Det1 TOF DAQ
(pre) Strawman

Tonko Ljubicic (BNL)
June 2022

Geometry

- Barrel
  - 63 cm radius, 2x128 cm length
- Electron Endcap
  - smaller disk; 64 cm radius
- Hadron Endcap
  - larger disk; 85 cm radius
- Total area ⇒ 14 m2

Channel Count

- under flux at the moment
  - strip size 0.5 mm X 1cm [ATHENA]
  - strip size 0.5 mm x 0.3 cm [ECCE hardware proposal]
  - pixel size 0.5 mm x 0.5 mm [assumption in ECCE simulations]
  - or some combination of the above??
  - **from 3-50(!) Mchannels** ⇒ the big unknown
    - should be known “soon”....
- for this pre-Strawman I will assume 0.5 mm x 1 cm
  - but at the end I will show which numbers are sensitive

Fiber Count

- Barrel
  - my assumptions: 5 cm wide staves, each stave 1 fiber ⇒ 160 fibers
- Electron (smaller) Endcap
  - maintaining similar channel count per fiber ⇒ 30 fibers
- Hardron (larger) Endcap
  - as above ⇒ 50 fibers
- total: 240 fibers
- channel count per fiber ~ 13000
- Comment: number of fibers will mostly be determined by the geometry of the readout scheme, mechanics, fiber routing etc and *not* throughput requirements

Rates on the fiber

- Data
  - 50 particles per event x 500 kHz x 3 strips per particle x 32 bits per strip / 240 fibers
    - ⇒ ~1 MB/s per fiber [puny]
- Noise
  - personal assumption → 1 kHz per strip x 3M channels x 32bits / 240
    - but also NOTE: noise strongly depends on various discriminator settings so it is somewhat under our control
    - ~50 MB/s per fiber [dominates the rate but not too bad]
- Total: ~50 MB/s per fiber
  - not a problem
  - BTW: I will be assuming “conservative” 10 Gbs fiber links towards the Global DAQ PCs
-

DAQ PCs: Incoming & Processing Side

- *assumption: PCIe Receiver Boards with 24 fibers*
  - ⇒ 10 DAQ PCs
  - BTW: Receiver Boards and DAQ PCs are designed and specced by the Global DAQ Group
    - but under discussions with detector subgroups, naturally
- processing on the DAQ PCs
  - 24 fibers x 50 MB/s ⇒ 1.2 GB/s of incoming data into a single DAQ PC
    - not a problem, similar processing rates already exist in e.g. the STAR TPC
  - noise removal
    - require hits ~in time with the collision [10x noise rejection]
    - require clusters of at least 2 close strips [10x noise rejection]
    - require close strips to have ~same time [10x noise rejection]
      - total ~1000x rejection
      - noise becomes small and is ignored :-)
    - caveat: synchrotron radiation not included but under investigation
  - cluster finding for higher precision xy as well as time
    - final “point” size 16 bytes per particle

DAQ PCs: outgoing to the Event Builders (tape)

- from previous slides:
  - 16 bytes per track x 50 tracks x 500 kHz ⇒ 400 MB/s to tape
- add fudge factor of 1.5x ⇒ 600 MB/s to tape expected (max)
  - fudge factor incorporates “known” unknowns at this moment
  - note that this *does not depend* on the channel count and all those uncertainties
- perhaps a bit high?

Special Runs

- "pedestal"-like runs to determine various discriminator thresholds
  - proposal: done "privately" using "private" (non-Global) commands to the TOF FEEs
  - no real involvement from Global DAQ (assumed)
    - apart from a Run Control setup (if that…)
  - will be done "rarely" (once a day, max)
  - results stored on local PCs
    - for efficiency & robustness since they will be constantly used
    - but also in a database provided by Global DAQ for reference and Offline use
- internal pulser runs to determine working channels
  - depends on ASIC functionality
  - otherwise same as above (but even rarer)
- TBD but I don't foresee any issue here
  - nor do I expect any large involvement from the Global DAQ

Timing (a crucial component *expected* from Global DAQ)

- TOF needs a very low jitter EIC clock
  - under deliberation but I'm assuming 50 MHz
    - NOTE: usual LHC ASICs use the unfortunate 40 MHz but we assume that the EIC-specific EICROC ASIC will be able to handle 50 MHz (*but not 100 MHz*)
  - TOF FEEs will house clock cleaner devices to get to required **~5 ps jitter**
    - TOF is a special case so we assume we will handle this locally within the TOF electronics sub-group
- But we also want/need constant phase to the EIC Global clock
  - the collision timing relative to the clock edge is fixed, does not change power-up to power-up
- Question to Global DAQ: will/can this be done and how??

Summary

	this Strawman	maximum
fiber count	240	~500
channel count	3 M	50 M [very unlikely]
rates/fiber	50 MB/s	500 MB/s
DAQ PCs	10	30?
rates to tape	400 MB/s	600 MB/s