The GMRT: System Parameters and Current Status

15 June 2025

Overview

The Giant Metrewave Radio Telescope (GMRT), located ∼80 km north of Pune, India, comprises thirty 45 m antennas spread over a 25 km region. Fourteen lie within a compact ∼1 km "central square", while the remaining sixteen are distributed along three ∼14 km arms in a "Y" configuration. Baselines range from ∼100 m to ∼25 km. Further details are provided in the Appendix.

Since its major upgrade in March 2019, the upgraded GMRT (uGMRT) operates with all 30 antennas and four wideband receivers: 120–250 MHz (Band-2), 250–500 MHz (Band-3), 550–850 MHz (Band-4), and 1,000–1,460 MHz (Band-5). Observations use the default GMRT wideband backend (GWB), supporting 100, 200 or 400 MHz bandwidths, with the choice of 2,048, 4,096, 8,192, or 16,384 spectral channels, for continuum, spectral line and IA/PA (incoherent-array / phased-array) beamformer outputs for pulsar work. The new Tango-based GMRT Control system applies antenna pointing models by default, and applied to all the observations. The GMRT is now formally available for VLBI observations in collaboration with the European VLBI Network (EVN). However, the approved EVN proposals that request GMRT time will undergo independent evaluation for technical feasibility and potential conflicts with regular GTAC observations and will be scheduled on a best-effort basis. Further system details are in Appendix (Section 2).

1. Observing with the upgraded GMRT

The Cycle 49 observing dummy schedule is available at
`http://www.ncra.tifr.res.in/ncra/gmrt/gtac`; it includes reserved slots for maintenance and testing: every alternate Wednesday 09:00 to Thursday 18:00 HRS, and 09:00 to 18:00 HRS on other Wednesdays. Ongoing maintenance and long-term upgrade activities may affect antenna availability. More specifically, feed servo upgrades could take one antenna offline for up to a week, and structural improvements may affect up to two antennas during the day for up to a month. The observatory aims to ensure at least 26 antennas are operational for all science projects. Proposals requiring specific antennas, e.g., W06, E06, S06 (antennas providing longest baselines), or C05, C06, C09 (antennas providing shortest baselines) should state this clearly.

The typical GMRT antenna pointing error is $\sim 1'$, though a few antennas may have errors up to $\lesssim 2'$. A pointing model is used to improve accuracy
(see, `http://library.ncra.tifr.res.in:8080/jspui/handle/2301/517` for details). A new user interface for creating TANGO-based GMRT Control and monitor system (TGC) compatible command files for interferometric and beamformer modes is available at `http://www.ncra.tifr.res.in/~secr-ops/cmd/cmd.html`. GMRT users are requested to share outputs with GMRT-operations, <gmrtoperations@ncra.tifr.res.in>. Additional tools for command/setup file creation, rise/set time calculations, and calibrator selection are at `http://www.gmrt.ncra.tifr.res.in/gmrt_users/help/help.html`, especially useful for absentee observers. A brief system overview follows, and more details are in the Appendix, and/or contact GMRT-operations <gmrtoperations@ncra.tifr.res.in>.

1.1 Overview of the system: uGMRT signal chain, observational modes and data

Front-End + Optical Fibre systems Key features of the Front-End (FE) system include:

(i) Band-5 (1,000–1,460 MHz) FE receivers on all 30 antennas, offering the full band or one of four 120 MHz sub-bands (regular release).

(ii) Band-4 (550–850 MHz) FE receivers on all antennas, with full band or one of four 100 MHz sub-band options (regular release).

(iii) Band-3 (250–500 MHz) FE receivers on all antennas, also supporting the full band or one of four 100 MHz sub-bands (regular release).

(iv) Band-2 (120–250 MHz) FE receivers on all antennas, with an in-band notch filter near ∼175 MHz to suppress TV transmitters (regular release).

(v) Additional features such as noise injection, temperature, and total power monitoring are available in shared-risk mode.

A high dynamic range wideband optical fiber (OF) system delivers full-band signals from all antennas to the back-end.

GMRT (analog and digital) backends GMRT wideband backend system comprises of analog and digital systems that are described below.

Analog backend – GMRT Analog Backend (GAB) is available on all 30 antennas, and (a) converts the selected RF band to baseband with final bandwidths of 100, 200, or 400 MHz; (b) provides LO (local oscillator) settings from 100 MHz to 1,500 MHz (in 10 kHz steps) for both polarizations; (c) includes variable attenuation for power equalization.

Digital backend – GMRT Wideband Backend (GWB) is available on all 30 Antennas. It supports both interferometric and beamforming modes. Key features of each mode are outlined below.

(i) **Interferometry modes** Available interferometric modes with uGMRT are as follows.

(a) Total intensity mode with 100/200/400 MHz bandwidth and up to 16,384 spectral channels (regular release).

(b) Full polarization mode: up to 8,192 channels for 100/200 MHz bandwidth (BW); up to 4,096 spectral channels for 400 MHz BW (regular release).
Note that high spectral channel resolution plus very short integration time may lead to excessive data rates (e.g., use $\gtrsim$5 s for 8,192 channels).

(c) Narrow-band spectral-line modes (total intensity) with BW from 100 MHz to 0.390625 MHz (in ×2 steps), up to 16,384 spectral channels (regular release).

(d) High time-resolution total intensity mode: up to 1,024 channels at 83 ms resolution for 200 MHz BW (regular release).

(e) Frequency switching for narrow-band spectral lines is available in shared-risk mode (from Cycle 40); contact Nissim Kanekar <nkanekar@ncra.tifr.res.in> for details.

(f) Polyphase Filter Bank (PFB) is the default in the F-stage of the FX correlator.

(g) Option of equalisation of the power across the band for each antenna.

(h) Walsh switching (antenna-based modulation/demodulation) for Bands 3, 4 and 5 is available from Cycle 45. The number of antennas with functional Walsh switching may vary and will be determined at the start of observations to generate an antenna-based mask for enabling modulation and demodulation.

(ii) **Beam modes (IA, PA, CD, PASV)** Beam modes that can be operated along with interferometric modes are as follows.

(a) Up to 4 total intensity IA/PA (incoherent-array/phased-array) beams over 100/200/400 MHz bandwidth.

(b) PA voltage beams with 100/200/400 MHz bandwidths support real-time coherent dedispersion (CD), generating multi-channel intensity data at user-defined time resolution in 8-bit or 16-bit formats. Simultaneous recording of IA/PA and CD beams is supported, provided the combined time-frequency resolution stays within the 48 MB/s per-beam data rate limit.

(c) Full-polar mode available for 2 PA beams at 100/200/400 MHz. CD beam not supported in this mode.

(d) Time resolution down to 81 μs and 2,048–16,384 frequency channels for IA/PA modes (see Table 1 in Beamformer Manual for mode-specific limits), available at `http://www.gmrt.ncra.tifr.res.in/gmrt_users/help/help.html`.

(e) PASV baseband data (full release) supports 25–400 MHz bandwidths with 4/8-bit sampling (400 MHz only with 4-bit). Useful for VLBI or high-resolution studies. Time-limited to $\sim$2 hr (200 MHz, 8-bit) or $\sim$4 hr (100 MHz, 8-bit). Requires a strong science case and prior arrangement for data transfer within 24 hr. Contact Visweshwar Ram Marthi,<viswesh@ncra.tifr.res.in>.

(f) GMRT can now join European VLBI Network (EVN) observing sessions (subject to technical review). PASV data will be used, and interferometric data may be shared on request. Details, available in the EVN Newsletter, EVN Newsletter and/or contact Visweshwar Ram Marthi <vrmarthi@ncra.tifr.res.in>.

(g) Reduced-bit (8-bit) IA/PA mode available for high-time/high-frequency resolution (see GTAC Beamformer Manual, Table 1 of `http://www.gmrt.ncra.tifr.res.in/doc/GTAC_obs_beamformer_ver4.pdf`).

(h) An online coherent dedispersion pipeline (CDP) for 4-bit voltage beams is now available, supporting quad-beam mode at 100 MHz per beam, dual-beam mode at 200 MHz, and single-beam mode at 400 MHz (shared-risk mode).

(i) Antenna phasing via standard procedure (regular release); a "wideband phasing" mode is also available (shared risk).

(j) PA-IA total intensity (post-correlation) beam for 8-bit and 16-bit recording is available in shared risk mode from Cycle 45.

(k) A band-equalisation tool (shared risk) now allows correction of slow spectral variations, configurable by frequency-window size, roll-off, and number of taps. Especially useful for 8-bit beamforming at Band-4.

(l) A reduced 8-bit total intensity CD beam mode for 200 MHz bandwidth is now available, alongside an 8-bit voltage beam option that enables higher time and frequency resolution (shared-risk mode).

(m) In-field phasing mode that derives antenna gains in real time using a user-provided sky model of the target field at the observing frequency. This method eliminates the need for switching to a calibrator, allowing direct phasing on the target field. With regular short-interval updates, the array remains phased throughout, enabling the inclusion of all antennas, including those on long baselines, and enhancing overall sensitivity. Continuous background phasing supports uninterrupted, long-duration observations. To use in-field phasing, an adequate model of the target field at the observing frequency must be provided by the user (shared-risk mode).

(iii) Some common features for both, interferometric and beam modes –

(a) Up to 8,192 spectral channels supported in regular release. Extreme combinations (e.g., high channels plus very short integration) are available in shared-risk mode and may be unreliable due to I/O or recording limitations.

(b) Standard power equalisation across antennas via GAB attenuators (regular release). Advanced equalisation for Galactic-plane or Galactic-centre observations is in shared-risk mode. Users should equalise at the target field to avoid saturation. A scheme for auto-adjust and details are available at
`http://www.ncra.tifr.res.in/ncra/gmrt/gmrt-users/galactic-plane`, and/or contact Subhasis Roy <roy@ncra.tifr.res.in>.

(c) Solar observations need special configuration; contact Divya Oberoi <div@ncra.tifr.res.in> for guidance.

(d) Real-time broadband RFI excision is available for Bands 3 and 4 (regular release), and Band-2 (shared risk). It is not recommended for Band-5 (but available as shared risk). Interested users should consult online-RFI <onlinerfi@ncra.tifr.res.in> in advance; and consult the online-rfi-filtering document
`http://www.ncra.tifr.res.in/ncra/gmrt/gmrt-users/online-rfi-filtering`. A web tool (shared-risk) for visualising real-time RFI flagging statistics is also available (e.g., flagging percentage per antenna at 5-min intervals or at the scan boundaries).

Note that shared-risk modes may have untested issues. Users are encouraged to help validate these configurations through real observations.

1.2 Observing conditions, system performance, and data tools

Data quality Not all modes under shared-risk release have been fully tested; users may encounter unanticipated issues. The goal is to enable broader usage and system shake-down. Additionally, data quality may be affected by the following two factors.

(a) **Radio frequency interference** Radio frequency interference (RFI) is often significant in Bands 2 and 3, especially during the day. Band-2 users are advised to use solar attenuators to prevent electronics saturation. Band-3 may be affected by aviation-related activity and strong satellite transmissions (e.g., MUOS). Tools to predict and diagnose satellite interference are available under "Satellite Tools" at GMRT Help (`http://www.gmrt.ncra.tifr.res.in/gmrt_users/help/help.html`). Real-time warnings are also displayed in the control room. Increasing mobile phone interference (∼950 MHz) can affect Bands 4 and 5

(b) **Ionospheric scintillation** Scintillation is more common near solar maximum and around equinoxes, and can even affect Band-5. High winds (April–June, Oct–Nov) and monsoon-related power outages (June–July) may disrupt observations. Users can request compensatory time via email to GMRT-operations, <gmrtoperations@ncra.tifr.res.in> after checking for available "white-slots" in the GMRT schedule webpage through the NAPS dashboard.

uGMRT system parameters and primary-beam shape parameters System specifications and primary beam models are given in Tables 1 and 2, respectively. Primary beam shapes were derived using eighth-order polynomial fits to measured responses. A detailed note (dated 29 Nov 2023) is available at
`http://www.ncra.tifr.res.in/ncra/gmrt/gmrt-users/observing-help/beam-shape-v1-29nov2023.pdf`.

Data archive and analysis The offline tools listscan and gvfits have been upgraded for compatibility with wideband uGMRT data. All interferometric data are formally archived in the GMRT Observatory Archive (GOA). A CASA-based pipeline toolkit for quick-look continuum imaging, CAPTURE, is available at GitHub, `https://github.com/ruta-k/CAPTURE-CASA6`. The beamformer data are currently not archived in GOA; users are responsible for backing up such data. Backup instructions are provided in Section 4 of the manual for "observations in beamformer mode", available at `http://www.gmrt.ncra.tifr.res.in/gmrt_users/help/help.html`.

Table 1: The uGMRT system parameters.

Band	Frequency range MHz	Gain (K/Jy)	T_{sys} K	RMS noise† μJy/Bm	Primary Beam$ $'$	Synth. beam$ $''$
Band-2	125 − 250	0.33	760 − 240	500	120	17.3
Band-3	250 − 500	0.38	165 − 100	10	75	8.3
Band-4	550 − 850	0.35	≈ 100	6	38	4.3
Band-5	1000 − 1460	0.22−0.28	≈ 75	2.5	23	2.3

† The quoted RMS noise values are the deepest obtained known to us so far with the different uGMRT bands, in continuum mode.

$ The values for primary and synthesised beams are at the center frequency of the band.

Table 2: Coefficients of an eighth-order polynomial fit to the antenna primary beam.

observing band		polynomial coefficients			
		a	*b*	*c*	*d*
	(MHz)	PBPARM(3)	PBPARM(4)	PBPARM(5)	PBPARM(6)
Band–2	125−250	−3.089	39.314	−23.011	5.037
Band–3	250−500	−3.129	38.816	−21.608	4.483
Band–4	550−850	−3.263	42.618	−25.580	5.823
Band–5	1050−1450	−2.614	27.594	−13.268	2.395

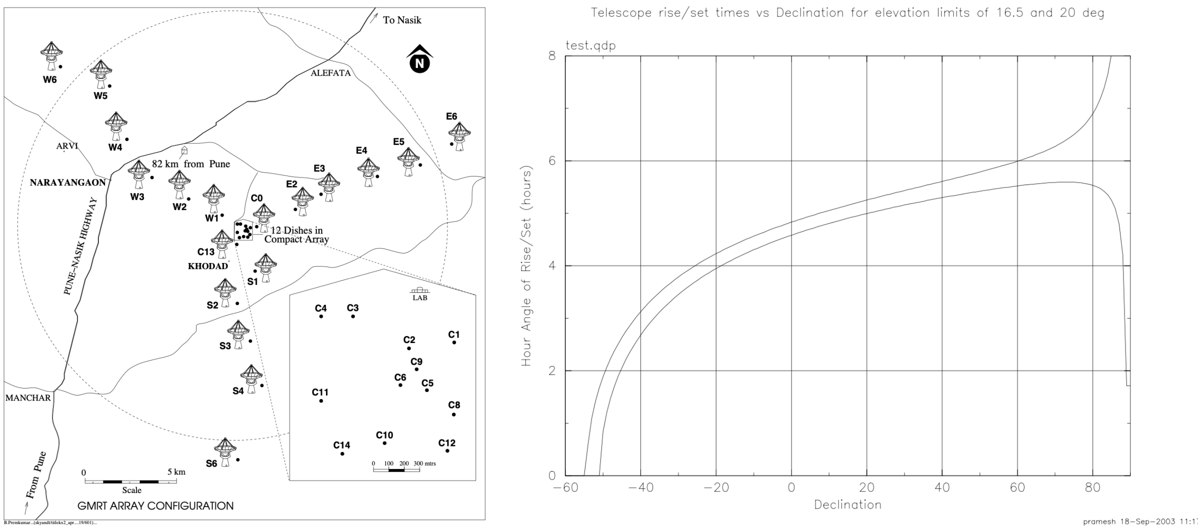

Fig. 1.— GMRT Array configuration (left-panel) and hour angle coverage (right-panel. The hour-angle at which sources at different declinations rise and set for GMRT antennas (the upper curve is for elevation limit of 16° and the lower for 20°).

Table 3: Relative locations of GMRT Antennas. Coordinate system is as defined in "Interferometry and Synthesis in Radio Astronomy" by Thompson, Moran and Swenson (1985), p87 : bx and by in the equatorial plane with by to the East.

Ant_ID	Name	bx (m)	by (m)	bz (m)	Ant_ID	Name	bx (m)	by (m)	bz (m)
ANT00	C00	40.48	687.87	-8.43	ANT14	E02	-319.41	2814.54	963.63
ANT01	C01	41.47	326.43	-30.57	ANT15	E03	-698.30	4575.99	1935.69
ANT02	C02	0.00	0.00	0.00	ANT16	E04	-1009.37	7780.52	2913.07
ANT03	C03	-41.88	-372.72	136.82	ANT17	E05	-1177.96	10199.78	3343.16
ANT04	C04	-42.21	-565.94	126.46	ANT18	E06	-1550.28	12073.19	4550.70
ANT05	C05	84.47	67.82	-244.74	ANT19	S01	971.77	633.92	-2795.96
ANT06	C06	80.11	-31.44	-217.50	ANT20	S02	1462.21	-367.08	-4275.93
ANT07	C08	139.65	280.67	-397.25	ANT21	S03	2212.71	333.12	-6395.07
ANT08	C09	77.40	41.94	-141.69	ANT22	S04	3072.97	947.47	-8979.47
ANT09	C10	200.22	-164.86	-584.43	ANT23	S06	4614.59	-369.05	-13374.92
ANT10	C11	135.99	-603.94	-309.88	ANT24	W01	-167.79	-1591.91	602.93
ANT11	C12	214.67	174.85	-633.66	ANT25	W02	-453.65	-3099.40	1429.36
ANT12	C13	402.19	-639.50	-1106.31	ANT26	W03	-982.31	-5199.93	2902.34
ANT13	C14	229.27	-474.67	-621.28	ANT27	W04	-1705.86	-7039.01	5077.25
					ANT28	W05	-2705.66	-8103.19	7817.06
					ANT29	W06	-3079.50	-11245.58	8923.76

1. Appendix

This section gives an overview of the latest status of the GMRT and relevant system parameters useful for planning GMRT observations. Section 1 gives the background and an overall description of the GMRT.

1.1. General Overview

The GMRT consists of thirty 45 m diameter antennas spread over a 25 km region. Fourteen antennas are in a compact, quasi randomly distributed array, in a region of size about 1 km (called the Central Square). The remaining sixteen antennas are on the 3 arms of a "Y" (NorthWest, NorthEast and South), each of length $\approx$ 14 km, with 5 or 6 antennas on each arm. The longest baseline is about 25 km and the shortest is about 100 m, without foreshortening. The array configuration is shown in Fig. 1.

The telescope (Latitude=$19.1°N$, Longitude = $74.05°E$) is located near Khodad village, which is about 80 km north of Pune. The telescope site houses laboratories, a guest house, a library and a canteen. The observatory can be reached using the daily shuttle service that starts from NCRA, Pune at 7 AM in the morning and return from GMRT at 5:30 pm (all days including holidays and weekends), or by a direct taxi from Mumbai or Pune. The closest town, Narayangaon, is about 14 km from the observatory and is connected to Pune and Mumbai by a public bus transport system. If advance information is given, arrangements can be made to transport observers from the Narayangaon bus stand to the observatory. See `http://www.ncra.tifr.res.in` for more details on various general aspects of observing at the GMRT, including a road-map for travel to the observatory.

The GMRT antennas are 45 m alt-azimuth mounted parabolic prime-focus dishes. While the dishes can go down to an elevation of 16°, at present, the elevation limit has been set at 17°, giving a declination coverage from $-53°$ to $+90°$. The usable hour-angle range for different declinations is shown in Fig. 2. The slew speed of the antennas is 20°/min on both axes and they can be operated upto wind speeds of 40 km/h (for safety, the antennas are parked at higher wind speeds). There is a rotating turret at the focus on which the different feeds are mounted. The feeds presently available are the Band-5 ($1000-1460$ MHz), Band-4 ($550-850$ MHz), Band-3 ($250-500$ MHz) and Band-2 ($125-250$ MHz) feeds. The reflecting surface is formed by a wire mesh and the efficiency of the antennas varies from about 60% to about 40%, from the lowest to the highest frequency. Signals from two orthogonal polarisations are brought to the control room from each antenna, over optical fiber. The native polarisations for all receiver systems are circular, except for the Band-5, which delivers linear polarisations.

The GMRT has been open to the international community of users since early 2002, via a proposal submission and approval scheme that presently runs two observing cycles in each year. After over a decade of operations, the GMRT has recently undergone a major upgrade of its capabilities, whose main goals have been to provide (i) near-seamless frequency coverage from $\sim$ 100 MHz to $\sim$ 1500 MHz (ii) improved sensitivity with better quality receivers (iii) a maximum instantaneous usable bandwidth of 400 MHz along with high spectral resolution (iv) a revamped and modern servo system (v) a next-generation monitor and control system (vi) improvements in the antenna mechanical structure and (vii) matching improvements in infrastructure and computational facilities. The upgrade has resulted in significant changes to almost all aspects of the GMRT receiver chain and other systems. However, full care was taken in the design of the new systems to ensure that the performance of the existing legacy GMRT system is not affected as the upgrade is implemented. The upgraded GMRT (hereafter, the "uGMRT"), now fully complete, has been made available in an incremental fashion to the user community since GMRT Cycle 30, and Cycle 36 marked the full release of the final uGMRT.

1.2. Overview of the uGMRT

The uGMRT replaces the narrow band feed and front-end receiver systems of the legacy system with wide-band receivers. The legacy 150 MHz feed has been replaced with a wider bandwidth feed, covering 125 to 250 MHz (Band-2). The legacy 325 MHz feed has also been replaced with a broadband feed operating from 250 to 500 MHz (Band-3), along with a broadband low noise amplifier with improved noise temperature. A new feed operating from 550 to 850 MHz (Band-4) has replaced the legacy 610/235 MHz co-axial feed, also with a matching LNA with improved noise figure. Due to this, the 235 MHz band of the legacy system is no longer available from Cycle 34 onwards. Both band-3 and band-4 have the provision to select sub-bands of 100 MHz bandwidth with significant overlap for each sub-band. The L-band feed (Band-5) has been upgraded with a better dynamic range front-end receiver system, covering the frequency range of about 1000 to 1460 MHz, along with four sub-bands, each of 120 MHz bandwidth.

As part of the upgrade, the optical fiber link to each antenna has been modified to provide additional wavelengths to bring back the dual polarisation broadband RF signals from the new front-end receivers directly to the Central Electronics Building (CEB), without disturbing the existing narrow bandwidth path for the legacy system that brings back the two polarisations on IF signals with a maximum bandwidth of 32 MHz. In the CEB, a new signal chain has been developed in parallel to the existing system that handles the narrow-band signals of the legacy GMRT, for catering to the broadband signals of the upgraded GMRT. The broadband RF signals are converted to baseband signals with a maximum bandwidth of 400 MHz, which are then processed with the new digital back-end system, the GMRT Wide-band Backend (GWB), consisting of a correlator, a beam-former, and a pulsar receiver, that can handle the full 400 MHz bandwidth. Both these signal paths run independently and in parallel, without affecting each other.

The servo system for all 30 antennas has been upgraded with new brush-less DC motor system along with a new servo computer. A new Tango based GMRT Control and monitor system (TGC) with improved hardware at each antenna connected to the central station via Ethernet, and improved software and user interface, replaces the current control and monitor system. Several improvements to the mechanical structure and reflecting surface of the antennas have been carried out, and continue to be undertaken. Matching enhancements in computing resources and data archiving capabilities are being implemented.

These upgrade activities are now complete and the full uGMRT was released to users from Cycle 36 (April 2019) onwards.

1.3. Front-end Receiver Systems

At the focus of each antenna, the front-end system for each feed has 2 low noise amplifiers (LNAs) (one for each polarisation), with a noise injection facility where the user can select one of 4 levels of injected noise power. For all the bands (except Band-5), the linear polarisation signals from the feeds are converted to circular polarisation signals just before the LNAs. The two polarisations signals from the front-end receivers of all the bands go to a common box (also located on the feed turret) where the user has to select one of the frequency bands for onward transmission, as only two RF cables go down to the antenna base. The common box also has facilities to select solar attenuators (0, 14, 30 or 44 dB), enable/disable noise and Walsh modulation, and swap the signals between the two polarisation channels.

In the upgraded system, the RF signals are directly transmitted to CEB using high dynamic range fibre optics system; these form the input to the GMRT Analog Backend (GAB). The GAB converts any of the RF bands to baseband, with a final bandwidth of 100/200/400 MHz. The LO settings for all antennas (both polarisations) can be set independently to any value in the range 100-1700 MHz, with a step size of 10 kHz. Variable attenuation control for power equalisation is available in both polarisations.

1.4. Backend Systems

The backend systems are housed at the CEB, with separate systems for processing the legacy and upgraded GMRT signals. The first stage of these systems is the analog processing chain that provides the final baseband signals, which are then digitised and processed by the digital backend systems – the GMRT Wideband Backend (GWB) for the upgraded GMRT.

The GWB processes a maximum of 400 MHz band for each of two polarisations for all the GMRT antennas. It implements an FX correlator for interferometry mode, supporting both total intensity and full polar mode processing. It also has narrow-band spectral zoom modes that are useful for spectral line observations. The maximum number of spectral channels that the GWB provides goes up to 16384 (the default is 2048), though some modes may support a smaller value for the maximum number of spectral channels. The range of integration for the final recorded visibility data is between 0.6 and 16 secs.

In parallel with the correlator, the GWB also has incoherent array (IA) and phased array (PA) beamformers for the array mode, which are useful for observations of sources such as pulsars and fast transients. In addition, the beamformer has an option for providing the phased array voltage beam, at Nyquist rate, followed by real-time coherent dedispersion (CD) resulting in multi-channel intensity data at desired time-frequency resolution. A total of 4 beams can be formed simultaneously, with completely independent control over the choice of antennas to be used for each beam. These 4 beams can be any combination of IA, PA or CD beams at single or multiple frequency bands. However, at present one can record either one CD beam for 200 MHz bandwidth (along with PA and IA beams) or upto 2 CD beams for 100 MHz bandwidth (along with PA and IA beams) in the 8-bit mode (see 2.2.2(h) for newly available 4-bit CDP). Observation with CD beam is not possible if the GWB is configured in full-polar mode. The beam data (total intensity or Stokes parameters) can be recorded with different combination of allowed time frequency resolutions determined by the maximum allowed data rate of 48 MB/s par beam. The allowed time frequency resolution for the IA, PA and CD modes are summarised in the Table 1 of "Manual for observations in beam-former mode" that can be found in `http://www.gmrt.ncra.tifr.res.in/gmrt_users/help/help.html` . Any question regarding the choice of observing modes for the beamformer observations can be directed to Bhaswati Bhattacharyya (bhaswati@ncra.tifr.res.in).

1.5. Control and Monitor System

The Control and Monitor System issues commands to set the parameters of the electronics, to slew and track the antennas, and to enable the recording of data. As part of the GMRT upgrade, the control and monitor system has been fully migrated to a new Tango based GMRT Control (TGC) system since January 2021. Observations of targets which moves in the sky during the course of observations (eg: Solar system objects) are possible, but users should provide the necessary ephemeris required for this kind of special observation. The control and monitor system also provides facilities for monitoring a wide range of parameters.

In practice, the GMRT is controlled by the telescope operator on duty. The responsibility of the user is limited to (1) providing the operator with the observing plan, the settings, and the command file, and (2) ensuring that the data quality is satisfactory. In the new TGC system, the format and syntax of the command files will be different from those in the legacy control system. Detailed explanation of the syntax can be found in `http://www.ncra.tifr.res.in/~secr-ops/cmd/cmd.html`.

Several useful tools for preparing observing files or command files, setup files, calculation of source rise and set times, selection of phase calibrators etc, are available at `http://www.gmrt.ncra.tifr.res.in/gmrt_users/help/help.html`. Users are encouraged to use these tools to prepare the observing files and mail them to GMRT-operations <gmrtoperations@ncra.tifr.res.in> well in advance.