



EVLA Computing

Software Overview



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History of EVLA Computing (1)



- EVLA computing consists of three parts:
 1. Monitor & Control
 - Array and antenna control, monitor, alarms/messaging, raw data collection
 2. Scientific Support Systems (SSS)
 - Proposal preparation, observation preparation, scheduling, archiving, image pipeline
 3. Post-processing (AIPS, CASA)
- The term E2E has been used for several combinations of 1, 2, and 3.
- All three parts are in the *scope* of the EVLA phase 1 proposal
 - Of these three, only M&C was *budgeted* in proposal
 - SSS and post-processing were not budgeted in proposal; instead were contracted out to Data Management, a separate division of NRAO with deliverables to all telescopes and projects



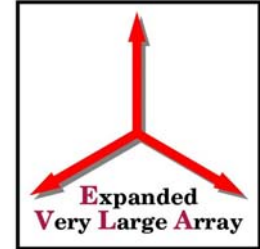
History of EVLA Computing (2)



- Data Management was dissolved in 2003
- Post-processing became part of Interferometry Software Division (ISD), jointly managed and funded by EVLA and ALMA
- Scientific Support Systems split between ISD (with observatory-wide focus) and the EVLA project, for EVLA-specific deliverables
 - EVLA specific activities funded out of EVLA contingency
 - Other activities funded out of VLA/VLBA operations
- Current EVLA Computing Division (ECD) staff responsibilities:
 - EVLA M&C
 - Basic VLA and VLBA operational support
 - Scientific Support Systems
- ISD role being taken over by the E2E Operations Division
 - Coordination and Focus of User Support



ECD Organization and Staffing



- EVLA computing division (ECD)
 - Head – Gustaaf van Moorsel (0.9 EVLA)
 - M&C – 9 staff members
 - 8.0 FTEs on EVLA (4.3 EVLA, 3.7 Contributed Effort)
 - 1.0 FTE on VLA/VLBA operations
 - In original EVLA budget
 - SSS – 6 staff members – soon to decrease to 5
 - 4.3 FTEs on EVLA (3.2 EVLA funded, 1.1 Contributed Effort)
 - Soon to decrease by one to 3.3 (2.2 EVLA, 1.1 Contributed effort)
 - 1.7 VLA/VLBA operations (Web, NRAO User Database, VLA/VLBA archive, etc)
 - Effort funded out of EVLA contingency, concerns about staffing level



Organization and Staffing (continued)



- Systems Engineer for Software (Bryan Butler, 0.5 FTE)
 - Reports to EVLA project manager
- Project Scientist for Software (Michael Rupen, 0.5 FTE)
 - Reports to EVLA project scientist
- Science Software Group (Headed by Joe McMullin)
 - Responsible for CASA, post-processing
 - Used to be jointly managed by EVLA and ALMA through Interferometry Software Division (ISD), now under E2E operations division
 - 8 FTEs, 2.65 FTEs EVLA



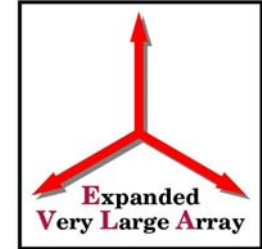
Organization and Staffing (continued)



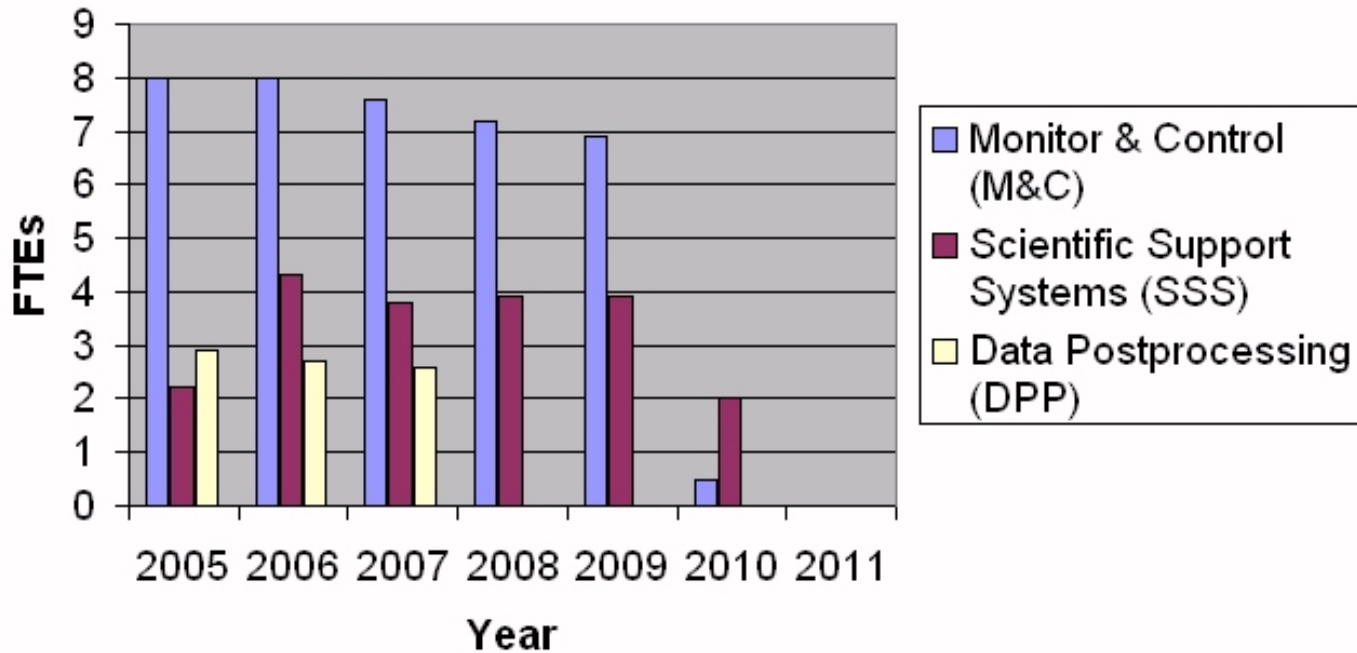
- Staffing developments in 2005/2006
 - Butler replaces Clark as EVLA Project Engineer for Software
 - Rupen replaces Frail as EVLA Project Scientist for Software
 - Ye (SSS/Proposal Tool) moves to ALMA, position filled by Loveland
 - Morgan (M&C/Correlator Backend) leaves NRAO, position filled by Pokorny
 - Two new SSS positions created out of EVLA contingency
 - Harland – High Level Architecture
 - Trutt – Observation Preparation Tool
 - Waters (SSS/HLA) to move to Data Post-Processing in May 2006; will not be replaced for now due to uncertainty in funding



Staffing Profile

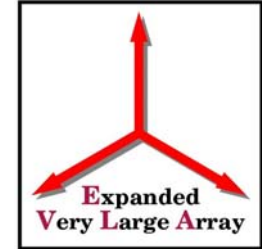


Allocation of Funded Effort

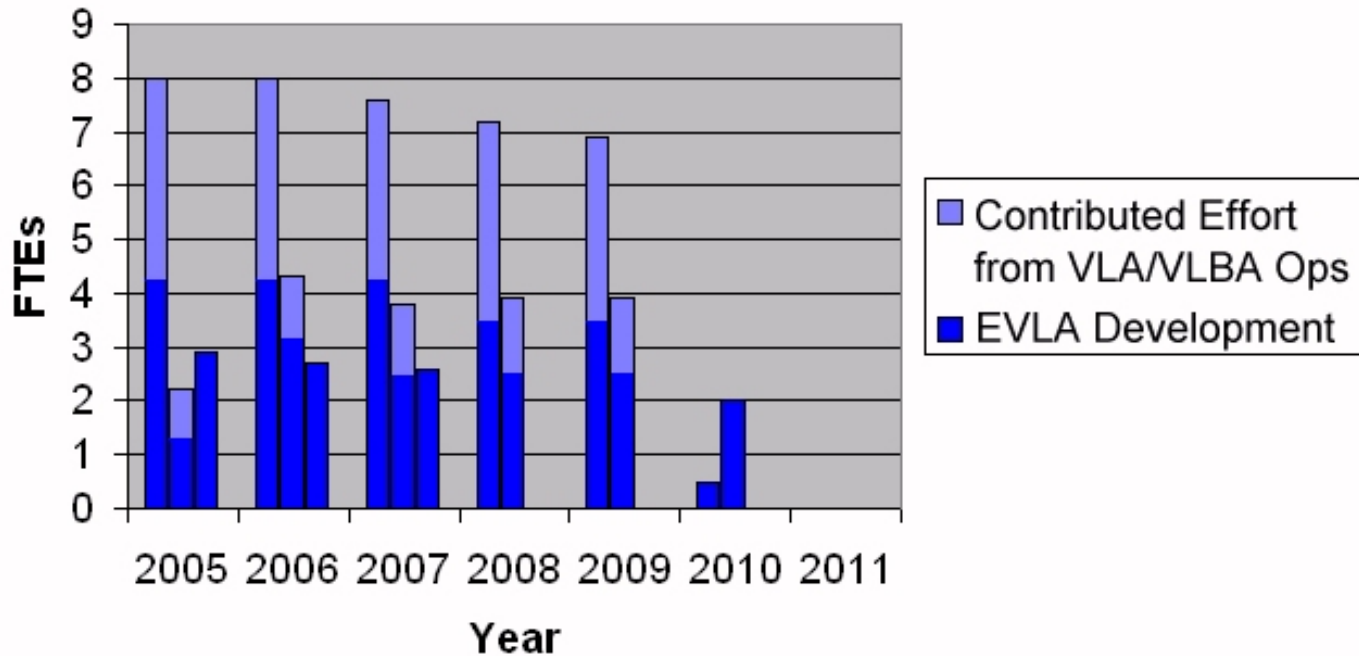




Staffing Profile



Distribution Between Budgets





SSS requirements



- Scientific requirements for all subsystems refined in 2005
 - Each requirement is assigned priority (1, 2, 3). Priorities:
 1. Essential
 - *Must be present*
 - *Must work with high efficiency*
 2. Important
 - *Should be present*
 - *There may have to sacrifices in performance*
 3. Desirable, but not critical
 - *Considered for upgrades or further development*
 - ... and timescale (A – E)



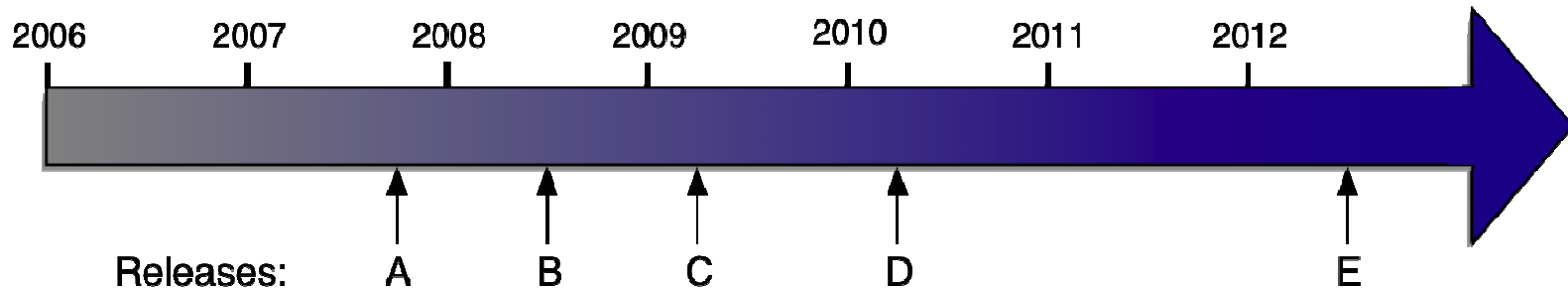
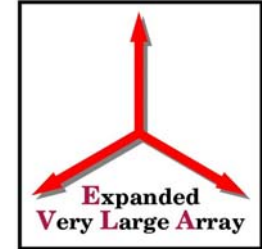
Illustration of Priorities: Observation Scheduling Tool



- **Priority 1**
 - Integrated with other tools; common look-and-feel
 - Supports Dynamic Scheduling, based on scientific priority and current conditions
- **Priority 2**
 - Upon request, tool observes provided list of calibrators, then chooses the best using pipeline results (based on heuristics)
 - Source-calibrator cycle time based on current conditions
 - Keep PI informed: e-mail; up-to-date project web page
 - Dynamic Scheduling priorities modified by u-v coverage, program completion pressure, and other influences
- **Priority 3**
 - Dynamic scheduling priorities modified by observations of targets themselves, or by contribution to “scientific value” of Scheduling Block



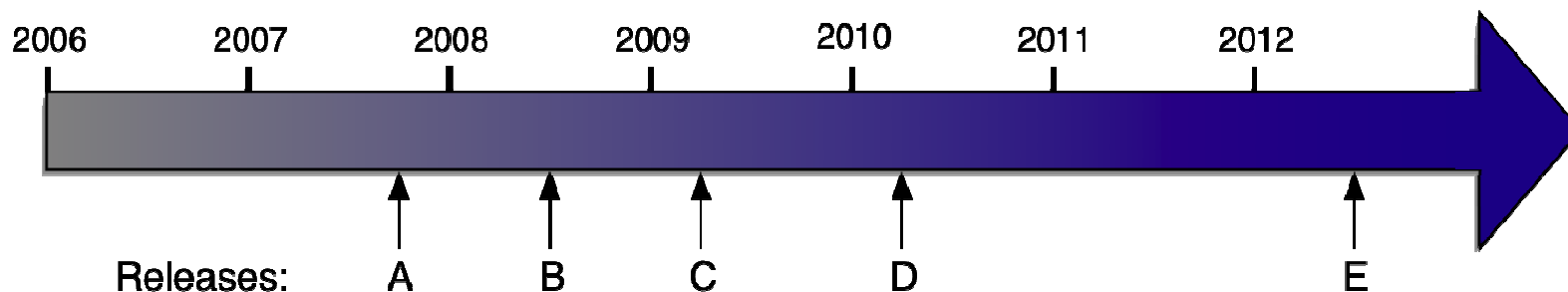
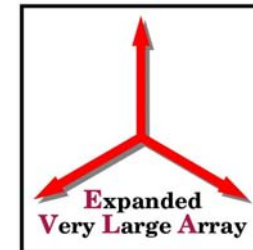
Time Scale and Major Milestones (1)



Release	Date	Event	Details
A	Q3, 2007	Arrival Prototype Correlator	4 SBs, 1 BB, some EVLA antennas
B	Q2, 2008	Arrival Production Correlator	16 SBs, 16 BBs
C	Q1, 2009	Science Commissioning/testing	Experiments of increased complexity
D	Q2, 2010	Shared Risk Observing	All station/baseline boards installed
E	Q2, 2012	Full Science operations	End of EVLA Project



Time Scale and Major Milestones (2)



Release	Date	Event	Main Users
A	Q3, 2007	Arrival Prototype Correlator	Engineers, expert local scientists
B	Q2, 2008	Arrival Production Correlator	Engineers, expert local scientists
C	Q1, 2009	Science Commissioning/testing	Expert observers
D	Q2, 2010	Shared Risk Observing	Intermediate observers
E	Q2, 2012	Full Science operations	All users, including novices



Milestones and SSS Subsystems (1)



- **Release A (Q3, 2007)**
 - Archive: basic storage functions for monitor data and raw visibilities, simple data retrieval
- **Release B (Q2, 2008)**
 - Scheduling: basic scheduling; support scheduling block concept
 - Archive: add control scripts, program/scheduling blocks, some environmental data
- **Release C (Q1, 2009)**
 - Proposal: basic proposal preparation functionality
 - OPT: scheduling/program block generation; expert H/W setup
 - Archive: more environmental/project data; improved search/retrieve; support proprietary/public data



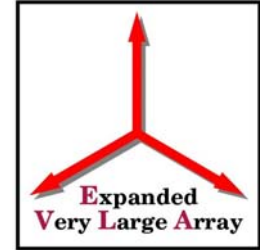
Milestones and SSS Subsystems (2)



- **Release D (Q2, 2010)**
 - Proposal: functionality of current GBT/VLA tool; sensitivity calculator
 - OPT: GUI, improved source list/calibrator selection for novice users
 - Scheduling: simple criteria to evaluate priority of scheduling block, simple feedback to observers
 - Archive: all project data stored, Web-based GUIs, improved search
- **Release E (Q2, 2012)**
 - Proposal: Wizard mode capable of creating Scheduling Blocks from simple observing modes
 - OPT: Wizards for selecting standard observing setups
 - Scheduling: Full dynamic scheduling + heuristics. Full feedback to observers
 - Archive: Full support for VO and pipeline



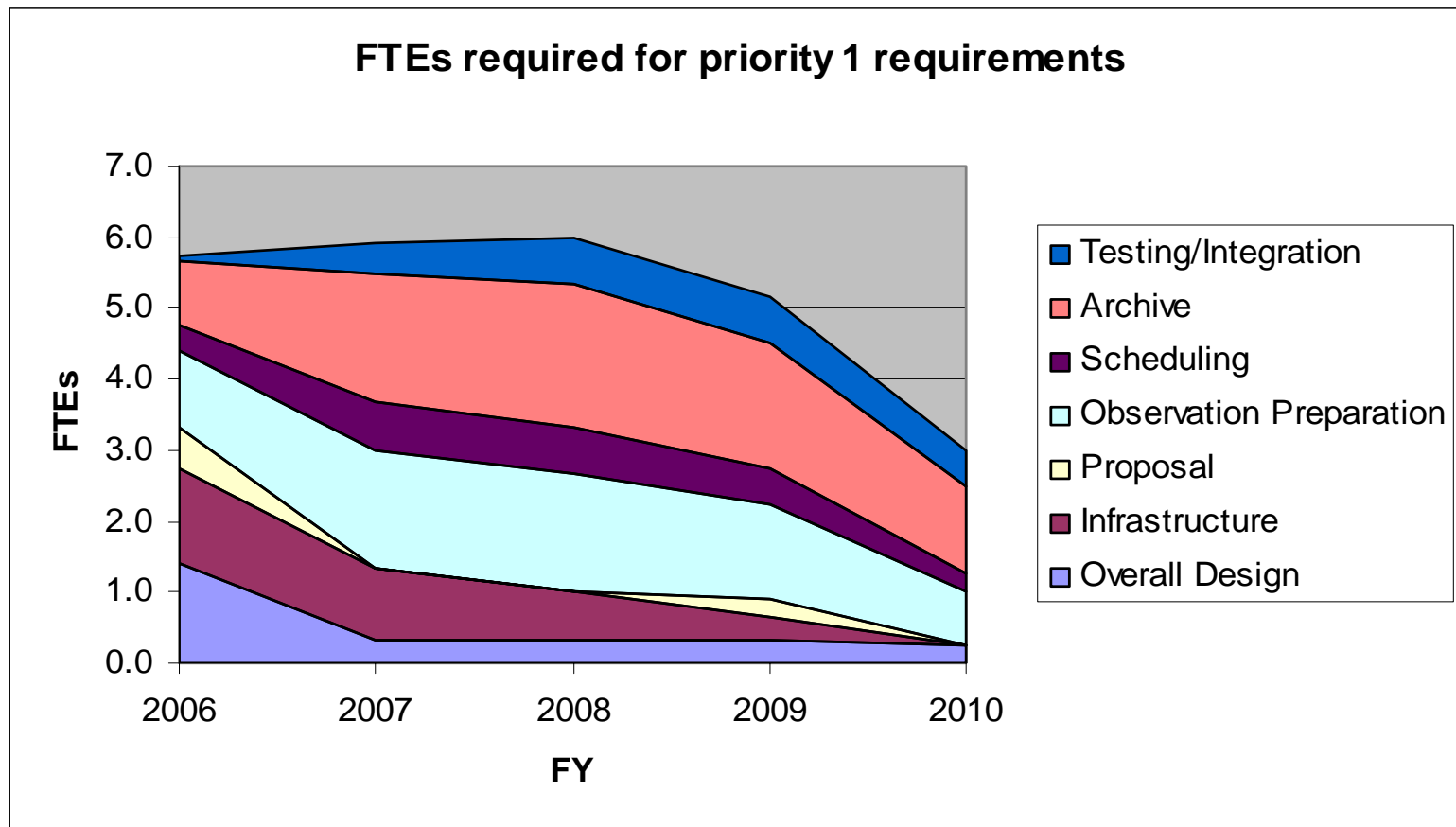
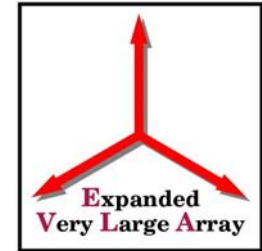
SSS priority 1 staffing requirements



- Staffing estimates based on SSS requirements were made
 - For Priority 1 and most of Priority 2 requirements
 - Assuming borrowing from ALMA where expedient
 - Will be refined when subsystem designs available
- Combined with SSS milestones into work-plan
 - Priority 1 requirements have to be delivered by their due date according to time scales A – E
 - May be scheduled to be worked on ahead of time, to make efficient use of staff or when non-project considerations require an earlier release
- Shows how much effort needed in each subsystem for each year



Required SSS staffing (for priority 1 requirements)





Required vs. available staffing - SSS priority 1



- Required staffing: 25.8 FTE-years
- Budgeted staffing: 12.7 FTE-years (EVLA) + 4.9 FTE-years (contributed effort) = 17.6 FTE-years
- Shortfall 8.2 FTE-years, or ~2 FTEs through 2010
 - Assumes contributed effort funding continues at current level
- These two required positions will now be provided through the NRAO E2E Operations Division, allowing us to deliver a system which:
 - Lowers barriers to non-radio astronomers/novice users
 - Provides easier access to an archive with a wider selection of products
- Again, this will deliver priority 1 items only!



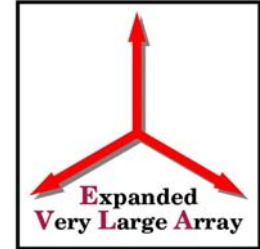
Developments 2005 and 2006: M&C



- 3 EVLA antennas turned over to operations
 - MIB module programming
 - Interim executor
 - Operator interface
 - Control/Monitor processor – archives VLA monitor data, will soon control VLA antennas
 - Monitor data archive
- WIDAR
 - Correlator board drivers complete and ready for testing
 - Station and baseline board test screen GUIs developed
 - Correlator backend ready to support prototype board testing



Developments 2005 and 2006: SSS



- High Level Architecture (HLA)
 - Refinement of 2004 overall design, includes subsystem design
 - Started in earnest early 2006 after hiring two new EVLA funded positions
 - Meeting with ALMA IPT on Common Project Data Model
 - Agreement on common Science Data Model with ALMA likely
- Proposal
 - GBT releases for June, October 2005, and February 2006 deadlines
 - VLA release (voluntary) for February 2006 deadline
- Observation Preparation
 - Plan in place to deliver by October 2007
- Scheduling
 - VLA dynamic scheduling
- Archive
 - Monitor data archive operational
 - NGAS hardware installed, NGAS software being obtained



Developments 2005 and 2006: Post-processing



- Science Software group co-managed with ALMA through ISD
 - Now: managed by the E2E Operations Division
- Focused on development of CASA
 - CASA infrastructure supports both EVLA and ALMA
 - EVLA has two-thirds of requirements in common with ALMA
- Applications unique to EVLA:
 - Wide field, wide-bandwidth imaging
 - Calibration
 - RFI
- EVLA testing:
 - Summer 2005 – wide field images; w-projection
 - Spring 2006 – User Interface working group (with ALMA)



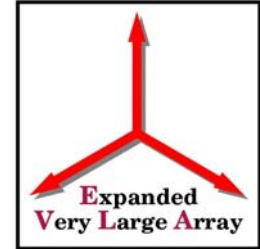
Collaboration with ALMA



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- **Proposal preparation** – EVLA has working version, agreement on common project model with ALMA in progress
 - **Observation Preparation**. More difficult because of more instrument dependencies; also requires agreement on common project model, but discussions are active
 - **Visibility data archive + DCAF** (Data Capture and Formatting) – sharing will require agreement on common science data model, which we are actively working on
 - **Pipeline** – Not among priority 1 items for EVLA; E2E Operations Division will facilitate efforts to adopt ALMA pipeline infrastructure
 - **Post-processing** – both ALMA and EVLA have adopted CASA as their default data post-processing system



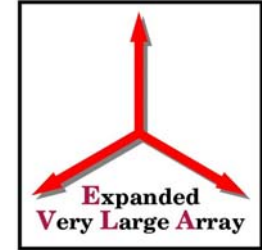
Plans for 2006 - 2007



- **Milestone A – support prototype WIDAR testing Q3, 2007**
 - TelCal, delivery of delay models, embryonic CBE
 - Basic control of prototype WIDAR
 - Simple visibility archive in place by Q3, 2007
 - CASA filler, data path into AIPS, calibration/data examination tests
- Replace Modcomp computers Q4 2006/Q2 2007
- Early development of subsystems needed at a later date
- Conduct design reviews with participation outside NRAO
 - SSS PDR early fall 2006
 - M&C CDR late fall 2006
- Build experience with existing EVLA prototypes
 - Proposal tool for VLA/GBT
 - Dynamic Scheduling for VLA
- Support EVLA specific CASA tests



Risk Profile



Relative Risk = Severity x Probability x (Scaled) First Time of Problem's Impact

Description	Severity	Prob.	First Impact	Rel. Risk	Mitigation Strategies, e.g.	E2E Ops support
Insufficient communications bandwidth within M&C System	80%	20%	C	10%	Purchase more hardware	X
Insufficient throughput of data from correlator	100%	50%	C	24%	Purchase more hardware	X
Unavailability of fully automated user-friendly systems for novice users	60%	100%	E	12%	Offer easy or automated, defer	Later
Scientific and technical opportunities missed due to late participation in VO	50%	70%	C	21%	Accelerate effort via other channels	Now
Modern hardware unable to support project requirements (Moore's law breaks down)	100%	60%	D	24%	Pursue parallel processing	X
CASA not accepted by users due to lack of functionality (for easier problems)	30%	50%	A	15%	Use other systems	Now
CASA not accepted by users due to lack of functionality (for more difficult problems)	100%	40%	C	24%	Provide data analyst support	Now
CASA not accepted by users due to difficulties with user interface/usability	80%	60%	D	19%	Provide data analyst support	Now