

## Minutes for the weekly Plan Meeting of 5 Nov 2014

### 1. FE & OF related :

#### 1.1 Documentation : follow-up on level 2 (ITR) -- from 22 Oct & earlier (SSK+team):

(i) Check status of new items : work was ongoing for

(a) power monitor (Gaurav) -- rough draft ready, was waiting for conclusions from FE box testing; was held up for latest issues to be resolved and incorporated; now waiting for last round of testing to be completed.

(b) temp monitor (VBB) -- work had started (after new 250-500 FE box (v2) installation); to check status of this : still waiting for 2nd round of results.

(c) following to be taken up later : spares for 1420 feed -- pending; to be taken up after temperature monitor (above).

==> for (a) still waiting for the procedure to run smoothly as data is not coming in the correct column (b) similar issues for monitoring of temperature (c) is still on hold for some time

(ii) Also, can we look at which ITRs may be ready for conversion to NTRs : it was thought that filter design work can be taken up for this, once the ITR is done.

(a) for the 250-500 filter, a paper has been submitted to IEEE by Sougata & Anil -- reviews have come for this (needs some improvements, including some more mathematical treatment) -- modifications under progress;

(b) Agreed that the 550-900 filter work can be looked at for a paper.

==> for (a) revised version has been shared and needs to be looked at; (b) Imran is looking at that.

#### 1.2 OF system NTR -- from 22 Oct & earlier (SSK): can this be initiated now, leading to a journal paper publication?

Agreed to take the first draft of what was done for the MWSky paper and build on the OF section of it towards a first draft of NTR / paper; updated version of ORx sent by SSK; OTx will come shortly; then one can talk about NTR / paper !

Quick discussion on ORx doc : it is somewhat brief, but probably adequate -- needs to refer explicitly to other docs which have supporting details; a few other changes mentioned -- to be done, and updated document to be circulated.

most of the changes have been done in ORx doc except for adding the details about supporting docs; OTx work is in progress, may get finished by next week.

==> still waiting for progress.

#### 1.3 Noise temp & gain vs temperature for new LNAs -- from 22 Oct & before (VBB/SSK):

Variation of gain and  $T_{sys}$  with temperature : tests show new 250-500 LNA has ~5 to ~55 deg K varn in  $T_{lna}$  for variation of 0-60 deg K in env chamber, and gain change is ~ 0.2 to 0.3 dB -- confirmed with new test that waits for temp to stabilise after giving 10 deg steps (tests are now done with one monitor in contact with the device and one in the box, alongwith chamber temp monitor); repeatability has been tested ok with 2nd round of experiment.

Results from testing of 130-260 LNA show about 35 to 40 deg K variation in  $T_{lna}$  over 0 to 60 deg and 0.6 to 0.8 dB (drop) in gain with increasing temp.

Results for 550-900 LNA : about similar 35 to 40 deg K change in  $T_{lna}$  with 0-60 deg change in temp, and gain change is 0.04 to 0.36 dB -- results obtained for two epochs for both cases and found to be repeatable.

Current action items :

(i) These constitute a nice set of measurements; now need to understand what may be the cause : what is the expected variation for the device (same is used in both stages of all the 3 LNAs) and what is the expected sensitivity to bias point variations with temp -- these issues need to be looked at in some detail now. Agreed to verify measured values against the data sheet specs; check for bias pt variation with temperature (empirically) and compare with data sheet; also try Lband amplifier, if time permits; this was agreed to be taken up now.. status !?  
==> no progress on this item.

1.4 Installing and testing of temperature monitors in front-end & common boxes -- from 22 Oct (VBB/SSK) : scheme for fitting two temp monitors (one for LNA, one for FE box) for tests on bench, followed by antenna tests and installation: lab test with manual readings had been done (showed 15 deg temp difference between LNA body and FE box (open)); work was ongoing to study online data from 3 antennas : W1 (130-260 FE box), W4 (250-500 FE box) and E2 (common box) was tested ok, and some long duration (8 hr) tests have been carried out on W1; need some data on W4 and E2; also 24 hr test to get simultaneous reading on all 3 antennas for follow-up.

Meanwhile, C4 & C10 now also have dual temp monitors in FE box, and C13 has monitor in both FE & CB -- some tests had been done but data obtained was not sensible : unresolved issues in the wiring of the existing common box units that prevents the desired data to come on the expected channels in the online monitoring set-up ! Agreed to select a few antennas (maybe W1, C13, E2) for proper monitoring after resolving the issue, and for the rest, keep putting the temp monitors and maintain a log of which ones work in online monitoring; later, correct the wiring whenever a common box is taken for maintenance or upgrade (same argument applies for power monitor also). Current action items :

(i) Check if operators can use the present version of SOP by themselves : SOP has been updated and operators have tried it by themselves; to check data quality and decide if things are ok.

==> discussed partly under item 1.1 above -- needs follow-up as discussed.

(ii) Confirm if SOP works for any subarray and then release SOP + data analysis package for use by others and then have the ITR done.

==> still not clear.

(iii) Analysis of the data : C13 & E2 both channels temp monitor available at online output (fixed for C13 one ch FE and both chans in CB, and E2 both chans in CB); some test data had been taken; also, some data had been collected for 6-7 antennas; to check if results are available from the combined expt for temp and power monitoring. Latest status : analysis results almost ready for power and temp monitoring.

==> no update on this.

1.5 Testing of 130-260 system -- from 22 Oct & before (HRB/GSS/SSK/NK) :

Analysis so far, from 2 antenna installation (C10 & W1) shows that deflection and sensitivity at 150 is better than existing 150 feed + receiver; at 235 it may be slightly less than existing system; need firm tests to establish this, including interferometric tests using 3 or more antennas. Current action items are as follows :

(i) to ensure 3 antennas with the new feed : agreed to add one more 130-260 system : since wideband FE box was not available, agreed to try and put it in place of the 235-610 feed in one antenna and use the existing 235 MHz band receiver for doing the test -- finally installed on 150 face on S3 and replaced the 150 FE box with a 235 FE box to carry out the tests; results showed C10 and W1 deflection matching each other quite well (and only 0.6 dB less than expected at 235); but S3 unit shows about 1 dB further less deflection : agreed to compare with statistics from PMQC data (related to item (i) above) and try swapping of the wideband and narrow box

between S3 and one of the antennas -- the swap appears to have been done between S3 and C10 (?); tests have been done and data is available; need to get an answer from these.

==> after swap problem moved to C10 and hence appears to be associated with the narrow band box -- older history of this box shows that it was working ok; to see if FE box can be swapped with a normal properly working 235 antenna to check.

(ii) plans to completed the 3rd wideband 130-260 FE box.

==> waiting for the spare FE box to come back from w'shop.

(iii) plans for further tests, including interferometric measurements.

==> waiting to resolve the above issues.

1.6 Mass production of 250-500 FE sub-systems -- from 22 Oct & before (ANR/SSK) : 15 antennas have the new feed installed (remaining feeds are kept in storage) and 10 antennas have been fitted with the broadband FE box (with 2 spare units).

Note that the new configuration of QH + dir coupler + LNA is working ok in the new FE boxes (e.g. C11) but it needs to be checked individually for each new box that is made ready. Ongoing actions are as follows :

(i) characterisation and testing of installed systems (using monthly data):

Main tasks are as follows (FE team to maintain a proper log of action taken on individual antennas during these tests and debugging activities) :

- \* stability of power levels and bandshapes to be checked from weekly plots for the available broadband antennas; bad antennas to be taken up for correction.

- \* antenna sensitivity to be checked from on-off plots generated from the data; bad antennas to be taken for investigation e.g. E6 was found bad in earlier tests; even after many changes (including change of dipole) the problem was not fixed.

- \* failure rate of new FE system : about 1 in 2 months over the past 5-6 months(?) -- what are main reasons : oscillations? device failures? loose connections?

Specific action items are as follows:

(a) to confirm if E6 sensitivity is ok or not.

(b) to check if new data is available and what results are seen from it : monthly reports available since last 2-3 months, which includes interpretation also -- to see if some conclusions / trends can be identified from these; discussion so far can be summarised as follows :

- specific failures traced to improper connections, cabling etc : some are found and fixed.

- some antennas showing slightly lower sensitivity than the best ones -- need to be followed to understand the cause;

- some antennas show ripples and unstable behaviour in on off and deflection plots which need to be characterised and understood

- some antennas show RFI (mostly military aircraft) -- but need to watch out for other possible sources and catalog and inform.

- to check validity of satellite RFI warning set-up in control room.

Waiting for next round of data (end of September) for a more detailed follow-up.

==> new data taken after MTAC shows power level differences -- this is being followed up (Sep and Oct data is not of good quality).

(ii) plans for sub-band filters for 250-500 MHz system -- results from sample units with all 4 sub-bands over plotted showed roll-off is a bit slow on the higher freq side compared to existing L-band sub-band filters, but insertion loss is better; lab tests with manual settings using patch card + old MCM card done successfully, and sample units assembled in the new FE box put on C13; meanwhile, new, integrated unit that is more compact was developed : one chassis with 4 filters (on 2 PCBs)? plus separate chassis for switch; following are the pending action items :

(a) prototype PCB for this had come and was tested : worked ok, except for small difference in 2 pols; maybe due to unit to unit variations?; one more PCB was given to Argus to make with stricter tolerance (less than 10%) to see if that fixes the problems (Shogini was unable to meet the specs); this new PCB from Argus had problem in meeting 4 mil requirement : 3 sub-bands ok; 360-460 band has some issues -- slight shift in the BPF result and repeatability of units is not assured; hence 4.5 mil is needed, and change has been done for all the subbands (caveat is that one may lose 3-4 MHz BW in each subband); design has been sent to Argus but PCB has not yet come back -- to check status.

==> PCBs (for 2 channels of all 4 sub-bands) will come shortly and will be tested.

(b) mass production : switch PCB (20 nos) are available, along with sample chassis -- agreed that first it will go to one antenna; if found acceptable, then for mass production; compact v2 installed on C11 and appears to be working fine (tests completed); agreed to check against the performance of the new box and take a call -- waiting for outcome from 2nd round of testing and final report / conclusions.

==> agreed to give order for mass production alongwith final sub-band filter PCBs; for the switch item itself, 100 nos are available (120 needed); can wait to check if same switch is to be used in other places.

(c) updates from V2 document by VBB : report was discussed and some improvements were suggested : to zoom some of the plots as needed; to check about comparison with expected values by giving appropriate reference; to see if an internal document for mass production vs report for users can be made as slightly different versions of this document; to add on-off plots in addition to on and off; to refine comparison table for Crab deflection; noise deflection -- to add the on-off plots; Walsh testing needs to be completed and reported; similarly, should have qualification of power and temperature monitor working all right or not; to update and report back.

==> document update work is ongoing; Walsh testing shows one channel working in C11 and both channels working in C13; agreed to track down this problem and then move to mass production.

(iii) status of other auxiliary items :

(a) current version of noise source, power splitter, directional coupler etc : units were tested before putting up in C13; but in-situ tests showed that the power level (deflection) of the noise was not sufficient; finally traced to faulty functioning (unequal distribution) of power divider module; different approach (using resistive components) seems to work fine -- equal powers on both channels of ~ 4.5 dB for E-Hi cal, no need to reduce coupling from 20 dB; to confirm the final values of noise deflection being obtained from antenna tests with new system on C11 & C13; also, additional issue of 7 dB slope over the band (due to coupler) and 4 dB due to noise source -- these need to be optimised. To discuss these in the light of the new test results from VBB.

==> see new report and below for optimisation.

(b) change in the layout of noise module -- to try and reduce the 4 dB slope (and also increase the noise power slightly?), reduce temperature sensitivity etc : more compact PCB with constant current source, shorter track lengths etc) is completed and under testing. To check status.

==> under test right now; will know after 2 weeks.

(c) post amp : Hitite 740 new stock for 30 antennas available; to check if post amp has been tested with slow rise power supply (no progress, but SSK wants to keep it on the agenda); may get done with CB power supply testing; new design of supply has been done and PCB has been done and tested -- appears to be Ok; to decide

further course of action for this.

==> agreed to give this PCB for mass production to cover this FE box and common box requirements; next FE box layout to use this PCB.

(d) ANR needs to talk to Techno Circuits about the issues and work out (long-term) solution : discussion with Techno Ckts had happened and is positive, and party may agree for long-term rate contract -- to confirm status of this.

==> discussion has happened, but outcome is not known -- ANR needs to update.

1.7 Final version of 250-500 FE box -- from 22 Oct and before (ANR/SSK/HSK) : modelling showed that existing size of box is not adequate (inspite of double decking of chassis); deeper FE boxes are needed -- 15 cm longer box was made (wt of new empty box was 15 kg) after mech group confirmed that this is ok (present depth is 468 mm, can be increased to 700 mm; also, rear member in the cage can be removed to further increase depth); also total weight of populated box will go up by a significant amount. One such bigger box was populated as a prototype and put up on C13 and is under test; meanwhile, FE team has gone back to a compact design and layout that makes everything fit in the original FE box size; action items :

(i) first new box (bigger dimensions) was supplied by w'shop, integrated by FE and put on C13, with mixed results : basic things worked ok, but filter cascading needed a change, power & temperature monitoring also had issues, noise firing showed problems etc. This box was brought down for repairs, modifications and improvements, and had gone back to C13 : Walsh was not working -- problem found (cable had come loose) and box was fully tested and put back on C13 with matching wiring etc with C11 box; basic tests ok, but Walsh still not working (?); to check status of thorough comparison of results from C11 and C13.

==> Walsh testing to be cleared as noted above.

(ii) compact design to fit into original FE box : increased size and weight of prototype new box makes it unwieldy to handle at the focus and is a potential problem; FE group worked on compacting the contents to shrink it back to the old size, with minimum increase in weight : some of the smaller units were integrated into single units; milled chassis were replaced by plate+rail chassis wherever possible; ver2 box with everything fitting inside the original box (now 19 kg, down by 9 kg) completed and tested in the lab; installed on C11; action items :

(a) box has been up there for more than 6-8 weeks. no problems reported except for the fringe problem due to wrong filter settings (to confirm if this is resolved).

Walsh has not yet been tested -- to check plans for this.

(c) After the final set of test results, to take a formal decision for acceptance for mass production (meanwhile, FE team can start planning for mass production).

Waiting for results from 2nd round of testing by VBB -- some of these are folded into the updated report (see above) that has been circulated and discussed (see item above); to discuss plans to formalise the document for next GSG meeting and get the clearance.

==> Bottom line : GSG note + Walsh clearing before starting formal work; meanwhile planning has been going one.

(iii) choice of reflective paint for the final FE boxes needs to be made : a few different options are available (ref : APK, HSK) -- need to identify the best option; methodology of the tests to be done -- empty box to be painted and tested in parallel with control unit (without paint) using in-situ temperature measuring device; issue of clash with powder coating needs to be understood; empty box with one brand of paint (Luxtrotherm?) has been made ready for tests; to try to do simultaneous measurements with a normal box and report the results.

==> first test did not show much change in temperature -- may be due to cloudy conditions; to be repeated, alongwith a control box that is normal painted.

(iv) additionally, need at least 5 new boxes; can use the shells of 10 boxes (meant for home-made power supply) for this work -- 6 to be used for making 2 nos of 250-500 FE, 1 nos of 130-260 FE, 1 nos of 550-900 FE and 2 nos of common box; inside plates need to be done -- correct drawings need to be identified; making ready 6 boxes as per above (alongwith correct drawings for inside plates) was work in progress; 2 more of these boxes will be used for the paint tests above; need status update on this activity; all 6 boxes are ready in workshop and have now gone for engraving.  
==> may come back from engraving by early next week.

1.8 Status of improved 500-1000 MHz CDF -- from 22 Oct & earlier (HRB/GSS/SSK) : there are 3 different versions of dipole (v1, v2a, v2b) and 2 versions of cone (v1, v2) in trial phase; 3 test feeds have been built using these :  
ver1 : dipole v1 + cone v1 : RL is OK, deflection is not good & falls with freq  
ver2a : dipole v2a + cone v2 (mesh?) : RL is good; deflection is OK & flat with freq  
ver2b : dipole v2b + cone v2 (solid?) : RL is v. good; deflection is good but not flat. Simulation results for different combinations of the above were carried out and discussed in detail : it appears that dipole (rather than cavity) is dominant for deciding the RL behaviour (and also H-plane taper?); cone appears important for E-plane taper; best results for RL and good beam pattern match over large freq range appear to be for dipole v2b (triple sleeve) with cone v1 (66 deg).  
Current action items are as follows :

(i) Testing dipole v2b + cone v1 combination in lab and on antenna : was waiting for v2b dipole to be free (or new one to be ready), and for 2 nos of FE boxes to be ready; agreed to modify 2nd CSIRO box for this purpose (on a temporary basis) and also modify one of the old 610 FE box to accommodate the new circuitry ?; lab tests done for 'dipole v2b + cone v1 combination'? to be done on C10 (after taking down 750 kildal feed); 2nd FE box was ready and tested and waiting to be installed (on C6) once the new adjustable stool is ready; still pending; to decide what should be done about this item.

==> some results for this are there now, using the existing combination on C10

(ii) simulation results for denser mesh case (higher order basis functions): new simulations are with finer planes rather than higher order basis functions; this needs to be confirmed; also, 50 MHz shift that is seen needs to be understood; also explore default number of current elements in simulation (from 19 Dec meet); discussion with WIPLD indicates that increase in PolDeg may make a difference; tried with some changes in values of PolDeg related but no change in the results is apparent; to contact WIPLD to see if they have a case study that exemplifies these effects and then decide the future course of action. WIPLD had sent a response but it had not been tried as PC is down right now. To report if this is possible now; licensed version of windows7 has been obtained to install on the lab PC and it should now work ok -- to check status of this activity.

==> not discussed.

(iii) there is noticeable difference in simulated and measured RL curves which needs some study also (it appears that agreement was better for 250-500 CDF?); to check if new simulations make any difference or not (the same can be compared for the test range pattern measurement results for the two feeds?)

==> not discussed.

(iv) to do deflection tests for ver2 with a rigid stool design (and with finer adjustment of the focus distance, if needed) and then bring down the ver2a feed and replace with normalg 235/610 feed (or with v2b dipole + v1 cone combination?). unit from test range has been got and it has been put on C10 alongwith ver2 cavity at 1480 stool height -- deflection is down by 2 dB (uniformly) compared to 1280 stool height and beamwidth has increased to 50' (from 46'-47' earlier); tests have now been done with 1180 stool height and results need to be discussed. Also test of comparing power levels for cold sky (with feed) with the level for FE terminated : shows same deflection at 610 ; maybe slightly better deflection at higher freqs but certainly reduced beamwidth (which is now closer to the 44' seen for the existing 610 feed); agreed to try with 1080 ht by either new stool or reducing supporting member ht of 2nd cone that is available in Pune. New adjustable heigth stool was made ready by workshop and tests were done with v2 cone + v2 dipole feed -- to report the summary from this, and plan follow-up action items; also to complete the same tests with v1 cone + v2 dipole; 5 readings taken but then servo and GB problems in C10 had stopped the work; initial set of results using Crab discussed -- the basic performance of deflection vs freq (610, 700 & 800) and stool height appears to be similar to v2 cone + v2 dipole (though data are a bit noisy) -- may be less sensitive to stool ht at the higher freqs ? Agreed to do a deflection test on Cass-A at 1060 stool ht and then do a beam shape measurement on Crab for both the feeds. latest update from deflection tests (27 Aug) : 30-1 on-off deflection test on CasA shows deflection less by 2.5 to 3 dB : need to cross check this with a full RF dump at OF o/p -- can be tried today evening; beam shape data has also been taken; also to complete the deflection across band plot for Crab; data taken (for cone1 + dipole2b) for deflection using CygA and for beamshape using Crab -- former one is being analysed by HRB to get the results; latter is with Manisha to help with change in header data due to different SpAnalyser being used. To check latest situation of this and update about the results and have a detailed discussion. ==> deflections at 610 and 750 for different stool hts for ver1 ver2a and cone1 + dipole2b and cone2 + dipole2a show different behaviour. #3 needs to be explored up to 1500 mm ht and #4 needs to be explored from 900 to 1200 region; to be done using variable stool on C10; if possible, add measurements of 750 Kildal feed also.

(v) any new ideas? discussion of 19th Dec came up with following action items:  
(a) design Kildal ring feed at 750 MHz using v2b dipole -- 14 dB RL achieved (over what BW?) -- first results from sample unit (tried on C10?) appear to show improvement by 2.8 dB at 750 MHz (compared to v2b dipole + v2 feed design) ! To circulate detailed results, including on-off plots after rechecking, including comparison with CDF at different heights; HRB has circulated the results -- to take up for discussion. (to try small variation in height to find optimal position and then review the status). This feed is back on C10 now, but without any height change?  
(b) try simulation of CDF250-500 scaled by factor of 2 (including with different dipole sleeve combinations) -- maybe after (b) is done; status update needed.  
(c) design Dual-ring feed 550-900 MHz (intial BFRs can be made for 650 & 800 MHz) -- waiting for above items to complete; to try Kildal with height change on C10 stool after cone-dipole tests are completed; still pending for existing exercise at C10 to be over.  
==> not discussed.

1.9 Releasing existing 610 MHz system as part of the wideband upgrade -- from 22 Oct (SSK/ANR) : Preliminary tests of existing 610 feed through the wideband path

show that ~ 100 MHz usable bandwidth may be possible as part of phase-I uGMRT. Agreed that only RF filter needs to be changed to new 550-900 BPF (alongwith mobile band and TV notch filters) -- two sample units had been made ready and were put in FE ch1 of C8 & C12; initial RF deflection tests look encouraging : extra 10 MHz on lower side and 20 MHz on upper side, leading to a total BW of ~ 120 MHz (~ 565 to ~ 690 MHz) + some lower level response (5 dB down) upto 780 MHz; basic user tests showed good response; 3 more boxes with broader filters + notches (x2 channels each) were prepared and put on C4, S2 & E2; to summarise current status : 2 antennas (C8 & C12) in one channel; 3 antennas (C4, S2, E2 in both channels); action items :

- (i) agreed to complete 5 more antennas to reach target of 8 antennas -- to check current status of this activity; 7 antennas with wideband BPF + 540 + mobile notch filters (in both pols) installed -- C4, C8, C12, C14, E2, W1, S2 and remaining one (C1) to be completed soon.

==> C1 is also done and hence 8 antennas are completed and 2 more boxes are ready as spares.

- (ii) 10 filters of each kind (BPF + 2 notch filters) made ready; there was a problem with new lot of 26 nos of BPF -- 10 MHz shift; now corrected adhoc by using conformal coating on the PCB; meanwhile dialogue with Argus is on to understand the cause of the problem; to check status update on this and plans for long-term understanding and fixing of the problem -- long-term solution to be discussed with Argus to decide how to tackle; meanwhile, adhoc solution appears to be stable and working.

==> no update on discussion with Argus. Other possible options : Atlantic ckt?

1.10 Design of new RFCM card (v3) -- from 22 Oct & before (SSK/Imran/Sougata) : RFCM card (v1) was built as part of generating spares for Lband system and fully tested for all control functionalities -- for Lband, as well as for 250-500 FE box (alongwith patch card); it was agreed that since this RFCM card can not do monitoring (without further changes), old RFCM card + patch card will be used for present in the new FE box; will upgrade later to new RFCM card with monitoring capabilities included. Later, 5 monitoring points were added to the existing card, tested ok. Plan was to enhance the design of v1 by explicitly adding the monitoring facilities & full compatibility with new MCM card so that it can be used in all FE systems. A prototype version of the v2 PCB was designed, sent for fabrication, assembled, tested and incorporated into one Lband feed (which is now on W1) -- it still had some unresolved issues about bringing out the TTL lines and to take in the 8 monitor points; appropriate connectors need to be put for this; new PCB (v3) was designed and sent for fabrication; 12 nos had been fabricated, received, assembled & tested; all cards were found ok, but not yet integrated into a box -- agreed to complete this before going ahead with mass production ~ 120 cards may be required in the long run); pending issues :

- (i) agreed to test the card in next Lband feed being made ready -- this has been done but feed is not ready due to lack of other electronics.

==> still waiting.

- (ii) was integrated and tested in one 327 box, waiting to go up when there is a failure -- waiting for LNA (there is a crisis of spares for the existing electronics)

==> 250-500 LNA is being used as the alternative, but there are only 10 spares for uGMRT; original was made on ultralam2000 and this is not easily available; need to find an alternative substrate -- Rogers 5880 may be a possibility (work is ongoing) can move this item under 250-500 mass production !

- (iii) can also be tested in one FE box that is connected to common box that is being tested with new Rabbit card; another option is to try in 550-900 or 130-260 box.

==> confirmed that it is being used in test setup in the lab; and will go in the next 130-260 FE box.

- (iv) report : first draft is ready, and 2nd version is underway -- needs additions



about monitoring points and internal review -- to check status of this.  
==> still in discussion between Sougata and ANR.

1.11 Next Gen Common Box -- from 22 Oct (ANR/SSK) : Like 250-500 FE box, final version of Common Box needs to be assembled and tested : final power & temp monitor (are in hand), interface to Rabbit card (work in progress), design of new RFCM card (work in progress), new arrangement for power supply distribution; a block diagram of the new box has been prepared and circulated and accepted after some modifications and improvements; action items to be looked into :

(i) plans for interface card to meet monitoring requirements to be studied (alternative is to go to Rabbit card directly?) -- BSCTL card was identified to have additional monitor points which are already being used for power monitoring and need to do the same for temp monitoring and make available 2 spare monitor points; this will work for both old and new MCM card ! modified BSCTL card is working fine (already in use in E2 for both temp and power monitoring) and only two jumpers are needed on the PCB -- agreed that this can be made into a SOP to be carried out for any common box that comes down. SOP was in internal circulation; to check if it has been released.

==> all the relevant actions have been taken and SOP has been updated and circulated amongst relevant lab members and all common box are modified as and when they come down. Item can be closed.

New item : The interface card in common box needs extra PCBs due to wear and tear of existing PCBs. One to one copy of the card to be made as a new PCB, on lower priority.

(ii) plans for integrated power supply card -- being looked into by Imran; expected to be completed in 1 week (23-Jul-14); given for fabrication, will take 2-3 weeks (13-20 Aug- 2014); design has been done; card has been ordered; received and tested; to discuss the status and see if item can be closed.

==> see item above (and close as needed).

(iii) whether new box will be needed or old one can be used? -- agreed that old box should be used, except for issue whether new MCM card can be inside or needs to be outside the common box (the former option would be preferable); FE team has worked out a plan for integrating the Rabbit card inside, which requires to swap the interface card to the other side of the box, and to ease the wiring issue, the centre plate needs to be cut into 2 pieces; some issues about stacking of power detector with broadband amplifier need to be addressed; integrated power supply card is included in this scheme; media converter added to allow for additional capability of fibre connect from top to bottom (as an alternate to shielded eth cable or serial link on RS485) -- FE team plans to mount it outside; confirmed that RS485 serial link will be supported as default option, and that eth over Cu is not viable; action items now :

(a) to take one old common box, get new plates made, put dummy boxes and work out the wiring scheme : mechanical items are completed for the sample box but final wiring is yet to be completed; wiring work had started (with Sougata, in touch with Bhalerao); not clear which way it is going; finally, after some discussion, agreed that Bhalerao should do the full job of wiring from scratch.

==> new box will come by next week and wiring will start after that.

1.12 Calibration scheme with radiator at apex of antenna -- from 22 Oct & before (SSK/PAR/SRoy/DO/YG): Current set of issues being tracked are as follows :

(i) testing of dynamic range of old vs new electronics on specific antennas :  
First round of tests were done on C0 and C1 (both old electronics); C4 was the first antenna with new electronics that was tested (in Dec 2013) and compared with C1 (old electronics); informal / short report was produced, which showed that : 1 dB compression pt has improved by 6 to 8 dB (from -6 to -10 dBm to about -1 to 0 dBm); change in phase (and also ampl?) with change in elevation shows cyclic variation -- may be due to position shift? W1 was identified for testing repeatability on new electronics, in addition to repeating on C4 itself (though it has old common box).

Summary of new results :

Sensitivity and 1 dB compression point results look ok; stability of ampl and phase response need some interpretation; fair amount of new data is available which needs to be studied and the summary understood and then taken up for discussion -- this was done, and conclusions about 1 dB compression point are reasonably clear and ok (need to compare with results from signal flow analysis results; for the ampl and phase vary with antenna position, the results and conclusions are not very clear, but there appears to be some indication of the variations; a more detailed study with a couple of concrete follow-up options may be considered; agreed to complete the 1 dB compression point comparison with SFA; to repeat tests on either C0 or C1 to check validity of old results

Updates from results extracted from the analysis :

1 dB compression point values shown for C4 and C0 (new and old) show 7-9 dB change between old and new electronics; there is a hint for frequency dependence with reducing improvement at higher freqs; agreed to check with 20 MHz steps of CW radiating signal for both these antennas, in the range of 250 to 500 MHz.

Results replotted to show ampl, phase and elevation vs time on same panel -- there is clear anticorrelation of phase with elevation; for ampl, things are not so clear; for phase there may even be some frequency dependence in going from 150/400 to 1250 MHz; to try the test for broadband response alongwith n/w analyser; also give a copy of the data to SRoy to try plotting ampl/phase vs elevation directly.

Current action items :

(a) confirm when new common box was put on C4 (12th July 2013; sr no 119) -- to correlate with results.

==> PAR to confirm results from data before and after this date.

(b) to get comparison plots for C4 with old and new radiator antenna -- no updates.

==> new data taken with new antenna at 327 Mhz : 6 dB ampl and 40 deg ph for elevation angle cycle -- this appears to be larger than that for the old antenna;

(c) to check the change in 1 dB compression pt against SFA numbers -- this has been done and they compare well; to extend this to test 1 dB compression point at different stages of the chain : from OF i/p to GAB o/p.

==> not yet started.

(d) to repeat on another antenna with new electronics and one with old : W1 had been identified, and work for RF cable and antenna mounting related arrangements was completed and tests were to be done -- agreed to defer this for some time.

==> this is not being pursued; instead can try on C11 and C13.

(e) to check meaning of results from other wavebands that have been done.

(f) to get the plots done for the variation with antenna position (elevation etc) and then work on interpretation -- SRoy has sent the first new plots, but not yet with angle as x-axis.

(g) to give a copy of the data to SRoy for a more detailed analysis -- see if some new plots are ready.

(h) new tests with sweeping of RF to check 1 dB compression points with finer resolution over the band -- some tests have been done at 610 band and after corrections, fairly good match for gain curve is seen, but some variation in the 1 dB point with frequency...

==> (f) and (g) results from plots of ampl or phase vs elevation angle show clear distinctive shape for the ph vs angle and less clear shape of ampl vs angle; also there is slow

secular variation of ampl and phase with time; to try and model ph vs angle with a mathematical form and see what physical phenomenon matches that form.

for (h) to try 250-500 with old antenna in steps of 25 MHz at C11 and C13.

(ii) Understanding change of amplitude with change in antenna elevation :

SRoy has done the basic calculations but needs to cross check against the beam width of the feed to estimate the amount of deflection / shift between feed and transmitter at apex required to produce the measured change in signal level.

Test done by Subhashis by rotating the feed : power falls by a factor of about 4 with about 600 counts from the 0 reference position (-700 to +200 arcmin range) : fitting a gaussian to the voltage pattern (asymmetric) gives a HPBW of about 21 deg (about 15 deg for power pattern); this gives about 2 deg for 0.5 dB change in power. SRoy to refine the calculations (including other antennas) and also check Raybole's new report on this matter and summarise for a discussion.

drop in power is 4 sec out of 20 sec ==> 15 deg is 3 dB beamwidth (ok with other test of SRoy); ==> about 2 deg for 0.5 dB change; if converted to lateral shift of the feed, it may be close to 1 m -- to check alternative interpretation about rotation about feed axis by the require angle. not clear if the matter has been resolved or not; SRoy has circulated a first draft note; agreed to discuss during the meeting of 13 Aug; meanwhile, SRoy to circulate a drawing to illustrate the geometry. both documents have been circulated, and a discussion is required... some discussion about the analysis done by Subhashis : whether lateral translation of feed converted into an angular shift is enough? does the transmitter beam pattern make a difference? how much rotational offset of the feed would produce the same change.

==> not discussed.

(iii) deployment of new broadband antenna : suitable unit (from Aronia) has been identified and ordered : 2 nos with slightly different freq coverage are there --

looks like will work from 100 MHz to few GHz (hence OK for our use); one unit mounted at C4 and tested with broadband noise source covering all GMRT frequencies; found to work ok to first order, but there are some frequencies where there is loss of power -- being studied; also, tested with varying power levels of noise source and data is being analysed; first version of report has been circulated; few points raised are : why 1 dB compression pt changes dramatically for some of the frequencies e.g. 327 vs 393; issue about plotting amp, ph vs elevation instead of time -- SRoy can help in converting the data; to check consistency of results with earlier for same frequency; then check change in ampl and phase response for other freq; to check the angular pattern of the new antenna and compare with the earlier dipole antenna that was used -- to check what has been done and discuss the new results; issue folded in items above.

==> to send one data set from old measurements to SRoy for same kind of plot; to cross-check measurements of old and new at the same frequency.

YG to rewrite the agenda item a bit more clearly for next time.

1.13 Walsh switching arrangement in FE -- from 22 Oct & before (SSK/SCC/PAR) :

Some tests have been done on the bench by FE group; first draft of report has

been circulated.

(i) to devise a simple test using Lband system + radiation from apex to demonstrate the working of the system (on any antenna) -- agreed to try and couple this with the new test set-up at W1; agreed that CW test can be done to check functioning of modulation scheme when other tests are done at W1; FE team tried 4 antenna test including C13 but could not get a definitive answer; appears that the problem was due to improper test cable used at antenna base; new cable with all cores connected was made and used; further, it was found that Walsh eeprom IC has been removed from all antennas by BE team -- restored in W1 now and tests to be completed and reported: this looks like working satisfactorily for a first round testing. To go to next step of getting the signal to receiver room and check on oscilloscope (one pol can still be going to the VVM at antenna base); 2nd step will be to talk to BE team and get the end to end test going. Antenna base tests completed (instead of C04, done at W1 - why?); demodulation at receiver room not done yet; further, Walsh switching has been tested on C4 with astronomical source : loss of correlation happens when Walsh is turned ON (need to understand upper and lower bit in Walsh); next step is to match it with the demodulator in the back-end system.

summary : radiation test from apex done at W1 to show that Walsh switching is happening; astronomical source test done with Walsh on-off at C4; in addition C11 and C13 are Walsh-ready and should be tested in similar manner; after that, to take up discussion with back-end team about extending test to demodulation side; need status update on these tests and the outcome.

==> C13 tested ok in both pols; C11 : required change in IC of Walsh gen ckt; result shows one poln work and one not working -- needs further testing to confirm.

## 2. RFI related matters :

2.1 RFI from different spectral lines -- from 22 Oct and before (PAR/SSK) : this covers RFI from TV signals (from cable to terrestrial systems + boosters), aviation and radar systems, police wireless and such like :

(i) TV lines : Cable TV leakage could be bigger problem than boosters etc? : tests were done to see how much is this leakage as a function of frequency etc, but no clear evidence was found; present thinking of RFI team is that the lines seen are from terrestrial TV transmitters, rather than cable TV (!) -- likely to be in 175 to 229 MHz range. Follow-up action items : generate list of all the terrestrial TV transmitters in neighbourhood (with large enough range) and their frequencies, and to check which ones are expected to affect us : updated document shows about 17 transmitters around GMRT area listed -- based on information gathered from DD personnel and web. Not all of these are seen by GMRT antennas (some are very low power ~ 10 to 100 W, including UHF transmitters); the list of ones seen at GMRT is 11 transmitters : 2 of them are at same freq : Junnar and Sangamner; all are analog TV transmitters, except Mumbai DTT (digital transmission at 471 MHz) -- its signature is not clear. Following points came up : lines are there, not at very strong level, but the level appears to vary from antenna to antenna in an unpredictable manner; agreed to use data from RFI monitor as the basis of a catalog that can give the relative strengths of these lines and other lines (as seen at CEB); not yet started -- to check status now.

(ii) civil aviation related lines -- these may be of 2 kinds : airport radars (e.g. near 1090 MHz?), and transponders on aircraft (and counterparts at airports?) -- these are generally at lower frequencies (TBC). Some further details: near 1030 and 1090 : interrogation at 1030+/- 3.5 from airport and response from

aircraft at 1090+/- 5 with width of about 20 MHz.

Aim : to draw up a comprehensive list of known / expected lines from civil aviation related activities near GMRT.

work ongoing to characterise this, but not seen in log-periodic; to check with omni-directional antenna system; to check current status.

==> around 1090 +/- 5 there are lines that come and go -- due to different aircraft?

(iii) any other sources of spectral line RFI : e.g. police wireless etc -- need to be discussed and characterised : work ongoing with omni-directional antenna; 48 hr data has been taken with disc-cone antenna set-up and needs to be analysed and presented.

(iv) Overall plan to characterise all the lines using the RFI antenna to be discussed; work ongoing with omni-directional antenna system.

(v) omni-directional antenna needs repair and replacement also; processing for 10 nos (including remote location sensing) is ongoing.

==> general note : information collected from disc-cone, log-period and GMRT antenna and master table of line RFI is almost ready; needs one round of cross-check.

(vi) New item : new RFI in 250-500 in 270-290 band (not quite matched with MUOS frequency) only one incident has been reported so far -- needs to be cross-checked. line seen at 485 MHz (very narrow, almost a CW) -- may be due to radar wind profiler -- needs to be confirmed.

==> have looked for it but not seen a second epoch of the RFI ; 485 line source is confirmed, but no known source known.

2.2 Radiation from CAT5 cable -- from 22 Oct & earlier (SSK/PAR): Follow-up on action from 3 Apr 2013 (!): to install shielded CAT5/CAT6 cable in conference room as trial and finalise the scheme for all other public places in the building: first report has been circulated that combines testing of switches and CAT5 cables; conclusion is that use of shielded cable makes significant difference to the discrete lines as well as to broadband RFI. Agreed to go ahead with controlled expt in GMRT Conf room to quantify the improvement; tests had been completed, and report showed not much change in radiation level with and without shielded CAT-5 cable in conference room (!) -- maybe dominated by RFI from other equipment in the room? Agreed to move ahead by extrapolating from the results of testing of Miltech + switch : to try and estimate the cost of material and labour (time) for changing to shielded cable + connector in all the unshielded rooms of the building; discussion on 16 Jul : table of inventory of un-shielded cables currently in use (94 copper lines); total length ~ 1200 metres; procurement of shielded cable to be initiated; data has been submitted by RFI team, and an updated document has been circulated; needs a discussion to decide the course of action.

about 900 m cable (3 rolls) + crimping tool need to be ordered (enough connectors are available); total investment is about Rs 1.7 lakhs : agree to go ahead with this; item is under negotiation about details of the pricing (Rs vs \$ quotes due to difference in value); will check next week; meanwhile, work has started using existing spare cables. Need status update.

==> work has started with old stock; need update on new order.

2.3 Effect of military satellite RFI in 243 band -- from 22 Oct & before (PAR/SSK/SN) : follow-up action on testing for saturation effects, decision about appropriate location of switchable filter, possibility about control room (ops

group) being able to come up with algorithm for prediction (for users); results for tests done by pointing to the satellite (and tracking for some time) show increase in total broadband power of about 12-15 dB on the strongest satellites (others are weaker) -- this leads to harmonic at ~ 500 MHz also visible; there is good evidence that the FE is saturating as harmonics level does not change with changing OF attenuation; current action items are as follows :

(i) filter related action items : to try a test where filter is inserted in the path (for 2 antennas) -- done for E2 & C6 and check effect on other bands (610 and Lband); need to decide if we want this filter in a switchable mode (at FE box or Rx room) or permanently in the path or not at all ! does the answer depend on the strength of the signal? not clear... trial results on one channel of C6 was to be circulated for getting feedback... no updates.  
==> not discussed.

(ii) to test saturation effects and limiting angular distance from satellites : we need to quantify : at what angular distance do the signatures of non-linearity (harmonics) show up. Agreed to try for a plot that shows power in the RFI band as a function of angle from the satellite; and also to quantify when the alarm turns on; to do the finer experiment to find the angle range that avoids saturation and to plot power in fundamental and harmonic as a function of angle from satellite. 2 kinds of tests done : keep Az fixed and move in Ele and vice-versa yield +/- 2.5 deg as the width over which saturation is seen -- tested for 2 satellites which show saturation. To confirm status of this and see if final conclusion can be drawn.  
==> waiting for couple more measurements.

(iii) Ops group to investigate and come up with alarm algorithm to use in control room, after getting the relevant data from PAR. Present aim to cover 3 scenarios :  
(a) real-time alarm in the control room -- SNK has implemented this, but may need some retuning (some refinement of coordinates is needed)  
(b) for a given source at a given time, for a given frequency, predict the effect, including a facility for running through an obs file -- this is TBD;  
(c) post-facto : given log of an observation (lta and servo files?) analyse how much data affected by satellite RFI -- this is also TBD.  
==> PAR to check with SNK and update.

2.4 RFI testing of LED lights for GMRT labs & building -- from 22 Oct and much before (PAR/SSK/RVS) :

Electrical group has indented for 5 W lamps + X Watt tube lights (after samples had been tested for RFI and cleared) -- delivered units had 5 W and 7 W lamps and latter found to generate RFI (not to be used at GMRT); mass installation done and tested; agreed to install in canteen as first location; tubelights were to go through mass installation testing before clearing for use; tubelights (50 nos) also failed the test; hence, only 5 W bulbs found suitable! plan was to keep the 5 W bulbs installed for about 6 months and then check for RFI and take a final decision about bulk purchase; agreed that it is time to test the lamps that were installed in the canteen; new tests have been done and results look ok. Hence, clearance for mass procurement can be done. Update from RVS : 30 nos of the original 50 nos of 5W LED lamps can be now installed in corridor and lab areas. Indent can be raised for additional quantities. Need update from electrical group on this.  
==> no update from electrical.

2.5 Mobile phone RFI -- from 22 Oct & earlier (SSK/PAR) :

Progress on identifying the operators at and around E06, and in Nagar, Junnar directions : letter had been sent to BSNL, some follow-up action was on -- they had agreed to change to 1800 at 3 locations (Ale, Gulanchwadi & Pargaon Mangarul) : one location (Pargaon Mangarul) tower has been switched over to 1800 by BSNL; Alephata tower -- 2 sectors changed to 1800 (what about the rest?); for Gulanchwadi tower -- work is pending (as per latest update from BSNL officials); RFI team to verify these changes by visit to the sites & by checking the GMRT data (compare old vs new data), and summarise their finding -- some new tests are done and looks like there is improvement; Gulanchwadi needs reminder to BSNL. Appears that BSNL has no spare hardware to move from 900 MHz to 1800 MHz; eventually will move when additional units become available -- no commitment about time frame; check if there is any change in status; latest update : looks like end of September for any work by BSNL? check with BSNL reveals, no change in situation; if no change till end Oct, to decide whether to escalate to higher level or not.  
==> wait till end of Nov and then decide about escalation to higher authority.

### 3. Operations :

3.1 Mass production of shielded box for MCM cards -- from 22 Oct & before (SN/CPK/HSK): RFI test report of Akvira vs Physimech showed Akvira is better and this has been selected. Testing of new MCM card in shielded box, with final configuration was done and report was very positive, and it was agreed that Ops group can now go ahead with mass production of this shielded box:

Ops group to report on discussions with Mech group and finalise + collect drawings for 2 types of box : with and without provision for SPI port on chassis + 1 serial port on each box; aim to place final order on Akvira. RFI group to complete 2 more prototype units, and then hand over the matter to Ops group. Ops group to start looking at the work required (parts list, jobs to be done, items to be ordered etc) and make a plan. Ops group needs to continue the dialogue with mechanical and also open the dialogue with RFI team to get the inputs : drawings, bill of material, identifying list of vendors etc. To aim for 60 + 10 shielded boxes. RFI specs provided to Operations group; mechanical boxes at work order stage (to be outsourced); enquiry for components in ~ 2 weeks (30-Jul-14); to be available in 3-4 months; to confirm present status and schedule long-term follow-up accordingly; order sent for 70 nos, with one prototype to be delivered first, and batch-wise delivery after that; sample box has come and being looked into.

==> not discussed as nobody from Ops team was present.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 22 Oct and before (SN/CPK/HSK) :

detailed RFI tests show that the shielded enclosure appears to be working quite well; RFI team has handed over the information and material to Ops Group for initiating mass production; last round of confirmation to finalise the drawings has been done; Ops group has started on the work requisition for this box (as well as the box for the Rabbit card), in cooperation with mechanical group; current target is for 35 nos of these shielded enclosures; order has been placed for 35 nos, with one prototype to be delivered first, and batch-wise delivery after that; sample box should have come by now.

==> not discussed as nobody from Ops team was present.

3.3 Interfacing of FE with new M&C system -- from 22 Oct & earlier (SN/NS/CPK) : Naresh + Charu & Sougata + Rodrigues were working on this; will have full set-up of FE + Common box, but will start with M&C of common box using Rabbit card : initial

h'ware connectivity may not be too much work as 32 lines have to be mapped to 16 lines on interface card; low level software for bit pattern setting may be enough to demonstrate basic connectivity; after that, packaging will be the issue to be sorted out. Action items:

(i) appears that the basic set-up is now working, and tested (by Rodrigues + others); basic difficulty of communicating via Rabbit to FE appears to have been resolved with demo of some commands by Rodrigues et al; to check if all the available commands can be exercised; 2-3 basic control commands have been tested; monitoring commands (6-7 FE + CB monitors need to be tested; a report has been produced by Rodrigues; follow-up discussion with telemetry team and Rodrigues organised by Nayak and basic action plan created : one CB was being made ready in FE lab for test set-up (to be reserved for telemetry testing related work); appears that the basic tests have been done -- most commands tested and cleared; some problems with bypass mode and RF on/off -- getting fixed; Walsh cmd not yet activated; monitoring tests yet to be done; to complete these pending items, and then work with issues related to eth vs serial port tests and also packaging of Rabbit inside the common box etc. SN to talk with SSK and come back with a plan; most of the tests done to clear initial functioning with Sougata and Naresh, including sub-band filter selection (using 250-500 in new C13 FE box); Walsh not yet tested; monitoring not tested; reiterated the plan to test one CB + 327 FE box and do all the control and monitor tests -- to be carried out by IER : need status update on this.

==> not discussed as nobody from Ops group was present.

(ii) to decide the set of high level commands for FE system; for many of these Naresh already has the placeholder to accept the commands and action to be taken has to be programmed, in Rabbit software -- this is to be initiated. Code for existing commands of common box have been done; can check for new commands in upgraded system and then move to FE box -- this should be nearing completion now -- can check status and see if it is completed satisfactorily; agreed that Naresh should send a note about the set of high-level commands being implemented, this has finally been circulated; not clear if it really implements high level commands that were expected; also how to include Walsh needs some thought; need to discuss these items in detail and include in testing plan. Item taken up as part of a bigger meeting (on 18th Sep); to check action items emerging from that meeting for follow-up discussion.

==> not discussed as nobody from Oss group was present.

### 3.4 Development of M&C software -- from 22 Oct & before (JPK/RU/SN/NGK/SJ) :

(i) taking up EPICs based PoC version for putting additional functionality : basic loading (and unloading) of the EPICS has been done successfully on the machine; now need to connect Rabbit card and test existing PoC software and then go to the new addition to be done; Naresh and Yogesh to coordinate about putting the Rabbit card in the lab. Joardar and Yogesh have made a fresh installation of the software (under Debian linux) and demo software is working fine; ready to start work on OF system end for integration and testing -- first test with Rabbit card (with v2 subsystem) done successfully; need the test jig to be shared with telemetry lab, as well as the "subroutine" for setting the appropriate bit patterns (both were arranged for); agreed to develop the software first for OF attenuators; work with headless CSS and GUI; have obtained the commands and information; have understood the workings and need to make to the next step; a SOP to make running of things easier was awaited and then full scale work was to resume.



(ii) plans for modbus learning & testing : simple set-up of PC + Rabbit card with modbus for "hello world" level -- no updates, as not get enough time; could keep it on low priority.

(iii) plans for tasks for next phase of work for new M&C software : architecture definition and UI definition tasks are on; to check current status of the activities to see if there are any bottle-necks or difficulties; template for the deliverables for both has been approved; there may be still some gaps in the architecture work (esp domain specific engines) and details about EPICs realisation, spec driven arch, sequential plan etc; hence may spill over by some time more than anticipated earlier.

(iv) M&C software in-house : next round of tests were underway -- tests done with switch + rabbit card at antenna base and used for commands and monitoring of the OF system -- this path is cleared. now testing with GWB corr at first level by interfacing to existing dassrv structure and environment; webpage based display done; some routines in astropy added; some additional code added for diagnostics purposes - to be completed by 30-Jul-14; Santaji has built web based monitoring temp/wind/3-phasepower etc; tested ok; need to separate out online V2 items from overall web-based tools for enabling absentee observing.

(v) in long run : is dassrv needed or not?; whether metadata and other related information may change the details of the interface to the backends; to look at pros and cons including sync of multiple correlators etc -- could generate a note about various aspects, including future possibilities. JPK to take up discussion with RU (may involve SSK also as needed) -- can this be addressed in the arch design study; automated starting of correlator may also be an issues...

(vi) common hardware requirements to be taken up for discussion -- to see if these (along with other common issues) can be taken up for discussion in a joint session of all interested parties -- this happened on 18th Sep : to discuss the results from this and take up resulting action items; 3 main action items discussed; to be formalised and taken up for follow-up; one follow-up meeting was held between RU, JPK and YG. To discuss further follow-up action.

==> not discussed as no members from Ops team present.

#### 4. Back-ends :

##### 4.1 Documentations :

(i) Detailed design doc -- from 22 Oct & before (BAK) : analog back-end was being done by Hande : 2nd version had been circulated in April. Next level of document going down to chassis level is to be made ready -- chassis level doc will take about 2 months; can be deferred till end of September or later; to check current plans for this.

==> holding till end of Nov.

(ii) ITRs for analog back-end systems and digital systems to be taken up : analog back-end : Sandeep and Navnath to look into; pkt corr first level has been done and circulated -- waiting for feedback; GWB first version (by Reddy + Irappa) has also been circulated; authors are working on a second version with additions -- this should have been circulated by now; need to discuss contents and decide follow-up action. Modified version has been circulated; to discuss and finalise next step; ITR issue can be closed now; some discussion to try to move to a point where a publication can be done -- this needs to be followed up appropriately;

agreed to have a discussion on this topic with the team and send a follow-up plan.  
To check if this is ready and can be discussed -- not much movement; agreed to be ready for a detailed discussion next time (10 Sep). To check status of this.  
==> BAK, SHR and YG had one discussion last week -- follow-up is due next week.

4.2 Analog back-end : LO setting related issues -- from 22 Oct & before (BAK) :  
The following remain to be resolved :

(i) problem with LO setting using FSW resulting in reduction of correlation (compared to LO from sig gen) -- understanding is that 10 MHz being used as reference was at the edge of the locking range; shifted to 105 MHz based reference generator; user level tests were still showing some problems with channel 2 (175 pol) of 1390 band (?) and also with some of the other sub-bands of L-band; upshot appears to be that system does not power up properly and needs a manual setting to get started, after which it takes commands from control room and works properly; meanwhile, the long-term solution requires the new online system to send the appropriate command as part of sequence after power-on -- Naresh has been trying this, but has not yet succeeded. some tests tried by Jitendra + Naresh, but did not succeed; may need more changes in the code on both ends, or better interface; no progress so far, need some more time / effort from Naresh (+JPK?); BAK to check with SN and status to be updated. After work done by Naresh + Jitendra, code tested on sample unit and found to work ok in terms of setting 105 (or any other frequency) from online. Now needs to be replicated on all Rabbit cards.

2 aspects : first is to set the reference for FSW from online -- is completed for all antennas. second aspect is that like 1st LO, FSW units in GAB also show phase jump when reinitialised; one possible solution (found by trial and error) is to use 50 MHz as the reference.

==> first part can be closed; for second part, to start planning for permanent arrangement for 50 MHz (can also check 10 MHz to see if the problem can be solved).

4.3 Analog back-end : completion of 30 antenna system -- from 22 Oct & before (BAK): 16 antenna system completed (from cabling from OF to cabling to corr wall panel); 24 antenna system also released (mid-April 2014); and now 30 antenna system has also been completed (July 2014). Pending action item :

(i) long-term plans for power supply and ethernet switches to be discussed : for power supply, discussion is as before; ethernet switch : there may be a complication about accommodation 24 port switch in terms of space and layout; 8-port switch was tested for RFI (with and without shielded CAT5 cable -- old 2013 report + new Jul 2014 report) and it is clear that there is some RFI even after shielded CAT5 cable is used. Possibilities for shielding box for 8-port switch discussed; BE team to check about space for putting a shielded box around the 8 port switch; Hande and Raybole have discussed the matter and it is agreed to try and design a shielded box that allows the switch to occupy a 1U slot in the backside of the GAB racks. Raybole is working on design of shielded box and is ready to order material for this; first sample box was ready; needs to be tested and then tried in-situ.

==> controlled tests show very good RFI rejection (report is awaited) -- can check after report comes and finalise on mass production. (true for both ps and eth units)

(ii) appropriate attenuator settings for Lband & 250-500 done; 610 band was being finalised -- updated table had been circulated; few iterations were done and a more accurate updated table for 16 antenna system has been circulated; also, agreed that BE group will do monthly monitoring and report the status (for all the 3 bands) -- regular monitoring was to be started in May 2014, but took some time to get

organised; montly reports will come regularly from June onwards. To discuss how to handle interpretation of the results and iterations to change the attenuator settings for future, as there are evolving changes happening in the FE systems. One round of measurements has been made and set-up is reasonably stable (may need a PC to be arranged?); will take some more time till regular monthly monitoring data can be meaningfully discussed. PC has been arranged; need to start the regular monitoring now; set-up is sort of in place; first round of checkign will happen during the MTAC. first round of readings has been taken and some summary will be sent shortly.  
==> results not yet circulated internally; BAK to check with team.

(iii) status of work for having i/p side RF filters : plans with FE group for sharing mass production units; agreed that FE group will share the designs of the filters, provided BE team is ok with the performance specs; ok to include BE requirements in order of PCBs and components by FE group (cost sharing to be worked out accordingly); however, BE group to take care of mass assembly separately, as it will be done with in-house manpower by FE group for their filters. BE group to make its own design for the final PIU, including their choice of 8:1 switch etc. This is looking like one PIU with existing chassis for 4 (or 5?) BPFs (one for each main band) + 1 straight through path, using 2 nos of 8:1 switches; agreed to go ahead with single chassis plan for the main 5 BPFs + one switch; second switch and other sub-band filters to be put outside, within the PIU. Can use two subbands from Lband and 250-500 for the present for testing effect of sub-band selection -- this may need a separate series of tests to be done. Current status and action items :  
prototype unit using existing PCBs with chassis has been assembled in the PIU and tested in-situ; now making own chasses to fit the PCBs in the PIU comofortably; can happen in one month (end-Sep?); will have direct path + one 100 MHz LPF path + main band filters for each band, with one 8:1 switch; BE team will buy the substrate board and give to FE for getting the PCBs and will buy their own components to populate the PCBs they will receive; own chassis for testing is work in progress; order for substrate is gone; list of components to be purchased is getting ready. Latest status : components for in-house modified prototype unit are in hand; integration work to start and then testing to be done and then final decision to be taken. For the items, order for the board material has been placed, and indent raised for the components and connectors yet to start the work; chassis order will be given after the final tests.  
==> connector shortage preventing completing integration and testing; indents now ready for components and connectors -- to go to next stage.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 29 Oct & before (SHR/SSK/BAK/DVL/YG) : (NOTE : GWB-I is existing released system !) : agreed to make 4 T7500 nodes with C2050/C2075 Fermi GPUs + remaining 4 T7500 nodes as host machines (to take care that these are the ones that transient pipeline uses presently so that sharing is possible); this should have ALL basic modes : total intensity and full polar IFR modes; IA + PA BFR modes with process\_psr pipeline attached; full GUI support; to come up in trial code section without affecting the presently released mode. Action items :

(i) testing of GWB-II interferometry mode with different OF attenuation values to check variation of correlation coefficient -- DVL + YG to provide an update. It looks like working ok now, with the sig gen LO. To confirm if working ok with the new, modified synthesiser mode; results from sig-gen versus syntheziser have been found to be consistent at 1280 MHz (marginally better than GSB); however, 1390 synthesiser scheme needs to be confirmed; it looks like that this may be resolved now (maybe due to setting problem, when it defaults to 10 MHz reference)? but some

problems noticed with other sub-bands of L-band) -- needs some clear follow-up, including combined testing of attenuator levels -- DVL to organise these tests; some updates from DVL's email last week : 1170 appears to be OK; need to complete the checks for 1280 and 1390 subbands and clear the matter. DVL to test and report back the status; updated results from all 4 sub-bands of Lband appear to show that the corrln coefficient values are in the same range for both choices of LO scheme. YG to check with DVL about the report and then close the matter.  
==> DVL has made first version of report and updating to 2nd version after discussion with YG.

(ii) testing of GWB-II in dual pol interferometric modes : some tests initiated by DVL + YG to check total intensity and full stokes mode -- to update about the results, and also plans to update the SOP etc about these modes; updates from DVL : dual pol total intensity and full stokes have been tested and found ok (in comparison with GSB data for same output); to check about SOP update and then see if item can be closed; waiting for DVL to circulate the final results (and also discuss with SHR) and then update the SOP and see if matter can be closed; SOP has been updated; waiting for it to be circulated; report also under preparation.  
==> same as (i) above.

(iii) beam modes in GWB II : new version with separate kernel (outside phase shift kernel) for beam formation has been developed (compute load is 7% increase on 2050 GPU); IA mode tested; PA mode completed and tested; phasing implemented & tested; 610 MHz with 200 MHz LPF -- to test with different setting in pmon to check S/N effects; process\_psr pipeline has been completed and released; first version of SOP has been released; pending action items :

(a) there appears to be a problem in the PA mode : integrator & square law detector are in opposite order -- SHR has fixed and last set of tests remain to be done before releasing. YG & SG have carried out some tests; first order tests indicate ok; but need a bit more checking; load estimates for GWB-II not important and this item can be closed if sufficient testing has been done.

(b) GUI changes for flexible phasing to be checked with SHR & NSR -- YG and others to test and report back -- can be closed after one more round of user tests.

(c) float to int conversion logic has been implemented for scaling but needs a cross-check -- user controlled scaling factor has been provided; updated SOP also provided; need user feedback about the functioning and then check if it can be closed.

(d) beam mode working with fixed channel and time factors -- need to be made general purpose; SSK had got the code changes done -- going up to 16k channels now (need to test beyond that) -- SSK feels that problem beyond 16k may be in main GWB code -- to discuss with SHR and try to resolve. Need status update on this.

==> problem of going beyond 16k is solved and it can go to 32k, but to go beyond may require lot of changes in the code; new version can go to GWB III.

(e) availability of psr\_mon / pmon on nodes 53 and 54 for recorded data is there; for shm attach needs some work; psr\_mon done; pmon still pending (YG to discuss details with SSK).

==> psr\_mon done but only for off-line upto 16k chans; no real-time version available; pmon still needs to be looked at.

(f) multi-subarray capability yet to be implemented (also to check about possibility of 4 beams) -- should be work in progress now.

==> this needs joint discussion between SHR and SSK -- may happen next week.

(g) header for beam mode data : to be taken up and incorporated alongwith the PA mode; discussion to be initiated.

==> work has started; to discuss the details of the contents of the header.

(iv) spikes in channels that are power of 2 : this problem needs to be discussed, understood and fixed. SHR has started looking at it, but no clear clues yet. may help with test using digital noise source; effect is seen in packetised corr also; now checking offline with raw voltage data acquired through Roach board, and with digital noise generated on Roach board; KDB has digital noise source + GWB spectra now running and some of the issues can be investigated; testing with noise generated in digital domain does not appear to show the problem. not clear what is the best thing to do now. SHR believes it is in ADC, but need a bit more thinking... a different ADC in the same slot or something else? some tests to be tried for one of four output of ADC? trying to see if selecting only 1 channel of ADC provides any clue? some difference seen between the FFT of the single stream vs the 4 interleaved stream data -- to check for all the 4 single streams; also can check at slower FPGA clock rates and see what happens; trying single ADC streams or channels still shows the spikes in each channel; slower FPGA clk rate also doesn't show any difference and it appears to be natively present in the ADC data ? To check if the power level of these spikes is constant and how much below the mean passband level; to complete the test of power levels and report back.

==> test yet to be done.

New item : GWB III about host machine configuration with and without GPUs -- ok.

4.5 RFI filtering -- from 22 Oct and before (KDB/BAK/YG) : to add the first version of the real-time RFI filtering block (after some modifications) into the packetizer of GWB-I (in one input out of two with different options like replace by median or by constant or by digital noise source sample or clip to threshold via s'ware registers) -- basic tests done; to try with real antenna signal split into 2 copies and check both self and cross outputs; to report about performance of the same, and then to look into optimisation of resource usage. tests completed with GWB-II and being planned for BOTH channels; bit of discussion and agreed to see if a time domain test using either corr self powers or 2 IA beam signals can be tried; some tests with varying sigma have been tried on antenna signals and results need to be summarised; fresh tests & analyses have been circulated (awaiting feedback); data taken with pulsed noise source [offline input]; new results that were circulated were discussed; agreed that the basic scheme appears to be working ok; to try 3 versions of the scheme, with different options for the statistics.

compilation for 4, 6, 8 bit inputs is available; utilisation (for one analog channel) : 41%, 19% and 17% (for total design) for 4 K window; agreed to produce a fixed BOF file with RFI filter on in 1 channel of each ADC (4 out of 8 antennas) with fixed replace with zero for 3 sigma clipping; check status of the work.

tests to see if there is some biasing by digitally splitting the antenna signal.

With very high thld, there is no change in DC value -- this may mean that thld may not be getting represented properly; to work some more and see what may be the problem; running with fixed statistics also almost working.

Latest status : control tests done with noise source : first issue is to check change in mean level with filtering : found that it does not happen when thld is more than 5 sigma or so; for lower thld it happens for replacement with zero or replacement with noise but not for clipping -- to check if lower thlds will show this problem.

second part is testing with two different methods of generating thld statistics : shown that a priori stats works better for rejecting RFI infected data. Need to discuss and decide follow-up plan.

==> to complete the tests with reduced thld to check change of mean; to support 3 modes : continuous update; update on request; external update; to report on results from actual antenna testing on GWB-II; aim to fit in the GWB-III design :

difficulty because all 4 inputs of Roach are being used. To try and see if the design can fit for 2 filters out of 4 channels on each Roach board with 800 MHz.

4.6 Power and cooling requirements for projected back-end systems -- from 22 Oct and earlier (GSJ/BAK/RVS/YG) : some modifications have been made and some tests have been done and preliminary results circulated -- to discuss these and plan further activities; some specific action items :

(i) scheme for monitoring of processor temperature to be refined -- for the main compute nodes : new package for temp monitoring requires slightly different version of kernel than what is used on the main GSB nodes; new kernel was installed on a few nodes and following 2 issues had come up : new kernel on 2 compute nodes may have been causing the buffer loss problem (new kernel was rolled back to the old one); and for the current kernel on gsbm2, the high time resolution mode did not work (gsbm2 kernel was rolled back to the previous version that was there); for the first matter, follow-up was to do a controlled test -- node18 and 19 test was repeated and some degradation of performance confirmed; agreed to put new kernel on ALL the GSB nodes and test again : 3-4 hours' data collected with all nodes with new kernel; analysis shows a few occasions of buffer loss; comparison with normal GSB kernel shows that it doesn't show buffer loss; agreed to try new kernel once more; also to check for possible causes of buffer loss with new kernel; tests done with 16 and 32 MHz 256 channels tending to show statistical difference in buffer loss -- TBC more carefully; confirmed that there is a difference between in the 16 and 32 MHz modes; need a bit more careful checkign (along with Sanjay).  
==> no updates.

(ii) to add temp monitoring package on all GWB nodes : to check if this is feasible and has been done or not -- agreed that this can be done easily and that we should implement on all the GWB-II and GWB-III nodes. To make a list of machines which have it and then put it on all the machines; to reuse the earlier code for logging the data, plotting it, and also to add an option to generate a warning if the value exceeds some threshold; to think about a real-time version of the warning algorithm. ready to run on GWB -- agreed to go ahead and test; to think about long-term monitoring tool that shows the temp of all the GWB nodes. To ensure that code starts every time GWB nodes are rebooted; to work a bit more about plan for bringing the results to a common place for visualisation. Discussed a few possible options ranging from MPI to sockets to cross mounted disk systems -- to decide on concrete action plan.  
==> installed "lmsensor" on all the GWB-III machines and working ok; right now using cross-mounted disks on 3 GWB-III machines; browser based tool for monitoring the data; cycle for 7 days for preserving the data. To see how this can be evolved.

4.7 Next-gen time & frequency standards -- from 24 Sep & before (NDS/BAK) :

(i) brief update from BE team from visit to NPL was provided in last discussion; waiting for detailed report to be circulated draft (maser report already circulated) complete report has been circulated today -- need to schedule a discussion. not much progress; need to follow-up and discuss within the group also, to work out a possible "plan".  
==> to be discussed.

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