NRAO Users Committee Report 2014

September 22, 2014

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1 Executive Summary

The NRAO Users Committee (UC) is a scientific advisory group to the National Radio Astronomy Observatory (NRAO) that provides input on matters relating to Observatory's interfaces to its user community, the Observatory's interactions with the larger astronomical community, and the Observatory's scientific productivity. This document reports on the discussions, findings, and recommendations of the UC following its annual meeting at NRAO Headquarters (Charlottesville, VA) on 2014 May 29–30. The UC has 22 members, of whom 15 attended at least some portion of the meeting.

This meeting also represented the initial steps of integrating the ALMA North American Science Advisory Committee (ANASAC) as a standing subcommittee of the NRAO Users Committee. The ANASAC also conducted a separate one day meeting on 2014 May 28, the outcomes from which are also incorporated into this report.

Summary of Key Findings and Recommendations:

- The NRAO continues to do an excellent job in representing the entire radio astronomy community, both at a national level and on the international stage, particularly in stewarding the observatory through a difficult period of declining budgets in recent years. The UC commends the NRAO staff and management for their considerable effort.

- Staff morale is a key aspect of a well-functioning observatory and, to this end, we urge the NRAO to ensure that the career progression and research opportunities available to NRAO staff remain a high priority.

- The UC applauds recent concerted efforts to improve observing efficiency across all facilities.

- The UC is highly supportive of continued NRAO efforts to explore new partnerships and arrangements towards increased external funding for the GBT and VLBA.

- The UC congratulates NRAO on its contributions to ALMA, recognizing that not all contributions may appear equally visible but that they are all important. The success of this international observatory owes much to the staff of the NRAO.

- In order to reach the full scientific potential of ALMA, the UC encourages the complete checkout of all pads and power as quickly as possible and recommends rapid development of a plan to address the apparent temperature-dependent astigmatism of the North American antennas.

- Early science from ALMA Cycles 0 has been spectacular and has resulted in more than 40 publications. To help maximize this productivity the UC encourages the NRAO to implement modifications to the ALMA OT to garner information on the status of data previously obtained by the PI and to proactively interact with PIs to understand and assist with any delays in publication.

- The UC recommends revising the definition of "large" programs for ALMA, lowering the threshold of such programs to 50 hours with large proposals allowed in Cycle 3.

- The UC recommends better systematic recovery of statistics on the non-expert and student user engagement for ALMA. In a similar vein, we strongly endorse the idea of having the interferometry school at Charlottesville on alternate years, with a focus on ALMA basics and on generating new users.

- Better structured and detailed constructive feedback to the PI is required in future ALMA proposal evaluation, compared to that achieved for Cycle 2.

- The VLA continues to perform impressively, with a number of new capabilities commissioned in the last year. The UC commends the efforts of the NRAO staff who have delivered this new telescope and their efforts to make new capabilities available to the user community rapidly.

- The UC notes that the prioritization algorithm used to schedule VLA observations has not been well documented, although there have been recent efforts to redress this problem. This can allow knowledgeable users to effectively "game the system" to obtain time in a manner unconnected to the scientific merit of their proposal. It is also not apparent that the current prioritization algorithm best ensures that the projects highly weighted by the SRPs are given high priority. In the long run, improved scheduling or prioritization algorithms should be developed.

- Clearer recommendations for whether to use 3-bit or 8-bit samplers at C and X bands with the VLA, e.g. via example use cases in the documentation, would be welcome.

- The UC recommends that the NRAO investigates how high sensitivity VLBI observations at high frequencies, involving the VLBA, ALMA and the Large Millimeter Telescope (LMT), can be offered to the community.

- The UC recommends that, to the extent possible, NRAO ensures that the GBT retains the necessary resources to allow for the successful deployment and operation of new instruments, such as Argus and Mustang 1.5, in a timely manner to allow key early science return on these significant investments.

- The UC understands that the Archive Access Tool (AAT) has had high priority for the Data Management & Software group in the last year, but would like to reiterate that the Proposal Submission Tool (PST) and Observation Preparation Tool (OPT) also represent significant user-facing tools with outstanding long term issues. The issues outlined in the Appendix to this document should be addressed in the prioritized manner presented, where possible.

- CASA continues to grow in capability and user adoption. The UC appreciated benchmarks of CASA performance, but ask that future benchmarks be more representative of the range of typical user experience, from laptops to optimized workstations. Concern still remains over the lack of migration of certain key capabilities from AIPS to CASA.

- The NRAO should continue to work toward a unified look and feel of the ALMA and NRAO archives, but not at the cost of functionality.

- The NRAO archive would be much enriched if users were encouraged to design their observing blocks to include commensal coverage of potential line-rich regions with high spectral resolution. We note that the associated pressure on data transport and storage will be a factor that must be considered, but the potential science return justifies investigation of the concept.

- The continued development of the VLA and ALMA pipelines is deemed high priority by the UC. The VLA pipeline has largely been a success and the ALMA pipeline release is eagerly awaited, with automated calibration a high priority. The automated flagging of SPWs that fail to be calibrated by the pipeline was suggested as a useful modification to the VLA pipeline.

- The UC recommends that the reciprocal time allocation programs (e.g. with HST), continue to be advertised widely to encourage user pick-up. Clearer guidelines on how to present the science and technical case for both instruments would be welcome and may perhaps warrant additional proposal space.

- The UC strongly recommends that the Jansky Fellowship program continues to allow fellows to reside at remote sites for the duration of their appointment. Abolishing this aspect of the program will negatively impact the pool of future applicants, and, as a consequence, diminish the prestige of the fellowship.

- The health of the CDL remains key to the continued operation of NRAO facilities and development of the technology that will shape the future of the observatory. ALMA development funds have been, and should continue to be, an excellent resource to maintain CDL expertise in key technology. Development of large array receivers may prove to be a future growth area for the lab.

- The VLASS has demonstrated a large degree of community support, but the review process must be rigorous and impartial and the opportunity cost of such a large allocation requires strong justification.

- A pragmatic and forward thinking approach to spectrum management was presented at the UC meeting. The UC encourages the NRAO to engage and lead the community in a strategy that explores all options to address this issue.

- The UC strongly supports the NRAO's traditional stance on Open Skies as a way of maximising the scientific productivity of its own telescopes. However, we acknowledge the difficult political situation presented and the need for the NRAO to have leverage to negotiate on behalf of the entire US community for access to restricted facilities.

- The UC welcomes the NRAO's continued engagement of the community on the scientific priorities that will motivate next generation NRAO facilities. This dialog needs to happen now to allow the NRAO to plan appropriately for the next decadal survey.

- We applaud the initiatives on outreach, and particularly on diversity (the National Astronomy Consortium), and encourage NRAO to continue pursuing them.

- In contrast to previous UC meetings, the presentations at the 2014 UC meeting were too focused on management issues, without specific questions or issues for which UC input was desired. The UC recommends that presentations at the 2015 UC meeting return to a focus on user-related issues and allow more time for discussion.

2 Facilities

2.1 ALMA Construction

As the construction phase of the ALMA project draws to a close, the UC congratulates NRAO on its contributions to this incredible observatory. Though not all of the systems that NRAO has been responsible for are as visible as, e.g., the excellent band 6 receivers and the correlator, they are obviously all integral to the success of the project. That the ALMA NA construction project will end with a projected budget surplus is also a notable achievement.

One ongoing construction project is the verification and acceptance of the antenna stations and power across the full array footprint. The completion of the 192 stations is obviously crucial to the success of ALMA science, as the array capabilities improve to complete Cycle 1 science, reach the full resolution promised in Cycle 2, and explore much more extended array configurations that will hopefully become available in Cycle 3 and beyond. The enormous sensitivity gains of ALMA have already largely been realized, combining this with angular resolution that matches or exceeds the best optical/IR imaging will be an important step toward matching the high expectations of the NA astronomical community. Toward these ends, the UC supports the goal of completing checkout of all pads and power as quickly as possible to ensure full readiness for Cycle 2 science operations, though pads needed for science and the long-baseline campaign must be thoroughly vetted in time for these activities.

The major remaining construction issue is the apparent astigmatism present in the Vertex antennas. Temperature-dependent deformation of the antennas is a pernicious problem, becoming most significant in the cold winter weather that favors precisely the high frequency observations that would be most degraded by the deformation. The subtlety of the effect is such that it was not detected in OSF holography and therefore additional vetting of the measurements was desirable. Now that independent evaluation of the holography measurements has verified prior results, the UC hopes that NRAO will again vigorously pursue a plan for corrective action with the antenna contractor, General Dynamics. An important goal for this process is to determine the impact on Cycle 3 observations in time for the call for proposals so that the community can be fully informed before preparing proposals. We encourage NRAO to make information about the problem available to the community so that its scope and the timescale for mitigation will not be the subject of rumors. The UC notes that ALMA's high-frequency capabilities are essential to its scientific impact in many science areas and must not be allowed to be degraded.

2.2 ALMA Operations

The ALMA Operations section is modified in scope from previous years, due to the integration of the ALMA North American Science Advisory Committee (ANASAC) as a standing subcommittee of the NRAO Users Committee. It incorporates the responses to the charges outlined to the ANASAC Committee in their 1-day face-to-face meeting on May 28, together with additional feedback from the full UC following its subsequent 2 day meeting.

ANASAC Charge 1 *Scientific outcomes and impact from Cycles 0 and 1. Is NA doing well, what are the challenges?*

Based on the statistics provided, **the productivity of NA in Cycle 0 appears to be on target**, with almost half of the projects resulting in one or more publications, and a total of over 40 publications so far, and rapidly climbing. Additionally, several of the projects have published results in high visibility journals such as Nature, bearing witness to the impressive scientific capabilities of even a very partially commissioned 16-antenna version of ALMA. The overarching concern is the fraction of projects that have not yet yielded publications. **We encourage the NAASC to be proactive at contacting the PIs of these projects** to offer help and ultimately determine whether the cause behind this delay in publishing is the quality of the data, the need for a more elaborate data reduction, the need for stronger support for non-expert users, or perhaps the lack of adequate resources (computational or manpower).

We strongly suggest that, in order to promote and help keep track of the productivity of the instrument, **future versions of the OT should request information about the status of data previously obtained by the PI**. This could easily be done in an automated way that minimizes the effort of the applicant: we suggest the OT should be designed to automatically retrieve the projects awarded to the PI in the last 4 cycles and produce a small "fill in" window for the PI to explain the current status of the project.

We have anecdotal evidence that resources available to the PIs may be an important factor at limiting their productivity. In that respect, **we congratulate NRAO for deciding to maintain the SOS program active for ALMA** (although unfortunately it is suspended for the other facilities). Not only is it a very cost-effective manner of providing some financial resources to the community, but it also helps at training the future generation of users. In fact, **NRAO should expand it if at all possible**.

The ANASAC finds that that whereas favoring short proposals was a good way to introduce ALMA to the community and "spread the wealth" of what initially were very constrained availabilities of science time, now the future productivity of the instrument rests on a combination of large and small programs. In particular, ALMA may now be at the point where several high-impact results are likely to arise from substantial proposals. Accordingly, **we recommend revising the definition of "large" programs and starting to allow "large" proposals in Cycle 3**.

ASAC anticipated Charge *Definition of "large" ALMA programs.*

An ALMA "large" program is currently defined as a proposal requesting 100 or more

hours, with the main practical effect of crossing that boundary being that the time proposed will be distributed among the ALMA regions in proportion to the number of CoIs. Large programs have not been allowed in Cyles 0–2. Until now, no proposals larger than approximately 30 hours have been awarded, and the typical award for Cycle 2 was 5.5 hrs. However, proposals have already been received that try to circumvent the "large" program limitation, for example by spreading sources among proposals led by different CoIs in different regions with a common scientific justification. We suspect that one of the practical "barriers" to proposals requesting several tens of hours right now is the fact that it would be unrealistic to expect about 10% of the regional time availability to be awarded to one PI.

Consequently, **we recommend lowering the threshold for "large" programs to 50 hours, and start allowing them in Cycle 3**. We believe that changing the threshold by a factor of 2 would make a significant difference, while still being higher than any proposal that has been successful up to now. We think the instrument has matured enough to enable this type of science, and there is an unmet appetite for such projects. We believe that the future several of the "high impact" results from ALMA will originate from projects that require more than a handful of hours, and that such observations will allow several separate studies of the same data-set. Accordingly, we also endorse the plan to remove language discouraging programs of more than a few hours from future calls for proposals.

We agree with the current plan, in recommending that these "large" proposals be evaluated together with the "normal" proposals to maintain the proper tension between different size projects. However, **we recommend that at least one more page of scientific justification be allowed for "large proposals," and that a section be added requesting information about a "management and data products plan"** (detailing CoI roles, data analysis path, and plans to make available enhanced data products). The role of this section is to encourage making the results of the research available to the wider community, which will improve the impact of ALMA science.

ANASAC Charge 2 *Assess status of Cycle 1 observations and progress towards Cycle 2.* **We congratulate the NAASC for the quick turnaround time in getting data reduced and delivered to the PI, faster than the partner regions**. These statistics, in combination with the implementation of the new PI contact scheme in place for Cycle 2 (i.e., emails when data are taken, etc.), would certainly help improve the view of the project among the user community. We were relieved to hear that the completion fraction at the end of Cycle 1 indicated that the number of hours carried over to Cycle 2 looked manageable (it was suggested to be approximately 300 hours during the face-to-face meeting). Unfortunately we were presented with the much larger figure of 466 hours to be transferred at the recent ASAC telecon. Little can be done now. Nonetheless, it remains a surprise that important numbers such as the carry over **are not uniformly known and tracked across the project**.

We foresee a problem looming in the near future for ALMA: the data volume will become very large, and the local computing facilities available to PIs may not be appropri-

ate to handling it. Consequently, **we see the proposed PI access to "on-demand processing" as a very good idea, and encourage NRAO to implement it as rapidly as possible and advertise its existence widely**.

We are surprised, as is the NAASC, at the low rate of requests for data reduction visits. Why are more PIs not taking advantage of this opportunity? We strongly encourage the NAASC to be considerably more proactive at advertising this possibility, raising it to the attention of users on the website and through emails from the contact scientists. We think that a non-expert user community should have a very strong demand for the visits.

Currently the utility of the offered ToO observational mode is of limited value to the user community because of long response times. Most ToO science requires short response times (of a day or less). We recognize that ALMA still has periods of time when this is not possible to offer due to instrument testing and commissioning, but during periods focused on science observations, the UC recommends that ToO observations are offered and executed the same day as they are triggered.

The current implementation of ToO time sequences could also be improved. Currently triggered sequences of observations are executed without determining if the target is detected in the first observation. To save valuable ALMA time, the UC recommends that whenever a sequence of ToO observations is scheduled, following e.g., a GRB event, the first observation should be assessed to determine whether there is a detection, and if there is no detection, the sequence should be aborted. This fast assessment could be done by ALMA staff or by making the uncalibrated observations available to the PI immediately following execution.

ANASAC Charges 3 and 4 *Evaluation of Outreach efforts and the widening of the ALMA user base.*

We are very pleased with the number of proposals received by ALMA in Cycle 2, and the raw number of CoIs involved in them. However, **we repeat our request that the NAASC work on statistics relevant to the question of the success of the mission in widening the user base**. A simple metric is: what is the fraction of successful PIs that are "mm" or "radio" experts? Measures such as these are crucial to establishing progress toward the long-term health and viability of the facility, and will be useful in any NSF proposals. Another interesting statistic is the level of student engagement: how many students are applying to ALMA?

Although we understand that resources are short, we note it took one of us (D. Calzetti) a couple of hours to roughly classify by hand the successful Cycle 0 PIs as "experts" or "non experts," based on their ADS records (the result is that approximately 30% of the world-wide PIs in that cycle were non-experts). We appreciate, however, the advantages of a more systematic approach, and we encourage the NAASC to undertake it. We suggest that an easy way to encourage users to self-classify their level of expertise is **to have this as a question in the ALMA online user profile**, and force them to refresh their profile (and answer it) the next time they log to the NA website as a user.

We applaud the NAASC initiatives on outreach, and particularly on diversity (the National Astronomy Consortium, presented by K. Sheth), and encourage NRAO to continue pursuing them. We think that it would be good for NRAO to advertise this successful model for bringing minorities into contact with science. Concerning outreach in general, **it is important to emphasize the formation of the younger contingent of users**. In that regard we think that ALMA AAS sessions can play a very important role. Furthermore, we strongly endorse the idea of having the synthesis imaging workshop (summer school) being held every year, alternating between NRAO/Socorro and NRAO/Charlottesville, with the focus on the school in Charlottesville being on ALMA basics and on generating new users. We do caution, however, that this additional task should be undertaken with due respect for the amount of work involved.

ASAC anticipated Charge *Conditions for Release of Data to Users in Advance of QA2.* Following the discussions in the 2013 ANASAC face-to-face meeting, the NA members of the ASAC presented the NA position favoring early data access for PIs, a position also presented by the NA ARC manager (J. Hibbard) to the managers of the other regional centers. As ANASAC we wish to acknowledge the efforts of the NAASC to represent the position of the NA community to other ARCs. As a result of these efforts, uniform agreement was reached among the ASAC members at its 2014 February face-to-face meeting, enabling the following recommendation to the Board: "there are conditions (to be determined) that warrant release of data to PIs in advance of QA2." **The ANASAC is unanimous in supporting early data release to the PI in the "stale data" case**, when it is anticipated that no more data will be obtained for a science goal for a period of several months due, for example, to a change in the array configuration. We recognize that this may constitute an extra load on the data reducers, and so it is probably not worth expanding to other cases until the automatic pipeline is fully working.

ASAC Standing Charge *Evaluation of Proposal Process.*

Two particular aspects of the Review Process were discussed at the ANASAC meeting: the quality of the feedback to the PIs, and the plans to manage duplications. Concerning the former, we note that the quality of the technical and scientific assessments is key to the process. The feedback to the PIs is the outward face of this process to the users of the instrument. It deserves special attention, not only because of the importance of maintaining this outward face, but also because the panel comments are used at the APRC stage to determine priorities across panels.

Several members of the ANASAC expressed concerns about the quality of feedback in Cycle 2. The plans discussed by the NA ARC manager, **in particular the idea of enforcing more structure and detailed constructive feedback to the PIs**, is a step in the correct direction. A recurrent problem that needs to be corrected is that too short a time is devoted to writing PI feedback (frequently the last 1-2 hours of the meeting). Strong guidance to the panel chairs on proven organizational and time management "best practices" may be helpful and desirable. We also suggest that, independent of the JAO plans, **somebody be responsible in NA for looking over**

the feedback to the NA PIs before its release.

We briefly discussed the plans to manage duplications, detection of which should be implemented as soon as possible into the OT. There were questions about what to do with observations that are not yet in the archive, but which may be acquired in the time between the call for proposals and the evaluation of proposals. The opinion of the ANASAC is that the overarching key principle is: **a proposal cannot be rejected because of the identification of a duplication based on information not available to the PI at the time of submission**. The project should plan accordingly, and be prepared to accept a small risk of this process resulting in duplicate observations, depending on how it is implemented.

2.3 VLA Operations and Development

The VLA continues to perform groundbreaking new science, using its exceptional capabilities to explore the radio sky at unprecedented sensitivity and spectral resolution. Achieving μJy sensitivities at K-band is a particularly impressive capability, and the UC commends the NRAO on delivery and continued operation of this world-leading instrument. The UC is also impressed at the wide range of new capabilities that have recently been made available to users. The commissioning of on-the-fly (OTF) mosaicking, phased array and pulsar modes, short dump times, subarrays, the P-band system and recircularization (albeit with some remaining shared-risk for the present) is an extremely impressive set of achievements over the past year, and the UC applauds the efforts of the NRAO staff who have delivered them in such a short time frame. The UC is also pleased to see that the risk associated with the aging antenna control units (ACUs) has now been retired.

The UC was delighted to see that observing efficiency had reached the target of 70%, comparable to what was routinely achieved by the legacy VLA. However, it noted that there was a decrease in the fraction of B and C priority observations that were actually observed, leading to a potential mismatch with community expectations.

The UC has two primary concerns regarding the proposal and scheduling of VLA observations. One of these concerns is with respect to the `prioritizer` and is discussed in the "Science Support & Research" section of this report. The second concern is that the current guidelines in the call for proposals do not yet provide a sufficiently clear recommendation for whether to use 3-bit or 8-bit samplers at C and X bands. The UC recognizes that the choice can be complicated, depending on factors such as RFI environment (and hence source declination), array configuration, and scheduling block (SB) length. Nonetheless, it would be useful to provide a few example use cases to guide the novice user interested in simple deep continuum observations as to where the break-even point is for switching to 3-bit mode (for example, in terms of scheduling block length, for targets both within and outside the "Clarke Belt").

In response to NRAO's question regarding the next DnC hybrid configuration, the UC recommends that the decision be based on how the science return can be maximized. In the case of low demand, the UC concurs with reducing the length of time that the VLA spends in the DnC configuration, or skipping DnC entirely (with a commensurate increase in the length of the most oversubscribed configuration) than to hold an additional proposal

call for how to fill the time. Some flexibility in the regular configuration cycle has already occurred during the EVLA Construction, following the Government shutdown, and is likely to be required again should the VLA Sky Survey be approved.

The UC also concurs with NRAO's decision to end the ongoing service observations monitoring Sgr A* during the passage of the G2 cloud. Given the lack of activity to date, and the ongoing PI-led monitoring observations both with NRAO telescopes and at other facilities, the UC does not find that continued service monitoring by NRAO is strongly motivated.

2.3.1 Development Projects

The UC reiterates its concern regarding the balance between externally-motivated development projects (Work For Others) and NRAO's core mission, especially given the demands they place on the staff. As long as significant commissioning milestones for general observers remain to be met, the UC recommends that they should be accorded the highest priority. However, following the delivery of so many of the outstanding capabilities over the past year, a gradual switch in focus to development projects now makes sense. VLITE/LOBO is a prime example; this is an excellent initiative, and should produce some very interesting science. However, given the plethora of other low-frequency telescopes already being operated across the globe, its implementation should not be allowed to detract from the primary goal of array operation.

The planned commensal fast transients system is another example of a potentially high-reward new development. With a calculated FRB detection rate (when summing the array incoherently) that is several times higher than Parkes at L-band (albeit significantly less at higher frequencies), the VLA has the potential to make an important contribution to this new and exciting field. The UC commends the NRAO's support of the technically challenging pilot efforts to detect an FRB with the VLA. The scientific impact of the first detection and, more importantly, localization of an FRB with the VLA will certainly provide strong justification for the development and (not inconsiderable) infrastructure costs of a future commensal system. However, this capability will require NRAO to fully define a policy for data rights in the case of commensal observations. While more standard commensal observations are now being offered in the regular Call for Proposals, the data rights policy is not clearly set out, to our knowledge. In the case where a commensal experiment is being run full-time, users should be aware of the situation and any associated data rights issues. The analogous experiment on the VLBA (V-FASTR) has clearly defined its data rights policy, and the UC requests an update on what NRAO envisions for the equivalent program on the VLA. Finally, the UC has a slight concern regarding RFI rejection. The VLA cannot rely on geographical separation to filter out RFI as effectively as in the case of the VLBA, particularly in compact configurations. The UC would like to know whether this is envisioned to be a problem.

Given that NRAO's future in the era of SKA is likely to be at higher frequencies, both the proposed digital VLA-Pie Town link and the development of the Water Vapor Radiometers (WVRs) are well motivated. The WVRs are likely to be of more value to current VLA users, increasing the amount of high-frequency time available. However, the strategic importance of developing the case for the NRAO NBT makes both projects strategically important from

an engineering perspective, even if the VLA-PT link is not expected to be driven by its immediate science return.

2.4 VLBA Operations and Development

The VLBA continues to offer an unparalleled suite of capabilities for high angular resolution astronomy with strong connections to, and synergy with, other facilities across the spectrum (e.g., *Fermi*, *Chandra*, etc.). With the sensitivity upgrade now complete, including work at several key HSA sites, there are new possibilities for expansion of scientific scope at the VLBA. For these reasons, the UC is highly supportive of NRAO efforts to explore new partnerships and arrangements that may lead to an increase in external (i.e. non-NSF) funding for the VLBA. The understanding by the UC is that prospects for securing external funding that will meet the NSF's requirements for "divestment" are very good. This activity is especially welcome given the concerns cited during the UC presentations on staffing, the outcome and consequences of the Portfolio Review, and the AUI re-competition. A more stable funding platform can only help attract and support VLBA staff, and NRAO and the NM Ops Team are to be commended for their successful efforts.

Apparently, an agreement with USNO is being considered that will continue support for Geodetic VLBI observations with the Mauna Kea and Pie Town sites. In addition, the UC heard about interesting progress on satellite positioning work with Mars spacecraft with potential application to future missions. It may be useful to investigate the possibility of VLBA user access to these types of capabilities.

The UC also notes the recent efforts by members of the US VLBI community to organize logistical and operational support for the VLBA through a network of user institutes and universities. The UC encourages NRAO to continue contact with this group, which includes members who are actively working on VLBI instrumentation, and could provide strong NRAO-University links for future joint projects and future planning.

As in the last report, the UC emphasizes that the planned phasing of ALMA for VLBI, and the recent successful VLBI detections at 3 mm wavelength to the LMT, provide new opportunities for VLBA users. The ALMA Phasing Project (APP) is scheduled to complete its commissioning by early 2015, and could offer VLBI capability to users worldwide soon after—depending on operational models for VLBI observations. The UC notes that the LMT has already been made available on a limited basis to VLBA users in the most recent proposal call within the High Sensitivity Array (HSA) program. These new facilities will increase the overall sensitivity of the VLBA by nearly an order of magnitude at 3 mm, while also creating long N-S baselines that complement the predominantly E-W layout of the VLBA. Because of the broad overlap in Hour Angle of these new sites with the VLBA, the baseline coverage for many sources will be excellent, and observations of Southern sources will be easier. The UC urges NRAO to consider how the VLBA should work with key stakeholders and the broader US and international communities to offer HSA-type observations that include ALMA and the LMT at short wavelengths. The UC offers its support and can help to organize this effort as needed.

The work cited in the UC presentations on WVRs ties in nicely with such HSA initiatives, as WVRs preferentially aid high frequency observations. WVR work may also be an area where mm interferometry and VLBI University groups may be able to partner with NRAO.

The UC notes that it is not always clear when VLBA dishes will be going down for maintenance, which can lead to observations being carried out without important baselines. Recently, for example, the AZ drive on NL was down for many weeks, but it was difficult to learn about this before observations were scheduled. Similarly, the regularly scheduled MK and PT observations for USNO mean that these two sites are simply removed from the array. If there is a way to signal to users that such scheduled omissions will occur prior to observations, this would be useful feedback.

Last, the UC commends the VLBA staff for achieving 70% on-sky time during the recent "surge." It applauds the effort to increase observing efficiency via the call for short blocks. However, it is notable that much of the VLBA time is still given to large projects. It appears that current time allocation allows smaller PI projects to secure needed time, but this should continue to be monitored, especially if HSA-type capabilities (as described above) excite increased interest in ultra-high sensitivity and high angular resolution targeted projects.

2.5 GBT Operations and Development

The focus of NRAO/GB staff has understandably been on the future of the GBT, following the "divestment" recommendation by the NSF Portfolio Review. Considerable efforts have been undertaken to identify sponsors, other than NSF, to allow for continued operation of the antenna. The UC encourages NRAO to continue these efforts, particularly if a future operational model can be identified that still provides some fraction of observing time to be available to the astronomical community on the basis of scientific merit.

As was the case last year, the UC notes that, although these activities were not emphasized in the presentations at the meeting, the highest profile science and STEM education efforts currently being done at the GBT involves searching for and timing radio pulsars. The GBT is one of the foundational telescopes for the North American Nanohertz Observatory for Gravitational Waves (NANOGrav), and its loss would impede, if not entirely cripple, U.S. participation in gravitational wave studies via pulsar timing. NANOGrav has made a concerted effort to develop partial support for the GBT, submitting multiple grant proposals that include operational support for the GBT as part of the proposals. Further, pulsar searching and timing by students using the GBT forms an integral part of a documentary movie currently nearing the end of production.

The UC noted that efforts have apparently been unsuccessful to identify community support from members most likely to use the telescope at its highest frequencies. Given that new GBT instruments such as *Argus* and Mustang 1.5 will substantially increase the capabilities of GBT allowing, for example, wide area surveys that complement ALMA, community interest is likely to grow. The UC urges NRAO to publicize these new capabilities and is pleased that the workshop "Filamentary Structure in Molecular Clouds" that NRAO will host in November is being used as just such an opportunity. The UC recommends that, to the extent possible, NRAO ensures that the GBT retains the necessary resources to allow for the successful deployment and operation of these instruments in a timely manner to allow sufficient time for community interest to develop.

The UC commends NRAO for making the larger Green Bank site available to the community to take advantage of the National Radio Quiet Zone. Multiple projects are in various states of development, testing, and operation for a variety of scientific projects. Given that

the Green Bank site is not affected by the GBT "divestment" recommendation, the UC recommends that NRAO continue this practice.

3 Data Management & Software

3.1 Proposal Submission Tool (PST) and Observation Preparation Tool (OPT)

The PST and OPT are both important user-facing tools. At the 2013 UC meeting, specific recommendations were made regarding improvements to both tools. The UC acknowledges that the current priority is the Archive Access Tool (AAT), followed by the PST, and the OPT. The UC also acknowledges that a timeline of 1–2 years was presented to the UC for reworking the PST and OPT but also that a "restructuring" effort for the PST was described.

The UC repeats its finding from last year that both tools continue to have significant issues, making them unintuitive and cumbersome. In the interest of expressing the UC's continuing concern about these issues, the Appendix presents the list of issues, in priority order, for the PST and OPT, some of which were also raised in the Telescope Time Allocation Committee report. To the extent possible, the UC continues to recommend that these issues be addressed.

Finally, as this report was being written and users were submitting proposals for the August 1 deadline, several reports were received of problems with the PST (e.g., "Internal Server Errors"). Further, one UC member who also serves on a Science Review Panel noted a problem with the abstract of a proposal to be reviewed, potentially suggesting that the PST problems near the deadline may also affect the SRP review process. Adequate capacity of the infrastructure for the PST must be regarded as a "critical capacity" of NRAO.

3.2 CASA

The UC applauds NRAO's hard work on the CASA software package, and CASA now appears to be the primary software package used by radio astronomers—particularly the younger generation. It is clear that progress has been made in CASA's functionality and versatility, although outstanding issues remain.

The UC appreciated the more detailed end-to-end tests of CASA which were presented at our 2014 meeting, and found the comparison with AIPS very informative. We appreciate the honesty and introspection demonstrated by the CASA developers in their candid admission that CASA remains slower than AIPS for many tasks, as well as their steps toward pinpointing where CASA bottlenecks lie. However, the UC believes that the presented tests are still not sufficient to fully assess CASA's performance and progress. In particular, the UC would like to see CASA's usage of computer resources clearly analyzed and prioritized. UC members consistently find that CASA consumes all of a computer's resources, prohibiting use of the machine for other simultaneous purposes (our collective experience is that AIPS does not dominate resources so dramatically). We hope future presentations of CASA performance will include statistics on the fraction of CPU, RAM, GPU, and scratch disk used. These data should be returned from benchmarks on hardware representing the range

of real-world user interaction with CASA, from laptops to large distributed clusters, rather than a single workstation or server optimized for CASA. In addition, the UC requests that analyses be run on CASA's image fidelity. One great advantage of CASA over AIPS are its cutting-edge imaging algorithms; we would like to see a demonstration of how CASA's capabilities affect image quality.

The UC understands the difficulties that plagued CASA release 4.2, and recognizes that keeping up with annual Mac OS X is difficult. However, the UC points out that the issues with CASA 4.2 were made much more severe, because CASA 4.2 capabilities were required for an impending proposal deadline, and so the NRAO user community was very tense about delayed release. The UC strongly recommends that new capabilities and versions of CASA should not be required for users to successfully meet NRAO deadlines. CASA developers should allow plenty of time to deal with unexpected issues, and community needs should not be tied to novel capabilities.

The development of tasks necessary to successfully reduce all data produced during standard observing modes for both ALMA and VLA must remain a high priority. This should obviously include those new observing modes that are now being offered for 2015A (e.g., wide-band, joint deconvolution for mosaicked OTF-mapping data). Although of lower priority, the UC was concerned about certain capabilities in AIPS that have not yet migrated to CASA. Fringe fitting is one example that has been repeated by previous committees, but remains undeveloped for CASA, preventing uptake of CASA by the wider VLBI community. The lack of duplication of the remaining small number of essential capabilities from AIPS to CASA represents a long-term risk that could become critical, for example, with the retirement of key personnel supporting AIPS.

The continued low-level support of CASA for usage by outside groups (e.g., MWA, LWA, or LOFAR) is welcomed by the UC as a necessary investment towards establishing CASA as the de facto standard for radio interferometric data reduction. The proposed plan to officially support ATCA data analysis, via an MoU with ATNF, is another positive step in this continued proliferation.

The UC is concerned that `exportuvfits()` still lacks critical functionality and stability and warns against a tapering of effort on this important task. The `exportuvfits()` task is crucial for linking CASA to other software packages and synthesizing radio/millimeter data with observations at other wavelengths. FITS is the international astronomical standard, and CASA must be robustly linked to this most widespread of file formats. For example, to enable advanced data modeling, as in the case of gravitational lensing or rotation curves, the analysis requires data in FITS format with correct visibility weights. In addition, FITS output from CASA is crucial to transfer data to other radio packages like AIPS, Miriad, and Difmap, which still have reduction and imaging capabilities that are not provided in CASA. The UC therefore requests that `exportuvfits()` remains an integral and supported capability in CASA.

Finally, the UC notes that a separate CASA Users' Committee was created, despite the 2013 UC recommendation that the NRAO staff and community are already over-committed, and another committee was unnecessary. While the UC acknowledges the motivation for a CASA Users' Committee, we caution that NRAO should seek to keep the work burden relatively light. We also encourage fair representation of users from all NRAO facilities that use CASA on this committee.

3.3 User Computing

The UC continues to appreciate the guidance offered by the NRAO on the optimal configuration for data processing workstations, servers and clusters hopes the NRAO will continue to update these recommendations, keeping pace with changing technology and CASA upgrades.

The initiative enabling remote access to NRAO resources for data reduction, and the recent advertising of this capability, is also very much welcomed by the UC, in light of the data deluge currently facing users. We hope to hear in future meetings regarding the uptake by users of data processing at NRAO sites, as it has a very significant impact on the future standard user experience. Indeed the UC advises the NRAO to monitor this uptake closely to determine whether the user community switches to data processing on NRAO resources, or continues with data processing on local resources in their home institutions. The results will have significant knock-on impact on both CASA development and the hardware expenditure policy of the NRAO. For example, CASA optimization would be much simplified if the the software was primarily used on homogeneous NRAO compute nodes. Information on the hardware locally employed by users would also be useful, but perhaps would be difficult to obtain. One possibility include having CASA "phone home" with statistics on the hardware being employed by users, and indeed with logs produced during fatal crashes, to help guide bug fixes and future optimization in CASA.

3.4 Archive

A comprehensive and readily accessible archive is a key component of any observatory aiming at maximizing the scientific return. With the advent of ALMA, the Jansky VLA, and the recent GBT and VLBA upgrades, the ALMA and NRAO Archives have great promise to become one of the leading astrophysical data resources. Thanks to enhanced sensitivities and bandwidths, many observational data sets will be rich enough that only a fraction of the data will be exploited by the original proposers. The Archives are also a common gateway for the wider astronomy community (e.g., "Does my newly discovered object have a radio counterpart?"). Finally, with an impending change in the operational model of the GBT and the VLBA, the Archives may become the only means of access to data from these telescopes for many members of the community. Because the ALMA Archive is an ESO deliverable, we will focus the recommendations on how to further improve the utility and accessibility of the NRAO Archive, but, from a user's perspective, the more the two can be integrated without loss of functionality, the better.

First, the UC commends the effort that has so far gone into building the new NRAO Archive. We understand that this effort is a major undertaking and appreciate that it has been granted a high priority. We are happy to hear that VO and ALMA protocols will be reused whenever possible, both to build the new archive structure as efficiently as possible and to provide an interface that most users are already used to and/or find intuitive. We congratulate NRAO on completing the design phase, and for being able to implement scripted access and other user-oriented requests in the final design.

As the work continues toward construction and deployment we advise NRAO to

- *Continue to work toward a unified look and feel of the ALMA and NRAO archives, but not at the cost of functionality.* That is, if the current or planned ALMA Archives

are missing components/functionalities that would be useful for the NRAO Archives, they should not be sacrificed to make the NRAO Archive more similar to the ALMA Archive.

- *Use the UC and other users as a resource when testing prototype deployment in October.* Obtaining input from many different kinds of users with different levels of expertise and different archival goals will be key to test and evaluate the utility of the new Archive. Members of the UC would also be happy to consult on specific functionality and design decisions.

- *Providing, or working with the community to provide efficient tools for data mining.* The richness of the NRAO Archive, particularly when viewed from a multi-wavelength or multi-messenger perspective, means that new approaches toward accessing and analyzing the data within the Archive are likely to be needed.

- *Encourage users to design their observing blocks to maximize archival value, e.g., by including bonus spectral lines if the target and frequency band justifies it.* While data transfer rates and data storage also need to be part of the equation when setting up observing blocks, archival legacy value should be considered as well. Short term, anything that can be done to produce a richer data set without putting too much pressure on existing resources should be encouraged, e.g., in the higher frequency bands this may mean encouraging the PI to put windows on potential line-rich regions with high spectral resolution even if the current science goal only requires continuum.

Furthermore to ensure that the archives are built up to be as scientifically rich as possible, the UC strongly supports efforts to increase data processing, transfer and storage capabilities to avoid any scientifically crippling reduction of data rates or storage in future cycles. There may still be many "smart" ways to reduce data rates and the UC supports efforts to do so and to help users to set up their observing blocks to maximize serendipitous science while optimizing the use of NRAO Archival resources.

3.5 Pipelines

The development of efficient pipelines for ALMA and VLA that result in high-quality data products has rightly been a high priority for NRAO and we commend the continued improvement of the VLA pipeline, as well as the conditional acceptance of the ALMA pipeline for Cycle 2. The UC finds that the successful building of a shared infrastructure for the two pipelines is an important achievement, which should facilitate the use of the ALMA pipeline once it is released. The full deployment of a reliable ALMA calibration pipeline should continue to be a priority, since it will free NRAO staff from manual calibration of "standard" measurement sets, enabling them to spend time on tasks that are more difficult to automate. It is thus key to complete the work on the calibration part of the pipeline to ensure that calibration is automated for a majority of measurement sets in ALMA Cycle 2 and 3. On longer timescales, the UC strongly supports the goal of developing the pipeline to produce (almost) science ready images that can be used by expert and novice users alike, but the UC recommends that at present enhancing the imaging capabilities is not done at

the expense of expanding the utility of the calibration pipeline and the observing modes it supports. The UC looks forward to an update on the ALMA pipeline performance at the next telecon.

Several members of the UC are regular users of the VLA pipeline and find that it works quite well in general. The output diagnostic plots and information are very useful and readily accessible. The timescale for acquiring pipeline datasets is also reasonable. There are a number of aspects that could be improved, however.

- The VLA pipeline flagging continues to be sub-optimal, however, and an improved flagging procedure should be a priority as the pipeline continues to be updated. A specific example, that could likely be easily implemented, is that there should be an option to flag entire spectral windows. Particular frequency ranges are consistently plagued by RFI and are highly unlikely to produce science quality data. In these cases, it is most efficient to simply remove these entire spectral windows.

- The definition of a clearer and more transparent benchmark diagnostic for pipeline would be useful, e.g., closeness to the thermal rms noise level in an image.

- Restarting the VLA pipeline is relatively difficult and interaction-intensive. NRAO should expect iterative use of the pipeline (especially while flagging strategies are still in development) and make repeat uses as simple as possible.

- Based on input from the user community, the utility of the VLA pipeline would further increase if it provided some way of giving users a "quick look" at the pipeline results, e.g., a FITS file of the continuum, without downloading the entire dataset. This would especially benefit non-traditional VLA users who are more used to working with sky maps in FITS format.

4 Science Support & Research

This is the second year in which the Science Support and Research (SSR) Department has been operating as an independent unit, which includes the Telescope Time Allocation (TTA), and the Science User Support (SUS). The UC received a presentation on the activities performed by this Department, and the TTA and SUS are discussed below separately.

4.1 Telescope Time Allocation (TTA)

The role of the TTA is to handle proposal submission, proposal review, and telescope time allocation for the GBT, VLA, and VLBA. With a proposal pressure of about 2.5:1 and an overall growth of submitted proposals of about 10% per year, the role of the TTA remains a crucial one for the NRAO.

One of the important recent initiatives is the reciprocal time allocation agreement with the HST, and similar agreements are coming with *Fermi*, *Swift*, and *Chandra*. The 2014B call-for-proposals, which was also the first one implementing the HST reciprocal time allocation, resulted in an underwhelming response from the NRAO user community, with only

three proposals requesting HST time for a total of 28 orbits (out of 30 available). None of these three proposals was selected by the SRPs/TAC.

While disappointing, this first experiment on reciprocal time allocation should not be perceived as a metric for future responses, since it takes time for any community to become fully aware of and/or adopt new capabilities. The UC recommends that this and future such opportunities are presented prominently to the NRAO user community through a variety of channels, including newsletters, articles, websites, etc.

After six semesters of operations under the panel-based review system, the SSR convened an external committee to review the TTA. The committee met at the end of February 2014, and provided a report with a series of recommendations at the end of March 2014. The report contains a series of specific recommendations on improvements for: the documentation, the Proposal Submission Tool, the VLA Prioritizer, the number of panelists/panels on the SRPs, the interfacing between the SRPs and the TAC, and the feedback received by proposers on the results for their proposals. All these recommendations aim at achieving a higher level of transparency in the proposal handling and selection process. The UC commends the NRAO and the SSR Department in particular for starting to act positively on the TTA Review Committee's recommendations. The UC recommends that: (1) the NRAO produces a written response to the TTA Review Report, as soon as possible; and (2) the SSR implements as many of the Report's recommendations as possible.

The UC specifically considered two of the issues discussed by the TTA Review Committee, namely the VLA Prioritizer and the feedback to proposers. (1) The lack of clarity regarding how Science Review Panel (SRP) scores are mapped to proposal prioritization and scheduling is a source of serious concern as it appears to allow for "gaming the system" in a manner unrelated to scientific merit. As a specific example, if there are two proposals of essentially equal SRP ranking with identical time requests at the same LST, but one requests eight half-hour scheduling blocks (SBs) while the other requests four hour-long SBs, the former proposal has a much higher chance of receiving A priority than the latter. This situation results from the algorithms used in the VLA Prioritizer and is exacerbated following prioritization, as there is no requirement to submit the same length SBs in the OPT as originally requested in the PST. On receipt of an A-priority ranking, the PI with the eight half-hour SBs could then submit a single four hour SB, and have a high chance of it being observed, while the PI with the four hour-long SBs could struggle to get even a half-hour SB on the telescope following a lower prioritization. Not only is this algorithm not ideal, the lack of clarity is unacceptable, as it provides an unfair advantage to those aware of the process. The UC strongly urges NRAO to ensure that the current situation is clearly documented both in the PST documentation, and in the call for proposals, and to improve the Prioritizer. (2) The UC also recommends that the feedback to proposers contains a summary that is informative, and that the Panels' Chairs ensure that such informative content is included, as part of the consensus report written by the primary and secondary reviewers.

The UC discussed the appropriateness of de-scoping and/or cutting down proposals at the SRP/TAC stage. The UC consensus was that that this approach may quickly become problematic, as it may require arbitrary interpretation of a PI's original science goal(s). The UC recommends that in general observing requests should not be reduced at the SRP/TAC level.

4.2 Science User Support (SUS)

The role of the SUS is to provide the scientific community with the necessary support to use the NRAO facilities successfully and to produce science results from the data collected from the NRAO facilities. Within this simple charge, there are a number of tasks that the SUS covers: providing user training, data documentation and data pipelines and software, supporting the help desk and outreach services, running a number of students programs (undergraduate, graduate, and the Student Observer Support); overseeing the Jansky Fellowship program; monitoring the progress and overseeing the promotion of the science staff; collecting and organizing the metrics that measure the impact of the NRAO facilities (publications, citations, etc.).

The UC commends the SUS for accomplishing a number of milestones, including: working towards the requirements for an integrated science portal, and producing an updated Science Policy Manual that clarifies the tracks and paths for promotion for the science staff.

The UC expresses concerns for a number of developments that have occurred in response to budget pressures: (1) the slow contraction of the students' programs, including the suspension of the SOS program for the GBT, VLA, and VLBA; (2) the proposed "trimming down" of the number of Jansky Fellows awarded each year; (3) the proposed idea of suspending the external Jansky Fellows (called "Remote Fellows"); and (4) the suspension of the page charges coverage support in CY14.

The UC acknowledges that the reaction of the science community to items (1) and (4) has been muted, but this should not necessarily be interpreted as agreement with the actions undertaken by NRAO, as much as recognition of the budget pressures currently imposed on the Observatories.

The UC recommends that the SUS develops a coordinated plan for responding to budget pressures that maximizes the scientific return of the NRAO data. One suggestion is to develop criteria that are based on objective metrics (drawn from number and impact of papers, educational impact, etc.). The UC also suggests that the NRAO explores the possibility of expanding the current REU program to the JAO. In addition, the UC strongly recommends that the Jansky Fellowship program maintains the "Remote Fellows." Abolishing Remote Fellows may negatively impact the pool of future applicants, and, as a consequence, diminish the prestige of the fellowship.

One important educational opportunity for the NRAO user community is the NRAO Synthesis Imaging Workshop, which is held every other year in Socorro. The UC recommends that, in the 'off-years', the NRAO hold a Charlottesville-based workshop centered on synthesis imaging with ALMA, including more introductory material than the Socorro workshop. This workshop should have higher priority than the "Community Days," if budget constraints arise.

Finally, the UC notes that, since 1990, there have been 3 women astronomers recipient of the Jansky Lectureship (3/25), and one since 2000 (1/15). The UC encourages the NRAO to consider ways to diversify their pool of nominations.

5 Central Development Laboratory

The CDL provides the core resources necessary to maintain and upgrade ALMA and the other NRAO instruments. With the ramp-down in ALMA and VLA construction, the CDL faces tight budgets. Despite these budget pressures, it is important for NRAO to preserve its expertise in technologies like SIS mixers that are essential to ALMA; once lost, such expertise will be difficult to rebuild. The CDL has been very successful in competing for ALMA development funds to help support continuing research. Current development activities include studies of second generation receivers for Bands 6 and 10, construction of a prototype cartridge for Band 2, local oscillators for Band 5, and an additional central LO to provide a 5th subarray. These projects help maintain the expertise at the CDL and will provide clear science benefits for ALMA users.

The CDL also works with university-based groups on new developments. Collaborations include the Band 2 MMIC work with Caltech/JPL, the ALMA phasing project with MIT/Haystack, and the PAPER/HERA feed with Berkeley. These partnerships work best if there is a well-defined science goal and if the person pushing the project forward can be clearly identified. In some cases the leadership of the project was a little unclear. For example, is the phased array feed development for the GBT directed by NRAO, WVU, or the BYU group? Is the PAF meant primarily as an engineering demonstration or is it driven by science goals? It seems that the installation of a PAF would be counterproductive for some GBT science, like pulsar timing measurements, where only a single beam is required and where any degradation of the noise temperature would be unfortunate.

Finally, the CDL pushes forward on more speculative developments that may benefit future instruments (a.k.a. "The Next Big Thing.") Tightly integrated components for array receivers are a promising avenue of research - large heterodyne cameras are the missing technology that would greatly speed up studies of molecular lines across extended regions of interstellar clouds or galaxies. Hopefully, this effort will be coordinated with university-based groups that also are working on array receivers. Digital signal processing is another area that will be vital for future instruments. However, thanks to the CASPER consortium and other projects, there is a lot of DSP expertise in the wider community, so it may not be essential for the CDL to build up a large DSP group.

Previous Committee suggestions to increase interactions with the broader community—by encouraging visiting scientists and engineers at the CDL, supporting students interested in hardware developments, and organizing workshops focused on new technologies—are still relevant, and it appears that NRAO is working to implement these suggestions. The committee did not get to hear the talk on technology transfer due to lack of time, but the presentation included in the meeting materials shows that NRAO is making a serious effort to market its inventions (e.g., reflectionless filters). The TT web page is clear and well organized. The committee applauds the technology transfer effort.

6 NRAO Future Initiatives

6.1 VLASS

A status report on proposal preparation for the VLA Sky Survey (VLASS) was presented. The response from the community for input on the survey has been strong: 22 white papers have been submitted that present ideas for surveys and approximately 50 people attended a planning workshop at the 2014 January AAS meeting. The VLASS Science Definition Group is preparing a formal proposal, which will be submitted to the NRAO Director in 2015 February.

The baseline VLASS will require 8500 hours and require about 25% of the science observing time on the VLA over a 5 year period. It will also require resources from the VLA staff to implement and reduce data from the survey. Given the large investment of resources required for the VLASS, it is imperative that the proposal be of exceptional quality, and that the project will have a high, lasting scientific impact. The review panel must consist of leading experts who not only evaluate the scientific merits of the VLASS proposal, but also assess the opportunity cost due the required cut in the hours allocated to individual investigator proposals. The VLASS review panel should be given clear instructions that they can recommend against the VLASS if the proposal does not meet the necessary high standard.

6.2 Spectrum Management

The UC appreciated the discussion of spectrum management, and in particular the realism in the approach being taken to what is an enormously complex issue. We appreciate, as was stated clearly that, "we are losing the war, and fast!" New issues are arising all the time, with currently important ones being the increased development of 76–81 GHz car radar (for collision avoidance etc., but which could damage telescope receivers) and new issues from satellites (earth-orbiting radar) and planes. We understand that there are many different bodies involved in dealing with spectrum management, and that radio astronomy is a relatively small player in this high-stakes world. It is therefore crucial that NRAO continue to keep on top of these matters and represent the radio astronomy community in the U.S. (and beyond) to mitigate the evolving situation. The UC agree that it is best to adopt a pragmatic approach, in which one considers sharing bands, scheduling if need be, and making any other kinds of deals that seem necessary in order to preserve our ability to do radio astronomy.

6.3 Open Skies

The UC strongly supports the NRAO's traditional stance on Open Skies as a way of maximising the scientific productivity of its own telescopes. However, the restricted access policies adopted by several new and planned observatories (e.g., ALMA, LOFAR, SKA) imply that NRAO's Open Skies policy may no longer best serve the U.S. radio astronomy community as a whole, as it leaves NRAO with limited options to negotiate better U.S. access to facilities that do not adopt it. This unfortunate political reality therefore mandates NRAO to reconsider its long-held and visionary policy. While the threat of any changes would provide an

important negotiating position, the UC urges NRAO to carefully consider the likely impact before abandoning its traditional stance on Open Skies.

For the past few decades, NRAO has run many of the world's premier radio astronomy facilities. However, the proliferation of internationally-based next-generation radio telescopes (e.g., e-MERLIN, LOFAR, MeerKAT, ASKAP, FAST, and eventually the SKA) are ushering in a more competitive era. NRAO's pre-eminence should not be taken for granted. With a growing but nonetheless limited pool of radio astronomers worldwide, there is also a risk that restricting access could force members of that pool to switch their focus elsewhere, thereby reducing the impact of the research done with NRAO facilities. Thus, an alternate perspective is that international users provide manpower to improve NRAO's publication and citation metrics at no cost to the U.S. taxpayer, and, in a similar fashion, U.S. researchers can improve the productivity of international facilities.

However, in the current fiscal and political climate, the UC finds that NRAO is well justified in planning for the possibility of changes being mandated by funding bodies in the medium-term future. Having available a fully-researched model for access to NRAO's facilities together with detailed impact assessments might help to head off any more restrictive policies that might be put forward at higher levels.

Given that the SKA Organization is not planning to support Open Skies, the UC recognises the fundamental problem of asymmetric access that this would create between U.S. astronomers and their counterparts from SKA member countries. One of the approaches described was the establishment of reciprocal arrangements between NRAO facilities and those in another nation. NRAO should be clear about the objectives and details of any such reciprocal arrangements, specifically including whether they are relevant to the SKA or not. Further, the 2–3 year timescale mooted by NRAO for revision of its Open Skies policy is well ahead of the timeline for completion of SKA Phase 1. The age of the basic VLA infrastructure could present challenges for sustaining such an agreement within the SKA operational lifetime.

Since the NRAO has been forward-thinking enough to provide a comprehensive archive (a policy strongly supported by the UC), the UC also seeks clarification on whether any proposed restrictions are also envisaged to apply to publicly-available archival data. Such an approach would raise serious concerns over the implied restrictions on the verification of published results by independent reanalysis. Having invested in such a rich and capable archive, it would make sense for NRAO to maximize its scientific return by ensuring it is accessible by the full international community.

NRAO has a significant international user base, fostered over several decades by NRAO's visionary Open Skies policy since its inception. These users not only improve the telescopes' scientific productivity, but also increase NRAO's exposure and impact among the wider worldwide astronomical community. In recent years, they have provided material support for the VLBA, in some cases with no formal *quid pro quo*. On behalf of this community of international users, the UC urges the NRAO to ensure that any policy revision continues to provide sufficient avenues (whether through collaboration, reciprocal agreements, or some fraction of open time) for these scientists to continue their excellent work with NRAO facilities. The UC would also like to see a more detailed breakdown of the number and nationalities of users that would be likely to be affected by any change in policy (including the fraction that would be envisaged to be covered by reciprocal agreements).

Regardless of NRAO's final policy decision, the UC urges the NRAO, in the strongest possible terms, to communicate any proposed changes in a clear, open and timely fashion, well ahead of the implementation of any changes. This would allow affected international scientists to plan for the changing environment, whether by setting up new collaborations or by redirecting their research foci.

6.4 "Next Big Thing" (NBT)

The lunchtime presentation by NRAO Chief Scientist, Chris Carilli, on "NRAO Science Trends" was helpful in providing an overview for where radio astronomy might be going in the future. The UC later heard the Director, Tony Beasley, present ideas (with much discussion) on the future of NRAO and radio astronomy in the U.S., in particular the "Next Big Thing." Options that were mentioned included

low frequencies SKA-Low, HERA, LWA;

intermediate frequencies SKA-Mid, GW Observatory, fast transients;

high frequencies VLA+, SKA-High, ALMA upgrade/expansion (2030s);

space a far-IR interferometer, DARE.

One highlighted issue is that specific science cases are needed in order to guide the prioritization process.

The UC welcomes the NRAO's stimulation of community-led efforts to determine the scientific avenues leading to next generation facilities in the radio, millimeter, and submillimeter. It looks forward to continuing discussion regarding how partnerships could be built for several of the new initiatives. The UC was also pleased to hear that NRAO is considering possible contributions to parts of SKA. This project will clearly be a driving force for radio astronomy in the coming decades, and it is important that NRAO investigate ways to become engaged.

7 Education and Public Outreach

We applaud the NRAO on their continued excellence in STEM education and public outreach. The new public website has been a success and should maintain high priority as the first point of contact for educators and the general public. Plans to upgrade the VLA visitor center are certainly overdue and very much welcome.

The UC looks forward to hearing about how the general public can find out "what the telescope is observing now" in 2015, although we acknowledge that a lot of work is required to enable that capability.

The 2013 UC report recommended the development of a section on the NRAO website devoted to the process of preparing a press release with the NRAO. This is now available and will certainly help engage users to promote exciting science.

8 UC Management Structure, Membership and Meeting Logistics

The term for the 2014 chair, Gregg Hallinan, ends in 2014 December. For 2015, Joseph Lazio will serve as chair, Laura Chomiuk was elected as deputy chair.

Three notable events occurred this year with respect to the structure of the UC and this annual meeting.

During the ALMA Construction project, the ALMA North American Science Advisory Committee (ANASAC) advised the NRAO on user-related issues of ALMA. This year, NRAO informed the UC that, with the ALMA Construction project nearing its end, the ANASAC would begin to be merged with the NRAO UC, with the ANASAC forming a subcommittee of the UC.

While there were concerns that this merger would produce a UC that would be too large and unwieldy, the meeting ran smoothly and the breadth of experience led to a number of valuable insights. Further, the merger of the ANASAC into the UC is clearly the correct direction for NRAO to have taken with respect to its user community.

A second change concerned the structure of the meeting itself. At the 2013 UC meeting, presentations by NRAO staff presented user-related issues, including specific questions or issues of which NRAO staff were aware and desired UC input. Presentations at the 2014 UC meeting had a quite different appearance, e.g., focusing more on management structure. Further, the presentations appeared to be designed to take the entire allotted time. Future meetings would be better structured by having shorter presentations that include specific questions or issues on which UC feedback is desired. The UC also unanimously felt that more time needed to be allocated for discussion, both after each talk and in the closed group meetings.

Finally, during the UC meeting itself, the expected notice of a cooperative agreement for the management and operation of the NRAO was released by the National Science Foundation. The UC recognizes that the outcome of the competition for the management and operation of the NRAO will affect users and the astronomical community for the next decade, but, given the timing of the announcement, there was only a short discussion on this topic. The UC looks forward to a clearer update during the mid-term telecon.

A 2014 Charlottesville Meeting Participants

The 2014 meeting of NRAO Users Committee was held on May 29-30 at the NRAO Headquarters in Charlottesville, VA. The members of the committee in attendance were:

Gregg Hallinan (Chair), Caltech (2015)
Joseph Lazio (Deputy Chair), JPL/CIT (2016)
Alberto Bolatto, University of Maryland (2014)
Daniela Calzetti, University of Massachusetts (2014)
John Carpenter, Caltech (2015)
Shami Chatterjee, Cornell University (2016)
Laura Chomiuk, Michigan State University (2016)
Sarah Church, Stanford University (2014) (via telecon)
Sheperd Doeleman, MIT Haystack Observatory (2015)
Dan Marrone, University of Arizona (2015)
James Miller-Jones, Curtin University (2015)
Karin Öberg, Harvard-Smithsonian Center for Astrophysics (2015)
Dick Plambeck, UC Berkeley (2015)
Dominik Riechers, Cornell University (2016)
Douglas Scott, University of British Columbia (2014)

B Proposal Submission and Observation Preparation

The specific issues and recommendations to the current PST and OPT are listed in a priority order in this section.

B.1 PST Specific Issues

The PST is many users' first encounter with NRAO, and also constitutes the only opportunity for proposers to effectively communicate with the SRPs and TAC. It must therefore be clear in its requests and thoroughly documented. Below is a ranked reordering of the issues presented in the Appendix to last year's UC Report, as well as additional issues discussed in the 2014 meeting.

B.1.1 PST: Highest Priority

1) *Sessions:* It is never mentioned in the call for proposals or PST that sessions are actually used to schedule and prioritize the telescope. Users need to be notified of the importance of sessions, and educated in what their sessions should look like to a) increase their use to NRAO staff and b) increase the likelihood of getting on the facility. The full importance of sessions should certainly be thoroughly discussed in Section 2.3.7 of the PST documentation.

2) *Cover Page:* Observing Type(s)- some of these may not be transparent to new users, and they should all be defined in the documentation. The acronym for 'OTF Mapping' should be defined.

3) *Sources:* The concept of a "source group" is unintuitive in many situations. Imagine a new observer who has a single target they would like to propose for—let's say M87. The very first thing they do is click on "new source group" and type in M87. Then they do a NED/SIMBAD search for M87, get its information, but when they click 'Save', they get an error: "The source name cannot be same as group name. Please try again." First, why not? Second, this user is not even making a group of sources, they just have one. The default unit for denoting sources should be a source, not a source group. It would be much clearer to simply input a list of sources, without having to group them. It should then be a possible, but higher-order option, to group sources together, for convenience in composing sessions.

4) *Sessions:* This issue of source groups then complicates the issue of sessions. Imagine a case where we have 15 targets—ten we want to observe in B configuration, and five we want to observe in A configuration. So we put them in two different source groups, according to desired configuration. But when we get to the sessions page, we are confused about how to input the desired observations (say, three 3-hour blocks on each source). We can only select the entire source group, which makes it sound like we want to observe all 10 targets in a single block. Should we say we want 30 sessions, each of 3 hours, for the B-config group? Or should we throw up our hands and say we just want 1 session of 90 hours, because we're confused anyway? Or should we go

back to 'sources' and place each target in a separate group, and then make one set of sessions per source (this is very time consuming)? We've tried all of these options in the past and we're still not sure which is right. Hence our complaint that sessions are quite unintuitive.

5) *Sessions:* In the PST documentation, it says that if one does set the LST range for a session, the range is assumed to be "anything sensible" (i.e., the source is observable). However, a warning pops up in the PST warning that not setting a LST range yield a session centered on an LST of 12h. These two pieces of information are in direct conflict with one another, and the PST documentation needs to be updated to reflect the actual situation.

B.1.2 PST: Medium Priority

1) *Technical Justification:* This section is, of course, very important, but the format for input seems to be encouraging proposers to be terse, and perhaps not as thorough as they would be if it was included in their scientific justification. Input boxes should be made bigger by default to encourage the use of full sentences and thorough input, especially in the case of justifying the amount of requested time. NRAO should stress to the users—both in the PST itself and in the documentation—that the proposers should be thorough, detailed, and clear, despite typing text into little boxes.

2) *Technical Justification:* The formatting of the Technical Justification could be made more clear for reviews by the SRP/TAC. For example, paragraph breaks and spacing should be preserved.

3) *Sessions:* In addition, requiring LST Session ranges is a lot to ask of observers, particularly because it should be relatively easy to write a piece of software that could calculate LST start/end time for a source and a user-inputted minimum elevation (if the user has additional restrictions like distance from zenith, they could still input these into the comments block; the LST time range does not allow for multiple entries now, anyway). At a minimum, if NRAO plans to require users to input LST start/stop times, they really need to supply a tool that calculates a source's elevation as a function of time at a given site. Because radio telescopes work during the day and to lower elevations than optical telescopes, most basic airmass plotting software used by optical/infrared astronomers is not sufficient for calculating LST start/end times on NRAO facilities.

4) *Sessions:* Once a session is established, if the user would like to go back and edit the session, there are multiple places to click edit, and only parts of the session are editable at a given time. For example, the user can click 'edit' under the session, or they can click on the source group name and then edit that. Why not just make everything editable if the user selects edit? This would make use of Sessions much easier and clearer.

5) *Authors:* When a proposal is copied to a new proposal, the author list is also copied over but not updated. This can lead to unintentionally outdated informations for co-

authors, which the SRP/TAC sometimes scold the proposers for. There should be a warning when copying proposals that the authors may need to be updated, and attention should be drawn to the 'update' button (which is not obvious as an option, unless one actually clicks on a name).

B.1.3 PST: Lower Priority

1) *General:* Some users have so many proposals in their `my.nrao.edu` that the proposal currently being edited is not displayed in the 'My Proposals' sidebar at the left, making it difficult to switch between pages. There is currently no option to scroll up/down the list or assurance that the proposal one is currently editing will be in the visible list.

2) *Sources:* For many scientific applications (i.e., continuum), velocities, reference frames, and conventions are very irrelevant, but can still create issues in inputting sources to the PST. Does this information really need to be included under sources? Or is it just a source of extra confusion?

3) *Resources:* The PST gives strong errors if there are unused resources in the proposal. This is confusing to the user, and often a significant inconvenience at submission time—is it not the sessions that count?

4) *Authors:* Reordering of authors is painful. The 'up/down' options only move an author one step at a time, which can be extremely tedious in long lists of authors. Perhaps a numbering scheme would be better-if an author is moved up by being given a higher ranking, all authors lowers than this new rank drop down one rank.

5) *Authors:* NRAO should be careful to notify proposers that all authors must have NRAO logins (perhaps in the Call for Proposals?). For that matter, is it crucial that all co-authors have NRAO logins? It seems counter-productive to leave people off proposals because their lack of NRAO login was not realized until the last minute.

6) *Authors:* The documentation and PST warnings should stress that the thesis proposal needs to be regularly updated to be of use. It might be helpful to give a few sentences in the PST documentation about how the thesis plan is used.

B.2 OPT Specific Issues

While performance of the OPT is much improved from several years ago, this software still remains slow and unwieldy. We understand that the DMS team is overstretched and extremely busy, and we understand that transfer to a new (non-web-based) platform would be labor intensive, and such a transfer is not an imminent priority. However, we do encourage DMS to revisit this possibility on occasion, as the UC believes it would lead to much greater flexibility of usage. Currently, the OPT regularly runs slowly due to connectivity issues with NRAO or performance issues at NRAO. A stand-alone tool would reduce much of these frustrations and lapses in reliability, and would likely give additional improvements in standard performance.

B.2.1 OPT: Highest Priority

1) The observer should be able to give it a range of LSTs, and it should be able to return the following to the user for each scan:

   –the minimum elevation (and LST time it occurs)

   –the maximum elevation (and LST time it occurs)

   –the minimum slew time (and LST time it occurs)

   –the maximum slew time (and LST time it occurs)

   This would cut down on a lot of wasted time spent entering different LST start times at 30 m intervals to evaluate the above. In the 2014 DMS talk, it was stated that this issue could be solved with Block Checker, but we assert that Block Checker is not a user-friendly solution by any means. We are not sure we understand what Block Checker is; perhaps it is not a publicly-available tool? Regardless, it can be extremely time-intensive to check the full LST start range at 30m intervals, and this process is very prone to human error. Checking the full LST range is tedious for seasoned users, and confusing for new users. Therefore, we respectfully disagree that this issue is solved, and request that DMS consider a simple algorithm to calculate the above elements for each scan. We believe a simple strategy like the one outlined above would alleviate the majority of tedium, confusion, and human error associated with the OPT.

2) We encountered a new bug in 2014A that appeared when the OPT lost connection with the server. If the disconnect happened while a new scan was being selected after editing the previous scan, the OPT was overwriting that scan with a copy of the previously edited scan. There are obvious situations where this can be very dangerous. This is just one example of stability issues with the OPT, which can produce unintended effects in scheduling blocks.

B.2.2 OPT: Medium Priority

1) Calculating a new summary report for a new LST start time remains slow.

2) It should be possible to assign manual priorities *within* priority A, B, C chunks of time. For example, if one is running a large mosaic on a field, there will be a clear priority order of the pointings and scheduling blocks. Currently, there is no way for a user to specify the order in which these blocks should be observed within the priority of the project block. This forces the user to hold off on submitting all scheduling blocks at the same time to avoid confusing the operators. A simple "priority order" tag to prioritize scheduling blocks would fix this issue.

3) It would be very useful if, under Project Details, the date of expiration of the program was listed. The expiration date can often be ambiguous (does the program cover move time? etc.), and currently, the Scheduling Officer must be contacted with such questions.

B.2.3 OPT: Lower Priority

1) Error messages in the OPT are often ambiguous. For example, when OPT complains about there not being enough time on source or shadowed antennas, it simply gives the name of the scan (and there are often multiple scans with the same name). It would be good to give the scan number too, as listed in the Summary report. The OPT currently notes a very confusing and long ID number in some errors (like shadowing) that does not seem to correspond to anything.

2) Any messages of import should show up in the Error window above the long list of shadowed antennas. That would include "Project passes validation" or "The scan XX will hit the minimum or maximum elevation at some point" or "there is no time on source for scan XXX." Error messages should be ordered in terms of importance, not chronological order, because the list can often be very long.

3) The OPT complains about "no time on source" even for dummies. This confusing error message could be simply fixed by not providing this error on scans with 'setup intent' flagged.

4) It would be great to have a tool to add and run simple mosaics without having to enter all pointings manually as separate sources.

5) It would be excellent if a user could "drag" items to change their position in a list (e.g., change the order of scans in a scheduling block). Currently the position of an item is changed one place at a time, slowly, with the up and down arrows.