Switch v3 Hardware Status and Plans

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Company overview

Seven Solutions (info@sevensols.com)
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: 11 active workers as manpower

- 1 Master of Business administration
- 1 Part-time accountant
- 2 Project managers
- 3 Hardware Engineers
- 1 Secretary
- 1 Business Manager
- 2 Software Engineers
Company overview

Services
- High-tech consulting & Advanced technical training
- Electronics boards design and production
- Embedded and real-time software development
- HW/SW dependable / safety-critical systems

**DO-254, DO-178B, IEC-61508**

Products
- Prototyping FPGA platforms, IP cores for communication, image processing and videoanalytics, instruments and control systems

Some customers
- Andalusia Institute of Astrophysics (Aerospace instruments), CERN, Telefónica I+D, Harvard University, several SMEs, etc...
7S role in White Rabbit project

- 7S is contracted by CERN to design the Switch board (White Rabbit Switch) as well as programming FPGA cores.
- The board has been designed according to the open hardware scheme and design files are available to the community.
The white Rabbit switch

OVERVIEW & STATUS
Switch elements

The switch is composed by two main elements:

- **Switch Core Board (SCB)**
  - It contains the main WR elements and interfaces

- **Additional board depending on configurations**
  - uTCA rack *(not available)*
  - Standalone: based on a minbackplane board, equipment inside a 19” case
White Rabbit Switch (WRS)

- SCB in uTCA. WRS Configuration:

- Tongue 4: SMI channels 7-12
- Tongue 3: SMI channels 1-6
- Tongue 2: Clocks (CLK1 and CLK2)
- Tongue 1: Power, IPMB, management and Downlinks[1:12]

- SCB in Standalone. Configuration:

- Connectors for communicating boards
- Tongue 3: not used

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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)
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.
White Rabbit switch production

- The design is already done.
- Additionally, we are involved on the production stages of the switch
  - PCB
  - Material orders and handling
  - Board soldering
  - Test and characterization
- Status
  - First prototypes produced but not all boards are functional
  - Production test under development ➔ Cesar’s Talk
  - Preliminary information available about switch cost, production time and different production-chain participants possibilities
Status (continuation)

- Soldering process rules: quality & manufacturability
  - This includes issues as component placement modification, pick&place considerations, components handling, manual vs automatic soldering, mounting sequence, etc..
  - Currently problems has been found on some BGA components. A new process has been re-defined in collaboration with third-party soldering companies to be tested at next board release.

- Boot problems: found ARM9 Atmel bug (see SAM9G45 errata list) for SPI FLASH memory par list under redefinition according to Atmel suggestions.

- DDR problems
  - Some boards present random problems, no deterministic.

Conclusion: production is not a trivial issue
The white Rabbit switch

FUTURE PLANS
Switch production planning

First commercial version available at this summer but:

- The PTS need to be fully implemented (a lot of progress already)
- Two productions batches are planned before commercialization
  - First one planed for late April
  - Second one for middle June.

(they could be available to beta-tester customers and/or tractors institutions but they could not be considered commercial products at these stages).

- Goals are:
  - Check that production quality and board reliability is high enough (this affects the final system cost).
  - Verify that PTS is able to cover the different HW failures
- Additional considerations: environmental conditions, industrial certifications, board durability, etc...
Switch production planning II

Starting kit based on Switches and spec boards

- Currently under definition.
- Probably, one switch as master plus two Spec board with fmc-dio card + fiber cable is a good configuration.
- Delivery dates to be discussed, what do you think?, before or after summer?

Switches hw modifications? T.B.D.

- Customized interfaces? (uTCA, other form-factor, reduced number of ports, etc.)
- White-rabbit for third-party products (for instance NI FlexRIO o cRIO).
SUMMARY

- HW design stage is finish
  - Modifications of the part-list or minor layout changes still under discussion ➔ Quality!
- Production process still need to be optimized.
  - Addressed in collaboration with third-party companies and quality departments (CERN?).
  - PTS of maximum relevance
  - Partnership for big projects
- Currently the switch is a beta product but the open-hardware framework allow to advance very fast ➔ commercial product available this summer
Thank you for your attention