



Xilinx Adapt: Automotive

Drive to the Future

Welcome

Willard Tu



Xilinx Adapt: Automotive

Day 3 – Driver and In-Cabin Monitoring Systems

January 14, 2021

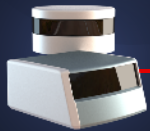
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- ▶ Semicast: Who Says DMS and ICMS Technology is Obsolete? 7:30 AM – 8:00 AM
- ▶ Driver Monitoring Systems are here, and Occupant Monitoring Systems are coming. Are you ready? 8:00 AM – 8:30 AM
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- ▶ The Future of In-Cabin Experience 9:30 AM – 10:00 AM

Xilinx Automotive ADAS & AD Focus Areas

Full Display Mirror



LiDAR



Surround View Camera
> Rear



> Side



> Front



Forward Camera



Driver and In-Cabin Monitoring Camera(s)

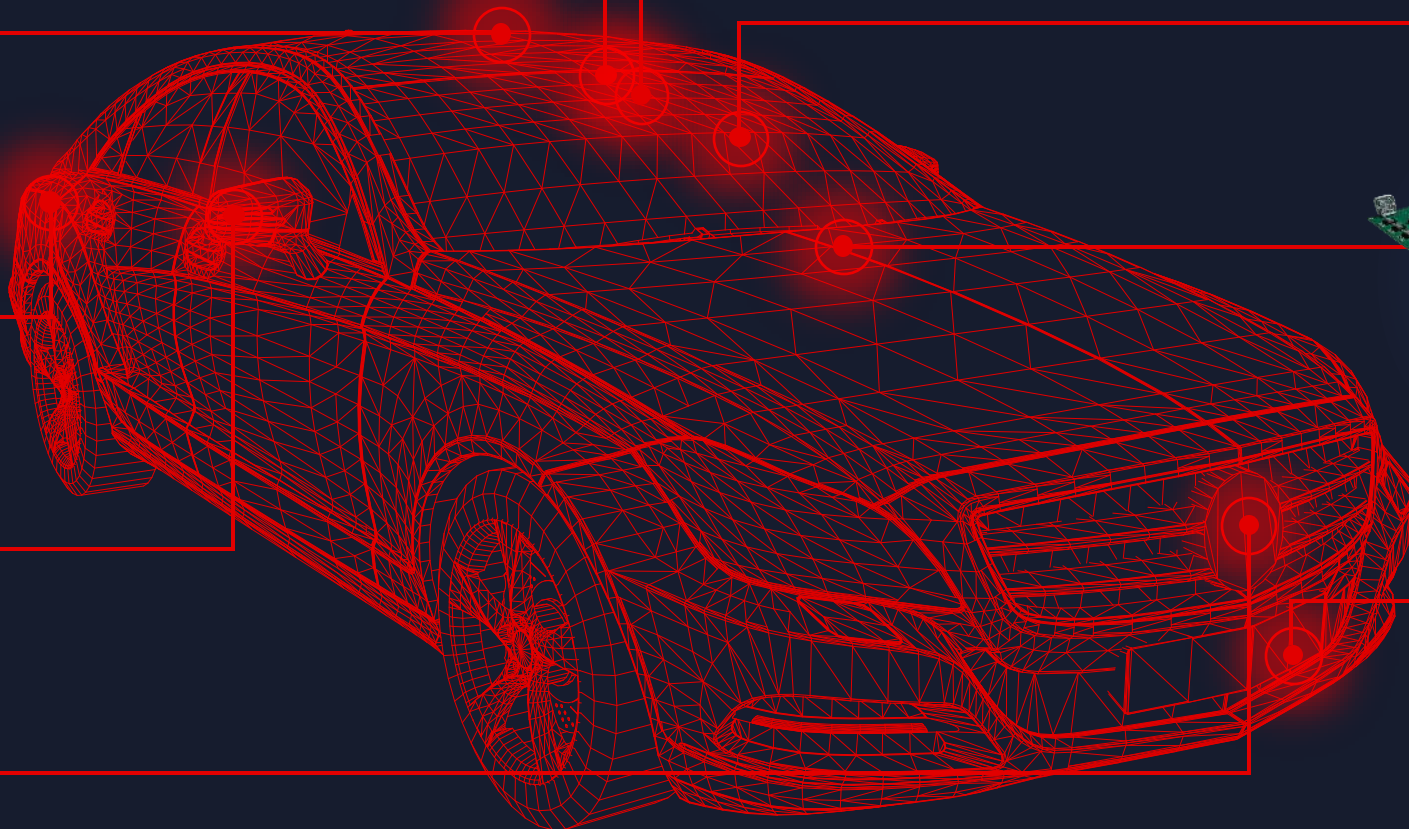
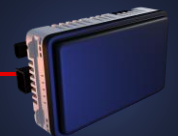


Domain Controller

- > Gateway
- > Compute Acceleration
- > Data Aggregation, Pre-processing, and Distribution (DAPD)



RADAR



Note: Not representing actual vehicle architecture; Sensors are for illustrative purposes

Xilinx SoC, MPSoC & ACAP Families

FUTURE

Domain Architectures

- ▶ Central Compute
- ▶ DAPD for Autonomous Driving
- ▶ Next-Gen Forward Camera

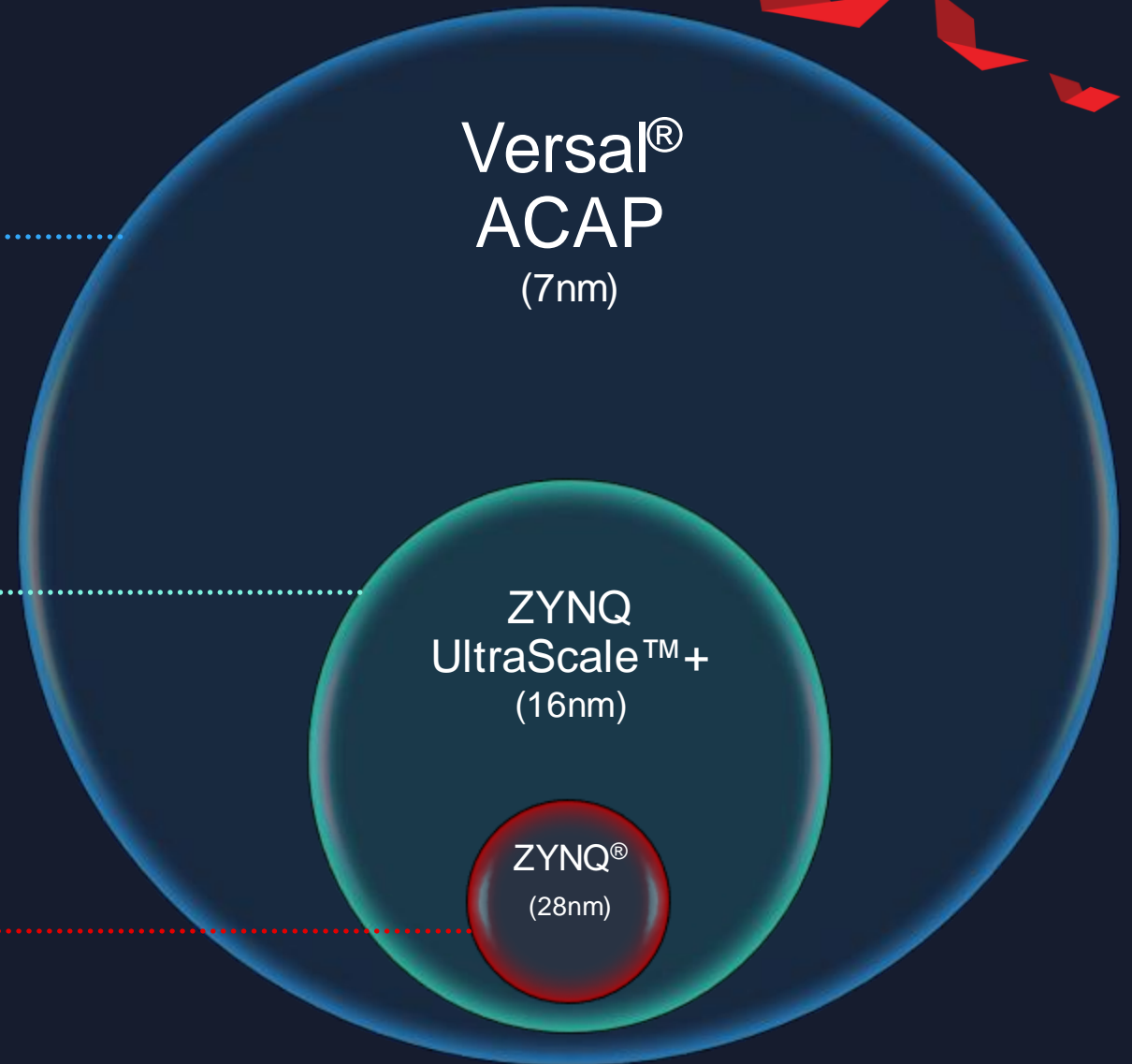
NOW

ICMS

- ▶ Forward Camera (~8MP)
- ▶ 3D Surround View w/ APA
- ▶ Domain Controller
- ▶ ToF Sensors

DMS

- ▶ Forward Camera (1-2MP)
- ▶ Full Display Mirror, eMirror, DVR
- ▶ 3D Surround View



What are Driver Monitoring Systems?

- ▶ A subset of In-Cabin Monitoring Systems
- ▶ **Active** Driver Monitoring Systems Analyze:
 - Driver Attentive State
 - Driver Engagement Level
 - Driver Impairment Level... with real-time tracking via infrared (IR) and camera sensor



- ▶ Computer Vision and Neural Nets interpret the real-time tracking data of:

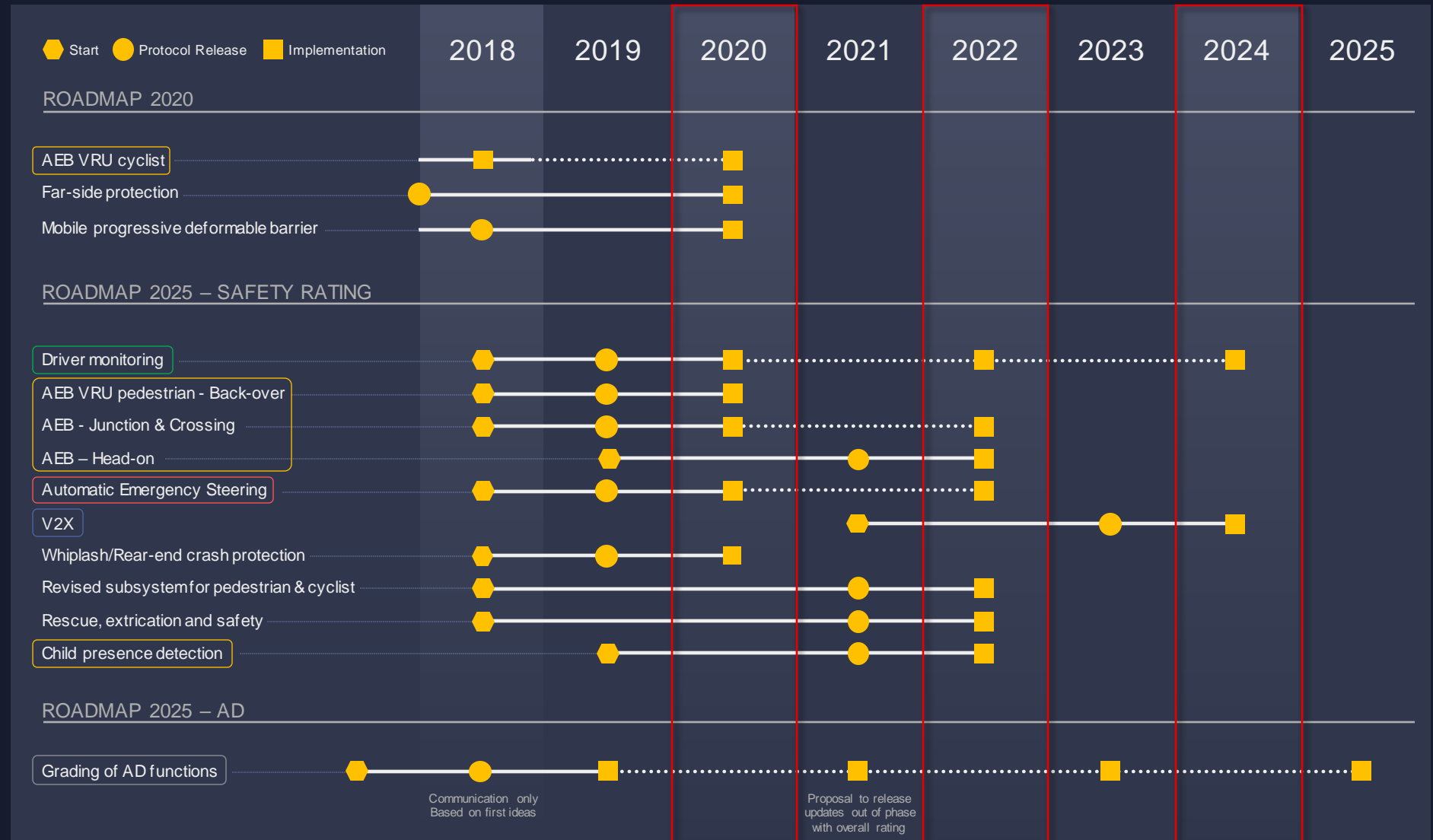
- Head pose and orientation
- Eyelids
- Eye gaze
- Pupils
- Emotions
- Attentiveness
- Sunglasses
- Scarves
- Face masks

Data captured from sensors creates contextual awareness of the driver behavior, which determines vehicle action (seat vibration, blinking icon, etc.)

Euro NCAP Roadmap 2020 – 2025

1. AEB requirements will be updated along the way
2. New functions need more performance and may only be achievable 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 foreseeable future

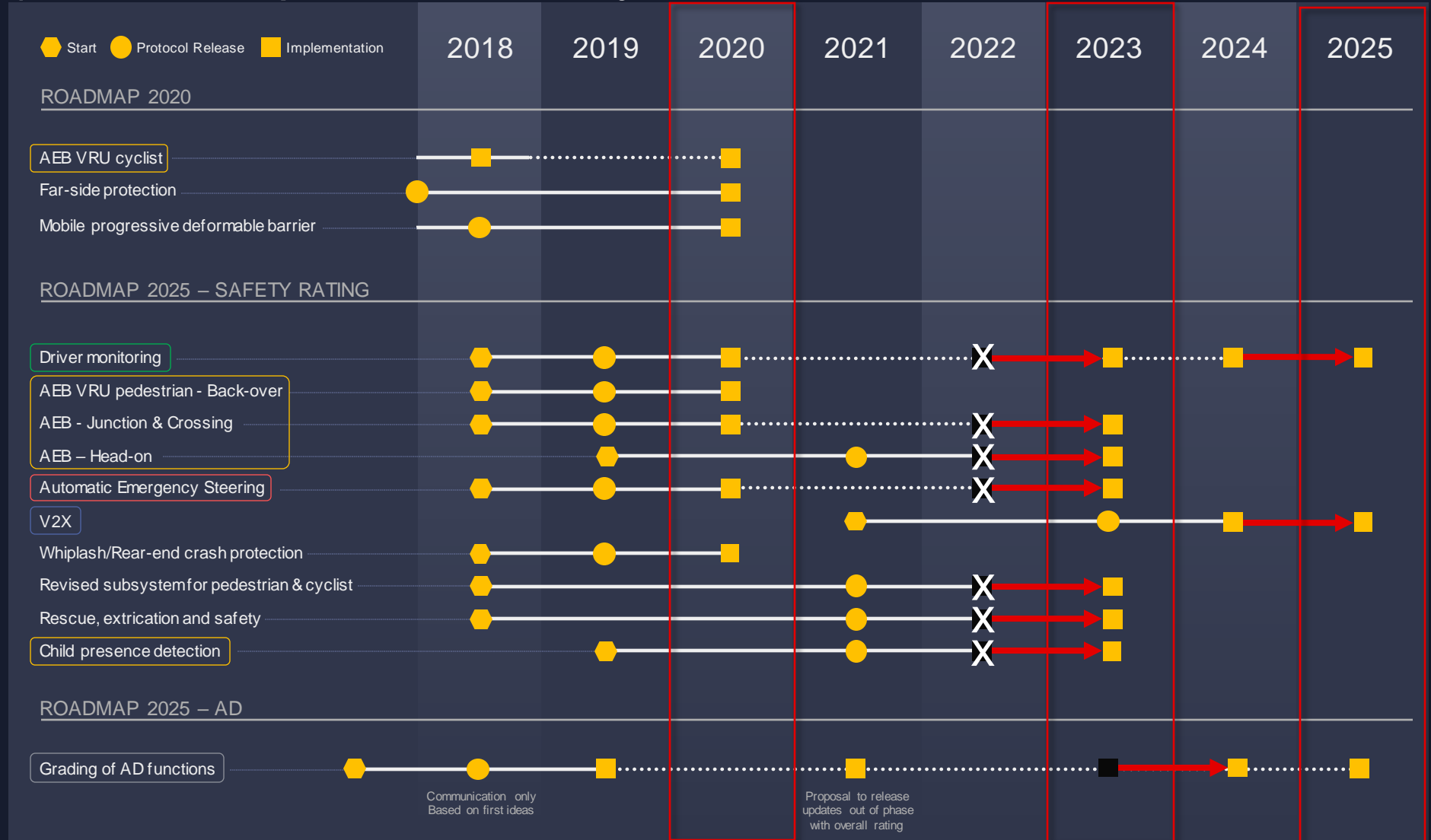


Euro NCAP Roadmap 2020 – 2025

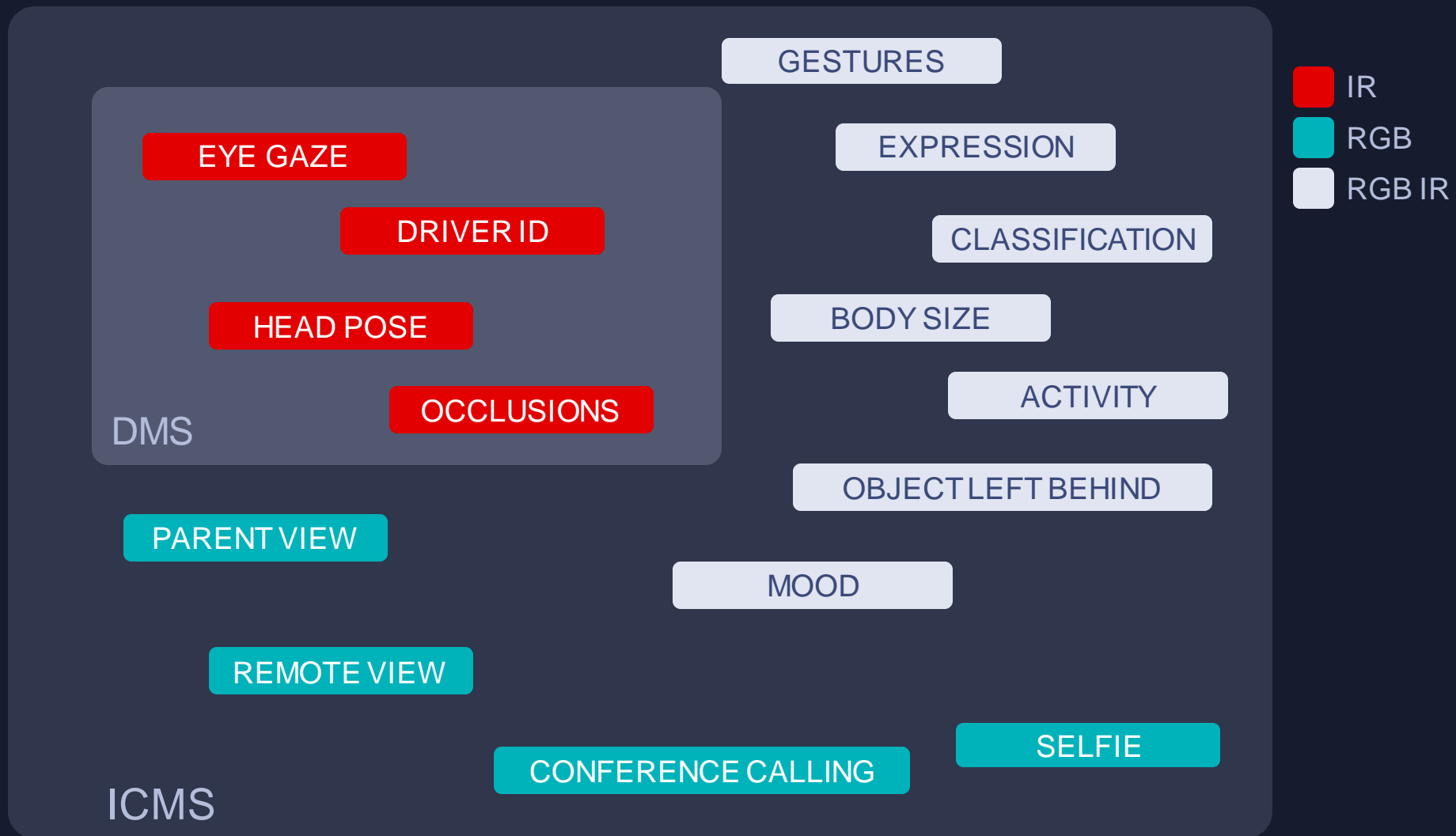
(Covid-19 Impact) - 2022 Requirements Delayed to 2023 and 2024 to 2025

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DMS/ICMS Features and Functions



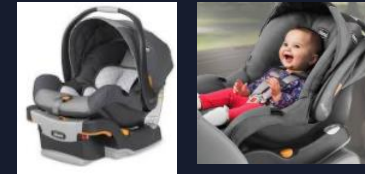
ICMS 2D Detection Task

Yolov3,
Yolov3-SPP,
Yolov4,
RefineDet,
SSD, etc.

Person



Infant Seat



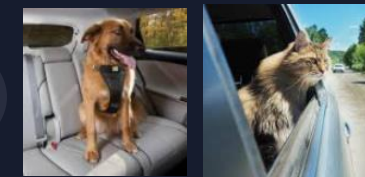
Child Seat



Everyday
Object



Pet



Cell Phone

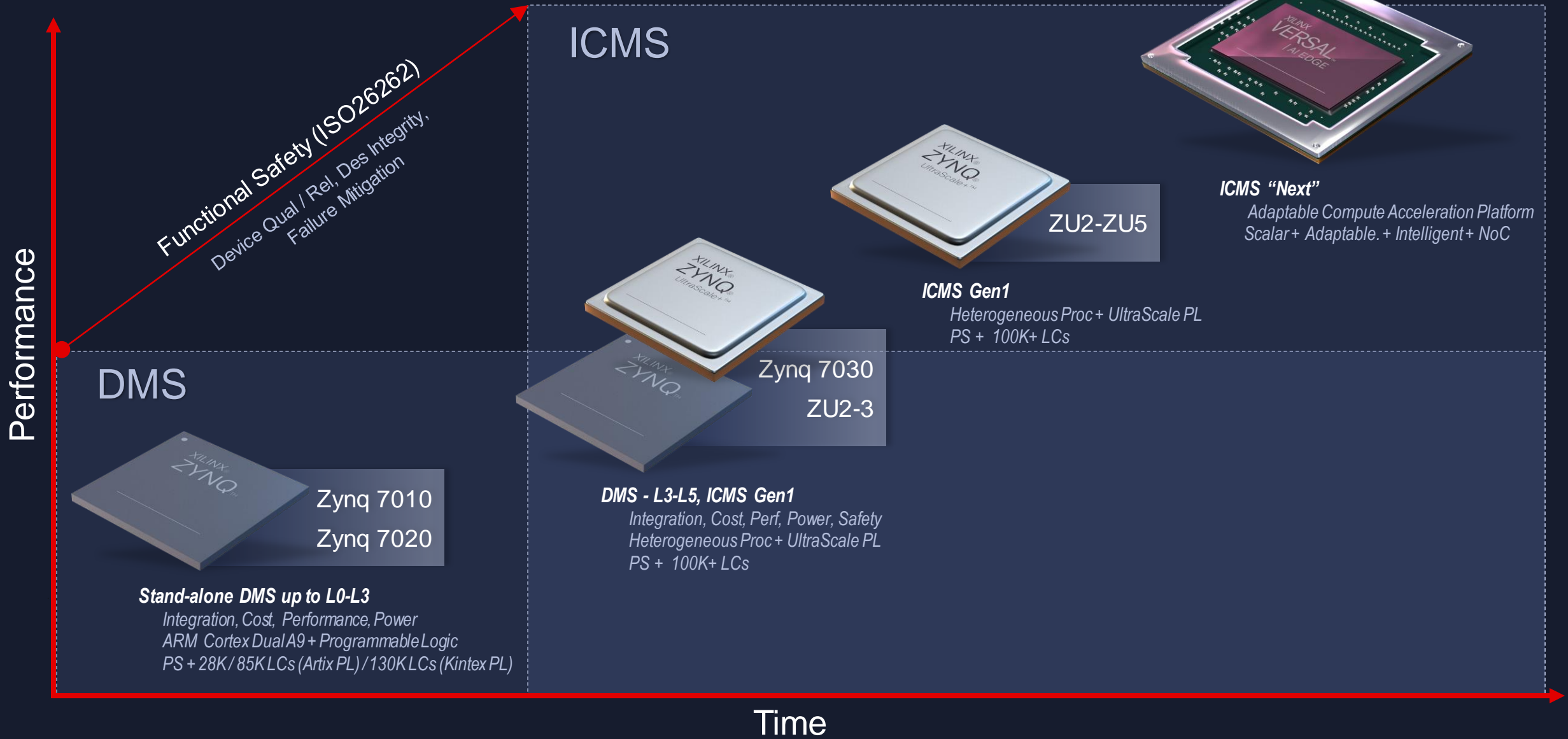


Challenges: Range of factors

System Design and development:

- Camera Resolution: WVGA or above
- Number of Cameras: 1 to 4
- Camera Type: RGB, RGBA, Monochrome or Near-IR or combinations
- FPS: 5, 15, 25
- FOV: 110 degrees (H) and 15 degrees (V)
- Camera location(s): overhead console, rear mirror area, pillars,
- Other Sensor: Short range radar: imaging or 2D
- IR Illumination: Needed for low-light, 850nm or 940nm
- IR LEDs Position: Flexible
- Lens type: Normal or fish-eye

Roadmap



Design with Xilinx for future-proof DMS and ICMS



Sensor-agnostic

- Xilinx platforms are well-suited for camera, radar and infrared sensor implementations



Real-time AI inference

- Ability to combine PL with CPU processors ideal for hosting CV as well as CNN-based ML
- Optimized processing chains with custom accelerators avoids storing data to reduce latency



OTA Hardware

- Future proof for emerging security threats and OEM requirements
- Adding tremendous value through TTM advantage and continuously improving user experience
- Evolve neural network implementations over time



Dynamic Function eXchange (DFX)

- Dynamically reconfigure device to reduce system-wide power and cost
- Ideal for ISP swap (IR vs RGB) and optimization

Xilinx for DMS and ICMS: Best-in-Class Platform

- **High Efficiency**

Highly optimized CV and AI acceleration balancing cost & performance

- **Scalable**

Scale across 28nm and 16nm platforms depending on desired features

- **Adaptable**

Custom ISP for IR and/or RGB-IR camera



Key Partnerships

Announcements with key OEMs, system and IP providers



DAIMLER

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Thank You

