EVLA Transition to Science Operations: An Overview

EVLA Advisory Committee Meeting, March 19-20, 2009

Bob Dickman

AD, NM Operations

Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array

NRAO

The EVLA is an Unusual Project

- More than a decade in duration
- EVLA will produce a tenfold increase in capabilities while keeping the old instrument operational and supporting users ⇔ maintain the user base:
  - >60% of hours kept available to community
  - EVLA-converted antennas must be usable with VLA correlator (hardware and software implications); the cost of this decision was built into EVLA budget
  - The EVLA will be delivered in an operational state that offers massively enhanced capabilities to the user community relative to the VLA: The commissioning of basic functionality must be carried out prior to delivery of the instrument
- Our mission is to deliver Science Opportunity to the community as rapidly as is practical.
  - To facilitate this, we will take advantage of synergies with the Observatory's other telescopes, especially ALMA
  - Users will see the EVLA as one instrument within a single, unified Observatory

What Will Be Delivered?

- The EVLA will be delivered four years hence (1/1/13) with:
  - ✓ All hardware complete
  - ✓ Support for essential correlator capabilities, which will be sufficient to serve the vast majority of EVLA users (see Rick Perley's talk on Science Use Cases):
    - ✓ For continuum observations: 8 GHz bandwidth, dual polarization
    - ✓ For spectral line observations: Up to 64 separately steerable sub-bands, with adjustable frequency resolution
  - ✓ Archived raw visibilities and calibration tables, with reference images compatible with VAO for projects carried out in standard modes
  - ✓ NRAO data reduction package(s) available to the community which are capable of supporting the analysis of data obtained with the completed EVLA
  - ✓ User support that leverages ALMA as much as possible
- More specialized capabilities (*e.g.*, production of noise-limited, low-frequency, wide-band images, phased array, pulsar gating, radar modes, *etc.*) will be added as resources permit

EVLA Commissioning: Some High-level Milestones

WIDAR Operational: VLA Correlator Turned Off ⇓

Construction Completed ⇓

Year	**2010**			**2011**			**2012**			**2013**			**2014**
	|			|			|			|			|
Configuration	**D**	**D**	**C**	**B**	**A**	**D**	**C**	**B**	**A**	**D**	**C**	**B**	**A**
$N_{EVLA\ Antennas}$	**25**	**26**	**27**	**28**									
WIDAR Bandwidth (to community at large)	**| 256 MHz ⇒**					**| 2 GHz ⇒**				**| 8 GHz ⇒**			
New Receivers Complete:	**K, Q**		**Ka**		**C**					**{L,S, X, Ku}**			
Reference Image Pipeline										**| Narrow Band Reference images ⇒**			

Integrating the EVLA's Transition to Full Science Operations

- Areas to be coordinated:
  - EVLA construction
  - NM Management and Operations
  - EVLA User Support and Integration
  - Post-Processing:
    - Software - Package(s)
    - Software - Algorithms
    - Hardware
- I shall summarize the status of these areas; details for those not already covered will be provided in the talks that follow

EVLA Construction and Commissioning

- Complete delivery, verify and integrate
  - WIDAR
  - Receivers
  - Antennas
  - Backend electronics
  - Software (M&C, SSS, Post-processing)
- Verify and integrate here includes:
  - Test and diagnose problems with hardware, software, and electronics
  - Certify that EVLA performance meets specifications required in the Project Book
  - Test and de-bug the WIDAR correlator
  - Test and certify supporting functional software (user support, calibration, etc.)
  - Test and certify first supported scientific observing modes
  - Test and certify science support software
- Plenty of challenge; project is well in hand

NM Operations and Management

- Ensure that the scientific productivity of the EVLA is optimized and place the array in the hands of the user community as rapidly as possible
- Allocate additional resources available/necessary to EVLA construction project to deliver instrument on time, budget
- Science Operations is a central aspect (see Claire's talk)
- Maintain the operational infrastructure of the EVLA

Post-processing Computing Software Packages

- CASA recently restructured (FY09)
  - Now being managed jointly by ALMA and EVLA/NM Operations
  - Enhanced opportunities for synergy
  - CASA capabilities will support WIDAR capabilities as they are released to the OSRO community
  - AIPS will also be able to handle all but the most complex data sets
- While many users will use the EVLA at its higher frequencies (Q, Ka, K bands), where fractional bandwidths are relatively small, there will also be strong pressure to address the special opportunities offered by data at the lower frequencies
  - This is new territory: Low-frequency, high dynamic range wide-band, wide field imaging (see talks by Sanjay Bhatnagar and Urvashi Rau)
  - Accelerating the development of the specialized algorithms required in order to take full advantage of the EVLA's low frequency capabilities is being carried out by an Algorithm Development Working Group led by Gareth Hunt and Frazer Owen (see my talk following Sanjay's)

Post-Processing in the EVLA Era

- EVLA data rates/data sets will be 10-1000 times larger than their VLA counterparts
- Archive disk space will be expanded to keep pace
- Bandwidths from EVLA site to DSOC, and from the DSOC to Internet2, will be increased to 1 Gbps; if necessary, we will physically ship the largest EVLA data sets to users on media
- With the advent of the EVLA, the current mutual compatibility between data set size, data analysis programs (CASA, AIPS, *etc.*) and the typical computing platforms available to the astronomer (lap tops, multiprocessor desk tops, *etc.*) will be seriously challenged
- NRAO is exploring the extent to which parallel processing can be used to expedite the analysis of larger EVLA data sets
  - Part of the EVLA project's deliverables
  - Exploiting synergies with ALMA

Post-Processing Hardware

- Tests have begun with a small prototype computing cluster, purchased jointly with ALMA funds last autumn and now in hand, to define how best to optimize the science pipeline to our users:
  - Tests are underway with a parallelized version of CASA to determine the optimum cluster architecture relative to WIDAR data sets (e.g., number of nodes, how to overcome I/O bottlenecks, memory requirements; see Bhatnagar/Rau talk)
- The results of this testing program will:
  - Help define high-end post processing computing requirements for the EVLA user base
  - Guide the purchase of the "final" post-processing cluster included in the EVLA construction budget
  - Determine optimum use of this cluster based on what we find in testing program
    - Remote access for multiple users?
    - Users travel to NM to use?
    - Other, more specialized applications?

Questions?