



CSC Track Finder: Hardware Status

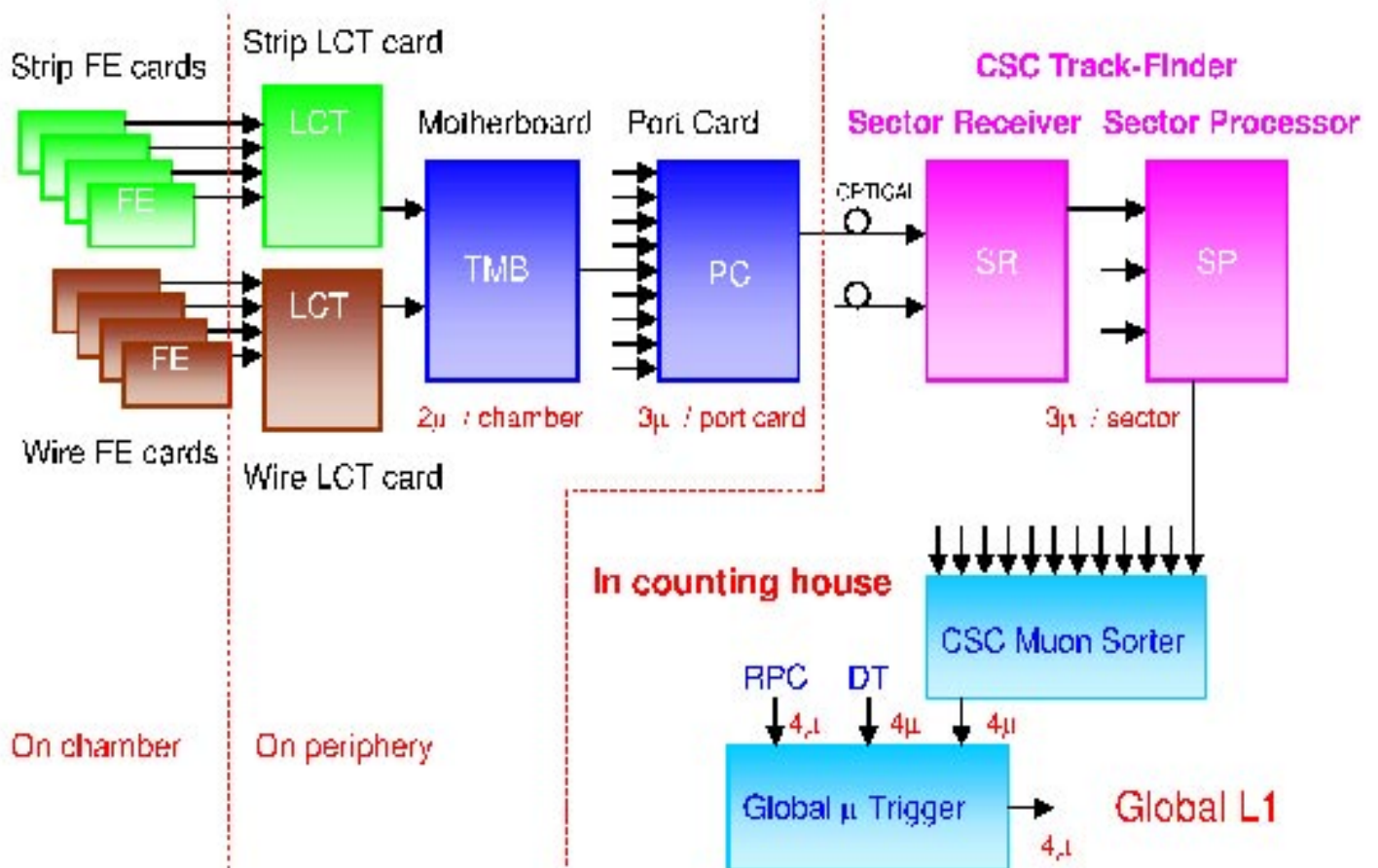
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EMU and CMS Week
Sept 1999

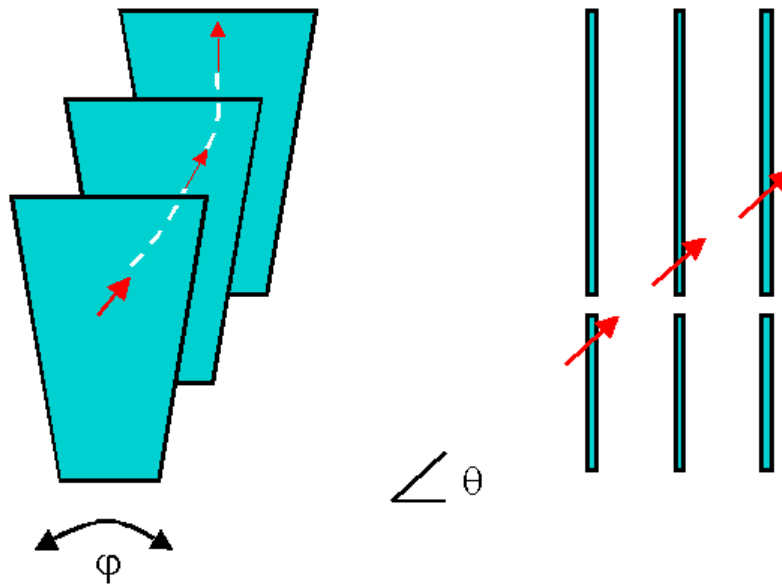
- Completed a conceptual design
CMS Note :
http://www.phys.ufl.edu/~acosta/cms/sp_design.pdf
- Internal review on the design in July at FermiLab

CSC Muon Trigger Scheme

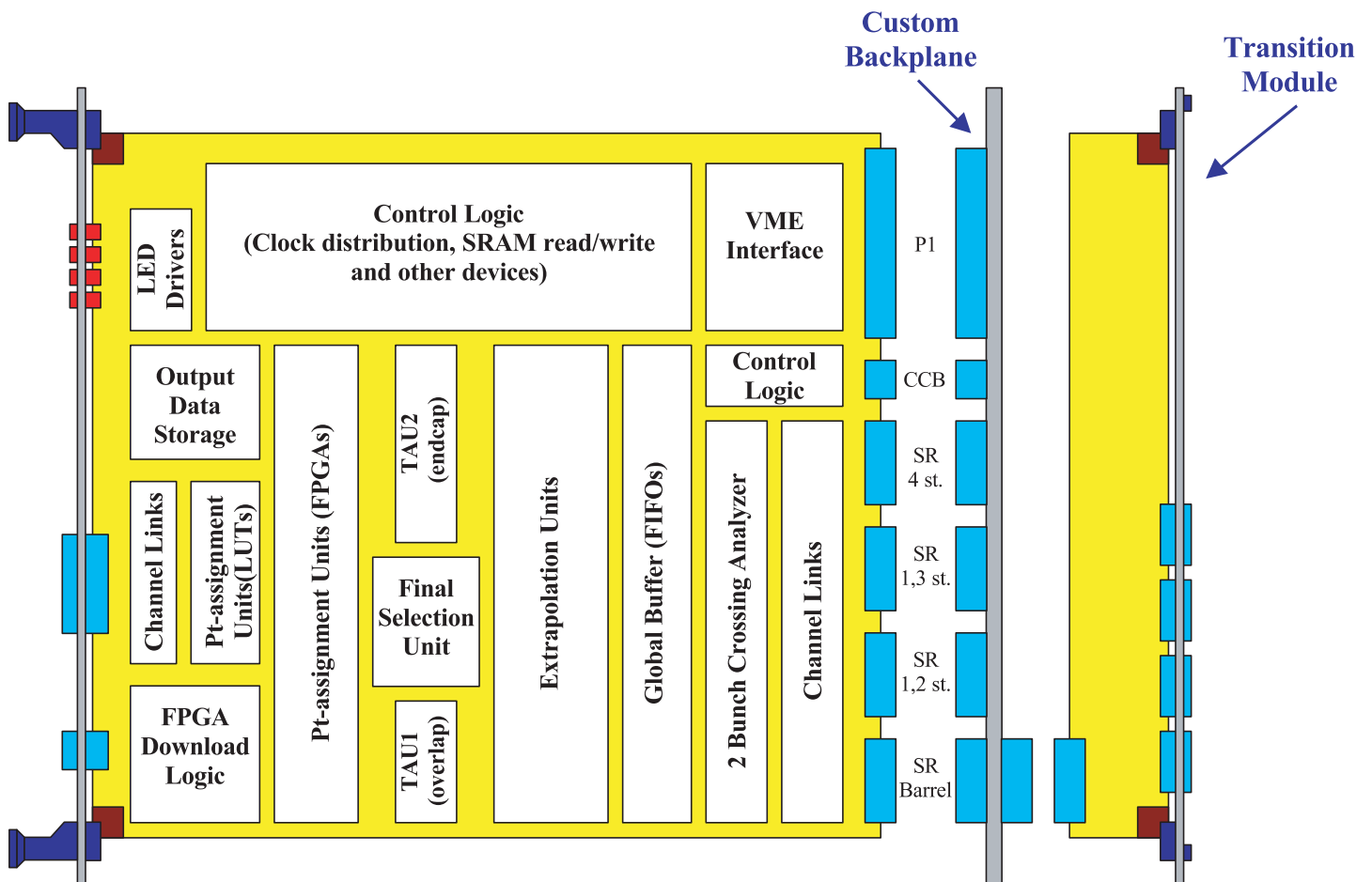


CSC Track-Finder

- CSC Track-Finder consists of 12 Sector Processors (SP) that cover CSC and CSC/DT overlap
Each SP handles track primitives (LCTs) in $\Delta\phi = 60^\circ$ and $1.0 < |\eta| < 2.4$
- link LCTs into tracks (3-D algorithm)
- Measure P_t , ϕ and η
- Send 3 best track candidates to the Muon Sorter



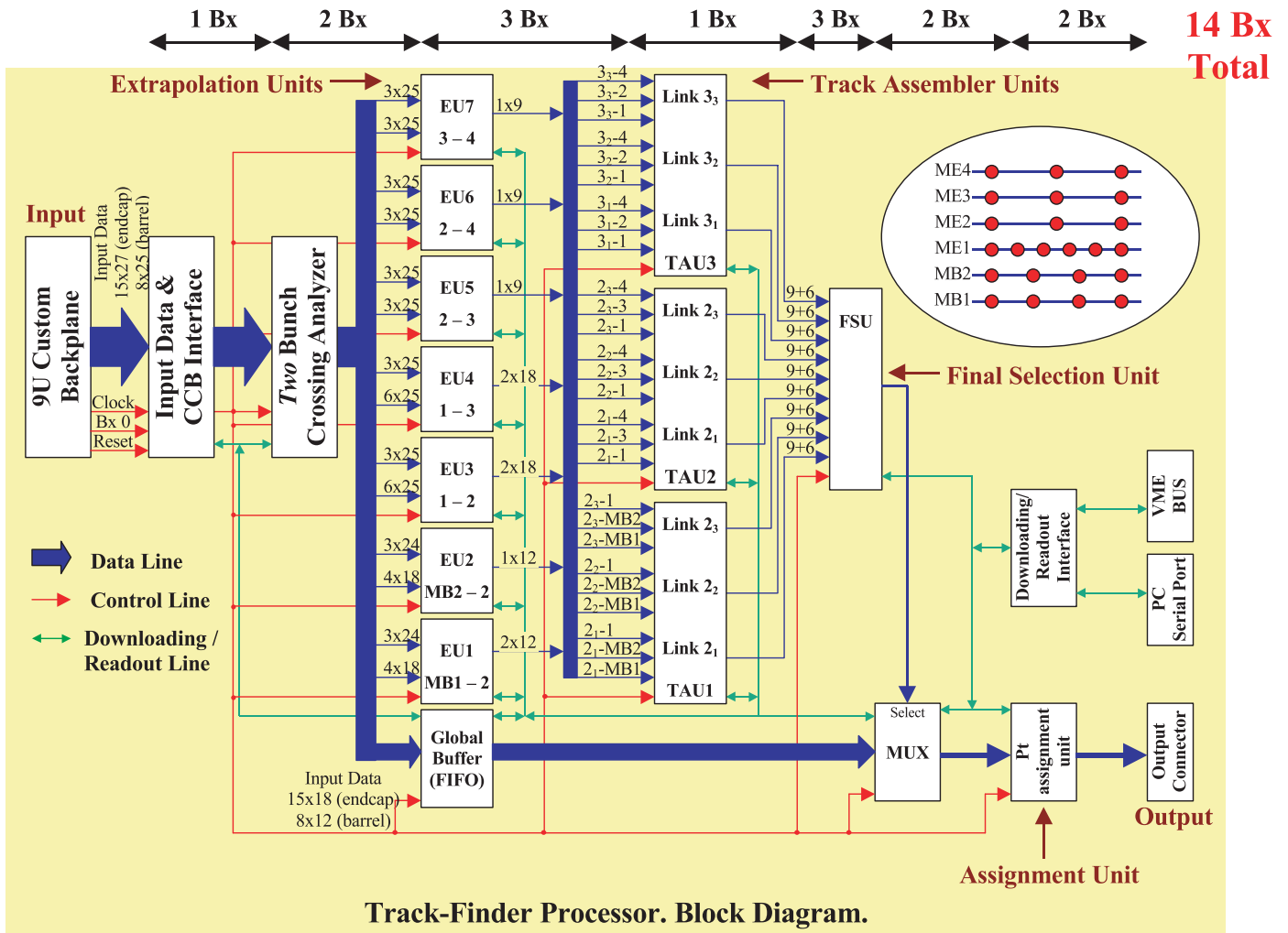
Sector Processor Functional Layout



Simplified Sector Processor Layout for Endcap + Overlap Regions

- All components in a 9U VME board
- Signals from Sector Receiver (SR) are sent across a point-to-point backplane to the SP
- DT track segments are delivered to SP via a transition board on the back of the crate

Sector Processor Block Diagram

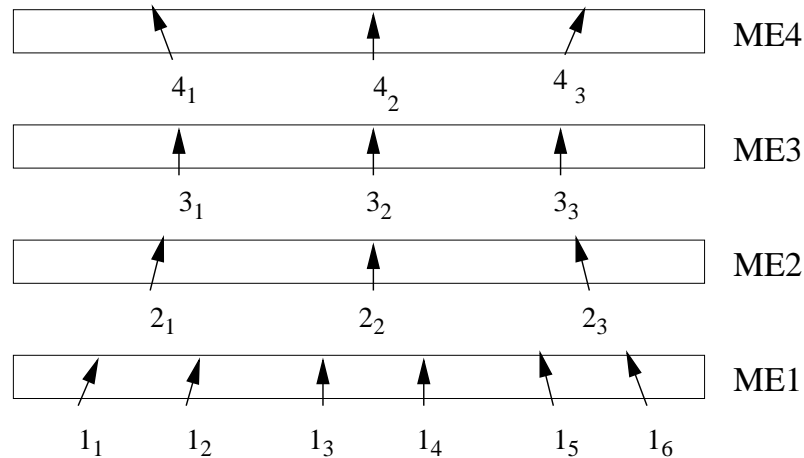


- **Two Bunch Crossing Analyzer** : Analyze LCTs received in two different bunch crossings
- **Extrapolation Unit (EU)** : Links LCTs in two CSC stations together
- **Track Assembler Unit (TAU)** : Use extrapolation results to form tracks
- **Final Selection Unit (FSU)** : Selects 3 best track candidates

- **Assignment Unit** : Determines the P_t , ϕ , η of the selected track candidates
- Latency expected to be 14 BX

Extrapolation Unit

Endcap

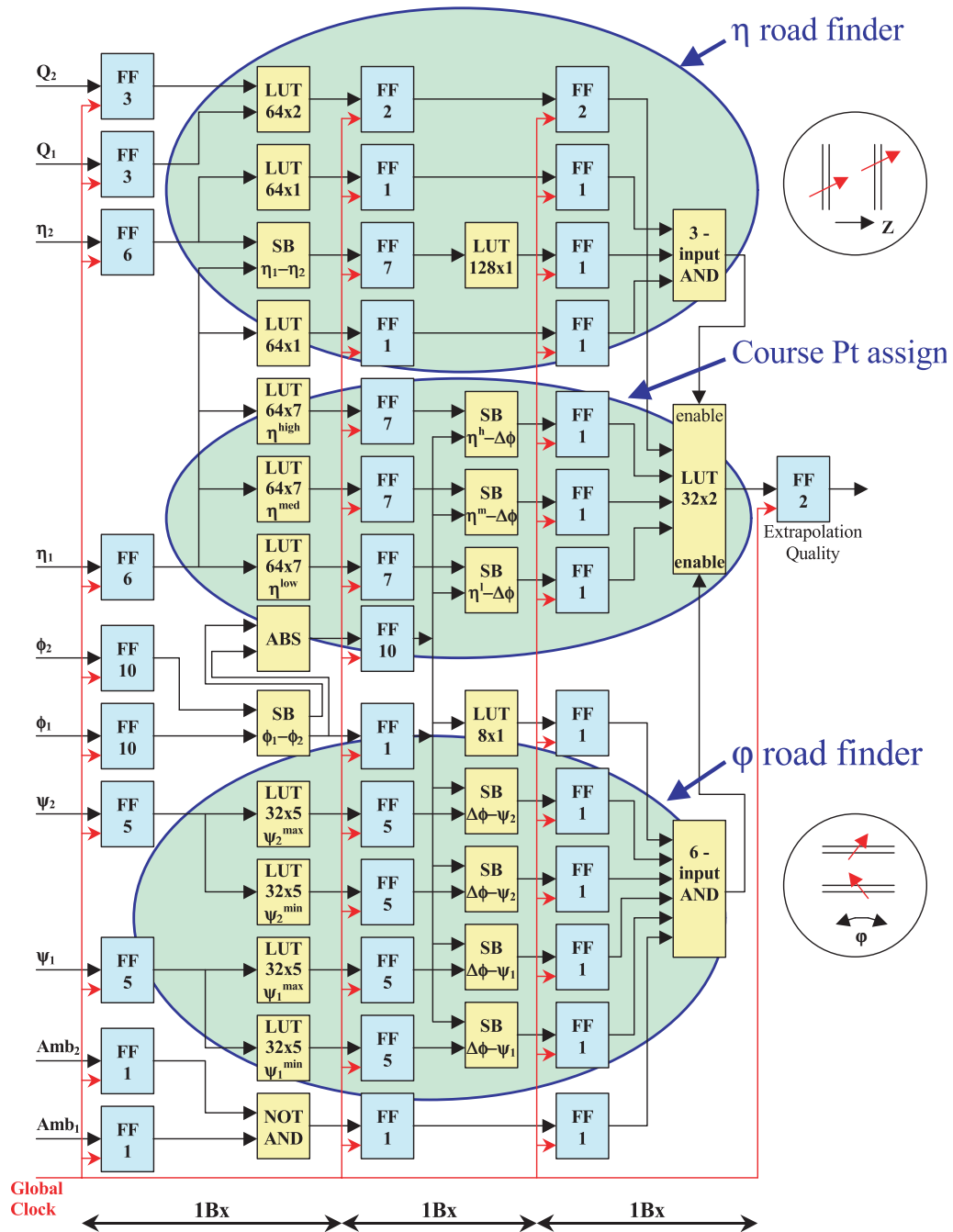


- Perform all combinations of extrapolations :
 $E1_i \leftrightarrow E2_k$, $E1_i \leftrightarrow E3_k$, $E2_i \leftrightarrow E3_k$,
 $E2_i \leftrightarrow E4_k$, $E3_i \leftrightarrow E4_k$,
no $E1_i \leftrightarrow E4_k$ (to save logic and reduce random coincidences)

Overlap

- Perform all combinations of extrapolations :
 $B1_i \leftrightarrow E2_k$, $B2_i \leftrightarrow E2_k$

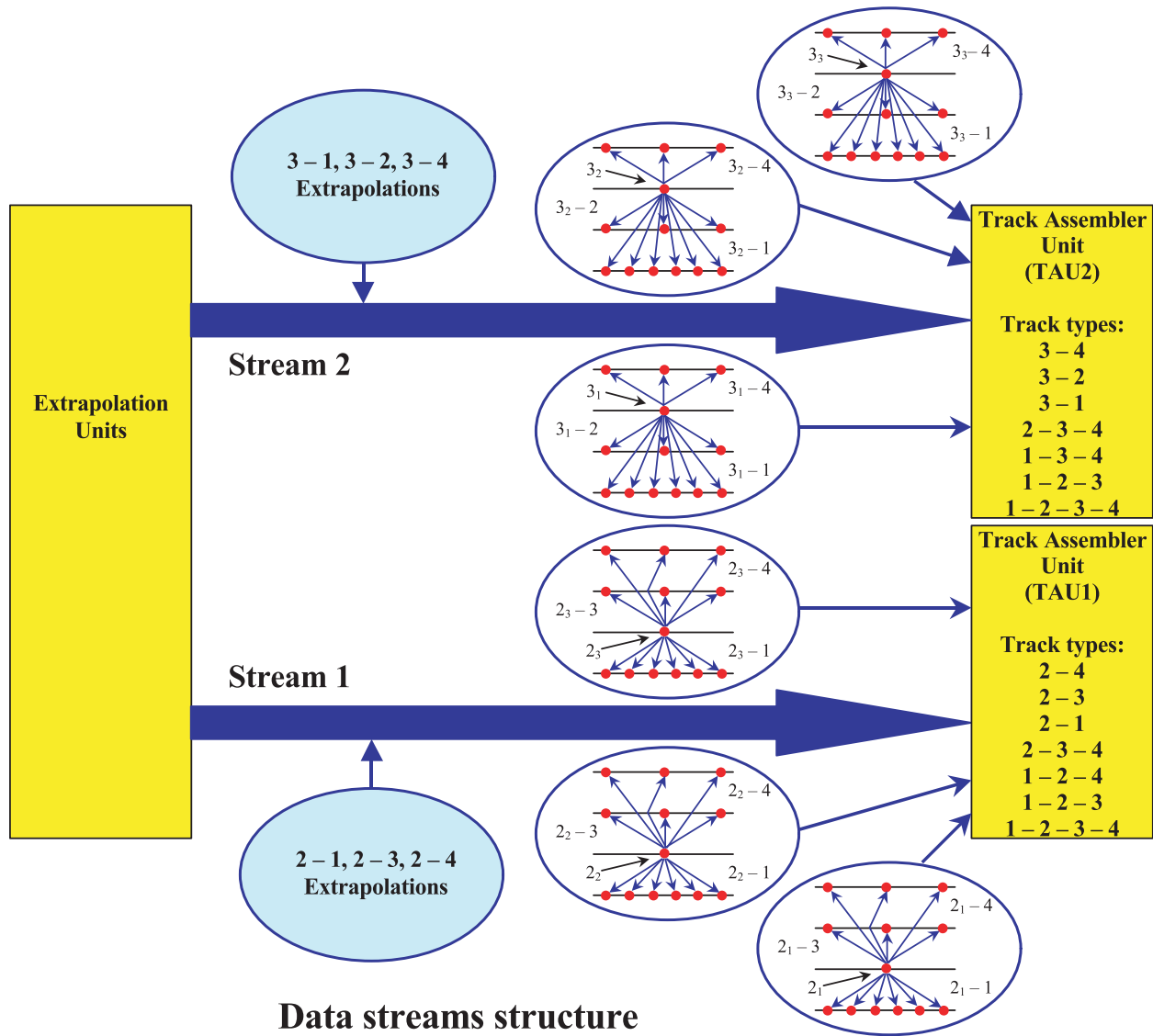
Extrapolation Unit in Detail



Extrapolation Unit for ME1-ME2, ME1-ME3.

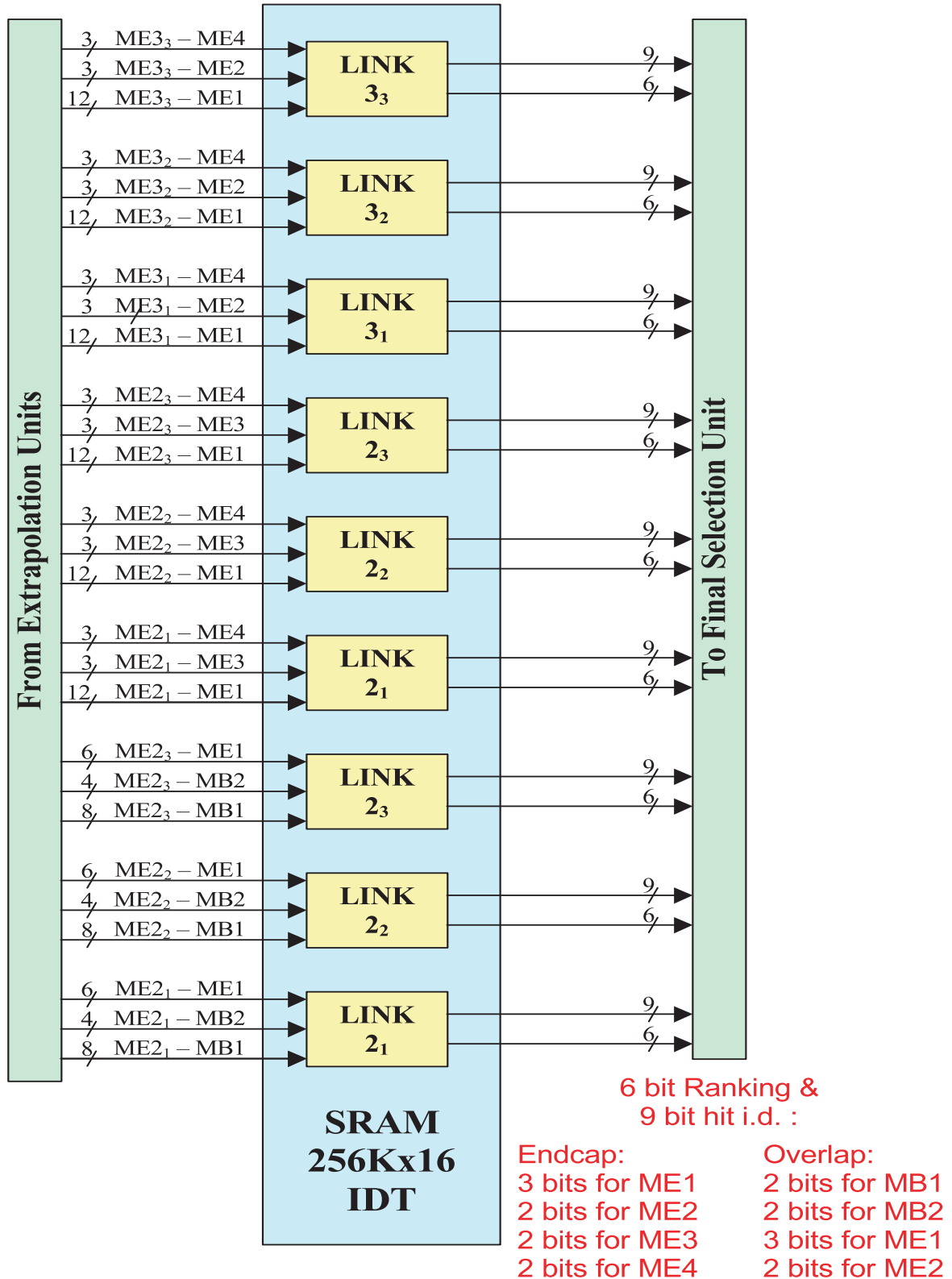
- Track primitives are matched in η (Endcap only)
- Assign coarse Pt (Low Pt, Medium Pt, High Pt)
- ϕ road finder : match $\Delta\phi$ with ϕ_b of the two LCTs
- Results of extrapolations are in form of quality codes

Data Streams to Track Assembler Unit (TAU)

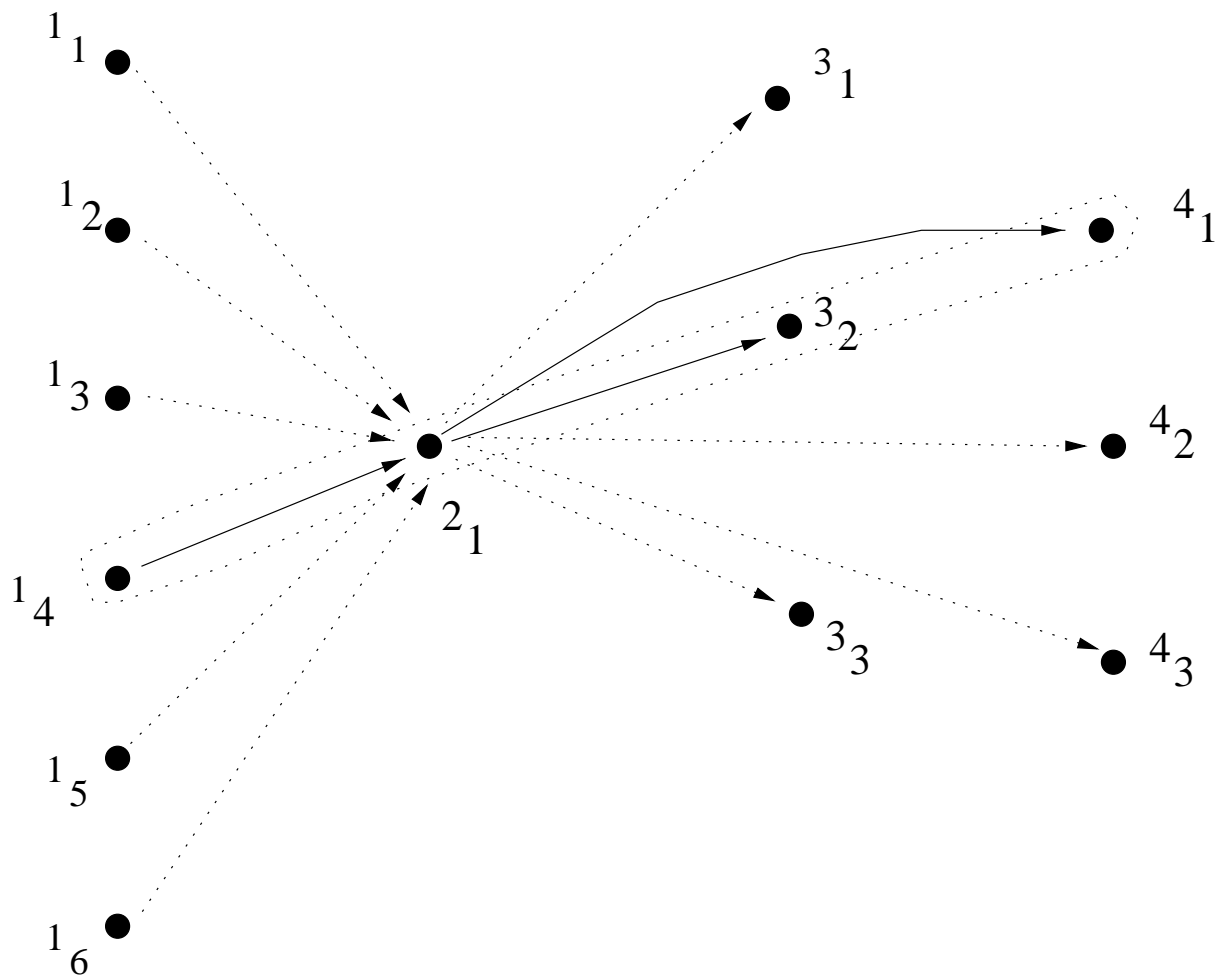


- Results from extrapolations are sent to TAU in 3 Streams
 - Stream 1 : $E1 \leftrightarrow E2$, $E2 \leftrightarrow E3$, $E2 \leftrightarrow E4$ (Endcap)
 - Stream 2 : $E1 \leftrightarrow E3$, $E2 \leftrightarrow E3$, $E3 \leftrightarrow E4$ (Endcap)
 - Stream 3 : $B1 \leftrightarrow E2$, $B2 \leftrightarrow E2$ (Overlap)

Track Assembler Unit (TAU)

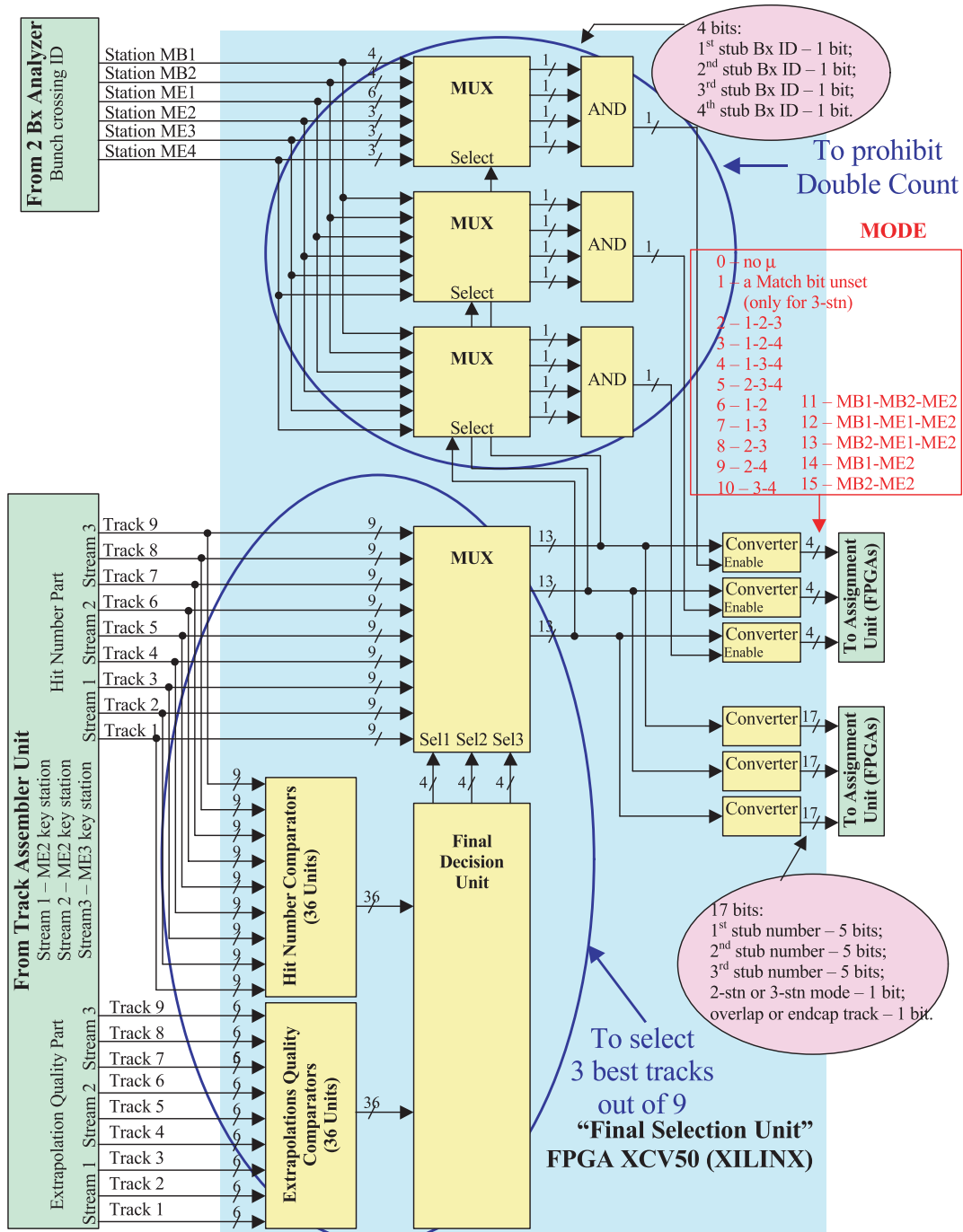


- TAU implemented as 9 static RAM memories for Endcap and Overlap
- Each Link unit handles all extrapolations to a single LCT in station 2 and 3. Successful extrapolations are used to form the best track pattern.



- Id of the track segments and the quality of the assembled track are sent to the Final Selection Unit (FSU)

Final Selection Unit (FSU)



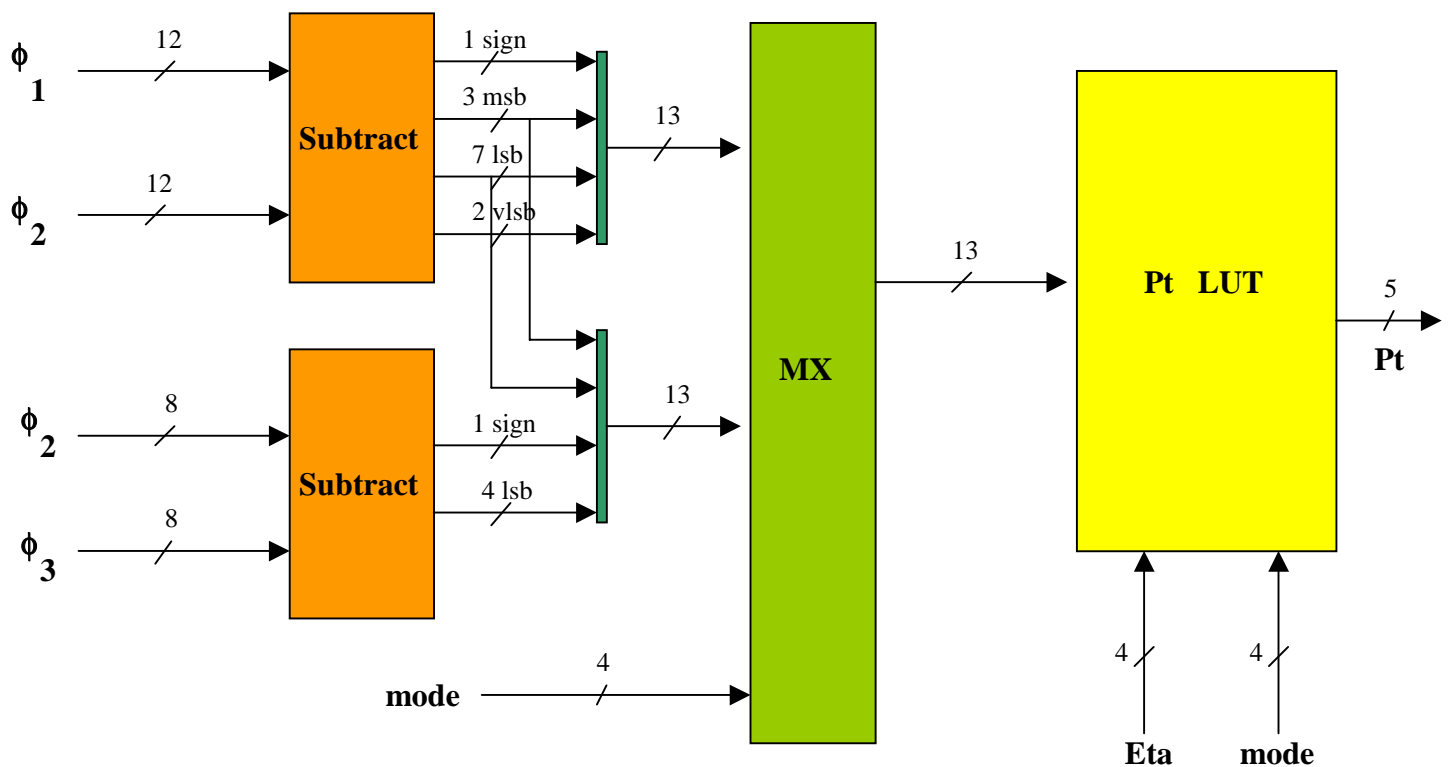
- Compare the qualities of the tracks and the ID of the LCTs that form the tracks to
 - cancel redundant tracks
 - select 3 best distinct tracks

Assignment Unit

- Determines the ϕ , η , Pt of the selected 3 best muon candidates

Pt Assignment

- Determines Pt using ϕ , η measurements from 2 or 3 stations



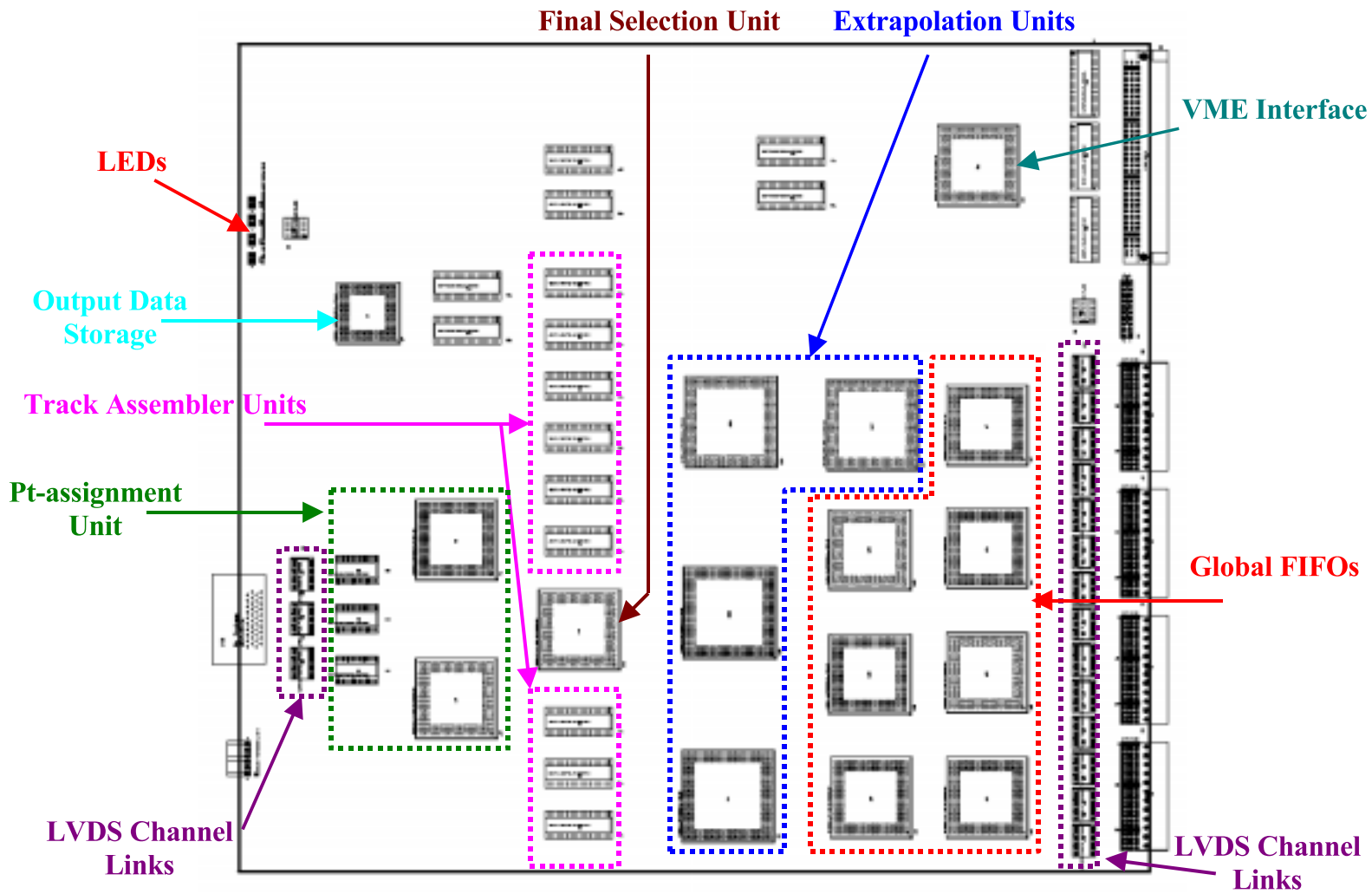
- $\sigma_{Pt}/Pt \sim 30\%$ with only 2 stations
- $\sigma_{Pt}/Pt \sim 20\%$ with 3 stations
 \Rightarrow improve rate reduction at Level 1

Plans

- Custom backplane design has started. Prototype board will be ready by late October.
- SP board layout has started
- Begin prototype production in Spring 2000
- Test SP + backplane + SR in Summer, finish by Fall

SP Layout

- Preliminary layout consideration of the Sector Processor



Board Layout of the Sector Processor (endcap + overlap region).