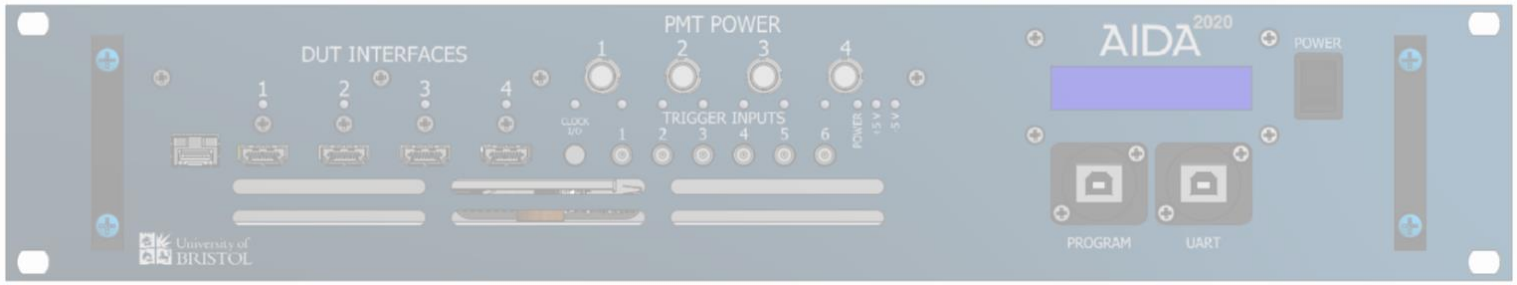
Report on Trigger Logic Unit status and test beam summary

P. Baesso, D. Cussans – University of Bristol

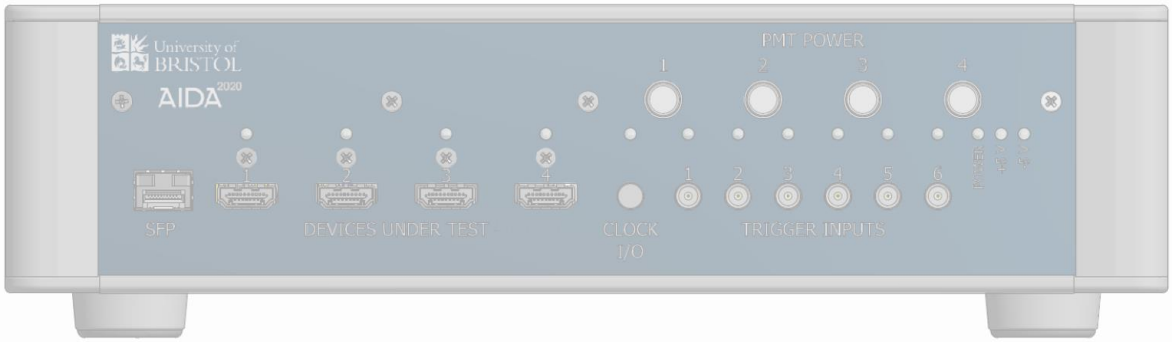
Oxford, 02nd April 2019

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654168.

Overview



AIDA2020 TLU: a flexible, easily configurable unit to provide trigger and control signal to devices in test-beams.

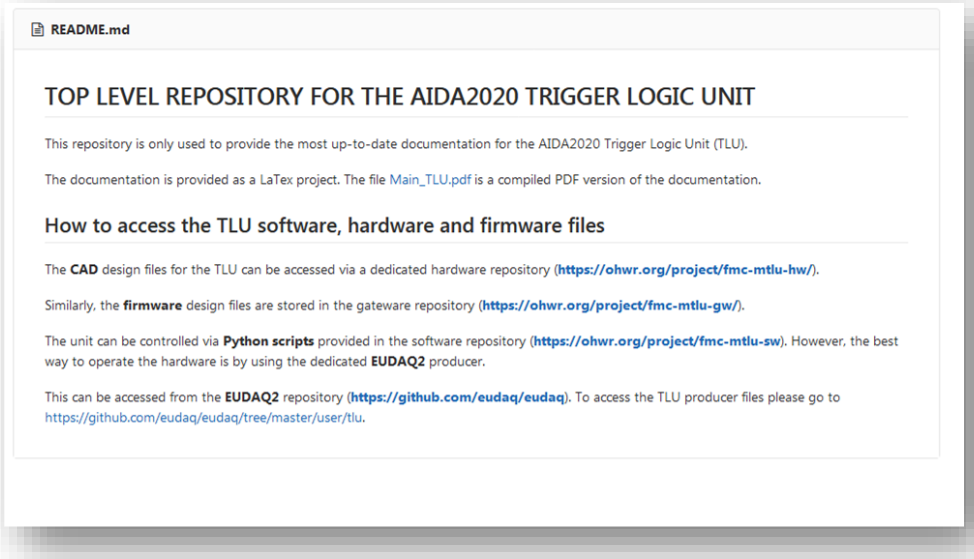


Documentation

- Migrating all TLU material to OHWR (hardware files, firmware, software, documentation)

- For all TLU related material, from now on please refer to:

  https://ohwr.org/project/fmc-mtlu



README.md

TOP LEVEL REPOSITORY FOR THE AIDA2020 TRIGGER LOGIC UNIT

This repository is only used to provide the most up-to-date documentation for the AIDA2020 Trigger Logic Unit (TLU).

The documentation is provided as a LaTex project. The file Main_TLU.pdf is a compiled PDF version of the documentation.

How to access the TLU software, hardware and firmware files

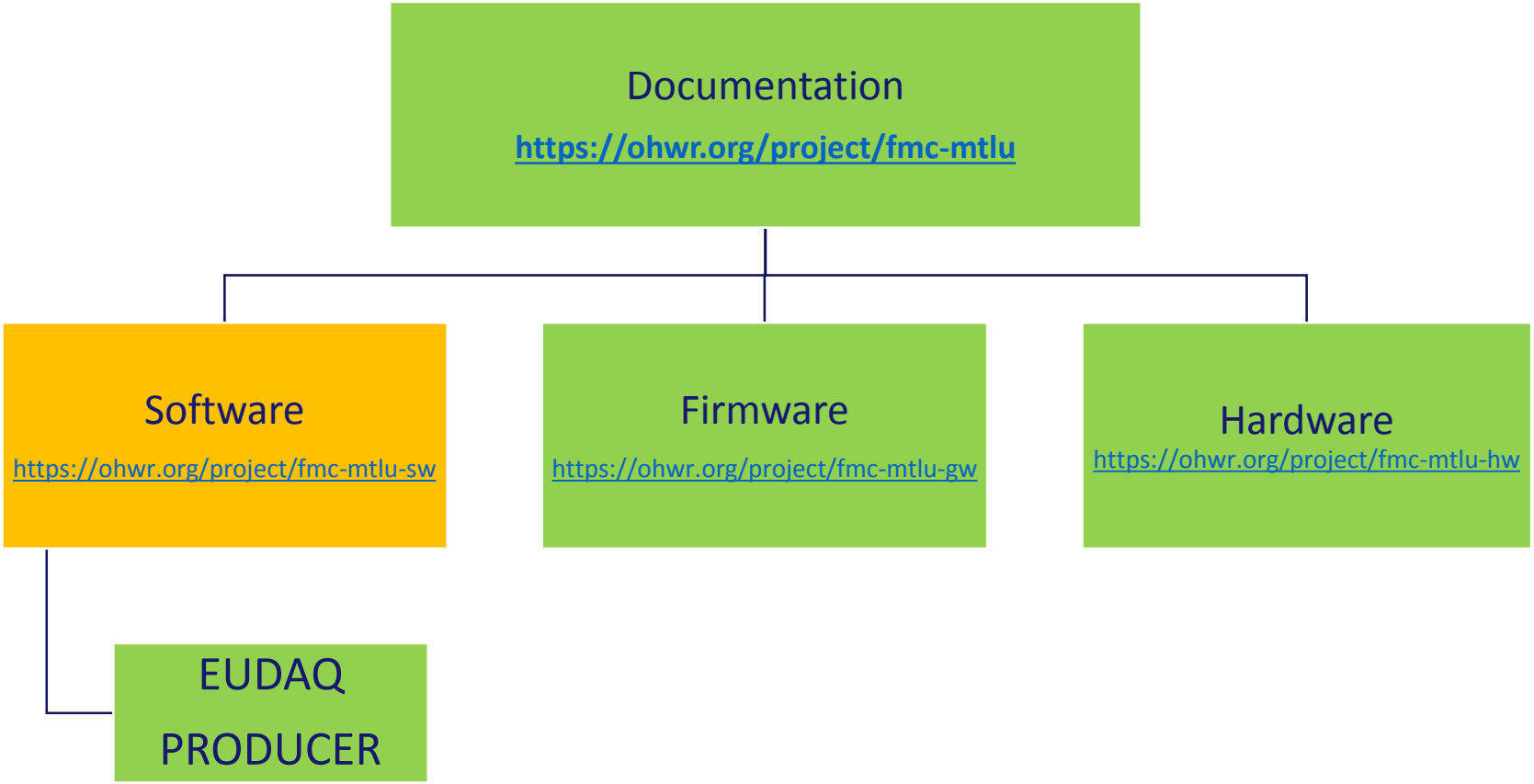
The **CAD** design files for the TLU can be accessed via a dedicated hardware repository (**https://ohwr.org/project/fmc-mtlu-hw/**).

Similarly, the **firmware** design files are stored in the gateware repository (**https://ohwr.org/project/fmc-mtlu-gw/**).

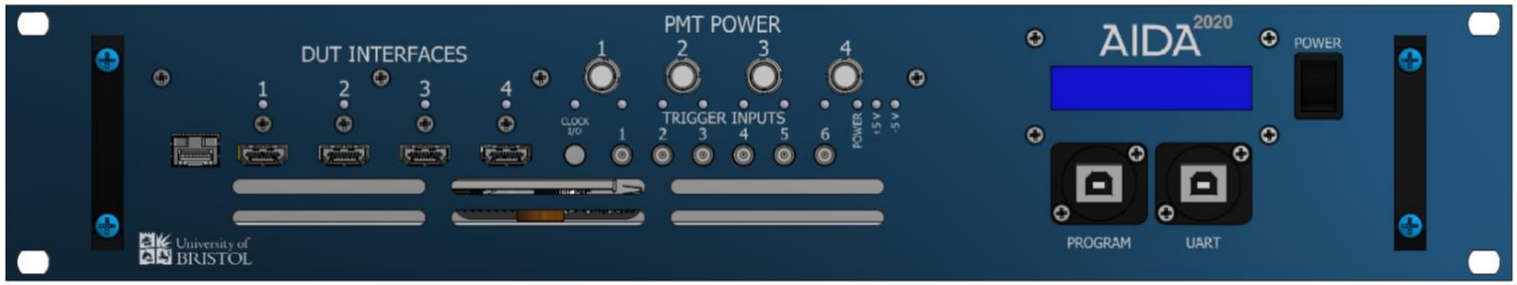
The unit can be controlled via **Python scripts** provided in the software repository (**https://ohwr.org/project/fmc-mtlu-sw**). However, the best way to operate the hardware is by using the dedicated **EUDAQ2** producer.

This can be accessed from the **EUDAQ2** repository (**https://github.com/eudaq/eudaq**). To access the TLU producer files please go to https://github.com/eudaq/eudaq/tree/master/user/tlu.

Documentation



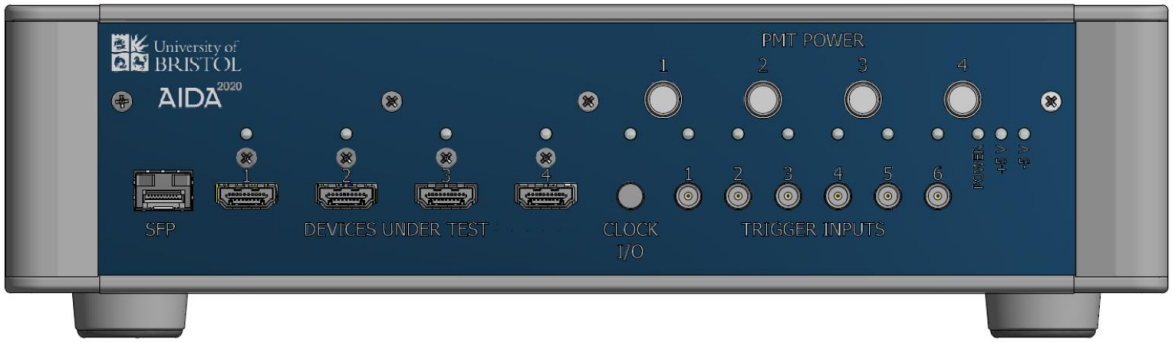
TLU v1E versions



2U RACK MOUNTED 19” ENCLOSURE

2U has additional display and built-in AC/DC converter to operate with mains. Identical core-hardware inside so no operational difference.

TABLE TOP ENCLOSURE

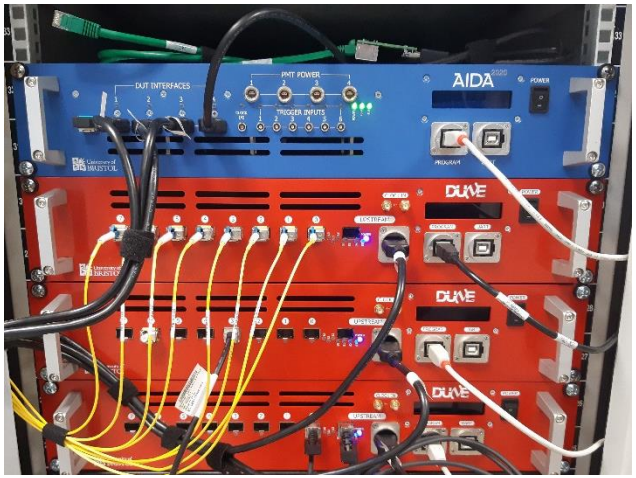


TLU v1e hardware status

A total of 19 units produced:

- 10 in **TABLE TOP** enclosure
- 9 in **RACK MOUNT 2U** enclosure 19”

Two units currently in Bristol for testing.
All other units distributed to users and beam lines.



TLU v1e usage

- Units successfully deployed at CERN and DESY beam-lines as well as several laboratories.
  - Slowly replacing old EUDET TLUs

- TLUs have been used for 15+ months by several users/experiments.

TLU v1e hardware issues

- No issues with the first batch of TLUs.
- Minor tweaks required to operate the SFP interface.

TLU v1e hardware issues

- Second batch had two units with hardware problems, discovered in testing:
  1. HDMI pins detached from PCB. Poor solder contact. Fixed in lab.
  2. Still under investigation.

- A third unit started to show issues on one of the HDMI ports after shipping:
  - Possible failure of component. Hard to investigate without access to TLU.

- Minor issue with display. Does not affect functionality.

TLU v1f ?

Currently gathering requests for a new batch of TLUs.

New unit will include minor tweaks to hardware (but compatible with v1E)

UK company contacted to investigate option to have units manufactured and assembled externally.

- Minimum order of ~10 units

Firmware

- Latest firmware available on Open Hardware Repository (Git)

  https://github.com/PaoloGB/firmware_AIDA

  https://ohwr.org/project/fmc-mtlu-gw/

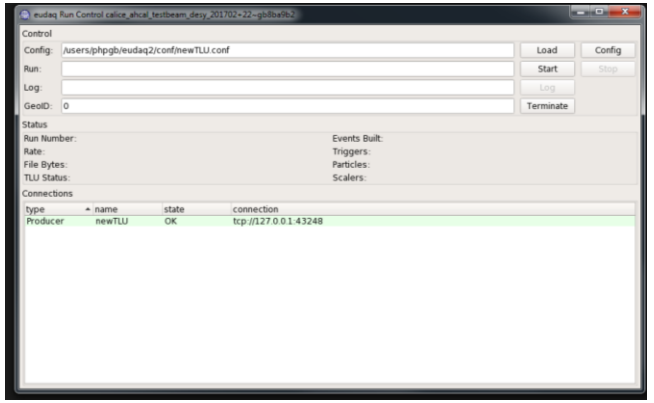
- Current version (0x1e000014.bit) is stable and has been used in test beams

Firmware

https://ohwr.org/project/fmc-mtlu-gw/

- New features added recently by David.
  - 0x1e000020 introduces new AIDA mode
- More to come.
- To report issues of request new feature please use the issue tracker
  https://ohwr.org/project/fmc-mtlu-gw/issues/1

Software



- Fully working EUDAQ TLU producer
- Latest (stable) version of TLU producer in EUDAQ
  - https://github.com/eudaq/eudaq
  - Thanks to all who helped debugging the producer
- Python scripts to configure and run the TLU also available
  - ~~https://github.com/PaoloGB/firmware_AIDA/tree/master/TLU_v1e/scripts~~
  - https://ohwr.org/project/fmc-mtlu-sw (soon)
  - They require uHAL and IPBus to work
  - Have been used with success (after some setup) at CERN and DESY

TLU Paper

Ongoing work but nearly ready.

The AIDA2020 TLU: a flexible trigger logic unit for test beam facilities.

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Abstract

The AIDA-2020 Trigger Logic Unit (TLU) has been designed to be a flexible and easily configurable unit to provide trigger and control signals to devices employed during test beams, integrating them with the beam telescope.

The most recent iteration of the unit (v1E) has been re-designed within the AIDA-2020 project to easily integrate with hardware used in beam facilities and research laboratories.

Configuration of the TLU is performed over Ethernet: the unit can be employed as a stand-alone unit or be deployed as part of the EUDAQ data acquisition framework, which allows it to connect to a wide range of devices including LHC readout systems.

It can cope with a sustained particle rate of 1 MHz and with instantaneous rates up to 20 MHz. In the current firmware iteration, the unit can time-stamp incoming signals with a resolution of 1.5 ns.

The hardware, firmware and software designs of the TLU are freely accessible and benefit from constant inputs and upgrades from experienced users.

TLU units have already been deployed successfully in beam lines at CERN and DESY.

Keywords: trigger logic unit, aida2020, eudaq, test beam

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 654168.

Preprint submitted to ??? *April 2, 2019*

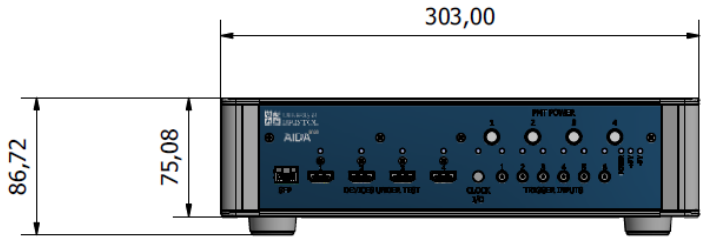
Summary

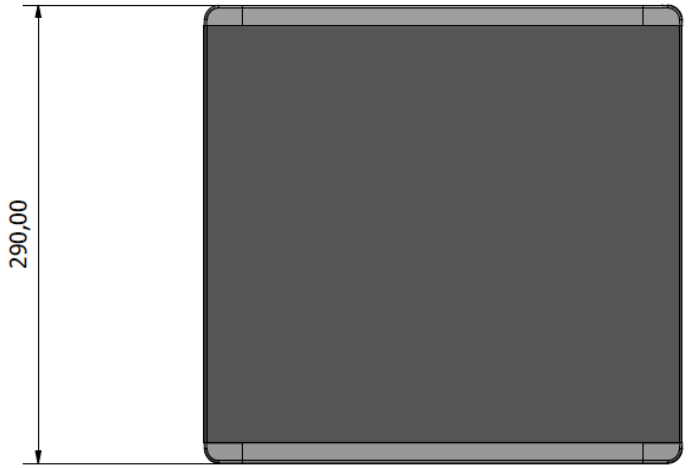
- TLU documents now consolidated on Open Hardware Repository.
  - https://ohwr.org/project/fmc-mtlu
  - Please use these to report issues and request features.
- 17 TLUs successfully deployed to several laboratories and beam lines.
  - In use for more than one year. No major issues encountered.
  - Planning new batch once enough demand for it.
- Firmware in constant evolution.
  - Request features already implemented.
  - More to be added.
- Software currently working (EUDAQ producer + Python scripts)
  - Still ironing out bugs and improving it.


University of BRISTOL
AIDA 2020
PMT POWER
1
2
3
4
SFP
DUT INTERFACES
CLOCK I/O
TRIGGER INPUTS
POWER
+5 V
-5 V
TRIGGER LOGIC UNIT - v1E

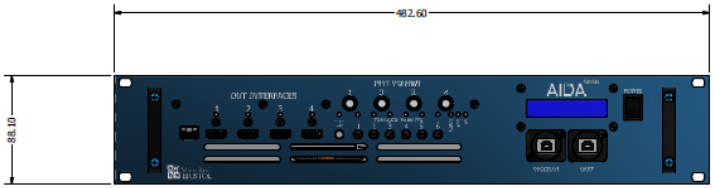
SPARE SLIDES

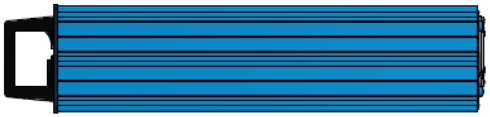
Table top enclosure

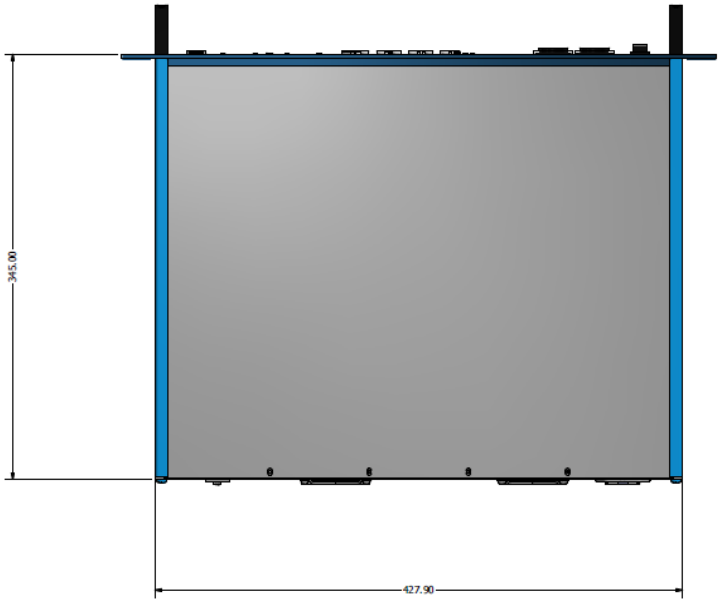


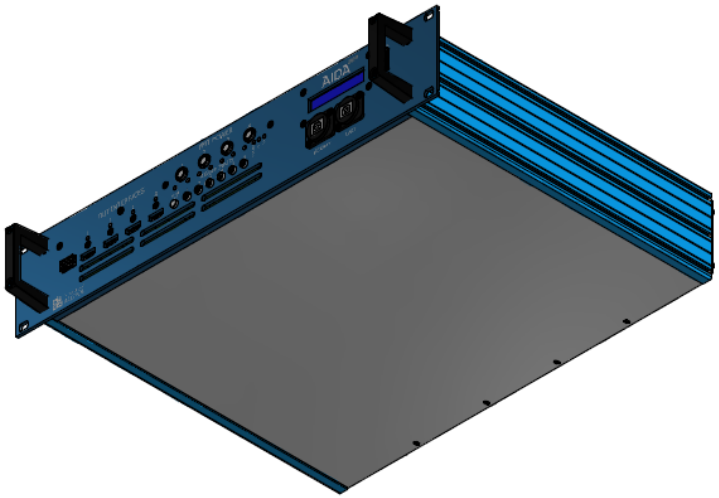


2U rack enclosure

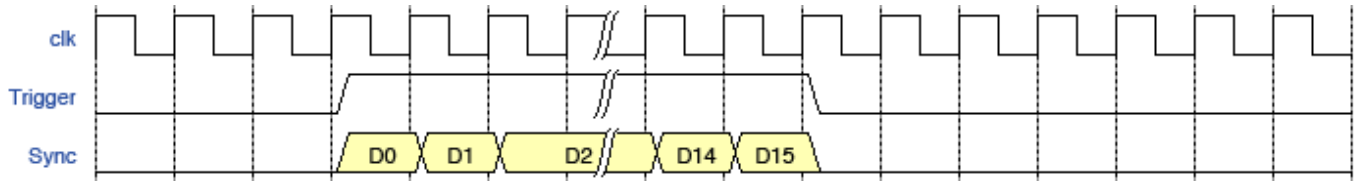








New AIDA mode



- Trigger number is clocked out from the TLU (similar to EUDET mode) but the clocking is driven by TLU rather than the DUT.
- No need for “smart” DUT
- Useful for debugging (for instance using an oscilloscope)