Correlator Specifications
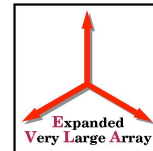
Michael P. Rupen
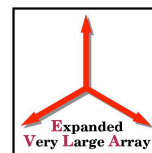
Principle Requirements

- 32 stations, scaleable in 8-station increments; up to 256 allowed
- 8 x 2 GHz "basebands", each comprised of 16 tunable sub-bands
- 16,384 channels per baseline @ max. BW
- 4 million channels per baseline, w/ recirculation
- High spectral dynamic range
- 1, 2, 3, 4, or 8-bit initial quantization; 4- or 7-bit after sub-band filter
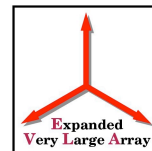
Sub-bands and recirculation

- Sub-band BW: 128, 64, 32 MHz, …, 31.25 kHz
- Sub-bands in integer 128/64 MHz slots (but note baseband tuning)
- Seamless (cross-correlation) sub-band stitching
- Recirculation on 4 of 8 sub-band pairs
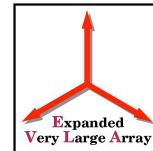- Max. recirculation factor= 256 (?)
- Wideband recirculation

Phased Array

- 1 GHz phased-VLA capability (8 sub-bands, 32 antennas)
  - ➢ Up to 16 GHz with more money
  - ➢ 8-bits
  - ➢ 4 sub-bands on 64 antennas
  - ➢ Can be fed back into WIDAR…
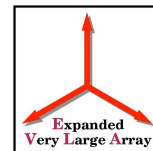 - ➢ Simultaneous with "normal" correlations @ same phase center

VLBI

- VLBI-ready
  - Max. baseline 25,000 km
  - Ability to accept and produce VSI
  - Trade bandwidth for antennas (see later)
  - "Two correlators in one": could correlator VLBA at the same time
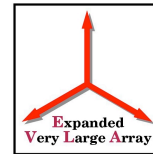
Auto-correlations etc.

- Auto-correlations
  - Wideband 4x1024 channels (64-lag chunks every 10 msec)
  - Sub-band as cross-corr'ns (up to 16,384 channels per antenna)
- Pre-filter
  - Wideband state counts, auto-correlation (time-multiplexed)
- Post-filter, pre-requantizer
  - Power (binned by noise tube ON/OFF)
- Post-requantizer
  - Power
 - Phase cals
  - State counts
  - Lag zero

Pulsar Processing

- Pulsar processing
  - ➢ 2 banks of 1000 bins each per baseline
  - ➢ Up to 65,536 bins per baseline in S/W
  - ➢ Bins as narrow as 200 microsec (all channels), or 15microsec with 64 channels/sub-band/baseline
  - ➢ Gating with one time+multi-gate generator per 2 GHz baseband
  - ➢ Can gate with different delays per sub-band
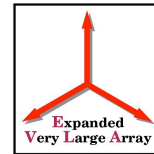- Phased array output as previously described

Dump time & data rate
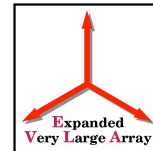
- Min. dump time: 100 msec with all channels (set by CBE)
  - ➢ Absolute minimum ~60 microseconds
- Max. dump time: unlimited
- Correlator Backend (CBE) I/O
  - ➢ Input: 1.6 GB/s
  - ➢ Output: 25 MB/s
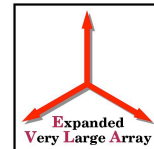 - ➢ N.B. CBE limited by I/O, not by processing power

Sub-arrays and low-bandwidth stations

- Sub-arrays
  - Unlimited for cross-correlations
  - 4 phased-array sub-arrays with complete flexibility in antenna selection
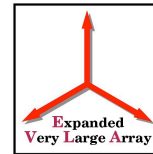- 16 GHz stations tradeable for 2x4 GHz (Nchan/4) or 4x1 GHz (Nchan/16)

RFI Excision

- RFI excision
  - Sub-band power over-range detection & blanking
  - Post-corr'n cancellation (CBE)
  - Excision based on autocorr'ns

Flexibility

- Flexibility
  - Single or dual pol'n BB pairs
  - 1, 2, or 4 polarizations/sub-band
  - Mixed high and low BW antennas
  - Each sub-band can be 4- or 7-bit
  - Recirculation available in 4 of 8 sub-band pairs
  - Each sub-band can have its own BW & (where applicable) recirculation factor
- FIR filters
- Radar mode: two 31.25 kHz 8-bit sub-bands; wider BW with fewer bits