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White Rabbit Timing: The new CERN accelerator timing system

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After more than 30 years of service, CERN's accelerator timing system is being renovated, moving from the existing distribution infrastructure based on the RS-485 technology and legacy hardware modules, to a new one based on White Rabbit.
Developed at CERN, White Rabbit Timing (WRT) is a generic toolkit composed of the White Rabbit Event Node (WREN) - a System-on-Chip based hardware module, and the corresponding software stack. WRT allows transmission and reception of messages, along with an arbitrary payload (key-value pairs). The received messages enable the generation of triggers in the form of software interrupts and electrical pulses, with sophisticated and highly configurable triggering patterns. WRT seamlessly integrates time derived from the radio frequency used for particle acceleration, with WRENs capable of locally generating beam orbit and bunch clocks, as well as broadcasting beam-synchronous timing streams over dedicated optical links.
We present the key concepts of WRT, its architecture, multi-layered distribution network layout, functionalities and usage at CERN. We also draw a potential path towards a turn-key timing system based on WRT that could be deployed anywhere for scientific or commercial applications.

Footnotes

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