

EVLA Software - High Level Design and Scientific Support Systems

Bryan Butler

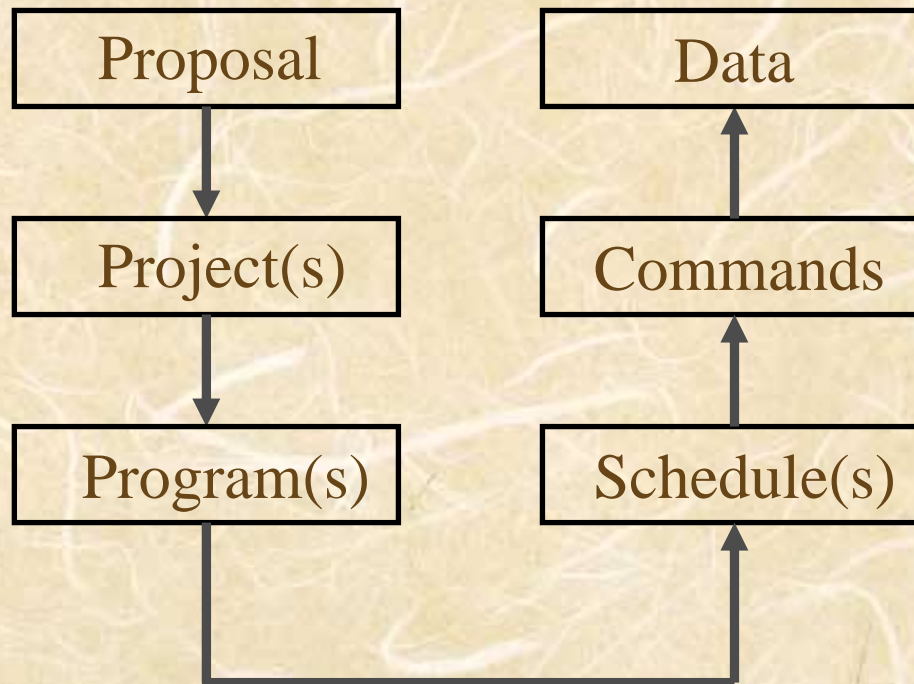
NRAO

EVLA High Level Design, ca. 2004

- Undertaken in spring of 2004
- “Team” created (Morgan, Ryan, Sowinski, Waters, plus several advisors)
- Completed high level design reviewed and accepted by NRAO e2e Oversight Committee in June 2004.
- Extensive modification in the past two years.

Major Elements (“Models”)

The main flow of information (and processes; the “workflow” or “dataflow”) is:

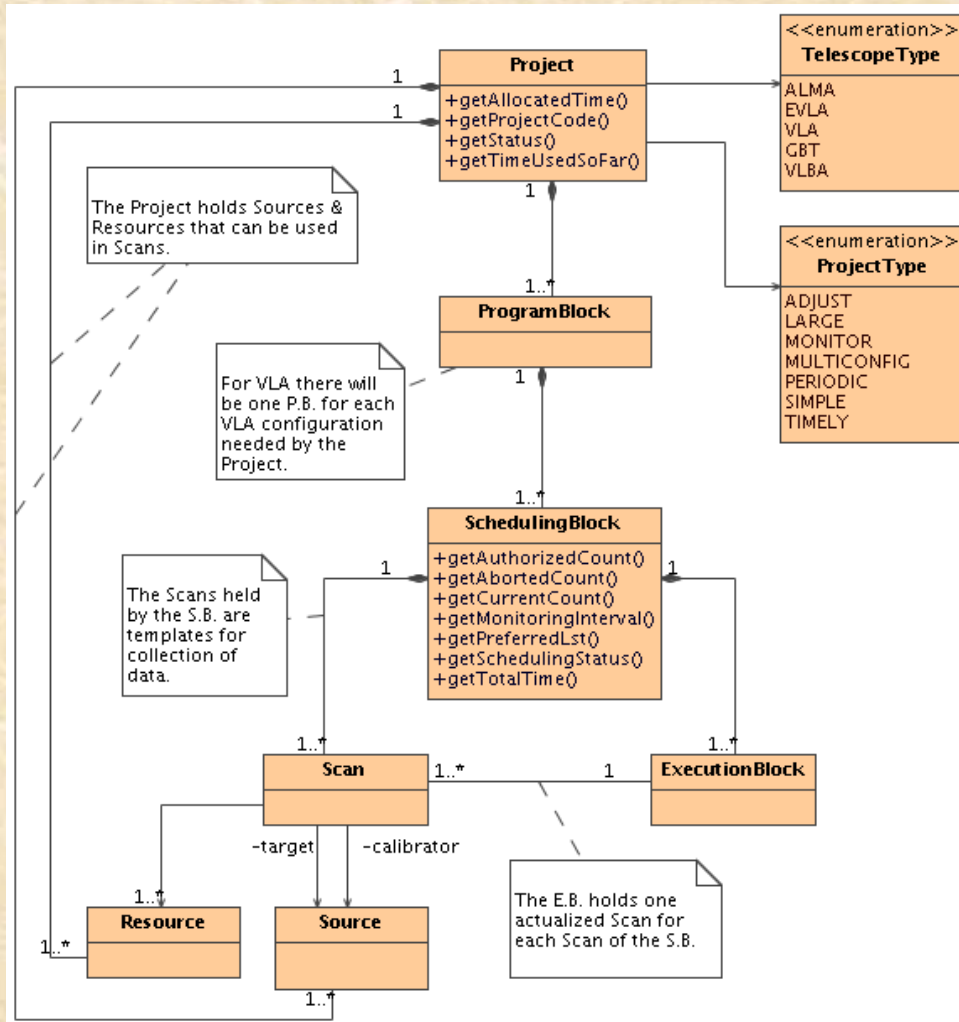


A **Scheduling Block (SB)** is an atomic unit of observing. It is made up of a sequence of *scans*; a scan is made up of *source(s)*, *resource(s)* (hardware definition - both Front End and Back End), *timing* information, and a “*mode*”. The *mode* defines the *subscan(s)*, which are comprised of a single *source*, *resource*, and *timing* information.

Developing Models

- Domain expert develops an XML model, based on requirements, and other information (for instance, information gained from dynamic scheduling tests on the VLA)
- XML is turned over to the developers, who then turn it into classes
- Classes are iterated with domain expert, which feeds back into the XML model

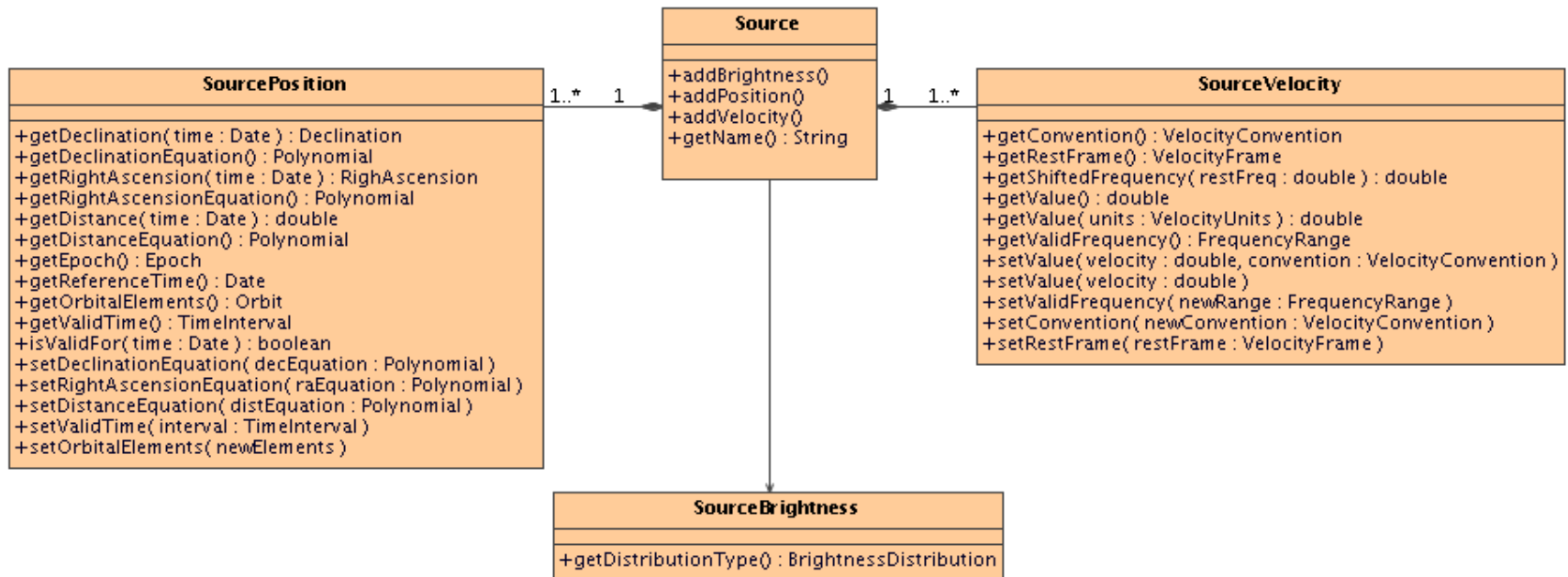
Project/PB/SB Model



A **Program Block (PB)** is the internal representation of a Program. It is the same as the ALMA ObsUnitSet, with the exception that ALMA allows infinite nesting of OUS's.

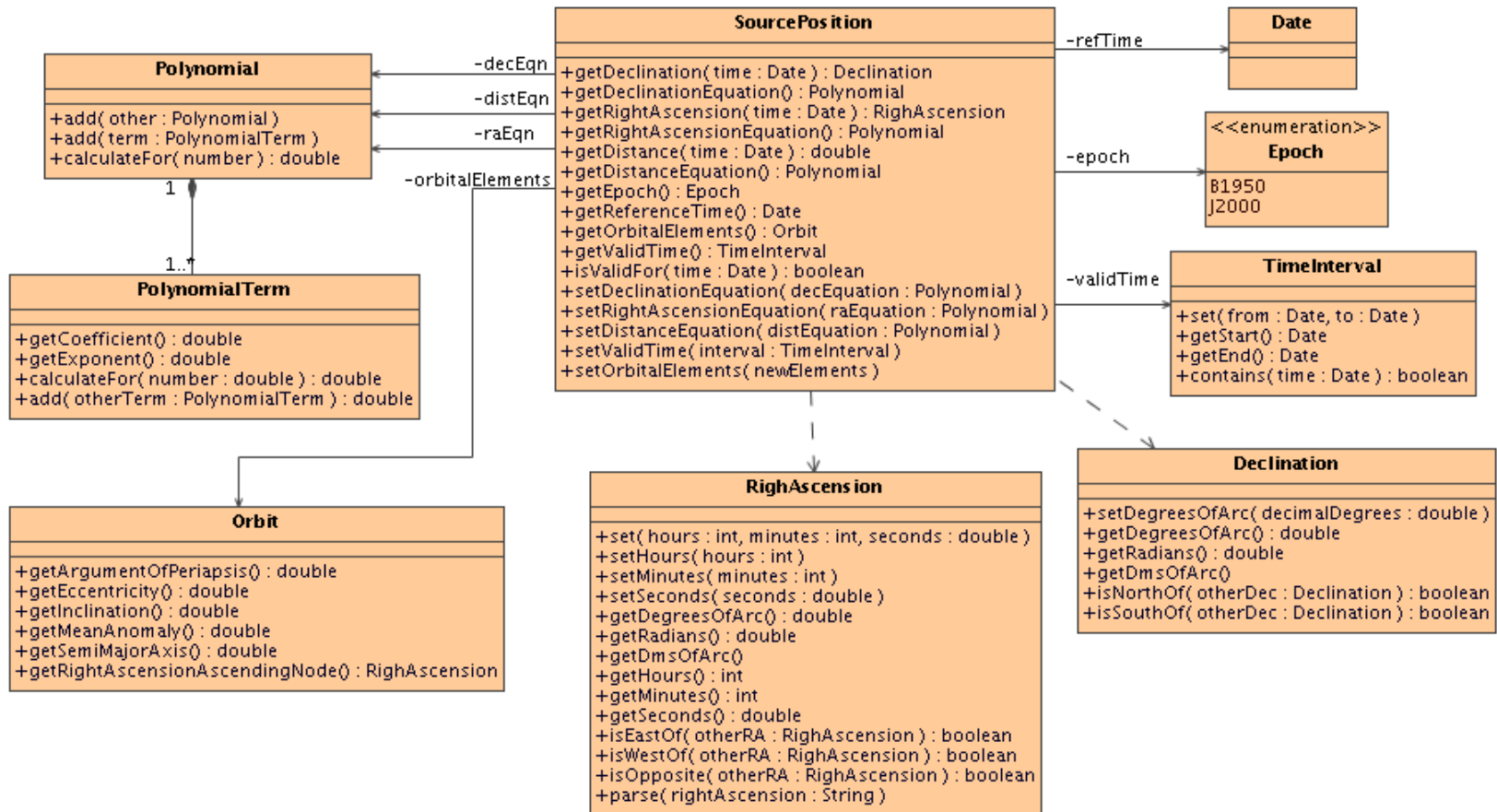
Source Model

Source



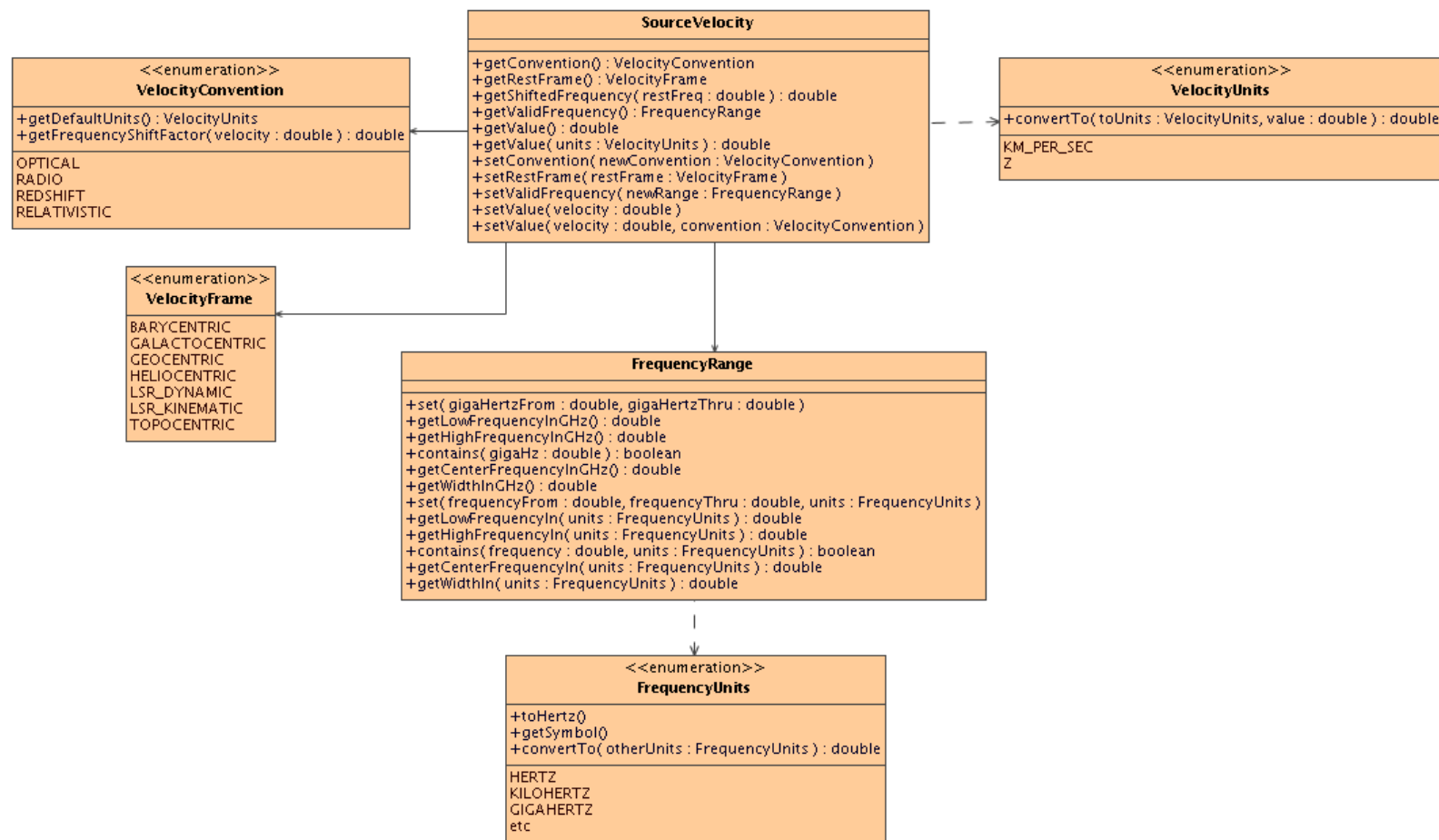
SourcePosition Detail

SourcePosition: Detail

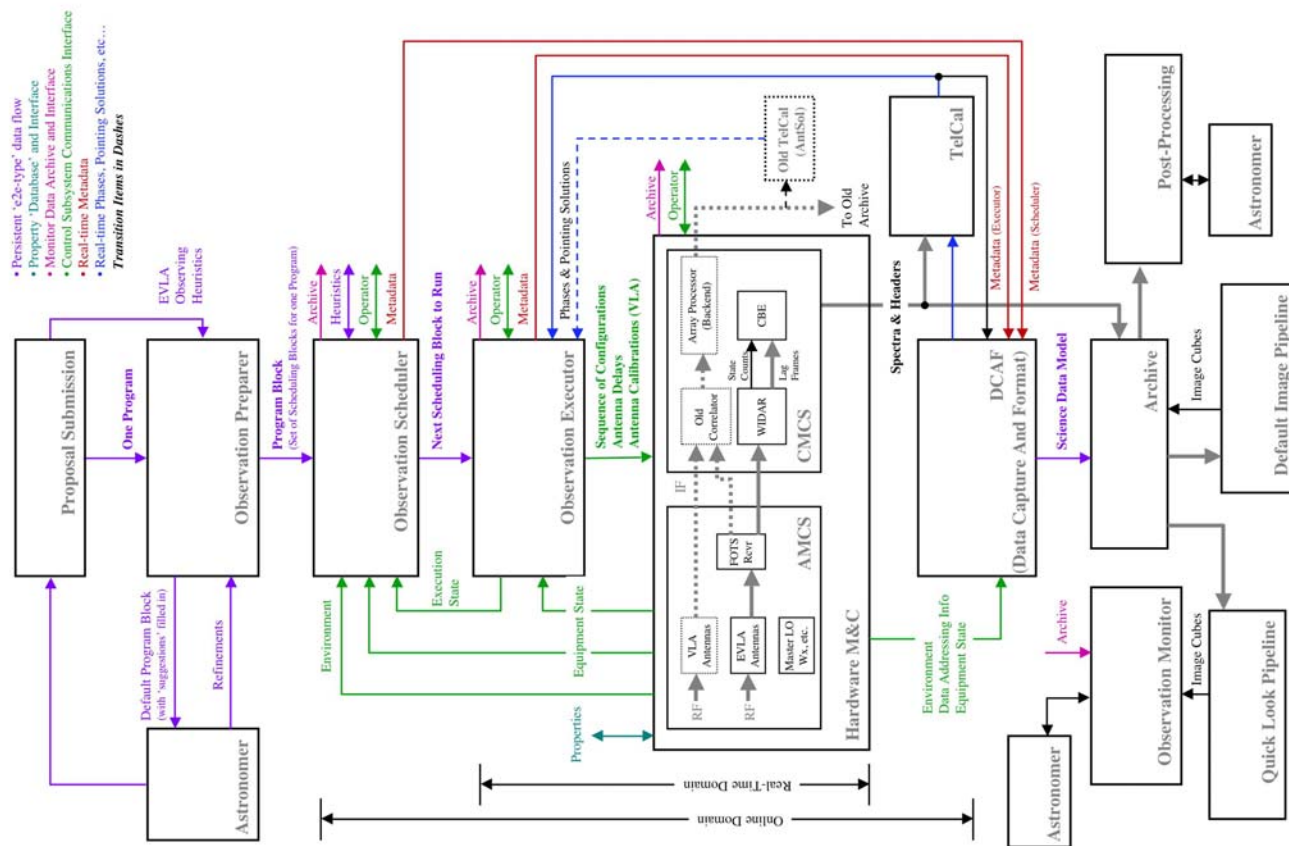


SourceVelocity Detail

SourceVelocity: Detail



EVLA High Level Design

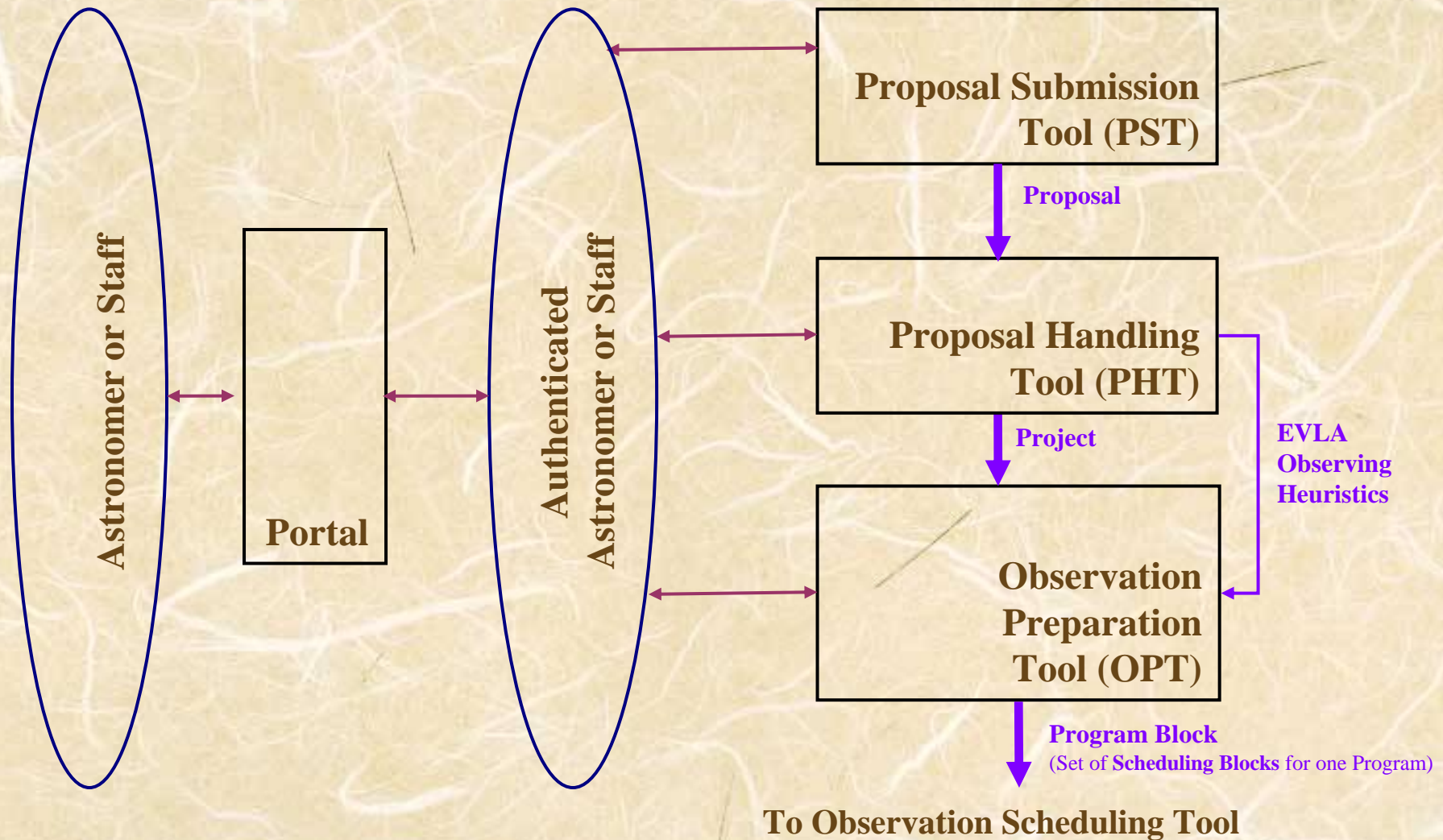
2004-12-08
MIPS/SAVER

→ DATAFLOW →

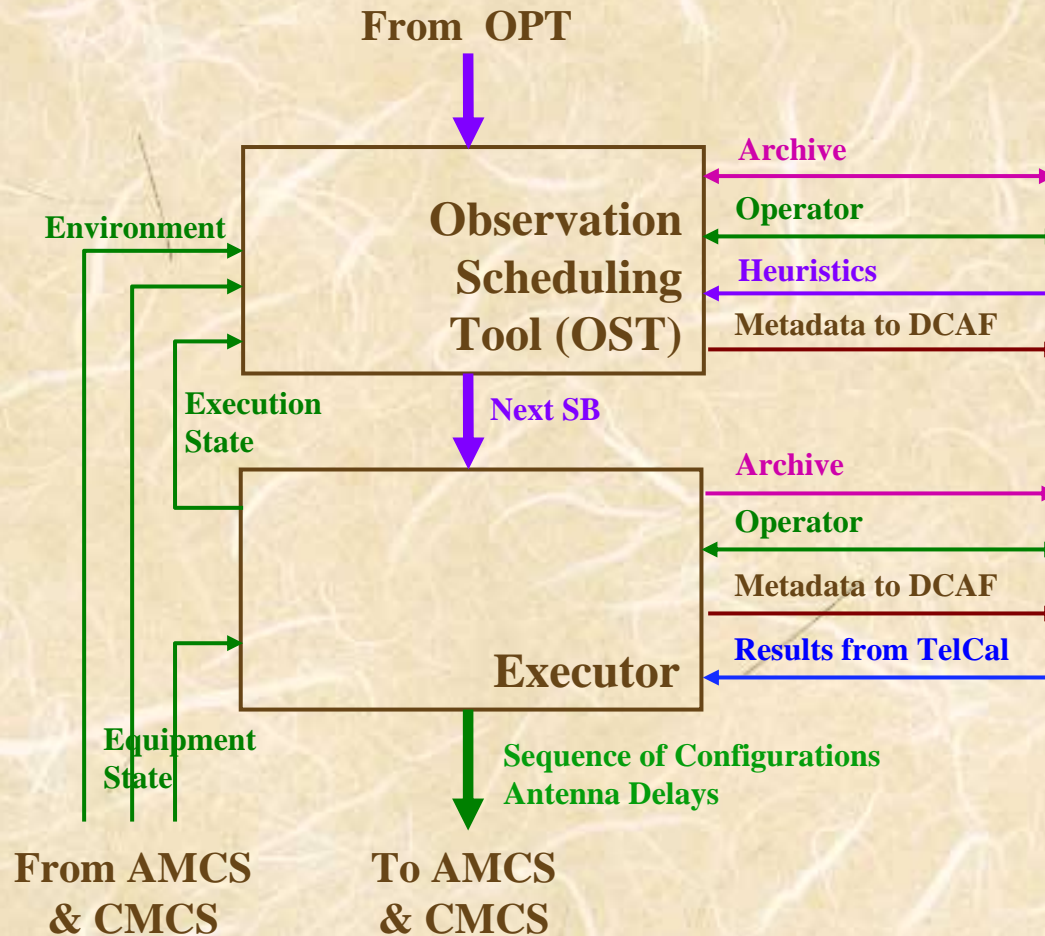
EVLA High Level Design

- Most major subsystems have a direct counterpart in current VLA software
- We have a significant amount of experience in what is needed for those subsystems
- Electronic storage and passage of information between subsystems, and therefore the ability to do much of this automatically, is the new part
- Subsystems are loosely coupled; information (the models) is stored in databases and accessed independently by the subsystems

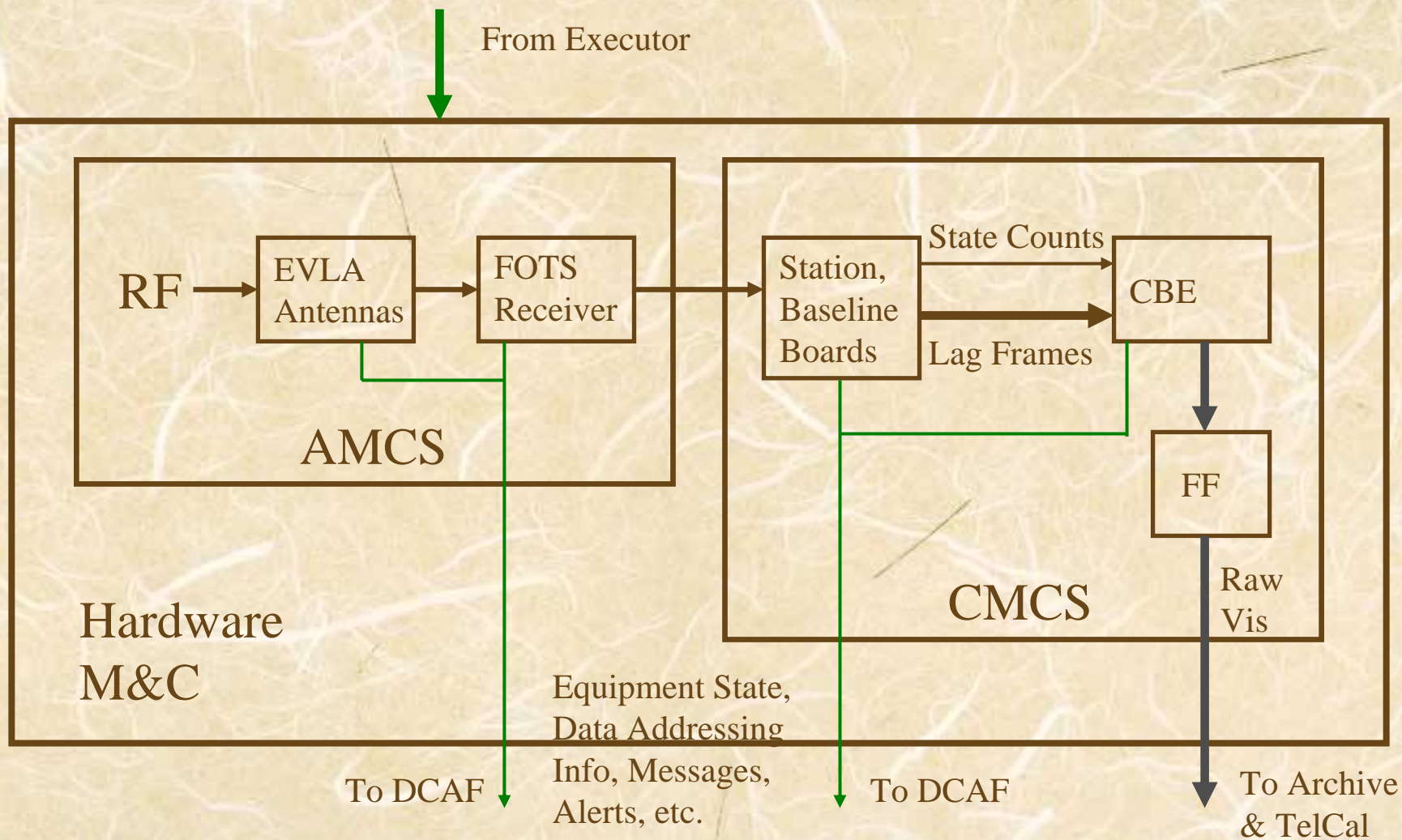
EVLA High Level Design (1)



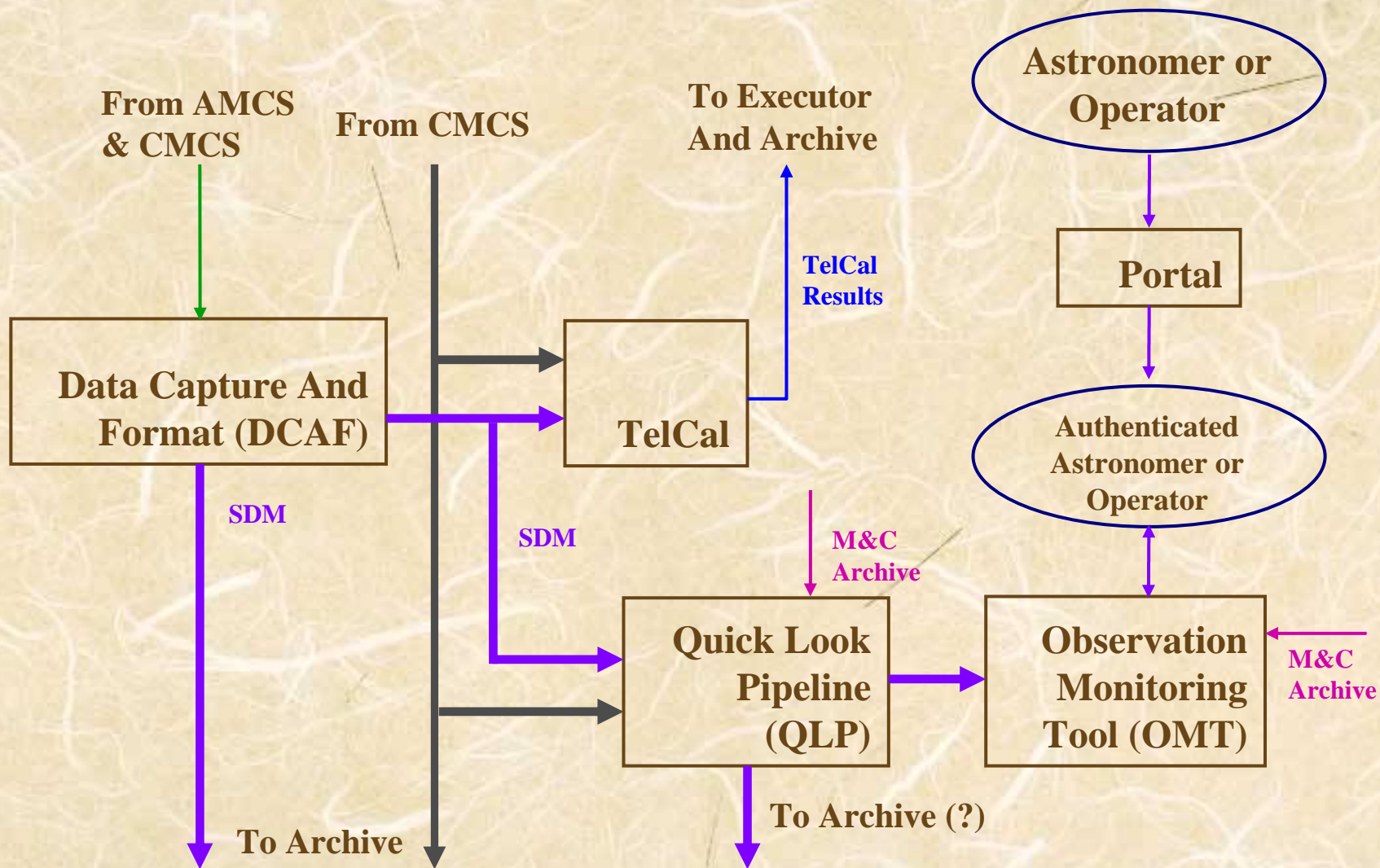
EVLA High Level Design (2)



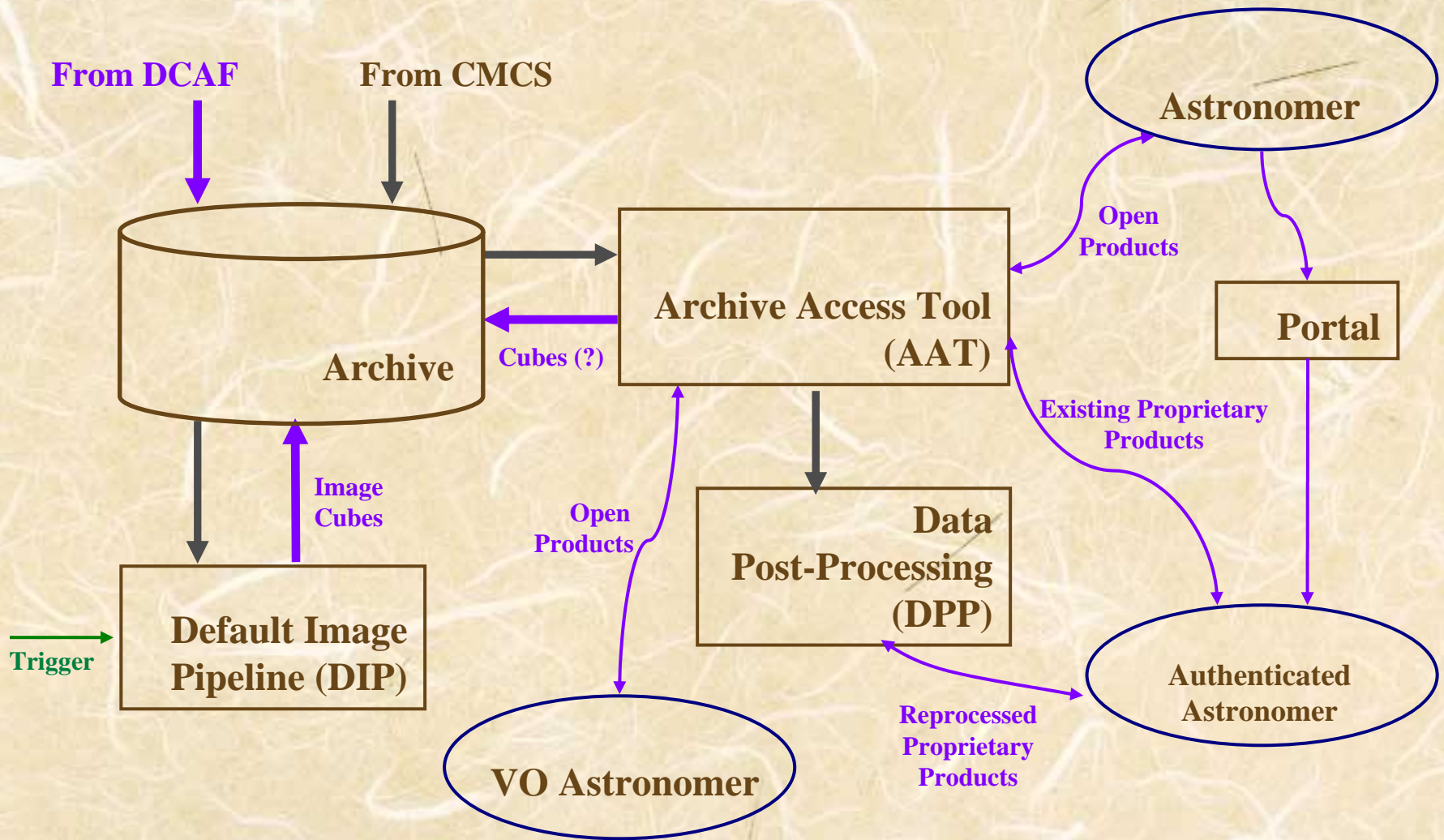
EVLA High Level Design (3)



EVLA High Level Design (4)

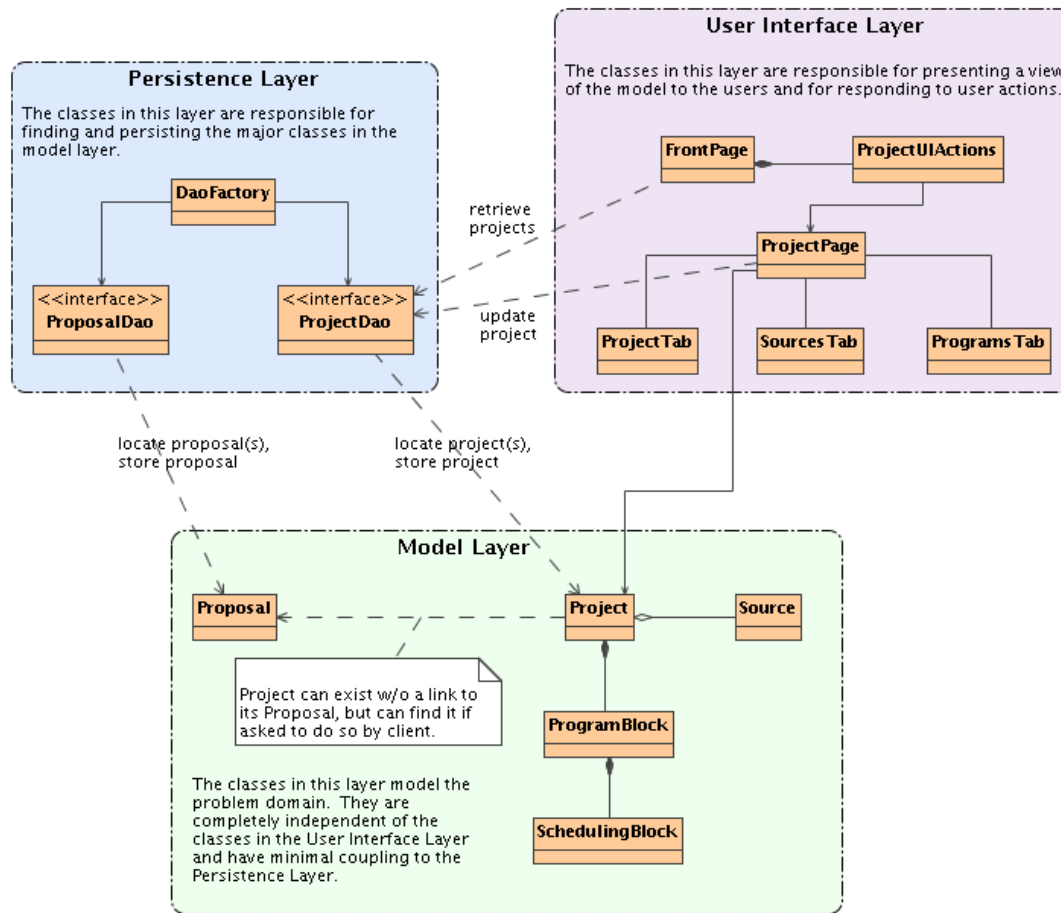


EVLA High Level Design (5)

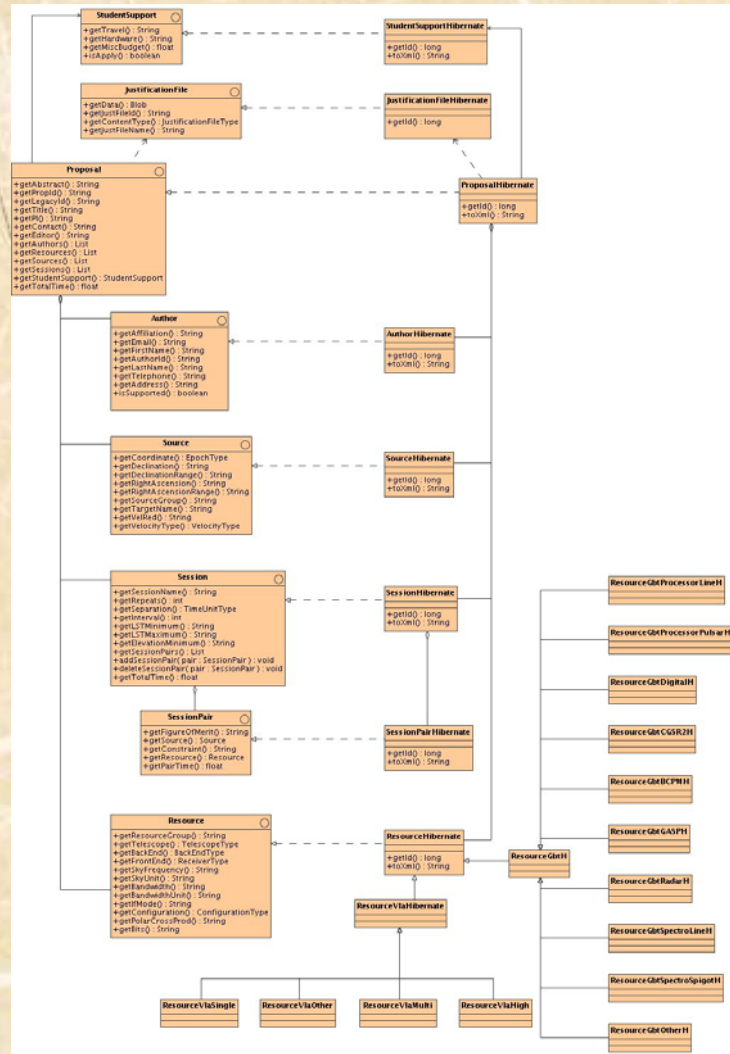


Design - Separation of Primary Components

OPT: Separation of Model, Persistence, & UI Layers



Detailed Design Example - PST



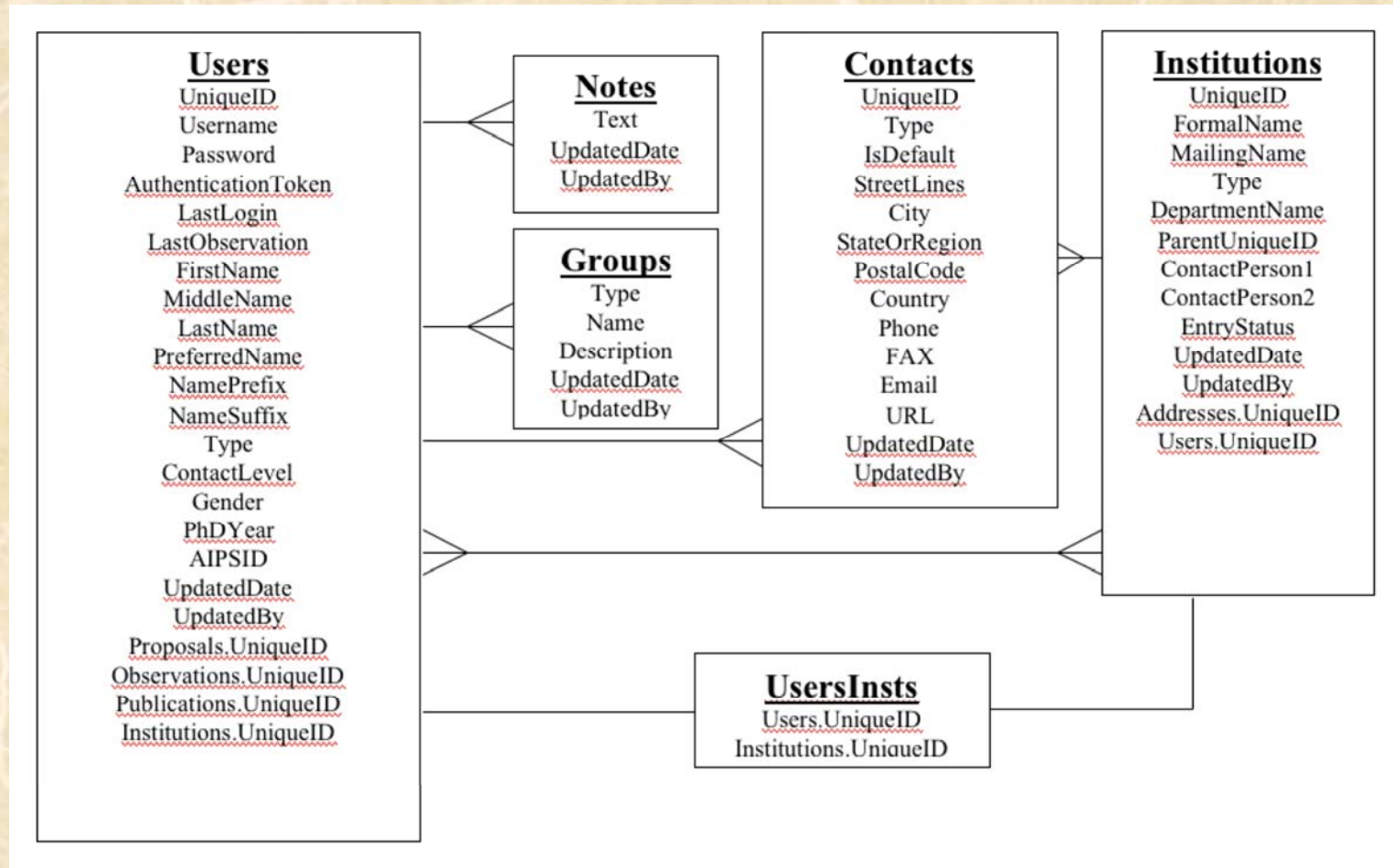
Subsystem Designs & Prototypes

- Subsystems with a very advanced prototype: Portal, PST, Executor, OMT
- Subsystems with an early prototype: PHT, OPT, OST, AAT, TelCal
- Subsystem with only a roughed out prototype: DCAF
- Subsystems with only block diagrams: QLP, DIP. Note that effort for these pipeline subsystems is not funded or staffed currently.


Portal

- Accesses “User Database” - storehouse of information on users
- Authenticates users
- Controls access to the various tools
- Generates unique token used to verify user login status within the other tools.

User Database



Portal

**National Radio Astronomy Observatory**

Sunday, April 30, 2006

[NRAO Home](#) > Online Tools Portal

User Manual

Welcome to the NRAO Online Tools Entry Portal

Returning User
Username
Password


New User
If you aren't yet registered in the NRAO user database, you can get started here.

Lost user name/password?
If you forgot your username or password, fill in one of the email addresses you registered with us and your user name will be sent to you along with a new password and instructions on how to reset it.
Email Address

[Home](#) | [Contact Us](#) | [Directories](#) | [Site Map](#) | [Help](#) | [Privacy Policy](#) | [Search](#)

Version number [0.970](#), last updated on 2006-04-14 by Stephan Witz

Portal

**National Radio Astronomy Observatory**

Sunday, April 30, 2006

NRAO Home > Online Tools Portal

Welcome
bryanbutler
[Logout](#)

User Manual

Welcome back, bryanbutler

Things you can do:

[Inst Admin](#) As an Admin, you can add or edit institutions.

[User Admin](#) As an admin, you can edit or approve a user, reset their password, change their account name or more.


[Update](#) Update your user information: you should review your account periodically to keep it up to date. The last time your account was updated was 2 weeks and 5 days ago.

[Proposal](#) Use the proposal tool to edit, submit or review a formal proposal for observing time on one of the NRAO radio telescopes.

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Version number [0.970](#), last updated on 2006-04-14 by Stephan Witz

Portal

**National Radio Astronomy Observatory**

NRAO Home > Online Tools Portal

Sunday, April 30, 2006

Welcome
bryanbutler
[Logout](#)

[User Manual](#)

Update Account

Fields marked with a * are required and must be filled in before you can submit the form.

[General Info](#) [Contact Info](#) [Affiliations](#) [Groups](#) [Notes](#) [Preferences](#)

Name

Title <input type="text"/>	*First Name <input type="text" value="Bryan"/> Middle Name <input type="text"/>	*Last Name <input type="text" value="Butler"/> Preferred Name <input type="text"/>	Suffix <input type="text"/>
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Miscellaneous Information

Gender <input type="text" value="M"/>	AIPS Number <input type="text" value="1953"/>
Estimated Graduation Year <input type="text" value="1994"/>	

Professional Status*

Describe your professional status, choose the types that apply to you.

<input type="radio"/> Yes	<input checked="" type="radio"/> No	All Others
<input type="radio"/> Yes	<input checked="" type="radio"/> No	Graduate Student
<input checked="" type="radio"/> Yes	<input type="radio"/> No	NRAO Staff
<input type="radio"/> Yes	<input checked="" type="radio"/> No	Postdoc
<input type="radio"/> Yes	<input checked="" type="radio"/> No	Professor
<input type="radio"/> Yes	<input checked="" type="radio"/> No	Research Scientist
<input type="radio"/> Yes	<input checked="" type="radio"/> No	Undergraduate Student

[Cancel](#) [Submit](#)

[Home](#) | [Contact Us](#) | [Directories](#) | [Site Map](#) | [Help](#) | [Privacy Policy](#) | [Search](#)
Version number [0.970](#), last updated on 2006-04-14 by Stephan Witz

Portal

Accomplishments and current status:

- Fully functional - extensively tested in 3 proposal deadlines
- 578 users, 381 institutions currently in User Database
- Integrated with PST and OPT
- Hooks in for integration with VLA/VLBA AAT.
- Code conforms to our new architecture

Portal

Remaining work:

- Continued user support
- Other support (adding a user group to facilitate the PHT referee process, for example)
- Coordination with ALMA on possible common authentication scheme (possibly even application)
- Keeping an eye on VO developments (single sign on for access to all VO sites, e.g.)
- Integration into current VLA/VLBA AAT

Proposal Submission Tool (PST)

- Used to collect form data (web browser)
- Mostly telescope independent, with “resources” the exception, and also some policies (student support, for instance)
- Implemented to support GBT and VLA first so that EVLA can benefit from early user feedback.

PST - Main Components

- Model - retrieve and write data to database
- Controller - business logic to map user input (from browser) into objects which are then written to database
- View - the look-and-feel of the interface (done in browser)
- Validation of various fields - an important and significant part of the tool
- Help system

PST - Model


The Model drives everything, and contains:

- science information - title, category, “mode”, abstract, scientific justification, and some misc. info.
- Authors, including which is the PI and “contact author”
- Sources
- Resources (telescope hardware setup)
- “Sessions” (a guide to SB setup)
- Student Support

This is all the information that is necessary to:

- Referee the proposal
- Assign telescope time (and money)
- Automatically generate SBs (mostly for novice users, but experienced users will use this too!)

PST - View

 *National Radio Astronomy Observatory*

Proposal Submission Tool [Help](#)

Next Proposal Deadline: Thursday, June 01 2006, 17:00 EDT

Today's Date: Thursday, April 27, 2006, 23:17 EDT

You can lose your work after 30 minutes of inactivity. Use the 'Save' button to prevent data loss. Please save often!

Inactivity Timer: 3 minute(s) since last activity.

[View](#) [Save](#) [Exit](#) [General](#) [Authors](#) [Sources](#) [VLA Resources](#) [Sessions](#)

General
[Help](#)

Changes that you make to the title page will be automatically saved for the duration of the web page session. Select the 'Save' button when you are ready to write the proposal to persistent storage.

Warning:
The proposal and justification file are automatically saved to persistent storage when a scientific and technical justification file is specified.
Depending on the length of the file, the proposal submission tool may be slow to respond to the first page change request after the file is loaded.

[Title \[80 character maximum\]](#)

[Abstract \[200 word maximum\] \[word count: 1\]](#)

[Scientific Category \(select all that apply\)](#)
☐ Extragalactic ☐ Solar System ☐ Galactic ☐ Stellar

[Proposal Type](#)
☒ Regular ☐ Large ☐ Rapid Response

[Joint Proposal](#)
☒ Not a Joint Proposal ☐ Joint with GBT ☐ Joint with VLBA ☐ Joint with GBT and VLBA

[Scientific and Technical Justification \[size limit: 25000000 bytes\]](#)
Select a file to upload or to replace (ps, pdf or txt):
 [Browse...](#)

[Load and Save](#)

[Observing Type \(select all that apply\)](#)

<input type="checkbox"/> Continuum	<input type="checkbox"/> Spectroscopy	<input type="checkbox"/> Solar	<input type="checkbox"/> Other
<input type="checkbox"/> Pulsar	<input type="checkbox"/> Planetary Radar	<input type="checkbox"/> High Time Resolution	Other: <input type="text"/>
<input type="checkbox"/> Polarimetry	<input type="checkbox"/> Single Pointing(s)	<input type="checkbox"/> Grid Mapping/Mosaicing	
<input type="checkbox"/> On-the-Fly-Mapping	<input type="checkbox"/> Monitoring	<input type="checkbox"/> Triggered Transient	

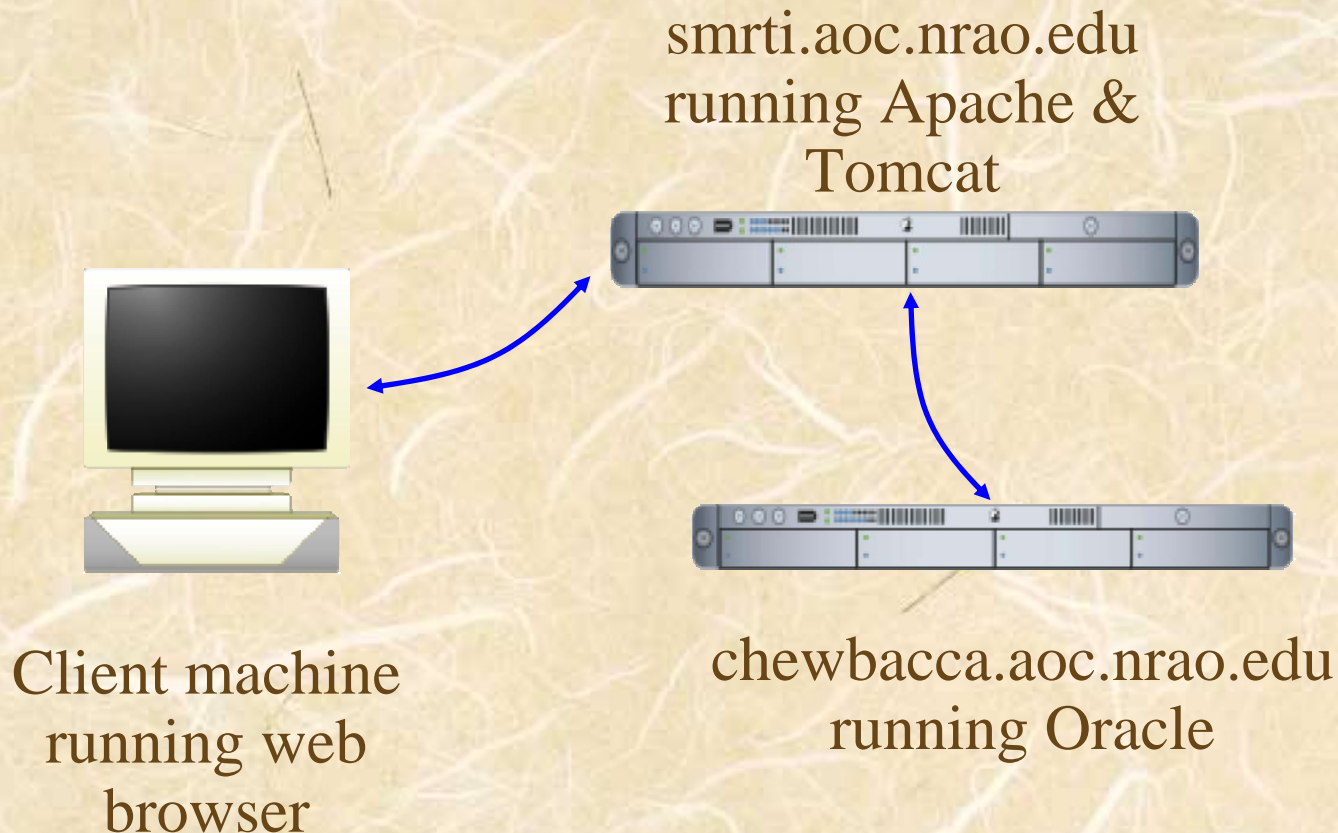
[Related Proposals](#)

[Observer Present for Observations](#)
☐ yes ☒ no

[Staff Support Required](#)
☒ None ☐ Consultation ☐ Friend

[Home](#) [Contact Us](#) [Directories](#) [Site Map](#) [Help](#) [Privacy Policy](#) [Search](#)

PST - Deployment



PST

Accomplishments and current status:

- Fully functional - tested in 3 proposal deadlines for GBT, 1 for VLA
- Last deadline, VLA PST use was optional - $\sim 2/3$ chose to use it over the old LaTeX forms
- Integrated with Portal and User Database
- No server problems at last deadline (110 proposals submitted via PST, all but 3 in last week, 73 in last day, 43 in last 3 hours)
- New code base, with improvements to interface and conforming to our new architecture, to be used for June deadline

PST

Remaining work:

- Continued user support
- Updates based on feedback from use for GBT and VLA deadlines
- New functionality (search old proposals, for example)
- Coordination with ALMA on potential of common PST and underlying model
- Used for EVLA in 2010 (means only addition of EVLA Resource tab page)

Proposal Handling Tool (PHT)

- Allows editing and adding of data to the proposal
- Supports assigning of referees to proposals
- Makes proposals available to referees online
- Supports scheduling committee functions

PHT

Current status:

- Requirements are in hand, but not in the form of detailed requirements like the other areas, but rather as a “user story” (converted to formal Use Cases by our developers)
- Minimal functionality incorporated within the PST:
 - editing and adding data
 - viewing and printing (to send to referees and scheduling committee)
- Other functions still handled by VLA and GBT staff

PHT

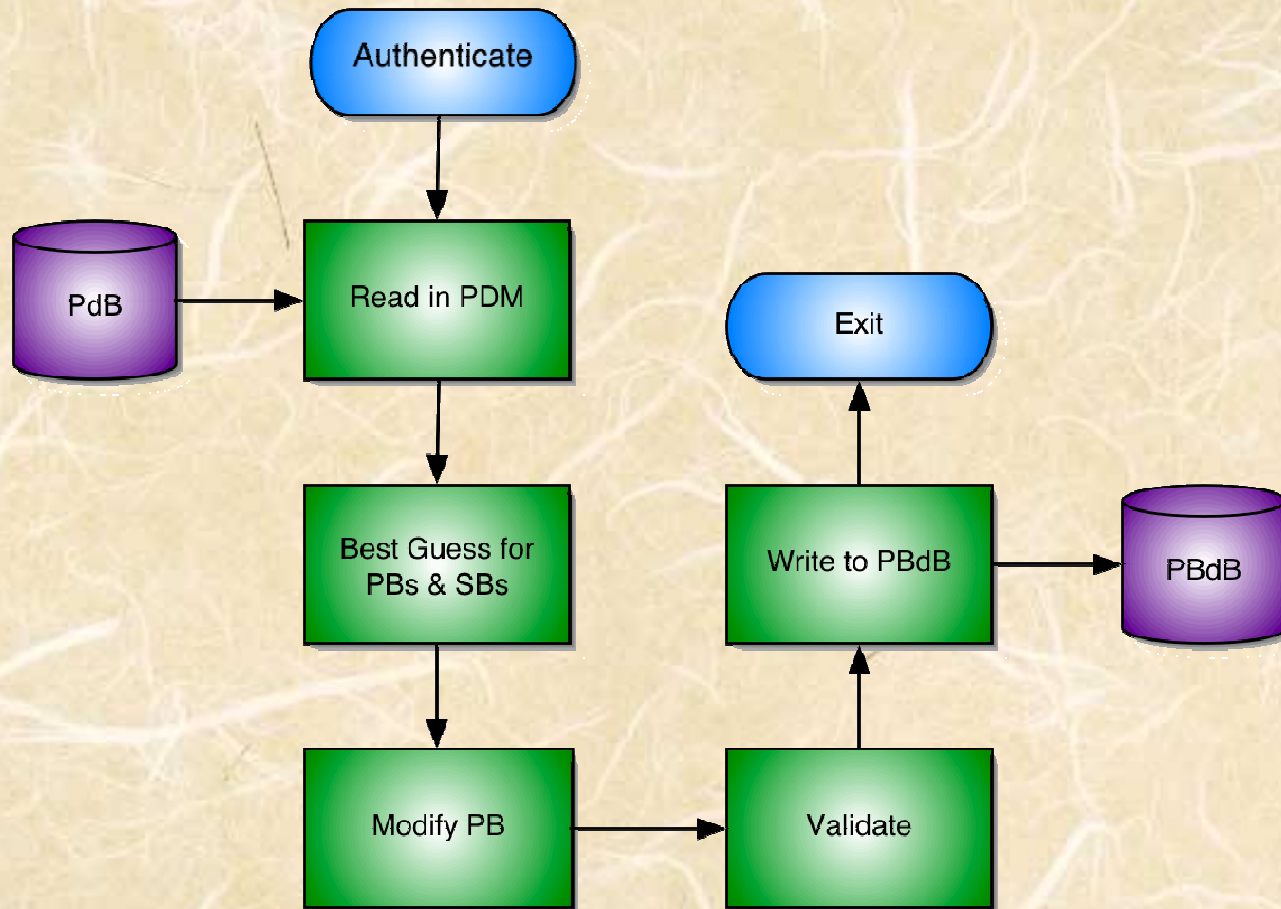
Remaining work:

- Assignment of referees
- Online referee access to proposals and ability to put in reviews online
- Handling of referee reviews
- Scheduling committee functions
- To be implemented before October deadline, except for more complicated scheduling committee functions
- Full EVLA support Q2 2012

Observation Preparation Tool (OPT)

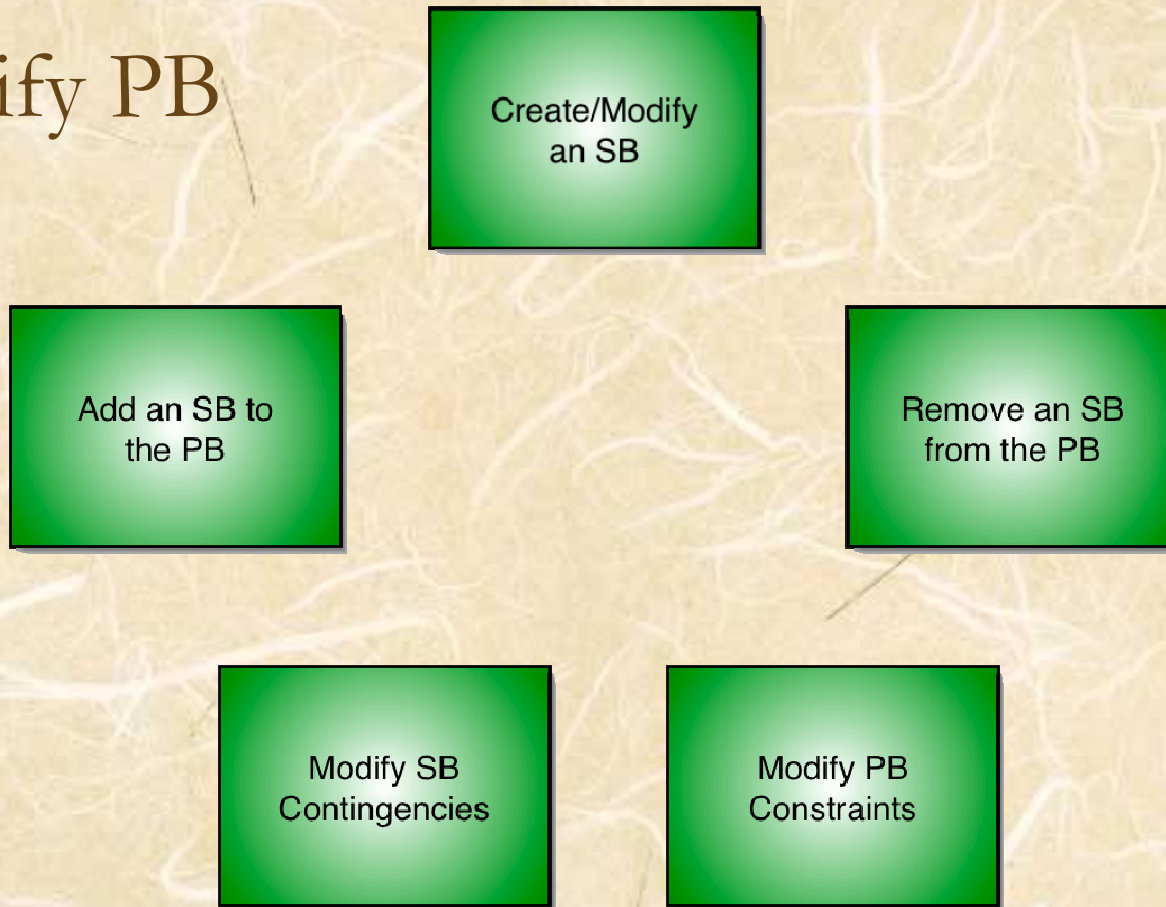
- Converts Project into Program Blocks (PB is a collection of Scheduling Blocks)
- Needs detailed telescope knowledge
- Needs to support 3 “levels” of user:
 - Novice (automatic generation of PBs for “standard modes”)
 - Intermediate (graphical setting of observing parameters)
 - Expert (allow for script level editing)

OPT - Components



OPT - Components

Modify PB



OPT - Components

Modify SB



OPT

[OPT](#) > **EVLA Project 3** > Program > Scheduling Block

[Reload](#) [Save Project](#) [Exit](#)

*Observation
Preparation
Tool*

Copyright 2006 NRAO

[Edit Project](#)

EVLA Project 3

Programs

Sources

Resources

Pairs

Directions

Need to fill in some directions here still.

Project Details

Proposal Code	Project Code	Title	Type	Telescope	Status	Priority	Allocated Time	Time Used
two	brandnew	EVLA Project 3	UNKNOWN	UNKNOWN	NOT_STARTED	2147483647	0.0	0.0

OPT

[OPT](#) > [EVLA Project 3](#) > [A Configuration](#) > **Scheduling Block**

[Reload](#) [Save Project](#) [Exit](#)

*Observation
Preparation
Tool*

Copyright 2006 NRAO

**Scheduling
Block**

Prereqs

Scans

Edit SB

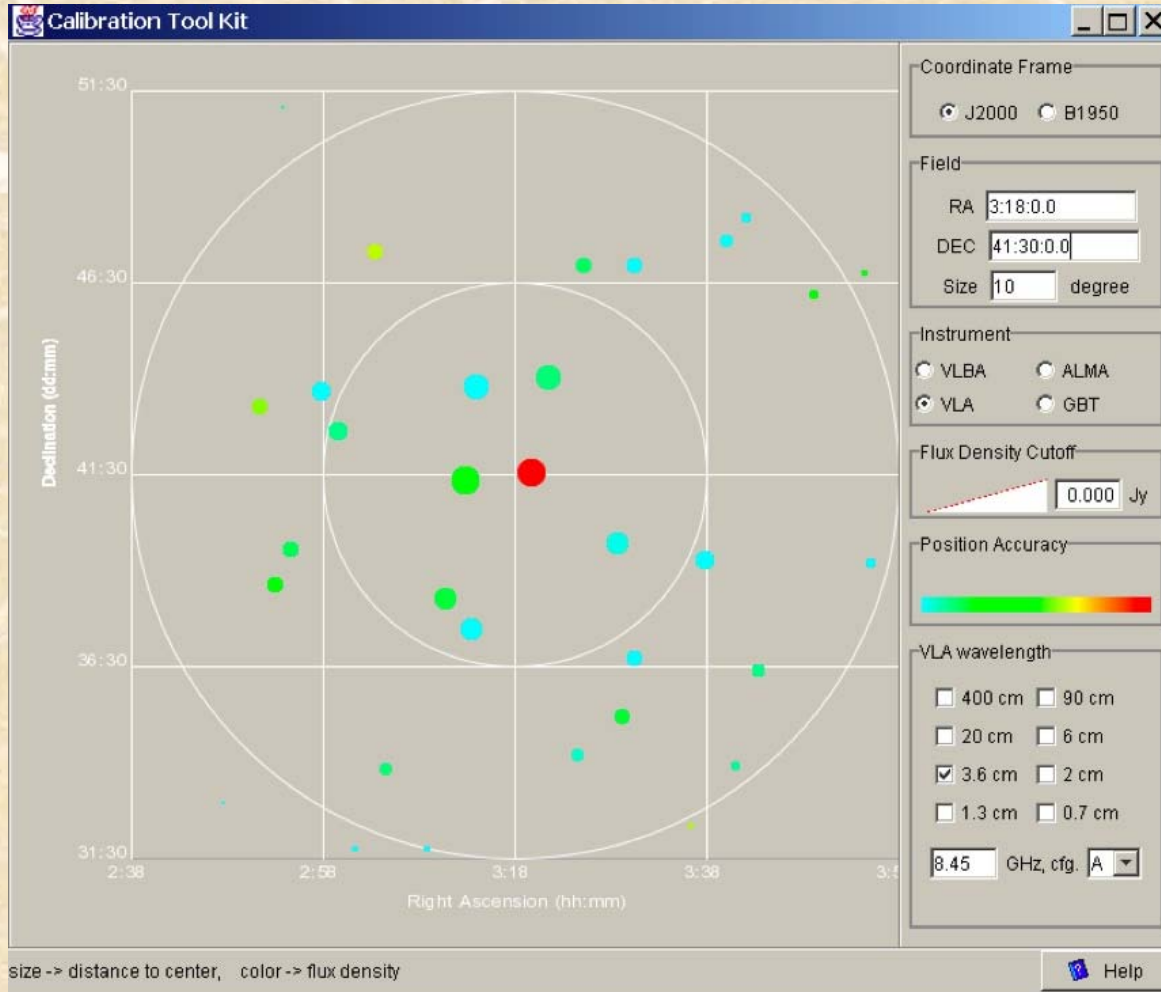
Directions

Add Instructions.

Scheduling Block Details

Name	Status
<input type="text" value="Scheduling Block"/>	NOT_YET_SCHEDULED

OPT - Calibrator Selection



- Calibrator Selection Tool developed as part of DM effort in 2002
- Code reuse unlikely
- Lots of scientific staff input on layout and interface, so can be used as a guide for look-and-feel

OPT

Accomplishments and current status:

- Detailed design in place, core classes designed for reuse in the rest of the system
- Early prototype of the web application in place
- Duplicates look-and-feel of the PST
- Integrated with Portal
- Simple navigation and input and output functions supported
- Old Calibrator Selection Tool available as guide to look-and-feel for that component

OPT

Remaining work:

- Calibrator selection component using NRAO-wide calibrator database (Q3 2006)
- Spectral setup component (for VLA; Q1 2007)
- Full VLA support (Q2 2007)
- Prototype WIDAR fully supported (Q3 2007)
- Full EVLA support (Q2 2012)

PST & OPT - ALMA Interactions

We just spent a week in in Edinburgh having a joint meeting with ALMA and GBT to determine what pieces of the PST and OPT software could be shared. Such items include:

- Proposal Model (ALMA's Science View of Project Data Model)
- Validation infrastructure
- Help system
- Astronomical tools (coordinates, time, etc.)
- Calibrator selection subcomponent (ALMA reuses EVLA)
- Spectral setup subcomponent (EVLA reuses ALMA)
- Development tools (Eclipse, MagicDraw, Hibernate)

A detailed report is being prepared (first draft complete).

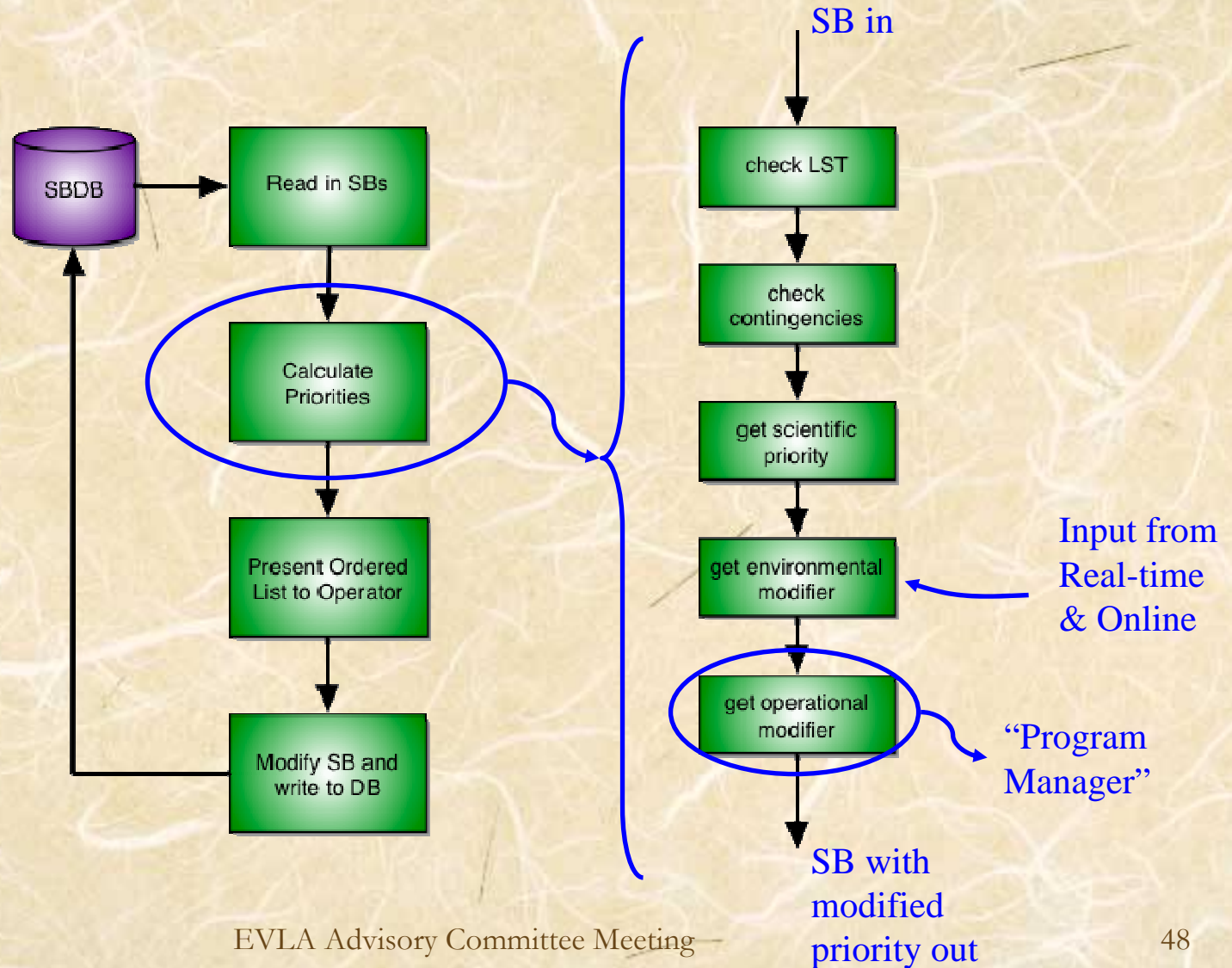
Observation Scheduling Tool (OST)

- Takes pool of available Scheduling Blocks and chooses what should be observed next on the telescope
- Must take into account scientific priority, current observing conditions, and other priority modifiers (project completion pressure, for example)
- Must be able to run autonomously, eventually

OST - Tests on VLA

- Prototype system tested on the VLA during all reconfigurations since July 2005
- Modification of OST used successfully for VLBA for several years
- Observers send in modified OBSERVE files (extra “header” information included in comments at the top)
- OBSERVE files wrangled by NRAO staff
- Prototype OST system presents operator with prioritized list of what to observe next
- Providing us with invaluable information on the practical aspects of dynamic scheduling of a many-element radio interferometer.

OST Prototype - Components



OST VLA Tests - Lessons Learned

- It works! Fundamentally, the VLA can be dynamically scheduled, with Scheduling Blocks drawn from a pool and subsequently observed.
- The system is inordinately fond of short SBs - it works well for them, but medium to long length SBs ($> \sim 2$ hours) have not been well tested.
- Popular LSTs are efficiently used - those LSTs that are not so oversubscribed are not so efficiently used.
- Currently effort-intensive (but getting better)

OST

Accomplishments and current status:

- Prototype system successfully used during several VLA reconfigurations - it works!
- All command line utilities at this point

OST

Remaining work:

VLA prototype:

- Over the next 6 months, a system is being phased in that will support the dynamic scheduling of all “filler” and “monitor” observing at the VLA.
- Make it possible for all VLA observing to be dynamically scheduled by mid-2007.

EVLA:

- Assigning effort beginning late summer 2006 to support the incorporation of the knowledge gained during prototype implementation into a tool which is integrated with the rest of the EVLA software system (conforms to the new HLA).
- Full EVLA support by Q2 2012.

Data Capture and Format (DCAF)

- Collects data necessary to write the Science Data Model (SDM)
- SDM is the logical description of the raw visibility data stored on disk
- SDM also contains any ancillary data necessary to process the visibilities
- Connects to many other subsystems

DCAF

Accomplishments and current status:

- Preliminary work done to determine that ALMA SDM is appropriate for EVLA (supports all WIDAR output products), with minor modifications
- Message format definition near completion
- Interim version in development for VLA ➤ EVLA transition

DCAF

Remaining work:

- Final determination on ALMA SDM (Q2 2006)
- Completion of interim prototype (Q3 2006)
- Development of interfaces (Q2 2008)
- Development and implementation of full EVLA subsystem (Q2 2009)


Archive Access Tool (AAT)

- Searches and retrieves data from the disk archive
- Raw data and processed products made available
- Should support Virtual Observatory (VO) access, at least on the processed products
- If EVLA has common SDM and archive storage software and hardware (NGAS) with ALMA, then tool can be common

AAT - VLA/VLBA Prototype

- VLA and VLBA raw data currently accessible via web application
- Extensively tested; available since October 2003
- Non-proprietary data openly available
- Proprietary data made available via observatory-supplied “key”
- Both simple (Project ID, for example), and complex (akin to VO cone search) searches supported
- More data downloaded via this mechanism than is taken real-time at the VLA (~ 3 GB/day)

AAT - VLA/VLBA Prototype

 *National Radio Astronomy Observatory* Wednesday, May 3, 2006

[NRAO Home](#) > [Archive Home](#) > [Advanced Query Tool](#)

NRAO Data Archive System

Returns a tabular listing based on query parameters

[Enter Locked Project Access key:](#) A keyword is required to unlock proprietary data. All archive data may be browsed, any data not under proprietary protection may be downloaded without a keyword.

Output Control Parameters :

[Query Returns:](#) [Sort Column 1:](#)
[Archive Data Type:](#) [Sort Column 2:](#)
[Output Format:](#)
[Max Output Rows:](#)

General Search Parameters :

[Program ID](#) [Project Segment](#)
[Observer Name](#) [Archive File ID](#) (partial strings allowed)
[Dates From](#) (format: 2002-jun-21 14:20:30) [To](#)

Object Search Field :

[Object Name](#) [Search Type](#) [Calibrator Type](#)

Directed Search Field :

[RA\(J2000\):](#) (12h30m25.5s) [Dec\(J2000\):](#) (16d41°57.82") [Search Radius](#) (1d00'00" or 0.2d or 0.2)

Sensitivity and Resolution :

[Min. Exposure Time:](#) (secs)

Observing Configurations Search Fields :

[Telescope](#) [Telescope Config](#)
[Observing Mode](#) [Sub_array](#)
[Observing Bands](#) [Frequency Range](#) (Frequencies in MHz : 1665.401) [To](#)

Please direct feedback and/or questions concerning this page and its associated search engine to [NRAO DAS contact](#).
(servlets version 4.7.5)

AAT

Accomplishments and current status:

- Prototype exists which makes raw VLA and VLBA data available
- Used extensively for several years now - extremely successful!
- Authentication code there, not exercised yet (because we haven't had VLA data come out for projects which used the online VLA PST yet)
- NGAS hardware and software beginning to be implemented at AOC for use by current tool

AAT

Remaining work:

- Complete NGAS evaluation (Q4 2006)
- Test authentication (Q4 2006)
- Collaboration with ALMA to impart our “lessons learned” and to evaluate possibility of using their archive access tool
- Minimal EVLA support (Q2 2007)
- Full EVLA support (Q2 2012)

Antenna Checkout Software

- ECD responsible for delivering software to make it possible for the VLA Operations Group to test and accept antennas into normal VLA operations
- List of needed software in place, developed in cooperation with the VLA Operations Group
- Most software in place; remainder being developed given two milestones:
 - initial (command line) version deliverable by the time antenna 18 is outfitted (end of May 2006)
 - final (GUI) version deliverable by the time antenna 24 is outfitted (end of July 2006)