MWA News Update - 18 August 2009

Defining the 32T Milestones

Understanding exactly the requirements of the 32T-capability milestones imposed by AAL and NSF has been an important issue since the meetings in Seattle in June. The topic has also been a major thrust at recent meetings in Cambridge, MA including NSF, Board members, management team, and the PI team, with communications to AAL in Australia. One of the major goals of these meetings was to clearly define a common set of 32T milestones agreed to by both AAL and NSF that will satify requirements for consideration of further project funding by both sponsors. In addition, a separate but related list of tasks was created that are more properly defined as responses to Critical Design Review (CDR) requests.

At this point, a draft document has been created specifically to address this issue, and it is now in the final stages of iteration, hopefully to be finalized within the next week. I hope to devote much of next week's MWA Update News to this issue.

More X8 reports

Further summary reports on X8 have been arriving, and more are expected, to give us a clearer picture of where things stand on all fronts.

X8 Report: Tiles and beamformers; DoC communications (Eric Kratzenberg, Haystack)

Our initial investigation involved getting the non-DOC tile 10, which had significant feedback ripples, to operate in a more reliable way. After a bit of trial and error it was concluded that chokes on the data lines and RG-6 significantly reduced the feedback ripples. Most likely RF feedback is escaping out the data lines, which we were expecting. To a lesser degree the following items seemed to have some effect;

-coil LNA cables at the gndplane edge.
-connect the tile gnd plane to the gnd stud on the bf.

At the same time it was noticed that there were several places where the LNA cables were rising 3 to 4 inches off the gnd plane near the element arms. It is recommended that the LNA cables be better tie-wrapped so they emerge at 45 deg angles from the arms. Dave E is familiar with the way it should be done and tile 2 is probably the best example of the way it ought to look. I believe this is an important thing to take care of as it is easy to do and has the potential to adversely affect the radiation pattern of the tile.

Some tiles have chokes on the LNA cables but that did not seem to make too much difference.

It was found later on that coiling the data/gnd/RG-6 cables was sufficient to reduce the gross ripples that appeared on the frequency spectrum. This was done to several of the worst performing tiles, but also should be done to the remaining tiles during the next expedition.

DOC tiles

The DOC beamformers where connected to Rec 2 , tiles 2 and 30, after some reworking and they seemed to work well from the get-go. There does not seem to be the feedback ripples but there are the expected LNA cable mismatch ripples at the low end. They seem to be stable and Chris has put a waterfall plot of the overnight spectrum on the twiki which looks very nice.

We tried moving cables around and spread them out but the changes seemed to be very small or negligible. We tried putting chokes on the RG-6 w/ cables spread out and it seemed to slightly improve the flatness of the band but this might just be subjective measurements. It is a probably a good idea to use chokes on the RG-6 cables as currents running on them could adversely affect the radiation pattern of the tile. Again, chokes on the LNA cables did not seem to make much difference. All in all the DOC bf's seem much more robust than their non-DOC counterparts but I would recommend getting a full compliment of 8 tested for several evenings of observations.

The DOC bf's were tested for gain, it seems that there is roughly 8dB of additional gain available from the point of saturation. This measurement used cold sky and all elements of the tile.

Anti Aliasing Filter

We took a look at Rec4, tile 4 and 8 each have a polarization with a new AA filter in the receiver which works correctly. The pass band on these two now has the correct rolloff. The second filter is a better candidate as the rolloff above 305MHz is steeper. Mark W will know the specs for that filter.

At this time I would have to say all the data we have taken, with the exception of those two tiles, is no good for Tsys measurements above roughly 220MHz due to the folding in of the image. At least we now know what the problem is.

Receiver (Prabu Thiagaraj, RRI)

During the X8 trip, we have completed the following list of work:

1. AgFo Codes with fiber interface components have been incorporated in all four receivers.
2. ADFB codes with Grant's new PFB and ADC power detection has been incorporated.
3. Clock and SCTN delay verification and adjustment for all 4 receivers has been done.
4. The ADC DC offsets have been estimated and correction values have been computed and applied for all 64 ADC channels. Ref: Girish et al [1]
5. ADC Total Power detection for 10ms and 1sec has been implemented and used in all four receivers for equalizing the power levels. Ref: Srivani et al[2]
6. In Receiver-4, a general maintenance has been carried out and the the problem reported/noticed by Frank did not repeat afterwards.

For the next field trip - Suggestions/feedback :

1. Temperature monitoring need to include probes for monitoring the ambient –
    a. inside the Hut
    b. outside the Hut

2. Temperature probes appear to show some large offsets, that needs to be "measured" and accounted for while taking/logging the temperature values. Possibly, the offsets can be obtained by the M&C, by first taking the "cold receiver" temperature from the all probes and comparing it with the Hut ambient.
3. It would be nice, if immediately after each days astronomical observation, a reasonable data set from each mode is processed automatically and feedback is generated about the "data-quality", or "instrument behavior". These could be e-mailed as brief reports and/or made available to the crew at the site for more effective improving/fixing of the reported performance/issues.

References:
1] http://mwa-lfd.haystack.mit.edu/pipermail/32t/attachments/20090731/8e56be01/AdcOffsetCompensation-0001.pdf
2] ADFB board : Functionalities of Version 1.1 firmware - A Draft, Srivani et al

Orbcomm Observations (Dan Mitchell, CfA)

By the end of X8 the 32T system was in a state to run orbcomm observations remotely. This includes the ability to change the sampler clock frequency so that coarse PFB channel 107 is aligned with the orbcomm band, and to select and switch between various dipole combinations on individual beamformers. After a series of initial drift scans to determine the appropriate attenuation settings for each tile, a number of longer observations containing several drifts were taken. The purpose of these observations was twofold; to measure individual beam shapes and to investigate parameterization using complex dipole gains as free parameters. The latter also gives information on mutual coupling between dipoles.

1. We took a number of scans of individual tile beams, at tile (azimuth,elevation) settings of (0,90), (45,60) and (90,60) degrees, as well as beams of individual dipoles in the three unique dipole locations. These will be used to generate beam shapes for the different beamformer settings, and allow us to compare beams from different tiles and different days.
2. We were not able to change dipoles fast enough to sample all 16 dipole beams during an orbcomm pass, so rows of 4 dipoles were selected at any given time, interspersed with full-tile measurements. A comparison of a full-tile beam with the beam generated from the superposition of the 4 row beams should give an indication of mutual coupling. It will also allow us to develop the dipole switching technique. All of these data were taken alongside tiles that had all but one dipole turned off, to act as slowly varying phase reference antennas. However, it is unclear whether these cross correlations can be constructed, due to an unrelated issue.
3. All of these observations were accompanied by observations with the simple dipole constructed at Curtin. This will be used to give an independent measurement of the transmitter beam.
4. A number (4?) of high-elevation DMSP F15 passes were recorded, although some with only a single receiver. This has a linearly polarized beacon, and the MWA tile response can be compared with similar data collected at Greenbank.

I'll fill you in more as I look at the data in the coming days and weeks.

Correlator/RTC (reported by Alan Whitney)

Correlator/RTC integration

Integration testing of the 32T correlator and RTC has been competed at Haystack with successful sustained data transfer from the 32T correlator board and a sample RTC computer via a 1 GigE interface; Stewart Gleadow, Steve Ord and Bart Kincaid spearheaded this work. The correlator crate and 32T correlator board have been shipped from Haystack to Curtin for further integration testing at Curtin.

Steve Ord achieved "first correlator light" at Haystack last week by imaging the correlator's output when the correlator input was a sawtooth test pattern. Using the 32T tile positions, a noisy image emerged showing the sort of characteristic pattern of the 32T sidelobe scale. Though not a thorough test by any means, the results showed expected characteristics.

PFB board development and integration testing

Ludi De Souza of CSIRO, along with Russ McWhirter of Haystack, have been working at ATNF since 1 August to complete the design and testing the PFB board. Reports are of steady progress, but not yet complete. Next week, Ludi and Russ, along with Anish Roshi and K. S. Srivani of RRI, will travel to Curtin, where they will be joined by Dave Emrich of Curtin for further integration testing and development. This testing will include a receiver, the 32T correlator, and the RTC brought from the site. All communications paths, along with M&C, will be tested and debugged to the extent possible within the one week window available for the entire team to be at Curtin. Following that, the system will remain in place for remote debug and development by team members.