Radio Astronomy

- Study celestial objects in radio frequencies
- LOFAR (LOw Frequency ARray)
  - 7000 Antennas
  - Below 250 MHz
  - Multiple stations
  - Biggest in the world
  - New design
Example image LOFAR

Cygnus A

(McKean et al., 2012)
LOFAR Superterp

- 6 Stations
- 288 usable ants
- 300m diameter
New Antenna Design

- Direction by phase delays between antennas
- Highly computational
- Cheap antennas
Enter The AARTFAAC Project

- Amsterdam Astron Radio Transients Facility And Analysis Centre
- 120 degrees FOV
- Realtime imaging
- Looking for transients
  - Non static objects
  - Pulsars
  - Galaxies
  - Jets
- Superterp only
- Trigger LOFAR
Computational Challenges

- Correlator: 12 Uniboards of FPGAs @ Astron
- Visibilities: \((288*289)/2*4 = 166464\) (dual pol.)
- Bandwidth: up to 13.8 MHz (576 images)
- Dump time: Every 1/10th second
- Data rate: 40 Gb/s
- Commensal to LOFAR
- Responsetime: \(\leq 1\) second
Pipeline Framework Candidates

- **Hadoop**
  - No streaming data (batch processing)

- **Storm**
  - Twitter
  - Define your own topology easily
  - Meta data overhead

- **Pelican**
  - Close collaboration
  - Astronomy examples/projects
  - Young

- **0-MQ**
  - Low level
  - Large userbase, docs
Pelican Framework (1/2)

- Streaming data processing
- Developed by OeRC (Oxford)
- C/C++
- Designed with astronomy in mind
- Modular

- Depends
  - Boost (minimal)
  - Qt framework
  - CppUnit
  - Doxygen
  - CMake
Pelican Framework (2/2)

- **Emulator**
  - Read from disk, self
  - Send udp packets

- **Server (bottleneck)**
  - Creates chunks from udp
  - Sends tcp packets
  - First come first served

- **Pipeline**
  - Creates datablobs from tcp
  - Manipulate datablobs with modules
  - Send/Store elsewhere
Pipeline Design

- Matlab
- Pelican
- CppUnit
- Eigen3
- Jenkins
Example Image AARTFAAC
More info

- Sourcecode
  - Sorry, not yet
  - Nearby future!!
  - Some legal issues
- www.aartfaac.org
- www.lofar.org
- github.com/pelican/pelican
- eigen.tuxfamily.org
Questions