SEVEN Solutions

An open hardware company

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3. Security & video surveillance
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Introduction to the company:

7S SERVICES AND PRODUCTS

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7S Company

- **Origin**
  - Created in 2006 as spin-off from the University of Granada
  - Technology-based created in the framework of several EU projects by a research group of the University of Granada.
- **Research and innovation awards**
  - AJE award to the best young company in Granada 2008
  - Bancaja National award to young entrepreneurs 2008
  - Entrepreneur Award XXI in Andalucía 2009

Team: 12 active workers as manpower

1 Business administration	1 Secretary	1 Part-time accountant
1 CEO	1 R&D Director	1 Technician
2 Software engineers	2 Telecommunications engineers	2 Hardware engineers

Three company ages

- **First period (2006-2009)**
  - Prototyping boards and electronics design services
- **Second period (2008-2011)**
  - Videoanalytics solutions
- **Third period (2010 - now)**
  - Industry for science

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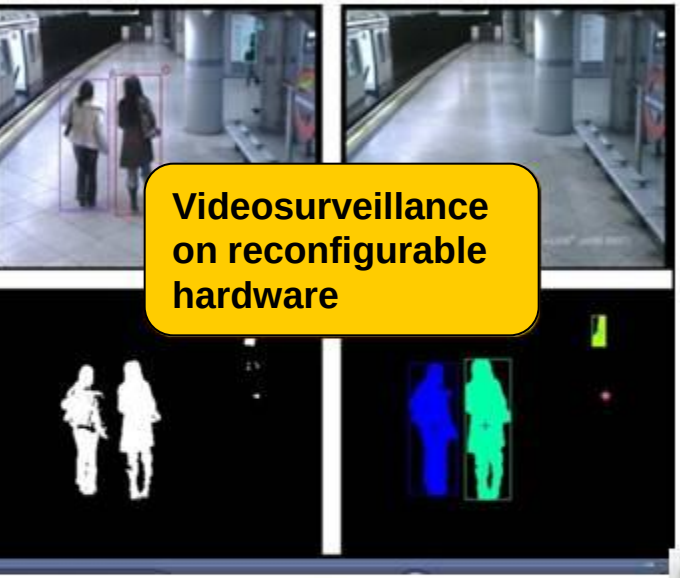
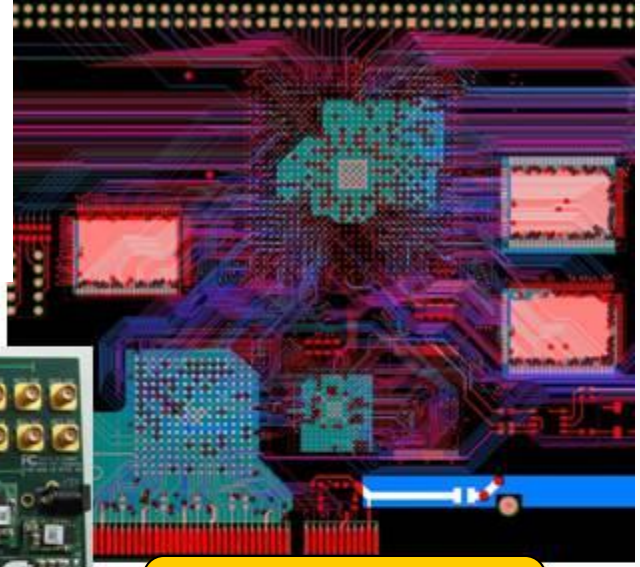
Company products & services



Videosurveillance on reconfigurable hardware



FPGA prototyping boards

IPcores

Biomedical portable systems for low vision

Company services & products

Services

- Electronics boards design and production
- Embedded software development (real-time, control…)
- HW/SW dependable systems & certification (***DO-254, DO-178B, IEC-615)***
- High-tech consulting & training
- Integration & turn-key solutions

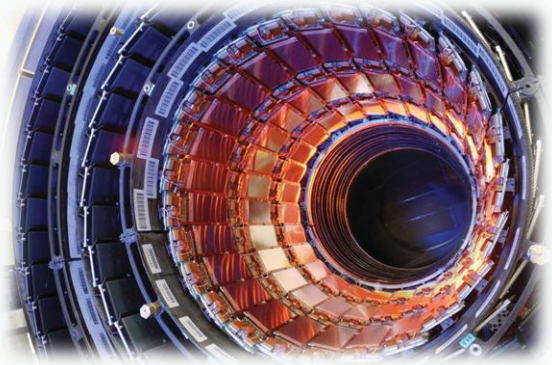
Products

- Prototyping FPGA platforms(XircaV4, S400, SB, ViSmart, WR6)
- Custom electronic products: CODE, Sensonic, Ledlocal
- FPGA IP cores: Memory controllers, Ethernet UDP stack, motion detection, video-analytics, etc..
- **White Rabbit products** (Switch, Spec , FMC DIO, FMC TDC; FMC ADC…..)

Markets & customers

Experience in different fields:

- Security
- Automobiles, Aerospace and industrial sectors
- Biomedicine / Health
- Robotics
- Hi-tech training



Some customers

- **CERN** (European Organization for Nuclear Research), GSI, DESY, NIK-HEF.
- IAA (Instituto Andaluz de Astrofísica, CSIC)
- Schepens Eye Institut (Harvard University), University of Genoa (Italy), University of Granada
- Telefónica I+D, NTGS,…
- Parque de las Ciencias de Granada, Sam Innovex,…

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- Participation in diverse research projects (subcontracted by research institutions or as partners → **RECOMP**, **ACELTEC, etc..**)

- Working team: high ratio of specialized Engineers and doctors.

Passion for challenges!

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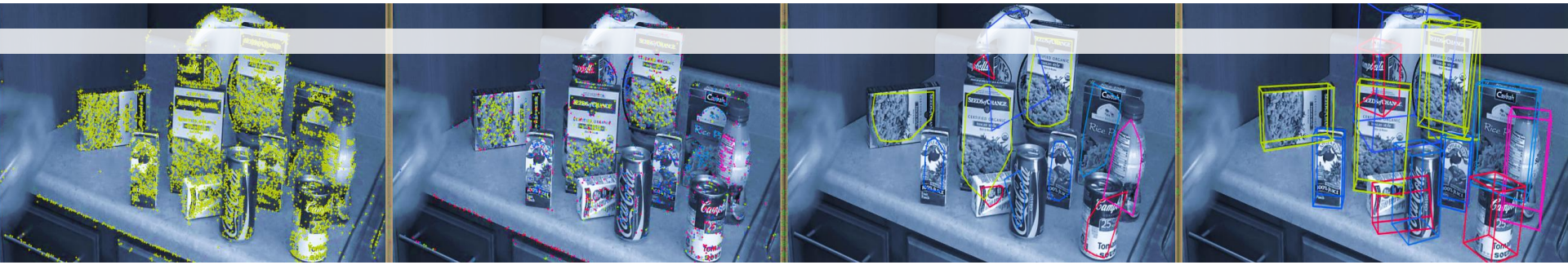

High-performance platforms for

EMBEDDED REAL-TIME VISION

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Xirca V4

- **XircaV4** is a **co-processing** platform, based on FPGA (Virtex-4 of Xilinx).
  - Also works as a "**stand-alone**" platform

- Designed for real-time image processing, and **IP-cores development and testing**.

- It includes an FPGA device (Virtex 4), communication buses (PCI Express, MGT Rochet IO and Ethernet Gigabit), off-chip memory support (DDR and ZBT).

- The platform is fully supported with **SoC** and **high-level synthesis** design tools

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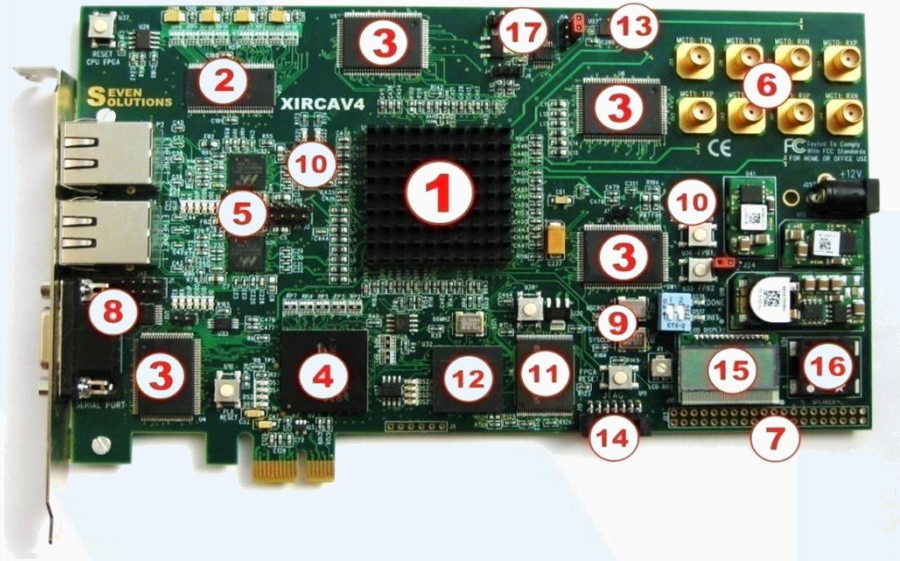
Xirca V4



1) **VIRTEX-4 FPGA** (XC4VFX100-10FFG1152).
2) 2 independent banks of **DDR SDRAM** (512Mb).
3) 4 Pipelined **SRAM** memory chips 72-Mbit.
4) 1 **PCI Express** port 1x.
5) 2 tri-speed **Ethernet PHY transceiver** 100/1000.
6) 8 SMA connectors connected to 2 **Rockets IO**.
7) 20 expansion pins.
8) 1 RS-232 Serial port.
9) 1 User clock, 100 MHz and 125 MHz.
10) 2 LEDs y 2 push buttons.
11) 2 Flash memories (32MB) connected to CPLD.
12) CPLD to arbitrate the local bus.
13) 4-Kb IIC EEPROM.
14) 1 JTAG configuration port.
15) 1 LCD display: 2 lines x 8 characters.
16) 1 Buzzer.
17) IIC Fan Controller.

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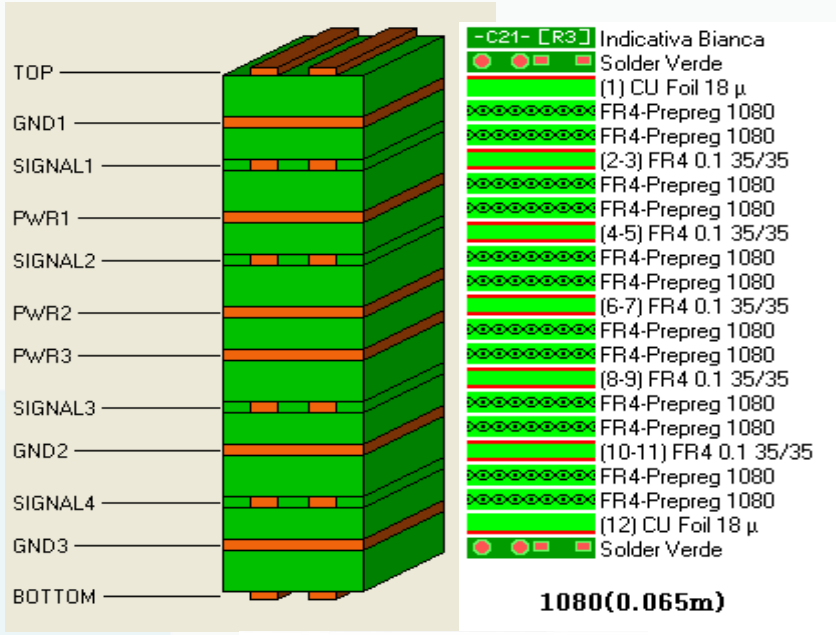
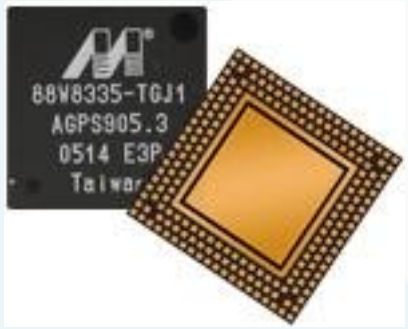
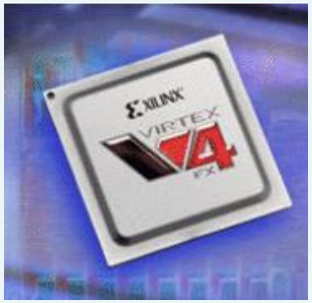
Xirca V4

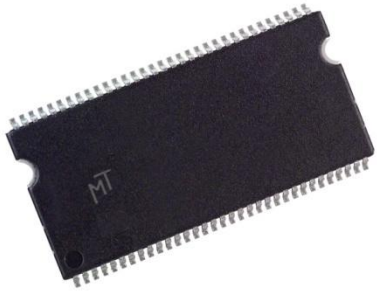
Technical characteristics

- **12 layers**
  - (6 planes and 6 routing layers)
- Minimum separation between paths: 0.095mm
- 1.6 mm thickness
- 3654 drills
- 9 different internal voltages
- Ecapsulated technology used:
  - **Flip Chip BGA** (FF1152), separation 1.0mm
  - CSP (Chip Scale Package), separation 0.5mm
  - TSSOP, TQFP, separation 0.6mm









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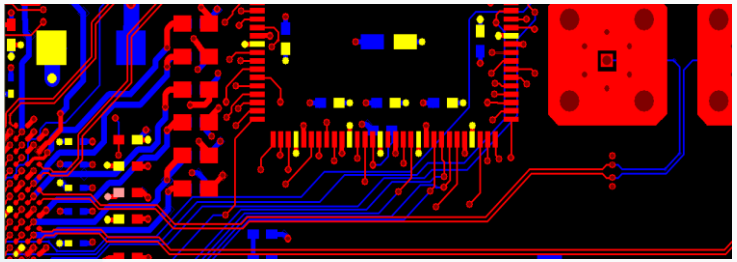
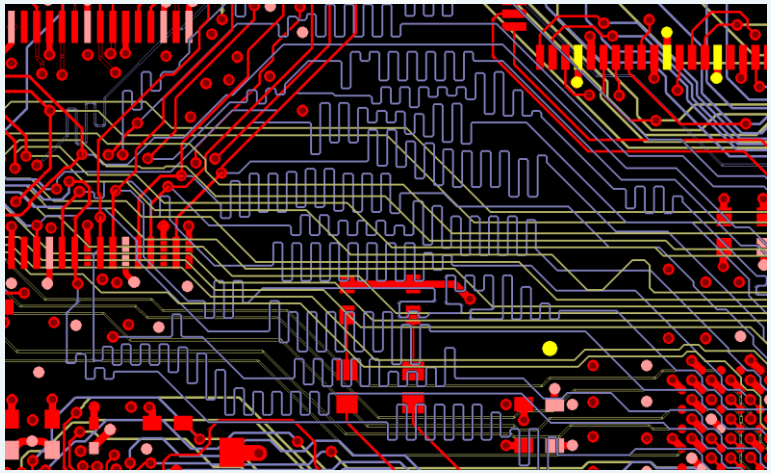
Xirca V4

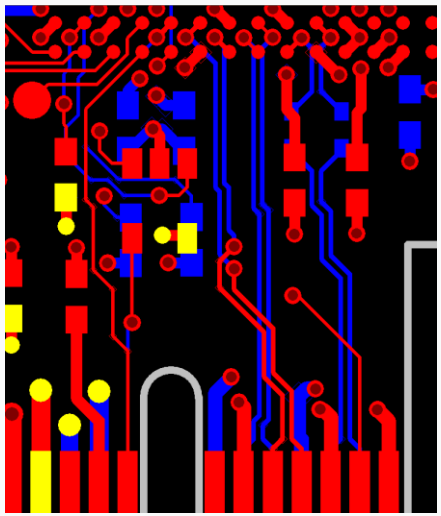
Technical Characteristics

- **Controlled impedance** (DDR, ZBT, Ethernet Gigabit, PCI-express, MGT RocketIO…):
  - 50 ohms (single traces).
  - 100 ohms (differential pairs).
- Signal Integrity simulations (Hyperlynx):
  - LineSim
  - BoardSim
  - Ussing IBIS models



- **Paths length control** (DDR, Differential pairs).





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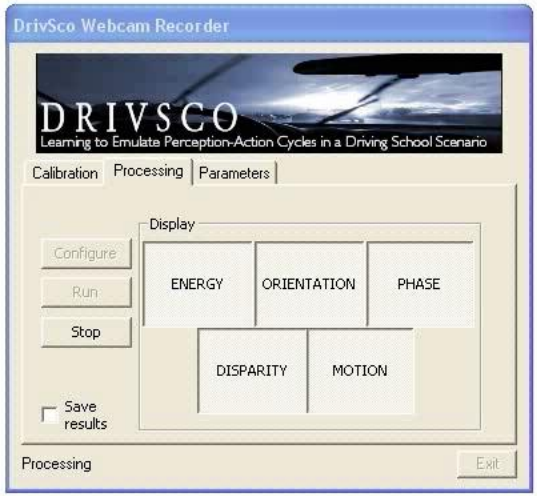
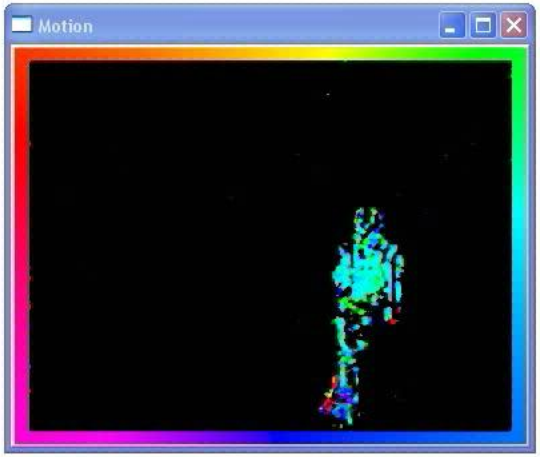
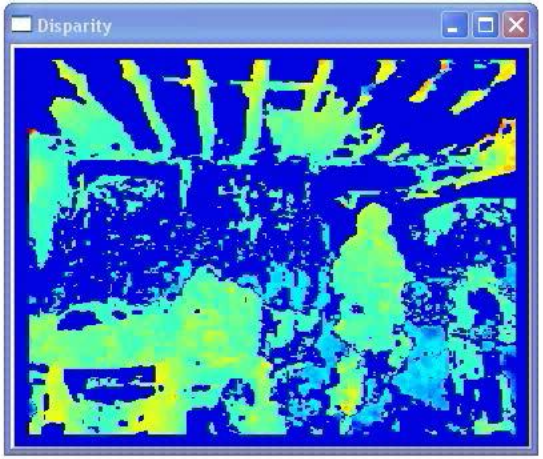
Coprocessing application example

- Demo developed by UGR for EU grant







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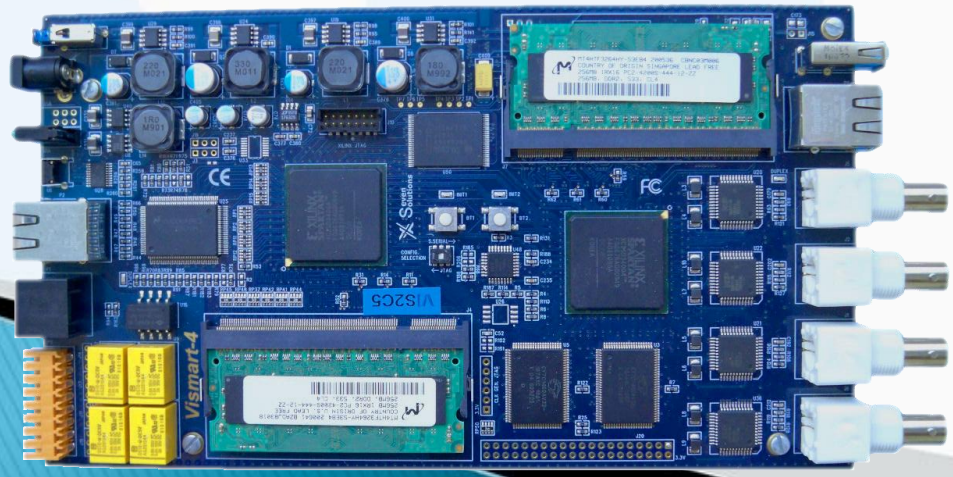
Vismart-4 multi-chip platform

- *High performance multi-chip FPGA platform (Spartan3 DSP)*
- *Stand-alone* platform
- **Hi scalability and memory support**
- **Fully supported peripherals**
- **SoC:** direct C programming
- **Parallel access to the cameras image streams:**
  - ✓ 4 cameras can be used and processed in parallel.



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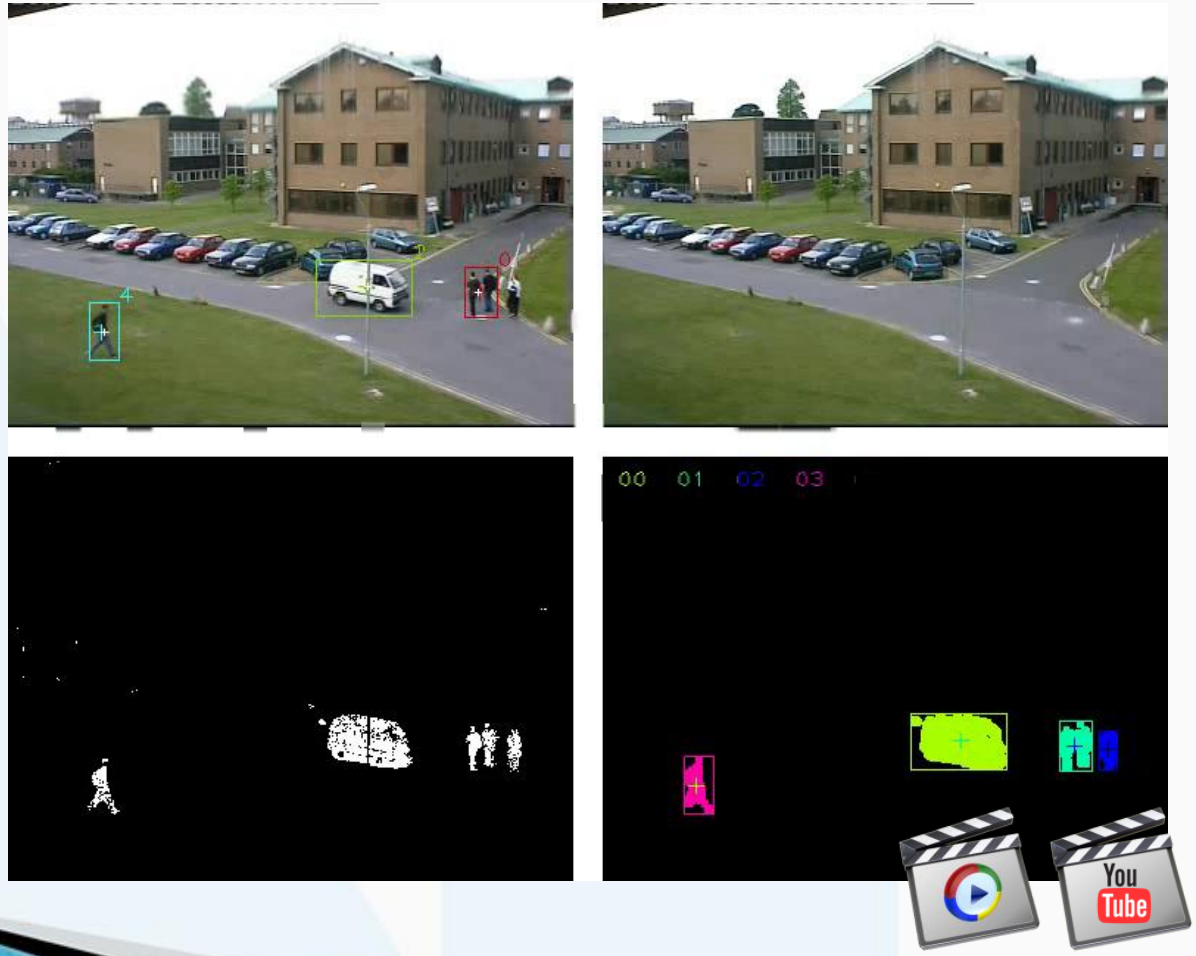
On-chip videoanalytics example



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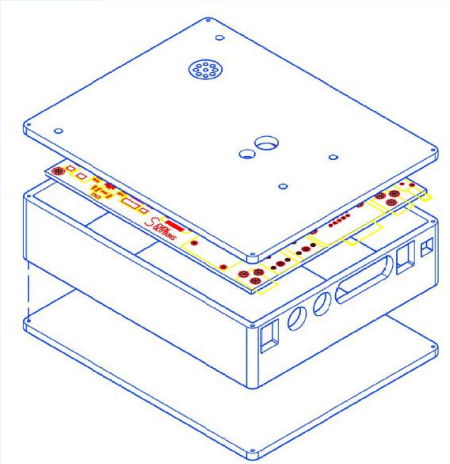
SB portable platform

- *Stand-alone platform*.
- **Portable**. 5000mA battery for more than 10 hours of autonomy
- **EDK support** for direct C programming
- **Peripherals fully supported**



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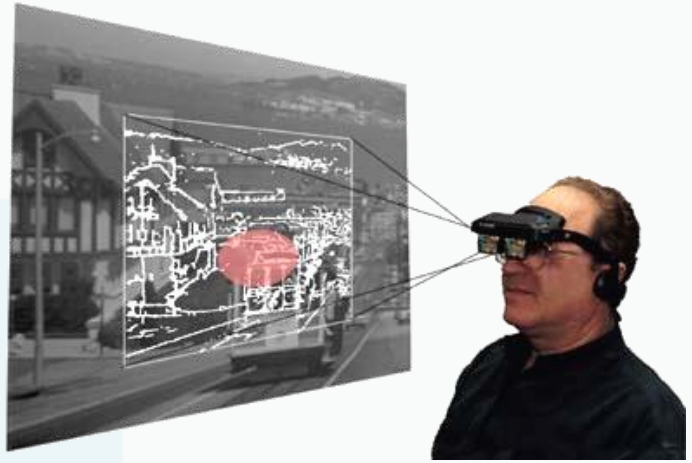
SB Application example

- Collaboration with UGR, UMU & Schepens Eye Institute (Harvard University),
  - Application oriented to low vision patients with **visual deficiencies** such as tunnel vision, foveal vision lost, etc.
  - On-chip processing: zoom, detection of edges, binarization, etc.



Embedded Video-Analytics
SECURITY & VIDEOSURVEILLANCE.

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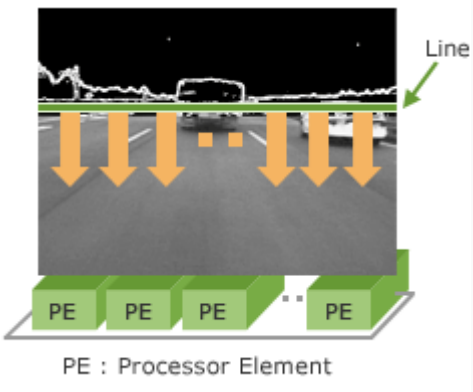
7S video analytics advantage

- Embedded hardware FPGA technology.
  - **100x processing speed up** thanks to the utilization of specific hardware (FPGA,DSP)
  - **100x durability**
    (no moving elements, low power consumption, etc)
  - **10x** less power consumption.
  - **Autonomous** system
  - **Scalable** system: flexible architecture



Expertise on distributed video surveillance solutions

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IP Core for videoanalytics I

- Multimodal background estimation
  - Basic stage of videoanalytics capable to detect moving object on a stationary camera.
  - Multimodal background model. Capable of dealing with periodic movement (waving trees, elevator movements, etc..) without producing false alarms.
- Applications: integration on smart IP cameras for security.
  - Ideal for distributed systems development

System accuracy example. From left to right: first image, input of a sequence with moving trees (Wallflower dataset). Second picture, background grounth-truh manually estimated. Third to fith, background models of well-known approaches. Last picture, our IP core results. .

IP Core for videoanalytics II

- Resources & performance
  - Resources on a Xilinx XC3SD3400aFG676 FPGA
    - 26% slices, 66% DSP48s.
    - Max operating frequency: 70 MHz.
  - Performance:
    - One camera with 1280x1024 pixels resolution at 16 fps
    - Four cameras with VGA resolution up to 18 FPS.
    - It require a system clock of 66 MHz and external memory DDR2 interface as provided with Vismark multichip platform.
- Software functional model for evaluation.
- IP core provided as netlist or source format.

Distributed videosurveillance

- Computational power on edge devices
- Number of camera unlimited
- Access from anywhere in the world
- Flexible & scalable architecture
- Third party integration

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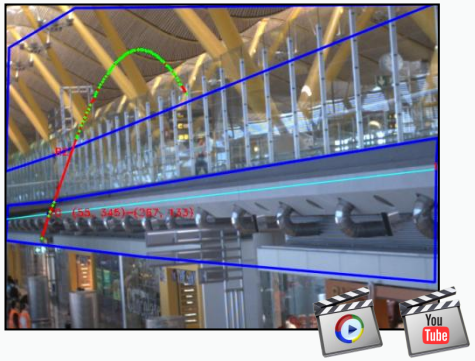
References

- **Virtual Roof** in the *Madrid/Barajas* Terminal4
  *(*detection of throwing objects)

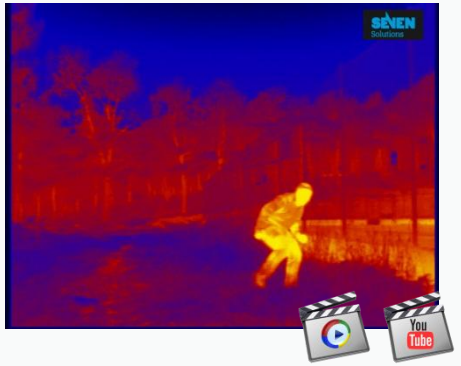


- Queue estimation in T4
  (Estimation of waiting time)

- Video analysis: counting people and dynamic privacy in the University of Granada

References (II)

- Perimeter security combined with thermal video analysis in a solar plant (perimeter>8km), Castuera (ASSYCE)



- CCTV synchronized with microwaves barrier in a private parking

- Perimeter security in a solar plant, Escúzar, Moraleda (*ASSYCE*)

Creating technology for science

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Capacities and expertise

- Technology for science:
  - Real time embedded software (DSP, microcontrolers, etc).
  - High performance processing with FPGA
  - IP cores design
  - System on Chip (SoC) design
  - High performance PCB design (FPGA, DSP, etc)
  - Safety critical design, test and certification
  - Embedded control systems

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Creating technology for science

- CERN: White-Rabbit Project
  - Currently collaborating in the development of White Rabbit platform (WR6).
  - Design of hardware boards (high performance switch based on FPGA)
  - IP cores design (Wishbone serializer)
  - PCB fabrication, test and support.

- ESA : E*uropean Spatial Agency (*IAA)
  - Development of embedded software, FPGA boards and HDL code (RTEMS OS, DSP baremetal code, LEON-3 architectures, Rad-tolerant electronics)
  - Related project:
    - IMAX in Sunrise project
    - NOMAD in EXOMARS
    - SOPHI of Solar Orbiter

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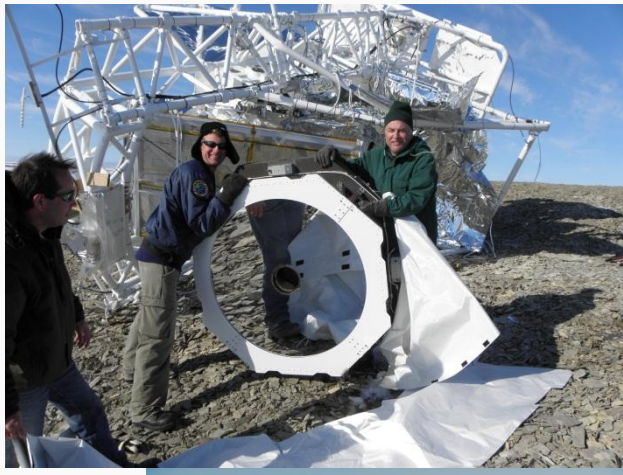
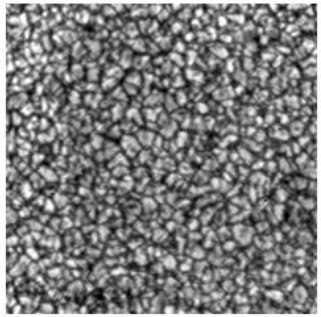
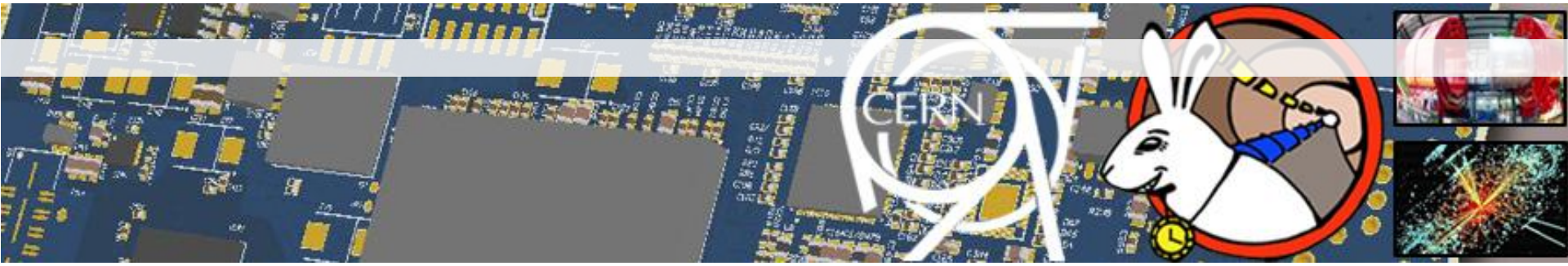
Creating technology for science

- IMAX Sunrise 2009





***Sunrise* first image.** Granulation at disk center as seen in one of the modulation states of the IMaX instrument. Preliminary processed thumbnail with a 4x4 binning. 256x256 pixels (0."22/px). Exposure time: 1.5 s. λ = 525.04 nm. Field of view: 56".



EXAMPLE OF COLLABORATION

THE WHITE RABBIT PROJECT

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White Rabbit project

What is White Rabbit?

An Ethernet extension which provides:

- Synchronous mode - **precise time** and frequency transfer.
- .Precision Time Protocol (IEEE1588) + Synchronous Ethernet + DMTD phase tracking
- **Deterministic** routing latency

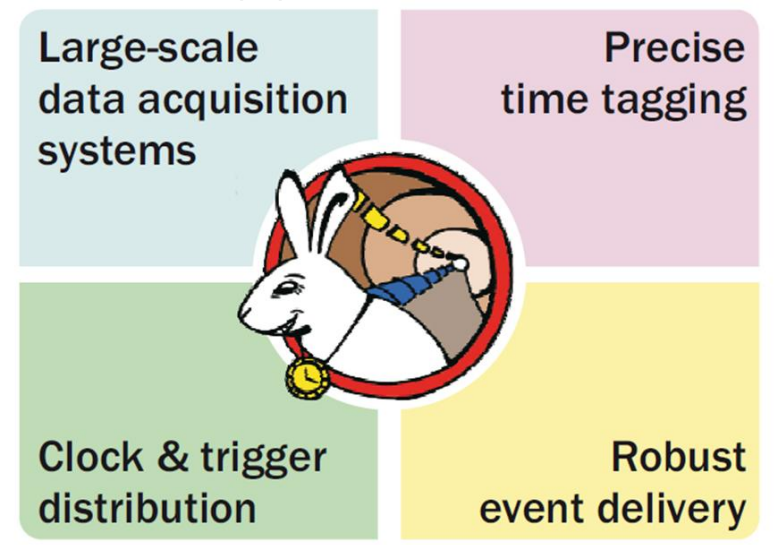
Characteristics

- ~1000 nodes synchronized up to 10 Km
- **Sub-nano second accuracy !!**
- **Selft-calibration**

Development model

- Collaborative, industry and research centers (CERN, GSI, …) but with **commercial support**.
- ❑ Open source

Applications



7S role in White Rabbit project

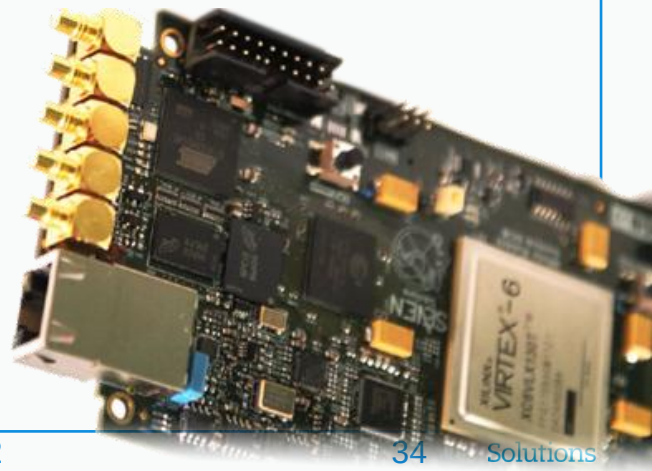
- **White Rabbit Switch**
- **White Rabbit integrated solutions:** production, customization, design, support and more…

OPEN HW/SW COMMUNITY

BRIDGE (7S)
- Support
- Customization
- Production

…

COMMERCIAL TECHNOLOGIES / FINAL CUSTOMERS



WRS-3/18

White Rabbit Switch v3

Standalone version with 18 SFP ports

White Rabbit Switch (WRS) is the key component of the White Rabbit Protocol that provides precision timing and high synchronization over an Ethernet-based network.

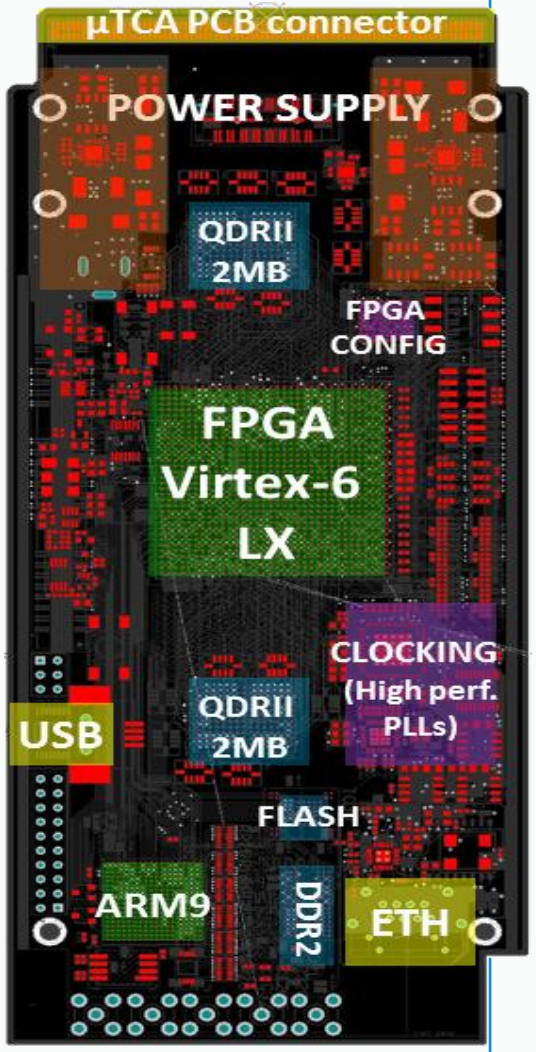
The WRS can be configured as master and sends its clock to all the nodes in the network using cascade architecture.

The WRS-3/18 version is a standalone version using 18 SFP connectors to synchronize the different nodes

- Time precision: sub-nanosecond timing.
- Scalability: 2000 nodes in the network
- Distance range: over 10km using fiber
- PTPv2, Sync-E
- Robustness configuration.
- RS-232 and USB debug.

WRS core board (SCB) components

- The board main elements are:
  - the High performance **Virtex-6 FPGA** (XC6VLX130T, XC6VLX240T or XC6VLX365T chips)
  - **ARM processor** (AT91SAM9G45). Well-known architecture and Linux support.
  - 32M x 16 DDR2
  - 256 MB NAND Flash
  - Ethernet 10/100 PHY
  - 8 MB SPI Boot Flash
  - ~~Two 512Kx36 QDRII SRAM~~
  - 8MB x 16 NOR Flash (for BPI FPGA Configuration)
  - 14-Output Clock Generator with Integrated 1.6 GHz VCO (AD9516-4)



White Rabbit switch status III

- Better with pictures!

White Rabbit switch status III

- Better with pictures!

An Open hardware model

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Open-hardware policy

- Subcontracting policies. Towards a service beyond subcontracting.
  - Open design and support for the customer (all materials are provided for the customer to make the full design available)
  - Flexibility in specifications and design cycle
  - Context of the design: Assimilation of previous designs by the customer.

Walking together makes friends!

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The Open hardware approach

- CERN license style (CERN OHL)
  - Publish everything needed for review, modify or produce
  - Persistent license. It requires that manufactures inform designers of dates and quantities of production.
- Advantages
  - Peer-review of designs → improving reliability
  - Design re-use
  - Healthier relationship between companies and scientific centers.
- Designs at: **Open Hardware Repository** http://www.ohwr.org

- **7S working policy**
  - Become one member more of your team.
  - Be involved at the very primary phases of our clients' designs
  - Use of Collaborative tools → sharing results on real-time

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SUMMARY AND CONCLUSIONS

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7S team profile

- We look for engineers…
  - Skillful and highly motivated (with electronics, computer science or telecommunications degrees)
  - Expertise on embedded systems (FPGA, DSPs, microcontrolers, RTOS, embedded Linux, optimized C/C++, CUDA, etc..)
  - Fluent in English, team players
  - Ready to face new challenges!

Summary & Conclusions

- 7S is a high-tech company focused on embedded platforms design and real-time image processing.
  - Systems customization as an important company advantage
  - We address the whole life-product cycle: requirements analysis, system design, fabrication, test and validation → **turn-key solutions**
- 7S creates solutions where conventional products cannot be used.
  - deep customization and development.
- We need embedded systems engineers!

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