

# NXP SEMICONDUCTORS

INTERNET DE LAS COSAS: UN VISTAZO A LAS INNOVACIONES TECNOLÓGICAS Y EL DISEÑO DE SOLUCIONES ELECTRÓNICAS PARA LA GESTIÓN INTEGRAL DE NUESTROS HOGARES Y LUGARES DE TRABAJO.

Ernesto Andrés Rincón Cruz



**2016**

EXTERNAL USE

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SECURE CONNECTIONS  
FOR A SMARTER WORLD

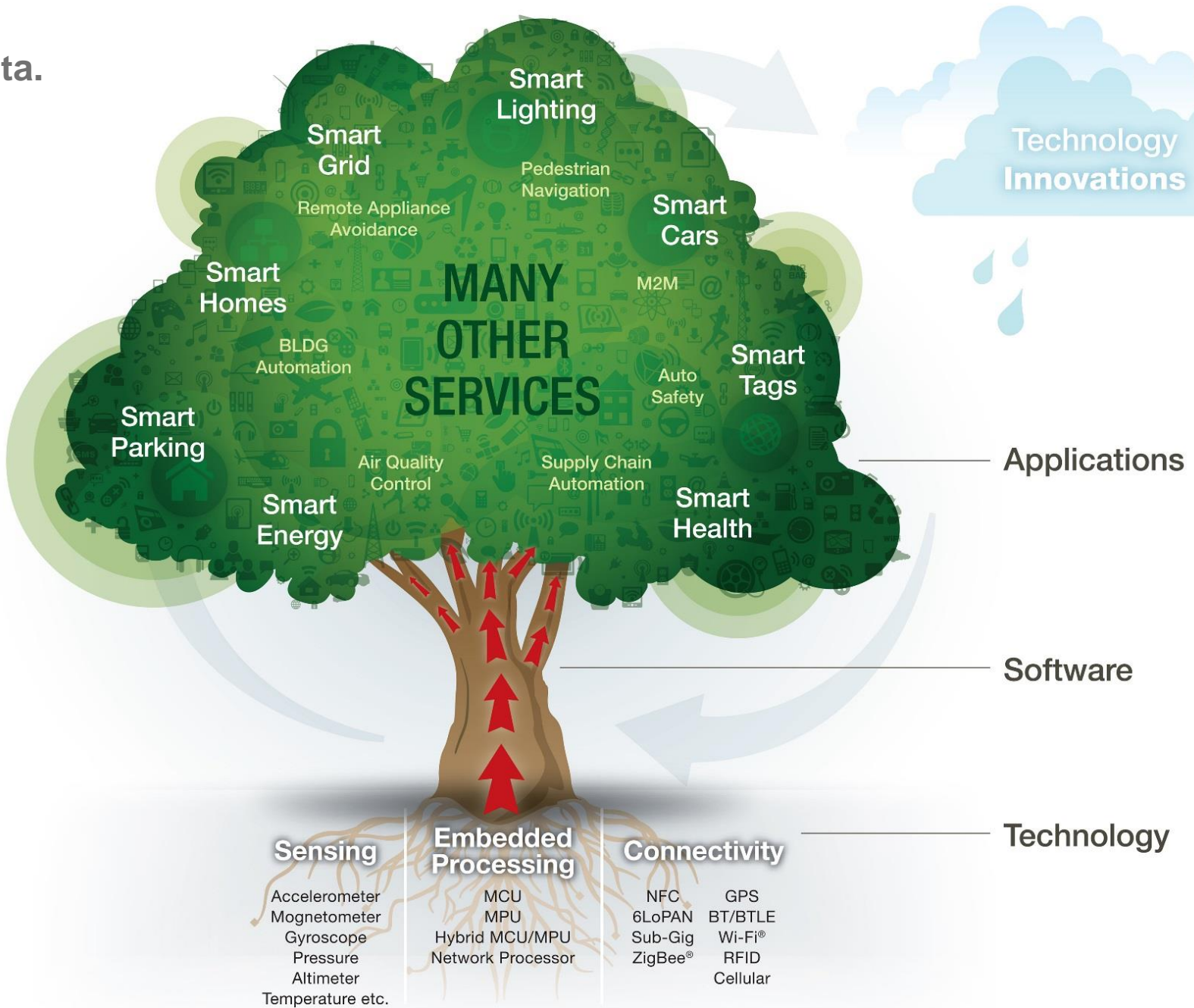
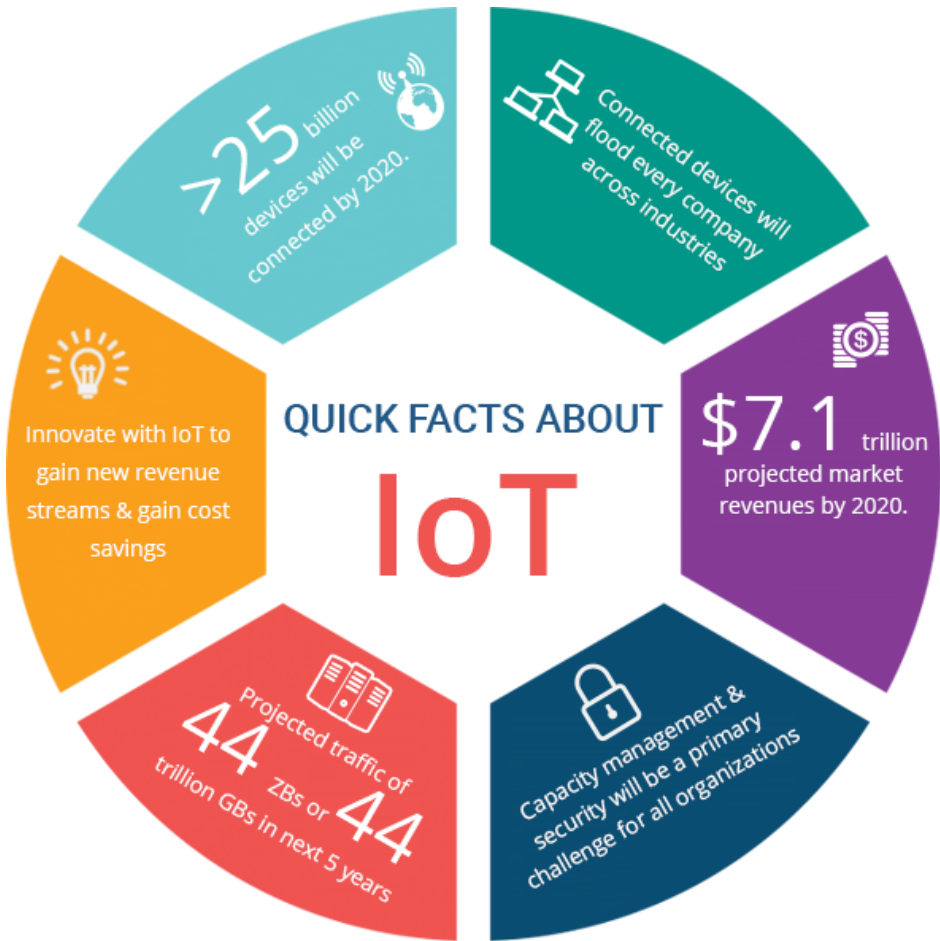
# CONGRESO ACADÉMICO UDI 2016

## SÉPTIMO CONGRESO DE INGENIERÍA ELECTRÓNICA

- IOT Overview
  - Automotive Applications
  - Consumer Applications
- IOT design
  - NFC Technology
  - Bluetooth - Zigbee Technology

# Internet of Things Tree

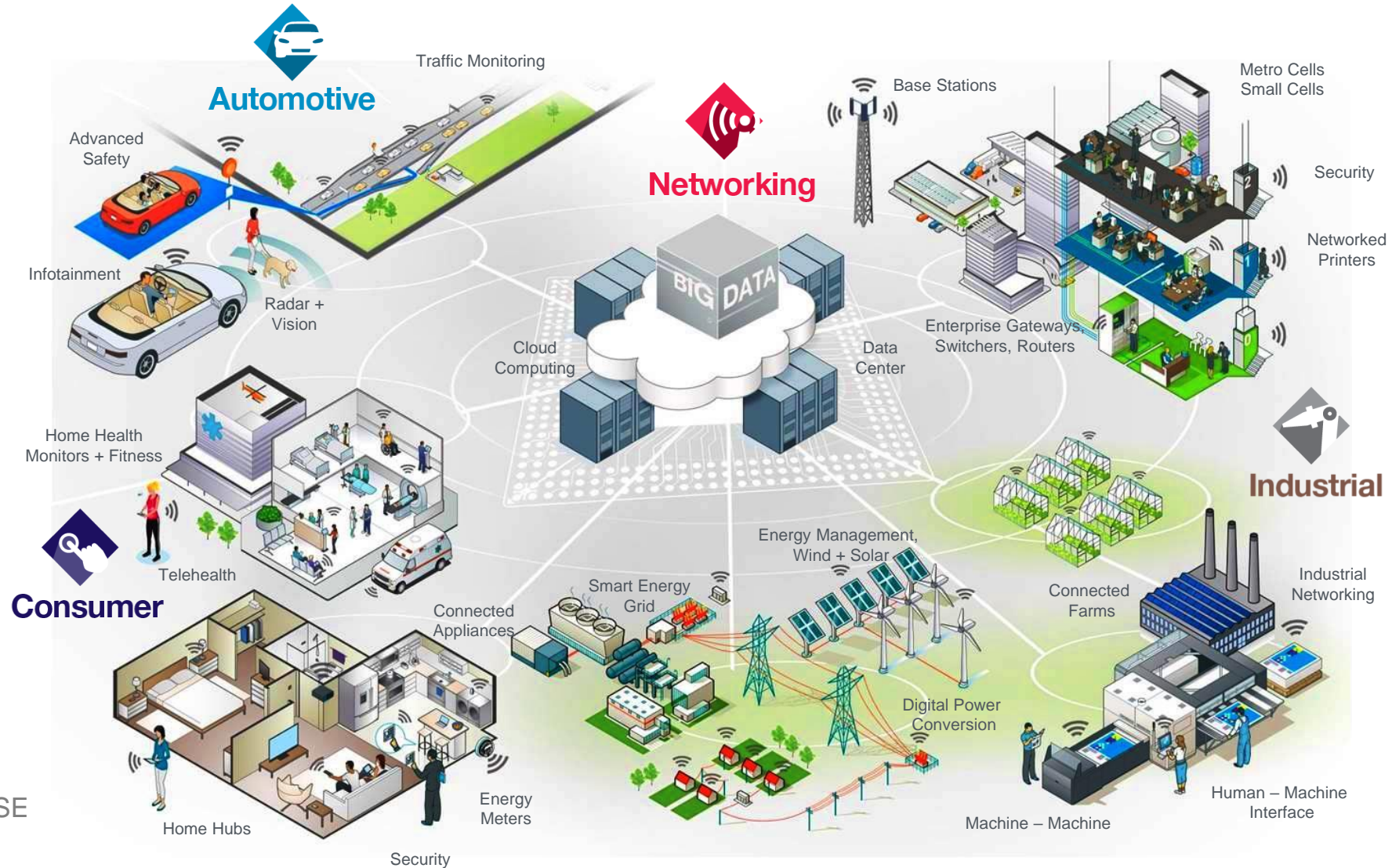
Sensors Are A Primary Source For Big Data.

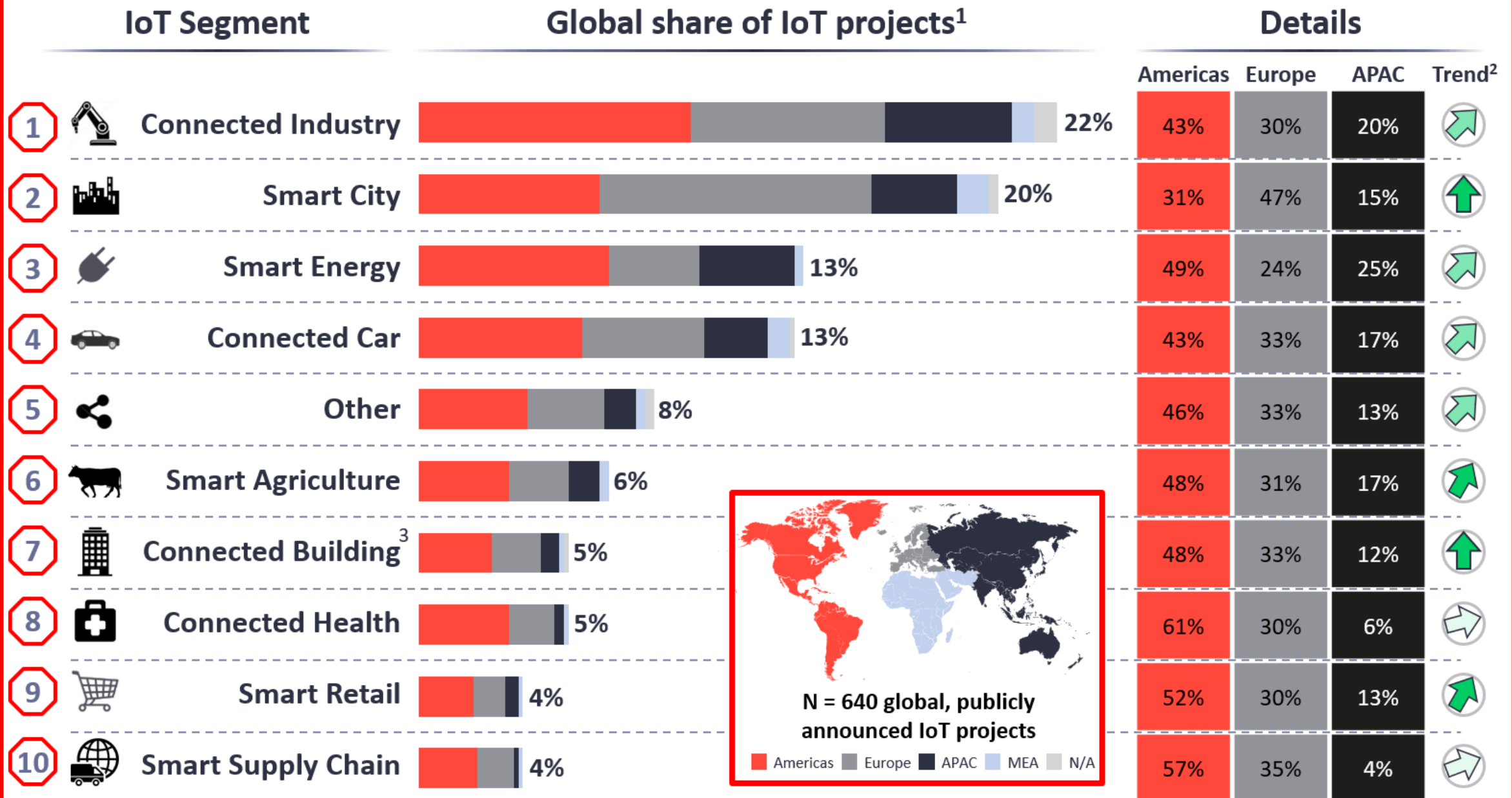




# “Things” need to be smarter to win

Microcontrollers | Digital Networking | Auto MCU | Analog and Sensors | RF





1. Based on 640+ publicly known enterprise IoT projects. (Not including consumer IoT projects e.g., Wearables, Smart Home) 2. Trend based on IoT Analytics's Q2/2016 IoT Employment Statistics Tracker 3. Not including Consumer Smart Home Solutions Source: IoT Analytics 2016 Global overview of 640 enterprise IoT use cases (August 2016)

# AUTOMOTIVE APPLICATIONS



# Automotive Roadmap



2015

## ASSIST

- SENSOR
- DRIVER ACTIVE
- FAIL SAFE



2020

## AUTOMATE

- SENSOR FUSION
- CO-PILOT
- DEPENDABLE



2030

## AUTONOMOUS

- HIGH ACCURACY MAPS
- DRIVERLESS
- SAFETY COCOON



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# NXP Connects the Car



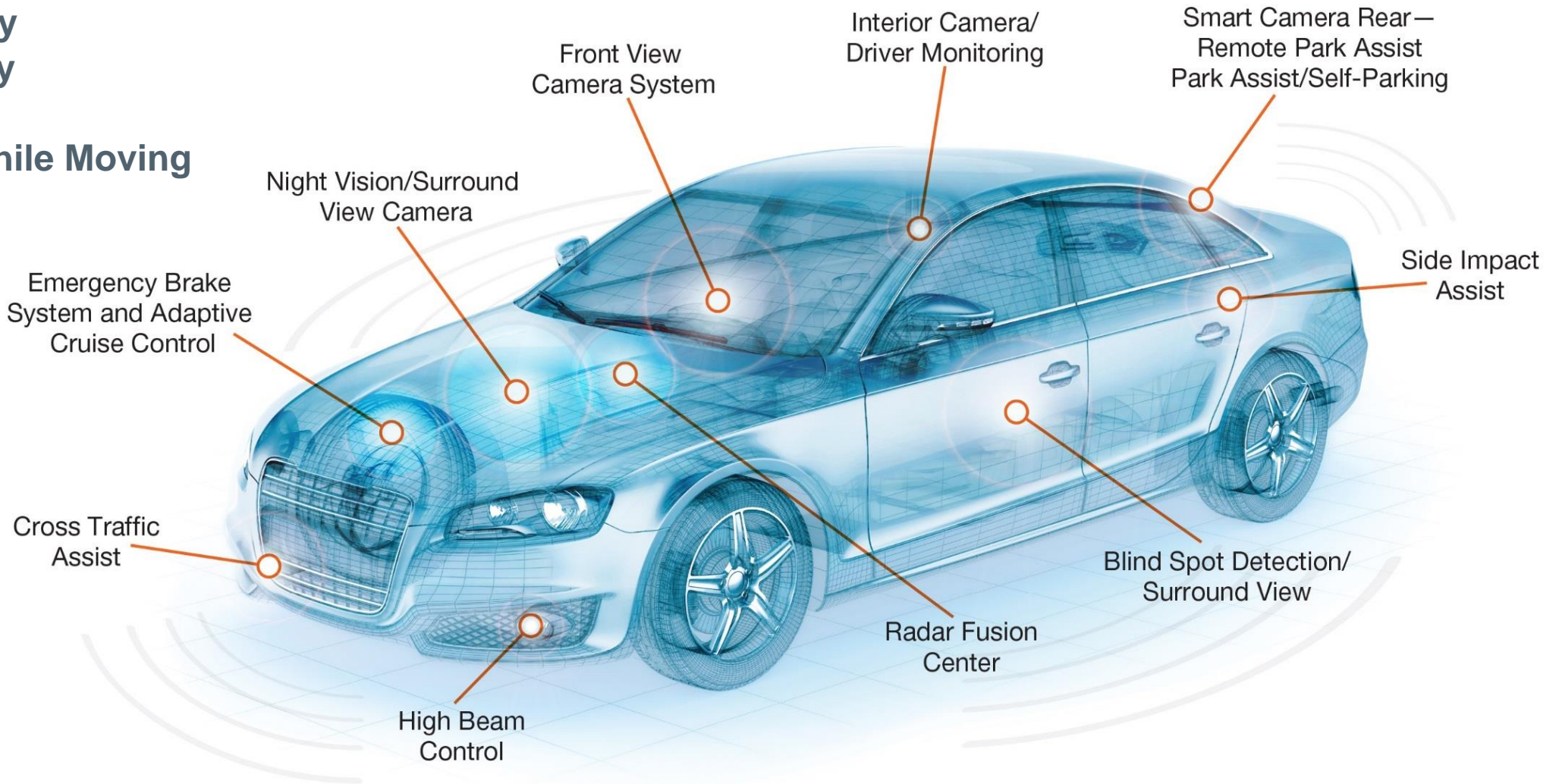
Car to Car, Car to Infrastructure, Car to Portable, Inside the Car





# Advanced Driver Assistance System (ADAS)

- **Increased Safety**
- **Greener Mobility**
- **New Mobility**
- **Connectivity While Moving**



# Advanced Driver Assistance System (ADAS) Technology

## Chassis and Safety

overview



16 Freescale Automotive Solutions

## Body Electronics

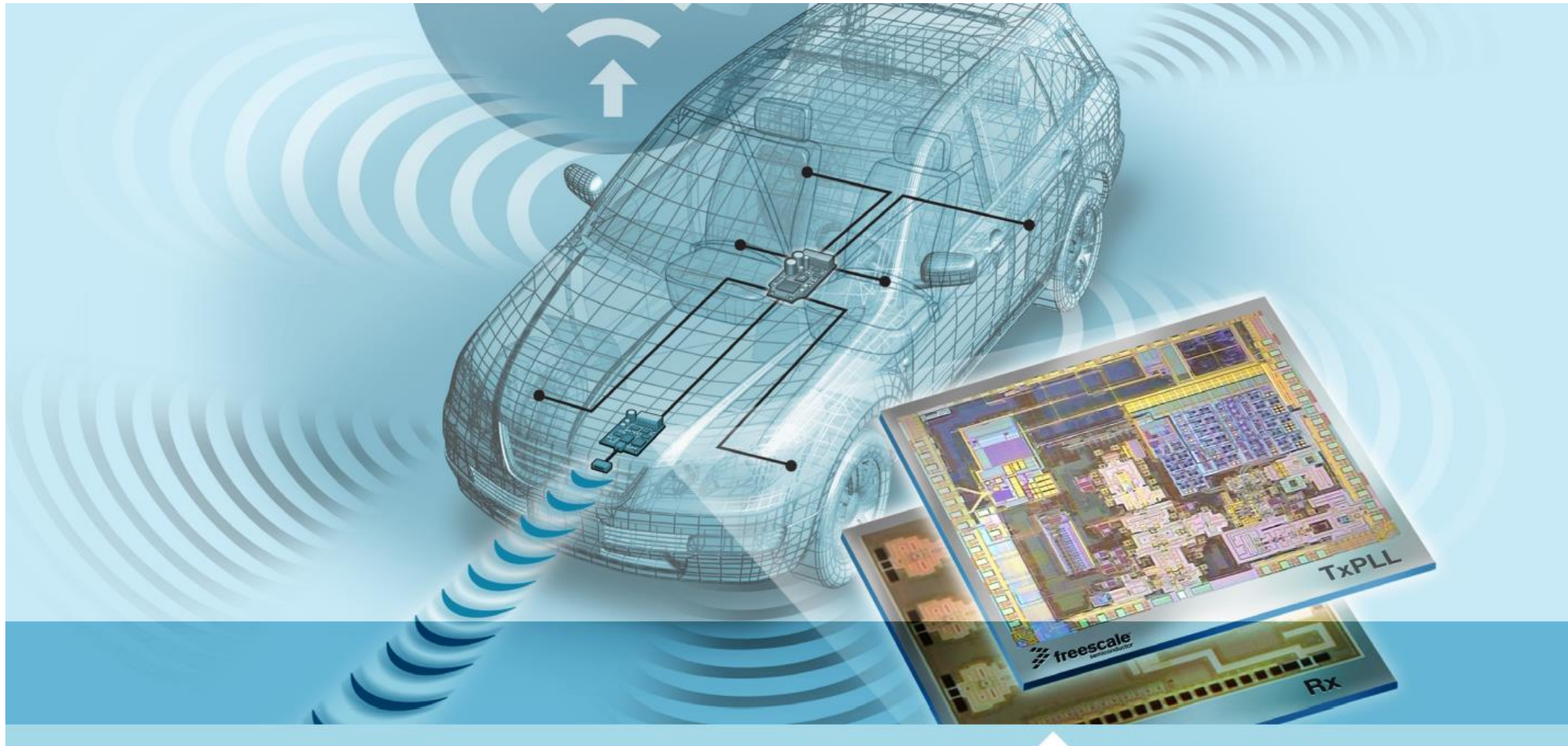
overview



28 Freescale Automotive Solutions



# Automotive Radar High-resolution 77 GHz radar



- Multi-mode, multi-application capability
- Simultaneous long- and mid-range functionality



# NXP® automotive vision system-on-chip S32V vision microprocessor



The S32V vision microprocessor integrates robust hardware including high-performance CogniVue APEX-642 core image processing technology, as well as four ARM Cortex-A53 cores

# NXP® Automotive Futuring

NXP Accelerates Its Solutions for Crashless and Autonomous Vehicles with the Acquisition of CogniVue



# CONSUMER APPLICATIONS





# NXP® I.MX28 .

ARM® family of multimedia applications processors



# Blood Pressure Monitor.

Heartbeat Detection, Systolic and Diastolic Measurements





# Pulse Oximetry/ Heart Rate Monitor.

Application note demonstrates the implementation of a pulse oximeter using the medical-oriented Kinetis K50 MCU.





# Blood Glucose Meter & Inhalers (Pulmonary Drug Delivery)

The transimpedance amplifier embedded on the Kinetis K50 allows the user to acquire the current generated by the glucose's .





# Wearables / Activity and Wellness Monitor

Wearable technology, a key driver of the IoT, is prevalent in the consumer, entertainment, sports and fitness markets.





























# IOT DESIGN





# Finding the best wireless option for your IoT design

	 <b>WiFi</b>	 <b>ZigBee (802.15.4)</b>	 <b>Bluetooth</b>	 <b>NFC</b>
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

WIRELESS TECHNOLOGIES AT A GLANCE					
Technology	Frequency	Data rate	Range	Power	Cost
2G/3G	Cellular bands	10 Mb/s	Several km	High	High
802.15.4	2.4 GHz	250 kb/s	100 m	Low	Low
Bluetooth	2.4 GHz	1, 2.1, 3 Mb/s	100 m	Low	Low
LoRa	< 1 GHz	<50 kb/s	2-5 km	Low	Medium
LTE Cat 0/1	Cellular bands	1-10 Mb/s	Several km	Medium	High
NB-IoT	Cellular bands	0.1-1 Mb/s	Several km	Medium	High
SIGFOX	<1 GHz	Very low	Several km	Low	Medium
Weightless	<1 GHz	0.1-24 Mb/s	Several km	Low	Low
Wi-Fi (11f/h)	2.4, 5, <1 GHz	0.1-1 Mb/s	Several km	Medium	Low
WirelessHART	2.4 GHz	250 kb/s	100 m	Medium	Medium
ZigBee	2.4 GHz	250 kb/s	100 m	Low	Medium
Z-Wave	908.42 MHz	40 kb/s	30 m	Low	Medium

[12 Wireless Options for IoT/M2M: Diversity or Dilemma?](#)



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# NFC TECHNOLOGY



# What is NFC?

Near Field Communication is a short-range wireless connectivity technology *standard*, designed for *intuitive* and *simple* communication between *two* electronic devices.



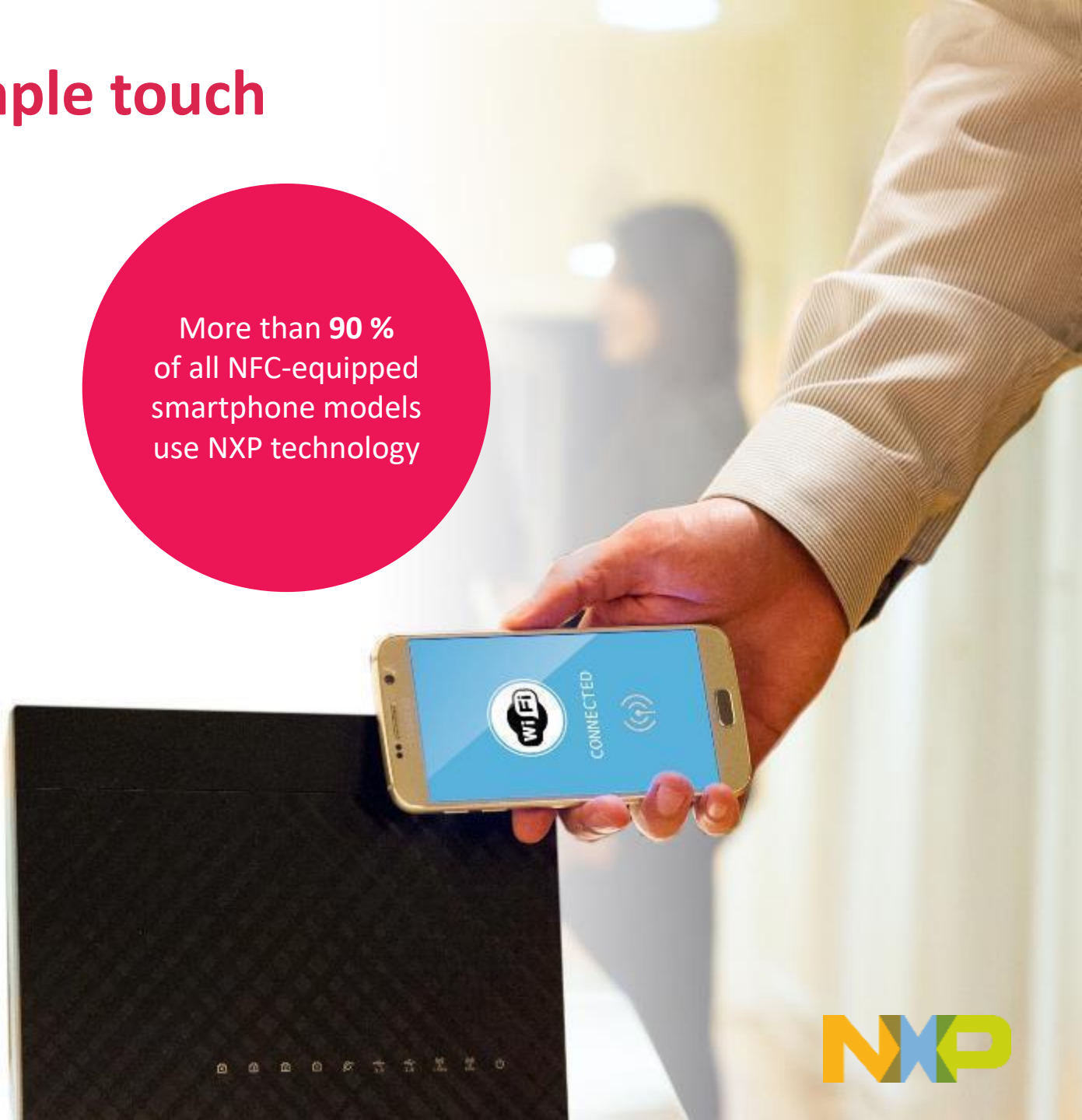


# Initiate interactions with a simple touch

## NFC 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

More than **90 %**  
of all NFC-equipped  
smartphone models  
use NXP technology



# NXP – Leader in NFC technology



## NXP highlights

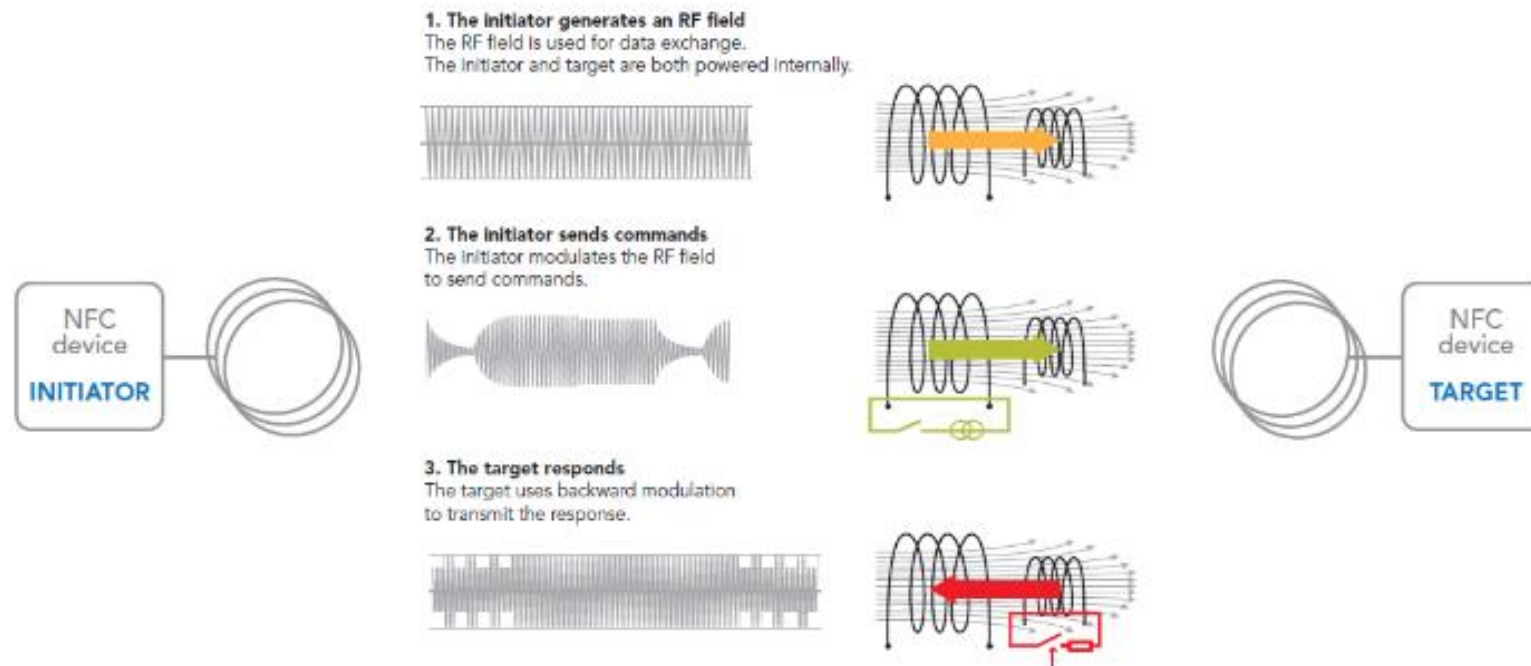
- Inventor of MIFARE technology in 1994
- Co-inventor of NFC in 2002
- Largest NFC development team with >500 engineers
- 74% market share for NFC CLFs (ABI Research)
- > 1 bn contact & contactless reader ICs distributed into the market



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# Passive communication scheme

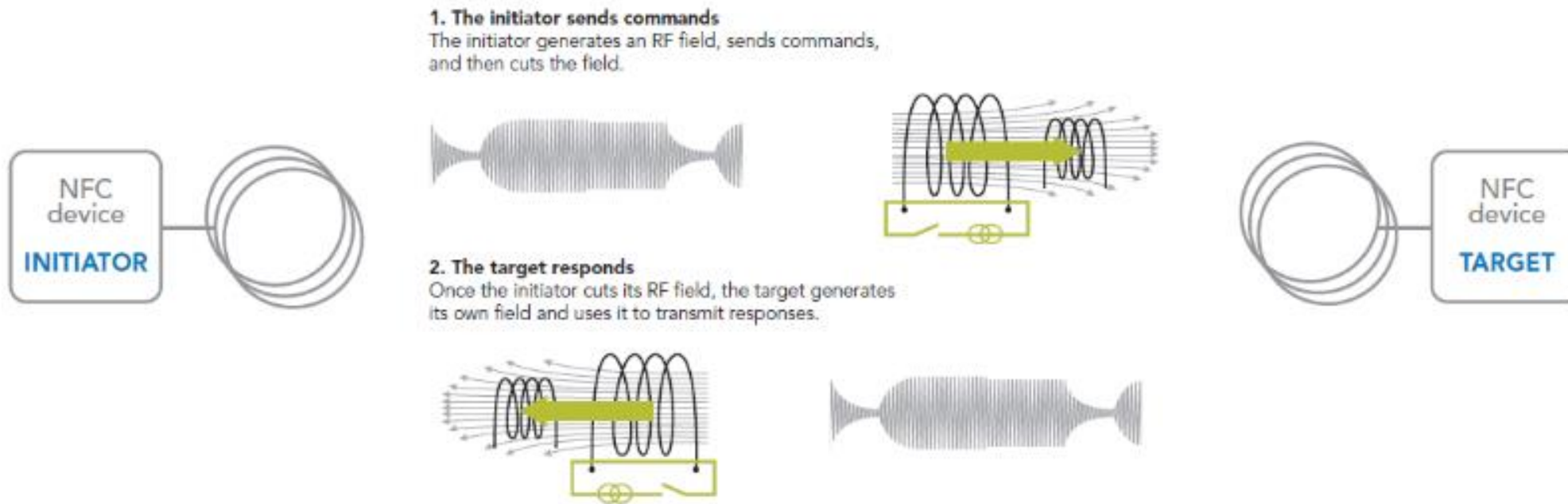
- All three modes are working in this scheme
- Initiating device produces 13.56 MHz carrier field
- Target device uses the field to draw energy
- Initiator transfers data by directly modulating the field
- Target transfers data by load-modulating the field
- Required by NFC Forum and compatible with other formats, including ISO/IEC 14443





# Active communication scheme

- Active Peer-to-Peer Mode only
- Initiator and target both generate an RF field
- Each side transmits data by modifying its own field with ASK modulation
- To avoid collisions, only the sending device emits an electromagnetic field
- Receiving device switches off its field to listen
- Send/receive roles can be reversed as needed

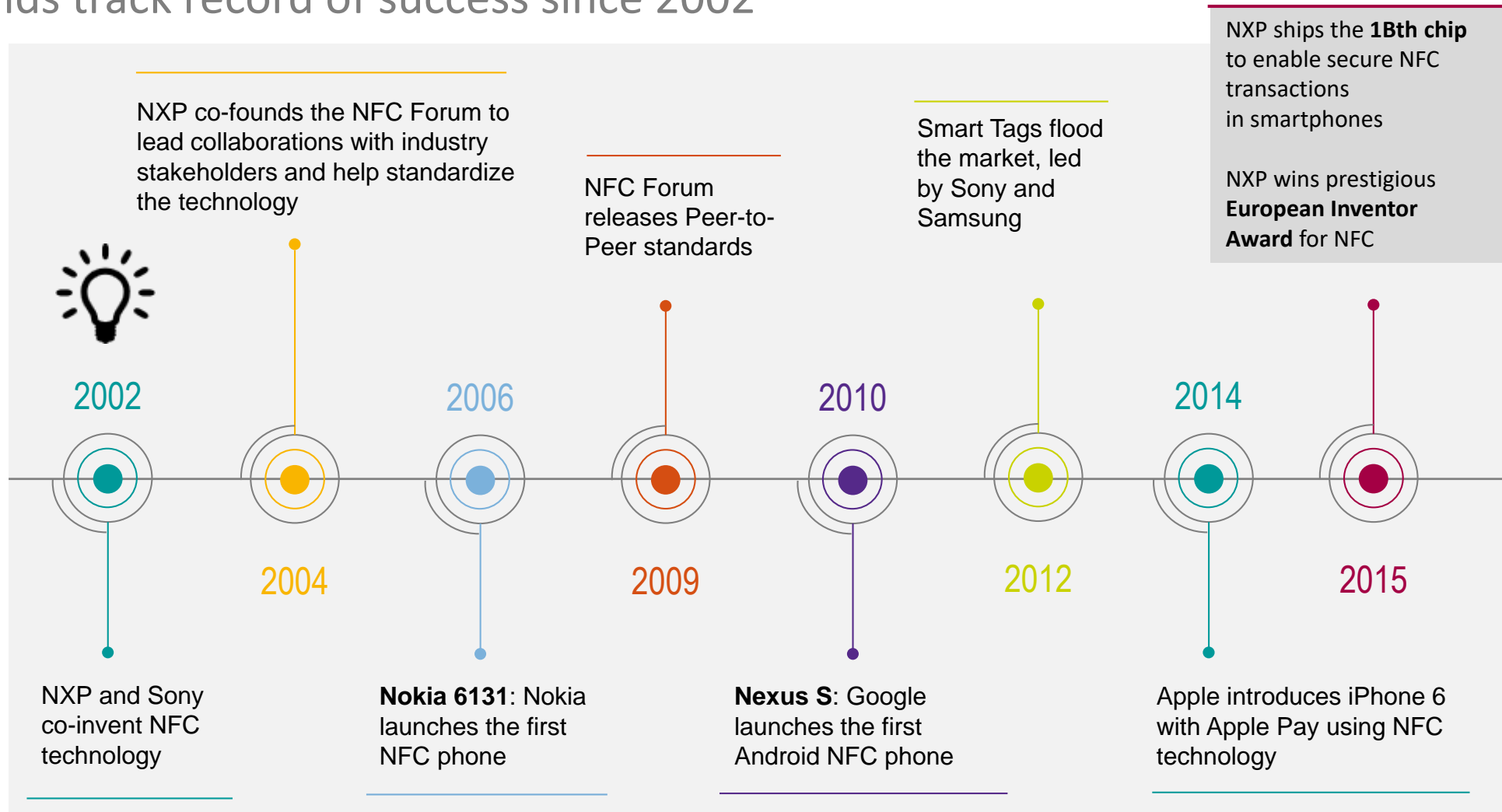


# NFC EVERYWHERE



# The evolution of NFC

NXP builds track record of success since 2002





# Amtmann, Maugars and their teams at NXP take home the prestigious European Inventor Award



# NFC-enabled devices

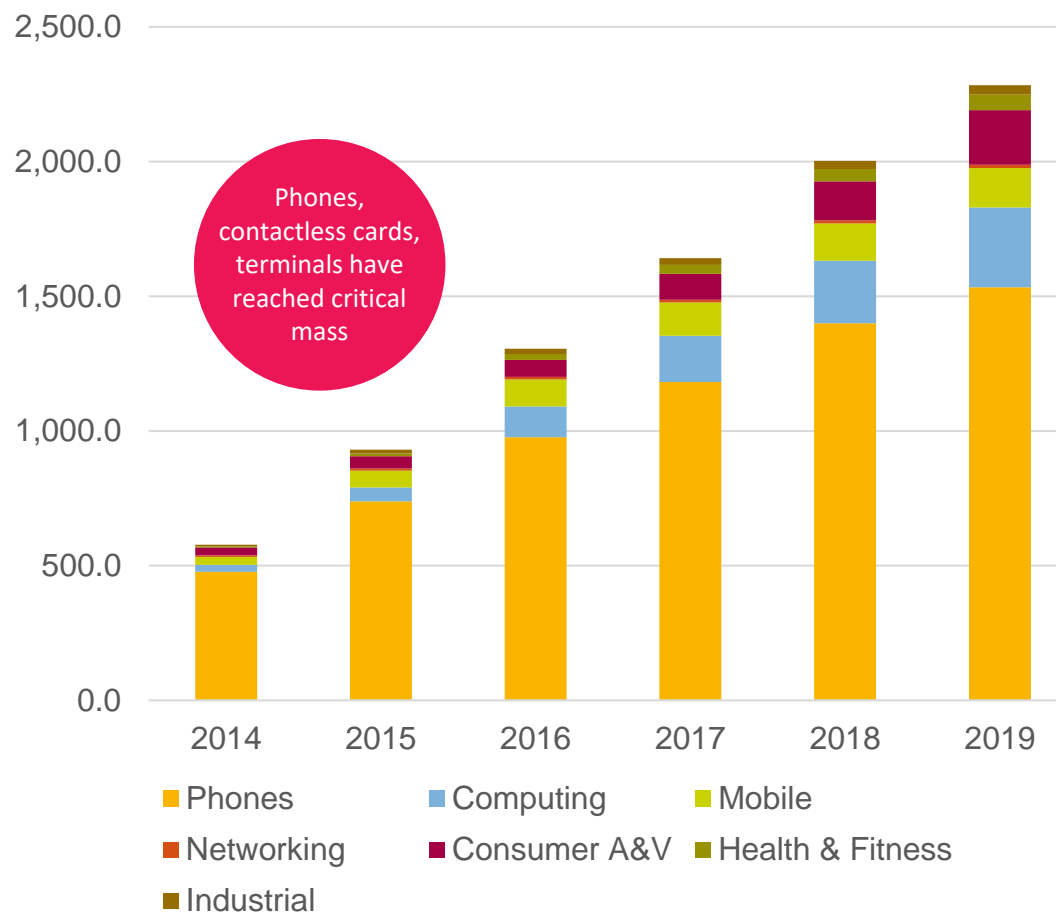
Market update - some key figures

- ▶ **>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

## NFC Market outlook

(MPC, ABI Research 2015)














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



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# Typical NFC use cases and segments covered

		 Access	 Industrial & Appliances	 Medical	 Consumer & IoT	 Payments
Conditional access		●	●	●		
Commissioning and pairing			●		●	
Authentication			●	●	●	
Zero-power configuration			●		●	
Device-to-device communication			●	●	●	
Payment						●



# A DAY IN YOUR LIFE WITH NFC

# A DAY IN YOUR LIFE WITH NFC



## City

Morning home  
Morning travel  
@work  
Lunch break  
Afternoon activity  
Home, sweet home

## Segments



# Good Morning







# Product authentication

## Conveniently protected through NFC



Drinking a delicious, hot coffee



Brushing your teeth before leaving for work

Ensure that only original parts are used in a device

### Benefits

- ▶ Revenue & quality protection
- ▶ Instant matching of settings
- ▶ Facilitate purchasing decision

### NXP NFC solutions

- ▶ NFC frontends: **MFRC630**
- ▶ NFC controllers: **PN7120/PN7150**



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# Zero-power-configuration

## Simplified access through NFC



Personalize the thermostat according to the weather forecast for the day



Configure the alarm before leaving home

Use a phone as external user interface and configure the device in unpowered state

### Benefits

- ▶ No power required
- ▶ Cost reduction
- ▶ Simplified human interface (no complex user manuals)

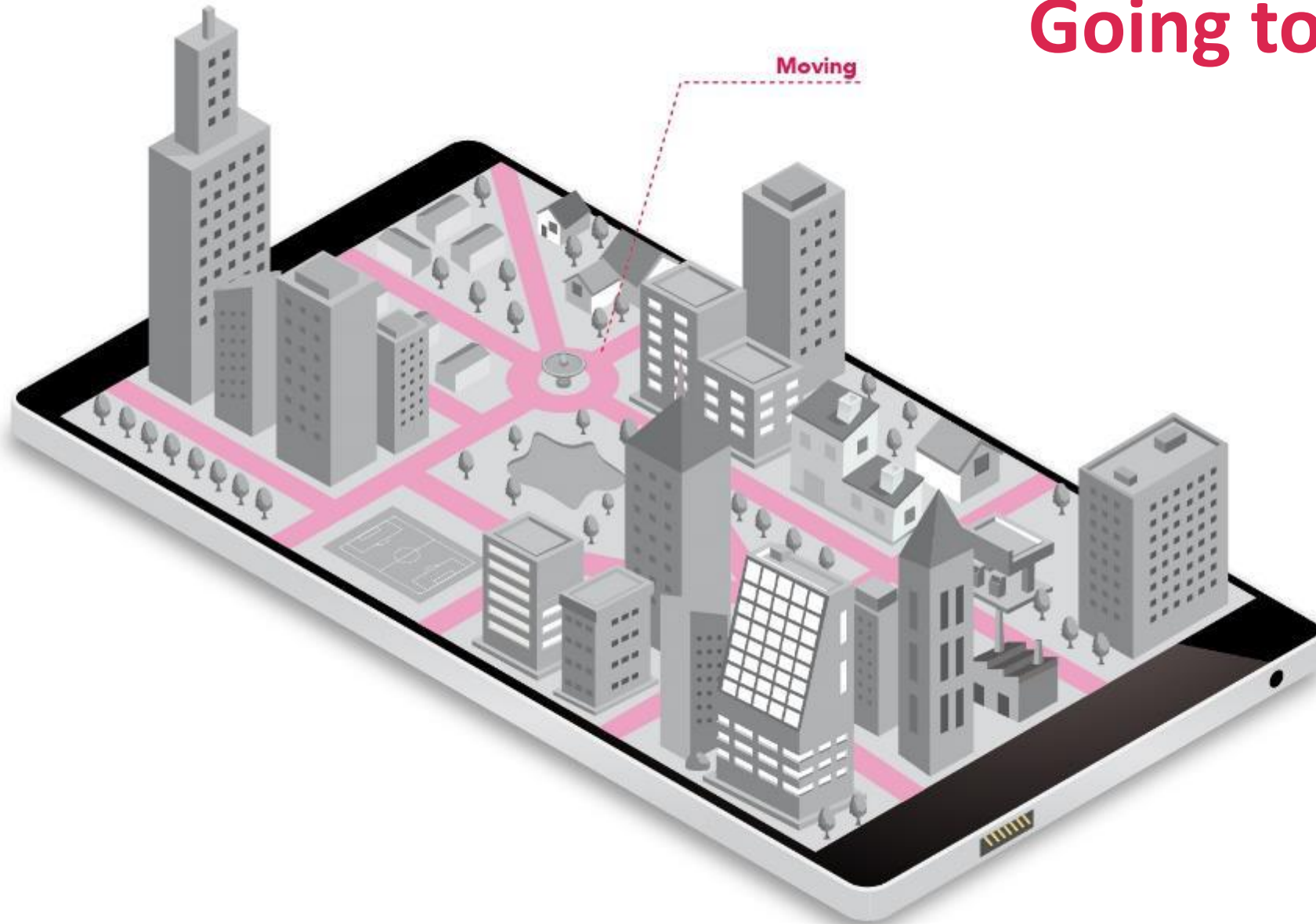
### NXP NFC solutions

- ▶ NFC connected tag: **NTAG I<sup>2</sup>C plus**



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# Going to work







# Pairing

## Easy pairing to Bluetooth through NFC



Walking to school while listening to your favorite band



Tap your headset against your friend's headset, silent disco

Tap to trigger pairing with Bluetooth or other RF technologies

### Benefits

- ▶ 20x faster than BLE or WiFi Pairing when using buttons
- ▶ No need to enter long codes
- ▶ Technology hidden behind human gesture

### NXP NFC solutions

- ▶ NFC connected tags: **NTAG 21xF**, **NTAG I<sup>2</sup>C plus**
- ▶ NFC controllers: **PN7120/PN7150**



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# Conditional access control

## Secure and convenient access through NFC



Use a bike rental service to get to work



Tap to access public transport

Give access to an installation or use a bike rental system

### Benefits

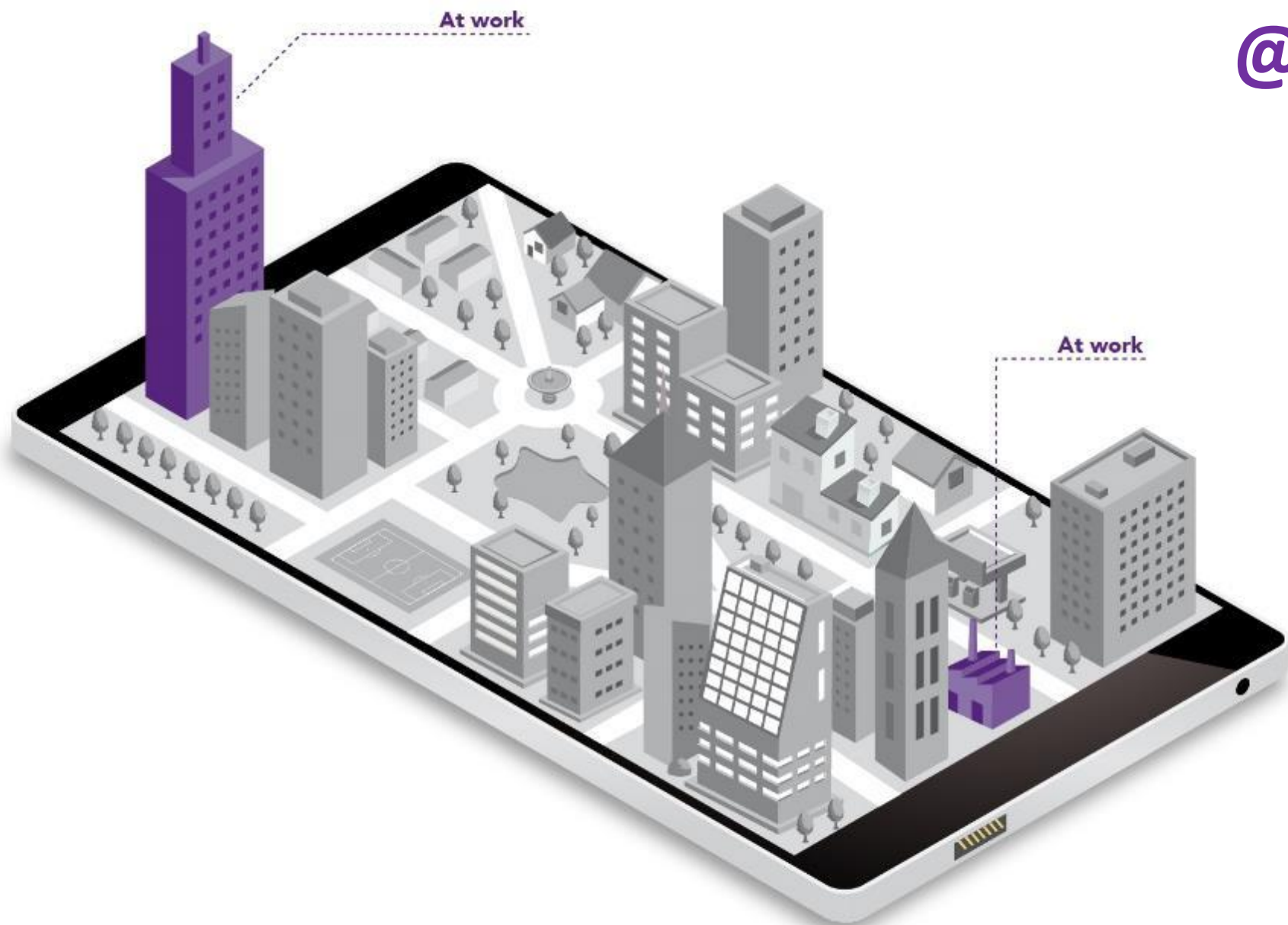
- ▶ Higher security compared with legacy technology
- ▶ Easier tracking of user behavior/fraud detection
- ▶ Increased user convenience and commercial speed
- ▶ Reduced maintenance costs

### NXP NFC solutions

- ▶ NFC frontends: **PN5180**, **CLRC663**
- ▶ NFC controller: **PN7462**



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@work





# Physical and logical access control



## Secure and convenient access through NFC



Use your badge to access the office



Tap-and-authenticate to workstation

Gives access to a physical door and allows logical access to a machine

### Benefits

- ▶ Easier management of office security: remote key distribution, time limited access, etc
- ▶ Time & attendance tracking
- ▶ Future proof

### NXP NFC solutions

- ▶ NFC frontends: **PN5180**, **CLRC663**
- ▶ NFC controller: **PN7462**



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# Device-to-device communication



## Exchange data with battery-less sensors



Read out water usage data from a sensing device isolated from the main unit



Obtain data associated with a circuit breaker to quickly and easily access information associated with the trip-type event.

Communicate with battery less sensors or moving elements to get instantaneous measurements with NFC

### Benefits

- ▶ Sensors do not require a battery since they utilize energy harvesting from the RF field
- ▶ Communication with sensors which can not be connected through wires to the main unit
- ▶ Friction-less interactions between components
- ▶ Costs savings on device-to-device interaction

### NXP NFC solutions

- ▶ NFC connected tag: **NTAG I<sup>2</sup>C plus**
- ▶ NFC frontends: **PN5180, CLRC663**



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# Zero-power configuration



## Smart manufacturing and maintenance



Customize product variants to adjust country settings, feature sets or firmware versions



If a machine stops and requires maintenance, the repair personnel can arrive with the relevant spare parts in hand

Increase factory supply chain flexibility during production, test and service maintenance even with sealed or packaged products

### Benefits

- ▶ Easy maintenance. No contact interface needed
- ▶ Device can be unpowered
- ▶ Higher supply chain flexibility
- ▶ Easily obtain product serial numbers, firmware version, repair history or activity, or error logs

### NXP NFC solutions

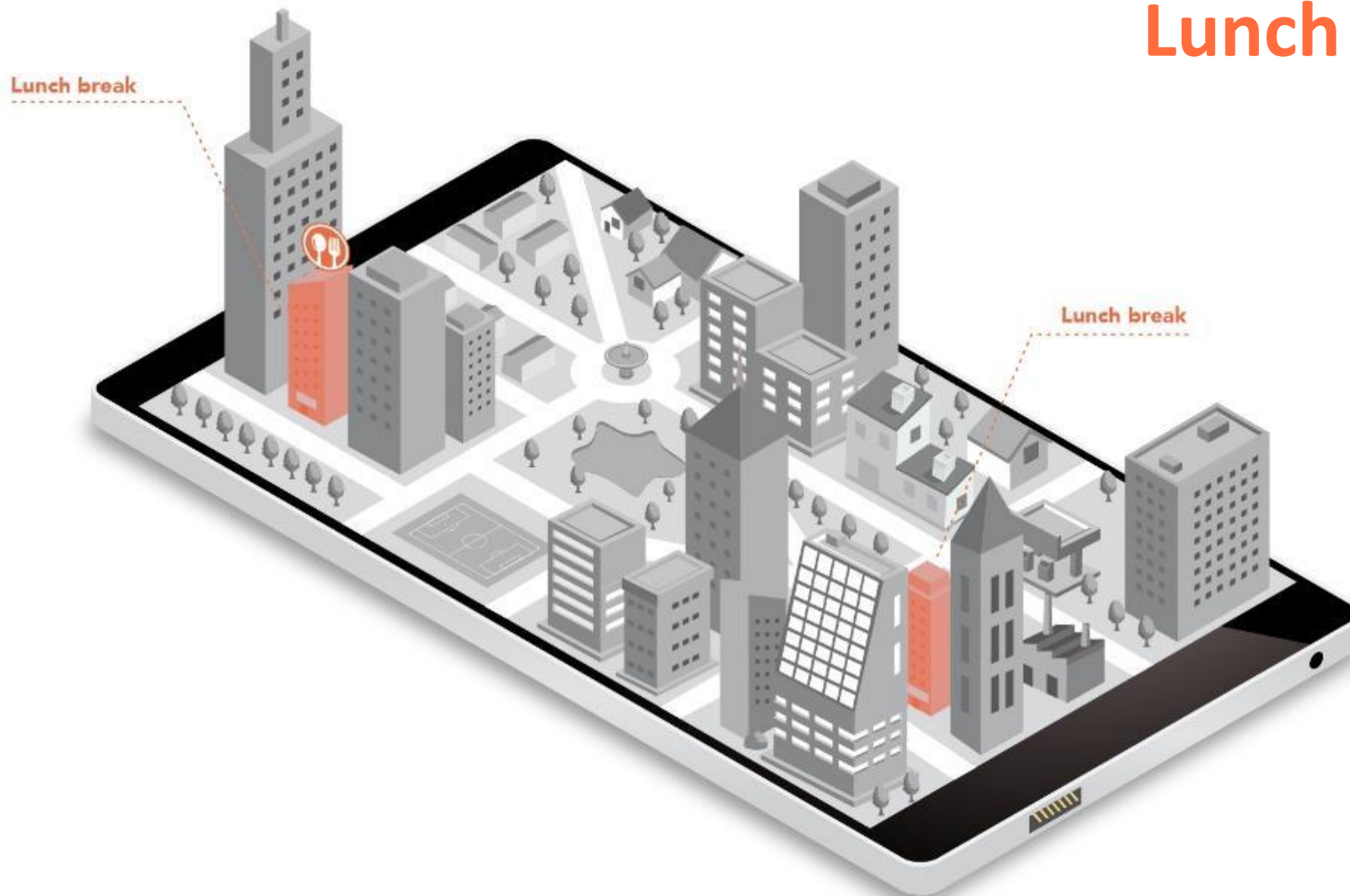
- ▶ NFC connected tag: **NTAG I<sup>2</sup>C plus**
- ▶ NFC controllers: **PN7120/PN7150**



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# Lunch break





# Payments



## Secure and convenient payment through NFC



Pay for your lunch at the cantina



Get a sandwich from the vending machine

Pay for goods or services with a simple tap

### Benefits

- ▶ Easier and more convenient (no PIN <20€)
- ▶ Cash elimination
- ▶ Increased customer engagement

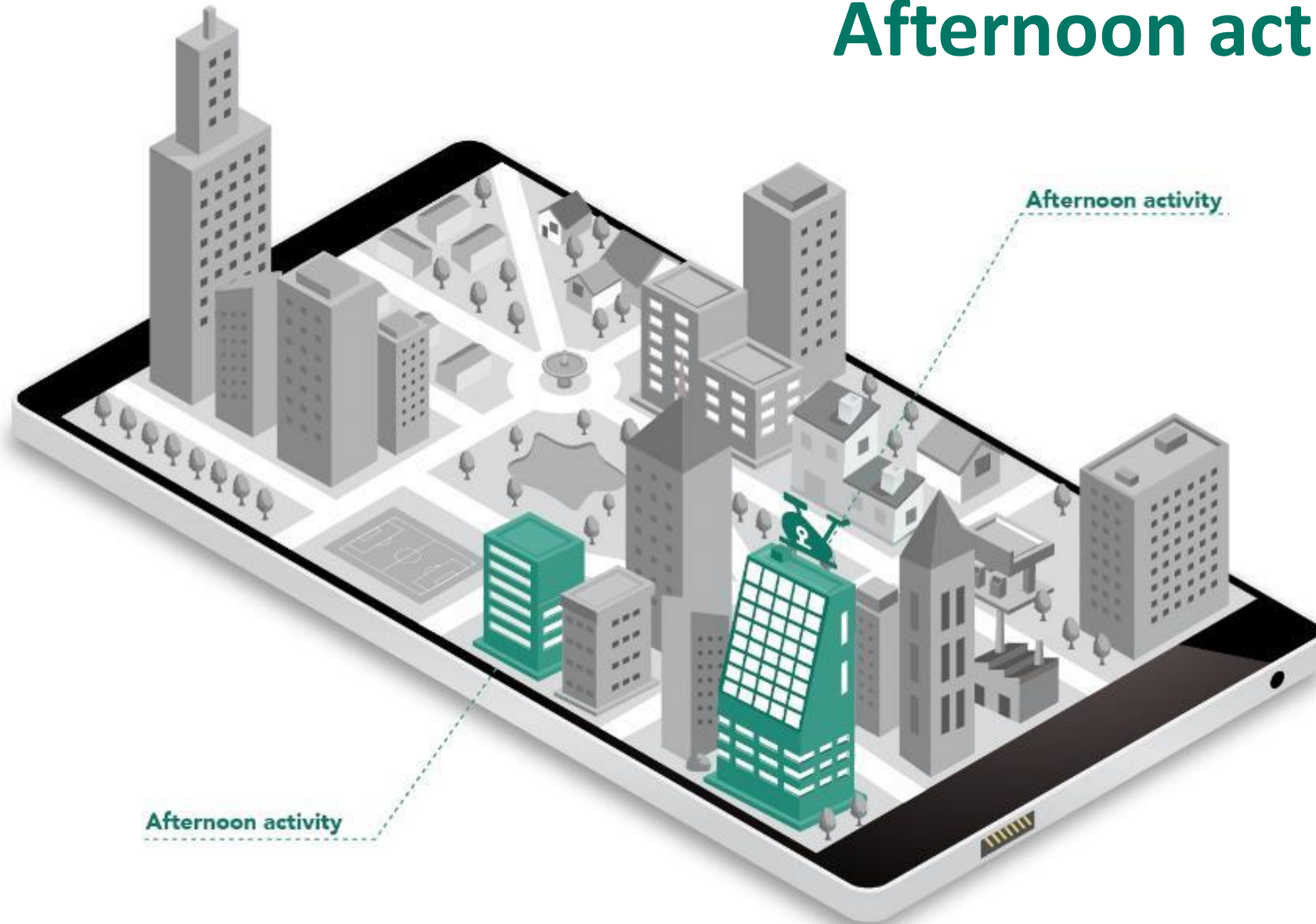
### NXP NFC solutions

- ▶ NFC frontend: **PN5180**
- ▶ NFC controller: **PN7462**



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# Afternoon activities







# Conditional access control

No need to carry cards or keys to access thanks to NFC



Use your bracelet to access the gym



Then open the locker with your bracelet

Gives access to an installation and open the locks

## Benefits

- ▶ Higher security compared with legacy technology
- ▶ Increased customer engagement
- ▶ Reduced maintenance costs

## NXP NFC solutions

- ▶ NFC frontends: **PN5180**, **CLRC663**



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# Pairing



## Easy pairing with fitness equipment thanks to NFC



Tap your phone to your fitness tracker to pair it



Tap your fitness tracker to the gym equipment to pair it

Tap to trigger pairing with Bluetooth or other RF technologies

### Benefits

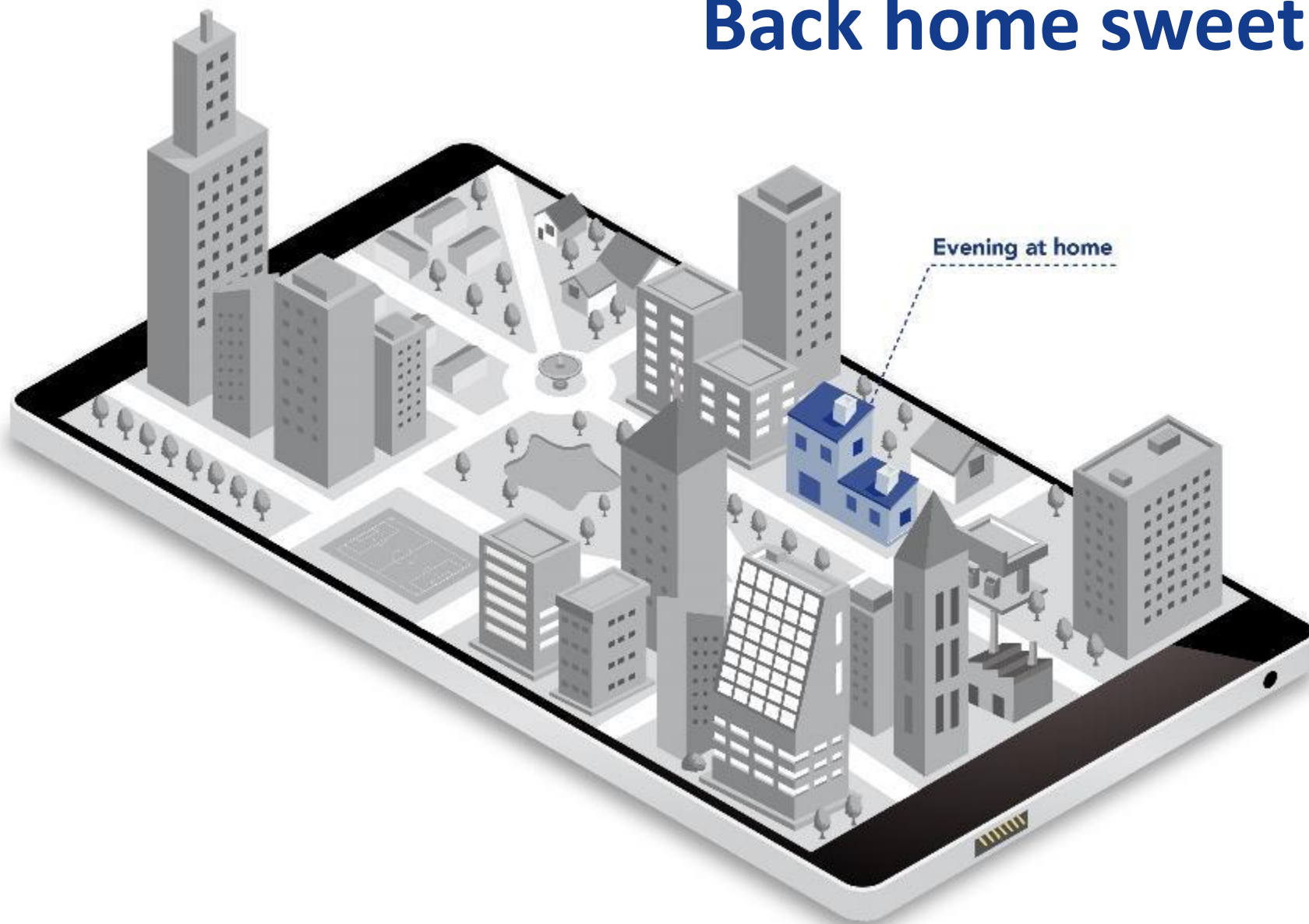
- ▶ 20x faster than BLE or WiFi Pairing when using buttons
- ▶ No need to enter long codes
- ▶ Technology hidden behind human gesture

### NXP NFC solutions

- ▶ NFC connected tag (for fitness tracker): **NTAG I<sup>2</sup>C plus**
- ▶ NFC controllers (for machine): **PN7120/PN7150**



# Back home sweet home





## Magical experiences thanks to NFC



Videogames are much more entertaining...  
than doing homework

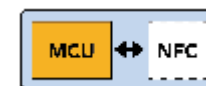
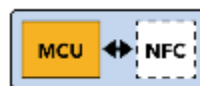
Toys can interact with other toys, video game accessories, bridging physical and virtual worlds

### Benefits

- ▶ Toys keep scores/credentials
- ▶ Physical toys trigger events in virtual world
- ▶ New revenue streams for gaming industry

### NXP NFC solutions

- ▶ NFC connected tags: **NTAG 21x(F)**, **NTAG I<sup>2</sup>C plus**
- ▶ NFC frontend: **MFRC630**
- ▶ NFC controller: **PN7462**







# Commissioning

## Simple interactions with technology thanks to NFC



Connect a new light bulb to your home network



Installing and connecting the new set top box with just a tap

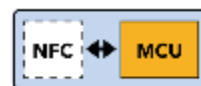
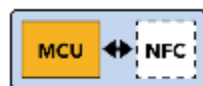
Bring a wireless node securely into a network (IoT)

### Benefits

- ▶ Shorter installation time, reduced customer support
- ▶ Secure credential exchange
- ▶ Covering any smart network protocol (NFC as trigger)
- ▶ No manual entry

### NXP NFC solutions

- ▶ NFC connected tags: **NTAG21x(F)**, **NTAG I<sup>2</sup>C plus**
- ▶ NFC controllers: **PN7120/PN7150**





# Zero-power configuration

## Simple personalization of preferences thanks to NFC



Configure the new set top box with your preferred adjustments, favorite channels, audio selection



Use a phone as external user interface to adjust the configuration to your specific needs.

### Benefits

- ▶ No power required
- ▶ Cost reduction
- ▶ Simplified human interface (no complex user manuals)
- ▶ Recover previous configurations for new devices

### NXP NFC solutions

- ▶ NFC connected tag: **NTAG I<sup>2</sup>C plus**





# Medical device-to-device communication

## Automatized and secured through NFC



Keep control of insulin level and ensure proper dose is given.



Fever tracking through just a tap away

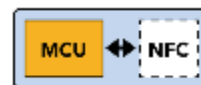
Tap the insulin pump on the glucose meter to set automatically optimum dose, tap the plaster to instantly retrieve the temperature

### Benefits

- ▶ Minimize risk of errors
- ▶ Monitor medication remotely
- ▶ Convenient and time efficient

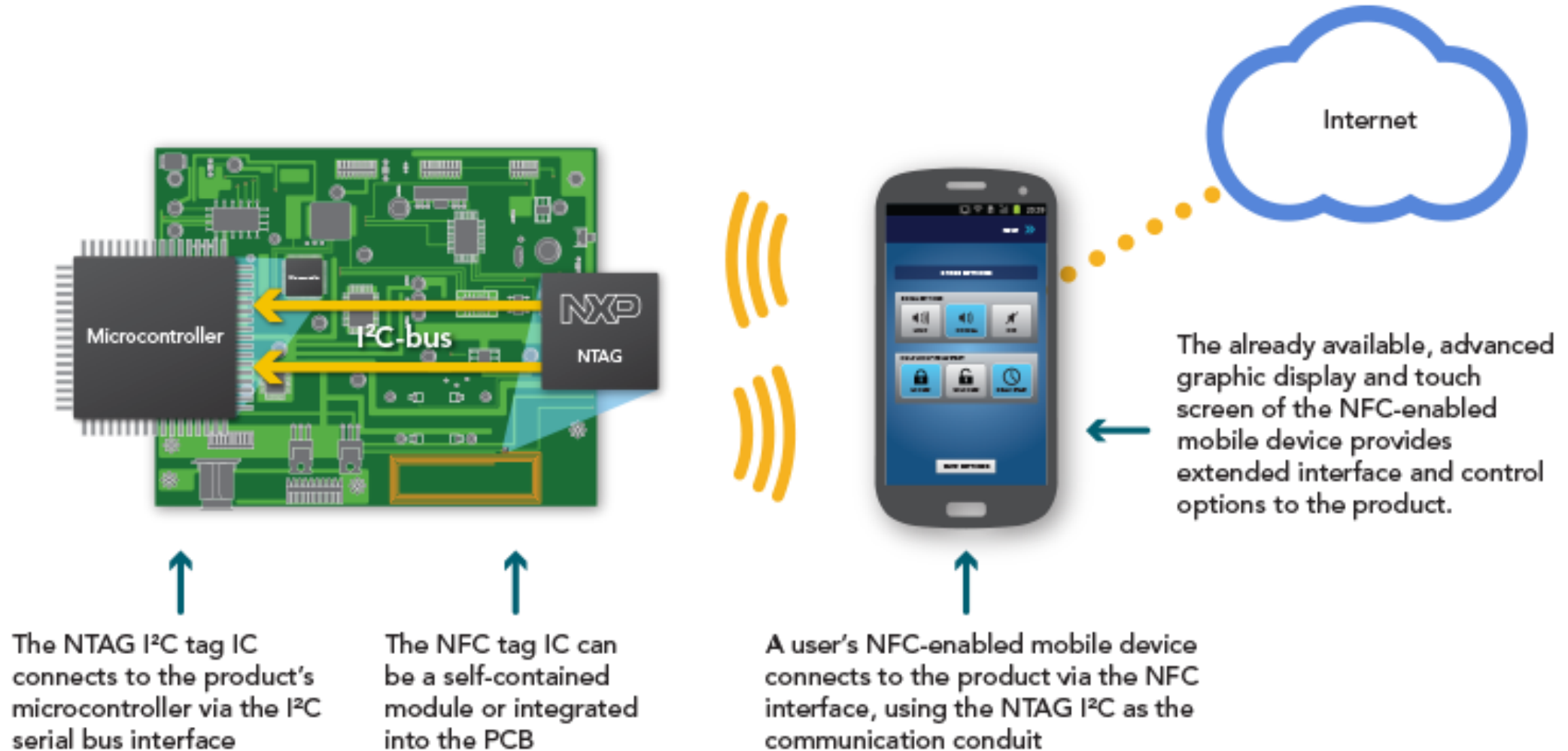
### NXP NFC solutions

- ▶ NFC connected tags: **NTAG21x(F)**, **NTAG I<sup>2</sup>C plus**
- ▶ NFC controllers: **PN7120/PN7150**





# NTAG technology for IOT applications



# NTAG I<sup>2</sup>C|NXP hardware development solution



# BLUETOOTH-ZIGBEE TECHNOLOGY



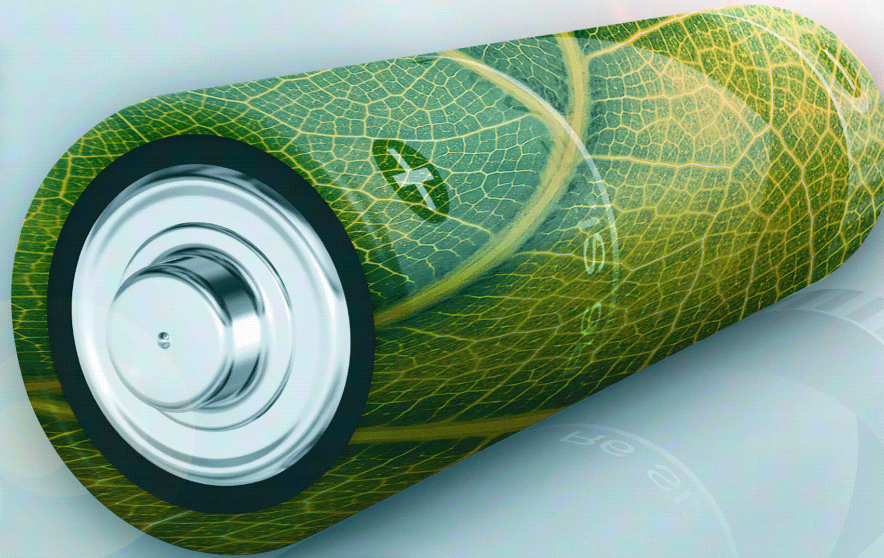
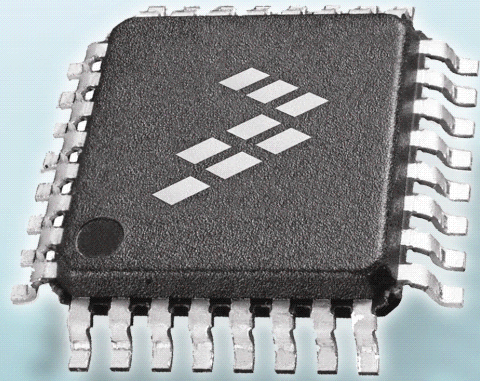
# Freescal<sup>®</sup> Kinetis KW series.

K5x Measurement MCUs & KW: 2.4GHz RF and Bluetooth MCUs.

Standard Key Features Timers, SPI, UART, I2C, GPIO		CPU	Memory	Supported Frequency Band	Supported Protocols					Radio Performance			
			Flash / SRAM		BLE	Thread	ZigBee Pro	802.15.4 MAC	SMAC	Sensitivity	Transmit Power	Receive Current	Transmit Current
<b>KW40Z</b>	Bluetooth <sup>®</sup> Low Energy & IEEE <sup>®</sup> 802.15.4	Cortex-M0+	160 KB / 20 KB	2.4 GHz	✓	✓	✓	✓	✓	-91 dBm (BLE) -102 dBm (802.15.4)	Up to +5 dBm	6.5 mA	8.4 mA
<b>KW30Z</b>	Bluetooth <sup>®</sup> Low Energy	Cortex-M0+	160 KB / 20 KB	2.4 GHz	✓					-91 dBm	Up to +5 dBm	6.5 mA	8.4 mA
<b>KW20Z</b>	IEEE <sup>®</sup> 802.15.4	Cortex-M0+	160 KB / 20 KB	2.4 GHz		✓	✓	✓	✓	-102 dBm	Up to +5 dBm	6.5 mA	8.4 mA
<b>KW2xD</b>	IEEE <sup>®</sup> 802.15.4	Cortex-M4	256–512 KB / 32–64 KB	2.4 GHz		✓	✓	✓	✓	-102 dBm	Up to +8 dBm	19.5 mA	18 mA
<b>KW01Z</b>	Sub-GHz	Cortex-M0+	128 KB / 16 KB	315 MHz, 433 MHz, 470 MHz, 868 MHz, 915 MHz, 928 MHz, and 955 MHz					✓	-120 dBm	Up to +17 dBm	16 mA	16 mA

# NXP® Kinetis CORTEX M0+ MCU.

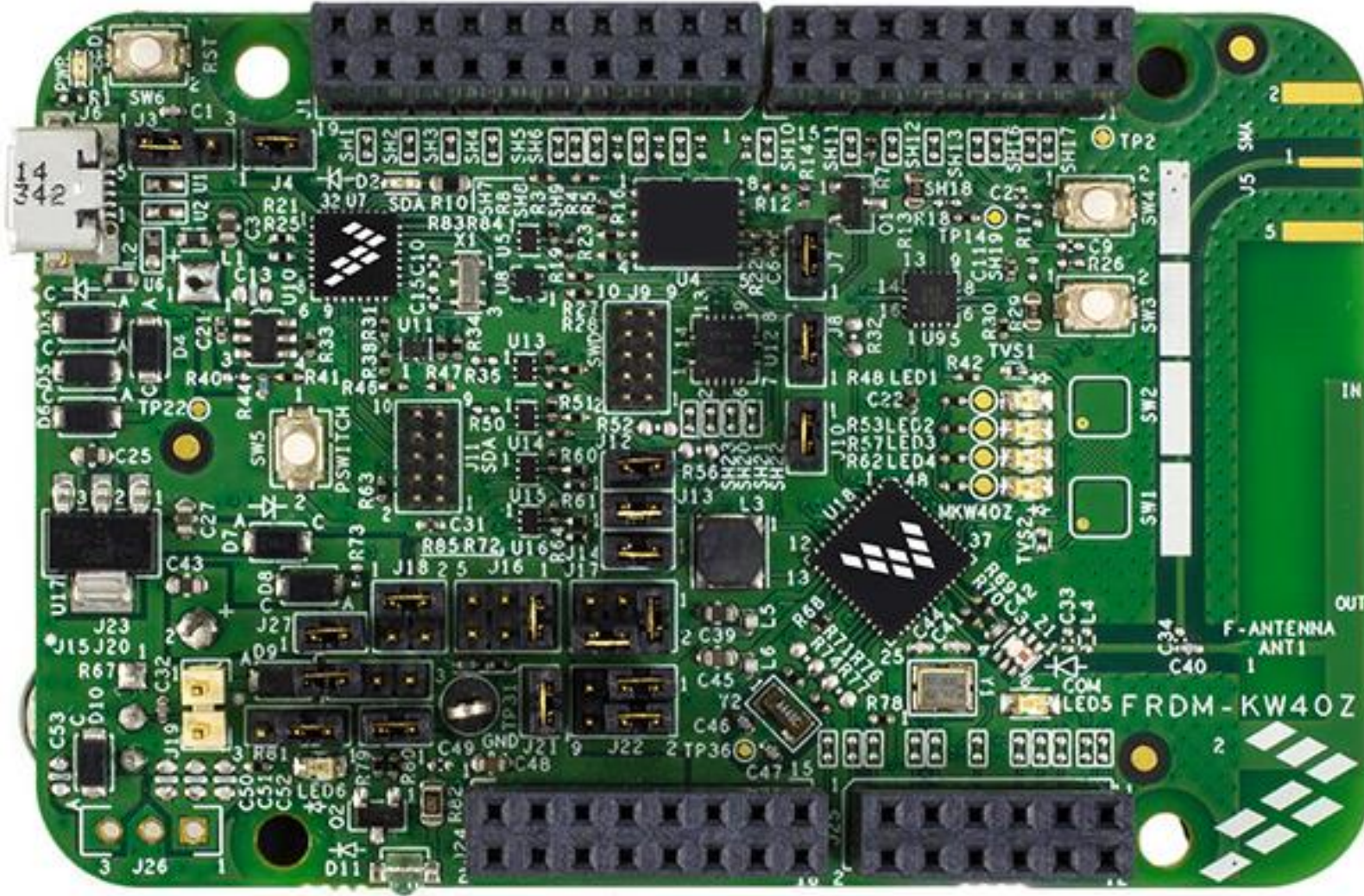
Low Power 32-bit Microcontroller (MCUs) based on ARM® Cortex®-M Cores





# NXP® FRDM-KW40Z.

## Low-cost development platform enabled by the Kinetis W series.







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