# Design studies for the off-detector electronics of the upgraded CMS calorimeter for the HL-LHC

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*on behalf of the USCMS Collaboration*

## Barrel Calorimeter Processor (BCP) ATCA Blade

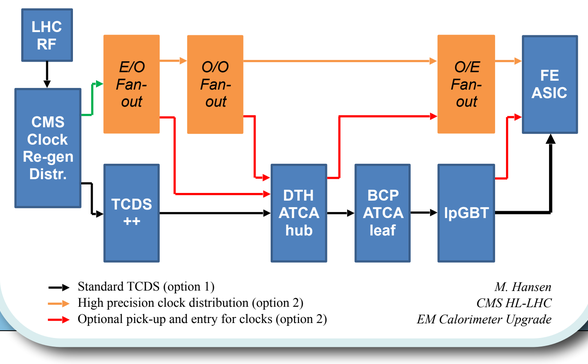
The Barrel Calorimeter Processor blade will be the core board of the off-detector electronics for the HL-LHC. This unified hardware design has the flexibility to support the back-electronics needs of both the ECAL Barrel (EB) and the HCAL Barrel (HB) sub-sections of the CMS experiment. It will be an ATCA blade with up to 12 BCPs per ATCA crate along with a DAQ & TTC Hub (DTH), which will be the interface with both the DAQ and the clock distribution electronics. The BCP will occupy the nexus between the front-end detector electronics, DAQ, Timing and Trigger, sending timing information to the front-end, receiving all sample data from the front-end, calculating the trigger primitives and sending them to the Level-1 Trigger (L1T) and buffering the events before sending the triggered data to the DAQ.

### Optical Engine: FireFly™

*A. Madorsky, Hardware R&D for Phase 2 upgrade of CMS Muon Endcap Level 1 Trigger*

- From Samtec
- Micro Flyover
- 1 - 15.7 Gbps
- multi-channel fiber
- MPO connector
- 12x TX or 12x RX

### Clock Distribution

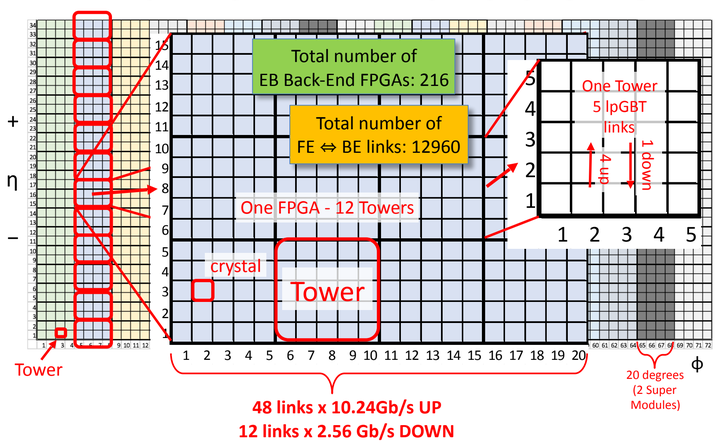


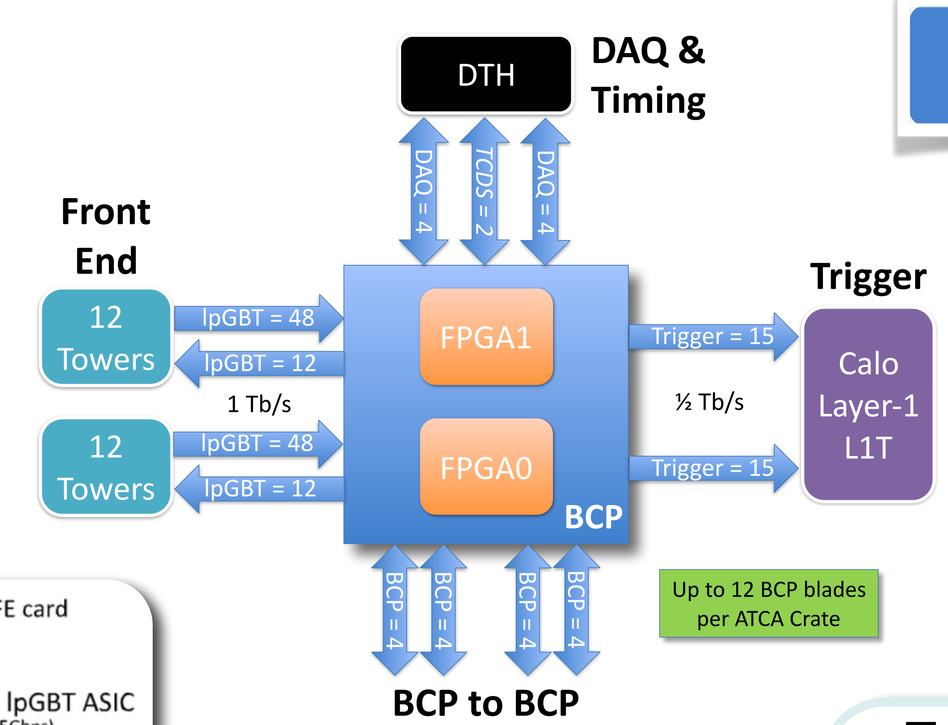

### Supported Links

| | Link rate | Encoding | bits/ BX | Effective data rate | Comments |
|---|---|---|---|---|---|
| #1 | **800Mb/s** | 8b10b | **16** | 640Mb/s | BCP-to-BCP links low rate |
| #2 | **2.4Gb/s** | GBT | **44** | 1.76Gb/s | HCAL clock, control and status |
| #3 | **2.56Gb/s** | lpGBT | **32** | 1.28Gb/s | ECAL FE clock and control |
| #4 | **3.2Gb/s** | 8b10b | **64** | 2.56Gb/s | TCDS++ interface and LHC clock |
| #5 | **4.8Gb/s** | GBT | **88** | 3.52Gb/s | ECAL Demonstrator |
| #6 | **5.0Gb/s** | 8b10b | **96** | 3.84Gb/s | HCAL data concentration |
| #7 | **10.24Gb/s** | lpGBT | **224** | 8.96Gb/s | ECAL data concentration and status |
| #8 | **16Gb/s** | 64b66b | **384** | 15.36Gb/s | BCP-to-BCP links high rate, DAQ, Calo Layer-1 |

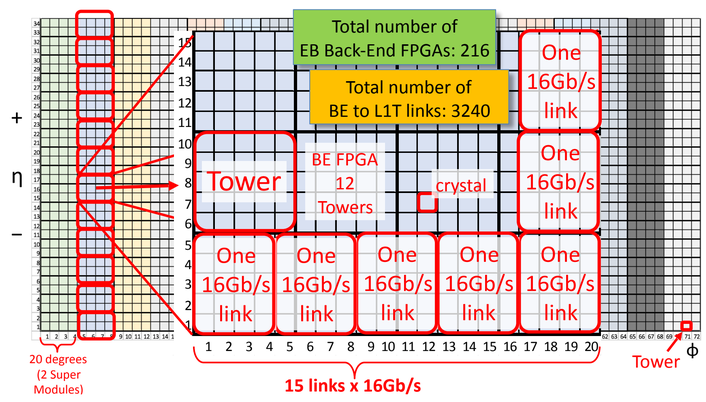
## PHASE-2 ECAL

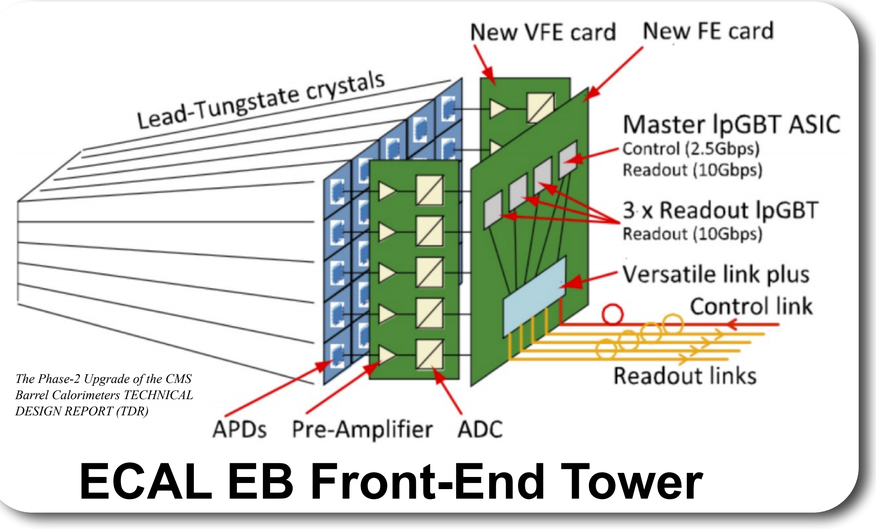
### Barrel FE Partitions



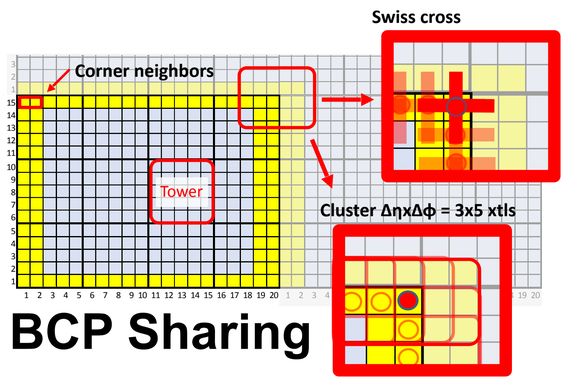




### Trigger Partitions



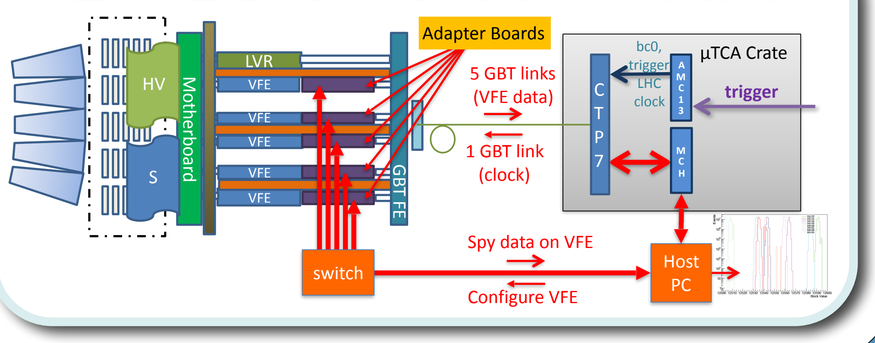




### ECAL EB Front-End Tower

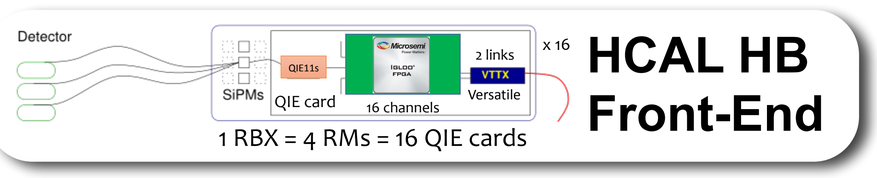



### BCP Sharing

### ECAL Demonstrator Chain

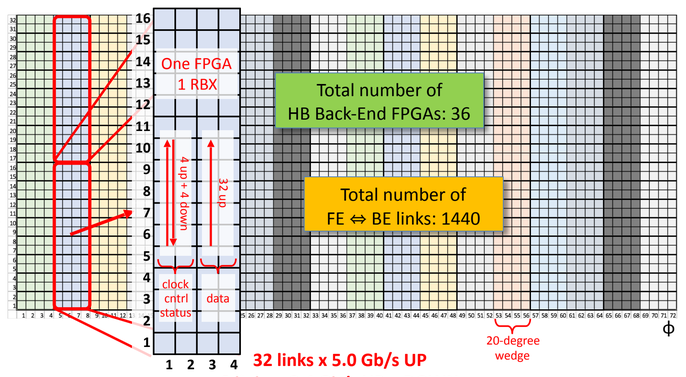


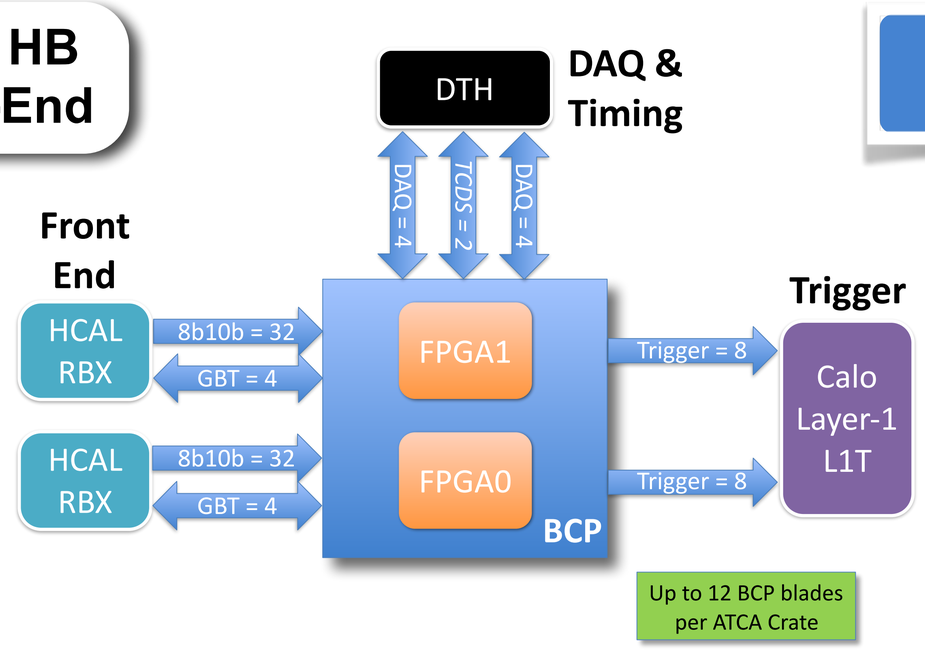

## PHASE-2 HCAL

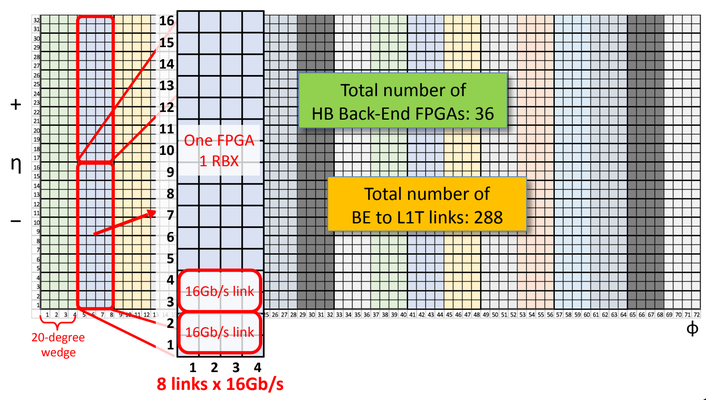



### HCAL HB Front-End

### Barrel FE Partitions




### Trigger Partitions