Shared Risk Observing

EVLA SSS Review, June 5, 2009

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Atacama Large Millimeter/submillimeter Array

Expanded Very Large Array

Robert C. Byrd Green Bank Telescope

Very Long Baseline Array

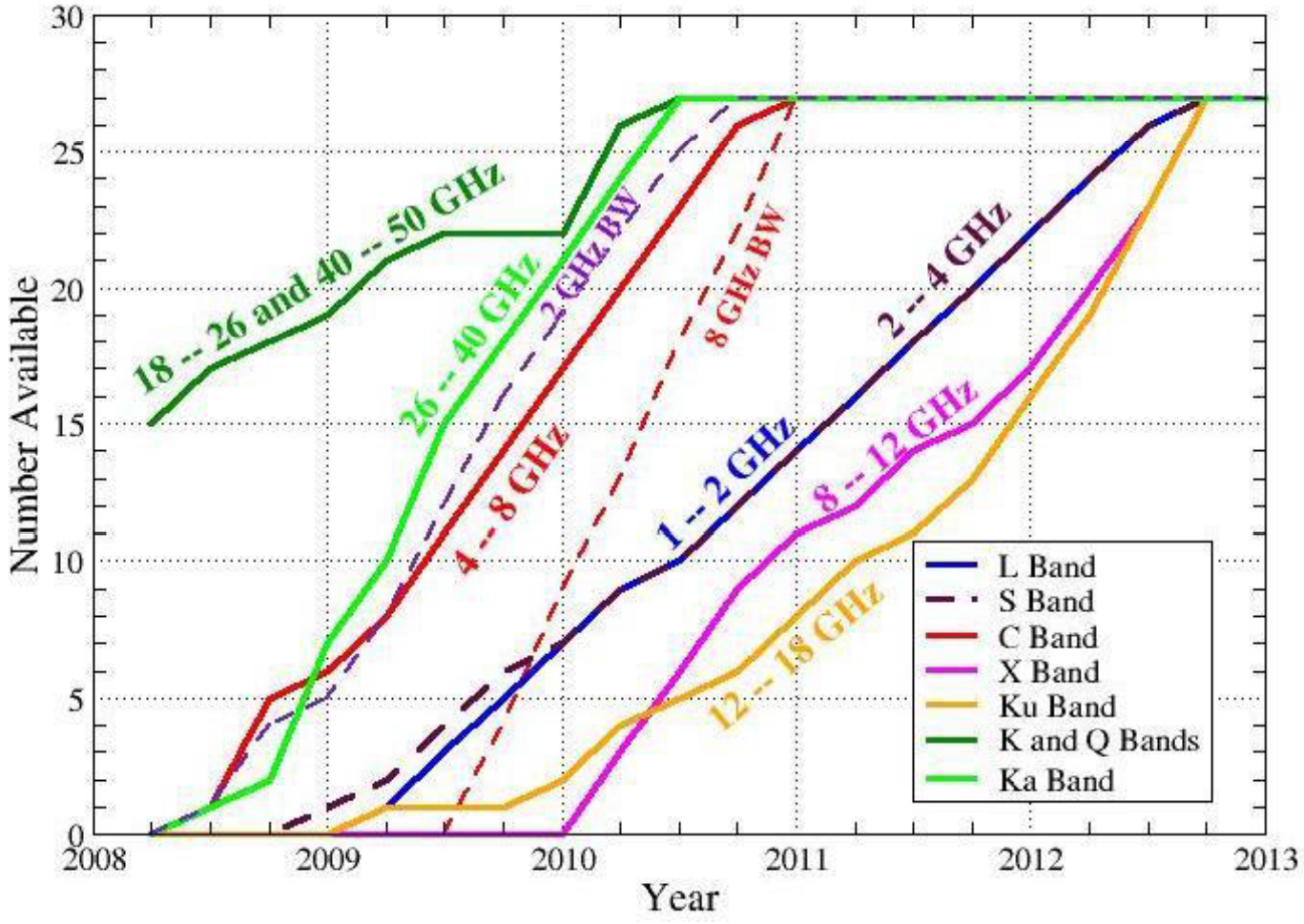
NRAO

EVLA Deliverables

- At the end of the construction project (1/1/2013) the EVLA will have:
  - Hardware complete (1–50 GHz provided by 8 receivers,28 antennas)
  - Support for essential correlator capabilities, sufficient to serve the vast majority of EVLA users:
    - 8 GHz BW, full polarization, for continuum applications
    - 64 separately tunable sub-bands, with adjustable BW and frequency resolution, for spectral line applications
  - Raw and calibrated visibilities, narrowband reference images for observations taken in standard modes
  - NRAO-supported data reduction and analysis software
- Specialized capabilities (e.g., noise-limited, low-frequency, wideband images, VLBI, pulsar and radar modes) will be added when resources permit

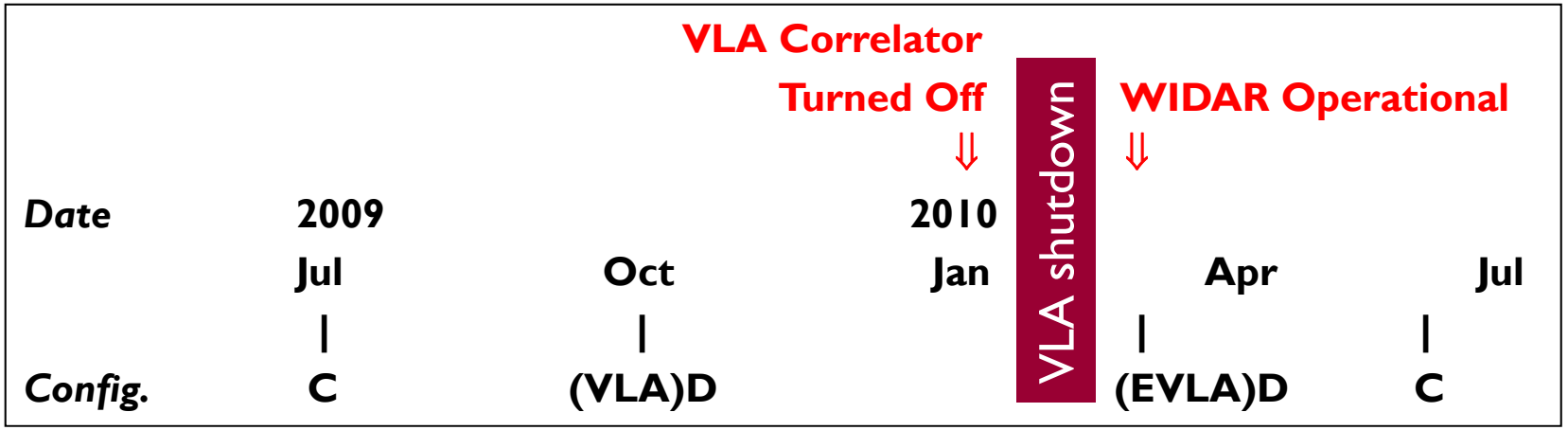
EVLA Capabilities, 2009-2013

- Antennas:
- Receivers:
- Samplers:



Transition to EVLA correlator, Jan 2010

- Currently testing WIDAR production boards in 10-station "WIDAR-0"
- All boards will be in place by Q1, 2010
- In order to commission correlator with 27 stations we must turn off the VLA correlator and transfer hardware to WIDAR



EVLA Capabilities, 2009-2013

- Correlator:
  - First modes for general users will offer up to 256 MHz BW
  - Then (as recommended by SAGE):
    - Increase bandwidth
    - Increase number of channels
    - Increase flexibility
    - Special modes
  - Access to these capabilities will be through two Early Science programs that recognize the EVLA is an instrument undergoing commissioning
  - ➢ *Use of EVLA/WIDAR will be Shared Risk*
    - *we'll do our best to provide good quality data, but no guarantees*
  - ➢ *Full access to current EVLA/WIDAR capabilities by outside users will be quid pro quo*

Early Science Programs

- We have developed two observing programs to provide early EVLA science. They will run concurrently:
  - The *Open Shared Risk Observing (OSRO)* program
    - Access for the whole user community to a number of capabilities beyond those of the VLA
    - Runs from 2010 until full operations in 2013
    - http://www.aoc.nrao.edu/evla/astro/osro.shtml
  - The *Resident Shared Risk Observing (RSRO)* program
    - Full access to current EVLA capabilities for peer-reviewed science in return for a period of residence in Socorro to help commission WIDAR, EVLA, and related software systems
    - Runs for two years, 2010-2011
    - http://www.aoc.nrao.edu/evla/astro/rsro.shtml
- Announced in the NRAO eNews, February 2009

Open Shared Risk Observing

- NRAO has been offering shared risk observing since the EVLA construction project began
  - New EVLA electronics
  - New on-line computing system
  - New receiver bands
  - *New correlator!*
- Most "risk" is at major transitions in capabilities, and predominantly impacts time-critical observations (e.g., transient sources) that cannot easily be repeated
- Initially plan to configure WIDAR in two modes that will provide significant enhancement over the VLA correlator

OSRO Details

- Correlator modes:
  - For continuum applications and spectro-polarimetry
    - Two independently-tunable sub-band pairs (IFs), full polarization, each with bandwidth $128/2^n$ MHz (n=0,..,12), 64 channels
  - For spectral line applications
    - One tunable sub-band pair (IF), dual polarization, with bandwidth $128/2^n$ MHz (n=0,..,12), 256 channels
- Other technical details:
  - Spectral smoothing, Doppler tracking, $t_{int} \geq 1$ sec
  - Data rates up to 10x current VLA maximum
- Time allocation
  - Via current time allocation process

OSRO Capability Growth

- Plan for increase in capabilities for OSRO driven by
  - *science: increase in BW provides biggest science impact*
  - *data rates: staged increases of an order of magnitude easiest to manage operationally*
- Capability growth:

WIDAR Operational; VLA Correlator Turned Off ⇓ — **Construction Completed** ⇓

Year	2010	2011	2012	2013	2014
Config.	D D C B A	D C B A		D C B A	
BW	| 256 MHz ⇒	| 2 GHz ⇒		| 8 GHz ⇒	…(recirc., sp. modes)

Resident Shared Risk Observing

- Aims to attract expert users to make the most of the early science opportunities with WIDAR, in return for commissioning help
- Capabilities available to RSRO users will be all those being commissioned at the time of observation
- Notional timescales for RSRO capabilities (depends on science requirements and coordination with EVLA software):
  - 2 GHz total BW, T1 2010
  - 8 GHz total BW, T2 2010
  - Recirculation, T3 2010
  - Increased flexibility in correlator resource allocation, T1-T2 2011
  - Special modes, T3 2011—

Potential Areas of RSRO Participation

- Development of correlator modes
  - General correlator resource allocation
  - Multiple spectral lines for Galactic and extragalactic applications
  - Solar observing
  - Planetary observing
  - Astrometry
  - Phased array and VLBI
  - Pulsars
- Development of observing and calibration strategies
  - Wideband calibration methods
  - High frequency calibration
  - Improved referenced pointing
  - Ionospheric calibration
  - Calibrator models
  - Polarimetry
  - Mosaicing
  - RFI excision
- Development of data reduction strategies and algorithms
  - Automated flagging
  - Wideband, wide-field imaging
  - High dynamic range imaging
  - Algorithm development
  - Algorithm implementation
  - Post-processing computing and networking optimization
  - On-the-fly imaging

RSRO requirements

- At least one expert from each participating group must be in residence in Socorro
  - must contribute effectively to commissioning
  - limited support for salaries or accommodation may be available
- Proposals will have three parts:
  1. Scientific justification, to be peer reviewed as part of NRAO's current time allocation process
  2. Technical section describing personnel and expertise to be involved in the residency, to be reviewed by NRAO staff
  3. Budget specifying the level and nature of any support requested from NRAO; proposals that do not require Observatory support will have a substantial advantage over those that request NRAO resources

RSRO details

- Time available:
  - Up to 25% of the time available for astronomy will go to RSRO programs (~100 hours/month)
- Residency:
  - Minimum of *one month* of resident commissioning effort required for every *20 hours* of time allocated, minimum residency of *3 months*
  - May take place before the observations, but observers must be present for observations
  - An EVLA commissioning staff collaborator will not satisfy the residency requirement
  - Graduate students will not (in general) satisfy the residency requirement
  - Resident personnel will work under NRAO management with well-defined deliverables

RSRO Status

- We have received 10 Letters of Interest in response to the announcement in the February eNews so far, offering up to 10 FTE-years of resident commissioning effort
- Expect that there will be more interest as the word spreads
- Formal proposals will be due October 1, 2009, and at subsequent proposal deadlines
- Mechanisms for visitors to be resident in Socorro prior to proposal submission
- Details of this and other EVLA Early Science programs can be found at the EVLA Information for Astronomers web page, http://www.aoc.nrao.edu/evla/astro/

Key SSS-related milestones leading to SRO

Date	Milestone
9/1/2009	PST ready for SRO proposal submission, including OSRO exposure calculator
10/1/2009	Proposal deadline for SRO proposals
1/15/2010	AAT ready for final OSRO commissioning
1/15/2010	OPT release for OSRO users
3/1/2010	OST ready for SRO observing
3/1/2010	SRO observing begins

Backup slides

OSRO Correlator Modes (1)

- Continuum applications and spectro-polarimetry
  - Two independently-tunable sub-band pairs (IFs), full pol., each with bandwidth $128/2^n$ MHz (n=0,..,12), 64 channels

Sub-band BW (MHz)	Number of poln. products	Number of channels/poln product	Channel width (kHz)	Channel width (kms^{-1} at 1 GHz)	Total velocity coverage (kms^{-1} at 1 GHz)
128	4	64	2000	600/ν(GHz)	38,400/ν(GHz)
64	4	64	1000	300	19,200
32	4	64	500	150	9,600
16	4	64	250	75	4,800
8	4	64	125	37.5	2,400
4	4	64	62.5	19	1,200
2	4	64	31.25	9.4	600
1	4	64	15.625	4.7	300
0.5	4	64	7.813	2.3	150
0.25	4	64	3.906	1.2	75
0.125	4	64	1.953	0.59	37.5
0.0625	4	64	0.977	0.29	18.75
0.03125	4	64	0.488	0.15	9.375

OSRO Correlator Modes (2)

- Spectral line applications
  - One tunable sub-band pair (IF), dual polarization, with bandwidth $128/2^n$ MHz (n=0,..,12), 256 channels

Sub-band BW (MHz)	Number of poln. products	Number of channels/poln product	Channel width (kHz)	Channel width (kms^{-1} at 1 GHz)	Total velocity coverage (kms^{-1} at 1 GHz)
128	2	256	500	150/ν(GHz)	38,400/ν(GHz)
64	2	256	250	75	19,200
32	2	256	125	37.5	9,600
16	2	256	62.5	19	4,800
8	2	256	31.25	9.4	2,400
4	2	256	15.625	4.7	1,200
2	2	256	7.813	2.3	600
1	2	256	3.906	1.2	300
0.5	2	256	1.953	0.59	150
0.25	2	256	0.977	0.29	75
0.125	2	256	0.488	0.15	37.5
0.0625	2	256	0.244	0.073	18.75
0.03125	2	256	0.122	0.037	9.375