BAORadio/PAON softwares

Réza Ansari
Univ. Paris-Saclay & IJCLab / CNRS-IN2P3

On behalf of PAON & IDROGEN teams

PUMA (virtual) workshop

August 2020

- Set of Softwares tools developed since the beginning of the BAORadio project in 2007
- Most packages are written in c++ , some python scripts for PAON4 data analysis.
- Theses packages rely on the **SOPHYA** class library (I/O , numerical algorithms … development started ~ 2000)

- **JSkyMap** : visibility simulation and map making, developed for Tianlai and PAON4 (~2012)
- **TAcq** : data acquisition and software correlator (~2007)
- AnaPAON4 : PAON4 analysis (~2016)

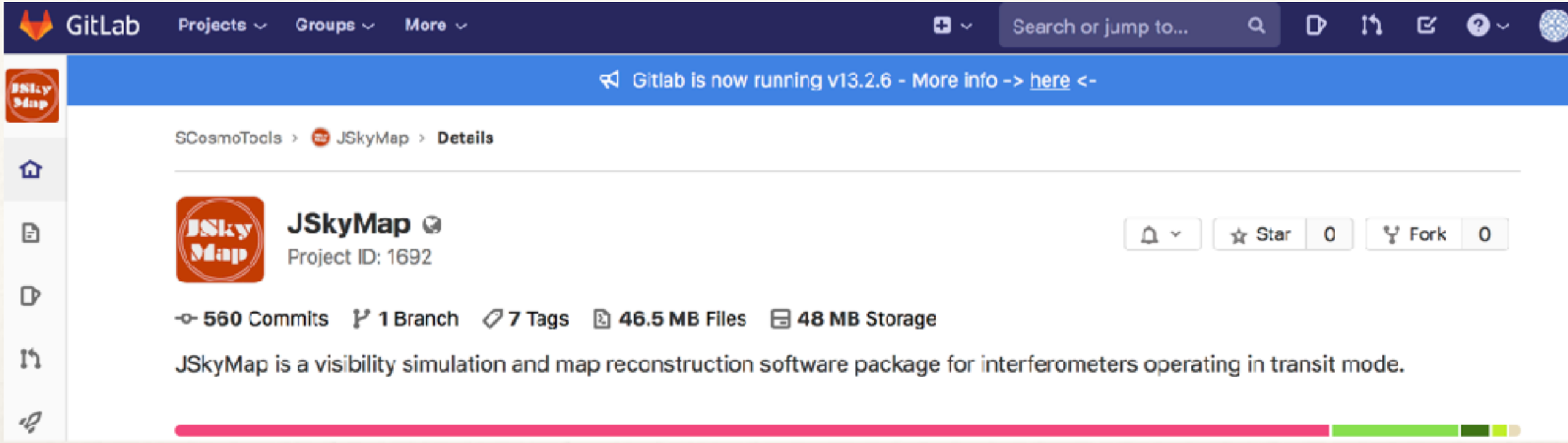
SOPHYA web site (docs) : http://www.sophya.org
git repository on https://gitlab.in2p3.fr/SOPHYA

JSkyMap

- Visibility simulation and map reconstruction software for transit arrays
- Computes visibilities from input map (in spherical harmonics space) or from a set of sources in angular domain
- Handles arbitrary single feed beam responses (analytical or map based)
- Map reconstruction using m-mode decomposition **JSphSkyMap** class , in (u,v) plane **JSphMap** class
- Very simple/fast map reconstruction (beam forming for each ra) : **QuickMapMaker** class
- Brute Force Map making , spherical geometry (**BFMTV_SphericalMap**) or rectangular geometry (**BFMTV_RectangularMap**)

J. Zhang et al, MNRAS 2016 , arXiv:1606.03090

J. Zhang et al, RAA 2016 , arXiv:1606.03830



JSkyMap git repository on (https://gitlab.in2p3.fr/SCosmoTools/JSkyMap)

- Several main programs can be used to generate visibilities time stream (or ra), starting from a list of sources or spherical maps , interferometer setup
- Main programs to reconstruct maps from the visibility streams
- Data written in several format: FITS, HDF5 (and native sophya PPF format)

TAcq

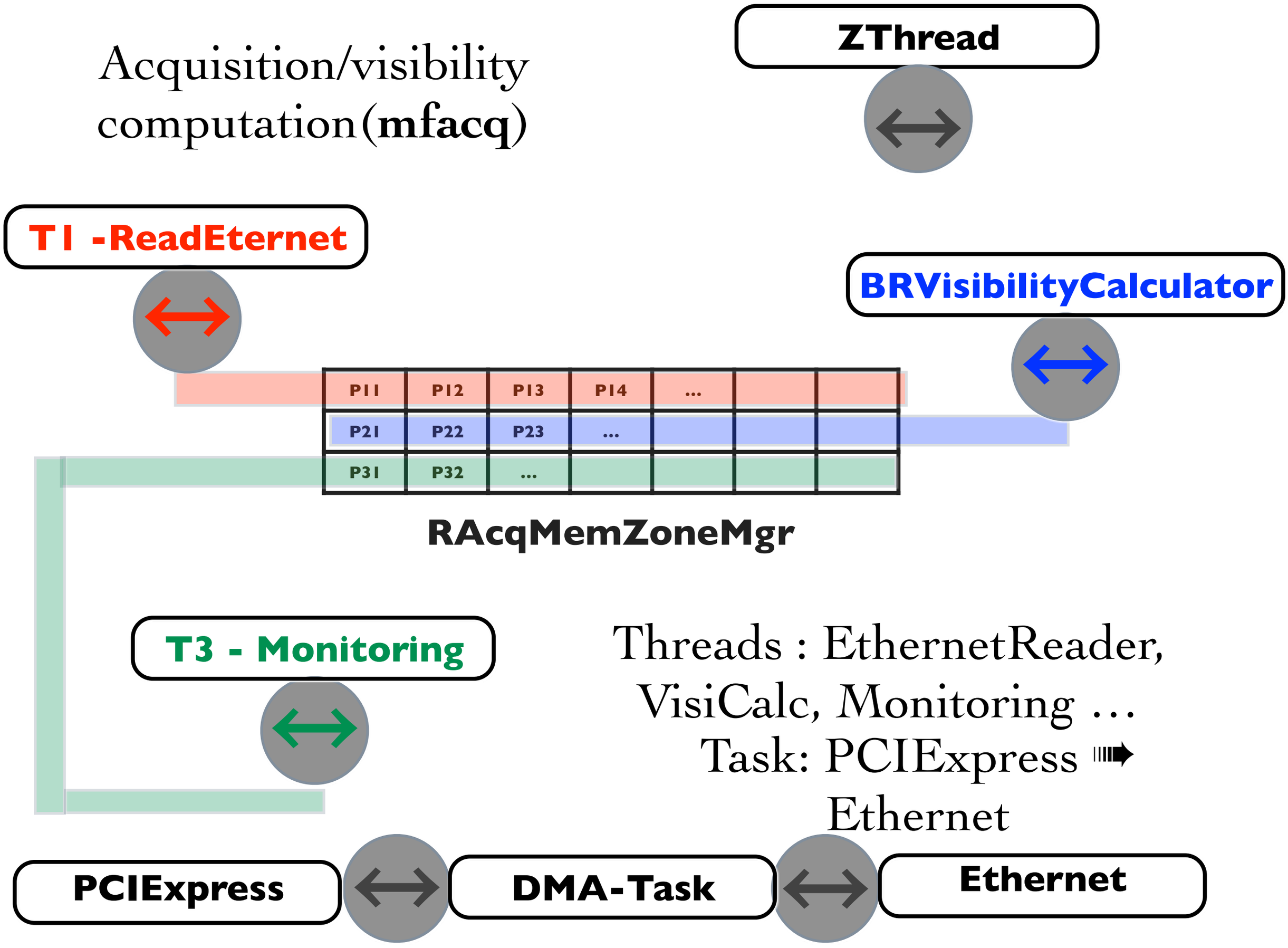
- An object oriented c++ framework for multi-thread, multi-node high level data acquisition and correlator software
- Data exchanged between different nodes (processes) in streaming mode, using a light weight packet structure with TimeTag (class **BRPaquet**)
- **RAcqMemZoneMgr** (memory manager) insure thread synchronisation/coordination between different threads within the same process
- Thread objects perform different tasks

TAcq git repository on (https://gitlab.in2p3.fr/baoradio/tacq)

Thread (task) classes (incomplete list)

- **PCIEMultiReader** : PCI-Express (DMA) to memory data transfer
- **PICIEToEthernet** : PCI_Express DMA to ethernet
- **MemToEthernet** : send data (packets) from memory over ethernet
- **EthernetReader** : data read (packets) from ethernet to memory
- **BRMultiFitsReader** : read data (packets) from FITS files
- **BRFitsCubeWriter** : data write (packets) to FITS files
- **BRFFTCalculator** : perform FFT on waveform data
- **BRVisibilityCalculator** : a complex class, multi-core inside to compute visibilities (correlator)
- **MonitorProc**(s) : data monitoring

Acquisition/visibility computation (**mfacq**)



Summary

- **JSkyMap** : visibility simulation and map reconstruction (several methods) from cleaned calibrated visibilities - Reasonably simple, robust package. Multi core level parallelism (single node) implemented, straightforward multi node parallelism to handle data/simulation at different frequencies. Handles arbitrary geometry and beam , intensity (Stokes I). Plan to extend it to polarisation
- **TAcq** : Robust, flexible and efficient, fully parallel (multi-core and multi-node) to implement data acquisition and processing (FX correlator) on a computer cluster - GPU enabled version of ***BRVisibilityCalculator*** will be used on IDROGEN/PAON4

JSkyMap git repository on (https://gitlab.in2p3.fr/SCosmoTools/JSkyMap)

TAcq git repository on (https://gitlab.in2p3.fr/baoradio/tacq)