Atacama Large Millimeter Array

ALMA Science Archive Requirements

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1 Description

The ALMA Science Archive (ASA) is the interface through which astronomers access ALMA data. It is a component of the ALMA Archive subsystem. All ALMA data is accessible through the ALMA Archive, but the ASA provides optimized access to the data in a scientifically meaningful way.
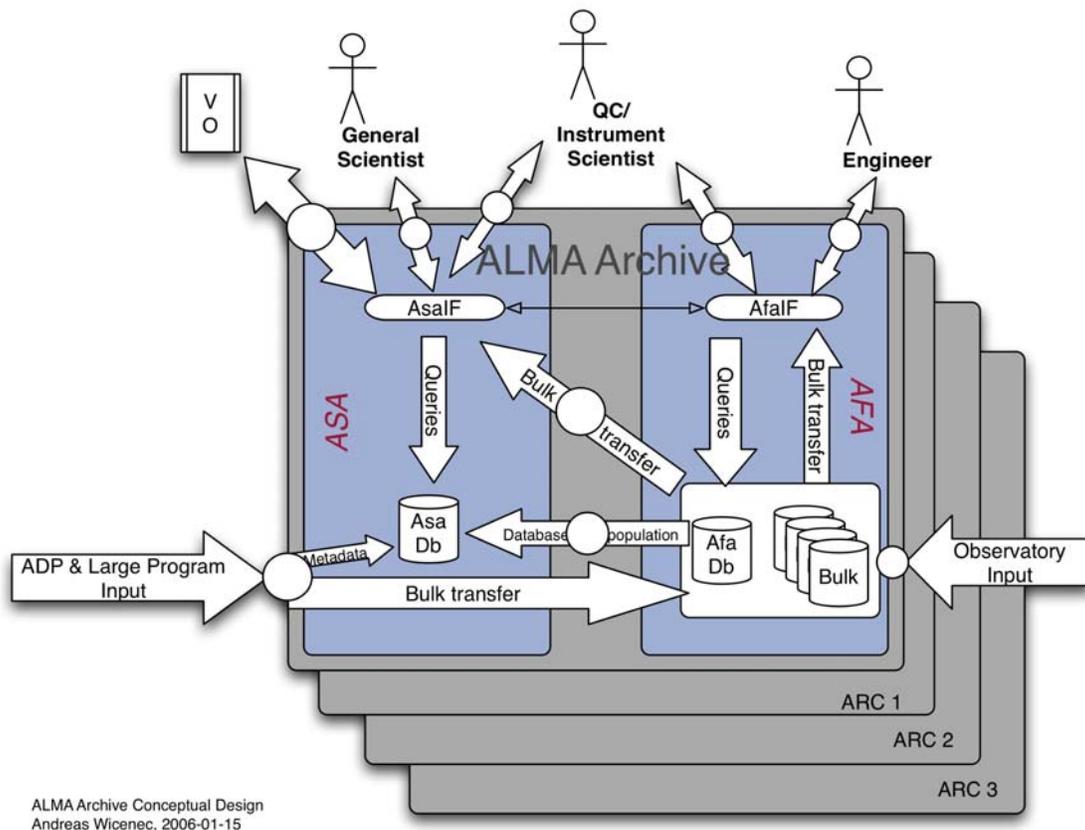
Figure 1: Conceptual design of the ALMA Archive, which shows the role of the ASA and its relation to the ASA database and the AFA (see Section 4 for a list of abbreviations).

The conceptual design of the ALMA Archive is shown in Figure 1. The Archive is conceptually comprised of two parts: the ALMA Science Archive (ASA) and the ALMA Frontend Archive (AFA). Observations made with ALMA are fundamentally organized and stored in the Archive through the concept of an ALMA project. The ASA and AFA are two parallel interfaces for accessing the information stored in these projects in the ALMA Archive. The ASA accesses the contents of the Archive through the ASA interface (ASAIF) which provides an astronomically oriented view of, and access to, the

Archive contents, allowing users to access astronomical data across multiple ALMA projects. On the other hand access through the AFA interface (AFAIF) will access the Archive contents via their ALMA project.

This document describes the requirements for the ASA. It draws together requirements previously `published' in a number of different sources, provides comments on these, including identifying ambiguities and unanswered questions, and attempts to analyze these requirements. In combination with a set of use cases, these existing requirements have been used to identify and clearly state requirements which, while implicit in previous documents, have not been explicitly stated. In addition, a number of new requirements necessary for the operation of the ASA are identified. The final set of requirements shall drive the design of the ASA.

1.1 User Lifecycle

Figure 2 highlights the lifecycle interaction of an ALMA user with the ALMA Archive. It shows how users interact with the Archive at various stages during the evolution of a research project. Initially a researcher will access the Archive to investigate what observations and data already exist. If sufficient appropriate data exist, then the researcher may carry out research based on these data. In parallel with this Archive research, or alternatively if the available data is inadequate, the researcher may prepare and submit proposal to carry out observations using ALMA. This decision to submit a proposal will initiate further interactions with various components of the Archive.
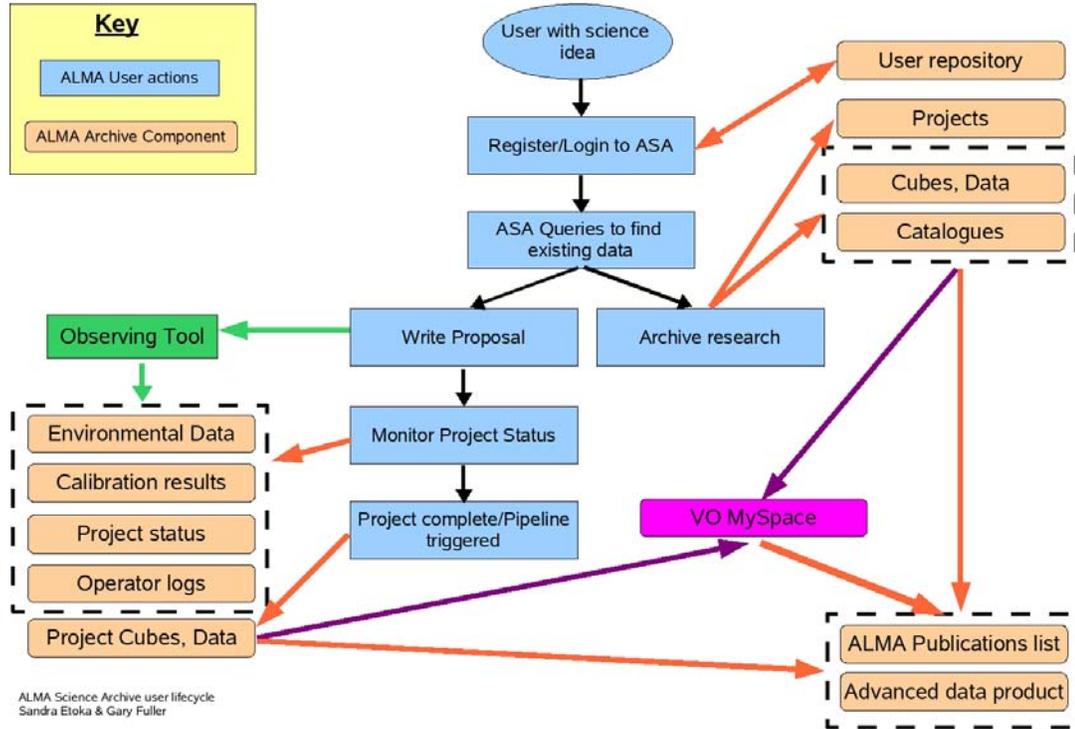
Figure 2: User interactions with the ALMA Archive. The blue boxes indicate user actions. The rounded tan boxes highlight components or contents of the Archive (both the AFA and the ASA). Arrows show the interactions and flow of information and data. The green box shows the ALMA observing tool and the magenta rounded box symbolises the Virtual Observatories (VO). The interaction of VO users with the ALMA Archive through the VO interface is not explicitly shown.

At the completion of a project the record of publications will be added to the publication list maintained in the Archive. Beyond that there is also scope for advanced data products resulting from the project to be accessible through the Archive.

1.2 Scope

This document defines the requirements and use cases that are the responsibility of the Archive subsystem. Some additional requirements and use cases that involve the Archive are also presented but these will not be developed by the Archive. These include: use cases that are clearly the responsibility of another subsystem but need access to the Archive to the completed, or sophisticated use cases that need analysis beyond the current scope of the Archive.

1.1.1 Definitions

Cube: A multi-dimensional image. A typical ALMA image will be 4 dimensional with 2 spatial, 1 spectral and 1 polarization dimensions.

Metadata: Information describing entries in the Archive.

Monitor data: Data describing the status of the instrument.

Environmental data: Data describing environmental conditions.

Quality flag: A numerical or categorical entry either automatically or manually generated in the metadata to summarise the quality of the astronomical data or calibration.

Astronomical data: Used here to refer to output from the correlator stored in the ALMA Archive.

2   ASA Requirements

Existing requirements have been collected from the SSR requirements (SSR), the eVLA, HLA and Operations documents. Other requirements coming from the interaction of other subsystems with the Archive are also listed. Where appropriate, the source of each requirement is identified. Some requirements are more general to the Archive rather than the ASA alone.

In the following sub-sections these requirements (together with implicit and new requirements) have been grouped together under headings related to the nature of the requirements. These headings are: General requirements, Archive content requirements, Access tools, Searches and Queries, Requirements in other documents.

2.1   General

ASA 2.1-R1 The ASA shall search only metadata associated with items stored in the Archive and information stored in catalogues/databases within the ASA.
Comment: The ASA shall not search through, for example, visibility data or data cubes.
Related requirements: New ASA requirement - implicit

ASA 2.1-R2 Access to the Archive shall be limited to registered users.

Comment: VO access will be done through a specific registered "VO user".
Related requirements: SSR 7.3-R20

ASA 2.1-R3 Each user of the Archive shall be uniquely identified.
Comment:
Related requirements: SSR 7.3-R20

ASA 2.1-R4 The ASA shall support catalogues of, for example, calibration sources, observing sources, spectral lines.
Comment:
Related requirements: SSR 7.2-R2
Requirements on catalogues
ASA 2.1-R4.1 Catalogues shall preserve the history of entries in the catalogue so that it shall be possible to reconstruct any changes made to entries and retrieve previous values associated with any entry.

ASA 2.1-R5 The ASA shall support catalogues to hold calibration and observatory specific information.
Comment: There are similar requirements on these databases/catalogues to those specified for catalogues.
Related requirements: SSR 7.2-R13, SSR 7.2-R13.1

ASA 2.1-R6 The Archive shall be VO compliant [1]
Comment:
Related requirements: SSR 7.4-R3

ASA 2.1-R7 There shall be two-way links between data and image cubes in which the data is used so that it will be straightforward to determine which astronomical data was used in generating a cube and also which cubes have been made using any particular astronomical data.
Comment: Needed so that all the data that went into a particular image cube can be traced.
Related requirements: New ASA requirement - implicit

ASA 2.1-R8 It shall be possible for authorized personnel to manipulate quality flags associated with the data in the Archive and add comments.
Comment:
Related requirements: 7.1-R1-AR3

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[1] http://almasw.hq.eso.org/almasw/bin/view/Archive/VOCompliance

ASA 2.1-R9 Changes to quality flags shall be "trackable" indicating who changed any flag and when. All such changes shall be reversible.
Comment:
Related requirements: New ASA requirement - implicit.

ASA 2.1-R10 Calibration updates shall be transparently incorporated into the Archive calibration database.
Comment:
Related requirements: SSR 7.2-R13

ASA 2.1-R11 The history of changes to the calibration database shall be user accessible.
Comment:
Related requirements: SSR 7.2-R13

ASA 2.1-R12 The Archive shall track its performance including the rate of transactions and the delay/latency in responding to requests.
Comment: delay/latency of the order of seconds is required for simple queries.
Related requirements: SSR 1.0-R9-AR2,3

ASA 2.1-R13 The ASA shall track requests for purposes of statistical analysis of user access and performance. This access and performance data will be user accessible.
Comment:
Related requirements: New ASA requirement

2.2 Archive Contents

There are several published requirements on what the Archive shall contain. Many of these are actually requirements on other subsystems to insert information into the Archive. But nevertheless, some of these are included here in addition to those that are actually requirements on the Archive.

ASA 2.2-R1 All raw observational data
Comment:
Related requirements: SSR 7.2-R1, SSR 7.2-R1.1

ASA 2.2-R2 Environmental and instrumental data

Comment:
Related requirements: SSR 7.1-R2, SSR 7.2-R2, SSR 7.2-R14

ASA 2.2-R3 Monitor data
Comment:
Related requirements: SSR 7.2-R1, SSR 7.2-R1.1, SSR 7.2-R2

ASA 2.2-R4 Pipeline produced images
Comment:
But not Quicklook images (SSR 7.2-R1.2), although this may have been superseded by operations requirements. So store Quicklook images in the Archive.
Related requirements: SSR 7.2-R1, SSR 7.3-R12

ASA 2.2-R5 Calibration data and results
Comment:
Related requirements: SSR 7.2-R1

ASA 2.2-R6 Observation descriptors
Comment: Metadata describing the observations
Related requirements: SSR 7.2-R1

ASA 2.2-R7 Observing proposals
Issue: In what format and with what metadata describing it?
Only the associated metadata shall be searchable through the Archive.
Comment:
Related requirements: SSR 7.2-R2

ASA 2.2-R8 Observing scripts
Comment:
Related requirements: SSR 7.2-R2

ASA 2.2-R9 Links between data and publications using the data
Comment:
Related requirements: SSR 7.3-R14

ASA 2.2-R10 Observing and operator logs
Comment:
Related requirements: New requirement

2.3 Access Tools

ASA 2.3-R1 The Archive shall allow browsing of the ObsProject structure
Comment:
Related requirements: SSR 7.3-R12

ASA 2.3-R2 There shall be both GUI and CLI interfaces to the Archive
Comment:
Related requirements: SSR 7.3-R1, SSR 7.3-R2

ASA 2.3-R3 The access tool shall allow a user to refine their query without the need to fully re-enter it
Comment:
Related requirements: SSR 7.3-R9

ASA 2.3-R4 The access tool shall allow a user to quickly execute common queries without the need for a detailed knowledge of the Archive or data structure or non-user friendly technologies such as XPATH queries
Comment: The definition of the "common queries" should be taken from the query statistics. This definition will evolve with time so it should be easy to change the interface to accommodate the creation of user-friendly queries.
Related requirements: New requirement expanding and clarifying other requirements.

ASA 2.3-R5 There shall be a tool to package data for delivery
Comment: Electronic and/or by physical medium?
Related requirements: SSR 7.3-R3

ASA 2.3-R6 There shall be the ability to preview cubes available as the results of querying the Archive
Comment:
Related requirements: SSR 7.3-R11

2.4 Queries and Searches

2.4.1 Queries

ASA 2.4.1-R1 Queries of the Archive shall allow matching and ranges of parameters and logical combinations (AND/OR/XOR/NOT) of parameters.

Comment: Can search for specific values, values within or outside a range. Issues to be determined or resolved: Shouldn't a priority be associated with (the type of) queries/ALMA users?
Related requirements: New ASA requirement

ASA 2.4.1-R2 Users shall be able to select whether searches return only results exactly matching the search criteria or whether the closest matches are (also) returned.
Comment: For some searches defining a closeness will be tricky, so perhaps allow the return of the closest results where the definition of close is obvious and makes sense - positions, time, noise level and some other numerical searches.
Related requirements: New ASA requirement - implicit

ASA 2.4.1-R3 Parameters returned by queries shall be user configurable.
Comment: For example the users might only be interested in having a list of ObsProjectIDs of the programs containing observations matching the query or alternatively the user might want the calibrated uv data or image resulting from the observations matched by the query.
Related requirements: SSR 7.3-R10, SSR 7.3-R11

ASA 2.4.1-R4 For each dataset which could be returned as the result of a query, a preview image generated from that dataset will be made available to the user.
Comment: If an image does not already exist, this will require the generation of the image from the data.
Related requirements: SSR 7.3-R11

ASA 2.4.1-R5 The format in which parameters are returned by a search shall be user selectable.
Comment:
The possible formats should include ASCII, csv, html, xml, VOTable, FITS.
Related requirements: New ASA requirement - implicit

ASA 2.4.1-R6 User specified parameters used in queries shall be checked for consistency and range before being used.
Comment: This shall be implemented via a Data Dictionary. This shall prevent users searching for things that cannot possibly exist.
Related requirements: New ASA requirement

ASA 2.4.1-R7 The system shall support simple, basic regular expression queries including wildcard and ranges with minimal software knowledge beyond that of a typical astronomer.
Comment:
Related requirements: SSR 7.3-R8

ASA 2.4.1-R8 It shall be possible to refine the results returned by a query without the need to fully re-execute the query.
Comment:
Related requirements: SSR 7.3-R9

ASA 2.4.1-R9 It shall be possible to assign a priority to each Archive request.
Comment: Needed as an operational issue to make sure important/urgent queries are executed first and not held up by `expensive' but less urgent queries.
Related requirements: New ASA requirement

ASA 2.4.1-R10 Archive requests shall be monitored and tracked for operational statistics purposes including future further optimization of Archive operations.
Comment:
Related requirements: New ASA requirement

ASA 2.4.1-R11 There shall be the ability to monitor, approve and/or block certain Archive requests possibly on the basis of the user or 'role' of the user submitting them.
Comment: Could be used to monitor the use of (possibly limited) bandwidth and to approve/block `expensive' requests.
Related requirements: New ASA requirement

2.4.2   Searches

The ASA shall allow searches on the basis of the following parameters:

ASA 2.4.2-R1 Positional Searches

> **ASA 2.4.2-R1.1** Astronomical cone and box search based on coordinates - including equatorial, galactic, ecliptic

> **ASA 2.4.2-R1.2** Hour angle of source

ASA 2.4.2-R2 Frequency, Wavelength and Velocity searches

> **ASA 2.4.2-R2.1** Line rest frequency or wavelength

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ASA 2.4.2-R2.2 Sky frequency

ASA 2.4.2-R2.3 Molecular transition

ASA 2.4.2-R2.4 Range of frequencies or wavelengths within spectrometer

ASA 2.4.2-R2.5 Spectral resolution

ASA 2.4.2-R2.6 Velocity or redshift

ASA 2.4.2-R2.7 Polarization

ASA 2.4.2-R3 Telescope parameters

ASA 2.4.2-R3.1 Telescope location/pad position

ASA 2.4.2-R3.2 Array configuration

ASA 2.4.2-R4 Observing parameters

ASA 2.4.2-R4.1 Weather conditions

ASA 2.4.2-R4.2 Atmospheric water

ASA 2.4.2-R4.3 Type of observation

ASA 2.4.2-R4.4 Observing mode

ASA 2.4.2-R4.5 Data quality

ASA 2.4.2-R4.6 Observing time/date

ASA 2.4.2-R4.7 Object name

ASA 2.4.2-R4.8 Telescope positions (Az/Elev)

ASA 2.4.2-R4.9 Subarray (multiple antennas)

ASA 2.4.2-R4.10 uv range

ASA 2.4.2-R4.11 Receiver

ASA 2.4.2-R4.12 Integration time

ASA 2.4.2-R4.13 RMS noise level of visibilities

ASA 2.4.2-R4.14 Maximum intensity in visibilities

ASA 2.4.2-R5 Project parameters

ASA 2.4.2-R5.1 PI and CoIs

ASA 2.4.2-R5.2 ProjectID

ASA 2.4.2-R5.3 Schedule Blocks by status - ready, executed, not
executed, remaining executions

ASA 2.4.2-R5.4 Priority

ASA 2.4.2-R5.5 Required observing constraints

ASA 2.4.2-R5.6 Category of project e.g. PI , observatory, calibration, ToO, DDT, Large, US, European, Japanese

ASA 2.4.2-R6 Cube parameters

ASA 2.4.2-R6.1 Angular resolution

ASA 2.4.2-R6.2 Spectral resolution

ASA 2.4.2-R6.3 Position and field of view

ASA 2.4.2-R6.4 Peak flux

ASA 2.4.2-R6.5 Total flux

ASA 2.4.2-R6.6 Image fidelity

ASA 2.4.2-R6.7 RMS noise level

Comment: Users shall be able to search for specific values, values within or outside a range.
Related requirements: SSR 7.3-R7
Issues to be determined resolved: a keyword entry should be present in the ObsProject (given by the PI him/herself) to specify what **type of object** the source is (i.e., AGN, SFR, PPN, YSO, local galaxy) to allow a broader search of the ASA. For velocity searches there needs to be a definition of the reference frame and the rest frequency and for spatial searches there needs to be a definition of the reference epoch.

Also note that for some searches such as on the RMS or maximum intensity in the cube or visibilities, this information will only be searchable if it has been previously evaluated from the data and stored in the metadata (see ASA 2.1-R1 above).

2.5 Requirements in Other Documents

The requirements listed hereafter are composed of requirements that, even though stipulated as Archive requirements are requirements on other subsystems (that are

using the Archive to comply to those requirements) and actual Archive requirements not been addressed yet.

2.5.1 Archive Related Requirements from the SSR

- 7.2-R7 *"There may be several shadow archives which hold all or subsets of data, which shall enable users over the world to access the observational data efficiently"*
  Comment: Operations requirement

- 7.2-R9 *"There shall be a backup for the archive to protect the data from any kind of catastrophe"*
  Comment: Operations requirement

- 7.2-R11 *"The archive shall provide, in the observation descriptors, the appropriate links to all technical data available for the observation period. This link is in addition to the set of technical data that is provided in the observation descriptors"*
  Comment: Operations on another subsystem. `Observation descriptors' means the metadata describing the observations.

- 7.2-R13 *"Updates to the calibration must be transparently incorporated in the archive"*
  Comment: Operations requirement

3 Use Cases

3.1 Introduction

The use cases have been divided into 3 main sections:
- Project Access: These use cases access the ALMA Project Data Model (APDM[2]), that is the ObsProject structure.

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[2] http://www.roe.ac.uk/ukatc/projects/alma/APDM-Refactored/APDM.html

- Observation Access: the use cases of which access of the ALMA Science Data Model (ASDM[3]).
- Catalogue Access: these are the use cases for accessing the catalogues in the ASA. These can be internal (i.e., spectra line catalogue, calibrator catalogue, source catalogue) or external (i.e., optical source catalogue for optical pointing).

The boundaries between categories, in particular between the Project Access and the Observation Access, is sometime blurred since some queries could refer to what was expected (i.e., defined in the ObsProject) or what was actually achieved at the time of observing.

3.2 List of use cases

For all the use cases presented here the **primary precondition is that the user is connected to the ASA**. This therefore implies that (s)he must be **registered user**, but in some cases this is not enough and there is a need for privilege and permission checking (e.g., for proprietary data) which may not be spelt out in details in the use cases since these are operational issues.

3.2.1 Project Access

These are use cases where the access to the data is through the ObsProjectID.

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[3] http://aramis.obspm.fr/~alma/AEDF/ver3.1/allhtm/ &
http://aramis.obspm.fr/~alma/ASDM/ASDMEntities.pdf

3.2.1-1   Return proposal associated with the ObsProject

Use Case: AssociateProposalObsProjectID

Goal: Given an ObsProjectID find the proposal which generated this ObsProjectID

Contact Author: GaryFuller

Role(s)/Actor(s):
Primary: All ASA users
Secondary:

Priority: Medium

Performance: Medium

Frequency of Use: Hourly (?)

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept ObsProjectID from user
2. Validate ObsProjectID
    Confirm ObsProjectID is of the correct format
    Exception Course: Return error: ObsProjectID invalid format
3. Identify proposal which generated this ObsProjectID
    Exception Course: No proposal found. This means that the requested
    ObsProjectID has not been generated. Return error: ObsProjectID invalid
4. Return associated proposal

Postconditions:

1. Proposal returned to user

Issues to be Determined or Resolved:

1. What exactly is returned? The actual proposal as a pdf or some reference/link to the proposal. This is actually a specific case of a more general question about exactly what the ASA returns.

Notes: ...

3.2.1-2   Return ObsProjects associated with user

Use Case: ReturnObsProjects

Goal: Return a list of projects associated with a user.

Contact Author: GaryFuller

Discussion:

Role(s)/Actor(s):
Primary: ASA user
Secondary: ...

Priority: High

Performance: Low

Frequency of Use: High

Preconditions:

1.   User connected to ASA

Basic Course:

1.   Accept UserID from user
2.   Confirm that the UserID is valid
     Exception Course: Return error: Invalid UserID
3.   Find list of ObsProjects associated with this UserID
     Exception Course: Issue warning if none found

Postconditions:

1. List of ObsProjects which the user can then browse to find the detailed status of any
    one of the projects.

Issues to be Determined or Resolved: ...

Notes:

1. Exactly what is contained in the returned 'list' of ObsProjects should be user configurable, for example allowing the user to get just a list of ProjectIDs, or project titles and line rest frequencies etc.
2. The user of this use case need not be logged in under the userID they are using in the query. For example this use case may be used by an operator to look for projects associated with a particular PI.

3.2.1-3   Deleted

3.2.1-4   Browsing ObsProject status on-line

Comments: Sort of result set in various ways (e.g. time).
Constraints on status search. (These are not yet in the use case.)

Use Case: BrowseObsProject

Goal: Allow a user to interactively browse the structure of an ObsProject

Contact Author: GaryFuller

Role(s)/Actor(s):
Primary: ALMA user
Secondary: ...

Priority: High

Performance: Good

Frequency of Use: High

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept ObsProjectID from user
    Exception Course: Invalid ObsProjectID: Return error.
2. Find ObsProject structure
3. Present user with text summary of ObsProject status, including
    3.1 Title of proposal
    3.2 Number of existing Schedule blocks
    3.3 Total observing time allocated to project
    3.4 Total observing time used by project so far
        Highlight the presence of any QuickLook or Pipeline products available in the Archive
4. Also present user with a graphical representation of the project structure allowing the user to interactively explore the structure

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5. From any point in the structure the user can retrieve: all the metadata from the lower levels, all the calibration information, all the source data (calibrated or raw), and/or all the environmental/system data from the MonitorStore

Postconditions:

1. View (and copy in some form) of the project structure, and/or
2. Some subset of the data from the project, and/or
3. Some subset of the MonitorStore information about the project, and/or
4. A datacube made from some subset of the data from the project

Issues to be Determined or Resolved: ...

Notes: The return of information, data and products are covered by other use cases.

3.2.1-5 Return monitor and environmental data associated with an observation

Use Case: ReturnMonitorData

Goal: Given an ObsProjectID return the monitor and environmental data associated with any of the executed schedule blocks

Contact Author: GaryFuller

Discussion:

Role(s)/Actor(s):
Primary: ASA User
Secondary: ...

Priority: High

Performance: Low

Frequency of Use: High

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept ObsProjectID user
    Exception Course: Return error if ObsProjectID is not valid.
2. Accept list of monitor/environmental data required
3. Validate list of requested information
    Exception Course: Return error if requested information is not valid.
4. Find all execution records associated with the ObsProjectID
    Exception Course: Return error if there are no execution records
5. Present user with list of execution records and allow them to select those of interest.
6. Find time range covered by selected execution records
7. Retrieve requested monitor/environmental data within this time range
8. Present user with requested monitor/environmental data as a time series

Alternate Course:

1. Accept time-date range
2. Accept list of monitor/environmental data required
3. Validate list of requested information
   Exception Course: Return error if requested information is not valid.
4. Retrieve requested monitor/environmental data within this time range
5. Present user with requested monitor/environmental data as a time series

Postconditions:

1. Time series of monitor/environmental data

Issues to be Determined or Resolved:

1. Should the monitor data be interpolated onto a common time base?
2. Should the monitor data be averaged, if so how? User specified in request?
3. How does the user specify the required monitor/environmental data?

Notes: As the Alternate Course makes it clear this use case really reduces to finding the time range during which a particular schedule block was executed and then retrieving the requested data for that time period.

3.2.1-6   Return quality information associated with an observation

Comments: This comprises actually 3 distinct use cases:

1. Return Required Quality Information
2. Return Current Quality Information
3. Return Final Quality Information

The information retrieved in 1 was entered in the ObsProject via the Observing Tool (OT) when the observer set up the observing program. This leads to the question: what is then 'returned' when the project is still active?
The information retrieved in 2 could potentially be a combined query of the APDM and ASDM. For example: one can imagine a project observing a Region of Interest already observed in the past in order to achieve a better sensitivity.
The information retrieved in 3 is stored in the ASDM after the ObsProject has been fully completed. As such it is also an Observation Access use case.
For comparison purpose the user-selectable parameters returnable should be the same in the 3 use cases.

Use Case: ReturnRequiredQualityInfo

Goal: Return required quality information associated with an observation

Contact Author: SandraEtoka

Discussion: Shall return the required quality information such as the required rms, dynamic range, weather condition, spatial and spectral resolution ...

Role(s)/Actor(s):
Primary: Observer, ASAUser
Secondary:

Priority: Major - 1

Performance: high

Frequency: Uncertain

Preconditions:

1.   User connected to ASA

Basic Course:

1.   Accept ObsProjectID from user
2.   Confirm ObsProjectID is of the correct format
     Exception Course: Return error: ObsProjectID invalid format
3.   Validate ObsProjectID
4.   Return required information

Alternate Course :

1.   ...

Postconditions:

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1. Return information (stored in the APDM) associated with the required quality of the observation
2. This shall be a user selectable subset of all the relevant fields as entered in the Observing Tool, i.e.,

ObsUnitSet data quality parameters:
Control (CalibrationRequirements) :
- Pointing Accuracy (arcsec)
- Bandpass Accuracy (%)
- Polarization Accuracy (%)
Data Processing:
- Angular Resolution (arcsec)
- Velocity Resolution (km/s)
- TB Sensitivity *goal* (K)
- RMS Goal (Jy)
SchedBlock quality parameters:
Preconditions:
- Min Allowed HA (degrees)
- Max allowed HA (degrees)
(WeatherConstraints:)
- Max PWVC (mm)
- Seeing (arcsec)
- Phase Stability (degrees)
Performance Goals:
- Representative Frequency (GHz)
- Min *acceptable* angular resolution (arcsec)
- Max *acceptable* angular resolution (arcsec)
- Dynamic range

Issues to be Determined or Resolved:

1. ...

Notes:

1. The parameters given here are those available in the APDM and OT at the time of writing this use case (12 April 2006) – the APDM refactoring may alter them

3.2.1-7 Return QuickLook results associated with an ObsProject

Use Case: ReturnQuickLook

Goal: Return Quicklook results associated with an ObsProject

Contact Author: SandraEtoka

Discussion:

Role(s)/Actor(s):
Primary: Observer, ASAUser
Secondary:

Priority: Major - 1

Performance: high

Frequency: Uncertain

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept ObsProjectID from user
2. Confirm ObsProjectID is of the correct format
    Exception Course: Return error: ObsProjectID invalid format
3. Validate ObsProjectID
4. Identify Quicklook results associated with project
    Exception Course: No Quicklook results associated with project. Return a message in the browser specifiying so
5. Return a list of Quicklook results

Alternate Course :

1. ...

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Postconditions:

   1. Present user with list of Quicklook results

Issues to be Determined or Resolved:

   1. Query issue: Is access to Quicklook results limited?

Notes:

   1. ...

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3.2.1-8   Return raw data

Comment: This use case accesses the ASDM since it concerns observation already stored in the ASA after a project has been completed

See use case 3.2.2-12 "Return Raw Data" of section "Observation Access".

3.2.1-9   Return a datacube

Comments: Constraints on data selection (sources, quality, frequency, calibration...).
          Either the pipeline image of the source is returned as it is stored in the Archive or an on-the-fly image is created from the visibilities (that is by invoking Pipeline).

See use case 3.2.2-13 "Return Data Cube" of section "Observation Access".

3.2.1-10 Return links to scientific publications associated with an ObsProject

Use Case: PublicationsObsProject

Goal: Returns links to scientific publications associated to an ObsProject

Contact Author: SandraEtoka

Role(s)/Actor(s):
Primary: ASAUser
Secondary:

Priority: Medium - 2

Performance: low

Frequency: Uncertain

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept ObsProjectID from user
2. Confirm ObsProjectID is of the correct format
   Exception Course: Return error: ObsProjectID invalid format
3. Validate ObsProjectID

Alternate Course:

1. ...

Postconditions:

1. Returns a list & link to the scientific publications associated to that ObsProject

Issues to be Determined or Resolved:

1. ...

Notes:

1. This use case could be extended to the following use case (browsing the ObsPproject structure of all projects as opposed to a single ObsProject as here): find me all the publications associated to:
    1. a patch of sky or a specific source
    2. a patch of sky or a specific source at a given frequency/frequency range

3.2.1-11 List all sources in an ObsProject

Use Case: ListSourcesObsProject

Goal: Return a list of all the sources in an ObsProject

Contact Author: SandraEtoka

Role(s)/Actor(s):
Primary: ASAUser
Secondary:

Priority: Medium - 2

Performance: low

Frequency: Uncertain

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept ObsProjectID from user
2. Confirm ObsProjectID is of the correct format
   Exception Course: Return error: ObsProjectID invalid format
3. Validate ObsProjectID
4. get the SchedBlockIDs (i.e, SchedBlockRefs) from the ObsProject selected
5. get sourceName, sourceCoordinate ... etc, from the corresponding SchedBlocks

Alternate Course:

1. ...

Postconditions:

1. Returns a list of all the sources of that ObsProject and their corresponding coordinates

2. Parameters such as observing parameters (i.e., all the FieldSource, but also FrequencySetup [for the ALMA band and rest Frequency] from the corresponding SchedBlocks) should also be available in a user selectable way for the query return

Issues to be Determined or Resolved:

1. Should all the sources including the calibrator sources used be returned ? In which case, the list should specify so: i.e., Target, Calibrator (and possibly the calibration intent)

Notes:

1. ...

3.2.1-12 Find calibration observations

Comment: Find calibration observations both associated with projects and with the calibration plan

Use Case: FindCalibrationObs

Goal: Finds calibration observations associated with an ExecBlock of a given ObsProject

Contact Author: SandraEtoka

Role(s)/Actor(s):
Primary: Observer, ASAUser
Secondary:

Priority: Major - 1

Performance: High

Frequency: Uncertain

Preconditions:

1. User connected to ASA
2. User has got the list of ExecBlockIDs associated to the ObsProject of interest

Basic Course:

1. Accept ExecBlockID from user
2. Confirm ExecBlockID is of the correct format
   Exception Course: Return error: ExecBlockID invalid format
3. Validate ExecBlockID

Alternate Course:

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1. ...

Postconditions:

1. Return a user selectable list of all the calibration sources (with for each calibrator: its name, RA, Dec, flux and type) associated with that ExecBlock
2. Give a list of the scans for each source of concerned

Issues to be Determined or Resolved:

1. As it is at the time of writing this use case, the ExecBlock in the ASDM does not contain a reference to the scans (from which the sourceIDs can be retrieved via fieldName) but only the other way round (i.e., Scan has got a reference to the ExecBlock)
2. This use case could be user selectable for the type of calibration performed (i.e., for 'scientific purpose': amplitude and/or phase and/or bandpass and/or polarization and for 'instrumental/technical purpose' : focus and/or pointing) - via the scanIntent entry of Scan
3. Should an image of the calibrators be part of the user selectable list returned ?
4. Should the amplitude and phase variation for relevant calibrators be returned/returnable too?
5. Should the 'point source quality' and the 'variability quality' [parameters] (at the time of the observation) of phase and amplitude calibrators be returned too ?

Notes:

1. …

3.2.1-13 Find observation according to type

Comment: Calibration, Technical, Test, Science, Pointing, Bandpass calibration, polarization calibration, etc. Also according to observing mode (mosaic, OTF interferometry, etc.)

Use Case: FindObsByType

Goal: For a given ObsProjectID find all the associated observations by type

Contact Author: GaryFuller

Discussion:

Role(s)/Actor(s):
Primary: ASA User
Secondary: ...

Priority: Medium

Performance: Medium

Frequency of Use: High

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept ObsProjectID
    Exception Course: Invalid ObsProjectID. Return error.
2. Accept requested type of observation (e.g. bandpass calibration)
    Exception Course: Invalid type. Return error
3. Search ObsProject for schedule blocks of the requested type of observation
    Exception Course: No such blocks. Return error
4. Return list of schedule blocks

Issues to be Determined or Resolved:

1. Who maintains a list of valid types of observation?
2. How are observations of a particular type associated with an execution record if they are not actually obtained as a part of the record, or possibly even that ObsProject ?

Notes: .

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3.2.1-14 Deleted

3.2.1-15 Find all the ExecBlocks of a given SchedBlock

Use Case: FindExecBlock

Goal: Return a list of all ExecBlocks for a given SchedBlock. There may be contraints on the required ExecBlocks.

Contact Author: GaryFuller

Discussion: There are several possible contraints on the required ExecBlocks:

1. Date/time,
2. data quality,
3. operational parameters,(e.g. number of antennas), or
4. environmental criteria

Role(s)/Actor(s):
Primary: Pipeline
Secondary: ...

Priority: Critical

Performance: High

Frequency of Use: High

Preconditions:

1. User connected to ASA
2. User knows UID of SchedBlock of interest

Basic Course:

1. Accept UID for SchedBlock
   Exception Course: Valid UID? No - return error

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2. Find requested SchedBlock
    Exception Course: UID does not point to SchedBlock. Return error
3. Find ExecBlocks of the SchedBlock
    Exception Course: No ExecBlocks exist. Return error
4. Find ExecBlocks which fall within the selection criteria
    Exception Course: No ExecBlocks consistent with selection criteria. Return error
5. Pass ExecBlocks matching selection criteria to user.

Issues to be Determined or Resolved:

1. Are the ExecBlocks actually returned or a reference to them?

Notes:

3.2.2   Observation Access

Those use cases allow the access to the metadata cross cutting the project structure

3.2.2-1   Find all observations of my favorite source

3.2.2-1.1   Cone search

Comment: The Science Archive user merely wishes to find if his/her favourite source has been observed with ALMA. Inputs would be a source name (name resolver required) or a position in and search radius in his/her choice of coordinates. Initially, a list of suitable observations would be returned. Subsequently, links to all the data products discussed below in single project use cases.

Use Case: **Cone Search**

Use case to take a central coordinate in equatorial format and a search radius, returning the minimum set of information on sources observed within the defined cone.

Goal: Retrieve list of observed calibrator sources within cone.

Contact Author: AlastairStirling – *redesign by:* SandraEtoka

Role(s)/Actor(s):

Primary: ASAUser, (or e.g. Observing Preparation Tool Subsystem).

Secondary: Calibration Source Catalogue.

Priority: Critical.

Performance: Response to user inputs in near real time.

Frequency: High

Preconditions:

1. Calibrator catalogue is accessible
2. Valid equatorial coordinates and search radius (SR) provided,

Basic Course

1. Search the calibrator catalogue for calibration sources inside cone

Alternate Course: No candidates found, report lack of success in Browser.

Postconditions

1. User selectable list returned.
2. User selectable format including VOTable.

Issues to be Determined or Resolved:

1. Updating of the calibration catalogue.
2. The pre-selection criteria should allow the user to select a maximum number of sources desired within the cone, either according to distance (i.e., the x first closest) or strength (i.e., the x first strongest)
3. This use case original goal can be extended to find "a" source (not only a calibrator) observed with ALMA within the cone. Therefore, another pre-selection criteria could be 'calibrator only'/ 'all type of ALMA sources', other types? Following this line of though 'calibrator only' could also be split into subcategories (i.e., point source, phase reference, polarization …)

Notes:

3.2.2-1.2   Find all project [proposal] relative to my favourite source

Comment: Returns a list of links to proposals. This implies that we need some coverage catalogue in the Archive.

Use Case: ProjectsAssociatedToSource

Goal: Finds all projects associated with a specific source or patch of sky

Contact Author: SandraEtoka

Discussion:

Will return a list of projects concerning a specific source or patch of sky. This use case should deal with the extended case where refinement on frequency and time range can be done: i.e., return only the projects that have been obtained in a specific ALMA band or spectral line or frequency range and/or within a certain time range.

Role(s)/Actor(s):
Primary: ASAUser, ObsPrep
Secondary:

Priority: Medium - 2

Performance: low

Frequency: high

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept User name or coordinates
2. If name is given, resolve it to coordinates
3. Accept radius of search
4. if not given a default radius TBD should be used
5. Accept Spectral line name or frequency range or ALMA Band

6. if spectral line name is given, resolve it to frequency
7. Accept time range
8. Check that requirements/constraints are reasonable for ALMA e.g.
   *Dec whithin ALMA capability range
   *frequencies are within ALMA bands
   *time range is within the start of operation of ALMA and the date of query
   Exception Course: Unreasonable constraint/requirements. Return error
9. Search for projects matching criteria

Alternate Course:

   1. No projects found for the selected source/region of sky and or frequency range and/or time range. Allow user to loosen her/his criteria if so desired.

Postconditions:

   1. Returns a list of matching projects in a user selectable way in which it should be able to retrieve:
   1. the actual name of the projects
   2. the corresponding ObsProjectIDs
   3. a link to the corresponding proposals

Issues to be Determined or Resolved:

   1. ...

Notes:

   1. This use case could therefore allow an ALMA User to retrieve all the appropriate projects (s)he did so far with ALMA concerning a specific source or patch of sky in order to load them in the OT and re-use the relevant parts in a new ALMA project

3.2.2-2 Find observations of a source given a time range/time resolution

Use Case: SourceObsAtTimeRange

Goal: Find observations of a source (or patch of sky) with a given time range/time resolution

Contact Author: SandraEtoka

Role(s)/Actor(s):
Primary: ASAUser
Secondary:

Discussion:

Will return all ExecBlocks (and also a link to all datacubes) concerning a specific source or patch of sky observed within a given time range/time resolution. This use case should deal with the extended case where refinement on frequency can be done: i.e., to return only observations that have been obtained in a specific ALMA band or spectral line or frequency range and within a certain time range.

Priority: Medium - 2

Performance: low

Frequency: high

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept User name or coordinates
2. If name is given, resolve it to coordinates
3. Accept radius of search
4. if not given a default radius TBD should be used
5. Accept time range

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6. Accept spectral line name or frequency range or ALMA Band
7. if spectral line name is given, resolve it to frequency
8. Check that requirements/constraints are reasonable for ALMA e.g.
   *Dec whithin ALMA capability range
   *time range is within the start of operation of ALMA and the date of query
   *frequencies are within ALMA bands
   Exception Course: Unreasonable constraint/requirements. Return error
9. Search for ExecBlocks matching criteria
10. Search for datacube references matching criteria

Alternate Course:

1. No observations (ExecBlocks) found for the selected source/region of sky and or frequency range and/or time range. Allow user to loosen her/his criteria if so desired.

Postconditions:

1. Returns a list to all matching ExecBlocks and the actual time where they have been created
2. If requested by user (i.e., selectable option) a link to all matching datacubes (depending on requested time resolution: created from observations taken within/including/overlaping requested time range)

Issues to be Determined or Resolved:

1. ...

Notes:

1. In the user selection, the following options should be considered:
1. the possibility to select the mode of observation used at observing time (i.e., continuum, spectral line, mosaic ...)
2. the possibility to select only the Main Array or the ACA

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3.2.2-3   Deleted

3.2.2-4   Find all observations associated with a type of object

Comments: e.g.: SFR, PPN, AGB, AGN, pulsar ...
         In order to do so a keyword entry should be present in the ObsProject (entered by the PI him/herself) to specify what *type of object* to search for. Therefore, a list of set *type of object* needs to be defined.

Use Case: FindTypeOfObject

Goal: Finds observations associated with a type of object

Contact Author: SandraEtoka

Discussion:

Shall return a list of observations concerning a specific type of object, the search been done, via keywords such as: SFR (*or more explicitly such as StarFormingRegion?*), AGB, Pulsar, AGN ... The query should also allow a time range and frequency range selection

Role(s)/Actor(s):
Primary: Observer, ASAUser
Secondary:

Priority: Medium - 2

Performance: Medium

Frequency: Uncertain

Preconditions:

1.   User connected to ASA

Basic Course:

1. Accept user specified object type, time range and frequency range

2. Check that requirements/constraints are reasonable for ALMA e.g.
*frequencies are within ALMA bands,
*time range is within the start of operation of ALMA and the date of query and
*the *type of object* is part of the set list allowed
Exception Course: Unreasonable constraint/requirements. Return error
3. Validate Object type
Exception Course: Return error
4. Validate time range
Exception Course: Return error
5. Validate Frequency range
Exception Course: Return error
6. Search for observations matching criteria

Alternate Course:

1. No observation found for the selected *type of object* within the frequency range or time range. Allow user to change them if desired.

Postconditions:

1. Return a list of matching observations in a user selectable way

Issues to be Determined or Resolved:

1. Should more 'processed information' such as the RMS and the maximum intensity observed in the image be given?

Notes:

1. The *type of object* needs to be selected by the PI when setting up his/her project of observations (ObsProject).
2. A 'set' list of type of object allowed needs to be defined.
3. The output should be user selectable and contain all relevant information such as: the name of the source, the date of the observation, the frequency at which the observation has been taken, and if desired and available a link to the corresponding image.
4. This use case could be extended to Scheduling Blocks (i.e., forthcoming observations) in a user selectable way, in which case the time range should accept date posterior to the current date.

3.2.2-5   Cross correlate with another archive or sample

This use case is essentially the same as "Cone search" (use case 3.2.2-1.1 of section "Observation Access"), except that the source list would be entered in a batch mode. Not all catalogues have a simple positional error circle so it would be necessary to allow searching within non-circular regions of the celestial sphere. Can be further filtered with e.g. frequency. Initially a list of suitable observations would be returned. Subsequently links to all the data products could be returned.

3.2.2-6   Find all observations within a frequency range including systematic velocities

The goal of this use case is to search for transitions of a new species. Every observation (including calibrators) needs to be searched to check whether it would have covered the frequencies of the transitions of the new species. The rest frequency of the new species is known. The velocity along the line of sight of the molecular material targeted as well as that of the calibrators should be known. Initially, a list of suitable observations would be returned. Subsequently, links to all the data products could be returned.

3.2.2-6.1   Search for redshifted CO

Again search every observation (including calibrators) to look at whether it would have covered the redshifted CO line frequencies and look for the presence of multiple CO lines at the appropriate spacing. This use case would require a measurement of the source redshift and some characterization of the images to exist. Initially, a list of suitable observations would be returned. Subsequently links to all the data products could be returned.

3.2.2-7   Finds all proposals relative to a single PI or multiple PIs

Comments: Returns a list of links to proposals. Linked to the use case 3.2.1-1 "Return proposal associated with the ObsProject" of section "Project Access".

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3.2.2-8   Make a image or data cube cut-out

A position and size are specified along with a target link from an ObsProject and the rectangular cut-out is returned but not resampled etc. The returned data cube or image(s) shall be a frequency/velocity-averaged image of all the available spectral channels in a single band.
Comments: This use case can be fulfilled by the use case 3.2.2-13 "Return Data Cube" of section "Observation Access"

3.2.2-9 Make most sensitive image of a user-defined field of view

An area in the sky is specified and all observations with overlapping frequencies are returned. Derive the data quality and resolution available by combining these images. Allow the user to select which observations are desired for inclusion. Return links to all visibilities.
Comment: Subsequently, a new data cube could be created from the selected observations, by invoking Pipeline.

3.2.2-10 Find all ALMA scientific papers associated with a particular source or a region of the sky

Comments: Returns links to papers for a particular source or region of the sky. See use case 3.2.1-10 "Return links to scientific publications associated with an ObsProject" of section "Project Access".

3.2.2-11 Associate multi-frequency

Comment: This use case needs more careful consideration of its scope before it can be developed beyond this outline.

Use Case: Associate Projects for Multi-Frequency Studies

ALMA will be used to observe (molecular) lines in different transitions. These transitions being far enough from each other in frequency they will be observed at different epochs with different antenna configurations. The physical interpretation of the data requires common angular and spectral resolutions. The purpose of this Use Case is to demonstrate the possibility to associate archived data from different projects and generate an ObservationUnit including the adequate data for processing and subsequent analysis.

Goal: Invoking the Archive, generate an ObservationUnit with the intent to combine data at different frequencies.

Contact Author: FrancoisViallefond

Role(s)/Actor(s):
Primary: ASA user (astronomer)
Secondary: ARC staff (operators, astronomers)

Priority: Very desirable

Frequency: Few times a week.

Preconditions:

1. Database is running
2. User got authenticated
3. The coordinates of the position(s) of the source are known.
4. The name of the line(s) with transitions to be associated are known.

Basic Course:

1. Connect to the ASA via ACS from the home institute
   Alternate Course: none

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Exception Course: Connection can't be established: try again until timeout.
Postcondition: Connection established.

2. Amongst the available services listed when the connection is established, select the service which allows to create an ObservationUnit; this opens a GUI for an interactive high level interface which maps user request into XPath queries.
    Alternate Course: select an interface to submit a script for batch mode request
3. In case of interactive mode, from the GUI, select the source, the line(s) of interest and the different transitions. Step by step selections could assist the user, e.g. for a given source and molecule the GUI leaves the choice on transitions only for those which have been observed. For requests of data being scheduled but not yet observed or private data when the ASA user has no permission access, a message has to inform the status of these peculiar data.
    Alternate Course: for batch mode the user selection is provided in the submitted script
    Exception Course:
    o an attribute for selection is rejected because of bad user input (e.g. bad syntax for coordinates); an on-line help is available; try again until proper syntax is provided.
    o no entities matching with the selection; the user is informed via comprehensive messages, e.g. transition unknown, no entities for that transition, no entity for that source etc...; quit button allows the user to exit and close the connection.
        Alternate Course: for batch mode requests the message is sent to the ASA user via email.
4. The list of available data is provided with information such as the rms noise level, the angular and spectral resolutions, the extend of the region observed in case of mosaicing, the availability or not of auto-correlation measurements, the availability or not of ACA short spacing measurements; whether such type of association for that source have already been done in the past by the ASA user community.
    Alternate Course: for batch mode requests this information is sent by email to the actor.
5. In case of mosaicing select the region corresponding to the intersection of the regions which have been observed in the different lines/transitions. For single-field observations select the field.
    Exception Course: no spatial overlap; a quit button allows the user to exit and close the connection. For batch mode the message is sent by email to the actor.
6. Select the lowest angular resolution amongst the listed values and select the lowest velocity resolution.
    This provides anticipated rms noise levels in brightness temperature and/or Jy/beam for that common spatial and spectral resolution.

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7. Satisfied with the data selection and the anticipated levels of sensitivity?
   no: offer the possibility for the user to modify selection criteria
   yes: inquire
   o to make DataCollections (probably one per line transition) including, mandatory, the visibilities with the associated calibration parameters.
      N.B.: not all visibilities may be required! only those suitable for the requested angular resolution are selected.
   o to make the association of the DataCollections for producing an ObservationUnit.
      Alternate Course: inform by email that an ObservationUnit has been created and is available up to some expiration date, either to retrieve them or to process them at the ARC provided the user submits a reduction script. This information by email could come with a suggested processing script to be checked and eventually modified, if necessary, by the user. Suggested scripts would come only in case of standard modes (TBD) or if scripts for associations of similar type have already been used sucessfuly in the past. These scripts may take advantages related to the nature of the association to use specific methods such as a joined deconvolution of the observations at the different frequencies, as that could be appropriate in the present case for some scientific applications.
8. Offer to the user 3 possibilities:
   1. retrieve the ObservationUnit either via internet (before some expiration date) or on some standard (TBD) media in the standard export data format (data format of the DRP supported by ALMA project or VOTable or FITS? TBD)
   2. switch to a new service for processing the ObservationUnit at the ARC if the user want to have some control in the sequence of events during the processing.
      Alternate Course: simple standard processing which computing time inexpensive could be done automaticaly using that service in batch mode
   3. submit a processing script.
9. In the case the ObservationUnit has been processed at the ARC, the noise level and some other relevant parameter as needed for the resulting images which have been generated. The images are new members in the DataCollecions. Reports (history files) about all events since the beginning of this Use Case become also new members at the relevant levels in the ObservationUnit structure. The ASA user can retrieve the ObservationUnit, with or without the Table members (those which host the visibilities and calibaration parameters) in the DataCollections.
10. Archive the result and make protection accesses at the DataColection level as needed.

Postconditions:

1. An ObservationUnit in an adequate format available (for an lapsed time TBD) for reprocessing at the ARC in case alternate processing methods would be desired.

2. Images of several lines/transitions at the same spatial and spectral resolutions as members in the data collections of the ObservationUnits.

Issues to be Determined or Resolved:

The concepts of ObservationUnits and DataCollections or any alternative project structure need to be agreed and designed first.
The services provided by the ARC for off-line data processing need to be assessed.

Notes: Creation of ObservationUnits is an OT responsibility
– **Last Modified by:** SandraEtoka

3.2.2-12 Return visibilities

Use Case: ReturnRawData

Goal: Return a set of raw (uncalibrated) uv data for a region of the sky. The data to be used is selected on the basis of a set of criteria which must include a target location on the sky, size of region of interest. A frequency, frequency range and channel width (these could also be specified in terms of velocity). Notice that other combinations of these parameters are (in principle) acceptable to specify the spectral range and resolution of the dataset to be returned. The dataset can also be selected so as to match other criteria on the telescope and/or environment conditions.

Contact Author: GaryFuller

Discussion: There are many possible aspects to the specification of what the user wants in this use case:

1. Criteria solely related to the data to be used: data quality flags, date ranges, antennas/baselines/baseline ranges/uv distances to include or exclude, weather criteria, other instrumental criteria
2. Criteria related to the data to be used and the parameters of the returned data: centre frequency, frequency channel width, frequency range (or number of channels)

Role(s)/Actor(s) :
Primary: ASA user
Secondary: ...

Priority: Critical

Performance: High

Frequency of Use: Uncertain. It is unclear how often a user will want the raw data, except possibly for debugging possible faults.

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept user requirements on data and output
2. If position on sky is specified by a name, and not coordinates, resolve the name to a position
3. Check that requirements/constraints are reasonable for ALMA e.g. frequencies are within ALMA bands, position is in the sky accessible to ALMA
   Exception Course: Unreasonable constraint/requirements. Return error
4. Find executions of scheduling blocks which covered the required region of the sky
   Exception Course: No observations have covered the required area. Return message
5. Check whether observations covered appropriate frequencies.
   Exception Course: No observations have covered the required frequencies. Return message
6. Check which observations consistent with remaining constraints
   Exception Course: No observations consistent with constraints. Return message
7. Pass datasets to user.

Issues to be Determined or Resolved:

1. Is the data actually returned or a reference to it?
2. The calibration information should be returned, even though not applied to the dataset so that the user can make use of it if they want.
3. Exactly what constitutes an error in specifying the required dataset and what defaults should be used if a parameter is not specified or is out of range?

Notes:

3.2.2-13 Return cube of a field on the sky

Use Case: ReturnDataCube

Goal: Return imaged data (a datacube) of a region of the sky. The data to be used is selected on the basis of a set of criteria which must include a target location on the sky, region to be imaged, a frequency, frequency range and channel width (these could also be specified in terms of velocity) Notice that other combinations of these parameters are (in principle) acceptable to specify the spectral range and resolution of the datacube to be returned.

Contact Author: GaryFuller

Discussion: There are many aspects to the specification of what the user wants in this use case:

1. Criteria solely related to the data to be used: data quality flags, date ranges, antennas/baselines/baseline ranges/uv distances to include or exclude, weather criteria, other instrumental criteria
2. Criteria related to the data to be used and the parameters of the returned data cube: centre frequency, frequency channel width, frequency range (or number of channels)
3. Criteria related to the imaging of the data: spatial resolution (but note that this and baseline ranges are related), angular size of region to be imaged.

I would suggest that since the mapping between spatial resolution and baseline ranges is complicated, this use case allows the user to specify both, and devolves the responsibility of deciding whether they make sense to the pipeline. Note that frequency and velocity are interchangeable throughout.

Role(s)/Actor(s):
Primary: ASA user
Secondary: ...

Priority: Critical

Performance: High

Frequency of Use: Majority of access to ASA will do this.

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept user requirements on data and output
2. If position on sky is specified by a name, and not coordinates, resolve the name to a position
3. Check that requirements/constraints are reasonable for ALMA e.g. frequencies are within ALMA bands, position is in the sky accessible to ALMA
   Exception Course: Unreasonable constraint/requirements. Return explanatory message
4. Find executions of scheduling blocks which covered the required region of the sky
   Exception Course: No observations have covered the required area. Return message
   Alternate Course: Would an existing cube made from these observations satisfy request? See ExistingCube
5. Check whether observations covered appropriate frequencies.
   Exception Course: No observations have covered the required frequencies. Return message
6. Check which observations consistent with remaining constraints
   Exception Course: No observations consistent with constraints. Return message
7. Pass list of observations and parameters requested for datacube to pipeline for processing and trigger pipeline
   Exception Course: Pipeline fails to make cube. Potentially many reasons this may happen. Return error message explaining reason pipeline failed.
8. Pipeline returns datacube. Pass datacube to user.

Alternate Course: ExistingCube

1. Could an existing datacube satisfy the request without the need to reimage/reprocess raw data?
2. Process cube to match request. For example extract appropriate part of sky-frequency space, smooth/average frequency channels to requirement, although smoothing spatially is not the best idea.
   Postcondition: Return cube to user

Issues to be Determined or Resolved:

1. Is the cube actually returned or a reference to it?
2. If it is the cube itself, what format is it in?
3. Exactly what constitutes an error in specifying the required dataset and what defaults should be used if a parameter is not specified or is out of range ?

Notes: This is the workhorse use case for access to the ASA to retrieve data cubes.

3.2.2-13.1 Average up the line-free part of the a line observation to make a
continuum image

If a data cube is selected, the Archive user may wish to visually inspect each plane
of the data cube to either include or reject it from a final frequency/velocity-
averaged image. This feature will be useful e.g. averaging up the line-free parts of a
CO observation to look for dust clumps. This use case should return a link to an
image.
Comment: advanced functionality beyond the scope of the Archive

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3.2.2-13.2   Deleted

3.2.3   Catalogue Access

Use cases for accessing the catalogues (i.e., spectral line catalogue, calibrator catalogue, source catalogue) in the ASA. Catalogues may be generated from results retrieved from the ASA itself or filled from an external source (presumably manually or semi-automatically). Catalogues in the ASA are bound to be a mixture of already existing databases and new entries in the ASA from ALMA observations themselves.

3.2.3-1   Access Calibration Database

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3.2.3-1.1   Check antenna gain

Use Case: Check Antenna Gain Solution

The calibration pipeline checks antenna gains by receiving archived results (summary tables and eventually plots) and hardware characteristics to be used as references. It eventually adds in the database of monitored parameters the new results.

Goal: Retrieve from Archive hardware properties and update with new measurements.

Contact Author: FrancoisViallefond

Role(s)/Actor(s):
Primary:

1. Calibration Pipeline.
2. Control: performance monitoring.

Secondary:

1. Operator, Staff Astronomer, Interactive Observer.

Priority: Critical

Performance: < second

Frequency: seconds.

Preconditions:

1. Database is running
2. A priori flux of calibrator known (FindSrcUseCase Basic course for Amplitude/phase and/or Primary flux calibrators executed
3. Antenna-based amplitudes from complex visibilities determined (ProcessCalibratorAmplitude Basic course 1).
4. Antenna gains computed for the list of antenna identifiers with their feeds used and the sky frequency (ProcessCalibratorAmplitude Basic course 2).

Basic Course:

1. Retrieve from Archive the antenna gains previously determined from observations obtained in approximately same conditions (feed, frequency, elevation).
   Alternate Course: No antenna gains known for those conditions. Skip the 2 next items in the basic course.
2. Scale these gains for the sky frequency of the gains to be checked.
3. Determine the means and rms of these archived antenna-gains for each antenna, restricting to those obtained since the most recent hardware setup.
4. Determine the distances of the current antenna-gains to those means in rms units.
5. Extract from the Archive the characteristics of the antennas (surface efficiencies, aperture blockage, feed spillover efficiency).
6. Publish these results for ProcessCalibratorAmplitude Basic course 3.
7. Archive the results if ProcessCalibratorAmplitude did not set an alarm flag.

Postconditions:

1. Archive updated with new antenna-gains values

Issues to be Determined or Resolved: None

Note: For Archive this use case implies only two operations: i) retrieve antenna gains from the calibration database and ii) store antenna gains in the calibration database.

3.2.3-2   Access Site Characteristics Database

Comment: Use case to be developed when Site Characteristics database is defined.

3.2.3-3   Access Calibrator Catalogues

3.2.3-3.1   Find a calibrator in catalogues

Comments: The goal of this use case is to find sources in the Archive to be used for calibration purposes with the perspective of observations in interferometric mode. The Archive is solicited to retrieve a list of potential calibrators according to different criteria. These calibrators have already been observed with ALMA and a history of the measurements is provided. The source parameters can originate from any dataset in the ALMA Archive. Areas of search are from a few to many square degrees depending on the calibration purpose. Statistics based on data existing in the Archive are also provided. Initially, a list of suitable observations would be returned. Subsequently links to all the data products could be returned.
The use case below provides a very complete description but much of the analysis will be done outside of the Archive.

 Use Case: **Search source calibrators**

The goal of this use case to find source in the Archive to be used for calibration purposes with the perspective of observations in interferometric mode. The Archive is solicited to retrieve a list of potential calibrators according to different criteria. These calibrators have already been observed with ALMA and a history of the measurements is provided. The source parameters can originate from any dataset in the ALMA Archive. Areas of search are from a few to many square degrees depending on the calibration purpose. Statistics based on data existing in the Archive are also provided.

Goal: Retrieve from the Archive a list of calibrators with their parameters.

Contact Author: FrancoisViallefond

Role(s)/Actor(s):
Primary: ObservingPreparationTool subsystem?
Secondary: Observer, AstronomerOnDuty

Priority: Critical

Performance: Response to user inputs in near real time.

Frequency: For each project, perform this for each frequency setting.

Preconditions:

1. Database is running
2. User got authenticated
3. The coordinates of the position(s) of the main target(s) to be observed are known.
4. The sky frequency(ies) to be used is (are) known.
5. The targeted angular resolution (or antenna configuration) is known.

Basic Course:

Amplitude/phase calibrators:

1. Set the maximum tolerable distance (in degrees) from the main target to search for amplitude calibrator candidates.
2. Set tolerable lower and upper limits in frequency about the sky frequency to be used to find the candidates.
3. Find the candidates (batch mode). If no source is found go to the alternate course.
4. For each candidate, using all the ALMA observations for these candidates, get:
   - the baseline length range (in meters and kilo-lambda), with an upper limits for the maximum baseline length if relevant, which can be used for calibration purpose.
   - a list of flux measurements and the corresponding frequency in ascending observing date. (if there is a large number of measurements, a graphic versus time could be generated, including when that is possible error bars).
   - if possible, the expected flux at the sky frequency based on the shape of the continuum spectrum.
   - the primary flux calibrator used in each case when these fluxes were derived.
   - the dates of observation for these candidates.
5. Select a small number (2 to 3) of *a priori* best candidates in that list (there is a trade-off between several parameters to perform this selection).
6. Retrieve the parameters with anticipated fluxes at the sky frequency(ies) to be observed.

Alternate Course: No candidate found.

1. Enter in an interactive mode.
2. Relax the tolerances (these would be probably interactive via cursors in a GUI).
3. Find the candidates interactively, e.g. clicking at the position of the sources on a finding chart.

Primary flux calibrator:

1. Relax the level of tolerance for the maximum distance to target criterion and find the strongest sources with their ranges of LST to be potentially observable (i.e. above a minimum elevation) within the Scheduling Block.
2. Search candidates.
3. For each candidate (eventually using all the ALMA observations for these candidates), get for each:
   - the maximum baselines length that can be used for calibration purpose.
   - a list of flux measurements and the corresponding frequency in ascending observing date. (if there is a large number of measurements, a graphic versus time could be generated, including when that is possible error bars).
   - the primary flux calibrator used in each case when these fluxes were derived.
4. Select in this list the potential targets to be used as primary flux calibrators.
5. Retrieve the parameters for these primary calibrators.

Bandpass calibrator:

1. Relax constraints on the maximum distance from the main target(s) but keep constraints that the calibrator must be observable above a critical elevation.
2. Relax criteria associated to the antenna configuration (histogram of baseline lengths).
3. Find the strongest observable sources at the sky-frequency to be used for the band-pass calibration.
4. Provide typical complex gain uncertainties already achieved using these sources for frequencies in proximity to the target frequencies (statistics from existing data, with weather conditions as those anticipated, in the Archive).

Phase referencing calibrator:

1. Set a broad frequency window in the 3mm band.
2. Set a tight limit to the maximum distance to the main target.
3. Set a limit to which the atmospheric phase error are tolerable. The attribute for this setting may be rejected until it is in a domain of validity for the given typical anticipated weather conditions and the antenna configuration used.
4. Reset the antenna configuration as a criterion to be used for finding candidates.
5. Find a list of candidates for phase referencing allowing enough signal to noise.
6. Select in this list one or 2 sources to be used for phase referencing. (see alternate course in case no candidate found)
7. Retrieve the parameters for these phase reference calibrators.

Alternate Course: No candidate found.

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1. Inform the user that using the phase referencing observing mode is inadequate for the level of tolerance on atmospheric phase errors requested with the given antenna configuration or
2. Relax tolerances on phase error within the domain of validity in the parameter space.

Postconditions:

1. List of calibrators is set (a precondition for observations).
2. Parameters for these calibrators have been retrieved.

Issues to be Determined or Resolved: Who has the responsibility to provide the various trade-offs while doing the source selections?

Notes:

3.2.3-4 Access other Catalogues
Comment: use cases for access to spectral line catalogues

Use Case: GetLineFrequency

Goal: Return the frequency of a spectral line.

Contact Author: GaryFuller

Discussion:

Role(s)/Actor(s):
Primary: ASA users, ObsPrep
Secondary: ...

Priority: See notes below

Performance: See notes below

Frequency of Use: See notes below

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept name of spectral line from user
2. Search spectral line catalogue to find line frequency
   Exception Course: Line not found. Return error

Alternate Course:

Allow users to search of all lines from a given molecule.

1. Accept name of molecule from user

2. Search spectral line catalogue to find frequency of lines from this molecule
   Exception Course: No lines found. Return error

Issues to be Determined or Resolved: Need to decide format for molecule and transitions names.

Notes: - Last modified by: SandraEtoka

Use Case: FindLinesInBand

Goal: Return a list (catalogue?) of lines between a user specified range of frequencies.

Contact Author: GaryFuller

Discussion:

Role(s)/Actor(s):
Primary: ASA users, ObsPrep
Secondary: ...

Priority: Medium

Performance: Low

Frequency of Use: Infrequent

Preconditions:

1. User connected to ASA

Basic Course:

2. Accept lower and upper frequency limits
3. Search spectral line catalogue
4. Return list of lines found

Postconditions:

1. Returned list of line frequencies and labels describing molecule and transition

Issues to be Determined or Resolved: Should the returned list be in the form of an ASA catalogue that the user can manipulate?

Notes:

 Use Case: CheckLineValidity

Goal: Given a line observed (i.e., the rest frequency and Doppler shift known) check that a line is expected in the frequency range observed

Contact Author: SandraEtoka

Discussion:

Role(s)/Actor(s):
Primary: ASA users, ObsPrep
Secondary: ...

Priority: Medium

Performance: Low

Frequency of Use: Infrequent

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept lower and upper frequency limits for the frequency range search (i.e., either a 'full ALMA band or portion of it)
2. Accept [rest] frequency (of the line observed)
3. Search spectral line catalogue
4. Return the name of the corresponding line or a list of the closest lines found around the frequency given inside the frequency range search

Postconditions:

1. Returned the name of the line or a list of line frequencies and labels describing molecule and transition and the frequency offset from the entered frequency

Issues to be Determined or Resolved:

Notes:

3.2.3-5   Access to MonitorStore

Comment: site characteristics and environmental parameters

3.2.3-5.1   Environmental and monitoring plots, daily yearly etc

Comments: Assemble daily, monthly and yearly plots of all environmental and monitor data, and Calibration reference results. Make available through Archive search form.

See use case 3.2.1-5 "Return Monitor data" of section "Project Access".

Use Case: ObsGivenConditions

Goal: Given a specified observing/instrumental condition (for example weather) find a list of ObsProjectID, SchedBlocks and Exec taken during these conditions.

Contact Author: GaryFuller

Discussion:

Role(s)/Actor(s):
Primary: ASA User
Secondary: ...

Priority: High

Performance: Low

Frequency of Use: High

Preconditions:

1. User connected to ASA

Basic Course:

1. Accept observing/instrumental condition. For example, weather had a wind speed of less than 5 m/s.
    Exception Course: Return error if condition is nonsensical. For example a negative wind speed.
2. Accept period of time over which to search for such conditions
3. Search for times during the specified period when conditions are matched.
    Exception Course: Return error if conditions not met during specified period.
4. Identify ExecBlocks taken during these periods
    Exception Course: Return error if no ExecBlocks taken during these periods.
5. Return list of ProjectIDs, SchedBlocks and ExecBlocks

Postconditions:

Issues to be Determined or Resolved:

1. Should we specify a minimum gap which is defined to separate periods of different conditions?

2. How does the user specify the required monitor/environmental data?

Notes:

3.3 Prioritization list

3.3.1 Top level prioritization

Priority	Areas
1	**Project Access (PA)**
2	**Catalogue Access (CA)**
3	**Observation Access (OA)**

3.3.2 Project Access Prioritization

Priority	Number	Use case
1	3.2.1-4	Browsing ObsProject status on-line - ***BrowseObsProject***
1	3.2.1-5	Return monitor and environmental data associated with an observation - ***ReturnMonitorData***
1	3.2.1-6	Return quality information associated with an observation - ***ReturnRequiredQualityInfo***
1	3.2.1-8	Return raw data - ***ReturnRawData*** *(cf. OA-3.2.2-12)*
1	3.2.1-12	Find calibration observations - ***FindCalibrationObs***
1	3.2.1-13	Find observations according to type - ***FindObsByType***
1	3.2.1-15	Find all the executions of a given schedule block - ***FindExecBlock***
2	3.2.1-2	Return ObsProjects associated with user - ***ReturnObsProjects***
2	3.2.1-7	Return QuickLook results associated with ObsProject - ***ReturnQuickLook***
2	3.2.1-11	List all sources in an ObsProject - ***ListSourcesObsProject***
3	3.2.1-1	Return proposal associated with the ObsProject - ***AssociateProposalObsProjectID***
3	3.2.1-9	Return a data cube - ***ReturnDataCube*** *(cf. OA-3.2.2-13)*
4	3.2.1-10	Return links to scientific publications associated with an ObsProject - ***PublicationsObsProject***

3.3.3 Catalogue Access Prioritization

Priority	Number	Use case
1	3.2.3-1	Access Calibration Database
	3.2.3-1.1	Check Antenna gain - ***CheckAntennaGainSolution***
1	3.2.3-2	Access Site Characteristics Database
1	3.2.3-3.1	Find a calibrator in Catalogues - ***SearchSourceCalibrators***
1	3.2.3-4	Access to other Catalogues - ***GetLineFrequency***

		FindLinesInBand & *CheckLineValidity*
1	3.2.3-5.1	Environmental and monitoring plots, daily, yearly etc ... - *ReturnMonitorData* (cf. PA-3.2.1-5) & *ObsGivenConditions*

3.3.4   Observation Access Prioritization

Priority	Number	Use case
1	3.2.2-1.1	Find all observations of my favorite source - *ConeSearch*
	3.2.2-1.2	Find all projects relative to a single source - *ProjectsAssociatedToSource*
2	3.2.2-2	Find observations of a source with a given time range/time resolution - *SourceObsAtTimeRangeProjects*
2	3.2.2-4	Find all observations associated with a type of object - *FindTypeOfObject*
2	3.2.2-8	Make an Image or data cube cut-out - *ReturnDataCube* (cf. OA-3.2.2-13)
2	3.2.2-12	Return Raw uv data on a field on the sky - *ReturnRawData*
2	3.2.2-13	Return Cube of a field on the sky - *ReturnDataCube*
3	3.2.2-5	Cross correlate with another archive or sample - *ConeSearch* (cf. OA-3.2.2-1)
3	3.2.2-6	Find all observations within frequency range
3	3.2.2-7	Find all proposals relative to a single PI or multiple PIs. - *AssociateProposalObsProjectID* (cf. PA-3.2.1-1)
4	3.2.2-6.1	Search for redshifted CO
4	3.2.2-9	Make most sensitive image of a user defined field of view
4	3.2.2-10	Find all ALMA scientific papers associated with a particular source or region of the sky

No observation access use case is likely to be essential for commissioning

4   References, Abbreviations and Acronyms

4.1   References

http://www.roe.ac.uk/ukatc/projects/alma/APDM-Refactored/APDM.html
http://aramis.obspm.fr/~alma/AEDF/ver3.1/allhtm/
http://aramis.obspm.fr/~alma/ASDM/ASDMEntities.pdf
http://almasw.hq.eso.org/almasw/bin/view/Archive/VOCompliance
http://www.us-vo.org/metadata/conesearch/

4.2 Abbreviations and Acronyms

AFA	ALMA Front-end Archive
AFAIF	ALMA Front-end Archive Interface
APD	Advanced Data Product
APDM	ALMA Project Data Model
ARC	ALMA Regional Centre
ASA	ALMA Science Archive
ASAIF	ALMA Science Archive Interface
ASDM	ALMA Science Data Model
DB	Database
IVOA	International Virtual Observatory Association
NVO	US National Virtual Observatory
QC	Quality Control
VO	Virtual Observatory
SSR	Science Software Requirement