# NXP's Scalable Arm® Portfolio

Picking the Best Arm Multicore for your Application aka Layerscape and i.MX Applications Processors, Better Together

**MARCH 2021**

SECURE CONNECTIONS
FOR A SMARTER WORLD

Marcel Bässler - Technology Field Application Engineer at Arrow

mbaessler@arroweurope.com

Klaus Kohl-Schoepe - Senior Technology Field Application Engineer at Arrow

kkohl-schoepe@arroweurope.com

Mirko Kegel - Account Manager at NXP

mirko.kegel@nxp.com

# A POSITION OF STRENGTH TO BETTER SERVE OUR 26,000+ CUSTOMERS

We accelerate breakthroughs that advance the world through our semiconductor technology leadership

EMPLOYEES IN
## 30+ COUNTRIES
Headquartered in Eindhoven, Netherlands

## ~29,000
EMPLOYEES

## 9,000
Patent Families

## $8.88B
Annual Revenue [1]

## 60+
Year History

## 11,000+
Engineers

PUBLIC

# SECURE CONNECTIONS FOR A SMARTER WORLD...HAS EVOLVED
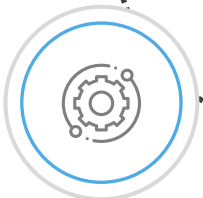
**AUTOMOTIVE**

**INDUSTRIAL**

**MOBILE**

**COMMUNICATION, INFRASTRUCTURE & OTHER**

## Focus Verticals

### CLOUD INFRASTRUCTURE

Machine Learning

Authentication

Services

Data Analytics

### ENABLING TECHNOLGIES

Sense

Think

Act

Connect

### EDGE TO EDGE

Home Gateway

Auto Gateway

Smart City

Industrial Controller

Smart Home

Smart Health

Smart Retail

Wearables

Smart Buildings

Voice Assistant

Robotics

Media Streaming

# NXP GERMANY AT A GLANCE

## Hamburg

- NXP CEO and CTO Office
- Automotive R&D, Marketing:
  - Infotainment / V2X / Radar
  - Functional Safety
  - Secure Car Access
  - Sensors
- Security R&D
- Industrial IoT R&D, Marketing
- NFC / Ultra-Wideband (UWB) R&D, Marketing
- Secure Identity / Payment

## Wiesbaden, Nuremberg, Boeblingen

- Sales Offices
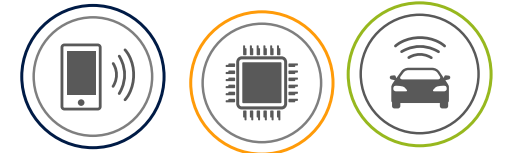
**Hamburg**
Headquarter

Dresden

Wiesbaden

Nuremberg

Karlsruhe

Boeblingen

**Munich**

## Munich

- Automotive:
  - Infotainment / Radar
  - Battery Management Systems
  - Microcontroller
- NFC
- Industrial IoT
- Sales EMEA MT

## Dresden

- Infotainment R&D

## Karlsruhe

- Wi-Fi R&D
- Sales

# NXP's Scalable Arm<sup>®</sup> Portfolio

**NXP**
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# NXP SCALABLE EDGE PROCESSING PORTFOLIO

- Massive portfolio of Arm® -based MCU and MPU
- 100:1 range of price and CPU performance

High Perf Multicore Processors

**Layerscape®**

High Perf Cortex-A Multicore w/ Integrated Networking

Applications Processors

**i.MX**

Cortex-A and -M Cores Voice, Audio, Graphics

Crossover Processors

**i.MX RT, i.MX ULP**

Arm® Cortex® -M Cores & Voice, Audio, Graphics

Microcontrollers

**LPC, Kinetis**

Arm® Cortex® -M Cores & Wireless Connectivity

*Industrial applications*

# INDUSTRIAL EDGE PRODUCT SPOTLIGHTS

## NXP's Edge Processing Product Spotlights
### Addressing Breadth of Industrial Applications



### LPC55S16
150MHz Cortex®-M33
CAN-FD,
High precision ADC,
Enhanced Safety
and Security

**Example Applications:**
- Remote IO and Sensor Nodes
- Elevators and Lifts
- Smart Lighting and Utilities

### i.MX RT1170
800MHz Cortex®-M7
GbE, TSN, CAN-FD,
Rich Integration,
Advanced Security

**Example Applications:**
- Industrial Control
- Security Access Panel
- Fleet Management
- Diagnostic Equipment

### i.MX 8M Plus
Quad/Dual Cortex®-A53
with 2.3 TOP NPU & ISP
Real-time Cortex-M7 with
CAN-FD, GbE, TSN

**Example Applications:**
- Machine Vision
- Industrial Computer
- Safety, security and surveillance

### LS1028A
Dual Cortex®-A72
Dual TSN Ethernet
Controllers with Port
Switch, CAN-FD

**Example Applications:**
- Industrial Networking
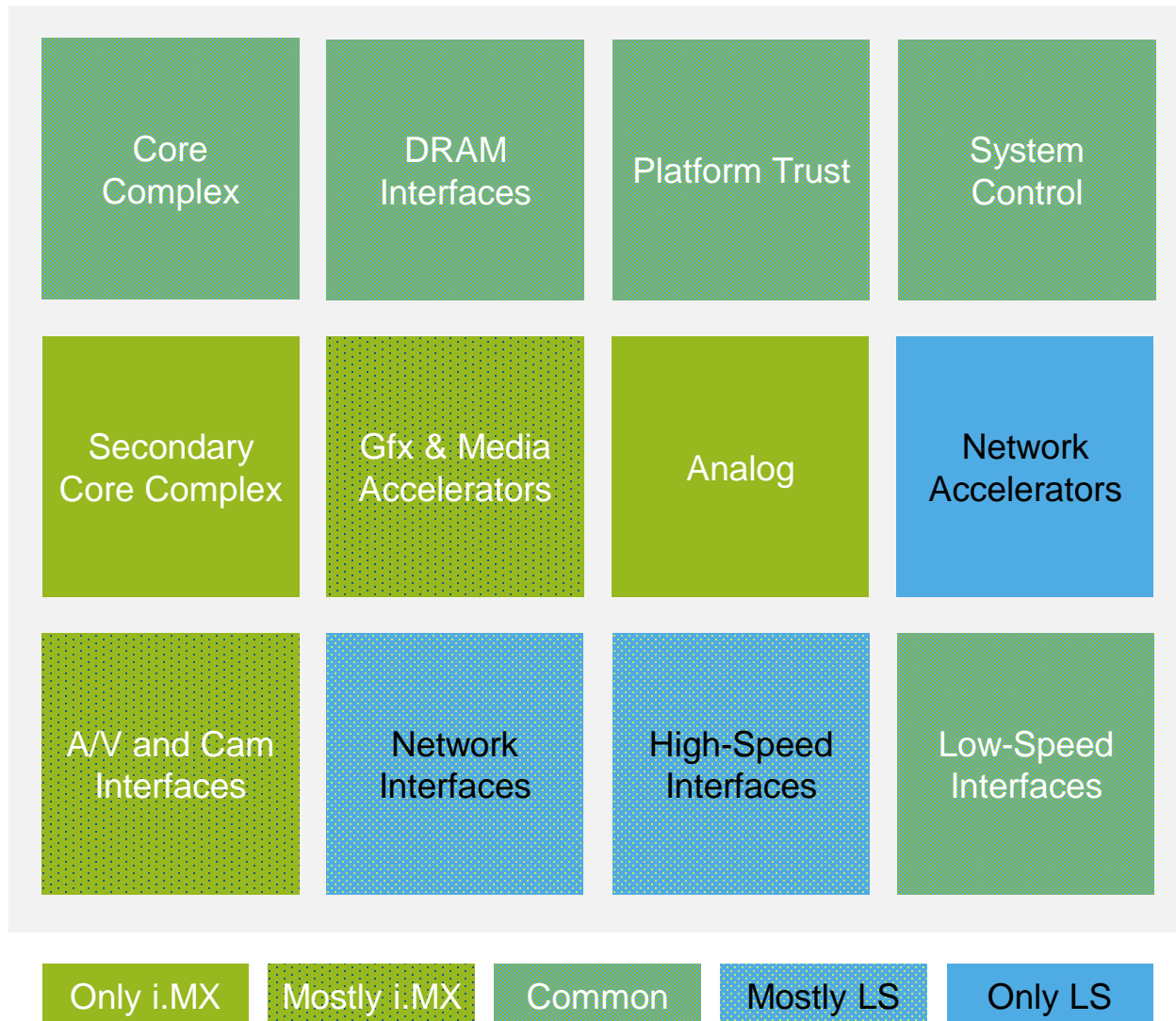- PLCs
- Robotics & Motion Control

### LX2160
16 high-performance
Cortex®-A72 cores
40G + Dual 25G
Ethernet, PCIe

**Example Applications:**
- Optical transport & backhaul
- Test & measurement
- Aerospace & Defense

# SIMPLIFIED PROCESSOR BLOCK DIAGRAM

| | | | |
|---|---|---|---|
| Core Complex | DRAM Interfaces | Platform Trust | System Control |
| Secondary Core Complex | Gfx & Media Accelerators | Analog | Network Accelerators |
| A/V and Cam Interfaces | Network Interfaces | High-Speed Interfaces | Low-Speed Interfaces |

**Legend:** Only i.MX | Mostly i.MX | Common | Mostly LS | Only LS

- i.MX and LS have common core functions
- Some target markets overlap
  - Price, performance scalability, and robustness (ECC) will drive customers' decisions
- Key functions differ
  - i.MX: graphics and multimedia
  - LS: networking
- Each is uniquely suited to other markets

# PROCESSOR FEATURES FOR DIVERSE MARKETS
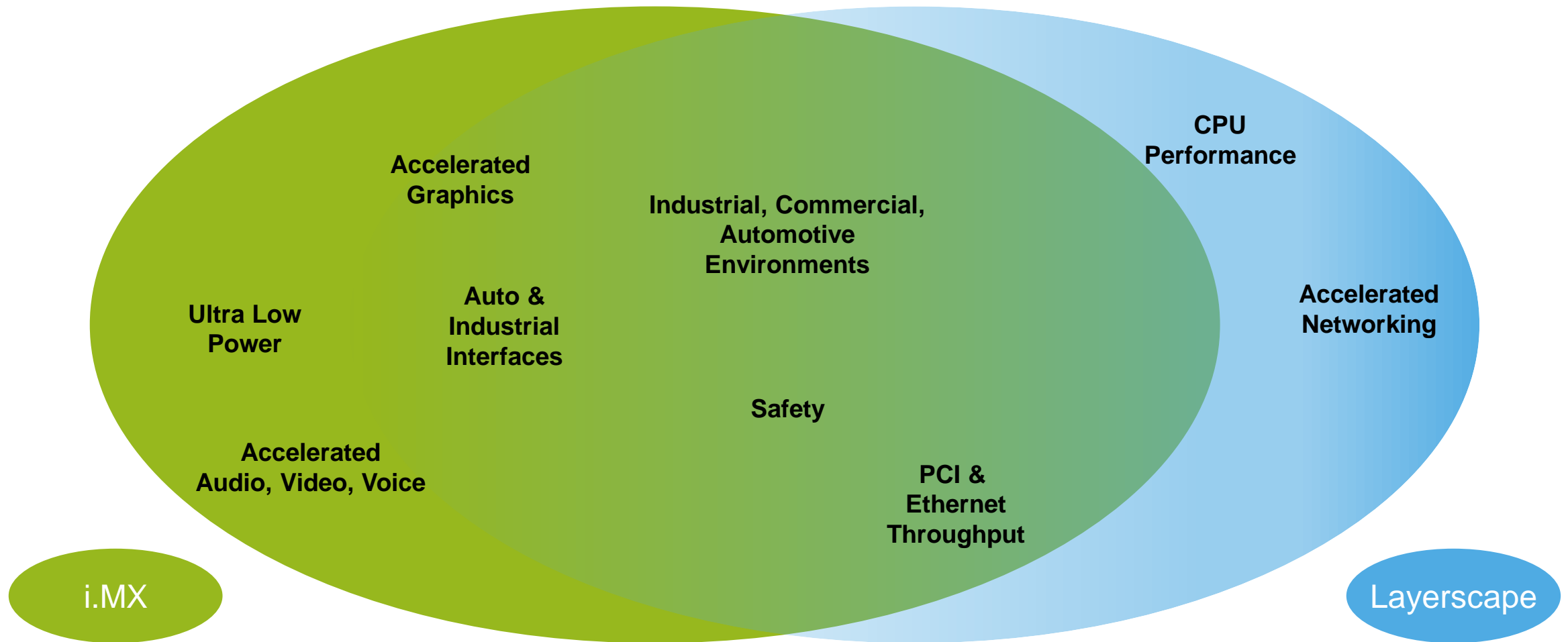
# LAYERSCAPE AND I.MX FAMILIES MEET STRINGENT EMBEDDED REQUIREMENTS



Longevity

Extreme Operating Conditions

Safety & Reliability

Security

Rich Software Ecosystem

Design Services

Broad Portfolio

# SAFETY AND RELIABILITY FEATURES IN NXP PROCESSORS



Support for ASIL and SIL Certifications

Safety-Certified Software Ecosystem

Failover Displays and Cameras

ECC-Protected On-Chip Memories

SER FIT Data Available

ECC-Protected DDR Interfaces

Ultra-Low-Alpha Packages

ECC-Protected NVRAM Interfaces

i.MX

Layerscape
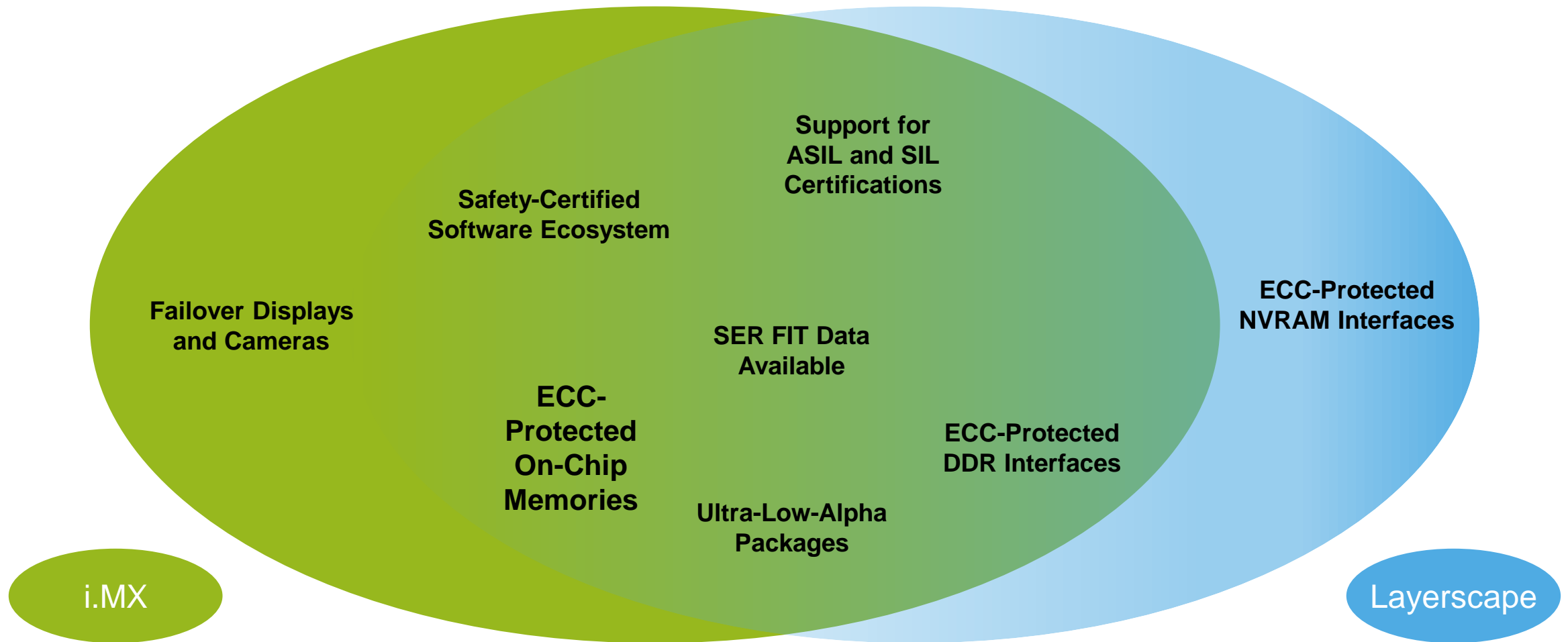
# PLATFORM TRUST & SECURITY

| | i.MX 8M Nano, i.MX 8M Mini, i.MX 8M, i.MX 8M Plus | i.MX 8, i.MX 8X | LS1012A, LS1021A, LS1028A, LS1043A, LS1046A, LS1088A, LS2088A, LX2160A |
|---|:---:|:---:|:---:|
| Secure/High-Assurance Boot | ✓ | ✓ | ✓ |
| Crypto Acceleration | ✓ | ✓ | ✓ |
| Runtime Integrity Checking | ✓ | ✓ | ✓ |
| Secure Debug | ✓ | ✓ | ✓ |
| Tamper Detection | — | ✓ | ✓ |
| Volt/Temp/Freq Detection | — | ✓ | — |
| Isolated Security Apps | — | ✓ | — |
| Content Protection (DRM) | ✓ | ✓ | — |
| Virtualization incl IOMMU | — | — | ✓ |
| IPSec, SSL Acceleration | — | — | ✓ |

# i.MX and Layerscape: Better Together

**NXP** SECURE CONNECTIONS FOR A SMARTER WORLD

# I.MX AND LAYERSCAPE SCALING: STANDARD SOM BOARDS
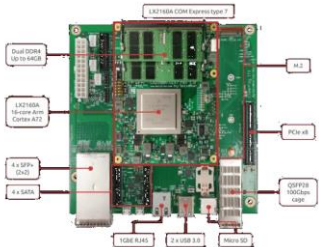
i.MX 8M Nano SOM

i.MX 8M Mini SOM

i.MX 8 SoM

SolidRun i.MX 8M Mini SOM

SolidRun Clear Fog CX LX2160

Kontron - SMARC-sAL28 LS1028

DHCOM – i.MX6, i.MX8M Plus

DHCOR - Solderable SOMs i.MX6UL

DHCON & DHMI

ADLINK – i.MX6, i.MX8M Plus
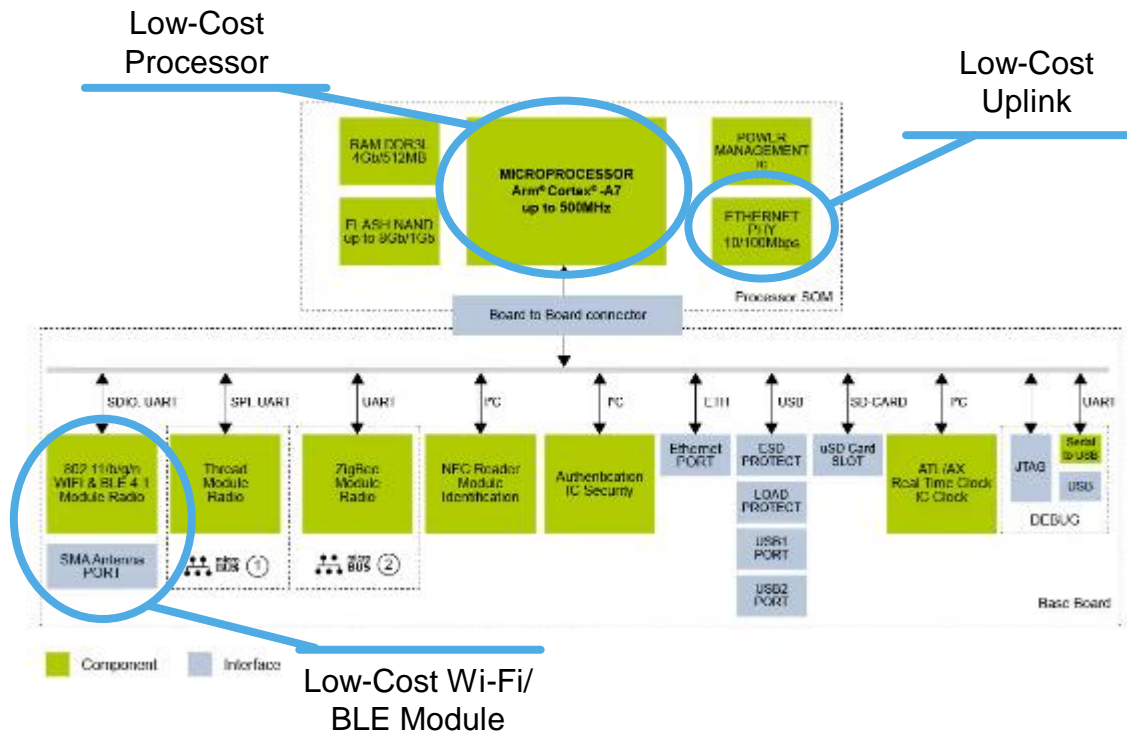
Panaonic – NXP based Wifi Solutions PAN9028
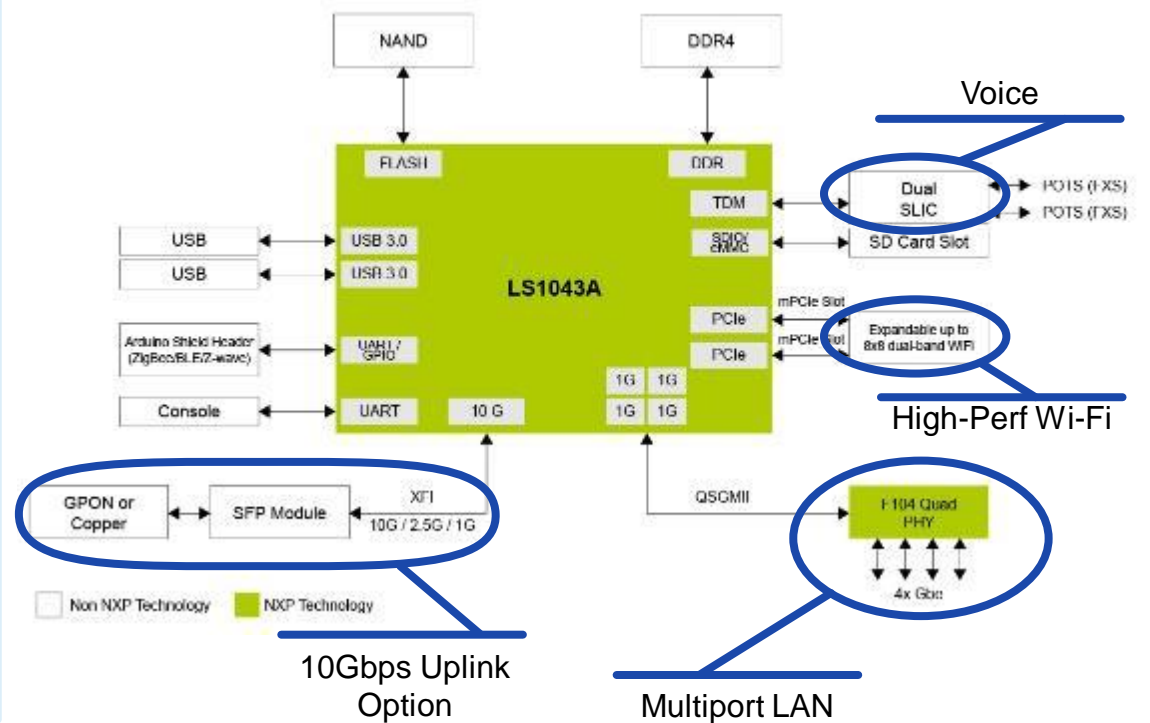
Panaonic – NXP based Wifi Solutions PAN9026

# I.MX AND LAYERSCAPE SCALING EXAMPLE: GATEWAY



i.MX

Layerscape

# EXAMPLE OF USING LAYERSCAPE TO ACHIEVE AI/ML SCALABILITY



## LS1046A

Application & Networking | Video Classification | Video Capture | Radar Capture & Classification

CPU | CPU | CPU | CPU | DDR

Cache | Platform Trust

Network Acceleration | PCIe

Ethernet | Ethernet | Ethernet | Ethernet | USB

To WAN | To LAN | Radar | IP Camera
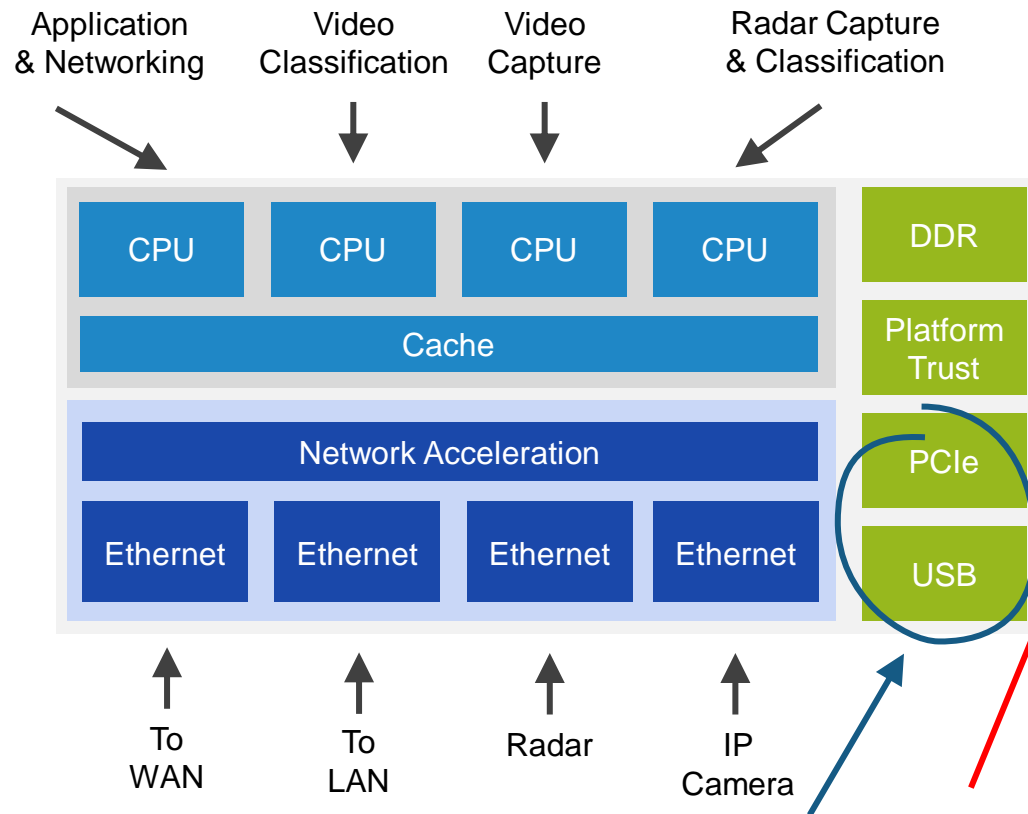
Rich interfaces for external accelerators

## LX2160A

Application & Networking | Video Classification | Video Capture | Radar Capture & Classification

CPU | CPU | CPU | CPU | DDR

Cache | Platform Trust

Network Acceleration | PCIe

Ethernet | Ethernet | Ethernet | Ethernet | USB

To WAN | To LAN | Radar | 4xIP Camera
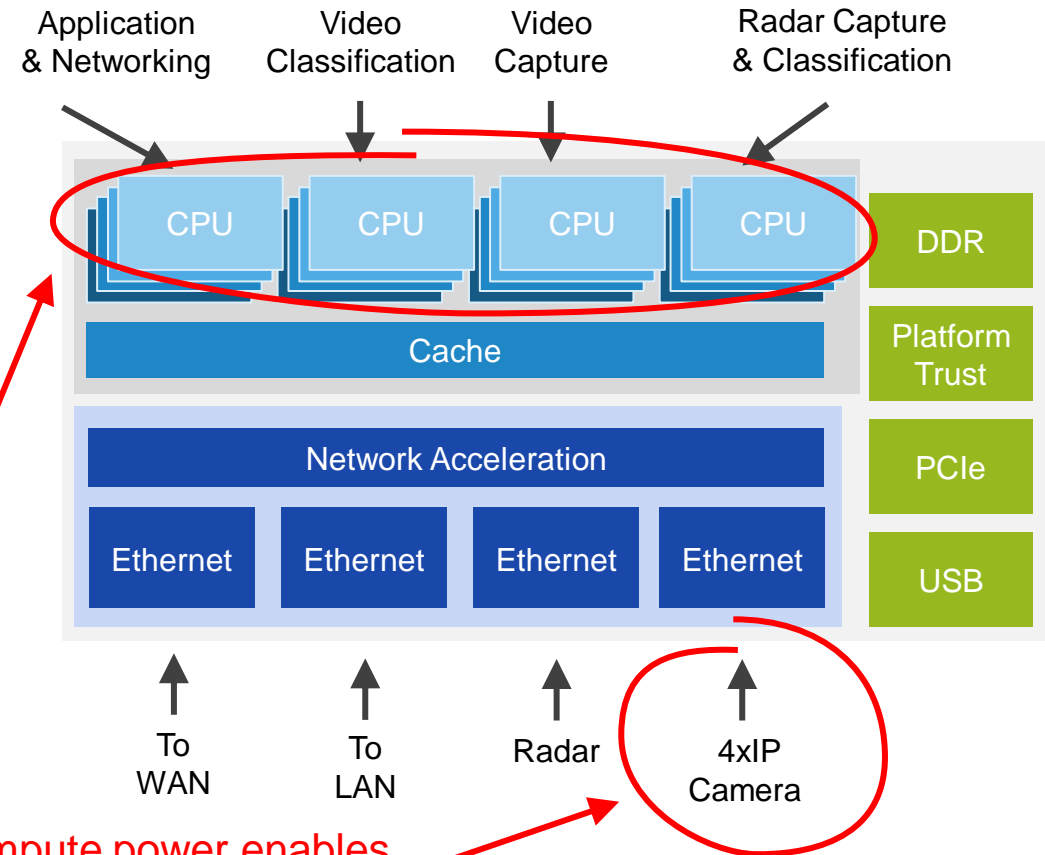
4x the compute power enables processing 4x the camera input

NXP

# CASCADE LAYERSCAPE AND I.MX PROCESSORS FOR COMPLEX DESIGNS

Image Classification

i.MX

Language Processing

i.MX-RT

Condition Monitoring

i.MX RT

Radar Analysis

LS

Analysis & Prediction

LS

More AI at 1st Level

More general compute @ 2nd Level
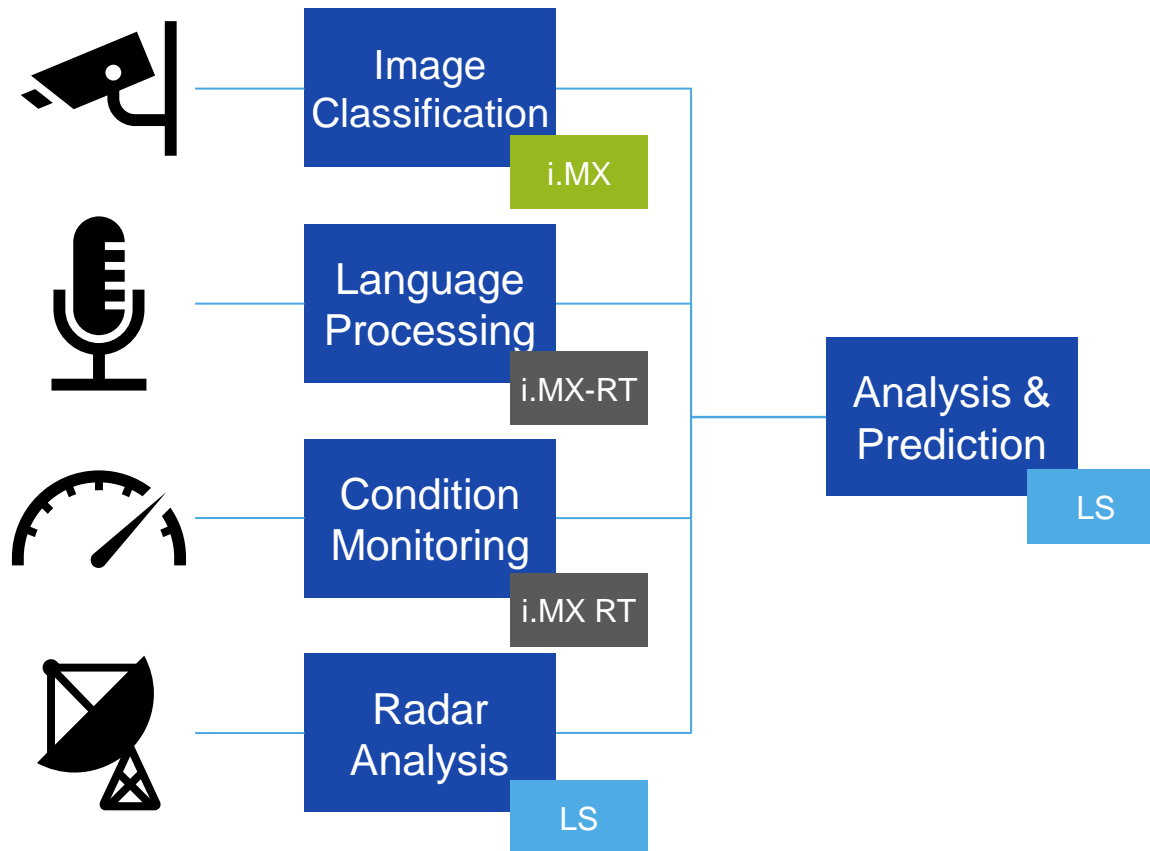
- First-level functions (i.MX, LS, MCU)
  - Classify/perceive
  - Recognize/model
  - Preprocess

- Second-level functions (Layerscape)
  - Fuse first-level inputs
  - Interpret data and model behavior
  - Predict and plan responses
  - Log data
  - Communicate

# I.MX 8M PLUS FOR INDUSTRIAL MACHINE VISION

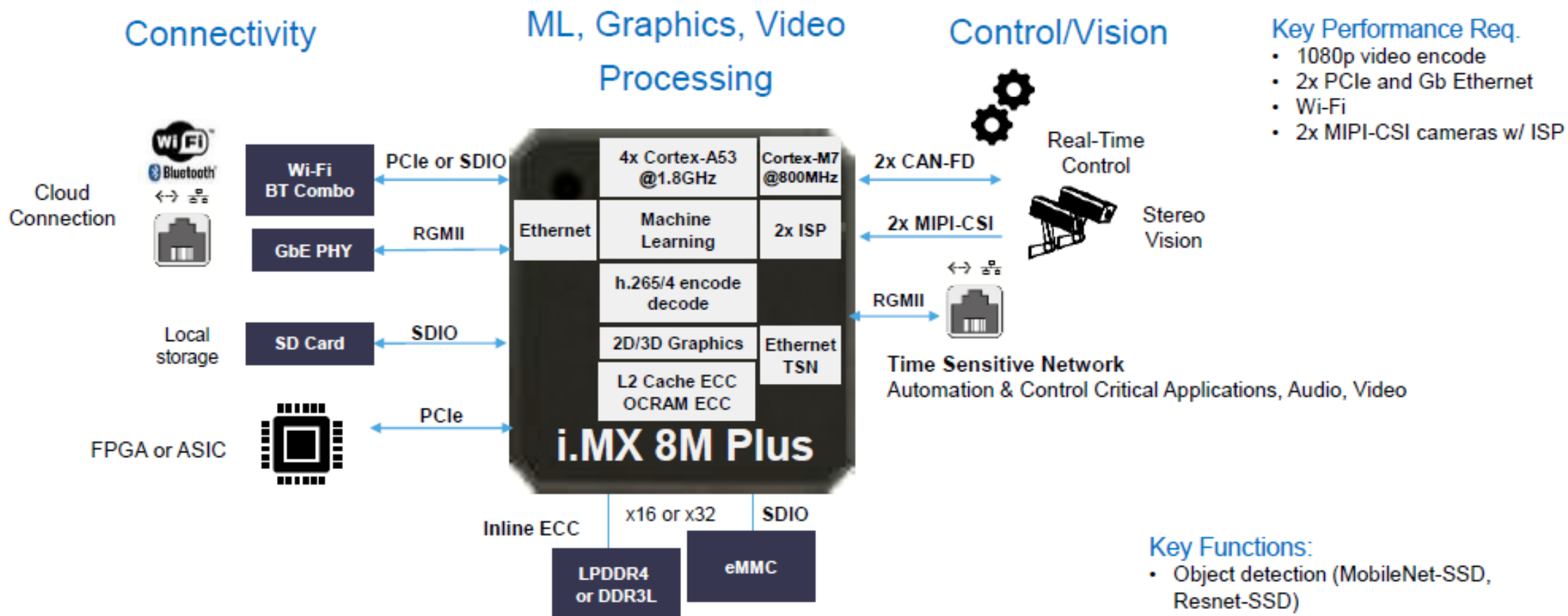

**Connectivity**

**ML, Graphics, Video Processing**

**Control/Vision**

Cloud Connection

Wi-Fi BT Combo — PCIe or SDIO

GbE PHY — RGMII

Local storage — SD Card — SDIO

FPGA or ASIC — PCIe

Ethernet

4x Cortex-A53 @1.8GHz | Cortex-M7 @800MHz

Machine Learning | 2x ISP

h.265/4 encode decode

2D/3D Graphics | Ethernet TSN

L2 Cache ECC OCRAM ECC

**i.MX 8M Plus**

Inline ECC | x16 or x32 | SDIO

LPDDR4 or DDR3L | eMMC

2x CAN-FD — Real-Time Control

2x MIPI-CSI — Stereo Vision

RGMII

**Time Sensitive Network**
Automation & Control Critical Applications, Audio, Video

**Key Performance Req.**
- 1080p video encode
- 2x PCIe and Gb Ethernet
- Wi-Fi
- 2x MIPI-CSI cameras w/ ISP

**Key Functions:**
- Object detection (MobileNet-SSD, Resnet-SSD)
- Connected to industrial network
- Cloud connection for remote monitoring
- Ensure system reliability
- Recognition

**Overview:**
Stereo vision camera feeds, connected to industrial network, connection to the cloud, object detection with Machine Learning at the edge

# Enablement

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# I.MX AND LAYERSCAPE HAVE A BROAD ECOSYSTEM OF OPERATING SYSTEMS

| Software | Supplier | i.MX | Layerscape |
|---|---|:---:|:---:|
| Linux (free) | NXP, public repo | ✓ | ✓ |
| Linux (commercial) | Mentor, Wind River, Timesys, Canonical, etc | ✓ | ✓ |
| RTOS (commercial/ free) | Mentor, QNX, GHS, Wind River, Express Logic, etc | ✓ | ✓ |
| Android | NXP | ✓ | — |
| Windows 10 IoT Core | Microsoft | ✓ | — |

# I.MX YOCTO PROJECT ENABLEMENT

Commitment: 10 versions released over past 8 years with 16 LTS kernel versions supported

Community Acceptance: Align NXP releases with community release support

Continued support: Upgrade of Yocto version on a bi-annual cadence

IVI Foundation: Demos to support integration of Automotive Grade Linux (AGL) and GENIVI meta-layers

Entertainment: Demos to support integration of Kodi/XBMC meta-layers

Connectivity: Demos to support Modular IoT Gateway

Cloud: Demos able to support AWS Greengrass, Azure IoT Edge, EdgeScale and OTA

Machine Learning: Demos able to support Machine Learning

# COMMON LINUX KERNEL AND U-BOOT ACROSS ALL I.MX & LS MPUS

- Kernel 5.4 is the latest with Long-Term Support (LTS)

- Released in the Yocto project 3.0 "Zeus"

- GA for i.MX 6, i.MX 7 and i.MX 8 series since March 2020

- One GA release for ARMv7-A (i.MX 6 and i.MX 7 series) and ARMv8-A (i.MX 8, i.MX 8X and i.MX 8M families)

- Consistent kernel patches for security updates


- Latest i.MX Tools and Software at www.nxp.com/imxtools

- i.MX GA releases at www.nxp.com/imxsw

- Source code on Code Aurora git repository

- https://www.codeaurora.org/projects/i-mx
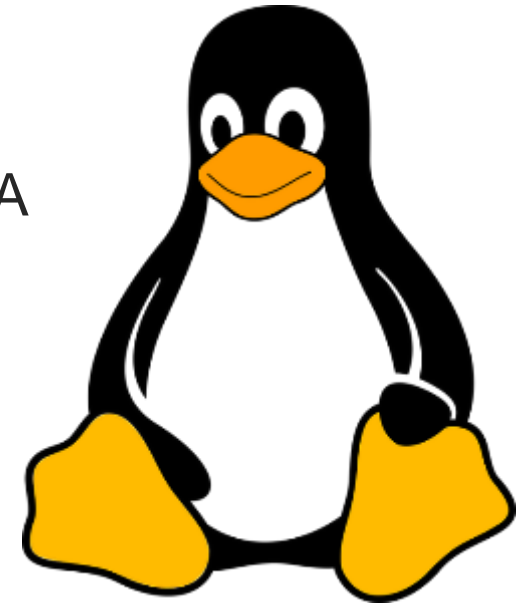
# I.MX ANDROID ENABLEMENT

**Commitment:** **14** Android OS versions released over past **10** years

**Broad Acceptance:** **35,000+ downloads** of BSP to date

**Fast Development:** **~4 months** from development start to production release on multiple Android versions

**Cross market robustness:** **Automotive, Embedded/Industrial, Consumer, IoT**

**Continued support:** New OS releases for **min. 2 years** after silicon production

**Leadership:** i.MX – **FIRST** Android system shipping in a **top-5 OEM infotainment platform**

| 2008 | 2009 | 2010 | 2011 | 2011 | 2012 | 2012 | 2013 | 2014 | 2015 | 2016 | 2016 | 2017 | 2018 | **10.0** 2019 |
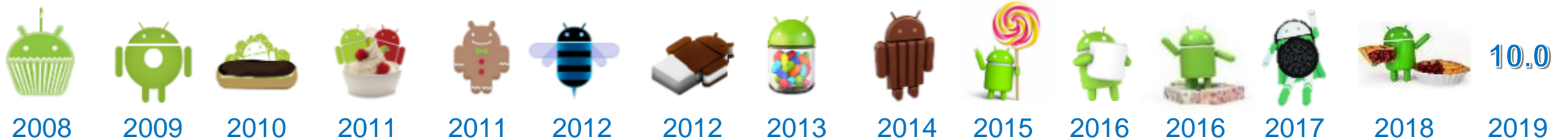
# Tools and Guidance for Selection

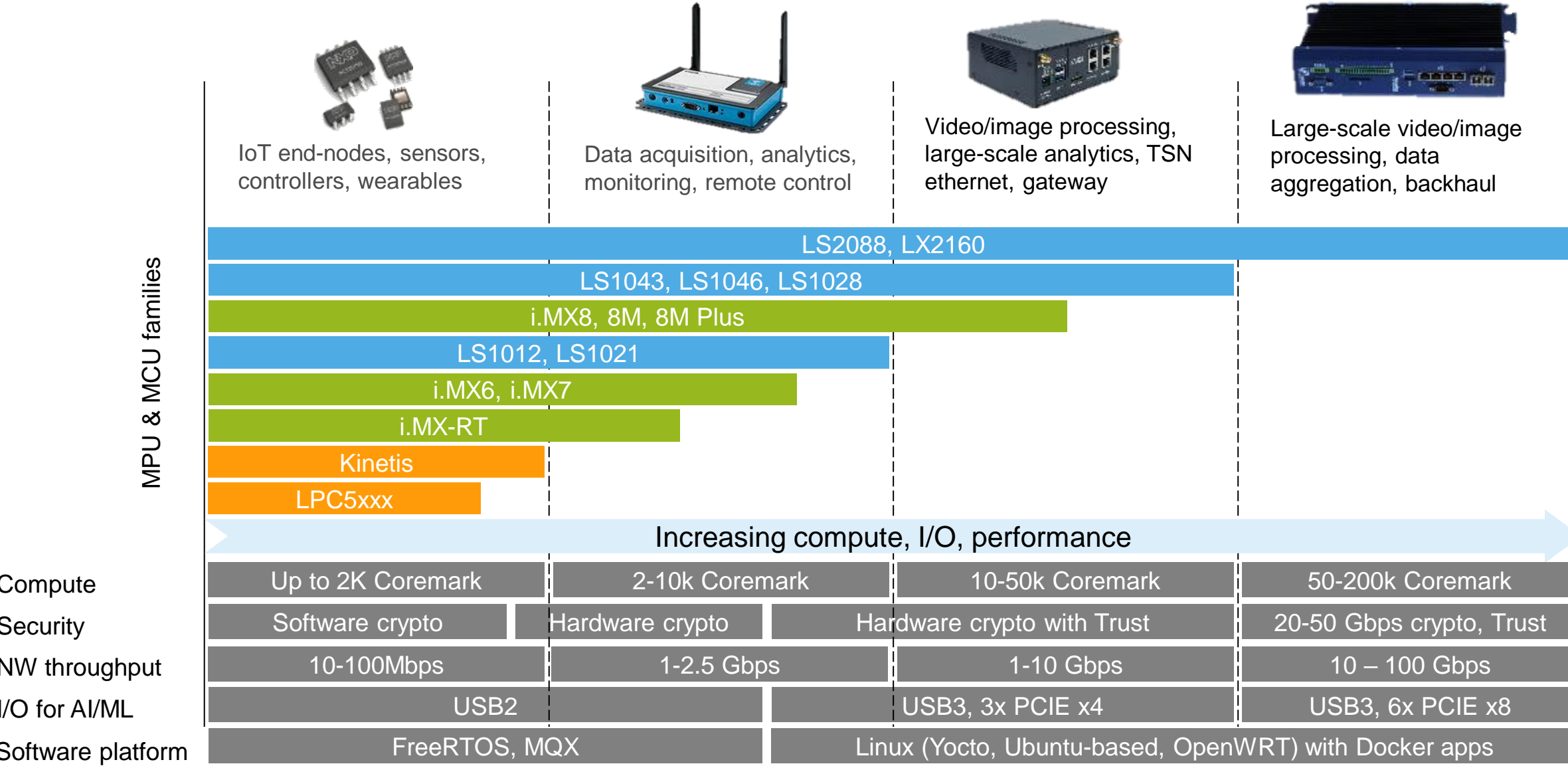SECURE CONNECTIONS
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# IOT & EDGE SELECTION CHART: NXP HAS THE INDUSTRY'S MOST SCALABLE PORTFOLIO OF SOLUTIONS FOR IOT AND EDGE COMPUTING

IoT end-nodes, sensors, controllers, wearables

Data acquisition, analytics, monitoring, remote control

Video/image processing, large-scale analytics, TSN ethernet, gateway

Large-scale video/image processing, data aggregation, backhaul

**MPU & MCU families**

| LS2088, LX2160 |
| LS1043, LS1046, LS1028 |
| i.MX8, 8M, 8M Plus |
| LS1012, LS1021 |
| i.MX6, i.MX7 |
| i.MX-RT |
| Kinetis |
| LPC5xxx |

**Increasing compute, I/O, performance**

| | IoT end-nodes | Data acquisition | Video/image processing | Large-scale |
|---|---|---|---|---|
| Compute | Up to 2K Coremark | 2-10k Coremark | 10-50k Coremark | 50-200k Coremark |
| Security | Software crypto | Hardware crypto | Hardware crypto with Trust | 20-50 Gbps crypto, Trust |
| NW throughput | 10-100Mbps | 1-2.5 Gbps | 1-10 Gbps | 10 – 100 Gbps |
| I/O for AI/ML | USB2 | | USB3, 3x PCIE x4 | USB3, 6x PCIE x8 |
| Software platform | FreeRTOS, MQX | | Linux (Yocto, Ubuntu-based, OpenWRT) with Docker apps | |

# INDUSTRIAL EDGE PRODUCT SPOTLIGHTS

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### Addressing Breadth of Industrial Applications

**LPC55S16**

150MHz Cortex ® -M33
CAN-FD,
High precision ADC,
Enhanced Safety
and Security

**Example Applications:**

- Remote IO and Sensor Nodes
- Elevators and Lifts
- Smart Lighting and Utilities

**i.MX RT1170**

800MHz Cortex ® -M7
GbE, TSN, CAN-FD,
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**Example Applications:**

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- Fleet Management
- Diagnostic Equipment

**i.MX 8M Plus**

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Real-time Cortex-M7 with
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**Example Applications:**

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**LS1028A**

Dual Cortex ® -A72
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Controllers with Port
Switch, CAN-FD

**Example Applications:**

- Industrial Networking
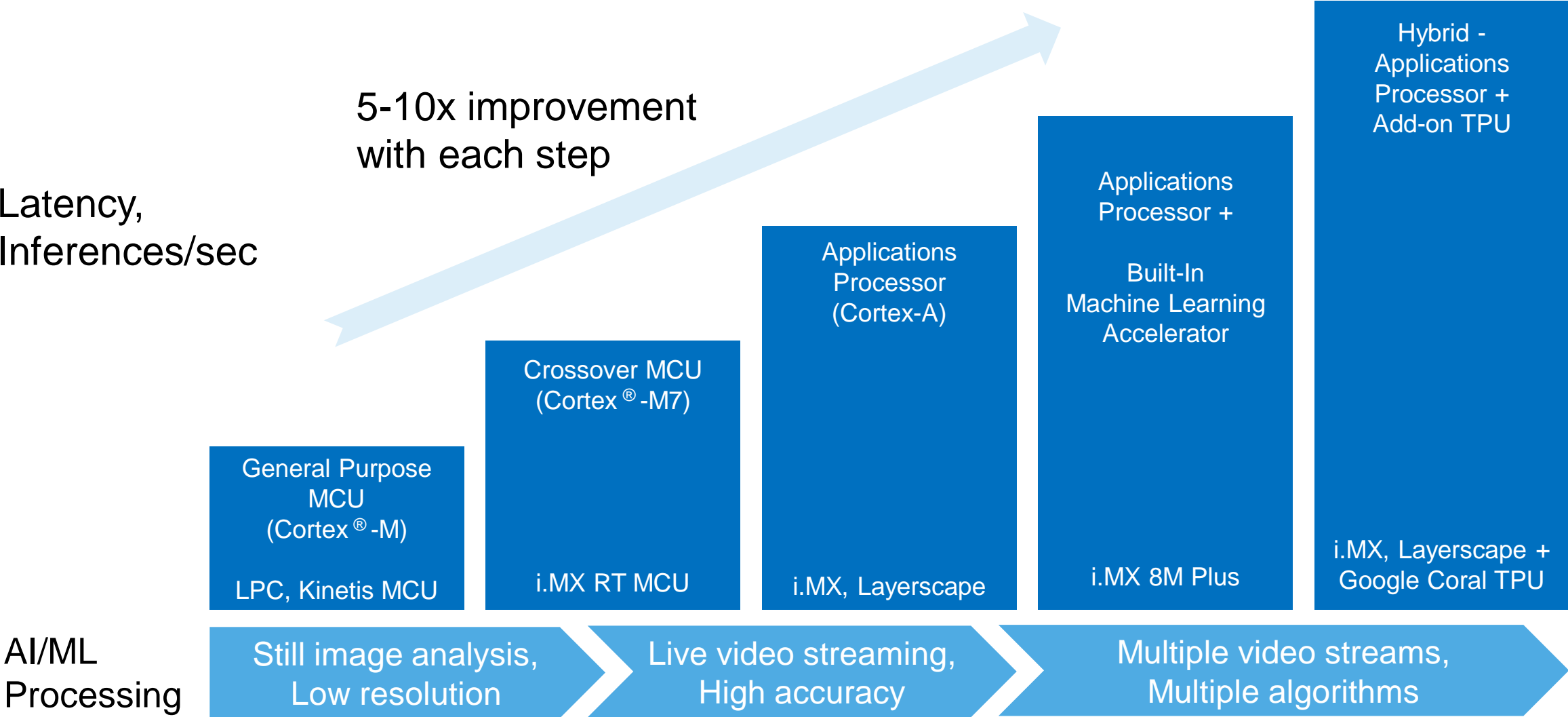- PLCs
- Robotics & Motion Control

**LX2160**

16 high-performance
Cortex ® -A72 cores
40G + Dual 25G
Ethernet, PCIe

**Example Applications:**

- Optical transport & backhaul
- Test & measurement
- Aerospace & Defense

PUBLIC

**SUMMARY**

- For some applications, the choice of 64-bit NXP multicore processor is clear
  - **Systems with displays, cameras, high-quality audio**: i.MX
  - **Systems for networking**: Layerscape

- Applications without such clear delineation will choose based on other criteria
  - **Cost or power**: i.MX 8M Nano, i.MX 8M Mini
  - **ECC-protected DRAM**: all Layerscape (except LS1012A) or i.MX 8M Plus
  - **TSN Ethernet**: i.MX 8M Plus or LS1028A
  - **CPU performance**: Layerscape LS1046A or LX2
  - **Ethernet or PCIe connectivity**: Layerscape, i.MX8
  - **On-target OS development**: Layerscape
  - **Android**: i.MX
  - **Built-in AI/ML acceleration**: i.MX 8M Plus
  - **Safety**: i.MX 8X
  - **Fifteen-year longevity**: i.MX 8M, i.MX 8M Mini, i.MX 8M Nano, i.MX 8M Plus, all Layerscape

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