DBBC3 – Digital Processing and Calibration

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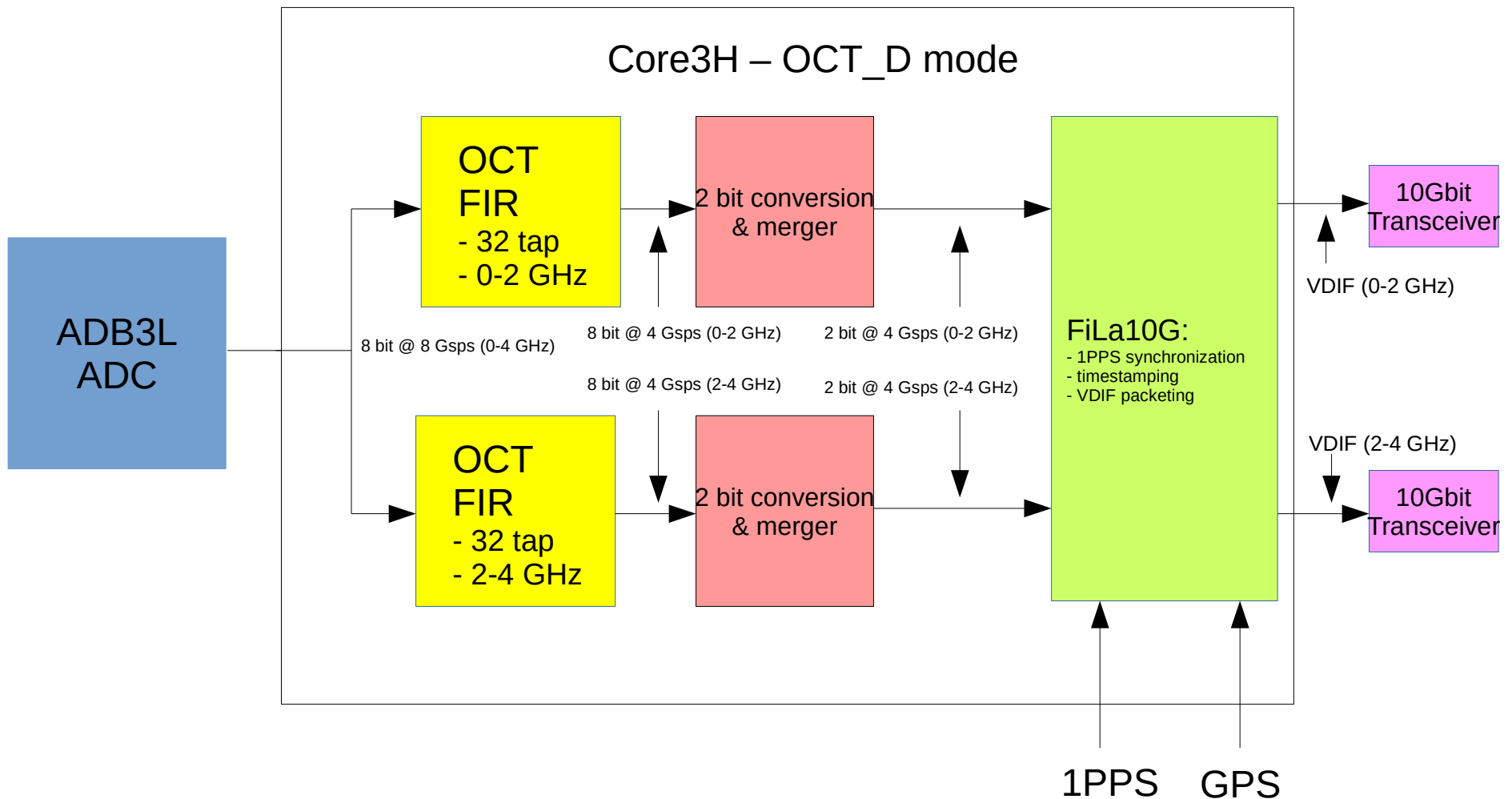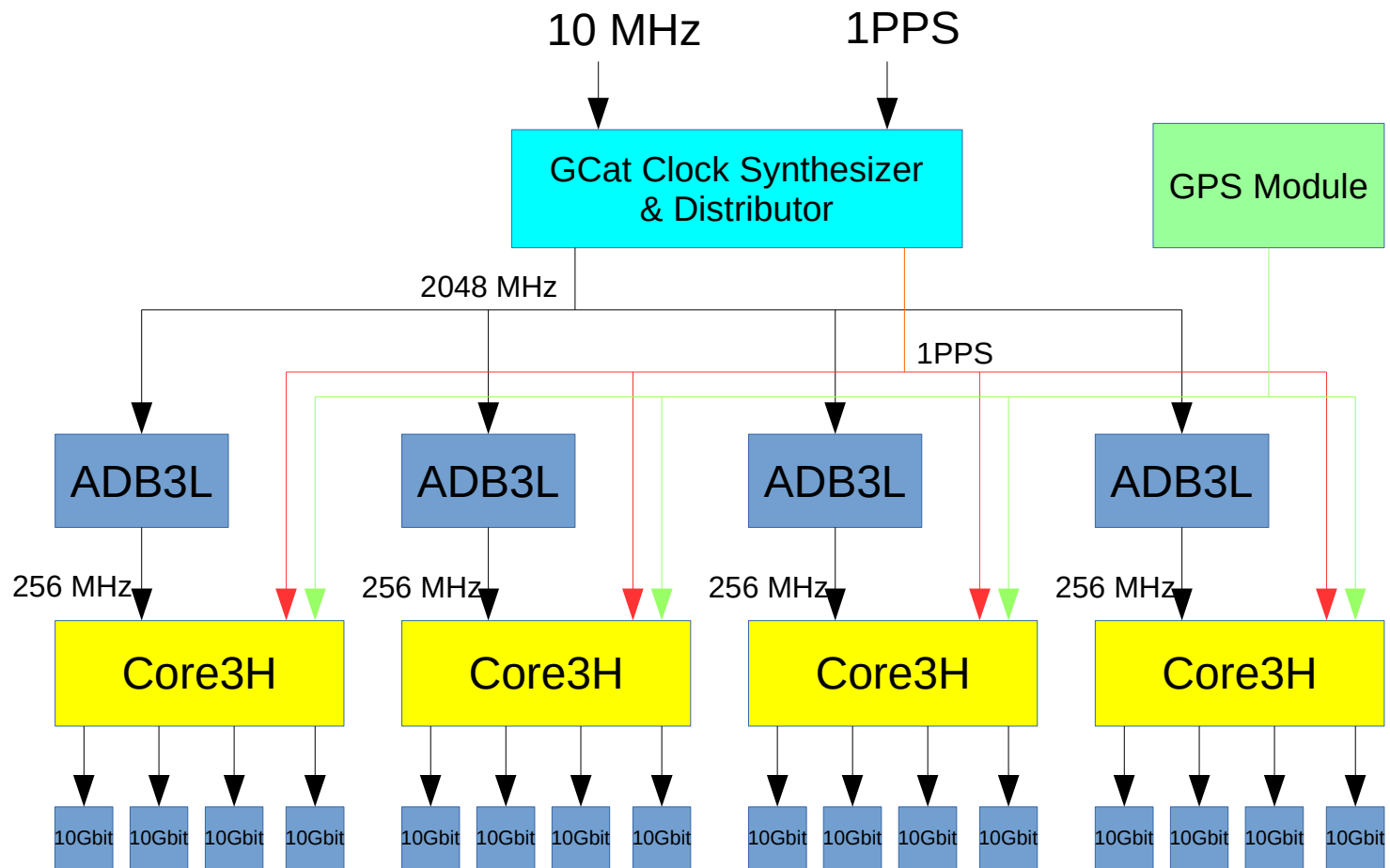
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Digital Processing - Overview

Core3H – OCT_D mode

ADB3L ADC

OCT FIR
- 32 tap
- 0-2 GHz

2 bit conversion & merger

OCT FIR
- 32 tap
- 2-4 GHz

2 bit conversion & merger

FiLa10G:
- 1PPS synchronization
- timestamping
- VDIF packeting

10Gbit Transceiver

10Gbit Transceiver

8 bit @ 8 Gsps (0-4 GHz)

8 bit @ 4 Gsps (0-2 GHz)

2 bit @ 4 Gsps (0-2 GHz)

8 bit @ 4 Gsps (2-4 GHz)

2 bit @ 4 Gsps (2-4 GHz)

VDIF (0-2 GHz)

VDIF (2-4 GHz)

1PPS   GPS

Clock Distribution and Synchronization

ADC Calibration

- ADB3L → interleaved sampling with 4 samplers per board → good calibration of offset, gain and delay necessary to prevent artifacts

- Calibration with noise source or stable noise input from receiver

- Control software provides simple commands for each calibration step (for example cal_offset=1 to calibrate offset of the first ADB3L-board)

- Calibration values are stored in a config-file and are loaded when the DBBC3 or the control software is restarted.

- Calibration values are very stable, recalibration only necessary when there are modifications on the hardware of the DBBC3 done.

- Control software can monitor offset and gain of the ADB3L during observation and do automatic fine-adjustments if needed.

OCT Mode

- OCT Firmware contains one (OCT_S) or two (OCT_D) 32-tap FIR filters

- Filter taps are not fixed and can be loaded during runtime, allowing the use of different filters configurations (f.e. 0-512 MHz, 0-2048 MHz, 2048-4096 MHz, ...)

- For EHT we use OCT_D version with 0-2048 MHz and 2048-4096 MHz configurations

- Both filters receive the 0-4 GHz input stream (8 bit) from the samplers

- Filter output is converted to 2 bit and then packed in VDIF format

- → Core3H provides 1x8 Gbps VDIF output stream for each filter
  → Output format is identical to that of the R2DBE
  → no different setup/configuration for Mark6 recorders needed

2 bit Conversion and Threshold Control

- 2 bit data should have 18/32/32/18 distribution

- Offset calibration necessary for 50/50 distribution, done by initial calibration and monitored during observation by control software including automatic fine adjustment if needed
  → no user interaction during observation necessary

- Threshold calculation is done automatically during runtime by control software
  → no user interaction during observation necessary

- Core3H calculates power of each Filter output stream, these values are queried by control software and used to calculate the correct threshold values.

- The values are updated each 10-20 seconds, (depending on the number of Core3H in the system)

Usability and Robustness

- Usability:
  - Setup is done by editing config files that are loaded at startup of the control software
  - socket connection of control software allows user interaction with socket client or field system
  → this allows configuration changes during runtime if needed and continuous monitoring of the system status.
  - Multicast support in development to allow additional monitoring capabilities

- Robustness:
  - DSC/OCT stable, already tested successfully in field
  - successful zero-baseline tests with R2DBE