

BonnDAQ Status and upgrade possibilities

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Current Idea for BonnDAQ





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Structure of BonnDAQ (05/2016)







CMD Client(s)

- Suggested solution: Easy to control, one file for full PXD data
- Needs work (and testing) for implementation
- Needs powerful machine



Support software already existing



- pyDepfetReader: python extension
 - Interpretation of both DHE and DHC data
 - Transparent: User does not notice
 - Data given as numpy array
 - Raw: Shape is Row, Col
 - ZS: Shape is Firing Pixel, 4
 - » Multiple words of [Col, Row, Value, CM]
 - Can read from file and live data
- DAQ module: python class
 - Steers DAQ from script

BonnDAQ: EPICS Integration status



- DAQ Health module (python + CS-Studio)
 - Shows status of threads, filename, file size, connected clients (for live data), buffer fill status, error counts etc.
 - Creates EPICs server, requests DAQ status and publishes EPICS variables.
 - **OPI** display available
 - Used in April 2016 testbeam

PXD:H1012		H1012 Trig Error 0			H2012 trig Errors 0			DAQ Monitor Versio	
		H1012 Missmatch 0			H2012 Missmatch 0			0.2	
ata Thread					UDP Thr	ead			
Data Thread State	Stopped				UDP Th	read State	Stopped - No Data		
Single request	0	Single framesSent	0		UDF	P Port	6000		
Continous request	0	Continous framesSe	nt o		Frame	Number	0	last Triggernu	mber 0
exclusive request	0	exclusive framesSe	nt o		empty	Frames	0		
Connections					Received	Data [KB]	0	received Pac	kets 0
					Sent d	ata [KB]	0	accepted Pac	kets 0
					payload [KiloBytes]	0	discarded Pac	ikets 0
					missing	triggers	0	empty Pack	ets 0
le Thread					# of artific	cial Trigger	0		
File Thread State	Stopped							Triggemumber	error 0
Filename					Headers	ize Errors	0	State Machine	Errors 0
File Error Message					CRC	Errors	0	wrong Header	Errors 0
Filesize	0				-				
# of Events in File	0	Start Run	Stop Run	1.00E	E0]				
				ļ	-				
6				8.006	5-1-				
E	Buffer 20	0 400	200 400	tie	-				
AQCNTRL	UDD 0. 111	0 , 500 0	0 / , 500	5 6.00E	5-1 -				
Start DAQ				5	-				
		now	nign	를 4.00E	5-1-				
	20	0 400	200 400	ž	1				
Exit DAQ	File 0, 1	0 , 500 0	0 //, 500	2.006	5-1-				
					-				
	•				-				

Trigger mismatch display bad

- Start/Stop buttons sometimes crash.
- Stability testing needed
- Sometimes does not reconnect when BonnDAQ is restarted

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Bytes per even

BonnDAQ: EPICS Integration status



- DQM display (python + CS-Studio)
 - Uses pyDepfetReader.TcpReader
 - Gets live data and calculates hit map, Seed/Cluster histogram, pixel occupancy histogram, common mode histogram, event size histogram
 - Creates EPICs server and publishes results
 - OPI display available
 - Used in April 2016 testbeam
 - ~500 frames/sec
 - two PXD modules, single thread
 - ~25 frames/sec for 40 modules



- Currently can only handle 1 DHC (5 DHEs)
- OPI Display has hardcoded DHE IDs
- Clustering only in space not in time.
- Single threaded

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PERFORMANCE, DATA AND COST ESTIMATES

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• Pedestals:

- Once per run, 3 runs/day, 200 days/year,
 10 years: 6000 pedestals during lifetime
- 100 (1000?) Frames: 760MB (7.5GB) for pedestals
- Total: 4 TB (40 TB)

• Offsets

- Once per Week, 40 weeks/year, 10 years: 400 Offset per lifetime
- ~32 (IPDAC) * 4(OFFSET) * 4(?) * 100
 Frames: 100-400 GB for Offsets
- Total: 40-160 TB

Delays

- Once a month, 10 months/year, 10 years: 100 delays per lifetime
- 5 frames * 16 * 16 settings: 10 GB
- Total: 1 TB

DCD transfer curves

- Once per 2 months, 10 months/year, 10 years: 50 measurements
- 80 GB for all ADC channels (2MB channel, 2000 points/channel, 256 values/point), one setting. (2 * 25 settings?)
- Total: 4 TB (200 TB?)

Time estimates:

Pedestals: 1 min DAQ + 1 min calc + 2 min upload. <u>4 min</u> Offset: 5 sec DAQ/setting * 32*4*4 settings. <u>10-40 min</u> + calc Delays: 4 sec DAQ/setting * 16 *16 settings: <u>18 min</u> + calc DCD transfer curves: DHE current source

- 20 min (All settings, two channels/DCD)
- 55 min (one setting, all channel)
- <u>42h</u> (full scan)

Other Scans

Subin/Gate voltage: Optimize Gate voltage for switcher pairs and Sub In for DCDs. Can be included in offset, would increase the time by 16 when using 4 voltage values and 4 SubIn values Else: Separate Short SubIn VGateOn scan, before offset scan. Much faster, perhaps less pedestal compression 5-40TB over lifetime: 4-16 (GateOn) * 4-8 (DACSubIn)*100 Frames, <u>3-10min</u> + calc

Pedestal verification/noisy pixel scan: 1 min DAQ, 1 min calc

Live DQM data acquisition

- DHP bandwidth: 160*1.6 Gbit/s * 8/10 = 204 Gbit/s
 - Assumes 3% at 30KHz > realistic occupancy : 0.75%
 - Effective bandwidth 50 Gbit/s at 30 KHz
 - Event: ~ 200-300KByte
- Target: 20 Mbit from each detector, 160 Mbit total
 - Factor 312 lower than 50Gbit
 - Keep every 256th or 512th event
 - 100 Hz
- Data rate:
 - 20MB/s * 3600 s/h * 6.6h/runs* 3 runs/day = 1.3 TB/day
 - Total runtime (200 days/y * 10 years): 2600 TB=2,5 PB

Data Reduction possibilities:

- Keep only triggered elements (which HLT keeps)
- Make more sparse with time
- Use compression (reduction by ? <2 ?)

Up to 8Gbit total possible

Should we permanently save DQM data at all? <u>Probably not!</u> Histograms only (?)



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Data estimates summary



Data per Sca	Raw an	Processed	Results and quality	Results only
Reduction	None	Medium	Strong	Very Strong
Pedestal	7.5 GB	0.4 GB	0.14 GB	0.008 GB
Offset	400 GB	200 GB	20 GB	0.01 GB
Delays	10 GB <mark>(0.1GB)</mark>	0.01 GB	-	0.0001 GB
ADC curve *	80 GB <mark>(8 GB)</mark>	0.8 GB	-	0.01 GB

• Data for lifetime

Reduction	None	Medium	Strong	Very Strong
Pedestal x 6000	45 TB	2.4 TB	0.84 TB	0.048 TB
Offset x 400	160 TB	~80 TB	8 TB	0.004 TB
Delays x 100	1 TB (0.01TB)	0.001 TB	-	0.00001 TB
ADC curve **	200 TB <mark>(20 TB)</mark>	2 TB	-	0.025 TB

BonnDAQ compression

* Single Setting, all ADCs

** Assuming 50 Scans during lifetime with RefIn/AmpLow, IPSource/IPSource2, 5 values for each setting (2 * 5 * 5 measurements), scan over all channels

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Cost estimates



- Server:
 - 8+1 1Gbit Ethernet for DHC and User
 - 2 10Gbit Ethernet for Raid/User
 - 2 * 12 Core CPU
 - 8*8 GB RAM CPU
 - <u>Est. price: 10K</u> (24 Core, 3GHz, 64 GB RAM)
- Fallback solution (Redundancy):
 - Powerful lab PC (800 Euro)
 - 9 1Gbit Ethernet for DHC and User (400 Euro)
 - 1 TB SSD (400 Euro)
 - <2000 Euro

- Storage:
 - Discs: 50-60euro/TB
 - Depending on Size: 5-10K for server
 - <u>~ 20K for 200TB</u>
 - Not certain about the price

- If only "small" storage: Single Server?
- Raid? JBOD? How do you handle 50+ Discs?
- Backup storage: LTO6 tape? 10euro/TB. Available at KEK. Also for us?

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- BonnDAQ is standard system for lab characterization
- Changes for Belle II operation summarized
- Total data for optimization during lifetime < 200TB
- Cost estimates: 10K (Server), 20K (Storage), 2K (Backup system)
- Open Questions:
 - Handling of DQM data
 - Data backup at KEK

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