EVLA Software

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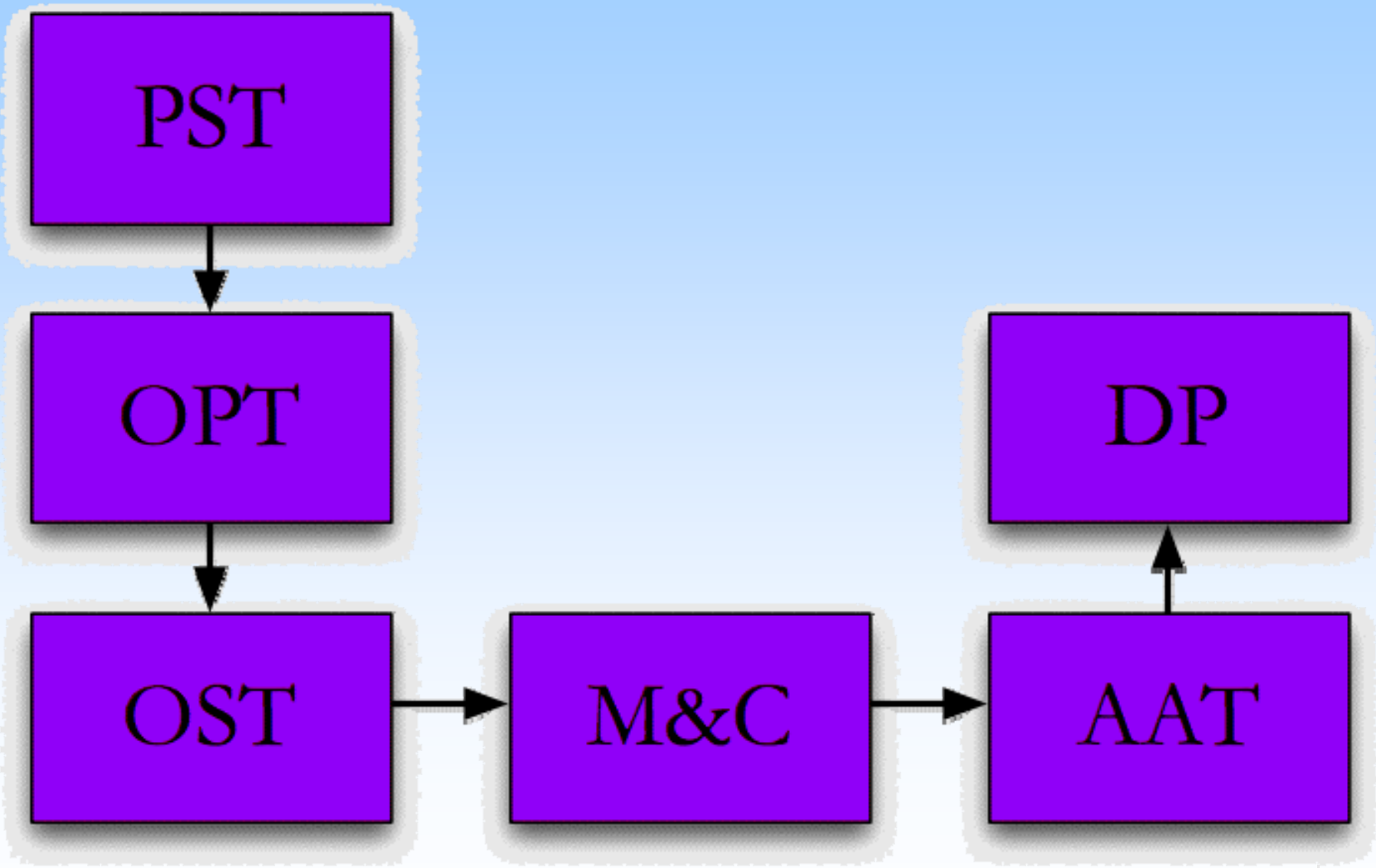
Requirements and Goals of EVLA Software

- Maximize scientific throughput of the instrument
- At a minimum be able to do what we can do with the VLA
- Easy to use, by both experts and novices
- Commonality among NRAO instruments where possible

EVLA Software (Crude) Block Diagram



Monitor and Control

The Monitor and Control (M&C) software comprises all that is necessary to run the instrument in real time, including:

- Antenna M&C (MIBs, mostly)
- Correlator M&C (CMIBs, GUIs, CPCC, MCCC, RTDD, CBE, etc.)
- Executor
- TelCal (real-time calibrations)
- Metadata Capture and Format (MCAF)
- Alert system
- Device Browser
- Operator's Interface
- Archive loading controller and SDM cataloger
- Monitor database storage, retrieval, plotting

M&C Status

- Antenna M&C is in place and fully functional
- Correlator M&C is partly in place (CMIBs, GUIs, prototype CPCC, RTDD, prototype CBE) - enough to support the Prototype WIDAR (PTC)
- Executor is in place and mostly fully functional (some WIDAR support remains to be implemented, as well as 3-bit sampler support)
- TelCal exists for transition system (working with VLA correlator)
- MCAF exists for transition system (called IDCAF - writes VLA format archive records)
- Alert system is in place and fully functional
- Device Browser is in place and fully functional
- Operator's Interface is in place and fully functional (though some additional screens will need to be added for WIDAR)
- Archive loading controller and SDM cataloger exist in early prototype - enough to support PTC
- Monitor database storage, retrieval, plotting exist and are fully functional (some WIDAR extensions may be needed)

M&C for SRO

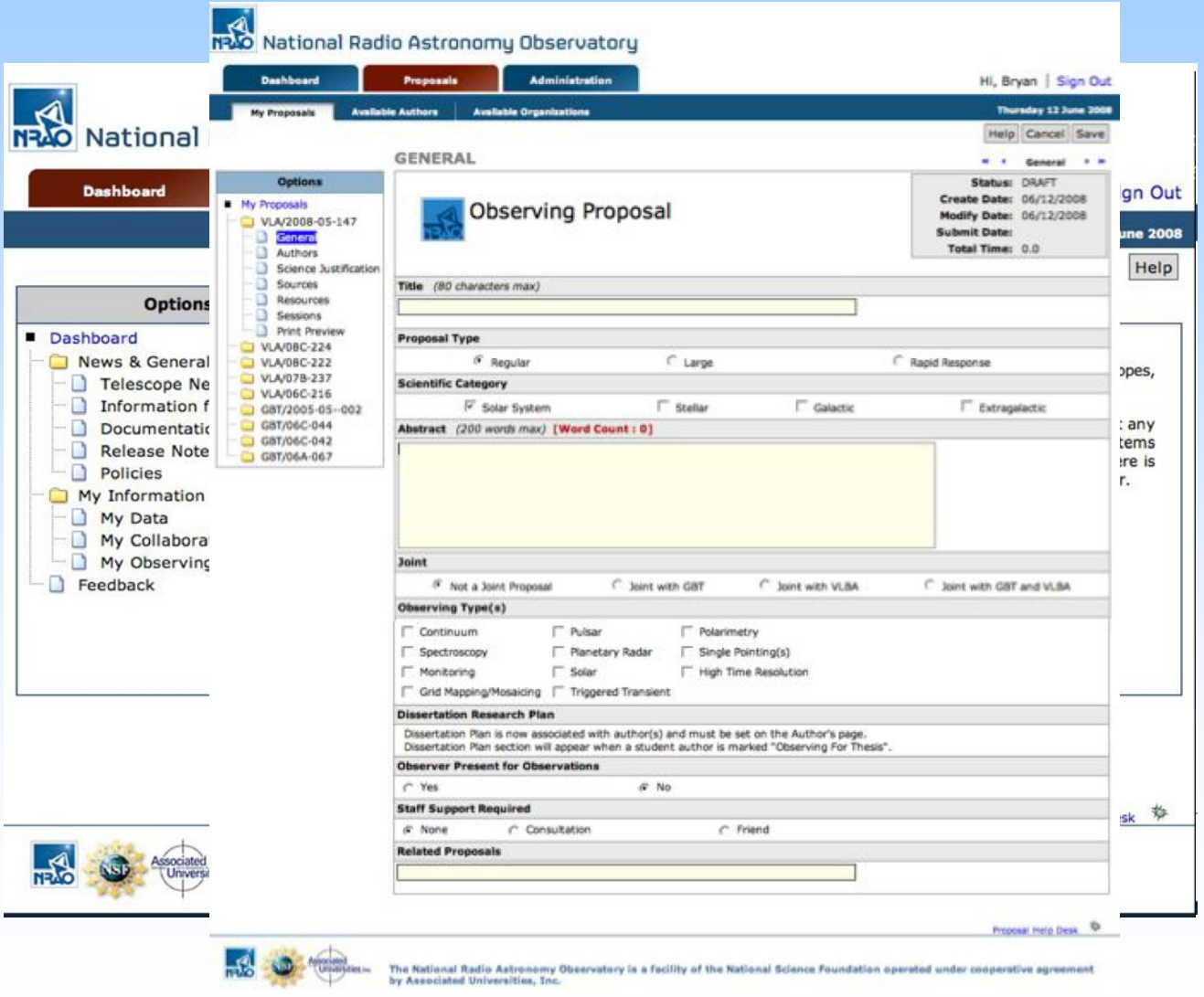
We need several additional elements of the M&C software to be completed in order for Shared Risk Observing to work (so must be in place by the beginning of Q1 2010):

- Correlator M&C: near-final CPCC, expanded CBE (able to handle 27 antennas with 2 sub-band pairs, and do frequency and time averaging), enough MCCC to support the modes needed (Configuration Mapper, notably)
- MCAF for EVLA format data (SDM)
- TelCal for EVLA format data (BDF+SDM)
- Other extensions to existing systems (as noted on previous slide)

Proposal Submission Tool

- Supports the preparation, submission, and handling of proposals
- Have a tool developed for VLA, GBT, and VLBA - has been used for the past 3 years (9 proposal deadlines)
- Continued development managed by E2E Operations Division, contracted to OpenSky Software
- EVLA needs are submitted to EOD and relayed to OpenSky
- Portal and single sign-on are part of this

Proposal Submission Tool

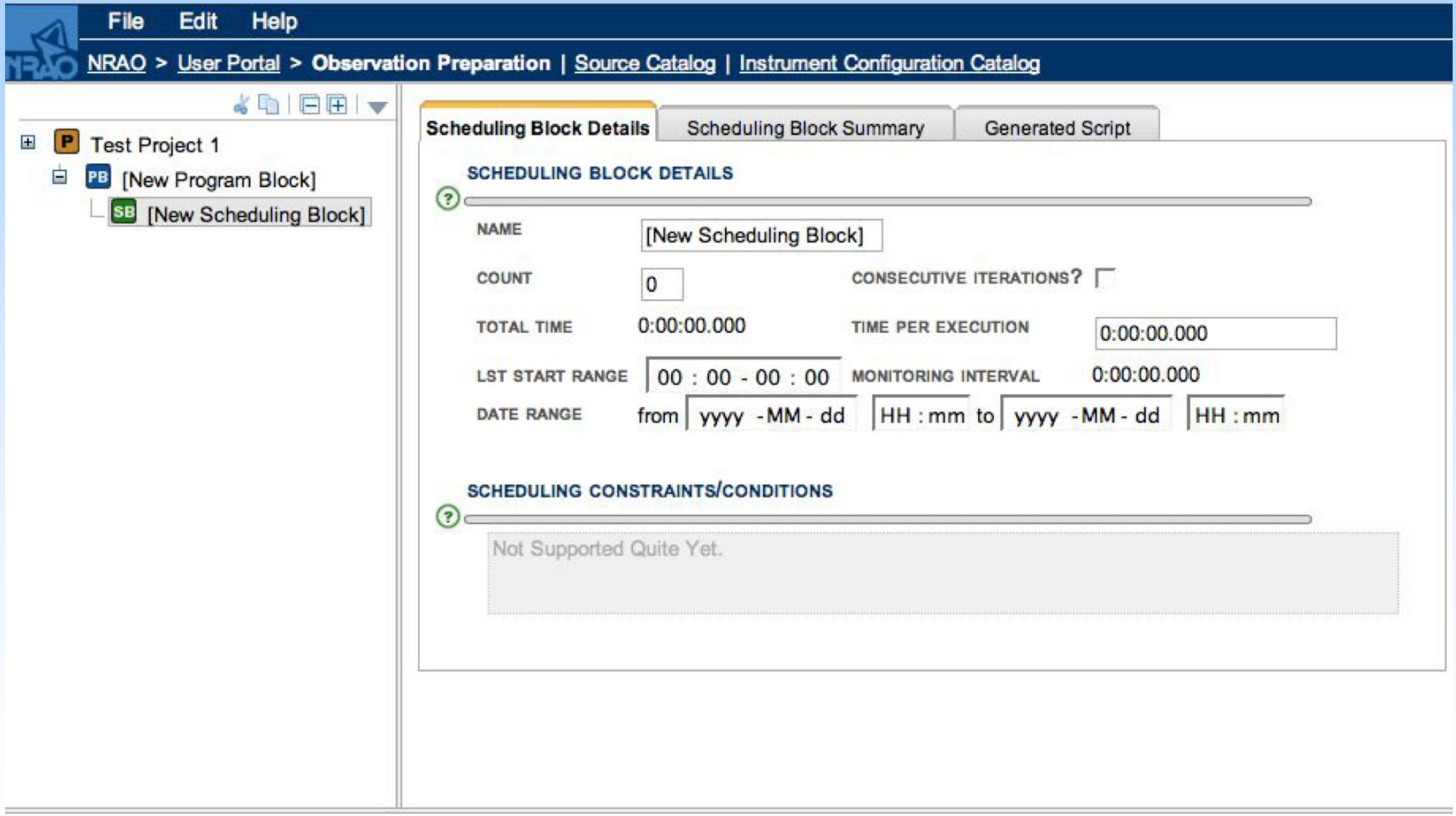


http://my.nrao.edu

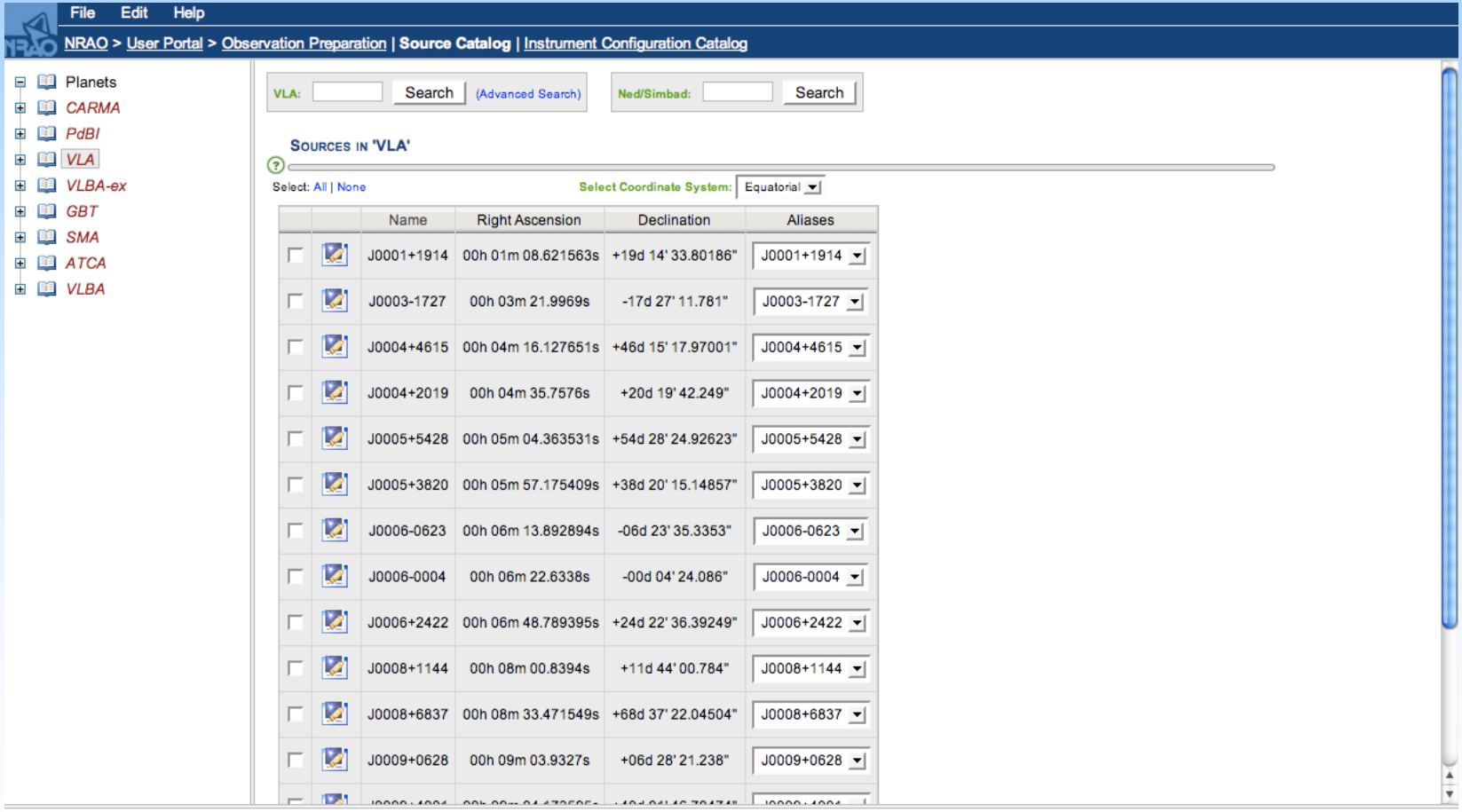
Observation Preparation Tool

- Supports the preparation and submission of observing scripts (think of *jobserve* for the VLA)
- Have an alpha release developed for EVLA - includes components for source setup and source catalog management, instrument setup and instrumental setup catalog management, scan setup, Scheduling Block definition (sequence of scans), etc.
- Being tested now for accuracy of converted scripts
- To be used for early Ka-band, and extended L- and C-band observations
- WIDAR support in development

Observation Preparation Tool



Source Catalog Tool



Observation Scheduling Tool

- Supports the scheduling of observing scripts - what gets observed next on the EVLA, either submitted manually or chosen dynamically (think of what Barry Clark or Joan Wrobel does manually for the VLA)
- Have a working early version for VLA that is being used to schedule ~40% of time on the VLA dynamically
- True EVLA prototype based on this, but integrated into EVLA software system and with full GUI; beta release spring 2011, full release winter 2012

Archive Access Tool

- Supports access to science data in the archive, the ability to search, to access proprietary data, support VO, etc.
- Have a tool developed for VLA, VLBA, and GBT - is being used extensively (~3X VLA data taken real time is downloaded through this tool)
- Early prototype in place to support WIDAR (EVLA) observations, being tested now (same tool as for VLA, VLBA, GBT).

Data Rates and Volumes

- At the end of the construction project (Q3 2012), to support EVLA bandwidths and resolutions (given beam size), we have the following data rates and volumes (for 6h observation) for the 4 EVLA configurations, for full-beam imaging in continuum:

Config	Nvis (Gvis)	Rate (MB/s)	Volume (GB)
D	0.1	.04	1
C	1	.4	10
B	10	5	100
A	100	50	1000

- This volume of data presents a significant challenge both for storage and retrieval and for post-processing

But We Don't Start There!

We don't need those final data rates right away - for the OSRO program we will limit the data rate to 1-2 MB/sec max; RSRO rates are currently being considered. The following table shows our expected growth rate of data rates and volumes over time:

Driver	Date	Mean Rate (MBy/s)	Total Volume (Tby/yr)
WIDAR0	Q1 2009	.1	3
OSRO	Q1 2010	.5	11
RSRO	Q1 2010	3	22
"Open Observing"	Q2 2011	10	250
Full Operations	Q3 2012	20	500

User Software for SRO

The following elements of the user software need to be completed in order for Shared Risk Observing to work (by Q1 2010 at the latest):

- PST must understand the limited modes offered for OSRO (this must be in place sooner, to allow proposals to be submitted - at the 2009 October deadline)
- OPT must be able to support setup of WIDAR for both OSRO and RSRO
- Single sign-on must be in place
- AAT must be able to serve up OSRO data in the way in which VLA data is served now

Support of Special Modes

There are some "special" modes of observing that are not within the current scope of the EVLA construction project:

- Pulsar
- Phased array (for VLBA support, notably)
- Solar
- Full support of planetary observing

A prioritized list of importance for these special modes would potentially allow some work to be directed toward the most important of them.

Algorithm Development

Two types of "algorithms":

- Development of things we don't currently know how best to do, for example:
  - Wide bandwidth, wide field, full polarization imaging
  - High dynamic range and fidelity imaging in the presence of significant confusion and instrumental errors
  - RFI suppression and excision
- Making things that we do know how to do run faster, i.e. parallel processing (because of size of datasets and magnitude of computing problem)

Parallel Processing

- New prototype cluster purchased jointly with ALMA
- 16 nodes, 1 TB disk per node with larger central disk
- CASA currently being installed and benchmarked for a single node
- Plan in place to extend the timing to multiple nodes
- Will purchase extensions based on these timing tests, to test different configurations (more memory, different I/O, etc.)
- Second generation cluster purchased for reduction of RSRO observations, based on above tests (Q1 2010)
- Final cluster purchase scheduled for 2012

New Algorithms

- Automatic flagging
- Wide-bandwidth calibration
- Multi-scale CLEAN
- Wide-bandwidth, full field, full polarization imaging
- W-projection, pointing self-cal
- RFI detection and removal

New Algorithms

- To facilitate development of new algorithms, forming an NRAO algorithm development group
- Comprised of CASA and other NRAO (mostly EOD) personnel
- Focused on EVLA problems to begin with, but the intent is to have them address problems at any NRAO telescope eventually
- Plan for organization and management in discussion currently

Algorithms for SRO

- It is envisioned that OSRO post-processing will be much like we do currently with VLA data (and potentially done in AIPS), so no new algorithm development is demanded by this program
- An algorithm group is currently being organized by NRAO. RSRO participating scientists will be expected to contribute to the development of algorithms to post-process their data by this group (not necessarily in code but conceptually at least) - c.f. Claire's talk.