



**FTF 2016**  
TECHNOLOGY FORUM

# AUTOMOTIVE ETHERNET

**SESSION N1774**

NICOLA CONGER  
INTERNATIONAL PRODUCT MANAGER  
SESSION N1774  
MAY 17, 2016

PUBLIC USE

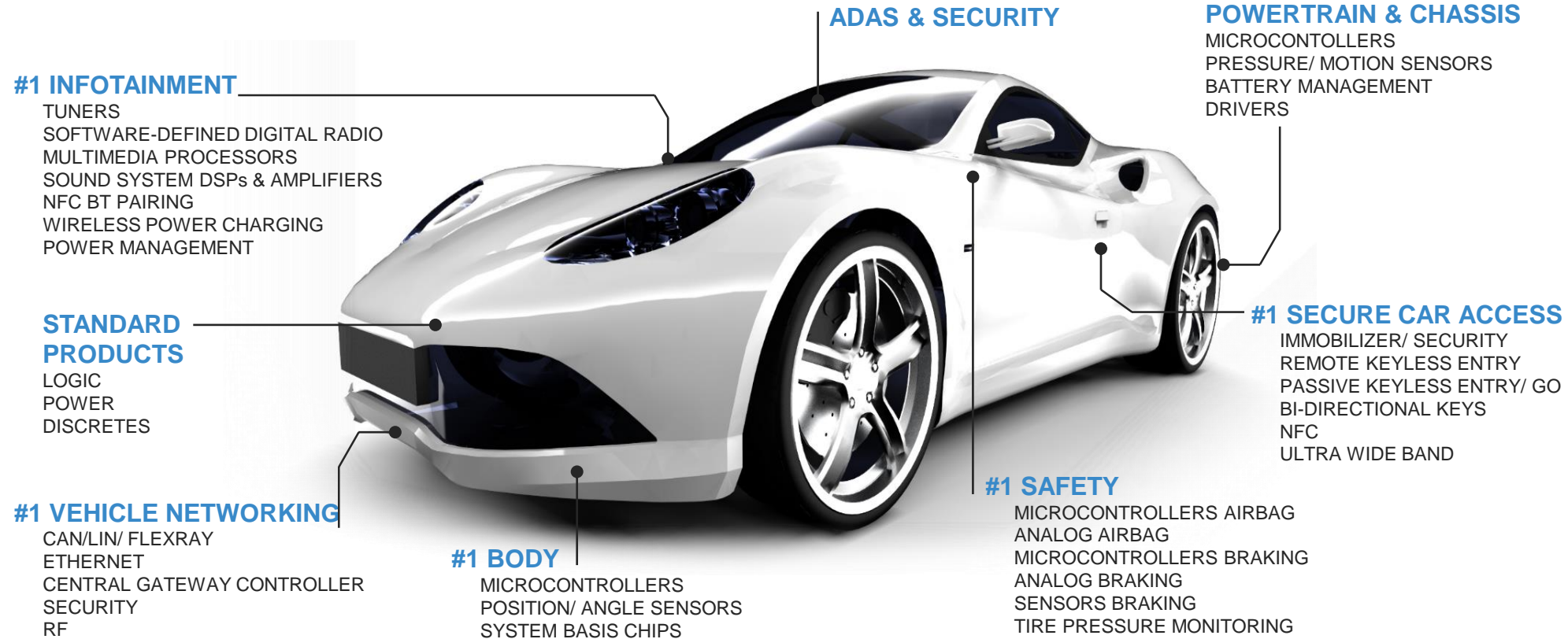


# AGENDA

- Automotive Ethernet, opportunities and challenges
- NXP portfolio
- NXP 2.0 – system solutions
- Conclusions



# Today: 90% of Auto Innovation via Electronics



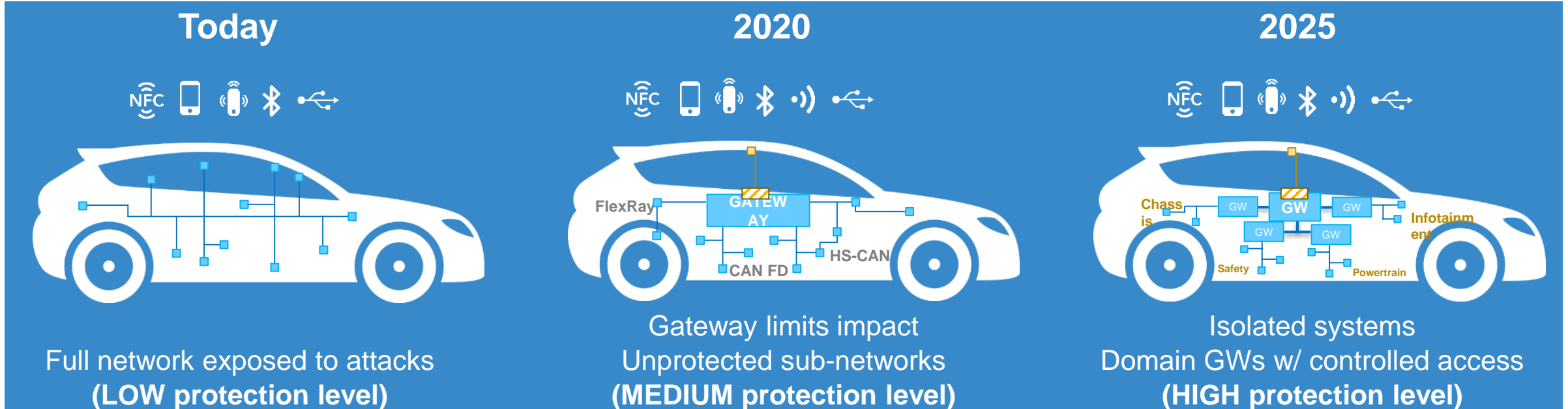
#1 Auto Analog/ RF

#1 Auto MCU (ex JPN)

#1 Auto Merchant MEMS Sensors



# Two Challenges for Car Networks: Speed and Security



## IVN TODAY

All classic CAN  
 No security  
 Few gateways  
 Squeezed systems (bandwidth, topology, CPU, EMC)

## << HURDLES >>




Major investments in network re-architecture  
 Strong security not possible on CAN 2.0  
 CAN FD hampered by ringing and EMC  
 Lack of CAN FD and Secure MCUs  
 Auto Ethernet eco-system still not mature

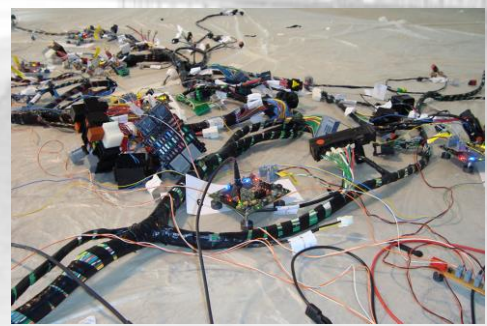
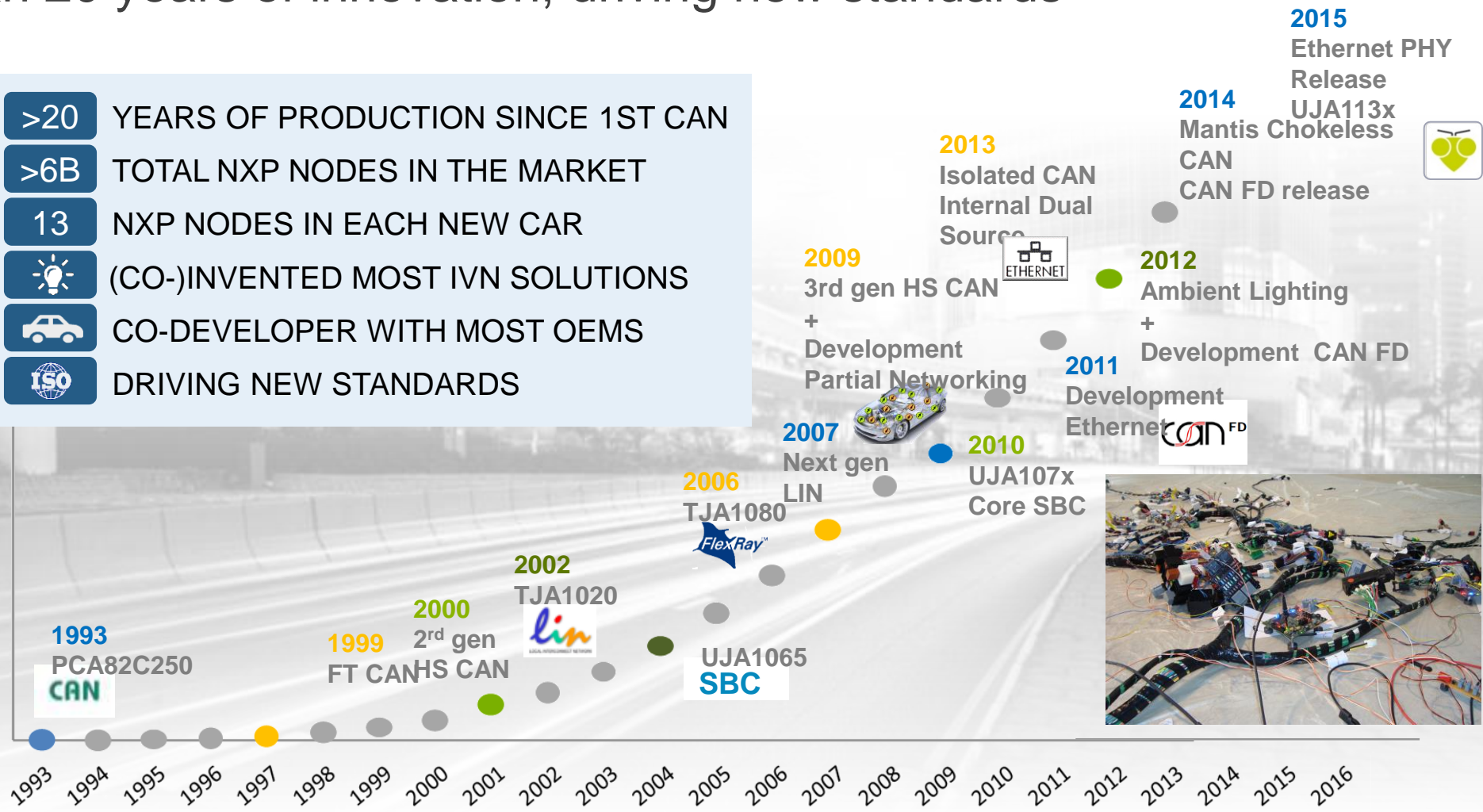
## IVN TOMORROW

CAN FD, Ethernet  
 Domain-based gateways  
 Tighter EMC specs  
 IDS and Crypto security

# NXP: the Leader In In-Vehicle Networking

More than 20 years of innovation, driving new standards

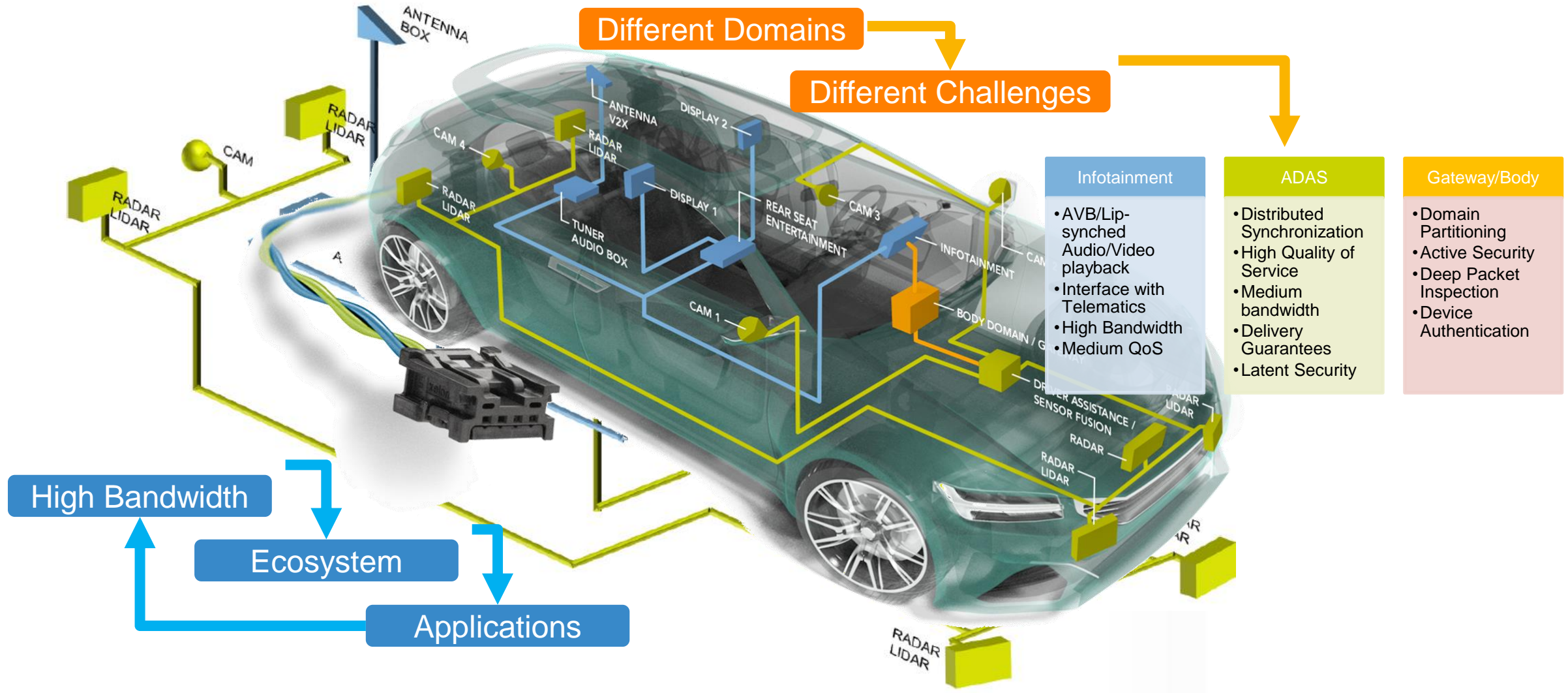
- >20** YEARS OF PRODUCTION SINCE 1ST CAN
- >6B** TOTAL NXP NODES IN THE MARKET
- 13** NXP NODES IN EACH NEW CAR
-  (CO-)INVENTED MOST IVN SOLUTIONS
-  CO-DEVELOPER WITH MOST OEMS
-  DRIVING NEW STANDARDS



# AUTOMOTIVE ETHERNET

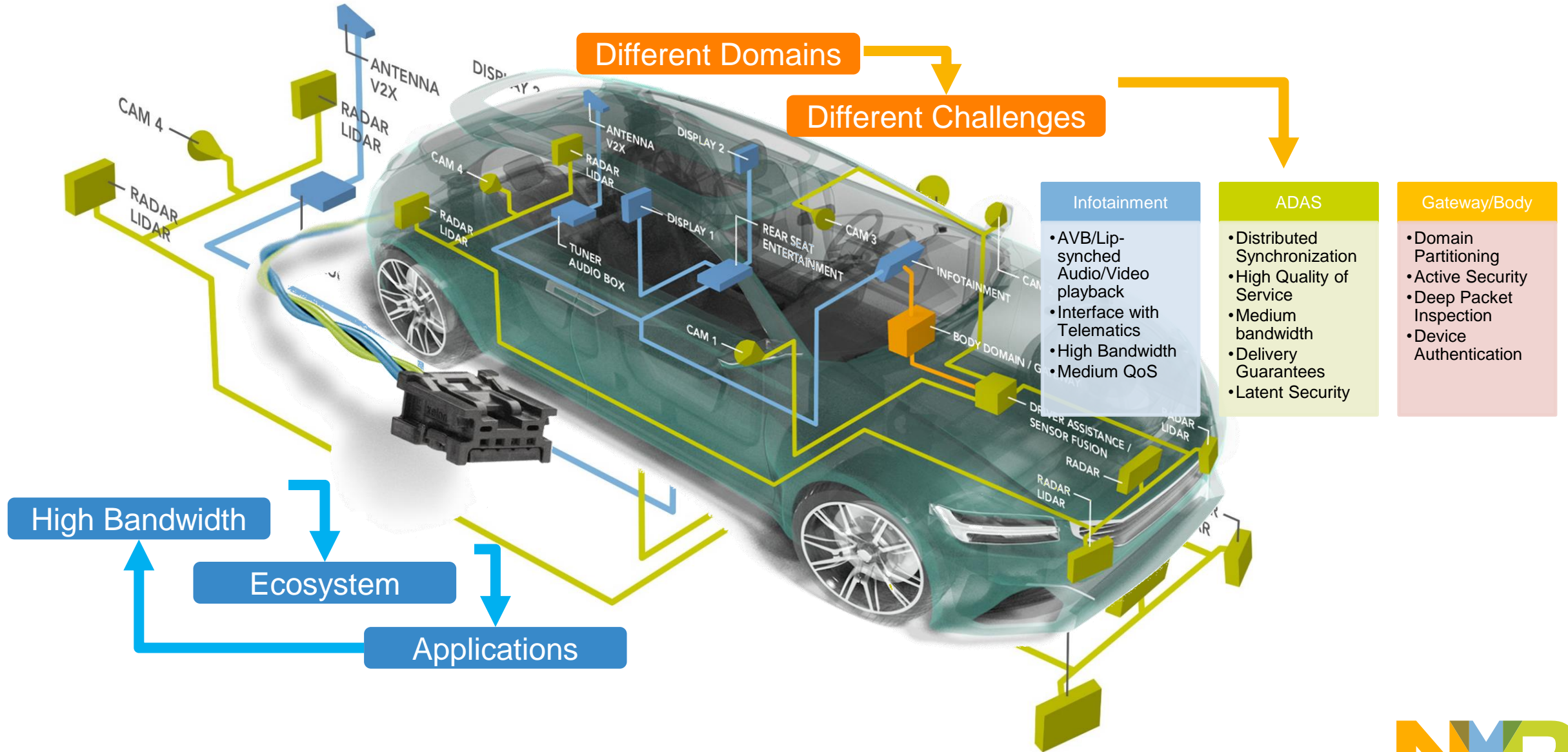


# The Added Value of Ethernet





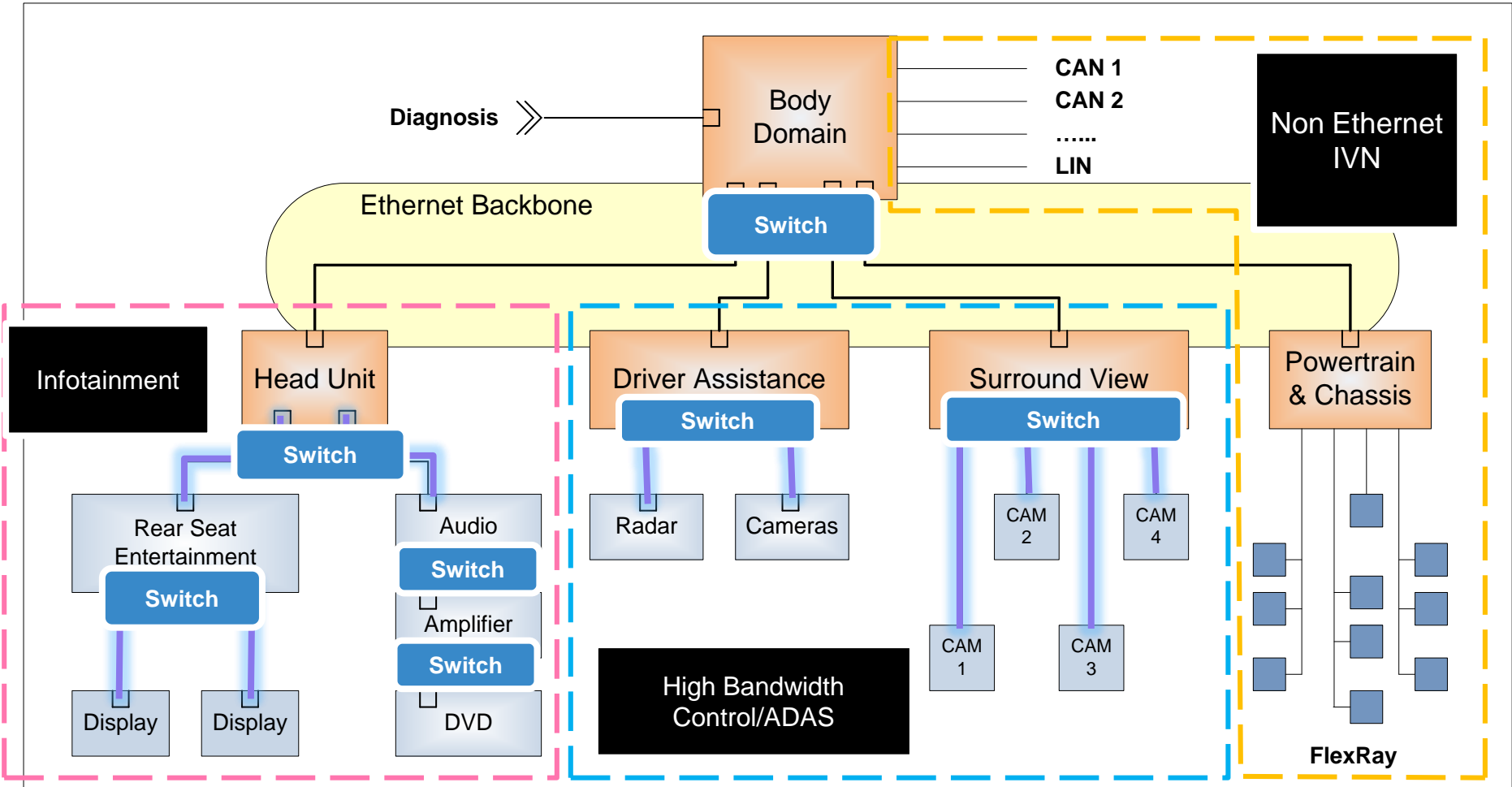
# The Added Value of Ethernet





# IVN in 2020: Domain-Based Network

Application Layer	User application
Presentation Layer	Encryption/Compression
Session Layer	Authentication
Transport Layer	End-to-end, Error Control
Network Layer	Network addressing, routing
Data Link Layer	Error Detection, Flow Control
Physical Layer	Bit stream, physical medium



# Automotive Ethernet / IEEE 100Base-T1 Ethernet

## Standardized

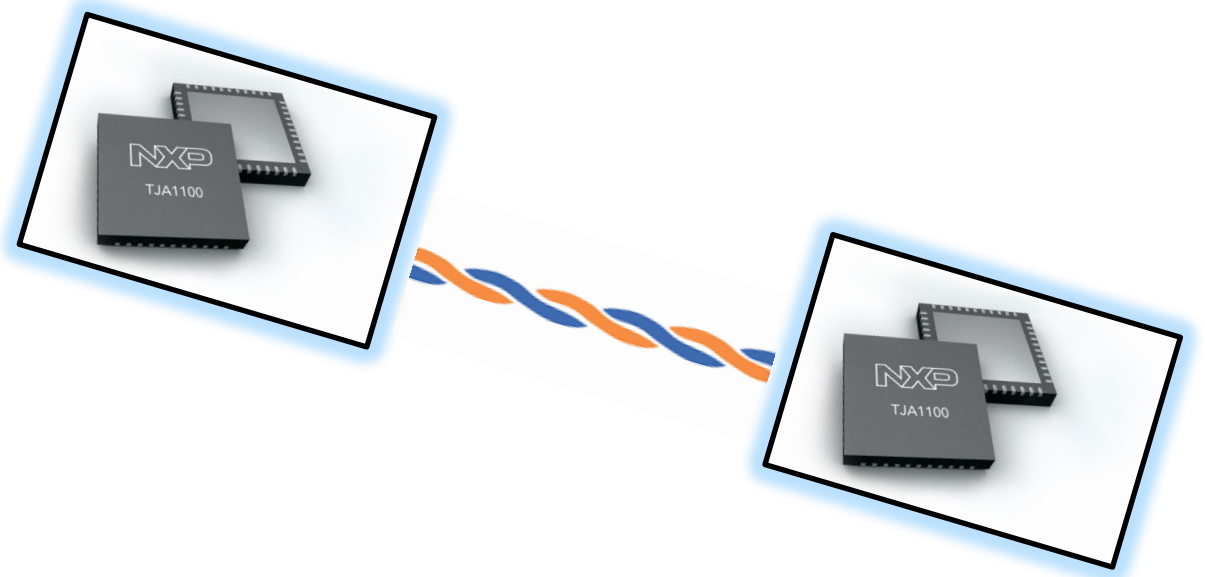
- IEEE Standard – 100 BASE-T1
- Large number of suppliers and equipment
- Derived from the OPEN Alliance BroadR-Reach (OABR)

## Cost Effective

- Supports Unshielded Twisted Pair up to 15m
- Similar cable as CAN and FlexRay
- Cheaper and easier than LVDS

## Automotive

- Limited EMC emissions, within Automotive Specs
- Compatible with automotive cabling and connectors



	Cable	Connector (2 ends, on-board & cable)
LVDS		
BroadR-Reach®		

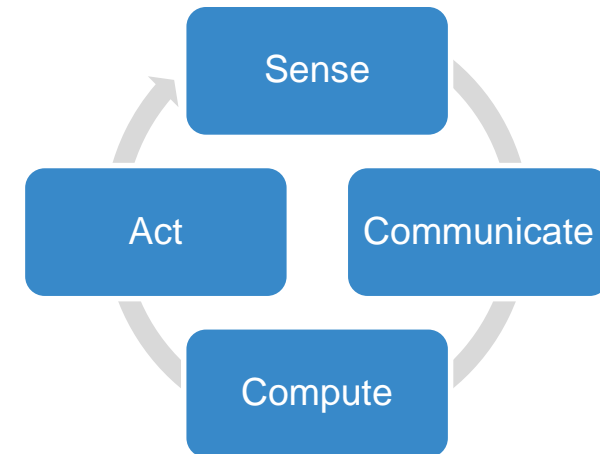
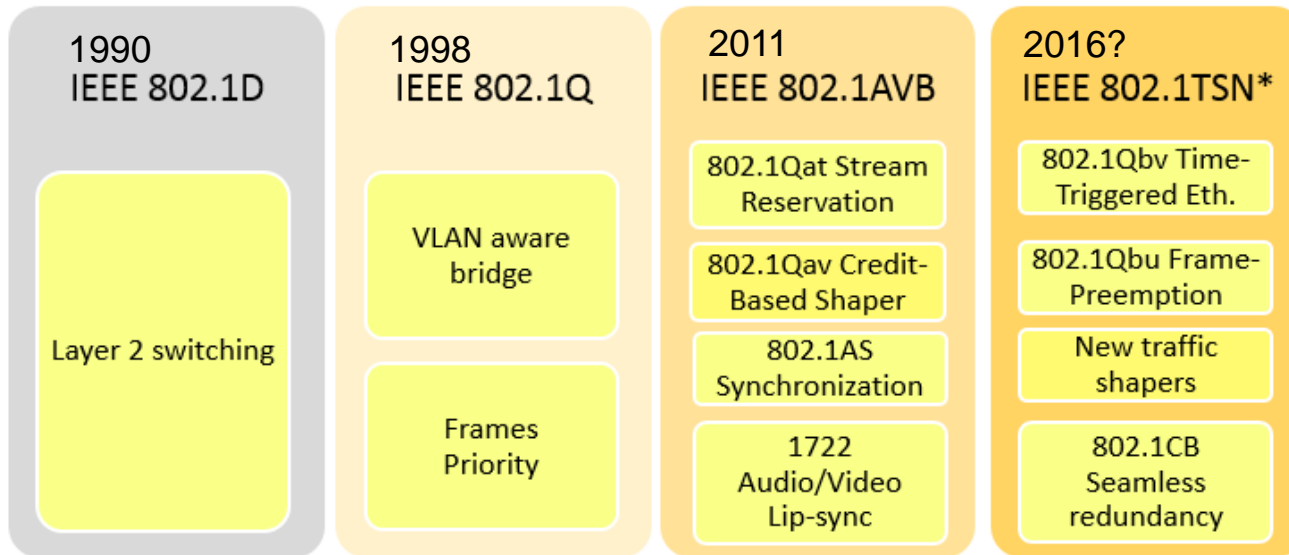
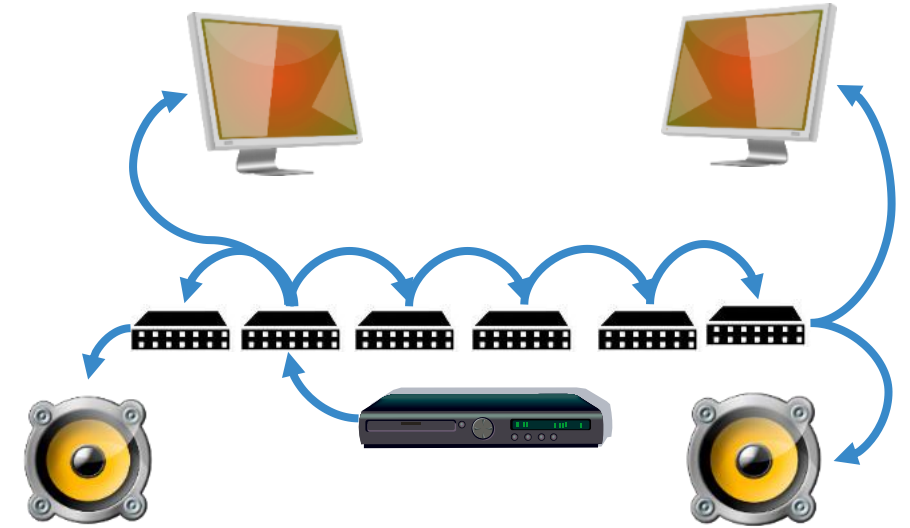
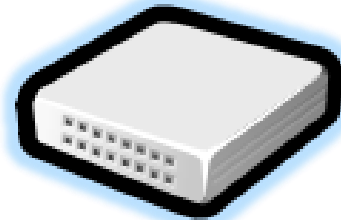
# Ethernet Switching

Basic Switching

Support for Virtual and Frame Priority

Distributed Synchronization for Lip-Sync Streaming

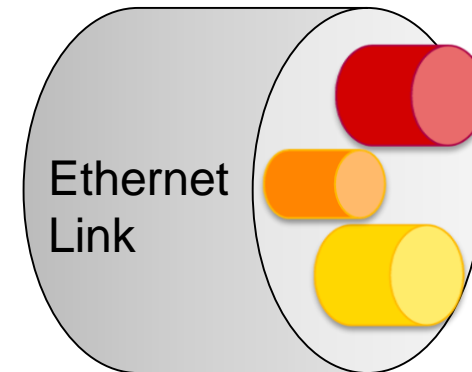
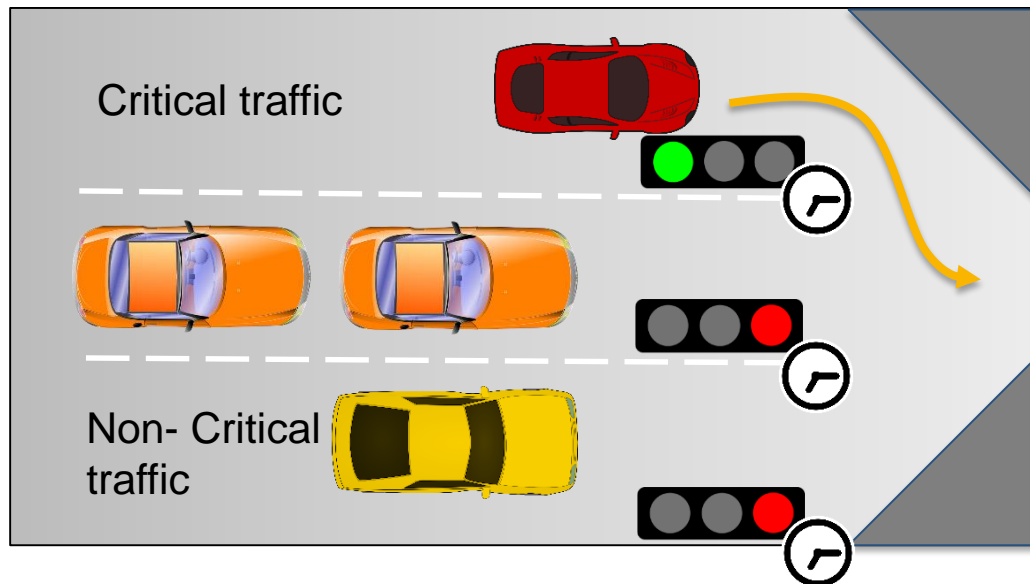
TDMA, Redundancy and Preemption for Control Traffic





# Deterministic Ethernet

- Prevents less critical traffic from slowing down the critical one by design
- Enables to define precise network delays for critical data
- Boosts the combined transmission of critical and non-critical traffic on the same network
- Virtualizes the network bandwidth, different classes are not aware of the other



# NXP ETHERNET PORTFOLIO



# Introducing Ethernet: NXP Provides Auto-Native Portfolio

## Flexible, Scalable Solution

### TJA1100 100MBPS PHY

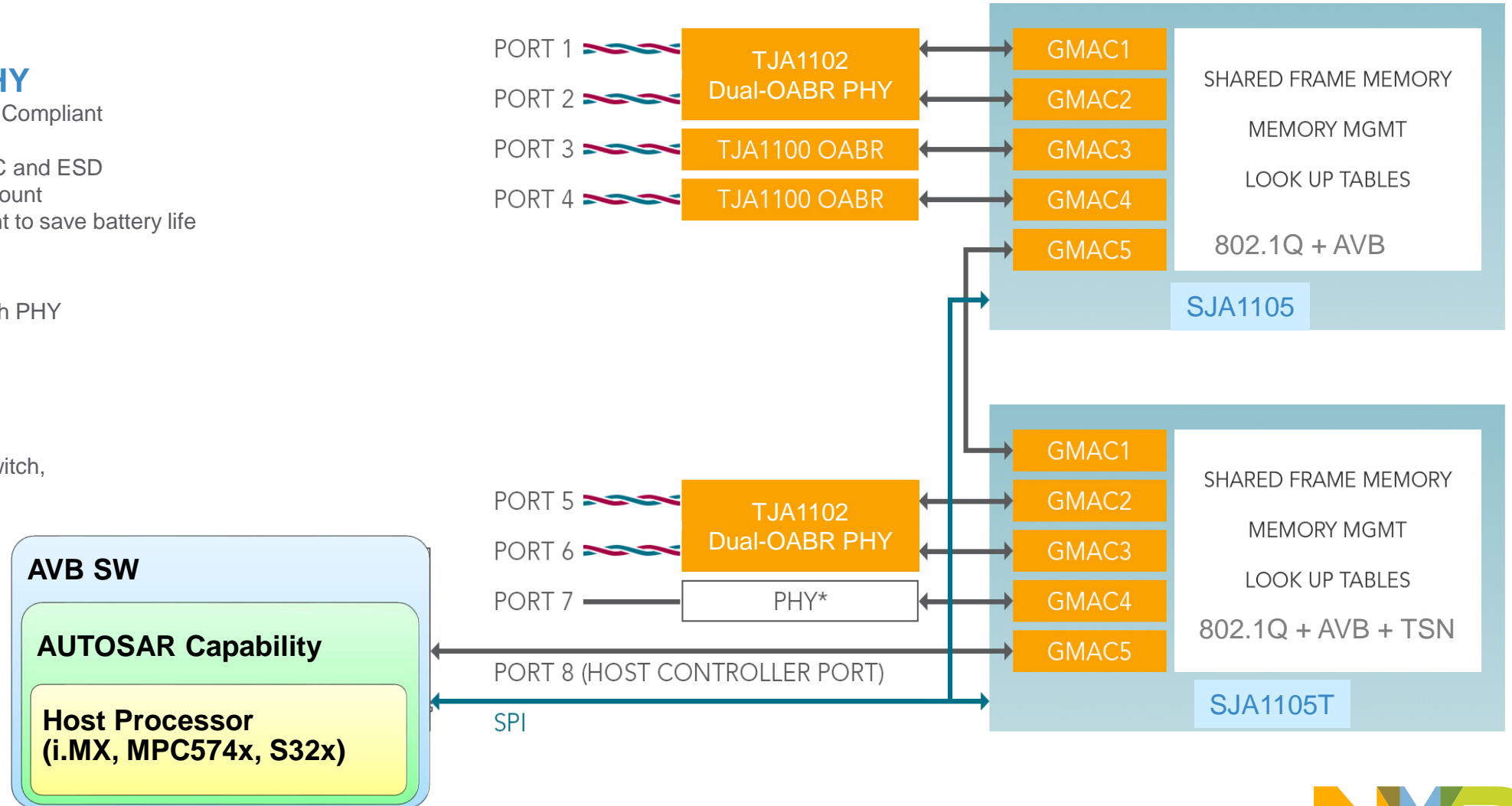
- Open Alliance BroadR-Reach Compliant
- Fully automotive qualified
- Robust automotive grade EMC and ESD
- Minimal external component count
- Enhanced Power Management to save battery life

### TJA1102 Dual-PHY

- Single chip dual Broad-R-Rach PHY
- Enables better scalability

### SJA1105 FIVE-PORT SWITCH

- Layer 2 Store and Forward Switch,
- Supports AVB, TSN and Deterministic Ethernet
- Up to 1-Gb network speed,
- MII/RMII/RGMII Interface
- Port Mirroring and VLAN support (IEEE 802.1Q and IEEE 802.1P)





# TJA1100: True Automotive 100 Mbps OABR PHY

## Value Proposition

- True automotive product, quality and support
- Enhanced low power management with remote wake-up
- Diagnosis – Fail safe behavior
- Lowest bill-of-material

## Features & Functions

- Compliant to OPEN Alliance BroadR-Reach and 100BASE-T1
- Reliable, cost-effective & space-optimized
- Automotive grade EMC / ESD / ISO pulses
- Small HVQFN-36 package – 6 x 6 mm<sup>2</sup>
- Temperature range: -40 to +125 °C
- 100 Mbits/s today, 1 Gbit/s tomorrow



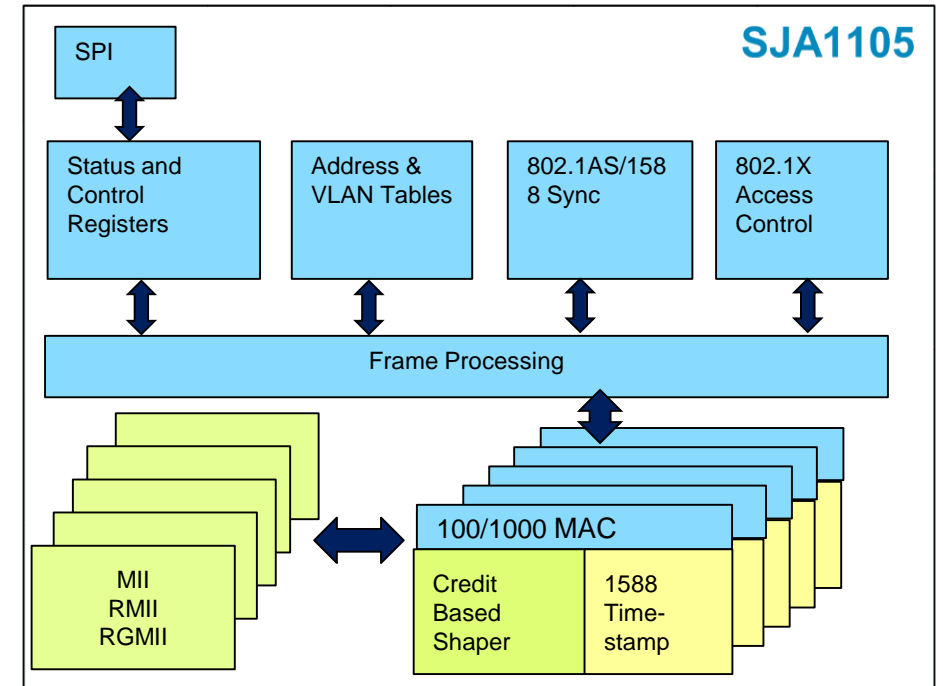
# SJA1105 & SJA1105T Five-port Gigabit Ethernet Switch

## Value Proposition

- Power-efficient, Smallest package
- Supporting Standard Ethernet, AVB, TSN and Deterministic Ethernet
- Compatible with SAE AS6802 Redundant Synchronization standard for industrial applications
- Scalable and flexible solution together with TJA1100 and TJA1102 Dual OABR PHY

## Features & Functions

- Layer 2 store-and-forward switch
- Cascaded configuration to increase port count when needed
- Full Support for IEEE AVB – 802.1 AS, Qav, Qat
- Support for IEEE TSN – 802.1Qbv, 802.Qci (pre-standard)
- Provisions for IEEE 802.1X Port-Based Network Access control
- Advanced network diagnostics and VLAN manipulation features



# Ethernet Switching, Audio/Video Bridging (AVB), Time Sensitive Networking (TSN), Guarantee of Service

	Ethernet Switch SJA1105	Ethernet Switch & AVB SJA1105	Ethernet Switch & AVB & TSN SJA1105T
<b>Daisy Chain</b>	<p>SJA1105 switch connected to ADAS Process or</p>	<p>Frame audio samples at in <u>Lip-sync</u> T=03:26am, 2sec 123ms</p>	<p>Movie A uses 20Mbps Movie B uses 30Mbps <u>If A goes bad, B is not affected</u></p>
<b>Data Hub</b>	<p>ADAS DSP</p> <p>SJA1105</p>	<p>ADAS DSP</p> <p>SJA1105</p> <p>Frame taken at T=03:26am, 2sec 123ms</p>	<p>SJA1105T</p> <p>Sensor Fusion</p> <p>Sense Process. Actuate Minimal jitter communications</p>
<b>Central processing</b>	<p>DSP A DSP B DSP C</p> <p>SJA1105</p>		<p>DSP A DSP B DSP C</p> <p>SJA1105T</p> <p>Deterministic delays: A-B delay = 10us A-C delay = 18us B-C delay = 21us</p>



# NXP 2.0 SYSTEM SOLUTIONS



# Gateway and Body Solutions

## Automotive Ethernet

- Full Automotive Ethernet Portfolio, Switch and PHY

## Automotive Software

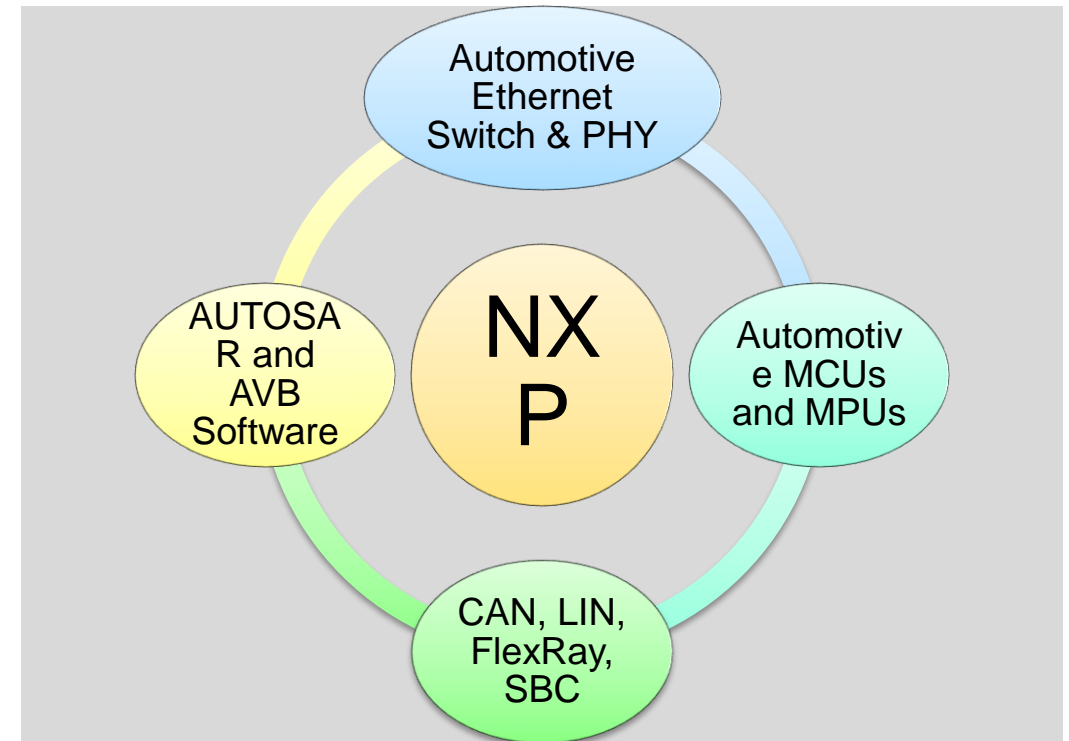
- AVB Software for end-nodes and switch for both Linux and AUTOSAR

## CAN/LIN/FlexRay/SBC

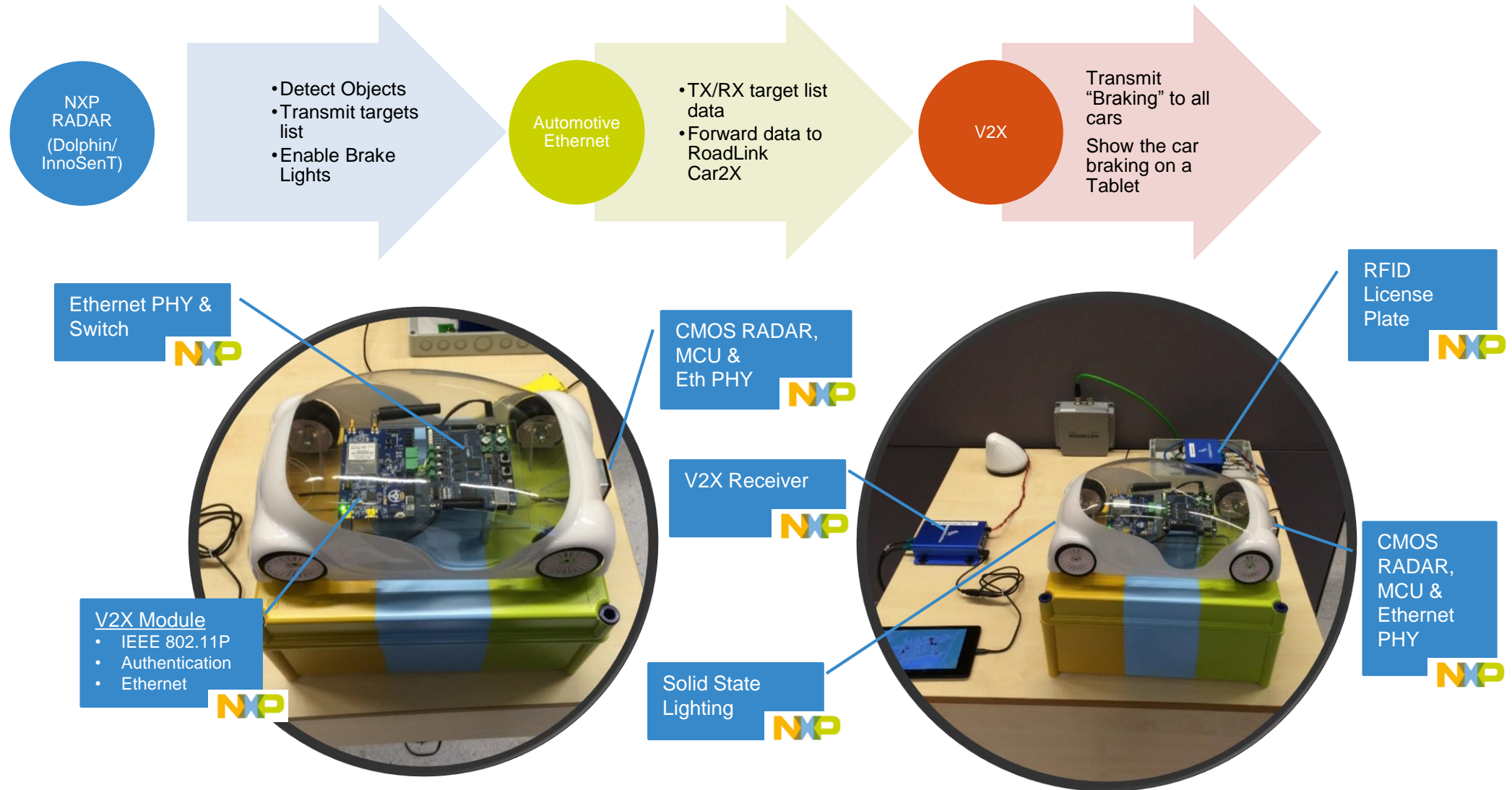
- Market leading portfolio

## Automotive MPU and MCU portfolio

- Market leading portfolio

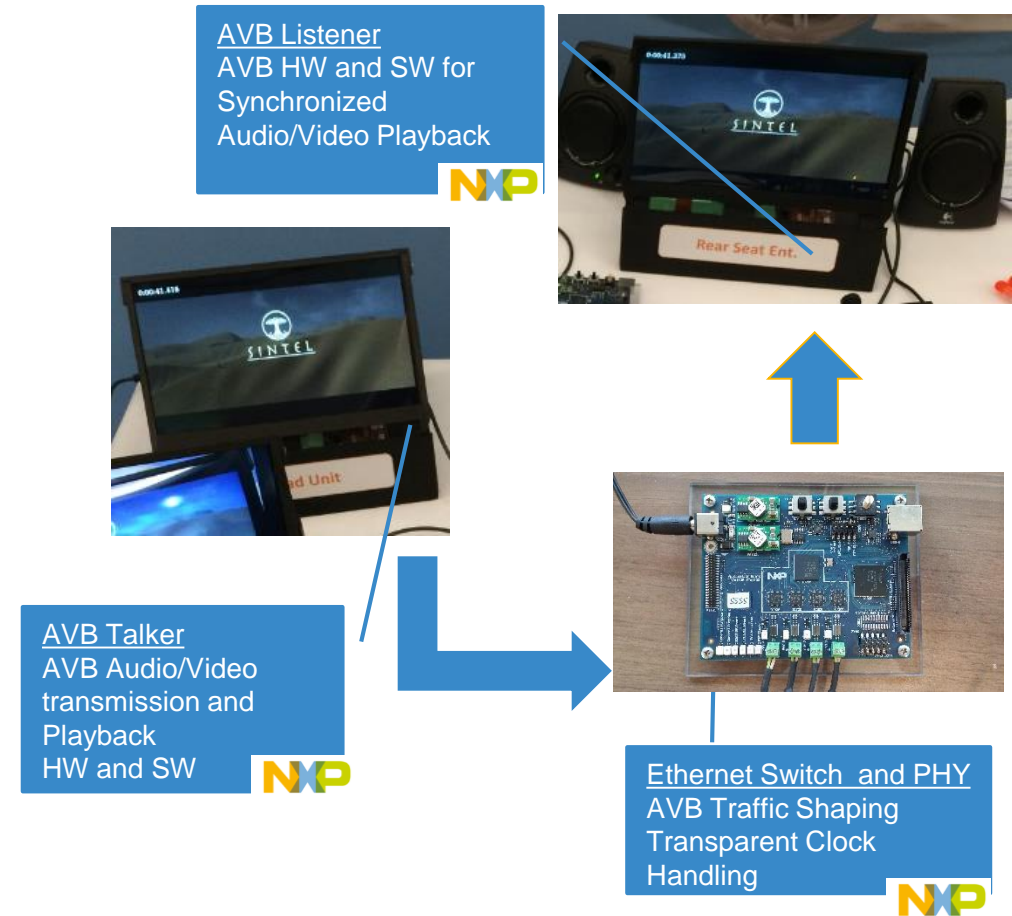
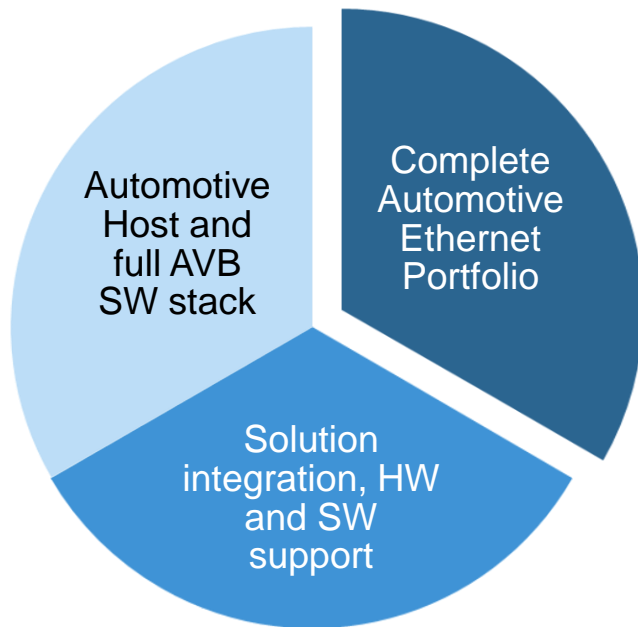


# Use Case: Ethernet for Radar and V2X ADAS



# Use Case: Ethernet for Infotainment

- Ethernet AVB end-nodes for high-quality Audio and Video playback
- Automotive Ethernet Switch and PHY with AVB Software



# Conclusions

- Ethernet is a disruptive technology that is entering the automotive and industrial domains
- IEEE 100Base-T1 supports high-speed connectivity enabling high-data rate applications in the automotive domain
- IEEE AVB and TSN standards provide the “tools” to engineer the networks supporting such complex applications
- NXP offers a complete and flexible portfolio of products to implement these applications
- NXP is committed to Ethernet as the future IVN technology



THANK YOU





SECURE CONNECTIONS  
FOR A SMARTER WORLD

## ATTRIBUTION STATEMENT

NXP, the NXP logo, NXP SECURE CONNECTIONS FOR A SMARTER WORLD, CoolFlux, EMBRACE, GREENCHIP, HITAG, I2C BUS, ICODE, JCOP, LIFE VIBES, MIFARE, MIFARE Classic, MIFARE DESFire, MIFARE Plus, MIFARE Flex, MANTIS, MIFARE ULTRALIGHT, MIFARE4MOBILE, MIGLO, NTAG, ROADLINK, SMARTLX, SMARTMX, STARPLUG, TOPFET, TrenchMOS, UCODE, Freescale, the Freescale logo, AltiVec, C 5, CodeTEST, CodeWarrior, ColdFire, ColdFire+, C Ware, the Energy Efficient Solutions logo, Kinetis, Layerscape, MagniV, mobileGT, PEG, PowerQUICC, Processor Expert, QorIQ, QorIQ Qonverge, Ready Play, SafeAssure, the SafeAssure logo, StarCore, Symphony, VortiQa, Vybrid, Airfast, BeeKit, BeeStack, CoreNet, Flexis, MXC, Platform in a Package, QUICC Engine, SMARTMOS, Tower, TurboLink, and UMEMS are trademarks of NXP B.V. All other product or service names are the property of their respective owners. ARM, AMBA, ARM Powered, Artisan, Cortex, Jazelle, Keil, SecurCore, Thumb, TrustZone, and  $\mu$ Vision are registered trademarks of ARM Limited (or its subsidiaries) in the EU and/or elsewhere. ARM7, ARM9, ARM11, big.LITTLE, CoreLink, CoreSight, DesignStart, Mali, mbed, NEON, POP, Sensinode, Socrates, ULINK and Versatile are trademarks of ARM Limited (or its subsidiaries) in the EU and/or elsewhere. All rights reserved. Oracle and Java are registered trademarks of Oracle and/or its affiliates. The Power Architecture and Power.org word marks and the Power and Power.org logos and related marks are trademarks and service marks licensed by Power.org. © 2015–2016 NXP B.V.

