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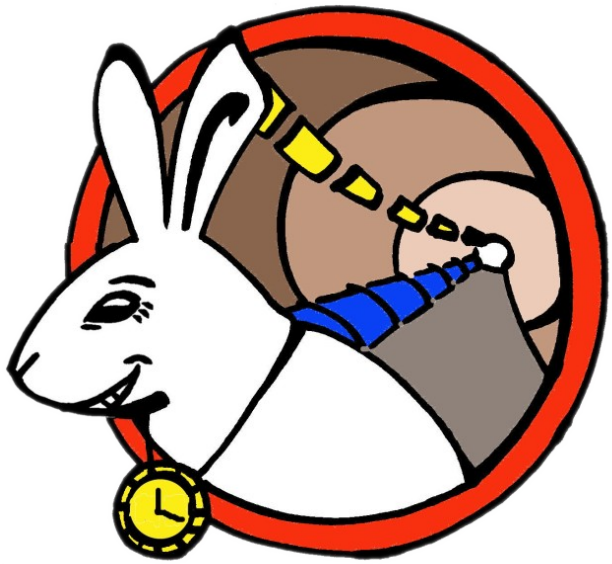

White Rabbit Switch

Functional Specification

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Acronyms List

CAM	Content Addressable Memory
CPU	Central Processor Unit
DDR	Double Data Rate
DRAM	Dynamic RAM
EMI	Electromagnetic Interference
EMC	Electromagnetic Compatibility
FCC	Federal Communications Commission
FPGA	Field Programmable Gate Array
GPS	Global Positioning System
HP	High Priority
ICD	Interface Control Document
IGMP	Internet Group Management Protocol
JTAG	Joint Test Action Group
MAC	Media Access Control
MB	Mega Byte
Mbps	Megabits per Second
PPS	Pulse Per Second
PTP	Precise Time Protocol
RAM	Random Access Memory
SDRAM	Synchronous Dynamic RAM
SFP	Small Form-factor Pluggable
SNMP	Simple Network Management Protocol
TBD	To be defined
WFR	White rabbit switch Functional Requirement
WRP	White Rabbit Protocol
WRS	White Rabbit Switch

Document Reference:

Ref	Title	Author	Version
[1]	White Rabbit Protocol Specification	White Rabbit Team	To be published
[2]	White Rabbit Switch ICD	White Rabbit Team	To be published

Content Index

1 Introduction.

The White Rabbit is intended to be the next-generation deterministic network based on synchronous Ethernet, allowing for low-latency deterministic packet routing and transparent, high precision timing transmission. The network consists of master node (only one active at a time) which provides time and frequency reference, switches interconnected through fibers or twisted-pair copper in star topology and slave nodes.

White Rabbit Switch (WRS) is the key component in new CERN timing system, allowing for multiplexing of high-precision timing and control data in single fiber connection.

This document describes the functional requirements that the White Rabbit Switch must accomplish. Every requirement will be numbered (WFR-#) in order to facilitate a better later identification. “Shall” auxiliary form will be used to indicate mandatory requirements.

2 White Rabbit Switch Functional Requirements.

2.1 Built-in-Test and debugging requirements

WFR-1. WRS shall include TBD led diodes for debugging purposes and error communication.

WFR-2. WRS shall use JTAG interfaces of their main components (CPUs, FPGAs) for debugging and/or Boundary-Scan Tests.

WFR-3. After power-up, WRS shall perform a test of the main components (power supplies, memories, communication ports...).

WFR-4. WRS shall include TBD temperature sensors in order to allow monitoring internal temperature. In case of overheating, WRS shall communicate error and shut-down to prevent internal damage.

WFR-5. WRS shall measure continuously voltages and current of their main power supplies. In case of error, WRS shall communicate error and shut-down in order to prevent internal damage.

2.2 Update capacities

WFR-6. WRS shall provide mechanisms for software and firmware updating.

2.3 Microprocessors requirements

WFR-7. WRS shall include a microprocessor capable of executing Linux operating system.

WFR-8. WRS shall provide at least the next memories types and sizes:

- 64 MB DRAM (SDRAM or DDR) @ 133 MHz.
- 8 MB NAND or NOR flash for booting.
- 256 MB main NAND flash.

WFR-9. Microprocessor shall be able to access to MAC address table in order to perform management tasks.

WFR-10. To prevent microprocessor hanging, watch-dog timer mechanisms shall be provided.

2.4 Switching capacities

WFR-11. WRS shall have 16 downlink ports (DP0-DP15) and 2 uplink ports (UP0 and UP1).

WFR-12. UP0 shall be, in normal conditions, the primary uplink port. UP1 shall be used when UP0 does not work properly (malfunction of UP0).

WFR-13. Downlink and uplink ports speed shall be 1.25 Gbps.

WFR-14. Port to port latency for HP packets shall be constant or less than 512 ns (64 x 8 ns).

WFR-15. Throughput of switching 64 bytes packets shall be at least of 50% of their maximal theoretical capacity.

WFR-16. MAC address table (CAM table) shall have capacity for storing at least 4K nodes.WRS shall have a packet memory buffer with at least 512 KB of capacity.

WFR-17. The transmission method used shall be “Store and Forward”. For HP packets, WRS shall support pre-emption.

WFR-18. For monitoring tasks, WRS shall implement port mirroring.

2.5 Layer 2 switch requirements

WFR-19. WRS shall provide “port security” features for preventing MAC flooding.

WFR-20. WRS shall perform IGMP snooping v2.

WFR-21. WRS shall implement “IEEE 802.1w Rapid Spanning Tree” and “IEEE 802.1s Multiple Spanning Tree Groups”.

WFR-22. WRS shall implement “IEEE 802,1Q”, or VLAN Tagging.

2.6 White Rabbit Protocol requirements

WFR-23. Switch shall accomplish the White Rabbit protocol, see document Ref[1].

WFR-24. WRS shall be compatible with existing standards, Ethernet and PTP (IEEE1588), except the following exceptions:

- Ethernet: no half-duplex operation (802.3x).
- PTP: operation as a PTP slave when connected to non-WR master.
- PTP: no operation as an one-way clock (with on-the-fly timestamp insertion).

WFR-25. WRS shall be able to interoperate with hardware/software not compliant with White Rabbit Protocol.

WFR-26. WRS shall be able to work in an ultra-low latency “hub” mode with no collision handling (first-come, first-go).

WFR-27. WRS shall be able to replicate the master clock received from master uplink UP0 with a maximum skew of 100 ps.

WFR-28. WRS shall be able to recover the clock from each node connected and measure the delay with respect to the primary reference125MHz clock with a precision of 100 ps. This delay shall be sent back to the node using PTP in order to be compensated.

WFR-29. WRS shall use deterministic transceivers. If not, appropriate calibration circuitry shall be provided.

2.7 Management requirements

WFR-30. WRS shall have one at least 100 Mbps Ethernet RJ45 (ETH_MNG) and one RS-232 (RS232_MNG) ports for management purposes.

WFR-31. Common management methods that WRS shall include are:

- Serial console or command line interface (CLI) accessed via RS232 or SSH.
- Embedded Simple Network Management Protocol (SNMP).
- Web interface for management from a web browser

2.8 Electrical interfaces

This paragraph will specify the inputs and outputs that the White Rabbit Switch must provide. For more information, see the ICD document, Ref [2].

WFR-32. WRS shall include the following inputs and outputs signals:

Name	Input/Output	Description
EXTREFIN125M	I	External 125MHz reference clock input.
EXTREFIN10M	I	External 10 MHz reference clock input from cesium/GPS.
EXTPPSIN	I	Receives PPS pulses from external source.
EXTREFOUT125M	O	125MHz clock signal recovered from uplink or provided by EXTREFIN125M.
EXTPPSOUT	O	Outputs PPS signal.
ETH_MNG	I/O	Twisted-pair 100 Mbit Ethernet port connected to management CPU.
RS232_MNG	I/O	RS232 port which can be used either by local serial management console or as input of NMEA timecode from cesium/GPS.
UP0-UP1	I/O	1 GbE SFP module sockets for uplink ports.
DP0-DP15	I/O	1GbE SFP module sockets for downlink ports.

WFR-33. All SFP ports shall be able to accommodate 1GbE twisted copper cables and optical 1GbE transceivers.

WFR-34. 1000Base-T (Category 5 Copper) SFP shall be supported.

WFR-35. 1000Base-BX10 (Single G.652 fiber) SFP shall be supported.

WFR-36. Power supply shall be AC 100-240V, 50-60Hz.

2.9 Physical interfaces

WFR-37. WRS form factor shall be according to ICD document, Ref [2].

2.10 Environmental requirements

WFR-38. WRS shall operate in the following environmental conditions:

- Ambient temperature: 0ºC to 40ºC
- Humidity: 10% to 90%, no condensing.
- Altitude: 0 m to 3500 m.

WFR-39. WRS shall withstand the following storage environment conditions:

- Ambient temperature: -25ºC to 70ºC
- Altitude: 0 m to 4500 m.

2.11 EMI and EMC requirements

WFR-40. WRS shall accomplish with the following EMI and EMC requirements:

- FCC Part 15 Class A
- CE Marking

End of document.