Secure Connectivity based Cyber Physical Systems towards Automated Driving
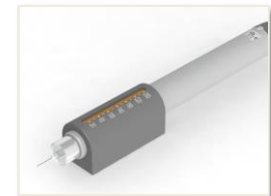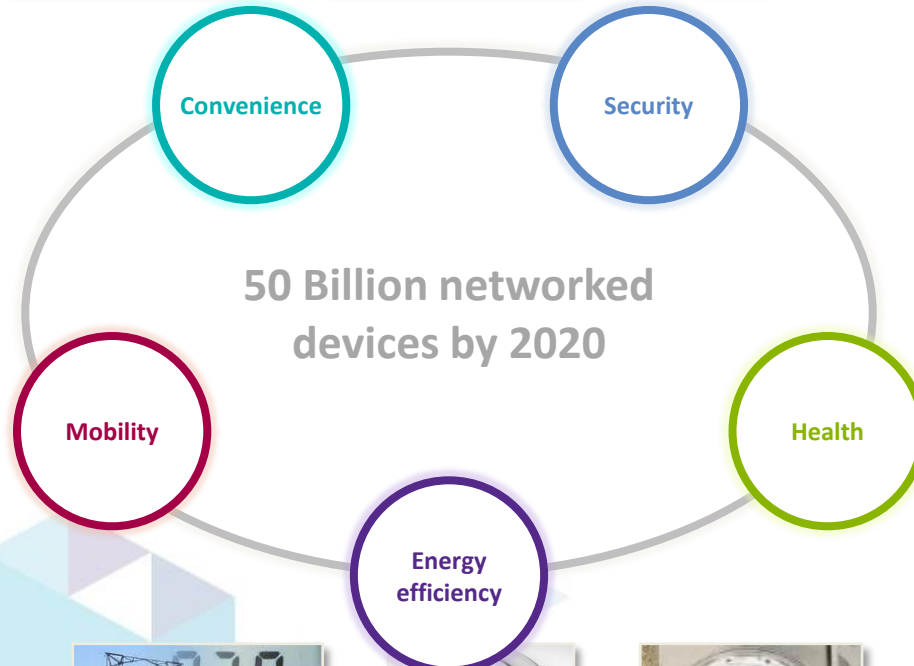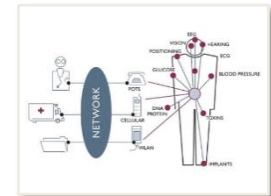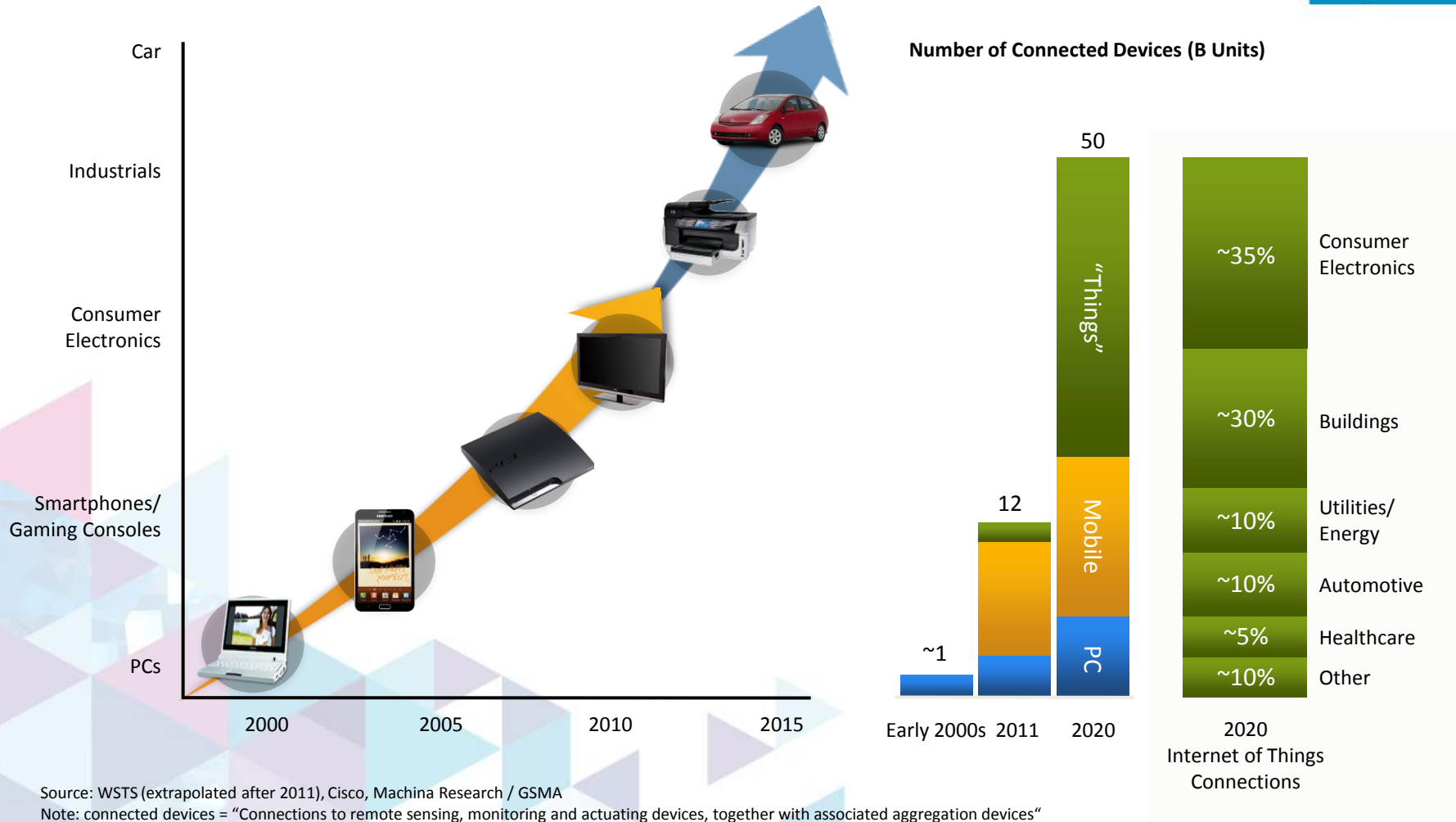
March 2015, Patrick Pype

Hyper connectivity changing our world

Convenience

Security

Mobility

Health

Energy efficiency

50 Billion networked devices by 2020

The internet of things – the next big wave

Number of Connected Devices (B Units)

- Consumer Electronics
- Smartphones/ Gaming Consoles
- PCs

Car
Industrials
Consumer Electronics
Smartphones/ Gaming Consoles
PCs

2000   2005   2010   2015

50

"Things"

Mobile

PC

12

~1

Early 2000s   2011   2020

2020 Internet of Things Connections	
~35%	Consumer Electronics
~30%	Buildings
~10%	Utilities/ Energy
~10%	Automotive
~5%	Healthcare
~10%	Other

Source: WSTS (extrapolated after 2011), Cisco, Machina Research / GSMA
Note: connected devices = "Connections to remote sensing, monitoring and actuating devices, together with associated aggregation devices"

Beckstrom's* Laws of Cyber Security

1. **Everything that is connected to the Internet can be hacked**

2. **Everything is being connected to the Internet**

3. **Everything else follows from the first two laws**

A fridge full of spam: Hacked domestic appliances send a torrent of junk email
Monday 20 Jan 2014 10:24 pm

FRIDAY | 23 MARCH 2012 | Sci/Tech

Millions of Barclays card users exposed to fraud

STUXNET Virus

IDENTITY THEFT
Yes, it could happen to you.

TARGET HACKED
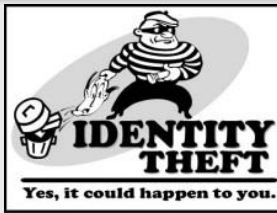
14 May 2013, 14:50 « previous | next »

Skype with care – Microsoft is reading everything you write

September 23, 2010 7:39 pm

Stuxnet worm causes worldwide alarm
By Joseph Menn and Mary Watkins

BANKING
Global Network of Hackers Steal $45 Million From ATMs
By AP / Colleen Long | May 09, 2013 | 3 Comments

December 5, 2012 1:01 pm

Hackers net €36m in Europe banking attack
By Bede McCarthy in London
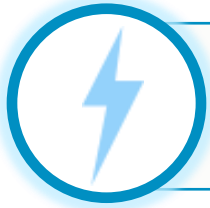
DigiNotar Hacked Out Of Business
Kelly Jackson Higgins
See more from Kelly   Connect directly with Kelly: Bio | Contact

*Rod Beckstrom, CEO and President of ICANN, former Director of the National Cyber Security Center

4

Mega Trends Shaping the Auto Industry

Energy Efficiency

- Government regulations
- Electrification of drive train
- Replacement of mechanics by smart electronics

Advanced Safety & Traffic Management

… towards Autonomous Driving

- Driver Assistance Systems
- Sensor Fusion
- Smart Actuators

Connected Devices

- Intelligent traffic management
- Safety & Remote Car Mgmt.
- Entertainment & convenience

Security

- Protection against hacking
- Theft prevention
- Detection of counterfeit parts

Safety

- Active accident prevention
- Rapid help in case of emergency
- Reliable wireless communication

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5

Connected cars –
Enablers for automated driving

Cars will be big part of the "50 Billion connected devices by 2020"

Connected Devices
we expect in 2020 & their estimated values

	Billion $
Connected Car	600
Pay-As-You-Drive Car Insurance	245
New Biz. Models for Car Usage	225
Traffic Management	100
Electric Vehicle Charging	75

Source: PC Today, April 2012

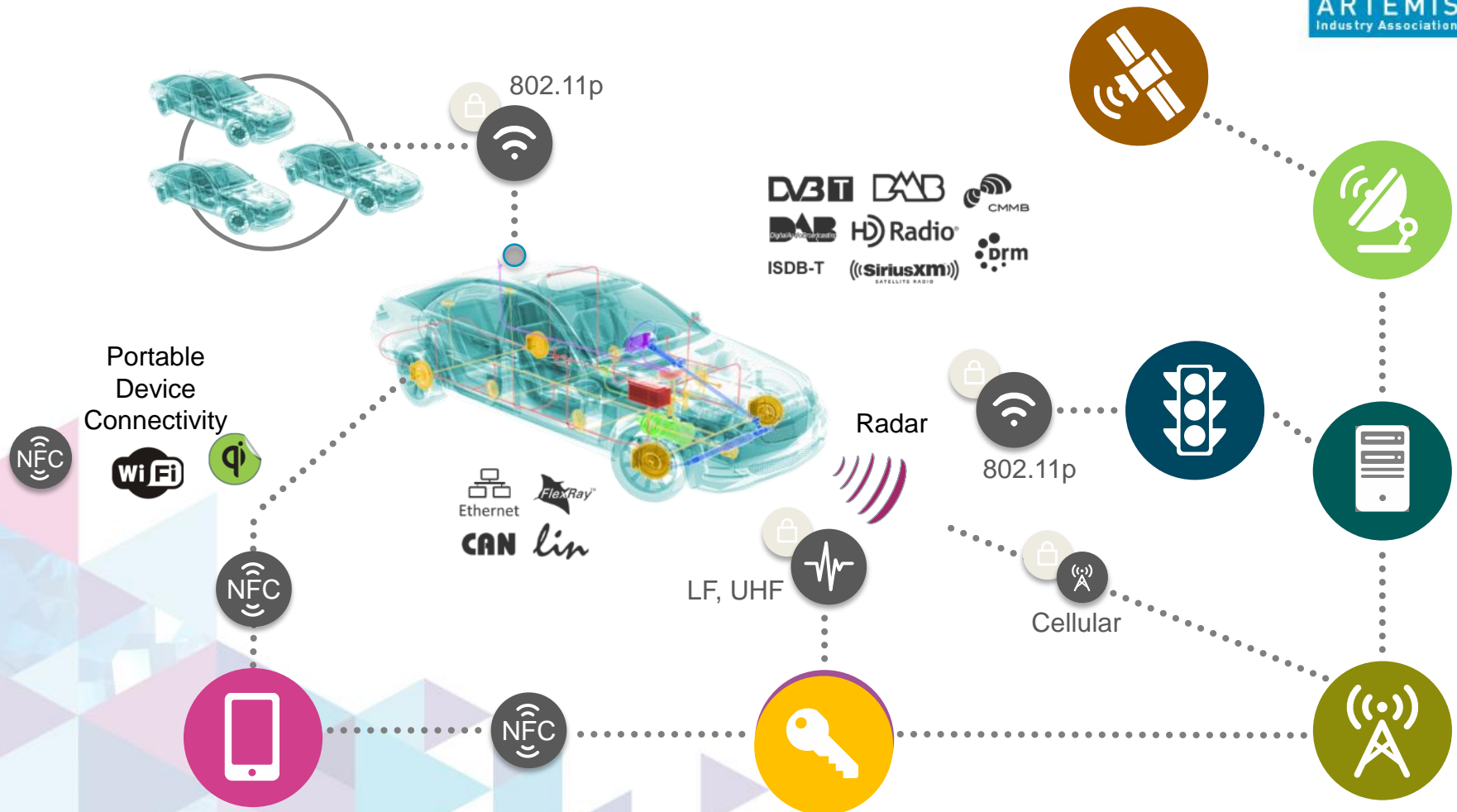55% (B$1,3) of connected devices market in 2020 is car-related

Driver assistant systems will be in "50% of the new cars by 2020"

Penetration of
Advanced Driver Assistant Systems (ADAS)
in new cars will grow from 6% today to 50+% in 2020
(CAGR >30%)

2005	Assisted driving (ADAS)
2015	Auto Pilot (@ limited conditions)
2025	Autonomous Driving

Source: Barclays – The Connected Car Report, April 2013

Connected Mobility

… enables communication between cars, people, infrastructure, inside the car

802.11p

DVBT DAB CMMB
DAB HD Radio DRM
ISDB-T ((SiriusXM))

Portable
Device
Connectivity

NFC WiFi Qi

Radar

802.11p

Ethernet FlexRay
CAN lin

LF, UHF

Cellular

NFC

NFC

ARTEMIS
Industry Association

Cars need to sense, think and act better than humans can

New entrants eyeing to earn revenue from big data (self driving cars generate up to 1GB per minute) and offering value add services (e.g., Pay As You Drive)

Source: Continental

ADAS towards Self-driving
The race towards fully automated cars in '20-'25

Evolution (Conti ➔#1 Auto T1 player)

Revolution (Google ➔ #1 Internet)

Evolution from **Active Safety** to **Advanced Driver Assistance Systems** to **Highly Automated by 2020** and **Fully Automated Cars by 2025**

Developing **Fully Automated** cars from the start, targeting 2020 introduction

ADAS is getting momentum in the news and stock market

Source: Continental and Google

Autonomous Driving enabled by complementary systems:
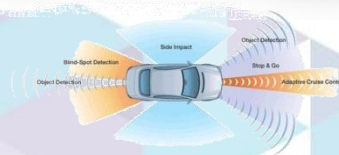## C2X + Radar + Camera

C2X
- Fast communication & cooperation (platoon)
- No vision necessary - Look around corners
- Long range – up to 2km
- 360° view
- Only works in connected infrastructure

Like Elephants in a platoon

Camera
- Visionary identification of objects (e.g. people, cars, buildings etc.)
- Safety warnings
- Autarkic

Radar
- Object detection to adjust speed/steering to situation
- Vision to objects needed
- Autarkic

C2X valued in 1.65 Mio km of driving

- 500 participants joined
  - 41000 hours of testing
  - 1,650,000 KMs of driving
  - 30 Terabyte of data
- Highest-rated functions:
  - traffic jam end warning
  - Signal phase and time of traffic light
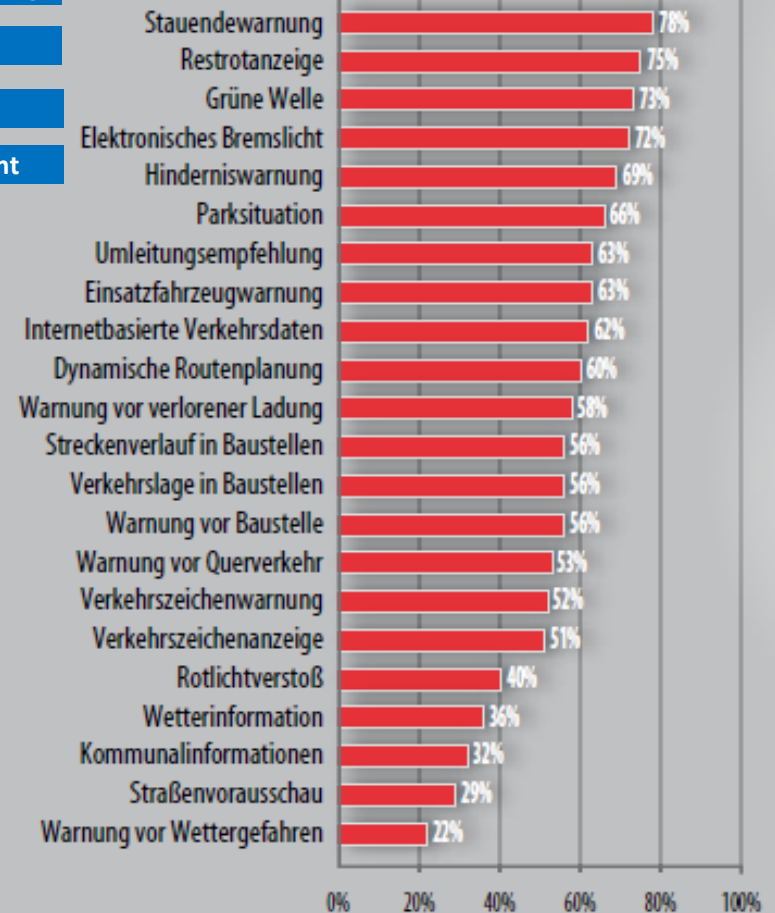 - Emergency Brake light
  - ….

Question: what function would you like to have in your car?

Traffic Jam Ahead warning

Time-to-Green

Green-wave

Emergency Brake Light

Function	%
Stauendewarnung	78%
Restrotanzeige	75%
Grüne Welle	73%
Elektronisches Bremslicht	72%
Hinderniswarnung	69%
Parksituation	66%
Umleitungsempfehlung	63%
Einsatzfahrzeugwarnung	63%
Internetbasierte Verkehrsdaten	62%
Dynamische Routenplanung	60%
Warnung vor verlorener Ladung	58%
Streckenverlauf in Baustellen	56%
Verkehrslage in Baustellen	56%
Warnung vor Baustelle	56%
Warnung vor Querverkehr	53%
Verkehrszeichenwarnung	52%
Verkehrszeichenanzeige	51%
Rotlichtverstoß	40%
Wetterinformation	36%
Kommunalinformationen	32%
Straßenvorausschau	29%
Warnung vor Wettergefahren	22%

BUT Connected Cars need enhanced security

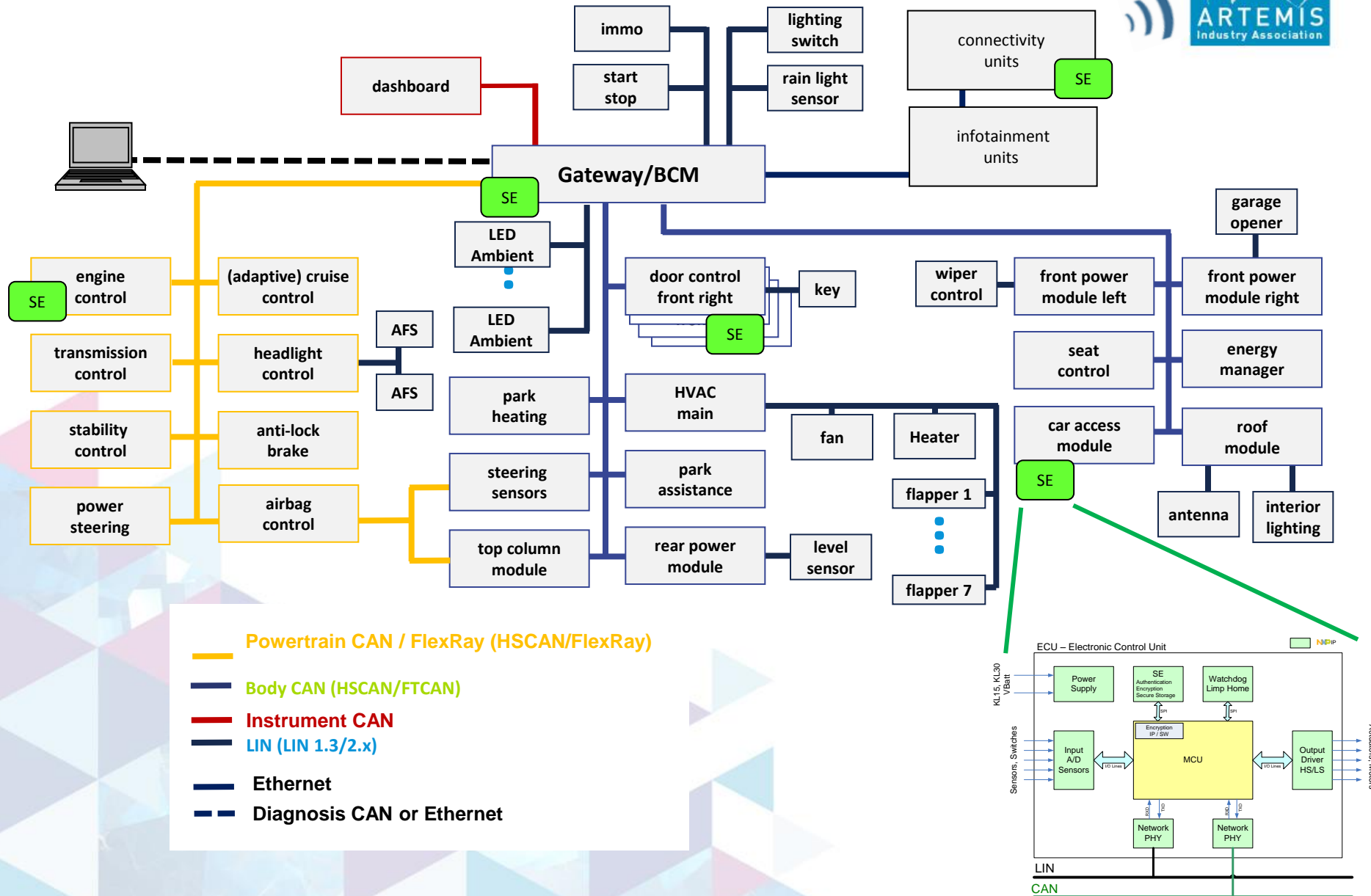| Connected Car	Hybrid/e-Vehicles	Manipulation	Counterfeiting
Avoid car hacking	Connection to the Grid at charging facilities	Easy access to car network	Counterfeiting creates high economic damage
Data Security is a *precondition* to Car2X communications	Secure billing & battery swapping	▪ Engine tuning ▪ Unpaid (optional) feature activation	Parts are looking good but perform badly

Security of external Interfaces

Connected device attacks increase massively

New Cyber threats per year
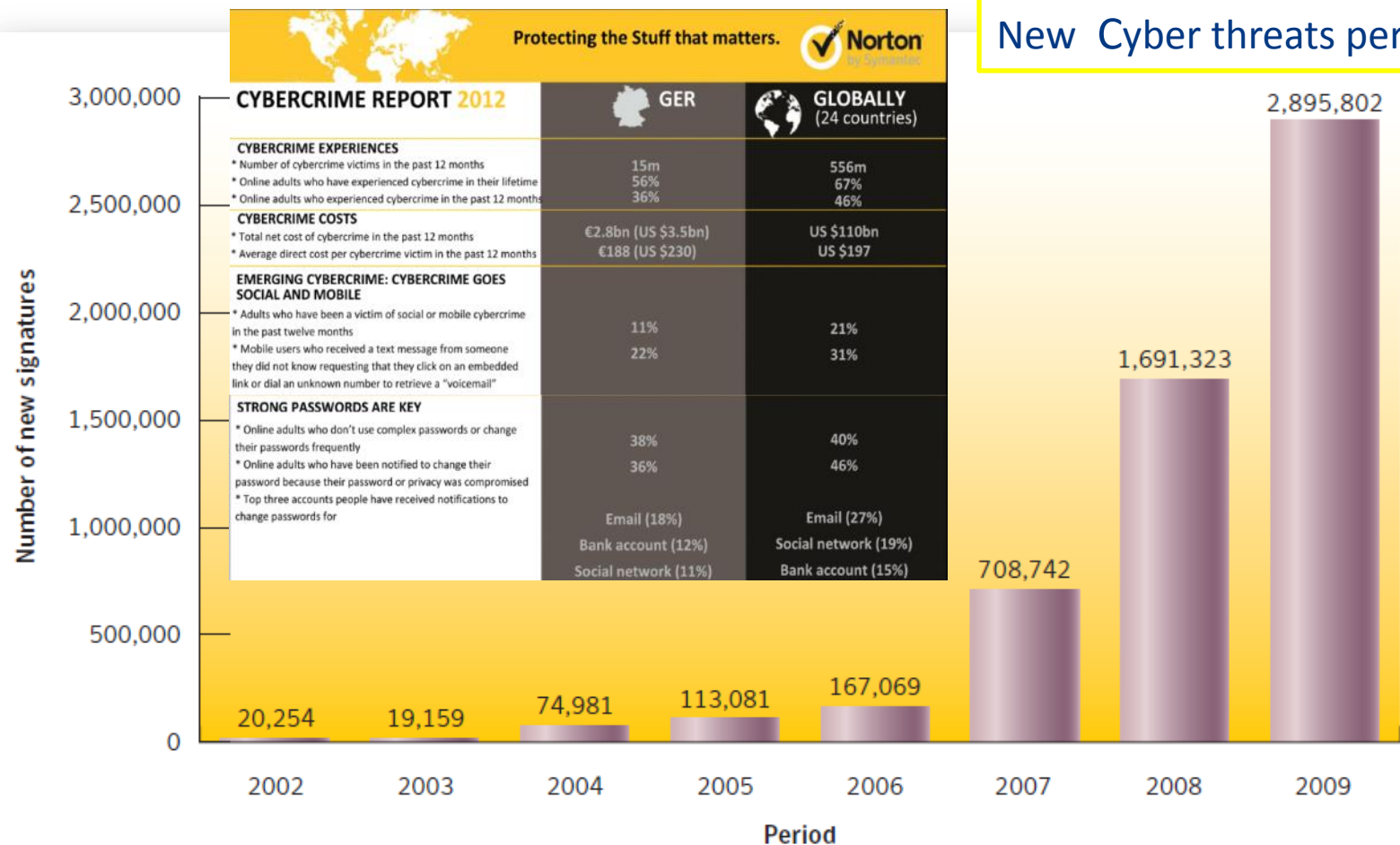
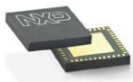# … adding Secure Elements (SE) to the In-Vehicle Network
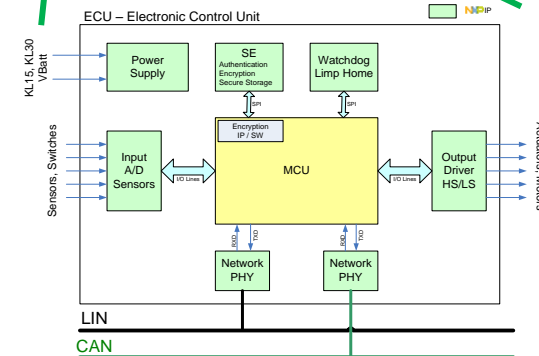
System Security requires a reliable Trust Provisioning Scheme

Chip Manufacturer

Not impacted by key management

Tier x

Dealer

Manufacturing

OEMs

Secure communication

Service Provider

Data/App

Trusted Service Manager

Secure communication

Initial Security Module key
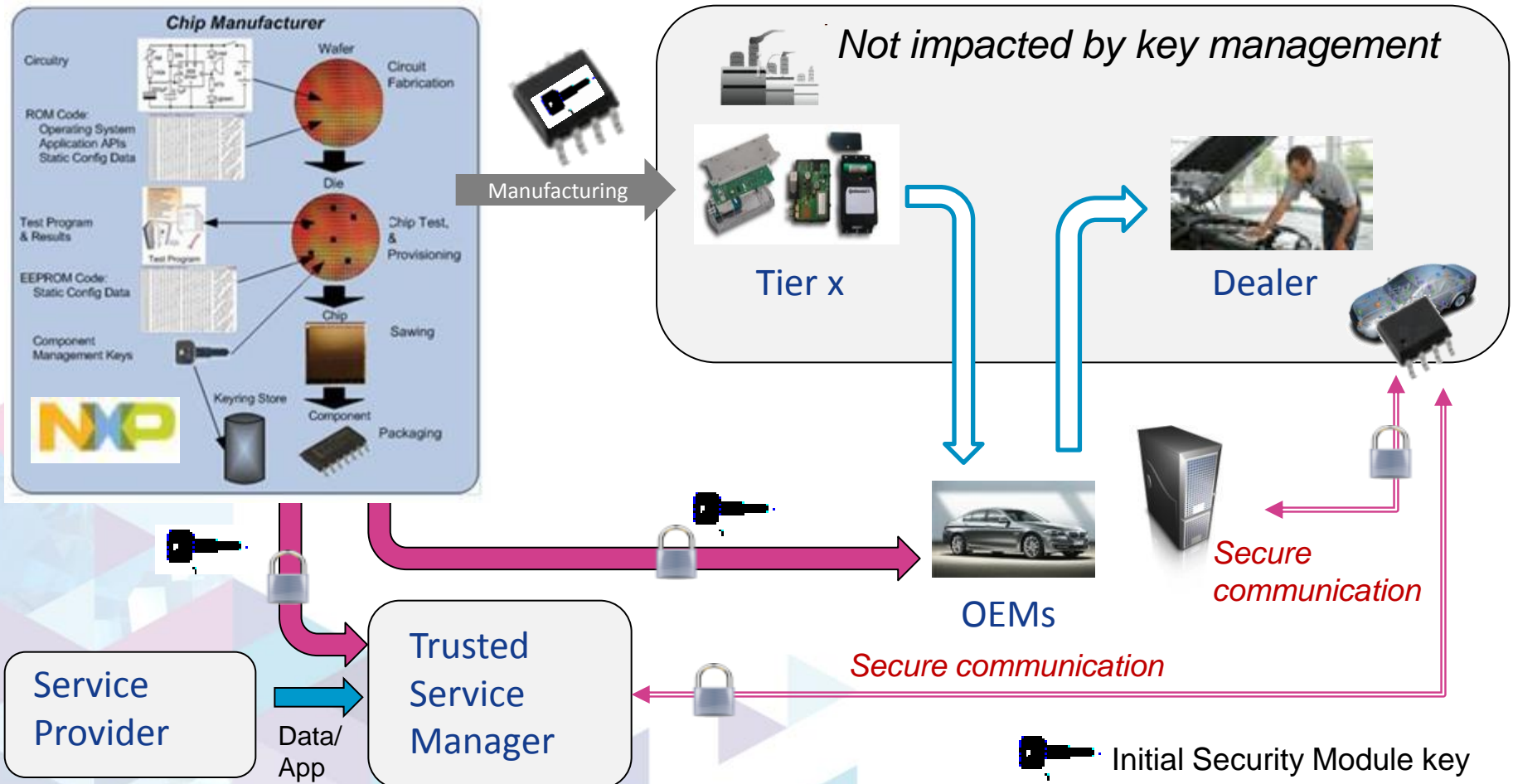
Applying security-levels from banking and electronic ID sectors to the Automotive industry

Secure Microcontrollers

Contactless Readers

Contactless Tags & Labels

- Car2X: secure access to in-vehicle networks
- eVehicles: secure financial transactions

- Tracking: privacy protection
- Traffic management: vehicle identification

- Remote car management: SW upgrade, feature activation

- Device protection: preventing theft, cloning, counterfeiting, tuning, manipulation

Field trials world wide with NXP engagement

USDOT ASD
Establishes a real world model deployment site (vehicle communications environment)
Partners
Delphi,
Cohda Wireless

Spookfiles
Dutch project to prevent and reduce phantom traffic jams
28 Partners, >15M Euro

simTD
Shaping tomorrow's mobility through researching and testing car-to-x and its applications
Partners
Continental, Daimler, Audi, BMW, Opel, VW, Cohda Wireless

Score@F
Regional Field trial in Paris region to apply car2x technology
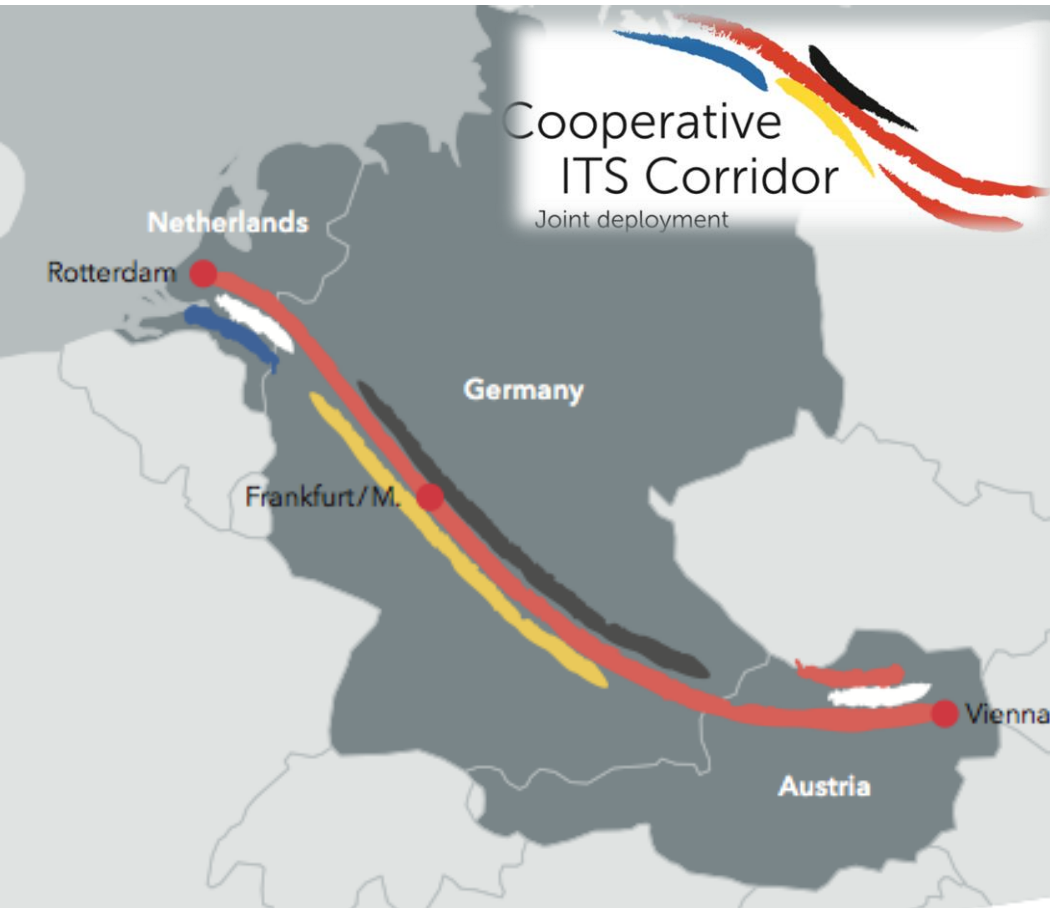**Partners**
Renault, PSA,
Cohda Wireless

ConnectSafe
Australia's first field trial and on-road demonstration of dedicated short range communications
Partners
University South Australia,
Cohda Wireless

Deployment: Cooperative ITS Corridor

MOU between The Netherlands, Germany and Austria to deploy in 2015 cooperative mobility on this corridor to improve traffic safety and reduce congestion

Conclusions

Improving mobility is a key enabler to demonstrate
how complex CPS and eco-systems drive our future !

Therefore, we need new programs to work on :
- Autonomous Driving
- The car into the IoT and the IoT inside the car
- From R&D to pilots to full deployment
- Technological, but also legal and societal acceptance aspects

And that's how the future looks like…

See : https://www.youtube.com/watch?v=KmG7c07MhzQ#t=268

Winning with NXP Automotive