White Rabbit

BE-CO Technical Meeting, 8th June 2017

<table>
<thead>
<tr>
<th>Presenters</th>
<th>Maciej Lipinski, Julien Palluel, Dimitris Lampridis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>874-1-011</td>
</tr>
<tr>
<td>Chairman/ Secretary</td>
<td>Eve Fortescue-Beck</td>
</tr>
</tbody>
</table>

**Agenda:**

- Real-Time distribution of magnetic field values using WR: the FIRESTORM project
- White Rabbit as a CO Service
- WRIXI: Distributed Instrumentation over White Rabbit

**Presentation: Real-Time distribution of magnetic field values using WR: the FIRESTORM project**

Maciej Lipinski from the Hardware and Timing Section gave an introduction to White Rabbit technology and its applications, focusing on the new installation for the B-Train system.

He explained that a White Rabbit network is an Ethernet network with 2 additional features: Deterministic Data delivery and Sub nanosecond accuracy of synchronisation. It was initially developed as a next generation network for controls and timing, however its versatility has led to it being adopted for many diverse applications both inside and outside CERN.

The B-train system is used to distribute the real-time magnetic field value for beam control. The current system uses obsolete, unrepairable, unsupported hardware which cannot perform at the required resolution. In addition, the installations are not standard between accelerators. The TE-MSC group initiated the FIRESTORM (Field In REal-time STreaming from Online Reference Magnets) project to renovate this critical operational system, in collaboration with EPC, RF, BI and CO, in order to address the shortcomings of the current system and consolidate its hardware and software for all accelerators. TE-MSC chose White Rabbit for the distribution of information in the new B-Train system.

In FIRESTORM, White Rabbit transmits Ethernet frames in a 1GB/s bandwidth and can distribute the magnetic field (B) values simultaneously from different sources in a single Ethernet Frame. The system is very flexible and a White Rabbit switch can be connected to many different clients.

Maciej explained the stack of cores in the FPGA-based WR BTrain nodes and how the WR network was configured for the BTrain in the PS using redundant VLANs. The system has been installed in the PS since 2014 and was tested with RF and POPs in 2017. Following this, equivalent BTrain WR systems have been installed in ELENA and LEIR, and the installation in the PSB is in progress. FIRESTORM is an excellent example of a smooth collaboration between the MSC, EPC, RF, BI and CO groups.

**Discussion Highlights:**

Andrzej asked where the synchronisation is provided when there is just one switch? Maciej replied that the switch is the timing master and all nodes are synchronised with it. Andrzej then asked what is the advantage gained by having two VLANs? Maciej said that it was to reduce collisions. Andrzej clarified whether this was to provide redundancy and Maciej confirmed that each node could be physically connected to two switches.

Fred asked how the White Rabbit Network manages clients that broadcast a lot of data. Maciej responded that if a client that is not expected to send data, sends data, it is discarded.
Presentation: White Rabbit as a CO Service

Julien Palluel from the Infrastructure Section presented the plan for how White Rabbit will be supported as a CO Service.

The purpose of this project is to provide BE-CO support to any CERN user, similar to the existing WorldFip service. It concerns all aspects of the installation, operation and the maintenance of a White Rabbit-based network. The service must be available and fully operational for the start of LS2.

Using a Goal Directed Project Management (GDPM) approach, Julien explained the scope of the project, its constraints and important milestones. Many people in CO are implicated in this project and the approach clearly showed the actors, their roles, tasks and dependencies. The project was officially started in February 2017, and is foreseen to end at the beginning of 2018. There are already some delays, but as most of the delayed tasks do not have a big impact on other milestones, it is possible that the schedule can recover.

Discussion Highlights:

Concerning the security review of the switches, Andrzej asked whether there was a specification of what is being tested, and what is guaranteed afterwards? Javier replied that as the switches would be deployed on the TN, Stefan Lueders was asked to make an assessment of potential security problems and approve the installation.

Presentation: WRXI: Distributed Instrumentation over White Rabbit

Dimitris Lampridis from the Hardware and Timing section presented White Rabbit Extensions for instrumentation, and its application in the renovation of the OASIS trigger distribution system.

White Rabbit eXtensions for Instrumentation (WRXI) is a communication protocol which aims to augment WR to allow easier detection, configuration and coordination of instrumentation distributed over long distances. The presentation introduced the basic ideas and mechanisms behind WRXI, the reasons for doing it now and the plans for its development.

Dimitris explained that with White Rabbit (WR) technology entering a mature phase, OASIS transitioning to a WR-based trigger distribution mechanism and an increasing number of commercial digitizers now including a WR interface by default, it is now the right time to develop and formalize the method which will allow users to easily deploy complex instrumentation networks over WR.

OASIS components were ageing and becoming hard to source. Furthermore the system was not scalable and there were uncompensated delays due to cable lengths and temperature variances etc. These problems could all be resolved by applying a straightforward WRXI approach. OASIS triggers are converted into WR messages at the sources using FMC-TDC cards and then broadcast on the WR network. The messages are received by WRXI-enabled digitizers, or converted back to TTL pulses using FMC-Delay cards.

White Rabbit is being increasingly adopted outside of CERN and many companies are producing different flavours of “White Rabbit Supported Hardware”. However, White Rabbit support is not well-defined and we need to formalise what this mean for an instrument. WRXI is required in order to avoid the need to develop different integration solutions for different commercial WR products, and hide the complexity via WRXI compliance. The WRXI Study is an ongoing CO initiative to study existing solutions, obtain user requirements and agree, through forming a consortium, on a standard for WRXI. Currently, the nearest standard is LXI (LAN eXtensions for Instrumentation) which has many compatible functions. This initiative also includes producing a WRXI demonstrator as a testbed for new commercial products.

Discussion Highlights:

Andrzej commented that even though the approach to scalability is good, aren’t you afraid that if you have 100,000s of devices, there could be problems due to all nodes broadcasting and saturating the network? Dimitris replied that the idea is to have 2 levels of priority in the network to avoid this problem. Andrzej continued, do you foresee any real time statistics to verify that the installation is scalable? Dimitris replied that this would be a good idea, but it is not foreseen. Javier added that we can always monitor latency to check that it matches the expected performance for the network.