INTRODUCTION TO NFC (Near Field Communication)

- Technical Introduction
- Trials, applications, use cases
- Mobile Architecture
- Market Overview

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A new Company has reborn on 2007

Few months ago, NXP has been launched on the markets with the new brand.
NFC: Three modes of operation

Secure
In combination with Smart Card Technology

Card Emulation Mode

Peer-to-Peer communication

Reader Mode
battery-less RFID object
NFC - Technical Basics

Wireless Short Range Communication Technology
- Based on RFID technology at 13.56 MHz
- Operating distance depending on implementation
- Compatible with today’s field proven contactless Mifare® and FeliCa™ smart cards
- Data exchange rate up to 424 kbit/s
- ISO18092: NFCIP-1 Interface and Protocol
- ISO21481: NFCIP-2 Interface and Protocol
NFC range of possible applications

NFC represents the 2nd generation of the proximity contact-less technology, which beyond the RFID, supports peer-to-peer communication, and enables consumer access to aggregated services, anytime, anywhere, with any type of consumer stationary and mobile devices.

NFC is a Short Range Device wireless technology designed to exchange data, initiate connections with other wireless networks and act as a secured smart key for access to services such as cashless payment, ticketing, on-line entertainment and access control.
NXP NFC & RF-ID Technology Overview

- **Cards, Smart Labels**
  - Contact reader ICs
  - Contact Smart Card Controller
  - PN51x, PN53x

- **Interface**
  - ISO 7816, GSM
  - ISO 14443-B, ISO 15693
  - ISO 14443-B, ISO 1592

- **Reader**
  - Proximity
  - Long range
  - Contactless reader ICs

- **NFC**
  - Access Tags
  - Card Emulation Mode
  - Peer to Peer Mode

- **NFCIP1**
  - NFCIP2
  - PN544
  - PN51x, PN53x

- **I•CODE**
  - I•CODE SLI
  - I•CODE OTP

- **MIFARE**
  - Ultra Light Standard 1K/4K
  - DESFire

- **HiPer Smart**
  - 8-bit Sec. µC
  - 16-bit multi Appl. µC
  - 32-bit Hiper Smart

- **Type-B**
  - PICC

- **Long range**
  - ISO 14443-B

- **Type-B**
  - PCD

- **Security**
  - MIFARE reader ICs
  - ISO 14443-B Type-B
  - Proximity
  - Type-B PICC

- **Passive Transponder Tags at 13.56 MHz**

- **16th IST Mobile & Wireless Communications Summit**
  - Budapest, Hungary 1-5 July 2007
Related Standards

- ISO14443 A/B Reader / Writer
  - ISO14443-3 (REQ, AC, Select)
  - ISO14443-4 (T=CL)

- ISO15693 Reader / Writer (I-Code)

- For Completeness:
  - ISO7816-4 (T=0, T=1)
  - Smart Card Contact Interface Protocol
NFC Forum
Mission & Objectives

- The NFC Forum promotes the use, supports standardization and directs the future developments of the NFC open platform technology.

- The NFC Forum is a non-profit organization which has the objective to support use of the technology in the industry by providing a platform for interested companies to achieve interoperability of devices with other devices, smart cards, and services.

- www.nfc-forum.org
NFC Technology is supported by the leading mobile device, infrastructure and technology manufacturers, and by all major payment providers.

NFC Forum was established in 2004 by leading mobile communications, semiconductor and consumer electronics companies formed the non-profit industry association, the NFC Forum, to advance the use of NFC technology through standard specifications that ensure interoperability.

Further the device communication protocols standards (NCFIP-1, NFCIP-2, NFC-WI), in June 2006 the NFC Forum introduced standardized technology architecture, initial specifications and tag formats for NFC-compliant devices; these include Data Exchange Format (NDEF), and three initial Record Type Definition (RTD) specifications for smart poster, text and Internet resource reading applications.

The NFC Forum, in addition, announced the initial set of four tag formats that all NFC Forum-compliant devices must support; these are based on ISO 14443 Types A and B (the international standards for contactless smartcards) and FeliCa (derived from the ISO 18092, passive communication mode, standard).
General View of NFC Stack according to NFC Forum Recommendations

Example of Card Emulation Technology Stack

- Apps & memory map stores & prop multi-app mat systems
- Payment application
- EMV (including app selection PFSE)
- Apps
- Suica (ticketing)
- EDY (payment)
- Memory mapping
- Prop cmds
- ISO/IEC 7815-4
- ISO/IEC 14443-4
- Prop cmds
- FeliCa cmds
- Prop cmds
- Application & multi-app management
- Transport (secured or not) & cmd set
- Anticollision
- RF layer
- Polling
- ISO/IEC 14443-3 A
- ISO/IEC 14443-3 B
- FeliCa anticollision
- ISO/IEC 15693-3
- Prop anticollision
- ISO/IEC 14443-2 A
- ISO/IEC 14443-2 B
- FeliCa RF I/F
- ISO/IEC 15693-2

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1. Active Communication mode

- Both - the initiator and the target - generate RF
- Standard mode for peer to peer (p2p) communication

2. Passive Communication mode

- Only the initiator generates the RF field. The target answers in a load modulation scheme.
- Extended mode for p2p and RFID communication

Benefit in passive mode: power saving mode for target
Active Communication mode

1. Initiator starts communication at selected transfer speed

Response

2. Target answers at the same transfer speed

Passive Communication mode

1. Initiator starts communication at selected transfer speed

2. Target answers using load modulated data at the same transfer speed
NFC Trials, Applications & Use cases
Hanau (Frankfurt) – Germany
- Ticketing for Public Transport [April 2005 – Nov. 2005]

Limburg (Roda Stadium) – Netherland

Caen – France

Atlanta (Philips Arena) – North America

Paris (Metro Systems) – France
- “Navigo” Travel SmartCards in the Underway [Nov. 2005–June 2006]

Singapore (Visa International-Maybank) – Malaysia
- Mobile Visa Wave Payment [Launched at the end of April 2006]
Mobile NFC Trials & Demonstrations 2/3

- Seoul (SKTelecom) - South Korea
  - Ticketing, Poster Download, Access Control [Start: June 2006]
- Xiamen (China Mobile’s Xiamen Office) – China
  - Ticketing, Payment [Start: July 2006]
- Manchester (Manchester City Stadium) – UK
  - Ticketing, Payment [Start: August 2006]
- Amsterdam (coop. JCB-CCV Holland B.V.) – Netherland
  - Payment Ticketing, Payment [Start: September 2006]
- Shanghai (download of loyalty applications OTA) – China
  - Users can download the applications over the mobile network to a secure chip embedded in the phones [Launched: August 2006]
- New York (MasterCard’s OTA m-Payments) – USA
  - Secure personalisation payment solution for Mobile phone-based payments [Start: January 2003]
Mobile NFC Trials & Demonstrations 3/3

Strasbourg (French Bank Crédit Mutuel-CIC) - France
- NFC Payment Trial with a MVNO using SWP protocol) [Start: Fall 2006]

Paris (Paris Métro Operator RATP) – France
- Ticketing Trial between Paris Métro Operator RATP and Bouygues mobile telco using SWP protocol) [Start: Fall 2006]

Other NFC Trials
- **Sylt**: Tourist Info [Start: Sept. 2006]
- **Taiwan**: Public Transport
- **Seattle**: Philadelphia&Detroit Stadium (Smart Sys. Tech.)
- **Hagenberg Austria**: Campus of the Univ. of Applied Sciences)
- **New York**: MasterCard, MTA, Citigroup trial NYC Subway “Tap & Go”
NFC Applications (1)

Payment & Ticketing

1. Request for OTA provisioning of payment/ticketing application
2. OTA provisioning of payment/ticketing application into the NFC phone
3. Pay and travel by touching with NFC phone

Service Initiation

1. Touch a poster to initiate service
2. Access the service over mobile network

Sharing & Peer2Peer

Setup Phase

Normal use Phase

Payment & Ticketing

Card management system (banks, transport companies)
OTA management server
NFC enabled mobile phone
Payment / ticketing terminals

Service Initiation

Service posters including tags
NFC enabled mobile phone
Mobile network incl. content delivery server

Sharing

Set up Phase

Normal use Phase
NFC Applications (2)

Mobile Phone =

- e-Business Card,
- Exchange for Ticket

Payment Everywhere

MP = POS

Credit card

Download content by touching smart posters!

Micro-Payment MP = Debit Card

POS: Point of Sale

NFC

Bus ticketing

MP = eTicket

Poster with RF ID Tag

Take Info from Poster

MP = OTA ticket/loyalties

Entrance

Operating MP = Key access

(work/home/hotel)

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Rodolfo Gomes – Budapest July 4th, 2007
NFC use cases (1): Connectivity

**WiFi pairing**
Sub cases:
- Prepayed time in WiFi zones
- WiFi interactive museum visit
- Set up of user profile at home: hi-fi or lightning profile

**BT pairing**
Sub cases:
- BT interactive museum visit
- Movie preview on phone/mp3
download from smart posters
- Smartposter Info pushing
  (Train/bus timetable, event list, shop discount/vauchers).
NFC use case (2): Contactless mobile payment

1. Users want to pay.
2. She selects and starts the financial application.
3. The financial application asks to enter the PIN.
4. She enters the PIN and waves the phone near the contact-less POS.
5. Instant offers and promotions are pushed.
6. Authorization is requested.
7. Authorization is confirmed.
8. Confirmation is pushed via SMS/WAP/GPRS/CDMA with amount and promotional offer.
NFC Mobile architecture overview
How NFC can look like in a Mobile phone?
Secure NFC front-end + antenna embedded in Mobile phone pcb = NFC-WI

- It is named NFC-WI (Wired interface or S2C), see link: http://www.nxp.com/acrobat_download/other/identification/S2C_survey_10.pdf
- NFC package contains both the connectivity chip and the multi-application chip smartMX
- Payment/transport application is resident on SmartMX operating system (e.g. JCOP, Multos, etc)
- The Secure Element (SmartMX) is different than the Mobile Network provider SIM chip.
- Such architecture is suited for CDMA phones (SIM-less operators) and for any device which does not have SIM and has to securely store applications
- Personalization can be done via NFC/OTA (Over The Air connection: EDGE/GPRS)
NFC WI Possible working modes

Mode I: Easy Connect

Mode II: Card Emulation Mode

Mode III: Dual Mode

Mode IV: Wired Mode
(Direct Link Host-SmartMx)
NFC + antenna in phone pcb, SE functionality embedded into MNO SIM = NFC–SWP (Single wire protocol)

- It is named NFC Single wire protocol (on-going standardization activities since Q4 2006)
- NFC is separated from multi-application java card secure env. which lays in the provider SIM card.
- Secure element functionality can be stored in the MNO SIM (Payment/transport application is resident on SIM operating system)
- Preferred solution from point of view of MNO’s
- Control of accessing/encryption keys inside SIM
- Personalization can easily be done via OTA GPRS infrastructure
- UICC is also synonym for SIM
Single Wire Protocol (SWP) Connectivity

Environment:
TX and RX over same wire

System Architecture

CLF: it refers to mobile phone host controller
NFC & Contactless Market Overview
Contactless Proximity Transaction IC Market 05

Type A (mifare®) covers about **72.5%** of the contactless proximity transaction IC market.
NFC market penetration

LONDON -- In recognition of continuing challenges surrounding the contactless payments business model for mobile operators, ABI Research has adjusted its forecast for Near Field Communications (NFC)-enabled cellular phones downwards to 450 million units in 2011, representing nearly 30% of handsets shipped worldwide in that year.

Source ABI Research, issued on Sept 11th, 2006:
http://www.findarticles.com/p/articles/mi_m0EIN/is_2006_Sept_11/ai_n16715441

For one throughout ABI research publication on NFC, refer to this link:
http://www.abiresearch.com/products/market_research/Near-Field_Communications_(NFC)
Latest market trends: Interest in NFC raised due to mobile payment initiative

- Announced at 3GSM in Barcelona (13 Feb 2007)

- Goals
  - Enable the worldwide use of mobile phones for payments
  - Definition of a common global approach to using NFC technology to link mobile devices with payment and contactless systems

- Supporters
  - 24 Mobile Network Operators (> 50% of the mobile market)
  - Leading mobile handset manufacturers, incl. Nokia, Samsung and LG

- White Papers
  - Mobile NFC Services (3GSM)
    - Mobile NFC needs a stable ecosystem providing value to all participants
    - UICC/SIM is the most appropriate secure element in mobile phones
    - Interoperability, backwards compatibility and standardization are essential

- Next Steps
  - GSMA intends to perform trials/demonstrations of UICC-based NFC enabled m-payment
Current situation in NFC products

Mobile Phone

- Pilots are turning into small commercial deployments
- At least five phone makers are working on their NFC-equipped devices

Contact Less Reader / Infrastructure

- Consistent trend for adoption of a Universal platform (Type A, B, Felica and P2P)
- New governmental requirements for more secure transactions bring NFC @ home for online authentication; this will demand NFC usb dongles for PC’s, SD dongles for Palm devices.
Useful Links for further info:

- Standardization sites:
  - http://www.ecma-international.org/
  - http://www.iso.org/
  - http://www.etsi.org/
  - http://www.nfc-forum.org/

- NXP Technology Overview:
Thank you very much!

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