

Automotive NFC Solutions

Marc Manninger

Technical Marketing Manager

Digital Key & NFC | PL Secure Car Access | BLAAA

October 2018 | AMF-AUT-T3355



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FOR A SMARTER WORLD

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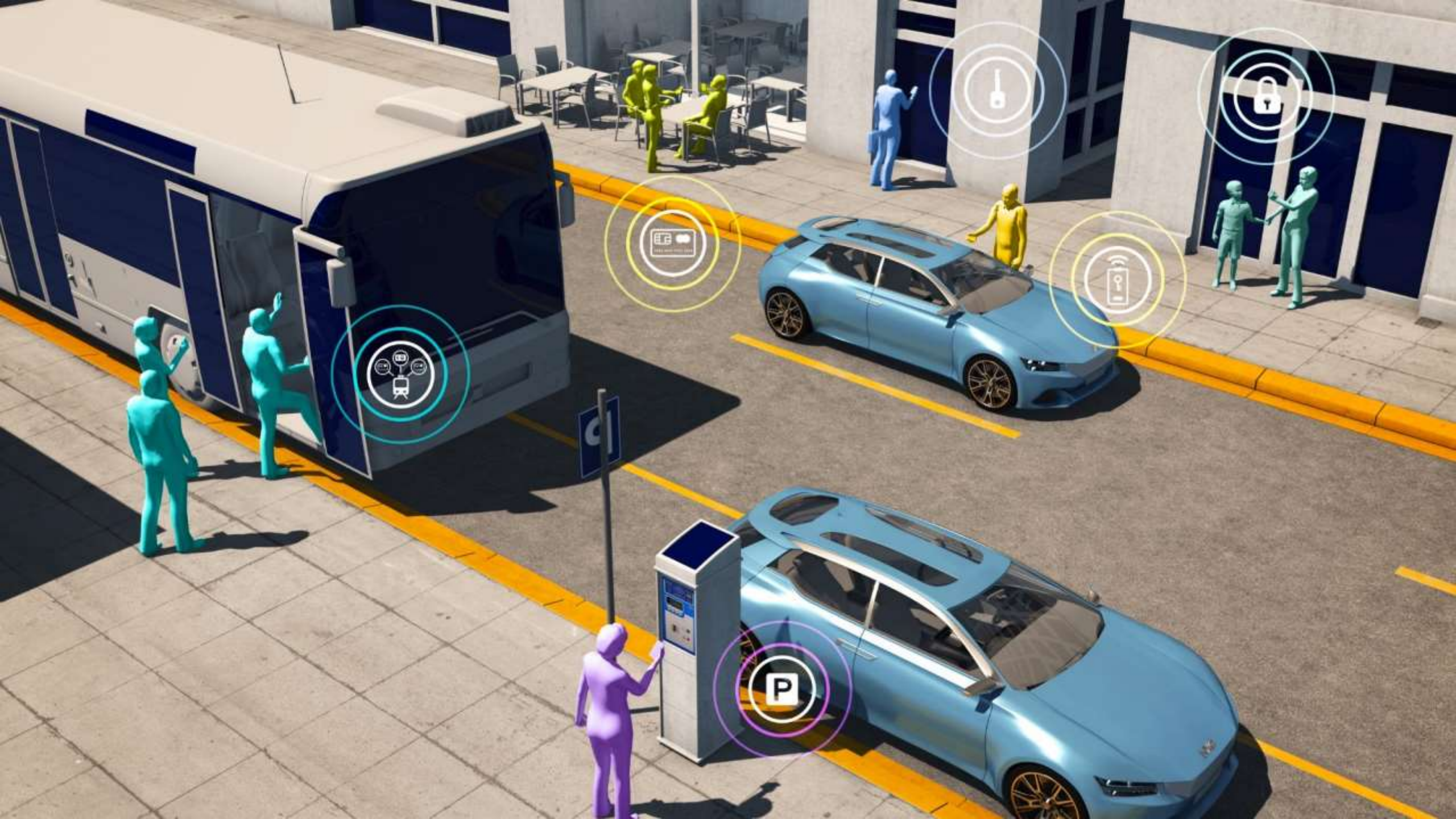
Agenda

- Market Updates & Use Cases
- Product Offering & Roadmap
- Reference Designs & Live Demos
- ANFC Stack
- Project Review



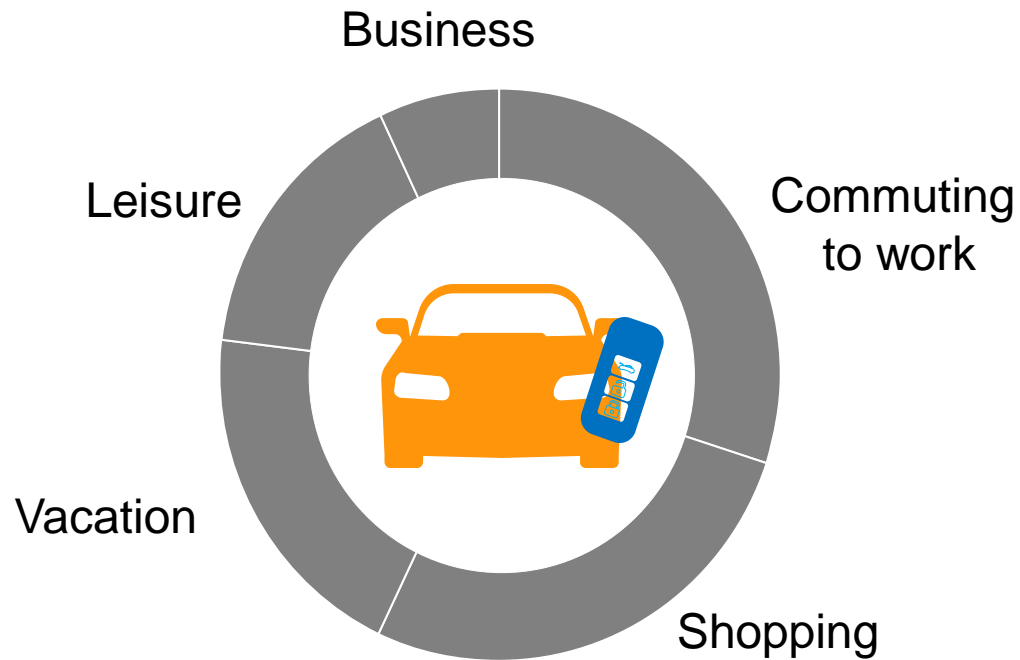
Market Updates & Use Cases



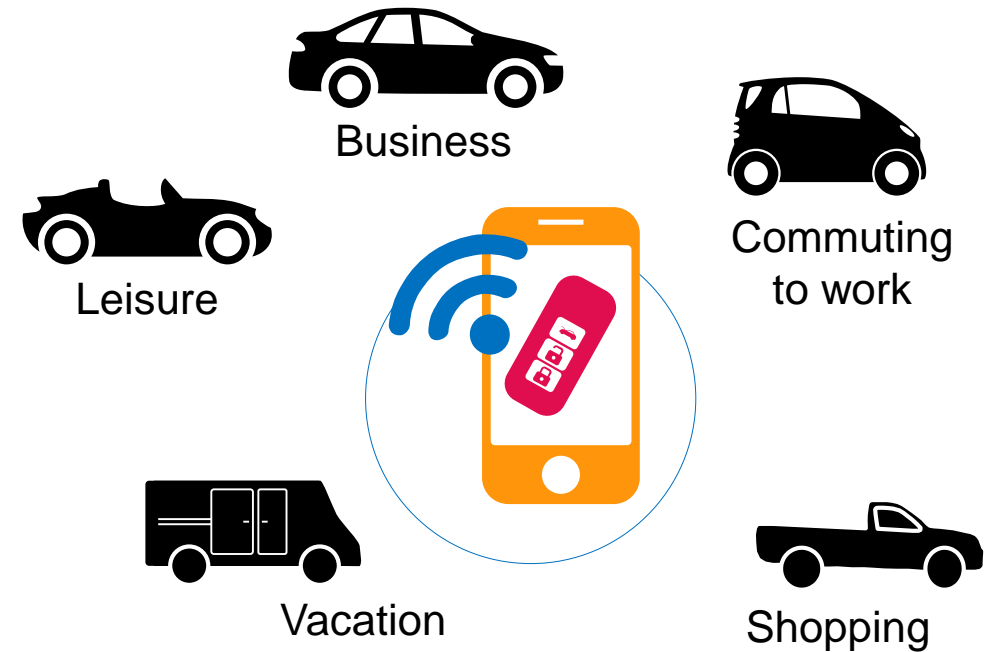


The Future of Vehicle Ownership: From Personal to Shared Ownership

Today:  One vehicle for different trip purposes

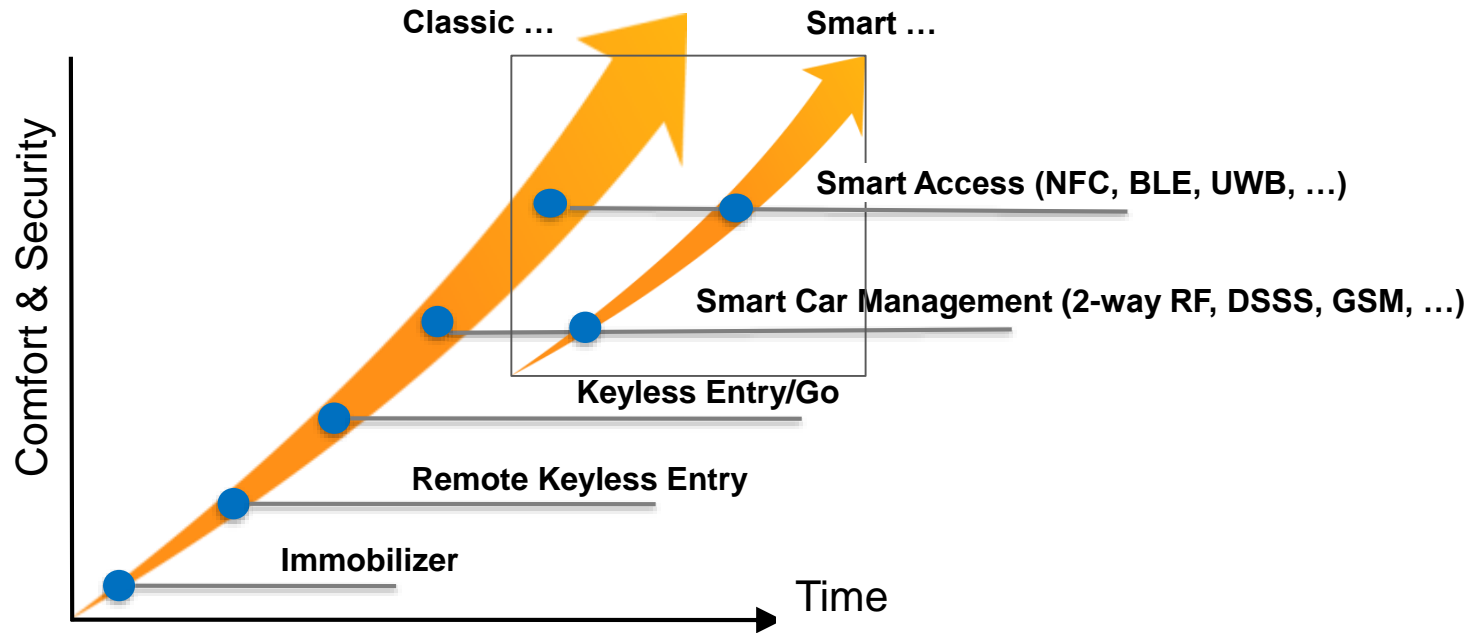


2030: Different vehicles for different trip purposes



+ non-vehicle modes of mobility

Evolution of Car Access Solutions



Classic Key
Immobilizer & Remote Entry & Keyless Entry/Go



Smart Car Access
Car Management & Smartphone Access & Wearable Access



Session: AMF-AUT-T3344

Presenter: Thomas Rudolph

Where & When: Judea, Wed 4:00 PM

Title: NXP Car Access—Roadmap Towards Smart Access (LF, UWB, Bluetooth LE, NFC)



























Session: AMF-AUT-T3354

Presenter: Kari Yockey

Where & When: Ruth, Wed 1:30 PM

Title: Hands-On Workshop: Developing with NXP's Automotive Smart RF Remote Control Interface

NFC Versus Other Wireless Technologies

	 WiFi	 ZigBee (802.15.4)	 Bluetooth	 NFC
Network topology	 Star	 Mesh	 Point-to-point	 Point-to-point
Range	 30-100 m	 10-20 m	 10 m	 < 0.1 m
Discovery	 Broadcast	 Broadcast	 Broadcast	 Response to field
Power	 High	 Low	 Classic: Mid  LE/Smart: Low	 Tag: Zero  Reader: Very low
Privacy	 Low	 Mid	 Mid	 High

- **Ease of use:** NFC connects automatically in a fraction of a second, so fast it seems instantaneous
- **Ultra low-power:** NFC consumes much less power than Wi-Fi or BLE.
- **Security:** NFC solutions combining secure elements are very attractive for smartphone/smart card based car access and drive authorization



- Smart phone car access
- Car sharing
- Fleet management



- Bluetooth®/Wi-Fi® pairing
- Driver authorization for engine start
- Personalization (air conditioning, seat and mirror settings)
- Card protection
- In-car payment

Smartphone's Battery Low - Analysis

When phone shuts off NFC car access still works for days

- Background:
 - **Car access** using smartphone **via NFC** offers high flexibility and security
 - Phone **batteries drain easily**. How to **access my car** if smartphone's **battery is low** and phone automatically shut down?
 - Typically, a smart **phone shuts down** at battery voltage level of **3V**. **Card emulation** is **guaranteed** until **2.5V**
- Evaluation
 - Samsung S8 with **digital car key** stored on **eSE**. Smartphone's battery drained until complete shut-down.
 - **NFC card emulation** on phone's eSE still running. **Accessing car via NFC door handle** tried out once a day for one week.

RESULT

*It is possible to access a car with a Samsung Galaxy S8 via NFC even with low battery (automatically shut down) for at least 5 attempts within 7 days**

**assuming one access attempt / day*



Day	APDU	RESULT
#1 2018-02-16	Car Access APDUs exchanged	0x9000 (PASS)
#2 2018-02-19	Car Access APDUs exchanged	0x9000 (PASS)
#3 2018-02-20	Car Access APDUs exchanged	0x9000 (PASS)
#4 2018-02-21	Car Access APDUs exchanged	0x9000 (PASS)
#5 2018-02-22	Car Access APDUs exchanged	0x9000 (PASS)
#6 2018-02-23	No detection of phone	FAIL



- Rear seat entertainment
- Bluetooth®/Wi-Fi® pairing

NFC Connected Devices Worldwide

Market update incl. Some key figures

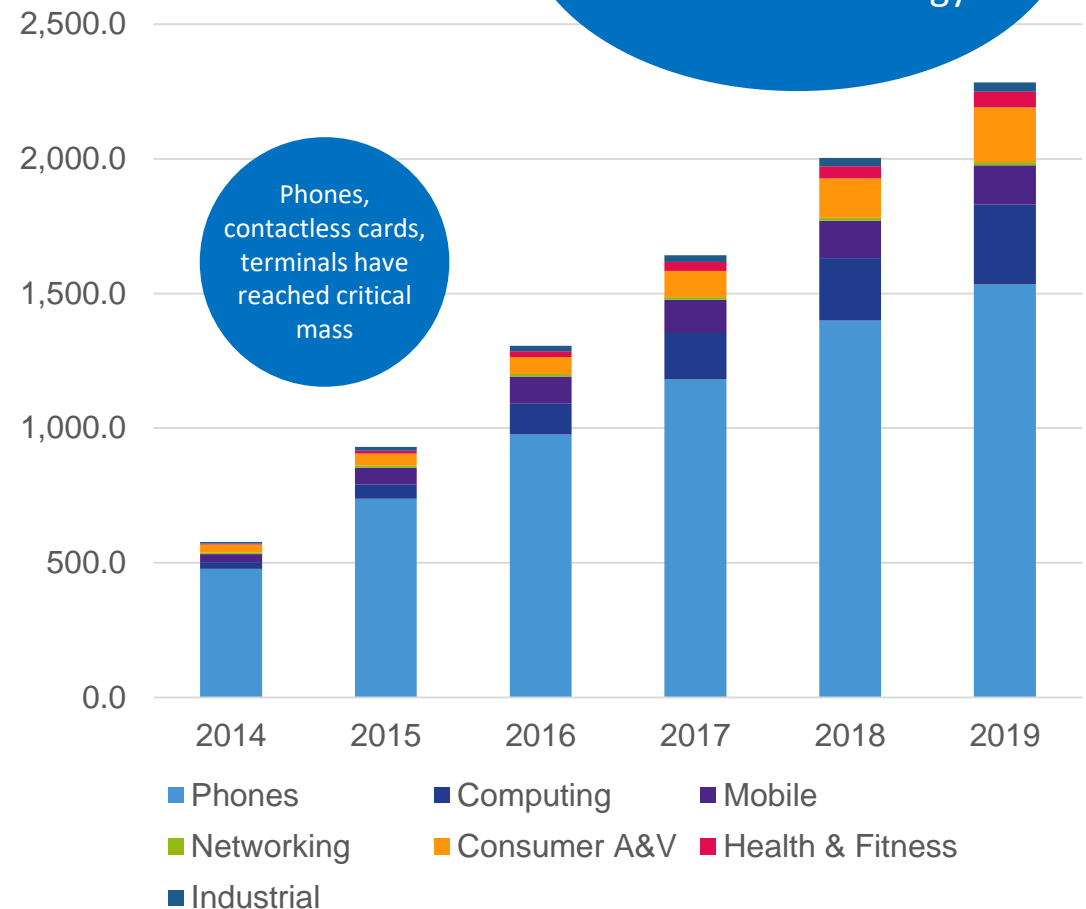
- >1 billion smartphones installed base (end of 2015)
- Smartphones share expected to continue growing: in 4 mobile phones to come with NFC by 2018
- >5 billion NFC handsets before 2019
- >2 billion NFC cards and tags per year
- Automotive NFC is gaining momentum due to the high penetration of NFC phones

* Updated list of NFC phones and tablets available in the market:
<http://www.nfcworld.com/nfc-phones-list/>

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NFC Market outlook

(MPc, ABI Research 2015)



BMW Introduces Digital Key at MWC 2018

BMW's public history

- Accessible from smartphones (initially Samsung devices) via BMW Connected
- Shareable with up to five other people
- Launch planned for July 2018 with software updates rolling out OTA to add later on further services



BMW is at Mobile World Congress and it is talking up some of the new technologies that will be coming to its vehicles. One of the coolest bits of tech is the BMW Digital Key, which is a system that allows users to lock and unlock their car using a smartphone. Once the device is in the car, the engine can be started with the help of the Wireless Charging Pad.

The Digital Key can be shared with up to five other people who need to be able to start the car. BMW says that the Digital Key will be accessible from smartphones via BMW Connected and will initially be compatible with Samsung smartphones with NFC capability. The launch of Digital Key will start in July 2018 with a new software update rolling out OTA to add other functions and digital services to the vehicle later.



Daimler Launches NFC for Car Sharing

Daimler's public history



- Set up for private car sharing
- Car can be opened, closed and started by means of NFC
- Authorized user opens the vehicle using the app
- Available in Germany with a Digital Vehicle Key Sticker with a built-in NFC controller



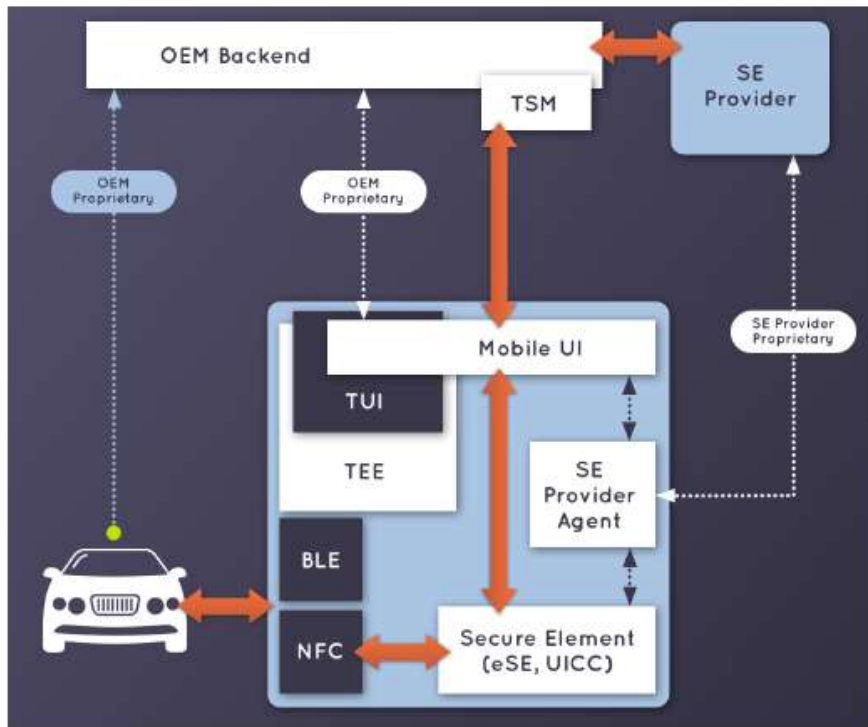
The new A-Class with the intuitive, teachable MBUX is also celebrating its show premiere in Barcelona. With Near Field Communication (NFC), the Digital Vehicle Key in the smartphone employs different technology. However, not every smartphone has an NFC interface that complies with Mercedes-Benz's security standards. For the new A-Class, therefore, there is now a special Digital Car Key Sticker with a built-in microchip available in Germany. Once stuck on the smartphone, the sticker allows contactless opening, closing and starting of the vehicle. To start the engine, the driver simply needs to place their smartphone with the Digital Car Key Sticker in the centre console stowage tray. The Digital Vehicle Key Sticker is also available for a number of car lines in conjunction with digital vehicle key for smartphone.



Thanks to the new Digital Vehicle Key technology, the new A-Class is also set up for private car sharing: The Mercedes me car sharing app allows a driver to share his or her vehicle with a specified group of users. Friends, family members or colleagues can then easily book the A-Class for a fixed period of time. The authorised user opens the vehicle using the app and by means of the Mercedes me communication module installed in the vehicle. The A-Class is started with a key which is left in the vehicle and temporary use of which is likewise enabled over the air by Mercedes me. When returning the vehicle, the driver leaves the key in the vehicle and closes it with the app, thereby bringing the sharing period to an end. The key in the vehicle can be used only

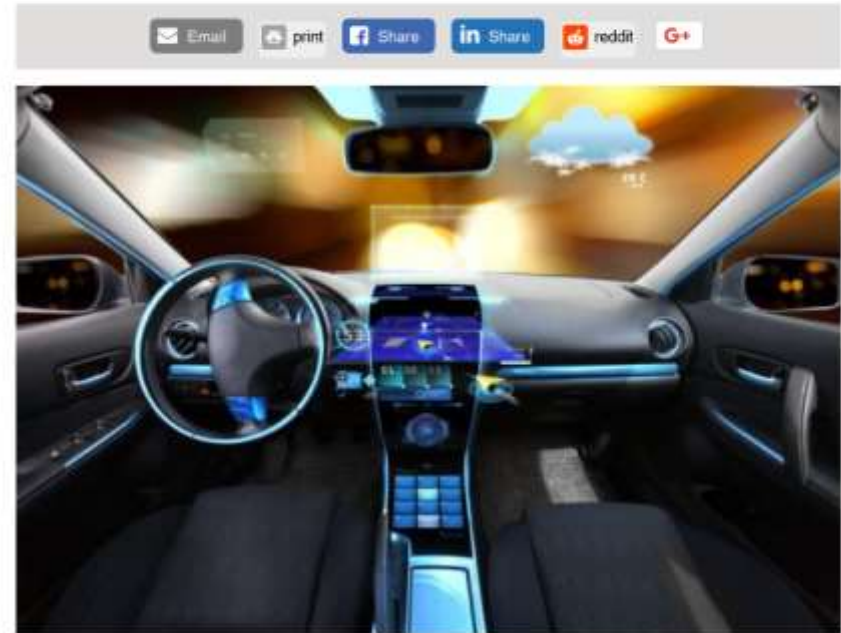
Car Connectivity Consortium

- CCC recently announces completing Phase 1 of Digital Key specification
 - <http://www.eenewsautomotive.com/news/initial-specification-smartphone-car-key-submitted>



Initial specification for smartphone as a car key submitted

February 23, 2018 // By Jean-Pierre Joosting



The Car Connectivity Consortium (CCC) has completed Phase One of the Digital Key specification, which documents the state-of-the-art of commercially available digital key systems. The specification, Digital Key represents an industry milestone for an interoperable system that enables smart devices like smart phones and smart watches to act as a digital key for any vehicle, allowing drivers to lock, unlock, start the engine and share access to the car.

Active Members of the Digital Key Group



Members of CCC – not active in digital key yet

TOYOTA HONDA



HYUNDAI



Mercedes-Benz

DENSO



MAZDA

Panasonic



HUAWEI

htc
quietly brilliant

SONY

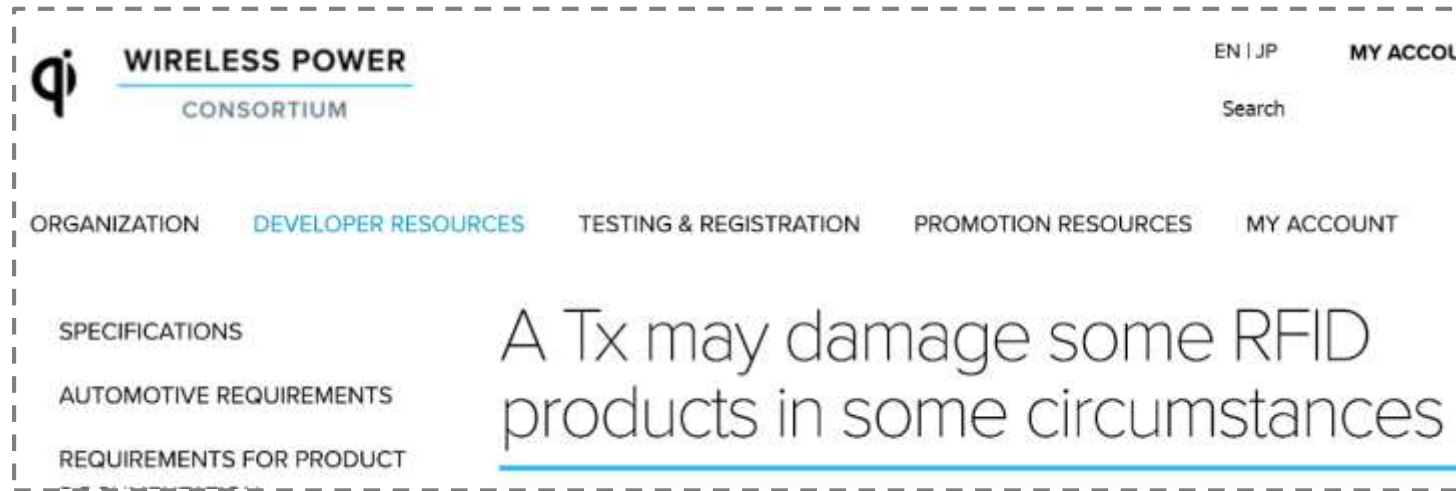
CO



New participants:



Wireless Charging Can Destroy NFC Cards



- Affected products: Credit cards, passports, library tags, transportation cards, company badges etc.

Video #1

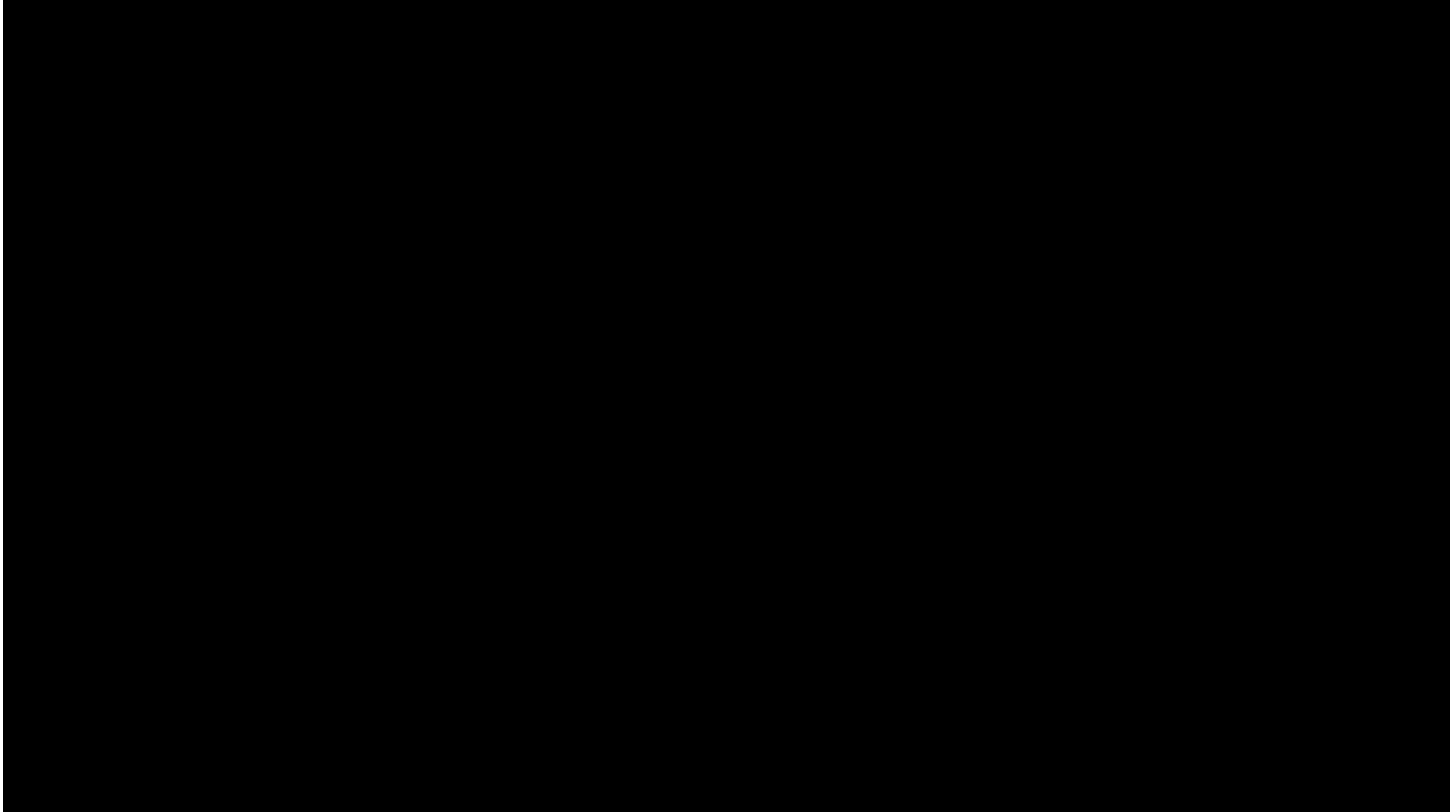


FOD Will Not Detect & Protect NFC Cards!

- Foreign Object Detection
 - Wireless charger typically use the Power Loss Detection Method (PLD) to detect foreign objects on their charger.
 - Works perfectly for coins or other metallic components.
 - No detection of contactless cards, as their metal content is low.
- NFC/RFID card detection
 - An NFC reader embedded in the smartphone cradle regularly polls for NFC/RFID cards.
 - On any response it determines if a card or a phone is present.
 - In case a vulnerable object is detected, charging is blocked and a warning message gets displayed.



Video #2



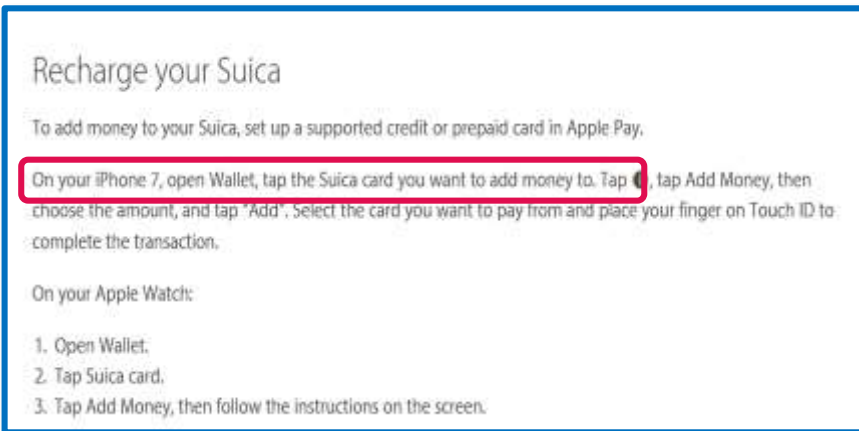
NFC Tag Reading Available for iOS 11

Apple's public history

1

September 7th 2016 - iPhone 7 release

- iPhone 7 supports reading Felica cards (NFC Forum Type 3 tag) in Japan [link [here](#)]



2

September 29th 2016 - NFC Forum

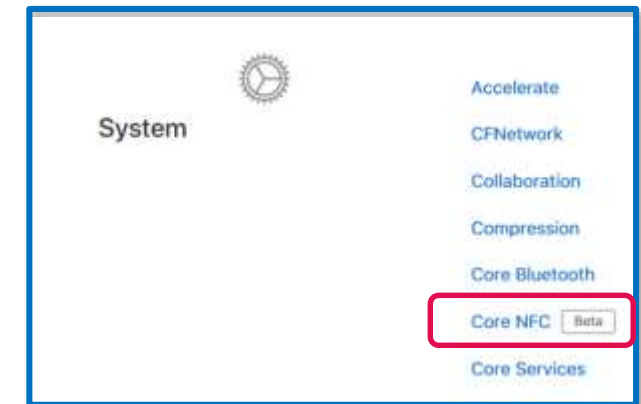
- Apple is officially chairing the IoT working group at the NFC forum [link [here](#)]
- Goal is to enforce tag performance certification for real-life implementations in any kind of application – e.g. Bluetooth speaker, headset... [link [here](#)]
- The NFC forum will be the certification provider



3

June 5th 2017 - WWDC 2017

- NFC tag reading functionality available for iOS developer community – see system section [link [here](#)]



NFC Communication Modes

Full NFC functionality for interior applications

Read/Write Mode

This is where NFC spends most of its time, with one NFC-enabled device interacting with another to get information or initiate an action. The initiating device can read data in from the second device or write data out to it.



Peer-to-Peer Mode

Sometimes referred to as “P2P” mode, this is the one you can use to exchange files between smartphones, or receive loyalty points when making a purchase.



Card Emulation Mode

This mode, used almost exclusively by NFC smartphones, lets the system behave as an ISO/IEC 14443-compliant contactless smartcard. That means your phone can be used in the existing contactless infrastructure, for things like ticketing, access control and payments. The mode can work even when the phone is off.



Relevant mode for
iOS 11

Roadmap & Products





NCx3340 - Flagship NFC Controller

Full NFC functionality for interior applications

Features:

- NFC controller combining NFC frontend with an advanced 32-bit microcontroller → system solution with lower BOM
- Separate RF driver supply 2,3 V - 5,5 V → High TX output power
- Integrated firmware with easy and standardized NCI interface → convenient software integration
- Supports Low Power Card Detection mode
- Multiple GPIO's
- IRQ pin → Improved host communication / host task scheduling
- SMD package HVQFN40
- Temperature range: NCF: - 40 .. +85°, NCJ: ..+105°

Supported host interfaces:

- SPI 7 Mbit/s
- I²C

Supported protocols:

Reader/Writer mode

- ISO/IEC 14443 A&B R/W support
- FeliCa R/W support
- R/W support for MIFARE 1K, 4K
- R/W support for ISO15693/18000-3

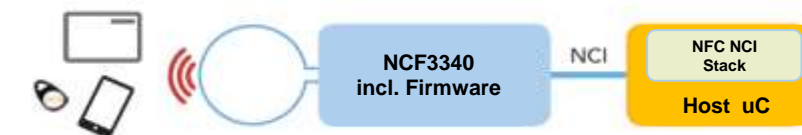
Peer to Peer mode

- Passive Target & Initiator
- Active Target & Initiator

Card emulation





- ISO/IEC 14443 A&B
- FeliCa

Application diagram



NCI Stack Solutions for NCF3340

Three entry levels for NCI communication

	ANFC STACK 	ANDROID (LibNFC)  	NCI EXAMPLE 
Features	Fully automotive, AUTOSAR, SPICE, MISRA, DTA, error handling, Full NFC	Full NFC, support for Kitkat till Oreo, error handling, DTA	Simple examples for all modes, limited quality and error handling
Cost	Cost adder	Free (Apache 2.0)	Free
Target projects	WPC+NFC applications using S32 and WCT family	Linux/Android based, infotainment	Demo purpose only
Footprint (config dependent)	~ 60kb flash / 5kb RAM	> 150 kb flash / 10kb RAM	~ 10kb flash / 5kb RAM
Availability	Available on request	Available via github	Available via nxp.com



AVAILABLE

NCx3320 - Enhanced NFC Frontend IC

Standalone NFC frontend for smartphone car access

Features:

- Standalone Automotive qualified NFC frontend performing contactless communication → Best way to add NFC R/W functionality to a car
- RF driver supply voltage 3 V - 5,5 V with **max. current of 350 mA** → Better read range with smaller antenna form factors
- **Enhanced wake-up (LPCD)** functionality → Increased robustness and better detection sensitivity
- **512 byte host interface buffer** → No need for high performant microcontroller
- IRQ pin → Improved host communication / host task scheduling
- **Generic Software Library easy portable across different MCU**
- HVQFN32 package with wettable flanks
- Temperature range: NCF: - 40 .. +85°, NCJ: ..+105°, NCK:..+125°

Supported protocols:

Reader/Writer mode

- ISO/IEC 14443 A&B R/W support
- FeliCa R/W support
- R/W support for MIFARE 1K, 4K
- R/W support for ISO15693 / 18000-3

Peer to Peer mode

- ISO/NFC 18092 NFC-IP1 support
- Passive initiator mode

Supported host interfaces:


- SPI 7 Mbit/s,
- UART
- I²C

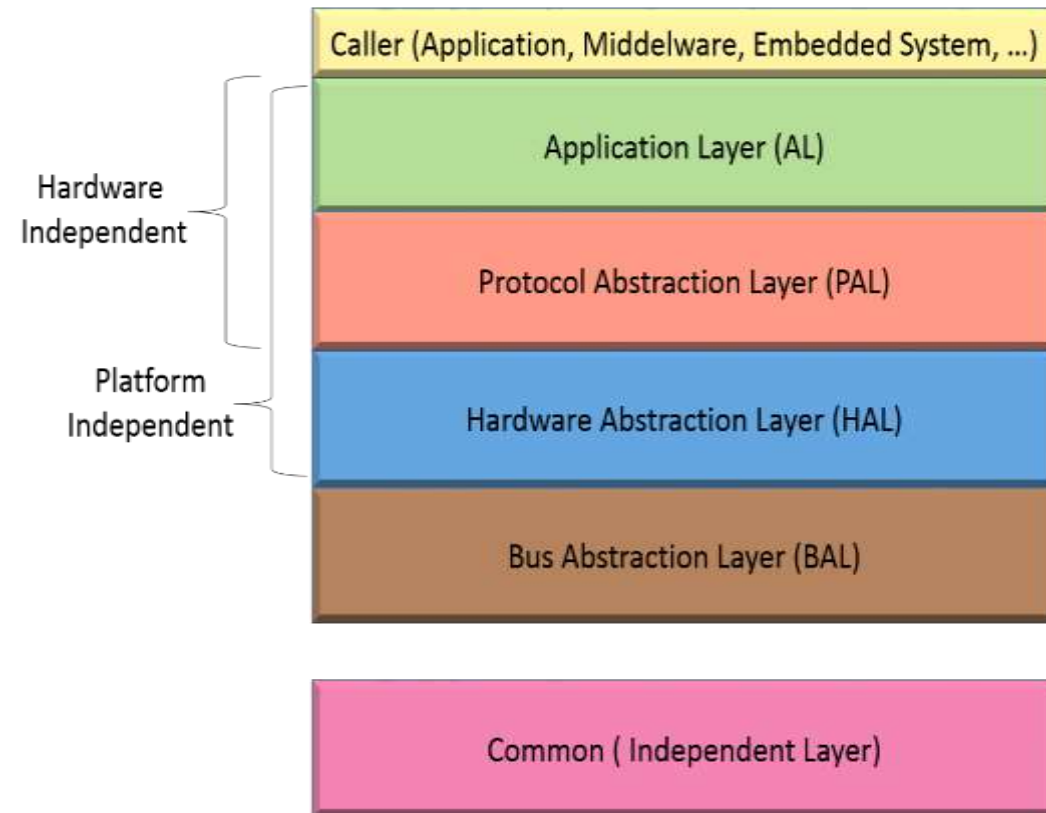
Application diagram



NXP NFC Reader Library

Free of charge sw solution for NCx3320

	NFC Reader Library 
Features	R/W support all tag type, easily configurable, error handling
Cost	Free
Target projects	Door handle, in-car readers, embedded
Footprint (config dependent)	> 30kb Flash / 500b RAM
Availability	Available via nxp.com



COMING SOON

NFC tag With I²C Interface

Low BOM solution for NFC connectivity in car

Features:

- Powered-by-the-field NFC tag with I²C interface → Low bill of material for adding NFC connectivity to a system
- RF Interface
 - Configurable up to 106 kBit/s
- Memory
 - 2 kB of user memory
 - 128 byte SRAM for fast data transfer (pass-through)
- Energy Harvesting
 - Regulated output 1.8V, 2.4V and 3V with up to 30mW output power
- Security
 - 128-bit AES mutual authentication
 - ECC based customer specific originality signature
- Temperature Range:
 - -40°C – 105°C
- Package:
 - HVQFN16

Supported protocols:

- Fully compliant with ISO/IEC 15693
- Fully compliant with NFC Forum Tag Type 5

Supported host interface:

- I²C interface supporting standard (100 kHz) and fast (400 kHz) modes
- I²C slave interface + transparent mode
- Up to 2 GPIO's (multiplexed I²C pins)
- Event detection pin

Application diagram



Use Cases & Differentiation to Other NFC Products

- **Suitable for ... :**

- BT / WiFi Pairing for mid/low end cars
- Rear seat entertainment pairing for premium cars
- Personalization, diagnostics
- Energy harvesting to supply car key (e.g. battery dead use case)



- **Not suitable for ... :**

- Car access applications (e.g. door handle transceiver)
- Driver authorization / engine start (e.g. center console transceiver)
- Integration on top of Qi wireless power charging to prevent RFID tag destruction



Reference Designs



Wireless Power & NFC

Robust communication link between TX and RX

NFC runs simultaneously with Wireless Power

Tightly coupled system – same principle as wireless power – no interference with another RX



Safety

- Detection and protection of payment cards, passports, IDs, etc



BT/Wi-Fi Pairing

- Simple and secure Bluetooth and Wi-Fi pairing



Personalization

- Customize various vehicle settings using NFC as a secure service interface to find the comfort that is all your own (set up of seating, mirrors, radio, etc..)

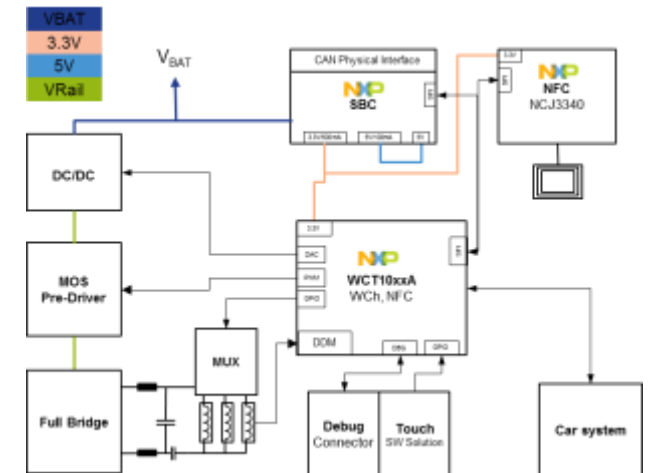


Authentication

- Fast authentication to ensure safe and seamless interoperability

Wireless Charging & NFC Reference Design

- Key differentiators of reference design:
 - Optimized bill-of-materials (BoM)
 - Pre-programmed wireless charging application
 - NFC stack
 - Antenna design ensuring interoperability with all NFC phones (no communication blind spots)
 - Boosted power (15 Watt) for mid power Qi 1.2
 - NFC/RFID card protection
- NXP is a one stop shop for key building blocks:
 - Inventor and market leader in NFC
 - Leading platforms for automotive wireless charging



How to Combine WCH & NFC for Convenience & Protection?

1. Standard Compliancy

- Qi
- NFC



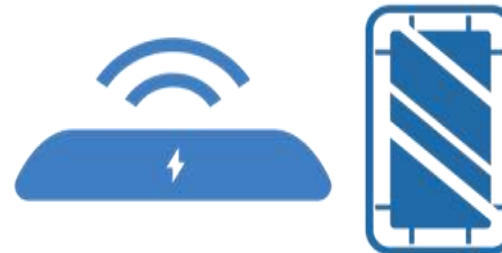
2. Comprehensive Software & sophisticated State Machine

- Supporting all NFC modes with all tag types
- Distinguishing between tag and phone



3. Optimized Hardware

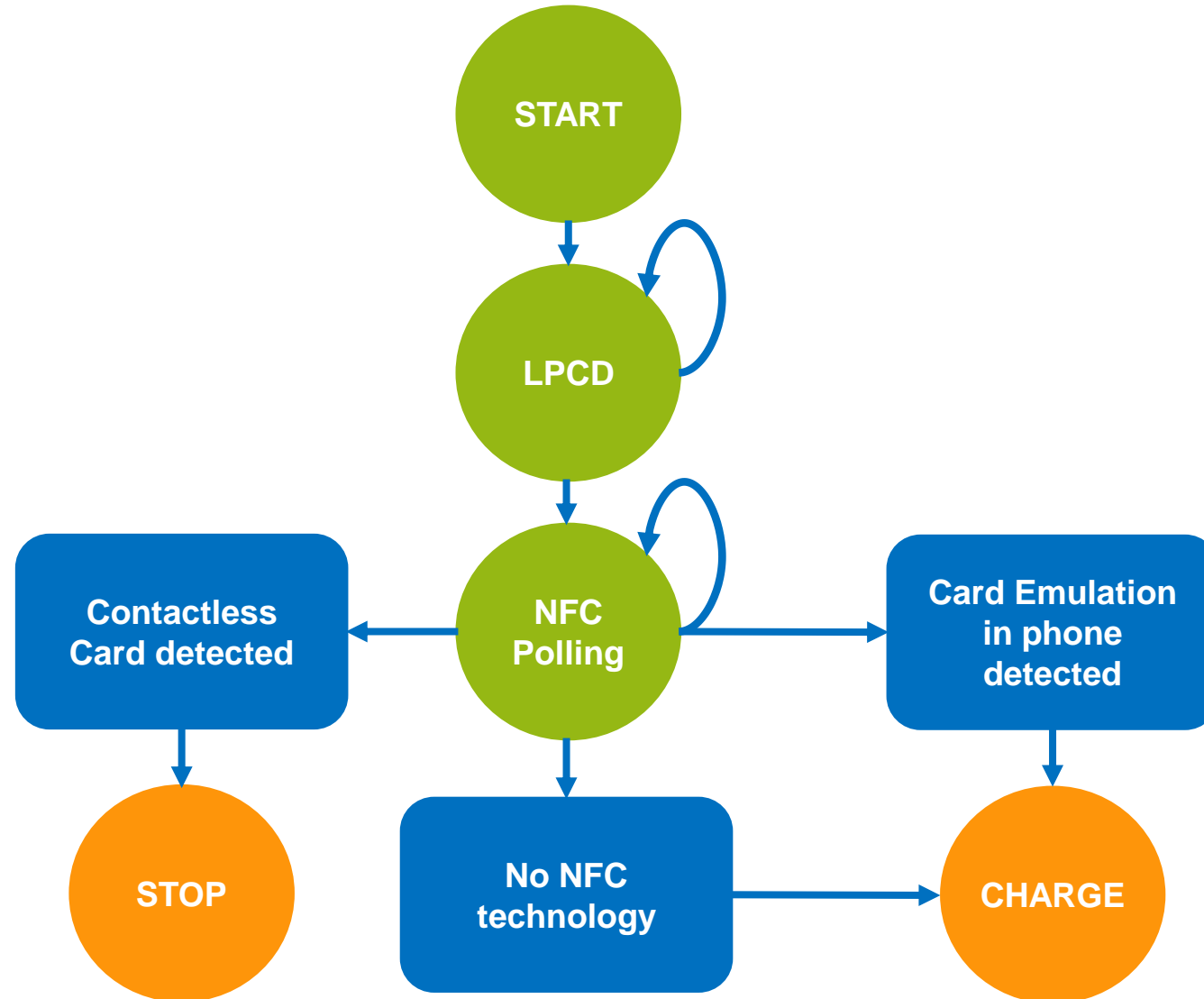
- Combining complex WCh HW with NFC
- No blind spots on whole PCB



NXP as the perfect partner who supports all requirements for a **successful WCH & NFC combination**

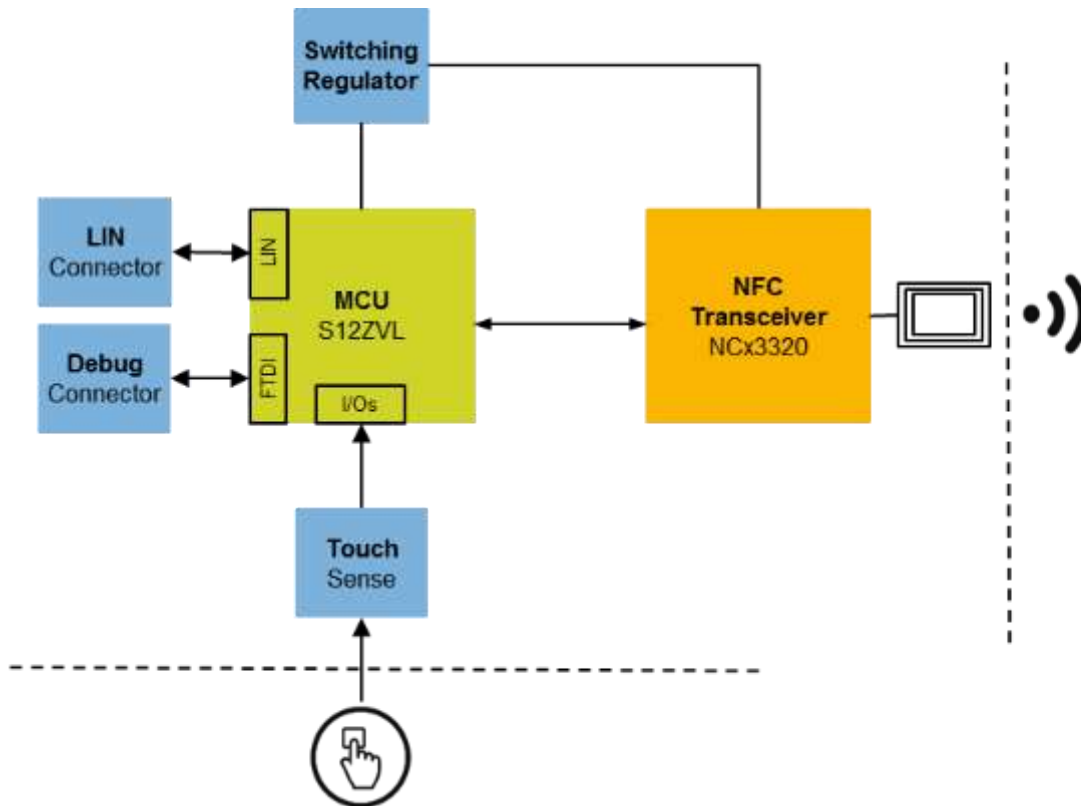


State Machine for RFID Tag Protection



NFC Door Handle Reference Design (1/2)

Plug & Play Experience

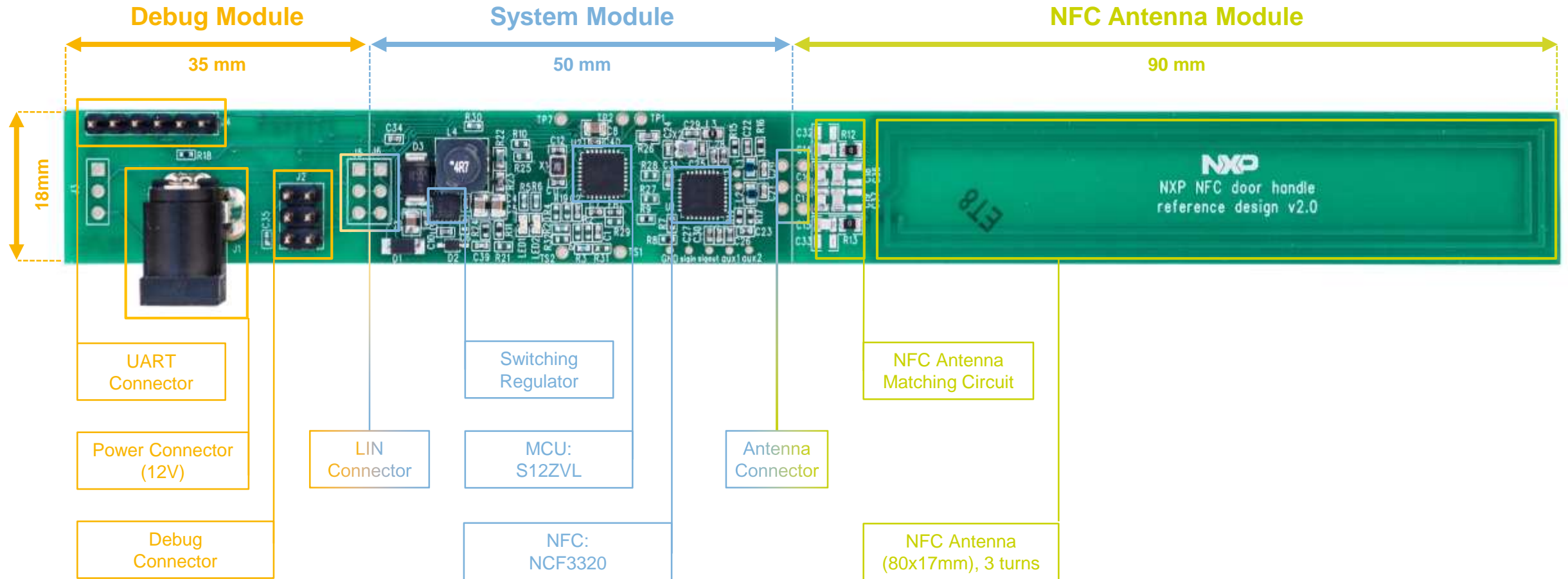


- Key features and benefits:

- **Automotive qualified** NFC frontend IC **NCx3320e** & MCU
- **Small form factor** to meet door handle size constraints
- “**One size fits all**” **antenna matching** concept for chrome and non-chrome door handles
- **Low power card detection** functionality to enable ultra-low power operation
- **Relay attack detection**

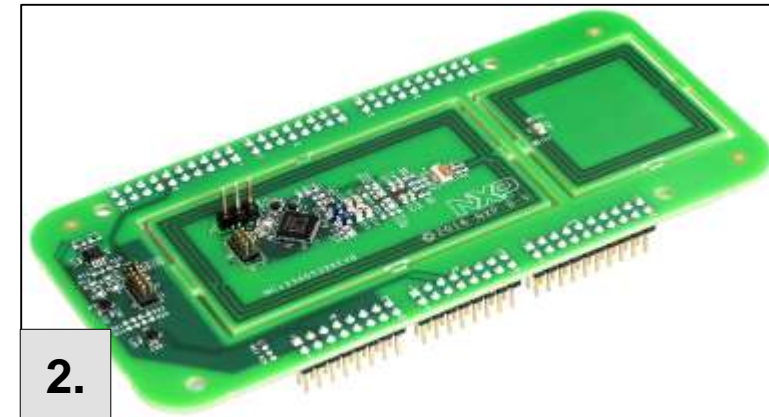
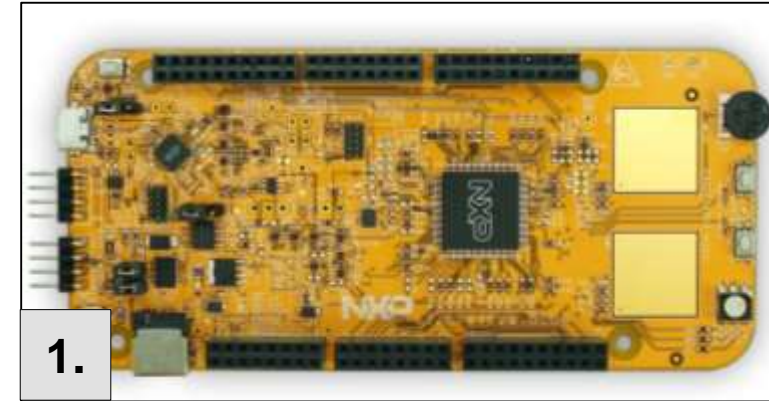
NFC Door Handle Reference Design (2/2)

Plug & Play Experience

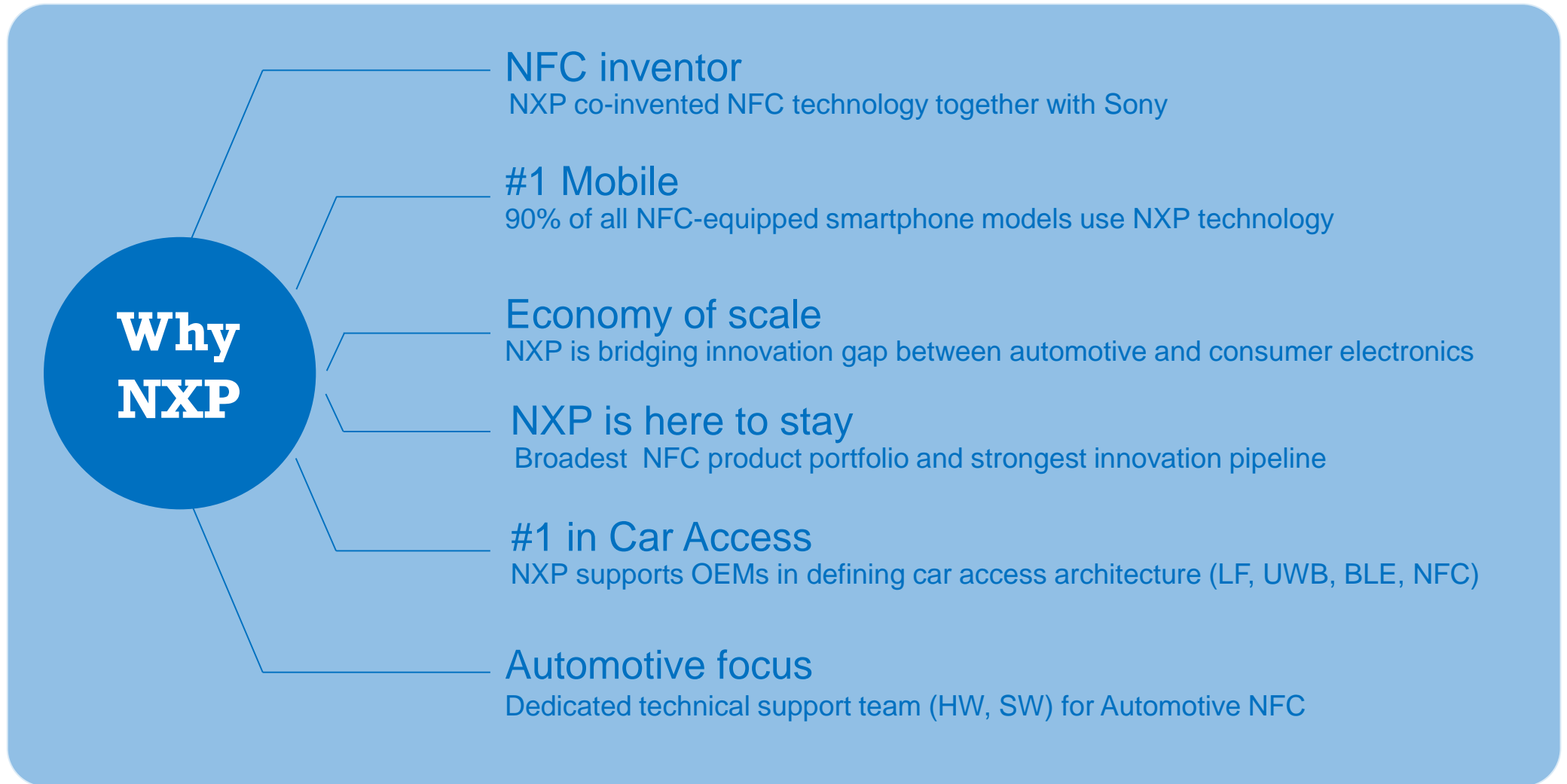


Availability

- What do I need?
 1. Order the [S32k144 Evaluation Board](#) at nxp.com
 2. Order the [NCx3340 Add-On board](#) at nxp.com
 3. Download the [ANFC NCI Stack](#) at nxp.com
- For more details please contact:
 - Marc Manninger, Technical Marketing Manager Automotive NFC



NXP – Partner of Choice for Auto Grade NFC Technology





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