Xilinx Automotive

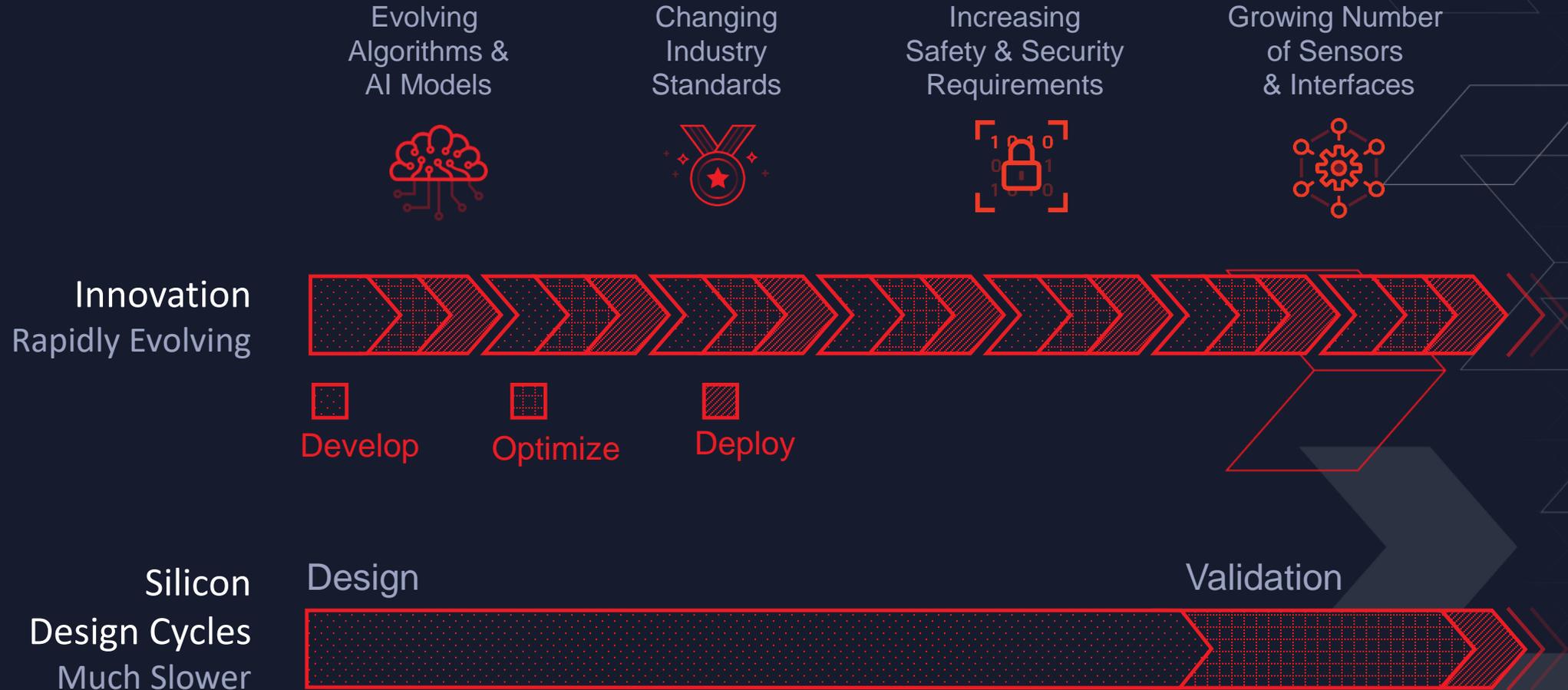## The Need For Real-Time Adaptive Silicon Solutions

Wayne Lyons

Director, Automotive and Strategic Customer Marketing

Note: Packaging shown is an illustration. For detailed package information refer to datasheet

Innovation Cycles Outpacing Silicon Design Cycles

Evolving Algorithms & AI Models

Changing Industry Standards

Increasing Safety & Security Requirements

Growing Number of Sensors & Interfaces

Innovation
Rapidly Evolving

Develop   Optimize   Deploy

Silicon Design Cycles
Much Slower

Design

Validation

The World Needs Adaptive Compute …

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The Redefinition Of The Automobile

- ## ADAS
  Gradual transition from Computer Vision to AI for object detection, tracking and collision avoidance using edge sensors, cameras, RADAR and LiDAR
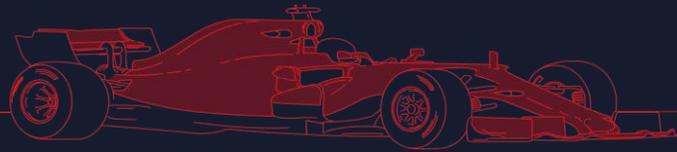
- ## In-Cabin Experience
  In-vehicle monitoring relying more on AI inference to identify occupants' alertness, gestures, preferences
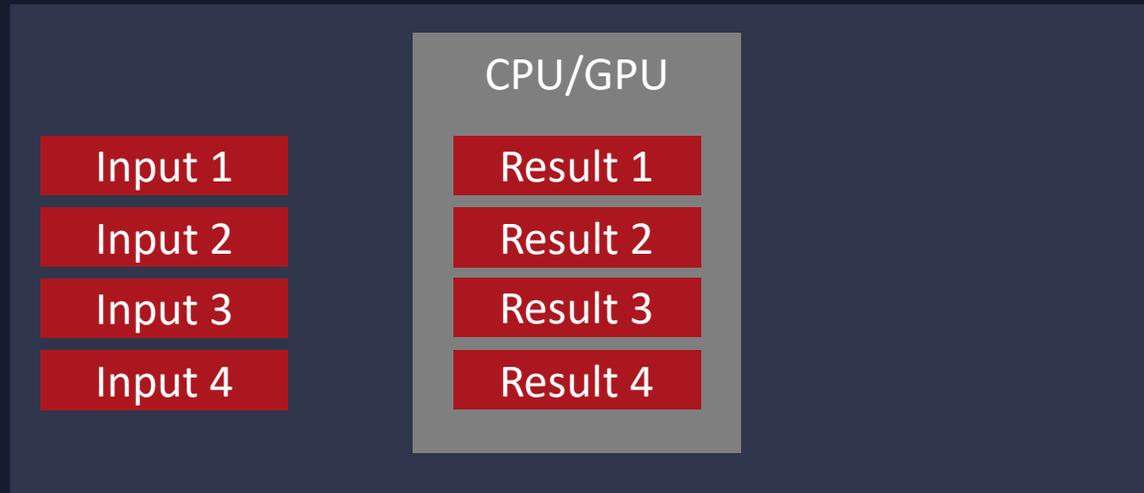
- ## Automated Driving
  Adoption over next decade of conditional vehicle automation to full autonomous vehicles and Transportation-as-a-Service (TaaS)

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Low Latency is Critical for Automotive AI

High throughput OR low latency

CPU/GPU

Input 1	Result 1
Input 2	Result 2
Input 3	Result 3
Input 4	Result 4

latency response

High throughput AND low latency

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Input 1	Result 1
Input 2	Result 2
Input 3	Result 3
Input 4	Result 4

latency response

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"Real Life" Example Of Latency With Level 4 AV

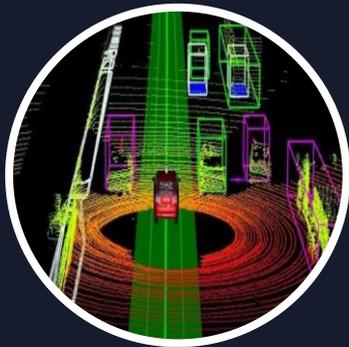**Without Xilinx**

With Xilinx

Data shared from Pony.AI

Similar relative speed between ego and other vehicle in both scenarios

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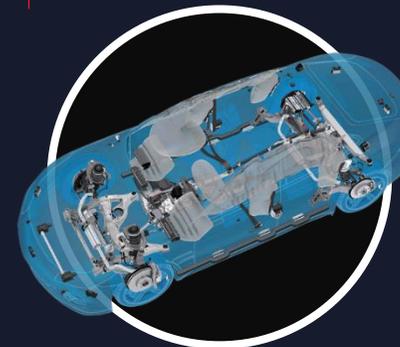# Example Applications Where Xilinx Is Successful

ADAS Applications

Forward Camera

LiDAR

4D RADAR

Surround View Camera

Full Display Mirror

DMS & OMS (ICMS)

AD Central Module Functions

Data Aggregation &
Pre-processing
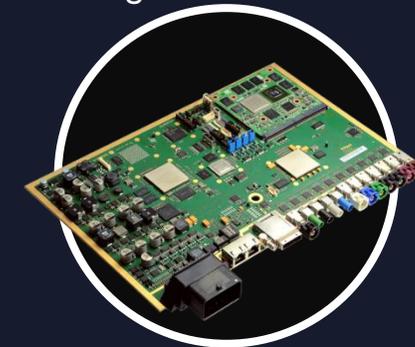
Sensor Fusion

Compute Acceleration

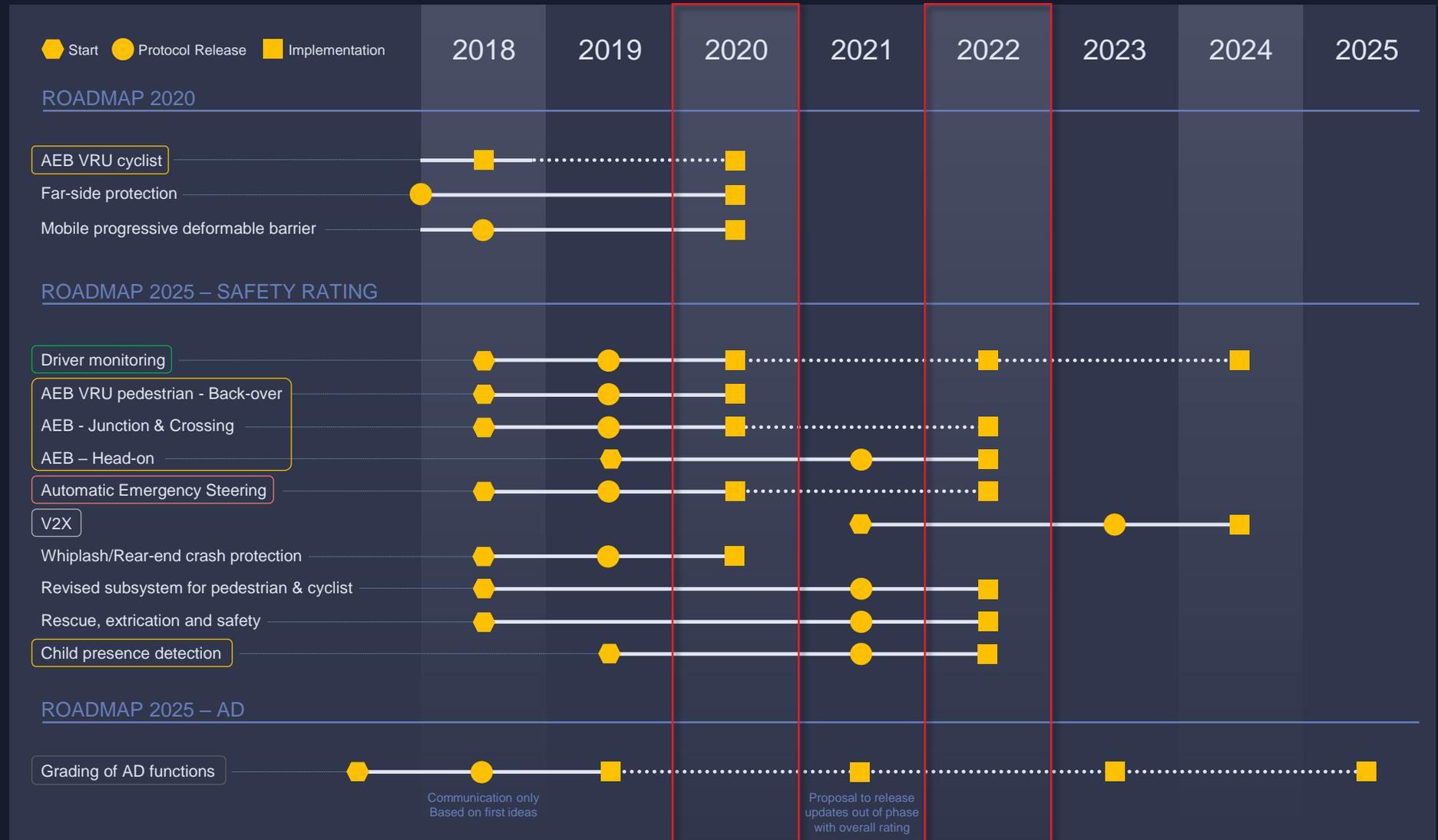XILINX.

One Example of Automotive Fast Changing Requirements
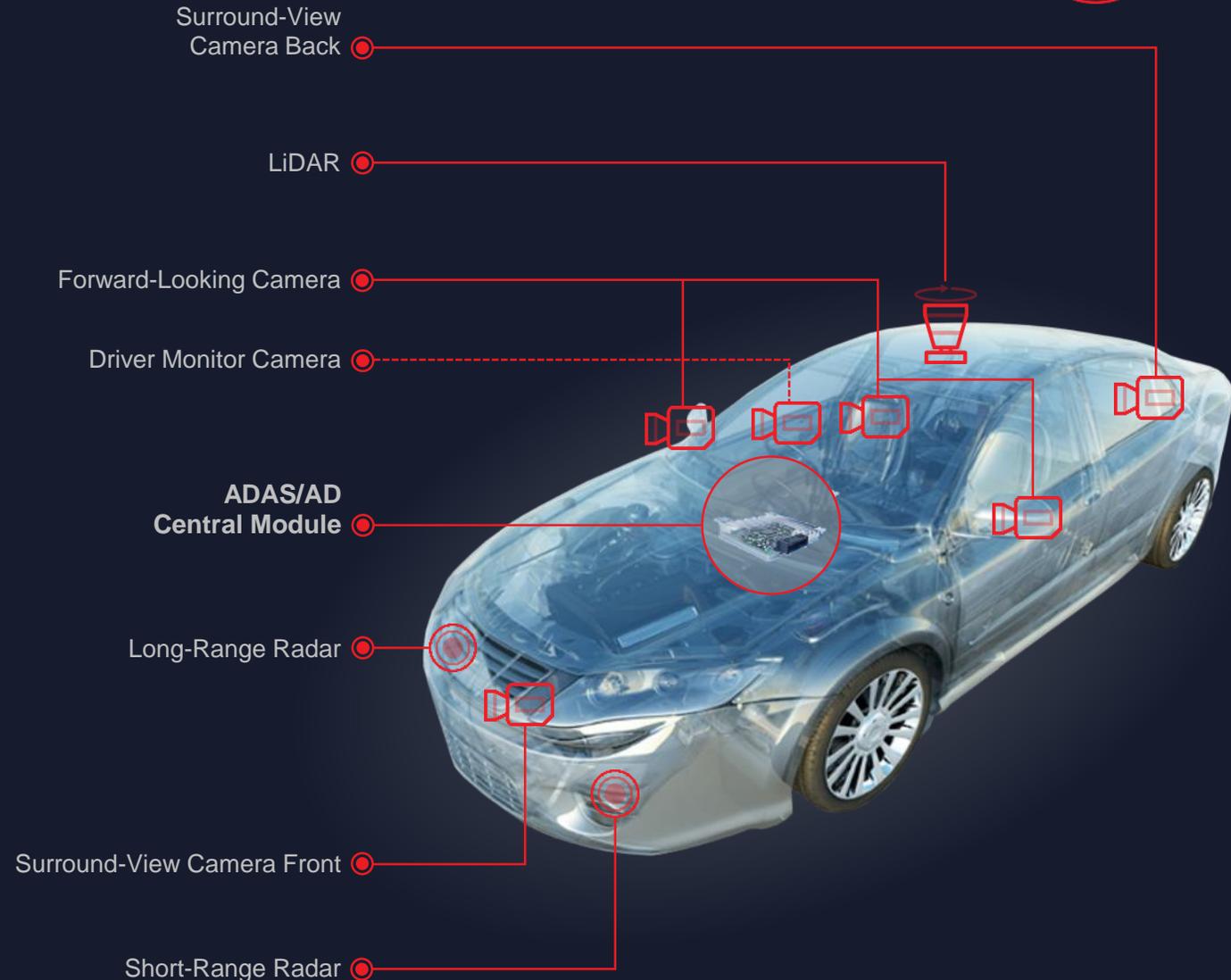## *Euro NCAP Roadmap 2020 – 2025*

1. AEB requirements will be updated along the way
2. New functions need more performance and may only be achieveable with sensor fusion (camera + x)
3. AEB – Back-over needs either additional camera (similar to FWD cam) or surround view system.

- Driver monitoring will be required, independent of any AD function
- Emergency Steering – most probably will re-use LKA hardware
- V2X – not relevant for now. Uncertainty regarding technical standardization and feature roll-out.
- Child presence detection – will drive additional hardware, may be combined with driver monitoring system
- AD – NCAP will drive acceptance of AD systems in the market but not include in star rating for the forseeable future

Start ●**Protocol Release** ■**Implementation**

| 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |

ROADMAP 2020

- AEB VRU cyclist
- Far-side protection
- Mobile progressive deformable barrier

ROADMAP 2025 – SAFETY RATING

- Driver monitoring
- AEB VRU pedestrian - Back-over
- AEB - Junction & Crossing
- AEB – Head-on
- Automatic Emergency Steering
- V2X
- Whiplash/Rear-end crash protection
- Revised subsystem for pedestrian & cyclist
- Rescue, extrication and safety
- Child presence detection

Communication only
Based on first ideas

Proposal to release updates out of phase with overall rating

ROADMAP 2025 – AD

- Grading of AD functions

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Sensors Market Trends

> **Forward Camera will become a "standard feature" in CY22/23**

> **Imager Resolutions and Field of View (FoV) increasing for ML**

>> Forward Camera   1.7M Pixel ➔ 8M Pixel

>> Surround View   1.0M Pixel ➔ 2/4M Pixel

>> Automated Driving   4.0M Pixel ➔ 8/12M Pixel

> **2D RADAR transitioning to 4D Imaging RADAR**

> **LiDAR market remains highly fragmented**

> **Sensing targeting >200m range**

> **Transition to ADAS domain controllers (Central Compute)**

Surround-View Camera Back

LiDAR

Forward-Looking Camera

Driver Monitor Camera

ADAS/AD Central Module

Long-Range Radar

Surround-View Camera Front

Short-Range Radar

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Differentiation & Innovation Needs Adaptive Silicon

	Multi-channel Macro-mechanical scanning	Other mechanical scanning	MEMS LiDAR	Optical-phased array LiDAR	Flash LiDAR
Pulse LiDAR	Velodyne Valeo robosense 速腾聚创 SureStar HESAI OUSTER 镭神智能 LeiShen Intelligent System OCULAR ROBOTICS	NEPTEC Technologies Corp **1540 nm** CEPTON LUMINAR **1550 nm** Panasonic	Velodyne LeddarTech INNOVIZ TECHNOLOGIES robosense 速腾聚创 Pioneer AEYE Valeo **1550 nm**	QUANERGY robosense 速腾聚创	ARGO AI sense photonics **1350 nm** Continental tetravue XENOMATIX AUTOMOTIVE VISION SOLUTIONS
Phase shift			Benewake		ifm
CW LiDAR	Most automotive LiDAR players are considering pulse LiDAR				
FMCW				blackmore **1550 nm**	oryx **10µm**

Source: Yole Development

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Enabling "Running Changes" In Silicon
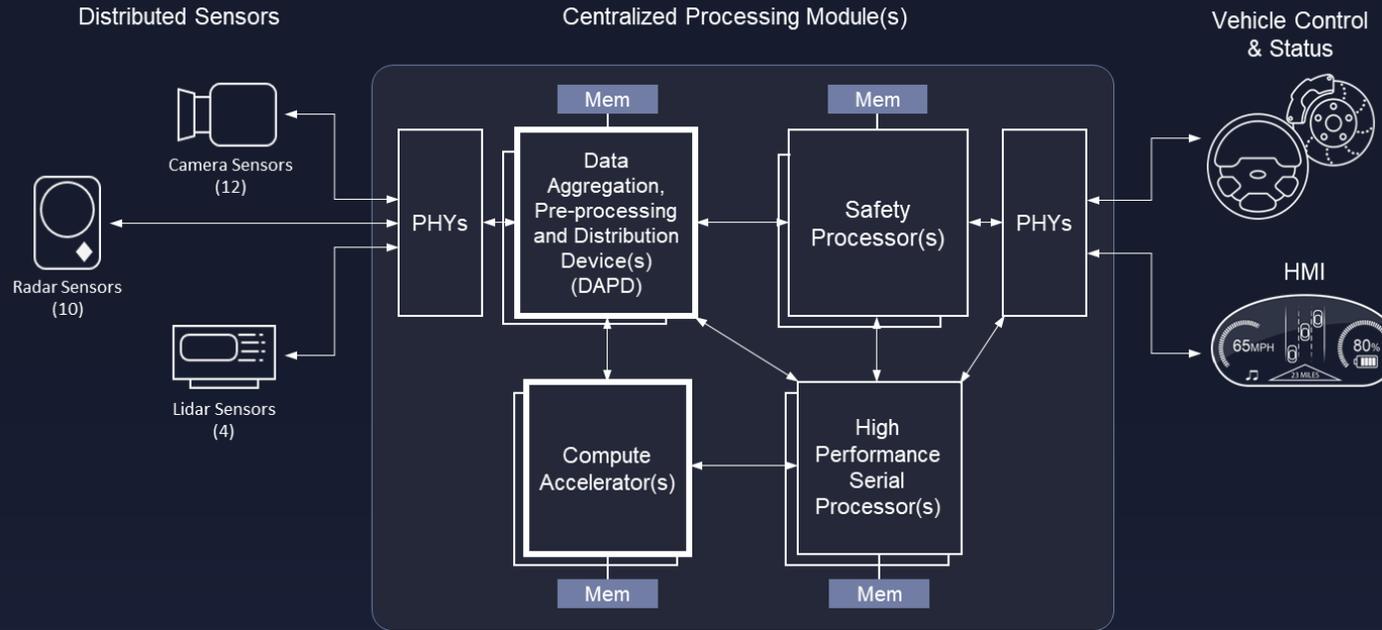
MIPI Performance Enhancement

> Roadmap of performance enhancements being made to the MIPI interface throughout 2019

> Another example of how mid-life enhancements are made possible with flexible technology

MIPI Protocol	2018.x	2019.2 (September)
PHY	D-PHY 1.1	D-PHY 2.0
Data rates	1.26/1.5Gbps	2.5Gbps
CSI (Camera)	CSI 2 V1.1	CSI V1.3
DSI (Display)	DSI V1.3	DSI V1.3

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Xilinx Dynamic Function eXchange (DFX)

For Mutually Exclusive Functions in ADAS/AD or ICMS

Pre-Drive Security

Keyless Entry
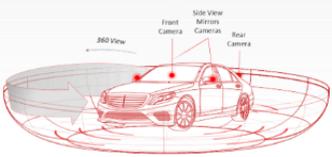
Vehicle Security
Perimeter & Interior Monitoring

Biometric Identification
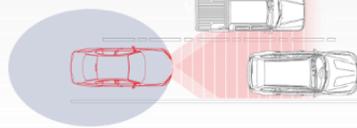Facial, Iris, or Voice

Low-Speed/Parking

Automated Park Assist

Front Camera
Side View Mirrors Cameras
Rear Camera
360 View

360 Degree Surround View

Highway Driving

Driver Monitoring System

Forward Camera w/ Surround Monitor

Pre-Drive Mode

Keyless Entry

Vehicle Security
Perimeter & Interior Monitoring

Biometric Identification
Facial, Iris, or Voice

Drive Mode

Driver Monitoring System

911

Passenger Safety

User Interfaces
Gesture, Voice

Advanced Restraints Control System

Post-Drive Mode

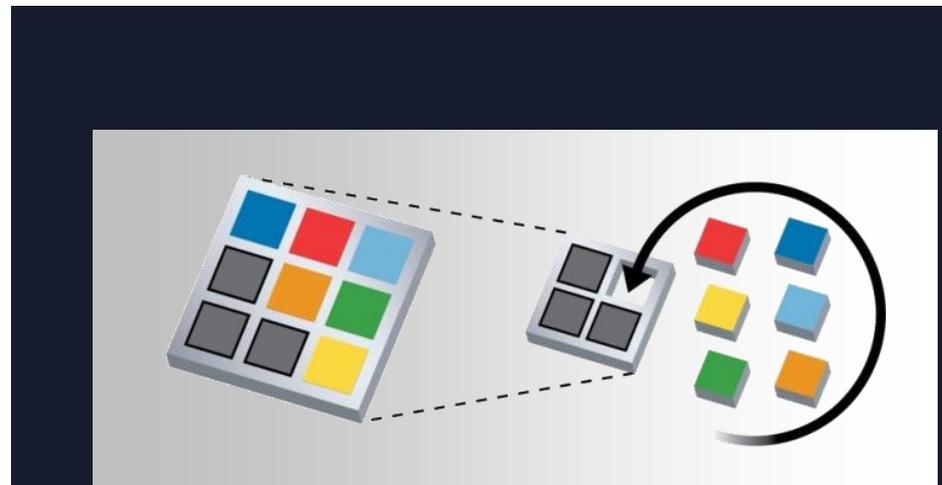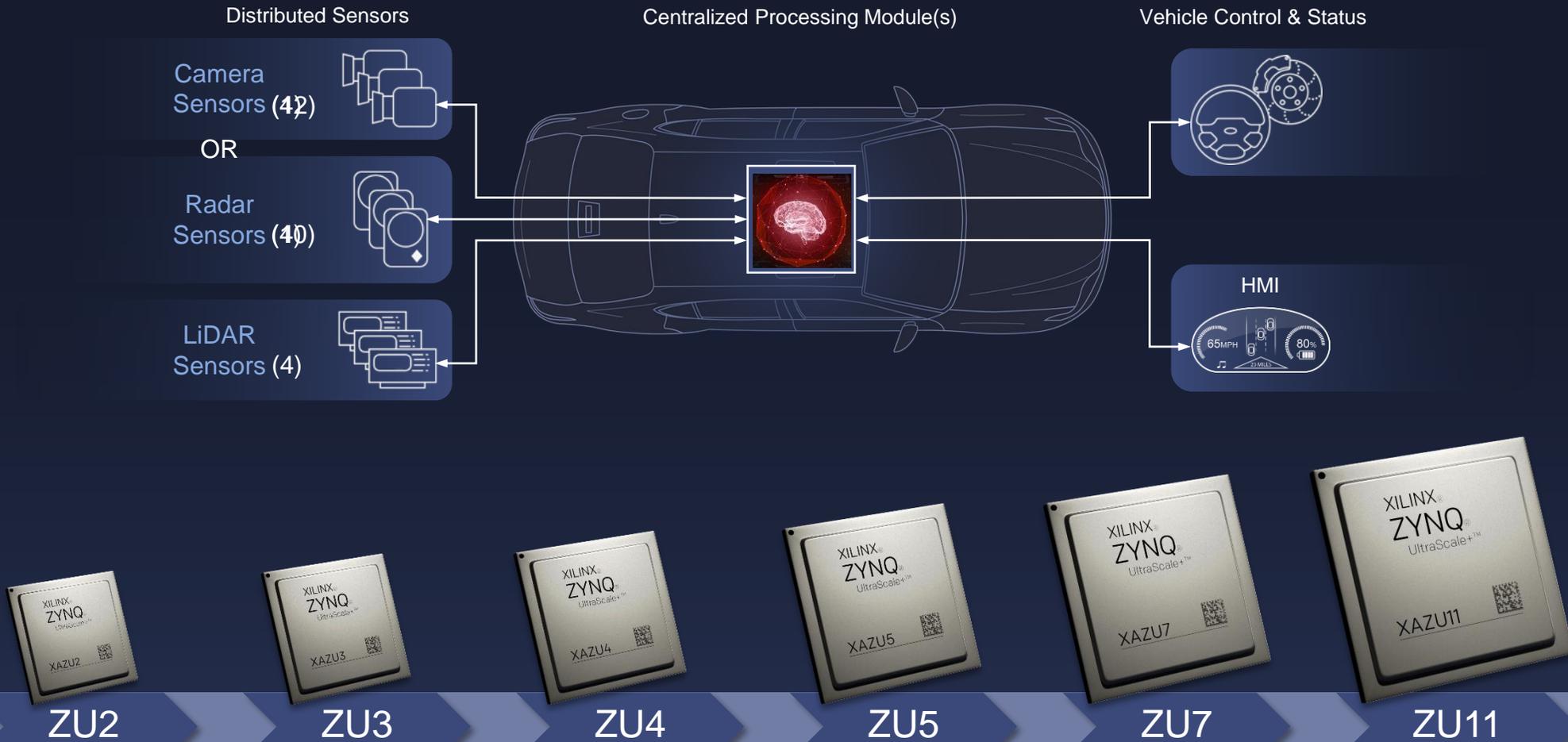**Child Left-Behind Warning**

Dog Mode
Perimeter & Interior Monitoring

Objects Left-Behind
Phone, Wallet, Purse, Sunglasses, Umbrellas

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Continuum From Edge Sensors To Domain Controllers

Distributed Sensors

Centralized Processing Module(s)

Vehicle Control & Status

Camera Sensors (12)

OR

Radar Sensors (40)

LiDAR Sensors (4)

HMI

65MPH   80%

ZU2   ZU3   ZU4   ZU5   ZU7   ZU11

XAZU2   XAZU3   XAZU4   XAZU5   XAZU7   XAZU11

Xilinx Announces the World's Highest Performance Adaptive Devices for Advanced ADAS and AD Applications

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We Are Very Pleased To Invite Two Companies From The Xilinx Ecosystem to Share Their Partnership Stories

Wind River

Silex

2+ BILLION DEVICES DEPLOYED

100+ AUTOMOTIVE PROJECTS ANNUALLY

500+ CERTIFIED CIVILIAN & MILITARY AIRCRAFT

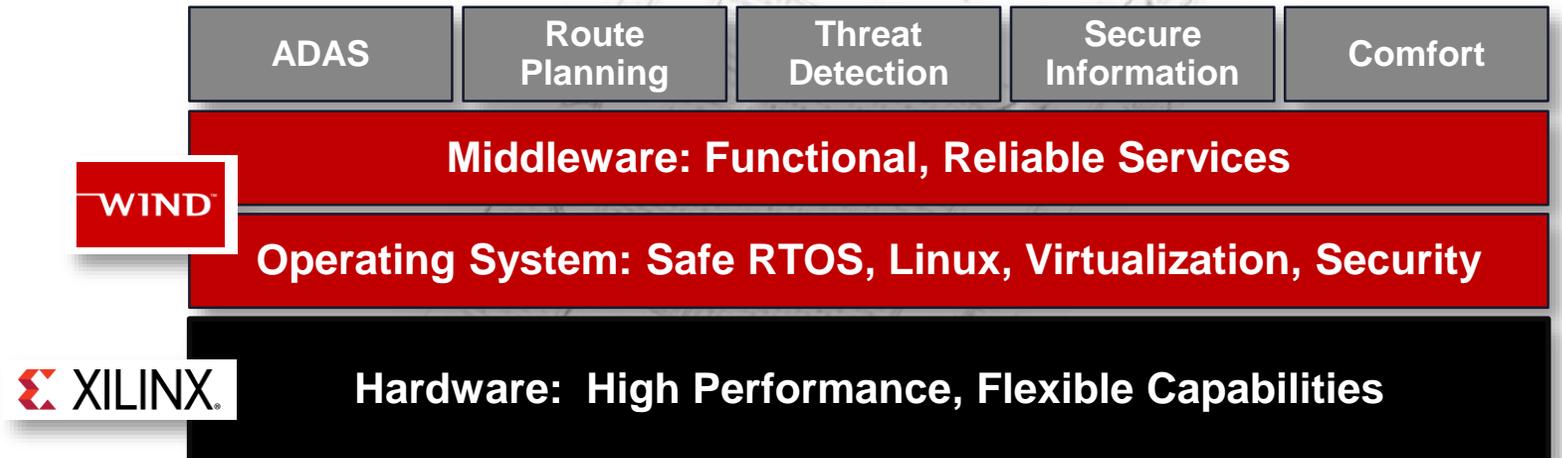**40% COMMERCIAL EMBEDDED LINUX MARKET**

ALL TOP TELCO MANUFACTURERS
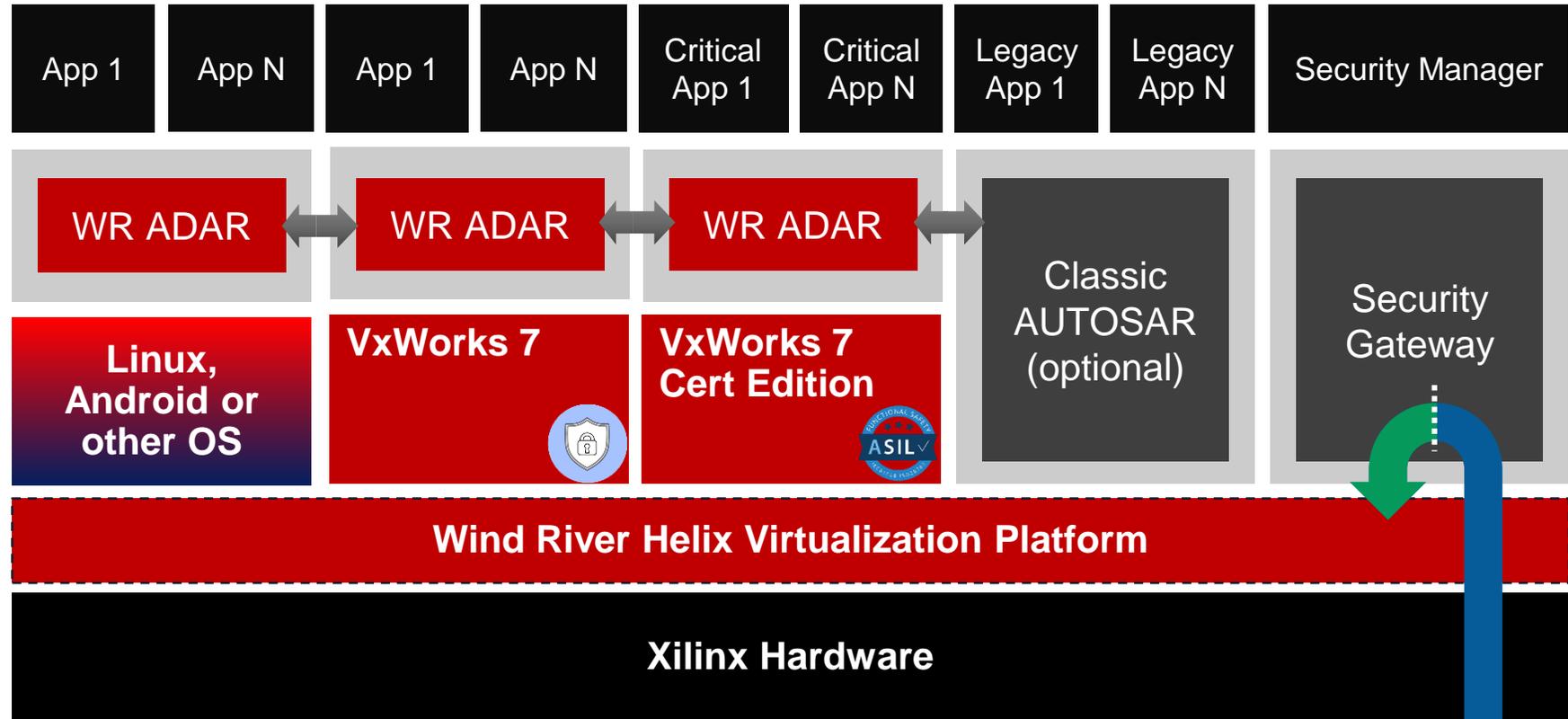
WIND

WIND RIVER VERTICAL MARKETS

OS SOFTWARE: Reliable, Safe, Secure

› Reliable foundation for every function and application

› Verifiably safe operation

› Secure operation from hardware to apps

ADAS	Route Planning	Threat Detection	Secure Information	Comfort

Middleware: Functional, Reliable Services

WIND

Operating System: Safe RTOS, Linux, Virtualization, Security

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Hardware: High Performance, Flexible Capabilities

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Automotive Solutions
AUTOSAR Adaptive & HYPERVISOR

Wind River's ADAR
- One system solution
- Multiple OS
- Mixed Criticality
- High Reliability
- Safety and Non-safety
- Time-Sensitive Networking (TSN)

App 1	App N	App 1	App N	Critical App 1	Critical App N	Legacy App 1	Legacy App N	Security Manager

WR ADAR	WR ADAR	WR ADAR	Classic AUTOSAR (optional)	Security Gateway
Linux, Android or other OS	VxWorks 7	VxWorks 7 Cert Edition		

Wind River Helix Virtualization Platform

Xilinx Hardware

STRONG SOFTWARE TIER-1 EXPERIENCE

SOFTWARE PRODUCTS

- Helix Virtualization Platform
- VxWorks RTOS
- Adaptive AUTOSAR
- Wind River Edge Sync
- Wind River Linux
- Wind River Simics
- Wind River Diab Compiler

AUTOMOTIVE SOLUTIONS

- End to End Software
- Architectural support
- Software Strategy
- Off the Shelf Frameworks
- Design, Integration, Test, and Validation Services

SERVICES

- Security Assessments
- Safety Audits
- Wind River product enabling
- Software/solution integration
- Software/solution consulting
- Connectivity solution for V2X

WIND

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MAJOR DIRECT ENGAGEMENTS WITH OEMS

WE UNDERSTAND THE SOFTWARE TRANSFORMATION

Safety Framework Featuring First Certifiable AUTOSAR + RTOS SW
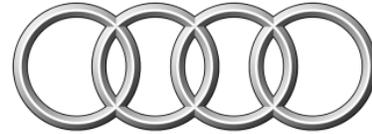
Multi-Vehicle Line Production L2/L3 Automated Driving Platform (ZFAS)

Linux IVI-system

Multi-Brand Android-Based Infotainment Software Platform

Global Purpose-Built Automotive OTA Architecture

Linux IVI platform integration, validation, maintenance

WIND™

WHEN IT MATTERS, IT RUNS ON WIND RIVER.

Connected Car Security Threats
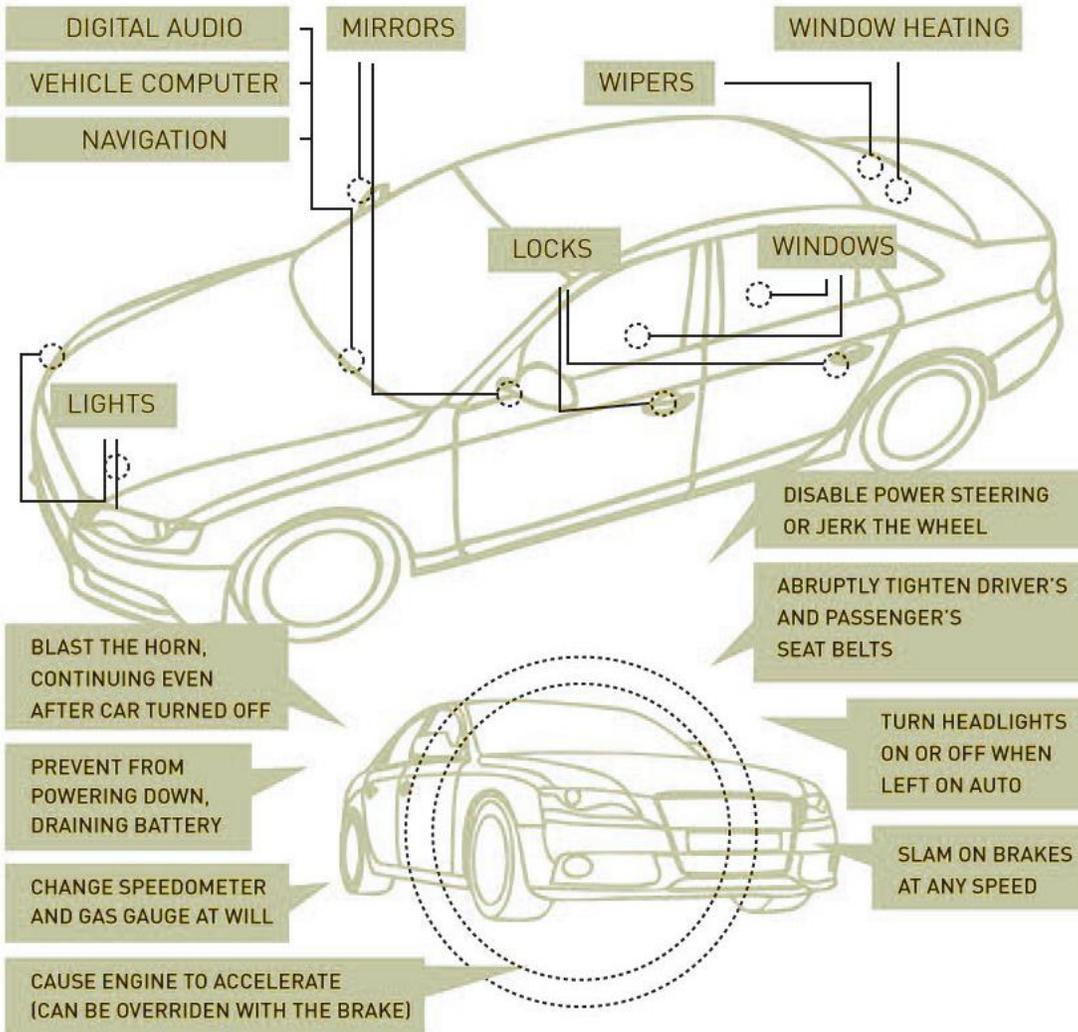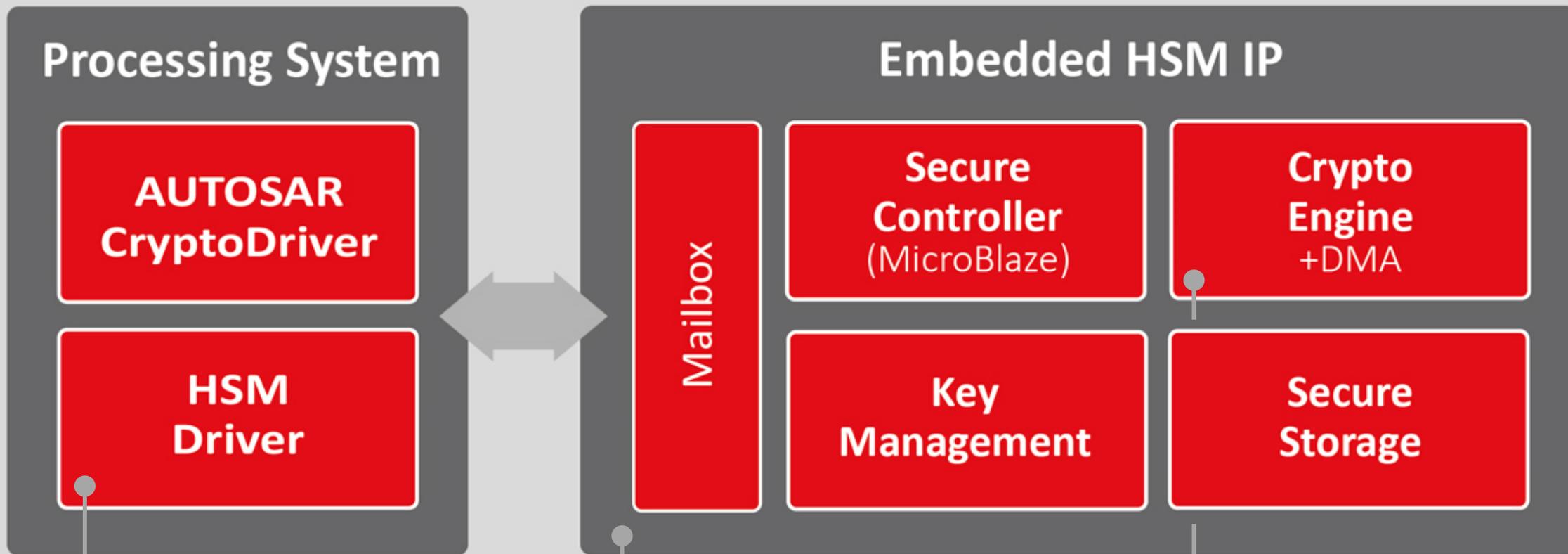
What is a Hardware Security Module?
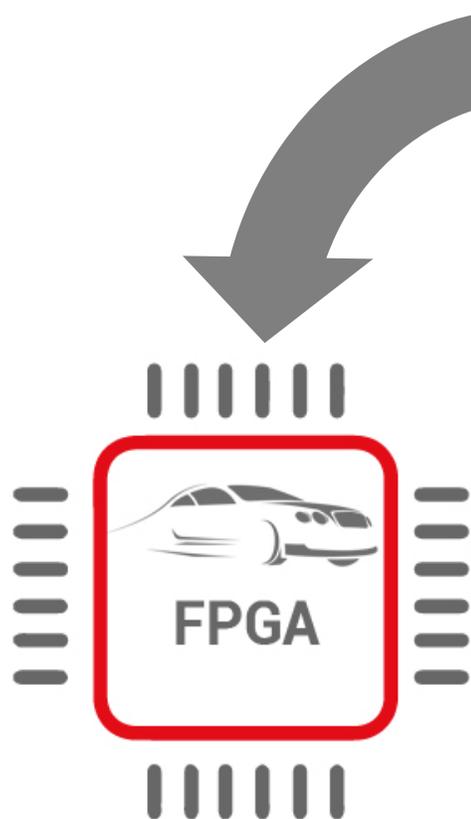
A **hardware security module** (**HSM**) safeguards and manages digital keys for strong authentication and provides crypto processing.

HSM FOR AUTOMOTIVE
For Xilinx Zynq UltraScale+ MPSoC

Processing System

AUTOSAR CryptoDriver

HSM Driver

Embedded HSM IP

Mailbox

Secure Controller (MicroBlaze)

Crypto Engine +DMA

Key Management

Secure Storage

Software stack available

Scalable (Tradeoff features, area, performance)

Configurable (All common algorithms supported)

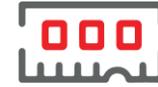# Choose single or a complete module
We build for your specific needs

Security enclave

eSecure ROT provides full system security

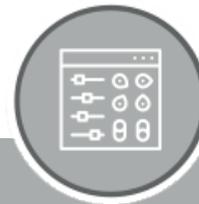**Memory protection**

Secure your flash and DDR

Networking solutions

Accelerate your complete TLS, MACsec and IPsec traffic

Crypto accelerators & processors

Accelerate your crypto operations

CONFIGURABLE
Include features as needed

SCALABLE
Define performance and footprint depending on your requirement

CUSTOMIZABLE
Adapt to your specific needs

This is Silex Insight

What we do: *IP provider for security and video in embedded systems*

- Headquarters in Brussels, Belgium

- Global presence

- Worldwide customer base

- Founded in 1991 – 28 years experience

- Silex Insight = Silicon experts with know-how

- 45 employees

SILEX INSIGHT Sales Offices

San Jose, CA, US

London, UK

BRUSSELS, BELGIUM

HQ

Seoul, South Korea

Shanghai, China

Tokyo, Japan

Taipei, Taiwan

Examples Of Adaptive Silicon Solutions Success

Daimler Selects Xilinx for AI-based Auto Applications

"Xilinx is providing technology that will enable us to deliver **very low latency and power-efficient solutions for vehicles that must operate in thermally constrained environments**. We have been very impressed by Xilinx's heritage and selected the company as a trusted partner for our future products."

Georges Massing, Director, Daimler AG

Xilinx powers ZF's artificial intelligence (AI)-based automotive control unit

ZF ProAI

Xilinx ZU11

Supports Sensor
Set up to Level 4 AD

(Sensor Fusion of Cameras, RADAR, LiDAR)

ZF ProAI is its modular hardware concept and open software architecture. **This approach is unique compared to other systems on the market,** which use a fixed combination of hardware and software architecture (which can limit functionality and add more cost)

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Summary

> Advanced electronics features such as ADAS and AD are <u>evolving rapidly</u>

> Industry has <u>not converged</u> on common approach

> Euro NCAP roadmap driving <u>continuous innovation</u>

> AI <u>exploding with change</u>

> <u>Flexibility in data pipeline</u> enables lowest AI latency

> Industry needs more versatility with <u>DFX</u>

> Increasing <u>safety and security</u> requirements

> **There is a need for <u>adaptive silicon!</u>**

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Building the Adaptable, Intelligent World