SKA pulsar search pipeline

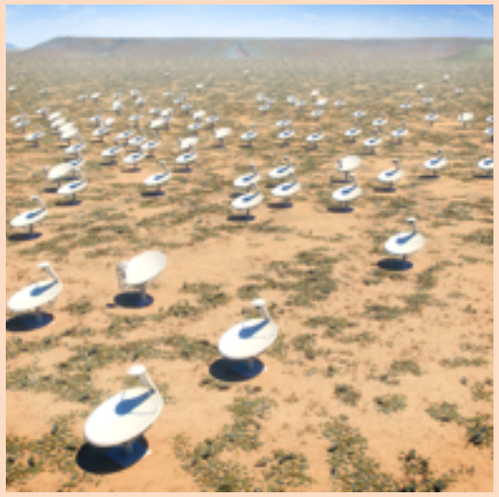

Image credit: SKA

SKA1-Mid, Southern Africa
1500 beams

Image credit: SKA

SKA-Low, Western Australia
500 beams

Telescope Manager

Discovery Alert

Beamforming

CSP:
- **De-dispersion**
- **Acceleration Search**
- **Candidate Sifting**
- **Candidate Folding**

SDP:
- **Multi-beam Coincidence Matching**
- **Machine Learning**
- **Candidate Classification**
- **Candidate Selection**

8 bits
64 µs time resolution
4096 frequency channels
4 polarizations

250 MB/beam =>
375 GB/obs (Mid)

“Detected” files with up to
4096 pulse phase bins
4096 frequency channels
180 sub-integrations

1000 pulsar candidates/beam
~ 270 MB/beam

50 GB/obs
=> 1.5 PB for all-sky survey

Science Archive

Processing steps:

- Correct for delays in the interstellar medium: 6000 “DM steps”
- Each step periodicity searched: 6000 8Mpoint FFTs
- Each step acceleration searched, with 85 acceleration trials
- Sift through candidates to remove duplicates and harmonics
- “Fold” the candidates to increase signal-to-noise and for easy visualization

Challenges:

- High data rate (~60PB/day)
  - Processing pipeline needs to run in real time
- Tight power constraints (~250 watts/beam)
- Complex algorithms with high computational load

Current solutions:

- Hardware:
  - Looking at using a combination of GPUs and FPGAs, to optimize outcome
  - GPUs mainly focussed on dedispersion and acceleration searching
  - FPGAs mainly focussed on long FFTs and convolution
- Software:
  - Optimizing current search codes to run faster

CSP processing pipeline

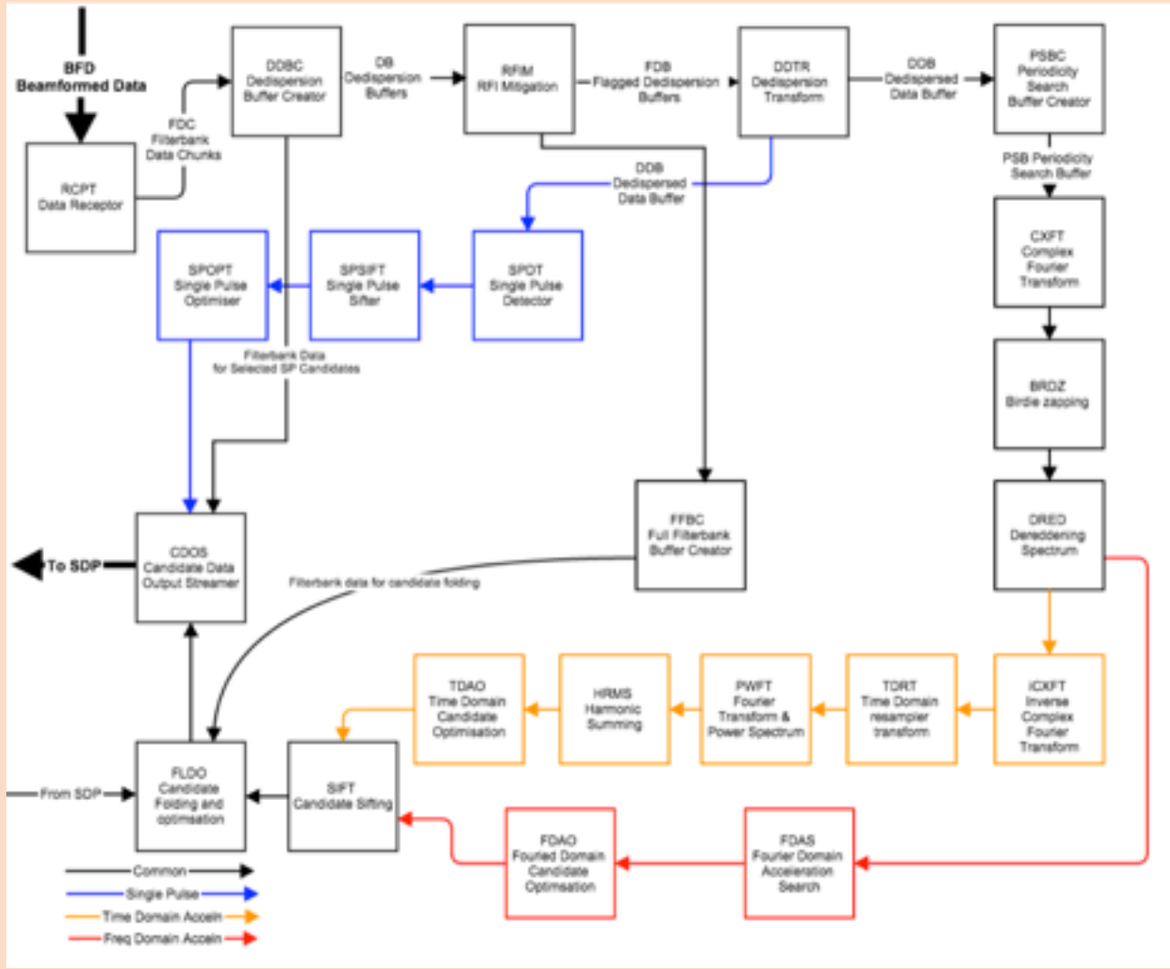

Image credit: Prabu Thiagaraj