

National Radio Astronomy Observatory

EVLA Advisory Committee 2006 – Final Report

6/1/2006

The committee thanks the project for its informative presentations and commends them for excellent progress over the past 18 months. Some of the highlights seen in recent days (e.g., the efficient implementation of pre-commissioning tests, and the band pass stability results) were extremely impressive. We find the project making strong progress towards its goals.

Management

1. Overall management: very little quantitative information allowing assessment of project performance has been presented. We urge the new PM to develop metrics for project performance (scaled appropriately for the EVLA) for review by NRAO and external stakeholders. The cost of the risks to the project should be estimated, and the appropriate level of contingency defined. The descope options presented must be examined closely to understand the real savings. This analysis should include all potential descopes, not just the easy or politically-preferred options; for example, we believe a decision to descope two receiver bands in favor of an advanced post-processing software system may not be supported by the general community. We urge NRAO to seek broad input from the community if descoping is required in the future.

There are faint signs that project performance is 5-15% below that required to execute the current scope within budget and schedule (with some evidence of an overall delay of up to a year); this needs to be quantified as soon as possible, and a recovery plan developed. Simple metrics can be very informative, for example, a plot of the number of problems versus time would convincingly demonstrate that EVLA technical performance is “over the hump,” or a tally of the number of external users of the EVLA antennas over time would show community acceptance.

2. Risk analysis: as noted by the PM, the existing risk/contingency analysis is a first step. The committee felt that with perhaps one or two exceptions (L-band OMT, digitizers), the technical risk remaining is pretty low. The schedule risks associated with correlator integration and delivery, software delivery, and lack of commissioning staff seem quite high, and should be quantified via standard techniques.
3. Formal testing, verification and integration plans need to be developed and reviewed immediately. Project management should develop consistent system engineering approaches for subsystems to follow to produce an efficient process. The project is now moving beyond subsystem development, and needs to focus on the upcoming integration task. These plans can be quite short (5-10 pages), at least defining the scope and purpose of each test, identifying the performance parameters to be verified, and specifying the targets for each integration step. For software test and verification plans, sufficient coverage of code should be ensured to avoid late detection of problems.
4. Science advisory group: based on the varying responses received regarding the scope and terms of reference of any such group, the committee urges further discussion within NRAO before proceeding. In general, working groups of interested parties may be more useful at this point.
5. Priorities: the committee felt that there is not a project-wide consensus on the priority 0, 1, and 2 development items for Scientific Support Services; this will make it difficult to set priorities or select descopes. A clearer statement of the project deliverables and priorities should be prepared and reviewed within the project.

The committee observed that priorities for Scientific Support Systems are not well defined since the priority 1 (essential) requirements are being reprioritized into priority 0 and 1. A stable set of priorities that accurately reflects what is essential for EVLA (and what is not) is needed for software development to be successful. Given the budget and schedule constraints, it is vital that the highest-level priority class contains only those requirements that are absolutely essential to the Observatory, and that this prioritization is used by all involved. The alternative is to invite thrashing as requirements are re-prioritized with each and every funding and schedule issue.

Hardware

1. The correlator team is presenting a success-driven schedule which is beginning to compress at the end; in addition, schedule risk from poor vendor performance is evident and may worsen, a risk largely outside project control. We urge the PM to monitor the situation closely; fallback positions (involving longer periods of transition observing) have been mentioned and should be planned with contingency. We anticipate that successful integration of the prototype correlator beginning August 2007 will be an extremely important (and difficult) activity for the project; more schedule contingency (e.g., in the commissioning plans) is strongly recommended.
2. Recommendation: we urge the project to more clearly define role of correlator On-Sky Testing (OST) – if the goal is to debug correlator hardware, then reschedule OST to where it can make a difference to the production; if the goal is to develop integration procedures, we suggest the project documents the deliverables e.g., calibration techniques.
3. The committee noted concerns expressed by both the Correlator and the M&C groups regarding data handling and throughput at the back of the correlator, and in particular how the backend of the correlator interacts with the M&C system. Clear well-documented interface control is required. We strongly urge the project to address this problem immediately via management review and data simulation (ongoing in other projects, e.g., LOFAR). The technical risk is probably low.
4. The committee notes that the recent progress on the debugging and testing of the EVLA receivers and feeds has been excellent. Recent tests of the performance show that the aperture efficiencies, system temperatures, and bandpass stability are all meeting expectation with the exception of the L-band performance, which is close. The L-band performance will most likely be improved by reducing the 5K contribution to the system temperature from the OMT/feed assembly. Work on improving the L-band OMT/feed is slow partly because the large feed currently takes three days to cool down so that tests of modifications to improve the heat conduction from the refrigerator cold station to the OMT and to reduce the heat loss to the feed is slow. It seems likely that the replacement of aluminum parts with copper to improve heat conduction and the addition of an added heat shield between the OMT and the outer case which connects to the feed will solve the problem. Other refinements which are being considered are material changes to the feed probes and the large window. Also the thermal gap between the cooled parts of the OMT and the outer case may need adjustment to keep the recently noticed resonance out of band. The fabrication of a C-band version of the OMT is underway which will aid in finalizing the design as it should be possible to cool down this feed much more rapidly and consequently reduce the time to test the final revisions to the design. Current estimates from Bob Hayward and Paul Lilie are that the C-band OMT prototype should be available within the next two months. A copy of the L-band OMT is now available to place in front of the cooled OMT for more accurate noise temperature measurements in the lab.

Measurements on both the L- and C-band OMTs may be important to solving this difficult problem and allow NRAO to finalize the optimization of the design. The committee is concerned that unless OMT development is completed soon there could be a serious impact on the schedule, and pointed out the urgency of this development 18 months ago. The OMT refinements probably need another couple of months to complete, assuming all goes to plan, and we urge the project to complete this as a high priority.

5. Round trip phase measurement system: this still needs more testing before finalizing the design of the system. There are no indications of any phase stability problems but more tests are needed to verify the performance.
6. Digitizers: the plan for the DTS digitizers seems to be in a holding pattern awaiting in-house evaluation of various options. The committee appreciates the project's wish to define fall-back scenarios, but urges NRAO to develop a plan for digitizer implementation, ensuring an "apples to apples" comparison (i.e., objective comparisons at comparable maturity levels). The trade-off between the two options should not be limited to a performance comparison of the digitizer chips, but should also take into account the effort needed to develop a new critical high-speed digital board for the in-house option.

Software

1. Scientific Support Systems (SSS): the committee noted the efforts ongoing within both the EVLA software group and ALMA to develop common standards, code sharing, and collaboration. This is an important effort not only for the projects themselves, but for the radio astronomy community and we commend the EVLA group for its proactive stance on this issue.

It is not clear to the committee that the EVLA software system, given the very similar scientific and technical requirements, will be significantly smaller or less complex than the ALMA system. The total investment for SSS could easily be 50-100 FTE-years of programming effort, requiring resources greatly exceeding anything mentioned in this review as available in the near future. It was also commented that the science impact of the wholesale adoption of the ALMA software infrastructure would be small or nothing.

As a result, the committee recommends that the e2e Operations Development Division and EVLA software team should continue to explore collaboration with ALMA's computing group in order to achieve significant reuse of ALMA software. This investigation should objectively examine the scientific, technical, and budget/schedule advantages of all the different modes of collaboration that might be considered.

2. e2e Operations Development Division –The committee was presented preliminary details regarding the motivation for and implementation of this major management change. The implementation of an e2e division which has both an Observatory-wide coordination role and direct line management of selected project developments seems complex; a mediating role throughout the Observatory may be the most important contribution. The management structure and interaction between e2e, SSS, and Operations was not at all clear, and clarification should be given a high priority. Another key role for e2e is to bring in expertise and resources to fill in the shortfall in EVLA budgeting. We strongly recommend the new e2e AD set her own schedule for planning this important effort, and not react to artificial external deadlines.
3. Recommendation: As it enters the project, the e2e Operations division must bring new resources to cover the EVLA budget shortfall for Scientific Support Systems software plus any contingency assessed against the software tasks. The existing (low) contingency should be left with the PM to handle broader project/hardware issues.
4. Algorithm Development: The handling of data from EVLA will pose real challenges and entire new algorithms will have to be developed. We strongly encourage NRAO to invest more in algorithm development and to seek collaborations with ongoing developments elsewhere. We applaud the work that was presented by Sanjay Bhatnagar and support his request for more dedicated staff time to work on problems related to low level RFI rejection, wide field imaging, interactive data display, and parallelization of code, just to mention a few examples.

5. Monitor & Control: planning for M&C support of transition observations seems to be in an advanced state; the committee notes the excellent progress, however we (again) recommend full documentation of the M&C design and interfaces be completed before further significant planning/development begins. The Operator Interface looks very good, and is already proving useful in transition. The interaction between programmers and experienced operators in this area has been quite productive.
6. RFI technical development, which is extremely important to the EVLA wide-bandwidth system, especially at L band, was not mentioned in detail at the meeting. It is clear from the project book that RFI mitigation in the EVLA systems (in the front-ends, the correlator, and in post-processing) has been considered. However, the committee recommends that its visibility within the project should be raised, and requests an update on the status of this work in the near future. The recent reassignment of Rick Fisher leaves an important vacancy which needs to be filled immediately.
7. CASA: the committee considers that the current approach being followed (extensive internal review followed by introduction of external reviewers) seems sensible and follows the recommendations made by the AIPS++ Technical Review in the Spring of 2003. However, that review anticipated that by this time, three years later, a usable product would be available to at least a limited set of users. To accelerate community acceptance of CASA, we encourage NRAO to involve more external testing and user feedback as soon as possible. Strong community use of the EVLA will depend critically on the functionality and interface of CASA, and the committee requests a more extensive demonstration of CASA (including an example data reduction) at the next meeting.
8. The committee commends the EVLA software group for pursuing archive solutions consistent with technologies used elsewhere in the radio astronomy community – this offers a significant reuse opportunity.

Operations & Commissioning

1. Operations: the plans presented need to be reviewed more closely within NRAO and the radio community, and should be presented in depth at the next review. The committee did not feel able to comment on the very preliminary plans presented for the Array Science Center.
2. The committee urges NRAO hire a postdoc to perform the antenna performance checkout, as discussed by the Project Scientist.
3. The committee noted that given the current staffing and the large number of tasks in commissioning for the EVLA, more staff are clearly needed. A hiring plan which clearly identifies skill sets, hiring dates, and funding should be developed by the project manager.
4. The committee feels that by far the best way to attract attention to the EVLA in the broader community is to get astronomers involved as early as possible. To work (if only temporarily) in an environment where new and unexpected things happen can be an inspirational experience. Many of the committee members have been in such a situation in the past and it got them hooked on synthesis imaging for life. We recommend that NRAO creates some EVLA commissioning postdoctoral fellowships. These fellows could be closely involved in testing the new system and would be ideally situated to write winning observing proposals for the early science stages of EVLA.
5. The committee urges NRAO to aggressively engage the user community in test observations in support of commissioning activities from the earliest possible time. Proposers should come to Socorro for the observations to ensure maximum interaction between staff and users.

APPENDIX

Meeting Attendees:

Beasley
De Vos
Dougherty
Miller
Raffi
Reid
Rogers
Scott
Van Gorkom

Charge from NRAO Director:

The charge of the Advisory Committee is to evaluate and report on the following aspects of the project:

- Progress in software development and deliverables, and adequacy of the external review process;
 We ask that software be an area of emphasis in this review;
- Progress in hardware development and deliverables;
- Progress in outfitting and re-commissioning EVLA antennas;
- Progress in development of the WIDAR correlator;
- Scientific commissioning plans;
- Early operations plans and long-range vision for operations;
- Progress in meeting the overall project plan;
- Management of budget; status of contingency funds, and contingency options;
- Project management team.

We request an exit interview with the NRAO Director at the conclusion of the Review meeting, and a written report with comments and recommendations within one month of the Review.