NFC Ticketing Mobile Service

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ABSTRACT

Near Field Communication(NFC) is a young radio technology which operates within 10 cm and data rates available are 106, 212, 424Kbps and mobile ticketing is considered as one of the most promising application of NFC. Customers could use their mobile phone which is configured with RFID tag. Furthermore, NFC enabled unit have been placed at station in the area containing station specific information. Touching one of these NFC enabled unit opens ticketing application on mobile phone and fills out the departure station information.

NFC ticketing has many advantages over smart card application such as it is faster in speed..

Keywords

NFC, Rfid Reader, Tag, Communication mode

INTRODUCTION

The application, named NFC Ticketing (Near Field Communication Ticketing), is being developed following a user-centered approach, so obtaining a balance between the information reduction required by the user and the increase of application flexibility. In this way, the NFC Ticketing service will not only be less complex and therefore less expensive (keeping low both the cost of development and implementation) but will also be more usable for a broad community of users. The NFC Ticketing application combines latest-generation technologies (such as NFC) with Radio Frequency Identification (RFID). The architectural components are discussed. A new technology is quietly taking shape that could alter the use of consumer electronics is being developed to facilitate transactions, data exchange and connections with a touch [2], namely Near Field Communication (NFC). The development of the specifications is driven by the NFC Forum, a consortium of manufacturers, developers and financial services among others [4]. Mobile ticketing (In addition to payment, loyalty, access, smart posters, and others) is considered as one of the most promising applications of NFC [5]. The public transportation services are a life line to the world population. The usage of such services eases many problems including traffic congestion and pollution. With increasing public transport services, easy use and access of such services are important. For example, the electronic ticketing has provided numerous advantages to both travelers and transport Operators [7]. The Near Filed Communication (NFC) [6] or RFID [8] technology is used in such service which integrates mobile tickets and mobile payments. By using this technology, travel card readers cannot distinguish the mobile phone from travel card. Mobile phone works as a travel card even when battery is depleted. Several high-end mobile ticketing applications also allow user to access locations, calendar, and journey planner while integrating them with ticketing and payment system. Users can also opt for receiving discount coupons and advertisements based on their locations or journey route.

1. NFC Technology

NFC is a short-range wireless communication protocol, which is primarily intended to be used on mobile phones [3]. It is essentially as an extension of Radio Frequency Identification (RFID) technology, evolved from a combination of contactless identification and inter-connection technologies provides data exchange between devices across distances of up to 10 centimeters. NFC enables rapid and easy communications. This short range is not a disadvantage, since it aggravates eavesdropping. Simply by bringing two NFC-enabled devices close together, they automatically initiate network communications without requiring the user to configure the setup; one device must have an NFC reader/writer and another must have an NFC tag. The tag is essentially an integrated circuit containing data, connected to an antenna that can be read and written by the reader. It operates within the globally available and unlicensed radio frequency Industry Scientific and Medical (ISM) band of 13.56 MHz with supported data rates are currently 106, 212-424 Kbit/s. NFC promotes sharing, pairing and transactions between NFC devices and develops and certifies device compliance with NFC standards [1].

There are two modes of operation covered by the NFC protocol: Active and passive. In active mode, both devices generate their own radio field to transmit data. In passive mode, only one device generates a radio field, while the other use load modulation to transfer data. The NFC protocol specified that the initiating device is responsible for generating the radio field in this case. The passive mode of communication is very important for battery-powered devices like mobile phones and PDAs that need to prioritize energy use. The NFC protocol enables such devices to be used in power-saving mode, so that energy can be conserved for other operations. In addition, the active and passive NFC modes can be used to describe the conditions needed to prevent collisions during initialization.

OPERATING MODES

NFC operates in three different modes. Each of these modes requires that NFC devices use a common data format for communications. With this mode, NFC technology can give additional functionality to a mobile device that can be used such as a contactless credit card or a contactless train ticket.

2.1 NFC Card Emulation (NCE) Mode:

NFC devices can also act as smartcard (ISO 14443) and contain a secure smartcard chip also referred as a Secure Element (SE) that operates in card emulation mode. The secure element is connected to the NFC controller for proximity transactions (contactless payments). Host controller is able to exchange data with the secure element. A NFC-enabled device emulates a contactless payment card and can be used to purchase goods and services. In this mode, the device is passive. so it does not generate a RF field.

Fig 1: card emulation

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2.2 Peer-to-Peer (P2P) Mode

In the peer-to-peer mode, two devices can exchange data at link-level. This mode is standardized on the ISO/IEC 18092 standard, and allows data speed up to 424 Kbit/sec. Peer-to-peer mode applications are developed fewer than other modes' applications. It is generally studied for data transfer operations. Users can exchange their business cards by touching their NFC enabled mobile phones. Also file transfer is performed between an NFC-enabled mobile phone and an NFC-equipped computer. It can be said that peer-to-peer mode is able to provide easy data exchange.

Fig 2: Peer to Peer

2.3 Reader/Writer (R/W) Mode

Reader/Writer mode enables NFC devices to read/write data from/to NFC compatible tags. Smart poster applications are one of the most important applications of this mode and in a university smart poster application is presented. In this application users are able to read data from NFC-enabled posters using their NFC-enabled mobile devices. Upon receiving a data to mobile device (e.g. a department staff information), she can walk away from the poster but she can still read data from mobile device. She doesn't need to write down the data to a paper neither she doesn't have to remember it which can still be read at the screen. As described above, user gained mobility from this process as she can get the required data to mobile device and leave the location.

Fig 3: Reader/Writer mode

3. SYSTEM ARCHITECTURE

Following are the components of system architecture.

3.1 Mobile Phone

The first component will be a GPRS enabled mobile phone with an RFID chip attached to it. The mobile phone will be fed with a computer program coded entirely in J2ME.

3.2 RFID Reader

The RFID Reader is the second component which is meant to be mounted on the wall of Railway Stations that would be accessible to the commuters.

3.3 Server

This is the most important component that is supposed to manage the entire system. The server will consist of the user database i.e. their unique ID's and a computer program coded in VB.NET.

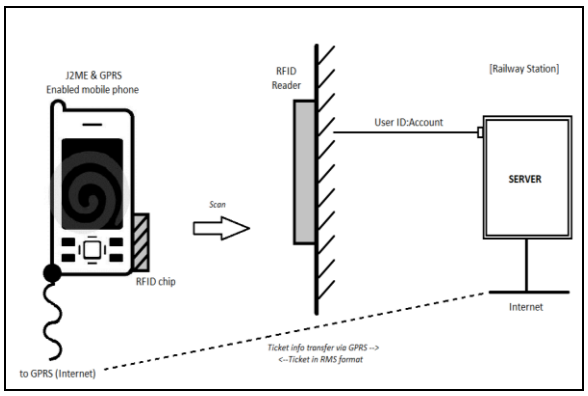

Fig 4: Block Diagram (architecture)

3.4 USB to TTL CP2102

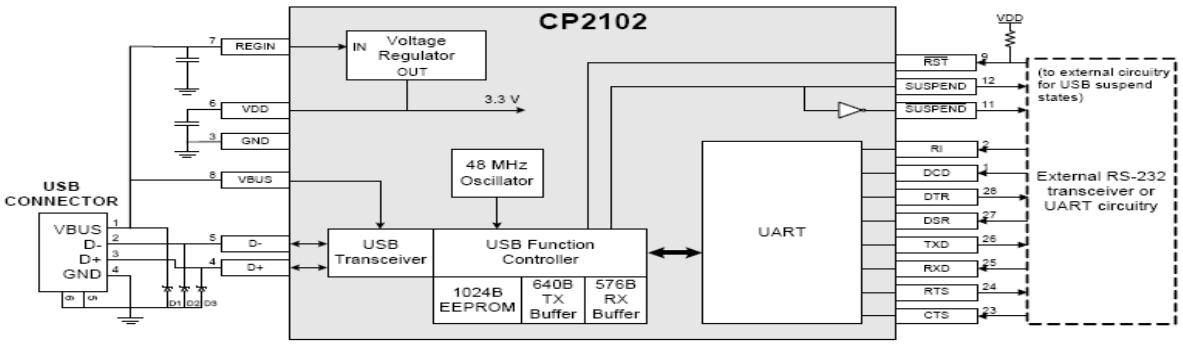

Fig 5: USB to TTL CP2102

The CP2102 is a highly-integrated USB-to-UART Bridge controller providing a simple solution for updating RS-232 designs to USB using a minimum of components and PCB space. The CP2102 includes a USB 2.0 full-speed function controller, USB transceiver, oscillator, EEPROM, and asynchronous serial data bus (UART) with full modem control signals in a compact 5 x 5 mm MLP-28 package. No other external USB components are required.
The on-chip EEPROM may be used to customize the USB Vendor ID, Product ID, Product Description String, Power Descriptor, Device Release Number, and Device Serial Number as desired for OEM applications. The EEPROM is programmed on-board via the USB allowing the programming step to be easily integrated into the product manufacturing and testing process.
The various sections of USB to TTL CP2102 are as follows.

3.4.1 USB Fuction controller and Transceiver

The Universal Serial Bus function controller in the CP2102 is a USB 2.0 compliant full-speed device with integrated transceiver and on-chip matching and pull-up resistors. The USB function controller manages all data transfers between the USB and the UART as well as command requests generated by the USB host controller and commands for controlling the function of the UART.

The USB Suspend and Resume signals are supported for power management of both the CP2102 device as well as external circuitry. The CP2102 will enter Suspend mode when Suspend signaling is detected on the bus. On entering Suspend mode, the CP2102 asserts the SUSPEND and SUSPEND signals. SUSPEND and SUSPEND are also asserted after a CP2102 reset until device configuration during USB Enumeration is complete.

3.4.2 UART Interface

The CP2102 UART interface consists of the TX (transmit) and RX (receive) data signals as well as the RTS, CTS, DSR, DTR, DCD, and RI control signals. The UART supports RTS/CTS, DSR/DTR, and X-On/X-Off handshaking. The UART is programmable to support a variety of data formats and baud rates. The data format and baud rate programmed into the UART is set during COM port configuration on the PC. The data formats and baud rates available are listed in Table 1.

Table 1. Data Formats and Baud Rates

Data bits	5, 6, 7 and 8
Stop bits	1, 1.5, 2
Parity type	None , even, odd, mark, space
Baud Rate	300, 600, 1200, 1800, 2400, 4000, 4800, 7200, 9600, 14400, 16000, 19200, 28800, 38400, 51200, 56000, 57600, 64000, 76800, 15200,128000, 153600, 230400, 250000, 256000,460800, 500000, 576000, 921600

3.4.3 Voltage Regulator

The CP2102 includes an on-chip 5 to 3 V voltage regulator. This allows the CP2102 to be configured as either a USB bus-powered device or a USB self-powered device. When enabled, the 3 V voltage regulator output appears on the VDD pin and can be used to power external 3 V devices. Alternatively, if 3 V power is supplied to the VDD pin, the CP2102 can function as a USB self-powered device with the voltage regulator disabled. For this configuration, it is recommended that the REGIN input be tied to the 3 V net to disable the voltage regulator.

3.4.3 Internal EEPROM

The CP2102 includes an internal EEPROM that may be used to customize the USB Vendor ID, Product ID, Product Description String, Power Descriptor, Device Release Number, and Device Serial Number as desired for OEM applications. Customization of the USB

configuration data is optional. If the EEPROM is not programmed with OEM data, the default configuration data shown in Table 2 is used. However, a unique serial number is required for OEM applications in which it is possible for multiple CP2102-based devices to be connected to the same PC.

Table 2. Default USB Configuration Data

Name	Value
Vendor ID	10C4h
Product ID	EA60h
Power Descriptor(Attr.)	80h
Power Descriptor(Max. power)	32h
Release Number	0100h
Serial Number	0001 (63 characters maximum)
Product Description String	"CP2102 USB to UART Bridge Controller" (126 characters maximum)

3.5 RFID 125Khz Tag

This is a basic RFID Tag Card used for presence sensing, Access Control etc. Works in the 125kHz RF range. These tags come with a unique 32-bit ID and are not re-programmable.

It is EM4001 ISO based RFID IC, consists of 125kHz carrier and supports 2kbps ASK and Manchester encoding. The 64-bit data stream consists of Header +ID + Data + parity.

Fig 6:EM4001 RFID Tag

3.6 Working

Initially the commuter willing to issue a ticket will open the application fed into his mobile phone. The application would consist of all the necessary details to be entered for issuing a basic ticket like destination, no of consumers, etc. After successfully entering the details the user will submit those over the internet.

The next step would be that the user will have to quickly get his mobile phone scanned with the RFID Reader mounted on the Railway Stations, which will lead scan the RFID tag on the users phone thus obtaining his unique ID. This ID will be transferred over to the Server. The Server in turn will connect to the internet to fetch the details entered by the user and create a ticket in RMS (record management store) format. RMS format is a kind of data storage format which cannot be tampered by the user. This RMS ticket will be sent to the users mobile phone via the internet thus completing the entire transaction. The ticket will be a timed version which will last for a stipulated time in which the user is meant to complete his journey.

In the meanwhile the server maintains an account of every user and while a ticket or transaction has been requested the amount will be deducted from the balance, further making it easier in the payment terms too.

This project consists of software as well as hardware components that need to go together for proper working of both. The implementation of this project began with the obvious first step i.e. collecting all the required details to kick start the project viz. RFID Model features, NFC Concept.

The next step is studying the concepts of programming required for the project viz. Serial Port controlling, Database creation and connectivity using VB.NET. MIDlet creation in J2ME for mobile phone application which acts as RFID tag and GPRS connectivity. Integration of all the above components and communicating Mobile phone and computer applications. Mounting up of RFID reader and USB to TTL creating a representation of the NFC Model.

4. CONCLUSION

Mobile and web services market is growing rapidly and services are helping users to make their lives easy. In this review; an example of the NFC ticketing application has been discussed. Mobile ticketing will play an important role in introducing users to the notion of using a mobile phone for mobile commerce. There might be creative applications and services being introduced that allow consumers to buy and store tickets on their mobile phone. This will become very convenient for consumer.

5. REFERENCES

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