



Mapping Requirements

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- Overview and assumptions
- Diagrams and Tables
- Ideas for FOX designs
- Responses to comments



Overview

• The problem

- The geometry of LAr/Tile and FEX modules is different
 - Need an overall reorganisation and regrouping of fibres
- eFEX and jFEX need multiple fanout of some signals
 - Copies from one LAr/Tile source have different FEX destinations
 - Hadronic sources (HEC) require a challenging amount of fanout
- gFEX is collecting $O(1)$ fibre from every possible source
- The connectivity overlaps everywhere
 - All sources are connected to multiple destinations
 - All destinations are connected to multiple sources
 - But the FOX must have some modularity and boundaries
- The mapping depends on some unknowns
 - Most importantly the link speed which affects the total number of fibres, amount of fanout, architecture of the jFEX, etc
 - Any specific FEX constraints on grouping of ribbons



Assumptions (1)

• LAr DPS

- One EM AMC covers 0.8×0.4 uniformly for $|\eta| < 2.4$
 - Barrel/Endcap overlap handled by organising ribbons from LTDBs
- HEC and forward EMEC in one AMC per octant (possibly)
- All FCAL (both sides) in four AMCs (one LDPS)
 - What provision should be made for sFCAL in phase 2 (with unknown mapping)?
- Single 48 way ribbon from each AMC to FOX (4 minipods)
 - Might split into 36+12 or 24+24 to two FOX modules??

• Tile

- Assuming PPM for phase 1 (sROD at phase 2)
- Roughly equal coverage 1.6×0.4 or 0.4×1.6 in $\eta \times \phi$
- Need three minipods at ~ 10 Gbit/s, 36 (or 48?) way ribbon
 - More minipods would reduce need for splitting at 6.4 Gbit/s
- PPM vs sROD: different mapping at input, but same at output
 - Do not assume BCMUX at phase 1 (but no harm in half empty fibres)



Assumptions (2)

- Provide fanout (multiple copies) at source if possible
- Most challenging for hadronic fibres (HEC, Tile)
 - Additional DPS modules for HEC, extra minipods on PPM RTMs & sRODs
 - Even so, passive optical splitting still needed at 6.4 Gbit/s
 - Could have less splitting with additional (>3) minipods per Tile source module
 - NB total of 29 DPS modules: 8 central barrel, 8 barrel/endcap overlap, 8 standard endcap, 4 HEC+EMfwd, 1 FCAL (reserve 1 for sFCAL?)



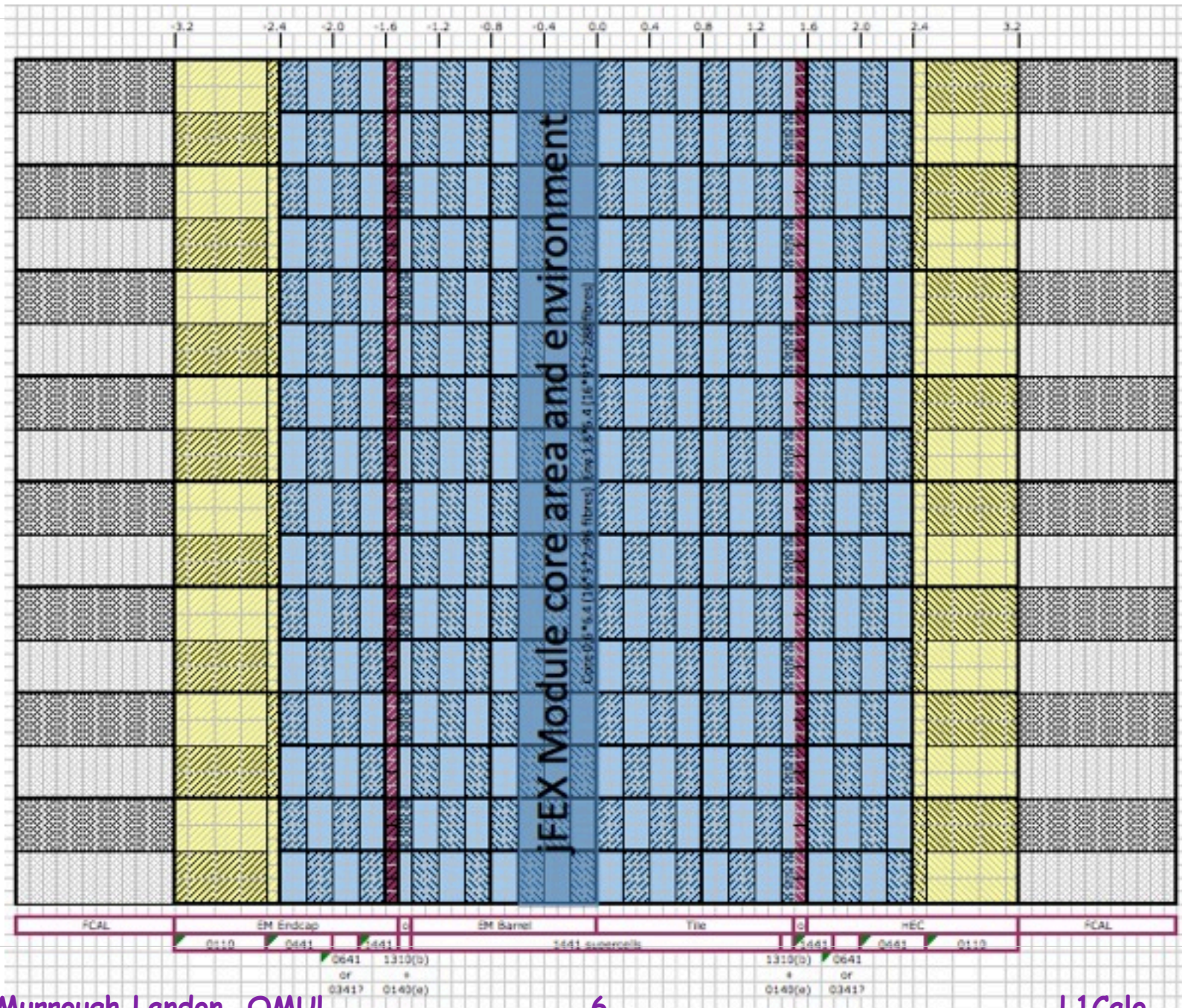
Diagrams: Fanout to eFEX

- Corners in eFEX design require additional copies at particular eta, phi locations - these diagrams show layout for 6.4 Gbit/s
- At ~10 Gbit/s the optimal pattern is shifted by 0.2 in phi
- PPMs (and sRODs at 10 Gbit/s) are different at different locations





jFEX Diagrams (1) 6.4 Gb/s





Fibre Counts at 6.4 Gbit/s

Calo Region vs N.Fibers to FEXes at 6.4 Gbit/s	EM Barrel	EM Endcap	Special Crate		FCAL	Tile (PPM) min/max	Tile (sROD)
			EM Fwd	HEC			
N.AMC/PPM/ROD	64	32	16		4	32	32
eFEX (direct)	25	20	6	6	0	12/0	18
eFEX (via 1:2 f/o)	0	0	2	6	0	0/12	0
eFEX (after f/o)	0	0	4	12	0	0/24	0
jFEX (direct)	12	12	0	9	24	16	0
jFEX (via 1:2 f/o)	0	0	2	11	0	4	12
jFEX (after f/o)	0	0	4	22	0	8	24
gFEX (direct)	1	1	2	3	3	2	2
Direct/AMC	38	33	8	18	27	30/18	20
To Fanout/AMC	0	0	4	17	0	4/16	12
After Fanout/AMC	0	0	8	34	0	8/32	24
Total direct	2434	1056	416		108	768	640
Total fanouts	0	0	336		0	320	384
Total from AMCs	2434	1056	752		108	1088	1024
Total to FEXes	2434	1056	1088		108	1408	1408



Fibre Counts at ~10 Gbit/s

Calo Region vs N.Fibers to FEXes at ~10 Gbit/s	EM Barrel min/max	EM Endcap min/max	Special Crate		FCAL	Tile (PPM) min/max	Tile (sROD) min/max
			EM Fwd	HEC			
N.AMC/PPM/ROD	64	32	16		4	32	32
eFEX (direct)	20/30	16/24	10	9	0	6/12	6/12
eFEX (via 1:2 f/o)	0	0	0	0	0	0	0
eFEX (after f/o)	0	0	0	0	0	0	0
jFEX (direct)	6	6	4	17	16	12	12
jFEX (via 1:2 f/o)	0	0	0	0	0	0	0
jFEX (after f/o)	0	0	0	0	0	0	0
gFEX (direct)	1	1	2	3	3	2	2
Direct/AMC	27/37	23/31	16	29	19	20/26	20/26
To Fanout/AMC	0	0	0	0	0	0	0
After Fanout/AMC	0	0	0	0	0	0	0
Total direct	2048	864	720		76	736	736
Total fanouts	0	0	0		0	0	0
Total from AMCs	2048	864	0		76	736	736
Total to FEXes	2048	864	720		76	736	736



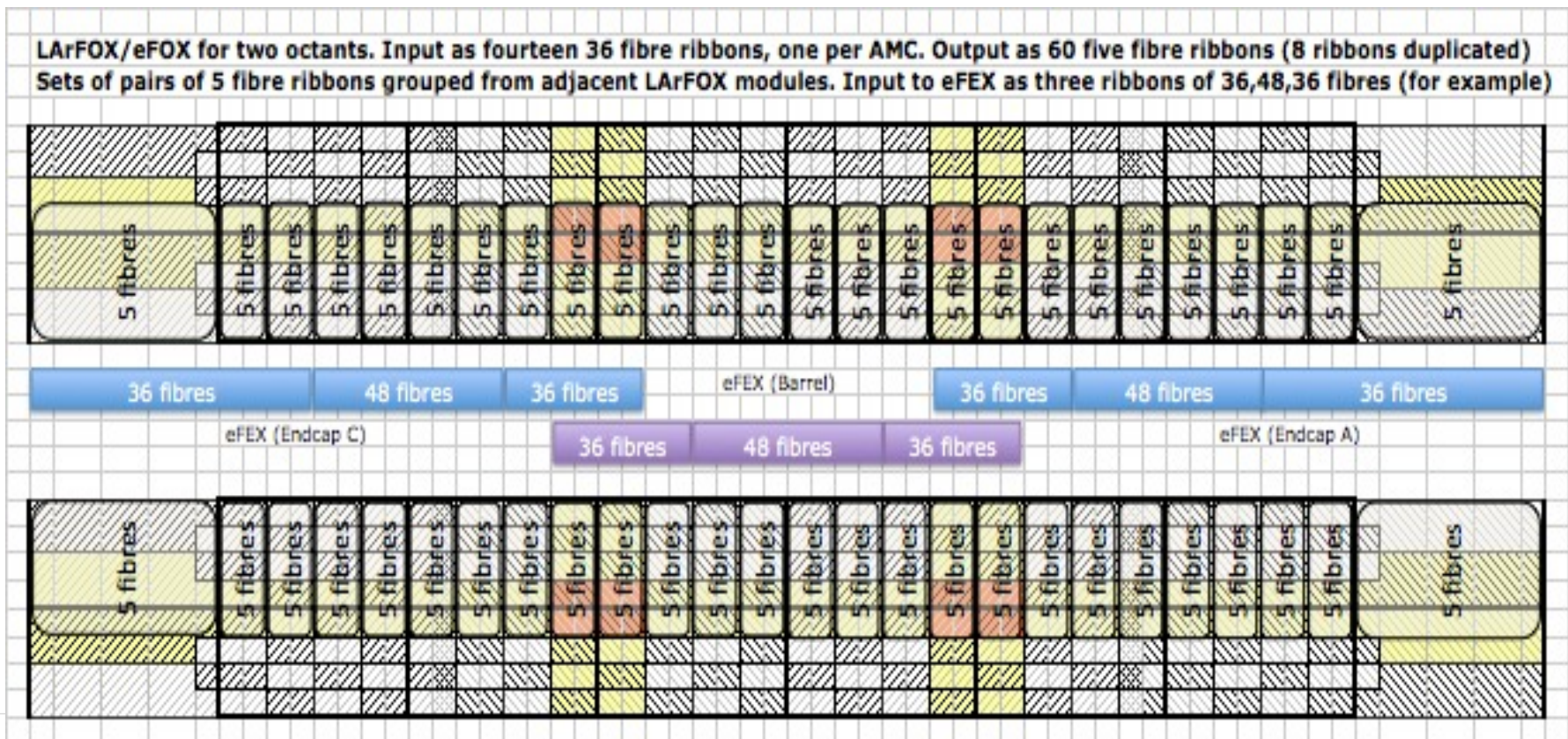
Ideas for FOX Modules

- No real designs yet (final designs depend on link speed)
- Starting to think about possible modularities
 - And mapping aim: translational or rotational symmetry??
- Begin with EM inputs to eFEX
 - Should be possible to have a number of identical modules each covering 0.8×0.8 in $\eta \times \phi$ - at least for $|\eta| < 2.4$ region
 - Once mapping is decided, hope to use fixed mapping modules
 - Eg PDF figure 16, section 3.4.1
 - May still need a few (4?) different types
- Hadronic and forward regions will be more custom
 - Could still have a few examples of the same module
 - May wish to keep fully flexible modules for FCAL
 - Or just replace it for phase 2?



FOX Module Examples (1)

- EM to eFEX (NB hadronic not shown)
 - LArFOX & eFOX modules each cover octant in $\phi * 0.8 \text{ eta}$
 - But eFOX octants offset by 0.4 in ϕ compared to LArFOX
 - Regroup sets of 5 + 5 fibres into 10 fibre ribbons
 - At ~10 Gbit/s the optimal pattern would (probably) be 7+3 fibres

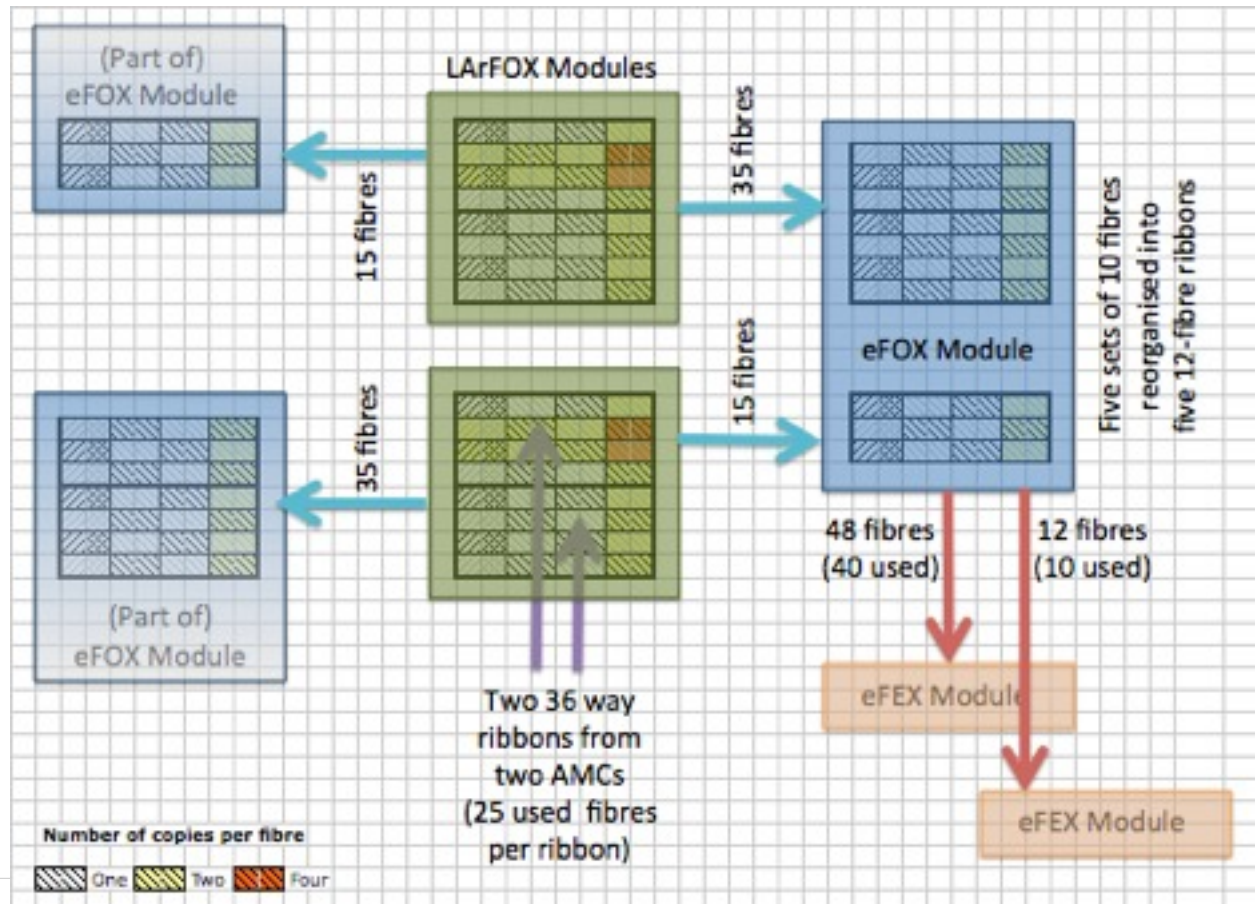




FOX Module Examples (2)

• EM to eFEX (~ 10 Gbit/s)

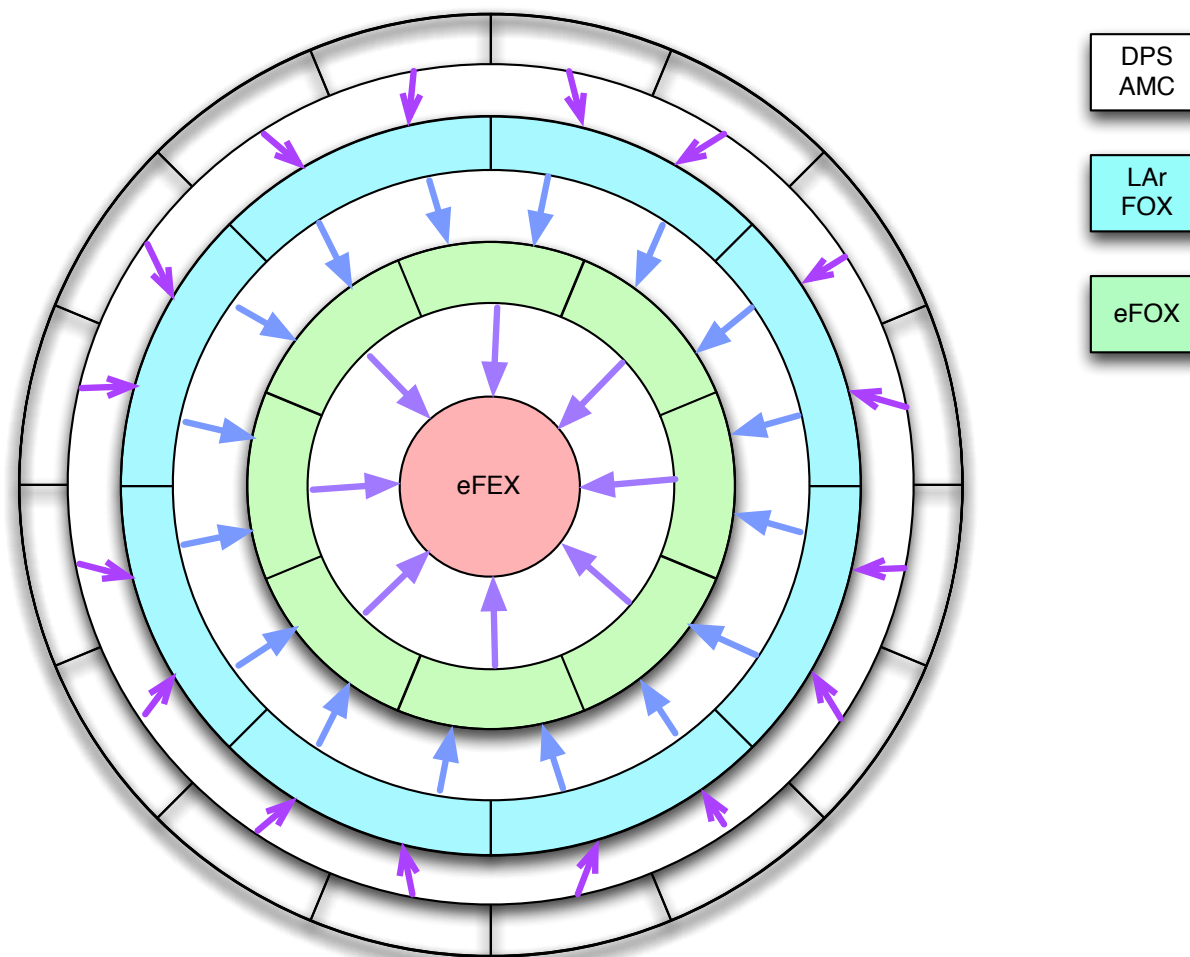
- Two LArFOX outputs regrouped into one eFOX module
- Two outputs from eFOX module to two eFEX modules
 - One for core inputs (48 fibres), one for environment (12 fibres)





FOX Module Examples (3)

- EM to eFEX full phi ring (for 0.8 in eta)
- LArFOX and eFOX modules aligned with phi offset





Comments Received (1)

• Michael

- Fwd EM and HEC in same AMC (maybe) - but not necessarily summed
- HEC overlap fibres ($1.5 < |\eta| < 1.6$) on same fibres as rest of HEC
 - But not necessarily summed into adjacent gTowers (if it fits into available fibres)
- Can split total fibres into eFEX/jFEX/gFEX
 - But FOX modules might cover jFEX+gFEX so separate per FOX might not be so clear
- Hard to provide to phase 2 sFCAL until its design is fixed (not yet??)
 - Perhaps best to leave that for a phase 2 M&O type update?
 - But jFEX and gFEX should ensure they have spare inputs for it
- Mapping should eventually be in a database (for diagnosing faults at least)
 - But probably not needed for simulation which can assume ideal connections as required?
- Figures 6&7 the edges are out to $|\eta|=3.2$, ie inner wheel (limit of eFEX)



Comments Received (2)

•Victor

- PDR mappings assume PPM as source of Tile in phase 1
 - If choice of PPM (option 2) is not agreed will revert to JEM (option 3)
- Assume same fibre counts from PPM as sROD (no need for BCMUX)
 - May have half empty fibres if BCMUX is used but can use same mapping at FEX end
- Fibre count tables: may well have mistakes - to be checked!
- Yes, number of eFEX fibres per PPM varies with eta (by a factor of two)
 - See PDR figure 5 for an illustration

•Yuji

- Yes, should add more tables and remove question marks
 - Now both PPM and sROD confirm they will provide enough (3) minipods
- BCMUX (or similar) is inevitable at 6.4 Gbit/s so we have to mention it
- And yes, high speeds are better for mapping as well as allowing no BCMUX and better jFEX design - lets hope we manage it!