Interfaces to DAQ

David Cussans

DUNE DAQ CDR

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University of BRISTOL

Outline

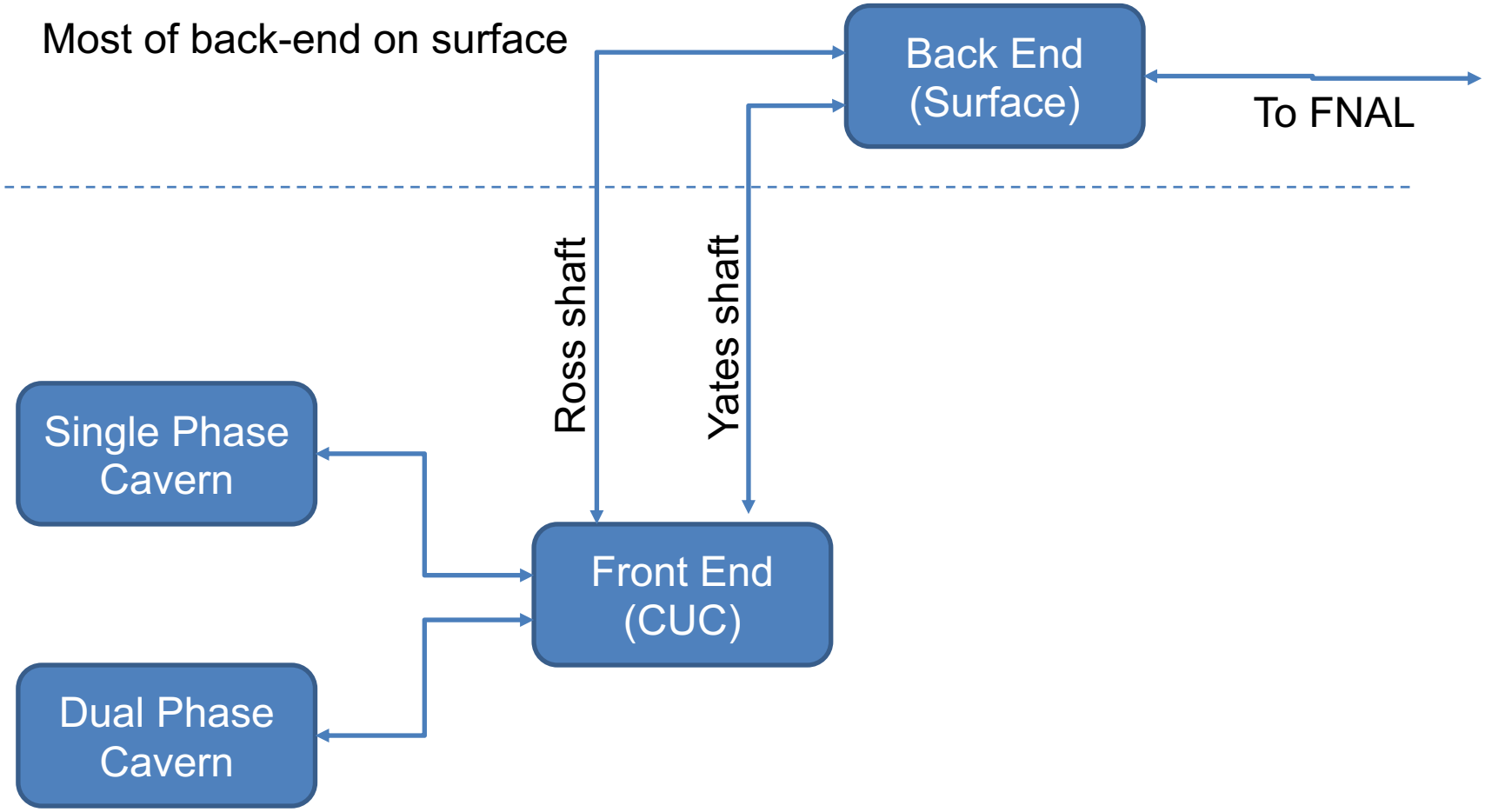
- Introduction
- Dual Phase
- Single Phase
  - TPC
  - Photon Detection System
- Calibration
- Summary

Introduction

- DUNE DAQ includes timing and trigger(data selection)
- Interfaces defined in bilateral documents:
  - 6727-v2 SP Photons
  - 6742-v6 SP TPC
  - 7042-v0 Integration facility
  - 6988-v1 Facilities
  - 6802-v1 DP Photons
  - 6790-v1 Slow controls, calibration
  - 6736-v0 HV
  - 6778-v1 DP TPC
  - 7015-v1 Installation interfaces
- Single interface document for timing system: 11224-v1

Introduction

- Front end of DAQ in CUC
- Most of back-end on surface



Dual Phase

- Readout based on uTCA crates
- MCH transmits data to DAQ using 10GBit/s links
  - Uniform protocol between Photon and TPC readout.
    - UDP/IP
  - Physical link:
    - Multimode (OM4) fibre
      - 300m fibres
    - SFP+ Transceivers in MCH
    - MiniPOD transceivers on Felix PCIe cards in DAQ PCs
  - Huffman compression, x10 anticipated for TPC
- More details in technical note.

Dual Phase

- TPC:
  - 640 channels per link
  - 12-bit, 2.5MSample/s
  - 240 links per cavern (one per uTCA crate)
- Photon Detection System:
  - ~ 145 channels per link
  - 14-bit, 2.5MSamples/s
  - 5 links per cavern

Single Phase

- TPC:
  - 150 Anode Plane Assemblies (APA)
    - 2560 channels per APA
  - 12-bit @ 2MSample/s
  - Each APA has a small crate housing Warm Interface Boards (WIB)
  - Total of ten 10GBit/s links per APA from WIBs to Felix
    - OM4 multi-mode fibre from SFP+ at WIB to MiniPOD on Felix
      - 300m fibres from WIB to Felix
    - No compression
    - Custom protocol (not UDP/IP)
- Photon Detection System
  - 40 channels per APA
  - Total data rate < 10GBit/s per APA

Calibration

- Trigger for laser , neutron generator
  - Distributed through timing/synchronization system
- Fast feedback
  - Triggers from radioactive sources
  - Received through timing/synchronization system

DAQ ←→CISC (Slow Control)

- Hardware Interface: Service network in CUC
- DAQ Operation information → Slow Control
  - Status displays
  - Produce automated warnings
  - Archival
- DAQ Hardware monitoring →Slow Control
  - Health of servers (temperature, fan speeds, disk self-test info)
  - Status, automated warnings, archival
- Power distribution units in DAQ racks → Slow Control
  - Voltages , currents
- Rack status → Slow Control
  - Temperatures, etc.
- Slow control information → DAQ

DAQ → Offline Computing

Primary constraint: DAQ will produce < 30 PB/year to be transferred to Fermilab

Online Computing Coordination responsible for

- WAN connection between SURF and Fermilab

DAQ Consortium responsible for

- Disk buffer to handle any temporary WAN disconnects
- Infrastructure needed for real-time data quality monitoring

Offline Consortium responsible for

- Development and operation of the tools for data transfers to Fermilab

DAQ and Offline Consortia jointly responsible for

- Data format definition and data access libraries
- Real-time DQM software

Detector → DAQ Link Summary

	Single Phase			Dual Phase			Fibres To Surface	WAN to FNAL
	TPC	PDS	Timing	TPC	PDS	Timing		
Number	1500	150	75	240	5	245	96 x 2	100GBit/s over ESS
Type	OM4	OM4	OS2	OM4	OM4	OS2	OS2	
Rate/Gbit/s	10	10	0.25	10	10	1.23	10	< 10GBit/s average

Summary

- DUNE DAQ includes timing and trigger systems
  - Reduces number of external interfaces
- Relatively homogenous detector compared to typical collider detector
  - TPC readout , Photon detection system, calibration
- All interfaces by optical fibre into DAQ
- All data time stamped at readout
  - Can use asynchronous links if advantageous