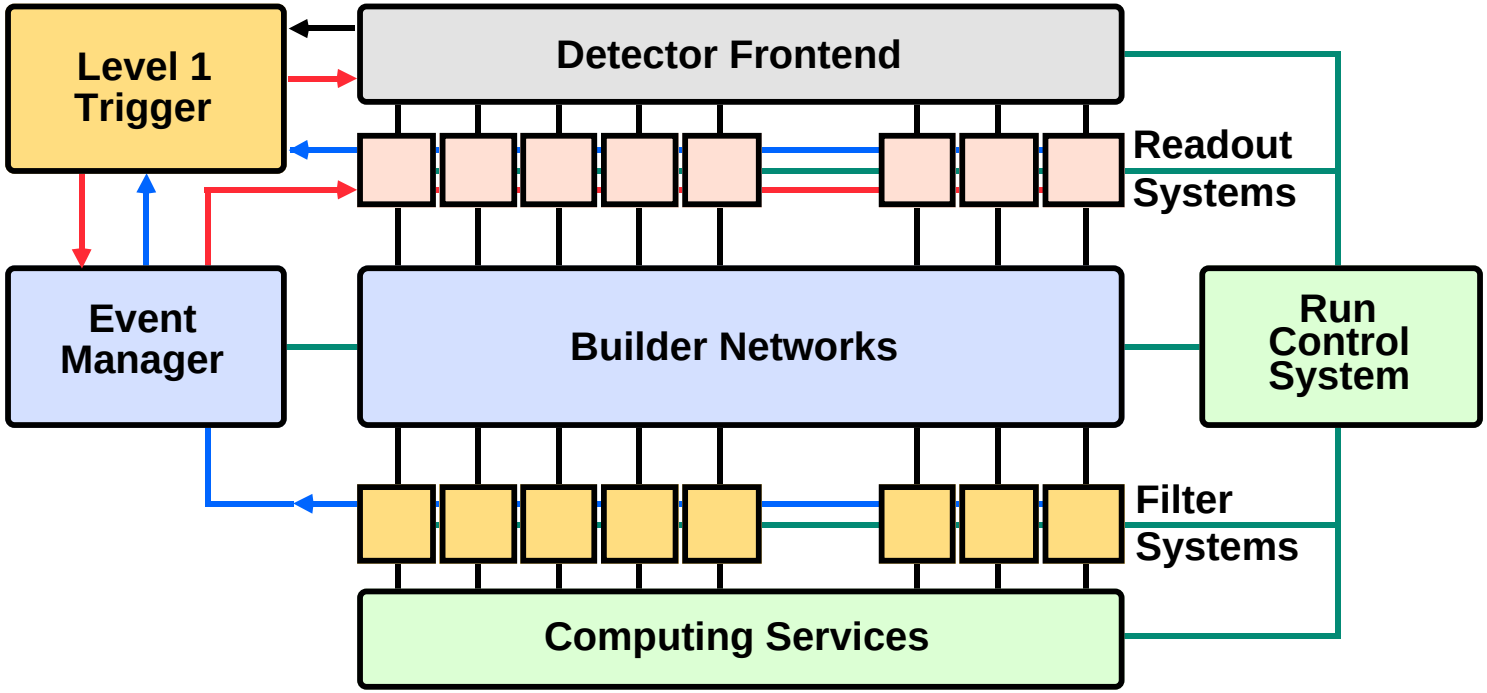
Trigger Overview

Wesley Smith, *U. Wisconsin*
CMS Trigger Project Manager

DOE/NSF Review
April 12, 2000

TriDAS Main Parameters



Collision rate	40 MHz
LV1 Maximum trigger rate	100 kHz
Average event size	≈ 1 Mbyte
Data production	≈ Tbyte/day
Event Flow Control	≈ 10^6 Mssg/s

I-O units bandwidth (512+512)	400 MByte/s
Builder network (512x512 port)	≥ 500 Gbit/s
Event filter computing power	≈ 5 10^6 MIPS
High Level Trigger acceptance	1 - 10 %
Overall dead time	≤ 2%

TriDAS Evolution

Plans for initial turnon of CMS:

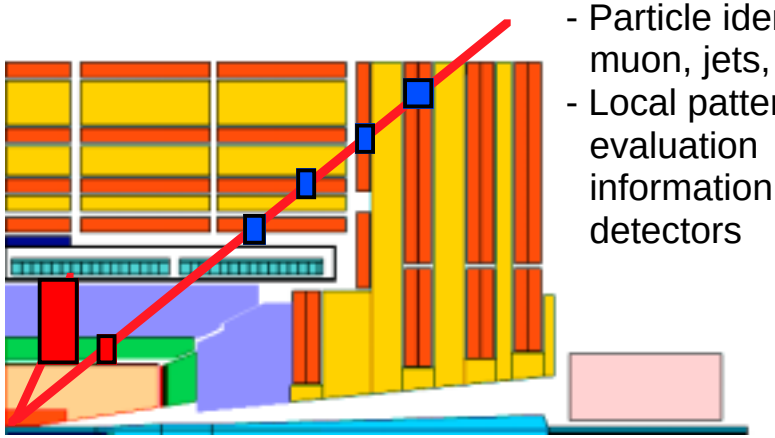
Rates (kHz)	Level 1 output	Readout thruput	Ev. Bld. thruput	Ev. Filt. capacity
Design	100	100	100	100
Implement.	100	100	75	75*
Operation	75	75	75	75*

* The final capacity will be determined by the evolution of technology, cost and financial resources

Plan set to exploit funding resources and computing technology advances in the most effective manner

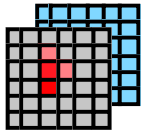
CMS Level 1 Trigger

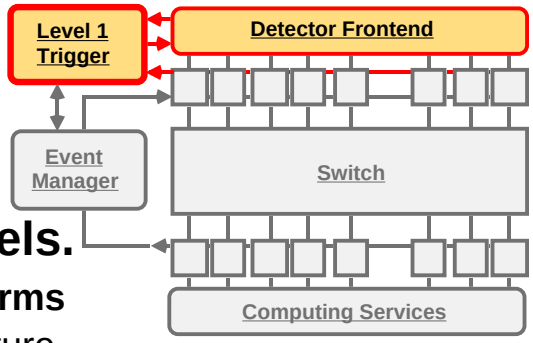
40 MHz



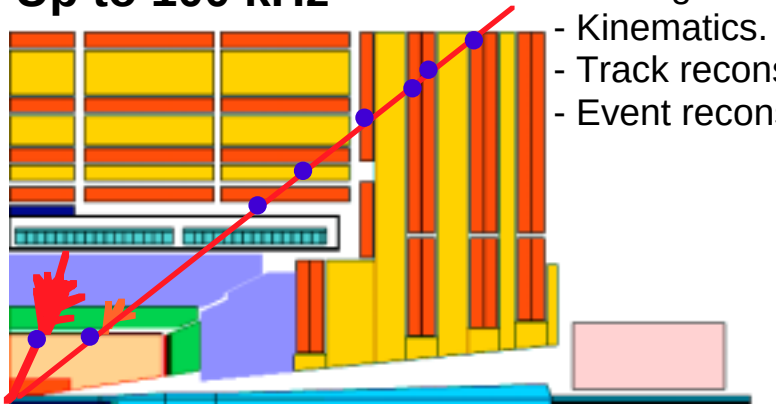
Level-1. Specialized processors

- Particle identification: high p_T electron, muon, jets, missing E_T
- Local pattern recognition and energy evaluation on prompt macro-granular information from calorimeter and muon detectors





Up to 100 kHz

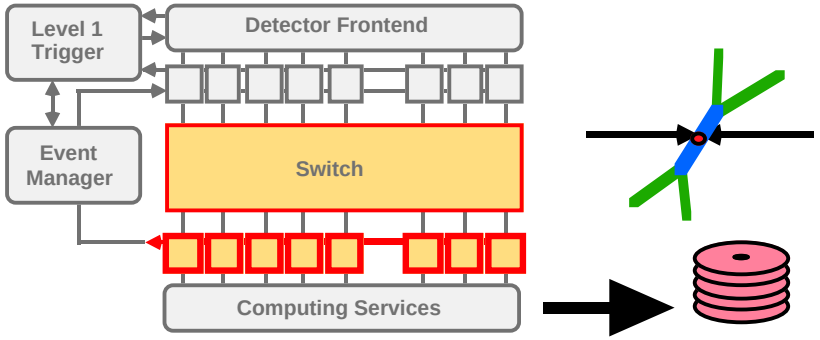


High trigger levels.

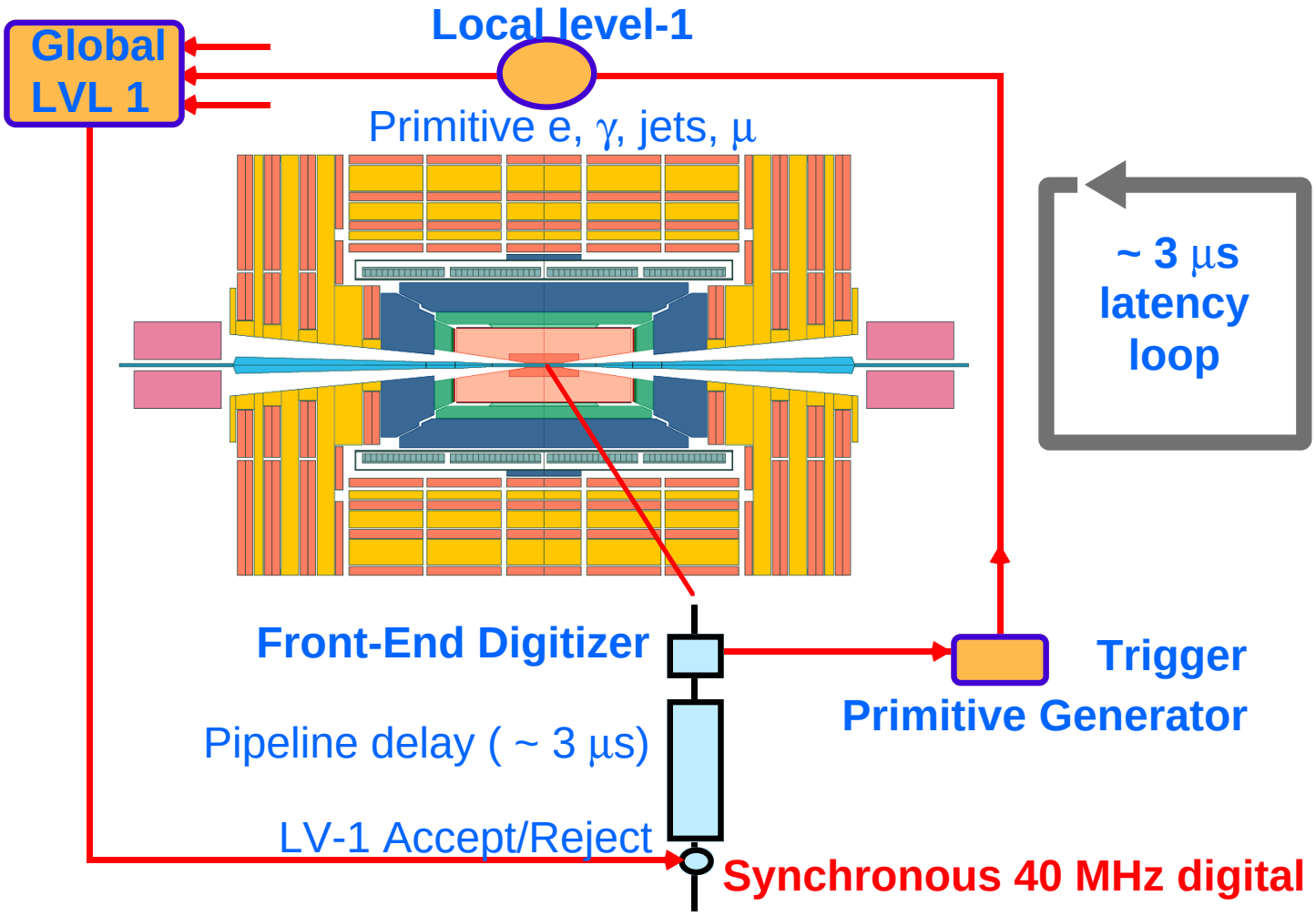
Network and CPU farms

- Clean particle signature
- Finer granularity precise measurement
- Kinematics. effective mass cuts & event topology
- Track reconstruction and detector matching
- Event reconstruction and analysis

≈ 100 Hz



CMS Level 1 Pipeline



Synchronous 40 MHz digital system

- **160 MHz internal pipeline**
- **Readout & processing latency < 1μs**
- **Signal distribution latency ~ 2 μs**

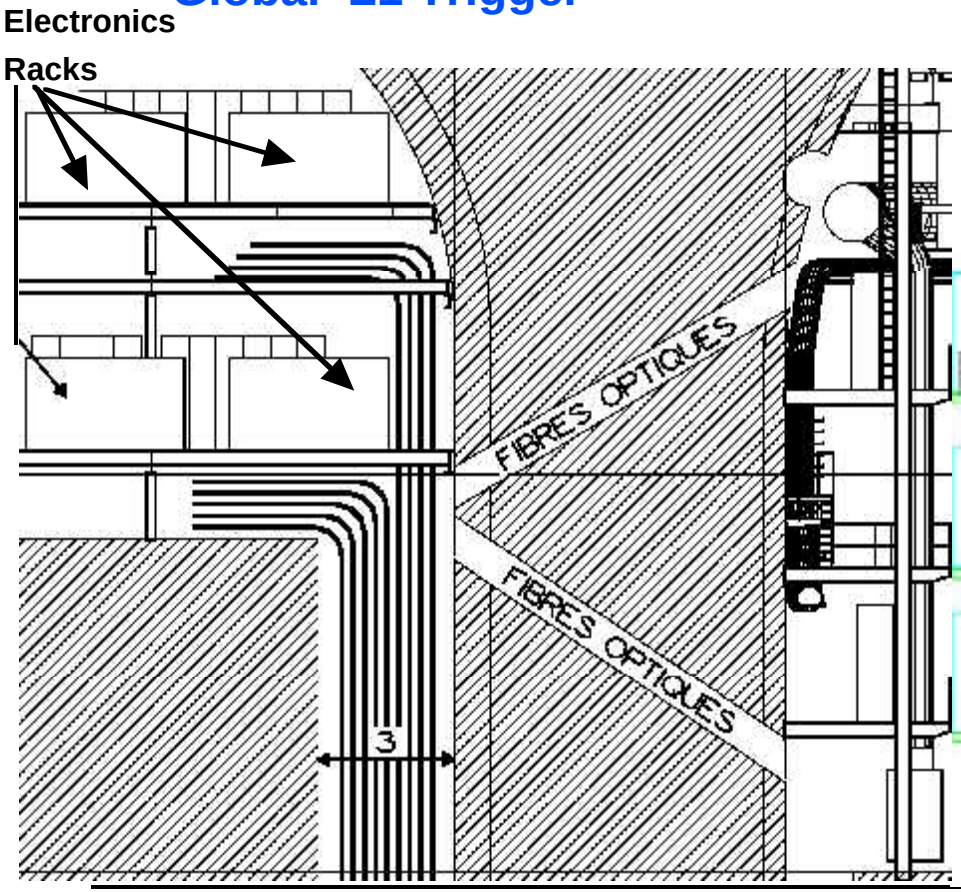
Trigger Electronics Locations

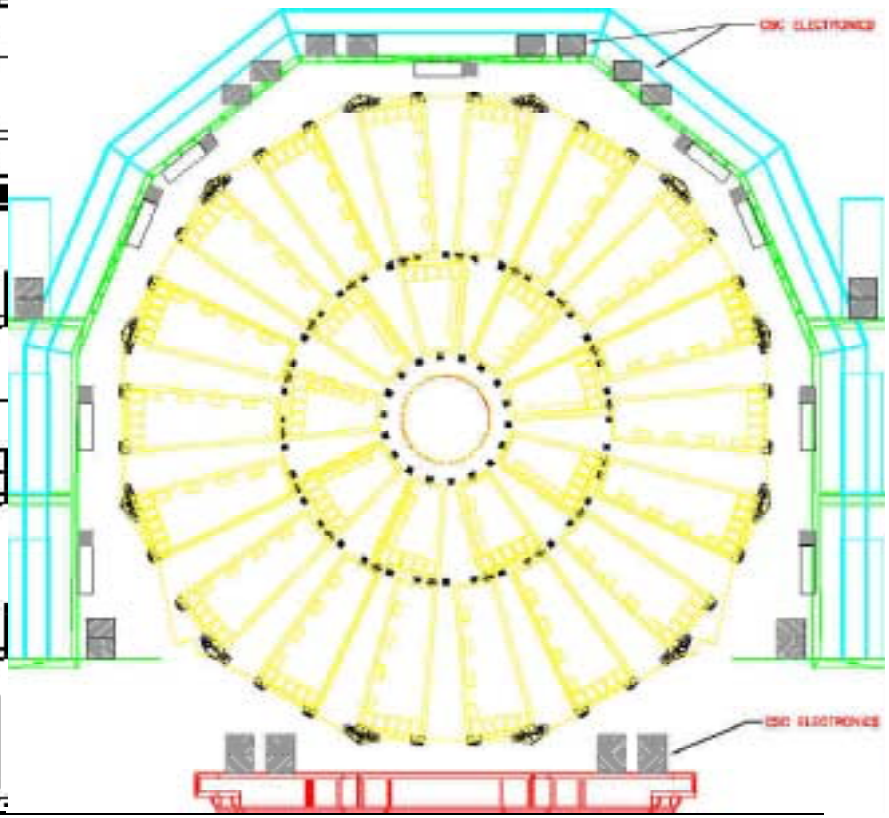
In Underground Shielded Room:

- CSC/DT Muon Trigger Track Finder
- RPC Muon Trigger Pattern Logic
- Calorimeter Regional/Global Trigger
- Global L1 Trigger

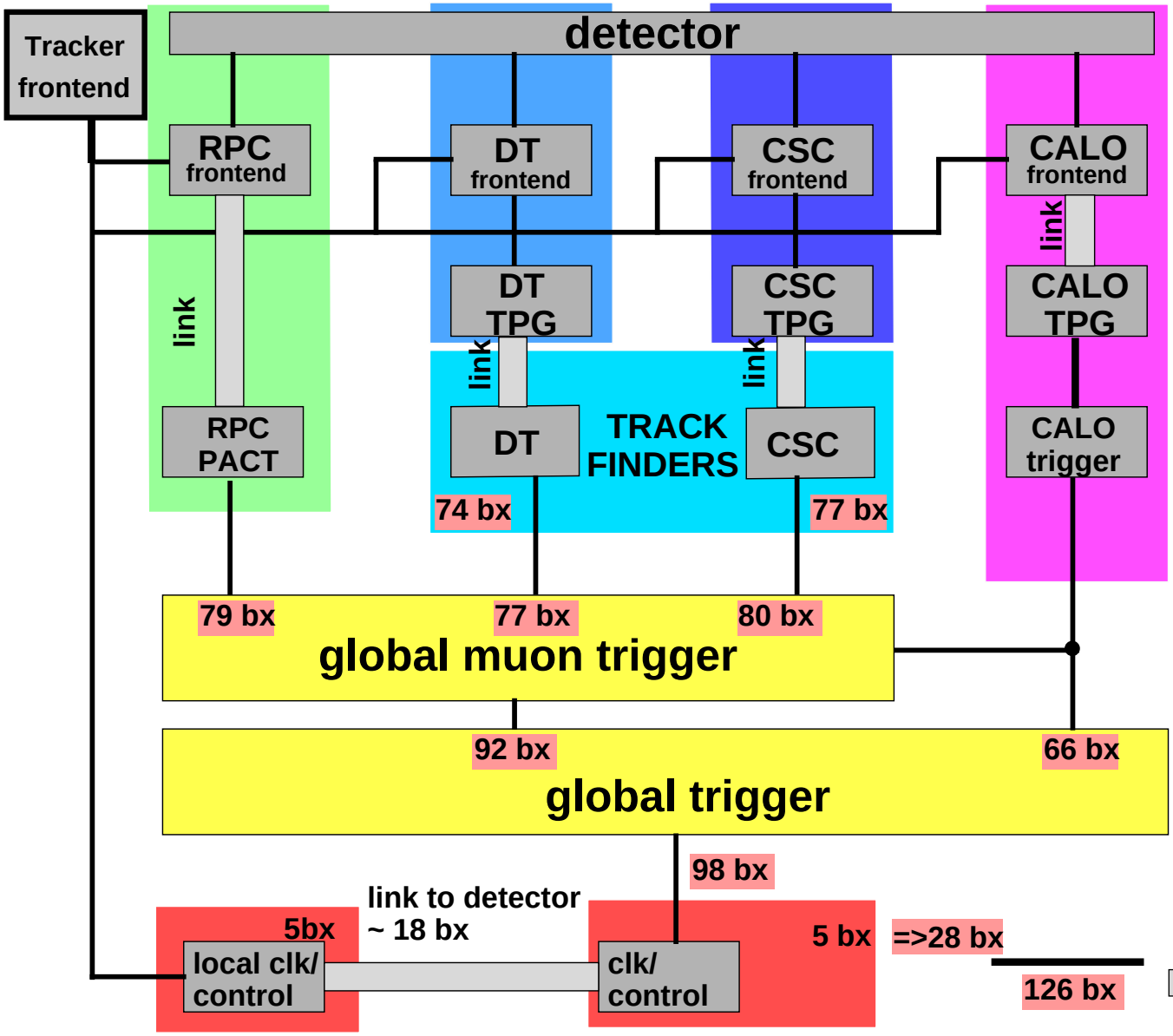
On Detector:

- CSC/DT Segment Generation
- RPC Muon Hit Generation
- Calorimeter Digitization only





CMS Level 1 Latency



Target is 128 bunch crossings

- 3.2 μs
- set by tracker

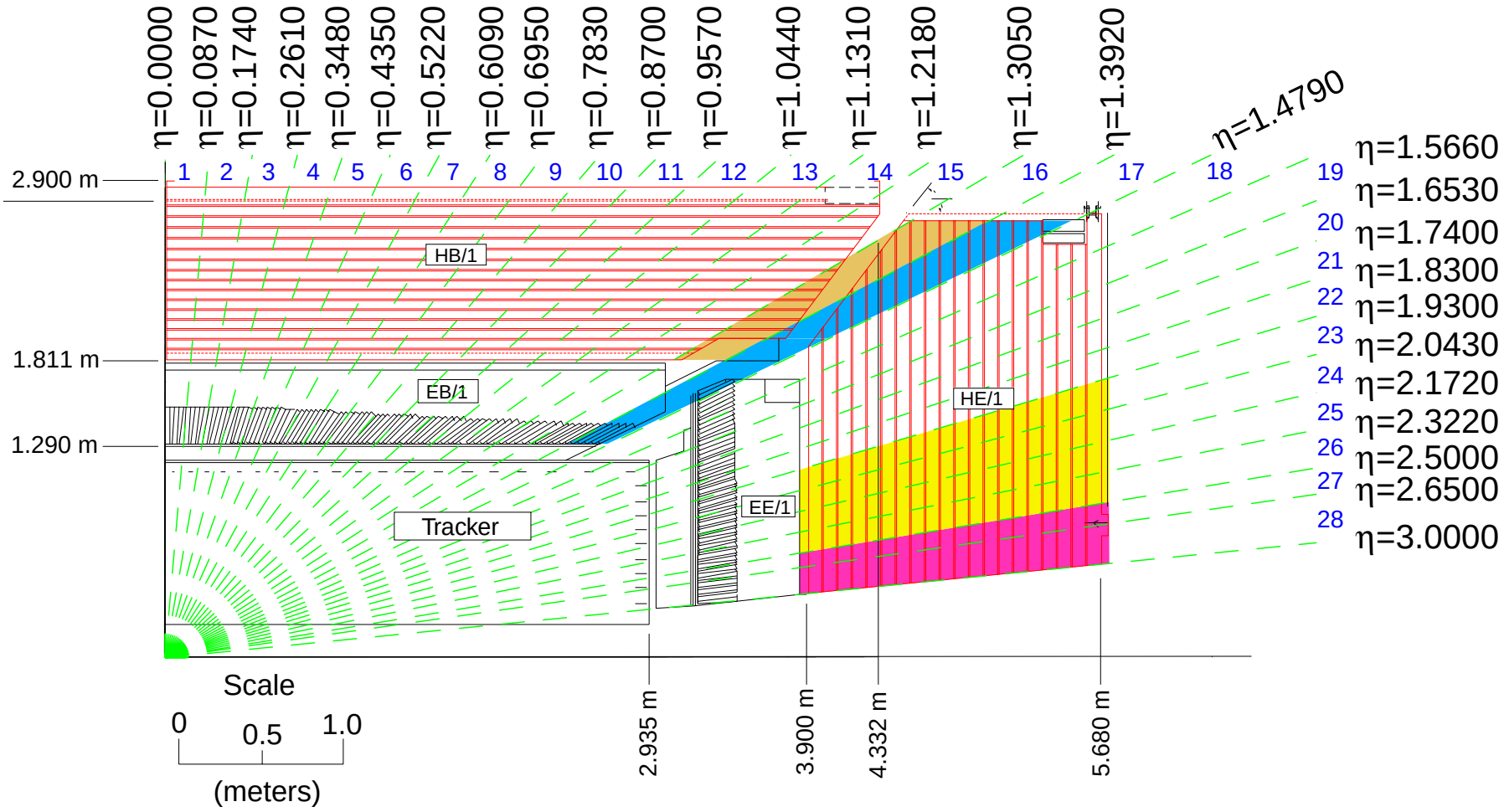
Reviewed in detail once/year

- Last Review in November

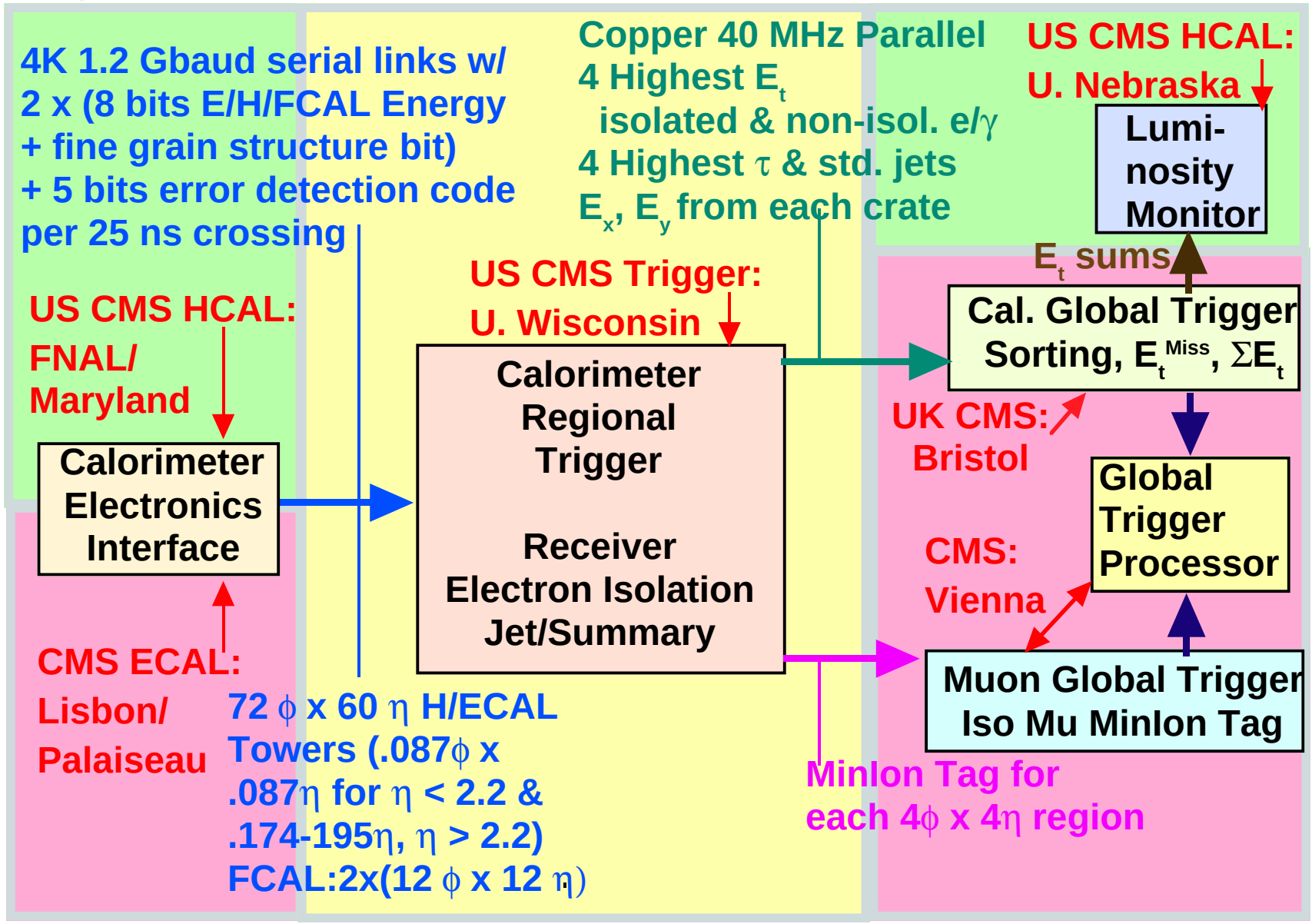
Number shown are latency budgets

- Units are bunch crossings
- Include contingency

Calorimeter Trigger Geometry

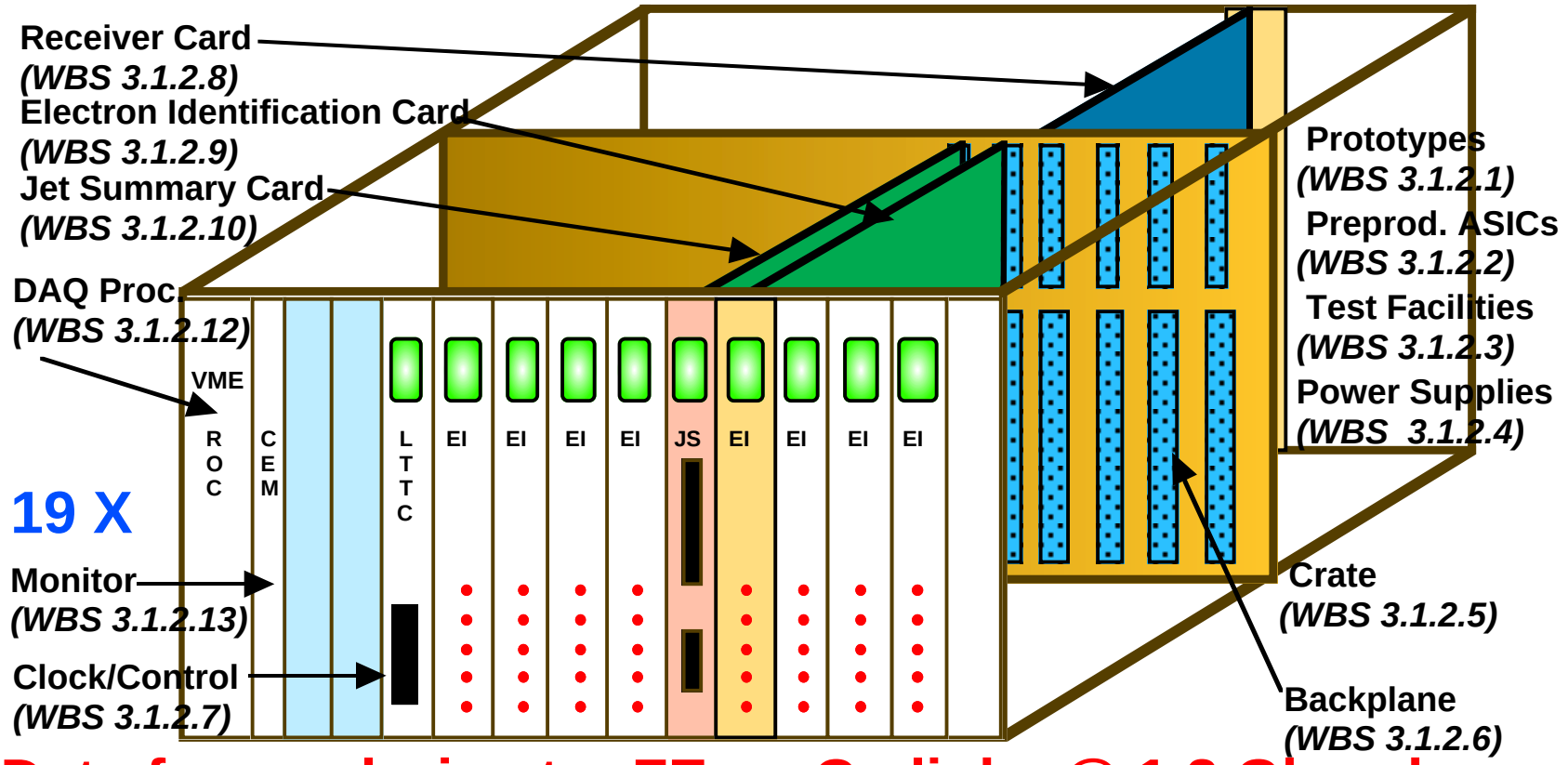


Calorimeter Trigger Overview



Regional Calorimeter Crate

(WBS 3.1.2)



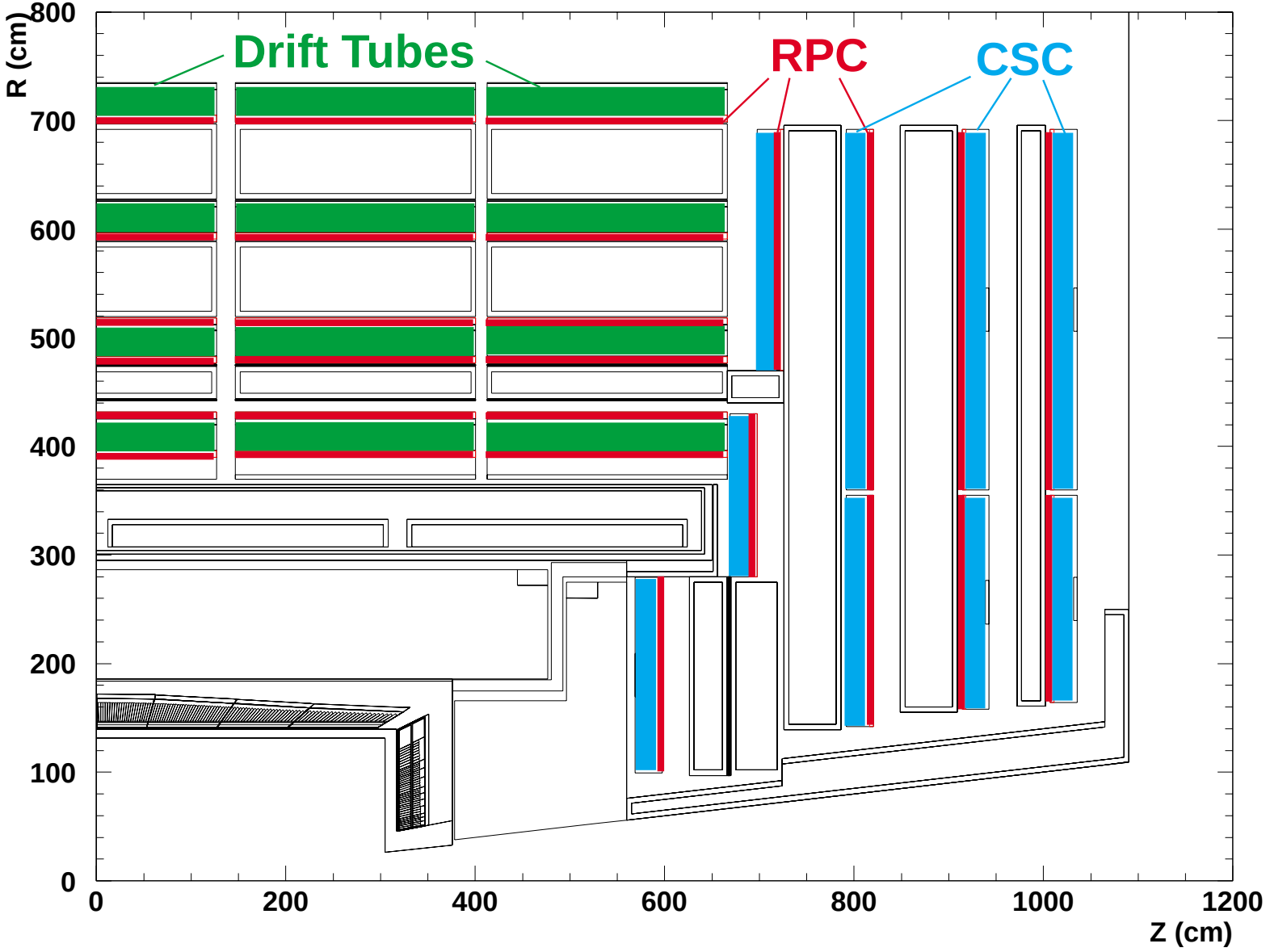
Data from calorimeter FE on Cu links @ 1.2 Gbaud (ptyp. tstd.)

- Into 133 rear-mounted Receiver Cards (ptyp. tstd. w/ ASICs)

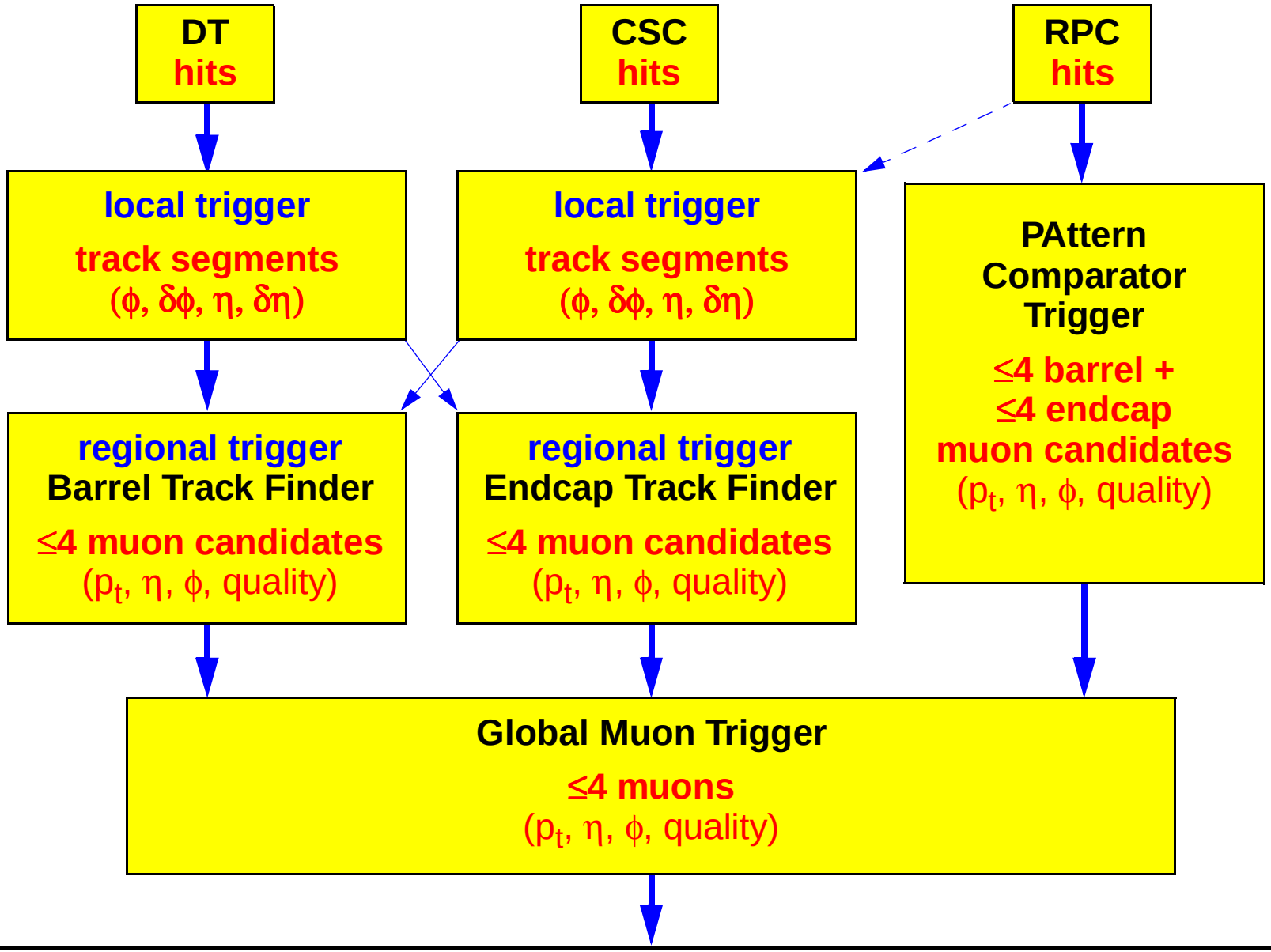
160 MHz point to point backplane (ptyp. tstd.)

- 19 Clock&Control (ptyp. tstd.), 133 Electron ID (ptyp. tstd.)
  19 Jet/Summary, Receiver Cards operate @ 160 MHz

Muon Trigger Geometry

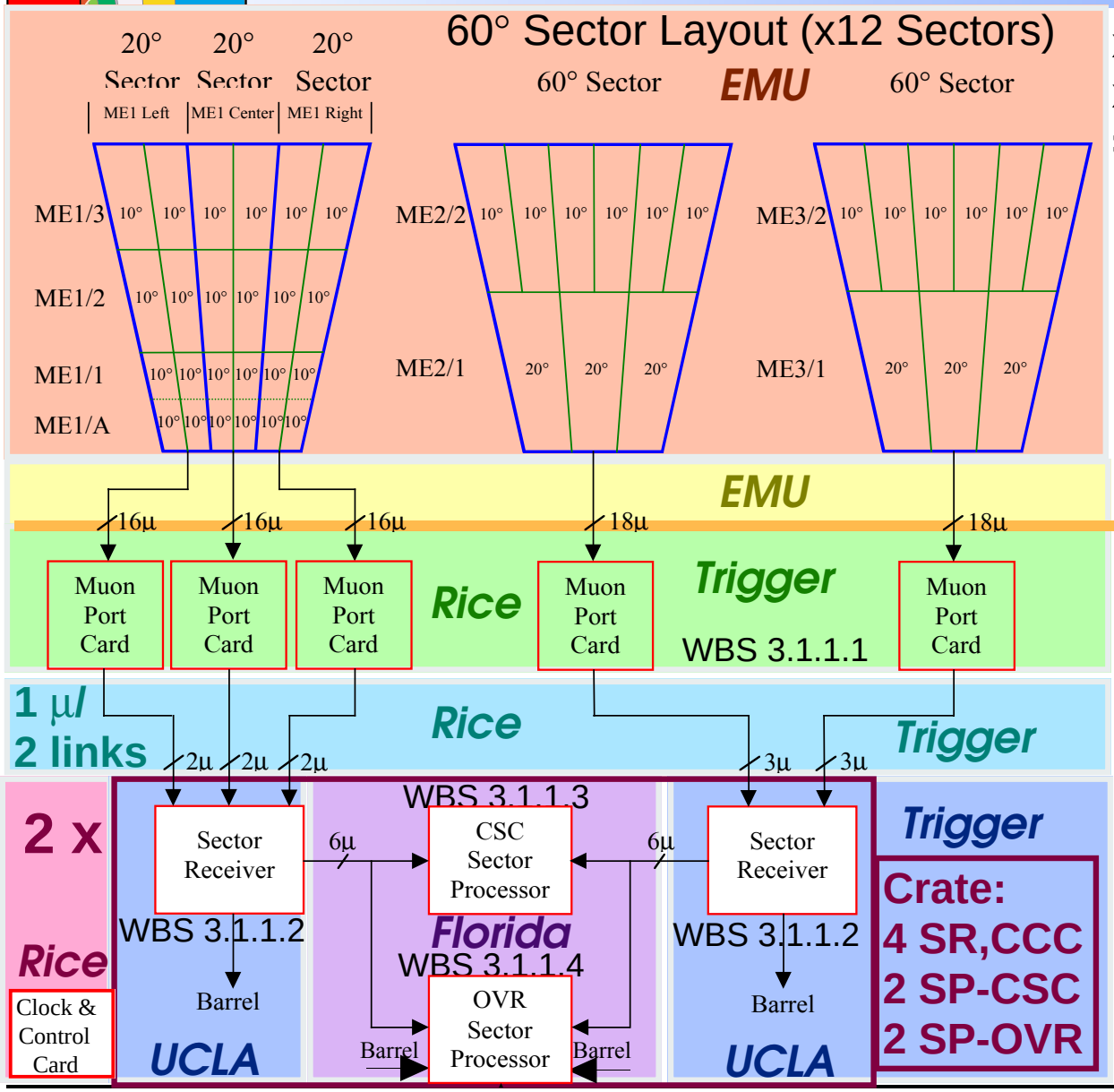


Muon Trigger Overview



CSC Trigger Layout

(WBS 3.1.1)



x 6 = 360°
x 2 Ends
= x 12

Trigger Mother Boards *(Rice)* in 8 Iron Disk Peripheral Crates

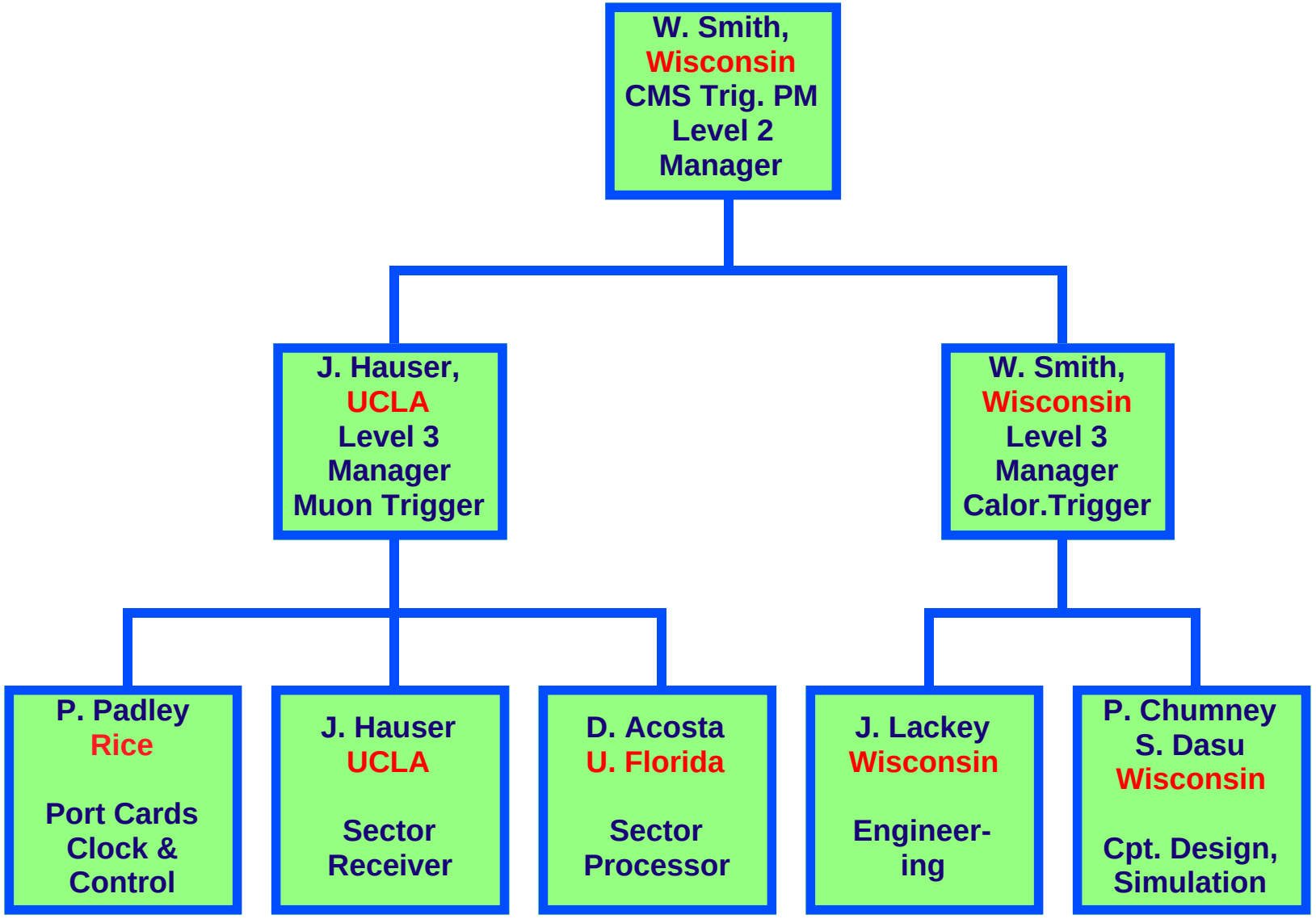
Backplane, Crate Interconnects *EMU* / *Trigger*

5 Muon Port Cards x 12

24 Optical Links x 12

6 Track Finder Crates in Counting Room (total). Sort output *(Rice)* to Global Muon Trigger *(Vienna)*

U. S. Trigger Organization



Trigger Status

Muon Trigger

- **Construction & test of prototype boards**
  - FPGA's, Optical Links, Interfaces
- **Integration test of prototype boards**
  - Muon Port Card, Sector Receiver, Sector Processor, Backplane, Crate, Clock Board, EMU Prototypes

Calorimeter Trigger

- **Produce & test 2nd generation prototype boards**
  - Receiver Card, Electron Isolation Card, Backplane
  - Copper high speed serial links
- **Produce & test ASICs**
  - Phase, Boundary Scan, Sort, Electron ID test on 2nd generation prototype boards

Produce TDR

Trigger Presentations

CMS Trigger Design & Status	W. Smith	11:15 - 11:30
Trigger Simulation Update	S. Dasu	11:30 - 12:00
Cal.Regional Trigger Status & Plan	W. Smith	12:00 - 12:30

LUNCH: 12:30 - 1:30 PM

Muon Trigger Overview	J. Hauser	1:30 - 1:50
Muon Trig. Electronics in Cavern	P. Padley	1:50 - 2:10
Muon Trig. Electr. in Counting Room	D. Acosta	2:10 - 2:30
Cost and Schedule: Status	W. Smith	2:30 - 3:00