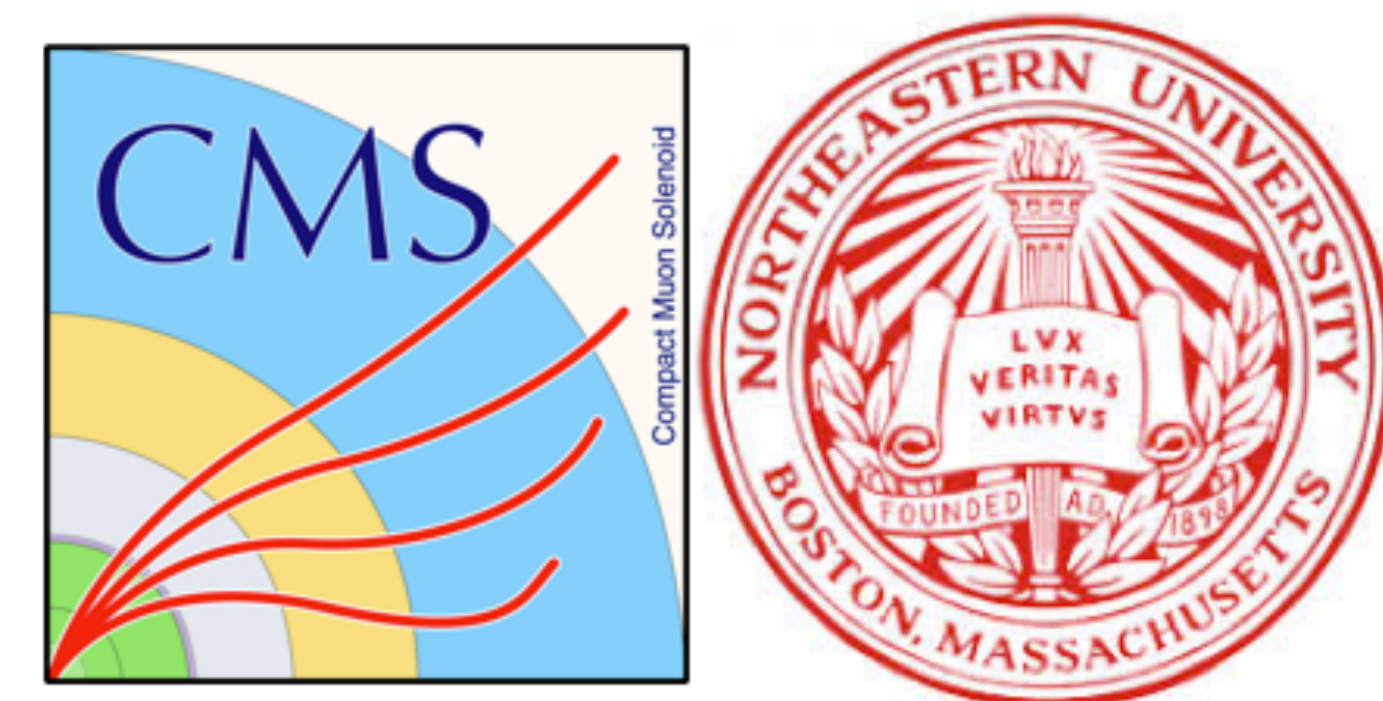
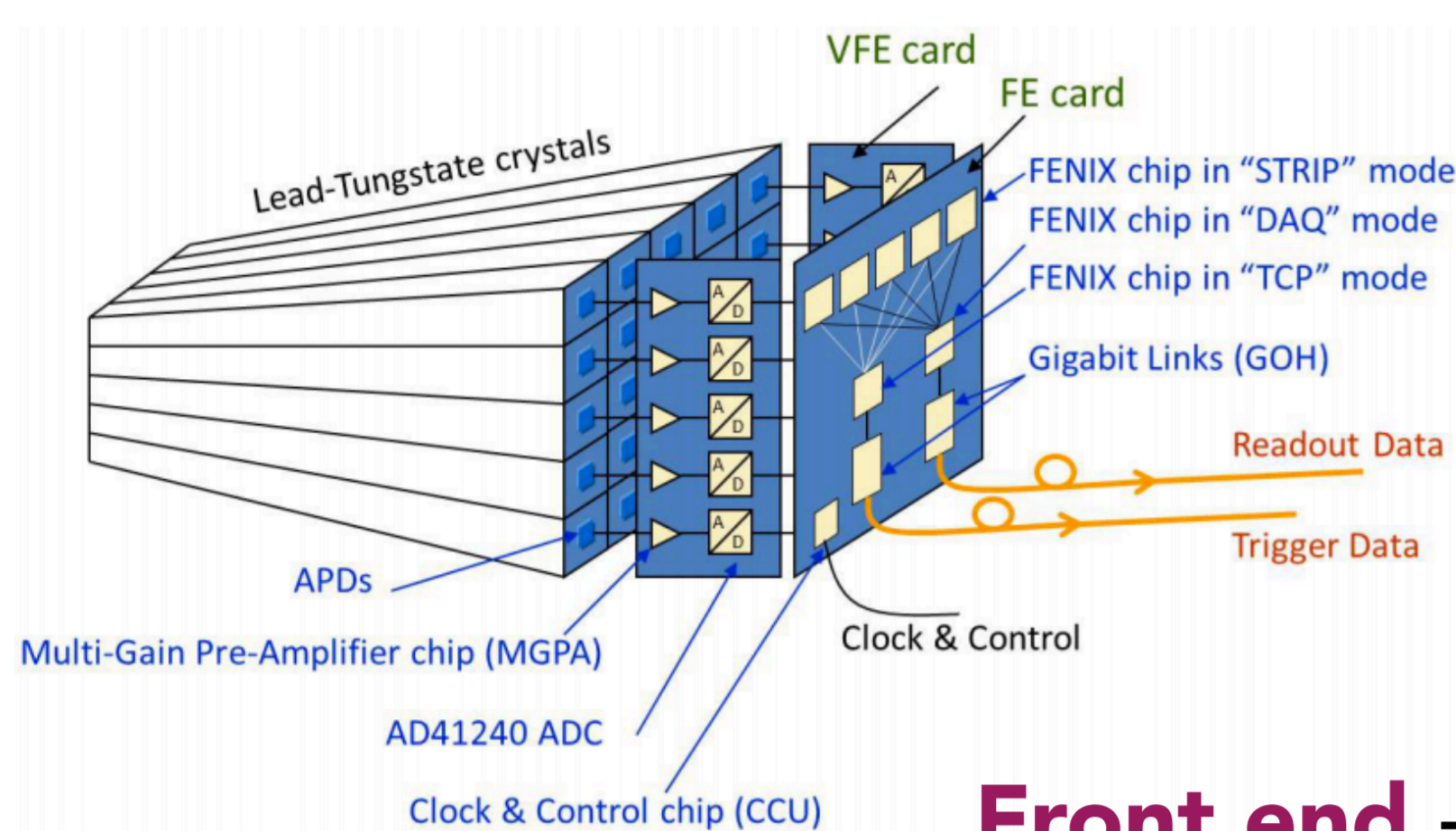


Performance of the CMS Electromagnetic Calorimeter data acquisition system at LHC Run 2



Tanvi Wamorkar, on behalf of the CMS collaboration
Northeastern University

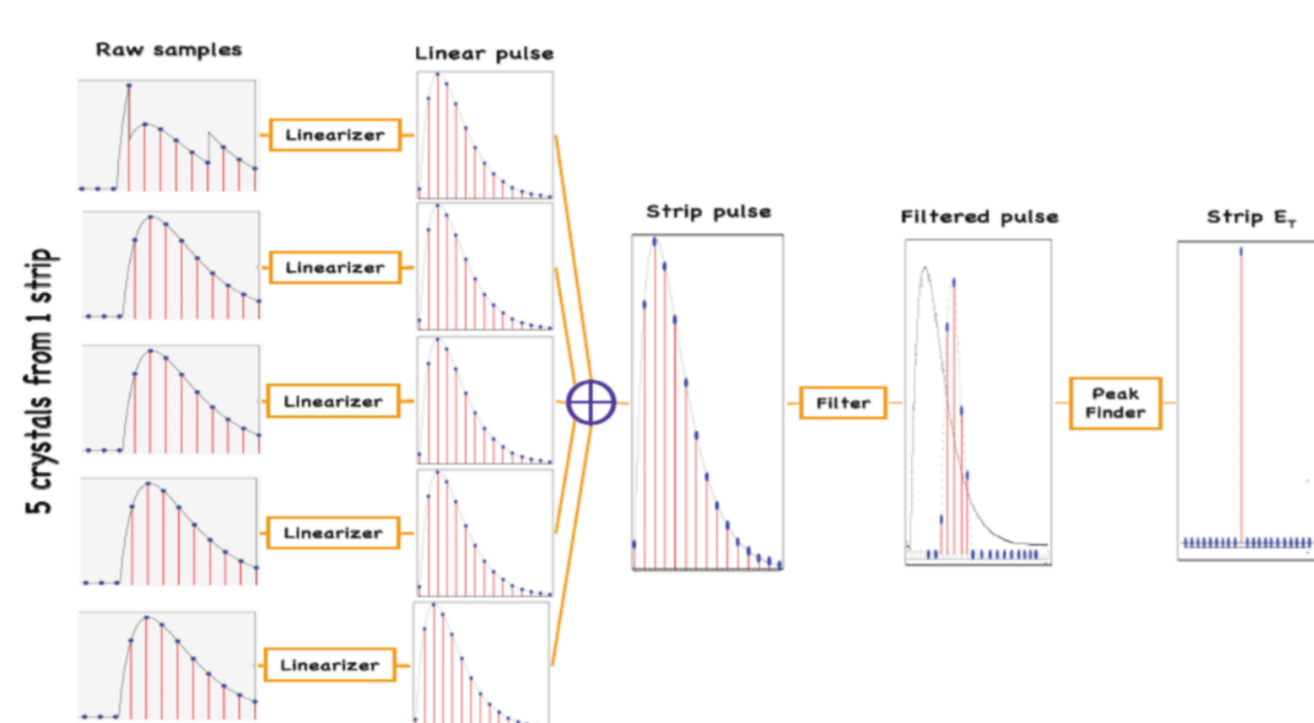
PM2018 (14th Pisa Meeting on Advanced Detectors)



Front end → **Off-detector trigger boards** → **Control path** → **DAQ path**

Trigger path (Front end)

- Front end electronics is the first step of trigger & DAQ path
- TT → Front End (FE): Shapes, amplifies, digitizes signals from photodetectors & generates trigger primitives
- FE cards send trigger primitive information to the off-detector electronics

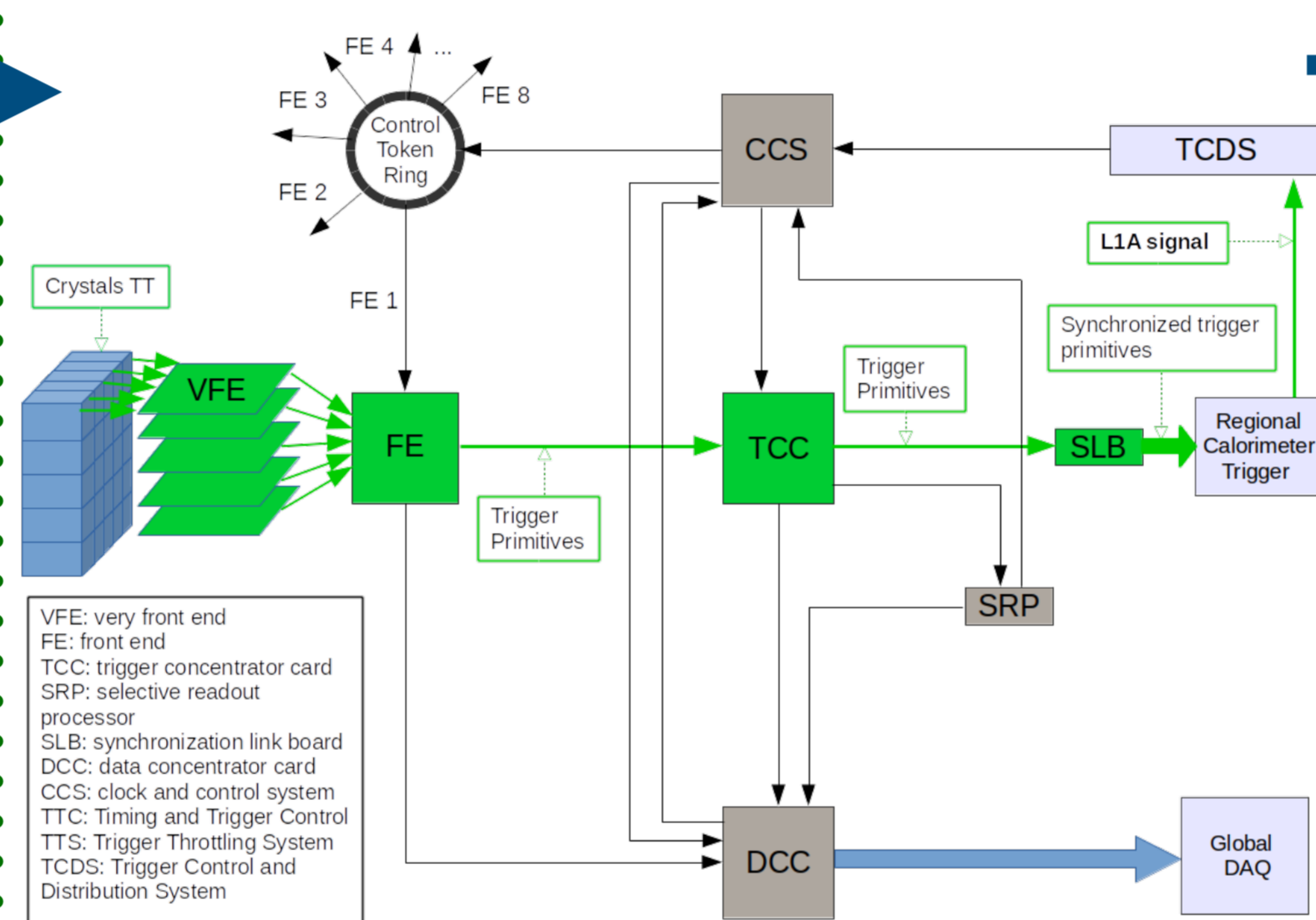


$$A = \sum_{i=0}^N w_i \cdot S_i$$

A : amplitude
 w_i : weights
 S_i : ADC time sample outputs
N: Number of samples used (10 in this case)

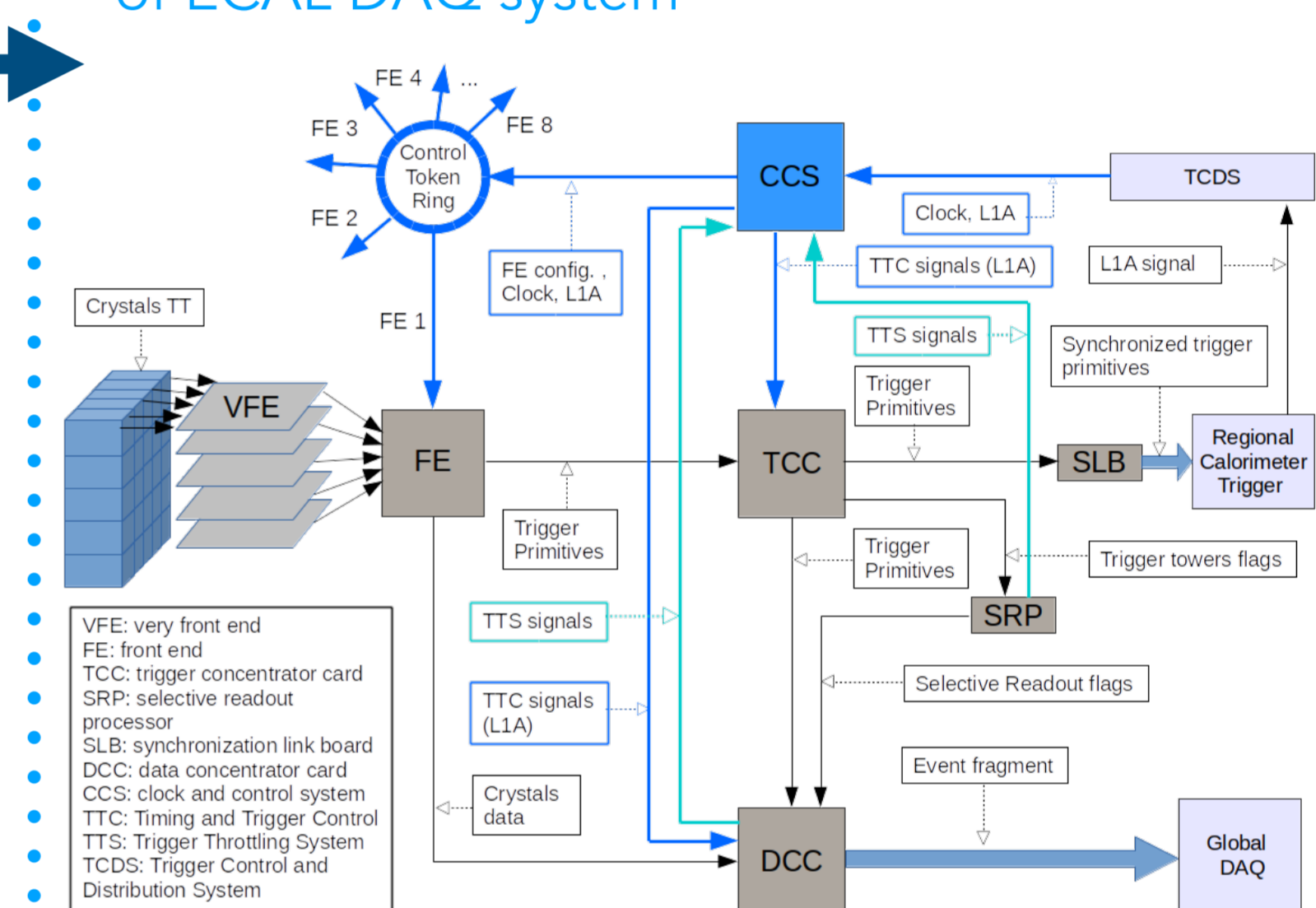
Trigger path (Off-detector Trigger boards)

- TCC boards elaborate TP's to extract interesting events & send potential triggers to L1 trigger (first stage of the central DAQ system)



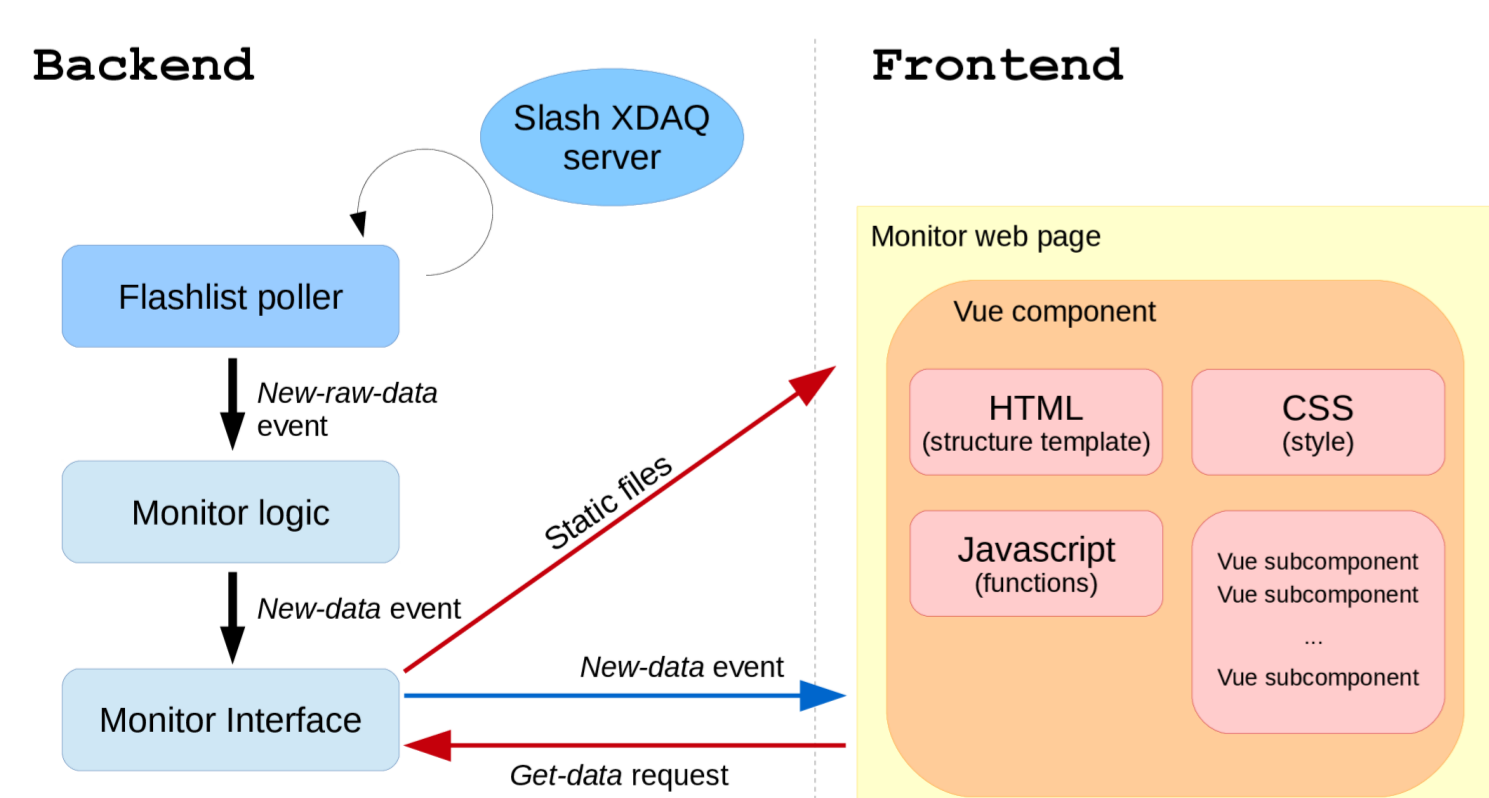
Control Path

- TCDS (Trigger control & distribution system) sends accepted triggers & control commands (Start, Stop, Reset...) to CCS boards
- From here, signals are distributed to the rest of ECAL DAQ system



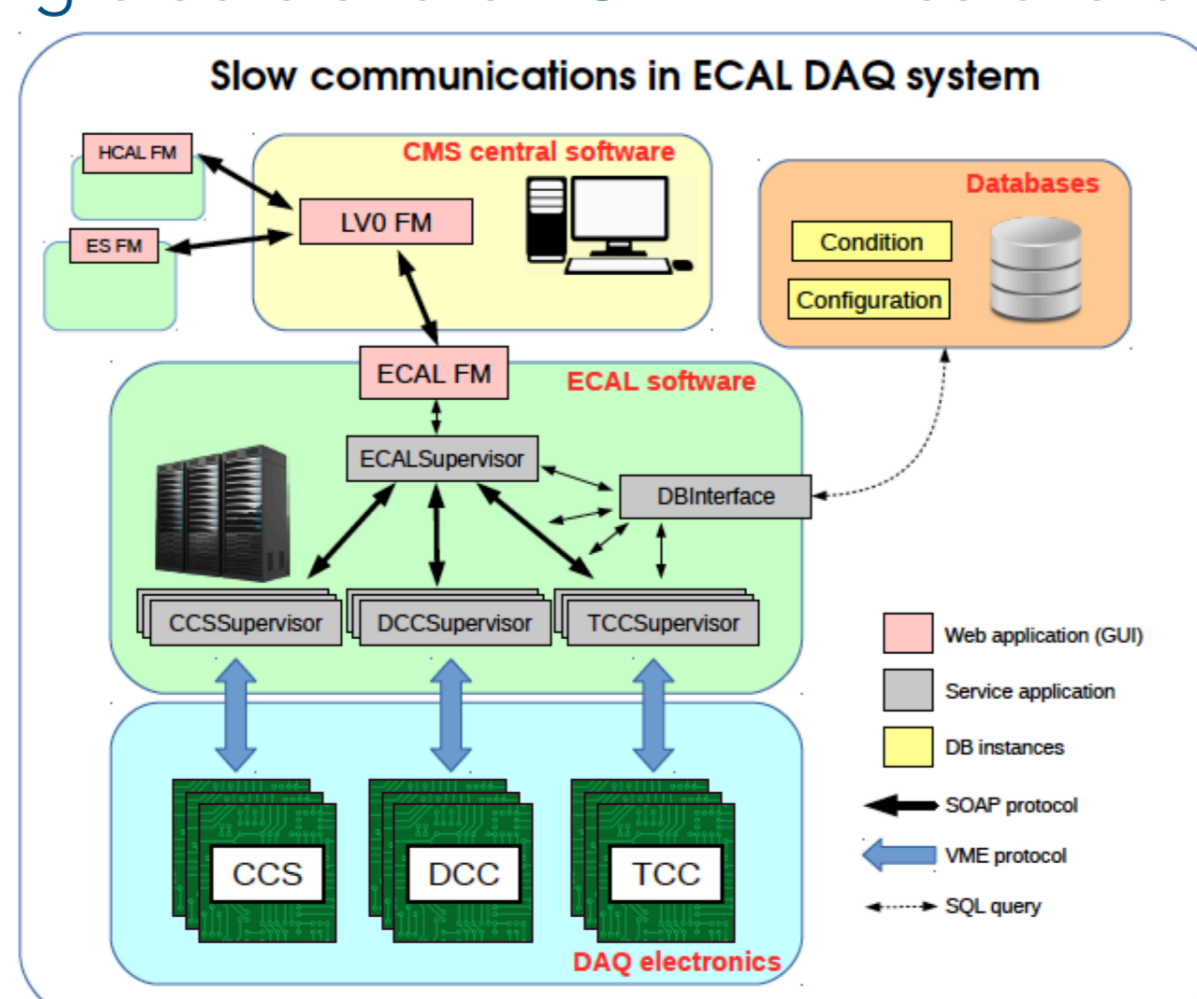
ECAL Monitoring Tools

- ecalView: web application to monitor online status of ECAL and Preshower
 - Acquires monitoring data from supervisor applications & elaborates it into useful information for ECAL shifters
- Backend: node.js modules
- Frontend: html files & javascript components



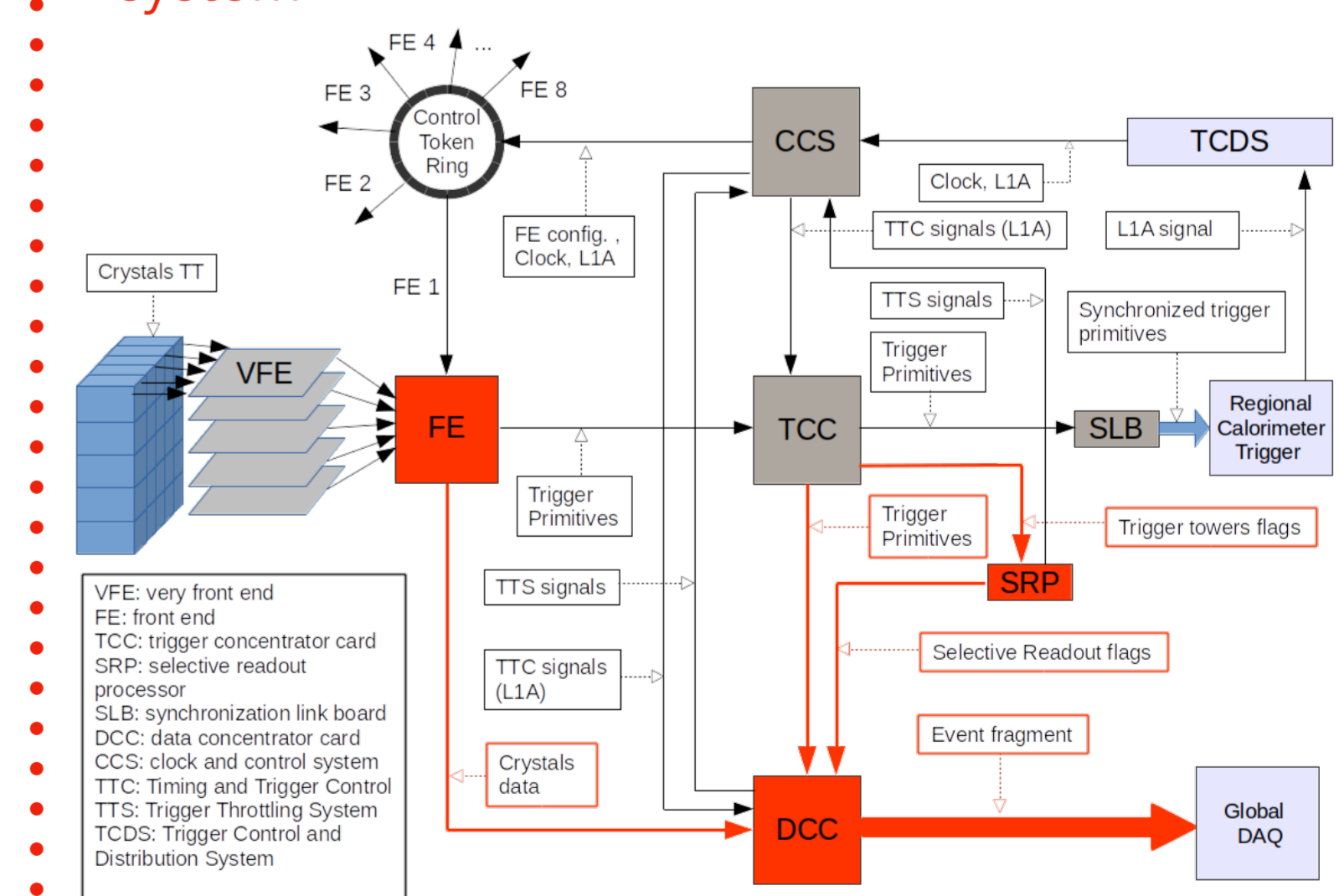
ECAL Online Software

- Responsible for configuration, operation & monitoring of ECAL Trigger & DAQ system
- Hierarchical organization - Function Managers (FM) @ top level
- ECAL supervisor & electronic supervisors are the building blocks of the ECAL DAQ software



DAQ path

- Additional information is added to the event package of the signal acquired by DCC boards
- Event fragments are sent to central DAQ system



ECAL DAQ performance and automatic recovery procedures

- In comparison to the luminosity delivered by CMS, ECAL DAQ and Preshower DAQ were responsible for 3% and 0.9%, respectively, of the lost luminosity in 2017. This improvement over 7% and 6% lost luminosity due to ECAL and Preshower DAQ in 2016 is a result of the different automatic recovery procedures, some of which are:
 - Integrity and link errors (noisy patterns in occupancy) in CCS for ECAL and Preshower
 - DCC errors when CMS clock is unstable (particularly for Preshower)
 - ECAL and Preshower stuck during Single Event Upset (SEU) in the front-end electronics
- For 2018: auto-recovery procedures being improved for ECAL DAQ to maintain excellent performance!