SensPro2

Highly Scalable Sensor Hub DSP for Computer Vision, AI, and Multi-sensor Fusion for Contextually Aware Devices

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SensPro™ by CEVA

CEVA's Sensing and Connectivity for IoT

Cellular

5G DSP-based platforms for smartphones, RAN and cellular IoT

IoT Connectivity

Comprehensive platforms for Bluetooth and Wi-Fi

Camera

Vision DSP
DNN accelerators &
CDNN SDK for NN inferencing

IMU

Software & algorithms
Sensor fusion, management, activity detectors

Microphone

DSPs, SW technologies, speech recognition, noise reduction, audio AI

SensPro™ by CEVA

SensPro2:
Multitasking
Sensing and AI

Wireless Connectivity

Smart Sensing

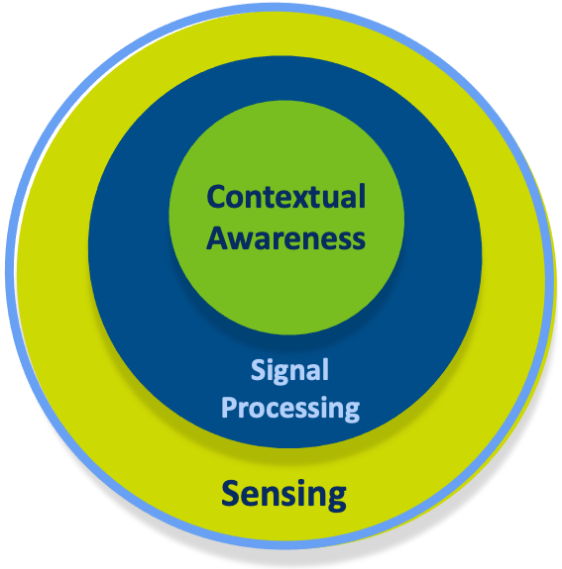
SensPro Architecture is Market Driven

More Sensors, More Data Generated

- Electronic devices **gather information** using **sensors**:
  - Visual Data: Cameras, ToF, Structured light, LiDar, Radar
  - Motion Data: Gyroscope, Magnetometer, Accelerometer
  - Audio Data: Microphones
- Analyzing the data requires both **AI** and traditional **DSP** approaches
  - **Process** each sensor independently
  - **Fusion** of the sensors data to get coherent information
  - **Contextual awareness** using AI to make decisions

Contextual Awareness

- Ability to **gather information**, **analyze** it and **adapt the behavior** accordingly
- A new type of processor architecture is required to efficiently process and fuse the data from these different sensors and data



Introducing SensPro2

Second Generation High Performance Sensor Hub DSP

SensPro™ by CEVA

Up to 6X Peak Performance*

2X Better AI Inferencing*

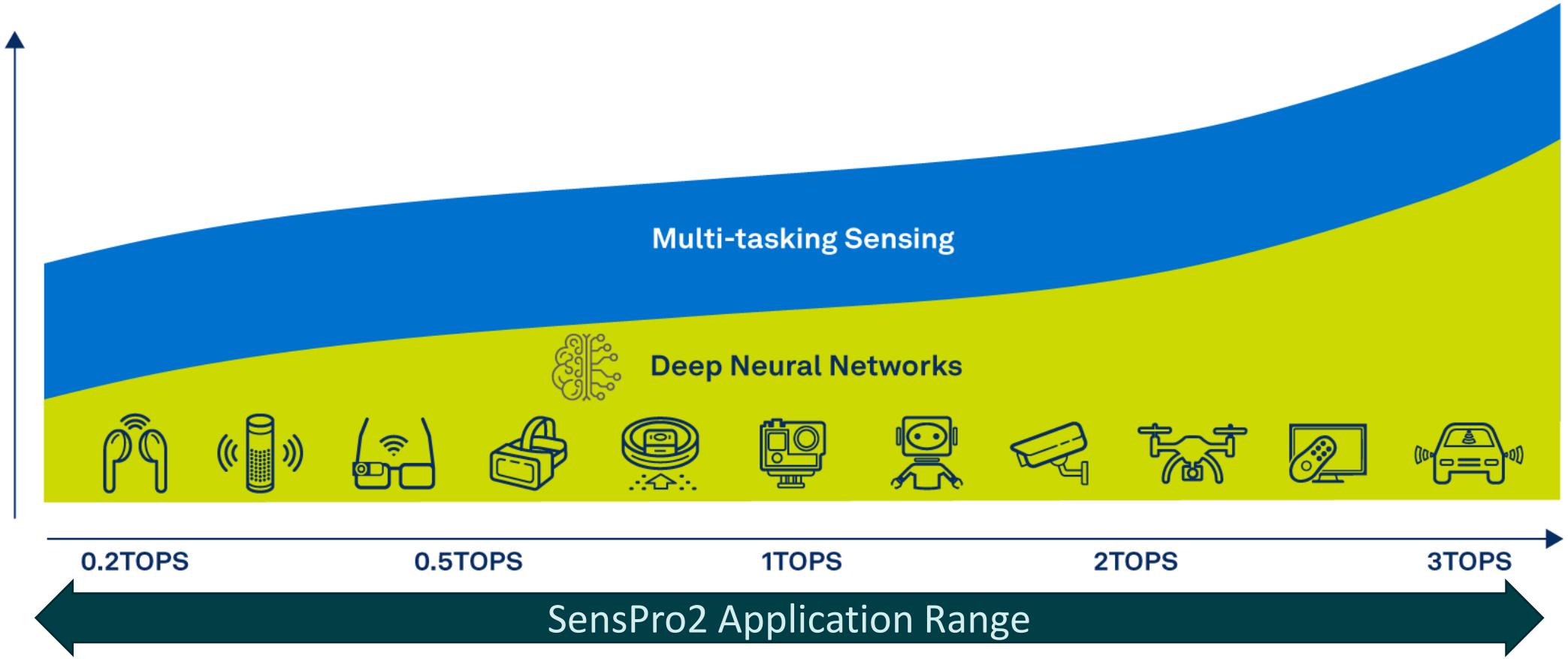
2X Memory Bandwidth* (fully connected layers)

20% Energy Savings*

* vs. SensPro Gen-1

Introducing SensPro2

Multiple IP Choices for Wide-Ranging Sensing & AI Applications



SensPro2 Configurations

	SensPro2 Core	MAC Configuration			Target Application
		INT8	INT16	FP32	
New in Gen-2	SP50	64	16	Optional	
New in Gen-2	SP100	128	32	Optional	
Enhanced in Gen-2	SP250	256	64	Optional	
Enhanced in Gen-2 (Gen-1)	SP500	512	128	Optional	
Enhanced in Gen-2 (Gen-1)	SP1000	1024	256	Optional	
New in Gen-2	SPF2	-	-	32	
New in Gen-2	SPF4	-	-	64	

Self-contained processors, scaling in performance for a broad range of end markets

SensPro2 Scalability

- SensPro is designed to serve as a hub for processing and fusing data from multiple sensors including camera, Radar, LiDAR, ToF, microphones and inertial measurement units, for contextually-aware devices
- SensPro2 family is expanded to **seven highly-configurable and self-contained DSPs**, combining a CEVA-BX **scalar processor** and **parallel vector compute units** for floating point and integer data types, as well as deep learning inferencing
- SensPro2 employs a **common and scalable ISA** across all cores to enable users seamless SW migration between different SP cores while scaling the performance
- SensPro2 architecture offers dedicated ISA required to process **sound, imaging, SLAM, Radar, and DNN** inference workloads
- SensPro2 is offered in seven core configurations:
  - Fixed point cores – **SP50, SP100, SP250, SP500, SP1000**
  - Floating point cores – **SPF2, SPF4**
- **SensPro2 offers a scalable solution for various processing and AI workloads while retaining code reuse across the family – whereas alternative DSPs only offer point solutions and cannot be scaled!**

SensPro™ by CEVA

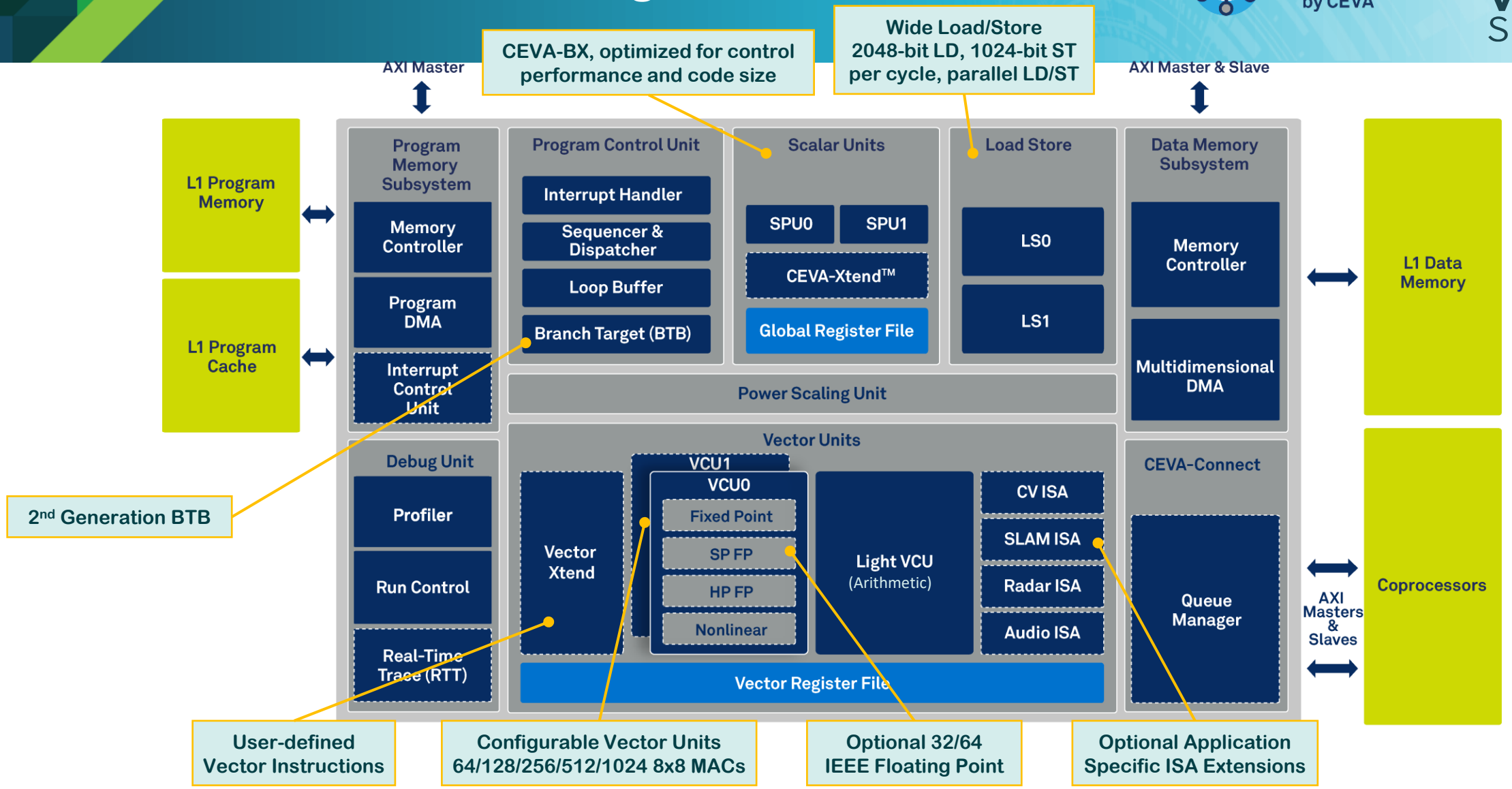
SensPro2 Architecture

CEVA

SensPro2 Feature Highlights

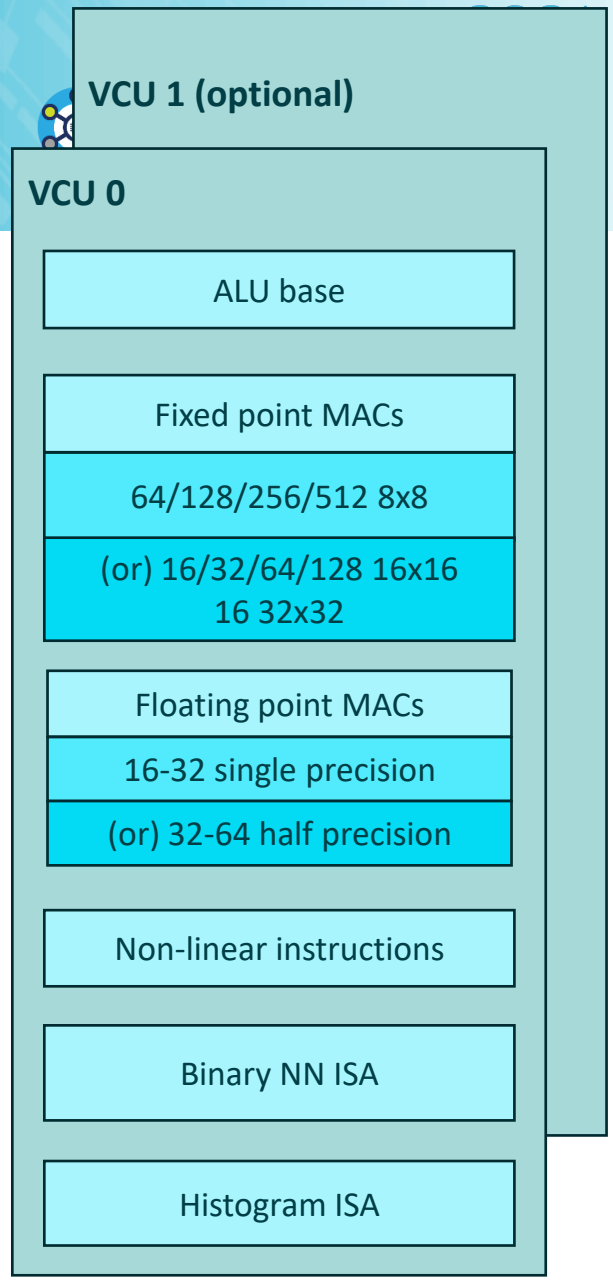
- 8-way VLIW, with highly configurable architecture
- 1.6GHz @ 7nm
- CEVA-BX DSP for Scalar Processing, control code for seamless migration
  - 4.3 CoreMark/MHz
- 3.2 TOPS (INT8)
  - 1024 8x8 MACs for the SP1000
- 400 GFLOPs
  - 64 Single Precision and 128 Half Precision FP MACs
  - Support for Complex Data for Radar
- Memory Architecture
  - 400 GByte/second Data Bandwidth
  - 4-Way Instruction Cache
  - DMA and Queue/Buffer Managers

SensPro2 Block Diagram



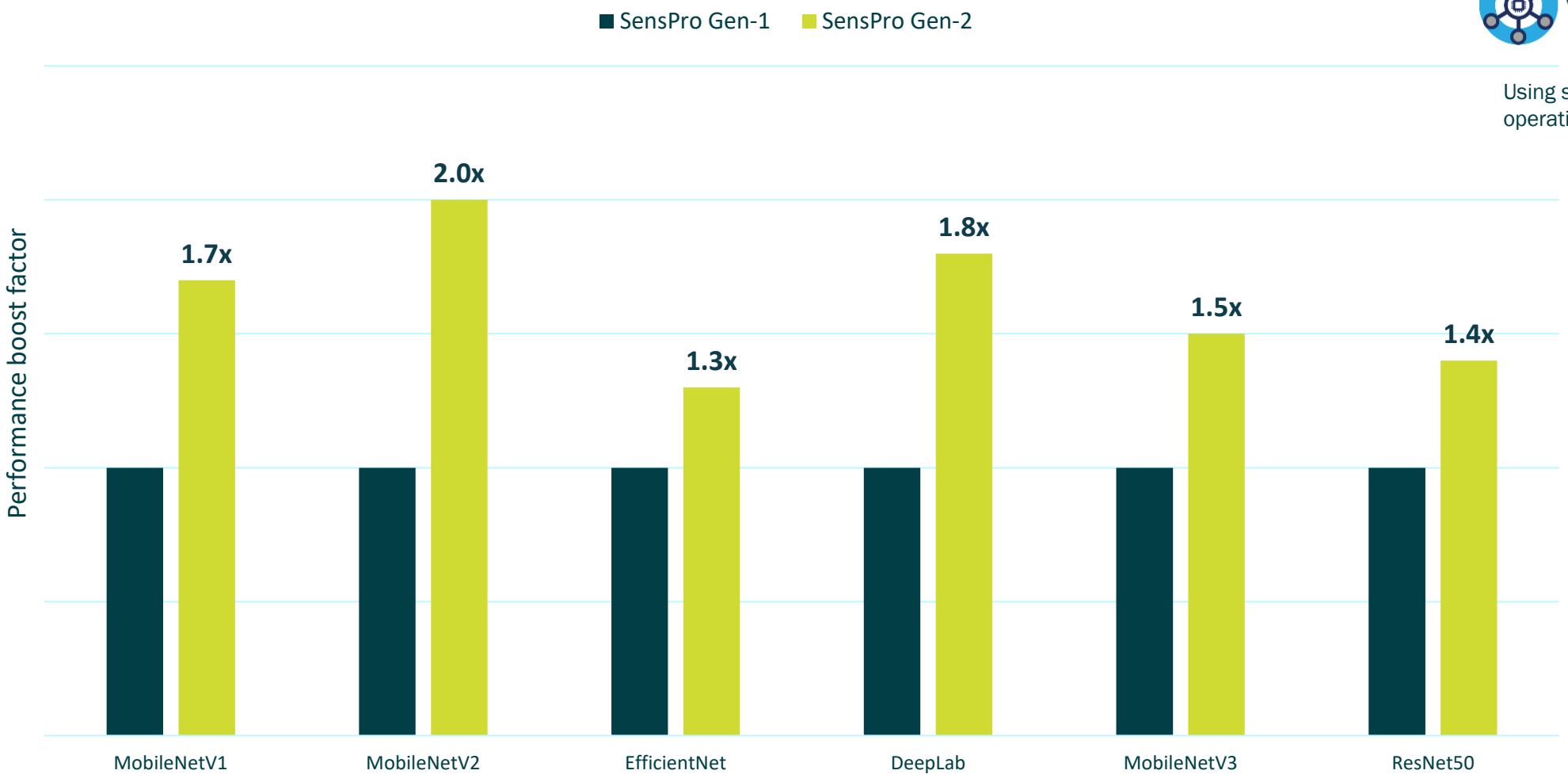
SensPro2 VCU Overview

- Fixed-point ALU operations
  - Flexible MAC operation range for data re-use
  - Wide SIMD with support for all data types
  - Variety of arithmetic, logic, bit manipulation, and special instructions
- Comprehensive Non-Linear instruction set optimized for accuracy and performance
  - Including native support for Taylor series and Newton Raphson approximations
- Floating-point support
  - Single (SPFP) and half precision (HPFP), IEEE-754 compliant
  - Fused MAC, with low-latency internal accumulation
  - Supports complex arithmetic
  - “Intra” vector operations



SensPro2 – Artificial Intelligence

SensPro 2nd Generation Neural Network **Performance Leap**

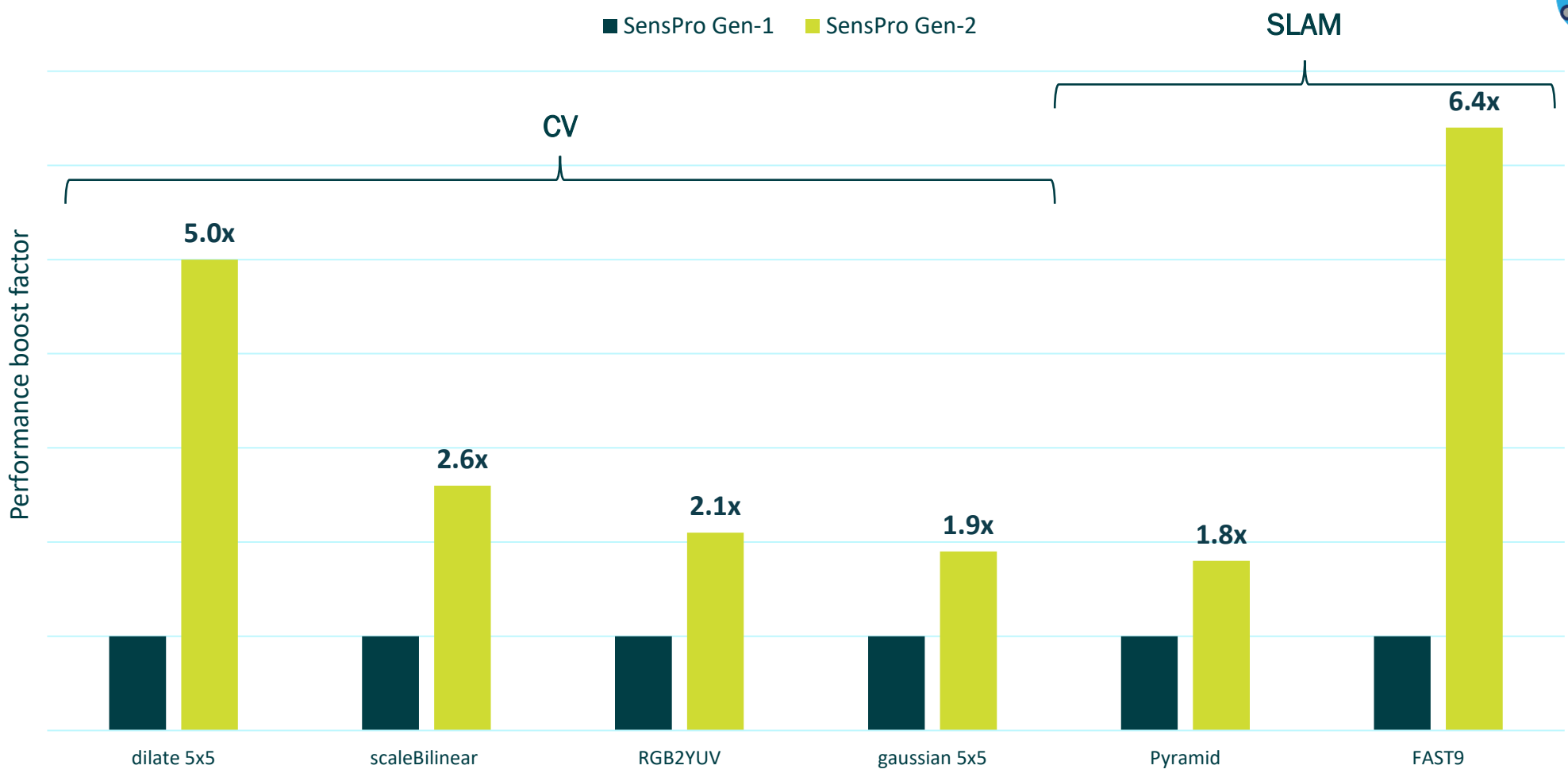


SensPro™ by CEVA

Using same SP core and operating frequency

SensPro2 – Computer Vision & SLAM

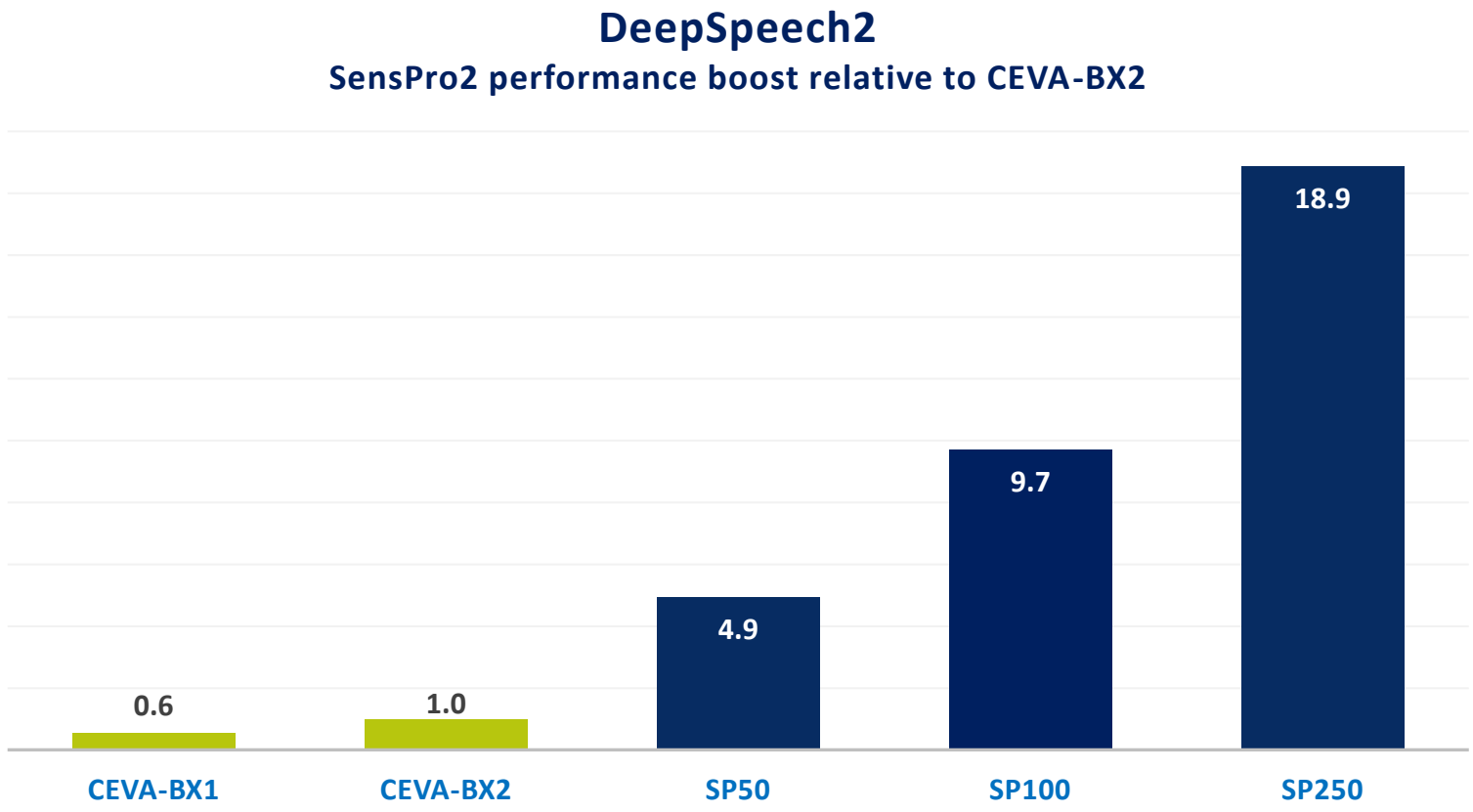
SensPro 2nd Generation CV + SLAM Performance Leap



Using same SP core and operating frequency

SensPro2 – Audio

- Most powerful DSP for audio processing and sound AI



SensPro2 – Radar

Range/Doppler Processing

- Mixed-radix DIT implementation:
  - 8X acceleration of high precision and High Dynamic Range: complex 16 & 32 bits
  - Dedicated ISA for DFT/FFT acceleration: Radix-2/Radix-3/Radix-4
  - Efficient support for FFT Windowing integrated into first FFT/DFT stage
  - Batch mode processing

Radar Detection

- Advanced detection algorithms: OS-CFAR
  - 4X acceleration using new VHIST ISA - Advanced histogram and accumulated histograms support
    - Supporting 1D/2D/3D CFAR processing
    - Supporting Flexible sliding windows configuration
    - Efficient Multi-channel operation mode and optional Data re-use
- GO/SO-CFAR based detection
  - 2X acceleration by new MIN4/MAX4 ISA: find min/max in 4 input vectors by single operation
- Sorting Acceleration
  - 2X acceleration of all comparison based sorting algorithms by new Min/Max ISA

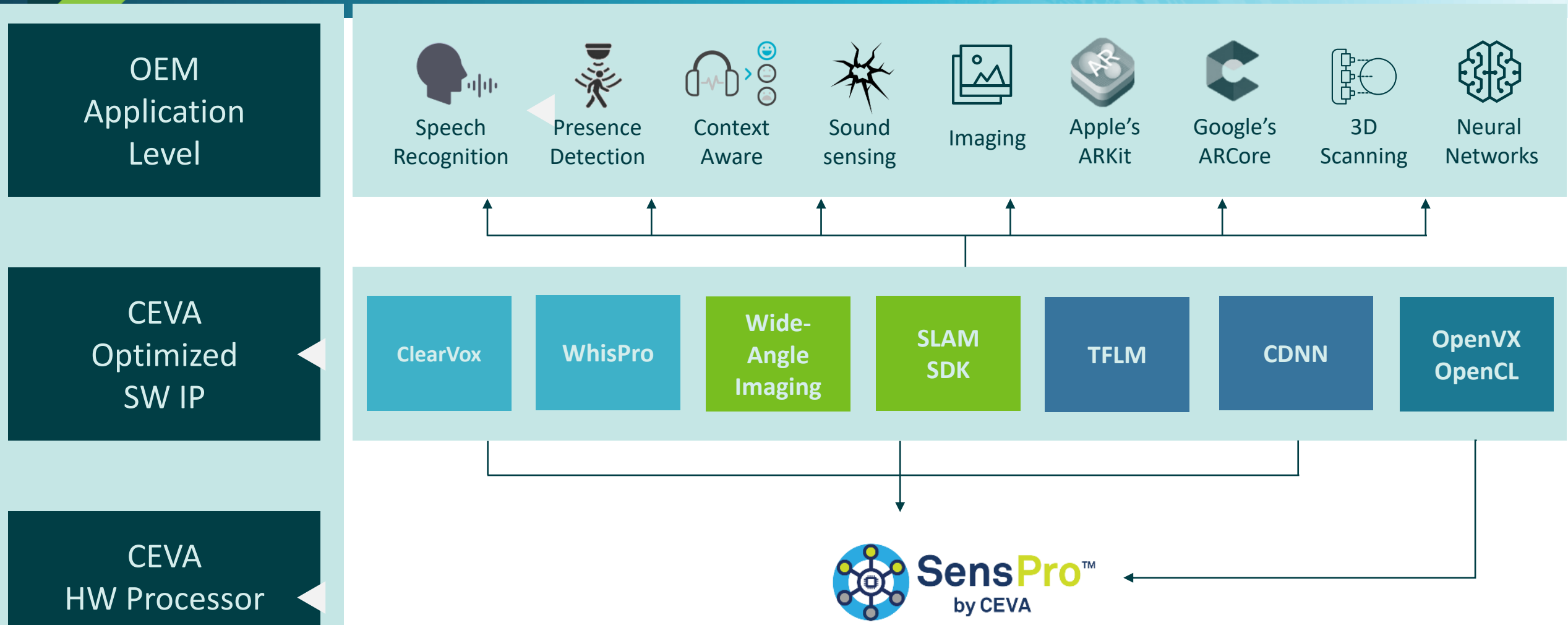
8X
Radar FFT*

4X
OS-CFAR*

2X
GO/SO-CFAR*

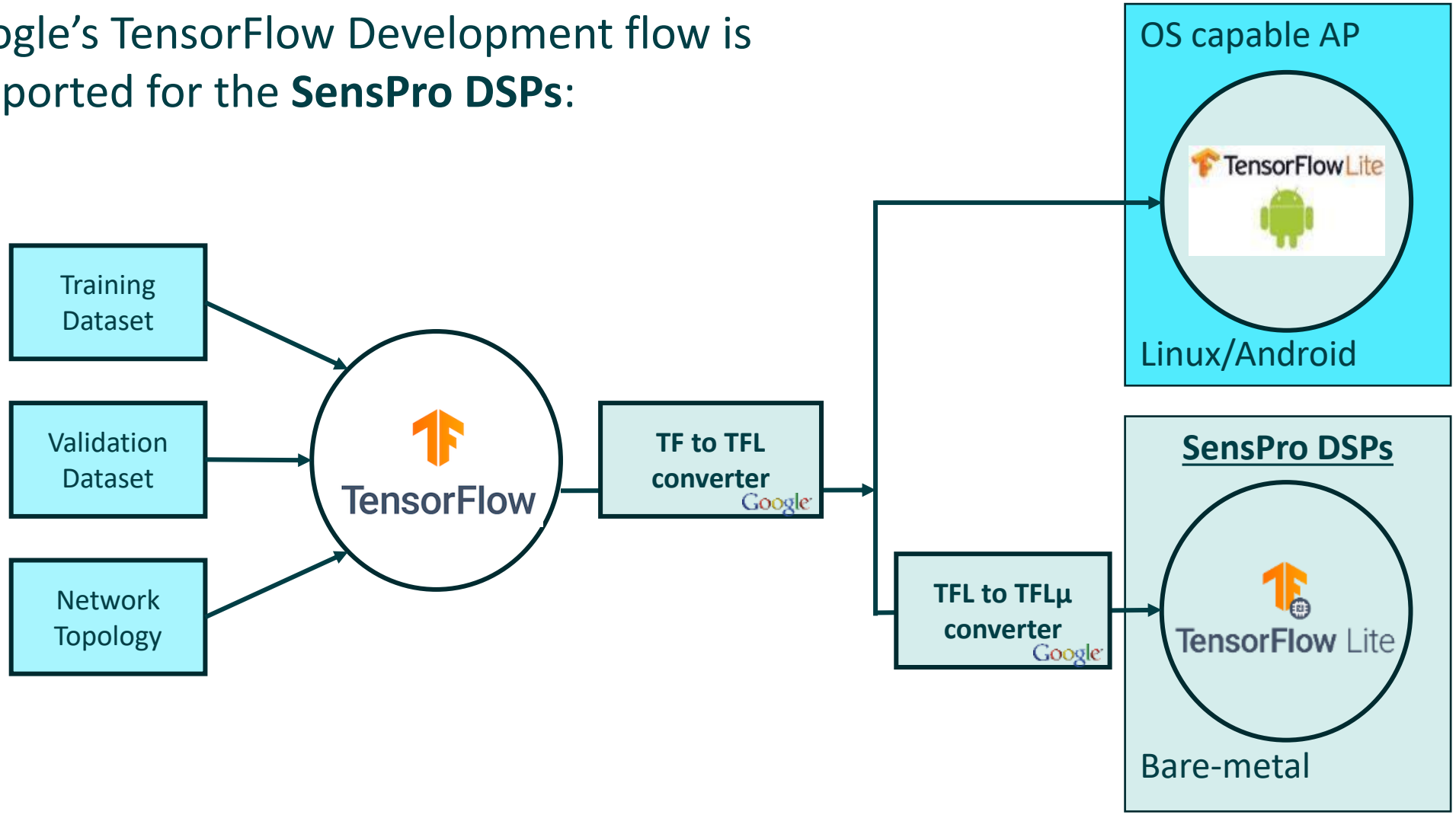
* Compared to SensPro Gen-1

Complementary Software and Libraries

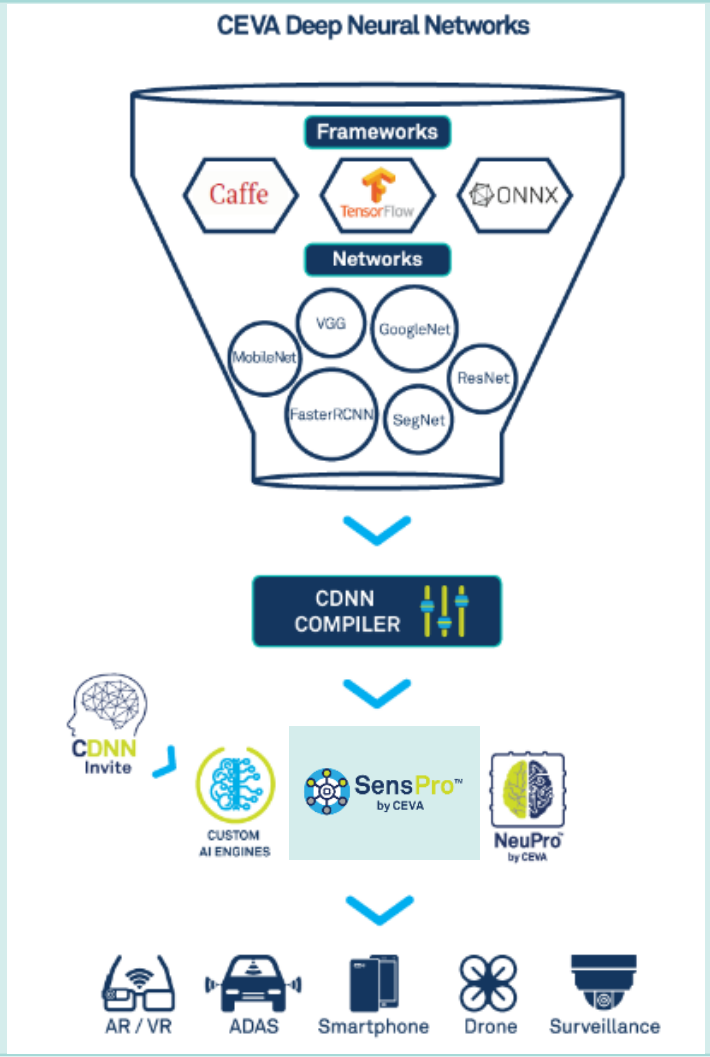


TensorFlow Lite Micro – NN Framework

- Google's TensorFlow Development flow is supported for the **SensPro DSPs**:



CEVA Deep Neural Network (CDNN) – NN Compiler



- Deep Neural network inferencing graph compiler w. automatic run time generation
- Graph Optimizer including accuracy optimization, retraining, and scaling per layer
- Comprehensive support for **over 200 NNs**
- Fully optimized for CEVA AI processors including SensPro2
- Support custom DNN accelerators (CDNN Invite) for seamless integration

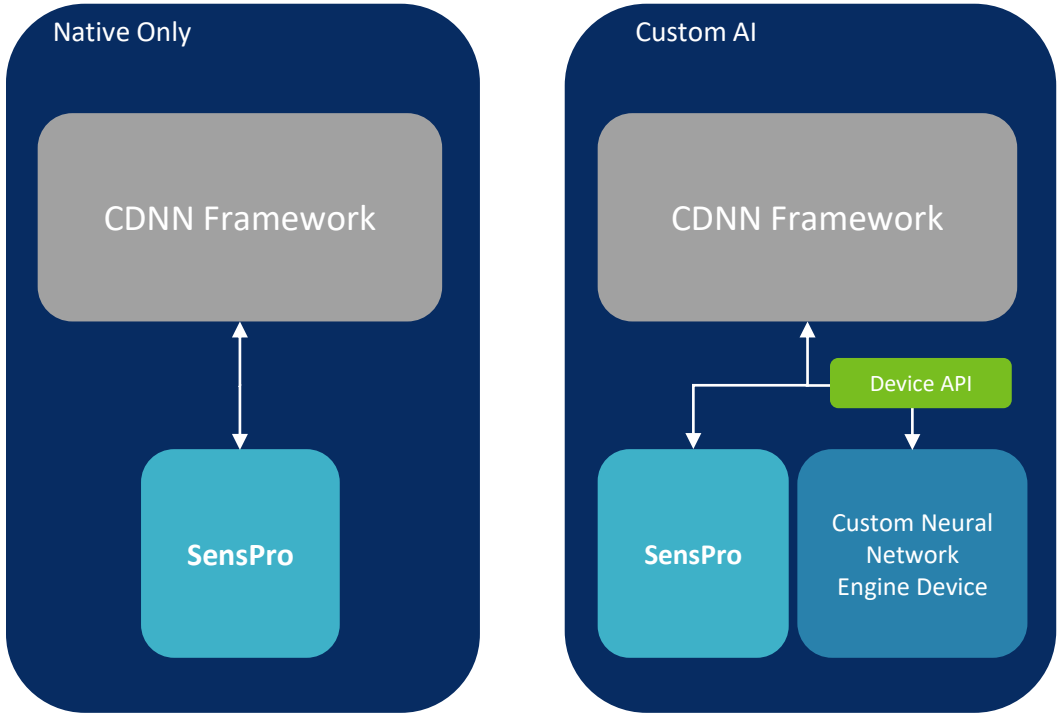
编辑选择奖

CDNN

Embedded TOP INNOVATIVE PRODUCT

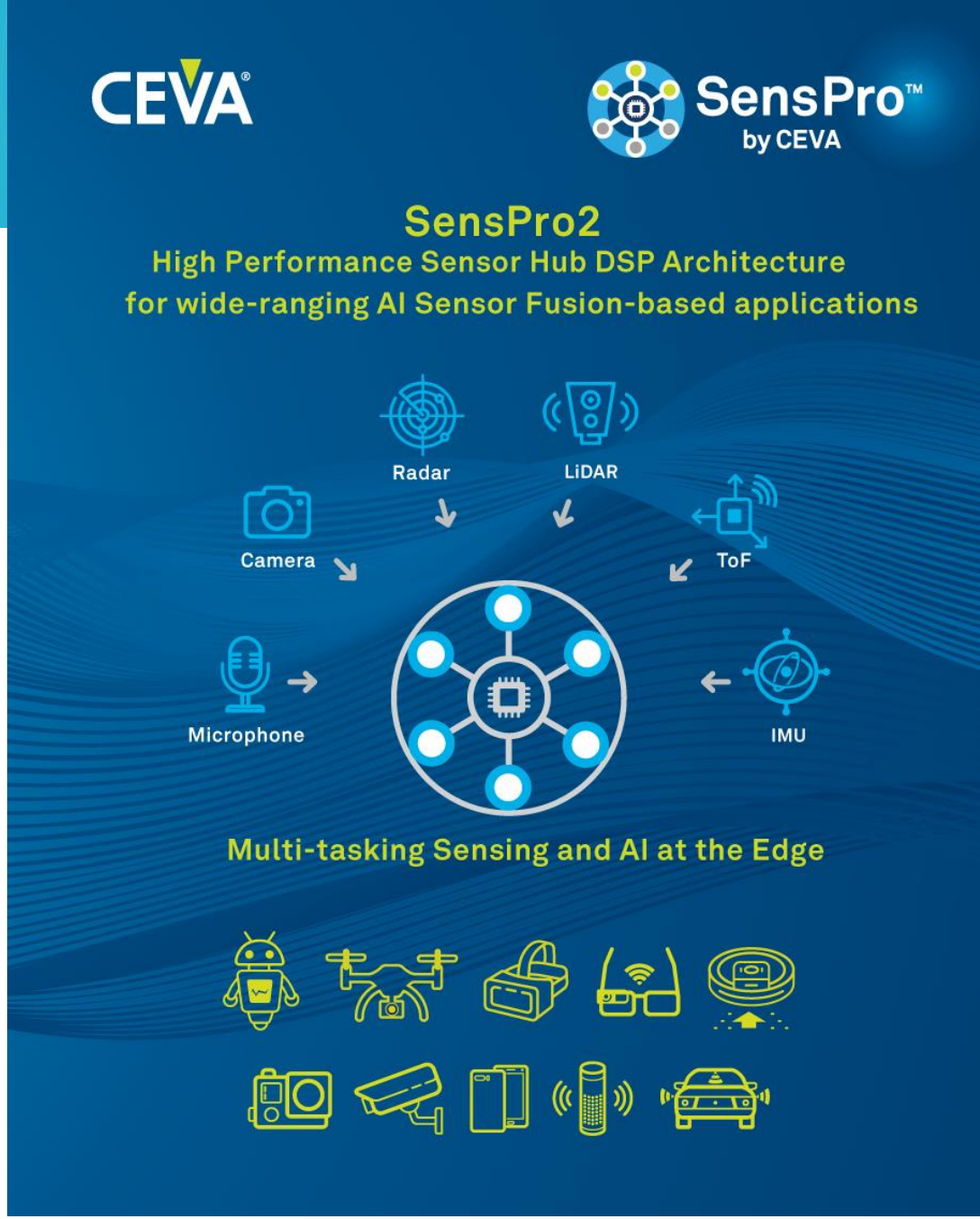
CDNN-Invite API

- CDNN-Invite API enables **Customer's AI engine** to benefit from the comprehensive network support, and optimization of the **CDNN compiler**
- CDNN-Invite Device and Driver software run on any of the SensPro2 DSPs
- CEVA DSP enables:
  - Software support of layers that are supported by the customer hardware
  - Using CEVA or its ecosystem partners software
- CEVA offers OS support that enables usage of the CEVA-DSP for sensor task while the AI accelerator "crunches"



SensPro2 – Key Takeaways

- High performance
  - 6X peak performance (CV, SLAM) and 2X better AI (CNN, FC) vs. SensPro Gen-1
  - 10X better audio AI – SP100 vs. CEVA-BX2
- Scalable family with 7 self-contained DSPs for wide range of sensing and AI applications
  - 0.2TOPS up to 3.2TOPS
- Modular Architecture with dedicated ISA for processing sound, imaging, SLAM, Radar, and DNN inferencing
  - Cost and Energy Efficiency
- Full SW toolchain with novel and Mature CDNN compiler and CDNN-Invite for custom AI engines



Thank You

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