

APPLYING BLUETOOTH AND SMS TECHNOLOGIES IN REALIZATION OF INFORMATION SYSTEM FOR NOTIFICATION AND INFORMING

Branislav T. Jevtović

Business school of professional studies – Blace, Serbia

Stefan N. Kostić

Business school of professional studies – Blace, Serbia

Danilo J. Oklobđžija

Business school of professional studies – Blace, Serbia

Vladica S. Ubavić

Business school of professional studies – Blace, Serbia

Abstract

Applying Bluetooth and SMS technologies in realization of information system for notification and informing. Development and realization of information system for notification and informing of mobile users in an organization is presented in this paper. Base technology used to communicate with mobile users is Bluetooth® and GSM SMS technology, that offers many benefits. Standard network infrastructures of information system allow it to be used in large diversity of organizations. Modular architecture of realized software allows efficient supply of services to mobile users via Bluetooth or SMS, with simultaneous display of most important information on info screen. By using OBEX Object Push protocol it is possible to serve greater amount of users simultaneously. With the information collected on workstations, to users there is available information from internet via parsed RSS Feed files.

Keywords: Bluetooth, GSM SMS, information system, OBEX, RSS, XML.

INTRODUCTION

In organizations with great fluctuation of people and many rooms there is a need of directing each individual to his/her destination. To prevent wasting of human resources and waste of working hours on such an immaterial job, and with a wish to follow an evolution of new technologies, we started developing an information system for notification and informing of mobile users.

Generally observed information system (IS) is an assembly of people, data, and resources for data processing, as well as adequate activities, which interact to generate and process information in some organization. Basic purpose of any information system is gathering, storage, processing and transfer of information. International Federation for Information Processing (IFIP) defines information system on this way: "Information system is a system that gathers, stores, processes and delivers information important to organization and society, on that way that they are available and useful for anyone who wants to use them, including administration, clients, employees and others. Information system is active society system

which can, but not necessary, uses information technology."

The fact that ascending number of portable devices which are applied on mass scale (particularly cellular phones), have possibility of communication via Bluetooth technology, influenced on selection of Bluetooth technology as base platform for communication with users. In information systems of this type, communication between partners imply: discovery, recognition, agreement of communication parameters and communication in real time. Bluetooth technology fully backs up requests for communication in limited space of one organization, i.e. close distances between named devices.

System for informing users in organizations should provide information in just a right moment and direct users to their destinations. This kind of system is very suitable for appliance in all public and private organizations like a service of informing and notification. For an example, in schools or faculties, system like this can be used to send schedules of exams and lectures, in purpose of time saving and avoiding of unneeded rows in halls. One of

those systems, developed and realized on Business school of applied studies Blace, principally is shown in Fig. 1.

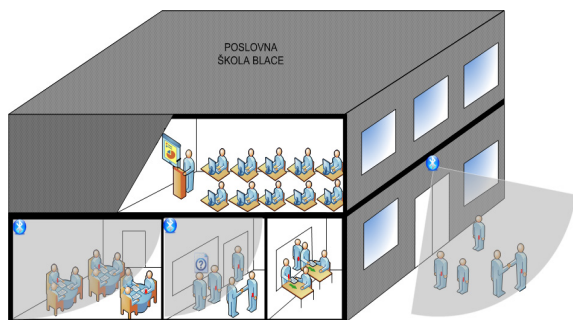


Fig. 1. School information system

Availability, low price and great general possibilities of mobile devices with embedded Bluetooth technology, create possibilities for commercial applications of such information systems. Starting with airports, ending with street stores and bus stations, this kind of systems could inform passengers on information in their best interest. Also there is possible application in hospitals, where those information systems could be helpful for avoidance of waiting rows on a receptions, unnecessary walks trough halls, and distraction of employees while searching for their destination.

Information system of Business school of applied studies Blace is designed modular which allows individual modules to function independently, but also as a part of greater system. Modular system is more functional, easier to expand, and simpler to maintain. Also, modular organization allows for some modules to be placed on distant locations, and it will still function like synchronized system.

BLUETOOTH TECHNOLOGY

Bluetooth is a standard for wireless data and voice transfer, short range, designed for low power consumption and cheap wireless communications, which are based on radio technology. Bluetooth specification has become IEEE standard now known as 802.15 WPAN (Wireless Personal Area Network). Many companies like SonyEricsson, Nokia, Toshiba, Intel, Microsoft, Motorola and others, are members of Bluetooth Special Interest Group (SIG) which has a prior course to work on development and evolution of this standard, as well as its mass introduction to the market.

Bluetooth technology allows connections between portable and desktop computers, computer equipment, cellular phones, cameras and other digital devices by using wireless radio communication on relatively close distances. Bluetooth devices operate on frequencies from 2.4GHz to 2.4835 GHz, which are known as ISM (Industrial Scientific Medicine). ISM zone is open for everyone, so radio systems which work on these frequencies must been designed on such way that they can successfully bear with interferences and fading (fading – change of signal strength). Those problems are solved by using a technology of FHSS (Frequency Hopping of Spread Spectrum). Bluetooth technology spread the spectrum of 83.9 MHz into 79 communication channels 1MHz wide. During communication radio receivers/ transmitters hop from channel to channel on pseudo random order. In other words, to Bluetooth channels are applied schemas of frequency hopping and two sided communication with time sharing. Channel is divided into time intervals of 625 ms, and for every individual interval have different frequency of hopping. That leads to nominal frequency of 1600 hops per second.

Two or more device who share the same channel, make a network, called *piconet*. In that network one of devices acts like master and controls traffic in the network, other devices acts as slaves. So devices can communicate they must work synchronized and to use the same hopping sequence. Depending on distance they can communicate, we divide Bluetooth devices into three categories (classes), which is shown on table 1.

Table 1. Bluetooth device classes

Class	Maximum allowed power [mW (dBm)]	Distance (approximative)
Class 1	100 mW (20 dBm)	~ 100 meters
Class 2	2.5 mW (4 dBm)	~ 10 meters
Class 3	1 mW (0 dBm)	~ 1 meters

Current implementations of Bluetooth are primary considered as simple connections point to point type between two devices, which are in range with each other. Bluetooth specification does not define only connection of point to point type, but also connections that can be used to achieve more complex network structures. Considering previous, our goal is to form

Bluetooth scatter nets which will allow efficient communication via greater number of hops with acceptable time response and little (micro) power consumption. Bluetooth specification splits Bluetooth protocol stack into three logical groups. Like it is shown on figure 2 there are Transport Protocol group, Middleware Protocol group, and Application Protocol Group [1].

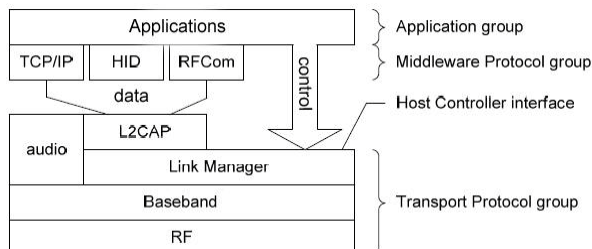


Fig. 2. Bluetooth protocol groups

Bluetooth specification, for the needs of communication among devices, uses TDD and TDMA techniques. One time slot lasts for 625 ms and responds to a packet of single unit length. On baseband level packet contains access code, header and information for user (payload), which is shown on figure 3.

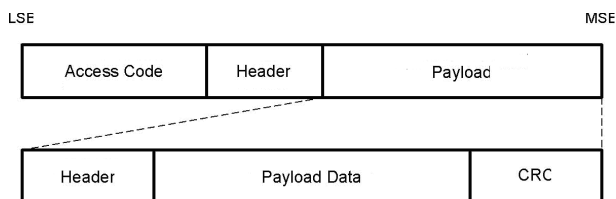


Fig. 3. Structure of Bluetooth packets

Access code is 72 bits long, and it contains piconet address (so other piconets could filter message). Header contains administrative data on connection, coded with FEC (Forward Error Correcting) code. This code is repetitive which means that every bit in header, for greater accuracy to be accomplished, is transmitted three times. Header is usually 18 bits long and contains address of active member for current active slave. Information for the user can contain from 0 to 2475 bits of data. Information for the user can be protected with FEC code for speed 1/3 (case when every packet is transmitted three times, this case is true for SCO packet), FEC code for speed 2/3 (case when Humming's code is used, which is able to correct one side, and detect two side errors), and also FEC code for speed 3/3 (case when there is no code for error detection). With SCO connections, packets can be long as 1, 3, or 5 time slots. Bluetooth

uses polling based packet transmission. All communications among devices are accomplished via master and slave using TDD, and there is no direct communication of type slave to slave. Master polls every active slave to find out does he has a data to transmit. Slave can transmit data only when he is polled. Also slave must transmit his data in a time slot that follows the slot when he is polled. Master transmits only in pair numerated time slots, and slaves can transmit only in non pair numerated time slots. In each time slot different frequency channel is being used [2].

Bluetooth standards are described in details in [3].

GSM SMS

GSM (Global System for Mobile Communications) is the most popular standard for mobile telephony systems in the world. The GSM Association, its promoting industry trade organization of mobile phone carriers and manufacturers, estimates that 80% of the global mobile market uses the standard. GSM is used by over 1.5 billion people across more than 212 countries and territories. Its ubiquity enables international roaming arrangements between mobile phone operators, providing subscribers the use of their phones in many parts of the world. GSM differs from its predecessor technologies in that both signaling and speech channels are digital, and thus GSM is considered a second generation (2G) mobile phone system. This also facilitates the wide-spread implementation of data communication applications into the system. In figure 4 is shown schematic diagram of GSM network communication.

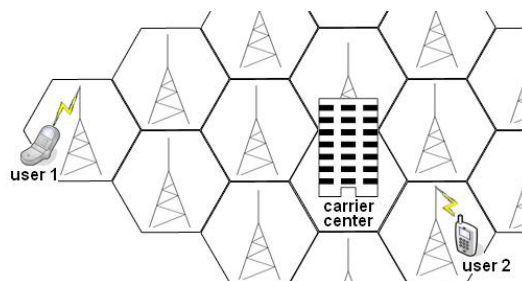


Fig. 4. Schematic diagram of GSM network communication

SMS (Short Message Service) as used on modern handsets was originated from radio telegraphy in radio memo pagers using standardized phone protocols and later defined as part of the Global System for Mobile

Communications (GSM) series of standards in 1985 as a means of sending messages of up to 160 characters, to and from GSM mobile handsets. Since then, support for the service has expanded to include other mobile technologies such as ANSI CDMA networks and Digital AMPS, as well as satellite and landline networks. Most SMS messages are mobile-to-mobile text messages, though the standard supports other types of broadcast messaging as well.

The Short Message Service - Point to Point (SMS-PP) is defined in GSM recommendation 03.40. GSM 03.41 defines the Short Message Service - Cell Broadcast (SMS-CB), which allows messages (advertising, public information, etc.) to be broadcast to all mobile users in a specified geographical area.

Messages are sent to a Short Message Service Center (SMSC) which provides a "store and forward" mechanism. It attempts to send messages to the SMSC's recipients. If a recipient is not reachable, the SMSC queues the message for later retry. Some SMSCs also provide a "forward and forget" option where transmission is tried only once. Both Mobile Terminated (MT, for messages sent to a mobile handset) and Mobile Originating (MO, for those sent from the mobile handset) operations are supported. Message delivery is "best effort", so there are no guarantees that a message will actually be delivered to its recipient, but delay or complete loss of a message is uncommon. Users may request delivery reports to confirm that messages reach the intended recipients, either via the SMS settings of most modern phones, or by prefixing each message with *0# or *N#.

Many mobile and satellite transceiver units support the sending and receiving of SMS using an extended version of the Hayes command set: AT commands, a specific command language originally developed for the Hayes Smartmodem 300-baud modem in 1977.

The connection between the terminal equipment and the transceiver can be realized with a serial cable (i.e. USB), a Bluetooth link, an infrared link, etc. Common AT commands include AT+CMGS (send message), AT+CMSS (send message from storage), AT+CMGL (list messages) and AT+CMGR (read message).

However, not all modern devices support receiving of messages if the message storage

(for instance the device's internal memory) is not accessible using AT commands.

The Short Message Service is realized by the use of the Mobile Application Part (MAP) of the SS#7 protocol, with Short Message protocol elements being transported across the network as fields within the MAP messages. These MAP messages may be transported using 'traditional' TDM based signaling, or over IP using SIGTRAN and an appropriate adaptation layer. The Short Message protocol itself is defined by 3GPP TS 23.040 for the Short Message Service - Point to Point (SMS-PP), and 3GPP TS 23.041 for the Cell Broadcast Service (CBS).

Four MAP procedures are defined for the control of the Short Message Service:

- Mobile Originated (MO) short message service transfer;
- Mobile Terminated (MT) short message service transfer;
- Short message alert procedure;
- Short message waiting data set procedure.

In figure 5 is shown a technical diagram of a call flow for the Mobile originated message service.

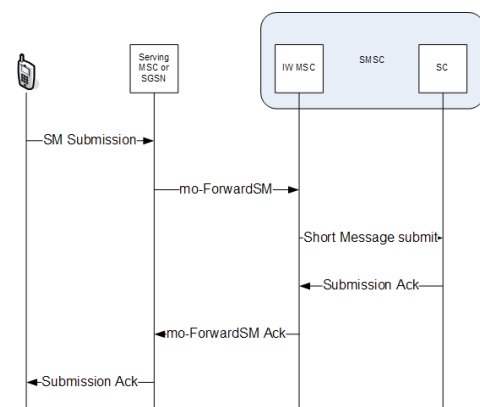


Fig. 5. Call flow for the Mobile originated message

ARCHITECTURE OF INFORMATION SYSTEM

Base infrastructure of realized information system for informing and notification of mobile users, realized in Business school of applied studies Blace is shown in figure 6. Specific to this realization is that among with standard servers (Data server and Web server) there are assigned computers that allow

Bluetooth and SMS communication. In this concrete realization computer used for Bluetooth communication is also used for SMS communication and displaying information on info screen to prevent limited resource wasting.

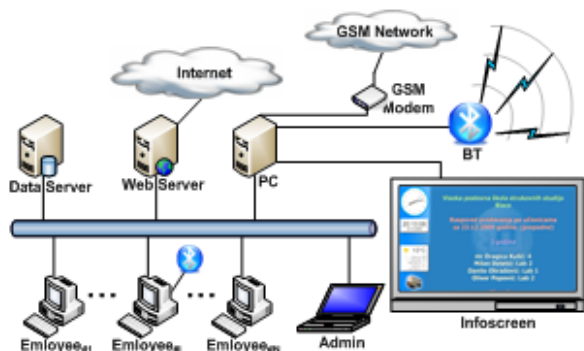


Fig. 6. Architecture of realized information system

It can be seen on the picture that it is possible to realize Bluetooth communication local and on any of employee's work station (Employee_{#i}). Basic purpose of employee's work stations is to make possible efficient data collecting and storing to an adequate database. Those data are related to information of interest for users, for an example schedule of lectures by rooms. Along with servers and employee's workstations there is assigned administrator's work station, which allows access to all of the resources of the information system.

In figure 7 is shown information screen of concrete realization in Business school of applied studies Blace.

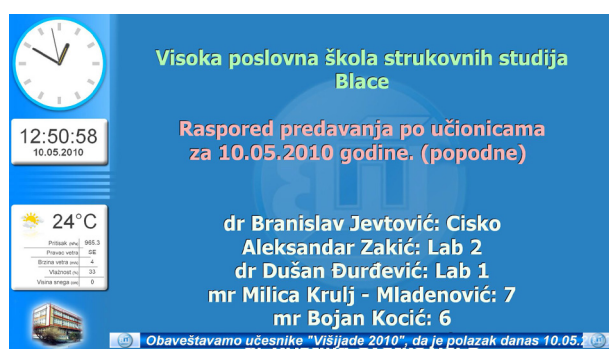


Fig. 7. Information screen of concrete realization

SOFTWARE SUBSYSTEM

Basic software modules of realized system are:

1. Module of employee work stations;
2. Module of info screen

3. Module for informing mobile users divided into two sub modules
 - a. Bluetooth module
 - b. SMS module

For development software subsystem is used Microsoft Visual Studio 2005. Among with standard libraries, library "32.Feet" of independent developer "In The Hand Ltd" [4] is also used. This dynamic library allows control of Bluetooth device which is connected on computer.

Module of employee work stations is a standard module for writing data entered by the user (employee) in correspondent MySQL tables. Architecture of information system allows access to databases via Web server, off course with right permissions from the administrator.

Module of information screen is realized through two separate services. First service is assigned to show information on information screen, while the other service is assigned to download data from nearest meteorological station and pass by those data to the first service. Service for showing graphics on the screen uses Windows GDI drivers. Service is made of a few separate parts: analog clock, digital clock and date, meteorological data, and text scroll. Data is refreshed in every 60 seconds. Service for collecting meteorological data uses Internet connection for downloading data in a form of RSS Feed [5] files from the official presentation of Meteorological Organization of Serbia. RSS Feed file is parsed, translated into program understandable data, and written into MySQL database server table. Data about weather is refreshed every 60 minutes.

Module for informing mobile users provides delivering files and text messages to mobile users. Process of file delivery is accomplished with the help of OBEX (Object EXchange) Object Push protocol (OPP) used for file transferring. OBEX Object Push allows file sending without previous device pairing (if this is enabled on device that receives data). By using those API calls, Object Push Protocol will be over OBEX protocol and by that mean it will follow specifications of Bluetooth stack.

Subpart of module designed to inform mobile users uses a GSM modem device attached to a computer. Users had to be previously subscribed

to this service, by sending an SMS with contents that will flag appropriate contents to be sent to the user. User's number is stored in MySQL data table. In that way user can subscribe to exam schedule for 2nd year students only of specific profile, and not receiving spam schedules meant to students of different profiles. Service checks for new information and sends them to the user daily. Once user want to quit his subscription to this service, he just have to send message with contents that say "quit" and his subscriber number and flags would be erased from data table. This will practically remove him from the system.

Process of data sending is composed out of many phases, searching, comparing founded MAC addresses of devices with addresses that are already in table (to prevent unwanted, repeated file sending to users), data sending, writing MAC addresses into table, like shown with diagram on figure 8.

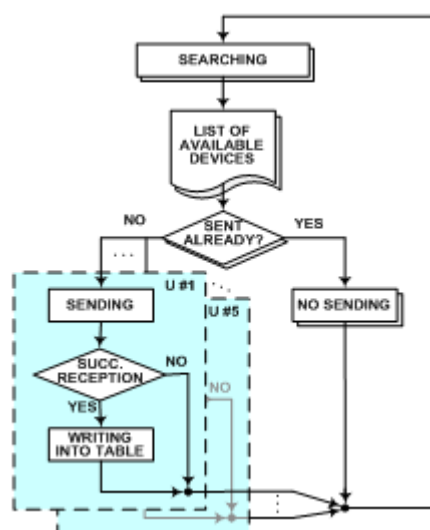


Fig. 8. Communication with mobile user

Phase of searching is repeated in every 30 seconds, if sending is not in progress. By searching we get an image of present devices. Sending of data is permitted on maximum five devices simultaneously. Communication with every device is enabled by starting an asynchronous thread that will be devoted to only one device – user (U#1 ... U#5). When communication is over, independently on whether file sent or not, thread that was assigned to communication is terminated. On that way we will allow communication with the next device

and create a new thread without consuming too much of computer resources.

Data that is transferred to a user is located on a MySQL data server, which can be running on local or remote machine. Because of permanent usage of services, application allows greater amount of users whose data is located on remote server. Communication of MySQL data server with application is applicable by local network or via Internet.

CONCLUSION

Information system for informing and notification of mobile users, realized on Business school of applied studies Blace, allows efficient notification in a range of one organization. Growing number of mobile devices with Bluetooth technology and their relatively low prices forwarded projectors to use that technology to realize communication with mobile users. Bluetooth and GSM SMS communication provides very wide specter of usability on system which basic characteristics are great functionality, efficiency and savings. Modular organization of system allows independent informing via information screen or by mobile devices.

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