



Решения для машинного зрения от Xilinx: Визуальный интеллект (Visual Intelligence) в краевых устройствах для автоматизации производства и робототехники, управляемой зрением



Xilinx

Компания основана в 1984



● Headquarters ● R&D and Engineering ● Sales and Support ● R&D and Sales ● Fab & Manufacturing Partners



\$3.15B
Revenue (FY21)



~5,000
Employees Worldwide



60K+
Customers



60+
Industry Firsts



4,800+
Patents

Послужной список инноваций Xilinx

HARDWARE INNOVATIONS



1984

World's First FPGA



1999

First High-End High-Capacity FPGA



2001

First FPGA with Integrated SerDes and Processor



2012

First 3D FPGA and Zynq Dual HW Programmable SoC



2017

First Zynq MPSoC & RFSoc



2018

ALVEO Data Center Accelerator Card



2019

VERSAL First Adaptive Compute Acceleration Platform



2021

ALVEO SN100 First Composable, Adaptable SmartNIC



KRIA SOM Adaptive System on Module with First Embedded App Store

Specifically for Industrial, Vision, Healthcare & Sciences markets

1984

Present

SOFTWARE INNOVATIONS



Next-Gen Dev Environment



Programmability for SW Developers



C, C++ and System C Enabled



Unified Software Platform



Традиционные области применения решений от Xilinx



Robotics



Drives & Motor Control



IIoT Gateways & Edge Appliances



PLC/PAC/IPC



I/O Modules & Smart Sensors



Human Machine Interface



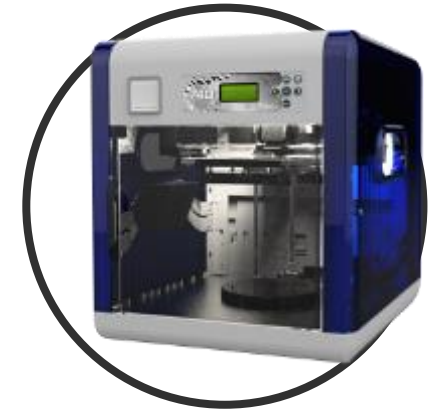
Smart Security



Machine Vision

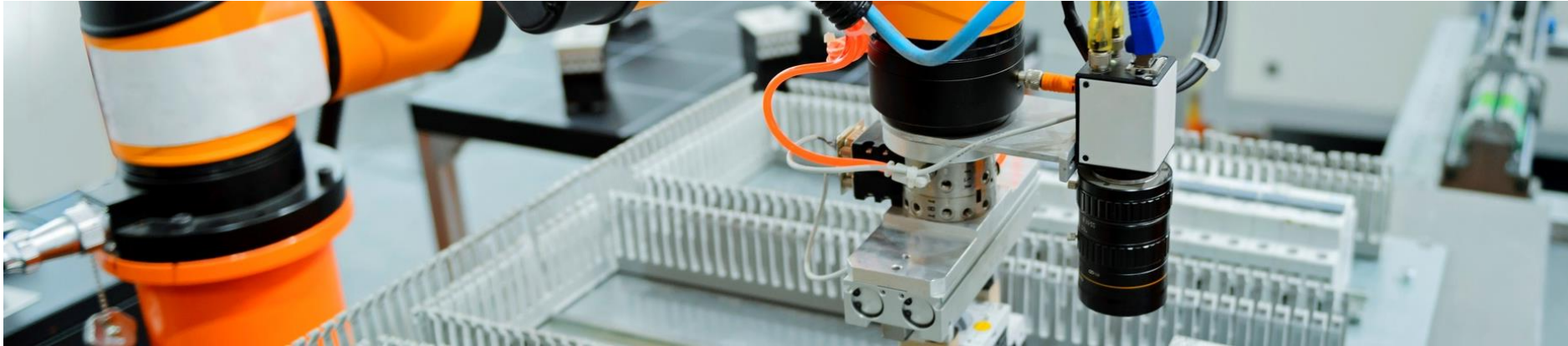


Smart Grid



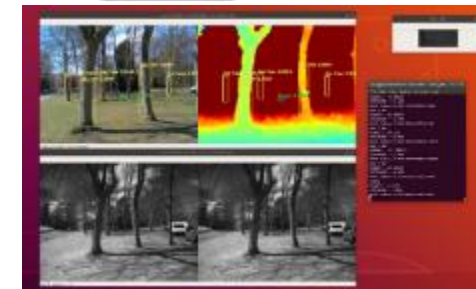
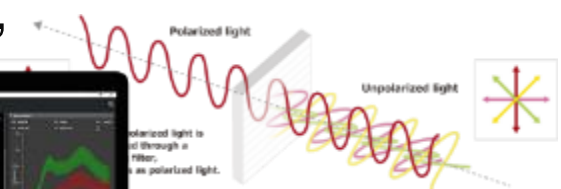
3D Printing & Additive Manufacturing

Машинное Зрение: Автоматизация производства и Робототехника, управляемая зрением



Тренды в области Машинного Зрения

- ▶ Взрывное увеличение объема данных
 - Высокое разрешение и более высокая частота кадров => Высокая скорость передачи данных = Высокоскоростные интерфейсы
 - Новые типы сенсоров: SWIR, Тепловые, Событийные (Event-based), Мультиспектральные и Гиперспектральные
- ▶ Бурное развитие ИИ
 - AI/ML аналитика
 - Низкая задержка
 - Узкая специализация
- ▶ Низкое потребление и уменьшение размера устройств
- ▶ Стандарты: Интерфейсы, Надежность, Безопасность



Машинное зрение: Устройства от Xilinx

Новые устройства Artix® UltraScale+™ FPGA Family



Serial I/O Performance

16Gb/s transceivers for advanced protocols in a cost-optimized family



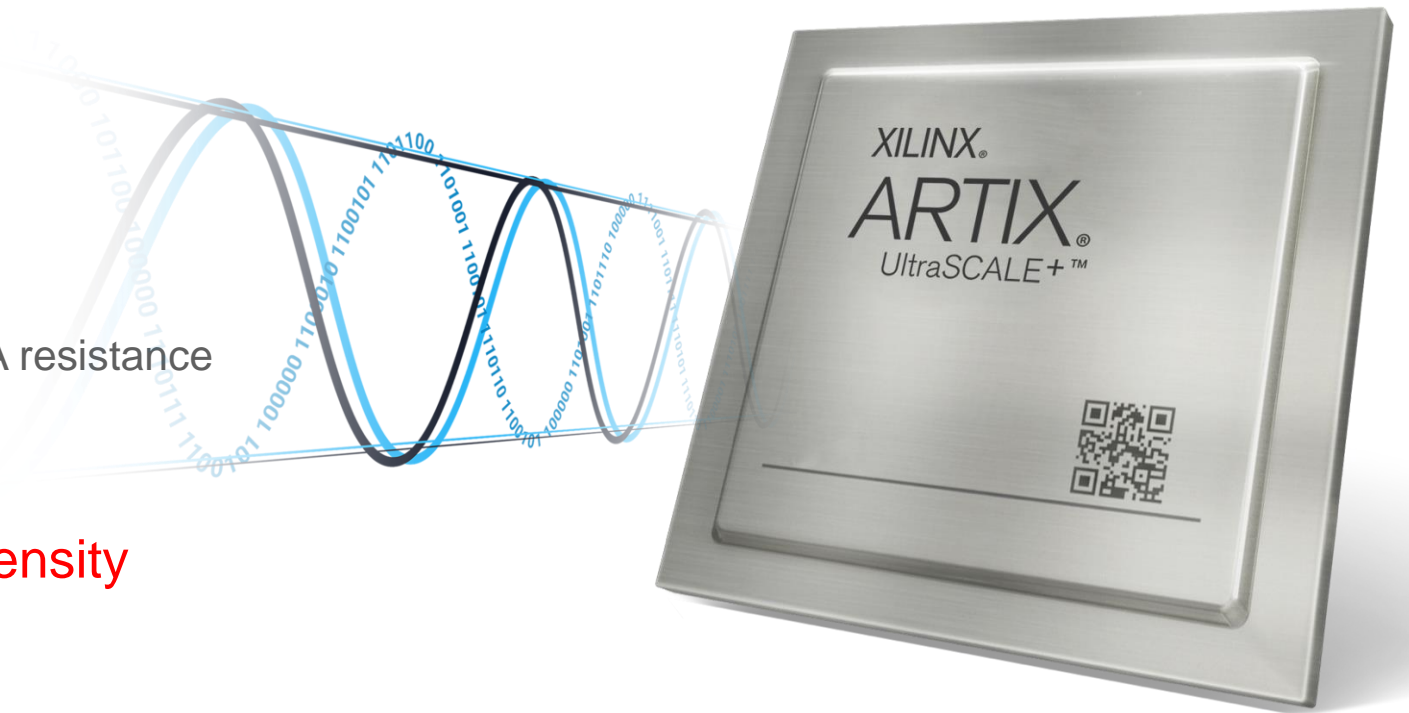
Multi-Level Security

Cryptography, authentication, and DPA resistance for cybersecurity and IP protection



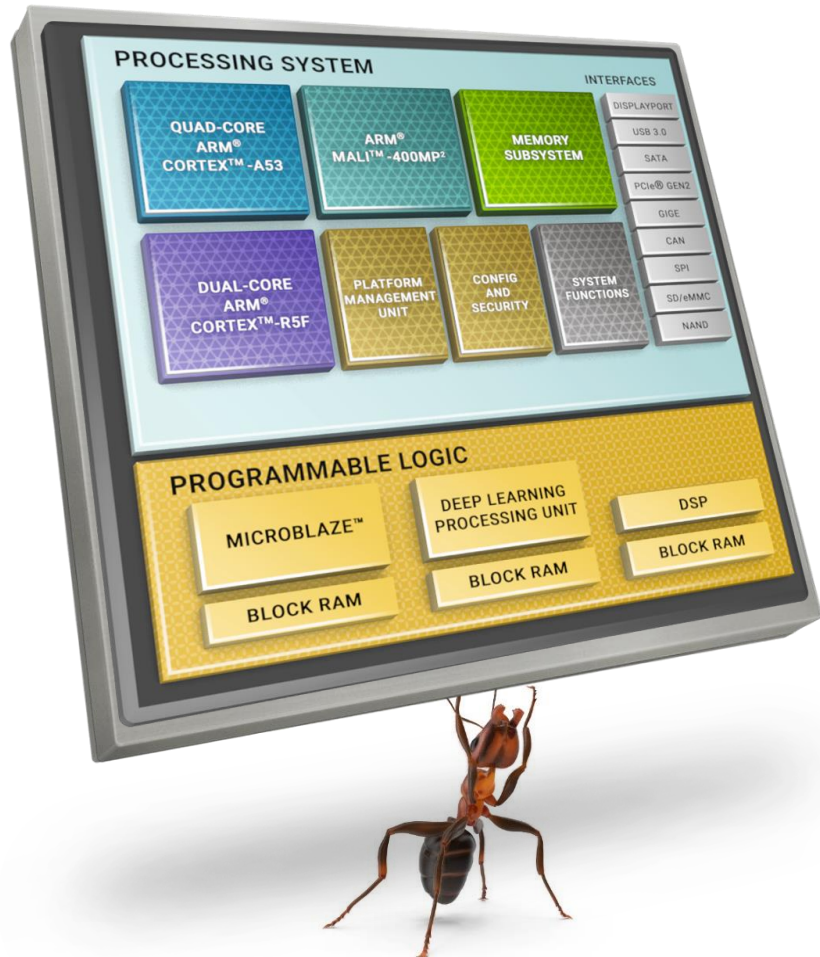
Signal Processing Compute Density

Best-in-Class DSP bandwidth in small form-factor packaging



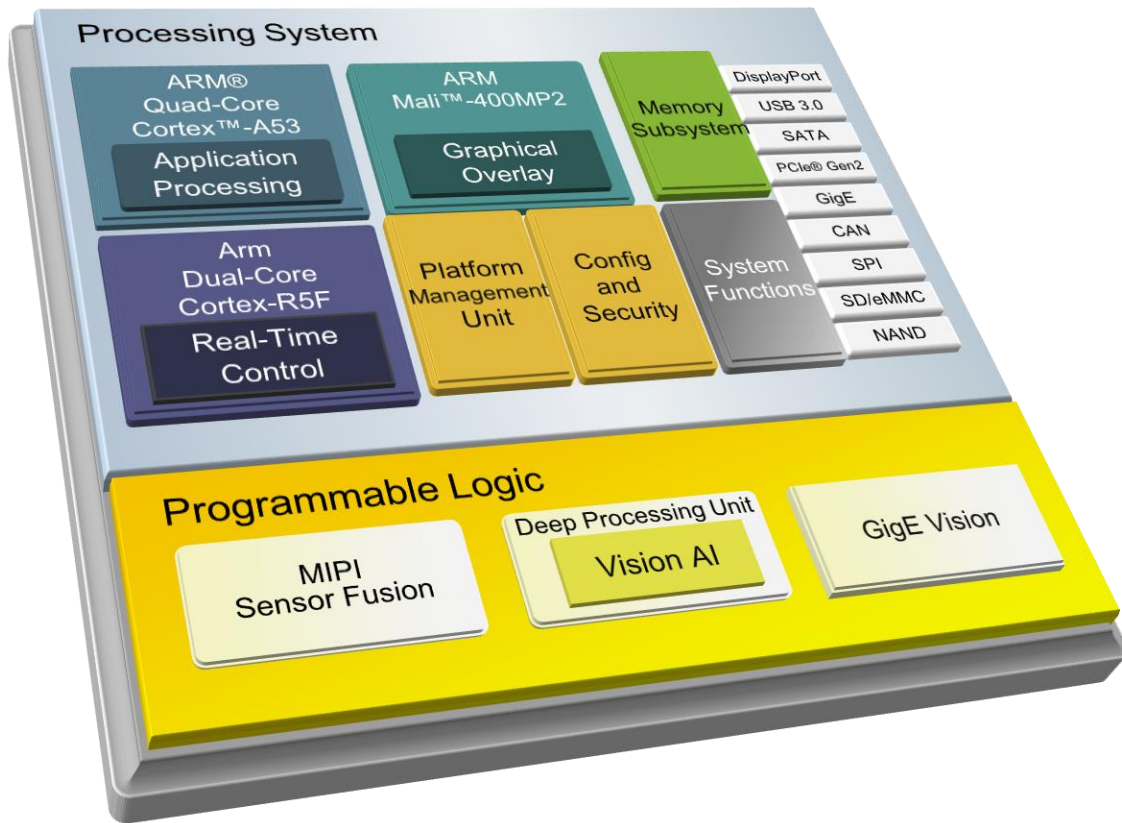
Новое ZU1 MPSoC устройство:

Самое дешевое и малопотребляющее в семействе Zynq UltraScale+



- ▶ **Lowest Power, Lowest Cost Adaptive SoC in the Portfolio**
 - Ideal for edge and battery powered applications
- ▶ **Highest I/O-to-Logic Cell Ratio**
 - 400 I/Os for any-to-any connectivity
- ▶ **Highest DSP-to-Logic Cell Ratio**
 - Maximum compute and AI offloading for smart applications
- ▶ **Same Multiprocessing Arm® Processing Power**
 - Application software scalability across the portfolio

Zynq UltraScale+ для ультра компактных Умных Камер



Требования к умной камере

- ▶ Высокопроизводительные I/O для новейших сенсоров
- ▶ Гибкая обработка изображений для различных вариантов использования (HDR, 4K, инфракрасный)
- ▶ Краевая обработка для минимизации задержки передачи данных в облако

Возможности Zynq® UltraScale+™

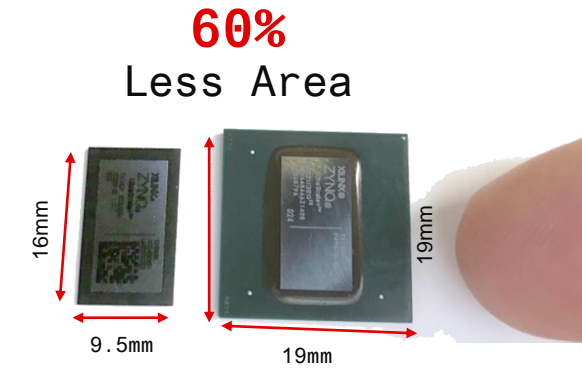
- ▶ 2500Mb/s MIPI (supports 30MPx and Up) and high perf. I/O
- ▶ Arm® подсистема анализа и функций управления
- ▶ Реализация алгоритмов ИИ
- ▶ IEC 62443 сертификация кибербезопасности

Новые ультра-компактные InFO (Integrated Fan-Out) корпуса

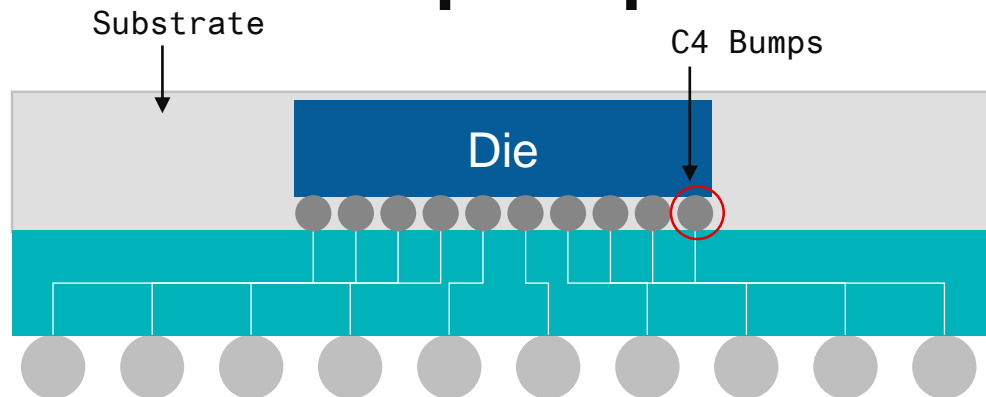
- ▶ Меньшая и более тонкая упаковка (без подложки или неровностей C4)
- ▶ Шаг шарика “Близкий к размеру штампа” (0,5 мм) без потери

количества I/Os

- ▶ На 60% меньше площади для лучшего распределения тепла и электроэнергии
- ▶ Более короткие межсоединения для лучшей целостности сигнала
- ▶ Доступны рекомендации по печатной плате и тепловому режиму (EA)

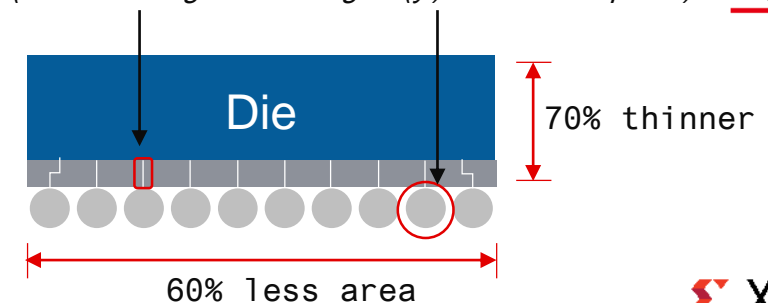


Flip Chip



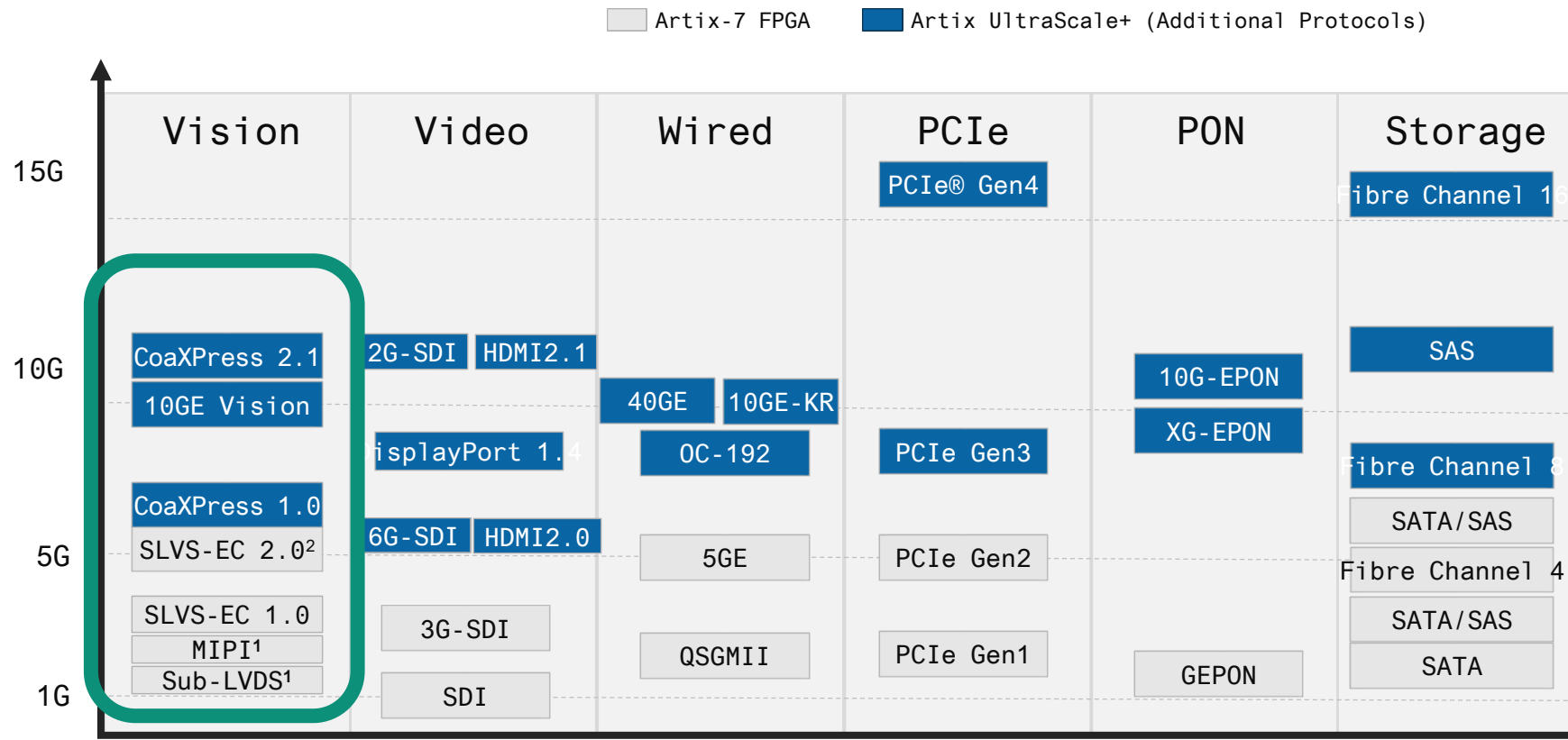
InFO

Shorter Interconnect 0.5mm Ball Pitch (better signal integrity) *(no loss of pins)*



Высокоскоростные интерфейсы для высокопроизводительного машинного зрения

- ▶ Интерфейсы высокоскоростных датчиков и камер с высоким разрешением, требующие высокоскоростных трансиверов / I/Os
- ▶ SLVS-EC 2.0, 10GigE Vision и др.



1: Artix® UltraScale+™ delivers 2500Mb/s LVDS/MIPI performance vs. Artix-7 at 1500MB/s
 2: Artix UltraScale+ supports up to 12 lanes of SLVS-EC 2.0 in 19mm package

Embedded Vision Industrial Camera Case Study

Triton™ Edge

Industrial All-in-One Edge Computing Camera.

Develop • Accelerate • Deploy

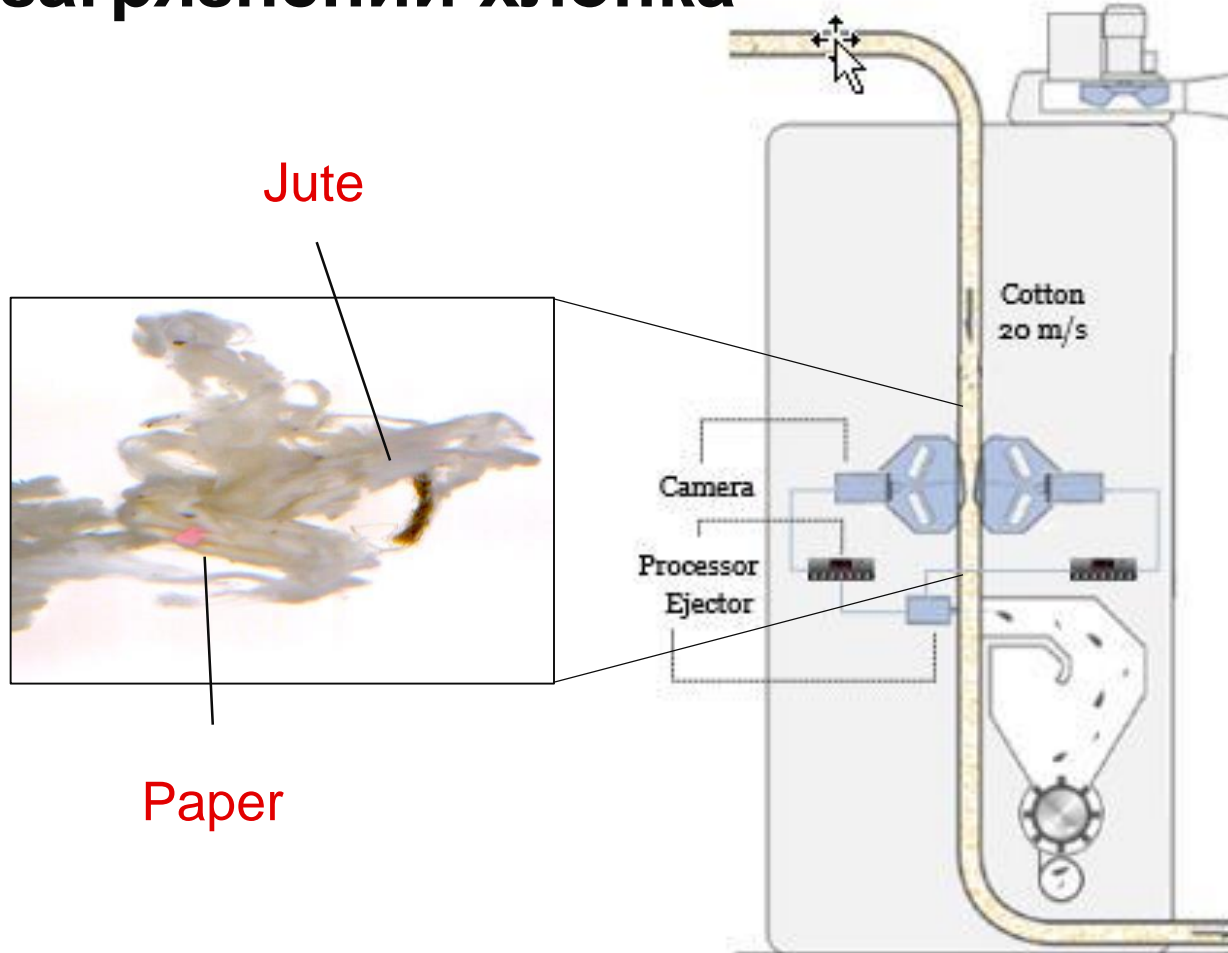
The Triton Edge features Xilinx's Zynq® UltraScale+™ technology with multi-processor functionality and user programmable FPGA accessibility. Offering unparalleled access to on-camera hardware to develop and run custom image processing, you'll create unique camera IP that's powerful, accelerated, and energy-efficient, running directly on the industrial Triton Edge camera.

[Learn More >](#)



<https://thinklucid.com/triton-edge/>

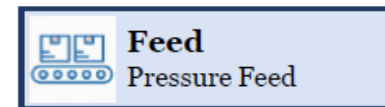
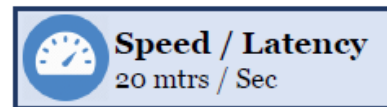
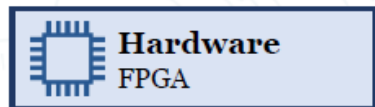
Пример применения Машинного Зрения на базе устройств Xilinx в текстильной промышленности - Сортировка загрязнений хлопка



YantraVision



Xilinx Zynq SoC powered
Camera Module and Framegrabber+



Machine Vision: Solutions and Tools





APPLICATION



EDGE AI



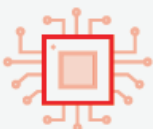
EMBEDDED SW
FOR MIXED CRITICALITY



ANY-TO-ANY CONNECTIVITY
SMARTER CONTROL
EMBEDDED VISION



FUNCTIONAL SAFETY
& CYBERSECURITY



SILICON ARCHITECTURE

Решения для Машинного Зрения:

- ▶ Sensor Interface
 - MIPI CSI, DSI; SLVS-EC 2.0; LVDS
- ▶ Image and Video Processing
 - Demosaicing, gamma correction, scaling, etc.
- ▶ Camera/Frame Grabber Connectivity
 - USB3, HDMI, CXP, 10GigE Vision, DisplayPort, SDI, Camera Link
- ▶ Partner Solutions
 - ISPs (Image signal processing), HDR, Software, Tools

Industry Alliances



Sensor Partners



ISP Partners



Software and IP Partners



SONY®



- ▶ *“Xilinx has been a key strategic partner in driving the adoption of Sony sensors in machine vision applications through their active support of the Sony SLVS-EC sensor interface. By our estimation, Xilinx has 70% market share in the machine vision industry.”*

Sony Semiconductor Solutions



SWIR Индустриальная Камера

Камера коротковолнового инфракрасного диапазона (SWIR Camera) от Aval Data

“The performance of Xilinx's Zynq 7000 MPSoC enabled advanced image quality and support of interfaces such as CameraLink and GigE Vision in our SWIR camera designs, leading to the building of a common platform with smaller size and lower cost. We have designed it into 2 of our SWIR camera models, the ABA-013VIR and ABA-003VIR.”



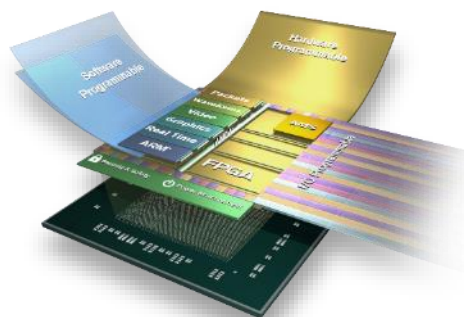
 **AVAL DATA**

Поддержка TSN (Time-Sensitive Networking) в Xilinx SoCs для промышленного интернета вещей (Industrial IoT)

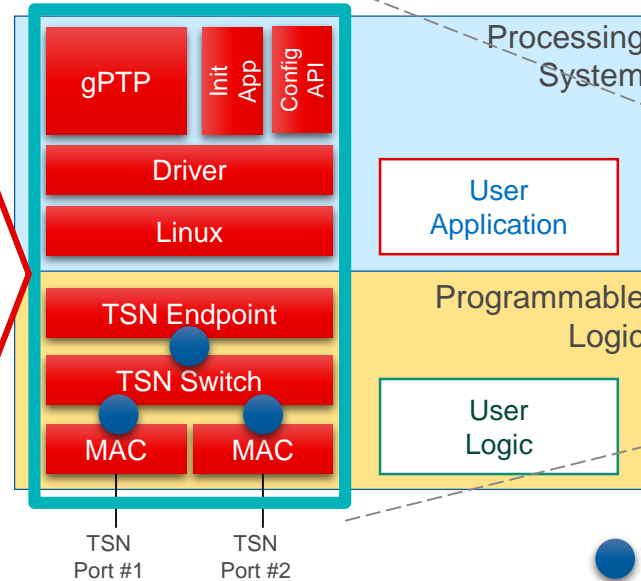
► Xilinx TSN LogiCORE

- Configurable as Bridged Endpoint or Pure Endpoint
- For Zynq-7000 APSoC and Zynq UltraScale+ MPSoC
- Since Vivado 2018.1 in IP Catalogue
- Gigabit Ethernet and 100 Mbit Ethernet
- Xilinx in-house IP development
- **Available: NOW!**

Xilinx
TSN Subsystem LogiCORE IP
(EF-DI-1GTSN-BRG-EPT-PROJ)



TSN
LogiCORE IP from XILINX.



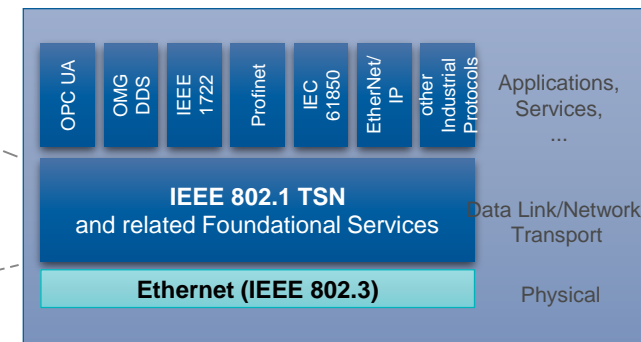
● Time-controlled Gates

ZYNQ

ZYNQ
UltraSCALE+

More Xilinx Solutions in:

- Any-to-any Connectivity
- Functional Safety
- Cybersecurity





Новое решение от Xilinx для систем машинного зрения и видеонаблюдения - системы на модуле KRIA SoM K26

Xilinx SOM - Портфолио

Kria KV260 Vision AI Starter Kit

For Evaluation and Development Use



Разработка



Kria K26

Production Module
Fully Qualified and Certified



C-Grade

For Commercial Environments
Operating Temp 0°C to 85°C
2 Year Warranty

I-Grade

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

Использование

K26 SOM Обзор характеристик

Модуль построен на базе Zynq® UltraScale+™ MPSoC архитектуры



COMPUTE

Application Processor	64-bit Quad-Core Arm® Cortex®-A53
Real-Time Processor	32-bit Dual-Core Arm Cortex-R5F
Graphics Processor	Arm Mali™-400MP2
Programmable Logic	256K System Logic Cells
Deep Learning Processor	4K INT8 (upgradable to INT4)
Video Codec (H.264/H.265)	Up to 32 Streams (total resolution ≤ 4Kp60)
Memory	26.6Mb On-Chip SRAM
Security	IEC62443 Security w/HW Root-of-Trust

INTERFACES

Camera	11 x4 Full MIPI or sub-LVDS Interfaces 1 x4 SLVS-EC Interfaces
USB	4x USB 2.0 / 3.0
Multi-Media	DisplayPort, HDMI
Network	1Gb up to 40Gb Ethernet (w/GigE Vision)
Memory Interface	4GB 64-bit DDR4
Transceivers	4x 12.5Gb/s, 4x 6Gb/s
Mechanical	77 x 60 x 11mm w/ dual 240-pin connectors

Kria™ K26 SOM – целевые области применения

► Для систем машинного зрения с видеоаналитикой на основе ИИ для **Умных Городов** and **Умных Предприятий**

Security
Cameras



City
Cameras



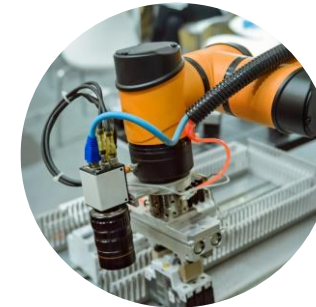
Traffic
Cameras



Retail
Analytics



Machine
Vision



Vision Guided
Robotics



Kria SOMs in Smart Cities

Object Detection at High Speeds

Up to 3X throughput at low latency vs. competition*
High resolution w/low latency critical for high-speed object identification

Adaptable AI for complex object & character detection
Covers emerging styles to "homemade" vehicle plates

Edge-to-Cloud scalable for camera network
End-to-end adaptability with Kria™ SOMs and Alveo™ accelerator cards



Kria™ SOMs in Retail Analytics

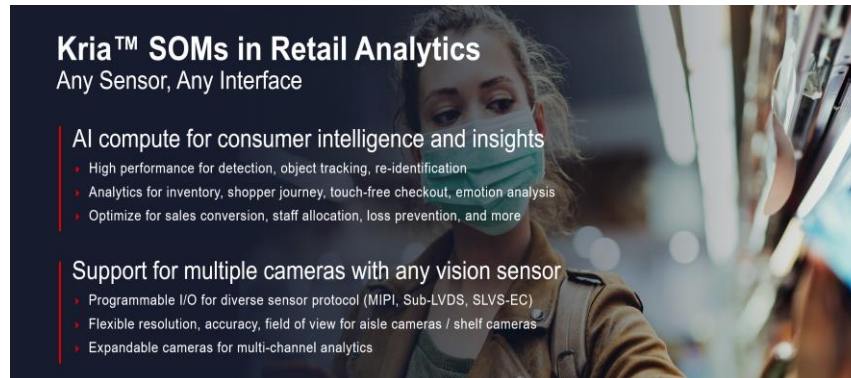
Any Sensor, Any Interface

AI compute for consumer intelligence and insights

- High performance for detection, object tracking, re-identification
- Analytics for inventory, shopper journey, touch-free checkout, emotion analysis
- Optimize for sales conversion, staff allocation, loss prevention, and more

Support for multiple cameras with any vision sensor

- Programmable I/O for diverse sensor protocol (MIPI, Sub-LVDS, SLVS-EC)
- Flexible resolution, accuracy, field of view for aisle cameras / shelf cameras
- Expandable cameras for multi-channel analytics



Kria™ SOMs in Smart Factories

Ruggedization, Cybersecurity, Industrial Life Cycle

Ruggedized for reliability in harsh environments
Built for indoor/outdoor, high and low temp, and shock resistance

Compliant with required cybersecurity; IEC 62443
Adaptable to security threats across product lifetime

Designed for industrial life cycle requirements
Industry's longest operating life and warranty

INDUSTRY CERTIFICATIONS



Широкий выбор готовых приложений для KRIA SOM, доступных на App Store

Ускоренные приложения “делают работу за вас”

Готовые к производству приложения, доступные сейчас как от Xilinx, так и от партнеров

Модель App Store поощряет партнеров предоставлять высококачественные приложения



First Embedded App Store for Edge Applications

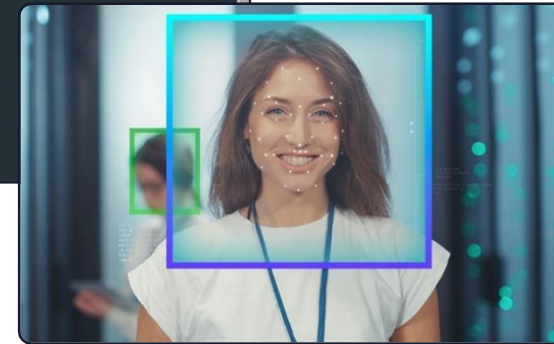
1: Smart Camera App supports face detection and other models in Xilinx Model Zoo

2: Coming Soon

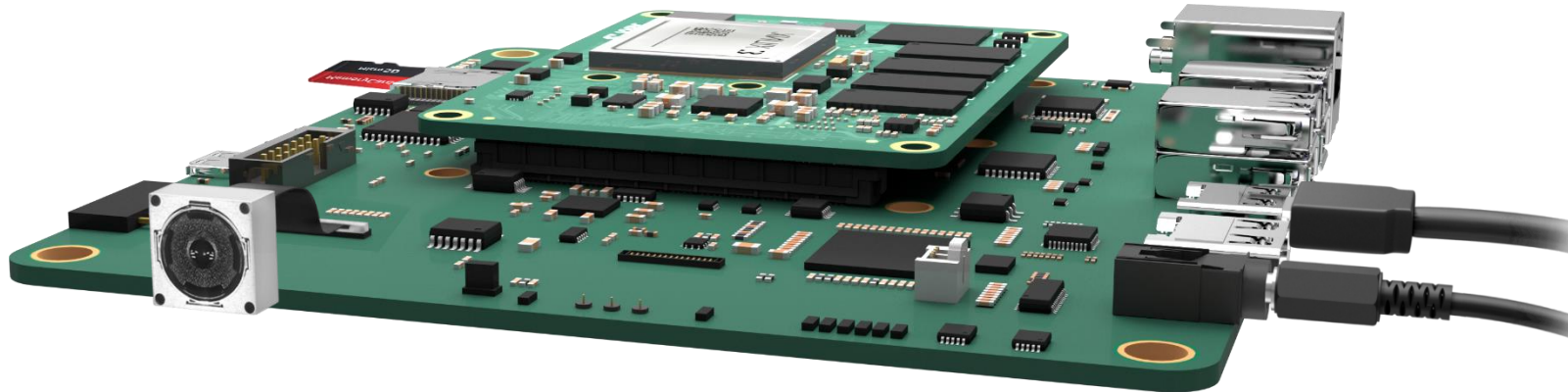
Готовый к разработке Стартовый Комплект + Периферийные устройства + Ускоренное Приложение

1. Подключите камеру, кабели и монитор
2. Вставьте запрограммированную карту microSD
3. Подайте питание на плату
4. Загрузите Ускоренная Приложение по вашему выбору
5. Запустите Ускоренное Приложение

```
Terminal  
[boolean ~]$ pageres google.com  
✓ Generated 1 screenshot from 1 url and 1 size  
[boolean ~]$
```



GETTING STARTED WEB PAGE



Запуск менее чем за 1 час, опыт работы с ПЛИС не требуется

Документ с таблицами сравнения производительности и KRIA SOM и конкурирующими решениями – WP529

Table 1: K26 SOM vs. Nvidia Jetson Features Comparison

No.	Feature	Xilinx's K26 SOM	Nvidia Jetson Nano ⁽¹⁾	Nvidia Jetson TX2 ⁽¹⁾
1	Application Processor	Quad-core Arm® Cortex®-A53 MPCore™ up to 1.5GHz	Quad-Core Arm Cortex-A57 MPCore processor	Dual-Core Nvidia Denver 2 64-Bit CPU and Quad-Core Arm Cortex-A57 MPCore processor
	Real-time Processors	Dual-core Arm Cortex-R5F MPCore up to 600MHz		
2	GPU	Mali™-400 MP2 up to 667MHz (primarily used for graphics rendering)	128-core Nvidia Maxwell GPU	256-core Nvidia Pascal GPU
3	Machine Learning Throughput	1.36TOPS ⁽²⁾	472GFLOPs (FP16)	1.33TFLOPs (FP16) 1.26TFLOPs for TX2i
4	Camera Interfaces	MIPI: Up to 44 DPHY2.0 lanes, Up to 11 Cameras, Max BW 10Gb/s BW per interface, Up to 16 virtual channels per interface	12 DPHY1.1 x 4 lanes Up to 4 cameras Max BW 6Gb/s per interface	12 DPHY 1.1 lanes Up to 6 cameras Max BW 6Gb/s per camera
		SLVS, LVDS: 11 x4 SLVS or LVDS cameras interfaces	NA	NA
		SLVS-EC: 4 lane, 5Gb/s /lane	NA	NA
5	Display Interface	DP1.2 x 2 lane	2x HDMI 2.0, DP 1.2, eDP 1.2, 2x MIPI DSI x2 lanes (1.5Gb/s /lane)	2x HDMI 2.0, DP 1.2, eDP 1.2, 2x MIPI DSI
		Additional HDMI 2.0 (GTs), DisplayPort 1.4 (GTs) with Soft IPs, MIPI DSI x4 lane (2.5Gb/s /lane) w/ Soft IPs	NA	NA
6	Video Encode H.264/H.265	Up to 32 simultaneous streams, Max resolution 4K @60FPS Color format: 422 8/10 bpc and 420 8/10bpc	Up to 9 streams; Max resolution 4K @30 FPS 420 8bpc	Up to 8 streams H.265, 14 streams of H.264, Max resolution 4K @60FPS 420 8bpc
7	Video Decode H.264/H.265	Up to 32 simultaneous streams, Max resolution 4K @60FPS Color format: 422 8/10bpc and 420 8/10bpc	Up to 9 streams; Max resolution 4K @60 FPS 420 8bpc	Up to 32 streams H.265, 16 streams of H.264, Max resolution 4K @60FPS 420 8bpc

Table 1: K26 SOM vs. Nvidia Jetson Features Comparison (Cont'd)

No.	Feature	Xilinx's K26 SOM	Nvidia Jetson Nano ⁽¹⁾	Nvidia Jetson TX2 ⁽¹⁾
8	Wireless	GTR M.2/SATA	M.2 Key-E site on carrier	802.11a/b/g/n/ac 2x2 867Mb/s Bluetooth 4.1 BCM4354 on module
9	Ethernet	4x 10/100/1000 Base-T Ethernet Additional Ethernet ports with Soft IP in HP I/Os	10/100/1000 Base-T Ethernet	10/100/1000 Base-T Ethernet
10	USB	2xUSB3.0, 2x USB2.0	4x USB 3.0 + Micro-USB 2.0	USB 3.0 + USB 2.0
11	PCIe®	PCIe Gen2 x 4 PCIe Gen3 x4 in with Soft IP on GTs	PCIe Gen2 x4 lanes	PCIe Gen2 x5 lanes
12	High-speed I/O (GTs) Provides Additional Interface Support	4x GTH transceivers in programmable logic can be configured to support a plethora of high-speed protocols such as SLVS - EC, PCIe Gen 3, HDMI, 10GE and many more	NA	NA
13	I/O Flexibility	69 3.3V I/Os, 116 1.8V I/Os allows users to create highly flexible and configurable I/O interfaces in programmable logic	NA	NA
14	Programmable Logic	256K System Logic Cells, 1248 DSPs, 26.6Mb on-chip memory allows users to implement custom accelerators for vision and ML functions	NA	NA
15	DRAM	4GB 64-bit DDR4	4GB 64-bit DDR4	8GB 128-bit LPDDR4?
16	eMMC	16GB	16GB	32GB
17	Flash	512MB QSPI	NA	NA
18	Socket Carrier Card Interface	Two 240-pin connectors	260-pin edge connector	400-pin board-to-board connector

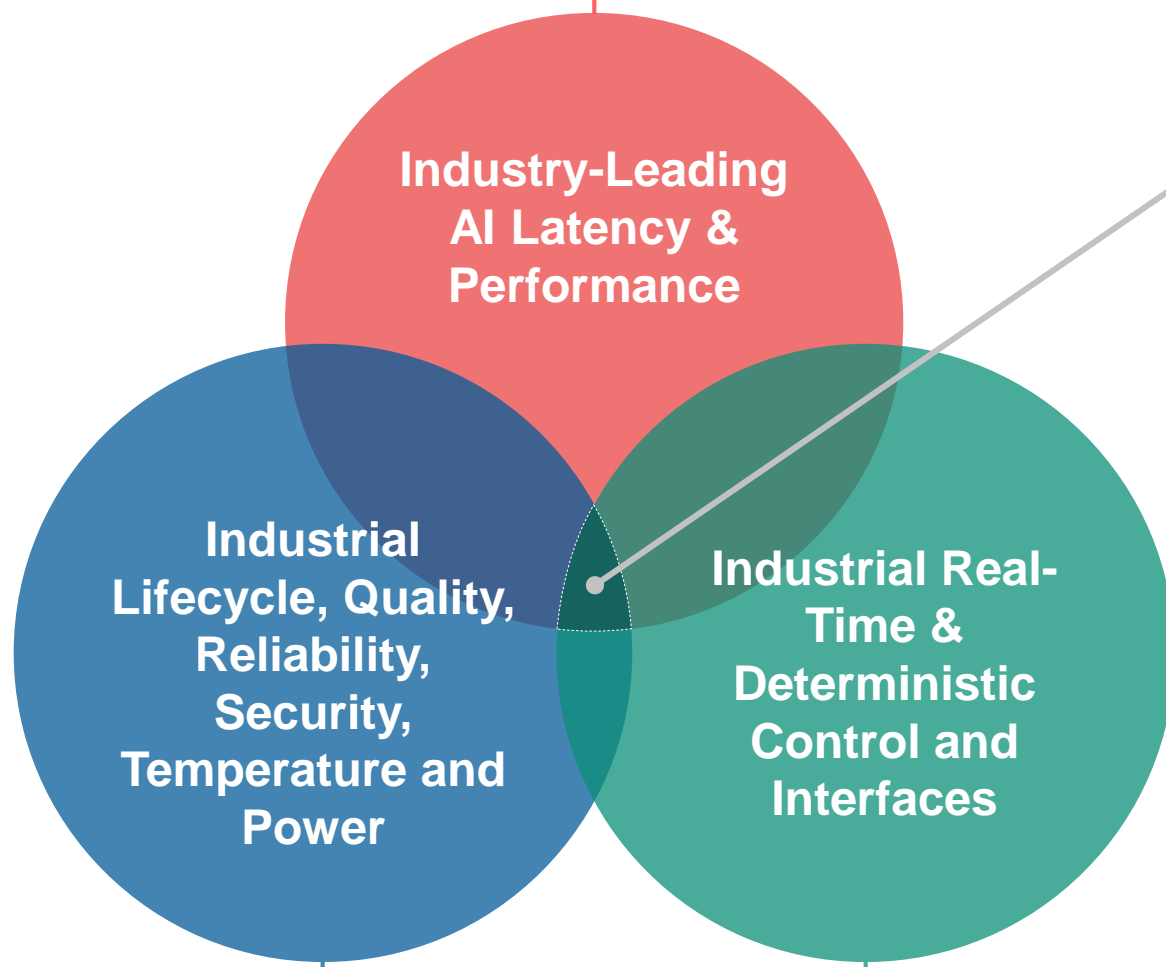
Table 2: Deep Learning Models Performance Comparison

No.	Model	Image Size	Xilinx K26 B3136 DPU		Xilinx K26 B4096 DPU		Nvidia Jetson Nano		Nvidia Jetson TX2	
			FPS (Latency Optimized) ⁽¹⁾	FPS (Throughput Optimized) ⁽²⁾	FPS (Latency Optimized)	FPS (Throughput Optimized)	FPS (Latency Optimized)	FPS (Throughput Optimized)	FPS (Latency Optimized)	FPS (Throughput Optimized)
1	Inception V4	299x299	19	19.1	30.3	30.4	11	13	24	32
2	VGG-19	224x224	17.9	17.9	17.4	17.4	10	12	23	29
3	Tiny Yolo V3	416x416	88.2	92.6	148.0	161.3	48	49	107	112
4	ResNet-50	224x224	49	49.1	75.6	75.9	37	47	84	112
5	SSD Mobilenet-V1	300x300	129.6	133.4	192.1	200.4	43	48	92	109
6	SSD ResNet34	1200x1200	1.6	1.6	2.5	2.5	1	1	3	2

https://www.xilinx.com/support/documentation/white_papers/wp529-som-benchmarks.pdf

Почему Xilinx для машинного зрения?

Xilinx strength for AI Inference deployment



Traditional Xilinx Strengths in Industrial

ONLY XILINX



Спасибо за внимание!

Компания Avnet Silica:

- ✓ **Официальный партнер Xilinx**
- ✓ **Комплексная поставка электронных компонентов**
- ✓ **Техническая поддержка по всем вопросам применения продукции и ПО Xilinx**

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- ✓ **Alexander.Vlasov@Avnet.eu**

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