GSB : Standard Operating Procedure
(Release Ver 2.3   17th July 2013)

1. GSB Hardware Set-up :

The present configuration of the GSB has 1 to 50 nodes and 4 control/peripheral machines. These are split as follows, based primarily on functionality :

RACK 1 : nodes 1 - 16   : data acquisition nodes (each hosts one 4 channel ADC card)
RACK 2 : nodes 17 - 32 : computing nodes (quad core machines which do the main computing)
RACK 3 : nodes 33 - 48 : compute nodes for extra computing (e.g. 32 MHz full stokes modes) and
                                                    recording nodes for voltage raw dump mode.
RACK 4 : nodes 49,50, gsbm1, gsbm2, gsbm3, gsbm4

nodes 49 and 50 are used for beam/pulsar data recording.
node49 is for beam 1 (normally IA beam) and node50 is for beam 2 (normally PA beam).

gsbm1 is the main control machine for the GSB.
gsbm2 and gsbm3 are used for presently used for offline work.
gsbm4 is for recording interferometry data.

Gateway to GSB is GMRT Core/Main Switch (in the server room). Also, important gsb gateways for nodes are gsbm1 and gsbm2.

astro8 is the default machine used as the GSB console in the control room. All the GSB control is done from this machine, using a user friendly GUI (see section 3 below). Use the login "observer" for this.

Local Oscillator Settings :

At present, both LO4 and LO5 need to be set explicitly for GSB observations :

LO4 can be set through the ONLINE command "bblocli"
LO5 can be set through elab@loconf
LO5 can be set through ONLINE also.

The default values are as follows:
For IF BW 32MHz, LO4 = 51MHz, and LO5 = 149, 156 (in MHz).
For IF BW 16MHz, LO4 = 62MHz, and LO5 = 138, 167 (in MHz).
For IF BW 06MHz, LO4 = 67MHz, and LO5 = 133, 172 (in MHz).

*For customized LO5 values, user should ask operator to calculate the corresponding LO4 value, and to set the same through ONLINE

GSB can be run through ONLINE with remote mode (one shivneri or lenyadri).

LTO4 tape drive is available for user data backup on gsbm2 (/dev/nst0).
SDLT600 tape drive is available for user data backup on node49 (/dev/nst0).

2. Currently available modes of the GSB (Release Ver. 2.3):

	Observation Type	Usage Mode		Input IF BW (MHz)	Acquisition BW or Final o/p BW (MHz)	Number of Channels	Output Time Resolution
1	Interferometry : Continuum	Total Intensity (32 MHz mode)		32,16,6	32	512, 256	2,4,8..(sec)
		Total Intensity (16 MHz mode)		16,6	16	512, 256	2,4,8..(sec)
						128	0.5,1,2..(sec)
						64, 32	0.25,0.5,1..(sec)
		Full Stokes (32 MHz mode)		32,16,6	32	512(*), 256	2,4,8..(sec)
		Full Stokes (16 MHz mode)		16,6	16	512, 256	2,4,8..(sec)
2	Interferometry : Spectral Line	Total Intensity (16 MHz and lower BW modes)		16,6	16 / N (N=4,8,16..128) (viz. 4, 2, 1, 0.5,0.25 & 0.125 MHz)	512, 256	2,4,8..(sec)
3	Array: Beams	IA	Total Intensity (32 MHz mode)	32,16,6	32	512, 256	Pre : (#) Post: 1,2,4
			Total Intensity (16 MHz mode)	16,6	16 / N (N=4,8,16) (viz. 4,2,1 MHz)	512, 256	Pre: (#) Post: 1,2,4
		PA	Total Intensity (32 MHz mode)	32,16,6	32	512, 256	Pre: (#) Post:1,2,4
			Total Intensity (16 MHz mode)	16, 6	16 / N (N=4,8,16) (viz. 4,2,1 MHz)	512, 256	Pre: (#) Post: 1,2,4
			Full Stokes (16 MHz mode)	16,6	16	512, 256	Pre: (#) Post:1,2,4
			Voltage Beam (32 MHz mode)	32,16,6	32	512, 256	15 nsec (@)
			Voltage Beam (16 MHz mode)	16,6	16	512, 256	30 nsec (@)
4	Raw Dump	Raw voltages from all antennas		16,6	16		30 nsec at 4 bits per sample

Notes :

(*) Released on trial basis : set lta-visibility pre-integration to 4sec and beam output 245.76 uSec.
(#) Regarding beam integration and beam-data-host

```
========================================================================
  BW      CHANNEL       PRE-INTEG   IFR     Beam-Stokes   Data-Nodes (Beam1-Beam2)
========================================================================
 16.666   256            30.72 uSec  TI      IA(TI):PA(TI)  node33-34
 16.666   512            61.44 uSec  TI      IA(TI):PA(TI)  node33-34
 16.666   256            61.44 uSec  FS      IA(TI):PA(FS)  node33-34
 16.666   512           122.88 uSec  FS      IA(TI):PA(FS)  node33-34

 33.333   256            30.72 usec  TI      IA(TI):PA(TI)  node33-34
 33.333   512            61.44 usec  TI      IA(TI):PA(TI)  node33-34
 33.333   256            61.44 usec  FS      IA(TI):PA(FS)  node47-48 with XNET
 33.333   512           245.76 usec  FS      IA(TI):PA(FS)  node47-48 with XNET
========================================================================
```

(@) Output data is in spectral voltage form; needs one inverse FT to get voltage time series with time resolution of 15 nsec for 32 MHz mode and 30 nsec for 16 MHz mode.

3. GSB control through ONLINE :

The GSB is run through ONLINE by using the ***sockcmd*** program on gsbm1. This can be started from the dasconsole. The steps for running the GSB are as follows (see section 5 for details of the GUI based commands) :

1. Save the required configuration of GSB using gsb_config. Also set LO4 and LO5.
2. Start gsb acq program from dasconsole, and wait till it says "ready for INIT".
3. Start gsbdassrv through ONLINE machine.
4. give initndas command through USER0.
    >allant;cmode=8;tpa(11)=15;initndas'/temp2/data/gsb.hdr'

5. Wait till acq starts running after receiving minute pulse (should happen at the next IST minute boundary).
6. Enter initprj command through online USER0.
    >allant;subar 4;prjtit'TEST';prjobs'GMRT';initprj(15,'test')

7. Start scan through USER-X terminal.
8. Start pulsar Beam Acquisition if user wants to observe pulsar.

The following table explains the various commands and options for GSB control through ONLINE.

Control	Corr	Online init files and commands	IFR-dascmd	IA-dascmd	PA-dascmd
ONLINE	GSB sockcmd	Initfile : /temp2/data/gsb.hdr DasSrv : /home/observer/bin/gsbdassrv Online commands : >allant;cmode=8;tpa(11)=15; >initndas'/temp2/data/gsb.hdr' >allant;subar 4; >prjtit'';prjobs'';initprj(15,'test')	initndas initprj strtndas stpndas stpprj hltndas	initndas.ia strtndas.ia stpndas.ia hltndas.ia	initndas.pa strtndas.pa stpndas.pa hltndas.pa

Note :
commands in blue color are shell commands and these commands can be issued through terminal window of the ONLINE machine or through user window of ONLINE by using "/" in the beginning of the command. Example.

>initndas.ia; strtndas.ia   - for shell (terminal window).
>/stpndas.ia; hltndas.ia -   for ONLINE user / command file.

4. Setting up the GSB from the GUI :

There is a user-friendly GUI that is used for set-up and control of the GSB, from astro8. It has two versions: a "release" version meant for regular use, and a "trial" version meant for developmental work (distinguished by different color combinations : orange vs blue shades). Usually, the "release" version is running by default on the astro8 machine; invoking the GUI afresh is normally required only when the machine is rebooted, or a change in the GSB mode (between release and trial) is desired.

astro8 setup in the control room :

Log-in as observer@astro8 located in the control room (normally, a log-in session will already be running; a new log-in is required only when logged out or the machine is restarted). The following default desktops are available on log-in to astro8, for use with the GSB set-up, and are recommended for running different GSB tasks/applications :

GSBCONSOLE - for the gsb_main_console, gsb_dasconsole and ONLINE interface.
CONFIG/PHS   - for the gsb_config and phasing.
IFR-MON   -   for the IFR data monitoring.
IA-MON   -   for IA beam data monitoring.
PA-MON   -   for PA beam data monitoring.

TAX   -   for running tax on lta data.
DASD/LO5   -   for starting dasd and to set LO5.

The individual details under each of these desktops are given below.

Desktop DASD/LO5 :

On the desktop named DASD/LO5 open 5 terminals (if they are not open), for the following actions :

1. log in as gsbuser@gsbm1 and issue command "dasd gsbuser"
2. log in as gsbuser@node49 and issue command "dasd gsbuser"
3. log in as gsbuser@node50 and issue command "dasd gsbuser"
4. log in as gsbuser@gsbm4 and issue command "dasd gsbuser"
5. log in as elab@loconf   and issue command "fswqt"
(these commands needs only when machine is rebooted or dasd/fswqt is not running;
 to log-in to nodes 49 and 50, log-in to gsbm1 first then log-in to node49 or node50).

NOTE : Depending upon the beam data acquisition node-host, user have to start "dasd gsbuser" on related node-host.

Desktop GSBCONSOLE :

GSB_MAIN_CONSOLE is splitted up into **ifr_gui** and **psr_gui**, to setup the GSB for interferometry and beam/pulsar observations, respectively. There are two versions "released" (for gtac observations) and "trial" (for development programs).

Commands to invoke the GUI :
        For Interferometry mode : **ifr_gui <released /trial>**
        For Beams mode   : **psr_gui <released /trial>**

ifr_gui can be used to open following tools :
          GSB_CONFIG, IFR_DASCONSOLE, IFR_MON, IF_POWER_EQ, PHASING and a terminal on gsbm4.

psr_gui can be used to invoke following tools during pulsar observations :
        GSB_CONFIG. (will not open if it is already running somewhere), PSR_DASCONSOLE, IF_POWER_EQ,PHASING, PSR_CONFIG, GAC_CONFIG, IFR_MON and BEAM (IA/PA) MON's and terminals on gsbm4, node49,node50.
        PSR_DASCONSOLE has several combinations depending on their data host names. User has to select one from given listings.

Open one more terminal for online interface (for das commands). Put it at the right bottom corner of the screen. Log-in as observer@shivneri/lenyadri (ONLINE machine). One can call it as a command window (it is needed only during beam/pulsar observations).

Desktop CONFIG/PHS :

GSB initial configuration :

GSB_CONFIG is the common configuration window for continuum, line and beam/pulsar mode observations. Configure it based on user requirement and save it (normally GSB_CONFIG is always open). Only one user interface of GSB_CONFIG can be run at a time.

GSB phasing window :

GSB_PHSING : A GUI based phasing tool for the GSB. It has antenna selection window for grouping antennas to be phased under different sub-arrays. This antenna selection window is also used by the command line based phasing script. Only one user interface of GSB_PHASING

can be run at a time.

Desktop IFR-MON :

 It needs to restart this IFR_MON for every new change is GSB configuration. It can be opened multiple times.

GSB IF POWER EQUALISE :

 This Application will help to equalize power levels at the output of GSB, with effect at 30-to-1 power levels. Steps for power equalization are as under :

1. Start GSB_IF_POWER_EQ from ifr_gui or psr_gui.
2. Select the antennas for power equalization.
3. Click 'ALLAttn 16' for setting up values globally to all antennas.
4. Save the attn and gain values for polarizations, as saved in cdsetX file.
5. Click on EQUALISE button, to calculate output attn-gain values.
6. Give 'run gsblev' on cdsetX terminal on online machine.
7. Repeat steps 5 and 6 to get satisfied desired result/ output power levels.
8. If any antenna goes bad during observation or an antenna released for observation after maintenance session. Then just setup frequency parameters to it and check power levels at GSB output.
9. Press 'LOAD' Button and Change Attn-gain values for antenna on user interface.
10. Save the content on GUI, and press FTP button. It will pop- up a window for antenna selection.
11. Select the antenna to equalize power, and press SAVE button (on antenna selection window).
12. Give 'run gsblev' command on cdsetX terminal.
13. Repeat steps 9 to 12 to get desired output.

Power equalization works for :

IF Bandwidth	Channels	Stokes
16.66666	32/64/128/256/512	TotalIntensity
16.66666	256/512	FullStokes
33.33333	256/512	TotalIntensity
33.33333	256/512	FullStokes.

Desktop IA-PMON :

GSB_IA_PMON : GUI-based pulsar data monitoring tool for data in IA beam mode. Observer can enter Several / required parameters on the user interface. Then save the configuration. Then click on start pmon to view pulsar monitoring plot (called as ia pmon).

Desktop PA-PMON :

GSB_PA_PMON : GUI-based pulsar data monitoring tool for data in PA beam mode. Observer can enter Several / required parameters on the user interface. Then save the configuration. Then click on start pmon to view pulsar monitoring plot (called as pa pmon).

Desktop TAX :

This desktop is used for running tax and ltahdr on lta data files, to monitor data and its quality.

5. Starting the observations :

The following table explains the sequence of the commands to start the gsb-das chain for IFR and IFR+PSR mode observations.

#	IFR	PSR	
		BEAM1 (IA) subar3	BEAM2 (PA) subar4
1	configure with beams OFF (calculate the step # and LO5 in case of line observations and set it)	configure with beam1 ON	configure with beam2 ON
2	Open IFR windows	Open IA windows	Open PA windows
3	Start acq and collect		
4	Init das chain		
5	Wait for minute pulse		
6	initprj and strtndasc		
7	Strt GSB-IFR-MON		
8	Start record		
9		Do GAC config and psr config	Do GAC config and psr config
10		Do Phasing	Do Phasing
11		Start process_psr	Start process_psr
12		Start collect_psr	Start collect_psr
13		initndas.ia/pa, strtndas.ia/pa	initndas.ia/pa, strtndas.ia/pa
14		Start GSB-IA-MON	Start GSB-PA-MON
15		Start record	Start record
16	stpndasc, subar x;stpprj	stpndas.ia/pa	stpndas.ia/pa
17	Hltndas	hltndas.ia/pa	hltndas.ia/pa
18	ltahdr, tax to see lta data	Offline psr_mon to check data	Offline psr_mon to check data

Notes:

1. **Beam selection:**
beam1 and beam2 by default are for two sub-arrays (subar1 and subar2, respectively); but two beams can be formed from a single sub-array also. This antenna selection is done through GAC config.

The following valid combinations are available for beam mode :

No.	Beam-1	Beam-2
1	IA	IA
2	PA	PA
3 (default)	IA	PA
4	IA	OFF
5	OFF	PA
6	OFF	VOLTAGE

2. **Beam running :**
Change in post integration will reflect after the ia/pa scan is restarted. Change in GAC config will reflect after restarting the IFR scan.

3. **IFR recording :**
 record dir "/gsbifrdata/<cur date>" and
 "/gsbifrdata1/<cur date>" on gsbm4.
 command : <PRJCODE> <ltafile name with full path> <integ>
 eg. **18_099 /gsbifrdata/2mar/18_099_02mar2010.lta 8m**

4. **Beam recording :**
 Beam record:record dir "/mnt/a/gsbuser/<cur date>" on node 49 and/or node 50.
 Command : -f <raw file name with full path> -n <no. of scans> -m 1
 e.g. **-f /mnt/a/gsbuser/25mar2010/psr_ia.raw -n 10 -m 1**

 if -n is 1 then one can use time option -t in minutes as follows

 eg. **-f /mnt/a/gsbuser/25mar2010/psr_ia.raw -n 1 -m 1 -t 10**

5. **IFR processing :**
  Standard Lta utilities works on gsb-lta files. Lta utilities and gsb-lta data is made available on all astro/gtac machines.

6. <u>Beam data backup :</u>

LTO4 drive is connected to gsbm2 (/dev/nst0)
SDLT600 drive is connected to node49 (/dev/nst0)

 For LTO4 drive : The commands need to be used from node49 or node50 are given below :

ssh gsbm2 "mt -f /dev/nst0 status"
tar cvfb - 20 <data file> | ssh gsbm2 "dd of=/dev/nst0 obs=20b"

 For SDLT600 drive : The commands need to be used from node50 are given below :

ssh node49a "mt -f /dev/nst0 status"
tar cvfb - 20 <data file> | ssh node49a "dd of=/dev/nst0 obs=20b"

Note : Please take back-up when GSB is NOT IN USE for pulsar observation and users are requested to use ONLY the given machine id for backup.

7. <u>Phasing :</u>

PHASING using the GUI :
Clicking gsb_phasing button on gsb_console will open the GSB phasing window. Select the antennas into appropriate sub-arrays, using the antenna selection box. Put non-working antennas in sub-array # 1. Select the sub-array, lta file names, records, scans, iteration no.

Before starting the phasing for the first time, keep iteration 0 and say "ldphs" to initialize with zero phases.   Then start the record to gather the data required for the phasing calculations.   Then click on "phs" and it will do the phasing; but one has to start a new scan to see the effect.   One can go backward or forward in iteration no to load the old phases.

PHASING using the command line of ONLINE :
One has to select the antennas into appropriate sub-arrays, using the antenna selection from the GUI phasing window.   The command line phasing option reads this antenna selection.

After that, type "phase_new.pl" on ONLINE's command line. For example : phase_new.pl -r C00 -s 4 -t 30

options for phase_new.pl are :
                    -h for help.
                    -r -ref ant
                    -s -subar #
                    -t -record time in sec.

If the phasing is giving the error of "use on uninitialized val" then say phase_zero.pl once, and restart DAS scan to solve the above problem.

Note : Effect of phasing will be seen only when the IFR scan is restarted.

8. How to set LO5 :

1. From the GUI :

Use Desktop DASD/LO5 on astro8.
login as elab@loconf
issue the command "fswqt" and it will open the GUI

Through this GUI one can set the default LO5 values for different IF bandwidth as follows :
IF   - Synth1, Synth2
32 MHz. - 149000, 156000 KHz.
16 MHz. - 138000, 167000 KHz.
06 MHz. - 133000, 172000 KHz.

One can set any custom LO5 through the entry box.
The green buttons of Synth1 and Synth2 indicates LO5 is set.

Note : Presently L05 can be changed in the step of 500 KHz.(0.5 MHz.).

2. From ONLINE :

To control and monitor BB and GSB-LO systems through ONLINE, a 'bblocli' (Baseband GSBLO client)
program has been developed using the 'nbbserv' functionality. This client program will communicate
with both the GSB-LO and Baseband server.   The details are as follows :

(1) The 'gsblosrv' server program runs on 'elab@loconf' machine. This program runs as a daemon
     process and will be always up.   Messages by the 'gsblosrv' can be seen in the file
     '/usr/local/gsblosrv/gsblosrvmsg.0'

(2) By default, the 'bblocli' program communicates with both the servers. In case, user
     wants to communicate with only one server, use 'bblocli -c 0 [BB] | 1 [GSBLO].

 (3) Commands to be given via ONLINE :
      # user0/master :
      > stgsb32lo, stgsb6lo, stgsb6lo # Set GSB LO for IF BW 32,16,6 MHz
      > stgsblo('X','X') # X valid GSBLO values in integer up to 6 digit
      # user2,3,4,5 :
      > stgsblo('X','X')
     Commands to control BB units are same as previous.

9. Decimate mode (sub band selection) :

In case of line observations we need to set the sub band number and custom LO5. For this, one can use the script tune.pl

One can call it from observer@astro0 or any astro/gtac machine (~snk/bin/tune.pl). It needs the following arguments :

COMMAND LINE INPUTS :

bash-3.2$:~snk/bin/tune.pl <line freq> <L/H>

    arg 1 is line freq (RF in MHz).
    arg 2 is lo1 is higher or lower(LO1 in MHz)

GUI INPUTS :

1. Line Freq
2. Max. channels
3. IF band width
3. ACQ-BW and final BW
4. digital sub band [step #]

#	IFBW	ACQ BW	Final BW	Sub Band [step #]	Type
1.	32	33.33	33.33/OFF	n=0/OFF	Continuum
2.	16	16.66	16.66/OFF	n=0/OFF	Continuum
3.	16/6	16.66	4.16	n=0...3	Line/Decimate
4.	16/6	16.66	2.08	n=0...7	Line/Decimate
5.	16/6	16.66	1.04	n=0...15	Line/Decimate
6.	16/6	16.66	0.52	n=0...31	Line/Decimate
7.	16/6	16.66	0.26	n=0...63	Line/Decimate
8.	16/6	16.66	0.13	n=0...127	Line/Decimate

5. LO1 Freq.
6. LO5 Freq.
7. Freq at each ch #
8. refresh or replot.

PLOTS

    a) plot # 1
      this plot shows RF band range in red color, green color
      indicates the IF-BW (filter), blue color line is the line freq.

      blue line should be present at the middle of IF filter
      it can be adjusted by moving LO1 freq.

    b) plot # 2
      this plot show the GSB-ACQ window, red color is indicates the
      data signal data, pink line indicates selected sub band, green
      line indicates the digital sub band borders and blue one is line
      freq. Yellow line indicates the no data OR band overlap.

      adjust LO5 such that data (red line) should be present
      at the middle of the GSB-ACQ window. select the digital
      sub band such that there should not be any overlap or nodata
      and it is indicated by the yellow line in the plot.
      IF band should be <=ACQ-BW. Blue line should be present at the
      center of selected sub band.

c) plot # 3

the last plot should show the line at the middle of the plot.

NOTES.

1.
LO1 freqs 0 to 355 can be changed in steps of 1 MHz.
LO1 freqs 355 to 1500 can be changed in stpes of 5 MHz.
LO4 freqs 50 to 90 MHz. can be changed in stps of 100 Hz.

2.   IF band width should not be more than ACQ-BW.

3.   Line freq should be math with the middle chans freq.

4.   While using the the "tune.pl" take the help from control-room

5.   press plot button to refresh the plot.

10. Switching OFF the GSB hardware :

Power down procedure for GSB cluster :
(48 nodes + gsbm1 + gsbm2 + gsbm3 + gsbm4 + node49 + node50 + SDLT-2 drives + LTO-4 drives)
a. login as root on gsbm1
b. cd /home/gsbuser/utility-scripts/
c. run "halt_all.csh" to halt node1-node52
    halt_l1.csh   # to halt rack 1.
    halt_l2.csh   # to halt rack 2.
    halt_l3.csh   # to halt rack 3.
d. login to gsbm2, gsbm3 and gsbm4 and halt each of them
e. halt gsbm1
f. press the power swith of each node to stop the power comming to motherboard
g. switch off power switches on the GSB power sockets.

11. Switching ON the GSB hardware :

Power up procedure for GSB cluster :
a. switch on all the power switches of the power sockets.
b. switch on the gsbm1 first and wait for it to boot.
   (as the /mnt/code/ disk is exported to all nodes from gsbm1)
c. switch on the rest of the machines and node1-to-52.

12. <u>Rebooting the GSB :</u>

1.   How to do soft reboot of the GSB network switches :
If acq on dsasconsole reports network band width problems and exits, we need to follow the following steps:
a. loging as root@gsbm2.
b. open firefox browser.
c. open four separate tabs for
    192.168.15.253, 192.168.15.252, 192.168.14.253 and 192.168.14.252 resp.
d. login as admin (passwd field keep empty) for all four windows.
e. go to the reset menu (left hand side of the browser page)
f.   reset the swithches.
g. wait for 3 minutes.
h. check the connectivity (e.g. ping node1) from gsbm1.

2.   How to do soft reboot of the GSB Nodes :
a. login as root@gsbm1.
b. cd /home/gsbuser/utility-scripts
c. reboot_all.csh   # to reboot all nodes.
    reboot_l1.csh   # to reboot rack 1.
    reboot_l2.csh   # to reboot rack 2.
    reboot_l3.csh   # to reboot rack 3.
d. If problem persists then first reboot gsbm1 and then all nodes. So that all node will be in time synchronization with gsbm1.

13. <u>Trouble shooting :</u>

a) acq on dasconsole reporting problem of "PLL unlock" : need to check the Rubidium clock in the receiver room.

b) acq on dasconsole reporting problem of "DMA TIME OUT" : need to check the "TM4" GPS in the receiver room & GPS signal conversion unit near the GSB rack.

c) If phasing is giving the error : "use of uninitialized val" then run phase_zero.pl once, and restart DAS scan.

d) If Band-shape in band-mon at output of GSB is not covers all channels selected in setup (or if band-mon is showing cut-off edge of the band) then please check the LO1,LO4 and LO5 values.

e) If Interferometry collect fails to run of crashes in between automatically. Try to get it done by clearing the shared memory for gsbm4 machine and restart the chain.