Note on using WR Switch in Grandmaster mode

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Requirements

The WR switch can operate as a synchronous PTP grandmaster referenced to externally provided 10 MHz and PPS signals. The signals must meet following electrical requirements:

- **PPS input**: 50 Ω, LVTTL or TTL levels
- **10 MHz input**: 50 Ω, TTL/LVTTL/sine (1 – 5 V rms)
- **t\_SETUP (PPS-to-10MHz)** = 10 ns (see fig. 1)

WR grandmasters require both 10 MHz and PPS to work. The 10 MHz is used to produce 125 MHz Sync-E reference and the PPS is used only to ensure the alignment of the edges of both clocks at inter-second boundary. The actual inter-second boundary is the 10 MHz rising edge after the rising edge of the PPS pulse (see fig. 1). PPS input is sampled only once (when the PLL is locking).

![Fig 1. Producing 125 MHz reference from 10 MHz GPS input in the WR Switch](image)

Since the switch must transfer the PPS signal between two clock domains with no metastablity, it is essential that **t\_SETUP** and **t\_HOLD** values shown on fig 1. are respected. When installing a WR grandmaster, one should first verify the relationship of PPS vs 10 MHz and compensate it if necessary.

**Warning 1:** The 10 MHz input must not „jump” (i.e. have temporary period different than 100 ns). Some GPS receivers were reported to produce such 10 MHz with such artifacts – these devices cannot be used with WR.

**Warning 2:** The PPS signal must not change its' phase with respect to the 10 MHz input beyond one 10 MHz clock cycle when the switch is locked.

Supplying time-of-day information

WRS is capable of retrieving time of day information from NMEA messages delivered to its' serial port. This requires configuring the GPS receiver to output a GPRMC message every second (right after the PPS pulse). Serial port transmission parameters are 115200 bps, 8N1.

Setup procedure

- ssh to the switch (default user is root with no password),
- edit `/wr/etc/wrsw_hal.conf` and change the line `mode` in timing section to `GrandMaster`. If time-of-day NMEA messages are going to be used, uncomment
use_nmea=1 line too,
- connect the 10 MHz and PPS signals,
- connect the serial port for time of day info (if used),
- reboot the switch,
- check the HAL output (it takes ~10 seconds to lock).

Frequently Asked Questions

Q: Do you know, what frequent GPS phase jumps of >100ns (PPS/10MHz) would cause for the WR-clock stability? Is there a smoothing algorithm installed on the WRS? With tunable parameters?
A: The Sync-E 125 MHz clock is tightly locked to the 10 MHz input in GM mode. Therefore, any phase jumps in the 10 MHz reference will cause the device to de-lock. This might be the case with low quality GPS receivers which produce the 10 MHz signal using a numerically controlled oscillator.

Q: I have followed the setup procedure, but my switch does not lock.
A: First try a setup without NMEA time-of-day (change `use_nmea` to 0). If it is locking now, check the format of the messages and the speed of the serial port used. A good way of testing whether NMEA messages arrive at the switch is to launch a serial terminal: `com /dev/ttyS2 115200`. If the messages appear to be correct, please send us a sample. If the switch still refuses to lock, connect to the right USB port, reboot the switch again and log all the messages outputted by the RT CPU. Then send us a bug report, including the RT log and the HAL messages.