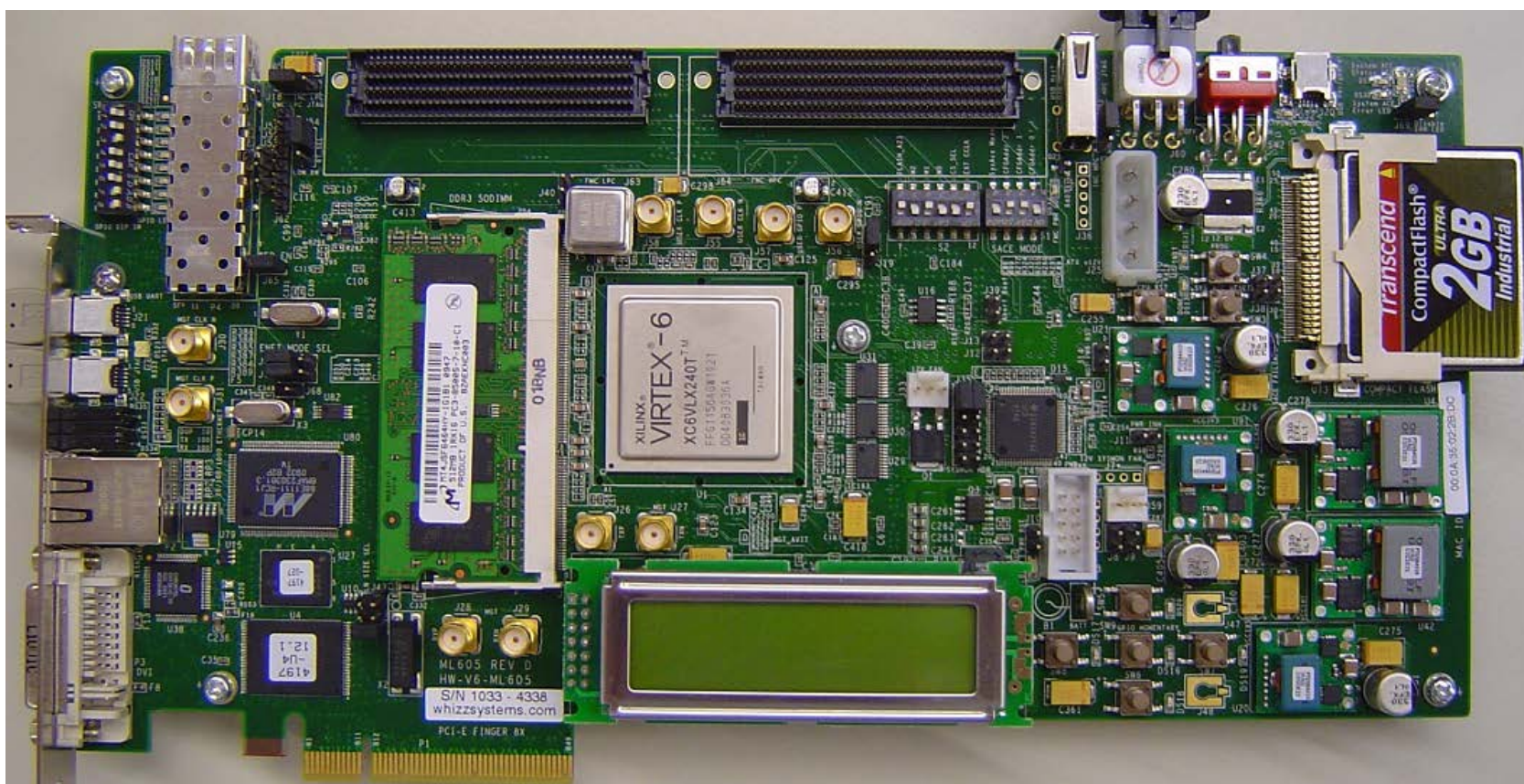


System on Chip 2011

Alarming System

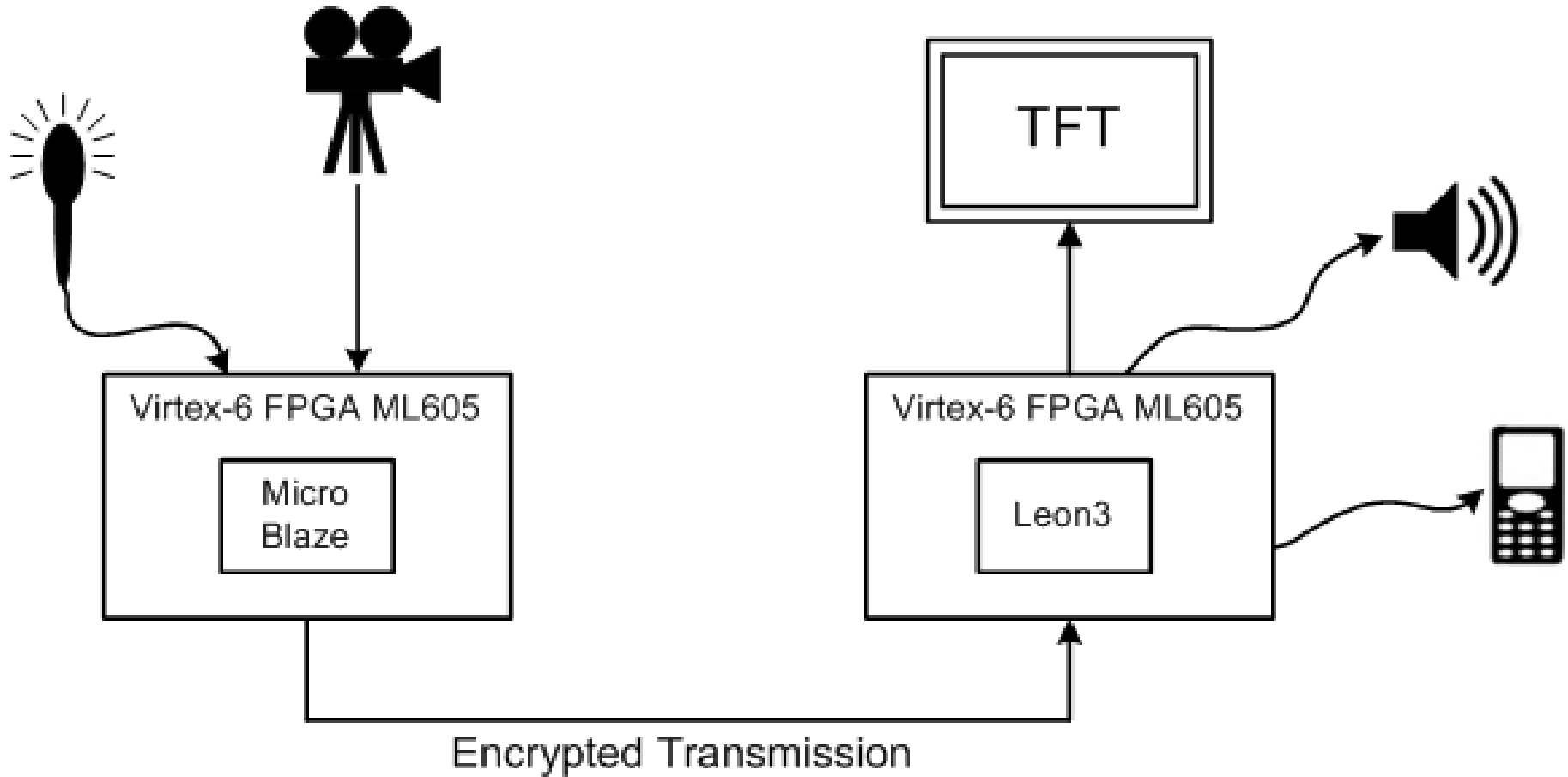


Introduction

Alarming System

- Motion detection
- Sound detection
- Encrypted transmission of captured video
- Display of video
- Notification in case of an alarm

System Overview



Equipment

- Virtex®-6 FPGA ML605
- Xilinx tools
- Leon3
- MicroBlaze
- Various open-source IP cores

Groups

Group 1

- Video Team
- Audio Team
- Linux Team 1
- Network Team

Group 2

- Graphic Team
- Alarming Team
- Linux Team 2
- Crypto Team

VIDEO - TEAM

Motion Detection



Object

Image

Filtered and scaled

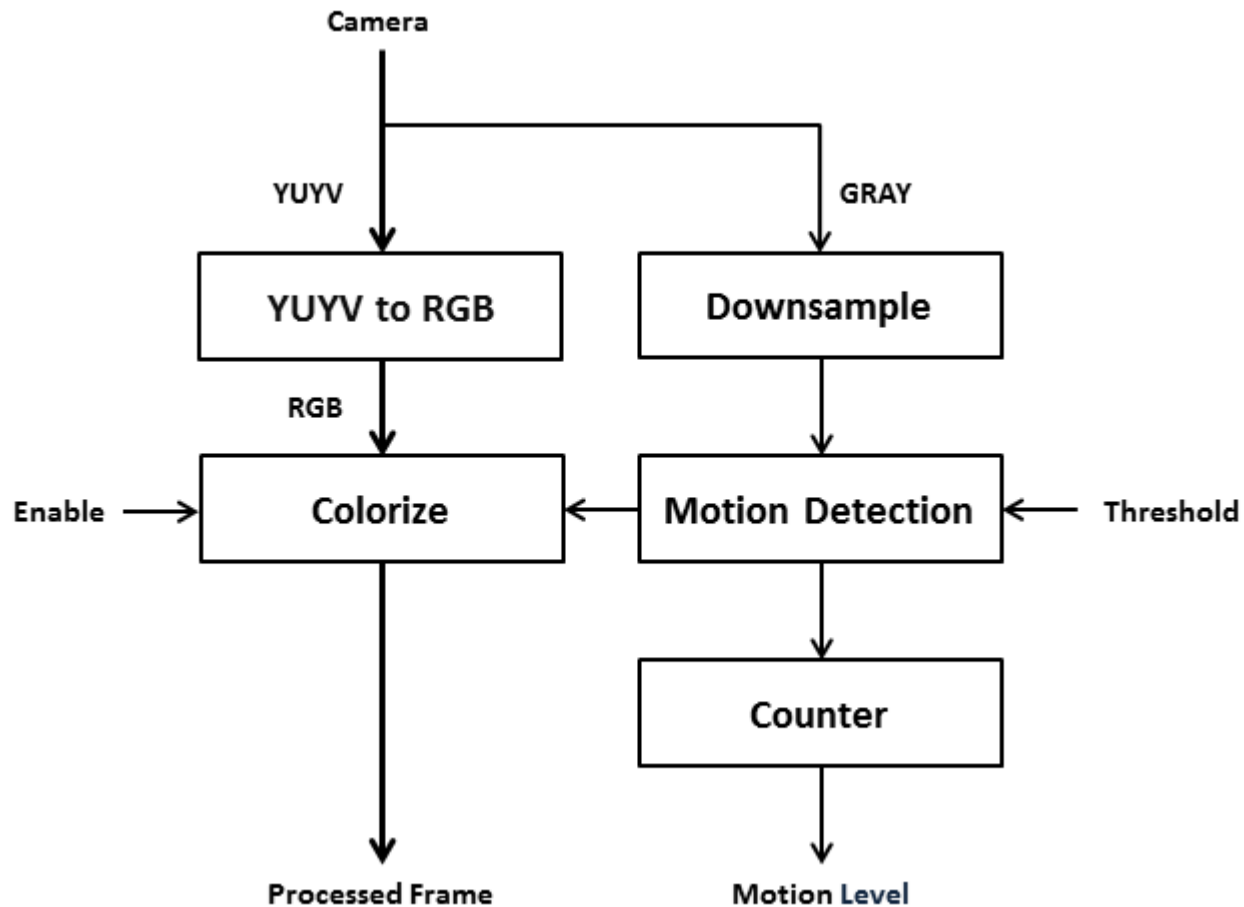


Motion

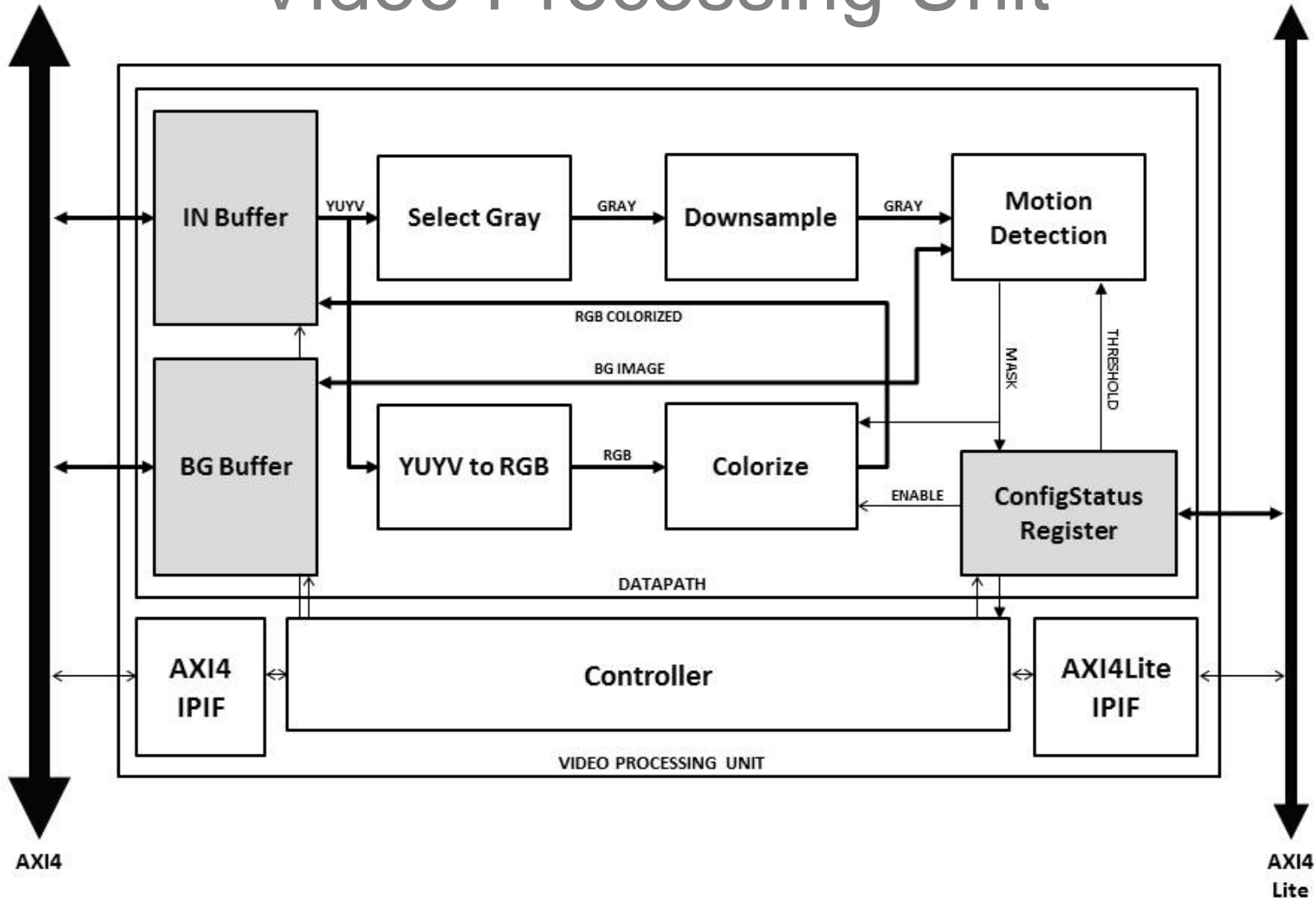
Diff. + Threshold

Result

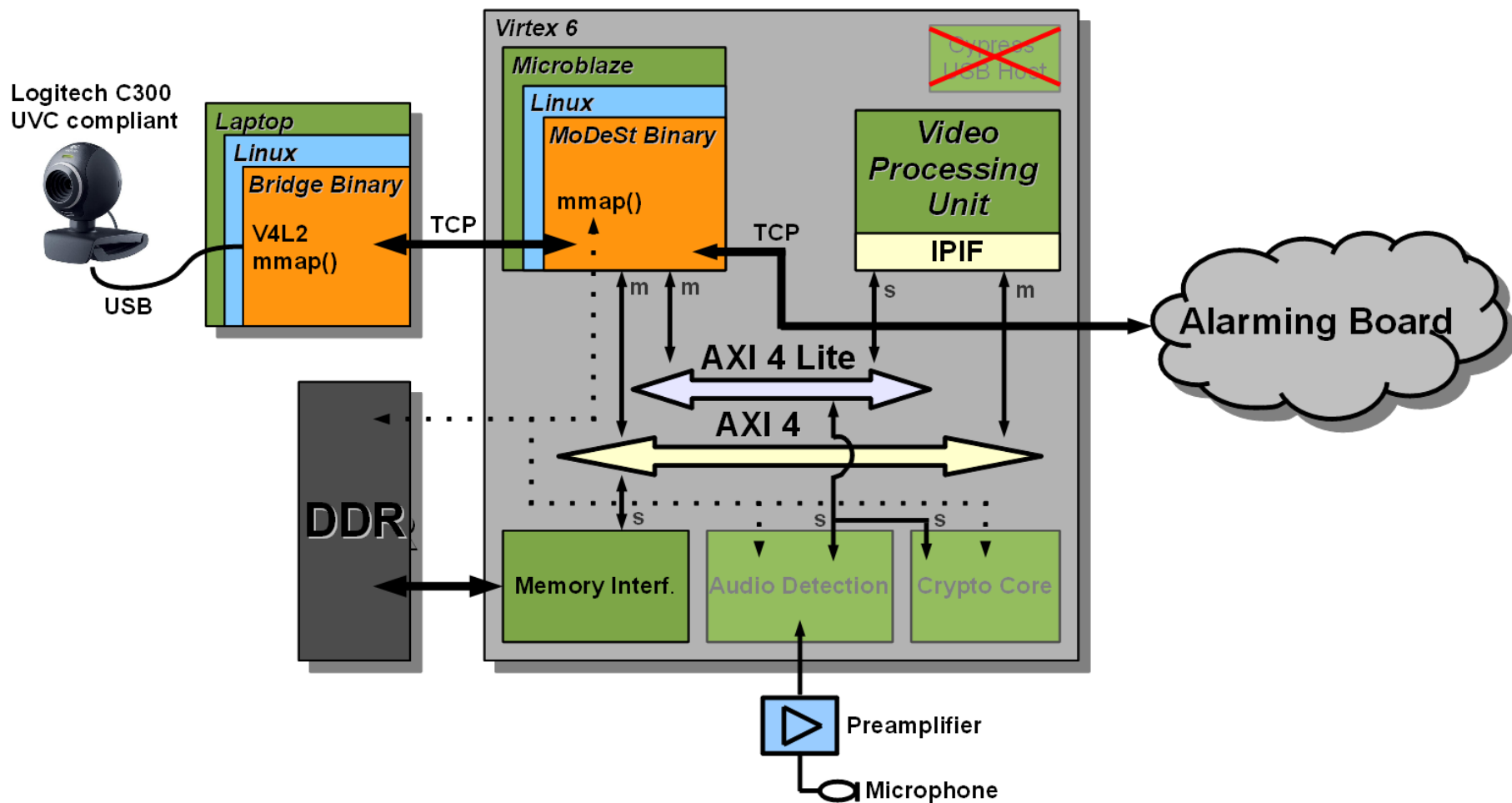
Video Team Data Flow



Video Processing Unit



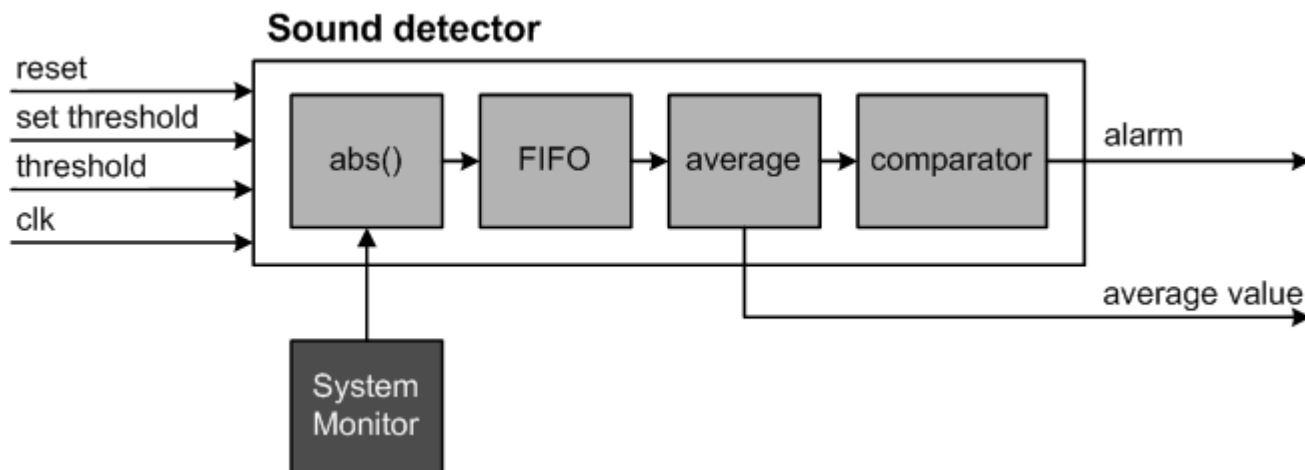
Detection Board Overview



AUDIO - TEAM

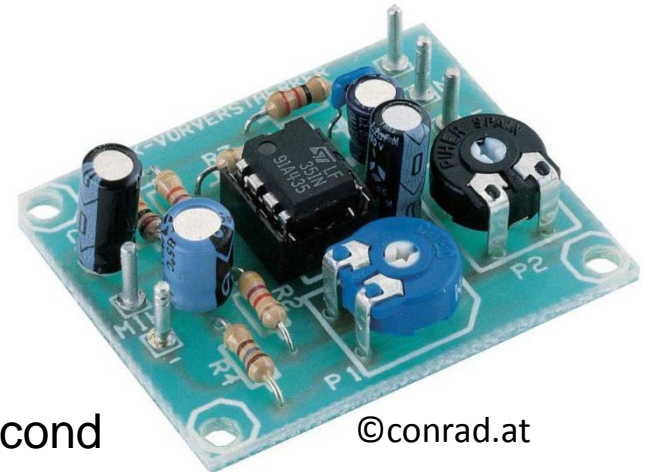
Task

- Sound detector
 - soundlevel reaches threshold
→ trigger an alarm signal



SoundDetector – Basic Components

- External hardware
 - Microphone, microphone preamplifier
- Analog to digital converter
 - Virtex 6 System Monitor
 - 10-bit resolution, up to 200k samples/second
- Sound detector
 - Digital audio samples
 - Average filter
 - Comparator to trigger an alarm



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Integration

- Sound detector connected to MicroBlaze
- Communication via AXI4-lite bus
- Alarm signal and average value stored in register
- Software features
 - Reset sound detector
 - Set new threshold
- Send alarm signal and average value to the second board

LINUX TEAM 1

Objectives

- Get familiar with AMBER project
 - ARM core from opencores
 - Inspect inner workings
- Synthesize AMBER
- Get linux running on AMBER
- Assist other teams in Linux issues

Obstacles

- AMBER
 - No RAM bridge
 - Documentation
 - No debugging facilities
- Backup solution
 - Xilinx microblaze CPU

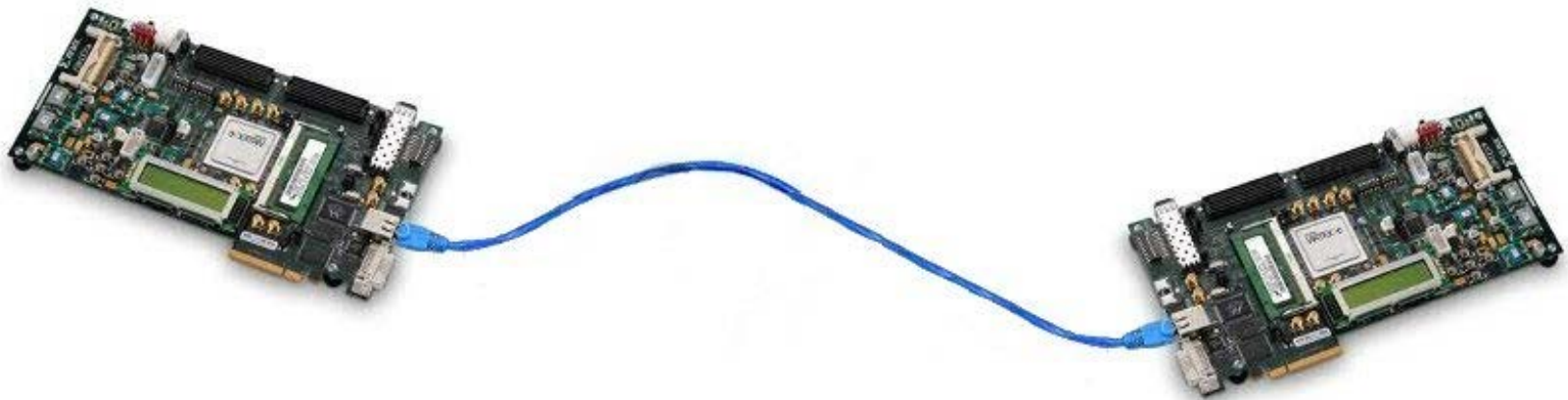
USB

- USB
 - Not supported within Xilinx kernel
 - Interfacing the USB chip
 - Xilinx USB demo

- Backup solution
 - USB IP
 - Stream RAW video

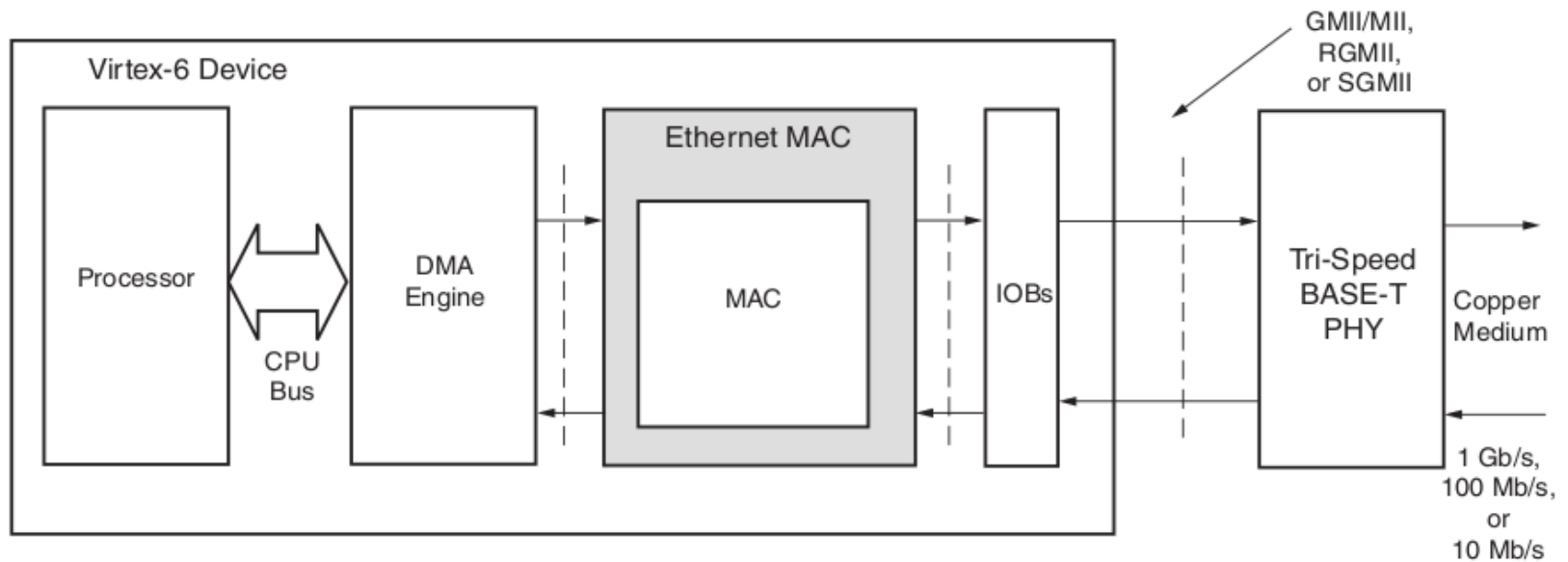
NETWORK - TEAM

Network Team



Ethernet Connection

Network Team



(ug800_v6_emac.pdf)



LogiCORE IP Virtex-6 FPGA Embedded Tri-Mode Ethernet MAC

Network Team

- Tutorial custom IP-core integration & access
- Support of Linux Team 1
- USB support – EPC-core integration – Cypress
- Template how to access registers from userspace
- Integration of IP cores from other teams

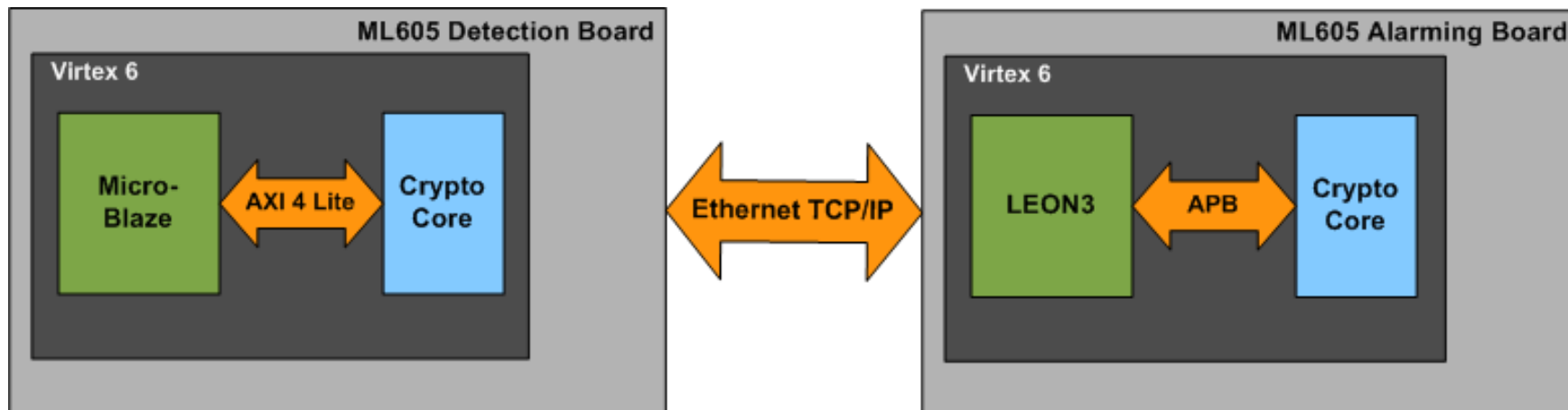
CRYPTO - TEAM

AES CryptoCore

- OpenCores
 - AES in ECB mode
 - 128-bit keysize

- Specification
 - 500 slices
 - 32-bit port width
 - Keyexpansion 83 clock cycles
 - Encryption / decryption 11 clock cycles

System View



Detection Board

- Encrypt
- Send via TCP/IP

Alarming Board

- Receive
- Decrypt

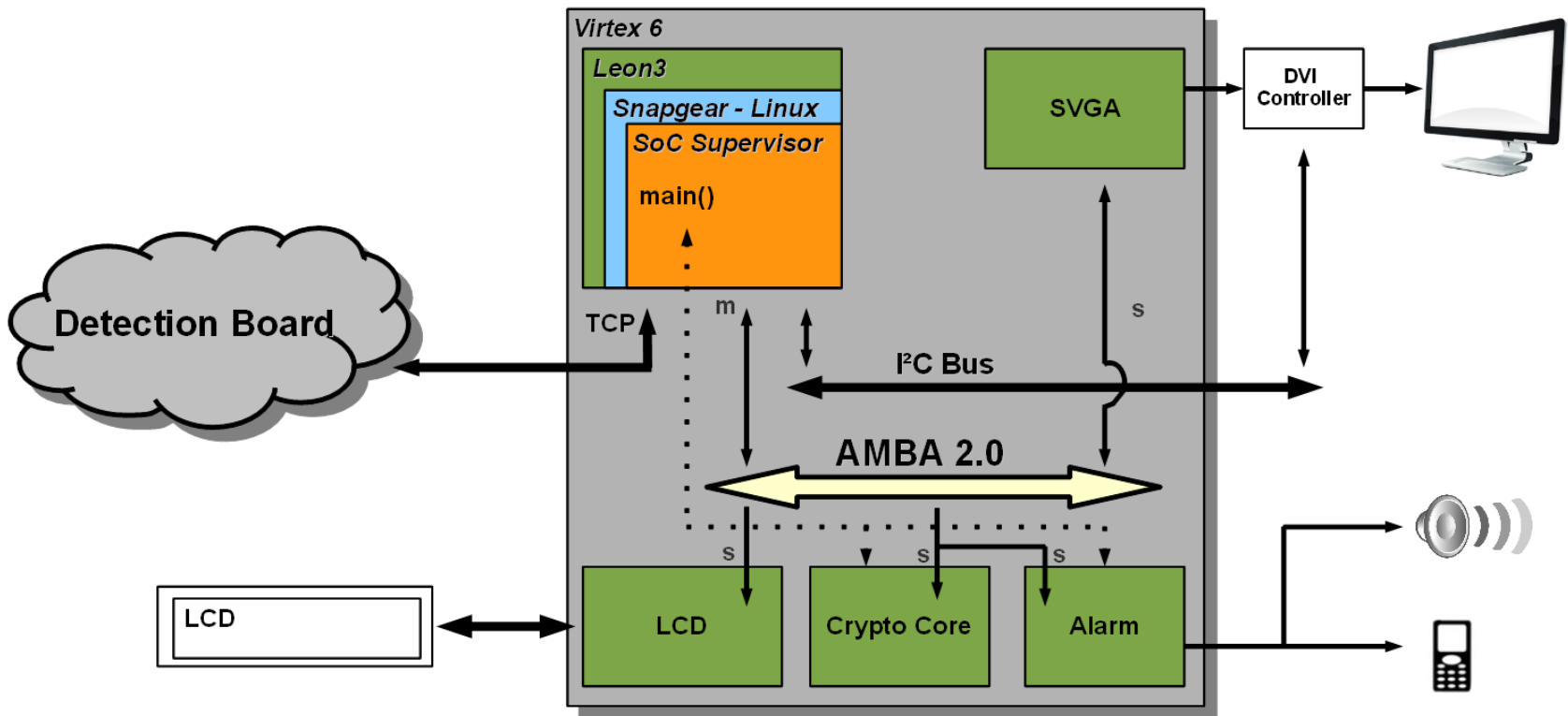
Integration

- MicroBlaze
 - Advanced eXtensible Interface (AXI) 4 Lite
 - $f_{\max, \text{Simulation}} = 188,4 \text{ MHz}$
 - Software integration
 - MMIO using kernel driver

- LEON 3
 - Advanced Peripheral Bus (APB)
 - $f_{\max, \text{Leon}} = 174 \text{ MHz}$
 - Software integration
 - MMIO using kernel driver

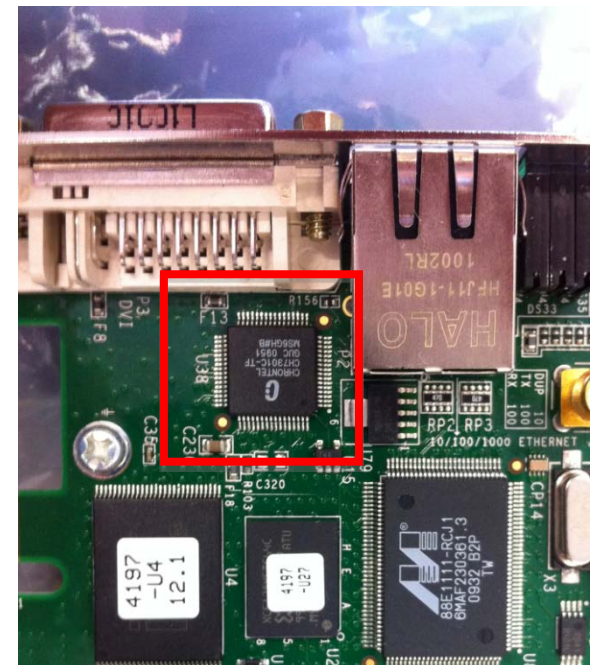
GRAPHICS - TEAM

Alarming Board Overview



Chrontel CH7301C DVI Transmitter

- Supporting graphics resolutions up to 1600x1200 pixels
- Up to 165M pixel/second
- Low jitter PLL for generation of the high frequency clock
- Convert digital data input to a DVI output
- Modes of operation:
 - RGB Bypass
 - DVI Output
- Configuration over I2C



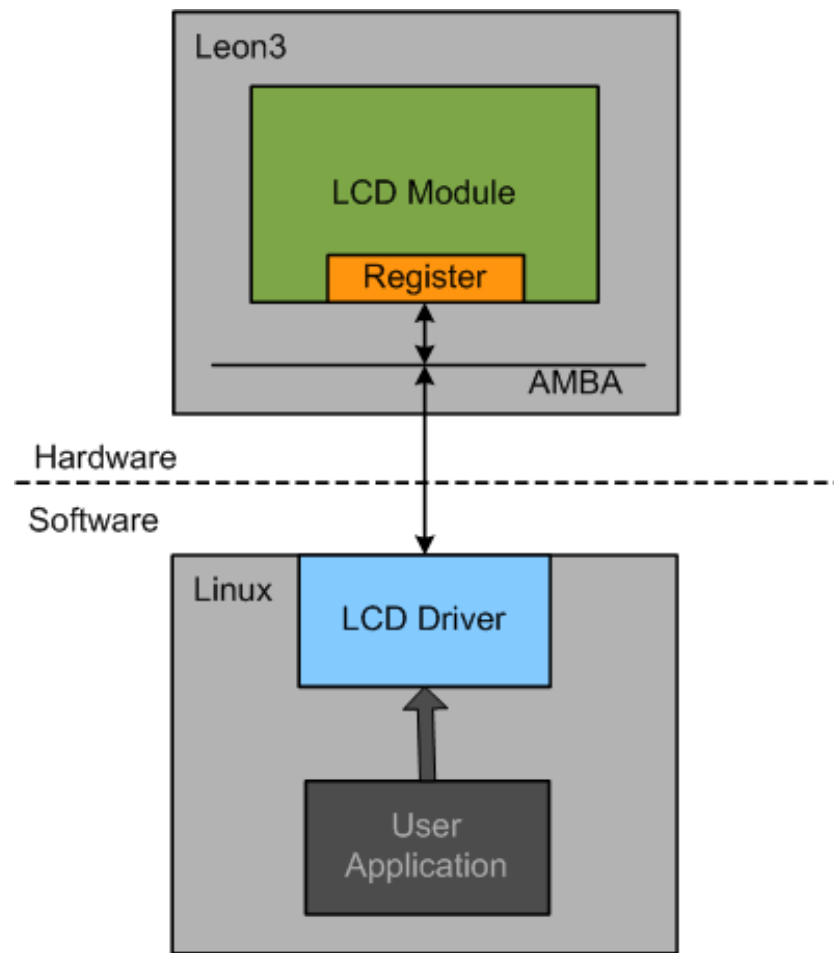
SVGA IP Core

- Developed by Gaisler Aeroflex
- Pixel based video controller
- Supports custom resolution with variable bit depth and refresh rates
- Uses external frame buffer in AHB address space
- Digital graphic interface for communication with DVI transmitter
- HSYNC, VSYNC signals for DVI control
- Video driver for the core is provided for Snapgear Linux

ALARMING - TEAM

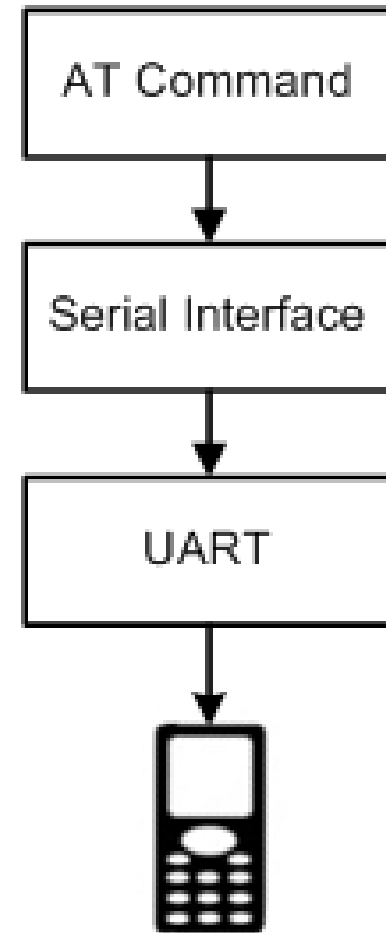
LCD

- Hardware IP module
- Integration in Leon3
- Software control via driver
- Userprogram for Linux
- Menu



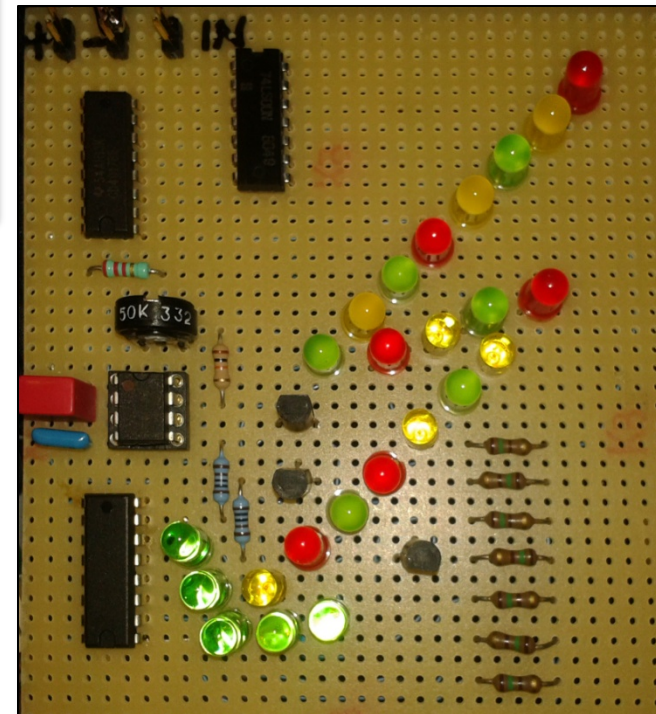
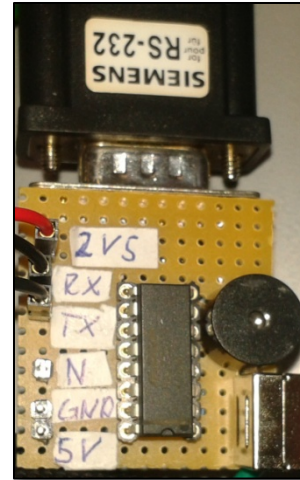
GSM

- Phone call
- SMS
- GSM capable mobilephone
- UART interface
- AT command



Sound and LEDs

- External circuits
- Buzzer
 - controlled by IO pin
- LEDs
 - controlled by IO pin



LINUX TEAM 2

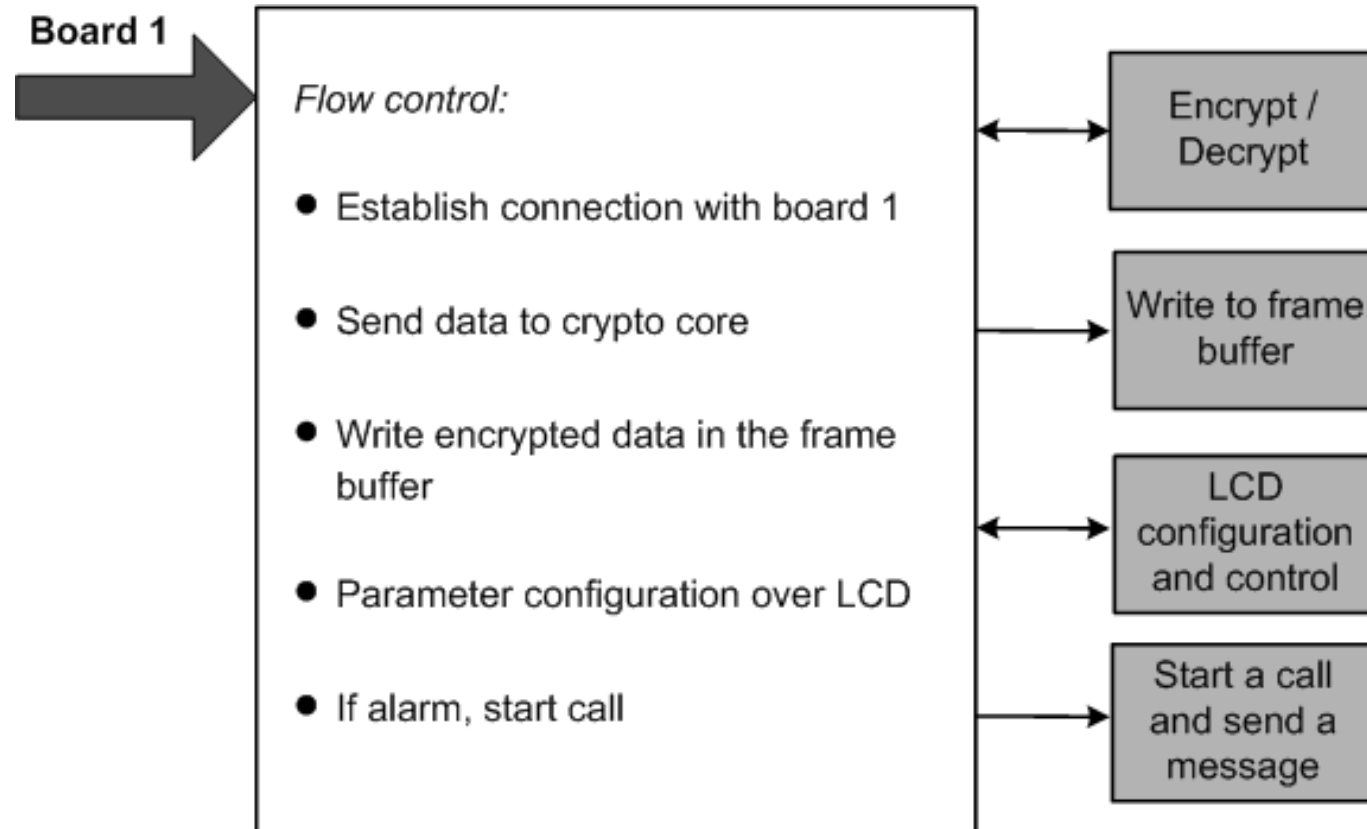
Leon3

- 32-bit SPARC V8 instruction set
- 7-stage pipeline (1.4 DMIPS/MHz)
- MMU included
- Hardware multiply and divide
- FPU (single and double precision)
- Amba 2.0 bus interface

Snapgear Linux

- Kernel 2.6.21.1
- MMU support
- Leon glibc cross compiler
- Interrupts and addresses not accessible from user space
→ kernel drivers

Software



Conclusion

- Open does not mean easy
- Debugging
- Hardware support

Thanks for your attention!

Live Demonstration!

References

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