NXP Solutions for Smart Mobility

Public

MobileKnowledge
September 2015

Agenda

► Introduction
  - NXP Smart Mobility vision
  - NXP contribution to Smart Mobility

► Short range smart mobility applications
  - Electronic ticketing for transit fare collection
  - Bike / car sharing services
  - Parking payment
  - Multi-application cards for different mobility solutions
  - Card top up via mobile phone
  - NFC mobile ticketing

► Long range smart mobility applications:
  - Electronic toll collection
  - Parking access control
  - Traffic light priority management

Smart mobility is one of the pillars of smart cities

e.g: e-Health, public safety, technology accesibility

Smart Living

ICT

ICT

Smart Environment

e.g: Sustainable buildings, water management

Smart city pillars

ICT

Smart Mobility

e.g: Emission free transport, advanced parking, accesibility

ICT

Smart Society

e.g: Agile civil society, social inclusion, e-learning

e.g: e-Goverment services, open data , transparency, resilience

Smart Goverment

ICT

ICT

Smart Economy

e.g: High-tech industry, innovation culture enterpreneurship

Smart mobility
an easy and convenient way from A to B

▶ Over a lifetime commuters spend an average of 10,634 hours traveling to work*
  - 10,634 is 443 days, 1 year and almost 3 months

▶ Over a lifetime commuters lose 1 week per year in traffic congestion (compared to 1980)

▶ 13% of income spent for transport in Europe (15% USA)**
  - More than half of end users willing to pay *at least 10% more* for technological enhancements ***
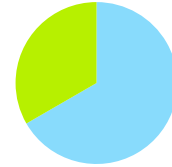
 * Daily Mail
 **Eurostat
 ***2013 Accenture survey

Multi application with single ticketing

► According to APTA 69% of commuters use multiple transportation options to reach a destination

► 3 is the average number of transportation options used on a typical trip

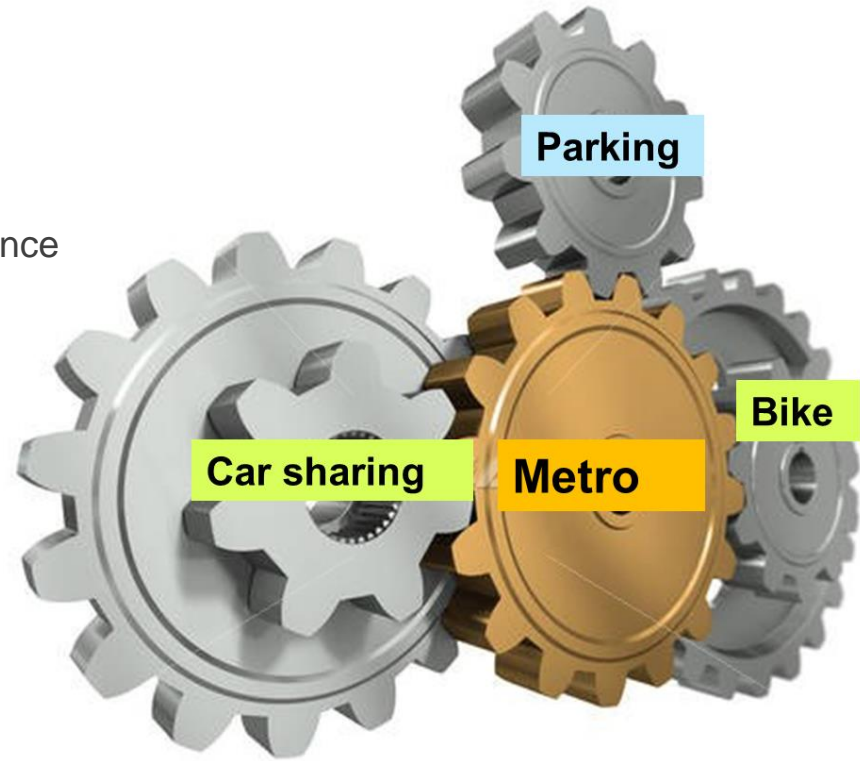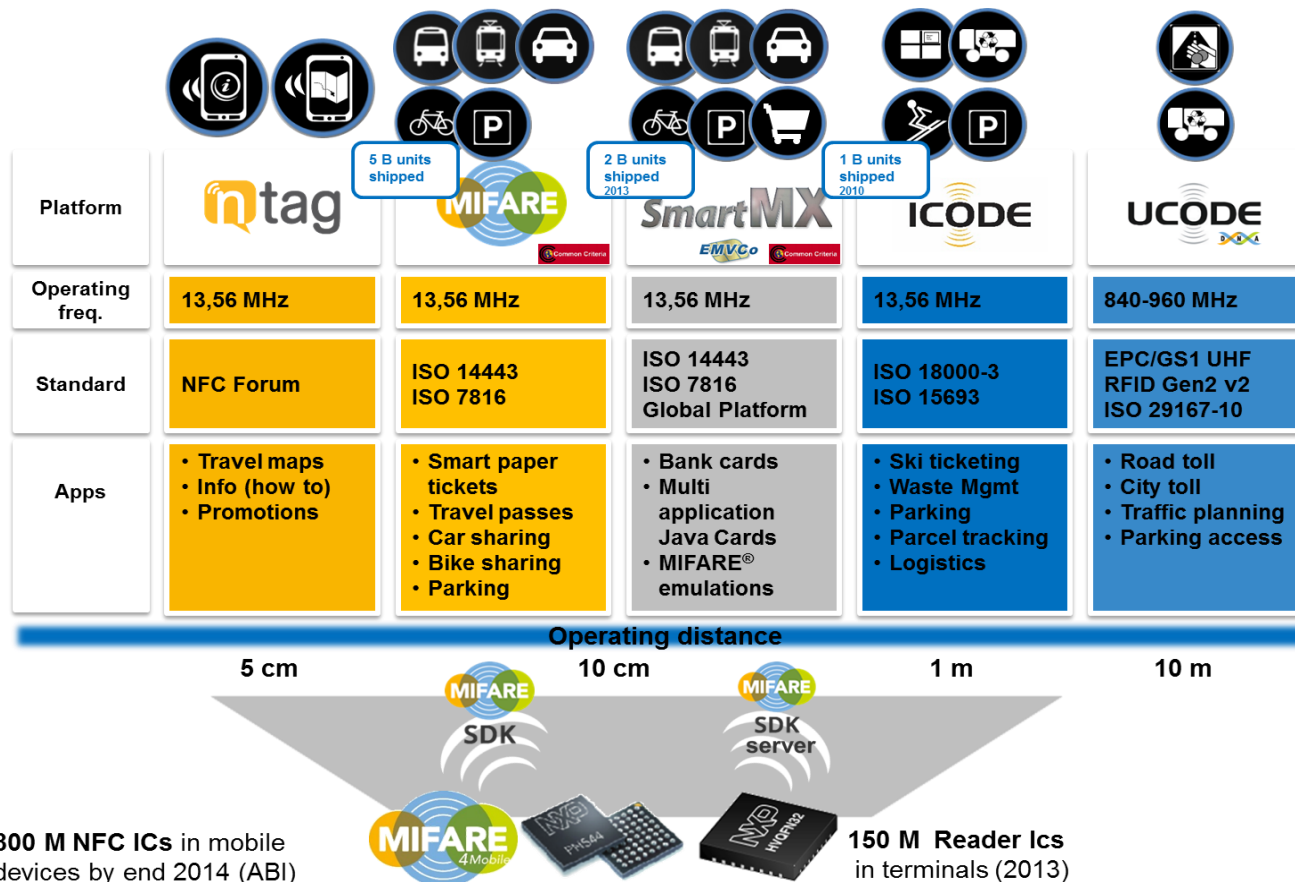► If a single ticket was available, 2/3 would use it daily *

* 2013 Accenture survey

DO THE RIGHT MIX

Why we are looking into shared services
One connected ecosystem

► Leverage existing systems

► Increasing end user convenience

► Driving adoption

Parking

Car sharing   **Metro**   **Bike**

NXP solutions contributing to a smarter mobility

	ntag	MIFARE	SmartMX	ICODE	UCODE
Platform		5 B units shipped	2 B units shipped 2013	1 B units shipped 2010	
Operating freq.	13,56 MHz	13,56 MHz	13,56 MHz	13,56 MHz	840-960 MHz
Standard	NFC Forum	ISO 14443 ISO 7816	ISO 14443 ISO 7816 Global Platform	ISO 18000-3 ISO 15693	EPC/GS1 UHF RFID Gen2 v2 ISO 29167-10
Apps	• Travel maps • Info (how to) • Promotions	• Smart paper tickets • Travel passes • Car sharing • Bike sharing • Parking	• Bank cards • Multi application Java Cards • MIFARE® emulations	• Ski ticketing • Waste Mgmt • Parking • Parcel tracking • Logistics	• Road toll • City toll • Traffic planning • Parking access

Operating distance

5 cm	10 cm	1 m	10 m

MIFARE SDK

MIFARE SDK server

MIFARE 4Mobile — NXP PH544

NXP HVQFN32

800 M NFC ICs in mobile devices by end 2014 (ABI)

150 M Reader Ics in terminals (2013)

NXP — Training Mobile Knowledge

NXP is technology agnostic

► Chose HF for
  - easier interoperability with existing Smart Mobility systems
  - NFC compatibility
  - highest security standards

► Choose UHF for
  - longer read range
  - increased use convenience
  - additional use cases (e.g. tolling, access control)

► In either case, NXP can support you with
  a. the right product portfolio, and with
  b. a wide network of eco-system partners
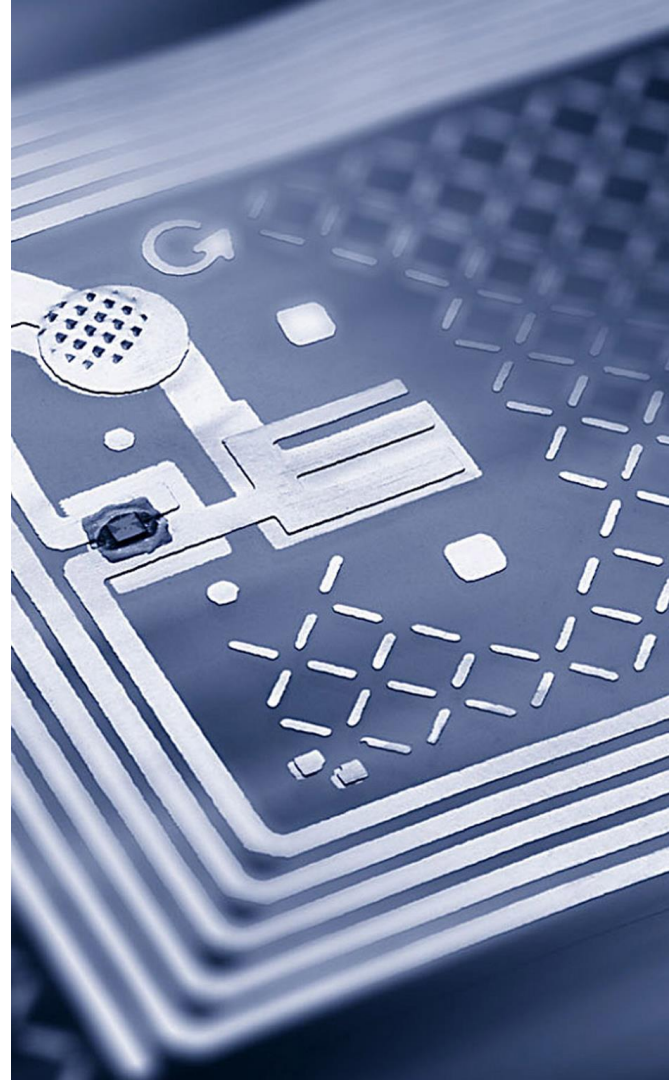
Smart Mobility

Short range applications

Smart Mobility
Short range applications

► Electronic ticketing for transit fare collection

► Bike / car sharing services

► Parking payment

► Multi-application cards for different mobility solutions

► Card top up via mobile phone

► Mobile ticketing

Electronic ticketing for transit fare collection

Contactless smart cards offer the most benefits

Paper tickets

- Low cost of manufacturing
- Interoperable
- Easy for passengers

- Greater transaction time
- Not rechargeable or reusable
- High rate of fare evasion
- Require monitoring

Magnetic stripe tickets

- Low cost of manufacturing

- Low memory capacity
- Susceptible to fraud
- Poor reliability
- Wear out quickly
- High cost of reader maintenance
- Require monitoring

Contactless smart cards

- More reliable, convenient, faster and easier to use
- Low customer service costs
- Reusable and rechargeable
- High memory capacity
- Low rate of fraud and fare evasion
- Protects customer privacy

- Higher implementation costs

Transit fare collection
Contactless smart cards

► Benefits for customers:
  - Convenience of use
  - Convenience of payment
  - Seamless travel
  - Enable aggregated valued-added services (loyalty, access, parking, etc)

► Benefits for operators:
  - Greater passenger throughput
  - Higher fare revenue collection
  - Lower operation and maintenance cost
  - Fraud reduction
  - Reliable ridership and system data

MIFARE DESFire EV1

NXP IC solution for contactless multi-application, high-speed and secure smart cards

Field proven: 14M transactions / day in +60 mega cities

How automatic fare collection works

► The transport operator issues personalized transport cards to customers.
- Personalized cards store unique crypto keys and personal customer data.

► Customer can add/transfer money to the transport card using the vending machines.

► Transport cards are checked at the entrance gates of the transport network and fee is debited.

► Transport cards keep log records of each transaction
- This data can be very useful for transit planners, from the day-to-day operation of the transit system to the strategic long-term planning of the network

Back Office System   **Vending Machines**

Top up

Validation

Transport Operator

MIFARE automatic fare collection success stories

► 1,2 B people rely on NXP's MIFARE products daily in 736 cities in more than 70 countries. Some examples:

Installation	# transactions	Product securing transactions
TFL – London	14 M / day	MIFARE DESFire
Sao Paulo	5 M / day	MIFARE Plus
Delhi Metro	4 M / day	MIFARE DESFire
Troika – Moscow	3,5 M / day	MIFARE Plus
Touch & Go – Kuala Lumpur	3 M / day	MIFARE Plus
NOL – Dubai	1,5 M / day	MIFARE DESFire
Myki – Melbourne	1 M / day	MIFARE DESFire
Clipper – San Francisco	0,7 M / day	MIFARE DESFire
Rabbit – Bangkok	0,6 M / day	MIFARE DESFire
Tap – Los Angeles	0,5 M / day	MIFARE Plus

250M transactions / day. Based on an average $2 fare, this would be equivalent to $500M / day

Vehicle Sharing services
Bicycle and car rental services

The real costs of car ownership

► Owning a car is getting more and more expensive:
- Gassing up the car
- Insurance
- Registration costs
- Vehicle payments
- Other expenses such as renting a parking space

► Owning a vehicle in the city contributes to:
- Polluted cities
- Congestion and traffic jams

Solution:

► Sharing services are cheaper and also more practical than owning an automobile.
- Car sharing
- Bike sharing

Vehicle sharing services growing quickly

► Sharing services offer an ideal complement to public transport services.

► **Carsharing**
- Growing 30% per year until 2020
- **15 mn** carsharing members **in EU by 2020***
- **32 mn** subscriptions **worldwide** expected **by 2020***
- 500 thousand vehicles by 2020*

► **Bikesharing**
- Growing 20% per year until 2020
- Almost 500k bikes in Asia - 10 countries – 108 systems
- 150k in Europe – 472 systems in 31 countries
- 10 k in South America - 18 systems in 5 countries

Map showing bikesharing systems in planning: www.bikesharingworld.com

*Frost & Sullivan

How car-sharing works

► Car sharing refers to companies that maintain a fleet of vehicles in a network of locations.

► Vehicles can be accessed by people on an as-needed basis (hourly / mileage rate)

► In most setups, you apply online to become a member and receive a preconfigured smartcard that lets you unlock any cars you reserve.

► Different ways to unlock the car:
  ▪ Car is unlocked when the member card is presented to the card reader behind the windshield. Then, type in pin in onboard unit
  ▪ Member card + PIN opens keysafe, key for reserved car is released, car unlocked via key, key fob read by boardcomputer pin code entry required (stadtmobil, autolib)

Reservation → **Key Lock Box** → **Get The Key** → **Drive!**

MIFARE delivers the right level of security to protect sensitive data and also offers the broadest compatibility with existing infrastructure

How bike-sharing works

- ► Bike sharing service operator issues personalized smart cards to subscribed members.
  - ▪ Personalized cards store unique crypto keys and personal customer data.
- ► Tapping the cards against the bicycle docking station reader, unlocks the bike from its storage rack and gets access to bicycles for short trips.
  - ▪ Automatization of check-in and check-out at bicycle docking stations

- ► It is recommended to implement an application and certain data structure for credential validations
  - ▪ The use of the card UID as credential is not recommended since card UID can be cloned.
  - ▪ An application note with a recommended data model will be available soon

MIFARE delivers the right level of security to protect sensitive data and also offers the broadest compatibility with existing infrastructure

Vehicle sharing services
Success stories

Car sharing, Car2GO

- Operating in 25 cities in Europe and USA
  - > 500k registered users
  - > 9000 cars (incl. 1100 e-cars)
- **How it works:**
  - User has to register, then go to office showing ID picking up card (MIFARE DESFIre).
  - Card reader behind the windshield
  - Opening with card, type in pin in board computer, key is next to board computer
  - Cars can be picked up anywhere and left anywhere

Hangzhou Public Bike, China

- A fleet of more than 66,000 bikes (plans to reach 175,000 over the next six years
- 2700 bike share stations
- Bikes are free to use for the first hour. Users pay for more than one hour use.
- Hangzhou bike sharing uses the concept of the last mile:
  - To make sure users can easily get from public transport stops to their destination by bikes

Parking payment

Parking payment

▶ Parking payment machines usability is poor
- Users often struggle to pay for parking

▶ Users need to carry coins for parking payment.

▶ Cash-heavy businesses are more vulnerable to errors made while handling cash

▶ **Solution**:
- Cash-free parking payment using a smartcard

▶ **Benefits**:
- Better customer services and convenience
- Increased revenues
- Increase operations
- Increase efficiency of payments
- Possibility to combine with other transport ticketing applications

How it works: *Perth's SmartRider*

- Park your vehicle in an available bay and go to the SmartParker machine located near the station entrance.
- Press the green button and wait for the beep. The screen will say, "Please present your card".
- Hold your SmartRider to the processor (indicated by the SmartRider tag on icon) and wait for the confirmation beep and for the screen to say, "Payment OK".

Multi-application cards for different mobility solutions

Mobility today
One card, one service

1. Leaving from home
2. Using private car
3. Park your car
4. Changing to public mass transit
5. Changing to public bike service for last mile distance
6. …

A different ticket for different services!
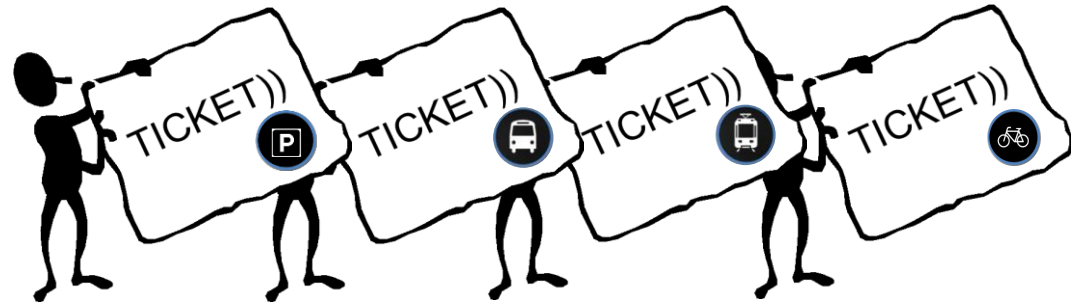
Mobility tomorrow
Different mobility applications integrated into one multi-application smart card

► Simplifies cash management

► Increases customer satisfaction

► Improves throughput by reducing boarding time

► Reduces fare evasion

► Allows implementation of creative and flexible fare policies

► Generates ridership data for planning and schedules

Car sharing

Bike

Parking

Metro
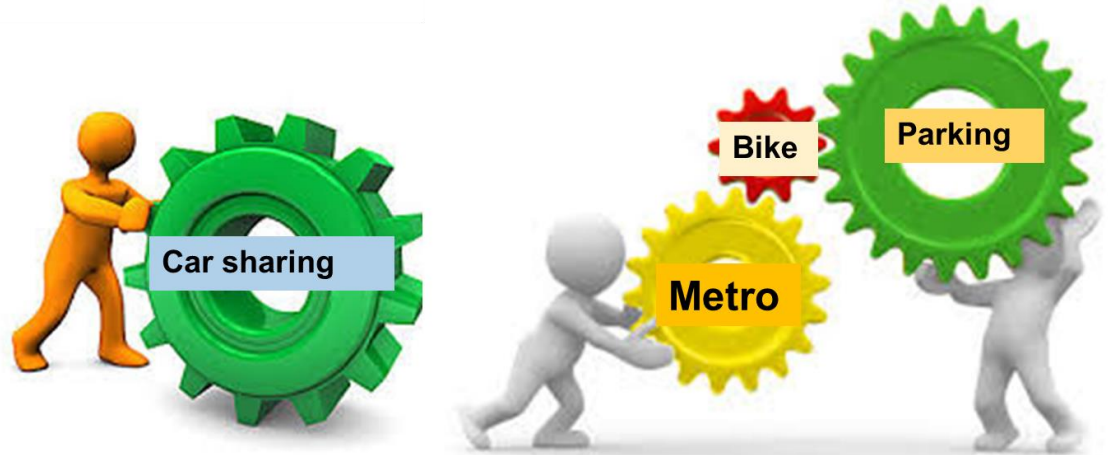
Using **MIFARE**, different mobility applications can easily be integrated in one multi-application smartcard

Smart mobility with MIFARE
Example success stories

Ljubljana, URBANA single city card

- Quick and convenient payment for rides on:
  - Ljubljana city buses
  - Cable-car ride to the Ljubljana castle
  - Parking fees for white zones
  - Bike rental
  - Other public services in municipality of Ljubljana (city library)

Dubai, NOL card

- Quick and convenient payment for rides on:
  - Dubai buses
  - Dubai metro
  - Dubai Waterbus
  - Roads and Transport Authority (RTA) paid parking
  - Taxi

Card top up via mobile phone

Card top up via mobile phone

Top up the transport card:

► User has to go to PTO counter

► Limited user convenience

► People want to top up easily and where and when they want

Solution:

► MIFARE SDK enables app development so that users can interact with their cards directly from their mobile phones
  ▪ E.g.: Reload tickets, view transaction history, schedule information, etc

Unsecure environment

DESFire.authenticate(pw);
DESFire.write(data);
DESFire.read();

E2E Secure connection

Backend
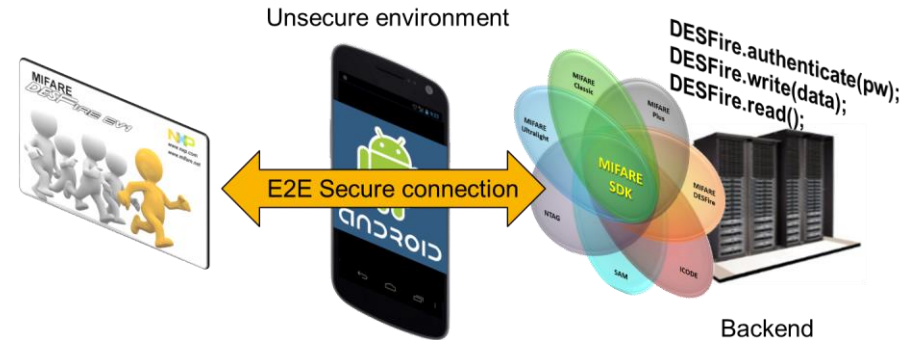
MIFARE SDK
Overview

▶ The MIFARE SDK is a software that allows developers to create contactless applications based on MIFARE, ICODE and NTAG products on any NFC-enabled devices

Advantages:

▶ Developers are able to benefit from an enormous reduction in development time.

▶ Get rid of "complicated" datasheets and application notes
   ▪ Full command set support on Java level

▶ Leverage the worldwide success of NXP's product installations.

▶ Comprehensive documentation with User Manual and Javadoc documentation

▶ Source code examples to get familiar with the technology as fast as possible

http://www.mifare.net/en/home/
http://www.mifare.net/en/products/mifare-sdk/
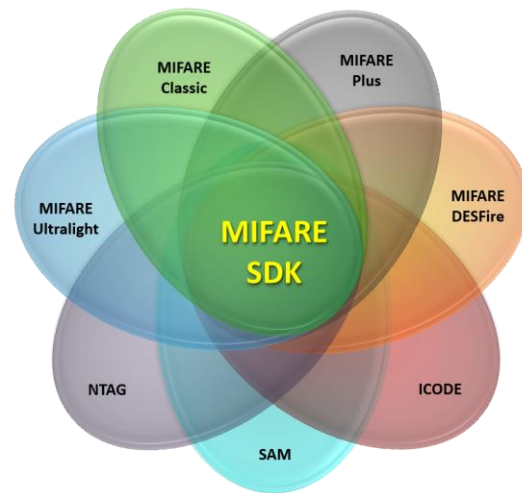
NFC mobile ticketing

Mobile ticketing
Use your phone as a card

► NFC technology in smartphones is becoming a commodity
  ▪ The number of NFC devices in use will exceed 1.6 billion in 2016, according to a report by ABI Research.

► MIFARE is the most widely adopted technology in public transportation and ticketing schemes.
  ▪ 1.2 billion people go to work and return home every day with contactless ticketing using our MIFARE technology (736 cities).

► How to bring MIFARE services to our mobile phones?

Solution: *MIFARE4Mobile* offers the possibility to have multiple virtual cards on a secure element of NFC-enabled mobile devices.
  ▪ Virtual cards can be used like their existing physical counterparts.
  ▪ Handling virtual cards in the mobile wallet is much more convenient and flexible.
  ▪ Des not involve any cost for service integrator
  ▪ Ability to integrate with real-time passenger information system, onboard Wi-Fi and other services

MIFARE4Mobile
Overview
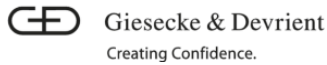
► MIFARE4Mobile is a technology used to manage MIFARE-based services in NFC mobile devices, from over-the-air installation to end-user interaction via the user interface of the mobile phone.

► MIFARE4Mobile ensures interoperability among different Secure Element form factors (embedded SE, UICC SIM and micro SD) and different vendors.

► MIFARE4Mobile provides the most flexible and scalable platform for transit agencies to make use of their existing infrastructure.

► GlobalPlatform will enable MIFARE4Mobile to co-exist with other applications such as mobile payments

► 2014: MIFARE4Mobile V2.1.1 published

http://mifare4mobile.org
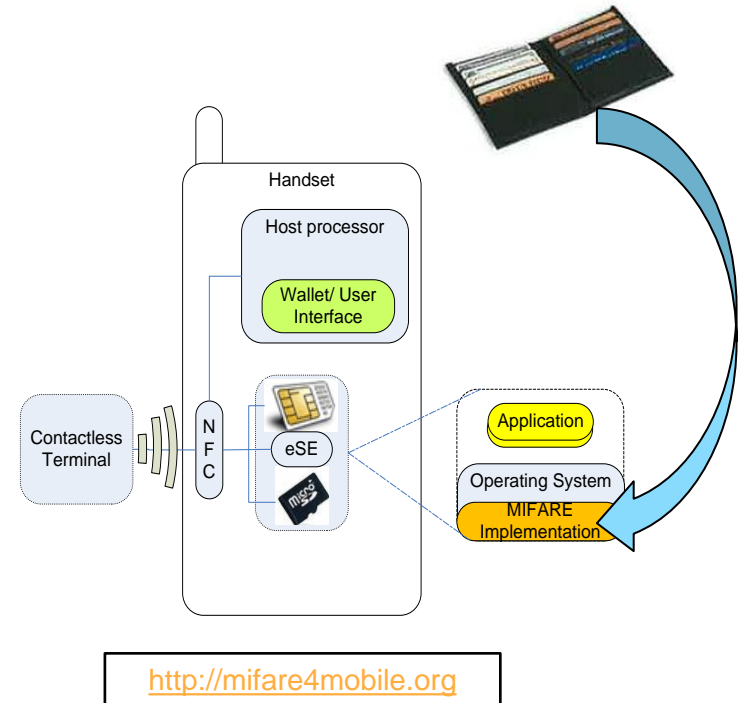
NFC mobile ticketing MIFARE commercial roll outs

NXP solutions for short range mobility applications

NXP solutions for short range mobility applications

MIFARE DESFire EV1

►Flexible file structure for multiple applications

►2kB, 4kB and 8kB EEPROM memory

►Supports DES, 2KTDES, 3KTDES and AES cryptographic algorithms

►Hardware and software common Criteria EAL 4+ certified

MIFARE Plus

►100% backwards compatible with MIFARE Classic

►2kB and 4kB EEPROM memory

►Crypto1 and AES cryptographic algorithms

►Hardware and software common Criteria EAL 4+ certified

MIFARE4Mobile v2.1

►Specification for the remote management of MIFARE virtual cards and applications in the secure element

►MIFARE DESFire EV1 and MIFARE Classic cards

MIFARE SDK

►Software development tool that lets developers create contactless applications for the complete portfolio of MIFARE, NTAG and ICODE products on any NFC-enabled devices.

Smart Mobility

Long range applications

Automatic Vehicle Identification systems
Contribution to Smart Mobility

► **Convenience**
- Long range RFID enables vehicles to gain access to restricted areas the easy way

► **Security**
- Avoid manual checking authorizations and inconsistent credential validation. Deployment of security policies such as time schedules and conditional authorizations for vehicles

► **Traffic flow in green environment**
- Contribute to greener cities by reducing congestion, lines and ensure speedy flow of traffic.

► **Fleet management**
- Vehicles can be tracked as part of logistics or production processes while keeping privacy safe.

Automatic Vehicle Identification systems
Toll collection

► Toll collection in motorways is still a manual process in many countries:

- Reduced revenue due to high human resources cost
- Increase congestion and pollution during peak hours or busy road conditions

► **Solution**:

- Electronic toll collection using an RFID system

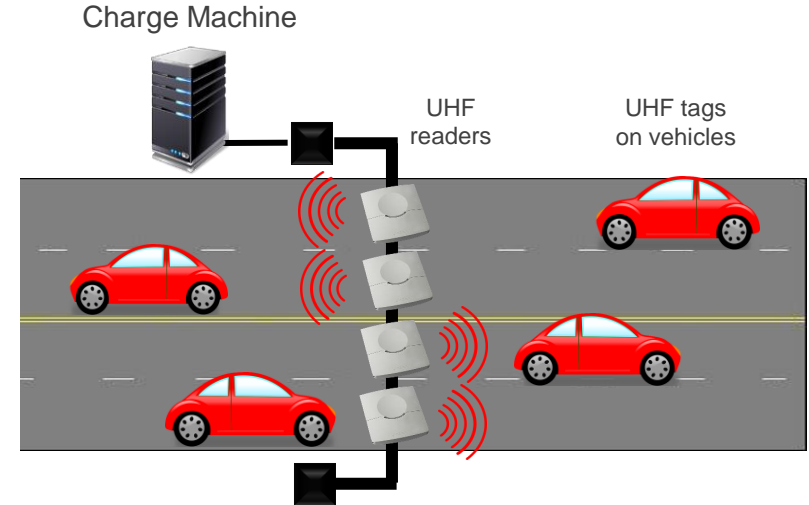**UCODE DNA** combines exceptional **long-range** with a **cutting edge cryptography** security implementation for tag authentication
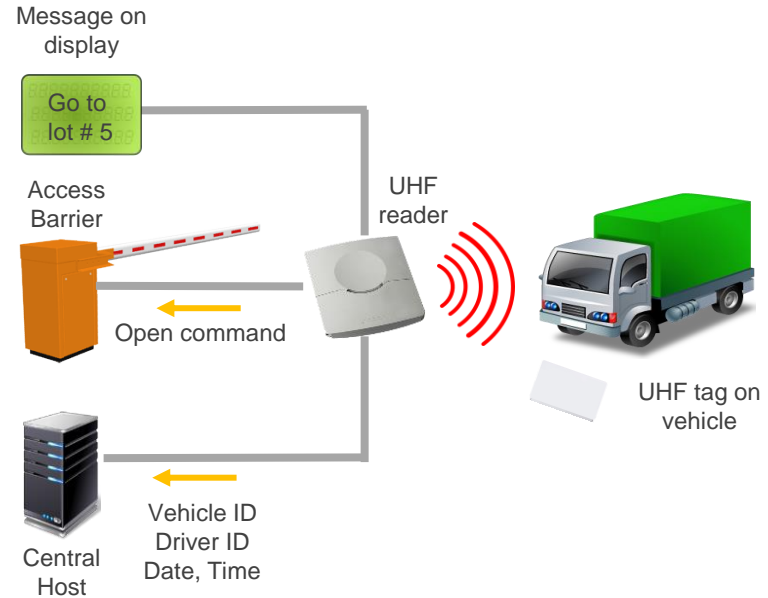
Charge Machine

UHF readers

UHF tags on vehicles

Fig. The UHF readers uniquely identify each vehicle (without stopping it) and charges the total amount directly to the driver's bank account.

Automatic Vehicle Identification systems
Parking access control and guided messages

► Operating big and busy parking lots can pose significant challenges
  - The parking area has to be secure, with barrier-enforced entrances and exits.

► Monitoring and accurate vehicle tracking and identification does not scale:
  - Need to hire some parking lot attendants
  - Slow and cumbersome process.

► **Solution**:
  - Access barrier control using an RFID systems

UCODE DNA combines exceptional **long-range** with a **cutting edge cryptography** security implementation for tag authentication

Message on display

Go to lot # 5

Access Barrier

UHF reader

Open command

UHF tag on vehicle

Central Host

Vehicle ID
Driver ID
Date, Time

Fig. When an authorized Tag is detected: Gate is immediately open, guided message for the best parking management and data collection with vehicle ID and entrance / exit time.

NXP Training Mobile Knowledge

Automatic Vehicle Identification systems
Traffic light priority management

► Traffic management has become a severe problem due to urban growth.
  ▪ Traffic jams, accidents, traffic law violation

► Priority services are affected by traffic congestion:
  ▪ Emergency vehicles (ambulances, fire trucks) get stuck at traffic lights and waste their valuable time.
  ▪ Buses decrease in speed and an increase in bus travel time variability and service irregularity.

► **Solution**:
  ▪ Traffic light control can be improved with RFID systems

Traffic light ECU

Reader

Vehicle ID

Tag on vehicle
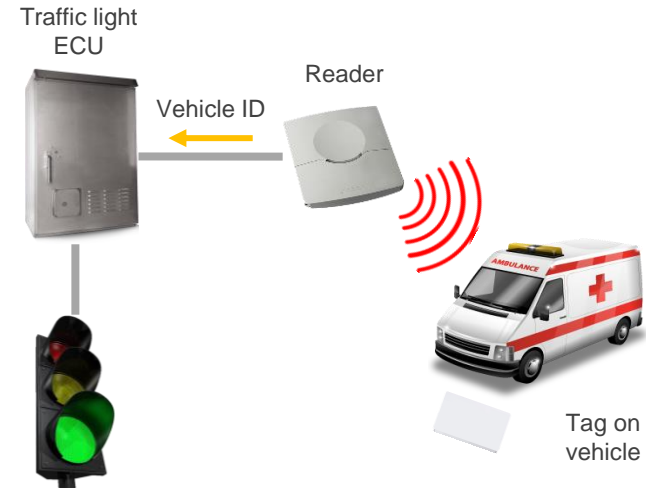
Fig. When an authorized Tag is detected, the reader sends the enable message to the traffic light management electronic control unit (ECU) to send the priority request

Automatic Vehicle Identification systems
Success stories

RFID windshield labels, Peru

- NXP partner Tönnjes delivered more than 2 million RFID-based windshield labels
- Use cases:
  - During vehicle registration, vehicle receives the label to reduce misuse of vehicles and license plates.
  - Labels are automatically destroyed when removed.
  - Ideal for vehicle registration certificate

IDeSTIX®

Parking facilities, Munich Airport

- Parking facilities are equipped with long range RFID (UHF) infrastructure for AVI based on NXP tag ICs
- Use case:
  - Quick and reliable detection of vehicles in the parking area

GreenTag, China

- 2 million NXP chips have been used for vehicle tagging in China (Beijing) for several years
- Use case:
  - Pollution in the city is monitored. When the pollution level is high, only tagged vehicles are allowed to enter certain city zones

UCODE DNA solution for long range mobility applications

NXP solutions for long range mobility applications

world-leading
long range
contactless performance

cutting-edge
security implementation
for tag authentication

UCODE DNA

All based on international standards

* GS1 (EPCglobal™ Inc.) UHF RFID Generation-2 Version 2.0

** ISO/IEC 29167-10 for proof of origin based on AES (Advanced Encryption Standard)

Multiple ways passive secure RFID can be attached to the vehicle

► eLicense Plates

- integrated RFID tag
- entire metal plate serves as the antenna → better read range and more reliable
- possibility to combine optical and RF identification
- drawback: potential removal from one vehicle to another

► Windshield Stickers

- integrated RFID inlay
- less removal risk since it is inside the vehicle
- self destruction if removal is attempted
- drawback: lower RF performance due to smaller antenna size

For maximum protection and best read reliability, use of license plates in combination with windshield stickers is recommended.

Wrap up

Conclusion

► Growing **cities face challenges** concerning traffic, space and pollution

► NXP is developing **contactless solutions** matching the **needs of service providers** to enable convenient, secure and affordable **mobility services**, resulting in increased ridership and hence, **greener cities**.

Major Markets	Mass transit	Individual	Tracking & Planning	Tolls
	▶ Underground, Buses, Boat, Tram ▶ Airlines ▶ Railways	▶ Car sharing ▶ Bike sharing ▶ Skiing	▶ Traffic flow ▶ Capacity planning ▶ Waste Management	▶ Highways ▶ Cities

Solution offering		
Secure, fast and convenient boarding	▶ fastest transaction times at lowest maintenance costs ▶ Security protecting assets, privacy	
Multi-application partnerships	▶ Convergence of mobility services with banking, governmental applications and NFC mobiles	
Shaping mobility behavior	▶ Incentive program on lowest emission footprint ▶ Building a emission credits system across all modes	

Product offering	UCODE	ntag	MIFARE	iCODE	SmartMX

Mobile**Knowledge**
Thank you for your attention

► 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.

For more information

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NXP Solutions for Smart Mobility

Jordi Jofre (Speaker) / Eric Leroux (Host)

Thank you for your kind attention!

► 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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www.themobileknowledge.com/content/knowledge-catalog-0