Astronomer's Proposal Tools (APT) Project Architecture Document

APT Development Team
December 13, 2001

1. Introduction

This document describes the APT architecture. It concentrates on the architecture to support APT inter-process issues. This is a living document that will be updated throughout the life of the project.

2. System Constraints and Assumptions.

This architecture was developed with two classes of APT users in mind, HST users and non-HST users. The HST user community is varied and different classes of HST user's require different capabilities. Both STScI and non-STScI HST investigators will use APT to prepare and submit their Phase 1 proposals and Phase 2 programs. These same classes of investigators will use APT for archival research. Internal to STScI the Program Coordinators and Instrument Scientists will use APT to help with program implementation.

We envision parts of APT being used by future missions, such as NGST and other missions (i.e., SOFIA, etc.). This architecture was developed with both classes of users in mind. This often means a trade off between generality and mission specifics.

We consider our primary goal to support HST users and our secondary goal to support non-HST missions.

3. APT Major Technical Components

This section describes the technical components that are part of the APT tool set. Tools included in the APT tool set will be distributed with the APT tool. This includes Spike, Trans, and Starview2.

APT consists of two major components; the APT toolset that provides users with tools that help them prepare their Phase 1 & 2 science programs, and the integrated environment that unifies all the tools and makes them interoperable. It is envisioned that some of the APT tools will be developed to work as a stand-alone tool outside the APT integrated environment. Figure 1 shows the list of envisioned tools and when the HST user community will use them.

All APT tools will be available to the user based on the user-selected mode (i.e., Phase 1 or Phase 2 mode). Tools, which will be available to support both Phase 1 and Phase 2, are shown as Generic support tools.

APT Technical Components

Figure 1.

In the Phase 1 configuration, APT will provide the user with the following Phase 1 specific tools:

- Phase 1 Proposal editor will provide users with a means of supplying descriptive information about the proposal, such as investigator names, proposal abstract, observations, etc.
- Resource Estimator tool will determine the number of orbits needed for their Phase 1 observation.
- Duplication Checking will determine whether a proposed observation has already been done. Starview2 will provide this capability.

In the Phase 2 configuration, APT will provide the user with the following Phase 2 specific tools:

- Phase 2 Program editor will provide users with a means of supplying descriptive information about the targets, visits, exposures, patterns, etc.
- Orbit Planner will model the layout of exposures within target visibility periods, display the results graphically, and allow for graphical tweaking of the orbit by operations such as copying, lengthening, moving, and deleting exposures.
- Visit Planner will allow graphical specification of visit dependencies (such as Visit 1 After Visit 2), and then display possible scheduling times based on all the constraints.
- Bright Object Checker will determine whether there are bright object concerns for an exposure that could affect science or instrument health and safety, and display the concerns to the user.

- RPS2 File Conversion Tool will convert and RPS2 file into the input format needed by APT.
- Guide Star Checker will provide guide star availability information to the user.

The following tools are available to the user in both Phase 1 & Phase 2 configurations.

- Visual Target Tuner will allow users to view and manipulate instrument apertures against an image of the target.
- Exposure Time Calculator will determine the exposure time for a selected exposure or determine the S/N expected for a particular exposure time.
- Archival Research Tool will allow users to display information about observations from the HST data archive and perform duplication checks.
- Submission Tool will allow users to submit their Phase 1 proposal information and Phase 2 program information to STScI.
- Observatory Constraint Manager Tool will ensure that the user provides legal instrument configurations.
- Top Level GUI & Architecture will provide the integrated environment to support all of the APT tools.

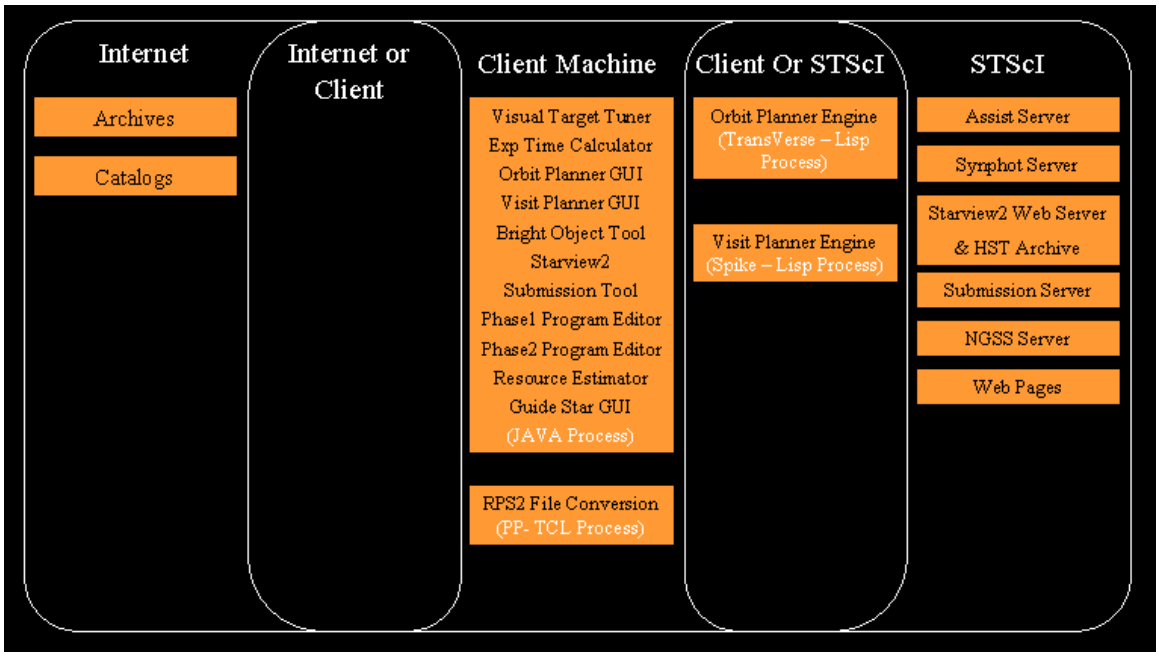
4. Non-APT Major Technical Components

This section describes the technical components that support APT, but are not part of the distributed APT tool set. These tools are not distributed with the APT tool set.

- SYNPHOT provides support to the Exposure Time Calculator tool
- STScI and non-STScI catalogs to support the Visual Target Tuner & Bright Object Checker
- HST Archive to support the Archival Research Tool (Starview2)
- HST Address information from the Assist Database for Phase 1 support
- STScI NGSS server for guide star support
- STScI submission server
- STScI Web Pages

5. Architecture Description

Figure 2 describe what tools or part of a tool will run locally on a client machine and what part will be servers at a remote/local host. There will be between 2 to 4 separate processes on the client side depending on whether the Lisp processes run locally or remotely. There will be one Java process for all Java code. There will be on TCL process for the RPS2 Preprocessor, which will be used for the RPS2 file conversion tool. Two separate lisp processes (Lisp1 & Lisp2), one for the orbit planner (Trans) and one for the visit planner (Spike).



APT Processes

Figure 2.

Table 1 describes which tools will operate synchronously and which tools will work asynchronously. By synchronously, we mean a user invokes a GUI action and the system waits until a response is returned from the tool. By asynchronous, we mean a user invokes a GUI action, and the system can proceed without a response. The system will notify the user when their action is complete. An example of a synchronous operation is: A user changes the exposure length in an orbit in the GUI. The system waits for the orbit planner engine to return the orbit overheads, etc. An example of an asynchronous operation is: A user submits their program to STScI. After the program is sent, they are able to continue working with APT. They will be notified when their program has been received.

CLIENT SIDE		**REMOTE SERVERS**		**Communication**
TOOL	**PROCESS**	**TOOL**	**SITE**	
Visual Target Tuner	Java	Catalog & Archive Servers	Anywhere	Synchronous
Submission GUI	Java	Submission Server	STScI	Asynchronous
Observatory Constraint Manager	Java	N/A	N/A	Synchronous
Exposure Time Calculator (GUI)	Java	SYNPHOT Server	STScI	Synchronous
Phase 1 Proposal Editing	Java	Assist Server	STScI	Synchronous

Phase 2 Program Editing	Java	N/A	N/A	Synchronous
RPS2 File Conversion (Preprocessor)	TCL	N/A	N/A	Synchronous
Orbit Planner GUI	Java	N/A	N/A	Synchronous
Orbit Planner Engine (TransVerse)	TransVerse Server (LISP1)	TransVerse Server if necessary	STScI	Synchronous
Visit Planner GUI	Java	N/A	N/A	Synchronous
Visit Planner Engine (Spike)	Spike Server (Lisp2)	Spike Server if necessary	STScI	Synchronous
Bright Object GUI	Java	DSS2 Server	STScI	Synchronous
Guide Star GUI	Java	Guide Star Server (NGSS)	STScI	Synchronous
Archival Research & Duplication Checking (Starview2)	Java	Starview2 Web Server & HST Archive	STScI	Synchronous
Resource Estimator	Java	N/A	N/A	Synchronous

APT Processes & Communication

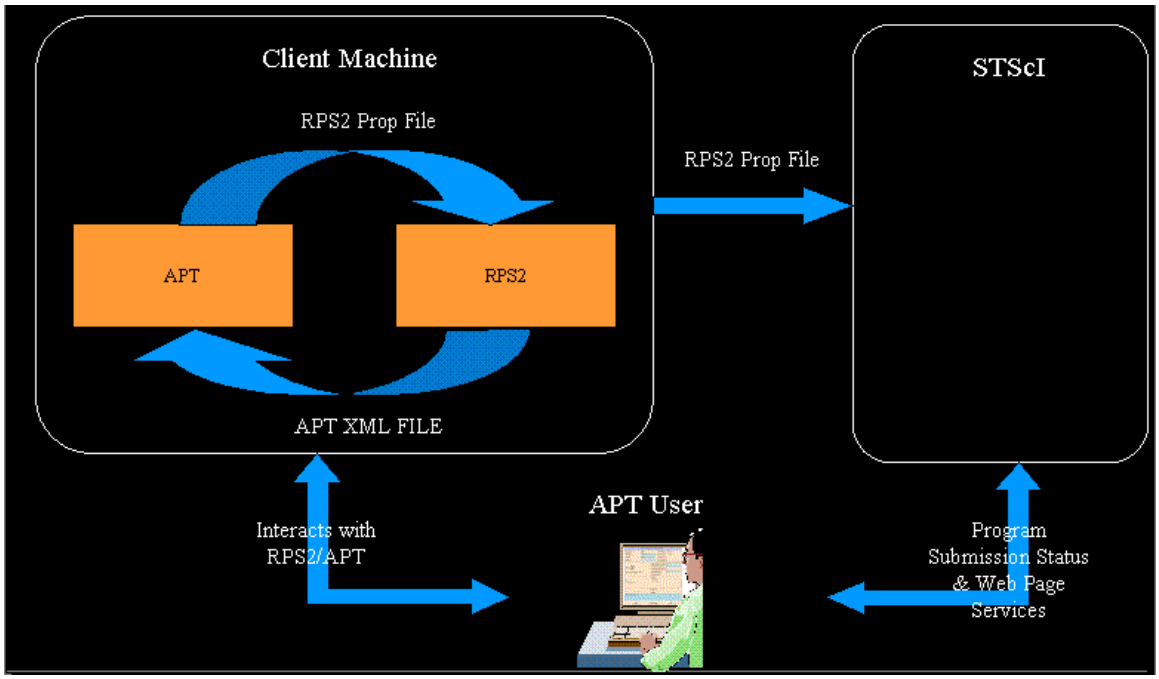
Table 1.

6. APT Inter-Process & Intra-Process Communication

This section describes the data products and method of communication between the APT processes running both locally and remotely. The description and format of the data are not documented here.

APT/RPS2 Inter-Process Communication

This section describes the inter-process communication between APT and RPS2. When RPS2 is retired, this interface will no longer be supported. This interface will allow APT to generate an RPS2 .prop file for input into RPS2. It will also support the generation of an APT XML input file from the RPS2 preprocessor program. This will allow user's to go back and forth between APT and RPS2 if necessary. The user will not be able to submit their Phase 2 programs from APT to STScI until RPS2 is retired.



APT/RPS2 Communication

Figure 3.

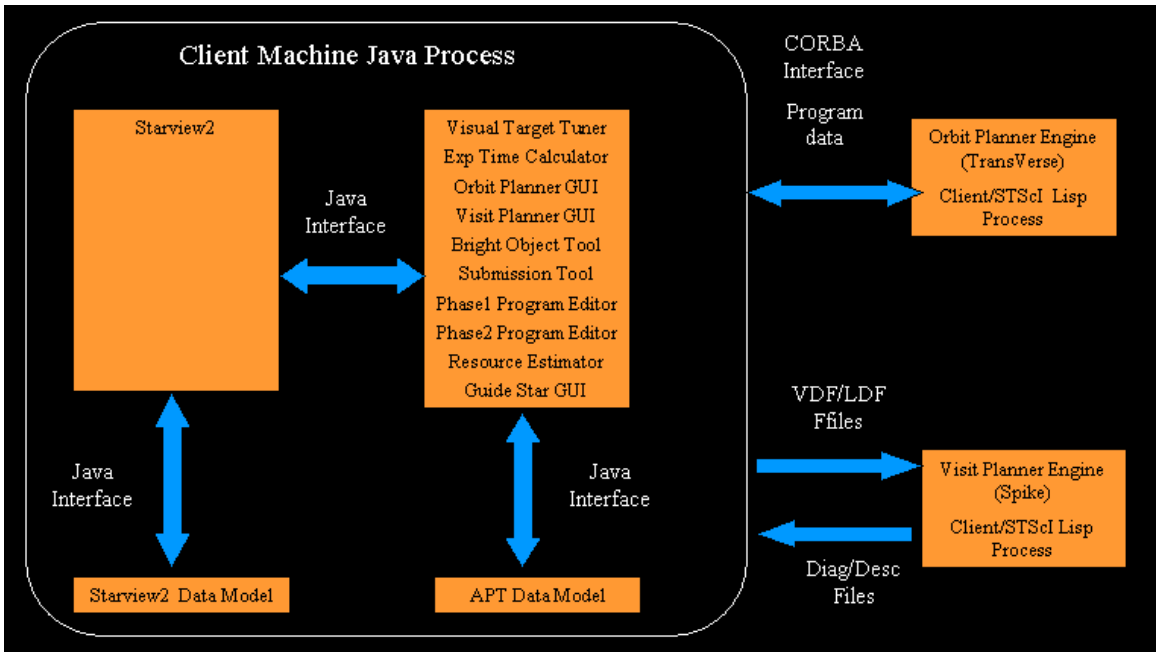
APT Client Inter/Intra-Process Communication

This section describes the communication between the 3 APT processes running on the client machine.

All the APT Java Tools and Starview2 co-exist in one Java process. Starview2 and the APT tools run as separate threads and communicate through a Java interface. This interface does not depend on both Starview2 and APT being present. If Starview2 is running without APT, this interface detects that and allows Starview2 to run standalone. This interface works similarly and allows APT to run without Starview2. Both Starview2 and APT have their own data models, which are kept separate. All data is passed through the Starview2/APT interface.

APT will communicate with the orbit planner (TransVerse) via CORBA. This is a new interface that will improve upon the older file based interface used by RPS2 and allow APT to process individual exposure changes in a more timely manner. We believe that this will allow us to provide the user with a more interactive orbit planner engine.

APT will communicate with the visit planner (Spike) via the existing RPS2 file based interface. Users typically don't iterate with Spike like they do with TransVerse to layout their orbits, we felt that the existing file based interface would be sufficient. This decision was also based upon the limited resources available on the Spike team to make the necessary Spike changes to support a new interface for APT.

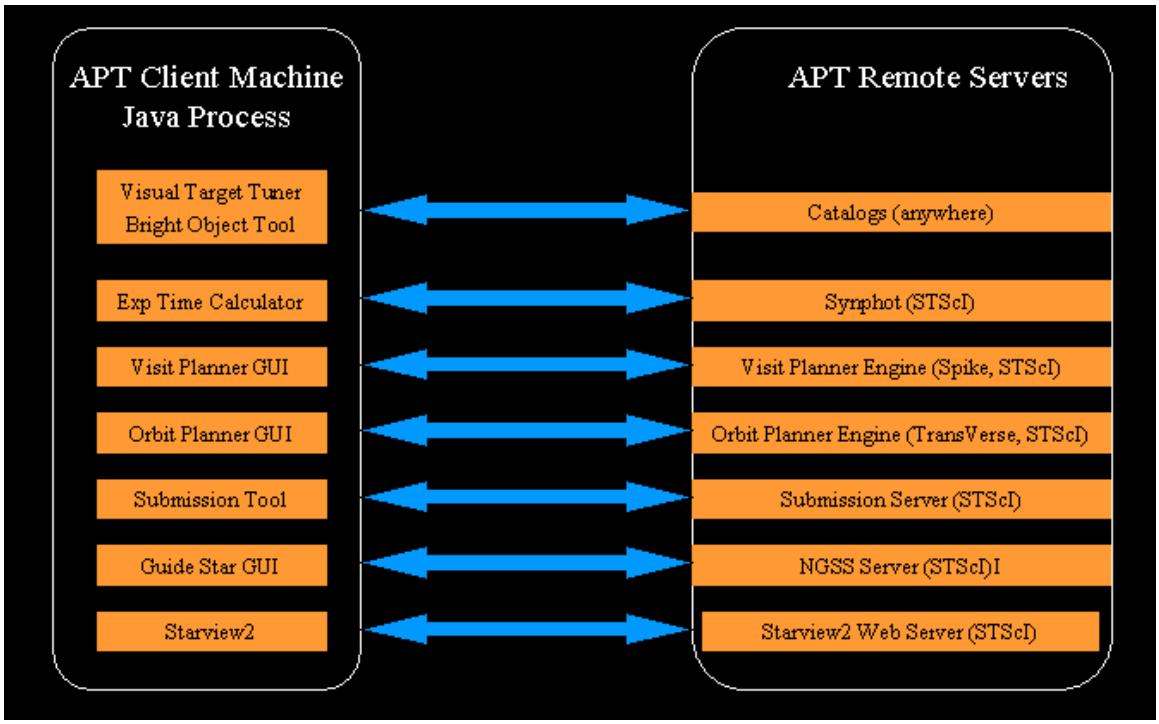


APT Client Interfaces

Figure 4

APT Client/Remote Inter-Process Communication

This section describes the communication between the APT toolset a remote processes not running on the client machine. Figure 5 describe which APT tools communicate with remote processes. For example, the Exposure Time Calculators communicate with Synphot for count rates.



APT Client/Remote Server Communication

Figure 5.

APT Communications

Table 2 provides a textual description of all of the APT interfaces described in this section. It is meant to supplement Figures 3-5.

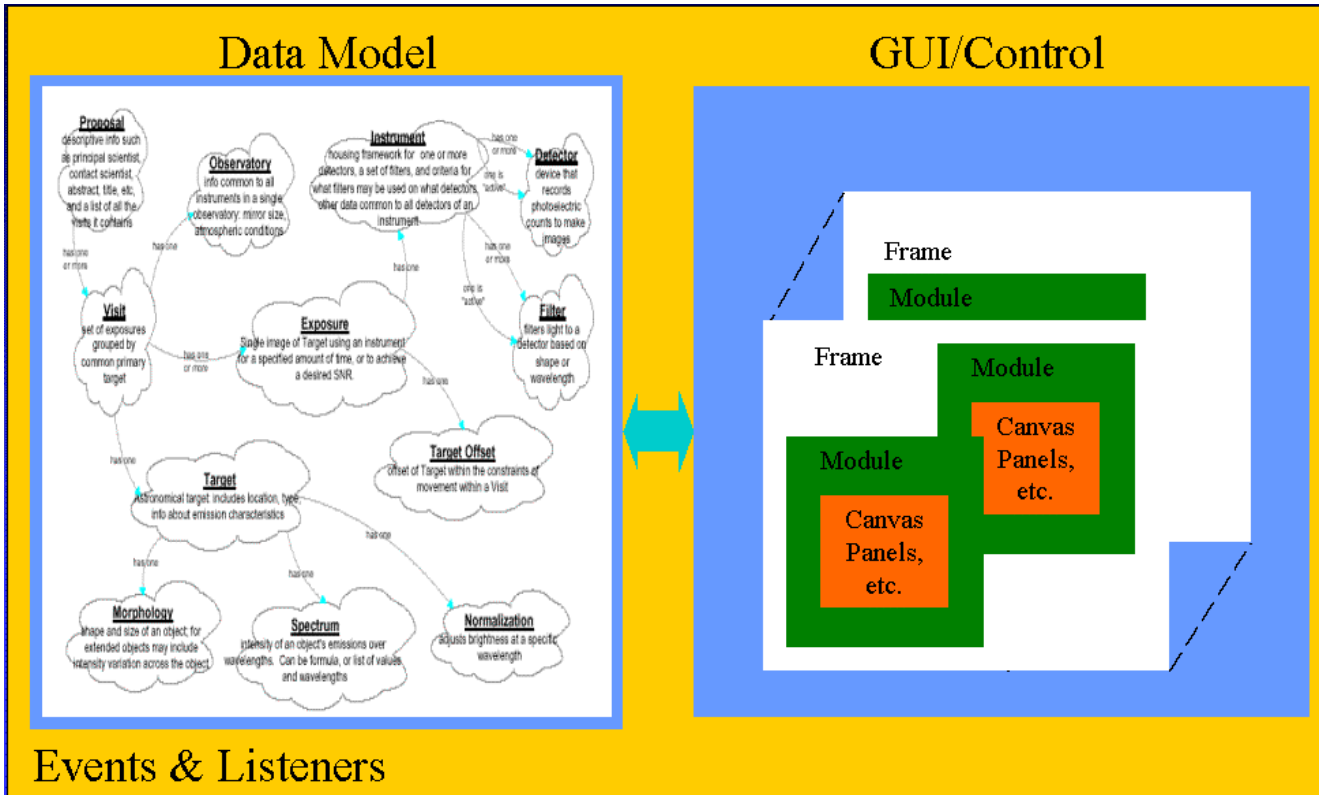
Sending Process	Receiving Process	Communication Method	Comments
APT Submission Tool	STScI Submission Process	Phase 1 XML File	File containing the Phase 1 proposal information provided by the PI. New interface, details to be defined.
APT Submission Tool	STScI Submission Process	Phase 2 .prop file	File containing the Phase 2 program information provided by the PI. This file is the current interface between RPS2 and STScI. It will be preserved until the in-house operational system is changed
APT Visit Planner GUI	APT Visit Planner Engine (Spike)	VDF and LDF files.	Files containing visit and link information. This is the current interface between RPS2 and Spike. It will be used in APT, since there are no resources to modify Spike to communicate in a different manner with APT.
APT Visit Planner Engine	APT Visit Planner GUI	Diagnostic and Description files	Files containing diagnostics and scheduling information. This is the current interface

(Spike)			between RPS2 and Spike. It will be used in APT, since there are no resources to modify Spike to communicate in a different manner with APT.
APT Visit Planner GUI	STScI GSSS	TBD	Request Guide Star Checks for visits. Existing Interface in RPS2, but will have to be modified for use by APT.
STScI GSSS	APT Visit Planner Engine (Spike)	GSSS file	File containing Guide Star availability information which affect scheduability. Existing Interface.
APT Orbit Planner GUI	APT Orbit Planner Engine (TransVerse)	CORBA Interface	Exposure information for orbital layout. New interface, details to be defined.
APT Orbit Planner Engine (TransVerse)	APT Orbit Planner GUI	CORBA Interface	Diagnostic and Orbital layout information. New interface, details to be defined.
APT ETC GUI	STScI Synphot	URL	Instrument and Exposure information. Existing interface.
STScI Synphot	APT ETC GUI	String of Count Rates and Exposure Times	Count Rates and Exposure times. Existing interface.
APT VTT & Bright Object Tool	Catalogs	URL	Request for archive and catalog information. Existing interfaces
Catalogs	APT VTT & Bright Object Tool	Catalogs information (FITS files)	Existing interface.
APT Orbit Planner Engine (TransVerse)	APT Visit Planner Engine	Trans orbital visibility information (TDF file)	This is an existing interface and is implemented in RPS2, but not sure
APT	RPS2	Phase 2 .prop file	This is only needed until RPS2 is retired. Existing interface, but needs to be expanded as more APT capabilities come on line.
RPS2 (Preprocessor)	APT	APT XML Phase 2 program file.	Phase 2 program used by APT. New interface, to be defined.
APT	APT	APT XML Phase 2 program file	Phase 2 program file used to save/reload user programs. New interface, to be defined.
APT	APT	APT XML Phase 1 proposal file	Phase 1 proposal file used to save/reload user proposals. New interface, to be defined.
APT/Starview2	Starview2 Web Server & Archive	URL	Contact SV2 web server as proxy. Web server requests information from database, archive, etc. Existing Interface.
Starview2 Web Server & Archive	APT/Starview2	XML document	Document contains formatted data and pointers to Archived images, etc. Existing Interface
APT GUI	STScI Assist Database	TBD	Query Proposer address information.
STScI Assist Database	APT GUI	TBD	Address information supplied to APT.

Table 2

7. System Model

The APT system uses a MVC (model, view, control) model. The control and view are implemented in the APT GUI and the data model is a collection of science objects representing the HST science program. Both the GUI and Data Model are in the same Java Process and run on the client machine. Events and Listeners communicate data model changes between the various tools. Figure 2 illustrates how the data model communicates with the GUI/Tools below.

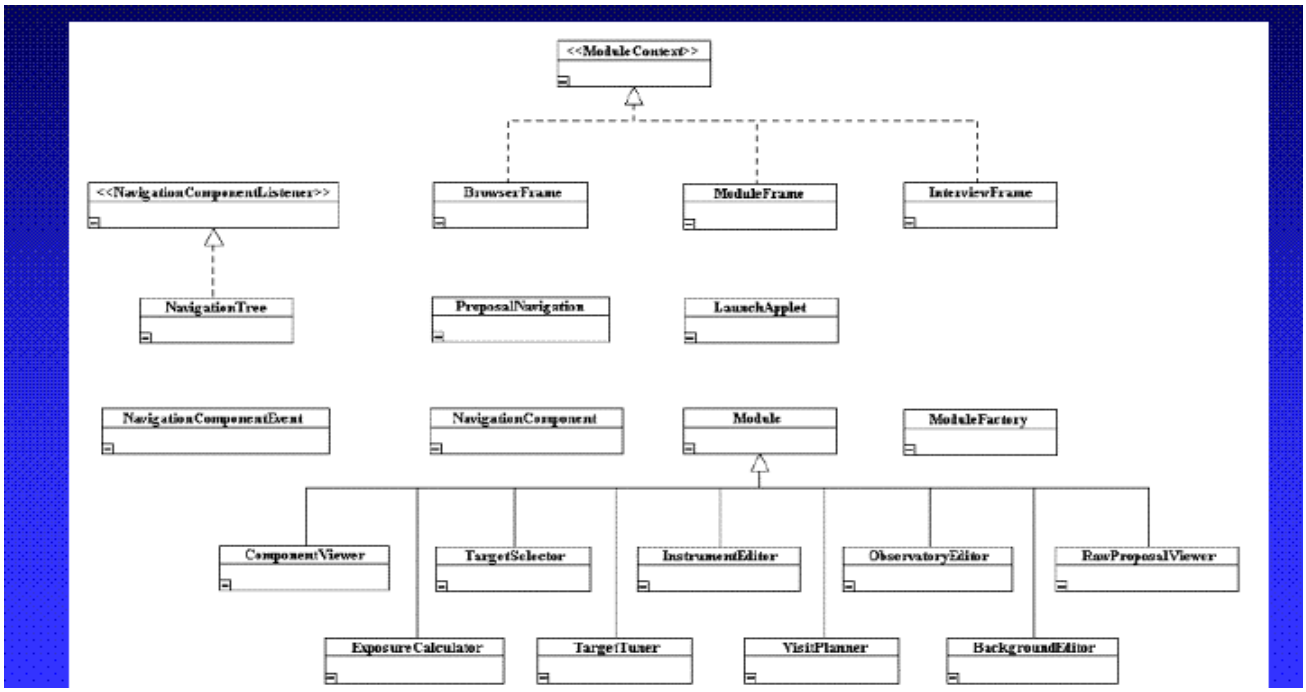


MVC Model

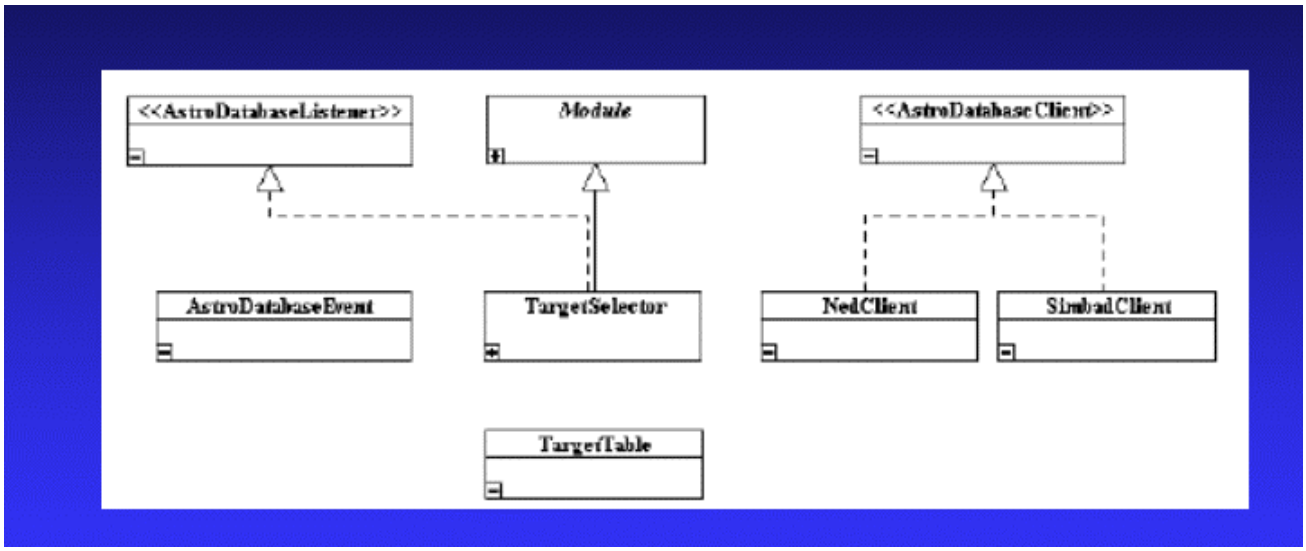
Figure 6.

Controller/Viewer (GUI)

The control/view are implemented in the GUI and consist of frames, modules, and canvases. These are extensions to the standard Swing Toolkit. Frames are containers for modules. A module is a self-contained tool (i.e., VTT). Module's have their own GUI and inherit their look and feel from the parent classes. Figures 7-8 illustrate the APT high-level GUI hierarchy and VTT GUI hierarchy, respectively. These figures show how a new tool module gets plugged into the top level APT GUI. Some GUI objects make changes to the data model. Other GUI objects register as event listeners for the particular data objects they display. Changes to those data objects then cause the GUI to update.



APT Top Level GUI Class Hierarchy
Figure 7.



APT VTT Module Class Hierarchy

Figure 8.

Data Model

The APT Data Model is the collection of objects, which describe the User's proposal. All of the objects are arranged in a hierarchy, which support the APT tool suite. At the top of the hierarchy is a Data Pool object, which collects all the other data relevant to an APT session and provides

the means of saving and restoring state. Below this are individual proposals that are being edited within the APT.

Proposals contain general information that is globally applicable to the observations that the User is working on, including bookkeeping data, such as Title and Investigators. A Proposal also contains a collection of Targets, Patterns, and Visits. Visits contain a collection of Exposures, each with references to a Target and possibly a Pattern object.

There are three types of tools that interact with Data Model. In general, Java Tools have access to and manipulate the Data Model directly. In contrast, Engines are fed some subset of the data and return results that are populated into the Data Model.

An Editor has direct access to the data fields of the objects they edit. When a change is made, the object is updated and all active change listeners are able to react to the changes.

For a detailed listing of APT editors, tools, engines and what data is shared between them see Section 8 below.

When a Tool is being used, it creates a copy of the object being changed and displays that to the user. The user manipulates the copy and makes changes as desired. When he is happy with those changes, he applies the changes, which are then copied back into the actual object in the Data Model, where all active change listeners are able to react to the changes.

Engines are very different. For each one, an interface has to be designed to share the data appropriate to the Engine and how it will be used. For example, Starview and the Bright Object tool communicate directly with the VTT. The ETC calls Synphot directly, passing the appropriate data.

However, the Orbit Planner will have a connection to Trans via CORBA. Objects needed by Trans provide data through Proxies, which are CORBA objects shared between the two processes. Data, which originates from APT, will be implemented on that side of the connection, while data, which is calculated by the end, will be implemented on the Engine side of the connection. When calculations are complete, APT will copy the information from the proxies back into the Data Model objects, where all active change listeners are able to react to the changes.

It is as yet unclear whether Spike would be accessed in the same way as Trans or with a simpler architecture, since initially there are no plans to make the Spike engine interactive within APT.

8. APT Data Map

This section describes what data in the data model is accessed and updated by the various APT tools. Table 3 describes the APT Phase 1 and Phase 2 program editors and what data is shared between them. For example, the abstract field is displayed in the general information editor and input in the text editor during Phase 1. Table 4 describes the APT tools how the program data is shared between them. These tables show both the Phase 1 & Phase 2 editors. Grayed columns are relevant to Phase 1. The following key is used to describe the values in the columns:

- I in a field means that a user will have the ability to enter this information into the editor/tool
- D in a field means that the editor/tool will display the information in its GUI
- A in a field means that the editor will allow the information to be attached
- U in a field means that the editor/tool will use the information only

	Field	Gen Info Ed	Adres Sheet Ed	Obs Sum Ed	FT Sheet Ed	MT Sheet Ed	GT Sheet Ed	FT Pos Ed	Mt Pos Ed	GT Pos Ed	Flux Ed	MT Wind Ed	Txt Input Ed	Vis Sheet Ed	Spec Req Ed	Pat Sheet Ed	Pat Explo der	Exp Sheet Ed	Op Parm Ed	Hier Prop Ed
	Applicable Phase	P1 P2	P1 P2	P1	P2	P2	P2	P2	P2	P2	P2	P2	P1 P2	P2	P2	P2	P2	P2	P2	P2
	Title	I																		
	Proposal Category	I																		
	Scientific Category	I																		
	Science Keywords	I																		
	Submission Mode	I																		
	PS Contact		I																	
	PI Name		I																	
	PI Institution		I																	
	PI Address		I																	
	PI Telephone		I																	
	PI email		I																	
	PI ESA member		I																	
G	Proposing Cycle	I																		
E	Requested Orbits			I																
N	Parallel Requested Orbits			I																
E	Allocated Orbits																			
R	Requested Orbits Next Cycle	I																		
A	Parallel Requested Orbits Next Cycle	I																		
L	Requested Orbits After Next Cycle	I																		
	Parallel Requested Orbits After Next Cycle	I																		

INFORMATION	SnapTargets	I																		
	Total Budget Request	I																		
	Proprietary Period	I																		
	Abstract	D											I							
	CoI Name		I																	
	CoI Institution		I																	
	CoI Address		I																	
	CoI Country or State		I																	
	CoI Email		I																	
	CoI Contact		I																	
	Admin PI		I																	
	CoI ESA member		I																	
	Special Proposal Flags	I																		
	Observation Flags			I																
	Scientific Justification	A																		
	Real Time Justification	A																		
	Observing Description	A																		
	Coordinated Obs Descrip	A																		
	Justify Duplications	D											I							
	Data Analysis Plans	A																		
	Budget Narrative	A																		
	Previous HST programs	D											I							
	Calibration Justification	A																		
	Additional Comments	A																		

	Parallel Pointing Tol	I																	
	Target Number				I	I	I												I
	Target Name			I	I	I	I										D		I
	Target Description				I		I												
	Target Flux (includes vmag for P1)				D	D	D				I								
	Target Comments				D	D	D						I						
	Alt Target Names				I														
T	Equinox				I														
A	Coord Source				I														
R	Rad Vel or Redshift				I														
G	RA/DEC PM				I														
E	Epoch				I														
T	Annual Parallax				I														
	GSSS Plate ID				I														
I	RA /DEC			I	D			I											
N	Target Offsets				D			I											
F	SV2 Search radius																		
O	Sky Reqion Targets				D			I											
R	Level-1					D			I										
M	Level-2					D			I										
A	Level-3					D			I										
T	Window(s)					D						I							
I	Ephem Uncertainty					I													
O	Acq Uncertainty					I													
N	Generic Target Specifications						D			I									

	Pattern Number															I	U	D		I/U
P	Prime Pattern Type															I	U			U/D
A	Prime Pattern Purpose															I	U			
T	Prime Num of Points															I	U			
T	Prime Point Spacing															I	U			
E	Prime Coordinate Frame															I	U			
R	Prime Pattern Orient															I	U			
N	Prime Center pattern															I	U			
	Secondary Pattern Type															I	U			I/D
I	Secondary Pattern Purpose															I	U			
N	Secondary Num of Points															I	U			
F	Secondary Point Spacing															I	U			
O	Secondary Coordinate Frame															I	U			
	Secondary Pattern Orient															I	U			
	Secondary Center pattern															I	U			
	Visit Number													I				D	D	I
	Visit Priority													I						
	PCS Mode													D	I					
	Guiding Tolerance													D	I					
V	Drop to Gyro													D	I					
I	Orient													D	I					

S	Orient from													D	I					
I	Orient from nominal													D	I					
T	Same Orient													D	I					
	CVZ			I										D	I					
I	After													D	I					
N	After By													D	I					
F	Before													D	I					
O	Between													D	I					
R	Group Within													D	I					
M	Period													D	I					
A	Seq within													D	I					
T	On Hold [for]													D	I					
I	Sched													D	I					
O	PAR													D	I					
N	On hold comments												I	D						
	Vist comment												I	D						
	Exposure Number														D			I	D	I
	Target Name Pointer													I				I		I
	Configuration			I											D			I	D	
	Opmode			I														I	D	
	Orbits Per Exposure			I																
	Aperture Flag Coron			I																
E	Aperture			I														I		
X	Spectral Elements			I														I		
P	wavelength																	I		
O	Optional Parameters																	D	I	
S	Number of iterations																	I		
U	Time per exposure																	I		
R	Signal to Noise																	D		
E	Pos Targ														I			D		

	Same Pos As														I			D		
	Pattern Pointer														I			D		
	Par with														I			D		
I	Saa Contour														I			D		
N	Rt analysis														I			D		
F	Req uplink														I			D		
O	Req ephem correction														I			D		
R	Low sky			I											I			D		
M	No split														I			D		
A	Phase														I			D		
T	Seq non-int														I			D		
I	shadow			I											I			D		
O	GS acq scenario														I			D		
N	Same alignment														I			D		
	New alignment														I			D		
	New obset full acq														I			D		
	Same obset														I			D		
	Use offset														I			D		
	Save offset														I			D		
	Exp pcs mode														I			D		
	Same guide star														I			D		
	Obset id														I			D		
	New obset														I			D		
	Exposure Comments												I							

APT Editors Data Map

Table 3.

	Field	Phase 1 Latex Form	Phase 2 RPS2 FILE	VTT	Bright Object Engine	Starview	ETC GUI	ETC Engine (synphot)	Orbit Plan GUI	Orbit Plan Engine (trans)	Visit Plan GUI	Visit Plan Engine (spike)	Resource Estimate	APT Top GUI	P2 Output GUI (DG like)	P1 Output GUI
	Applicable Phase	P1	P2	P1 P2	P1 P2	Mostly P1	Mostly P1	Mostly P1	Mostly P2	Mostly P2	Mostly P2	Mostly P2	P1	P1 P2	P2	P2

APT	APT User Mode Flag													I		
	Title	I	I												D	D
	Proposal Category	I	I												D	D
	Scientific Category	I														D
	Science Keywords	I														D
	Submission Mode	I														D
	PS Contact	I														D
	PI Name	I	I												D	D
	PI Institution	I	I												D	D
	PI Address	I														D
	PI Telephone	I														D
	PI email	I														D
	PI ESA member	I														D
	Proposing Cycle	D	I												D	
	Requested Orbits	I											U			D
	Parallel Requested Orbits	I											U			D
G	Allocated Orbits									U					D	
E	Requested Orbits Next Cycle	I														D
N	Parallel Requested Orbits Next Cycle	I														D
E	Requested Orbits After Next Cycle	I														D
R	Parallel Requested Orbits After Next Cycle	I														D
A	SnapTargets	I														D
L	Total Budget Request	I														D
	Proprietary Period	I														D
	Abstract	I	I													D

	CoI Name	I	I													D
I	CoI Institution	I	I													D
N	CoI Address		I													
F	CoI Country or State	I														D
O	CoI Email	I														D
R	CoI Contact		I												D	
M	Admin PI	I														D
A	CoI ESA member	I														D
T	Special Proposal Flags	I														D
I	Observation Flags	I														D
O	Scientific Justification	I														D
N	Real Time Justification		I													
	Observing Description	I	I													D
	Coordinated Obs Descrip	I														D
	Justify Duplications	I														D
	Data Analysis Plans	I														D
	Budget Narrative	I														D
	Previous HST programs	I														D
	Calibration Justification		I													
	Additional Comments		I													
	Parallel Pointing Tol		I												D	
	Avail Ok Flag		I	U	U	U		U		U		U			D	
[redacted]																
	Target Number		I												D	
	Target Name	I	I	I/U	U	I/U	D								D	D
	Target Description		I			I/U										
	Target Flux (includes vmag for P1)		I				I	U					U		D	
	Target Comments		I												D	
	Alt Target Names		I													
T	Equinox		I	U											D	

A	Coord Source		I												D	
R	Rad Vel or Redshift		I													
G	RA/DEC PM		I												D	
E	Epoch		I												D	
T	Annual Parallax		I												D	
	GSSS Plate ID		I	D	U										D	
I	RA /DEC	I	I	U	U	U	I	U		U	D	U	U		D	D
N	Target Offsets		I	U							D	U			D	
F	SV2 Search radius					U										
O	Sky Reqion Targets		I								D	U			D	
R	Level-1		I								D	U			D	
M	Level-2		I								D	U			D	
A	Level-3		I								D	U			D	
T	Window(s)		I												D	
I	Ephem Uncertainty		I													
O	Acq Uncertainty		I													
N	Generic Target Specifications		I												D	
	Pattern Number		I	U/D											D	
	Prime Pattern Type		I	U											D	
P	Prime Pattern Purpose		I	U											D	
A	Prime Num of Points		I	U					I				I/U		D	
T	Prime Point Spacing		I	U									I/U		D	
T	Prime Coordinate Frame		I	U											D	
E	Prime Pattern Orient		I	U											D	
R	Prime Center pattern		I	U											D	
N	Secondary Pattern Type		I	U											D	
	Secondary Pattern Purpose		I	U											D	
I	Secondary Num of Points		I	U					I				I/U		D	
N	Secondary Point Spacing		I	U									I/U		D	

F	Secondary Coordinate Frame		I	U											D	
O	Secondary Pattern Orient		I	U											D	
	Secondary Center pattern		I	U											D	
	Visit Number		I	I/U					D		D				D	
	Visit Priority		I						I	U					D	
	PCS Mode		I						I	U		U			D	
	Guiding Tolerance		I						I	U					D	
V	Drop to Gyro		I						I	U					D	
I	Orient		I	I/U								I	U		D	
S	Orient from		I									I	U		D	
I	Orient from nominal		I									I	U		D	
T	Same Orient		I									I	U		D	
	CVZ	I	I						I	U	I	U	U		D	D
I	After		I									I	U		D	
N	After By		I									I	U		D	
F	Before		I									I	U		D	
O	Between		I									I	U		D	
R	Group Within		I									I	U		D	
M	Period		I							U	I	U			D	
A	Seq within		I									I	U		D	
T	On Hold [for]		I									I	U		D	
I	Sched		I						I	U					D	
O	PAR		I												D	
N	On hold comments		I												D	
	Vist comment		I												D	
	Exposure Number		I	D			D		D						D	
	Target Name Pointer	I	I	I			D				D				D	D
	Configuration	I	I	I/U	U	U	I/U	U	D	U			U		D	D
	Opmode	I	I			I/U	I	U	D	U			U		D	D
	Orbits Per Observation	I											D			D
	Aperture Flag	I														D
E	Aperture	I	I	I/U	U	I/U	I	U		U			U		D	D

X	Spectral Elements	I	I	U	U	I/U	I	U		U			U		D	D
P	wavelength		I		U		I	U	I	U					D	
O	Optional Parameters		I	I/U	U		I	U		U			U		D	
S	Number of iterations		I						I	U			U		D	
U	Time per exposure		I		U		I	U	I	U			U		D	
R	Signal to Noise				I		I									
E	Pos Targ		I	D						U					D	
	Same Pos As		I	U						U					D	
	Pattern Pointer		I	I					I	U					D	
	Par with	I	I						I	U					D	D
I	Saa Contour		I							U					D	
N	Rt analysis		I							U					D	
F	Req uplink		I							U					D	
O	Req ephem correction		I							U					D	
R	Low sky	I	I							U		U	U		D	D
M	No split		I						I	U					D	
A	Phase		I							U		U			D	
T	Seq non-int		I						I	U					D	
I	shadow	I	I							U		U	U		D	D
O	GS acq scenario		I							U					D	
N	Same alignment		I							U					D	
	New alignment		I							U					D	
	New obset full acq		I							U					D	
	Same obset		I							U					D	
	Use offset		I										U		D	
	Save offset		I										U		D	
	Exp pcs mode		I							U					D	
	Same guide star		I							U					D	
	Obset id		I							U					D	
	New obset		I							U					D	
	Exposure Comments		I												D	

APT Tools Data Map

Table 4