Addressing Tomorrow's Sensor Fusion and Processing Needs with Cadence's Newest Processors

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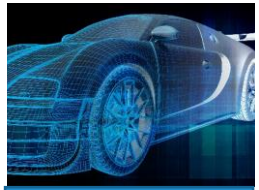
Cadence Design Systems

cadence®

Major Market Trends


AR/VR


Automotive


IoT


Mobile


Robotics/Drones

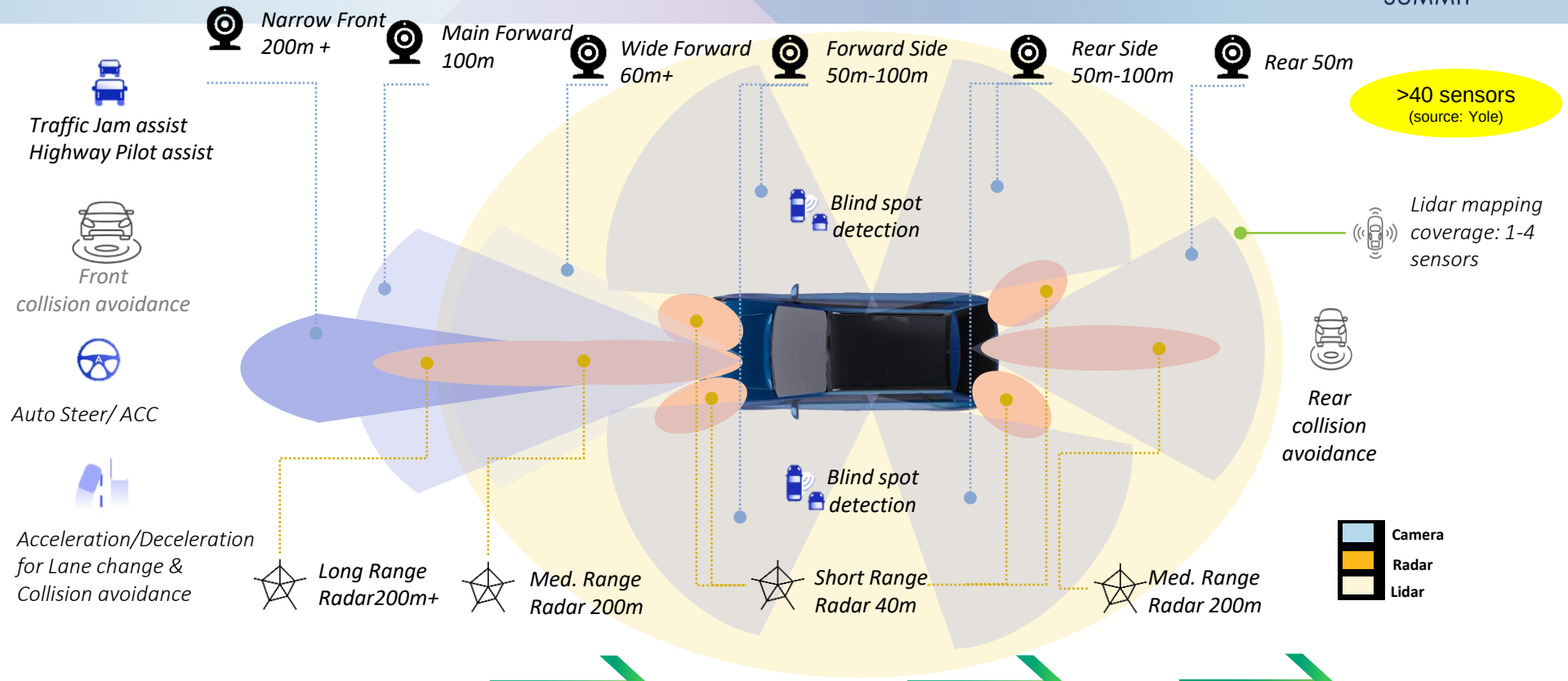

IP Camera


Data Center


Consumer Electronics

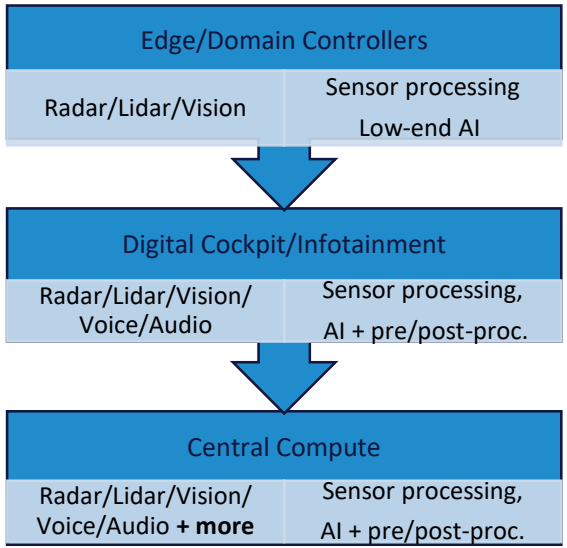
- The number of sensors feeding data is increasing
- Combination of vision, radar, lidar, and Time-of-Flight (ToF) in use
- Automotive is a good example of a large number of sensors per vehicle

The Path to Autonomy (Growing Number of Sensors)



More Sensors → **Better Perception** → **ADAS** → **Autonomy**

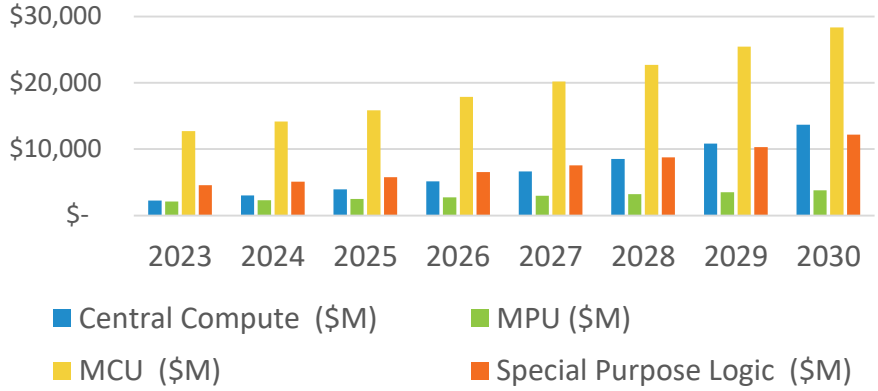
Automotive Market Trends and Segmentation



ASIC or ASSP

MCU and CPU

Central Compute SoC



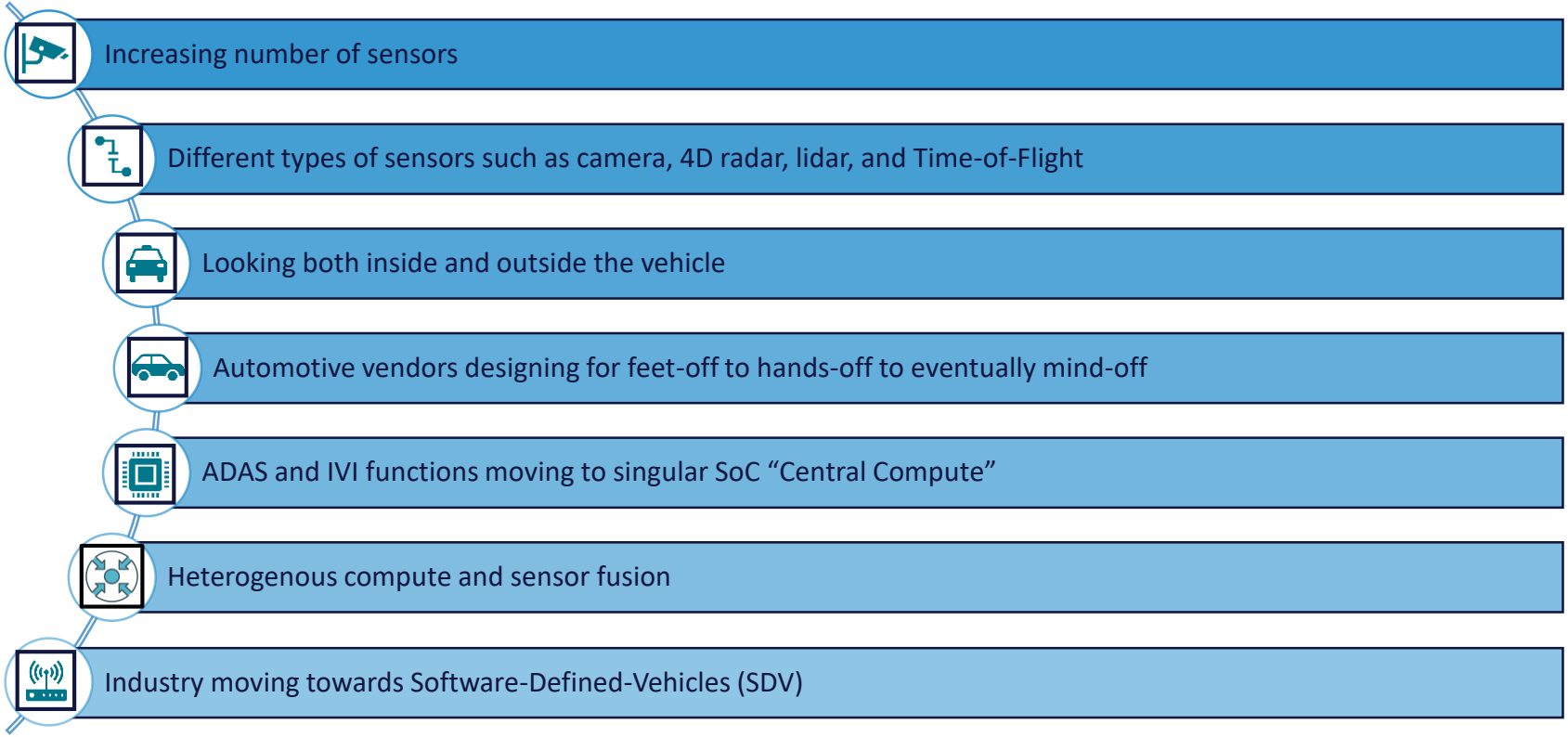
2023 to 2033 CAGR
Automotive SoC

MPU: 8.95%
Central Compute: 29.28%
MCU: 12.14%
Special Purpose Logic: 15.14%

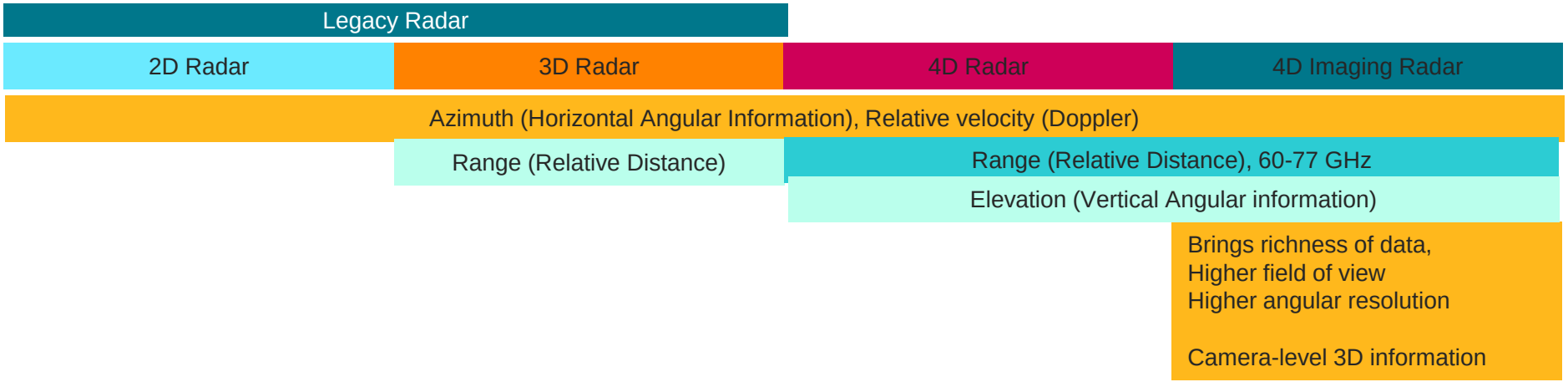
Source: IBS Aug 2022

Customers decide on platforms: Same basic architecture for different segments

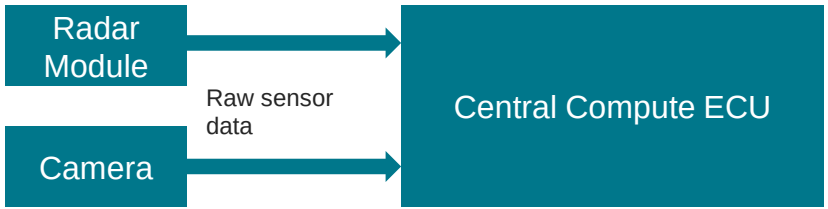
Major Automotive Market Trends



Evolution of the 4D Imaging Radar



Use of Radar/Vision/Lidar



- Need for sensor fusion
- Sensor processing
- 3D point cloud processing
- AI

AI Inference Trend

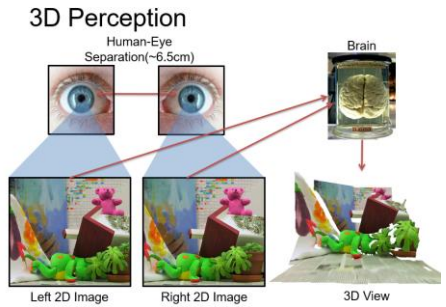
- AI workloads are changing rapidly
- SoCs have lengthy design/development cycles
- Silicon designed today, needs to stay relevant two or more years from now

Need for future readiness in a rapidly evolving world of AI

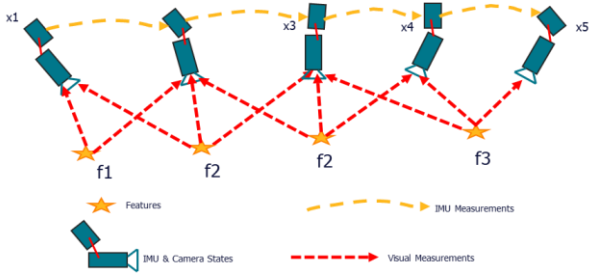
Need For Sensor Fusion?

- What is sensor fusion?
  - Combine information from multiple sensors
  - E.g., left eye and right eye
- How does it help?
  - Redundancy: If one fails other works
  - Better quality: Error compensation and seeing more
- Utilize each sensor’s strength and minimize their weakness
- Leverage classical approaches + AI for the best combination!

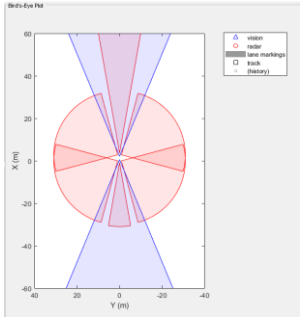
Sensor Fusion Examples



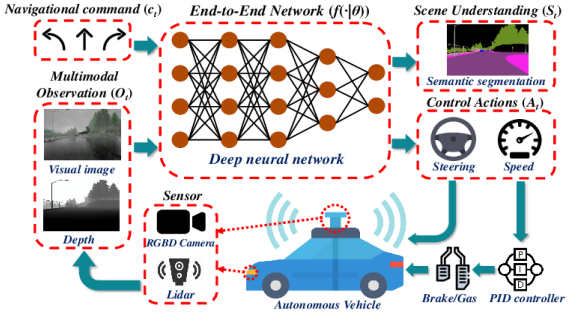
Depth Perception (2 or more cameras)



SLAM (Camera + IMU)

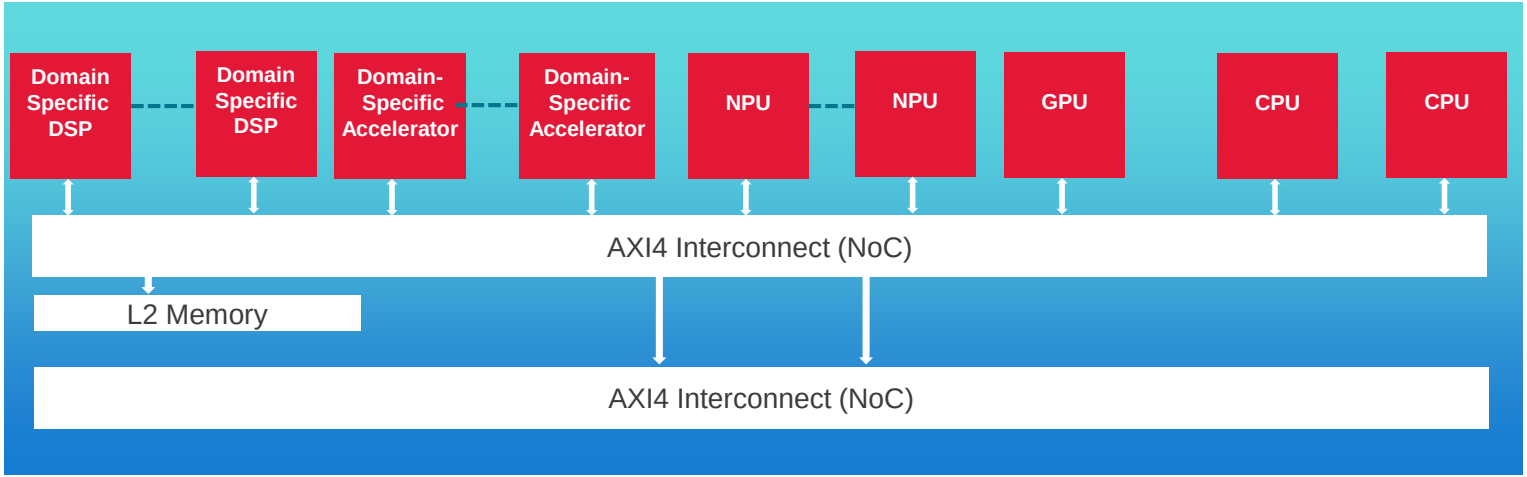


ADAS (Radar + Camera)



ADAS (Camera + LiDAR + AI)

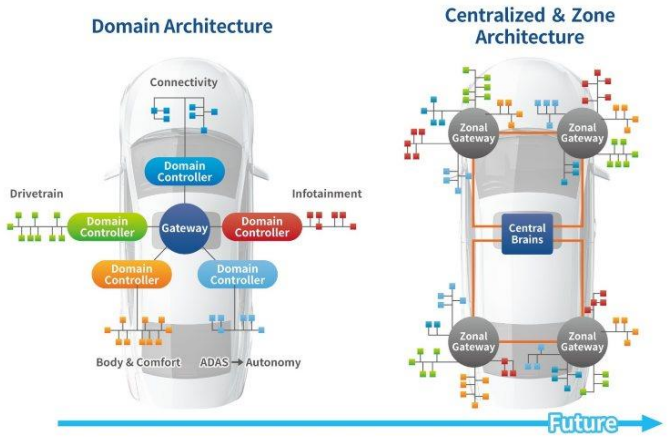
Typical Perception System

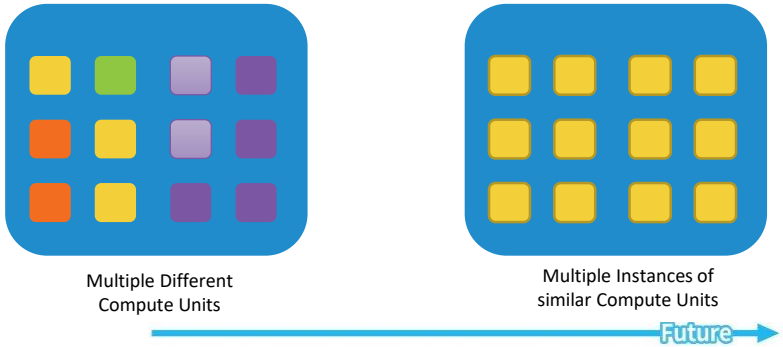


- So many sensors feeding data
- So many different processing blocks
- Need for heterogeneous compute:
  - Different architectures? Or common architectures
  - Scalability issue
  - Code reuse

Racing Towards Central Compute

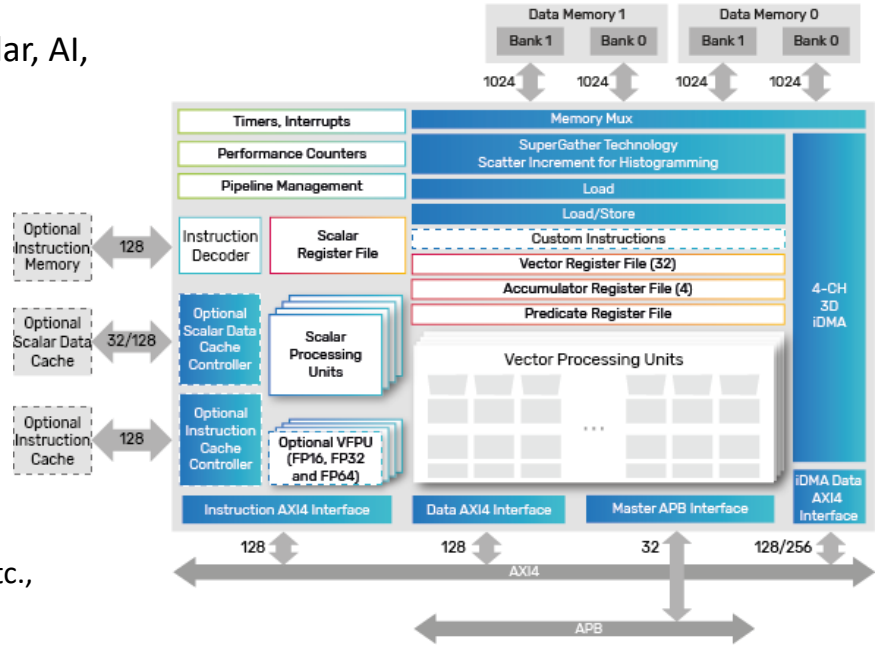
- Move toward central compute architecture
- Majority of compute will come to the central compute block
- Central SoC will be a critical component for computing
- Technology nodes are shrinking but manufacturing costs are going up
- Scalability of processing unit/compute unit/IP will be necessary to reduce costs
    - Can I get more out of my IPs?
- Common architecture helps scale performance
    - One IP can process multiple input modalities (camera, radar, lidar, etc.)
    - Increase performance by adding more instances or multi-core
- Cadence has the answer for you





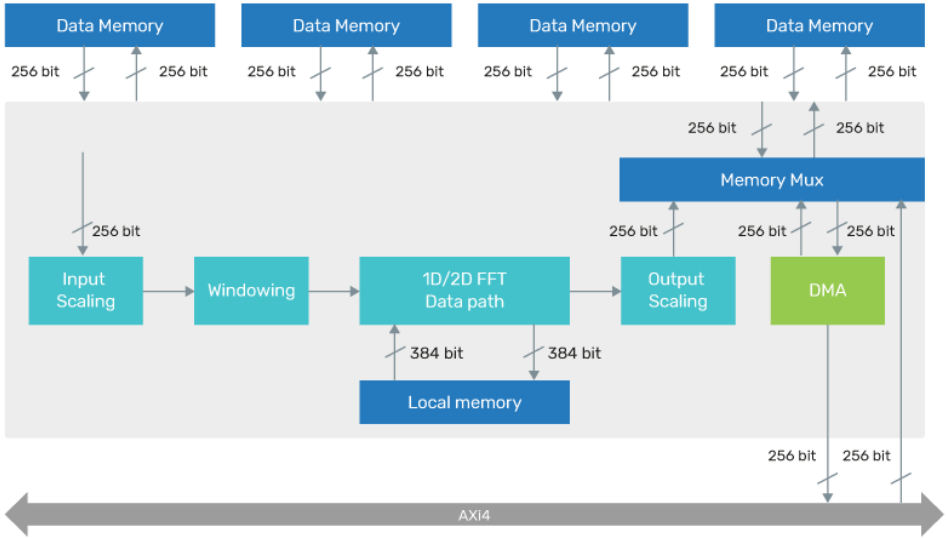
Tensilica Vision 341/331 DSP IP: Vision/Radar/AI

- New 512b and 1024b SIMD DSPs to address vision, radar, lidar, AI, and sensor fusion needs
- Combining the proven Tensilica® ConnX and Vision ISAs to deliver the best PPA for high-end multi-sensor processing
- Everything of Tensilica® Vision Q7 and Vision Q8 plus more!
- Key improvements over previous Tensilica Vision DSPs:
  - More datatypes: BFloat16, Complex floating point
  - CV filter improvements: 1D filters up to 2X better and NMS up to 2.5X better
  - New ISA to support fixed and floating point-based
  - Fixed point and floating point support for radar operations, FFT, etc., and up to 6x performance improvement
  - Improvements to neural network quantization and depthwise separable convolution performance
- Same libraries, software, ecosystem, and backward code compatibility
- Automotive grade and ASIL-certified IP



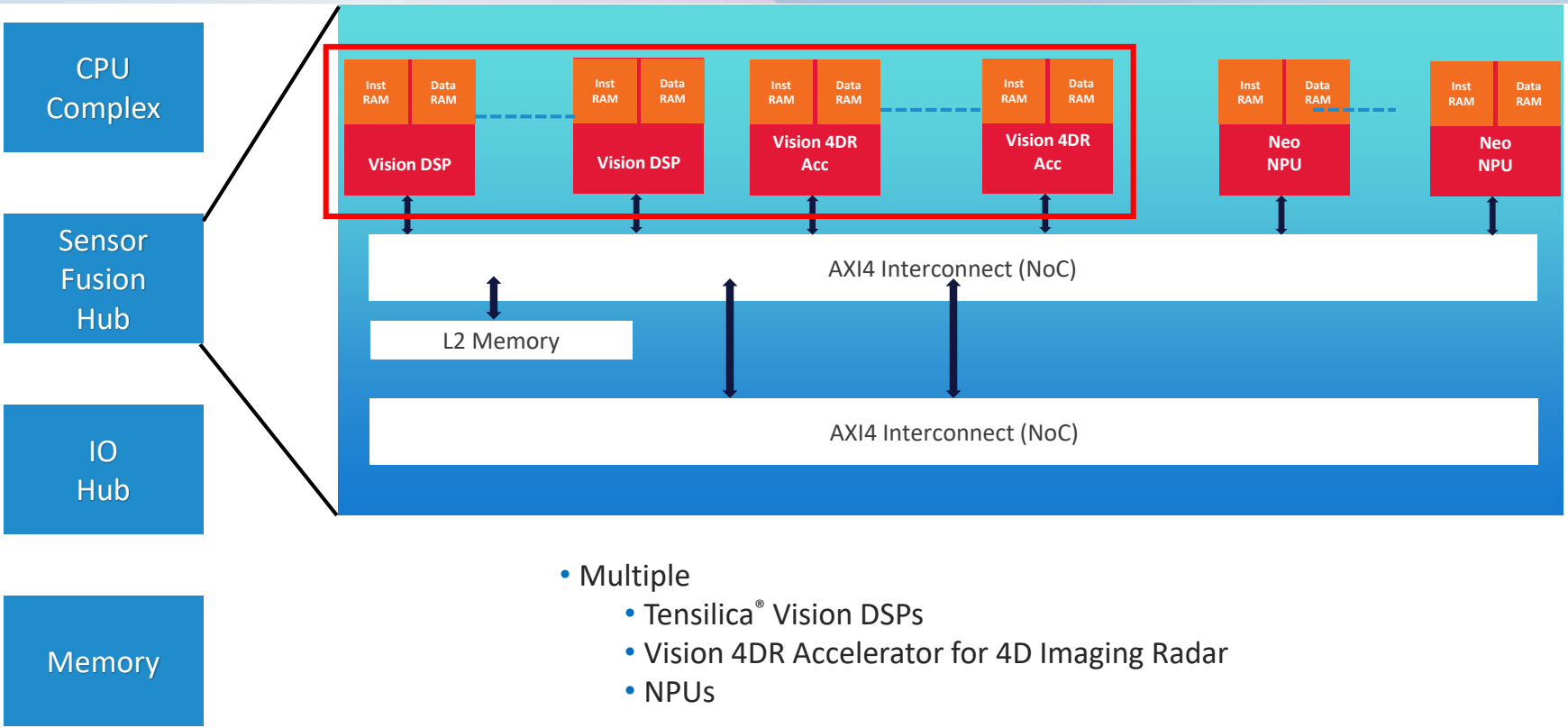
Vision 4DR Accelerator

- Accelerates 2D and 1D Fast Fourier Transform (FFT) commonly used in radar processing
- 16/24-bit fixed-point processing
- AXI-based IP with multiple DMA (128/256-bit) for fast data movement
- System software to work as FFT offload engine for Vision 331/341
- ISO 26262 ready for automotive market



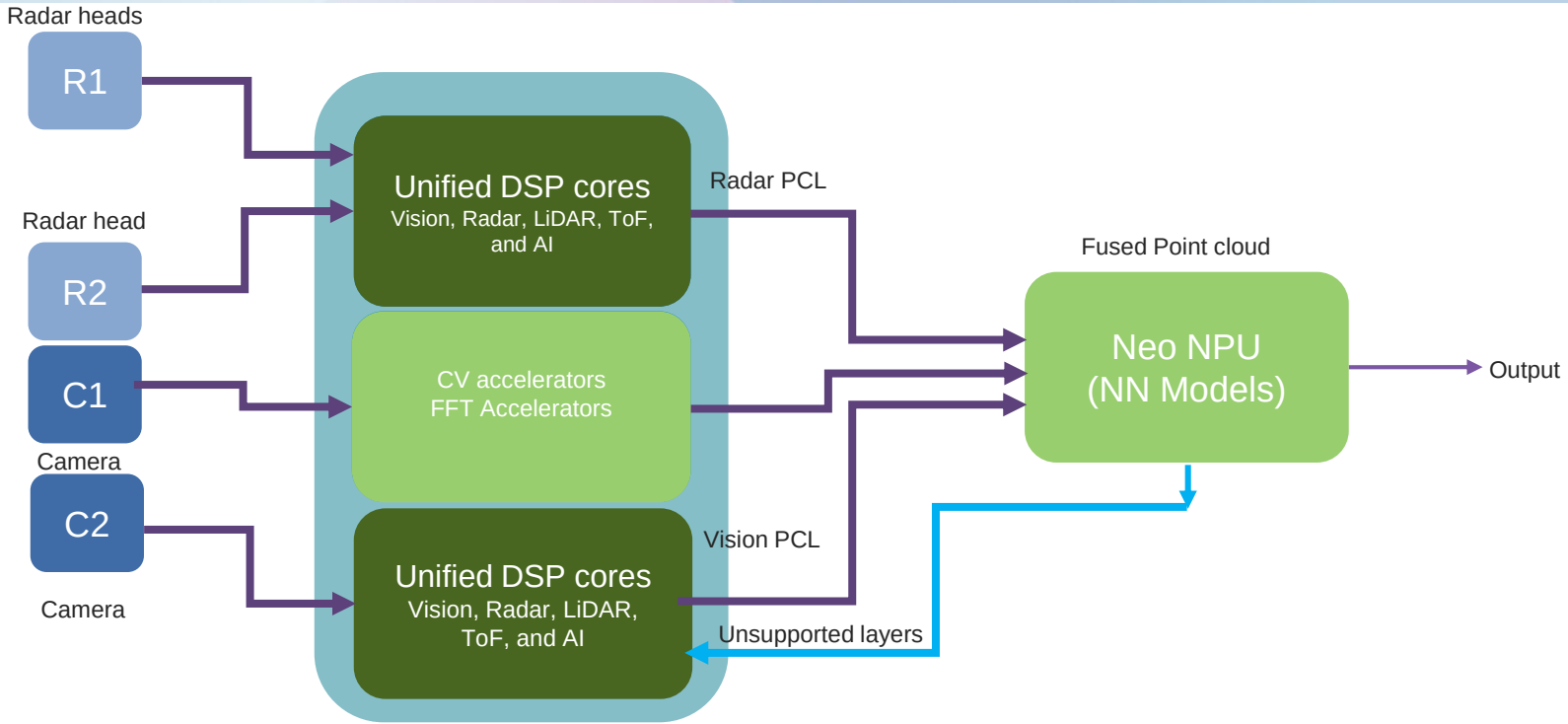
Compared to a Vision 341 DSP:
4X greater performance
6X greater performance/area

Sensor Fusion Hub for Automotive



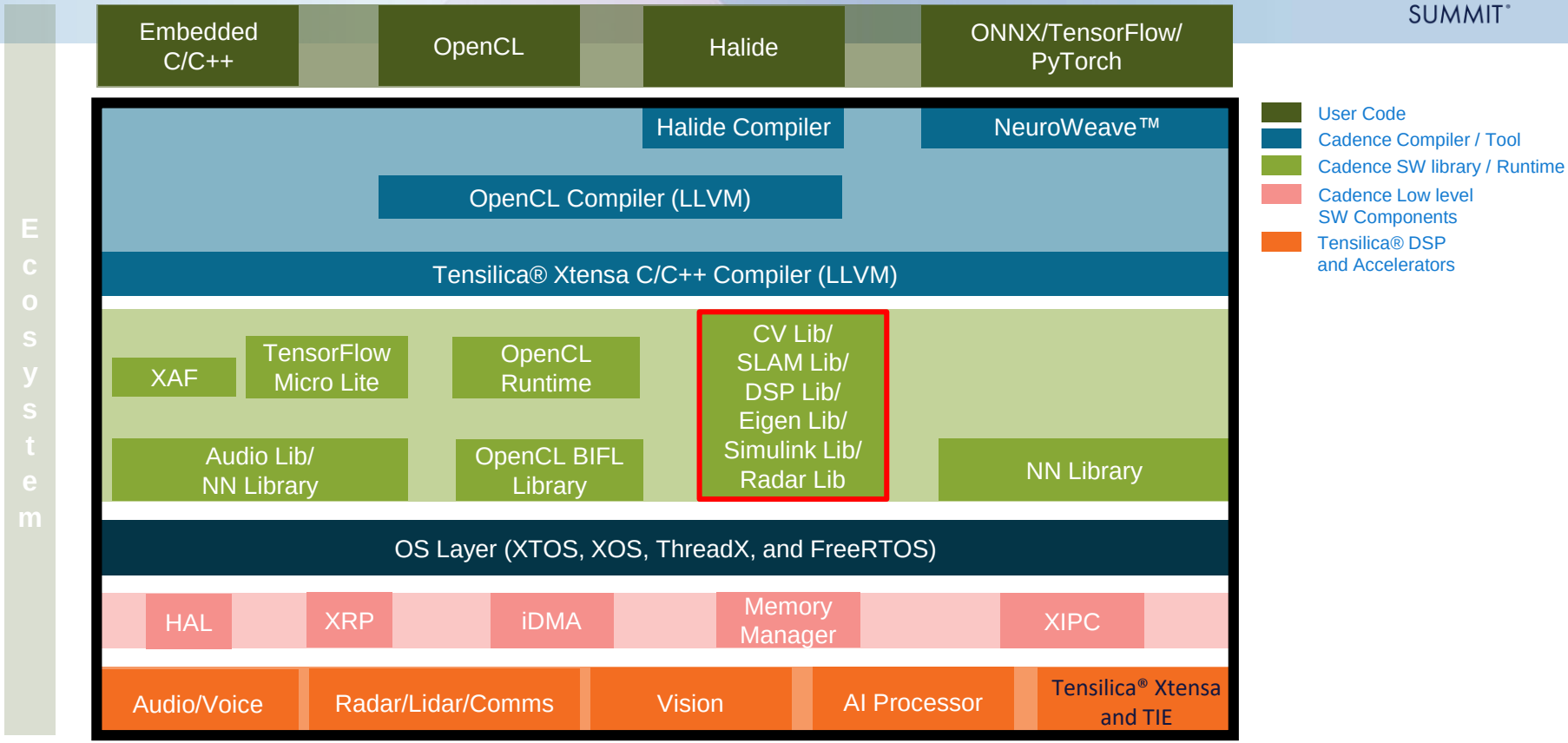
- Multiple
  - Tensilica® Vision DSPs
  - Vision 4DR Accelerator for 4D Imaging Radar
  - NPUs

Sensor Fusion: Vision + Radar + LiDAR



Single DSP capable of processing multi sensor work loads saves area, power and increases performance + efficiency on an SOC

Cadence Tensilica: Comprehensive Software Solutions



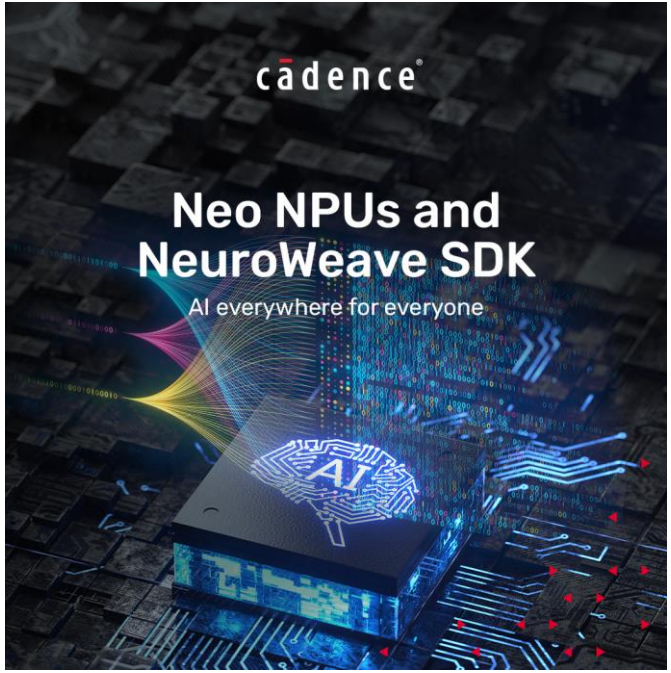
AI Product Announcement – September 13, 2023

Cadence® Neo™ Neural Processing Units (NPUs)

- Target broad range of on-device and edge AI applications from smart speakers to autonomous driving
- Deliver wide range of AI performance in a low-energy footprint
- Efficiently offload AI inferencing from any host processor

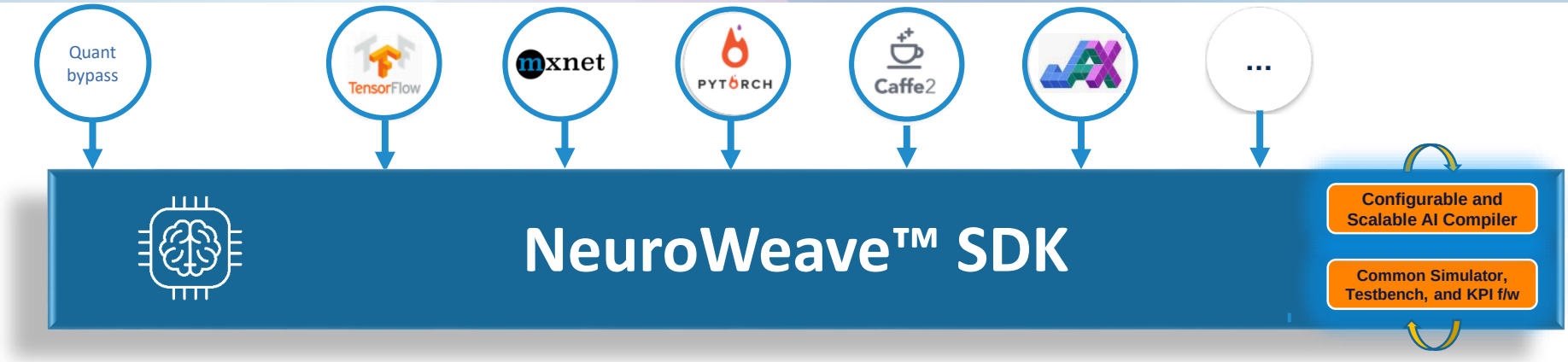
Cadence NeuroWeave™ Software Development Kit (SDK)

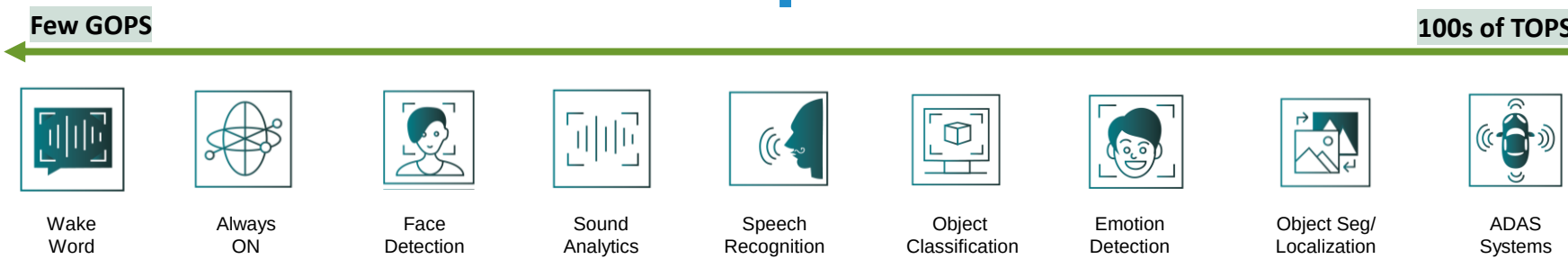
- Provides unified support across Cadence AI and Tensilica IP products
- Streamlines product development and enables an easy migration as design requirements evolve



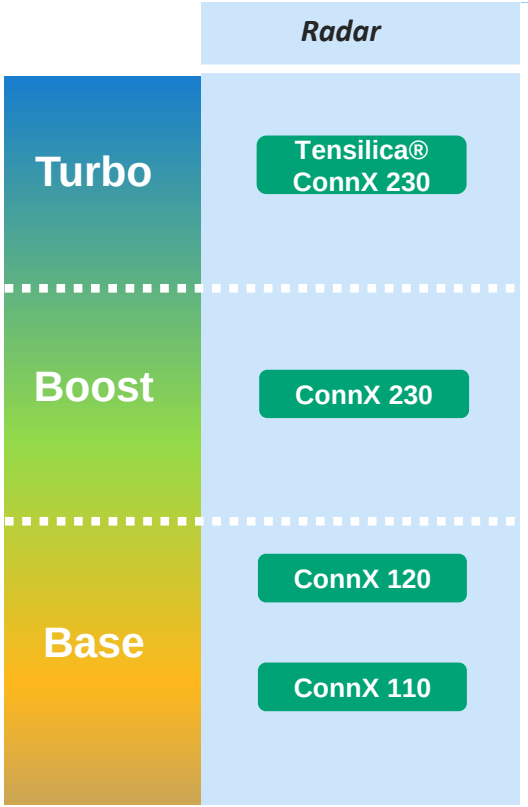
http://www.cadence.com/go/NPU

One Cadence Tensilica AI Software Compiler Toolchain





Putting It All Together



Summary

Automotive Market

- Automotive SoC architectures driven by software-defined vehicles, large number of diverse sensors, and higher throughput

Tensilica® Vision 331 DSP and Vision 341 DSP: single DSP for sensor fusion

- A single DSP eliminates the need for multiple DSPs for different sensors: camera, radar
- Both DSPs come with large software ecosystems; existing vision and radar software, vision, and radar library
- Enable fast TTM with the same SIMD and VLIW architecture and instruction set used by their highly successful Vision DSP predecessors

Vision 4DR Accelerator: Hardware accelerator for growing 4D imaging radar

- When paired with the new DSPs for 4D imaging radar applications, the Vision 4DR accelerator offers:
  - Greater performance and performance/area advantage compared to a DSP alone

Resources

- The Role of Centralized Storage in the Emerging Zonal Automotive Architecture
- Multi-Modal Sensor Fusion-Based Deep Neural Network for End-to-End Autonomous Driving With Scene Understanding

2024 Embedded Vision Summit

- **Talk:** SLAM for Embedded Systems: An introduction and its challenges
  May 23rd, 4:50 pm

- **Cadence Booth**
  #518 Exhibition Hall