Title: Charge to the ngVLA CSV Workgroup	Date: 12/28/2018
Authors: R. Selina, E. Murphy, J. Kern, M. McKinnon	Version: 04

Charge to the ngVLA CSV-WG

1. Overview

The ngVLA Commissioning and Science Validation (CSV) Work Group (CSV-WG) is charged with defining the CSV Concept for the facility and developing a preliminary ngVLA CSV Plan. This group should provide the interface between the various affected teams within the project, as well as other large-facility commissioning experts within the observatory, and ensure that their feedback is incorporated into the ngVLA CSV Concept.

The CSV concept may impose requirements on functional capabilities and their deployment schedule, as well as the effort and processes required to deliver a commissioned telescope to Operations. The CSV requirements and their impacts should be reflected in the Astro2020 Decadal Survey proposal materials.

The overall construction concept for the ngVLA has work-packages delivering qualified sub-systems or sub-assemblies to the Assembly, Integration and Verification (AIV) team, the AIV team assembling these into integrated and verified systems, and handing over these verified systems to the CSV team for progressive commissioning of capabilities. Construction ends with the hand-over of a commissioned ngVLA to Operations. These hand-offs are expected to be incremental, with a goal of completing the construction phase by 2035 (10 years for all construction activities). The ultimate deliverables from CSV are commissioned observing modes that can be used by standard PIs to conduct their science.

The details of the roles of the work packages, AIV, and CSV are still in flux. In parallel to the CSV-WG, an AIV-WG will develop the assembly, integration and commissioning concept for the facility. Each WG should stay informed with the activities of the other to ensure the final concepts are coherent and complementary. The CSV-WG should also be aware of the operations concept for the facility and any implications for early science and commissioning.

The roles and responsibilities of the ngVLA CSV-WG are summarized below.

2. Membership

The membership of the ngVLA CSV-WG will be selected to cover a broad range of expertise in relevant areas and should include representation from prior project commissioning teams (VLBA, JVLA, ALMA) and affected work packages. The number of

people serving on the CSV-WG is not set. The CSV-WG will be overseen by a chair, who will be responsible for coordinating the group's activities.

The proposed composition of the CSV-WG has some overlap with the Operations Work Group (OWG) to ensure the CSV concept is consistent with both the transition concept and the operations concept for the facility.

Possible group members, pending discussion with and approval by relevant supervisors, include:

1. Todd Hunter (**Chair**, CSV Lead)
2. Jeff Kern (SRDP, ALMA S/W)
3. Rafael Hiriart (ngVLA Software & Computing IPT Lead)
4. Joan Wrobel (Sci Ops, ngVLA Early Science)
5. Bryan Butler (ALMA and EVLA Commissioning)
6. Barry Clark (VLA, VLBA, and EVLA Commissioning)
7. Vivek Dhawan (Sci Ops)
8. Walter Brisken (VLBA)
9. John Hibbard (Sci Ops, ALMA Commissioning)

Additional members to be added based on suggestions from Project Director or experience of the Chair.

Ex-Officio members:

1. Eric Murphy (ngVLA Project Scientist)
2. Rob Selina (ngVLA Project Engineer)
3. Cristina Simon (ngVLA Systems Engineer)
4. Chris Langley (ngVLA AIV Lead)

3. Meetings

The frequency of ngVLA CSV-WG meetings or teleconferences is to be decided by the CSV-WG chair, but should be no less frequent than monthly.

4. Charge

The CSV-WG will play a critical role in the technical design of the ngVLA. The initial charge to the CSV-WG is as follows:

- Consult widely with the construction and commissioning communities of ALMA, VLBA, and the EVLA to provide advice to the ngVLA Project Office on CSV concerns.
- Provide the ngVLA CSV concept. Prepare a preliminary CSV plan to guide the design of the facility and the commissioning approach.

5. Deliverables

The ngVLA CSV-WG will be responsible for the following deliverables to the ngVLA Project Office leading up to the Astro2020 Decadal Survey and extending into the conceptual design phase. Where appropriate, target dates are listed for each deliverable. Deliverables may be modified or refined with the agreement of the CSV-WG and Project Office.

1. **Commissioning and Science Validation Concept**: The CSV concept would describe the overall approach to taking verified sub-systems and validating observing capabilities that can be provided to users. A first draft is requested by February 8th, 2018, with a final draft by March 30th, 2019 in support of the Astro2020 Decadal Survey submission.
2. **Preliminary Commissioning and Science Validation Plan:** Building on the CSV concept, this plan would provide sufficient detail for accurate costing of the effort involved. Where the Concept is qualitative, the Plan is quantitative and provides clear steps for progressive validation and the deployment of capabilities, and the criteria that defines the state of these system capabilities as they are handed over to the Operations team. The plan is preliminary as it will be expected to be elaborated through the design and early construction phase of the facility. This preliminary version is due by October 30th, 2019 to support the MREFC candidacy proposal which will likely be submitted in FY2020.

6. Notes on the AIV and CSV Concepts

The following notes are applicable to both the AIV (out of scope) and CSV concepts. The notes are provided to both groups for consistency and clarity.

- AIV will complete an engineering check-out and verification that the antennas, CSP and associated systems perform to their specified requirements.
- CSV is responsible for taking those verified components and performing any necessary integrated performance tests to release useful observing modes to users.
- While formally outside the scope of AIV, the AIV concept should describe the overall production concept for the deliverables of the major work packages, with an emphasis on the degree of verification performed by the work package, the state at delivery, and the location of delivery. This guidance will then be elaborated by each work package lead in their respective production plans.
- It is highly desirable to broadly identify the resources (infrastructure, people, etc.) required activities in each concept document.
- The AIV concept should define a set of integration milestones that show a progressive integration of the system and functional capabilities. The scope of

AIV would include initial verification of not only the antennas, but functional integration with the correlator and online control system.

- The final AIV milestone, where capabilities are handed over to CSV, is stable computer-controlled fringes on a calibrator source. This milestone should be elaborated as part of the AIV concept, but may include:
    - A performance-verified antenna with pointing model, tracking model, and focus model coefficients recorded into the observatory calibrations database. The antenna surface (forward gain) and system temperature should also be verified to be within specification.
    - Measurements of electronic delays recorded in the observatory calibration database.
    - A functional demonstration of the digital signal processing chain ending with visibility data in the correlator back end.
    - Producing stable fringes will require that fringe tracking and fringe rotation functions be implemented for short-baselines (<1 km).
- The AIV and CSV teams may negotiate the interface/hand-off boundaries, modifying the milestone described above to their mutual satisfaction.
- The preliminary AIV Plan would develop specific criteria for pass/fail of each integration milestone, identification of clear inputs that would be required before starting the activities of the milestone, the high-level procedure/steps/test plan associated with that specific milestone, and required resources.
- The CSV concept should define a set of early commissioning milestones that show a progressive integration of the system and provide useful observing capabilities. The following list provides some examples:
    - Phase closure, long-baseline fringe tracking, short baseline manual imaging, long baseline manual imaging, full-beam and full-bandwidth modes, automated instrumental calibration, automated imaging, etc.
- The CSV milestones should initially progress towards capabilities that observers can use for early science. The ‘early science’ milestone could be refined in the process.
- CSV milestones would get progressively more complex, extending into use of the calibration and imaging pipelines for more science use cases and delivery of SRDP. The ultimate deliverables from CSV are commissioned observing modes that can be used by standard PIs to conduct their science.
- CSV ends when all capabilities that are required to meet the Science Requirements and Operations Concept are reached and the facility is handed over to Operations. A reasonable exit criteria is that for any delivered mode the data can be acquired using a standard SB created using the PST and post processed by the automated system.

- The depth of the concept is the definition of the milestones, likely with a paragraph associated with each. Specific criteria would not likely be present for each milestone.
- It may be desirable to include some early science within CSV, demonstrating that the facility can actually achieve a KSG-supporting observation. How much of this is done under CSV vs. PI proposals is up for discussion.
- The CSV concept may want to address how CSV communicates deficiencies back to AIV for resolution (e.g., via JIRA tickets with an appropriate workflow to report problems, and have the design/production/integration teams resolve the issue and then hand the system back to CSV).
- The preliminary CSV Plan would develop specific criteria for pass/fail of each commissioning milestone, identification of clear inputs that would be required before starting the activities of the milestone, the high-level procedure/steps/test plan associated with that specific milestone, and required resources.