Agenda

Session 1<sup>st</sup> December:

*NFC use cases for industrial applications*

- NFC technology essentials
- NFC Forum specifications
- Application examples
- NFC functionalities for industrial applications
- Product portfolio and support package
NFC TECHNOLOGY ESSENTIALS
RFID, proximity cards and NFC

**RFID**
- Generic term for contactless technology
- **Wide** reading range (few cm to several meters)
- Standardized in ISO/IEC 18000

**Proximity cards**
- Subset of RFID HF 13,56 MHz
- **Short** reading range (few cm)
- Standardized in ISO/IEC 14443

**NFC**
- Adds a two-way communication between NFC-enabled devices
- NFC-enabled device can behave as a contactless smartcard
- Standardized in ISO/IEC 18092 and ISO/IEC 21481
How is NFC different from or related to other wireless technologies

<table>
<thead>
<tr>
<th>Data Rate</th>
<th>Range</th>
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<tr>
<td>1 Gbps</td>
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- NFC
- Zigbee
- Bluetooth
- WiFi
- 3G
- 4G / LTE
- GSM
Near Field Communication
Initiate interactions with a simple touch

Technology at a glance:
• Contactless proximity technology
• Standardized under ISO/IEC 18092 and ISO/IEC 21481
• Operating frequency: 13.56 MHz
• Operating range: 10 cm (4 in)
• Max. speed: 424 Kbps
• Co-developed by NXP and Sony
• Origins in payment and access control
• Works with existing contactless infrastructure

Unique benefits:
• Easy to use ("Tap to initiate an action")
• Act of will
• Zero-power
• Highest security
With NFC, you can interface any device to...

**Any Device**
- Powered by battery or mains
- Can initiate NFC connection
- Reads data in from device or writes data out
- Small: typically ~25 mm² IC, 40x30mm antenna
- Many form factors

**Another Device**
- Even battery-less devices

**An NFC-enabled phone**
- >1 billion NFC phones on the market (end of 2015)

**NFC card or tag**
- More than 2 billion pieces produced per year
NFC is ramping up

- >1 billion NFC phones installed base (end of 2015)
- Smartphone share expected to continue growing: 3 in 4 mobile phones to come with NFC by 2018
- >5 billion NFC handsets will ship before 2019
- >2 billion NFC cards and tags per year

Source: NXP, ABI Research
The three modes of NFC: a tap is all it takes

- **Read/write**
  The system performs the functions of a contactless reader

- **Peer-to-peer**
  Establishes a two-way communication channel between a pair of NFC devices

- **Card emulation**
  The system behaves as a contactless smartcard
NFC passive communication scheme

1. The initiator produces a 13.56 MHz carrier field
   The field enables data exchanges and sends energy to the target

2. The initiator sends commands
   The initiator transfers data by directly modulating the field

3. The target responds
   The target transfers data by load-modulating the field
1. The initiator sends commands
   The initiator generates a 13.56 MHz carrier field, uses Amplitude Shift Key (ASK) modulation to send commands, then cuts the field.

2. The target responds
   Once the initiator cuts its field, the target generates its own and uses ASK modulation to send responses.

To avoid collisions, only the sending device emits an electromagnetic field. The send / receive roles are reversed as needed to support the transaction.
NFC FORUM

LEADING THE WAY TO NFC INNOVATION
NFC Forum
Leading the way to NFC innovation

• The NFC Forum is a non-profit organization established to promote the use of NFC technology in consumer electronics, mobile devices, PCs, and more.

• The NFC Forum represents all of the world’s major:
  - Chip vendors.
  - Payment service providers.
  - Smart phone manufacturers.
  - Mobile operating system providers.

• The NFC Forum missions are:
  - Develop standards-based NFC specs.
  - Encourage the development of products based on NFC Forum specifications.
  - Work to ensure that products claiming NFC capabilities comply with NFC Forum specs.
  - Educate consumers and enterprises globally about NFC.
NFC Forum specification architecture
Build solutions and ensure the global interoperability
The 5 NFC Forum Tag Types

- **Type 1 Tag**: ISO14443-3A (Broadcom Topaz)
- **Type 2 Tag**: ISO14443-3A (MIFARE Ultralight & NTAG)
- **Type 3 Tag**: JIS X 6319-4 (Sony FeliCa)
- **Type 4 Tag**: ISO/IEC14443-4 (MIFARE DESFire)
- **Type 5 Tag**: ISO/IEC15693 (ICODE)
NFC Forum specification architecture
Build solutions and ensure the global interoperability

Card emulation
Applications
Read & Write
Application specifications (e.g. Connection Handover Protocol)
Peer-to-Peer
RTD (Text, URI, Smart poster...)
NDEF
Tag 1-5 Type operation
SNEP
LLCP
Activity
Digital protocol
Analog
Formats for data exchange
NFC data exchange format (NDEF)

- Specifies a common data format for NFC Forum-compliant devices and NFC Forum-compliant tags.

- It is used to describe how a set of actions are to be encoded onto a NFC tag (e.g. open a URL, create an SMS, create an email, etc.).

- The benefit of using NDEF is that you do not need to have custom software running on the touching device.
Formats for data exchange
NFC record type definition (RTD)

• Specifies the format and rules for building standard record types used by NFC Forum application definitions and third parties that are based on the NDEF data format.

• Common NFC record types:
  - **vCard**: Stores contact information (e.g. electronic business cards)
  - **URI**: Stores Universal Resource Identifiers (URIs), which include web addresses and other network resources and files
  - **Text**: Stores text strings in multiple languages.
  - **Smart poster**: Stores text strings, URLs, SMS or phone numbers.
  - **Connection handover**: Stores pairing with Bluetooth, Wi-Fi or other protocols
  - **Device information**: Stores basic details about the device mode and its identity.
  - **Signature**: Provides an algorithm or certificate type for use as a digital signature

* For more on these formats, check the NFC Forum website (nfc-forum.org)
NFC Forum specification architecture
Build solutions and ensure the global interoperability

Card emulation
Applications

Read & Write
Application specifications (e.g. Connection Handover Protocol)
RTD (Text, URI, Smart poster...)
NDEF
Tag 1-5 Type operation

Peer-to-Peer
SNEP
LLCP
Activity
Digital protocol
Analog
NFC Forum Connection Handover Protocol (CHP)
Making device pairing with NFC really easy

**Without NFC**

1. Keep the sensor power-on button pressed
2. Browse phone menu for Bluetooth or Wi-Fi settings
3. Find Bluetooth device and write passcode or write Wi-Fi network credentials
4. Paired!

**With NFC**

1. Tap phone to the sensor.
2. Paired!

Pairing credentials are encoded and exchanged using NDEF messages as defined by NFC Forum specifications
APPLICATION EXAMPLES
• Industry 4.0 relies on a number of technologies that add intelligence to production, inspection, security, service support and business operations.

• NFC is a welcome addition to the industrial environment, because it delivers new levels of convenience, communication, and configurability, such as:
  - Better man-machine interfaces.
  - Easy maintenance.
  - Pairing, commissioning and parametrization of machinery and sensors.
  - Authenticated tools.
  - Late customization.
  - Device-to-device communication, e.g. communication with battery-less or galvanically-isolated devices.
  - Controlled access to restricted facilities and devices.
NFC for machinery access rights control

Use cases
- Tap-and-authenticate to machines.
- Restrict logical access to specialized machinery to only trained or skilled employees.

Benefits
- Set up individual profiles, personalize settings and adjust preferences.
- Varying levels of authorized access.
- Increase productivity with faster access to specialized machinery.

NFC solutions
- NFC frontends: CLRC663.
- NFC controller: PN7462, PN736x.

Fig. Cleaning machine for professional use enabled with NFC technology. More info
NFC for access control into restricted areas

Use cases
- Securing and protecting access to an installation, warehouse, assembly line plant, datacenter, etc.

Benefits
- Time & attendance logging for secure areas.
- Remote key distribution management.
- Time-limited access for temporary personal.
- Reduce maintenance and replacement costs, with fewer lost or damaged keys, cards or badges.

NFC solutions
- NFC frontends: CLRC663.
- NFC controller: PN7462, PN736x.

Fig. Physical access control into datacenter facilities.
NFC for extended user interface, parametrization and zero-power configuration

Use cases

- Use your smartphone as the configuration interface for products with rudimentary interface or completely sealed without user interface at all.
- Customize and personalize product settings with a single tap (e.g. adjust country settings, feature sets or firmware versions at the store).

Benefits

- Handle complex device settings easily on the phone/tablet touchscreen.
- Better accuracy adjustments than mechanical controls.
- Zero-power operation, the device can be unpowered.

NFC solutions

- NFC connected tags: NTAG I²C plus.

Fig. NFC-enabled timer relay. More info
NFC for easy troubleshooting and product diagnostics

Use cases
- Upgrade device firmware using the phone/tablet connection.
- Identify breakdown issue and bring the appropriate replacements.
- Check warranty or product registration.
- Read product diagnostics before powering up the machinery.

Benefits
- Easy maintenance. No contact interface needed.
- Easily obtain product serial numbers, firmware version, repair history.
- Error logs or activity statistics can be read even when the device is completely dead and does not boot up anymore.
- UART service port replacement.

NFC solutions
- NFC connected tag: NTAG I²C plus

Fig. Use of a phone touchscreen for sealed device diagnostics
NFC for easy commissioning of nodes to a wireless network

**Use cases**

- Commissioning of sensors and other nodes to a wireless network so they can be remotely managed and controlled.
- Configure sensors to trigger an alert when certain threshold is reached.

**Benefits**

- Faster device pairing, avoiding manual settings, cumbersome button combinations or entering long codes.
- Make devices easier to use and reduce tech-support costs.
- Exchange credentials securely, just by tapping.
- Use NFC to pair any wireless networking standard.

**NFC solutions**

- NFC connected tags: NTAG I²C plus

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Fig. Smart lighting system in a factory facility.
NFC for authenticated tools and consumables

Use cases

- Authenticate replacement parts and automatically adjust settings of the main unit based on the accessory attached.
- Protect correct device functioning making sure that only original consumables or tools are used for a given task.
- Identification of robot attachment.

Benefits

- Ensure authenticity and combat counterfeits of accessories or consumables.
- Boost manufacturing by automatically choosing the right tool every time.

NFC solutions (shorter distances)

- NFC tags: NTAG21x, MIFARE Ultralight C.
- NFC frontends: MFRC630.

NFC solutions (larger distances)

- NFC tags: ICODE SLIX, ICODE DNA.
- NFC frontends: SLRC610.
NFC for device-to-device communication

Use cases
- Let a fully sealed, battery-free sensor unit interact with the meter housing.
- Record mechanical-stress readings on moving parts.
- Avoid galvanic connections by letting machines talk without wires.
- Devices next to each other with a need to communicate without cables.

Benefits
- The device can remain completely sealed (e.g. water proof, dust proof, etc).
- Communication with sensors, parts or devices which can not be connected through wires to the main unit (replaces cables for moving, rotating or sealed parts).

NFC solutions
- NFC connected tag: NTAG I²C plus
- NFC frontends: MFRC630

Fig. NFC-enabled wireless charger
NFC for reading product details, user manuals or emergency instructions

Use cases

- Staff access to important hazardous information by tapping their NFC devices against products.
- Read emergency instructions in case of accident.
- Get access to machinery instructions or user manuals.

Benefits

- Save time in the operating processes.
- Reduce the cost of identifying items, goods, inventories, etc.
- Increase the reliability of the data collected.
- Reduce the time and training costs.

NFC solutions

- NFC tag: NTAG21x
- NFC connected tags: NTAG I²C plus

Fig. NFC label encoding chemical handling information. More info.
Long range UHF RFID for industrial applications

Use cases
- Track & trace spare parts, PCBs and finished products throughout the supply chain
- Inventory management
- Production control and variant management
- Brand protection
- Recycling management

Benefits
- Increased production efficiency and flexibility
- One tag providing identification and authentication at the same time
- UHF allows long read ranges up to 10 m
- Bulk reading of many items in a box or on a pallet

UHF solutions
- UCODE 7, UCODE 7xm, UCODE 7xm+ with digital signature,
  UCODE DNA with authentication
NFC FUNCTIONAL BLOCK CONCEPT
NFC functionalities for industrial applications

NDEF: vCard
Service Contact
Get in touch with the service support team in case of system malfunctioning.

NDEF: URL
User Manual
Quick referrals to operating manuals and other kinds of assistance.

NDEF: Product information
Reduce the cost of identifying items, goods, inventories, etc.

NDEF: URL
Emergency info
Use your phone to read emergency instructions in case of accident at the workplace in any given moment.
NFC functionalities for industrial applications (II)

Energy Harvesting
Communicate with battery-less or unpowered devices.

Galvanic isolated Power Supply
Communicate with galvanically isolated sensors which can not be connected through wires to the main unit.

Wireless Display/HMI
The worker’s tablet or phone can be used as the man-machine interface to verify or change parameters, refine settings or monitor activity.

Access to machinery
Identify users and immediately provide personalized settings and preferences. Better equipment uptime with fast access to specialized machinery.
NFC functionalities for industrial applications (III)

- **Pairing to wireless networks**
  Add new nodes to a wireless network avoiding wasting time entering password and setting configurations.

- **Authenticated tools**
  Ensure that machinery only uses branded and certified tools for a given task.

- **Brand protection**
  Ensure that customers can validate that your products and accessories are original and genuine.

- **Identification of attachment**
  Boost manufacturing by automatically choosing the right tool every time.
NFC functionalities for industrial applications (IV)

- **Wireless Troubleshooting**: Check history and machinery usage, perform maintenance operations or calibration tasks without any contact interface needed. UART service port replacement.

- **Wireless Software Update**: Update firmware version wirelessly without un-mounting the device.

- **Wireless Interface**: Cable replacement. Enable communication with moving, rotating or hermetically sealed devices.
NFC functionalities for industrial applications (V)

Controlled environment
Control access to sensitive or restricted areas to only authorized employees.

Wireless Parametrization
Use the phone / tablet touchscreen for parametrization or for better accuracy adjustments than mechanical controls.

Late customization
Change particular product settings before being shipped to a certain region or customize settings at the store.
Application Industrial Control

Wireless parametrization

Energy Harvesting

Wireless Display/HMI

NDEF: URL

User Manual

NDEF: vCard

Service Contact
NFC READER PORTFOLIO
&
SUPPORT MATERIAL
Your partner in every step of a reader design

Evaluate functionality & choose an NFC product
Investigate which NFC functionality you need and choose one NFC solution from our broad portfolio

Evaluate features
Explore the possibilities with one of our development boards, then use the same board to start prototyping

Start prototyping
Re-use design of NXP development boards and sample code examples

Test & debug
We use standard-based design and support the most popular development tools to make it easy to fine-tune performance and catch errors

Get certified
Our solutions are designed to meet CE and FCC, and make it easier to pass EMVCo certification

We reduce complexity, streamline tasks, and add flexibility at every point of the product development process
NFC focus products for each application need

<table>
<thead>
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<th>Features and price</th>
<th>High end</th>
<th>All round</th>
<th>Entry level</th>
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<tbody>
<tr>
<td>Connected tag solutions</td>
<td>NFC tags with non-volatile memory and host connection</td>
<td>Connected tag solutions are not specified</td>
<td>Connected tag solutions, NFC tags with non-volatile memory and host connection</td>
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<tr>
<td>NFC Frontend solutions</td>
<td>NFC reader with NFC Reader SW Library</td>
<td>High-perf multi-protocol reader CLRC663</td>
<td>High-perf proximity &amp; vicinity readers MFRC630 and SLRC610</td>
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<tr>
<td>NFC controller solutions</td>
<td>NFC reader with integrated 32-bit Cortex MCU and either integrated firmware or freely programmable memory</td>
<td>Plug &amp; Play NFC for Linux, Android, Win PN7150</td>
<td>One chip system, freely programmable NFC controller with DPC PN7462/PN736x</td>
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**High end**
- High-perf full NFC with DPC PN5180

**All round**
- High-perf multi-protocol reader CLRC663
- Plug & Play NFC for Linux, Android, Win PN7150

**Entry level**
- High-perf proximity & vicinity readers
  - MFRC630 (ISO14443A – MIFARE/NTAG reader)
  - SLRC610 (ICODE ISO15693 and ISO18000-3M3)
The product selection path

Passive solution
- I will interact only with NFC phones
  - NTAG I²C plus
    - Linux Android Windows
    - Own application code
      - RTOS NullOS
        - I will talk to any NFC-enabled system
          - High performance full NFC with DPC
            - High performance multi-protocol reader
              - I will interact with contactless cards
                - High performance ISO/IEC14443 reader
                  - High performance ISO/IEC15693 and ISO/IEC18000-3M3 reader
                    - PN5180 NFC frontend
                      - CLRC663 NFC frontend
                        - MFRC630 NFC frontend
                          - SLRC610 NFC frontend

Active solution
- What OS requirements do you have?
  - Linux Android Windows
  - Own application code
    - RTOS NullOS
      - I will talk to any NFC-enabled system
        - High performance full NFC with DPC
          - High performance multi-protocol reader
            - I will interact with contactless cards
              - High performance ISO/IEC14443 reader
                - High performance ISO/IEC15693 and ISO/IEC18000-3M3 reader
                  - PN71xx NFC controller with integrated FW
                    - PN746x_736x NFC controller with customizable FW
                      - PN5180 NFC frontend
                        - CLRC663 NFC frontend
                          - MFRC630 NFC frontend
                            - SLRC610 NFC frontend
Our demokits are comprehensive packages with extensive support material

- **Hardware PCBs**

- **Reference source code and tools**

- **IC samples**

- **Documentation**
  - Application notes, User Manuals, Quick start guides
Support for connected tags

PC tools
- Windows application for NTAG I2C plus Explorer board
- Peek and Poke
- RFID discover

Development kit
- NTAG I2C plus Explorer Kit

Android applications
- NTAG I2C demo app
- TagInfo
- TagWriter

Source code examples
- NTAG I2C Explorer board C firmware
- NTAG I2C demo app Android app source
- NTAG I2C PC app source code

Documentation
- Application notes
- User Manuals
- Getting started guides

Development environment
- LPCXpresso IDE for LPC MCUs
- MIFARE SDK
Support for NFC frontend & NFC controllers with customizable firmware

NFC Reader Library
- Software support for NFC frontend solutions:
- Available for: PN512, CLRC663, PN5180, PN7462 and Linux

Development kits and demoboards
- CLEV663B
- OM25180FDK
- OM27462CDK
- PNEV512R
- PNEV512B

Source code examples
- SW examples based on NFC Reader Library demonstrating frontend capabilities

Development environment
- LPCXpresso IDE for LPC MCUs
- Keil and IAR tool chain (PN7462)

Documentation
- Application notes
- User Manuals
- Getting started guides

NFC Cockpit
- A PC tool that eases design process, antenna tuning and register configuration (PN5180, PN7462)
Support for **NFC controllers with integrated FW**

**Single board computer kits**
- SingleBoard Computer (SBC) kits with interface boards for Arduino, Raspberry Pi and BeagleBone Black (OM5578, OM5577)

**Compatibility with development boards**
- Integration with any boards featuring Arduino-compatible header, including many LPC, Kinetis and i.MxX boards

**SW images and SW examples**
- For Windows 10 IoT, Android, Linux, RTOS, NullOS together with illustrative NFC SW examples

**Documentation**
- Application notes
- User Manuals
- Getting started guides
Use our technical community for your questions

Become a registered member and get expert advice from the developer community
https://community.nxp.com/community/nfc

How to get there
- NFC and Reader Ics → NFC Technology hub → NFC support → NFC community
- URL: https://community.nxp.com/community/nfc

Ask your question
Look for answers
Watch on-demand any recorded session

Tap into our free on-demand training library.

Hundreds of hours of webinars and presentations on NXP products, applications, software, and tools.

Find recorded sessions, among others, for:

- NFC essentials
- NFC use cases
- NFC standards
- NFC reader antenna design (6 sessions)
- NFC reader portfolio
- NFC in smart home, gaming, payments,
- …

How to get there

- NFC and Reader ICs → NFC Technology hub → NFC support → NFC webinars
Find the right partner
Independent design houses

Partner List

Our partners are listed in an alphabetical order below. Click on the company name to view a description of the company, their contact information, and a link to their website.

Search for "NFC"

<table>
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<tr>
<th>Company name</th>
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How to get there

- NFC and Reader ICs → NFC Technology hub → NFC support → NFC IDH partners
- URL: http://www.nxp.com/pages/partner-list:PARTNER-LIST

NXP > Support > NXP Partner Program > Partner List
Partner List  [and search for NFC]
Software development in Android and iOS
Embedded software for MCUs
JCOP, Java Card operating Systems
Hardware design and development
Digital, analog, sensor acquisition, power management
Wireless communications WiFi, ZigBee, Bluetooth, BLE
Contactless antenna RF design, evaluation and testing

MIFARE applications
End-to-end systems, readers and card-related designs
EMVco applications
Readers, cards, design for test compliancy (including PCI)
Secure Element management
GlobalPlatform compliant backend solutions
Secure services provisioning OTA, TSM services

We help companies leverage the mobile and contactless revolution
NFC use cases for industrial applications
Jordi Jofre (Speaker)
Angela Gemio (Host)

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