



Architecting the Future – More Than Brains on Wheels

LARS REGER

CTO Automotive, Senior Vice President
NXP Semiconductors



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SECURE CONNECTIONS FOR THE SMARTER WORLD

Everything Smart



40B+ devices with intelligence shipped in 2020

Processing

Everything Connected



1B+ additional consumers online, 30B+ connected devices

Connectivity

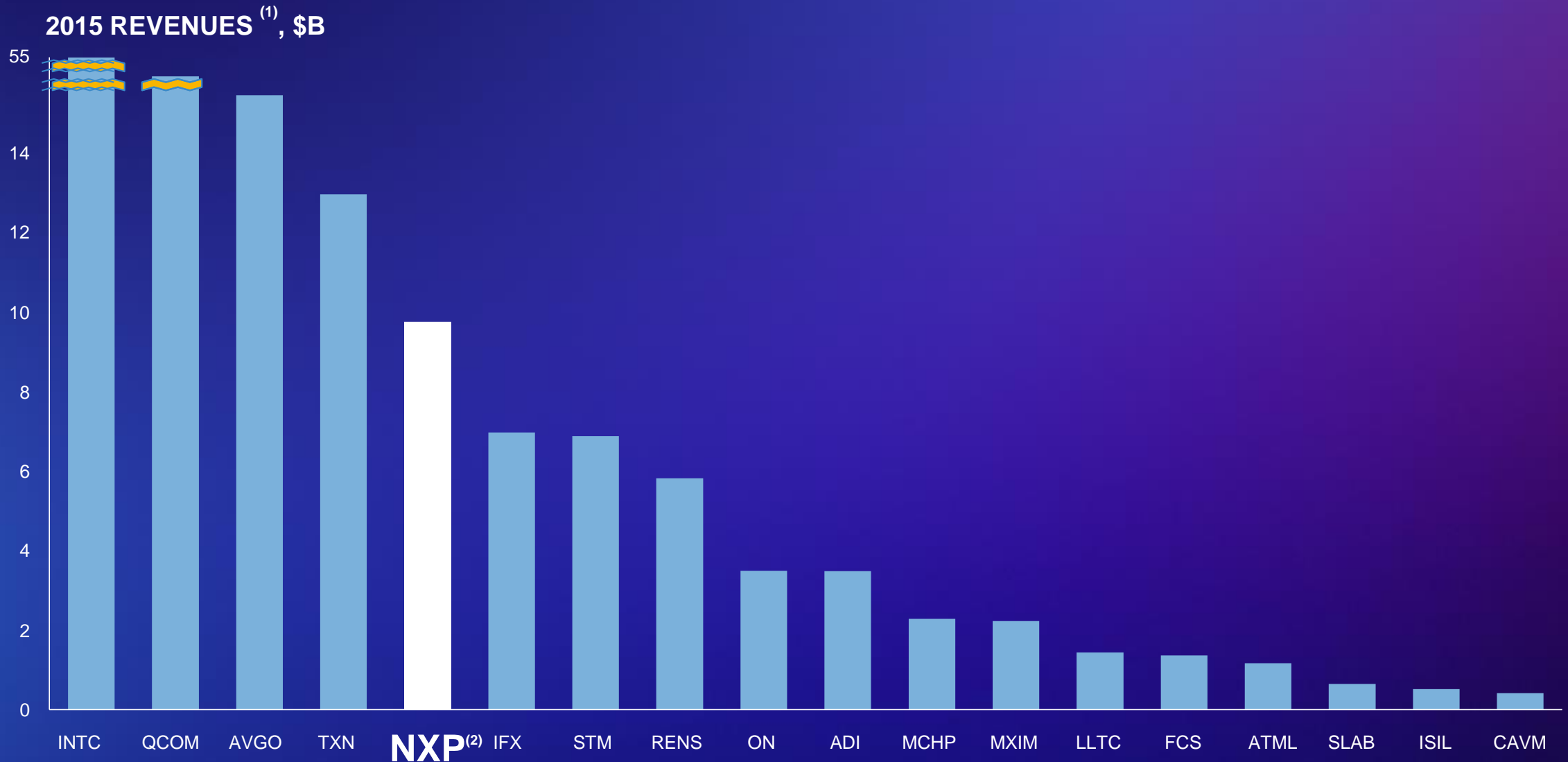
Everything Secure



Potential economy savings up to half trillion dollars

Security

NXP – TOP 5 SEMICONDUCTOR COMPANY



(1) Source: public filings (2) For NXP, reference is made to the Combined Non-GAAP Adjusted Revenue which is the combined consolidated revenue of NXP and Freescale. The information excludes the divestment of previously announced businesses and the creation of joint-ventures. Please refer to the NXP Historic Financial Model file found on the Financial Information page of the Investor Relations section of our website at www.nxp.com/investor for additional information relative to our Non-GAAP Financial Measures.

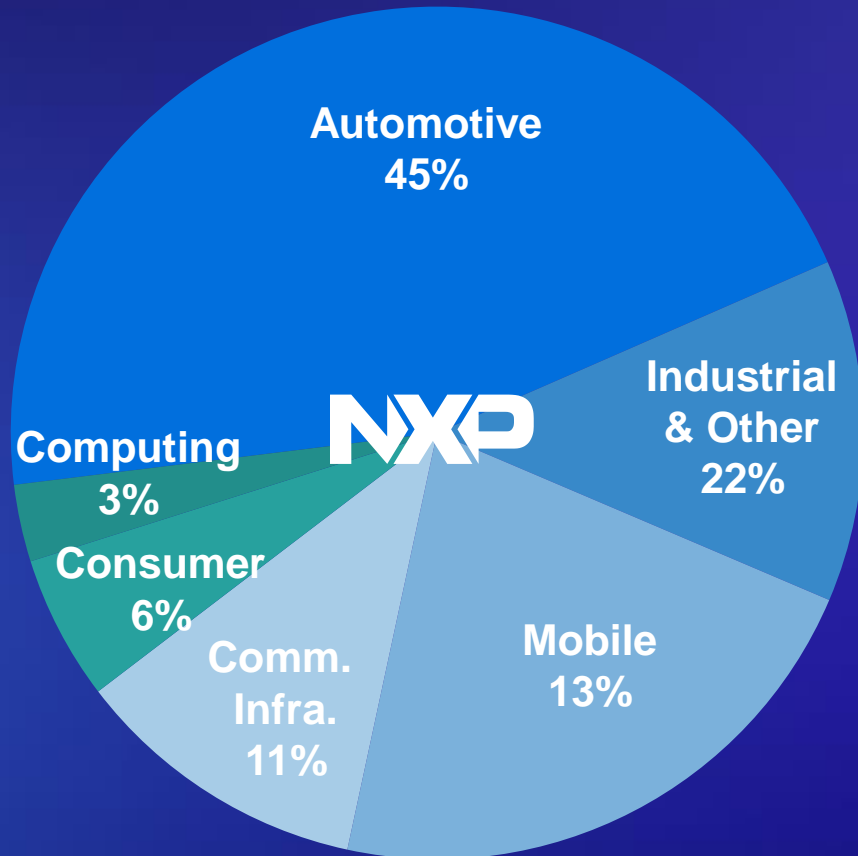
NXP TOP 20 CUSTOMERS > 40% OF 2016 REVENUE⁽¹⁾



Note: (1) Through all channels,

FOCUSSED LEADERSHIP – END MARKETS

**NXP 2016 Product Revenue
by End-market Exposure**



Broad end market exposure

- Long life cycles
- High barriers to entry
- Application expertise

Product leadership positions

- #1 Automotive
- #1 Non-auto MCU
- #1 Secure identification
- #1 Mobile transactions

Note: Combined Non-GAAP Adjusted Revenue is the combined consolidated revenue of NXP and Freescale. The information excludes the divestment of previously announced businesses and the creation of joint-ventures. Please refer to the NXP Historic Financial Model file found on the Financial Information page of the Investor Relations section of our website at www.nxp.com/investor for additional information relative to our Non-GAAP Financial Measures.

NXP Leads Automotive Innovation – #1 Global Auto Semi

Car Infotainment

ADAS & Safety



Secure Car Access

Body, Comfort & Networking

Powertrain & Chassis



BMW 7-series Awarded
2016 World Luxury Car
NY International Auto Show

Safe & Secure Mobility – 90% Innovation Through Electronics

Seamlessly Connected
Mobility Experience



One hour per
day in the vehicle
Enjoying Life

ADAS Towards
Self-Driving



1.3M global road fatalities
every year
Saving Lives

Energy
Efficiency



US mandates 163 grams / mile
and 54.5 MPG by 2025
Reducing CO₂

1.3 MILLION

Road traffic deaths occur every year



HIT BY A VEHICLE TRAVELING AT:



9 OUT OF 10 PEDESTRIANS SURVIVE*

HIT BY A VEHICLE TRAVELING AT:



5 OUT OF 10 PEDESTRIANS SURVIVE

HIT BY A VEHICLE TRAVELING AT:



ONLY 1 OUT OF 10 PEDESTRIANS SURVIVES



OUT OF ALL ACCIDENTS GLOBALLY, 90% are caused by **HUMAN ERROR**

VISION ZERO

ROAD SAFETY REFORM STRATEGY

Ultimate target of
no deaths
or serious injuries

- ▶ **High fines**
(example — texting while driving)
- ▶ **Stronger police presence**
- ▶ **Concrete between road tracks**
- ▶ **Slow-but-safe principle**
- ▶ **Additional traffic lights**
- ▶ **Additional roundabouts**
- ▶ **Speed bumps**





WE BELIEVE
ELECTRONICS
ARE THE ROAD TO
ZERO

NXP

SENSE



THINK



ACT



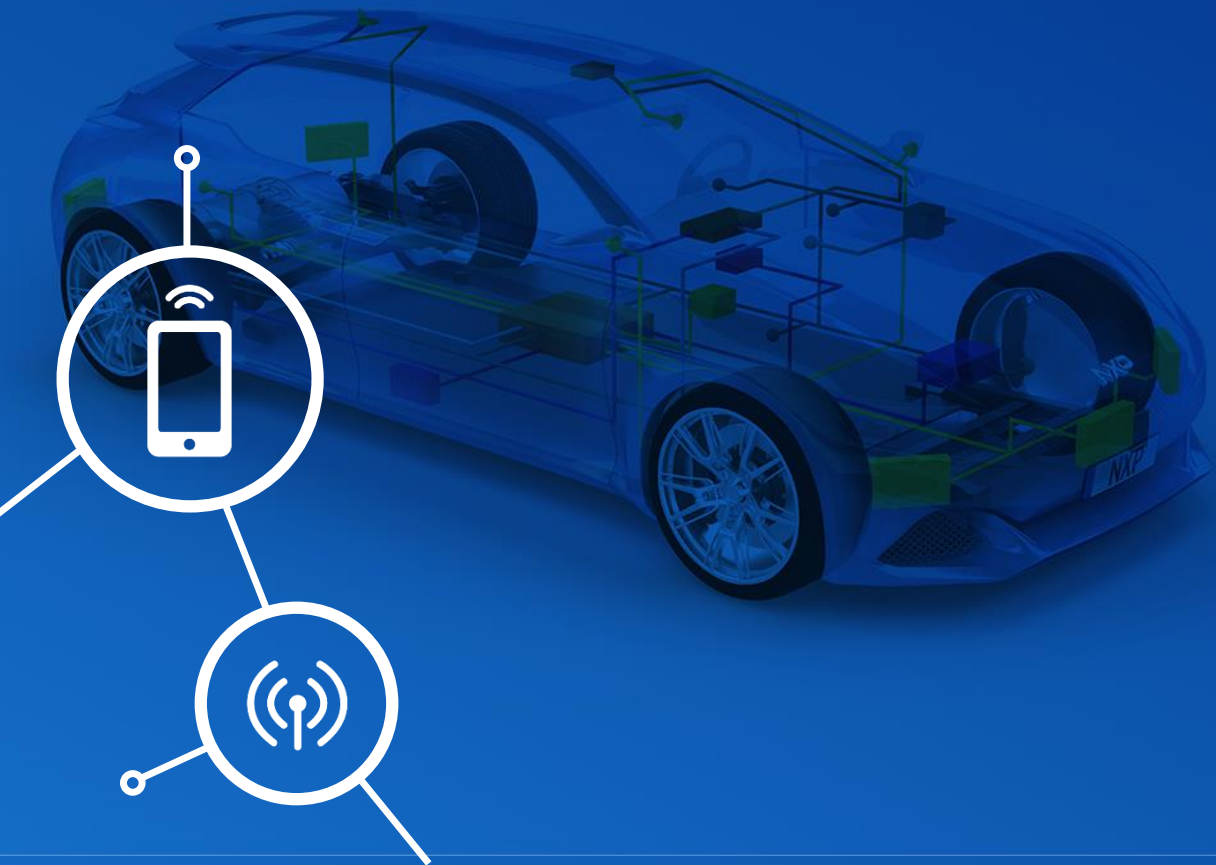
ENABLING SELF-DRIVING CARS

Better senses than the human driver.

Automation of driving decisions.



5 System domains



new

Connectivity domain

Driver substitute domain

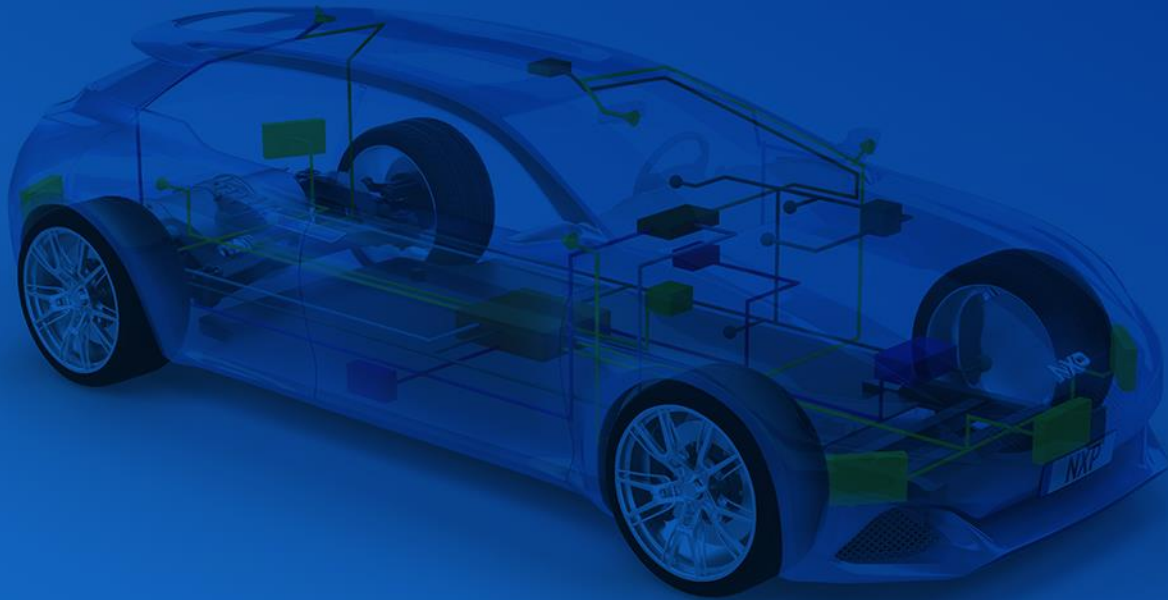
traditional

Experience domain

Body & Comfort domain

Powertrain & Vehicle Dynamics domain

5 System domains



Gateway

Connectivity domain

Driver substitute domain

Experience domain

Body & Comfort domain

Powertrain & Vehicle Dynamics domain

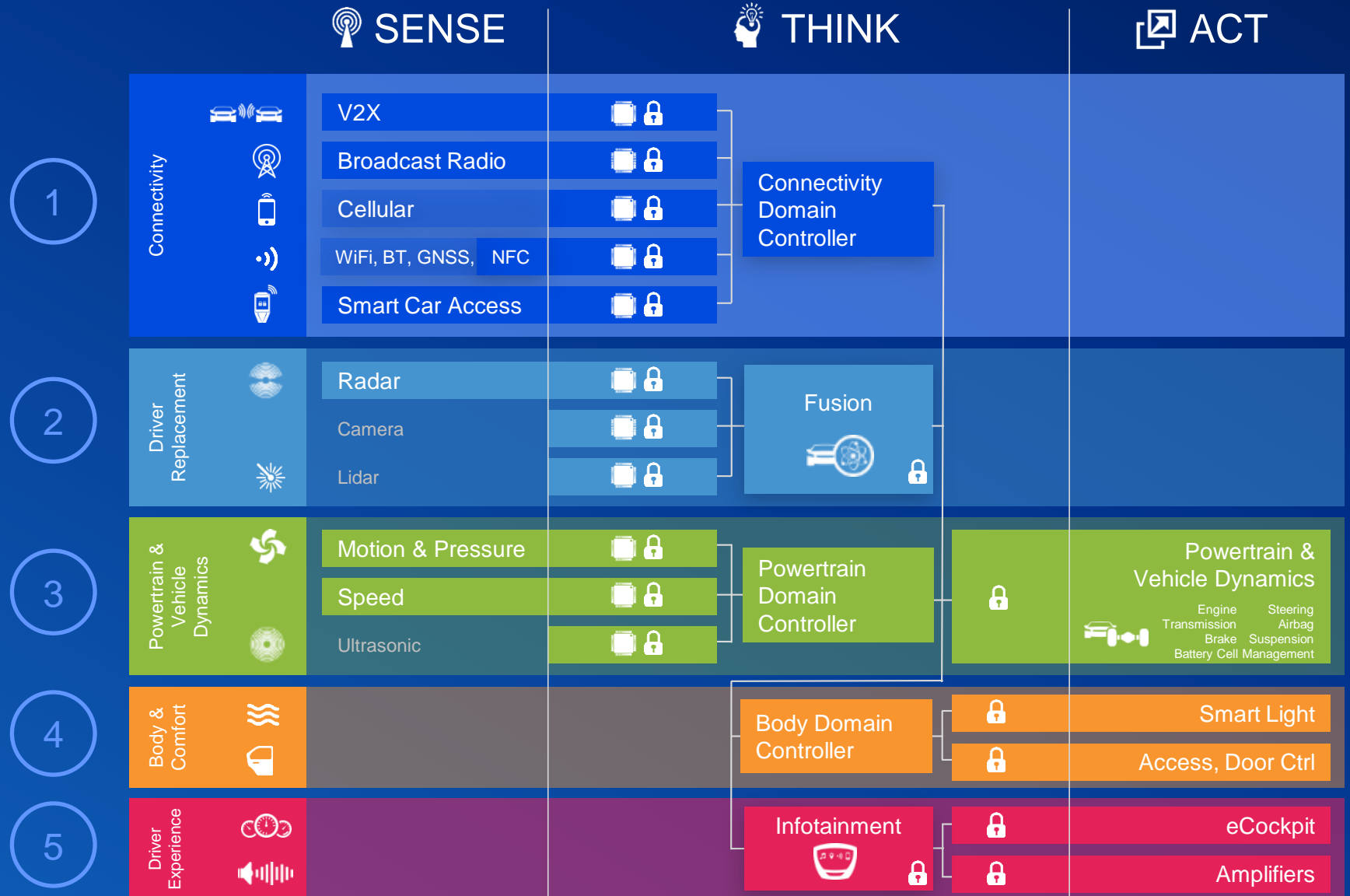


COMPLETE SOLUTIONS

Faster Time To Market
Full Scalability

NXP Leads Domain Based Vehicle Architectures:

- ▶ Connectivity
- ▶ Driver Replacement
- ▶ Powertrain & Vehicle Dynamics
- ▶ Body & Comfort
- ▶ Driver Experience



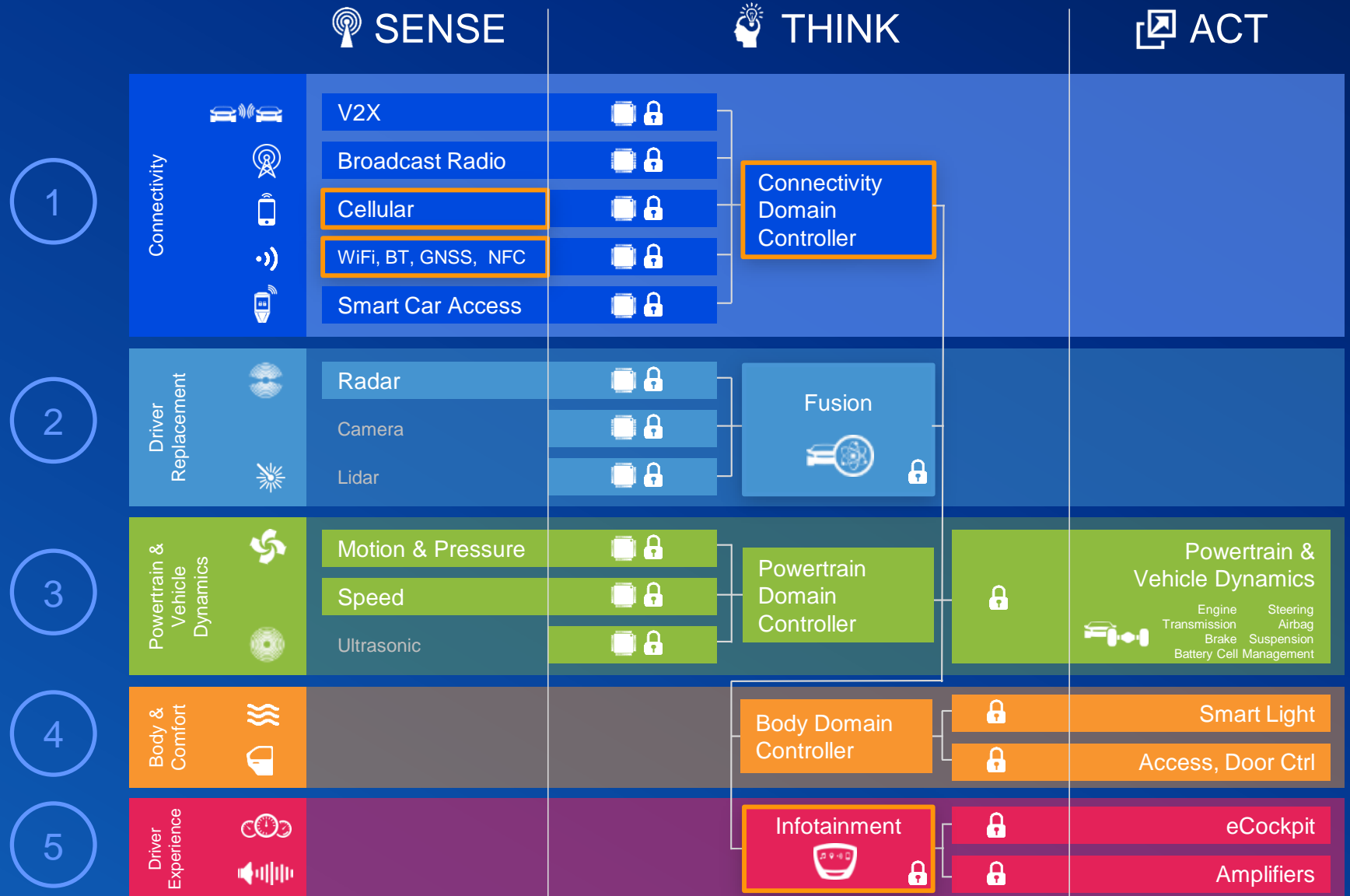


COMPLETE SOLUTIONS

Faster Time To Market
Full Scalability

QCOM Complements NXP

- Cellular
- WiFi / BT / GNSS
- Fusion
- Infotainment

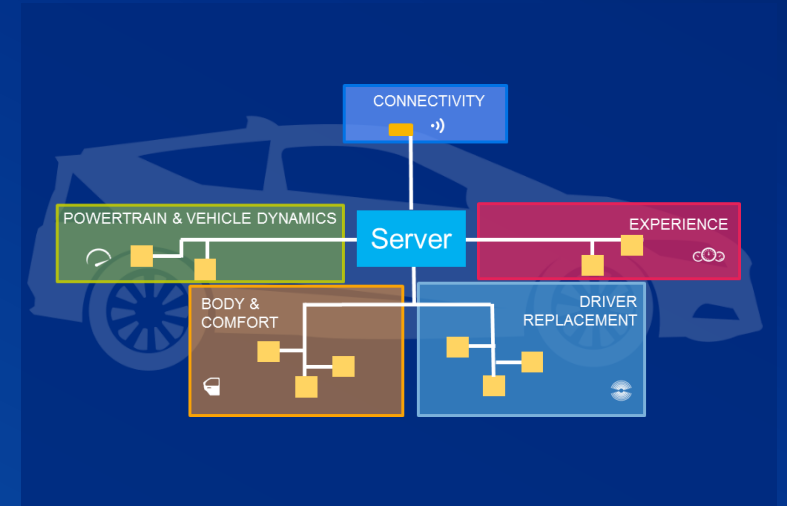
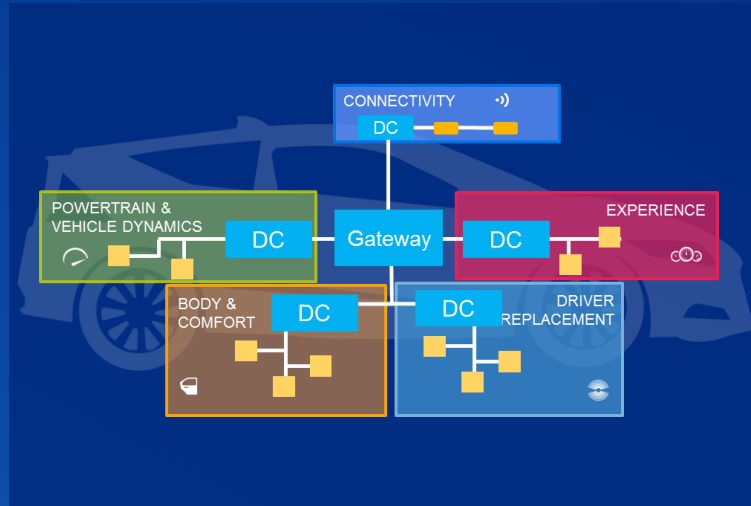
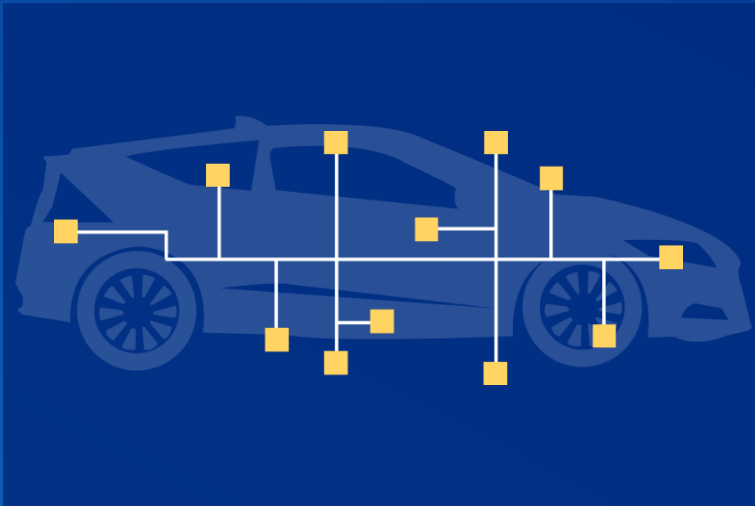


Future Networks Drive Future Architectures

Distributed: Flat Hierarchy

Domain: Domains separated by gateway

Centralized: Central server hosts >1 domain



Simple: few ECUs only

- Direct connections
- Easily for low amount of ECUs



Separation of Concern (HW & SW)

- Safety
- Security
- Upgradeability
- Performance
- Improved SW scalability
- For complex networks



Cost

- Fewer ECUs
- Flexible use of compute power
- HW + SW upgradability
- Feature un-locking
- SW virtualization & hypervisor



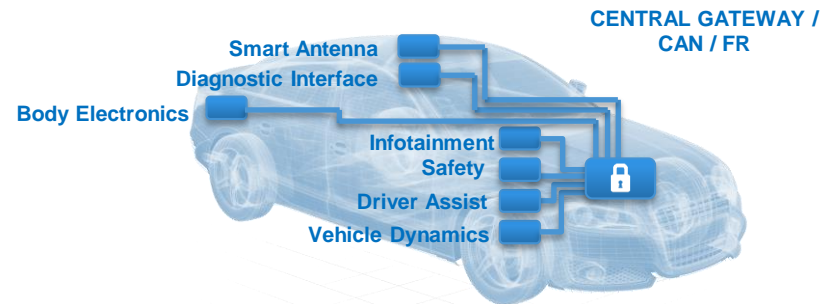
THE GLUE

NXP Gateways and In Vehicle Networks



NXP Gateway μ Cs & In Vehicle Networking

Secure Gateway μ C



Strong products, Strong growth markets

Target Applications:

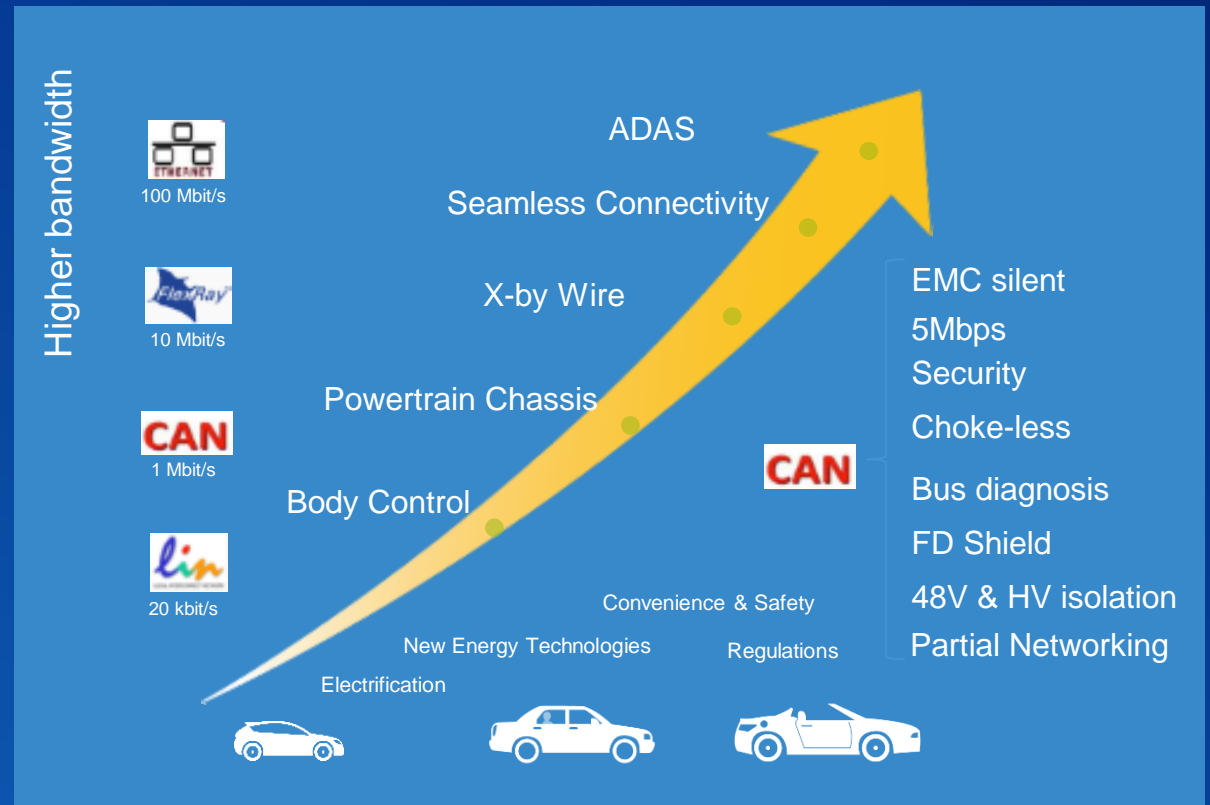
- Domain Gateways
- Central Gateways
- High-end Body Controllers

Key Value Proposition:

- Safety – ASIL B solutions with roadmap to ASIL D
- Security – Secure Hardware Extension (SHE) and HSM
- Networking – Multiple CAN/LIN, FlexRay, Ethernet interfaces
- Processing – Multi-core processing with hardware acceleration

In Vehicle Networking

More Functions & Higher Value




















Connectivity

WINDOW TO THE OUTSIDE WORLD

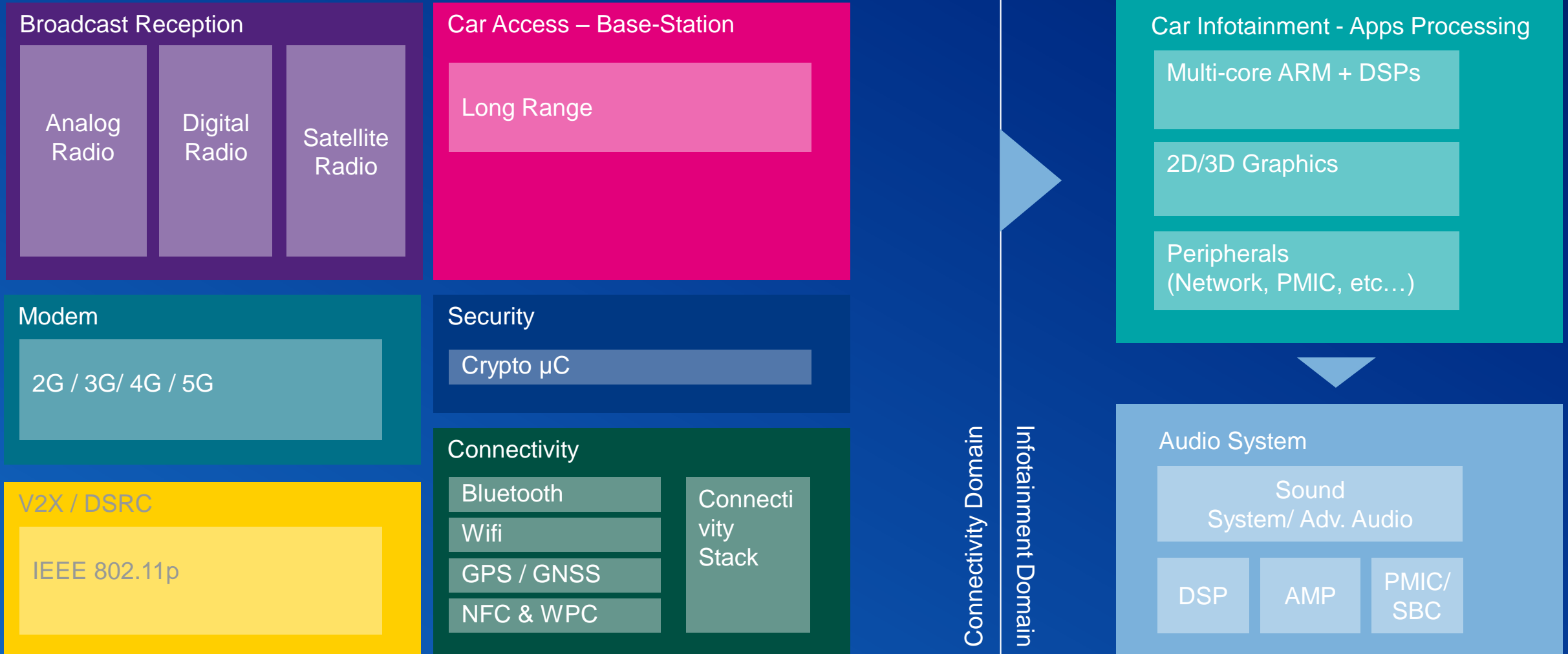
 SENSE

 THINK

 ACT

    	V2X	 
	Broadcast Radio	 
	Cellular	 
	WiFi, BT, NFC	 
	Smart Car Access	 

SMART ANTENNA → Connectivity Domain in ONE ECU



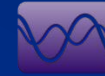
Mercury family

Mercury One-Chip



Mercury Key Features

- ✓ Global single chip radio (analog, digital, audio)
- ✓ Software Defined Radio / field upgradeable
- ✓ Wideband tuner concept / turbo tuning
- ✓ Advanced Audio & reception improvement



Advanced Audio Upgrades

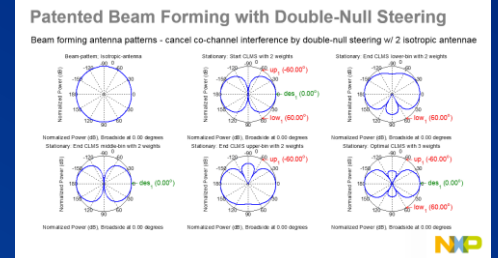
Digital Radio Upgrades

Engine Sound Design

Electrical Vehicle Radio

Prepared for future features

- ✓ Seamless-blend / IP-blend
- ✓ HD beamforming & reception algorithms
- ✓ AM Wideband Noise cancelling (EV/HV)
- ✓ Reception improvement (IM3, CEQ, FMSI, INCA, etc.)



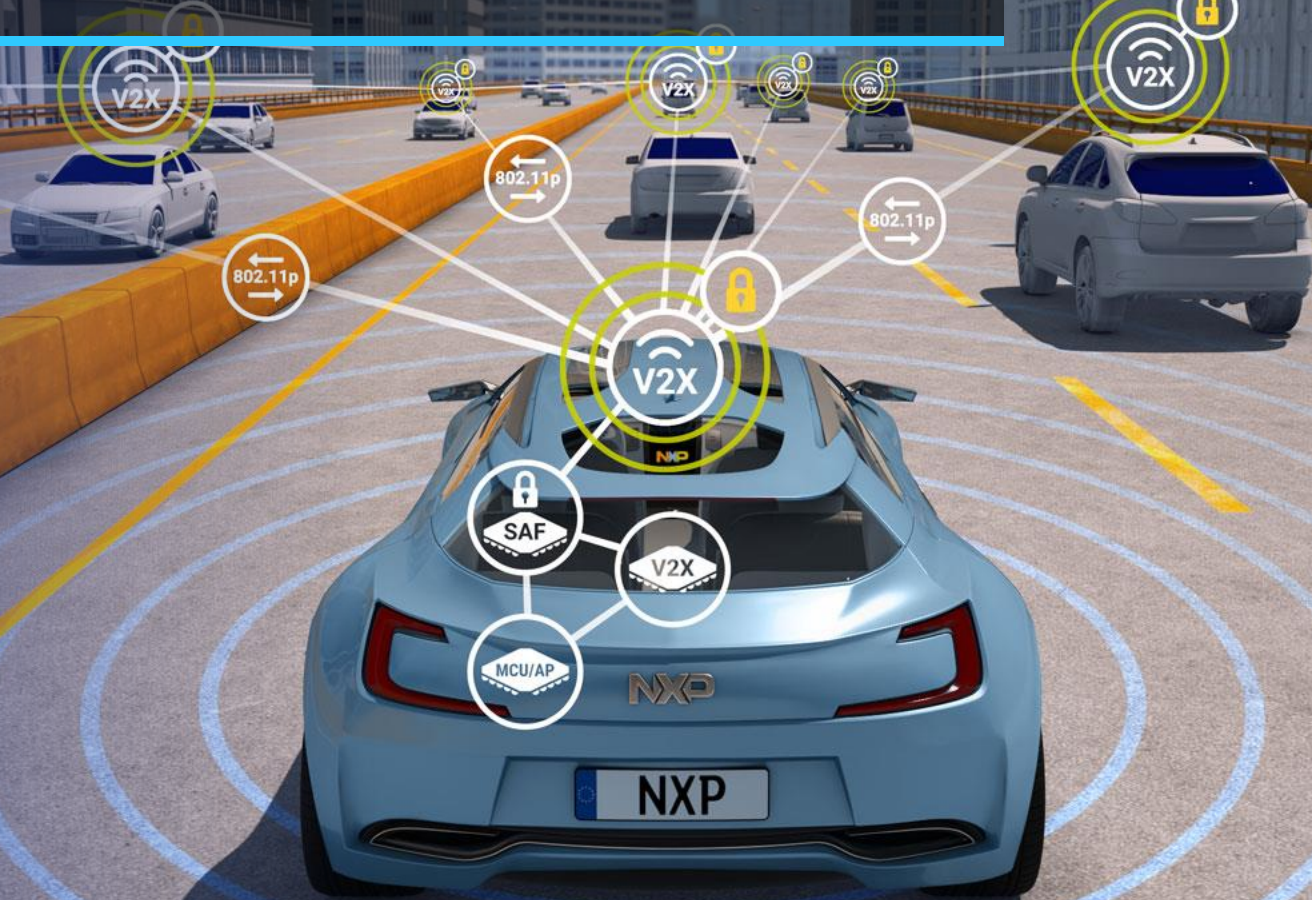
NXP 1st silicon fully functional

- ✓ 1st silicon fully functional
- ✓ Sampling @ multiple T1's
- ✓ FM & DAB audio out running, other standards on track
- ✓ Validation & pre-qualification ongoing



BETTER SENSES WITH V2X

Seeing the invisible



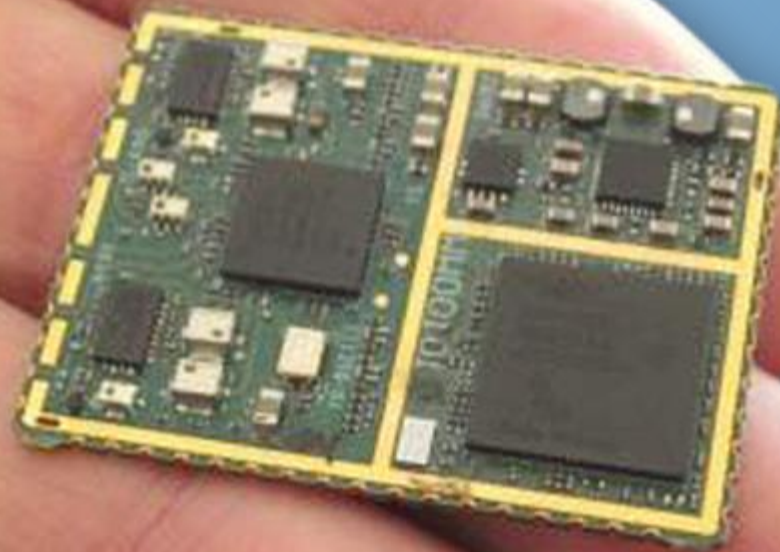
BETTER SENSES WITH V2X

Seeing the invisible

Announcing
THE NEXT-GENERATION
OF SECURE VEHICLE-TO-X



RoadLINK



FIELD TESTED
+ 1 million days of testing

ON THE ROAD TODAY
major U.S. carmaker
Road Side Units around the globe

NXP

Secure Car Access – System Evolution

Market Trend Towards Flexible & Smart Access Solutions

HW-based Solutions



Smart Key

Enhanced PKE System in a high-end design (Sensors, MCU, Display, 2-RF)



PKE Modules

Key is integrated in small form-factor PKE hardware to fit into a portable device

SW based Solutions



Virtual Keys

Use temporary keys from cloud to provide mobile/wearables car access

Security

Flexibility

VIP Key

Flexible Key in a Smart Device

Car Sharing/Pool & Payment



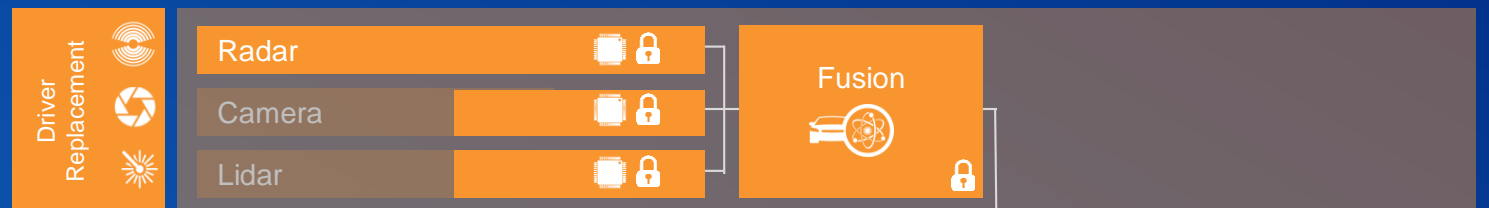
Driver Replacement



 SENSE

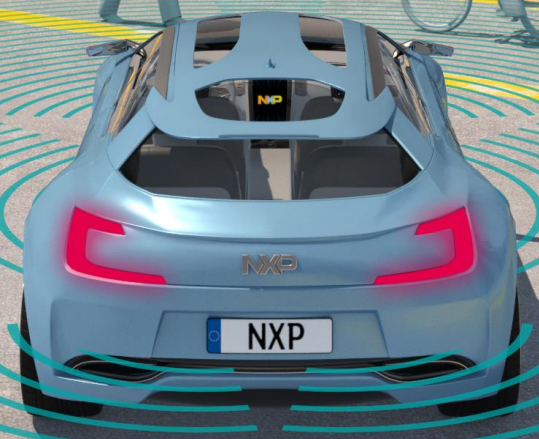
 THINK

 ACT



BETTER SENSES WITH RADAR

Miniature sensors with imaging capabilities, 360°



BETTER SENSES WITH RADAR

Miniature sensors with imaging capabilities, 360°

FIELD TESTING

Underway in Google's self-driving car project

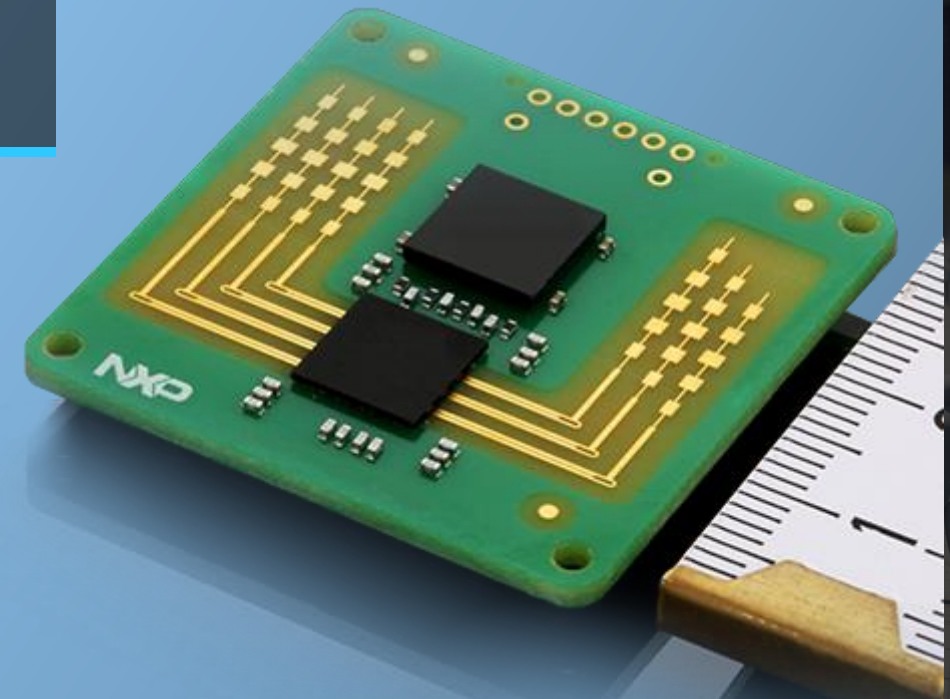
COMING TO ROADS

Basis for next-generation Hella sensors

Releases early 2018

Field tested by

Google



NXP

RADAR SENSORS – OEM Expectations

PERFORMANCE

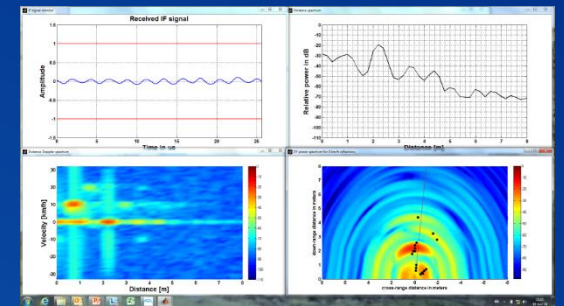
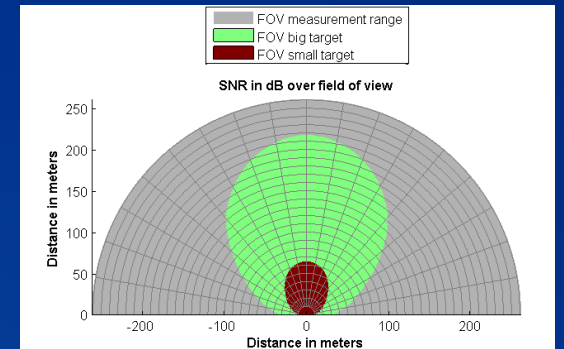
- Robust performance under all conditions
- Miniaturization / cost effectiveness
- Improved Perception: height, imaging, classification
- High 360° detection performance of static and dynamic targets

TOOLS & SUPPORT

- Efficient simulation tooling
- 3D construction combined with simulation
- Support for sensor validation & virtual validation

FEATURES

- Standardized Interface (Measurement, Debugging & Vehicle Connectivity)
- High data rate interconnectivity to record and replay sensor data
- Testing capability at all processing stages – from antenna to object data



77GHz RFCMOS Radar – A Logical Choice



Autonomous Functions

- Braking
 - Parking
 - Steer, Stop & Go
- Towards full auto-pilot



Regulations to protect Vulnerable Road Users

- Pedestrians
- Bikes



Silicon Technology Smaller feature size

- Faster RF
- Faster Digital
- Lower Power

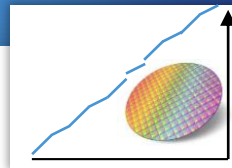
INDUSTRY DRIVERS



Fast Chirp

76-81GHz Radar

- High Resolution
- Direct Speed & Range Measurement
- Low Power Consumption
- Small footprint
- Ease of application



Increased

- mmWave Performance
- Processing Power
- Integration Level
- Scale Economies

DEMAND FOR SILICON INNOVATION

RFCMOS Radar Transceiver



RFCMOS 1-chip Radar



RFCMOS RADAR

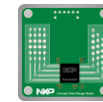
> 250m ✓

High Performance Radar

- Multi Frontends
- Strong Radar μ C

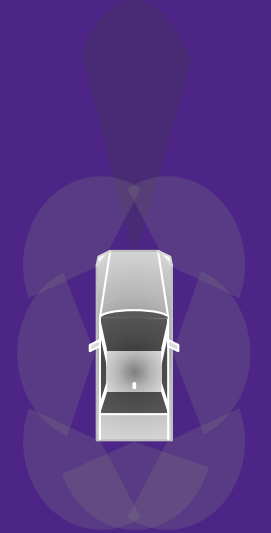


Small Affordable High Resolution Radar Sensors



0-120m ✓

ENABLING NEW TYPES OF SENSORS



- Precise range, approach speed, angle data
- Short-, mid- and long-range functionality
- Multi-target discrimination
- One radar for multiple safety systems

ENABLING COCOONING

/Autonomous
/Sensing
/Communication
/Battery
/Navigation
/Mirrorless

BETTER SENSES WITH HIGH-PERFORMANCE VISION

Scalable, functionally safe, AI ready



/Autonomous
/Sensing
/Communication
/Battery
/Navigation
/Microservices

BETTER SENSES WITH HIGH-PERFORMANCE VISION

Scalable, functionally safe, AI ready



HELLA Aglaia and NXP revealing at IAA:
OPEN VISION PLATFORM FOR
SAFE AUTONOMOUS DRIVING



235A53+

NXP RADAR & VISION μ C Portfolio

Radar



#1 in Radar μ C

Strong growth through Integration

S32R

Scalable, highly Integrated, Safe and Secure family driving the digitalization of radar and sensor data fusion; designed in at 8 of top 10 OEMs
Strong System Know-How

Vision-Fusion



Entering Vision-Fusion

OpenVision: Perf/Power, Safe and Secure

S32V

Automotive Open Platform built on Quality, highly performing fully abstracted Accelerators, uncompromised Safety and Security

AUTOMATION OF DRIVING DECISION

Industrializeable, low power, secure



Massive Growth in Computing AND Safety Requirements

Super Computing

Safe Computing

Automated Drive

Co-Pilot

Collision Avoidance

Self Parking

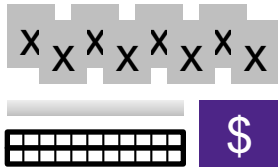
Lane Keeping

Collision Warning

Sign View

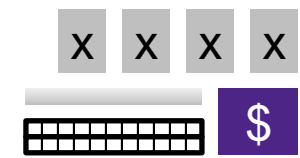
Number Cruncher

Layerscape



Safety Processor

S32V234



Probabilistic

1. Analyze Scenario
2. Make Contextual Decision

Deterministic

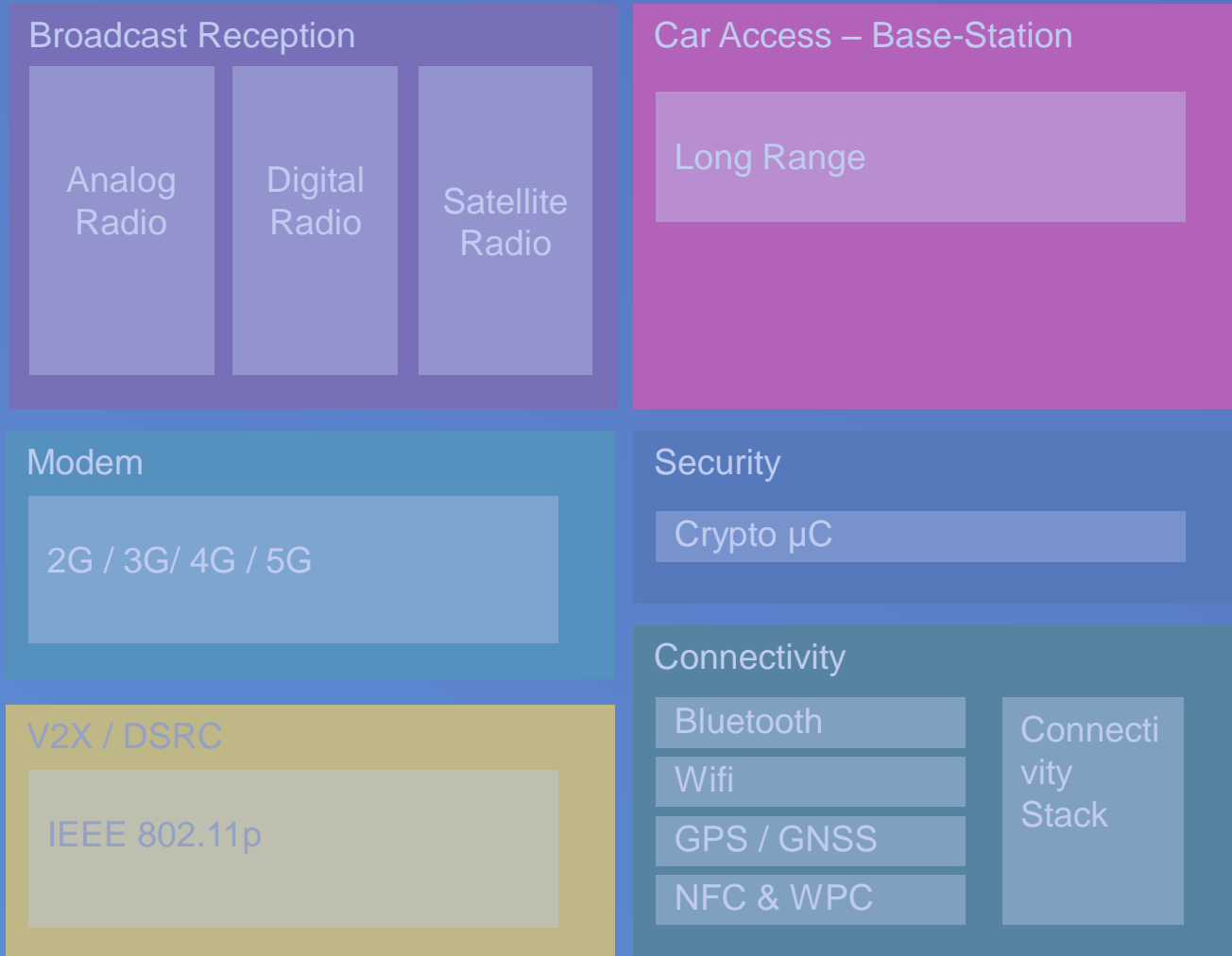
1. Initiate Safe Measure
2. Fail Safe / Operational



EXPERIENCE & PASSENGER WELLBEING

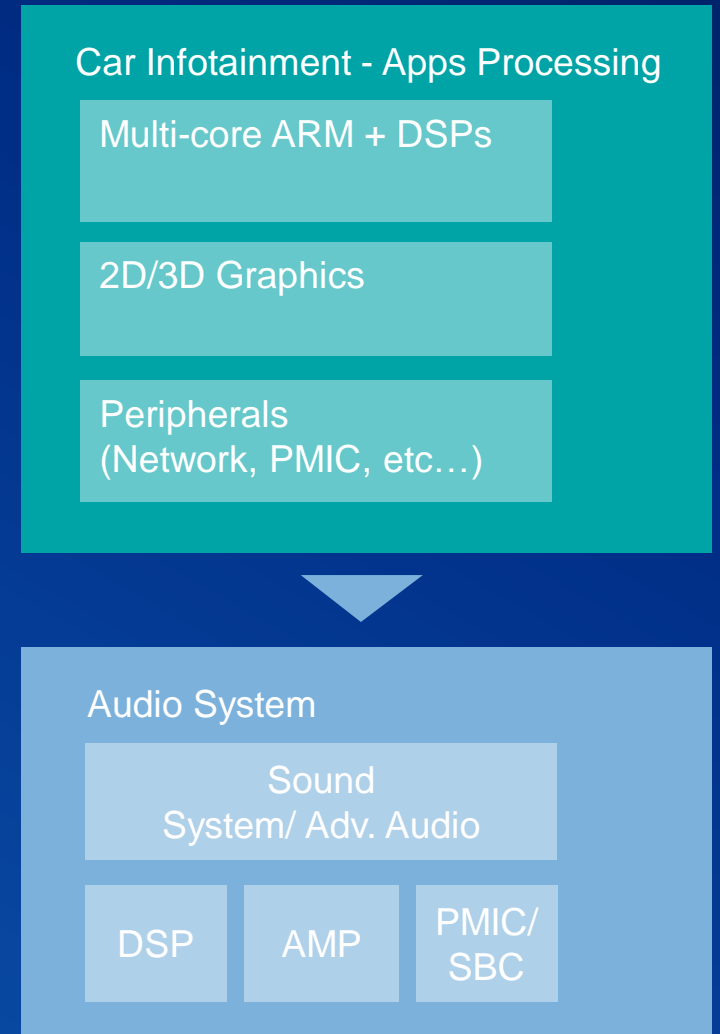


NXP INFOTAINMENT - APPS & AUDIO

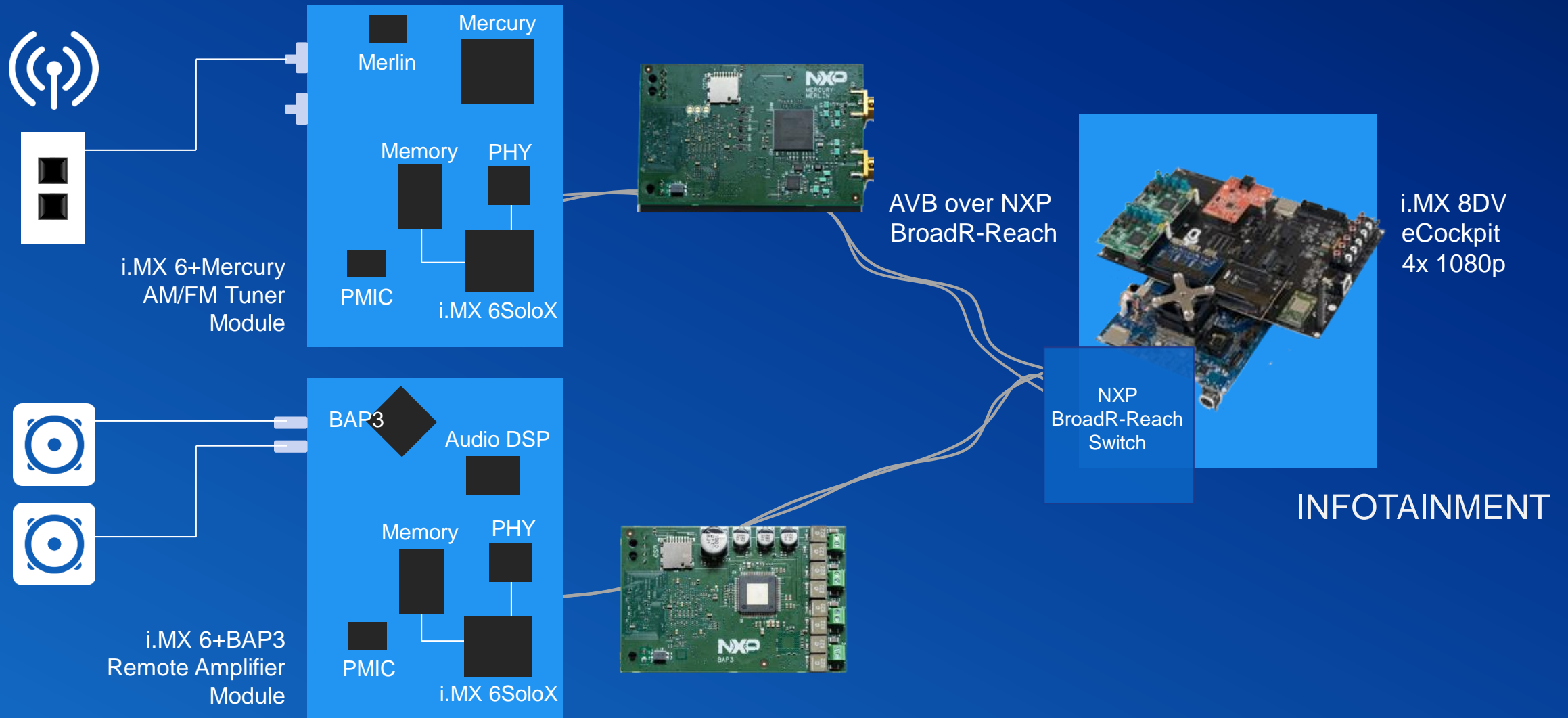


Connectivity Domain

Infotainment Domain



Infotainment: Unique System Opportunity



Infotainment: Development Platform

QCA 6574 (BT/WiFi)

PMIC

Snapdragon
S820Am

Hex Inverter

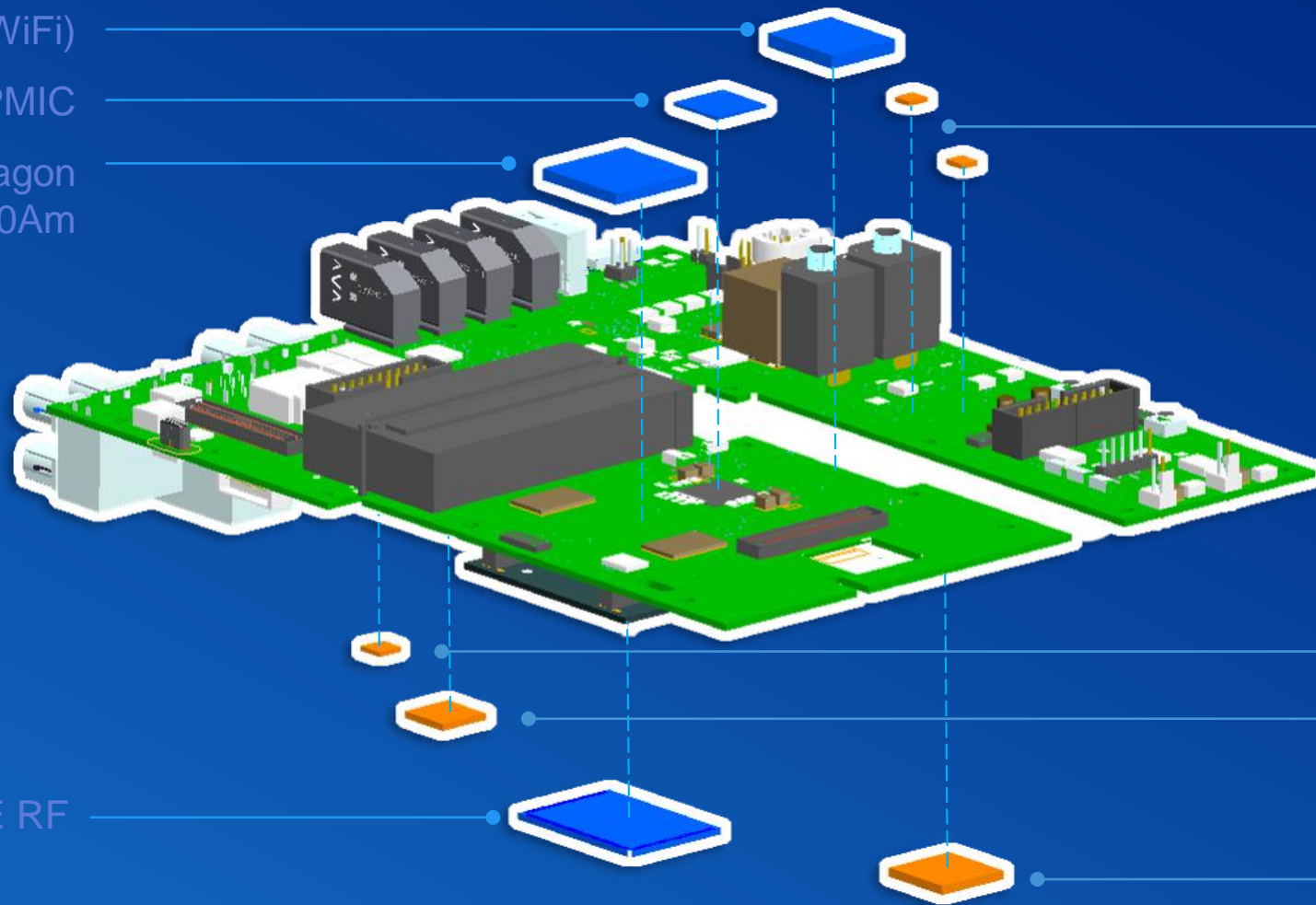
Qualcomm
NXP

BroadReach PHY

Ethernet Switch

LTE RF

Dirana III (Car Radio)





BODY & COMFORT

 SENSE

 THINK

 ACT



POWERTRAIN & VEHICLE DYNAMICS

 SENSE

 THINK

 ACT



SMART ACTUATORS - Drivers and Energy Management

Enabling green power train for efficient energy management

Solid State Lighting Control

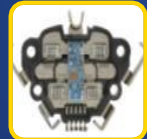
LED Drivers, Intelligent Matrix Controllers



1st driver with 2 stage scalable buck boost
Driver supports high current LED, laser
Controller with ramp curve generation

DC, BLDC Motor Control

H-Bridges Drivers, 3-Phase Gate Drivers



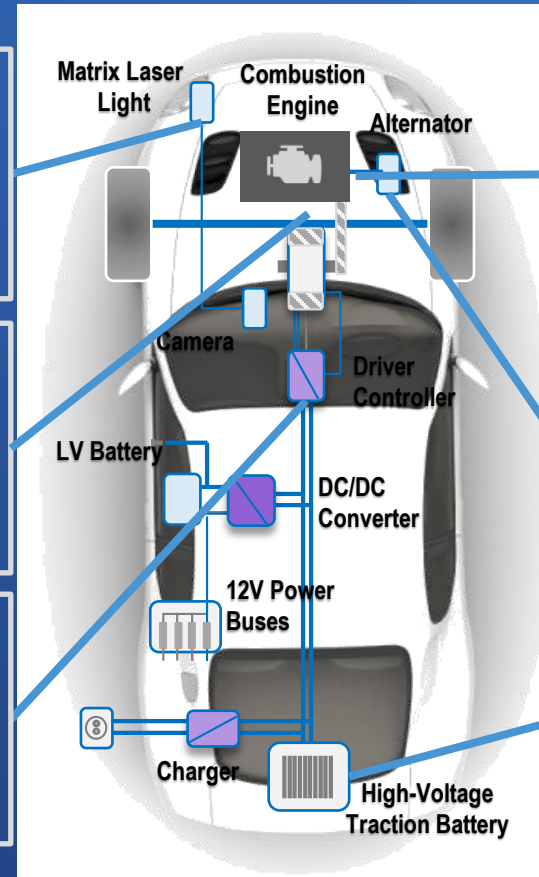
SPI control with configurable slew
Real-time load current monitoring
Functional safety ASIL-C solution

Electric Vehicle Power Converter

IGBT Gate Drivers, 48V Gate Drivers



Low IGBT Module BOM cost
Small footprint over-current protection
Integrated HV Isolation
Functional Safety ASIL-D



Power Train Solenoid Control

Direct Fuel Injection (DFI),
Automatic Transmission Solenoid Controllers



Integrated End-of-Injection measurement
Low latency and high dynamic precision
Lowest system BOM implementation

Combustion Engine Energy Management

LIN-based Alternator Regulators



High regulation accuracy
12A capable
Robust low battery operation
Highly configurable

Electric Vehicle Li-Ion Battery Management

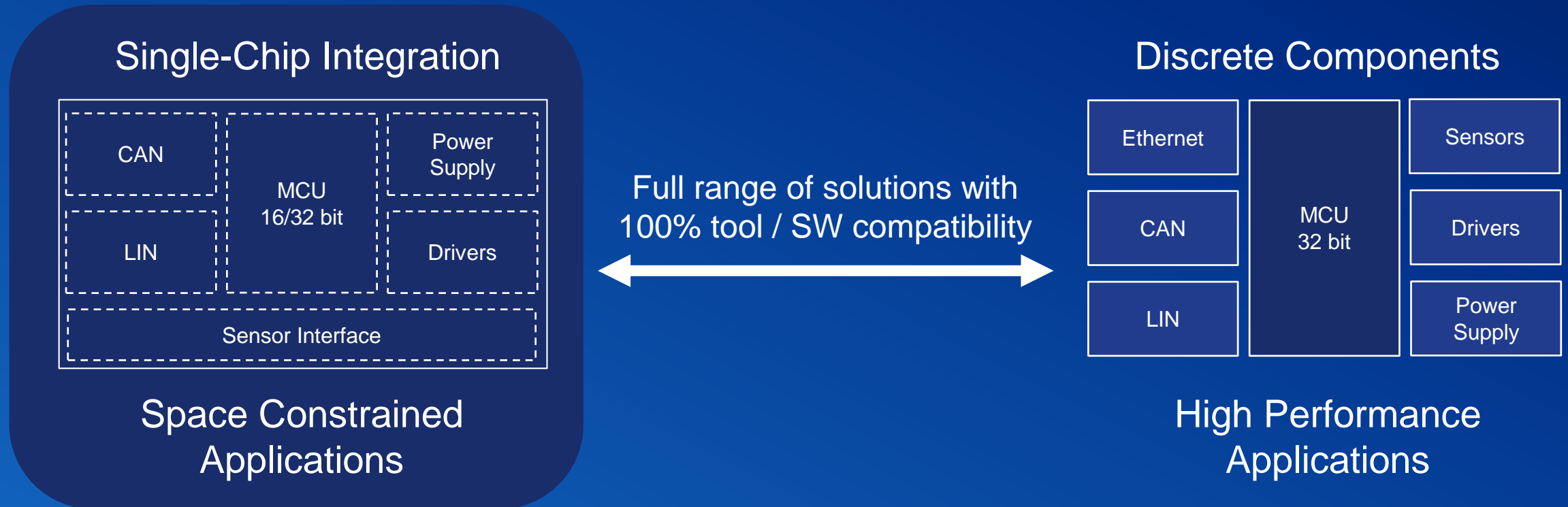
14V, 48V & HV Li-Ion Battery Cell Controllers



Highest integration
Single-chip ASIL-C
High speed isolated daisy-chain
Time aligned impedance measurement

NXP S12 MagniV Microcontrollers - Integration of Body μ C & IVN

Full Scalability for Easiest Design



MAKING VISION ZERO A REALITY



AUTO PORTFOLIO

We offer the most complete system solutions for fastest time to market and scalability



AUTO DOMAIN COMPETENCE

We embrace stringent functional safety and quality requirements



INNOVATION POWER

We leverage in-house processing, software, security and mobile eco-system capabilities



AUTO QUALITY

We consider zero defect quality as core element of our business strategy



MAKING
VISION ZERO
A REALITY

NXP





SECURE CONNECTIONS
FOR A SMARTER WORLD