

## Minutes of Plan meeting of 21 Jan 2015

### 1. FE & OF related :

1.1 Detailed design doc / ITR -- pending for long : from 7 Jan & before (SSK/BAK) :

(i) OF Rx system to be completed (Satish Lokhande) : first version circulated -- some improvements and additions suggested (e.g. to give explicit reference to other docs which have supporting details; to give reason for 10 dB attn; to give comparison with expected values from SFA report; to mention some precautions and practical issues during assembly etc). Update version was ready and SSK was to check if it has been sent or not -- still pending with SSK to send.

(ii) OF Tx started (may have only blk diags for now, without full details, till a paper is ready!); initial write-up (by Satish) needed improvement; functional blk diagram has been made and detailed description needed to be added; 1st draft has been sent; updates versions of both Rx and Tx will come out together in next few days. ==> SSK has sent draft versions for both ORx and OTx -- can be discussed in detail next week. SSK may want to add more detailed description for ORx.

1.2 Update on results from test range -- pending from 7 Jan & before (HRB/GSS/SSK) : Reorganised into the following issues :

(i) calculation (based on reference paper) of expected deflection & comparison with measurements to check if there is significant loss of sensitivity -- GSS developing refined version more relevant for GMRT (also, if further expts with 250-500 or 500-1000 feed are useful) : cross check of results from code (0.3 dB drop for 0.5 lambda offset) wrt curves from Kildal paper was confirmed; for GMRT specific case of 250-500, efficiency factor as a function of freq over the band, using the data for the measured feed pattern, was implemented; after correcting one error in the code, better result (9.9 dB vs 11.6 dB expected) was achieved; further, a realistic phase response (instead of 1.0) was included by reading data from a file; results (reported on 19th Mar) showed better match between measured and expected deflections for the 250-500 system : 327 -- 12.8 dB vs 12.4 dB; 400 -- 12.8 dB vs 12.2 dB; 450 -- 12.4 dB vs 11.4 dB; 500 -- 11.2 dB vs 11.0 dB (some re-work needed for lower frequencies?); computed results (based on change in efficiency due to shift of phase centre) show likely drop in sensitivity by about 1.4 dB from 250 to 500 -- this is now to be folded into the net sensitivity / deflection curves made by GP (see agenda item following this one). Present action items :

(a) GSS is working on plans to extend this to 550-900 system -- was waiting to get measured values from test range : ver 2b of 550-900 system has been measured on test range; first order comparison of C1 dipole 2B vs C2 dipole 2B -- some differences can be seen : C1 dipole 2B shows better E-H match at 610 ; C2 dipole 2B shows good E-H match at 700; and appears to be decent even at 800, though 3 dB width may be changing; agreed to make plots vs freq for 3 dB and 9-11 dB widths, and for taper of E and H at fixed dish angle of 62.5 to check mismatch in taper -- for both the feed versions. Meanwhile, phase centre measurements for C2 + d2b can be tried at the range. ==> some results from the measurements for the plots of 3 dB and taper values vs freq shown -- there is evidence for change of properties with freq as well as asymmetry of the pattern (as had been seen in the earlier plots also); agreed to try to compare with results from C1 + d2b (make fresh measurements, if needed); phase centre measurements have not yet been done.

(ii) Comparison of computed results with measurements for 250-500 band : initial results for good antennas at 250-500 (other than C6) with default height of 1280 (and for C6 with reduced height of 1080) showed that computed values are actually better at high freq end for 1080, which is different from the observations which are showing droop at high freq for 1080 (in conflict with first results reported above); computed results, which were for 1180 to 1480 in 4 steps, were extended to 1080 & 980 and 1180 was found to give the best response (note : this is for a particular value of ph centre based on range measurements); computations were extended to much smaller values (down to 580 mm) and latest results show a peak in the response around 580 o 780 (!), which are in sharp contrast to the experimental results which were carried out in the range 1080 to 1480 mm and showed optimum performance around 1280 mm -- this needs closer scrutiny of the simulation code and experimental results.  
==> no updates.

(iii) Phase efficiency computation has to be linked to the aperture efficiency computation (NRAO's eff. program, modified for GMRT specific parameters) -- this work is ongoing, alongwith Sougata (was expected to take 4 weeks -- till mid-Sep); code is being ported to matlab (?); some issues about input file with the values to be given -- this also needs to be resolved; also, original NRAO fortran program can be made to run to give some initial cross-checks? code had been ported from the C version that student had written to Matlab but results are not yet matching with expected behaviour and debugging is going on.  
Now trying to port original fortran version to matlab; meanwhile, YG to try with somebody at NRAO to check current status after getting the info from GSS (?)  
One email has been sent by Sougata with some updates on pattern calculations -- need to discuss next time, and understand its relevance.  
FORTRAN to MatLab conversion : ~ 50% completed & to be fully done by end-Jan'15.  
==> work is ongoing; may take till early Feb to resolve the matter and debug.

(iv) status of phase centre checking for ver1 550-900 CDF and CSIRO feeds -- new results with VVM set-up, after installation of new encoder + notch filter for mobile band, showed : for ver2 550-900 CDF : reasonable E-H match at 610 and then degradation in shape and matching at 700 & 800; partially supported by older measurements from Dec 2013 (with slightly different set-up). Further, results for dipole v2a and v2b with cone v2 show that the degradation of pattern with frequency is worse for v2a than with v2b; radiation pattern measurements have been done with 50 MHz step & using CW signal; comparison with simulation results is awaited (also earlier note from HRB needs to be discussed); phase centre of ver1 550-900 CDF and CSIRO feeds needs to be done; basic radiation pattern test has been done (see above); phase centre test needs to be done (to see if both these agenda items can be combined); plans to redo measurements for ver 2b.  
==> nothing new here; can be combined with earlier agenda item.

==> Regular follow-up after 2 weeks.

1.3 Comparison of measured & expected sensitivity curves -- from 7 Jan (SSK/GP/HRB): scheme for (re)calculation of expected values across the broad bands to be finalised (and added to measured curves) : curves being done with constant QH value and with variation of T\_lna with freq incorporated; model for the main BPF was also put in; after that antenna efficiency factor (based on measurements with 4-5 points across the band) was added by interpolating the measured values; return loss of the feed was added to the above and the result now matches much better with the data -- all this was done for 250-500 band; some follow-up action :

(i) Antenna efficiency factor : to determine what is the best thing to use and stick to that; are there cases where the theoretical curve gives less deflection than measurements? agreed that both the efficiency term (which includes default ap eff + phase eff, from measurements on test range) and the return loss term should be kept and the product should be used. No actionable item here?

(ii) It appears that there may be some discrepancy on the high freq side (seen only for a couple of antennas out of 10?) -- could be due to absence / presence of 540 notch filter ? For the units already installed, there are small (~ 5 to 10 MHz) unit to unit variations in the filter response; for new systems all the the 540 notch filters will be tuned to match an overall BPF + notch filter template response. Agreed that Ankur to check both LF and HF side and then topic can be closed? ==> agreed that Ankur can look into this as part of the work on looking at antenna to antenna varn in 250-500 system response and report bakc together with that.

(iii) possibility to try it for Lband to be explored -- information gathering had been started : feed pattern (efficiency) at 3 individual freqs is available, and measurements are now available for 5-6 frequencies (?); agreed to work with the 3 pt data and do simple interpolation and see what kind of curve is produced; first order calculation of model has been done -- needs to be compared with actual measurements : Sanjit + Gaurav to do the comparison and produce the plots and then issue of RL can be taken up; theoretical curves have been given by GP to SKR -- need to follow-up next time, when both Sanjit and Gaurav are present. ==> first round work has been done and new weekly plots are now having theoretical curve for Lband; 1 or 2 antennas with response better than theoretical esp at lower edge of Lband -- need to be checked; fall-off of theoretical curve at edges needs to be investigate -- may become ok once RL of feed is included.

==> Regular follow-up on all items after 2 weeks.

1.4 Phase centre tests for 250-500 CDF -- from 7 Jan and before (HRB/GSS): to test with 100 to 200 mm height change (around default of 1280 mmm) in 250-500 feed on one antenna to see how much change in sensitivity is seen. Tests done on c6 using feed with shortened support legs of the cone (instead of shortened stool) -- comparison of results for 1180, 1280 (default) and 1380 : 1280 & 1380 show slightly better sensitivity at low freq (250-400) but at higher frequencies they match with 1180 (which is quite flat throughout freq range); agreed to try for 1480 to see if there is a monotonic behaviour; also compare with simulation results of GSS. Consolidated results tend to show that the latest level at 1180 height does show a slightly better response; a final confirmation is needed about the optimum performance from the measuements; confirmed that we can't go below 1080 by further cutting the support legs of the cone; also, current adjustable stool will not work for 325 MHz face due to welded nature of existing stool; agreed with HSK to reproduce one more adjustable stool with modifications learnt from present experience (?). Agreed to try on one CSQ antenna (C6?) by removing the Lband feed, shifting the cone-dipole with new stool to this face and using the existing 250-500 FE box on it; tried on C6 during MTAC period, but measurements could not be completed as antenna was required for L-band GTAC observations. Agreed to go back to C8 at a later point of time (after 550-900 measurements are completed); meanwhile, FE team to go over all the available measurements and produce a consolidated summary.

==> still waiting for 550-900 to converge; meanwhile summary of existing results can be produced. Follow-up after 2 weeks.

1.5 Total power detector for FE & common boxes -- from 7 Jan & earlier (GP/ANR/SSK):

follow-up on plans for final scheme : 20 dB coupler for CB and 10 dB coupler for FE (at final output) with common 20 dB amplifier (Galli-52 instead of Sirenza); feed-thru vs connectorised arrangement also resolved; after lab tests (including monitoring via MCM channel) in FE and common box, sample units installed in C4 FE box and E2 common box. Some other details are as follows :

For common box : data from 2 units installed on E2 showed basic things working ok: first round of testing showed 11 dB deflection (12.4 dB expected) on Cass-A; later on Crab, getting 5.5 to 6 dB (6.6 dB expected); flat-top on-source waveform to be understood -- likely to be due to quantisation of step size of detector levels (to check rms vs least count?); script / SOP created for automated running of tests; For FE version : 2 units had been assembled and found to give identical performance as per specs; problem of feed-thru vs connector was resolved in favour of feed-thru (as per original chassis design); all testing completed in the lab; first units (on C4) showed problems -- traced to incorrect mapping of channels etc.; new units (batch of 20) that were assembled showed unexpected change in detector o/p due to grounding problem which was corrected (manually) for 10 units and final PCB for mass production was modified for this change; automated script for running the observations has been done and released by GP.

Current action items being followed :

(i) for RC time constant : main aim is to check and ensure that some appropriate RC integration is in place at o/p of the detector; some feedback from vendor, but not fully satisfactory; existing ckt has 10k series resistor (as per data sheet); measurements done in the lab show some kind of a curve with rms changing inversely with increasing time constant, but the results are not repeatable from day to day, indicating some pick-up in the circuit or the measurement tool; needs to be checked carefully. Current status : agreed to put 1 s time constant in all the PCBs -- this requires very large capacitor; few microfarad may be more practical, pushing the time constant to ~ msec; agreed that 100 micro-Farad maybe the largest practical value, giving 100 ms time constant; assembled one board with 100 microfarad -- no observable change in performance seen; need to go to antenna & test (to be done by ~ 14 Jan'15).

==> fitted in new 250-500 box -- may end up on C11.

(ii) analysis of test data and results/conclusions : 9 antennas with FE power monitor installed; test data recorded for 8 antennas; out of these, signals seen for only 3 antennas : C13, C11 & S4 (both pols); some sign of life in E6 and something on W4 (very noisy / weak); deflection on Cass-A is about 10-11 dB (bit less than expected); flat nature of curves understood as least count limitation; simultaneously CB signal is being recorded, but working CB monitor is only on C13, E2 & W4 + W1 -- all of these are showing deflection; some sign of "memory" in holding a stale value in FE monitor (all antennas at same time!) -- confirmed with Ops group to be due to combination of cycling of FE monitoring (being turned off when at a source transition) + the fact that cold sky off source is quite far away from the source (!); further, two sets of new data had been taken (3 and 6 hrs long); analysis of these to help answer some of the problems of repeatability of working antennas, as well as status of partially working antennas (as seen in first data set) and correlation with 30-1 data (which is TBD even for first data set); at least 3 sets of data are now available for detailed comparison; first order impression is that new 2 data sets are consistent with 1st data set (tbc). To try and make a comparison for each antenna (both FE and CB) for different epochs to check for consistency and accuracy of results; compare different antennas for the same epoch only when trying to point out effect of external agencies like RFI etc vs malfunctioning of the detector units. To check status of this work.

Distilled action items for GP : to take 3-4 antennas in each of FE and CB (with one common antenna C13) and analyse 4-5 good epochs for the following :

- (a) repeatability of deflection and to check that it matches with expected values -- this has been done and appears to be ok.
- (b) consistency between FE and CB : checked for C13 and found ok.
- (c) checking spurious behaviour -- RFI or something else : data log of 30:1 output checked -- power detector changes when RFI is present;

Many of these points have been addressed with the existing data and the same can now be summarised in the ITR -- draft version for internal discussion / comments has been done, and should be ready for release now -- it is still in internal circulation.

==> has been finalised in internal circulation and is ready for release by today.

(iii) All these data sets also have temperature monitoring (for all of these antennas, as well as for a few others of 130-260 etc). Plotting and first look has been done; consistency across antennas (and FE/CB) appears to be there -- need to complete a formal analysis of the same; agreed that temperature data (for 250-500 FE and CB) to be given to VBB for plotting; fresh data to be taken for 130-260 FE box. first results for ~ 5-6 antennas (LNA + FE box) + 2 antennas (CB) for 3 hr duration shows some basic behaviour but not clear how well things are working; to try 2 things : (a) to check if any old data of longer duration (from last 2-3 months) is available (b) to try a longer run, even for one antenna like W4 which is under maintenance -- this is planned.

==> new data from recent tests has been provided to VBB -- can follow-up 2 weeks later.

(iv) possibilities for automating data reading, analysis and plotting also discussed -- GP has now implemented automated program for plotting CB, FE power levels (both chans) and 3 temp monitor values (2 in FE and 1 in CB) in one go from a file containing data for X nos of antennas is ready; this has been tested with the above data sets; agreed that it is generic but not tested for anything other than temp and pwr; can be generalised for all channels of all 30 antennas but can be taken up at lower priority; also, does not have a user friendly interface; current actions :

(a) agreed that working version of code + SOP to be fully released asap -- this has now been done.

==> SOP has been released; GP working on note about analysis procedure (using matlab)

(b) SSK to take up discussion with SN about GUI development with suitable person from control room.

==> initial discussion with SN has happened, but not clear if optimal person has been identified.

(v) plans for building 70 units for CB : all PCBs and chassis are now in hand; to decide plan and schedule for mass production and installation on upgraded antennas; agreed that new units can be made ready to match the typical / expected consumption rate of going into boxes; assembly of 5 sample new units gave some problems : old vs new flux (resolved); 10 units assembled and tested; 4 nos consumed in the lab in spare common box units; 6 are available; agreed to leave status quo till some units are consumed in CB items coming down for repair; for FE, 20 PCBs had been made and all are used up; current status :

for FE : 10 units assembled (PCB + chassis) and tested and ready to use;

for CB : 12 nos of PCBs assembled & tested; will use out of the 20 chassis remaining; meanwhile request for next lot of 50 chassis is under process.

(a) to check above status and future plans for mass production

(b) the full quantity (360 PCBs for FE and 60 PCBs for CB, with Techno Ckt) is in hand;

after x10, next batch of x30 FE assembled (waiting for chassis)

==> For FE : 12 units for 6 antennas are in hand -- similar situation for CB; in addition, 30 out of 360 PCBs are assembled; before that 20 had been done and used; for CB, new ones will be assembled when needed; chassis will be ordered when needed in units of 50 nos.

==> Regular follow-up after 2 weeks.

1.6 Spare LNAs for L-band feeds -- from 7 Jan & before (SSK/ANR) : we had 32 feeds; 2 were not working (1 has been dismantled for making drawings of new feed) due to lack of electronics spares -- mostly device failures (including some new ones?); some new LNAs were successfully assembled by Gopi and failed feeds for C3,W1,E2 & E5 were fitted with these and found working ok. Also, one spare feed was assembled and installed on W1 and working fine. Current action items :

(i) to update about status of feed on W1 and other recently installed units : finally, after a lot of follow-up, it was confirmed from PMQC data that W1 appears to be working ok for past few months. 2 other recent units are on C1 + one more antenna : C1 has units with new LNAs, for both pols made ready from older batch of devices with careful retuning; action items :

(a) confirm which is the second antenna -- still no clarity !!

(b) confirm status of performance of these antennas (C1 had been giving ripple and bad bandshape problem) -- problem found to be due to broken cable; fix requires cable re-laying alongwith mechanical clamps : to check status of this.

==> cable work will be done in near future.

(ii) making spare LNAs -- agreed to have at least 5 LNAs ready & available as spares : 10 nos of LNAs had been assembled, tuned and made ready; these have all been used up now; new batch of devices ordered and delivered. Action items :

(a) the assembled devices may be having some possible problem with bias point -- it was found that LNA is drawing unusually lower supply current, even when 'gain' & 'T\_noise' are normal; not much progress in understanding low deflection of new LNAs; retuning is not helping -- increasing the bias current leads to oscillation (to check OMT etc for any problems?). Devices from new batch appeared to give a stable solution(?) -- however, not all devices in new batch are the desired ones -- there is a mix and it may be only about 1/3 that are usable? Finally, one unit fully assembled (all 3 stages) and working ok; 2nd unit also assembled -- these 2 used for 2 channels of feed #32 (note that this is now the 1st spare feed after 30 working feeds!). 2 more LNAs (3rd and 4th) assembled and tuned; work on 5th & 6th is ongoing. To check current status of number of spares available. Status from 31 dec 14 :

x1 feed completely wired & tested;

x2 with filter-banks (minus LNA) : filter-banks have some design issue related to component availability; by end-Jan'15, x3 will be ready.

==> count of working LNAs is same as in Dec 2014 -- Ramesh will be looking into it now. Summary is that : one fully working spare feed is there; next one has LNAs, but no working filters; 3rd one has neither LNAs nor filters.

(iii) alternate LNA designs : to see if design used for 550-900 can be modified for 1-2 GHz use; to also check the design done by Abhay Kulkarni and see if it can be improved for our needs; design files had been obtained and were being checked by GP and ANR : model files converted to match simulator used by us; component models in software had to be downloaded; also ultralam2000 that was used is not available in the market now; agreed to simulate with ultalam2000 first to check ckt works ok; then concentrate only upto 2 GHz and change substrate to RT 5870 (easily available);

simulations matching with original results completed; results reproduced with RT 5870; current action items :

(a) trying to tune the design to required specs of gain (30 vs 34), Tlna (~28 or better); in terms of NF target is to go from 0.4 to 0.3, and maybe at cost of reduced BW; current status : getting close to Tlna of 28-30 across the band; overall gain is also very good ~ 38 dB; but 4 db slope across the band needs to be adjusted; move from s2p to non-linear model completed successfully -- did not disturb the situation. Work still ongoing to try to flatten 4 dB slope.

(b) meanwhile going ahead with layout & ordering of PCB and making couple of units, while continuing to improve the design. The design & layout will be ready by mid-Jan; ==> first proto PCB will be sent for fabrication this week.

(iv) possibilities for new LNA with Tantrayukt (Yogesh Karandikar) : item to be taken up for discussion, following the visit of YK in Dec 2014.

==> to discuss and formulate a response.

==> Regular follow-up after 2 weeks.

1.7 Completion of spare L-band feeds -- from 7 Jan & before (SSK/ANR) : Target to have a total of at least 5 (out of 8) working spare feeds -- from mechanical to electronics : 30 antennas had working Lband feeds, but there were no spares, though we had 2 feeds; one unit was assembled back from the feed that was dismantled for making the drawings -- this was completed and installed on W1 (one feed is now in the regular 'maintenance cycling' of feeds); 32nd unit was there in Pune wshop and was shifted back after assembling by mech group and then fitted with the electronics; it uses newly fabricated push-type (press-fit) probes; after 2 LNAs were made ready (see above) this feed is now available as the 2nd spare feed. Furthermore, 6 new feeds were made (via outsourcing) in 2 batches of 3 nos; in the first set of 3, 2 nos had wrong size of horn and had to be corrected by the vendor; all 3 needed new covers as old ones were not suitable; second set of 3 feeds from Akvira : OMT + horn + cover; hence, total of 8 spares CAN become available; note that weight of 3 latest feeds is 18 kg more (72 vs 61 kg) than earlier feeds -- now accepted as 'fait accompli' !

Following issues need to be resolved currently :

(i) having sufficient number of spare LNAs : see item above for details; LNAs for 3rd spare feed now ready, waiting for filterbank to be ready.

==> status as noted above.

(ii) other electronics : sub-band filter bank is the main item missing; it was found that the sub-band filter ckts spares don't work as one gnd line (for switch ckt) is missing in the films from RRI (!) -- to try with a wire providing the gnding ckt; alternate is to start using the new design -- this shows good performance for individual filters, but integrated unit is giving poor performance for selection of 1280 -- problem with the switch (new make is not giving same performance as original make) and this is affecting both reuse of old filter PCBs and also the new design; looking for original make (MACOM) and also trying a different switch (Hitite, which means new PCB); new PCB designed with Hitite switch (will need additional patch PCB to convert logic levels; one chassis (for 2 pols) is available for testing; new design still not working for 1280. To check status of the debugging for this.

==> after isolating the filter from the switch, response was found to be fine; found some issue about the layout on the PCB for the Hitite case and PCB is being redone and waiting for vendor to send back.

(iii) plans for assembling and making completing additional new feeds : all the 6 new feeds after corections, completion of covers, powder coating etc had been sent to GMRT; new issue about mating and alignment of probe had cropped up -- press fit (old schme) vs threading (new scheme) : the latter was made "workable" after one round of adjustments; at present, 1st of these 6 (33rd feed) is fully ready and waiting for LNAs and filterbank, as above); 2 more feeds are mechanically ready (one has push-pull and other has threaded probes) and getting wired; LNA and filterbank are not available for these. Work is ongoing, last step is the plates to be made for these. May not work on the last 3 feeds for present.

==> see updates above and rationalise the agenda item.

==> Follow-up after 2 weeks.

1.8 Testing of LBand wideband systems on 30 antennas -- from 7 Jan (PAR/SSK/SN) : (to maintain a proper log of action taken on individual antennas during these tests and debugging activities); data being taken fairly regularly since June; some history is as follows :

June data : C08 & W01 CH-2??shows ripples at OF RX output -- gone now (to check possible cause); Sep data showed problem with W4 ch2 -- fixed;

RFI issues : S04 & E02 showed RFI type lines, E06 showed RFI lines in CH1 (June data); line RFI in 1070-80 range (likely to be airport radar), around 1280 (likely to be due to GPS) -- July data; lines at 1030 and 1090 (3 MHz BW) also seen (Aug data); also, is there a RFI line at ~ 1200 (3 Sep data)? -- need to confirm status of all these lines (can be covered under RFI agenda). From Sep data : 1176.0 and 1176.45, 1191.80 and 1204.70 are likely to GPS (in addition to 1280) and 1090 is airport radar; there appear to be a few unknown ones also (e.g. 1320, 1480 etc) -- check with RFI team separately by including in that agenda item.

Current action items are as follows :

(i) some antennas with poor deflection overall : to be addressed as and when such cases are found. e.g. Ch2 of C1 (may be a cable problem?) -- confirmed that it is cable problem; to check current status of the work to fix the problem.

==> as noted above, it is getting fixed shortly.

(ii) some antennas with deflection changing over the band (less at high frequencies): checked if pointing offset can explain this -- not found relevant; current thinking is that this happens for cases where the RF power level (at laser input) is too low; this has been confirmed with a more careful set of tests (and plots) for few selected antennas, including make good ones look bad by increasing OF attenuation -- has been demonstrated in the report of 11th Nov data; to check if appropriate reasons for low power levels can be identified.

==> one possible reason is that there may be issues with OF attenuation settings.

(iii) some antennas with poor on/off bandshapes, including large slope e.g. W1 (has been there for several months); C4 and W6 also; S4 has very low power; such cases need to be checked (call sheeted) and understood.

(iv) few antennas with ripple or large slope across the band -- to be followed up as and when seen.

(v) there is data from Oct, Nov and now Dec -- can we have a well-defined algorithm for comparison of different data sets and getting statistical conclusions? -- to look at developing a tool for this.

==> latest report (10th Jan) has a good classification of the problem antennas; team is looking one by one into the problems e.g. W5 found bad cable between feed to CB of ch1; now looking at W6...



==> Regular follow-up 2 weeks later.

1.9 Characterisation of recommended attenuator settings for different bands -- from 7 Jan and before (SSK/AP) :

(i) values had been given for Lband, 250-500, existing 610; only 130-260 / existing 150 was pending -- this was also completed (appears that 6,6 may be the best value); note to be circulated soon (Sanjeet + Ankur); then can be taken up for detailed discussion and closure.

==> meanwhile, new problem detected where it appears that attenuation setting may not be working reliably -- need to be investigated in detail .

(ii) FE team to test the power levels at OF o/p and cross-check against SFA values : for 250-500, this has been done and results incorporated in the updated SFA report; for Lband the exercise is ongoing; antenna to antenna variation is still an issue for Lband; can be done now, as Lband is relatively stable now; was done by Ankur in a report back in July 2014 -- discussed and suggested to add a few refinements of the statements used (for 250-500) and add an explicit entry in the table; for L-band to compare for each sub-band using the realistic cable loss value for each sub-band -- this can then be done for 250-500 also, if found significant. Updated version of report to be produced with these modifications; first part (for changes related to 250-500) has been done; waiting for measurements at Lband to be completed; some work has been done by Ankur, some work has been done by Imran to characterise and FE SFA report also has measurements of cable loss; calculations have been done; need to cross-check with measurements; updated report in internal circulation; to check if it can be released for discussion.

==> ??

==> Follow-up on all items after 2 weeks.

1.10 Switched filters at different stages of receiver -- from 7 Jan & before (SSK) : 2 main categories of switched filters are needed : (a) switched filter banks inside FE boxes and (b) switched filter banks in rx room; these are being designed using the new switches : 2, 4, 8 way switches with different possible configurations; (c) a 3rd application of these switches is for designing the monitoring set-up in rx room. Current action items are as follows :

(i) for rx room monitoring work : note that all these circuits are connected to the monitor ports of the OF system; first design required higher isolation for highest freq of operation and hence new design was done; ckt for 2:1 and 4:1 versions now ready & tested -- 25 dB isolation achieved; drops from 25 to 17 dB with frequency for 8:1 switch -- now getting improved rejection : better than 25 dB below 1 GHz; goes down to 16 dB above 1 GHz; the leakage between the signals with this switch is still unacceptable; now trying another switch which terminates the unused inputs while selecting the desired input (will be used in the final 30:1 monitoring system) -- device is to be procured; order has been placed; item received; PCB designed and sent for fabrication; PCB ready but not delivered (waiting for payment !) -- to check if PCB has come and is being assembled.

PCB has been received; work ongoing for using new switch with 40dB isolation; change of configuration.

==> new switch (MACOM) + modified design with additional isolation switch and power supply isolation -- now achieving 35 dB at Lband and more than 50-55 dB at lower frequencies, with all channels powered; will be tested in monitoring system for 16 antenna system. To do an additional test with signal injected at Tx i/p;

also to summarise the design in a note.

(ii) for rx room switched filterbank : prototype system was almost ready for testing; need updated block diagram of the prototype system; to see if first results from integrated testing are available; also, need to check about space in rx room for housing these units; also check plans for installation and testing of the 1650 MHz LPF units alongwith the above; tests have been completed; a report needs to be produced characterising the performance -- work ongoing for compilation of report; report in internal circulation; to check if it can be released now.

==> report to be released.

==> Regular follow-up on all items after 2 weeks.

1.11 Follow-up on 550-900 MHz band filters -- from 7 Jan & before (ANR/SSK) : Comparison of product obtained from ICON with in-house effort and finalisation of plans : technical comparison of individual filter responses showed in-house design to be slightly better; tests with integrated unit using new PCB showed insertion loss increases to 3 dB now and some change in slope on higher side; complete chassis and full integration done and tests repeated to make detailed comparison with ICON results -- showed performance is very similar except for some out of band bumps (at 30 dB level) and slightly slower roll-off ; tried with AC coupling capacitors (no improvement); new board fabricated which after retuning gave much better roll-off; meanwhile, some realistic cost estimates for in-house production vs getting things done by ICON were made, and it was concluded that ICON option will be much more expensive; sample PCBs from Argus and Shogini had been obtained -- first test results (without chassis) showed ~ 5 MHz shift in 2 sub-bands but better roll-off; final plots showed same IL but the higher sub-bands having slightly shifted centre and widths which cross the main BPF upper cut-off; the filter design was retuned and modified PCB was obtained from Shogini and tested ok and one complete system with chassis (for one poln) was made ready and it was agreed to defer further work till ready for integration in new FE box; meanwhile, cost estimates for mass production were also made : 32000 for 2 PCBs is the dominant cost; total is about Rs 41,000 per antenna (compared to Rs 90,000 by ICON); hence, agreed to go ahead with building our own design; meanwhile, reduced wt chassis (700 g less) had been made (2 nos) by w'shop and integrated filter unit was made and tested ok; for mass production : PCB material is in hand; switches needed are in hand; so may not be a major problem for going ahead; now waiting till layout of 550-900 FE box is finalised.

Agreed to go ahead with PCB and chassis, while waiting for layout to be finalised.

Layout is now final; x1 proto is ready; to go for mass production;

==> to do mass production in units of 20 nos (10 antennas); can check status after 4 weeks.

1.12 Finalisation of 550-900 FE box -- from 7 Jan (ANR/SSK) : to produce a block diagram for the 550-900 FE box; then to start seeing which units are ready, which need to be done; which may need to be combined into single units etc; roughly same number of components as 250-500 box, slight difference in the arrangement of notch filters; size of sub-band filter chassis will be different; will take up the layout of this after common box layout is completed. Still waiting for common box work to be completed.

==> agreed to start with this, even as common box is going on in parallel; to check status after 2 weeks.

1.13 New filters for Lband -- from 7 Jan & before (ANR/SSK) : Sample Lband full-band BPF had been designed -- has no slope with freq and better insertion

loss, and maybe a better option than the existing main BPF; similarly, prototype design of new sub-band filters (with better insertion loss) has also been done. Detailed results for the main BPF shows that the BW is slightly less than existing BPF : 500 MHz (965 to 1465 MHz), instead of 590 MHz (890 to 1500 MHz) -- this gives better rejection to mobile band signals, but has implications for final usable BW of L-band system; furthermore, an improved notch filter has been designed for the 850-950 mobile band (-60 dB vs -45 dB at 900 MHz), alongwith a LPF for cutting off the 1800 mobile band has been designed -- 3 dB cut-off freq of 1650 MHz. The matter was presented to the users in Friday meeting on 9th May, and it was agreed to generate a note about this proposal, for clearance in the GSG. This was done and matter was discussed in GSG of 13 Nov and it was cleared to proceed on the following: new BPF + mobile notch filter to replace existing filters in FE box; LPF to be put in common path at antenna base as a common facility for all bands; to be taken up as a case-by-case replacement job, whenever a unit comes down for maintenance work. current action items :

(i) status of mass production : 10 units of 1650 LPF have been fabricated out of 40 PCBs available; PCBs (stripline) does not need much work for assembly -- can be given for manufacture; new chassis will be needed; PCB order for 70 nos can be sent using existing eps10 board; both pols can be combined in one chassis requiring 35 nos only -- drawing to be finalised for rail-type chassis; to check if existing chassis can be re-used; PCB + chassis for new BPF ready for 40 nos (30 antennas + 10 spares); for the new notch filter, 60 nos had been made (PCB + chassis) of which 30 have been used in existing system (waiting to order more)...

(a) to confirm the present status from Ankur's spreadsheet; status was supposed to be confirmed by email, but that has not happened.

(b) new complication is that mounting plate has to be made for putting the new units in existing systems;

(c) agreed to put 10 units of 1650 LPF in one channel of 10 antennas which have 250-500 broadband system installed.

==> waiting for confirmation of status via spreadsheet; mounting plate issue to be tackled for long-term; 10 antennas installation to proceed.

(ii) sub-band filters (design is at simulation level) can be taken up as a replacement for the problem encountered while making new spares for Lband feed (see above) -- to try new PCB with different switch (Hitite) -- see update on this in earlier agenda.

Right now, using old design with new PCB for populating in spare Lband feeds. To see how the matter can be resolved.

==> see above.

==> Regular status check after 2 weeks; agenda items to be rationalised.

1.14 New item : Long-term maintenance of OF field joints : Growing evidence for problems with older joints (over last 10-20 years); need some kind of consolidated approach to address the problem. Likely causes : nature and condition of splicing equipment? Nature of cover / protection provided? ... Agreed to get the statistics of the old field joints over time, including a comparison of the losses seen with fresh measurements -- this exercise may take 2-4 weeks; meanwhile, urgent attention is required for the field joint near W1 as it is affecting W4 and W3 significantly.

There is a technical problem that the newer kits are not compatible with our existing cable and old kits are not available -- 2 options ongoing : trying through Chinese company and also workign with mech group for additional support structure.

==> not discussed explicitly -- can be taken up next week, alongwith status of new OF installation.

## 2. RFI related matters :

2.1 RFI tests of ethernet switches for antenna base & GAB -- from 7 Jan & earlier (SN/BAK/SSK): Testing the available switches for RFI & plans for design of RFI box for ethernet switches : sample units from Cisco, HP, Dlink and DELL had come and were tested for RFI -- conclusion from final report was that D-link is much better than others (but it is 2x more expensive than next best option of CISCO -- by Rs 20K); also, use of shielded CAT5 cable provides significant improvement; later, during March-April 2014, tests were done with RFI enclosures (with mounting of filtered and shielded adapters, eth cables, AC pwr line filter, shielding for fan etc); results looked very good : isolation is about 70 to 35 dB from 100 to 1400 MHz; also, good improvement is seen with switch + shielded CAT5 only (without box); both CISCO & D-link workf equally well in shielded enclosure, but CISCO is slightly worse when only shielded CAT5 cable (without enclouser) is used as it has more number of discrete lines in that configuration. However, it is now clear that it is not possible to use this 24-port switch in GAB; hence, CISCO can be selected as the final version for antenna base, alongwith the shielded enclosure -- agreed to go ahead with this. Pending action items are as follows :

(i) to confirm that final report of the tests has been circulated : there is a draft report of 12 May 2014 circulated in early June; new, updated report was sent on 10th Oct -- discussed and small, minor change to be done and then submitted. Item can be closed after that -- still pending for change to be made.

Modifications made; new report to be ready by evening (07Jan15)

==> updated report has been circulated and this matter can be closed.

(ii) meanwhile testing of prototype unit from vendor showed need for change of location of AC powerline filter -- this has been communicated to mech team to cross-check first of the new units that come.

==> mech group has been informed about this and he change is being implemented in the units that will come; can cross-check and close the matter.

==> Regular follow-up after 2 weeks to see if item can be closed.

2.2 Discussion relating to Industrial RFI survey -- from 7 Jan & before (PAR/SSK) : revised docs (from 2009 and 2012 discussions) had been circulated by RFI group and were discussed in 5 June 2013 meeting (is the document too exhaustive?); new survey planned with main aim to generate updated database which will be useful to pinpoint likely hotbeds of RFI in the industrial areas in addition to finding those without NOC; after months of planning and discussion with DIC, was finally conducted during 23-27 June with 4 teams; covered Ambegaon and Junnar talukas ~ 40-50 villages in each; ~ 40-80 working industrial units (large number are closed down or never existed!). Some of the progress is as follows :

A form had been prepared for use in the survey and had been discussed in detail and agreed that it is suitable for use; about 70% of existing data had been entered into this form; agreed that this activity would be superseded with making a database of equipment and NOC record for the existing industries found in the survey; this data entry now completed for all 3 regions : Junnar, Ambegaon and V-K industrial estate; some highlidshts from the database : of the total list, a significant number of industries are closed down, and another significant factor are no longer traceable; about 1/3 of the original are still working (ignoring poultry which is about 1/4, but is considered RFI-friendly).

A follow-up meeting with DIC took place on 30th Sep 2014. Summary is as follows :

- a. To maintain proper record of the data of existing and future industries in the same format. The data format and data base was shared with them during the meeting.
- b. Complete list of the villages in Zone I to Zone IV is submitted to them, based on which they can decide the issuing of NOC for industries in different regions (and also outside?).
- (c) DIC to issue NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT

Some of the present action items are as follows :

(i) To cross-check the list against the ones which have NOC (for those operating without NOC, add to our database and inform them about informing us for changes, and DIC to issue NOC post-facto as mentioned in other agenda item) -- this is happening now; current table has a column indicating whether NOC is there or not. DIC has started taking action on parties without NOC (e.g. Govardhan dairy, ~ 20-30 km away).  
==> DIC will be sending the standard form to all and it will come to us for clearance; we need to be careful about to whom we say "yes" in retrospective manner, so as to avoid setting up a precedent of giving NOC to somebody with wrong kind of equipment already installed and running ! Possibilities for improvement can be suggested to them.

(ii) To follow up with DIC about

(a) issuing of NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT.

(b) Follow-up on single phase welding units : they have requested letter from GMRT to collect information from users around GMRT antennas. Action will happen after 6 months (when?). After payment (Rs 4,500/-)??;

==> this matter needs follow-up with admin to see how it can be handled.

(iii) during the survey, some units which are likely to be important from RFI point of view have been identified for detailed studies later on -- some work can start in parallel with completion of database, beginning with the bigger units; measurements (using LPDA) for 2 big industrial units in Junnar & Ambegaon area completed; others are in progress; no new progress on this.

==> meanwhile, team has been doing a check on transformer RFI and the updated results from this will be available soon -- will need to see how this compares with the earlier round of this work. (can be put as a separate agenda item next time).

(iv) procurement of new equipment : 2 nos of ultrasound dishes (needed as existing 2 units are barely working) : indent had been placed ; to check status of the order (also to explore possibilities for IR thermal cameras?); 2 dishes have been ordered expect delivery by end-Jan; no action on IR camera right now.

==> delivery still pending.

==> Regular follow-up on all items after 2 weeks.

2.3 Follow-up on UPS RFI -- from 7 Jan & earlier (SSK/PAR/RVS) : UPS units from Ador were found to be the most suitable : 2 nos of 3 kVA was purchased, tested for RFI & cleared; units are in use in C9 and C10. Updated RFI report has comparative statements quantifying the repeatability. Further, 2 nos of 4.5 kVA units were also ordered with Ador, with option of 2 single phase o/p with different isolation transformers (3 + 1.5 kVA); units were delivered but failed the RFI tests -- lots

of discrete lines seen; Ador had taken the units back for modifications -- finally, modified version of Ador 4.5 kVA was tested and preliminary results are quite good; report for this has also been circulated. Current pending action item is:

(i) to finalise plans for going with 3 kVA unit from Ador as the final choice : agreed to order 10 nos of these as a starting option; RVS had received budgetary quote; (total cost per antenna may turn out to be around 2.x lakhs); indent had been raised; was waiting for formal quote from vendor; order has been placed; delivery of 10 nos expected in Jan last week; to check if things are on track.  
==> 5 nos have come; random selection of 1 unit shows 1 dB increase in noise floor level at 150 to 270 MHz; remaining 4 units show 2-4 dB increase in 140 to 240 MHz; check of major changes : MCB make has been changed; panel plate is missing -- direct screen printed units are used; connectors size / type have been changed : need to feedback to electrical team and appropriate action to be taken.

==> May need to follow-up next week with electrical and RFI teams.

2.4 RFI testing of LED lights for GMRT labs & building -- from 31 Dec 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 was raised for additional quantities; it appears these have been delivered (how many?); electrical team has put a request to RFI group for testing of new batch that has been delivered. To check the status.

==> new batch has been tested as per earlier procedure and found to be ok from RFI point of view; additionally, RFI team to test the units that have failed in the last 6 months or so. To check status after 2 weeks.

### 3. Operations :

3.1 Mass production of shielded box for MCM cards -- from 7 Jan & 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; sample box of Rabbit + switch + media converter + Miltech PC combination tested on 4th Dec (report is awaited) : results match with earlier results. Two minor points to be conveyed to vendor : size of one of the opening and assembly of the side plates, which has been conveyed to mech group (!) now awaiting for feedback about delivery of mass production from the vendor; to check status and see if the item can be deferred for longer duration. x70 (for MCM) received.

==> item not discussed due to shortage of time.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 31 Dec 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. See agenda item above; x35 in 1 month (for layer-2 switch).

==> item not discussed due to shortage of time.

3.3 Planning for proper UPS & space utilisation for new equipment at antenna base -- from 7 Jan & long before (SN/CPK/RVS) : long-term plans for installation of final UPS system and proper utilisation of the space at antenna base. Follow-up on 14 Aug 2013 discussion on first report : 2nd report was generated and detailed discussion took place on 5 Feb 2014; successive follow-up & final agreement on way forward (alongwith updated report) reached c. May 2014.

Some highlights are as follows :

(a) Regarding electrical loads : power drawn by different sub-systems estimated carefully, alongwith actual sample measurements on a few different antennas, for both existing systems as well as upgrade systems; effect of in-rush current at switch on also considered; total current requirement of 10 A for the ABR systems + servo control electronics found to be sufficient; hence 3 kVA UPS is adequate; agreed that, if needed, peak load requirement (e.g. in-rush current) can be balanced out by synchronised delayed switching on of different units -- this is already implemented to some extent at present. Final load requirements have been carefully checked and tabulated in the updated report.

(b) Regarding electrical wiring : agreed to have separate isolated supplies for (i) servo drive system (without UPS) (ii) servo control electronics (with UPS) and (iii) ABR electronics (with UPS); one common 3 KVA UPS with split o/p (2 KVA + 1 KVA for servo and ABR respectively) each with its own isolation transformer is the ideal solution; the new UPS can have the isolation transformer(s) integrated into it, without increasing its footprint (only height may go up); updated wiring diagram has been produced by RVS in consultation with SKB and others, and is available alongwith the updated report.

(c) Regarding space utilisation : new UPS can be located in the space between the ABR and servo racks -- this has been done in one antenna with the new UPS and appears

to work ok; existing servo FPS units can be left where they are; if isolation transformer can be moved out from the rack, then space in that common rack is enough for all growth plans of FE and OF systems; this leaves some empty space in ABR rack bottom that can be utilised for further growth of telemetry system; all new servo growth to be accommodated in the servo racks (or in-situ replacement of existing units); extraneous items in the surrounding of the racks (electrical fittings etc) can be relocated, as far as possible, to make it convenient for people visiting for work. Most of these issues have been captured in the updated report. Matter discussed in GSG meeting of 13th Nov 2014. This item can now be taken to the logical conclusion : net outcomes can be summarised and follow-up action to be finalised.

Main list of actionable items :

(i) ordering of 10 nos of UPS : order has been placed; delivery expected end-Jan.

(ii) final wiring diagram for servo + ABR is needed : new wiring diagram circulated by RVS -- can check for any comments or suggestions and then incorporate as the updated wiring diagram; modified wiring diagram prepared by electrical and shared with servo (4th August); meanwhile, discussion with BLDC supplier : now ok to ground the neutral of the main 3ph transformer; extra emi filter may be required (RVS confirmed it to be only Rs 10,000 per antenna) + only one set of line-filters will be required. RVS to come up with the updated wiring diagram (in consultation with servo) and circulate to all concerned. RVS has circulated suggested wiring diagram, which includes input from MACON via servo group -- need to clarify the nature of the radiation shield suggested between the BLDC rack and other racks. RVS to check with SS and report status, so that final wiring diagram can be produced -- this is now pending for some time !

(iii) making one antenna as a prototype or model where all the configurations are made as per the recommendations : finally, agreed to use both C10 and C00. At C10 : 3 kVA UPS is installed, but feeding power to ABR only; servo to make arrangement to shift PC104 load to UPS; switch boards / extension boards have been shifted to safe level. At C00 : 4.5 kVA UPS, with 2 isolation transformers, is installed with ABR rack connected on it; PC104 to be transferred shortly; relocation of elec boards is pending. Latest situation : in both C0 and C10, ABR and servo loads now connected to UPS -- in C10 the servo isolation transformer is still there. Agreed to put the FE power supply in the proper location in both antennas -- work ongoing to make space for this; also ask servo to confirm FPS drive in keeping with the agreed diagram. Will also check for unshielded cable entries in model antenna shell, include unused holes and punctures. RVS to circulate an email about the updates and finalisation of layout in C0 and C10 for replicaton in all antennas. RVS has taken photos for C10 and will circulate final configuration -- this is pending for some time now.

(iv) also agreed to populate C0 & C10 with Rabbit, switch, PC (with shielding) as and when available -- these 2 antennas can be used for next gen M&C work to add to C4,C6,C12 to make a total of 5. JPK to keep track of this aspect.

==> item not discussed due to shortage of time.

3.4 New, improved Miltech PC -- from 24 Dec and earlier (CPK/SN/PAR) : Two units of Miltech PC with two changes (more screws on panels + panel mount pwrline filters instead of chassis mount) were under test : conclusion was that PC ok from all aspects. Pending action items :



(i) agreed to initiate the purchase of 10 nos of the final version above -- indent had been raised for 10 nos (including some spare accessories?); current status of the PO : order sent; expected date of delivery 31st Dec -- trying to expedite, if possible; note from vendor informing about delay due to late arrival of m'boards : end of Jan is new delivery date. To check status of this item.

==> item not discussed due to shortage of time.

#### 4. Back-ends :

##### 4.1 Documentations :

Current action items are as follows :

(i) Detailed design doc -- from 7 Jan & 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; was deferred till end Oct; and then deferred till end of Dec; 2nd version had ~50% chassis level inputs; to be completed by end-Jan'15;  
==> work is on track; can check 1 or 2 weeks later.

(ii) ITRs for analog back-end systems and digital systems to be taken up :

(a) analog back-end : Sandeep and Navnath to look into that; pending.

==> work pending for some time; team to review and pick up the activity.

(b) pkt corr first level has been done and circulated -- waiting for feedback; if none then this item can be closed; can be closed.

==> agreed to close this.

(c) GWB first version (by Reddy + Irappa) done circulated; second version with additions and modifications also done and circulated; can be closed now.

==> agreed to close this.

(iii) to move to a point where formal publications can be done -- this needs to be followed up appropriately within the team and a summary plan brought up for discussion; finally, SHR and BAK have started work on modifying GWB ITR to convert to a paper -- to check if first version of this can be circulated soon; still pending.

==> SHR has sent to BAK who is making some edits and will circulate within a day or two.

==> Regular follow-up on all items after 1 or 2 weeks.

4.2 : Power supply for GAB : from 7 Jan and before (NDS/BAK) : Two options are possible : linear vs SMPS. Agreed to produce comparison note with all pros & cons. Meanwhile, a few SMPS units can be bought, as the cost is very small. Still waiting for comparison note ! -- it was in internal circulation, waiting for Ajith to give his comments; comparison report has been generated; pros and cons are in terms of convenience (and price) vs RFI properties; agreed that present set-up of 30 ant GAB (with 5 spare SMPS supplies on order) can run for 6 months or so; final decision can be taken later on. 4 of the 5 units have come and these can be made ready and then we can have 4 racks with SMPS and 4 racks with linear / CVT supplies -- this has been achieved; need objective criteria for comparison; meanwhile, shielded box has been designed for the SMPS by RFI team and is in final stages of testing and improvements; waiting for RFI report; meanwhile, shielded box has been installed with one SMPS power supply in the GAB rack. Finally, PAR has circulated the report -- can be taken up for discussion and follow-up action can be decided, including plans for

mass production of shielding units; meanwhile, SMPS installed in 4 racks (mass production : 12 boxes with RFI shielding planned - 8 needed & 4 spare);  
=> total of 13 boxes will be there -- 8 will be used and 4 will be spare; mech will place the order for 12 nos (after BE and RFI teams check the drawings); only timeline for delivery needs to be established and then the item can be closed or deferred accordingly. To check status after 2 weeks.

4.3 Power equalisation schemes for new back-ends -- from 7 Jan and before (SSK/NSR/BAK/SRoy): Need updates on both of the following :

(i) option 1 : using detectors in GAB and local feedback loop -- monitoring set-up working; DKN working on code (using algorithm taken from NSR) which was under first round of testing -- detector output saturation, gain adjustment now checked and this needs to be done for each channel; basic power equalisation algorithm has been tested ok with 4 antennas; now working for larger number of antennas; SOP has been done; agreed to do a comparative study of this scheme with the GWB-based scheme to see if there are any differences or pros and cons.

first part of the test has been done : do GAB power equalise and look at GWB bandshapes -- looks like they are not equalised very well; to check the results and quantify; also complete the loop by doing GWB power equalise and checking GAB o/p. Both ways test has been done and both are self consistent, but not consistent with each other? more refined tests (though with 4 antennas only) show quite good agreement for both cases of testing; agreed to extent this to all 8 antennas.

to complete testing for larger number of antennas (8 or more) and come with a status and then decide next step of growth.

=> tests have been done for 8 antennas both channels and BE team is ready to release for use by operators -- a basic SOP to be generated and released; to run this alongwith GWB bandshape check to help debug problems in GAB -- can be formalised as a debug tool to be run by PMQC periodically.

(ii) option 2 : using correlator self outputs and computing gain corrections : basic scheme is implemented & working; more general implementation of a user controlled ALC mode requires the following:

4 modes of operations had been identified (see MoM of 3 Oct 2013 !):

(1) on demand -- this is the current released mode.

(2) repeatable at some interval specified by the user -- can it be script based?

Sanjay has completed the core coding; a wrapper is being done by SRoy; to be taken up for discussion.

(3) automatic, should adjust in response to a stimulus in the input power -- needs a discussion.

(4) should provide a reliable power monitoring scheme -- needs discussion.

Also, issues like logging of results etc to be discussed. Issues related to attenuation value accuracy and setting have been discussed : 5% (0.25 dB) ok; agreed to add median calculation feature; to check if a feature to predict the expected change in attn for a given change in sky direction can / needs to be added; better option for saving the attenuation values for future use / reference to be defined; agreed to have a document that summarises all of the above and spells out the main requirements (from user point of view) and possible solution options / techniques; detailed discussion has taken place between SRoy, BAK, SSK and YG on 14Aug2014 -- main conclusions and action items are as follows :

(a) attenuator values : aim is to check if measurements match with specs (within +/- 0.25 dB); initial test results for 3-4 units (at one epoch) had been reported by BE team (found acceptable); pending items (for BE team) are :

to check the constancy of the values across the band;  
to repeat the tests for varying i/p power levels with constant o/p power;  
to repeat the tests on different epochs to verify constancy with time;  
to work out plan for calibration table for each attenuator (after above results).  
Data for 3 epochs has already been taken; data across the band may already be there;  
for different levels, it is being done; new results had been circulated and SRoy  
has analysed these; SRoy to summarise from all of the above.

Summary as per email exchanges : ok -- main pending test is one with varying input  
power levels; tests have been done; waiting for update; email has been circulated;  
to discuss and plan further, as required.

==> i/p range from -37 to -17 dBm tested and behaviour of attenuator appears to be  
all right. SRoy to cross-check the results and confirm if we are ok.

(b) requirements document to be updated to reflect the outcomes of the discussions  
e.g. better clarity about the 3 modes of operation etc. -- SRoy has produced an  
updated version : needs to be checked to see if it can be cleared.

(c) self data (from correlator data stream) to be saved in shared memory ring buffer  
of ~ 30 mins depth for further processing tasks to work on (should also work off a  
recorded lta file) -- SSK to work with NSR to get this implemented (work in progress).  
SRoy / BAK to check with NSR.

==> NSR has been working on the writing to file version and it may be working by  
now -- SRoy to check and confirm the status and arrange appropriate follow-up.  
NSR has been looking at the matter (after discussion with SSK) and has a basic version  
working -- SRoy will be discussing with NSR in early December : SRoy to update on  
the outcomes of the discussion via an email.

(e) to further develop the relevant routines that read the data and process to  
achieve the desired results -- SRoy to build from the basic routines available at  
present, with participation from NSR; work in progress; to cross-check about median  
calculations -- not yet done; first looking at ring buffer issues (may club both?);  
same as item (d) above.

==> to take up after file mode above is cleared.

(f) testing of bandpass shape (ampl and phase) for different values of attenuation :  
6 out of 7 antennas showed less than 5% percent and 5 degrees change in ampl and  
phase over 5 dB change in attenuation. band-pass variations with time reported by  
SRoy -- to be taken up for detailed discussion -- maybe under testing of GWB?  
SRoy would like to follow-up to see how much is the intrinsic varn of the GWB  
corrln level with change in input power level -- to cross-check with DVL about the  
expt done there; SRoy to discuss with DVL and revert back.

==> SRoy has analysed the data provided by DVL and found that behaviour is acceptable  
for the range of i/p power variation tested which is about factor of 5 (~ 7 dB); to  
plan to extend this to larger range : set power level on galactic plane calibrator  
to about 80 or so; then go to calibrator away and equalise to 350 -- larger change  
in attenuation (~ 12 dB) required -- can check if corrln coeff (bandshape) remains  
ok or not.

==> Regular follow-up on all aspects after 2 weeks; items to be reorganised to  
make more compact.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from  
14 Jan & 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) 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) beam mode working with fixed channel and time factors : SSK had got the code changes done for making it general purpose -- going up to any number of channels for corr + beamformer + DAS -- SSK has tested upto 16K channels; 32K may require some extra coding; agreed to first release GWB-II code with 16k channels for users, alongwith modification to SOP; second, work ongoing for coding 32k (and 64k) in GWB-II code for testing; final version will be released in GWB-III; modification in GUI for multiple time integration & channel selection added & tested.

==> no further updates right -- to clarify about updates in GWB-II and between 32k and 64k plans, and close the matter.

(b) header for beam mode data : to be taken up and incorporated alongwith the PA mode; SSK has done first round, and needs a discussion.

Discussion between YG and SSK is pending; meanwhile version with header to be released alongwith 16k channel code release on GWB-II.

==> pending for SSK and YG to discuss.

(c) availability of psr\_mon / pmon on nodes 53 and 54 for recorded data is there; for shm attach needs some work; psr\_mon done but only for off-line upto 16k chans; no real-time version available; pmon still needs to be looked at...

Agreed to confirm off-line psr\_mon available on nodes 53 and 54; to try and provide online psr\_mon with 16k channel release; later, to integrate Rajora's new code into the system : first with GSB, then with GWB-II and III.

==> some discussions are ongoing on this, including with Rajora for resolving the shared memory issue.

(ii) 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.

==> no work done on this.

(iii) change of host machines to 1U HP machines for GWB-II : work is ongoing by SHR, including OS, disks and location in the rack; may be able to complete in one month

time scale (from 3rd week of Nov); work ongoing, SHR needs to coordinate with Nilesh.  
=> machines are ready; GUI needs a version which has new IPs and maybe some paths;  
in order to switch between old and new hosts, infiniband cables need to be swapped  
at the 8-port switch.

=> Regular follow-up on all aspects next week.

4.5 GPU corr (GWB-III) : next gen system -- from 7 Jan & before (SHR/SSK/GSJ/BAK) :  
Design and delivery of 32 input (16 ant dual pol or 32 ant single pol) system :  
4 new DELL machines are in the rack and wiring + cabling is complete, tested with  
analog noise source; new code with 2 x 10 Gbe I/ + improved logic for assigning  
specific threads to each core + env variables completed (tested for 200 MHz / 8 bits  
and 400 MHz / 4 bits, 16 inputs and working ok with no pkt loss); basic GWB-III has  
been completed and released; ongoing action items are as follows :

(i) plans for testing the GWB-III : this has 2 parts :

(a) regular user level tests of basic modes : updated SOP has been released; modified  
ferrules have been put and GWB-III has been released with full online control; final  
connections to GWB-II and III can be chosen by the user on the wall panel; to check  
if new SOP supports flexible connectivity for GWB-III -- this requires manual editing  
of the file (explained in SOP); confirmed that GSB, GWB-II, GWB-III can all be run  
simultaneously with full online control;

DVL has started some of the basic tests -- to check status of these activities.

=> manual editing may not be required anymore -- new GUI has to be tested and SOP  
to be updated.

(b) testing of the 400 MHz BW mode : basic changes to the code for the 400 MHz, 4-bit  
mode have been done; some pending tasks are there : proper delay correction for this  
mode needs some changes / testing; also choice of which 4 bits to use needs to be  
decided -- right now it is set for 4 MSbits; final tests with astronomical source  
need to be done; to confirm if 400 MHz 32 inputs will work or needs to be restricted  
to 16 inputs?

computation does not fit in existing set-up and hence can't be tested right now.

=> for 400 MHz mode, all algorithm issues are sorted out (include delay setting);  
however, existing GWB-III set-up does not sustain 400 MHz; safe limit is 300 MHz  
(including beams ON); agreed to leave it at this level right now and not formally  
release the 400 MHz mode.

(c) checking of beam modes : sockngetcmd for beam mode; one beam host m/c is writing  
slow to disk? -- this is fixed and can be closed.

above problems are cleared and all basic beam modes are working; only phasing needs  
to be verified.

=> verified that the basic beam modes are working; only phasing in one poln appears  
to have some problems -- SHR is looking into it.

(ii) improvements in GPU code using K20 card (SHR/SSK) : a few different optimisations  
have been tried and these need to be further refined and ported to the GWB-III code:

(a) looking at XGPU code (with Vinay of nvidia) : optimised XGPU for GMRT is showing  
~20% improvement -- needs to be confirmed and then incorporated; ready to upgrade to  
CUDA 6.0?; results from R2C vs C2C (with callback) to be finalised and then decide  
about incorporating.

=> SHR has started working on porting XGPU in GMRT code to GWB-III

(b) another concern is about data ordering at XGPU o/p vs LTA format requirement --  
needs to be discussed alongwith SSK and decided; other than that SHR is ready to try  
out. To check status of these discussions.

=> this is important to check and discuss this in order for the changes in (a) to

be meaningful.

(c) dual K20 option : total corr + beamformer is exceeding real-time by 9% for full 400 MHz bandwidth for 16 input correlation (fits for 2 x 8 input corr); to check if the full correlation job will fit in 16 GPUs (after some of the optimisations above); if not, we need to start planning for 32 GPUs : 2 K20s per host, or double-GPU card, or 32 host machines; agreed to try a test where 2 GPUs on one host machine is used to test if the correlator code is portable (set-up with 2 GPUs is there on 4 of the 6 nos 620 machines -- so tests can be done on this when the code development reaches that stage); agreed to wait till main GWB-III is ready and released -- this has happened now, but can wait for some more time...

==> based on current status and work done with nvidia, it appears that optimisation of GPU code will not be sufficient to make final system fit in one GPU and hence, agreed to start looking into 2 GPU per node option : either try with dummy calculation or with actual alternate data buffers going to each GPU...

(iii) other improvements in code :

(a) need some software updates in DAS chain to handle more than 2048 channels ? not clear.

==> this needs clarification about whether this is available in currently released GWB-III or not !?!

(b) new features to be added in next version of GWB-III code : correction for net\_sign[] flipping (LSB/USB modes of correlator); channels upto 32k, lower beam integrations (tbd), beam header, multi-subarray, 4 beam capability; all off-line utilities with backward compatibility; time ? + DUT corrections; optimised code to be ported; shift to 2 inputs per Roach board.

Some of these can be delayed for some time, depending on priorities.

==> BAK to discuss with the team and come back on this.

(c) long-term items like provision for control of FPGA and other peripherals (like sig generator) for different modes : agreed to identify one PC for control of all the peripherals related to GWB; this m/c can / is interfaced to online via a socket and GUI can send commands via this -- already done for loading of FPGA files, needs to be extended for other applications; for other things like turning RFI rejection or Walsh modulation on/off, writing to registers in powerPC would work all right; agreed to start working towards implementing scheme in GUI for taking additional parameters that allow different bof files to be loaded; agreed that these flags need not go into ltahdr but can go in the user log as setting parameters (can also be there in gpu.hdr); agreed to go ahead with discussion with NSR for implementing the logic for allowing support of multiple corr modes that use different BOF files; other action items to be taken up later.

==> not clear if any action has been taken in this; BAK to check with Nilesh and see if the logic can be incorporated.

(d) incorporation of DDC : this is important requirement in the long run :

Agreed to try on one node of GWB-II or GWB-III and get back to earlier stage and see exactly what was the bug. SHR has circulated an update -- to discuss and decide action.

==> first part is that it appears that the current realisation is properly implementing a DDC; only the filter BW needs to be decoupled from the decimating factor and do a careful set of tests; in the long run, better filters with sharper cut-offs may be required (can check with nvidia about availability of std library functions for such applications); second aspect to the check about the nature or format of the o/p to see whether I & Q components are ok for further work or whether we need / can have the real voltage representation of the o/p signal.

(iv) Layout and racks (GSJ/BAK) : layout diagram to be updated and long-term plan

for racks to be initiated; 3 different kinds of President racks discussed ("cyber", "cool" + one more?) -- to try and finalise after one more round of discussions including RVS (also, check new vendor Jyoti Tech); as an interim, 2 nos of cyber racks ordered with President. Current action items :

(a) 4 nos of half-height racks are now in use for GWB-III -- two nos are populated with 4 compute nodes each, third one has 3 host machines + 1 extra machine + clk source etc; fourth one has 8 Roach boards + IFB switch; will need to expand this to 16 Roach boards at some point of time -- may need to add one more half-height rack? ==> one half-height rack is available in hand and can be used when required.

(b) For the 2 President racks : first one has been used for GSB related nodes (spares) -- this is ready now, waiting for riser cards for the spare nodes (to be moved in during MTAC); to check current status of this, including swapping of bad node with CITA node. 2nd rack being used for trying the arrangement for special cooling (with help from mech group) -- tested with 1 kW load and increasing slowly; loading up to 4 kW tested by comparing the temp difference between input and output air; need to compare with unmodified rack; results so far appear to show that there is about factor of 2 discrepancy in estimated CFM rate and AC plant capacity CFM rate.

Next - to decide on number of racks to be procured;

==> agreed to include the test with unmodified rack and then circulate the report; current estimate is for 5 racks (32 Roach boards + 16 compute m/cs with 2 GPUs each); with 2 AC vents feeding these 5 racks, the estimate is that the available CFM may be marginal -- this needs to be resolved against the CFM discrepancy noted earlier. Also to explore additional margin the AC system. Maybe useful to have a joint meeting with RVS and team.

==> Regular follow-up on all aspects after 2 weeks, after some reorganisation of agenda items.

4.6 Procurement of new hardware and accessories required for GWB systems -- from 7 Jan and before (BAK/GSJ) :

(i) purchase of 4 new host machines for GWB III : to decide configuration of host machines (disk i/o to be kept in mind); also to check if SSD is a viable option for recording of data. Investigation shows that SSD vs SATA has pros and cons; it may be possible that one class of server may be there that supports both?

4 nos of T620s have come and integrated into GWB-III: 2 are with 16 TB with and 2 with 4 TB -- compute vs host.

For future purchases : PERC card issue needs to be resolved : agreed that we will buy machine that can support upto 12 disks (which means with PERC card) but will have 2 x 2 TB to start with. More disks can be added as needed, and if at all extra slot is needed, PERC can be removed (will support only 4 disks) and backplane has to be changed with a new one (which has to be bought along with the machines); To decide quantity to order at present : agreed to proceed with 16 nos with full waiver for DELL proprietary item with DELL as the supplier.

==> to initiate the appropriate paperwork, including waiver of public tender.

(ii) procurement of accessories like network cards, disks, cables etc to be looked into -- 20 nos of CX4 based dual 10 Gbe cards purchased and tested; to confirm that this order is enough to meet our long-term requirements; Agreed to produce a formal note about the situation for long-term : to relook at the spares requirement without counting the units already being used in the existing systems (including the PoCo and pkt corr) and buy more if needed; GSJ has produced this list and fresh orders to be done, based on this : 10 Gbe cables and NIC cards (spares); IB switch

36-port -- folders are ready for ordering; indent for 8 nos of K20 has been raised. cables for NIC cards : PO released; IB switch indent to be raised again.  
==> 8 nos of K20 : order has gone; IB cables and NIC : order has gone; IB switch : new folder has reached final approval stage; for 10 Gbe dual-port NIC cards + cables are all in hand.

(iii) new purchase of Roach boards etc :

(a) 12 nos of Roach1 + 16 ADCs and 4 nos of Roach2 have come; Roach1 test set-up ok; all 12 Roach1 and 16 ADCs tested ok; to make a summary sheet about current stock and usage of Roach1 and ADC and bring up for discussion.

==> xls spreadsheet has been created; to circulate the latest version; to check requirement of ADCs and verify the situation for 1 ADC per 32 Roach boards vs 2 per Roach board.

(b) for Roach2 : to check standard test procedure on CASPER; to check if we need to buy add-on mezzanine card; to check if Roach2 can be seen on USB port using Ubuntu and if some basic tests can be done with this; indent for mezzanine card has been put.

==> folder has reached final approval stage.

(c) also software environment needs to be upgraded -- Matlab-Simulink upgrade order is under process; Xilinx ISE v14 has been ordered and CD is in hand -- to be installed; to see if one existing PC can be adapted for testing of Roach2, including installation of these new softwares.

==> new Matlab-Simulink installed on one machine (64-bit), including updated license manager. (additional license 2014 is for parallel toolbox)

==> Regular follow-up on all issues after 2 weeks.

4.7 Testing leakage, coupling and correlated noise in new back-end chain -- from 7 Jan & before (BAK/YG/++) : detailed tests had been done by Vikram Jaiswal (with SSK, SHR and YG) and report has been circulated; for GAB systems, some follow-up action for testing the leakage has been initiated; procedure for testing to be done with GWB-II release modes clarified and tried out -- new tests show significantly different results for cross-coupling for GAB+GWB; maybe due to synth LO (old tests) vs sig gen LO (new tests), whereas earlier tests used synth LO; new report had been circulated that showed significantly reduced coupling; agreed to repeat the original, user level tests done by YG & VJ to see if things are different now ; agreed to try the ADC noise input and north pole sky tests and see what results come out; 2nd round of tests done, show leakage of 2-4% (consistent with first round results of 1-3%) -- to check with SCC whether all user level tests (done earlier by YG + Jaiswal) have been covered; some user level tests done with north pole and different leakage found for lower and higher LO settings -- needs to be understood.

From Aug-2014 : <= 4% leakage; FE+GAB+GWB (L-band) ~ 40% leakage;

==> need to organise a detailed discussion on this.

4.8 Walsh modulation : prototype set-up on Roach board -- from 7 Jan & before (SCC/BAK): plans of BE team for implementing prototype scheme -- basic unit for switching using sq wave signal from GPIO pin tested ok; was put in PoCo correlator and was being tested; walsh waveform delay functionality has been added now and can set delay from 1 to  $2^{32}$  clk samples (!); with this, variation of correlation with delay has been tested using noise source inputs and found ok; a robust algorithm for hunting for the peak correlation and fixing the delay needs to be developed; can also think of a test case of showing cross-correlated signal goes away with modulation with square wave in one channel; Walsh pattern being put in the Roach (not many slices needed); there was some mismatch between CPLD waveform and FPGA waveform that was resolved and all FPGA waveforms are matching; current action items



are as follows :

(i) issue of accuracy of oscillator being used needs to be resolved.

(ii) to complete the Walsh modulate and demodulate set-up in the lab and test -- this is close to being ready.

==> this is ready and can be closed.

(iii) to complete the final delay setting algorithm : to provide upto 500 msec of delay (for 128x4 Walsh length) with resolution of 5 nsec (FPGA clk); there were problems related to varying start-up offsets and fractional delay setting, as well as problems related to set up and hold -- these are now reported to have been resolved : to check current status and see if this item can be closed.

==> this is confirmed to be work ok and can be closed.

(iv) what about synchronisation of starting?

==> this is taken care of by running the CPLD with a sig gen locked to 10 MHz.

(v) to optimise the hunting algorithm;

==> to start testing a basic algorithm and see what we get.

(vi) to demonstrate cancellation of unwanted signals in ADC card and/or GAB; first, need to run a test where pattern from external source can be synchronised to the pattern generated in the FPGA -- this requires being able to hunt and correct for the unknown delay !

==> this is coupled to item (v)

==> Regular follow-up on all aspects after 2 weeks; agenda item to be rationalised.

## 5. Other items :

5.1 New python assembly design -- from 7 Jan (HSK/SSK) : FE group wants the python configuration in E6 to be adopted for all antennas -- this needs to be discussed with mechanical group and finalised; FE and mech have dicussed about plans for modified python assembly that will give additional protection to cables; mech group had circulate a short note on their view of the matter, alongwith photos; this was discussed and existing vs E6 system was compared; Action item :

(i) modified E6 design with hinge-like support was installed on C4; to watch the set-up on C4 and do periodic inspection for checks of (a) damage to hose (b) hose clamps (c) water entry etc -- first inspection to be done after 2 months (mid-Sep) by mech and fe teams; subsequently, inspection has been done (around mid-Nov?) and a video of the same has been circulated; scheme appears to be working ok; however HSK feels that this scheme with hinge may not be good in the long run -- needs to be discussed and understood; agreed to keep this as status quo till IGUS assembly done and tested.

HSK showed video of 'C4' (E6 solution NOT successful for C4) - hinge is bending; need a plane plate;

==> further discussion is required to decide on the action.

(ii) IGUS cable wrap -- new technology prototype to be developed and tested on quadripod; also option of hose without wire impregnation -- long-term solutions.

1] hose without wire impregnation

2] Entire hose assembly under procurement (long-term solutions).

Quotes for both items received : item 1 is Rs 10k for 10m (4 antennas);

item 2 is 60k each -- will try on the quadripod test range;

items received; basic assembly made ready; waiting for some manpower to be free for installation (around 13-14 Oct); then 4-5 days for 1000 rotation testing; basic arrangement done on quadripod and tested ok without cabling (video for this is also

available); now waiting for FE team to populate cable wrap with cables for further tests; proto model now ready; to discuss further plans for action.

==> discussion is pending.

5.2 Problem of access to FE boxes with 500-1000 CDF feed -- from 7 Jan & before (HSK) : Update on new solution being designed by Mech group -- tested in situ and found working ok; agreed to use this for present; for future where bigger and heavier boxes will come into play, mech group will think of an improved solution, including an option for removing one feed and bringing the stool inside the basket; a few options explored by mech group, with target of 1800 mm height for boxes with max weight up to 150 kg (?), quotes received from some parties, processed and order placed; delivery by end of November; inspection done (in Bangalore) in mid/late November; some simple improvements suggested to vendor (guard rail, simple clamping arrangement for item); platform delivered at GMRT (early-Dec) and tested and found ok, including modifications that had been suggested. To discuss and plan next step of action.

==> item is in regular use now; can have one discussion to confirm status and safety related issues, and then close the item.

5.3 Fabrication of 6 spare L-band feeds -- from 7 Jan & before (SSK/HSK) : Order to Akvira for 3 nos (with enclosure) + 2 extra horns. Hence, total of 6 feeds to be made ready + 1 dis-assembled unit + 1 old feed at Pune -- so total of 8 spare feeds will become available.

After inspection, many corrections / suggestions for improvements : e.g. improved probe mount : press-fit vs. screws; M4 -> M5; etc]; 3 sets delivered at GMRT, after powder-coating -- there were some issues about thickness of plates for mounting of connectors etc and in-situ modifications were needed; there was also the issue of press-fit vs threaded probe assembly -- finally a mix of both schemes is being used : 2 of 8 new feeds will have push-pull type and 6 will have threaded type; also, new enclosures were procured for these feeds; finally, 4 complete and corrected units were delivered to GMRT by 24th Oct 2014. To confirm current status and see if this matter can be closed.

new connectors (gold plating) to be checked within next few days;

==> plated connector has been given ??? 2 sets of threaded type and 2 sets of push-pull type -- on 12 Jan 2015, now no pending works with mech group related to L band; to check if item can be closed.

5.4 Improved software for work requests -- from 7 Jan and before (HSK/SJ) :

To review the current process of taking job orders for better facilitation of the tasks with end users like electronics groups. YG discussed offline with HSK : to look to fill the lacunae in the process with maybe new development of in-house version -- agreed to try and get this done in-house with Joardar; work was taken up after completion of ongoing tasks related to electrical (meanwhile, old software also started working (to check with Mangesh about what fixed it) -- hence urgency not very high; first version likely completed and released in late Dec/early Jan; awaiting user feedback for improvements; to discuss long-term plans.

==> released software appears to be working fine; still waiting for any significant user feedback; can check again after 2 weeks and see if item can be closed.

5.5 Status of new CSIRO feeds : from 7 Jan & before (ANR/JNC/HSK) : to report on performance of the newly manufactured feeds -- new results are slightly better compared to ver2 (casting) but not as good as the original ver 1 (machined by Godrej); it was discovered that a major change in the design /drawing required to maintain alignment between different sections [using guide-pins etc]; how to

proceed further needs serious discussion about alternate options.

HSK to try some new ideas to see if a solution can be found e.g. liquid Al layer to cover ? additional coating of Al paste being looked at as a possible option; email update from HSK : discussion with Dr. Shenoy -- Al conductive paint may not work best (only 80% conductivity)...  
==> email update from HSK : repair not possible because of Al casting -- need to discuss and decide future course of action.

5.6 New FE boxes and testing with reflective paint -- from 7 Jan (HSK/SSK) : two kinds of paint received and 1 box will be made ready next week for testing. 6 new boxes are ready as per specifications -- only some engraving work is pending. email update from HSK : One FE box painted with Luxtropherm HT 400 (range from 250-400 deg C ?) and handover to FES group for testing. Second grade paint : Luxtropherm HT 600 (range from 400 to 600 deg C) -- waiting for arrival; 3 types of FE boxes handed over to FE team : (i) plain box with powder coating (ii) box painted with HT400 (iii) box painted with HT 600; waiting for test results. 2 types of paints tried : HT400 & HT600; neither successful; to try new paint options?  
==> item needs to be discussed to understand why the original selection did not work and what should be done about it.

=====

## Minutes of weekly Plan Meeting of 28 Jan 2015

### 1. FE & OF related :

#### 1.1 Documentation : follow-up on level 2 (ITR) -- from 14 Jan 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; was in internal circulation within FE group (for long time), so earlier draft was taken up for discussion in the meeting, and some comments and suggestions were made : to give some more background and motivation and requirements, add a block diagram, explain about RC, point out interesting artefacts in the results, mention the SOP etc -- revised version should have been released by now.

(b) temp monitor (VBB) -- work had started (after v2 250-500 FE box installation); initial draft is there (2-3 pages), needs some more work to be done.

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

==> for (a) one updated version has been produced : still needs the background and motivation to be put in; blk diagram is there; RC yet to included; some explanation of artefacts is included; one more update will be done to include the missing items.

(b) emphasis will shift to this as updated 250-500 report is now released .

(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. For the 250-500 filter, a paper has been accepted for publication in IEEE (Sougata & Anil).

Pending action items :

(a) agreed that the 550-900 filter work can be looked at for a paper : Imran is looking at that -- will come back shortly with a proposal for presentation in paper content.

(b) to check what else can be taken up for publication.

==>

1.2 OF system NTR -- from 14 Jan & 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.

Any updates ?

==> No progress on this.

#### 1.3 Noise temp & gain vs temperature for new LNAs -- from 14 Jan & before (VBB/SSK):

Results for new 250-500 LNA show ~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 0-60 deg and 0.6 to 0.8 dB (drop) in gain with increasing temp.

Results for 550-900 LNA are 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 :

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; expt has been tried to measure bias voltage but it is difficult as the probe affects the bias voltage and LNA behaviour changes; to check if any another method can allow the test to be done; in parallel to check existing schemes (in lit) for temperature compensation of bias pt (assuming that this is the cause of the problem); to check about option for artificial heating of LNA to constant temp (via a TEC); meanwhile, to complete the test on Lband LNA.

==> agreed to start the Lband work; meanwhile to keep checking for any other clues for probing and testing.

1.4 Installing and testing of temperature monitors in front-end & common boxes -- from 14 Jan (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 tests had been carried out; meanwhile, C4 & C10 fitted with dual temp monitors in FE box, and C13 with monitor in both FE & CB -- some tests had been done but data was not sensible due to unresolved issues in the wiring of the existing common box units that prevents desired data to come on expected channels in 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) Completion and release of SOP : checked that operators can use present version of SOP by themselves -- data obtained has been checked ok; confirmed that SOP works for any subarray; there were some issues related to stopping of recording & command : facility for stopping recording after given time is already there; stopping of the command (file) will remain manual feature; agreed to have single SOP for power & temperature monitoring; VBB to provide additional information to GP and SOP to be finalised and released, alongwith data analysis package for use by others; current status : for power monitoring all has been tested and okayed; need to confirm the same for temp monitoring -- only info required is channel numbers for temperature monitoring. To check if this matter can be closed now.

==> SOP now has all the statements and matter can be closed.

(ii) Analysis of the data : C13 & E2 both channels temp monitor available at online output (fixed for C13 one ch FE & 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; first results for ~ 5-6 antennas (LNA + FE box) + 2 antennas (CB) for 3 hr duration shows some basic behaviour but not clear how well things are working; to try two things : (a) to check if any old data of longer duration (from last 2-3 months) is available (b) to try a longer run, even for one antenna like W4 which is under maintenance; some of the short data stretches have been looked at; need a long

stretch to come to any reasonable conclusion about the working and about range of temperature variation seen -- to be tried on W4 and results to be reported.

==> at least one 6 hr data has been taken; but not clear why the team is not able to analyse it !?!

1.5 Testing of 130-260 system -- from 14 Jan & 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; 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. C10 has one 1 dB less deflection compared to W1 & S3; new 130-260 FE boxes made ready and installed at C10 -- first look appears to be working ok; need final confirmation on the deflections.

==> plots for 2 antennas C10 and W1 agree very well, S3 is about 1 dB down in deflection; at 235 it is known to be down by 1 dB which is being investigated; there is some slope in 150 MHz part, can be looked into; there are RFI lines which need to be identified; to look for possibility of getting a 4th feed made (at lower priority) as 4th FE box is already available.

(ii) plans to complete the 3rd wideband 130-260 FE box -- waiting for the spare FE box to come back from w'shop -- any updates? 2 boxes will be ready by 10th Dec, as noted above -- it appears that one box is done; second is in progress; to confirm that 2nd box is also ready and available as a spare, and see what is the follow-up action item on this.

==> 2nd spare is confirmed; for longer term, most of the items required are there; noise source and coupling needs to be integrated; possibility of sub-band filter discussed -- not clear if it is required, except for RFI related issues (space in the FE box will not be a problem).

(iii) plans for further tests, including interferometric measurements -- waiting to resolve the above issues and 3 antennas to be available; it should be possible to initiate this now; to check status of this.

==> NK to update.

1.6 Testing of 250-500 FE receiver system -- from 14 Jan & 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. C1) but it needs to be checked individually for each new box that is made ready.

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:

- (i) to confirm if E6 sensitivity is ok or not -- agreed to check and report.

- (ii) 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.

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

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

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

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

- (vii) to check validity of satellite RFI warning set-up in control room (can be checked under RFI agenda items)

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) : to check if results are available.

Agreed to maintain the log of the various issues; to check Nov data and also new data being taken now in Dec and summarise the results.

==> attenuator setting problems found in 4 antennas (W6, W4, S2, C13) -- due to wrong wiring; now corrected for 2 antennas (S2 and C13); move RFI matters to corresponding section.

1.7 Mass production of 250-500 FE receiver system -- from 14 Jan & 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. First version (v1) of FE box was installed on C13; final version (v2) of new FE box was installed on C11 and found working ok except for Walsh problems. Meanwhile, GSG cleared to go ahead with mass production.

Current action items towards mass production are :

- (i) 250-500 LNA : there are only 10 spares for uGMRT at present; it is also being used as spare for existing narrowband 327 MHz system (as devices are not available any more) -- original was made on ultralam2000 and this is not easily available; current action items are :

- (a) to confirm the total number of units available today : earlier report said that 2 new LNAs were added to the stock; however, email update from ANR states that 20 LNAs (10 antennas) spares are available -- need to confirm the final count.

- (b) plans for making more units : need to find an alternative substrate; Rogers 5880

may be a possibility (work is ongoing); first prototype PCB was made, but used substrate with wrong thickness (!) -- now awaiting arrival of PCB ordered with correct thickness material.

==> there are 20 nos (10 antennas) on ultralam2000 (old system) available; now waiting for the final prototype after correction of thickness.

(ii) status of QH, noise source, coupler etc :

(a) to confirm status of mass production of QH ==> available for all 30 antennas.

(b) 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; traced to faulty functioning (unequal distribution) of power divider module; alternate approach (using resistive components) seems to work ok -- equal powers on both channels ~ 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 (from the document by VBB?).

(c) also, additional issue of 7 dB slope over the band (due to coupler) and 4 dB due to noise source; 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) was completed and first results show fairly flat (+/- 1 dB) spectrum over 200-600 MHz; agreed to check on 2-3 more units for repeatability and also thermal cycling and then finalise the matter; also need a discussion about the 7 dB slope due to coupler. strategy for mass production to be decided.

One more unit has been made but now held up for more units because switch needed for noise level change is not available (has been indented); thermal cycling test passed; agreed to put the one working unit in the new FE box (either C11 or C0) and let user run some tests; 7 dB slope issue can be taken up later on.

==> want to do express ordering; meanwhile, yet to be put on C11; waiting for switch.

(iii) 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 had been sent to Argus and after receipt of PCB 2 filters for each of 2 pols ready and 1 filter tested.

Some confusion about whether there is repeatability or not as Argus appears to be using different sub-contractors -- out of 4 units, 3 are sort of same and acceptable, 1 is quite different; to talk to Argus and see what minimum guarantee he can give for repeatability and then take a final call.

SSK has talked to Argus -- need an update.

==> Argus has agreed to meet the min specs and 2 boards (all sub-band filters for 2 antennas) have been sent to him -- expected in Feb 1st week.



(b) plans for 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); waiting to check if same switch is to be used in other places -- may not use switch in other places; to finalise the order for number of switches and other accessories, including chassis at the time of ordering the PCBs.

indent for switch not yet raised -- tbd; chassis to be asked for at the time of ordering the PCBs, which is waiting for finalisation of the design as in item (a).

==> switch indent will be placed (alongwith other similar requirements); PCB for the switch ckt is ordered -- will come in 4 weeks or so; chassis request has been put; consolidated spreadsheet for 250-500 system getting ready; will be available in 4 weeks time.

(iv) post amp : Hitite 740 new stock for 30 antennas available; plans for slow rise power supply -- may get done with CB power supply testing; new design of supply was done and PCB was ordered & tested -- worked Ok; agreed to give this PCB for mass production to cover this FE box and common box requirements for 30 antennas; next FE box layout to use this PCB; mass production PCBs have come, but not yet populated. ==> few cards populated and tested ok; this will now go into mass production.

(v) ANR needs to talk to Techno Circuits about PCB manufacturing issues and work out (long-term) solution : discussion with Techno Ckts had happened and was positive, and party agreed for long-term rate contract; placing of work order for one year duration was in progress; folder had gone for final approval; order has been placed; to check if this will suffice for all the mass production needs and see if item can be closed now.

==> confirmed that the volume limit is sufficient for about one year of work; item can be closed now.

(vi) 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; document update work is ongoing; some of the updates have been done, some are work in progress; to check if it is ready for release now.

==> most of the changes have been done; a few simple changes suggested in blk diag etc.

(vii) Walsh testing shows both channels working in C13, but only one channel working in C11 -- agreed to track down this problem before moving to mass production.

C11 box was brought down to check Walsh matter + one other problem (which is call sheeted); C11 FE box tested in the lab -- Walsh working ok in both channels -- may be a common box problem or D49 PIU -- to carry out in-situ test at C11 for this; second problem was about spurious bandshape of LNA -- not seen in the lab, except when i/p is loose or not connected -- this could be typical for all units; can go back to antenna after common box and D49 PIU tests are completed.

==> finally cable found to be the problem -- now being replaced.

1.8 Final version of 250-500 FE box -- from 14 Jan 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 tested; meanwhile, FE team went 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; after that it was brought down for repairs, modifications and improvements, and had gone back to C13 : Walsh testing to be cleared for this box -- this has been done now (after fixing one connection where the wire was found to be loose and open); to check if this item can be closed.  
==> this is done and can be closed.

(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 few months now and no problems reported except for the fringe problem due to wrong filter settings (to confirm if this is resolved). Walsh has not yet been cleared : C11 box coming down for fixing Walsh problem + one other problem -- see agenda item earlier; to confirm if problem fixed or not.

(b) meanwhile, work on 2nd unit of v2 FE box had started : box was assembled but LNAs gave some problems (dip in passband) -- changed with other LNA units and now working ok; integrated testing to be completed and then put on antenna which has upgraded common box : C0 is a possible choice; check current status of this.

(c) updated document from VBB is still pending.

==> new box fully ready, will go to C11 (with improved noise cal system); original box, after fixing the QH / LNA problem (not clear where the problem is), will go to C00.

(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 possible clash with powder coating needs to be understood.

3 types of FE boxes handed over by mech group to FE team :

(a) plain box with powder coating (b) box painted with HT400 (c) box painted with HT 600; waiting for test results -- tests not yet done.

initial results seen from 5 day continuous run having 4 curves : ambient (shows large increase at sunrise, even a spike to 55 deg); powder coating box; 2 boxes under test : result is slightly confusing as one box under test and powder coating box track each other very well and other box under test behaves worse than these 2 (!); also there is extra cooling in the night ! To confirm time axis in absolute units and to cross-check the results. Can try a cross-check with sensor in the thermal chamber. Need follow-up to understand what happened in these tests and how to proceed further.  
==> it appears that this is not working out; FE team to send a brief report with

the data and their conclusions and matter to be taken up next week.

(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 gone for engraving -- boxes have been delivered and work is ongoing in FE lab. Next block of x5 for 250-500 & x5 for 130-260 planned -- work order put in; to check delivery status and also discuss long-term plans.

==> 10 new boxes in process as above; mech group is interested in trying recycling of the shell (outer portion of the box) -- to be discussed next week to understand pros and cons.

1.9 Status of improved 500-1000 MHz CDF -- from 14 Jan & 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 VG; 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) 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 13 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 seen; 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 was down; licensed version of windows7 was obtained to install on the lab PC and it should be ok now? Software is installed but there may be some hardware problem of hanging or shut down. YG discussed with HRB and MU; detailed update provided by MU + SM, but still some issues with the PC -- needs another round of look by comp group. To check current status.

==> still having some issues (windows ver not compatible with h'ware?) -- to see if this can be taken up tomorrow.

(ii) 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?)

(iii) to do deflection tests for different combinations of dipole and cavities (as mentioned above) for varying distance from focus using a variable height

stool to see which design gives optimal performance.

After a lot of effort, a reasonable set of results on Cass-A obtained for the different combinations, including 750 MHz Kildal feed -- this is very similar to Cone1-Dipole2; Cone1-Dipole2b as well as Cone2-Dipole2b are similar to CSIRO feed plots obtained in ~ 2011; agreed to do both things in parallel :

(a) ask for specific stool modification for cone2 + dipole2b at 1260 ht + matching short length cables to minimise loss; HRB wants to put it on a separate antenna (other than C10 which can continue to have other cone-dipole combination) -- agreed to check W1 & S3 at 235 using 130-260 system for fringe and sensitivity and if ok, use W1 or S3 for the new experiment;

test done (at C10) with shorter cable (0.6 m instead of 1.4 m) shows measurable difference ~ 1 dB over most of the band (!); to follow-up with LMR low loss cable and even shorter distance.

(b) to complete the exercise for cone1 + dipole2b with stubs to increase ht by 50, 100, 200 mm to make it reach upto 1500 mm or so; reviewed the results now available : not too much shift in the peak for cone1 + dipole2b -- peak is around 1310-20 mm ht; this is now pending for making a stool of the correct height for further tests.

(c) getting beam shapes for the 2 feed combinations to see if one is better -- quick results from PMQC data (at 610) give some indication that cone1+dipole2b has slightly broader beam -- need to the full RF test data taken and analysed, for both cases.

==> Reduced the cable length further to 0.3 m and seeing about 0.5 dB improvement again mostly across the band. Agreed to try with plate mounted QH + LNAs with DC voltage reaching there. HRB also wants to try small adjustment in height of stool. Also to complete the beamshape measurements also (with 0.3 m ht) and then change to variable stool if needed. Also, GP to work out the sensitivity curves for the expected parameters for this range.

(iv) any new ideas? discussion of 19 Dec 2013 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), including varying stool height -- see discussion above;

(b) try simulation of CDF250-500 scaled by factor of 2 (including with different dipole sleeve combinations) -- maybe after (a) is done; status update needed.

(c) design Dual-ring feed 550-900 MHz (initial BFRs can be made for 650 & 800 MHz) -- waiting for above items to complete;

(d) modified version of cone-dipole based on patent by Shefai + ... (1991) : refers to Kildal paper of 1982; recommends additional choke structure just below the cone but protruding out to  $\lambda/4$  : supposed to improve (a) cross-polar (E-H match) by 30 dB; (b) reduce back-lobe and (c) ???; agreed to (a) circulate the document (b) cross-check the date of the paper on which our cone-dipole is based (c) build a prototype using cone2 (why?) matched to  $\lambda$  at 750 MHz.

1.10 Releasing existing 610 MHz system as part of the wideband upgrade -- from 14 Jan (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 is also done and hence 8 antennas are completed and 2 more boxes are ready as spares; further confirmed that total of 9 antennas completed (C1 & E6 are the last two); to confirm status on webpage and confirm number of spare units and see if item can be closed (only regular monitoring to be continued).

==> ok.

(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?

==> not clear what is to be done here?

(iii) testing of released systems : to discuss results from weekly / montly tests. first report has been circulated; all deflections seem to be OK; to check if there are any issues that need to be addressed.

==> to wait for next round of tests.

1.11 Design of new RFCM card (v3) -- from 14 Jan & 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; later, assembled in fully working spare feed, not yet on antenna.

==> still on the ground.

(ii) was integrated and tested in one 327 box, waiting to go up when there is a failure -- waiting for LNA; any updates?

==> ready in 2nd new box; will go on C11, as mentioned above.

(iii) was also integrated into new 130-260 FE box, which is now installed at C10 : to check if working ok.

==> working ok at C10.

(iv) can also be tested in one FE box that is connected to common box that is being tested with new Rabbit card; confirmed it is being used in test set-up in the lab.

==> ok

(v) report : first draft is ready, and 2nd version is underway -- needs additions about monitoring points and internal review -- still in discussion between Sougata and ANR; some significant changes were to be put in; should be ready for release now.

==> updated version will be sent by next week.

(vi) PCBs have gone for mass production : will be coming by 3-4 weeks; will be populated in-house; meanwhile ~ 10 nos are available.

1.12 Next Gen Common Box -- from 14 Jan (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) 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. To check plans for this.

(ii) 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 were completed for the sample box and all the items were available, including Rabbit card enclosure, slow-rise power supply card etc; wiring was to start after completing the layout -- this needs to be redone as things did not fit into the box in the first attempt.

==> mechanical issue due to space crunch, requires swap switch PCB and chassis to be redone. Sample unit is getting ready -- PCB in fabrication; new chassis getting made.

1.13 Calibration scheme with radiator at apex of antenna -- from 14 Jan & 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 : 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 share the data with SRoy to get the plots done for the variation with antenna position (elevation etc) & then work on interpretation : 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 phenomenn matches that form. SRoy has had some discussion with PAR on the data sent and some additional data is required to be sent by PAR. First attempting at fitting with mathematical fn has been tried.
- (g) 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... to try 250-500 with old antenna in steps of 25 MHz at C11 and C13.

No updates, except that some tests have been done to estimate P1dB point for down the chain using the radiation set-up -- results to be summarised and shared.

(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.

(iii) deployment of new broadband antenna : suitable unit (from Aronia) had 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.

1.14 Walsh switching arrangement in FE -- from 14 Jan & before (SSK/SCC/PAR) :

Some tests have been done on the bench by FE group; first draft of report has been circulated. Current action items are :

(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, and tests done : this looks like working



satisfactorily in 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 -- to check status of these activities.

(ii) 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; 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. ==> work on verifying that Walsh works is pretty much over; need to work with BE team to do end to end test.

1.15 OF links : new and old, from 14 Jan and before (PAR/SSK) : There are 2 parts to this work :

(i) installation of new, broadband links :

22 antennas installed : C0, C1, C2, C3, C4, C5, C6, C8, C9, C10, C11, C12, C13, C14, E2, E6, W1, W4, W6, S2, S4, S6.

One arm antenna was to be taken up and completed -- need status update on this.

==> now S3 is completed and released; next one will be S1 -- can check after one month.

(ii) long-term maintenance of OF field joints : Growing evidence for problems with older joints (over last 10-20 years); need some kind of consolidated approach to address the problem. Likely causes : nature and condition of splicing equipment? Nature of cover / protection provided? ... Agreed to get the statistics of the old field joints over time, including a comparison of the losses seen with fresh measurements -- this exercise may take 2-4 weeks; meanwhile, urgent attention is required for the field joint near W1 as it is affecting W4 and W3 significantly. There is a technical problem that the newer kits are not compatible with our existing cable and old kits are not available -- 2 options ongoing : trying through Chinese company and also workign with mech group for additional support structure. ==> trying to understand the problem : fibre cable used is the same type as original; however, the splice kit for new cables is incompatible with older cables -- this problem is from about 2007 / 2010 onwards?; claim is that joints made before this are ok, as the quality of the material in the older (Australian) ones are better. except if there is a problem of break or crack in the protective coating or the kit. basic list shows ~ 40 cuts (80 joints) distributed over the array; agreed to produce the table alongwith the loss values; then one can look at the worst losses and compare with other external factors like location, environment and old vs new kit etc.

2. RFI related matters :

2.1 RFI from different spectral lines -- from 14 Jan 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 :

(a) TV lines : Cable TV leakage does not appear to be a problem; present thinking is that the lines seen are from terrestrial TV transmitters -- mostly in 175 to 229 MHz range. Need a comprehensive list of 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 -- 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, but needs to be checked for carefully. Level of lines appears to vary from antenna to antenna -- need to do a careful check of this aspect.

(b) 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). Lines seen near 1030 and 1090 : interrogation at 1030+/- 3.5 from airport and response from aircraft at 1090+/- 5 with width of about 20 MHz. In addition to these lines, 108 to 140 MHz is used by ATC -- again stronger near W-arm antennas. Need a comprehensive list of known / expected lines from civil aviation related activities near GMRT -- the list of lines have been identified in the main document (below)

(c) any other sources of spectral line RFI : e.g. police wireless etc -- need to be discussed and characterised : work ongoing with omni-directional antenna and disc-cone antenna; police wireless is in 159 to 163 MHz; there are some reports that there is increasing amounts of such activities in GMRT area (earlier it was more eastern side; now also seen in southern side).

(d) other, unidentified lines : new RFI was reported in 270-290 range (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 at a second epoch; nature of 485 line is confirmed (?), but no known source known to be nearby !

Current action items :

(i) to generate comprehensive report on list of lines seen around GMRT and their RFI influence : updated report with list of lines around GMRT getting ready ; have used log-periodic + disc-cone + actual GMRT data for making final compilation. Highlights of the results : lines are color coded as per different sources of RFI e.g. mobile phone, TV, civil aviation. Good amount of information appears to be captured here -- discussed in fair detail during Dec 2014 : agreed to modify title of report; to clearly mark lines not seen in GMRT region; to think of separate version of table (for external circulation) that has ONLY lines seen at GMRT; to think of prediction algorithm for GPS satellites (similar to military satellites).

(ii) For TV lines :

- (a) to check for evidence for Mumbai digital TV transmission near 470 MHz;
- (b) noticed that 540 TV line still leaks through for some antennas (also maybe true for the 175 TV line?) -- need to check if this is due to shift of the filters or not enough rejection of the line.
- (c) can we take the strongest TV line & characterise if it saturates the electronics or not.

(iii) For civil aviation : some follow-up is needed to see if they saturate the W-arm antennas.

(iv) For police wireless : to discuss with admin if the information about their transmitters (esp the fixed ones) can be obtained.

(v) New lines : to check about new RFI in 270-290 range; some expts to be tried to confirm nature of 485 line.

(vi) omni-directional antenna needs repair and replacement also; processing for 10 nos (including remote location sensing) was ongoing -- order had been placed; all 10 nos arrived around mid-Jan; one unit opened to verify the components; to be assembled and performance to be tested.

2.2 Radiation from CAT5 cable -- from 14 Jan & 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 had been circulated that combines testing of switches and CAT5 cables; conclusion was 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 2014 : table of inventory of un-shielded cables currently in use (94 copper lines); total length ~ 1200 metres; procurement of shielded cable was initiated; data was submitted by RFI team, and an updated document had been circulated; about 900 m cable (3 rolls) + crimping tool need to be ordered (enough connectors are available); total investment is about Rs 1.7 lakhs : agreed to go ahead with this; item was under negotiation about details of the pricing (Rs vs \$ quotes due to difference in value); meanwhile, work had started using existing spare CAT5 cables (old stock) to replace older cables in various labs, as per their requirements; conference room & canteen annexe has also been done; meanwhile, folder for main order was followed up and it appears that there is no choice but to go with the Rupee quote and hence total outlay will be ~ 5 lakhs. Current action items :

(i) To check status of completion of the work in different labs and rooms : conf room, canteen annexe, EPABX room and all engineer's rooms, user's room are done; rest are waiting for main order to supply.

(ii) To check status of final order and availability of cables, connectors, crimping tools etc : to check if order is gone and expected date of delivery.

(iii) Need to work out a scheme for proper long-term maintenance with OF and computer group : at the level of PAR to MU it has been discussed -- SSK to send an email to formalise the arrangement.

2.3 Effect of military satellite RFI in 243 band -- from 14 Jan & 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.

(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.

2 out of the 6 satellites have 2 deg limit. Can we put this as the default limit for all the satellites? Ops group to generate statistics of the duration of encounters in the current set-up.

This needs to be followed-up, including checking the log that Santaji has created.

(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.

email from SNK gives some details about implementation and testing for (a);

Giving refined coords is still pending; (b) and (c) are still pending.

For (a) refinement of coordinates is still pending; for (b) and (c) updates are still pending.

2.4 Follow-up on UPS RFI -- from 21 Jan & earlier (SSK/PAR/RVS) : UPS units from Ador were found to be the most suitable : 2 nos of 3 kVA was purchased, tested for RFI & cleared; units are in use in C9 and C10. Updated RFI report has comparative statements quantifying the repeatability. Further, 2 nos of 4.5 kVA units were also ordered with Ador, with option of 2 single phase o/p with different isolation transformers (3 + 1.5 kVA); units were delivered but failed the RFI tests -- lots of discrete lines seen; Ador had taken the units back for modifications -- finally, modified version of Ador 4.5 kVA was tested and preliminary results are quite good; report for this has also been circulated. Current pending action item is:

(i) to finalise plans for going with 3 kVA unit from Ador as the final choice : agreed to order 10 nos of these as a starting option; RVS had received budgetary quote; (total cost per antenna may turn out to be around 2.x lakhs); indent had been raised; was waiting for formal quote from vendor; order has been placed;

delivery of 10 nos expected in Jan last week; 5 nos had come; random selection of 1 unit shows 1 dB increase in noise floor level at 150 to 270 MHz; remaining 4 units show 2-4 dB increase in 140 to 240 MHz; check of major changes : MCB make has been changed; panel plate is missing -- direct screen printed units are used; connectors size / type have been changed : need to feedback to electrical team and appropriate action to be taken.

==> tests have been done in the presence of vendor and cause has been identified as an additional switch that was added after the unit was tested. Offending unit has been moved inside for now and shielding fabric has been put that needs to be replaced by a plate and other units have to be tested.

### 2.5 Mobile phone RFI -- from 14 Jan & 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.

update on 10dec14 : BSNL has finally done at Gulanchwadi -- this is now verified that power in 950 has come down and 1800 has gone up in that direction. Letter of appreciation can be sent -- PAR has given draft to YG -- needs to be refined and sent. nature of letter required is changed (!) -- YG and PAR to discuss and resolve the matter.

### 3. Operations :

3.1 Mass production of shielded box for MCM cards -- from 14 Jan & 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; sample box of Rabbit + switch + media converter + Miltech PC combination tested on 4th Dec (report is awaited) : results

match with earlier results. Two minor points to be conveyed to vendor : size of one of the opening and assembly of the side plates, which has been conveyed to mech group (!) All these have been done; now awaiting for feedback about delivery of mass production from the vendor. 70 shielded boxes (for MCM) have been delivered; to check status and plans for follow-up.  
==> to keep them in storage and use as needed; next part is to start procurement of the RFI material and components needed -- list is with Ops Group and indent has to be raised.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 14 Jan 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. Shielded box for layer-2 switch (35 nos) will take ~ 1 month (till end of Jan or so) -- to check status.  
==> still waiting for shipment. similar issue of ordering the components needs to be tackled.

3.3 Interfacing of FE with new M&C system -- from 14 Jan & 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 : report awaited from IER -- document has been circulated; to discuss and decide future course of action.

==> IER has given the test report for the work done so far -- appears to be generally ok; what is the next step to be done?

(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 beend 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.

==>

### 3.4 Development of M&C software -- from 14 Jan & 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 prepared by JPK and then full scale work was to resume. Mock system on rabbit card tested (optical fibre system)  
SJ : making a new module (old : GAB) for fibre optic link; problem with structure of communication [telemetry group to look into this in the long run]; communication established; sending commands tbd : ~ 1 week it may be possible; installation program (TCS) does not exist; script is being written for installing.

==>

(ii) plans for tasks for next phase of work for new M&C software : architecture definition and UI definition tasks are completed; to check current status of next phase of the work : indent and work order being finalised; meanwhile, preparatory activities for testing using the prototype version to be initiated by JPK to check the interface with the existing systems.  
2 meetings held with TCS; 3 phases of work identified : core, business logic, web application; ~ 6 months per phase; cost estimation in progress.

==>

(iii) 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.  
during last MTAC, 3 antennas (C1, C4 & C6), 2-sub-systems tested, using 2 rabbit cards; servo system tested in servo lab and in C1 antenna (all commands tried out). draft report circulated.

==>

(iv) 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...

JPK : online -> local M & C (EPIC -> needs local M&C for broadcasting FE command

==>

3.5 Long-term plans for evolution of M&C systems (from 14 Jan) :

MoM of Sep 2014 meeting discussed and following urgent / immediate action items identified :

(i) For GAB M&C System total 30 rabbit cards are identified but need to discuss with concern department if further additional 8 cards are required for the GAB rack monitoring -- Nayak to confirm.

==> Yes, 8 cards are required for GAB rack monitoring.

(ii) To confirm if Rabbit card interface to MCM 14 via serial link tested & cleared : null command has been tested; CPK working on implementation of the other cmds.

Almost all commands have been coded; could test only 'null' command; reponse (feedback) related work left out for now.

==> null command and response both tested; able to get encoder and rpm reading from FPS system.

(iii) Rabbit card need to support serial link to control FE-CB during developmental phase: this has 2 aspects : Rabbit to MCM via serial and Rabbit to Rabbit via serial. To arrange a discussion (alongwith FE) to resolve the matter.

==> need a discussion to be set-up; SN to coordinate with SSK.

(iv) Verification of compatibility of switching equipment at antenna base and CEB to be compatible with HRS requirements -- CPK and Nayak to ensure the same.

==>

(v) To discuss and finalise optimised packet format for Command/Data response with the Rabbit card -- RU + JPK with YG.

==> discussed briefly, but not clear how to resolve; to try and generate a current status summary.

(vi) To discuss and agree upon a unique set of Rabbit commands per sub-system -- Nayak to coordinate with JPK + ?

==> not clear if this has been started.

(vii) Hardware at antenna base : JPK to circulate a background note for antenna base computer system and then item can be taken up for a larger discussion.

==> not done yet.

4. Back-ends :

4.1 Documenations :

Current action items are as follows :

(i) Detailed design doc -- from 21 Jan & 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; was deferred till end Oct; and then deferred till end of Dec; 2nd version had ~50% chassis level inputs; to be completed by end-Jan'15; work is on track; can check 1 or 2 weeks later.



(ii) ITRs for analog back-end systems and digital systems to be taken up :

(a) analog back-end : Sandeep and Navnath to look into that; pending.

work pending for some time; team to review and pick up the activity.

(iii) to move to a point where formal publications can be done -- this needs to be followed up appropriately within the team and a summary plan brought up for discussion; finally, SHR and BAK have started work on modifying GWB ITR to convert to a paper -- to check if first version of this can be circulated soon; still pending.

SHR has sent to BAK who is making some edits and will circulate within a day or two.

==> one draft has been circulated; needs to be looked at and discussed.

4.2 Analog back-end : LO setting related issues -- from 14 Jan & 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 -- done. Pending action item :

Problematic 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 -- agreed to start planning for permanent arrangement for 50 MHz (can also check 10 MHz to see if the problem can be solved).

50 MHz has been tried for 1st LO but it appears that problem is seen there also.

To go back to the vendor on the matter; to explore other possible options?

==> new test done which shows that only when 105 MHz is used as reference, there appears to be a problem -- evidence has been sent to vendor. Meanwhile, problem of loss of correlation at 10 MHz reference remains to be fully debugged -- will be trying that. meanwhile, GWB can be used with 50 MHz as the reference frequency (right now both GWB-II and GWB-III running from same sig gen)

4.3 Analog back-end : completion of 30 antenna system -- from 14 Jan & 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; 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) --- shielded box finalized; 12 nos ordered in work shop. To check if any immediate action remains pending.

==> components required have been ordered; first box will be tested and then order for rest will be cleared; can check after 4 or 6 weeks.

(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. Tests are now done regularly; need a way to share the summary of the results for taking appropriate follow-up action.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 21 Jan & 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) 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) beam mode working with fixed channel and time factors : SSK had got the code changes done for making it general purpose -- going up to any number of channels for corr + beamformer + DAS -- SSK has tested upto 16K channels; 32K may require some extra coding; agreed to first release GWB-II code with 16k channels for users, alongwith modification to SOP; second, work ongoing for coding 32k (and 64k) in GWB-II code for testing; final version will be released in GWB-III; modification in GUI for multiple time integration & channel selection added & tested. no further updates -- to clarify about updates in GWB-II and between 32k and 64k plans, and close the matter.

(b) header for beam mode data : to be taken up and incorporated alongwith the PA mode; SSK has done first round, and needs a discussion.

Discussion between YG and SSK is pending; meanwhile version with header to be released alongwith 16k channel code release on GWB-II.

(c) availability of psr\_mon / pmon on nodes 53 and 54 for recorded data is there; for shm attach needs some work; psr\_mon done but only for off-line upto 16k chans; no real-time version available; pmon still needs to be looked at...

Agreed to confirm off-line psr\_mon available on nodes 53 and 54; to try and provide online psr\_mon with 16k channel release; later, to integrate Rajora's new code into the system : first with GSB, then with GWB-II and III. To check status of ongoing discussion on this, including incorporating of Rajora's new code.

(ii) 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.

(iii) change of host machines to 1U HP machines for GWB-II : work is ongoing by SHR, including OS, disks and location in the rack; may be able to complete in one month time scale (from 3rd week of Nov); work ongoing, SHR needs to coordinate with Nilesh. machines are ready; GUI needs a version which has new IPs and maybe some paths; in order to switch between old and new hosts, infiniband cables need to be swapped at the 8-port switch.  
==> no updates.

4.5 RFI filtering -- from 14 Jan and before (KDB/BAK/YG) : first version of real-time RFI filtering block (after some modifications) was added to 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 were done and found ok; trials with real antenna signal split into 2 copies and checking both self and cross outputs proved somewhat harder; further, design (with some optimisation of FPGA resources) was ported to GWB-II; agreed for time domain tests using either corr self powers or 2 IA beam signals; some tests with varying sigma were tried on antenna signals (results?); data taken with pulsed noise source [offline input]; new results were circulated and discussed; agreed that the basic scheme appears to be working ok; to try 3 versions of the scheme, with different options for the statistics. Meanwhile, design compilation for 4, 6, 8 bit inputs available; utilisation (for one analog channel) : 41%, 19% and 17% (for total design) for 4 K window; tests were done to see if there is some biasing by digitally splitting the antenna signal -- confirmed ok (mean level changes for lower thld it happens for replacement with zero or replacement with noise but not for clipping); second part is testing with two different methods of generating thld statistics :

shown that a priori stats works better for rejecting RFI infected data. Some action items are as follows :

(i) Agreed to support 3 modes : continuous update; update on request; external update; 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.

3 modes demonstrated as working; work for fitting 2 channels on 1 Roach board still ongoing -- to try for the 3 modes separately; also, to concentrate on long-term solution of 2 RFI channels on Roach board with 2 analog inputs at 800 MHz; pulsed noise generator (PNG) ckt with additive noise source shown to be working -- can now be used for demonstrating RFI cancellation on visibility data.

==> optimised design works at 800 MHz, for 2 out of 4 analog channels on a Roach board with compensating delay for other 2 channels, with 8K window which can be changed in run-time by changing register values (can be used on GWB-II or III).

(ii) To work out proper scheme for testing

==> KDB has circulated a proposed scheme -- to look at and respond if ok or not.

(iii) To optimise the design for fitting on the Roach board -- short-term and long-term goals.

==> see (i) above.

(iv) book-keeping : trying to work out the packing scheme, with the understanding that jumbo packet size is taking up. ....

4.6 Power and cooling requirements for projected back-end systems -- from 14 Jan 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; discussion between SSK and GSJ to try once more with kernel change only one node and examine the log file carefully and report back.

GSB data old & new kernels taken; 17-43 nodes completely new kernel gives heavy buffer loss; (old kernel have very small buffer loss ; old does not support temp monitoring).

==> more tests have been done and it appears that GSB is rather sensitive to the exact choice of kernel.

(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 is working ok; cycle for 7 days for preserving the data. To see how this can be evolved.

Right now running on 1 compute m/cs and 1 host m/c of GWB-III (waiting to install on other m/cs); refining the scheme for cross-mounting of disks; auto-restart and halt scripts; cgi script for plotting on monitor can be made more intelligent.

H1 & cor5 cor5 packages installed; auto-restart completed; cross-mounting of disks : to use old scheme.

==> installed on 2 more and ongoing; for cross-mounting : not using autofs, but using old scheme of cross-mounting via /etc/fstab; auto-restart is done (every 30 secs).

4.7 Next-gen time & frequency standards -- from 14 Jan & 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".

First discussion has happened between NDS, BAK and YG -- need a follow-up.

=====

## Minutes of Plan meeting of 4 Feb 2015

### 1. FE & OF related :

#### 1.1 Detailed design doc / ITR -- pending for long : from 21 Jan & before (SSK/BAK) :

(i) OF Rx system to be completed (Satish Lokhande) : first version circulated -- some improvements and additions suggested (e.g. to give explicit reference to other docs which have supporting details; to give reason for 10 dB attn; to give comparison with expected values from SFA report; to mention some precautions and practical issues during assembly etc). Update version was sent by SSK last week -- to be discussed.

(ii) OF Tx started (may have only blk diags for now, without full details, till a paper is ready!); initial write-up (by Satish) needed improvement; functional blk diagram has been made and detailed description needed to be added; 1st draft has been sent; updates version has been sent by SSK -- to be discussed.

==> discussion on ORx and OTx documents : blk diag of OTx -- couple of small changes suggested (APC controller to bias control), also add one more blk diag at beginning giving the context of the OTx system in the overall antenna base set-up; ORx is much simpler and brief and needs a bit more of material + some elaboration of precautions section; SSK to produce an updated version (for both docs) and circulate.

2-3 other reports are in the pipeline : for OF power and RF power monitoring schemes; characterising and test set-up of OF system.

#### 1.2 Update on results from test range -- pending from 21 Jan & before (HRB/GSS/SSK) : Reorganised into the following issues :

(i) Tests of ver1 550-900 CDF and CSIRO feeds at test range : new results with VVM set-up, after installation of new encoder + notch filter for mobile band, showed : for ver2 550-900 CDF : reasonable E-H match at 610 and then degradation in shape and matching at 700 & 800; partially supported by older measurements from Dec 2013 (with slightly different set-up). Further, results for dipole v2a and v2b with cone v2 show that the degradation of pattern with frequency is worse for v2a than with v2b; radiation pattern measurements have been done with 50 MHz step & using CW signal; comparison with simulation results is awaited. Current results and action items are :

(a) ver 2b of 550-900 system has been measured on test range; first order comparison of C1 dipole 2B vs C2 dipole 2B -- some differences can be seen : C1 dipole 2B shows better E-H match at 610 ; C2 dipole 2B shows good E-H match at 700; and appears to be decent even at 800, though 3 dB width may be changing; agreed to make plots vs freq for 3 dB and 9-11 dB widths, and for taper of E and H at fixed dish angle of 62.5 to check mismatch in taper -- for both the feed versions.

Some results from the measurements for the plots of 3 dB and taper values vs freq shown -- there is evidence for change of properties with freq as well as asymmetry of the pattern (as had been seen in the earlier plots also); agreed to try to compare with results from C1 + d2b (make fresh measurements, if needed);

(b) Phase centre of ver1 550-900 CDF and CSIRO feeds needs to be done -- phase centre measurements for C2 + d2b can be tried at the range.

==> radiation pattern tests redone for C2 + d2b combination to check repeatability; to discuss and come out with the conclusions.

(ii) calculation (based on reference paper) of expected deflection & comparison with

measurements to check if there is significant loss of sensitivity -- GSS developing refined version more relevant for GMRT (also, if further expts with 250-500 or 500-1000 feed are useful) : cross check of results from code (0.3 dB drop for 0.5 lambda offset) wrt curves from Kildal paper was confirmed; for GMRT specific case of 250-500, efficiency factor as a function of freq over the band, using the data for the measured feed pattern, was implemented; after correcting one error in the code, better result (9.9 dB vs 11.6 dB expected) was achieved; further, a realistic phase response (instead of 1.0) was included by reading data from a file; results (reported on 19th Mar) showed better match between measured and expected deflections for the 250-500 system : 327 -- 12.8 dB vs 12.4 dB; 400 -- 12.8 dB vs 12.2 dB; 450 -- 12.4 dB vs 11.4 dB; 500 -- 11.2 dB vs 11.0 dB (some re-work needed for lower frequencies?); computed results (based on change in efficiency due to shift of phase centre) show likely drop in sensitivity by about 1.4 dB from 250 to 500 -- this is now to be folded into the net sensitivity / deflection curves made by GP (see agenda item following this one). Present action items :

(a) GSS is working on plans to extend this to 550-900 system -- was waiting to get measured values from test range.

==> waiting for firm test results.

(iii) Comparison of computed results with measurements for 250-500 band : initial results for good antennas at 250-500 (other than C6) with default height of 1280 (and for C6 with reduced height of 1080) showed that computed values are actually better at high freq end for 1080, which is different from the observations which are showing droop at high freq for 1080 (in conflict with first results reported above); computed results, which were for 1180 to 1480 in 4 steps, were extended to 1080 & 980 and 1180 was found to give the best response (note : this is for a particular value of ph centre based on range measurements); computations were extended to much smaller values (down to 580 mm) and latest results show a peak in the response around 580 o 780 (!), which are in sharp contrast to the experimental results which were carried out in the range 1080 to 1480 mm and showed optimum performance around 1280 mm -- this needs closer scrutiny of the simulation code and experimental results.

==> no updates on this for now.

(iv) Phase efficiency computation has to be linked to the aperture efficiency computation (NRAO's eff. program, modified for GMRT specific paramters) -- this work is ongoing, alongwith Sougata (was expected to take 4 weeks -- till mid-Sep); code is being ported to matlab (?); some issues about input file with the values to be given -- this also needs to be resolved; also, original NRAO fortran program can be made to run to give some initial cross-checks? code had been ported from the C version that student had written to Matlab but results are not yet matching with expected behaviour and debugging is going on.

Now trying to port original fortran version to matlab; meanwhile, YG to try with somebody at NRAO to check current status after getting the info from GSS (?) One email has been sent by Sougata with some updates on pattern calculations -- need to discuss next time, and understand its relevance.

FORTTRAN to MatLab conversion : ~ 50% completed; was to be fully done by end-Jan / early-Feb -- need status update on this.

==> no updates on this today.

1.x Update on 550-900 feed work :

plots of beamwidth vs frequency obtained from Manisha's program : shows ele and az beamwidths varying with freq, but with some difference in slope and also absolute values are higher than expected (x2 for Ele and x4 for Az); these issues need to be sorted out and a more detailed comparison can be done.

1.3 Comparison of measured & expected sensitivity curves -- from 21 Jan (SSK/GP/HRB): scheme for (re)calculation of expected values across the broad bands to be finalised (and added to measured curves) : curves being done with constant QH value and with variation of T\_Ina with freq incorporated; model for the main BPF was also put in; after that antenna efficiency factor (based on measurements with 4-5 points across the band) was added by interpolating the measured values; return loss of the feed was added to the above and the result now matches much better with the data -- all this was done for 250-500 band; some follow-up action :

(i) Antenna efficiency factor : to determine what is the best thing to use and stick to that; are there cases where the theoretical curve gives less deflection than measurements? agreed that both the efficiency term (which includes default ap eff + phase eff, from measurements on test range) and the return loss term should be kept and the product should be used. No actionable item here?  
==> to get clear confirmation about which all terms are included in the efficiency term that is currently being used in the calculations.

(ii) It appears that there may be some discrepancy on the high freq side (seen only for a couple of antennas out of 10?) -- could be due to absence / presence of 540 notch filter ? For the units already installed, there are small (~ 5 to 10 MHz) unit to unit variations in the filter response; for new systems all the the 540 notch filters will be tuned to match an overall BPF + notch filter template response. Agreed that Ankur to check both LF & HF side as part of the work looking at antenna to antenna varn in 250-500 system response and report bakc together with that.  
==> HF discrepancy resolved as being due to notch filter; LF discrepancy was mostly resolved after RL was included in calculations; item can now be closed.

Extra : discussion about results from regular monitoring of 250-500 system and conclusions from that : misbehaving antennas are clearly seen : some with low deflection (e.g. C13), some with dips in the performance e.g. E6, some with a bit of ripple in the band -- team understands these issues and is beginning to take up follow-up action items; attenuation setting problem also being solved one by one in offending antenns... Can be added to agenda item in next week..

(iii) possibility to try it for Lband to be explored -- information gathering had been started : feed pattern (efficiency) at 3 individual freqs is available, and measurements are now available for 5-6 frequencies (?); agreed to work with the 3 pt data and do simple interpolation and see what kind of curve is produced; first order calculation of model had been done -- Sanjit + Gaurav had worked to put the curve for expected deflection alongwith the measurement results to do the comparison, and now weekly plots are having this added. Current action items :

- (a) 1 or 2 antennas with response better than theoretical esp at lower edge of Lband -- need to be checked;
- (b) fall-off of theoretical curve at edges needs to be investigated
- (c) RL of feed is to be included.

==> no updates on this; to wait till RL is included; to add notch filter alongwith BPF.

1.4 Phase centre tests for 250-500 CDF -- from 21 Jan and before (HRB/GSS): to test with 100 to 200 mm height change (around default of 1280 mmm) in 250-500 feed on one antenna to see how much change in sensitivity is seen. Tests done on c6 using feed with shortened support legs of the cone (instead of shortened stool) -- comparison of results for 1180, 1280 (default) and 1380 : 1280 & 1380 show slightly better



sensitivity at low freq (250-400) but at higher frequencies they match with 1180 (which is quite flat throughout freq range); agreed to try for 1480 to see if there is a monotonic behaviour; also compare with simulation results of GSS. Consolidated results tend to show that the latest level at 1180 height does show a slightly better response; a final confirmation is needed about the optimum performance from the measurements; confirmed that we can't go below 1080 by further cutting the support legs of the cone; also, current adjustable stool will not work for 325 MHz face due to welded nature of existing stool; agreed with HSK to reproduce one more adjustable stool with modifications learnt from present experience, and try on one CSQ antenna (C6?) by removing the Lband feed, shifting the cone-dipole with new stool to this face and using the existing 250-500 FE box on it; tried on C6 during MTAC period (Oct 2014), but measurements could not be completed as antenna was required for L-band GTAC observations. Current action items :

(i) Agreed to go back to C8 at a later point of time (after 550-900 measurements are completed).

(ii) Meanwhile, FE team to go over all the available measurements and produce a consolidated summary.

==> no work done on this as waiting for 550-900 work to be completed.

1.5 Total power detector for FE & common boxes -- from 21 Jan & earlier (GP/ANR/SSK):

follow-up on plans for final scheme : 20 dB coupler for CB and 10 dB coupler for FE (at final output) with common 20 dB amplifier (Galli-52 instead of Sirenza); feed-thru vs connectorised arrangement also resolved; after lab tests (including monitoring via MCM channel) in FE and common box, sample units installed in C4 FE box and E2 common box. Some other details are as follows :

For common box : data from 2 units installed on E2 showed basic things working ok: first round of testing showed 11 dB deflection (12.4 dB expected) on Cass-A; later on Crab, getting 5.5 to 6 dB (6.6 dB expected); flat-top on-source waveform to be understood -- likely to be due to quantisation of step size of detector levels (to check rms vs least count?); script / SOP created for automated running of tests;

For FE version : 2 units had been assembled and found to give identical performance as per specs; problem of feed-thru vs connector was resolved in favour of feed-thru (as per original chassis design); all testing completed in the lab; first units (on C4) showed problems -- traced to incorrect mapping of channels etc.; new units (batch of 20) that were assembled showed unexpected change in detector o/p due to grounding problem which was corrected (manually) for 10 units and final PCB for mass production was modified for this change; automated script for running the observations has been done and released by GP.

Current action items being followed :

(i) for RC time constant : main aim is to check and ensure that some appropriate RC integration is in place at o/p of the detector; some feedback from vendor, but not fully satisfactory; existing ckt has 10k series resistor (as per data sheet); measurements done in the lab show some kind of a curve with rms changing inversely with increasing time constant, but the results are not repeatable from day to day, indicating some pick-up in the circuit or the measurement tool; needs to be checked carefully. Current status : agreed to put 1 s time constant in all the PCBs -- this requires very large capacitor; few microfarad may be more practical, pushing the time constant to ~ msec; agreed that 100 micro-Farad maybe the largest practical value, giving 100 ms time constant; assembled one board with 100 microfarad -- no observable change in performance seen; need to go to antenna & test : fitted in new 250-500 box -- may end up on C11. To check current status of this.

==> box is up on the antenna and test results will come soon.

(ii) analysis of test data and results/conclusions : 9 antennas with FE power monitor installed; test data recorded for 8 antennas; out of these, signals seen for only 3 antennas : C13, C11 & S4 (both pols); some sign of life in E6 and something on W4 (very noisy / weak); deflection on Cass-A is about 10-11 dB (bit less than expected); flat nature of curves understood as least count limitation; simultaneously CB signal is being recorded, but working CB monitor is only on C13, E2 & W4 + W1 -- all of these are showing deflection; some sign of "memory" in holding a stale value in FE monitor (all antennas at same time!) -- confirmed with Ops group to be due to combination of cycling of FE monitoring (being turned off when at a source transition) + the fact that cold sky off source is quite far away from the source (!); further, two sets of new data had been taken (3 and 6 hrs long); analysis of these to help answer some of the problems of repeatability of working antennas, as well as status of partially working antennas (as seen in first data set) and correlation with 30-1 data (which is TBD even for first data set); at least 3 sets of data are now available for detailed comparison; first order impression is that new 2 data sets are consistent with 1st data set (tbc). To try and make a comparison for each antenna (both FE and CB) for different epochs to check for consistency and accuracy of results; compare different antennas for the same epoch only when trying to point out effect of external agencies like RFI etc vs malfunctioning of the detector units. To check status of this work.

Distilled action items for GP : to take 3-4 antennas in each of FE and CB (with one common antenna C13) and analyse 4-5 good epochs for the following :

- (a) repeatability of deflection and to check that it matches with expected values -- this has been done and appears to be ok.
- (b) consistency between FE and CB : checked for C13 and found ok.
- (c) checking spurious behaviour -- RFI or something else : data log of 30:1 output checked -- power detector changes when RFI is present;

Many of these points have been addressed with the existing data and the same can now be summarised in the ITR -- draft version for internal discussion / comments was in internal circulation; to check if it has been released and can be discussed.

==> Updated report has been circulated and matter can be closed.

(iii) All these data sets also have temperature monitoring (for all of these antennas, as well as for a few others of 130-260 etc). Plotting and first look has been done; consistency across antennas (and FE/CB) appears to be there -- need to complete a formal analysis of the same; agreed that temperature data (for 250-500 FE and CB) to be given to VBB for plotting; fresh data to be taken for 130-260 FE box. first results for ~ 5-6 antennas (LNA + FE box) + 2 antennas (CB) for 3 hr duration shows some basic behaviour but not clear how well things are working; to try 2 things : (a) to check if any old data of longer duration (from last 2-3 months) is available (b) to try a longer run, even for one antenna like W4 which is under maintenance -- this is planned.

New data from recent tests has been provided to VBB -- to check status of this.

==> Plots have been made by GP and to be given to VBB for interpretation and results can be discussed next week.

(iv) possibilities for automating data reading, analysis and plotting also discussed -- GP has now implemented automated program for plotting CB, FE power levels (both chans) and 3 temp monitor values (2 in FE and 1 in CB) in one go from a file containing data for X nos of antennas is ready; this has been tested with the above data sets; agreed that it is generic but not tested for anything other than temp and pwr; can be generalised for all channels of all 30 antennas but can be taken up at

lower priority; also, does not have a user friendly interface; current actions :

(a) agreed that working version of code + SOP to be fully released asap : SOP has been released; GP working on note about analysis procedure (using matlab).

(b) SSK to take up discussion with SN about GUI development with suitable person from control room : initial discussion with SN has happened, but not clear if optimal person has been identified -- YG to take up the discussion jointly with SSK & SN.

==> 3-way discussion to take places.

(v) plans for mass production : full quantity of PCBs (360 for FE and 60 for CB) are in hand; agreed that new units can be made ready to match the typical / expected consumption rate of going into boxes; in between, assembly of 5 sample new units gave some problems : old vs new flux (resolved); latest status is as follows :

for FE : 12 units (PCB + chassis), for 6 antennas, are assembled, tested & ready;

for CB : 12 nos of PCBs (for 6 antennas) assembled & tested; will use out of the 20 chassis remaining; chassis will be ordered in units of 50 nos, when needed.

(a) to check current status of assembly of FE units (including chassis)

(b) to check current status of assembly of CB units (including chassis).

==> new set of chassis have come; item seems to be going smoothly and can be put on low priority list.

1.6 Spare LNAs for L-band feeds -- from 21 Jan & before (SSK/ANR) : we had 32 feeds; 2 were not working (1 has been dismantled for making drawings of new feed) due to lack of electronics spares -- mostly device failures (including some new ones?); some new LNAs were successfully assembled by Gopi and failed feeds for C3,W1,E2 & E5 were fitted with these and found working ok. Also, one spare feed was assembled and installed on W1 and working fine. Current action items :

(i) to update about status of feed on W1 and other recently installed units :

finally, after a lot of follow-up, it was confirmed from PMQC data that W1 appears to be working ok for past few months. 2 other recent units are on C1 + one more antenna : C1 has units with new LNAs, for both pols made ready from older batch of devices with careful retuning; action items :

(a) confirm which is the second antenna -- still no clarity !!

(b) confirm status of performance of these antennas (C1 had been giving ripple and bad bandshape problem) -- problem found to be due to broken cable; fix requires cable re-laying alongwith mechanical clamps : to check status of this.

==> records are not good enough to determine (a) -- maybe C3.

C1 ripple problem is fixed and new results about sensitivity are awaited.

(ii) making spare LNAs -- agreed to have at least 5 LNAs ready & available as spares : 10 nos of LNAs had been assembled, tuned and made ready; these have all been used up now; new batch of devices ordered and delivered. Action items :

(a) the assembled devices may be having some possible problem with bias point -- it was found that LNA is drawing unusually lower supply current, even when 'gain' & 'T\_noise' are normal; not much progress in understanding low deflection of new LNAs; retuning is not helping -- increasing the bias current leads to oscillation (to check OMT etc for any problems?). Devices from new batch appeared to give a stable solution(?) -- however, not all devices in new batch are the desired ones -- there is a mix and it may be only about 1/3 that are usable? Finally, one unit fully assembled (all 3 stages) and working ok; 2nd unit also assembled -- these 2 used for 2 channels of feed #32 (note that this is now the 1st spare feed after 30 working feeds!). 2 more LNAs (3rd and 4th) assembled and tuned; work on 5th & 6th is ongoing. To check current status of number of spares available. Status from 31 dec 14 :  
x1 feed completely wired & tested;

x2 with filter-banks (minus LNA) : filter-banks have some design issue related to component availability; by end-Jan'15, x3 will be ready.

Current status :

Count of working LNAs is same as in Dec 2014 -- Ramesh will be looking into it now.

Summary is that : one fully working spare feed is there; next one has LNAs, but no working filters; 3rd one has neither LNAs nor filters.

==> no progress to report on this for now.

(iii) alternate LNA designs : to see if design used for 550-900 can be modified for 1-2 GHz use; to also check the design done by Abhay Kulkarni and see if it can be improved for our needs; design files had been obtained and were being checked by GP and ANR : model files converted to match simulator used by us; component models in software had to be downloaded; also ultralam2000 that was used is not available in the market now; agreed to simulate with ultalam2000 first to check ckt works ok; then concentrate only upto 2 GHz and change substrate to RT 5870 (easily available); simulations matching with original results completed; results reproduced with RT 5870; current action items :

(a) trying to tune the design to required specs of gain (30 vs 34), Tlna (~28 or better); in terms of NF target is to go from 0.4 to 0.3, and maybe at cost of reduced BW; current status : getting close to Tlna of 28-30 across the band; overall gain is also very good ~ 38 dB; but 4 db slope across the band needs to be adjusted; move from s2p to non-linear model completed successfully -- did not disturb the situation. Work still ongoing to try to flatten 4 dB slope.

(b) meanwhile going ahead with layout & ordering of PCB and making couple of units, while continuing to improve the design. The design & layout completed; first proto PCB should have been sent for fabrication in last week of Jan.

==> PCB has gone and may come by next week.

(iv) possibilities for new LNA with Tantrayukt (Yogesh Karandikar) : item to be taken up for discussion, following the visit of YK in Dec 2014.

==> to check if YK has got results from his first prototype for 500 to 1500 and then take the matter forward.

1.7 Completion of spare L-band feeds -- from 21 Jan & before (SSK/ANR) : Target to have a total of at least 5 (out of 8) working spare feeds -- from mechanical to electronics : 30 antennas had working Lband feeds, but there were no spares, though we had 2 feeds; one unit was assembled back from the feed that was dismantled for making the drawings -- this was completed and installed on W1 (one feed is now in the regular 'maintenance cycling' of feeds); 32nd unit was there in Pune wshop and was shifted back after assembling by mech group and then fitted with the electronics; it uses newly fabricated push-type (press-fit) probes; after 2 LNAs were made ready (see above) this feed is now available as the 2nd spare feed. Furthermore, 6 new feeds were made (via outsourcing) in 2 batches of 3 nos; in the first set of 3, 2 nos had wrong size of horn and had to be corrected by the vendor; all 3 needed new covers as old ones were not suitable; second set of 3 feeds from Akvira : OMT + horn + cover; hence, total of 8 spares CAN become available; note that weight of 3 latest feeds is 18 kg more (72 vs 61 kg) than earlier feeds -- now accepted as 'fait accompli' !

Following issues need to be resolved currently :

(i) having sufficient number of spare LNAs : see item above for details; LNAs for 3rd spare feed now ready, waiting for filterbank to be ready.

==> no change in status of LNA and filter work.

(ii) other electronics : sub-band filter bank is the main item missing; it was found that the sub-band filter ckts spares don't work as one gnd line (for switch ckt) is missing in the films from RRI (!) -- to try with a wire providing the gnding ckt; alternate is to start using the new design -- this shows good performance for individual filters, but integrated unit is giving poor performance for selection of 1280 -- problem with the switch (new make is not giving same performance as original make) and this is affecting both reuse of old filter PCBs and also the new design; looking for original make (MACOM) and also trying a different switch (Hitite, which means new PCB); new PCB designed with Hitite switch (will need additional patch PCB to convert logic levels; one chassis (for 2 pols) is available for testing; new design still not working for 1280. After isolating the filter from the switch, response was found to be fine; found some issue about the layout on the PCB for the Hitite case and PCB is being redone and waiting for vendor to send back.  
==> PCB is still awaited.

(iii) plans for assembling and making completing additional new feeds : all the 6 new feeds after corections, completion of covers, powder coating etc had been sent to GMRT; new issue about mating and alignment of probe had cropped up -- press fit (old schme) vs threading (new scheme) : the latter was made "workable" after one round of adjustments; at present, 1st of these 6 (33rd feed) is fully ready and waiting for LNAs and filterbank, as above); 2 more feeds are mechanically ready (one has push-pull and other has threaded probes) and getting wired; LNA and filterbank are not available for these. Work is ongoing, last step is the plates to be made for these. May not work on the last 3 feeds for present.  
==> probes and plates for mounting of electronics are done, but plates may need some case to case modifications when assembling.

1.8 Testing of LBand wideband systems on 30 antennas -- from 21 Jan (PAR/SSK/SN) : (to maintain a proper log of action taken on individual antennas during these tests and debugging activities); data being taken fairly regularly since June; some history is as follows :

June data : C08 & W01 CH-2??shows ripples at OF RX output -- gone now (to check possible cause); Sep data showed problem with W4 ch2 -- fixed;  
RFI issues : S04 & E02 showed RFI type lines, E06 showed RFI lines in CH1 (June data); line RFI in 1070-80 range (likely to be airport radar), around 1280 (likely to be due to GPS) -- July data; lines at 1030 and 1090 (3 MHz BW) also seen (Aug data); also, is there a RFI line at ~ 1200 (3 Sep data)? -- need to confirm status of all these lines (can be covered under RFI agenda). From Sep data : 1176.0 and 1176.45, 1191.80 and 1204.70 are likely to GPS (in addition to 1280) and 1090 is airport radar; there appear to be a few unknown ones also (e.g. 1320, 1480 etc) -- check with RFI team separately by including in that agenda item.

Current action items are as follows :

(i) some antennas with poor deflection overall : to be addressed as and when such cases are found. e.g. Ch2 of C1 (may be a cable problem?) -- confirmed that it is cable problem; to check current status of the work to fix the problem.

(ii) some antennas with deflection changing over the band (less at high frequencies): checked if pointing offset can explain this -- not found relevant; current thinking is that this happens for cases where the RF power level (at laser input) is too low; this has been confirmed with a more careful set of tests (and plots) for few selected antennas, including make good ones look bad by increasing OF attenuation -- has been demonstrated in the report of 11th Nov data; to check if appropriate reasons for low power levels can be identified.

(iii) some antennas with poor on/off bandshapes, including large slope e.g. W1 (has been there for several months); C4 and W6 also; S4 has very low power; such cases need to be checked (call sheeted) and understood.

(iv) few antennas with ripple or large slope across the band -- to be followed up as and when seen.

(v) there is data from Oct, Nov and now Dec -- can we have a well-defined algorithm for comparison of different data sets and getting statistical conclusions? -- to look at developing a tool for this.

Latest report (10th Jan) has a good classification of the problem antennas; team is looking one by one into the problems e.g. W5 found bad cable between feed to CB of ch1; now looking at W6... to check current status.

==> not discussed in detail, but similar approach as for 250-500 being followed.

1.9 Characterisation of recommended attenuator settings for different bands -- from 21 Jan and before (SSK/AP) :

(i) values had been given for Lband, 250-500, existing 610; only 130-260 / existing 150 was pending -- this was also completed (appears that 6,6 may be the best value); note to be circulated soon (Sanjeet + Ankur); then can be taken up for detailed discussion and closure.

Meanwhile, new problem detected where it appears that attenuation setting may not be working reliably -- need to be investigated in detail .

==> attenuation problem is understood and being fixed; note can be taken up shortly.

(ii) FE team to test the power levels at OF o/p and cross-check against SFA values : for 250-500, this has been done and results incorporated in the updated SFA report; for Lband the exercise is ongoing; antenna to antenna variation is still an issue for Lband; can be done now, as Lband is relatively stable now; was done by Ankur in a report back in July 2014 -- discussed and suggested to add a few refinements of the statements used (for 250-500) and add an explicit entry in the table; for L-band to compare for each sub-band using the realistic cable loss value for each sub-band -- this can then be done for 250-500 also, if found significant. Updated version of report to be produced with these modifications; first part (for changes related to 250-500) has been done; waiting for measurements at Lband to be completed; some work has been done by Ankur, some work has been done by Imran to characterise and FE SFA report also has measurements of cable loss; calculations have been done; need to cross-check with measurements; updated report in internal circulation; to check if it can be released for discussion.

==> report to be finalised.

1.10 Switched filters at different stages of receiver -- from 21 Jan & before (SSK) :

2 main categories of switched filters are needed : (a) switched filter banks inside FE boxes and (b) switched filter banks in rx room; these are being designed using the new switches : 2, 4, 8 way switches with different possible configurations; (c) a 3rd application of these switches is for designing the monitoring set-up in rx room. Current action items are as follows :

(i) for rx room monitoring work : note that all these circuits are connected to the monitor ports of the OF system; first design required higher isolation for highest freq of operation and hence new design was done; ckt for 2:1 and 4:1 versions now

ready & tested -- 25 dB isolation achieved; drops from 25 to 17 dB with frequency for 8:1 switch -- now getting improved rejection : better than 25 dB below 1 GHz; goes down to 16 dB above 1 GHz; the leakage between the signals with this switch is still unacceptable; now trying another switch (MACOM make) which terminates unused inputs while selecting the desired input (will be used in the final 30:1 monitoring system), and gives 40 dB isolation; new switch + modified design with additional isolation switch and power supply isolation -- now achieving 35 dB at Lband and more than 50-55 dB at lower frequencies, with all channels powered; will be tested in monitoring system for 16 antenna set-up. To do an additional test with signal injected at Tx i/p; also to summarise the design in a note.

==> 4 units wired for 16 antenna system that is getting assembled; additional test will be done shortly.

(ii) for rx room switched filterbank : prototype system was almost ready for testing; need updated block diagram of the prototype system; to see if first results from integrated testing are available; also, need to check about space in rx room for housing these units; also check plans for installation and testing of the 1650 MHz LPF units alongwith the above; tests have been completed; a report needs to be produced characterising the performance -- work ongoing for compilation of report; report in internal circulation; to check if it can be released now.

==> still internal circulation.

1.11 Follow-up on 550-900 MHz band filters -- from 21 Jan & before (ANR/SSK) : Comparison of product obtained from ICON with in-house effort and finalisation of plans : technical comparison of individual filter responses showed in-house design to be slightly better; tests with integrated unit using new PCB showed insertion loss increases to 3 dB now and some change in slope on higher side; complete chassis and full integration done and tests repeated to make detailed comparison with ICON results -- showed performance is very similar except for some out of band bumps (at 30 dB level) and slightly slower roll-off ; tried with AC coupling capacitors (no improvement); new board fabricated which after retuning gave much better roll-off; meanwhile, some realistic cost estimates for in-house production vs getting things done by ICON were made, and it was concluded that ICON option will be much more expensive; sample PCBs from Argus and Shogini had been obtained -- first test results (without chassis) showed ~ 5 MHz shift in 2 sub-bands but better roll-off; final plots showed same IL but the higher sub-bands having slightly shifted centre and widths which cross the main BPF upper cut-off; the filter design was retuned and modified PCB was obtained from Shogini and tested ok and one complete system with chassis (for one poln) was made ready and it was agreed to defer further work till ready for integration in new FE box; meanwhile, cost estimates for mass production were also made : 32000 for 2 PCBs is the dominant cost; total is about Rs 41,000 per antenna (compared to Rs 90,000 by ICON); hence, agreed to go ahead with building our own design; meanwhile, reduced wt chassis (700 g less) had been made (2 nos) by w/shop and integrated filter unit was made and tested ok; for mass production : PCB material is in hand; switches needed are in hand; so may not be a major problem for going ahead; now waiting till layout of 550-900 FE box is finalised.

Agreed to go ahead with PCB and chassis, while waiting for layout to be finalised. Layout is now final; x1 proto is ready; to go for mass production in units of 20 nos (10 antennas). Check status of this work.

==> problem with Shogini for mass production -- to be discussed later today.

1.12 Finalisation of 550-900 FE box -- from 21 Jan (ANR/SSK) : to produce a block diagram for the 550-900 FE box; then to start seeing which units are ready, which need to be done; which may need to be combined into single units etc; roughly same

number of components as 250-500 box, slight difference in the arrangement of notch filters; size of sub-band filter chassis will be different; will take up the layout of this after common box layout is completed. Agreed to start with this, even as common box is going on in parallel; to check status.

==> Imran + one looking at it, with Bhalerao's help.

1.13 New filters for Lband -- from 21 Jan & before (ANR/SSK) : Sample Lband full-band BPF had been designed -- has no slope with freq and better insertion loss, and maybe a better option than the existing main BPF; similarly, prototype design of new sub-band filters (with better insertion loss) has also been done. Detailed results for the main BPF shows that the BW is slightly less than existing BPF : 500 MHz (965 to 1465 MHz), instead of 590 MHz (890 to 1500 MHz) -- this gives better rejection to mobile band signals, but has implications for final usable BW of L-band system; furthermore, an improved notch filter has been designed for the 850-950 mobile band (-60 dB vs -45 dB at 900 MHz), alongwith a LPF for cutting off the 1800 mobile band has been designed -- 3 dB cut-off freq of 1650 MHz. The matter was presented to the users in Friday meeting on 9th May, and it was agreed to generate a note about this proposal, for clearance in the GSG. This was done and matter was discussed in GSG of 13 Nov and it was cleared to proceed on the following: new BPF + mobile notch filter to replace existing filters in FE box; LPF to be put in common path at antenna base as a common facility for all bands; to be taken up as a case-by-case replacement job, whenever a unit comes down for maintenance work. current action items :

(i) status of mass production : 10 units of 1650 LPF have been fabricated out of 40 PCBs available; PCBs (stripline) does not need much work for assembly -- can be given for manufacture; new chassis will be needed; PCB order for 70 nos can be sent using existing eps10 board; both pols can be combined in one chassis requiring 35 nos only -- drawing to be finalised for rail-type chassis; to check if existing chassis can be re-used; PCB + chassis for new BPF ready for 40 nos (30 antennas + 10 spares); for the new notch filter, 60 nos had been made (PCB + chassis) of which 30 have been used in existing system (waiting to order more)...

(a) to confirm the present status from Ankur's spreadsheet; status was supposed to be confirmed by email, but that has not happened.

(b) new complication is that mounting plate has to be made for putting the new units in existing systems;

(c) agreed to put 10 units of 1650 LPF in one channel of 10 antennas which have 250-500 broadband system installed.

Waiting for confirmation of status via spreadsheet; mounting plate issue to be tackled for long-term; 10 antennas installation to proceed.

==> for (a) : updated spreadsheet discussed; Lband new filters included -- BPF is completed; sub-band filters TBD. For (b) it is an internal matter; for (c) waiting for chassis; will be putting on antennas in adhoc fasion for now and later on with proper mounting arrangement.

(ii) sub-band filters (design is at simulation level) can be taken up as a replacement for the problem encountered while making new spares for Lband feed (see above) -- to try new PCB with different switch (Hitite) -- see update on this in earlier agenda. Right now, using old design with new PCB for populating in spare Lband feeds. To see how the matter can be resolved.

==> new PCBs with Hitite and MACOM switch are awaited.

2. RFI related matters :



2.1 RFI tests of ethernet switches for antenna base & GAB -- from 21 Jan & earlier (SN/BAK/SSK): Testing the available switches for RFI & plans for design of RFI box for ethernet switches : sample units from Cisco, HP, Dlink and DELL had come and were tested for RFI -- conclusion from final report was that D-link is much better than others (but it is 2x more expensive than next best option of CISCO -- by Rs 20K); also, use of shielded CAT5 cable provides significant improvement; later, during March-April 2014, tests were done with RFI enclosures (with mounting of filtered and shielded adapters, eth cables, AC pwr line filter, shielding for fan etc); results looked very good : isolation is about 70 to 35 dB from 100 to 1400 MHz; also, good improvement is seen with switch + shielded CAT5 only (without box); both CISCO & D-link work equally well in shielded enclosure, but CISCO is slightly worse when only shielded CAT5 cable (without enclosure) is used as it has more number of discrete lines in that configuration. However, it is now clear that it is not possible to use this 24-port switch in GAB; hence, CISCO can be selected as the final version for antenna base, alongwith the shielded enclosure -- agreed to go ahead with this. Updated report on the tests has been circulated. Pending action items are as follows :

(i) Testing of prototype unit from vendor showed need for change of location of AC powerline filter -- mech group has been informed about this and the change is being implemented in the units that will come; can cross-check and close the matter. ==> email update from PAR : confirmed that the information has been conveyed to the vendor and item can be closed.

2.2 Discussion relating to Industrial RFI survey -- from 21 Jan & before (PAR/SSK) : revised docs (from 2009 and 2012 discussions) had been circulated by RFI group and were discussed in 5 June 2013 meeting (is the document too exhaustive?); new survey planned with main aim to generate updated database which will be useful to pinpoint likely hotbeds of RFI in the industrial areas in addition to finding those without NOC; after months of planning and discussion with DIC, was finally conducted during 23-27 June with 4 teams; covered Ambegaon and Junnar talukas ~ 40-50 villages in each; ~ 40-80 working industrial units (large number are closed down or never existed!). Some of the progress is as follows :

A form had been prepared for use in the survey and had been discussed in detail and agreed that it is suitable for use; about 70% of existing data had been entered into this form; agreed that this activity would be superseded with making a database of equipment and NOC record for the existing industries found in the survey; this data entry now completed for all 3 regions : Junnar, Ambegaon and V-K industrial estate; some highlights from the database : of the total list, a significant number of industries are closed down, and another significant factor are no longer traceable; about 1/3 of the original are still working (ignoring poultry which is about 1/4, but is considered RFI-friendly).

A follow-up meeting with DIC took place on 30th Sep 2014. Summary is as follows :

- a. To maintain proper record of the data of existing and future industries in the same format. The data format and data base was shared with them during the meeting.
- b. Complete list of the villages in Zone I to Zone IV is submitted to them, based on which they can decide the issuing of NOC for industries in different regions (and also outside?).
- (c) DIC to issue NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT

Some of the present action items are as follows :

- (i) To cross-check the list against the ones which have NOC (for those operating

without NOC, add to our database and inform them about informing us for changes, and DIC to issue NOC post-facto as mentioned in other agenda item) -- this is happening now; current table has a column indicating whether NOC is there or not. DIC has started taking action on parties without NOC (e.g. Govardhan dairy, ~ 20-30 km away). DIC will be sending the standard form to all and it will come to us for clearance; we need to be careful about to whom we say "yes" in retrospective manner, so as to avoid setting up a precedent of giving NOC to somebody with wrong kind of equipment already installed & running ! Possibilities for improvement can be suggested to them.  
==> no updates.

(ii) To follow up with DIC about

(a) issuing of NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT.

(b) Follow-up on single phase welding units : they have requested letter from GMRT to collect information from users around GMRT antennas. Action will happen after 6 months (when?). After payment (Rs 4,500/-)??;

This matter needs follow-up with admin to see how it can be handled.

==> email update from PAR : payment issue remains unresolved.

(iii) during the survey, some units which are likely to be important from RFI point of view have been identified for detailed studies later on -- some work can start in parallel with completion of database, beginning with the bigger units; measurements (using LPDA) for 2 big industrial units in Junnar & Ambegaon area completed; others are in progress; no new progress on this.

Meanwhile, team has been doing a check on transformer RFI and the updated results from this will be available soon -- will need to see how this compares with the earlier round of this work. (can be put as a separate agenda item next time).

==> email update from PAR : comparison of old and new data is in progress.

(iv) procurement of new equipment : 2 nos of ultrasound dishes (needed as existing 2 units are barely working) : indent had been placed ; to check status of the order (also to explore possibilities for IR thermal cameras?); 2 dishes have been ordered expect delivery by end-Jan; no action on IR camera right now.

Delivery still pending.

==> email update from PAR : no delivery yet; purchase is following up with vendor.

2.3 Follow-up on UPS RFI -- from 21 Jan & earlier (SSK/PAR/RVS) : UPS units from Ador were found to be the most suitable : 2 nos of 3 kVA was purchased, tested for RFI & cleared; units are in use in C9 and C10. Updated RFI report has comparative statements quantifying the repeatability. Further, 2 nos of 4.5 kVA units were also ordered with Ador, with option of 2 single phase o/p with different isolation transformers (3 + 1.5 kVA); units were delivered but failed the RFI tests -- lots of discrete lines seen; Ador had taken the units back for modifications -- finally, modified version of Ador 4.5 kVA was tested and preliminary results are quite good; report for this has also been circulated. Current pending action item is:

(i) to finalise plans for going with 3 kVA unit from Ador as the final choice : agreed to order 10 nos of these as a starting option; RVS had received budgetary quote; (total cost per antenna may turn out to be around 2.x lakhs); indent had been raised; was waiting for formal quote from vendor; order has been placed; delivery of 10 nos expected in Jan last week.

5 nos have come; random selection of 1 unit shows 1 dB increase in noise floor level at 150 to 270 MHz; remaining 4 units show 2-4 dB increase in 140 to 240 MHz;

check of major changes : MCB make has been changed; panel plate is missing -- direct screen printed units are used; connectors size / type have been changed : need to feedback to electrical team and appropriate action to be taken.

May need to follow-up next week with electrical and RFI teams.

==> email update from PAR : second batch tested for RFI and report with all changes suggested has been submitted. To check what should be done next.

2.4 RFI testing of LED lights for GMRT labs & building -- from 21 Jan 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 was raised for additional quantities; it appears these have been delivered (how many?); electrical team has put a request to RFI group for testing of new batch that has been delivered.

New batch has been tested as per earlier procedure and found to be ok from RFI point of view; additionally, RFI team to test the units that have failed in the last 6 months or so.

==> email update from PAR : report for test of new units will be circulated in next few days; tests yet to be completed on faulty / failed units.

### 3. Operations :

3.1 Mass production of shielded box for MCM cards -- from 21 Jan & 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; sample box of Rabbit + switch + media converter + Miltech PC combination tested on 4th Dec (report is awaited) : results match with earlier results. Two minor points to be conveyed to vendor : size of one of the opening and assembly of the side plates, which has been conveyed to mech group (!) now awaiting for feedback about delivery of mass production from the vendor; to

check status and see if the item can be deferred for longer duration. x70 (for MCM) received.

==> to finalise parts to be bought and indent the same.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 21 Jan 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. See agenda item above; x35 in 1 month (for layer-2 switch).

==> parts for this also will be combined with above item.

3.3 Planning for proper UPS & space utilisation for new equipment at antenna base -- from 21 Jan & long before (SN/CPK/RVS) : long-term plans for intallation of final UPS system and proper utilisation of the space at antenna base. Follow-up on 14 Aug 2013 discussion on first report : 2nd report was generated and detailed discussion took place on 5 Feb 2014; successive follow-up & final agreement on way forward (alongwith updated report) reached c. May 2014.

Some highlights are as follows :

(a) Regarding electrical loads : power drawn by different sub-systems estimated carefully, alongwith actual sample measurements on a few different antennas, for both existing systems as well as upgrade systems; effect of in-rush current at switch on also considered; total current requirement of 10 A for the ABR systems + servo control electronics found to be sufficient; hence 3 kVA UPS is adequate; agreed that, if needed, peak load requirement (e.g. in-rush current) can be balanced out by synchronised delayed switching on of different units -- this is already implemented to some extent at present. Final load requirements have been carefully checked and tabulated in the updated report.

(b) Regarding electrical wiring : agreed to have separate isolated supplies for (i) servo drive system (without UPS) (ii) servo control electronics (with UPS) and (iii) ABR electronics (with UPS); one common 3 KVA UPS with split o/p (2 KVA + 1 KVA for servo and ABR respectively) each with its own isolation transformer is the ideal solution; the new UPS can have the isolation transformer(s) integrated into it, without increasing its footprint (only height may go up); updated wiring diagram has been produced by RVS in consultation with SKB and others, and is available alongwith the updated report.

(c) Regarding space utilisation : new UPS can be located in the space between the ABR and servo racks -- this has been done in one antenna with the new UPS and appears to work ok; existing servo FPS units can be left where they are; if isolation transformer can be moved out from the rack, then space in that common rack is enough for all growth plans of FE and OF systems; this leaves some empty space in ABR rack bottom that can be utilised for further growth of telemetry system; all new servo growth to be accommodated in the servo racks (or in-situ replacement of existing units); extraneous items in the surrounding of the racks (electrical fittings etc) can be relocated, as far as possible, to make it convenient for people visiting for work. Most of these issues have been captured in the updated report. Matter discussed in

GSG meeting of 13th Nov 2014. This item can now be taken to the logical conclusion : net outcomes can be summarised and follow-up action to be finalised.

Main list of actionable items :

(i) ordering of 10 nos of UPS : order has been placed; delivery expected end-Jan.  
==> 5 units had arrived and tested for RFI -- small modification required; additional issue of PF of the UPS -- vendor will try with adding capacitors + input side xmer -- to be tried this week.

(ii) final wiring diagram for servo + ABR is needed : new wiring diagram circulated by RVS -- can check for any comments or suggestions and then incorporate as the updated wiring diagram; modified wiring diagram prepared by electrical and shared with servo (4th August); meanwhile, discussion with BLDC supplier : now ok to ground the neutral of the main 3ph transformer; extra emi filter may be required (RVS confirmed it to be only Rs 10,000 per antenna) + only one set of line-filters will be required. RVS to come up with the updated wiring diagram (in consultation with servo) and circulate to all concerned. RVS has circulated suggested wiring diagram, which includes input from MACON via servo group -- need to clarify the nature of the radiation shield suggested between the BLDC rack and other racks. RVS to check with SS and report status, so that final wiring diagram can be produced -- this is now pending for some time !  
==> diagram has been circulated; can be discussed in SMEC and frozen.

(iii) making one antenna as a prototype or model where all the configurations are made as per the recommendations : finally, agreed to use both C10 and C00. At C10 : 3 kVA UPS is installed, but feeding power to ABR only; servo to make arrangement to shift PC104 load to UPS; switch boards / extension boards have been shifted to safe level. At C00 : 4.5 kVA UPS, with 2 isolation transformers, is installed with ABR rack connected on it; PC104 to be transferred shortly; relocation of elec boards is pending. Latest situation : in both C0 and C10, ABR and servo loads now connected to UPS -- in C10 the servo isolation transformer is still there. Agreed to put the FE power supply in the proper location in both antennas -- work ongoing to make space for this; also ask servo to confirm FPS drive in keeping with the agreed diagram. Will also check for unshielded cable entries in model antenna shell, include unused holes and punctures.

RVS to circulate an email about the updates and finalisation of layout in C0 and C10 for replicaton in all antennas. RVS has taken photos for C10 and will circulate final configuration -- this is pending for some time now.

==> some feedback from FE and BE teams : to check if sentinel "yellow box" can be shifted; alternate arrangement for keeping the phone to be decided; UPS heatsink is not a major issue; directive to keep AC flow downwards when not in use.

To look at proper exit of earth cables, as well as for AC pipes, for RFI mitigation. contactor and timer for delayed start is obstructing FE pwr supply -- can be removed once UPS is there.

(iv) also agreed to populate C0 & C10 with Rabbit, switch, PC (with shielding) as and when available -- these 2 antennas can be used for next gen M&C work to add to C4,C6,C12 to make a total of 5. JPK to keep track of this aspect.

==>

3.4 New, improved Miltech PC -- from 21 Jan and earlier (CPK/SN/PAR) :

Two units of Miltech PC with two changes (more screws on panels + panel mount pwrline filters instead of chassis mount) were under test : conclusion was that

PC ok from all aspects. Pending action items :

(i) agreed to initiate the purchase of 10 nos of the final version above -- indent had been raised for 10 nos (including some spare accessories?); current status of the PO : order sent; expected date of delivery 31st Dec -- trying to expedite, if possible; note from vendor informing about delay due to late arrival of m'boards : end of Jan is new delivery date. To check status of this item.  
==> not delivered yet; party still saying m'bd not received.

#### 4. Back-ends :

##### 4.1 Documentations :

Current action items are as follows :

(i) Detailed design doc -- from 21 Jan & 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; was deferred till end Oct; and then deferred till end of Dec; 2nd version had ~50% chassis level inputs; to be completed by end-Jan'15;  
==> not yet complete.

(ii) ITRs for analog back-end systems and digital systems to be taken up :

(a) analog back-end : Sandeep and Navnath to look into that; pending.

Work pending for some time; team to review and pick up the activity.

==> no progress on this -- BAK to follow-up.

(iii) to move to a point where formal publications can be done -- this needs to be followed up appropriately within the team and a summary plan brought up for discussion; finally, SHR and BAK have started work on modifying GWB ITR to convert to a paper; first version has been circulated; to check and take up for discussion.

==> YG, BAK and SHR to discuss tomorrow.

4.2 : Power supply for GAB : from 21 Jan and before (NDS/BAK) : Two options are possible : linear vs SMPS. Agreed to produce comparison note with all pros & cons. Meanwhile, a few SMPS units can be bought, as the cost is very small. Still waiting for comparison note ! -- it was in internal circulation, waiting for Ajith to give his comments; comparison report has been generated; pros and cons are in terms of convenience (and price) vs RFI properties; agreed that present set-up of 30 ant GAB (with 5 spare SMPS supplies on order) can run for 6 months or so; final decision can be taken later on. 4 of the 5 units have come and these can be made ready and then we can have 4 racks with SMPS and 4 racks with linear / CVT supplies -- this has been achieved; need objective criteria for comparison; meanwhile, shielded box has been designed for the SMPS by RFI team and is in final stages of testing and improvements; waiting for RFI report; meanwhile, shielded box has been installed with one SMPS power supply in the GAB rack. Finally, PAR has circulated the report -- can be taken up for discussion and follow-up action can be decided, including plans for mass production of shielding units; meanwhile, SMPS installed in 4 racks (mass production : 12 boxes with RFI shielding planned - 8 needed & 4 spare); Total of 13 boxes will be there -- 8 will be used and 4 will be spare; mech will place the order for 12 nos (after BE and RFI teams check the drawings); only timeline for delivery needs to be established and then the item can be closed or deferred accordingly.

==> drawing had errors; needs modification; stuck for PC problems.

4.3 Power equalisation schemes for new back-ends -- from 21 Jan and before (SSK/NSR/BAK/SRoy): Need updates on both of the following :

(i) option 1 : using detectors in GAB and local feedback loop -- monitoring set-up working; DKN working on code (using algorithm taken from NSR) which was under first round of testing -- detector output saturation, gain adjustment now checked and this needs to be done for each channel; basic power equalisation algorithm has been tested ok with 4 antennas; now working for larger number of antennas; SOP has been done; agreed to do a comparative study of this scheme with the GWB-based scheme to see if there are any differences or pros and cons.

first part of the test has been done : do GAB power equalise and look at GWB bandshapes -- looks like they are not equalised very well; to check the results and quantify; also complete the loop by doing GWB power equalise and checking GAB o/p. Both ways test has been done and both are self consistent, but not consistent with each other? more refined tests (though with 4 antennas only) show quite good agreement for both cases of testing; agreed to extent this to all 8 antennas. to complete testing for larger number of antennas (8 or more) and come with a status and then decide next step of growth.

Tests have been done for 8 antennas both channels and BE team is ready to release for use by operators -- a basic SOP to be generated and released; to run this alongwith GWB bandshape check to help debug problems in GAB -- can be formalised as a debug tool to be run by PMQC periodically.

==> SOP is close to being ready; further activity to make into a formal tool to be taken up subsequently.

(ii) option 2 : using correlator self outputs and computing gain corrections : basic scheme is implemented & working; more general implementation of a user controlled ALC mode requires the following:

4 modes of operations had been identified (see MoM of 3 Oct 2013 !) :

(1) on demand -- this is the current released mode.

(2) repeatable at some interval specified by the user -- can it be script based?

Sanjay has completed the core coding; a wrapper is being done by SRoy; to be taken up for discussion.

(3) automatic, should adjust in response to a stimulus in the input power -- needs a discussion.

(4) should provide a reliable power monitoring scheme -- needs discussion.

Also, issues like logging of results etc to be discussed. Issues related to attenuation value accuracy and setting have been discussed : 5% (0.25 dB) ok; agreed to add median calculation feature; to check if a feature to predict the expected change in attn for a given change in sky direction can / needs to be added; better option for saving the attenuation values for future use / reference to be defined; agreed to have a document that summarises all of the above and spells out the main requirements (from user point of view) and possible solution options / techniques; detailed discussion has taken place between SRoy, BAK, SSK and YG on 14Aug2014 -- main conclusions and action items are as follows :

(a) attenuator values : aim is to check if measurements match with specs (within +/- 0.25 dB); initial test results for 3-4 units (at one epoch) had been reported by BE team (found acceptable); pending items (for BE team) are :

to check the constancy of the values across the band;

to repeat the tests for varying i/p power levels with constant o/p power;

to repeat the tests on different epochs to verify constancy with time;

to work out plan for calibration table for each attenuator (after above results).

Data for 3 epochs has already been taken; data across the band may already be there; for different levels, it is being done; new results had been circulated and SRoy has analysed these; SRoy to summarise from all of the above.

Summary as per email exchanges : ok -- main pending test is one with varying input power levels; tests have been done : i/p range from -37 to -17 dBm tested and behaviour of attenuator appears to be all right. SRoy to cross-check the results and confirm if we are ok.

(b) requirements document to be updated to reflect the outcomes of the discussions e.g. better clarity about the 3 modes of operation etc. -- SRoy has produced an updated version : needs to be checked to see if it can be cleared.

(c) self data (from correlator data stream) to be saved in shared memory ring buffer of ~ 30 mins depth for further processing tasks to work on (should also work off a recorded lta file) -- SSK to work with NSR to get this implemented (work in progress). SRoy / BAK to check with NSR.

NSR has been working on the writing to file version and it may be working by now -- SRoy to check and confirm the status and arrange appropriate follow-up.

NSR has been looking at the matter (after discussion with SSK) and has a basic version working -- SRoy will be discussing with NSR in early December : SRoy to update on the outcomes of the discussion via an email.

(e) to further develop the relevant routines that read the data and process to achieve the desired results -- SRoy to build from the basic routines available at present, with participation from NSR; work in progress; to cross-check about median calculations -- not yet done; first looking at ring buffer issues (may club both?); same as item (d) above. To take up after file mode above is cleared.

(f) testing of bandpass shape (ampl and phase) for different values of attenuation : 6 out of 7 antennas showed less than 5% percent and 5 degrees change in ampl and phase over 5 dB change in attenuation. band-pass variations with time reported by SRoy -- to be taken up for detailed discussion -- maybe under testing of GWB? SRoy would like to follow-up to see how much is the intrinsic varn of the GWB corrln level with change in input power level -- to cross-check with DVL about the expt done there; SRoy has analysed the data provided by DVL and found that behaviour is acceptable for the range of i/p power variation tested which is about factor of 5 (~ 7 dB); to plan to extend this to larger range : set power level on galactic plane calibrator to about 80 or so; then go to calibrator away and equalise to 350 -- larger change in attenuation (~ 12 dB) required -- can check if corrln coeff (bandshape) remains ok or not.

==> no immediate action on this, as SRoy away at present.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 28 Jan & 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) 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) beam mode working with fixed channel and time factors : SSK had got the code changes done for making it general purpose -- going up to any number of channels for corr + beamformer + DAS -- SSK has tested upto 16K channels; 32K may require some extra coding; agreed to first release GWB-II code with 16k channels for users, alongwith modification to SOP; second, work ongoing for coding 32k (and 64k) in GWB-II code for testing; final version will be released in GWB-III; modification in GUI for multiple time integration & channel selection added & tested.

no further updates -- to clarify about updates in GWB-II and between 32k and 64k plans, and close the matter.

(b) header for beam mode data : to be taken up and incorporated alongwith the PA mode; SSK has done first round, and needs a discussion.

Discussion between YG and SSK is pending; meanwhile version with header to be released alongwith 16k channel code release on GWB-II.

(c) availability of psr\_mon / pmon on nodes 53 and 54 for recorded data is there; for shm attach needs some work; psr\_mon done but only for off-line upto 16k chans; no real-time version available; pmon still needs to be looked at...

Agreed to confirm off-line psr\_mon available on nodes 53 and 54; to try and provide online psr\_mon with 16k channel release; later, to integrate Rajora's new code into the system : first with GSB, then with GWB-II and III. To check status of ongoing discussion on this, including incorporating of Rajora's new code.

==> no updates; to check with SSK about it.

(ii) 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 is 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.

==> some fresh tests done by SHR : varying i/p power level of broadband noise source at ADC allows characterisation of input power level at which spikes show up; looks like occuring at multiples of 128 ch (for 2K spectrum); to check the level as seen in cross of two such signals.

(iii) change of host machines to 1U HP machines for GWB-II : work is ongoing by SHR, including OS, disks and location in the rack; may be able to complete in one month time scale (from 3rd week of Nov); work ongoing, SHR needs to coordinate with Nilesh. machines are ready; GUI needs a version which has new IPs and maybe some paths; in order to switch between old and new hosts, infiniband cables need to be swapped at the 8-port switch.

==> not yet done.

4.5 GPU corr (GWB-III) : next gen system -- from 21 Jan & before (SHR/SSK/GSJ/BAK) :

Design and delivery of 32 input (16 ant dual pol or 32 ant single pol) system :  
4 new DELL machines are in the rack and wiring + cabling is complete, tested with analog noise source; new code with 2 x 10 Gbe I/ + improved logic for assigning specific threads to each core + env variables completed (tested for 200 MHz / 8 bits and 400 MHz / 4 bits, 16 inputs and working ok with no pkt loss); basic GWB-III has been completed and released; ongoing action items are as follows :

(i) plans for testing the GWB-III : this has 2 parts :

(a) regular user level tests of basic modes : updated SOP has been released; modified ferrules have been put and GWB-III has been released with full online control; final connections to GWB-II and III can be chosen by the user on the wall panel; to check if new SOP supports flexible connectivity for GWB-III -- this requires manual editing of the file (explained in SOP); confirmed that GSB, GWB-II, GWB-III can all be run simultaneously with full online control;

DVL has started some of the basic tests -- to check status of these activities.

==> quick summary : by and large system appears to be work ok; some cases of low self and poor cross. pending problems have been call sheeted and will be checked again to see if fixed or not.

Manual editing may not be required anymore -- new GUI has to be tested and SOP to be updated.

==> not done and released it yet; also fixed order may still be needed -- to check with NSR.

(b) testing of the 400 MHz BW mode : basic changes to the code for the 400 MHz, 4-bit mode have been done; some pending tasks are there : proper delay correction for this mode needs some changes / testing; also choice of which 4 bits to use needs to be decided -- right now it is set for 4 MSbits; final tests with astronomical source need to be done; to confirm if 400 MHz 32 inputs will work or needs to be restricted to 16 inputs? Computation does not fit in existing set-up and hence can't be tested right now. Current summary : For 400 MHz mode, all algorithm issues are sorted out (include delay setting); however, existing GWB-III set-up does not sustain 400 MHz; safe limit is 300 MHz (including beams ON); agreed to leave it at this level right now and not formally release the 400 MHz mode.

==> no further updates on this from GWB team.

(c) checking of beam modes : all basic beam modes are working; only phasing needs to be verified -- phasing in one poln appears to have some problems -- SHR is looking into it.

==> phasing problem is fixed and can be tested now.

(ii) improvements in GPU code using K20 card (SHR/SSK) : a few different optimisations have been tried and these need to be further refined and ported to the GWB-III code:

(a) looking at XGPU code (with Vinay of nvidia) : optimised XGPU for GMRT is showing ~20% improvement -- needs to be confirmed and then incorporated; ready to upgrade to CUDA 6.0?; results from R2C vs C2C (with callback) to be finalised and then decide about incorporating. SHR has started working on porting XGPU in GMRT code to GWB-III  
==> this is ongoing by SHR.

(b) another concern is about data ordering at XGPU o/p vs LTA format requirement -- needs to be discussed alongwith SSK and decided; other than that SHR is ready to try out. This is important to check and discuss this in order for the changes in (a) to be meaningful -- to check status of this.

==> this has not yet been discussed and it is URGENT ! BAK to take up on priority.

(c) dual K20 option : total corr + beamformer is exceeding real-time by 9% for full 400 MHz bandwidth for 16 input correlation (fits for 2 x 8 input corr); to check if the full correlation job will fit in 16 GPUs (after some of the optimisations above);

if not, we need to start planning for 32 GPUs : 2 K20s per host, or double-GPU card, or 32 host machines; agreed to try a test where 2 GPUs on one host machine is used to test if the correlator code is portable (set-up with 2 GPUs is there on 4 of the 6 nos 620 machines -- so tests can be done on this when the code development reaches that stage); agreed to wait till main GWB-III is ready and released -- this has happened now, but can wait for some more time...

Based on current status and work done with nvidia, it appears that optimisation of GPU code will not be sufficient to make final system fit in one GPU and hence, agreed to start looking into 2 GPU per node option : either try with dummy calculation or with actual alternate data buffers going to each GPU...

==> no action on this for now.

(iii) other improvements in code :

(a) need some software updates in DAS chain to handle more than 2048 channels ? this needs clarification about whether this is available in currently released GWB-III or not !?!

==> not resolved.

(b) new features to be added in next version of GWB-III code : correction for net\_sign[] flipping (LSB/USB modes of correlator); channels upto 32k, lower beam integrations (tbd), beam header, multi-subarray, 4 beam capability; all off-line utilities with backward compatibility; time ? + DUT corrections; optimised code to be ported; shift to 2 inputs per Roach board. Some of these can be delayed for some time, depending on priorities. BAK to discuss with the team and come back on this.

==> this needs a discussion to prioritise.

(c) long-term items like provision for control of FPGA and other peripherals (like sig generator) for different modes : agreed to identify one PC for control of all the peripherals related to GWB; this m/c can / is interfaced to online via a socket and GUI can send commands via this -- already done for loading of FPGA files, needs to be extended for other applications; for other things like turning RFI rejection or Walsh modulation on/off, writing to registers in powerPC would work all right; agreed to start working towards implementing scheme in GUI for taking additional parameters that allow different bof files to be loaded; agreed that these flags need not go into ltahdr but can go in the user log as setting parameters (can also be there in gpu.hdr); agreed to go ahead with discussion with NSR for implementing the logic for allowing support of multiple corr modes that use different BOF files; other action items to be taken up later.

Not clear if any action has been taken in this; BAK to check with Nilesh and see if the logic can be incorporated.

==> need update on this.

(d) incorporation of DDC : this is important requirement in the long run :

Agreed to try on one node of GWB-II or GWB-III and get back to earlier stage and see exactly what was the bug. SHR has circulated an update; first part is that it appears that the current realisation is properly implementing a DDC; only the filter BW needs to be decoupled from the decimating factor and do a careful set of tests; in the long run, better filters with sharper cut-offs may be required (can check with nvidia about availability of std library functions for such applications); second aspect to the check about the nature or format of the o/p to see whether I & Q components are ok for further work or whether we need / can have the real voltage representation of the o/p signal.

==> new tests still pending; to check about nvidia primitives; to check about I,Q version vs real output possibilities.

(iv) Layout and racks (GSJ/BAK) : layout diagram to be updated and long-term plan for racks to be initiated; 3 different kinds of President racks discussed ("cyber",

"cool" + one more?) -- to try and finalise after one more round of discussions including RVS (also, check new vendor Jyoti Tech); as an interim, 2 nos of cyber racks ordered with President. Current action items :

(a) 4 nos of half-height racks are now in use for GWB-III -- two nos are populated with 4 compute nodes each, third one has 3 host machines + 1 extra machine + clk source etc; fourth one has 8 Roach boards + IFB switch; will need to expand this to 16 Roach boards at some point of time -- may need to add one more half-height rack? One half-height rack is available in hand and can be used when required. Item can be closed for now?

==> no discussion on this; can be closed.

(b) For the 2 President racks : first one has been used for GSB related nodes (spares) -- this is ready now, waiting for riser cards for the spare nodes (to be moved in during MTAC); to check current status of this, including swapping of bad node with CITA node. 2nd rack being used for trying the arrangement for special cooling (with help from mech group) -- tested with 1 kW load and increasing slowly; loading up to 4 kW tested by comparing the temp difference between input and output air; need to compare with unmodified rack; results so far appear to show that there is about factor of 2 discrepancy in estimated CFM rate and AC plant capacity CFM rate.

Next - to decide on number of racks to be procured;

Agreed to include the test with unmodified rack and then circulate the report; current estimate is for 5 racks (32 Roach boards + 16 compute m/cs with 2 GPUs each); with 2 AC vents feeding these 5 racks, the estimate is that the available CFM may be marginal -- this needs to be resolved against the CFM discrepancy noted earlier. Also to explore additional margin the AC system. Maybe useful to have a joint meeting with RVS and team.

==> Irappa has made some further tests and will be circulate new results shortly; check about having a session with RVS.

4.6 Procurement of new hardware and accessories required for GWB systems -- from 21 Jan and before (BAK/GSJ) :

(i) purchase of 4 new host machines for GWB III : to decide configuration of host machines (disk i/o to be kept in mind); also to check if SSD is a viable option for recording of data. Investigation shows that SSD vs SATA has pros and cons; it may be possible that one class of server may be there that supports both?

4 nos of T620s have come and integrated into GWB-III: 2 are with 16 TB with and 2 with 4 TB -- compute vs host.

For future purchases : PERC card issue needs to be resolved : agreed that we will buy machine that can support upto 12 disks (which means with PERC card) but will have 2 x 2 TB to start with. More disks can be added as needed, and if at all extra slot is needed, PERC can be removed (will support only 4 disks) and backplane has to be changed with a new one (which has to be bought along with the machines); To decide quantity to order at present : agreed to proceed with 16 nos with full waiver for DELL proprietary item with DELL as the supplier.

To initiate the appropriate paperwork, including waiver of public tender.

==> action started to generate the papers...

(ii) procurement of accessories like network cards, disks, cables etc to be looked into -- 20 nos of CX4 based dual 10 Gbe cards purchased and tested; to confirm that this order is enough to meet our long-term requirements; Agreed to produce a formal note about the situation for long-term : to relook at the spares requirement without counting the units already being used in the existing systems (including the PoCo and pkt corr) and buy more if needed; GSJ has produced this list list and fresh

orders to be done, based on this : 10 Gbe cables and NIC cards (spares); IB switch 36-port -- folders are ready for ordering; indent for 8 nos of K20 has been raised. cables for NIC cards : PO released; IB switch indent to be raised again. For 8 nos of K20 : order has gone; IB cables and NIC : order has gone; IB switch : new folder has reached final approval stage; for 10 Gbe dual-port NIC cards + cables are all in hand.

==> to confirm if all the items here are under control and then close as needed.

(iii) new purchase of Roach boards etc :

(a) 12 nos of Roach1 + 16 ADCs and 4 nos of Roach2 have come; Roach1 test set-up ok; all 12 Roach1 and 16 ADCs tested ok; to make a summary sheet about current stock and usage of Roach1 and ADC and bring up for discussion.

xls spreadsheet has been created; to circulate the latest version; to check requirement of ADCs and verify the situation for 1 ADC per 32 Roach boards vs 2 per Roach board.

==> this issue needs to be discussed and a final call has to be taken.

(b) for Roach2 : to check standard test procedure on CASPER; to check if we need to buy add-on mezzanine card; to check if Roach2 can be seen on USB port using Ubuntu and if some basic tests can be done with this; indent for mezzanine card has been put. Folder has reached final approval stage.

==> to confirm if order has been placed and expected date of delivery.

(c) also software environment needs to be upgraded -- Matlab-Simulink upgrade order is under process; Xilinx ISE v14 has been ordered and CD is in hand -- to be installed; to see if one existing PC can be adapted for testing of Roach2, including installation of these new softwares.

New Matlab-Simulink installed on one machine (64-bit), including updated license manager. (additional license 2014 is for parallel toolbox)

==> item not discussed.

4.7 Testing leakage, coupling and correlated noise in new back-end chain -- from 21 Jan & before (BAK/YG/++) : detailed tests had been done by Vikram Jaiswal (with SSK, SHR and YG) and report has been circulated; for GAB systems, some follow-up action for testing the leakage has been initiated; procedure for testing to be done with GWB-II release modes clarified and tried out -- new tests show significantly different results for cross-coupling for GAB+GWB; maybe due to synth LO (old tests) vs sig gen LO (new tests), whereas earlier tests used synth LO; new report had been circulated that showed significantly reduced coupling; agreed to repeat the original, user level tests done by YG & VJ to see if things are different now ; agreed to try the ADC noise input and north pole sky tests and see what results come out; 2nd round of tests done, show leakage of 2-4% (consistent with first round results of 1-3%) -- to check with SCC whether all user level tests (done earlier by YG + Jaiswal) have been covered; some user level tests done with north pole and different leakage found for lower and higher LO settings -- needs to be understood.

From Aug-2014 :  $\leq 4\%$  leakage; FE+GAB+GWB (L-band) ~ 40% leakage.

Need to organise a detailed discussion on this.

==> Item not discussed due to shortage of time.

4.8 Walsh modulation : prototype set-up on Roach board -- from 21 Jan & before (SCC/BAK): plans of BE team for implementing prototype scheme -- basic unit for switching using sq wave signal from GPIO pin tested ok; was put in PoCo correlator and was being tested; walsh waveform delay functionality has been added now and can set delay from 1 to  $2^{32}$  clk samples (!); with this, variation of correlation with delay has been tested using noise source inputs and found ok; a robust algorithm for hunting for the peak correlation and fixing the delay needs to be developed; can

also think of a test case of showing cross-correlated signal goes away with modulation with square wave in one channel; Walsh pattern being put in the Roach (not many slices needed); there was some mismatch between CPLD waveform and FPGA waveform that was resolved and all FPGA waveforms are matching; current action items are as follows :

(i) issue of accuracy of oscillator being used needs to be resolved.

(ii) to complete the Walsh modulate and demodulate set-up in the lab and test -- this is ready and can be closed.

(iii) to complete the final delay setting algorithm : to provide upto 500 msec of delay (for 128x4 Walsh length) with resolution of 5 nsec (FPGA clk); there were problems related to varying start-up offsets and fractional delay setting, as well as problems related to set up and hold -- these are now reported to have been resolved : this is confirmed to be work ok and can be closed.

(iv) what about synchronisation of starting?

This is taken care of by running the CPLD with a sig gen locked to 10 MHz.

(v) to optimise the hunting algorithm;

To start testing a basic algorithm and see what we get.

(vi) to demonstrate cancellation of unwanted signals in ADC card and/or GAB; first, need to run a test where pattern from external source can be synchronised to the pattern generated in the FPGA -- this requires being able to hunt and correct for the unknown delay ! This is coupled to item (v)

==> some tests are underway; some problems being resolved about the hardware set-up. detailed discussion on various issues above can be taken up next time.

## 5. Other items :

5.1 New python assembly design -- from 21 Jan (HSK/SSK) : FE group wants the python configuration in E6 to be adopted for all antennas -- this needs to be discussed with mechanical group and finalised; FE and mech have discussed about plans for modified python assembly that will give additional protection to cables; mech group had circulate a short note on their view of the matter, alongwith photos; this was discussed and existing vs E6 system was compared; Action item :

(i) modified E6 design with hinge-like support was installed on C4; to watch the set-up on C4 and do periodic inspection for checks of (a) damage to hose (b) hose clamps (c) water entry etc -- first inspection to be done after 2 months (mid-Sep) by mech and fe teams; subsequently, inspection has been done (around mid-Nov?) and a video of the same has been circulated; scheme appears to be working ok; however HSK feels that this scheme with hinge may not be good in the long run -- needs to be discussed and understood; agreed to keep this as status quo till IGUS assembly done and tested.

HSK showed video of 'C4' (E6 solution NOT successful for C4) - hinge is bending; need a plane plate;

Further discussion is required to decide on the action.

==> The hinge arrangement on C4 is NOT exactly same as the E6 arrangement ! The C4 design does not completely solve the problem. Agreed that E6 set-up does solve the problem ! Agreed that it can be replicated if needed.

(ii) IGUS cable wrap -- new technology prototype to be developed and tested on quadripod; also option of hose without wire impregnation -- long-term solutions.

1] hose without wire impregnation

2] Entire hose assembly under procurement (long-term solutions).

Quotes for both items received : item 1 is Rs 10k for 10m (4 antennas);

item 2 is 60k each -- will try on the quadripod test range;  
items received; basic assembly made ready; waiting for some manpower to be free for installation (around 13-14 Oct); then 4-5 days for 1000 rotation testing; basic arrangement done on quadripod and tested ok without cabling (video for this is also available); now waiting for FE team to populate cable wrap with cables for further tests; proto model now ready; to discuss further plans for action. Discussion is pending.

==> The arrangement uses a slightly different arrangement of fixed members, along with the IGUS hose; this will work as well as the E6 design.

Agreed to : (i) replicate the test arrangement on 2 antennas, one with normal hose and one with IGUS hose (ii) to check how much extra cable can be accommodated in the existing hose and (iii) look for wider diameter assembly (32 to 40 mm or more).

5.2 Problem of access to FE boxes with 500-1000 CDF feed -- from 21 Jan & before (HSK) : Update on new solution being designed by Mech group -- tested in situ and found working ok; agreed to use this for present; for future where bigger and heavier boxes will come into play, mech group will think of an improved solution, including an option for removing one feed and bringing the stool inside the basket; a few options explored by mech group, with target of 1800 mm height for boxes with max weight up to 150 kg (?), quotes received from some parties, processed and order placed; delivery by end of November; inspection done (in Bangalore) in mid/late November; some simple improvements suggested to vendor (guard rail, simple clamping arrangement for item); platform delivered at GMRT (early-Dec) and tested and found ok, including modifications that had been suggested. To discuss and plan next step of action.

Item is in regular use now; can have one discussion to confirm status and safety related issues, and then close the item.

==> trials have been happening on ground; ready to test with actual antenna operations.

5.3 Fabrication of 6 spare L-band feeds -- from 21 Jan & before (SSK/HSK) : Order to Akvira for 3 nos (with enclosure) + 2 extra horns. Hence, total of 6 feeds to be made ready + 1 dis-assembled unit + 1 old feed at Pune -- so total of 8 spare feeds will become available.

After inspection, many corrections / suggestions for improvements : e.g. improved probe mount : press-fit vs. screws; M4 -> M5; etc]; 3 sets delivered at GMRT, after powder-coating -- there were some issues about thickness of plates for mounting of connectors etc and in-situ modifications were needed; there was also the issue of press-fit vs threaded probe assembly -- finally a mix of both schemes is being used : 2 of 8 new feeds will have push-pull type and 6 will have threaded type; also, new enclosures were procured for these feeds; finally, 4 complete and corrected units were delivered to GMRT by 24th Oct 2014. To confirm current status and see if this matter can be closed.

new connectors (gold plating) to be checked within next few days;

Plated connector has been given ??? 2 sets of threaded type and 2 sets of push-pull type -- on 12 Jan 2015, now no pending works with mech group related to L band; to check if item can be closed.

==> Agreed that mech has no further role to play in this for now and can be closed.

5.4 Improved software for work requests -- from 21 Jan and before (HSK/SJ) :

To review the current process of taking job orders for better facilitation of the tasks with end users like electronics groups. YG discussed offline with HSK : to look to fill the lacunae in the process with maybe new development of in-house

version -- agreed to try and get this done in-house with Joardar; work was taken up after completion of ongoing tasks related to electrical (meanwhile, old software also started working (to check with Mangesh about what fixed it) -- hence urgency not very high; first version likely completed and released in late Dec/early Jan; awaiting user feedback for improvements; to discuss long-term plans. Released software appears to be working fine; still waiting for any significant user feedback; can check again after 2 weeks and see if item can be closed. ==> seems to be working fine; no major comments from users, except for one comment from SSK.

5.5 Status of new CSIRO feeds : from 21 Jan & before (ANR/JNC/HSK) : to report on performance of the newly manufactured feeds -- new results are slightly better compared to ver2 (casting) but not as good as the original ver 1 (machined by Godrej); it was discovered that a major change in the design /drawing required to maintain alignment between different sections [using guide-pins etc]; how to proceed further needs serious discussion about alternate options. HSK to try some new ideas to see if a solution can be found e.g. liquid Al layer to cover ? additional coating of Al paste being looked at as a possible option; email update from HSK : discussion with Dr. Shenoy -- Al conductive paint may not work best (only 80% conductivity)... Email update from HSK : repair not possible because of Al casting -- need to discuss and decide future course of action. ==> no updates; item can be closed.

5.6 New FE boxes and testing with reflective paint -- from 21 Jan (HSK/SSK) : two kinds of paint received and 1 box will be made ready next week for testing. 6 new boxes are ready as per specifications -- only some engraving work is pending. email update from HSK : One FE box painted with Luxtropherm HT 400 (range from 250-400 deg C ?) and handover to FES group for testing. Second grade paint : Luxtropherm HT 600 (range from 400 to 600 deg C) -- waiting for arrival; 3 types of FE boxes handed over to FE team : (i) plain box with powder coating (ii) box painted with HT400 (iii) box painted with HT 600; waiting for test results. 2 types of paints tried : HT400 & HT600; neither successful; to try new paint options? Item needs to be discussed jointly with mech and FE to understand why the original selection did not work and what should be done about it. ==> agreed to circulate the description of the method used, the results and the conclusions and then take up for discussion and decide what needs to be done.

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## Minutes of weekly Plan Meeting of 11 Feb 2015

### 1. FE & OF related :

#### 1.1 Documentation : follow-up on level 2 (ITR) -- from 28 Jan earlier (SSK+team):

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

(a) total 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; was in internal circulation within FE group (for long time), so earlier draft was taken up for discussion in the meeting, and some comments and suggestions were made : to give some more background and motivation and requirements, add a block diagram, explain about RC, point out interesting artefacts in the results, mention the SOP etc; updated draft was discussed and still needs background and motivation to be put in, as well as section on RC time constant; updated version to be made ready & circulated.

(b) temp monitor (VBB) -- work had started (after v2 250-500 FE box installation); initial draft is there (2-3 pages), needs some more work to be done -- agreed to shift emphasis on this as 250-500 report has been updated and released.

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

(d) OF & RF monitoring schemes

(e) Test and characterisation set-up for OF system

==> for (a) work is ongoing and RC time constant tests have been done : no visible difference is seen between the 2 cases (with and without), but probably the one with RC is somewhat smoother -- to do a quick cross-check about what it does to RFI signals; agreed to use this as default set-up and include the same in the report.

for (b) draft document discussed : to take care about symbols & standard nomenclature and terminology; 2 stage amplifier card with sensor mounted on it for general use in a box; for LNA, the sensor is taken off and put close of LNA and card is outside the box -- does this produce pick-up; online display shows calibrated temp; 400 s and 6 hr data shown for a few antennas, some with 1,2 or 3 monitors running : basic data looks ok, but there is some noise / pick-up on top of the 0.5 deg C steps which need to be probed; need a longer stretch of 24 hrs or more, alongwith record of ambient temp to compare; to include the thermal chamber calibration curve in the report. To continue with some long duration tests (both temp and power) and update the document.

for (d) Pravin and Ankur will be looking into (starting from initial work of Gehlot)

for (e) Sanjit will be looking into

(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. For the 250-500 filter, a paper has been accepted for publication in IEEE (Sougata & Anil).

Pending action items :

(a) agreed that the 550-900 filter work can be looked at for a paper : Imran is looking at that -- will come back shortly with a proposal for presentation in paper content.

==> not started yet.

(b) to check what else can be taken up for publication.

==> defer for now

#### 1.2 OF system NTR -- from 28 Jan & 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. Any updates ?  
==> no progress.

1.3 Noise temp & gain vs temperature for new LNAs -- from 28 Jan & before (VBB/SSK): Results for new 250-500 LNA show ~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 0-60 deg and 0.6 to 0.8 dB (drop) in gain with increasing temp.

Results for 550-900 LNA are 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 :

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; expt has been tried to measure bias voltage but it is difficult as the probe affects the bias voltage and LNA behaviour changes; to check if any another method can allow the test to be done; in parallel to check existing schemes (in lit) for temperature compensation of bias pt (assuming that this is the cause of the problem); to check about option for artificial heating of LNA to constant temp (via a TEC); meanwhile, agreed to complete the test on Lband LNA -- status ?  
==> Lband LNA tests done : shows about ~ 5 deg to 40 deg variation (at 1300 MHz) for 0 to 60 deg change in ambient; clear varn of tmeq with freq; also 5 deg  $T_{lna}$  apepars to good to be true -- need a check on the calibration of the noise source? Otherwise, the varn is in the same ball park as 130-260, 550-900 LNAs. No progress on bias related issues...

1.4 Installing and testing of temperature monitors in front-end & common boxes -- from 28 Jan (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 tests had been carried out; meanwhile, C4 & C10 fitted with dual temp monitors in FE box, and C13 with monitor in both FE & CB -- some tests had been done but data was not sensible due to unresolved issues in the wiring of the existing common box units that prevents desired data to come on expected channels in 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). Combined SOP for temp monitoring and total power monitoring has been prepared and releaCurrent action items :

(i) Analysis of the data : C13 & E2 both channels temp monitor available at online output (fixed for C13 one ch FE & 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; first results for ~ 5-6 antennas (LNA + FE box) + 2 antennas (CB) for 3 hr duration shows some basic behaviour but not clear how well things are working; to try two things : (a) to check if any old data of longer duration (from last 2-3 months) is available (b) to try a longer run, even for one antenna like W4 which is under maintenance; some of the short data stretches have been looked at; need a long stretch to come to any reasonable conclusion about the working and about range of temperature variation seen -- to be tried on W4 and results to be reported. At least one 6 hr data has been taken; but not clear why the team is not able to analyse it !?!

==> not discussed in much detail.

1.5 Testing of 130-260 system -- from 28 Jan & 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; 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. C10 has one 1 dB less deflection compared to W1 & S3; new 130-260 FE boxes made ready and installed at C10 -- first look appears to be working ok; detailed checks show that results for 2 antennas -- C10 and W1 -- agree very well, S3 is about 1 dB down in deflection; at 235 it is known to be down by 1 dB which is being investigated; there is some slope in 150 MHz part, can be looked into; there are RFI lines which need to be identified; to look for possibility of getting a 4th feed made (at lower priority) as 4th FE box is already available. To discuss these items and make plans. ==> small variations in sensitivity can be deferred for longer term; checking for RFI lines is ongoing -- will be updated shortly; request for 4th feed at low priority to be given by today.

(ii) plans to complete the 3rd wideband 130-260 FE box -- 2 spare boxes made ready by Jan 2015 (giving a total of 4 units, with 3 in use and one spare); for longer term, most of the items required are there; noise source and coupling needs to be integrated; possibility of sub-band filter discussed -- not clear if it is required, except for RFI related issues (space in the FE box will not be a problem). To discuss and plan further.

==> new PCB for QH + dir coupler with noise injection port has been designed and sent for manufacture to TechnoCkt -- will be integrated in box #5. need for sub-band filter can be kept pending for now.

PCB manufacturing with proper tolerance : new party identified in Ahmednagar; visit to be planned, after sending him some gerber files to get a feel for it.

(iii) plans for further tests, including interferometric measurements -- waiting to resolve the above issues and 3 antennas to be available; it should be possible to initiate this now; to check status of this with NK.

==> tests to be scheduled this week?

1.6 Testing of 250-500 FE receiver system -- from 28 Jan & 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. C1) but it needs to be checked individually for each new box that is made ready.

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:

(i) to confirm if E6 sensitivity is ok or not -- agreed to check and report.

(ii) 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.

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

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

(v) some antennas show ripples and unstable behaviour in on off and deflection plots which need to be characterised and understood;

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

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) : to check if results are available.

Agreed to maintain the log of the various issues; to check Nov data and also new data being taken now in Dec and summarise the results.

Attenuator setting problems were found in 4 antennas (W6, W4, S2, C13) -- due to wrong wiring; now corrected for 2 antennas (S2 and C13).

Discussion about results from regular monitoring of 250-500 system and conclusions from that (from 4 Feb meeting) : misbehaving antennas are clearly seen : some with low deflection (e.g. C13), some with dips in the performance e.g. E6, some with a bit of ripple in the band -- team understands these issues and is beginning to take up follow-up action items; attenuation setting problem also being solved one by one in offending antennas... To check current status of tests, results and action items.

==> attenuation problem remaining only for W4; E6 yet to be checked; new plots will come in next few days, and detailed discussion can be taken up after that.

1.7 Mass production of 250-500 FE receiver system -- from 28 Jan & 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. First version (v1) of FE box was installed on C13; final version (v2) of new FE box was installed on C11 and found working ok except for Walsh problems. Meanwhile, GSG cleared to go ahead with mass production.

Current action items towards mass production are :

(i) 250-500 LNA : there are only limited for uGMRT at present; it is also being used as spare for existing narrowband 327 MHz system (as devices are not available any more) -- original was made on ultralam2000 and this is not easily available; verified that a total of 20 nos (on ultralam2000) are available.

Current action items are :

(a) plans for making more units : need to find an alternative substrate; Rogers 5880 may be a possibility (work is ongoing); first prototype PCB was made, but used substrate with wrong thickness (!) -- now awaiting arrival of PCB ordered with correct thickness material.

==> PCB has not come yet -- to follow-up with vendor.

(ii) status of QH, noise source, coupler etc : QH is available for all 30 antennas; (current version of noise source, power splitter, directional coupler etc were tested before putting up in C13; but in-situ tests showed that the power level (deflection) of the noise was not sufficient; traced to faulty functioning (unequal distribution) of power divider module; alternate approach (using resistive components) seems to work ok -- equal powers on both channels ~ 4.5 dB for E-Hi cal, no need to reduce coupling from 20 dB.

Also, additional issue of 7 dB slope over the band (due to coupler) and 4 dB due to noise source; 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) was completed and first results show fairly flat (+/- 1 dB) spectrum over 200-600 MHz;

Current action items are :

(a) to confirm which antennas have the new system at present (C11, C13 or other?) and the final values of noise deflection being obtained from tests on these antennas with new system on C11 & C13 (from the document by VBB?).

==> C13 has original (heavier) new box; C11 has 2nd unit of final box; 1st unit is in lab for some work and will go to C00. Next boxes that will get ready can go to antennas which need new 250-500 systems (put in appropriate agenda item !)

(b) for new PCB : agreed to check on 2-3 more units for repeatability and also thermal cycling and then finalise the matter : one more unit has been made but work held up due to shortage of switch needed for noise level change control -- this has been indented (express ordering being tried); meanwhile, thermal cycling tests passed ok.

==> order for 30 nos has gone.

(c) also need a discussion about the 7 dB slope due to coupler.

==> to be deferred for now.

(d) strategy for mass production to be decided.

==> 30 nos PCB to be ordered.

(iii) 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 had been sent to Argus and after receipt of PCB 2 filters for each of 2 pols ready and 1 filter tested.

Some confusion about whether there is repeatability or not as Argus appears to be using different sub-contractors -- out of 4 units, 3 are sort of same and acceptable, 1 is quite different; to talk to Argus and see what minimum guarantee he can give for repeatability and then take a final call.

Argus has agreed to meet the min specs and 2 boards (all sub-band filters for 2 antennas) have been sent to him -- expected in Feb 1st week : to confirm status.

==> 2 boards have not come yet from Argus.

(b) plans for mass production : switch PCB (20 nos) were available, along with sample chassis; agreed to first put on one antenna; if found acceptable, then go for mass production; compact v2 was installed on C11 and worked fine (tests completed); agreed to give order for mass production alongwith final sub-band filter PCBs; for the switch item itself, 100 nos were available (120 needed); confirmed that this switch is not used in other circuits, hence quantity can be finalised; chassis requirement has been worked out and request has been put (for how many?); mass production spreadsheet getting ready -- to check status of this.

==> spreadsheet by Temkar in internal circulation.

(iv) post amp : Hitite 740 new stock for 30 antennas available; plans for slow rise power supply -- may get done with CB power supply testing; new design of supply was done and PCB was ordered & tested -- worked Ok; agreed to give this PCB for mass production to cover this FE box and common box requirements for 30 antennas; next FE box layout to use this PCB; mass production PCBs have come, but not yet populated. Few cards populated and tested ok; this will now go into mass production now.

==> will go into population for CB box; FE team to discuss about use in FE box and come back.

(v) 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; updated document discussed : most of the changes have been done; a few simple changes suggested in blk diag etc. To check if those are completed and the matter can be closed.

==> changes have been made and document can be circulated.

(vi) Walsh testing shows both channels working in C13, but only one channel working in C11 -- box was brought down to check Walsh matter + problem of spurious bandshape of LNA; current action items :

(a) C11 FE box tested in the lab -- Walsh working ok in both channels -- may be a common box problem or D49 PIU? -- to carry out in-situ test at C11 for this; finally, cable from antenna base to top found to be faulty -- was being replaced; to check status now.

==> cable has been replaced; Walsh has been tested by Sougata but needs confirmation.

(b) spurious bandshape of LNA -- not seen in the lab, except when i/p is loose or not connected -- this could be typical for all units?; need to check about this.

==> various tests have been done in the lab and spurious lines are seen under some conditions of thermal cycling. There is an issue with central pin of QH (at both i/p and o/p side); at o/p side problem was fixed by ordering special connectors and may need same solution for cable connector i/p side; sample machined pins have been got from workshop for making a trial version of the cable -- box will be tested with that before putting on antenna (C00).

1.8 Final version of 250-500 FE box -- from 28 Jan and before (ANR/SSK/HSK) : modelling showed that existing size of box is not adequate (inspite of double deckering 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 tested; meanwhile, FE team went back to a compact design and layout that makes everything fit in the original FE box size; action items :

(i) 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 few months now and no problems reported except for the fringe problem due to wrong filter settings (to confirm if this is resolved).

Walsh has not yet been cleared : C11 box coming down for fixing Walsh problem + one other problem -- see agenda item earlier; to confirm if problem fixed or not.

(b) meanwhile, work on 2nd unit of v2 FE box had started : box was assembled but LNAs gave some problems (dip in passband) -- changed with other LNA units and now working ok; integrated testing to be completed and then put on antenna which has upgraded common box : C0 is a possible choice; check current status of this.

New box fully ready, will go to C11 (with improved noise cal system); original box, after fixing the QH / LNA problem (not clear where the problem is), will go to C00. To confirm current status of this. Also, plans for next set of boxes to be discussed.

==> see notes above.

(ii) 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 possible clash with powder coating needs to be understood.

3 types of FE boxes handed over by mech group to FE team :

(a) plain box with powder coating (b) box painted with HT400 (c) box painted with HT 600; waiting for test results -- tests not yet done.

initial results seen from 5 day continuous run having 4 curves : ambient (shows large increase at sunrise, even a spike to 55 deg); powder coating box; 2 boxes under test : result is slightly confusing as one box under test and powder coating box track each other very well and other box under test behaves worse than these 2 (!); also there is extra cooling in the night ! To confirm time axis in absolute units and to cross-check the results. Can try a cross-check with sensor in the thermal chamber. Need follow-up to understand what happened in these tests and how to proceed further. It appears that this is not working out; FE team to send a brief report with the data and their conclusions and matter to be taken up for discussion -- status? ==> pending action item : FE team to produce the report.

(iii) 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; 6 boxes as per above were made ready and delivered to FE team; for next block of 5 nos for 250-500 & 5 nos for 130-260 -- work order put in; 10 new boxes in process as above; mech group is interested in trying recycling of the shell (outer portion of the box) -- to be discussed next week to understand pros and cons.

==> agreed that shell of old box will be refurbished and inside will be done new based on need (CB or FE for different bands); 8 such boxes have been given to mech in last month for refurbishing; next 5 250-500 boxes will from this set of 8.

1.9 Status of improved 500-1000 MHz CDF -- from 28 Jan & earlier (HRB/GSS/SSK) : there are 3 different versions of dipole (v1, v2a, v2b) and 2 versions of cone (v1 with 66 deg and v2 with 70 deg) 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 2b + cone v2 (solid?) : RL is VG; 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) 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 13 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 seen; 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 was down; licensed version of windows7 was obtained to install on the lab PC and it should be ok now? Software is installed but there may be some hardware problem of hanging or shut down. Matter still under investigation by MU + SM -- to check current status.



==> replacement m/c seems to be working ok, except with monitor -- some intermittent problem that needs to be checked by comp group.

(ii) 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?)

(iii) to do deflection tests for different combinations of dipole and cavities (as mentioned above) for varying distance from focus using a variable height stool to see which design gives optimal performance.

After a lot of effort, a reasonable set of results on Cass-A obtained for the different combinations, including 750 MHz Kildal feed -- this is very similar to Cone1-Dipole2; Cone1-Dipole2b as well as Cone2-Dipole2b are similar to CSIRO feed plots obtained in ~ 2011; agreed to do the following things in parallel :

(a) ask for specific stool modification for cone2 + dipole2b at 1260 ht + matching short length cables to minimise loss (can put it on a separate antenna, other than C10 which can continue to have other cone-dipole combination, e.g. W1 or S3); test was done (at C10) with shorter cable (0.6 m instead of 1.4 m) shows measurable difference ~ 1 dB over most of the band (!); further reduction to 0.3 m appeared to produce another ~ 0.5 dB improvement (!!) over most of the band; agreed to follow-up with LMR low loss cable and also to try with plate mounted QH + LNAs with DC voltage supply; also HRB wants to try with small adjustments of stool height...

==> test done with new arrangement of QH + LNA mounted on plate and kept right next to the feed -- shows another ~ 1 dB increase in sensitivity at 610, but no improvement by 800; note that this is a different LNA and not the same one used in the FE box (with the matching connectorisation) : so may be worth trying with proper connectorisation and same LNA -- HRB and ANR to discuss and work out a plan.

(b) to complete the exercise for cone1 + dipole2b with stubs to increase ht by 50, 100, 200 mm to make it reach upto 1500 mm or so; reviewed the results now available : not too much shift in the peak for cone1 + dipole2b -- peak is around 1310-20 mm ht; this is now pending for making a stool of the correct height for further tests, similar to those done for cone2 + dipole2b combination above.

==> no progress on this.

(c) getting beam shapes for the 2 feed combinations to see if one is better -- quick results from PMQC data (at 610) give some indication that cone1+dipole2b has slightly broader beam -- need to the full RF test data taken and analysed, for both cases; plots of beamwidth vs frequency obtained from Manisha's program : shows ele and az beamwidths varying with freq, but with some difference in slope and also absolute values are higher than expected (x2 for Ele and x4 for Az); these issues need to be sorted out and a more detailed comparison can be done.

==> hand calculations on the data plots confirm HPBW to be around 35 to 40 arcmin (cf around 45 arcmin for the existing 610 antennas) but automated fitting algorithm still giving the larger values. Manisha is in discussion with Deepak to check her program and see if the matter can be resolved.

(d) Also, GP to work out the sensitivity curves for the expected parameters for this range : first version has been done, may need some refinement. There is some indication that some of the drop in sensitivity at ~ 750 MHz may be due to slight (10%) increase in Tlna -- this needs to be investigated in some more detail.

==> refined analysis with 2 different (fixed) values for  $T_{lna}$  show that the range of variation of  $T_{lna}$  over 600 to 750 MHz can explain the change in sensitivity seen in the expected curve. To check about options for retuning this LNA design; meanwhile, can test the commercial off-the-shelf broadband LNA available in the lab (which may have constant  $T_{lna}$  of about 30K) to see if it can be used to test flatness of the response across the band. Meanwhile, ANR to look at the existing LNA design critically to see what are the characteristics and what can be done to improve the  $T_{lna}$  vs freq.

(iv) any new ideas? discussion of 19 Dec 2013 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), including varying stool height -- see discussion above;
- (b) try simulation of CDF250-500 scaled by factor of 2 (including with different dipole sleeve combinations) -- maybe after (a) is done; status update needed.
- (c) design Dual-ring feed 550-900 MHz (initial BFRs can be made for 650 & 800 MHz) -- waiting for above items to complete;
- (d) modified version of cone-dipole based on patent by Shefai + ... (1991) : refers to Kildal paper of 1982; recommends additional choke structure just below the cone but protruding out to  $\lambda/4$  : supposed to improve (a) cross-polar (E-H match) by 30 dB; (b) reduce back-lobe and (c) ???; agreed to cross-check the date of the paper on which our cone-dipole is based and also to build a prototype using cone2 (why?) matched to  $\lambda$  at 750 MHz.

==> FE team to go ahead with a first cut choice to make another cone with the choke arrangement.

1.10 Releasing existing 610 MHz system as part of the wideband upgrade -- from 28 Jan (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 540 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; finally, a total of 9 antennas completed (C1, C4, C8, C12, C14, E2, E6, W1, S2) and 2 more boxes made ready as spares.

(i) 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?

==> not clear what to do on this.

(ii) testing of released systems : to discuss results from weekly / montly tests. first report has been circulated; all deflections seem to be OK; to check if there are any issues that need to be addressed; to wait for next round of tests; also, to add the new, broadband feed antennas (e.g. C10) to the tests.

==> skipped for today.

1.11 Design of new RFCM card (v3) -- from 28 Jan & 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; later, assembled in fully working spare feed, not yet on antenna.  
==> this feed has gone W6.

(ii) was integrated and tested in one 327 box, waiting to go up when there is a failure -- waiting for LNA; ready in 2nd new box; will go on C11, as mentioned above.  
==> this is also up on C11.

(iii) was also integrated into new 130-260 FE box, which is now installed at C10 : to check if working ok -- yes.  
==> appears to be working ok.

(iv) can also be tested in one FE box that is connected to common box that is being tested with new Rabbit card; confirmed it is being used in test set-up in the lab.

==> overall conclusion : v3 card appears to be working ok and the above items can be closed.

(v) report : first draft is ready, and 2nd version is underway -- needs additions about monitoring points and internal review -- still in discussion between Sougata and ANR; some significant changes were to be put in; will be released within the next week (by 4th Feb).  
==> almost complete; will be released by end of this week (13th).

(vi) PCBs have gone for mass production : will be coming by 3-4 weeks; will be populated in-house; meanwhile ~ 10 nos are available.  
==> PCBs have not come yet.

1.12 Next Gen Common Box -- from 28 Jan (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) 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. To check plans for this.

(ii) 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 were completed for the sample box and all the items were available, including Rabbit card enclosure, slow-rise power supply card etc; wiring was to start after completing the layout -- this needs to be redone as things did not fit into the box in the first attempt.

Mechanical issue due to space crunch, requires swap switch PCB and chassis to be redone. Sample unit is getting ready -- PCB in fabrication; new chassis getting made. ==> same status even now.

1.13 Calibration scheme with radiator at apex of antenna -- from 28 Jan & 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 : 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 share the data with SRoy to get the plots done for the variation with antenna position (elevation etc) & then work on interpretation : 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 phenomenn matches that form. SRoy has had some discussion with PAR on the data sent and some additional data is required to be sent by PAR. First attempting at fitting with mathematical fn has been tried.
- (g) 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... to try 250-500 with old antenna in steps of 25 MHz at C11 and C13.

No updates, except that some tests have been done to estimate P1dB point for down the chain using the radiation set-up -- results to be summarised and shared.

- (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.

(iii) deployment of new broadband antenna : suitable unit (from Aronia) had 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.

==> item not discussed at all.

1.14 Walsh switching arrangement in FE -- from 28 Jan & before (SSK/SCC/PAR) : Some tests have been done on the bench by FE group; first draft of report has been circulated. Current action items are :

(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, and tests done : this looks like working satisfactorily in 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 -- to check status of these activities.

(ii) 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; C13 tested ok in both pols; C11 : required change in IC of Walsh gen ckt; result shows one poln work and one not working -- to confirm if working or not. Work on verifying that Walsh works is pretty much over; need to work with BE team to do end to end test.

==> item not discussed at all.

1.15 OF links : new and old, from 14 Jan and before (PAR/SSK) : There are 2 parts to this work :

(i) installation of new, broadband links :

22 antennas installed : C0, C1, C2, C3, C4, C5, C6, C8, C9, C10, C11, C12, C13, C14, E2, E6, W1, W4, W6, S2, S4, S6.

Further, S3 was completed and released; next in line is S1 -- check current status.

==> work ongoing.

(ii) long-term maintenance of OF field joints : Growing evidence for problems with older joints (over last 10-20 years); need some kind of consolidated approach to address the problem. Likely causes : nature and condition of splicing equipment? Nature of cover / protection provided? ... Agreed to get the statistics of the old field joints over time, including a comparison of the losses seen with fresh measurements -- this exercise may take 2-4 weeks; meanwhile, urgent attention is required for the field joint near W1 as it is affecting W4 and W3 significantly. There is a technical problem that the newer kits are not compatible with our existing cable and old kits are not available -- 2 options ongoing : trying through Chinese company and also work with mech group for additional support structure.

Trying to understand the problem : fibre cable used is the same type as original; however, the splice kit for new cables is incompatible with older cables -- this problem is from about 2007 / 2010 onwards?; claim is that joints made before this are ok, as the quality of the material in the older (Australian) ones are better. except if there is a problem of break or crack in the protective coating or the kit. basic list shows ~ 40 cuts (80 joints) distributed over the array; agreed to produce the table along with the loss values; then one can look at the worst losses and compare with other external factors like location, environment and old vs new kit etc.

==> this aspect not taken up; to discuss further plans for this.

2. RFI related matters :

2.1 RFI from different spectral lines -- from 28 Jan 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 :

(a) TV lines : Cable TV leakage does not appear to be a problem; present thinking is that the lines seen are from terrestrial TV transmitters -- mostly in 175 to 229 MHz range. Need a comprehensive list of 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 -- 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, but needs to be checked for carefully. Level of lines appears to vary from antenna to antenna -- need to do a careful check of this aspect.

(b) 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). Lines seen near 1030 and 1090 : interrogation at 1030+/- 3.5 from airport and response from aircraft at 1090+/- 5 with width of about 20 MHz. In addition to these lines, 108 to 140 MHz is used by ATC -- again stronger near W-arm antennas. Need a comprehensive list of known / expected lines from civil aviation related activities near GMRT -- the list of lines have been identified in the main document (below)

(c) any other sources of spectral line RFI : e.g. police wireless etc -- need to be discussed and characterised : work ongoing with omni-directional antenna and disc-cone antenna; police wireless is in 159 to 163 MHz; there are some reports that there is increasing amounts of such activities in GMRT area (earlier it was more eastern side; now also seen in southern side).

(d) other, unidentified lines : new RFI was reported in 270-290 range (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 at a second epoch; nature of 485 line is confirmed (?), but no known source known to be nearby !

Current action items :

(i) to generate comprehensive report on list of lines seen around GMRT and their RFI influence : updated report with list of lines around GMRT getting ready ; have used log-periodic + disc-cone + actual GMRT data for making final compilation. Highlights of the results : lines are color coded as per different sources of RFI e.g. mobile phone, TV, civil aviation. Good amount of information appears to be captured here -- discussed in fair detail during Dec 2014 : agreed to modify title of report; to clearly mark lines not seen in GMRT region; to think of separate version of table (for external circulation) that has ONLY lines seen at GMRT; to think of prediction algorithm for GPS satellites (similar to military satellites).

(ii) For TV lines :

(a) to check for evidence for Mumbai digital TV transmission near 470 MHz;  
(b) noticed that 540 TV line still leaks through for some antennas (also maybe true for the 175 TV line?) -- need to check if this is due to shift of the filters or not enough rejection of the line.  
(c) can we take the strongest TV line & characterise if it saturates the electronics or not.

(iii) For civil aviation : some follow-up is needed to see if they saturate the W-arm antennas.

(iv) For police wireless : to discuss with admin if the information about their transmitters (esp the fixed ones) can be obtained.

(v) New lines : to check about new RFI in 270-290 range; some expts to be tried to confirm nature of 485 line.

(vi) omni-directional antenna needs repair and replacement also; processing for 10 nos (including remote location sensing) was ongoing -- order had been placed; all 10 nos arrived around mid-Jan; one unit opened to verify the components; to be assembled and performance to be tested.



==> no updates.

2.2 Radiation from CAT5 cable -- from 28 Jan & 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 had been circulated that combines testing of switches and CAT5 cables; conclusion was 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 2014 : table of inventory of un-shielded cables currently in use (94 copper lines); total length ~ 1200 metres; procurement of shielded cable was initiated; data was submitted by RFI team, and an updated document had been circulated; about 900 m cable (3 rolls) + crimping tool need to be ordered (enough connectors are available); total investment is about Rs 1.7 lakhs : agreed to go ahead with this; item was under negotiation about details of the pricing (Rs vs \$ quotes due to difference in value); meanwhile, work had started using existing spare CAT5 cables (old stock) to replace older cables in various labs, as per their requirements; conference room & canteen annexe has also been done; meanwhile, folder for main order was followed up and it appears that there is no choice but to go with the Rupee quote and hence total outlay will be ~ 5 lakhs. Current action items :

- (i) To check status of completion of the work in different labs and rooms : conf room, canteen annexe, EPABX room and all engineer's rooms, user's room are done; rest are waiting for main order to supply.
- (ii) To check status of final order and availability of cables, connectors, crimping tools etc : to check if order is gone and expected date of delivery.
- (iii) Need to work out a scheme for proper long-term maintenance with OF and computer group : at the level of PAR to MU it has been discussed -- SSK to send an email to formalise the arrangement.

==> no updates.

2.3 Effect of military satellite RFI in 243 band -- from 28 Jan & 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.

- (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.

2 out of the 6 satellites have 2 deg limit. Can we put this as the default limit for all the satellites? Ops group to generate statistics of the duration of encounters in the current set-up.

This needs to be followed-up, including checking the log that Santaji has created.

(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.

email from SNK gives some details about implementation and testing for (a); Giving refined coords is still pending; (b) and (c) are still pending.

For (a) refinement of coordinates is still pending; for (b) and (c) updates are still pending.

==> no updates.

2.4 Mobile phone RFI -- from 28 Jan & 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.

update on 10dec14 : BSNL has finally done at Gulanchwadi -- this is now verified that power in 950 has come down and 1800 has gone up in that direction. Letter of appreciation can be sent -- PAR has given draft to YG -- needs to be refined and sent. nature of letter required is changed (!) -- YG and PAR to discuss and resolve the matter.

==> no updates.

### 3. Operations :

3.1 Mass production of shielded box for MCM cards -- from 28 Jan & 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; sample box of Rabbit + switch + media converter + Miltech PC combination tested on 4th Dec (report is awaited) : results match with earlier results. Two minor points to be conveyed to vendor : size of one of the opening and assembly of the side plates, which has been conveyed to mech group (!) All these have been done; now awaiting for feedback about delivery of mass production from the vendor. 70 shielded boxes (for MCM) have been delivered; agreed to keep them in storage and use as needed; next part is to start procurement of the RFI material and components needed -- list is with Ops Group and indent has to be raised.

==> List is being prepared.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 28 Jan 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. Shielded box for layer-2 switch (35 nos) will take ~ 1 month (till end of Jan or so) -- still waiting for shipment. Issue of ordering the components needs to be tackled.

==> To check whether sample unit had come and was tested for RFI; and when all the units are expected; meanwhile list of components is being made ready.

3.3 Interfacing of FE with new M&C system -- from 28 Jan & 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 : report awaited from IER -- document has been circulated; to discuss and decide future course of action. IER has given the test report for the work done so far -- appears to be generally ok; what is the next step to be done?

==> technical aspects : all commands except Walsh have been tested; for monitoring, logic / software has yet to be implemented in Rabbit card and then only testing can be done.

(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.

==> discussed briefly.

### 3.4 Development of M&C software -- from 28 Jan & 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 prepared by JPK and then full scale work was to resume.

Mock system on rabbit card tested (optical fibre system)

SJ : making a new module (old : GAB) for fibre optic link; problem with structure of communication [telemetry group to look into this in the long run]; communication

established; sending commands tbd : ~ 1 week it may be possible; installation program (TCS) does not exist; script is being written for installing.

==> first attempt was to take the given code and modifying / editing it to do both monitor and control -- to produce a short report describing this phase of work; development of new module to implement the same functionality -- working for monitoring and trying for control (to discuss with JPK and come back); script for installation of EPICS + peripherals getting ready.

(ii) plans for tasks for next phase of work for new M&C software : architecture definition and UI definition tasks are completed; to check current status of next phase of the work : indent and work order being finalised; meanwhile, preparatory activities for testing using the prototype version to be initiated by JPK to check the interface with the existing systems.

2 meetings held with TCS; 3 phases of work identified : core, business logic, web application; ~ 6 months per phase; cost estimation in progress.

==> at higher level, still waiting for the final quote; at lower level, discussions are going on and progressing reasonably;

(iii) 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.

during last MTAC, 3 antennas (C1, C4 & C6), 2-sub-systems tested, using 2 rabbit cards; servo system tested in servo lab and in C1 antenna (all commands tried out). draft report circulated.

==> communication to FPS being tested; NOVAS library interface done in C, Perl, Python and PHP -- can be utilised by any of the new software developments.

(iv) 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...

JPK : online -> local M & C (EPIC -> needs local M&C for broadcasting FE command

==> not discussed.

3.5 Long-term plans for evolution of M&C systems (from 28 Jan) :

MoM of Sep 2014 meeting discussed and following urgent / immediate action items identified :

(i) For GAB M&C System total 30 rabbit cards are identified but need to discuss with concern department if further additional 8 cards are required for the GAB rack monitoring -- Nayak to confirm. Yes, 8 cards are required for GAB rack monitoring.

(ii) To confirm if Rabbit card interface to MCM 14 via serial link tested & cleared : null command has been tested; CPK working on implementation of the other cmds. Almost all commands have been coded; could test only 'null' command; reponse (feedback) related work left out for now. Null command and response both tested; able to get encoder and rpm reading from FPS system.

(iii) Rabbit card need to support serial link to control FE-CB during developmental phase: this has 2 aspects : Rabbit to MCM via serial and Rabbit to Rabbit via serial.

To arrange a discussion (alongwith FE) to resolve the matter.

Need a discussion to be set-up; SN to coordinate with SSK.

(iv) Verification of compatibility of switching equipment at antenna base and CEB to be compatible with HRS requirements -- CPK and Nayak to ensure the same.

(v) To discuss and finalise optimised packet format for Command/Data response with the Rabbit card -- RU + JPK with YG.

==> wait till end-march for a detailed check of what the existing framework offers and what is required for next gen system and decide if any changes needed.

Discussed briefly, but not clear how to resolve; to try and generate a current status summary.

(vi) To discuss and agree upon a unique set of Rabbit commands per sub-system -- Nayak to coordinate with JPK + ? : Not clear if this has been started.

==> RU to put out the list of currently implemented commands (with parameters) and matter can be taken forward from there for checking suitability for different requirements.

(vii) Hardware at antenna base : JPK to circulate a background note for antenna base computer system and then item can be taken up for a larger discussion -- not done yet.

==> pending for note from JPK.

#### 4. Back-ends :

##### 4.1 Documentations :

Current action items are as follows :

(i) Detailed design doc -- from 4 Feb & 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; was deferred till end Oct; and then deferred till end of Dec; 2nd version had ~50% chassis level inputs; to be completed by end-Jan'15; to check current status.

==> getting ready.

(ii) ITRs for analog back-end systems and digital systems to be taken up :

(a) analog back-end : Sandeep and Navnath to look into that; pending.

work pending for some time; team to review and pick up the activity -- no progress reported; BAK to follow-up with the team.

==> not yet started.

(iii) to move to a point where formal publications can be done -- this needs to be followed up appropriately within the team and a summary plan brought up for discussion; finally, SHR and BAK have started work on modifying GWB ITR to convert to a paper; first version has been circulated; needs to be taken up for discussion between YG, BAK and SHR.

==> can try to meet tomorrow.

##### 4.2 Analog back-end : LO setting related issues -- from 28 Jan & 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 -- done. Pending action item : Problematic 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 -- agreed to start planning for permanent arrangement for 50 MHz (can also check 10 MHz to see if the problem can be solved). 50 MHz has been tried for 1st LO but it appears that problem is seen there also. To go back to the vendor on the matter; to explore other possible options? New test done which shows that only when 105 MHz is used as reference, there appears to be a problem -- evidence has been sent to vendor. Meanwhile, problem of loss of correlation at 10 MHz reference remains to be fully debugged -- will be trying that. meanwhile, GWB can be used with 50 MHz as the reference frequency (right now both GWB-II and GWB-III running from same sig gen) ==> some further tests are going on to understand the problem. can check next time.

4.3 Analog back-end : completion of 30 antenna system -- from 28 Jan & 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; 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) --- shielded box finalized; 12 nos ordered in work shop. Components required have been ordered; first box will be tested and then order for rest will be cleared; can check after 4 or 6 weeks. ==> need to check exact status of drawing modification for the box and then w'shop will decide where and how the mass production will be done.

(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. Tests are now done regularly; need a way to share the summary of the results for taking appropriate follow-up action.

==> raw data is being uploaded on plan website; Atul Ganla looking into some intelligent interpretation and summarising of the results.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 4 Feb & 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) 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) beam mode working with fixed channel and time factors : SSK had got the code changes done for making it general purpose -- going up to any number of channels for corr + beamformer + DAS -- SSK has tested upto 16K channels; 32K may require some extra coding; agreed to first release GWB-II code with 16k channels for users, alongwith modification to SOP; second, work ongoing for coding 32k (and 64k) in GWB-II code for testing; final version will be released in GWB-III; modification in GUI for multiple time integration & channel selection added & tested. no further updates -- to clarify about updates in GWB-II and between 32k and 64k plans, and close the matter.

==> to check with Sanjay about this and clean up this action item.

(b) header for beam mode data : to be taken up and incorporated alongwith the PA mode; SSK has done first round, and needs a discussion.

Discussion between YG and SSK is pending; meanwhile version with header to be released alongwith 16k channel code release on GWB-II.

(c) availability of psr\_mon / pmon on nodes 53 and 54 for recorded data is there; for shm attach needs some work; psr\_mon done but only for off-line upto 16k chans; no real-time version available; pmon still needs to be looked at...

Agreed to confirm off-line psr\_mon available on nodes 53 and 54; to try and provide online psr\_mon with 16k channel release; later, to integrate Rajora's new code into the system : first with GSB, then with GWB-II and III. To check status of ongoing discussion on this, including incorporating of Rajora's new code.

==> see email updates from SSK : psr\_mon is compiled for all beam host m/c's (node52/53/gwbh2/gwbh3) locally. Need a discussion for pmon regarding polyco, catalogues etc...

(ii) 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 -- tests done by SHR : varying i/p power level of broadband noise source at ADC allows characterisation of input power level at which spikes show up; looks like occurring at multiples of 128 ch (for 2K spectrum); to check the level as seen in cross of two such signals.  
==> no further updates this week.

(iii) change of host machines to 1U HP machines for GWB-II : work is ongoing by SHR, including OS, disks and location in the rack; may be able to complete in one month time scale (from 3rd week of Nov); work ongoing, SHR needs to coordinate with Nilesh. machines are ready; GUI needs a version which has new IPs and maybe some paths; in order to switch between old and new hosts, infiniband cables need to be swapped at the 8-port switch -- not done yet.  
==> no progress on this as Nilesh has been busy.

4.5 RFI filtering -- from 28 Jan and before (KDB/BAK/YG) : first version of real-time RFI filtering block (after some modifications) was added to 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 were done and found ok; trials with real antenna signal split into 2 copies and checking both self and cross outputs proved somewhat harder; further, design (with some optimisation of FPGA resources) was ported to GWB-II; agreed for time domain tests using either corr self powers or 2 IA beam signals; some tests with varying sigma were tried on antenna signals (results?); data taken with pulsed noise source [offline input]; new results were circulated and discussed; agreed that the basic scheme appears to be working ok; to try 3 versions of the scheme, with different options for the statistics. Meanwhile, design compilation for 4, 6, 8 bit inputs available; utilisation (for one analog channel) : 41%, 19% and 17% (for total design) for 4 K window; tests were done to see if there is some biasing by digitally splitting the antenna signal -- confirmed ok (mean level changes for lower thld it happens for replacement with zero or replacement with noise but not for clipping); second part is testing with two different methods of generating thld statistics : shown that a priori stats works better for rejecting RFI infected data. Some action items are as follows :

(i) Agreed to support 3 modes : continuous update; update on request; external update; 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.

3 modes demonstrated as working; work for fitting 2 channels on 1 Roach board still ongoing -- to try for the 3 modes separately; also, to concentrate on long-term solution of 2 RFI channels on Roach board with 2 analog inputs at 800 MHz; pulsed noise generator (PNG) ckt with additive noise source shown to be working -- can now be used for demonstrating RFI cancellation on visibility data.

(ii) To work out proper scheme for testing -- KDB has circulated a proposed scheme -- to discuss and check if results are available.

(iii) To optimise the design for fitting on the Roach board -- short-term and long-term goals : optimised design works at 800 MHz, for 2 out of 4 analog channels on a Roach board with compensating delay for other 2 channels, with 8K window which can be changed in run-time by changing register values (can be used on GWB-II or III).

(iv) book-keeping : trying to work out the packing scheme, with the understanding that jumbo packet size is taking up. ....

4.6 Power and cooling requirements for projected back-end systems -- from 28 Jan 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; discussion between SSK and GSJ to try once more with kernel change only one node and examine the log file carefully and report back.

GSB data old & new kernels taken; 17-43 nodes completely new kernel gives heavy buffer loss; (old kernel have very small buffer loss ; old does not support temp monitoring).

More tests have been done and it appears that GSB is rather sensitive to the exact choice of kernel.

==> looks like no progress on getting out of this;

(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 is working ok; cycle for 7 days for preserving the data. To see how this can be evolved.

Right now running on 1 compute m/cs and 1 host m/c of GWB-III (waiting to install on other m/cs); refining the scheme for cross-mounting of disks; auto-restart and halt scripts; cgi script for plotting on monitor can be made more intelligent.

H1 & cor5 cor5 packages installed; auto-restart completed; cross-mounting of disks : to use old scheme.

Installed on 2 more and ongoing; for cross-mounting : not using autofs, but using old scheme of cross-mounting via /etc/fstab; auto-restart is done (every 30 secs).

==> not discussed in detail today.

4.7 Next-gen time & frequency standards -- from 28 Jan & 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".

First discussion has happened between NDS, BAK and YG -- need a follow-up.

==> not discussed.

=====

## Minutes of Plan meeting of 25 Feb 2015

### 1. FE & OF related :

#### 1.1 Detailed design doc / ITR -- pending for long : from 4 Feb & before (SSK/BAK) :

- (i) OF Tx started (may have only blk diags for now, without full details, till a paper is ready!); initial write-up (by Satish) needed improvement : functional blk diagram has been made and detailed description needed to be added; updated version been sent by SSK, was discussed : blk diag of OTx -- couple of small changes suggested (APC controller to bias control), also add one more blk diag at beginning giving the context of the OTx system in the overall antenna base set-up;
- (ii) OF Rx system to be completed (Satish Lokhande) : first version circulated -- some improvements and additions suggested (e.g. to give explicit reference to other docs which have supporting details; to give reason for 10 dB attn; to give comparison with expected values from SFA report; to mention some precautions and practical issues during assembly etc). update version sent last week by SSK discussed : ORx is much simpler and brief; but needs a bit more of material + some elaboration of precautions section; SSK to produce an updated version (for both docs) and circulate.  
==> should be ready by next week.

#### 1.2 Update on results from test range -- pending from 4 Feb & before (HRB/GSS/SSK) : Reorganised into the following issues :

- (i) Tests of ver1 550-900 CDF and CSIRO feeds at test range : new results with VVM set-up, after installation of new encoder + notch filter for mobile band, showed :  
for ver2 550-900 CDF : reasonable E-H match at 610 and then degradation in shape and matching at 700 & 800; partially supported by older measurements from Dec 2013 (with slightly different set-up). Further, results for dipole v2a and v2b with cone v2 show that the degradation of pattern with frequency is worse for v2a than with v2b; radiation pattern measurements have been done with 50 MHz step & using CW signal; comparison with simulation results is awaited. Current results and action items are :

- (a) ver 2b of 550-900 system has been measured on test range; first order comparison of C1 dipole 2B vs C2 dipole 2B -- some differences can be seen : C1 dipole 2B shows better E-H match at 610 ; C2 dipole 2B shows good E-H match at 700; and appears to be decent even at 800, though 3 dB width may be changing; agreed to make plots vs freq for 3 dB and 9-11 dB widths, and for taper of E and H at fixed dish angle of 62.5 to check mismatch in taper -- for both the feed versions.

Some results from the measurements for the plots of 3 dB and taper values vs freq shown -- there is evidence for change of properties with freq as well as asymmetry of the pattern (as had been seen in the earlier plots also); agreed to try to compare with results from C1 + d2b (make fresh measurements, if needed);

- (b) Phase centre of ver1 550-900 CDF and CSIRO feeds needs to be done -- phase centre measurements for C2 + d2b can be tried at the range.

Radiation pattern tests redone for C2 + d2b combination to check repeatability; FE team to summarise the results for discussion.

==> no progress.

- (ii) calculation (based on reference paper) of expected deflection & comparison with measurements to check if there is significant loss of sensitivity -- GSS developing refined version more relevant for GMRT (also, if further expts with 250-500 or

500-1000 feed are useful) : cross check of results from code (0.3 dB drop for 0.5 lambda offset) wrt curves from Kildal paper was confirmed; for GMRT specific case of 250-500, efficiency factor as a function of freq over the band, using the data for the measured feed pattern, was implemented; after correcting one error in the code, better result (9.9 dB vs 11.6 dB expected) was achieved; further, a realistic phase response (instead of 1.0) was included by reading data from a file; results (reported on 19th Mar) showed better match between measured and expected deflections for the 250-500 system : 327 -- 12.8 dB vs 12.4 dB; 400 -- 12.8 dB vs 12.2 dB; 450 -- 12.4 dB vs 11.4 dB; 500 -- 11.2 dB vs 11.0 dB (some re-work needed for lower frequencies?); computed results (based on change in efficiency due to shift of phase centre) show likely drop in sensitivity by about 1.4 dB from 250 to 500 -- this is now to be folded into the net sensitivity / deflection curves made by GP (see agenda item following this one). Present action items :

(a) GSS is working on plans to extend this to 550-900 system -- was waiting to get measured values from test range.

==> no progress.

(iii) Comparison of computed results with measurements for 250-500 band : initial results for good antennas at 250-500 (other than C6) with default height of 1280 (and for C6 with reduced height of 1080) showed that computed values are actually better at high freq end for 1080, which is different from the observations which are showing droop at high freq for 1080 (in conflict with first results reported above); computed results, which were for 1180 to 1480 in 4 steps, were extended to 1080 & 980 and 1180 was found to give the best response (note : this is for a particular value of ph centre based on range measurements); computations were extended to much smaller values (down to 580 mm) and latest results show a peak in the response around 580 or 780 (!), which are in sharp contrast to the experimental results which were carried out in the range 1080 to 1480 mm and showed optimum performance around 1280 mm -- this needs closer scrutiny of the simulation code and experimental results.

==> no progress to report.

(iv) Phase efficiency computation has to be linked to the aperture efficiency computation (NRAO's eff. program, modified for GMRT specific parameters) -- this work is ongoing, along with Sougata (was expected to take 4 weeks -- till mid-Sep); code is being ported to matlab (?); some issues about input file with the values to be given -- this also needs to be resolved; also, original NRAO fortran program can be made to run to give some initial cross-checks? code had been ported from the C version that student had written to Matlab but results are not yet matching with expected behaviour and debugging is going on. Now trying to port original fortran version to matlab; one email has been sent by Sougata with some updates on pattern calculations -- need to discuss and understand its relevance.

FORTTRAN to MatLab conversion : ~ 50% completed; was to be fully done by end-Jan / early-Feb -- need status update on this.

==> no progress due to lack of time to work on it.

1.3 Phase centre tests for 250-500 CDF -- from 4 Feb and before (HRB/GSS): to test with 100 to 200 mm height change (around default of 1280 mm) in 250-500 feed on one antenna to see how much change in sensitivity is seen. Tests done on c6 using feed with shortened support legs of the cone (instead of shortened stool) -- comparison of results for 1180, 1280 (default) and 1380 : 1280 & 1380 show slightly better sensitivity at low freq (250-400) but at higher frequencies they match with 1180 (which is quite flat throughout freq range); agreed to try for 1480 to see if there is a monotonic behaviour; also compare with simulation results of GSS. Consolidated results tend to show that the latest level at 1180 height does show a slightly better

response; a final confirmation is needed about the optimum performance from the measurements; confirmed that we can't go below 1080 by further cutting the support legs of the cone; also, current adjustable stool will not work for 325 MHz face due to welded nature of existing stool; agreed with HSK to reproduce one more adjustable stool with modifications learnt from present experience, and try on one CSQ antenna (C6?) by removing the Lband feed, shifting the cone-dipole with new stool to this face and using the existing 250-500 FE box on it; tried on C6 during MTAC period (Oct 2014), but measurements could not be completed as antenna was required for L-band GTAC observations. Current action items :

(i) Agreed to go back to C8 at a later point of time (after 550-900 measurements are completed).

(ii) Meanwhile, FE team to go over all the available measurements and produce a consolidated summary.

==> agreed that this is still on hold till 550-900 work converges; meanwhile summary can be sent by HRB.

1.4 Comparison of measured & expected sensitivity curves -- from 4 Feb (SSK/GP/HRB): scheme for (re)calculation of expected values across the broad bands to be finalised (and added to measured curves) : curves being done with constant QH value and with variation of T\_lna with freq incorporated; model for the main BPF was also put in; after that antenna efficiency factor (based on measurements with 4-5 points across the band) was added by interpolating the measured values; return loss of the feed was added to the above and the result now matches much better with the data -- all this was done for 250-500 band; some follow-up action :

(i) Antenna efficiency factor : to determine what is the best thing to use and stick to that; are there cases where the theoretical curve gives less deflection than measurements? agreed that both the efficiency term (which includes default ap eff + phase eff, from measurements on test range) and the return loss term should be kept and the product should be used.

(a) To get clear confirmation about which all terms are included in the efficiency term that is currently being used in the calculations.

(b) Also, to see if a note summarising the overall scheme can be generated.

==> GP to look into both the items and get back.

(ii) It appears that there may be some discrepancy on the high freq side (seen only for a couple of antennas out of 10?) -- could be due to absence / presence of 540 notch filter ? For the units already installed, there are small (~ 5 to 10 MHz) unit to unit variations in the filter response; for new systems all the the 540 notch filters will be tuned to match an overall BPF + notch filter template response. Agreed that Ankur to check both LF & HF side as part of the work looking at antenna to antenna varn in 250-500 system response and report back together with that. HF discrepancy resolved as being due to notch filter; LF discrepancy was mostly resolved after RL was included in calculations; item can now be closed.

==> both of these seem to be ok; now there appears to be some discrepancy in the mean deflection value, as the theoretical formula was revised to change the const ! This needs to be checked, including simple comparison using basic formula.

(iii) possibility to try it for Lband to be explored -- information gathering had been started : feed pattern (efficiency) at 3 individual freqs is available, and measurements are now available for 5-6 frequencies (?); agreed to work with the 3 pt data and do simple interpolation and see what kind of curve is produced; first order calculation of model had been done -- Sanjit + Gaurav had worked to put the curve for expected deflection alongwith the measurement results to do the comparison,

and weekly plots now have this added. Current action items :

(a) 1 or 2 antennas with response better than theoretical esp at lower edge of Lband

-- need to be checked;

(b) fall-off of theoretical curve at edges needs to be investigated

(c) RL of feed is to be included.

(d) notch filter alongwith BPF to be added.

==> GP to check and report; also, the change in constant reported above will affect this comparison also !

1.5 Installing and testing of temperature monitors in front-end & common boxes -- from 11 Feb (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 tests had been carried out; meanwhile, C4 & C10 fitted with dual temp monitors in FE box, and C13 with monitor in both FE & CB -- some tests had been done but data was not sensible due to unresolved issues in the wiring of the existing common box units that prevents desired data to come on expected channels in 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). Combined SOP for temp monitoring and total power monitoring has been prepared and relea

(i) Analysis of the data : C13 & E2 both channels temp monitor available at online output (fixed for C13 one ch FE & 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; first results for ~ 5-6 antennas (LNA + FE box) + 2 antennas (CB) for 3 hr duration shows some basic behaviour but not clear how well things are working; to try two things : (a) to check if any old data of longer duration (from last 2-3 months) is available (b) to try a longer run, even for one antenna like W4 which is under maintenance; some of the short data stretches have been looked at; need a long stretch to come to any reasonable conclusion about the working and about range of temperature variation seen -- to be tried on W4 and results to be reported.

At least one 6 hr data has been taken; need to discuss results of this and also the status of the report.

==> Report has been updated and submitted to library for uploading; longer stretch of data and analysis of that is still pending.

1.6 Total power detector for FE & common boxes -- from 4 Feb & earlier (GP/ANR/SSK): plans for final scheme : 20 dB coupler for CB and 10 dB coupler for FE (at final output) with common 20 dB amplifier (Galli-52 instead of Sirenza); feed-thru vs connectorised arrangement also resolved; after lab tests (including monitoring via MCM channel) in FE and common box, sample units installed in C4 FE box and E2 common box. Some other details are as follows :

For common box : data from 2 units installed on E2 showed basic things working ok: first round of testing showed 11 dB deflection (12.4 dB expected) on Cass-A; later on Crab, getting 5.5 to 6 dB (6.6 dB expected); flat-top on-source waveform was understood to be due to quantisation of step size of detector levels (least count issue); script / SOP created for automated running of tests;

For FE version : 2 units had been assembled and found to give identical performance as per specs; problem of feed-thru vs connector was resolved in favour of feed-thru

(as per original chassis design); all testing completed in the lab; first units (on C4) showed problems -- traced to incorrect mapping of channels etc.; new units (batch of 20) that were assembled showed unexpected change in detector o/p due to grounding problem which was corrected (manually) for 10 units and final PCB for mass production was modified for this change; script for automating the observations has been done and released by GP.

Current action items being followed :

(i) for RC time constant : main aim is to check and ensure that some appropriate RC integration is in place at o/p of the detector; some feedback from vendor, but not fully satisfactory; existing ckt has 10k series resistor (as per data sheet); measurements done in the lab show some kind of a curve with rms changing inversely with increasing time constant, but the results are not repeatable from day to day, indicating some pick-up in the circuit or the measurement tool; needs to be checked carefully. Current status : agreed to put 1 s time constant in all the PCBs -- this requires very large capacitor; few microfarad may be more practical, pushing the time constant to ~ msec; agreed that 100 micro-Farad maybe the largest practical value, giving 100 ms time constant; assembled one board with 100 microfarad -- no observable change in performance seen; need to go to antenna & test : fitted in new 250-500 box -- may end up on C11. Box is up on the antenna and test results will come soon -- to check status of this.

==> one set of measurements taken which look ok; can try another set today, including slightly weaker sources like Crab, Virgo...

(ii) analysis of test data and results/conclusions : 9 antennas with FE power monitor installed; test data recorded for 8 antennas; out of these, signals seen for only 3 antennas : C13, C11 & S4 (both pols); some sign of life in E6 and something on W4 (very noisy / weak); deflection on Cass-A is about 10-11 dB (bit less than expected); flat nature of curves understood as least count limitation; simultaneously CB signal recorded, but working CB monitor is only on C13, E2 & W4 + W1 -- all of these showed deflection; signs of "memory" in holding a stale value in FE monitor (all antennas at same time!) -- confirmed with Ops group to be due to combination of cycling of FE monitoring (being turned off when at a source transition) + the fact that cold sky off source is quite far away from the source (!); further, two sets of new data had been taken (3 and 6 hrs long), to check for repeatability of working antennas, as well as status of partially working antennas (as seen in first data set) and correlation with 30-1 data; first order impression is that new 2 data sets are consistent with 1st data set (tbc).

Distilled action items for GP : to take 3-4 antennas in each of FE and CB (with one common antenna C13) and analyse 4-5 good epochs for the following :

(a) repeatability of deflection and to check that it matches with expected values -- this has been done and appears to be ok.

(b) consistency between FE and CB : checked for C13 and found ok.

(c) checking spurious behaviour -- RFI or something else : data log of 30:1 output checked -- power detector changes when RFI is present;

Many of these points have been addressed with the existing data and the same can now be summarised in the ITR -- draft version for internal discussion / comments was in internal circulation; updated report has been circulated and matter can be closed.

==> update of report is just waiting for results on RC time constant at C11...

To decide upon long-term plan for power monitoring.

==> GP to generate a note about the proposed scheme for this.



(iii) All these data sets also have temperature monitoring (for all of these antennas, as well as for a few others of 130-260 etc). Plotting and first look has been done; consistency across antennas (and FE/CB) appears to be there -- need to complete a formal analysis of the same; agreed that temperature data (for 250-500 FE and CB) to be given to VBB for plotting; fresh data to be taken for 130-260 FE box. first results for ~ 5-6 antennas (LNA + FE box) + 2 antennas (CB) for 3 hr duration shows some basic behaviour but not clear how well things are working; to try 2 things : (a) to check if any old data of longer duration (from last 2-3 months) is available (b) to try a longer run, even for one antenna like W4 which is under maintenance -- this is planned; new data from recent tests has been provided to VBB -- to check status of the results from this.  
==> see above for the discussion.

(iv) possibilities for automating data reading, analysis and plotting also discussed -- GP has now implemented automated program for plotting CB, FE power levels (both chans) and 3 temp monitor values (2 in FE and 1 in CB) in one go from a file containing data for X nos of antennas is ready; this has been tested with the above data sets; agreed that it is generic but not tested for anything other than temp and pwr; can be generalised for all channels of all 30 antennas but can be taken up at lower priority; also, does not have a user friendly interface; current actions :  
(a) agreed that working version of code + SOP to be fully released asap : SOP has been released; GP working on note about analysis procedure (using matlab).  
(b) SSK to take up discussion with SN about GUI development with suitable person from control room : initial discussion with SN has happened, but not clear if optimal person has been identified -- YG to take up the discussion jointly with SSK & SN.  
==> for (a), the note is still pending; for (b) the discussion is still pending.

(v) plans for mass production : full quantity of PCBs (360 for FE and 60 for CB) are in hand; agreed that new units can be made ready to match the typical / expected consumption rate of going into boxes; in between, assembly of 5 sample new units gave some problems : old vs new flux (resolved); latest status is as follows :  
for FE : 12 units (PCB + chassis), for 6 antennas, are assembled, tested & ready;  
for CB : 12 nos of PCBs (for 6 antennas) assembled & tested; will use out of the 20 chassis remaining; chassis will be ordered in units of 50 nos, when needed.  
(a) to check current status of assembly of FE units (including chassis)  
(b) to check current status of assembly of CB units (including chassis).  
New set of chassis have come; item seems to be going smoothly and can be put on low priority list.  
==> there are no major issues here except for ordering of capacitors etc and item can be really closed and removed from agenda.

1.7 Spare LNAs for L-band feeds -- from 4 Feb & before (SSK/ANR) : we had 32 feeds; 2 were not working (1 has been dismantled for making drawings of new feed) due to lack of electronics spares -- mostly device failures (including some new ones?); some new LNAs were successfully assembled by Gopi and failed feeds for C3, W1, E2 & E5 were fitted with these and found working ok. Also, one spare feed was assembled and installed on W1 and working fine. Current action items :

(i) to update about status of feed on W1 and other recently installed units : finally, after a lot of follow-up, it was confirmed from PMQC data that W1 appears to be working ok for past few months. 2 other recent units are on C1 + one more antenna : C1 has units with new LNAs, for both pols made ready from older batch of devices with careful retuning; action items :

(a) confirm which is the second antenna -- still no clarity -- maybe C3 ?  
(b) confirm status of performance of these antennas (C1 had been giving ripple and bad bandshape problem) -- problem found to be due to broken cable; now fixed; to check sensitivity results.

==> now C1 feed is down due to low deflection in one poln; right now there is no spare and this one needs to be repaired and better book-keeping needs to be done.

(ii) making spare LNAs -- agreed to have at least 5 LNAs ready & available as spares : 10 nos of LNAs had been assembled, tuned and made ready; these have all been used up now; new batch of devices ordered and delivered. Action items :

(a) the assembled devices may be having some possible problem with bias point -- it was found that LNA is drawing unusually lower supply current, even when 'gain' & 'T\_noise' are normal; not much progress in understanding low deflection of new LNAs; retuning is not helping -- increasing the bias current leads to oscillation (to check OMT etc for any problems?). Devices from new batch appeared to give a stable solution(?) -- however, not all devices in new batch are the desired ones -- there is a mix and it may be only about 1/3 that are usable?

Finally, one unit fully assembled (all 3 stages) and working ok; 2nd unit also made ready -- these 2 used for 2 channels of feed #32 (note : this is now the 1st spare feed after 30 working feeds!). 2 more LNAs (3rd and 4th) assembled and tuned; work on 5th & 6th is ongoing. To check if there is any improvement in the count.

==> Ramesh will be working on 2 more cards which have been assembled.

(iii) alternate LNA designs : to see if design used for 550-900 can be modified for 1-2 GHz use; to also check the design done by Abhay Kulkarni and see if it can be improved for our needs; design files had been obtained and were being checked by GP and ANR : model files converted to match simulator used by us; component models in software had to be downloaded; also ultralam2000 that was used is not available in the market now; agreed to simulate with ultalam2000 first to check ckt works ok; then concentrate only upto 2 GHz and change substrate to RT 5870 (easily available); simulations matching with original results completed; results reproduced with RT 5870; trying to tune the design to required specs of gain (30 vs 34), Tlna (~28 or better); in terms of NF target is to go from 0.4 to 0.3, and maybe at cost of reduced BW; now getting close to Tlna of 28-30 across the band; overall gain is also very good ~ 38 dB; but 4 db slope across the band needs to be adjusted; move from s2p to non-linear model completed successfully -- did not disturb the results.

Current action items :

(a) work still ongoing to try to flatten 4 dB slope.

(b) meanwhile going ahead with layout & ordering of PCB and making couple of units, while continuing to improve the design; design & layout completed; first proto PCB should have come by now and may be ready for testing?

==> PCB will come this week -- it already has 4 dB correction done in it !

(iv) possibilities for new LNA with Tantrayukt (Yogesh Karandikar) : item to be taken up for discussion, following the visit of YK in Dec 2014.

To check if YK has got results from his first prototype for 500 to 1500 and then take the matter forward.

==> YG to contact YK about it.

1.8 Completion of spare L-band feeds -- from 4 Feb & before (SSK/ANR) : Target to have a total of at least 5 (out of 8) working spare feeds (from mechanical to electronics) : 30 antennas had working Lband feeds, but there were no spares, though we had 2 feeds; one unit was assembled back from the feed that was dismantled for making the drawings -- this was completed and installed on W1 (one feed is now in

the regular 'maintenance cycling' of feeds); 32nd unit was there in Pune wshop and was shifted back after assembling by mech group and then fitted with electronics; it uses newly fabricated push-type (press-fit) probes; after 2 LNAs were made ready (see above) this feed is now available as the 2nd spare feed. Furthermore, 6 new feeds were made (via outsourcing) in 2 batches of 3 nos; in the first set of 3, 2 nos had wrong size of horn and had to be corrected by the vendor; all 3 needed new covers as old ones were not suitable; second set of 3 feeds from Akvira : OMT + horn + cover; hence, total of 8 spares CAN become available; note that weight of 3 latest feeds is 18 kg more (72 vs 61 kg) than earlier feeds -- now accepted as 'fait accompli' !

Following issues need to be resolved currently :

(i) having sufficient number of spare LNAs : see item above for details; LNAs for 3rd spare feed now ready, waiting for filterbank to be ready.

==> no change in status of LNA and filter work.

(ii) other electronics : sub-band filter bank is the main item missing; it was found that the sub-band filter ckts spares don't work as one gnd line (for switch ckt) is missing in the films from RRI (!) -- to try with a wire providing the gnding ckt; alternate is to start using the new design -- this shows good performance for individual filters, but integrated unit is giving poor performance for selection of 1280 -- problem with the switch (new make is not giving same performance as original make) and this is affecting both reuse of old filter PCBs and also the new design; looking for original make (MACOM) and also trying a different switch (Hitite, which means new PCB); new PCB designed with Hitite switch (will need additional patch PCB to convert logic levels; one chassis (for 2 pols) is available for testing; new design still not working for 1280. After isolating the filter from the switch, response was found to be fine; found some issue about the layout on the PCB for the Hitite case and PCB is being redone and waiting for vendor to send back.

==> PCBs received and will be populated and tested.

(iii) plans for assembling and making completing additional new feeds : all the 6 new feeds after corrections, completion of covers, powder coating etc are now available at GMRT; new issue about mating and alignment of probe had cropped up -- press fit (old schme) vs threading (new scheme) : the latter was made "workable" after one round of adjustments; at present, 1st of these 6 (33rd feed) is fully ready and waiting for LNAs and filterbank, as above); 2 more feeds are mechanically ready (one has push-pull and other has threaded probes) and getting wired; LNA and filterbank are not available for these. Work is ongoing, last step is the plates to be made for these. May not work on the last 3 feeds for present.

Probes and plates for mounting of electronics are done, but plates may need some case to case modifications when assembling. To check if this item can be closed.

==> first 3 feeds are fully done; next 3 need some minor works -- item can be closed.

1.9 Testing of LBand wideband systems on 30 antennas -- from 4 Feb (PAR/SSK/SN) : (to maintain a proper log of action taken on individual antennas during these tests and debugging activities); data being taken fairly regularly since June; some history is as follows :

June data : C08 & W01 CH-2?? shows ripples at OF RX output -- gone now (to check possible cause); Sep data showed problem with W4 ch2 -- fixed;

RFI issues : S04 & E02 showed RFI type lines, E06 showed RFI lines in CH1 (June data); line RFI in 1070-80 range (likely to be airport radar), around 1280 (likely to be due to GPS) -- July data; lines at 1030 and 1090 (3 MHz BW) also seen (Aug data);

also, is there a RFI line at ~ 1200 (3 Sep data)? -- need to confirm status of all these lines (can be covered under RFI agenda). From Sep data : 1176.0 & 1176.45, 1191.80 & 1204.70 are likely to GPS (in addition to 1280) and 1090 is airport radar; there appear to be a few unknown ones also (e.g. 1320, 1480 etc) -- check with RFI team separately by including in that agenda item.

Current action items are as follows :

(i) some antennas with poor deflection overall : to be addressed as and when such cases are found. e.g. Ch2 of C1 (may be a cable problem?) -- confirmed that it is cable problem; to check current status of the work to fix the problem.

==> see status above.

(ii) some antennas with deflection changing over the band (less at high frequencies): checked if pointing offset can explain this -- not found relevant; current thinking is that this happens for cases where the RF power level (at laser input) is too low; this has been confirmed with a more careful set of tests (and plots) for few selected antennas, including make good ones look bad by increasing OF attenuation -- has been demonstrated in the report of 11th Nov data; to check if appropriate reasons for low power levels can be identified.

==> no updates on why some antennas have low RF power level...

(iii) some antennas with poor on/off bandshapes, including large slope e.g. W1 (has been there for several months); C4 and W6 also; S4 has very low power; such cases need to be checked (call sheeted) and understood.

==>

(iv) few antennas with ripple or large slope across the band -- to be followed up as and when seen.

(v) there is data from Oct, Nov and now Dec -- can we have a well-defined algorithm for comparison of different data sets and getting statistical conclusions? -- to look at developing a tool for this.

Latest report (10th Jan) has a good classification of the problem antennas; team is looking one by one into the problems e.g. W5 found bad cable between feed to CB of ch1; now looking at W6... to check current status.

==> latest data from 3 weeks of Jan provides a useful data set to confirm systematic problems in antennas and then initiate follow-up action; nature of set of problems remains pretty much the same.

1.10 Characterisation of recommended attenuator settings for different bands -- from 4 Feb and before (SSK/AP) :

(i) values had been given for Lband, 250-500, existing 610; only 130-260 / existing 150 was pending -- this was also completed (appears that 6,6 may be the best value); note to be circulated soon (Sanjeet + Ankur); then can be taken up for detailed discussion and closure; meanwhile, new problem detected where it appears that attenuation setting may not be working reliably -- this is now understood and being fixed; after that, note can be taken up shortly.

==> pending for some more time...

(ii) FE team to test the power levels at OF o/p and cross-check against SFA values : for 250-500, this has been done and results incorporated in the updated SFA report;

for Lband the exercise is ongoing (antenna to antenna variation is a major issue); can be done now, as Lband is relatively stable now; was done by Ankur in a report back in July 2014 -- discussed and suggested to add a few refinements of the statements used (for 250-500) and add an explicit entry in the table; further to compare for each sub-band of Lband using realistic cable loss value for each sub-band (this can then be done for 250-500 also, if found significant). Updated version of report to be produced with these modifications; first part (for changes related to 250-500) has been done; waiting for measurements at Lband to be completed; some work has been done by Ankur, some work has been done by Imran to characterise FE, and SFA report also has measurements of cable loss; calculations have been done; need to cross-check with measurements; updated report in internal circulation; to check if it can be released for discussion -- waiting for report to be finalised. ==> report being updated after some internal feedback.

1.11 Switched filters at different stages of receiver -- from 4 Feb & before (SSK) :  
2 main categories of switched filters are needed : (a) switched filter banks inside FE boxes and (b) switched filter banks in rx room; these are being designed using the new switches : 2, 4, 8 way switches with different possible configurations; (c) a 3rd application of these switches is for designing the monitoring set-up in rx room. Current action items are as follows :

(i) for rx room monitoring work : note that all these circuits are connected to the monitor ports of the OF system; first design did not give enough isolation at highest freq of operation and hence new design was done; ckt for 2:1 and 4:1 versions now ready & tested -- 25 dB isolation achieved; drops from 25 to 17 dB with frequency for 8:1 switch -- now getting improved rejection : better than 25 dB below 1 GHz; goes down to 16 dB above 1 GHz; the leakage between the signals with this switch is still unacceptable; now trying another switch (MACOM make) which terminates unused inputs while selecting the desired input (will be used in the final 30:1 monitoring system), and gives 40 dB isolation; new switch + modified design with additional isolation switch and power supply isolation -- now achieving 35 dB at Lband and more than 50-55 dB at lower frequencies, with all channels powered; will be tested in monitoring system for 16 antenna set-up. Current action items :

- (a) To do an additional test with signal injected at Tx i/p;
- (b) To completed 16 antenna system (4 units wired and ready)
- (c) also to summarise the design in a note.

==> right now 8 antenna is getting ready in 1-2 weeks; after that (a) will be done; to expand to 16 will need more switches and some more time. tests will be done with 8 antenna. note to be taken up after completion of 8 antenna system.

(ii) for rx room switched filterbank : prototype system was almost ready for testing; need updated block diagram of the prototype system; to see if first results from integrated testing are available; also, need to check about space in rx room for housing these units; also check plans for installation and testing of the 1650 MHz LPF units alongwith the above; tests have been completed; a report needs to be produced characterising the performance -- work ongoing for compilation of report; report in internal circulation; to check if it can be released now.

==> some improvements in report underway after internal feedback; meanwhile, 1650 filter has been put in C10 in one poln on a trial basis -- has about 0.5 dB insertion loss; appears to remove the 1800 mobile line and doesn't appear to affect other bands; agreed to put available 10 nos in ch1 of 10 antennas; also agreed to move 70 MHz HPF to just before signal enters existing IF system (instead of just after signal enters the ABR cage).

1.12 Follow-up on 550-900 MHz band filters -- from 4 Feb & before (ANR/SSK) : Comparison of ICON product with in-house effort and finalisation of plans : technical comparison of individual filter responses showed in-house design to be slightly better; tests with integrated unit using new PCB showed insertion loss increases to 3 dB now and some change in slope on higher side; complete chassis and full integration done and tests repeated to make detailed comparison with ICON results -- showed performance is very similar except for some out of band bumps (at 30 dB level) and slightly slower roll-off ; tried with AC coupling capacitors (no improvement); new board fabricated which, after retuning, gave much better roll-off; meanwhile, some realistic cost estimates for in-house production vs getting it done by ICON were made : concluded that ICON option will be much more expensive. Sample PCBs from Argus and Shogini had been obtained -- first test results (without chassis) showed ~ 5 MHz shift in 2 sub-bands but better roll-off; final plots showed same IL but the higher sub-bands having slightly shifted centre and widths which cross the main BPF upper cut-off; design was modified and new PCB was obtained from Shogini and tested ok and one complete system with chassis (for one poln) was made ready; it was agreed to defer further work till ready for integration in new FE box; meanwhile, cost estimates for mass production made : Rs 32000 for 2 PCBs is the dominant cost; total is about Rs 41,000 per antenna (compared to Rs 90,000 by ICON); hence, agreed to go ahead with building our own design; meanwhile, reduced wt chassis (700 g less) had been made (2 nos) by w'shop and integrated filter unit was made and tested ok.

For mass production : PCB material is in hand; switches needed are in hand; so may not be a major problem for going ahead; now waiting till layout of 550-900 FE box is finalised.

Agreed to go ahead with PCB and chassis, while waiting for layout to be finalised. Layout is now final; one prototype unit is ready; to go for mass production in units of 20 nos (10 antennas). Also, to confirm if design report is ready and released?

4 Feb : roblem with Shogini for mass production -- to be discussed later today.

==> discussion with Shogini now converged and he is ready to go ahead under the same terms and conditions; so, first batch of 20 PCBs will be done as soon as the work order reaches him. Report was completed quite some time ago and released (YG to check).

1.13 Finalisation of 550-900 FE box -- from 4 Feb (ANR/SSK) : to produce a block diagram for the 550-900 FE box; then to start seeing which units are ready, which need to be done; which may need to be combined into single units etc; roughly same number of components as 250-500 box, slight difference in the arrangement of notch filters; size of sub-band filter chassis will be different; will take up the layout of this after common box layout is completed; later, agreed to start with this, even as common box is going on in parallel -- Imran + one looking at it, with Bhalerao's help. To check current status.

==> items being collected : dir coupler not available -- being designed fresh; sub-band filter chassis (only unit) given to w'shop for mass production needs !

1.14 New filters for Lband -- from 4 Feb & before (ANR/SSK) : Sample Lband full-band BPF had been designed -- has no slope with freq and better insertion loss, and maybe a better option than the existing main BPF; similarly, prototype design of new sub-band filters (with better insertion loss) has also been done. Detailed results for the main BPF shows that the BW is slightly less than existing BPF : 500 MHz (965 to 1465 MHz), instead of 590 MHz (890 to 1500 MHz) -- this gives better rejection to mobile band signals, but has implications for final usable BW of L-band system; furthermore, an improved notch filter has been designed for the 850-950 mobile band (-60 dB vs -45 dB at 900 MHz), alongwith a LPF for cutting off

the 1800 mobile band has been designed -- 3 dB cut-off freq of 1650 MHz. The matter was presented to the users in Friday meeting on 9th May, and it was agreed to generate a note about this proposal, for clearance in the GSG. This was done and matter was discussed in GSG of 13 Nov and it was cleared to proceed on the following: new BPF + mobile notch filter to replace existing filters in FE box; LPF to be put in common path at antenna base as a common facility for all bands; to be taken up as a case-by-case replacement job, whenever a unit comes down for maintenance work. current action items :

(i) status of mass production : 10 units of 1650 LPF have been fabricated out of 40 PCBs available; PCBs (stripline) does not need much work for assembly -- can be given for manufacture; new chassis will be needed; PCB order for 70 nos can be sent using existing eps10 board; both pols can be combined in one chassis requiring 35 nos only -- drawing to be finalised for rail-type chassis; to check if existing chassis can be re-used; PCB + chassis for new BPF ready for 40 nos (30 antennas + 10 spares); for the new notch filter, 60 nos had been made (PCB + chassis) of which 30 have been used in existing system (waiting to order more)...

(a) to confirm the present status from Ankur's spreadsheet -- discussed : Lband new filters now included (BPF is completed); sub-band filters TBD; to check current status.

(b) new complication is that mounting plate has to be made for putting the new units in existing systems; this is an "internal matter" and can be taken care of?

(c) agreed to put 10 nos of 1650 LPF in one channel of 10 antennas which have 250-500 broadband system installed. Waiting for chassis; will be putting on antennas in adhoc fashion for now and later on with proper mounting arrangement.

==> for (a) sub-band filter to be added to spreadsheet later on; for (b) and (c) see item above (can rationalise the agenda items).

(ii) sub-band filters (design is at simulation level) can be taken up as a replacement for the problem encountered while making new spares for Lband feed (see above) -- to try new PCB with different switch (Hitite) -- see update on this in earlier agenda. Right now, using old design with new PCB for populating in spare Lband feeds. To see how the matter can be resolved; new PCBs with Hitite and MACOM switch are awaited. ==> PCBs have come; need to be tested.

## 2. RFI related matters :

2.1 RFI tests of ethernet switches for antenna base & GAB -- from 4 Feb & earlier (SN/BAK/SSK): Testing the available switches for RFI & plans for design of RFI box for ethernet switches : sample units from Cisco, HP, Dlink and DELL had come and were tested for RFI -- conclusion from final report was that D-link is much better than others (but it is 2x more expensive than next best option of CISCO -- by Rs 20K); also, use of shielded CAT5 cable provides significant improvement; later, during March-April 2014, tests were done with RFI enclosures (with mounting of filtered and shielded adapters, eth cables, AC pwr line filter, shielding for fan etc); results looked very good : isolation is about 70 to 35 dB from 100 to 1400 MHz; also, good improvement is seen with switch + shielded CAT5 only (without box); both CISCO & D-link work equally well in shielded enclosure, but CISCO is slightly worse when only shielded CAT5 cable (without enclosure) is used as it has more number of discrete lines in that configuration. However, it is now clear that it is not possible to use this 24-port switch in GAB; hence, CISCO can be selected as the final version for antenna base, alongwith the shielded enclosure -- agreed to go ahead with this. Updated report on the tests has been circulated. Pending action items are as follows :

(i) Testing of prototype unit from vendor showed need for change of location of AC powerline filter -- mech group has been informed about this and the change is being implemented in the units that will come; email update from PAR : confirmed that the information has been conveyed to the vendor and item can be closed.  
==> can be closed.

2.2 Discussion relating to Industrial RFI survey -- from 4 Feb & before (PAR/SSK) : revised docs (from 2009 and 2012 discussions) had been circulated by RFI group and were discussed in 5 June 2013 meeting (is the document too exhaustive?); new survey planned with main aim to generate updated database which will be useful to pinpoint likely hotbeds of RFI in the industrial areas in addition to finding those without NOC; after months of planning and discussion with DIC, was finally conducted during 23-27 June with 4 teams; covered Ambegaon and Junnar talukas ~ 40-50 villages in each; ~ 40-80 working industrial units (large number are closed down or never existed!). Some of the progress is as follows :

A form had been prepared for use in the survey and had been discussed in detail and agreed that it is suitable for use; about 70% of existing data had been entered into this form; agreed that this activity would be superseded with making a database of equipment and NOC record for the existing industries found in the survey; this data entry now completed for all 3 regions : Junnar, Ambegaon and V-K industrial estate; some highlights from the database : of the total list, a significant number of industries are closed down, and another significant factor are no longer traceable; about 1/3 of the original are still working (ignoring poultry which is about 1/4, but is considered RFI-friendly).

A follow-up meeting with DIC took place on 30th Sep 2014. Summary is as follows :

a. To maintain proper record of the data of existing and future industries in the same format. The data format and data base was shared with them during the meeting.

b. Complete list of the villages in Zone I to Zone IV is submitted to them, based on which they can decide the issuing of NOC for industries in different regions (and also outside?).

(c) DIC to issue NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT

Some of the present action items are as follows :

(i) To cross-check the list against the ones which have NOC (for those operating without NOC, add to our database and inform them about informing us for changes, and DIC to issue NOC post-facto as mentioned in other agenda item) -- this is happening now; current table has a column indicating whether NOC is there or not. DIC has started taking action on parties without NOC (e.g. Govardhan dairy, ~ 20-30 km away). DIC will be sending the standard form to all and it will come to us for clearance; we need to be careful about to whom we say "yes" in retrospective manner, so as to avoid setting up a precedent of giving NOC to somebody with wrong kind of equipment already installed & running ! Possibilities for improvement can be suggested to them.

(ii) To follow up with DIC about

(a) issuing of NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT.

(b) Follow-up on single phase welding units : they have requested letter from GMRT to collect information from users around GMRT antennas. Action will happen after 6 months (when?). After payment (Rs 4,500/-)??;

This matter needs follow-up with admin to see how it can be handled.

(iii) during the survey, some units which are likely to be important from RFI point



of view have been identified for detailed studies later on -- some work can start in parallel with completion of database, beginning with the bigger units; measurements (using LPDA) for 2 big industrial units in Junnar & Ambegaon area completed; others are in progress; no new progress on this.

(iv) procurement of new equipment : 2 nos of ultrasound dishes (needed as existing 2 units are barely working) : indent had been placed ; to check status of the order (also to explore possibilities for IR thermal cameras?); 2 dishes have been ordered expect delivery by end-Jan; no action on IR camera right now.

Delivery still pending; purchase is following up with vendor. Need status update.

==> 2 dishes have arrived.

2.3 Transformer RFI revisited -- from 4 Feb and before (PAR): Team has been doing a check on transformer RFI and the updated results from this will be available soon -- will need to see how this compares with the earlier round of this work.

Comparison of old and new data is in progress. To check status update.

2.4 Follow-up on UPS RFI -- from 4 Feb & earlier (SSK/PAR/RVS) : UPS units from Ador were found to be the most suitable : 2 nos of 3 kVA was purchased, tested for RFI & cleared; units are in use in C9 and C10. Updated RFI report has comparative statements quantifying the repeatability. Further, 2 nos of 4.5 kVA units were also ordered with Ador, with option of 2 single phase o/p with different isolation transformers (3 + 1.5 kVA); units were delivered but failed the RFI tests -- lots of discrete lines seen; Ador had taken the units back for modifications -- finally, modified version of Ador 4.5 kVA was tested and preliminary results are quite good; report for this has also been circulated. Current pending action item is:

(i) to finalise plans for going with 3 kVA unit from Ador as the final choice : agreed to order 10 nos of these as a starting option; RVS had received budgetary quote; (total cost per antenna may turn out to be around 2.x lakhs); indent had been raised; was waiting for formal quote from vendor; order has been placed; delivery of 10 nos expected in Jan last week.

5 nos have come; random selection of 1 unit shows 1 dB increase in noise floor level at 150 to 270 MHz; remaining 4 units show 2-4 dB increase in 140 to 240 MHz; check of major changes : MCB make has been changed; panel plate is missing -- direct screen printed units are used; connectors size / type have been changed : need to feedback to electrical team and appropriate action to be taken.

meanwhile, second batch tested for RFI and report with all changes suggested has been submitted. To take up for discussion

==> test had failed at first level because of extra switch that had been installed outside -- this was moved inside and RFI problem resolved; further, auto transformer added inside the unit to improve the power factor (to ~ 0.5); after all this, RFI tests and inspection done and some further desirable improvements have been suggested; RVS to discuss with the vendor and see if he is ready to carry out these (maybe with some support from us).

2.5 RFI testing of LED lights for GMRT labs & building -- from 4 Feb 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; this was done for the lamps that were installed in canteen and results were found ok. Hence, clearance for mass procurement was given. 30 nos of the original 50 nos of 5W LED lamps were installed in corridor & lab areas. Indent was raised for additional quantities; these were delivered (how many?), and this new batch was tested for RFI as per earlier procedure and found to be ok; additionally, RFI team to test the units that have failed in the last 6 months or so.

Current action items :

- (i) to confirm current quantity purchased and installed  
==> 50 nos purchased (and installed mostly in the corridors)
- (ii) to circulate report for tests of new units  
==> report is available -- to be circulated.
- (iii) to complete tests on faulty units : completed failed or partially failed.  
==> to confirm whether these have been tested or not and what is the conclusion.

### 3. Operations :

3.1 Mass production of shielded boxes for MCM cards -- from 4 Feb & before (SN/CPK/HSK): RFI test report of Akvira vs Physimech showed Akvira is better and this was selected. Testing of new MCM card in shielded box (final configuration) was done and report was very positive; it was agreed that Ops group can go ahead with mass production of this shielded box, of 2 types : with and without provision for SPI port on chassis + 1 serial port on each box; aim to place final order on Akvira (for total quantity of 60 + 10 spares), after finalisation of drawings with mech team (RFI group to help complete 2 more prototype units, and then hand over the matter to Ops group). All inputs (drawings, BoM, list of vendors etc) collected by Ops group and work initiated in collaboration with mech group. Mechanical boxes to be outsourced; order placed for 70 nos, with one sample to be delivered first, and batch-wise delivery after that; sample box of Rabbit + switch + media converter + Miltech PC combination tested on 4th Dec : results matched well with earlier tests. Two minor points conveyed to vendor : size of one of the opening and assembly of the side plates, which has been conveyed to mech group -- to check if same has been conveyed to the vendor; 70 nos of boxes now received; to finalise parts to be bought and indent the same.  
==> parts list has been made; CPK needs one round with PAR to verify the parts and the expected cost.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 4 Feb and before (SN/CPK/HSK) : detailed RFI tests on sample unit (made in w'shop) showed that the shielded enclosure appears to be working quite well; RFI team was handed over the information and material to Ops Group for initiating mass production; last round of confirmation to finalise the drawings had been done; Ops group had started on the work requisition for this box, in cooperation with mechanical group; order was 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. To check status of this, including schedule for mass delivery. Also to check procurement of parts.  
==> sample box had come and was tested successfully; full delivery expected any time now; order for parts will be included in item above.

3.3 Planning for proper UPS & space utilisation for new equipment at antenna base -- from 4 Feb & long before (SN/CPK/RVS) : long-term plans for intallation of final UPS system and proper utilisation of the space at antenna base. Follow-up on 14 Aug 2013 discussion on first report : 2nd report was generated and detailed discussion took

place on 5 Feb 2014; successive follow-up & final agreement on way forward (alongwith updated report) reached c. May 2014.

Some highlights are as follows :

(a) Regarding electrical loads : power drawn by different sub-systems estimated carefully, alongwith actual sample measurements on a few different antennas, for both existing systems as well as upgrade systems; effect of in-rush current at switch on also considered; total current requirement of 10 A for the ABR systems + servo control electronics found to be sufficient; hence 3 kVA UPS is adequate; agreed that, if needed, peak load requirement (e.g. in-rush current) can be balanced out by synchronised delayed switching on of different units -- this is already implemented to some extent at present. Final load requirements have been carefully checked and tabulated in the updated report.

(b) Regarding electrical wiring : agreed to have separate isolated supplies for (i) servo drive system (without UPS) (ii) servo control electronics (with UPS) and (iii) ABR electronics (with UPS); one common 3 KVA UPS with split o/p (2 KVA + 1 KVA for servo and ABR respectively) each with its own isolation transformer is the ideal solution; the new UPS can have the isolation transformer(s) integrated into it, without increasing its footprint (only height may go up); updated wiring diagram has been produced by RVS in consultation with SKB and others, and is available alongwith the updated report.

(c) Regarding space utilisation : new UPS can be located in the space between the ABR and servo racks -- this has been done in one antenna with the new UPS and appears to work ok; existing servo FPS units can be left where they are; if isolation transformer can be moved out from the rack, then space in that common rack is enough for all growth plans of FE and OF systems; this leaves some empty space in ABR rack bottom that can be utilised for further growth of telemetry system; all new servo growth to be accommodated in the servo racks (or in-situ replacement of existing units); extraneous items in the surrounding of the racks (electrical fittings etc) can be relocated, as far as possible, to make it convenient for people visiting for work. Most of these issues have been captured in the updated report. Matter discussed in GSG meeting of 13th Nov 2014. This item can now be taken to the logical conclusion : net outcomes can be summarised and follow-up action to be finalised.

Main list of actionable items :

(i) ordering of 10 nos of UPS : order has been placed; delivery expected end-Jan. ==> 5 units had arrived and tested for RFI -- small modification required; additional issue of PF of the UPS -- vendor will try with adding capacitors + input side xmer -- to be tried this week. To check status of this and discuss plans. ==> SEE earlier agenda item

(ii) final wiring diagram for servo + ABR is needed : modified wiring diagram was prepared by electrical and shared with servo (4th August); meanwhile, discussions with BLDC supplier converged : now ok to ground the neutral of the main 3phase transformer; extra emi filter may be required (RVS confirmed it to be only Rs 10,000 per antenna) + only one set of line-filters will be required. RVS had circulated updated wiring diagram (done in consultation with servo) which included inputs from MACON (via servo group) whic suggested radiation shield between the BLDC rack and other racks. Finally, updated diagram providing sufficient shielding distance has been prepared and circulated. To check if this is acceptable to all.

==> No objections received so far; can think about implementing in one or two antennas. Can take 1st of the 5 new UPS units and put in C00. Can get few units of the line filter on trial basis.

(iii) making one antenna as a prototype or model where all the configurations are made as per the recommendations : finally, agreed to use both C10 and C00.

At C10 : 3 kVA UPS was installed, but was feeding power to ABR only; later, servo shift PC104 load to UPS (isolation transformer still in use?); switch boards / extension boards shifted to safe level.

At C00 : 4.5 kVA UPS, with 2 isolation transformers, was installed with ABR rack connected on it; PC104 load was added to it subsequently; relocation of elec boards was pending.

Current action items are :

(a) agreed to put the FE power supply in the proper location in both antennas -- work ongoing to make space for this;

==> space is now ready (after removing delay contactor) in C10.

(b) ask servo to confirm FPS drive location is in keeping with the agreed diagram.

==> it appears that current location is as per "agreed diagram"

(c) check for unshielded cable and pipe entries in model antenna shell, including unused holes and punctures, and initiated appropriate corrective steps.

==> RVS to make a list of all the punctures in both C00 and C10 and bring for discussion.

(d) RVS to circulate an email about the updates and finalisation of layout in C0 and C10 for replication in all antennas. This was done and some feedback from FE and BE teams received : to check if sentinel "yellow box" can be shifted; alternate arrangement for keeping the phone to be decided; UPS heatsink is not a major issue; directive to keep AC flow downwards when not in use (?). contactor and timer for delayed start is obstructing FE pwr supply -- can be removed once UPS is there?

==> yellow box can be shifted to better location; phone to be made wall hanging; clear SOP to be made and 2 stickers to be put in the shell; contactor already removed in C10.

(iv) also agreed to populate C0 & C10 with Rabbit, switch, PC (with shielding) as and when available -- these 2 antennas can be used for next gen M&C work to add to C4,C6,C12 to make a total of 5. JPK to keep track of this aspect. To check current status of this.

==> work in progress.

3.4 New, improved Miltech PC -- from 4 Feb and earlier (CPK/SN/PAR) :

Two units of Miltech PC with two changes (more screws on panels + panel mount pwrline filters instead of chassis mount) were under test : conclusion was that PC ok from all aspects. Pending action items :

(i) agreed to initiate the purchase of 10 nos of the final version above -- indent had been raised for 10 nos (including some spare accessories?); current status of the PO : order sent; expected date of delivery 31st Dec -- trying to expedite, if possible; note from vendor informing about delay due to late arrival of m'boards : end of Jan is new delivery date. To check status of this item.

==> "still under test" reply from vendor -- to see if delivery date estimate can be got.

4. Back-ends :

#### 4.1 Documentations :

Current action items are as follows :

(i) Detailed design doc -- from 4 Feb & 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; was deferred till end Oct; and then deferred till end of Dec; 2nd version had ~50% chassis level inputs; to be completed by end-Jan'15; check current status.

==> no updates.

(ii) ITRs for analog back-end systems and digital systems to be taken up :

(a) analog back-end : Sandeep and Navnath to look into that; pending. Work pending for some time; team to review and pick up the activity. BAK to follow-up.

==> SCC to come back on this by next time.

(iii) to move to a point where formal publications can be done -- this needs to be followed up appropriately within the team and a summary plan brought up for discussion; finally, SHR and BAK have started work on modifying GWB ITR to convert to a paper; first version has been circulated; to check and take up for discussion.

==> YG to discuss with SHR tomorrow (26th).

4.2 : Power supply for GAB : from 4 Feb and before (NDS/BAK) : Two options are possible : linear vs SMPS. Comparison note with all pros & cons was produced : pros and cons are in terms of convenience (and price) vs RFI properties; agreed that present (c. Aug 2014?) set-up of 30 ant GAB (with 5 spare SMPS supplies on order) can run for 6 months or so ; final decision can be taken later on. 4 SMPS units that had come were used to get 4 racks with SMPS and 4 racks with linear / CVT supplies; meanwhile, shielded box was designed for the SMPS by RFI team -- RFI report showed good performance; agreed to go ahead with it for mass production; meanwhile, SMPS installed in 4 rack; 12 new boxes with RFI shielding planned -- 8 are needed in the system, and 4+1 will be spare. Mech group to place the order for 12 nos (after BE and RFI teams check the drawings); drawing had errors (!); needs modification; was stuck for PC problems. To check current status and see if order can be / has been placed.

==> no updates.

4.3 Power equalisation schemes for new back-ends -- from 4 Feb and before (SSK/NSR/BAK/SRoy): Need updates on both of the following :

(i) option 1 : using detectors in GAB and local feedback loop -- monitoring set-up was made ready; DKN worked on code (using algorithm taken from NSR); first round of testing showed problems like detector output saturation -- gain adjustment checked and problem fixed; basic power equalisation algorithm was first tested ok with 4 antennas, and then expanded to more antennas; comparative study of this scheme with the GWB-based scheme to see if there are any differences or pros and cons was done : do GAB power equalise and look at GWB bandshapes; complete the loop by doing GWB power equalise and checking GAB o/p. Test completed both ways, first for 4 antennas and then later for 8 antennas (extended to more?); BE team is ready to release for use by operators -- a basic SOP to be generated and released. Current actions :

(a) to completed the SOP and release the set-up

(b) to run this alongwith GWB bandshape check to help debug problems in GAB -- can be formalised as a debug tool to be run by PMQC periodically -- this needs to be taken up.

(ii) option 2 : using correlator self outputs and computing gain corrections : basic scheme is implemented & working; more general implementation of a user controlled ALC mode aims for the following 4 modes of operation (see MoM of 3 Oct 2013 !):

(1) on demand -- this is the current released mode.

(2) repeatable at some interval specified by the user -- can it be script based?

Sanjay has completed the core coding; a wrapper is being done by SRoy; to be taken up for discussion.

(3) automatic, should adjust in response to a stimulus in the input power -- needs a discussion.

(4) should provide a reliable power monitoring scheme -- needs discussion.

Issues that came up are as follows :

Accuracy of attenuator values and repeatability of settings : 5% (0.25 dB) ok; agreed to add median calculation feature; to check if a feature to predict the expected change in attn for a given change in sky direction can / needs to be added; better option for saving the attenuation values for future use / reference to be defined; logging of results to be looked into; agreed to have a document that summarises all of the above and spells out the main requirements (from user point of view) and possible solution options / techniques; detailed discussion has taken place between SRoy, BAK, SSK and YG on 14Aug2014 -- main conclusions and action items are as follows :

(a) attenuator values : aim is to check if measurements match with specs (within +/- 0.25 dB); initial test results for 3-4 units (at one epoch) had been reported by BE team (found acceptable); pending items (for BE team) are :

- \* to check the constancy of the values across the band;

- \* to repeat the tests for varying i/p power levels with constant o/p power;

- \* to repeat the tests on different epochs to verify constancy with time;

- \* to work out plan for calibration table for each attenuator (after above results).

Test data were taken and analysed by BE team and results reported; SRoy had done some cross-checks on these; tests have been done with varying i/p range from -37 to -17 dBm also and behaviour of attenuator appears to be all right. SRoy to cross-check the results and confirm if we are ok, and if this aspect can be closed.

(b) requirements document to be updated to reflect the outcomes of the discussions e.g. better clarity about the 3 modes of operation etc. -- SRoy has produced an updated version : needs to be checked to see if it can be cleared.

(c) self data (from correlator data stream) to be saved in shared memory ring buffer of ~ 30 mins depth for further processing tasks to work on (should also work off a recorded lta file) -- SSK to work with NSR to get this implemented (work in progress). NSR has been working on the writing to file version and a basic version was done; SRoy to check and confirm the status and arrange appropriate follow-up. Need a status update.

(d) to further develop the relevant routines that read the data and process to achieve the desired results -- SRoy to build from the basic routines available at present, with participation from NSR; work in progress; to cross-check about median calculations -- not yet done; first looking at ring buffer issues (may club both?);

(e) testing of bandpass shape (ampl and phase) for different values of attenuation : 6 out of 7 antennas showed less than 5% percent and 5 degrees change in ampl and

phase over 5 dB change in attenuation. band-pass variations with time reported by SRoy -- to be taken up for detailed discussion -- maybe under testing of GWB? SRoy would like to follow-up to see how much is the intrinsic varn of the GWB corrln level with change in input power level -- SRoy has analysed the data provided by DVL and found that behaviour is acceptable for the range of i/p power variation tested which is about factor of 5 (~ 7 dB); to plan to extend this to larger range: set power level on galactic plane calibrator to about 80 or so; then go to calibrator away and equalise to 350 -- larger change in attenuation (~ 12 dB) required -- can check if corrln coeff (bandshape) remains ok or not; SRoy to update status of this.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 11 Feb & 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) 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) beam mode working with fixed channel and time factors : SSK had got the code changes done for making it general purpose -- going up to any number of channels for corr + beamformer + DAS -- SSK has tested upto 16K channels; 32K may require some extra coding; agreed to first release GWB-II code with 16k channels for users, alongwith modification to SOP; second, work ongoing for coding 32k (and 64k) in GWB-II code for testing; final version will be released in GWB-III; modification in GUI for multiple time integration & channel selection added & tested. no further updates -- to clarify about updates in GWB-II and between 32k and 64k plans, and close the matter.

(b) header for beam mode data : to be taken up and incorporated alongwith the PA mode; SSK has done first round, and needs a discussion.

Discussion between YG and SSK is pending; meanwhile version with header to be released alongwith 16k channel code release on GWB-II.

(c) availability of psr\_mon / pmon on nodes 53 and 54 for recorded data is there; for shm attach needs some work; psr\_mon done but only for off-line upto 16k chans; no real-time version available; pmon still needs to be looked at...

Agreed to confirm off-line psr\_mon available on nodes 53 and 54; to try and provide online psr\_mon with 16k channel release; later, to integrate Rajora's new code into the system : first with GSB, then with GWB-II and III. To check status of ongoing discussion on this, including incorporating of Rajora's new code. updates from SSK : psr\_mon compiled for all beam host m/cs (node52/53/gwbh2/gwbh3) locally; for pmon, need a discussion related to polycos, catalogue etc...

(ii) 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.

Some fresh tests done by SHR : varying i/p power level of broadband noise source at ADC allows characterisation of input power level at which spikes show up; looks like occurring at multiples of 128 ch (for 2K spectrum); to check the level as seen in cross of two such signals.

(iii) change of host machines to 1U HP machines for GWB-II : work is ongoing by SHR, including OS, disks and location in the rack; may be able to complete in one month time scale (from 3rd week of Nov); work ongoing, SHR needs to coordinate with Nilesh. machines are ready; GUI needs a version which has new IPs and maybe some paths; in order to switch between old and new hosts, infiniband cables need to be swapped at the 8-port switch -- not yet done.

==> change-over has been completed and GWB-II is running on these machines now; SOP will be circulated soon; may want to have node52 available for some more time before disconnecting completely from GWB-II network (will remain on GSB network).

4.5 GPU corr (GWB-III) : next gen system -- from 4 Feb & before (SHR/SSK/GSJ/BAK) : Design and delivery of 32 input (16 ant dual pol or 32 ant single pol) system : 4 new DELL machines are in the rack and wiring + cabling is complete, tested with analog noise source; new code with 2 x 10 Gbe I/O + improved logic for assigning specific threads to each core + env variables completed (tested for 200 MHz / 8 bits and 400 MHz / 4 bits, 16 inputs and working ok with no pkt loss); basic GWB-III has been completed and released; ongoing action items are as follows :

(i) plans for testing the GWB-III : this has 2 parts :

(a) regular user level tests of basic modes : updated SOP has been released; modified ferrules have been put and GWB-III has been released with full online control; final connections to GWB-II and III can be chosen by the user on the wall panel; confirmed that GSB, GWB-II, GWB-III can all be run simultaneously with full online control; DVL had started some of the basic tests :

quick summary : by and large system appears to be work ok; some cases of low self and poor cross. pending problems have been call sheeted and will be checked again to see if fixed or not.

To check if new SOP supports flexible connectivity for GWB-III -- this requires manual editing of the files (explained in SOP); Manual editing may not be required anymore -- new GUI has to be tested and SOP to be updated : not done and released yet; also fixed order may still be needed -- to check with NSR.

==> this matter remains unresolved as of now -- YG to talk with NSR about it.

(b) testing of the 400 MHz BW mode : basic changes to the code for the 400 MHz, 4-bit mode have been done; some pending tasks are there : proper delay correction for this mode needs some changes / testing; also choice of which 4 bits to use needs to be



decided -- right now it is set for 4 MSbits; final tests with astronomical source need to be done; to confirm if 400 MHz 32 inputs will work or needs to be restricted to 16 inputs? Computation does not fit in existing set-up and hence can't be tested right now.

Current summary : For 400 MHz mode, all algorithm issues are sorted out (include delay setting); however, existing GWB-III set-up does not sustain 400 MHz; safe limit is 300 MHz (including beams ON); agreed to leave it at this level right now and not formally release the 400 MHz mode.

==> no action to be taken here.

(c) checking of beam modes : all basic beam modes are working; only phasing needs to be verified -- phasing in one poln appears to have some problems -- SHR is looking into it; phasing problem is fixed and can be tested now.

==> note that phasing will work only if beam mode is turned on (!) -- can leave it like that for now and see what is the feedback.

(ii) improvements in GPU code using K20 card (SHR/SSK) : a few different optimisations have been tried and these need to be further refined and ported to the GWB-III code:

(a) looking at XGPU code (with Vinay of nvidia) : optimised XPGU for GMRT is showing ~20% improvement -- needs to be confirmed and then incorporated; ready to upgrade to CUDA 6.0?; results from R2C vs C2C (with callback) to be finalised and then decide about incorporating. SHR has started working on porting XGPU in GMRT code to GWB-III.

(b) another concern is about data ordering at XGPU o/p vs LTA format requirement -- needs to be discussed alongwith SSK and decided; other than that SHR is ready to try out. This is important to check and discuss this in order for the changes in (a) to be meaningful -- to check status of this, in the light of recent nvidia discussions.

==> no progress on this at present (except for the nvidia discussions).

(c) dual K20 option : total corr + beamformer is exceeding real-time by 9% for full 400 MHz bandwidth for 16 input correlation (fits for 2 x 8 input corr); to check if the full correlation job will fit in 16 GPUs (after some of the optimisations above); if not, we need to start planning for 32 GPUs : 2 K20s per host, or double-GPU card, or 32 host machines; agreed to try a test where 2 GPUs on one host machine is used to test if the correlator code is portable (set-up with 2 GPUs is there on 4 of the 6 nos 620 machines -- so tests can be done on this when the code development reaches that stage); agreed to wait till main GWB-III is ready and released -- this has happened now, but can wait for some more time...

Based on current status and work done with nvidia, it appears that optimisation of GPU code will not be sufficient to make final system fit in one GPU and hence, agreed to start looking into 2 GPU per node option : either try with dummy calculation or with actual alternate data buffers going to each GPU...

==> meanwhile, 2 new K40s have come from nvidia; could think of trying with K20 replaced with K40 on one node of GWB-III (may need to install new drivers) ?

(iii) other improvements in code :

(a) need some software updates in DAS chain to handle more than 2048 channels ? this needs clarification about whether this is available in currently released GWB-III or not ??? Not yet resolved.

==> GWB-III should work upto 32K channels, may need to confirm DAS path (and also maybe GUI?).

(b) new features to be added in next version of GWB-III code : correction for net\_sign[] flipping (LSB/USB modes of correlator); channels upto 32k, lower beam integrations (tbd), beam header, multi-subarray, 4 beam capability; all off-line utilities with backward compatibility; time ? + DUT corrections; optimised code to be ported; shift to 2 inputs per Roach board. Some of these can be delayed for some

time, depending on priorities. BAK to discuss with the team and come back on this, based on the priorities.

==> no clear direction on this as yet.

(c) long-term items like provision for control of FPGA and other peripherals (like sig generator) for different modes : agreed to identify one PC for control of all the peripherals related to GWB; this m/c can / is interfaced to online via a socket and GUI can send commands via this -- already done for loading of FPGA files, needs to be extended for other applications; for other things like turning RFI rejection or Walsh modulation on/off, writing to registers in powerPC would work all right; agreed to start working towards implementing scheme in GUI for taking additional parameters that allow different bof files to be loaded; agreed that these flags need not go into ltahdr but can go in the user log as setting parameters (can also be there in gpu.hdr); agreed to go ahead with discussion with NSR for implementing the logic for allowing support of multiple corr modes that use different BOF files; other action items to be taken up later.

Not clear if any action has been taken in this; BAK to check with Nilesh and see if the logic can be incorporated.

==> no update on this matter. YG to check with NSR.

(d) incorporation of DDC : this is important requirement in the long run :

Agreed to try on one node of GWB-II or GWB-III and get back to earlier stage and see exactly what was the bug. SHR has circulated an update; first part is that it appears that the current realisation is properly implementing a DDC; only the filter BW needs to be decoupled from the decimating factor and do a careful set of tests; in the long run, better filters with sharper cut-offs may be required (can check with nvidia about availability of std library functions for such applications); second aspect to check about the nature or format of the o/p to see whether I & Q components are ok for further work or whether we need / can have the real voltage representation of the o/p signal.

new tests still pending; to check about nvidia primitives; to check about I,Q version vs real output possibilities.

==> no update on any of these, but can be taken up next in the list of priorities.

(iv) Layout and racks (GSJ/BAK) : layout diagram to be updated and long-term plan for racks to be initiated; 3 different kinds of President racks discussed ("cyber", "cool" + one more?) -- to try and finalise after one more round of discussions including RVS (also, check new vendor Jyoti Tech); as an interim, 2 nos of cyber racks ordered with President. Current action items :

(a) 4 nos of half-height racks are now in use for GWB-III -- two nos are populated with 4 compute nodes each, third one has 3 host machines + 1 extra machine + clk source etc; fourth one has 8 Roach boards + IFB switch; will need to expand this to 16 Roach boards at some point of time -- may need to add one more half-height rack? One half-height rack is available in hand and can be used when required. Item can be closed for now?

(b) For the 2 President racks : first one has been used for GSB related nodes (spares) -- this is ready now, waiting for riser cards for the spare nodes (to be moved in during MTAC); to check current status of this, including swapping of bad node with CITA node. 2nd rack being used for trying the arrangement for special cooling (with help from mech group) -- tested with 1 kW load and increasing slowly; loading up to 4 kW tested by comparing the temp difference between input and output air; need to compare with unmodified rack; results so far appear to show that there is about factor of 2 discrepancy in estimated CFM rate and AC plant capacity CFM rate.

Next - to decide on number of racks to be procured;

Agreed to include the test with unmodified rack and then circulate the report; current estimate is for 5 racks (32 Roach boards + 16 compute m/cs with 2 GPUs each);

with 2 AC vents feeding these 5 racks, the estimate is that the available CFM may be marginal -- this needs to be resolved against the CFM discrepancy noted earlier. Also to explore additional margin in the AC system. Maybe useful to have a joint meeting with RVS and team.

Irappa has made some further tests and will be circulating new results shortly; check about having a session with RVS.

==> no updates on this today.

4.6 Procurement of new hardware and accessories required for GWB systems -- from 4 Feb and before (BAK/GSJ) :

(i) purchase of 4 new host machines for GWB III : to decide configuration of host machines (disk i/o to be kept in mind); also to check if SSD is a viable option for recording of data. Investigation shows that SSD vs SATA has pros and cons; it may be possible that one class of server may be there that supports both?

4 nos of T620s have come and integrated into GWB-III: 2 are with 16 TB and 2 with 4 TB -- compute vs host.

For future purchases : PERC card issue needs to be resolved : agreed that we will buy machine that can support up to 12 disks (which means with PERC card) but will have 2 x 2 TB to start with. More disks can be added as needed, and if at all extra slot is needed, PERC can be removed (will support only 4 disks) and backplane has to be changed with a new one (which has to be bought along with the machines); To decide quantity to order at present : agreed to proceed with 16 nos with full waiver for DELL proprietary item with DELL as the supplier.

To initiate the appropriate paperwork, including waiver of public tender.

Action started to generate the papers, to check current status.

==> paperwork is moving and will be going to TIFR for waiver and then enquiry.

(ii) procurement of accessories like network cards, disks, cables etc to be looked into -- 20 nos of CX4 based dual 10 Gbe cards purchased and tested; to confirm that this order is enough to meet our long-term requirements; Agreed to produce a formal note about the situation for long-term : to relook at the spares requirement without counting the units already being used in the existing systems (including the PoCo and pkt corr) and buy more if needed; GSJ has produced this list and fresh orders to be done, based on this : 10 Gbe cables and NIC cards (spares); IB switch 36-port -- folders are ready for ordering; indent for 8 nos of K20 has been raised. cables for NIC cards : PO released; IB switch indent to be raised again.

For 8 nos of K20 : order has gone; IB cables and NIC : order has gone; IB switch : new folder has reached final approval stage; for 10 Gbe dual-port NIC cards + cables are all in hand.

To confirm if all the items here are under control and then close as needed.

==> 8 nos of K20 have come; IB cables and NIC : order has gone; same for IB switch.

(iii) new purchase of Roach boards etc :

(a) 12 nos of Roach1 + 16 ADCs and 4 nos of Roach2 have come; Roach1 test set-up ok; all 12 Roach1 and 16 ADCs tested ok; to make a summary sheet about current stock and usage of Roach1 and ADC and bring up for discussion.

xls spreadsheet has been created; to circulate the latest version; to check requirement of ADCs and verify the situation for 1 ADC per 32 Roach boards vs 2 per Roach board. This issue needs to be discussed and a final call has to be taken.

(b) for Roach2 : to check standard test procedure on CASPER; to check if we need to buy add-on mezzanine card; to check if Roach2 can be seen on USB port using Ubuntu and if some basic tests can be done with this; indent for mezzanine card has been put.

Folder has reached final approval stage.

To confirm if order has been placed and expected date of delivery.

==> order has gone and delivery expected in March.

(c) also software environment needs to be upgraded -- Matlab-Simulink upgrade order is under process; Xilinx ISE v14 has been ordered and CD is in hand -- to be installed; to see if one existing PC can be adapted for testing of Roach2, including installation of these new softwares.

New Matlab-Simulink installed on one machine (64-bit), including updated license manager. (additional license 2014 is for parallel toolbox)

==> Confirmed that one machine now has Matlab, Simulink, ISE v14.2; casper stuff yet to be installed; after that, can think of running a test where existing Roach-1 design is compiled and executable used on Roach-1 board. After that, can think of trying the same design on Roach-2, taking into account the differences in architecture.

4.7 Testing leakage, coupling and correlated noise in new back-end chain -- from 4 Feb & before (BAK/YG/++) : detailed tests had been done by Vikram Jaiswal (with SSK, SHR and YG) and report has been circulated; for GAB systems, some follow-up action for testing the leakage has been initiated; procedure for testing to be done with GWB-II release modes clarified and tried out -- new tests show significantly different results for cross-coupling for GAB+GWB; maybe due to synth LO (old tests) vs sig gen LO (new tests), whereas earlier tests used synth LO; new report had been circulated that showed significantly reduced coupling; agreed to repeat the original, user level tests done by YG & VJ to see if things are different now ; agreed to try the ADC noise input and north pole sky tests and see what results come out; 2nd round of tests done, show leakage of 2-4% (consistent with first round results of 1-3%) -- to check with SCC whether all user level tests (done earlier by YG + Jaiswal) have been covered; some user level tests done with north pole and different leakage found for lower and higher LO settings -- needs to be understood.

From Aug-2014 :  $\leq 4\%$  leakage; FE+GAB+GWB (L-band) ~ 40% leakage.

Need to organise a detailed discussion on this.

==> To try for a discussion tomorrow ?

4.8 Walsh modulation : prototype set-up on Roach board -- from 4 Feb & before (SCC/BAK): plans of BE team for implementing prototype scheme -- basic unit for switching using sq wave signal from GPIO pin tested ok; was put in PoCo correlator and was being tested; walsh waveform delay functionality has been added now and can set delay from 1 to  $2^{32}$  clk samples (!); with this, variation of correlation with delay has been tested using noise source inputs and found ok; a robust algorithm for hunting for the peak correlation and fixing the delay needs to be developed; can also think of a test case of showing cross-correlated signal goes away with modulation with square wave in one channel; Walsh pattern being put in the Roach (not many slices needed); there was some mismatch between CPLD waveform and FPGA waveform that was resolved and all FPGA waveforms are matching; current action items are as follows :

(i) issue of accuracy of oscillator being used needs to be resolved.

(ii) to complete the Walsh modulate and demodulate set-up in the lab and test -- this is ready and can be closed.

(iii) to complete the final delay setting algorithm : to provide upto 500 msec of delay (for 128x4 Walsh length) with resolution of 5 nsec (FPGA clk); there were problems related to varying start-up offsets and fractional delay setting, as well as problems related to set up and hold -- these are now reported to have been resolved : this is confirmed to be work ok and can be closed.

(iv) what about synchronisation of starting?

This is taken care of by running the CPLD with a sig gen locked to 10 MHz.

(v) to optimise the hunting algorithm;

To start testing a basic algorithm and see what we get.

(vi) to demonstrate cancellation of unwanted signals in ADC card and/or GAB; first, need to run a test where pattern from external source can be synchronised to the pattern generated in the FPGA -- this requires being able to hunt and correct for the unknown delay ! This is coupled to item (v)

Some tests are underway; some problems being resolved about the hardware set-up. detailed discussion on various issues above can be taken up next time.

==> demodulator now working all right; waiting for modulator ckt to come back from FE team; meanwhile, can try a test where both noise inputs are demodulated with the same pattern to see if it recovers full correlation or not; also to make first estimates of total FPGA resources that will be used up.

## 5. Other items :

5.1 New python assembly design -- from 4 Feb (HSK/SSK) : FE group wants the python configuration in E6 to be adopted for all antennas -- this needs to be discussed with mechanical group and finalised; FE and mech have dicussed about plans for modified python assembly that will give additional protection to cables; mech group had circulate a short note on their view of the matter, alongwith photos; this was discussed and existing vs E6 system was compared; Action item :

(i) modified E6 design with hinge-like support was installed on C4; to watch the set-up on C4 and do periodic inspection for checks of (a) damage to hose (b) hose clamps (c) water entry etc -- first inspection to be done after 2 months (mid-Sep) by mech and fe teams; subsequently, inspection has been done (around mid-Nov?) and a video of the same has been circulated; scheme appears to be working ok; however HSK feels that this scheme with hinge may not be good in the long run -- needs to be discussed and understood; agreed to keep this as status quo till IGUS assembly done and tested.

HSK showed video of 'C4' (E6 solution NOT successful for C4) - hinge is bending; need a plane plate;

Further discussion is required to decide on the action.

The hinge arrangement on C4 is NOT exactly same as the E6 arrangement ! The C4 design does not completely solve the problem. Agreed that E6 set-up does solve the problem ! Agreed that it can be replicated if needed.

(ii) IGUS cable wrap -- new technology prototype to be developed and tested on quadripod; also option of hose without wire impregnation -- long-term solutions.

1] hose without wire impregnation

2] Entire hose assembly under procurement (long-term solutions).

Quotes for both items received : item 1 is Rs 10k for 10m (4 antennas);

item 2 is 60k each -- will try on the quadripod test range;

items received; basic assembly made ready; waiting for some manpower to be free for installation (around 13-14 Oct); then 4-5 days for 1000 rotation testing; basic arrangement done on quadripod and tested ok without cabling (video for this is also available); now waiting for FE team to populate cable wrap with cables for further tests; proto model now ready; to discuss further plans for action.

The arrangement uses a slightly different arrangement of fixed members, along with the IGUS hose; this will work as well as the E6 design.

Agreed to : (i) replicate the test arrangement on 2 antennas, one with normal hose and one with IGUS hose (ii) to check how much extra cable can be accommodated in the

existing hose and (iii) look for wider diameter assembly (32 to 40 mm or more).  
==> no specific updates on these items.

5.2 Problem of access to FE boxes with 500-1000 CDF feed -- from 4 Feb & before (HSK) : Update on new solution being designed by Mech group -- tested in situ and found working ok; agreed to use this for present; for future where bigger and heavier boxes will come into play, mech group will think of an improved solution, including an option for removing one feed and bringing the stool inside the basket; a few options explored by mech group, with target of 1800 mm height for boxes with max weight up to 150 kg (?), quotes received from some parties, processed and order placed; delivery by end of November; inspection done (in Bangalore) in mid/late November; some simple improvements suggested to vendor (guard rail, simple clamping arrangement for item); platform delivered at GMRT (early-Dec) and tested and found ok, including modifications that had been suggested. To discuss and plan next step of action.

Item is in regular use now; can have one discussion to confirm status and safety related issues, and then close the item.

Trials have been happening on ground; ready to test with actual antenna operations.  
==> ready for use in antenna; waiting for new crane to be operational (why can't it be done with the HLPs ?)

5.3 Improved software for work requests -- from 4 Feb and before (HSK/SJ) : To review the current process of taking job orders for better facilitation of the tasks with end users like electronics groups. YG discussed offline with HSK : to look to fill the lacunae in the process with maybe new development of in-house version -- agreed to try and get this done in-house with Joardar; work was taken up after completion of ongoing tasks related to electrical (meanwhile, old software also started working (to check with Mangesh about what fixed it) -- hence urgency not very high; first version likely completed and released in late Dec/early Jan; awaiting user feedback for improvements; to discuss long-term plans. Released software appears to be working fine; still waiting for any significant user feedback; can check again after 2 weeks and see if item can be closed. Seems to be working fine; no major comments from users, except for one comment from SSK.

==> need to include SSK's comment, as well as some comments from Admin staff?

5.4 Status of new CSIRO feeds : from 4 Feb & before (ANR/JNC/HSK) : to report on performance of the newly manufactured feeds -- new results are slightly better compared to ver2 (casting) but not as good as the original ver 1 (machined by Godrej); it was discovered that a major change in the design /drawing required to maintain alignment between different sections [using guide-pins etc]; how to proceed further needs serious discussion about alternate options.

HSK to try some new ideas to see if a solution can be found e.g. liquid Al layer to cover ? additional coating of Al paste being looked at as a possible option; email update from HSK : discussion with Dr. Shenoy -- Al conductive paint may not work best (only 80% conductivity)...

Email update from HSK : repair not possible because of Al casting -- need to discuss and decide future course of action.

==> no updates.

5.5 New FE boxes and testing with reflective paint -- from 4 Feb (HSK/SSK) : two kinds of paint received and 1 box will be made ready next week for testing. 6 new boxes are ready as per specifications -- only some engraving work is pending. email update from HSK : One FE box painted with Luxtropherm HT 400 (range from

250-400 deg C ?) and handover to FES group for testing. Second grade paint : Luxtropherm HT 600 (range from 400 to 600 deg C) -- waiting for arrival; 3 types of FE boxes handed over to FE team : (i) plain box with powder coating (ii) box painted with HT400 (iii) box painted with HT 600; waiting for test results. 2 types of paints tried : HT400 & HT600; neither successful; to try new paint options? Item needs to be discussed jointly with mech and FE to understand why the original selection did not work and what should be done about it. Agreed to circulate the description of the method used, the results and the conclusions and then take up for discussion and decide what needs to be done. ==> waiting for updates from FE team.

=====

## Minutes of Plan meeting of 11 Mar 2015

### 1. FE & OF related :

1.1 Detailed design doc / ITR -- pending for long : from 25 Feb & before (SSK/BAK) :

- (i) OF Tx started (may have only blk diags for now, without full details, till a paper is ready!); initial write-up (by Satish) needed improvement : functional blk diagram made and detailed description needs to be added; updated version sent by SSK, was discussed : blk diag of OTx -- couple of small changes suggested (APC controller to bias control), also add one more blk diag at beginning giving the context of the OTx system in the overall antenna base set-up; new version ready?
- (ii) OF Rx system to be completed (Satish Lokhande) : first version circulated -- some improvements and additions were suggested (e.g. to give explicit reference to other docs which have supporting details; to give reason for 10 dB attn; to give comparison with expected values from SFA report; to mention some precautions and practical issues during assembly etc); updated version awaited from SSK.  
==> waiting for updates from SSK

1.2 Update on results from test range -- pending from 25 Feb & before (HRB/GSS/SSK) :  
Reorganised into the following issues :

(i) Tests of ver1 550-900 CDF and CSIRO feeds at test range : new results with VVM set-up, after installation of new encoder + notch filter for mobile band, showed : for ver2 550-900 CDF : reasonable E-H match at 610 and then degradation in shape and matching at 700 & 800; partially supported by older measurements from Dec 2013 (with slightly different set-up). Further, results for dipole v2a and v2b with cone v2 show that the degradation of pattern with frequency is worse for v2a than with v2b; radiation pattern measurements have been done with 50 MHz step & using CW signal; comparison with simulation results is awaited. Current results and action items are :

(a) ver 2b of 550-900 system has been measured on test range; first order comparison of C1 dipole 2B vs C2 dipole 2B -- some differences can be seen : C1 dipole 2B shows better E-H match at 610 ; C2 dipole 2B shows good E-H match at 700; and appears to be decent even at 800, though 3 dB width may be changing; agreed to make plots vs freq for 3 dB and 9-11 dB widths, and for taper of E and H at fixed dish angle of 62.5 to check mismatch in taper -- for both the feed versions.

Some results from the measurements for the plots of 3 dB and taper values vs freq shown -- there is evidence for change of properties with freq as well as asymmetry of the pattern (as had been seen in the earlier plots also); agreed to try to compare with results from C1 + d2b (make fresh measurements, if needed);

(b) Phase centre of ver1 550-900 CDF and CSIRO feeds needs to be done -- phase centre measurements for C2 + d2b can be tried at the range.

Radiation pattern tests redone for C2 + d2b combination to check repeatability; FE team to summarise the results for discussion.

(ii) calculation (based on reference paper) of expected deflection & comparison with measurements to check if there is significant loss of sensitivity -- GSS developing refined version more relevant for GMRT (also, if further expts with 250-500 or 500-1000 feed are useful) : cross check of results from code (0.3 dB drop for 0.5 lambda offset) wrt curves from Kildal paper was confirmed; for GMRT specific case of 250-500, efficiency factor as a function of freq over the band, using the data



for the measured feed pattern, was implemented; after correcting one error in the code, better result (9.9 dB vs 11.6 dB expected) was achieved; further, a realistic phase response (instead of 1.0) was included by reading data from a file; results (reported on 19th Mar) showed better match between measured and expected deflections for the 250-500 system : 327 -- 12.8 dB vs 12.4 dB; 400 -- 12.8 dB vs 12.2 dB; 450 -- 12.4 dB vs 11.4 dB; 500 -- 11.2 dB vs 11.0 dB (some re-work needed for lower frequencies?); computed results (based on change in efficiency due to shift of phase centre) show likely drop in sensitivity by about 1.4 dB from 250 to 500 -- this is now to be folded into the net sensitivity / deflection curves made by GP (see agenda item following this one). Present action items :

(a) GSS is working on plans to extend this to 550-900 system -- was waiting to get measured values from test range.

(iii) Comparison of computed results with measurements for 250-500 band : initial results for good antennas at 250-500 (other than C6) with default height of 1280 (and for C6 with reduced height of 1080) showed that computed values are actually better at high freq end for 1080, which is different from the observations which are showing droop at high freq for 1080 (in conflict with first results reported above); computed results, which were for 1180 to 1480 in 4 steps, were extended to 1080 & 980 and 1180 was found to give the best response (note : this is for a particular value of ph centre based on range measurements); computations were extended to much smaller values (down to 580 mm) and latest results show a peak in the response around 580 or 780 (!), which are in sharp contrast to the experimental results which were carried out in the range 1080 to 1480 mm and showed optimum performance around 1280 mm -- this needs closer scrutiny of the simulation code and experimental results.

(iv) Phase efficiency computation has to be linked to the aperture efficiency computation (NRAO's eff. program, modified for GMRT specific parameters) -- this work is ongoing, along with Sougata (was expected to take 4 weeks -- till mid-Sep); code is being ported to matlab (?); some issues about input file with the values to be given -- this also needs to be resolved; also, original NRAO fortran program can be made to run to give some initial cross-checks? code had been ported from the C version that student had written to Matlab but results are not yet matching with expected behaviour and debugging is going on. Now trying to port original fortran version to matlab; one email has been sent by Sougata with some updates on pattern calculations -- need to discuss and understand its relevance.

FORTTRAN to MatLab conversion : ~ 50% completed; was to be fully done by end-Jan / early-Feb -- need status update on this.

1.3 Phase centre tests for 250-500 CDF -- from 25 Feb and before (HRB/GSS): to test with 100 to 200 mm height change (around default of 1280 mm) in 250-500 feed on one antenna to see how much change in sensitivity is seen. Tests done on C6 using feed with shortened support legs of the cone (instead of shortened stool) -- comparison of results for 1180, 1280 (default) and 1380 : 1280 & 1380 show slightly better sensitivity at low freq (250-400) but at higher frequencies they match with 1180 (which is quite flat throughout freq range); agreed to try for 1480 to see if there is a monotonic behaviour; also compare with simulation results of GSS. Consolidated results tend to show that the latest level at 1180 height does show a slightly better response; a final confirmation is needed about the optimum performance from the measurements; confirmed that we can't go below 1080 by further cutting the support legs of the cone; also, current adjustable stool will not work for 325 MHz face due to welded nature of existing stool; agreed with HSK to reproduce one more adjustable stool with modifications learnt from present experience, and try on one CSQ antenna (C6?) by removing the Lband feed, shifting the cone-dipole with new stool to this

face and using the existing 250-500 FE box on it; tried on C6 during MTAC period (Oct 2014), but measurements could not be completed as antenna was required for L-band GTAC observations. Current action items :

- (i) Agreed to go back to C8 at a later point of time (after 550-900 measurements are completed).
- (ii) Meanwhile, FE team to go over all the available measurements and produce a consolidated summary -- this is pending for some time now !

1.4 Comparison of measured & expected sensitivity curves -- from 25 Feb (SSK/GP/HRB): Scheme for (re)calculation of expected values across the broad bands to be finalised (and added to measured curves) : curves being done with constant QH value and with variation of T\_lna with freq incorporated; model for the main BPF was also put in; after that antenna efficiency factor (based on measurements with 4-5 points across the band) was added by interpolating the measured values; return loss of the feed was added to the above and the result now matches much better with the data -- all this was done for 250-500 band; some follow-up action :

(i) Antenna efficiency factor : to determine what is the best thing to use and stick to that; are there cases where the theoretical curve gives less deflection than measurements? agreed that both the efficiency term (which includes default ap eff + phase eff, from measurements on test range) and the return loss term should be kept and the product should be used.

(a) To get clear confirmation about which all terms are included in the efficiency term that is currently being used in the calculations.

(b) Also, to see if a note summarising the overall scheme can be generated.

GP to look into both the items and get back.

==> GP waiting for inputs from GSS about factors in efficiency calculation; to start on the note.

(ii) Overall comparison with data : It appears that there may be some discrepancy in the mean deflection values, after the formula was revised to change the constant factor -- this needs to be understood, including a cross-check using the basic formula.

==> some corrections / refinements have been done in the formula : dir coupler loss value, source flux from Baars et al, constant was recalculated; spot value of 13.0 dB at 325 for CassA compares with 12.7 used in the control room; to cross check with simple  $0.5 \cdot S \cdot A = k \cdot T$  calculation.

(iii) possibility to try it for Lband to be explored -- information gathering had been started : feed pattern (efficiency) at 3 individual freqs is available, and measurements are now available for 5-6 frequencies (?); agreed to work with the 3 pt data and do simple interpolation and see what kind of curve is produced; first order calculation of model had been done -- Sanjit + Gaurav had worked to put the curve for expected deflection alongwith the measurement results to do the comparison, and weekly plots now have this added. Current action items :

(a) 1 or 2 antennas with response better than theoretical esp at lower edge of Lband -- need to be checked;

(b) fall-off of theoretical curve at edges needs to be investigated

(c) RL of feed is to be included.

(d) notch filter alongwith BPF to be added.

GP to check and report; also, the change in constant reported above will affect this comparison also !

==> item discussed and issue of how BPF or notch filter kills the deflection came up ! Agreed to defer for some time till note by GP is ready.

1.5 Total power detector for FE & common boxes -- from 25 Feb & earlier (GP/ANR/SSK): plans for final scheme : 20 dB coupler for CB and 10 dB coupler for FE (at final output) with common 20 dB amplifier (Galli-52 instead of Sirenza); feed-thru vs connectorised arrangement also resolved; after lab tests (including monitoring via MCM channel) in FE and common box, sample units installed in C4 FE box and E2 common box. Some other details are as follows :

For common box : data from 2 units installed on E2 showed basic things working ok: first round of testing showed 11 dB deflection (12.4 dB expected) on Cass-A; later on Crab, getting 5.5 to 6 dB (6.6 dB expected); flat-top on-source waveform was understood to be due to quantisation of step size of detector levels (least count issue); script / SOP created for automated running of tests;

For FE version : 2 units had been assembled and found to give identical performance as per specs; problem of feed-thru vs connector was resolved in favour of feed-thru (as per original chassis design); all testing completed in the lab; first units (on C4) showed problems -- traced to incorrect mapping of channels etc.; new units (batch of 20) that were assembled showed unexpected change in detector o/p due to grounding problem which was corrected (manually) for 10 units and final PCB for mass production was modified for this change; script for automating the observations has been done and released by GP.

Current action items being followed :

(i) for RC time constant : main aim is to check and ensure that some appropriate RC integration is in place at o/p of the detector; some feedback from vendor, but not fully satisfactory; existing ckt has 10k series resistor (as per data sheet); measurements done in the lab show some kind of a curve with rms changing inversely with increasing time constant, but the results are not repeatable from day to day, indicating some pick-up in the circuit or the measurement tool; needs to be checked carefully. Current status : agreed to put 1 s time constant in all the PCBs -- this requires very large capacitor; few microfarad may be more practical, pushing the time constant to ~ msec; agreed that 100 micro-Farad maybe the largest practical value, giving 100 ms time constant; assembled one board with 100 microfarad -- no observable change in performance seen; need to go to antenna & test : fitted in new 250-500 box -- may end up on C11. Box is up on the antenna and one set of data taken which look ok; to try another set to check for consistency, including slightly weaker sources like Crab, Virgo...

==> no new data has been taken as yet.

(ii) analysis of test data and results/conclusions : 9 antennas with FE power monitor installed; test data recorded for 8 antennas; out of these, signals seen for only 3 antennas : C13, C11 & S4 (both pols); some sign of life in E6 and something on W4 (very noisy / weak); deflection on Cass-A is about 10-11 dB (bit less than expected); flat nature of curves understood as least count limitation; simultaneously CB signal recorded, but working CB monitor is only on C13, E2 & W4 + W1 -- all of these showed deflection; signs of "memory" in holding a stale value in FE monitor (all antennas at same time!) -- confirmed with Ops group to be due to combination of cycling of FE monitoring (being turned off when at a source transition) + the fact that cold sky off source is quite far away from the source (!); further, two sets of new data had been taken (3 and 6 hrs long), to check for repeatability of working antennas, as well as status of partially working antennas (as seen in first data set) and correlation with 30-1 data; first order impression is that new 2 data sets are consistent with 1st data set (tbc).

Distilled action items for GP : to take 3-4 antennas in each of FE and CB (with one

common antenna C13) and analyse 4-5 good epochs for the following :

- (a) repeatability of deflection and to check that it matches with expected values -- this has been done and appears to be ok.
- (b) consistency between FE and CB : checked for C13 and found ok.
- (c) checking spurious behaviour -- RFI or something else : data log of 30:1 output checked -- power detector changes when RFI is present;

Most of these points have been addressed with the existing data and the same have been summarised in the draft ITR; update to final version of report is just waiting for results on RC time constant at C11 -- to check current status of this.

==> status quo.

(iii) To decide upon long-term plan for power monitoring : GP to generate a short note about the proposed scheme for this.

==> some discussion about exactly what this note should specify (over and above the SOP). GP to produce the note.

(iv) possibilities for automating data reading, analysis and plotting also discussed -- GP has now implemented automated program for plotting CB, FE power levels (both chans) and 3 temp monitor values (2 in FE and 1 in CB) in one go from a file containing data for X nos of antennas is ready; this has been tested with the above data sets; agreed that it is generic but not tested for anything other than temp and pwr; can be generalised for all channels of all 30 antennas but can be taken up at lower priority; also, does not have a user friendly interface; current actions :

(a) agreed that working version of code + SOP to be fully released asap : SOP has been released; GP working on note about analysis procedure (using matlab) -- this is still pending.

==> yet to be made ready.

(b) SSK to take up discussion with SN about GUI development with suitable person from control room : initial discussion with SN has happened, but not clear if optimal person has been identified -- YG to take up the discussion jointly with SSK & SN (still pending).

==> discussion yet to happen.

1.6 Installing and testing of temperature monitors in front-end & common boxes -- from 25 Feb (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 tests had been carried out; meanwhile, C4 & C10 fitted with dual temp monitors in FE box, and C13 with monitor in both FE & CB -- some tests had been done but data was not sensible due to unresolved issues in the wiring of the existing common box units that prevents desired data to come on expected channels in 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). Combined SOP for temp monitoring and total power monitoring has been prepared and released.

(i) Analysis of the data : C13 & E2 both channels temp monitor available at online output (fixed for C13 one ch FE & 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;

first results for ~ 5-6 antennas (LNA + FE box) + 2 antennas (CB) for 3 hr duration shows some basic behaviour but not clear how well things are working; to try two things : (a) to check if any old data of longer duration (from last 2-3 months) is available (b) to try a longer run, even for one antenna like W4 which is under maintenance; some of the short data stretches have been looked at; at least one 6 hr data has been taken; report has been updated and submitted to library for uploading; longer stretch of data and analysis of that is still pending.  
==> tried one run on E2, but signal is flat ! Could have been problem of MCM5 not being in scan mode. Expt being redone today (11th)

1.7 Spare LNAs for L-band feeds -- from 25 Feb & before (SSK/ANR) : we had 32 feeds; 2 were not working (1 has been dismantled for making drawings of new feed) due to lack of electronics spares -- mostly device failures (including some new ones?); some new LNAs were successfully assembled by Gopi and failed feeds for C3,W1,E2 & E5 were fitted with these and found working ok. Also, one spare feed was assembled and installed on W1 and working fine. Current action items :

(i) to update about status of feed on W1 and other recently installed units : finally, after a lot of follow-up, it was confirmed from PMQC data that W1 appears to be working ok for past few months. 2 other recent units are on C1 + one more antenna : C1 has units with new LNAs, for both pols made ready from older batch of devices with careful retuning; action items :  
(a) confirm which is the second antenna -- still no clarity -- maybe C3 ?  
(b) confirm status of performance of these antennas (C1 had been giving ripple and bad bandshape problem) -- problem found to be due to broken cable; now fixed; now C1 feed is down due to low deflection in one poln; right now there is no spare and this one needs to be repaired and better book-keeping needs to be done.  
==> problem found in phase switch -- repaired and put back on C1 and working ok.

(ii) making spare LNAs -- agreed to have at least 5 LNAs ready & available as spares : 10 nos of LNAs had been assembled, tuned and made ready; these have all been used up now; new batch of devices ordered and delivered. Action items :  
(a) the assembled devices may be having some possible problem with bias point -- it was found that LNA is drawing unusually lower supply current, even when 'gain' & 'T\_noise' are normal; not much progress in understanding low deflection of new LNAs; retuning is not helping -- increasing the bias current leads to oscillation (to check OMT etc for any problems?). Devices from new batch appeared to give a stable solution(?) -- however, not all devices in new batch are the desired ones -- there is a mix and it may be only about 1/3 that are usable?  
Finally, one unit fully assembled (all 3 stages) and working ok; 2nd unit also made ready -- these 2 used for 2 channels of feed #32 (note : this is now the 1st spare feed after 30 working feeds!). 2 more LNAs (3rd and 4th) assembled and tuned; work on 5th & 6th is ongoing. Ramesh will be working on 2 more cards which have been assembled. To check current status.  
==> 2 spare LNAs are ready, waiting for sub-band filters.

(iii) alternate LNA designs : to see if design used for 550-900 can be modified for 1-2 GHz use; to also check the design done by Abhay Kulkarni and see if it can be improved for our needs; design files had been obtained and were being checked by GP and ANR : model files converted to match simulator used by us; component models in software had to be downloaded; also ultralam2000 that was used is not available in the market now; agreed to simulate with ultalam2000 first to check ckt works ok; then concentrate only upto 2 GHz and change substrate to RT 5870 (easily available); simulations matching with original results completed; results reproduced with RT 5870;

trying to tune the design to required specs of gain (30 vs 34),  $T_{lna}$  (~28 or better); in terms of NF target is to go from 0.4 to 0.3, and maybe at cost of reduced BW; now getting close to  $T_{lna}$  of 28-30 across the band; overall gain is also very good ~ 38 dB; but 4 db slope across the band needs to be adjusted; move from s2p to non-linear model completed successfully -- did not disturb the results.

Current action items :

(a) work still ongoing to try to flatten 4 dB slope -- this has been attempted in the new PCB that has been sent for fabrication (see below)

(b) meanwhile going ahead with layout & ordering of PCB and making couple of units, while continuing to improve the design; design & layout completed; first proto PCB should have come by now (it already has the 4 dB correction) and may be ready for testing?

==> problem with layout of the PCB due to error in device footprint -- needs to be redone.

(iv) possibilities for new LNA with Tantrayukt (Yogesh Karandikar) : item to be taken up for discussion, following the visit of YK in Dec 2014.

To check if YK has got results from his first prototype for 500 to 1500 and then take the matter forward. Discussions are ongoing with Yogesh.

==> no fresh updates today.

1.8 Completion of spare L-band feeds -- from 25 Feb & before (SSK/ANR) : Target to have a total of at least 5 (out of 8) working spare feeds (from mechanical to electronics) : 30 antennas had working Lband feeds, but there were no spares, though we had 2 feeds; one unit was assembled back from the feed that was dismantled for making the drawings -- this was completed and installed on W1 (one feed is now in the regular 'maintenance cycling' of feeds); 32nd unit was there in Pune wshop and was shifted back after assembling by mech group and then fitted with electronics; it uses newly fabricated push-type (press-fit) probes; after 2 LNAs were made ready (see above) this feed is now available as the 2nd spare feed. Furthermore, 6 new feeds were made (via outsourcing) in 2 batches of 3 nos; in the first set of 3, 2 nos had wrong size of horn and had to be corrected by the vendor; all 3 needed new covers as old ones were not suitable; second set of 3 feeds from Akvira : OMT + horn + cover; hence, total of 8 spares CAN become available; note that weight of 3 latest feeds is 18 kg more (72 vs 61 kg) than earlier feeds -- now accepted as 'fait accompli' !

Following issues need to be resolved currently :

(i) having sufficient number of spare LNAs : see item above for details; LNAs for 3rd spare feed now ready, waiting for filterbank to be ready. Any change in status?

==> 2 LNAs are tuned and ready; 3 sets of subband filters are ready -- the best of these 3 can be used to assemble one more spare feed to add to one spare feed (31st) that is ready and waiting.

(ii) other electronics : sub-band filter bank is the main item missing; it was found that the sub-band filter ckts spares don't work as one gnd line (for switch ckt) is missing in the films from RRI (!) -- to try with a wire providing the gnding ckt; alternate is to start using the new design -- this shows good performance for individual filters, but integrated unit is giving poor performance for selection of 1280 -- problem with the switch (new make is not giving same performance as original make) and this is affecting both reuse of old filter PCBs and also the new design; looking for original make (MACOM) and also trying a different switch (Hitite, which means new PCB); new PCB designed with Hitite switch (will need additional patch

PCB to convert logic levels; one chassis (for 2 pols) is available for testing; new design still not working for 1280. After isolating the filter from the switch, response was found to be fine; found some issue about the layout on the PCB for the Hitite case and PCB is being redone and waiting for vendor to send back. PCBs received and will be populated and tested -- results available now? ==> looks like that the new effort is also not producing proper results -- TBC.

1.9 Testing of LBand wideband systems on 30 antennas -- from 25 Feb (PAR/SSK/SN) : (to maintain a proper log of action taken on individual antennas during these tests and debugging activities); data being taken fairly regularly since June; some history is as follows :

June data : C08 & W01 CH-2??shows ripples at OF RX output -- gone now (to check possible cause); Sep data showed problem with W4 ch2 -- fixed; RFI issues : S04 & E02 showed RFI type lines, E06 showed RFI lines in CH1 (June data); line RFI in 1070-80 range (likely to be airport radar), around 1280 (likely to be due to GPS) -- July data; lines at 1030 and 1090 (3 MHz BW) also seen (Aug data); also, is there a RFI line at ~ 1200 (3 Sep data)? -- need to confirm status of all these lines (can be covered under RFI agenda). From Sep data : 1176.0 & 1176.45, 1191.80 & 1204.70 are likely to GPS (in addition to 1280) and 1090 is airport radar; there appear to be a few unknown ones also (e.g. 1320, 1480 etc) -- check with RFI team separately by including in that agenda item.

Current action items are as follows :

(i) some antennas with poor deflection overall : to be addressed as and when such cases are found. e.g. Ch2 of C1 (may be a cable problem?) -- confirmed that it is cable problem; to check current status of the work to fix the problem.

==> C1 still shows slope whereas test at antenna base shows OK -- to resolve the matter...

(ii) some antennas with deflection changing over the band (less at high frequencies): checked if pointing offset can explain this -- not found relevant; current thinking is that this happens for cases where the RF power level (at laser input) is too low; this has been confirmed with a more careful set of tests (and plots) for few selected antennas, including make good ones look bad by increasing OF attenuation -- has been demonstrated in the report of 11th Nov data; to check if appropriate reasons for low power levels can be identified.

==> C8 ch2 being investigated.

(iii) some antennas with poor on/off bandshapes, including large slope e.g. W1 (has been there for several months); C4 and W6 also; S4 has very low power; such cases need to be checked (call sheeted) and understood.

==> S4 solved with RF PIU in OF system; C8 ch2 being investigated.

(iv) few antennas with ripple or large slope across the band -- to be followed up as and when seen.

==> C3 and C12 identified as problematic and being looked into.

(v) there is data from Oct, Nov and now Dec -- can we have a well-defined algorithm for comparison of different data sets and getting statistical conclusions? -- to look at developing a tool for this.

Latest report (10th Jan) has a good classification of the problem antennas; team is looking one by one into the problems e.g. W5 found bad cable between feed to CB of ch1; now looking at W6... to check current status.

Latest data from 3 weeks of Jan provides a useful data set to confirm systematic problems in antennas and then initiate follow-up action; nature of set of problems remains pretty much the same.

1.10 Characterisation of recommended attenuator settings for different bands -- from 25 Feb and before (SSK/AP) :

(i) values had been given for Lband, 250-500, existing 610; only 130-260 / existing 150 was pending -- this was also completed (appears that 6,6 may be the best value); note to be circulated soon (Sanjeet + Ankur); then can be taken up for detailed discussion and closure; meanwhile, new problem detected where it appears that attenuation setting may not be working reliably -- this is now understood and being fixed; after that, note can be taken up shortly -- still pending !

(ii) FE team to test the power levels at OF o/p and cross-check against SFA values : for 250-500, this has been done and results incorporated in the updated SFA report; for Lband the exercise is ongoing (antenna to antenna variation is a major issue); can be done now, as Lband is relatively stable now; was done by Ankur in a report back in July 2014 -- discussed and suggested to add a few refinements of the statements used (for 250-500) and add an explicit entry in the table; further to compare for each sub-band of Lband using realistic cable loss value for each sub-band (this can then be done for 250-500 also, if found significant). Updated version of report to be produced with these modifications; first part (for changes related to 250-500) has been done; waiting for measurements at Lband to be completed; some work has been done by Ankur, some work has been done by Imran to characterise FE, and SFA report also has measurements of cable loss; calculations have been done; need to cross-check with measurements; updated report in internal circulation; to check if it can be released for discussion -- waiting for report to be finalised, after some internal feedback. Check current status.

Digression to 550-900 system : further tests with LNA used with CSIRO feed (SMA coupler may be producing some loss), mini-circuit LNA (very bad result); best result is for 15 cm long cable connecting feed to LNA directly with type-N; agreed to repeat this deflection test and also get beam shape data and repeat both these steps also for cone1-dipole2b (may need to adjust the height a little bit).

1.11 Switched filters at different stages of receiver -- from 25 Feb & before (SSK) : 2 main categories of switched filters are needed : (a) switched filter banks inside FE boxes and (b) switched filter banks in rx room; these are being designed using the new switches : 2, 4, 8 way switches with different possible configurations; (c) a 3rd application of these switches is for designing the monitoring set-up in rx room. Current action items are as follows :

(i) for rx room monitoring work : note that all these circuits are connected to the monitor ports of the OF system; first design did not give enough isolation at highest freq of operation and hence new design was done; ckt for 2:1 and 4:1 versions now ready & tested -- 25 dB isolation achieved; drops from 25 to 17 dB with frequency for 8:1 switch -- now getting improved rejection : better than 25 dB below 1 GHz; goes down to 16 dB above 1 GHz; the leakage between the signals with this switch is still unacceptable; now trying another switch (MACOM make) which terminates unused inputs while selecting the desired input (will be used in the final 30:1 monitoring system), and gives 40 dB isolation; new switch + modified design with additional isolation switch and power supply isolation -- now achieving 35 dB at Lband and more than 50-55 dB at lower frequencies, with all channels powered; will be tested in



monitoring system for 16 antenna set-up. Current action items :

- (a) To do an additional test with signal injected at Tx i/p;
- (b) To complete 16 antenna system (4 units wired and ready)
- (c) also to summarise the design in a note.

Right now 8 antenna set-up is getting ready; after that (a) will be done; to expand to 16 antennas will need more switches and some more time; tests will be done with 8 antenna system. Design note to be taken up after completion of 8 antenna system.

==> 8 antenna system is under test -- looks like working ok; once confirmed, item (a) can be done; to expand to 64 antenna, 16 nos of switches ordered and next step would be to go 16 inputs.

(ii) for rx room switched filterbank : prototype system has been developed.

(a) tests have been completed; a report needs to be produced characterising the performance -- work ongoing for compilation of report; some improvements in report underway after internal feedback;

==> need updates from Ankur.

(b) to check about space in rx room for housing these units.

==> not yet looked out.

1.12 Follow-up on 550-900 MHz band filters -- from 25 Feb & before (ANR/SSK) :

Comparison of ICON product with in-house effort and finalisation of plans :

technical comparison of individual filter responses showed in-house design to be slightly better; tests with integrated unit using new PCB showed insertion loss increases to 3 dB now and some change in slope on higher side; complete chassis and full integration done and tests repeated to make detailed comparison with ICON results -- showed performance is very similar except for some out of band bumps (at 30 dB level) and slightly slower roll-off ; tried with AC coupling capacitors (no improvement); new board fabricated which, after retuning, gave much better roll-off; meanwhile, some realistic cost estimates for in-house production vs getting it done by ICON were made : concluded that ICON option will be much more expensive. Sample PCBs from Argus and Shogini had been obtained -- first test results (without chassis) showed ~ 5 MHz shift in 2 sub-bands but better roll-off; final plots showed same IL but the higher sub-bands having slightly shifted centre and widths which cross the main BPF upper cut-off; design was modified and new PCB was obtained from Shogini and tested ok and one complete system with chassis (for one poln) was made ready; it was agreed to defer further work till ready for integration in new FE box; meanwhile, cost estimates for mass production made : Rs 32000 for 2 PCBs is the dominant cost; total is about Rs 41,000 per antenna (compared to Rs 90,000 by ICON); hence, agreed to go ahead with building our own design; meanwhile, reduced wt chassis (700 g less) had been made (2 nos) by w'shop and integrated filter unit was made and tested ok.

For mass production : PCB material is in hand; switches needed are in hand; so may not be a major problem for going ahead; now waiting till layout of 550-900 FE box is finalised.

Agreed to go ahead with PCB and chassis, while waiting for layout to be finalised.

Layout is now final; one prototype unit is ready; to go for mass production in units of 20 nos (10 antennas). Also, to confirm if design report is ready and released?

4 Feb : Problem with Shogini for mass production -- discussion with Shogini now converged and he is ready to go ahead under the same terms and conditions; so, first batch of 20 PCBs will be done as soon as the work order reaches him. Report was completed quite some time ago and released (to be confirmed).

==> no updates (Imran not present).

1.13 Finalisation of 550-900 FE box -- from 25 Feb (ANR/SSK) : to produce a block

diagram for the 550-900 FE box; then to start seeing which units are ready, which need to be done; which may need to be combined into single units etc; roughly same number of components as 250-500 box, slight difference in the arrangement of notch filters; size of sub-band filter chassis will be different; will take up the layout of this after common box layout is completed; later, agreed to start with this, even as common box is going on in parallel -- Imran + one looking at it, with Bhalerao's help; items being collected : dir coupler not available -- being designed fresh; sub-band filter chassis (only unit) given to w'shop for mass production needs ! ==> dir coupler designs (2 options) done and PCB going to Mohite; to check with w'shop about returning of chassis.

1.14 New filters for Lband -- from 25 Feb & before (ANR/SSK) : Sample Lband full-band BPF had been designed -- has no slope with freq and better insertion loss, and maybe a better option than the existing main BPF; similarly, prototype design of new sub-band filters (with better insertion loss) has also been done. Detailed results for the main BPF shows that the BW is slightly less than existing BPF : 500 MHz (965 to 1465 MHz), instead of 590 MHz (890 to 1500 MHz) -- this gives better rejection to mobile band signals, but has implications for final usable BW of L-band system; furthermore, an improved notch filter has been designed for the 850-950 mobile band (-60 dB vs -45 dB at 900 MHz), alongwith a LPF for cutting off the 1800 mobile band has been designed -- 3 dB cut-off freq of 1650 MHz. The matter was presented to the users in Friday meeting on 9th May, and it was agreed to generate a note about this proposal, for clearance in the GSG. This was done and matter was discussed in GSG of 13 Nov and it was cleared to proceed on the following: new BPF + mobile notch filter to replace existing filters in FE box; LPF to be put in common path at antenna base as a common facility for all bands; to be taken up as a case-by-case replacement job, whenever a unit comes down for maintenance work. current action items :

(i) status of mass production : 10 units of 1650 LPF have been fabricated out of 40 PCBs available; PCBs (stripline) does not need much work for assembly -- can be given for manufacture; new chassis will be needed; PCB order for 70 nos can be sent using existing eps10 board; both pols can be combined in one chassis requiring 35 nos only -- drawing to be finalised for rail-type chassis; to check if existing chassis can be re-used; PCB + chassis for new BPF ready for 40 nos (30 antennas + 10 spares); for the new notch filter, 60 nos had been made (PCB + chassis) of which 30 have been used in existing system (waiting to order more)...

(a) to confirm the present status from Ankur's spreadsheet -- discussed : Lband new filters now included (BPF is completed); sub-band filters TBD; to check current status.

(b) new complication is that mounting plate has to be made for putting the new units in existing systems; this is an "internal matter" and can be taken care of? -- close

(c) agreed to put 10 nos of 1650 LPF in one channel of 10 antennas which have 250-500 broadband system installed; waiting for chassis; meanwhile, 1650 filter was put in one poln of C10 on a trial basis; appears to remove the 1800 mobile signal and does not appear to affect other bands; shows about 0.5 dB insertion loss; agreed to put available 10 nos in ch1 of 10 antennas.

(d) also agreed to move the 70 MHz HPF to just before the signal enters existing IF system (instead of just after the signal enters the ABR cage) -- to check the plans for mass implementation of this.

==> no updates on any item.

(ii) sub-band filters (design is at simulation level) can be taken up as replacement for the problem encountered while making new spares for Lband feed (see above) -- to try new PCB with different switch (Hitite) -- see update on this in earlier agenda.

Right now, using old design with new PCB for populating in spare Lband feeds. To see how the matter can be resolved; new PCBs with Hitite and MACOM switch have come; to be tested. Check current status.

==> not giving suitable performance with either Hitite or MACOM switch ! Needs a detailed discussion.

## 2. RFI related matters :

2.1 Discussion relating to Industrial RFI survey -- from 25 Feb & before (PAR/SSK) : revised docs (from 2009 and 2012 discussions) had been circulated by RFI group and were discussed in 5 June 2013 meeting (is the document too exhaustive?); new survey planned with main aim to generate updated database which will be useful to pinpoint likely hotbeds of RFI in the industrial areas in addition to finding those without NOC; after months of planning and discussion with DIC, was finally conducted during 23-27 June with 4 teams; covered Ambegaon and Junnar talukas ~ 40-50 villages in each; ~ 40-80 working industrial units (large number are closed down or never existed!). Some of the progress is as follows :

A form had been prepared for use in the survey and had been discussed in detail and agreed that it is suitable for use; about 70% of existing data had been entered into this form; agreed that this activity would be superseded with making a database of equipment and NOC record for the existing industries found in the survey; this data entry now completed for all 3 regions : Junnar, Ambegaon and V-K industrial estate; some highlights from the database : of the total list, a significant number of industries are closed down, and another significant factor are no longer traceable; about 1/3 of the original are still working (ignoring poultry which is about 1/4, but is considered RFI-friendly).

A follow-up meeting with DIC took place on 30th Sep 2014. Summary is as follows :

- a. To maintain proper record of the data of existing and future industries in the same format. The data format and data base was shared with them during the meeting.
- b. Complete list of the villages in Zone I to Zone IV is submitted to them, based on which they can decide the issuing of NOC for industries in different regions (and also outside?).
- (c) DIC to issue NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT

Some of the present action items are as follows :

(i) To cross-check the list against the ones which have NOC (for those operating without NOC, add to our database and inform them about informing us for changes, and DIC to issue NOC post-facto as mentioned in other agenda item) -- this is happening now; current table has a column indicating whether NOC is there or not. DIC has started taking action on parties without NOC (e.g. Govardhan dairy, ~ 20-30 km away). DIC will be sending the standard form to all and it will come to us for clearance; we need to be careful about to whom we say "yes" in retrospective manner, so as to avoid setting up a precedent of giving NOC to somebody with wrong kind of equipment already installed & running ! Possibilities for improvement can be suggested to them.  
==> waiting for issue with DIC to be resolved.

(ii) To follow up with DIC about

(a) issuing of NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT.

(b) Follow-up on single phase welding units : they have requested letter from GMRT to collect information from users around GMRT antennas. Action will happen after

6 months (when?). After payment (Rs 4,500/-)??;

This matter needs follow-up with admin to see how it can be handled.

==> waiting for ...

(iii) during the survey, some units which are likely to be important from RFI point of view have been identified for detailed studies later on -- some work can start in parallel with completion of database, beginning with the bigger units; measurements (using LPDA) for 2 big industrial units in Junnar & Ambegaon area completed; others are in progress; no new progress on this.

==> no new ones have been done (about 10 more need to be done); results for the 1st two have been analysed and no strong RFI is seen other than the ambience due to powerlines etc.

(iv) procurement of new equipment : 2 nos of ultrasound dishes (needed as existing 2 units are barely working) : to confirm if these have been procured and item can be closed.

==> verified working ok; can be closed.

2.2 Transformer RFI revisited -- from 25 Feb and before (PAR): Team has been doing a check on transformer RFI and the updated results from this will be available soon -- will need to see how this compares with the earlier round of this work.

Comparison of old and new data is in progress. To check status update.

==> only 6 locations are common between new and old data (!) -- many new installations are coming up ! No clear conclusions have been drawn from the study; also more data needs to be taken to cover a larger number of transformers -- to wait for an update from RFI team.

2.3 Follow-up on UPS RFI -- from 25 Feb & earlier (SSK/PAR/RVS) : UPS units from Ador were found to be the most suitable : 2 nos of 3 kVA was purchased, tested for RFI & cleared; units are in use in C9 and C10. Updated RFI report has comparative statements quantifying the repeatability. Further, 2 nos of 4.5 kVA units were also ordered with Ador, with option of 2 single phase o/p with different isolation transformers (3 + 1.5 kVA); units were delivered but failed the RFI tests -- lots of discrete lines seen; finally, modified version of Ador 4.5 kVA was tested and preliminary results are quite good; report for this has also been circulated. Current pending action item is:

(i) to finalise on 3 kVA unit from Ador : 10 nos of these were ordered as a starting option (total cost per antenna may turn out to be around 2.x lakhs); 5 nos had come in Jan; RFI tests showed 1 unit with 1 dB increase in noise floor level at 150 to 270 MHz; remaining 4 units showed 2-4 dB increase in 140 to 240 MHz; following changes were noted : MCB make has been changed; panel plate is missing -- direct screen printed units are used; connectors size / type have been changed; finally, found that test had failed at first level because of extra switch that had been installed outside -- this was moved inside and RFI problem resolved; further, auto transformer added inside the unit to improve the power factor (to ~ 0.5); after all this, RFI tests and inspection done and some further desirable improvements have been suggested; RVS to discuss with the vendor and see if he is ready to carry out these (maybe with some support from us). To check current status.

==> additional suggestions are : (i) cover over MCB switch panel needs to be shielded; (ii) input and output power connectors need to be shielded and filtered; (iii) to remove the powder coating and provide enough grounding points. Need to follow up with electrical

Finally, agreed to take one unit from last Friday and make the required modifications

(full gasket and filtered power connectors -- to be bought) and then give to the vendor for reproduction.

Power Factor is up to 0.5 and can be taken as satisfactory.

2.4 RFI testing of LED lights for GMRT labs & building -- from 25 Feb 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; this was done for the lamps that were installed in canteen and results were found ok. Hence, clearance for mass procurement was given. 30 nos of the original 50 nos of 5W LED lamps were installed in corridor & lab areas. Indent was raised for additional quantities; these were delivered (how many?), and this new batch was tested for RFI as per earlier procedure and found to be ok; additionally, RFI team to test the units that have failed in the last 6 months or so.

Current action items :

(i) to confirm current quantity purchased and installed : 50 nos purchased (and installed mostly in the corridors)

==> an additional 200 nos have been received last month; plan is to put them in guest house rooms, hostel rooms, guest house corridor, and labs as per choice of users.

(ii) to circulate report for tests of new units : report is available -- to be circulated.

(iii) to complete tests on faulty units : completed failed or partially failed.

to confirm whether these have been tested or not and what is the conclusion.

==> tests done for partially failed or completely units and no RFI issues found; updated report to be generated; sample batch of Syska make tested and found NOT suitable.

3. Operations :

3.1 Mass production of shielded boxes for MCM cards -- from 25 Feb & before (SN/CPK/HSK): RFI test report of Akvira vs Physimech showed Akvira is better and this was selected. Testing of new MCM card in shielded box (final configuration) was done and report was very positive; it was agreed that Ops group can go ahead with mass production of this shielded box, of 2 types : with and without provision for SPI port on chassis + 1 serial port on each box; aim to place final order on Akvira (for total quantity of 60 + 10 spares), after finalisation of drawings with mech team (RFI group to help complete 2 more prototype units, and then hand over the matter to Ops group). All inputs (drawings, BoM, list of vendors etc) collected by Ops group and work initiated in collaboration with mech group. Mechanical boxes to be outsourced; order placed for 70 nos, with one sample to be delivered first, and batch-wise delivery after that; sample box of Rabbit + switch + media converter + Miltech PC combination tested on 4th Dec : results matched well with earlier tests. Two minor points to be conveyed to vendor : size of one of the opening and assembly of the side plates, which had been conveyed to mech group; 70 nos of boxes now received; current action items :

(i) to finalise parts to be bought and indent the same : parts list has been made;

CPK needs one round with PAR to verify the parts and the expected cost.

==> one round between CPK and PAR yet to happen.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 25 Feb and before (SN/CPK/HSK) : detailed RFI tests on sample unit (made in w'shop) showed that the shielded enclosure appears to be working quite well; RFI team was handed over the information and material to Ops Group for initiating mass production; last round of confirmation to finalise the drawings had been done; Ops group had started on the work requisition for this box, in cooperation with mechanical group; order was placed for 35 nos, with one prototype to be delivered first, & batch-wise delivery after that; sample box had come and was tested successfully;

current action items :

(i) full delivery of all 35 units : should have come by now.

==> not yet delivered.

(ii) procurement of parts needed : it is being coupled with procurement of parts for MCM shielded box (see item 3.1 above).

==> see above.

3.3 Planning for proper UPS & space utilisation for new equipment at antenna base -- from 25 Feb & long before (SN/CPK/RVS) : long-term plans for installation of final UPS system and proper utilisation of the space at antenna base. Follow-up on 14 Aug 2013 discussion on first report : 2nd report was generated and detailed discussion took place on 5 Feb 2014; successive follow-up & final agreement on way forward (alongwith updated report) reached c. May 2014.

Some highlights are as follows :

(a) Regarding electrical loads : power drawn by different sub-systems estimated carefully, alongwith actual sample measurements on a few different antennas, for both existing systems as well as upgrade systems; effect of in-rush current at switch on also considered; total current requirement of 10 A for the ABR systems + servo control electronics found to be sufficient; hence 3 kVA UPS is adequate; agreed that, if needed, peak load requirement (e.g. in-rush current) can be balanced out by synchronised delayed switching on of different units -- this is already implemented to some extent at present. Final load requirements have been carefully checked and tabulated in the updated report.

(b) Regarding electrical wiring : agreed to have separate isolated supplies for (i) servo drive system (without UPS) (ii) servo control electronics (with UPS) and (iii) ABR electronics (with UPS); one common 3 KVA UPS with split o/p (2 KVA + 1 KVA for servo and ABR respectively) each with its own isolation transformer is the ideal solution; the new UPS can have the isolation transformer(s) integrated into it, without increasing its footprint (only height may go up); updated wiring diagram has been produced by RVS in consultation with SKB and others, and is available alongwith the updated report.

(c) Regarding space utilisation : new UPS can be located in the space between the ABR and servo racks -- this has been done in one antenna with the new UPS and appears to work ok; existing servo FPS units can be left where they are; if isolation transformer can be moved out from the rack, then space in that common rack is enough for all growth plans of FE and OF systems; this leaves some empty space in ABR rack bottom that can be utilised for further growth of telemetry system; all new servo growth to be accommodated in the servo racks (or in-situ replacement of existing units); extraneous items in the surrounding of the racks (electrical fittings etc) can be

relocated, as far as possible, to make it convenient for people visiting for work. Most of these issues have been captured in the updated report. Matter discussed in GSG meeting of 13th Nov 2014. This item can now be taken to the logical conclusion : net outcomes can be summarised and follow-up action to be finalised.

Main list of actionable items :

(i) ordering of 10 nos of UPS : order has been placed; delivery expected end-Jan. 5 units had arrived and tested for RFI -- some modifications required; additional issue of PF of the UPS -- vendor will try with adding capacitors + input side xmer; to confirm present status of these items. Plan to put first of these units in C00.  
==> not yet ready for use (see discussion above).

(ii) final wiring diagram for servo + ABR is needed : modified wiring diagram was prepared by electrical and shared with servo (4th August); meanwhile, discussions with BLDC supplier converged : now ok to ground the neutral of the main 3phase transformer; extra emi filter may be required (RVS confirmed it to be only Rs 10,000 per antenna) + only one set of line-filters will be required. RVS had circulated updated wiring diagram (done in consultation with servo) which included inputs from MACON (via servo group) which suggested radiation shield between the BLDC rack and other racks. Finally, updated diagram providing sufficient shielding distance has been prepared and circulated. To check if this is acceptable to all : no objections received so far; agreed to implement in one or two antennas; agreed to procure few units of the line filter on trial basis. RVS to update on status.  
==> contact with party (Schaffner) is proving difficult to establish; can try other parties also.

(iii) making 1 or 2 antennas as model where all the configurations are made as per the recommendations : finally, agreed to use both C10 and C00.  
At C10 : 3 kVA UPS was installed, but was feeding power to ABR only; later, servo shift PC104 load to UPS (isolation transformer still in use?); switch boards / extension boards shifted to safe level.  
At C00 : 4.5 kVA UPS, with 2 isolation transformers, was installed with ABR rack connected on it; PC104 load was added to it subsequently; relocation of elec boards was pending.

Current action items are :

(a) agreed to put the FE power supply in the proper location in both antennas -- work ongoing to make space for this; space is now ready (after removing delay contactor) in C10.

==> agreed to do in C00 also.

(b) ask servo to confirm FPS drive location is in keeping with the agreed diagram. it appears that current location is as per "agreed diagram" -- to confirm and close.  
==> JPK to confirm and update.

(c) check for unshielded cable and pipe entries in model antenna shell, including unused holes and punctures, and initiated appropriate corrective steps.  
RVS to make a list of all the punctures in both C00 and C10 and bring for discussion.  
==> work has started at C10 for this.

(d) RVS to circulate an email about the updates and finalisation of layout in C0 and C10 for replication in all antennas. This was done and some feedback from FE and BE teams received : to check if sentinel "yellow box" can be shifted; alternate arrangement for keeping the phone to be decided; UPS heatsink is not a major issue; directive to keep AC flow downwards when not in use (?). contactor and timer for delayed start is obstructing FE pwr supply -- can be removed once UPS is there?  
Current thinking : yellow box can be shifted to better location; phone to be made

wall hanging; clear SOP to be made and 2 stickers to be put in the shell; contactor already removed in C10. To check current status with RVS.

==> work on phone rearrangement is in progress; BSP and Rajendran to look into shifting of yellow box; reminder about putting stickers about AC configuration.

(iv) also agreed to populate C0 & C10 with Rabbit, switch, PC (with shielding) as and when available -- these 2 antennas can be used for next gen M&C work to add to C4,C6,C12 to make a total of 5. Work in progress; JPK to keep track of this aspect. To check current status of this.

==> agreed to start activity of populating during MTAC for C00 and C10, and next to C8 and C11; and then, if needed, to C4, C6, with aim to have 5 antennas ready.

3.4 New, improved Miltech PC -- from 25 Feb and earlier (CPK/SN/PAR) :

Two units of Miltech PC with two changes (more screws on panels + panel mount pwrline filters instead of chassis mount) were under test : conclusion was that PC ok from all aspects. Pending action items :

(i) agreed to initiate the purchase of 10 nos of the final version above -- indent had been raised for 10 nos (including some spare accessories?); current status of the PO : order sent; expected date of delivery 31st Dec -- trying to expedite, if possible; note from vendor informing about delay due to late arrival of m'boards : end of Jan is new delivery date. "still under test" reply from vendor -- to see if delivery date estimate can be got.

==> no update.

4. Back-ends :

4.1 Documentations at various levels -- from 25 Feb and before (BAK+others) :

Current action items are as follows :

(i) Detailed design doc : 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; was deferred till end Oct; and then deferred till end of Dec; 2nd version had ~50% chassis level inputs; to be completed by end-Jan'15; check current status.

==> work is still in progress.

(ii) ITRs for analog back-end systems and digital systems to be taken up :

(a) analog back-end : Sandeep and Navnath to look into that; pending. Work pending for some time; team to review and pick up the activity. BAK to follow-up. SCC to come back on this by next time (11 Mar).

==> SCC and Navnath have had one discussion and will follow-up with BAK.

(iii) to move to a point where formal publications can be done -- this needs to be followed up appropriately within the team and a summary plan brought up for discussion; finally, SHR and BAK have started work on modifying GWB ITR to convert to a paper; first version has been circulated; to check and take up for discussion.

==> pending...

4.2 : Power supply for GAB : from 25 Feb and before (NDS/BAK) : Two options are possible : linear vs SMPS. Comparison note with all pros & cons was produced : pros and cons are in terms of convenience (and price) vs RFI properties; agreed that present (c. Aug 2014?) set-up of 30 ant GAB (with 5 spare SMPS supplies on order)



can run for 6 months or so ; final decision can be taken later on. 4 SMPS units that had come were used to get 4 racks with SMPS and 4 racks with linear / CVT supplies; meanwhile, shielded box was designed for the SMPS by RFI team -- RFI report showed good performance; agreed to go ahead with it for mass production; meanwhile, SMPS installed in 4 rack; 12 new boxes with RFI shielding planned -- 8 are needed in the system, and 4+1 will be spare. Mech group to place the order for 12 nos (after BE and RFI teams check the drawings); drawing had errors (!); needs modification; was stuck for PC problems. To check current status and see if order can be / has been placed.

==> to confirm about the modified drawing and follow-up as needed.

4.3 Power equalisation schemes for new back-ends -- from 25 Feb and before (SSK/NSR/BAK/SRoy): Need updates on both of the following :

(i) option 1 : using detectors in GAB and local feedback loop -- monitoring set-up was made ready; DKN worked on code (using algorithm taken from NSR); first round of testing showed problems like detector output saturation -- gain adjustment checked and problem fixed; basic power equalisation algorithm was first tested ok with 4 antennas, and then expanded to more antennas; comparative study of this scheme with the GWB-based scheme to see if there are any differences or pros and cons was done : do GAB power equalise and look at GWB bandshapes; complete the loop by doing GWB power equalise and checking GAB o/p. Test completed both ways, first for 4 antennas and then later for 8 antennas (extended to more?); BE team is ready to release for use by operators -- a basic SOP to be generated and released. Current actions :

(a) to completed the SOP and release the set-up

==> to be checked.

(b) to run this alongwith GWB bandshape check to help debug problems in GAB -- can be formalised as a debug tool to be run by PMQC periodically -- this needs to be taken up.

==> DKN to be asked to make the procedure for control room.

(ii) option 2 : using correlator self outputs and computing gain corrections : basic scheme is implemented & working; more general implementation of a user controlled ALC mode aims for the following 4 modes of operation (see MoM of 3 Oct 2013 !):

(1) on demand -- this is the current released mode.

(2) repeatable at some interval specified by the user -- can it be script based?

Sanjay has completed the core coding; a wrapper is being done by SRoy; to be taken up for discussion.

(3) automatic, should adjust in response to a stimulus in the input power -- needs a discussion.

(4) should provide a reliable power monitoring scheme -- needs discussion.

Issues that came up are as follows :

Accuracy of attenuation values and repeatability of settings : 5% (0.25 dB) ok; agreed to add median calculation feature; to check if a feature to predict the expected change in attn for a given change in sky direction can / needs to be added; better option for saving the attenuation values for future use / reference to be defined; logging of results to be looked into; agreed to have a document that summarises all of the above and spells out the main requirements (from user point of view) and possible solution options / techniques; detailed discussion has taken place between SRoy, BAK, SSK and YG on 14Aug2014 -- main conclusions and action items are as follows :

(a) attenuator values : aim is to check if measurements match with specs (within +/- 0.25 dB); initial test results for 3-4 units (at one epoch) had been reported by BE team (found acceptable); pending items (for BE team) are :

- \* to check the constancy of the values across the band;
- \* to repeat the tests for varying i/p power levels with constant o/p power;
- \* to repeat the tests on different epochs to verify constancy with time;
- \* to work out plan for calibration table for each attenuator (after above results).

Test data were taken and analysed by BE team and results reported; SRoy had done some cross-checks on these; tests have been done with varying i/p range from -37 to -17 dBm also and behaviour of attenuator appears to be all right. SRoy to cross-check the results and confirm if we are ok, and if this aspect can be closed.

==> SRoy has sent some plots from his analysis of the data and some follow-up is needed to see in what operating regime we are hitting the non-linear range of the GAB system.

(b) requirements document to be updated to reflect the outcomes of the discussions e.g. better clarity about the 3 modes of operation etc. -- SRoy has produced an updated version : needs to be checked to see if it can be cleared.

(c) self data (from correlator data stream) to be saved in shared memory ring buffer of ~ 30 mins depth for further processing tasks to work on (should also work off a recorded lta file) -- SSK to work with NSR to get this implemented (work in progress). NSR has been working on the writing to file version and a basic version was done; SRoy to check and confirm the status and arrange appropriate follow-up. Need a status update.

==> some work has been done by NSR to write raw data to file for 10 mins duration; to convert this to shm and also to add a feature for calculating median values every 2 sec or so and saving these to a file for long durations. SRoy to work with NSR to implement these (take help from SSK where needed).

(d) to further develop the relevant routines that read the data and process to achieve the desired results -- SRoy to build from the basic routines available at present, with participation from NSR; work in progress; to cross-check about median calculations -- not yet done; first looking at ring buffer issues (may club both?);

(e) testing of bandpass shape (ampl and phase) for different values of attenuation : 6 out of 7 antennas showed less than 5% percent and 5 degrees change in ampl and phase over 5 dB change in attenuation. band-pass variations with time reported by SRoy -- to be taken up for detailed discussion -- maybe under testing of GWB? SRoy would like to follow-up to see how much is the intrinsic varn of the GWB corrln level with change in input power level -- SRoy has analysed the data provided by DVL and found that behaviour is acceptable for the range of i/p power variation tested which is about factor of 5 (~ 7 dB); to plan to extend this to larger range: set power level on galactic plane calibrator to about 80 or so; then go to calibrator away and equalise to 350 -- larger change in attenuation (~ 12 dB) required -- can check if corrln coeff (bandshape) remains ok or not; SRoy to update status of this. ==> SRoy would like to now try the test with upto 10 dB variation in attenuator values to see how the bandshape changes.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 4 Mar & 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) 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) beam mode working with fixed channel and time factors : SSK had got the code changes done for making it general purpose -- going up to any number of channels for corr + beamformer + DAS -- SSK has tested upto 16K channels; 32K may require some extra coding; agreed to first release GWB-II code with 16k channels for users, alongwith modification to SOP; second, work ongoing for coding 32k (and 64k) in GWB-II code for testing; final version will be released in GWB-III; modification in GUI for multiple time integration & channel selection added & tested. no further updates -- to clarify about updates in GWB-II and between 32k and 64k plans, and close the matter.

==> GWB-II working for upto 16k and not going beyond (to check SOP and GUI are consistent with that); for going to 32k, in GWB-III it should be possible, with some checking and testing. After that freeze GWB-II and move all new developments to GWB-III.

(b) header for beam mode data : to be taken up and incorporated alongwith the PA mode; SSK has done first round, and needs a discussion.

Discussion between YG and SSK is pending; meanwhile version with header to be released alongwith 16k channel code release on GWB-II.

==> to be discussed tomorrow (12th)

(c) availability of psr\_mon / pmon on nodes 53 and 54 for recorded data is there; for shm attach needs some work; psr\_mon done but only for off-line upto 16k chans; no real-time version available; pmon still needs to be looked at...

Agreed to confirm off-line psr\_mon available on nodes 53 and 54; to try and provide online psr\_mon with 16k channel release; later, to integrate Rajora's new code into the system : first with GSB, then with GWB-II and III. To check status of ongoing discussion on this, including incorporating of Rajora's new code.

updates from SSK : psr\_mon compiled for all beam host m/cs (node52/53/gwbh2/gwbh3) locally; for pmon, need a discussion related to polycos, catalogue etc...

==> to check if psr\_mon will work with the new GWB-II host m/cs; to discuss plans for pmon / Rajora's code for GWB-III.

(ii) 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.

Some fresh tests done by SHR : varying i/p power level of broadband noise source at ADC allows characterisation of input power level at which spikes show up; looks like occurring at multiples of 128 ch (for 2K spectrum); to check the level as seen in cross of two such signals.

==> some results for correlation studies are available; SHR to update.

(iii) change of host machines to 1U HP machines for GWB-II : work is ongoing by SHR, including OS, disks and location in the rack; may be able to complete in one month time scale (from 3rd week of Nov); work ongoing, SHR needs to coordinate with Nilesh. machines are ready; GUI needs a version which has new IPs and maybe some paths; in order to switch between old and new hosts, infiniband cables need to be swapped at the 8-port switch; change-over has been completed and GWB-II is running on these machines now; SOP will be circulated soon; may want to have node52 available for some more time before disconnecting completely from GWB-II network (will remain on GSB network).

==> this item can be closed.

4.5 GPU corr (GWB-III) : next gen system -- from 25 Feb & before (SHR/SSK/GSJ/BAK) : Design and delivery of 32 input (16 ant dual pol or 32 ant single pol) system : 4 new DELL machines are in the rack and wiring + cabling is complete, tested with analog noise source; new code with 2 x 10 Gbe I/ + improved logic for assigning specific threads to each core + env variables completed (tested for 200 MHz / 8 bits and 400 MHz / 4 bits, 16 inputs and working ok with no pkt loss); basic GWB-III has been completed and released; ongoing action items are as follows :

(i) plans for testing the GWB-III : updated SOP has been released; modified ferrules have been put & GWB-III has been released with full online control; final connections to GWB-II and III can be chosen by the user on the wall panel; confirmed that GSB, GWB-II, GWB-III can all be run simultaneously with full online control; current items:

(a) basic user level tests : DVL had carried out some of the basic tests -- quick summary : by and large system appears to be work ok (some cases of low self and poor cross); pending problems have been call sheeted and will be checked again to see if fixed or not -- to check status of this.

==> to be checked next week.

(b) to check if new SOP supports flexible connectivity for GWB-III -- this requires manual editing of the files (explained in SOP); manual editing may not be required anymore -- new GUI has to be tested and SOP to be updated : not done and released yet; also fixed order may still be needed -- to check with NSR.

==> 2 possible options discussed for getting flexibility in connection : ascii file update or drop down menu -- to discuss with NSR and decide which is easier to implement.

(c) testing of the 400 MHz BW mode : basic changes to the code for the 400 MHz, 4-bit mode have been done; some pending tasks are there : proper delay correction for this mode needs some changes / testing (done now?); also choice of which 4 bits to use needs to be finalised (right now it is set for 4 MSbits) -- can it be made a user

level choice?; computationally, existing GWB-III does NOT sustain 400 MHz for all inputs -- safe limit is 300 MHz (including beams ON); will it work for 400 MHz for less number of inputs? some tests with astronomical source need to be done to validate the performance; meanwhile, agreed to leave it at this level right now and not formally release the 400 MHz mode.

==> discussed briefly if limited antennas 400 MHz mode is easily possible -- agreed that this may not be very simple and hence can postpone anything higher than 200 MHz for now.

(d) checking of beam modes : all basic beam modes are working; only phasing needs to be verified -- phasing in one poln appeared to have some problems -- now fixed and tested ok; note that phasing will work only if beam mode is turned on (!) -- can leave it like that for now and see what is the feedback?

==> agreed to revert back in the next release of the code.

(ii) improvements in GPU code using K20 card (SHR/SSK) : a few different optimisations have been tried and these need to be further refined and ported to the GWB-III code:

(a) looking at XGPU code (with Vinay of nvidia) : optimised XGPU for GMRT is showing ~20% improvement -- needs to be confirmed and then incorporated; ready to upgrade to CUDA 6.0?; results from R2C vs C2C (with callback) to be finalised and then decide about incorporating. SHR has started working on porting XGPU in GMRT code to GWB-III.

==> further progress in optimising the code by SHR -- maybe able to benchmark by next week onwards.

(b) another concern is about data ordering at XGPU o/p vs LTA format requirement -- needs to be quantified in order for changes in (a) to be meaningful; note : Vinay has already written the code that does this on the CPU.

==> currently using unoptimised routine which will work for about 4k channels; for larger number, optimised version will be needed.

(c) dual K20 option : total corr + beamformer is exceeding real-time by 9% for full 400 MHz bandwidth for 16 input correlation (fits for 2 x 8 input corr); to check if the full correlation job will fit in 16 GPUs (after some of the optimisations above) -- from present status (Feb 2015) of work done with nvidia, it appears that optimised code will NOT give real-time performance for 400 MHz BW with 16 K20 GPUs. Hence, we need to start planning for 32 GPUs : 2 K20s per host, or double-GPU card, or one K20 + one K40 per host or 32 host machines; agreed to try a test where 2 GPUs on one host machine is used to test if the correlator code is portable (set-up with 2 GPUs is there on 4 of the 6 nos 620 machines -- so tests can be done on this when the code development reaches that stage); agreed to wait till main GWB-III is ready and released -- this has happened now; agreed to try either with dummy calculations (same buffer going to both GPUs) or with actual alternate data buffers going to each GPU... meanwhile, 2 new K40s have come from nvidia; could think of trying with K20 replaced with K40 on one node of GWB-III (may need to install new drivers) ? To discuss and decide the strategy.

==> keep the dual GPU option pending for some time till the optimisation on single K20 is completed.

(iii) other improvements in code :

(a) need some software updates in DAS chain to handle more than 2048 channels ? this needs clarification about whether this is available in currently released

GWB-III or not ?? GWB-III should work upto 32K channels, may need to confirm DAS path (and also maybe GUI?).

==> to summarise again : GWB-II currently up to 16K channels; can extend easily to 32K for GWB-III; difficult to extend to 64K -- to check with user community if 32K max is fine.

(b) new features to be added in next version of GWB-III code : correction for net\_sign[] flipping (LSB/USB modes of correlator); channels upto 32k, lower beam integrations (tbd), beam header, multi-subarray, 4 beam capability; all off-line utilities with backward compatibility; time ? + DUT corrections; optimised code to be ported; shift to 2 inputs per Roach board. Some of these can be delayed for some time, depending on priorities. BAK to discuss with the team and come back on this, based on the priorities.

==> order as per SSK : multi-subarray + beam header; time + DUT corrections; net\_sign corrections; all off-line utilities with backward compatibility; beam integration : default is 128 pre-int on GPU -- now it is variable (can be upto 1024) and needs to be tested (constraints in the range of parameter choice needs to be established); to look into reduced visibility integration time scales + folding ; 2 inputs per Roach Board; 4 beam capability can be done at the end; also need to keep PFB implementation on the horizon.

(c) long-term items like provision for control of FPGA and other peripherals (like sig generator) for different modes : agreed to identify one PC for control of all the peripherals related to GWB; this m/c can / is interfaced to online via a socket and GUI can send commands via this -- already done for loading of FPGA files, needs to be extended for other applications; for other things like turning RFI rejection or Walsh modulation on/off, writing to registers in powerPC would work all right; agreed to start working towards implementing scheme in GUI for taking additional parameters that allow different bof files to be loaded; agreed that these flags need not go into ltahdr but can go in the user log as setting parameters (can also be there in gpu.hdr); agreed to go ahead with discussion with NSR for implementing the logic for allowing support of multiple corr modes that use different BOF files; other action items to be taken up later.

Not clear if any action has been taken in this; BAK to check with Nilesh and see if the logic can be incorporated.

==> not tried yet.

(d) incorporation of DDC : this is important requirement in the long run :

Agreed to try on one node of GWB-II or GWB-III and get back to earlier stage and see exactly what was the bug. SHR has circulated an update; first part is that it appears that the current realisation is properly implementing a DDC; only the filter BW needs to be decoupled from the decimating factor and do a careful set of tests; in the long run, better filters with sharper cut-offs may be required (can check with nvidia about availability of std library functions for such applications); second aspect to the check about the nature or format of the o/p to see whether I & Q components are ok for further work or whether we need / can have the real voltage representation of the o/p signal.

new tests still pending; to check about nvidia primitives; to check about I,Q version vs real output possibilities.

==> to go ahead with X and SHR working on it.

(iv) Layout and racks (GSJ/BAK) : layout diagram to be updated and long-term plan for racks to be initiated; 3 different kinds of President racks discussed ("cyber", "cool" + one more?) -- to try and finalise after one more round of discussions including RVS (also, check new vendor Jyoti Tech); as an interim, 2 nos of cyber racks ordered with President. Current action items :

(a) 4 nos of half-height racks are now in use for GWB-III -- two nos are populated with 4 compute nodes each, third one has 3 host machines + 1 extra machine + clk source etc; fourth one has 8 Roach boards + IFB switch; will need to expand this to 16 Roach boards at some point of time -- may need to add one more half-height rack? One half-height rack is available in hand and can be used when required. Item can be closed for now?

(b) For the 2 President racks : first one has been used for GSB related nodes (spares) -- this is ready now, waiting for riser cards for the spare nodes (to be moved in during MTAC); to check current status of this, including swapping of bad node with CITA node. 2nd rack being used for trying the arrangement for special cooling (with help from mech group) -- tested with 1 kW load and increasing slowly; loading up to 4 kW tested by comparing the temp difference between input and output air; need to compare with unmodified rack; results so far appear to show that there is about factor of 2 discrepancy in estimated CFM rate and AC plant capacity CFM rate. Next - to decide on number of racks to be procured; Areed to include the test with unmodified rack and then circulate the report; current estimate is for 5 racks (32 Roach boards + 16 compute m/cs with 2 GPUs each); with 2 AC vents feeding these 5 racks, the estimate is that the available CFM may be marginal -- this needs to be resolved against the CFM discrepancy noted earlier. Also to explore additional margin the AC system. Maybe useful to have a joint meeting with RVS and team. Irappa has made some further tests and will be circulate new results shortly; check about having a session with RVS. ==> need to get latest update from Irappa and then follow-up with RVS.

4.6 Procurement of new hardware and accessories required for GWB systems -- from 25 Feb and before (BAK/GSJ) :

(i) purchase of 4 new host machines for GWB III : to decide configuration of host machines (disk i/o to be kept in mind); also to check if SSD is a viable option for recording of data. Investigation shows that SSD vs SATA has pros and cons; it may be possible that one class of server may be there that supports both? 4 nos of T620s have come and integrated into GWB-III: 2 are with 16 TB with and 2 with 4 TB -- compute vs host.

For future purchases : PERC card issue needs to be resolved : agreed that we will buy machine that can support upto 12 disks (which means with PERC card) but will have 2 x 2 TB to start with. More disks can be added as needed, and if at all extra slot is needed, PERC can be removed (will support only 4 disks) and backplane has to be changed with a new one (which has to be bought along with the machines); To decide quantity to order at present : agreed to proceed with 16 nos with full waiver for DELL proprietary item with DELL as the supplier. To initiate the appropriate paperwork, including waiver of public tender. Action started to generate the papers, to check current status. Paperwork is moving and will be going to TIFR for waiver and then enquiry. ==> tender waiver is done; and enquiry has been sent.

(ii) procurement of accessories like network cards, disks, cables etc to be looked into -- 20 nos of CX4 based dual 10 Gbe cards purchased and tested; to confirm that this order is enough to meet our long-term requirements; Agreed to produce a formal note about the situation for long-term : to relook at the spares requirement without counting the units already being used in the existing systems (including the PoCo

and pkt corr) and buy more if needed; GSJ has produced this list list and fresh orders to be done, based on this : 10 Gbe cables and NIC cards (spares); IB switch 36-port -- folders are ready for ordering; indent for 8 nos of K20 has been raised. cables for NIC cards : PO released; IB switch indent to be raised again. For 8 nos of K20 : order has gone; IB cables and NIC : order has gone; IB switch : new folder has reached final approval stage; for 10 Gbe dual-port NIC cards + cables are all in hand. 8 nos of K20 have come; IB cables and NIC : order has gone; same for IB switch. ==> IB cables and NIC have arrived; IB switch order has gone -- should come in a month.

(iii) new purchase of Roach boards etc :

(a) 12 nos of Roach1 + 16 ADCs and 4 nos of Roach2 have come; Roach1 test set-up ok; all 12 Roach1 and 16 ADCs tested ok; to make a summary sheet about current stock and usage of Roach1 and ADC and bring up for discussion.

xls spreadsheet has been created; to circulate the latest version; to check requirement of ADCs and verify the situation for 1 ADC per 32 Roach boards vs 2 per Roach board. This issue needs to be discussed and a final call has to be taken.

==> to check with Digicom about possibilities for supplying our requirement in the near future, 1 yr or so.

(b) for Roach2 : to check standard test procedure on CASPER; to check if we need to buy add-on mezzanine card; to check if Roach2 can be seen on USB port using Ubuntu and if some basic tests can be done with this; indent for mezzanine card has been put. Order has gone and delivery expected in March.

==> waiting for arrival.

(c) also software environment needs to be upgraded -- Matlab-Simulink upgrade order is under process; Xilinx ISE v14 has been ordered and CD is in hand -- to be installed; to see if one existing PC can be adapted for testing of Roach2, including installation of these new softwares.

New Matlab-Simulink installed on one machine (64-bit), including updated license manager. (additional license 2014 is for parallel toolbox)

Confirmed that one machine now has Matlab, Simulink, ISE v14.2; casper stuff yet to be installed; after that, can think of running a test where existing Roach-1 design is compiled and executable used on Roach-1 board. After that, can think of trying the same design on Roach-2, taking into account the differences in architecture.

==> casper tool flow installed; LED blinking on Roach1 tested ok; some changes in PoCo design to make it work; then could try pkt design and the GWB-III design; after that one can move to trying on Roach2.

4.7 Testing leakage, coupling and correlated noise in new back-end chain -- from 25 Feb & before (BAK/YG/++) : detailed tests had been done by Vikram Jaiswal (with SSK, SHR and YG) and report has been circulated; for GAB systems, some follow-up action for testing the leakage has been initiated; procedure for testing to be done with GWB-II release modes clarified and tried out -- new tests show significantly different results for cross-coupling for GAB+GWB; maybe due to synth LO (old tests) vs sig gen LO (new tests), whereas earlier tests used synth LO; new report had been circulated that showed significantly reduced coupling; agreed to repeat the original, user level tests done by YG & VJ to see if things are different now ; agreed to try the ADC noise input and north pole sky tests and see what results come out; 2nd round of tests done, show leakage of 2-4% (consistent with first round results of 1-3%) -- to check with SCC whether all user level tests (done earlier by YG + Jaiswal) have been covered; some user level tests done with north pole and different leakage found for lower and higher LO settings -- needs to be understood.

From Aug-2014 : <= 4% leakage; FE+GAB+GWB (L-band) ~ 40% leakage.

Need to organise a detailed discussion on this.



==> pending for a discussion.

4.8 Walsh modulation : prototype set-up on Roach board -- from 25 Feb & before (SCC/BAK): plans of BE team for implementing prototype scheme -- basic unit for switching using sq wave signal from GPIO pin tested ok; was put in PoCo correlator and was being tested; walsh waveform delay functionality has been added now and can set delay from 1 to  $2^{32}$  clk samples (!); with this, variation of correlation with delay has been tested using noise source inputs and found ok; a robust algorithm for hunting for the peak correlation and fixing the delay needs to be developed; can also think of a test case of showing cross-correlated signal goes away with modulation with square wave in one channel; Walsh pattern being put in the Roach (not many slices needed); there was some mismatch between CPLD waveform and FPGA waveform that was resolved and all FPGA waveforms are matching; current action items are as follows :

- (i) issue of accuracy of oscillator being used needs to be resolved.
- (ii) to complete the Walsh modulate and demodulate set-up in the lab and test -- this is ready and can be closed.
- (iii) to complete the final delay setting algorithm : to provide upto 500 msec of delay (for 128x4 Walsh length) with resolution of 5 nsec (FPGA clk); there were problems related to varying start-up offsets and fractional delay setting, as well as problems related to set up and hold -- these are now reported to have been resolved : this is confirmed to be work ok and can be closed.
- (iv) what about synchronisation of starting? -- this is taken care of by running the CPLD with a sig gen locked to 10 MHz.
- (v) to optimise the hunting algorithm -- to start testing a basic algorithm and see what we get.
- (vi) to demonstrate cancellation of unwanted signals in ADC card and/or GAB; first, need to run a test where pattern from external source can be synchronised to the pattern generated in the FPGA -- this requires being able to hunt and correct for the unknown delay ! This is coupled to item (v)

Some tests are underway; some problems being resolved about the hardware set-up. detailed discussion on various issues above can be taken up next time.

Current status: demodulator now working all right; waiting for modulator ckt to come back from FE team; meanwhile, can try a test where both noise inputs are demodulated with the same pattern to see if it recovers full correlation or not; also to make first estimates of total FPGA resources that will be used up.

==> demodulator integrated with PoCo; Walsh delay module created; external modulator already working; now ready to test with correlated noise source and develop the hunting algorithm.

## 5. Other items :

5.1 New python assembly design -- from 25 Feb (HSK/SSK) : FE group wants the python configuration in E6 to be adopted for all antennas -- FE and mech have discussed about plans for modified python assembly that will give additional protection to cables; mech group had circulate a short note on their view of the matter, alongwith photos; this was discussed and existing vs E6 system was compared; Action items :

- (i) modified E6 design with hinge-like support was installed on C4 (July 2014); agreed to watch the set-up on C4 and do periodic inspection for checks of (a) damage to hose (b) hose clamps (c) water entry etc -- first inspection was done after 2 months (mid-Sep 2014) by mech and fe teams; subsequently, inspection was done (around mid-Nov?) and a video of the same was circulated; scheme appeared to be working ok;

however HSK felt that this scheme with hinge may not be good in the long run -- this was discussed in detail; the hinge arrangement on C4 is NOT exactly same as the E6 arrangement (!); the C4 design does not completely solve the problem; agreed that E6 set-up does solve the problem (!); agreed that it can be replicated if needed.

(ii) IGUS cable wrap -- new technology prototype to be developed and tested on quadripod : a) hose without wire impregnation b) entire hose assembly (both could be tried as long-term solutions).

Quotes for both items received : item (a) is Rs 10k for 10m (4 antennas); item (b) is 60k each -- will try on the quadripod test range; items received; basic assembly made ready; finally, installed on test range around Oct 2014; tested ok without cabling (video available); then populated with cables by FE team for further testing; proto model made fully ready; this set-up uses a slightly different arrangement of fixed members, along with the IGUS hose; will work as well as the E6 design.

Agreed to : (a) replicate the test arrangement on 2 antennas, one with normal hose and one with IGUS hose (b) to check how much extra cable can be accommodated in the existing hose and (c) look for wider diameter assembly (32 to 40 mm or more).

==> email update from HSK : (i) hose procurement in progress under cash purchase (ii) spare assembly with old type hose will be prepared for 2 antennas in time for installation during Mar-April 2015 MTAC (ii) spare assembly with new IGUS hose will be also be prepared for 2 antennas for installation during MTAC (iv) extra hose of 38/40 mm is being procured and assembly preparation is in progress -- will be ready by 1st week of April.

5.2 Problem of access to FE boxes with 500-1000 CDF feed -- from 25 Feb & before (HSK) : Update on new solution being designed by Mech group -- tested in situ and found working ok; agreed to use this for present; for future where bigger and heavier boxes will come into play, mech group will think of an improved solution, including an option for removing one feed and bringing the stool inside the basket; a few options explored by mech group, with target of 1800 mm height for boxes with max weight up to 150 kg (?), quotes received from some parties, processed and order placed; delivery by end of November 2014; inspection done (in Bangalore) in mid/late Nov 2014; some simple improvements suggested to vendor (guard rail, simple clamping arrangement for item); platform delivered at GMRT (early-Dec 2014), tested and found ok, including modifications that had been suggested; trials had been happening on ground; ready to test with actual antenna operations -- waiting for new crane to be operational (why can't it be done with the HLPs ?)

==> email update from HSK : waiting for RTO registration of new crane to complete.

5.3 Improved software for work requests -- from 25 Feb and before (HSK/SJ) :

To review the current process of taking job orders for better facilitation of the tasks with end users like electronics groups. YG discussed offline with HSK : to look to fill the lacunae in the process with maybe new development of in-house version -- agreed to try and get this done in-house with Joardar; work was taken up after completion of ongoing tasks related to electrical (meanwhile, old software also started working (to check with Mangesh about what fixed it) -- hence urgency not very high; first version completed and released in late Dec 2014/early Jan 2015; awaiting user feedback for improvements; appears to be working fine; no major comments from users, except for one comment from SSK and one from admin staff.

==> email update from HSK : both the issues resolved by Yogesh Gaikwad and things are working fine. To check if this item can now be closed.

5.4 Status of new CSIRO feeds : from 25 Feb & before (ANR/JNC/HSK) : to report on performance of the newly manufactured feeds -- new results are slightly better compared to ver2 (casting) but not as good as the original ver 1 (machined by Godrej); it was discovered that a major change in the design /drawing required to maintain alignment between different sections [using guide-pins etc]; how to proceed further needs serious discussion about alternate options; HSK to try some new ideas to see if a solution can be found e.g. liquid Al layer to cover ? additional coating of Al paste being looked at as a possible option; discussion with Dr. Shenoy -- Al conductive paint may not work best (only 80% conductivity)... need a discussion and decision about what should be done; can keep the matter in suspension for some time?

5.5 New FE boxes and testing with reflective paint -- from 25 Feb (HSK/SSK) : two kinds of paint received and 1 box will be made ready next week for testing. 6 new boxes are ready as per specifications -- only some engraving work is pending. email update from HSK : One FE box painted with Luxtropherm HT 400 (range from 250-400 deg C ?) and handover to FES group for testing. Second grade paint : Luxtropherm HT 600 (range from 400 to 600 deg C) -- waiting for arrival; 3 types of FE boxes handed over to FE team : (i) plain box with powder coating (ii) box painted with HT400 (iii) box painted with HT 600; waiting for test results. 2 types of paints tried : HT400 & HT600; neither successful; to try new paint options? Item needs to be discussed jointly with mech and FE to understand why the original selection did not work and what should be done about it. Agreed to circulate the description of the method used, the results and the conclusions and then take up for discussion and decide what needs to be done; this has now been done by the FE team; need a follow-up discussion.

=====

## Minutes of the Plan Meeting of 18 Mar 2015

### 1. FE & OF related :

1.1 Documentation : follow-up on level 2 (ITR) -- from 4 Mar and earlier (SSK+team):

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

(a) total 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; was in internal circulation within FE group (for long time), so earlier draft was taken up for discussion in the meeting, and some comments and suggestions were made : to give some more background and motivation and requirements, add a block diagram, explain about RC, point out interesting artefacts in the results, mention the SOP etc; updated draft was discussed and still needs background and motivation to be put in, as well as section on RC time constant; updated version to be made ready & circulated; work is ongoing and RC time constant tests have been done : no visible difference is seen between the 2 cases (with and without), but probably the one with RC is somewhat smoother -- to do a quick cross-check about what it does to RFI signals; agreed to use this as default set-up and include the same in the report.

==> work still ongoing and report not yet ready.

(b) temp monitor (VBB) -- work had started (after v2 250-500 FE box installation); initial draft is there (2-3 pages), needs some more work to be done -- agreed to shift emphasis on this as 250-500 report has been updated and released; draft document discussed : to take care about symbols & standard nomenclature and terminology; 2 stage amplifier card with sensor mounted on it for general use in a box; for LNA, the sensor is taken off and put close of LNA and card is outside the box -- does this produce pick-up; online display shows calibrated temp; agreed to include the thermal chamber calibration curve in the report. To confirm if updated version has been released.

==> this has been released and submitted to Plan webpage c. 25 Feb 15; item can be closed now.

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

==> can start looking into this now.

(d) OF & RF monitoring schemes : Pravin and Ankur will be looking into (starting from initial work of Gehlot)

==> OF power monitoring (starting from initial version from Gehlot) will be done by Sanjit; and RF power monitoring (to be named as "Broadband RF monitor") to be Pravin, Sanjit and Ankur.

(versus "Broadband BB monitor"?)

(e) Test and characterisation set-up for OF system : Sanjit will be looking into this. To be ready in 2 weeks (18-Mar-15) & then report will come; work ongoing (Sanjit + SSK)

(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. For the 250-500 filter, a paper has been accepted for publication in IEEE (Sougata & Anil). Pending action items :

(a) agreed that the 550-900 filter work can be looked at for a paper : Imran is looking at that -- will come back shortly with a proposal for presentation in paper

content; not started yet.

==> no progress yet; IK urged to look at it.

(b) to check what else can be taken up for publication -- defer for now.

1.2 OF system NTR -- from 4 Mar & 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.

Any updates ?

==> still waiting for SSK.

1.3 Noise temp & gain vs temperature for new LNAs -- from 4 Mar & before (VBB/SSK): Results for new 250-500 LNA show ~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 0-60 deg and 0.6 to 0.8 dB (drop) in gain with increasing temp.

Results for 550-900 LNA are 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 :

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; expt has been tried to measure bias voltage but it is difficult as the probe affects the bias voltage and LNA behaviour changes; to check if any another method can allow the test to be done; in parallel to check existing schemes (in lit) for temperature compensation of bias pt (assuming that this is the cause of the problem); to check about option for artificial heating of LNA to constant temp (via a TEC); meanwhile, Lband LNA tests done : shows about ~ 5 deg to 40 deg variation (at 1300 MHz) for 0 to 60 deg change in ambient; clear varn of tmeq with freq; also 5 deg  $T_{lna}$  apepars to good to be true -- need a check on the calibration of the noise source? Otherwise, the varn is in the same ball park as 130-260, 550-900 LNAs. No progress on bias related issues..

the very low  $T_{LNA}$  (~ 5 K) issue being looked into by using 'new calibrated noise source' which just arrived ...

==> first look at data with new noise source shows results which are more sensible : absolute values of  $T_{lnas}$  are higher and easier to believe. variation with chamber temperature is a bit less over the range.

other general comments : at all RF bands, the  $T_{lnas}$  with old and new noise source are showing an increase of 10 to 20 K ! Further, 2 different measurements of Lband, inside and outside the chamber are NOT giving matching results -- needs to be checked with use of the same LNA. Also to check other outside locations for testing : DIAT, IITB, Sameer etc.

1.4 Testing of 130-260 system -- from 4 Mar & 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; 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. C10 has one 1 dB less deflection compared to W1 & S3; new 130-260 FE boxes made ready and installed at C10 -- first look appears to be working ok; detailed checks show that results for 2 antennas -- C10 and W1 -- agree very well, S3 is about 1 dB down in deflection; at 235 it is known to be down by 1 dB which is being investigated; there is some slope in 150 MHz part, can be looked into; there are RFI lines which need to be identified; to look for possibility of getting a 4th feed made (at lower priority) as 4th FE box is already available. Small variations in sensitivity can be deferred for longer term; checking for RFI lines is ongoing -- will be updated shortly; request for 4th feed at low priority to be given.  
==> request for 4th feed has been given.

(ii) plans to complete the 3rd wideband 130-260 FE box -- 2 spare boxes made ready by Jan 2015 (giving a total of 4 units, with 3 in use and one spare); for longer term, most of the items required are there; noise source and coupling needs to be integrated; possibility of sub-band filter discussed -- not clear if it is required, except for RFI related issues (space in the FE box will not be a problem). New PCB for QH + dir coupler with noise injection port has been designed and sent for manufacture to TechnoCkt -- will be integrated in box #5. need for sub-band filter can be kept pending for now.  
==> PCB is ready with the vendor; will come shortly.

(iii) plans for further tests, including interferometric measurements -- waiting to resolve the above issues and 3 antennas to be available; it should be possible to initiate this now; to check status of this with NK; tests have been scheduled; to check if some results are available.  
==> C10 both channels have failed due to lightning strike; device has been replaced and antenna has been restored; team will start regular monitoring of the 3 antennas (Sougata); NK has taken some data, still interpreting the results.

1.5 Testing of 250-500 FE receiver system -- from 4 Mar & 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. C1) but it needs to be checked individually for each new box that is made ready.

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:

(i) to confirm if E6 sensitivity is ok or not -- agreed to check and report.

one dipole had poor return loss; after replacement of dipole (& also FE box), sensitivity found to be OK; to check what was the problem with the dipole and lessons learnt.

==> spare feed has been put; problem traced to use of metal screw in place of teflon screw (with some insulating tape) -- confirmed this was done only for one feed and others should not have this problem.

(ii) 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.

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

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

(v) some antennas show ripples and unstable behaviour in on off and deflection plots which need to be characterised and understood;

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

Recent report generated with list of lines shows 4 lines within 250-500 MHz from 24x7 monitoring : from localized satellites? to take up in RFI discussion.

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) : to check if results are available.

Agreed to maintain the log of the various issues; to check Nov data and also new data being taken now in Dec and summarise the results.

Attenuator setting problems were found in 4 antennas (W6, W4, S2, C13) -- due to wrong wiring; now corrected for 2 antennas (S2 and C13); now corrected in all x5 antennas -- to check if this issue can be closed.

Discussion about results from regular monitoring of 250-500 system and conclusions from that (from 4 Feb meeting) : misbehaving antennas are clearly seen : some with low deflection (e.g. C13), some with dips in the performance e.g. E6, some with a bit of ripple in the band -- team understands these issues and is beginning to take up follow-up action items; attenuation setting problem also being solved one by one in offending antennas (only W4 remains); E6 yet to be checked; new plots will come in next few days, and detailed discussion can be taken up after that.

To check status of W4.

==> status update on W4 : several tests and checks have been done; exact issue is not clear, but RF cable change has been initiated; other issues to be taken up after next data set is available.

1.6 Mass production of 250-500 FE receiver system -- from 4 Mar & 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. First version (v1) of FE box was installed on C13; final version (v2) of new FE box was installed on C11 and found working ok except for Walsh problems. Meanwhile, GSG cleared to go ahead with mass production. Current action items towards mass production are :

(i) 250-500 LNA : there are only limited for uGMRT at present; it is also being used as spare for existing narrowband 327 MHz system (as devices are not available any more) -- original was made on ultralam2000 and this is not easily available; verified that a total of 20 nos (on ultralam2000) are available.

Current action items are :

(a) plans for making more units : need to find an alternative substrate; Rogers 5880 may be a possibility (work is ongoing); first prototype PCB was made, but used substrate with wrong thickness (!) -- now awaiting arrival of PCB ordered with correct thickness material; 10 PCBs have been received; 2 PCBs being populated to test. Check status of this.

==> new PCB shows results matching quite well with old one; so problem may be resolved now; to wait for results to be circulated.

(ii) status of QH, noise source, coupler etc : QH is available for all 30 antennas; (current version of noise source, power splitter, directional coupler etc were tested before putting up in C13; but in-situ tests showed that the power level (deflection) of the noise was not sufficient; traced to faulty functioning (unequal distribution) of power divider module; alternate approach (using resistive components) seems to work ok -- equal powers on both channels ~ 4.5 dB for E-Hi cal, no need to reduce coupling from 20 dB.

Also, additional issue of 7 dB slope over the band (due to coupler) and 4 dB due to noise source; 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) was completed and first results show fairly flat (+/- 1 dB) spectrum over 200-600 MHz;

Current action items are :

(a) to confirm which antennas have the new system at present (C11, C13 or other?) and the final values of noise deflection being obtained from tests on these antennas with new system on C11 & C13 (from the document by VBB?).

C13 has original (heavier) new box; C11 has 2nd unit of final box; 1st unit is in lab for some work and will go to C00. Next boxes that will get ready can go to antennas which need new 250-500 systems (put in appropriate agenda item !) C00 has new feed with old box; S2 has new system; 4th box to go to C00; also, check results from user tests about noise cals.

==> 1st heavy box on C13; 1st new box (which went to C11) is now on S2; #2 of new one is on C11; #3 is getting ready and will go to C00.

(b) for new PCB : agreed to check on 2-3 more units for repeatability and also thermal cycling and then finalise the matter : one more unit has been made but work held up due to shortage of switch needed for noise level change control -- this has been indented (express ordering being tried); meanwhile, thermal cycling tests passed ok. Order for 30 nos of switch has gone -- switches have arrived; wired & testing in progress; to check if repeatability can be established.



==> prototype unit (now in box #1 on S02), original unit (now in box #2 on C11) + 2 new units ready and tested (data appeared to repeat well, but final record is not available) -- one of these will go in box #3. to cross-check against results from DVL.

(c) discussion about the 7 dB slope due to coupler : to be deferred for now.  
==> to be left deferred.

(d) strategy for mass production to be decided : 30 nos PCB to be ordered, and plans to be finalied.  
==> PCBs are in hand.

(iii) 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 untis 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 had been sent to Argus and after receipt of PCB 2 filters for each of 2 pols ready and 1 filter tested.

Some confusion about whether there is repeatability or not as Argus appears to be using different sub-contractors -- out of 4 units, 3 are sort of same and acceptable, 1 is quite different; to talk to Argus and see what minimum guarantee he can give for repeatability and then take a final call.

Argus has agreed to meet the min specs and 2 boards (all sub-band filters for 2 antennas) have been sent to him -- expected in Feb 1st week, but haven't come yet. two nos of filter PCB received from Argus are problematic; exploring alternate vendors - Arpito from Ahmednagar; needs a discussion.

==> 3 different aspects : Argus is ready to try and correct the problem -- should go ahead with that; alternate fabricators : Arpito from Ahmednagar is ready to take the job (Atlantis from H'bad may also take it); 3rd option is to try simulating with 5 mil spacing and see what results are available.

(b) plans for mass production : switch PCB (20 nos) were available, along with sample chassis; agreed to first put on one antenna; if found acceptable, then go for mass production; compact v2 was installed on C11 and worked fine (tests completed); agreed to give order for mass production alongwith final sub-band filter PCBs; for the switch item itself, 100 nos were available (120 needed); confirmed that this switch is not used in other circuits, hence quantity can be finalised; chassis requirement has been worked out and request has been put (for how many?); mass production spreadsheet getting ready -- spreadsheet by Temkar in internal circulation -- to check status of this; meanwhile, 30 nos chassis to come next week (~ 11-Mar-15);

==> spreadsheet still in internal circulation -- changes being made as per suggestions of ANR; will be ready by next week.

(iv) post amp : Hitite 740 new stock for 30 antennas available; plans for slow rise power supply -- may get done with CB power supply testing; new design of supply was done and PCB was ordered & tested -- worked Ok; agreed to give this PCB for mass production to cover this FE box and common box requirements for 30 antennas; next FE box layout to use this PCB; mass production PCBs have come, but not yet populated. Few cards populated and tested ok; this will now go into mass production now. Will go into mass population for CB box; FE team to discuss about use in FE box and come back.

==> for CB mass production, waiting for final layout of CB; not being planned for FE box (may not be needed?).

(v) 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; updated document discussed : most of the changes have been done; a few simple changes suggested in blk diags; changes have been made and document can be circulated; confirm if final version of document released and matter can be closed.

==> this has also been sent to Plan webpage around end of Feb and can be closed.

(vi) Walsh testing shows both channels working in C13, but only one channel working in C11 -- box was brought down to check Walsh matter + problem of spurious bandshape of LNA; current action items :

(a) C11 FE box tested in the lab -- Walsh working ok in both channels -- may be a common box problem or D49 PIU? -- to carry out in-situ test at C11 for this; finally, cable from antenna base to top found to be faulty -- has been replaced; Walsh has been tested by Sougata but needs confirmation. To confirm that both channels of C11 now working and what was the exact cause of the problem.  
==> agreed to test at C11 (alongwith S2 and C13) to verify that everything is working fine.

(b) spurious bandshape of LNA -- not seen in the lab, except when i/p is loose or not connected -- this could be typical for all units?; need to check about this. Various tests have been done in the lab and spurious lines are seen under some conditions of thermal cycling. There is an issue with central pin of QH (at both i/p and o/p side); at o/p side problem was fixed by ordering special connectors and may need same solution for cable connector i/p side; sample machined pins have been got from workshop for making a trial version of the cable -- box will be tested with that before putting on antenna (C00); appears that the centre pin problem is now addressed successfully;  
==> sample cable tried on W4 to see if it solves the problem -- did not make a difference; however, since there is a fundamental mismatch, better to make this as a permanent feature; to check with Amphenol and Raidall to see if they will make to order for this (temporay solution is with workshop).

1.7 Final version of 250-500 FE box -- from 4 Mar and before (ANR/SSK/HSK) : modelling showed that existing size of box is not adequate (inspite of double deckering 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 tested; meanwhile, FE team went back to a compact design and layout that makes everything fit in the original FE box size; action items :

(i) 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;

Current action items :

(a) box has been up there for few months now and no problems reported except for the fringe problem due to wrong filter settings (to confirm if this is resolved). Walsh has not yet been cleared : C11 box coming down for fixing Walsh problem + one other problem -- see agenda item earlier; to confirm if problem fixed or not.

(b) meanwhile, work on 2nd unit of v2 FE box had started : box was assembled but LNAs gave some problems (dip in passband) -- changed with other LNA units and now working ok; integrated testing to be completed and then put on antenna which has upgraded common box : C0 is a possible choice; new box fully ready, will go to C11 (with improved noise cal system); original box, after fixing the QH / LNA problem (not clear where the problem is), will go to C00. It appears 2nd unit of v2 FE box has gone on S2 -- to confirm; also, plans for next set of boxes to be discussed.

(ii) 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 possible clash with powder coating needs to be understood.

3 types of FE boxes handed over by mech group to FE team :

(a) plain box with powder coating (b) box painted with HT400 (c) box painted with HT 600; waiting for test results -- tests not yet done.

initial results seen from 5 day continuous run having 4 curves : ambient (shows large increase at sunrise, even a spike to 55 deg); powder coating box; 2 boxes under test : result is slightly confusing as one box under test and powder coating box track each other very well and other box under test behaves worse than these 2 (!); also there is extra cooling in the night ! To confirm time axis in absolute units and to cross-check the results. Can try a cross-check with sensor in the thermal chamber. Need follow-up to understand what happened in these tests and how to proceed further. It appears that this is not working out; FE team to send a brief report with the data and their conclusions and matter to be taken up for discussion -- report circulated; no significant gain; current coating thickness 0.7 mm, to try higher value [can that help ?? skin depth much smaller];  
==> need a joint discussion with mechanical to decide the way forward.

(iii) 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; 6 boxes as per above were

made ready and delivered to FE team; for next block of 5 nos for 250-500 & 5 nos for 130-260 -- work order put in;

10 new boxes in process as above; mech group is interested in trying recycling of the shell (outer portion of the box) -- to be discussed next week to understand pros and cons.

Agreed that shell of old box will be refurbished and inside will be done new based on need (CB or FE for different bands); 8 such boxes have been given to mech in last month for refurbishing; next 5 250-500 boxes will from this set of 8; workshop is modifying old boxes; to check status and timeline of these activities.

==> right now in stock : 6 boxes for 250-500; 2 boxes for 130-260... so situation is comfortable and turn around time is not much...

1.8 Status of improved 500-1000 MHz CDF -- from 4 Mar & earlier (HRB/GSS/SSK) : there are 3 different versions of dipole (v1, v2a, v2b) and 2 versions of cone (v1 with 66 deg and v2 with 70 deg) 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 VG; 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) 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 13 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 seen; 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 was down; licensed version of windows7 was obtained to install on the lab PC and it should be ok now? Software is installed but there may be some hardware problem of hanging or shut down. Replacement m/c seems to be working ok, except with monitor -- some intermittent problem that needs to be checked by comp group.

==> finally all resolved and PC working properly ! Can resume some simulation studies.

(ii) 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?)

(iii) to do deflection tests for different combinations of dipole and cavities (as mentioned above) for varying distance from focus using a variable height stool to see which design gives optimal performance.

After a lot of effort, a reasonable set of results on Cass-A obtained for the different combinations, including 750 MHz Kildal feed -- this is very similar to

Cone1-Dipole2; Cone1-Dipole2b as well as Cone2-Dipole2b are similar to CSIRO feed plots obtained in ~ 2011; agreed to do the following things in parallel :

(a) ask for specific stool modification for cone2 + dipole2b at 1260 ht + matching short length cables to minimise loss (can put it on a separate antenna, other than C10 which can continue to have other cone-dipole combination, e.g. W1 or S3); test was done (at C10) with shorter cable (0.6 m instead of 1.4 m) shows measurable difference ~ 1 dB over most of the band (!); further reduction to 0.3 m appeared to produce another ~ 0.5 dB improvement (!! ) over most of the band; agreed to follow-up with LMR low loss cable and also to try with plate mounted QH + LNAs with DC voltage supply; also HRB wants to try with small adjustments of stool height. Test done with new arrangement of QH + LNA mounted on plate and kept right next to the feed -- shows another ~ 1 dB increase in sensitivity at 610, but no improvement by 800; note that this is a different LNA and not the same one used in the FE box (with the matching connectorisation) : so may be worth trying with proper connectorisation and same LNA -- HRB and ANR to discuss and work out a plan. Further tests with LNA used with CSIRO feed (SMA coupler may be producing some loss), mini-circuit LNA (very bad result); best result is for ~ 15 cm long cable connecting feed to LNA directly with type-N; agreed to repeat this deflection test and also get beam shape data and repeat both these steps also for cone1-dipole2b (may need to adjust the height a little bit).

==> latest results for cone2 + dipole2b show : decent results for 0.3 m cable length and further low freq improvement on direct connection (but needs N-type connector) : to check N-type connector LNA in the lab; do beamshape measurement with SMA and 0.3m cable; theoretical curve to have mobile notch added in it.

(b) to complete the exercise for cone1 + dipole2b with stubs to increase ht by 50, 100, 200 mm to make it reach upto 1500 mm or so; reviewed the results now available : not too much shift in the peak for cone1 + dipole2b -- peak is around 1310-20 mm ht; this is now pending for making a stool of the correct height for further tests, similar to those done for cone2 + dipole2b combination above.

==> to ask for mechanical arrangement to be done and do the test; to get deflection and beam shape data for this, for 0.3 m cable arrangement.

To prepare for comparison with CSIRO results : ANR to check with JNC about the deflection results available.

(c) getting beam shapes for the 2 feed combinations to see if one is better -- quick results from PMQC data (at 610) give some indication that cone1+dipole2b has slightly broader beam -- need to the full RF test data taken and analysed, for both cases; plots of beamwidth vs frequency obtained from Manisha's program : shows ele and az beamwidths varying with freq, but with some difference in slope and also absolute values are higher than expected (x2 for Ele and x4 for Az); these issues need to be sorted out and a more detailed comparison can be done.

Hand calculations on the data plots confirm HPBW to be around 35 to 40 arcmin (cf around 45 arcmin for the existing 610 antennas) but automated fitting algorithm still giving the larger values. Manisha is in discussion with Deepak to check her program and see if the matter can be resolved.

==> need a discussion on this.

(d) Also, GP to work out the sensitivity curves for the expected parameters for this range : first version has been done, may need some refinement. There is some indication that some of the drop in sensitivity at ~ 750 MHz may be due to slight (10%) increase in Tlna -- this needs to be investigated in some more detail.

Refined analysis with 2 different (fixed) values for  $T_{lna}$  show that the range of variation of  $T_{lna}$  over 600 to 750 MHz can explain the change in sensitivity seen in the expected curve. To check about options for retuning this LNA design; meanwhile, can test the commercial off-the-shelf broadband LNA available in the lab (which may have constant  $T_{lna}$  of about 30K) to see if it can be used to test flatness of the response across the band. Meanwhile, ANR to look at the existing LNA design critically to see what are the characteristics and what can be done to improve the  $T_{lna}$  vs freq.

==> see above.

(iv) any new ideas? discussion of 19 Dec 2013 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), including varying stool height -- see discussion above;

(b) try simulation of CDF250-500 scaled by factor of 2 (including with different dipole sleeve combinations) -- maybe after (a) is done; status update needed.

(c) design Dual-ring feed 550-900 MHz (initial BFRs can be made for 650 & 800 MHz) -- waiting for above items to complete;

(d) modified version of cone-dipole based on patent by Shefai + ... (1991) : refers to Kildal paper of 1982; recommends additional choke structure just below the cone but protruding out to  $\lambda/4$  : supposed to improve (a) cross-polar (E-H match) by 30 dB; (b) reduce back-lobe and (c) ???; agreed to cross-check the date of the paper on which our cone-dipole is based and also to build a prototype using cone2 (why?) matched to  $\lambda$  at 750 MHz.

FE team to go ahead with a first cut choice to make another cone with the choke arrangement.

==> request has been given to workshop for sample fabrication.

1.9 Releasing existing 610 MHz system as part of the wideband upgrade -- from 4 Mar (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 540 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; finally, a total of 9 antennas completed (C1, C4, C8, C12, C14, E2, E6, W1, S2) and 2 more boxes made ready as spares.

(i) 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?  
==> this has also been given to the A'nagar party on trial basis.

(ii) testing of released systems : to discuss results from weekly / montly tests. first report has been circulated; all deflections seem to be OK; to check if there are any issues that need to be addressed; to wait for next round of tests; also, to add the new, broadband feed antennas (e.g. C10) to the tests.

==> C10 now included, but working only one day and one channel -- HRB to confirm which feed combination was there on 4th Feb.

1.10 Design of new RFCM card (v3) -- from 4 Mar & 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); meanwhile, the v3 card has been tested ok in different conditions (L-band system on W6, 327 FE box that is now on C11, 130-260 box on C10 etc.. Pending issues :

(i) report : first draft is ready, and 2nd version is underway -- needs additions about monitoring points and internal review -- still in discussion between Sougata and ANR; some significant changes were to be put in; will be released within the next week (by 4th Feb); report getting complete; to check if released or not. ==> almost done with internal review; will be sent out shortly.

(ii) PCBs have gone for mass production : will be coming by 3-4 weeks; will be populated in-house; meanwhile ~ 10 nos are available. PCBs have not come yet. ==> PCBs may come by this week.

1.11 Next Gen Common Box -- from 4 Mar (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) 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. To check plans for this. ==> work in progress.

(ii) 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 were completed for the sample box and all the items were available, including Rabbit card enclosure, slow-rise power supply card etc; wiring was to start after completing the layout -- this needs to be redone as things did not fit into the box in the first attempt; mechanical issue due to space crunch, requires swap switch PCB and chassis to be redone. Sample unit is getting ready -- PCB in fabrication; new chassis getting made : to check status of the work. ==> PCB is ready with vendor (Technocircuit) should come shortly; chassis will be made after PCB comes; wiring can be taken up after that.

1.12 Calibration scheme with radiator at apex of antenna -- from 4 Mar & 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.

==> no updates.

(b) to get comparison plots for C4 with old and new radiator antenna : 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;

==> no updates

(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; tests have been done and upto optical receiver output [OF Tx Rx FE CB] 1 dB compression point available; awaiting tabulation of the results.

==> still waiting for the tabulation of results.

(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; instead of W1, C4 in progress? to confirm status of this activity.

==> c4 has one of the new antenna; put one more of new antenna in old electronics antenna and old radiator in C11 or C13 kind of antenna.

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

==> ??

(f) to share the data with SRoy to get the plots done for the variation with antenna position (elevation etc) & then work on interpretation : 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 phenomenn matches that form.

SRoy has had some discussion with PAR on the data sent and some additional data is required to be sent by PAR. First attempting at fitting with mathematical fn has been tried; new data now with SRoy; 'servo file' different now - extracted & given by PAR to SRoy; to check if any updates from SRoy on this matter.

(g) 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... 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.

(iii) deployment of new broadband antenna : suitable unit (from Aronia) had 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.

==> data has been shared with SRoy; preliminary look has been taken and more detailed analysis is ongoing and results can be discussed two weeks from now.

1.13 Walsh switching arrangement in FE -- from 4 Mar & before (SSK/SCC/PAR) :

Some tests have been done on the bench by FE group; first draft of report has been circulated. Current action items are :

(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, and tests done : this looks like working satisfactorily in 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 -- to check status of these activities.

(ii) 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;

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

Work on verifying that Walsh works is pretty much over; need to work with BE team to do end to end test.

==>

1.14 OF links : new and old, from 11 Feb and before (PAR/SSK) : There are 2 parts

to this work :

(i) installation of new, broadband links :

22 antennas installed : C0, C1, C2, C3, C4, C5, C6, C8, C9, C10, C11, C12, C13, C14, E2, E6, W1, W4, W6, S2, S4, S6.

Further, S3 was completed and released; next in line is S1 -- check current status.

==> S1 is completed and only telemetry connectivity is remaining; next antenna (which one?) to be taken up.

(ii) long-term maintenance of OF field joints : Growing evidence for problems with older joints (over last 10-20 years); need some kind of consolidated approach to address the problem. Likely causes : nature and condition of splicing equipment? Nature of cover / protection provided? ... Agreed to get the statistics of the old field joints over time, including a comparison of the losses seen with fresh measurements -- this exercise may take 2-4 weeks; meanwhile, urgent attention is required for the field joint near W1 as it is affecting W4 and W3 significantly. There is a technical problem that the newer kits are not compatible with our existing cable and old kits are not available -- 2 options ongoing : trying through Chinese company and also work with mech group for additional support structure.

Trying to understand the problem : fibre cable used is the same type as original; however, the splice kit for new cables is incompatible with older cables -- this problem is from about 2007 / 2010 onwards?; claim is that joints made before this are ok, as the quality of the material in the older (Australian) ones are better. except if there is a problem of break or crack in the protective coating or the kit. basic list shows ~ 40 cuts (80 joints) distributed over the array; agreed to produce the table along with the loss values; then one can look at the worst losses and compare with other external factors like location, environment and old vs new kit etc. ==> 30 nos of new kits (15 joints) have come; these look quite good and fairly cheap and should meet all the requirements for different kinds of joints; first trial may happen by MTAC.

2. RFI related matters :

2.1 RFI from different spectral lines -- from 4 Mar 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 :

(a) TV lines : Cable TV leakage does not appear to be a problem; present thinking is that the lines seen are from terrestrial TV transmitters -- mostly in 175 to 229 MHz range. Need a comprehensive list of 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 -- 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, but needs to be checked carefully. Level of lines appears to vary from antenna to antenna -- need to do a careful check of this aspect.

(b) 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). Lines seen near 1030 and 1090 :

interrogation at 1030+/- 3.5 from airport and response from aircraft at 1090+/- 5 with width of about 20 MHz. In addition to these lines, 108 to 140 MHz is used by ATC -- again stronger near W-arm antennas. Need a comprehensive list of known / expected lines from civil aviation related activities near GMRT -- the list of lines have been identified in the main document (below)

(c) any other sources of spectral line RFI : e.g. police wireless etc -- need to be discussed and characterised : work ongoing with omni-directional antenna and disc-cone antenna; police wireless is in 159 to 163 MHz; there are some reports that there is increasing amounts of such activities in GMRT area (earlier it was more eastern side; now also seen in southern side).

(d) other, unidentified lines : new RFI was reported in 270-290 range (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 at a second epoch; nature of 485 line is confirmed (?), but no known source known to be nearby !

Current action items :

(i) to generate comprehensive report on list of lines seen around GMRT and their RFI influence : updated report with list of lines around GMRT getting ready ; have used log-periodic + disc-cone + actual GMRT data for making final compilation. Highlights of the results : lines are color coded as per different sources of RFI e.g. mobile phone, TV, civil aviation. Good amount of information appears to be captured here -- discussed in fair detail during Dec 2014 : agreed to modify title of report; to clearly mark lines not seen in GMRT region; to think of separate version of table (for external circulation) that has ONLY lines seen at GMRT; to think of prediction algorithm for GPS satellites (similar to military satellites).

==>

(ii) For TV lines :

(a) to check for evidence for Mumbai digital TV transmission near 470 MHz;  
(b) noticed that 540 TV line still leaks through for some antennas (also maybe true for the 175 TV line?) -- need to check if this is due to shift of the filters or not enough rejection of the line.

(c) can we take the strongest TV line & characterise if it saturates the electronics or not.

==> maybe only Junnar TV at 189 and 194 MHz saturates only W6 (needs to be confirmed)

(iii) For civil aviation : some follow-up is needed to see if they saturate the W-arm antennas.

==> not done yet.

(iv) For police wireless : to discuss with admin if the information about their transmitters (esp the fixed ones) can be obtained.

==> not done yet.

(v) New lines :

(a) to check all the RFI lines in 250-500 band (at least 4 have been identified)

(b) to confirm status of about new RFI in 270-290 range;

(c) some expts to be tried to confirm nature of 480-485 MHz line -- this appears to be from a Russian satellite system; 24x7 (12 hour period; x6 satellites) -- to

discuss possible strategies for this.

==> updated list includes all known lines in 250-500 band; discussed about possibility of tracking the moving satellites like GPS and Russian for avoidance.

(vi) omni-directional antenna needs repair and replacement also; processing for 10 nos (including remote location sensing) was ongoing -- order had been placed; all 10 nos arrived around mid-Jan; one unit opened to verify the components; to be assembled and performance to be tested; to check outcome from the tests.

==> one antenna tested and found ok; will mount 3 antennas at 3 different heights on the wind tower of servo..

2.2 Radiation from CAT5 cable -- from 4 Mar & 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 had been circulated that combines testing of switches and CAT5 cables; conclusion was 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 2014 : table of inventory of un-shielded cables currently in use (94 copper lines); total length ~ 1200 metres; procurement of shielded cable was initiated; data was submitted by RFI team, and an updated document had been circulated; about 900 m cable (3 rolls) + crimping tool need to be ordered (enough connectors are available); total investment is about Rs 1.7 lakhs : agreed to go ahead with this; item was under negotiation about details of the pricing (Rs vs \$ quotes due to difference in value); meanwhile, work had started using existing spare CAT5 cables (old stock) to replace older cables in various labs, as per their requirements; conference room & canteen annexe has also been done; meanwhile, folder for main order was followed up and it appears that there is no choice but to go with the Rupee quote and hence total outlay will be ~ 5 lakhs.

Current action items :

(i) To check status of completion of the work in different labs and rooms : conf room, canteen annexe, EPABX room and all engineer's rooms, user's room are done; rest are waiting for main order to supply.

==> still waiting for order to come.

(ii) To check status of final order and availability of cables, connectors, crimping tools etc; finally, order is gone; to confirm expected date of delivery.

==> to confirm expected date of delivery.

(iii) Need to work out a scheme for proper long-term maintenance with OF and computer group : at the level of PAR to MU it has been discussed -- SSK to send an email to formalise the arrangement; cables, connectors, tools given to Mangesh; a concluding discussion may be required with computer group.

==> YG to bring up with BAK.

2.3 Effect of military satellite RFI in 243 band -- from 4 Mar & 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.

==> some results were displayed by Ankur. filters are still there in C6 & E2 -- can be checked.

(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.

2 out of the 6 satellites have 2 deg limit. Can we put this as the default limit for all the satellites? Ops group to generate statistics of the duration of encounters in the current set-up.

This needs to be followed-up, including checking the log that Santaji has created.

==> this needs a bit of follow-up.

(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.

email from SNK gives some details about implementation and testing for (a); Giving refined coords is still pending; (b) and (c) are still pending.

For (a) refinement of coordinates is still pending; for (b) and (c) updates are still pending.

2.4 Mobile phone RFI -- from 4 Mar & 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.  
update on 10dec14 : BSNL has finally done at Gulanchwadi -- this is now verified that power in 950 has come down and 1800 has gone up in that direction. Letter needs to be sent (to confirm if it is to be a letter or request or appreciation)  
-- YG and PAR to discuss and resolve the matter.  
==> to finalise by tomorrow.

### 3. Operations :

3.1 Mass production of shielded box for MCM cards -- from 4 Mar & 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; sample box of Rabbit + switch + media converter + Miltech PC combination tested on 4th Dec (report is awaited) : results match with earlier results. Two minor points to be conveyed to vendor : size of one of the opening and assembly of the side plates, which has been conveyed to mech group (!) All these have been done; now awaiting for feedback about delivery of mass production from the vendor. 70 shielded boxes (for MCM) have been delivered; agreed to keep them in storage and use as needed; next part is to start procurement of the RFI material and components needed -- list is with Ops Group and indent has to be raised; Charu's list ready; Pravin to decide line filter connectors and then indent can be put; total cost ~ Rs 33 lakh (including parts for switch enclosure?)  
==> discussion between CPK and PAR is still pending -- will happen this week.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 4 Mar 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.

Shielded box for layer-2 switch (35 nos) will take ~ 1 month (till end of Jan or so) -- still waiting for shipment. Issue of ordering the components needs to be tackled. To check whether sample unit had come and was tested for RFI; and when all the units are expected; meanwhile list of components is being made ready -- see item 3.1 above.

NOTE : above 2 items can be shifted to alternate week.

3.3 Interfacing of FE with new M&C system -- from 4 Mar & 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 : this had been done and report circulated -- appears to be generally ok? summary of technical issues : all commands except Walsh tested ok; for monitoring, logic / software has yet to be implemented in Rabbit card and then only testing can be done.

==> status quo.

(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.

3.4 Development of M&C software -- from 4 Mar & 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 prepared by JPK and then full scale work was to resume.

Mock system on rabbit card tested (optical fibre system)

SJ : making a new module (old : GAB) for fibre optic link; problem with structure of communication [telemetry group to look into this in the long run]; communication established; sending commands tbd : ~ 1 week it may be possible; installation program (TCS) does not exist; script is being written for installing.

First attempt was to take the given code and modifying / editing it to do both monitor and control -- to produce a short report describing this phase of work; development of new module to implement the same functionality -- working for monitoring and trying for control (to discuss with JPK and come back); script for installation of EPICS + peripherals getting ready.

==> for monitor side : able to get data and display; working on command flow for control side; some extra information may be required.

(ii) plans for tasks for next phase of work for new M&C software : architecture definition and UI definition tasks are completed; to check current status of next phase of the work : indent and work order being finalised; meanwhile, preparatory activities for testing using the prototype version to be initiated by JPK to check the interface with the existing systems.

2 meetings held with TCS; 3 phases of work identified : core, business logic, web application; ~ 6 months per phase; cost estimation in progress.

At higher level, still waiting for the final quote; at lower level, discussions are going on and progressing reasonably; to check curret status.

==> kick-off meeting has happened and work is starting; can bring up the issue of which Linux OS should be used : CentOS or enterprise, instead of Fedora (for rapid changes) ?

(iii) 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.

during last MTAC, 3 antennas (C1, C4 & C6), 2-sub-systems tested, using 2 rabbit cards; servo system tested in servo lab and in C1 antenna (all commands tried out). draft report circulated.

Communication to FPS being tested; NOVAS library interface done in C, Perl, Python and PHP -- can be utilised by any of the new software developments.

Web tools, core switch ready (tested FPS, servo); further tests planned during MTAC time.

==> going on as per plans for MTAC; may need some cash purchase.

(iv) 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...

JPK : online -> local M & C (EPIC -> needs local M&C for broadcasting FE command

3.5 Long-term plans for evolution of M&C systems (4 Mar and before) : MoM of Sep 2014 meeting identified the following urgent / immediate action items :

(i) For GAB M&C System total 30 rabbit cards are identified but need to discuss with concern department if further additional 8 cards are required for the GAB rack monitoring -- Nayak to confirm. Yes, 8 cards are required for GAB rack monitoring; item can be closed?

==>

(ii) To confirm if Rabbit card interface to MCM 14 via serial link tested & cleared : null command has been tested; CPK working on implementation of the other cmds. Almost all commands have been coded; could test only 'null' command; reponse (feedback) related work left out for now. Null command and response both tested; able to get encoder and rpm reading from FPS system; to confirm if all aspects have tested and decide future strategy.

==> all FPS commands have been tested in the lab; need to repeat in-situ at some point.

(iii) Rabbit card need to support serial link to control FE-CB during developmental phase: this has 2 aspects : (a) Rabbit to MCM via serial and (b) Rabbit to Rabbit via serial.

To arrange a discussion (alongwith FE) to resolve matters.  
Need a discussion to be set-up; SN to coordinate with SSK.

==> defered for today.

(iv) Verification of compatibility of switching equipment at antenna base and CEB to be compatible with HRS requirements -- CPK and Nayak to ensure the same; to check if this has been done and item can be closed?

==> waiting for confirmation.

(v) To discuss and finalise optimised packet format for Command/Data response with the Rabbit card -- RU + JPK with YG.

Agreed to wait till end-march for a detailed check of what the existing framework offers and what is required for next gen system and decide if any changes needed. Discussed briefly, but not clear how to resolve; to try and generate a current status summary.

==> outcome of current discussion : online V2 already has a packet structure; during TCS proto development, one version of protocol was defined and used; JPK to cross-check if that will be sufficient to meet the present needs; also, telemetry team is agreed that whatever changes are needed to modify on Rbabit side to meet this requirement, will be done by the team.

(vi) To discuss and agree upon a unique set of Rabbit commands per sub-system -- Nayak to coordinate with JPK + ? : Not clear if this has been started.

RU to put out the list of currently implemented commands (with parameters) and matter can be taken forward from there for checking suitability for different requirements; 'list of currently implemented commands' circulated; need a follow-up discussion.

==> to bring out the list of commands needed for the next gen system and compare with v2 list and quantify the extra amount of work to be put in by the team.

(vii) Hardware at antenna base : JPK to circulate a background note for antenna base computer system and then item can be taken up for a larger discussion -- not done yet. Pending for note from JPK. To check status of this.

==> pending for some time; JPK urged to bring this out now.

#### 4. Back-ends :

4.1 Documentation at various levels -- from 11 Mar and before (BAK + team) :

To complete basic, internal documentation (at ITR level) and then move to the point where formal publications of relevant items can be done.

Current action items are as follows :

(i) Detailed design doc : 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; was deferred till end Oct 2014; and then deferred till end of Dec 2014; 2nd version had ~50% chassis level inputs; to be completed by end-Jan'15; to check current status.

==>

(ii) ITRs + publications for analog back-end systems to be taken up : Sandeep and Navnath to look into that; pending for a fairly long time; SCC to look into this and come back on this by 11 Mar -- SCC and Navnath have had one discussion and will follow-up with BAK; to check current status.

==>

(iii) ITRs + publications for digital backend : ITR was completed by SHR; after some follow-up, SHR and BAK started work on modifying GWB ITR to convert to a paper; first version has been circulated; needs to be taken up for discussion between YG, BAK and SHR.

==>

4.2 Analog back-end : LO setting related issues -- from 4 Mar & before (BAK) :

There are at least 2 different issues that remain to be resolved :

(i) problem of non-repeatable behaviour of LO system, leading to correlation problems in user tests : upshot appeared to be that system does not power up properly and needs appropriate settings to be done, after which it takes commands from control room and functions properly; this was first done manually, and later the Rabbit card software and new online control was modified to include appropriate config commands as part of the sequence after power-on; JPK + Naresh first tested on prototype unit and later it was replicated on all Rabbit cards; to confirm if this matter is completed and item can be closed?

(ii) problem with LO setting using FSW resulting in reduction of correlation in GWB (compared to LO from sig gen) : understanding is that 10 MHz reference is at the edge of the locking range; shifted to 105 MHz based reference -- this appears to

solve the correlation problem; however, this appears to show phase jumps whenever it is reinitialised (see action item below); trial and error tests show that using 50 MHz reference avoids this problem for GWB (?); work is still ongoing to check how and what causes the loss of correlation.

(iii) problem of phase jump on reinitialisation of FSW LO reference : this has been noted in usage of FSW in GAB and in 1st LO in existing GMRT antennas; there appears to be some difference as to which frequencies (out of 10, 50 and 105 MHz) do / don't show phase jump when used in GWB and in 1st LO systems -- to cross-check and confirm this; check what has been the response from the vendor; decide follow-up action.

4.3 Analog back-end : completion of 30 antenna system -- from 4 Mar & 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; 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) --- shielded box finalized; 12 nos ordered in work shop. Components required have been ordered; first box will be tested and then order for rest will be cleared; can check after 4 or 6 weeks.

Need to check exact status of drawing modification for the box and then w'shop will decide where and how the mass production will be done.

(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; monthly 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.

Tests are now done regularly; need a way to share the summary of the results for taking appropriate follow-up action.

Raw data is being uploaded on plan website; Atul Ganla looking into some intelligent interpretation and summarising of the results.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from

11 Mar & 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) 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) beam mode working with fixed channel and time factors : SSK had got the code changes done for making it general purpose -- going up to any number of channels for corr + beamformer + DAS; summary status is as follows :  
for frequency channels : GWB-II tested ok upto 16k channels and we are not going beyond that for GWB-II (to check that SOP and GUI are updated consistent with this); going to 32K will be possible in GWB-III, but will require some coding, checking and testing to confirm;  
for integration time : modification in GUI for multiple time integration selection added & tested.

To check if this item can now be closed.

(b) header for beam mode data : to be taken up & incorporated alongwith the PA mode; SSK has done first round, and needs a discussion between YG and SSK (pending); meanwhile version with header to be released alongwith 16k channel code release on GWB-II. To check if current release version has this.

(c) availability of online monitoring tools for beam data : psr\_mon was successfully installed, compiled and tested (for 16k channels?) on node 52, node 53, gwbh2 & gwbh3 -- need to check if it will work on the new GWB host machines; installing pmon needs a discussion regarding polycos, psr catalog etc; meanwhile, work for incorporating new code developed by Rajora by adding shared memory interface is ongoing (both of these can go directly to GWB-III?) -- to check status of these activities.

(ii) spikes in channels that are power of 2 : this problem needs to be discussed, understood and fixed. SHR has done several tests, including using digital noise source; effect is seen in packetised corr also; checked with offline analysis of raw voltage data acquired through Roach board, and with digital noise generated on Roach board -- appears that problem is seen only in data coming through the ADC path only? further, trying single ADC streams or channels (compared to the interleaved data streams that come normally) still shows the spikes in the streams; slower FPGA clk rate also doesn't show any difference -- 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; varying i/p power level of broadband noise source at ADC allows characterisation of input power level at which spikes show up; looks like occuring at multiples of 128 ch (for 2K spectrum); to check the level as seen in cross of two such signals -- some test results are available.

==> no updates.

(iii) change of host machines to 1U HP machines for GWB-II : work is ongoing by SHR, including OS, disks and location in the rack; may be able to complete in one month time scale (from 3rd week of Nov); work ongoing, SHR needs to coordinate with Nilesh.

machines are ready; GUI needs a version which has new IPs and maybe some paths; in order to switch between old and new hosts, infiniband cables need to be swapped at the 8-port switch; change-over has been completed and GWB-II is running on these machines now; SOP will be circulated soon; may want to have node52 available for some more time before disconnecting completely from GWB-II network (will remain on GSB network). This item can be closed.

==> SHR to send one email to close out on the pending items.

4.5 RFI filtering -- from 4 Mar and before (KDB/BAK/YG) : first version of real-time RFI filtering block (after some modifications) was added to 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 were done and found ok; trials with real antenna signal split into 2 copies and checking both self and cross outputs proved somewhat harder; further, design (with some optimisation of FPGA resources) was ported to GWB-II; agreed for time domain tests using either corr self powers or 2 IA beam signals; some tests with varying sigma were tried on antenna signals (results?); data taken with pulsed noise source input also; new results were circulated and discussed; agreed that the basic scheme appears to be working ok; to try 3 versions of the scheme, with different options for the statistics. Meanwhile, design compilation for 4, 6, 8 bit inputs completed; utilisation (for one analog channel) : 41%, 19% and 17% (for total design) for 4 K window; tests were done to see if there is some biasing by digitally splitting the antenna signal -- confirmed ok, i.e. mean level changes for lower thld happens for replacement with zero or replacement with noise but not for clipping; next part is testing with two different methods of generating thld statistics : shown that a priori stats works better for rejecting RFI infected data.

Some action items are as follows :

(i) Agreed to support 3 modes : continuous update; update on request; external update; this has been demonstrated in tests on GWB-II (?); do we need separate design versions for these (for optimised FPGA usage)?

==> 3 separate versions are required, but we will carry forward the full design and then, when final baseline is established, the reduced modes can be made available. Also, will carry forward only 8 bit design for now -- other options can be brought up whenever needed.

(ii) optimise the design to fit on Roach board 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 at 800 MHz (with compensated delay in the 2 other channels) -- work ongoing;

meanwhile, to concentrate on long-term solution of 2 RFI channels on Roach board with 2 analog inputs at 800 MHz; also to implement feature for changing window size dynamically (?)

==> design for GWB-III with 2 channel filtering and 2 channel passive with block delay correction done and shown to be working; dynamic window size control also implemented : works upto 8k size for 800 MHz, 8 bits.

(iii) pulsed noise generator (PNG) ckt with additive noise source shown to be working -- can now be used for demonstrating RFI cancellation on visibility data.

==> some tests will be done soon;

(iv) to work out proper scheme for testing -- KDB has circulated a proposed scheme, which is now been refined and accepted; to discuss and check if results are available.

==> some tests have been done and can be discussed next time.

(v) book-keeping : trying to work out the packing scheme, with the understanding that jumbo packet size is taking up. Need to discuss long-term plans for this.

==> 1bit flag implementation has been started; need a discussion for agreeing on the option for double rate sampling and how to structure the packets.

4.6 Power and cooling requirements for projected back-end systems -- from 4 Mar 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; discussion between SSK and GSJ to try once more with kernel change only one node and examine the log file carefully and report back.

GSB data old & new kernels taken; 17-43 nodes completely new kernel gives heavy buffer loss; (old kernel have very small buffer loss ; old does not support temp monitoring).

More tests have been done and it appears that GSB is rather sensitive to the exact choice of kernel.

==> 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 is working ok; cycle for 7 days for preserving the data. To see how this can be evolved.

Right now running on 1 compute m/cs and 1 host m/c of GWB-III (waiting to install on other m/cs); refining the scheme for cross-mounting of disks; auto-restart and

halt scripts; cgi script for plotting on monitor can be made more intelligent.  
H1 & cor5 cor5 packages installed; auto-restart completed; cross-mounting of  
disks : to use old scheme.  
Installed on 2 more and ongoing; for cross-mounting : not using autofs, but using  
old scheme of cross-mounting via /etc/fstab; auto-restart is done (every 30 secs).  
==> no updates.

4.7 Next-gen time & frequency standards -- from 4 Mar & 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".  
First discussion has happened between NDS, BAK and YG -- need a follow-up.  
==> no discussion.

=====



## Minutes of Plan meeting of Thursday 26 Mar 2015

### 1. FE & OF related :

#### 1.1 Detailed design doc / ITR -- pending for long : from 11 Feb & before (SSK/BAK) :

(i) OF Tx started (may have only blk diags for now, without full details, till a paper is ready!); initial write-up (by Satish) needed improvement : functional blk diagram made and detailed description needs to be added; updated version sent by SSK, was discussed : blk diag of OTx -- couple of small changes suggested (APC controller to bias control), also add one more blk diag at beginning giving the context of the OTx system in the overall antenna base set-up; new version ready?  
(ii) OF Rx system to be completed (Satish Lokhande) : first version circulated -- some improvements and additions were suggested (e.g. to give explicit reference to other docs which have supporting details; to give reason for 10 dB attn; to give comparison with expected values from SFA report; to mention some precautions and practical issues during assembly etc); updated version awaited from SSK.  
**NOW PENDING FOR A LONG TIME !!**

==> not done yet; agreed to a deadline of 8th April (2 weeks from now).

#### 1.2 Update on results from test range -- pending from 11 Feb & before (HRB/GSS/SSK) : Reorganised into the following issues :

(i) Tests of ver1 550-900 CDF and CSIRO feeds at test range : new results with VVM set-up, after installation of new encoder + notch filter for mobile band, showed : for ver2 550-900 CDF : reasonable E-H match at 610 and then degradation in shape and matching at 700 & 800; partially supported by older measurements from Dec 2013 (with slightly different set-up). Further, results for dipole v2a and v2b with cone v2 show that the degradation of pattern with frequency is worse for v2a than with v2b; radiation pattern measurements have been done with 50 MHz step & using CW signal; comparison with simulation results is awaited. Current results and action items are :

(a) ver 2b of 550-900 system has been measured on test range; first order comparison of C1 dipole 2B vs C2 dipole 2B -- some differences can be seen : C1 dipole 2B shows better E-H match at 610 ; C2 dipole 2B shows good E-H match at 700; and appears to be decent even at 800, though 3 dB width may be changing; agreed to make plots vs freq for 3 dB and 9-11 dB widths, and for taper of E and H at fixed dish angle of 62.5 to check mismatch in taper -- for both the feed versions.

Some results from the measurements for the plots of 3 dB and taper values vs freq shown -- there is evidence for change of properties with freq as well as asymmetry of the pattern (as had been seen in the earlier plots also); agreed to try to compare with results from C1 + d2b (make fresh measurements, if needed);

(b) Phase centre of ver1 550-900 CDF and CSIRO feeds needs to be done -- phase centre measurements for C2 + d2b can be tried at the range.

Radiation pattern tests redone for C2 + d2b combination to check repeatability; FE team to summarise the results for discussion.

==> repeat tests for cone2 + dipole2b sent by HRB with show repeatability with earlier results; GSS to check for cone1 + dipole2b data and complete the comparison.

(ii) calculation (based on reference paper) of expected deflection & comparison with measurements to check if there is significant loss of sensitivity -- GSS developing refined version more relevant for GMRT (also, if further expts with 250-500 or

500-1000 feed are useful) : cross check of results from code (0.3 dB drop for 0.5 lambda offset) wrt curves from Kildal paper was confirmed; for GMRT specific case of 250-500, efficiency factor as a function of freq over the band, using the data for the measured feed pattern, was implemented; after correcting one error in the code, better result (9.9 dB vs 11.6 dB expected) was achieved; further, a realistic phase response (instead of 1.0) was included by reading data from a file; results (reported on 19th Mar) showed better match between measured and expected deflections for the 250-500 system : 327 -- 12.8 dB vs 12.4 dB; 400 -- 12.8 dB vs 12.2 dB; 450 -- 12.4 dB vs 11.4 dB; 500 -- 11.2 dB vs 11.0 dB (some re-work needed for lower frequencies?); computed results (based on change in efficiency due to shift of phase centre) show likely drop in sensitivity by about 1.4 dB from 250 to 500 -- this is now to be folded into the net sensitivity / deflection curves made by GP (see agenda item following this one). Present action items :

(a) GSS is working on plans to extend this to 550-900 system -- was waiting to get measured values from test range.

(iii) Comparison of computed results with measurements for 250-500 band : initial results for good antennas at 250-500 (other than C6) with default height of 1280 (and for C6 with reduced height of 1080) showed that computed values are actually better at high freq end for 1080, which is different from the observations which are showing droop at high freq for 1080 (in conflict with first results reported above); computed results, which were for 1180 to 1480 in 4 steps, were extended to 1080 & 980 and 1180 was found to give the best response (note : this is for a particular value of ph centre based on range measurements); computations were extended to much smaller values (down to 580 mm) and latest results show a peak in the response around 580 o 780 (!), which are in sharp contrast to the experimental results which were carried out in the range 1080 to 1480 mm and showed optimum performance around 1280 mm -- this needs closer scrutiny of the simulation code and experimental results.

(iv) Phase efficiency computation has to be linked to the aperture efficiency computation (NRAO's eff. program, modified for GMRT specific paramters) -- this work is ongoing, alongwith Sougata (was expected to take 4 weeks -- till mid-Sep); code is being ported to matlab (?); some issues about input file with the values to be given -- this also needs to be resolved; also, original NRAO fortran program can be made to run to give some initial cross-checks? code had been ported from the C version that student had written to Matlab but results are not yet matching with expected behaviour and debugging is going on. Now trying to port original fortran version to matlab; one email has been sent by Sougata with some updates on pattern calculations -- need to discuss and understand its relevance.

FORTTRAN to MatLab conversion : ~ 50% completed; was to be fully done by end-Jan / early-Feb -- need status update on this.

==> code is still giving problems in terms of the results; now trying with simplified geometries to see if sensible results can be achieved. Meanwhile, agreed to try and see if the original NRAO Fortran code can be compiled and executed.

1.3 Phase centre tests for 250-500 CDF -- from 11 Feb and before (HRB/GSS): to test with 100 to 200 mm height change (around default of 1280 mmm) in 250-500 feed on one antenna to see how much change in sensitivity is seen. Tests done on c6 using feed with shortened support legs of the cone (instead of shortened stool) -- comparison of results for 1180, 1280 (default) and 1380 : 1280 & 1380 show slightly better sensitivity at low freq (250-400) but at higher frequencies they match with 1180 (which is quite flat throughout freq range); agreed to try for 1480 to see if there is a monotonic behaviour; also compare with simulation results of GSS. Consolidated results tend to show that the latest level at 1180 height does show a slightly better

response; a final confirmation is needed about the optimum performance from the measurements; confirmed that we can't go below 1080 by further cutting the support legs of the cone; also, current adjustable stool will not work for 325 MHz face due to welded nature of existing stool; agreed with HSK to reproduce one more adjustable stool with modifications learnt from present experience, and try on one CSQ antenna (C6?) by removing the Lband feed, shifting the cone-dipole with new stool to this face and using the existing 250-500 FE box on it; tried on C6 during MTAC period (Oct 2014), but measurements could not be completed as antenna was required for L-band GTAC observations. Current action items :

- (i) Agreed to go back to C8 at a later point of time (after 550-900 measurements are completed).
- (ii) Meanwhile, FE team to go over all the available measurements and produce a consolidated summary -- this is pending for some time now !  
==> no updates on this.

1.4 Comparison of measured & expected sensitivity curves -- from 11 Mar (SSK/GP/HRB): Scheme for (re)calculation of expected values across the broad bands to be finalised (and added to measured curves) : curves being done with constant QH value and with variation of T\_lna with freq incorporated; model for the main BPF was also put in; after that antenna efficiency factor (based on measurements with 4-5 points across the band) was added by interpolating the measured values; return loss of the feed was added to the above and the result now matches much better with the data -- all this was done for 250-500 band; some follow-up action :

(i) Antenna efficiency factor : to determine what is the best thing to use and stick to that; are there cases where the theoretical curve gives less deflection than measurements? agreed that both the efficiency term (which includes default ap eff + phase eff, from measurements on test range) and the return loss term should be kept and the product should be used.

(a) To get clear confirmation about which all terms are included in the efficiency term that is currently being used in the calculations.

(b) Also, to see if a note summarising the overall scheme can be generated.

GP to look into both the items and get back. GP waiting for inputs from GSS about factors in efficiency calculation; agreed to start on the note.

==> GP is getting ready to circulate the note.

(ii) Overall comparison with data : It appears that there may be some discrepancy in the mean deflection values, after the formula was revised to change the constant factor -- this needs to be understood, including a cross-check using the basic formula; some corrections / refinements have been done in the formula : dir coupler loss value, source flux from Baars et al, constant was recalculated; spot value of 13.0 dB at 325 for CassA compares with 12.7 used in the control room; to cross check with simple  $0.5 * S * A = k * T$  calculation and report back.

==> waiting for source flux issue to be resolved with dialogue with DVL.

(iii) possibility to try it for Lband to be explored -- information gathering had been started : feed pattern (efficiency) at 3 individual freqs is available, and measurements are now available for 5-6 frequencies (?); agreed to work with the 3 pt data and do simple interpolation and see what kind of curve is produced; first order calculation of model had been done -- Sanjit + Gaurav had worked to put the curve for expected deflection alongwith the measurement results to do the comparison, and weekly plots now have this added. Current action items :

- (a) 1 or 2 antennas with response better than theoretical esp at lower edge of Lband -- need to be checked;

(b) fall-off of theoretical curve at edges needs to be investigated

(c) RL of feed is to be included.

(d) notch filter alongwith BPF to be added.

GP to check and report; also, the change in constant reported above will affect this comparison also !

Item discussed on 11 Mar and issue of how BPF or notch filter kills the deflection came up ! Agreed to defer for some time till note by GP is ready.

==> agreed to keep deferred for some time.

1.5 Total power detector for FE & common boxes -- from 11 Mar & earlier (GP/ANR/SSK):

plans for final scheme : 20 dB coupler for CB and 10 dB coupler for FE (at final output) with common 20 dB amplifier (Galli-52 instead of Sirenza); feed-thru vs connectorised arrangement also resolved; after lab tests (including monitoring via MCM channel) in FE and common box, sample units installed in C4 FE box and E2 common box. Some other details are as follows :

For common box : data from 2 units installed on E2 showed basic things working ok: first round of testing showed 11 dB deflection (12.4 dB expected) on Cass-A; later on Crab, getting 5.5 to 6 dB (6.6 dB expected); flat-top on-source waveform was understood to be due to quantisation of step size of detector levels (least count issue); script / SOP created for automated running of tests;

For FE version : 2 units had been assembled and found to give identical performance as per specs; problem of feed-thru vs connector was resolved in favour of feed-thru (as per original chassis design); all testing completed in the lab; first units (on C4) showed problems -- traced to incorrect mapping of channels etc.; new units (batch of 20) that were assembled showed unexpected change in detector o/p due to grounding problem which was corrected (manually) for 10 units and final PCB for mass production was modified for this change; script for automating the observations has been done and released by GP.

Current action items being followed :

(i) for RC time constant : main aim is to check and ensure that some appropriate RC integration is in place at o/p of the detector; some feedback from vendor, but not fully satisfactory; existing ckt has 10k series resistor (as per data sheet); measurements done in the lab show some kind of a curve with rms changing inversely with increasing time constant, but the results are not repeatable from day to day, indicating some pick-up in the circuit or the measurement tool; needs to be checked carefully. Current status : agreed to put 1 s time constant in all the PCBs -- this requires very large capacitor; few microfarad may be more practical, pushing the time constant to ~ msec; agreed that 100 micro-Farad maybe the largest practical value, giving 100 ms time constant; assembled one board with 100 microfarad -- no observable change in performance seen; need to go to antenna & test : fitted in new 250-500 box -- may end up on C11. Box is up on the antenna and one set of data taken which look ok; to try another set to check for consistency, including slightly weaker sources like Crab, Virgo... Check if this has been done now and what are the results. ==> some tests were tried, but corrupted by RFI; to give it another try.

(ii) analysis of test data and results/conclusions : 9 antennas with FE power monitor installed; test data recorded for 8 antennas; out of these, signals seen for only 3 antennas : C13, C11 & S4 (both pols); some sign of life in E6 and something on W4 (very noisy / weak); deflection on Cass-A is about 10-11 dB (bit less than expected); flat nature of curves understood as least count limitation; simultaneously CB signal recorded, but working CB monitor is only on C13, E2 & W4 + W1 -- all of these showed deflection; signs of "memory" in holding a stale value in FE monitor (all antennas

at same time!) -- confirmed with Ops group to be due to combination of cycling of FE monitoring (being turned off when at a source transition) + the fact that cold sky off source is quite far away from the source (!); further, two sets of new data had been taken (3 and 6 hrs long), to check for repeatability of working antennas, as well as status of partially working antennas (as seen in first data set) and correlation with 30-1 data; first order impression is that new 2 data sets are consistent with 1st data set (tbc).

Distilled action items for GP : to take 3-4 antennas in each of FE and CB (with one common antenna C13) and analyse 4-5 good epochs for the following :

- (a) repeatability of deflection and to check that it matches with expected values -- this has been done and appears to be ok.
- (b) consistency between FE and CB : checked for C13 and found ok.
- (c) checking spurious behaviour -- RFI or something else : data log of 30:1 output checked -- power detector changes when RFI is present;

Most of these points have been addressed with the existing data and the same have been summarised in the draft ITR; update to final version of report is just waiting for results on RC time constant at C11 -- to check current status of this.

==> still pending for closure as above.

(iii) To decide upon long-term plan for power monitoring : GP to generate a short note about the proposed scheme for this; some discussions on 11 Mar about exactly what this note should specify (over and above the SOP). Agreed for GP to produce the note.

==> GP has produced a note for procedure to be followed, which is useful; need to move to a strategy document for running the program on a long-term basis.

(iv) possibilities for automating data reading, analysis and plotting also discussed -- GP has now implemented automated program for plotting CB, FE power levels (both chans) and 3 temp monitor values (2 in FE and 1 in CB) in one go from a file containing data for X nos of antennas is ready; this has been tested with the above data sets; agreed that it is generic but not tested for anything other than temp and pwr; can be generalised for all channels of all 30 antennas but can be taken up at lower priority; also, does not have a user friendly interface; current actions :

(a) agreed that working version of code + SOP to be fully released asap : SOP has been released; GP working on note about analysis procedure (using matlab) -- this is still pending.

(b) SSK to take up discussion with SN about GUI development with suitable person from control room : initial discussion with SN has happened, but not clear if optimal person has been identified -- YG to take up the discussion jointly with SSK & SN (still pending).

==> note from GP discussed (see above); 3-way meeting pending.

1.6 Installing and testing of temperature monitors in front-end & common boxes -- from 11 Mar (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 tests had been carried out; meanwhile, C4 & C10 fitted with dual temp monitors in FE box, and C13 with monitor in both FE & CB -- some tests had been done but data was not sensible due to unresolved issues in the wiring of the existing common box units that prevents desired data to come on expected channels in 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). Combined SOP for temp monitoring and total power monitoring has been prepared and released. Current action items :

(i) Analysis of the data : C13 & E2 both channels temp monitor available at online output (fixed for C13 one ch FE & 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; first results for ~ 5-6 antennas (LNA + FE box) + 2 antennas (CB) for 3 hr duration shows some basic behaviour but not clear how well things are working; to try two things : (a) to check if any old data of longer duration (from last 2-3 months) is available (b) to try a longer run, even for one antenna like W4 which is under maintenance; some of the short data stretches have been looked at; at least one 6 hr data has been taken; report has been updated and submitted to library for uploading; longer stretch of data and analysis of that is still pending. Tried one run on E2, but signal is flat ! Could have been problem of MCM5 not being in scan mode. Expt being redone on 11th -- to check if new results available. ==> one long run data is available; shows decent results for first attempt : temp of FE and CB following each other; with LNA temp a bit below but tracking (with some delay maybe?); need more confirmation runs to establish repeatability; regular monitoring can be folded into strategy doc for power monitoring.

1.7 Spare LNAs for L-band feeds -- from 11 Mar & before (SSK/ANR) : we had 32 feeds; 2 were not working (1 has been dismantled for making drawings of new feed) due to lack of electronics spares -- mostly device failures (including some new ones?); some new LNAs were successfully assembled by Gopi and failed feeds for C3, W1, E2 & E5 were fitted with these and found working ok. Also, one spare feed was assembled and installed on W1 and working fine. Current action items :

(i) to update about status of feed on W1 and other recently installed units : finally, after a lot of follow-up, it was confirmed from PMQC data that W1 appears to be working ok for past few months. 2 other recent units are on C1 + one more antenna (C3?): C1 has units with new LNAs, for both pols made ready from older batch of devices with careful retuning; action items : (a) confirm status of performance of these antennas (C1 had been giving ripple and bad bandshape problem) -- problem found to be due to broken cable; now fixed; now C1 feed is down due to low deflection in one poln; problem found in phase switch -- repaired and put back on C1 and working ok. Other recently installed antennas working ok ? ==> no reports at the moment.

(ii) making spare LNAs -- agreed to have at least 5 LNAs ready & available as spares : 10 nos of LNAs had been assembled, tuned and made ready; these have all been used up now; new batch of devices ordered and delivered. Action items : (a) the assembled devices may be having some possible problem with bias point -- it was found that LNA is drawing unusually lower supply current, even when 'gain' & 'T\_noise' are normal; not much progress in understanding low deflection of new LNAs; retuning is not helping -- increasing the bias current leads to oscillation (to check OMT etc for any problems?). Devices from new batch appeared to give a stable solution(?) -- however, not all devices in new batch are the desired ones -- there is a mix and it may be only about 1/3 that are usable? Finally, two units fully assembled (all 3 stages) and working ok -- used for two

channels of feed #32 (note : this is now the 1st spare feed after 30 working feeds!).  
Two more LNAs (3rd and 4th) assembled and tuned; work on 5th & 6th is ongoing.  
Current status (11 Mar) : 2 spare LNAs are ready, waiting for sub-band filters.  
Any more are ready now?  
==> no change in status.

(iii) alternate LNA designs : to see if design used for 550-900 can be modified for 1-2 GHz use; to also check the design done by Abhay Kulkarni and see if it can be improved for our needs; design files had been obtained and were being checked by GP and ANR : model files converted to match simulator used by us; component models in software had to be downloaded; also ultralam2000 that was used is not available in the market now; agreed to simulate with ultalam2000 first to check ckt works ok; then concentrate only upto 2 GHz and change substrate to RT 5870 (easily available); simulations matching with original results completed; results reproduced with RT 5870; trying to tune the design to required specs of gain (30 vs 34), Tlna (~28 or better); in terms of NF target is to go from 0.4 to 0.3, and maybe at cost of reduced BW; now getting close to Tlna of 28-30 across the band; overall gain is also very good ~ 38 dB; but 4 db slope across the band needs to be adjusted; move from s2p to non-linear model completed successfully -- did not disturb the results.

Current action items :

(a) work still ongoing to try to flatten 4 dB slope -- this has been attempted in the new PCB that has been sent for fabrication (see below)

(b) meanwhile going ahead with layout & ordering of PCB and making couple of units, while continuing to improve the design; design & layout completed; first proto PCB should have come by now (it already has the 4 dB correction) and may be ready for testing? Problem with layout of the PCB due to error in device footprint -- needs to be redone. To check status of this.

==> waiting for PCB with correction to come; meanwhile, original design fabricated on RT 5870 with retuning of components has given a working solution -- gain is not high enough (28-30 dB) and Tlna maybe a bit on the higher side (28-30 K). Can keep track of both the options.

(iv) possibilities for new LNA with Tantrayukt (Yogesh Karandikar) : item to be taken up for discussion, following the visit of YK in Dec 2014.

To check if YK has got results from his first prototype for 500 to 1500 and then take the matter forward. Discussions are ongoing with Yogesh.

==> no progress.

1.8 Completion of spare L-band feeds -- from 11 Mar & before (SSK/ANR) : Target to have a total of at least 5 (out of 8) working spare feeds (from mechanical to electronics) : 30 antennas had working Lband feeds, but there were no spares, though we had 2 feeds; one unit was assembled back from the feed that was dismantled for making the drawings -- this was completed and installed on W1 (one feed is now in the regular 'maintenance cycling' of feeds); 32nd unit was there in Pune wshop and was shifted back after assembling by mech group and then fitted with electronics; it uses newly fabricated push-type (press-fit) probes; after 2 LNAs were made ready (see above) this feed is now available as the 2nd spare feed. Furthermore, 6 new feeds were made (via outsourcing) in 2 batches of 3 nos; in the first set of 3, 2 nos had wrong size of horn and had to be corrected by the vendor; all 3 needed new covers as old ones were not suitable; second set of 3 feeds from Akvira : OMT + horn + cover; hence, total of 8 spares CAN become available; note that weight of 3 latest feeds is 18 kg more (72 vs 61 kg) than earlier feeds -- now accepted as 'fait accompli' !

Following issues need to be resolved currently :

(i) having sufficient number of spare LNAs : see item above for details; LNAs for 3rd spare feed now ready, waiting for filterbank to be ready.

Current status (11 Mar) : 2 LNAs are tuned and ready; 3 sets of subband filters are ready -- the best of these 3 can be used to assemble one more spare feed to add to one spare feed (31st) that is ready and waiting.

==> already discussed above.

(ii) other electronics : sub-band filter bank is the main item missing; it was found that the sub-band filter ckts spares don't work as one gnd line (for switch ckt) is missing in the films from RRI (!) -- to try with a wire providing the gnding ckt; alternate is to start using the new design -- this shows good performance for individual filters, but integrated unit is giving poor performance for selection of 1280 -- problem with the switch (new make is not giving same performance as original make) and this is affecting both reuse of old filter PCBs and also the new design; looking for original make (MACOM) and also trying a different switch (Hitite, which means new PCB); new PCB designed with Hitite switch (will need additional patch PCB to convert logic levels; one chassis (for 2 pols) is available for testing; new design still not working for 1280. After isolating the filter from the switch, response was found to be fine; found some issue about the layout on the PCB for the Hitite case and PCB is being redone and waiting for vendor to send back. PCBs received, populated and tested -- looks like that the new effort is also not producing proper results -- TBC.

==> problem was with the amount of grounding; added a metal plate below and screws to provide additional ground area -- now both MACOM and Hitite designs are working ! modified PCB layout being done (for both cases).

1.9 Testing of LBand wideband systems on 30 antennas -- from 11 Mar (PAR/SSK/SN) : (to maintain a proper log of action taken on individual antennas during these tests and debugging activities); data being taken fairly regularly since June; some history is as follows :

June data : C08 & W01 CH-2?? shows ripples at OF RX output -- gone now (to check possible cause); Sep data showed problem with W4 ch2 -- fixed; RFI issues : S04 & E02 showed RFI type lines, E06 showed RFI lines in CH1 (June data); line RFI in 1070-80 range (likely to be airport radar), around 1280 (likely to be due to GPS) -- July data; lines at 1030 and 1090 (3 MHz BW) also seen (Aug data); also, is there a RFI line at ~ 1200 (3 Sep data)? -- need to confirm status of all these lines (can be covered under RFI agenda). From Sep data : 1176.0 & 1176.45, 1191.80 & 1204.70 are likely to GPS (in addition to 1280) and 1090 is airport radar; there appear to be a few unknown ones also (e.g. 1320, 1480 etc) -- check with RFI team separately by including in that agenda item.

Current action items are as follows :

(i) some antennas with poor deflection overall : to be addressed as and when such cases are found. e.g. Ch2 of C1 (may be a cable problem?) -- confirmed that it is cable problem; to check current status of the work to fix the problem.

C1 still shows slope whereas test at antenna base shows OK -- to resolve the matter...

(ii) some antennas with deflection changing over the band (less at high frequencies): checked if pointing offset can explain this -- not found relevant; current thinking is that this happens for cases where the RF power level (at laser input) is too low;



this has been confirmed with a more careful set of tests (and plots) for few selected antennas, including make good ones look bad by increasing OF attenuation -- has been demonstrated in the report of 11th Nov data; to check if appropriate reasons for low power levels can be identified. Currently (11 Mar), C8 ch2 being investigated.

(iii) some antennas with poor on/off bandshapes, including large slope e.g. W1 (has been there for several months); C4 and W6 also; S4 has very low power; such cases need to be checked (call sheeted) and understood.  
S4 solved with RF PIU in OF system; C8 ch2 being investigated.

(iv) few antennas with ripple or large slope across the band -- to be followed up as and when seen. C3 and C12 identified as problematic and being looked into.

(v) there is data from Oct, Nov and now Dec 2014 -- can we have a well-defined algorithm for comparison of different data sets and getting statistical conclusions?  
-- to look at developing a tool for this.

Latest report (10th Jan) has a good classification of the problem antennas; team is looking one by one into the problems e.g. W5 found bad cable between feed to CB of ch1; now looking at W6... to check current status.

Latest data from 3 weeks of Jan provides a useful data set to confirm systematic problems in antennas and then initiate follow-up action; nature of set of problems remains pretty much the same.

==> new data set has been circulated -- needs to be digested (Sanjit not present).

1.10 Characterisation of recommended attenuator settings for different bands -- from 11 Mar and before (SSK/AP) :

(i) values had been given for Lband, 250-500, existing 610; only 130-260 / existing 150 was pending -- this was also completed (appears that 6,6 may be the best value); note to be circulated soon (Sanjeet + Ankur); then can be taken up for detailed discussion and closure; meanwhile, new problem detected where it appears that attenuation setting may not be working reliably -- this is now understood and being fixed; after that, note can be taken up shortly -- still pending !  
==> Ankur is back and will be addressing.

(ii) FE team to test the power levels at OF o/p and cross-check against SFA values : for 250-500, this has been done and results incorporated in the updated SFA report; for Lband the exercise is ongoing (antenna to antenna variation is a major issue); can be done now, as Lband is relatively stable now; was done by Ankur in a report back in July 2014 -- discussed and suggested to add a few refinements of the statements used (for 250-500) and add an explicit entry in the table; further to compare for each sub-band of Lband using realistic cable loss value for each sub-band (this can then be done for 250-500 also, if found significant). Updated version of report to be produced with these modifications; first part (for changes related to 250-500) has been done; waiting for measurements at Lband to be completed; some work has been done by Ankur, some work has been done by Imran to characterise FE, and SFA report also has measurements of cable loss; calculations have been done; need to cross-check with measurements; updated report in internal circulation; to check if it can be released for discussion -- waiting for report to be finalised, after some internal feedback. Check current status.  
==> Ankur will be addressing now.

1.11 Switched filters at different stages of receiver -- from 11 Mar & before (SSK) :

2 main categories of switched filters are needed : (a) switched filter banks inside FE boxes and (b) switched filter banks in rx room; these are being designed using the new switches : 2, 4, 8 way switches with different possible configurations; (c) a 3rd application of these switches is for designing the monitoring set-up in rx room. Current action items are as follows :

(i) for rx room monitoring work : note that all these circuits are connected to the monitor ports of the OF system; first design did not give enough isolation at highest freq of operation and hence new design was done; ckt for 2:1 and 4:1 versions now ready & tested -- 25 dB isolation achieved; drops from 25 to 17 dB with frequency for 8:1 switch -- now getting improved rejection : better than 25 dB below 1 GHz; goes down to 16 dB above 1 GHz; the leakage between the signals with this switch is still unacceptable; now trying another switch (MACOM make) which terminates unused inputs while selecting the desired input (will be used in the final 30:1 monitoring system), and gives 40 dB isolation; new switch + modified design with additional isolation switch and power supply isolation -- now achieving 35 dB at Lband and more than 50-55 dB at lower frequencies, with all channels powered; will be tested in monitoring system for 16 antenna set-up. Current action items :

(a) To do an additional test with signal injected at Tx i/p;

(b) To complete 16 antenna system (4 units wired and ready)

(c) also to summarise the design in a note.

Right now 8 antenna set-up is getting ready; after that (a) will be done; to expand to 16 antennas will need more switches and some more time; tests will be done with 8 antenna system. Design note to be taken up after completion of 8 antenna system.

11 Mar : 8 antenna system is under test -- looks like working ok; once confirmed, item (a) can be done; to expand to 64 antenna, 16 nos of switches ordered and next step would be to go 16 inputs. To check present status.

==> all tests of 8 antenna completed; item (a) to be taken up now; assembly for 16 input system is ongoing (components are there for full 64 input system); work on the report to start.

(ii) for rx room switched filterbank : prototype system has been developed.

(a) tests have been completed; a report needs to be produced characterising the performance -- work ongoing for compilation of report; some improvements in report underway after internal feedback; need updates from Ankur.

(b) to check about space in rx room for housing these units -- not yet looked into.

==> agreed to complete the report and leave the matter of space pending till final requirement is finalised.

1.12 Follow-up on 550-900 MHz band filters -- from 11 Mar & before (ANR/SSK) :

Comparison of ICON product with in-house effort and finalisation of plans :

technical comparison of individual filter responses showed in-house design to be slightly better; tests with integrated unit using new PCB showed insertion loss increases to 3 dB now and some change in slope on higher side; complete chassis and full integration done and tests repeated to make detailed comparison with ICON results -- showed performance is very similar except for some out of band bumps (at 30 dB level) and slightly slower roll-off ; tried with AC coupling capacitors (no improvement); new board fabricated which, after retuning, gave much better roll-off; meanwhile, some realistic cost estimates for in-house production vs getting it done by ICON were made : concluded that ICON option will be much more expensive. Sample PCBs from Argus and Shogini had been obtained -- first test results (without chassis) showed ~ 5 MHz shift in 2 sub-bands but better roll-off; final plots showed same IL but the higher sub-bands having slightly shifted centre and widths which cross the main BPF upper cut-off; design was modified and new PCB was

obtained from Shogini and tested ok and one complete system with chassis (for one poln) was made ready; it was agreed to defer further work till ready for integration in new FE box; meanwhile, cost estimates for mass production made : Rs 32000 for 2 PCBs is the dominant cost; total is about Rs 41,000 per antenna (compared to Rs 90,000 by ICON); hence, agreed to go ahead with building our own design; meanwhile, reduced wt chassis (700 g less) had been made (2 nos) by w'shop and integrated filter unit was made and tested ok.

Current action items :

Preparing for mass production : PCB material is in hand; switches needed are in hand; so may not be a major problem for going ahead; now waiting till layout of 550-900 FE box is finalised.

Agreed to go ahead with PCB and chassis, while waiting for layout to be finalised.

Layout is now final; one prototype unit is ready; to go for mass production in units of 20 nos (10 antennas). Also, to confirm if design report is ready and relased?

4 Feb : Problem with Shogini for mass production -- discussion with Shogini now converged and he is ready to go ahead under the same terms and conditions; so, first batch of 20 PCBs will be done as soon as the work order reaches him. Report was completed quite some time ago and released (to be confirmed).

==> To confirm status of WO with Shogini. Meanwhile 35 chassis (for all 30 antennas) now available.

1.13 Finalisation of 550-900 FE box -- from 11 Mar (ANR/SSK) : to produce a block diagram for the 550-900 FE box; then to start seeing which units are ready, which need to be done; which may need to be combined into single units etc; roughly same number of components as 250-500 box, slight difference in the arrangement of notch filters; size of sub-band filter chassis will be different; will take up the layout of this after common box layout is completed; later, agreed to start with this, even as common box is going on in parallel -- Imran + one looking at it, with Bhalerao's help; items being collected : dir coupler not available -- being designed fresh; sub-band filter chassis (only unit) given to w'shop for mass production needs ! Dir coupler designs (2 options) done and PCB going to Mohite; to check with w'shop about returning of chassis.

==> PCB gone to Argus finally; may take couple of weeks to be ready.

1.14 New filters for Lband -- from 11 Mar & before (ANR/SSK) : Sample Lband full-band BPF had been designed -- has no slope with freq and better insertion loss, and maybe a better option than the existing main BPF; similarly, prototype design of new sub-band filters (with better insertion loss) has also been done. Detailed results for the main BPF shows that the BW is slightly less than existing BPF : 500 MHz (965 to 1465 MHz), instead of 590 MHz (890 to 1500 MHz) -- this gives better rejection to mobile band signals, but has implications for final usable BW of L-band system; furthermore, an improved notch filter has been designed for the 850-950 mobile band (-60 dB vs -45 dB at 900 MHz), alongwith a LPF for cutting off the 1800 mobile band has been designed -- 3 dB cut-off freq of 1650 MHz. The matter was presented to the users in Friday meeting on 9th May, and it was agreed to generate a note about this proposal, for clearance in the GSG. This was done and matter was discussed in GSG of 13 Nov and it was cleared to proceed on the following: new BPF + mobile notch filter to replace existing filters in FE box; LPF to be put in common path at antenna base as a common facility for all bands; to be taken up as a case-by-case replacement job, whenever a unit comes down for maintenance work.

current action items :

(i) status of mass production : 10 units of 1650 LPF have been fabricated out of 40

PCBs available; PCBs (stripline) does not need much work for assembly -- can be given for manufacture; new chassis will be needed; PCB order for 70 nos can be sent using existing eps10 board; both pols can be combined in one chassis requiring 35 nos only -- drawing to be finalised for rail-type chassis; to check if existing chassis can be re-used; PCB + chassis for new BPF ready for 40 nos (30 antennas + 10 spares); for the new notch filter, 60 nos had been made (PCB + chassis) of which 30 have been used in existing system (waiting to order more)...

(a) to confirm the present status from Ankur's spreadsheet -- discussed : Lband new filters now included (BPF is completed); sub-band filters TBD; to check current status.

(b) new complication is that mounting plate has to be made for putting the new units in existing systems; this is an "internal matter" and can be taken care of? -- close

(c) agreed to put 10 nos of 1650 LPF in one channel of 10 antennas which have 250-500 broadband system installed; waiting for chassis; meanwhile, 1650 filter was put in one poln of C10 on a trial basis; appears to remove the 1800 mobile signal and does not appear to affect other bands; shows about 0.5 dB insertion loss; agreed to put available 10 nos in ch1 of 10 antennas.

(d) also agreed to move the 70 MHz HPF to just before the signal enters existing IF system (instead of just after the signal enters the ABR cage) -- to check the plans for mass implementation of this.

==> for (a) Ankur will take up now; for (b) nothing for (c) put in 2 ants (C4 & C10)

(d) has been done for just one antenna (C4) so far...

(ii) sub-band filters (design is at simulation level) can be taken up as replacement for the problem encountered while making new spares for Lband feed (see above) -- to try new PCB with different switch (Hitite) -- see update on this in earlier agenda. Right now, using old design with new PCB for populating in spare Lband feeds. To see how the matter can be resolved; new PCBs with Hitite and MACOM switch have come; tested; not giving suitable performance with either Hitite or MACOM switch ! Needs a detailed discussion.

==> see discussion above.

## 2. RFI related matters :

2.1 Discussion relating to Industrial RFI survey -- from 11 Mar & before (PAR/SSK) : revised docs (from 2009 and 2012 discussions) had been circulated by RFI group and were discussed in 5 June 2013 meeting (is the document too exhaustive?); new survey planned with main aim to generate updated database which will be useful to pinpoint likely hotbeds of RFI in the industrial areas in addition to finding those without NOC; after months of planning and discussion with DIC, was finally conducted during 23-27 June with 4 teams; covered Ambegaon and Junnar talukas ~ 40-50 villages in each; ~ 40-80 working industrial units (large number are closed down or never existed!). Some of the progress is as follows :

A form had been prepared for use in the survey and had been discussed in detail and agreed that it is suitable for use; about 70% of existing data had been entered into this form; agreed that this activity would be superseded with making a database of equipment and NOC record for the existing industries found in the survey; this data entry now completed for all 3 regions : Junnar, Ambegaon and V-K industrial estate; some highlights from the database : of the total list, a significant number of industries are closed down, and another significant factor are no longer traceable; about 1/3 of the original are still working (ignoring poultry which is about 1/4, but is considered RFI-friendly).

A follow-up meeting with DIC took place on 30th Sep 2014. Summary is as follows :

a. To maintain proper record of the data of existing and future industries in the

same format. The data format and data base was shared with them during the meeting.

b. Complete list of the villages in Zone I to Zone IV is submitted to them, based on which they can decide the issuing of NOC for industries in different regions (and also outside?).

(c) DIC to issue NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT

Some of the present action items are as follows :

(i) To cross-check the list against the ones which have NOC (for those operating without NOC, add to our database and inform them about informing us for changes, and DIC to issue NOC post-facto as mentioned in other agenda item) -- this is happening now; current table has a column indicating whether NOC is there or not. DIC has started taking action on parties without NOC (e.g. Govardhan dairy, ~ 20-30 km away). DIC will be sending the standard form to all and it will come to us for clearance; we need to be careful about to whom we say "yes" in retrospective manner, so as to avoid setting up a precedent of giving NOC to somebody with wrong kind of equipment already installed & running ! Possibilities for improvement can be suggested to them. Waiting for issue with DIC to be resolved.

==> no updates.

(ii) To follow up with DIC about

(a) issuing of NOC to the old units which are working in the GMRT identified zones, with guidelines from the GMRT.

(b) Follow-up on single phase welding units : they have requested letter from GMRT to collect information from users around GMRT antennas. Action will happen after 6 months (when?). After payment (Rs 4,500/-)??;

This matter needs follow-up with admin to see how it can be handled.

==> no updates; pending for YG to discuss with JKS.

(iii) during the survey, some units which are likely to be important from RFI point of view have been identified for detailed studies later on -- some work can start in parallel with completion of database, beginning with the bigger units; measurements (using LPDA) for 2 big industrial units in Junnar & Ambegaon area completed; no new ones have been done (about 10 more need to be done); results for the 1st two have been analysed and no strong RFI is seen other than the ambience due to powerlines etc.

==> no updates.

2.2 Transformer RFI revisited -- from 11 Mar and before (PAR): Team has been doing a check on transformer RFI and the updated results from this will be available soon -- will need to see how this compares with the earlier round of this work.

Comparison of old and new data is in progress. Only 6 locations are common between new and old data (!) -- many new installations are coming up ! No clear conclusions have been drawn from the study; also more data needs to be taken to cover a larger number of transformers -- to wait for an update from RFI team.

==> no updates.

2.3 Follow-up on UPS RFI -- from 11 Mar & earlier (SSK/PAR/RVS) : UPS units from Ador were found to be the most suitable : 2 nos of 3 kVA was purchased, tested for RFI & cleared; units are in use in C9 and C10. Updated RFI report has comparative statements quantifying the repeatability. Further, 2 nos of 4.5 kVA units were also ordered with Ador, with option of 2 single phase o/p with different isolation transformers (3 + 1.5 kVA); units were delivered but failed the RFI tests -- lots of discrete lines seen; finally, modified version of Ador 4.5 kVA was tested and

preliminary results are quite good; report for this has also been circulated.  
Current pending action item is:

(i) to finalise on 3 kVA unit from Ador : 10 nos of these were ordered as a starting option (total cost per antenna may turn out to be around 2.x lakhs); 5 nos had come in Jan; RFI tests showed 1 unit with 1 dB increase in noise floor level at 150 to 270 MHz; remaining 4 units showed 2-4 dB increase in 140 to 240 MHz; following changes were noted : MCB make has been changed; panel plate is missing -- direct screen printed units are used; connectors size / type have been changed; finally, found that test had failed at first level because of extra switch that had been installed outside -- this was moved inside and RFI problem resolved; further, auto transformer added inside the unit to improve the power factor (to ~ 0.5); after all this, RFI tests and inspection done and some further desirable improvements have been suggested; RVS to discuss with the vendor and see if he is ready to carry out these (maybe with some support from us).

Additional suggestions are : (a) cover over MCB switch panel needs to be shielded; (b) input and output power connectors need to be shielded and filtered; (c) to remove the powder coating and provide enough grounding points. Need to follow up with electrical. Finally, agreed to take one unit from last Friday and make the required modifications (full gasket and filtered power connectors -- to be bought) and then give to the vendor for reproduction.

Power Factor is up to 0.5 and can be taken as satisfactory.

Need status update on this matter.

==> vendor had visited on 25th March and some changes were made jointly, but RFI is not fully gone; may need shielded power connectors to make the final change; party is a bit reluctant for further changes now; agreed to try shielded power connectors and/or cables ourselves on one of the unmodified units and see if the problem is fixed and then go back to vendor.

2.4 RFI testing of LED lights for GMRT labs & building -- from 11 Mar 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; this was done for the lamps that were installed in canteen and results were found ok. Hence, clearance for mass procurement was given. 30 nos of the original 50 nos of 5W LED lamps were installed in corridor & lab areas. Indent was raised for additional quantities; these were delivered (how many?), and this new batch was tested for RFI as per earlier procedure and found to be ok; additionally, RFI team to test the units that have failed in the last 6 months or so.

Current action items :

(i) to confirm current quantity purchased and installed : 50 nos purchased (and installed mostly in the corridors); an additional 200 nos have been received last month (Feb 2015); plan is to put them in guest house rooms, hostel rooms, guest house corridor, and labs as per choice of users -- to check status of this.

(ii) to circulate report for tests of new units : report is available -- to be circulated.

(iii) to complete tests on faulty units : completed failed or partially failed; tests done for partially failed or completely units and no RFI issues found; updated report to be generated; sample batch of Syska make tested and found NOT suitable.

==> report has been made but not circulated yet.

### 3. Operations :

3.1 Mass production of shielded box for MCM cards -- from 18 Mar & 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; sample box of Rabbit + switch + media converter + Miltech PC combination tested on 4th Dec (report is awaited) : results match with earlier results. Two minor points to be conveyed to vendor : size of one of the opening and assembly of the side plates, which has been conveyed to mech group (!) All these have been done; now awaiting for feedback about delivery of mass production from the vendor. 70 shielded boxes (for MCM) have been delivered; agreed to keep them in storage and use as needed; next part is to start procurement of the RFI material and components needed -- list is with Ops Group and indent has to be raised; Charu's list ready; Pravin to decide line filter connectors and then indent can be put; total cost ~ Rs 33 lakh (including parts for switch enclosure?) discussion between CPK and PAR is still pending -- should have happened by now. ==> Indent has been raised and is being processed.

3.2 Mass production of shielded box for switch enclosure at antenna base -- from 18 Mar 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. Shielded box for layer-2 switch (35 nos) will take ~ 1 month (till end of Jan or so) -- still waiting for shipment. Issue of ordering the components needs to be tackled. To check whether sample unit had come and was tested for RFI; and when all the units are expected; meanwhile list of components is being made ready -- see item 3.1 above.

==> All 35 boxes have been delivered; indent has been prepared and being processed.

3.3 Planning for proper UPS & space utilisation for new equipment at antenna base -- from 11 Mar & long before (SN/CPK/RVS) : long-term plans for intallation of final UPS system and proper utilisation of the space at antenna base. Follow-up on 14 Aug 2013

discussion on first report : 2nd report was generated and detailed discussion took place on 5 Feb 2014; successive follow-up & final agreement on way forward (alongwith updated report) reached c. May 2014.

Some highlights are as follows :

(a) Regarding electrical loads : power drawn by different sub-systems estimated carefully, alongwith actual sample measurements on a few different antennas, for both existing systems as well as upgrade systems; effect of in-rush current at switch on also considered; total current requirement of 10 A for the ABR systems + servo control electronics found to be sufficient; hence 3 kVA UPS is adequate; agreed that, if needed, peak load requirement (e.g. in-rush current) can be balanced out by synchronised delayed switching on of different units -- this is already implemented to some extent at present. Final load requirements have been carefully checked and tabulated in the updated report.

(b) Regarding electrical wiring : agreed to have separate isolated supplies for (i) servo drive system (without UPS) (ii) servo control electronics (with UPS) and (iii) ABR electronics (with UPS); one common 3 KVA UPS with split o/p (2 KVA + 1 KVA for servo and ABR respectively) each with its own isolation transformer is the ideal solution; the new UPS can have the isolation transformer(s) integrated into it, without increasing its footprint (only height may go up); updated wiring diagram has been produced by RVS in consultation with SKB and others, and is available alongwith the updated report.

(c) Regarding space utilisation : new UPS can be located in the space between the ABR and servo racks -- this has been done in one antenna with the new UPS and appears to work ok; existing servo FPS units can be left where they are; if isolation transformer can be moved out from the rack, then space in that common rack is enough for all growth plans of FE and OF systems; this leaves some empty space in ABR rack bottom that can be utilised for further growth of telemetry system; all new servo growth to be accommodated in the servo racks (or in-situ replacement of existing units); extraneous items in the surrounding of the racks (electrical fittings etc) can be relocated, as far as possible, to make it convenient for people visiting for work. Most of these issues have been captured in the updated report. Matter discussed in GSG meeting of 13th Nov 2014. This item can now be taken to the logical conclusion : net outcomes can be summarised and follow-up action to be finalised.

Main list of actionable items :

(i) ordering of 10 nos of UPS : order has been placed; delivery expected end-Jan. 5 units had arrived and tested for RFI -- some modifications required; additional issue of PF of the UPS -- vendor will try with adding capacitors + input side xmer; to confirm present status of these items. Plan to put first of these units in C00. Not yet ready for use (see discussion above).

(ii) final wiring diagram for servo + ABR is needed : modified wiring diagram was prepared by electrical and shared with servo (4th August); meanwhile, discussions with BLDC supplier converged : now ok to ground the neutral of the main 3phase transformer; extra emi filter may be required (RVS confirmed it to be only Rs 10,000 per antenna) + only one set of line-filters will be required. RVS had circulated updated wiring diagram (done in consultation with servo) which included inputs from MACON (via servo group) whic suggested radiation shield between the BLDC rack and other racks. Finally, updated diagram providing sufficient shielding distance



has been prepared and circulated. To check if this is acceptable to all : no objections received so far; agreed to implement in one or two antennas; agreed to procure few units of the line filter on trial basis. RVS to update on status. Contact with party (Schaffner) is proving difficult to establish; can try other parties also.

(iii) making 1 or 2 antennas as model where all the configurations are made as per the recommendations : finally, agreed to use both C10 and C00.

At C10 : 3 kVA UPS was installed, but was feeding power to ABR only; later, servo shift PC104 load to UPS (isolation transformer still in use?); switch boards / extension boards shifted to safe level.

At C00 : 4.5 kVA UPS, with 2 isolation transformers, was installed with ABR rack connected on it; PC104 load was added to it subsequently; relocation of elec boards was pending.

Current action items are :

(a) agreed to put the FE power supply in the proper location in both antennas -- work ongoing to make space for this; space is now ready (after removing delay contactor) in C10; agreed to do in C00 also.

(b) ask servo to confirm FPS drive location is in keeping with the agreed diagram. it appears that current location is as per "agreed diagram" -- to confirm and close. JPK to confirm and update.

(c) check for unshielded cable and pipe entries in model antenna shell, including unused holes and punctures, and initiated appropriate corrective steps.

RVS to make a list of all the punctures in both C00 and C10 and bring for discussion. Work has started at C10 for this -- check current status.

(d) RVS to circulate an email about the updates and finalisation of layout in C0 and C10 for replication in all antennas. This was done and some feedback from FE and BE teams received : to check if sentinel "yellow box" can be shifted; alternate arrangement for keeping the phone to be decided; UPS heatsink is not a major issue; directive to keep AC flow downwards when not in use (?). contactor and timer for delayed start is obstructing FE pwr supply -- can be removed once UPS is there? Current thinking : yellow box can be shifted to better location; phone to be made wall hanging; clear SOP to be made and 2 stickers to be put in the shell; contactor already removed in C10.

Work on phone rearrangement is in progress; BSP and Rajendran to look into shifting of yellow box; reminder about putting stickers about AC configuration.

==> shifting of yellow boxes is underway (confirm if C00 and C10 are done); to confirm contactor shifted in C00; phone shifting needs discussion with telemetry team; list of punctures in C10 is ongoing;

(iv) also agreed to populate C0 & C10 with Rabbit, switch, PC (with shielding) as and when available -- these 2 antennas can be used for next gen M&C work to add to C4,C6,C12 to make a total of 5. Work in progress; JPK to keep track of this aspect.

Agreed to start activity of populating during MTAC for C00 and C10, and next to C8 and C11; and then, if needed, to C4, C6, with aim to have 5 antennas ready.

==> action has been initiated for C00 and C10.

3.4 New, improved Miltech PC -- from 11 Mar and earlier (CPK/SN/PAR) :

Two units of Miltech PC with two changes (more screws on panels + panel mount pwrline filters instead of chassis mount) were under test : conclusion was that PC ok from all aspects. Pending action items :

(i) agreed to initiate the purchase of 10 nos of the final version above -- indent had been raised for 10 nos (including some spare accessories?); current status of

the PO : order sent; expected date of delivery 31st Dec -- trying to expedite, if possible; note from vendor informing about delay due to late arrival of m'boards : end of Jan is new delivery date. "still under test" reply from vendor -- to see if delivery date estimate can be got.

==> SN to follow-up with BRJ on an urgent basis.

#### 4. Back-ends :

##### 4.1 Documentations at various levels -- from 11 Mar and before (BAK+others) :

Current action items are as follows :

(i) Detailed design doc : 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; was deferred till end Oct; and then deferred till end of Dec; 2nd version had ~50% chassis level inputs; to be completed by end-Jan'15; check current status.

==> needs some more time as 2nd LO scheme inputs are also being folded in.

(ii) ITRs for analog back-end systems and digital systems to be taken up :

(a) analog back-end : Sandeep and Navnath to look into that; pending. Work pending for some time; team to review and pick up the activity. BAK to follow-up. SCC and Navnath have had one discussion and will follow-up with BAK.

==> not much progress.

(iii) to move to a point where formal publications can be done -- this needs to be followed up appropriately within the team and a summary plan brought up for discussion; finally, SHR and BAK have started work on modifying GWB ITR to convert to a paper; first version has been circulated; to check and take up for discussion.

==> not much progress.

4.2 : Power supply for GAB : from 11 Mar and before (NDS/BAK) : Two options are possible : linear vs SMPS. Comparison note with all pros & cons was produced : pros and cons are in terms of convenience (and price) vs RFI properties; agreed that present (c. Aug 2014?) set-up of 30 ant GAB (with 5 spare SMPS supplies on order) can run for 6 months or so ; final decision can be taken later on. 4 SMPS units that had come were used to get 4 racks with SMPS and 4 racks with linear / CVT supplies; meanwhile, shielded box was designed for the SMPS by RFI team -- RFI report showed good performance; agreed to go ahead with it for mass production; meanwhile, SMPS installed in 4 rack; 12 new boxes with RFI shielding planned -- 8 are needed in the system, and 4+1 will be spare. Mech group to place the order for 12 nos (after BE and RFI teams check the drawings); drawing had errors (!); needs modification; was stuck for PC problems. To check current status and see if order can be / has been placed.

To confirm about the modified drawing and follow-up as needed.

==> one sample being made in-house for clearing the drawing etc. required fans etc being indented by Raybole.

##### 4.3 Power equalisation schemes for new back-ends -- from 11 Mar and before (SSK/NSR/BAK/SRoy): Need updates on both of the following :

(i) option 1 : using detectors in GAB and local feedback loop -- monitoring set-up was made ready; DKN worked on code (using algorithm taken from NSR); first round of testing showed problems like detector output saturation -- gain adjustment checked

and problem fixed; basic power equalisation algorithm was first tested ok with 4 antennas, and then expanded to more antennas; comparative study of this scheme with the GWB-based scheme to see if there are any differences or pros and cons was done : do GAB power equalise and look at GWB bandshapes; complete the loop by doing GWB power equalise and checking GAB o/p. Test completed both ways, first for 4 antennas and then later for 8 antennas (extended to more?); BE team is ready to release for use by operators -- a basic SOP to be generated and released. Current actions :

(a) to completed the SOP and release the set-up

(b) to run this alongwith GWB bandshape check to help debug problems in GAB -- can be formalised as a debug tool to be run by PMQC periodically -- this needs to be taken up -- DKN to be asked to make the procedure for control room.

==> basic SOP for power equalise has been prepared and will be circulated to control room shortly and then trial run can be conducted; meanwhile, DKN will start work in item (b) to see how the tests should be run.

(ii) option 2 : using correlator self outputs and computing gain corrections : basic scheme is implemented & working; more general implementation of a user controlled ALC mode aims for the following 4 modes of operation (see MoM of 3 Oct 2013 !):

(1) on demand -- this is the current released mode.

(2) repeatable at some interval specified by the user -- can it be script based?

Sanjay has completed the core coding; a wrapper is being done by SRoy; to be taken up for discussion.

(3) automatic, should adjust in response to a stimulus in the input power -- needs a discussion.

(4) should provide a reliable power monitoring scheme -- needs discussion.

Issues that came up are as follows :

Accuracy of attenuaton values and repeatability of settings : 5% (0.25 dB) ok; agreed to add median calculation feature; to check if a feature to predict the expected change in attn for a given change in sky direction can / needs to be added; better option for saving the attenuation values for future use / reference to be defined; logging of results to be looked into; agreed to have a document that summarises all of the above and spells out the main requirements (from user point of view) and possible solution options / techniques; detailed discussion has taken place between SRoy, BAK, SSK and YG on 14Aug2014 -- main conclusions and action items are as follows :

(a) attenuator values : aim is to check if measurements match with specs (within +/- 0.25 dB); initial test results for 3-4 units (at one epoch) had been reported by BE team (found acceptable); pending items (for BE team) are :

\* to check the constancy of the values across the band;

\* to repeat the tests for varying i/p power levels with constant o/p power;

\* to repeat the tests on different epochs to verify constancy with time;

\* to work out plan for calibration table for each attenuator (after above results).

Test data were taken and analysed by BE team and results reported; SRoy had done some cross-checks on these; tests have been done with varying i/p range from -37 to -17 dBm also and behaviour of attenuator appears to be all right. SRoy to cross-check the results and confirm if we are ok, and if this aspect can be closed.

SRoy has sent some plots from his analysis of the data and some follow-up is needed to see in what operating regime we are hitting the non-linear range of the GAB system.

==> BAK to look at the results from SRoy and send an email.

(b) requirements document to be updated to reflect the outcomes of the disussions

e.g. better clarity about the 3 modes of operation etc. -- SRoy has produced an updated version : needs to be checked to see if it can be cleared.

(c) self data (from correlator data stream) to be saved in shared memory ring buffer of ~ 30 mins depth for further processing tasks to work on (should also work off a recorded lta file); also median calculations; NSR has been working on the writing to file version and a basic version was done; SRoy to check and confirm the status and arrange appropriate follow-up; some work has been done by NSR to write raw data to file for 10 mins duration; to convert this to shm and also to add a feature for calculating medial values every 2 sec or so and saving these to a file for long durations. SRoy to work with NSR to implement these (take help from SSK where needed). ==> some progress from NSR's side on median calculations; SRoy to follow-up in a few days.

(d) testing of bandpass shape (ampl and phase) for different values of attenuation : 6 out of 7 antennas showed less than 5% percent and 5 degrees change in ampl and phase over 5 dB change in attenuation. band-pass variations with time reported by SRoy -- to be taken up for detailed discussion -- maybe under testing of GWB? SRoy would like to follow-up to see how much is the intrinsic varn of the GWB corrln level with change in input power level -- SRoy has analysed the data provided by DVL and found that behaviour is acceptable for the range of i/p power variation tested which is about factor of 5 (~ 7 dB); to plan to extend this to larger range: set power level on galactic plane calibrator to about 80 or so; then go to calibrator away and equalise to 350 -- larger change in attenuation (~ 12 dB) required -- can check if corrln coeff (bandshape) remains ok or not; SRoy to update status of this. SRoy would like to now try the test with upto 10 dB variation in attenuator values to see how the bandshape changes. ==> SRoy is looking for an appropriate white slot for doing the test.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 18 Mar & 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) 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) beam mode working with fixed channel and time factors : SSK had got the code changes done for making it general purpose -- going up to any number of channels for corr + beamformer + DAS; summary status is as follows :  
for frequency channels : GWB-II tested ok upto 16k channels and we are not going beyond that for GWB-II (to check that SOP and GUI are updated consitent with this); going to 32K will be possible in GWB-III, but will require some coding, checking and testing to confirm;  
for integration time : modification in GUI for multiple time integration selection added & tested.

To check if this item can now be closed.

(b) header for beam mode data : to be taken up & incorporated alongwith the PA mode; SSK has done first round, and needs a discussion between YG and SSK (pending); meanwhile version with header to be released alongwith 16k channel code release on GWB-II. To check if current release version has this.

(c) availability of online monitoring tools for beam data : psr\_mon was successfully instaled, compiled and tested (for 16k channels?) on node 52, node 53, gwbh2 & gwbh3 -- need to check if it will work on the new GWB host machines; installing pmon needs a discussion regarding polycos, psr catalog etc; meanwhile, work for incorporating new code developed by Rajora by adding shared memory interface is ongoing (both of these can go directly to GWB-III?) -- to check status of these activities.  
==> YG to follow-up with SSK on relevant matters and close the others.

(ii) spikes in channels that are power of 2 : this problem needs to be discussed, understood and fixed. SHR has done several tests, including using digital noise source; effect is seen in packetised corr also; checked with offline analysis of raw voltage data acquired through Roach board, and with digital noise generated on Roach board -- appears that problem is seen only in data coming through the ADC path only? further, trying single ADC streams or channels (compared to the interleaved data streams that come normally) still shows the spikes in the streams; slower FPGA clk rate also doesn't show any difference -- 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; varying i/p power level of broadband noise source at ADC allows characterisation of input power level at which spikes show up; looks like occuring at multiples of 128 ch (for 2K spectrum); to check the level as seen in cross of two such signals -- some test results are available; some new ones have been sent by Reddy recently.

==> can take up later when SHR is present.

(iii) change of host machines to 1U HP machines for GWB-II : work is ongoing by SHR, including OS, disks and location in the rack; may be able to complete in one month time scale (from 3rd week of Nov); work ongoing, SHR needs to coordinate with Nilesh. machines are ready; GUI needs a version which has new IPs and maybe some paths; in order to switch between old and new hosts, infiniband cables need to be swapped at the 8-port switch; change-over has been completed and GWB-II is running on these machines now; SOP will be circulated soon; may want to have node52 available for some more time before disconnecting completely from GWB-II network (will remain on GSB network). SHR to send one email to close out on the pending items.

==> this has been done and only one conclusive tests needs to be done to show that node51, 52 are irrelevant.

4.5 GPU corr (GWB-III) : next gen system -- from 11 Mar & before (SHR/SSK/GSJ/BAK) :

Design and delivery of 32 input (16 ant dual pol or 32 ant single pol) system : 4 new DELL machines are in the rack and wiring + cabling is complete, tested with analog noise source; new code with 2 x 10 Gbe I/ + improved logic for assigning specific threads to each core + env variables completed (tested for 200 MHz / 8 bits and 400 MHz / 4 bits, 16 inputs and working ok with no pkt loss); basic GWB-III has been completed and released; ongoing action items are as follows :

(i) plans for testing the GWB-III : updated SOP has been released; modified ferrules have been put & GWB-III has been released with full online control; final connections to GWB-II and III can be chosen by the user on the wall panel; confirmed that GSB, GWB-II, GWB-III can all be run simultaneously with full online control; current items:

(a) basic user level tests : DVL had carried out some of the basic tests -- quick summary : by and large system appears to be work ok (some cases of low self and poor cross); pending problems have been call sheeted and will be checked again to see if fixed or not -- to check status of this.  
==> nothing new here; can be closed>

(b) to check if new SOP supports flexible connectivity for GWB-III -- this requires manual editing of the files (explained in SOP); manual editing may not be required anymore -- new GUI has to be tested and SOP to be updated : not done and released yet; also fixed order may still be needed -- to check with NSR.  
2 possible options discussed for getting flexibility in connection : ascii file update or drop down menu -- to discuss with NSR and decide which is easier to implement.  
==> need to check with SHR or NSR about this.

(c) testing of the 400 MHz BW mode : basic changes to the code for the 400 MHz, 4-bit mode have been done; some pending tasks are there : proper delay correction for this mode needs some changes / testing (done now?); also choice of which 4 bits to use needs to be finalised (right now it is set for 4 MSbits) -- can it be made a user level choice?; computationally, existing GWB-III does NOT sustain 400 MHz for all inputs -- safe limit is 300 MHz (including beams ON); will it work for 400 MHz for less number of inputs? some tests with astronomical source need to be done to validate the performace; meanwhile, agreed to leave it at this level right now and not formally release the 400 MHz mode.  
Discussed briefly if limited antennas, 400 MHz mode is easily possible -- agreed that this may not be very simple and hence can postpone anything higher than 200 MHz for now.  
==> no action.

(d) checking of beam modes : all basic beam modes are working; only phasing needs to be verified -- phasing in one poln appeared to have some problems -- now fixed and tested ok; note that phasing will work only if beam mode is turned on (!) -- can leave it like that for now and see what is the feedback?  
Agreed to revert back in the next release of the code.  
==> to wait for next release.

(ii) improvements in GPU code using K20 card (SHR/SSK) : a few different optimisations have been tried and these need to be further refined and ported to the GWB-III code:

(a) looking at XGPU code (with Vinay of nvidia) : optimised XPGU for GMRT is showing ~20% improvement -- needs to be confirmed and then incorporated; ready to upgrade to CUDA 6.0?; results from R2C vs C2C (with callback) to be finalised and then decide about incorporating. SHR has started working on porting XGPU in GMRT code to GWB-III. Further progress in optimising the code by SHR -- maybe able to benchmark by next week onwards -- to check current status of this.  
==> summary of the results : xGPU has been ported and shown to work; gets 20% speed-up overall; but works only in full polar mode; other modes need change in xGPU code; output shuffling work in real-time for present time,freq combination, but may not work for faster rates and finer channels... agreed to halt xPGU work and concentrate on 2-GPU per host GMRT correlator code.

(b) another concern is about data ordering at XGPU o/p vs LTA format requirement -- needs to be quantified in order for changes in (a) to be meaningful; note : Vinay

has already written the code that does this on the CPU.

Currently using unoptimised routine which will work for about 4k channels; for larger number, optimised version will be needed.

==> see above.

(c) dual K20 option : total corr + beamformer is exceeding real-time by 9% for full 400 MHz bandwidth for 16 input correlation (fits for 2 x 8 input corr); to check if the full correlation job will fit in 16 GPUs (after some of the optimisations above) -- from present status (Feb 2015) of work done with nvidia, it appears that optimised code will NOT give real-time performance for 400 MHz BW with 16 K20 GPUs. Hence, we need to start planning for 32 GPUs : 2 K20s per host, or double-GPU card, or one K20 + one K40 per host or 32 host machines; agreed to try a test where 2 GPUs on one host machine is used to test if the correlator code is portable (set-up with 2 GPUs is there on 4 of the 6 nos 620 machines -- so tests can be done on this when the code development reaches that stage); agreed to wait till main GWB-III is ready and released -- this has happened now; agreed to try either with dummy calculations (same buffer going to both GPUs) or with actual alternate data buffers going to each GPU... meanwhile, 2 new K40s have come from nvidia; could think of trying with K20 replaced with K40 on one node of GWB-III (may need to install new drivers) ? To discuss and decide the strategy.

Keep the dual GPU option pending for some time till the optimisation on single K20 is completed -- may be read for this now?

==> agreed to start this activity now.

(iii) other improvements in code :

(a) need some software updates in DAS chain to handle more than 2048 channels ? this needs clarification about whether this is available in currently released GWB-III or not !? GWB-III should work upto 32K channels, may need to confirm DAS path (and also maybe GUI?).

To summarise status again : GWB-II currently up to 16K channels; can extend easily to 32K for GWB-III; difficult to extend to 64K -- to check with user community if 32K max is fine.

(b) new features to be added in next version of GWB-III code : correction for net\_sign[] flipping (LSB/USB modes of correlator); channels upto 32k, lower beam integrations (tbd), beam header, multi-subarray, 4 beam capability; all off-line utilities with backward compatibility; time ? + DUT corrections; optimised code to be ported; shift to 2 inputs per Roach board. Some of these can be delayed for some time, depending on priorities. BAK to discuss with the team and come back on this, based on the priorities.

Priority order as per SSK : multi-subarray + beam header; time + DUT corrections; net\_sign corrections; all off-line utilities with backward compatibility; beam integration : default is 128 pre-int on GPU -- now it is variable (can be upto 1024) and needs to be tested (constraints in the range of parameter choice needs to be established); to look into reduced visibility integration time scales + folding ; 2 inputs per Roach Board; 4 beam capability can be done at the end; also need to keep PFB implementation on the horizon; also time domain folding of visibilities.

==> multi-subarray implemented and tested, including online interface; needs some more testing for getcmd mode; DUT corrections coded, but not yet fully tested; both of these work upto 32k channels but some testing may still be needed;

(c) long-term items like provision for control of FPGA and other peripherals (like sig generator) for different modes : agreed to identify one PC for control of all

the peripherals related to GWB; this m/c can / is interfaced to online via a socket and GUI can send commands via this -- already done for loading of FPGA files, needs to be extended for other applications; for other things like turning RFI rejection or Walsh modulation on/off, writing to registers in powerPC would work all right; agreed to start working towards implementing scheme in GUI for taking additional parameters that allow different bof files to be loaded; agreed that these flags need not go into Itahdr but can go in the user log as setting parameters (can also be there in gpu.hdr); agreed to go ahead with discussion with NSR for implementing the logic for allowing support of multiple corr modes that use different BOF files; other action items to be taken up later; BAK to talk with NSR / SSK to work out the time frame for having it in place.

(d) incorporation of DDC : this is important requirement in the long run :

Agreed to try on one node of GWB-II or GWB-III and get back to earlier stage and see exactly what was the bug. SHR has circulated an update; first part is that it appears that the current realisation is properly implementing a DDC; only the filter BW needs to be decoupled from the decimating factor and do a careful set of tests; in the long run, better filters with sharper cut-offs may be required (can check with nvidia about availability of std library functions for such applications); second aspect to the check about the nature or format of the o/p to see whether I & Q components are ok for further work or whether we need / can have the real voltage representation of the o/p signal.

new tests still pending; to check about nvidia primitives; to check about I,Q version vs real output possibilities.

To go ahead with Upendra and SHR working on it -- check present status.

==> independent DDC has been developed by UG and tested and appears to be working ok; to circulate summary of test results to see if more parameter space

(iv) Layout and racks (GSJ/BAK) : layout diagram to be updated and long-term plan for racks to be initiated; 3 different kinds of President racks discussed ("cyber", "cool" + one more?) -- to try and finalise after one more round of discussions including RVS (also, check new vendor Jyoti Tech); as an interim, 2 nos of cyber racks ordered with President. Current action items :

(a) 4 nos of half-height racks are now in use for GWB-III -- two nos are populated with 4 compute nodes each, third one has 3 host machines + 1 extra machine + clk source etc; fourth one has 8 Roach boards + IFB switch; will need to expand this to 16 Roach boards at some point of time -- may need to add one more half-height rack? One half-height rack is available in hand and can be used when required. Item can be closed for now?

(b) For the 2 President racks : first one has been used for GSB related nodes (spares) -- this is ready now, waiting for riser cards for the spare nodes (to be moved in during MTAC); to check current status of this, including swapping of bad node with CITA node. 2nd rack being used for trying the arrangement for special cooling (with help from mech group) -- tested with 1 kW load and increasing slowly; loading up to 4 kW tested by comparing the temp difference between input and output air; need to compare with unmodified rack; results so far appear to show that there is about factor of 2 discrepancy in estimated CFM rate and AC plant capacity CFM rate. Next - to decide on number of racks to be procured; Areed to include the test with unmodified rack and then circulate the report; current estimate is for 5 racks (32 Roach boards + 16 compute m/cs with 2 GPUs each); with 2 AC vents feeding these 5 racks, the estimate is that the available CFM may be marginal -- this needs to be resolved against the CFM discrepancy noted earlier.



Also to explore additional margin the AC system. Maybe useful to have a joint meeting with RVS and team.

Irappa has made some further tests and will be circulate new results shortly; check about having a session with RVS.

Need to get latest update from Irappa and then follow-up with RVS.

==> Report is under internal circulation and will be available soon.

4.6 Procurement of new hardware and accessories required for GWB systems -- from 11 Mar and before (BAK/GSJ) :

(i) purchase of 4 new host machines for GWB III : to decide configuration of host machines (disk i/o to be kept in mind); also to check if SSD is a viable option for recording of data. Investigation shows that SSD vs SATA has pros and cons; it may be possible that one class of server may be there that supports both?

4 nos of T620s have come and integrated into GWB-III: 2 are with 16 TB with and 2 with 4 TB -- compute vs host.

For future purchases : PERC card issue needs to be resolved : agreed that we will buy machine that can support upto 12 disks (which means with PERC card) but will have 2 x 2 TB to start with. More disks can be added as needed, and if at all extra slot is needed, PERC can be removed (will support only 4 disks) and backplane has to be changed with a new one (which has to be bought along with the machines); To decide quantity to order at present : agreed to proceed with 16 nos with full waiver for DELL proprietary item with DELL as the supplier.

To initiate the appropriate paperwork, including waiver of public tender.

Action started to generate the papers, to check current status.

Paperwork is moving and will be going to TIFR for waiver and then enquiry.

Tender waiver is done; and enquiry has been sent -- status of quotes?

==> last date is 30th for the quotes and then tender will be opened. YG to check with DELL about their quote.

(ii) procurement of accessories like network cards, disks, cables etc to be looked into -- 20 nos of CX4 based dual 10 Gbe cards purchased and tested; to confirm that this order is enough to meet our long-term requirements; Agreed to produce a formal note about the situation for long-term : to relook at the spares requirement without counting the units already being used in the existing systems (including the PoCo and pkt corr) and buy more if needed; GSJ has produced this list list and fresh orders to be done, based on this : 10 Gbe cables and NIC cards (spares); IB switch 36-port -- folders are ready for ordering; indent for 8 nos of K20 has been raised. cables for NIC cards : PO released; IB switch indent to be raised again.

For 8 nos of K20 : order has gone; IB cables and NIC : order has gone; IB switch : new folder has reached final approval stage; for 10 Gbe dual-port NIC cards + cables are all in hand.

8 nos of K20 have come; IB cables and NIC : order has gone; same for IB switch.

IB cables and NIC have arrived; IB switch order has gone -- should come in a month (mid-April)?

==> all items have come, except the IB switch -- due date is 26th March.

(iii) new purchase of Roach boards etc :

(a) 12 nos of Roach1 + 16 ADCs and 4 nos of Roach2 have come; Roach1 test set-up ok; all 12 Roach1 and 16 ADCs tested ok; to make a summary sheet about current stock and usage of Roach1 and ADC and bring up for discussion.

xls spreadsheet has been created; to circulate the latest version; to check

requirement of ADCs and verify the situation for 1 ADC per 32 Roach boards vs 2 per

Roach board. This issue needs to be discussed and a final call has to be taken. To check with Digicom about possibilities for supplying our requirement in the near future, 1 yr or so.

==> BAK to look into this, urgently.

(b) for Roach2 : to check standard test procedure on CASPER; to check if we need to buy add-on mezzanine card; to check if Roach2 can be seen on USB port using Ubuntu and if some basic tests can be done with this; indent for mezzanine card has been put. Order has gone and delivery expected in March -- waiting for arrival.

==> cards have come and work can move forward on Roach2 tests

(c) also software environment needs to be upgraded -- Matlab-Simulink upgrade order is under process; Xilinx ISE v14 has been ordered and CD is in hand -- to be installed; to see if one existing PC can be adapted for testing of Roach2, including installation of these new softwares.

New Matlab-Simulink installed on one machine (64-bit), including updated license manager. (additional license 2014 is for parallel toolbox)

Confirmed that one machine now has Matlab, Simulink, ISE v14.2; casper stuff yet to be installed; after that, can think of running a test where existing Roach-1 design is compiled and executable used on Roach-1 board. After that, can think of trying the same design on Roach-2, taking into account the differences in architecture. Casper tool flow installed; LED blinking on Roach1 tested ok; some changes in PoCo design to make it work; then could try pkt design and the GWB-III design; after that one can move to trying on Roach2.

==> email updates from SCC : CASPER toolflow for ROACH-2 installed takes a lot of time for compilation of simple ADC Snap design almost 45 minutes. Also POCO compilation needs rebuilding of design using new casper libraries. Still the toolflow has some freaky issues. ROACH-2 booting environment has been setup and need to test booting of roach2.

4.7 Testing leakage, coupling and correlated noise in new back-end chain -- from 11 Mar & before (BAK/YG/++) : detailed tests had been done by Vikram Jaiswal (with SSK, SHR and YG) and report has been circulated; for GAB systems, some follow-up action for testing the leakage has been initiated; procedure for testing to be done with GWB-II release modes clarified and tried out -- new tests show significantly different results for cross-coupling for GAB+GWB; maybe due to synth LO (old tests) vs sig gen LO (new tests), whereas earlier tests used synth LO; new report had been circulated that showed significantly reduced coupling; agreed to repeat the original, user level tests done by YG & VJ to see if things are different now ; agreed to try the ADC noise input and north pole sky tests and see what results come out; 2nd round of tests done, show leakage of 2-4% (consistent with first round results of 1-3%) -- to check with SCC whether all user level tests (done earlier by YG + Jaiswal) have been covered; some user level tests done with north pole and different leakage found for lower and higher LO settings -- needs to be understood.

From Aug-2014 : <= 4% leakage; FE+GAB+GWB (L-band) ~ 40% leakage.

Need to organise a detailed discussion on this.

==> no updates.

4.8 Walsh modulation : prototype set-up on Roach board -- from 11 Mar & before (SCC/BAK): plans of BE team for implementing prototype scheme -- basic unit for switching using sq wave signal from GPIO pin tested ok; was put in PoCo correlator and was being tested; walsh waveform delay functionality has been added now and can set delay from 1 to  $2^{32}$  clk samples (!); with this, variation of correlation with delay has been tested using noise source inputs and found ok; a robust algorithm for hunting for the peak correlation and fixing the delay needs to be developed; can also think of a test case of showing cross-correlated signal goes away with

modulation with square wave in one channel; Walsh pattern being put in the Roach (not many slices needed); there was some mismatch between CPLD waveform and FPGA waveform that was resolved and all FPGA waveforms are matching; current action items are as follows :

- (i) issue of accuracy of oscillator being used needs to be resolved.
- (ii) to complete the Walsh modulate and demodulate set-up in the lab and test -- this is ready and can be closed.
- (iii) to complete the final delay setting algorithm : to provide upto 500 msec of delay (for 128x4 Walsh length) with resolution of 5 nsec (FPGA clk); there were problems related to varying start-up offsets and fractional delay setting, as well as problems related to set up and hold -- these are now reported to have been resolved : this is confirmed to be work ok and can be closed.
- (iv) what about synchronisation of starting? -- this is taken care of by running the CPLD with a sig gen locked to 10 MHz.
- (v) to optimise the hunting algorithm -- to start testing a basic algorithm and see what we get.
- (vi) to demonstrate cancellation of unwanted signals in ADC card and/or GAB; first, need to run a test where pattern from external source can be synchronised to the pattern generated in the FPGA -- this requires being able to hunt and correct for the unknown delay ! This is coupled to item (v)

Some tests are underway; some problems being resolved about the hardware set-up. detailed discussion on various issues above can be taken up next time.

Current status: demodulator now working all right; waiting for modulator ckt to come back from FE team; meanwhile, can try a test where both noise inputs are demodulated with the same pattern to see if it recovers full correlation or not; also to make first estimates of total FPGA resources that will be used up.

Latest status (11 Mar) : Demodulator integrated with PoCo; Walsh delay module created; external modulator already working; now ready to test with correlated noise source and develop the hunting algorithm.

==> see email updates from SCC :

The test is going on with pocket correlator to check effect of Walsh pattern delay on normalized cross. CH-1 Walsh modulated and CH-2 delaying Walsh pattern by 50uS and check effect on normalized cross. The testing software is ready and will be tested soon. The design doesn't take much resources only 2-3% of FPGA.

## 5. Other items :

5.1 New python assembly design -- from 11 Mar (HSK/SSK) : FE group wants the python configuration in E6 to be adopted for all antennas -- FE and mech have discussed about plans for modified python assembly that will give additional protection to cables; mech group had circulated a short note on their view of the matter, along with photos; this was discussed and existing vs E6 system was compared; Action items :

- (i) modified E6 design with hinge-like support was installed on C4 (July 2014); agreed to watch the set-up on C4 and do periodic inspection for checks of (a) damage to hose (b) hose clamps (c) water entry etc -- first inspection was done after 2 months (mid-Sep 2014) by mech and fe teams; subsequently, inspection was done (around mid-Nov?) and a video of the same was circulated; scheme appeared to be working ok; however HSK felt that this scheme with hinge may not be good in the long run -- this was discussed in detail; the hinge arrangement on C4 is NOT exactly same as the E6 arrangement (!); the C4 design does not completely solve the problem; agreed that E6 set-up does solve the problem (!); agreed that it can be replicated if needed.

(ii) IGUS cable wrap -- new technology prototype to be developed and tested on quadripod : a) hose without wire impregnation b) entire hose assembly (both could be tried as long-term solutions).

Quotes for both items received : item (a) is Rs 10k for 10m (4 antennas); item (b) is 60k each -- will try on the quadripod test range; items received; basic assembly made ready; finally, installed on test range around Oct 2014; tested ok without cabling (video available); then populated with cables by FE team for further testing; proto model made fully ready; this set-up uses a slightly different arrangement of fixed members, along with the IGUS hose; will work as well as the E6 design.

Agreed to : (a) replicate the test arrangement on 2 antennas, one with normal hose and one with IGUS hose (b) to check how much extra cable can be accommodated in the existing hose and (c) look for wider diameter assembly (32 to 40 mm or more).

Email update from HSK : (i) hose procurement in progress under cash purchase (ii) spare assembly with old type hose will be prepared for 2 antennas in time for installation during Mar-April 2015 MTAC (ii) spare assembly with new IGUS hose will be also be prepared for 2 antennas for installation during MTAC (iv) extra hose of 38/40 mm is being procured and assembly preparation is in progress -- will be ready by 1st week of April.

==> 2 sets of hose assembly are ready for use -- two antennas to be selected : maybe W1 + one. HSK says no scope for adding more cables in existing; wider assembly of 38/40 mm is getting ready -- can go to antenna directly (W4) and add optical fibre cable as a test case.

5.2 Problem of access to FE boxes with 500-1000 CDF feed -- from 11 Mar & before (HSK) : Update on new solution being designed by Mech group -- tested in situ and found working ok; agreed to use this for present; for future where bigger and heavier boxes will come into play, mech group will think of an improved solution, including an option for removing one feed and bringing the stool inside the basket; a few options explored by mech group, with target of 1800 mm height for boxes with max weight up to 150 kg (?), quotes received from some parties, processed and order placed; delivery by end of November 2014; inspection done (in Bangalore) in mid/late Nov 2014; some simple improvements suggested to vendor (guard rail, simple clamping arrangement for item); platform delivered at GMRT (early-Dec 2014), tested and found ok, including modifications that had been suggested; trials had been happening on ground; ready to test with actual antenna operations -- waiting for new crane to be operational (why can't it be done with the HLPs ?)

Email update from HSK : waiting for RTO registration of new crane to complete. ==> confirmed that not a good idea to carry it to remote locations in HLP basket; hence, crane has to go (as item is too heavy to be easily handled by humans) !

5.3 Improved software for work requests -- from 11 Mar and before (HSK/SJ) :

To review the current process of taking job orders for better facilitation of the tasks with end users like electronics groups. YG discussed offline with HSK : to look to fill the lacunae in the process with maybe new development of in-house version -- agreed to try and get this done in-house with Joardar; work was taken up after completion of ongoing tasks related to electrical (meanwhile, old software also started working (to check with Mangesh about what fixed it) -- hence urgency not very high; first version completed and released in late Dec 2014/early Jan 2015; awaiting user feedback for improvements; appears to be working fine; no major comments from users, except for one comment from SSK and one from admin staff. Email update from HSK : both the issues resolved by Yogesh Gaikwad and things

are working fine. To check if this item can now be closed.

==> agreed that all changes required are done and final version can be released.

5.4 Status of new CSIRO feeds : from 11 Mar & before (ANR/JNC/HSK) : to report on performance of the newly manufactured feeds -- new results are slightly better compared to ver2 (casting) but not as good as the original ver 1 (machined by Godrej); it was discovered that a major change in the design /drawing required to maintain alignment between different sections [using guide-pins etc]; how to proceed further needs serious discussion about alternate options; HSK to try some new ideas to see if a solution can be found e.g. liquid Al layer to cover ? additional coating of Al paste being looked at as a possible option; discussion with Dr. Shenoy -- Al conductive paint may not work best (only 80% conductivity)...

need a discussion and decision about what should be done; can keep the matter in suspension for some time?

==> no discussion.

5.5 New FE boxes and testing with reflective paint -- from 11 Mar (HSK/SSK) : two kinds of paint received and 1 box will be made ready next week for testing. 6 new boxes are ready as per specifications -- only some engraving work is pending.

email update from HSK : One FE box painted with Luxtropherm HT 400 (range from 250-400 deg C ?) and handover to FES group for testing. Second grade paint : Luxtropherm HT 600 (range from 400 to 600 deg C) -- waiting for arrival; 3 types of FE boxes handed over to FE team : (i) plain box with powder coating (ii) box painted with HT400 (iii) box painted with HT 600; waiting for test results.

2 types of paints tried : HT400 & HT600; neither successful; to try new paint options? Item needs to be discussed jointly with mech and FE to understand why the original selection did not work and what should be done about it.

Agreed to circulate the description of the method used, the results and the conclusions and then take up for discussion and decide what needs to be done; this has now been done by the FE team; need a follow-up discussion.

==> to cross-check properties of HT400 and 600 about reflective nature and what are the other alternatives.

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