

White Rabbit Workshop 2022

Report of Contributions

Contribution ID: 1

Type: **not specified**

Welcome to the 12th White Rabbit Workshop

Saturday 8 October 2022 14:00 (30 minutes)

A quick introduction for newcomers and setting the scene for the workshop. One of the main themes of this workshop will be the final discussions before the launch of the White Rabbit Collaboration, which aims at making WR more sustainable, higher-quality and generally more useful to more people. The second part of this presentation will introduce this subject briefly, and we will have more in-depth discussions in later slots.

Contribution ID: 2

Type: **not specified**

Status of the WR Switch (current v3 and new v4)

Saturday 8 October 2022 14:30 (30 minutes)

The presentation will summarize features available in the latest firmware release v6.0.1 of the WR Switch v3, as well as new features available in the master that will be added to the next release. It will also explain how new features can be submitted by contributors. The presentation will then outline the architecture, features and design status of the next generation WR Switch v4. A road map for related developments will be presented.

Contribution ID: 3

Type: **not specified**

New WRPC release (v5)

Saturday 8 October 2022 15:00 (30 minutes)

The presentation gives an overview of the White Rabbit PTP Core (WRPC) gateway and software architecture.

It summarizes the newly introduced features and boards in the WRPC v5 release as well as those features in the pipeline for the next release.

Finally the repo management and how new features can be submitted by contributors will be discussed.

Contribution ID: 4

Type: **not specified**

The new WR Collaboration scheme

Saturday 8 October 2022 16:00 (30 minutes)

In this talk, I will present the White Rabbit Collaboration, which is currently being shaped and will launch in the coming months. The Collaboration aims to gather all stakeholders of the technology in a global community that will work to ensure society and companies can benefit from the full potential of the technology. By pooling resources from all its members, the collaboration will work to ensure the IEEE 1588-2019 standard can be implemented through an open hardware core that is maintained and upgraded to the highest level of performance. We thus intend to create a supportive and forward-looking community that drives the uptake of the technology in emerging sectors. The collaboration aims to become the reference point for the White Rabbit technology and offer a unique voice to its members.

Contribution ID: 5

Type: **not specified**

Discussion session

Saturday 8 October 2022 16:30 (30 minutes)

Contribution ID: 6

Type: **not specified**

BabyWR: White Rabbit in Gravitational Observatories:

Saturday 8 October 2022 17:00 (30 minutes)

A Gravitational Observatory is a large interferometer for detection of gravitational waves. The timing system of the Virgo European Gravitational Observatory near Pisa will be upgraded. A White Rabbit demonstrator was designed to validate White Rabbit in the Virgo timing system. Currently a pathfinder experiment for Einstein Telescope (ET-Pathfinder) is under construction in Maastricht (NL) as a first step towards future Einstein Telescope (ET). Throughout these Gravitational Observatory infrastructures many clocks are needed. Clocks need deterministic phase, some clocks need to be ultra low phase noise. We believe that BabyWR, a small plugin module with minimal functionality, will be an easy and cost effective solution for the many clocks that will be needed in these Gravitational Observatories. BabyWR will generate a 1PPS and a low phase noise 10MHz ($< 100\text{dBc/Hz}@10\text{Hz}$). Optionally a more expensive high performance external oscillator can be used to improve phase noise for demanding clocks. Third parties and companies can profit from this implementation as well by re-using the design and/or bringing the design to the market.

Contribution ID: 7

Type: **not specified**

Field experience with high channel count WR systems

Saturday 8 October 2022 17:30 (30 minutes)

D-TACQ Solutions provides high channel count data acquisition systems to “Big Physics”. Over 20 years, we’ve concentrated on the Y axis, while developing various schemes to ensure T axis synchronization both in-crate and out of crate. Porting the White Rabbit core to our existing platform solved the synchronization problem and allowed us to deliver a large “distributed oscilloscope” application. Since then, “White Rabbit On Board” has allowed our business to branch out into new applications. The talk focuses on how WR helped us, some technical and institutional workarounds that allowed us to succeed, and where the availability of distributed precision timing is taking future development.

Contribution ID: 8

Type: **not specified**

Operational experience with a WR-based timing system in GSI

Sunday 9 October 2022 14:00 (30 minutes)

At GSI, the White Rabbit based General Machine Timing System is used for operation of all three ring machines (SIS18, ESR and CRYRING) as well as all transfer lines. Moreover, the system is in test operation at the linear accelerator UNILAC, which serves as injector for the SIS18 synchrotron. The productive system uses about 50 White Rabbit switches and a couple of hundred nodes. In 2022, the GSI accelerator complex was used for about seven months of beam production and this presentation reports on our operational experience with the White Rabbit based timing system.

Contribution ID: 9

Type: **not specified**

WR at CERN

Sunday 9 October 2022 14:30 (30 minutes)

Presentation of White Rabbit Timing (WRT), the new CERN project that aims at providing a generic event-based timing system covering both TAI and RF timebases.

WRT is planned for deployment in 2026 at CERN and with more than 2k nodes it will become the biggest WR installation of the laboratory.

The presentation will also provide an overview of some of the most important WR applications currently in operation at CERN.

Contribution ID: **10**Type: **not specified**

WR deployment at the Swiss Plasma Center

Sunday 9 October 2022 15:00 (30 minutes)

The Swiss Plasma Center (SPC) scientists work on plasma and nuclear fusion on the Tokamak à Configuration Variable (TCV) operated using a timing system designed in the late 80's. Newer acquisition devices have higher timing requirements than when TCV was built. There is a need for an accurate timing system inter-operable with the legacy timing system and with newer devices. This presentation shows the work that has been done so far at SPC for deploying White Rabbit Protocol in parallel with our existing timing system

Contribution ID: 11

Type: **not specified**

Using White Rabbit Trigger Distribution protocol in a heterogeneous timing environment

Sunday 9 October 2022 16:00 (15 minutes)

Fusion experiments involve controlling things and measuring things over a very wide range of timescales. Processes range from experiment lifespan (years), campaigns (months), day to day operations (weeks, days), shots (seconds) and measurement samples (milliseconds to fractions of microseconds). It is very important to be able to align events and measurements over this entire range. The upcoming SPARC tokamak (Commonwealth Fusion Systems / MIT) will be built with high temperature superconducting magnets. They will be cooled, charged and energized over long periods of time. We have decided to adopt an absolute time of day time-base for both control and data acquisition. Triggers will be distributed using the white rabbit trigger distribution (WRTD) protocol and consumed by heterogeneous clients synchronized by white rabbit, IEEE/1588 or NTP depending on their needs and capabilities. The central control system will send a WRTD message declaring that 'plasma start' will be at some whole second time of day in the future. Clients will then perform their preprogrammed activities on a time-base with 0.0 (or other defined time) happening at the time specified in the message. Constraining these messages to talk only about whole seconds allows clients to begin operating at specified timing phases prior to the absolute time of the event being defined. A C language library with python bindings, and a command line tool have been developed and tested. It can both generate and wait for timing events as well as programmatically returning the WRTD desired times.

Contribution ID: 12

Type: **not specified**

Precision Time Sync in Datacenters and potential applications for WR and Time Appliances Project

Sunday 9 October 2022 16:15 (15 minutes)

With the increase in demand for cloud services, horizontal expansion is a must. Getting multiple machines to perform consistently requires consensus. Consensus can be achieved by exchanging votes between all participating machines. This process is difficult to scale, while the alternative is to use a distributed clock. Depending on the method, distributed clocks can have different levels of precision which in return, affects the performance of the cloud services. Time Appliances Project was formed three years ago to help with the development of hardware and software as well as alignment of the datacenter industry. Time Card and Open Time server were a result of this project and paved the road for the adaption of PTP which led to a significant improvement over the performance bottleneck previously imposed by NTP. WR can provide an incremental improvement in performance over PTP by enabling distributed clocks with higher performance across the datacenter.

Contribution ID: 13

Type: **not specified**

IEEE Standardisation

Sunday 9 October 2022 16:30 (30 minutes)

The presentation will summarise how WR was included into the IEEE1588-2019 standard as the High Accuracy Default PTP Profile. It will compare the new High Accuracy protocol with the White Rabbit protocol it was based on, and provide a road map towards using High Accuracy with existing White Rabbit hardware. The presentation will also cover other contributions of the WR community to the standard, such as standardisation of in-situ asymmetry calibration, development of an SNMP MIB to allow standardised management of devices implementing High Accuracy, or standardisation of WR-required parameters in the EEPROM of SFPs.

Contribution ID: 14

Type: **not specified**

Distributed radiofrequency signal acquisition and synthesis along a White Rabbit network using embedded boards (Raspberry Pi4 + SPEC)

Sunday 9 October 2022 17:00 (30 minutes)

White Rabbit (WR) allows for synchronizing any device on a dedicated GbE network with sub-ns accuracy (typically 60 ps at 1s integration time) most often materialized by providing 1-PPS and 10 MHz outputs. However, practical applications for distributed coherent radiofrequency (RF) synthesis or acquisition, e.g. for a distributed RADAR requiring coherent local oscillators and synchronized sampling for Direction of Arrival measurement, must exploit the WR clocks. After demonstrating last year [1] the use of WR implemented on PCi SPEC boards on embedded single board computers (OEM version of the Raspberry Pi4), we discuss how the WR-synchronized clocks can be used for generating the signals needed for RF signal synthesis and acquisition, first by using external network synchronizing dedicated peripherals (ADi AD9548) and then thanks to CERN's control of the Si570 oscillator controlling the analog to digital converter of the FMC-ADC board implemented by Tomasz Włostowski. We show from phase noise measurements that the local oscillator fluctuation is the main source of instability and the phase locked loops do not add additional noise. Perspectives include merging distributed acquisition brought by the WRTD project with this PLL controlling feature to provide coherent acquisition capability.

[1] <https://github.com/oscimp/WRTD-FMC-ADC>

Contribution ID: 15

Type: **not specified**

New features in experimental phase:

Sunday 9 October 2022 17:30 (30 minutes)

Disciplining Si57x oscillators and a DAC-less WR; this presentation focuses on features the WR community is currently experimenting with.