Update on Interference Mitigation and Spectrum Management Effort in India

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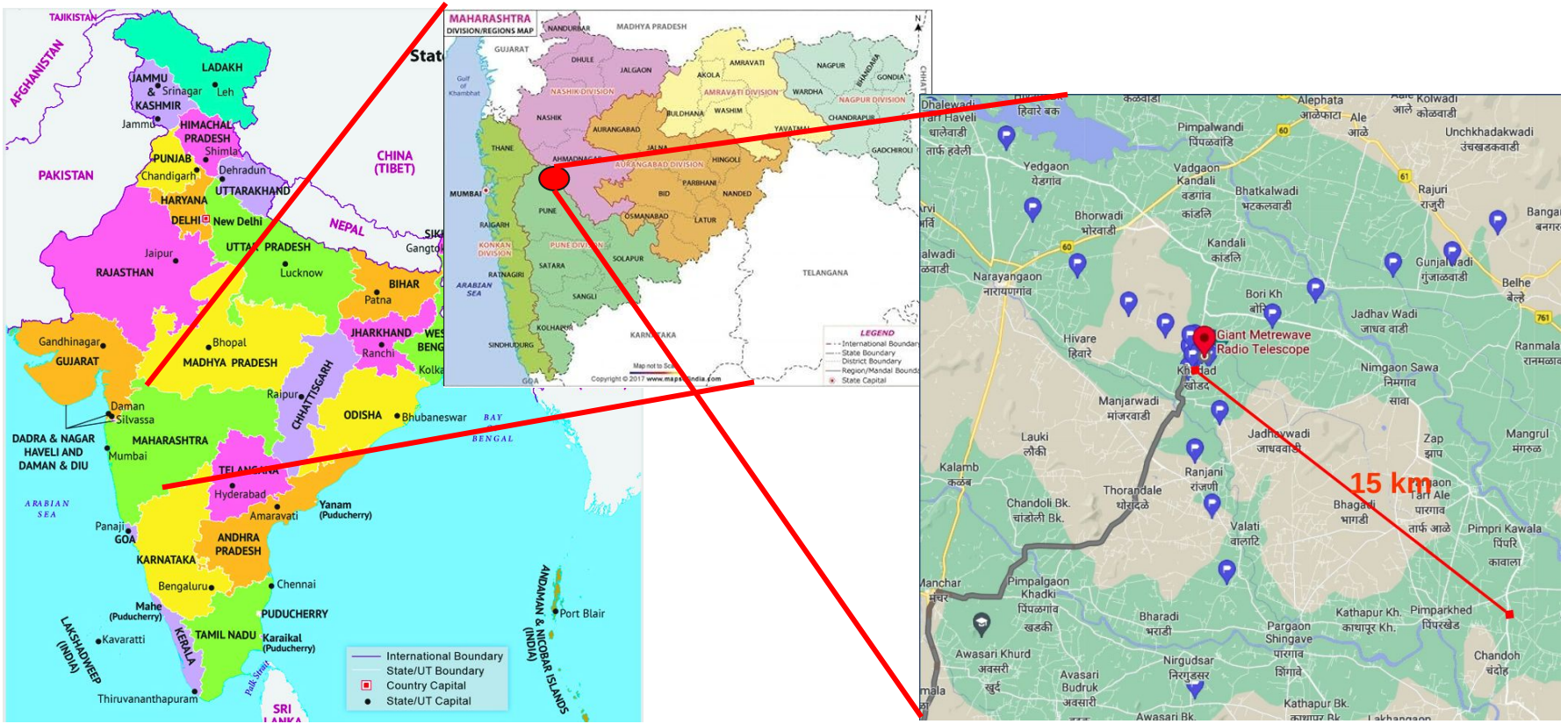
Giant Metrewave Radio Telescope : Location



GMRT : A quick intro

- World class facility for astrophysics at low radio frequencies (50-1450 MHz)
- 30 antennas, 45 m diameter each, spread over a region of about 25 km diameter
- Designed and built primarily by NCRA, a part of TIFR and a unit of Dept. of Atomic Energy, Govt. of India
- Designed and built in the mid 90s and operational since 2001 and completed a massive upgrade in 2021
- Most sensitive metrewave instrument till SKAO arrives

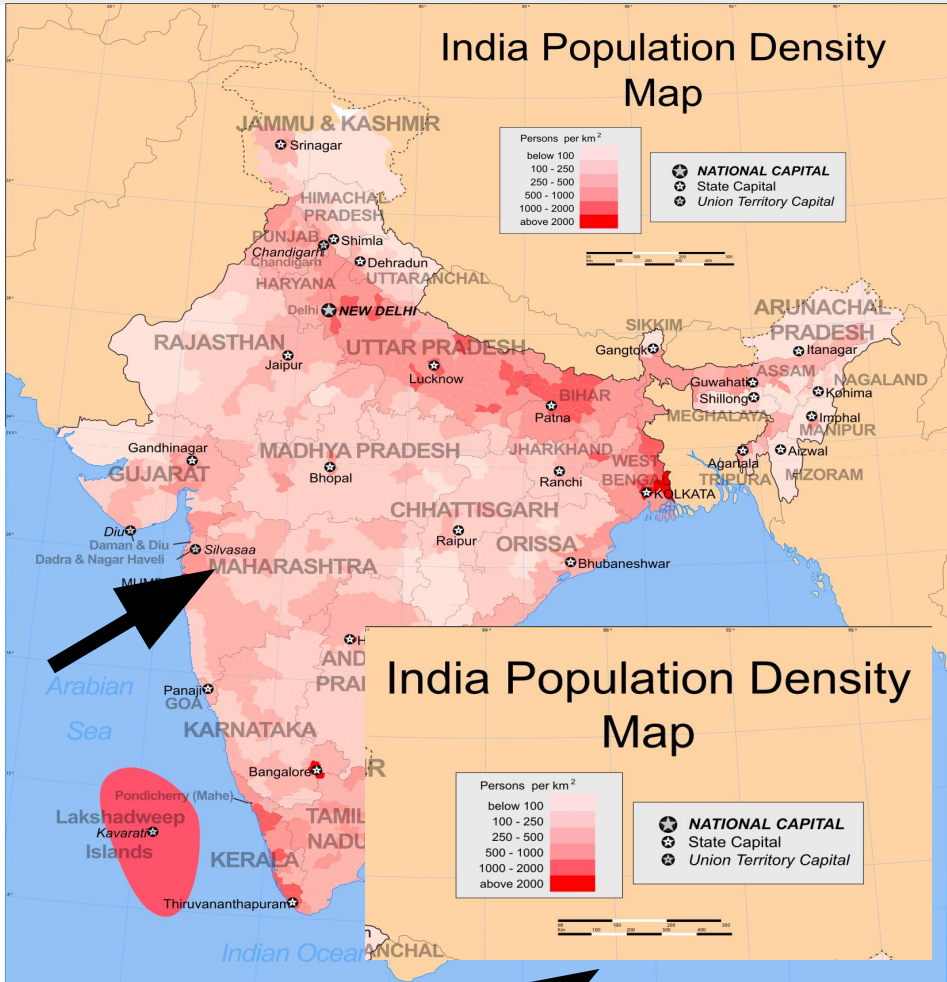
GMRT : A quick intro

- Versatile science instrument - Solar science to cosmology and everything in between
- Served 4000+ astronomers from 40+ countries
- Open skies policy with
- For over a decade
    - ~50% of the PIs from outside India
    - oversubscription factor ~2
- 1+ PB archive
- Approaching 1000 refereed research publications (~50/year)
- Recognized as an IEEE Milestone in 2021
- Only facility of its stature in India

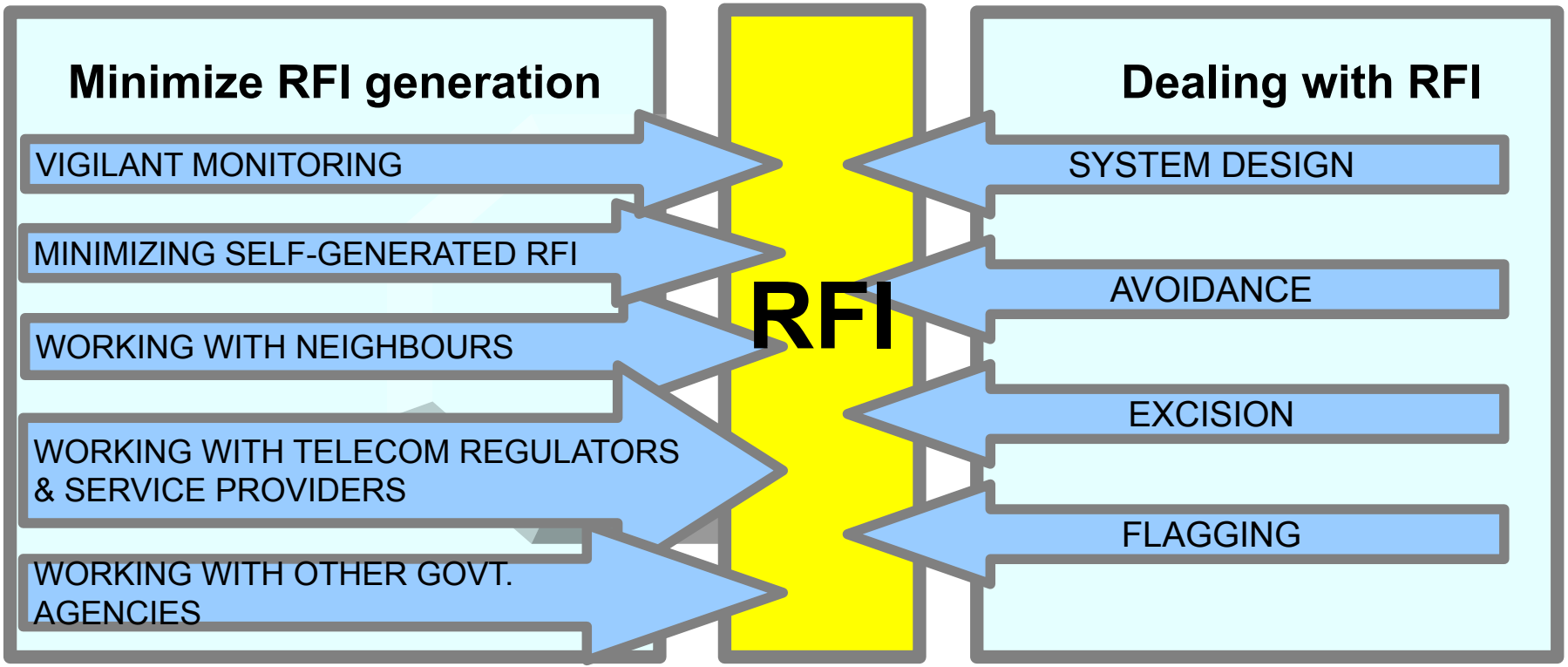
Lots of neighbours

- People were already living in this region before the telescope came
- 231 villages in 30 km radius region
  - ~half a million people

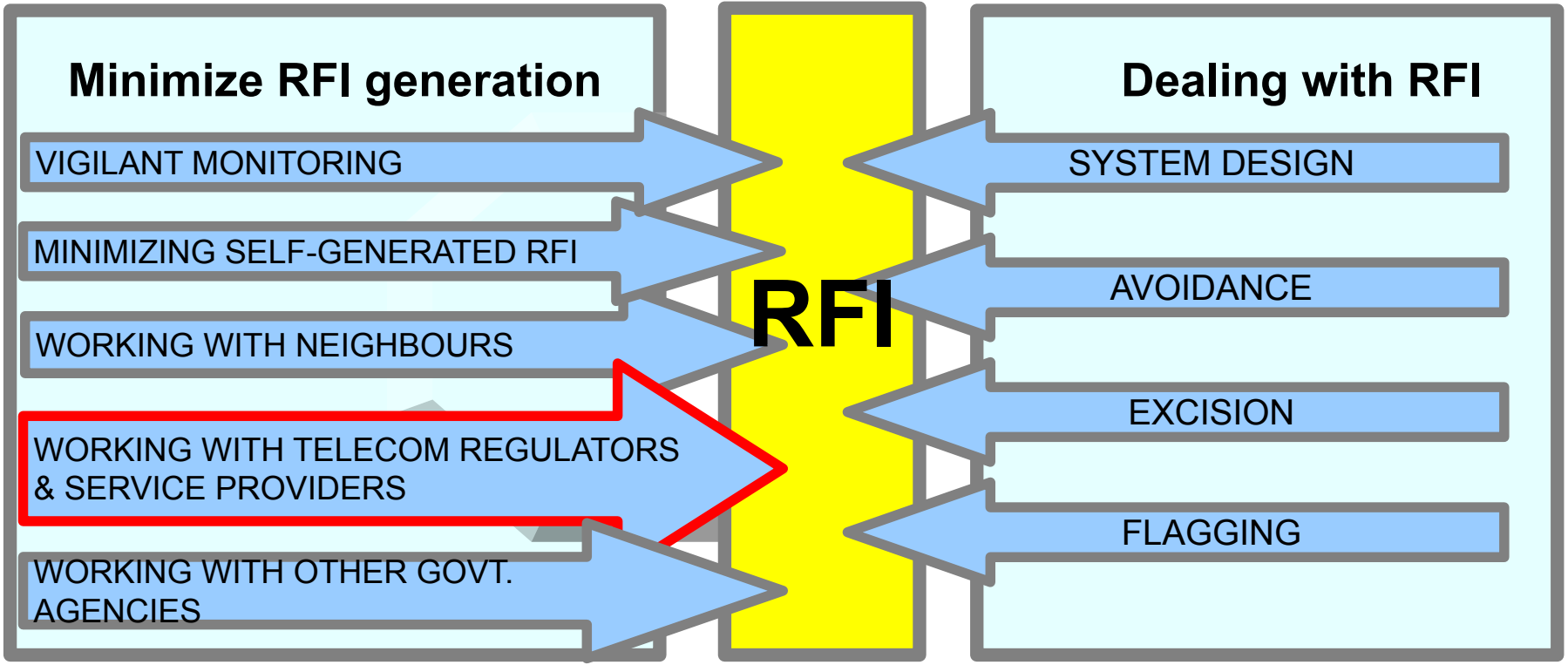
- “Radio Quiet Zone” approach not feasible



RFI management at GMRT



RFI management at GMRT



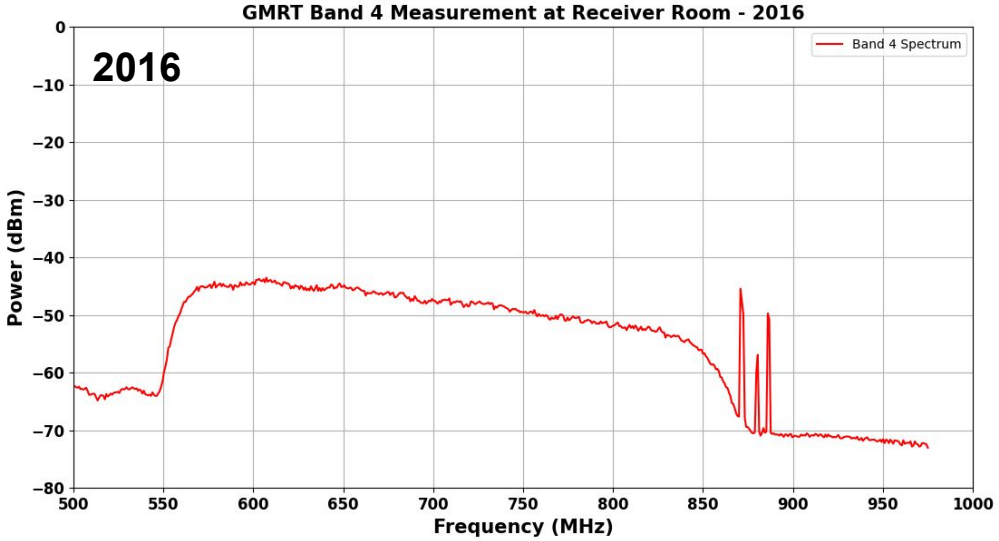
The Objective

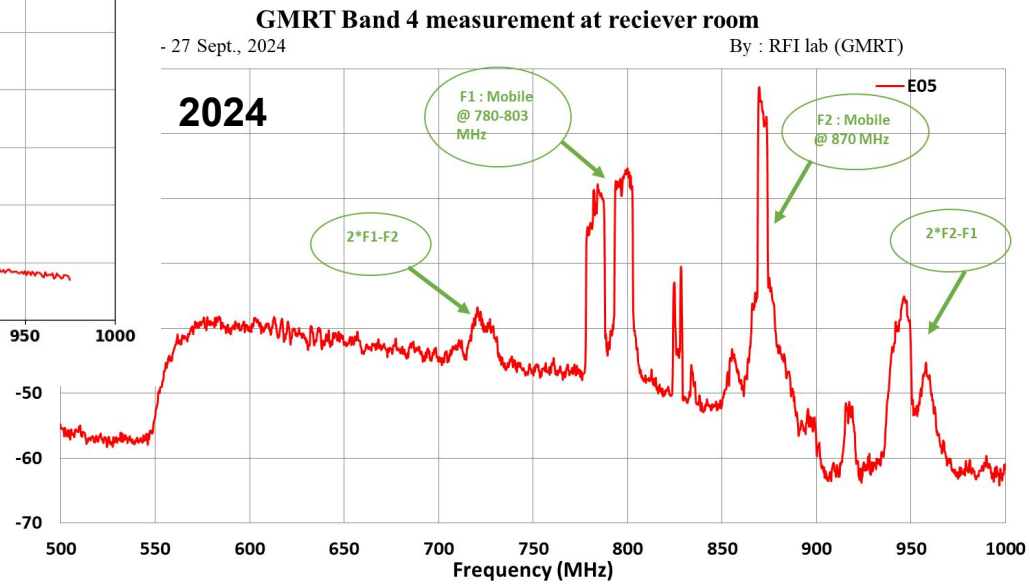
Strive to maintain a “clean” spectrum in the entire GMRT band from 50-1450 MHz, well beyond the protected RAS bands

The Strategy

Co-existence

Impact of Emissions From Telecom Service Providers (TSPs)

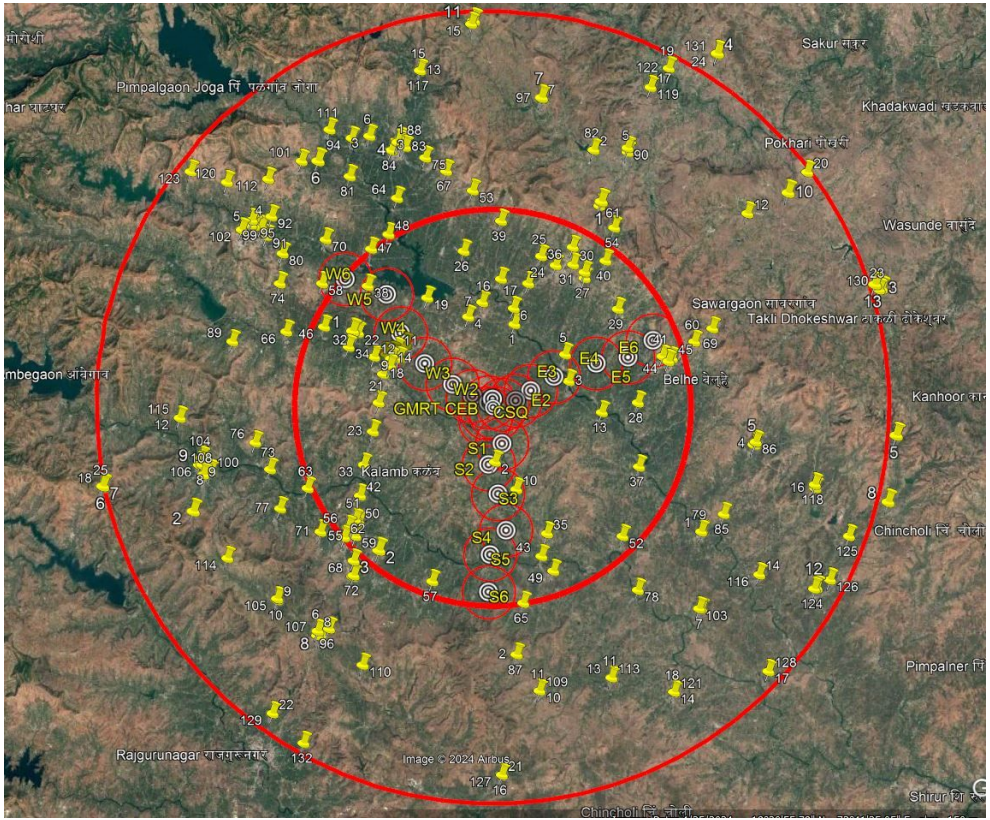




Telecom Services in GMRT Area

- Telecom towers in the 800-900 MHz bands around GMRT

- Four major TSPs operate in GMRT region



Our Specific Circumstances

- GMRT operates only in the metrewaves regime (50)150-1450 MHz
- Bands are available to TSPs at 1800 MHz and above but it is more cost effective for TSPs to operate in 800 and 900 MHz bands.
- Higher frequencies have a smaller range, so more towers are needed to service the same geographic area.
- TSPs are operating in the bands they have bought and in accordance with the Dept. of Telecom (DoT) guidelines.

History and Status

- During early days GMRT signed MoUs with TSPs operating in the GMRT region.
- As TSPs got bought and sold and people transitioned, some of the MoUs got lost in the mists of time
- New TSPs entered the market

- No legal recourse for 2G, 3G and 4G emissions
- Pursuing goodwill based solutions with the relevant parts of the DoT, Govt. of India - Wireless Planning and Coordination (WPC) wing

The Approach

The upgraded GMRT offers:

- Near seamless coverage of the band from 150-1450 MHz
- Maximum instantaneous bandwidth of 400 MHz.

Seek:

- Regulatory protection over the entire GMRT observing band in the limited geographic region around the GMRT

The Approach - Dealing with the present

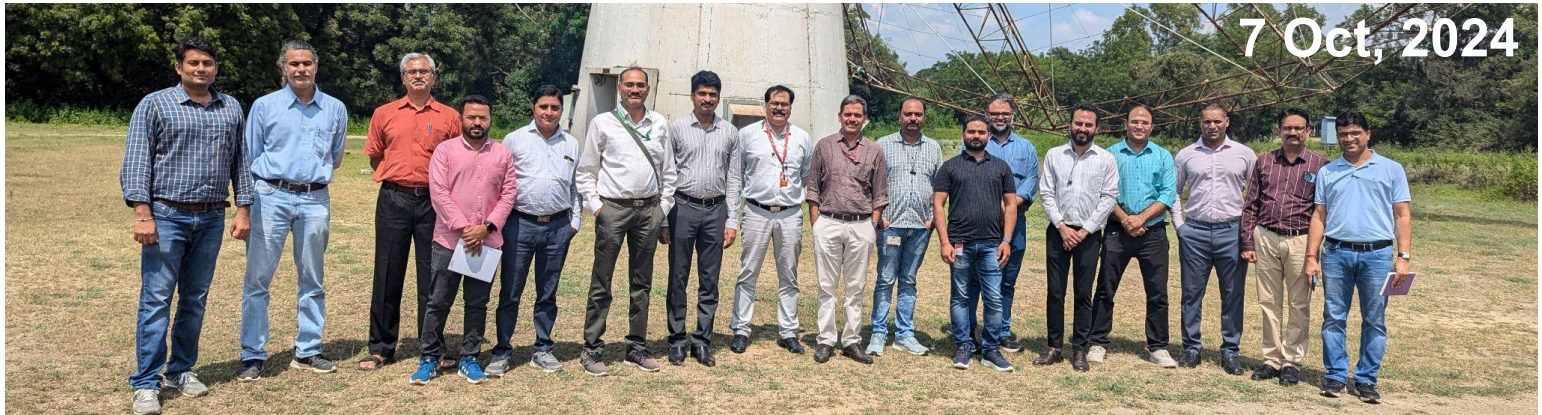
For the present emissions from 2G, 3G and 4G technologies

- Have been working since ~2020 to convince the DoT authorities of the issues being faced by GMRT due to TSP emissions
- Finally they agreed in late 2023 to facilitate the migration of TSPs to frequencies above the GMRT bands in this region via an open and transparent exercise involving all TSPs

Joint Exercise with the WPC and TSPs

Under the direction of senior DoT officers, representatives from three TSPs spent two days at the GMRT in Oct 2024 and then again in Dec 2024 to:

- learn first hand about the GMRT, carry out joint measurements to verify the impact of TSP emissions on GMRT and estimate the zone of avoidance around GMRT
- **Recommendation** - set up a “switch-off” zone of radius 30 km around GMRT and “coordination” zone between 30 and 35 km for all IMT transmissions below 1500 MHz.



The Approach - Planning for the future

5G technology

- Successfully worked with the Dept. of Telecom in 2022 to ensure that the 5G frequencies overlapping with GMRT bands (600, 700, 800 and 900 MHz) were not available for auction in a region of 30 km radius around the GMRT.

The Approach - Planning for the future

Getting involved with National Frequency Allocation Planning (NFAP) process

- The 2022 edition of the NFAP included a footnote stating that *“In addition to bands listed in No. 5.149, the bands 68-74.8 MHz, 585-608 MHz, and 614-890 MHz will also be protected by all practical means, to the extent possible, for radio astronomy service facility at Pune.”*
- This now covers the spectrum seamlessly from 585-890 MHz
- An updated NFAP is expected to be published in Q2 2025 and strengthens this footone to apply to all frequencies below 1500 MHz.

Engaging with WPC wing, DoT

- Organising trainings for their new-hires and in-service officers twice a year
- Offering technical advice when sought (e.g. on upgrading their setups for spectrum monitoring)
- Working with the policy makers on India's National Frequency Allocation Plan (NFAP)
- Contributing our perspective to formulating the Indian views for WRC Agenda items
- …

Engaging with the TSPs

- Recently became an institutional member of the ITU APT Foundation of India, the umbrella organisation of radio spectrum users in India, dominated by the telecom industry
- Engaging with their annual flagship event “Indian Spectrum Management Conference” (ISMC) and other meetings
- GMRT representatives attended the 3rd ISMC in 2023
- Invited speakers from GMRT at
  - the 4th ISMC, Nov. 2024
  - 3rd WRC-27 Preparatory Workshop, Apr. 2025
- Have offered to host a meeting and organize a visit to the GMRT

Summary

Thank you!

A challenging RFI environment, but GMRT has continued to maintain itself as among the most sensitive metrewave radio interferometers globally (μJy RMS, 600+ hr integrations).

Result of considerable and sustained multi-faceted approach taken at GMRT at limiting RFI in its neighborhood.

Engaging actively with the regulatory authorities and the TSPs has played a key role in our efforts.

We take this opportunity to thank the WPC, DoT, Govt. of India and the TSPs for their willingness to find solutions and their strong support.