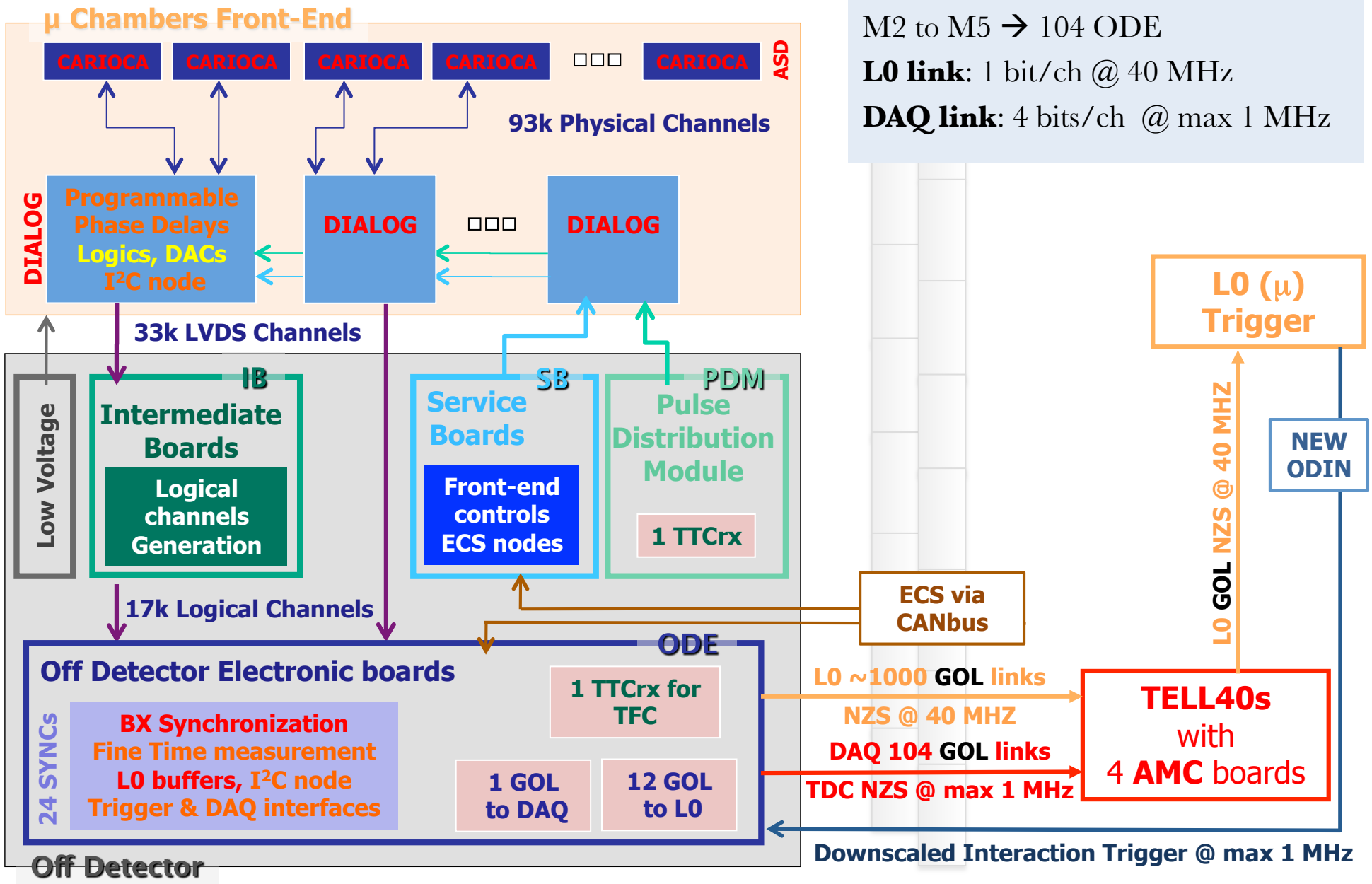
Muon Detector Upgrade

Review of Electronics Upgrade

Outline

- Last news for the architecture foreseen for the upgrade
- ECS hardware: what we are asked to provide for the next Electronics Upgrade meeting (14 October)
- Conclusions

Muon Electronics Upgrade



M2 to M5 → 104 ODE

L0 link: 1 bit/ch @ 40 MHz

DAQ link: 4 bits/ch @ max 1 MHz

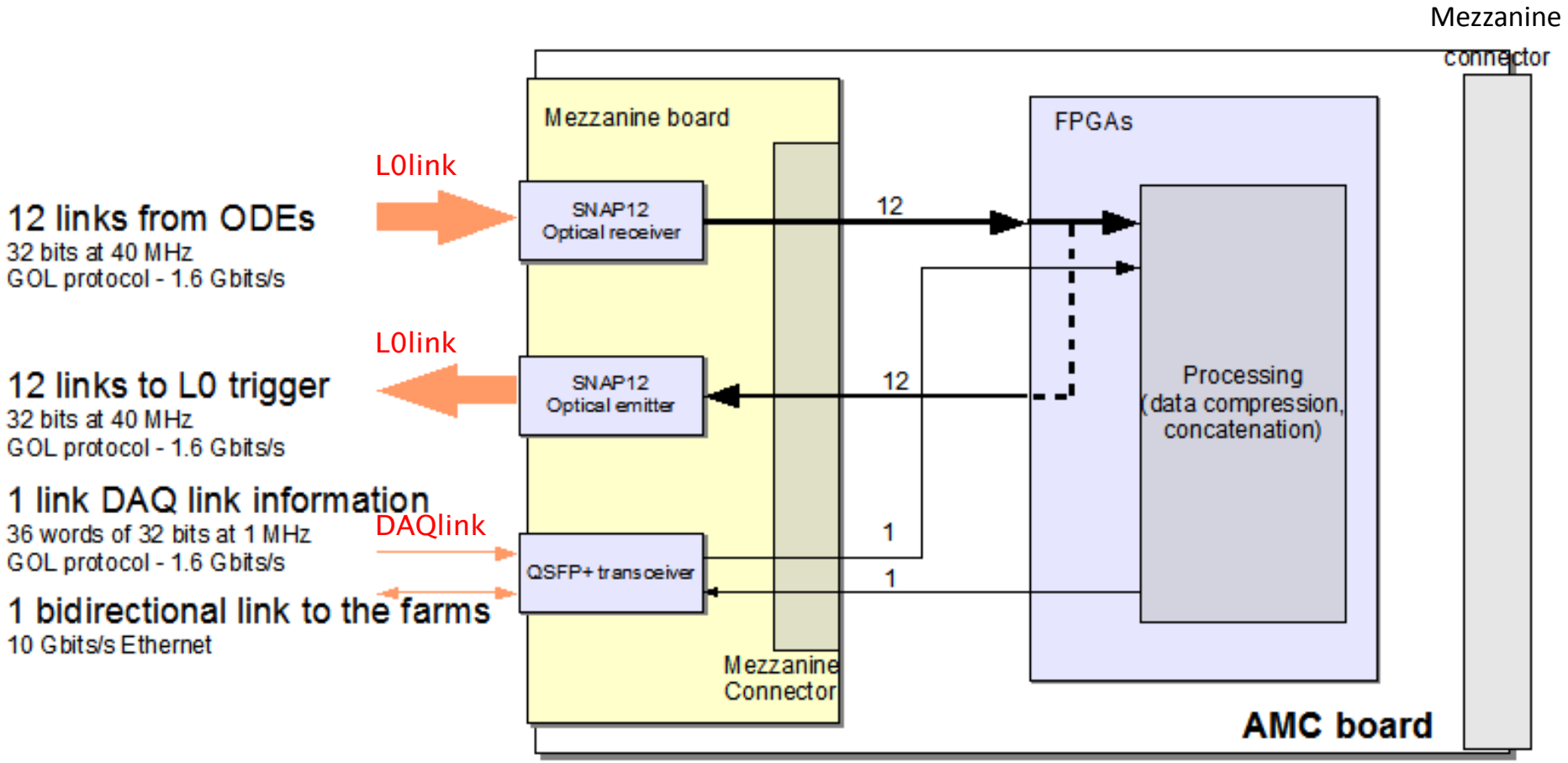
ODE to TELL40

- **Output ODE → Input TELL40**
  1. **L0 links** @ 40 MHz from ODE (GOL data format); NZS 1 bit/channel information
     - 104 bundles of 12 fibers each
  2. **DAQ link** @ 1 MHz from ODE (GOL data format); NZS 4 bits TDC/channel information
     - 104 single fibers (exiting from ODE) → grouped into 24 bundles of 12 fibers each

- Behavior of Muon TELL40 dedicated firmware **(AMC board)**
  - **Duplicate the L0link (HOW???)**
    - The first link to be **forwarded to L0mu** with the **GOL** data format
    - The second link is decoded and processed inside the TELL40
  - **Decode** the **DAQlink**
  - Than for the **L0link and the DAQlink:**
    - **Z**ero **S**uppression if/where needed
    - **Merge the data information L0link + DAQlink**
      - ✓ **Different acquisition rate → synchronization of the two links**
    - **Data converted into GBTX** data format and Muon Bank definition …

- **TELL40 Output →**
  1. **L0 links** @ 40 MHz **to L0mu** (**GOL** data format)
  2. One bidirectional link **to the farms** (10 Gbits/s)

AMC Implementation could be as follow:



1 ODE corresponds to 1 AMC board

- The DAQlink bundles have to be divided in single fibers (In D3)
- Each TELL40 embed 4 AMC board
- For **104 ODE** only **26 TELL40** will be needed

AMC Implementation could be as follow:

- Remarks **ODE side:** ODE input channels in the upgrade layout
  - TTC signals from newODIN received on ODE with the TTCrx
  - Current L0yes became → (Interaction Trigger AND Muon L0trigger) @ max 1 MHz

- Remarks **AMC side:**

1. In this implementation scheme **1 ODE corresponds to 1 AMC board**
   - L0link and DAQlink DATA together in the same bank
   - A pipeline must be foreseen for the L0link to wait the DAQlink information
     - at least: 4μs of L0latency + 900ns DAQlink read back
   - Different Zero Suppression algorithm for each ODE link (L0link and DAQlink)
   - A pipeline to compensate the latency related to the Interaction Trigger

     → is this already inside the general Guido firmware?
2. Evaluate the possibility of an AMC-ODE connection per link type instead of per ODE board?
   - In this case the L0link and the DAQlink would have different data banks

Upgrade Remarks

- The 4 bits **TDC information** could be **recorded** only for a **subset of events** @ max 1 MHz
  - **Very useful** to monitor and fine tune the time alignment of the Muon Stations

- To **reconstruct** MUON particles only the 1 bit hit/channel information will be used (as currently done)
  - **Same information** for L0mu and DAQ @ 40 MHz from ODE boards to TELL40
  - Only **the two LSB bits** of the Bunch Crossing Id are transmitted for each link
  - It is still necessary to extract the logical pad information as currently done for the HLT1?

- **ZS** done on the **AMC boards**

ECS → Hardware Implementation

- For each different interface in the Muon System we have to **provide an answer** to (14th October – next Electronics Upgrade meeting):
  1. **Which of the existing interfaces** will you require to be maintained for the upgrade (eg ELMB, SPECs, CCPC, Wiener, CAEN, ISEG….)? And **in what quantity** (eg how many ELMBs)?
  2. For the existing interfaces, **do you have enough units** to cover your requirements?
  3. What new interfaces will you require? (eg GBT)
  4. Please present how you will use the new interfaces and the number of interfaces you will use.
  5. How much configuration data will you **download** to the detector hardware?

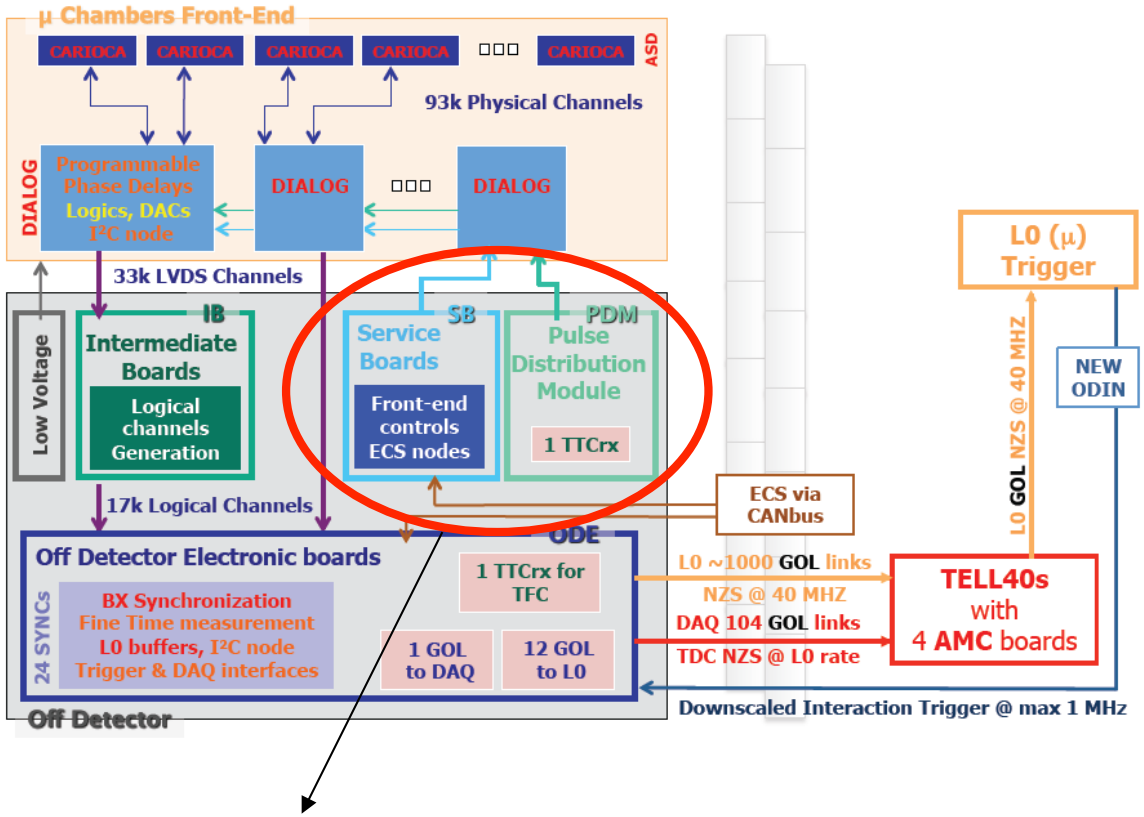
- This is the list of "item-people" which I suppose involved; there is something or someone which is missing?
  - Chamber/SB → Valerio, Davide
  - ODE → Maurizio, Paolo
  - LV → Giovanni, Paolo
  - HV (PNPI/CAEN) → Nicolay , Giovanni

ECS → Hardware Implementation

- **LV system (Paolo)**

1. *Which of the existing interfaces will you require to be maintained for the upgrade (eg ELMB, SPECs, CCPC, Wiener, CAEN, ISEG….)? And in what quantity (eg how many ELMBs)?*
   - LV System untouched → RCM interface (ethernet)
   - For M2 to M5 stations → a total of 10 RCM
     - 8 RCM for ODE/IB/SB crates
     - 6 RCM for FEE crates
2. *For the existing interfaces, do you have enough units to cover your requirements?*
   - No spares "Muon Dedicated"; common pool?
3. *What new interfaces will you require? (eg GBT)*
   - -
4. *Please present how you will use the new interfaces and the number of interfaces you will use.*
   - -
5. *How much configuration data will you download to the detector hardware?*
   - ? Very few, only to switch the module ON/OFF and to monitor voltage and current

Service Board and PDM boards upgrade



120 Service Boards main components:

- 4x120=480 ELMBs
- 120 FPGA Actel proasicplus flash technology

8 Pulse distribution Module (PDM) main components:

- 8 TTCRX
- 8 ELMBs
- 8 Actel proasic+ flash technology

The ECS structure can be the same to mantain the infrastructure and the software.
The major problems can be the obsolescense of components. Probably we have to redesign the controller board with new components: using the ELMB++
(we request a backward compatibility with actual ELMB)
The Actel proasicplus FPGA risks obsolescense also if some family is used in **Boeing 787 *Dreamliner*** (Dec 2009 first flight).

Valerio Bocci 2010

ECS → Hardware Implementation

- **Service Board and PDM system (Valerio)**

1. Which of the existing interfaces will you require to be maintained for the upgrade (eg ELMB, SPECs, CCPC, Wiener, CAEN, ISEG….)? And in what quantity (eg how many ELMBs)?

- SB/PDM System untouched (?) →
  - ELMB interface and FPGA Actel proasicplus flash technology
  - For M2 to M5 stations →
    - ✓ 8 PDM boards; 8 TTCrx; 8 Actel proasic+ flash technology
    - ✓ 120 SB; 120x4=480 ELMBs

2. For the existing interfaces, do you have enough units to cover your requirements?

- 8 SB; (plus the dismounted M1 → 36 SBs more)
- 2 PDM; (plus the dismounted M1 → 2 PDMs more)
- ~ 100 ELMB

3. What new interfaces will you require? (eg GBT)

- Maybe the radiation hard ELMB (backward compatibility required)

4. Please present how you will use the new interfaces and the number of interfaces you will use.

- -

5. How much configuration data will you download to the detector hardware?

- ?

ECS → Hardware Implementation

- **ODE system (Maurizio)**

1. *Which of the existing interfaces will you require to be maintained for the upgrade (eg ELMB, SPECs, CCPC, Wiener, CAEN, ISEG….)? And in what quantity (eg how many ELMBs)?*
   - ODE System untouched →
     - ELMB interface (1 ELMB for each ODE)
     - For M2 to M5 stations → 104 ELMBs
2. *For the existing interfaces, do you have enough units to cover your requirements?*
   - 10 ODE → 10 ELMB (plus the dismounted M1 → 48 ODE (ELMB) more)
3. *What new interfaces will you require? (eg GBT)*
   - -
4. *Please present how you will use the new interfaces and the number of interfaces you will use.*
   - -
5. *How much configuration data will you download to the detector hardware?*
   - ?

Conclusions

1. Currently **NO responsibility** has been taken with respect to the electronics development, implementation and commissioning
   - The development of the Muon dedicated FPGA for the AMC board could start **after the LHCb upgrade approval**
   - **There is anyone interested to join** in this item??? Let me know!!!

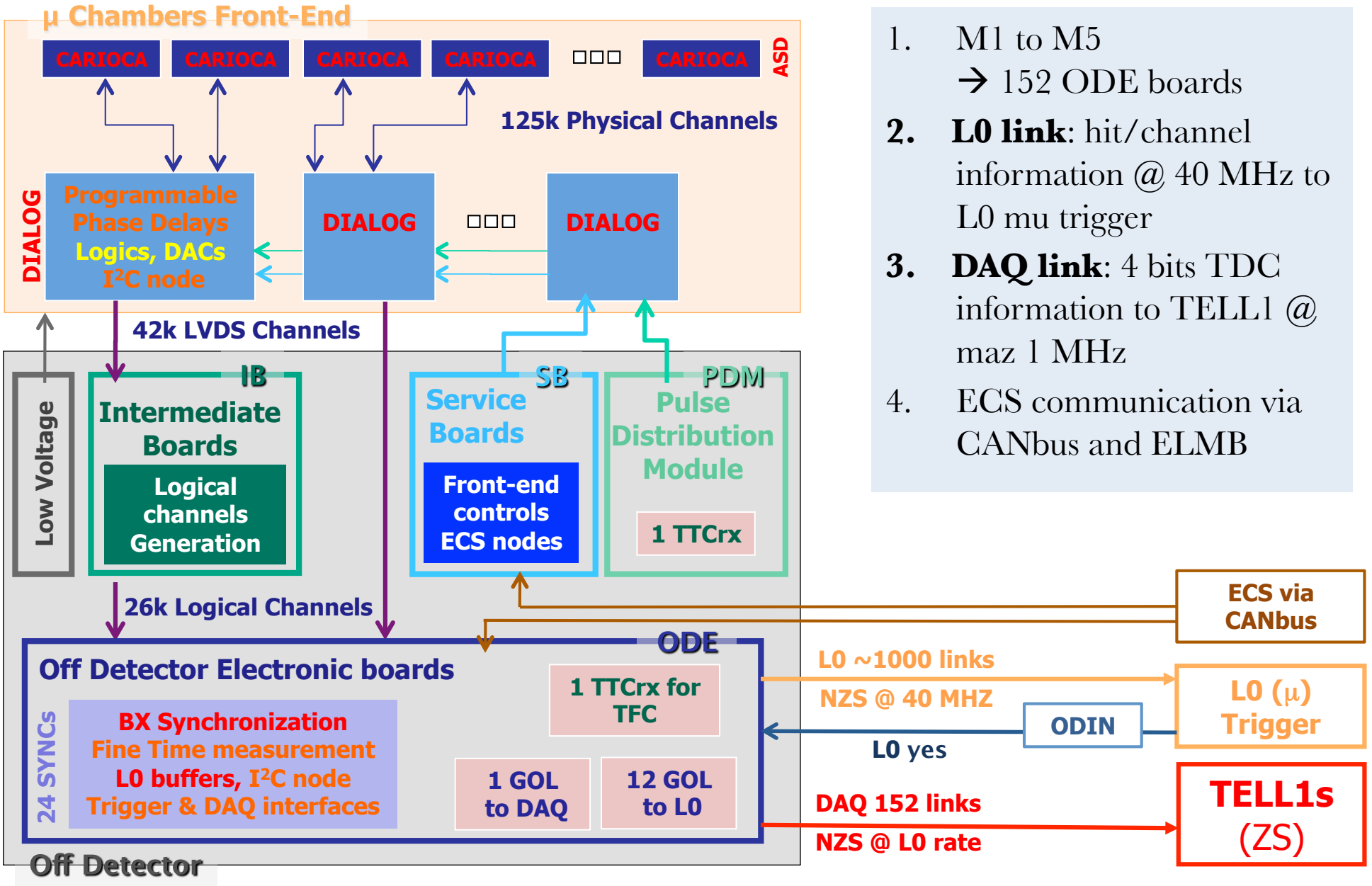
2. No PVSS hardware changes are foreseen → NO GBT link for PVSS data

3. ELMB radiation hard: do we need more time to decide if use it? How many time?

4. There is anyone of you which would like to present the ECS situation in the Upgrade Electronics meeting of the 14th October? Even via EVO?

5. Next steps:
   1. An **approved documentation** with the requirements (LoI) → **in progress**
   2. Simulation of the data paths: output ODE trough TELL40 processor

Present Muon Electronics Architecture



1. M1 to M5
   → 152 ODE boards
2. **L0 link**: hit/channel information @ 40 MHz to L0 mu trigger
3. **DAQ link**: 4 bits TDC information to TELL1 @ maz 1 MHz
4. ECS communication via CANbus and ELMB