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Near Field Communication (NFC)

Harnoor Singh[1], Prof. Sukhwinder Singh[2]
[12]E & EC Department, PEC University Of Technology, Chandigarh, India

Abstract: Near field communication (NFC) is a set of standards for smartphones and similar devices to establish radio communication with each other by touching them together or bringing them into proximity, usually no more than a few inches. Near Field Communication (NFC) is one of the short range wireless communication technologies based on RFID. NFC provides secure and inherent communication between electronic devices. This paper gives us the various applications of NFC and its growing use in our life like wireless charging, promoting mobile payment, etc.

Keywords: PLC, RFID, Qi specification, SCADA, tags, wireless communication.

I. Introduction

The amount of NFC phones is increasing at a fast pace. One hundred million NFC phones have been estimated to be shipped in 2012 [1]. Hence, applications utilizing NFC can reach large amounts of users and have potential for profitable business. Android Beam uses NFC to enable Bluetooth on both devices, instantly pair them, and disable Bluetooth automatically on both devices once the desired task has completed. This only works between Android devices version Jelly Bean and above. The advantage of using Wi-Fi Direct over Bluetooth is that it is much faster than Bluetooth, having a speed of 300Mbit/s for sharing large files. Since unpowered NFC "tags" can also be read by NFC devices, it is also capable of replacing earlier one-way applications. Payment, ticketing, and information access are seen as promising application areas for NFC– and these application areas have indeed attracted a large share of the development efforts. In addition, some games using NFC have been presented, like Angry Bird Magic and Fruit Ninja. Foursquare is an example of social applications utilizing NFC [2]. These examples illustrate how NFC can be applied in many different application areas. Generally, NFC technology can be used to replace manual typing, menu selections, and other user interface actions with acts of touching. Users can carry either devices equipped with NFC readers or NFC tags and, respectively, either NFC tags or NFC readers can be installed in the environment. In this article, we focus on NFC phones and NFC tags placed in the environment. In the simplest case, the environment contains only individual NFC tags storing commands for phones. We foresee much richer environments in which large amounts of devices (like displays and white goods) and services are controlled by touching NFC tags with phones. NFC tags areattached both on the devices and onto physical objects related toservices, devices, commands, and content.
NFC has industrial applications in monitoring plant information. NFC has a short range of 0-4 centimetres which is normally a drawback in some applications. However it's an advantage in this application as it helps us to deliver localization based information just by simply touching the NFC tag with NFC enabled smart phone.

II. What Is NFC?

Near Field Communication (NFC) is a standard based short-range wireless connection technology that enabled simple and safe peer-to-peer interconnections between electronic devices. Based on the Radio Frequency Identification (RFID), it uses the magnetic field induction to communicate between electronic devices. RFID system comprise of two components, the transponder (it also called contactless target or simply tag) and the transceiver (it also called read-write-device or simply reader or writer). RFID is an asymmetric technology because only the reader/writer device can initiate the data transmission. On the contrary, NFC allows the two-way communication between the two devices. NFC is based on RFID technology and uses the same communication mechanism. It combines the benefits of Radio Frequency Identification (RFID) and wireless communication technologies, included Bluetooth, WLAN, and IrDA. The NFC standards were proposed in 2003 [3]. It operates in the unlicensed frequency band of 13.56MHz. The data transmission rate of NFC is up to 424 Kbit/s between devices over a 10 centimetre (4 inches) distance. The transmission module inside can operate as the reader/writer component to access the tags, and the contactless smartcards based on proximity-card standard (ISO 14443), like Mifare (included NXP, Gratkorn, Austria) and Felica (included Sony, Tokyo, Japan) products. It combines the smartcard interface and the reader in a single device. NFC devices could communicate with the existing smartcards, the contactless readers, and support two-way communication between the other NFC-enabled devices in active and passive mode. Basically, NFC function enabled data exchange by taking two NFC-enabled devices close together. For any device with NFC tag built-in it, the device possesses the NFC function. NFC enabled the devices to use the tags and connect to them by the antenna. The antenna makes NFC enabled devices exchange the data. NFC communication via the magnetic field induction where the antenna are both located within near field and form an air-core transformer. NFC devices are unique; therefore they are capable of changing the mode of operation in accordance with the purpose of usage.

NFC devices can send and receive the data at the same time. The basic idea of NFC is to introduce a communication session by an intuitive, easy to operate, and secure way. Users only simply wave the device closed the device or point to the device accepted the NFC signals, the transaction can be completed immediately. Therefore, NFC is appropriate to be integrated in the consumer electronic devices, like mobile phones, Tablet PC, MPs, Personal Digital Assistants (PDA), watch, digital camera and so on. NFC really has a wide application in every aspect. Nokia made the first available mobile phone with NFC technology. To enable the NFC technology, users have to equip a special NFC shell with the mobile phone. It makes the mobile phones can read data from RFID tags as well as communicate with other NFC-enabled devices. As the service is provided, the build-in application is initiated for a phone call, sending an SMS, or connecting to a defined web service.

III. Wireless Charging Using NFC

Both the NFC and the WPC Qi specification are based on inductive coupling between antenna coils with tuning networks. A fundamental difference in their technical implementation is the operating frequency, which in the Qi specification is 110–205 kHz and in the NFC specification 13.56 MHz [4], [5]. This chapter discusses the consequences of the higher operating frequency of NFC for its power transfer capability and efficiency. The discussion is based on theoretical analysis, and the power transfer level and efficiency figures given here should be considered only as target values for the technical implementation. A simplified circuit model of a serial tuned inductive power transfer system is presented in Fig. 1. The primary side (transmitter) encompasses a carrier generator, RF amplifier (or inverter); an antenna tuning network for cancelling the reactive power from the RF amplifier, matching the antenna impedance, and damping the harmonic components of the basic operating frequency; and a transmitter antenna coil with inductance L1 and equivalent serial resistance R1. The secondary side (receiver) features a receiver antenna coil with inductance L2 and equivalent serial resistance R2, tuning capacitor C2S, and equivalent load resistance RLS emulating the rectifier and the DC load behind it. The mutual inductance between the transmitter and receiver antenna is M.

The total power transfer efficiency of inductive power transfer systems can be divided into three factors:

- Transmitter efficiency ηP, which is related to the power losses of the RF amplifier and tuning network in the transmitter;
- Link efficiency ηL, which is related to the power losses in R1 and R2 (antenna losses); and
- Receiver efficiency ηR, which is related to the power losses of the rectifier in the receiver.

Link efficiency ηLis defined as the output power to the load resistor (RLS) divided by the real power to the transmitter antenna including R1.

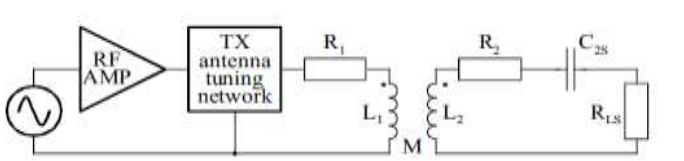
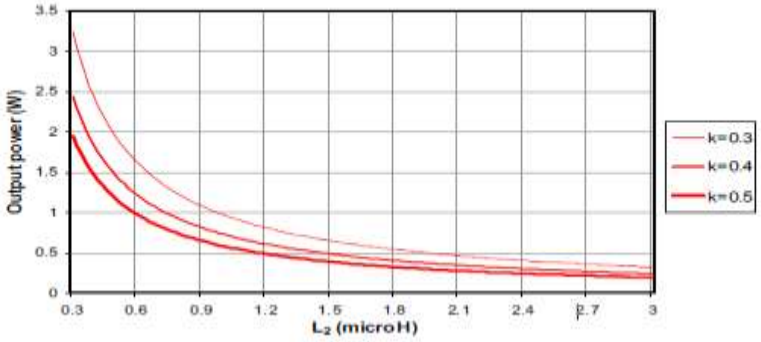


Figure 1. A simplified circuit model of a serial tuned inductive power transfer system.

Fig. 2 illustrates the output power level of a 13.56 MHz inductive link with typical NFC antennas that are optimally tuned. The power level of the inductive link is adjusted such that the output voltage across the optimal load resistor RLS_OPT is 5 VRMS. The graphs give an indication of a reasonable power transfer level attainable by properly tuned and loaded NFC-enabled charging systems. A higher output power level with this output voltage (i.e., lower RLS) would be possible but would lead to non-optimal loading of the receiver and thus to decreased link efficiency.



Equation (4) indicates that the relatively high operating frequency of NFC increases RLS_OPT, which means lower power transfer capability with a fixed output voltage [6]. On the other hand, the high operating frequency with fixed output power and voltage enables smaller antenna inductances and thereby also smaller and lighter antennas. Moreover, the high operating frequency enables higher antenna quality factors and thus also increased power transfer efficiency of tuned inductive links. On the other hand, the high operating frequency increases losses in the transmitter and the receiver electronics.

IV. Monitoring Plant Information Using NFC

Short-range communication technologies have been very useful in the development of various applications for devices, ranging from payment of goods and services, downloading information, sharing data between two devices etc. NFC has become an attractive research area for many researchers and practitioners due to its exploding growth, promising applications and related services. NFC as a promising design science research area grew significantly in recent years, especially after 2008. However most of the researches using NFC Reader/Writer Mode Applications are on the fields relating to retailing, health, education, supply chain management, museums, social networking, shopping, electronic voting, multimedia controller, smart posters etc. This paper is an effort to make use of NFC technology in industrial automation. The manufacturing plant consists of different process modules which perform different operations and in some cases it can also have sub process modules. If the Maintenance Engineer wants to view the real time information of a particular process module for effective surveillance or if a particular module failed due to some reason or other. Initially the maintenance department first has to gather some useful real time information about the process module before they start fixing the problem. In order to get the relevant information they have to browse through the industrial control systems like Distributed Control System (DCS), Programmable Logic Controller (PLC) or Supervisory Control and Data Acquisition (SCADA) systems which sometimes quite tedious and laborious.

We propose NFC technology to access the required real time process information like time series of process variables, number of work pieces produced and the health condition of the process module. Just by doing a simple touch to the special location of NFC tag on the process module with the NFC enabled mobile phone the required real time process information can be obtained. The advantages of using NFC technology compared with other short range wireless communications are NFC is inexpensive and no setting up of connection is required. NFC is compatible with existing RFID infrastructures. RFID is widely used in Industrial and manufacturing settings. Another important feature of NFC when compared with other short range wireless communication technologies such as Bluetooth and WIFI are it uses magnetic coupling so that a passive device can also communicates by absorbing the power from the active device. The combination of NFC with Bluetooth, WIFI, and GPRS can enable long range wireless access.

V. Collaborative Mobile Payment Using NFC Micro Sd Technology

Mobile payment is the transaction in which a mobile device is used to initiate, authorize and confirm an exchange of financial value in return for goods and services. According to the definition of the Mobile Payment Forum, the mobile payments are the transactions with monetary value that is guided through the mobile network by diverse mobile devices [7]. Contactless technologies, such as Radio Frequency Identification (RFID) and Near Field Communication (NFC) are emerging as proximity payment means. These technologies generally support the communication of the specific chip or tag in the smartcard of the mobile device and connect to the sale terminals. The direct participators of remote mobile payment contain the financial institutors, the mobile operators, third parties, Certificate Authority (CA) organizations, business organizations and the mobile users, etc. Comparing to traditional payment and online payment, the main advantage of mobile payment is ubiquity. The traditional payment is the transaction via the credit cards and cash. The users have to bring more credit cards and use it based on the different preferences of the credit cards. The credit cards service brings not only the convenience but also the trouble in life. With NFC mobile payment, the users can conduct payment via their mobile devices anytime and anywhere.

We mentioned that NFC-Micro SD technology not only provides the higher security mechanism, but also applies in every type of mobile phone with the unique patent. The consumers can transact by NFC-enabled devices without carrying many credit cards. The NFC-enabled devices can replace the credit cards and the cash. About the credit card operation, it involves in the confidential personal information. By NFC-Micro SD solution, the banks can keep the confidential personal information and follow the original procedure. The least change improves the willingness and acceptance of the card issuers. In order to follow the original procedure of card issuing, NFC-Micro SD provider only offers the empty NFC-Micro SD cards and specific recording machines to the Perso Company, like line 1 in Fig. 3.

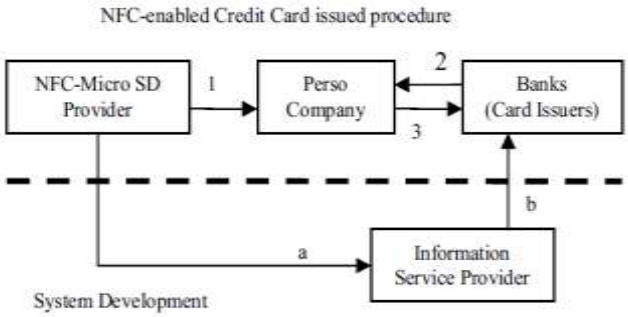


Figure 3. Collaborative mobile payment in NFC-Micro SD solution

In the original card issue procedure, the banks (the card issuers) entrusts the regional Perso Company to input all personal data into the credit cards. In Fig. 3, as the original procedure, the banks provide the confidential personal information to Perso Company, like line 2 shown. Perso Company will record the confidential data in the SmartCard Controller in NFC-Micro SD card according to the requirement of the banks. After PersoCompany finish recording, Perso Company will give the cards to the banks, like line 3 shown. With the procedure, NFC-Micro SD solution can enter in the financial industry without more obstacles [8]. By OTA function NFC-Micro SD provides, the banks can do the identity authentication directly, without identifying face-to-face or by telephone. The OTA function saves more cost and time for the card issuers. The OTA function also helps the consumers can not only consume in the physical stores, but also enjoy the virtual shopping in Apps online shopping mall.

Each NFC-Micro SD card includes several credit cards inside. To choose the certain credit card to do the payment, it depends on apps to choose the credit card would like to use. In Fig. 3, the whole procedure also contains the system development. In system development procedure, the participators are NFC-Micro SD provider and information service provider. NFC-Micro SD provider is responsible to assist the information service provider to develop the system and apps, like line a in Fig. 3. The information service provider will develop the apps according to the requirement of the banks and managed interface, information system for the banks, like line b in Fig. 3. The platforms of apps contain Android, iOS and etc. to support all types of mobile phones. The consumers choose the App (e.g. ICash) on their mobile phones, and open the App. After inputting the account name and password the consumers defined in advance, the consumers can choose the function (e.g. credit card transaction, mobile bank, ticketing etc.) and the credit card would like to use. Then the consumers can put the cellular phones close to the reader and conduct payment immediately or operate the mobile bank.

VI. Conclusion

In this project we came to know what NFC is and what its various applications in our life are. From using NFC as a wireless communicator, it can be used for monitoring plant information and evn mobile payments can be made using NFC based micro SD technology. The applications published so far are clearly just the tip of the iceberg. They use NFC for simple interaction (for example, to start an application). We envision NFC technology to be a key technology in building easy to use but functionally rich interactive spaces. NFC is applicable to a truly large set of applications as it can simplify many tasks a user has to perform, whether entering data, giving commands to an application, or creating links between resources in the environment.

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