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Figure 1: ACAP-VDF Reference Framework provides complete multi-camera to display Versal ACAP designs

Features

- Complete video design framework for embedded multi-camera vision applications
- Demonstrates a logicBRICKS IP Block Suite for simultaneous six video camera processing and includes hardware accelerated Sobel filtering and Lidar data visualization for the Ouster OS1 LIDAR[1]
- Enables vision developers to quickly add their own algorithms to the provided infrastructure
- Jump-starts development and saves valuable design time
- Includes licensed[2] Xylon logicBRICKS IP cores
- Intended for use with next generation Maxim Integrated GMSL2 high-speed serial interface
- Uses minimal logic resources to leave room for adding very complex vision functions (Table 1)

- Design fully compatible for use with Xylon's logiVID-ACAP-6CAM ACAP vision development kit, which is based on the AMD-Xilinx Versal VCK190 evaluation kit
- Design prepared for the following environment:
  - AMD-Xilinx Vivado Design Suite 2021.2
  - AMD-Xilinx Vitis Unified Software Platform
  - AMD-Xilinx PetaLinux 2021.2
- Runs on Linux OS and includes logicBRICKS software drivers and demo applications
- HDMI display output with the Xilinx HDMI 1.4/2.0 Transmitter Subsystem[3] controlled via Xylon's DRM kernel driver
- Input video resolution: 1928x1208@30fps, Output video resolution: 1920x1080@60fps
- Full evaluation version available for request online
- Documentation and Tech support (e-mail)

[1.] *The framework does not require LIDAR to be connected for full functionality of the 6 camera application to be achieved.*

[2.] *Included are 3-month Xylon seat evaluation licenses for the logiCVC-ML and logiWIN Xylon logicBRICKS IP cores, as well as a 3-month Xylon seat evaluation license for the logi3D logicBRICKS IP Core (used for 3D LIDAR data visualization).*

[3.] *Xilinx licensed IP. Digital code vouchers provided by Xylon to buyers of the logiVID-ACAP-6CAM ACAP Vision Development Kit.*

Table 1: Resources utilization for the IP Framework Implementation Statistics

	Available in XCVC1902-VSVA2197-1	Used Resources in logiREF-ACAP-VDF
Look-Up Tables (LUTs)	899,840	86, 200 (~11,0%)
Flip-Flops (FFs)	1,799,680	88,000 (~5,0%)
Block RAM (36kB BRAM)	967	142 (~15,0%)
DSP Slices (MULT/DSP)	1,968	198 (~10,0%)

Applications

- Machine Vision and other vision applications, AR/VR, AD/ADAS, AI, guided robotics, drones etc.

General Description

The logiREF-ACAP-VDF Video Design Framework for Multi-Camera Vision Applications enables Xylon logiVID-ACAP-6CAM vision development kit users to quickly utilize the provided hardware platform for the development of Xilinx's Versal Adaptive Compute Acceleration Platform (ACAP) based embedded multi-camera vision systems.

The Versal ACAP family of devices offers new architectural advantages to developers looking to utilize modern machine learning methods. Complex modern computer vision systems, such as advanced driver-assistance systems, simultaneously use many different sensors to understand their surroundings, and then choose the best actions in demanding traffic situations. To perceive the environment more accurately, information provided by multiple sensors and heterogeneous sensor types are combined through sensor fusion. The logiREF-ACAF-VDF reference framework showcases the advantages of the Versal ACAP platform by visualizing 6 camera streams in parallel, with or without running advanced image filters, and with real-time LIDAR data that is visualized instantly on the screen in the form of a 3D point cloud.

The complete camera-to-display ACAP design, which is prepared for AMD-Xilinx Vivado Design Suite and Vitis Unified Software Platform, uses just a fraction of available programmable logic and significantly saves design time. Instead of starting from scratch and having to spend months designing and building a new design framework, users of the logiREF-ACAP-VDF reference framework can immediately focus on specific vision-based parts of their next ACAP design. The logiVID-ACAP-6CAM vision development kit can be installed on test vehicles (cars, robots…) and used in exhaustive tests, e.g. for testing and validation of new AD/ADAS developments in the test vehicle and in different road conditions.

Figure 2: Ouster OS1 LIDAR device

The logiREF-ACAP-VDF reference design supports six parallel video inputs from Xylon's GMSL2 video cameras and a single HDMI display output. All video inputs are stored in the video memory and by mean of the on-board user push button, the user can select between displaying all video inputs from all six video cameras simultaneously in a tiled manner (see Figure 1), or video input from one of the video cameras (with selectable Sobel filtering on Camera #1).

Sobel Filter implementation provides a simple example on how to use the Vitis hardware acceleration library. The Vitis platform supports Linux applications and contains precompiled Linux kernel drivers for the included logicBRICKS IP cores (DRM and V4L2):

Figure 3: Sobel Filter demonstration

The design is also prepared for use with the OS-1-64 high resolution imaging Lidar from Ouster. The Lidar Visualization Demo Application is included and will render the acquired data in the form of a 3D point cloud, with the perspective being controllable via a mouse connected to the board. This visualization is achieved with the use of Xylon's logi3D Graphics Accelerator IP, which is designed to support OpenGL ES 1.1 API:

Figure 4: Lidar Visualization Demo Application in action indoors

All logicBRICKS IP cores are supplied with appropriate software drivers. The provided video capture and display demo applications run in Linux OS.

The logiREF-ACAP-VDF Reference Framework is sold as a part of the logiVID-ACAP-6CAM Vision Development Kit.
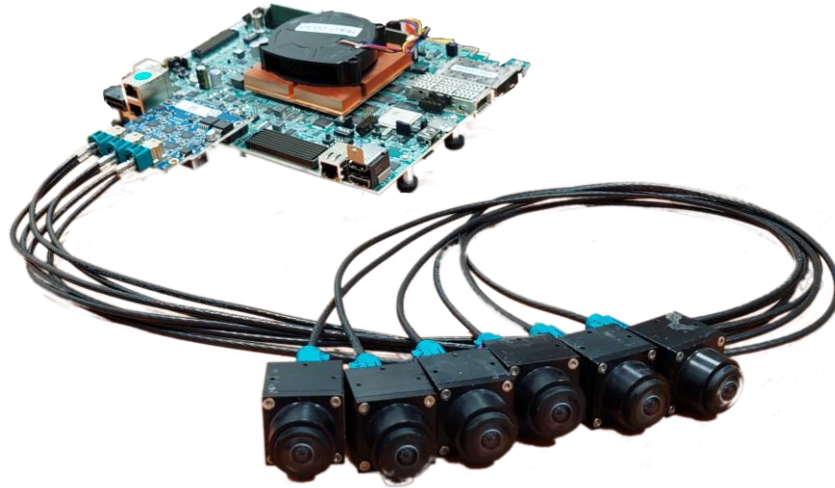

Figure 5: logiVID-ACAP-6CAM ACAP Vision Development Kit and VCK190 board

⚠️ AMD-Xilinx Versal AI Core Series VCK190 evaluation kit must be purchased from AMD-Xilinx and distributers, while the Ouster OS1 LIDAR should be acquired separately from Ouster. All other components of the logiVID-ACAP-6CAM Vision Development Kit can be purchased directly from Xylon.

Xylon delivers video cameras with heat sinks which aren't visible on the photo

The licensed logiREF-ACAP-VDF Reference Design is delivered as part of the complete logiVID-ACAP-6CAM Vision Development Kit. This development kit provides system designers with the proprietary hardware they need to evaluate Xylon's logicBRICKS IP Suite and develop multi-camera vision applications on AMD-Xilinx Versal devices.

The complete logiVID-ACAP-6CAM Vision Development Kit includes Xylon's logiFMC-GMSL2 12-Ch GMSL2 deserializer FMC module, six Xylon 2.3 MP GMSL2 automotive video cameras and the necessary cables. It does not include the VCK190 board itself.

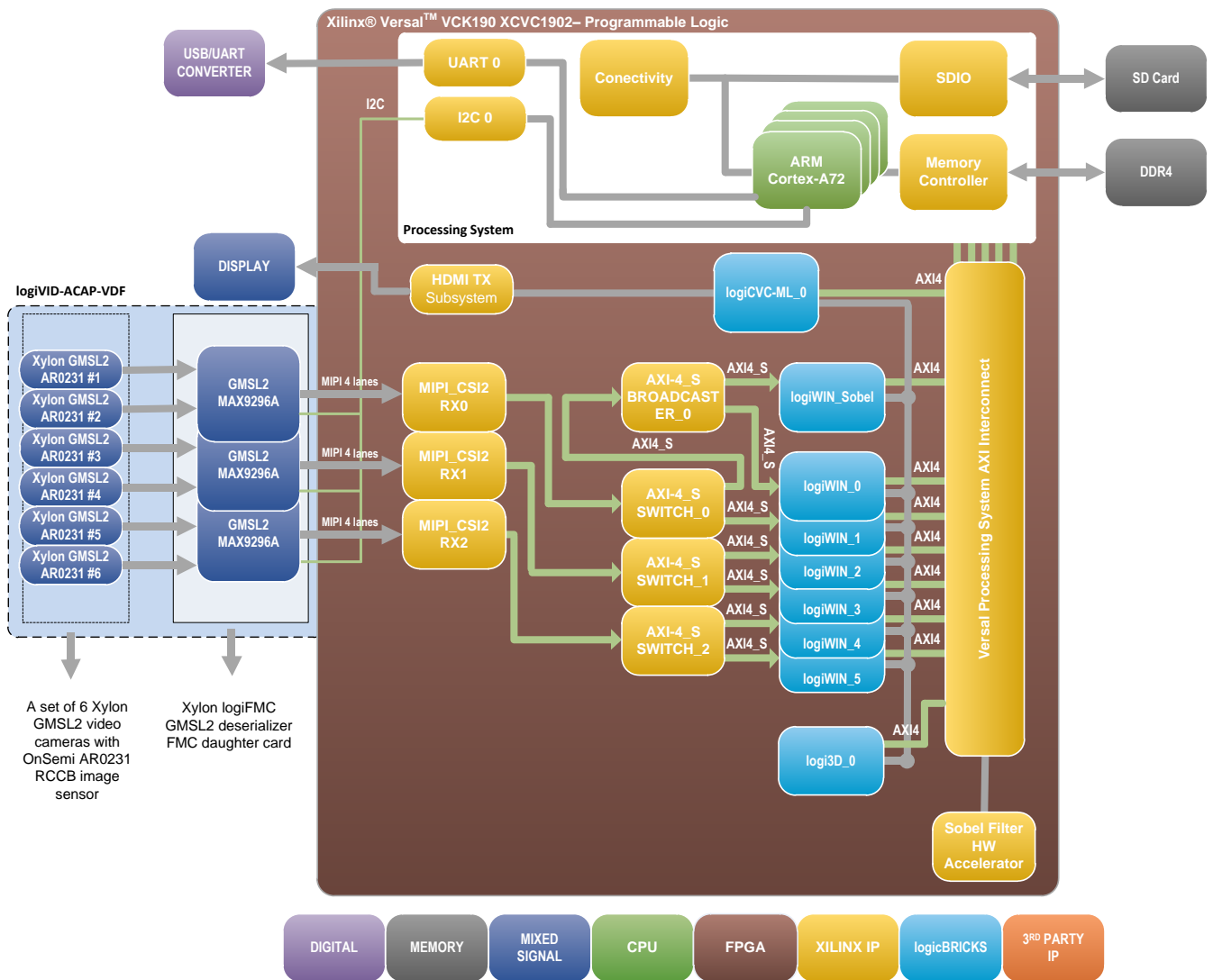To learn more about it, please visit:
https://www.logicbricks.com/Solutions/Xylon-ACAP-Vision-Development-Kit.aspx

Figure 6: Subsystem block diagram for logiREF-ACAP-VDF Reference Design

Reference Design Content

Hardware Design Files

- Hardware description file (XSA) as Vivado export of the reference design that allows for instant design check-up and software changes in Vitis
- Reference design prepared for the Xilinx Vivado Design Suite (script-based)
- AMD-Xilinx HDMI 1.4/2.0 Transmitter Subsystem IP
- Xylon's licensed and evaluation logicBRICKS IP cores:
    - logiCVC-ML Compact Multilayer Video Controller
    - logiWIN Versatile Video Input
    - logi3D Scalable 3D Graphics Accelerator
    - Xylon Utility IP cores (license-free)

Software

- Vitis workspace files with Linux demo application projects
- Xylon plf+ library
- Ouster Lidar control library modifications and Lidar Visualization demo application sources
- PetaLinux 2021.2 project files

Binaries

- Precompiled SD card image for the fastest demo startup:
  - Default Linux application for reference design
  - Xylon startup script
  - Initialization files for Xylon's GMSL2 deserializer FMC module and cameras
  - Linux binaries

Recommended Design Experience

Users that want to make changes on the provided designs should have experience in the following areas:

- Xilinx design tools
- C/C++ programming
- Embedded hardware and software design

All logicBRICKS IP cores provided with the design framework are fully compatible with Xilinx's implementation tools and their use does not require any particular skillset beyond general Xilinx tools knowledge.

Related Xylon Products

The logiVID-ACAP-6CAM vision development kit provides system designers with everything they need to evaluate Xylon's logicBRICKS IP Suite and to efficiently develop multi-camera vision applications on AMD-Xilinx Versal devices. The complete hardware platform includes Xylon's 12-Ch GMSL2 deserializer FMC module, the necessary cables and six of Xylon's 2.3MP automotive video cameras with a raw Bayer video output. The development kit supports HDMI video output to a monitor.

> Email: support@logicbricks.com
> URL: https://www.logicbricks.com/Products/logiVID-ACAP-6CAM.aspx

The ACAP HDR Image Signal Processing Framework is intended to showcase a complete logicBRICKS IP suite implementation of the High-Dynamic Range (HDR) Image Signal Processing (ISP) pipeline in an embedded design based on AMD-Xilinx ACAP programmable devices. The HDR ISP pipeline enables crisp camera video under altering and rough lighting conditions in next generation multi-channel embedded systems for use in automotive, surveillance, medical, aerospace and similar video and vision AI applications. This design is prepared for use with the AMD-Xilinx Versal AI Core Series VCK190 evaluation board. For more information, please visit our website:

> Email: support@logicbricks.com
> URL: http://www.logicbricks.com/Products/logiREF-ACAP-MULTICAM-ISP.aspx

The logi3D Scalable 3D Graphics Accelerator IP core is specifically designed for Xilinx Versal ACAPs and Zynq-7000 SoCs. The logi3D enables designers to add attractive 2D and 3D graphics, including advanced Graphical User Interfaces (GUI), to their SoC design. The logi3D is a parametrizable and scalable Graphics Processing Unit (GPU) IP core that allows advanced and highly customized graphic controller designs. For more information, please visit our website:

Email: support@logicbricks.com
URL: http://www.logicbricks.com/Products/logi3D.aspx

Ordering Information

Products are available directly from Xylon. Please visit our web shop or contact Xylon for pricing and additional information:

Email: sales@logicbricks.com

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Related Information

AMD-Xilinx Programmable Logic

For information on AMD-Xilinx programmable logic or development system software, contact your local AMD-Xilinx sales office, or:

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Revision History

Version	Date	Note
1.00	19.10.2022.	Initial public release.