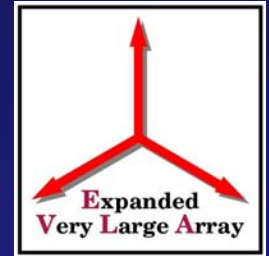


EVLA Advisory Panel Mtg. System Overview

Jim Jackson, Hardware Systems Engineer



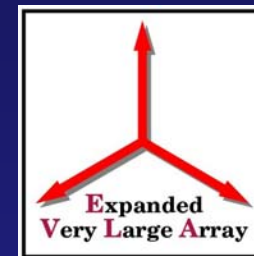
What will be Replaced?



- Most feeds and front end electronics
- All LO/IF electronics
- IF transmission system
- All monitor & control electronics
- Correlator
- Computing systems / software



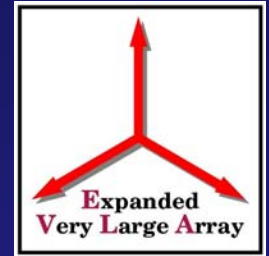
Frequency Coverage



VLA BAND	FREQUENCY	FREQ RANGE	Receiver Temp (K)
4	74 MHz	73.5 – 74.5 MHz	1000-10000
P	327 MHz	300 – 340 MHz	150-180
L	1.5 GHz	(1.0)1.2 – 2.0 GHz	9
S	3.0 GHz	2.0 – 4.0 GHz	14
C	6.0 GHz	4.0 – 8.0 GHz	19
X	10.0 GHz	8.0 – 12.0 GHz	21
U	15.0 GHz	12.0 – 18.0 GHz	21
K	22.0 GHz	18.0 – 26.0 GHz	28
Ka	33.0 GHz	26.5 – 40.0 GHz	38
Q	43.0 GHz	40.0 – 50.0 GHz	44



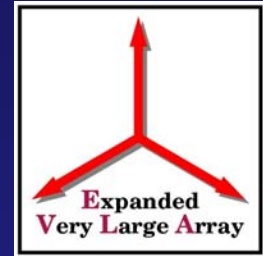
LO System



- New hydrogen MASER
- GPS timing reference
- Fiber optic reference distribution
 - Carrier 1: 512 MHz, 128MHz
 - Carrier 2: 32 MHz + Timing
- Round trip phase measurement on 512 Mhz



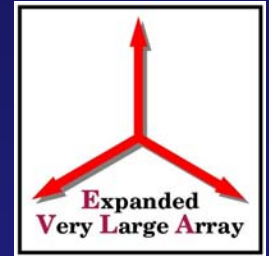
LO System



- Three new synthesizer designs:
 - 12 - 20 GHz Synthesizer
 - LO to K,Ka and Q Front Ends
 - LO to UX and LCS Converters
 - 10.8 – 14.8 GHz Synthesizer
 - Primary LO to main downconverter
 - 4.096 GHz Synthesizer
 - Secondary LO to main downconverter (for transition)



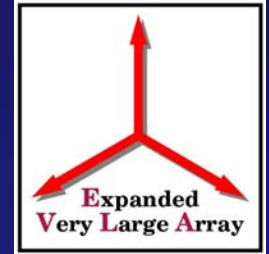
IF System



- Four conversion stages
 - 4P Converter: 4 and P-Band to L-Band
 - LCS Converter: L, C and S-Bands to X Band
 - UX Converter: Ku-Band to X-Band
 - Main Downconverter: X-Band to Digitizers



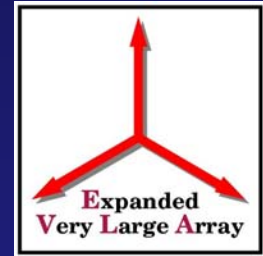
Wideband Digitizers



- 4.096 giga samples / second
- 3 bits / 8 level
- 2-4 GHz harmonic sampling
- 256 MHz LVDS parallel data output
- Being developed for ALMA at the University of Bordeaux in France



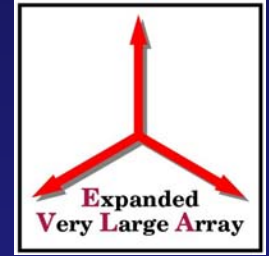
High Resolution Digitizers



- 2.048 giga samples / second
- 8 bits / 256 level
- 1-2 GHz harmonic sampling
- 256 MHz PECL parallel data output
- Two Maxim MAX108 devices interleaved
- Supports high resolution observing and VLA to EVLA transition phase



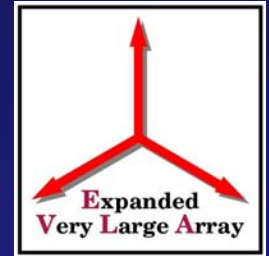
IF Data Transmission



- Fiber optic based system
 - Twelve 10 gigabit per second links per antenna
 - Based on SONET/OC-192 technology
 - Using hardware designed for ALMA
 - Slightly modified for longer baselines / VLBI
 - Custom packaging being designed for low RFI



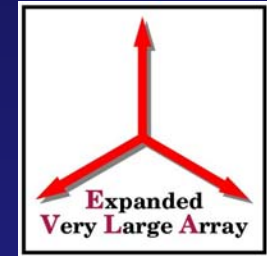
Transition Interface



- Use digital FIR filters and D/A converters to regenerate 64MHz analog IF signals
- Feed to VLA digitizers via existing baseband filter and driver modules
- FIR's and D/A converters may be combined with EVLA data transmission system receiver modules



WIDAR Correlator

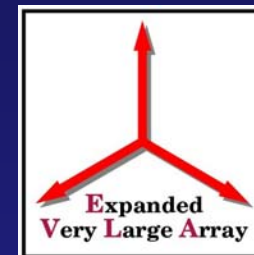


- Being developed by HIA/DRAO in Canada

Number of Stations	32 (installed racks for 40; architecture supports up to 256).
Max spectral channels/baseline @ max bandwidth	16,384 (more with “wideband recirculation” and sensitivity losses).
Max spectral channels/cross-correlation with recirculation	262,144
Polarization products	1, 2 or 4
No. of basebands/antenna	8 x 2 GHz each (more with narrower bandwidths)
Quantization	1, 2, 3, 4, or 8-bit initial quantization; 4 or 7-bit re-quantization after sub-band filter.



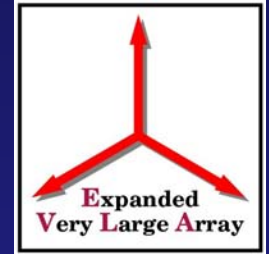
WIDAR Correlator



Correlator efficiency	~95% (4-bit initial quantization, 4-bit re-quantization, 5-level fringe rotation)
Sub-band bandwidth	125 MHz, 62.5 MHz, 31.25 MHz, ..., 30 kHz (2-stage radar-mode). Each sub-band's width and position can be set independently of any other sub-band.
Sub-band tuning	Each sub-band should remain within an appropriate integer slot to minimize band edge SNR loss. E.g. a 125 MHz sub-band should be within 1 of 16 equally spaced slots in a 2 GHz band.
Spectral dynamic range	(Initial quantization) 3-bit: ~44dB; 4-bit: ~50dB; 8-bit: ~58dB.
Auto-correlations	Wideband (4x2 GHz pairs): 4 products of 1024 spectral channels each, SNR loss of 4. Sub-band: 16,384 total spectral channels per station (widest sub-band), no SNR Loss.



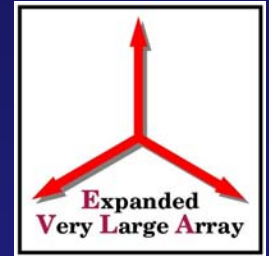
Monitor & Control



- Ethernet based system
- 100 Mb fiber in antennas
- 1Gb fiber CEB to antennas
- 100Mb and 1Gb fiber and copper in CEB
- Module Interface Board (MIB) being developed for modules



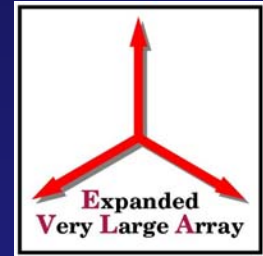
Power Supplies



- 48 VDC in antennas and correlator
 - Lower current distribution
 - Components widely used in telecom industry
- Combination of linear and switching regulators
- Backup power on critical subsystems



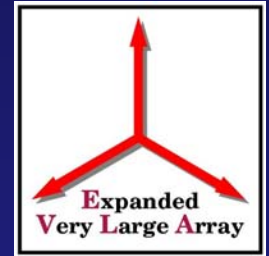
Racks/Bins/Modules



- Use a modified version of existing designs
 - Improved RFI characteristics
 - More high speed digital circuits in antennas and CEB
 - Wider bandwidth front ends
 - Improved Thermal characteristics
 - Heat generated by high speed digital electronics
 - RFI sealed modules/racks present greater challenge
 - Greater thermal stability for LO/IF electronics



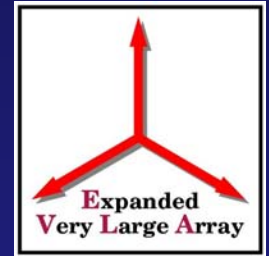
Racks/Bins/Modules



- New packaging being design to accomodate:
 - IF Data Transmission System (DTS)
 - 8 Bit digitizers
 - 3 Bit digitizers
- RFI shielded
- Air cooled



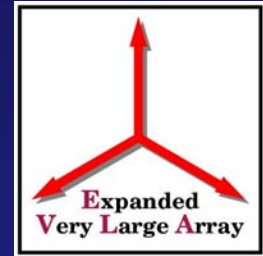
RFI Considerations



- External RFI
 - More RFI sources
 - Ground and space based
 - Cell phones / PCS
 - Satellite radio / television broadcasting
 - DME / military & civilian radar / super doppler weather radar
 - More sensitive front ends
 - Environmental Monitoring System (EMS)
 - Located at VLA site
 - Collecting data for use in system design



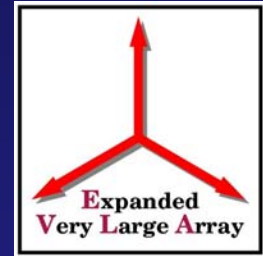
RFI Considerations



- Internal (VLA site generated) RFI
 - High speed digital electronics
 - Digitizers, data transmission system, correlator
 - More and faster computers on site
 - Comb generators in 6 synthesizers per antenna
 - Wider IF bandwidths
 - Switching regulators
 - Alma test interferometer on site



RFI Considerations



- Solutions:
 - WIDAR correlator design
 - High resolution digitizers at antenna
 - High dynamic range IF system
 - New shielded room for correlator
 - Improved rack/bin/module designs
 - Flexible system design
 - Fast total power measurement, variable gain, test points, etc...
 - Low emission electronic design techniques



Questions?

