Thoughts, comments, suggestions on SETI with the SKA

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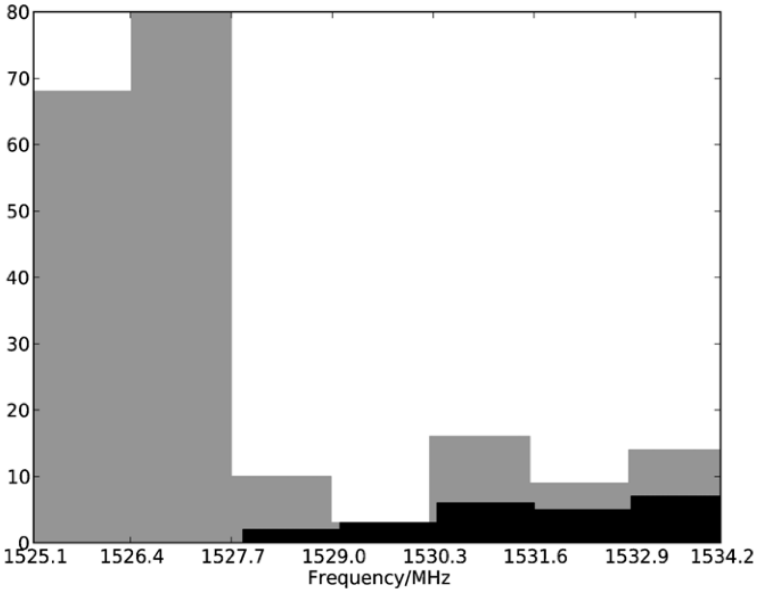
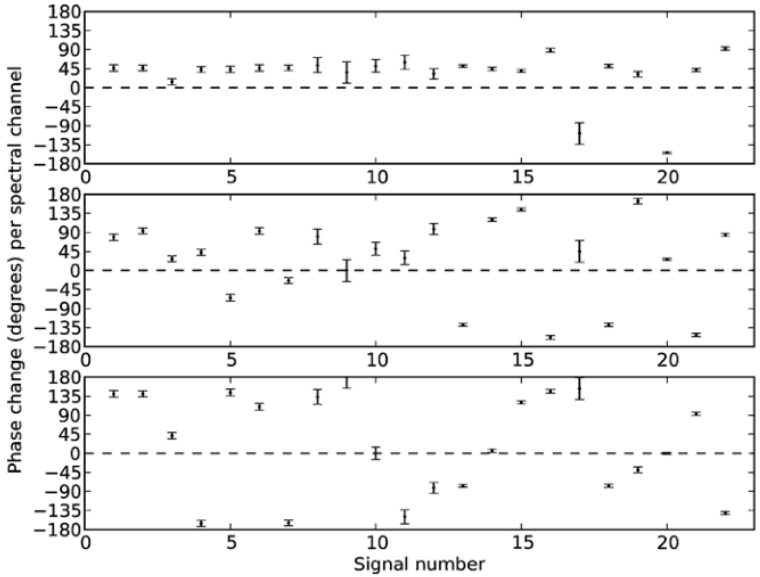
- Requirements cf pulsars:
  - Tied array voltage beams (for SKA_low and SKA_mid). Also required for VLBI capability. Pulsars want ~10 beams. Targeted SETI searches.
  - Wide range of frequencies (pulsars = propagation effects, SETI = transmitter frequencies).
  - Centralised collecting area. Ok for SETI.
  - Sub-arraying for SETI surveys.
  - Like pulsars, SKA_low usage in non-EoR times/seasons = “galactic time”.

- VLBI SETI (GL 581: Rampadarath, Morgan, Tingay & Trott 2012, ApJ, 144, 38). Non-imaging analysis using distributed antennas for mitigation/localisation of RFI.

- Could be implemented via "spigot" and real-time signal processing system from correlator to use some fraction of available data, a la V-FASTR experiment at VLBA (Trott et al. 2013, Wayth et al. 2012, 2011 etc).

- Voltage "spigot" could also be used from beamforming engine, for VLBI and SETI processing. Commensal/ parallel use with pulsar timing? Cf MWA.





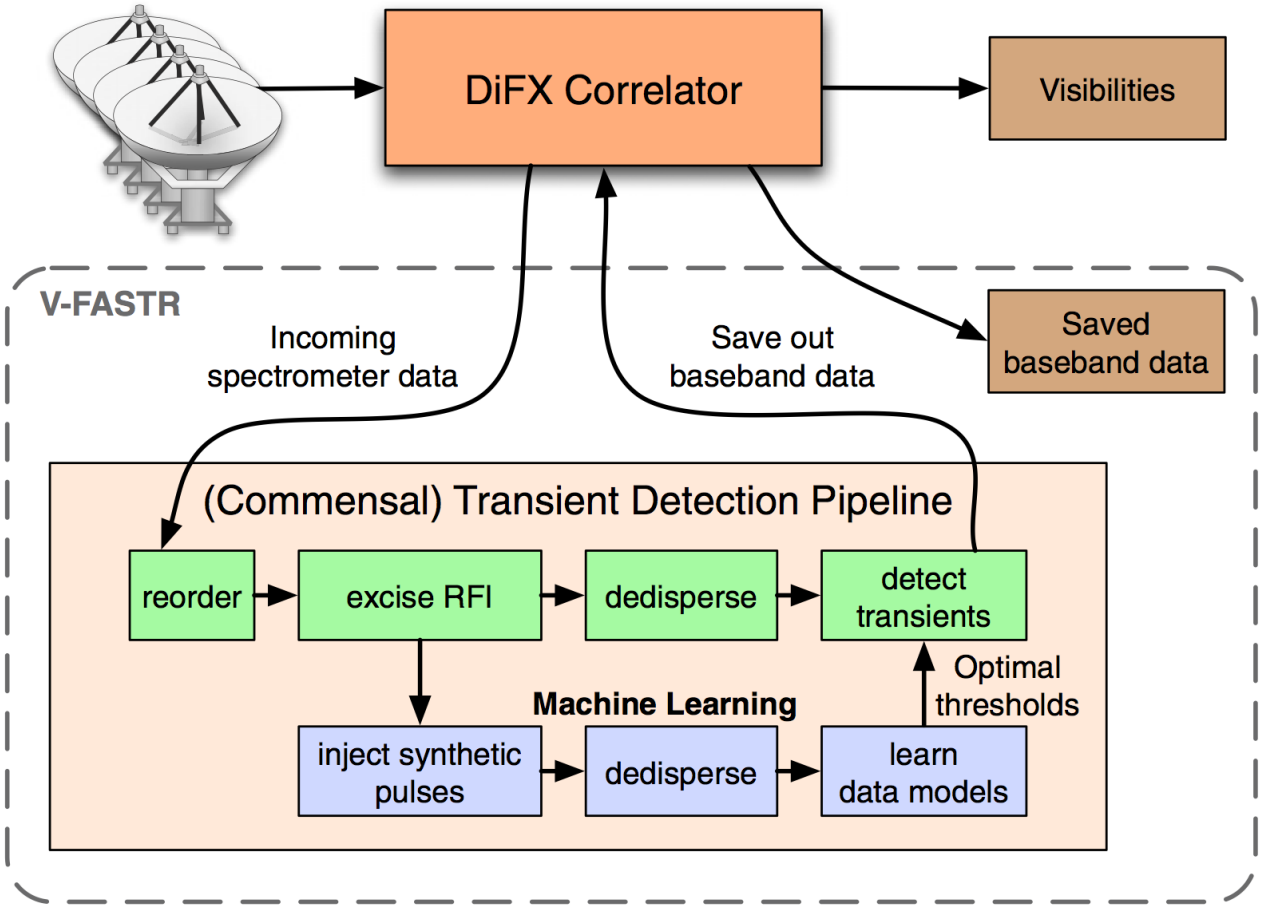
8 hrs of observations = 12 x 40 min blocks.
1230 – 1544 MHz in 64 MHz bands (32,768 channels per 64 MHz, ~2 kHz channels)

200 narrow-band signals and 22 broad-band signals survived correlation
None of the 222 signals were consistent with GL 581 position

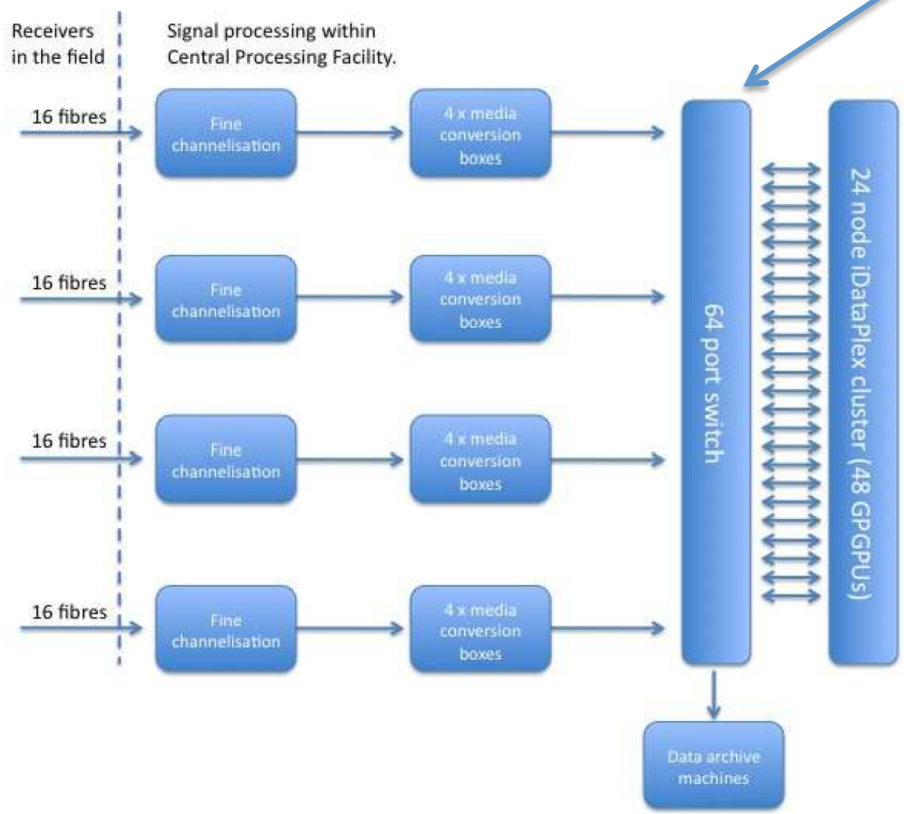
All signals fall in Optus/Mobilesat/INMARSAT geostationary satellite frequency range and are consistent with spatial localisation of satellites.

Entirely non-imaging analysis.

Correlated data “spigot” implemented for V-FASTR at VLBA



Voltage capture "spigot" implemented at MWA:



All voltage data available via 10 Gbps switch at full rate for all antennas.

Data are transferred to Perth via 10 Gbps link for processing at Pawsey/Curtin computing facilities off-line.

- SETI
- FRB searches
- Pulsar searching/timing
- Detailed RFI characterisation
- Instrument diagnostics

- Challenges:
  - General beamforming challenge – need antenna-based corrections essentially in real-time, unless low duty cycle post-real-time beamforming is performed (save and process voltages post-observation). Sounds like this has been addressed in the requirements (Cornwell). Also, solved for LOFAR.
  - Data rates/volumes. Limits to duration of observations, off-line processing facilities, duty cycle of observations.

- Solutions:
  - Implement capabilities for full throughput spigots (in signal processing architecture: at voltage and correlator output levels) and initially use fraction of capability.

- Conclusion:
  - With spigots enabled, most of which exist already in the baseline design / requirements, SETI should be entirely feasible.

- Recommendation:
  - Strongly recommend defining spigot, defining interface to spigot, providing data transport options and assume SETI users will process data off-lineand off-site and outside scope of SKA project and operational budget.