Training Mobile Knowledge

Smart home NFC commissioning solution

Public

MobileKnowledge
October 2015

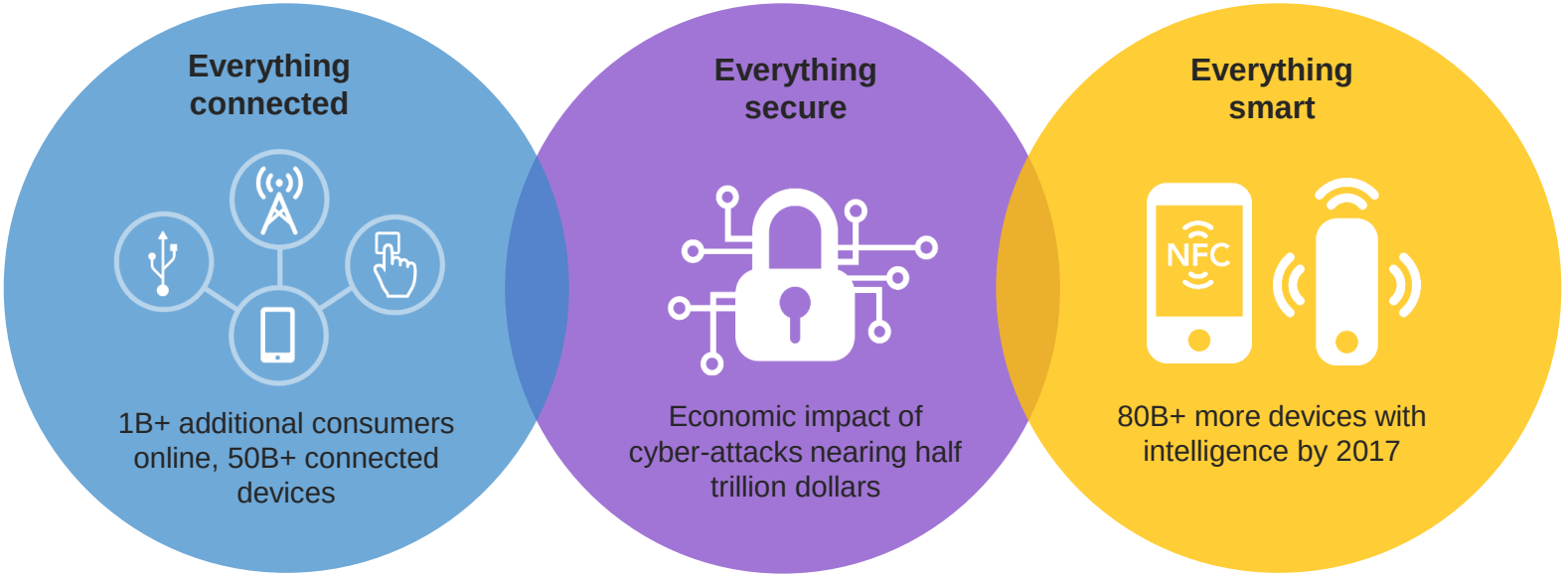
Agenda

- What is the Internet of Things and how NFC supports it
- How NFC makes smart homes easier to manage
- NFC Forum specs ensuring interoperability among devices and services
- NFC network commissioning schemes
- NXP product offering
- Solution resources

What is the Internet of Things and how NFC supports it

Hyper-connectivity has changed our world forever

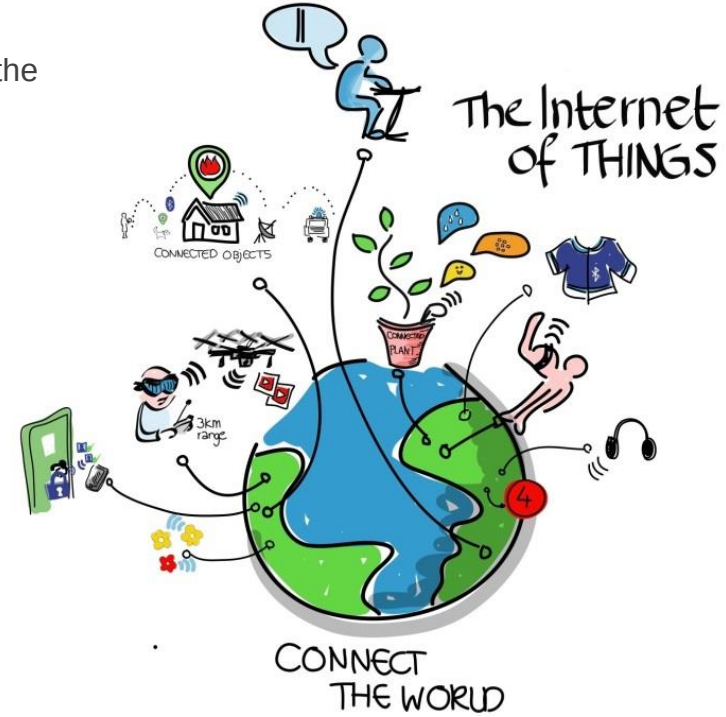
80% of the World's Economic Value will come from Improvements to existing products



Source: Euromonitor; Gartner; ARM Holdings; UBS; Center for Strategic and International Studies; McAfee, NXP analysis, International Telecommunications Union

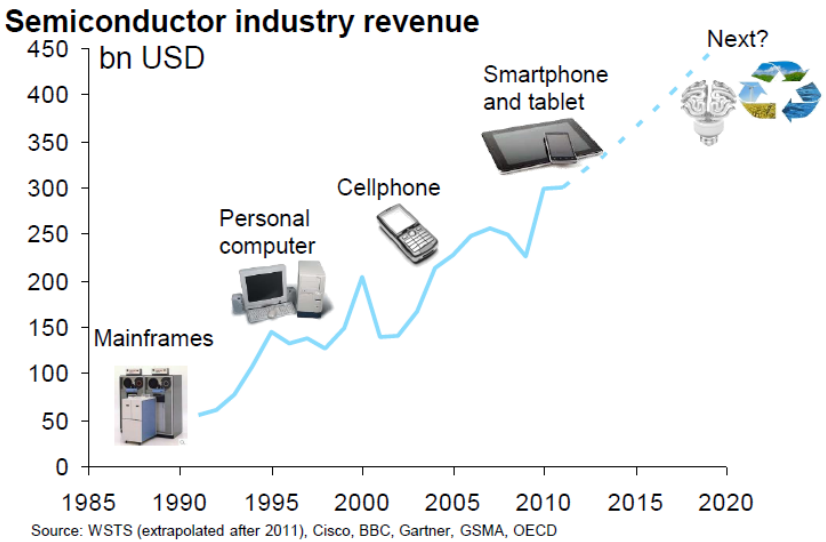
What is the Internet of Things

- A world in which every device that produces data can connect to the Internet
  - Remote sensors
  - Home appliances
  - Consumer electronics
  - Heating / cooling systems
  - Office equipment
  - Automobile engines
  - … and many more

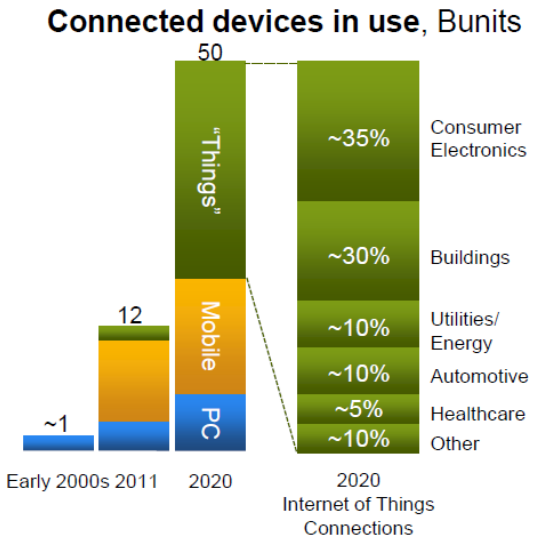


The Internet of Things, a fast growing application domain

Bringing the industry over $400Bn…



…and doubling IP device volumes



How NFC supports the Internet of Things

An inexpensive means of providing intelligence

NFC-enabled chips

A way to link physical objects of the online world

NFC tags

Easy network access

NFC Connection Handover

A means of easy user control

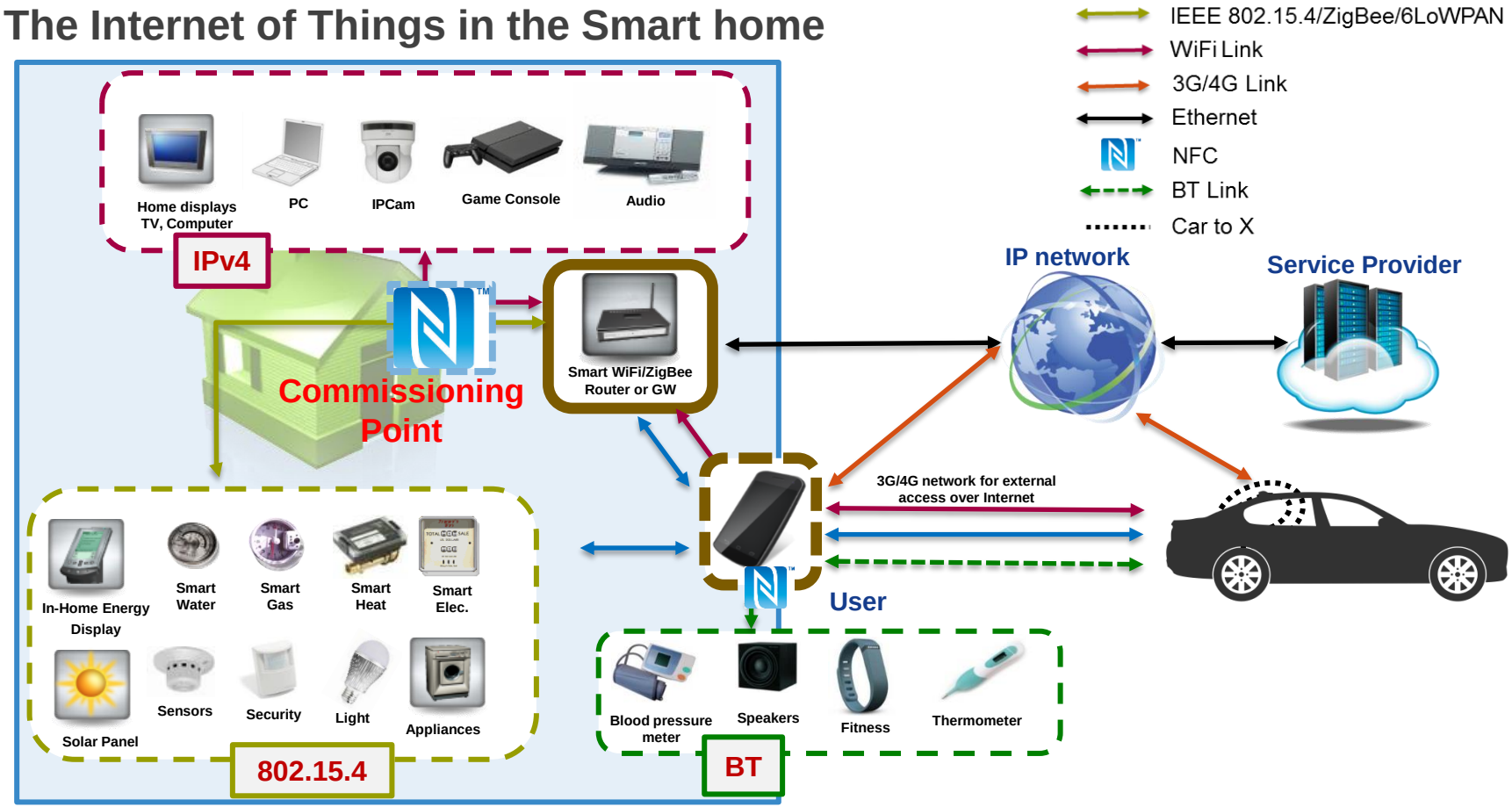
Intuitive tap interface

NFC connectivity growing ubiquitous

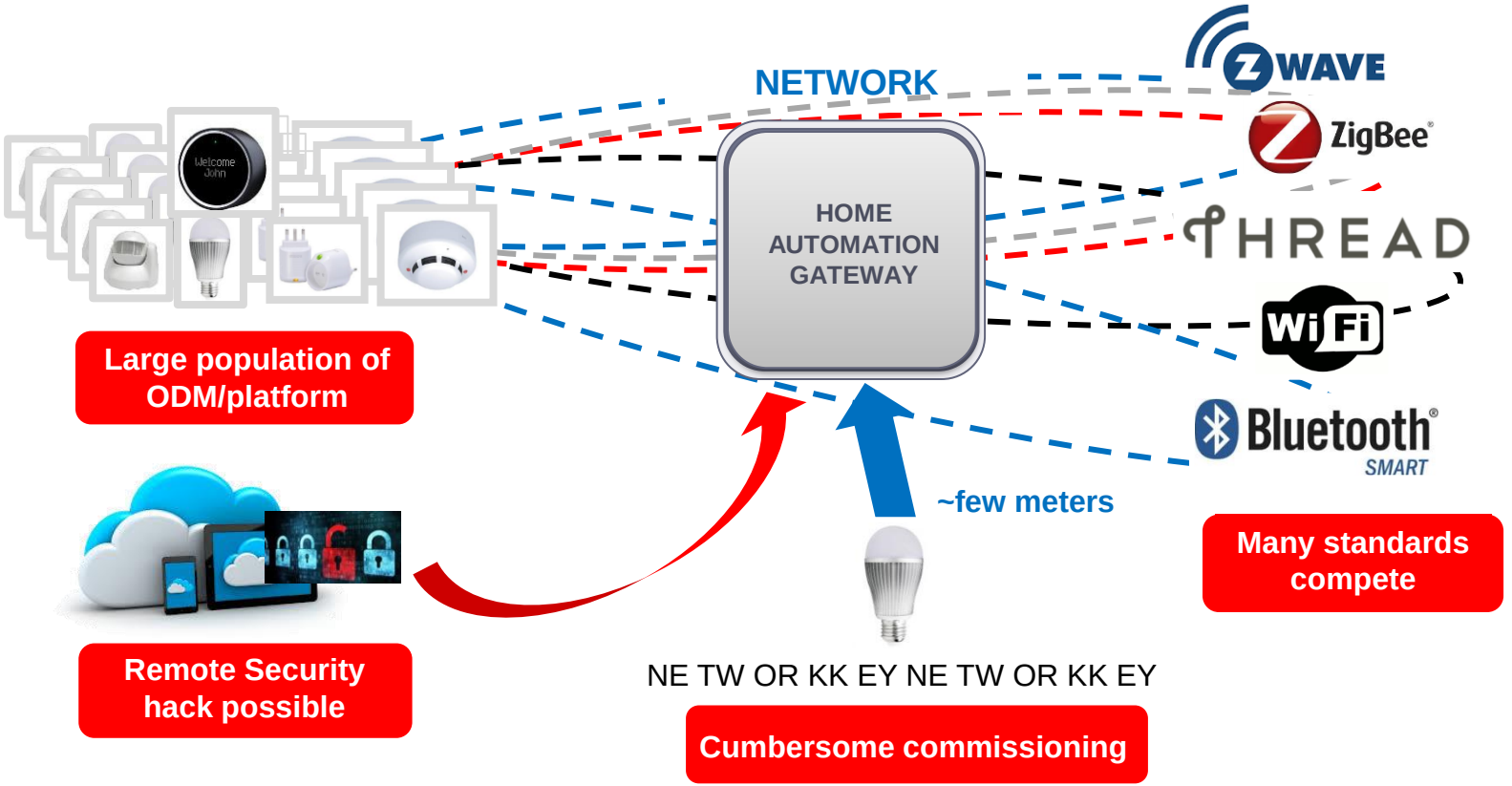
- ABI Research
  - Over 500+m devices on the market in 2014
  - > 5 billion NFC handsets will ship between 2013 and 2018
- IHS Technology
  - Annual shipments increasing from 275m units in 2013 to 1.2bn units in 2018
  - Two in three phones to come with NFC by 2018
- Juniper Research
  - 516m mobile users of NFC by 2019
- Mobile NFC Association
  - Over 20m NFC handsets now in use in Japan
- Research and Markets
  - The global NFC market was valued at USD 1.06bn in 2012 and is expected to grow at a CAGR of 43.7% from 2013-2019
- Transparency Market Research
  - NFC market to reach 20.01bn USD by 2019

NFC makes smart homes easier to manage

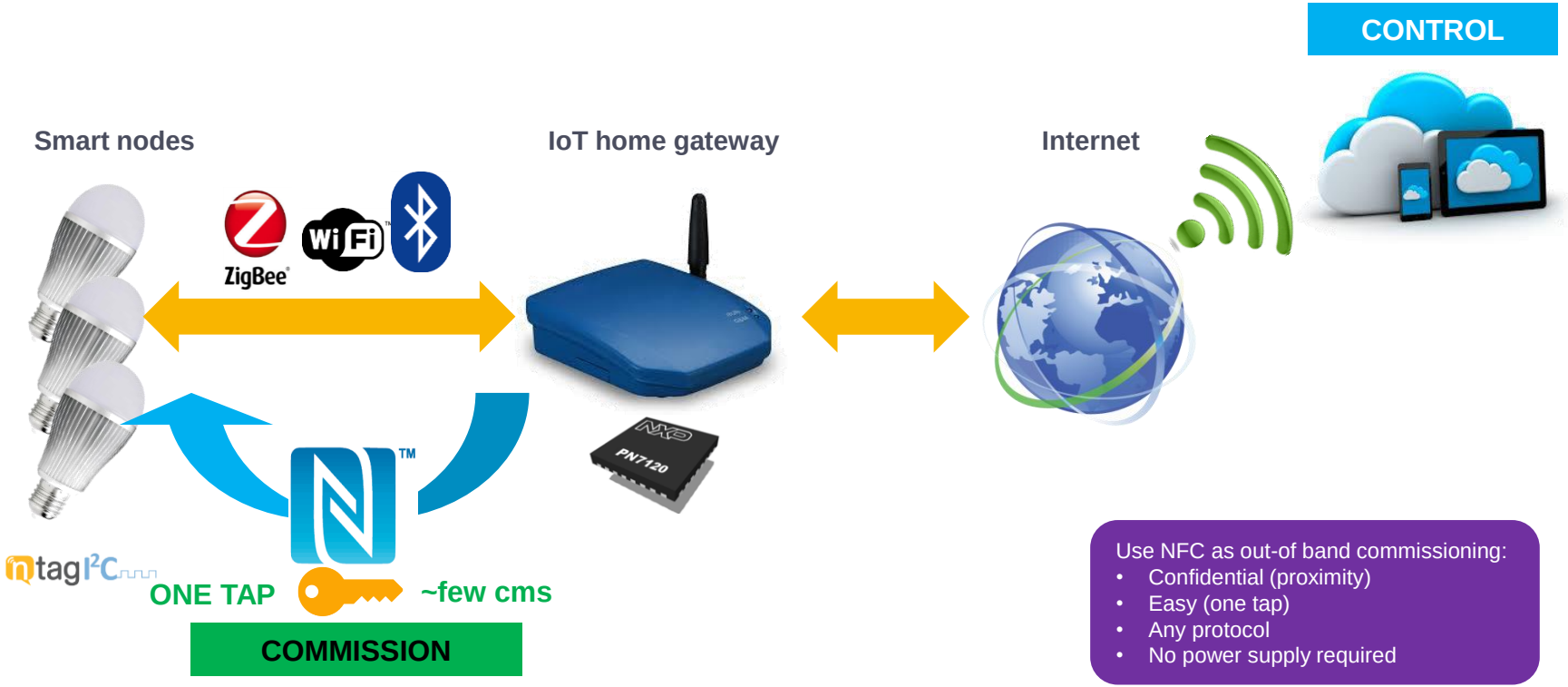
The Internet of Things in the Smart home



Smart home current roadblocks for mass market adoption



NFC one-touch commissioning solution



Use NFC as out-of band commissioning:

- Confidential (proximity)
- Easy (one tap)
- Any protocol
- No power supply required

Easy, flexible, and protocol agnostic “one tap” commissioning with NFC

- Protocol & platform agnostics
  - NFC supports any kind of protocol
  - NFC supported by a large population of smart phones and tablets
- Easy
  - No manual entry
  - Exchange network keys in one tap
- Flexible
  - No need for power supply for the nodes to exchange credentials
  - No direct network connection with the gateway required when powering the node for the first time – directly connecting to the network
  - Pre-configuration of the nodes possible (“in the box” customization)
- Safe through proximity
  - Network key exchange is done via proximity versus long range network
  - Can be further enhanced by secure element OTA connection

NFC one-touch commissioning benefits

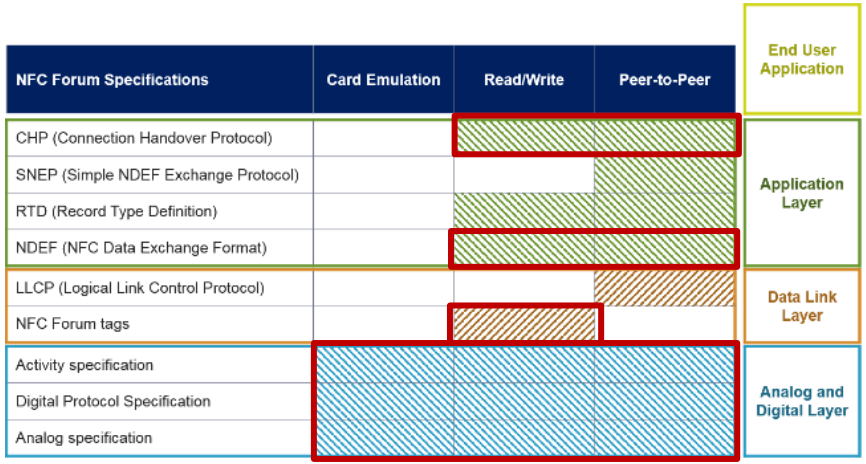
- MSOs / MNOs
  - Increase end user satisfaction
  - Limit technicians effort / after sales service
  - Smooth bridging of multi network systems (e.g: WiFi with Zigbee)
- ODMs
  - Ensure max interoperability with all existing standards
- End user
  - Safety through proximity
  - Simple handling
  - Plug & play set-up

NFC Forum specifications

Ensuring interoperability among devices and services

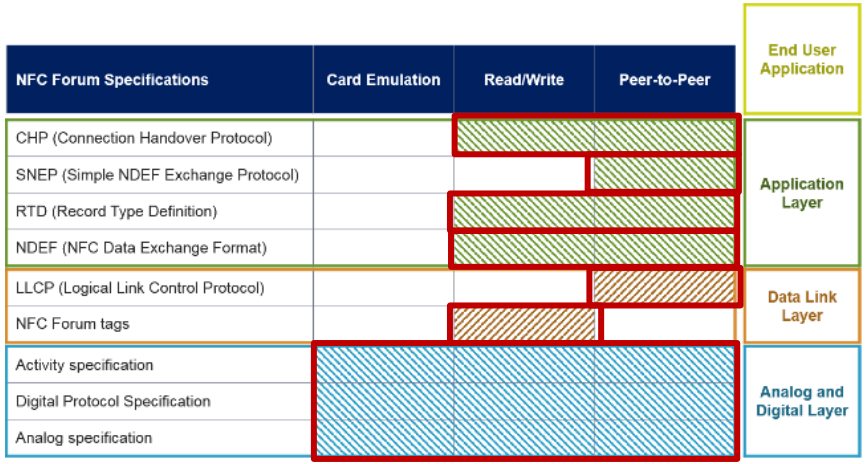
NFC Forum architecture

- **Connection Handover protocol (CHP)**
  - Defines the mechanism and format of the messages to exchange Alternative Carrier information
- Analog and Digital Protocol:
  - Based on NFCIP-1 and NFCIP-2
- NFC Forum Type Tag 1-4 Operation:
  - Commands and instructions to operate the four defined NFC Forum Type Tags.
- NFC Data Exchange Format (NDEF):
  - Defines a message encapsulation format to exchange information. Composed of one or NDEF records.
  - Defined supported payload types.
  - Standardized and Interoperable solution



NFC Forum architecture

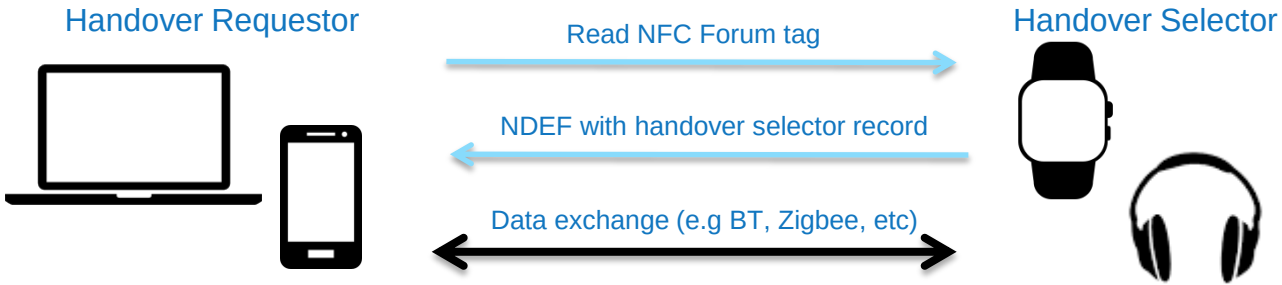
- Record Type Definition (RTD):
  - Defines NFC-specific record types for inclusion in NDEF messages (e.g. Smart Poster, Text, URI etc.)
- LLCP (Logical Link Control Protocol)
  - In charge of the creation and management of the logical link between peers. This includes link activation /deactivation, data flow control and multiplexing
- SNEP (Simple NDEF Exchange Protocol)
  - implements a client/server based architecture. It is used for the exchange of NDEF messages between two NFC Devices operating in Peer to Peer Mode. .

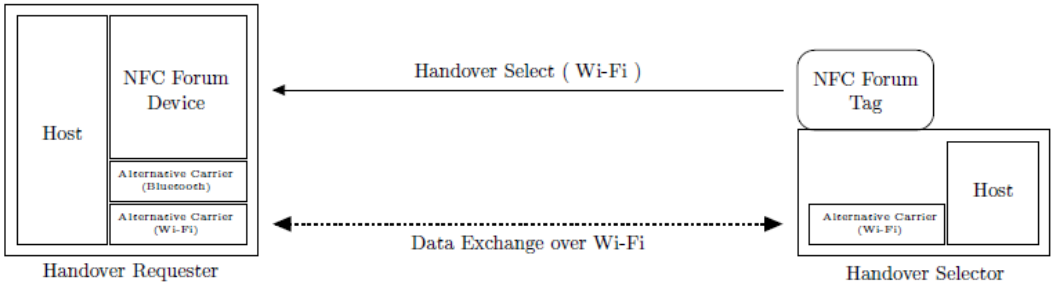


NFC Forum Connection Handover specification

Static handover

- Provision of an NDEF message to an NFC Forum device containing alternative carrier information that may be used for further data exchange

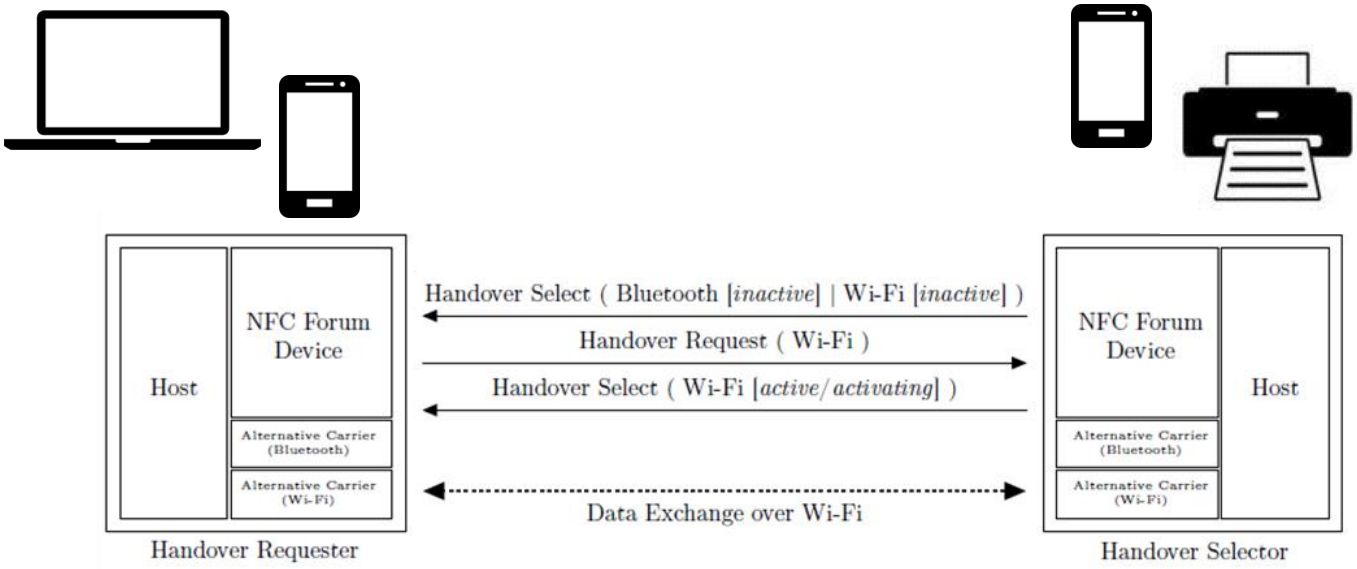




NFC Forum Connection Handover specification

Negotiated handover

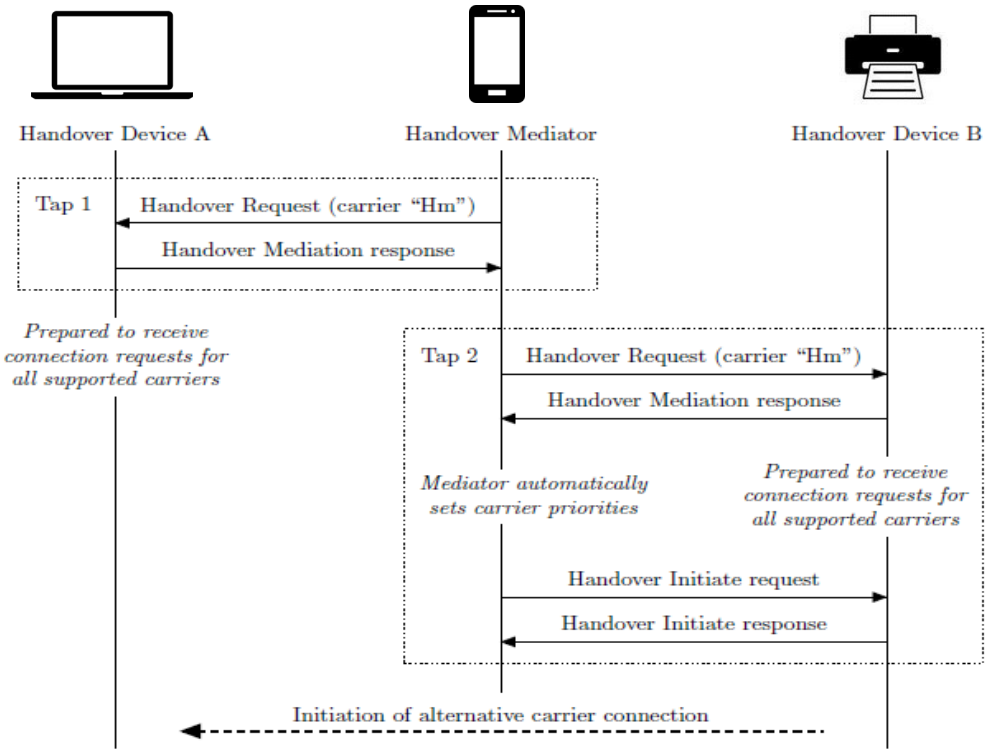
- Exchange of NDEF messages between two NFC Forum devices to agree on one or several alternative carriers and associated parameter set for further data exchange



NFC Forum Connection Handover specification

Mediated handover

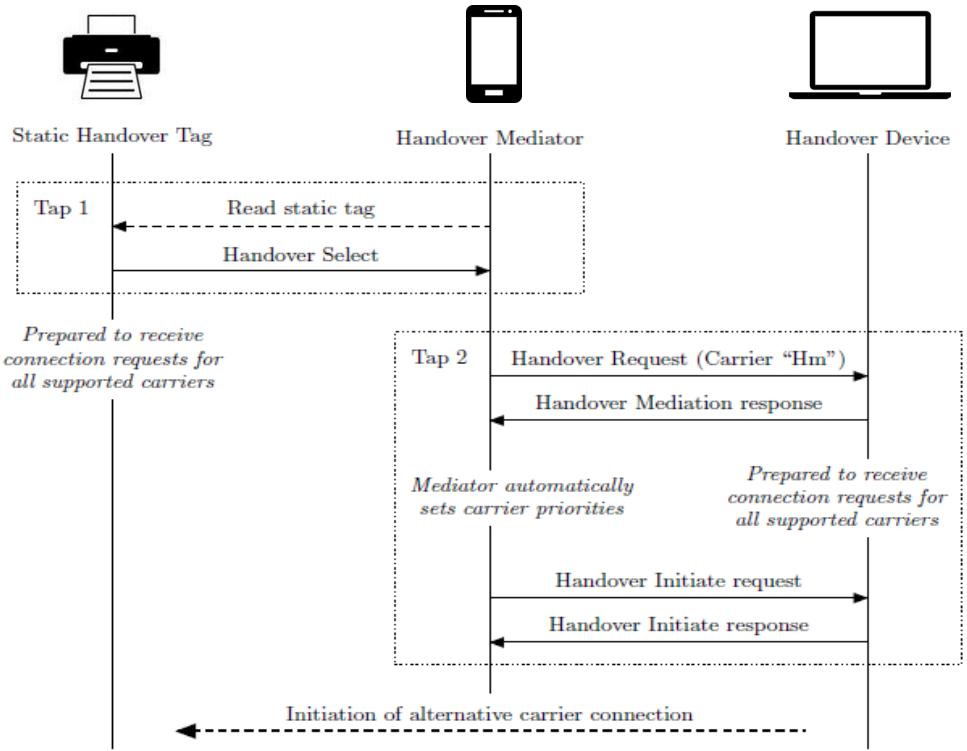
- Exchange of NDEF messages between two NFC-enabled devices via a third NFC Forum device (handover mediator) to agree on one or several alternative carriers and associated parameter set for further data exchange.



NFC Forum Connection Handover specification

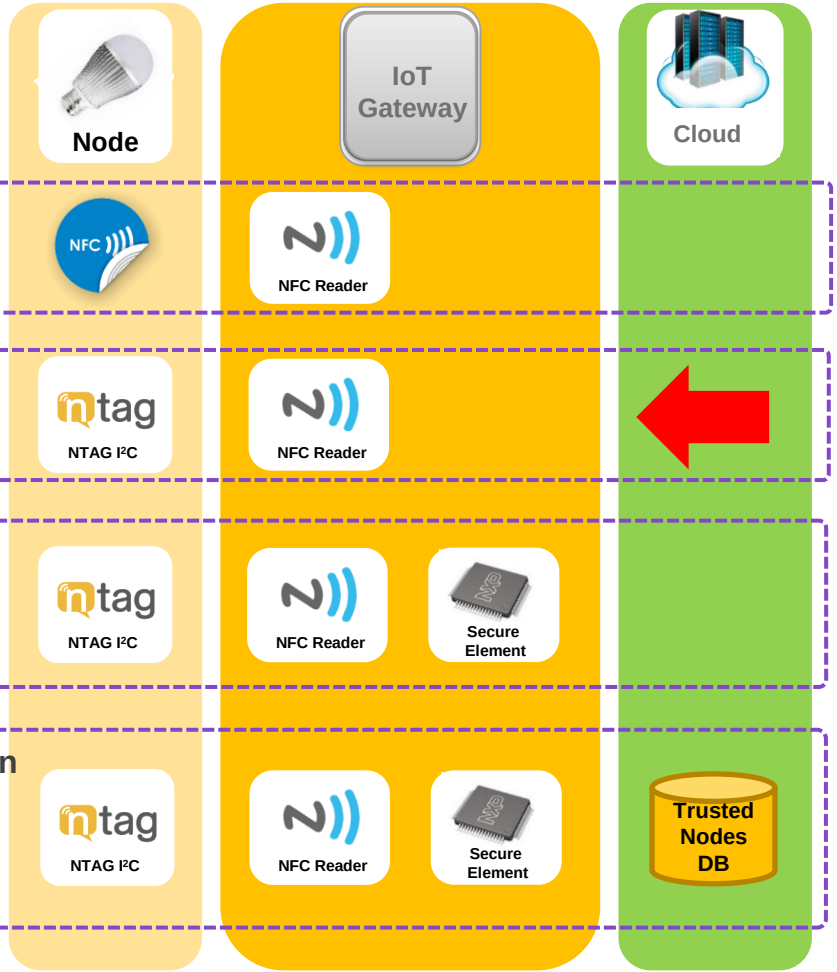
Mediated handover (II)

- Exchange of NDEF messages between two NFC-enabled devices via a third NFC Forum device (handover mediator) to agree on one or several alternative carriers and associated parameter set for further data exchange.



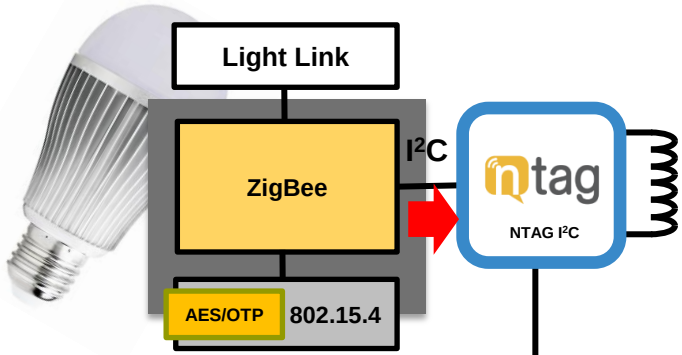
NFC commissioning schemes

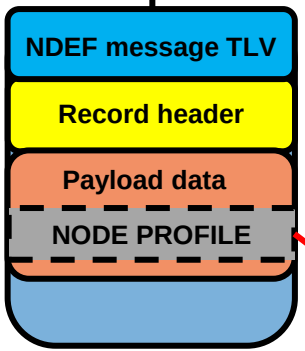
NFC commissioning schemes



NFC commissioning scheme #2

1. Node initialization





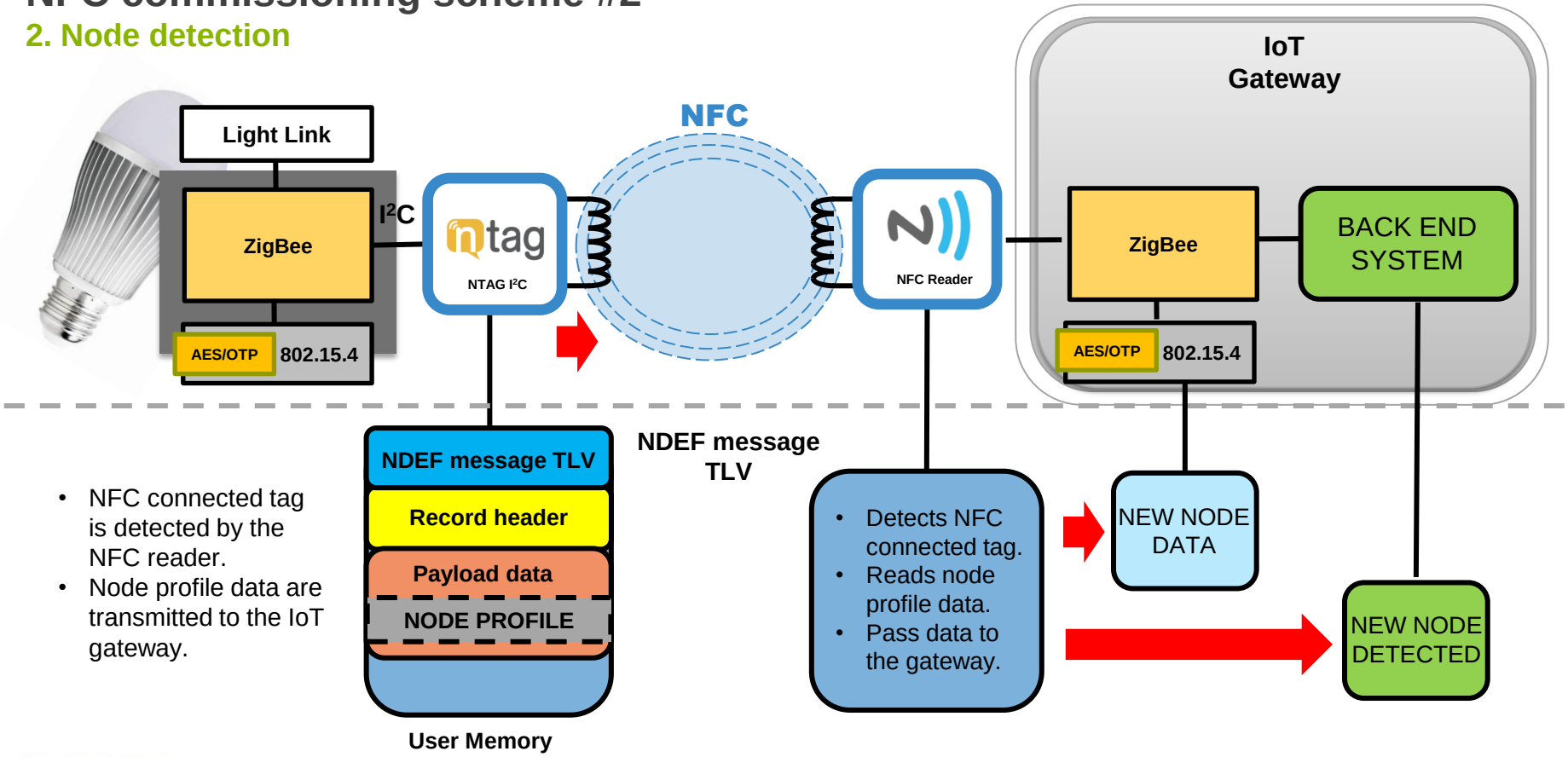
User Memory

- Load node profile into the user memory of the NFC connected tag via I²C interface and the Zigbee module at manufacturing.
- Default profile being written by the node to the NTAG-I2C after powering the device.
- Can be locked to avoid profile change.
- Data format follows the NFC forum standard (NDEF message).

1 Byte Version	Version number, identifies the NDEF message layout.
1 Byte From	ID of this device.
1 Byte SeqNr	Information if the commissioning action is already taken.
69 Bytes NodeEccPubKey	Reserved for future implementation scheme
8 Bytes NodeMacAddress	MAC address of this device.
16 Bytes NodeLinkKey	Identifies the network to be commissioned to.

NFC commissioning scheme #2

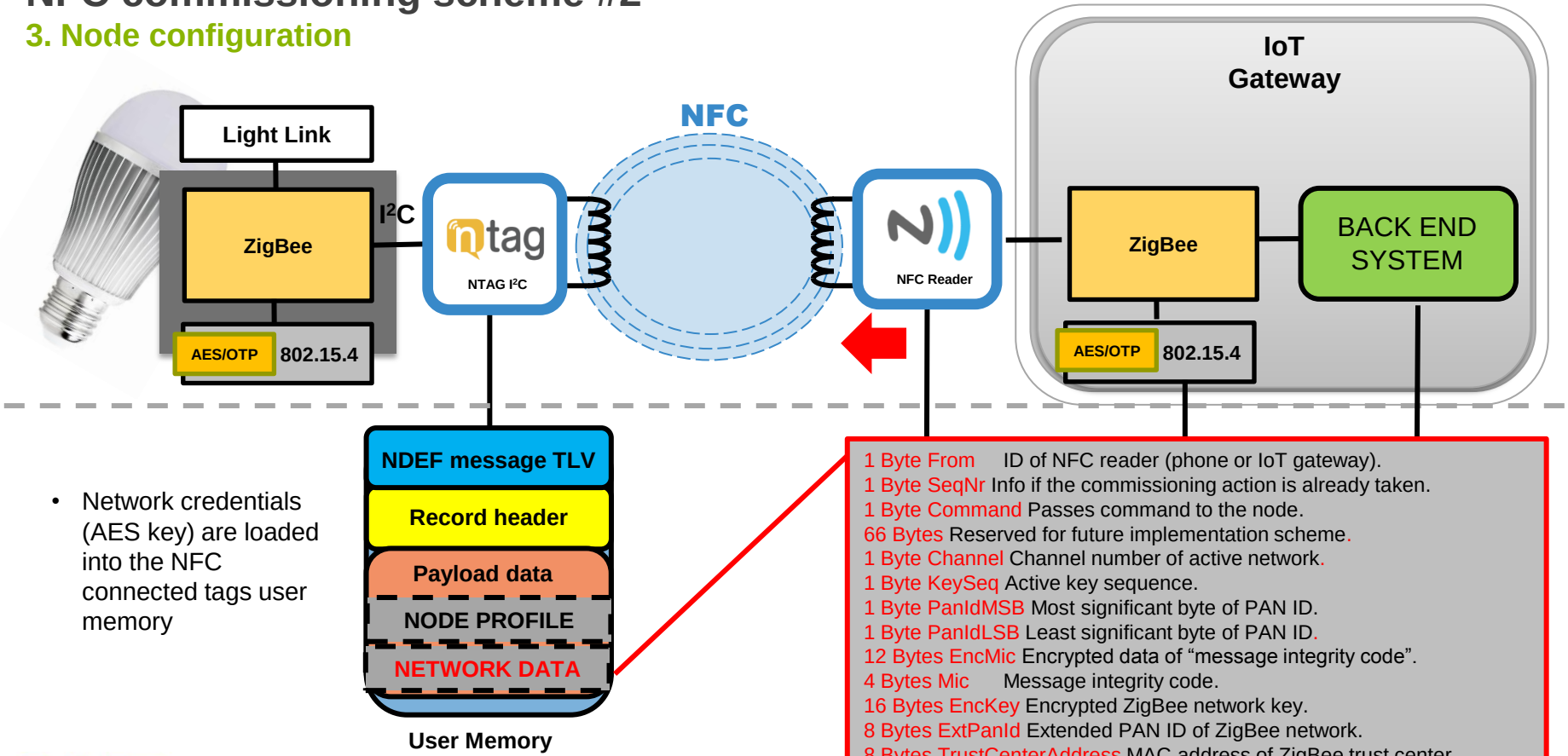
2. Node detection



- NFC connected tag is detected by the NFC reader.
- Node profile data are transmitted to the IoT gateway.

NFC commissioning scheme #2

3. Node configuration

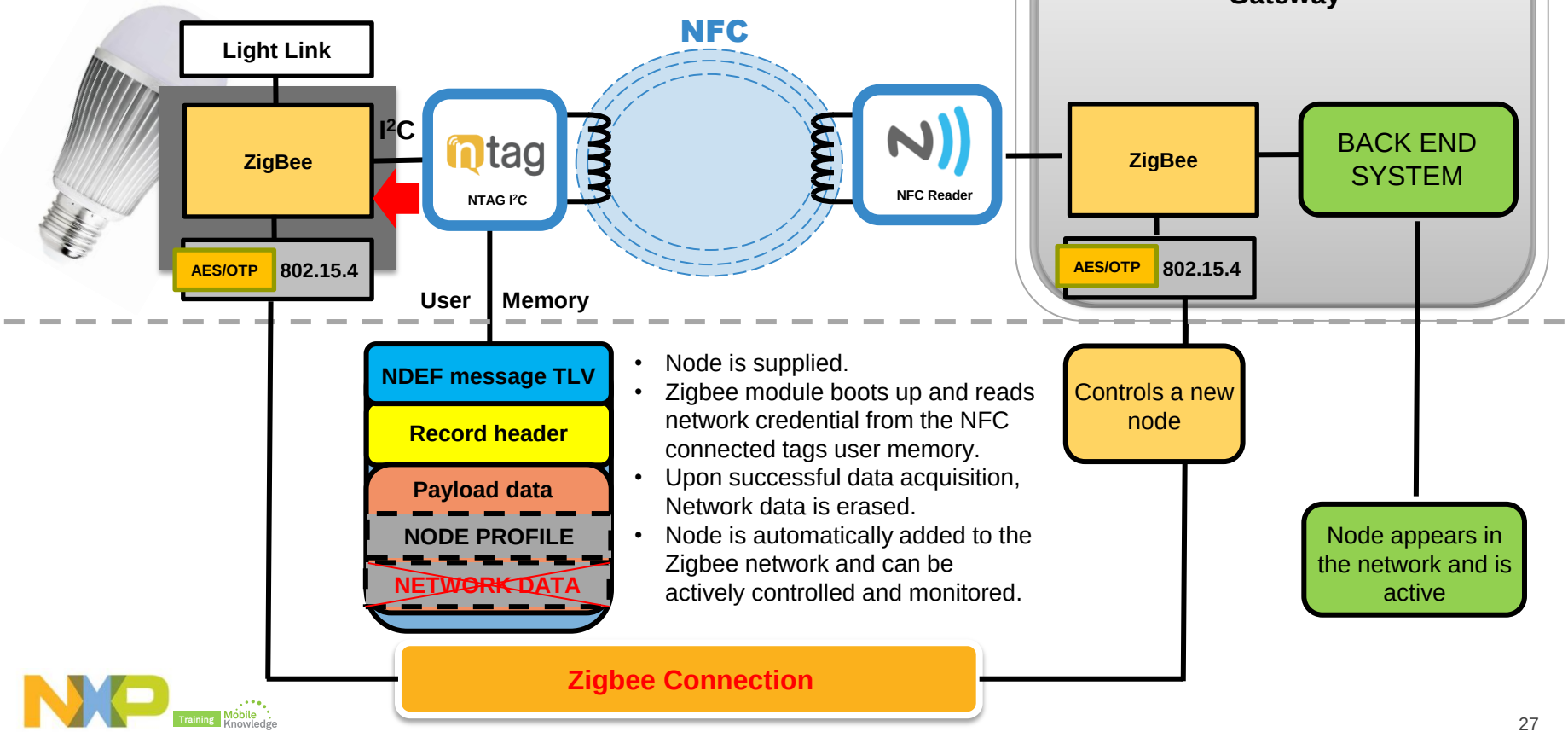


- Network credentials (AES key) are loaded into the NFC connected tags user memory

1 Byte From ID of NFC reader (phone or IoT gateway).
1 Byte SeqNr Info if the commissioning action is already taken.
1 Byte Command Passes command to the node.
66 Bytes Reserved for future implementation scheme.
1 Byte Channel Channel number of active network.
1 Byte KeySeq Active key sequence.
1 Byte PanIdMSB Most significant byte of PAN ID.
1 Byte PanIdLSB Least significant byte of PAN ID.
12 Bytes EncMic Encrypted data of “message integrity code”.
4 Bytes Mic Message integrity code.
16 Bytes EncKey Encrypted ZigBee network key.
8 Bytes ExtPanId Extended PAN ID of ZigBee network.
8 Bytes TrustCenterAddress MAC address of ZigBee trust center.

NFC commissioning scheme #2

4. Node activation



- Node is supplied.
- Zigbee module boots up and reads network credential from the NFC connected tags user memory.
- Upon successful data acquisition, Network data is erased.
- Node is automatically added to the Zigbee network and can be actively controlled and monitored.

NXP complete offering for the Smart home and NFC commissioning

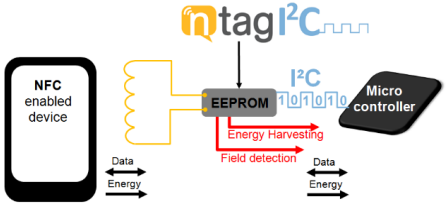
NXP product portfolio for the Smart home

Secure Transactions and Authentication	• Secure Mobile Transactions, • Device and Identity Authentication • Cyber Security for IoT nodes and Cloud Services
Communication & Networking	• 802.15.4 (Zigbee, 6LowPAN), BLE, NFC • Sub-Ghz ISM band communication, MI communication • 802.11p (car WiFi), automotive cellular modules
Processing	• Low power MCU's • Based on ARM 9 and Cortex M0-M4 cores • Discrete and embedded, eg in HD-IPCAM SoC
RFID / NFC	• Readers • Tags • Connected tags
Sensors & Sensor Subsystems	• ULP CMOS multi-sensors with digital output • Sensor hubs & sensor-MCU integration • Smart IP Camera solutions

NXP product portfolio for the NFC commissioning

Items	Nodes	Gateway	
NXP product	NTAG I2C	PN512	PN7120
NFC interface	NFC forum compliant - Type 2 tag	NFC forum compliant – Front end	NFC forum compliant – Controller
Non Volatile Memory	Up to 1,9kB EEPROM	-	-
Contact interface	I2C	I2C / SPI / UART	I2C
Embedded FW	-	-	Yes – ARM Cortex M0
Drivers / SW support	Source code	NFC reader library	Linux / Android drivers
Package	XQFN8 / TSSOP8	HVQFN40, HVQFN32	VFBGA49

NTAG I2C: the NFC node solution



Customer Benefits

- Fully NFC forum compliant
- Interoperability with every NFC-enabled device on the market
- Large read range and fast data exchange for smooth interactions
- Non-Volatile storage of data for zero-power operation
- Field-detection signal and energy harvesting for optimized power management
- Small antenna footprint for best integration

Supported RF protocols

- Fully compliant with ISO/IEC 14443A 2-3
- Fully compliant with NFC Forum Tag Type 2

Features

- Input capacitance of 50pF
- 888 or 1,904 bytes of user memory for NDEF message (based on EEPROM)
- Unique 7-byte serial number
- Read-only locking function
- 64-byte SRAM memory buffer
- Configurable Field-Detection output signal for data transfer synchronization and device wake-up during low-power mode
- Energy harvesting
- Clear arbitration between RF and I²C
- Fast Read command for shorter test times and increased throughput
- Get Version command for easy ID of chip type and supported features
- Package SOT902 (XQFN8) 1.6 x 1.6 x 0.5mm

Interface

- I²C interface supporting standard (100 kHz) and fast (400 kHz) modes

PN512: simple front end solution (gateway)

Customer Benefits

- Fits for multi application and NFC use cases in embedded environments
- Low BOM RF front-end IC
- NFC compatible with FeliCa, NFC-IP1, ISO/IEC14443 A & B support
- Provided Reader library
- Easy integration

Supported RF protocols

Reader/Writer mode

- ISO/IEC 14443 A&B R/W up to 848 kbit/s
- FeliCa R/W support
- Support of all mandatory NFC Forum tags
- R/W support for MIFARE 1K, 4K

NFC Peer to Peer mode

Card Emulation

- ISO/IEC 14443 A, FeliCa, MIFARE over S2C

Features

- 64 Byte FIFO
- Interrupts using IRQ pin
- Dedicated ID for every Operating Mode
- PVDD interface supply voltage down to 1,6V
- S2C interface available
- Different packages (HVQFN40, HVQFN32)
- Basic Function Library (source code)
- PN512 with dedicated antenna EMVco, (VISA, MASTERCARD) RF compliant

Interface

- SPI/UART/I²C Host Interface
- 2.5 V- 3.6 V power supply, typ. 3.3V

PN7120 fully integrated solution (gateway)

Customer Benefits

- NFC Forum compliant
- Interoperability with every NFC-enabled device on the market
- Low integration effort thanks to an embedded Firmware providing high level NCI interface
- Optimized power management
  (<1mW during Polling Phase)

Supported RF protocols

Reader/Writer modes

- ISO/IEC 14443 Type A & B R/W up to 848 kbit/s
- ISO/IEC 15693
- FeliCa R/W support up to 424kbit/s
- Support of all mandatory NFC Forum tags types
- R/W support for MIFARE 1K, 4K

Peer to Peer mode

- NFCIP-1 compliance

Card Emulation mode

- ISO/IEC 14443 Type A & B card emulation via host

Features

- ARM cortex M0 microcontroller core
- Integrated power management unit
  - Hard power down mode
  - Direct connection to battery 2.3 to 5.5V
- Integrated clock generator to save crystal
- Integrated self test to test antenna matching circuit during production.
- Package
  - VFBGA49 (4.0 x 4.3 x 0.9mm, pitch 0.5mm)
- SW Drivers
  - Linux and Android

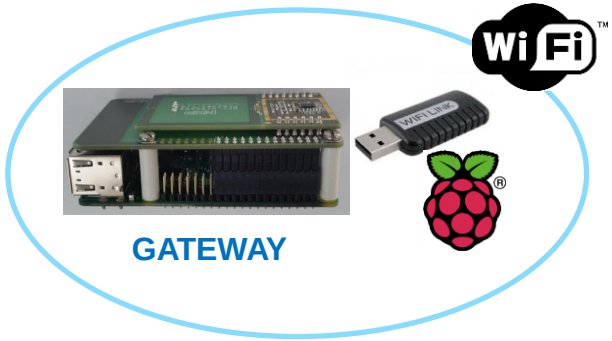
Interface

- NCI over I²C Host Interface
- 1.8V or 3.3V
- Up to 3Mbits/s

Solution resources

NFC commissioning demo with Zigbee

2 NODES
Smart RGB bulb
Smart Plug



GATEWAY

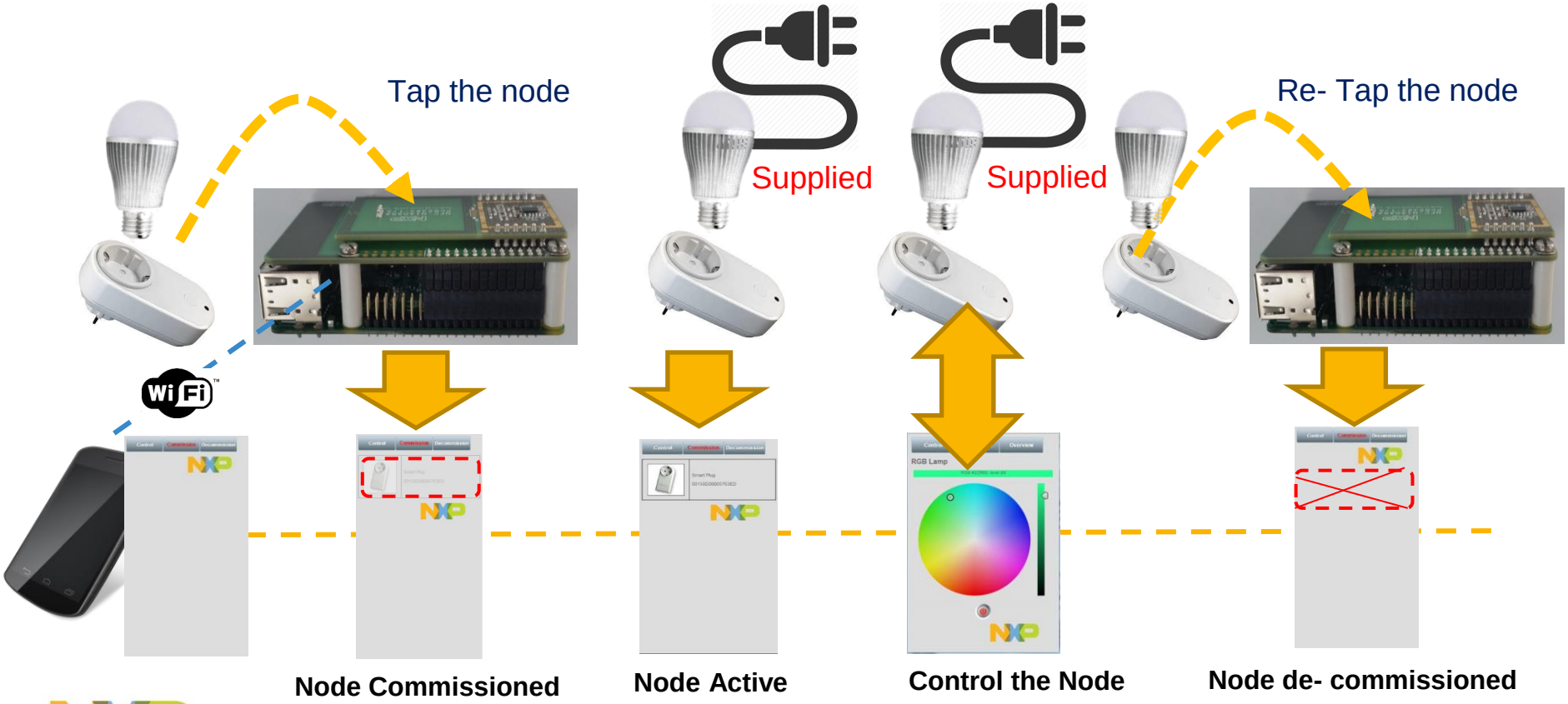
JN5169 — I²C — NTAG I²C

Zigbee | NFC

JN5169 — HOST — PN7120

Zigbee | NFC

NFC commissioning demo with Zigbee



PN7120 controller SBC and NTAG I2C demo kits

OM5577/PN7120S and OM5569

OM5577/PN7120S

- Demoboard for the PN7120 NFC controller
- Designed to work with Raspberry-Pi or BeagleBone
  - Can be adapted to other systems
- Drivers available for Linux and Android
- Linux images available for Raspberry-Pi and BeagleBone

Demoboard website
www.nxp.com/demoboard/OM5577.html

OM5569

- A simple all-in-one demonstrator kit for NFC connected tag chips
- **An all-in-one kit**
  - **Ready-to-use** demonstrator
  - **Complete** evaluation tools for all NTAG I²C functionalities
  - **Flexible** development platform for your own application

Demoboard website
http://www.nxp.com/board/OM5569.html

Wrap up

Smart home market is heating up

- IHS technology
  - *“smart home market will grow by 56 percent in the next three years”*
  - *“190 million products shipping by 2018”*
- Strategy Analytics
  - *“224 million homes, or nearly 12% of all households worldwide, will have at least one type of smart home system installed”*
- Zigbee/802.15.4 is expected to become the backbone of the wireless Smart Home
- Adding new nodes / network commissioning is cumbersome

NFC offers an easy, flexible, and protocol agnostic “one tap” commissioning solution

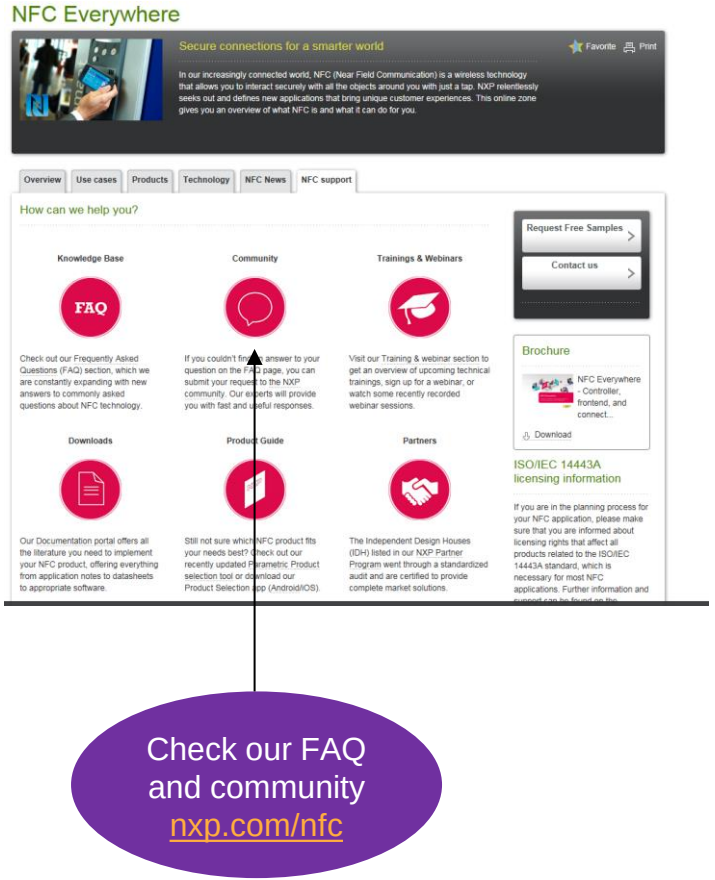
Do you need more?

Resources and useful links

Reference material & documentation:

- **NFC Everywhere**
  http://www.nxp.com/nfc
- **NFC Everywhere support page:**
  http://www.nxp.com/techzones/nfc-zone/community.html
- **From here check out the community for FAQs of post your question into the**
  discussion forum for NFC Readers
- **Wireless connectivity techzone**
  http://www.nxp.com/techzones/wireless-connectivity/overview.html

For other questions or further support, please contact: nfc.readers@nxp.com



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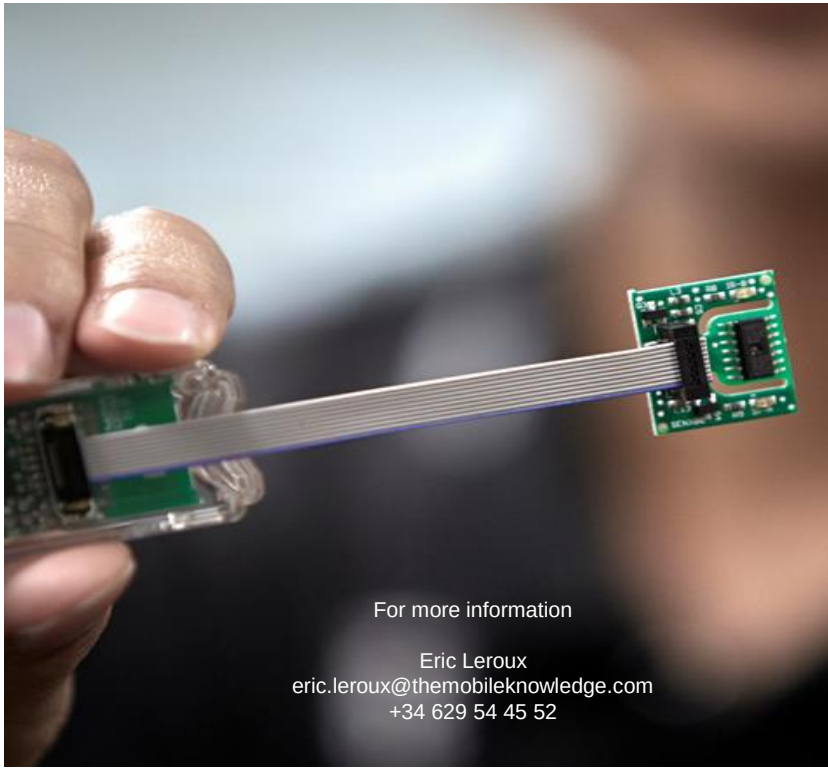
- We are a global competence team of hardware and software technical experts in all areas related to contactless technologies and applications.

- Our services include:
  - Application and system Design Engineering support
  - Project Management
  - Technological Consulting
  - Advanced Technical Training services

- We address all the exploding identification technologies that include NFC, secure micro-controllers for smart cards and mobile applications, reader ICs, smart tags and labels, MIFARE family and authentication devices.



NXP Training Mobile Knowledge

NFC commissioning

Jordi Jofre (Speaker) / Eric Leroux (Host)

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- Please remember to fill out our evaluation survey (pop-up)
- Check your email for material download and on-demand video addresses
- Please check NXP and MobileKnowledge websites for upcoming webinars and training sessions

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