White Rabbit PTP Core: Failures and Diagnostics

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CERN BE-CO-HT

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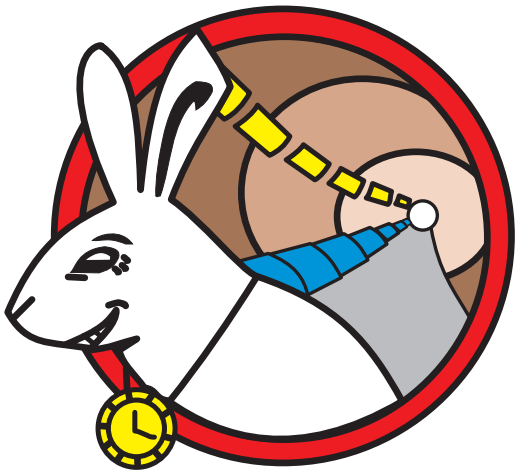

Contents

1 Introduction

This document provides information about the diagnostics of the White Rabbit PTP Core (WRPC) - an HDL module present in every White Rabbit node. It is a complementary documentation to the official *White Rabbit PTP Core User's Manual* published with every stable release. Please refer to this user manual for the information about the WRPC, its interfaces and building instructions for the official reference designs.

White Rabbit PTP Core starting from *v4.0* provides diagnostic mechanisms in the form of SNMP objects and optional Syslog messages (depending on the build time LM32 software configuration). The implementation of an SNMP agent in the WRPC is very basic comparing to the diagnostics offered by the White Rabbit Switch. Since we are very constraint on the code size running inside the WR PTP Core, almost all of the logic to detect and report errors has to be implemented on the SNMP Manager's side.

This document has many internal hyperlinks that associate SNMP objects with related problems description and the other way round. These links can be easily used when reading the document on a computer.

2 Possible Errors

This section tries to identify all the possible ways the White Rabbit PTP Core can fail. The structure of each error description is the following:

Severity: describes how critical is the fault. Currently we distinguish two severity levels:
- WARNING - means that despite the fault the synchronization functionality was not affected so the WRPC behaves correctly in the WR network.
- ERROR - means that the fault is critical and most probably WRPC misbehaves.

Mode: for timing failures, it describes which modes are affected. Possible values are:
- *Slave* - the WR Node (WR PTP Core) synchronizes to another WR device.
- *Grand Master* - the WR Node (WR PTP Core) is at the top of the synchronization hierarchy. It is synchronized to an external clock (e.g. GPS, Cesium) and provides timing to other WR/PTP devices.
- *Master* - the WR Node (WR PTP Core) at the top of the synchronization hierarchy. It provides timing to other WR/PTP devices but runs from a local oscillator (not synchronized to an external clock).
- *all* - any WR PTP Core can be affected regardless the timing mode.

Description: What the problem is about, how important it is and what are the effects if it occurs.

SNMP objects: Which SNMP objects should be monitored to detect the failure. These are objects from the `WR-WRPC-MIB`.

Error/Warning condition: condition that should be checked at the SNMP manager's side to detect given problem. Often you will see there conditions like:
`[value] != [value]_prev` or
`[value] - [value]_prev > [threshold]`
where [value] and [value]_prev are the current and previous iteration readouts of an SNMP object. This way we check if the value of the object has changed from the previous readout or if it has changed by more than a safe threshold.

Action: list of actions that should be performed in case of an error/warning. Regardless of the detailed actions described for each of the errors below, there are some common remarks that apply to all situations:

- If a procedure given for a specific SNMP object does not solve the problem, please contact WR experts to perform a more in-depth analysis of the network. For this, you should provide a complete dump of the WRPC status generated in the first step of each procedure.
- The first action in most of the procedures, called *Dump state* requires simply calling a tool provided by WR developers that reads all the detailed information from the node and writes it to a single file that can be later analyzed by the experts.
- If a problem solving procedure requires restarting or replacing a WR Node working in the *Grand Master* mode, please make sure that after the repair, all other WR devices in the network are synchronized and do not report any problems.
- If a procedure requires replacing WR Node with a new unit, the broken one should be handled to WR experts or the hardware manufacturer to investigate the problem.

2.1 Timing error

As a timing error we define the WR PTP Core not being able to synchronize its local time to the WR Master (if WRPC runs in the slave mode), or not being able to provide correct WR time to the rest of the WR network (if WRPC runs in the master mode). This section contains the list of faults leading to a timing error.

2.1.1 WR PTP Core operates in a wrong timing mode

Severity: ERROR
Mode: *all*
Description:
If the WRPC operates in a wrong timing mode (i.e. due to the configuration error) it will be unable to provide a user application with the correct WR time. For example, if the WRPC is supposed to operate as Slave but is misconfigured to a Free-running Master mode, its time would be different from other WR devices in the network, despite no other errors being reported.
To be able to detect this problem, SNMP manager has to be fed with the desired timing mode for the each monitored WR node.
SNMP objects:
`WR-WRPC-MIB::wrpcSpllMode`
Error condition:
`wrpcSpllMode != <desired mode>`
Action:
1. Modify the configuration of the WR PTP Core. Please check the *White Rabbit PTP Core User's Manual* for instructions how to modify the init script to set the timing mode.

2.1.2 PTP/PPSi went out of `TRACK_PHASE`

Severity: ERROR
Mode: *Slave*
Description:
If the *PTP/PPSi* WR servo goes out of the `TRACK_PHASE` state, this means something bad has happened and the node lost synchronization to its Master.
SNMP objects:
`WR-WRPC-MIB::wrpcPtpServoStateN`
`WR-WRPC-MIB::wrpcPtpServoStateErrCnt`
Error condition:
`wrpcPtpServoStateErrCnt != wrpcPtpServoStateErrCnt_prev`
Action:
1. Check if the WR Master - timing source, was not restarted. If it was, Slave leaving `TRACK_PHASE` state is a normal behavior and it should automatically re-synchronize.
2. Dump state
3. Check the status of the WR Master - timing source. In case it has reported some problems, please follow the diagnostics document for the WR Switch.
4. If the switch did not report any problems, restart the WR Node.

5. If the problem persists replace the WR Node hardware with a new unit.
6. If the problem persists, please notify WR experts.

2.1.3 Offset jump not compensated by Slave

Severity: ERROR
Mode: *Slave*
Description:
This may happen if the Master resets its WR time counters (e.g. because it lost the link to its Master higher in the hierarchy or to external clock), but the WR Slave does not follow the jump.
SNMP objects:
`WR-WRPC-MIB::wrpcPtpClockOffsetPsHR`
`WR-WRPC-MIB::wrpcPtpClockOffsetErrCnt`
Error condition:
`wrpcPtpClockOffsetErrCnt != wrpcPtpClockOffsetErrCnt_prev`
Action:
1. Dump state
2. Check the status of the WR Master - timing source. Normally, time jumps should not happen and if they do, the problem should be investigated on the WR Master side (e.g. *Grand Master* unlocked from the external reference).
3. Restart the WR Node and let it synchronize again.

2.1.4 Detected jump in the RTT value calculated by *PTP/PPSi*

Severity: ERROR
Mode: *Slave*
Description:
Once a WR link is established the round-trip delay (RTT) can change smoothly due to the temperature variations. However, if a sudden jump is detected, that means that an erroneous timestamp was generated either on the Master or the Slave side. One cause of that could be the wrong value of the t24p transition point.
SNMP objects:
`WR-WRPC-MIB::wrpcPtpRTT`
`WR-WRPC-MIB::wrpcPtpRTTErrCnt`
Error condition:
`wrpcPtpRTTErrCnt != wrpcPtpRTTErrCnt_prev`
Action:
1. Dump state.
2. Check the status status of the WR Master - timing source. Eventually proceed to investigate the problem on the WR Master side.
3. Restart the Node.
4. If the problem persists, replace the WR Node with a new unit.

2.1.5 Wrong Δ_{TXM}, Δ_{RXM}, Δ_{TXS}, Δ_{RXS}, α values are reported to the *PTP/PPSi* daemon

Severity: ERROR

Mode: *Slave*
Description:
If *PTP/PPSi* doesn't get the correct values of fixed hardware delays, it won't be able to calculate a proper Master-to-Slave delay. Although the estimated offset in *PTP/PPSi* is close to 0, the WRPC won't be synchronized to the Master with sub-nanosecond accuracy.
SNMP objects:
```
WR-WRPC-MIB::wrpcPtpDeltaTxM
WR-WRPC-MIB::wrpcPtpDeltaRxM
WR-WRPC-MIB::wrpcPtpDeltaTxS
WR-WRPC-MIB::wrpcPtpDeltaRxS
WR-WRPC-MIB::wrpcPtpAlpha
```
Error condition:
```
wrpcPtpDeltaTxM == 0 || wrpcPtpDeltaRxM == 0 ||
wrpcPtpDeltaTxS == 0 || wrpcPtpDeltaRxS == 0 ||
wrpcPtpAlpha == 0
```
Action:
1. Check if the correct calibration values are entered both for the WR Node and WR Master. WR Switch will report this in its own SNMP status objects.
2. Check the White Rabbit PTP Core User Manual [1] for the instructions how the calibration values can be configured locally or remotely using SET for SNMP objects.

2.1.6 PTP servo is not updating

Severity: ERROR
Mode: *Slave*
Description:
If PTP servo is not updating, we still increment the internal timing counters, but don't have updated information on the Master time and link delay. After some time the slave local time will drift away from the master.
SNMP objects:
```
WR-WRPC-MIB::wrpcPtpServoUpdates
WR-WRPC-MIB::wrpcPtpServoUpdateTime
```
Error condition:
```
wrpcPtpServoUpdates == wrpcPtpServoUpdates_prev
```
Action:
1. Dump state
2. Check if the PTP frames are flowing between the WR Node and its timing master (error 2.1.8).
3. Check the status of the WR Master - timing source.
4. Check if the SoftPLL did not unlock (error 2.1.7).
5. Restart the WR Node.
6. If the problem persists, replace the WR Node with a new unit.

[1] `http://www.ohwr.org/projects/wr-cores/wiki/Current_release`

2.1.7 *SoftPLL* became unlocked

Severity: ERROR / WARNING
Mode: *all*
Description:
If the *SoftPLL* loses lock, for any reason, Slave, Master or Grand Master node can no longer be syntonized and phase aligned with its time source. WRPC in Master mode without properly locked Helper PLL is not able to perform reliable phase measurements for enhancing Rx timestamps resolution. For a Grand Master the reason of *SoftPLL* going out of lock might be disconnected 1-PPS/10MHz signals or that the external clock is down.
SNMP objects:

```
WR-WRPC-MIB::wrpcSpllMode
WR-WRPC-MIB::wrpcSpllSeqState
WR-WRPC-MIB::wrpcSpllAlignState
WR-WRPC-MIB::wrpcSpllHlock
WR-WRPC-MIB::wrpcSpllMlock
WR-WRPC-MIB::wrpcSpllDelCnt
```

Error condition:

```
wrpcSpllSeqState != ready(3) ||
[wrpcSpllMode == grandmaster(1) && wrpcAlignState != locked(6)] ||
[wrpcSpllMode == slave(3) && wrpcSpllHlock == 0] ||
[wrpcSpllMode == slave(3) && wrpcSpllMlock == 0] ||
[wrpcSpllMode != grandmaster(1) && wrpcSpllMode != master(2) && wrpcSpllMode
!= slave(3)]
```

Warning condition:

```
[wrpcSpllMode == grandmaster(1) && wrpcSpllDelCnt > 0]
```

Action for *Grand Master* WR Node:
1. Dump state
2. Check 1-PPS and 10MHz signals coming from an external source. Verify if they are properly connected and, in case of a GPS receiver, check if it is synchronized and locked.
3. Restart the WR Node
4. If the problem persists, replace the WR Node with a new unit

Action for *Slave* WR Node:
1. Dump state
2. Check the status of the WR Master - timing source. Eventually proceed to investigate the problem on the Master.
3. Verify if the WR link was not lost and re-initialized by checking the SNMP manager software logs.
4. Restart the WR Node
5. If the problem persists, replace the WR Node with a new unit.

2.1.8 PTP frames don't reach LM32

Severity: ERROR
Mode: *all*
Description:

In this case, *PTP/PPSi* will fail to stay synchronized and provide synchronization. Even if the WR servo is in the `TRACK_PHASE` state, it calculates a new phase shift based on the Master-to-Slave delay variations. To calculate these variations, it still needs timestamped PTP frames flowing. There could be several causes of such fault:

- WR Switch problem
- wrong VLANs configuration
- WR PTP Core HDL problem

SNMP objects:

```
WR-WRPC-MIB::wrpcPtpTx
WR-WRPC-MIB::wrpcPtpRx
WR-WRPC-MIB::wrpcPortInternalTx
WR-WRPC-MIB::wrpcPortInternalRx
```

Error condition:

```
wrpcPtpTx == wrpcPtpTx_prev || wrpcPtpRx == wrpcPtpRx_prev ||
wrpcPortInternalTx == wrpcPortInternalTx_prev ||
wrpcPortInternalRx == wrpcPortInternalRx_prev
```

Action:

1. Dump state.
2. Check the state of the WR Master - timing source. Especially, if the PTP daemon is still running there.
3. Check if the VLANs configuration on the WR Node matches the configuration of the WR Switch where this node is connected. Wrong configuration (e.g. different VIDs) will cause the frames to be dropped.
4. Restart the WR Node.
5. If possible, stop or reduce any additional (heavy) traffic that might be sent through the WR network.
6. If the problem persists, please notify WR experts.

2.1.9 Detected SFP not supported for WR timing

Severity: ERROR
Mode: *all*
Description:
By not supported SFP for WR timing we mean a transceiver that doesn't have the *alpha* parameter and fixed hardware delays defined in the SFP database. The consequence is *PTP* not having the right values to estimate the link asymmetry. Despite the *PTP* offset being close to *0ps*, the device won't be properly synchronized.
SNMP objects:

```
WR-WRPC-MIB::wrpcPortSfpPn
WR-WRPC-MIB::wrpcPortSfpInDB
WR-WRPC-MIB::wrpcSfpPn.<n>
```

Error condition:

```
wrpcPortSfpInDB != inDataBase(2)
```

Action:

1. Check if the SFP database is correctly defined by making sure the error 2.1.10 is not reported.
2. If you have written calibration data to the SFP database, check if there is no typing error in the SFP part number. You can do this over SNMP by reading `WR-WRPC-MIB::wrpcSfpPn.<n>` objects.
3. Change the optical SFP transceiver in the WR Node. Either it is broken and should be replaced since its ID cannot be read correctly, or a non-supported transceiver was plugged to the device.

2.1.10 SFP database not configured

Severity: ERROR
Mode: *all*
Description:
If there are no SFP entries in the database, any (even WR-supported) SFP cannot be matched with the calibration values for a given hardware and fiber. Despite *PTP/PPSi* offset being close to 0 *ps*, the device won't be properly synchronized.
SNMP objects:
`WR-WRPC-MIB::wrpcSfpPn.<n>`
`WR-WRPC-MIB::wrpcSfpDeltaTx.<n>`
`WR-WRPC-MIB::wrpcSfpDeltaRx.<n>`
`WR-WRPC-MIB::wrpcSfpAlpha.<n>`
Note: It's enough to try reading index 1 of the above SNMP objects tables to make sure there is at least one entry in the database.
Error condition:
Error when trying to get any of the `wrpcSfpPn.1`; `wrpcSfpDeltaTx.1`; `wrpcSfpDeltaRx.1`; `wrpcSfpAlpha.1` SNMP objects
Action:
1. Check the White Rabbit PTP Core User's Manual[2] for the instructions how the calibration values can be configured locally or remotely using SET for SNMP objects.

[2] `http://www.ohwr.org/projects/wr-cores/wiki/Current_release`

2.2 Other errors

2.2.1 WR link is down or FPGA not programmed or FPGA programmed with incorrect bitstream

Severity: ERROR
Description:
WRPC is monitored over the WR network. This means, to detect whether the communication link is down we can either periodically ping the device or monitor if there are no timeouts from SNMP requests.
SNMP objects: *(none)*
Error condition:
SNMP request timeout or PING timeout
Action:

1. Investigate on the computer/front-end where the WR Node card is installed, if all the drivers are properly loaded and if the FPGA gets programmed. You can take another WR Master device and connect it locally to verify if the WR Node is programmed correctly.
2. If you have access to the physical UART connected to the WRPC or you have a Virtual-UART for your hosted environment, you may try accessing the WRPC shell to make sure the FPGA is programmed. Please see the official *White Rabbit PTP Core User's Manual* for more information.
3. Check the fiber link e.g. by connecting another WR Node, with a different SFP transceiver to the same fiber.
4. If there is still no link on the new WR Node, try connecting fiber on the Master side to another port of the WR Switch (using different SFP transceiver).
5. If there is still no link, the fiber connection is either dirty or broken.

2.2.2 WR PTP Core reset

Severity: ERROR
Description:
If the WRPC was reset it might either mean that there was a power cut or some not yet known bug caused the WRPC software to crash.
SNMP objects:
`WR-WRPC-MIB::wrpcTimeSystemUptime`
Error condition:
`wrpcTimeSystemUptime < wrpcTimeSystemUptime_prev`
Action:

1. Dump state.
2. Check if there was a power cut e.g. by checking the uptime of the computer/front-end where the WR Node card is installed.
3. If there was no power cut or intended machine restart, make a full state dump and report problem to WR experts.

2.2.3 WR PTP Core time reset

Severity: ERROR
Description:
If the WRPC internal time counters are reset, this might mean the WR Master in the network has some problems and WRPC has followed the time reset. If that's not the case, this might mean some not yet known bug caused the WRPC time reset.
SNMP objects:
`WR-WRPC-MIB::wrpcTimeTAI`
`WR-WRPC-MIB::wrpcTimeTAIString`
Error condition:
`wrpcTimeTAI == 0`
Action:
1. Dump state.
2. Check the status of the WR Master - timing source.
3. Check in the SNMP manager software logs, if there were no *link down* errors for the WR Node or the WR Master Switch. In that case, the SFP optical transceivers should be changed or the fiber link should be investigated.

2.2.4 Temperature of the node too high

Severity: WARNING
Description:
If the temperature raises too high we might break our electronics. It also means that most probably something is wrong with the node cooling.
SNMP objects:
`WR-WRPC-MIB::wrpcTemperatureName.<n>`
`WR-WRPC-MIB::wrpcTemperatureValue.<n>`
Error condition:
`wrpcTemperatureValue.<n> > THRESHOLD`
Action:
1. Check the cooling for the computer/front-end/rack where the WR Node is installed.

3 List of exported SNMP objects

This section lists all the SNMP objects exported by the WR PTP Core. The objects provide read-only values unless stated otherwise in their description.

- `WR-WRPC-MIB::wrpcVersionGroup`
  Group containing information about the WR PTP Core firmware version.
  - `wrpcVersionHwType`
    Description: Type of the hardware of a given WR Node.
  - `wrpcVersionSwVersion`
    Description: Version of the LM32 software running inside the WR PTP Core.
  - `wrpcVersionSwBuildBy`
    Description: Information who has compiled the LM32 software running inside the WR PTP Core.
  - `wrpcVersionSwBuildDate`
    Description: Information when the LM32 software was compiled.
- `WR-WRPC-MIB::wrpcTimeGroup`
  Group containing system timers information
  - `wrpcTimeTAI`
    Description: Current TAI time of the WR Node.
    Related problems: 2.2.3
  - `wrpcTimeTAIString`
    Description: The current TAI time, printed as %y-%m-%d-%H:%M:%S (no time zone)
    Related problems: 2.2.3
  - `wrpcTimeSystemUptime`
    Description: System uptime in hundreds of second
    Related problems: 2.2.2
- `WR-WRPC-MIB::wrpcTemperatureTable`
  Table of onboard thermometers measurements.
  - `wrpcTemperatureName.<n>`
    Description: Name of the temperature sensor *n*.
    Related problems: 2.2.4
  - `wrpcTemperatureValue.<n>`
    Description: Temperature value of the sensor *n*.
    Related problems: 2.2.4
- `WR-WRPC-MIB::wrpcSpllStatusGroup`

Group containing White Rabbit PLLs status

- `wrpcSpllMode`
  Description: Mode of operation of the Soft PLL inside WR PTP Core. Possible values:
  - `grandmaster` *(1)* – Master synchronized to external reference (e.g. GPS or Cesium)
  - `master` *(2)* – Free-running Master
  - `slave` *(3)*
  - `disabled` *(4)*

  Related problems: 2.1.1, 2.1.7

- `wrpcSpllIrqCnt`
  Description: Number of interrupts received by SoftPLL for DDMTD tags.

- `wrpcSpllSeqState`
  Description: SoftPLL sequencer state. Possible values:
  - `startExt` *(1)*
  - `waitExt` *(2)*
  - `startHelper` *(3)*
  - `waitHelper` *(4)*
  - `startMain` *(5)*
  - `waitMain` *(6)*
  - `disabled` *(7)*
  - `ready` *(8)*
  - `clearDacs` *(9)*
  - `waitClearDacs` *(10)*

  Related problems: 2.1.7

- `wrpcSpllAlignState`
  Description: SoftPLL aligner state. Possible values:
  - `extOff` *(0)*
  - `start` *(1)*
  - `initCsync` *(2)*
  - `waitCsync` *(3)*
  - `waitSample` *(4)*
  - `compensateDelay` *(5)*
  - `locked` *(6)*
  - `startAlignment` *(7)*
  - `startMain` *(8)*
  - `waitClkin` *(9)*
  - `waitPlock` *(10)*

Related problems: 2.1.7

- wrpcSpllHlock
  Description: Helper PLL lock status.
  Related problems: 2.1.7

- wrpcSpllMlock
  Description: Main PLL lock status.
  Related problems: 2.1.7

- wrpcSpllHY
  Description: Helper PLL DAC value (range 0-65535).

- wrpcSpllMY
  Description: Main PLL DAC value (range 0-65535).

- wrpcSpllDelCnt
  Description: Delock counter - how many times either Helper of Main PLL lost lock since the WRPC software has started.
  Related problems: 2.1.7

- WR-WRPC-MIB::wrpcPtpGroup
  Group with various information about PTP state

  - wrpcPtpServoStateN
    Description: Current state of WR synchronization servo running in the PTP. Possible values:
    - uninitialized*(0)*
    - syncNsec*(1)*
    - syncSec*(2)*
    - syncPhase*(3)*
    - trackPhase*(4)*
    - waitOffsetStable*(5)*

    Related problems: 2.1.2

  - wrpcPtpClockOffsetPsHR
    Description: Current clock offset from master in picoseconds, calculated by PTP.
    Related problems: 2.1.3

  - wrpcPtpSkew
    Description: The estimated change of master-to-slave delay, in picoseconds.

  - wrpcPtpRTT
    Description: Round-trip-time in picoseconds calculated by PTP.
    Related problems: 2.1.4

  - wrpcPtpServoUpdates

Description: Counter incremented each time the WR PTP servo calculates the offset value from WR master and corrects the local clock.
Related problems: 2.1.6

- `wrpcPtpServoUpdateTime`
  Description: TAI nanoseconds when the WR PTP servo was last updated.
  Related problems: 2.1.6

- `wrpcPtpDeltaTxM`
  Description: Fixed Tx latency of the WR master.
  Related problems: 2.1.5

- `wrpcPtpDeltaRxM`
  Description: Fixed Rx latency of the WR master.
  Related problems: 2.1.5

- `wrpcPtpDeltaTxS`
  Description: Fixed Tx latency of the WR slave.
  Related problems: 2.1.5

- `wrpcPtpDeltaRxS`
  Description: Fixed Rx latency of the WR slave.
  Related problems: 2.1.5

- `wrpcPtpServoStateErrCnt`
  Description: Number of times when WR PTP servo has lost the synchronization, i.e. went ouf from the `TRACK_PHASE` state.
  Related problems: 2.1.2

- `wrpcPtpClockOffsetErrCnt`
  Description: Number of times when calculated offset to the Master was larger than +/-500ps.
  Related problems: 2.1.3

- `wrpcPtpRTTErrCnt`
  Description: Number of times when the jump was detected in the calculated round-trip-time value. The jump is detected when rtt changes by more than 1ns comparing to the previously calculated value.
  Related problems: 2.1.4

- `wrpcPtpAsymmetry`
  Description: Link asymmetry calculated by PTP.

- `wrpcPtpTx`
  Description: Number of transmitted PTP frames.
  Related problems: 2.1.8

- `wrpcPtpRx`

Description: Number of received PTP frames.
Related problems: 2.1.8

- `wrpcPtpAlpha`
  Description: Alpha value (fiber asymmetry coefficient) used for WR to estimate the one-way link delay.
  Related problems: 2.1.5

- `WR-WRPC-MIB::wrpcPtpConfigGroup`
  The groups contains objects for configuring remotely the SFP database with calibration parameters

  - `wrpcPtpConfigRestart`
    Description: Read-write object to trigger the PTP restart to use the new settings. Possible values:

    - write: `restartPtp` *(1)* – triggers PTP restart
    - read: `restartPtpSuccessful` *(100)* – PTP restart triggered successfully
    - read: `restartPtpFailed` *(200)* – failed to trigger PTP restart

  - `wrpcPtpConfigApply`
    Description: Read-write object to validate and apply SFP settings. Possible values:

    - write: `writeToFlashGivenSfp` *(1)* – write provided `wrpcPtpConfigDeltaTx`, `wrpcPtpConfigDeltaRx`, `wrpcPtpConfigAlpha` values to the SFP database stored in the Flash for the SFP product number provided in `wrpcPtpConfigSfpPn`. The new values are automatically loaded to the memory (*sfp match* command is executed).
    - write: `writeToFlashCurrentSfp` *(2)* – write provided `wrpcPtpConfigDeltaTx`, `wrpcPtpConfigDeltaRx`, `wrpcPtpConfigAlpha` values to the SFP database stored in the Flash for the SFP that is currently used. The new values are automatically loaded to the memory (*sfp match* command is executed).
    - w: `writeToMemoryCurrentSfp` *(3)* – write provided `wrpcPtpConfigDeltaTx`, `wrpcPtpConfigDeltaRx`, `wrpcPtpConfigAlpha` values only to the memory. The SFP database in the Flash is not modified.
    - write: `eraseFlash` *(50)* – erase SFP database stored in the Flash
    - read: `applySuccessful` *(100)* – required configuration applied successfully
    - read: `applySuccessfulMatchFailed` *(101)* – required values written to the database but could not be matched with the currently used SFP
    - read: `applyFailed` *(200)* – failed to apply configuration
    - read: `applyFailedI2CError` *(201)* – failed to apply, communication error with the flash memory
    - read: `applyFailedDBFull` *(202)* – failed to apply, SFP database is full
    - read: `applyFailedInvalidPN` *(203)* – failed to apply, invalid SFP product number

- wrpcPtpConfigSfpPn
  Description: Read-write object. SFP product number identifying which entry in the Flash SFP database to update.

- wrpcPtpConfigDeltaTx
  Description: Read-write object. Fixed Tx delay value to be written, in picoseconds.

- wrpcPtpConfigDeltaRx
  Description: Read-write object. Fixed Rx delay value to be written, in picoseconds.

- wrpcPtpConfigAlpha
  Description: Read-write object. Alpha fiber asymmetry parameter to be written.

- WR-WRPC-MIB::wrpcPortGroup
  Group containing various information about the WR Ethernet port.

  - wrpcPortLinkStatus
    Description: Status of the link. Possible values:
    down *(1)* – link is down
    up *(2)* – link is up

  - wrpcPortSfpPn
    Description: Product number of the SFP currently plugged into the WR port.
    Related problems: 2.1.9

  - wrpcPortSfpInDB
    Description: Information whether the currently plugged SFP was matched with the calibration values stored in the database. Possible values:

    – notInDataBase *(1)* – currently plugged SFP could not be matched with any database entry
    – inDataBase *(2)* – currently plugged SFP was matched with database entry

    Related problems: 2.1.9

  - wrpcPortInternalTx
    Description: Total number of Ethernet frames transmitted from LM32 processor.
    Related problems: 2.1.8

  - wrpcPortInternalRx
    Description: Total number of Ethernet frames received by LM32 processor.
    Related problems: 2.1.8

- WR-WRPC-MIB::wrpcSfpTable
  Table of the calibration values stored in the SFP database.

  - wrpcSfpPn.<n>
    Description: Product number for the SFP *n* in the database. 2.1.9, 2.1.10

- `wrpcSfpDeltaTx.<n>`
  Description: Fixed Tx delay for the SFP *n* in the database.
  Related problems: 2.1.10

- `wrpcSfpDeltaRx.<n>`
  Description: Fixed Rx delay for the SFP *n* in the database.
  Related problems: 2.1.10

- `wrpcSfpAlpha.<n>`
  Description: Alpha fiber asymmetry coefficient for the SFP *n* in the database. 2.1.10