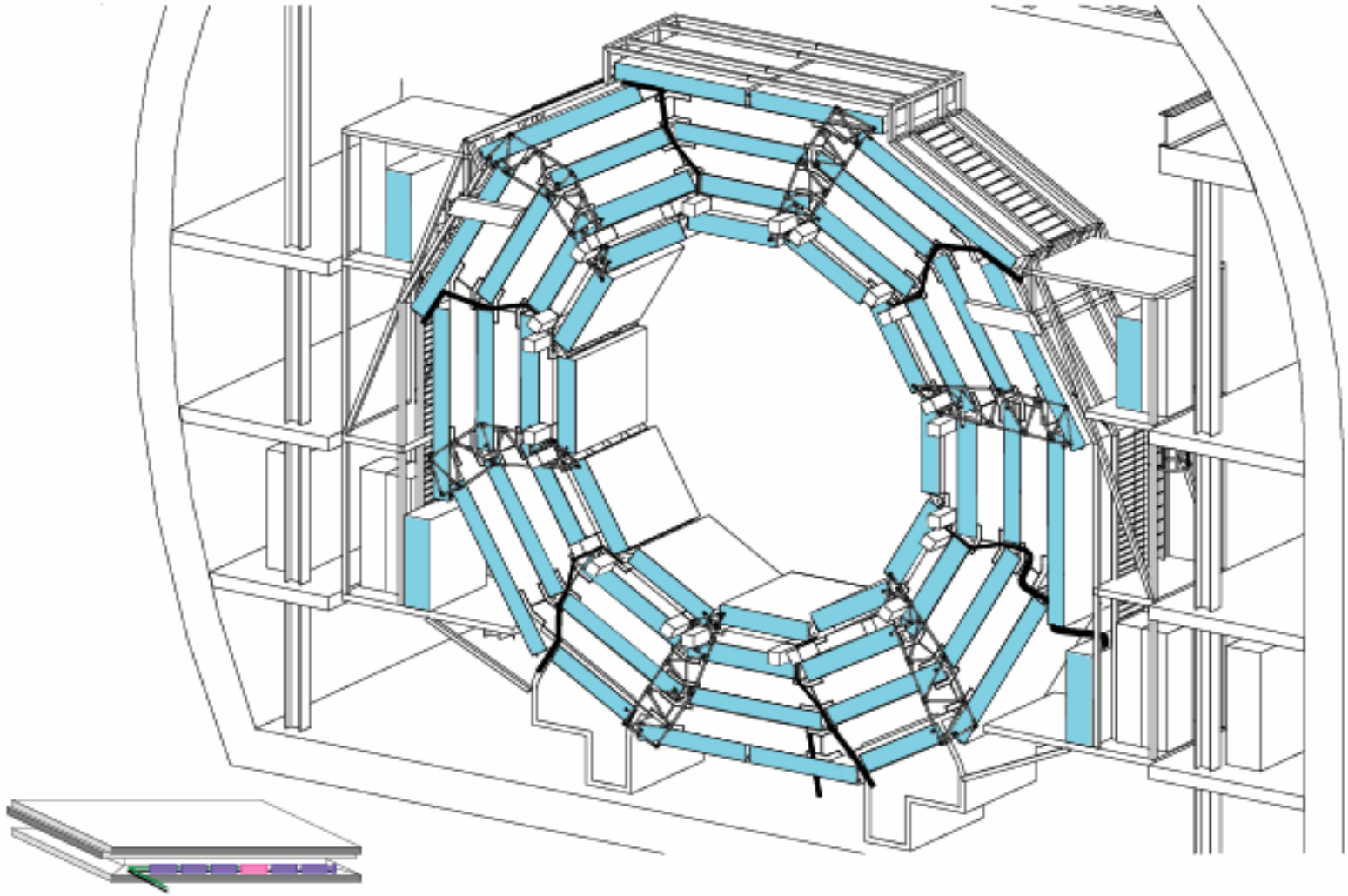
SLOW CONTROLS FOR CMS DRIFT TUBE CHAMBERS

M. Bellato INFN Padova - On behalf of DT-DCS group

DETECTOR ASSEMBLY

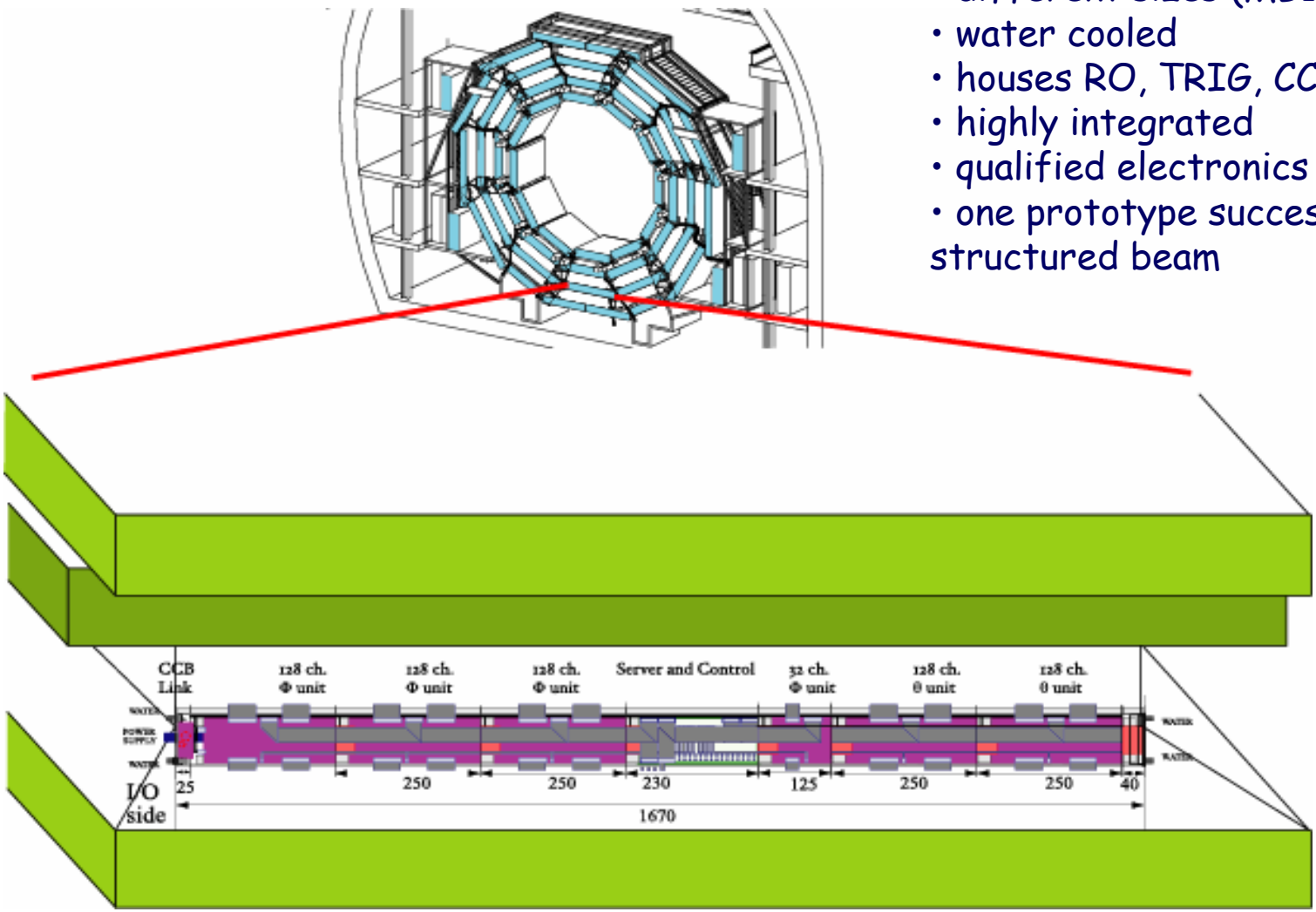


DT DCS Supervision

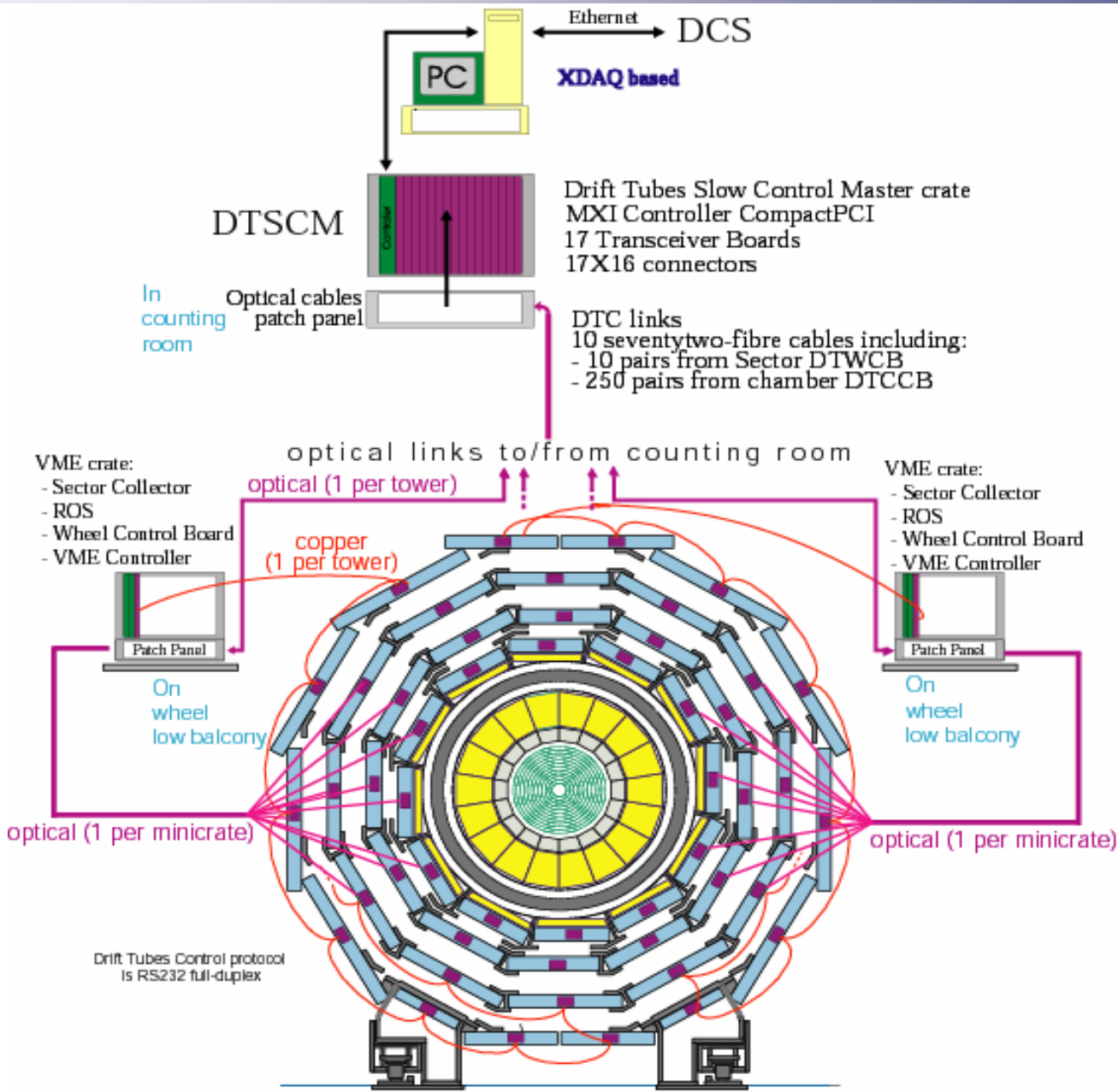
• Minicrates	250
– (Readout Boards)	through CCB
– (Trigger Boards)	through CCB
– (Front-End Boards)	through CCB
– Control Boards	
• VME crates for Tr+Ro	10 crates
• DT Front-End DDU's	1 crate
• HV + LV	4 racks per wheel
• Alignement Leds on DT	10000
• DT TTC branch	1
• Gas Lines, Cooling Lines	250

DT Minicrate

- sticked to one border of each chamber
- different sizes (MB1-MB4)
- water cooled
- houses RO, TRIG, CCB boards
- highly integrated
- qualified electronics
- one prototype successfully tested with structured beam

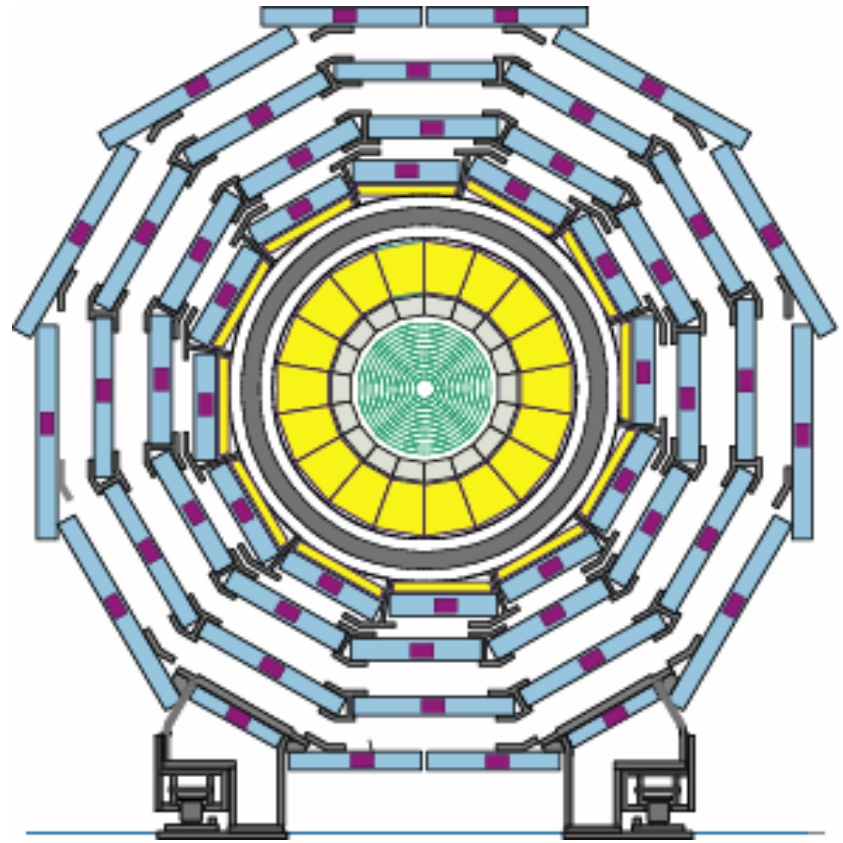


DT DCS Layout



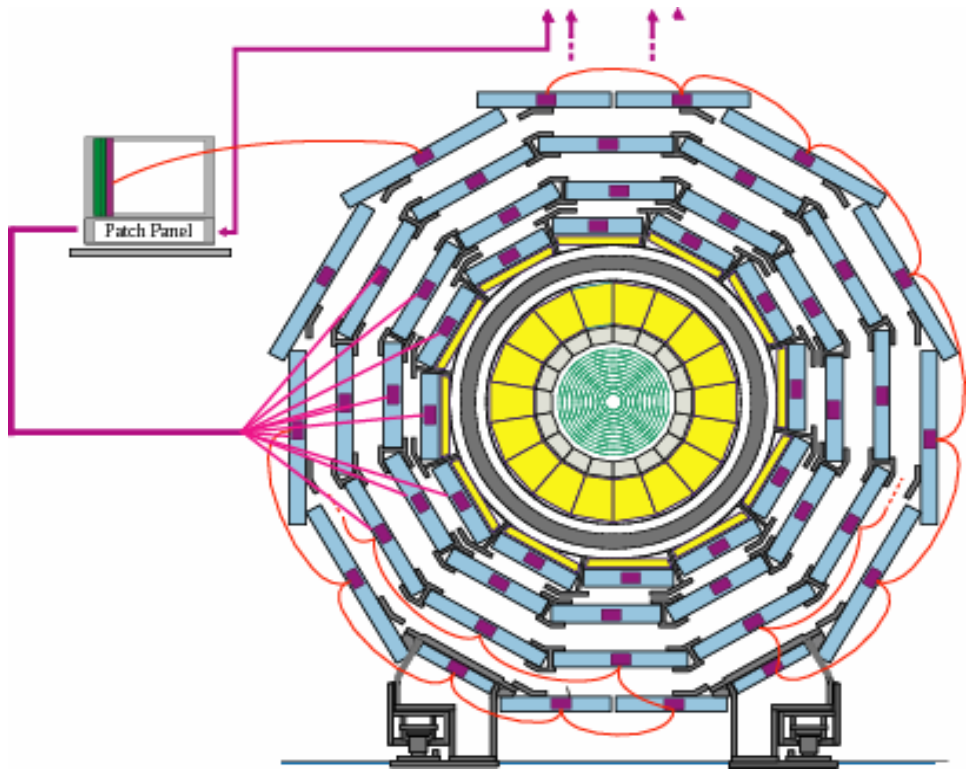
DTSC COMPONENTS –1

- CONTROL BOARD
  - Close to DTBX chambers
  - Housed in cooled minicrates
  - Microprocessor based
  - External world I/F via serial optical link(s)



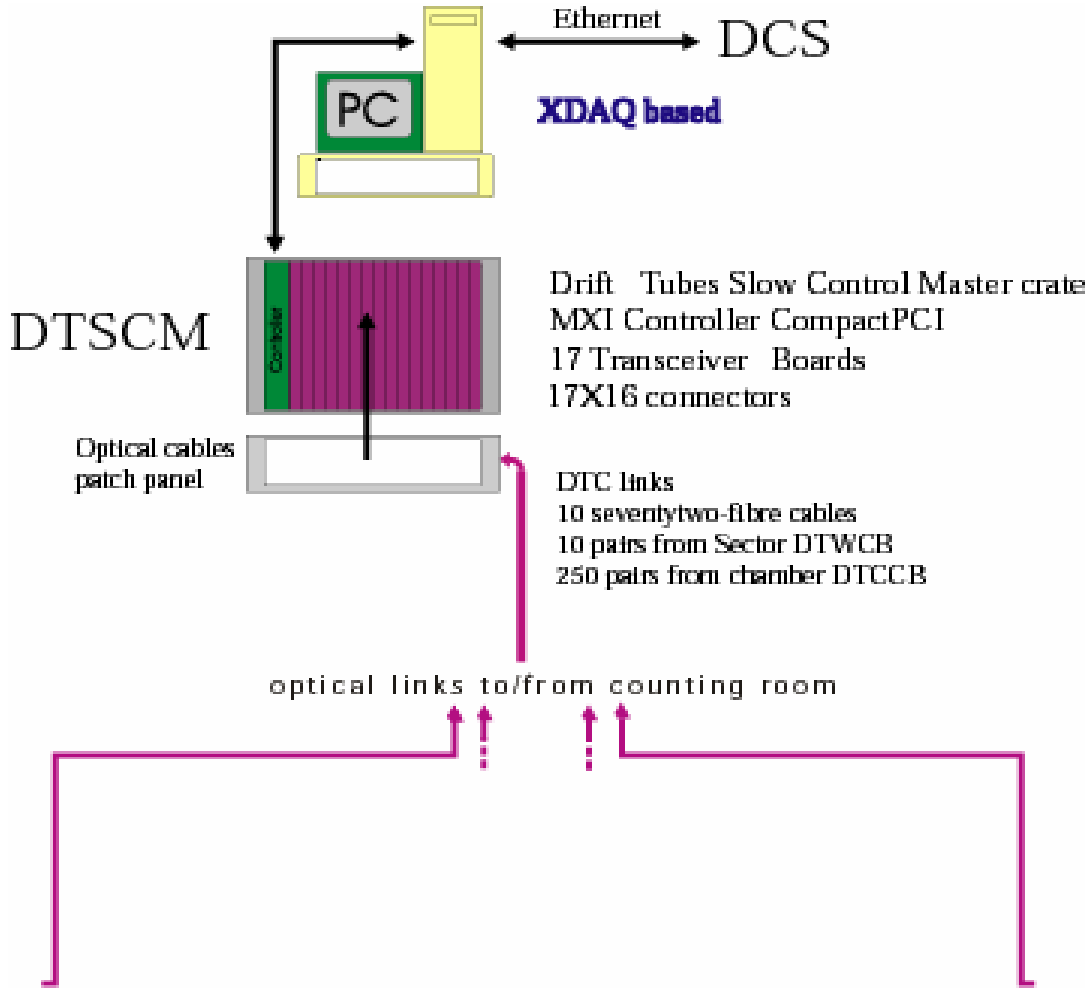
DTSC COMPONENTS - 2

- SERIAL LINKS
  - One direct link from each control board to counting room (optical asynchronous)
  - One direct link from half wheel control board to counting room (optical asynchronous)
  - One daisy chained link from sector collector to control boards (half wheel - copper)
  - One local link for maintenance

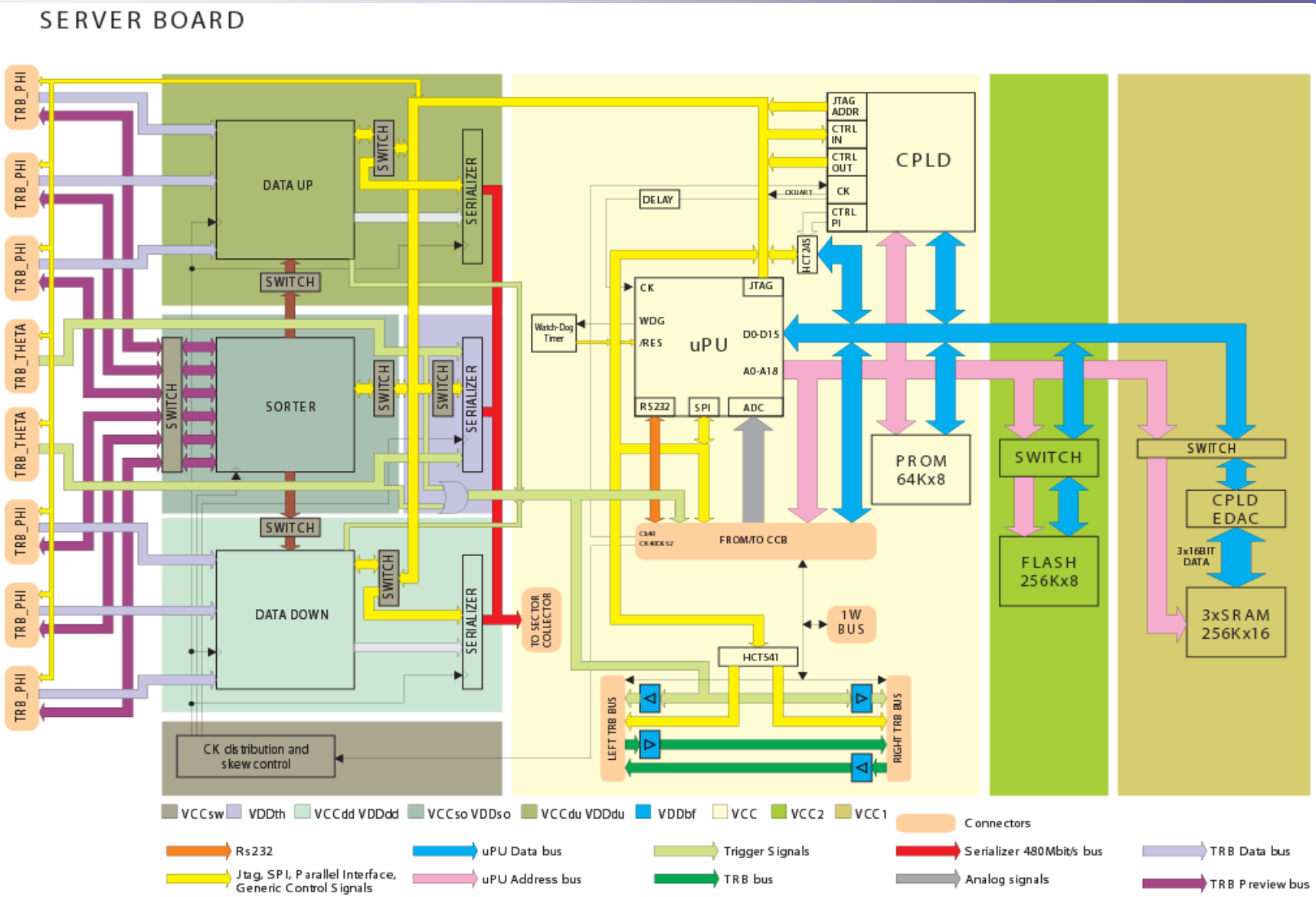


DTSC COMPONENTS - 3

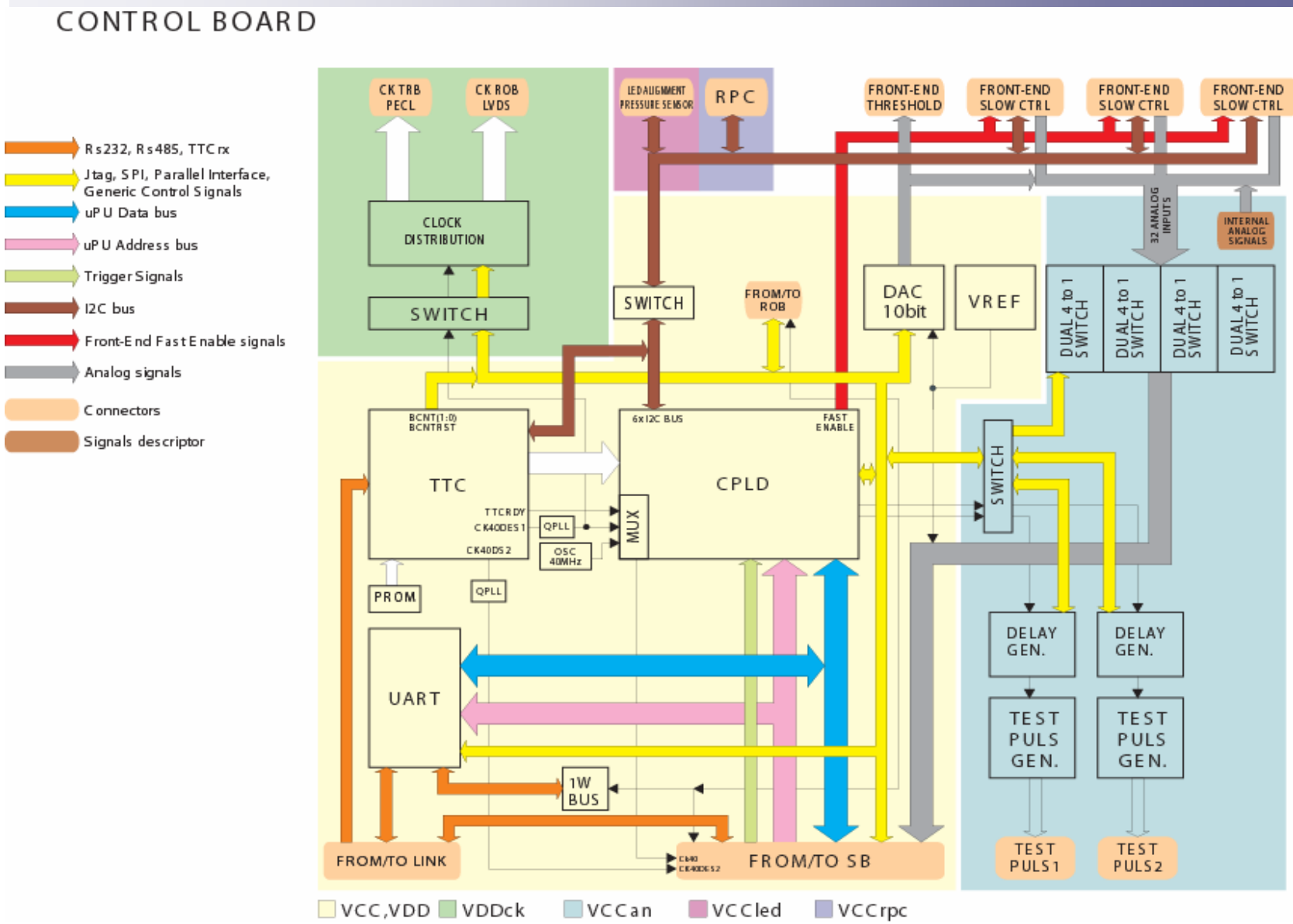
- SLOW CONTROL MASTER
  - Sits in the counting room
  - 260 RS232 optical connections
  - Houses the DCS interface



DT Control Board (1)



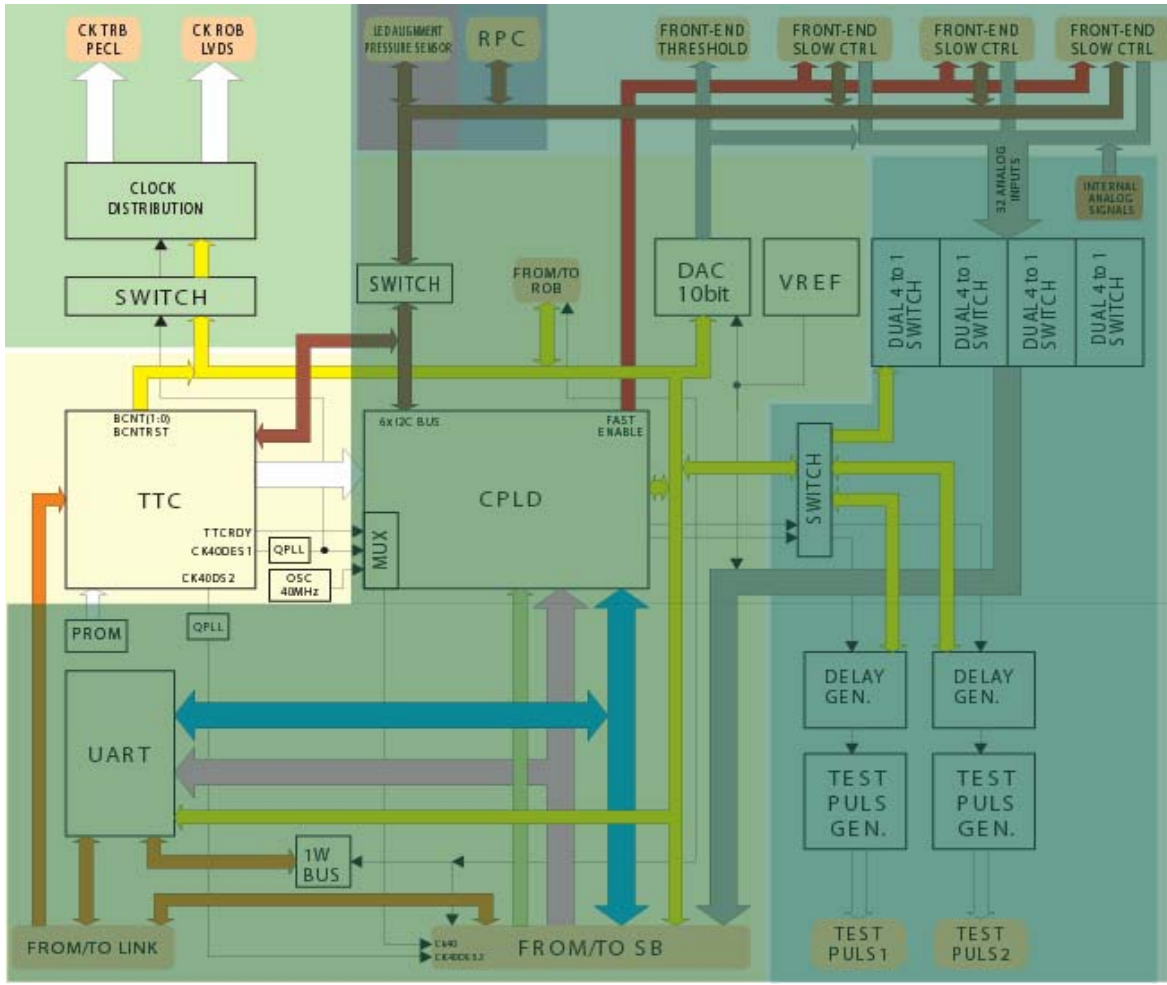
DT Control Board (2)



- Clock distribution
- Test Pulse signals distribution
- Distribution and Readout of analog signals
- Distribution and Readout of control signals
- Temperature monitoring
- Trigger Board and Readout Board ASICs setup and housekeeping

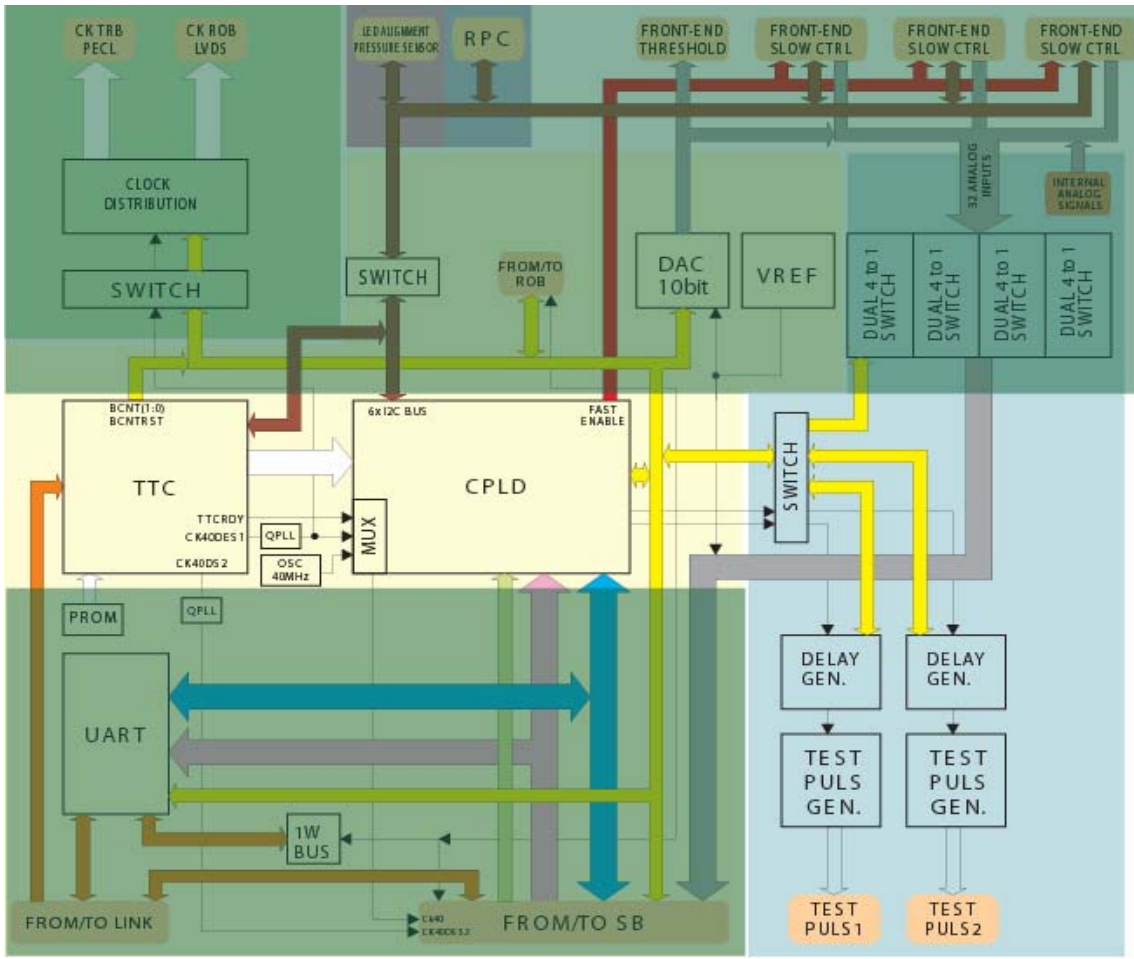
DTCCB – CLOCK DISTRIBUTION

- 40 MHZ LHC clock(s) via a TTCrx chip
- Low skew (< 1ns) clock tree network to Trigger Boards, Server Boards and Readout Boards
- Decoding of TTC signals (custom commands)
- TTCRx Jitter filtering :
  - By QPLL
  - By commercial PLL



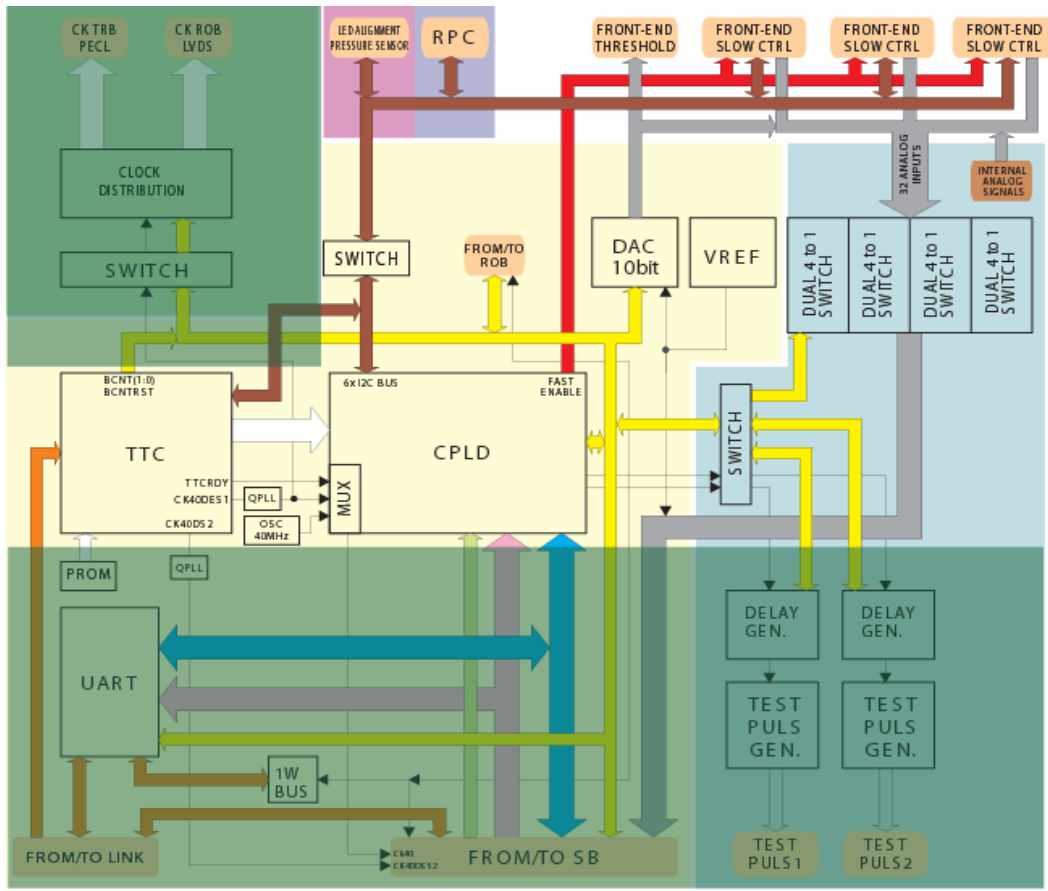
DTCCB – Test Pulse Signals Distribution

- Programmable test pulse generation during orbit gap via TTC TEST signal
- Only orthogonal tracks
- Programmable delay



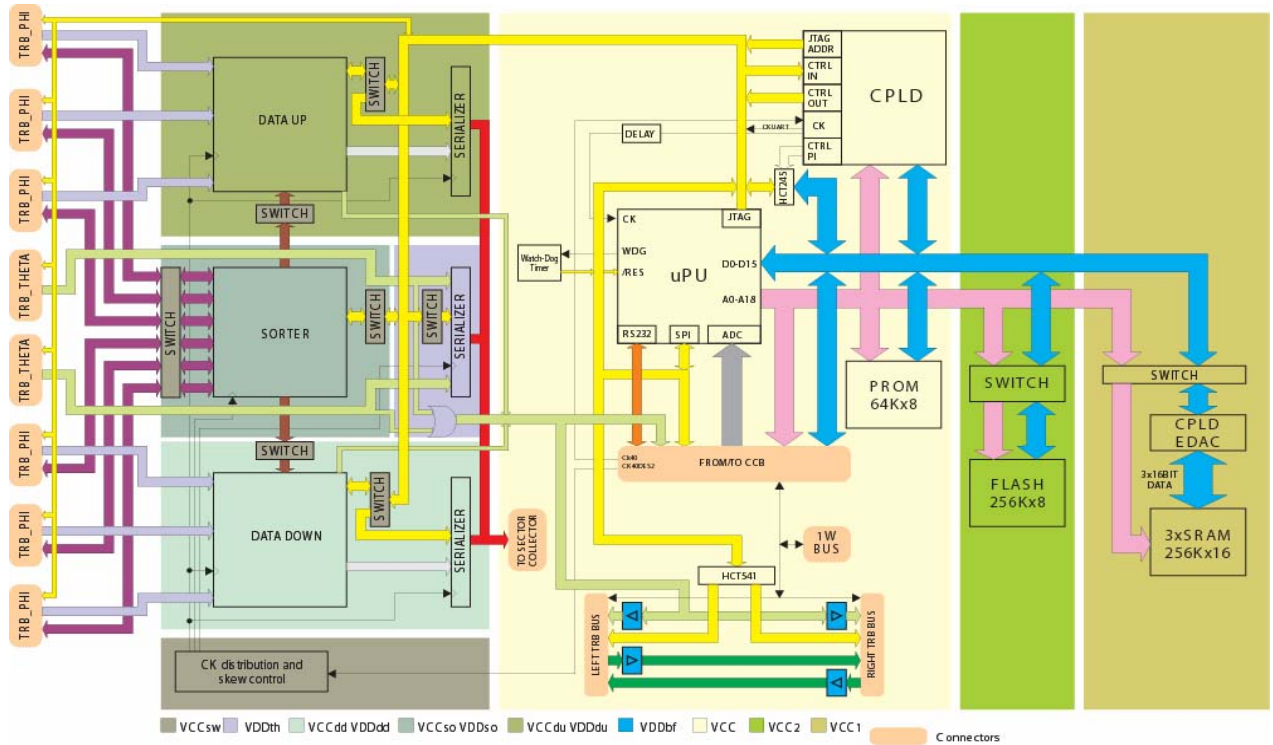
DTCCB - Distribution and Readout of analog signals

- One 8 inputs ADC and 10 DACs
- Monitor of Power Supply lines for front-end boards
- Monitor of Power Supply lines for minicrate boards
- Readout of pressure values in the chamber
- Set of operational parameters in the front-end boards (threshold, bias,…)
- Readout of various temperatures in the chamber and in the minicrate
- 3 I2C ports for front-end boards,1 RPC and 1 alignment system
- Test pulse sequence control



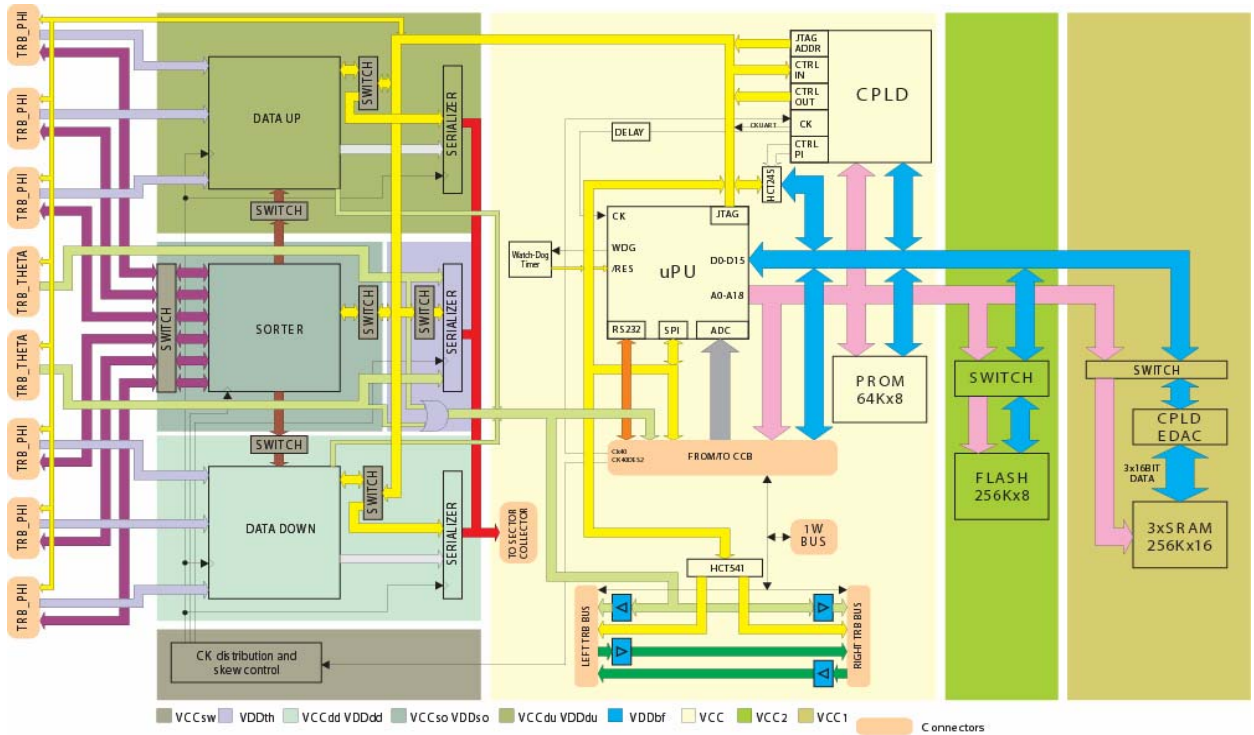
DTCCB – Power Management Features

- On/Off to different boards and to sections of the board itself
- Different VCC planes individually monitored
- Voltage regulators FAULT signal detection & recording
- Individual Faults don't compromise complete CCB functionality

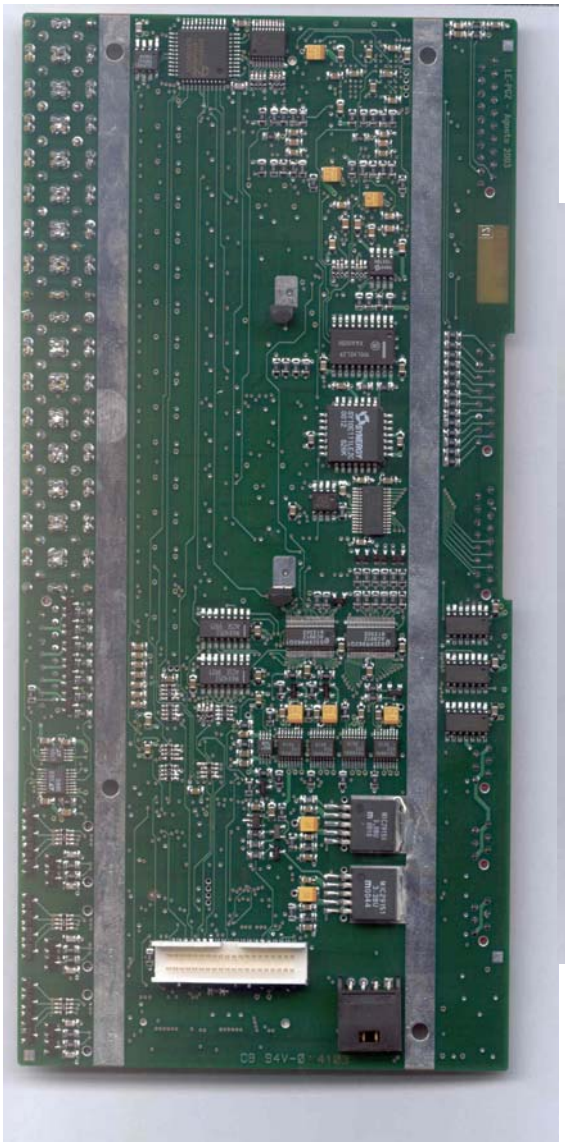


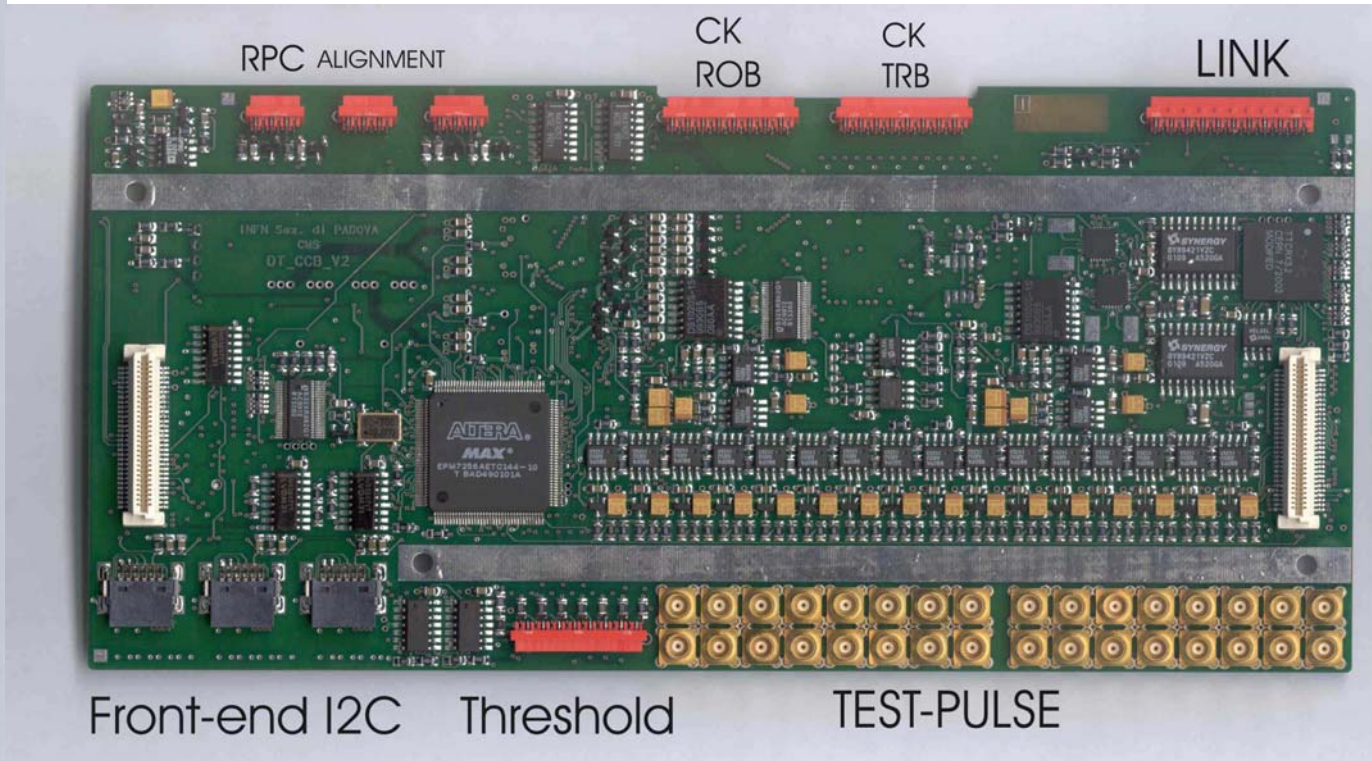
DTCCB – ASICs Interface

- JTAG I/F for programming the Trigger Board and Readout Board
- Independent JTAG chains for the Trigger Board and Readout Board
- 4 bit addressable JTAG bus (max. 16 boards)
- Fast Parallel I/F for accessing Trigger Board (e.g. loading of lookup tables, etc..)
  - Shares the Trigger Data Path

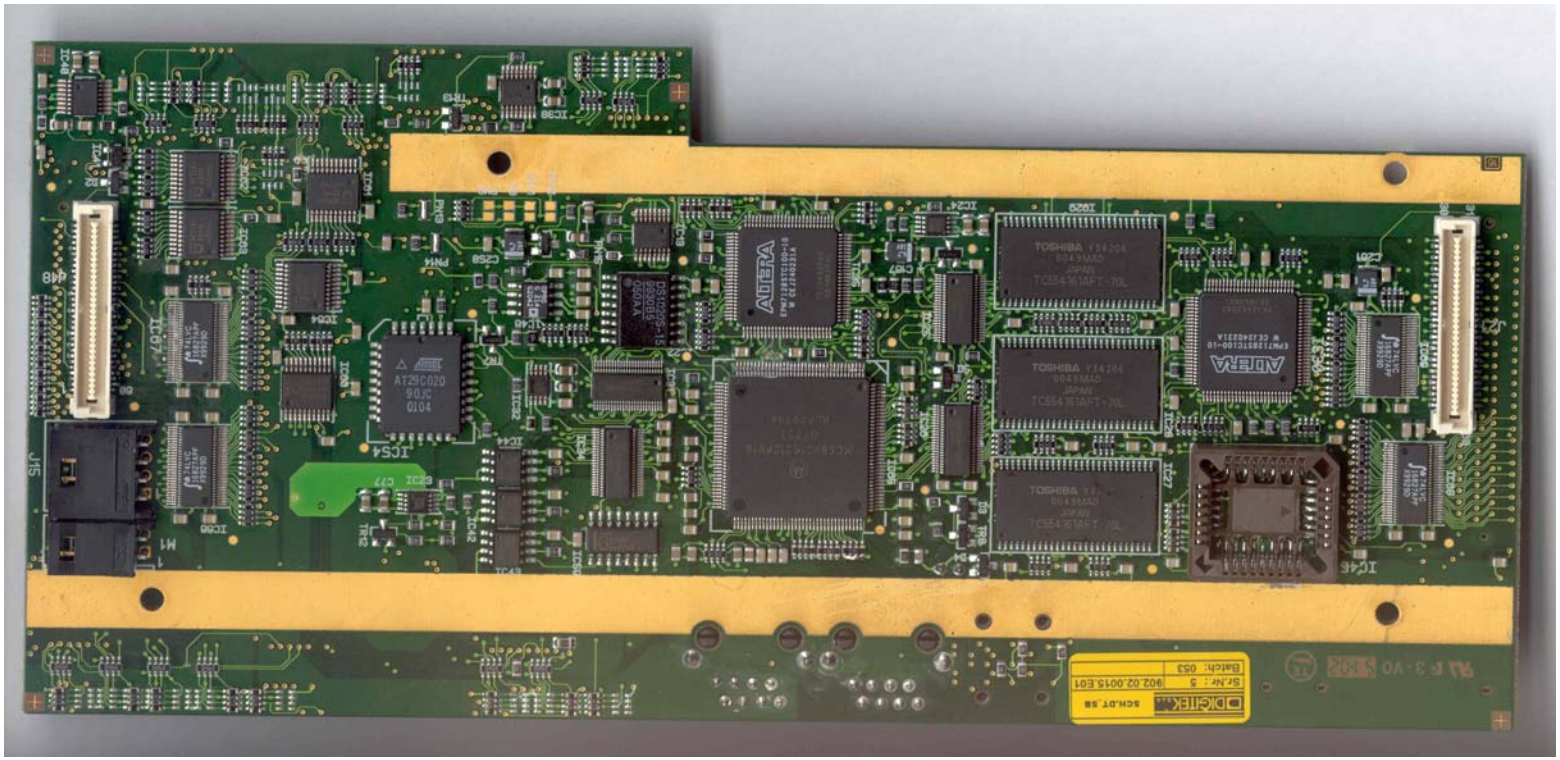


DTCCB Printed Circuit Boards

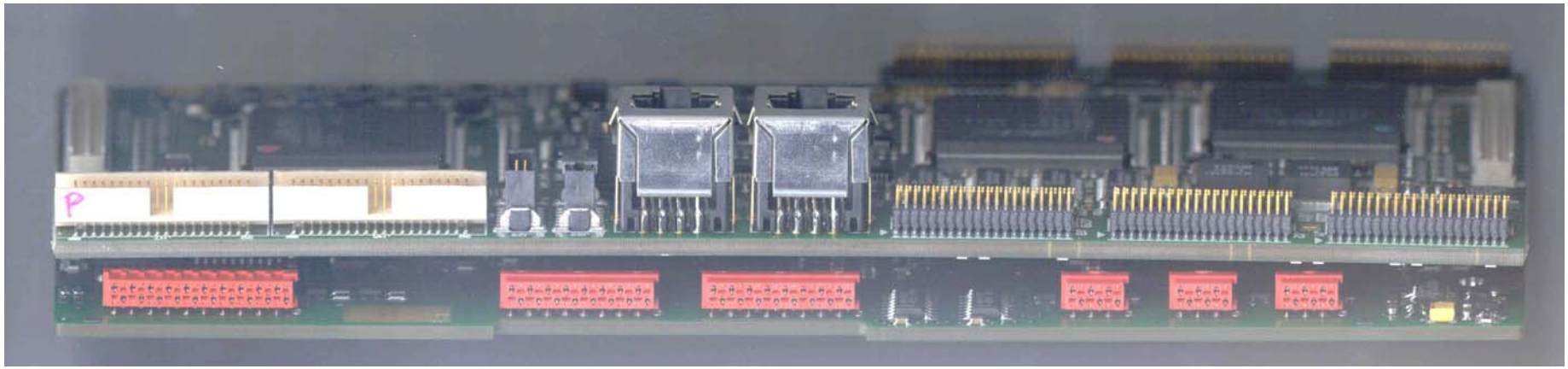


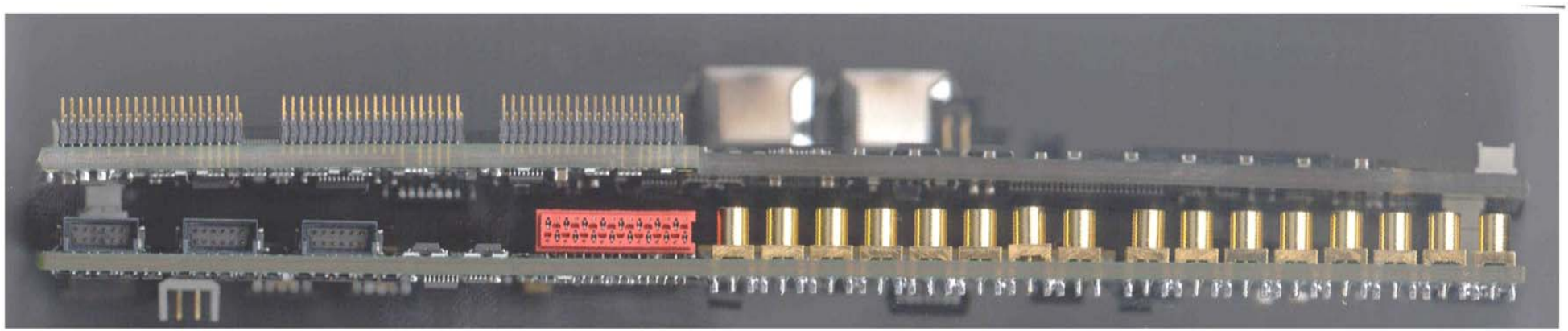


DTCCB Printed Circuit Boards



CCB + SB





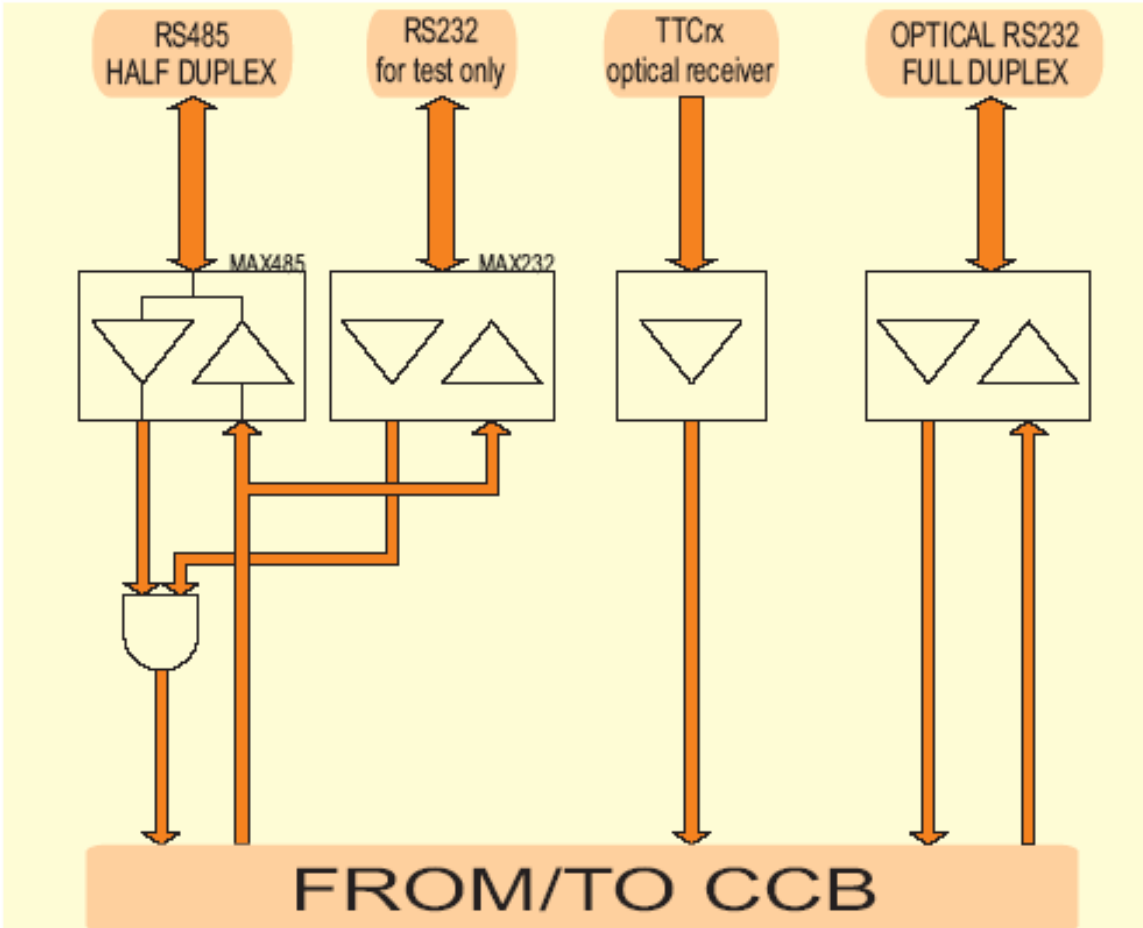
CCB Status and Tests

- Six prototypes fully working
  - Design has been validated during May03 testbeam with full MB1 minicrate operation
- Ready for production
- Acceptance tests
  - Performed as part of full minicrate production tests
  - Minicrate tests exercise all the functionalities of CCB
- Qualification tests
  - Almost all components have been irradiated and qualified with an earlier CCB version
  - Few components (due to engineering changes) still need to be tested
  - A full CCB test under protons planned before mass production (Nov. 03)
- Burn-in test planned with CCB powered and clocked

Link Board

Essentially a level translator for the CCB communication channels :

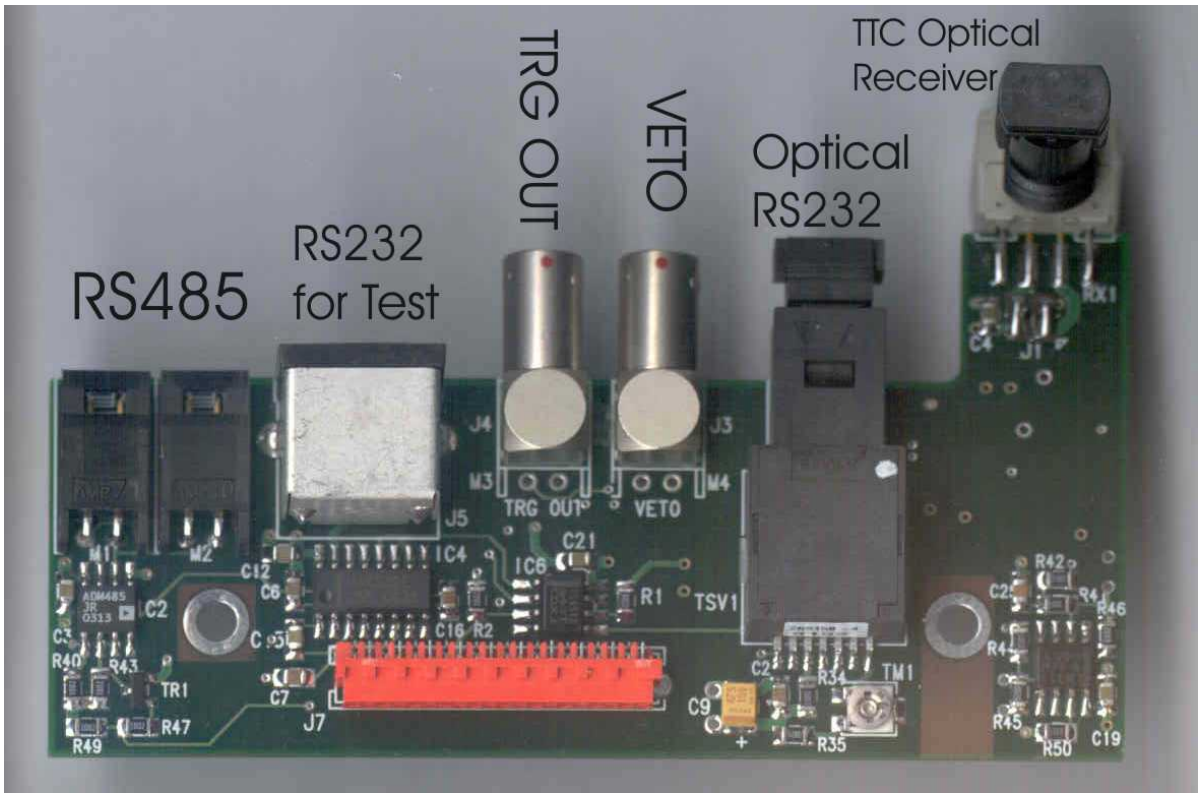
- TTC optical receiver
- DCS main channel optical transceiver
- DCS backup channel electrical rtx
- Service channel transceiver

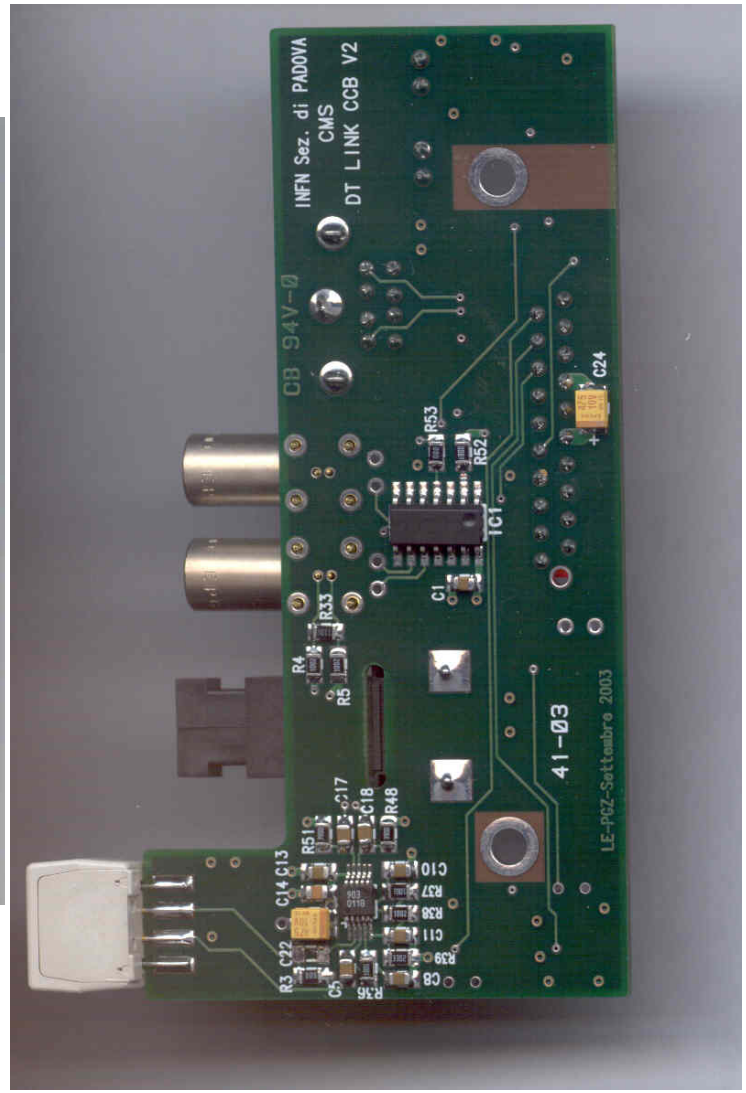


Link Board Status and Tests

- Two prototypes fully working
  - Design has been validated during May03 testbeam with full MB1 minicrate operation
- Ready for production
- Acceptance tests
  - Performed as part of full minicrate production tests
  - Minicrate tests exercise all the functionalities of Link Board
- Qualification tests
  - All components have been irradiated and qualified with an earlier LB version
  - A full Link Board test under protons planned before mass production
- Burn-in test planned

Link Board PCB



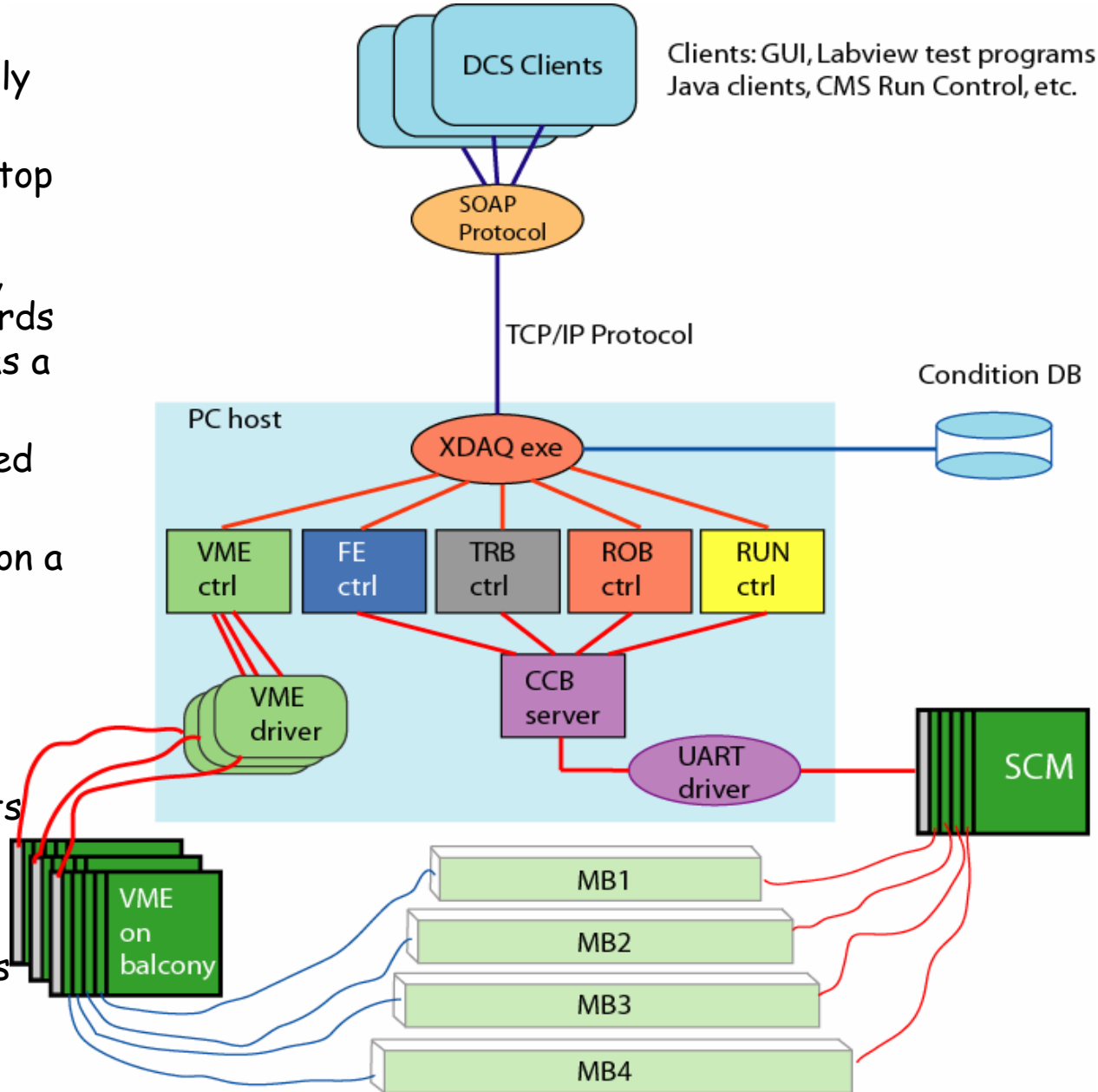


Software Components

- Control Board Firmware
  - Boot sequence, local monitoring, SEU checking, DCS communication
- DTSCM Firmware
  - Transparent bridging of 260 optical serial communication channels
- DCS run control
  - Minicrate setup, online monitoring, alarms
  - Sector Collectors setup and monitoring
  - ROS setup and monitoring
  - DDU setup and monitoring
  - TTC setup and control
- Condition Database logging
- High Voltage and Low Voltage setup and monitoring
- Gas and pressure gauges monitoring (CERN provided)
- Rack monitoring (CERN provided)
- Graphical User Interface(s)

Software Layout-1

- Muon Barrel Slow Control built essentially around the embedded MC controller
- A software "backbone" is being built on top of XDAQ environment
- All MC related tasks (Front-end control, Trigger boards control, Readout boards control, alignement, ...) can be seen as a set of XDAQ classes
- Communications with hardware are routed through a software server to SCM
- Controls of VME crates on balconies is on a different path w.r.t. to MCs
- Clients are of different natures and purposes
  - Graphical User Interface
  - Labview programs for MC local tests
  - CMS Central Run Control
  - Any Java/C++ client
- Any client can access the XDAQ objects through SOAP



Software Status

- Control Board Firmware — OK
  - Boot sequence, local monitoring, SEU checking, DCS communication
- DTSCM Firmware — OK
  - Transparent bridging of 260 optical serial communication channels
- DCS run control
  - Minicrate setup, online monitoring, alarms — Testbeam version
  - Sector Collectors setup and monitoring — Testbeam version
  - ROS setup and monitoring — Testbeam version
  - DDU setup and monitoring — NO
  - TTC setup and control — Testbeam version
- Condition Database logging — NO
- High Voltage and Low Voltage setup and monitoring — Testbeam version
- Gas and pressure gauges setup and monitoring — CERN provided
- Rack monitoring — CERN provided
- Graphical User Interface(s) — NO

Hardware Status

• Chamber Control Board (CCB)	Ok ready for production
• Optical fibres	In procurement
• Slow Control Master	Prototyping
• High Voltage Crate Controller	Prototype from CAEN
• Low Voltage Crate Controller	Prototype from CAEN
• VME Controllers on balconies	SBS-618 ??

2004 DCS plan vs. manpower

- Hardware
  - CCB mass production — OK
  - SCM completion of prototyping — OK
  - Purchase of fibres — TBD
  - Choice of VME Controller for balconies — TDB
- Software
  - Start of migration of CCB related subtasks to XDAQ — TBD
  - CCB UART server — OK
  - PVSS prototype for HV and LV Caen Controller — OK
  - Start of GUI development — TDB