Quarterly Report on Frequency Spectrum Monitoring

(October - December 2025)

Bhutan InfoComm and Media Authority

Royal Government of Bhutan

December 2025

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1. Background

Spectrum monitoring is the practice of maintaining and monitoring the network or devices that use Radio Frequency (RF) signals and frequencies. Due to the growing demands on the radio frequency spectrum, it is critical that spectrum monitoring is consistently carried out and also keep track with advanced techniques in radio communication technology. Spectrum monitoring is carried out mainly to ensure that technical parameters and standards or guidelines for radiocommunication systems are adhered to by the users. In addition spectrum monitoring assists in promoting the efficient utilization of the radio frequency spectrum.

Spectrum Monitoring is closely associated with inspection and compliance that enables the identification and measurement of spectrum usage, interference sources, the verification of proper technical and operation characteristics of radiated signals, and detection and identification of illegal transmitters. The Monitoring further supports the overall spectrum management effort by providing general measurement of channel and band usage, including the channel availability and measure of spectrum occupancy.

The Bhutan InfoComm and Media Authority conducts fixed and mobile spectrum monitoring to ensure that spectrum use complies with the National Radio Rules and Regulations. The monitoring can detect, identify and resolve the unauthorized transmission or interference, verify technical and operational parameters, and to monitor occupancy and field strength.

2. Monitoring

To ensure effective and proper utilization of spectrum, to control unauthorized transmission and to ensure compliance of equipment and stations with the the National Radio Rules and Regulation, the Authority has monitored the fixed and mobile spectrum from October to December, 2025 in following places;

Sl. No	Monitored Places	Monitored Frequency
1.	Thimphu (Fixed Spectrum Monitoring)	4G TDD Frequencies 2300 MHz
2.	Thimphu (Fixed Spectrum Monitoring)	4G LTE Frequencies 1800MHz
3.	Thimphu (Fixed Spectrum Monitoring)	3G Frequencies 850 MHz
4.	Tsirang (Fixed Spectrum Monitoring remotely)	FM Frequencies 88-108 MHz
5.	DF (Directional Finding) Monitoring in Samtse	FM Frequencies

3. Objective of Spectrum Monitoring

The main objective of the Spectrum measurement monitoring is:

a. To ensure the authorized spectrum for proper application in conformity with the licensing terms and conditions.

b. To survey and inspect radio communication systems.

c. To ensure compliance of transmitters and stations with the National Radio Rules and Regulations.

d. To detect and identify unauthorized transmission.

e. To determine the spectrum occupancy, field strength and assessment of channel availability which will be useful for proper spectrum planning and management.

4. Details of the Equipment used for Fixed and Mobile Spectrum Monitoring

The details of existing Spectrum monitoring equipment of the Authority are as mentioned below:

a. Fixed Spectrum Monitoring

Equipment Make/Model: LS Telecom FMU308w

Type of the Antenna: HF/VHF/UHF/SHF omni-directional antenna

Monitoring Receiver: FMU supports frequency range from 9kHz to 8GHz

Calibration details: Calibrated on 15-02-2023 and valid up to 2 to 3 years

b. Mobile Spectrum Monitoring

Equipment Make/Model: Narda SignalShark 3310

Type of the Antenna: HF/VHF/UHF/SHF directional antennas

Spectrum Analyzer/Receiver: Frequency range for the receiver is from 8KHz to 8GHz

Calibration details: Calibrated on 23-01-2023 and valid up to 2 to 3 years

5. Methodology

The Spectrum measurement monitoring was carried out as mentioned below;

a. Fixed Spectrum Monitoring

The fixed spectrum monitoring was done with the Fixed Monitoring equipment and LS Observer software for the transmission frequency signals. The Fixed Monitoring equipment is fixed to a particular location and the monitoring is usually done through the scanning of the frequency and obtaining its transmission and reception characteristics.

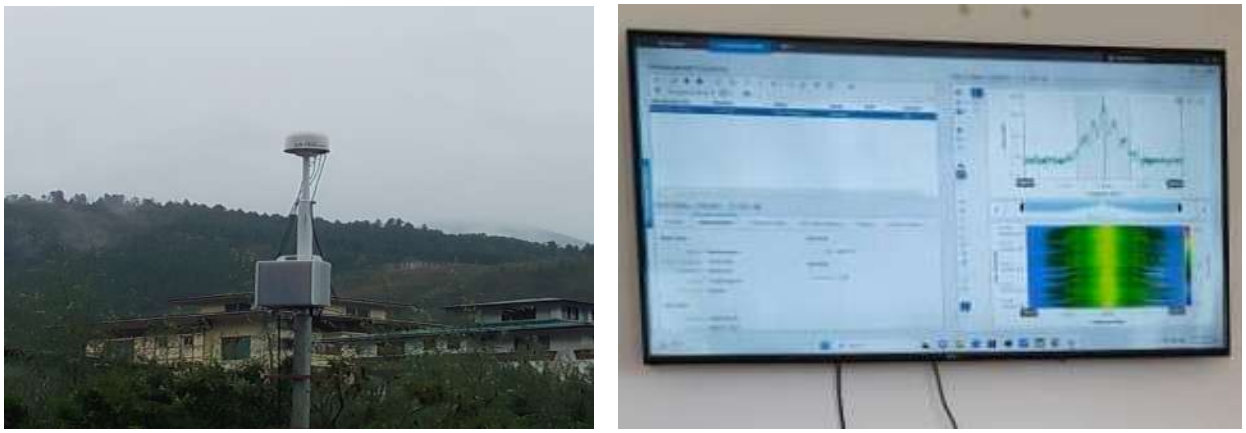

Figure 1: Fixed Spectrum Monitoring

b. Mobile Spectrum Monitoring

The Mobile Spectrum Monitoring was carried out using the DF monitoring equipment which was mounted in the roof of the car. These vehicles are passenger cars used to carry equipment and antennas. The antenna array used for DF and monitoring is mounted in an unobtrusive roof-top carrier mounted directly to the luggage rack on the roof of the car. The monitoring and DF equipment is mounted in the luggage area at the rear of the car.

Figure 2: Mobile Spectrum Monitoring

6. Findings

i. Fixed Spectrum Monitoring in Thimphu

a. Spectrum Occupancy Monitoring for 4G 2300 transmitters

1. The team has carried out the fixed Spectrum Monitoring for 4G transmitter frequencies ranging from 2300 MHz to 2390 MHz.
2. During the monitoring in Thimphu, we have found out that following frequency are actively operating and occupied the band;

Sl.	**Frequency Range**	**Spectrum Occupancy**	**Remark**
1	2300-2310 MHz	Not occupied	Channel is free
2.	**2320 MHz**	**Occupied band is 51%**	**These Frequencies are actively operated by BTL.**
3	**2330 MHz**	**Occupied band is 49%**	**These Frequencies are actively operated by BTL.**
4	**2340 MHz**	**Occupied band is 42%**	**These Frequencies are actively operated by BTL.**
5.	**2350 MHz**	**Occupied band is 51%**	**These Frequencies are actively operated by BTL.**
6.	2360 MHz	Not Occupied	Operation is inactive
7.	2370 MHz	Not Occupied	Operation is inactive.
8.	2380 MHz	Not Occupied	Operation is inactive.
59	2390 MHz	Not Occupied	Operation is active

3. The details of the spectrum occupancy result are attached in **annexure 1.**
4. No illegal operations were detected so far in the 4G TDD transmitter.
5. There is no out of band transmission from 4G transmitters. The detailed findings are attached **annexure 1**.
6. The channel are free in 2300- 2310 Mhz and 2390 MHz-2399 MHz

b. Spectrum Occupancy Monitoring for LTE 1800 band

1. The team has carried out the fixed Spectrum Monitoring for 4G transmitter frequencies ranging from 1800 MHz to 1890 MHz.
2. During the monitoring in Thimphu, we have found out that following frequency are actively operating and occupied the band;

Sl.	Frequency Range	Spectrum Occupancy	Remark
1	1800-1810 MHz	Not occupied	Channel is free
2.	**1820 MHz**	**Occupied band is 98%**	**These frequencies are actively operated by BTL.**
3	**1830 MHz**	**Occupied band is 94%**	**These frequencies are actively operated by BTL.**
4	**1840 MHz**	**Occupied band is 98%**	**These frequencies are actively operated by BTL.**
5.	**1850 MHz**	**Occupied band is 94%**	**These frequencies are actively operated by TICPL.**
6.	**1860 MHz**	**Occupied band is 90%**	**These frequencies are actively operated by TICPL.**
7.	**1870 MHz**	**Occupied band is 83%**	**These frequencies are actively operated by TICPL.**
8.	**1880 MHz**	**Occupied band is 94%**	**These frequencies are actively operated by TICPL.**
59	1880-1890 MHz	Not Occupied	Channel is free

3. The details of the spectrum occupancy result are attached in **annexure 2.**
4. No illegal operations were detected so far in the 4G transmitter.
5. There is no out of band transmission from 4G transmitters. The detailed findings are attached **annexure 2**.
6. The channel are free in 1800- 1810 Mhz and 1880 MHz-1890 MHz

c. Spectrum Occupancy Monitoring for 3G 850 Band

1. The team has carried out the fixed Spectrum Monitoring for 3G transmitter frequencies ranging from 860MHz to 899 MHz.
2. During the monitoring in Thimphu, we have found out that following frequency are actively operating and occupied the band;

Sl.	Frequency Range	Spectrum Occupancy	Remark
1	860- 868 MHz	Not occupied	Channel is free
2.	**868.00 MHz**	**Occupied band is 98%**	**It is a down link Frequencies and actively operated by TIPL.**
3.	**873.50 MHz**	**Occupied band is 95%**	**It is a down link Frequencies and actively operated by TIPL.**
4.	**878.50 MHz**	**Occupied Band is 100%**	**It is a down link Frequencies and actively operated by TIPL.**
5.	**883.50 MHz**	**Occupied Band is 100%**	**It is a down link Frequencies and actively operated by BTL.**
6.	**888.50 MHz**	**Occupied Band is 100%**	**It is a down link Frequencies and actively operated by BTL.**
7.	890-899 MHz	Not Occupied	Channel is free

3. The details of the spectrum occupancy result are attached in **annexure 3.**
4. No illegal operations were detected so far in the 3G transmitter.
5. There is no out of band transmission from 3G transmitters. The detailed findings are attached **annexure 3**.
6. The channels are free in 860-868 MHz and 890 MHz-899 MHz

ii. Tsirang Fixed Spectrum Monitoring Remotely

1. FM Transmitter Frequency from 88 MHz to 108 MHz

a. The team has carried out the Fixed Spectrum Monitoring for Short wave frequencies ranging from 88 MHz to 105 MHz.
b. During the monitoring, we have found out that following frequencies are actively operating and occupying the band and also done with the audio listing monitoring for each occupied band.
c. The details of the Spectrum Monitoring result is attached in **Annexure 1**

Sl.	Frequency Range	Spectrum Occupancy	Remark
1	**88.1 MHz**	**Active/Occupied**	**BBS**
2.	**90.012 MHz**	**Active/Occupied**	**BBS**
3.	**93 MHz**	**Active/Occupied**	**BBS**
4.	**94.312 MHz**	**Active/Occupied**	**BC India**
5.	**101.612 MHz**	**Active/Occupied**	**BC India**
6.	**102.675 MHz**	**Active/Occupied**	**BC India**
7	**103.287MHz**	**Active/Occupied**	**BC India**
9	**104.050 MHz**	**Active/Occupied**	**BC Kuzoo FM**

iii. DF (Direction Finding) Monitoring in Samtse

1. The Authority has carried out the DF Monitoring in Samtse for FM Transmitters to locate the exact location of the transmitter in Samtse.

2. The detailed monitoring activities carried out using the DF equipment for triangulation test at Samtse are mentioned below;

a. Samtse for 96 MHz frequency of FM transmitter

The monitoring team carried out the DF monitoring by keeping the two receiver at different location, one in Samtse, Hindu Mandir and another in Samtse Bukay, while doing the triangulation, we were able to detect the location of transmitter signal for 96 MHz frequency at **Longitude (26.90284), Latitude (89.13763)** above Saurani Lhakhag and actual location of transmitter is at **Longitude (26.89624)**, **Latitude (89.12351)** as shown below:

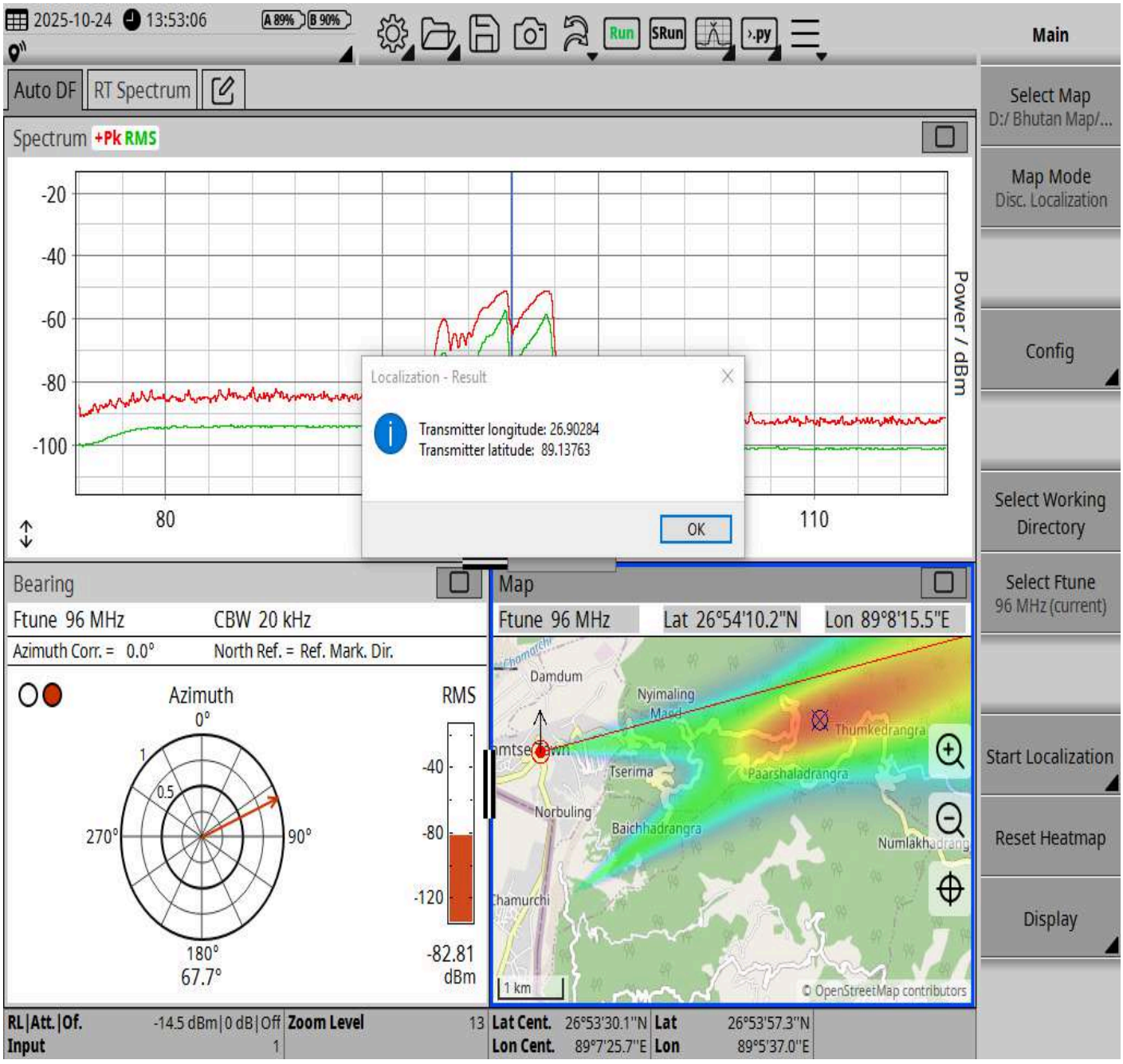

Figure 1: Triangulation Result

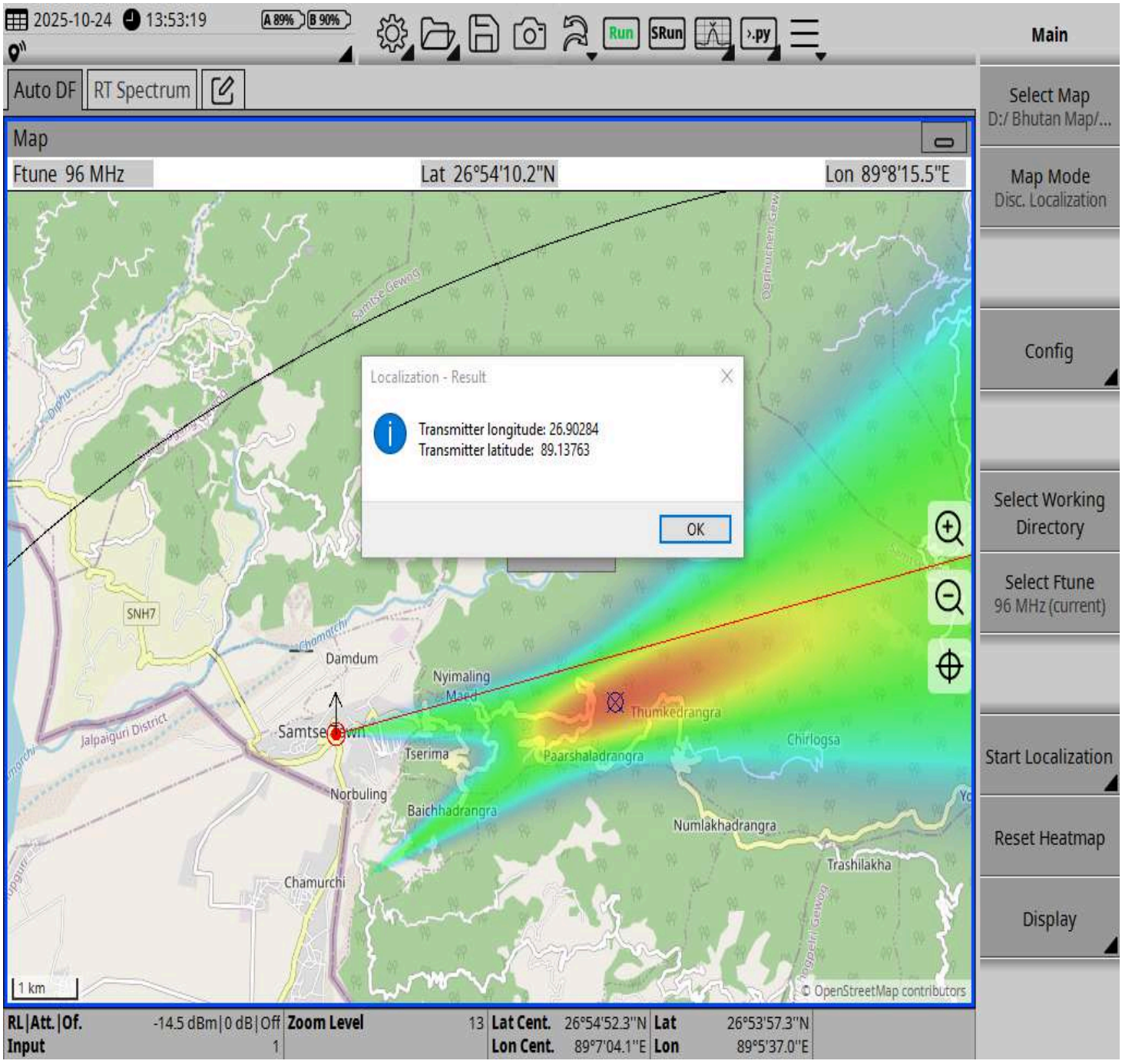

Figure 2: Heat Map for Triangulation

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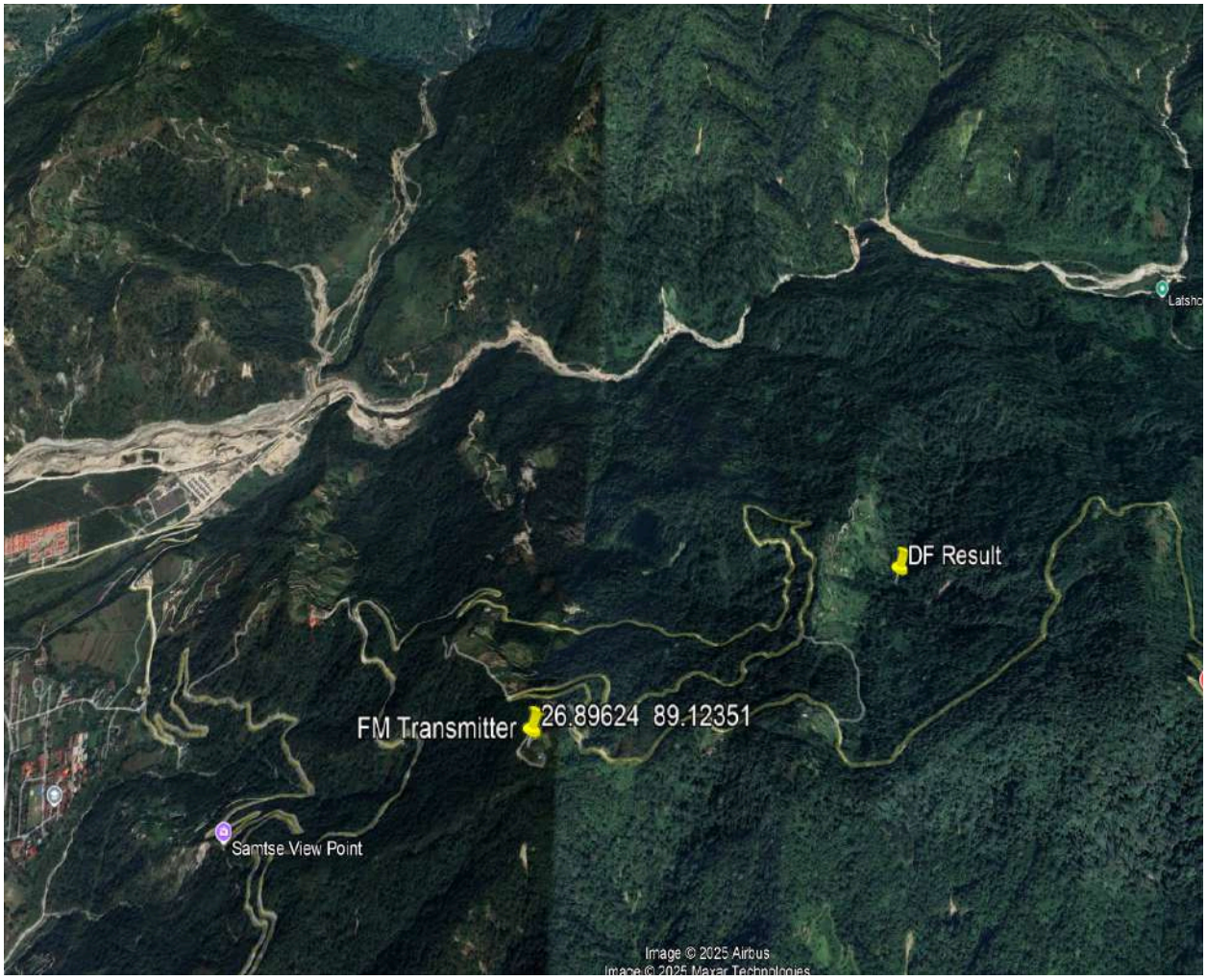
b. Plotting the DF result and Actual location of Transmitter in Map

The following map shows the actual location of the FM transmitter and Triangulation result for DF monitoring and we observed that the location of the transmitter using DF equipment is near to the actual location of the FM transmitter.



3. While doing the DF Monitoring in the Samtse we are able to pinpoint the transmission source

4. During this monitoring practice, we observed that the two receivers of the DF equipment need to be repositioned until the transition source is located between them. Only then can we triangulate and determine the exact transmitter's location

5. After the DF showed the intersection, we had to do the localisation using the vehicle (equipment and antenna placed on the vehicle) and tracing the exact location until the vehicle reached the location of the transmitter.

7. Follow up

i. The Authority has to maintain the database for any spectrum signal detected during the monitoring from the outside country.

ii. The authority will continue monitoring the spectrum occupancy for 2G, 3G, 4G and 5G in different places.

iii. The Authority will compare the fixed and mobile spectrum monitoring result with the frequency assigning database to see whether they are operating illegally or not.

vi. The authority will continue monitoring the Fixed Spectrum Monitoring in Thimphu and Tsirang.

v. The Authority has to practise more and periodically (once in a month or two) on DF Monitoring system to find out the accurate bearing and to get more familiar with the DF monitoring system.

iv. The authority will keep the record of external radio signal and transmission location which was obtained from the DF monitoring result.

Annexure 1

The following are the details of the system generated spectrum occupancy report monitoring for 4G 2300 band (4G) transmitter frequencies ranging from 2300 MHz to 2390 MHz.

Measurement **Receiver Settings**

Name: **TDD 23 DECEMBER 25**

Mode: **Frequency Range Freq. Range:** **2.30 GHz - 2.40 GHz**

RBW: **12.50 kHz**

Step Width: **12.44 kHz**

Start Time: **12/31/2025 9:15:00 AM**

Stop Time: **12/31/2025 9:20:00 AM**

Duration: **5 Minutes 0 Second**

Attenuation: **0 dB**

Channel Name	Main Frequency	Bandwidth	Occupancy [%]		
			Max	Avg	Min
S1	2.31 GHz	10.00 MHz	0	0	0
S2	2.32 GHz	10.00 MHz	53	51	50
S3	2.33 GHz	10.00 MHz	49	49	49
S4	2.34 GHz	10.00 MHz	52	52	52
S5	2.35 GHz	10.00 MHz	52	51	50
S6	2.36 GHz	10.00 MHz	0	0	0
S7	2.37 GHz	10.00 MHz	0	0	0
S8	2.38 GHz	10.00 MHz	0	0	0
S9	2.39 GHz	10.00 MHz	0	0	0

Annexure 2

The following are the details of the system generated spectrum occupancy report monitoring for 4G LTE frequency range 1800-1899 MHz from the fixed monitoring equipment**.**

Measurement **Receiver Settings**

Name: **4G December 25**

Mode: **Frequency Range Freq. Range:** **1.80 GHz - 1.90 GHz**

RBW: **8.33 kHz**

Step Width: **8.31 kHz**

Start Time: **11/05/2025 2:30:00 PM**

Stop Time: **12/31/2025 3:30:00 PM**

Duration: **0 Second**

Attenuation: **0 dB**

Channel Name	**Main Frequency**	Bandwidth	**Occupancy [%]**		
			Max	Avg	Min
S1	1.81 GHz	10.00 MHz	0	0	0
S2	1.82 GHz	10.00 MHz	98	98	98
S3	1.83 GHz	10.00 MHz	94	94	94
S4	1.84 GHz	10.00 MHz	98	98	98
S5	1.85 GHz	10.00 MHz	94	94	94
S6	1.86 GHz	10.00 MHz	90	90	90
S7	1.87 GHz	10.00 MHz	83	83	83
S8	1.88 GHz	10.00 MHz	94	94	94
S9	1.89 GHz	10.00 MHz	0	0	0

Annexure 3

The following are the details of the system generated spectrum occupancy report monitoring for 3G frequency range 860 MHz to 890 MHz from the fixed monitoring equipment**.**

Measurement **Receiver Settings**

Name: **3G DECEMBER 25**

Mode: **Frequency Range**

Freq. Range: **860.00 MHz - 899.00 MHz**

RBW: **8.33 kHz**

Step Width: **8.31 kHz**

Start Time: **12/31/2025 9:35:00 AM**

Stop Time: **12/31/2025 9:40:00 AM**

Duration: **5 Minutes 0 Second**

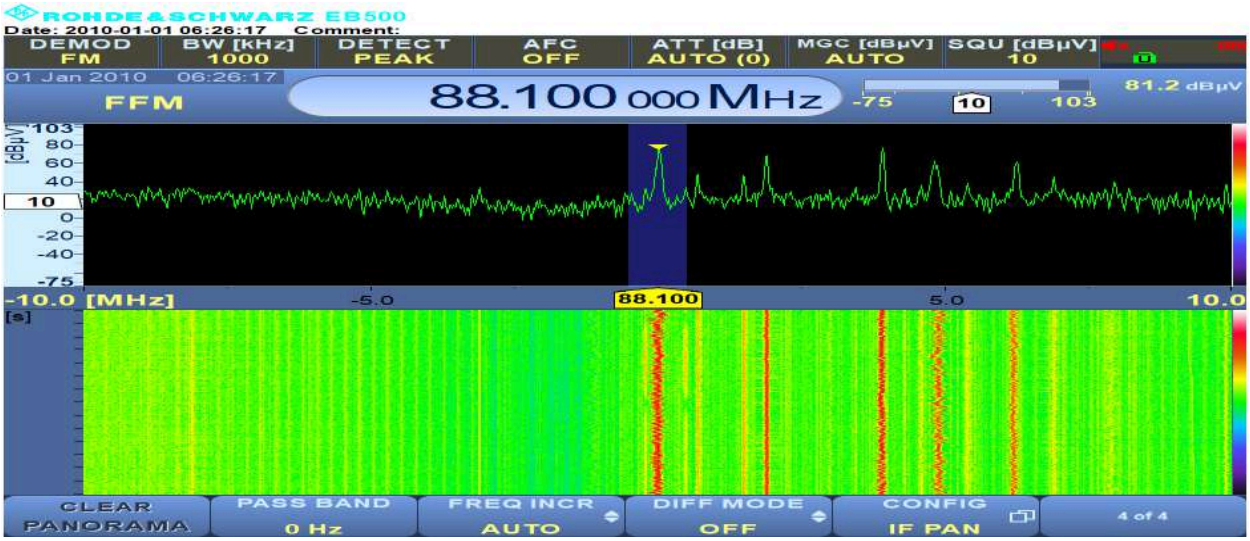
Attenuation: **0 dB**

Channel Name	Main Frequency	Bandwidth	Occupancy [%]		
			Max	Avg	Min
S1	868.50 MHz	5.00 MHz	98	98	98
S2	873.50 MHz	5.00 MHz	95	95	95
S3	878.50 MHz	5.00 MHz	100	100	100
S4	883.50 MHz	5.00 MHz	100	100	100
S5	888.50 MHz	5.00 MHz	100	100	100
S6	893.50 MHz	5.00 MHz	1	1	1

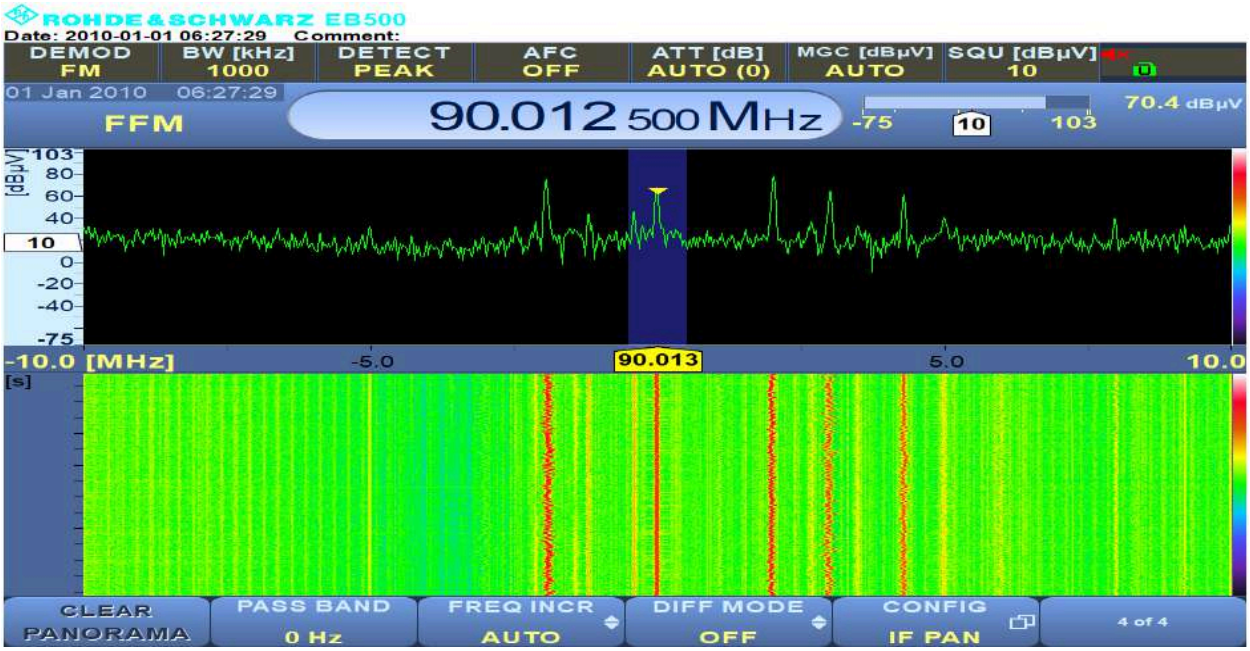
Annexures 4

The following shows the signal detected during the Fixed Spectrum Monitoring in Tsirang for FM Transmitter Frequency from 88 MHz to 108 MHz

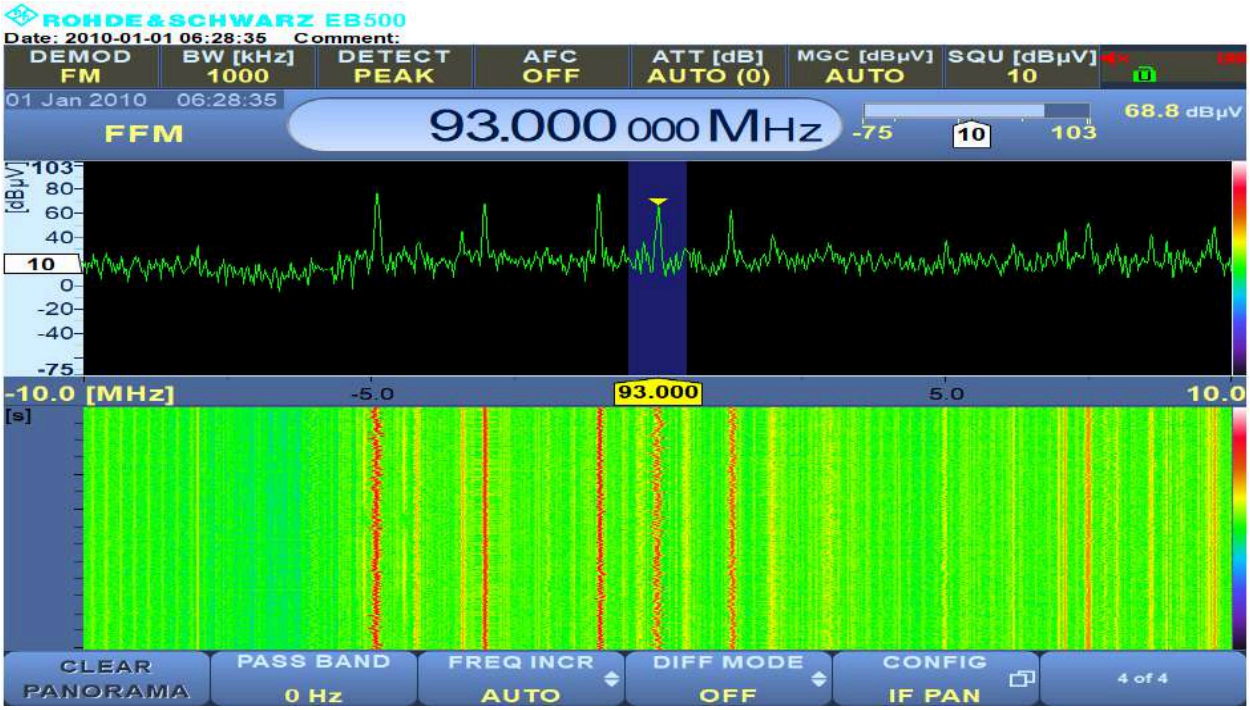
BBS



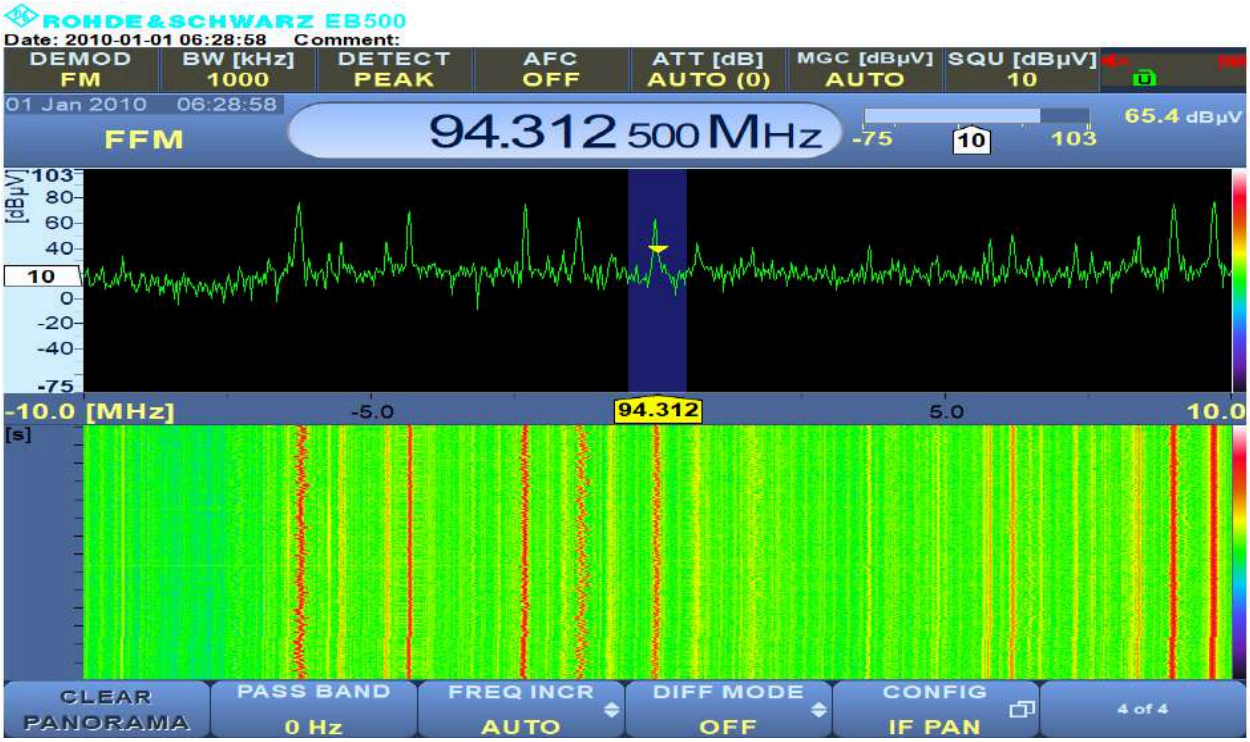
BBS



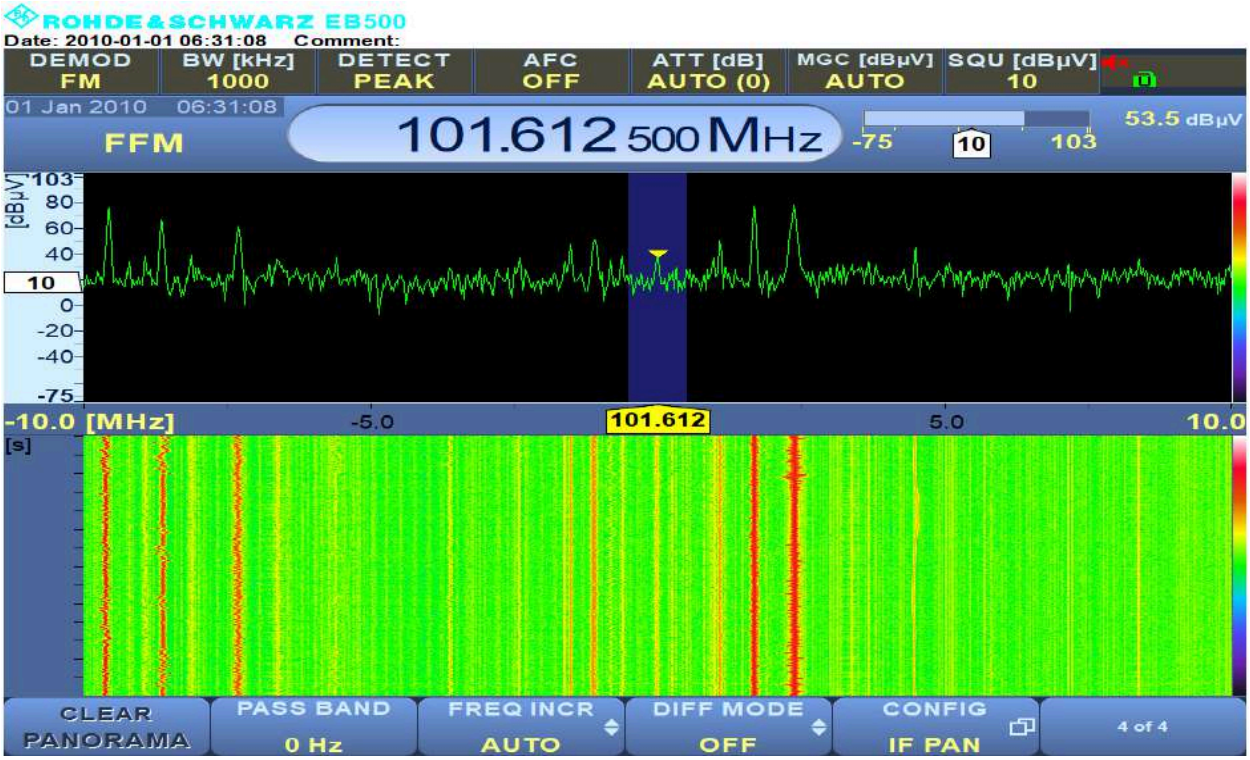
BBS



Indian Broadcasting



Indian BC



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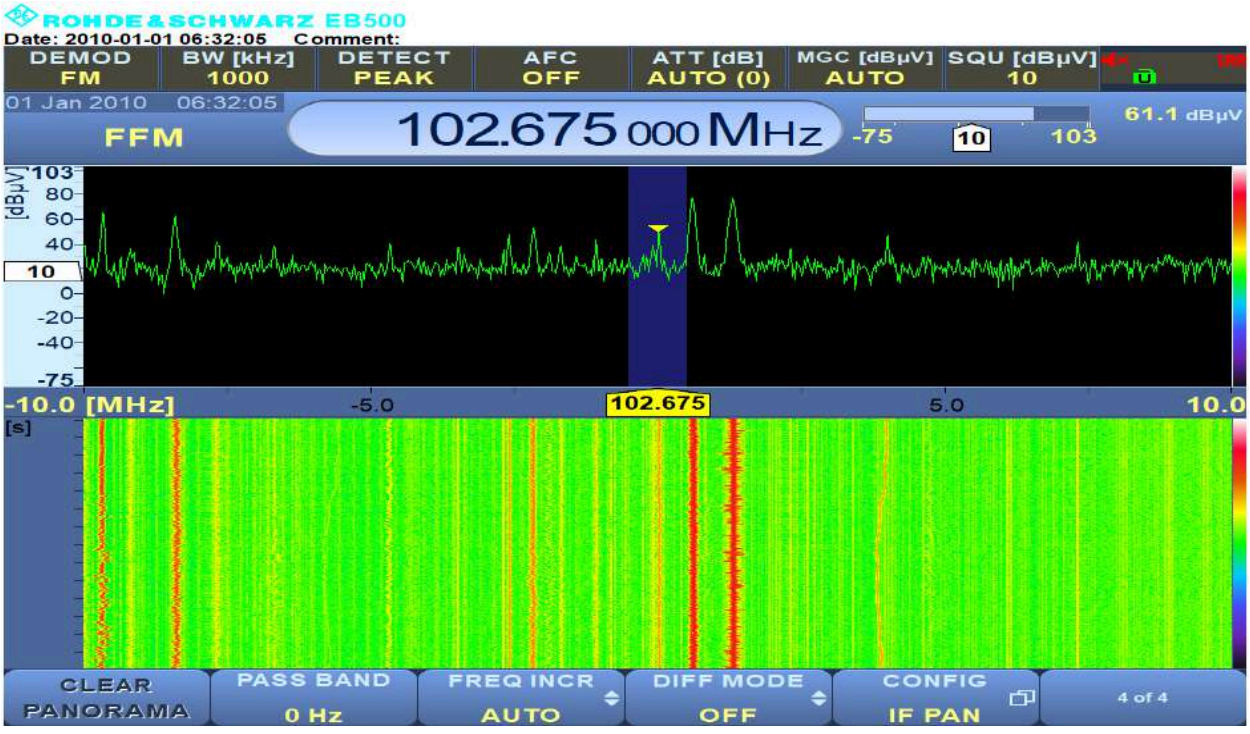
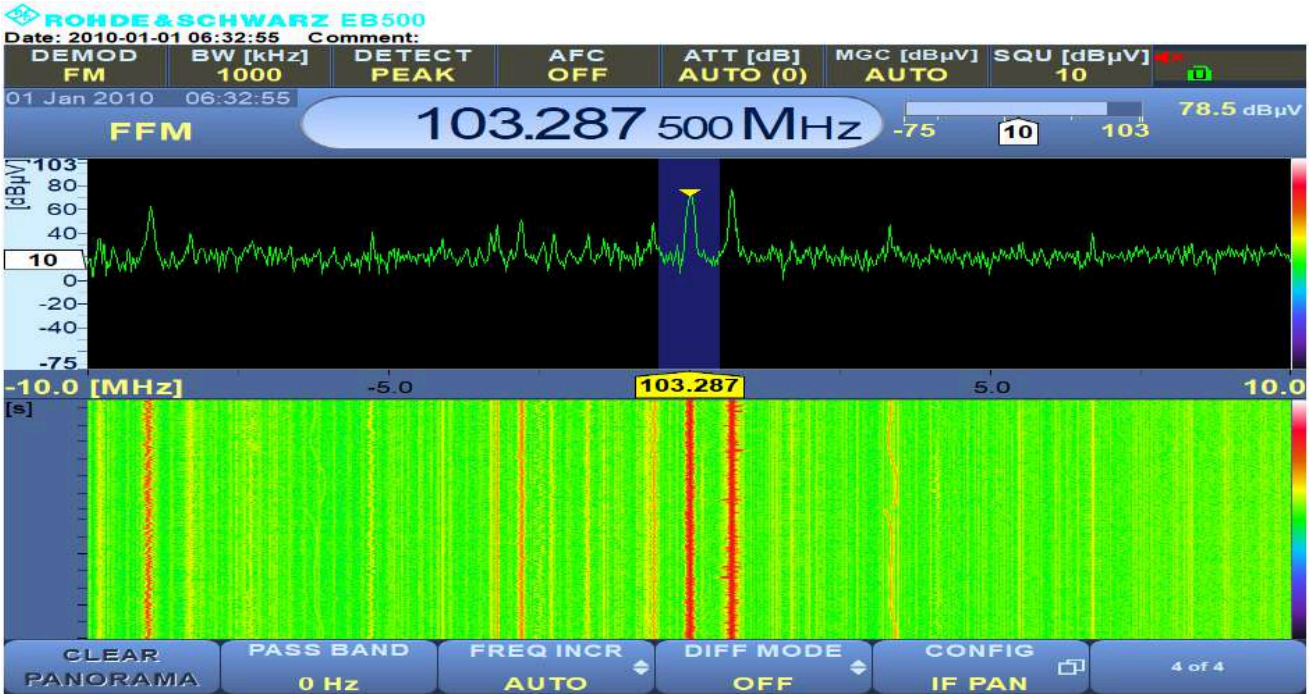


Indian BC



Kazoo FM