DESIGN AUTOMATION
EMBEDDED SYSTEMS

FPGA - EMBEDDED - INTERNET OF THINGS - PCB TECHNOLOGIEËN

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D&E event 2014

System on Module FPGA based with integrated processor

iWave
Embedding Intelligence

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Adelco Electronics

Adelco

Agenda

- Introduction
  - Adelco Electronics
  - iWave Systems
- Advantages using FPGA on standard Qseven SOM
- Design Challenges
- Product Details
- Development Kit
- Design Examples
- Summary
- Questions

Adelco Electronics

- Founded in April 2003
- Solution provider for Displays, Embedded Computing and Wireless Products
- Experienced and technically skilled sales team providing application support
- Headquarter in Capelle aan den IJssel/NL
- Sales office in Belgium

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iWave Systems

- 15+ Years of Experience in Embedded Product Design Services
- Based in Bangalore/India
- 180+ Team Size, 140+ Engineers
- Expertise in Design & Development of System On Modules (SoM)
- Quick Customization to "Time to Market"
- Onsite and Offshore Design Support
- Through Partners in Europe, USA & Singapore

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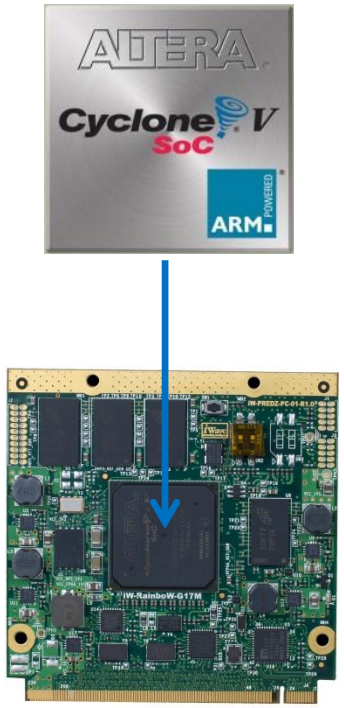
Advantages using FPGA on standard Qseven SoM

- **Implementing custom proprietary hardware IP with the use of an external FPGA, where standard ARM CPUs cannot be used.**
- **Providing simple single-chip solution for complex requirements:**
  ARM + FPGA = SoC
- **Standard Qseven form-factor architecture used in design**
- **Custom Secure IP solution**
- **Cost-effective and Time-to-market benefits**
- **The only Qseven ARM solution offered in the market with PCIe x4 lane support available through SoC.**



Design Challenges

- **Meeting the SoC power requirements within the small form-factor**
- **Implementing the high speed and differential signal requirements of SoC design**
- **Meeting the high density PCB layout requirements within a small form-factor**
- **Mapping the SOC's flexible IO's to meet the Qseven standard interface requirements**

Product Details

Cyclone V SoC Qseven SOM

iW-RainboW-G17M-Q7

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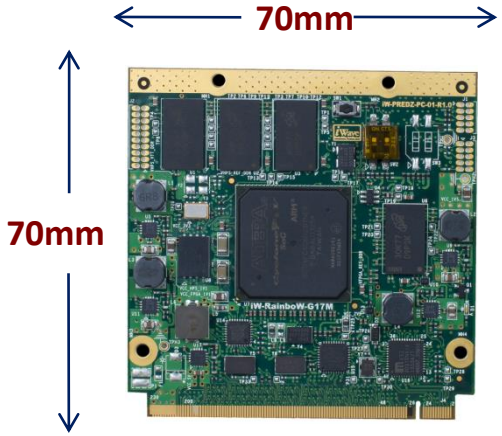
Highlights

- ARM Cortex A9 Dual core with FPGA with up to 110KLEs
- Integrated transceivers and hard memory controller
- Easy available FPGA IP cores for integration
- R2.0 Qseven compatible module
- First ARM based SOM module with PCIe x 4 lane support



Top view

Bottom view

Benefits:

- Technical support
- Customization
- Longevity 5+ years
- Quick time to market
- Board Support Packages Available

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Features and Specification

- **CPU:**

  Altera's Cyclone V SX SoC FPGA
  - Integrated Dual core ARM Cortex-A9 Hard Processor System(HPS)
  - FPGA with upto 110K LEs
- **Memory:**
  - 512MB DDR3 with ECC for HPS
  - 16MB QSPI Flash
  - 256MB DDR3 for FPGA
  - EPCQ flash*/QSPI Flash for FPGA
  - EEPROM*
- **On Board Peripherals Support:**
  - JTAG Header for FPGA*
  - JTAG Header for HPS*
  - DIP Switch for boot settings
  - RTC controller
- **80 Pin Expansion Connector:**
  - FPGA IOs (Up to 45 Single Ended IOs - SE IOs)
  - 9 TX LVDS Pairs / 18 SE IOs
  - 11 RX LVDS Pairs / 22 SE IOs
- **Power Input:** 5V DC
- **Operating Temp:** -40°C to +85°C Industrial
- **Qseven PCB Edge Connector Interfaces:**
  - **From HPS:**
    - Gigabit Ethernet - 1 No (On-SOM PHY)
    - USB 2.0 Host - 4 Ports (On-SOM HUB)
    - CAN x 1 Port
    - SD/MMC (8 bit)
    - I2C x 2 Ports
    - SPI x 1 Port
    - Debug UART x 1 Port
    - 2nd UART x 1 Port
    - Other Control IOs - Through HPS
  - **From FPGA:**
    - LVDS LCD - 2 Ports (FPGA Soft IP)/ 23 SE IOs
    - AC97/I2S Audio (FPGA Soft IP)/ 5 SE IOs
    - PWM
    - FPGA IOs- 8 CMOS
  - **From FPGA High Speed Transceivers:**
    - SATA (FPGA Soft IP)
    - PCIe Gen2 x 4 Lane
- **Form Factor:** 70 x 70 mm Qseven Spec 2.0
- **OS Support:** WEC7 & Linux

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*Optional

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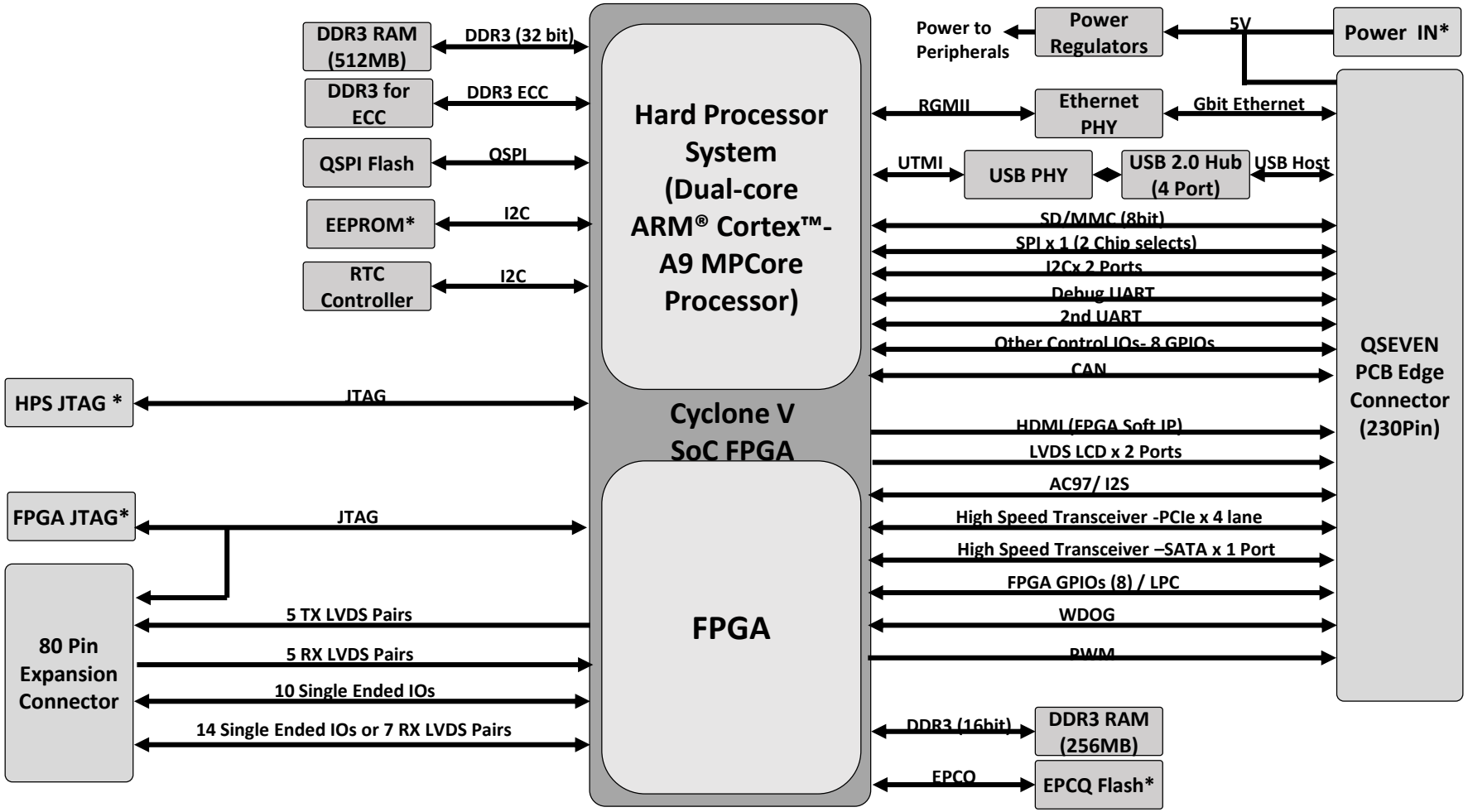
Block Diagram



*Optional

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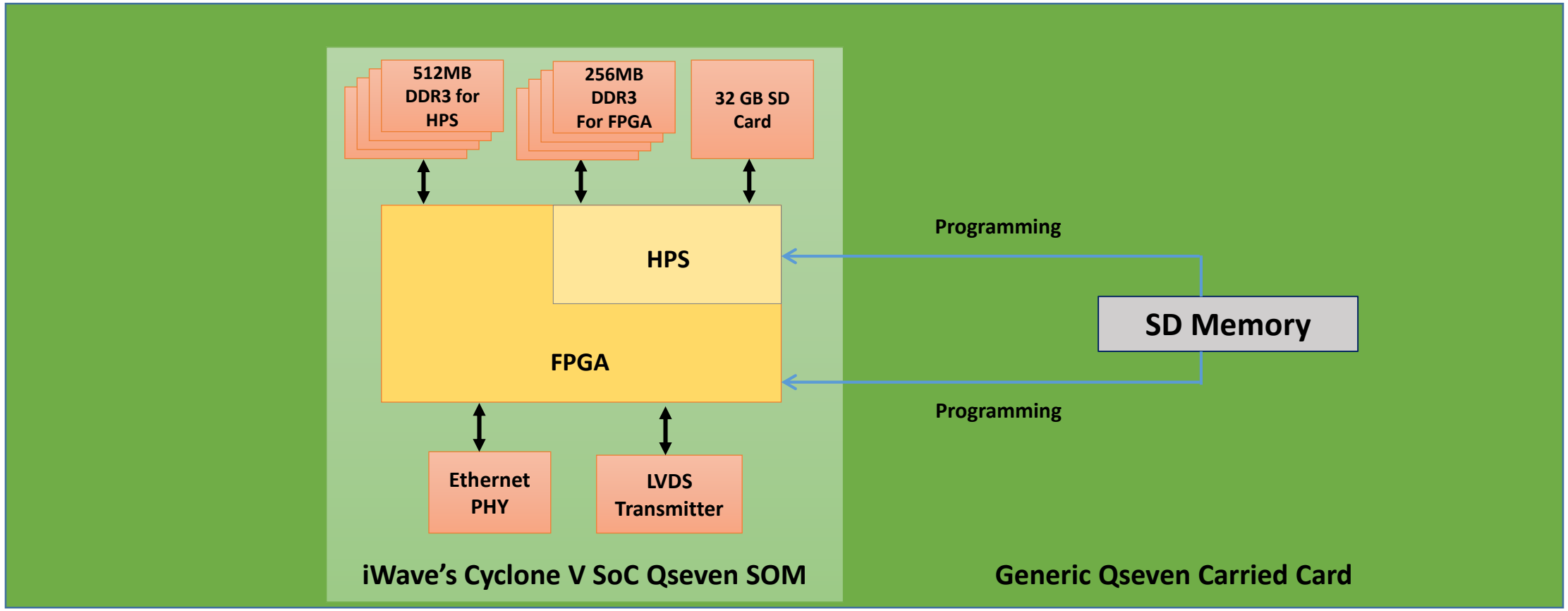
Development Kit

- CPU: Altera's Cyclone V 5CSXFC6 SoC FPGA
- RAM: 512MB HPS / 256MB FPGA
- Gigabit Ethernet
- Standard SD - 1 Port (Boot & OS Storage)
- SATA 3.0 - 1 Port
- Data UART- 1 Port
- CAN – 1 Port
- Debug Console through Micro USB
- USB 2.0 Host - 3 ports
- PCIe x 1 slot
- LVDS - 2 Port
- 7"TFT Display with Capacitive touch
- Sensors, GPIO's, RTC, JTAG Header (optional)
- AC'97 codec - Audio IN/OUT Jacks

Programming

- The FPGA can be configured/programmed in either of below ways:
  - With the Quartus Programmer Tool (FPGA fabric)
  - From Hard Processing System (HPS)
- The different FPGA configuration options from HPS software using U-boot and Eboot
- For iWave's Cyclone V SoC, the selected method of programming the FPGA is from U-boot/Eboot. FPGA configuration file(.rbf) is stored in the standard SD memory.
- The U-boot/Eboot will read .rbf file from the SD memory and then programs the .rbf files to the FPGA fabric.

Programming



Debugging: One device, Two Tools?

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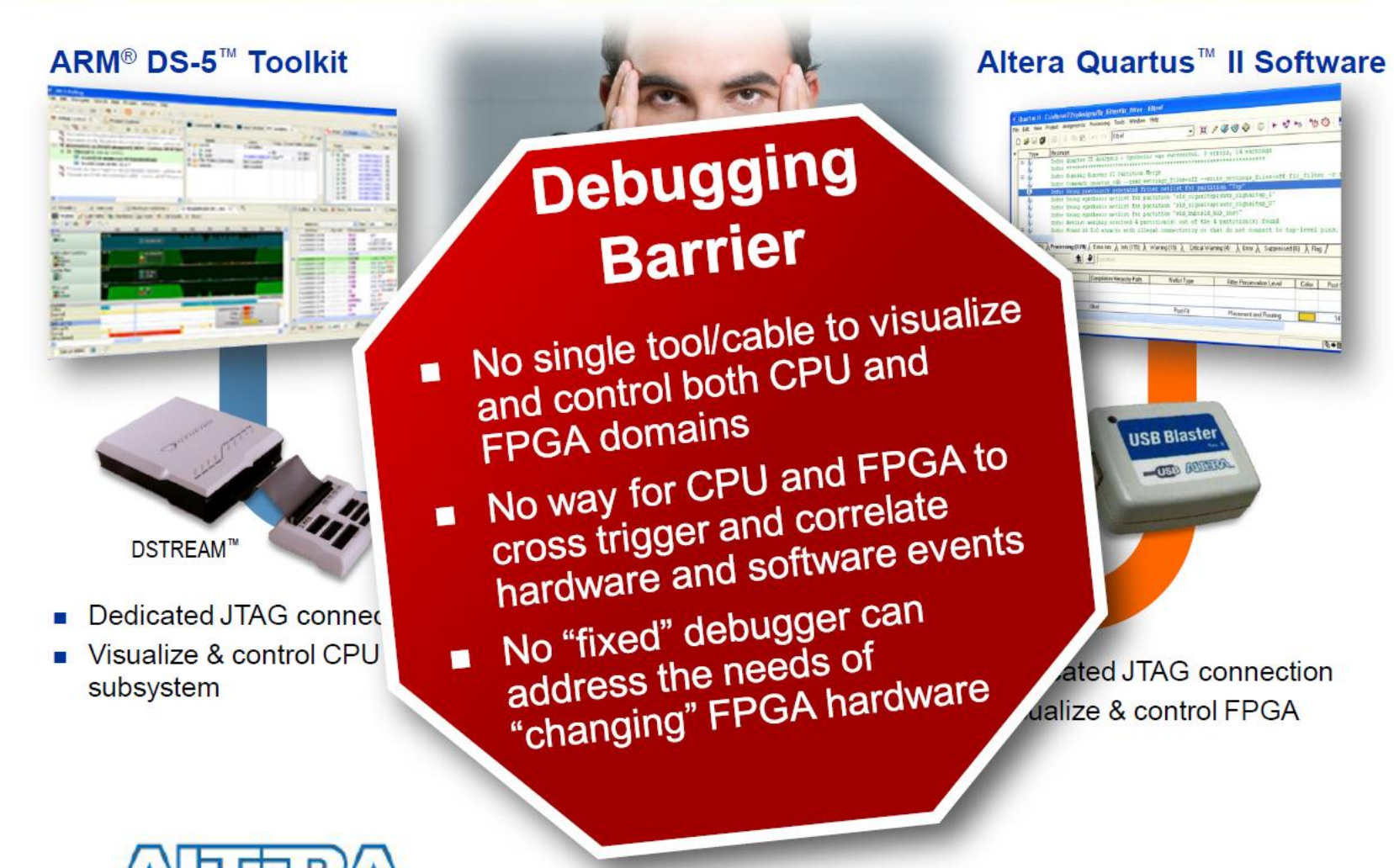
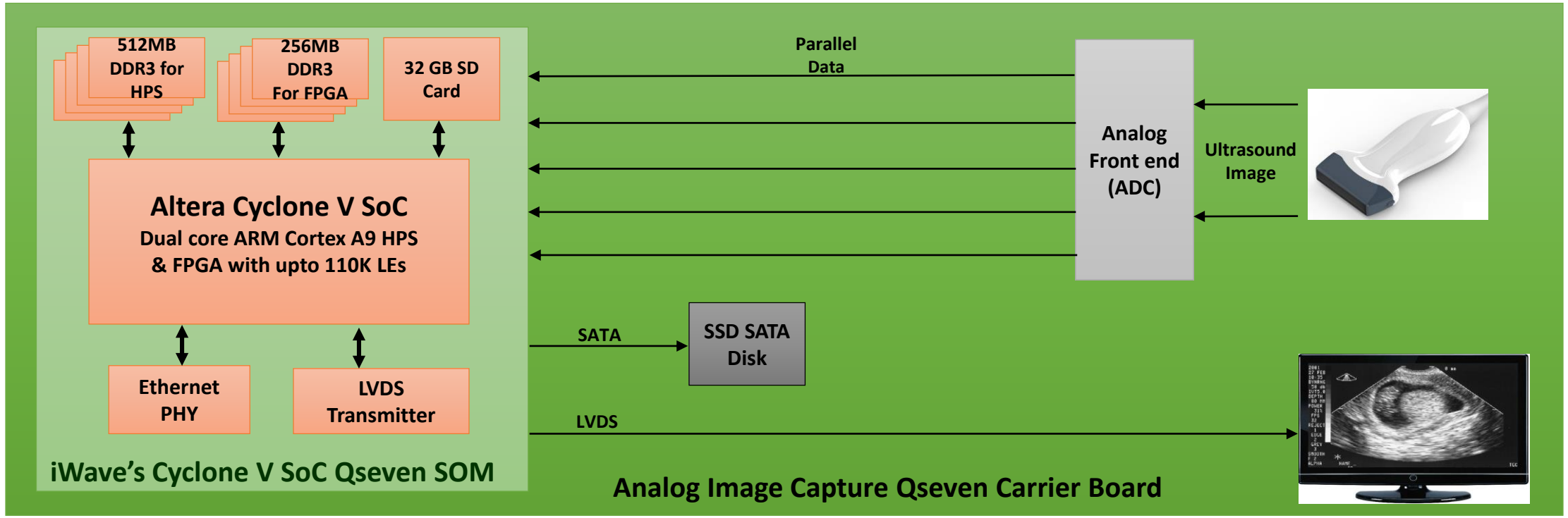


FPGA: Adaptive Debugging

ARM Development Studio 5 (DS-5™) Altera Edition Toolkit

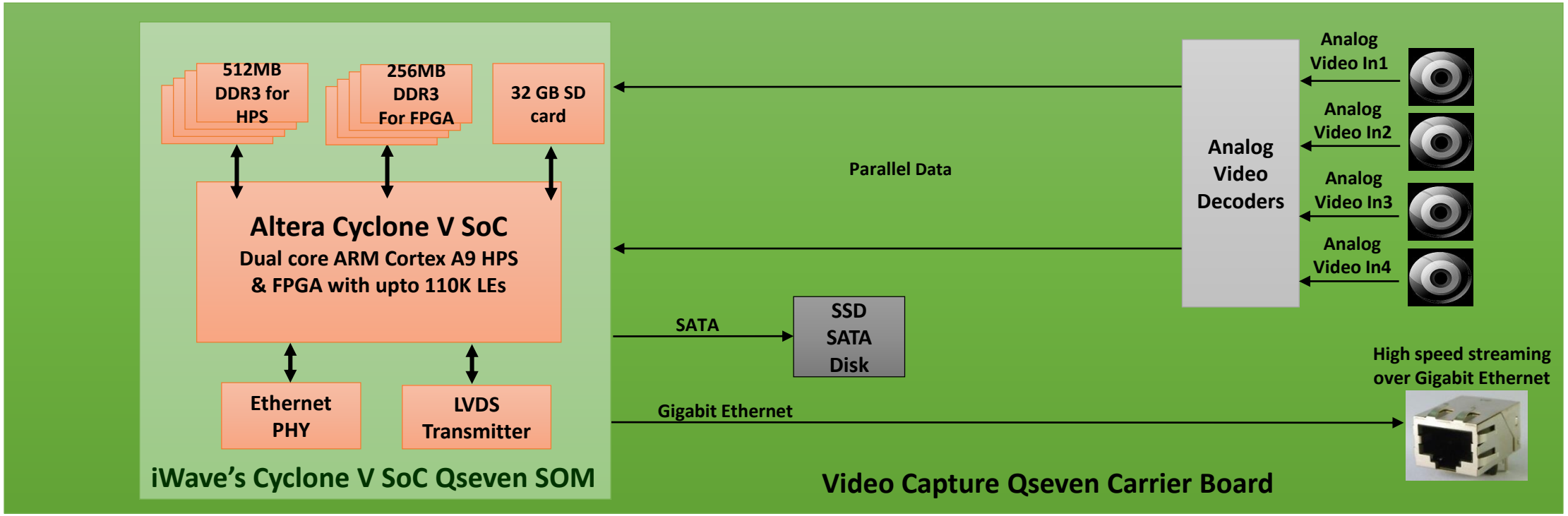
- **Removes debugging barrier between CPUs and FPGA**
- **Exclusive OEM agreement between Altera and ARM**
- **Result of innovation in silicon, software, and business model**

Examples



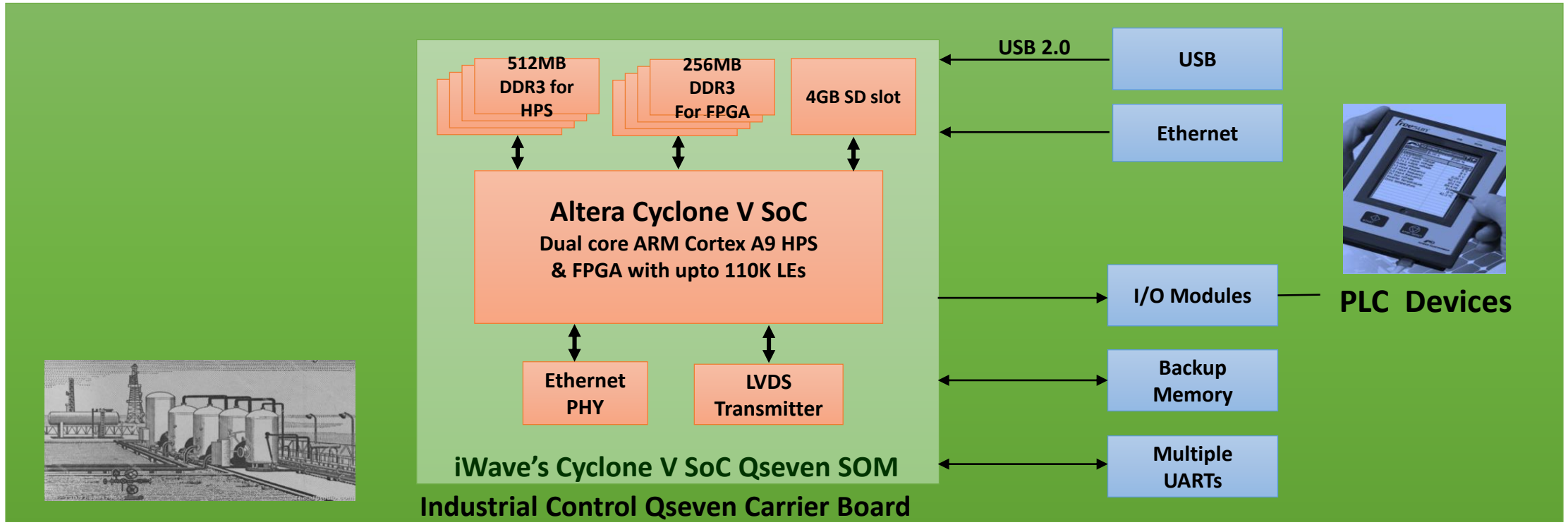
- **High speed image capture using SOC's FPGA IF**
- **Image processing through the Dual core CPU**
- **High speed mass storage on SATA SSD disk**
- **LVDS Display Interface Support**

Examples



- High speed video capture using SOC's FPGA IF
- Video & Graphic processing through Dual core CPU
- High speed mass storage on SATA SSD disk
- High speed video streaming over Gigabit Ethernet

Examples



- **SD, USB, I2C, SPI, Ethernet, GPIO interfaces will be used from the ARM CPU.**
- **By using the FPGA's PCIe interface, PCIe to multiple UARTs, PCIe to memory interface and other PLC specific IO interfaces will be developed.**

Summary

System on Module FPGA based with integrated processor

- Implementing custom proprietary hardware IP
- Standard Qseven form-factor
- Cost-effective and Time-to-market benefits
- PCIe x4 lane support

Questions?

You are welcome to visit our boot!

- To discuss your design opportunities
- To see more demo's!

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