VLA EXPANSION PROJECT

Requirements and Additional Capabilities

Outline

- "Dream" correlator requirements comparison.
- Additional capabilities.
- Other requirements.

Description	"Dream" Correlator Spec.	Planned deliverable
No. of antennas	36	
Bandwidth	4 x 2 x 2 GHz (16 GHz)	
Freq. Resolution	few Hz ... 10's MHz	
No. of independently tunable IF pairs	at least 4, prefer 8	
No. of frequency channels	1000 (full polarization per IF pair), 8000 total	
Frequency channel flexibility	split flexibly among IFs, select subset for writing	
Flexibility	Frequency resolution: factors of 2 Flexible tradeoffs (#baselines, B.W., #channels, pol'n, time res'n) Interf. sub-arrays: 4 independent Phased sub-arrays: 4 independent	
Integration times	0.1 sec (less with tradeoffs)	
Total data rates	few tens of Mvis/sec	
Autocorrelations	all stokes parameters	
RFI	as many channels as possible 10^6 dynamic range automatic flagging gating	
Pulsar phase binning	up to 1000	
Phase Cal	at least auto-spectra	
Delay tracking	$1/16^{th}$ sample, 250 km baseline	

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Additional Capabilities

- With front-end switch, able to multi-beam/multi-process basebands (IFs).
- Sub-band multi-beaming within ~0.25^{o} of baseband beam (all up to 2200 km baselines, 1 per baseband up to 10k baselines).
- VLBI-ready.
- Digital phased output…expandable to phase up to 16 GHz.
- Multiple digital sub-bands that are width, number of channels, and placement flexible.
- Flexible baseband width inputs…useful for phased-VLA corr.
- Expandable architecture.
- Tradeoff number of antennas for bandwidth (2X, 4X)
- Future “cheap” upgrade path (#ants, #channels).

Other Requirements

- **Change configurations in ~1 second.**
- **Sub-band reject-band attenuation.**
  - No specification, plan 12-bit LUT, should be ok for -60 dB.
  - Smaller LUT, can be traded off for more taps. FPGA programmable.
- **Aliasing attentuation.**
  - No specification, but amplitude ~= $10\log(1/(12 f_{shift} T)$; T is the *incoherent* integration time.
    - T=10 msec; f_{shift}=10 kHz : -30 dB.
    - T=100 msec; f_{shift}=10 kHz : -40 dB.
    - T=10 msec; f_{shift}=1 kHz : -20 dB; T=100 msec : -30 dB.
  - …and a factor of two sensitivity loss at the sub-band boundary. Some control over SNR loss region possible with different filter shapes depending on requirements.
- **Digital passband ripple.**
  - Should be small (~1 dB?) to minimize requantization sensitivity losses. Can tradeoff steepness of transition band for flatness of passband. "Just load in different tap coefficients".