

sPHENIX Timing, Trigger & Controls and Raw data

- sPHENIX follows more or less the similar approach we have used in the previous PHENIX experiment
 - Uniform Timing, Trigger & Controls
 - Uniform raw data format

Limited information available at,
<https://wiki.bnl.gov/sPHENIX/index.php/Electronics>

- Timing System
 - Distribute RHIC Clock to frontend electronics(FEMS)
 - Send accepted Lvl-1 trigger to the FEMs
 - Manage multi-event buffers (5-event deep buffer)
- One level trigger system - Lvel-1
 - trigger latency $\sim 4\mu\text{S}$ (~ 37 RHIC Clocks in PHENIX)
 - Handle subsystem busy
 - Control minimal trigger interval (“dead for 4” in PHENIX)

(s)PHENIX DAQ & GTM

- PHENIX Timing and Control – Mode bits: 11-bit
– very similar system to be used for sPHENIX

http://www.phenix.bnl.gov/phenix/project_info/electronics/mode_bits/mode_v2.html

Table 1. Timing & Control Interface Bit Definitions

Bit Name	Bit Definition
Beam Clock	Beam Clock - 108ns Period
Beam ClockX4	4X Beam Clock - 27ns Period
LVL-1	LVL_1 Accept
MB7	Extra Bit - No Assigned Function
MB6	Extra Bit - No Assigned Function
MB5	Extra Bit - Pulse Enable (optional)
MB4	Reserved For Command Encoding
MB3	Reserved For Command Encoding
MB2	Reserved For Command Encoding
MB1	Reserved For Command Encoding
MB0	Reserved For Command Encoding

Table 2. Mode Bit Definitions for MB1 and MB0 (Reset Group)

MB1	MB0	Command
0	0	No-op (Reset None)
0	1	Resync Reset
1	0	Initialization Reset
1	1	Special Reset

Table 3. Mode Bit Definitions for MB3 and MB2 (Special Function Group)

MB3	MB2	Command
0	0	No-op
0	1	Special Function 1
1	0	Special Function 2
1	1	Special Function 3

(s)PHENIX Raw Data Format - PRDF

https://www.phenix.bnl.gov/phenix/project_info/electronics/dcm/DCM_formats/PHENIX_Formats/

PRDF (PHENIX Raw Data Format)

- Header words
- Data words
- Trailer words

Muon Tracker System data format

- Un-zero suppressed
- Zero suppressed

FVTX data format

- Zero suppressed

The length of the package is detector specific:

- Header words
- Trailer words

For MVTX: for a 9-chip stave, raw data could be:

Header: RU ID, Event #, Clocks

Trailer: RU error, Parity

Data: Hit #, Chip ID, Region ID, pixel address ...

FVTX data format

Packet 25124 24 0 (Unformatted)
425 (IDFVTX_DCM0)

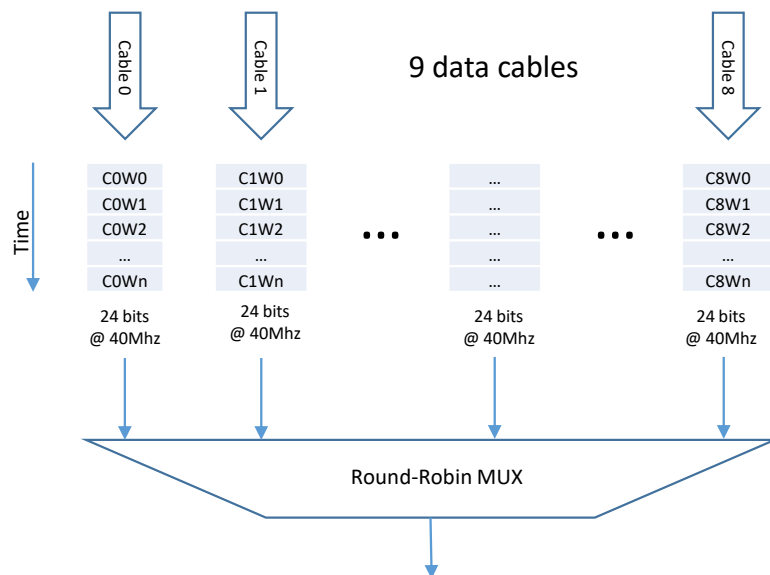
Number of hits	9
Event number:	54347
Det id	64512
Error Code	0
module address	27
Flag word	0x5555
beam clock counter	37264
FEM Error word	0
Parity	b5a0
Parity Ok	Yes
hit # FemId Chip Chan ADC	
0 1 52 104 0	
1 1 17 120 2	
2 1 52 105 7	
3 1 52 106 0	
4 1 17 121 2	
5 1 17 122 1	
6 1 17 123 1	
7 2 42 54 3	
8 2 42 55 4	

Muon Tracker Data Format

Num	Name	Upper 16-bit label
====	=====	=====
0	flag word	0x000f....
1	module address	0x000e....
2	event number	0x0006....
3	beam clock counter	0x0006....
4	detector id	0x0006....
5	amu cell 0	0x0001....
6	amu cell 1	0x0002....
7	amu cell 2	0x0003....
8	amu cell 3	0x0004....
9	(chan 0 - samp 2) ^ 0x0fff	0x000b....
10	(chan 0 - samp 0) ^ 0x0fff	0x0009....
11	(chan 0 - samp 1) ^ 0x0fff	0x000a....
12	(chan 0 - samp 3) ^ 0x0fff	0x000c....
13	(chan 1 - samp 2) ^ 0x0fff	0x001b....
14	(chan 1 - samp 0) ^ 0x0fff	0x0019....
15	(chan 1 - samp 1) ^ 0x0fff	0x001a....
16	(chan 1 - samp 3) ^ 0x0fff	0x001c....
17	(chan 2 - samp 2) ^ 0x0fff	0x002b....
..		
517	(chan 127 - samp 2) ^ 0x0fff	0x07fb....
518	(chan 127 - samp 0) ^ 0x0fff	0x07f9....
519	(chan 127 - samp 1) ^ 0x0fff	0x07fa....
520	(chan 127 - samp 3) ^ 0x0fff	0x07fc....
521	user word 0	0x0808....
522	user word 1	0x0808....
523	user word 2	0x0808....
524	user word 3	0x0808....
525	user word 4	0x0808....
526	user word 5	0x0808....
527	user word 6	0x0808....
528	user word 7	0x0808....
529	longitudinal parity word	0x0808....
530	summary word	0x0807....

ALICE RU-CRU Data Format V0, still in flux, 08/9/2017

https://www.phenix.bnl.gov/WWW/publish/mxliu/sPHENIX/Readout/CRU/CRU_Specification_v0.7.pdf



DataValid	72	64	56	48	40	32	24	16	8	0
0	SOP Parameters									SOP (4bit)
1	EqID	0x0	FID	ORBIT(32bit)			BCID(12bit)	TrgType		
1	Status									
1	C0_Id	C0W2			C0W1			C0W0		
1	C1_Id	C1W2			C1W1			C1W0		
1	C2_Id	C2W2			C2W1			C2W0		
1	...	...			...			...		
1	C8_Id	C8W2			C8W1			C8W0		
1	C0_Id	C0W5			C0W4			C0W3		
1	C1_Id	C1W5			C1W4			C1W3		
1	C2_Id	C2W5			C2W4			C2W3		
1	...	...			...			...		
1	C8_Id	C8W5			C8W4			C8W3		
1	...	...			...			...		
1	...	...			...			...		
1	C8_Id	C8W(n)			C8W(n-1)			C8W(n-2)		
0	0x0 (60bits) PACKET_LENGTH (16bits)									EOP (4bit)
0	0x0									IDLE (4bit)

C<n>W<m>: Cable <n>, Word <m>
Cx_Id: FIFO identifier (0-27, 5bit)
SOP: CRU Start-of-Packet
EOP: CRU End-of-Packet
FID: Frame ID (0,...,3 relative to Heartbeat, 2bit)
BCID: Bunch Crossing ID (12bit)
EqID: Equipment ID (0-191, 8bit)

Inner Barrel Data Format