INDUSTRIAL MACHINE VISION AT THE EDGE

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SECURE CONNECTIONS FOR A SMARTER WORLD

Agenda

- Industrial machine vision landscape
- NXP’s edge computing technology for machine vision
- Basler’s embedded vision technology
- NXP & Basler technology applied at NXP’s wafer factory
- Q&A

Industrial Machine Vision Landscape

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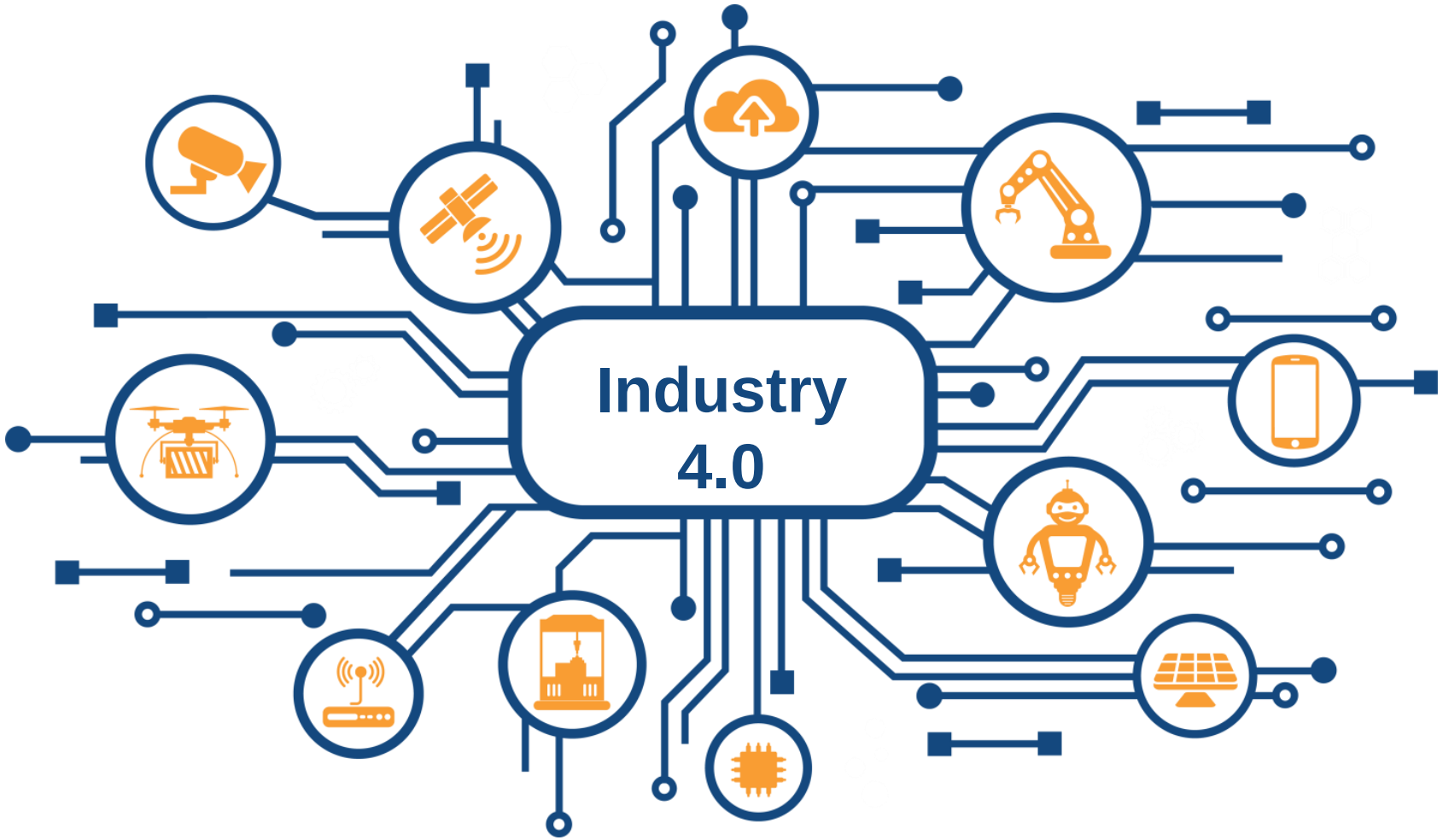
TREND: INDUSTRY 4.0



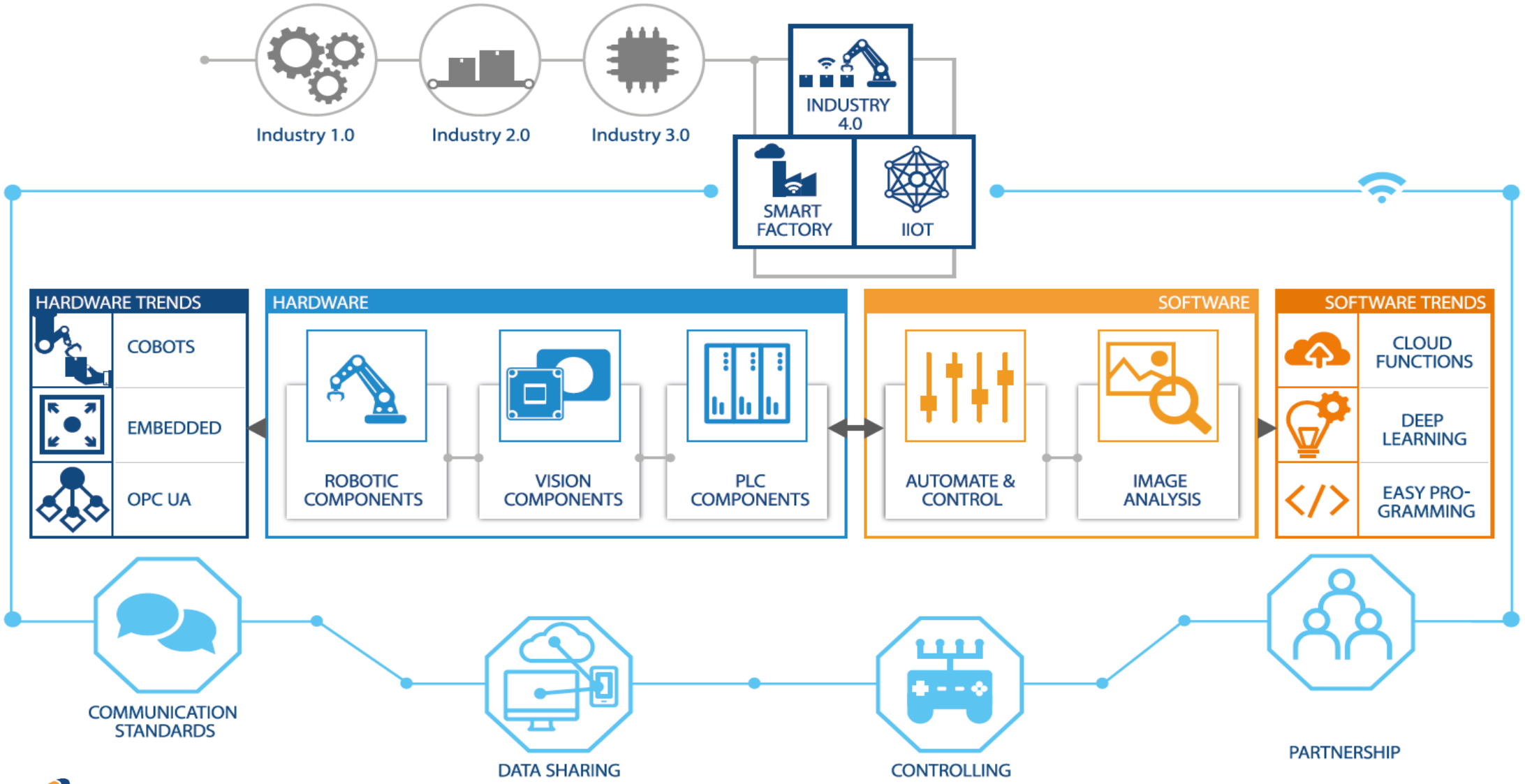
MACHINE VISION IN FACTORY AUTOMATION

Industry

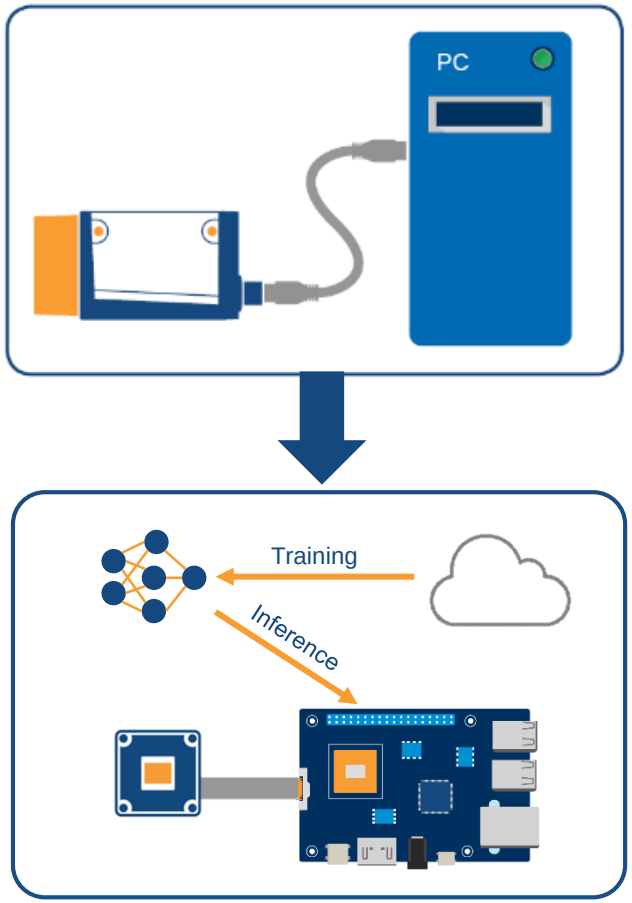
Automation and Quality Control:

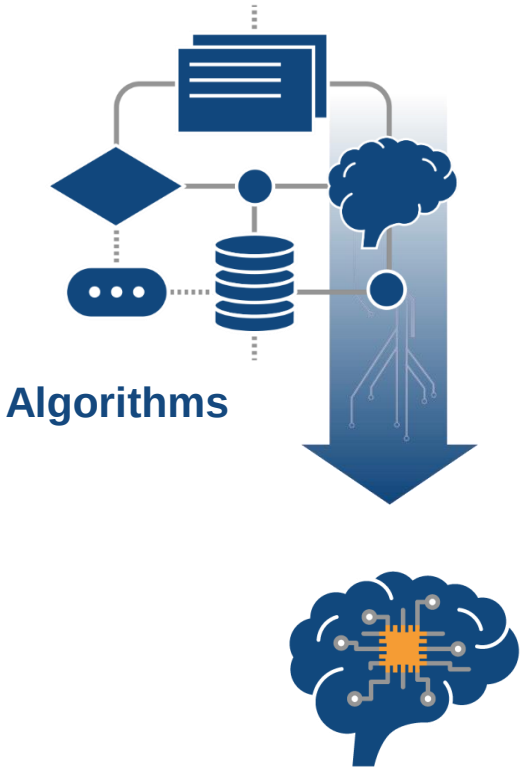
- Semiconductor & Electronics
- Logistics
- Food & Beverage
- Automotive
- Display
- Robotics
- Smart Factory

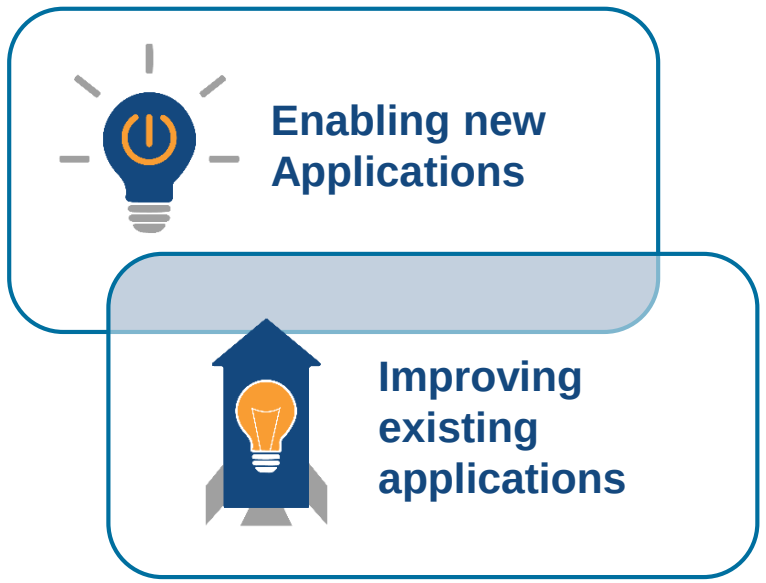
COMPUTER VISION IN INDUSTRY 4.0



MACHINE VISION SYSTEMS: MORE TRENDS







COMPLEXITY OF EMBEDDED VISION SYSTEMS

Camera Modules	▶ Speed (fps), Resolution (MP), Interface (MIPI, LVDS, USB)
Computing Board	▶ Performance, SoC Model
System Software	▶ Firmware, BSP, Drivers, Camera SDK
Application Software	▶ Classic algorithms or ML-Models for various applications
Cloud Connectivity	▶ Cloud connector integrated

MV Edge Device can provide and send to cloud:

- Images
- Meta data (results coming from image analytics on the edge)

MACHINE VISION ON THE EDGE

Advantages

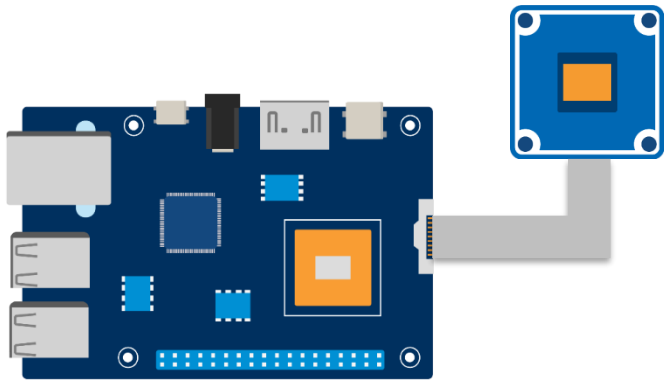
- Potential for further development
- Lean and efficient
- Compactness
- Low energy consumption
- Low material and operating costs

Market demands

- Growing need for real time applications
- Everything is connected

Result

- Classic existing PC based applications will go embedded
- New possibilities for the use of vision systems due to its compactness
- Processing at the edge
- AI and IoT



NXP’s Edge Computing Technology for Machine Vision

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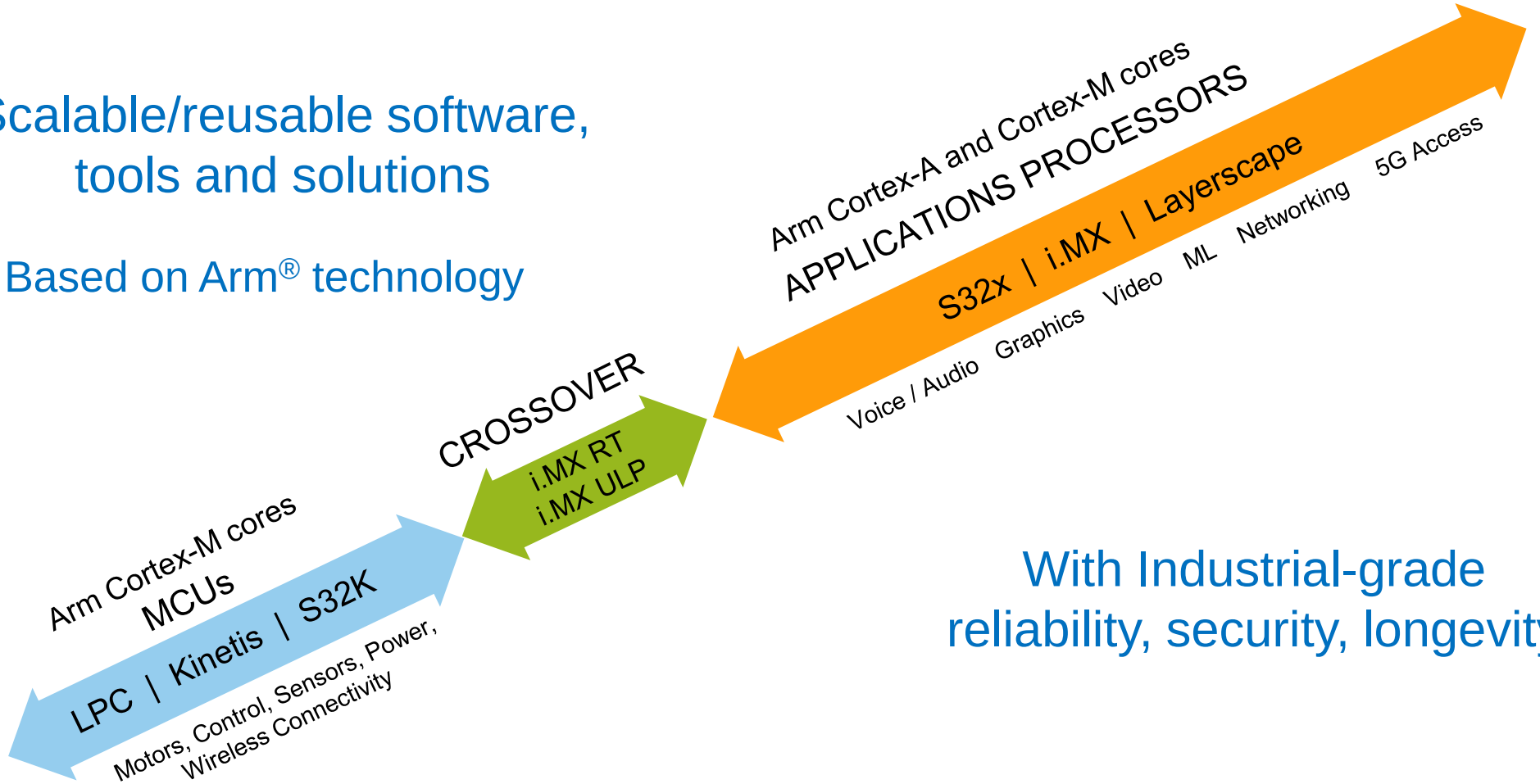
AMPLIFY MARKET DEPLOYMENT WITH NXP'S SCALABLE EDGE PROCESSING CONTINUUM

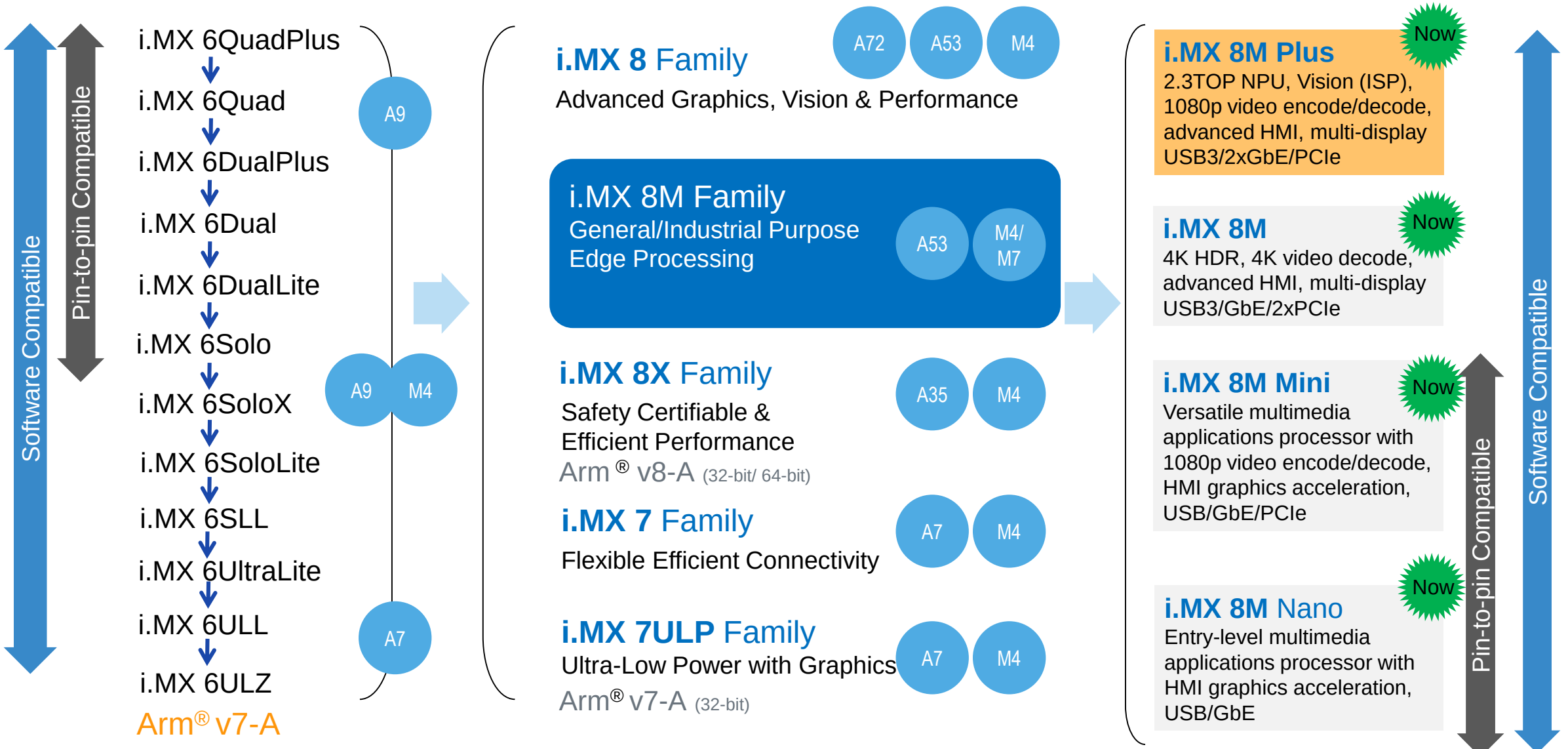
Scalable/reusable software, tools and solutions

Based on Arm® technology



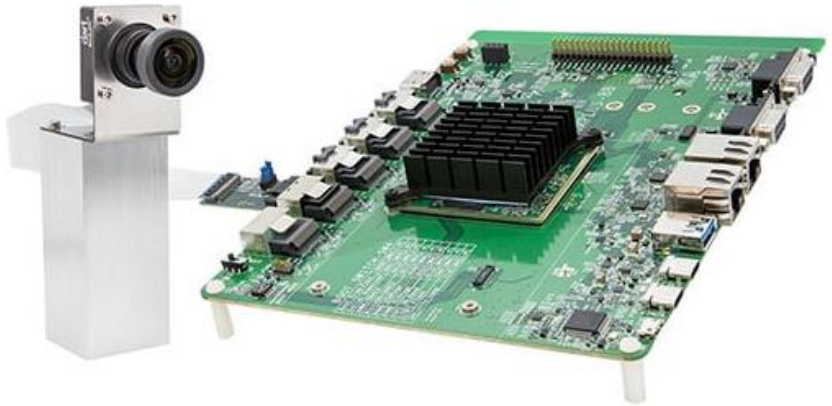
With Industrial-grade reliability, security, longevity

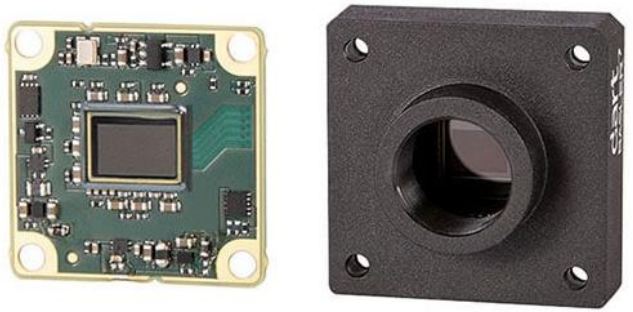
i.MX 8M FAMILY OF APPLICATIONS PROCESSORS



ZOOM-IN ON i.MX 8M APPLICATIONS PROCESSORS FAMILY

	Cores	GPU	NPU	Camera Interfaces
i.MX 8M Plus	**- 4xA53 (1.8 GHz) with x32-bit DDR (ECC) - 1xM7 (800 MHz)**	**Yes**	**Yes (Up to 2.3 TOPS)**	**2x MIPI-CSI Dual Camera ISP**
i.MX 8M Quad	**- 4xA53 (1.5 GHz) with x32-bit DDR - 1xM4 (266 MHz)**	**Yes**	**---**	**2 x MIPI-CSI**
i.MX 8M Mini	**- 4xA53 (1.8 GHz) with x32-bit DDR - 1xM4 (266 MHz)**	**Yes**	**---**	**1x MIPI-CSI**
i.MX 8M Nano	**- 4xA53 (1.5 GHz) with x16-bit DDR - 1xM7 (800 MHz)**	**Yes**	**---**	**1x MIPI-CSI**





NPU: Neural Processing Unit; ISP: Image Signal Processor; ECC: Error Correction Code; TOPS: Trillions of Operations Per Second

i.MX 8M PLUS APPLICATIONS PROCESSOR – MACHINE VISION AND INFERENCE






YUV, RGB

YUV, RGB

Bayer Raw, YUV, RGB

YUV, RGB

2x USB

Bayer

2x MIPI-CSI 4-lanes each

2x ISP Dewarp

RGB-IR

2x ISI

x

PCIe 3.0

2x Gigabit Ethernet

VPU Video decode (optional)

2D GPU or 3D GPU (OpenCL or Open GL)

1. YUV or Video color space conversion to RGB
2. RGB Scale for Inference

VPU Video decode (optional)

RGB NPU

RGB

Neural Net Classifier 2.3 TOPS (optional)

RGB

CPU

Application and Machine Decision and Inference Engine Runtime

4x Cortex-A53

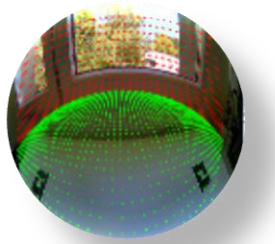
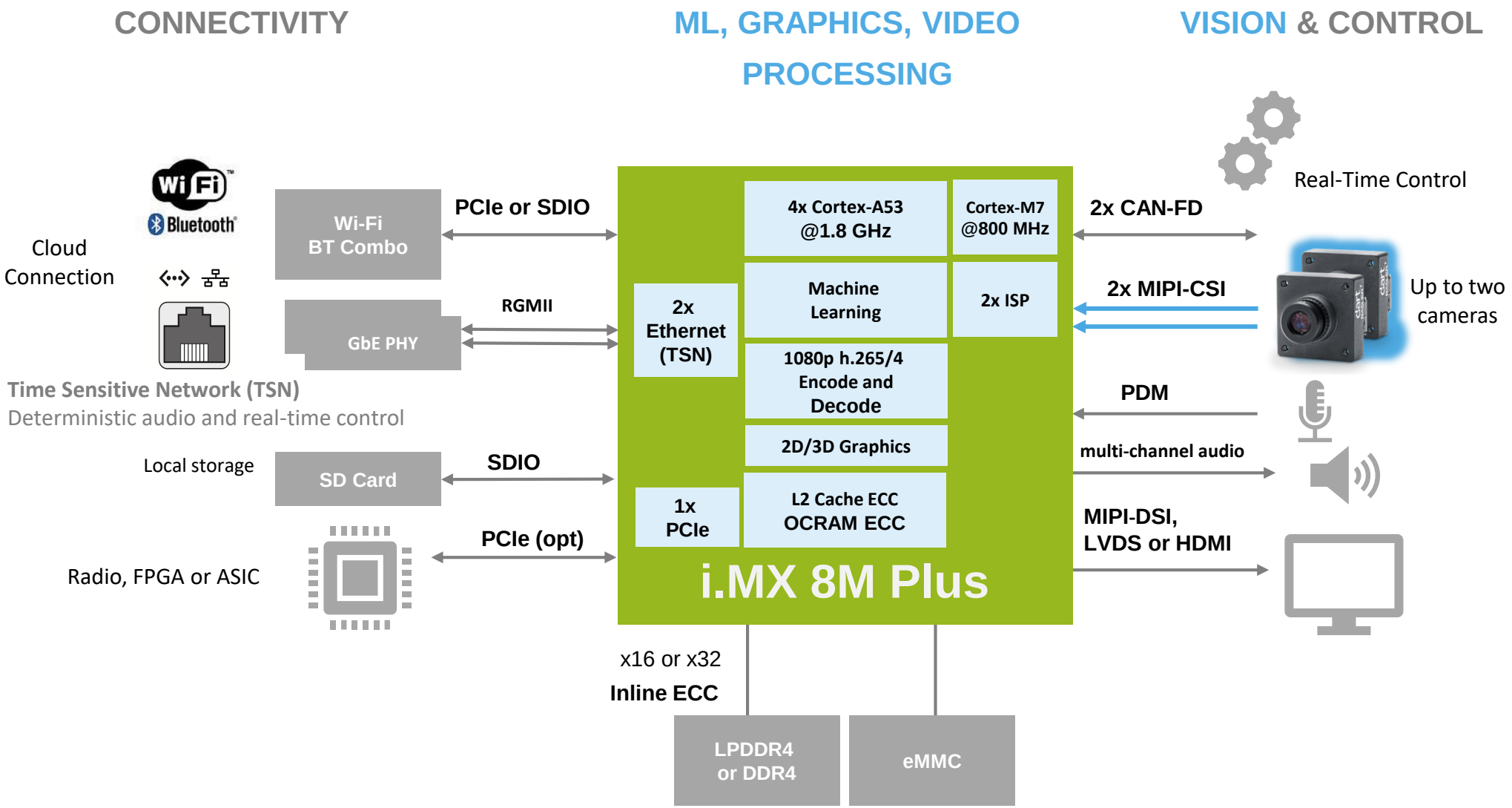




IMAGE PROCESSING WITH CAMERA INTERFACES, AUDIO AND DISPLAY



Basler’s Embedded Vision Technology

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BASLER'S EMBEDDED VISION TECHNOLOGY

~ 800 employees

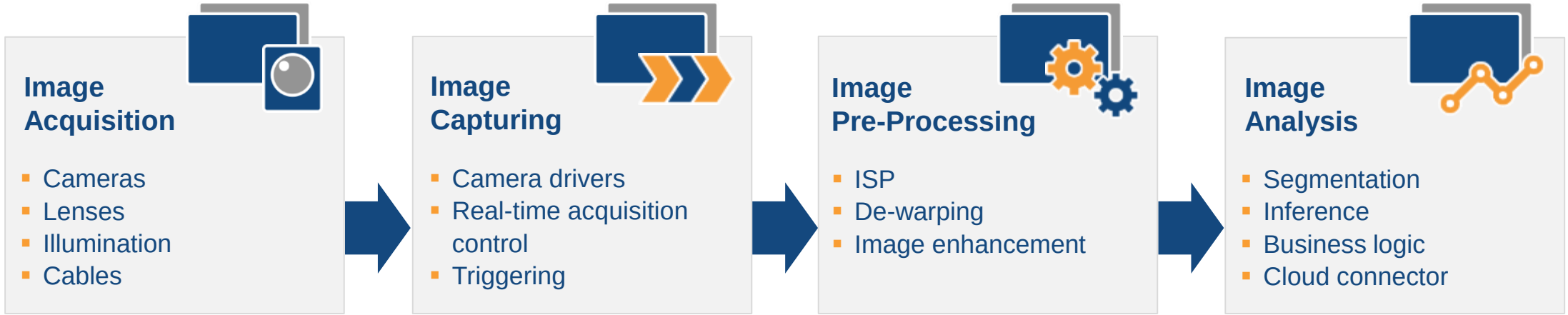
Publicly traded
family business
(2019 Revenue 162 Mio €)

Most trusted brand
in industrial cameras

Global market and technology leader of
imaging components for Computer Vision

30 years of insight driven innovation

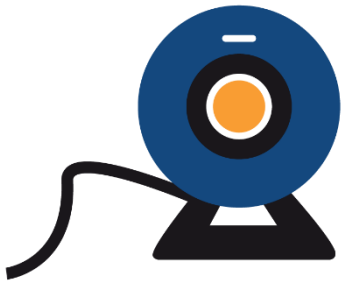
ELEMENTS OF A VISION SYSTEM – BASLER

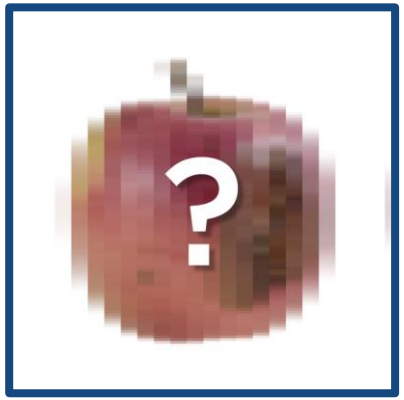


- Spending effort on image acquisition considerably lowers the image analysis effort.
- Optimizing the complete vision system will give optimum price/performance solution

THE EMBEDDED VISION SYSTEM AS A WHOLE

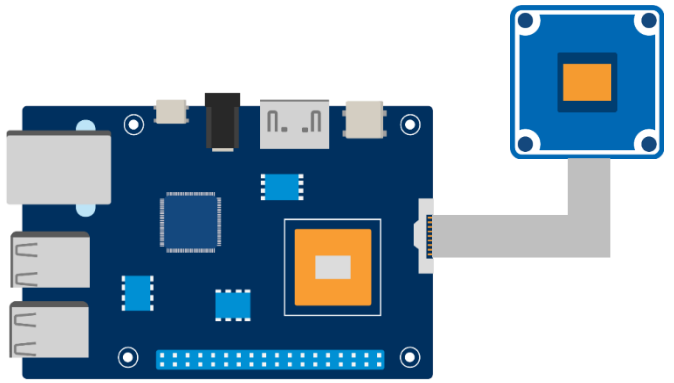
- The whole system can only be as good as it‘s weakest component!





- Design your system detached from a single desired component.

- Go back to the requirements and select the individual components.

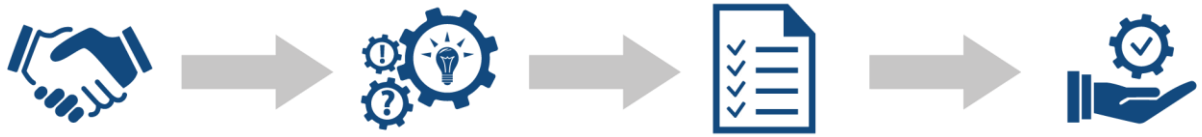


BASLER EMBEDDED VISION SOLUTIONS

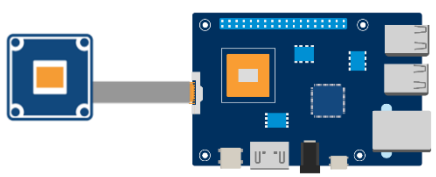
REGISTERED PARTNER

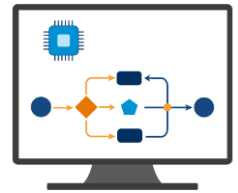
NXP

Solution Consulting



Development: HW & SW





Production

Life Cycle Management

BASLER

NXP

NXP i.MX 8 PLATFORM
ENABLER PRODUCTS FROM BASLER

Camera Modules

Add-On Camera Kits for i.MX 8 EVKs

Embedded Vision Development Kits

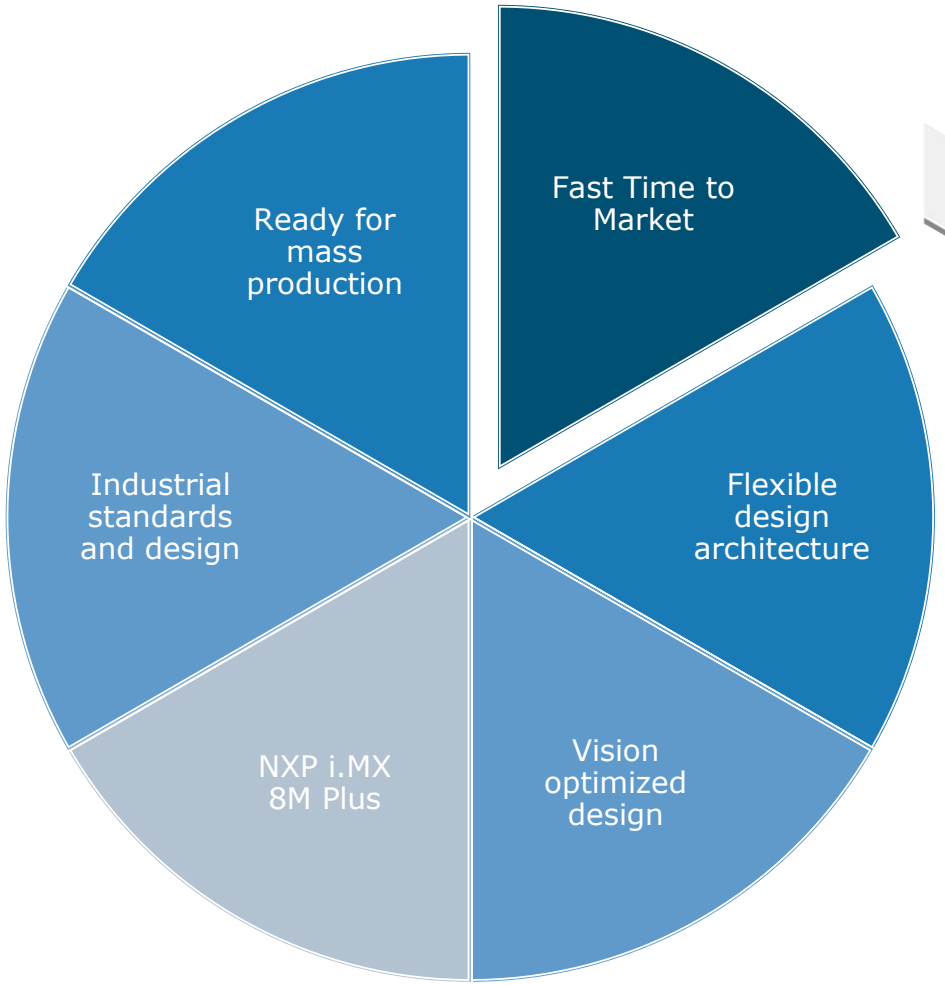
pylon

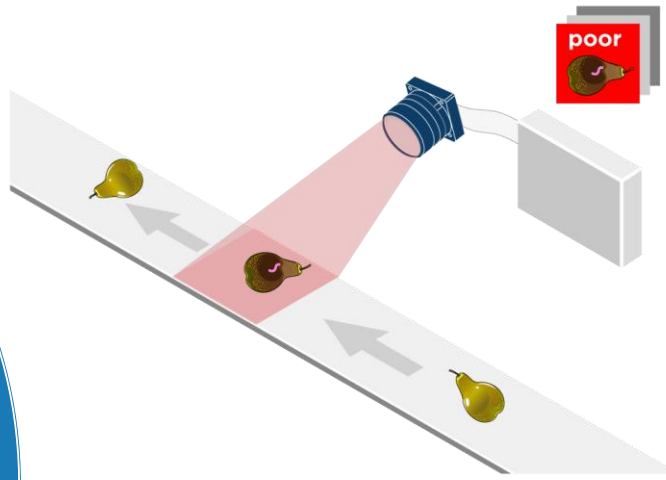
BCON for MIPI USB3 VISION GiGE VISION

Embedded Vision Processing Kits

Application Software & Cloud Connection

BASLER'S EMBEDDED VISION PROCESSING KIT
FASTEST WAY TO YOUR VISION SOLUTION

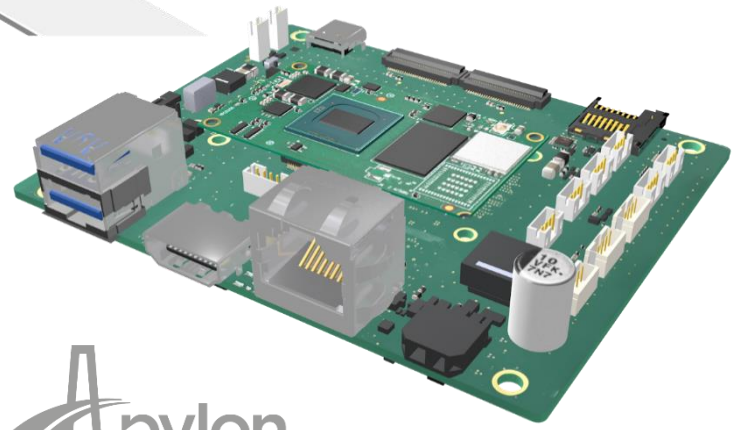




Processing

Vision

System Software



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BCON for MIPI

USB3 VISION

GiGE VISION

BASLER

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NXP & Basler Technology Applied at NXP's Wafer Factory

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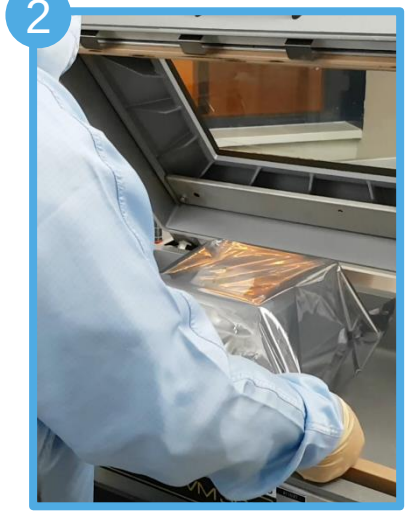
VISUAL INSPECTION PoC FOR NXP WAFER FACTORY

- ✓ A typical silicon wafer manufacturing process ends in a delicate packaging process of the wafers in a transport box before they leave the factory.

1

- ✓ Once the transport box is closed, an operator performs a visual inspection.

2



- ✓ Placement of ID sticker.
- ✓ Wrapping of transport box

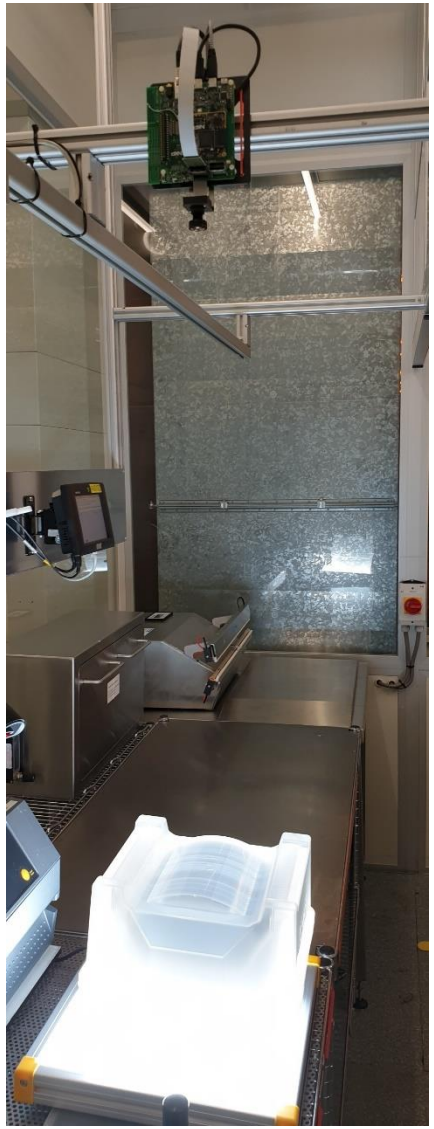
3

- ✓ Ready for shipment

VISUAL INSPECTION PoC FOR NXP WAFER FACTORY

[i.MX 8M Mini Evaluation Board]

[daA2500-60mci-IMX8-EVK - Embedded Vision Kit]

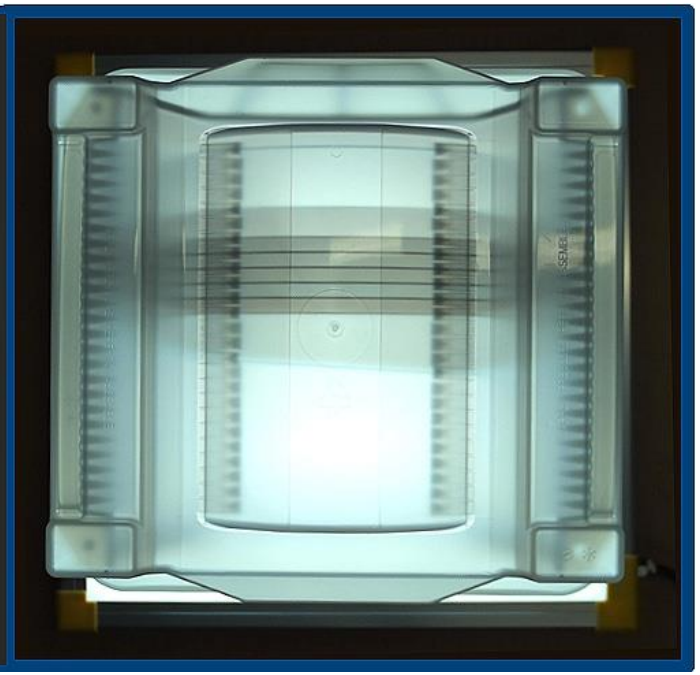


Steps:

1. i.MX 8M Mini receives MQTT or operator triggers a digital input.
2. Algorithm looks for empty slots, slanted wafer disks or missing disks.
3. Report generation with below info:
   - ✓ OK or NOK Message
   - ✓ Number of wafers
   - ✓ Index identifying wafer positions

Further details at our NXP Blog: *See How NXP Optimizes Wafer Manufacturing with Vision-Based Edge Devices*

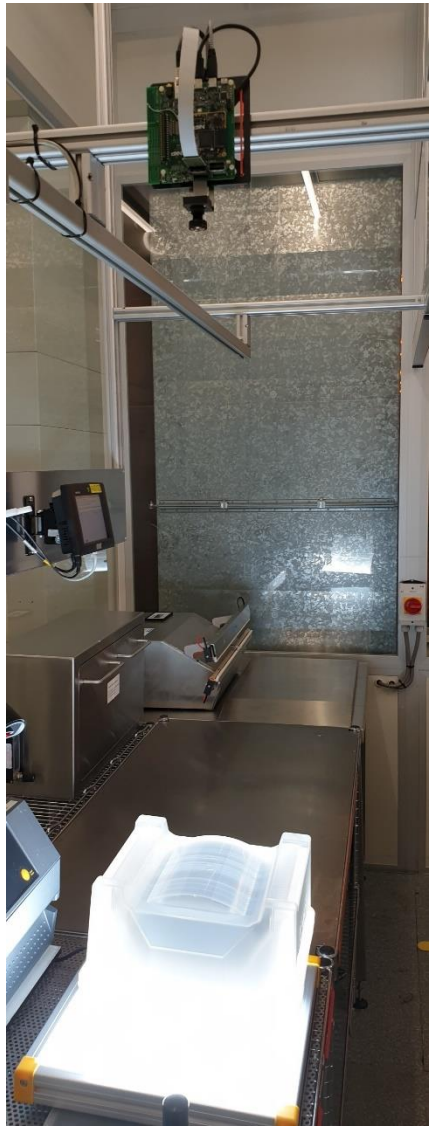
```
container is not ok
9 wafers counted
        missing at position 1
        missing at position 2
        missing at position 3
        missing at position 5
        missing at position 12
        missing at position 13
        missing at position 14
        slant at position 15
        missing at position 16
        missing at position 17
        missing at position 18
        missing at position 19
        missing at position 20
        missing at position 21
        missing at position 22
        missing at position 23
        missing at position 24
```

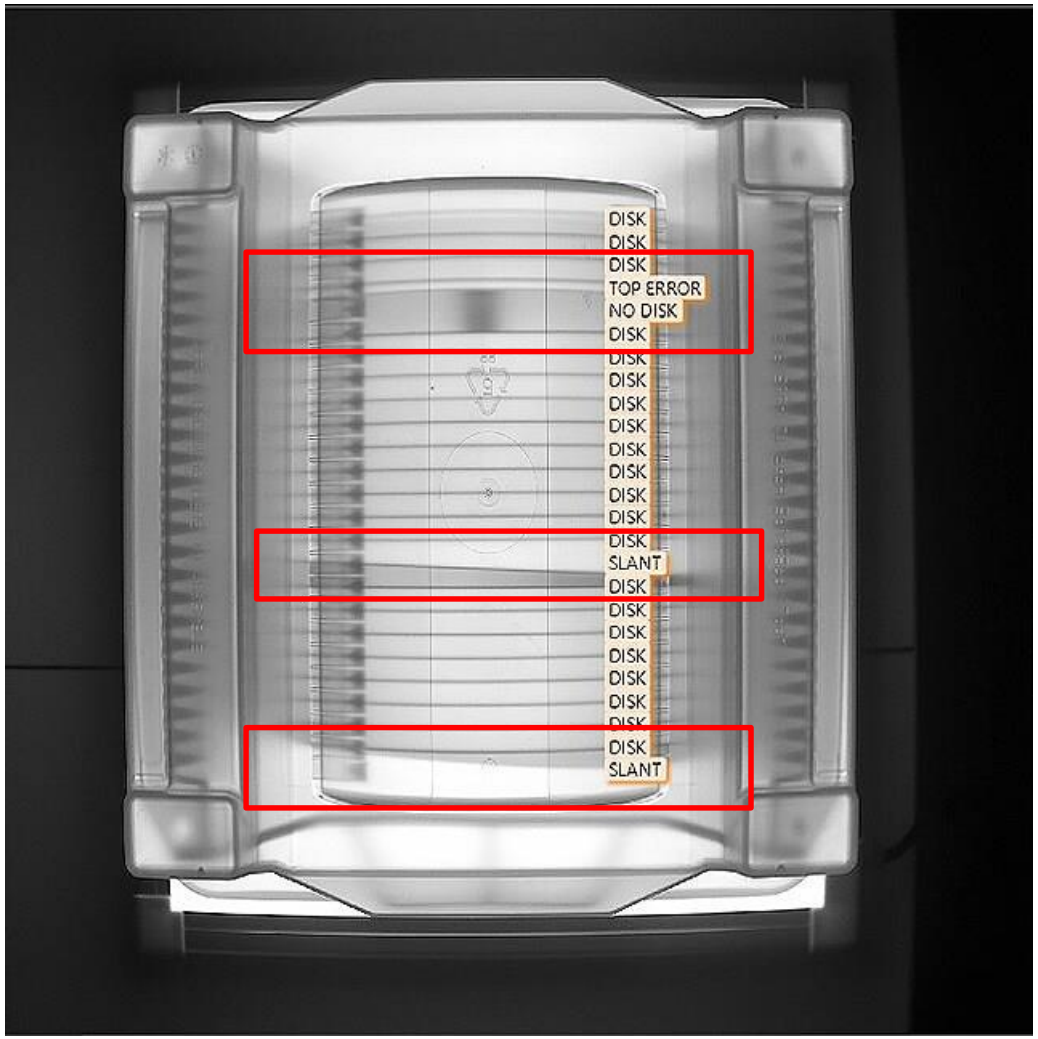


VISUAL INSPECTION PoC FOR NXP WAFER FACTORY

[i.MX 8M Mini Evaluation Board]

[daA2500-60mci-IMX8-EVK - Embedded Vision Kit]





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