

Integration and performance of the HMPID in the ALICE O2 system

ALICE-HMPID plenary meeting CERN - 11/12/2019

Overview

- HMPID commissioning - Equipment distribution/connection.
- HMPID performance at 100KHz of trigger rate.
- HMPID software integration to O2 framework.
- Conclusions.

HMPID commissioning - Equipment distribution/connection

EQUIPMENT-#	CROC-#	PCI Addr	Channel	SIU (SN)	JTAG (IP)	LOCAL Host Name
0-LEFT	1	3b:00.0	0	03027	10.160.128.67	HMPID-P2-JTAG-0L.cern.ch
0-RIGHT	1	3b:00.0	1	03029	10.160.128.64	HMPID-P2-JTAG-0R.cern.ch
1-LEFT	1	3b:00.0	2	03038	10.160.128.63	HMPID-P2-JTAG-1L.cern.ch
1-RIGHT	1	3b:00.0	3	03039	10.160.128.62	HMPID-P2-JTAG-1R.cern.ch
2-LEFT	0	af:00.0	0	03028	10.160.128.57	HMPID-P2-JTAG-2L.cern.ch
2-RIGHT	0	af:00.0	1	03034	10.160.128.65	HMPID-P2-JTAG-2R.cern.ch
3-LEFT	0	af:00.0	2	03025	10.160.128.66	HMPID-P2-JTAG-3L.cern.ch
3-RIGHT	0	af:00.0	3	03033	10.160.128.61	HMPID-P2-JTAG-3R.cern.ch
4-LEFT	2	d8:00.0	0	03035	10.160.128.55	HMPID-P2-JTAG-4L.cern.ch
4-RIGHT	2	d8:00.0	1	03030	10.160.128.56	HMPID-P2-JTAG-4R.cern.ch
5-LEFT	2	d8:00.0	2	03036	10.160.128.68	HMPID-P2-JTAG-5L.cern.ch
5-RIGHT	2	d8:00.0	3	03037	10.160.128.58	HMPID-P2-JTAG-5R.cern.ch
6-LEFT	2	d8:00.0	4	03032	10.160.128.59	HMPID-P2-JTAG-6L.cern.ch
6-RIGHT	2	d8:00.0	5	03026	10.160.128.60	HMPID-P2-JTAG-6R.cern.ch

Using the JTAG :

- We need around 4 min to upload the firmware to all readout Cards.
- We need around 14 min to program the flash off all readout Cards

The programing operation is made in parallel !!!

After the Power On cycle the booting FPGA process need a few seconds.

Data acquisition :

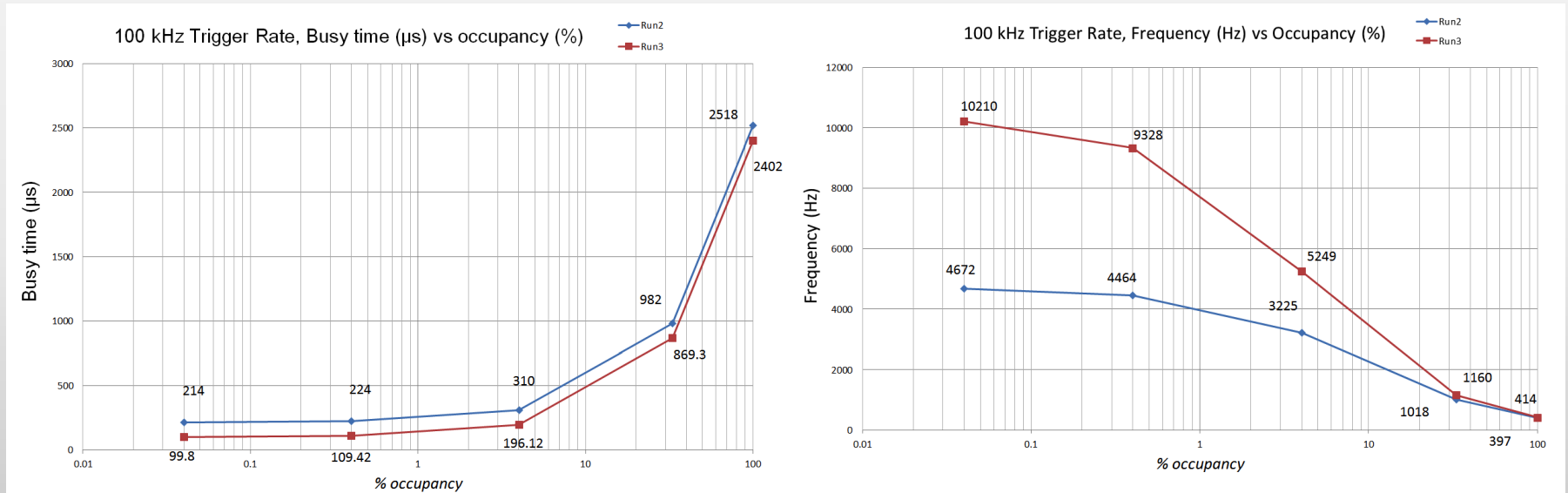
- The communication with all the channel was tested successfully.
- The data taking and local store was tested using LTU trigger.

The HMPID electronic is working in the RUN3 environment !!!

HMPID performance at 100kHz of trigger rate, P2.

One year ago the theoretical expectations of doubling the readout frequency was proved at Lab581. HMPID electronics work stable at 100 kHz trigger rates throughout different percentages of occupancy.

ALICE-HMPID plenary meeting CERN – 14/12/2018



100 kHz Trigger Rate, Busy vs Occupancy, Run2 vs Run3

100 kHz Trigger Rate, Frequency vs Occupancy, Run2 vs Run3

HMPID performance at 100KHz of trigger rate, P2.

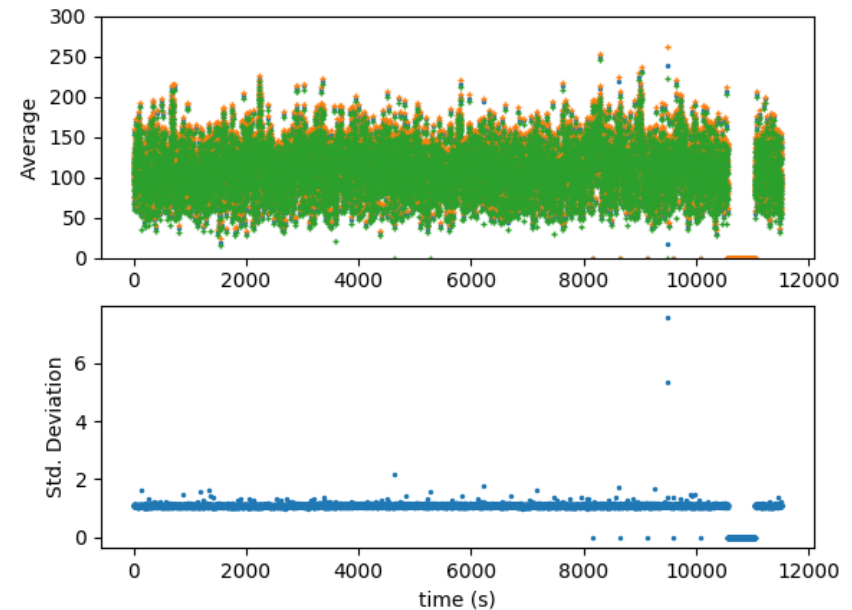
BUSY TIME (us) vs OCCUPANCY (%)



The current firmware is a full VHDL version, with internal busy time counter.

HMPID performance at 100KHz of trigger rate, P2.

Module 4 Left



The controller of the column 23 is not working. The firmware wait for the arrive of the start column marker, then if after a fixed numbers of clock it not arrive the firmware send an error and continue to the next column.

This loop increase the busy time for the module. We need to fix the column controller or mark the column as bad in order to skip the waiting loop.

HMPID software integration to O2 framework.

GitLab repository: <https://gitlab.cern.ch/rarteche/hmpid-readout-software>

The screenshot shows the GitLab web interface for the repository 'HMPID-Readout-Software'. The browser address bar shows the URL 'https://gitlab.cern.ch/rarteche/hmpid-readout-software'. The repository page includes a sidebar with navigation options like 'Project', 'Repository', and 'Issues'. The main content area displays the repository name, project ID (71930), and statistics (37 Commits, 1 Branch, 0 Tags, 512 KB Files). A commit history table is visible, listing files like 'C++', 'doc', 'python', and 'README.md' with their last commit and update dates. The README section is partially visible at the bottom.

Name	Last commit	Last update
📁 C++	-	2 days ago
📁 doc	Upload New File	1 month ago
📁 python	Update python/script/LIB/ROC.py, python/script/LIB/ROC.pyc, p...	1 month ago
📄 README.md	Update README.md	3 days ago

README.md

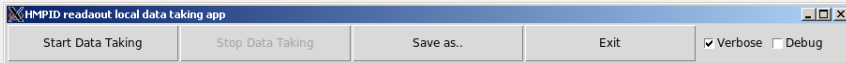
HMPID-Readout-Software

HMPID - ReadoutCard (RoC) module Python and C++ integration. The repository contain:

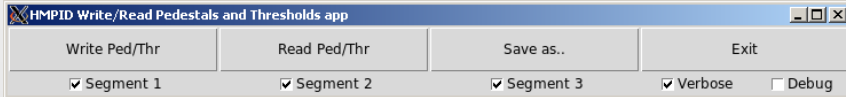
HMPID software integration to O2 framework.

ReadoutCard (RoC) module, Python integration.

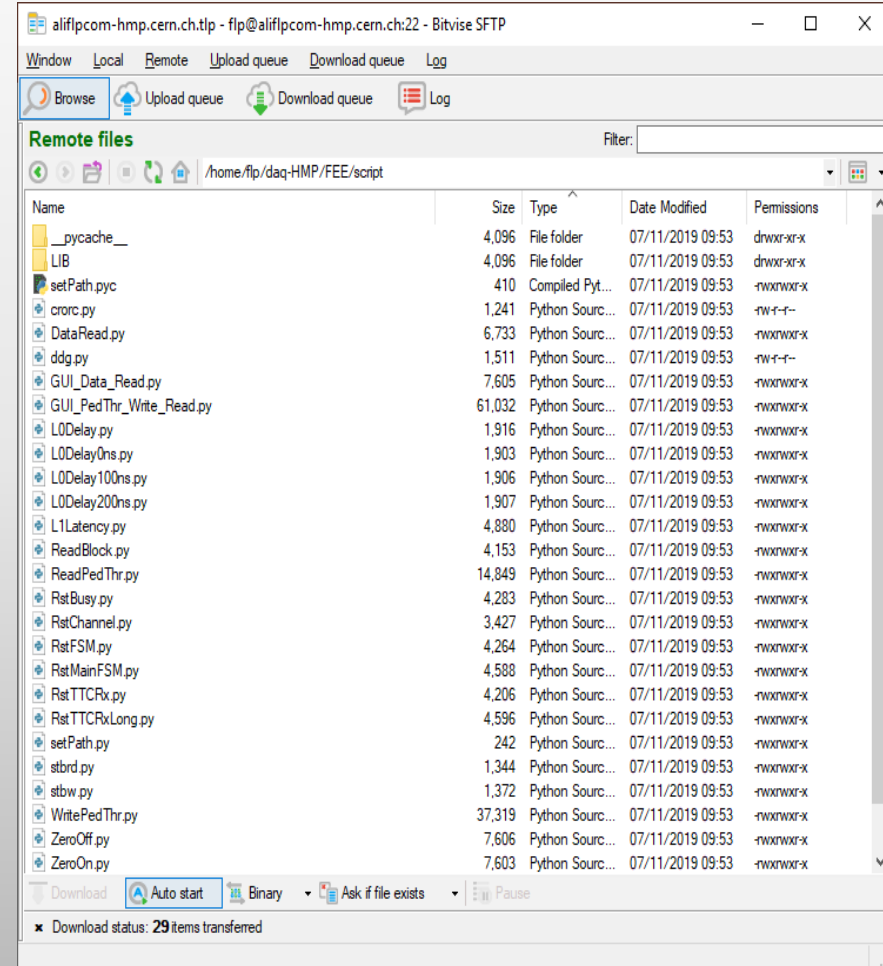
GUI Python App for readout local data taking



GUI Python App for Write and Read Pedestals and thresholds.



- L0Delay.py, L0Delay0ns.py, L0Delay100ns.py, L0Delay200ns.py are used to set L0 delay at different time.
`L0Delay.py --id=3b:00.0 --channel=0 --verbose`
- L1Latency.py is used to set L1 Latency.
`L1Latency.py --id=3b:00.0 --channel=0 --verbose`
- WritePedThr.py is used to send to the FEE the pedestals and thresholds.
`WritePedThr.py --id=3b:00.0 --channel=0 --verbose`
- ReadPedThr.py is used to get the pedestals and thresholds from the FEE.
`ReadPedThr.py --id=3b:00.0 --channel=0 --verbose`
- RstBusy.py is used to reset the busy line.
`RstBusy.py --id=3b:00.0 --channel=0 --verbose`
- RstFSM.py and RstMainFSM.py are used to reset the FSMs in the firmware.
`RstFSM.py --id=3b:00.0 --channel=0 --verbose`
- RstTTCRx.py and RstTTCRxLong.py are used to reset the TTCRx module.
`RstTTCRx.py --id=3b:00.0 --channel=0 --verbose`
- DataRead.py is used to start a local data taking.
`DataRead.py --id=3b:00.0 --channel=0 --verbose`



HMPID software integration to O2 framework.

ReadoutCard (RoC) module, C++ integration.

Commands line utilities developed in C++ using O2 framework. The programs call directly the functions of the ReadoutCard library, also is possible to compile directly in the FLP machine. Source include the instructions of how to compile it.

The image displays two side-by-side screenshots of a remote file manager interface, likely SFTP, showing the file structure of a project. Both windows are titled 'aliflpcom-hmp.cern.ch.tlp - flp@aliflpcom-hmp.cern.ch:22 - Bitvise SFTP'.

The left window shows the directory `/home/flp/daq-HMP/FEE/src`. It contains a list of files and folders:

Name	Size	Type	Date Modified	Permissions
CommandLineUtilities	4,096	File folder	07/11/2019 09:53	drwxr-xr-x
BarHammer.h	2,192	C Header So...	07/11/2019 09:53	-rw-r--r--
Common.h	1,449	C Header So...	07/11/2019 09:53	-rw-r--r--
Options.h	2,441	C Header So...	07/11/2019 09:53	-rw-r--r--
Options_old.h	2,441	C Header So...	07/11/2019 09:53	-rw-r--r--
Program.h	1,843	C Header So...	07/11/2019 09:53	-rw-r--r--
Common.cxx	1,918	C++ Source ...	07/11/2019 09:53	-rw-r--r--
LoadPedThr.cpp	60,964	C++ Source ...	19/11/2019 09:10	-rw-r--r--
Options.cxx	6,525	C++ Source ...	07/11/2019 09:53	-rw-r--r--
Options_old.cxx	6,395	C++ Source ...	07/11/2019 09:53	-rw-r--r--
ProgramConfig.cxx	6,126	C++ Source ...	07/11/2019 09:53	-rw-r--r--
ProgramDmaBench.cxx	49,395	C++ Source ...	19/11/2019 09:11	-rw-r--r--
reset_channel.cpp	3,562	C++ Source ...	19/11/2019 09:11	-rw-r--r--
stbrd.cpp	6,513	C++ Source ...	07/11/2019 09:53	-rw-r--r--
stbwr.cpp	7,522	C++ Source ...	07/11/2019 09:53	-rw-r--r--
UploadPedThr.cpp	19,779	C++ Source ...	19/11/2019 09:12	-rw-r--r--
ZeroOff.cpp	11,877	C++ Source ...	19/11/2019 09:12	-rw-r--r--
ZeroOn.cpp	12,003	C++ Source ...	19/11/2019 09:13	-rw-r--r--
croc.cfg	1,245	CFG File	28/11/2019 15:59	-rw-rw-r--
flp-hmp-data_taking.sh	6,375	SH Source File	05/12/2019 22:47	-rwxrwxr--
flp-hmp-tools-compilation.sh	3,645	SH Source File	07/11/2019 10:16	-rwxr-xr-x

The right window shows the directory `/home/flp/daq-HMP/FEE/Linux`. It contains a list of files and folders:

Name	Size	Type	Date Modified	Permissions
CommandLineUtilities	4,096	File folder	07/11/2019 09:53	drwxr-xr-x
hmpid-program-dma-bench-v14	1,163,640	Local Disk	07/11/2019 09:53	-rwxr-xr-x
hmpid-Read-PedThr-v14	451,032	Local Disk	19/11/2019 09:16	-rwxrwxr-x
hmpid-reset-channel-v14	419,192	Local Disk	19/11/2019 09:16	-rwxrwxr-x
hmpid-roc-bench-dma-v14	1,170,336	Local Disk	19/11/2019 09:16	-rwxrwxr-x
hmpid-Write-PedThr-v14	479,480	Local Disk	19/11/2019 09:16	-rwxrwxr-x
hmpid-Zero-Off-v14	439,408	Local Disk	19/11/2019 09:17	-rwxrwxr-x
hmpid-Zero-On-v14	439,392	Local Disk	19/11/2019 09:16	-rwxrwxr-x

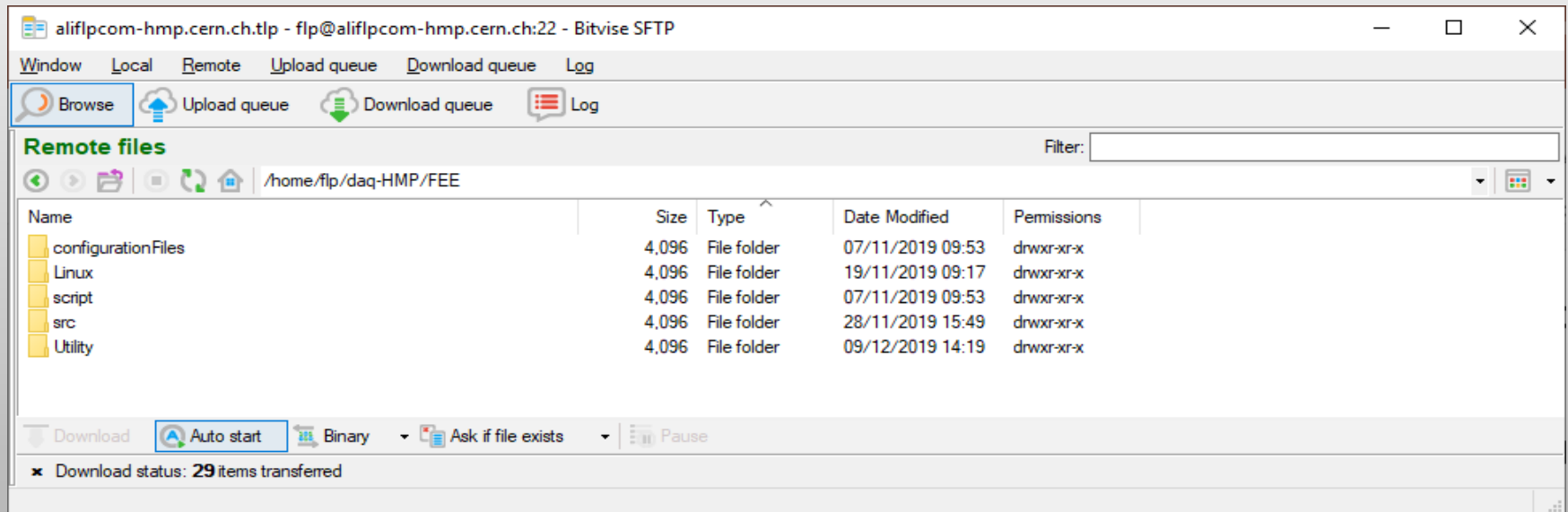
HMPID software integration to O2 framework.

Software used during the detector commissioning.

Basically, three command line utilities are used in this phase.

- `hmpid-Write-PedThr-v14 --verbose --id=3b:00.0 --channel=0`
- `hmpid-Zero-On-v14 --verbose --id=3b:00.0 --channel=0`
- `hmpid-roc-bench-dma-v14 --verbose --id=3b:00.0 --dma-channel=0 --no-errorcheck --data-source=FEE --to-file-bin=/tmp/data_on_0L.raw --bytes=100M`

Ansible role was prepare at *aliflpcom-hmp.cern.ch*



HMPID ReadOut tools

The screenshot shows a Bitvise SFTP client window titled "aliflp-hmp.cern.ch.tlp - flp@aliflp-hmp.cern.ch:22 - Bitvise SFTP". The window has a menu bar with "Window", "Local", "Remote", "Upload queue", "Download queue", and "Log". Below the menu bar are buttons for "Browse", "Upload queue", "Download queue", and "Log". The main area is titled "Remote files" and shows a directory listing for the path "/home/flp/daq-HMP/FEE/Utility". The listing includes columns for Name, Size, Type, Date Modified, and Permissions. The file "4_2.zip" is selected. At the bottom, there are buttons for "Download", "Auto start", "Binary", "Ask if file exists", and "Pause". A status bar at the bottom indicates "Download status: 3 items transferred" and "Remote selection: 1 file (4.48 MiB)".

Name	Size	Type	Date Modified	Permissions
pedfile	4,096	File folder	24/06/2019 20:15	drwxr-xr-x
peds	4,096	File folder	14/09/2019 16:39	drwxr-xr-x
4_2.zip	467,220,441	7z Archive	10/12/2019 17:54	-rw-r--
convertAll.sh	226	SH Source File	10/12/2019 12:39	-rwxr-xr-x
hmpCheckPedThr.py	9,801	Python Sourc...	20/05/2019 17:43	-rwxrwxr-x
hmpConvertRawFile.py	6,142	Python Sourc...	25/11/2019 17:03	-rwxr-xr-x
hmpConvertRawFile3-1.py	6,375	Python Sourc...	05/12/2019 17:54	-rwxr-xr-x
hmpConvertRawFile3-2.py	6,380	Python Sourc...	10/12/2019 09:40	-rwxr-xr-x
hmpConvertRawFile3-3.py	5,985	Python Sourc...	10/12/2019 11:38	-rwxr--
hmpDisplayMapRun3-1.py	21,316	Python Sourc...	09/12/2019 15:08	-rwxr-xr-x
hmpDisplayMapRun3-2.py	21,321	Python Sourc...	10/12/2019 09:41	-rwxr-xr-x
hmpDisplayMapRun3-3.py	20,502	Python Sourc...	10/12/2019 11:38	-rwxr--
hmpDisplayMapRun3.py	21,363	Python Sourc...	09/09/2019 15:30	-rwxrwxr-x
hmpDumpThrPedFile.py	2,533	Python Sourc...	26/06/2019 20:26	-rwxrwxr-x
hmpEventMonitor.py	26,264	Python Sourc...	02/05/2019 22:38	-rwxrwxr-x
hmpReadRawFile.py	12,313	Python Sourc...	04/09/2019 03:31	-rwxrwxr-x
hmpReadRawFile3-1.py	9,894	Python Sourc...	05/12/2019 17:54	-rwxr-xr-x
hmpReadRawFile3-2.py	9,948	Python Sourc...	10/12/2019 09:40	-rwxr-xr-x
hmpReadRawFile3-3.py	10,769	Python Sourc...	11/12/2019 10:44	-rwxr-xr-x
hmpReadRawFile3.py	8,408	Python Sourc...	05/12/2019 12:21	-rwxr-xr-x
hmpThrPedBuilder.py	2,782	Python Sourc...	18/09/2019 10:52	-rwxrwxr-x
hmpThrPedCheck.py	2,558	Python Sourc...	02/05/2019 22:38	-rwxrwxr-x
hmpThrPedCompare.py	3,604	Python Sourc...	02/05/2019 22:38	-rwxrwxr-x

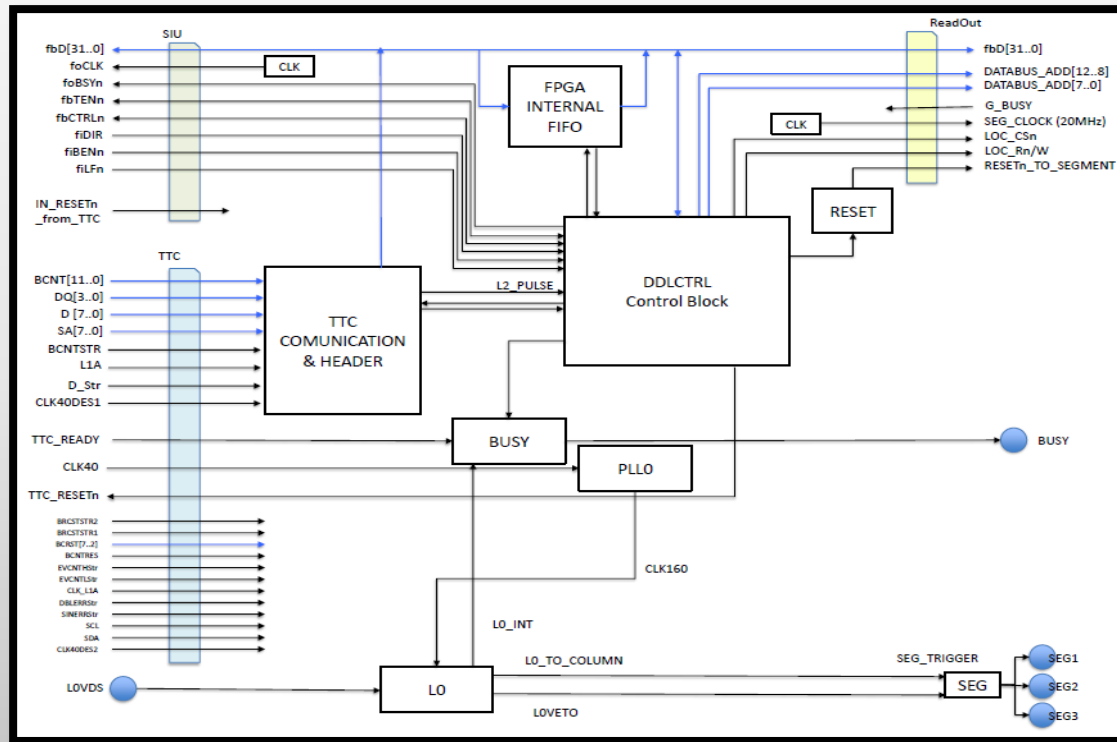
HMPID ReadOut tools

- `hmpReadRawFile3-3.py` : program to read raw files, check errors and display the file contents
 - `hmpReadRawFile3-3.py <inputRawFile> <verbosity>`
 - `<verbosity> := -1..9`
- `hmpConvertRawFile3-3.py` : program to extract from raw files the values of PAD charges in ASCII format
 - `hmpConvertRawFile3-3.py <sourceRawFile> <destinationFile> <verbosity>`
 - `<verbosity> := 0,1`
 - Example of output:
 - `# HMPID RUN3 Event dump : v.1.1 - A.Franco 6/11/2019`
 - `# Column Dilogic Channel Charge [Column == -1 -> Start of Event]`
 - `-1 2017 34546 34546 0 4294967295`
 - `1 1 0 100`
 - `1 1 1 109`
- `hmpDisplayMapRun3-3.py` : program to generate a PAD map



The VHDL firmware

- The old RCB FPGA firmware was written in AHDL (Altera Hardware Description Language). The current firmware is written in VHDL but conserving the same architecture.



- The DDL controller is finish, some new requirement could be include if is needed.
- The final version of the TTC communication module is going to be finish in the first month of 2020.

Conclusions

- The HMPID is working in the RUN3 environment with very good performance.
- We have the necessary software tools, to continue its integration to the rest of the O2 framework.
- More analysis needs to be done in the acquired data in order to know better the status of the electronics and plan any intervention if needed.
- More jobs are coming!!!.

Thank you