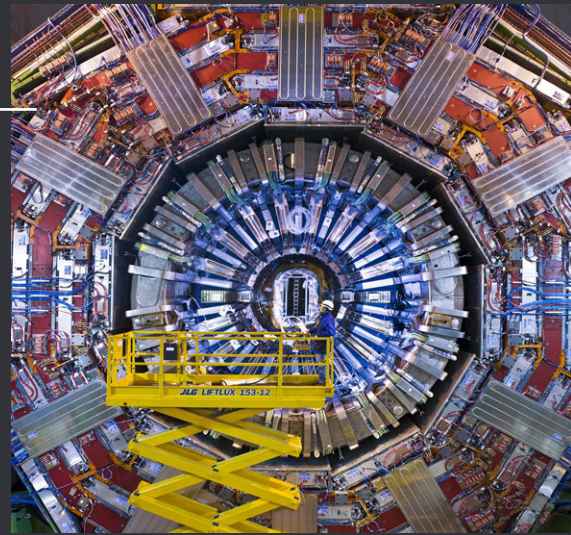


Consulting on timing systems and open source collaboration tools at the inception of CERN's White Rabbit project



EXECUTIVE SUMMARY

CERN, the European Organization for Nuclear Research, is one of the world's largest centres for scientific research. In 2008 Cosylab carried out a requirements gathering project commissioned as a part of the renovation of the master timing system that coordinates all machines taking part in the Large Hadron Collider (LHC) chain, the world's largest and most powerful particle accelerator. The requirements gathered from GSI (FAIR), IN2P3 and ITER contributed to the definition of the White Rabbit Timing system, part of CERN's Open Hardware initiative. White Rabbit now forms the basis for co-ordination of actions across accelerator machines at FAIR, for which Cosylab is delivering several hundred timing receivers in multiple form-factors.

To help bootstrap the open hardware initiative, Cosylab also implemented the initial web-based Open Hardware Repository portal for CERN.

CERN AND THE TIMING SYSTEM CHALLENGE

The Open Hardware Repository and White Rabbit are answers to the avoidable duplication of effort, across different labs and sometimes even within one lab, when it comes to the design and implementation of Accelerator Timing Systems. Compared with software, hardware development comes with specific additional challenges when it comes to reuse:

- Schematics and PCB layouts are harder to share than software code
- The non-open nature of commercial tools
- The multitude of file formats

CUSTOMER

CERN, European Organization for Nuclear Research

INDUSTRY

BIG SCIENCE

22 EUROPEAN MEMBER STATES
Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland and United Kingdom

8 ASSOCIATE MEMBER STATES
Cyprus, India, Lithuania, Pakistan, Serbia, Slovenia, Turkey and Ukraine

YEARLY BUDGET

approx. 1,1 Billion CHF



supplier

SERVICES

- Timing Systems for Big Physics
- System Analysis and Requirements Gathering
- Expert Advice

TECHNOLOGIES

- FPGA
- MicroTCA, VME, PCI
- White Rabbit

If it is the ambition of an open source project to cater to the needs and demands of different facilities, then it is essential that there is a phase of diligent requirements gathering at the start. The consultants that will be collecting timing system requirements from different labs need to have the time and resources available to execute the project and also need to have the high level of specific technical expertise around timing system architectures.

The Beams Department - Controls - Hardware and Timing (BE-CO-HT) section at CERN found in Cosylab to be a suitable partner for this task.

REQUIREMENTS GATHERING

Cosylab collected timing system requirements, through phone, video conference or in person, from:

- CERN, particularly the General Machine Timing that was considered for renovation
- the GSI Helmholtz Centre for Heavy Ion Research, particularly the Facility for Antiproton and Ion Research (FAIR) project
- Institut national de physique nucléaire et de physique des particules (IN2P3), particularly L'Institut de Physique Nucléaire de Lyon (IPNL)
- ITER, the International Thermonuclear Experimental Reactor in France

In preparing the first version of the Open Hardware Repository, CERN benefited from Cosylab's range of skills and connections with many laboratories.

Javier Serrano, Hardware and Timing section leader, BE-CO, CERN

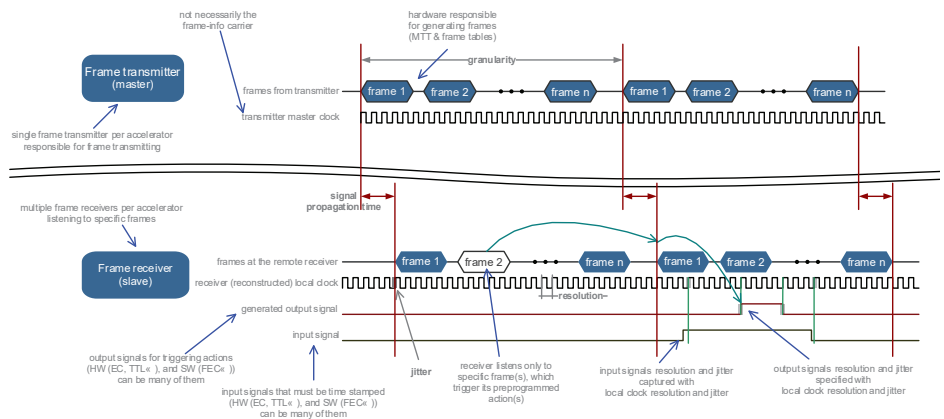
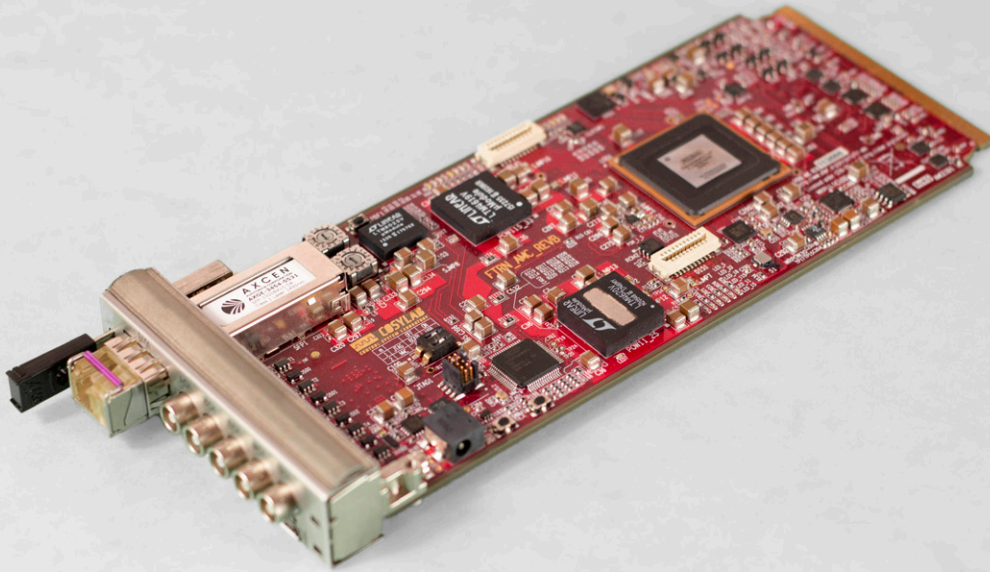


Illustration: Low-level timing aspects overview of General Machine Timing



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The MTCA.4 AMC White Rabbit based Timing Receiver card that Cosylab developed for GSI/FAIR

The requirements were organized into layers, starting at the lowest (physical) layer and moving up until the event distribution processor. Then commonalities were listed and the potential incompatibilities were identified.

Javier Serrano says: "The presence of a timing expert in Cosylab's team was instrumental for choosing them as a partner in the early days of the White Rabbit project. In addition, the experience of Cosylab working on many projects for many different users in our community made them a suitable partner for the requirements gathering phase."

Open Hardware Repository Setup

Cosylab implemented the first version of the Open Hardware Repository website portal, that consisted of a file repository, a wiki and general project documentation. Because of Cosylab's understanding of open source collaboration workflows, they could quickly converge with the customer to the best setup and what was to be done. To further speed up the "time to market", Cosylab also took on the implementation and hosting of the first version of the site.

Cosylab was a suitable partner because they could quickly identify the needs and come up with a first version of the site in a few months.

Javier Serrano



White Rabbit provides sub-nanosecond accuracy and picosecond precision of synchronization for large distributed systems.

SERVICE BENEFITS

- Time saved by having fast research results
- Increased quality of requirements by adding a wide field of expertise
- Time saved by flexible addition of complementary development services
- Solution tailored, fitting an open-source community



On October 12 2017, in Barcelona, Javier Serrano was awarded the ICALEPCS Lifetime Achievement Award for major contributions to the creation of the Open Hardware movement. (images: ICALEPCS 2017)

White Rabbit and the Open Hardware Repository today

On October 12 2017, in Barcelona, Javier Serrano was awarded the ICALEPCS Lifetime Achievement Award for his major contributions to the creation of the Open Hardware movement.

ICALEPCS is the leading international conference in the field of accelerator control systems.

The Open Hardware Repository currently holds more than 280 projects and subprojects (White Rabbit is one of the key projects).

<https://www.ohwr.org/>

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Javier Serrano



Founded in 2001, Cosylab provides and integrates state-of-the-art software and electronics for the world's most complex, precise and advanced systems, to enable research organizations to make scientific breakthroughs, hospitals to deliver better cancer treatment and organizations to improve their performance. The company employs engineers and physicists that understand the physical operational principles of highly complex devices and master the software and hardware engineering of large-scale distributed control systems at the same time. Headquartered in Slovenia, Cosylab has a strong international presence and has worked on hundreds of multi-year and multi-people projects all over the world.



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We're here to answer your questions.

For more information on building the right control system infrastructure for your integration project, send an email to info@cosylab.com

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