Renovation of the Trigger Distribution in CERN'S Open Analogue Signal Information System Using White Rabbit

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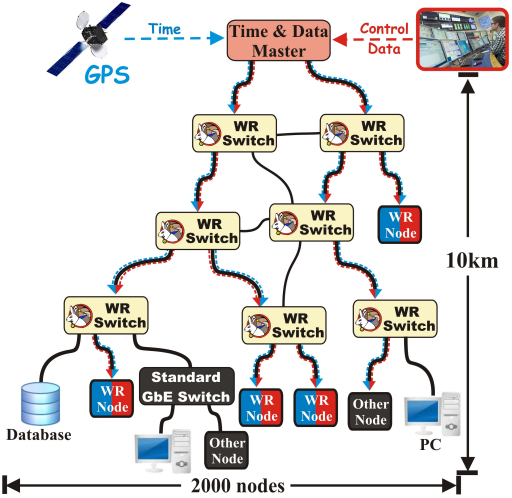
Outline

OASIS

Open Analogue Signal Information System

- A distributed oscilloscope.
- Monitor and correlate signals across the CERN accelerator complex.
- 5000+ analogue signals.
- 500+ multiplexed digitisers.
- 250+ triggers.
- Accessible in the form of a virtual scope GUI.

White Rabbit



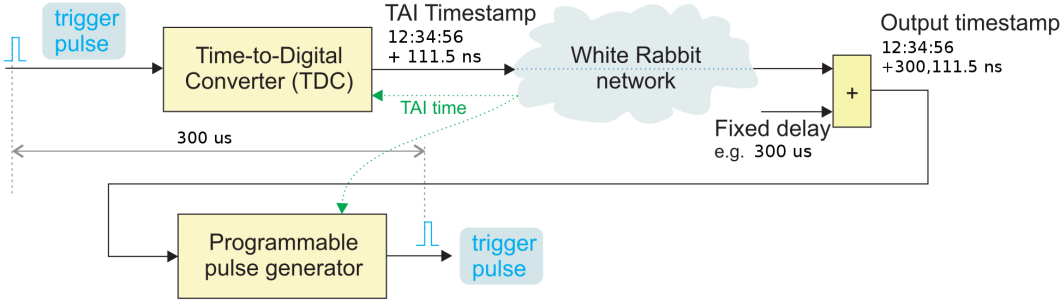
- White Rabbit (WR) is an Ethernet-based network.
- It provides sub-ns synchronisation between connected nodes.
- It is deterministic (upper-bound latency).

OASIS Trigger Distribution over WR

- Ongoing project to renovate the OASIS trigger distribution.
- New approach based on White Rabbit Trigger Distribution[1].
- Deprecate obsolete hardware.
- Improve performance and scalability.

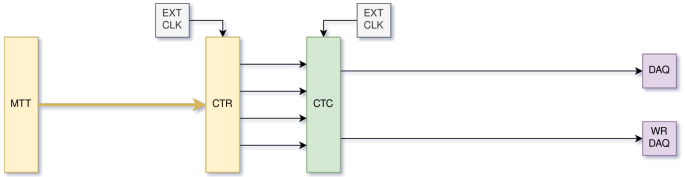
[1] Presented in ICALEPCS2019 (TUBPR01)

WRTD Recap



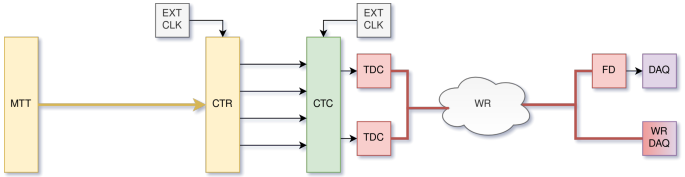
- Replicate a trigger pulse at destination(s) with fixed latency.
- Increase pre-trigger acquisition buffer accordingly.
- Rewind the buffer to the moment of the original trigger.

Current state of OASIS trigger distribution



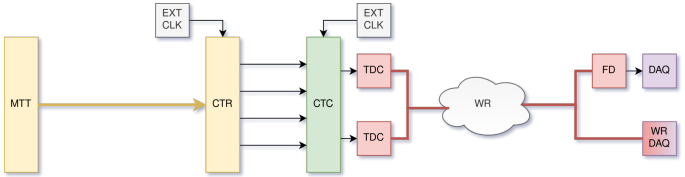
- Timing events converted to triggers by timing receivers (CTRs).
- Triggers multiplexed by CTCs.
- Triggers resynced statically by CTRs and dynamically by CTCs.
- Dedicated CTC output channel and long trigger cable per digitiser.

OASIS WRTD: phase I



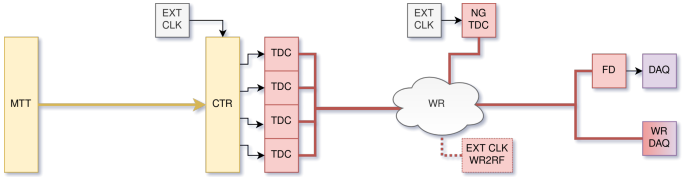
- CTCs and CTRs remain, to generate and resync triggers.
- Some CTC outputs selectively repurposed to drive TDCs.
- Digitisers at the other end triggered by FDs (or directly).
- Fixed latency set to 400µs during testing.

OASIS WRTD: phase I



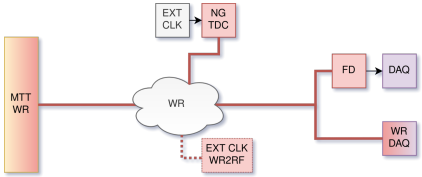
- During a new connection request, OASIS server checks if the trigger is already generated for another digitiser.
- If yes, it finds the correct FD/WR-DAQ and programs it.
- If not, it first reserves a CTC output and programs the TDC as well.

OASIS WRTD: phase II



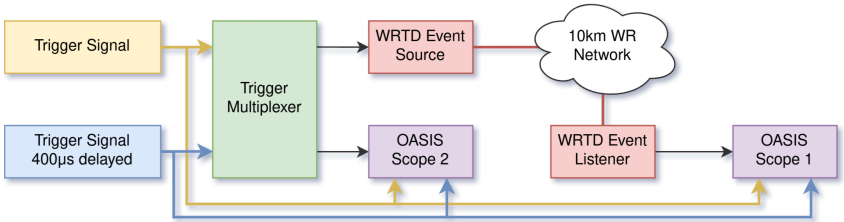
- Full deployment, no more CTCs.
- CTR outputs digitised directly by TDCs.
- Triggers still resynced statically by CTRs.
- Triggers resynced dynamically by new devices.

OASIS WRTD: phase III

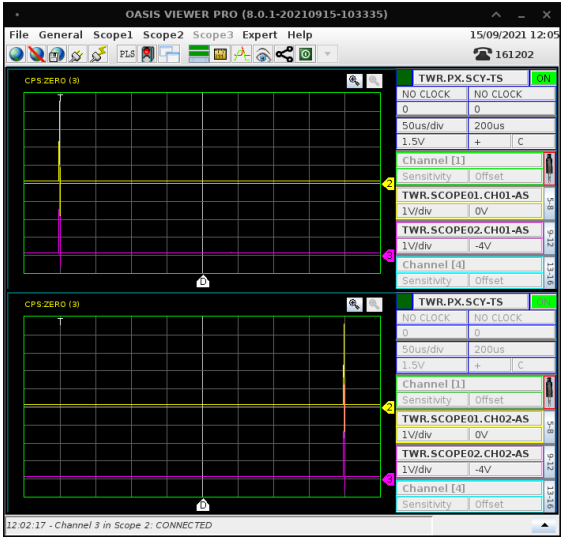


- No more TDCs to digitise triggers.
- Produce WRTD events directly from the timing system.

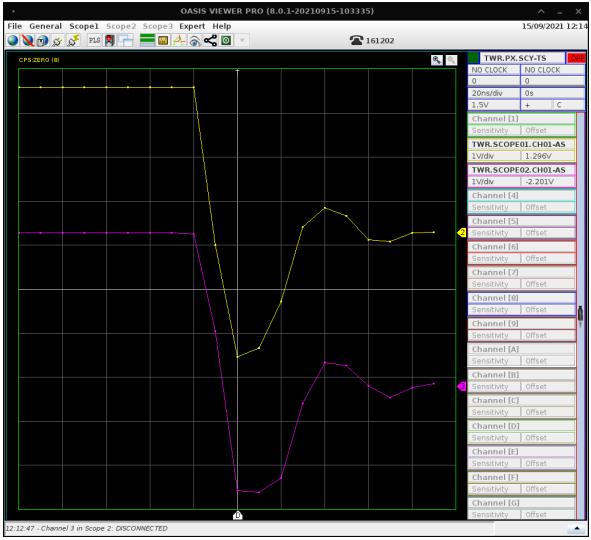
Lab Test Setup



Lab Test Results



Lab Test Results



Conclusions and Outlook

- OASIS is migrating its trigger distribution to a WR-based solution.
- New distribution scheme based on WRTD.
- Migration to be done in three phases.
- First operational deployments before the end of 2021.
- Full deployment of phase I in 2022-2023.
- Phases II and III will follow (est. 2024-2029).

Thank you for your attention!