Contactless Communication through Near Field Communication

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Abstract: **Near field communication is a set of principles for smart phones and alike devices to establish radio communication with each other by connecting them together or bringing them into compatibility which are usually not more than a few centimeters apart. Present and anticipated applications include contactless transactions, data exchange, and simplified setup of more complex communications such as Wi-Fi. This paper highlights the capabilities of near field communication and its potential to enhance everyday lives. It shows how NFC would transform standalone wireless networking resources into truly interoperable communications media for accessing public transportation and facilities, making retail payments, transferring data, gaining new information, and more. It further describes how the NFC Forum works to drive NFC standardization and encourage its adoption in the market.**

Keywords: Near Field Communication (NFC), protocol, network, RFID, NDEF (NFC Data Exchange Format).

I. INTRODUCTION

Think about the way in which mobile phones have made it so easy to be in touch with people friends, family, co-workers from just about anywhere: no cords, no coins, no laborious connections or tedious routines to remember. Then think about what it would be like if you face the complexities of setting up network connection between devices. Awkward network settings can possibly be dealt within the computer world but certainly not in the consumer electronics world. Let us think if other electronic devices in your life would work as easily and as intuitively, if you could set up connections with a simple touch or transfer information from one device to another just by holding them close to one another.

This is the main motivation for the Near Field Communication Interface and Protocol [1] (NFCIP-1), which is targeted towards the consumer electronics users that would use the secured means of communication between various devices without applying much intellectual attempt in configuring their network. The possibilities for using Near Field Communication are nearly limitless. The powerful attraction of touch-less transactions will help knit NFC technology into the fabric of our daily lives [4]. What   Is Near Field Communication? Near field Communication or NFC is a standard defined by the NFC Forum, a global consortium of hardware, software/application, credit card companies, banking, network providers, and others who are interested in the progression and standardization of this promising technology.

Figure1: Limitless possibilities for using NFC

NFC is a short-range radio technology that operates on the 13.56 MHz frequency, with data transfers of up to 424 kilobits per second. NFC communication is triggered when two NFC-compatible devices are brought within proximity, around four centimeters. Think of waving your iPhone near a credit card reader at the counter of Chipotle. NFC is based on a communication standard that specifies how two devices establish a peer to peer network in order to exchange data. NFC uses electromagnetic radio fields to communicate. This is in contrast to Bluetooth or Wi-Fi which use radio transmissions. However, NFC is compatible with both technologies. It is inherently secure as the distance requirement is so close. NFC is distinguished by its intuitive interface and its ability to enable largely proprietary wireless

networking platforms to interoperate in a seamless manner. The primary uses are to:
• Connect electronic devices, such as wireless components at home or office system or a headset with a mobile phone.
• Access digital content, using a wireless device such as a cell phone to read a smart picture embedded with an RF tag.
• Make contactless transactions, including those for payment, device access and ticketing.
The concept of NFC network is remarkably simple: in order to make two devices communicate, bring them together or make them touch. This will engage the NFCIP-1 wireless devices interfaces and configure them to link up in a peer-to-peer network. Once the configuration data has been exchanged using NFC, the devices can set up and continue communication for longer range and faster protocols like Bluetooth or Wireless Ethernet.

	NFC	RFID	IRDA	BLUETOOTH
Set-up time	<0.1ms	<0.1ms	~0.5s	~6s
Range	Up to 10cm	Up to 3m	Up to 5m	Up to 30m
Usability	Human centric Easy,Intuitive ,fast	Item centric Easy	Data Centric Easy	Data Centric medium
Selectivity	High, given, security	Partly given	Line of sight	Who are you?
Use cases	Pay, get access,share,i nitiate service, easy set up	Item tracking	Control & exchan ge data	Network for data exchanga,he adset
Consumer experience	Touch,wave,s imply connect	Get informati on	Easy	Configuratio n needed

Table1:Comparing NFC to other close range communication.

As shown in Table 1, when compared to the other short-range radio technologies, NFC is extremely short ranged and is called as people centric [8]. Some of the other short-range communication technologies have similar characteristics, for example RFID, while others are wholly different yet complimentary to NFC; for example Bluetooth and Infrared. A good scenario of such compliment is the combination of NFC and Bluetooth, where NFC is used for pairing (authenticating) a Bluetooth session used for the transfer of data.
The technology works on the idea of powering the target the passive device with the electromagnetic field of the active device[2]. Similar to the technology being used in smartcards used by all of us while travelling in metros or punch cards at office. Adoption of this technology has opened the surplus of

opportunities for new ventures to develop the software, hardware in the form of dongles to be used at the seller's end, application of technology into new domains and meeting the challenges posed by the technology mainly into the security domain.

II. UNIQUE FEATURES OF NFC

What makes the communication between the devices so easy is that the NFC protocol provides some features not found in other general purpose protocols.
First of all, it is a very short-range protocol. It supports communication at distances measured in centimeters. The devices have to be literally almost touched to establish the link between them. This has two important consequences:
1) The devices can rely on the protocol to be inherently secured since the devices must be placed very close to each other. It is easy to control whether the two devices communicate by simply placing them next to each other or keeping them apart.
2) The procedure of establishing the protocol is inherently familiar to people: you want something to communicate – touch it. This allows for the establishment of the network connection between the devices be completely automated and happen in a transparent manner. The whole process feels then like if devices recognize each other by touch and connect to each other once touched.
3) Another important feature of this protocol is the support for the passive mode of communication.
4) The NFC protocol is also compatible with the widely used contactless smart card protocols FeliCa and Mifare. The NFC devices are able to work with the smart cards and smart card readers conforming to these protocols in a flawless manner. Not only a card may be viewed with an NFC device but also an NFC device can be used instead of a card.

III. NFC MODES

As shown in figure 2, the NFC forum defines three communication modes:
• Peer-to-Peer mode is defined for device to device link-level communication. This mode is not supported by the Contactless Communication API.
• Read/Write mode allows applications for the transmission of NFC Forum-defined messages. This mode is not secure and supported by the Contactless Communication API.
• NFC Card Emulation mode allows the NFC-handset behave as a standard smartcard. This mode is secure. and is supported by the Contactless Communication API.
• NDEF - NFC Data Exchange Format - standard exchange formats for URI, Smart Posters.
• RTD - Record Type Definition - An NFC-specific record type and type name which may be carried in an NDEF record.
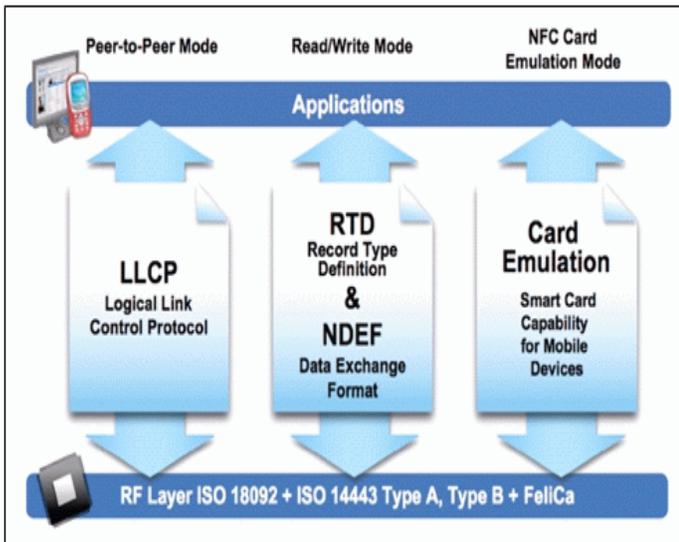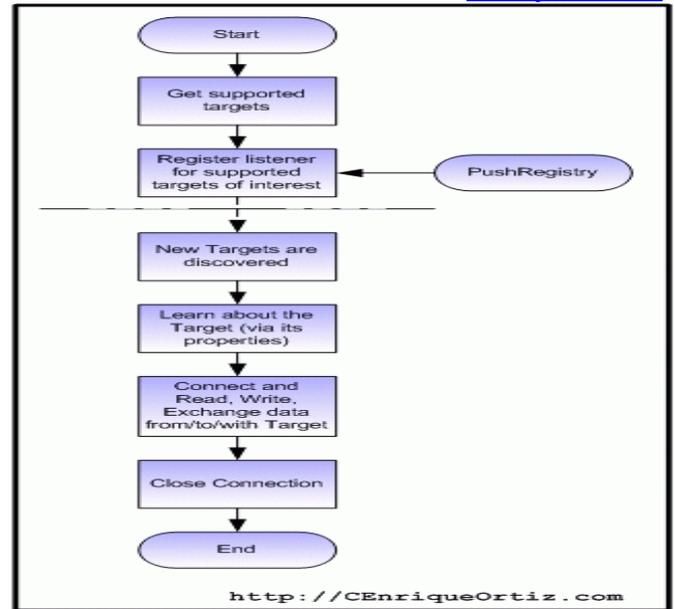
Figure 2: NFC Modes

Figure 3:Typical flow of Contactless Communication.

IV. CONTACTLESS COMMUNICATION API

- NDEF message - Basic message construct defined by this specification. An NDEF message contains one or more NDEF records.
- NDEF record - Contains a payload described by a type, a length, and an optional identifier.NDEF payload - The application data carried within an NDEF record.

As shown in figure 3, the Contactless Communication API allows you to discover and exchange data with supported contactless radio and visual targets (tags).
The first step is for the application to query the implementation to discover the target types that are supported by the handset.
1. For each supported target type, the application can register a target listener to receive activity notifications. Alternatively, the application can register with the Push Registry for activation due to target activity, supported target activities are NDEF and secure element in card emulation mode activities [7].
2. As targets come into closeness, they are detected by the implementation, which in turn notifies the application(s) by invoking the appropriate activity listeners. Alternatively the Push Registry activates the MIDlet.
3. For each discovered target, the application can learn the target's properties.

4. The application can connect to, read, write and exchange data with the discovered target. After the completion of the work, it closes all the opened connections.

V. BENEFITS OF NFC

- Highest convenience for the user, due to intuitive usage by just holding two devices close to each other.
- Complementary to existing wireless technologies
- Interoperable with compatible RFID systems at 13,56 MHz.
- Allows communication, both between two powered devices and between powered and passive devices.

VI. NFC APPLICATIONS

Early uses of the technology are expected to be with NFC-enabled mobile phones, which can easily be configured to become the only thing anyone needs to carry. Everyone will be able to:
• make payments with a wave or a touch anywhere contactless card readers have been deployed.
• read information and "pick up" special offers and discounts from smart posters or smart billboards.
• Store tickets to access transportation gates, parking garages or get into events.
• store personal information that will allow secure building access.

• take a picture and transfer it to an NFC-enabled printer or monitor.
• share business cards with other NFC-enabled phones.

A. Transit and Ticketing

Figure 4: Transportation using NFC

As shown in figure 4, Transportation is the first entity and has leading use of NFC Technology. Contactless tickets have already begun to transform the speed and ease with which all consumers can use public transport and access Controlled environments like parking garages. Users praise NFC transactions for their speed, security, and flexibility. With NFC enabled mobile phones, you can buy tickets, receive them electronically and use them for seamless traveling [6]. Later, you can check your balance or update your tickets remotely. The cost of providing mass transport or event ticketing will be driven down because NFC based systems reduce the cost of card issuance and management. Commuter transit systems in Europe and a number of Asian countries already use NFC compatible contactless technologies to speed up travelers through to their destinations.

B. Payment Facility

NFC enabled mobile devices can store a payment application that is compatible with the millions of installed contactless payment readers. The natural simplicity of holding a mobile phone close to a terminal to purchase products or services instead of swiping or handing over a payment card reflects NFC's potential to bring about the next main change in the way the average buyer pays for things. A phone can store information about multiple accounts, such as credit, debit and prepaid cards, allowing users to select payment instruments more easily than they would from their wallets. Transactions are also secure, with the payment application usually protected by a password. Payment information on lost or stolen phones can be remotely deactivated, enabling a strong layer of security.

C. Advertising

Eliciting and gathering information is easy to do with NFC, whether by bringing a phone to a point on an indoor retail display to obtain an electronic coupon or by holding it up to a

poster to download the latest ring tone from your favorite musical group. NFC enabled devices can be a great marketing tool and a source of new revenue for business [5]. Users are surrounded with advertisements and offers of valuable information, making it easy to obtain and utilize rich media content. Other advantage to mention is when a consumer initiates the contact by bringing an NFC enabled mobile phone to an NFC tag, effectively self qualifying for the product or service being offered. NFC will fuel the market for advanced personal electronic devices capable of purchasing, playing, storing, and sharing media. Mobile content providers earn income when users choose value added services.
Travelers will find it easier to get around in an NFC enabled world. Tourists from France can use an NFC equipped tourism kiosk in Singapore to get information in French on their phone's display screen. Visitors to an unfamiliar location can bring their phones close to a street side signboard outside a museum to find out about the latest exhibition inside and can be translated conveniently into several languages. NFC tags can be placed nearly anywhere inside product packaging, at cash registers and on point-of-sale equipment, or outdoors on access gates, parking meters, newspaper dispensers, offices, houses, garage doors, bus stops or ATMs. The possibilities are as wide as the imagination.

D. Connectivity

Whether you are holding two phones together to exchange electronic business card information or photos, or bringing two laptop computers together to initiate a high-speed file transfer, NFC offers several ways to speed and simplify data exchange transactions among consumer electronics products. As NFC technology penetrates throughout the office, WLAN settings, printer IDs and even maps of the building can be picked up by NFC-enabled devices, allowing mobile workers to quickly get to work in any office location. Staff members can synchronize calendars, exchange electronic business cards, and access online digital content. In brief, NFC simplifies connections. To connect a Bluetooth headset to a mobile phone, for example, just place the two together and a fast NFC handshake link establishes between the two devices.

E. Maximizing Other Wireless Platforms

Beyond the exceptional success of the mobile phone, the acceptance of mobile communications technologies has not progressed as rapidly as many industry experts have predicted. Thirteen years after its invention, Bluetooth® has

become part of the daily lives of technically progressive users, but it has by no means become omnipresent. A similar story can be told for Wi-Fi and ZigBee communications protocols. That is where NFC comes in, overcoming barriers to wireless technology stand adoption by making the system easier to use. Using Bluetooth as an example, you can visit a client and leave behind a PowerPoint presentation. Even if the presenter's computer and the target computer are Bluetooth enabled, it is still necessary to manually set up the link between the two systems using a password to secure the transfer. But if both Bluetooth systems have NFC chips built in, a Bluetooth peer-to-peer connection can be established simply by bringing the distinctive NFC "hot spot," or target mark, of the first computer to the corresponding NFC target mark of the second. The Wireless USB Promoter Group will incorporate "touch-and-go" NFC technology into the second specification of Wireless USB, version 1.1. Recently, the Wi-Fi Alliance introduced NFC as the one of four Ways to configure home networks. The NFC option is widely recognized as the simplest method for setting up home networks, making use of NFC's sensitive user interface for automated out-of-band pairings of Wi-Fi devices. NFC enables the two Bluetooth enabled devices to exchange communications parameters, establish a secret key, and create a Bluetooth communication link automatically. The devices can then be moved apart as the picture copies securely from one device.

F. Near Field Communications (NFC) – Security
The basic need for security is because the two devices must be within a very close proximity to function. Data between the two NFC devices connecting can be encrypted using AES standards [3]. Encryption is not required by the standard, but would definitely be a best practice. The omission of encryption was intentional in order to make sure the technology was compatible with prior implementations of RFID. Eavesdropping is something of concern in terms of security[2]. Theoretically, a third device could enter the picture and steal data. This is why encryption would be necessary for things such as credit card transactions. In the event that an NFC ready device is stolen, there is a risk that a credit card can be used to make procurement. The situation of a stolen NFC ready mobile device might be prevented with the use of a pass code or password to complete the communication. Researchers are looking at ways to deal with security in credit cards and other passive devices. When it comes to the secure connection between two NFC enabled devices, encryption is the best method to protect the communication stream.

VII. CONCLUSION

NFC (Near-Field Communication) is a technology that delivers on the pledge of connecting the physical and virtual environments. It promises to offer the key to omnipresent wireless networking of all kinds. It is a powerful means, a highly stable wireless connectivity technology that provides intuitively simple and safe two-way interactions between electronic devices. It has the impending potential to make almost all wireless technologies easy enough so that everyone and even the non-technical persons can use them.

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