NEAR FIELD COMMUNICATION

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WHAT IS NFC

Near-field Communication or NFC is a short range wireless technology standard defined by the NFC Forum, a global consortium of hardware, software/application companies who are interested in the advancement and standardization of this technology.

It offers safe, simple and intuitive low power communication between two NFC capable devices and facilitates simplified transactions, data exchange when they are in close proximity to each other.

This communication generally involves low power so NFC targets have simple form factors that don’t require power. (stickers, tags etc...)
NFC Consumer Device

- Get information by touching smart posters
- Use your NFC phone as an event ticket
- Print from your camera by holding it close to the printer
- Set up your wireless home office with a touch
- Share business cards with a touch
- Get on the bus by waving your NFC phone
- Pay for goods with a tap of your NFC phone
HISTORY

NFC traces its roots back to Radio-frequency identification, or RFID. RFID allows a reader to send radio waves to a passive electronic tag for identification and tracking.

The Near Field Communication forum (NFC Forum) was first established in 2004 by Nokia, Philips and Sony and their objective was to create a secured wireless communication tool. Today the forum has more than 140 members including HTC, Samsung, Google, Microsoft and PayPal.

The next to next slide shows some partners of this forum.
TIMELINE

1983
- The first patent to be associated with the abbreviation RFID was granted to Charles Walton.

2004
- Nokia, Philips and Sony established the Near Field Communication (NFC) Forum

2006
- Initial specifications for NFC Tags
- Specification for "Smart Poster" records
- Nokia 6131 was the first NFC phone

2009
- In January, NFC Forum released P2P 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.
- NFC support becomes part of the Symbian mobile operating system.
TECHNICAL SPECIFICATIONS AND HOW NFC WORKS
NFC technology is a simple extension of the ISO/IEC 14443 proximity-card standard (contactless card, RFID) that combines the interface of a smartcard and a reader into a single device.

An NFC device can communicate with both existing ISO/IEC 14443 smartcards and readers, as well as with other NFC devices, and is thereby compatible with existing contactless infrastructure already in use for public transportation and payment.
NFC COMPARED TO OTHER SHORT RANGE WIRELESS TECHNOLOGIES

Compared to other wireless communication technology such as Bluetooth or Wi-Fi, NFC does not require users to enter the processing information manually. NFC is preferred for payment methods over other communication technology due to its fast and automatic connection. This technology also has the advantage of only working at very short distance, hence reducing fraudulent connections and interference.

Even though both Bluetooth and NFC use short-range frequency, the latter consumes much less power and does not require pairing. Despite the protocol for the future Bluetooth 4.0 stipulating low energy consumption, it’s still higher than what consumed by NFC while used in an active mode. On the other hand Bluetooth has transfer rate of 2.1Mbits/s, Bluetooth 3.0 has even higher transfer rate of up to 24Mbits/s compared to low data transfer rates offered by NFC standards.
<table>
<thead>
<tr>
<th></th>
<th>NFC</th>
<th>RFID</th>
<th>IrDa</th>
<th>Bluetooth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Set-up time</strong></td>
<td>&lt;0.1ms</td>
<td>&lt;0.1ms</td>
<td>~0.5s</td>
<td>~6 sec</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>Up to 10cm</td>
<td>Up to 3m</td>
<td>Up to 5m</td>
<td>Up to 30m</td>
</tr>
<tr>
<td><strong>Usability</strong></td>
<td>Human centric</td>
<td>Item centric</td>
<td>Data centric</td>
<td>Data centric</td>
</tr>
<tr>
<td></td>
<td>Easy, intuitive, fast</td>
<td>Easy</td>
<td>Easy</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Selectivity</strong></td>
<td>High, given, security</td>
<td>Partly given</td>
<td>Line of sight</td>
<td>Who are you?</td>
</tr>
<tr>
<td><strong>Use cases</strong></td>
<td>Pay, get access, share, share, initiate service, easy set up</td>
<td>Item tracking</td>
<td>Control &amp; exchange data</td>
<td>Network for data exchange, headset</td>
</tr>
<tr>
<td><strong>Consumer experience</strong></td>
<td>Touch, wave, simply connect</td>
<td>Get information</td>
<td>Easy</td>
<td>Configuration needed</td>
</tr>
</tbody>
</table>
NFC communication is achieved via magnetic field induction, where two loop antennas are located within each other's near field, effectively forming an air-core transformer.

NFC operates within the globally available and unlicensed radio frequency ISM band of 13.56 MHz. Placing the NFC equipped device to a distance less than 4cm creates the connection with the receiver.

The NFC standard supports varying data rates, again to ensure interoperability between pre-existing infrastructure. The current data rates are 106kbps, 212kbps, and 424kbps.
There are two modes of communication and the data transfer is half duplex, meaning at one time one device is only in sending and the other is only in receiving mode. Without a message a reply is not obtained

- **Passive** Communication Mode: The Initiator device provides a carrier field and the target device answers by modulating existing field. In this mode, the Target device may draw its operating power from the Initiator-provided electromagnetic, thus making the Target device a transponder.

- **Active** Communication Mode: Both Initiator and Target device communicate by alternately generating their own field. A device deactivates its RF field while it is waiting for data. In this mode, both devices typically need to have a power supply
OPERATING MODES

- **PEER-TO-PEER MODE (NFC):** This mode is the classic NFC mode, allowing data connection for up to 424 Kbit/sec. The electromagnetic properties and the protocol (NFCIP-1) are standardized in ISO 18092 and ECMA 320/340.

- **READER/WRITER MODE (PCD):** NFC devices can be used as a reader/writer for tags and smart cards. In this case the NFC device acts as an initiator and the passive tag is the target. In reader/writer mode data rates of 106 Kbit/sec are possible.

- **TAG EMULATION MODE (PICC):** In this mode the NFC device emulates an ISO 14443 smart card or a smart card chip integrated in the mobile devices which connected to the antenna of the NFC module. A normal reader can’t distinguish a mobile phone operating in tag emulation mode from an ordinary smart card.
MODULATION TECHNIQUES

ACTIVE MODE

In active mode the data is sent using **amplitude shift keying** (ASK). This means the base RF signal (13,56 MHz) is modulated with the data according to a coding scheme.

Depending on baud rate different coding schemes are used.

PASSIVE MODE

In passive mode the data sent is always encoded using **Manchester coding** with a modulation of 10%.

Additionally to the active and passive mode, there are two different roles a device can play in NFC communication.

Initiator  Target
The NFC Forum has released eleven specifications to date:

- **NFC data exchange format (NDEF)** – Data format for devices and tags
- **NFC tag types 1,2,3 & 4 operation** - Defines R/W operation for NFC tags
- **NFC record type definition (RTD)** - Used in messages between devices/tags
- **Smart poster RTD** - for posters with tags with text, audio or other data
- **Text RTD** - for records containing plain text
- **Uniform resource identifier (URI) RTD** - for records that refer to an internet resource
- **Generic control record type definition (RTD)** - ways to request an action
- **Connection handover specification** - how to establish a connection with other wireless technologies
SECURITY

- An NFC transmission can be intercepted despite being further away than a few centimeters. Also, hackers can initiate a jammer to make the NFC field malfunction which will buy them time to successfully hack into a person’s NFC-capable device and compromise all information stored on the device.
- If the device connects to the wrong initiator, which will act as a fake initiator. Any information sent to this ‘fake initiator’ will be available for hackers to see.
- Probably the easiest way for your NFC information to be compromised is by losing an NFC device thus compromising all data.

However steps have been taken, such as creating a field around the NFC field that will restrict the NFC field from going out of a certain area and restrict any other wireless communications from coming into the NFC field. Also a timeout rule for a transmission has been incorporated.
USE CASES
Uses of NFC can be broadly categorized in this way.

- Peer to peer
- Payment and ticketing
- Service initiation
In the peer-to-peer scenario, NFC is used to enable communication between two devices so that data can be transmitted locally between the two. If the amount of information is relatively small (up to one kilobyte), it is possible to use NFC to transmit the data itself.

However, a more common peer-to-peer scenario is likely to be when NFC is used to establish another wireless connection method (such as Bluetooth or Wi-Fi) to carry the information to be shared or it is used as a medium for device handshake.

An NFC device can be used to connect a camera and printer via Bluetooth to enable printing. It can be used at events to authenticate and setup Wi-Fi networks.
Payment and ticketing applications were one of the drivers for the creation of the **NFC** standard. Banks and mobile network operators are very interested in putting payment and ticketing applications on NFC-enabled mobile phones.

NFC enables a user’s **handset to become** his electronic **wallet** and/or his electronic **ticket replacing credit cards** etc. that people carry these days.

**Initially**, however, NFC-enabled cards and devices are likely to be used for **small payment situations**, like vending machines and parking meters. In smart ticketing schemes, NFC-enabled mobile phones could be used to check how much credit is left on a multi-use smart ticket, without the user having to visit a ticket machine. Ultimately, **when all** the NFC reader **infrastructure**, transaction handling and security checking routines are **in place**, NFC devices can be used ubiquitously.
In the service initiation scenario, the user touches an NFC-enabled device – such as a mobile phone – against a specially located NFC tag, which then typically provides a small amount of information to the device. This could be some lines of text, a web address (URL), phone number or other simple piece of data, which the user has decided to obtain.

One example of this type of application is the smart poster. This poster could be promoting some kind of new product or service, or an event, and by touching his or her device against an NFC tag embedded in the poster, the user receives the URL for a web site where the user can get further information or book tickets. This type of application could also be useful for obtaining further information about a product in store, or for downloading information about medication, simply by touching the NFC-reading device against the packaging.
SMART POSTERS

NFC Smart Posters are objects in or on which readable NFC tags have been placed. It's main components are:

- An Object (A plain poster, statue, etc.)
- An NFC tag encoded in the NDEF format with content from a provider
- An NFC Reader/Writer, capable of writing NDEF formatted tags, to program the content
NFC based Digital signage

An interesting extension of the NFC Smart Poster concept adds a contactless reader and backend system to a display screen. This enables an interactive and highly customized experience for the user. Preferences are set in consumers’ mobile phones with simple software upgrades. These could include language preferences, home currency, favorite sports team or player, etc. A Smart Digital Sign includes an LCD display connected to a contactless reader and a backend program. When a user approaches the reader and screen, the phone triggers the display to change and show the user information according to his or her preferences.

For example, a U.S. traveler in Beijing who sees a fast food menu in Chinese can tap the reader to change the display to English and U.S. dollars.

Advantages of NFC smart posters

NFC Smart Posters are:

- Low in cost compared with other forms of dynamic display (such as LCD displays)
- Interactive
- Readily updateable
- Flexible in size and usage
LET’S WRAP THINGS UP!
CONCLUSION

At the heart of NFC’s benefits is its simplicity of use – holding two objects together is intuitive for everyone, young or old. NFC is building on existing systems and human actions, so it has a very good chance to be valued and used for many years to come.

NFC is a new technology and like other new technologies it is hard to make it mainstream as of now because of technological limitations etc. A major challenge is interoperability which is guaranteed only if the devices comply to the standards required. Retrofitting the existing phones is a technological challenge.
## NFC EVERYWHERE!

<table>
<thead>
<tr>
<th>Area</th>
<th>Station Airport</th>
<th>Vehicle</th>
<th>Office</th>
<th>Store Restaurant</th>
<th>Theater Stadium</th>
<th>Anywhere</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Usage of NFC Mobile Phone</strong></td>
<td>Pass gate</td>
<td>Adjust seat position</td>
<td>Enter/exit office</td>
<td>Pay by credit card</td>
<td>Pass entrance</td>
<td>Download and personalize application</td>
</tr>
<tr>
<td></td>
<td>Get information from smart poster</td>
<td>Open door</td>
<td>Exchange business cards</td>
<td>Get loyalty point</td>
<td>Get event information</td>
<td>Check usage history</td>
</tr>
<tr>
<td></td>
<td>Get information from information kiosk</td>
<td>Pay parking fee</td>
<td>Log in to PC; Print using copier machine</td>
<td>Get and use coupon</td>
<td>Download ticket</td>
<td>Download ticket</td>
</tr>
<tr>
<td></td>
<td>Pay bus/taxi fare</td>
<td></td>
<td></td>
<td>Share information and coupon among users</td>
<td></td>
<td>Lock phone remotely</td>
</tr>
<tr>
<td><strong>Service Industries</strong></td>
<td>Mass Transport</td>
<td>Public Transport</td>
<td>Security</td>
<td>Banking</td>
<td>Entertainment</td>
<td>Any</td>
</tr>
<tr>
<td></td>
<td>Advertising</td>
<td></td>
<td></td>
<td>Retail</td>
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<td></td>
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</tbody>
</table>
Considering the outlook of the market now, NFC enabled phones will be **ubiquitous in two years** time and this is a technology which will **change our lifestyle** to a great extent.
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THANK YOU