D0 Upgrade *Electronics*

Cassette Allocation

Version 2

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1. Introduction

Preparations of the budget for the Lehman review brought to light an inadequacy in our planning. Cassette design so far has been almost exclusively tailored towards the main user, the CFT, and no one it seems has a clear idea how the VLPC cassettes are to be allocated among the other detectors that plan on using them. Which detectors go into which cassettes and how different detectors share some of the cassettes has several ramifications. Firstly this effects how the clear fiber light guides are bundled and how they and the cassette top connectors are laid out. Secondly it effects how many types of FE electronics boards there are and how each type is laid out.

Given here are three schemes for allocating the cassettes. The first was derived by choosing as the primary consideration: 'Keep the FE board types few in number and as simple as possible.' The second was derived by choosing as the primary consideration: 'No mixer box for the CFT stereo channels.' The third follows a 'separate function' approach, i.e. tries to minimize cassette sharing and cassette top connector type proliferation.

Tables 1, 2 and 3 below are spread sheets outlining the layout of the cassettes. The first column is the user of the cassettes. The second column is the number of cassettes. Some rows have a user listed but no number of cassettes

listed. For these cases the second user shares each of the cassettes with the first user. For example in the first row the CFT axial has 40 cassettes while in the second row CPS axial has a blank for the number of cassettes. In this case each CPS axial cassette also has CPS axial channels in it. The third column is the number of FE boards. There are always two FE boards per cassette but they need not be the same type of board. The forth column is the type or flavor of board. The fifth column is the number of multi-chip modules, MCM, on each FE board for each detector and the sixth column is the total number. The seventh column is the number of VLPC channels per 1/2 cassette used and the eighth column is the total number used. For each detector this should equal the total number of channels to be built. The ninth column is the number of MCM channels needed per FE board. For the CFT this is the number of VLPC channels, for the preshower detectors this is twice the number of VLPC channels. The MCMs are being built with 72 available channels each. The tenth column is the number of available MCM channels per board and the eleventh column is the total count

2. FE Electronics Optimized Design

Table 1 outlines the cassette allocation for the FE electronics optimized design. For this case the CFT and CPS share 80 cassettes. In each of these cassettes 7 of 8 MCMs are used by the CFT and the CPS uses the 8th. Note that the 480 CFT channels are input into 7 MCM, which works out to 480/7 = 68.6 channels per MCM and 17.1 channels for each of the four SIFT chips in the MCM. This is why the MCM was designed for more than 64 channels and the SIFT chip was designed for more than 16 channels. CFT axial and CPS axial share 40 cassettes and 80 CFT/CPS Trigger boards. The CFT stereo and CPS stereo share another 40 cassettes. When done this way the CFT/CPS stereo board looks like its trigger cousin without the trigger logic. In this way one flavor of board can be designed and parts left off for the stereo version. However, only one of the two CPS stereo layers can be put into the 40 axial cassettes. The other must find some other home.

The FPS is built in octants for each of two ends for a total of 16 parts. For trigger reasons all layers of one octant must be in the same cassette. Therefore the FPS channels are distributed into 16 cassettes and 32 FE boards. Each of these FPS FE boards has 16 MCMs. 13 of these are allocated to the FPS for a channel count per octant of 416 and a total channel count of 13,312. The other 3 of 16 are allocated to the other CPS stereo layer for a channel count into each FE board of 96 and a total channel count of 8192. The CPS total is 512 greater than the number needed. While this corresponds to 1/2 cassette the unused channels are equally distributed over 16 cassettes.

The bottom of the table shows the sums. The last row is the total sums and the three rows above this give the totals for each detector. The ninth column here gives the number of unused or spare VLPC channels. The CPS is allocated 512 more than it needs while the FPS is allocated 512 less than it needs. This inequity can be resolved by changing the 13 MCMs the FPS uses on each FE board to 13.5. This means that one of the MCMs would have inputs

from both the CPS and the FPS. Each MCM is being designed with two of the interior SIFT chips sharing a common threshold setting the other two a different common threshold. Thus sharing should be possible.

Mixing inputs from different detectors on the same FE board has at least one significant ramification. The signals from both detectors must arrive at the same time. It will not be possible to accommodate variations of more than 5ns in the arrival times of the 512 input signals. With modifications because of the eta range of the different detectors and their individual scintillator layouts, the clear fiber wave guides must differ in length by less than 1m.

3. No Mixer Box (for CFT stereo) Design

The mixer box, which is being designed for the CFT axial layers, costs a significant amount of money. One would like to save the expense of and the space for a mixer box on the stereo CFT channels if possible. The table 2 shows the cassette allocation for this case. The most efficient way to bundle clear fibers from the stereo fibers to the cassettes is to cable each 128 half ribbon into each of the 8 modules within the cassette.

For this design the 40 axial / trigger cassettes are left as before. The CFT stereo fibers are now placed into 37 cassettes where each 1/2 ribbon connects to one module. The remaining 512 channels are input into a half cassette which is shared with the CPS.

In this design it is not so clear that the CFT stereo board can be a subset of the CFT trigger board. The CPS stereo board may be a subset of the FPS board. Remember that the FPS board also has triggering logic on it. In both cases the back planes would be the same. The 40 CFT trigger cassettes would have one type of back plane set, the 16 FPS cassettes another, and the remaining 40 a third set.

4. Separate Function Design

There is no mixer for the CFT stereo boards, and in addition, there is no cassette sharing beyond CFT+CPS axial, alleviating the need for ‘splitting’ of 128 channel cassette top connectors. This layout assumes that the FPS channel count is reduced to 256 trigger and 128 outer channels per one of 32 (two times 16) sectors. Two inner sectors share one trigger board, four outer sectors one outer board.

In this design there are two basic types of boards, the CFT/CPS trigger board and the multipurpose FPS trigger/FPS outer/CPS stereo/CFT stereo board. The second board can be populated with trigger logic for 512 channels and double channel (preshower) MCMs for 512 channels. The FPS trigger uses such a fully populated board, whereas for the CFT stereo fibers the minimal configuration would be used.

4. Summary

This note presents three possible allocations of the VLPC cassettes among the three detectors using them. Each has strengths and weaknesses. The purpose of this note is to lay out the problem and these three differing possible solutions so that the groups involved can conduct an informed discussion leading to a solution suitable to all.

Use of Cassettes

User	Cassettes	FE bds	type	# of MCM		VLPC Channels		MCM Channels		
				per brd	total	per brd	total	per brd	pb av	total
CFT Axial	40	80	CFT Trig	7	560	480	38400	480	504	40320
CPS Axial				1	80	32	2560	64	72	5760
CFT-Stereo	40	80	CFT Stereo	7	560	480	38400	480	504	40320
CPS-U-Stereo				1	80	32	2560	64	72	5760
FPS	16	32	FPS	13	416	416	13312	832	936	29952
CPS-V-Stereo				3	96	96	3072	192	216	6912
							Spare VLPC			
CFT Total	80	160			1120		76800	0		80640
CPS Total					256		8192	512		18432
FPS Total	16	32			416		13312	-512		29952
Grand Total	**96**	**192**			**1792**		**98304**	**0**		**129024**

Table 1. Electronics Optimized Design

Use of Cassettes										
User	**Cassettes**	**FE bds**	**type**	**# of MCM**		**VLPC Channels**		**MCM Channels**		
				per brd	total	per brd	total	per brd	pb av	total
CFT Axial	40	80	CFT Trig	7	560	480	38400	480	504	40320
CPS Axial				1	80	32	2560	64	72	5760
CFT-Stere	40	80	CFT Stereo	7	560	480	38400	480	504	40320
CPS-U-Stereo				1	80	32	2560	64	72	5760
CPS-Stere	1.5	3	CFT Stereo	16	48	512	1536	480	1152	3456
FPS	16	32	FPS	14	448	480	15360	960	1008	32256
CPS-V-St				2	64	32	1024	64	144	4608
								Spare VLPC		
CFT Total	80	160			1120		76800	0		80640
CPS Total	*1.5*	*3*			224		7680	0		16128
FPS Total	16	32			448		15360	-64		32256
Grand To	**97.5**	**195**			**1792**		**99840**	**-64**		**129024**

Table 2. as Table1, w/ new FPS numbers

User	Cassettes	FE bds	type	# of MCM		VLPC Channels		MCM Channels	
				per brd	total	per brd	total	per brd	pb av
CFT Axial	40	80	CFT Trig	7	560	480	38400	480	504
CPS Axial				1	80	32	2560	64	72
CFT-Stereo	37	74	CFT Stereo	8	592	512	37888	512	576
CFT-Stereo	0.5	1	CFT Stereo	8	8	512	512	512	576
CPS-Stereo	0.5	1	CPS Stereo	16	16	512	512	1024	1152
CPS-U-Stereo	2	4	CPS Stereo	16	64	512	2048	1024	1152
FPS	16	32	FPS	13	416	416	13312	832	936
CPS-V-Stereo				3	96	96	3072	192	216
								Surplus VLPC	
CFT Total	77.5	155			1160		76800	0	
CPS Total	*2.5*	*5*			256		8192	512	
FPS Total	16	32			416		13312	-512	
Grand Total	**96**	**192**			**1832**		**98304**	**512**	

Table 3. No stereo mixer box design

Use of Cassettes										
User	**Cassettes**	**FE bds**	**type**	**# of MCM**		**VLPC Channels**		**MCM Channels per board**		
				per brd	total	per brd	total	needed	available	total MCM
CFT Axial	40	80	CFT Trig	7	560	480	38400	480	504	40320
CPS Axial				1	80	32	2560	64	80	5760
CFT-Stereo	38	75	CFT Stereo	8	600	512	38400	512	576	43200
CPS-Stereo	5	10	CPS Stereo	16	160	512	5120	1024	1152	11520
FPS Trigger	8	16	FPS	16	256	512	8192	1024	1152	18432
FPS Outer	4	8	FPS	16	128	512	4096	1024	1152	9216
								Surplus VLPC		
CFT Total	78	155			1160		76800	0		83520
CPS Total	*5*	*10*			240		7680	0		17280
FPS Total	12	24			384		12288	0		18432
Grand Total	**95**	**189**			**1784**		**96768**	**0**		**119232**

Table 4. 'Separated Function' Design

Use of Cassettes

User	Cassettes	FE bds	type	# of MCM		VLPC Channels		MCM Channels per board		
				per brd	total	per brd	total	needed	available	total MCM
CFT Axial	40	80	CFT Trig	7	560	480	38400	480	504	40320
CPS Axial				1	80	32	2560	64	80	5760
CFT-Stereo	37.5	75	CFT Stereo	8	600	512	38400	512	576	43200
CPS-Stereo	5	10	CPS Stereo	16	160	512	5120	1024	1152	11520
FPS	16	32	FPS	16	512	512	16384	1024	1152	36864
								Surplus VLPC		
CFT Total	77.5	155			1160		76800	0		83520
CPS Total	*5*	*10*			240		7680	0		17280
FPS Total	16	32			512		16384	960		36864
Grand Total	**98.5**	**197**			**1912**		**100864**	**960**		**137664**

Table 5. Separate Function, w/ correct FPS numbers