

DE LA RECHERCHE À L'INDUSTRIE

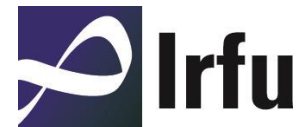


# HIGH PRECISION CLOCK DISTRIBUTION PROJECTS AT IRFU AND POSSIBLE R&D PLANS

**D. Calvet,  
CEA Paris-Saclay**

Saclay, 13 January 2020

[www.cea.fr](http://www.cea.fr)

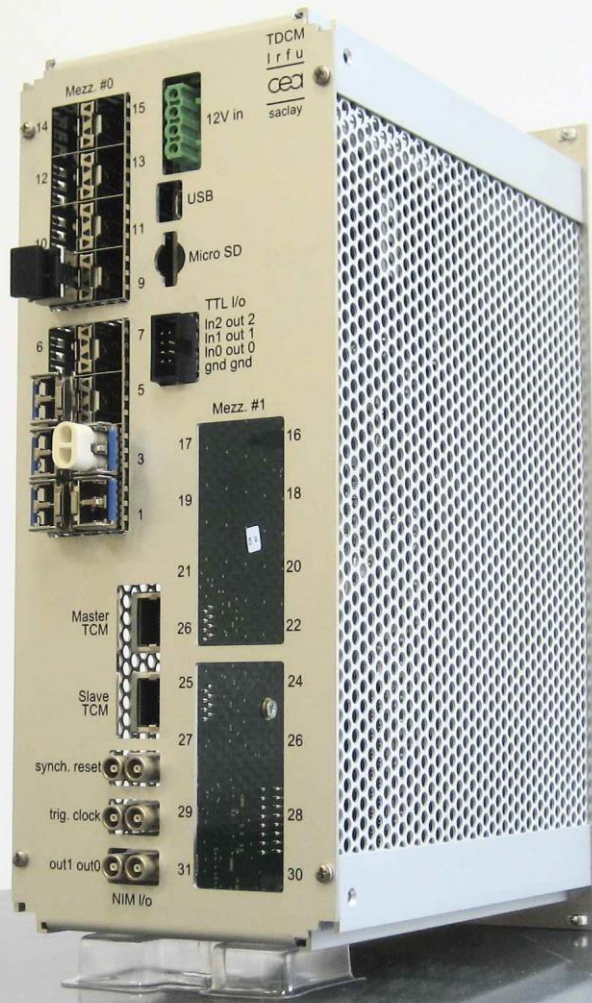


- *CMS Phase II Upgrade: High Granularity Calorimeter*
  - . *7.5 M channels*
  - . *Desired clock distribution precision: few 10 ps jitter*

- *T2K nd280m Upgrade: High Angle TPCs*
  - . *36 K channels*
  - . *Desired clock distribution precision: few 100 ps jitter*

→ *Expertise being developed in the field of precise clock distribution at Irfu for several years and growing*

*Investments on test equipment, e.g. 80 GSPS oscilloscope, phase noise analyzer*



## Features

- Clock and Trigger fanout distributor + data aggregator
- Master clock/trigger input port: electrical RJ45 or optical SFP
- Fanout side: up to 32 optical ports 100 Mbps downstream to front-end; 400 Mbps per upstream link from each front-end
- Data readout and control: 1 port Gigabit Ethernet
- Fast data readout (untested; not to be used for T2K-II)
  - 3 x SFP (6.6 Gbps each)
  - PCIe (Gen 2 x 4, 20 Gbps raw, 16 Gbps net)
- Based on commercial FPGA module with Xilinx ZYNQ SoC
- 4 TDCM prototypes in operation at various sites since 2018
- Plan to launch final board production for T2K-II in 2020

→ *The HA TPCs in T2K-II will use 2 TDCMs*

*...but in theory this system is scalable to 32 x 32 = 1024 ports: 1 root TDCM and 32 slave TDCMs*

## Current work

- Pursue development of TDCM for T2K-II and other applications (PandaX-III, PUMA?, ...)
- Measure clock distribution performance for T2K-II specs and see where we stand for more demanding applications

## Prospects

- Conceptual studies on a 48-port TDCM scalable to  $48 \times 48 = 2304$  ports in dual stage cascaded configuration
- R&D on concepts, methods, key technologies and components for building large scale ultra-precise clock distribution systems: ZYNQ Ultrascale+ SoM, optical links, passive optical networks, PCIe, PLL's, etc.
- Benchmarking, testing, demonstrator boards, proof-of-concept...

→ *Could contribute to the proposal of potential solutions for HyperK if Irfu staff join the project*