

ALICE Trigger System



Features

Overall layout

Central Trigger Processor

Local Trigger Unit

Software

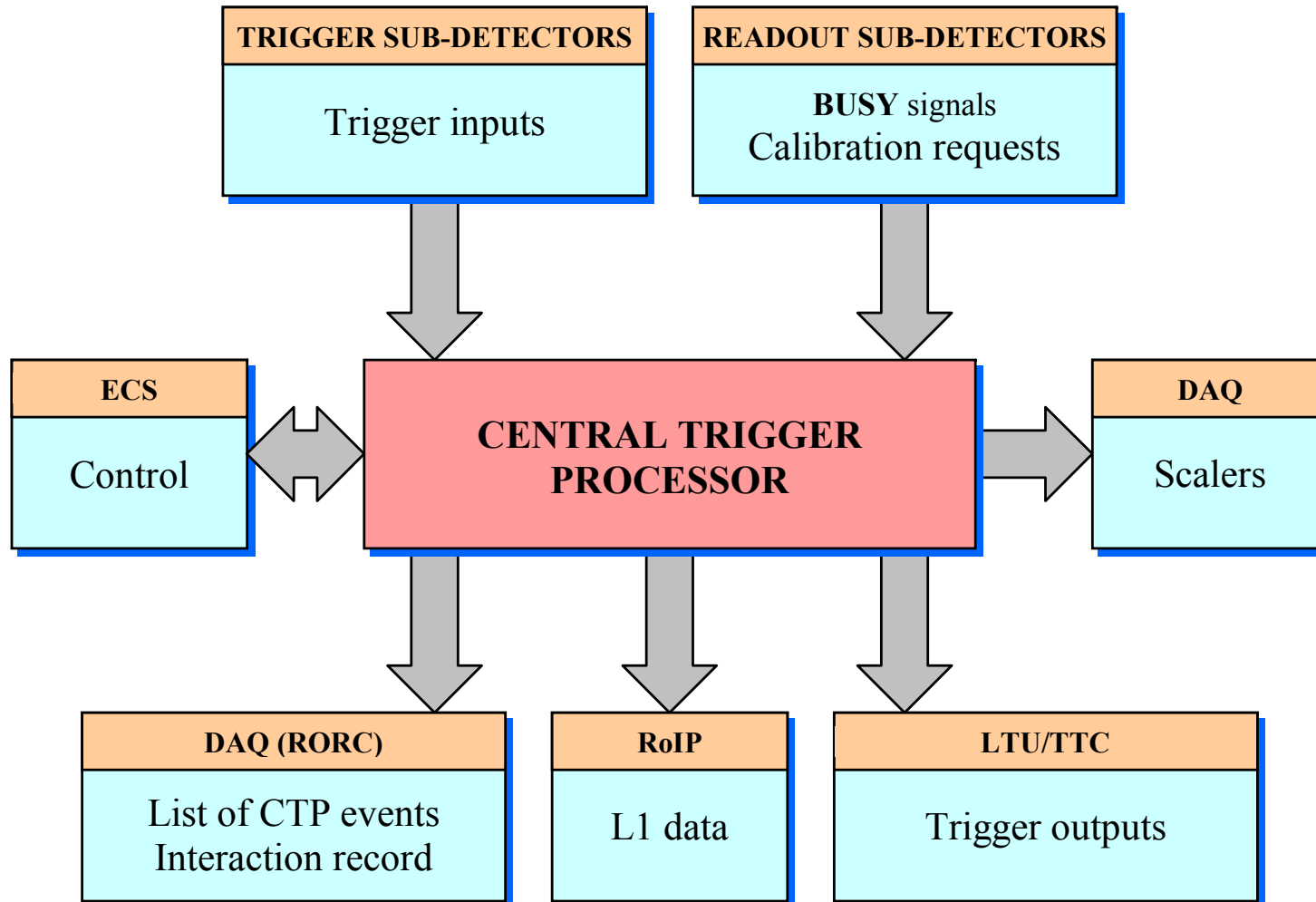
Current status

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O. Villalobos-Baillie

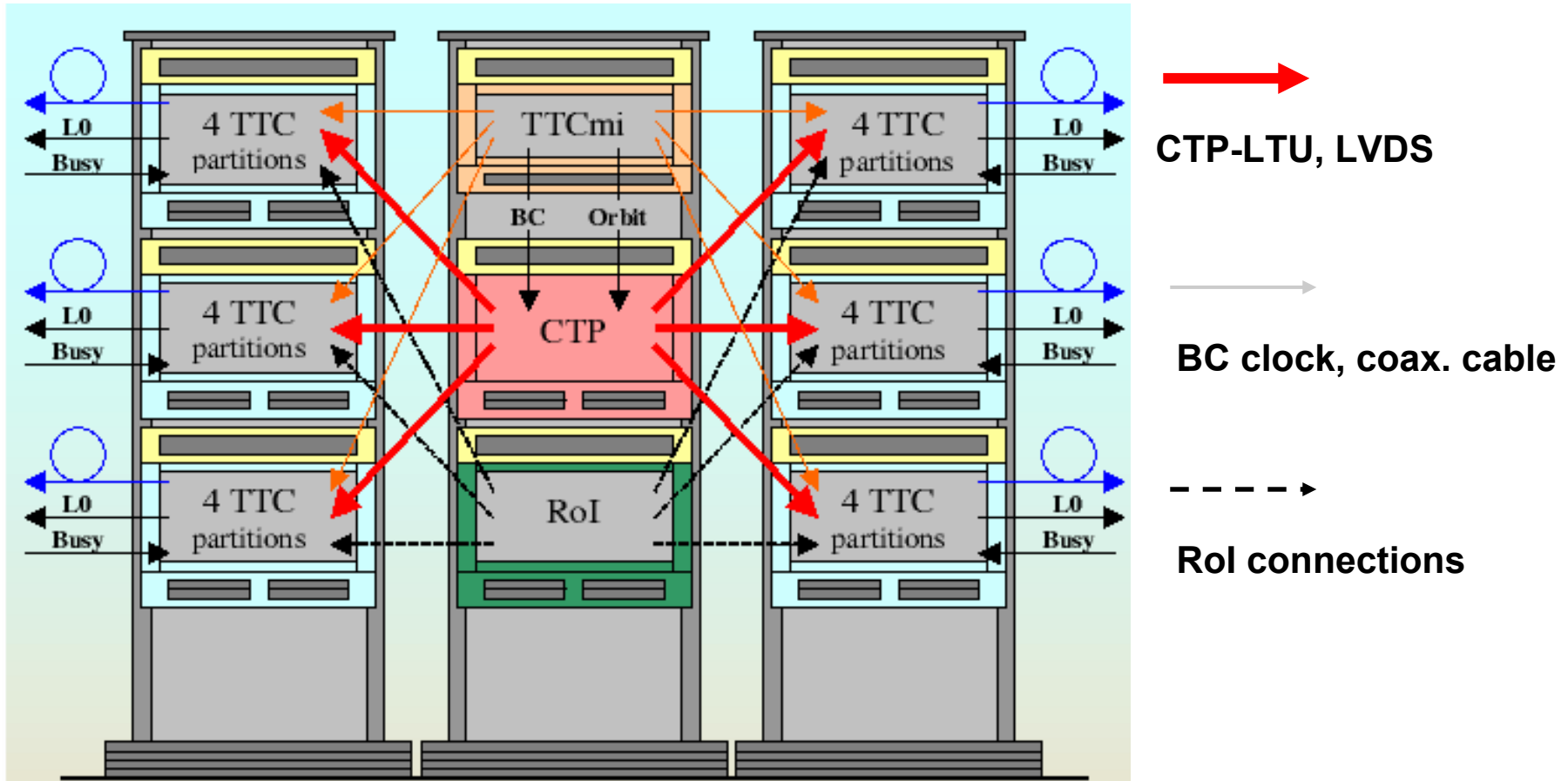
Features

- **3 decision levels:** L0: 1.2 μs , L1: 6.5 μs , L2: 88 μs
- **Parallel decisions** at each level –different groups of detectors (clusters) are reading out different events at the same time
- All the readout detectors (max. **24**) are partitioned in up to **6** dynamically partitioned independent detector clusters
- **4 past/future** protection circuits for each decision level shared among all detectors, which protects the system against pile-up
- **50 trigger classes** (combination of input signals and trigger vetos) for each level
- 24 L0 trigger inputs
- 20 L1 trigger inputs
- 6 L2 trigger inputs

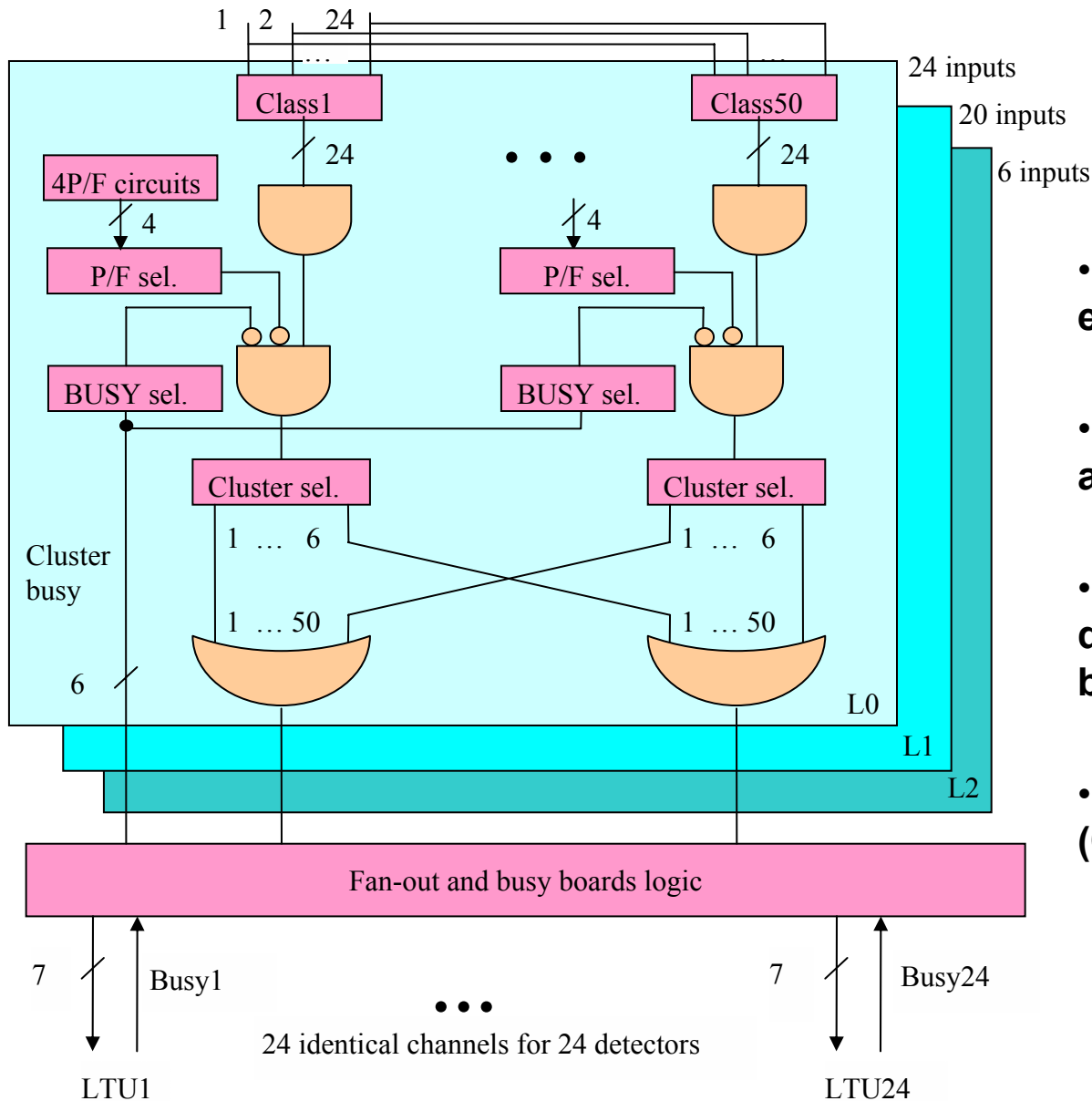
Overall layout



Connections



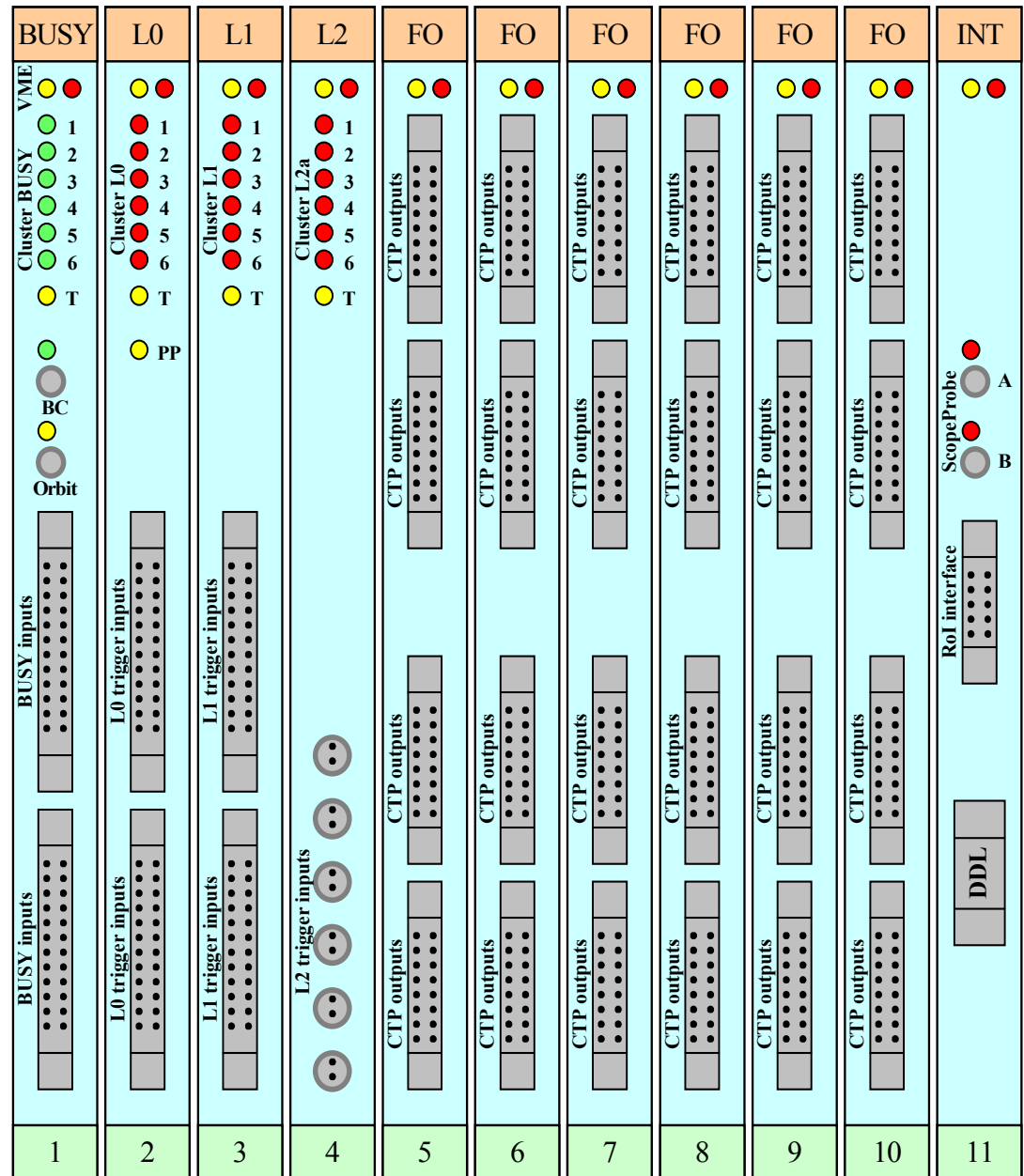
CTP logic



- 50 programmable trigger classes for each level (AND of trigger inputs)
- past/future protection circuits shared among all classes
- BUSY veto replaced by delayed decision from previous level on L1, L2 boards
- On the output, classes are combined (OR) to detector clusters

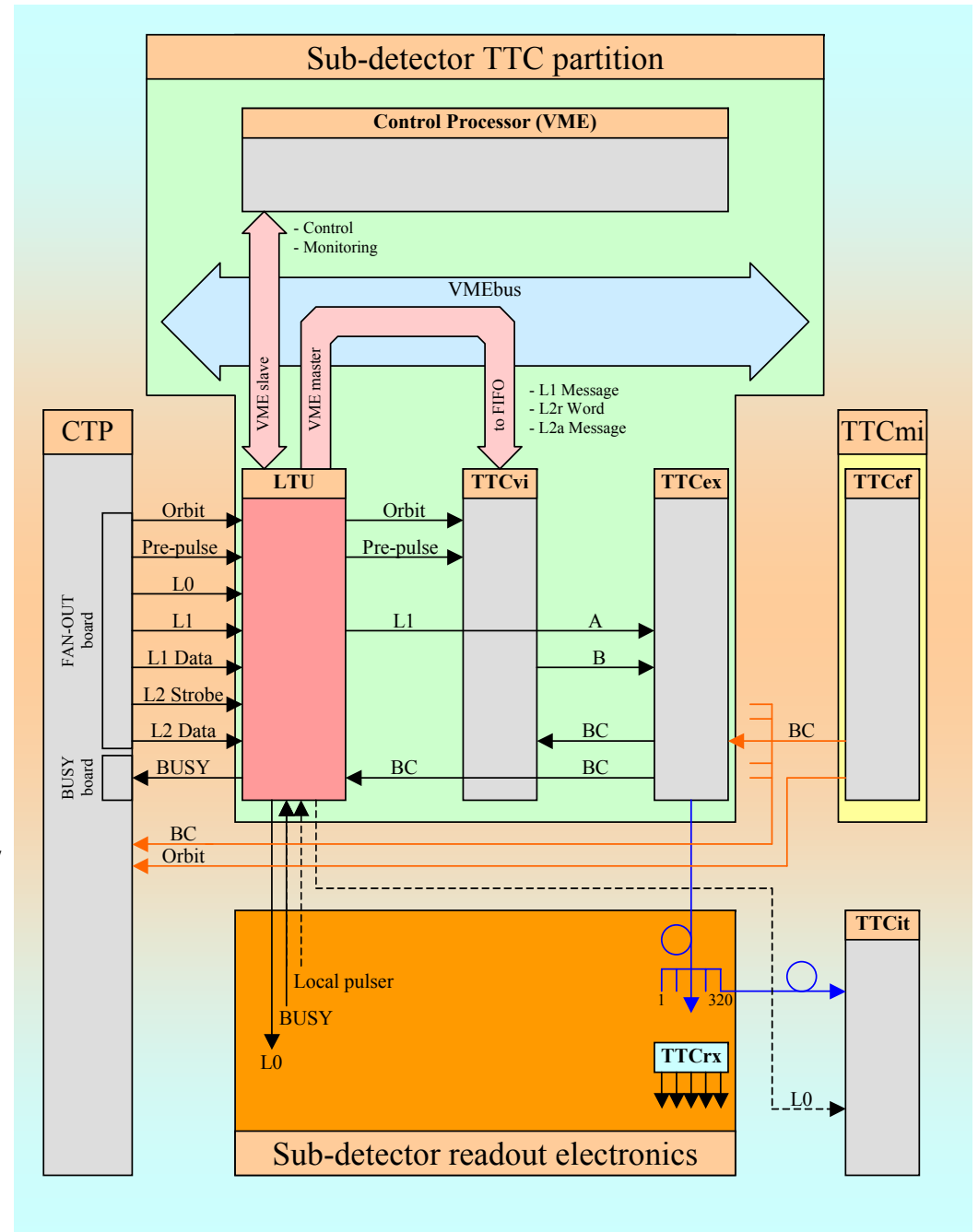
CTP partitioning

- 11 6U VME boards connected by special backplane
- 6 passive fan-in boards of 6U VME size (not shown on the picture) for:
 - L0 inputs (2)
 - L1 inputs (2)
 - BUSY inputs (2)

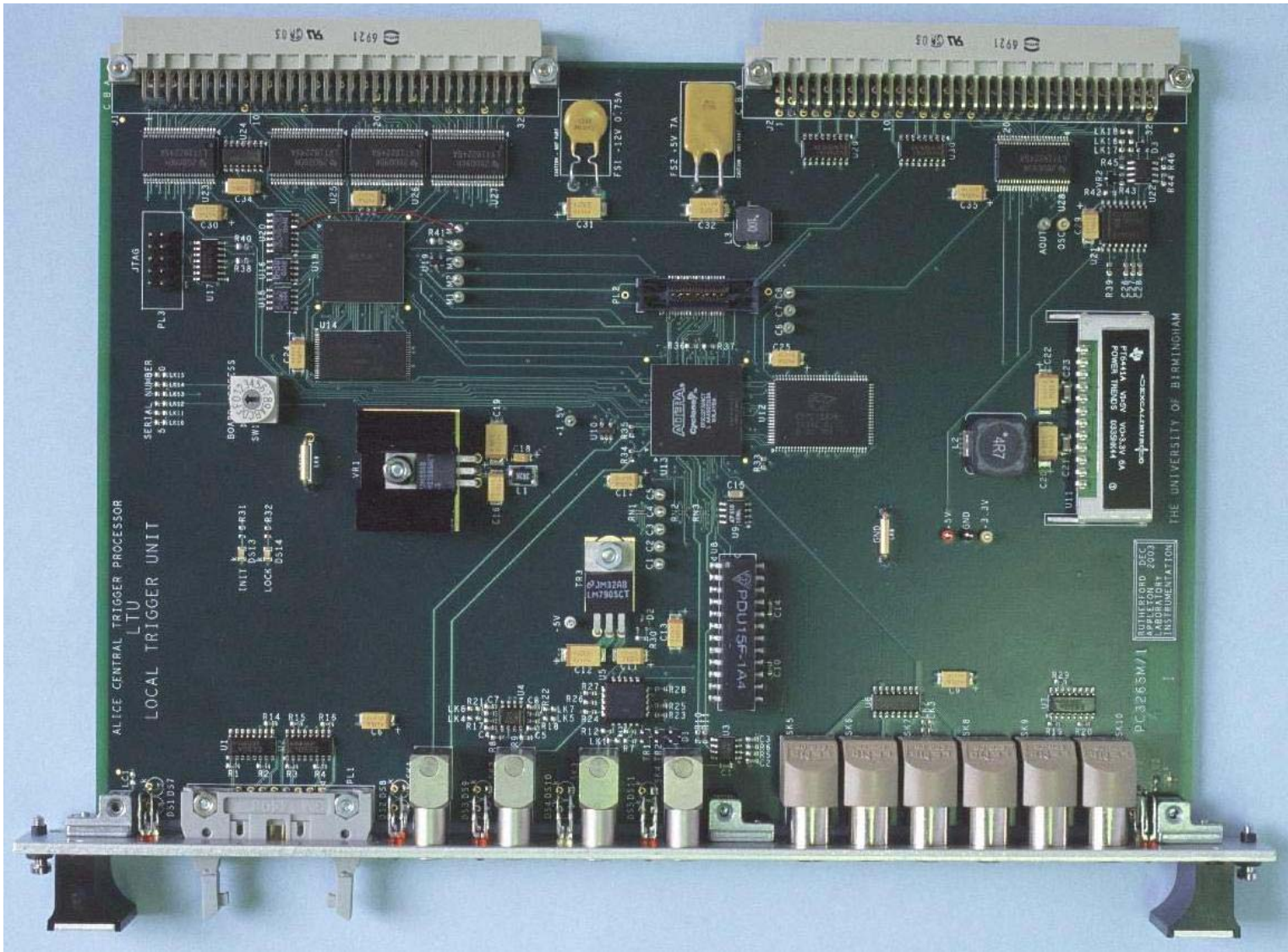


Context diagram of LTU

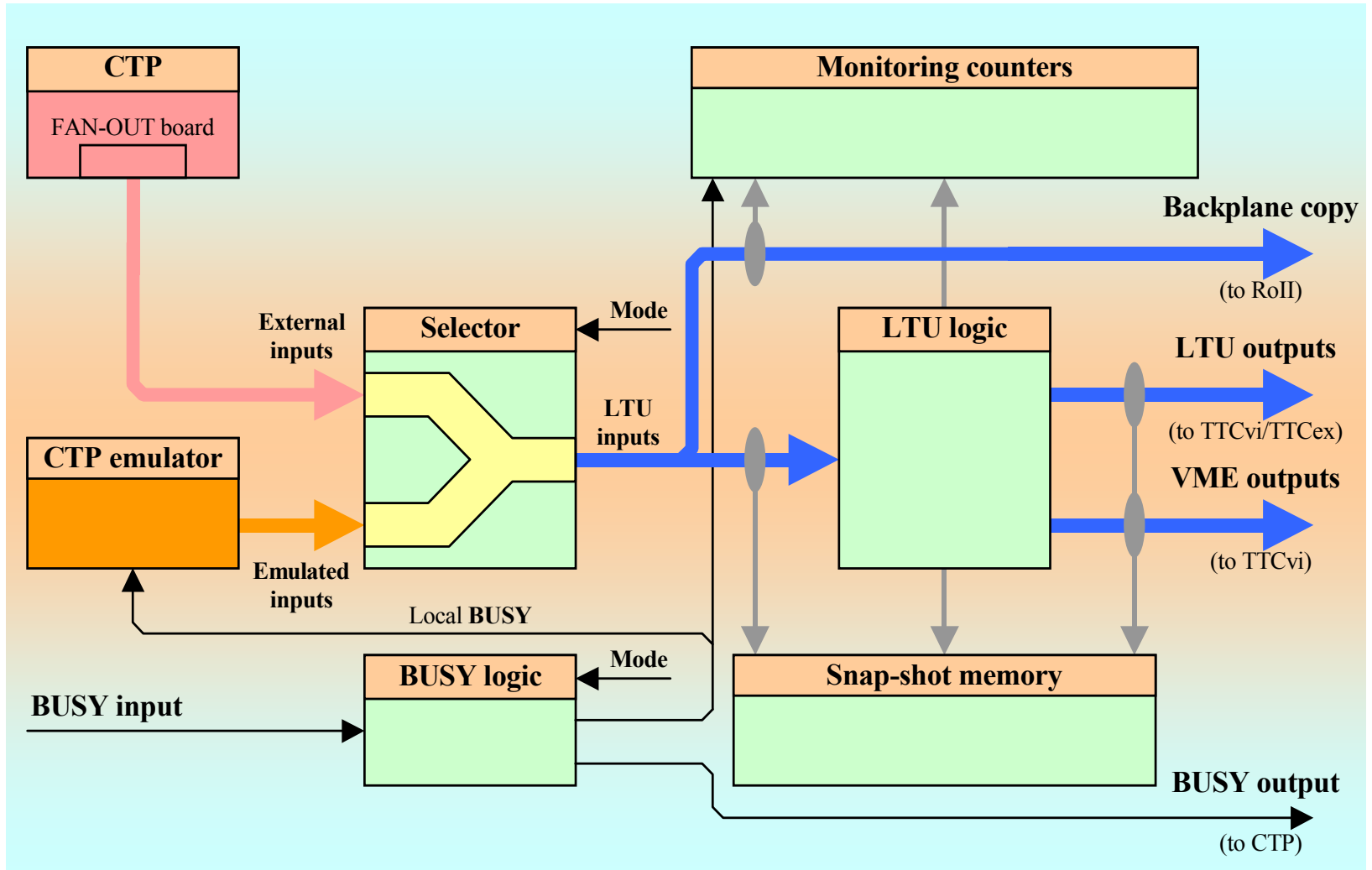
- Up to 4 TTC partitions configured by 1 SBC in 1 crate
- TTC partition controlled by LTU through its VME master interface and I/O connections
- GLOBAL (DAQ) mode: LTU is controlled by CTP
- STANDALONE mode: LTU is controlled by on-board CTP emulator
- The same front-end interface in both modes (L0, BUSY, FO)



LTU board



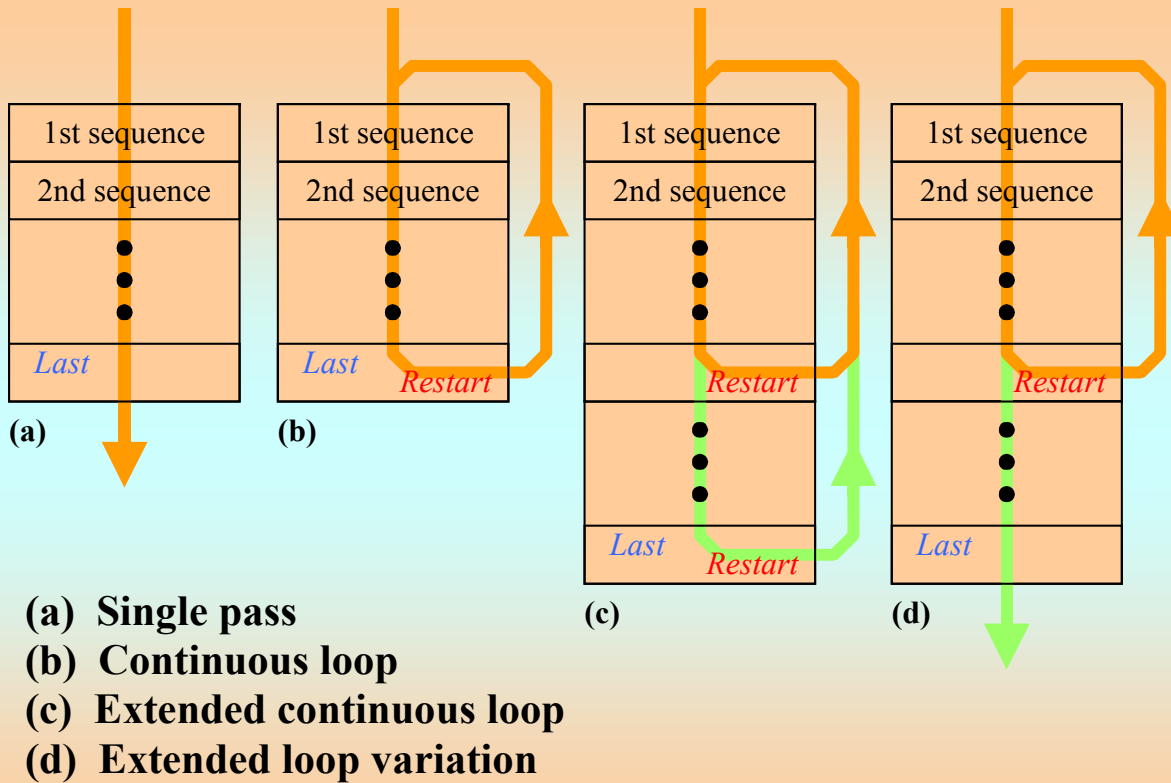
LTU block diagram



CTP emulation

- Together with selector, it allows **STANDALONE** mode operation, presenting the same FE interface as in **GLOBAL** mode
- 7 legal sequences
- Programs of max. 32 sequences are prepared in emulator memory. L1 and L2 data are fully programmable
- Sequence execution triggered by **Start signal** derived from BC scaled down, random generator, external pulser or software request
- **Error prone flag** enables programmable random or 'on demand' errors with chosen sequences in order to allow the FE electronics testing for error recovery

LTU sequences



Possible sequences:

L0

L0 - L1 - L2a (DAQ)

L0 - L1 - L2r

PP

PP - L0

PP - L0 - L1 - L2a

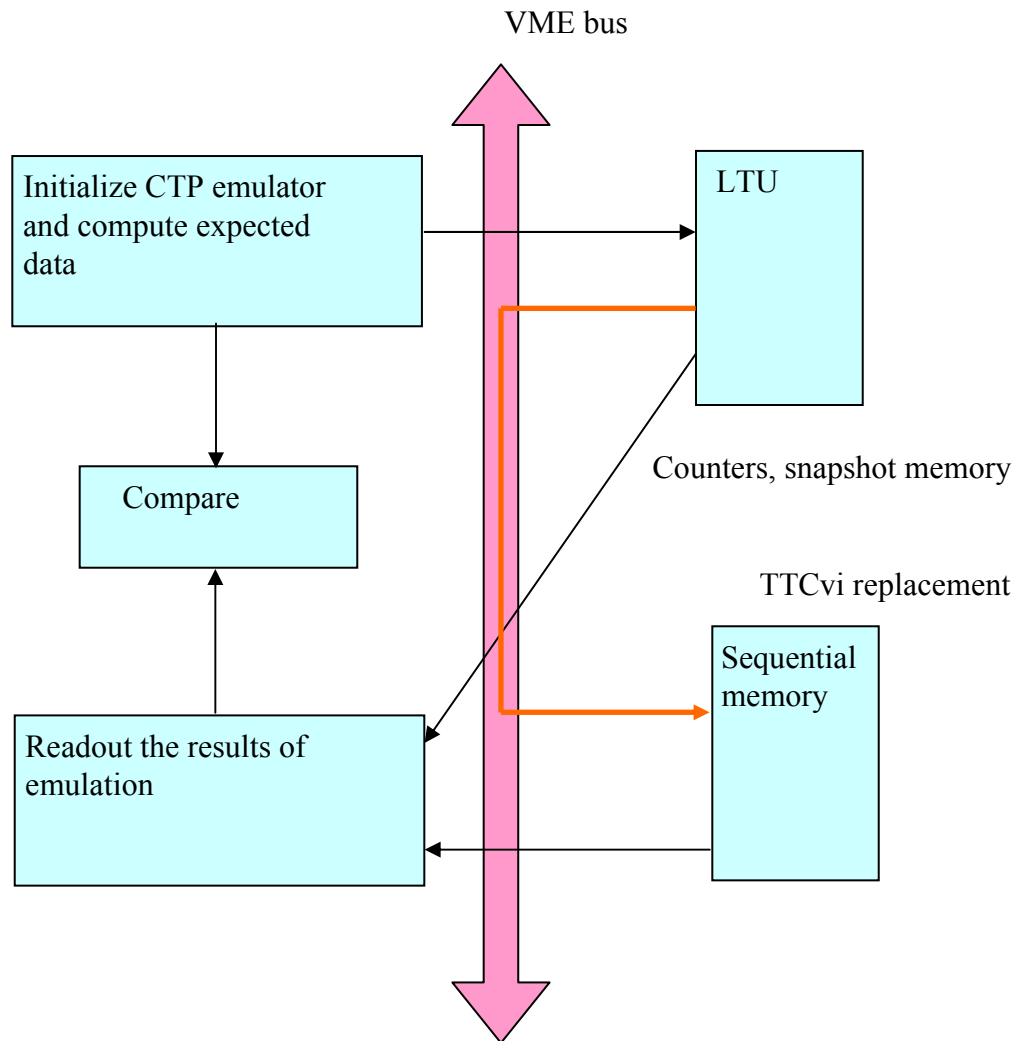
PP - L0 - L1 - L2r

Erroneous sequences:

L0 - ~~L1~~ - L2a

PP - L0 - ~~L1~~ - L2r

LTU testing, just completed



- I/O tests – front panel connectors, backplane connector - I2C bus and Roll connections
- Functional tests with CTP emulator, the TTCvi was replaced by VME board with large sequential memory where data sent to B-channel of TTC were caught

LTU software

The control software for the LTU is ready. It is a subset of the software prepared during LTU development and testing. It is written in **Python/Tkinter** and **Tcl/Tk (GUI)** and **C (VME interface)**.

Platforms:

- VME SBC CCTVP110, **Linux/VMERCC** or CCT driver
- VME SBC Motorola, **AIX**
- PC + NI VME MXI cards with **Windows/VISA** possible

In addition to LTU control, SW supplies GUI for limited TTCvi control.

The same SW framework will be used with CTP boards

LTU software -example

The screenshot displays the LTU software interface with several windows:

- multreg itu:** A window showing various counters and their values:

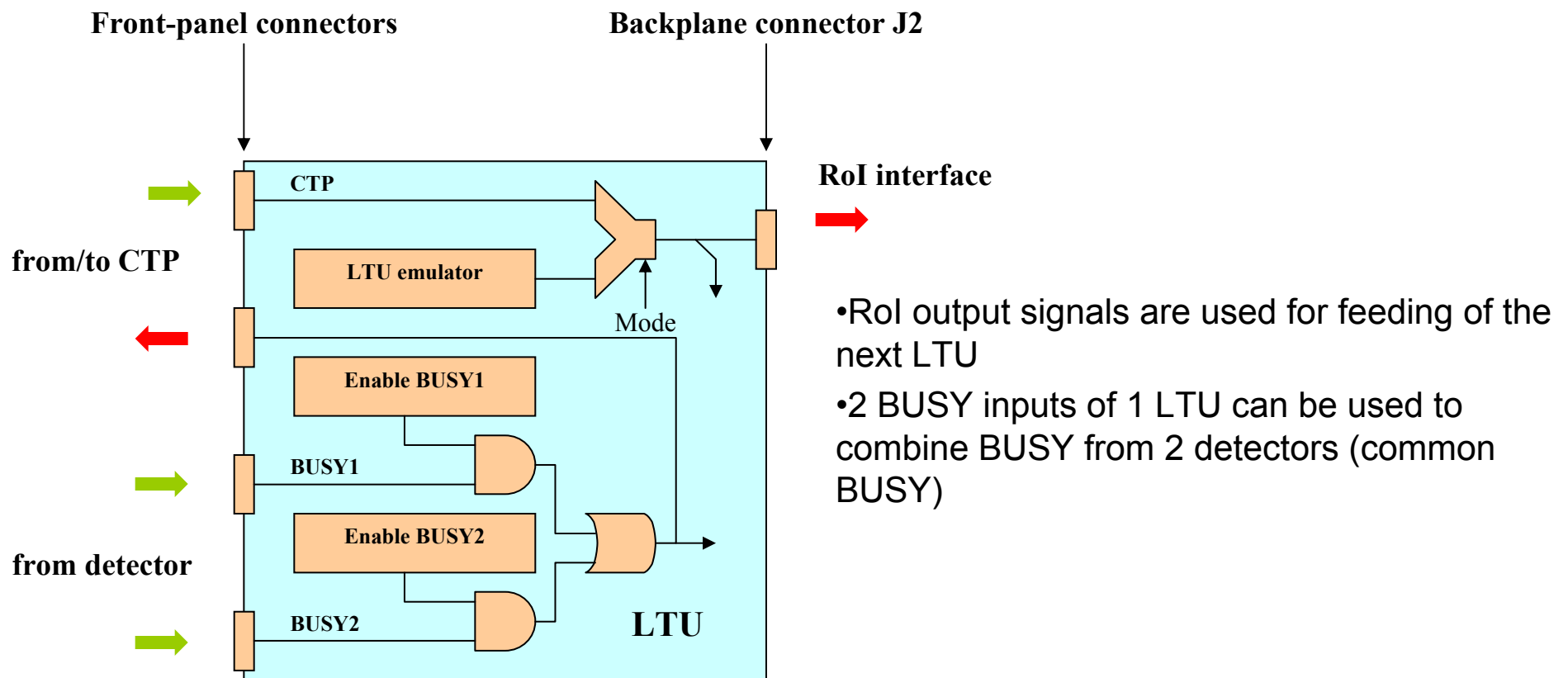
L1FIFO_COUNTER	0
L2FIFO_COUNTER	0
PP_COUNTER	0
L0_COUNTER	34485
L1_COUNTER	28742
L1sCOUNTER	30381
L2aCOUNTER	16422
L2rCOUNTER	15601
START_COUNTER	34485
BUSY_COUNTER	0
BUSY_TIMER	0
SUBBUSY_TIMER	0

Buttons: read, periodic read, quit. Address: CODE_ADD, Clear.
- CTP emulator:** A window for configuring the CTP emulator. Sequence: L2a1. Errors enabled. Error signal rate: 0x7ffff. Error generation allowed for: L1. Error on demand: Pre-pulse error, L0 error, L1 error, L1 Message error, L1&L1 Message error, L2a Message error, L2r Word error. L1 message format: Complete L1m, LHC Gap Veto OFF. Automatic START signal selection: not selected. Generate 'Start signal(s)' # of signals: 1, spacing[ms]: 0. Buttons: Start emulation, Break emulation, Quit emulation.
- Snapshot memory:** A window for snapshot memory configuration. Start After, Start Before, Scheduled start: Start After when StartSignal Selected. Buttons: Stop, Dump, Show.
- xterm:** A terminal window showing the following output:

```
0: VMES/3
29: VMES/5
1237: ORBIT/40
2591: ALLSTART/1
2593: L0
2818: L1S
2818: ANYERR
2818: L1DATA:009.555.400.000.004 TrC1: 0x2555500000001
2842: VMEM/14
2845: TTCMS:10 L1h
2845: TTCLS:09
2869: VMEM/14
2872: TTCMS:25 L1d
2872: TTCLS:55
2897: VMEM/14
2900: TTCMS:24 L1d
2900: TTCLS:00
2925: VMEM/14
```

Testbeam setup

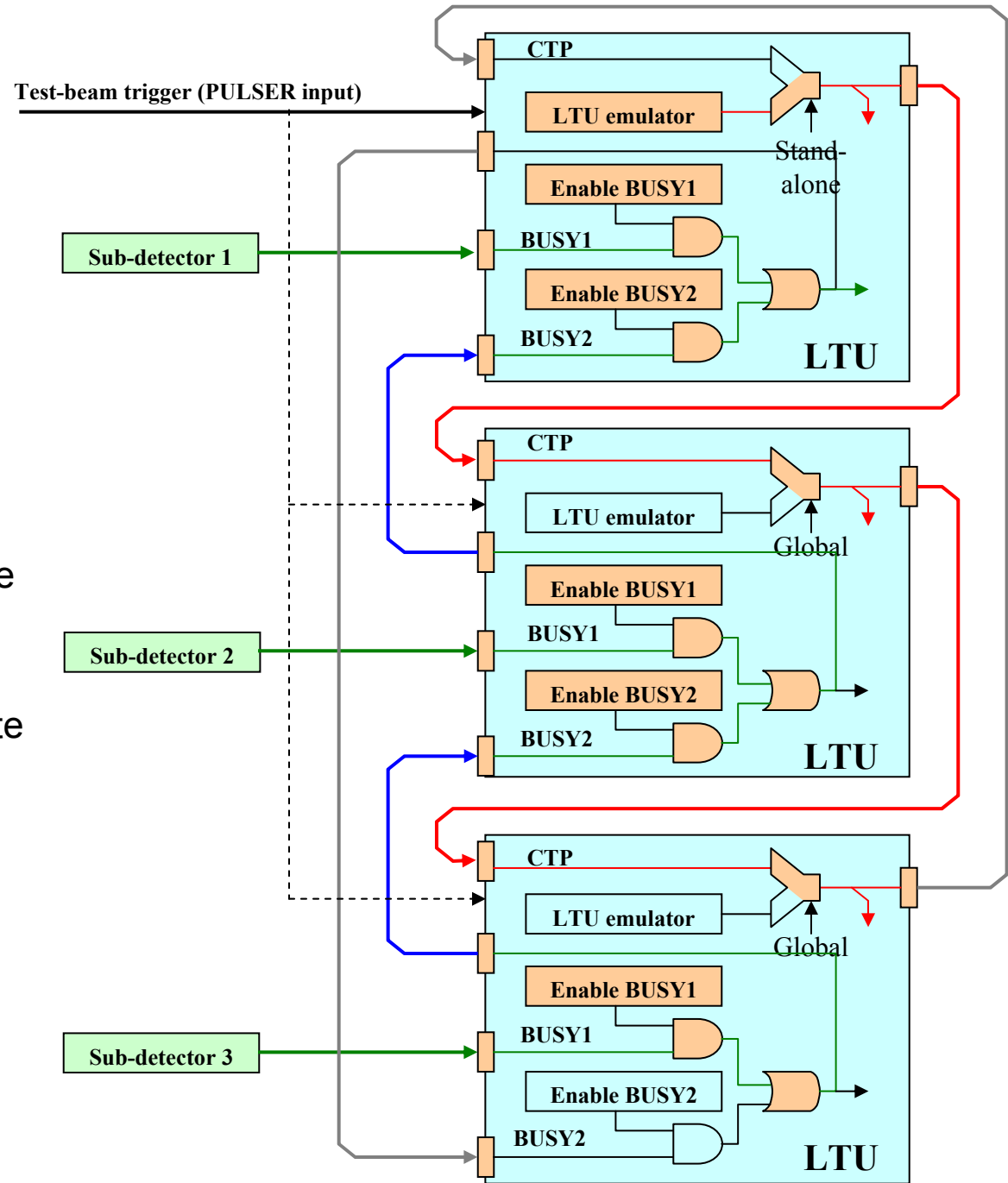
Simplified block-diagram of LTU



- RoI output signals are used for feeding of the next LTU
- 2 BUSY inputs of 1 LTU can be used to combine BUSY from 2 detectors (common BUSY)

Testbeam setup

- Thanks to programmability of busy logic and LTU Mode, any LTU can become Master (CTP emulator) by simple reprogramming of LTUs
- If trigger is connected to all the LTUs, the exclusion of any detector is possible **without recabling**
- **Advantage:** all the three LTUs operate together, without additional hardware.



Current status

- 53 LTUs manufactured and tested, prepared to be used for tests with front-end electronics
- 3 LTUs are going to be used together in October combined Inner Tracking Subsystem test
- The ALICE CTP is being developed, first set of boards expected at the beginning of next year