. The Subscribers can talk each other, and use their required personal services by themself. We provides the enhanced IN services for POTS and mobile subscribers simultaneously, and solve the mobility issue by signaling via IP-Based Networks. The subscribers also can use the enhanced IN services by Web-GUI via Internet. Such as: Setting the personal services, querying the accounts, etc. In the system, we can easily integrate the telecommunication services and IP-Applications.

II. Background

In order to reduce the cost of developing a new service and increase the efficiency of communication resources. We integrated the present technologies which contain IN, IP-Based Networks, DECT[7] and CTI (Computer Telephone Integration)[8][9][10] to a system. PC-DECT System is a CTI-based PBX (private branch exchange) which is based on the PBX-based CTI technology. This System is produced by WINCOMM Corporation[1].

The PC-DECT System architecture is illustrated at Fig. 1 [11]. The hardware of PC-DECT system contains a Radio Exchange (RE) and a CTI Server. The RE is an exchange and the CTI server is the server which could be a personal computer for controling the RE. They are connected with each other by the CTI Link (RS232). The RE supports many different module cards and can connect with several DECT base stations for DECT subscribers by U-Interface, traditional analog telephones and other exchanges (Such as: PSTN). The PC-DECT provides wired subscribers and wireless DECT subscribers to use the telecommunication services. The subscribers can communicate with each other in the local telecommunication network and the other telecommunication networks.

The software of PC-DECT system for DECT system is illustrated in Fig. 2. The gray blocks of protocol stack are the protocol stack of DECT standard. The Base Station handle the DECT Physical and MAC Layers functions. The

[1]Address: 3F., No.14 prosperity Rd., 2 Science-Based Industrial Park, Hsinchu, Taiwan, R.O.C. Tel:(03)578-0000 E-Mail: server@wincomm.com.tw

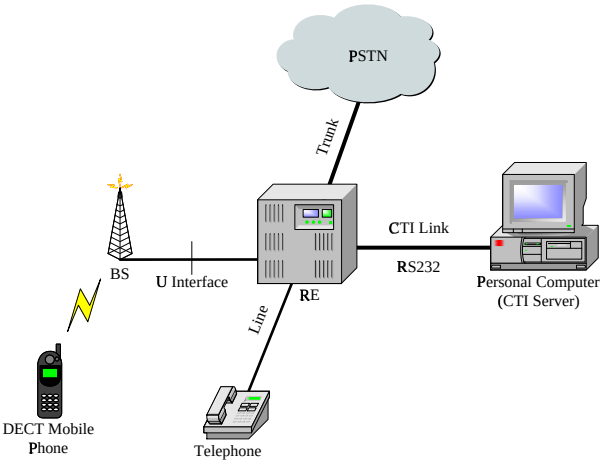

Figure 1: The PC-DECT System Architecture

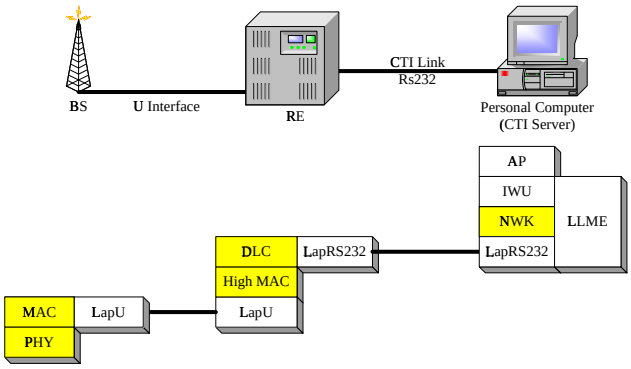

Figure 2: The PC-DECT Protocol Stack

Base Station and the RE communicate by the HDLC-LapU protocol which is drawn up by the factory of Base Station. The RE handles the DECT higher MAC and DLC layers functions and the DECT Network layer of DECT is handled by CTI Server. The RE and the CTI server communicate by the LapRS232 protocol which is formulated by WINCOMM Corporation. For example: If the base station receives the messages from a DECT mobile phone, it will transmits the messages of MAC layer to RE by the HDLC-LapU protocol. After the RE processes the DECT DLC and higher MAC layer functions, it will transmits the messages of DECT Network layer to the CTI server by the LapRS232 protocol. Furthermore, the CTI server can control the RE and send the messages of DECT Network layer to the DECT mobile phone by the RE and base station.

Our integrated system is implemented based on the PC-DECT system. WINCOMM Corporation only supports few service software. Such as: The monitor and manual call control functions, etc. Therefor, based on the integrated system, IN service softwares are developed and implemented.

III. Integrated System Platform

In this section, we divide into three subsections to describe the architecture of integrated system and how to implement it.

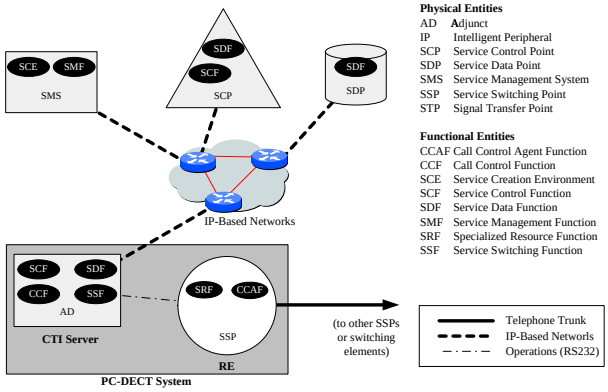

Figure 3: The Functional Architecture of Integrated System

A. The Architecture of Integrated System

In this environment, we require a telecommunication system which can provide more services for us. We also need the signaling networks which have the features of low cost and high reliability for implementing the enhanced IN services. Therefore, we redesign the architecture of Intelligent Network and implement the signaling of telecommunication on the IP-Based Networks.

The functional architecture of the integrated system is illustrated in Fig. 3. The system contains the PC-DECT system, IP-Based Networks and the other IN components. The PC-DECT System contains SSP(RE) and AD(CTI Server). The IP-Based Networks are the signaling backbone networks. The other IN components contain SCP, SDP and SMS. In the Fig. 3, we have not modified the RE in our integrated system. We devote to design and implement the AD(CTI Server), SCP, SDP and SMS. The functions of the components are described below.

- **SSP (RE):** The RE of PC-DECT System provides CCAF and SRF. It supplies for user access, interacting with the user to establish, maintain, modify and release as required, a call or instance of service. It also provides specialized resources required for the execution of PC-DECT System provided services (e.g. DTMF receivers, tone generators, conference chips, etc.)

- **AD (CTI Server):** In our design, The AD provides the CCF, SSF, SDF and SCF functions. It shares the work of the SSP and SCP functions. It supplies call/service processing and contrl, the set of functions required for interaction between the CCF and the SCF, the functions in the processing of service requests, and the local management of customer and network data.

- **SCP:** It provides the SDF and SCF functions. It contains customer and network data management for real-time access, and processing for customer service requests.

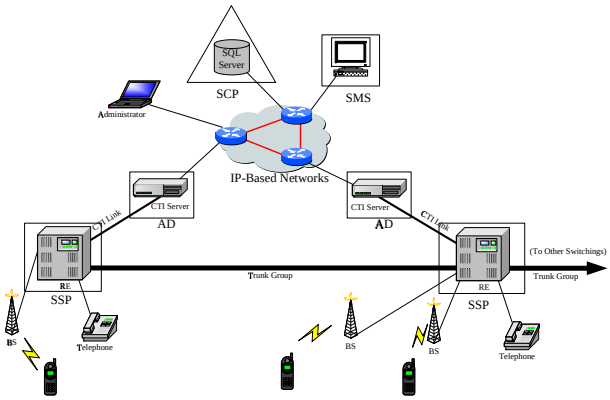

Figure 4: The Physical Architecture of Integrated System

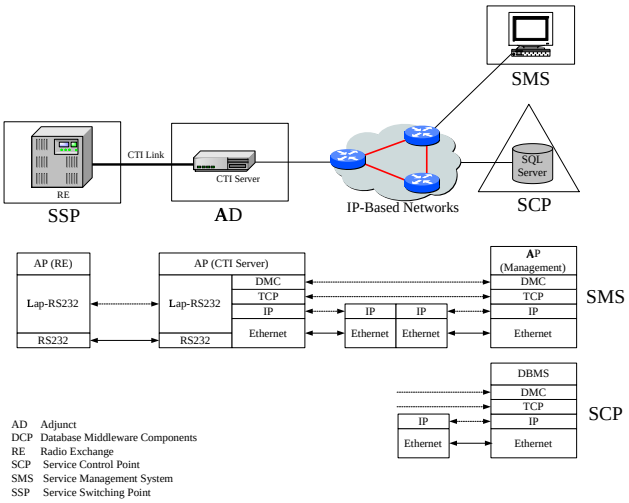

Figure 5: The Protocol Stack of Integrated System

- **SDP:** It provides the SDF function.It contains customer and network data management for real-time access. (e.g. A DBMS (Database Management System).)
- **SMS:** It provides the SCE and SMF functions. It contains service operation control functions, service monitoring functions, service develop functions, and billing functions.

The physical architecture of integrated system is illustrated in Fig. 4. The signaling backbone network is the IP-Based Networks. The CTI Server (AD) is connected with the RE by the CTI-Link (RS232). The all of AD (CTI Server), SCP (SQL Server), and SMS are connected to the IP-Based Networks. In this system, the My-SQL is designed for our DBMS that is a freeware and very powerful. The administrators could remotely login and manage the system configuration from anywhere via Internet. This architecture is very flexibility. Furthermore, the enhanced IN services could combined more IP-Applications and more telecommunication services.

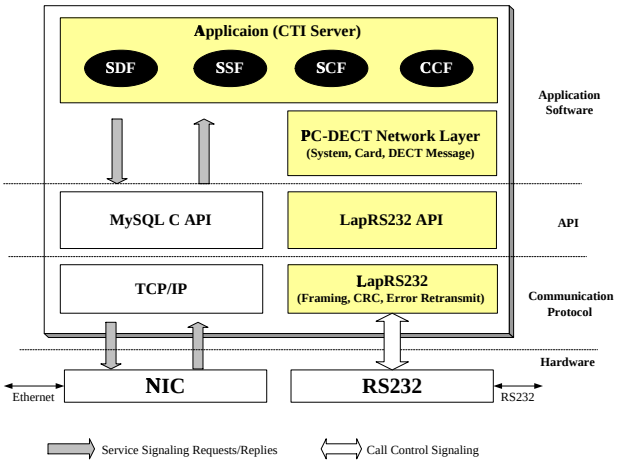

Figure 6: The Hardware and Software Architecture of Enhanced CTI Server

The protocol stack of integrated system is illustrated in Fig. 5. The RE and CTI Server are connected by the RS-232 link and communicate by the Lap-RS232 protocol. The AD, SCP and SMS are connected by Ethernet, communicate by TCP/IP, and access the DBMS by DMC (Database Middleware Components). However, if you require the other higher reliable or longer distant transmission, you could replace the Ethernet to other WAN technologies (e.g. ATM, X.25, Frame Relay, etc.).

B. Enhanced CTI Server

The hardware and software architecture of Enhanced CTI Server is illustrated in Fig. 6.The system is develop in an embedded Linux OS environment. In this paper, we focus on the LapRS232 protocol, LapRS232 API (Application Programming Interface), PC-DECT Network layer functions, and the application of CTI Server. The LapRS232 is the software of LapRS232 Protocol. The LapRS232 API is the API of LapRS232 protocol. The PC-DECT Network Layer functions provide processing the system, card, and DECT control functions of RE which must manage the traditional wired and wireless DECT mobile telephones simultaneously. The Application of CTI Server contains the AD functions which contains the SDF, SSF, SCF, and CCF.

C. Database Middleware Components

The DMC provides the open access interface of DBMS for all clients. The DMC is divided into three main components: API, Databased Translator, and Network Translator[12]. These components (or their functions) are generally distributed among several software layers that are interchangeable in a plug-and-play fashion. The comparison between DMC and TCAP is illustrated in Table 1. The API and Databased Translator are similar to the functions in CSL (Component Sublayer) of TCAP. The Network Translator is similar to the functions in TSL (Transaction Sublayer) of TCAP.

Table 1: The Comparison with DMC and TCAP

DMC (Database Middleware Components)		**TCAP** (Transaction Capabilities Application Part)	
API	The API allows the programmer to write generic SQL codeinstead of code specific to each database server.	CSL	The CSL modles the users' request and response behavior and has one or more components, it includes: * Invoke * Return * Result * Return Error * Reject
Databased Translator	The Databased Translator translats the SQL requests into the specific database server syntax.		
Network Translator	The Network Translator manages the network communications protocols. A client applicationcould use any network protocol to communicate with DMBS, such as:TCP/IP, SPX/IPX, etc.	TSL	The TSL provides an efficient, low-overhead end-to-end connection to carry CSL components between CSL peers. The transaction portion of the message specifies, it includes: * UNIDIRECTIONAL * BEGIN * CONTINUE * END * ABORT

There are several standards of middleware. Such as: Open Data Base Connectivity (ODBC), MySQL C API, etc. ODBC is the standard used by Microsoft Windows applications for database access. MySQL C API is the C API for MySQL access. In our integrated system, the MySQL is used to implement the SDF and the MySQL C API is used to implement the DMC. If the other DBMS is used in the system, we only change the DMC of the other DBMS. In this architecture, we can change the MySQL to other DBMS readily.

IV. Conclusion

This article proposes a new framework about the implementation of enhanced IN services via IP-Based Networks. Furthermore, we make a small integrated system environment to prove it. We integrated the PC-DECT System, IP-Based Networks, and other technologies in a system, and developed more enhanced IN services. The enhanced IN services contain Basic Conversation Service, Conference Service, Call Waiting,Call Transfer, Short Message Service , etc. The subscribers also can send Short Message and set the configuration of personal IN service by Web-GUI from anywhere via Internet. The implementation proves that the integrated system is realizable easily and simply. In the architecture, providers and factories only spend few cost and time for developing a new telecommunication service easily.

References

[1] ITU-T, *ITU-T Recommendation Q.122x series: Intelligent Network Capability Set 2,* International Telecommunication Union, Sept. 1997.

[2] Roger K. Berman and John H. Brewster, "Perspectives on the AIN architecture," *IEEE Communications Magazine*, vol. 30, pp. 27–32, Feb. 1992.

[3] Russo P.A. Garrahan J.J. and K. Kitami, "Intelligent network overview," *IEEE Communications Magazine*, vol. 31, pp. 30–36, Mar. 1993.

[4] W.W. Chao, "Emerging advanced intelligent network (AIN) for 21st century warfighters," in *Military Communications Conference Proceedings, 1999. MILCOM 1999.*, 31 Oct.-3 Nov. 1999, vol. 1, pp. 235–238.

[5] Yi-Bing Lin, "Signaling system number 7," *IEEE Potentials*, pp. 5–8, Aug.-Sep. 1996.

[6] Joohn G. van Bosse, *Signaling Telecommunication Networks*, Wiley series in telecommunications and signal processing, 1997.

[7] ETSI, *EN 300 175-1 V1.4.2, Digital Enhanced Cordless Telecommunications (DECT); Common Interface (CI); Part 1: Overview*, European Telecommunications Standards Institute, June 1999.

[8] D.G. Messerschmitt, "The future of computer telecommunications integration," *IEEE Communications Magazine*, vol. 34, pp. 66–69, April 1996.

[9] P. Scharff X., Lorenz and Z. Mammeri, "CTI and multimedia applications applied to intelligent networks," in *Intelligent Network Workshop, 1998., 7th IEEE*, 10-13 May 1998, pp. 53–62.

[10] Duan Yun-Feng and Song Jun-De, "Personalized service in CTI," in *Communications, 1999. APCC/OECC '99.*, 18-22 Oct. 1999, vol. 2, pp. 1109–1113.

[11] WINCOMM, *PC-DECT User Manual version 1.0*, WINCOMM Corporation, Jan. 2000.

[12] Kristen Duerr, *Database Systems Design, Implementation, and Management*, Course Technology, 1997.