

## Minutes of weekly Plan meet of 8 Oct 2014

### 1. FE & OF related :

1.1 Detailed design doc / ITR -- pending for long : from 17 Sep & before (SSK/BAK) :

(i) OF Rx system to be completed (Satish Lokhande) : first version has been circulated -- some improvements and additions suggested (e.g. 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.

ORx was discussed last week and some suggestions for changes were made -- updated version to be produced shortly.

==> no updates.

(ii) OF Tx started; first draft is ready and should have been circulated by now. for both, docs are with SSK waiting to be cleared and circulated for comments.

Note : the Tx design doc may have only blk diags for now, without full details, till a paper is ready (!); need status update to see why it is stuck !

still pending for SSK to complete the integration !!

==> no updates.

==> To take up in the next meeting.

1.2 Update on results from test range -- pending from 17 Sep & before (HRB/GSS/SSK) :

Reorganised into the following issues :

(i) status of the test range :

(a) better mechanical alignment -- under discussion with Inteltek (proposal was due around 2nd July) -- no response from Inteltek (likely to give up on them).

==> no response, hence item can be closed.

(b) set-up was re-installed after better protection circuit for encoder against lightning (home made surge protector using 30 V transobs), including better grounding scheme, improved corrosion protection (including better water proofing); improvements in water-proofing have been done; limit switch functioning still not resolved; needs Ajee to spend some time; should be done by now.

==> gaskets used for water-proofing etc were giving problem -- these have been fixed now and unit if working ok now; new measurements will start this week.

(ii) calculation (based on reference paper) of the expected deflection & comparison with measurements to check if there is significant loss of sensitivity -- GSS to develop refined version more relevant for GMRT, and to see 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 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 -- waiting for some of the lightning protection work to be completed, to get measured values from test range; waiting for test range to be working.

==> still waiting for new measurements 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. 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 (likely 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 C-program can be made to run to give some initial cross-checks.

==> code has been ported from C to Matlab but results are not yet matching with expected behaviour and debugging is going on.

(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; waiting for test range to be working.

==> still waiting for test range to be ready.

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

1.3 Comparison of measured & expected sensitivity curves -- from 17 Sep (SSK/GP/HRB): scheme for (re)calculation of expected values across the broad bands to be finalised (and added to measured curves) : curves now being done with constant QH value and with variation of T\_lna with freq incorporated; model for the main BPF has also been put in : the deflection peak now matches fairly well across the band, but the curve rise and fall at the edges of the band was not quite matching; follow-up action to be discussed (mostly for 250-500 band) :

(i) Antenna efficiency factor : GSS has sent a table at 5 MHz steps to GP, it appears that the table has only 4-5 points across the band (from measurement values); GP has done interpolation & has got a curve that falls off with increasing frequency, but has kept the efficiency constant below 250 -- this needs to be understood & resolved; final curves for 250-500 still appear to show a bit of mismatch at the edges of the band. GP has taken RL curve and is incorporating in the code.

==> adding RL effect as an efficiency factor does show different cut-off (a bit

earlier than the BPF) and it matches better with the data. Couple of secondary items: to check if all antenna data matches with the new curve; also to check why theoretical curve gives less deflection than measured for some antennas.

(ii) It appears that the discrepancy on the high freq side is not really significant (seen only for a couple of antennas out of 10) -- TBC; discrepancy on LF side is still there and may be due to holding efficiency factor constant below 250 ? high freq side could be due to absence / presence of 540 notch filter -- confirmed that this edge matches with the BPF response; hence, the slightly higher cut-off at 250 MHz seen in real-life is likely to be due to feed efficiency -- this needs to be checked -- action to be taken by GP for using RL curve as a first order measure. ==> see comments above; also agreed to check the HF part while comparing with data.

(iii) possibility to try it for Lband to be explored -- information gathered has 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 the actual measurements.

==> Regular follow-up after 2 weeks.

1.4 Phase centre tests for 250-500 CDF -- from 17 Sep and before (HRB/GSS): to report on expt with 10 to 20 cm height change in 250-500 feed on one antenna to see how much change in sensitivity is seen.

Tests done on c6 with feed having 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. See also 2.1(ii)(c) below. 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; agreed that FE team to go over all the available measurements and produce a consolidated summary to check if 1180 or 1280 gives the best result; confirmed that adjustable stool will not work for the current 325 MHz face due to welded nature of existing stool -- need a discussion with HSK about this; also confirmed that we can't go below 1080 by further cutting the support legs of the cone; agreed with HSK to reproduce one more adjustable stool (in about 2 weeks time) 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.

==> probably no progress on this as C6 has been taken by mechanical for maintenance; may resume only by next week. To check status after 2 weeks.

1.5 Total power detector for FE & common boxes -- from 17 Sep & 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;

Current action items being followed :

(i) automated script for running the observations : there was a bug in the script that caused problem for FE box data (common box data was ok) -- now fixed by JPK and new data taken on 16th Sep -- being analysed. To wait till this data has been verified before closing the matter of the SOP and testing / data acquisition procedure. ==> looks ok except for testing for other than subarray 4 -- tbc this week and then matter can be closed.

(ii) 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. ==> 1 s time constant requires very large capacitor; few microfarad may be more practical, pushing the time constant to ~ msec. GP to check and report about the largest practical value of capacitor.

(iii) 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 monitored, but working CB monitor is only on C13, E2 & W4 -- 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); ==> 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.

(iv) All these data sets also have temperature monitoring (for all of these antennas, as well as for a few others of 130-260 etc). To check status of the analysis. ==> plotting and first look has been done; consistency across antennas (and FE/CB) appears to be there -- need to put out a formal analysis of the same.

(v) 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; will be tested on the new data set of 16th Sep and comparative analysis will be done and reported

==> script and software working ok; possibility of making a GUI tbc; otherwise task is complete and item can be closed.

(vi) plans for building 70 units for CB : all PCBs and chassis are now in hand; need to decide plan and schedule for mass production and installation on upgraded antennas; agreed to work out an algorithm such that new units are 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 units coming down for repair; to check plans for mass production and installation for FE systems. for CB it is still status quo; for FE, 20 PCBs had been made and all are used up; new order for full quantity (~ 300 PCBs) has been placed -- to check status of this. 360 PCBs (with Techno Ckt) -- status being followed up.

==> all 360 PCBs have come and assembly for 250-500 box (60 nos) being made ready; value of capacitor to be finalised.

(vii) status of ITR, which was ongoing, but was halted pending above problems : agreed to resume the work now; need status update on this. "work in progress" i.e. yet to start ?! waiting for last round of test data analysis to get completed.

==> yet to be started; will do so once the 3 data sets are analysed and compared.

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

1.6 Spares for L-band feeds -- from 17 Sep & before (SSK/ANR) : we have 32 feeds, 2 not working (1 dismantled for making drawings of new feed) due to electronics failures -- these are device failures (including some new ones?); now some LNAs have been successfully assembled by Gopi and C3, W1, E2 & E5 have been fitted with these and found working ok. Also, one spare feed has been assembled and installed on W1 and working fine. Current action items :

(i) to update about status of feed on W1 and see if this matter can be closed : not yet confirmed whether deflection is less than expected or not -- to cross-check with JPrakash about performance of W1 and report back; this is pending for long. VBB to be asked to sit with JPrakash and get the answer -- any updates?

no updates yet; SSK agreed to take it up and close.

==> VBB agreed to get the statistics from JPrakash and send email update by today. Subsequent email update from VBB shows that W1 appears to be working ok for the past few months. To check other newly installed L-band spare feeds working ok or not.

(ii) spare LNAs : Agreed to have at least 5 LNAs ready and 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; LNA is being investigated (may need re-tuning?) -- no progress in understanding low deflection of new LNAs; retuning is not helping -- increasing the bias current leads to oscillation. To wait for new batch of devices and also

check OMT etc for any problems. Devices from new batch used and appears to give a stable solution. To confirm if this does solve the problem.

==> 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? one unit fully assembled (all 3 stages) and working ok; 2nd unit under assembly -- will be used for 2 channels of feed #32.

(b) old PCBs not easy to use for replacing devices as coils get spoilt and need gold plated wire for which need to go back to the old party (only one new device was put in one of the 3 stages of the LNA and was found to draw the proper bias current);

==> new stock of gold plated wire (30m) is now available (done with the same party);

(c) meanwhile, using the earlier batch of devices, two LNAs have been made ready and this is going on C1 -- to check status of this.

==> unit has gone on C1 with new LNA in both pols (after retuning) -- may be ok, but can't confirm till ripple and bad bandshape problem is solved.

(iii) check status of alternate LNA designs : to try and see if design used for 550-900 can be modified for 1-2 GHz use ; to also check the design done by Abhay Kulkarni -- ANR now looking into this design to see if it can be improved for our needs; design files had been obtained and were being checked by GP and ANR : model files to be converted to match simulator used by us; also ultralam2000 was used and that is not available in the market now; work is ongoing; component models in software had to be downloaded; agreed to simulate it with ultalam2000 and make sure that ckt works ok; and then concentrate only upto 2 GHz and change the substrate to RT 5870 which is easily available; initial simulations now matching with original results (for ultralam2000); now going for simulations using RT 5870. Status ?

==> results reproduced with RT 5870; now trying to tune the design to required specs of gain (30 vs 34), Tlna (~28 or better needed) and maybe at cost of reduced BW; process likely to converge.

(iv) finalisation of plans for having total of 8 working spare feeds -- from mechanical to electronics :

30 antennas have working Lband feeds; 31st was assembled back after being dismantled for making the drawings -- this was completed and installed on W1 (#31 is now in the regular 'maintenance cycling' of feeds); 32nd is there in Pune wshop and can be shifted back after assembling by mech group and then fitted with the electronics; 3 new feeds were made in 1st round of work; all 3 are in Pune wshop and have been tested for RL with probes; but 2 of them have wrong size of horn and needs to be replaced; all 3 need new covers as old ones were not suitable (may be done in workshop, but not decided yet); in addition, 3 more feeds from Akvira have come : OMT + horn + cover ; also 2 horns have come and can be fitted in the 2 older feeds. Hence, total of 8 spares can become available. Note that weight of 3 latest feeds is 18 kg more than earlier feeds (72 vs 61 kg) -- this has been accepted as 'fait accompli'. Following issues need to be resolved currently :

(a) to check status of feed #32 -- agreed that mech group should assemble and send to GMRT -- has been sent, alongwith newly assembled press-fit probes, but not clear if full unit is available, or only partial (!) -- unit 32 has come back to GMRT, but cover is NOT there; OMT and feed have been assembled; newly fabricated push-type probes have been used; RL has been tested; new box/cover is being taken for this -- mounting plates need to be made ready;

==> box/cover is ready and inspected and ready to be shifted; final plates etc (for #32 + 2 more feeds) after chrome plating will come by early next week and then final assembly will start for #32.

(b) plans for assembling and making completely working feeds to be discussed; 3 feeds

after powder coating have come to GMRT (3 others are ready for inspection in Pune); FE to target making ready one feed per month; however, new issue about mating and alignment of probe has cropped up -- press fit (old schme) vs threading (new scheme) mechanical problem -- agreed that we can go back to the old scheme of "push-pull" on one feed at Pune for checking and then retrofit all 6 units; meanwhile one new unit at GMRT can be checked for alignment; 3 sets of old (press-fit) probes being made -- almost ready to go for silver plating; one person from FE lab needed for soldering of these when assembling in the 3 feeds still at Pune; change of track again here as the first of the new feeds has been assembled with the new type of probe!  
==> see further details under item x.x in mech.

(c) in terms of electronics, 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 (see below).  
==> appears that new filter bank is going to be tried?

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

1.7 Testing of LBand wideband systems on 30 antennas -- from 17 Sep (PAR/SSK/SN) : (to maintain a proper log of action taken on individual antennas during these tests and debugging activities); Current set of discussion items :

(i) some new data had been taken in June and results had been summarised :  
(a) C08 & W01 CH-2??shows ripples at OF RX output -- gone now (to check possible cause);  
(b) S04 and E02 show RFI type lines; E06 shows RFI lines in CH1; need status update on follow-up on these matters, as well as comparison with newer data.

(ii) new data from 1 July for 14 antennas looked quite decent :  
(a) two RFI lines : 1070-80 likely to be airport radar, other ~ 1280 likely to be due to GPS (to be taken up under RFI agenda);  
(b) C2 has new OF system without attenuation control hence data is not good; this is now corrected and can be closed after a cross-check.

(iii) new data from 8 Aug for 18 antennas in rx room (taken manually) : useful data; brief discussion shows the following issues :  
(a) RFI lines clearly seen near 1030 and 1090 (details in RFI agenda item): RFI team to try for some statistics with dedicated monitoring set-up.

(b) FE team to follow-up on the following :  
-- some antennas with poor deflection overall  
-- some antennas with deflection changing over the band -- less at high frequencies : to see if pointing offset can explain this.

-- some antennas with poor on/off bandshapes  
-- few antennas with ripple or large slope across the band -- to be followed up.  
new results of 3 Sep data discussed in detail; some classification of problems and follow-up has been done and some problems fixed (like W4 ch2); first trial with pointing offset has been done; to try again with pointing done at the highest freq; some follow-up has been done for RFI lines also -- 1090 line appears to have BW of 3 MHz or so. Other main line at ~ 1200 needs to be identified.

==> results from new data of 26 sep 2014 for ~ 19 antennas : some learnings are as follows : deflection falling at high freqs looks like happening for cases where the RF power level (at laser input) is too low -- this needs to be confirmed with a more careful set of tests (and plots) for a few selected antennas (including good ones made to look bad by increasing the OF attenuation); also using pointing corrections

at the higher freq of 1390 did not improve such bad antennas; better characterisation of RFI : 1176.0 and 1176.45, 1191.80 and 1204.70 are likely to GPS (in addition to 1280) and 1090 is airport rader -- check with RFI team separately.

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

1.8 Characterisation of recommended attenuator settings for different bands -- from 17 Sep (SSK/VBB/AP) :

(i) values had been given for Lband, 250-500, existing 610; only 130-260 / existing 150 was pending -- some tests are still being done to verify the values before releasing (for 150 / 130-260 systems); appears that number may be around 9,9 -- may converge soon; work has been completed; appears that 6,6 may be the best value; note will be circulated shortly.

==> short note to be circulated soon; then can be taken up for detailed discussion.

(ii) also, need a discussion if values given to control room are optimal (e.g. 7,7 for Lband sub-bands) -- from tests done by YG and DVL, this appears to be too large? first, to confirm if it is 10,10 and 4,4 for full-band and sub-band; second, to redo tests again and confirm present status and then decide about discussion on this topic. DVL to repeat the tests and confirm the performance; tests have been done; waiting for results from DVL.

==> appears that 4,4 is fine and upto 7,7 may be ok; but higher than that may give some problems; may be worth settling on 4,4 for the default; agreed to try for full band also and report back the recommended value.

(iii) 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; still pending, but can be done now, as Lband is relatively stable now; this has been done by Ankur in a report back in July -- this was 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 the report to be produced with these modifications -- measurements are pending; will be completed shortly.

==> first part for changes related to 250-500 has been done; waiting for measurements at Lband to be completed.

(iv) also, at 1390 some antennas have an extra 10 dB gain stage; appears that there are only 2-3 antennas which don't have this modification?; one of them is S6 which is being done now; 1 or 2 others may be there -- needs to be confirmed; meanwhile, APK's notebook has been found and shows that ONLY 12 antennas have 10 dB stage; but VBB thinks that more have it... finally, agreed to do in-situ band shape measurements for all 30 antennas to infer if 10 dB stage is present or not -- for those with broadband link, it can be done in rx room; VBB is looking into this; measurements have been done, appears that only 4 antennas may be without the modification -- VBB will send a summary, alongwith the evidence shortly. VBB yet to compile the results and circulate !

==> summary sent by VBB discussed; the conclusion is not clear; needs a proper comparison of the bandshapes for full band and subbands.

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

1.9 Filters at different stages of receiver -- from 17 Sep & 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; a third 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; changes 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 -- device is to be procured; order has been placed; delivery date not clear.

==> delivery date still not clear.

(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. To check status of this.

==> report is under preparation.

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

1.10 Finalisation of PCBs & chassis for various notch filters -- from 17 Sep (SSK/ANR):

Different kinds of filters with different PCBs (some common) and different chassis (again, some are common) are needed. Further, various filters are in varying stages of acceptance and mass production. To keep track of matters globally, agreed that FE team to produce a spreadsheet giving details of all the notch filters presently being used, alongwith the type of PCB, total # required, total # available (and where used at present), and plans for procurement; and similar columns for chassis; first version of the spreadsheet had been done, and some feedback had been given; updated version of spreadsheet discussed; agreed to move 2 columns to the front of the table; and add one column of comments at the end, and circulate the updated table; to check status of this.

==> changes have been made; will be circulated after some time. To check status after 2 weeks.

1.11 Follow-up on 550-900 MHz band filters -- from 17 Sep, 23 Jul & 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; hence, agreed to retune the filter in-house and get modified versions done with Shogini quickly and then take a final decision; current status and action items :

(i) new PCB from Shogini works all-right; complete system with chassis is available for one poln; to assemble second poln unit with existing older PCB + new chassis; agreed to defer further development and integration to the point when the new FE box is ready.

==> no action item here for now.

(ii) to review the cost estimates for mass production in preparation for final decision : updated estimates : 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) has been ordered (2 nos) to workshop, on lower priority; agree to wait till chassis comes and final layout for the new FE box is decided before going for mass production; PCB material is in hand; switches needed are in hand; so may not be a major problem for mass production; 2 nos of chassis received and integrated filter unit made and tested ok; now to wait till layout of FE box is taken up.

==> no action for now.

==> To check status of all items after 2 weeks.

1.12 Finalisation of 550-900 FE box -- from 17 Sep (ANR/SSK) : to produce a block diagram for the 610 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.

==> no updates available. Follow-up after 2 weeks to check the status.

1.13 New filters for Lband -- from 17 Sep, 23 Jul & 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. Current action items are as follows :

(i) to finalise the GSG note : ANR has sent the modified version after first round of feedback; YG to finalise and circulate to GSG.

(ii) new BPF + mobile notch filter to replace existing filters in FE box; LPF to be put in common path (CB or antenna base?) -- confirmed that LPF will be at antenna base as a common facility for all bands; agreed; waiting for GSG clearance.

(iii) plans for implementation : to do is as a case-by-case replacement job; PCBs (stripline) does not need much work for assembly -- can be given for manufacture; new chassis will be needed; population can be done as and when a FE box comes down. 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) -- see also Ankur's spreadsheet; can start on Lband, once the formal go-ahead comes.

(iv) sub-band filters can be taken up at even lower priority later on; still at simulation design level; can discuss next time if we have the resources to go into this. Given some of the problems with the existing Lband filters, agreed to start assembling these are the new filters, using the existing switch unit -- new layout has to be made, sample unit has to be ordered, and then decide about mass production. ==> need update from Imran.

==> Regular follow-up after 2 weeks.

1.14 OF systems -- from 17 Sep & before (SSK/PAR) : Plans for further systems : 17 antennas installed : C4, C6,C8, C9, C10, C11, C13, E2, E6, W1, W4,W6, S2,S4,S6, C12 & C14. Next, C01 done as the 18th antenna by 3rd week of April. C3 was to be the 19th antenna, but got changed to C2, which is now complete (except for M&C for attenuation settings control?); next antenna to be taken up (20th) is C5; system was ready in the lab; needs to be tested and then installed at C5. To confirm that C2 M&C work is completed; check status of C5; check status of next antenna (C0 or C3 ?). ==> for C2, 2 bits from telemetry still not coming -- SN to check and revert back; C5 is complete, including telemetry; C3 is likely to be next. To check status of this work.

==> C2 is fully cleared and functional; instead of C3, C0 has been taken up and completed, except for telemetry work -- tbc. Next antenna will be C3. Can check status after 2 weeks for C0 completion and 4 weeks for C3 installation.

## 2. RFI related matters :

2.1 RFI tests of ethernet switches for antenna base & GAB -- from 17 Sep & 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 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. 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; to confirm if any changes are needed or not and accordingly finalise the report -- PAR to check existing document and see if any parts need to be updated or not and circulate a final report (by end-Sep). final report not yet ready, but still on track for end-Sep. Need status update.

==> email update from PAR : first version of updated report is ready and circulated; may need one more revision. Status check after 2 weeks.

## 2.2 Follow-up on UPS RFI -- from 17 Sep & 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 items:

(i) to finalise plans for going with 3 kVA unit from Ador as the final choice : can we order 10 nos of these as a starting option? RVS has received budgetary quote; need one more confirmation at C10 about the current drawn by servo to fix the split at o/p of the UPS (total cost per antenna may turn out to be around 2.x lakhs) -- to check current status of relevant items; servo current issue was resolved; to check status of order for 10 nos of 3 kVA units from Ador -- indent had been raised; to check status of ordering process.  
==> still waiting for formal quote from vendor. To check status after 2 weeks.

2.3 Discussion relating to Industrial RFI survey -- from 17 Sep & 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!); follow-up actions identified :

(i) 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); to cross-check the list against the ones which have NOC (nothing much can be done for those operating without NOC, except to add to our database and inform them about informing us for changes) -- this is happening now. database for Junnar + Ambegaon was ready; remaining data entry has been completed. To confirm the same and see if this item can be closed.  
==> no updates.

(ii) single phase welding machines in use, which are hard to account for -- to check with DIC for advice about it; based on the survey results, identify areas where one would like to go and quantify the level of RFI -- agreed that this will be taken up with DIC when sharing the database from the survey (around 20th Aug); to start looking at these, starting with the big units; discussion to be taken up with DIC when presenting the report; measurements should have been started next; sample data to be collected from different areas and will be shared during meeting with DIC; need status update on this.  
==> see update under (iv) below.

(iii) during the survey, some units which are likely to be important from RFI point of view, are to be studied in detail later on -- some work can start in parallel

with completion of database, beginning with the bigger units; may need 1-2 ultra sound dishes, as the existing 2 are barely functional now (check status of order of these); can also look into IR thermal cameras. some RFI measurements of industrial units in Junnar area have started -- measurements (using LPDA) from 2 big industrial units in Junnar and Ambegaon completed; others are in progress; indent for 2 nos of ultra sound dish placed and under processing.

==> no updates on new measurements; procurement of 2 nos of ultrasound dishes is under process.

(iv) To see if DIC can be requested to issue a letter to all those active industries who don't have NOC -- discussion to be taken up with DIC when presenting the report; to check if date of meeting has been finalised.

==> email update from PAR : meeting held with DIC on 30th Sep. Summary highlights are 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 which are not falling in the mention region.
- c. Issuing of NOC to the old units which are working in the GMRT identified zones with guidelines from the GMRT.
- d. They have requested letter from our office to collect information from single phase welding machine users in and around GMRT antennas. This work will be carried after six month.

==> Regular follow-up to check status after 2 weeks.

### 3. Operations :

3.1 Identification and procurement of appropriate ethernet switches for antenna base (and GAB) -- from 17 Sep & before (SN/PAR/BAK) : Ops group to work with Comp team and RFI group to work out scheme for getting appropriate 24 port switches for antenna base use (2-layers, manageable); CISCO make was finalised after the detailed RFI testing was over (see item in 2.x); current action items :

(i) to finalise plans for procurement of CISCO switch : 3 more such switches (in addition to the 1st sample unit) are in hand (total of 4); agreed to by 32 more in one bulk order (may be 10 k each) -- waiting for quotations. To check status.

==> quotes received; folder under process. To check status after 2 weeks.

3.2 New, improved Miltech PC -- from 17 Sep 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?); to check current status of the PO. SN to check the status and report back.

==> order sent; expected date of delivery 31st Dec -- trying to expedite, if possible. To check status after 2 weeks.

3.3 Planning for proper UPS & space utilisation for new equipment at antenna base -- from 17 Sep & 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.

Current action items :

New, updated report has been produced. 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) there was an issue raised about extra current requirement for servo due to

(a) stow on UPS? (b) core losses in the xmer

Agreed in discussion with servo (S. Sabhpathy) that stow on UPS is not required at all as it does not make any sense; also core losses in existing servo isolation transformer (in control electronics) is not an issue. Agreed that 1kVA isolated UPS supply is sufficient for servo. This matter can be CLOSED NOW !

(ii) ordering of 10 nos of UPS; budgetary quote has been received; indent to be placed shortly (se earlier agenda item). need status update urgently !  
==> waiting for formal quote from vendor.

(iii) a closer to 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 has been prepared by electrical and shared with servo (4th August) -- awaiting response.

meanwhile, discussion with BLDC supplier : now ok to gnd the neutral of the main 3ph transformer; extra emi filter may be required -- RVS is looking into this; only one set of line-filters will be required. RVS to modify the wiring diagram to reflect the above changes and send to servo for final agreement.

==> extra emi filter confirmed to be about Rs 10000 per antenna. RVS to come up with the final wiring diagram based on all this information and circulate to all concerned.

(iv) 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. To check status of both C00 & C10 and decide future course of action.

==> work ongoing for making the space for the FE power supply; also ask servo to conform FPS drive in keeping with the agreed diagram. RVS to circulate an email about the updates and asking for comments, if any, before finalising the plans for all antennas.

==> Regular follow-up and status check after 2 weeks.

#### 4. Back-ends :

##### 4.1 Documentations :

(i) Detailed design doc -- from 3 Sep & before (BAK) : analog back-end was being done by Hande : 2nd version had been circulated in April. Next level of document going down to chassis level is to be made ready -- chassis level doc will take about 2 months; can be deferred till end Oct; to check status & progress in early Oct.

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

==> no updates on this. To check status after 2 weeks.

4.2 : Power supply for GAB : from 3 Sep 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; can wait for ~ 1 month and revisit the matter; now due for a discussion.

==> no inputs; can be taken up at a later date. To check status after 2 weeks.

4.3 Power equalisation schemes for new back-ends -- from 17 Sep 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. Agreed to check this further and try to identify which element may be responsible for the spread (~ 4-5 dB). Need status update on this.

==> no further update on this right now -- to be tested and reported upon.

(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; need status update.

(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) SRoy to test the recently added feature of saving attenuation values to file.



SRoy has checked with Nilesh (ok) and will check himself later on; Status?

(d) 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. This should lead to a sophisticated total power monitor tool. SRoy has had some discussion with NSR : can initiate the activity for short length of data.

(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.

(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?

==> no updates for (a), (b) and (c); for (d) SSK has discussed in detail with NSR and latter has started looking into it; no updates on (e) and (f).

==> Regular follow-up and status check after 2 weeks.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 24 Sep & before (SHR/SSK/BAK/DVL/YG) : (NOTE : GWB-I is existing released system !) : agreed to make 4 T7500 nodes with C2050/C2075 Fermi GPUs + remaining 4 T7500 nodes as host machines (to take care that these are the ones that transient pipeline uses presently so that sharing is possible); this should have ALL basic modes : total intensity and full polar IFR modes; IA + PA BFR modes with process\_psr pipeline attached; full GUI support; to come up in trial code section without affecting the presently released mode. Action items :

(i) testing of GWB-II interferometry mode with different OF attenuation values to check variation of correlation coefficient -- DVL + YG to provide an update. It looks like working ok now, with the sig gen LO. To confirm if working ok with the new, modified synthesiser mode; results from sig-gen versus synthesiser have been found to be consistent at 1280 MHz (marginally better than GSB); however, 1390 synthesiser scheme needs to be confirmed; it looks like that this may be resolved now (maybe due to setting problem, when it defaults to 10 MHz reference)? but some problems noticed with other sub-bands of L-band) -- needs some clear follow-up, including combined testing of attenuator levels -- DVL to organise these tests; some updates from DVL's email last week : 1170 appears to be OK; need to complete the checks for 1280 and 1390 subbands and clear the matter. DVL to test and report back the status; waiting for updates from DVL.

==> updated results from all 4 sub-bands of Lband appear to show that the corrln coefficient values are in the same range for both choices of LO scheme. This topic can be closed now.

(ii) testing of GWB-II in dual pol interferometric modes : some tests initiated by DVL + YG to check total intensity and full stokes mode -- to update about the results, and also plans to update the SOP etc about these modes; waiting for DVL.

==> dual pol total intensity and full stokes have been tested and found ok (in comparison with GSB data for same output). to check about SOP update.

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

effects; process\_psr pipeline has been completed and released; first version of SOP has been released; pending action items :

- (a) there appears to be a problem in the PA mode : integrator & square law detector are in opposite order -- SHR has fixed and last set of tests remain to be done before releasing. YG & SG have carried out some tests; first order tests indicate ok; but need a bit more checking; load estimate still pending, but since extra kernel is not used, may not be an issue.
  - (b) GUI changes for flexible phasing to be checked with SHR & NSR -- YG and others to test and report back -- can be closed after one more round of user tests.
  - (c) float to int conversion logic has been implemented for scaling but needs a cross-check -- user controlled scaling factor has been provided; updated SOP also provided; need user feedback about the functioning and then check if it can be closed.
  - (d) beam mode still working with fixed channel and time factors -- need to be made general purpose; this should have been completed by now -- SSK has got the code changes done; needs to be verified and released.
  - (e) availability of psr\_mon / pmon on nodes 53 and 54 for recorded data is there; for shm attach needs some work; this is still pending -- to be done along with (d) above.
  - (f) multi-subarray capability yet to be implemented (also to check about possibility of 4 beams)
  - (g) header for beam mode data : to be taken up in the present situation and incorporated alongwith the PA mode; to discuss further to see if it should be introduced at the time when sub-array is being tested -- pending.
- summary update for items (d) to (g) : das chain for more than 2K channels done; beam mode being tackled now; psr\_mon compiled on node54; need to go to pmon; multi-subarray needs a bit of careful prog in das code; header for beam mode to come after that.
- ==> for (d) freq chans can go up to 16k (need to test beyond that), will take some more work for flexible time integration; no update on (e); (f) and (g) to follow.
- (a) thru (c) require a bit more testing to close.

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

==> no updates.

==> Regular follow-up and status check in next meeting.

4.5 GPU corr (GWB-III) : next gen system -- from 17 Sep & before (SHR/SSK/GSJ/BAK) : New improvements needed for finalising the design for the full 32 ant, dual pol system : 4 new DELL machines are in the rack and wiring + cabling is complete, running with analog noise source; new code with 2 x 10 Gbe I/ + improved logic for assigning specific threads to each core + env variables is completed (tested for 200 MHz / 8 bits and 400 MHz / 4 bits, 16 inputs and working ok with no pkt loss); ongoing action items :

(i) improvements in GPU code using K20 card (SHR/SSK) : cross-check on FFT code (done and can be closed); calibrating MAC performance vs data reshuffle load (done and no further improvements look possible; can be closed); some changes in the overall stream organisation of the code to get better overlap between data transfer and computation and also less number of times that global memory is accessed inside the MAC -- shows ~25% improvement for 32k chan and 64 input mode. 16k channels is 20% and much less for 8k channels. pending action items :

(a) looking at XGPU code (with Pradeep & Vinay of nvidia) -- there is some progress in these efforts -- XPGU work is showing ~20% improvement; one more round of testing with variable gulp size did not show noticeable benefit; new aspects are being looked at by the joint team as part of further work on optimisation; summary of the results from discussion with Vinay taken up; may help to upgrade to 6.0; also R2C vs C2C may need to be looked into a bit closer.

(b) trying sample PA beamformer code to estimate load etc. -- will come when PA beam mode is released in GWB-III -- to confirm that load is less than 7% for both beams? old estimates are for C2050, ratio may change on K20 -- fraction of time for beamforming is 6% for K20 -- to check after the latest corrections in PA code; waiting for timing tests to be done on GWB-II; to discuss further plans, including taking up with nvidia for optimisation.

(c) from all the tests done so far with nvidia, it looks like the full correlation job will not fit in 16 GPUs (though a couple of optimisations that can be tried are still pending); hence, 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 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.

==> for (a) can take up for detailed discussion in Friday meeting with nvidia; for (b) the load is ranging from 4% to 11% (of real-time) for total intensity and full polar over 200 and 400 MHz mode -- a few details need to be understood. 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); (c) is still pending.

(ii) other improvements in code :

(a) issue of net\_sign[] flipping (LSB/USB modes of correlator) to be resolved : needs some change in GPU & DAS code; for GWB-II, it was agreed to not fix this problem in GWB code, and a patch was provided for LTA files -- this has been done and tested ok; to fix the code ab initio in GWB-III; pending for now.

(b) long-term items like provision for control of FPGA and other peripherals (like sig generator) for different modes -- details of existing provisions to be discussed and plans for final configuration to be finalised: 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; existing proposed option is fine and 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).

==> no updates on this.

(iii) to start testing 400 MHz BW mode -- how best to conduct these tests? the hardware (nodes + FPGA boards, i/o wiring, power cabling etc are all ready; changes in the main code to handle 4 bits etc have been done (?), but some pending tasks were there : 2 x 10 Gbe has to be integrated with the correlator code; proper delay

correction for 4-bit mode needs some changes; also choice of which 4 bits to use needs to be decided -- right now it is set for 4 MSbits; handling of 4 bits in main code is now completed; 2x10 Gbe integration with correlator code also done; delay correction 4-bit mode under test; all the above are tested with noise generator i/p; 16 input 400 MHz 4bit just fits (no room beamformer!); tested with pseudo DAS interface, using 3 host machines; need some software updates in DAS chain to handle more than 2048 channels; to start planning for interfacing with real online system and see where the bottle-necks may be;

agreed to start porting improvements from the optimisation work with nvidia into the GWB III code from next week onwards; meanwhile, one test run with real online can be tried to see if there are any stumbling blocks.

agreed to test with the real online; also agreed to hold work on beam modes for GWB III till final optimisation of FX on K20 is established.

still some issues to be resolved for running with real online e.g. information transfer at init das level.

==> first round of tests has been done -- system works for 200 and 360 MHz, but there are some artefacts in the visibility data that need to be checked with a repeat test (and then debugged as needed).

(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) 3 nos of half-height racks are made ready for immediate use for GWB-III -- two nos are populated with the 4 new nodes each, the other has 8 Roach boards; clk and input cabling to be finalised (need current status); host nodes to be kept separately; the final configuration should be ready for test soon. check status of these items.

(b) For the 2 President racks : first one is being modified 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 status of this.

2nd rack being modified for trying an 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.

==> no updates.

(v) purchase of 4 new host machines for GWB III : to decide configuration of host machines (disk i/o to be kept in mind) within next few days; also to check if SSD is a viable option now for recording of data. Investigaiton shows that SSD vs SATA has pros and cons; it may be possible that one class of server may be there that supports both; to check if we can shorten this process by choosing basic server that meets the requirements using SATA disks -- to confirm final choice of units being ordered and status of the procurement : 4 nos of T620s (2 nos have 16 TB and 2 nos have 4 TB disks); all the 4 machines have come; 2 are with 16 TB with and 2 with 4 TB -- compute vs host; PERC card issue needs to be resolved; one K20 on each machine can be there for some time; to check current status.

To start thinking about the next phase and how many compute machines we should buy.

==> some updates from DELL, but not yet satisfactory. need a way to follow-up. need to complete the CentOS installation and then they can be integrated into GWBIII.

==> To check status on all items after 2 weeks.

4.6 Procurement of accessories and other hardware required for GWB systems -- from

17 Sep and before (BAK/GSJ) :

(i) procurement of accessories like network cards, disks, cables etc to be looked into -- 20 nos of CX4 based dual 10 Gbe cards to be purchased -- these are compatible with T620, may give some trouble with R720 (for 2 GPUs). indent submitted and only party quoted -- in last stages of clearance for placing the order; 20 nos of CX4 cards have come and being 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 -- first draft circulated by GSJ. Agreed to relook at the spares requirement without counting the units already being used in the existing systems and buy more if needed; issue is coupled with what we want to do with existing packetised corr unit -- agreed to leave the PoCo and pkt corr in place and get enough peripherals to meet the requirements; spares list needs to be updated and fresh orders to be done. ==> update had been sent by GSJ long time ago; to raise indent accordingly. to check about procurement of more rack(s).

(ii) new purchase of Roach boards etc : 12 nos of Roach1 + 16 ADCs and 4 nos of Roach2 have come; test bench for Roach1 board is getting ready; need discussion about plans for testing of Roach2. Roach1 test set-up ok; 10 boards cleared, 2 are not booting over network -- work ongoing to test; for Roach2 : need to check if we need to buy add-on mezzanine card; also software environment needs to be upgraded -- this is ongoing; had agreed to check the standard procedure for Roach-2 testing on casper and check what peripheral items are needed; also Matlab-Simulink upgrade is ongoing (to get status of that) and for Xilinx software it needs to be initiated. all 12 Roach1 boards are now working and 16 ADCs also tested; for Roach2 : mezzanine card needs to be initiated; Matlab-Simulink is on order; Xilinx upgrade needs to be looked at; for Roach2 can be seen on USB port using Ubuntu -- basic tests can be done; need to fix the compile tools for Roach2 (ver of Matlab-Simulink and Xilinx); mezzanine card to be ordered; to take one of the existing PCs and adapt it for Roach2. Need status update. ==> mezzanine cards for SFP and CX4 budgetary quotes asked for, but no reply so far. new Xilinx software has been downloaded -- needs to be installed on a machine.

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

4.7 Testing leakage, coupling and correlated noise in new back-end chain -- from 17 Sep & before (BAK/YG/++) : detailed tests had been done by Vikram Jaiswal (with SSK, SHR and YG) and report has been circulated; follow-up action item discussed between SCC, BAK & YG : for GAB systems, some follow-up action for testing the leakage has been initiated; need a more detailed discussion for actions for the GWB FPGA & GPU subsystem; procedure for testing to be done with GWB-II release modes to be clarified and tried out -- checking to see if earlier results can be reproduced -- working as expected; plus some new tests showing a few other things -- to be checked and taken up for discussion; new tests show significantly different results for cross-coupling for GAB+GWB; this needs to be understood better -- confirmed that these tests used sig gen LO, whereas earlier tests used synth LO; maybe separate tests for the analog system can be done -- these have been carried out now, and results can be discussed; new report has been circulated that also shows 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; sky test with north pole and noise at input to GAB have been done; need to be interpreted carefully, in comparison with the earlier results; also to complete the test with noise at ADC input; check status of this.

email update form SCC : 2nd round of tests done about 2 weeks ago, show leakage of 2-4% (consistent with first round of measurements of 1-3%) -- YG to discuss with SCC about the range of tests and 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. To take up for follow-up after 2 weeks.

4.8 Walsh modulation : prototype set-up on Roach board -- from 17 Sep & 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 main 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; to generate final plot showing this behaviour (done?); to aim for a robust algorithm for hunting for the peak and detecting; 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 Roach2 : ok, as very few slices are needed; issue of accuracy of the oscillator being used in the Walsh generator; what about synchronisation of starting?; Identified 3 possible action areas for work:

(i) to complete the Walsh modulate and demodulate set-up in the lab -- almost ready.

(ii) to optimise the hunting algorithm;

(iii) to demonstrate cancellation of unwanted signals in ADC card and/or GAB

Some mismatch between the CPLD waveform and FPGA waveform for the Walsh signal; now resolved and all FPGA generated waveforms (which use the CPLD logic; different from the original EPROM scheme) are matching. Now 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 ! A few different aspects of this discussed; SCC to try out and report the progress.

SCC is finalising the block that will allow max delay of 500 msec (for 128x4 msec Walsh length) with a resolution of 5 nsec (FPGA clock); to check if this is working now and tested ? delay block ready and under test to resolve some issue related to start-up offsets.

==> fractional delay is still giving some problems and needs a bit more debugging. To check status after 2 weeks.

## 5. Other items :

5.1 New python assembly design -- from 17 Sep (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; agreed that it is now time for a joint inspection at C4 -- check status.

==> mech group to do the inspection and circulate the report for comments and inputs.

(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 have been received; will be doing test on quadripod behind lab building during MTAC period -- need status update.

==> 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.

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

5.2 Problem of access to FE boxes with 500-1000 CDF feed -- from 17 Sep & 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;

quick status update from mech group, with detailed follow-up later on. Action

items agreed upon : first to check with new heavier box and see if existing solution

is practical; if not, then to work on new option; meanwhile, a few alternative

options are being 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; may need inspection (in Bangalore) in

early/mid November; party is visiting this week for other jobs; check status of this.

==> work is on track by the party; inspection likely in early November (HSK + one).

Follow-up after 2 weeks.

5.3 Fabrication of 6 spare L-band feeds -- from 17 Sep & before (SSK/HSK) :

Order to Akvira for 3 nos (with enclosure) + 2 extra horns. Hence, total of 6 feeds

will be ready + 1 dis-assembled unit + 1 old feed at Pune -- so total of 8 spare

feeds will become available.

Feeds inspected at Akvira site - many corrections / suggestions for improvements

have been made [e.g. improved probe mount : press-fit vs. screws; M4 -> M5; etc];

delivery expected (after these modifications) by end-March'14; one assembly made

ready at NCRA w'shop and sent to GMRT last week; 3 sets have been delivered at GMRT;

fabrication of 3 enclosures is under process; and procurment of 3 enclosures is in

progress; 3 new feeds after powder coating had come to GMRT; there was some issue about

the thickness of the plate used for mounting connectors and some in-situ modifications

have been done on one of them and it is found working ok; pending clearance for the

other two; and decision needs to be taken for the 3 new ones not yet delivered --

these are complete and ready with the vendor, except for the finalisation of the

above plate. The enclosures have been received -- will be shifted after inspection

is done; work on conversion to press fit type from screw type is being looked into;

probe with press type and screw type deliver to FE group for further tests;

for feed #32 -- see above; for feed #33 : combination of mechanical units

with threaded probe has been made ready; for numbers 34 & 35, will try for threaded

units, with push-pull probe (3 sets will be made available by w'shop) as a fall-back

option; box has to be made ready for #33 (and then for #34 & #35) with matching

plates -- there are some unit to unit variations that require specialised attention;

for #34 and #35 horn and OMT are being corrected to exact specs and will be fitted

with the probes and will be sent to GMRT by next week. Need status update.

==> for #32, status is as updated earlier; for #33, same status except plates are

going for chrome plating; for #34 and #35, mech work is over for the OMT and horn

and waiting for inspection; for #34 plates are also gone; box/cover ready for #s32-35

and ready to ship; 3 sets each of push-pull and threaded type probes has been made

and delivered (some confusion exists about exact number received by FE team). To check status after 2 weeks.

5.4 Improved software for work requests -- from 17 Sep 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? Aagreed to try and get this done in-house with Joardar -- can be taken up after completion of ongoing tasks related to electrical -- to confirm plans and status : work not started yet; needs a discussion with Joardar -- it should be possible to take up the job now, as electrical task is over; to check if this is underway now -- work ongoing, basic structure ready, first version could be available shortly; work in progress, but there may be some issues -- YG to check. ==> may need one month for completion -- beginning of Nov. meanwhile, old software has also started working (to check with Mangesh about what fixed it); hence urgency is not very high. Check status after 2 weeks.

5.5 Status of new CSIRO feeds : from 17 Sep & 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) -- to decide follow-up action.

recently it has been 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; follow-up after 2 weeks.

==> no new updates. Check status after 2 weeks.

extra items :

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.

==> put formally on the agenda 2 weeks from now.

automated scheme for moving the feed adjustment stool? agreed to try a short feasibility study by HSK.

-==> put formally on the agenda 2 weeks from now.

=====



## Minutes for weekly Plan meet of 29 Oct 2014

### 1. FE & OF related :

1.1 Detailed design doc / ITR -- pending for long : from 8 Oct & before (SSK/BAK) :

(i) OF Rx system to be completed (Satish Lokhande) : first version has been circulated -- some improvements and additions suggested (e.g. 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.

ORx was discussed last week and some suggestions for changes were made -- updated version to be produced shortly.

==> still pending.

(ii) OF Tx started; first draft is ready and should have been circulated by now. for both, docs are with SSK waiting to be cleared and circulated for comments.

Note : the Tx design doc may have only blk diags for now, without full details, till a paper is ready (!); need status update to see why it is stuck !

still pending for SSK to complete the integration !!

==> initial write-up (by Satish) needs improvement; functional blk diagram has been made and detailed description needs to be added. work in progress; can check status of both items after 2 weeks.

1.2 Update on results from test range -- pending from 8 Oct & before (HRB/GSS/SSK) : Reorganised into the following issues :

(i) status of the test range : set-up was re-installed after better protection circuit for encoder against lightning (home made surge protector using 30 V transobs), including better grounding scheme, improved corrosion protection (including better water proofing); improvements in water-proofing have been done (including refixing of gaskets that were giving problem); limit switch functioning also resolved; new measurements should have started -- to confirm status and see if item can be closed.

==> all issues resolved and unit is working fine; first round of measurements have been done; item can be closed.

(ii) calculation (based on reference paper) of the expected deflection & comparison with measurements to check if there is significant loss of sensitivity -- GSS to develop refined version more relevant for GMRT, and to see 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 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 -- waiting for some of the lightning protection work to be completed, to get measured values from test range;

was waiting for test range to be working -- to check if started now.

==> 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; to wait for more detailed analysis results to be available.

(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. 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 (likely 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 C-program can be made to run to give some initial cross-checks. code had been ported from C to Matlab but results are not yet matching with expected behaviour and debugging is going on. ==> issue not yet resolved.

(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; waiting for test range to be working. ==> 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).

1.3 Comparison of measured & expected sensitivity curves -- from 8 Oct (SSK/GP/HRB): scheme for (re)calculation of expected values across the broad bands to be finalised (and added to measured curves) : curves now being done with constant QH value and with variation of T\_lna with freq incorporated; model for the main BPF has also been put in : the deflection peak now matches fairly well across the band, but the curve rise and fall at the edges of the band was not quite matching; follow-up action to be discussed (mostly for 250-500 band) :

(i) Antenna efficiency factor : GSS has sent a table at 5 MHz steps to GP, it appears that the table has only 4-5 points across the band (from measurement values); GP has done interpolation & has got a curve that falls off with increasing frequency, but has kept the efficiency constant below 250 -- this needs to be understood & resolved; final curves for 250-500 still appear to show a bit of mismatch at the edges of the band. GP has taken RL curve and is incorporating in the code. Adding RL effect as an efficiency factor does show different cut-off (a bit earlier

than the BPF) and it matches better with the data. Couple of secondary items: to check if all antenna data matches with the new curve; also to check why theoretical curve gives less deflection than measured for some antennas.

==> this may not be worth chasing in too much detail.

(ii) It appears that the discrepancy on the high freq side is not really significant (seen only for a couple of antennas out of 10) -- TBC; could be due to absence / presence of 540 notch filter ?; agreed to check the HF part while comparing with data.

==> Ankur to check both LF and HF side and then topic can be closed.

(iii) possibility to try it for Lband to be explored -- information gathered has 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 the actual measurements.

==> Sanjit to do the comparison and produce the plots and then issue of RL can be taken up.

1.4 Phase centre tests for 250-500 CDF -- from 8 Oct and before (HRB/GSS): to report on expt with 10 to 20 cm height change in 250-500 feed on one antenna to see how much change in sensitivity is seen.

Tests done on c6 with feed having 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. See also 2.1(ii)(c) below. 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; agreed that FE team to go over all the available measurements and produce a consolidated summary to check if 1180 or 1280 gives the best result; confirmed that adjustable stool will not work for the current 325 MHz face due to welded nature of existing stool -- need a discussion with HSK about this; also confirmed that we can't go below 1080 by further cutting the support legs of the cone; agreed with HSK to reproduce one more adjustable stool (in about 2 weeks time) 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 move to some other antenna (C0?) -- to check plans and status.

==> agreed to go back to C8 at a later point of time (after 550-900 measurements are completed);

1.5 Total power detector for FE & common boxes -- from 8 Oct & 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;

Current action items being followed :

(i) automated script for running the observations : there was a bug in the script that caused problem for FE box data (common box data was ok) -- now fixed by JPK and new data taken on 16th Sep -- being analysed. To wait till this data has been verified before closing the matter of the SOP and testing / data acquisition procedure : looks ok except for testing for other than subarray 4 -- tbc, and then matter can be closed. ==> test yet to be done; GP to do the basic test of on-off power deflection for antenna in 2 different sub-arrays, one at a time.

(ii) 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 -- 1 s time constant requires very large capacitor; few microfarad may be more practical, pushing the time constant to ~ msec. GP to check and report about the largest practical value of capacitor. ==> work not yet done; GP to look into it.

(iii) 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 monitored, but working CB monitor is only on C13, E2 & W4 -- 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);

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.

==> in CB system, W1 is also now working; FE list is the same as before; number of data sets (on different dates) is more than 3-4 epochs; 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 (b) consistency between FE and CB (c) reasons for spurious behaviour

(iv) 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.

==> similar exercise needs to be done for temp detector.

(v) 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; will be tested on the new data set of 16th Sep and comparative analysis will be done and reported; script and software working ok; possibility of making a GUI tbc; otherwise task is complete and item can be closed.

==> agreed that it is generic but not tested for anything other than temp and pwr; does not have a user friendly interface; can think of GUI development with help from control room, after this is released for general use.

(vi) plans for building 70 units for CB : all PCBs and chassis are now in hand; need to decide plan and schedule for mass production and installation on upgraded antennas; agreed to work out an algorithm such that new units are 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 units coming down for repair; to check plans for mass production and installation for FE systems. for CB it is still status quo; for FE, 20 PCBs had been made and all are used up; new order for full quantity (~ 300 PCBs) has been placed; all 360 PCBs (with Techno Ckt) have come and assembly for 250-500 box (60 nos) being made ready; value of capacitor to be finalised.

==> 60 nos PCBs have been assembled; ~ 30 chassis in hand (more need to be ordered); 10 antennas for 250-500 will be populated, remaining 5 or so can be used for other places.

(vii) status of ITR, which was ongoing, but was halted pending above problems : agreed to resume the work now; need status update on this. "work in progress" i.e. yet to be started; will do so once the 3 data sets are analysed and compared.

==> to be taken up when the basic analysis above is completed.

1.6 Spares for L-band feeds -- from 8 Oct & before (SSK/ANR) : we have 32 feeds, 2 not working (1 dismantled for making drawings of new feed) due to electronics failures -- these are device failures (including some new ones?); now some LNAs have been successfully assembled by Gopi and C3,W1,E2 & E5 have been fitted with these and found working ok. Also, one spare feed has been assembled and installed on W1 and working fine. Current action items :

(i) to update about status of feed on W1 and see if this matter can be closed : not yet confirmed whether deflection is less than expected or not -- to cross-check with JPrakash about performance of W1 and report back; this is pending for long. VBB to be asked to sit with JPrakash and get the answer -- no updates ! Subsequent email update from VBB shows that W1 appears to be working ok for the past few months. To check other newly installed L-band spare feeds working ok or not, and then close this item.

==> C1 + one more antenna -- to get the details about the LNAs used in these.

(ii) spare LNAs : Agreed to have at least 5 LNAs ready and 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; LNA is being investigated (may need re-tuning?) -- no progress in understanding low deflection of new LNAs; retuning is not helping -- increasing the bias current leads to oscillation. To wait for new batch of devices and also check OMT etc for any problems. Devices from new batch used and appears to give a stable solution. To confirm if this does solve the problem -- 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? one unit fully assembled (all 3 stages) and working ok; 2nd unit under assembly -- will be used for 2 channels of feed #32. To check status of this.

==> status is same as above; Ramesh to try and tune for the 2nd channel (note that this is now the 1st spare feed after 30 working feeds !)..

(b) old PCBs not easy to use for replacing devices as coils get spoilt and need gold plated wire for which need to go back to the old party (only one new device was put in one of the 3 stages of the LNA and was found to draw the proper bias current); new stock of gold plated wire (30m) is now available (done with the same party); to check if this item can be closed.

==> this can be closed.

(c) meanwhile, using the earlier batch of devices, two LNAs have been made ready and this is going on C1 -- to check status of this : unit has gone on C1 with new LNA in both pols (after retuning) -- may be ok, but can't confirm till ripple and bad bandshape problem is solved.

==> not able to confirm; SSK to confirm alongwith earlier information.

(iii) check status of alternate LNA designs : to try and see if design used for 550-900 can be modified for 1-2 GHz use ; to also check the design done by Abhay Kulkarni -- ANR now looking into this design to see if it can be improved for our needs; design files had been obtained and were being checked by GP and ANR : model files to be converted to match simulator used by us; also ultralam2000 was used and that is not available in the market now; work is ongoing; component models in software had to be downloaded; agreed to simulate it with ultalam2000 and make sure that ckt works ok; and then concentrate only upto 2 GHz and change the substrate to RT 5870 which is easily available; initial simulations now matching with original results (for ultralam2000); results reproduced with RT 5870; now trying to tune the design to required specs of gain (30 vs 34), Tlna (~28 or better needed) and maybe at cost of reduced BW; process likely to converge. Need status update.

==> no fresh updates; target in NF terms is to go from ~ 0.4 to 0.3.

(iv) finalisation of plans for having total of 8 working spare feeds -- from mechanical to electronics :

30 antennas have working Lband feeds; 31st was assembled back after being dismantled for making the drawings -- this was completed and installed on W1 (#31 is now in the regular 'maintenance cycling' of feeds); 32nd is there in Pune wshop and can be shifted back after assembling by mech group and then fitted with the electronics; 3 new feeds were made in 1st round of work; all 3 are in Pune wshop and have been tested for RL with probes; but 2 of them have wrong size of horn and needs to be replaced; all 3 need new covers as old ones were not suitable (may be done in workshop, but not decided yet); in addition, 3 more feeds from Akvira have come : OMT + horn + cover ; also 2 horns have come and can be fitted in the 2 older feeds.

Hence, total of 8 spares can become available. Note that weight of 3 latest feeds is 18 kg more than earlier feeds (72 vs 61 kg) -- this has been accepted as 'fait accompli'. Following issues need to be resolved currently :

(a) status of feed #32 -- had been assembled by mech group at Pune and sent to GMRT, alongwith newly assembled press-fit probes, but cover was NOT there; OMT and feed had been assembled (newly fabricated push-type probes have been used); RL had been tested; new box/cover was ready and inspected and was to be shifted from Pune; final plates etc (for #32 + 2 more feeds) after chrome plating should have come and final assembly should have started for this feed. Need status update.

==> this feed is now ready except of LNA for one channel.

(b) plans for assembling and making completing additional new feeds : 3 feeds after powder coating have come to GMRT (3 others are ready for inspection in Pune); FE to target making ready one feed per month; however, new issue about mating and alignment of probe has cropped up -- press fit (old schme) vs threading (new scheme) mechanical problem -- agreed that we can go back to the old scheme of "push-pull" on one feed at Pune for checking and then retrofit all 6 units; meanwhile one new unit at GMRT can be checked for alignment; 3 sets of old (press-fit) probes being made -- almost ready to go for silver plating; one person from FE lab needed for soldering of these when assembling in the 3 feeds still at Pune; change of track again here as the first of the new feeds has been assembled with the new type of probe! see further details under item 5.x in mech.

==> 2 more feeds are mechanically ready (one has push-pull and other has threaded probes) and getting wired; LNA and filterbank not there.

(c) in terms of electronics, 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 (see below) -- appears that new design is going to be used. confirm status.

==> there is a 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.

1.7 Testing of LBand wideband systems on 30 antennas -- from 8 Oct (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; consolitated set of discussion items are as follows :

(i) 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;

(ii) 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 -- check with RFI team separately.

(iii) C2 has new OF system without attenuation control hence data is not good; this is now corrected and can be closed after a cross-check.

(iv) FE team to follow-up on the following :

(a) some antennas with poor deflection overall

(b) some antennas with deflection changing over the band -- less at high frequencies: to see if pointing offset can explain this -- tried (using 1390 band offsets), but

no improvements seen; may be happening for cases where the RF power level (at laser input) is too low ? -- needs to be confirmed with a more careful set of tests (and plots) for a few selected antennas (can make good ones made to look bad by increasing the OF attenuation);

(c) some antennas with poor on/off bandshapes

(d) few antennas with ripple or large slope across the band -- to be followed up.

==> no discussion; postponed till next round 2 weeks later.

1.8 Characterisation of recommended attenuator settings for different bands -- from 8 Oct (SSK/VBB/AP) :

(i) values had been given for Lband, 250-500, existing 610; only 130-260 / existing 150 was pending -- some tests are still being done to verify the values before releasing (for 150 / 130-260 systems); appears that number may be around 9,9 -- may converge soon; work has been completed; appears that 6,6 may be the best value; note to be circulated soon; then can be taken up for detailed discussion.

==> note yet to be sent; SSK to look into it.

(ii) also, need a discussion if values given to control room are optimal (e.g. 7,7 for Lband sub-bands) -- from tests done by YG and DVL, this appears to be too large? first, to confirm if it is 10,10 and 4,4 for full-band and sub-band; second, to redo tests again and confirm present status and then decide about discussion on this topic. DVL repeated the tests and results are : appears that 4,4 is fine and upto 7,7 may be ok; but higher than that may give some problems; may be worth settling on 4,4 for the default; agreed to try for full band also and report back the recommended value. ==> to remind DVL about the summary of the tests and results, and also to check the full band values.

(iii) 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; still pending, but can be done now, as Lband is relatively stable now; this has been done by Ankur in a report back in July -- this was 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 the report to be produced with these modifications -- measurements are pending; 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 --

(iv) also, at 1390 some antennas have an extra 10 dB gain stage; appears that there are only 2-3 antennas which don't have this modification?; one of them is S6 which is being done now; 1 or 2 others may be there -- needs to be confirmed; meanwhile, APK's notebook has been found and shows that ONLY 12 antennas have 10 dB stage; but VBB thinks that more have it... finally, agreed to do in-situ band shape measurements for all 30 antennas to infer if 10 dB stage is present or not -- for those with broadband link, it can be done in rx room; VBB is looking into this; measurements have been done, appears that only 4 antennas may be without the modification -- VBB will send a summary, alongwith the evidence shortly. summary sent by VBB discussed : the conclusion is not clear; needs a proper comparison of the bandshapes for full band and subbands.

==> comparison of bandshapes for different sub-bands has been done and it is clear to see 10 dB extra step there; final list : 4 antennas (C11, C13, W3 & E3) don't have



the 10 dB stage -- this can be checked in user data; finally, agreed that this can be corrected whenever these FE units come down for any maintenance work.

1.9 Filters at different stages of receiver -- from 8 Sep & 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; a third 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; changes 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 -- device is to be procured; order has been placed; delivery date not clear.

==> delivery expected in another 15 days; will be used in the final 30:1 monitoring 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. To check status of this.

==> work still ongoing.

1.10 Finalisation of PCBs & chassis for various notch filters -- from 8 Oct (SSK/ANR):

Different kinds of filters with different PCBs (some common) and different chassis (again, some are common) are needed. Further, various filters are in varying stages of acceptance and mass production. To keep track of matters globally, agreed that FE team to produce a spreadsheet giving details of all the notch filters presently being used, alongwith the type of PCB, total # required, total # available (and where used at present), and plans for procurement; and similar columns for chassis; first version of the spreadsheet had been done, and some feedback had been given; updated version of spreadsheet discussed; agreed to move 2 columns to the front of the table; and add one column of comments at the end, and circulate the updated table; to check status of this.

==> updated spreadsheet has been circulated and the format looks ok now; to be used for internal tracking of the progress; matter can be closed.

1.11 Follow-up on 550-900 MHz band filters -- from 8 Sep & 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; current status and action items :

(i) to review the cost estimates for mass production in preparation for final decision : updated estimates : 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) has been ordered (2 nos) to workshop, on lower priority; agree to wait till chassis comes and final layout for the new FE box is decided before going for mass production; PCB material is in hand; switches needed are in hand; so may not be a major problem for mass production; 2 nos of chassis received and integrated filter unit made and tested ok; now to wait till layout of FE box is taken up.

==> no real action item here; waiting for first version of new FE box.

1.12 Finalisation of 550-900 FE box -- from 8 Oct (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. Can defer to month later or so.

1.13 New filters for Lband -- from 8 Oct, 17 Sep & 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. Current action items are as follows :

(i) to finalise the GSG note : ANR has sent the modified version after first round of feedback from YG; will be circulated for approval in coming GSG meeting.

==> pending with YG.

(ii) new BPF + mobile notch filter to replace existing filters in FE box; LPF to be put in common path (CB or antenna base?) -- confirmed that LPF will be at antenna base as a common facility for all bands; agreed; waiting for GSG clearance.

==> pending for GSG clearance; meanwhile 10 units of 1650 LPF have been fabricated out of 40 PCBs available.

(iii) plans for implementation : to do it as a case-by-case replacement job; PCBs (stripline) does not need much work for assembly -- can be given for manufacture; new chassis will be needed; population can be done as and when a FE box comes down. 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) -- see also Ankur's spreadsheet; can start on Lband, once the formal go-ahead comes.

==> ready to start once GSG clearance is there.

(iv) sub-band filters can be taken up at even lower priority later on (still at simulation design level); given some of the problems with the existing Lband filters, agreed to start assembling these as the new filters, using the existing switch unit -- new layout has to be made, sample unit has to be ordered, and then decide about mass production; need a status update.

==> see above for problem related to 4:1 switch : new PCB with different (Hitite) switch being tried; will take about 2 weeks to make design ready for sending for PCB fabrication.

1.14 OF systems -- from 8 Oct & before (SSK/PAR) : Plans for further systems : 17 antennas installed : C4, C6,C8, C9, C10, C11, C13, E2, E6, W1, W4,W6, S2,S4,S6, C12 & C14. Next, C01 done as the 18th antenna by 3rd week of April. C2 became the 19th antenna -- completed (after some delay for M&C for attenuation settings control); next antenna taken up (20th) was C0 -- check if completed; next antenna : C3 ?

==> C3 will be done by mid-Nov.

## 2. RFI related matters :

2.1 RFI tests of ethernet switches for antenna base & GAB -- from 8 Oct & 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; to confirm if any changes are needed or not and accordingly finalise the report -- PAR to check existing document and see if any parts need to be updated or not and circulate a final report (by end-Sep). first version of updated report circulated; may need one more revision. To take up for discussion.

2.2 Follow-up on UPS RFI -- from 8 Oct & 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 items:

(i) to finalise plans for going with 3 kVA unit from Ador as the final choice : can we order 10 nos of these as a starting option? RVS has received budgetary quote; need one more confirmation at C10 about the current drawn by servo to fix the split at o/p of the UPS (total cost per antenna may turn out to be around 2.x lakhs) -- to check current status of relevant items; servo current issue was resolved; to check status of order for 10 nos of 3 kVA units from Ador -- indent had been raised; was waiting for formal quote from vendor. Need current status.

2.3 Discussion relating to Industrial RFI survey -- from 8 Oct & 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!); follow-up actions identified :

(i) 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); to cross-check the list against the ones which have NOC (nothing much can be done for those operating without NOC, except to add to our database and inform them about informing us for changes) -- this is happening now. database for Junnar + Ambegaon was ready; remaining data entry has been completed. To confirm this same and see if this item can be closed.

(ii) follow-up from the survey with DIC : meeting took place on 30th Sep 2014.

Summary items are 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. Issuing of NOC to the old units which are working in the GMRT identified zones with guidelines from the GMRT.
- d. 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 (?)

(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; need status update.

(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.

### 3. Operations :

3.1 Identification and procurement of appropriate ethernet switches for antenna base (and GAB) -- from 8 Oct & before (SN/PAR/BAK) : Ops group to work with Comp team and RFI group to work out scheme for getting appropriate 24 port switches for antenna base use (2-layers, manageable); CISCO make was finalised after the detailed RFI testing was over (see item in 2.x); current action items :

(i) to finalise plans for procurement of CISCO switch : 3 more such switches (in addition to the 1st sample unit) are in hand (total of 4); agreed to by 32 more in one bulk order (may be 10 k each) -- quotes received; folder under process. Need status update.

==> folder in final stage of approval.

3.2 New, improved Miltech PC -- from 8 Oct 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. Need status update.

==> no update, will know by next week.

3.3 Planning for proper UPS & space utilisation for new equipment at antenna base -- from 8 Oct & 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.

Current action items :

New, updated report has been produced. 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) there was an issue raised about extra current requirement for servo due to

(a) stow on UPS? (b) core losses in the xmer

Agreed in discussion with servo (S. Sabhapathy) that stow on UPS is not required at all as it does not make any sense; also core losses in existing servo isolation transformer (in control electronics) is not an issue. Agreed that 1kVA isolated UPS supply is sufficient for servo. This matter can be CLOSED NOW !

(ii) ordering of 10 nos of UPS; budgetary quote has been received; indent to be placed shortly (se earlier agenda item). was waiting for formal quote from vendor -- to check the status of this.

==> no updates; need inputs from RVS.

(iii) a closer to 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) -- awaiting response.

meanwhile, discussion with BLDC supplier : now ok to gnd the neutral of the main 3ph transformer; extra emi filter may be required -- RVS is looking into this; only one set of line-filters will be required.

extra EMI filter confirmed to be about Rs 10000 per antenna. RVS to come up with the final wiring diagram based on all this information and circulate to all concerned.

==> no updates; need inputs from RVS.

(iv) 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. RVS to circulate an email about the updates and asking for comments, if any, before finalising the plans for all antennas.

==> no updates; to check with RVS about the status of the activities.

3.4 Plans for populating antennas with Rabbit card (with or without PC) for testing -- from 20 Aug and before (CPK/JPK/RU/SN) : The aim is to have 6 antennas with Rabbit card (to be kept on only during test time !), with ethernet connections to a multi-port switch in Rx room, with one connection to the lab. After many twists and turns, current situation is as follows : Due to restriction of having systems on during test times only, the list was modified to C1,C4,C13,C9 & C10; for the PoC tests & improvements, C8 & C12 will be used. C13 replaced with C6; all else remains the same. installed MCMs are communicating ok with online v2. C6 has 2 Rabbit cards for sentinel and OF, and tests have been done for 1 and 2 card configuration -- to confirm both work ok : this has ben done now; cisco layer-3 s/w to be put in x3 Ae with muplitle (> 2) MCMs.

Latest status : C1, C4, C6, C9 & C10 have Rabbit cards (in switched off condition); C12 has some PC hardware. Any new updates?

==> no new updates except for tests done during MTAC.

#### 4. Back-ends :

##### 4.1 Documenations :

(i) Detailed design doc -- from 8 Oct & before (BAK) : analog back-end was being done by Hande : 2nd version had been circulated in April. Next level of document going down to chassis level is to be made ready -- chassis level doc will take about 2 months; can be deferred till end Oct; to check status & progress in early Oct. ==> deferred till end of Nov.

(ii) ITRs for analog back-end systems and digital systems to be taken up : analog back-end : Sandeep and Navnath to look into; pkt corr first level has been done and circulated -- waiting for feedback; GWB first version (by Reddy + Irappa) has also been circulated; authors are working on a second version with additions -- this should have been circulated by now; need to discuss contents and decide follow-up action. Modified version has been circulated; to discuss and finalise next step; ITR issue can be closed now; some discussion to try to move to a point where a publication can be done -- this needs to be followed up appropriately within the team and a summary plan brought up for discussion; check status of this. ==> to be taken up for discussion tomorrow (30th).

4.2 : Power supply for GAB : from 8 Oct and before (NDS/BAK) : Two options are possible : linear vs SMPS. Agreed to produce comparison note with all pros & cons. Meanwhle, a few SMPS units can be bought, as the cost is very small. Still watiing 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; can wait for ~ 1 month and revisit the matter; now due for a discusison.

==> shielded box has been designed for the SMPS by RFI team and is in final stages of testing and improvements; can take up discussion after the results are available; maybe one month later.

4.3 Power equalisation schemes for new back-ends -- from 8 Oct 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. Agreed to check this further and try to identify which element may be responsible for the spread (~ 4-5 dB). Need status update.

==> 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.

(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; need status update.

==> to look at the results from 27th Sep email and come back for a discussion next time

(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.

==> YG to look at the document.

(c) SRoy to test the recently added feature of saving attenuation values to file.

SRoy has checked with Nilesh (ok) and will check himself later on; Status?



==> SRoy to complete the action item by next discussion.

(d) 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.

(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.

==> median calculations not yet done; first looking at ring buffer issues (may club both together)

(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.

4.4 GPU corr (GWB-II) : release of 4 node, 8 input, 200/250/400 MHz version -- from 21 Oct & before (SHR/SSK/BAK/DVL/YG) : (NOTE : GWB-I is existing released system !) : agreed to make 4 T7500 nodes with C2050/C2075 Fermi GPUs + remaining 4 T7500 nodes as host machines (to take care that these are the ones that transient pipeline uses presently so that sharing is possible); this should have ALL basic modes : total intensity and full polar IFR modes; IA + PA BFR modes with process\_psr pipeline attached; full GUI support; to come up in trial code section without affecting the presently released mode. Action items :

(i) testing of GWB-II interferometry mode with different OF attenuation values to check variation of correlation coefficient -- DVL + YG to provide an update. It looks like working ok now, with the sig gen LO. To confirm if working ok with the new, modified synthesiser mode; results from sig-gen versus syntheziser have been found to be consistent at 1280 MHz (marginally better than GSB); however, 1390 syntheziser scheme needs to be confirmed; it looks like that this may be resolved now (maybe due to setting problem, when it defaults to 10 MHz reference)? but some problems noticed with other sub-bands of L-band) -- needs some clear follow-up, including combined testing of attenuator levels -- DVL to organise these tests; some updates from DVL's email last week : 1170 appears to be OK; need to complete the checks for 1280 and 1390 subbands and clear the matter. DVL to test and report back the status; updated results from all 4 sub-bands of Lband appear to show that the corrln coefficient values are in the same range for both choices of LO scheme. YG to check with DVL about the report and then close the matter.

==> same status as before.

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

==> SOP has been updated; waiting for it to be circulated; report also under preparation.

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

(a) there appears to be a problem in the PA mode : integrator & square law detector are in opposite order -- SHR has fixed and last set of tests remain to be done before releasing. YG & SG have carried out some tests; first order tests indicate ok; but need a bit more checking; load estimate still pending, but since extra kernel is not used, may not be an issue.

==> load estimates for GWB-II not important and this item can be closed if sufficient testing has been done.

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

==>

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

==>

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

==> discussion to happen this week.

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

==> needs a discussion.

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

==> no updates.

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

==> no updates.

(iv) spikes in channels that are power of 2 : this problem needs to be discussed, understood and fixed. SHR has started looking at it, but no clear clues yet. may help with test using digital noise source; effect is seen in packetised corr also; now checking offline with raw voltage data acquired through Roach board, and with digital noise generated on Roach board; KDB has digital noise source + GWB spectra now running and some of the issues can be investigated; testing with noise generated in digital domain does not appear to show the problem. not clear what is the best thing to do now. SHR believes it is in ADC, but need a bit more thinking... a different ADC in the same slot or something else? some tests to be tried for one of four output of ADC? trying to see 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.

#### 4.5 GPU corr (GWB-III) : next gen system -- from 8 Oct & before (SHR/SSK/GSJ/BAK) :

New improvements needed for finalising the design for the full 32 ant, dual pol system : 4 new DELL machines are in the rack and wiring + cabling is complete, running with analog noise source; new code with 2 x 10 Gbe I/ + improved logic for assigning specific threads to each core + env variables is completed (tested for 200 MHz / 8 bits and 400 MHz / 4 bits, 16 inputs and working ok with no pkt loss); ongoing action items :

(i) improvements in GPU code using K20 card (SHR/SSK) : cross-check on FFT code (done and can be closed); calibrating MAC performance vs data reshuffle load (done and no further improvements look possible; can be closed); some changes in the overall stream organisation of the code to get better overlap between data transfer and computation and also less number of times that global memory is accessed inside the MAC -- shows ~25% improvement for 32k chan and 64 input mode. 16k channels is 20% and much less for 8k channels. pending action items :

(a) looking at XGPU code (with Pradeep & Vinay of nvidia) -- there is some progress in these efforts -- XPGU work is showing ~20% improvement; one more round of testing with variable gulp size did not show noticeable benefit; new aspects are being looked at by the joint team as part of further work on optimisation; summary of the results from discussion with Vinay taken up; may help to upgrade to 6.0; also R2C vs C2C may need to be looked into a bit closer.

==> further discussions with nvidia to continue; incorporation of these improvements to happen later on.

(b) trying sample PA beamformer code to estimate load etc. -- will come when PA beam mode is released in GWB-III -- to confirm that load is less than 7% for both beams? old estimates are for C2050, ratio may change on K20 -- fraction of time for beamforming is 6% for K20 -- to check after the latest corrections in PA code; waiting for timing tests to be done on GWB-II;

the load is ranging from 4% to 11% (of real-time) for total intensity and full polar over 200 and 400 MHz mode -- a few details need to be understood. 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);

==> no specific action item, except to ensure that all bfr modes are activated in GWB-III.

(c) from all the tests done so far with nvidia, it looks like the full correlation job will not fit in 16 GPUs (though a couple of optimisations that can be tried are still pending); hence, 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 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.

==> no new action item here till GWB-III is released.

(ii) other improvements in code :

(a) issue of net\_sign[] flipping (LSB/USB modes of correlator) to be resolved : needs some change in GPU & DAS code; for GWB-II, it was agreed to not fix this problem in GWB code, and a patch was provided for LTA files -- this has been done and tested ok; to fix the code ab initio in GWB-III; pending for now.

==> discussion needed for this to be implemented in GWB-III.

(b) long-term items like provision for control of FPGA and other peripherals (like sig generator) for different modes -- details of existing provisions to be discussed and plans for final configuration to be finalised: 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; existing proposed option is fine and 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.

(iii) to start testing 400 MHz BW mode -- how best to conduct these tests? the hardware (nodes + FPGA boards, i/o wiring, power cabling etc are all ready; changes in the main code to handle 4 bits etc have been done (?), but some pending tasks were there : 2 x 10 Gbe has to be integrated with the correlator code; proper delay correction for 4-bit mode needs some changes; also choice of which 4 bits to use needs to be decided -- right now it is set for 4 MSbits; handling of 4 bits in main code is now completed; 2x10 Gbe integration with correlator code also done; delay correction 4-bit mode under test; all the above are tested with noise generator i/p; 16 input 400 MHz 4bit just fits (no room beamformer!); tested with pseudo DAS interface, using 3 host machines; need some software updates in DAS chain to handle more than 2048 channels; to start planning for interfacing with real online system and see where the bottle-necks may be;

agreed to start porting improvements from the optimisation work with nvidia into the GWB III code from next week onwards; meanwhile, one test run with real online can be tried to see if there are any stumbling blocks.

agreed to test with the real online; also agreed to hold work on beam modes for GWB III till final optimisation of FX on K20 is established.

still some issues to be resolved for running with real online e.g. information transfer at init das level.

first round of tests has been done -- system works for 200 and 360 MHz, but there are some artefacts in the visibility data that need to be checked with a repeat test (and then debugged as needed). Need status update.

==> bugs related to phase shifting, integer delay correction and time stamp have been fixed and tests are being done; also right now tests are done with command line interface -- needs to move to GUI interface -- can be done in a week's time.

(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) 3 nos of half-height racks are made ready for immediate use for GWB-III -- two nos are populated with the 4 new nodes each, the other has 8 Roach boards; clk and input cabling to be finalised (need current status); host nodes to be kept separately; the final configuration should be ready for test soon. check status of these items.

==> agreed to replace the "instrument rack" with another rack that allows 3 host machines + instruments to be accommodated; then 2 original racks for 8 compute nodes and one original rack for Roach boards and switch.

(b) For the 2 President racks : first one is being modified 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 status of this.

2nd rack being modified for trying an 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.

==> GSB matters to be finalised; 2nd rack still being used for heating and loading tests : tests done so far appear to show that there is about factor of 2 discrepancy in estimated CFM rate and AC plant capacity CFM rate.

(v) purchase of 4 new host machines for GWB III : to decide configuration of host machines (disk i/o to be kept in mind) within next few days; also to check if SSD is a viable option now for recording of data. Investigaiton shows that SSD vs SATA has pros and cons; it may be possible that one class of server may be there that supports both; to check if we can shorten this process by choosing basic server that meets the requirements using SATA disks -- to confirm final choice of units being ordered and status of the procurement : 4 nos of T620s (2 nos have 16 TB and 2 nos have 4 TB disks); all the 4 machines have come; 2 are with 16 TB with and 2 with 4 TB -- compute vs host; PERC card issue needs to be resolved; one K20 on each machine can be there for some time; need to complete the CentOS installation and then they can be integrated into GWBIII. To start thinking about the next phase and how many compute machines we should buy. ==> PERC card bypass issues resolved : need to buy the backplanes for the 2 machines and onboard SATA controller can be used; and all future machines can be with the configuration where PERC card is not needed; CentOS installation is also completed and machines can be integrated into GWB-III as and when needed.

4.6 Procurement of accessories and other hardware required for GWB systems -- from 8 Oct and before (BAK/GSJ) :

(i) procurement of accessories like network cards, disks, cables etc to be looked into -- 20 nos of CX4 based dual 10 Gbe cards to be purchased -- these are compatible with T620, may give some trouble with R720 (for 2 GPUs). indent submitted and only party quoted -- in last stages of clearance for placing the order; 20 nos of CX4 cards have come and being 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 -- first draft circulated by GSJ. Agreed to relook at the spares requirement without counting the units already being used in the existing systems and buy more if needed; issue is coupled with what we want to do with existing packetised corr unit -- agreed to leave the PoCo and pkt corr in place and get enough peripherals to meet the requirements; spares list needs to be updated and fresh orders to be done. update had been sent by GSJ long time ago; to raise indent accordingly. to check about procurement of more rack(s).

(ii) new purchase of Roach boards etc : 12 nos of Roach1 + 16 ADCs and 4 nos of Roach2 have come; test bench for Roach1 board is getting ready; need discussion about plans for testing of Roach2. Roach1 test set-up ok; 10 boards cleared, 2 are not booting over network -- work ongoing to test; for Roach2 : need to check if we need to buy add-on mezzanine card; also software environment needs to be upgraded -- this is ongoing; had agreed to check the standard procedure for Roach-2 testing on casper and check what peripheral items are needed; also Matlab-Simulink upgrade is ongoing (to get status of that) and for Xilinx software it needs to be initiated. all 12 Roach1 boards are now working and 16 ADCs also tested; for Roach2 : mezzanine card needs to be initiated; Matlab-Simulink is on order; Xilinx upgrade needs to be looked at; for Roach2 can be seen on USB port using Ubuntu -- basic tests can be done; need to fix the compile tools for Roach2 (ver of Matlab-Simulink and Xilinx); mezzanine card to be ordered; to take one of the existing PCs and adapt it for Roach2. mezzanine cards for SFP and CX4 budgetary quotes asked for from Digicom.

new Xilinx software has been downloaded -- needs to be installed on a machine.

4.7 Testing leakage, coupling and correlated noise in new back-end chain -- from 8 Oct & before (BAK/YG/++) : detailed tests had been done by Vikram Jaiswal (with SSK, SHR and YG) and report has been circulated; follow-up action item discussed between SCC, BAK & YG : for GAB systems, some follow-up action for testing the leakage has been initiated; need a more detailed discussion for actions for the GWB FPGA & GPU subsystem; procedure for testing to be done with GWB-II release modes to be clarified and tried out -- checking to see if earlier results can be reproduced -- working as expected; plus some new tests showing a few other things -- to be checked and taken up for discussion; new tests show significantly different results for cross-coupling for GAB+GWB; this needs to be understood better -- confirmed that these tests used sig gen LO, whereas earlier tests used synth LO; maybe separate tests for the analog system can be done -- these have been carried out now, and results can be discussed; new report has been circulated that also shows 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; sky test with north pole and noise at input to GAB have been done; need to be interpreted carefully, in comparison with the earlier results; also to complete the test with noise at ADC input; check status of this.  
email update from SCC : 2nd round of tests done about 2 weeks ago, show leakage of 2-4% (consistent with first round of measurements of 1-3%) -- YG to discuss with SCC about the range of tests and 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.

4.8 Walsh modulation : prototype set-up on Roach board -- from 8 Oct & 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 main 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; to generate final plot showing this behaviour (done?); to aim for a robust algorithm for hunting for the peak and detecting; 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 Roach2 : ok, as very few slices are needed; issue of accuracy of the oscillator being used in the Walsh generator; what about synchronisation of starting?; Identified 3 possible action areas for work:  
(i) to complete the Walsh modulate and demodulate set-up in the lab -- almost ready.  
(ii) to optimise the hunting algorithm;  
(iii) to demonstrate cancellation of unwanted signals in ADC card and/or GAB  
Some mismatch between the CPLD waveform and FPGA waveform for the Walsh signal; now resolved and all FPGA generated waveforms (which use the CPLD logic; different from the original EPROM scheme) are matching. Now 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 ! A few different aspects of this discussed; SCC to try out and report the progress.  
SCC is finalising the block that will allow max delay of 500 msec (for 128x4 msec Walsh length) with a resolution of 5 nsec (FPGA clock); to check if this is working now and tested ? delay block ready and under test to resolve some issue related to start-up offsets; fractional delay is still giving some problems and needs a bit more debugging.

## 5. Other items :

5.1 New python assembly design -- from 8 Oct (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; agreed that it is now time for a joint inspection at C4 -- check status. Mech group to do the inspection and circulate the report for comments and inputs.

==> email update from HSK : inspection has been done 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.

(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 have been received; will be doing test on quadrupod behind lab building during MTAC period : 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.

Check status of this.

==> email update from HSK : work in progress -- the feed drive system on test quadripod has been corrected and made workable; the new feed cable wrap assembly to be installed shortly for testing.

5.2 Problem of access to FE boxes with 500-1000 CDF feed -- from 8 Oct & 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; quick status update from mech group, with detailed follow-up later on. Action items agreed upon : first to check with new heavier box and see if existing solution is practical; if not, then to work on new option; meanwhile, a few alternative options are being 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; may need inspection (in Bangalore) in early/mid November; party is visiting this week for other jobs; work is on track by the party; inspection likely in early November (HSK + one).

==> email update from HSK : assembly work is in progress, inspection date will be given shortly.

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

Feeds inspected at Akvira site - many corrections / suggestions for improvements have been made [e.g. improved probe mount : press-fit vs. screws; M4 -> M5; etc]; delivery expected (after these modifications) by end-March'14; one assembly made ready at NCRA w'shop and sent to GMRT last week; 3 sets have been delivered at GMRT; fabrication of 3 enclosures is under process; and procurment of 3 enclosures is in progress; 3 new feeds after powder coating had come to GMRT; there was some issue about the thickness of the plate used for mounting connectors and some in-situ modifications have been done on one of them and it is found working ok; pending clearance for the other two; and decision needs to be taken for the 3 new ones not yet delivered -- these are complete and ready with the vendor, except for the finalisation of the above plate. The enclosures have been received -- will be shifted after inspection is done; work on conversion to press fit type from screw type is being looked into; probe with press type and screw type deliver to FE group for further tests; for feed #32 -- see above; for feed #33 : combination of mechanical units with threaded probe has been made ready; for numbers 34 & 35, will try for threaded units, with push-pull probe (3 sets will be made available by w'shop) as a fall-back option; box has to be made ready for #33 (and then for #34 & #35) with matching plates -- there are some unit to unit variations that require specialised attention; for #34 and #35 horn and OMT are being corrected to exact specs and will be fitted with the probes and will be sent to GMRT by next week.

For #32, status is as updated earlier; for #33, same status except plates are going for chrome plating; for #34 and #35, mech work is over for the OMT and horn and waiting for inspection; for #34 plates are also gone; box/cover ready for #s 32-35 and ready to ship; 3 sets each of push-pull and threaded type probes has been made and delivered (some confusion exists about exact number received by FE team).  
==> email update from HSK : 4 nos of feeds corrected as per requirement and sent to GMRT on 27th Oct -- no more feeds in NCRA workshop.

#### 5.4 Improved software for work requests -- from 8 Oct 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? Aagreed to try and get this done in-house with Joardar -- can be taken up after completion of ongoing tasks related to electrical -- to confirm plans and status : work not started yet; needs a discussion with Joardar -- it should be possible to take up the job now, as electrical task is over; to check if this is underway now -- work ongoing, basic structure ready, first version could be available shortly; work in progress, may need one month for completion, i.e. by beginning of Nov. Meanwhile, old software has also started working (to check with Mangesh about what fixed it); hence urgency is not very high.

==> email update from HSK : work is ongoing, some delay due to other commitments.

#### 5.5 Status of new CSIRO feeds : from 8 Oct & 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) -- to decide follow-up action.

recently it has been 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; follow-up after 2 weeks.

==> email update from HSK : discussion with Dr. Shenoy -- Al conductive paint may not work best (only 80% conductivity)...



5.6 New FE boxes and testing with reflective paint -- from 8 Oct (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; 5 new boxes given for engraving to outside party -- need ~ 10 days.

5.7 Automated scheme for moving the feed adjustment stool -- from 8 Oct (HSK/HRB) : agreed to try a short feasibility study by HSK.  
==> email update from HSK : work in progress.

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