



Introducing the Kria Robotics Starter Kit: Robotics and Machine Vision for Smart Factories

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AMD

Expanding the Kria Portfolio

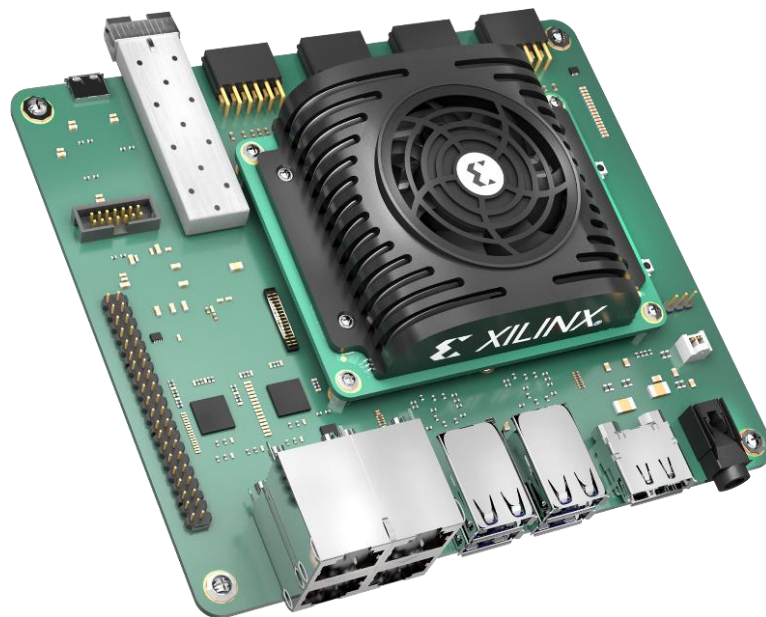


NEW

Kria KV260
Vision AI Starter Kit



Kria KR260
Robotics Starter Kit



Kria K26
Production Module
Fully Qualified and Certified



DEVELOP



DEPLOY

Now Introducing the Kria KR260 Robotics Starter Kit



Native ROS 2 Support

- 5X productivity with Robotics Stack¹
- C/C++ and RTL flexibility for HW/SW architects



Complete Industrial Solution

- Pre-built interfaces for robotics and industrial solutions
- Simplified integration, faster time from out-of-box to deployment



Low-Latency and Determinism

- Real-time response for high performance machines
- Safety & security for industrial-grade solutions



Out-of-the-Box Ready for Software and Hardware Developers

¹: Compared to Nvidia CUDA flows; accounts for setting up robotics toolchain with ROS 2, cross-compilation of host code or creation and build of accelerator among other necessary steps.

Target Applications for KR260 Robotics Kit



Robotics

Multi-Axis Control • Embedded Controller
Multi-Camera Vision AI

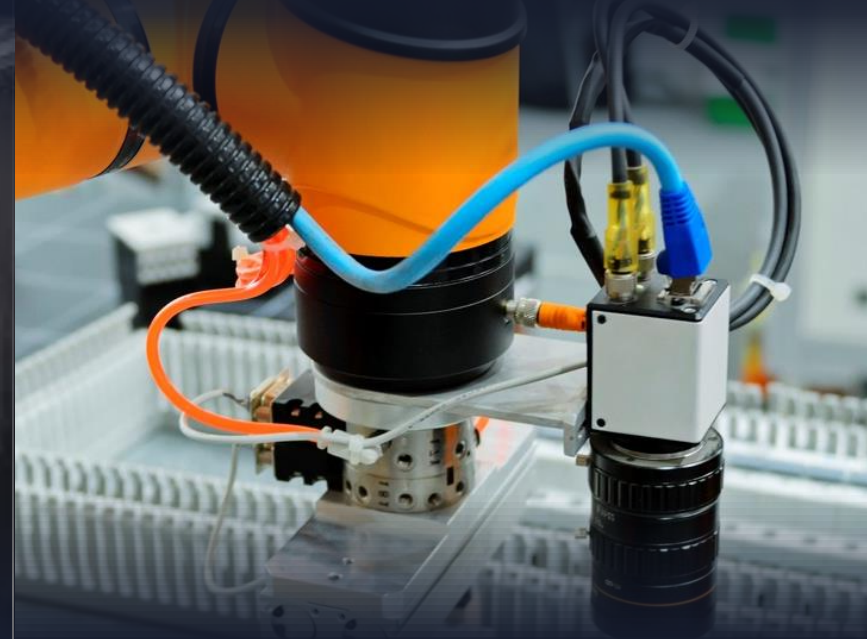
- Collaborative Robots
- Surgical Robots
- AGVs, AMRs, and Aerial Robots



Industrial Communication & Control

Real-Time Control • Predictive Maintenance
Mixed Criticality • TSN

- Programmable Logic Controllers (PLC)
- Programmable Automation Controllers (PAC)
- Computer Numerical Control Router (CNC)
- Wired/Wireless Secure Industrial Gateway



Machine Vision

Low Latency • Fast High-Resolution Image Sensor
Minimum CPU load, Maximum Bandwidth

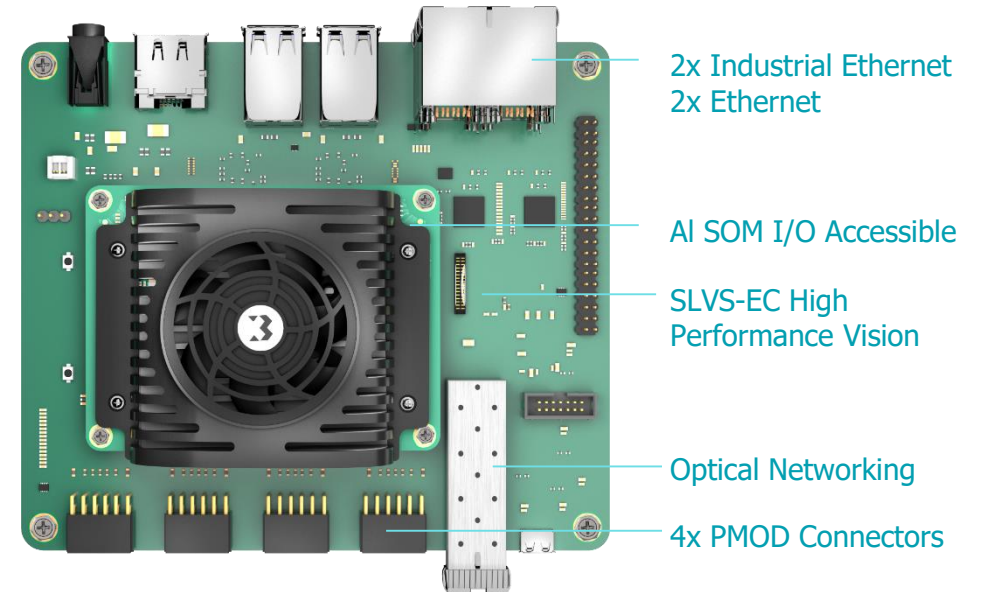
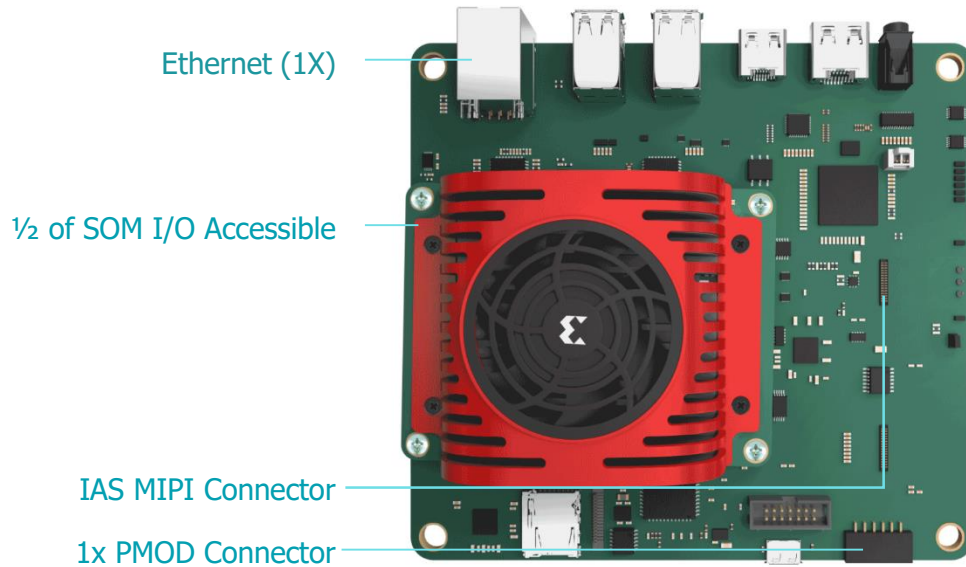
- SLVS-EC Sensor-Based Camera
- USB-Stereo Camera
- 1/10GigE Vision / CXP Over Fiber

Comparing Vision AI Starter Kit and Robotics Starter Kit



For Mainstream Vision AI Cameras

For High-Performance Industrial Systems



KV260 Vision AI Starter Kit

KR260 Robotics Starter Kit

SOM I/O ACCESS

1x 240-Pin Connector

▶ 2x SOM I/O ▶

2x 240-Pin Connector¹

NETWORK

1x Ethernet

▶ 4x Ethernet ▶

2x Ethernet, 2x Ind. Ethernet, SFP+

VISION

MIPI Vision Sensors

▶ SLVS-EC ▶

SLVS-EC Vision Sensors

INTERFACE EXPANSION

1X PMOD

▶ 4x PMOD ▶

4X PMOD

1: All SOM I/O accessible to user, including dedicated board connectors (SFP, Ethernet, VLVS-EC headers) and IO expanders (e.g., PMODs)

Developing and Deploying with Kria

Save Up to 9 Months Time to Deployment vs. Chip-Down Design



KR260 Kit for Development

Develop application with kit and Kria Robotics Stack (KRS)



Design for K26 SOM

Small form factor embedded PCB based on Hardware Adaptive SoC



Go to Production

Plug SOM directly into carrier card and end-product for deployment



K26 SOM for Deployment

Based on the Zynq® UltraScale+™ MPSoC Architecture



COMPUTE

Arm®

A53 Quad-Core
R5F Dual-Core

Native ROS 2

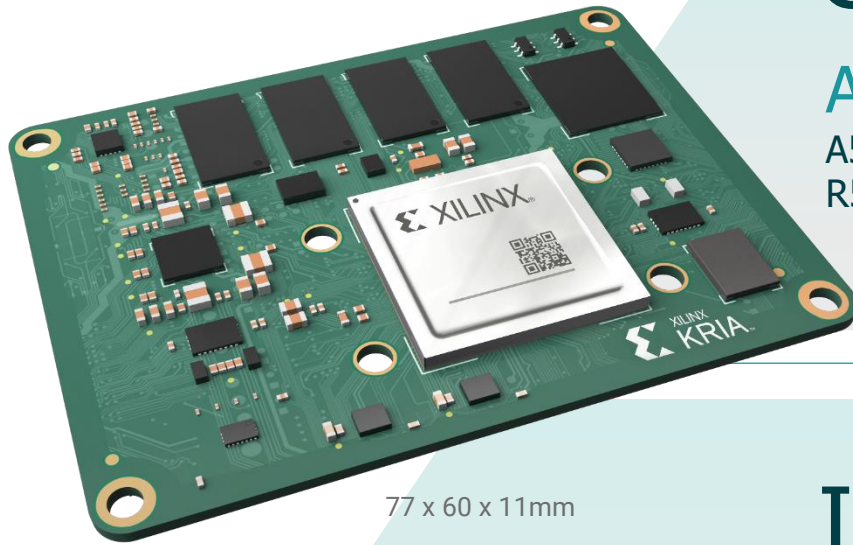
Humble Hawksbill
Ubuntu 22.04

256K

System Logic Cells for
Custom Acceleration

4K60p

H.264/265
Video Codec



77 x 60 x 11mm

INTERFACES

245 I/O

Flexible for
Multiple

15 Cameras

Mix of SLVS-EC,
MIPI, sub-LVDS

TSN-Enabled

40G Ethernet
Up to 4x 10GE

4x USB

Mix of USB
3.0 and 2.0

4GB

64-bit DDR4
Memory

Why Adaptive Computing in Robotics



PERFORMANCE/WATT

- HW Parallelism eliminates performance bottlenecks
- Power efficiency due to more compute-per-clock-cycle (vs. CPUs, DSPs)



LOW LATENCY AND DETERMINISM

- Critical paths implemented in HW, no SW in-the-loop
- CPU / GPU SW handling → unpredictable behavior
- Arm® Cortex™-R5F dual-core processor



HARDWARE ADAPTABLE

- Flexible for diverse architectures
- Adapt to evolving algorithms
- GPUs not suitable for all robotic algorithms



SAFETY AND SECURITY

- Security includes processing, HW Root-of-Trust¹, TPM²
- Compliance for IEC 62443 (security) and ISO13849 / 61508 (safety)

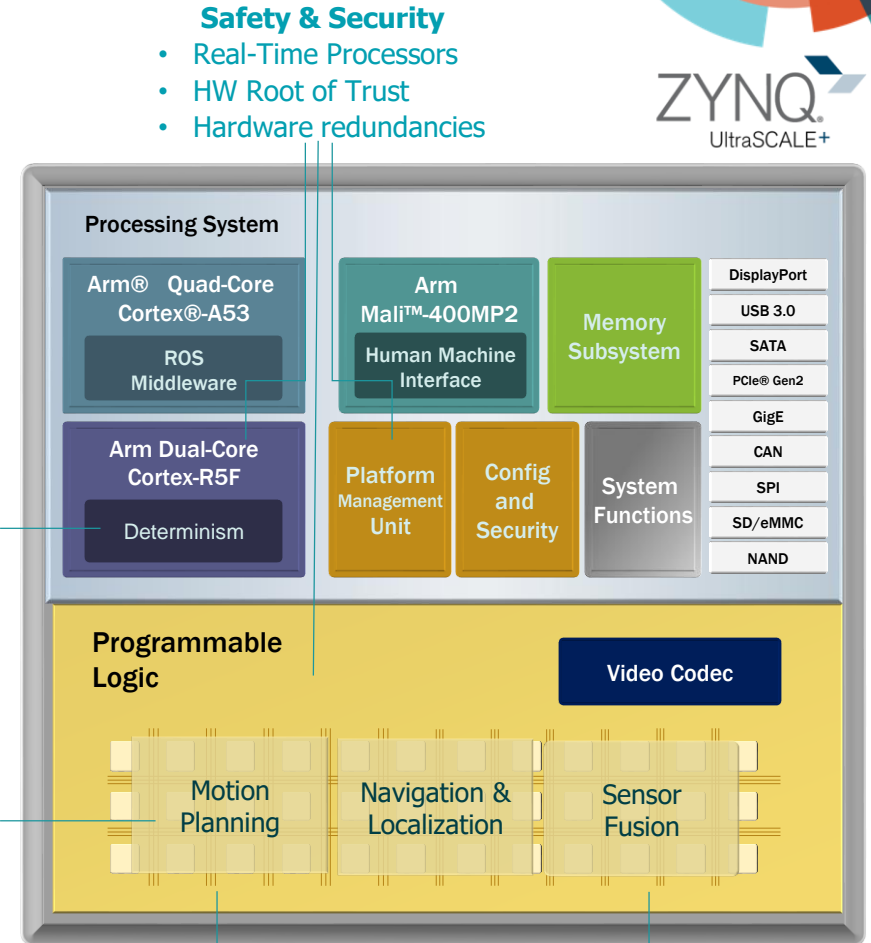
1: Not available in Nvidia Jetson platforms

2: TPM component on K26 SOM for HW-based security for remote attestation, measured boot, cryptographic functions



Deterministic, Real-Time Processing

Hardware Adaptable for diverse architectures



Low Latency & Determinism
Critical paths in hardware

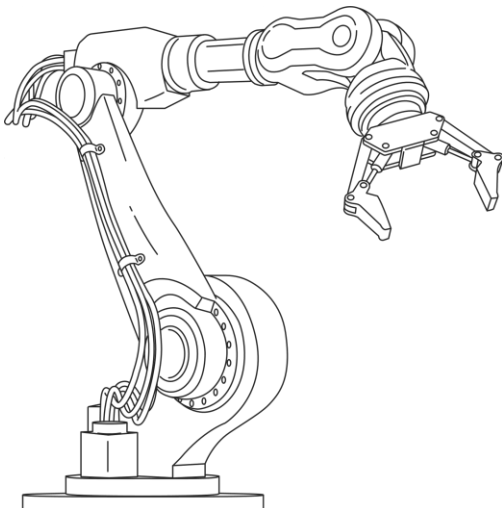
Performance/Watt
Hardware Parallelism

ROS: Robotician's Familiar Design Environment



- ▶ Robots are a 'system of systems' where heterogeneous compute clusters work together
- ▶ ROS is opensource middleware and frameworks specialized for robotics architectures
- ▶ Allows control, message-passing, implementation of common functionality via libraries, C++, Python, etc.
- ▶ Gazebo commonly used for simulation (development and debug prior to HW implementation)

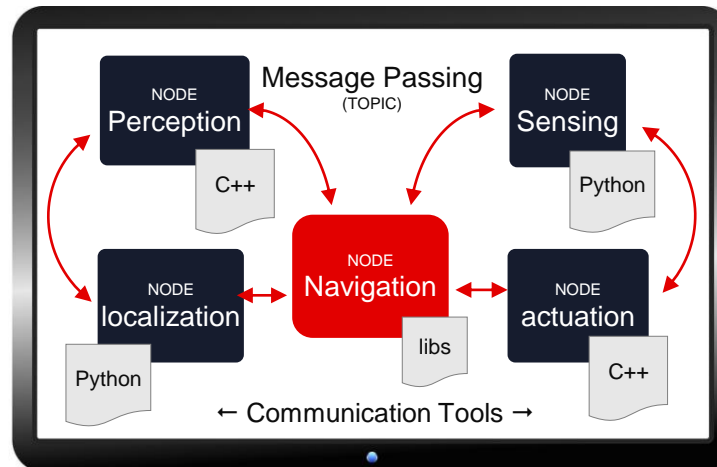
Robots are "System of Systems" Compute Clusters Working Together



ROS

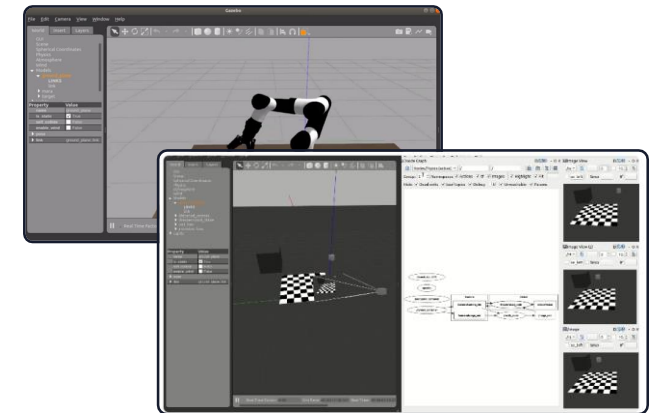
Robot Operating System

Opensource Middleware and Frameworks



Supports computational graphs and data layer graphs, central to ROS design flows

Simulation with Gazebo For Debug Prior to HW Implementation



ROS 2 for Next Generation, Real-Time Robotics

Addressing Limitations of ROS



ROS 2

Made with Embedded Systems in Mind



Real-Time Capabilities



Cybersecurity Enabled



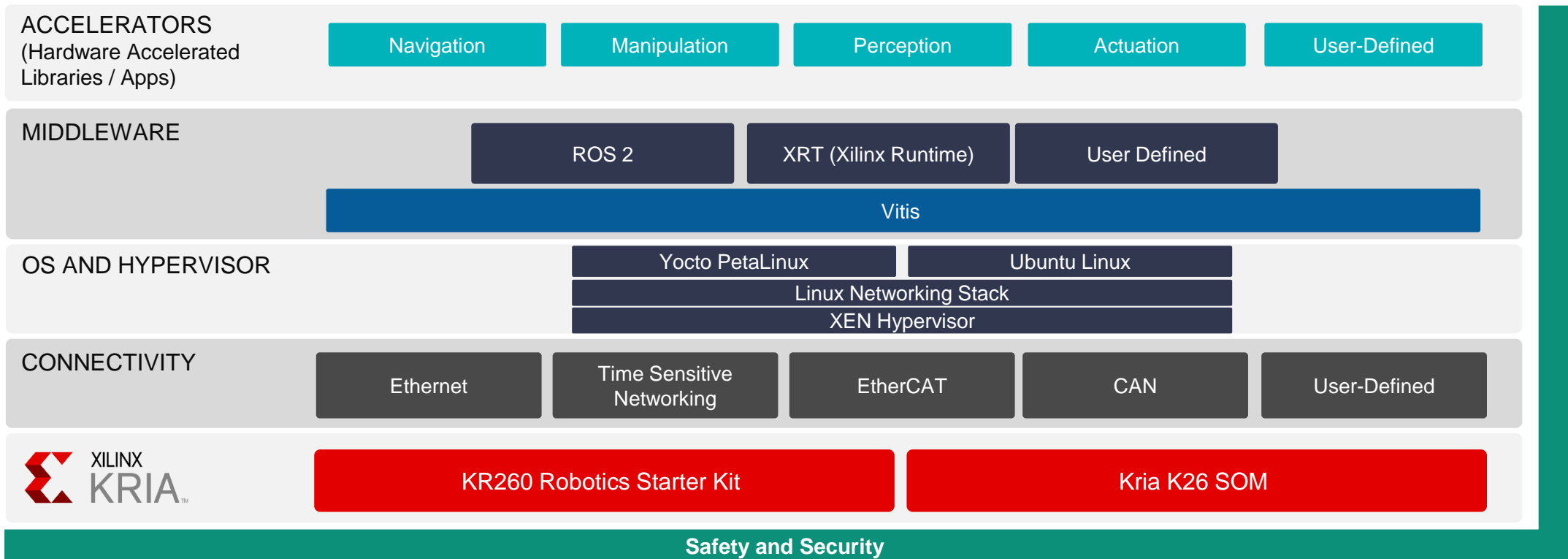
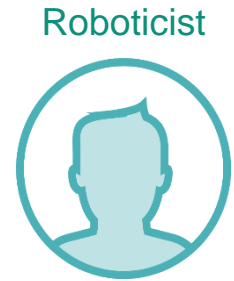
Scalable Communication and Across Multiple Robots



The Kria Robotics Stack for Roboticians

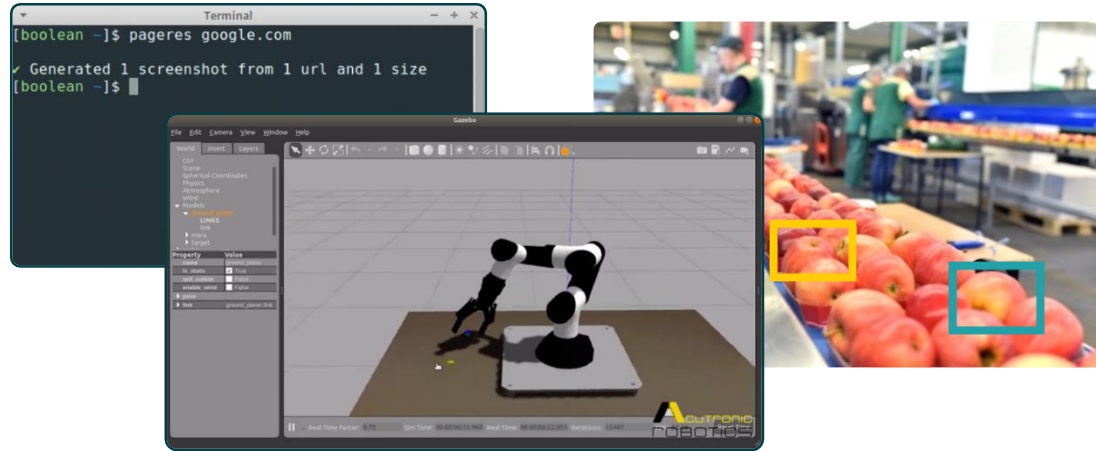


- A familiar entry-point aligned with common robotics flows
- An integrated set of libraries and utilities to accelerate development
- Developed around ROS 2 SDK to enable a SW-defined, HW-accelerated platform

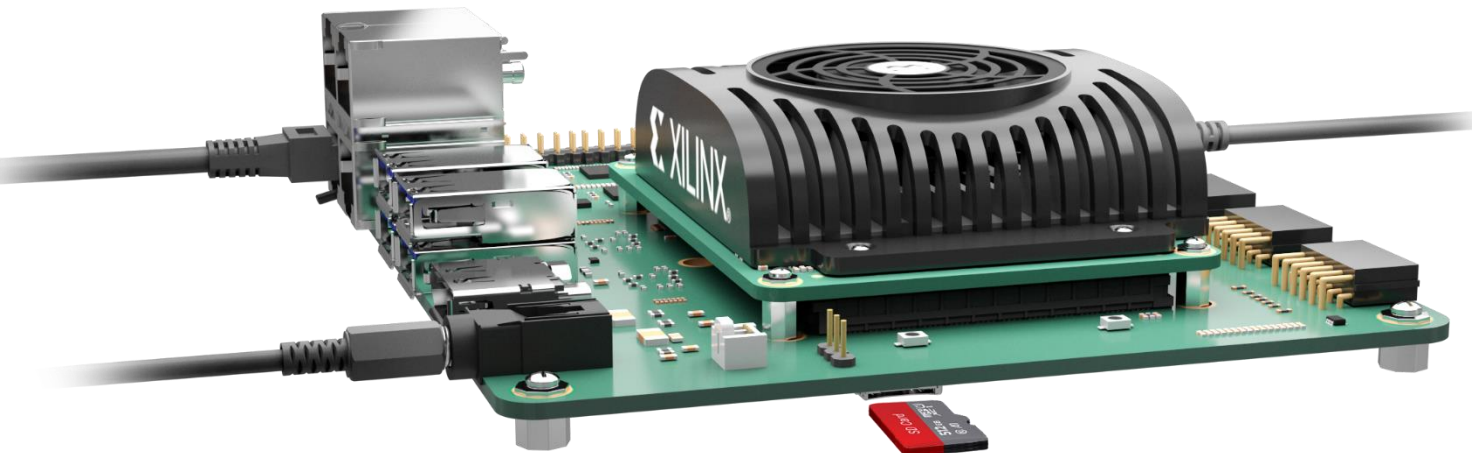


Out-of-the-Box Ready for Application Development

Starter Kit + Peripherals + Accelerated Application



1. Connect peripherals and cables
2. Insert the programmed microSD card
3. Power-on the board
4. Load accelerated application of your choice
5. Run accelerated application



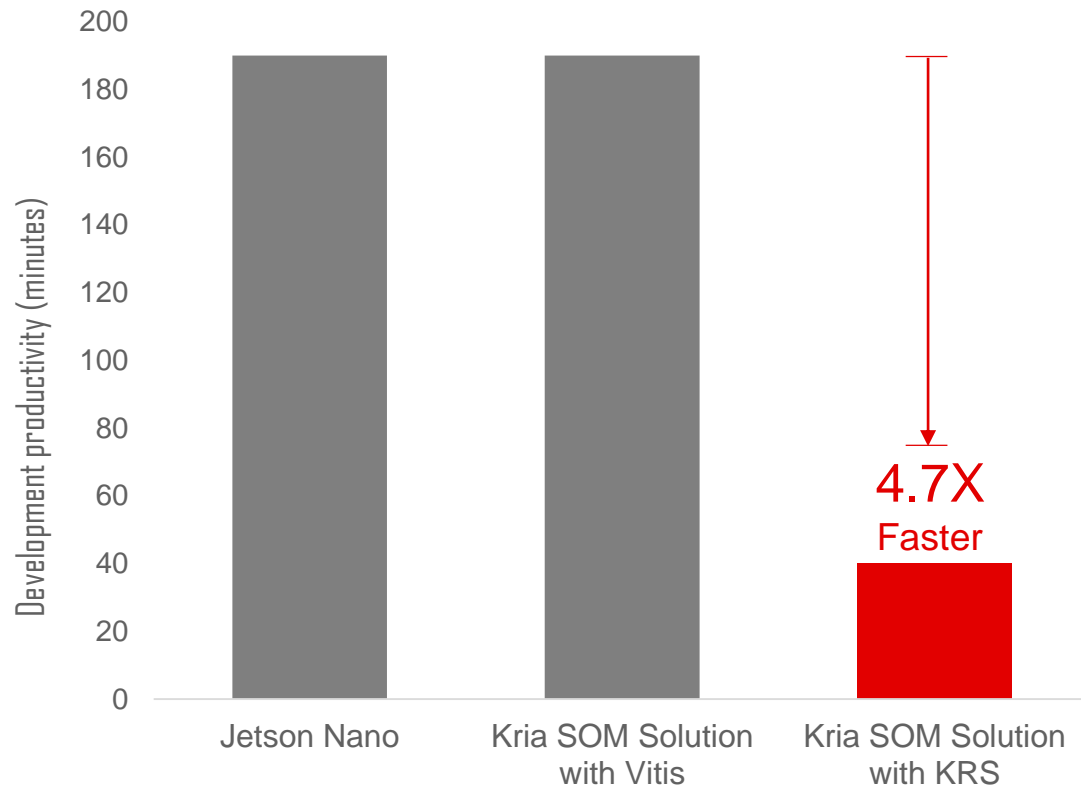
Up and Running in Less Than **1 Hour**, No FPGA Experience Needed

SW-Defined, HW Accelerated for Higher Productivity and Lower Latency



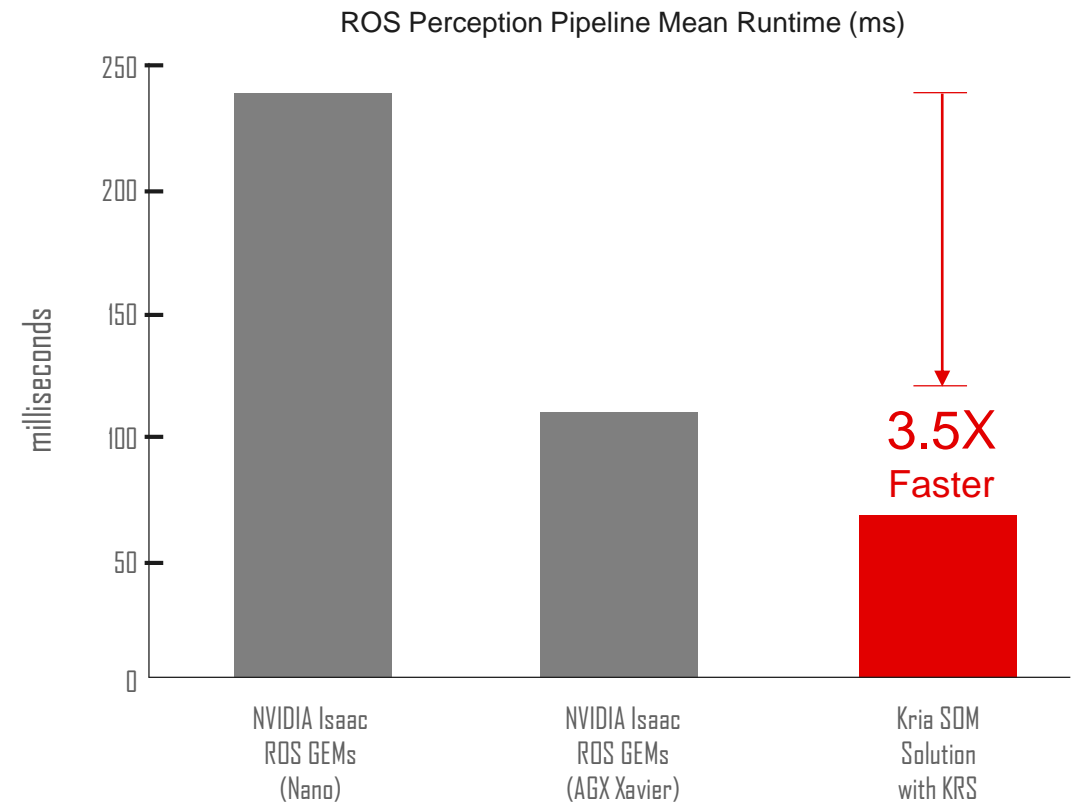
4.7X ROS 2 Development Productivity

when compared to NVIDIA CUDA¹ or Xilinx Vitis flows²



3.5X Faster Execution Time (Lower Latency)

when compared to NVIDIA Isaac ROS GEMs (Jetson Nano)



1: Accounts for setting up the toolchain with ROS 2, cross-compilation of host code or creation and build of the accelerator among other necessary steps.

2: Evaluated using doublevadd_publisher and accelerated_doublevadd_publisher – https://github.com/ros-acceleration/acceleration_examples

Design Path for Software and Hardware Developers



AI Developer



Time

Customize AI Model

- Build custom AI application
- Configure AI processor to your requirements



Robotician



Develops Robot Behavior via KRS

- Based on workspaces (vs. applications)
- Computational graph-centric
- Software-oriented, native support for Kria



Embedded Developer



Customize Vision / Connectivity

- Change pre- and post-processing
- Accelerate entire pipeline in SW
- Customize connectivity in firmware



HW Developer



Full Custom RTL Development

- Ultimate Flexibility (RTL)
- HW Differentiation



Accelerated Applications in the Kria App Store

Start From a Higher Level of Abstraction



- Pre-built applications for evaluation with no FPGA expertise required
- Each app transforms the SOM to, e.g., a TSN node, perception node, or 10GigE camera
- Developer “drops in” their differentiation using their preferred design environment

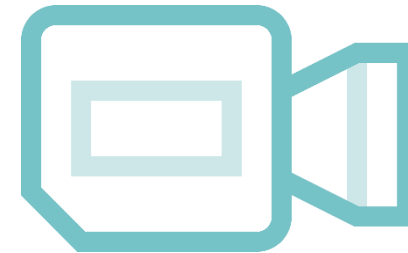
TSN Communications



Perception



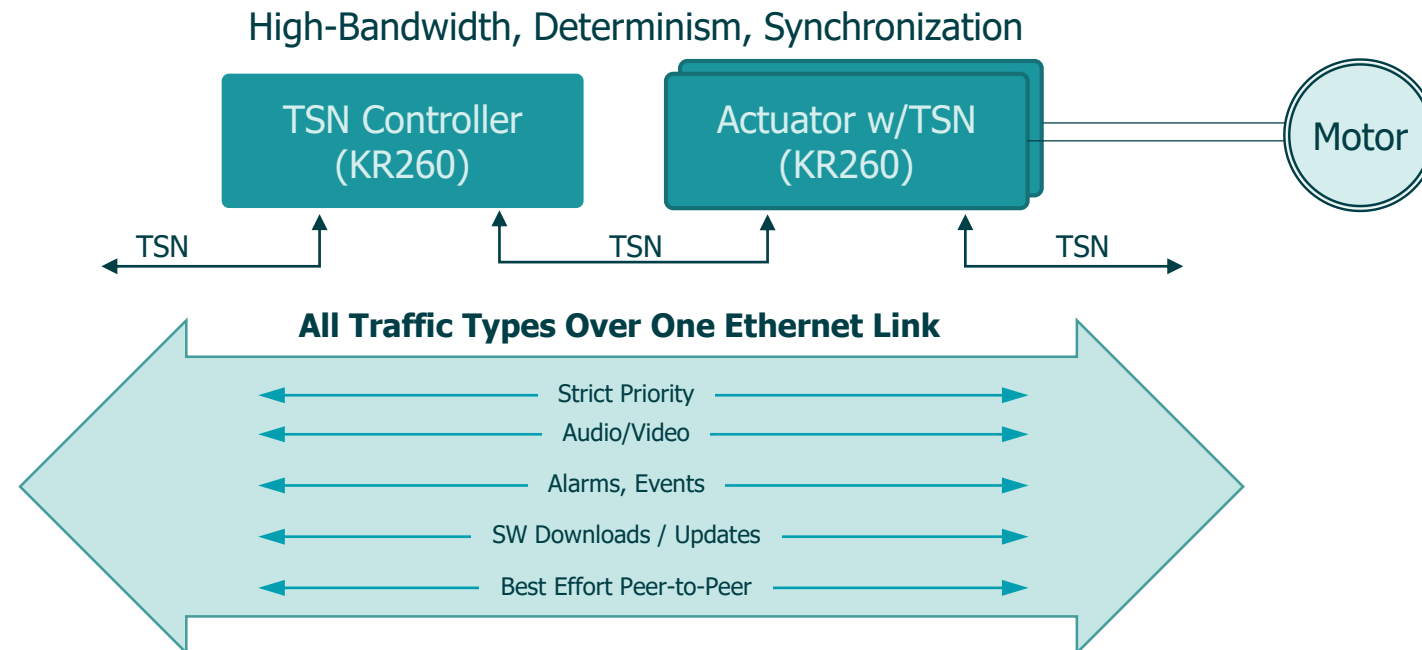
10GigE Vision Camera



First Mainstream TSN Industrial Communication and Real-time Control Platform



- Two TSN ports for high-bandwidth, deterministic transmission
- IEEE 802.1AS compliant time synchronization (< 20ns) for scheduled traffic
- Built-in ethernet switch eliminates external TSN switch
- All traffic types over a single industrial ethernet link

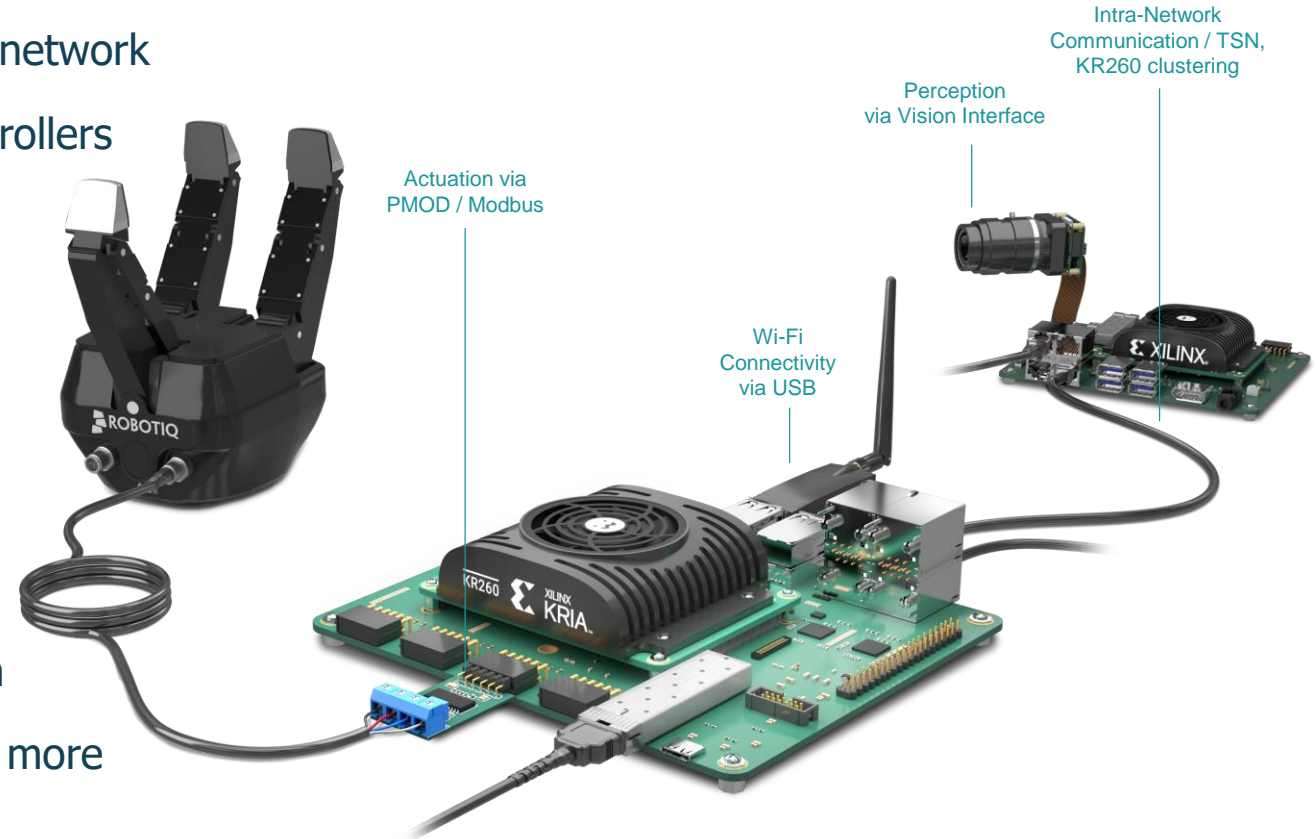


End-to-End Adaptive Robotics Platform

TSN, Vision & Sensor Fusion, Actuation, HW Acceleration



- Intra-network communication
 - Predictable TSN communication for robotics internal network
 - KR260 clustering w/synchronization for multiple controllers
- Perception via vision interface and Pmods
 - e.g., USB Camera, depth sensors, radar, lidar
- Actuation via Pmod/Modbus interfaces
 - Motors, steppers, grippers, manipulators
- Hardware acceleration and offloading
 - Low-latency inter-process, intra-process computation
 - Motional planning, motor control, sensor fusion, and more

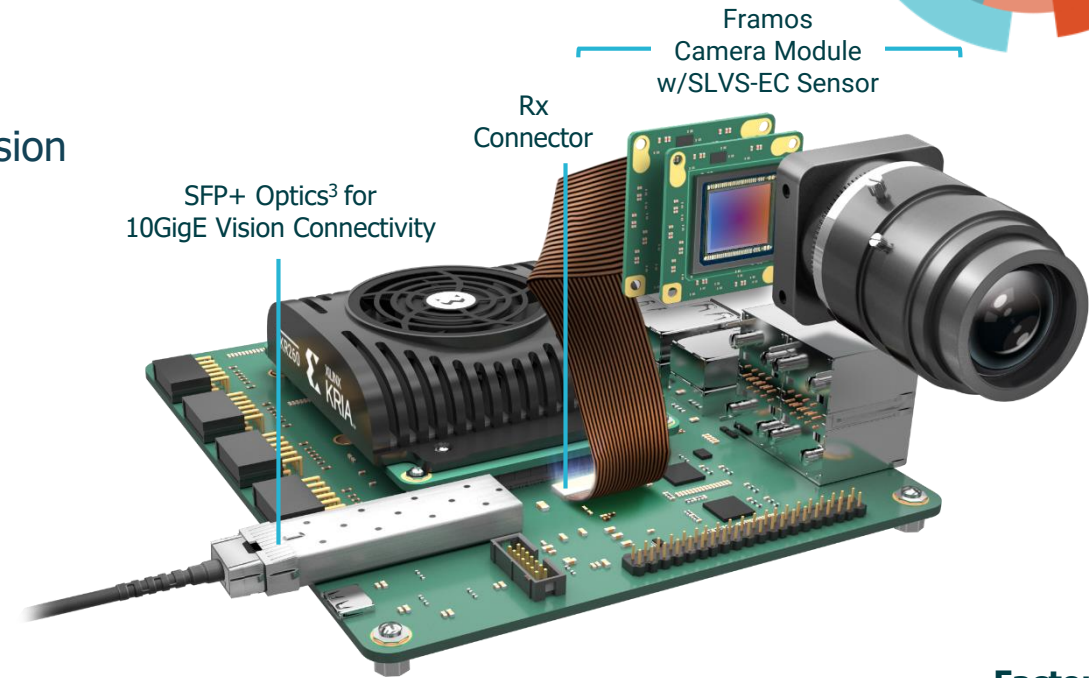


“Instant-On” Robotics Experience

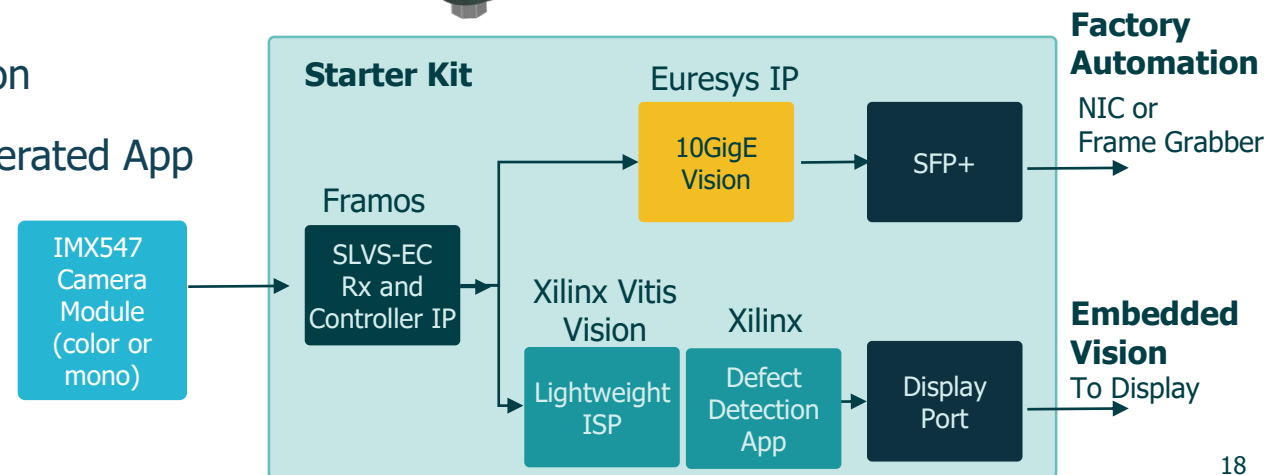
A High-Performance Vision Platform



- Support for Sony SLVS-EC Sensors¹
 - Increasing industry adoption of SLVS-EC, future of Machine Vision
 - 9.5Gb/s over 2 lanes supporting up to 860 MPixel/s
 - Superior signal integrity for longer cable length
 - Uses lightweight ISP (soft IP in Zynq SoC)
 - Partner IP available from Framos2 w/Xilinx Accelerated App
- 10GigE Vision Connectivity³
 - Performance: faster sensor read-out / overall imaging
 - Long cabling: 100m and more for easier camera installation
 - Partner IP available from Sensor to Image2 w/Xilinx Accelerated App
 - Compliant with latest version of GigE Vision



1: Sony SLVS-EC sensor sold separately via KR260 accessory pack
 2: Partner IP available with no-charge evaluation license via Xilinx App Store for Kria SOMs
 3: SFP+ module and NIC sold separately



Next Steps

Join ROS 2 Hardware Acceleration Working Group (HAWG¹)

- Community focused on reducing time to compute w/Gazebo and ROS 2 flows on accelerated HW
- Contributions to design tool integration, reference examples, testing environments, and more



1: Scan QR Code to join HAWG



Expanding the Kria Portfolio



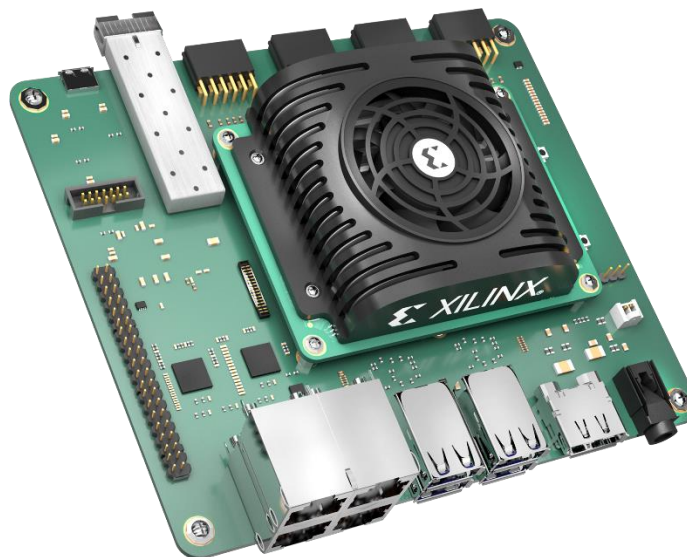
Kria KV260 Vision AI Starter Kit



For Mainstream
Vision AI Cameras

\$199

Kria KR260 Robotics Starter Kit



For High-Performance
Industrial Systems

\$349

Kria K26 Production Module Fully Qualified and Certified



C-Grade

Commercial Environments
Temp: 0°C to 85°C
2 Year Warranty

\$300

I-Grade

For Rugged Environments
Temp: 40°C to 100°C
3 Year Warranty

\$420

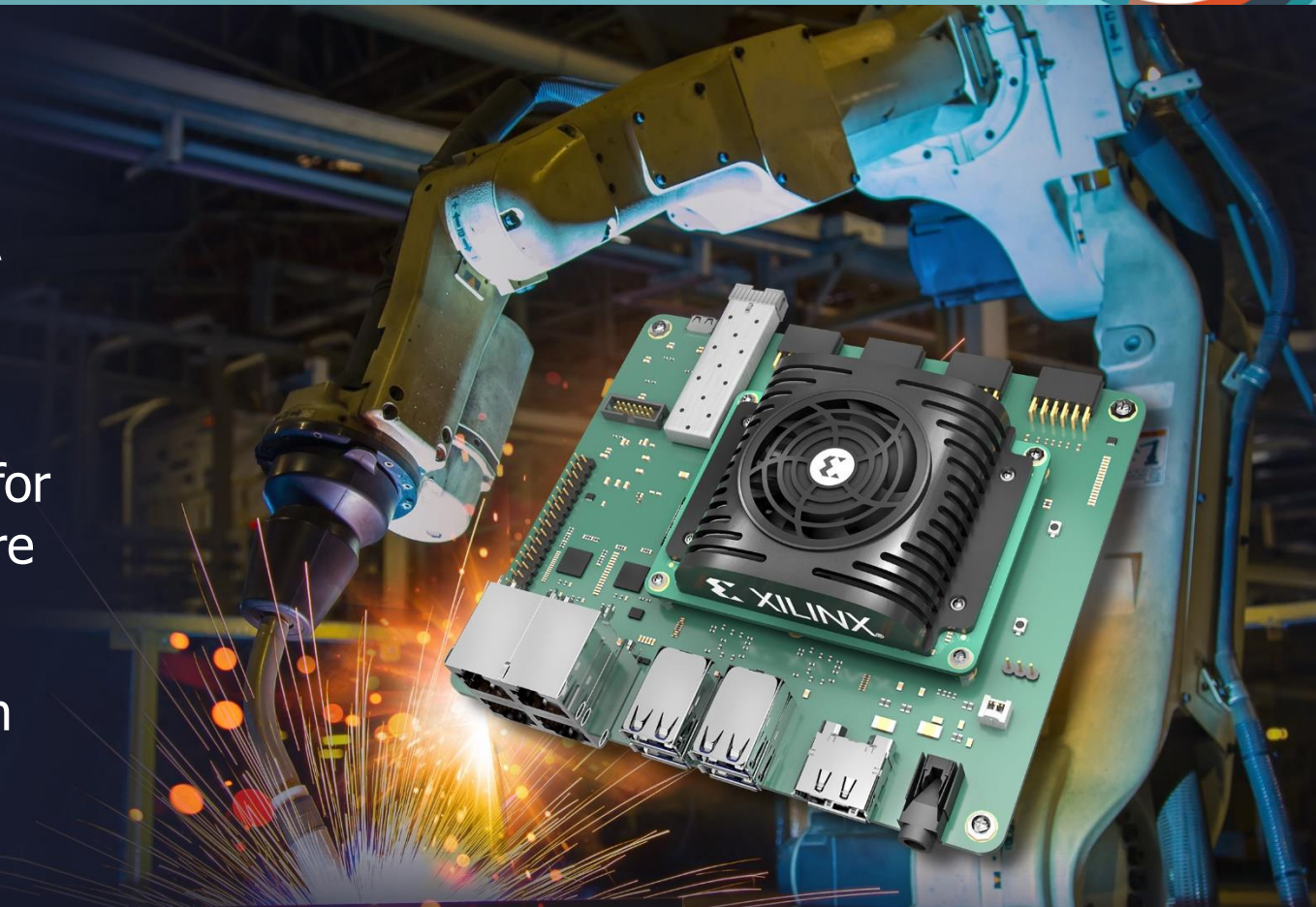
Key Take-Aways



Designed for Robotist without FPGA expertise, with native ROS 2 support

Supports key interfaces and sensors for vision, real-time networking, and more

Low latency and determinism for high performance machines



Kit Available Now at www.xilinx.com/robotics

Thank You