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Computing and Software System: Use Cases

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1	2025-08-11	R. Rosen et al.	All	Initial draft
A	2025-08-13	M. Archuleta	All	Minor edits and formatting for pdf and release.
B	2025-10-15	R. Rosen	Section 7	Updated in response to CDR RID.

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1 Purpose of the Document

This document outlines the key operational scenarios, or "use cases," for the ngVLA Computing and Software System (CSS). It details the end-to-end workflows from the perspective of different users and for various observatory functions. These scenarios include:

- Standard scientific observations, from proposal submission to final data product delivery.
- Automated calibration procedures that support science observations.
- System commissioning and science validation activities for new observing modes.
- Daily operations from the perspective of an Array Operator.

By describing the interactions between users (e.g., Principal Investigators, Array Operators, Commissioning Scientists) and the system, these use cases serve as a foundational guide for defining the requirements and operational context for the design, development, and validation of the ngVLA software.

2 Reference Documents

Table 1. Documents used in producing the CSS conceptual design descriptions and use cases.

Ref. No.	Document Title	Rev/Doc. No.
REF01	ngVLA Data Processing & Archive Workflow Concept	020.50.55.00.00-0001 DSN
REF02	ngVLA Calibration Concept	020.10.05.05.00-0015 PLA
REF03	ngVLA Proposal Process Concept	020.10.05.05.00-0011 PLA
REF04	Observation Preparation Concept	020.10.05.05.00-0010 PLA
REF05	Observation Scheduling Concept	020.10.05.05.00-0012 PLA
REF06	ngVLA Subarraying Operational Concept	020.10.05.05.00-0014 PLA
REF07	Observation Execution Concept	020.10.05.05.00-0013 PLA
REF08	Scientific User Support and Outreach Concept	020.10.05.05.00-0009 PLA
REF09	Telescope Support Concept	020.10.05.05.00-0008 PLA
REF10	Conceptual Narrative for Time Domain Science	020.10.05.05.00-0016 PLA
REF11	Maintenance and Support Concept	020.10.05.05.00-0007 PLA

3 Use Case I: Standard Mode Data Reduction

3.1 Description

This use case outlines the process for Standard Mode Data Reduction (SMDR) [REF01] during the full operational phase of the observatory. This mode is expected to cover the majority of all scientific observations.

3.2 Key Concepts

- Proposal review process
- Telescope time allocation
- Schedule block creation
- Scheduling
- Subarrays
- Data acquisition
- Quality Assurance and associated actions
- Data processing
- Data archiving

3.3 Use Case Description

The Excalidraw diagram linked below is a high-level functional software design. Its purpose is to visually represent the entire end-to-end lifecycle of a the SDMR during normal operations within the ngVLA CSS. While the text in this use case document provides the essential, detailed "what" and "how" of the process in a step-by-step format, the Excalidraw diagram provides the crucial "where" and "why," showing how all the pieces fit together into a cohesive system. The goal of the diagram is to transform a complex procedural list into an intuitive system architecture, making it easy to visualize.

https://link.excalidraw.com/readonly/wCoJ7nDmIMZVs4OPsTGI

1. The Observatory puts out a solicitation, namely a Call for Proposals (CfP), using the Telescope Time Allocation (TTA) Tools.
2. A PI starts a proposal for a request for telescope time for a science observation.
    a. Based on the time request, the PI receives an estimate of compute resources based on science specifications (observing mode, angular scales, field of view, number of channels, number of targets, etc.).
    b. The Observing Strategy creates a facility-specific Scheduling and Calibration Strategy.
    c. The Observation Planner creates a sequence of scans based on science input from the PI and the Scheduling and Calibration Strategies.
    d. Observation Specifications are created by the Observation Planner. The Observation Specifications are mutable at this point and are viewable to the proposer.
    e. The proposal is validated and submitted.
3. After proposals are submitted and the CfP closes, the Observation Specifications are no longer mutable. The proposal can go through a science review, technical review, and a data management review, depending on the type of proposal. The collection of reviews is the Proposal Review process. The Feasibility Review (for technical and data management review) may be conducted asynchronously to the Science Review or not at all.
4. After the science review process, a Schedule Forecast is created for the incoming requests based on pressure plots, historical and predicted weather, compute resources, and other information in preparation for the Time Allocation Committee (TAC).
5. During the Schedule Forecast Review, a preliminary set of recommendations, including scheduling priorities, is made (this could be automated, done by a person, or both). As the Observation Specification is not mutable, Observation Specification Dispositions are generated and modified, if a change to the PI request is necessary. An Observation Specification Disposition is initially a clone of the Observation Specification.

6. The TAC meets to review the preliminary scheduling priorities, considering science rank but also observing and computing pressure. The TAC recommends a program, which may require modification of the priorities and the creation of a new Schedule Forecast (item 4).
7. The program is reviewed by the director; it may repeat items 4 or 5. The Director approves a final program.
8. In the Closeout process, the PIs are notified of their proposal disposition, regardless of if they are awarded time.
9. In the final step called the "Project Creation" or "Export" Process, the Observation Specification Dispositions may be modified based on the outcome of the proposal disposition, which may also need input from the PI. At the end of this process, the Observation Specification Dispositions are no longer mutable and the work in TTA Tools is concluded.
10. For proposals that are awarded time, projects are created and the observing preparation phase begins.
11. Phase I Scheduling Blocks (SBs) are automatically generated, early at the beginning of the cycle, and are populated with all the information available. At this point, the Phase I SBs and Observation Specifications are largely aligned. The Phase I SBs are viewable and modifiable to (mostly internal) users. The Observation Specification is in the parlance of the proposal process; they are view-only to (mostly external) users. The Phase I SBs contains a list of candidate reference subarrays, identification of necessary Observatory Provided Calibrations (OBCs) and Scheduling Block Calibrations (SBCs), and scan intents.
12. The scheduling of the awarded projects for observation is carried out through a 3-step scheduling process: with progressively narrower time windows: a long term, mid-term and dynamic. At this point, a coarse-grain schedule for the entire cycle (long-term) and monthly/weekly (mid-term) schedule are created. The long-term schedule is created by the long-term scheduler and the mid-term schedule is created by the mid-term scheduler; both the mid- and long-term schedulers are part of the Scheduling software. The mid-term and long-term schedules should be updated periodically.
13. The Phase II SBs are generated. The Phase II SBs are commands run by the telescope and could be executable. The Phase II SB contains the chosen reference subarray from the list of candidate reference subarrays. The Phase II SB also contains the selected calibrators, as selected in Use Case II. The generation of the Phase II SBs requires input from the mid-term scheduler, which selects the reference subarray and calibrators. The Phase II SB can be updated by the dynamic scheduler (or manually) at the time of execution. The generation of the Phase II SBs concludes the Observation Preparation phase.
14. As part of the observing process, the scheduling phase begins. The dynamic scheduling software decides which subarrays should be scheduled based on available antennas (per band), what is in the observing queue and their priority/rank, weather conditions, what executions are finishing, etc. If necessary, Phase II SBs are updated/finalized (just for SBs about to be queued).
15. Scheduling creates Calibratable Scan Blocks (CSBs) from the Phase II SBs.
16. Scheduling queues any OBCs that are needed for scheduled or to-be-scheduled observations.
17. The Scheduling software schedules the CSB for observing on the appropriate subarray.
18. Data acquisition begins.
    a. The data are stored in memory and formatted.
    b. Analysis on the calibration scans occurs (TelCal) and the results should be displayed/made available.

19. During an observation, the array operators are notified if any executions/calibrations indicate errors.
20. At the end of the CSB, QA_{obs} is executed. TelCal is executed at the end of each calibration scan; QA_{obs} is done at the end of each CSB.
    a. If QA_{obs} passed, the execution fraction is updated.
    b. If QA_{obs} fails, the count of the CSB for the SB is updated and either:
        i. The CSB can be added to the current SB and the SB extended
        ii. The SB can be rescheduled
21. When the SB execution is completed or canceled, the Execution Block (EB) is created, concluding the observing phase. The Calibratable Scan Execution (CSE) are the data resulting from a single Calibratable Scan Block (CSB) execution. This is the atomic unit that is evaluated by the observing QA system and given a pass or fail QA score (QA_{obs}). An EB is the collection of all CSEs from an SB execution, irrespective of their QA_{obs} score, as well as reference to other necessary calibrations including OBCs.
22. The Calibration Processing Block (CPB) is created when all required EBs are complete, indicating the start of the data processing phase. The Calibration Processing Block consists of only CSEs that are QA_{obs} = Pass, and all necessary OBCs. In the case of an observation where an OBC is scheduled and completed in the future, the creation of the CPB would await OBC acquisition. CPB is marked/flagged as "Ready for Calibration".
    a. If this is estimated to be the last execution, then the SB is put into "SB pending QA_{cal}"
23. The Calibration Processing Block is put in the queue for calibration processing, which is scheduled dynamically.
24. The Calibration Processing Block is calibrated once the available compute resources have been allocated for processing based on priority.
25. QA_{cal} occurs automatically after calibration.
    a. If QA_{cal} is marked Fail/NoRepeat or Pass, the processing report (human readable report of what happened during processing) and calibration products are stored, the PI is notified, and the execution fraction is updated.
    b. If QA_{cal} is marked as Fail/Repeat, the execution fraction is updated. If the SB is in the "SB pending QA_{cal}", set the SB back to “Ready”.
    c. If QA_{cal} is marked as Inspect, a Data Processing Support Staff (DPSS) reviews the results and moves it to one of the other QA_{cal} states.
26. Steps 8-20 are repeated until the project has amassed the required set of calibrated data for High Level Data Product (HLDP) creation. This collection of data is called the Data Product Processing Block (DPPB).
27. The Data Product Processing Block is put in the queue for final processing and is scheduled dynamically. Any EB-combination algorithms (e.g. adjusting flux scales between different EBs) has to be part of DPPB processing.
28. The High Level Data Products are created.
29. QA_{Final} occurs automatically after final processing.
    a. If QA_{Final} is marked as Pass, the final products (including weblogs and processing report) are stored.
    b. If QA_{Final} is marked as Fail, the processing report (or similar) are stored but the final products are not stored.
    c. If QA_{Final} is marked as Inspect, a DPSS reviews the QA_{Final} score and moves it to one of the other QA_{Final} states.

30. The PI is notified, including links to Archive if applicable.
31. Steps 25-29 can be repeated to combine DPPBs from different SBs into Group Level Processing Blocks (GLPBs). Calibration will not be redone (due to cost of compute and not to invalidate already delivered HLDPs). GLPBs result in Group Level Data Products (GLDPs). Any DPPB-combination algorithms (e.g. adjusting subarray weights) has to be part of GLPB processing.

4 Use Case II: Standard Calibration Observation Preparation & Execution

4.1 Description

This use case describes the automated process for preparing and executing standard calibration observations [REF02]. It does not elaborate on the steps required for various calibrators (like those for pointing, delay, and polarization) and instead assumes various OBC calibration to have been obtained and available for use.

There are multiple Observatory Provided Calibrator (OBC) types e.g. antenna positions, delay model, pointing model, gain curve, feed positioning model, polarization calibration, flux calibration, switched-power diode calibration, I-Q bandshape (lab data), each with respective pipeline recipes to achieve QA_{obs}. the processing of the respective data would branch out, leading to storage of the results in databases as OBCs for use by the current and other observations. Since we are tracing out a “happy path”, only the Scheduling Block Calibrator (SBC) types are outlined in this use case.

Pointing, delay, feed calibrations use pointing, delay and feed models which are then applied by the ONL system are a special case and delegated to “ONL calibration” and are not explicitly captured in this use case.

4.2 Key Concepts

- Standard Calibration Observing Scripts
- Three tier calibration
- Search for OBCs
- Conversion from SBCs to OBCs
- Data Processing and QA for OBCs
- Storing OBCs
- Validity Periods
- Accessibility of OBCs

4.3 Use Case Description

Steps are:

1. Step 11 in Use Case I: Phase 1 SBs are automatically generated, early at the beginning of the cycle, and are populated with all the information available. At this point, the Phase 1 SBs and Observation Specifications are largely aligned. The Phase 1 SBs are viewable and modifiable to (mostly internal) users. The Observation Specification is in the parlance of the proposal process; they are view-only to (mostly external) users. The Phase 1 SBs should include identification of OBCs and SBC types that are needed (unless the calibrator is explicitly specified by the user, which may not be a

standard observing mode), even if they are not currently available, and a prioritized list of candidate reference subarrays.

2. The mid-term scheduler generates the Phase II SBs, which include[1]:
   a. Observatory provided Calibrations (OBC): single dish and array calibration parameters maintained by the observatory through periodic measurements on a cadence appropriate for the individual parameters. This information will be provided to individual observations and used during their execution and data processing to ensure adequate calibration of the data obtained. OBCs include:
      i. A reference to an observation that has a value (like a flux) that can be referenced by an observation
      ii. A catalog of calibrator sources and their parameters that can be used in an observation (like a gain calibrator).
   b. Scheduling Block Calibrators (SBC): calibration data specific to individual observations and are obtained as part of the scheduling block to track parameters that change within an observation or are too specific and not generally applicable for the observatory to devote time to maintain under OBC.
3. A three-tier process is used for calibrator selection (details below).

Table 2. The three-tier calibration process [REF02].

Tier 1 (most common)	Tier 2	Tier 3
If a calibrator that meets the suitability criteria is in the calibrator database, then the Phase II SB is modified to include the SBC and if OBC, reference the OBC pointer.	If there is no suitable calibrator in the calibrator database, the mid-term scheduler uses reference source catalogs (like the VLASS source catalog) to find a nearby calibrator or choose an existing calibrator with an expired validity.	If there is not a suitable calibrator in the reference source catalogs or found in Tier 2, a cone-search is needed to find a calibrator.
The selected SBC calibrator will be used for both reference gain calibration and reference pointing calibration.	Using a "verification SB", the calibrator is scheduled, observed, and processed.	Using a "verification SB", the region surrounding the science target is scanned for a calibrator; prospective nearby calibrator is scheduled, observed, and processed.
The OBCs include multiple calibrator types and suitability includes period of validity check for each type, which when not met triggers creation of a verification SB for the OBC observation and data processing (or second step of Tier 2)	Once the calibrator passes QA_{cal}, it is evaluated by the Telescope Support Group. The Telescope Support Group must approve the addition of the calibrator to the calibrator catalog. The calibrator is then considered an OBC with validity parameter updated so	Once the calibrator passes QA_{obs}, it is evaluated by the Telescope Support Group. The Telescope Support Group must approve the addition of the calibrator to the calibrator catalog. The calibrator is then considered an OBC with validity criteria so that it can be

[1] See Calibration Conceptual Narrative.

Tier 1 (most common)	Tier 2	Tier 3
	that it can be scheduled within an SB as an SBC without further qualification.	scheduled within an SB as an SBC without further qualification.
The Phase II SB is updated to: • include a reference to the OBC so that it can be recorded appropriately in the metadata of the observation • include SBCs whose parameters in the calibration catalog meet the suitability criteria for the science observation.	Any Phase II SBs that include or reference this calibrator are updated.	Any Phase II SBs that include or reference this calibrator are updated.

4. The dynamic scheduler updates cycling and integration times for the SBC for the current conditions before execution. Validity of OBCs is checked before execution, which when not met triggers future OBC update process with high priority.
5. The dynamic scheduler executes the Phase II SB. During execution, TelCal is active, providing delay updates, pointing updates, computing and providing reference pointing solutions to the ONL system, computing switched power gain calibration factors and carrying out diagnostic analysis of calibration scans for immediate remediation action (steps 18a & 19 in 3.3). (covered separately).
6. QA_{obs} is conducted at the end of each CSB.
7. For OBCs in SBs, those data are sent to the calibrator pipeline for processing with high priority.
8. The Calibration Processing Block (CPB) is created when all required EBs are complete. See Step 22 in Use Case I.
    a. The CPB must be able to retrieve all relevant OBCs.
9. If the CSB contains an SBCs that can be used by other projects or SBs and the CSB passes QA_{cal}, then the SBC gets stored or updated as an OBC.
10. Telescope support staff are responsible for all OBCs entered into the calibrator catalog.
11. Users must be able to extract OBCs when downloading data.

5 Use Case III: Commissioning and New Modes

5.1 Description

This use case details the procedures for commissioning new observing modes and performing science validation. It covers the necessary support for these activities, which would occur alongside normal observatory operations.

5.2 Key Concepts

- Creation of manual SBs

- Command-line interface
- Commissioning GUIs
- Repository Access
- Interactive workspace

5.3 Use Case Description

1. The Commissioning Scientist decides which SB should be executed. The SB can either be:
   a. Download CSV repository of SBs, to be used as-is or modified
   b. Create a new SB
2. If an SB is modified or a new SB is created, it must be:
   a. Associated with a Project
   b. Uploaded to the SB repository for future CSV use.
3. The Commissioning Scientist have SBs executed by:
   a. asking the Array Operator to execute the SB on a given subarray or set of antennas.
   b. submitting SBs to the scheduling queue and set the priority of the SB.
4. The Commissioning Scientist runs SBs through a SB validator:
   a. to ensure the SB will run
   b. to ensure what is executed on the subarray will produce data that is structured in a way that can be used by other parts of the system (like data processing).
5. The Commissioning Scientist monitors the status of the hardware and alarms through a graphical user interface, which includes:
   a. Viewing the status of hardware (receivers, bands, etc.)
   b. Searching/filtering capability in the alarm system
6. The Commissioning Scientist views the output of[2]:
   a. the CSP in a graphical user interface
   b. the online (ONL) telescope calibration in a graphical user interface
   c. the values of the focus, pointing, delay models and antenna positions stored in the calibration database
   d. the results of pointing scans, values and/or in a graphical user interface
7. The Commissioning Scientist updates the values in the calibration database and needs the calibration database to retain historical/previous values.
8. The Commissioning Scientist uses a workspace that has access to the domain library of the data processing system and a python environment to:
   a. Read in stored data sets and examine the metadata and binary data
   b. Create plots of values extracted from the calibration database
   c. Recreate plots produced by the online telescope calibration
   d. Create holography maps (e.g., using Astrohack)
9. The Commissioning Scientist uses a command-line interface to the Observation Execution software to:
   a. Test the functionality of specific software, such as turning on/off fringe tracking and stowing
   b. Test the functionality of hardware, including reading the status (such as feeds, receivers and electronics, attenuators, RF switches, etc.). If the hardware is moveable, the

[2] See AIV/CSV document

Commissioning Scientist uses the command-line interface to move and/or interact with the hardware.

10. The Commissiong Scientist can:
    a. submit tickets regarding problems found during commissioning/testing
    b. can change the priority of a ticket, especially in the case of a blocker
    c. views problems reported through a ticketing system from others (engineering, operations, etc.) and can comment/update/investigate on the ticket.
11. The Commissioning Scientist views
    a. the monitoring database, which has filtering and search capabilities
    b. the electronic logs kept by the Array Operator (i.e., shift log tool)
12. The Commissioning Scientist searches/filters on:
    a. the software version in which the data were acquired
    b. the weather conditions
    c. time of day
13. The Commissioning Scientist has the option to re-execute the online telescope calibration manually from either a command-line or graphical interface with a given set of input parameters on historical data.
14. The Commissioning Scientist runs the data processing software, which includes:
    a. requesting computing resources, potentially with non-standard/non-production data processing software
    b. an interactive interface
    c. the ability to checkout, modify, store data processing scripts from a repository
15. The Commissioning Scientist stores and retrieves data sets for commissioning and testing purposes, which includes (both modified raw data and data processing results):
    a. benchmarking and end-to-end validation data sets
    b. executing the pipeline or parts of the pipeline
    c. datasets from the same observation using two different pipelines
    d. intermediate results from pipeline development
    e. data sets that may have been modified from original data
    f. launching an arbitrary pipeline build using production or test hardware
    g. store and retrieve results from test pipeline executions

6 Use Case IV: Operations from an Array Operator Perspective

6.1 Description

This use case focuses on observatory operations from the perspective of an Array Operator. It describes the standard operational procedures, including the interaction between the operator and key software components like the dynamic scheduler, to manage and oversee scientific observations.

6.2 *Key Concepts*

- Operator Logging
- Configure Telescope System
- Create and Destroy Subarrays
- View and Edit Schedule
- Stop Running Observation
- Operator Supervision and Control
- Hardware Monitoring
- Calibrator Database Maintenance
- Statistics and Reporting

6.3 *Use Case Description*

1. The Array Operator(s) handoff
   a. New Array Operator authenticates and verifies all services are operational.
   b. Services will be restarted automatically in case of power goes down/failure (recovery).
   c. If the Array Operator detects a failure in one of the services, they can restart specific services and/or hardware components. If needed, a call-out list is used to contact the appropriate staff.
2. The mid-term and long-term scheduler run automatically on a given cadence; the output is viewable to Array Operators and Scheduling Scientific staff.
   a. The mid-term scheduler, which operates on an approximately 1–4-week window, generates the Phase II SBs based on known/current calibrators and available antennas compared to the reference subarray.
   b. The long-term scheduler should be run approximately monthly, forecasts the rest of the observing cycle based on already executed SBs, upcoming SBs, and current and predicted conditions. This can be compared to the Schedule Forecast (see Use Case #1, Step 4).
3. The Array Operator monitors the dynamic scheduler through:
   a. Fully automated mode.
   b. A semi-automatic (“advisory”) mode, where the dynamic scheduler suggests options and the Array Operator, modifies as necessary, and approves it.
   c. A manual mode.
   d. The dynamic scheduler shows all the subarrays, the antennas included in the subarrays, and all the executions queued for them.
   e. Each subarray can be set in a different mode (automatic, advisory, manual).
4. The Array Operator can set aside antennas for maintenance and testing through the manual mode of the dynamic scheduler.
   a. The Array Operator can mark antennas that should be removed for consideration for use by the dynamic scheduler.
   b. The Array Operator can mark antennas that have been returned to service to be used by the dynamic scheduler.
5. The scheduling queue can be modified:
   a. Array Operator can view alternative solutions to the scheduling queue suggested by the dynamic scheduler

   b. The Array Operator may change the ordering/priority of the SBs or change the SB scheduling parameters.
   c. The Array Operators, Scheduling Scientific staff, and other authenticated users can create SBs as long as the SB is associated with a project.
   d. The Array Operator can add SBs (that are linked to a project) to the queue with an associated priority.
   e. The dynamic scheduler will display metrics based on (possible) changes to the scheduling queue.
6. At the end of each CSB, the Array Operator can:
   a. Monitor the online calibration and QA_{obs} results at the end of each CSB.
   b. Monitor the incremental writing of data to a storage buffer and/or the archive.
   c. Monitor any alarms triggered at the execution.
   d. Add notes at the end of the CSB as part of the QA_{obs} report.
7. The Array Operator may (in an exceptional case) stop/cancel the execution of an SB.
   a. The Array Operator should have the option to stop the execution either during a CSB or at the end of the CSB.
   b. The Array Operator should have the option to create a ticket if an execution is canceled.
   c. In the case of science observing, a ticket should be automatically created if the Array Operator stops or cancels an execution.
8. The Array Operator takes out antennas or adds in antennas into a subarray.
9. The Array Operator needs the ability to stow an antenna.
10. The Array Operators need to record notes electronically during the operator shift.
11. At the end of an execution, the dynamic scheduler determines if the subarray is needed for upcoming observations and, if not, destroys the subarray.
    a. The dynamic scheduler should make decisions of creating or destroying subarrays at any time, maintaining a schedule of subarrays that is constantly getting updated whenever a significant change that could affect the schedule is detected. Relevant changes are associated with the inputs to the scheduling algorithm: changes in priorities or weights, triggered observations, changes in weather, etc.

6.4 Array Operator Graphical Views

6.4.1 Dynamic Scheduler Views

1. Runs automatically and can be triggered on conditions such as: the completion of an SB, changes in weather conditions, reception of a triggered observation, on a time-cadence
2. The dynamic schedule can apply optimization options on the schedule, for example:
   a. the dynamic adjustment of the cycle times upon changing weather conditions
   b. coordinating the execution of OBC observations when the corresponding calibrations have expired
   c. the avoidance of zones of high expected RFI.
3. For the upcoming observation, the dynamic scheduler may update the Phase II SB based on available antennas and hardware resources and may adjust the calibrator.
4. The dynamic scheduler creates a subarray for the upcoming observation.
5. The dynamic scheduler executes the SB on the assigned subarray.

6.4.2 Scheduling Views

1. The Array Operator can look at the upcoming observation and its position in the current observing schedule through a "timeline" view. The Array Operator can see:
    a. all the subarrays that have been created and will be created by the real-time scheduler.
    b. the SBs that are being executed or will be executed on all existing subarrays.
    c. the CSBs that are to be executed in each subarray.
    d. the SBs that are paused or canceled.
2. The scheduling queue can be altered:
    a. The Array Operator can view alternative solutions to the scheduling queue from the real-time scheduler.
    b. The Array Operator can change the ordering of SBs or change the SB scheduling parameters.
    c. The dynamic scheduler will present metrics for these solutions and display graphical visualizations such as pressure plots.
3. The Array Operator can view the status of the different resources required by an observation: antenna resources, CSP resources, data transport and processing resources, RFI status, and weather.
4. The Array Operator to pause/resume/cancel the execution of SBs through the dynamic scheduler.
5. The Array Operator can take out antennas or add in antennas into a sub-array that has been paused.

6.4.3 Observation Monitoring and Quality Assurance Views

1. The Array Operator can view the timeline of the SB, displaying target scans, calibration scans, and underlying hardware operations.
    a. The Array Operator can click in these operations and see the parameters that will be sent to the telescope hardware.
2. The Array Operator can view all the logs generated by the system during the observation, through an interface that allows filtering and searching, including by priority and subarray.
3. The Array Operator can view the calibration results calculated by TelCal in graphical and tabular form.
    a. The calibration results should be presented in a similar way as PI science data (i.e., a "mini" science portal).
4. The Array Operator can view QA_{obs} alarms that are triggered when the calibration results are outside the allowed (and configurable) threshold.

6.4.4 Hardware Monitoring Views

1. The Array Operator can visualize the status and health of all the telescope electronic equipment, such as the antennas or the CSP.
    a. The Array Operator can "zoom-in" into detailed views for specific devices.
2. The Array Operator can view the alarms, which alert users of abnormal conditions. The view of these alarms incorporates logic for analyzing the root cause of failures, in order to avoid overwhelming the Array Operator with large numbers of derived or secondary alarms.
    a. The Array Operator can acknowledge and confirm alarms, according to standard error management interfaces.

    b. The Array Operator can view more details for each alarm.
    c. The Array Operator can filter/sort the alarms based on priority.
3. The Array Operator can configure the alarm management function and other views.

6.4.5 Weather View

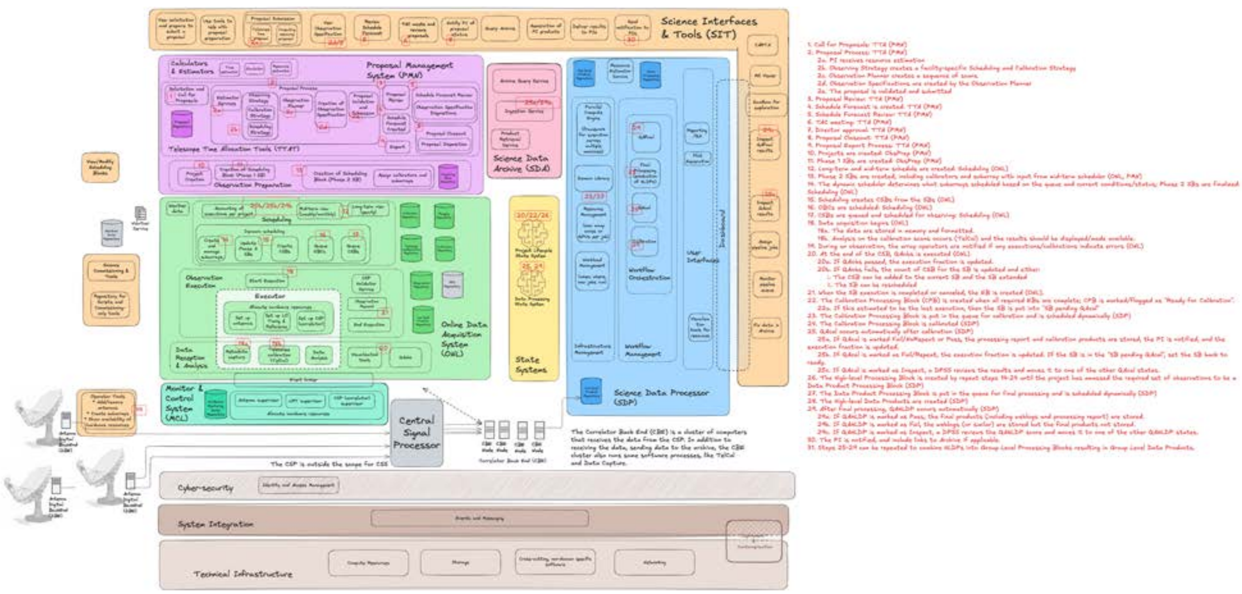
1. The Array Operator can view the weather station data from all weather stations.
2. If external weather information is provided, the Array Operator can view these data.

6.4.6 Safety and Maintenance View

1. The Array Operators can view video and still images located at each of the antennas.

7 Excalidraw Diagram

https://link.excalidraw.com/readonly/wCoJ7nDmIMZVs4OPsTGI



8 Acronyms

Term	Meaning
AD	Applicable Document
CfP	Call for Proposals
CPB	Calibratable Processing Block
CSB	Calibratable Scan Block
CSE	Calibratable Scan Execution
CSS	Computing and Software Subsystem
DPPB	Data Processing Product Block
DPSS	Data Processing Support Staff
HLDP	High Level Data Product
HPB	HLDP Processing Block
IPT	Integrated Product Team
ngVLA	The Next Generation Very Large Array Project
NRAO	National Radio Astronomy Observatory
NSF	National Science Foundation
OBC	Observatory Provided Calibration
GLPB	Group Level Processing Block
SB	Scheduling Block
SBC	Scheduling Block Calibration
SMDR	Standard Mode Data Reduction
TAC	Time Allocation Committee
TBC	To Be Confirmed
TBD	To Be Determined
VLA	Very Large Array
VLBA	Very Long Baseline Array