Xilinx Adapt 2021: Data Center, 5G and Core Vertical Markets News

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Aerospace & Defense

Industry's First 7nm Radiation Tolerant Adaptive SoC for Space 2.0 Applications

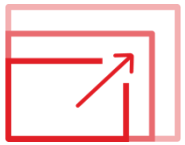
Space Industry Market Challenges & Requirements

- Downlink bandwidth is limited
- Fast time-to-market
  - Platform concept for reuse on multiple missions

- Low latency and high bandwidth
  - Seamless and reliable connectivity for broadband communications

- Machine learning in orbit
  - Object Detection
  - Image Classification

- Need capability to process on board a satellite vs ground station
  - Reduce development time to launch (2-3 years vs. 5-6 years)
  - Process hundreds of Gbps data streams in real time



- Flexible system architecture
  - Change algorithms “on the fly”
- Reliable components for long mission life, extreme environments
- SWaP (Size, Weight and Power) Tradeoffs

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Target Markets and Applications

for Space 2.0

Communications Constellations

- Broadband Internet
- High Speed Networks

Earth Observation Payloads

- Hyperspectral Cameras
- Synthetic Aperture Radar

Navigation/ Technology

- GPS
- Entry/Descent/ Landing
- Instruments
- Avionics

Signal Processing, HW/SW Reconfigurable, Robust Package, Space Grade Tested, On Orbit Flexibility

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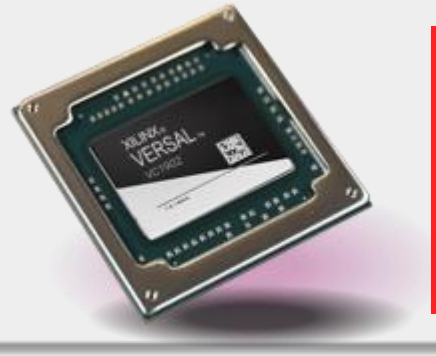
Introducing XQR Versal for Space 2.0 Applications



7nm Adaptable SoC for Space Applications

- AI Core and AI Edge family members with Scalar, Intelligent and Adaptable Engines (ARM CPUs, AI Engines & Prog. Logic)
- Innovative silicon design for SEU mitigation
- True on-orbit reconfiguration with unlimited programming cycles

XILINX VERSAL™

Ruggedized Organic Packaging

- AI Core 45mm x 45mm, AI Edge TBD
- Lidless with stiffener ring for added thermal mitigation capabilities
- Footprint compatible with commercial packages

MIL-PRF-38535

Production Space Test Flow

- Xilinx B-Flow for Organic Substrates (QML Q Equivalent)
- Designed for Space 2.0 Applications

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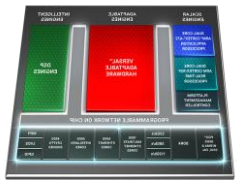
Xilinx Space Grade Solutions

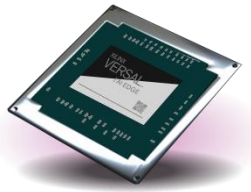
XQR Versal for Space 2.0



AI-Core
XQRVC1902

400 AIE, ~2K DSP58
PCIe, MRMAC, GTY

AI-Edge
XQRVE*



AIE-ML, DSP58s
SWaP Optimized

- Machine Learning
- Processor System
- High Density
- Internal Scrubber
- Ruggedized
- 5-7 Year Missions
- Xilinx Class B

Virtex
XQR4QV

Shipping
Xilinx Class V

Virtex
XQR5QV

Shipping
Xilinx Class B, Class V

Kintex
UltraScale
XQRKU060

Shipping
Xilinx Class B, Class Y
QML Class Y 2021-22
(Covid delayed)

90nm **65nm** **20nm** **7nm**

First 7nm Programmable Device for Space Applications

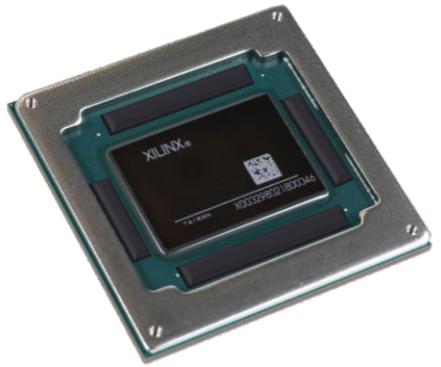
Industry Leading Compute Performance for On-board Data Processing!

* Under evaluation

XQR Versal for Space 2.0 Portfolio

		AI Core	AI Edge
		XQRVC1902-1MSBVSRA2197	**XQRVE***
Intelligent Engines	AI Engines	400 (AIE)	12 - 34 (AIE-ML)
	AI Engine Data Memory (Mb)	100	6 – 17
	AI-ML Shared Memory (Mb)	-	48 – 68
	DSP Engines	1,968	176 – 464
Adaptable Engines	System Logic Cells (K)	1,968	80 – 329
	LUTs	899,840	36,608 - 150,272
	NoC Master/Slave Ports	28	2 – 5
	Distributed RAM (Mb)	27	1.1 - 4.6
Memory	Total Block RAM (Mb)	34	1.7 - 5.4
	UltraRAM (Mb)	130	13.2 - 43.6
	Accelerator RAM (Mb)	0	32
	Total SRAM Capacity (Mb)	164	48 - 85.6
	DDR Memory Controllers	4	1
	DDR Bus Width	256	64
Scalar Engines	Application Processing Unit	Dual-core Arm Cortex-A72, 48KB/32KB L1$ w/ECC 1 MB L2$ w/ECC	
	Real-time Processing Unit	Dual-core Arm Cortex-R5, 32KB/32KB L1$ and 256KB TCM w/ECC	
	Memory	256KB On-Chip Memory w/ECC	
	Connectivity	Ethernet (x2); UART (x2); CAN-FD (x2) USB 2.0 (x1); SPI (x2); I2C (x2)	
	Platform Management Controller	Boot, Security, Safety, Monitoring, High-Speed Debug	
Serial XCVRs	GTY Transceivers (32.75Gb/s)	44	0 – 8
Integrated Protocol IP	CCIX & PCIe w/DMA (CPM)	1 x Gen4x16, CCIX	-
	PCI Express	4 x Gen4x8	0 - 1 x Gen4x8
	Multi-rate Ethernet MAC	4	0 – 1
Package	Ruggedized Organic BGA	VSRA2197, 45mm x 45mm, 0.92mm pitch	SSRA484/784, 19/23mm x 19/23mm, 0.8mm pitch
IO		648 XPIO, 44 HDIO, 78 MIO, 44 GTY	114-216 XPIO, 0-22 HDIO, 78 MIO, 0-8 GTY

* Under evaluation



Device Availability

- XQR AI Core - 3Q2022
- XQR AI Edge - 2Q2024

XQR Versal Product Tables

Start designing today

- Use XC equivalent device
- Migrate to XQR

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Payload Use Case

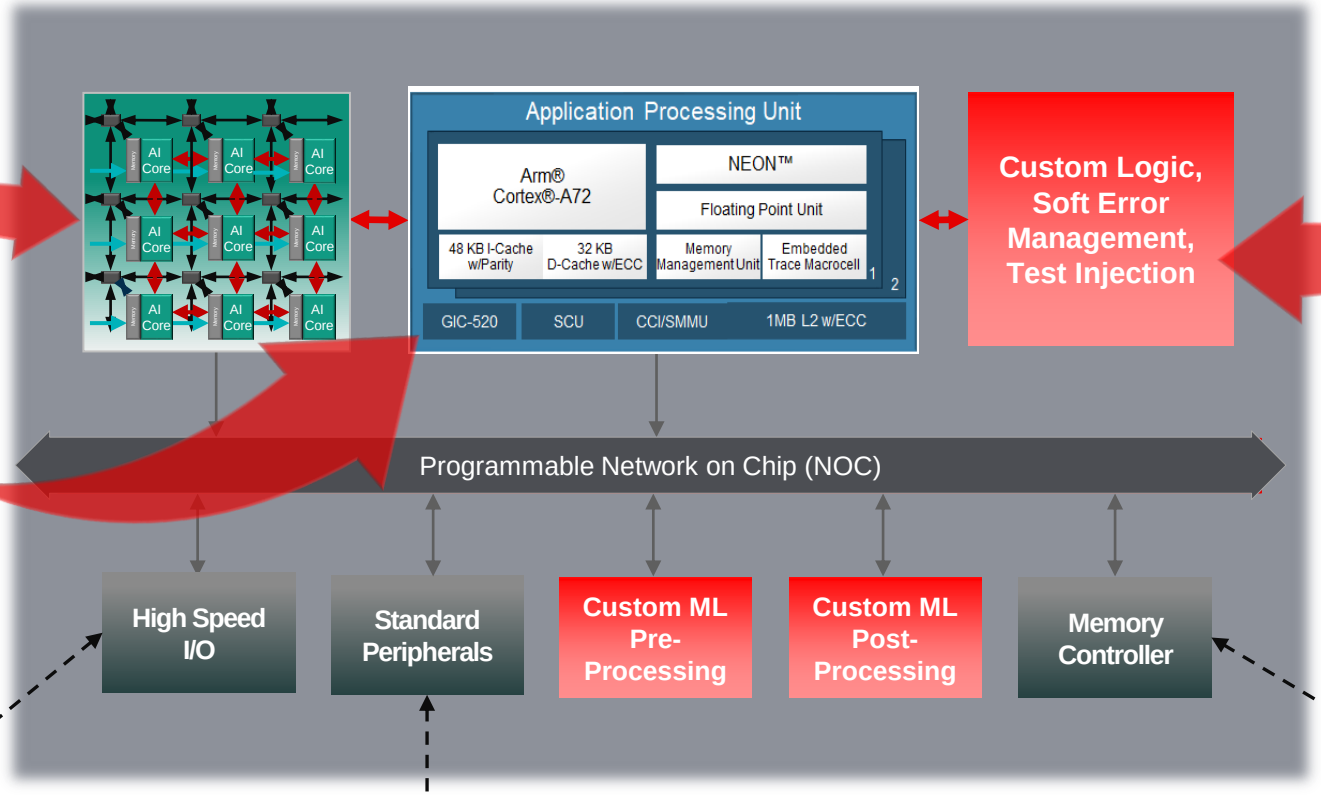
ML/AI DPU Convolutional Neural Network Platform

AIE
DPU

Custom Logic

ARM A72
Host Controller

FAT Model
Weights & Activations,
Data Buffers, Host OS



Sensors

Boot, Networking, UART, GPIO, Debug, etc.

DDR4

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Key Takeaways

- Industry’s first 7nm Radiation Tolerant Adaptive SoC targeted for broadband and constellation satellite applications
- True unlimited on-orbit reconfiguration to enable “upgrade-on-the-fly” capability
- Complete solution to “process and analyze” for real-time on-board processing needs including machine learning and artificial intelligence

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Aerospace & Defense

Defense-Grade XQ Ruggedized Versal Portfolio

Aerospace & Defense Industry System Challenges

High-availability in harsh environments

- Exposure to temperature extremes, moisture, dirt, shock vibration, radiation

Long product life cycle

- Supporting systems for 20+ years lifecycle requirements
- Obsolescence management
- Ensuring supply chain resilience against counterfeit devices deployment

Rigorous qualification requirements

- MIL-STD Reliability, hardware & embedded software qualifications
- Security certifications (agencies, military specific, EAL, etc.)
- Safety certifications (DO-254, DO-178, etc.)

Support Mission Critical Applications, Protection of Design and IP

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Xilinx Defense-Grade (XQ) Versal – Key Features

- Eutectic Sn / Pb (Tin / Lead) BGA
- Ruggedized Packaging
- Full Mitigation of Tin Whiskering (Sn / Pb ++)
- Extended Temperature Range & Full Range Tested
- Mil-Std 883 Group D Characterization
- Anti-counterfeiting Protections
- Mask Set Control
- Long Term Availability

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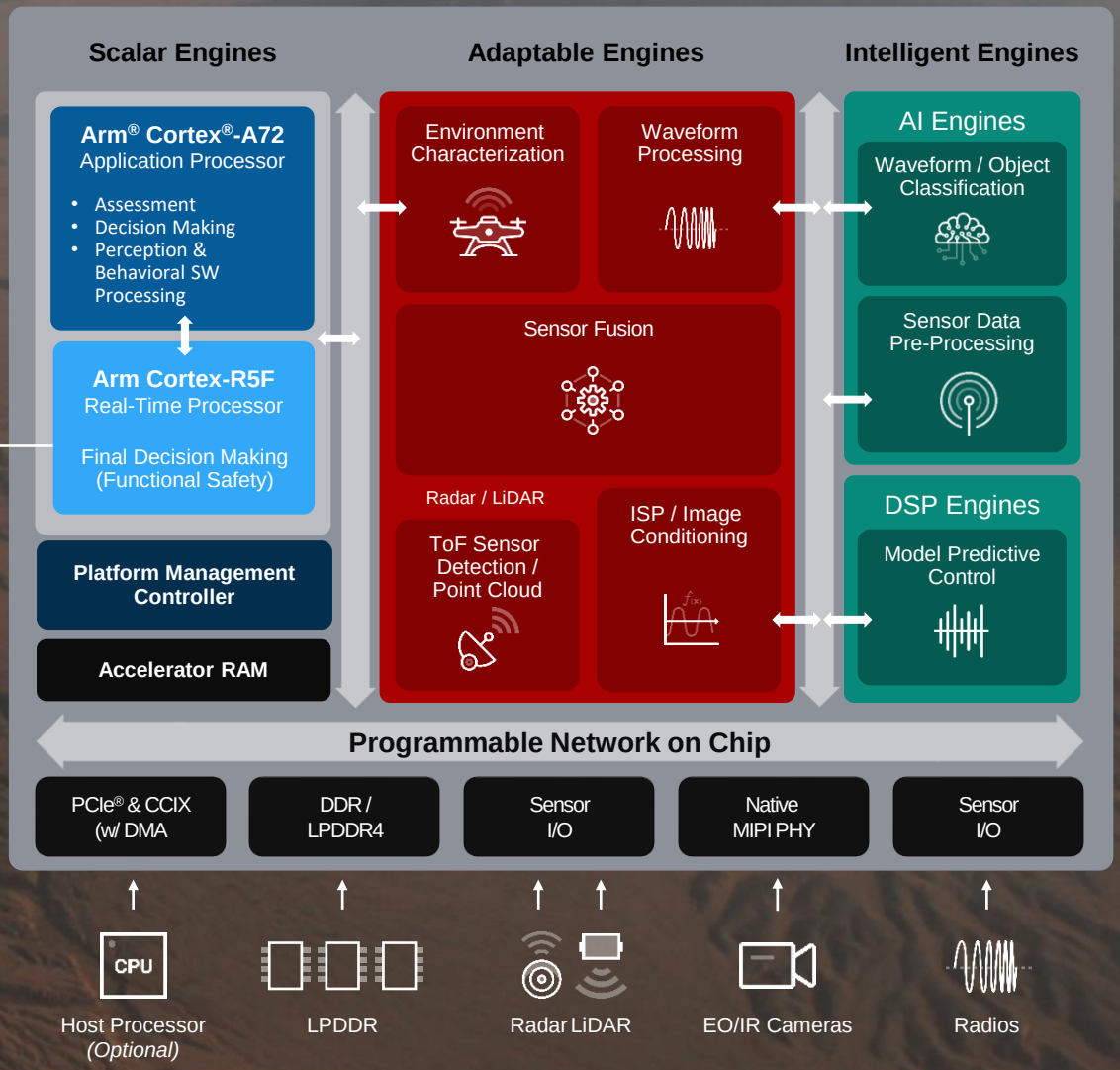
Defense-Grade XQ Versal AI Edge for Unmanned Systems

Multi-Mission and Situationally Aware Unmanned Systems with Low SWaP

- Adaptable Engines for sensor fusion and pre-processing
- Intelligent Engines for low power, low latency AI and signal conditioning
- Scalar Engines for command and control
- Ruggedized Defense-grade parts (XQ)



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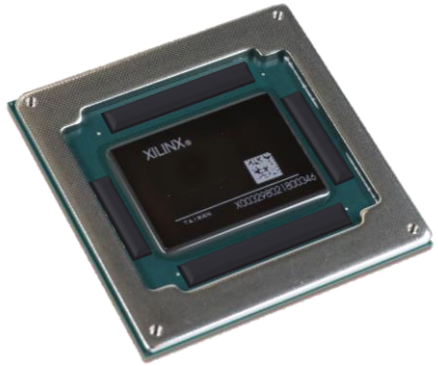
XQ Versal Ruggedized Portfolio

Product	XQ Versal Edge		XQ Versal AI Core			XQ Versal Prime				XQ Versal Premium			
Device	VE2102	VE2302	VC1352	VC1702	VC1902	VM1102	VM1402	VM1502	VM1802	VP1202	VP1402	*VP1502*	*VP1702*
XQ Package Footprint	SBRA484, SSRA784	SSRA784	NBRA1024, NSRE1369	NSRG1369, VSRA1596, VSRA2197	VIRA1596, VSRD1760, VSRA2197	SSRA784	NSRB1369, VSRD1760, VSRC1596	VSRA2197	VSRD1760, VSRA2197	VSRC2197, *VSRA2785*	VSRF1760, VSRA2785	*VSRA2785, VSRA3340*	VSRA3340
Speed-Temperature	1LSI, -1MSI, -2MSI, -1MSM											-1LSI, -1MSI, -2MSI	



- 1st Devices Availability: 1Q2022
  - XQ AI Core device (XQVC1902)
  - XQ Prime device (XQVM1802)
- XQ Versal Product Tables
- Start designs today
  - Use XC equivalent device-footprint
  - Migrate to XQ from compatible XC

- Select speed-temp-voltage options available in XQ
- M-temp (-55C to +125C) available in most devices -1MSM grade

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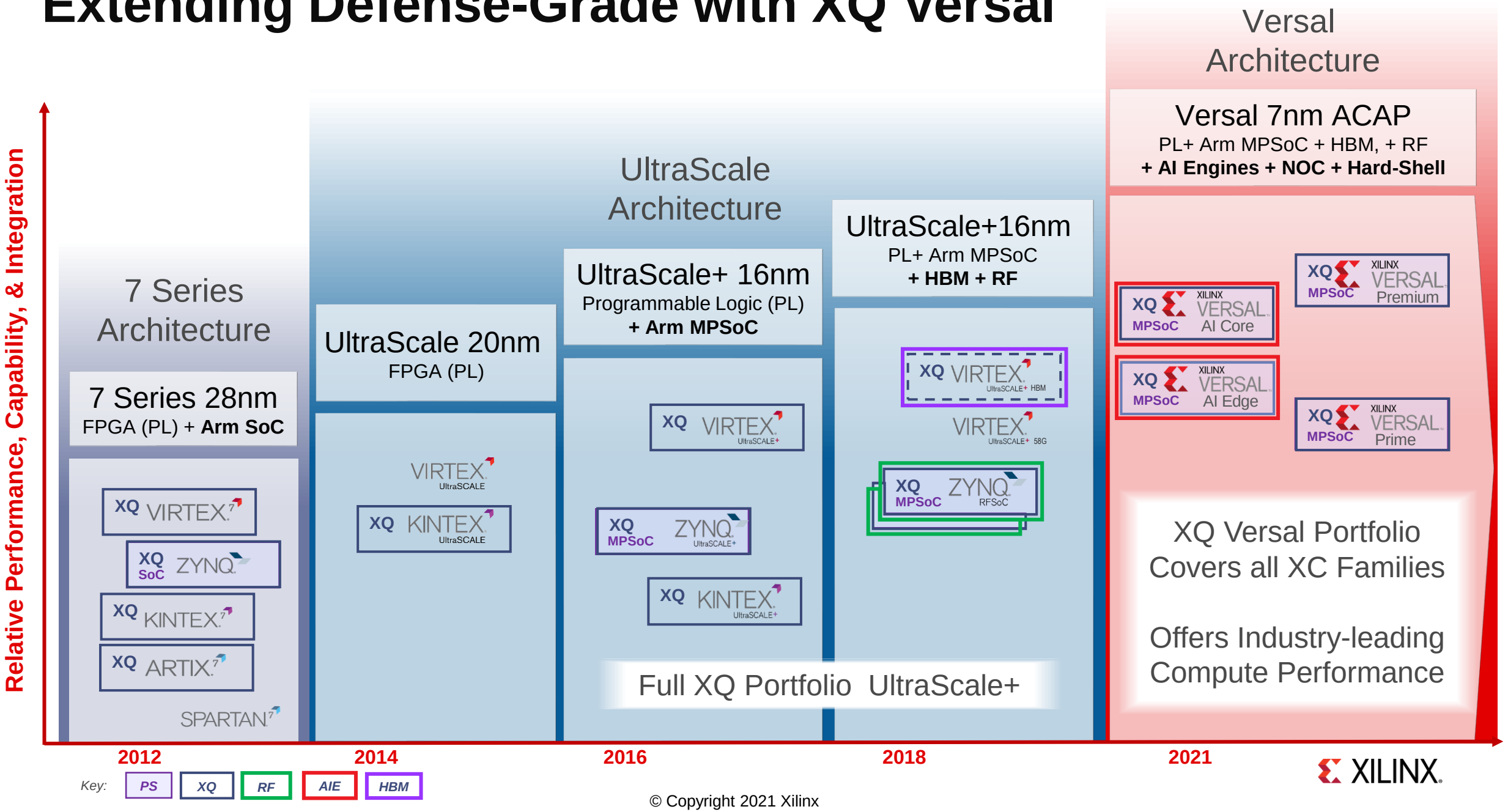
Extending Defense-Grade with XQ Versal



Key Takeaways

- Extending 30+ years of Xilinx heritage & commitment to aerospace & defense industry, extending XQ families with the addition of XQ Versal Portfolio
- Industry's most advanced defense-grade product: XQ Versal ACAP built on 7nm technology, offered in ruggedized package, with extended qualifications
- Enabling industry-leading AI/ML and compute capability with XQ Versal ACAP in the harshest aerospace & defense application environments
- Available military temp range (-55°C to +125°C), for full XQ Versal ACAP, including advanced processor system, programmable logic, and adaptable compute engines

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Automotive

New Automotive LiDAR Research From Xilinx and Strategy Analytics

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New Global LiDAR Forecast

Xilinx Value Proposition in LiDAR

Flexibility

- Hardware re-programmability for adaptable algorithm implementations over time, over-the-air updates (OTA HW), and fast time-to-market.
- Heterogeneous compute domains (the right engine for the right job) for raw data processing, point cloud generation, and CNN.

Parallel Processing

- Xilinx programmable logic (PL) offers parallel processing of multiple data paths simultaneously and independently. This capability enables true hardware (HW)-based processing pipelines for multiple lidar receive (RX) channels. Parallel HW processing reduces the need for clock speed, thus, reducing power.

Customizable Deep Learning Processor Unit (DPU)

- Configurable computation engine dedicated to point cloud data processing – specifically object detection and segmentation.
- Adaptable for both 2D & 3D point cloud data processing.
- Helps our customers to future-proof their next-gen lidar systems with object detection & segmentation capabilities.

We are the Leading Silicon Supplier in the LiDAR Market

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Top Customer Collaborations

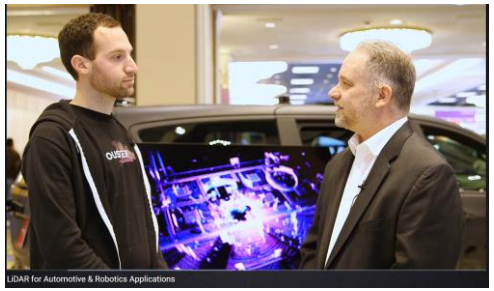
Velodyne LiDAR

Xilinx field programmable gate arrays (FPGA) and adaptive system-on-chips (SoC) are used in Velodyne's LiDAR sensors for image processing. Xilinx technology allows for flexible programming while providing scalable processing performance for complex sensory data. Our multi-processor system-on-a-chip (MPSoC) devices, which we're providing to Velodyne, combine CPU processing power with the flexibility of field-programmability, which means the devices can be reprogrammed as the design evolves. One device can be used for multiple "flavors" of Velodyne lidar, including future generations of product.

Image credit: Xilinx

OUSTER™

Fixed-function silicon cannot match the flexibility and adaptability of the Xilinx programmable logic, advanced DSP, and connectivity options. The adaptability of our silicon allows us to keep pace with Ouster's evolving requirements without forcing them to redesign their entire architecture. We've also got a long-standing heritage in functional safety, which means customers like Ouster have the assurance that our automotive-qualified products provide them with the reliability they, and their customers, require.



Video credit: Xilinx

Xilinx Value Proposition:

- Low latency point cloud data transmission
- High-speed connectivity and data transmission via GTH transceivers
- Advanced DSP capabilities produce rich point cloud images

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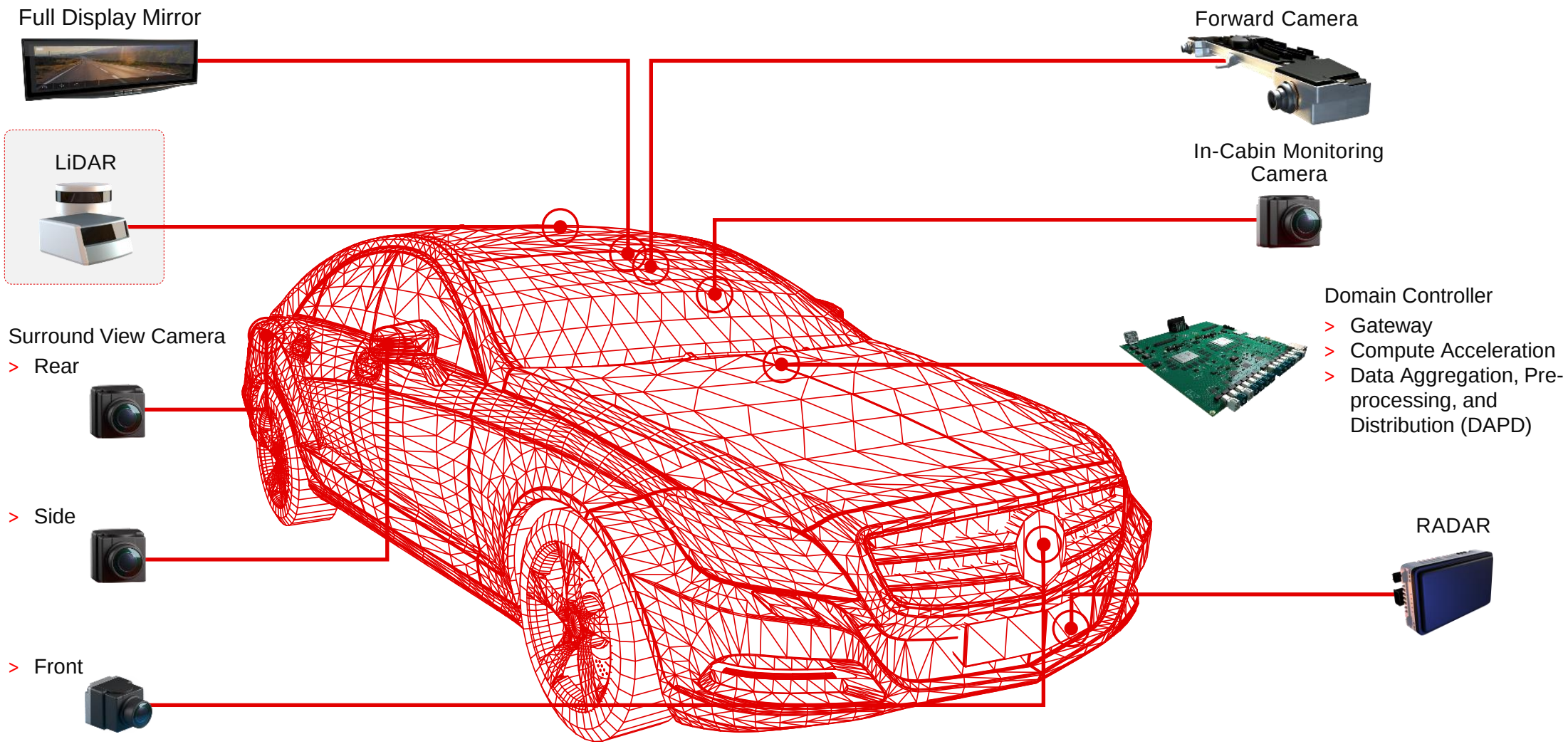
Xilinx Automotive ADAS & AD Focus Areas



Note: Not representing actual vehicle architecture;
Sensors are for illustrative purposes

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Data Center

Microsoft Azure Synapse Analytics Powered by Alveo Acceleration

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Azure Synapse Accelerates Big Data Analytics with Alveo

- 90% of Synapse Apache Spark workloads are CSV/JSON/Parquet. Xilinx Alveo U250 accelerators address one of the most common problems associated with Spark workloads: CSV/JSON parsing performance
- Xilinx accelerators deliver **40x performance improvements for Synapse Apache Spark** instances
- Azure Synapse now leverages Azure NP-VM FPGA-a-a-Service, powered by Xilinx Alveo, for Spark query acceleration
- Result: >40x increase in CSV/JSON Spark performance
  - CPU CSV parser per core(Ev3 series): 15MB/sec
  - FPGA CSV parser raw performance: 6.1 - 7.7 GB/sec

Microsoft

Data Center

Xilinx Video Transcoding SDK

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Xilinx Video Transcoding SDK

U30: Industry-best performance

- 2x Density
- 50% lower power
- 50% lower cost

Video SDK: Ready To Stream

- Full SDK: Tutorials, docs, examples, broad media framework support
- Production hardened and ready to deploy
- Faster time to market

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Industrial and Healthcare

Kria robotics stack

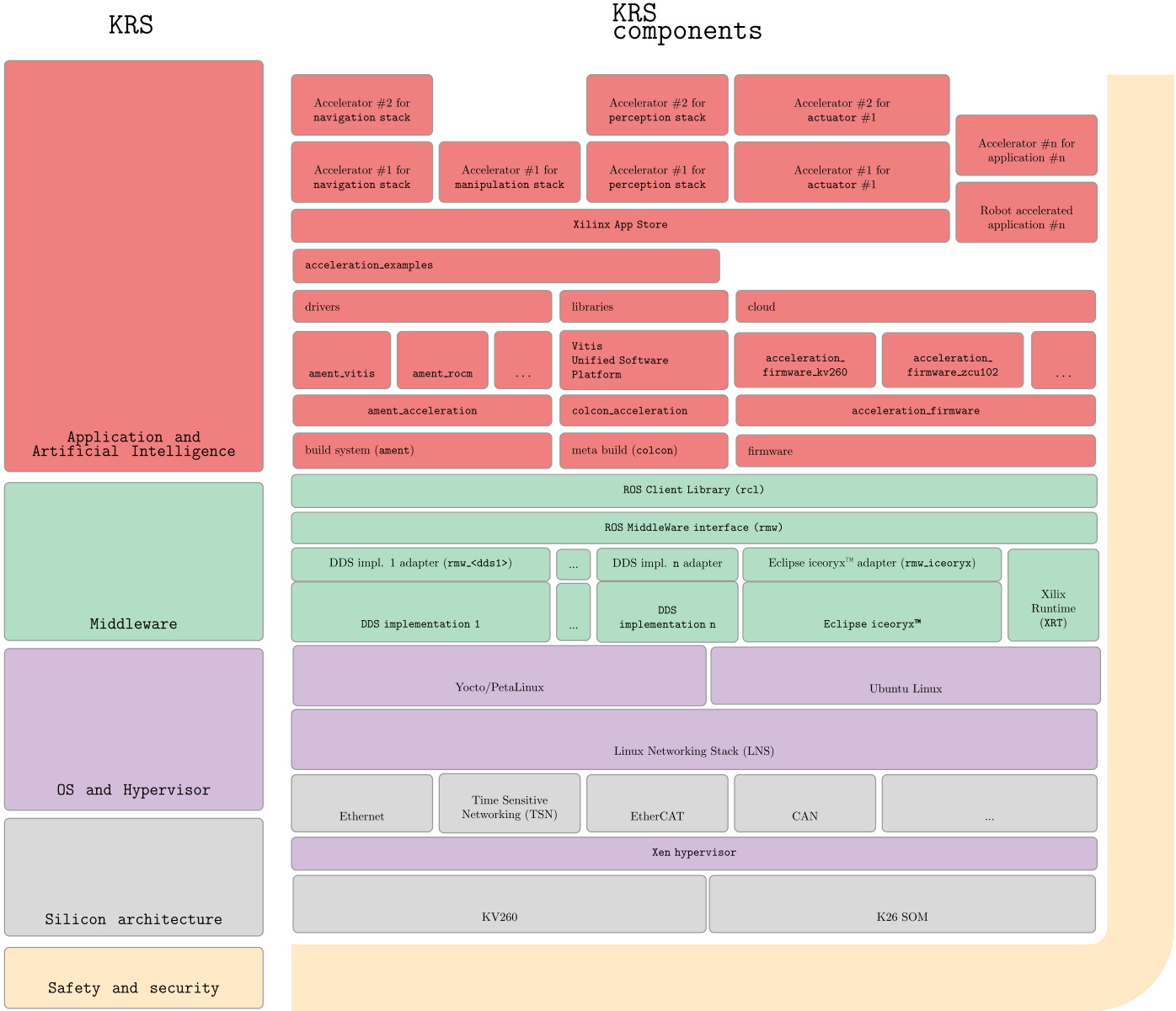
Bringing ROS 2 down to silicon

The **Kria robotics stack (KRS)** is ***a complete integrated set of robot components and utilities, built around ROS 2 and set to accelerate the development, certification and maintenance of industrial-grade robotic solutions***

Empowering Hardware Acceleration and next-gen “robot chips”

ROS

GAZEBO



Xilinx is Adopting ROS 2 and Gazebo as its **Robotics SDK**

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KRS, a ROS 2 superset for industrial applications

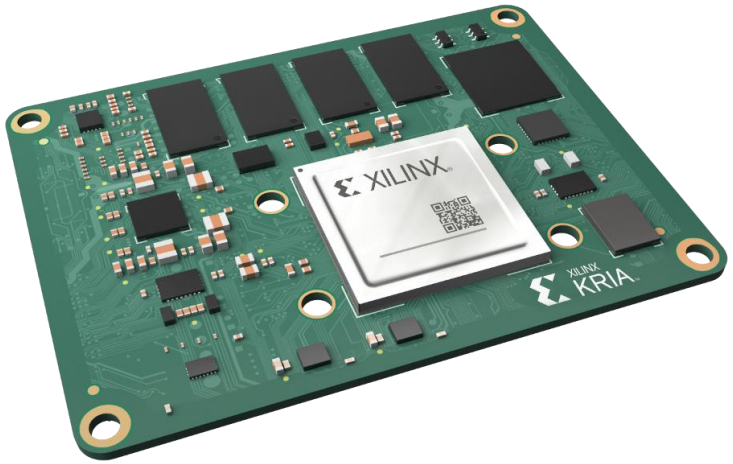
Build industrial-grade Accelerated Applications for Robots with ROS 2

ROS 2-centric experience

- ROS 2 and Gazebo focused Software Development Kit (SDK)
- Roboticists can leverage Xilinx tools easily through KRS to produce robot accelerated applications

Real-time ROS 2

- More deterministic ROS 2 behaviors
- Through KRS, roboticists can leverage adaptive computing to create custom compute architectures and obtain a more deterministic and reliable ROS 2 experience



Kria K26 System-On-Module (SOM)

Accelerated Apps for Robots

- A marketplace for ROS 2 packages
- Download accelerated and customized ROS 2 underlayers for improved real-time, throughput, low latency or cybersecurity

KRS Extends the Kria SOM Portfolio to Roboticists

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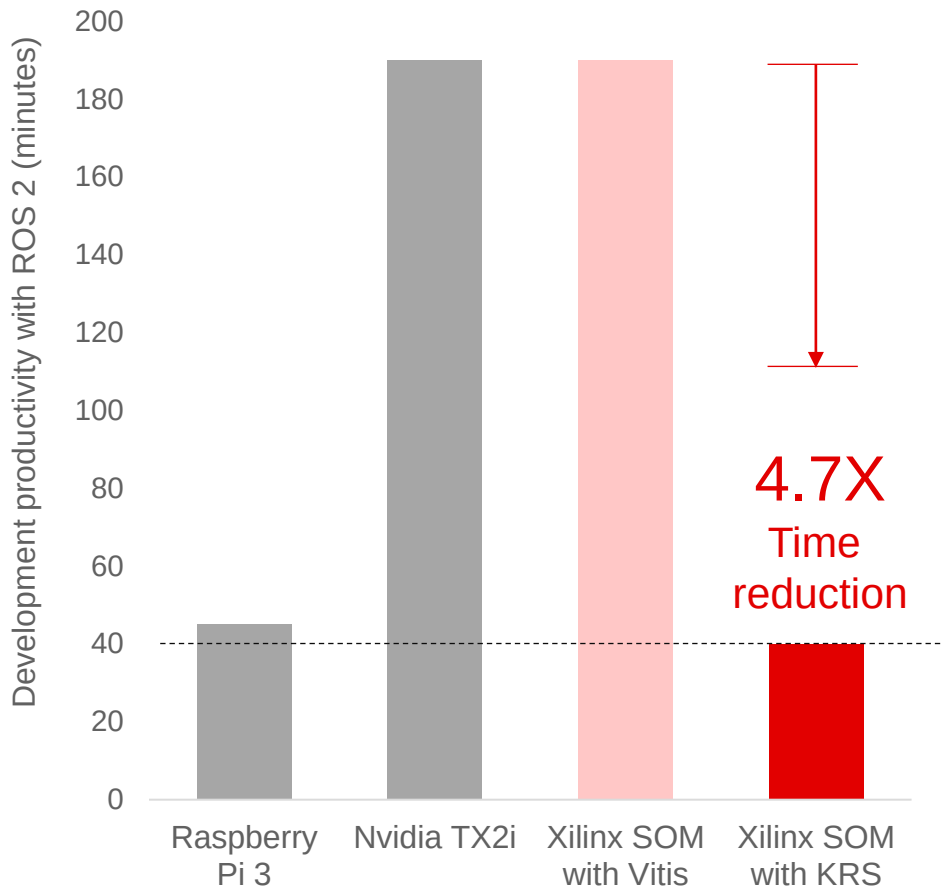
Performance & ROS 2 Dev. Productivity Advantages

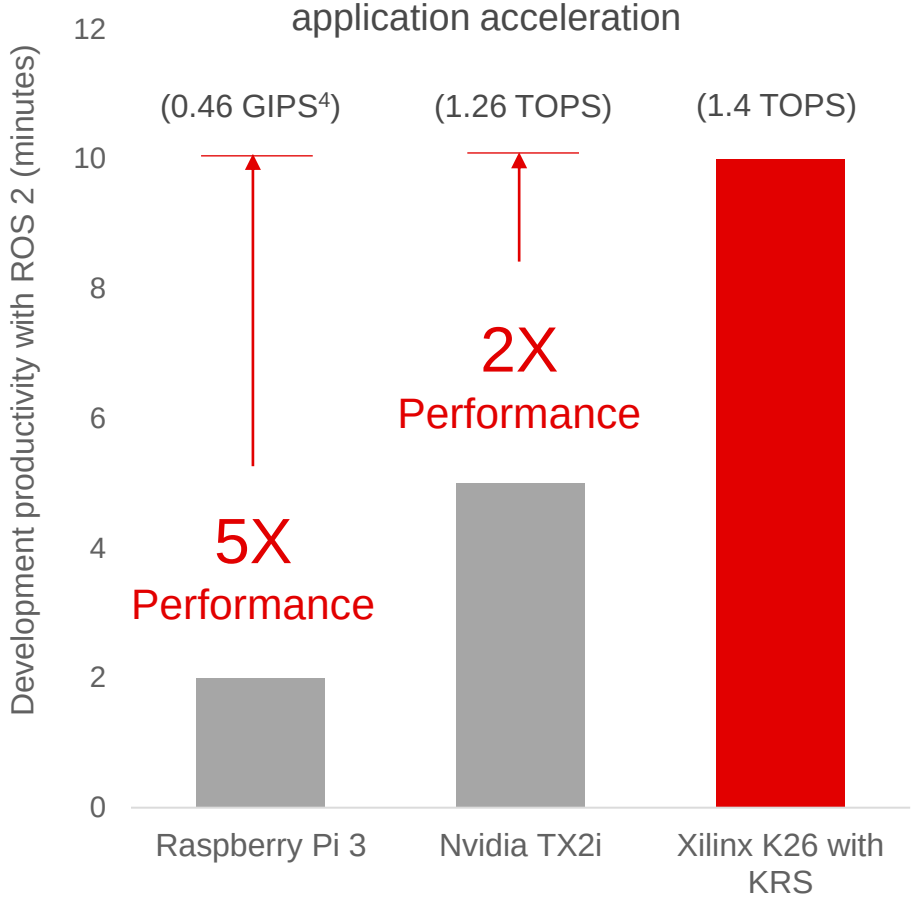
4.7X ROS 2 dev. productivity

when compared to NVIDIA CUDA[2] or Xilinx Vitis flows[1]



2X Performance[1]

A boost in performance when compared to Raspberry Pi and Nvidia TX2i[3] through whole application acceleration



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

2: 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.

3: ROS 2 Node running in the scalar CPUs.

4: https://magpi.raspberrypi.org/articles/raspberry-pi-4-specs-benchmarks

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Xilinx is Leading ROS 2 Acceleration with the *Hardware Acceleration Working Group (HAWG)*

- Announced in April, received strong interest, watch full meeting here (discussion).
- Xilinx contributed and open-sourced a reference architecture for acceleration
- Check out the acceleration ROS Enhancement Proposal (REP) to learn more
- Join us in the next HAWG meeting, happening September 29th.

KV260 is the official reference hardware platform of the HAWG

Collaborating with Industry to Make ROS 2 Faster and Real-Time

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Industrial and Healthcare

Vitis Libraries for Medical Ultrasound

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Xilinx a Leader Across Medical Modalities

Market Leader

Surgical Robots

Market Leader

Endoscopy

CT, MRI, PET Imaging

Radio Therapy

Market Leader

Ultrasound is #1 Application

Ultrasound

Fast Growing

3D Dental Imaging

Fast Growing

Patient Monitors

Ventilators and Pumps

Fast Growing

Smart Hospital Beds

Fast Growing

Defibrillators

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Supporting Demand in Markets Disrupted by COVID-19

Existing Applications

Hospital Equipment + Test Diagnostic

Patient Monitors

Ultrasound

Ventilators

CT Scanners

Lab / Chemistry

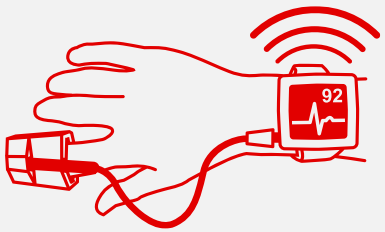
Endoscopy

Helping Accelerate New Technology Trends

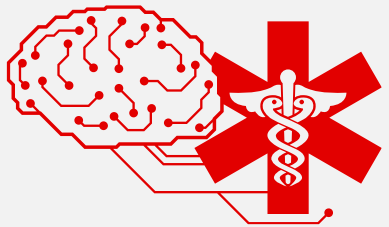
HcIoT - New and Emerging

Telemedicine /
TeleHealth

Point
of Care



Remote
Patient Monitoring



AI Applications
in Healthcare

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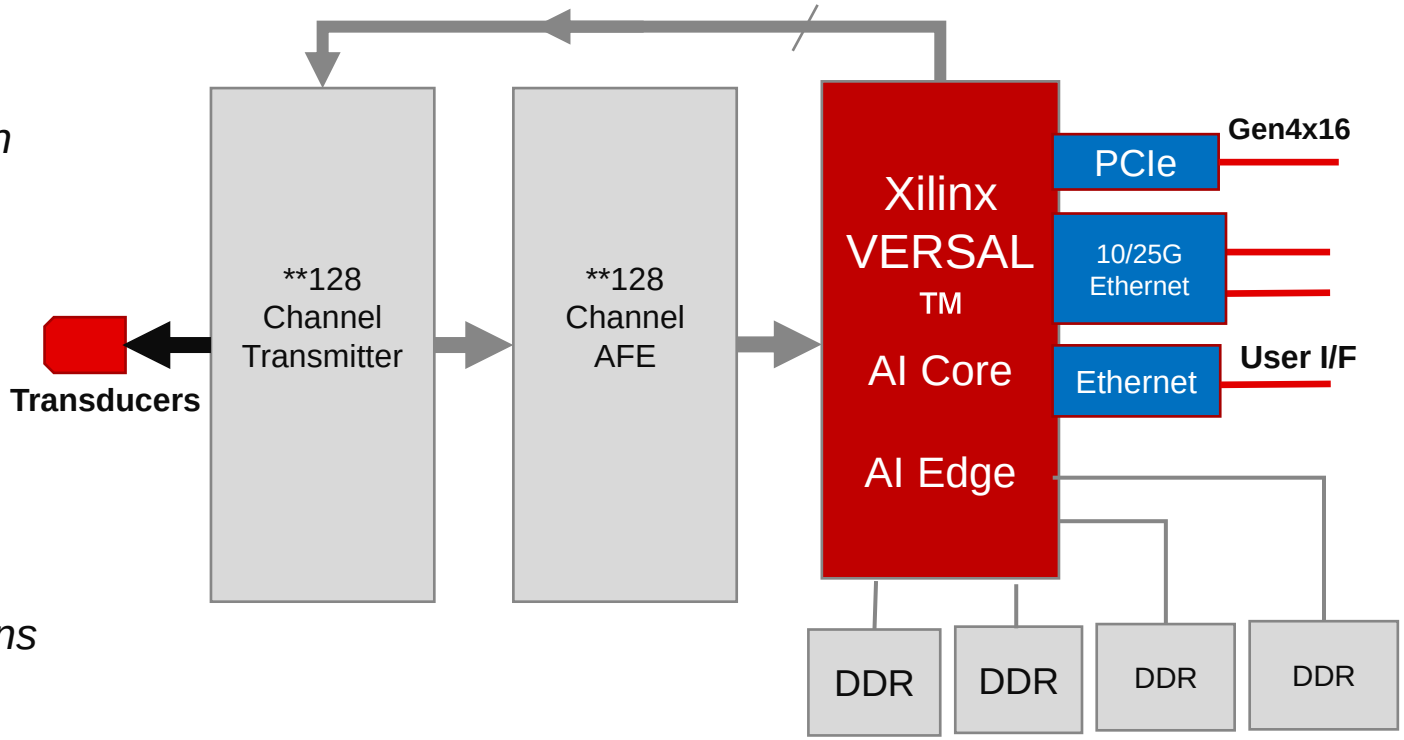
Xilinx Versal SoCs for Ultrafast Imaging in Ultrasound

- **'Ultrafast' Imaging** techniques in medical Ultrasound scanners can produce the
  - *Best image quality, accuracy, coverage depth*
- A single **Xilinx Versal™ SoC** can enable 'UltraFast' Imaging in an Ultra-Premium Medical Ultrasound Scanner
- Xilinx expanding **Vitis** unified software platform to include libraries for 'UltraFast' imaging
  - *Fast development times and multiple iterations of algorithms for developers*
- Libraries optimized and targeted for the innovative **Versal AI engines**



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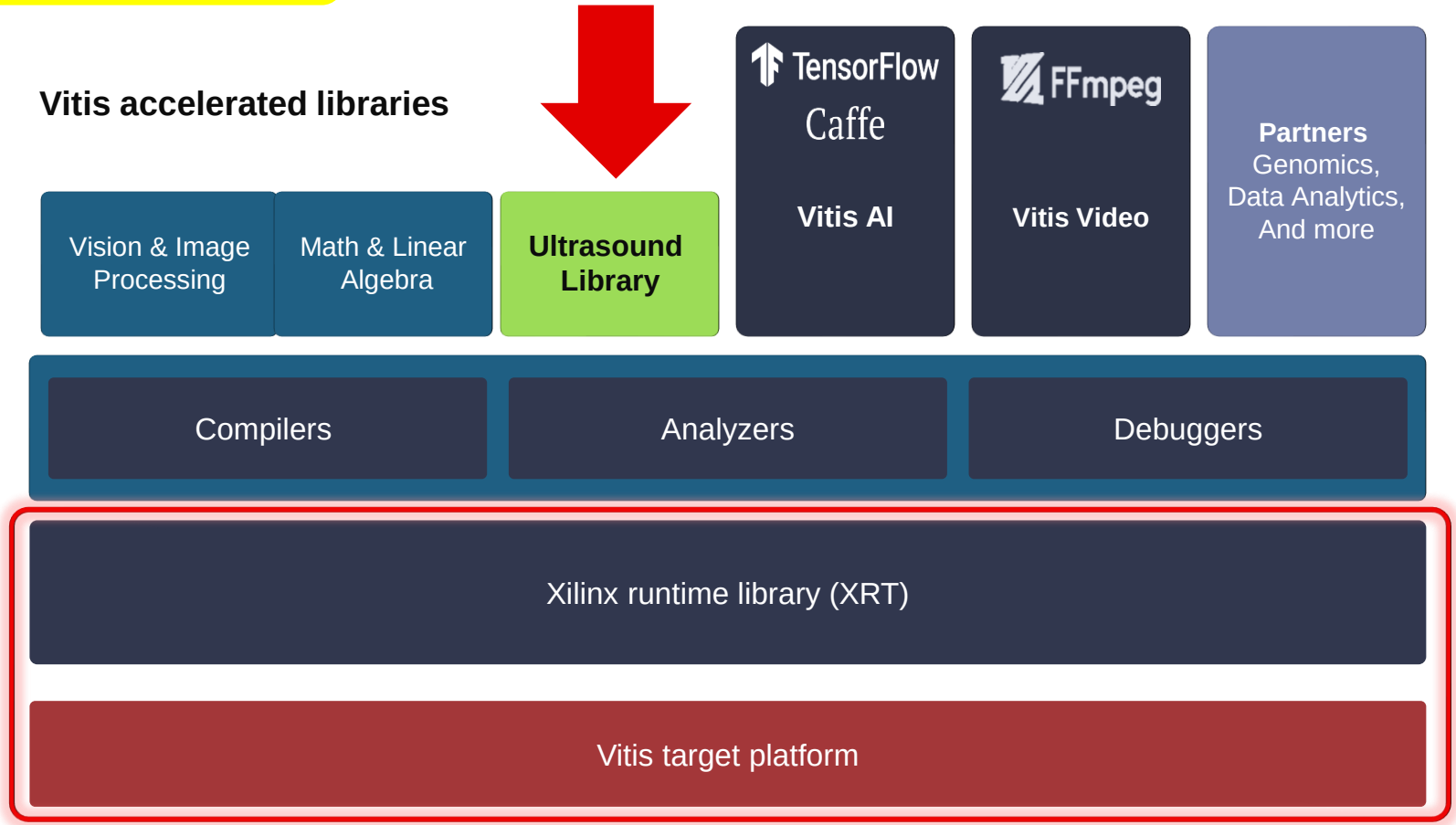
Integrated UltraFast Medical Ultrasound Libraries:
Productivity & Performance

****Early Access- End 2021****
**** Production – Mid 2022****

- Xilinx Vitis™ Unified Software Platform enables productivity

Vitis Ultrasound Libraries

- Domain-specific, open-source and performance-optimized libraries
- Enables rapid design for medical imaging scientists' Matlab code to Xilinx's Model-based design tool
- Develop using commonly-used high-level programming languages like C, C++, and Python



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Performance: UltraFast Ultrasonic Imaging

All Data: 64 Active Elements, 1 Beamformer, 200 Lines

* FPS – Frames per second

**Benchmarks shown above against RTX2070 running CUDA

Small Parts Ultrasound Imaging

	Versal VCK190	GPU-RTX 2070	PC i7
Linear Interpolation	1101 fps	~40 fps	~1 fps
Matched Filter or **Catmull-Rohm Spline Interpolation**	365 fps	~4 fps	~0.006 fps
Linear Interpolation (int16)	4406 fps	~100 fps	~1 fps
Matched Filter Interpolation (int16)	1461 fps	~15 fps	~0.006 fps

Abdominal Imaging

	Versal VCK190	GPU-RTX 2070	PC i7
Linear Interpolation	482 fps	~20 fps	~0.25 fps
Matched Filter **Catmull-Rohm Spline Interpolation**	160 fps	~1 fps	~0.0015 fps
Linear Interpolation (int16)	1920 fps	~90 fps	~0.25 fps
Matched Filter Interpolation (int16)	640 fps	~10 fps	~0.0015 fps

AI Engines on Versal Produced Benchmarks ~40 Times Faster Than CUDA Optimized GPUs

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Wired & Wireless Communications

Xilinx Shipping Zynq RFSoC DFE in Volume

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ZYNQ®
RFSoC DFE

Portfolio for Current and Future Market Needs

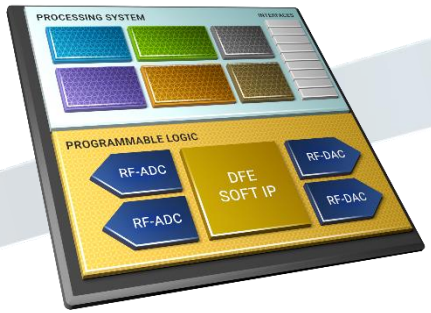
Performance

ZYNQ RFSoC

4GHz
of Analog Bandwidth

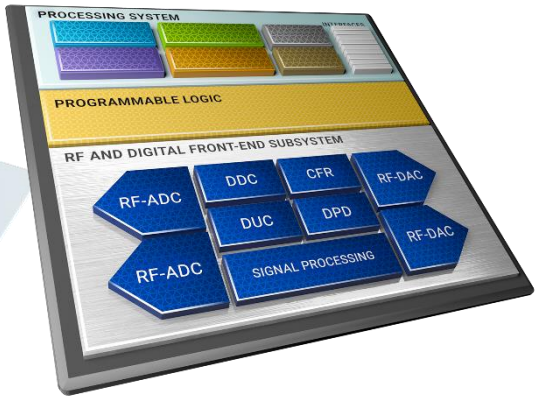
5GHz
of Analog Bandwidth

6GHz
of Analog Bandwidth



Zynq RFSoC
Gen3

7.125GHz
of Analog Bandwidth
w/Hardened DFE Subsystem



Meeting 5G NR Requirements Now and in the Future

- ✓ More processing per channel
- ✓ Greater instantaneous bandwidth
- ✓ More integration
- ✓ ½ the DC power for a given use case
- ✓ Cost-effective for high volume

2018 2019 2020 2021

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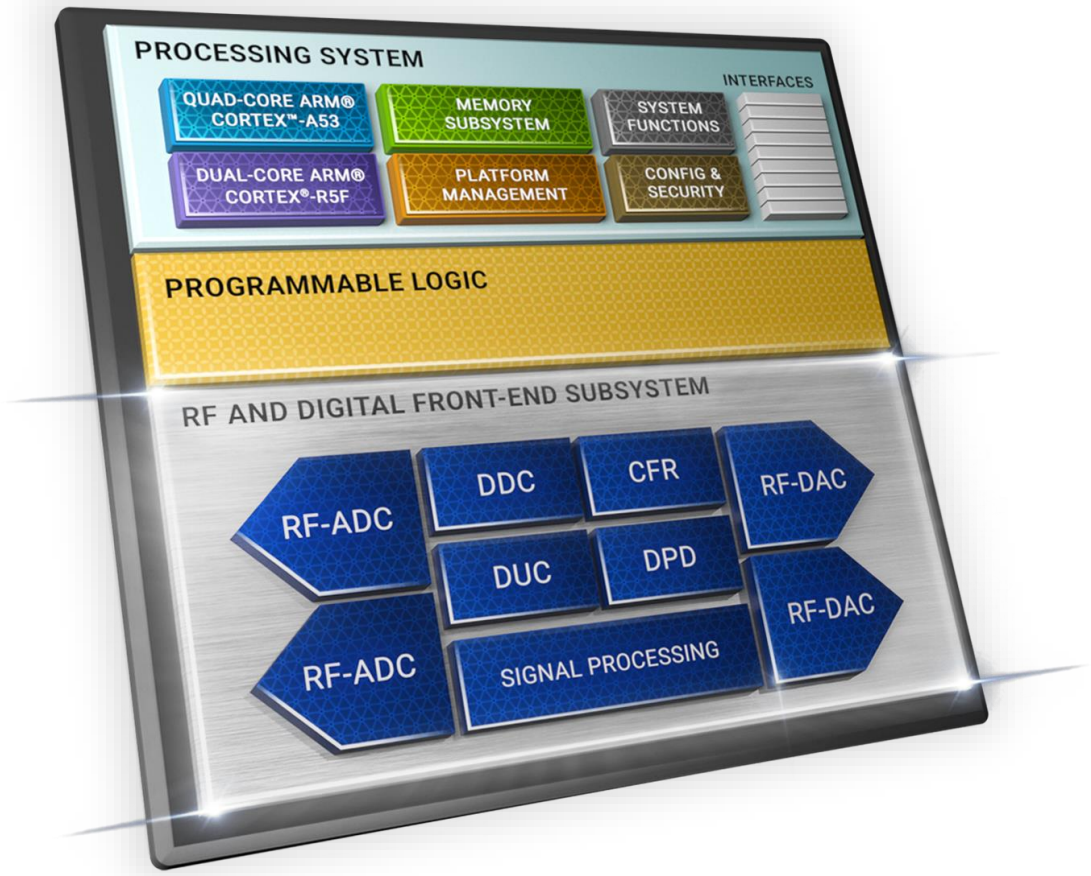
Zynq RFSoC DFE: Adaptive SoC with a Hardened Radio Subsystem



Adaptive SoC

Arm Processing System • UltraScale+ Programmable Logic • 32G SerDes

Hardened Radio Subsystem

Single-Chip 8T8R FDD/TDD

Direct-RF DACs/ADCs
7.125GHz Direct-RF Bandwidth

Digital Pre-Distortion (DPD)
Supports traditional & ultrawide band (400MHz) GaN PAs

Crest Factor Reduction (CFR)
Up to 400MHz of Instantaneous Bandwidth

DUC / DDC[1]
Multi-carrier, multiband support

Signal Processing IP
Re-Sampling, Equalizer

1: Digital Up-Conversion, Digital Down Conversion

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Thank You