COT & MUON DETECTOR CALIBRATION & MONITORING

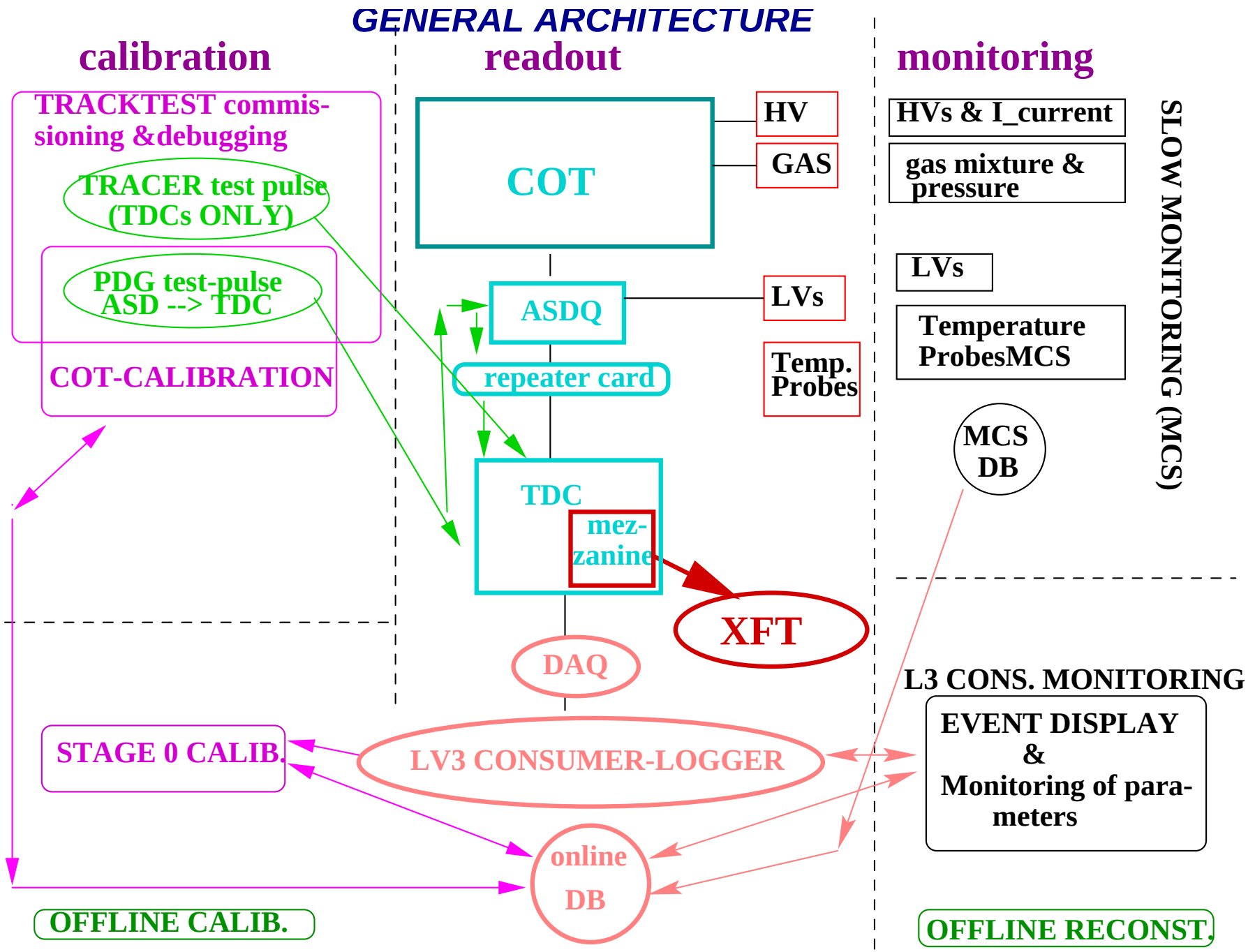
Online Software Workshop

FERMILAB March, 25-26, 1999.

Aurore Savoy-Navarro

MAIN ITEMS

- GENERAL ARCHITECTURE
- MAIN FEATURES
- TDC CALIBRATIONS: WHAT ? WHEN? HOW?
  - NO BEAM CALIBRATIONS
    - A COMMON READOUT FRAMEWORK FOR THESE TDC CALIBs.
    - PDG T.P. CALIBRATION
    - TRACKTEST TASK
  - WITH BEAM CALIBRATION:
    - STAGE 0
- TDC MONITORING TASKS
  - L3 CONSUMER MONITORING
  - SLOW CONTROL MONITORING
- DATA & INFO TRANSMISSIONS TO & FROM DBs


GENERAL ARCHITECTURE
calibration
readout
monitoring
TRACKTEST commis-
sioning &debugging
TRACER test pulse
(TDCs ONLY)
PDG test-pulse
ASD --> TDC
COT-CALIBRATION
COT
HV
GAS
ASDQ
LVs
repeater card
Temp.
Probes
TDC
mez-
zanine
XFT
DAQ
HVs & I_current
gas mixture &
pressure
LVs
Temperature
ProbesMCS
MCS
DB
SLOW MONITORING (MCS)
L3 CONS. MONITORING
EVENT DISPLAY
&
Monitoring of para-
meters
STAGE 0 CALIB.
LV3 CONSUMER-LOGGER
online
DB
OFFLINE CALIB.
OFFLINE RECONST.

GENERAL FEATURES & ISSUES

- **COMMON SOLUTION FOR THE READOUT & THE CALIBRATION & MONITORING TASKS FOR ALL THE TDC USERs**
- **USE TOOLS THAT SHOULD BE COMMON TO ALL READOUT, CALIBRATION & MONITORING TASKS**
  - **RUN CONTROL FRAMEWORK**
  - **ONLINE DB**
  - **THE L3 CONSUMER SERVER/LOGGER FOR MONITORING OR CALIBRATIONS TASKS**

    L3 DATA
  - **MCS (MONITORING CONTROL SYSTEM) FOR SLOW CONTROL TASKS**
  - **ROOT FOR HISTOGRAMMING & DISPLAYS**
  - **HARMONIZATION BETWEEN ON-LINE & OFFLINE CALIBRATIONS AND MONITORING**
- ***BE MODULAR TO COPE WITH EVOLUTIVE DAQ !!***

THE TDC CALIBRATION TASKS

TWO TYPES OF CALIBRATION:

- NO BEAM CALIBRATION (using test pulse)
- WITH BEAM CALIBRATION (using L3 triggered data)

1.- NO BEAM CALIBRATIONS

1.1 USE A COMMON READOUT FRAMEWORK

1.2 PDG Test Pulse CALIBRATION

- test pulse calibration with BNC PDG
- Calibration of the overall F.E. and readout chain (see schema)
- Must be able to run multicrates simultaneously (i.e. > or = 1 board on each of the 24 crates in //)

MAIN GOALS:

- The channel to channel t0 calibration
- The dE/dX calibration
- Analyse and decide to update the online DB

THE "NO-BEAM" TDC CALIBRATIONS WILL USE A COMMON TDC READOUT FRAMEWORK, FOLLOWING THE RUN_CONTROL PRECEPTS

(see next transparency)

- The Front-end Template has to be coded.
  It will communicate with RUN_CONTROL, accept state, change requests and send acknowlegements.

(see next transparency)

- Readout or calibration subroutine must "plug" into the RUN_CONTROL framework, and make use of the message passing facility provided in the template.
- The readout is driven by a "readout list" which specifies the banks that need to be outputed, the output path, card type etc...
- Currently the TRACER is being polled to check for and event. Use of INTERRUPTS has to be tried VERY SOON!!
- SPY mode must be implemented.
  In SPY mode the TRACER transmits the data it sees in the backplane up to the VRB.
- The readout code needs to be made robust, handling errors and recovering.

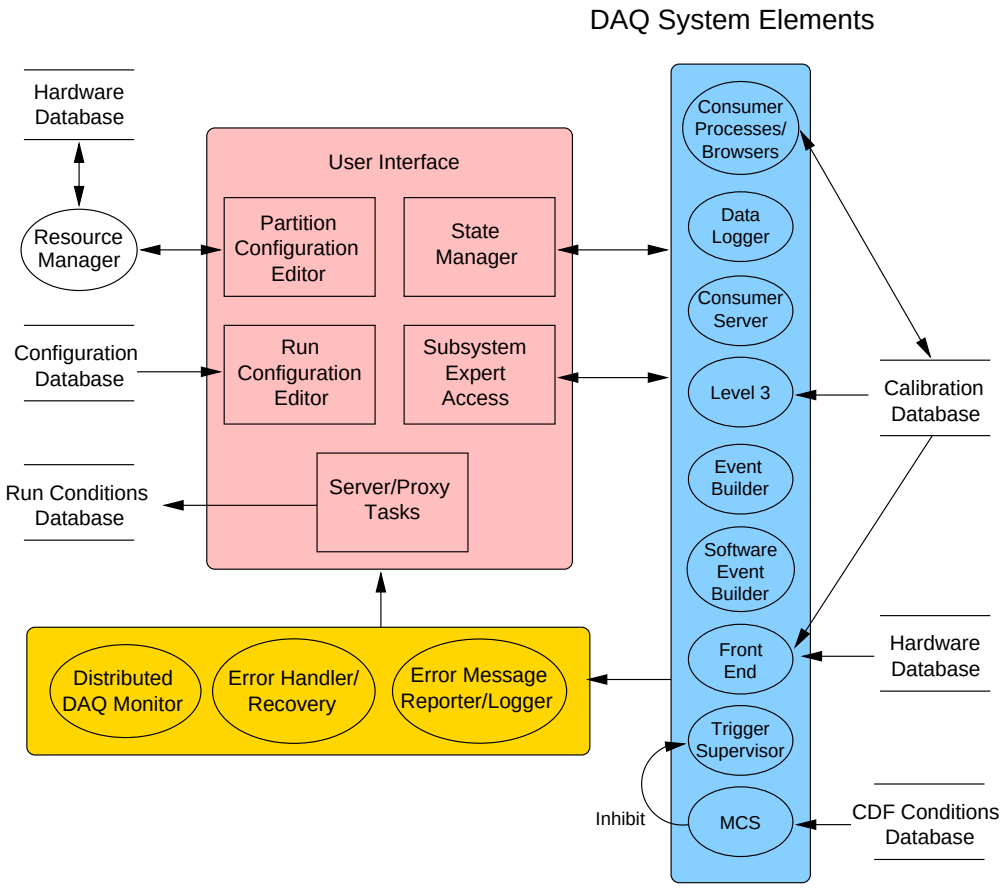


Figure 1: *Block diagram of the elements making up Run Control.*

1.1 Usage scenario

After starting up a copy of Run Control the user must request the partition of the detector to be used. A schematic of the detector is presented showing the user what partitions are available and what are currently in use. Predefined partitions are available or the user can custom configure the request. The request is sent to a resource manager who determines if the components are available and tracks requests from multiple RCs. In addition to the parts of the detector, the user must also specify the desired data acquisition system configuration:

- the output path from the front-end crates such as Ethernet or through Level 3
- what parts of the Event Building system are needed
- what part of Level 3 is desired
- Data Logger configuration

Once the partition has been successfully reserved the user begins a run and selects run dependent parameters. These include:

- Run Type

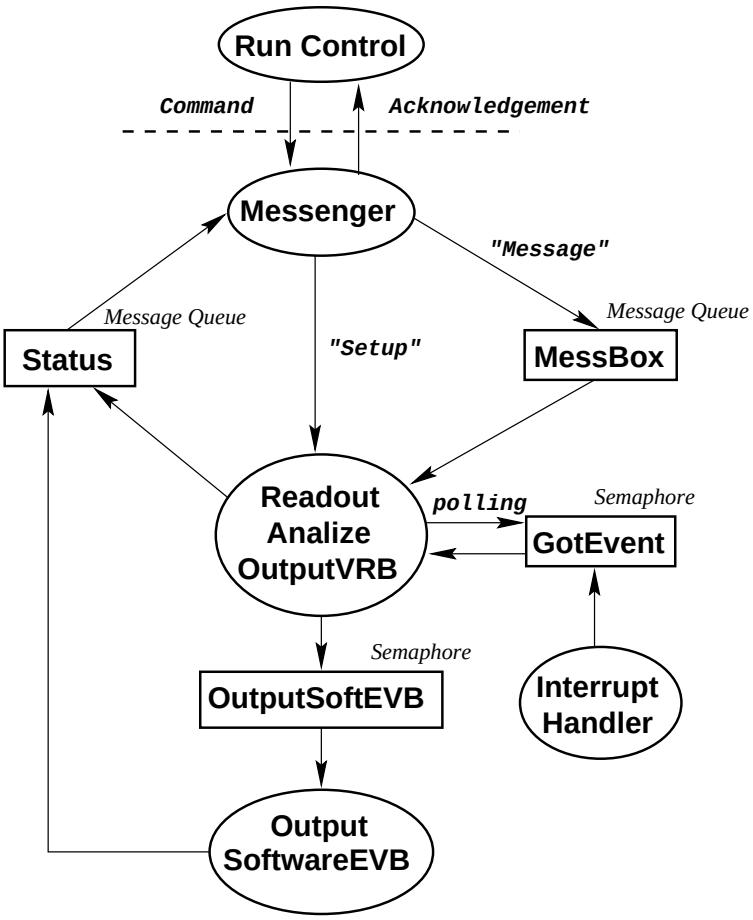


Figure 5: *The Front End Framework. The ovals represent processes while the boxes represent either semaphores or message queues. The implementation details of the messaging software is isolated in the messenger task.*

- If compiled for TESTCLK support then configure the TESTCLK.
- Loop through readout list elements; for each with a valid slot number:
  - VISIONclose() previous handle in array of handles.
  - VISIONopen() a new one.
  - Attempt to verify ID PROM.
  - For selected readout types, invoke special board initialization function, passing slot number and bank name.
- If network output, attempt to create connection to the software event builder and spawn network output task.
- Attaches interrupt handler.

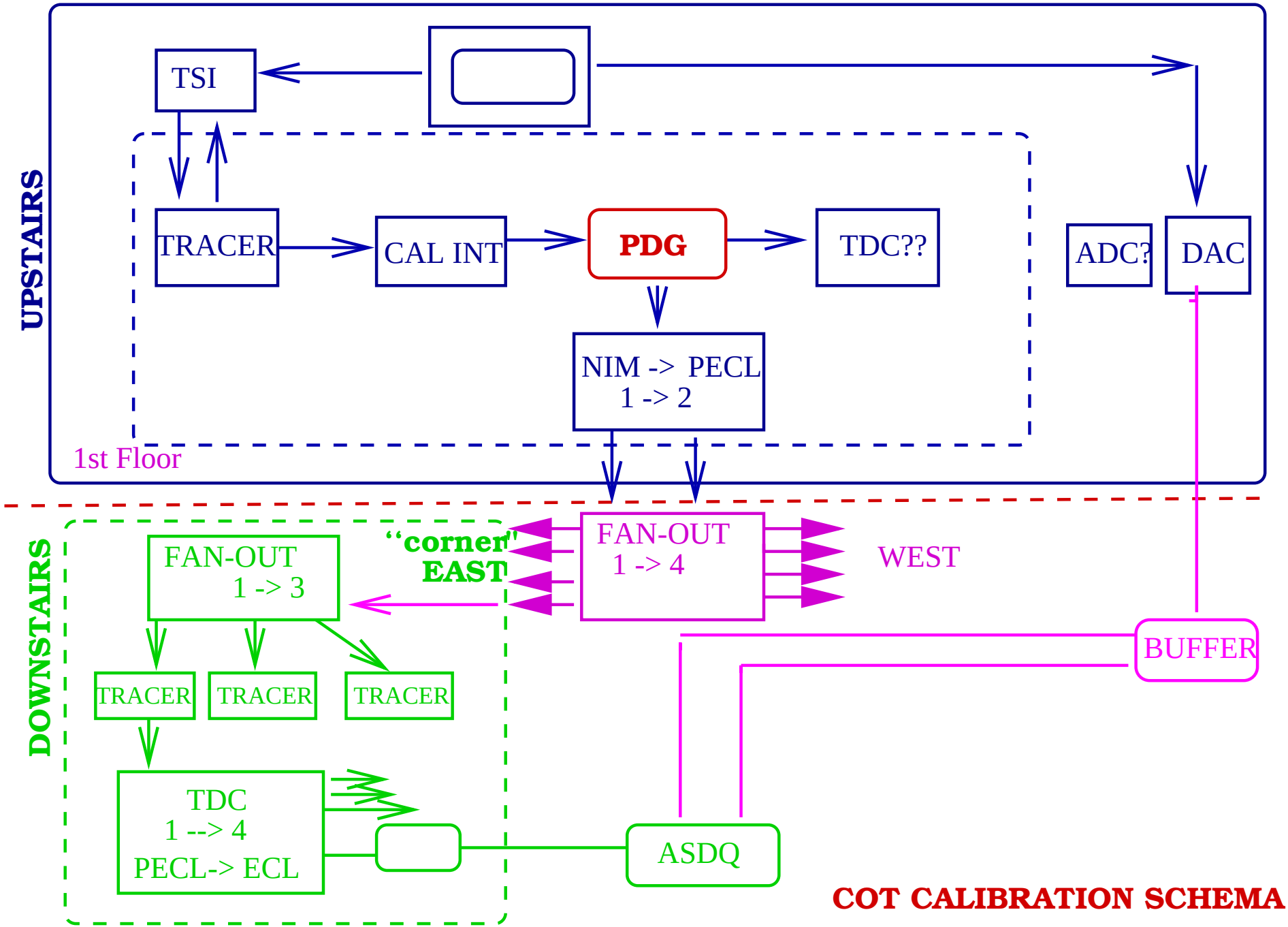
- **Lot of software needed to be able to collect/analyze TDC data that is not TDC specific such as:**
  - **RUN_CONTROL**
  - **Front-end template**
  - **Software/real event builder**
  - **Database access**
  - **Data access, AC++, monitoring etc....**

STRATEGY:

STARTS FROM COSMIC-READOUT and MODIFY IT TO BE CLOSER TO THE FINAL F.E. CODE.
This will evolve with the FRONT-END TEMPLATE.

The calibrat ion and readout tasks will basically use a common readout framework, but main differences:

- **Proceadure to set-up the calibration (hard + soft)**
- **Setting up of the T.S.**
- **Accesses to the ONLINE DB and the LV3**
  To be DEFINED: informations to be transmitted, where, when, how ????
- **Online analysis and online displays of the results and diagnoses.**


UPSTAIRS
TSI
TRACER
CAL INT
PDG
TDC??
ADC?
DAC
NIM -> PECL
1 -> 2
1st Floor
DOWNSTAIRS
FAN-OUT
1 -> 3
"corner"
EAST
FAN-OUT
1 -> 4
WEST
BUFFER
TRACER
TRACER
TRACER
TDC
1 --> 4
PECL-> ECL
ASDQ
COT CALIBRATION SCHEMA

DETAILED RUNNING OF THE COT CALIBRATION (see Kevin Pitts)

- *CHANNEL TO CHANNEL t0 CALIBRATION*
  - *frequency: once per day*
  - *run condition: HV OFF*
  - *length: few minutes (assumed to be dominated by set up/download time)*
  - *configuration: acquire data by even/odd ch. (all crates)*
  - *data size: 30240 ch. x 75 hits/ch. +4 bytes/hit = 9 MB (75 hits ; 15 hits at 5 diff. time slots)*
  - *storage: keep only the results of calib (t0 and slopes) stored in the online DB*
  - *trigger: a L1A will be delivered by the TS, a fixed number of cycles after the calib pulse*

- *ASD dE/dX CALIBRATION*

  idem than previous one except for:
  - *frequency: < or = once per week*
  - *data size: 30240 ch. x 375 hits/channel + 4 bytes/hit = 45 MB (375 hits: 15 hits at 5 different time slots AND 5 diff. charges)*

- *ASD/TDC TIMING CALIBRATION*
  - *functionally identical to the ASD timing calib. but 2 PULSES/EVT delivered to the F.E.*
  - *primarily a TDC DIAGNOSIS TASK !!! TDC calibration is done by Michigan group and embedded in the FRAM in the TDC.*

DB TRANSFERS:

ALL THESE CALIBRATIONS IMPLY DB CONNECTIONS

& 3 TYPES of DB RELATED TASKS:

- *Analysis of calib. data*
- *Validation*
- *DB interface*

1.2-TRACKTEST CALIBRATION/DEBUGGING

- Two test pulse: BNC PDG & TRACER
- Essential tool for the debugging & commissioning of the electronics or if severe pbs during data taking.
- Common to COT, MUON and HADRON calo.
- Primarily a DIAGNOSIS/DEBUGGING tool and NOT a calibration stricto senso.
- Must be able to handle MULTICRATES
- NO interaction with DB
- Must be included in RUN_CONTROL framework

Main features (user's wishes):

- Hands on, flexible and interactive facility
- standalone (i.e. can be run during data taking to look at pbs).
- Must be fast and ready for the commissioning of the COT and its readout electronics
- Must be able to select patterns and pulsing modes (i.e. TDC or ASD).

- **For ASD pulsing, must be able to select**

  - **the pulseheight & ASD settings:**
    i.e. dE/dX : yes or no, thresholds, etc...
  - **Which crates, chamber sections to pulse**
    i.e quadrant & superlayer
  - **Number of pulses**
    So can set-up a "SCOPE LOOP" (N>>> pulses)
  - **What information to display**

- **The information must be used as follows:**

  - **For each channel, and each selected time delay,**
    - **Display <leading edge time> , pulse width, sigma, deviation from the TDC average etc...**
  - **Set flags for channels not passing the user set cuts**
  - **Diagnose, fix and quickly re-run to verify.**

THIS IS THE TOOL FOR COMMISSIONING THE TDCs @ B0

THIS IS THE TOOL FOR COMMISSIONING COT @ B0.

2.- WITH BEAM CALIBRATIONS

— *STAGE 0 CALIBRATION* —

- ***Uses real LV3 data***
- ***Provided during normal data taking with beam***

MAIN FEATURES:

- *Provide very accurate and reliable calibrations of functioning of the F.E. and readout electronics as taken in REAL LIFE CONDITIONS*
- *Content very similar to STAGE 0 for RUN I (see Aseet)*
- *Technically, totally new*
- *Natural connections with the offline calibration*
- *Interacts with ONLINE DB*

STAGE0 CALIBRATION

- **Operating mode**

  DURING NORMAL DATA TAKING

  - HV ON, BEAM ON, ALL DETECTORS

    IN FULL OPERATION MODE

  TRIGGERED WITH MIN BIAS TRIGGERS (or other physics triggers)

- **Stage 0 process:**

  ONLINE CONSUMER THAT FILTERS THE SELECTED TRIGGERS

- **Post0 process :**

  PROGRAM THAT ANALYZES THE EVTS SELECTED BY STAGE0

  & DETERMINES THE CURRENT VALUES FOR THE COT
  (i.e. "DRIFT CSTS") AND THE MUON DETECTORS

  < or = 12 PARAMS /SUPERLAYER (were 8 for the CTC)

- **Frequency : ONCE/DAY**

- **DB transfers :** AUTOMATICALLY ACCESSED ONLINE

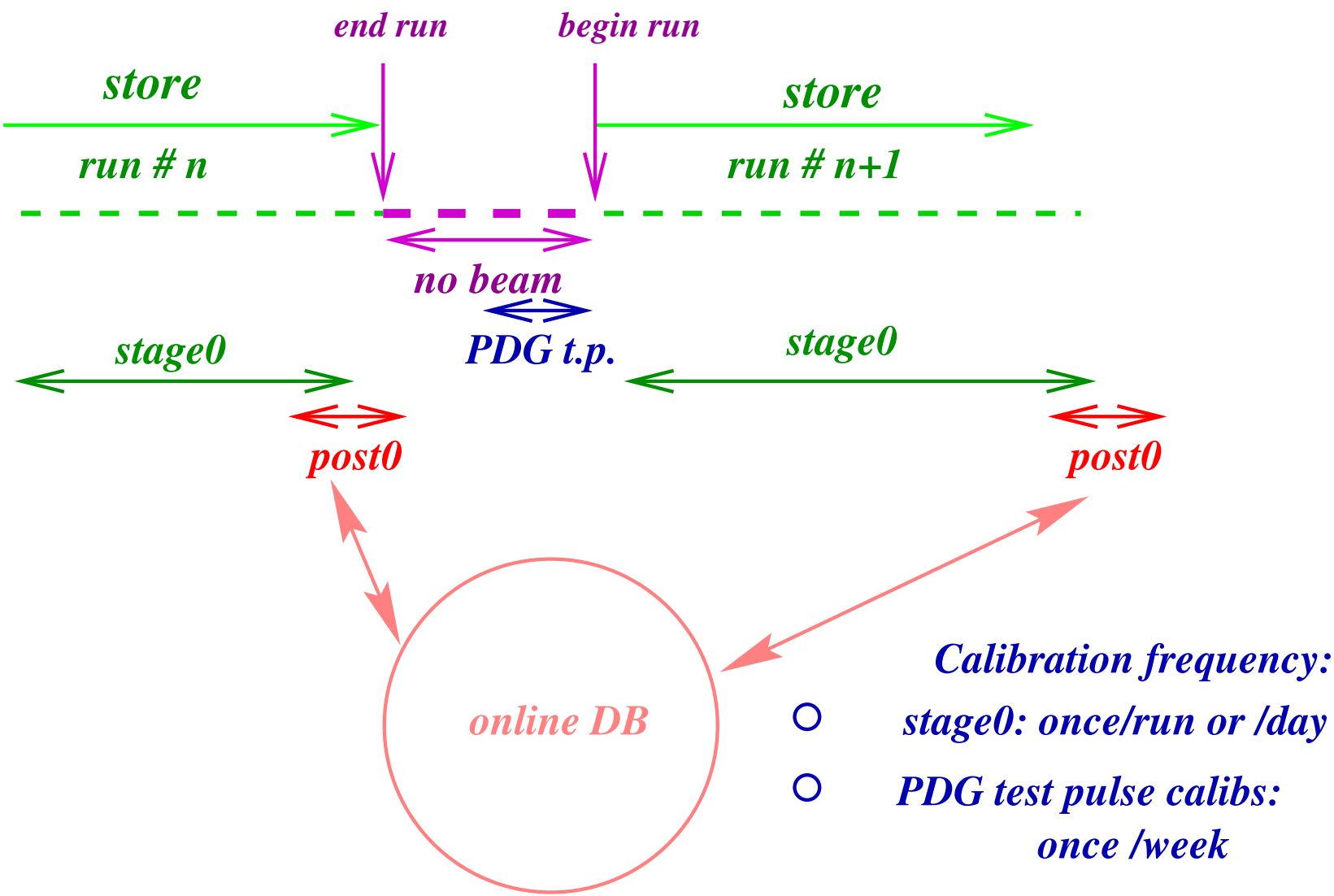
  THE INFOS PRODUCED BY THE ONLINE CONSUMER
  ARE REGULARLY WRITTEN TO THE DB

  ACCESS BY THE OFFLINE ANALYSIS IS REQUIRED

CALIBRATED DATA: drift velocity, t0/superlayer,
drift angle, non linearity (drift), time slewing, dE/dX

Z!! And also: Info to verify that STAGE 0 ran successfully.

when to calibrate ???



Calibration frequency:

- ***stage0: once/run or /day***
- ***PDG test pulse calibs: once /week***

THE TDC-COT MONITORING TASKS

TWO TYPES OF MONITORING

- *L3 CONSUMER MONITORING*
- *SLOW CONTROL MONITORING (MCS)*
  (external to general DAQ)

1.- L3 CONSUMER MONITORING

- *MONITORING OF PARAMS*
  (COT & electronics & related items ...)

http://www-cdf.fnal.gov/internal/upgrades/daq_trig / twg/what_to_monitor.txt

- *DISPLAY OF EVENTS*

- *Choice of the DISPLAY : see offline team (ITEP)*
  Two considered possibilities:
  - *OPEN/INVENTOR (Open base toolkit)*
  - *ROOT/Open GL*

For the time being: let's use ROOT (see next , Rick S.)

- *Implement useful monitoring features:*
  full track reconstruction, tracks in sector of COT,
  pattern reconstruction (i.e segment of tracks).

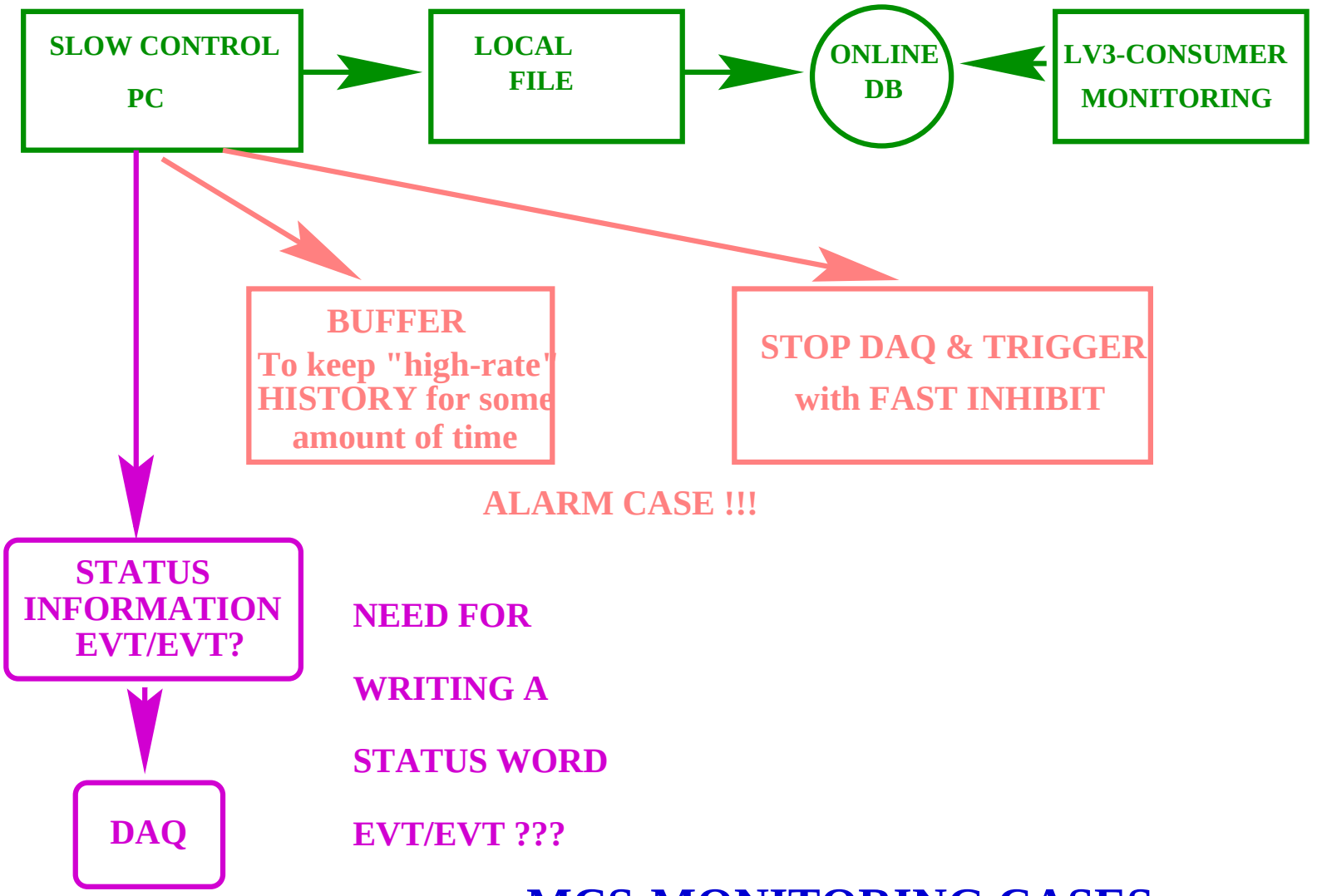
2.- SLOW MONITORING CONTROL (MCS)

- *HVs & I_currents of COT*
- *LVs*
- *TEMPERATURE PROBES*
- *GAS MIXTURE & PRESSURE (MCS?)*

Some important issues:

- *Keeping history*
- *Catastrophe scenario: FAST-INHIBIT & History*
- *Status word on evt/evt basis (SVX-like ?)*

1) KEEPING HISTORY



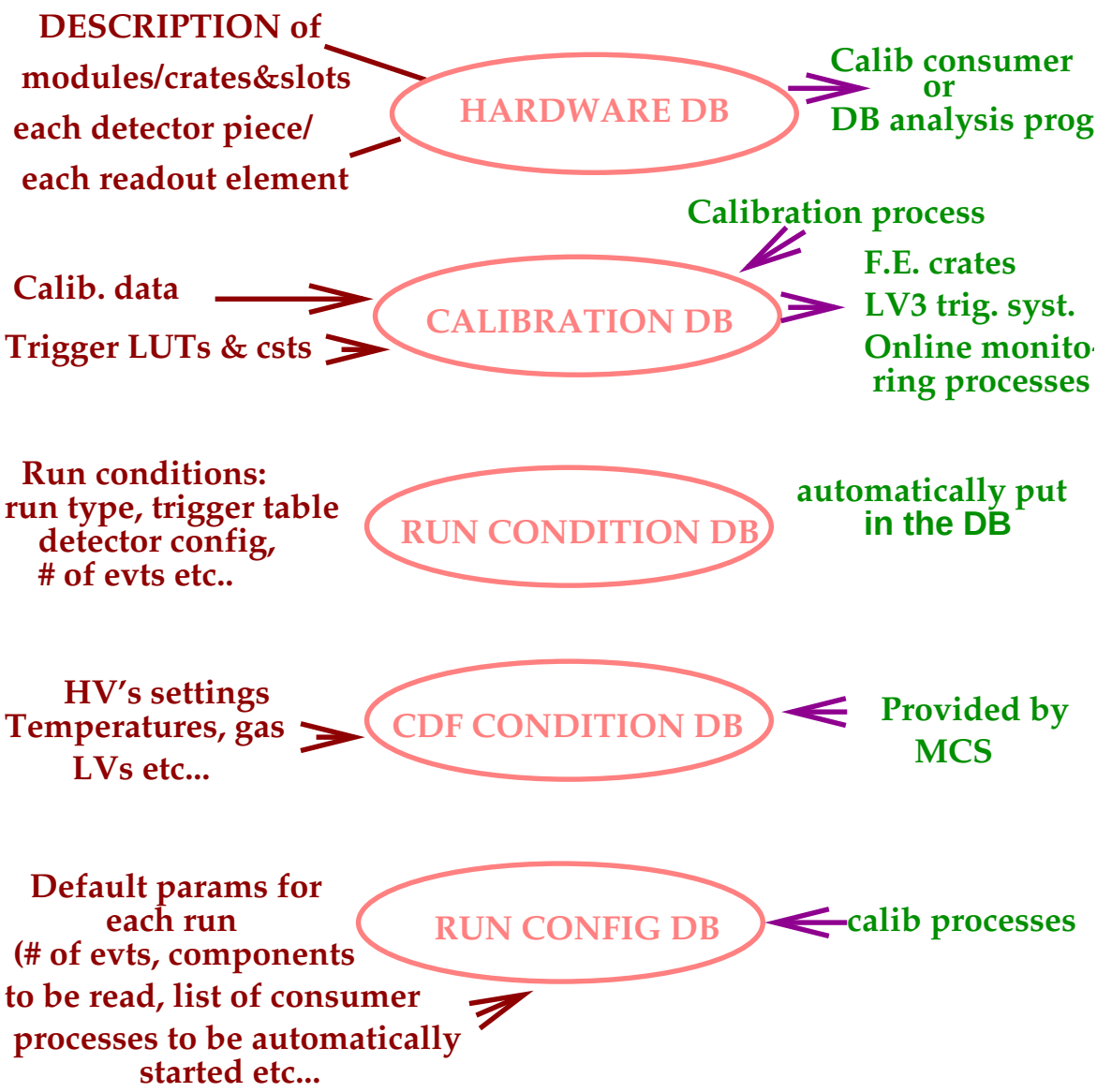
MCS-MONITORING CASES

DATA & INFO TRANSMISSIONS

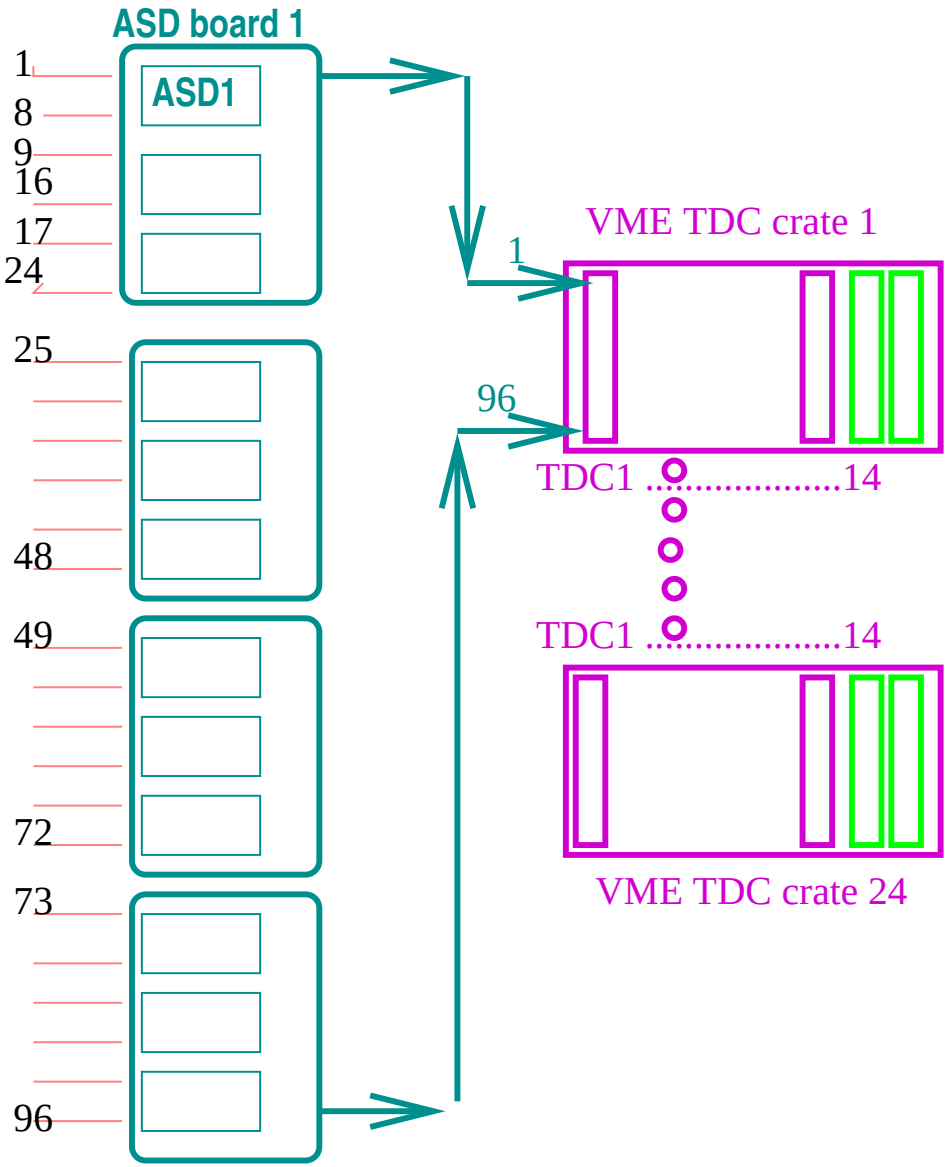
TO & FROM

THE DATABASE(S)

VARIOUS DBs TO BE ACCESSSED



COT READOUT COMPONENTS TO RECORD IN DB



HARDWARE DB

Detailed description of hardware set-up

Correspondence : crate/slot - comp./ch id

Mapping of F.E. crates (what Xpoint &VRB)

COT= 34560 wires (30240)

1440 ASD boards (1260)

360 TDC boards (315)

24 VME crates

MUON=8773 channels

95 TDC boards

8 VME crates

ASD SPECS TO BE STORED BY SUPERLAYER

- discri threshold (real: 4 bytes)
- dE/dX “ drain current" (real: 4 bytes)
- dE/dX enable (integer: 1 byte)
- ASD attenuation (integer: 1 byte)
- Layer number (integer: 1 byte)

TOTAL: 11 x 8 = 88 bytes

To be recorded in the CALIB DB

ACCESS REQUIREMENTS:

- downloaded to F.E. electronics
- monitoredand automatically entered in DB
- infrequent chances during normal running
- modified several times during commissioning

must keep track of changes

DATA TO BE RECORDED FROM MCS

(in CDF CONDITIONS DB)

- **HV SETTINGS**

  supplied by a VME based system (BiRA VME 4877PS)

  controlled by MCS PC

  Per superlayer: 25 HV SETTINGS (real:4bytes)

  12 sense wire voltages + 13 potential wire voltages

  25 CURRENT LIMITS (real: 4 bytes)

  25 HV LIMITS (real: 4 bytes)

  Layer # and wire # (integer: 1 byte)

  TOTAL : 2.8 Kbytes

- **LVs**

- **ENVIRONMENTAL PARAMETERS**

  - Temperature Probes
  - Air pressure & humidity (real: 4 bytes)
  - Gas mixture & pressure

  Z!! SIMILAR INFOS FOR THE MUON DETECTOR

SUMMARY for COT & MUON CALIBRATIONS

- what calibrations ? — OK
- when to calibrate ? — OK
- how long it takes ? — Still to be worked out at B0 with set-up in dev.
- how much data is needed ? — ~ OK
- what detector elements are needed? — OK
- where are csts used ? — ~ OK
- define output banks — to be define
- interface with DB ? — in progress (list of items to be finalized & "access strategy")
- raw data access ? — OK
- data monitoring ? — ~ OK (need to finalize)