Status of L0 Trigger in a FPGA implementation Update from Torino

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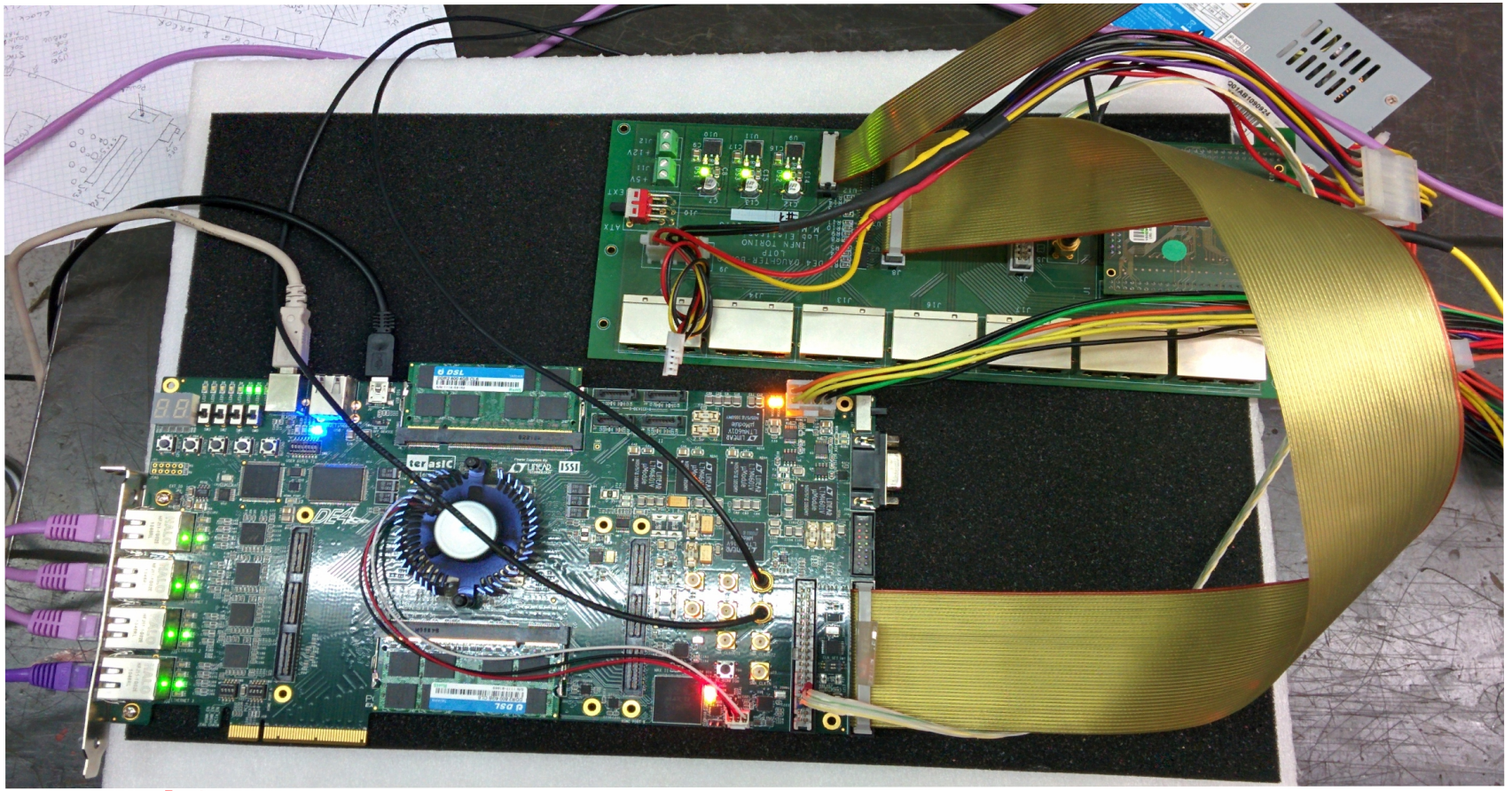
Status of Hardware

- 1 DE4 installed @ CERN;
- 1 DE4 board in Turin;
- 1 DE4 to create a station for development in Turin: ordered;
- Daughter cards to add ethernet connections (from 4 to 8): ordered;
- Crate for DE4 board and TTCrx daughter card: to be done.

Quartus 14.0 linux version and DE4 USB - control interface installed @ CERN

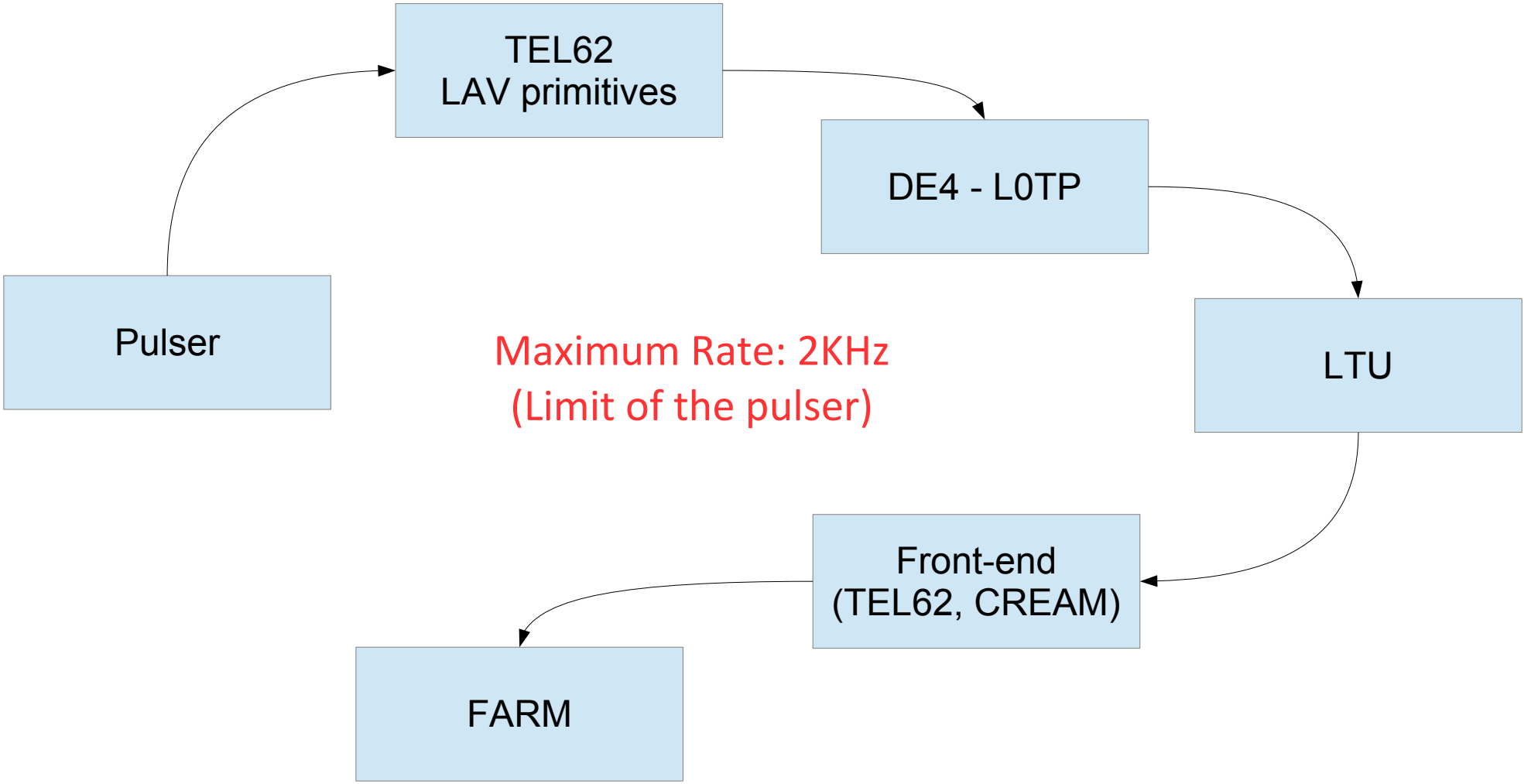
Status of Hardware



Homeless board...it needs a case!

Preliminary Test @ CERN:

- Performed in July;
- Primitives generated by Tel62 with the appropriate format;
- Trigger generated by DE4 and received by LTU – TEL62/CREAM – PC-FARM.



Status of Firmware

- Selected trigger were sent back to detectors and via ethernet to a PC and dumped with WireShark.
- USB communication interface and Debug Monitor developed.
- Added the possibility of periodic random triggers.
- Added the possibility of setting parameters via Run Control:
  - Trigger masks in LUT
  - Latency before triggers are sent to the LTU
  - Number of events in MEP
  - Frequency of random triggers
  - .....

Random trigger

```
Status: 2
> ActivatePeriodicTrigger
Periodic Trigger Active
BURST ON
0
************* BURST OFF ************************************
number of burst                                          : 3
number_of_CHOD_primitives                                : 0
number_of_MUV_primitives                                 : 0
number_of_LAV_primitives                                 : 0
Refering Detector: CHOD
number_of_triggers CHOD and not(MUV)           : 0
number_of_triggers CHOD and LAV3 not(MUV)      : 0
number_of_triggers CHOD and LAV2 not(MUV)      : 0
number_of_triggers CHOD and LAV1  and not(MUV) : 0
Refering Detector: LAV
number_of_triggers LAV1          : 0
number_of_triggers LAV2          : 0
number_of_triggers LAV3          : 0
number_of_MEP_sent                                       : 0
latency time:                                            : 0.8 ms
SENDFIFOFULL                                             : 0
FIFO2FULL                                                : 0
n of chokes                                              : 0
n of errors                                              : TO BE IMPLEMENTED
periodic triggers                                        : 5509
n of triggers sent to LTU                                : 5509
************************************************************
Status: 2
```

MONITOR DE4
(1 KHz Random trigger)

LAV4 TEL62
(975.5 kHz random trigger)

```
---------- OUTPUT ------------------------------------------------------------
TX flows: Trig:       3373 Data:    1347384 SPI3RX:        0 TXMEM:         0
TX ports: 0:          3382 1:       1351016 2:             0 3:             0
GbE TX pause: Trig:      0   Data:      0   Time:        0 ms
Last pkt words:      16 (<= 64 bytes)
[IDLE]TDSpy>slstatus
---------- SL-FPGA
Mode: RUN    Status: 0x000401fd
Error:  0x40000200 [ TRDIS BURST ]
Running since: 65535 s (42823 bursts)  Burst: OFF  TS at last EOB: 0x0d22f757 (
5.51 s)
QPLL lock: OK  Lock lost: 0 (    0.00 us)  TTC: Ready
TTC: Broadcast FIFO: 244   IAC FIFO: 0   Single err: 0   Double err: 0
TTC Triggers:    5374717   Timestamp:   0 [E  ] Max:   1 [  ]    (975.5 kHz)
TTC Messages:    5374717   Trig type:   0 [E  ] Max:   1 [  ]
Trig dispatch:   5374716   Triginfo:    0 [E  ] Max:   8 [  ] Phys:         0
Choke: 0 [PP: 0000 SL: 0 ] Monitor: 0 [PP: 0000 SL: 0] Count:   0 Time:     0 us

Error: - [PP: 0000 SL: 0 ] Monitor: - [PP: 0000 SL: 0]
```

To do – L0 development

- Test with high rates of primitives should be done in stand alone mode (with a DE4 as simulator of TEL) in order to measure the efficiency of the L0TP.
- Ethernet packets to the farm. A preliminary version of them, but it should be completed.
- Extension of the ethernet connection number (4 -> 8).
- Logic for the calibration triggers during the burst.

To do – TEST with complete system

- Test with high rates of primitives with the complete acquisition chain, saving data coming after the trigger decision.
- Reception of the Ethernet packets by the FARM.
- Test of the Choke/Error signals.

L0 – RUN CONTROL

Status

L0 RunControl software – last upgrades

- A program to interface Run Control with DE4 has been implemented
- It can also be used to manipulate the DE4 configuration file (*.xml) to set:
  - some fundamental parameters for DE4 setting-up

[as the time latency between the SOB and the trigger forward to LTU , the number of events in MEP etc]

  - construct the trigger masks

[with simple labels for each detector, which shifters can check during the run]

- Debug Info implementation with two options:
  - Standalone mode

[with a verbose and detailed log for an in-depth DE4 monitoring, thought for L0 shifters]

  - Central Server mode

[with essential information on the DE4 status, which will be displayed on the RunControl monitor]

L0 RunControl software – operational tests

- USB interface with DE4 can manage the following operation:
  - ✓ Upload firmware by a local system call to Quartus
  - ✓ Write parameter (read from the xml configuration file) on register
  - ✓ Write mask on RAM
  - ✓ Send command of “init”, “start”, “stop”, “reset”, “writeParameter”

- Inferface with RunControl system checked in the experimental area

  Properly reception of
  - ✓ configuration files
  - ✓ basic commands as “init”, “start”, “stop”, “reset”, “debugOn”

STILL MISSING : complete list of primitive IDs from each detector to make the definitive Look Up Table of physics triggers in view of the October run.

Back Up Slides

Latencies

Physics triggers suppose a detector as reference (i.e: CHOD). Latency between signal in ref detector and other systems should be taken in account:

- Where set the offsets?
  - It should be done channel by channel in the detector firmware, while the time sent to the L0 should be “absolute”, referred to the start of burst.
  - Dangerous have an time-offset written in L0 for the alignment:
    - It could be different run by run, detector by detector, data-type by data-type...