Mapping in Run 2B

Bill Reay, June 26, 2002

This document is a modification of the SST document created June 21, 2002 by Uli Heintz. Because there are fiber patch panels behind the VRB crates, the STT does not require recombination into sectors, but instead puts the following strong restrictions on hybrid lines joined in each 80-conductor cable:

- Don't combine different types I, II, III and IV (explained below).
- L0 cannot be combined with any other layer.
- L4 cannot be combined with any other layer.
- Don't combine one 30^o sector (explained below) with any other 30^o sector.
- A weaker rule: If possible, don't combine any layer with any other layer.

Discussions with Lisa Chabolina, Lyn Bagby, Eric Kajfasz, Andrei Nomerotsky, Breese Quinn and Petros Rapidis indicated the efficacy of recombining into 60^o sectors at the sequencers and VRBs in order to simplify debugging both of hardware and software. This also will be taken as a strong restriction.

The following writeup, taken from Uli, explains his nomenclature.

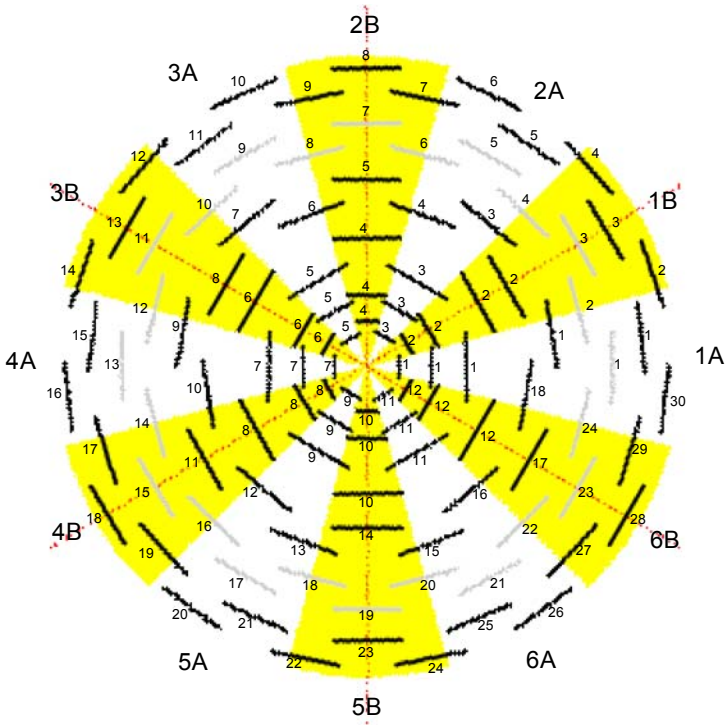

Figure 1: end-on view of the D0 Run 2B silicon tracker.

Figure 1 shows an end-on view of the D0 Run 2B silicon tracker. It consists of six concentric barrel layers of detectors, numbered from 0 (inside) to 5 (outside). Layer 4 will not be included in the STT. Several detectors may be combined along z into one readout unit. Layer, phi, and z indices identify each readout unit. The phi indices are indicated in the figure. Processing in the STT will be divided into twelve azimuthal sectors indicated by the yellow and white wedges, and numbered from 1A to 6B. Data from each sector will be processed in one (or two) TFCs. The STT is housed in six crates, numbered from 1 to 6. The "A" and "B" TFCs of equally numbered sectors reside in the same crate. Data from detectors in layers 3, 4, and 5 that extend across sector boundaries will be processed in both sectors and must therefore be fed to at least two TFCs.

Table 1 lists the readout elements that are connected to STCs in crate 1. The other five crates should be mapped analogously. Every STC has four input fibers. Each fiber carries the data from two readout units. The readout units can be classified into four types (I to IV), according to the TFCs that they feed. In order to minimize the number of cables into the TFCs, the readout units must be mapped into STCs such that the readout units in one STC feed into as few TFCs as possible. Thus there will be four STCs that feed only TFC 1A, and four STCs that feed only TFC 1B. There will be one STCs that feed TFCs 1A and 1B, and one STC that feeds TFCs 1B and 2A. Each TFC will receive inputs from five STCs. The maximum number of STC that can be connected to one TFC is eight. In order to achieve this mapping, the two readout units on each fiber must be of the same type.

Table 1: Mapping of axial readout lines in STT Crate 1.

Type	layer	phi index	number of readout units in z	TFC1	TFC2	Number of readout units	number of STCs
I	0	1	12	1A		30	3.75
	1	1	6	1A			
	2	1	4	1A			
	5	1	4	1A			
	5	30	4	1A			
II	3	1	4	1A	1B	8	1
	5	2	4	1A	1B		
III	0	2	12	1B		30	3.75
	1	2	6	1B			
	2	2	4	1B			
	3	2	4	1B			
	5	3	4	1B			
IV	3	3	4	1B	2A	8	1
	5	4	4	1B	2A		

Note that type I consists of all hybrid lines for which the sensors are entirely contained in the first 30^o sector, and type II includes hybrids for which the sensors penetrate in a counterclockwise (CCW) fashion into the next sector. Types III and IV are similarly labeled for the next CCW 30^o sector. The Silicon Track Trigger (STT) requires split readouts from types II and IV into adjoining sectors. Uli's choice of sectors minimizes this splitting.

Since the above takes into account only half the hybrid lines, with Uli's blessing I've taken the liberty of modifying his axial-sensor table to include layer 4, and to add a stereo table that follows Uli's nomenclature. The following includes readouts from one end only.

Table 2: Mapping of axial readout lines in first 60^o sector.

Type	layer	phi index	number of readout lines in z	TFC1	TFC2	Number of readout lines
I	0	1	6	1A		17
	1	1	3	1A		
	2	1	2	1A		
	4	1	2	1A		
	5	1	2	1A		
	5	30	2	1A		
II	3	1	2	1A	1B	6
	4	2	2	1A	1B	
	5	2	2	1A	1B	
III	0	2	6	1B		17
	1	2	3	1B		
	2	2	2	1B		
	3	2	2	1B		
	4	3	2	1B		
	5	3	2	1B		
IV	3	3	2	1B	2A	6
	4	4	2	1B	2A	
	5	4	2	1B	2A	
TOTAL READOUT LINES						***46***

The above accounts for the 46 axial readout lines, but neglects 28 stereo lines. Therefore, we'll add a table for stereo lines that strictly obeys Uli's nomenclature:

Table 3: Mapping of stereo readout lines.

Type	layer	phi index	number of readout units in z	TFC1	TFC2	Number of readout units
I	2	1	2	1A		8
	4	1	2	1A		
	5	1	2	1A		
	5	30	2	1A		
II	3	1	2	1A	1B	6
	4	2	2	1A	1B	
	5	2	2	1A	1B	
III	2	2	2	1B		8
	3	2	2	1B		
	4	3	2	1B		
	5	3	2	1B		
IV	3	3	2	1B	2A	6
	4	4	2	1B	2A	
	5	4	2	1B	2A	
TOTAL READOUT LINES						***28***

The total number of readout lines in a 60^o sector for one end is 74. As a check, there are six sectors and two ends, and 74 X 6 X 2 = 888, which is the correct number of lines for the 2b design. The next step is to see if we can satisfy all rules when combining neighboring lines into an 80-conductor cable. This is done for one 60^o sector in the following table. The 46 lines at the top are for a complete axial readout section, while the 28 lines at the bottom (after the one-line gap) are for the stereo readout section.

Type	Layer & phi index	Line	80 #		Type	Layer & phi index	Line	80 #
I	L0-1	1	1		III	L0-2	24	13
I	L0-1	2	1		III	L0-2	25	13
I	L0-1	3	2		III	L0-2	26	14
I	L0-1	4	2		III	L0-2	27	14
I	L0-1	5	3		III	L0-2	28	15
I	L0-1	6	3		III	L0-2	29	15
I	L1-1	7	4		III	L1-2	30	16
I	L1-1	8	4		III	L1-2	31	16
I	L1-1	9	5 + blank		III	L1-2	32	17 + blank
I	L2-1	10	6		III	L2-2	33	18
I	L2-1	11	6		III	L2-2	34	18
I	L4-1	12	7		III	L3-2	35	19
I	L4-1	13	7		III	L3-2	36	19
I	L5-1	14	8		III	L4-3	37	20
I	L5-1	15	8		III	L4-3	38	20
I	L5-30	16	9		III	L5-3	39	21
I	L5-30	17	9		III	L5-3	40	21
II	L3-1	18	10		IV	L3-3	41	22
II	L3-1	19	10		IV	L3-3	42	22
II	L4-2	20	11		IV	L4-4	43	23
II	L4-2	21	11		IV	L4-4	44	23
II	L5-2	22	12		IV	L5-4	45	24
II	L5-2	23	12		IV	L5-4	46	24
I	L2-1	47	25		III	L2-2	61	32
I	L2-1	48	25		III	L2-2	62	32
I	L4-1	49	26		III	L3-2	63	33
I	L4-1	50	26		III	L3-2	64	33
I	L5-1	51	27		III	L4-3	65	34
I	L5-1	52	27		III	L4-3	66	34
I	L5-30	53	28		III	L5-3	67	35
I	L5-30	54	28		III	L5-3	68	35
II	L3-1	55	29		IV	L3-3	69	36
II	L3-1	56	29		IV	L3-3	70	36
II	L4-2	57	30		IV	L4-4	71	37
II	L4-2	58	30		IV	L4-4	72	37
II	L5-2	59	31		IV	L5-4	73	38
II	L5-2	60	31		IV	L5-4	74	38

Thus, by setting up two 80-conductor cables with a single lead, we add one extra cable but satisfy all the rules. Note that 38/sector X 6 sectors X 2 ends = 456, exactly the number of 80-conductor cables installed for the 912 signal lines in run 2a.