A Paper Presentation

On

**Near Field Communication (NFC)**

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**Abstract:**

Near field communication (NFC) is a wireless communication technology where the communication happens over a short distance of normally 4 cm or less. It is a technology based on radio waves, and can be seen as an extension of RFID (Radio Frequency Identification). The technology always involves an initiator and a target. An active initiator generates a radio frequency field, which powers a passive target. Due to the fact that only one actor has to be powered, the passive target takes up little space and can be implemented in a wide range of products, such as magazines, and all kinds of other products. The technology can also involve two active devices, where they alternate their own fields.

**Introduction:**

NFC is a radio technology that supports transactions at distances of a few centimeters. NFC is designed to support existing RFID transactions including contactless payments and some ticketing systems, as well as being a generally programmable platform. During a transaction, one party can be completely inactive, drawing power inductively from the active party. Even the active party draws little power and can be left on all the time with minimal effect on the phone’s overall power draw. Also, the nearness of NFC transactions creates the possibility of using proximity as context and triggering an appropriate action almost instantaneously.

Availability of NFC on smart phones presents an exciting opportunity for system and application designers, because not only can phones scan in information, but also programmatically generate new information to be presented for scanning. Furthermore, information received can be processed by the many available applications on the phone, facilitated by NFC’s RTD architecture. The ubiquity of mobile phones means that most consumers in the future will have access to this technology. The programmability means that many applications can be developed to facilitate peer interactions. They can communicate directly without requiring a third-party server. The effortless connection of NFC opens up many opportunities for the phones to be used to enhance physical social encounters. When we touch our phone with another NFC device, the other device provides the context that can be used to automatically invoke one or more applications on our phone with appropriate parameters.

**History:**

NFC traces its roots back to [radio-frequency identification](http://en.wikipedia.org/wiki/Radio-frequency_identification), or RFID. RFID allows a reader to send radio waves to a passive electronic tag for identification, authentication and tracking.

* 1983 The first patent to be associated with the abbreviation [RFID](http://en.wikipedia.org/wiki/RFID) was granted to Charles Walton.
* 2004 Nokia, Philips and Sony established the Near Field Communication (NFC) Forum.
* 2006 Initial specifications for NFC Tags.
* 2006 Specification for "Smart Poster" records.
* 2006 [Nokia 6131](http://en.wikipedia.org/wiki/Nokia_6131) was the first NFC phone.
* 2009 In January, NFC Forum released Peer-to-Peer standards to transfer contact, URL, initiate Bluetooth, etc.
* 2010 Samsung Nexus S: First Android NFC phone shown.
* 2011 Google I/O "How to NFC" demonstrates NFC to initiate a game and to share a contact, URL, app, video, etc.
* 2011 NFC support becomes part of the [Symbian](http://en.wikipedia.org/wiki/Symbian) [mobile operating system](http://en.wikipedia.org/wiki/Mobile_operating_system) with the release of Symbian Anna version.
* 2011 Research In Motion is the first company for its devices to be certified by MasterCard Worldwide, the functionality of Pay Pass.
* 2012 Sony introduces the "Smart Tags", which use NFC technology to change modes and profiles on a Sony Smartphone at close range, included in the package of (and "perfectly paired" with) the Sony Xperia P Smartphone released the same year.

**Specifications:**

NFC is a set of short-range wireless technologies, typically requiring a distance of 4 cm or less. NFC operates at 13.56 [MHz](http://en.wikipedia.org/wiki/MHz) on ISO/IEC 18000-3 air interface and at rates ranging from 106 Kbit/s to 424 Kbit/s. NFC always involves an initiator and a target; the initiator actively generates an [RF](http://en.wikipedia.org/wiki/Radio_frequency) field that can power a passive target. This enables NFC targets to take very simple form factors such as tags, stickers, key fobs, or cards that do not require batteries. NFC peer-to-peer communication is possible, provided both devices are powered. A patent licensing program for NFC is currently under development by Via Licensing Corporation, an independent subsidiary of [Dolby Laboratories](http://en.wikipedia.org/wiki/Dolby_Laboratories). A public, platform-independent NFC library is released under the free [GNU Lesser General Public License](http://en.wikipedia.org/wiki/GNU_Lesser_General_Public_License) by the name [libnfc](http://en.wikipedia.org/w/index.php?title=Libnfc&action=edit&redlink=1).

NFC tags contain data and are typically read-only, but may be rewriteable. They can be custom-encoded by their manufacturers or use the specifications provided by the NFC Forum, an industry association charged with promoting the technology and setting key standards. The tags can securely store personal data such as debit and credit card information, loyalty program data, PINs and networking contacts, among other information. The NFC Forum defines four types of tags that provide different communication speeds and capabilities in terms of configurability, memory, security, data retention and write endurance. Tags currently offer between 96 and 4,096 bytes of memory.

1. As with [proximity card](http://en.wikipedia.org/wiki/Proximity_card) technology, near-field communication uses [magnetic](http://en.wikipedia.org/wiki/Magnetic_field) [induction](http://en.wikipedia.org/wiki/Electromagnetic_induction) between two [loop antennas](http://en.wikipedia.org/wiki/Loop_antenna) located within each other's [near field](http://en.wikipedia.org/wiki/Near_and_far_field), effectively forming an air-core [transformer](http://en.wikipedia.org/wiki/Transformer). It operates within the globally available and unlicensed [radio frequency](http://en.wikipedia.org/wiki/Radio_frequency) [ISM band](http://en.wikipedia.org/wiki/ISM_band) of 13.56 MHz Most of the RF energy is concentrated in the allowed ±7 kHz bandwidth range, but the full spectral envelope may be as wide as 1.8 MHz when using [ASK](http://en.wikipedia.org/wiki/Amplitude-shift_keying) modulation.
2. Theoretical working distance with compact standard antennas: up to 20 cm (practical working distance of about 4 centimeters)
3. Supported data rates: 106, 212 or 424 [Kbit/s](http://en.wikipedia.org/wiki/Kbit/s) (the bit rate 848 Kbit/s is not compliant with the standard ISO/IEC 18092)
4. There are two modes:
	* Passive communication mode: The initiator device provides a carrier field and the target device answers by modulating the existing field. In this mode, the target device may draw its operating power from the initiator-provided electromagnetic field, thus making the target device a [transponder](http://en.wikipedia.org/wiki/Transponder).
	* Active communication mode: Both initiator and target device communicate by alternately generating their own fields. A device deactivates its RF field while it is waiting for data. In this mode, both devices typically have power supplies.

|  |  |  |
| --- | --- | --- |
| **Speed** | **Active device** | **passive device** |
| 424 Kbit/s | Manchester, 10% [ASK](http://en.wikipedia.org/wiki/Amplitude-shift_keying) | Manchester, 10% ASK |
| 212 Kbit/s | Manchester, 10% ASK | Manchester, 10% ASK |
| 106 Kbit/s | Modified Miller, 100% ASK | Manchester, 10% ASK |

1. NFC employs two different [codings](http://en.wikipedia.org/wiki/Coding_theory) to transfer data. If an active device transfers data at 106 Kbit/s, a modified [Miller coding](http://en.wikipedia.org/wiki/Miller_coding) with 100% [modulation](http://en.wikipedia.org/wiki/Modulation) is used. In all other cases [Manchester coding](http://en.wikipedia.org/wiki/Manchester_coding) is used with a modulation ratio of 10%.
2. NFC devices are able to receive and transmit data at the same time. Thus, they can check for potential collisions, if the received signal frequency does not match with the transmitted signal's frequency.

**Working:**

NFC devices communicate via magnetic field induction, where two loop antennas are located within each other's near field, effectively forming an air-core transformer. It operates within the globally available radio frequency ISM band of 13.56 MHz, with a bandwidth of almost 2 MHz The radius of near field communication having maximum strength can be calculated as follows:

 Rmax= λ/2\*π or Rmax= v/2\*π\*f

Working distance with compact standard antennas is up to 20 cm. Supported data rates of NFC are 106, 212, or 424 Kbit/s now. But according to NFC Forum, in near future it will come with a supported data rate of 1Mbps. NFC employs two different codings to transfer data. If an active device transfers data at 106 Kbit/s, a Modified Miller coding with 100% modulation is used. In all other cases Manchester coding is used with a modulation ratio of 10%.

MANCHESTER CODING

A low-to-high transition expresses a 0 bit, whereas a high-to-low transition stands for a 1 bit.

 

MILLER CODING

This line code is characterized by pauses occurring in the carrier at different positions of a period. While a 1 is always encoded in the same way, coding a 0 is determined on the basis of the preceded bit .

 



NFC has two communicative terminals as follows:

* The Initiator
* The Target

The initiator is the one who wishes to communicate and starts the communication. The target receives the initiator’s communication request and sends back a reply.

This concept prevents the target from sending any data without first receiving a message.

The NFC interface can operate in two different modes:

* + - * Active Mode
			* Passive Mode

An active device generates its own radio frequency (RF) field, whereas a passive device just uses the inductive coupling to receive data.

The communication between two active devices is called Active communication mode, whereas the communication between an active and a passive device is called Passive communication mode.

 

The active device acts as the initiator, responsible for generating the radio field. In the case of an active configuration in which the RF field is alternately generated, the roles of initiator and target are strictly assigned by the one who starts the communication.

By default all devices are NFC targets, and only act as NFC initiator device if it is required by the application. In the case of two passive devices communication is not possible.

 

**Example:**

NFC technology has the power to bring new simplicity and convenience to many aspects of a typical person's daily life, as this example illustrates:

7:30 - Eric gets on a train to go to his office, using his NFC-enabled phone to tap a reader and easily open the turnstile.

7:32 - He sees a poster announcing a free concert that evening. He touches his NFC-enabled phone to the N-Mark on the poster, which transfers the detailed information onto his phone. He reserves seats for the concert with his mobile phone, using mobile communications (e.g., SMS, internet, packet-based connections), and the complimentary tickets are sent to his mobile phone. He sends a text message to his wife to invite her to the concert and dinner.

8:15 - When he arrives at his office, Eric touches his NFC-enabled phone to the office gate to unlock the security mechanism.

Noon - At lunch time, he pays for his meal using one of the credit cards stored in his phone.

13:00 - After lunch, Eric visits the office of his new business partner for a meeting. Those attending the meeting exchange electronic business cards, stored in their NFC-enabled phones, by touching their phones together.

18:00 - Eric meets his wife and they go to the concert venue. He touches his NFC-enabled phone to a turnstile at the entrance to the venue, their reservations are confirmed, and they are admitted.

20:00 - After the concert, they visit a shopping center, where they make a few purchases and have dinner, using their NFC-enabled phones to pay for everything.

22:00 - When they arrive home, Eric realizes that he left his NFC-enabled phone on the train. He immediately calls the mobile network operator and makes a request to disable all active NFC services in the phone. If his phone is later found and returned to him, he will be able to reactivate these services.

**Applications:**

### Commerce: NFC devices can be used in [contactless payment](http://en.wikipedia.org/wiki/Contactless_payment) systems, similar to those currently used in [credit cards](http://en.wikipedia.org/wiki/Credit_card) and [electronic ticket](http://en.wikipedia.org/wiki/Electronic_ticket) smartcards, and allow [mobile payment](http://en.wikipedia.org/wiki/Mobile_payment) to replace or supplement these systems. For example, [Google Wallet](http://en.wikipedia.org/wiki/Google_Wallet) allows consumers to store credit card and store loyalty card information in a virtual wallet and then use an NFC-enabled device at terminals that also accept [MasterCard Pay-Pass](http://en.wikipedia.org/wiki/MasterCard#PayPass) transactions.

1. **Bluetooth and Wi-Fi Connections:** NFC offers a low-speed connection with extremely simple setup, and can be used to [bootstrap](http://en.wikipedia.org/wiki/Bootstrap) more capable wireless connections. For example, the [Android Beam](http://en.wikipedia.org/wiki/Android_Beam) software uses NFC to automatically complete the steps of enabling, pairing and establishing a [Bluetooth](http://en.wikipedia.org/wiki/Bluetooth) connection when doing a file transfer. Nokia has used NFC technology to pair Bluetooth headsets and speakers with one tap in its NFC-enabled devices. The same principle can be applied to the configuration of Wi-Fi networks.
2. **Social Networking:** NFC can be used in [social networking](http://en.wikipedia.org/wiki/Social_networking_service) situations, such as sharing contacts, photos, videos or files, and entering multiplayer [mobile games](http://en.wikipedia.org/wiki/Mobile_game).
3. **Identity and access tokens:** The NFC Forum promotes the potential for NFC-enabled devices to act as electronic [identity documents](http://en.wikipedia.org/wiki/Identity_document) and [keycards](http://en.wikipedia.org/wiki/Keycard_lock). As NFC has a short range and supports encryption, it may be more suitable than earlier, less private RFID systems.
4. **Smartphone Automation and NFC Tags:** Smartphones equipped with NFC can be paired with NFC tags or stickers which can be programmed by NFC apps to automate tasks. This can allow for a change of phone settings, a text to be created and sent, an app to be launched, or any number of commands to be executed, limited only by the NFC app and other apps on the Smartphone. This is perhaps one of the most practical current uses for NFC since it does not rely on a company or manufacturer but can be utilized immediately by anyone anywhere with an NFC equipped Smartphone and an NFC tag.

**Future Uses:**

* Identification: In the upcoming time, NFC services will be used for identification purposes. Persons will be identified by their NFC tags. Hence, one should not have to be careful about taking his ID card just for identification.
* Time and attendance: Using NFC enabled sensors, it will help a lot in checking the amount of people entered and left. It can also be used in offices for the check-in of employees.
* Physical access: With the use of NFC, one can prevent the chances of getting fake entries at any place.
* Secure log-on: If NFC tags are used, security can be maintained at a good level.
* Transit: NFC will help in transportation purposes, as one can get the information about his luggage update.
* Paperless Payments: Using NFC, we can do paperless payments, as one can save its credit card in its phone itself.
* Business: The most important thing in a business is trust. So if NFC is used, one can prevent illegal deals and contracts and will provide legal memberships.
* Reservations: Using NFC, one can reserve its tickets and can submit it using NFC tags.
* Wal-Mart: With the coming of Wal-Mart (Retail Store) announced this September in India, NFC could come in limelight. There could be a possibility that many Desi Retail stores like Big Bazaar, More, D-Mart, would use the same technology for their consumer for getting ahead in the competition.

**Conclusion:**

NFC has revolutionized the whole of short range wireless communication technology with its security, compatibility, user friendly interface, immense applications etc. NFC will allow what we term contextual application invocations. Applications can be invoked as a side-effect (attachment) of another transaction that provides it meaningful context. Applications can also be launched to exchange tokens, with our phones responding to the context of the token grantor. Finally, one phone may provide context to another to create a junction between them, allowing them to partake in a cross-device activity. It is quite predictable that in no time in future, we all will be well acquainted with this technology and it will be a prominent part of our lives.

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