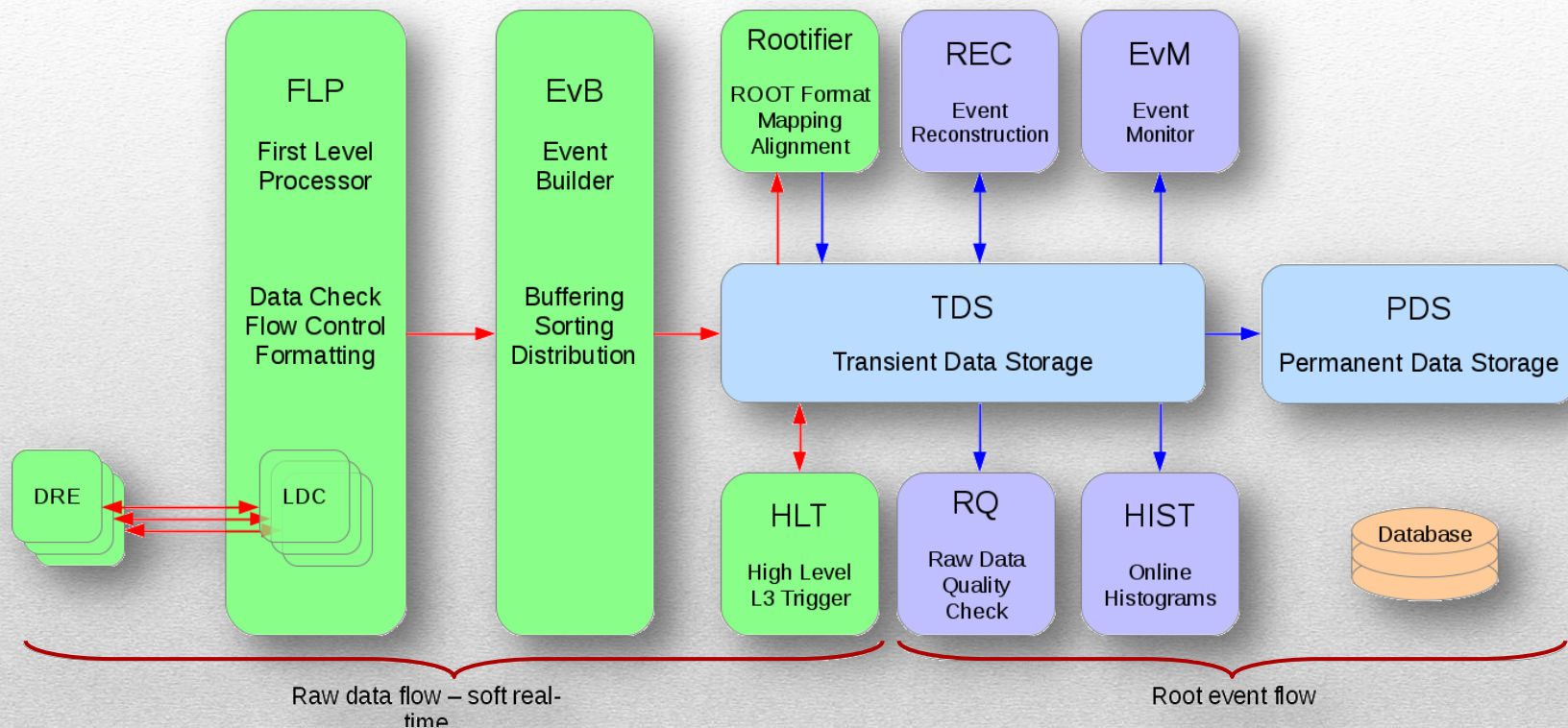


DAQ software in MPD experiment NICA

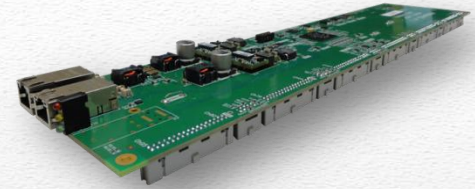
I.A. Filippov, I.V. Slepnev

MPD DAQ Data Flow

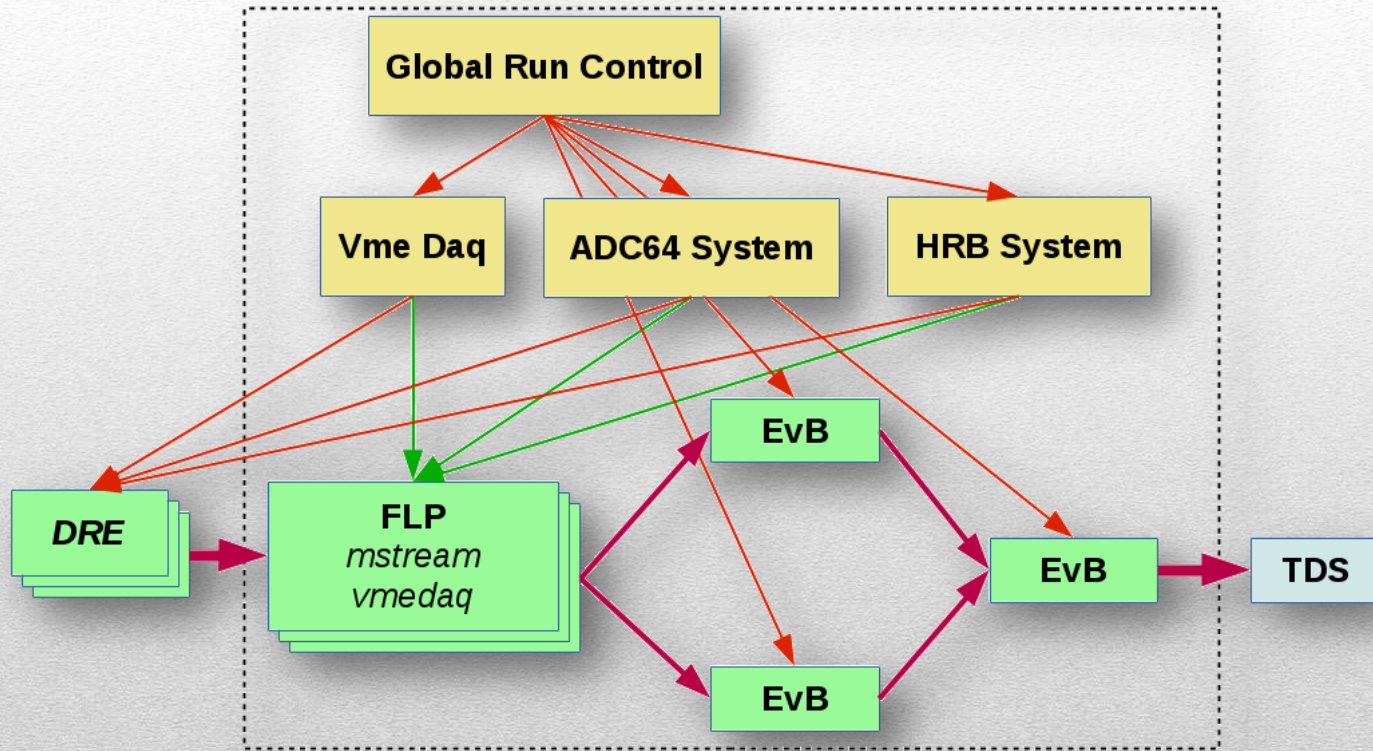


DRE list:

- ✓ HRB6ASD – CPC
- ✓ ADC64s2 – ZDC, ECAL
- ✓ TDC64V – DCH
- ✓ TDC72VHL – mRPC (TOF-400), T_0 T (FFD)
- ✓ TDC32VL – mRPC (TOF-700)



MPD DAQ Software

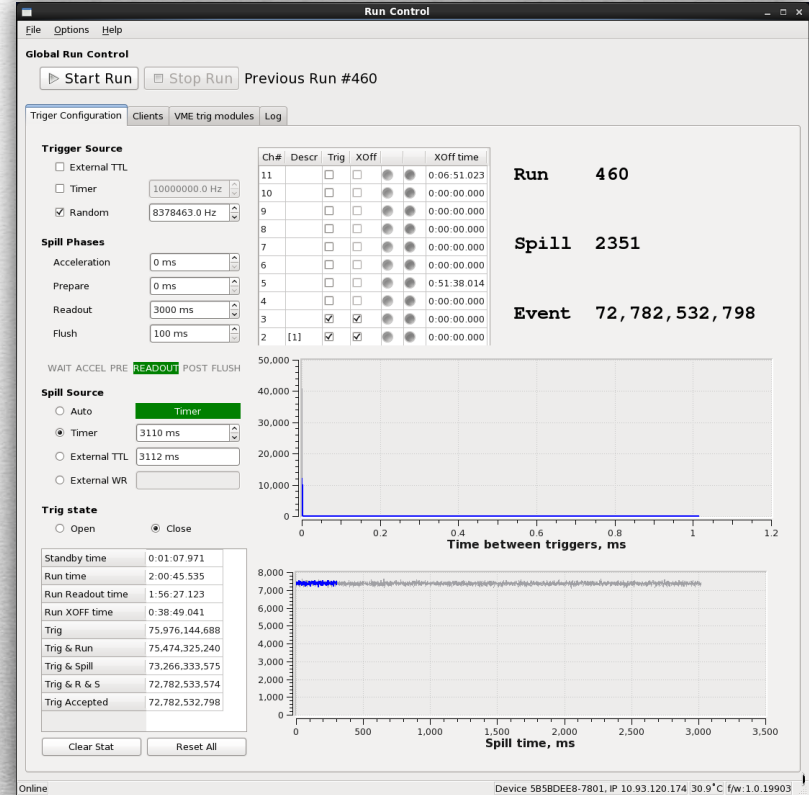


Global Run Control

✓ Configure trigger block

- trigger source
- worked detectors

✓ Current Run status



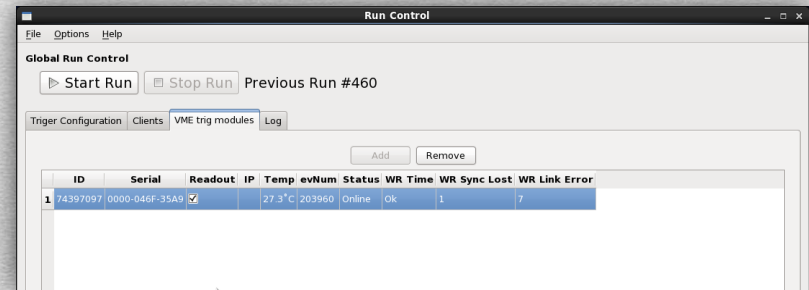
Global Run Control – Clients

- ✓ Enable/disable worked clients
- ✓ Client's state



Global Run Control – VME trigger

- ✓ Configure trigger source
- ✓ Configure working detectors



VME DAQ

- ✓ Presets configurations to all modules in VME crate
- ✓ Itself a FLP program

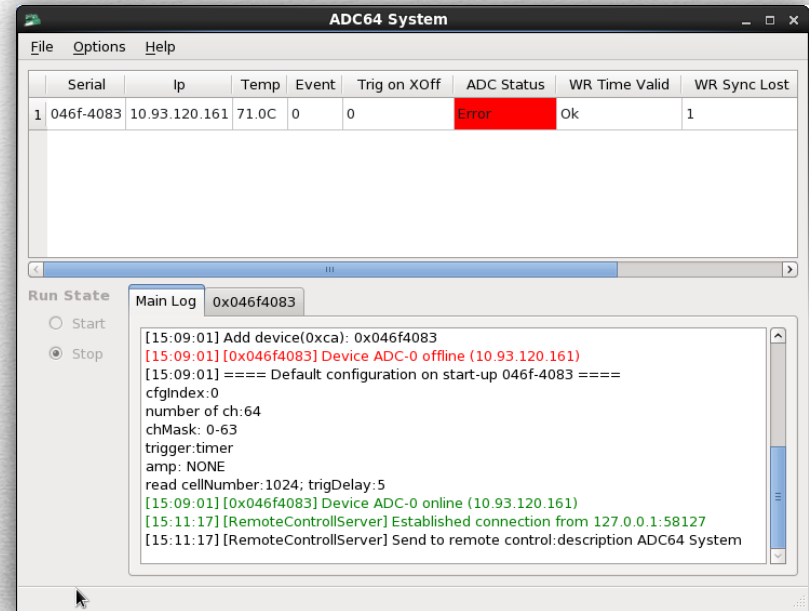
The screenshot shows the VMEDAQ Control software interface. The main window is titled "VMEDAQ Control [1]". It features a menu bar (File, Operation, View, Help) and a toolbar with buttons for INIT, RESET, PREP, RUN, and PAUSE. The interface is divided into several sections:

- RAW Decoder:** CPU 0%, Disk 7%, Events decoded 100%, 0.0 $\mu\text{s}/\text{ev}$.
- Histograms:** Reset every cycle, Downscale 1, Reset Counts.
- RAW Data Storage:** RUN (no storage), File: disabled, Disable, Setup...
- Spill:** Ext Gate, Ext Pulse, Timer (selected). Wait: 1 s, Duration: 1000 s, Repeat: 1000 s.
- Trigger Signal Shaper:** Shaper 3, 50 ns.
- Internal Trigger Generator:** Noise, Pulser 1000 Hz.
- LEMO I/O Function:** 1 Spill (gate), 2 Spill (gate), 3 Spill (gate), 4 Spill (gate).
- Enable LVDS:** LVDS1 (ST), LVDS6 (TQDC1), LVDS10 (TQDC1), LVDS14 (TQDC1), LVDS18 (TQDC2), LVDS22 (TQDC2), LVDS26 (TQDC2), LVDS30 (TQDC2).
- Trigger Logic:** Any (ST + TQDC1 + TQDC2 + LEMO).
- TRIG Event Statistics:** Unblocked triggers 1041, Read out triggers 1041 100.00%.
- Trigger Bits:** 0 (Pulser) 1041 100.00%, 19 (Endspill) 1.
- Data Table:**

Title	Count	ST	TQDC1	TQDC2	LEMO IN
0 Pulser	1042				
1 State 0001	0+	-	-	-	-
2 State 0010	0-	+	-	-	-
3 State 0011	0+	+	-	-	-
4 State 0100	0-	-	+	-	-
5 State 0101	0+	-	+	-	-
6 State 0110	0-	+	+	-	-
7 State 0111	0+	+	+	-	-
8 State 1000	0-	-	-	+	+
9 State 1001	0+	-	-	+	+
10 State 1010	0-	+	-	+	+
11 State 1011	0+	+	-	+	+
12 State 1100	0-	-	+	+	+
13 State 1101	0+	-	+	+	+
14 State 1110	0-	+	+	+	+
15 State 1111	0+	+	+	+	+

ADC64 System

- ✓ Presets configuration to ADC64 boards
- ✓ Starts FLP program (mstream)



The screenshot displays the ADC64 System software interface. At the top, there is a menu bar with 'File', 'Options', and 'Help'. Below the menu bar is a table with the following columns: Serial, Ip, Temp, Event, Trig on XOff, ADC Status, WR Time Valid, and WR Sync Lost. The table contains one row of data:

Serial	Ip	Temp	Event	Trig on XOff	ADC Status	WR Time Valid	WR Sync Lost
1 046f-4083	10.93.120.161	71.0C	0	0	Error	Ok	1

Below the table is a 'Run State' section with two radio buttons: 'Start' (unselected) and 'Stop' (selected). To the right of the 'Run State' section is a 'Main Log' window for device '0x046f4083'. The log contains the following text:

```
[15:09:01] Add device(0xca): 0x046f4083  
[15:09:01] [0x046f4083] Device ADC-0 offline (10.93.120.161)  
[15:09:01] ==== Default configuration on start-up 046f-4083 ====  
cfgIndex:0  
number of ch:64  
chMask: 0-63  
trigger:timer  
amp: NONE  
read cellNumber:1024; trigDelay:5  
[15:09:01] [0x046f4083] Device ADC-0 online (10.93.120.161)  
[15:11:17] [RemoteControlServer] Established connection from 127.0.0.1:58127  
[15:11:17] [RemoteControlServer] Send to remote control:description ADC64 System
```


HRB System

Hrb Status

File Options Help

	Id	Ip	Time	Temp	Spill	Event	Write	ASD 0	ASD 1	ASD 2	ASD 3	ASD 4	ASD 5	Pass	Block
1	0x046efa79	10.93.120.171	03:03:56	49.0C	1	400800	<input checked="" type="checkbox"/>	0.000	0.000	0.000	0.000	0.000	0.000	388315	404
2	0x046f304f	10.93.120.186	02:35:08	48.8C	2	2129554119	<input checked="" type="checkbox"/>	0.000	0.000	0.000	0.000	0.000	0.000	388215	404

Threshold, V: 0.000

Latency, ns: 24

Window, ns: 80

Min hit dur, ns: 8

Write Enable:

Run analyzer:

Run number: 0

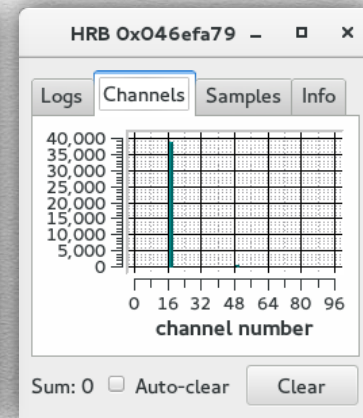
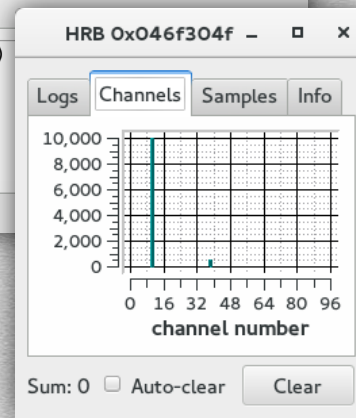
Reset

Id	Ip	Time	Temp	Event
1	0x046f06a7	10.93.120.160	14:53:49	29.1C 0

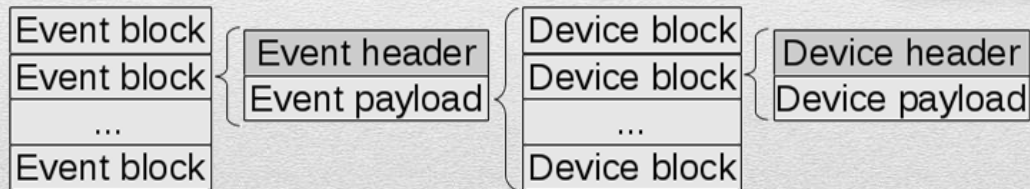
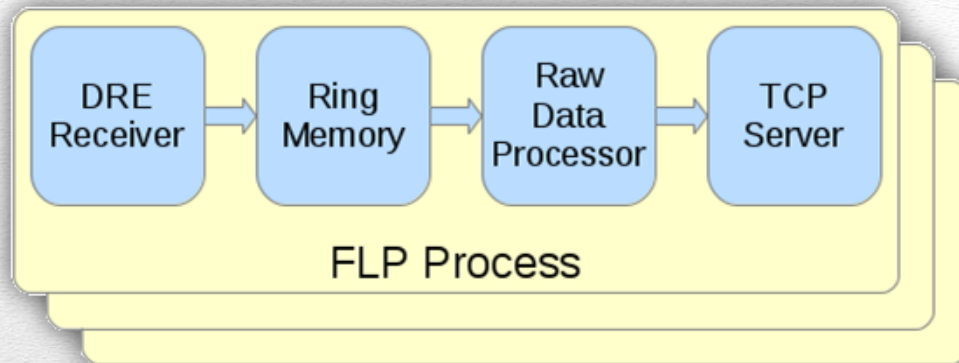
Main Log

```

0x046efa79 0x046f304f
[14:50:25] [0x046f304f] set trig_src=003e; latency=3(24ns); window=10(80ns); minHitDuration=4(8ns)
[14:51:03] TTB-0 host updated: 0.0.0.0
[14:51:05] TTB-0 host changed from 0.0.0.0 to 10.93.120.160
[14:51:08] [0x046f06a7] Device TTB-0 online (10.93.120.160)
[14:51:08] [0x046f06a7] device connected fw=1.0.20446
    
```



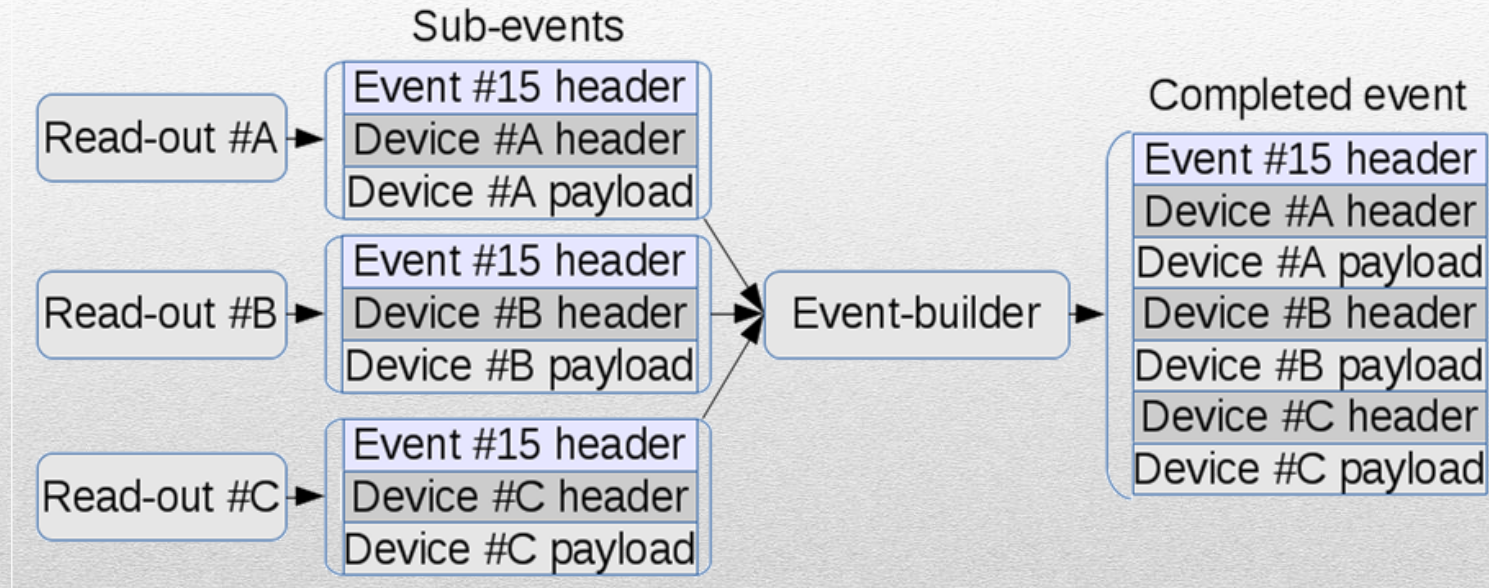
FLP Structure



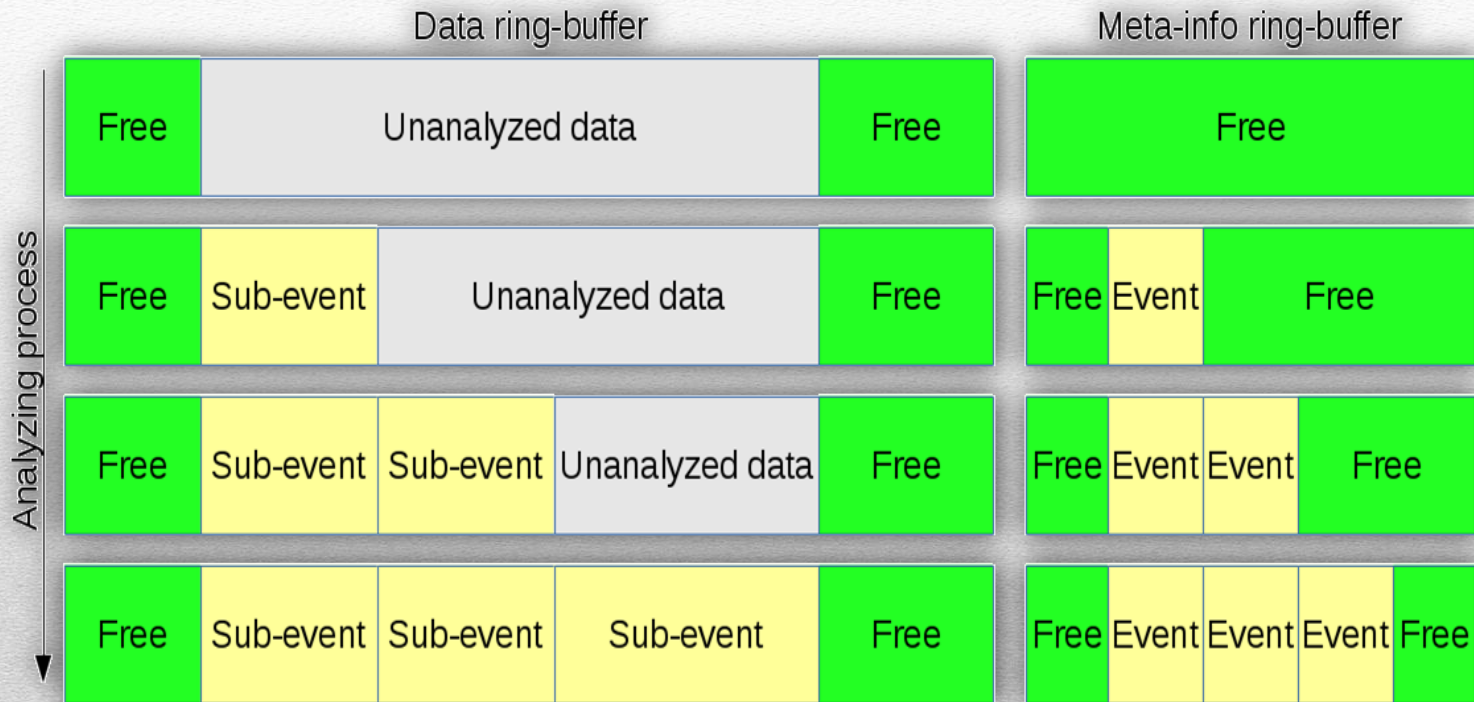
Event header	Bits
Synchro word	31:0
Payload length	31:0
Event number	31:0

Device header	Bits
Serial Number	31:0
Device ID	31:24
Payload length	23:0

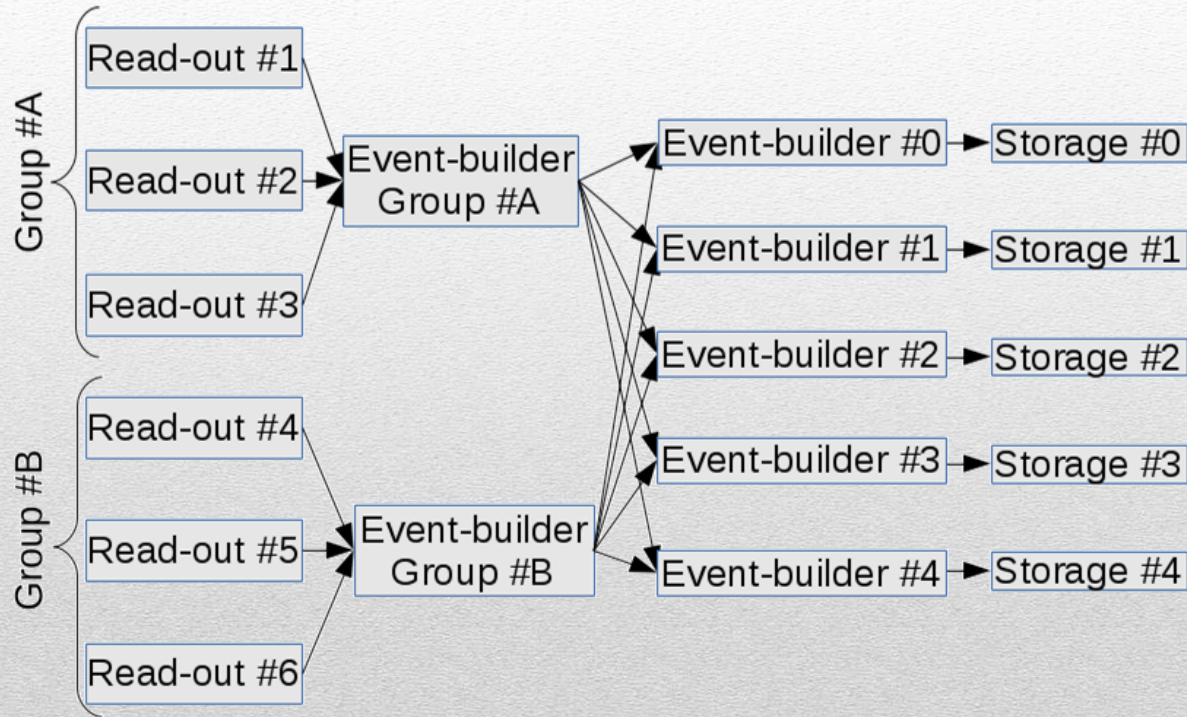
Event Builder Concept



Event Builder Analyzer work



Event Builder Global Architecture



Event Builder

- ✓ Connects to FLP programs (mstream)
- ✓ Receives subevents
- ✓ Combines them into completed event block
- ✓ Save to disk or retransmit to 2nd stage of EvB

mpd_20150924_153359.data

id	readout	address	port	state	evNum	trashed	all	flushedSize
1	1	127.0.0.1	34301	137 packages received; load=0.0%	9316	0	7524	1444608
2	2	127.0.0.1	34300	150 packages received; load=0.0%	9316	0	7515	1442880

```
[15:33:50] Added client 127.0.0.1:34301
[15:33:50] Added client 127.0.0.1:34300
[15:33:50] [Summer] Start writing to file:/home/ivan/svn/soft/
mpd-evb/build-src-Desktop_Qt5-Debug/mpd-evb/
mpd_20150924_153350.data
[15:33:50] [OutputTcpServer] TcpServer started on
0.0.0.0:33399
[15:33:50] [Summer] clientNumbers=2
[15:33:50] [RemoteControlServer] TcpServer started on
0.0.0.0:33390
[15:33:59] [TcpClient #1] TcpClient #1 connected.
[15:33:59] [TcpClient #2] TcpClient #2 connected.
[15:33:59] [Summer] Start writing to file:/home/ivan/svn/soft/
mpd-evb/build-src-Desktop_Qt5-Debug/mpd-evb/
mpd_20150924_153359.data
[15:34:15] [TcpClient #2] Remote hoste closed connection.
[15:34:15] [TcpClient #1] Remote hoste closed connection.
```

reg:7524;skip:0;eob:0;clients:2 1 ,nextEv:9317 out:0

Auto-discovery

- ✓ Name
- ✓ Serial number
- ✓ Firmware ID
- ✓ IP address
- ✓ Connections



Conclusion:

- ✓ All DAQ system in passed BM@N run worked successfully.
- ✓ Current DAQ architecture is suitable for future BM@N and MPD experimental facilities.

Active development:

- ✓ Data transfer management
- ✓ Live monitor and central logging
- ✓ Configuration management



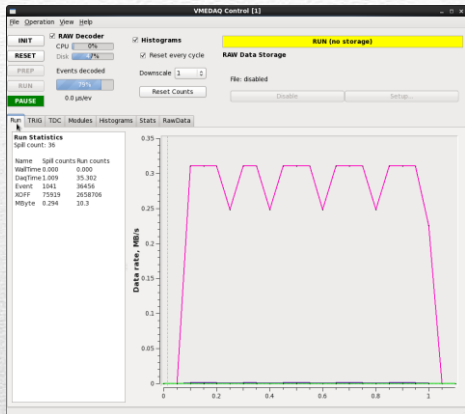


Thank you!

Conclusion:

- Connects to FLP programs (msteam)
 - Receives subevents
 - Combines them into completed event block
 - Save or retransmit to second stage of Event Builder
-

VMEDAQ:



VMEDAQ Control [1] - Hardware Table

Name	Class	Rmware	SN	Slot	Capabilities	Status	L ^o C	# ch	Read	OK Spills	Warnings	Overflows	Errors	Fails
0	TDC3VLS	TDC	1.0.20706	[40F-200C]	131x128 4k4 x32	ReadyOut OK	20.8	32x6	256	0	0	0	0	0
1	TDC3VLS	TDC	1.0.33293	[40F-200C]	131x128 4k4 x32	ReadyOut OK	20.8	32x6	256	0	0	0	0	0
2	TRIG	TRIG	1.1.20719	[40F-354S]	201x128 4k4 x32	ReadyOut OK	27.3	4x6	256	0	0	0	0	0

VMEDAQ Control [1] - Trigger Signal Shaper

Shaper: 3, 50 ns

Enable LVDS: LVDS1 (RT)

Internal Trigger Generator: LVDS6 (TODC1)

LEMO I/O Function: LVDS38 (TODC2)

Trigger Logic: Any (ST + TODC1 + TODC2 + LEMO)

TRIG Event Statistics: Unlocked Triggers: 1043, Readout Triggers: 1043, 100.00%

Title	Count	ST	TODC1	TODC2	LEMO IN
0	Pulsar	1042	-	-	-
1	State 0001	0+	-	-	-
2	State 0010	0+	-	-	-
3	State 0011	0+	-	-	-
4	State 0100	0+	-	-	-
5	State 0101	0+	-	-	-
6	State 0110	0+	-	-	-
7	State 0111	0+	-	-	-
8	State 1000	0+	-	-	-
9	State 1001	0+	-	-	-
10	State 1010	0+	-	-	-
11	State 1011	0+	-	-	-
12	State 1100	0+	-	-	-
13	State 1101	0+	-	-	-
14	State 1110	0+	-	-	-
15	State 1111	0+	-	-	-

VMEDAQ Control [1] - Timing Diagram

Machine: 40, 1 us

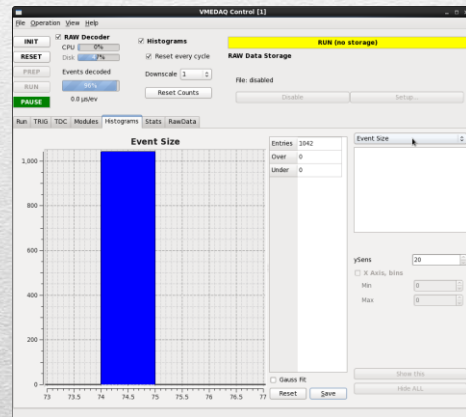
Latency: 40, 1 us

Leading: 25 ps

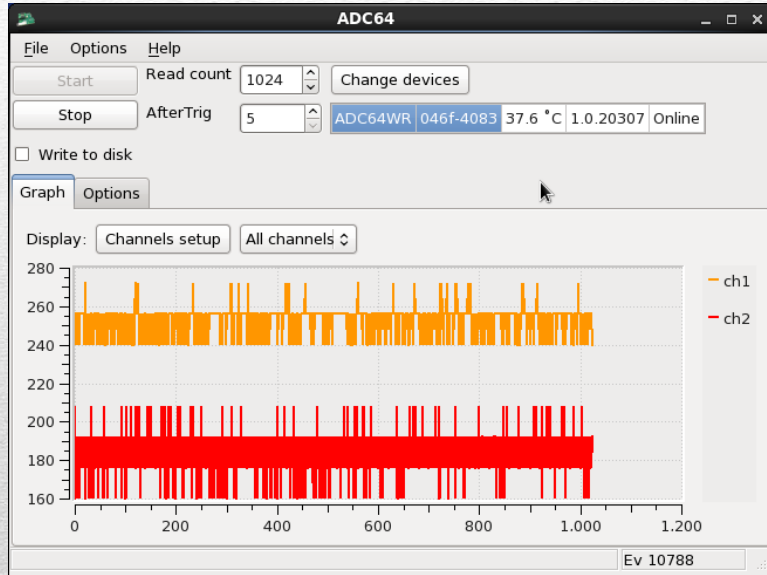
Common Stop channel: 0

TDC Event Statistics: Total events: 1043, 100%

En	TDC HRS
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	0
17	0
18	0
19	0
20	0
21	0
22	0
23	0
24	0
25	0
26	0
27	0
28	0



ADC64:



Channels setup

	Enable	Thr On/Off	Thr value	Baseline
Global	<input type="checkbox"/> Set/clear all	<input checked="" type="checkbox"/> Set/clear all	0	0
ch 1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	100	-1
ch 2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	100	-3
ch 3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	100	0

ADC64

File Options Help

Start Read count 1024 Change devices

Stop AfterTrig 5 ADC64WR 046f-4083 39.6 °C 1.0.20307 Online

Write to disk

Graph Options

Amp64 Options

baseline 0 level 0 board version 2

Trigger setup

Timer Threshold Lemo(TTL)

Threshold trigger Rising

Zero suppression

Threshold

0 Rising

Ev 14236