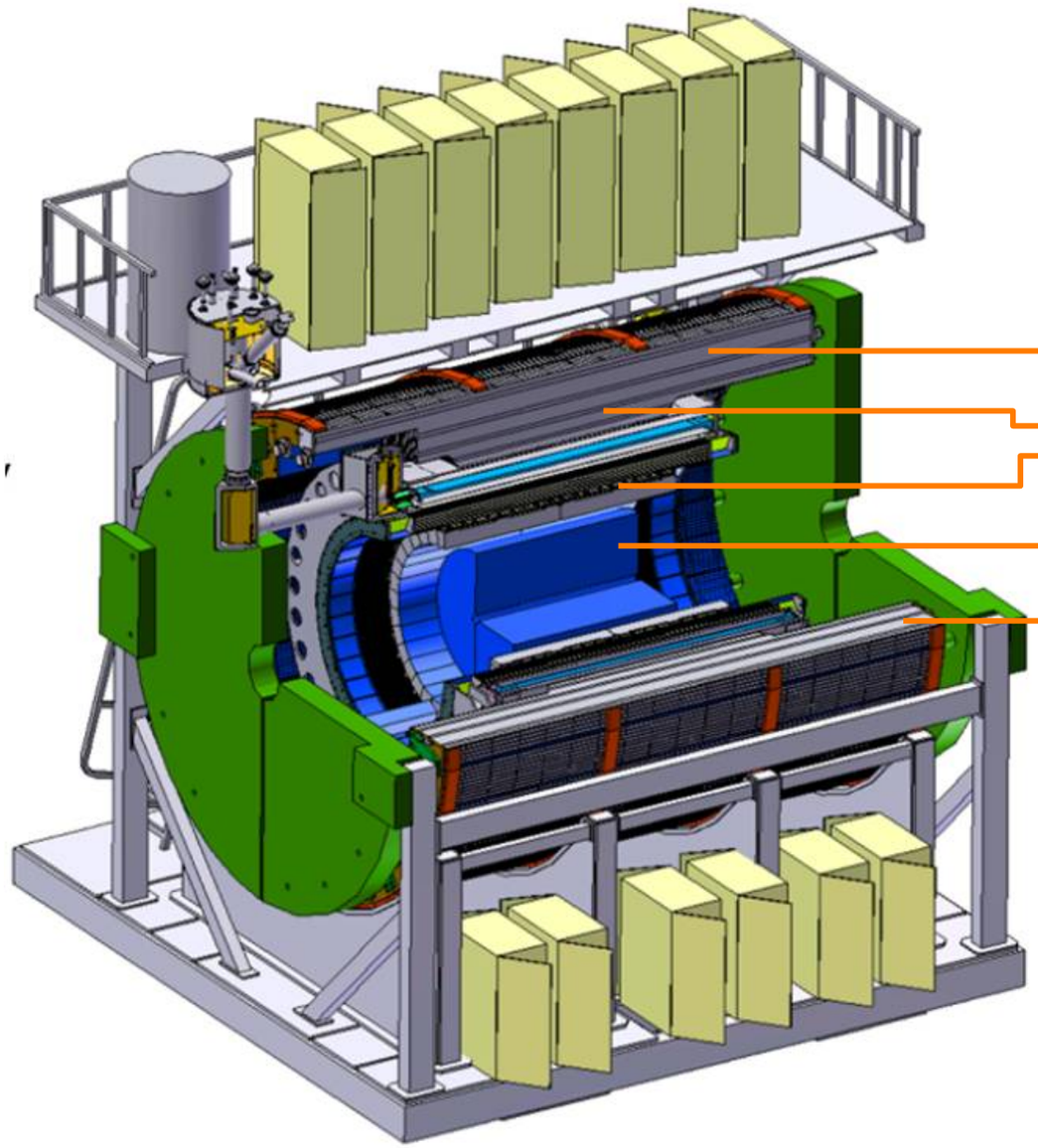
WBS 1.6 – DAQ-Trigger



WBS	sPHENIX MIE Project Elements
1.1	Project Management
1.2	Time Projection Chamber
1.3	Electromagnetic Calorimeter
1.4	Hadron Calorimeter
1.5	Calorimeter Electronics
1.6	DAQ/Trigger
1.7	Minimum Bias Trigger Detector

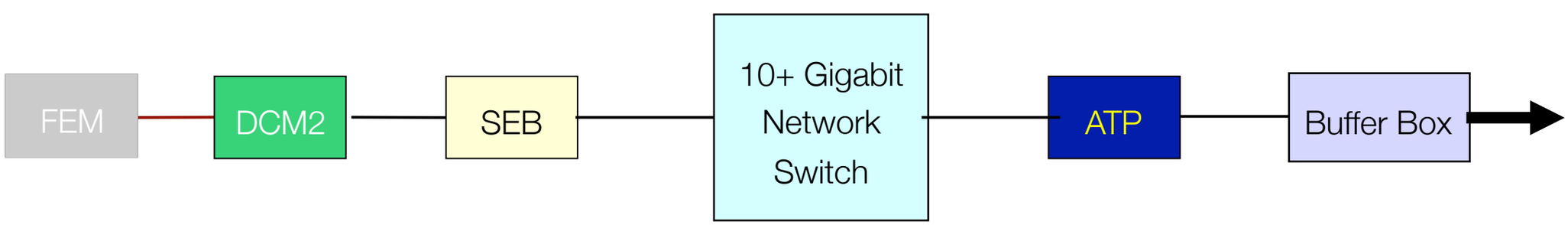
WBS	Infrastructure & Facility Upgrade
1.8	SC-Magnet
1.9	Infrastructure
1.10	Installation-Integration

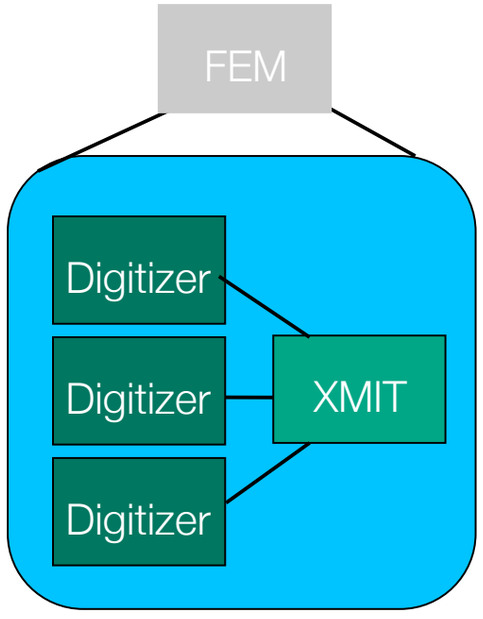
WBS	Parallel Activities
1.11	Intermediate Silicon Strip Tracker
1.12	Monolithic Active Pixel Sensor

L2 Manager: Martin L Purschke, BNL

Package Walkthrough

- Front-end module
- Data Collection Module
- Sub-Event Buffer
- Network Switch
- Assembly and Trigger Module
- Buffer box



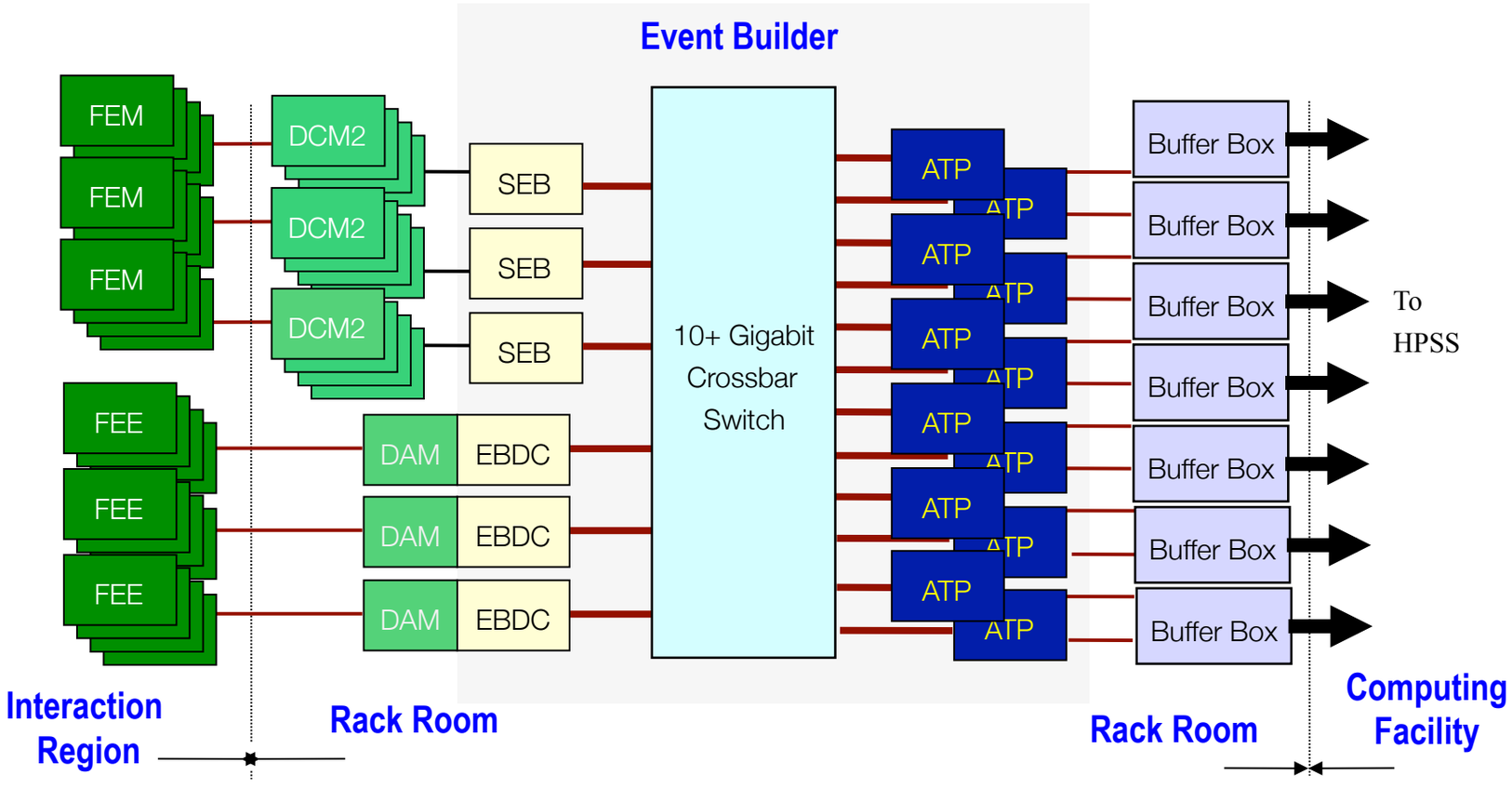


A Calorimeter FEM from my perspective.. .

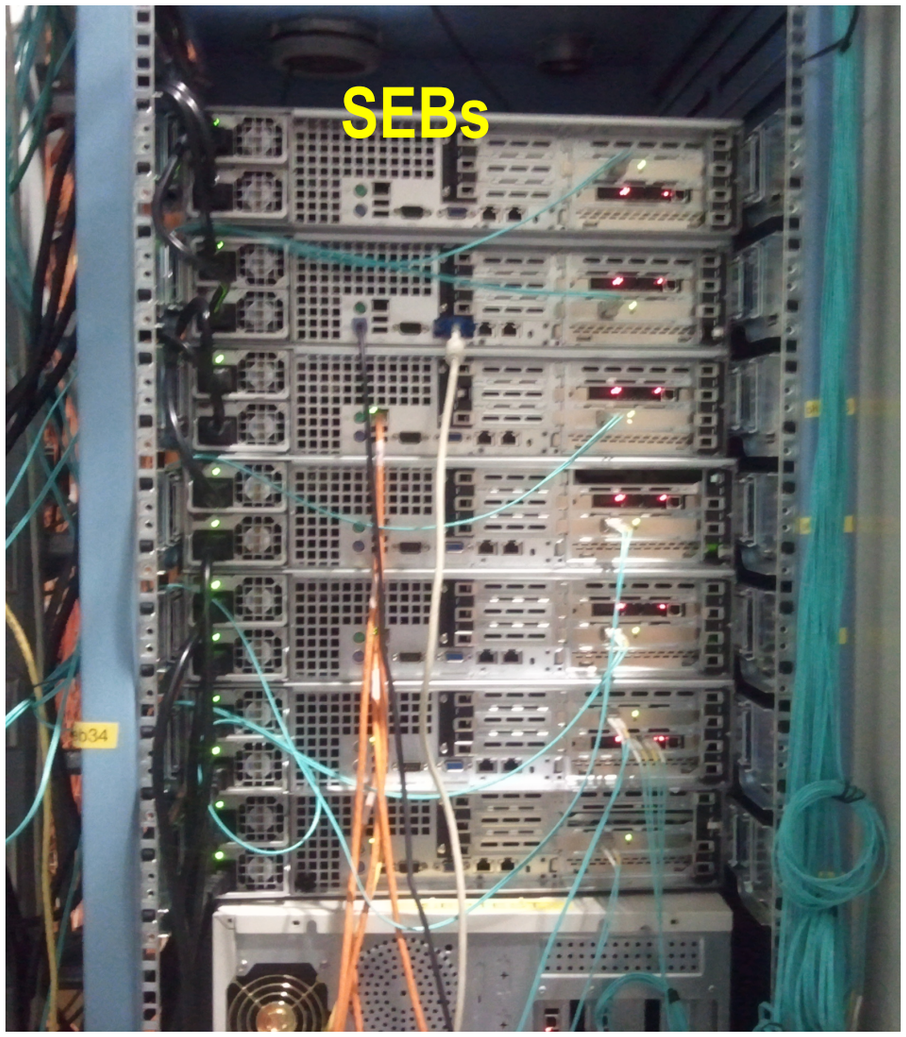
The FEM itself is not in DAQ purview

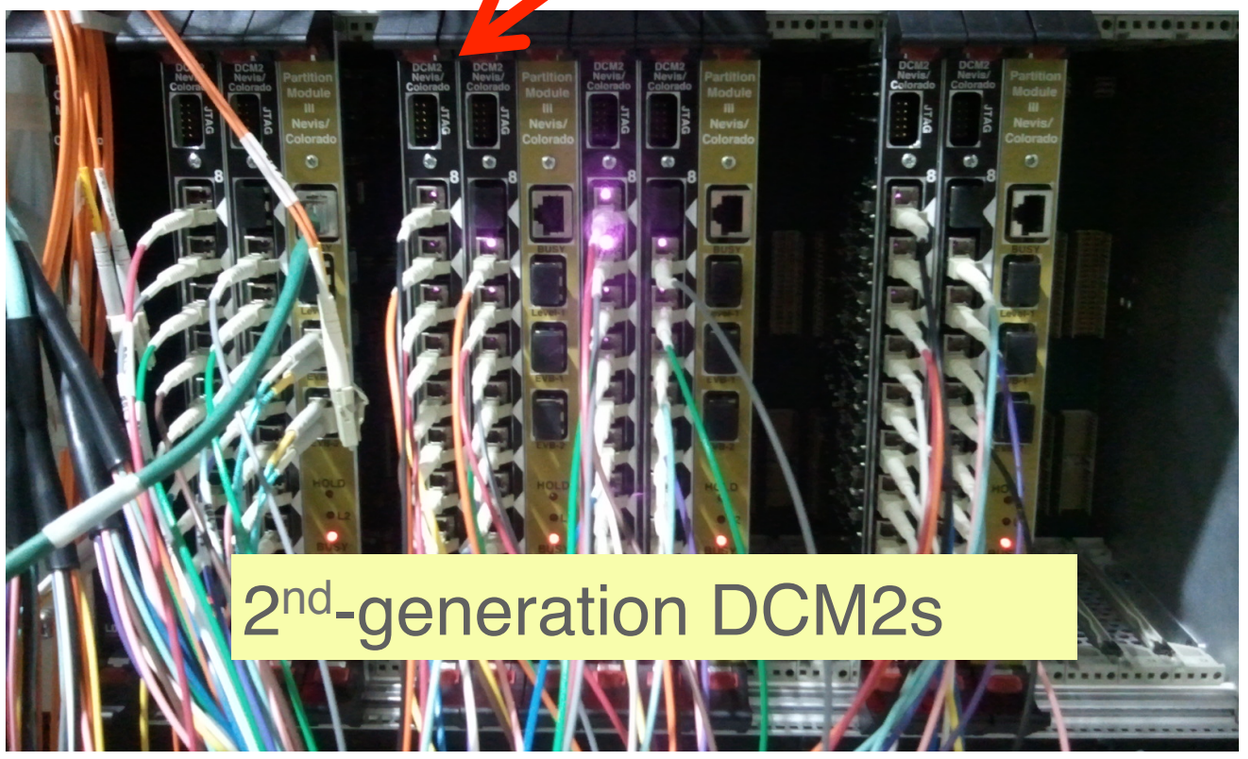
But some connections to it are.. .

1.6.1 Data acquisition (All together)

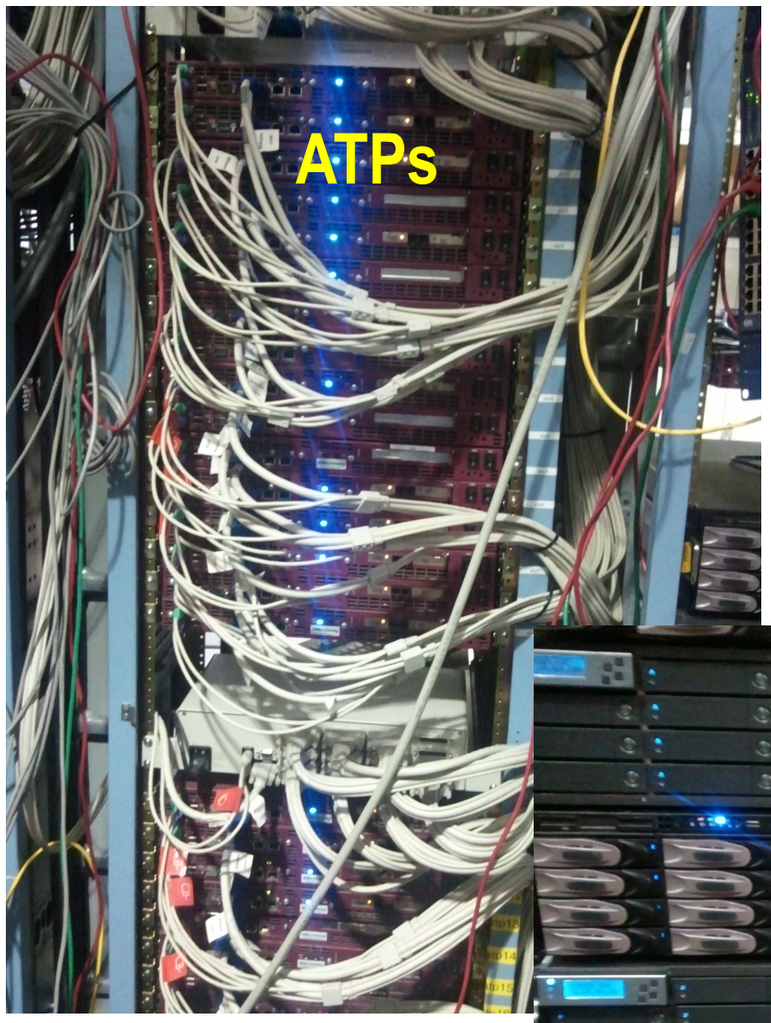


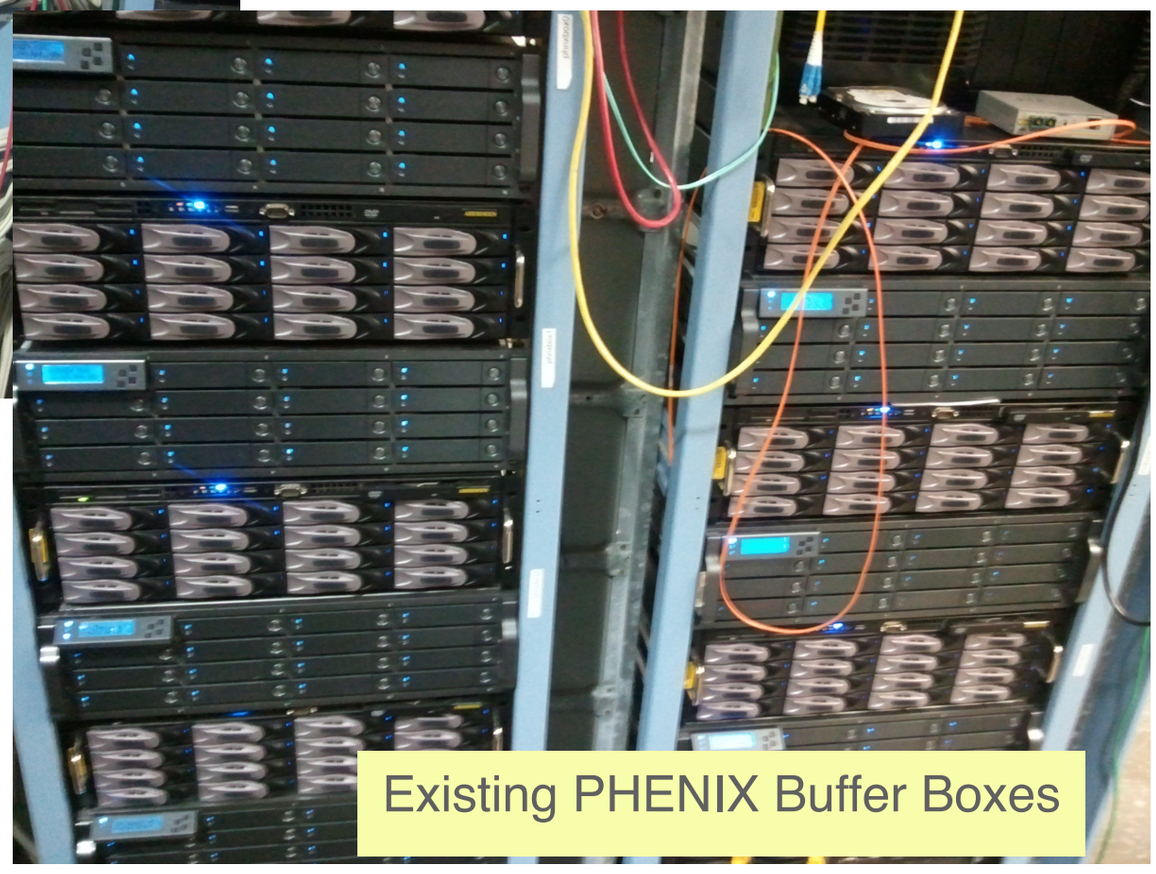
Pictures of existing Components



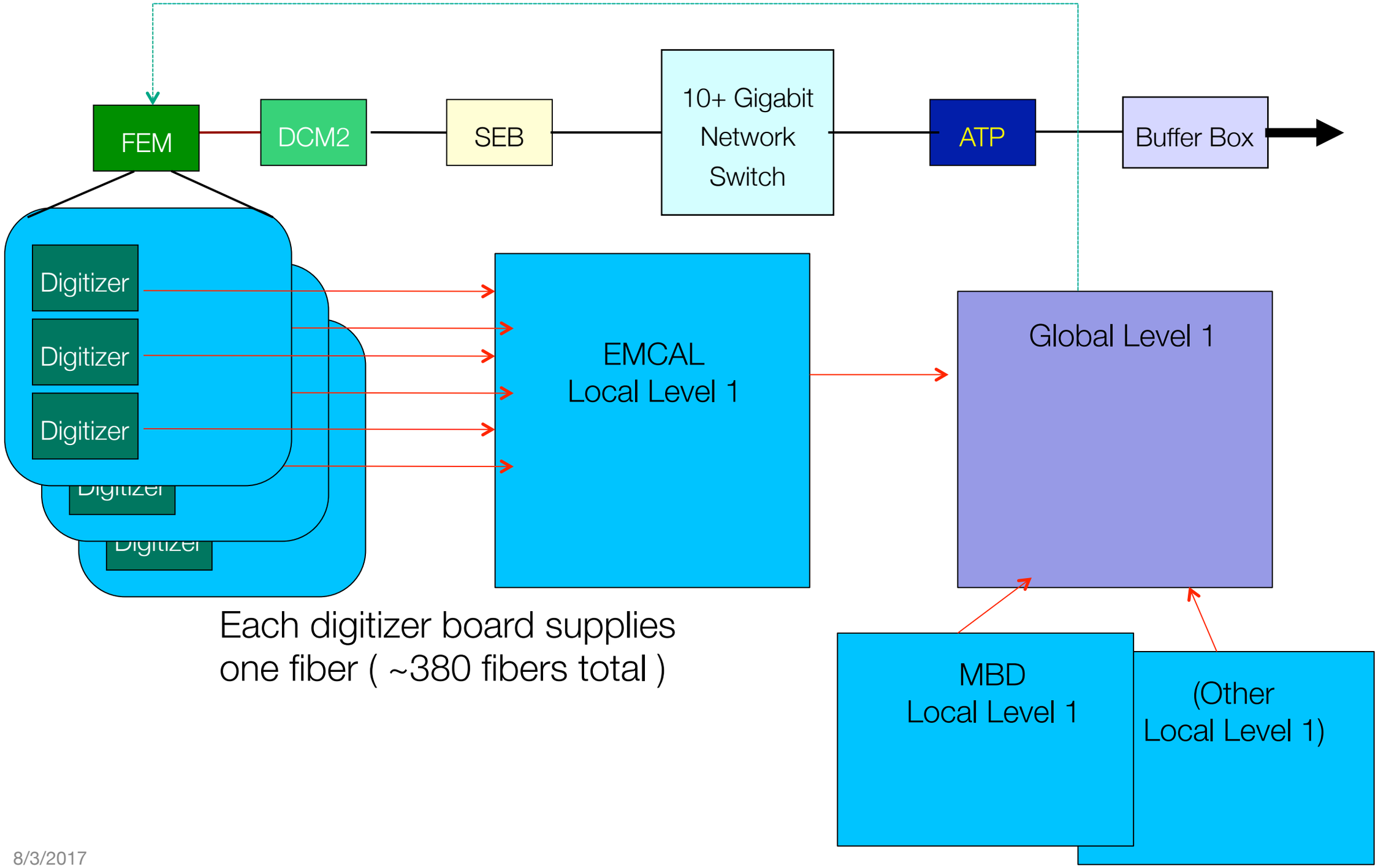


Pictures of existing Components



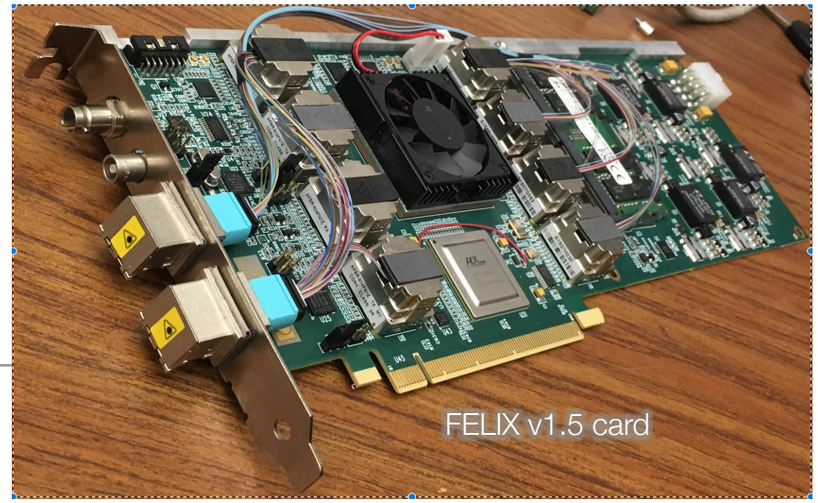

Existing PHENIX Buffer Boxes

Emcal Local Level 1



Each digitizer board supplies one fiber (~380 fibers total)

FELIX Card



The FELIX card is a potential platform for other upgrade applications in sPHENIX (GL1, Timing, LL1)

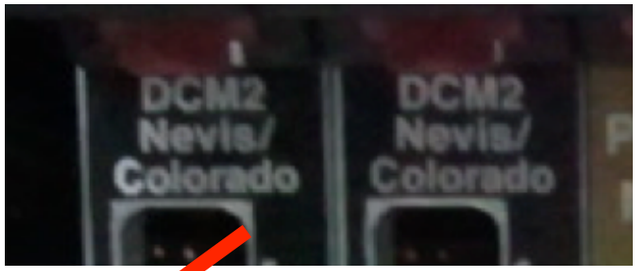
- Not that many generic cards on the market with 48 instrumented full-duplex high-speed transceivers.
- Just one learning curve with just one card type
- Same drivers/APIs (and same experts)
- Economizing on spares with one card type

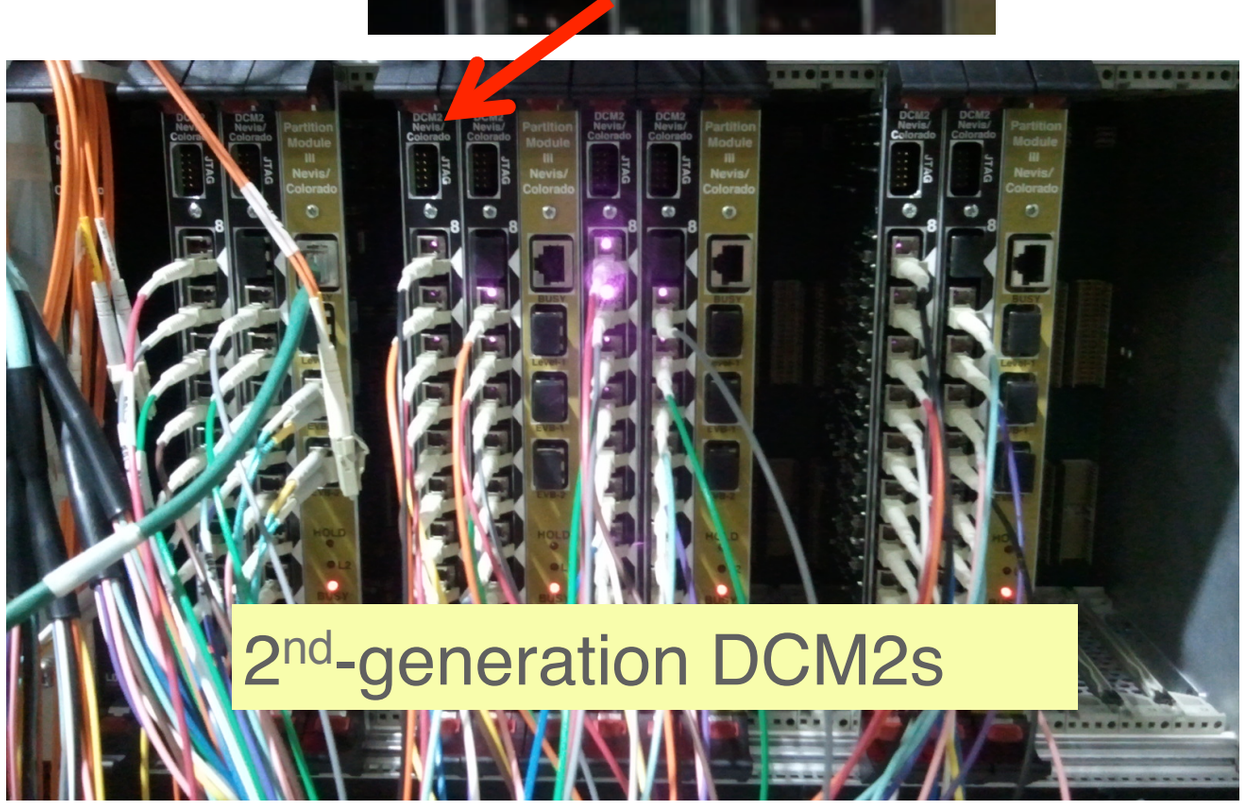
Work with the FELIX card for TPC development will allow preliminary engineering design to take place

DCM2's and assorted boards

The Data Collection Modules receive the full data set from the FEMs

They zero-suppress the data and package them





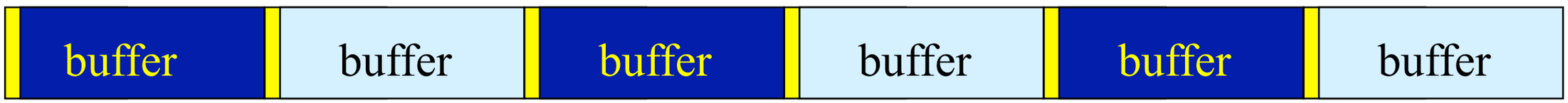
2nd-generation DCM2s

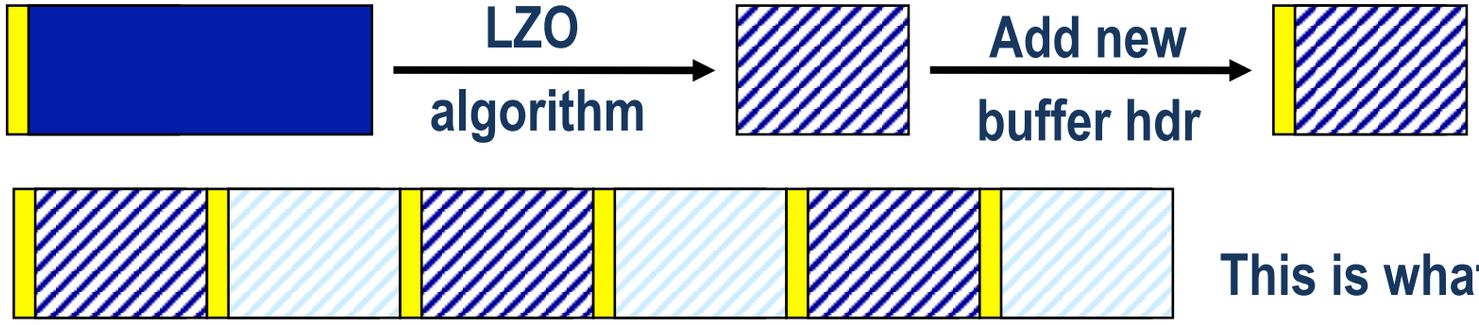
Test Stand in the Hcal Lab (cosmics tests, noise, pedestals, . . .)
Already uses hardware and software components of the final DAQ front-end

Data Compression

After all data *reduction* techniques (zero-suppression, bit-packing, etc) are applied, you typically find that your raw data are still gzip-compressible to a significant amount

Compressed raw data format that supports a late-stage compression





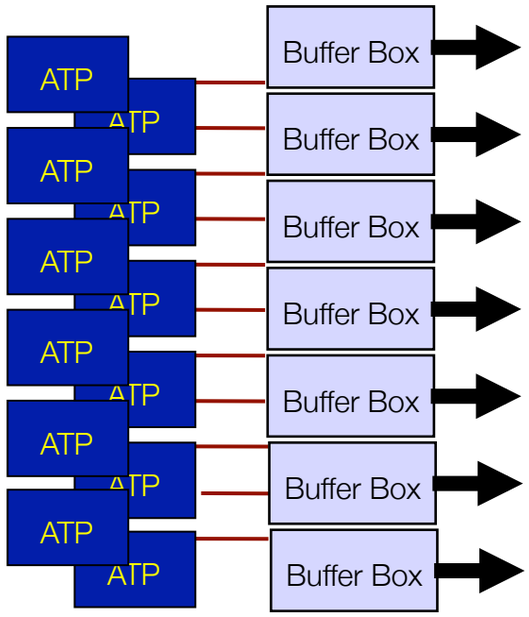
All this is handled completely in the I/O layer, the higher-level routines just receive a buffer as before.

Distributed Data Compression

No single computer can keep up with compressing a 100+Gbit/s data stream

The key is to *distribute* the compression workload

The ATPs are building buffers and compress them before sending them on

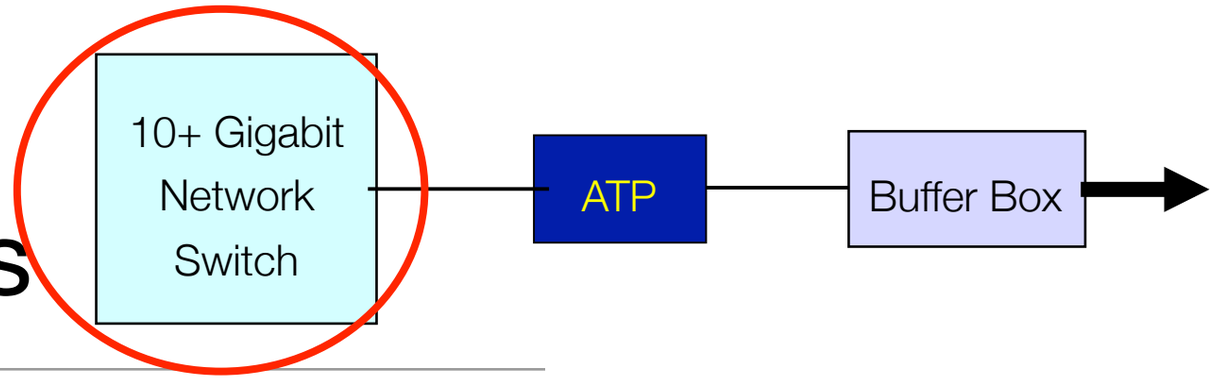


This technology has been in routine use since 2003

Per-buffer compression ratio (in line with what other experiments see)

```
record    0 length = 2385997  396  Or.length: 4266836  55.91% events: 19 from ATP 7
record  396 length = 2385997  415  Or.length: 4435180  56.50% events: 19 from ATP 15
record  811 length = 2279823  384  Or.length: 4294892  53.08% events: 22 from ATP 22
record 1195 length = 2210292  375  Or.length: 4274632  51.70% events: 24 from ATP 43
record 1570 length = 2434291  403  Or.length: 4332936  56.18% events: 20 from ATP 59
record 1973 length = 2471746  408  Or.length: 4312068  57.32% events: 18 from ATP 34
record 2381 length = 2463457  413  Or.length: 4591900  53.64% events: 23 from ATP 51
```

Individual High-Value items



sun mgt
RISING TECHNOLOGIES

2000 14th Street North
Suite 770

Account Manager: Daniel L. Haney
Phone: 5712866245
Email: dan@sunmanagement.net
Fax: 7037783797

Quote Number: DCKHQ1019-01
Date: 05-17-16
Valid Until: 06/16/16

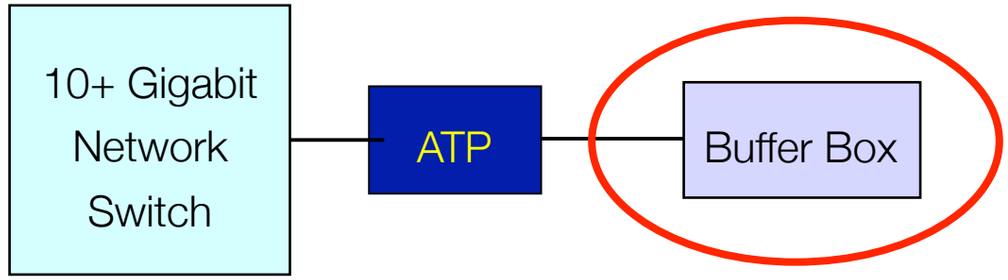
SubTotal	**$109,347.20**
Tax	**TBD**
Total	**$109,347.20**
Total with Credit Card	**$111,534.14**

Sold To	**Ship To**	**Corporate Information**
Brookhaven National Laboratory Frank Burstein Brookhaven National Laboratory Receiving: Bldg 98 Rochester St Upton, NY 11973 **Phone** (631) 344-2313 **Fax** **Email** fburs01@bnl.gov	**Brookhaven National Laboratory** Frank Burstein Brookhaven National Laboratory Receiving: Bldg 98 Rochester St Upton, NY 11973 **Phone** (631) 344-2313 **Fax** **Email** fburs01@bnl.gov	TIN: 364546036 DUNS: 36-116-5561 Small Business: SBA P064494 **Notes** *Confidential ARISTA Pricing for DOE- BNL Only*

P.O. Number	Ship Via	Terms
	UPS	

Line	Qty	Item	Description	Mfg List Price	Discount	Price Ea.	Ext. Price
1	2	DCS-7280SE-72-F	Arista 7280E, 48x10GbE (SFP+) & 2x100GbE MXP switch, front-to-rear air, 2x AC and 2xC13-C14 cords	$24,995.00	36%	$15,996.80	$31,993.60
2	24	SVC-7280SE-72-1M-NB	1 Month A-Care Software & NBD Hardware Replacement/Same Day Ship for 7280SE-72	$335.00	15%	$284.75	$6,834.00
3	4	DCS-7010T-48-F	Arista 7010T, 48x RJ45 (100/1000), 4 x SFP+ (1/10GbE) switch, front to rear air, 2x AC, 2xC13-C14 cords	$7,995.00	36%	$5,116.80	$20,467.20
4	4	LIC-7048-E	Enhanced License for Arista 48-port Gigabit Ethernet Switches (OSPF, BGP, PIM)	$3,594.00	100%	$0.00	$0.00
5	48	SVC-7010T-1M-NB	1 Month A-Care Software & NBD Hardware Replacement/Same Day Ship for 7010T-48	$34.00	15%	$28.90	$1,387.20
6	2	DCS-7010T-48-R	Arista 7010T, 48x RJ45 (100/1000), 4 x SFP+ (1/10GbE) switch, rear to front air, 2x AC,	$7,995.00	36%	$5,116.80	$10,233.60

Individual High-Value items (2)



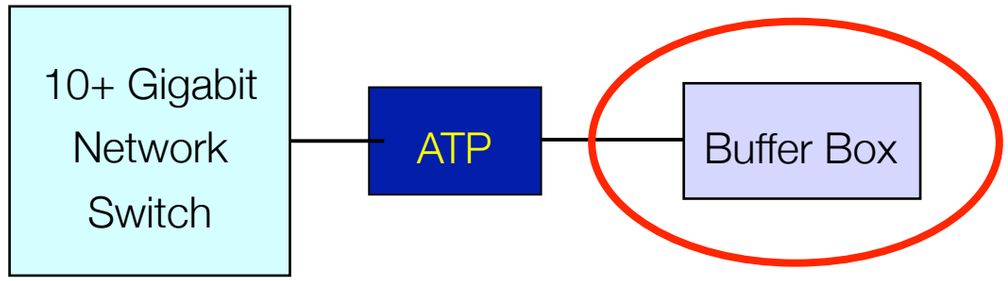
RS-Ability4U-84Bay-EBOD-672TB-8401

QTY	PART #	DESCRIPTION	EXTENDED
16.00	Ability 4U 84 Bay Full 12Gb	4U x 84 3.5" Drive Dual 12G JBOD Includes: • (2) 12Gb SAS I/O Module • (1) 12Gb Baseboard • (2) 12V Output Only Power and Cooling Modules • (1) Standard Adjustable Rail Kit • (1) Cable Management Assembly	$517,008.00
1,344.00	3.5" 8TB SAS 12Gb/s 7.2K RPM 256M 512E	Seagate 3.5", 8TB, SAS 12Gb/s, 7.2K RPM, 256M, 512E, Performance (MAKARA+),	Included
32.00	3M SAS 12G Cable	3M SAS 12G Cables	Included
16.00	**LSI 9300-8e 12Gb/s SAS Dual-port HBA	12Gb/s SAS, dual port x8 lane PCI Express® 3.0	Included
1.00	*RS-T2-36	RAIDserv support services - NBD cross ship with parts replacement, including firmware updates and 24 hour phone support, 36 months.	Included
		RS-Ability4U-84Bay-EBOD-672TB-8401 TOTAL:	$517,008.00

	TOTAL: $517,008.00

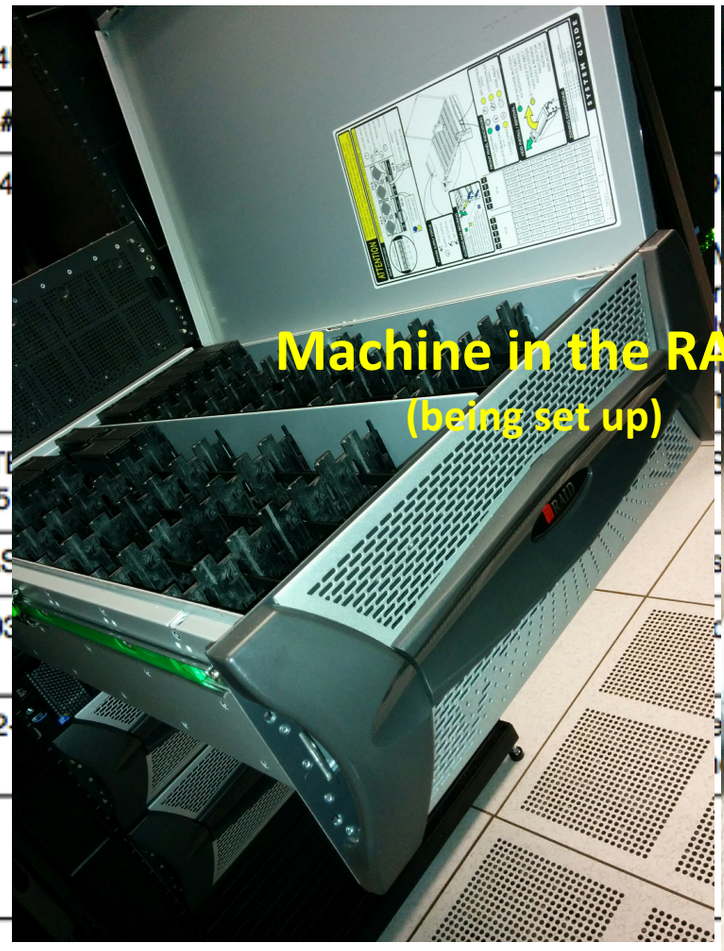
$517,000 / 16 * 6 = $195,000

Individual High-Value items (2)



RS-Ability4U-84

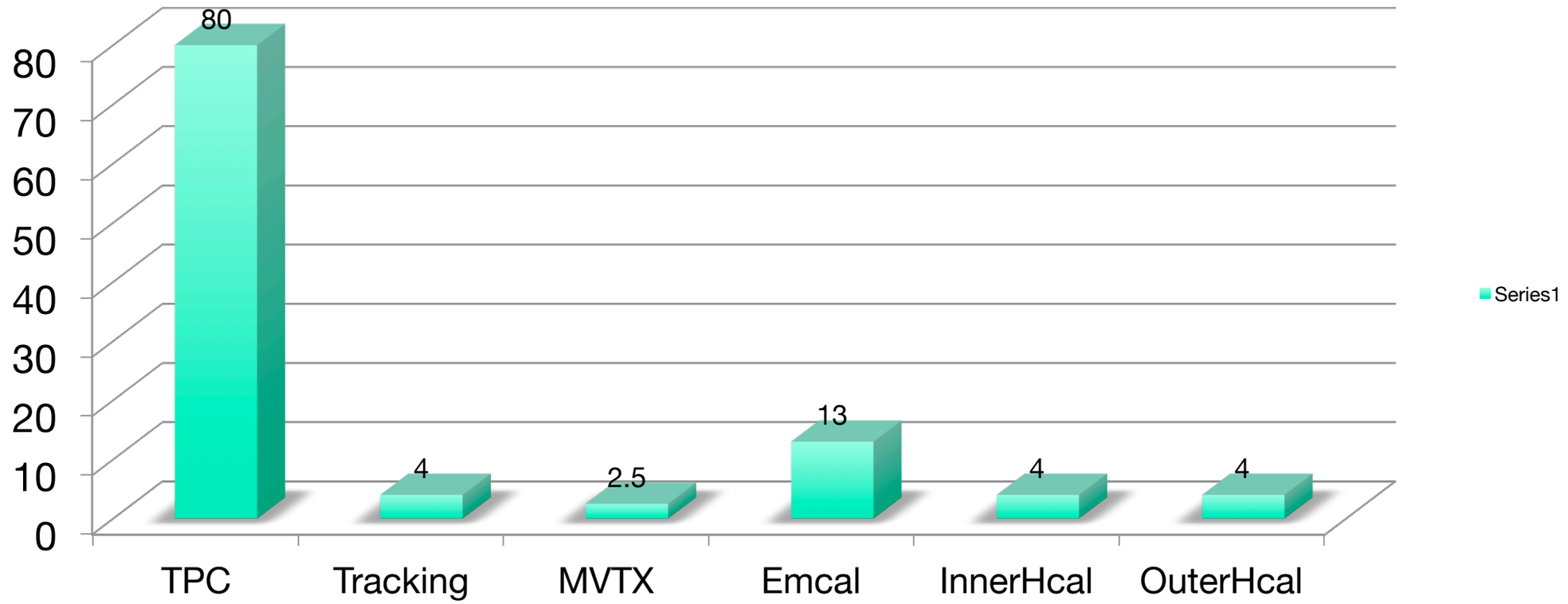
QTY	PART #		EXTENDED
16.00	Ability 4		$517,008.00
1,344.00	3.5" 8TB 256M 5		Included
32.00	3M SAS		Included
16.00	**LSI 93 HBA		Included
1.00	*RS-T2-	ling	Included
		TAL:	$517,008.00
			TOTAL: $517,008.00



$517,000 / 16 * 6 = $195,000

“Homework” – Questions from yesterday

Will we be able to cope with the data volume with what we will have in 2024?



Rule of thumb: ~2 PB/week (convenient to multiply with cryo- or “beam weeks”)

Logging: No real problem – 25Gbit/s *average*

Based on actual past AuAu performance data – includes many no-beam periods (Fill time, APEX, MD, access, …)

Analysis realm

There was a question if we will be able to analyse all the data we are taking

So far (PHENIX) we have been content with what the RCF has to offer

Today we have ~15000 condor slots available, not counting opportunistic slots

Based on ALICE experience, expect 90s/event reconstruction time, assume 100

1 second worth of data taking: 15KHz * 100s /15000 -> 100s

35% “average factor”: -> 35s (somewhat generous)

10 “beam weeks” -> 350 reconstruction weeks

Looking for a rough factor of 7…10 in resources

We are talking 2024. Today our best machine has 88 cores – x4 of today’s average

2024? If the “same CPU speed but more cores” trend continues, we should be close to ok “in-house”

We are working hard on making our job submission grid-transparent – additional resources will be accessible

Past experience is clearly in our favor

We have to keep an eye on this, but it seems perfectly in line with expectations

Backup Slides

GL1 Cost

1.6.3.3	**GL1 Production**								$0	
1.6.3.3.1	Procure final hardware	FPGA Boards	$11,400	10	$114,000	10	Atlas felix card w/48 fibers	25%		
		Server for Felix card	$1,805	5	$9,025	5		20%	$28,500	Price without additional cards
		MTO <->MTP fiber couplers	$130	40	$5,200	40	12 MTP - 12 MTO	20%	$1,805	
		MTP <-> MPT fiber couplers	225	10	$2,250	10	48 -> 4x12	20%	$1,040	
		Fiber patch panel	$450	6	$2,700	6	48 ports	20%	$450	
1.6.3.3.2	Procure PCs and misc. materials	Server for Felix card	$1,805	5	$9,025	5		20%	$540	Price without additional cards
									$1,805	

$142,200

LL1 Cost

Local Level 1

Prototype	$27,510.00
preproduction	$59,400.00
production	$152,350.00
Total	$239,260.00

1.6.2.4	**Trigger Production**							$0
1.6.2.4.2	Final updates to trigger crate requirements							$0
1.6.2.4.3	Readiness Review							$0
1.6.2.4.4	Procure Components	FPGA Boards	$11,400	5	$57,000	Atlas felix card w/ 48 fibers	25%	$14,250
		Server for Felix card	$1,805	5	$9,025		20%	$1,805
		MTO <->MTP fiber couplers	$130	40	$5,200	12 MTP - 12 MTO	20%	$1,040
		MTP <-> MPT fiber couplers	225	10	$2,250	48 -> 4x12	20%	$450
		Fiber patch panel	$450	6	$2,700	48 ports	20%	$540
								$0