Quarterly Report on EMF Monitoring

(October - December 2024)

Bhutan InfoComm and Media Authority

Royal Government of Bhutan

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1. Background

Electromagnetic Field (EMF) Emissions are the electric and magnetic fields that are produced by radios, microwaves, mobile phones and base stations (mobile towers). Telecommunications transmitters generate electromagnetic fields at radio and microwave frequencies. Transmitters have proliferated with siting of wireless communication networks often co-located among other transmitters and the transmitter used in contact with human bodies. If the EMF exposure is prolonged there may be issues of possible health risks. Such risks must be managed and prevented. Currently International Commission on Non-Ionizing Radiation Protection (ICNIRP) standards and various other standards are adopted on the assessment and compliance of the exposure levels radiated from different electromagnetic spectrum sources according to the permissible levels in order to protect the people from exposure to higher RF radiations. The most sources of exposure include the cellular network using GSM, WCDMA, LTE and others which occupy the VHF, UHF, L and S band frequencies.

The Bhutan InfoComm and Media Authority have always been monitoring and measuring the EMF radiation level of each Telecommunication Base Transceiver station (towers) in the country based on the EMF emission standards. The Authority also certifies the EMF compliance of the mobile towers in the country mainly in urban areas and satellite towns areas.

The EMF emission standard is derived from the EMF radiation threshold developed by ICNIRP and the Authority has standardized the threshold level of EMF radiation exposure based on the regional threshold.

2. Monitoring

The Authority has monitored the EMF from October to December, 2024 in following places;

Sl.No	Name of the Monitored Places	Number of tower Monitored
1	Sarpang	9
2	Tsirang	5
3	Danaga	4
4.	Thimphu	4

The Authority will continue to monitor and measure the mobile towers in the country and will be issued with the certificate of EMF threshold compliance respectively.

3. Objective of the Monitoring

The main objective of the EMF measurement monitoring is:

- To ensure the safe and reliable communication services.
- To test the exposure levels produced by any transmitter or emitter such as telecommunication facilities and mobile telephone base stations for safety purposes and maintain the EMF emission within the standard threshold.
- To ensure that all telecommunication equipment is safe and secure.

4. Details of the Equipment used for EMF Compliance Test

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

Equipment Make/Model:	Narda Safety test solution
Type of the Antenna:	Isotropic Antenna/Type (3-Axis), 420 MHz-6GHz
Spectrum Analyzer:	SRM3006 (9kHz-6GHz)
Calibration details:	Calibrated on 7-03-2024 and valid up to 2 to 3 years

5. Specification of the Equipment/ Instrument

The specification of the above equipment are as mentioned below:

- 3-axis, E-field antenna: 420 MHz to 6 GHz
- Spectrum analyzer SRM 3006: 9 kHz to 6GHz
- A 1.5 meter cable to separate the antenna from the meter
- Tripod to hold the antenna

Figure 1: EMF Monitoring

6. Measurement Parameter

The following quantities are measured while monitoring:

- Electric Field strength E in **V/m**

7. Methodology

The following methodology processes are followed while carrying out the monitoring:

- The measurement is done around 10 meters to 30 meters away from the sectoral antenna's BTS towers facing towards the measurement equipment which is based on the ICNIRP standards measurement.
- The measurement result is taken as the average/Max over a time period of 6 minutes.
- The measurement is done for 2G, 3G, 4G and 5G BTS Tower for both the telecom operators.
- Measurement values will be recorded and compare the measurement values with the reference level as per the international standard ICNIRP.
- Measurement is done through broadband measurement and if the exposure ratio is higher than the exposure ratio limits, the frequency selective measurement is recommended.

8. Reference Standards and Regulation/ICNIRP limits

According to Section 10(1), and 10(2) of the "Standard for the Establishment of Telecommunications Tower"

- 10 (1): *All telecommunication and broadcasting sites shall ensure compliance with the ICNIRP Procedures and Standards for general public exposure and take immediate actions to rectify any non-compliant Sites.*

- 10(2): *Antennas in all sites shall not emit the EMF radiation more than the standards shown in the table below*;

Frequency range	**Electric field-strength (V/m)**		**Equivalent plane wave power-density S_{eq}(W/m^2)**	
	general public	**occupational**	**general public**	**Occupational**
0.1 - 30 Hz	$300/(10^{0.5}*f^{0.7)}$ MHz)	$600/(10^{0.5}*f^{0.7}$MHz)	NA	NA
>30 – 400 MHz	$27.7/10^{0.5}$	$61/10^{0.5}$	0.2	1

>400 - 2000 MHz	$(1.375f^{0.5}$(MHz) $)/10^{0.5}$	$(3f^{0.5}$ (MHz))$/10^{0.5}$	(f/2000)	(f/400)
>2 - 300 GHz	19.289	43.323	1	5

9. Findings and Permissible limits of Electric Field and Exposure Ratio

The EMF measurement of the BTS tower was carried out in **Sarpang, Tsirang, Dagana and Thimphu** town Area. It is found that the maximum exposures around all of the base stations are **very low** than exposure limits. The detailed measurement readings , findings, electric field and exposure ratio results are attached below in **Annexure 1** and screenshots of each measurement result are attached in **Annexure 2.**

10. Satellite View of the Measurement Location/Telecom site

The satellite view of the measurement location of each telecom site or transmitter is attached in **Annexure 3.**

Annexure 1 (Measurement Results)

The detailed measurement readings of Electric Field and Exposure Ratio are attached below;

1. Sarpang (Bhutan Telecom Limited)

Sl. No	Site Name	Latitude	Longitude	Frequency Band	Field Strength Measurement Value (V/m)	BICMA Limits V/m ($1.375f^{0.5}$(MHz))/$10^{0.5}$	Exposure Ratio SQRT (Measured V/Limit Value)^2	Exposure Ratio Limits	Remark
1	Tashiding	26°53'02.2" N	90°29'11.8" E	LTE 1800	1.316	18.49	0.0711	**0.5**	**Below the Limits**
2.	Gelephu thromde	26°52'51.2" N	90°29'31.2" E	900 GSM	0.2305	13.27	0.0173	**0.5**	**Below the Limits**
				850 UMTS	0.3721	12.87	0.0289		
				LTE 700	0.6476	12.14	0.0533		
				LTE 1800	1.413	18.49	0.0764		
				UMTS 1900	0.9499	19.29	0.0492		
				TDD2300	0.02891	19.29	0.002017		

				5G 3.5-3.6	0.505	19.29	0.02617		
3	Main Exchange	26°52'09.1" N	90°29'16.3" E	LTE 700	0.5834	12.14	0.0480	**0.5**	**Below the Limits**
				UMTS 850	0..865	12.87	0.0672		
				GSM 900	0.2847	13.27	0.0205		
				LTE 1800	1.3	18.49	0.0703		
				UMTS 1900	0.5742	19.29	0.0297		
				TDD 2300	2.3	19.29	0.119		
				5G	1.434	19.29	0.0743		
4	Near Fisheries	26°52'37.4" N	90°29'42.4" E	LTE 1800	2.048	18.49	0.110	**0.5**	**Below the Limits**
5	Sarpang tar	26°51'58.9" N	90°16' 01.4" E	LTE 700	0.5321	12.14	0.0438	**0.5**	**Below the Limits**
				UMTS 850	0.3274	12.87	0.0254		
				GSM 900	0.6908	13.27	0.0520		
				TLE 1800	0.9685	18.49	0.0523		
				UMTS 1900	0.6521	19.29	0.0338		
				TDD 2300	0.0281	19.29	0.001456		
				5G	0.717	19.29	0.0371		
6	Old Sarpang Checkpost	26°52'44.2" N	90°16'01.9" E	GSM 900	0.332	13.27	0.0250		

				LTE 1800	0.5992	18.49	0.0324	**0.5**	**Below the Limits**
				5G	0.06589	19.29	0.003411		
7	Rani Bagan new town	26°53'04.3" N	90°16'03.6" E	LTE 1800	0.5677	18.49	0.0307	**0.5**	**Below the Limits**
				5G	0.06675	19.29	0.003461		

2. Sarpang (Tashi InfoCom Private Limited)

Sl. No	**Site Name**	**Latitude**	**Longitude**	**Frequency Band**	**Field Strength Measurement Value (V/m)**	**BICMA Limits V/m ($1.375f^{0.5}$(MHz))/$10^{0.5}$**	**Exposure Ratio SQRT (Measured V/Limit Value)^2**	**Exposure Ratio Limits**	**Remark**
1	Netop Building, Tashidhing	26°53'02.2" N	90°29'11.8" E	GSM 900	0.03219	13.34	0.002413	**0.5**	**Below the Limits**
				LTE 1800	1.853	18.64	0.0994		
				5G	0.6438	19.29	0.0333		
				LTE 700	0.04124	11.95	0.00345		
				UMTS 850	0.0291	12.79	0.00227		
				TDD 2300	0.02782	19.29	0.00144		
2	Near BOD	26°52'16.5" N	90°29'07.2" E	GSM 900	0.4969	13.34	0.0372		

				UMTS 850	0.4584	12.79	0.0358	**0.5**	**Below the Limits**
				LTE 700	0.5157	11.95	0.0431		
				TDD 2300	0.0542	19.29	0.00280		
				LTE 1800	1.583	18.64	0.0847		
				5G 3.4-3.5	0.3747	19.29	0.019		

3. Tsirang (Bhutan Telecom Limited)

Sl. No	**Site Name**	**Latitude**	**Longitude**	**Frequency Band**	**Field Strength Measurement Value (V/m)**	**BICMA Limits V/m ($1.375f^{0.5}$(MHz))/$10^{0.5}$**	**Exposure Ratio SQRT (Measured V/Limit Value)^2**	**Exposure Ratio Limits**	**Remark**
1	Main Exchange	27°0'09.9" N	90°7'25.8" E	GSM 900	0.2724	13.27	0.0205	**0.5**	**Below the Limits**
				LTE 1800	1.269	18.49	0.0686		
				LTE700	0.7749	12.34	0.0627		
				UMTS 850	0.06715	12.678	0.00529		
				5G	0.8672	19.29	0.0449		

2.	Near Police station	27°0'34.0" N	90°7'25.2" E	LTE 700	0.8132	12.14	0.0669	**0.5**	**Below the Limits**
				GSM 900	0.3594	13.27	0.0270		
				LTE 1800	1.688	18.49	0.0912		
				TDD 2300	1.413	19.29	0.0732		
				5G	1.512	19.29	0.0783		
3	Danphu Main Town	27°0'34.0" N	90°7'25.2" E	LTE 1800	0.6025	18.49	0.0309	**0.5**	**Below the Limits**

4. Tsirang (Tashi InfoComm Limited)

Sl. No	**Site Name**	**Latitude**	**Longitude**	**Frequency Band**	**Field Strength Measurement Value (V/m)**	**BICMA Limits V/m $(1.375f^{0.5}(MHz))/10^{0.5}$**	**Exposure Ratio SQRT (Measured V/Limit Value)^2**	**Exposure Ratio Limits**	**Remark**
1	Damphu Town	27°0'16.3" N	90°7'30.3" E	GSM 900	0.4307	13.34	0.0322	**0.5**	**Below the Limits**
				LTE 1800	0.7439	18.64	0.0399		
				LTE 700	0.05174	11.95	0.00432		

				5G	3.765	19.29	0.195		
				UMTS 850	0.3483	12.79	0.0272		

5. Dagana (Bhutan Telecom Limited)

Sl. No	**Site Name**	**Latitude**	**Longitude**	**Frequency Band**	**Field Strength Measurement Value (V/m)**	**BICMA Limits V/m ($1.375f^{0.5}$(MHz))/$10^{0.5}$**	**Exposure Ratio SQRT (Measured V/Limit Value)^2**	**Exposure Ratio Limits**	**Remark**
1	Dzong area	27°4'121.6" N	89°52'49.3" E	GSM 900	0.3208	13.27	0.0241	**0.5**	**Below the Limits**
				LTE 1800	0.7716	18.49	0.0417		
				5G	0.3918	19.29	0.0203		
2	Kana Gewog	27°2'12.1" N	89°54'38.4" E	LTE 1800	0.2327	18.49	0.0125	**0.5**	**Below the Limits**
				GSM 900	0.1687	13.27	0.0127		
				UMTS 850	0.094	12.37	0.00487		
				5G	0.06363	19.29	0.00329		
3	Dagapela Town	26°55'51.5' N	89°57'35.5" E	LTE 1800	2.576	18.49	0.139	**0.5**	**Below the Limits**

4	Dagapela school	26°56'03.5' N	89°57'24.7" E	LTE 700	0.329	12.14	0.0271		
				UMTS 850	0.0667	12.87	0.00518		
				GSM 900	0.5327	13.27	0.040	**0.5**	**Below the Limits**
				LTE 1800	0.6999	18.49	0.0378		
				5G	0.0668	19.29	0.00346		

6. Dagana (Tashi Infocom Private Limited)

Sl. No	**Site Name**	**Latitude**	**Longitude**	**Frequency Band**	**Field Strength Measurement Value (V/m)**	**BICMA Limits V/m ($1.375f^{0.5}$(MHz))/$10^{0.5}$**	**Exposure Ratio SQRT (Measured V/Limit Value)^2**	**Exposure Ratio Limits**	**Remark**
2	Kana Gewog	27°4'121.3" N	89°52'49.1" E	LTE 1800	0.8151	18.64	0.0437	**0.5**	**Below the Limits**
				UMTS 850	0.0.2122	12.79	0.001659		
				GSM 900	0.4535	13.34	0.0339		
				5G	0.9026	19.29	0.0467		

7. Changjiji Tashi InfoCom Private Limited)

Sl. No	Site Name	Latitude	Longitude	Frequency Band	Field Strength Measurement Value (V/m)	BICMA Limits V/m $(1.375f^{0.5}(MHz))/10^{0.5}$	Exposure Ratio SQRT (Measured V/Limit Value)^2	Exposure Ratio Limits	Remark
1	Changjiji	27°27'20.6" N	89°39'12.2" E	5G	1.607	19.29	0.03833	0.5	Below the Limits
				LTE 1800	0.8824	18.49	0.04782		

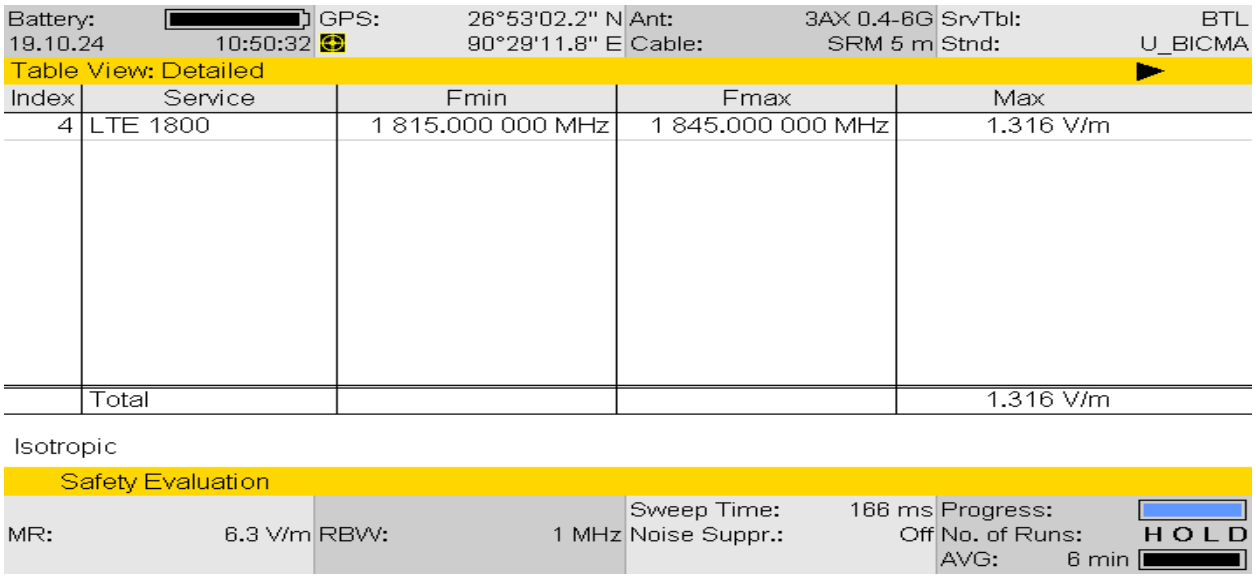
8. Changjiji (Bhutan Telecom Limited)

Sl. No	Site Name	Latitude	Longitude	Frequency Band	Field Strength Measurement Value (V/m)	BICMA Limits V/m $(1.375f^{0.5}(MHz))/10^{0.5}$	Exposure Ratio SQRT (Measured V/Limit Value)^2	Exposure Ratio Limits	Remark
1	Changjiji	27°27'20.6" N	89°39'12.2" E	2300 TDD	2.522	19.29	0.1307	0.5	Below the Limits
				5G	0.3998	19.29	0.02072		
				LTE 1800	0.1757	18.49	0.009502		

2	Changjiji	27°27'13.8" N	89°39'20.4" E	LTE 1800	4.270	18.49	0.230	**0.5**	**Below the Limits**
				5G	1.436	19.29	0.0744		
				LTE 700	0.2555	12.14	0.0210		
				TDD 2300	0.1902	19.29	0.00986		
				UMTS 850	0.1838	12.87	0.01428		
				GSM 900	0.1681	13.27	0.01266		
				UMTS 1900	0.1125	18.49	0.00608		
3	Changjiji	27°27'07.8" N	89°39'12.8" E	LTE 1800	1.524	18.49	0.0824	**0.5**	**Below the Limits**
				5G	0.4416	19.29	0.0228		
				TDD2300	0.4106	19.29	0.0212		
				LTE700	0.2664	12.14	0.0219		
				GSM900	0.1887	13.27	0.0142		
				UMTS850	0.1826	12.87	0.01418		
				UMTS1900	0.1186	18.49	0.00641		

Annexure 2 (Screenshot of the result)

The following are the screenshot images of measurement result;



Battery:		GPS:	26°53'02.2" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
19.10.24	10:50:32		90°29'11.8" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

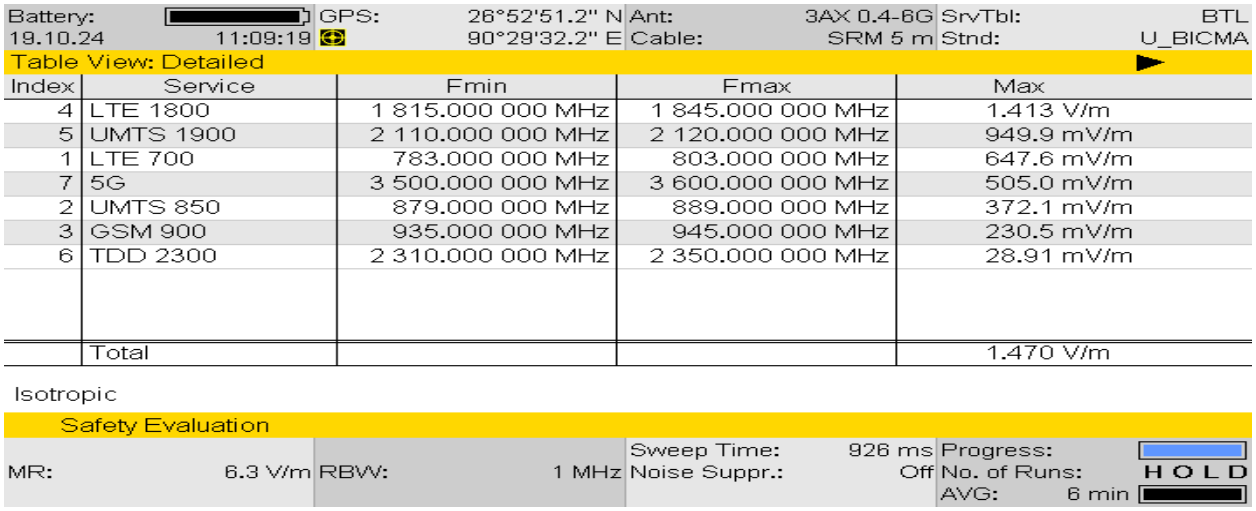
Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	1.316 V/m
	Total			1.316 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	166 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 1: Tashidhing Gelephu Bhutan Telecom Limited



Battery:		GPS:	26°52'51.2" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
19.10.24	11:09:19		90°29'32.2" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	1.413 V/m
5	UMTS 1900	2 110.000 000 MHz	2 120.000 000 MHz	949.9 mV/m
1	LTE 700	783.000 000 MHz	803.000 000 MHz	647.6 mV/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	505.0 mV/m
2	UMTS 850	879.000 000 MHz	889.000 000 MHz	372.1 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	230.5 mV/m
6	TDD 2300	2 310.000 000 MHz	2 350.000 000 MHz	28.91 mV/m
	Total			1.470 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	926 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 2: Gelephu Thromde Bhutan Telecom Limited

Battery:		GPS:	26°52'09.1" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
19.10.24	11:40:54		90°29'16.3" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
6	TDD 2300	2 310.000 000 MHz	2 350.000 000 MHz	2.300 V/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	1.434 V/m
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	1.300 V/m
2	UMTS 850	879.000 000 MHz	889.000 000 MHz	865.0 mV/m
1	LTE 700	783.000 000 MHz	803.000 000 MHz	583.4 mV/m
5	UMTS 1900	2 110.000 000 MHz	2 120.000 000 MHz	574.2 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	284.7 mV/m
	Total			2.649 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	926 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 3: Main Exchange Bhutan Telecom Gelephu

Battery:		GPS:	26°52'37.4" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
19.10.24	12:01:57		90°29'42.4" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	2.048 V/m
	Total			2.048 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	166 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 4: Near the Fishery Centre Gelephu Bhutan Telecom Limited

Battery:		GPS:	26°51'58.9" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
20.10.24	10:20:39		90°16'01.4" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	968.5 mV/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	711.7 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	690.8 mV/m
5	UMTS 1900	2 110.000 000 MHz	2 120.000 000 MHz	652.1 mV/m
1	LTE 700	783.000 000 MHz	803.000 000 MHz	532.1 mV/m
2	UMTS 850	879.000 000 MHz	889.000 000 MHz	322.4 mV/m
6	TDD 2300	2 310.000 000 MHz	2 350.000 000 MHz	28.10 mV/m
	Total			1.187 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	925 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG: 6 min	

Figure 5: Sarpang tar Bhutan Telecom Limited

Battery:		GPS:	26°52'44.2" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
20.10.24	10:50:17		90°16'01.9" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	599.2 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	332.0 mV/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	65.89 mV/m
	Total			673.0 mV/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	442 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG: 6 min	

Figure 6: Old Sarpang Check Post

Battery:		GPS:	26°53'04.3" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
20.10.24	11:07:22		90°16'03.6" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	567.7 mV/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	66.75 mV/m
	Total			571.2 mV/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	327 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 7: Sarpang Ranibagan Bhutan Telecom Limited

Battery:		GPS:	26°53'02.2" N	Ant:	3AX 0.4-6G	SrvTbl:	TICPL
19.10.24	10:41:40		90°29'11.8" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 845.000 000 MHz	1 880.000 000 MHz	1.853 V/m
6	5G	3 400.000 000 MHz	3 500.000 000 MHz	643.8 mV/m
1	LTE 700	758.000 000 MHz	778.000 000 MHz	41.24 mV/m
3	GSM 900	945.000 000 MHz	955.000 000 MHz	32.19 mV/m
2	UMTS 850	869.000 000 MHz	879.000 000 MHz	29.10 mV/m
5	TDD 2300	2 350.000 000 MHz	2 390.000 000 MHz	27.82 mV/m
	Total			1.856 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	811 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 8: Net top Building Tashi Infocom Limited

Battery:		GPS:	26°52'16.5" N	Ant:	3AX 0.4-6G	SrvTbl:	TICPL
19.10.24	11:26:13		90°29'07.2" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 845.000 000 MHz	1 880.000 000 MHz	1.583 V/m
1	LTE 700	758.000 000 MHz	778.000 000 MHz	515.7 mV/m
3	GSM 900	945.000 000 MHz	955.000 000 MHz	496.9 mV/m
2	UMTS 850	869.000 000 MHz	879.000 000 MHz	458.4 mV/m
6	5G	3 400.000 000 MHz	3 500.000 000 MHz	374.7 mV/m
5	TDD 2300	2 350.000 000 MHz	2 390.000 000 MHz	54.20 mV/m
	Total			1.706 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	809 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 9: BOD Gelephu Tashi Infocom Limited

Battery:		GPS:	27°4'21.6" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
22.10.24	14:43:43		89°52'49.3" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	771.6 mV/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	391.8 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	320.8 mV/m
	Total			821.1 mV/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	449 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 10: Dagana Dzong area Bhutan Telecom Limited

Battery:		GPS:	27°2'12.1" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
23.10.24	10:53:16		89°54'38.4" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	232.7 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	168.7 mV/m
2	UMTS 850	879.000 000 MHz	889.000 000 MHz	94.23 mV/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	63.63 mV/m
	Total			260.1 mV/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	559 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 11: Dagana, Kana Gewog Bhutan Telecom Limited

Battery:		GPS:	26°55'51.5" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
23.10.24	12:05:46		89°57'35.5" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	2.576 V/m
	Total			2.576 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	166 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 12: Dagapela town Bhutan Telecom Limited

Battery:		GPS:	26°56'03.5" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
23.10.24	12:42:29		89°57'24.7" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	699.9 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	532.7 mV/m
1	LTE 700	783.000 000 MHz	803.000 000 MHz	329.0 mV/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	66.86 mV/m
2	UMTS 850	879.000 000 MHz	889.000 000 MHz	66.77 mV/m
	Total			819.5 mV/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	675 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 13: Dagapela School Bhutan Telecom Limited

Battery:		GPS:	27°4'21.3" N	Ant:	3AX 0.4-6G	SrvTbl:	TICPL
22.10.24	14:53:16		89°52'49.0" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
6	5G	3 400.000 000 MHz	3 500.000 000 MHz	902.6 mV/m
4	LTE 1800	1 845.000 000 MHz	1 880.000 000 MHz	815.1 mV/m
3	GSM 900	945.000 000 MHz	955.000 000 MHz	453.5 mV/m
2	UMTS 850	869.000 000 MHz	879.000 000 MHz	212.2 mV/m
	Total			1.103 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time:	568 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 14: Dagana Dzong area Tashi Infocomm Private Limited

Battery:	GPS: 27°0'09.9" N	Ant: 3AX 0.4-6G	SrvTbl: BTL
25.10.24 10:48:38	90°7'25.8" E	Cable: SRM 5 m	Stnd: U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	1.269 V/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	867.2 mV/m
1	LTE 700	783.000 000 MHz	803.000 000 MHz	774.9 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	272.4 mV/m
2	UMTS 850	879.000 000 MHz	889.000 000 MHz	67.15 mV/m
	Total			1.289 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time: 684 ms Noise Suppr.: Off	Progress: No. of Runs: HOLD AVG: 6 min

Figure 15: Tsirang Bhutan Telecom Limited Main Exchange

Battery:	GPS: 27°0'34.0" N	Ant: 3AX 0.4-6G	SrvTbl: BTL
25.10.24 11:22:13	90°7'25.2" E	Cable: SRM 5 m	Stnd: U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	1.688 V/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	1.512 V/m
6	TDD 2300	2 310.000 000 MHz	2 350.000 000 MHz	1.413 V/m
1	LTE 700	783.000 000 MHz	803.000 000 MHz	813.2 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	359.4 mV/m
	Total			2.045 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time: 694 ms Noise Suppr.: Off	Progress: No. of Runs: HOLD AVG: 6 min

Figure 16: Tsirang Police station Bhutan Telecom Limited

Battery:	GPS: 27°0'24.6" N	Ant: 3AX 0.4-6G	SrvTbl: BTL
25.10.24 11:37:09	90°7'28.9" E	Cable: SRM 5 m	Stnd: U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	602.5 mV/m
	Total			602.5 mV/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time: 166 ms Noise Suppr.: Off	Progress: No. of Runs: HOLD AVG: 6 min

Figure 17: Tsirang Main Town Bhutan Telecom Limited

Battery:	GPS: 27°0'16.3" N	Ant: 3AX 0.4-6G	SrvTbl: TICPL
25.10.24 11:03:57	90°7'30.3" E	Cable: SRM 5 m	Stnd: U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
6	5G	3 400.000 000 MHz	3 500.000 000 MHz	3.765 V/m
4	LTE 1800	1 845.000 000 MHz	1 880.000 000 MHz	743.9 mV/m
3	GSM 900	945.000 000 MHz	955.000 000 MHz	430.7 mV/m
2	UMTS 850	869.000 000 MHz	879.000 000 MHz	348.3 mV/m
	Total			3.805 V/m

Isotropic

Safety Evaluation

MR:	6.3 V/m	RBW:	1 MHz	Sweep Time: 568 ms Noise Suppr.: Off	Progress: No. of Runs: HOLD AVG: 6 min

Figure 18: Tsirang Main town Tashi Infocom Private Limited

Battery:		GPS:	27°27'20.6" N	Ant:	3AX 0.4-6G	SrvTbl:	TICPL
28.11.24	10:36:08		89°39'12.2" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
6	5G	3 400.000 000 MHz	3 500.000 000 MHz	1.607 V/m
4	LTE 1800	1 845.000 000 MHz	1 880.000 000 MHz	882.4 mV/m
	Total			1.833 V/m

Isotropic

Safety Evaluation

MR:	40 V/m	RBW:	1 MHz	Sweep Time:	331 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 19: Tashi InfoCom Private Limited, Changjiji

Battery:		GPS:	27°27'20.6" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
28.11.24	10:44:47		89°39'12.2" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
6	TDD 2300	2 310.000 000 MHz	2 350.000 000 MHz	2.522 V/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	399.8 mV/m
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	175.7 mV/m
	Total			2.551 V/m

Isotropic

Safety Evaluation

MR:	40 V/m	RBW:	1 MHz	Sweep Time:	467 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 20: Bhutan Telecom Limited, Changjiji

Battery:		GPS:	27°27'13.8" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
28.11.24	11:03:55		89°39'20.4" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	4.270 V/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	1.436 V/m
1	LTE 700	783.000 000 MHz	803.000 000 MHz	255.5 mV/m
6	TDD 2300	2 310.000 000 MHz	2 350.000 000 MHz	190.2 mV/m
2	UMTS 850	879.000 000 MHz	889.000 000 MHz	183.8 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	168.1 mV/m
5	UMTS 1900	2 110.000 000 MHz	2 120.000 000 MHz	112.5 mV/m
	Total			4.308 V/m

Isotropic

Safety Evaluation

MR:	40 V/m	RBW:	1 MHz	Sweep Time:	940 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 21: Bhutan Telecom Limited, Changjiji Temple

Battery:		GPS:	27°27'07.8" N	Ant:	3AX 0.4-6G	SrvTbl:	BTL
28.11.24	11:15:47		89°39'12.8" E	Cable:	SRM 5 m	Stnd:	U_BICMA

Table View: Detailed

Index	Service	Fmin	Fmax	Max
4	LTE 1800	1 815.000 000 MHz	1 845.000 000 MHz	1.524 V/m
7	5G	3 500.000 000 MHz	3 600.000 000 MHz	441.6 mV/m
6	TDD 2300	2 310.000 000 MHz	2 350.000 000 MHz	410.6 mV/m
1	LTE 700	783.000 000 MHz	803.000 000 MHz	266.4 mV/m
3	GSM 900	935.000 000 MHz	945.000 000 MHz	188.7 mV/m
2	UMTS 850	879.000 000 MHz	889.000 000 MHz	182.6 mV/m
5	UMTS 1900	2 110.000 000 MHz	2 120.000 000 MHz	118.6 mV/m
	Total			1.631 V/m

Isotropic

Safety Evaluation

MR:	40 V/m	RBW:	1 MHz	Sweep Time:	940 ms	Progress:	
				Noise Suppr.:	Off	No. of Runs:	HOLD
						AVG:	6 min

Figure 22: Bhutan Telecom Limited, Hotel Valley

Annexure 3 (Satellite View of Location of Monitored Sites)

The following are the satellite view of the measurement location of the each Telecom site transmitter;

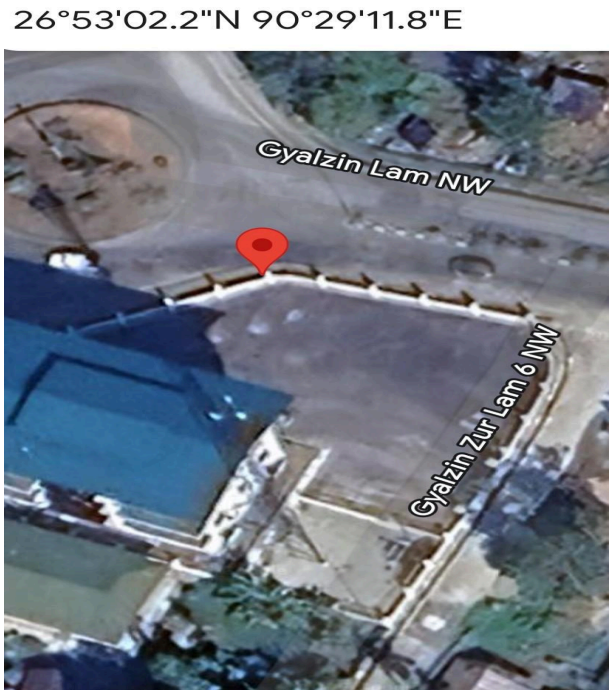


Figure 1: Tashiding*, Sarpang (BTL)*

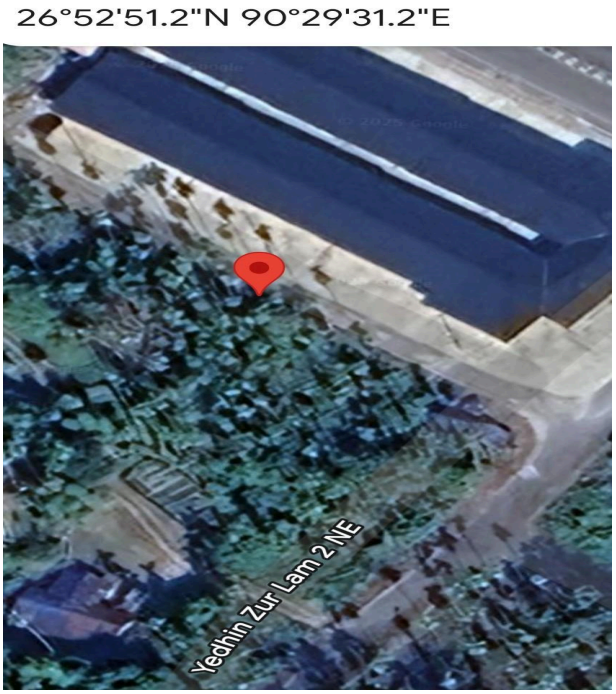


Figure 2: Gelephu Thromde (BTL)

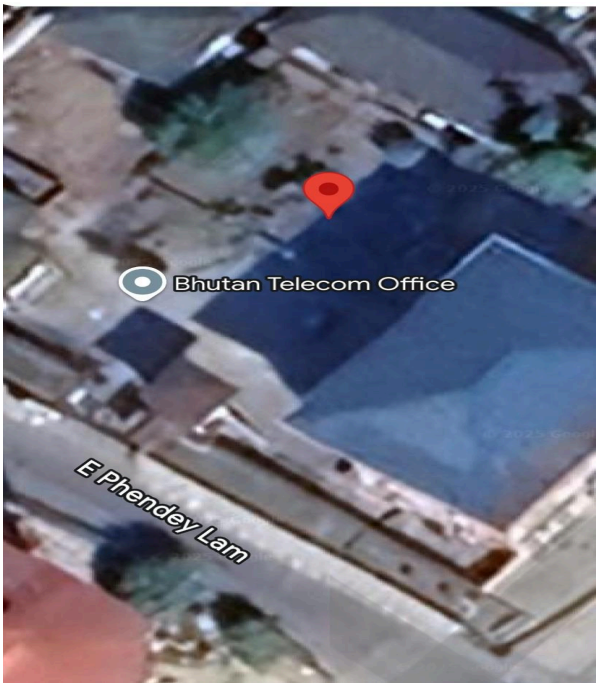


Figure 3: Main Exchange, Sarpang (BTL)

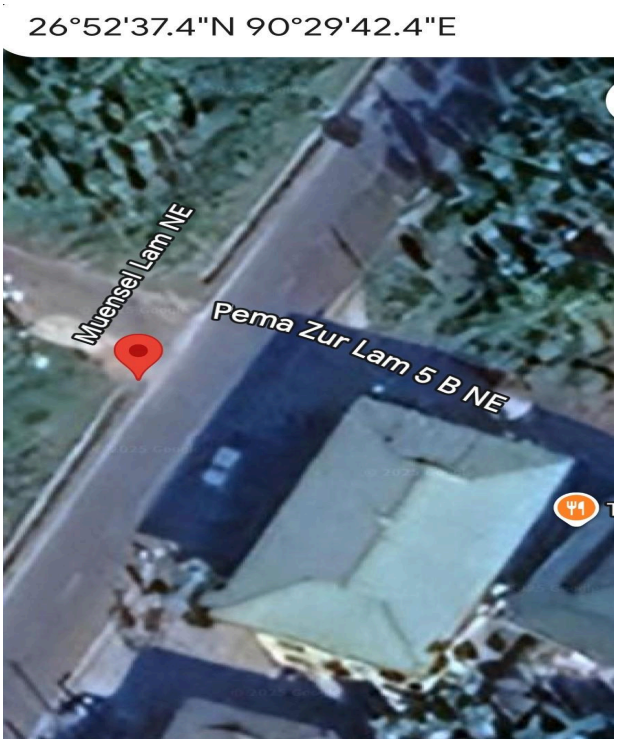


Figure 4: Near Fisheries, Sarpang (BTL)

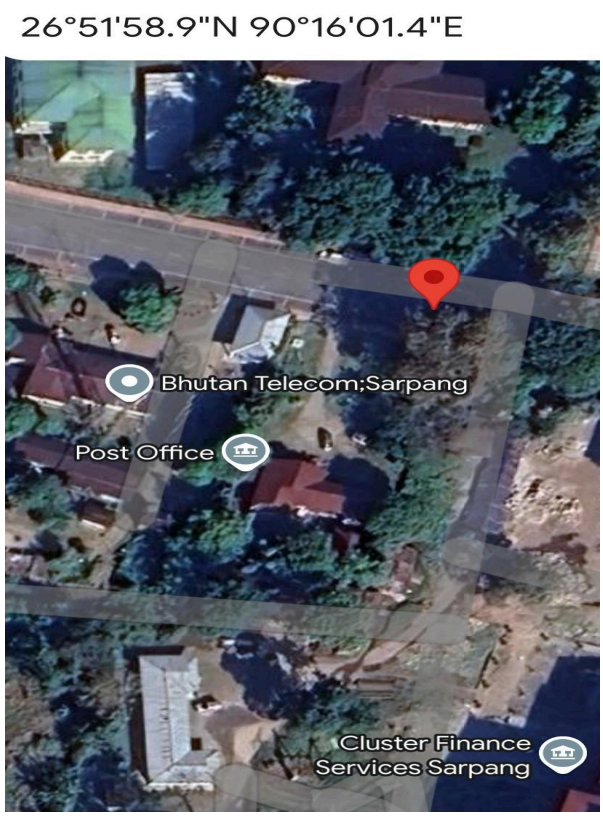


Figure 5: Sarpang tar (BTL)

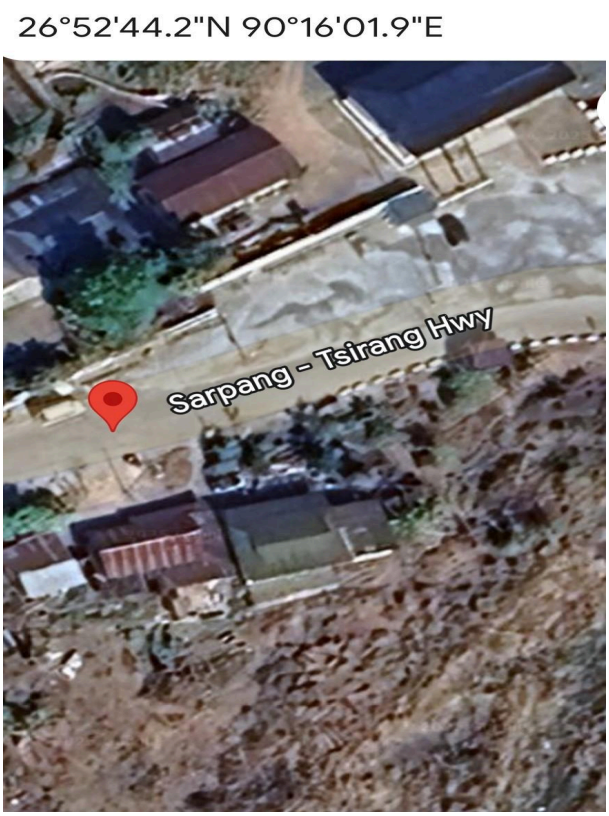


Figure 6: Old Sarpang Checkpost (BTL)

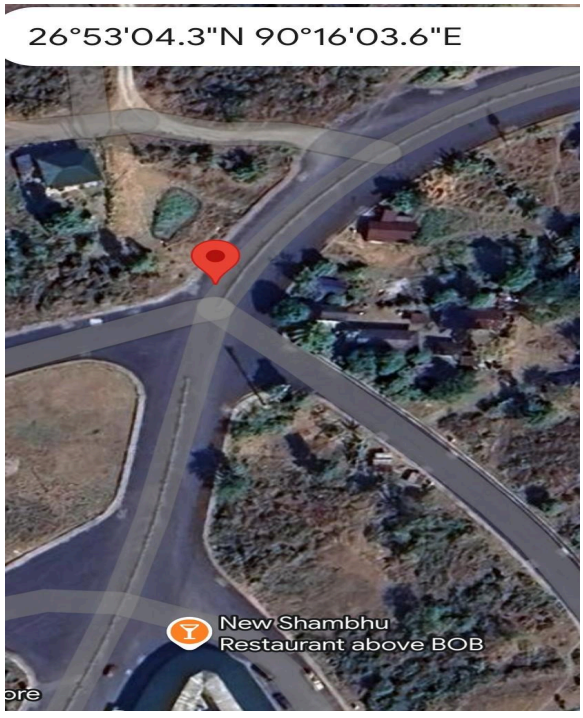


Figure 7: Rani Bagan new town (TICPL)

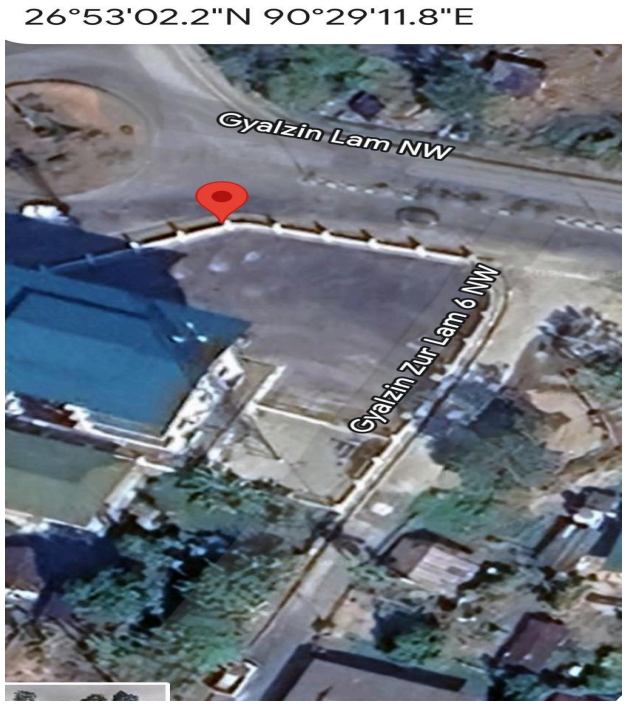


Figure 10: Netop Building, Tashidhin , Sarpang (TICPL)

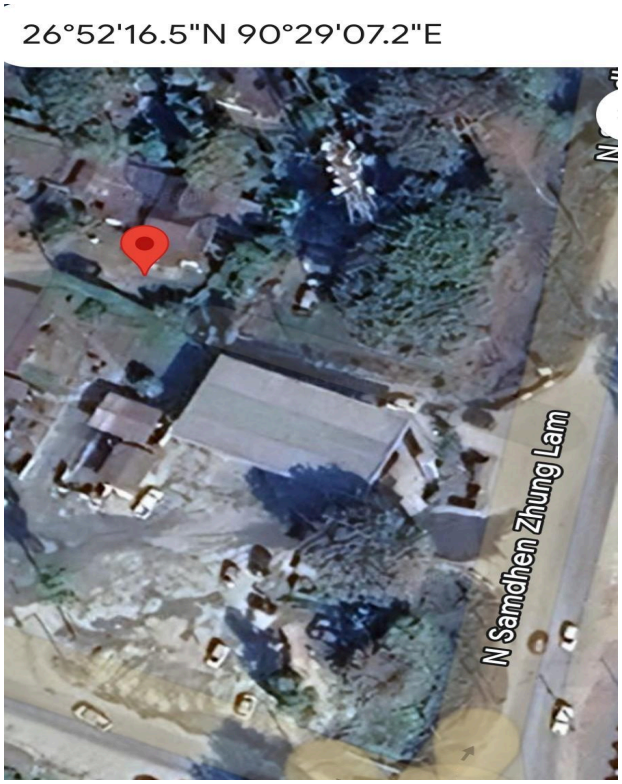


Figure 11: Near BOD, Sarpang (TICPL)

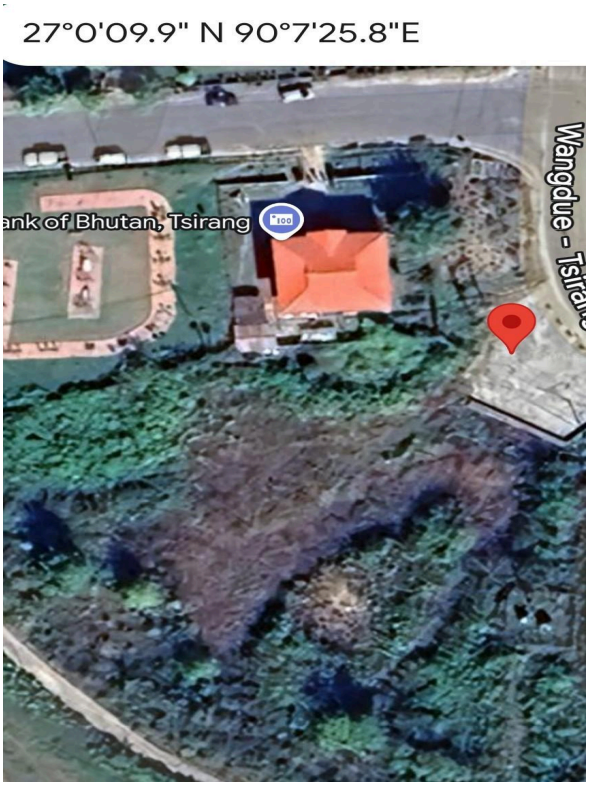


Figure 12: Main Exchange, Tsirang *(BTL)*

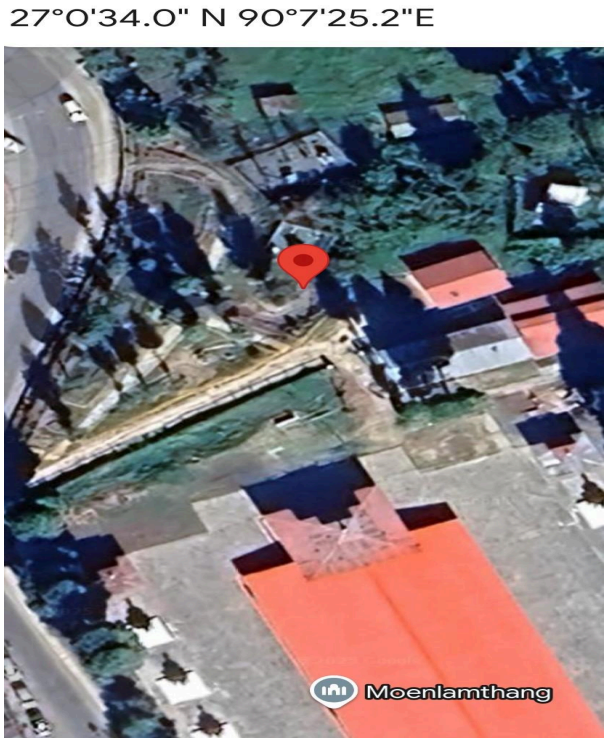


Figure 11: Near Police station, Tsirang (BTL)

Figure 12: Damphu Town, Tsirang (TICPL)

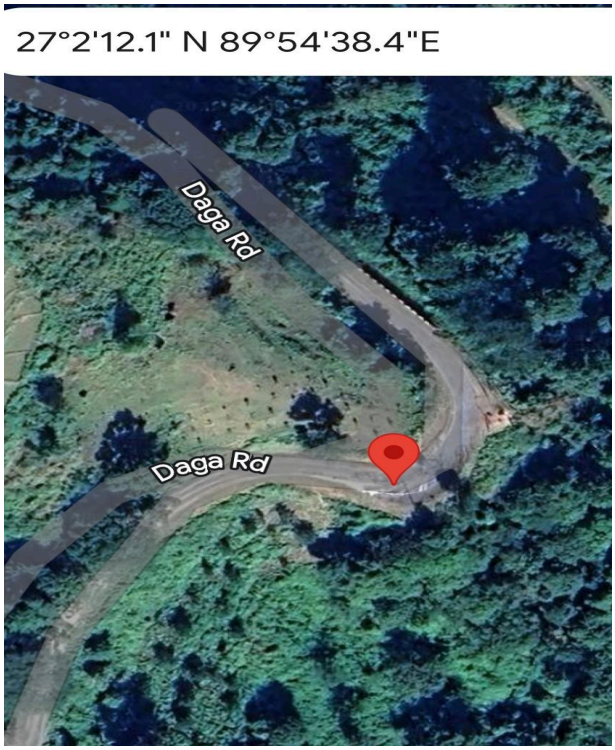


Figure 13: Kana Gewog, Dagana *(BTL)*

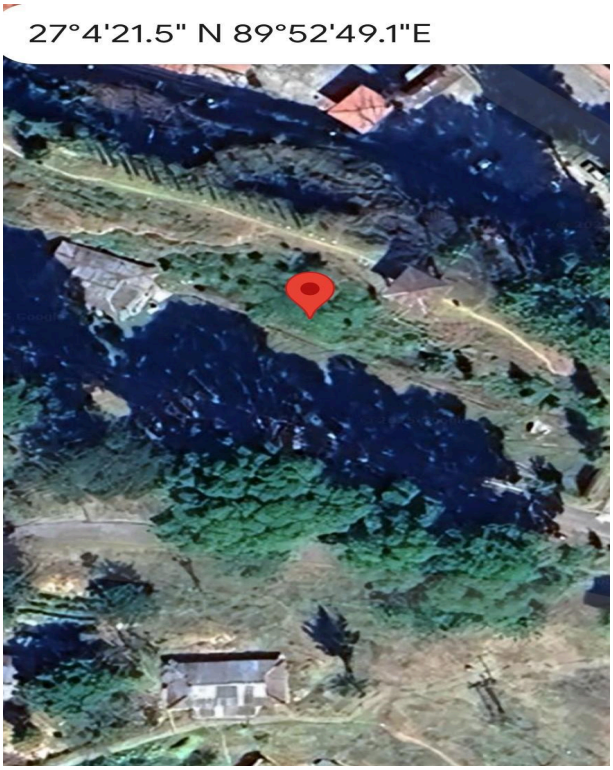


Figure 14: Dagapela Town*(TICPL)*

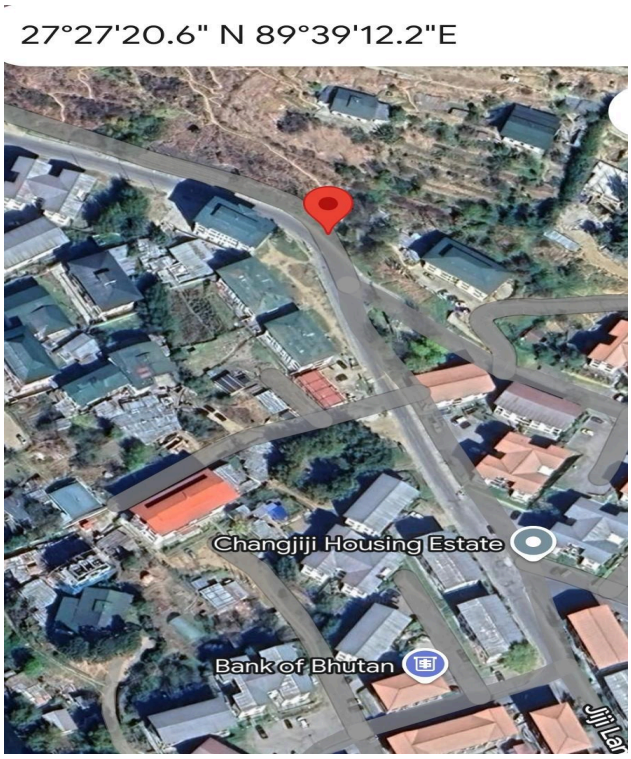


Figure 15: Changjiji, Thimphu (TIPL)

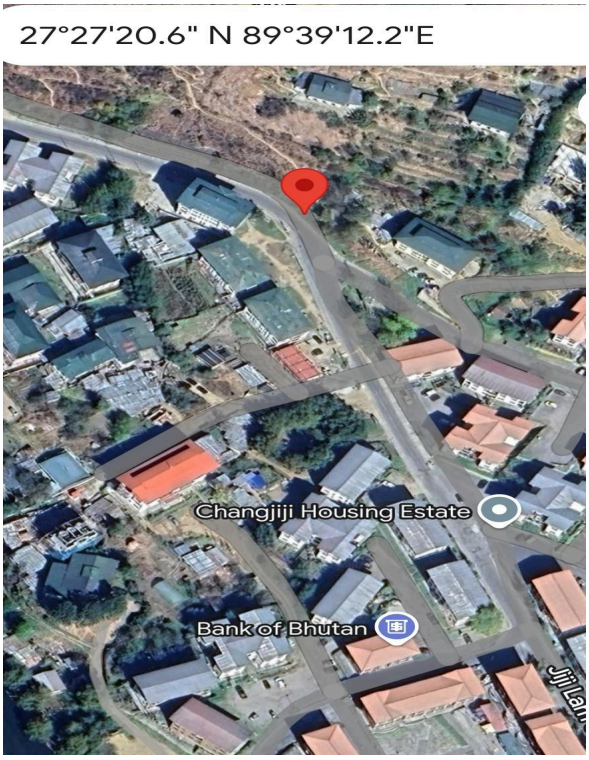


Figure 16: Changjiji, Thimphu (BTL)

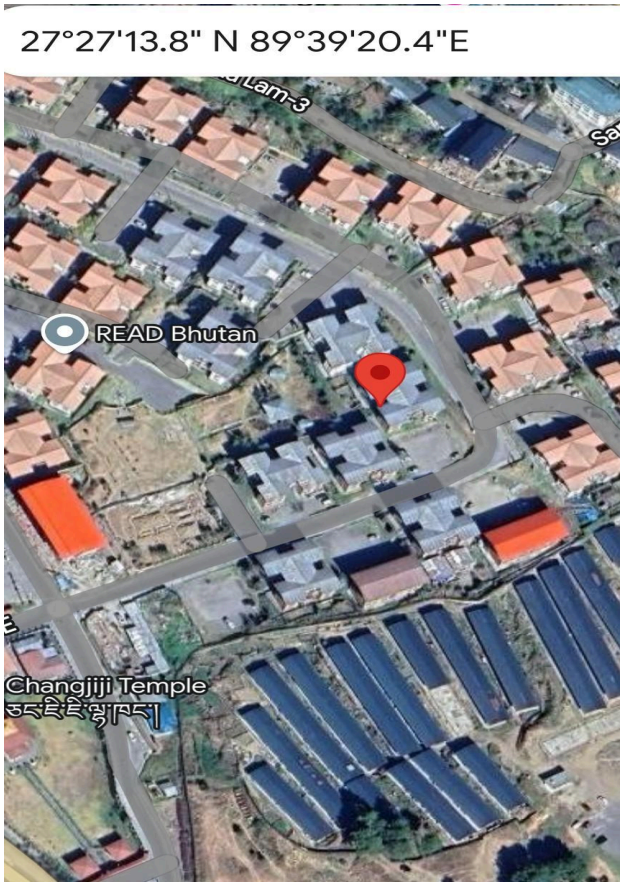


Figure 17: Changjiji Temple, Thimphu (BTL)

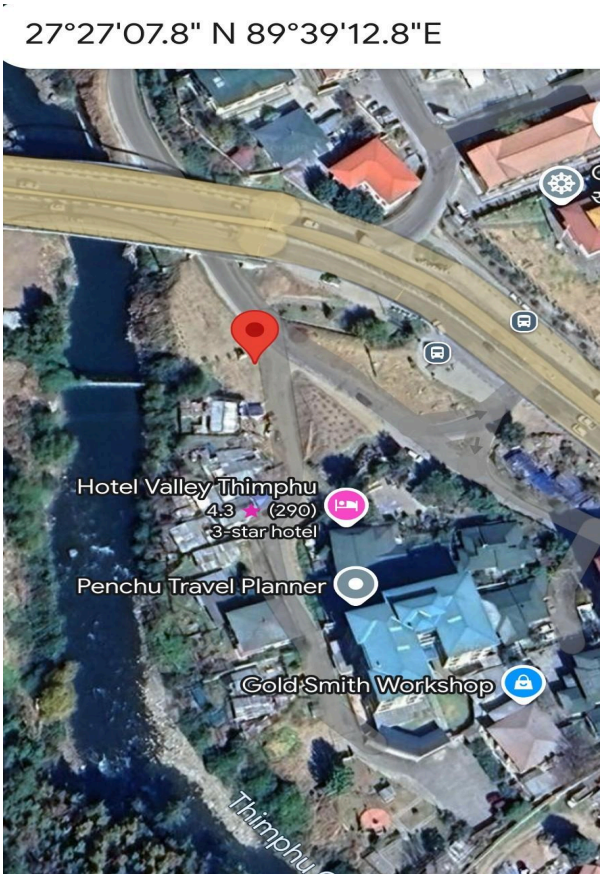


Figure 18: Hotel Valley, Thimphu (BTL)

Annexure 4 (Image of Monitored BTS)

The following are the images of the each Telecom BTS transmitters;

Figure 1: Exchange Gelephu (BTL)

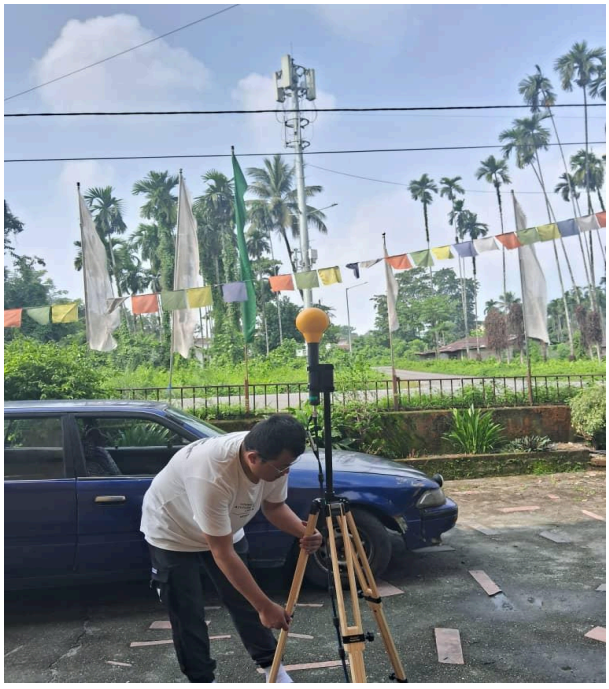


Figure 2: Ranibagan Sarpang (BTL)

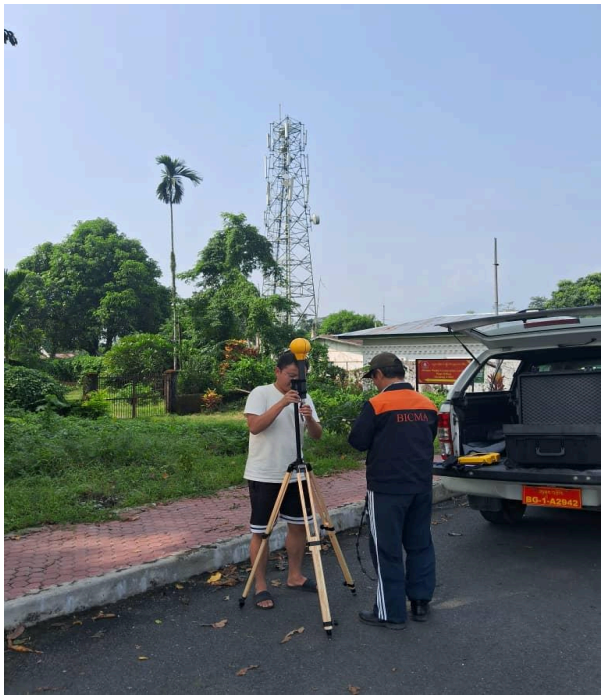


Figure 3: Gelephu Thromde*(BTL)*

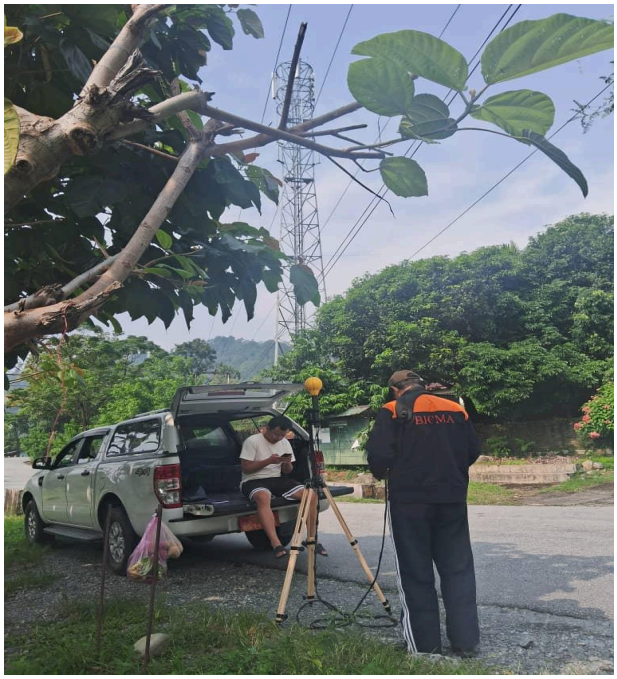


Figure 4: Gelephu Exchange (TIPL)

F*igure 5: Near Fisheries center, Gelephu (BTL)*

Figure 6: Dagana (TIPL

Figure 7: Kana Gewog dagana (BTL)

Figure 8: Dagapela (BTL)

Figure 9: Tsirang Exchange (BTL)

Figure 10:Tsirang (TIPL)

Figure 11: Tsirang Near Police Station (BTL)

Figure 12: Damphu Town (BTL)

Figure 13: Changjiji, Thimphu (TIPL)

Figure 14: Changjiji, Thimphu (BTL)