NFC Essentials & More

Get up to date with NFC!

Mubeen Abbas

Product & Segment Marketing

NFC Infrastructure

September 2019 | Session #AMF-SMH-T3811

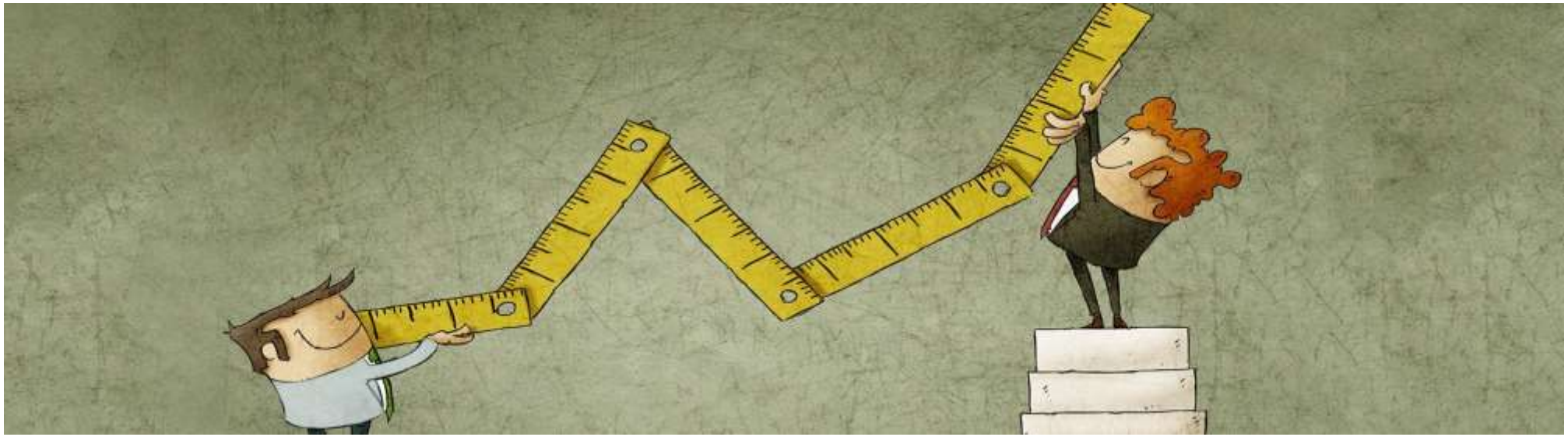
SECURE CONNECTIONS FOR A SMARTER WORLD

Agenda

- NFC Introduction
- What's New in NFC?
- Use Cases & Products / NPI
- Use Cases Explained
- NFC Support
- Q & A

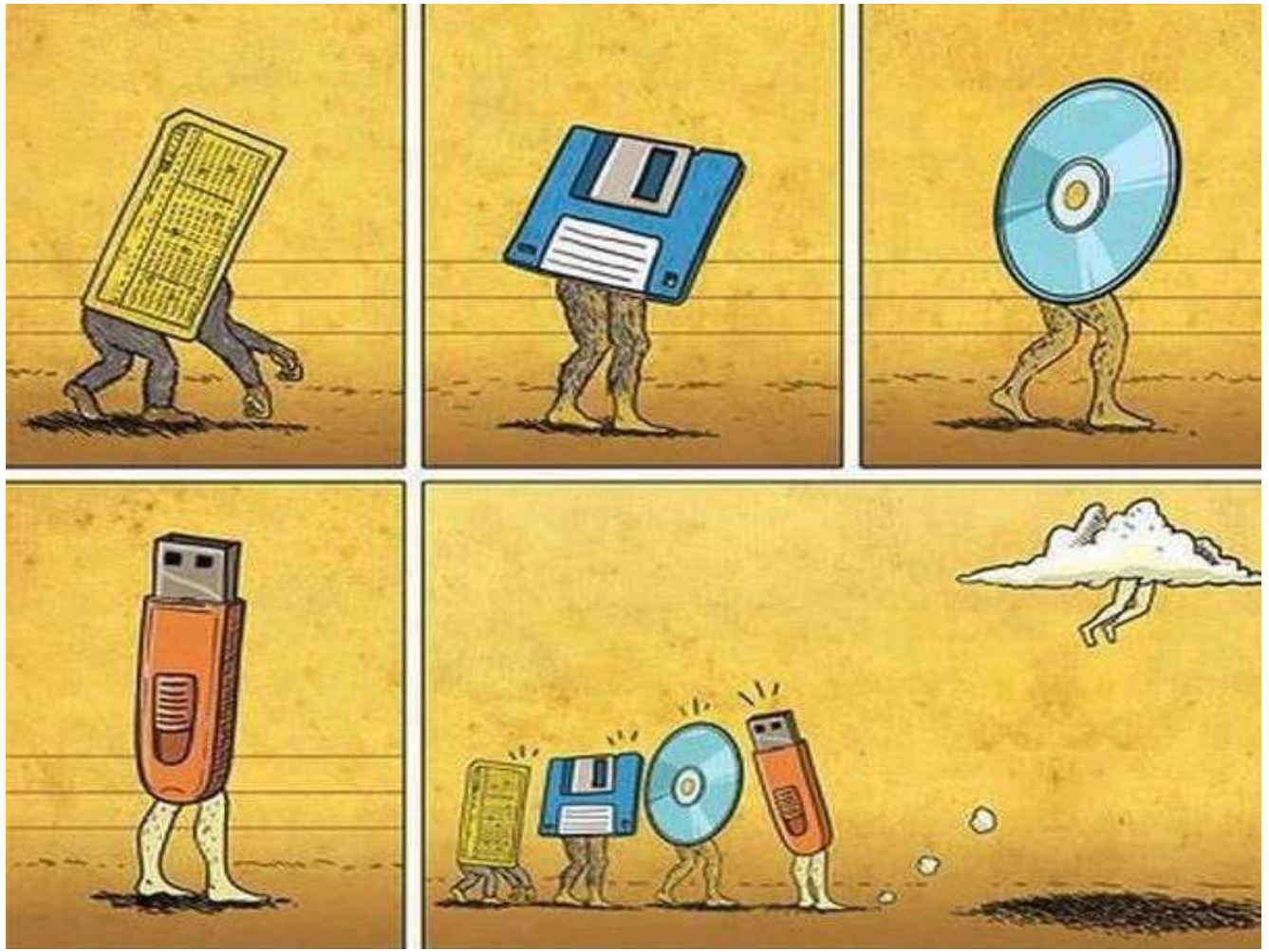
Good to Know…

- How many of you have worked with NFC already?
- How does NFC work? What is the principle behind?
- Who created this technology and when?
- What is the operating frequency?
- To how many customers have you pitched NFC in 2019 so far?



Technology Evolution

Same Use Case, Easier & Better Solution



What is NFC?

Short Overview

NFC = Near Field Communication

- NFC is a contactless short range technology, based on inductive coupling (10cm / 4 in)
- Co-invented in 2002 by NXP and Sony
- Operating frequency 13.56MHz, speed < 848 kbits/s

More intuitive than any technology
It's like shaking hands

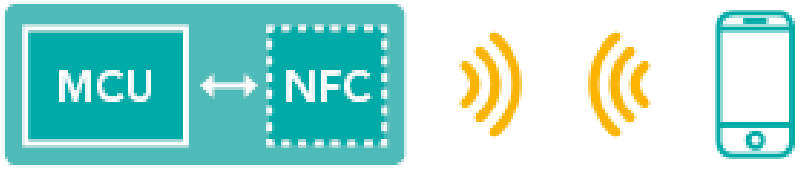
Use Power Very Efficiently
One powered device & Energy harvesting

Trusted addition to other technology
Especially for pairing devices

You can add NFC to any MCU and MPU!

NFC connects the device to other objects over a short range (typically ~10 cm):

… any NFC tag or card



… any NFC-enabled smartphone

… any other NFC-enabled embedded system

NFC Smartphones Supporting Tag Interaction

All operating modes supported

Tag reading based on NDEF supported

New

iOS 13: announced tag writing capabilities

Use Cases & NFC Products

Innovative NFC solutions

The Well-known Use Cases…

… and the newer emerging ones

Payment

Access control

Parameterization and diagnosis

Authentication and identification

Pairing and commissioning

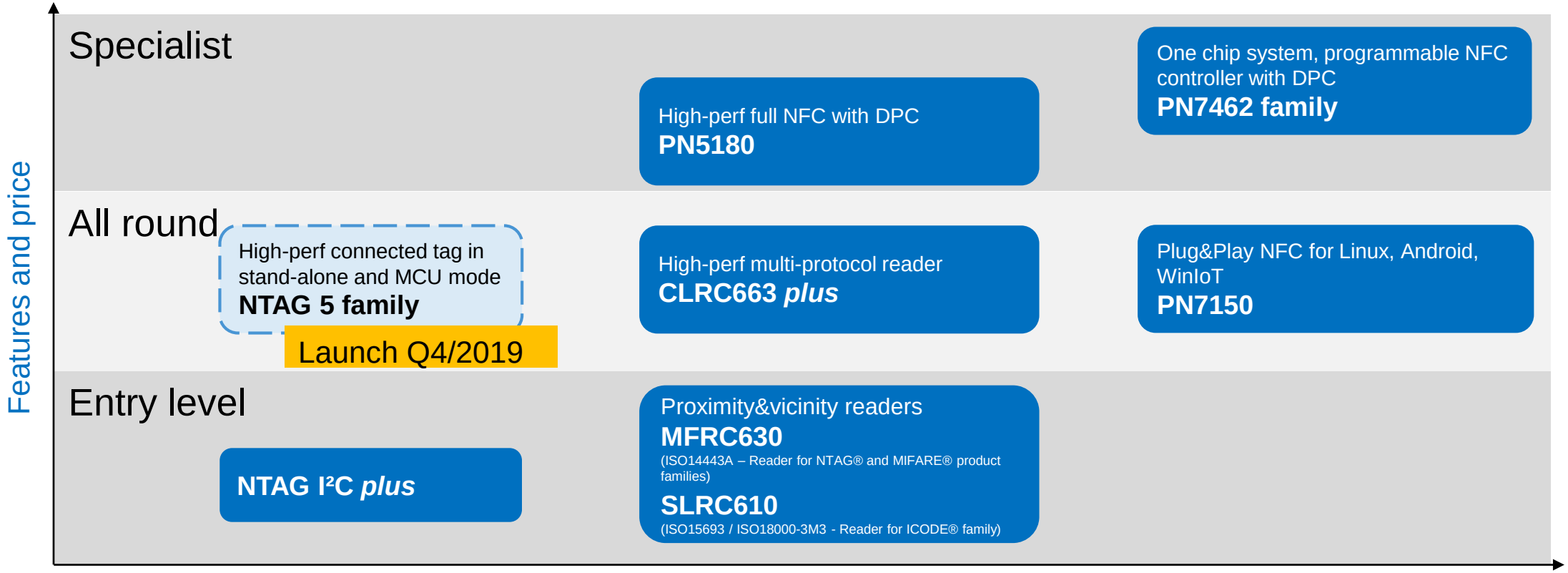
Device-to-device communication

And More in this Interesting Video…

Video: What is NFC?

NFC Focus Products for Each Application Need

Readers/connected Tags: for Embedded Electronics



Connected tag solutions
NFC tags with non-volatile memory and host connection or integrated MCU

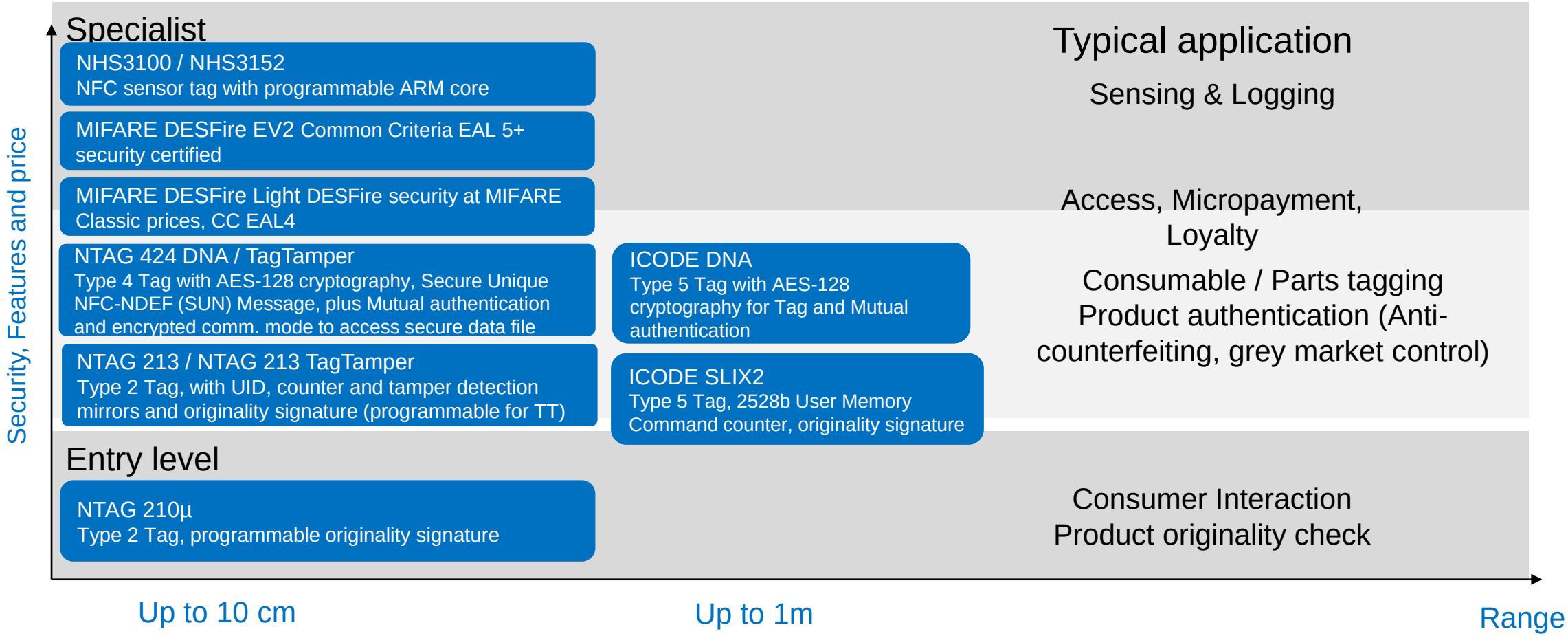
NFC Frontend solutions
NFC reader with NFC Reader SW Library

NFC controller solutions
NFC reader with integrated 32-bit Cortex MCU and either integrated firmware or freely programmable memory

* Single chip: Cortex M0 MCU + last generation NFC reader + ISO 7816 Contact reader

NFC Focus Products for Each Application Need

ICs for tags, labels and cards



Entire passive tag portfolio can be found in: https://www.mifare.net/wp-content/uploads/2019/05/SMR-Z-Card-May-2019-Update-web-FINAL.pdf

NTAG I²C *plus*

NTAG I²C *plus* – The Simplest & Lowest BoM NFC Solution

- Low Bill of Material
- Energy harvesting and field detection
- Fast & convenient data exchange
- 15 years longevity program

NTAG I²C *plus* Product Features

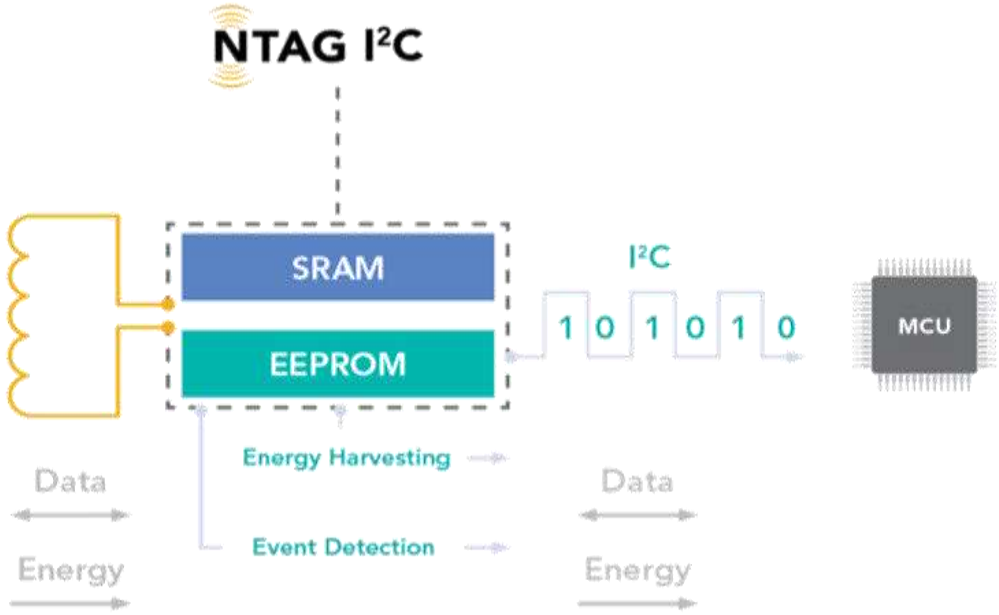
Features

NFC interface	ISO/IEC 14443-3 Type A compliant NFC Forum Type 2 Tag
Memory	1912 or 888-bytes user memory area 64-bytes SRAM buffer for data transfer
Host interfaces	I²C slave 100/400 Kbit/s Field detection pin
Energy harvesting	Up to 15mW
Data transfer	Pass-through mode with 64-byte SRAM buffer FAST_WRITE and FAST_READ NFC commands for higher data throughput
Security	7-byte Unique Identifier One time programmable Capability Container Read-only locking Elliptic curve based originality signature Data access protection from NFC and I²C perspective
Temperature range	-40ºC, +105ºC

More info: http://www.nxp.com/products/:NT3H2111_2211

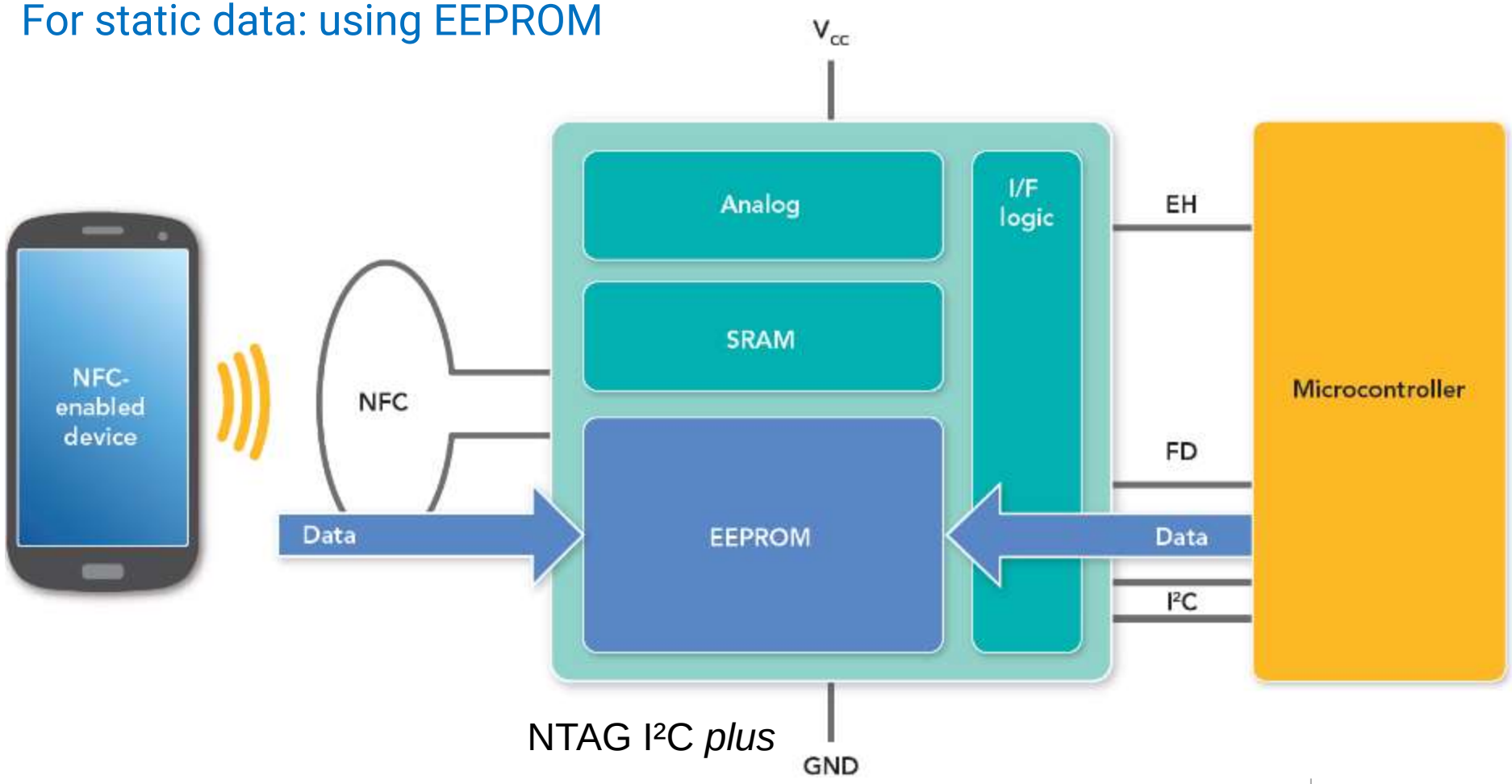
Packages

XQFN8	1.8 x 2.6 x 0.5 mm
TSSOP8	3 x 3 x 1.1 mm
SO8	4.9 x 3.9 x 1.75 mm



Zero Power Device and at the Same Time Real Time NFC Modem

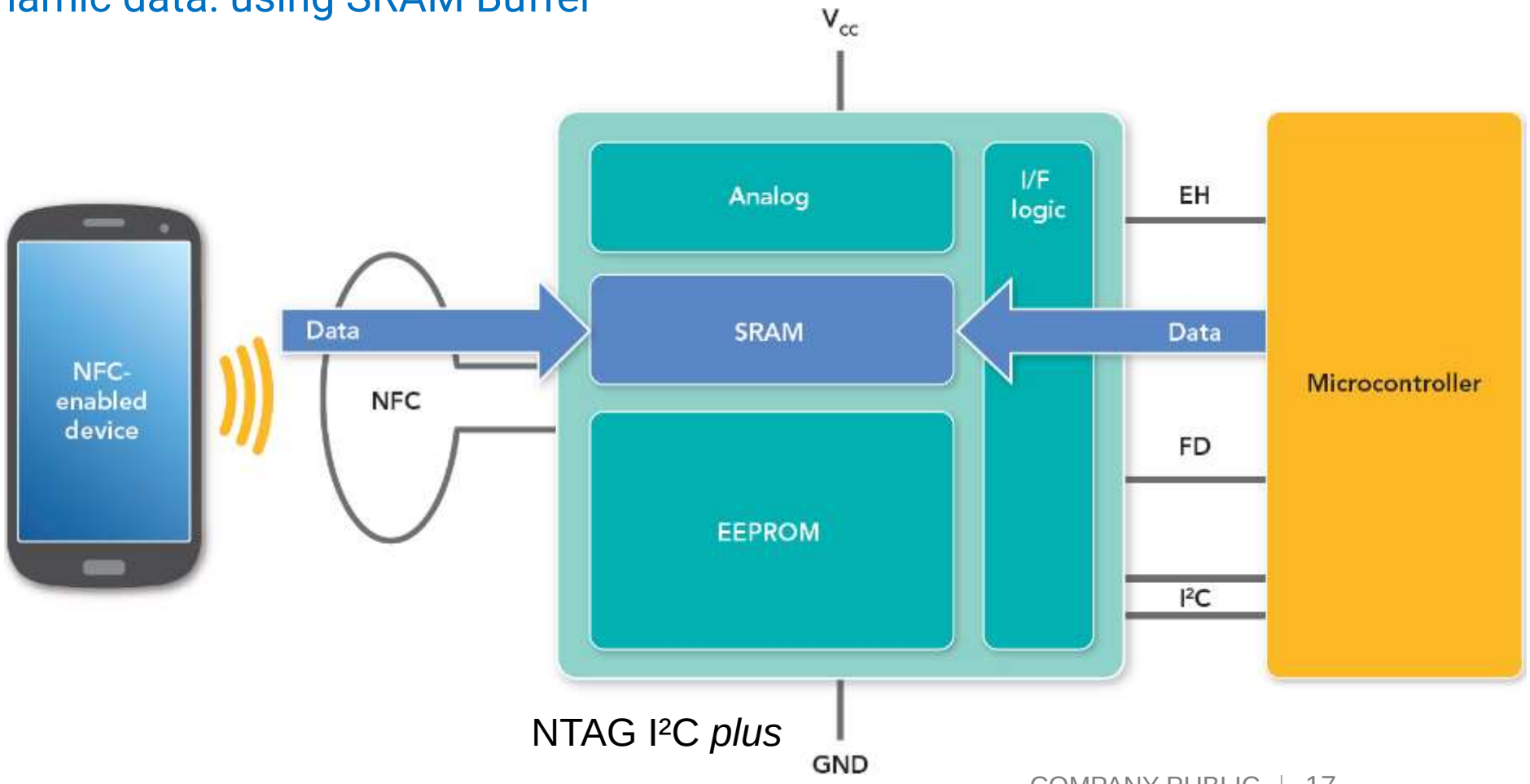
For static data: using EEPROM



NTAG I²C *plus*

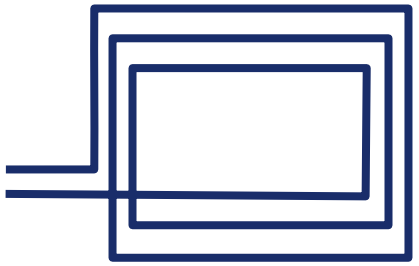
Zero Power Device and at the Same Time Real Time NFC Modem

For dynamic data: using SRAM Buffer



NTAG I²C *plus*

Beyond the Silicon: 3 Main Steps in Development



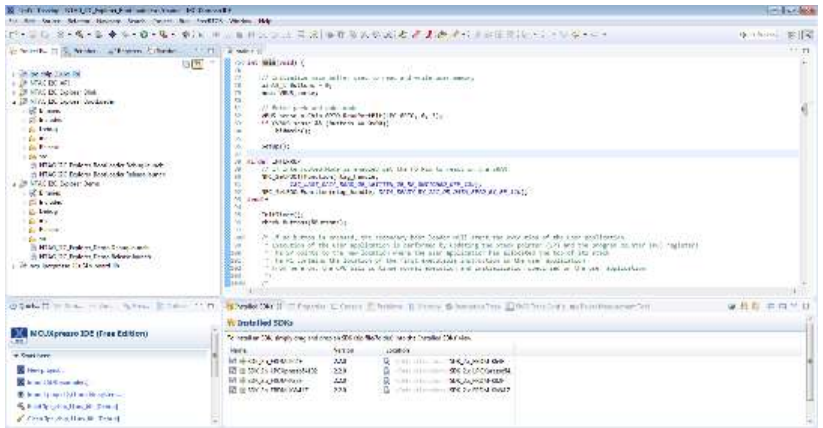
Antenna

Firmware

App

Reference antenna from nxp.com

Custom design – see webinar



NTAG I²C *plus* Target Markets

Industrial

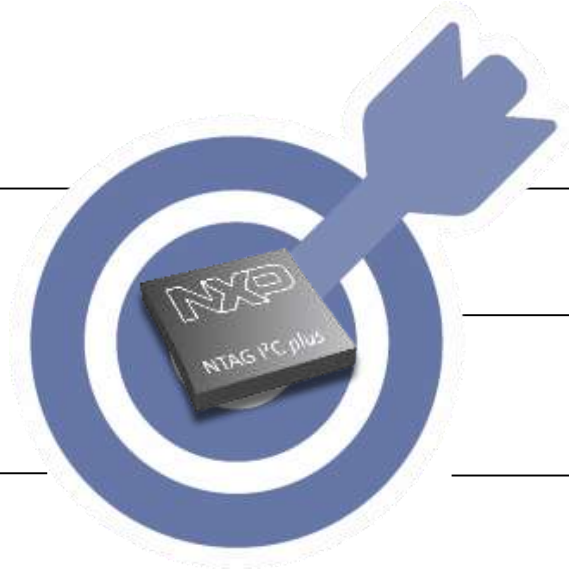
- Parametrization using NFC avoids opening the housing
- Full interoperability with NFC-enabled devices
- Non-volatile memory area to store application data.
- Energy harvesting allows operation without power supply/Battery

logistics

- Zero power operation with non-volatile data storage
- Password protection to prevent unauthorized data manipulation
- Unique ID optimizes inventory

Internet of things

- NFC for intentional and easy commission devices to a network
- Non-volatile memory area to store application data.



Smart meters

- Meter maintenance via NFC avoids opening the housing.
- Full interoperability with NFC-enabled devices
- Password protection to prevent unauthorized data manipulation

Electronic Shelf label

- De facto standard in ESLs used for maintenance or for more intuitive customer interaction
- Zero power operation with non-volatile data storage
- Password protection to prevent unauthorized access.

Consumer electronics

- NFC for intentional and easy commission devices to a network
- Full interoperability with NFC-enabled devices
- Non-volatile memory area to store application data.

CLRC663 *plus*

CLRC663 *plus* Family – Push Your Design Faster

Best performance at lowest power consumption

Extended Low Power Card Detection range with new configuration options. Low supply voltage for battery support down to 2.5V

Design flexibility

Max. operating transmitter current of 350mA with limiting value of 500mA broad temperature range from -40°C to +105°C

Backward compatible to CLRC663

Pin-to-pin and software compatible to CLRC663

Faster time-to-market

Complete support package including EMVCo compliant NFC SW library and NFC Cockpit with VCOM interface and easy antenna configuration

CLRC663 *plus* Product Features

Features

NFC interface	Full RF standard compliance EMVCo 2.6 L1 analog & digital compliance
Host interfaces	I²C (1000Kbps), SPI (10Mbps), UART (1228.8Kbps) SAM interface in X-mode Up to 8 GPIO
RF transmitter supply voltage	2.5 to 5.5 V
Operating transmitter current	350 mA (max), 500 mA (Lim.)
Power management	Flexible and efficient power saving modes including hard power down, standby and LPCD
LPCD range (EMVCo RefPICC)	66 mm
Operating ambient temp. range	-40ºC, +105ºC
FIFO buffer	512 bytes
Waveform control	Yes
Integrated PLL	Integrated PLL provides external system clock from 27.12MHz RF crystal

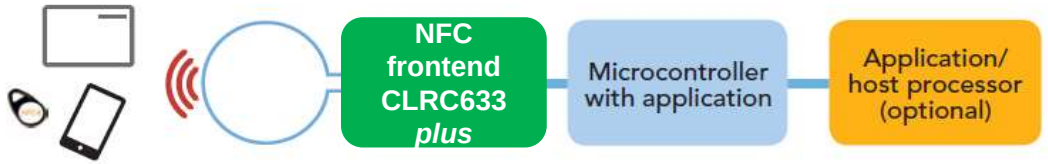
More info: http://www.nxp.com/products/:CLRC66303HN

Supported RF protocols

Read / Write mode	ISO/IEC 14443A (NTAG® and MIFARE® product family) ISO/IEC 14443B JIS X 6319-4 (comparable with FeliCa1 scheme) ISO/IEC 15693 (ICODE® SLIX, SLIX2, DNA) ISO/IEC 18000-3 mode 3/ EPC Class-1 HF (ICODE® ILT)
Peer-to-Peer mode	Passive-Initiator according to ISO/IEC 14443A (106kbit/s) and FeliCa (212 and 424kbit/s)

Packages

HVQFN32 Wettable flanks	5 x 5 x 0.85 mm



CLRC663 *plus* Family Members

Feature	CLRC663 *plus*	MFRC630 *plus*	SLRC610 *plus*	MFRC630	SLRC610
ISO/IEC14443-A (MIFARE / NTAG)	Yes	Yes		Yes	
ISO/IEC14443-B	Yes				
JISX6319-4 - FeliCa	Yes				
ISO/IEC15693 – ICODE SLIX/DNA	Yes		Yes		Yes
ISO/IEC18000-3M3 – ICODE ILT	Yes		Yes		Yes
ISO/IEC18092 passive initiator	Yes				
Operating transmitter current	350 mA (max), 500 mA (lim)			250 mA (max)	
LPCD[1] range[2] (EMVCo RefPICC)	66 mm			26 mm	
Operating ambient temp. range	-40 ºC to +105 ºC			-25 ºC to +85 ºC	
RF transmitter supply voltage	2.5 to 5.5 V			3.0 to 5.5 V	
Package type	HVQFN32 with wettable flanks			HVQFN32	

- **MFRC630 *plus* and MFRC630** → (ISO14443A – Reader for NTAG® and MIFARE® product families)
- **SLRC610 *plus* and SLRC610** → ISO15693 and ISO18000-3M3 – Reader for ICODE® family
- All derivatives are pin-to-pin compatible

1. Low Power Card Detection
2. All detection ranges measured using the standard CLRC663 *plus* development board (CLEV6630B) operated with external power supply at room temperature

CLRC663 *plus* Target Markets

Access control

- Broad temperature range -40°C to +105°C
- Pin-to-pin and SW compatible to CLRC663.

Payment terminal

- Highest transmitter current.
- EMVCo 2.6 L1 analog and digital compliant.

Gaming

- Extended Low Power Card Detection range with new configuration options.
- Low supply voltage for battery support down to 2.5 V.

PN5180

PN5180 – The Best Full NFC Frontend on the Market

- Contactless high power NFC
- Dynamic Power Control - strong RF performance in harsh environments
- NFC Cockpit design-in tool
- NFC Forum, EMVCo and ISO/IEC compliant library
- NFC frontend development kit OM25180FDK

PN5180 Product Features

Features

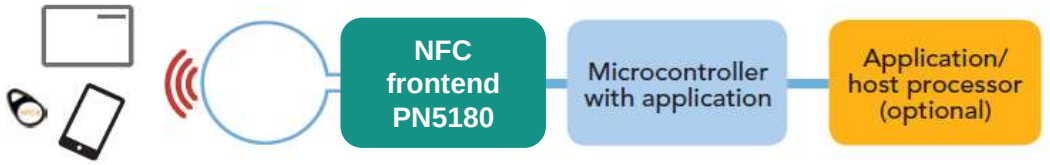
NFC interface	Full RF standard compliance EMVCo 2.6 L1 analog & digital compliance Automatic HW EMD handling
Host interfaces	SPI up to 7Mbps IRQ and BUSY signal for improved host communication Up to 7 outputs
RF transmitter supply voltage	2.7 to 5.5 V
Operating transmitter current	250 mA Dynamic Power Control (DPC)
Waveform control	Adaptive waveform control (AWC)
Operating ambient temp. range	-30ºC, +85ºC
Receiver control	Adaptive receiver control (ARC)

Packages

HVQFN40	6 x 6 x 1 mm
TFBGA64	5.5 x 5.5 x 0.85 mm

Supported RF protocols

Read / Write mode	ISO/IEC 14443A (NTAG® and MIFARE® product family) ISO/IEC 14443B JIS X 6319-4 (comparable with FeliCa1 scheme) ISO/IEC 15693 (ICODE® SLIX, SLIX2, DNA) ISO/IEC 18000-3 mode 3/ EPC Class-1 HF (ICODE® ILT)
Peer-to-Peer mode	Passive-Initiator / Passive-Target Active-Initiator / Active-Target
Card emulation	ISO/IEC 14443A (up to 848 kbit/s) Active Load Modulation

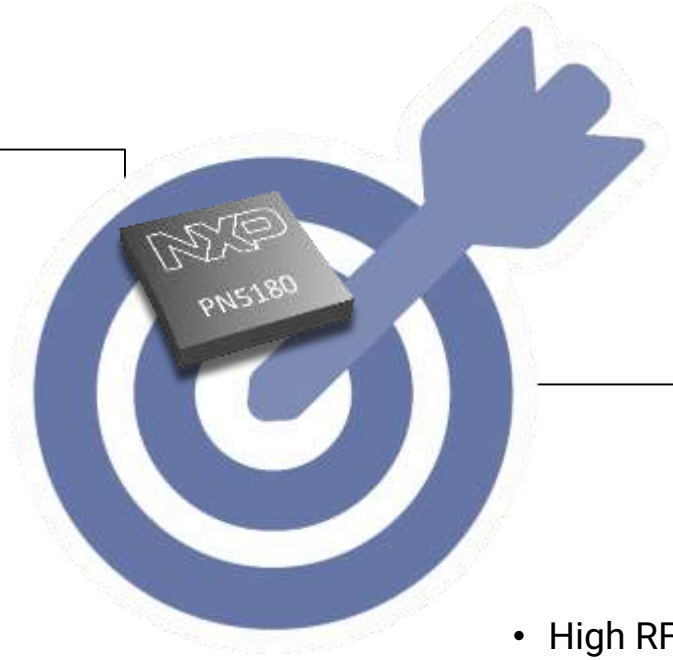


More info: http://www.nxp.com/products/:PN5180

PN5180 Target Markets

Payment, POS & MPOS terminals

- Full interoperability with NFC-enabled devices
- High RF field output power
- DPC simplifies operation in harsh environment
- TFBGA package eases PCI certification
- EMVCO L1 compliancy



Industrial and EGOV

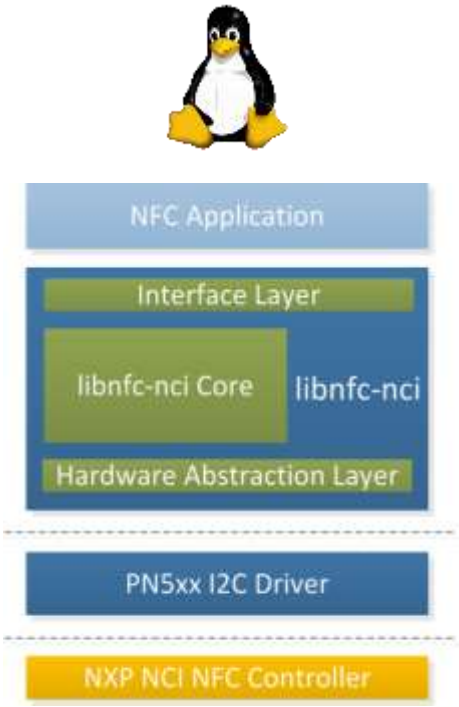
- High RF field output power
- DPC simplifies operation in harsh environment
- Integrated EMD handling for robust communication links
- Vicinity card standards support for industrial applications
- ISO/IEC 14443 compliant library reduces design in cycles

PN7150

PN7150 – Plug-and-play NFC Solutions

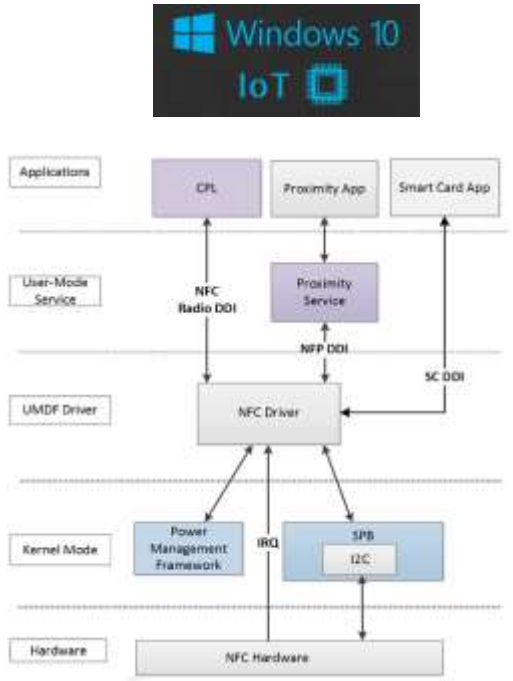
- Very easy to integrate thanks to embedded firmware and NCI standardized interface
- Complete, power-efficient NFC control.
  Active Load Modulation to enhance the card mode performances
- Linux, Android and Windows IoT drivers ease integration and reduce time to market
- Low cost Bill of Material, with HVQFN40 package enabling low cost PCB manufacturing package
- Full interoperable and NFC Forum-compliant controller
- Single Board Computer kits for easy integration into platforms such as RaspberryPi, BeagleBone Black and board with Arduino-compatible headers.

PN7150 Software Drivers for SW Integration into any Platform



Linux NFC architecture
Linux integration is offered through NXP's Linux libnfc-nci SW stack

Android NFC architecture
Android integration is offered through the Android AOSP SW stack for which NXP delivers dedicated patches.



Windows NFC architecture
Windows integration is offered through Microsoft Windows universal NFC device driver model,

NullOS/RTOS architecture
NullOS/RTOS integration is demonstrated with code examples running on NXP's LPC , Kinetis and i.MX MCUs

PN7150 Target Markets

Set-top box, tv, blu-ray

Remote control, accessories

Gateway, routers, wireless access points

Healthcare, fitness, medical

Home appliances

printer

Gaming

Audio

PN7462 Family

PN7462 Family – The First All-in-one Full NFC Solution

State-of-the-art reader solution on a single chip
Contact and contactless interfaces with full MIFARE family support powered by an ARM Cortex-M0 core

All integrated although highly customizable
160/80kB Flash memory, USB, GPIOs, various host and master interfaces

Faster time-to-market
Complete support package including NFC Forum compliant SW library and source code of typical applications

Smaller footprint at lower system BOM
Reducing system components and PCB by up to 50% in typical applications

NFC controller development kit OM27462CDKP

PN7462AU Product Features

Features

NFC interface	Full RF standard compliance EMVCo 2.6 L1 analog & digital compliance Automatic HW EMD handling
Contact interface	Class A, B, C card supported Contact EMVCo 4.3 compliance Fully integrated ISO/IEC 7816-3&4 UART Baud rate up to 1Mbit/s Capability to drive external frontend for SAMs
CPU core	Cortex M0 160kB flash, 12kB RAM, 4kB EEPROM, clock= 20MHz Freely programmable MCU (160KB)
Interfaces and GPIOs	One configurable host interface: I^2C (1000Kbps), SPI (7Mbps), USB, HSUART (1228.8Kbps) Two master interfaces: I^2C and SPI 12 to 21 GPIOs
RF transmitter supply voltage	2.7 to 5.5 V
Operating transmitter current	250 mA Dynamic Power Control (DPC)
Waveform control	Adaptive waveform control (AWC)
Operating ambient temp. range	-40ºC, +85ºC
Receiver control	Adaptive receiver control (ARC)

Supported RF protocols

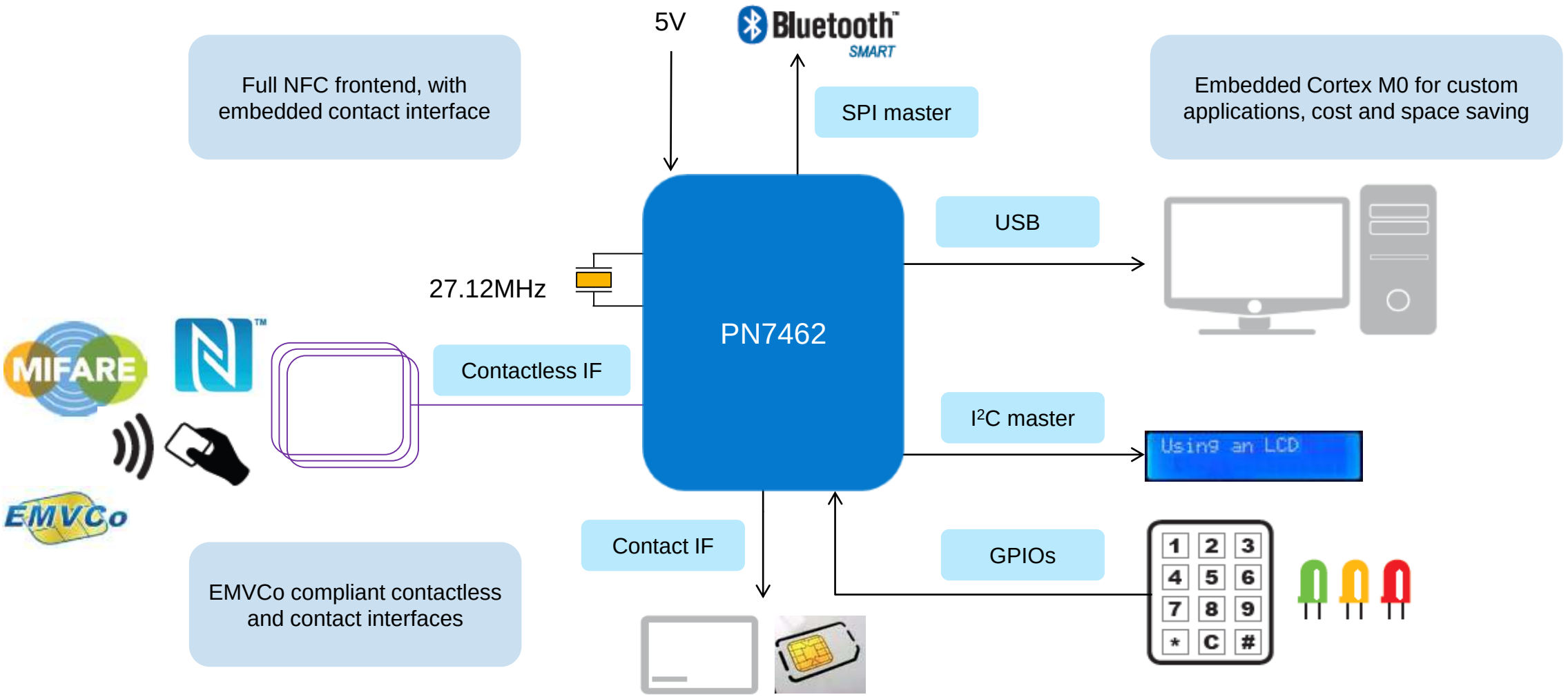
Read / Write mode	ISO/IEC 14443A (NTAG® and MIFARE® product family) ISO/IEC 14443B JIS X 6319-4 (comparable with FeliCa1 scheme) ISO/IEC 15693 (ICODE® SLIX, SLIX2, DNA) ISO/IEC 18000-3 mode 3/ EPC Class-1 HF (ICODE® ILT)
Peer-to-Peer mode	Passive-Initiator / Passive-Target Active-Initiator / Active-Target
Card emulation	ISO/IEC 14443A (up to 848 kbit/s) Active Load Modulation

Packages

HVQFN64	9 x 9 x 0.85 mm
VFBGA64	4.5 x 4.5 x 0.8 mm

More info: http://www.nxp.com/products/:PN7462

PN7462 All-in-one Solution



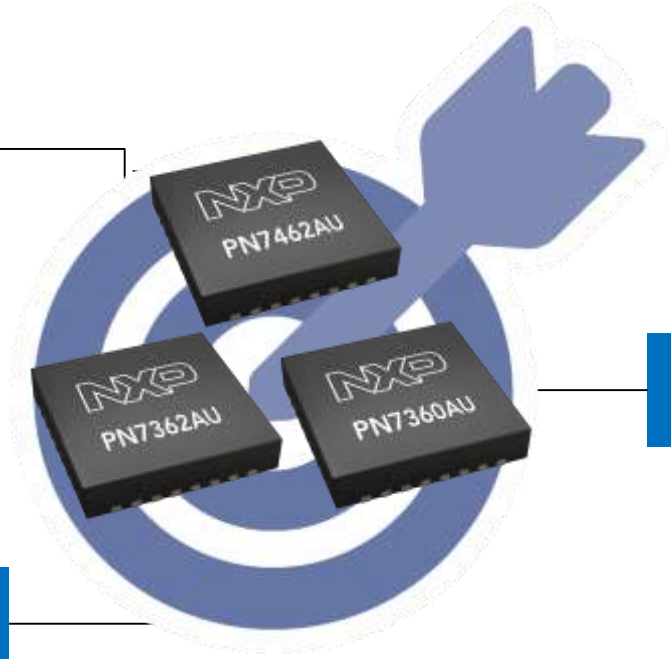
PN7462 Family Target Markets

Access control

- Single chip solution for standalone readers
- Broad temperature range from -40 to +85°C
- Full NFC-enabling communication with cards and phones

Home banking & payment

- Single chip solution: USB, contact and contactless interfaces
- EMVCo L1 compliance for interoperability with payment cards



Multi-market USB reader

- Highly customizable interfaces
- Complete PSP with NFC Forum and EMVCo L1 SW
- Source code of typical applications

Use Cases Explained

For Today, Let's Focus on the Following Use Cases

Payment

Access control

Parameterization and diagnosis

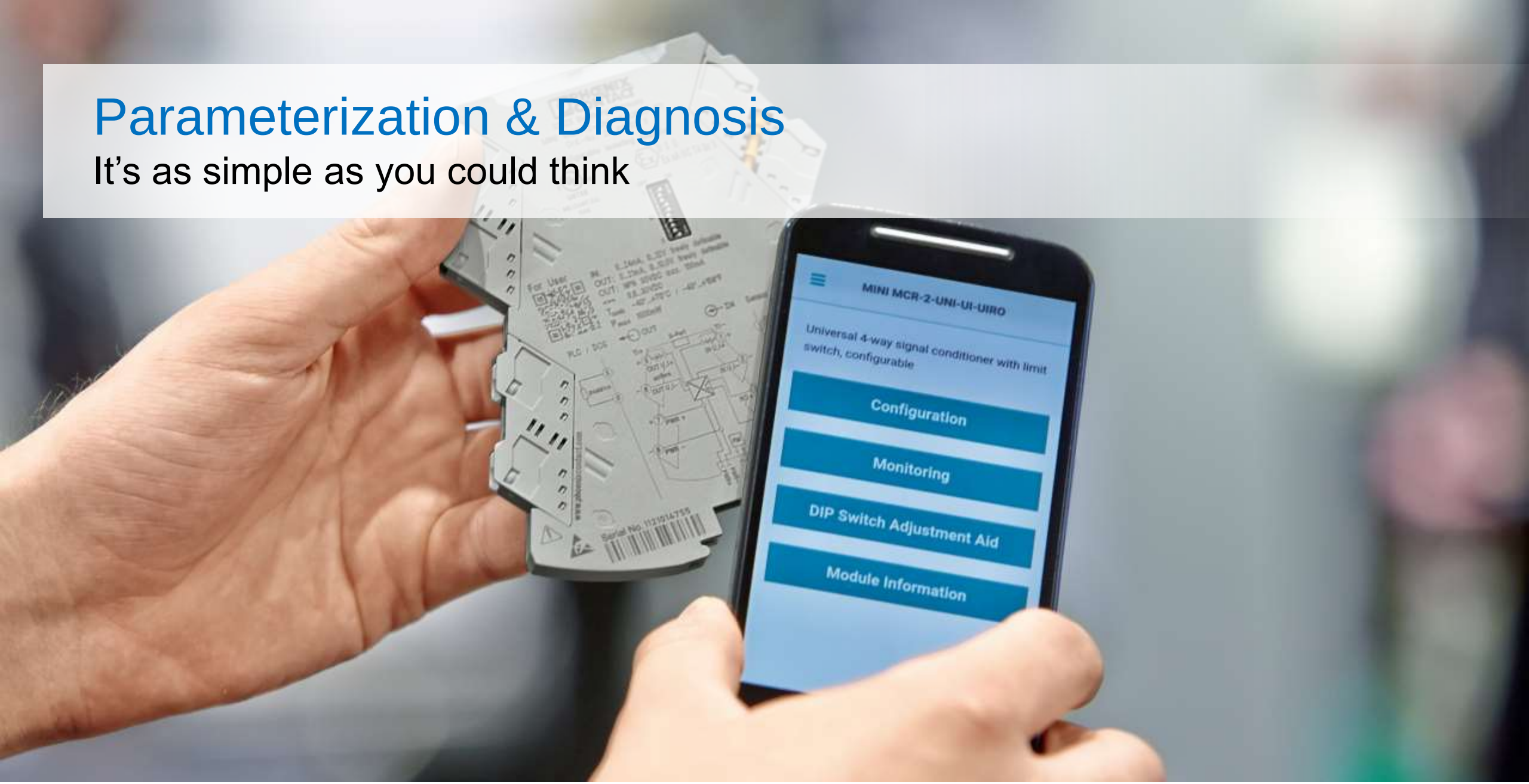
Authentication and identification

Pairing and commissioning

Device-to-device communication

Parameterization & Diagnosis

It’s as simple as you could think

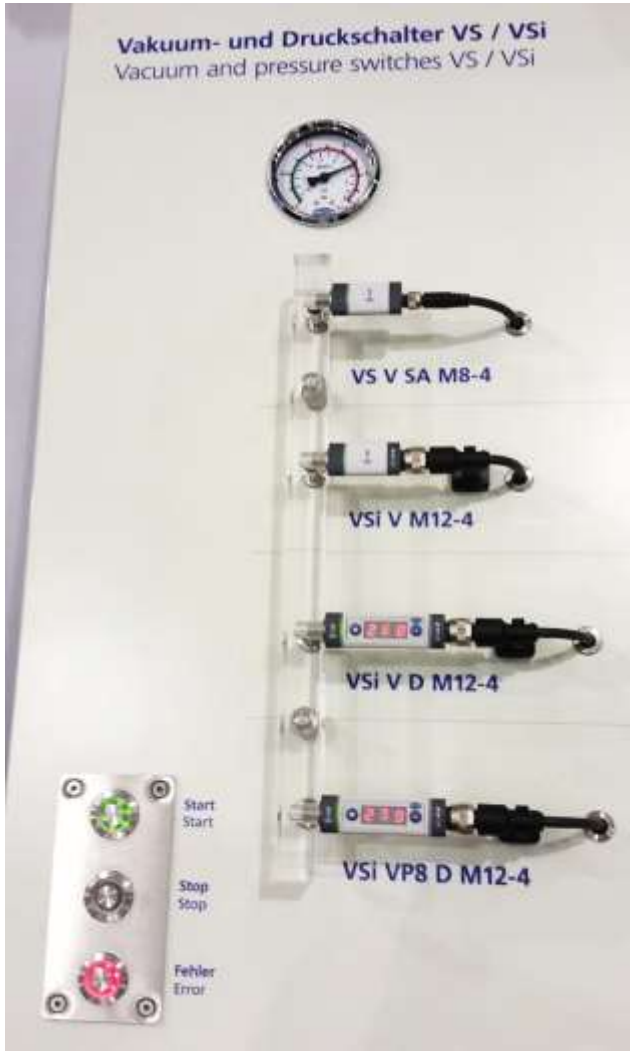


Many Industrial Devices Using NFC for Parameterization & Diagnosis

Customer Benefits

Cost reduction	• NTAG I²C *plus* < $0.25
Higher accuracy, more parameters	• Can store 2 kBytes on-chip
Zero-power operation	• Phone powers the NTAG I²C *plus* via the NFC field
Device can be fully sealed	• NFC communication possible through plastic, glass, wood, …

IoT on Demand



For Today, Let's Focus on the Following Use Cases

Payment

Access control

Parameterization and diagnosis

Authentication and identification

Pairing and commissioning

Device-to-device communication

Accessories and Consumables Tagging

	Blood glucose meter	Face brush	Water filter
			
NFC implementation	• NFC reader in the main unit • NFC Tag on the cartridge	• NFC reader in the handle • NFC Tag in the brushheads	• NFC reader in the fridge base • NFC Tag in the water filter
Application	Wireless SAFETY: Check expiration date, calibration settings, originality	Wireless CONFIGURATION: Configure automatically the brush speed, spinning parameters…	Wireless AUTHENTICATION: Check that the right & genuine water filter is in place

Why Identify Accessories and Consumables?

Example Healthcare: Patient Safety

- Enforce expiration dates
- Calibration data increases measurement accuracy
- Prevents re-use of disposables
- Ensures original material

Future Proof

- New accessories can configure the main device with new functions

Appliances: Air Purifier

- The air purifier automatically detects via NFC which filter cartridge is inserted
- Protecting from counterfeit and ensuring good quality reputation
- Tracks the time a filter is used, performs an automatic reset when a new filter is inserted

Reference projects
- Xiaomi Mi Air Purifier 2S
- IDEAL AP60 Pro

Recommended products

MFRC630 (reader)
+ NTAG2xx/NTAG4xx DNA (Tag ICs)
- ISO/IEC 14443A
- NFC Forum Type 2 and Type 4 Tags
- Many memory and feature options

SLRC610 (reader) + ICODE SLIX/ICODE DNA (Tag ICs)
- ISO/IEC 15693
- NFC Forum Type 5 Tags
- Higher read range

Authentication & identification

Easy NFC Retrofitting and Prototyping with the NFC Nutshell Kit

Developed by NXP's approved engineering consultant (AEC) GMMC. Find all AECs here: https://nxp.surl.ms/NFC_AEC

GMMC
we deliver for your success

For Today, Let's Focus on the Following Use Cases

Payment

Access control

Parameterization and diagnosis

Authentication and identification

Pairing and commissioning

Device-to-device communication

Products With NFC Pairing Technology are Increasing…

Audio

SoundTouch 300

Soundsport headphone

UE BOOM2

QC35

SoundLink II

SRS-XB3

speakerphone

Printer

WF-2660DWF

MFC-J870DW

Pixma MG6650

HP Envy 5640

Projector

EB-1795F

Camera

PowerShot SX610 HS

GEAR360

WB350F

… plus many more

Customer Benefits – Why Use NFC for Pairing?

Ease of Pairing – less customer support needed

- Simple secure pairing at a single tap for many devices
- Less support means saving resources and money!

Pair your phone faster with Bluetooth devices, without conflicts

Flexibility

- All kinds of protocol supported for pairing e.g. Bluetooth, Wifi, Zigbee etc.

Wi Fi ZigBee Bluetooth SMART THREAD

Tap your Wi-Fi router to get an instant Wi-Fi connection

Security

- Network key exchange is guaranteed by proximity
- Customer protection

Pair wireless accessories to your main unit

NFC Support

Everything your customers need

The NFC Reader Library

Focus on Scalability

Simplify Test & Debug

Optimize Performance

Validate Interoperability

<table>
<tr><td colspan="6">Application</td></tr>
<tr><td colspan="3">Application Layer (AL)</td><td>NFC activity</td><td>SNEP</td><td rowspan="2">NFC
P2P</td></tr>
<tr><td>MIFARE
card
operations</td><td>NFC Forum
tag type
operations</td><td>. . .</td><td>Discovery
loop</td><td>LLCP</td></tr>
<tr><td colspan="6">Protocol Abstraction Layer (PAL) for contactless communication protocols</td></tr>
<tr><td>ISO/IEC
14443 A</td><td>ISO/IEC
14443 B</td><td>FeliCa-
compliant
protocol</td><td>. . .</td><td colspan="2">ISO/IEC 18092
(P2P)</td></tr>
<tr><td colspan="6">Hardware Abstraction Layer (HAL) supporting our NFC solutions</td></tr>
<tr><td colspan="6">Generic</td></tr>
<tr><td colspan="3">NFC frontends</td><td colspan="3">NFC controller with customized firmware</td></tr>
<tr><td colspan="6">Bus Abstraction Layer (AL) with all low-level functions</td></tr>
<tr><td colspan="6">Generic</td></tr>
<tr><td>Interfaces</td><td>SPI</td><td>I²P</td><td>. . .</td><td colspan="2"></td></tr>
</table>

Supported dev boards:

- CLEV6630A
- CLEV6630B
- PNEV5180B
- PNEV7462B

Supported platforms:

- LPC1769
- FRDM-K82F
- Raspberry Pi Model 3
- … portable to other MCUs and platforms.

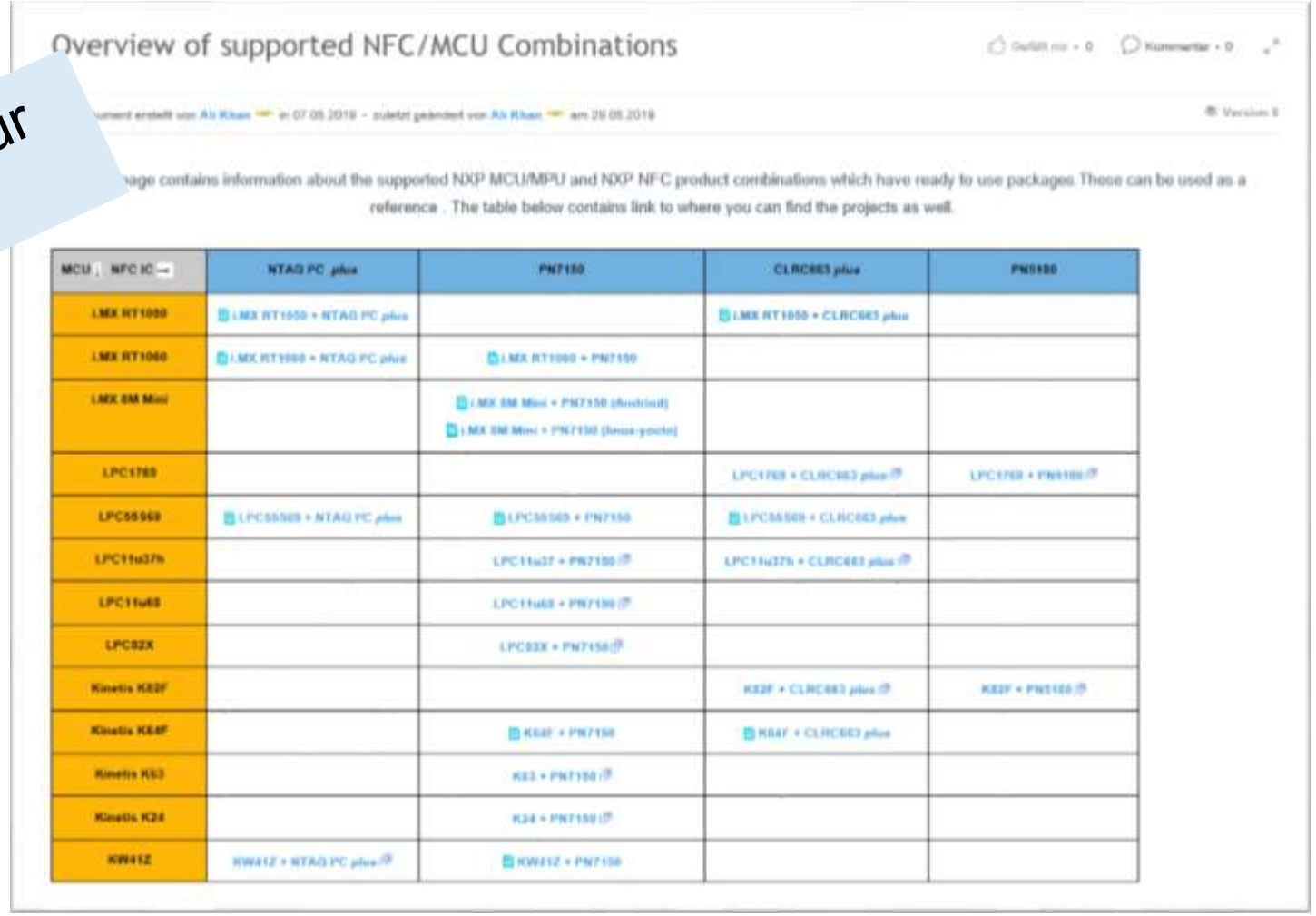
www.nxp.com/products/:NFC-READER-LIBRARY

www.nxp.com/products/:NFC-COCKPIT

New: Supported MCU / NFC Combinations

https://nxp.surl.ms/nfcmcu

Supporting your cross-selling!

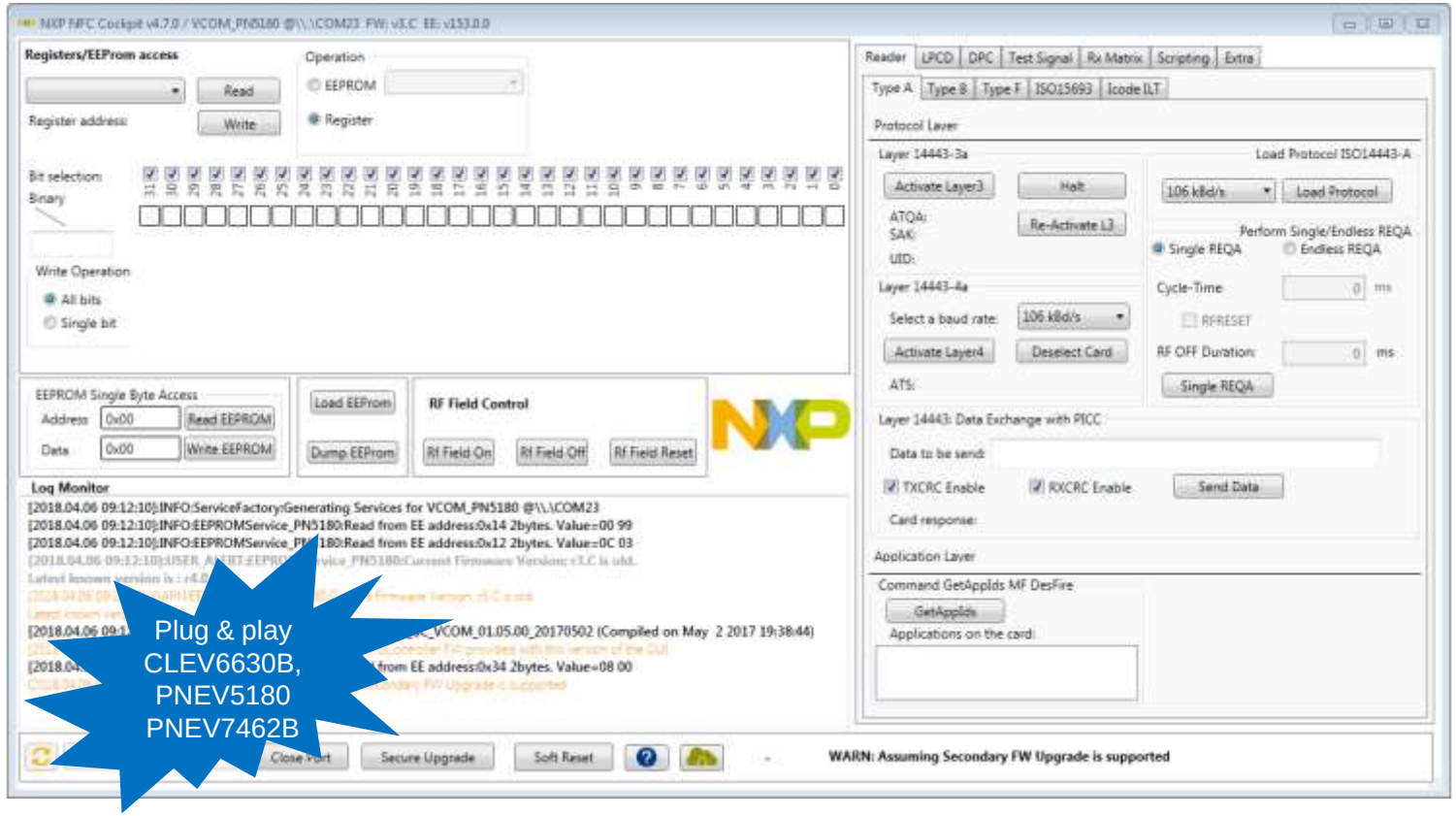


Overview of supported NFC/MCU Combinations

age contains information about the supported NXP MCU/MPU and NXP NFC product combinations which have ready to use packages These can be used as a reference . The table below contains link to where you can find the projects as well.

MCU / NFC IC	NTAG I²C plus	PN7150	CLRC663 plus	PN5180
i.MX RT1050	i.MX RT1050 + NTAG I²C plus		i.MX RT1050 + CLRC663 plus	
i.MX RT1060	i.MX RT1060 + NTAG I²C plus	i.MX RT1060 + PN7150		
i.MX 8M Mini		i.MX 8M Mini + PN7150 (Android) i.MX 8M Mini + PN7150 (linux-yocto)		
LPC1769			LPC1769 + CLRC663 plus	LPC1769 + PN5180
LPC55S69	LPC55S69 + NTAG I²C plus	LPC55S69 + PN7150	LPC55S69 + CLRC663 plus	
LPC11u37h		LPC11u37 + PN7150	LPC11u37h + CLRC663 plus	
LPC11u68		LPC11u68 + PN7150		
LPC82X		LPC82X + PN7150		
Kinetis KE2F			KE2F + CLRC663 plus	KE2F + PN5180
Kinetis KE4F		KE4F + PN7150	KE4F + CLRC663 plus	
Kinetis KE3		KE3 + PN7150		
Kinetis K24		K24 + PN7150		
KW41Z	KW41Z + NTAG I²C plus	KW41Z + PN7150		

NFC Cockpit Configuration Tool for NFC Readers

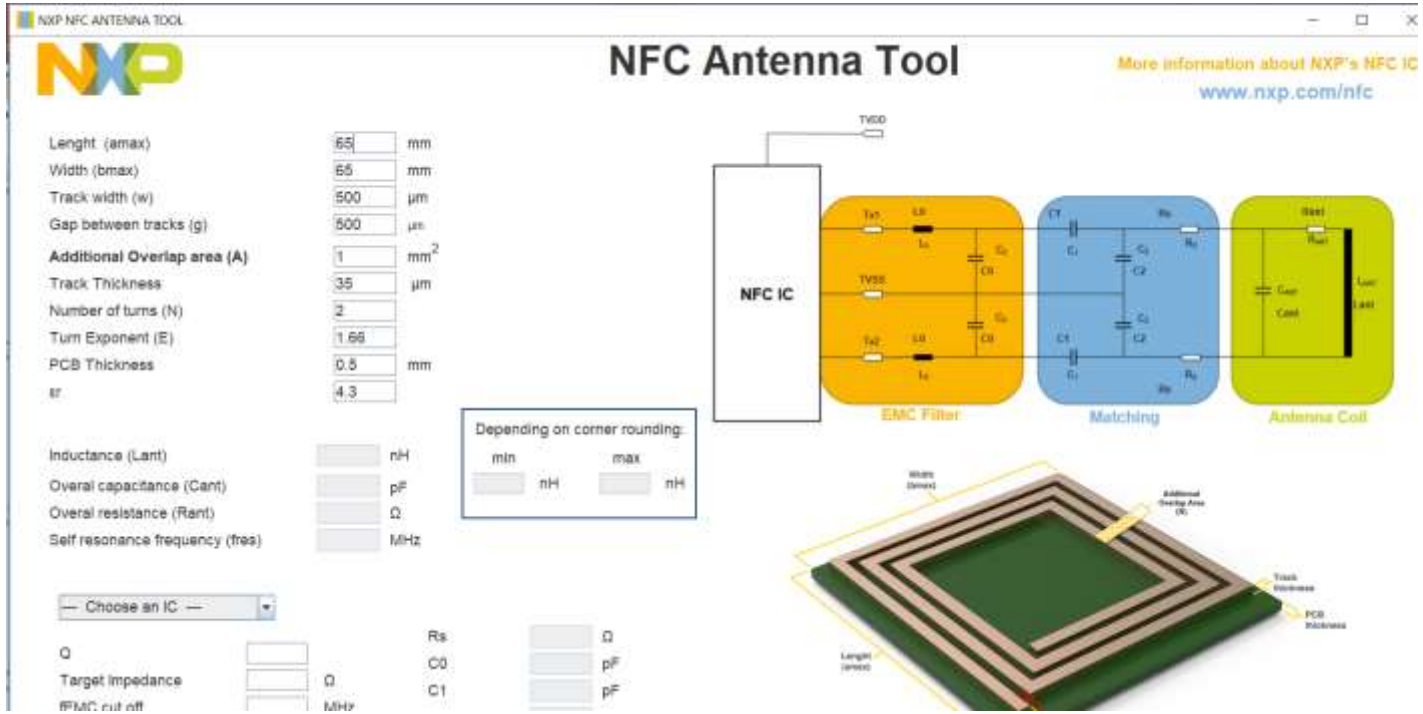


NFC Cockpit features

- Direct access to registers and EEPROM memory.
- Reader for card activation and card communication.
- Low Power Card Detection (LPCD) calibration and configuration.
- Test signal unlocking and routing.
- RX matrix test for receiver settings optimization.

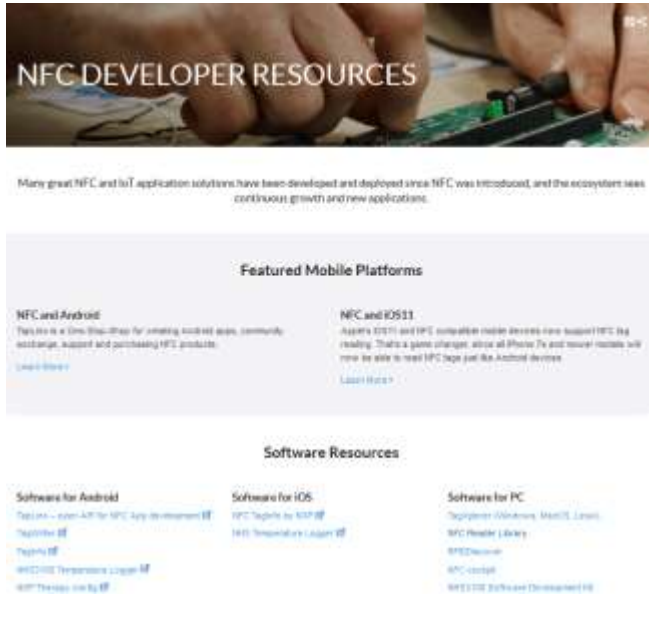
- Helps to speed up the design, allows quick and easy configuration of registers (USB interface connection to PC) using the development board
- Get familiar with the IC (on line information of register bits), a fast antenna tuning, a quick DPC parameter setting and perform some tests with NFC devices (cards or mobile phones)

New Online Antenna Design Tool



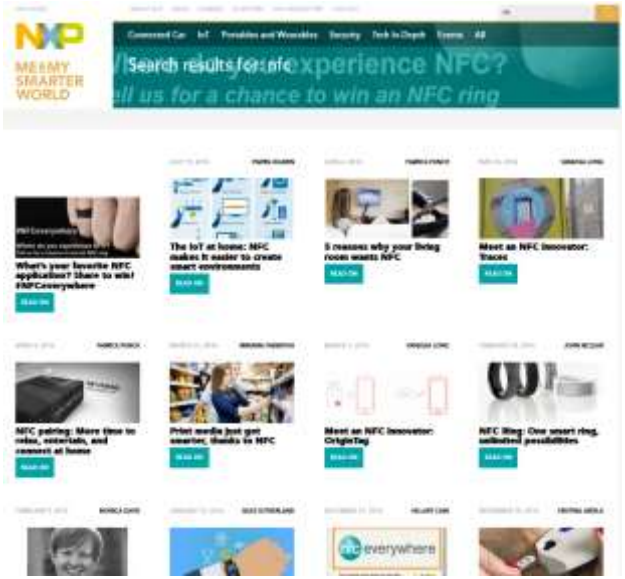
More Information About NFC

Visit **NFC developer resources** for a quick start



https://www.nxp.com/nfc

Visit our **blog** for more news about NFC…



https://blog.nxp.com

Evaluation Form

Please fill out the evaluation form!

Open Discussion Questions & Answers

SECURE CONNECTIONS
FOR A SMARTER WORLD