DAQ Software WBS 1.7.1/2.7.1

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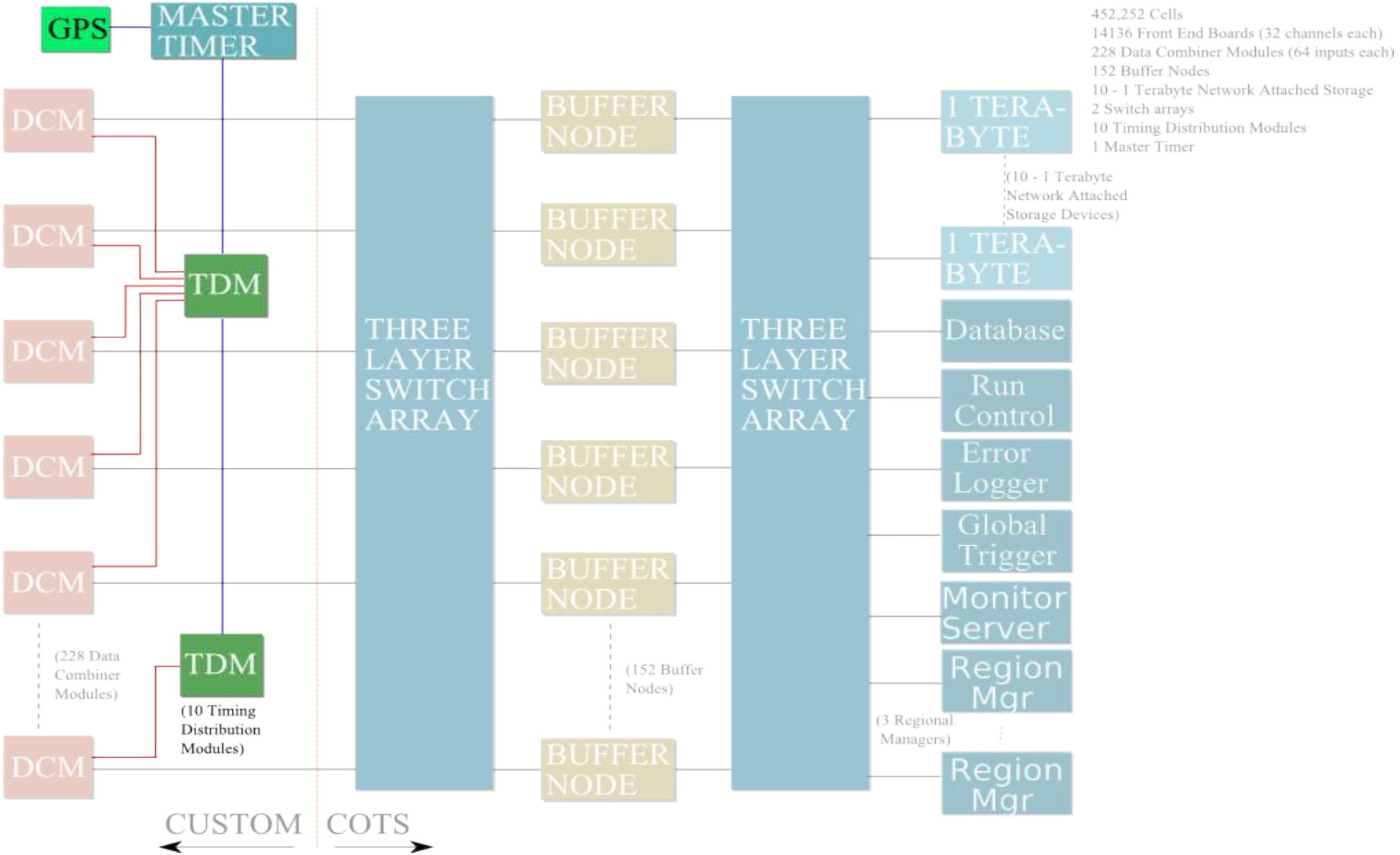
(NOVA-doc-1986)

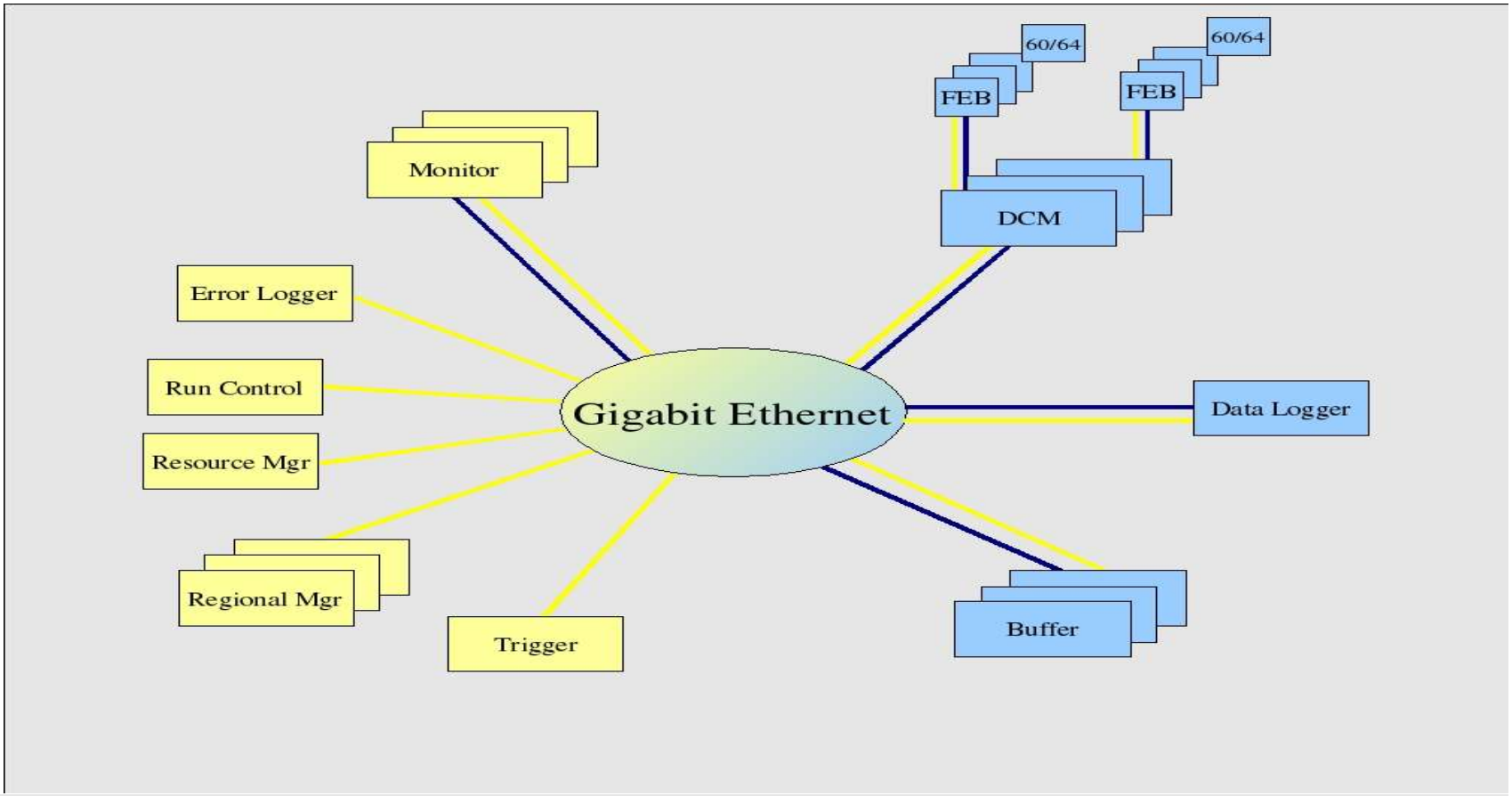
DAQ Software (Rate Overview)

- Team For DAQ Software System 18 KT Detector
  - FNAL/CD/ILC/DAC
  - Alec Habig (UM-Duluth)
- Parallel system with many to many data flows.
- Moderate nominal (design) raw data rates:
  - DAQ System
    - 0.54 (1.1) GB/s, buffering for seconds
  - Data Concentrator Modules (x228)
    - 2.4 (4.8) MB/s, buffering for seconds
  - Buffer Farm Nodes (x152)
    - 3.6 (7.2) MB/s, buffering for seconds
  - Data Logger
    - 7.8 (15.6) KB/s beam, 259 (518) KB/s calibration

DAQ Software Layout



DAQ Software Control and Data Flow



Ctrl & Mon (Left) <-> Data path (Right)

Control Flow Data Flow

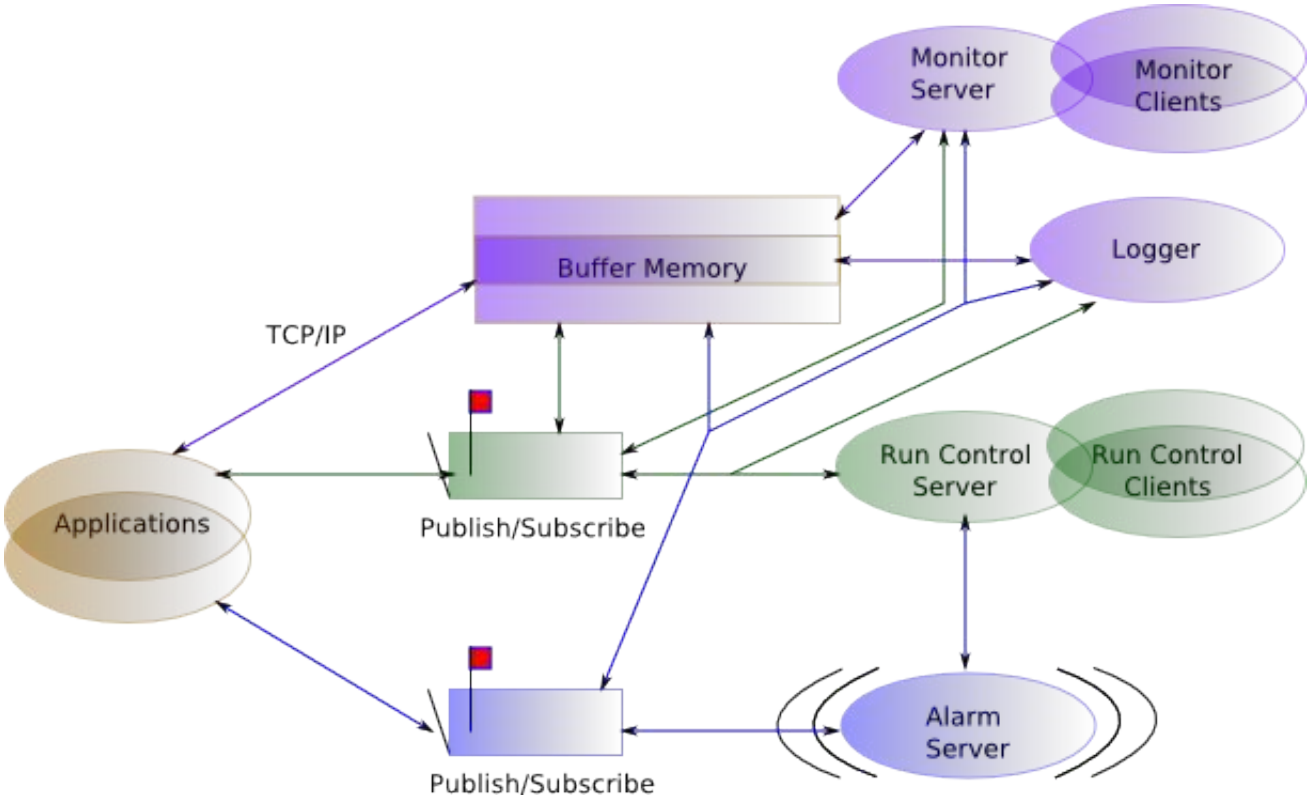
Responsive Messaging System (RMS)

- Basic Control Messaging System
- Provide Publish/Subscribe API
  - Publish: Producer creates messages of broad interest
  - Subscribe: Many applications want to see same messages
- Wrapper Abstracts Away Provider Specifics
  - Applications need not change if provider is replaced
  - No sufficient Open Source publish/subscribe found (so far)
- Serialize Messages as XML
  - Castor for Java
    - http://www.castor.org.
  - C++ still evaluating

Reliable Messaging System (2)

- EPICS with Patches
  - EPICS model for reliability by default not what we need
  - http://www.aps.anl.gov/epics
  - Sufficient for IPND
  - Evaluate field after IPND

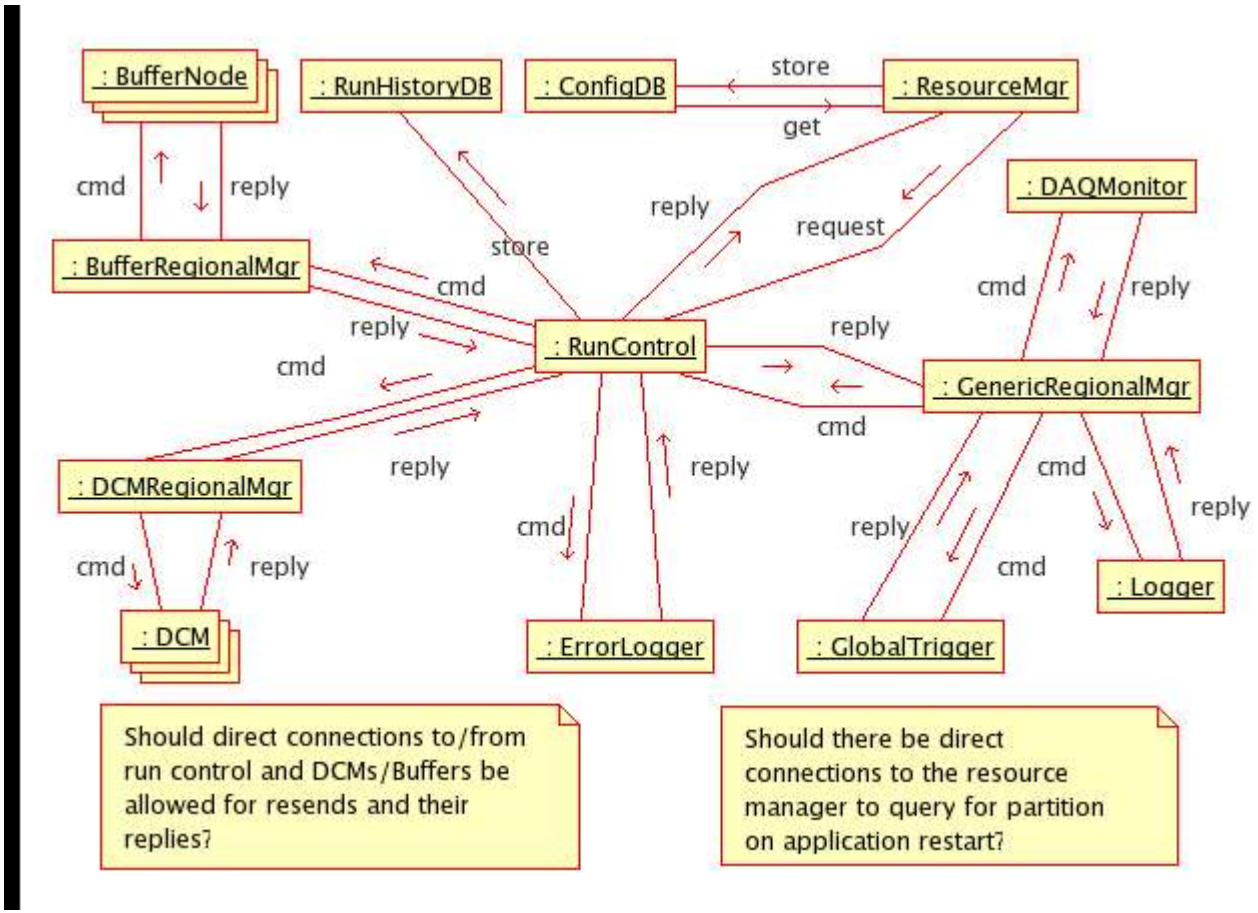
RMS System Concept



Run Control System

- Nominal Interface to DAQ via client/server model
  - Central server with persistent state
    - State Machine Compiler (http://smc.sourceforge.net/)
    - Allow multiple clients and manage state for them
    - Support partitioning of DAQ system
    - Automatic pause run
    - Run history to database
  - Client interfaces
    - Configure/start/stop/pause/resume/etc
    - Allow transparent disconnect/reconnect (server holds state)
    - Support for read-only version
- Requirements document NOVA-doc-1877-v2

Run Control Command Flow



Resource Manager

- Manage Detector and DAQ Resources
  - Persistent management
    - Database for persistency
  - Components available or unavailable
    - Map of resource states to “clients”
    - Hardware database referencing
  - Partitioning support
    - Assigning and freeing resources for clients
    - Saving and updating component state
      - Assigned, free, bad, etc
- Requirements document NOVA-doc-1877-v2

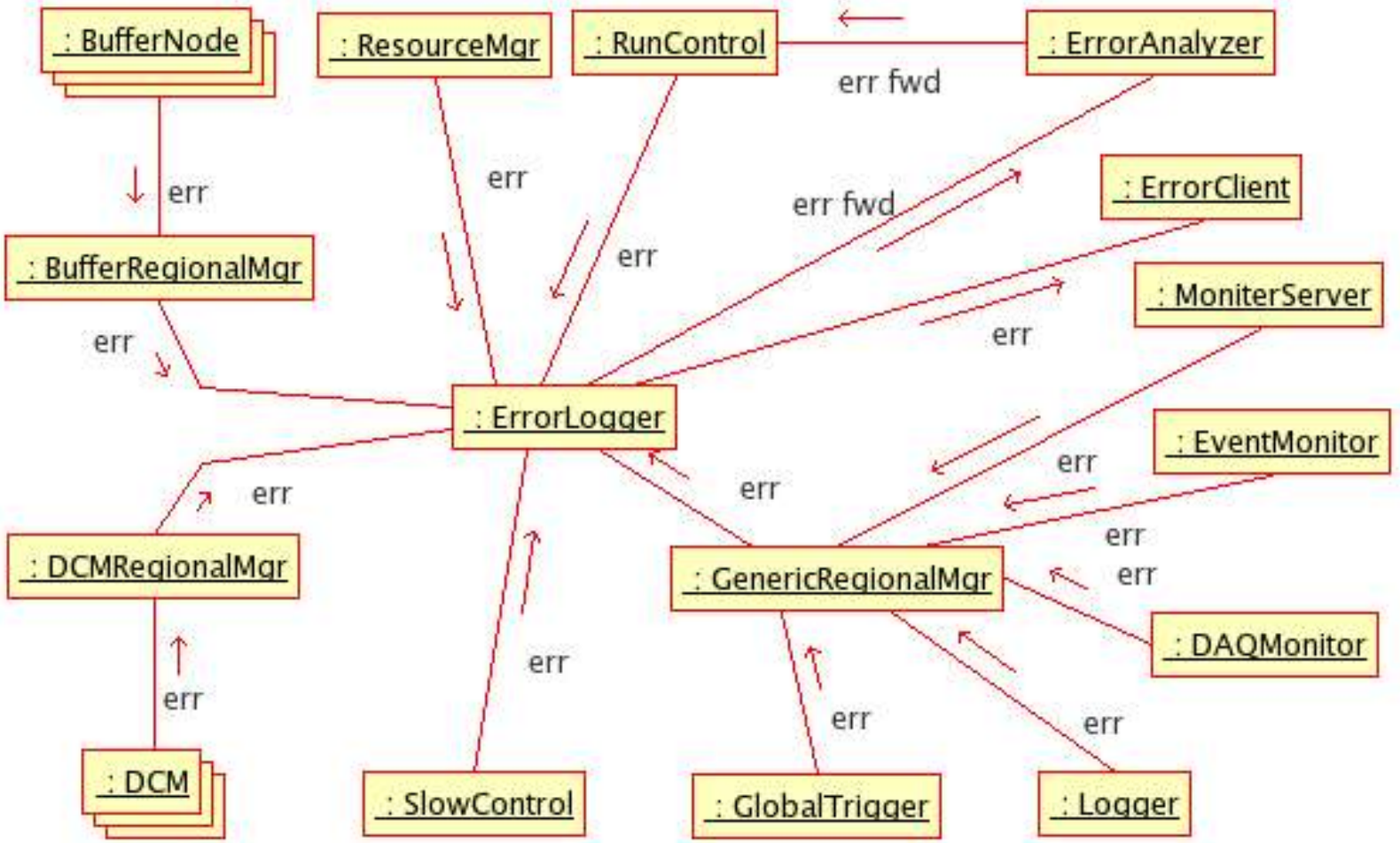
Global Trigger System

- Beam signal from Fermilab
  - TCP/IP routing
    - MINOS experience > 98% received within 20 seconds
- Port Minos beam server code
  - Extend to include additional triggers
  - Integrate with Nova DAQ system (RMS)
- Hardware
  - GPS receiver
  - Server node
- University of Minnesota – Duluth (A. Habig)
- Starting on Requirements Document

Error Logger

- Central Server for Error Messages
  - Extension of Nova RMS
  - Aggregate error messages
  - Log messages
    - Transient storage in DB?
      - 1-3 months maybe
    - Persistent storage in log files
  - Filter messages to determine actions (if any)
    - Reduce rate to Run Control Server
  - Act as provider to error monitoring clients
- Requirements document written

Error Logger (2)



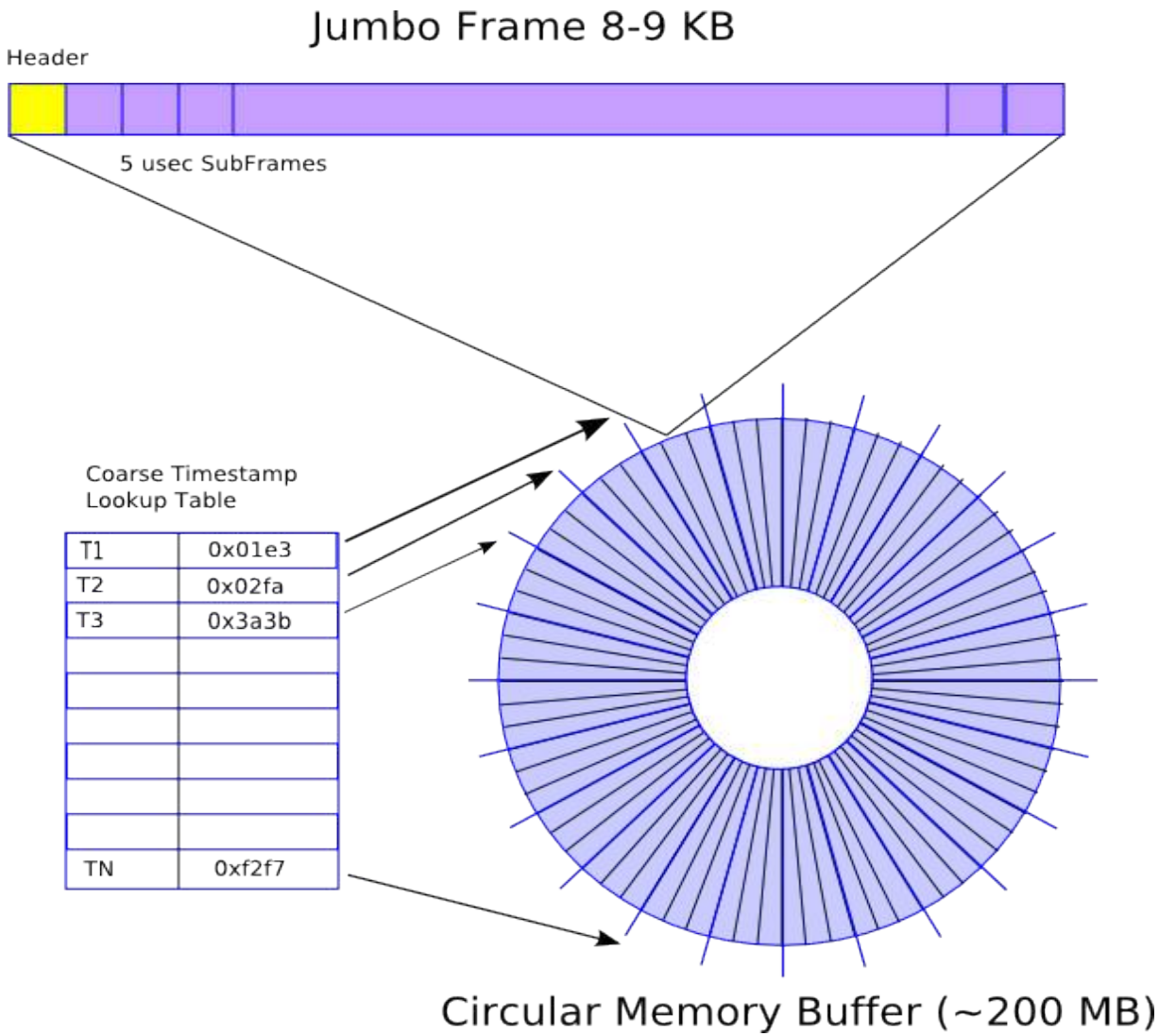
Buffer Mgt. & Event Building

- Building
  - Large packets from all DCMs
    - All on same buffer node (offset arrivals)
  - Trigger window data
    - All on same logger (may be split across buffer nodes)
- Buffer management
  - Circular memory buffer
    - Order 20 seconds
    - Efficient search for time window (*i.e.* trigger)
  - Processing framework
    - Monitoring data quality

Buffer Mgt. & Event Building (2)

- Data routing
  - Trigger data to loggers
  - Monitor summaries to displays
  - Trigger data to event monitors/displays
- Requirements document NOVA-doc-1168-v3

Buffer Seeking



Data Logger & Backend

- Final Event Building if Necessary
- Write data to files on local disk systems
  - A few different trigger types
    - Minimally beam and background
- Transfer data to Mass Storage System
  - Enstore at Fermilab
    - encp directly to Enstore
    - dccp to dCache, then to Enstore
  - Keep local copy until data on tape
    - check layers 2&4 explicitly
  - Possibly update data handling system on file location

Monitor Systems

- Monitor Server
  - Single gateway for client applications
    - Maybe one for DAQ and one for data
  - Transient Database Tables for Information
    - 1-3 months maybe
  - Cache of event data for online applications
- DAQ Monitor System
  - Statistical assessment of health of DAQ
- Data Quality Monitor System
  - Statistical assessment
    - Signal levels, number hits, etc
  - Event by event
    - Event display

DAQ Teststand

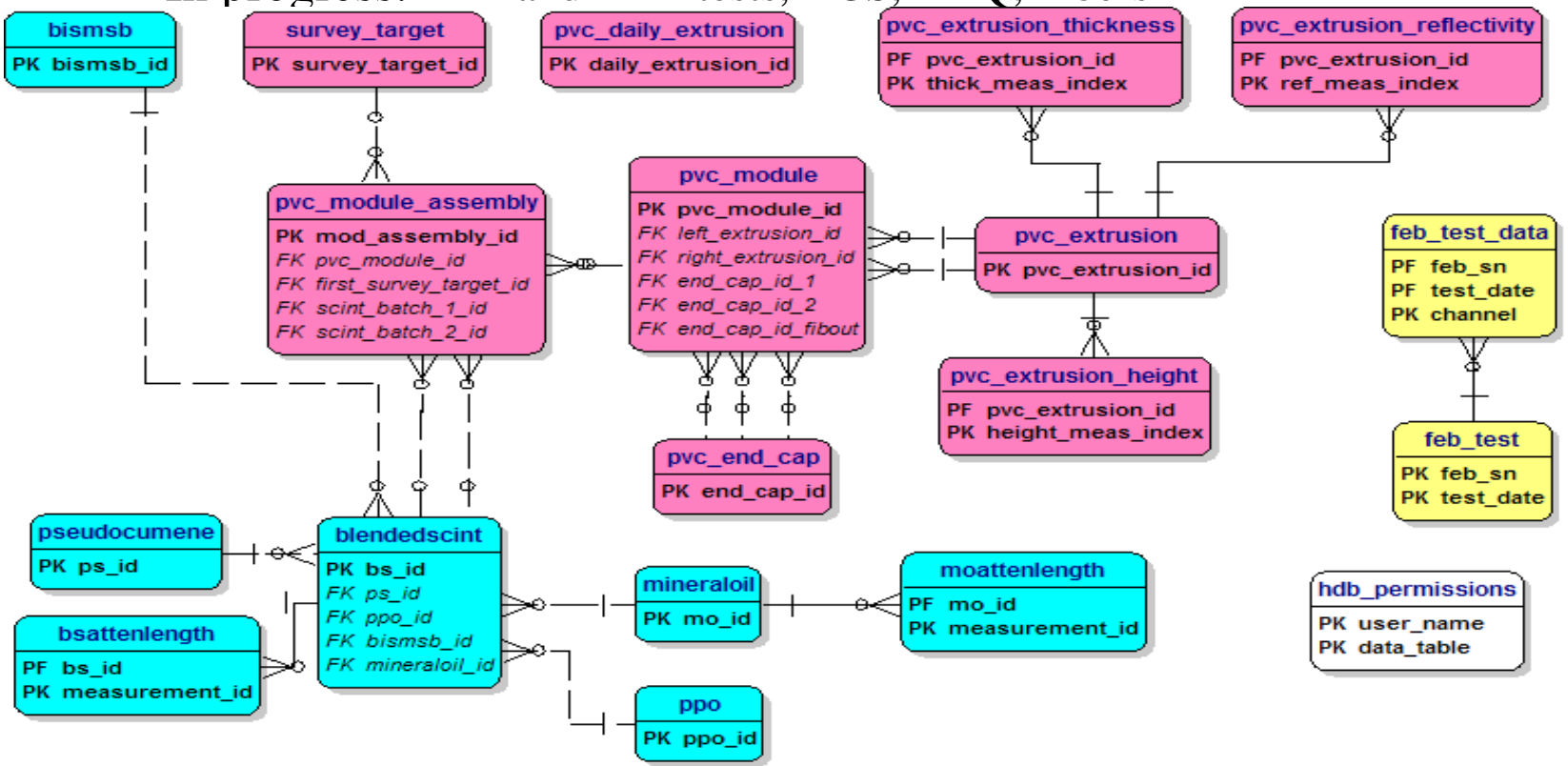
- Re-purpose OLD Run 2 Farm Nodes
  - Approx. 10 nodes for testing (no cost)
    - Several configured and used for testing
  - Switch provides private network
    - Gateway machine allows remote access to network system
  - Working on demo of application on DCM talking to host nodes
    - Linux installed on DCM and network running
    - Code under development
    - Tested client on DCM sending fake data to server on Linux node
    - RMS messaging between DCM and Linux nodes under development

Online Databases General

- Team
  - Jon Paley (IU) Coordinating
  - LSC/DBI/APP & LSC/DBI/DBA (FNAL/CD)
- Online hardware
  - 2 Systems for redundancy (remote location)
  - Linux systems
- Postgres
  - Require 100 GB minimum (up to 30 GB transient)
  - Availability
    - 99% when beam and server up
    - 95% when no beam and server up
- Requirements document written
  - http://enrico1.physics.indiana.edu/jpaley/nova/dB/docs/dB_Requirements.pdf

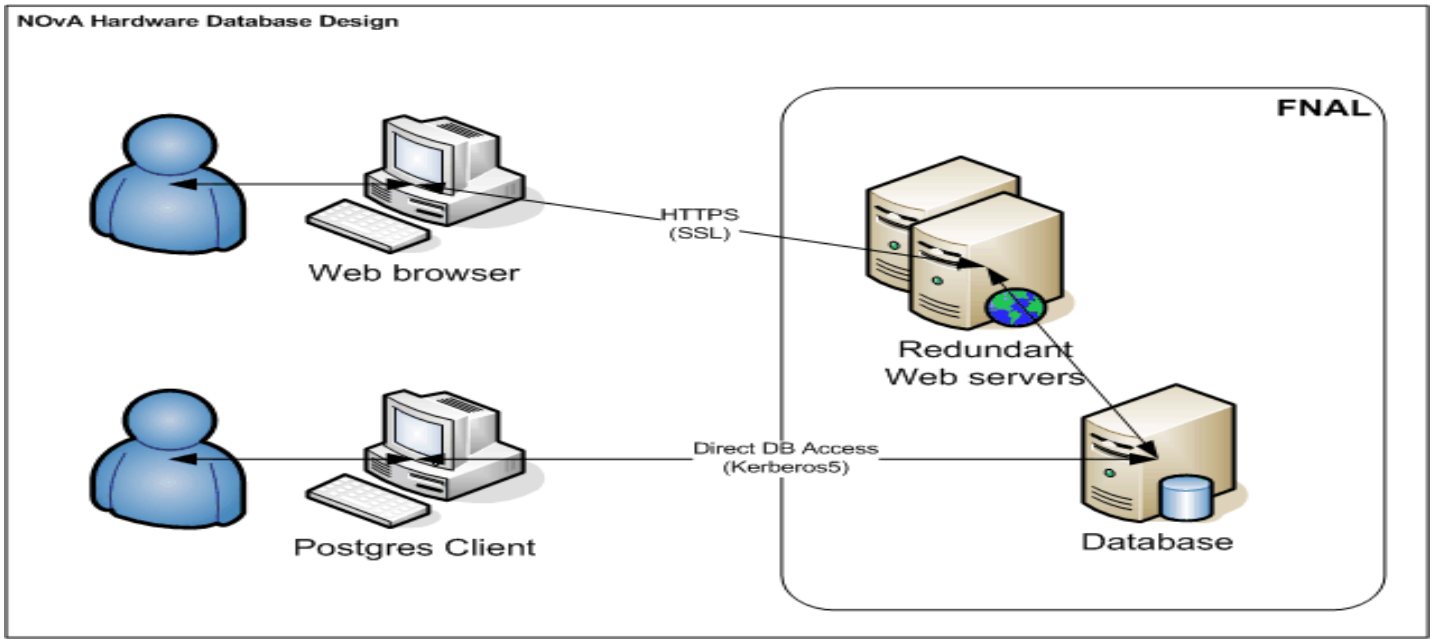
Hardware Database

- First Production Schema in Place
  - Done: Scintillator, PVC extrusions, PVC modules, assembly
  - In progress: FEB and APD tests, DCS, DAQ, Fibers



Hardware Database (2)

- Web Interface Running
  - Read/write
  - Plotting functionality
  - https://dbweb1.fnal.gov:8443/nova/NovaHandler.py/login_form



Hardware Database (3)

- Production Hardware DB Servers on order
  - Purchase requisition written for 2 machines
  - Production running currently on borrowed equipment

Run History Database

- Run Definitions and Run Quality
  - Per-run quantities
    - Start/Stop/Times/etc
  - Per-file quantities
    - Name/Start/Stop/Events/etc
  - Not a big size impact
  - No schema yet

Resource Management Database

- Manage Assignments of Hardware to Partitions
  - Track hardware status
    - Available, unavailable
    - Good, bad
    - Partition assigned
  - Persistent until cleared
  - Associations with hardware tables
  - Schema not yet started

Monitor Databases

- DAQ and Data Quality
  - Transient
    - 1-3 months for trouble shooting/diagnostics
  - General idea of needs and estimates
    - Better understanding on DAQ side
    - Data quality still to be defined
  - Schema not yet defined

Online Calibration Database

- Strongly DCS dependent
  - Still need to understand FEB downloads
    - How often
    - Number of parameters per FEB
    - Download framework
  - FEB and DCM prototype experience will help
  - Schema not yet defined

Remote Operations

- Monitoring only (a.k.a read only)
  - Dynamic (office or laptop)
    - Periodic screen snapshots (Snap Shot Service from LHC at FNAL)
    - Client applications in read only mode
- Control and monitoring
  - Dedicated 24x7 Operations center
  - Dynamic (office or laptop)
  - GAN/GDN (DESY for ILC) not yet mature
    - VPN plus other tricks to get desktop on remote system
    - Web and Java based, claim no need for client side installs
    - https://www.desy.de/~sven/Projects/projects.html

Remote Operations (2)

- Control and monitoring (cont.)
  - Other possibilities already exist (some free others not)
    - Sun Secure Global Desktop
      - License fee, advanced features
    - Virtual Network Computing (VNC)
      - Free
    - NX Protocol
      - Concurrent use version has fee
      - Faster than VNC (compression)
    - Haven't surveyed the landscape yet