



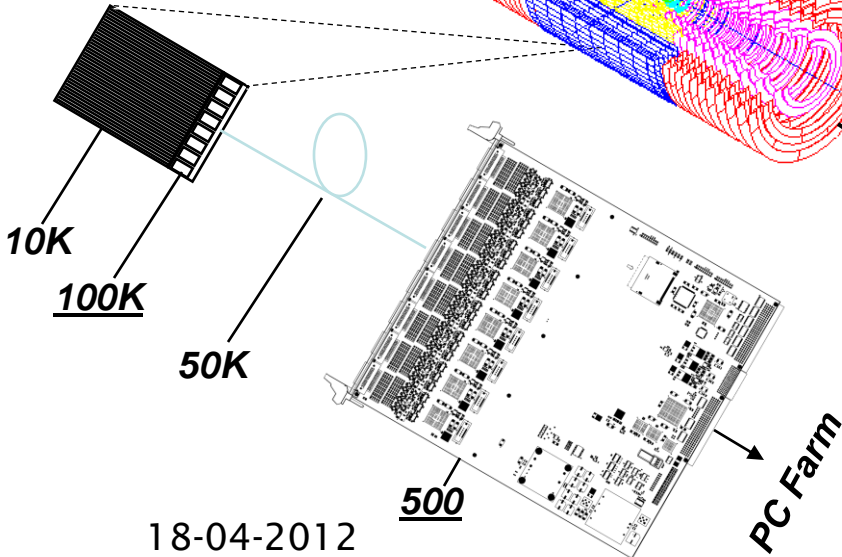
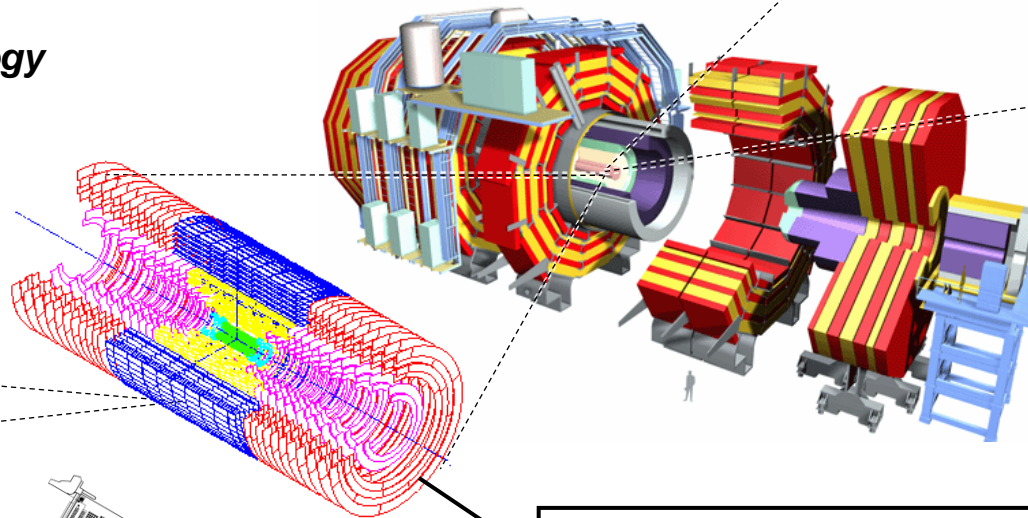
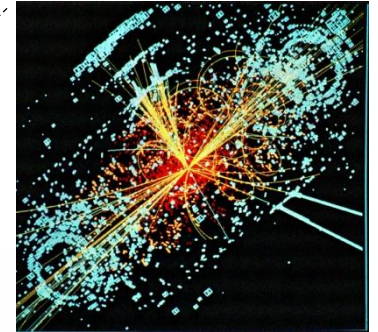
eXtreme Data Workshop Readout Technologies

Rob Halsall

The Cosener's House
18 April 2012

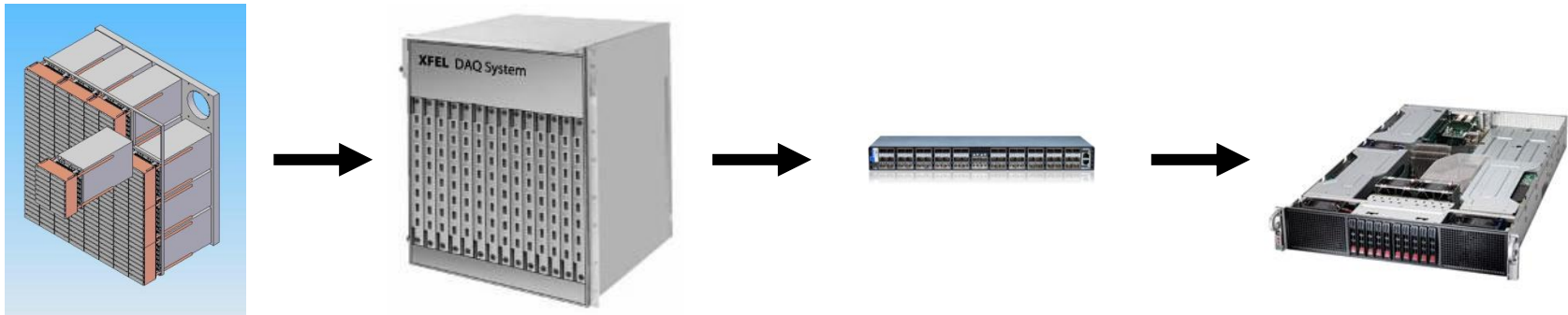
CMS

Early 2000s Technology



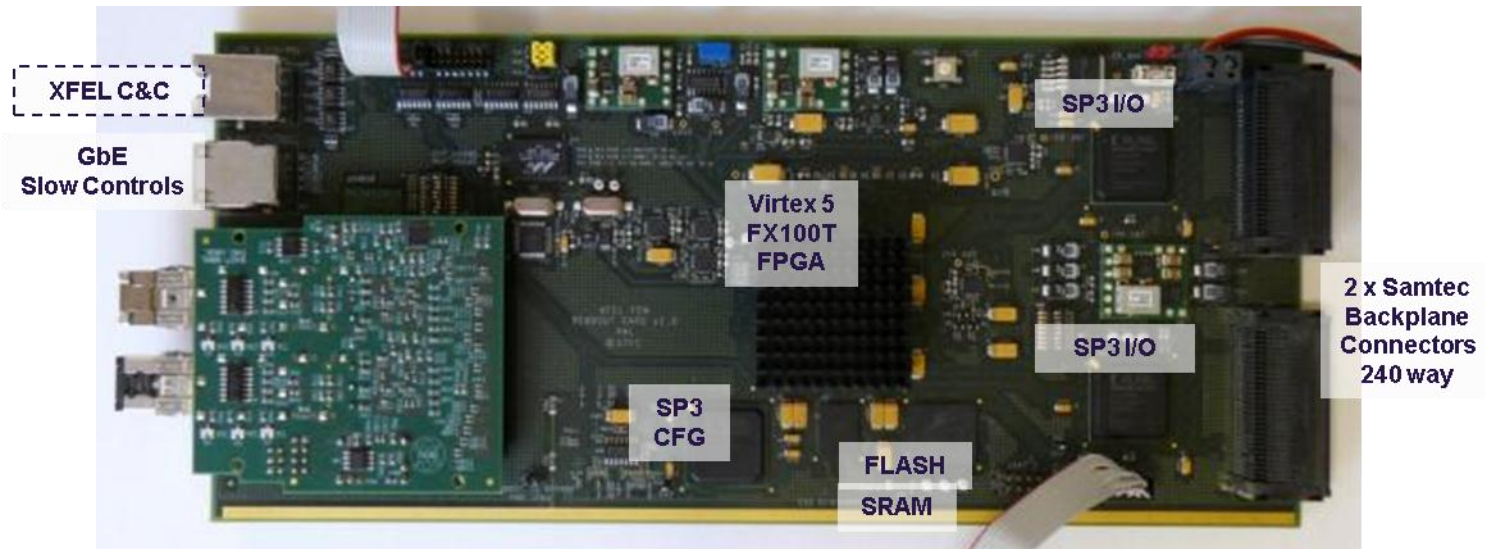
10.5 Million Channel
80K APV25 Readout Chips on Detector
40K ADC Readout System Off Detector
400 ADC Readout Boards
2 TByte/s ADC Conversion Rate
Hardware (FPGA) data processing
75 GByte/s to Processor Farm

XFEL



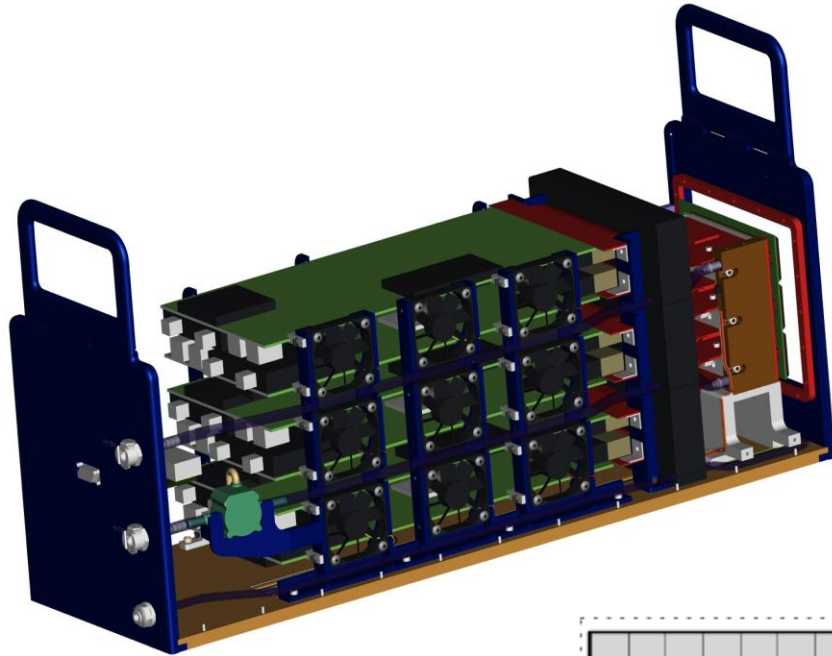
- 16 x 10G Links off detector per Megapixel
- 10Gbyte per Second per Megapixel
- Scalable to multiple Megapixels
- Farm Size?

XFEL Detector Head Card

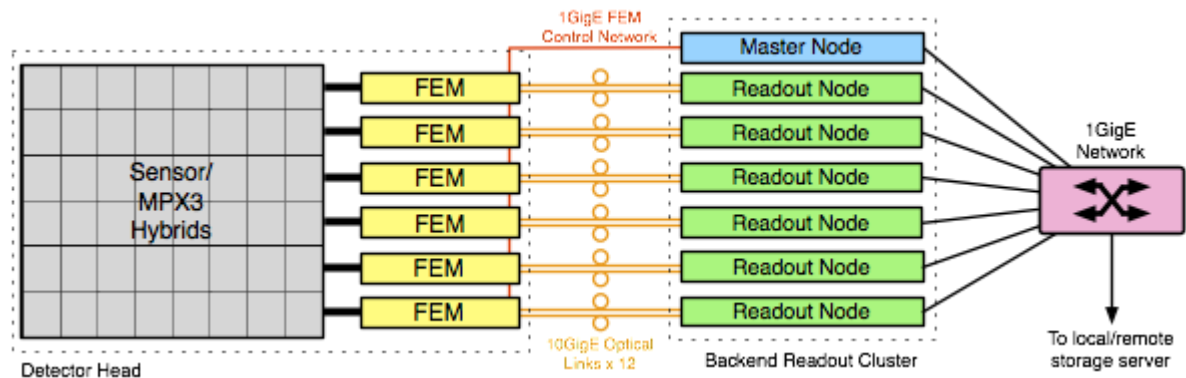


- 480 Way Detector Head Connector LVDS
- Xilinx Virtex 5 FPGA + SODIMM
- Dual 10G Output Ethernet
- Latest Technology => Dual 40G or 100G...

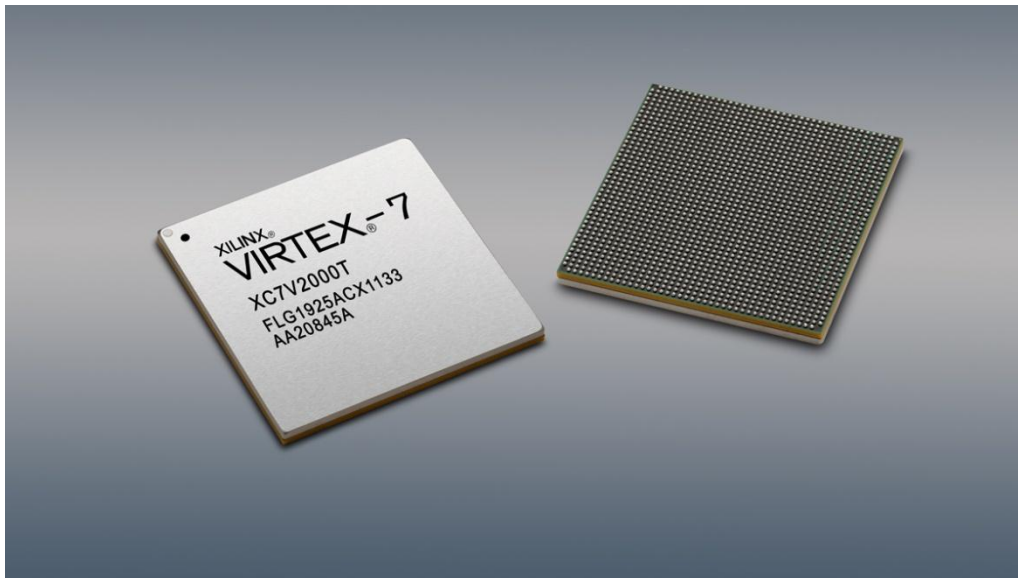
DIAMOND



EXCALIBUR – Medipix 3
3MPixel 1kHz 6GB/s



FPGA



Features	Virtex-7
Logic Cells	2,000,000
BlockRAM	68Mb
DSP Slices	3,600
DSP Performance	5,335GMACS
Transceiver Count	96
Transceiver Speed	28.05Gb/s
Total Transceiver Bandwidth	2,784Gb/s
Memory Interface (DDR3)	1,866Mb/s
PCI Express® Interface	Gen3x8
I/O Pins	1,200

- 28nm today
- Up to 80 x 10G Transceiver per device

Opto



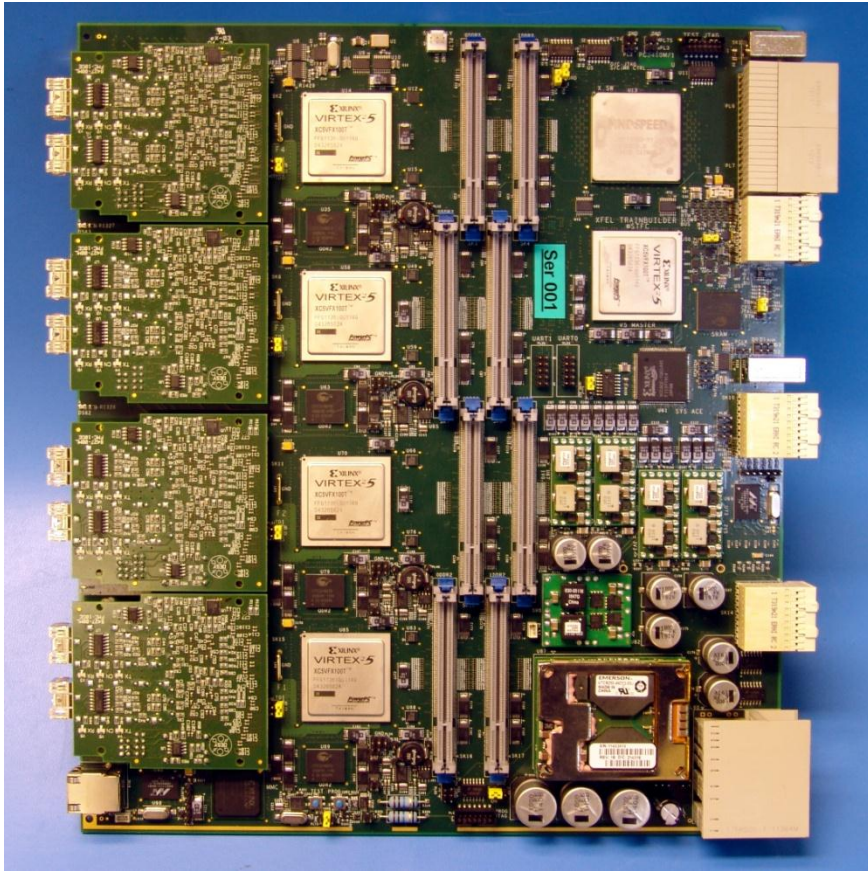
- Optical Transceivers
 - SFP+ 10G
 - QSFP 40G
 - Mini-pod 120G
 - CFP 100G

Memory



- DDR3 Module
 - 1866, 2133, 2400 MHz+
 - 19.2 GByte/s
 - FPGAs @ 1850MHz
 - 14.8 Gbyte/s per bank
- QDR II Component
 - 1.1 Ghz
 - 4GByte/s throughput

Form Factors



- AdvancedTCA & MicroTCA
 - High Speed Serial Backplanes
 - FPGA/Memory/Xpoint/Opto...
 - FMC - SFP/QSFP Optical I/O
 - RTM - SFP/QSFP Optical I/O
 - 250W
- XFEL Train Builder pictured
 - 80G throughput

Network



- Ethernet

- 10/40G Today
- 100G Soon
- 400G Test
- 1000G R&D

- NICs

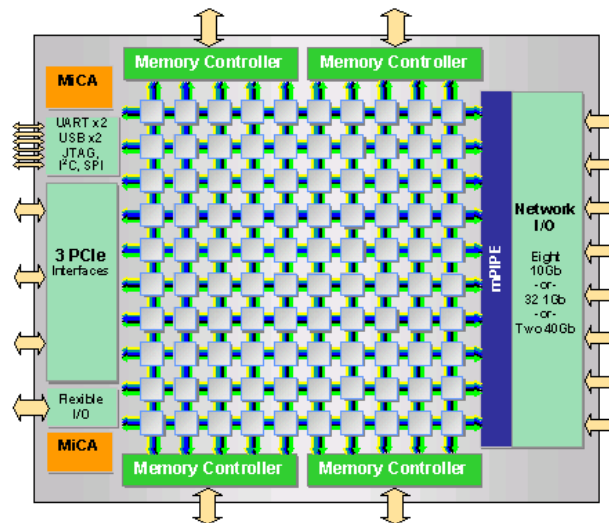
- Multi-protocol 10G
- Protocol offload
- User-space buffering (zero copy)

PC



- 2U Chassis
 - Dual E5 Xeon
 - 32 Core
 - 256 GB RAM
 - Quad GPU
 - Dual 40G NIC
 - 1KW+
 - £££

Alternatives



- 100 Core
- Lower clock speed
- Lower Power
- Embedded & PC Layer

	TILE-Gx100	TILE-Gx64	TILE-Gx36	TILE-Gx16
Number of Cores	100	64	36	16
Core Frequency	1.2, 1.5GHz	1.2, 1.5GHz	1.0, 1.2, 1.5GHz	1.0, 1, 1.2GHz
Network Interface	2x 50G Interlaken 8 XAUI, 32 SGMII	2x 50G Interlaken 6 XAUI, 24 SGMII	— 4 XAUI, 16 SGMII	— 2 XAUI, 12 SGMII
PCIe	Three 8-lane	Three 8-lane	One 8-lane, Two 4-lane	Three 4-lane
DDR3 Controllers	4	4	2	2
DDR3 Frequency	1866 MT/s	1600 MT/s	1600 MT/s	1333 MT/s

Summary

- Plenty of technology for Extreme Data Rates!
- Not necessarily cheap or low power
- Relatively easy to create/move Extreme Rates
- Not so easy to process or store...

- A future detector with 100KHz frame rate would generate 200GByte/s per megapixel