Fifth-Generation
CEVA Imaging & Vision Silicon IP

www.ceva-dsp.com

Sep, 2016

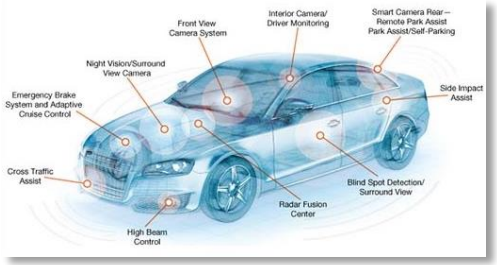
The Demand for Vision Processor IP

Smartphones

- Smartphone OEMs looking for ways to ‘stand out from the crowd’
- Qualcomm or Mediatek SoCs means a ‘me too’ smartphone
- But adding a co-processor for camera/vision allows for customization and true differentiation

Automotive

- Automotive industry focus is completely dominated by ADAS/Autonomous
- MobilEye and NVIDIA lack the ‘openness’ to allow OEMs add own algorithms and differentiating features
- OEMs want to control their destiny and pricing!



Consumer Electronics

- Drones, Surveillance, Action Cameras, Auto After-market etc
- Large volume opportunities that justify cost of SoC development.
- A programmable vision processor allows multiple end markets be addressed with a single SoC through software.

CEVA-XM4 – "Best Processor IP 2015"

- CEVA's first imaging and vision processor supporting deep learning
- Widely licensed and silicon available
  - Customer target applications include:
    - Smartphone APs
    - Smartphone Vision 'co-processors'
    - Smart surveillance systems
    - Drone 'collision avoidance' systems
    - Automotive surround vision & cognitive computing

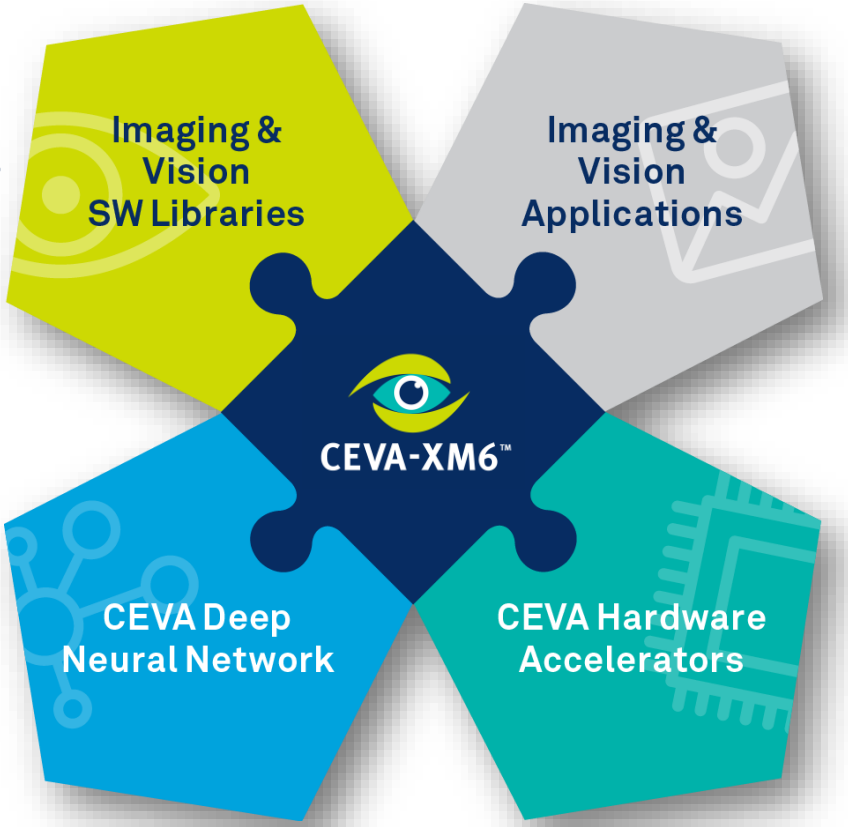
Vast experience & knowledge accumulated across multiple end markets and applications where neural networks are being deployed

Introducing CEVA's 5th Generation Imaging & Vision Technology

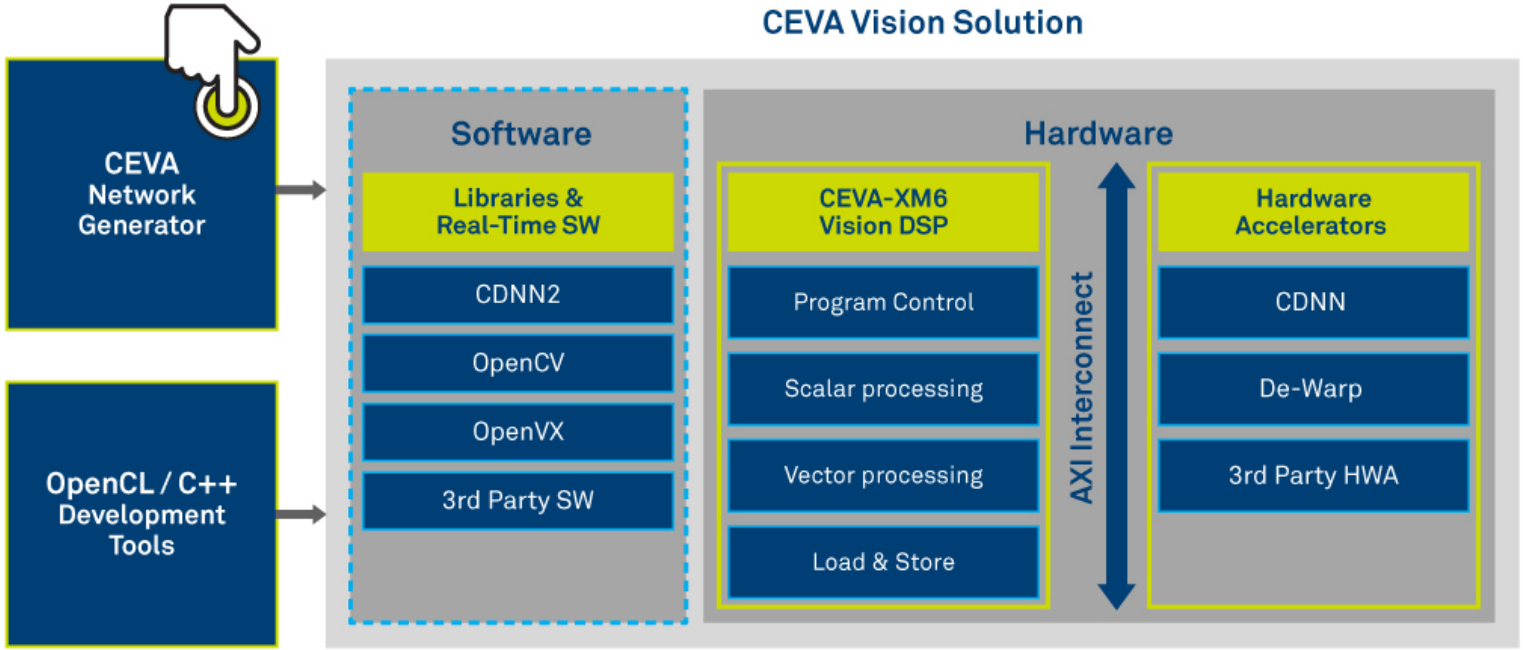
NEW PRODUCT

CEVA

- Comprehensive vision platform
- Centered on New CEVA-XM6 Vision DSP
- Enables embedded neural networks for mass market intelligent vision applications
- Simplifies delivery of powerful deep learning solutions on low-power embedded devices



Introducing CEVA's 5th-Generation Imaging & Vision Technology



Comprehensive and Scalable Vision Solution

The CEVA-XM6 Vision DSP

- **5th generation imaging and vision processor IP**
  - Major non-linear operations enhancements
  - Major performance increase in scatter-gather and sliding window mechanisms
- Significant performance gain*
  - Up to 3x performance gain for vector heavy kernels
  - 2x average performance gain across all kernels
- Leverages existing infrastructure, tools and ecosystem
  - 50% control code improvement

Performance Gain*

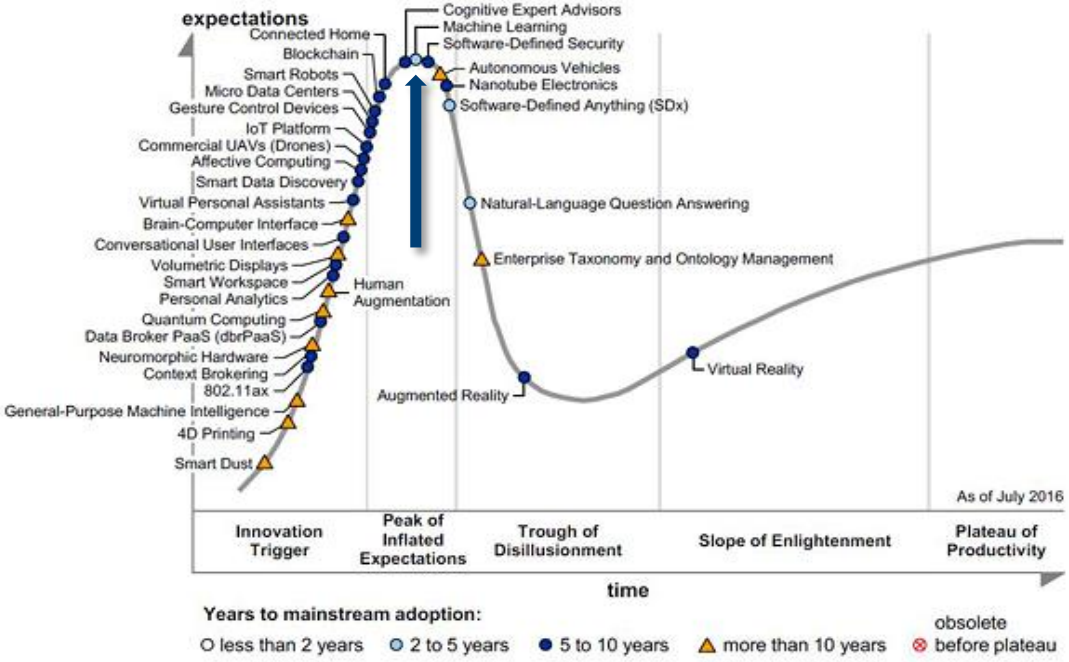
Control Code Improvement*

High Performance, yet flexible in precision and operation

* vs. CEVA-XM4

Hype Cycle for Emerging Technologies

2016: Machine Learning at the hype peak



Source: Gartner's Aug 2016 Hype Cycle for Emerging Technologies

Neural Network Embedded Challenges

Implementing a deep neural network in an embedded systems is an extremely challenging task!

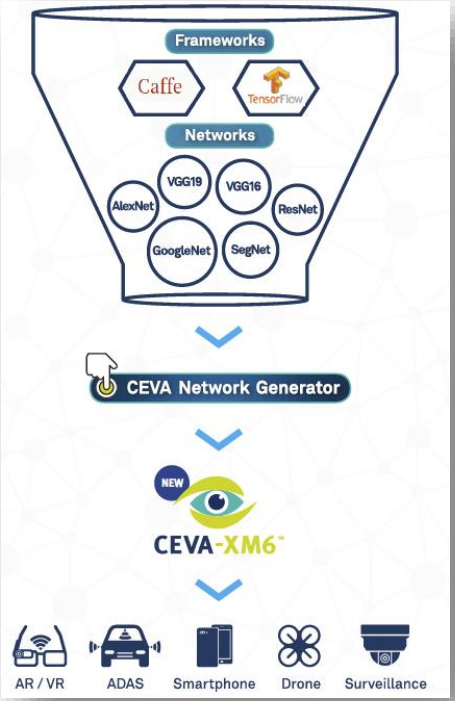
Very high bandwidth consuming and computing bottleneck

Porting and optimization capabilities

Stringent power budget and system cost

Long “Time-To-Market”

CEVA Deep Neural Network (CDNN2)

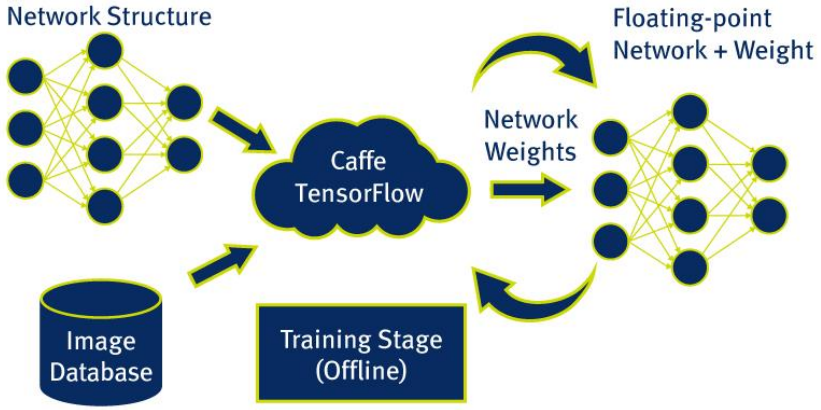


- 2nd gen SW framework support
  - Caffe and TensorFlow Frameworks
  - Various networks*
  - All network topologies
  - All the leading layers
  - Variable ROI
  - “Push-button” conversion from pre-trained networks to optimized real-time
  - Accelerates machine learning deployment for embedded systems
  - Optimized for CEVA-XM6 vision DSP together with CDNN HW accelerator

(*) Including AlexNet, GoogLeNet, ResNet, SegNet, VGG, NIN and others

CDNN2 Usage Flow

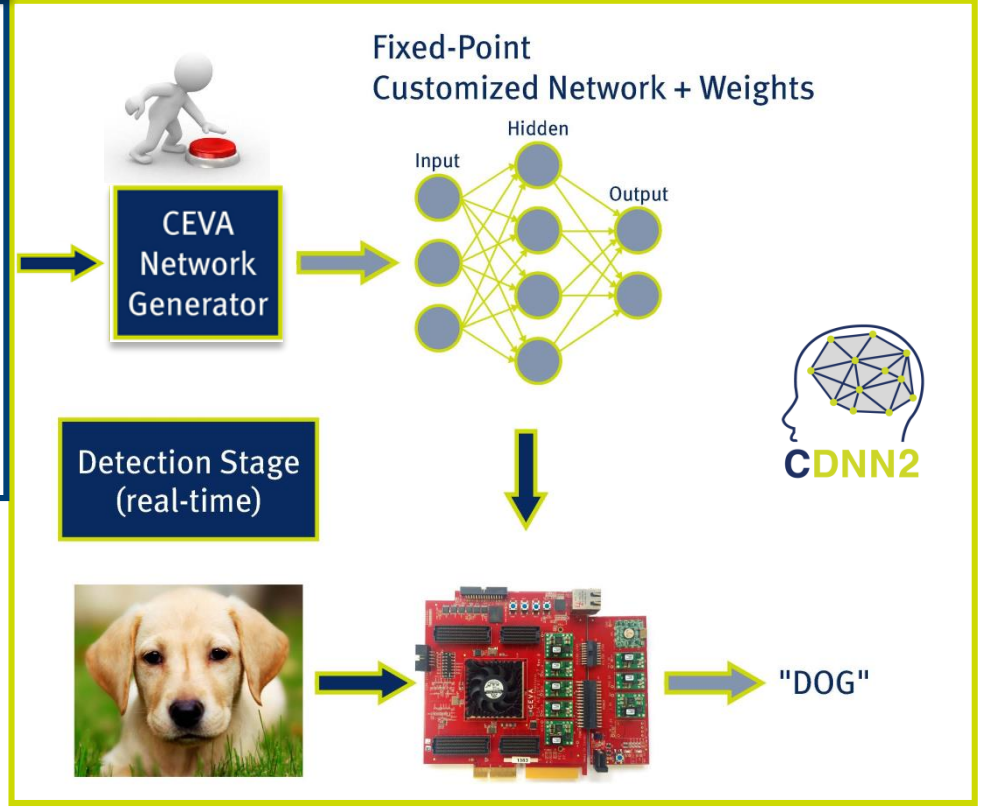
OEM / Partner (offline)



Caffe

TensorFlow

CEVA (offline + real-time)



Live CDNN2 demo

CDNN HW Accelerator

NEW PRODUCT

CEVA

- **Motivation**
  - Dedicated HW engine for executing the **convolutions** layers in CNN
  - Convolutions are the major and most cycles consuming layers
  - Provides the flexibility to cope with future Neural Network development

>8X

Performance Gain*

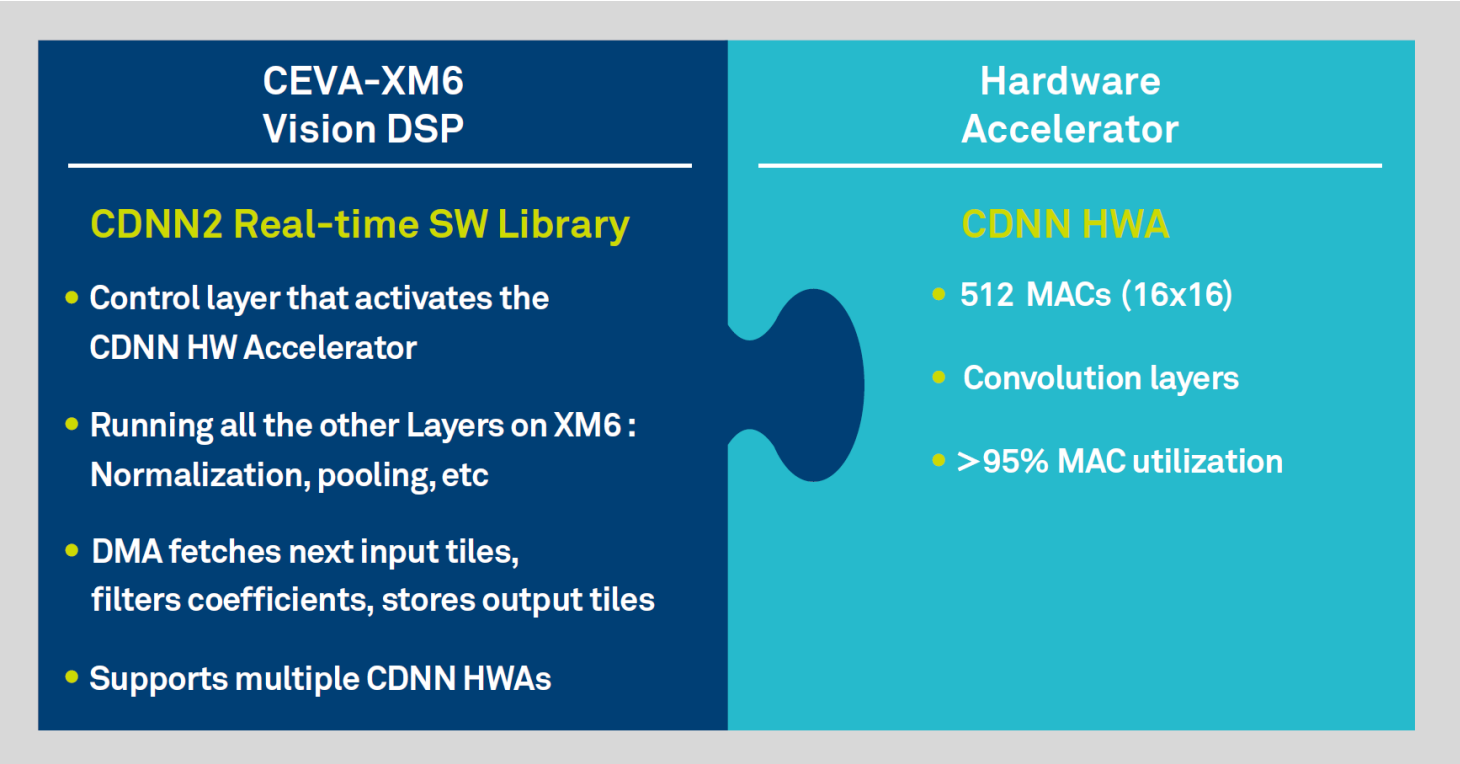
>95%

MAC utilization

- **Compatibility**: CEVA-XM vision processors

* vs. CEVA-XM4

Flexible Embedded CNN Solution



Flexible embedded solution and 16bit support are required to cope with the evolving and leading neural networks

CEVA-XM6 Platform vs. NVidia TX1 GPU for Implementing Deep Learning

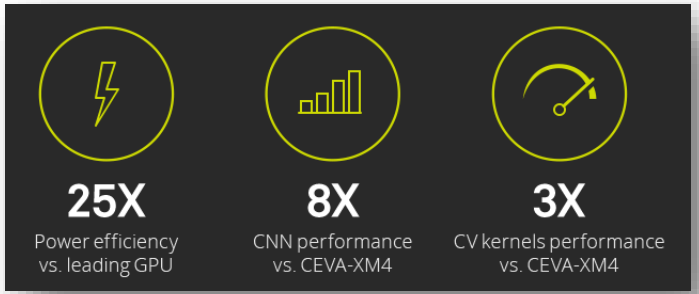
- Single CEVA-XM6 based platform is

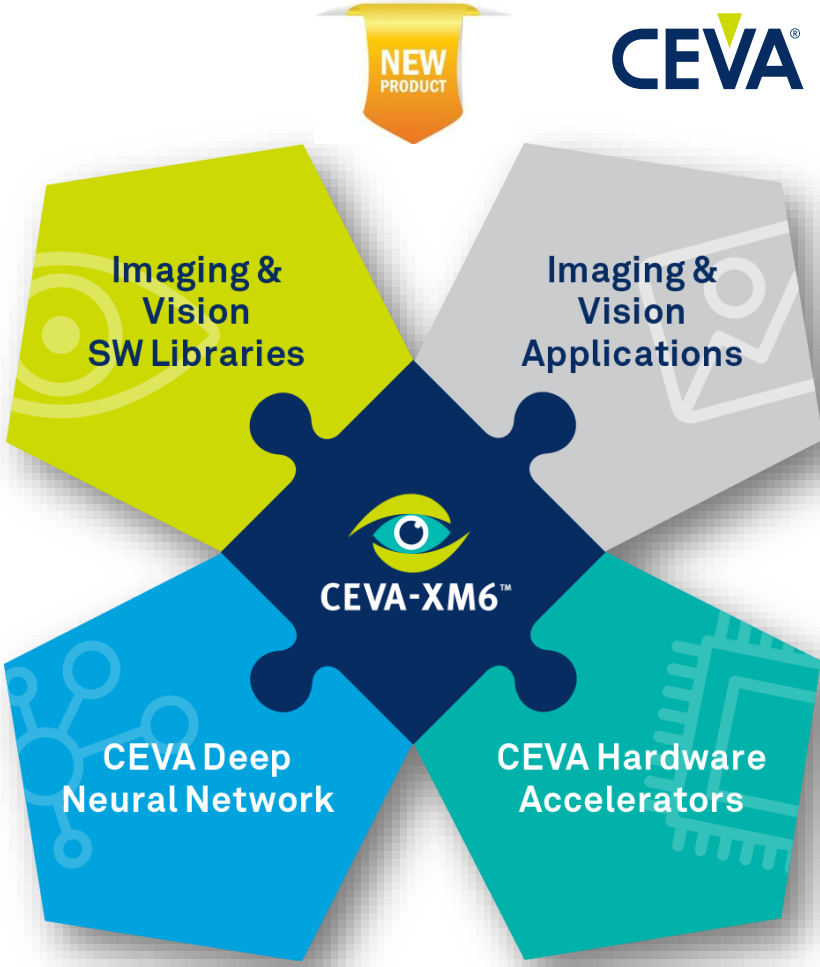
Assumptions:

- Based on the implementations of AlexNet and GoogleNet (single batch)
- TSMC 20nm technology and core @690MHz
- ROI single batch; (*) ROI/Sec/Watt (**) ROI/Sec
- Nvidia TX1 information: https://www.nvidia.com/content/tegra/embedded-systems/pdf/jetson_tx1_whitepaper.pdf

CEVA's 5th Generation Imaging & Vision Technology

- Comprehensive vision platform
- Power efficient and scalable platform
- Targeting DL, AI and advanced CV functionality
- Significant time-to-market advantage
- Higher performance





NEW

CEVA-XM6™

Intelligent Vision Processor

CEVA®

CDNN2

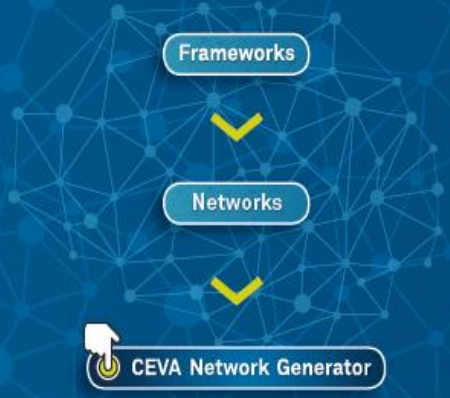
COMPREHENSIVE VISION PLATFORM ENABLING EMBEDDED NEURAL NETWORKS

Depth Map

Dual Cameras

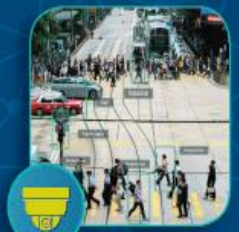
ADAS
& Autonomous Cars

360° Cameras



AR and VR

Drones



Smart Security
& Surveillance

Visual perception
& Analytics

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Thank You

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