

# **Quarterly Report on Mobile Quality of Service (QoS)**



**Bhutan InfoComm and Media Authority**  
**Royal Government of Bhutan**

**(October - December) 2022**

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## Report on Mobile Quality of Service (QoS)

### 1. Background

The Bhutan Infocomm and Media Authority (Authority) carries out the Mobile QoS drive test to monitor and report the QoS regularly. The report contains the mobile quality of services for both voice and data through the various parameters of key performance indicators (KPI). The test was carried out in various places in Zhemgang, Pemagatshel, Samdrup Jongkhar and Thimphu.

### 2. Locations and date of monitoring

Sl. No	Dzongkhag	Locations	Monitoring month
1	Zhemgang	Panbang Town	October
2		Panbang Dungkhag	
3		Sonam Thang	
4	Pemagatshel	Nganglam Town	
5		Tshenkhari	
6	Samdrup Jongkhar	Bangtar	
7	Thimphu	Changangkha (Housing, CMSS and RKPS)	
8		Lower Motithang	
9		Ministers' Colony (including the road above MHSS)	
10		MoIC (including ministry areas, BTL and Kawajangsa)	
11		Sangaygang (RITH, Motithang Takin Preserve)	
12		Upper Motithang	
13		Zilukha - Motithang Highway	
14		Bebena	November and December
15		BPC colony Simtokha	
16		Changjalu	
17		Hejo	



18		Jungshina	
19		Olakha Workshop	
20		Around White Tara Hotel (Old BICMA office area)	
21		RIM	
22		Simtokha Dzong	
23		Bhutan Kitchen and Village Restaurant Babesa	
24		Dr.Tobgay school area Babesa	
25		Old Highway Babesa	
26		Zimdra (Below Highway Babesa)	
27		Lower Pamtsho	
28		Upper Pamtsho 1	
29		Upper Pamtsho 2	
30		Lower Taba	
31		Upper Taba	
32		YHSS area	
33		Lower Town	
34		Upper Town	
35		Vegetable Market	
36		Kaja Throm	
37		Changbangdu	
38		Changzamtog	
39		NPPF colony	

### 3. Findings

The findings of the QoS drive test of different operators are presented for different places as shown below:

#### A. Zhemgang

##### 1. Panbang Town.

###### • *Mobile Voice Service*

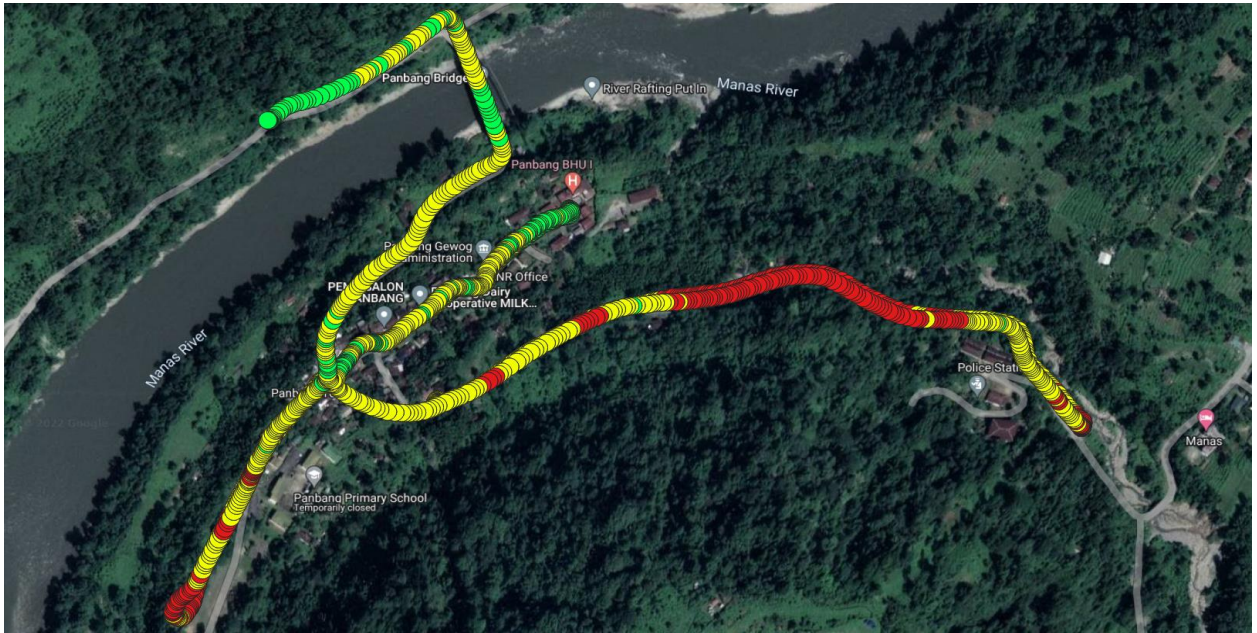
Operators	Call Drop rate (<2%)	Mean Opinion Score ≥3.5	Call Fallback Setup Time ≤9	Remarks
BTL	0	3.77	5.62	No issues
TICL	0	3.83	5.58	No issues

###### • *Data Throughputs (Mbps)(4G)*

Operators	File Transfer Protocol		Remarks
	Download ≥6 Mbps	Upload ≥2 Mbps	
BTL	31.905	11.292	No issues
TICL	31.859	6.901	No issues



Figure A.1.1: RSRP(4G) plot of B-mobile (QGIS) [Panbang Town]



*Figure A.1.2:RSRP(4G) plot of Tashi Cell (QGIS) [Panbang Town]*



## 2. Panbang Dungkhag

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score ≥3.5	CSFB Setup Time ≤9	Remarks
BTL	0	3.86	5.41	No issues
TICL	0	4.09	6.52	No issues

- *Data Throughputs (Mbps)(4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
<b>BTL</b>	23.788	4.204	No issues
<b>TICL</b>	34.981	7.178	No issues

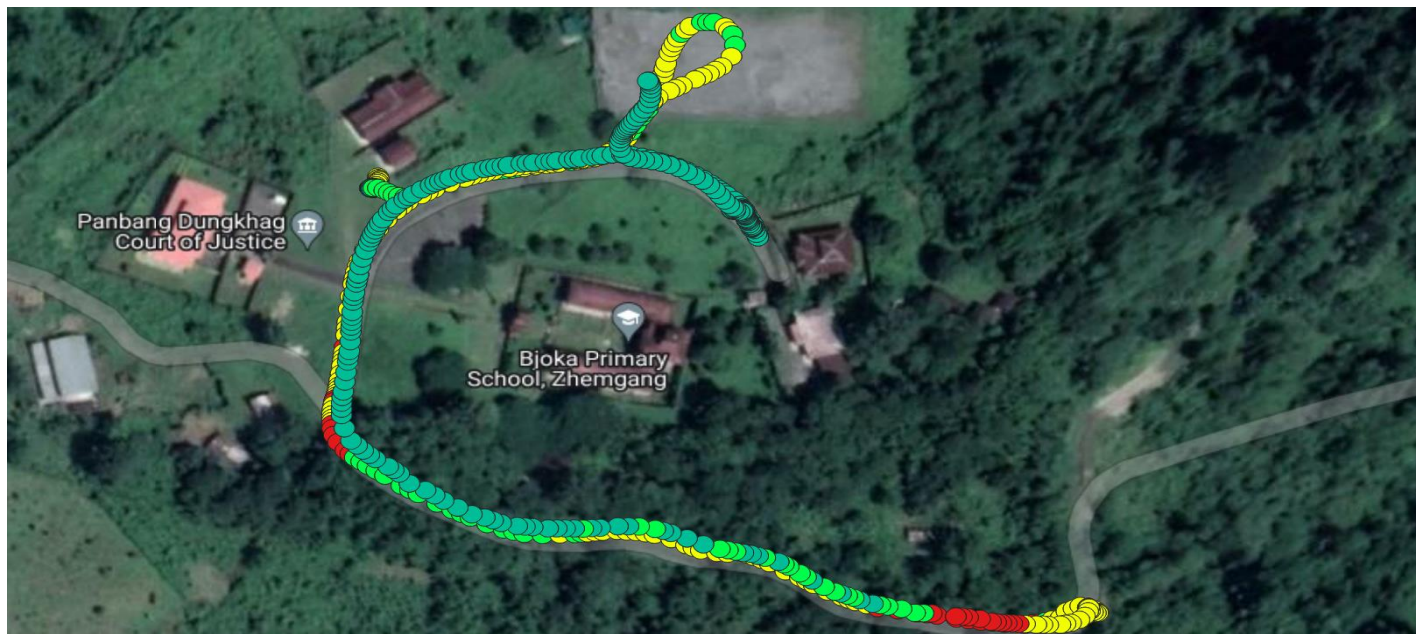
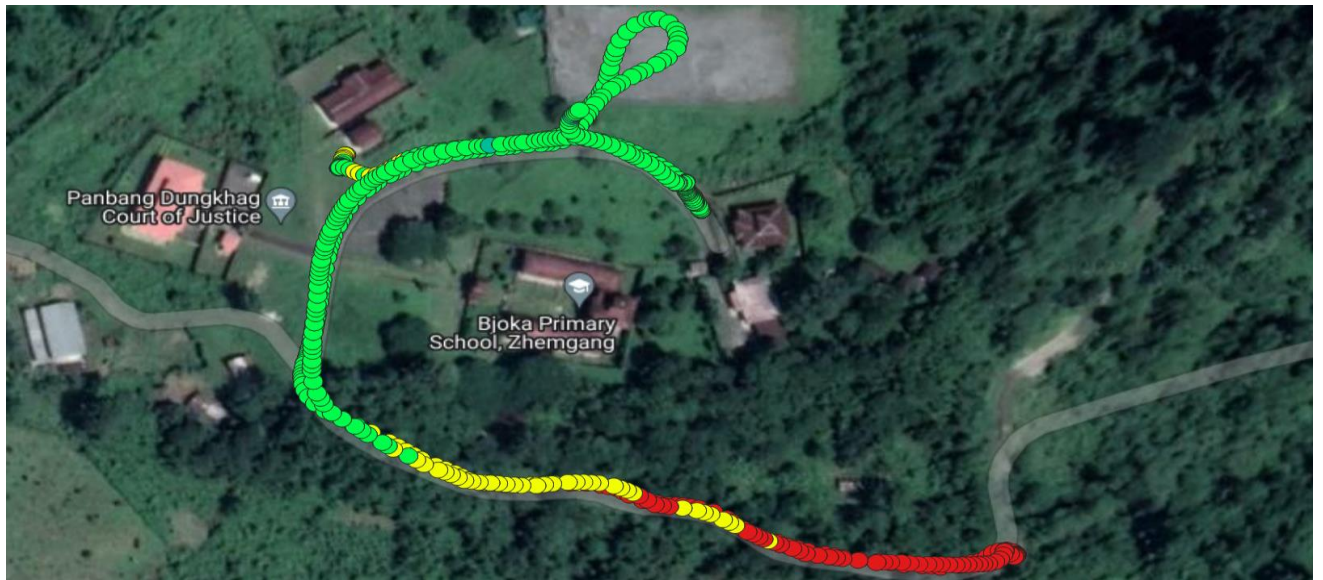


Figure A.2.1: RSRP(4G) plot of B-mobile (QGIS)[Panbang Dungkhag]



*Figure A.2.2:RSRP(4G) plot of Tashi Cell (QGIS))[Panbang Dungkhag]*

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### 3. Sonam Thang

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score ≥3.5	CSFB Setup Time ≤9	Remarks
BTL	0	3.84	5.28	No issues
TICL	0	3.92	5.55	No issues

- *Data Throughputs (Mbps)(4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	49.105	1.81	Issue with UL throughput
TICL	55.812	7.99	No issues

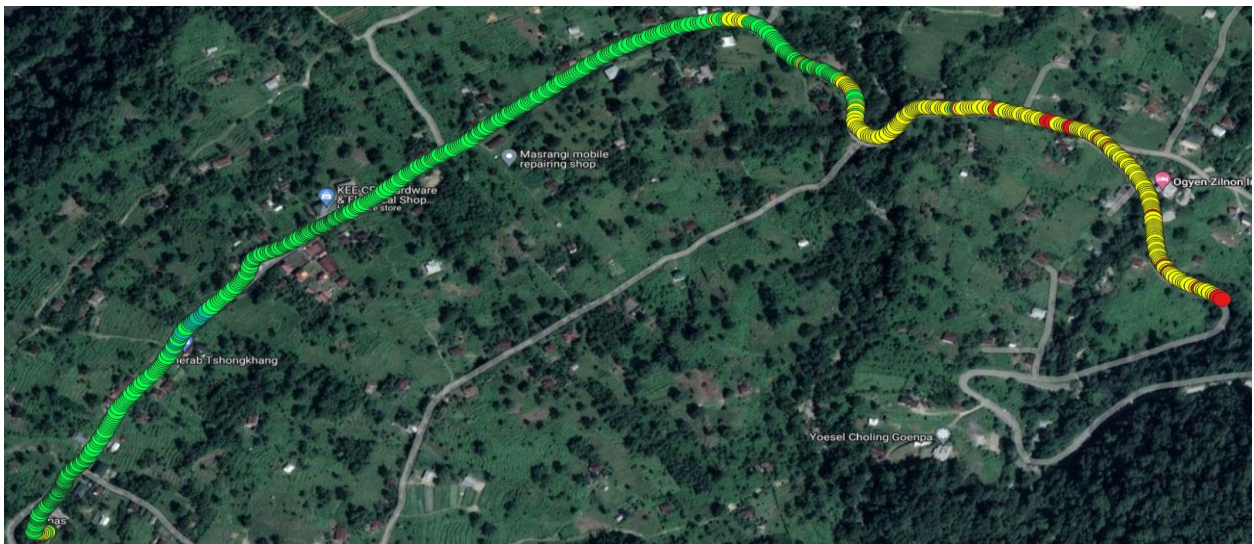
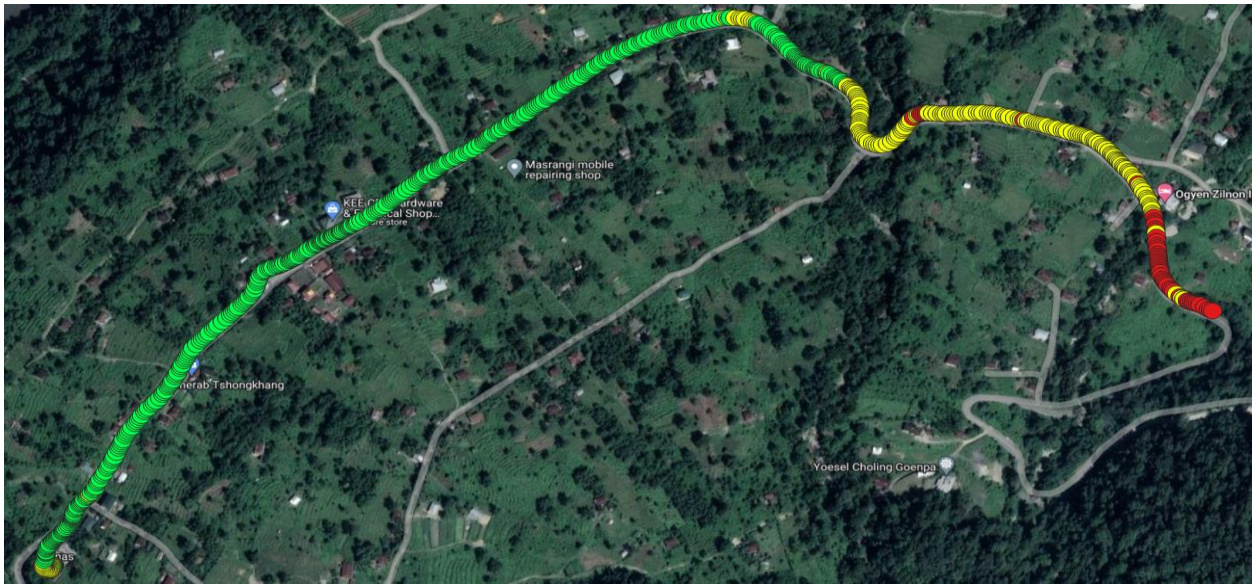


Figure A.3.1: RSRP(4G) plot of B-mobile (QGIS)[Sonamthang]





*Figure A.3.2: RSRP(4G) plot of Tashi Cell (QGIS)[Sonamthang]*

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## B. Pemagatshel

### 1. Nganglam Town

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score ≥3.5	CSFB Setup Time ≤9	Remarks
BTL	0	3.88	5.80	No issues
TICL	0	3.98	5.34	No issues

- *Data Throughputs (Mbps)(4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
<b>BTL</b>	36.045	<b>1.704</b>	Issue with UL throughput
<b>TICL</b>	13.213	24.045	No issues

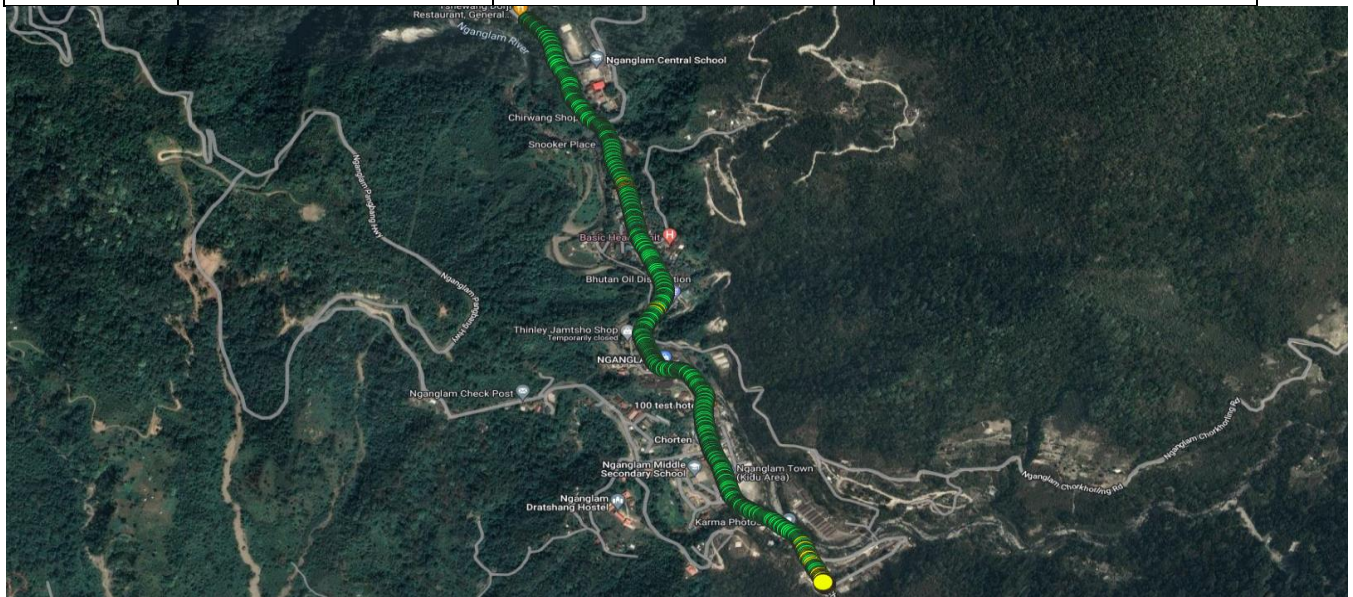
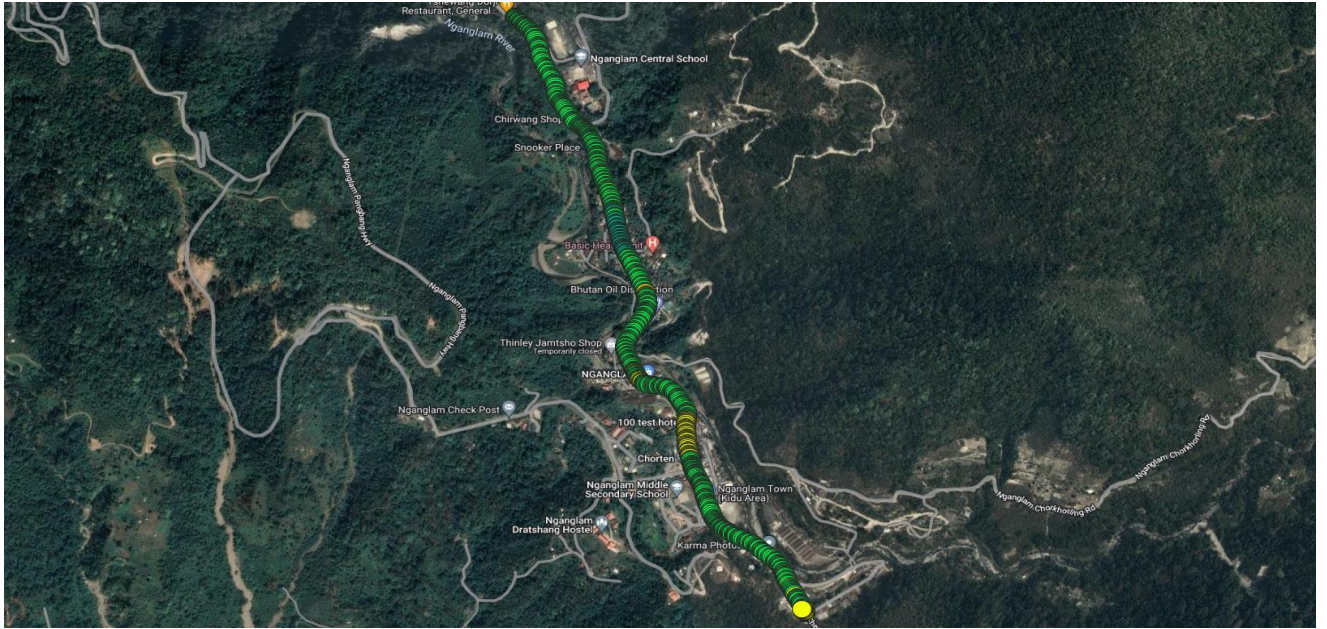


Figure B.1.1: RSRP(4G) plot of B-mobile (QGIS)[Nganglam Town]





*Figure B.1.2:RSRP(4G) plot of Tashi Cell (QGIS))[Nganglam Town*

## 2. Tshenkhari Area

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score ≥3.5	CSFB Setup Time ≤9	Remarks
BTL	0	3.73	6.06	No issues
TICL	0	3.82	5.29	No issues

- *Data Throughputs (Mbps)(4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	5.98	0.900	Issue with DL and UL throughput
TICL	10.082	1.262	Issue with UL throughput



Figure B.2.1: RSRP(4G) plot of B-mobile (QGIS)[Tshenkhari Area]





*Figure B.2.2:RSRP(4G) plot of Tashi Cell (QGIS)[Tshenkhari Area]*

## C. Samdrup Jongkhar

### 1. Bangtar

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score $\geq 3.5$	CSFB Setup Time $\leq 9$	Remarks
BTL	0	3.68	6.10	No issues
TICL	0	4.09	6.01	No issues

- *Data Throughputs (Mbps)(4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
BTL	3.808	2.325	Issue with DL throughput
TICL	18.55	11.545	No issues

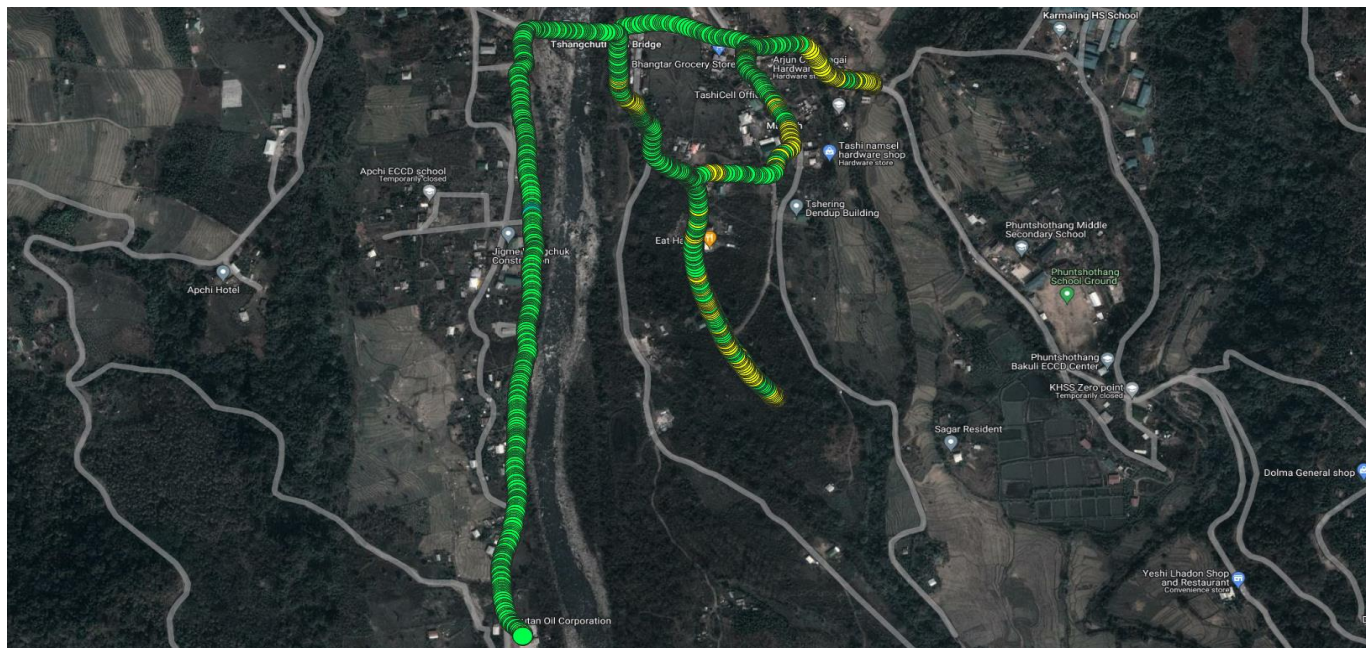
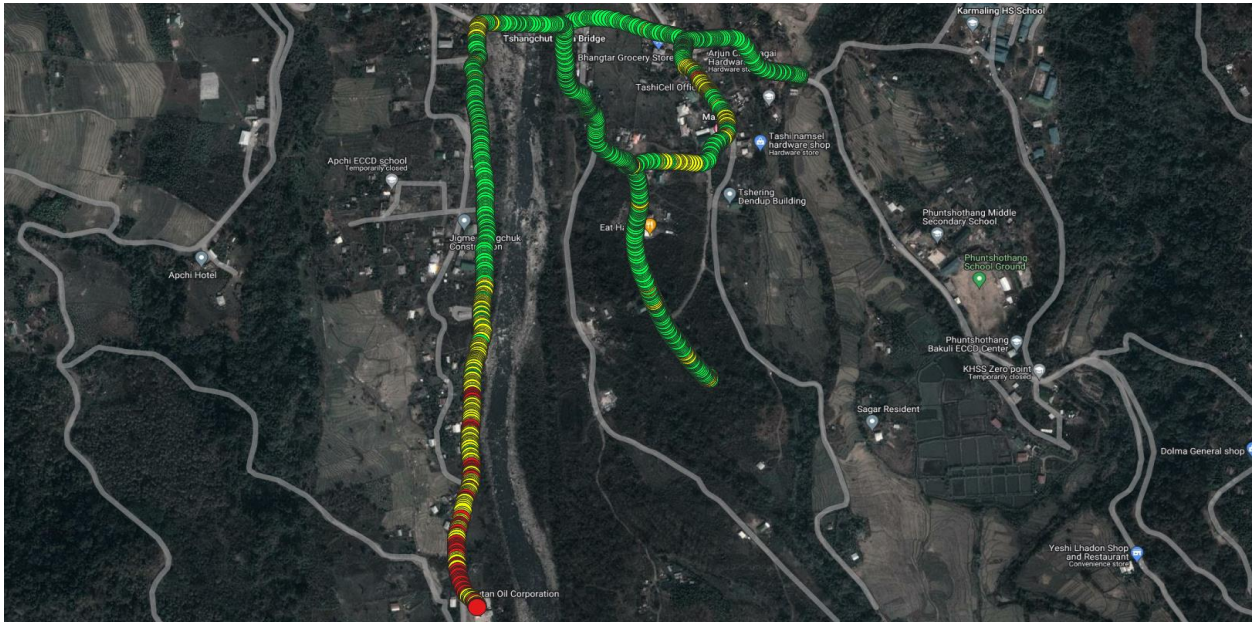


Figure C.1.1: RSRP(4G) plot of B-mobile (QGIS)[Bangtar S/J]





*Figure C.1.2:RSRP(4G) plot of Tashi Cell (QGIS)[Bangtar S/J]*

## D. Thimphu

### 1. Changangkha (Housing, CMSS and RKPS) area

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.86	6.84	No issues
TICL	0	3.91	8.38	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
<b>BTL</b>	23.87	15.86	No issues
<b>TICL</b>	26.73	15.31	No issues



Figure number D.1.1 : RSRP plot 4G B-mobile (QGIS) [Changangkha (Housing, CMSS and RKPS)]



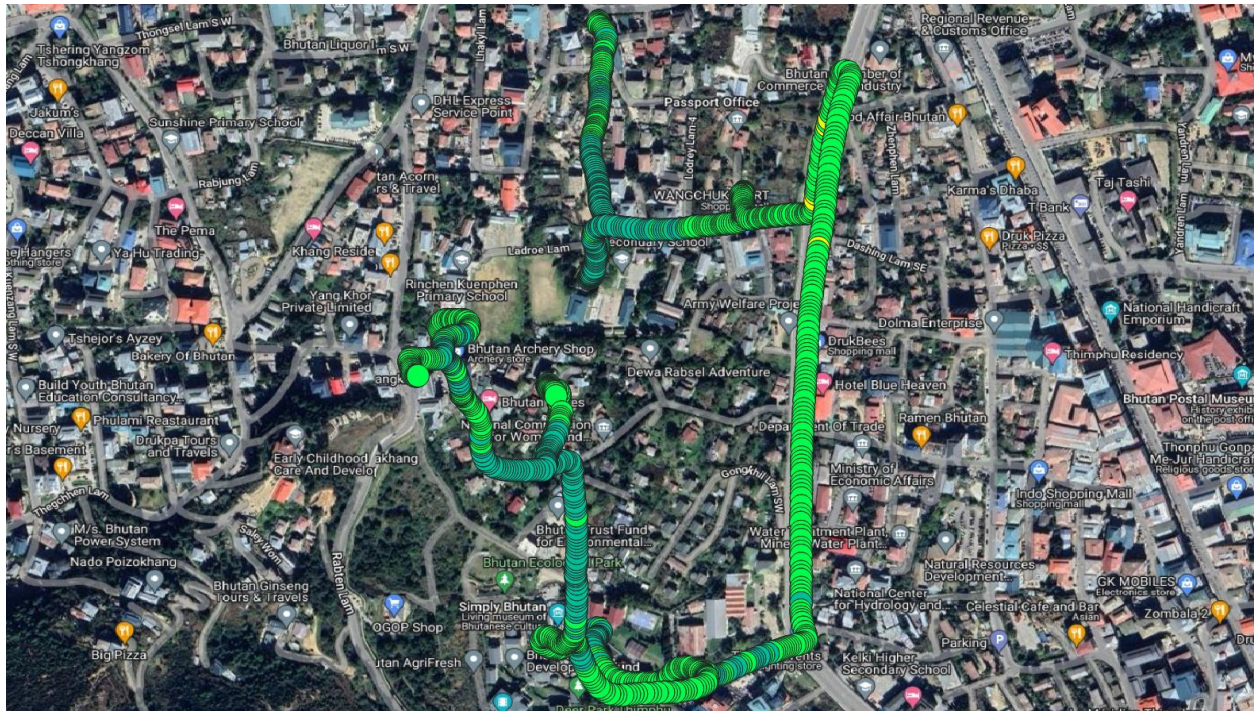


Figure number D.1.2 : RSRP plot 4G Tashi Cell (QGIS) [Changangkha (Housing, CMSS and RKPS)]

## 2. Lower Motithang

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score ( $\geq 3.5$ )	Call Fallback Setup Time ( $\leq 9$ Seconds)	Remarks
BTL	0	3.79	6.6	No issues
TICL	0	4.03	6.82	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
BTL	28.01	16.63	No issues
TICL	29.16	22.69	No issues



Figure number D.2.1 : RSRP plot 4G B-mobile (QGIS) - Lower Motithang





*Figure number D.2.2 : RSRP plot 4G Tashi Cell (Google earth) - Lower Motihang*

- *Mobile Voice Service*

- *Data Throughputs (Mbps) (4G)*

22





*Figure number D.3.2: RSRP plot 4G Tashi cell (QGIS) - Ministers' colony (including the road above MHSS)*

#### 4. MoIC areas (including ministry areas, BTL and Kawajangsa)

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.86	6.04	No issues
TICL	0	4	7.59	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	24.02	34.38	No issues
TICL	29.13	18.55	No issues



Figure number D.4.1: RSRP plot 4G B-mobile (QGIS) - MoIC (including ministry areas, BTL and Kawajangsa)





*Figure number D.4.2: RSRP plot 4G Tashi cell (QGIS) - MoIC (including ministry areas, BTL and Kawajangsa)*

## 5. Sangaygang (RITH, Motithang Takin Preserve)

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.82	6.27	No issues
TICL	0	3.61	7.86	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	24.14	16.34	No issues
TICL	34.46	13.17	No issues



Figure number D.5.1: RSRP plot 4G B-mobile (QGIS) - Sangaygang (RITH, Motithang Takin Preserve)





*Figure number D.5.2: RSRP plot 4G Tashi cell (QGIS) - Sangaygang (RITH, Motithang Takin Preserve)*

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## 6. Upper Motithang

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.89	6.01	No issues
TICL	0	3.62	7.91	No issues

- *Data Throughputs (Mbps) (4G)*

Operato rs	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
<b>BTL</b>	41.58	30.89	No issues
<b>TICL</b>	45.64	28.24	No issues

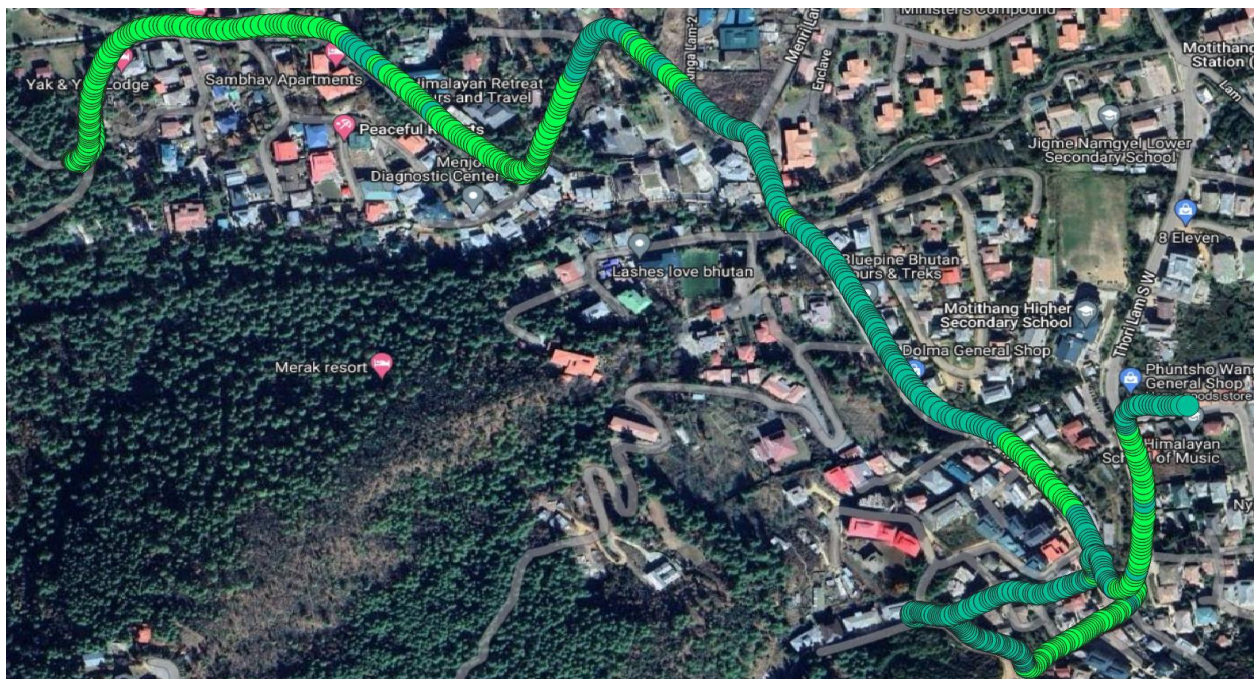


Figure number D.6.1: RSRP plot 4G B-mobile (QGIS) - Upper Motithang





*Figure number D.6.2: RSRP plot 4G Tashi cell (QGIS) - Upper Motithang*

## 7. Motithang - Zilukha Highway

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.85	6.89	No issues
TICL	0	3.96	10.05	Issue with CFBST

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	23.29	21.04	No issues
TICL	15.71	15.64	No issues

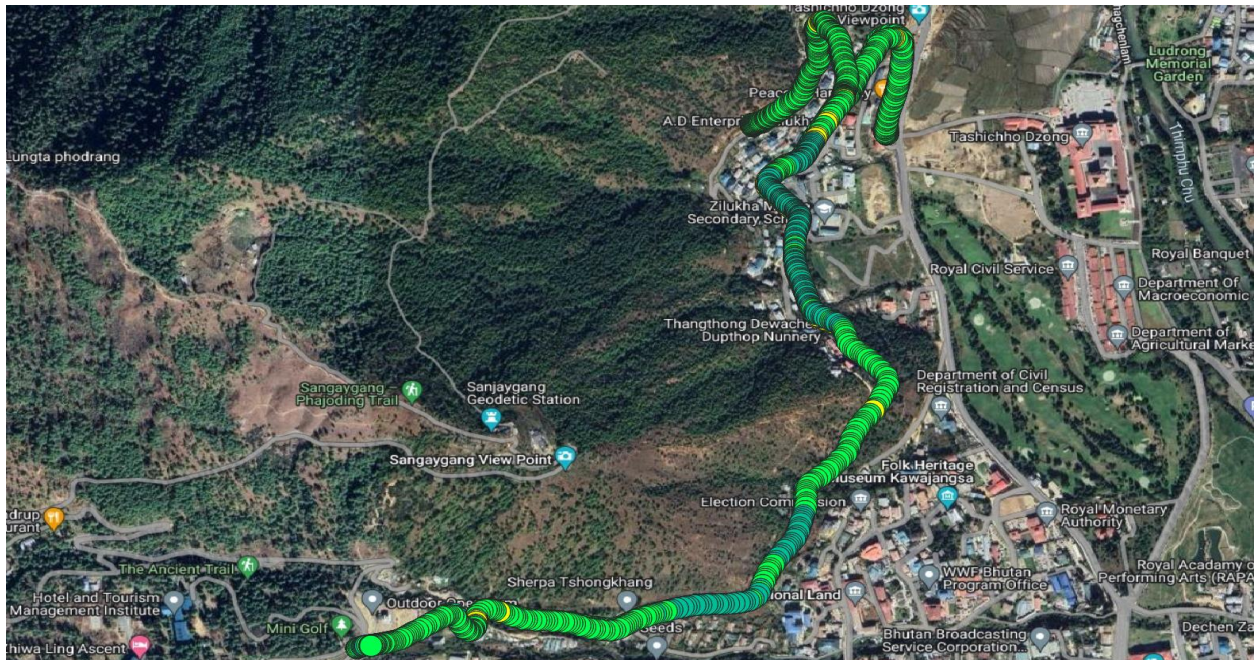
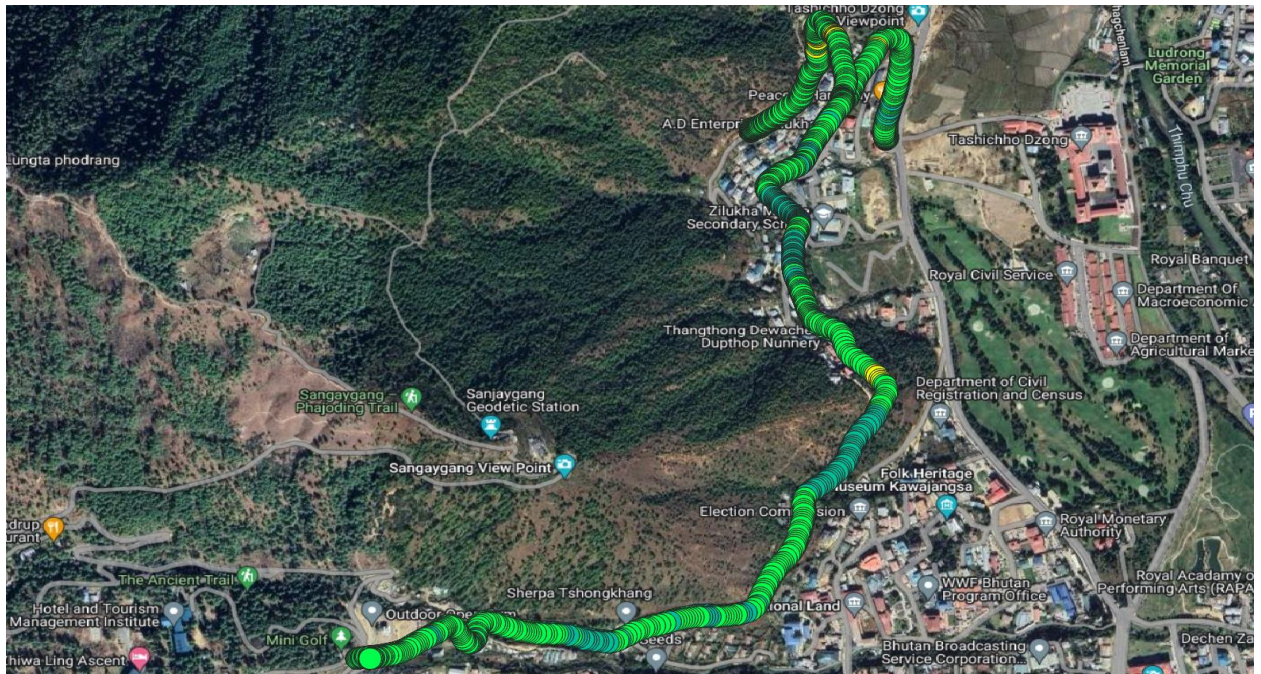


Figure number D.7.1: RSRP plot 4G B-mobile (QGIS) - Motithang - Zilukha Highway





*Figure number D.7.2: RSRP plot 4G Tashi cell (QGIS) - Motithang - Zilukha Highway*

## 8. Bebena

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.89	6.12	No issues
TICL	0	3.84	8.81	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
<b>BTL</b>	10.44	17.96	No issues
<b>TICL</b>	19.73	11.55	No issues

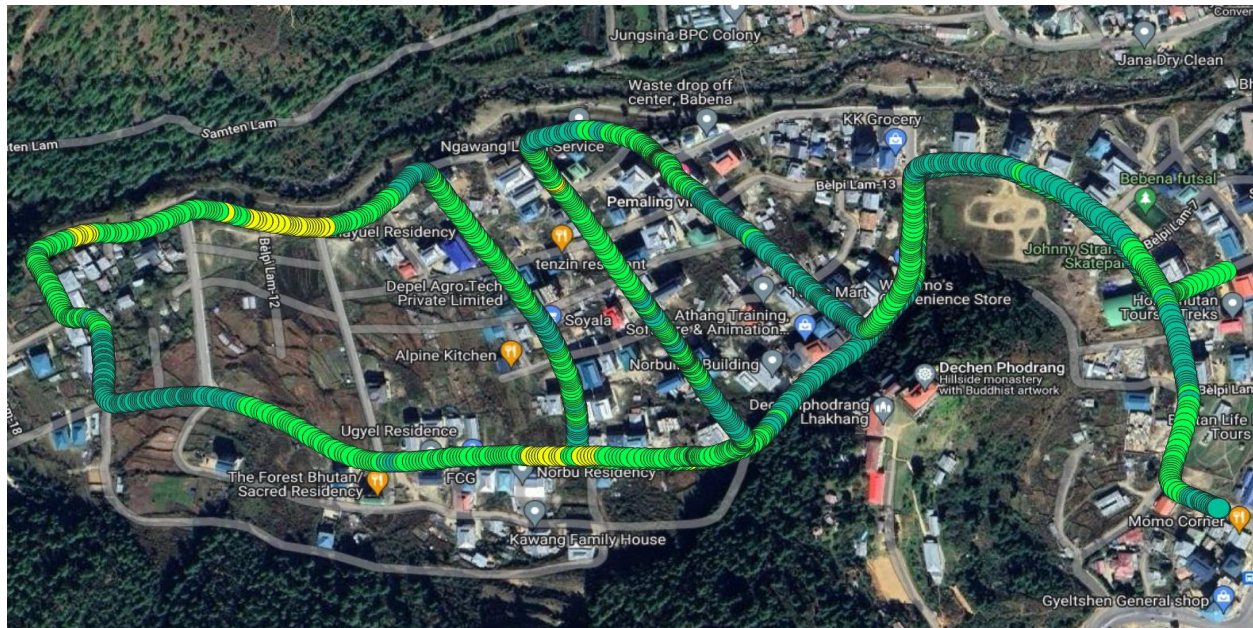


Figure number D.8.1 : RSRP plot 4G B-mobile (QGIS) [Bebena]





*Figure number D.9.2 : RSRP plot 4G Tashi Cell (QGIS) [Bebena]*

## 9. BPC Colony Simtokha

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score ( $\geq 3.5$ )	Call Fallback Setup Time ( $\leq 9$ Seconds)	Remarks
BTL	0	3.6	5.91	No issues
TICL	0	4.2	5.36	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
BTL	20.74	25.26	No issues
TICL	11.99	17.13	No issues

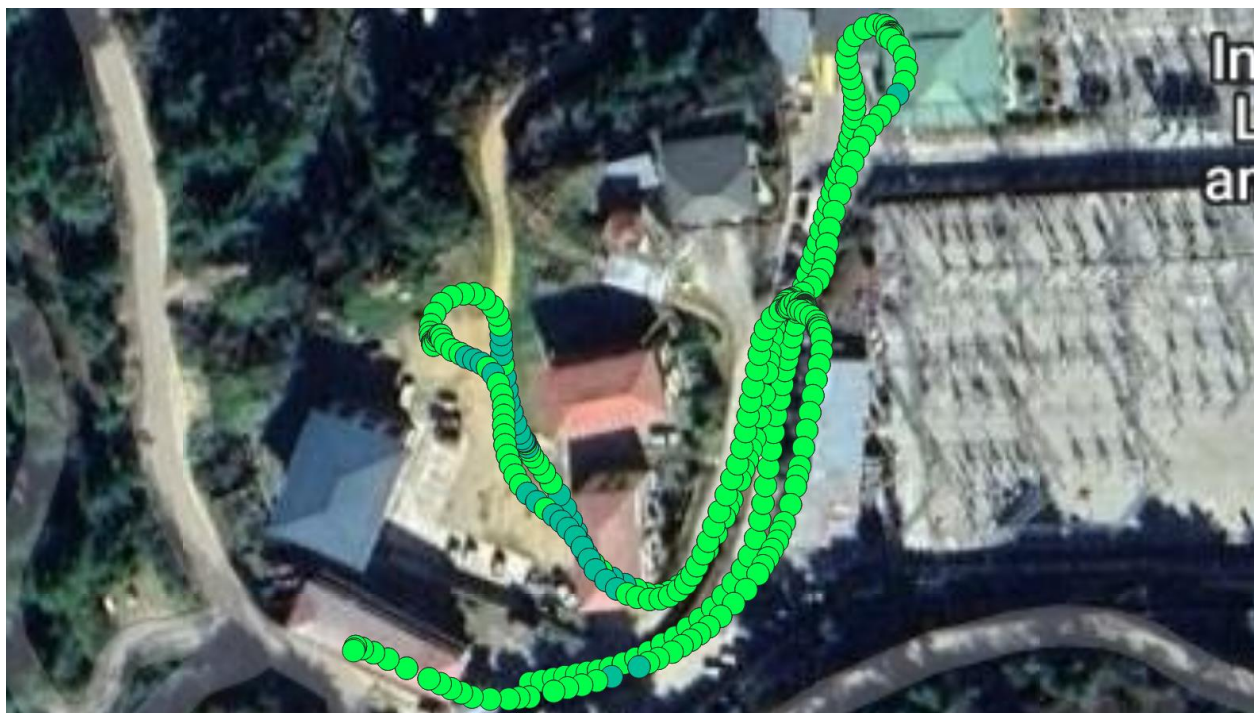


Figure number D.9.1 : RSRP plot 4G B-mobile (QGIS) [BPC Colony Semtokha]





*Figure number D.9.2 : RSRP plot 4G Tashi Cell (QGIS) [BPC Colony Simtokha]*

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## 10. Changjalu

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.75	6.16	No issues
TICL	0	4	7.87	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
<b>BTL</b>	19.24	13.32	No issues
<b>TICL</b>	13.28	20.59	No issues



Figure number D.10.1: RSRP plot 4G B-mobile (QGIS) [Changjalu]





*Figure number D.10.2: RSRP plot 4G Tashi cell (QGIS) [Changjalu]*

## 11. Hejo

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.89	7.22	No issues
TICL	0	4.03	6.29	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
<b>BTL</b>	5.1	7.2	No issues
<b>TICL</b>	18.04	19.03	No issues



Figure number D.11.1: RSRP plot 4G B-mobile (QGIS) [Hejo]





## 12. Jungshina

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.84	6.65	No issues
TICL	0	4.03	7.01	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
<b>BTL</b>	16.21	19.61	No issues
<b>TICL</b>	24.93	28.27	No issues

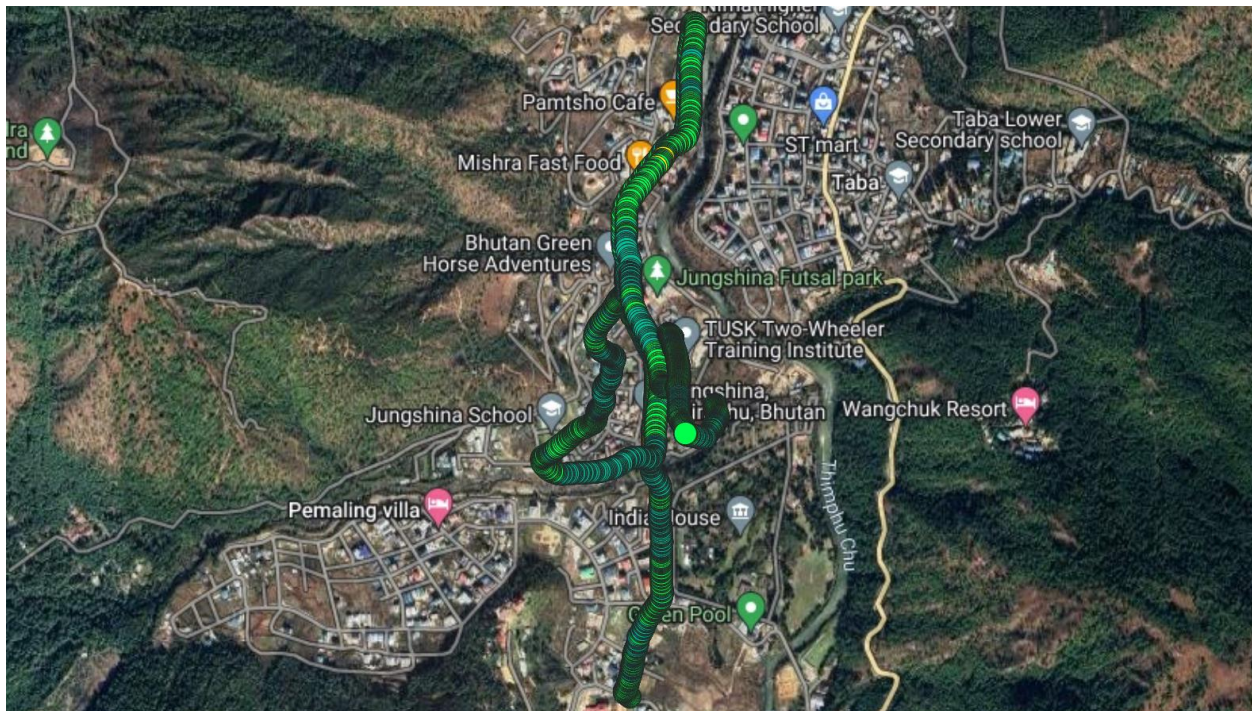


Figure number D.12.1: RSRP plot 4G B-mobile (QGIS) [Jungshina]





*Figure number D.12.2: RSRP plot 4G Tashi cell (QGIS) [Jungshina]*

### 13. Olakha Workshop

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.85	6.53	No issues
TICL	0	3.98	7.58	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	9.9	17.31	No issues
TICL	22.56	22.39	No issues



Figure number D.13.1: RSRP plot 4G B-mobile (QGIS) [Olakha Workshop]





#### 14. Old BICMA Office Area

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.7	6.47	No issues
TICL	0	3.87	6.44	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
BTL	17.61	13.51	No issues
TICL	9.3	13.26	No issues

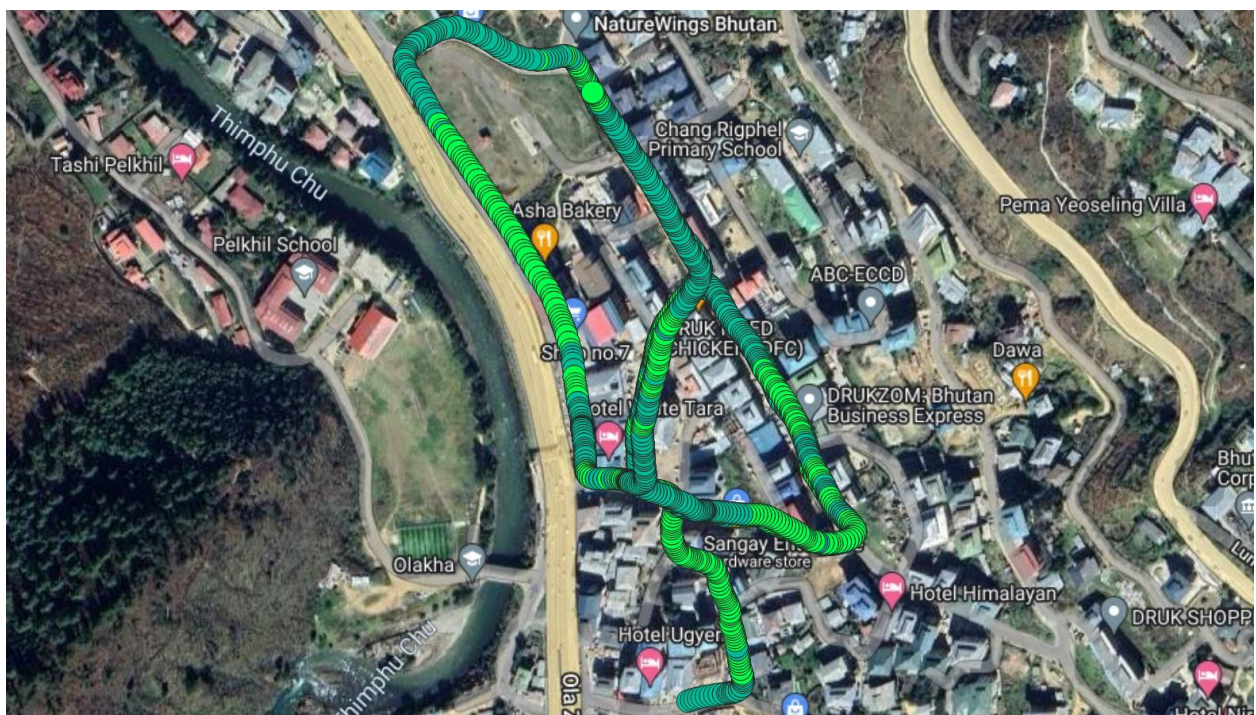
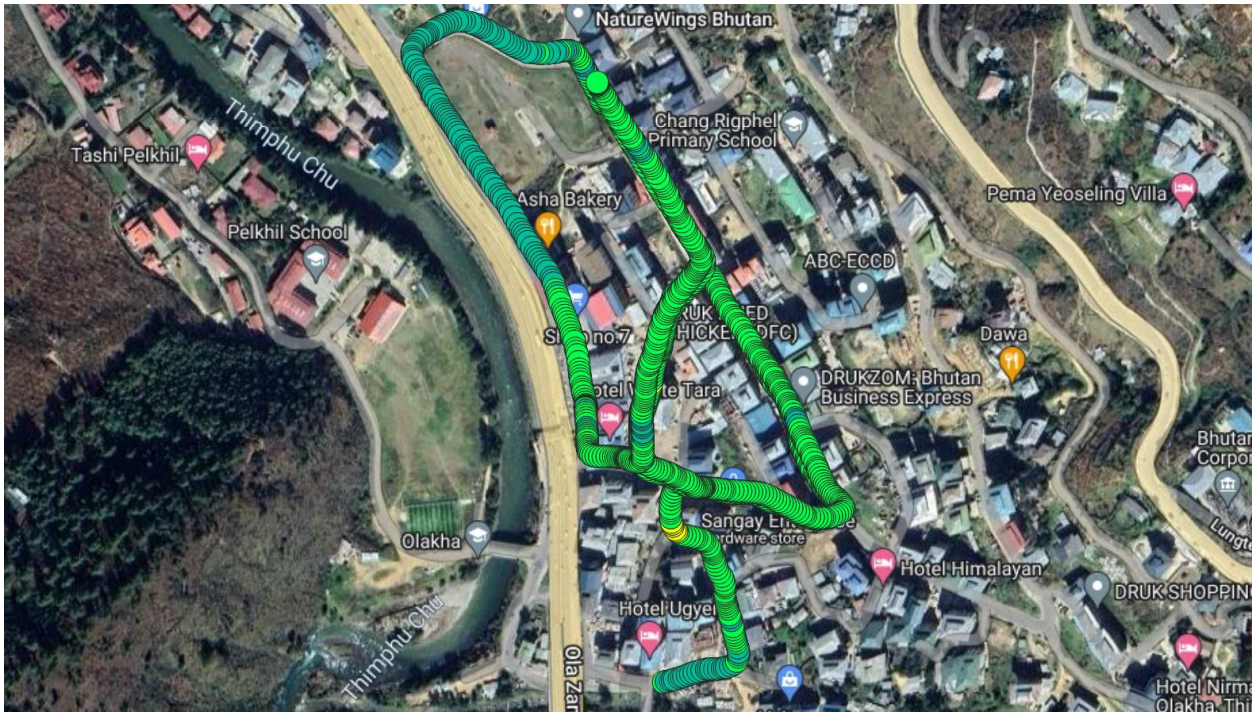


Figure number D.14.1: RSRP plot 4G B-mobile (QGIS) [Old BICMA Office Area]





*Figure number D.14.2: RSRP plot 4G Tashi cell (QGIS) [Old BICMA Office Area]*

## 15. RIM

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (≥ 3.5)	Call Fallback Setup Time (≤ 9 Seconds)	Remarks
BTL	0	3.88	5.97	No issues
TICL	0	3.81	6.19	No issues

- *Data Throughputs (Mbps) (4G)*

Operato rs	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
<b>BTL</b>	14.29	20.04	No issues
<b>TICL</b>	12.21	17.74	No issues



Figure number D.15.1: RSRP plot 4G B-mobile (QGIS) [RIM]





Figure number D.15.2: RSRP plot 4G Tashi cell (QGIS) [RIM]

## 16. Simtokha Dzong

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.86	5.68	No issues
TICL	0	4.09	5.89	No issues

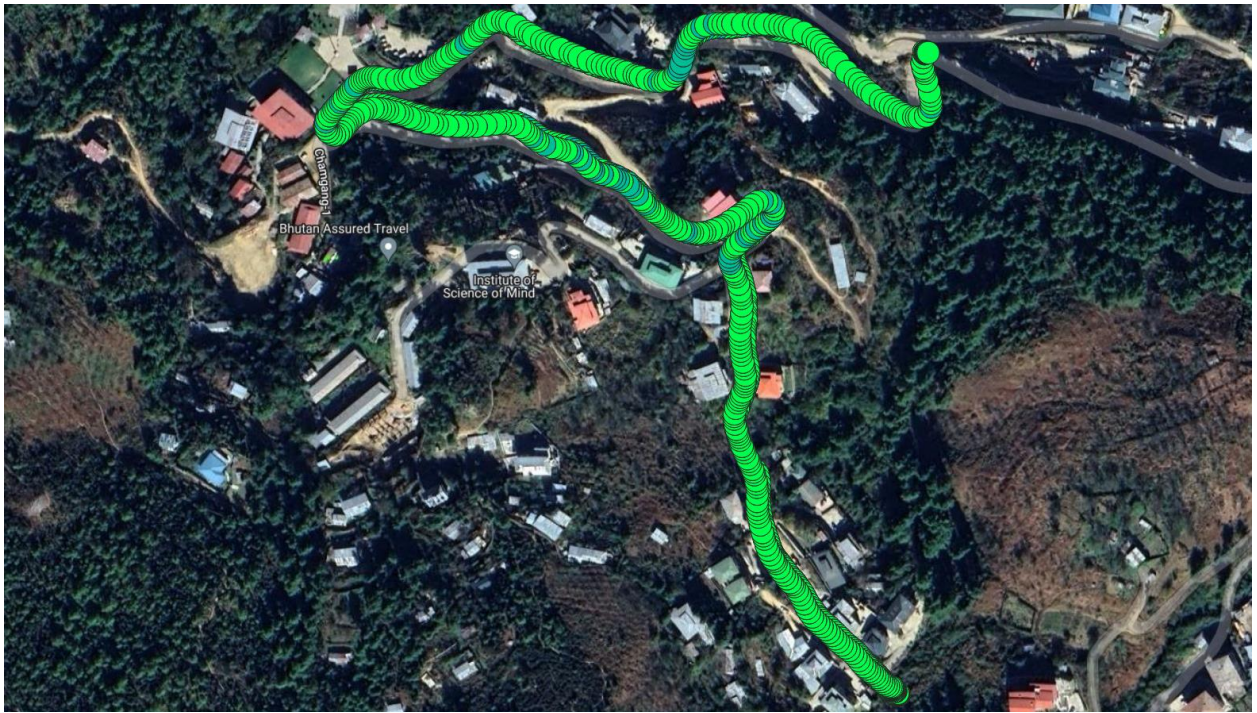
- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	15.91	32.25	No issues
TICL	6.99	16.82	No issues



Figure number D.16.1: RSRP plot 4G B-mobile (QGIS) [Simtokha Dzong]





*Figure number D.16.2: RSRP plot 4G Tashi cell (QGIS) [Simtokha Dzong]*

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## **17. Bhutan Kitchen and Village Restaurant Babesa Area**

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.82	7.05	No issues
TICL	0	3.75	<b>10.07</b>	<b>Issue with CFBST</b>

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	16.04	16.75	No issues
TICL	11.87	17.470	No issues

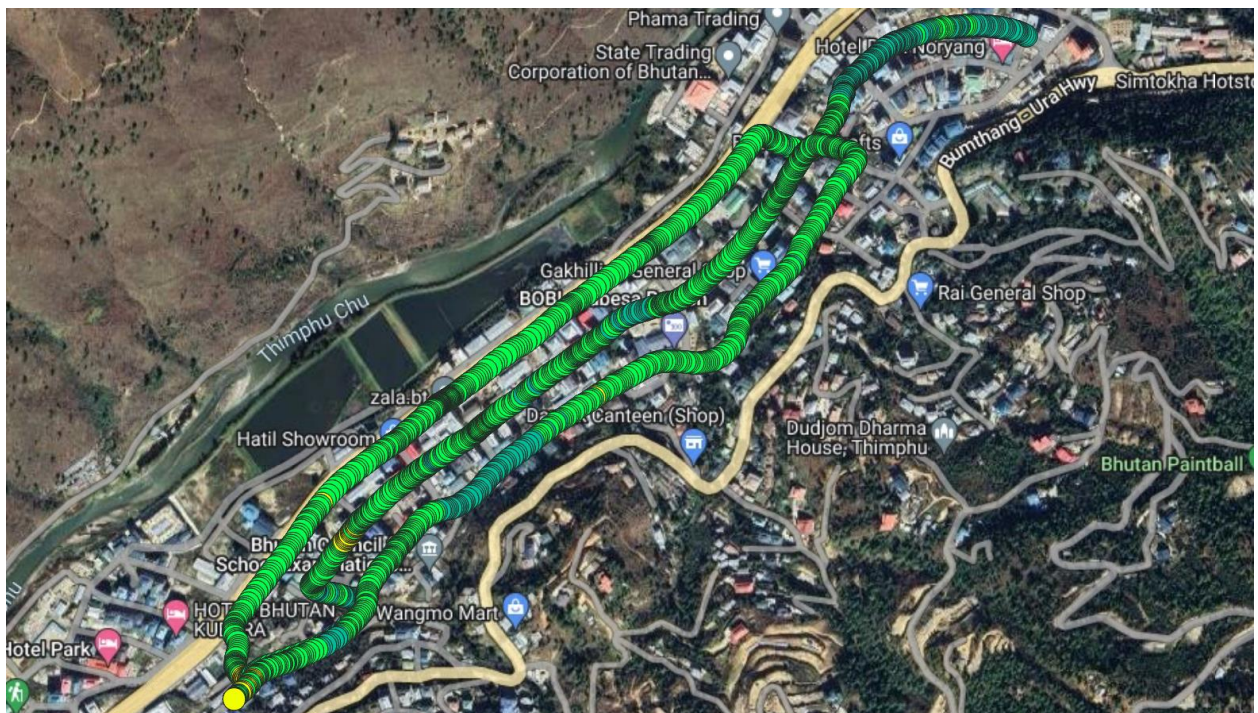
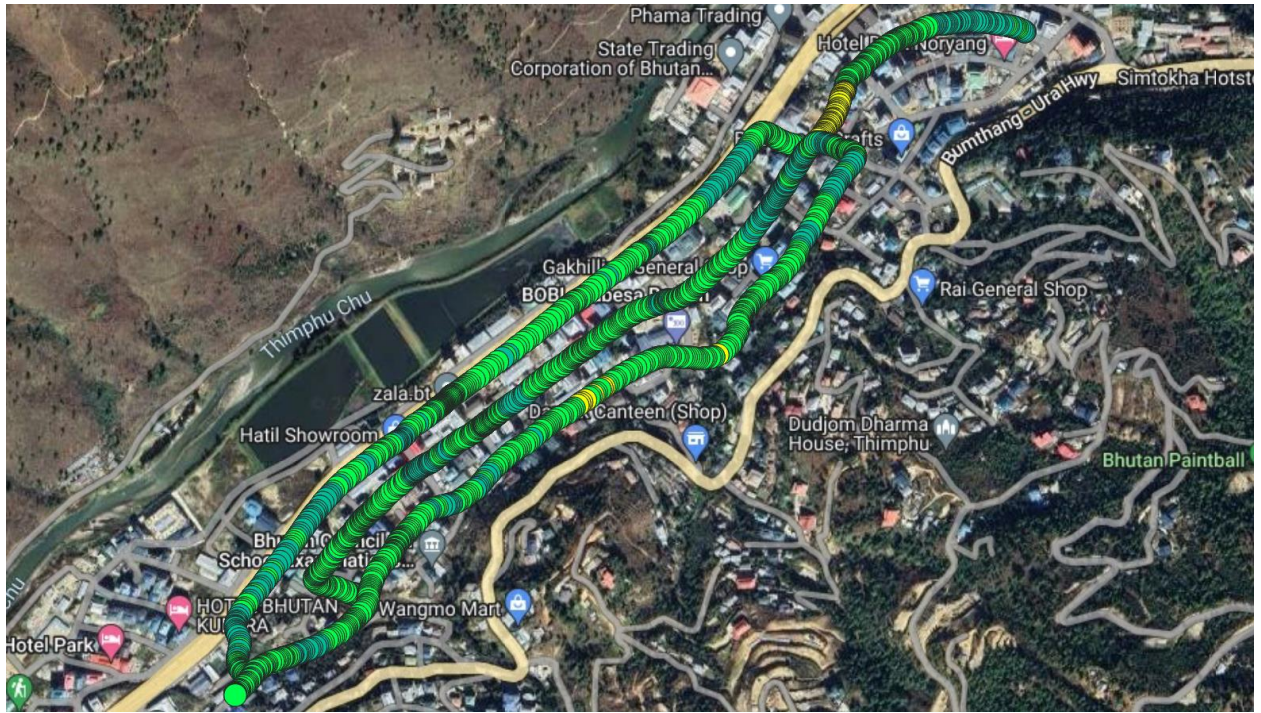


Figure number D.17.1: RSRP plot 4G B-mobile (QGIS) [Bhutan Kitchen and Village Restaurant Babesa]





*Figure number D.17.2: RSRP plot 4G Tashi cell (QGIS) [Bhutan Kitchen and Village Restaurant Babesa]*

## 18. Dr.Tobgay School area Babesa

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.75	6.99	No issues
TICL	0	3.58	6.08	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	13.66	7.917	No issues
TICL	6.037	10.35	No issues



Figure number D.18.1: RSRP plot 4G B-mobile (QGIS) [Dr.Tobgay School area Babesa]





*Figure number D.18.2: RSRP plot 4G Tashi cell (QGIS) [Dr.Tobgay School area Babesa]*

## 19. Old Highway Babesa

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.63	9.27	Issue with CFBST
TICL	0	3.58	7.19	No issues

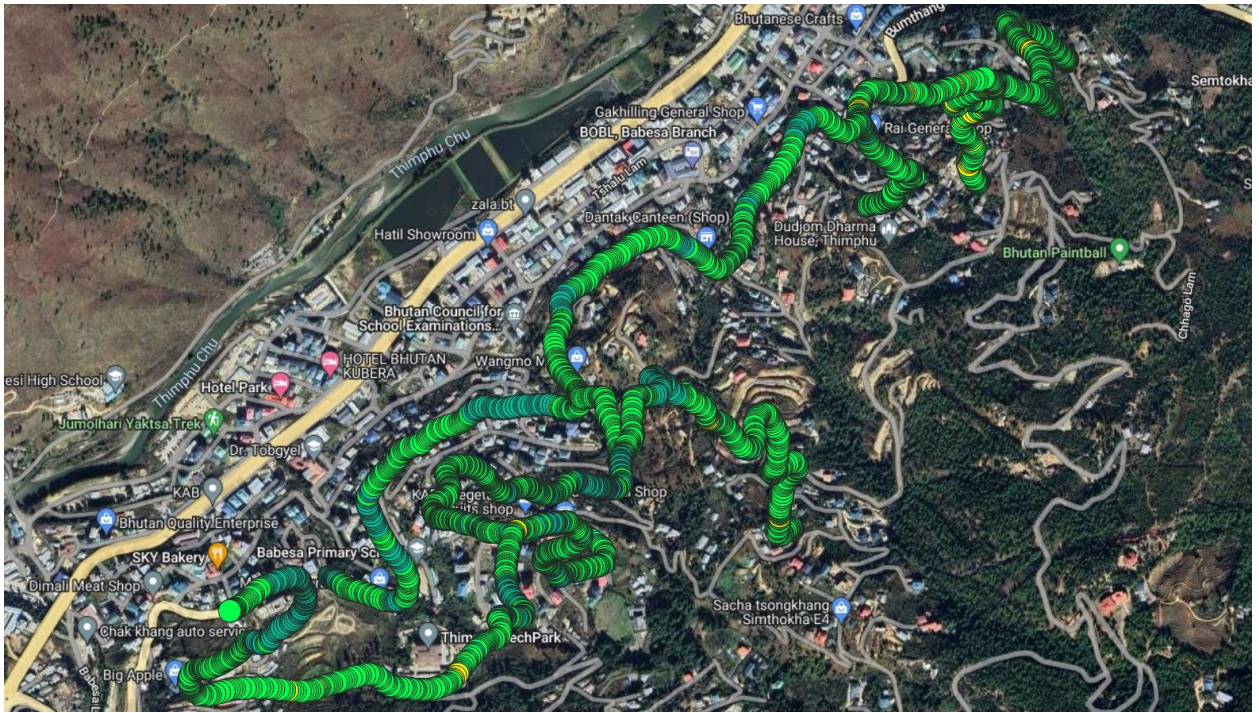
- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	14.764	14.059	No issues
TICL	8.051	10.524	No issues



Figure number D.19.1: RSRP plot 4G B-mobile (QGIS) [Old highway Babesa]





*Figure number D.19.2: RSRP plot 4G Tashi cell (QGIS) [Old highway Babesa]*

## 20. Below Babesa Highway (Zimdra)

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.91	6.49	No issues
TICL	0	3.84	7.72	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
<b>BTL</b>	20.554	9.714	No issues
<b>TICL</b>	11.059	14.758	No issues



Figure number D.20.1: RSRP plot 4G B-mobile (QGIS) [Below Babesa Highway(Zimdra)]





Figure number D.20.2: RSRP plot 4G Tashi cell (QGIS) [Below Babesa Highway(Zimdra)]

## 21. Lower Pamtsho

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.77	5.92	No issues
TICL	0	4.89	7.49	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	11.51	14.95	No issues
TICL	10.08	12.05	No issues



Figure number D.21.1: RSRP plot 4G B-mobile (QGIS) [Lower Pamtsho]





Figure number D.21.2: RSRP plot 4G Tashi cell (QGIS) [Lower Pamtsho]

## 22. Upper Pamtsho 1

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.34	5.26	Issue with MOS
TICL	0	3.74	13.06	Issue with CFBST

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	31.74	19.39	No issues
TICL	4.2	11.28	Issue with DL throughput

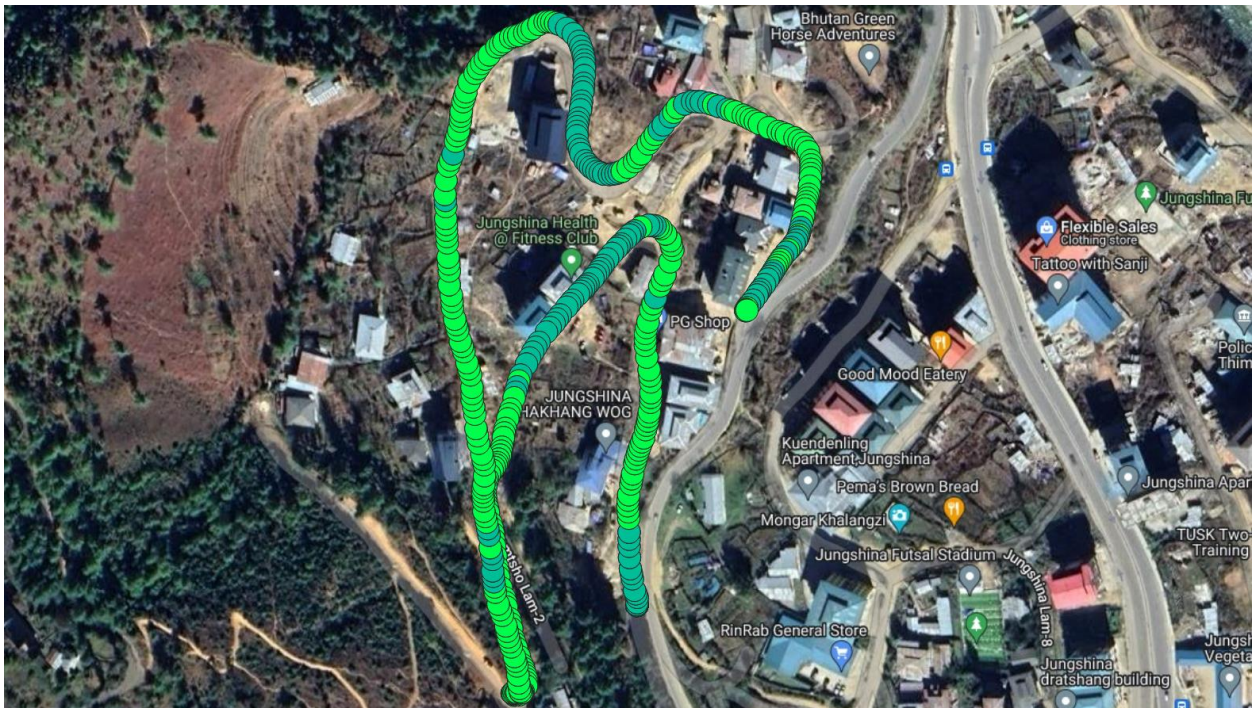
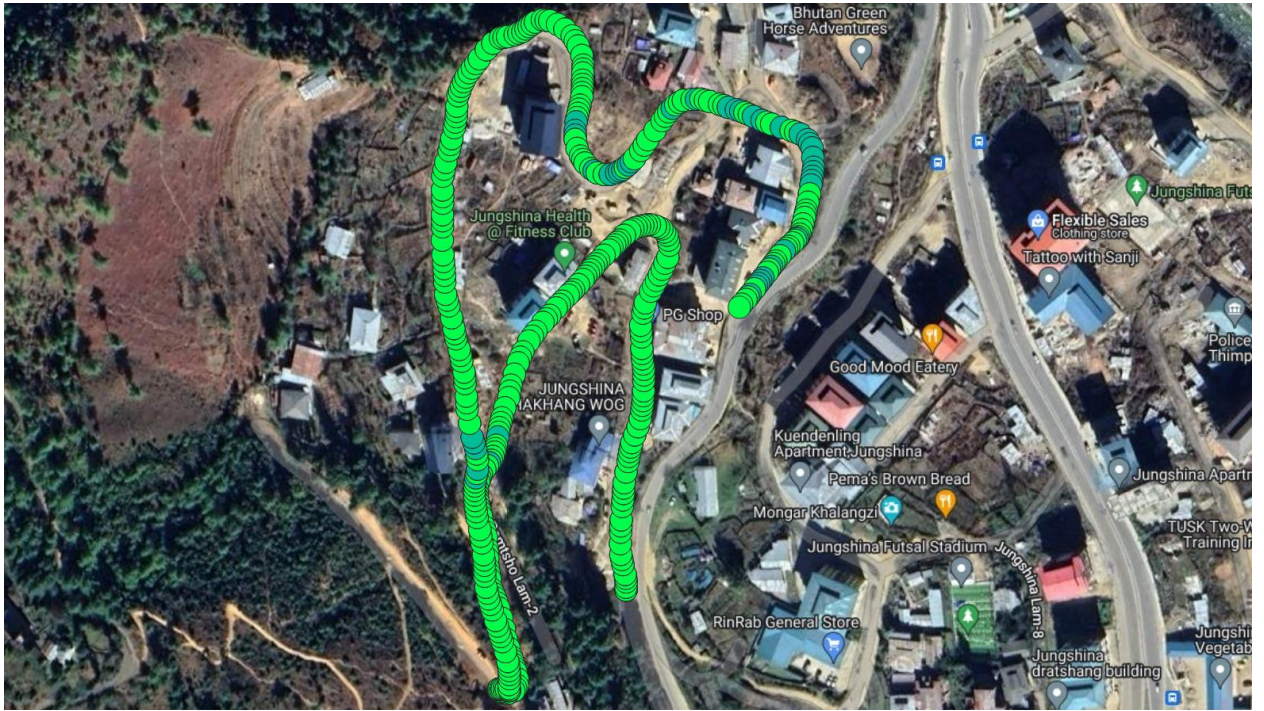


Figure number D.22.1: RSRP plot 4G B-mobile (QGIS) [Upper Pamtsho 1]





*Figure number D.22.2: RSRP plot 4G Tashi cell (QGIS) [Upper Pamtsho 1]*

## 23. Upper Pamtsho 2

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.94	6.24	No issues
TICL	0	3.82	8.54	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
<b>BTL</b>	7.42	12.12	No issues
<b>TICL</b>	12.15	17.15	No issues

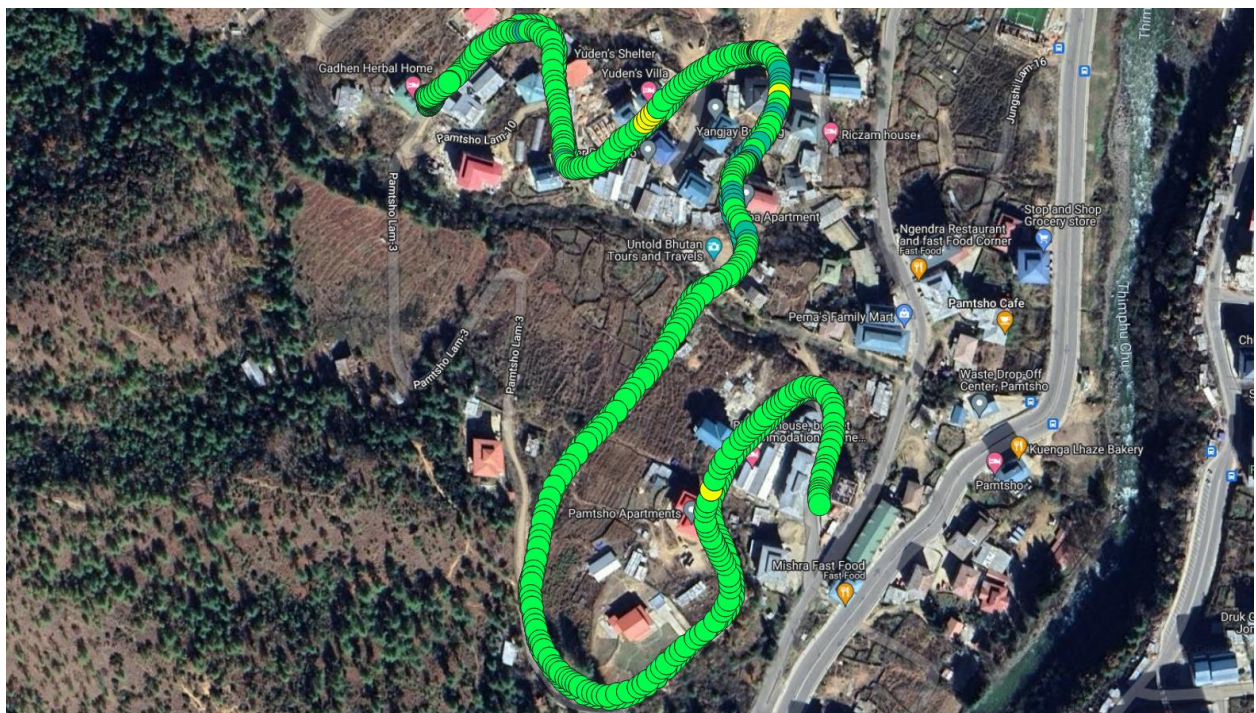


Figure number D.23.1: RSRP plot 4G B-mobile (QGIS) [Upper Pamtsho 2]





*Figure number D.23.2: RSRP plot 4G Tashi cell (QGIS) [Upper Pamtsho 2]*

## 24. Lower Taba

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.85	6.67	No issues
TICL	0	3.72	9.43	Issue with CFBST

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	19.87	11.96	No issues
TICL	13.38	11.81	No issues

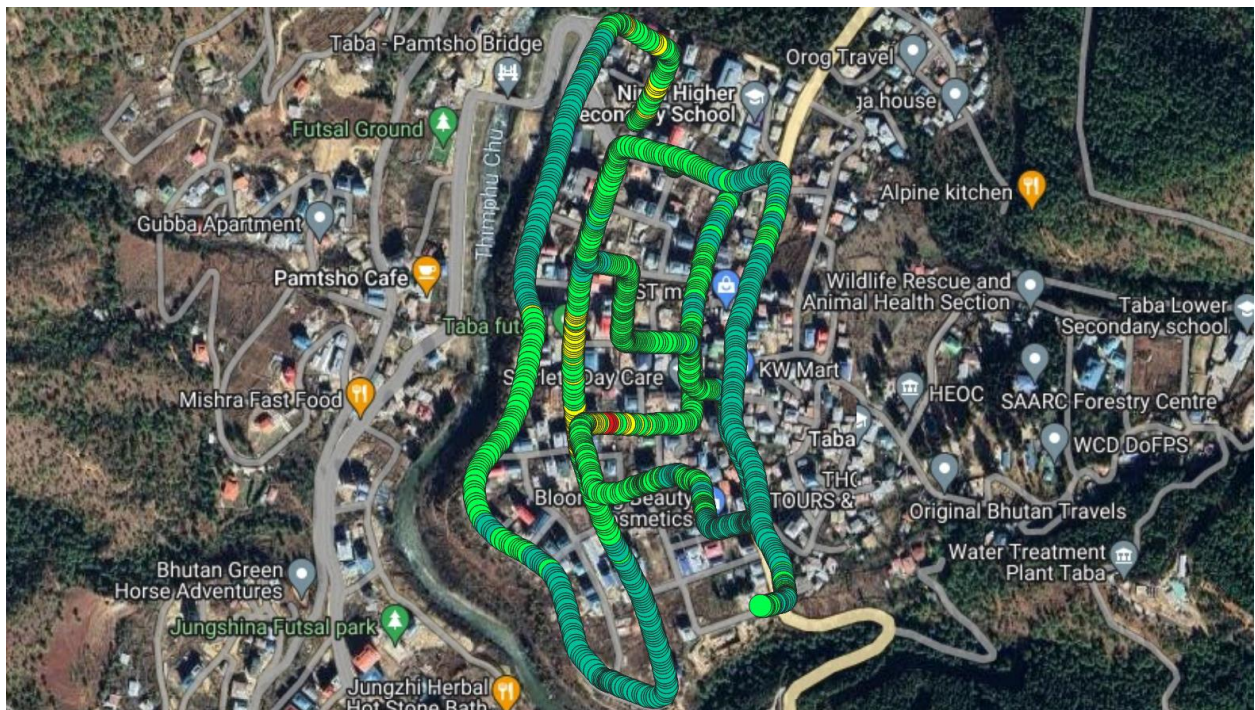
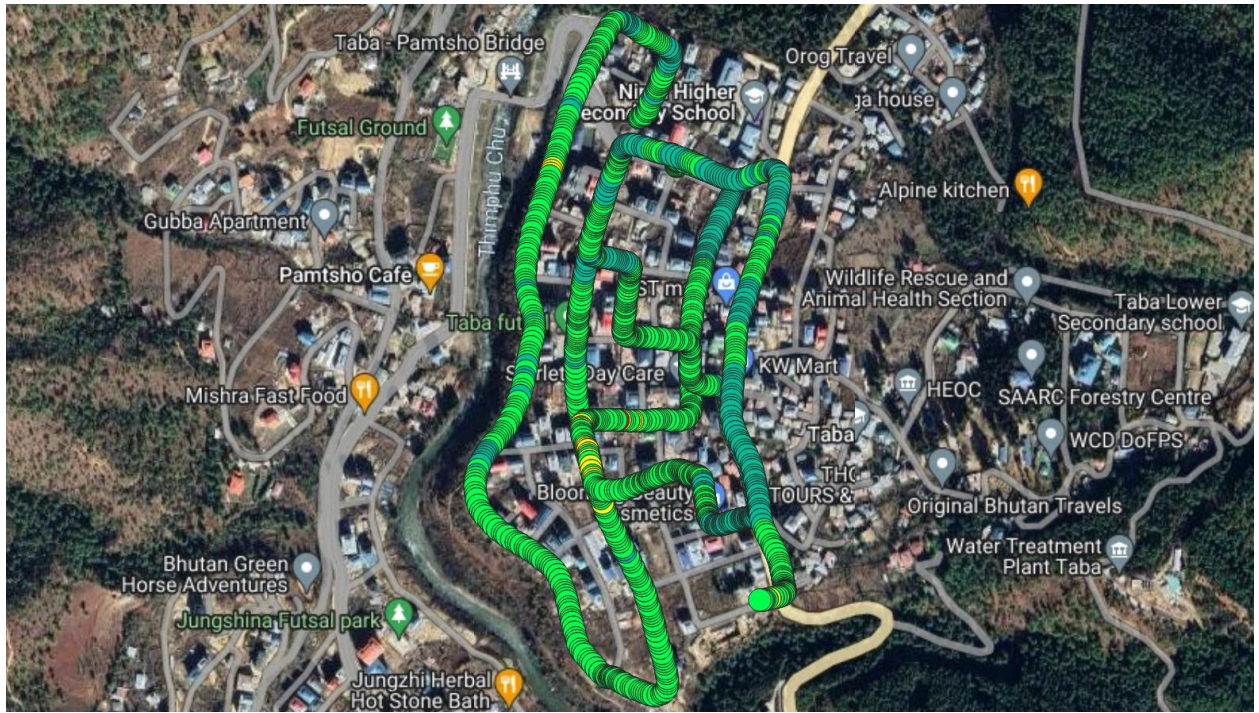


Figure number D.24.1: RSRP plot 4G B-mobile (QGIS) [Lower Taba]





*Figure number D.24.2: RSRP plot 4G Tashi cell (QGIS) [Lower Taba]*

## 25. Upper Taba

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.84	5.15	No issues
TICL	0	3.92	6.29	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	32.39	15.815	No issues
TICL	20.77	21.18	No issues

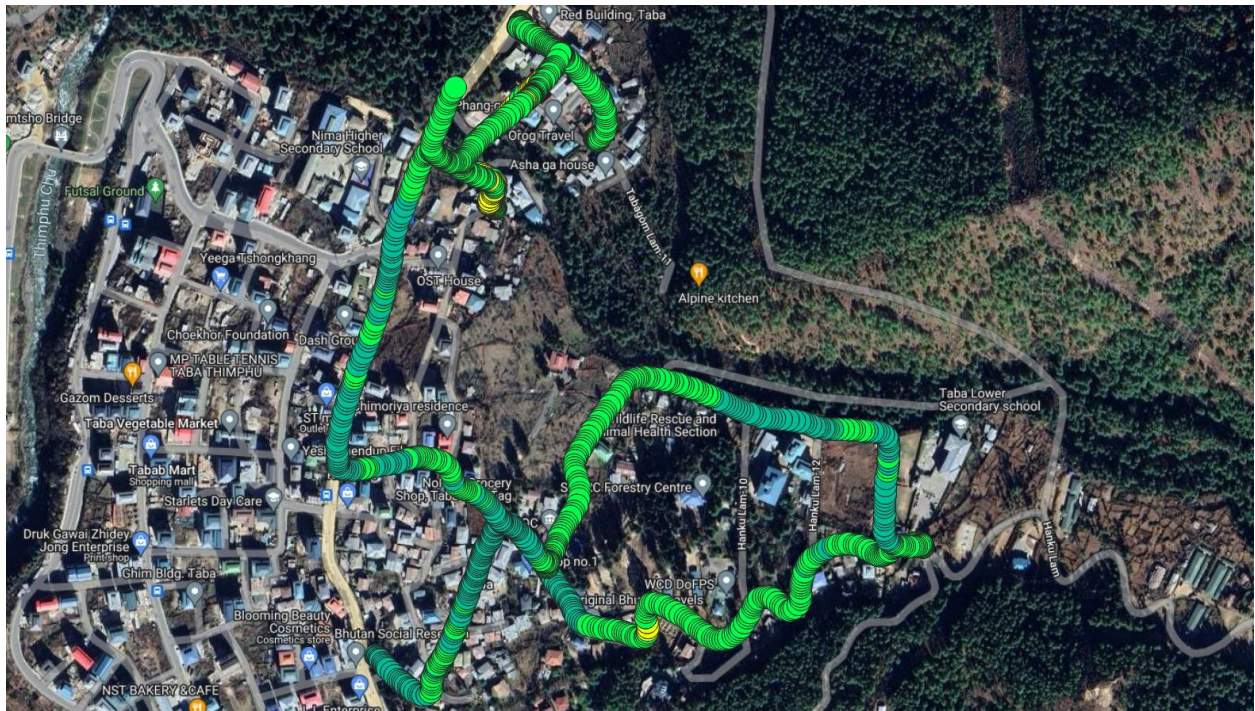


Figure number D.25.1: RSRP plot 4G B-mobile (QGIS) [Upper Taba]



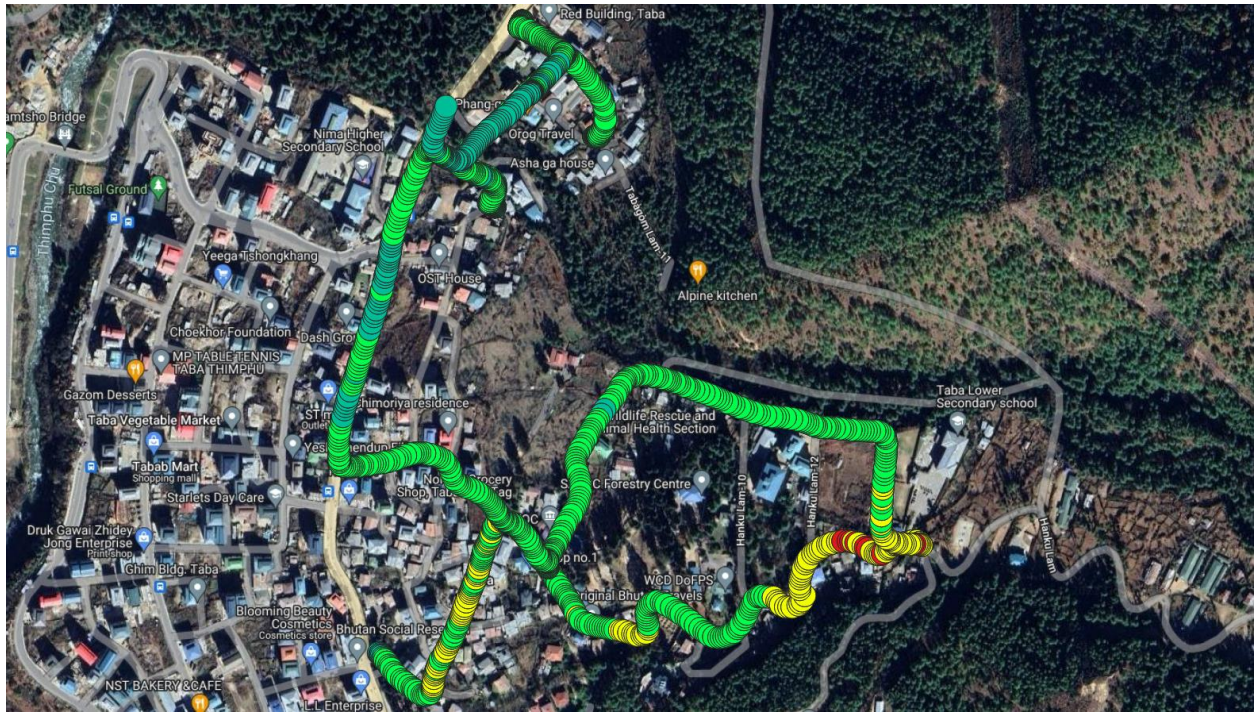


Figure number D.25.2: RSRP plot 4G Tashi cell (QGIS) [Upper Taba]

## 26. YHSS area

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.83	7.15	No issues
TICL	0	3.61	11.51	Issue with CFBST

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download ( $\geq 6$ Mbps)	Upload ( $\geq 2$ Mbps)	
BTL	3.17	6.01	Issue with DL throughput
TICL	2.61	4.53	Issue with DL throughput

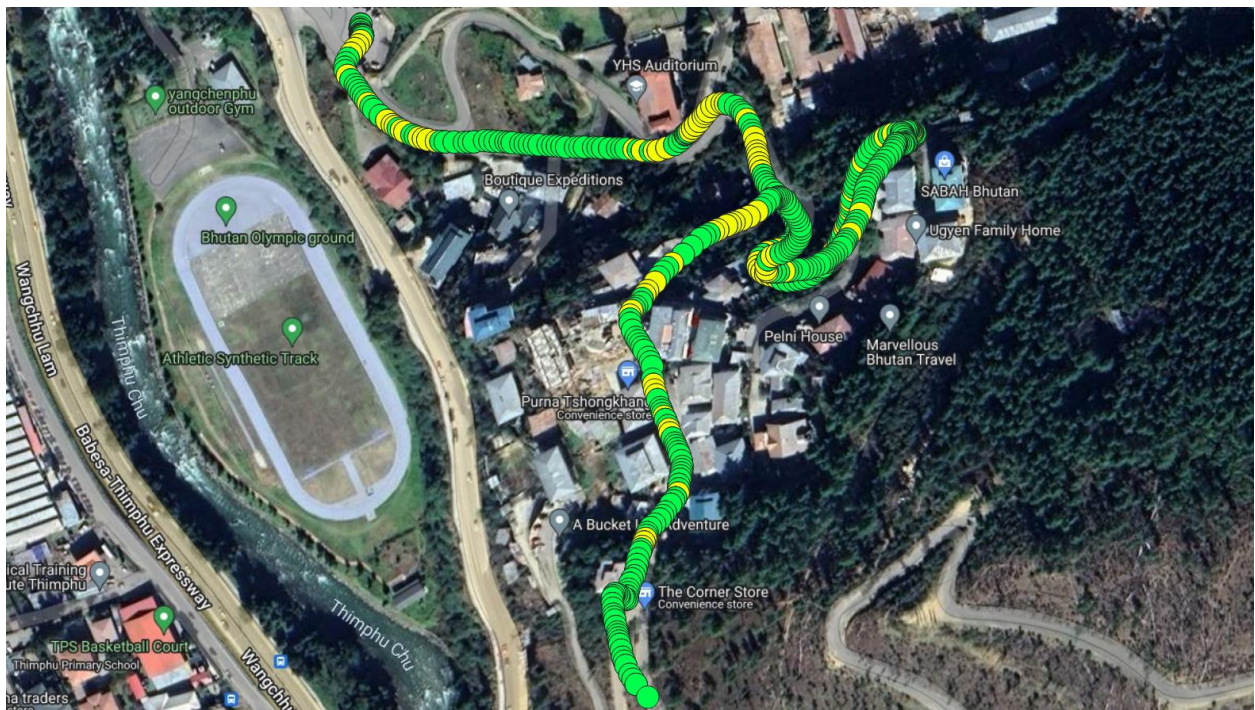


Figure number D.26.1: RSRP plot 4G B-mobile (QGIS) [YHSS area]





*Figure number D.26.2: RSRP plot 4G Tashi cell (QGIS) [YHSS area]*

## 27. Lower Town

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.89	6.34	No issues
TICL	0	3.80	6.96	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	21.7	20.7	No issues
TICL	17.3	25.3	No issues

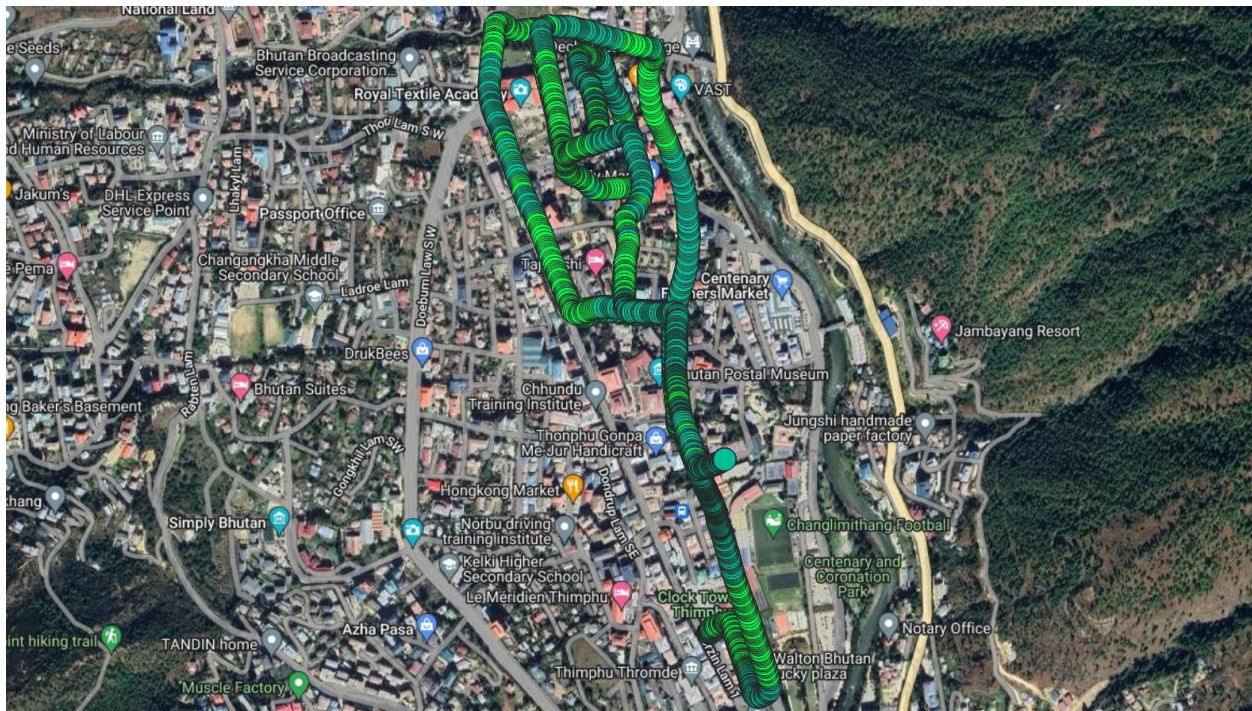
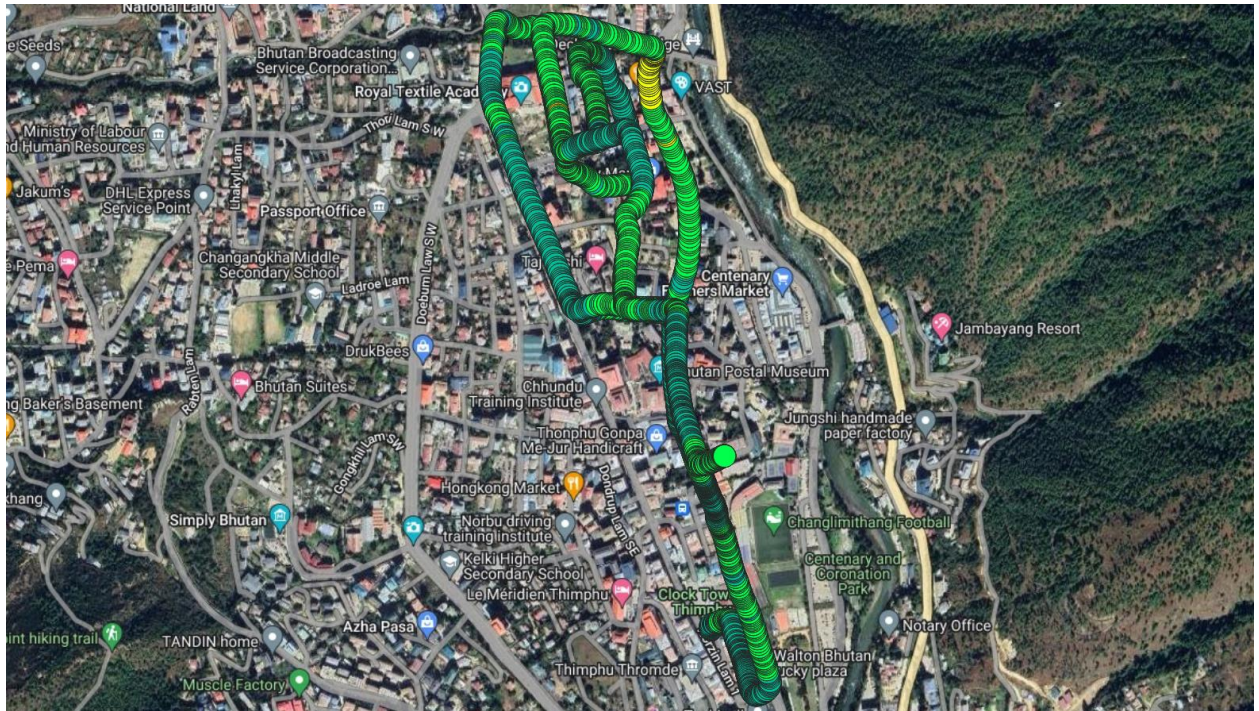


Figure number D.27.1: RSRP plot 4G B-mobile (QGIS) [Lower Town]





*Figure number D.27.2: RSRP plot 4G Tashi cell (QGIS) [Lower Town]*

## 28. Upper Town

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.87	6.89	No issues
TICL	0	3.76	7.68	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	14.68	16.53	No issues
TICL	16.35	15.61	No issues

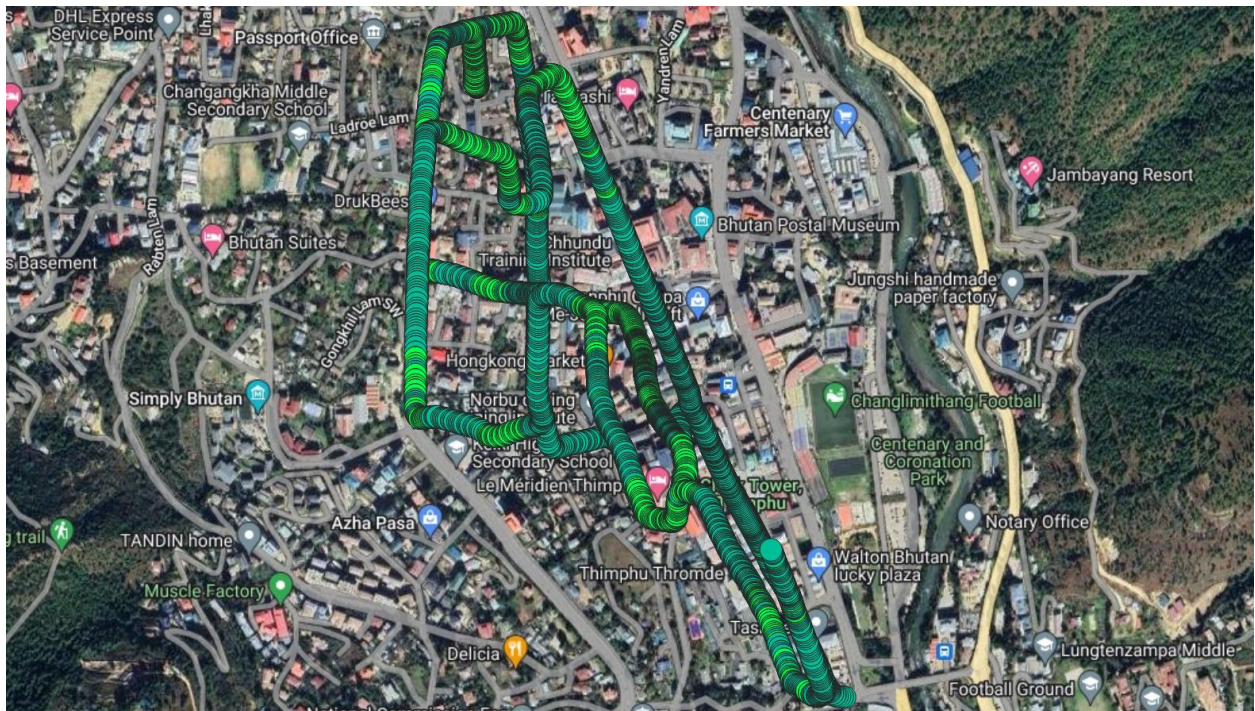


Figure number D.28.1: RSRP plot 4G B-mobile (QGIS) [Upper Town]





*Figure number D.28.2: RSRP plot 4G Tashi cell (QGIS) [Upper Town]*

## 29. Vegetable Market

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.91	6.41	No issues
TICL	0	3.82	6.78	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	25.66	21.35	No issues
TICL	22.85	18.47	No issues

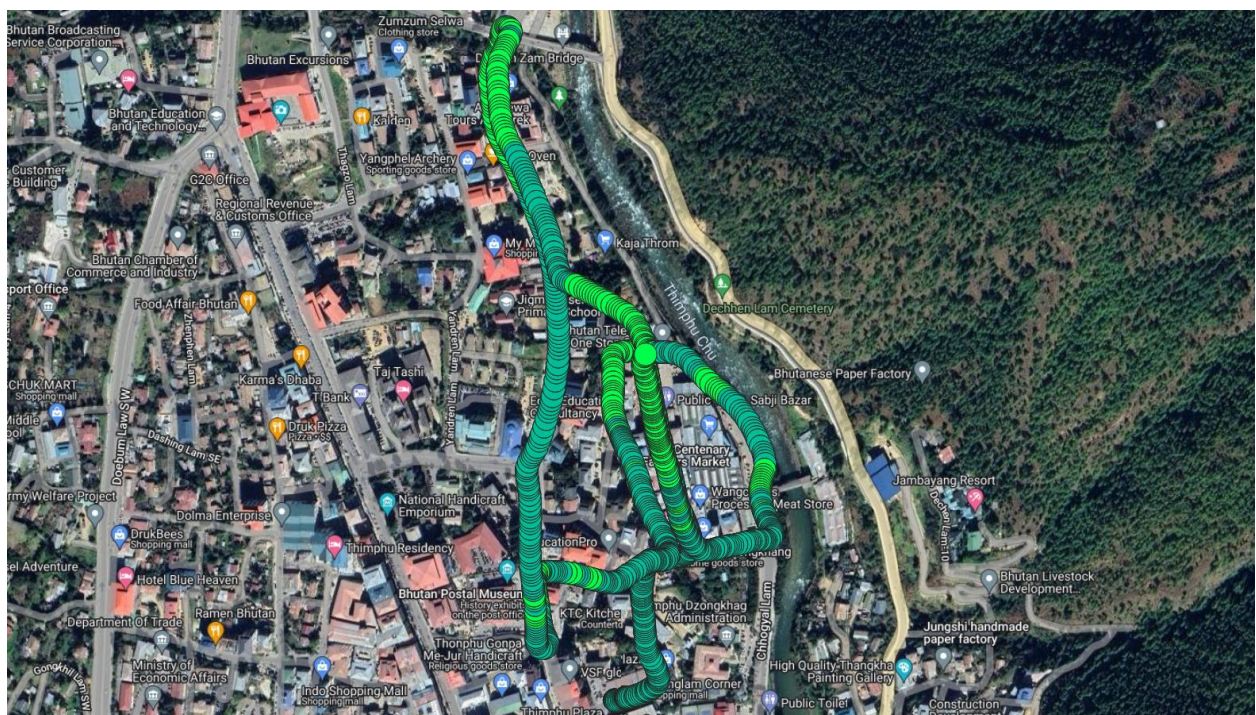


Figure number D.29.1: RSRP plot 4G B-mobile (QGIS) [Vegetable Market]



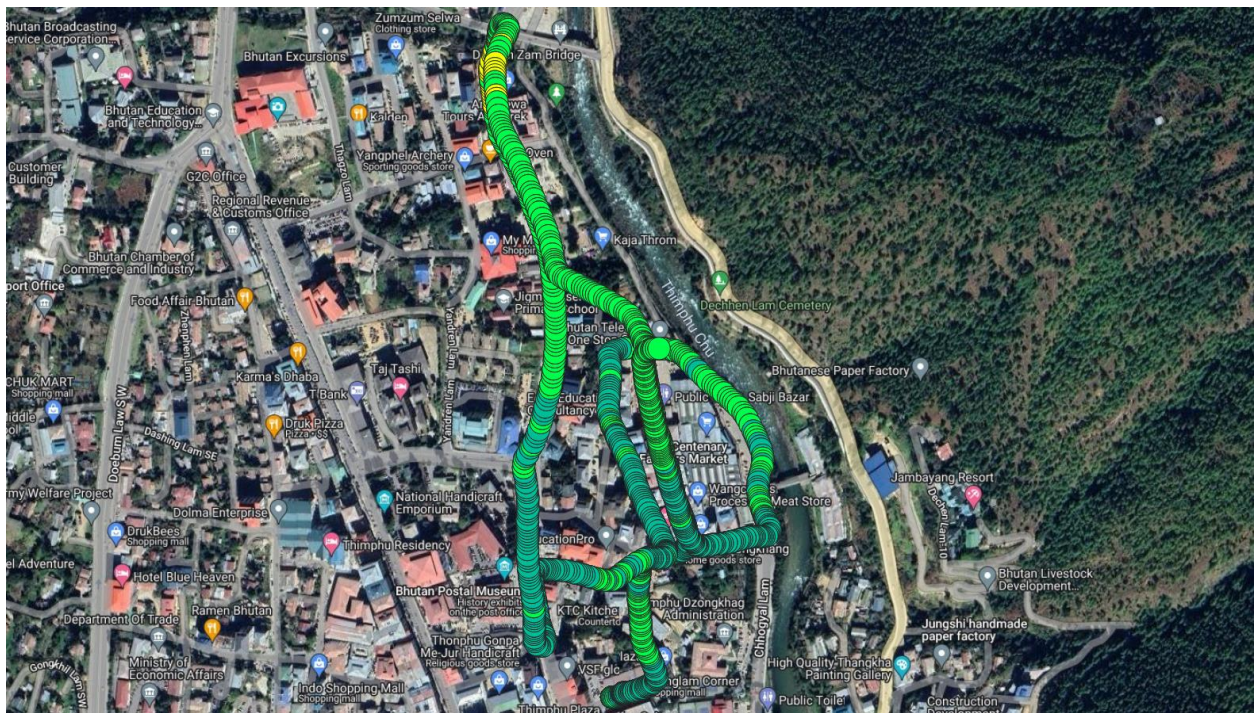


Figure number D.29.2: RSRP plot 4G Tashi cell (QGIS) [Vegetable Market]

### 30. Kaja Throm

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (≥ 3.5)	Call Fallback Setup Time (≤ 9 Seconds)	Remarks
BTL	0	3.75	5.88	No issues
TICL	0	3.76	6.11	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	28.25	23.16	No issues
TICL	12.29	14.4	No issues

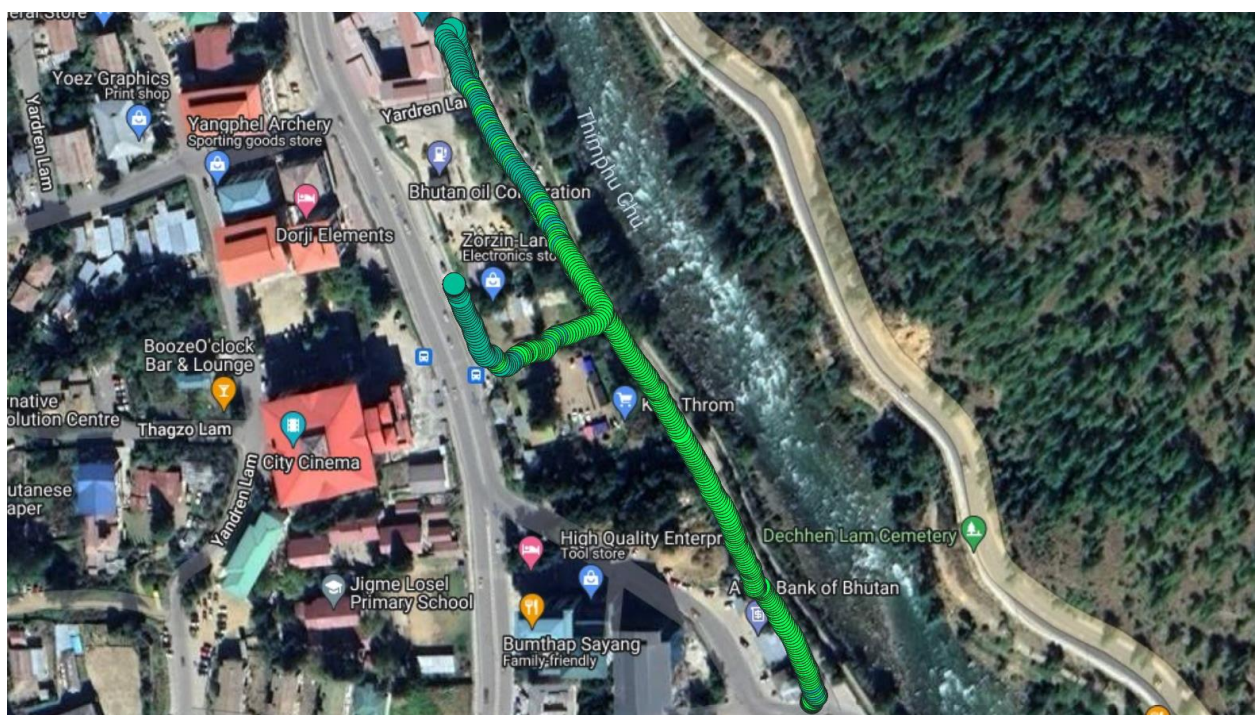


Figure number D.30.1: RSRP plot 4G B-mobile (QGIS) [Kaja Throm]



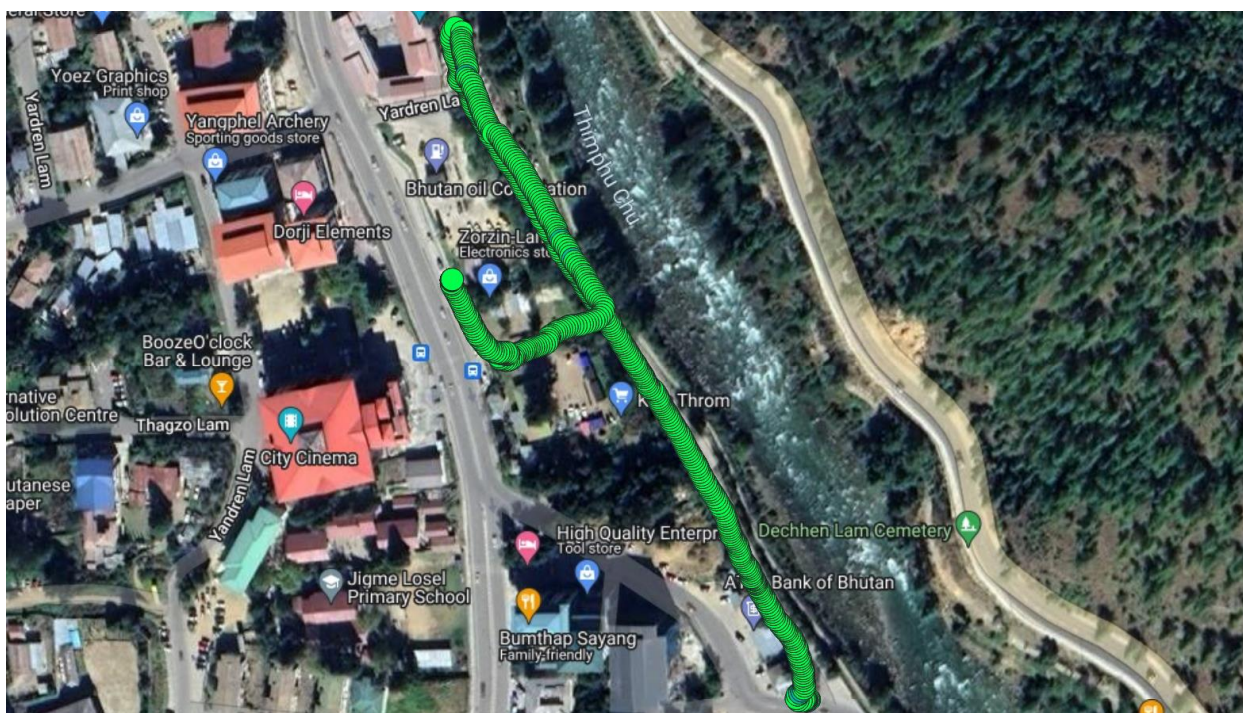


Figure number D.30.2: RSRP plot 4G Tashi cell (QGIS) [Kaja Throm]

- *Mobile Voice Service*

- *Data Throughputs (Mbps) (4G)*

78



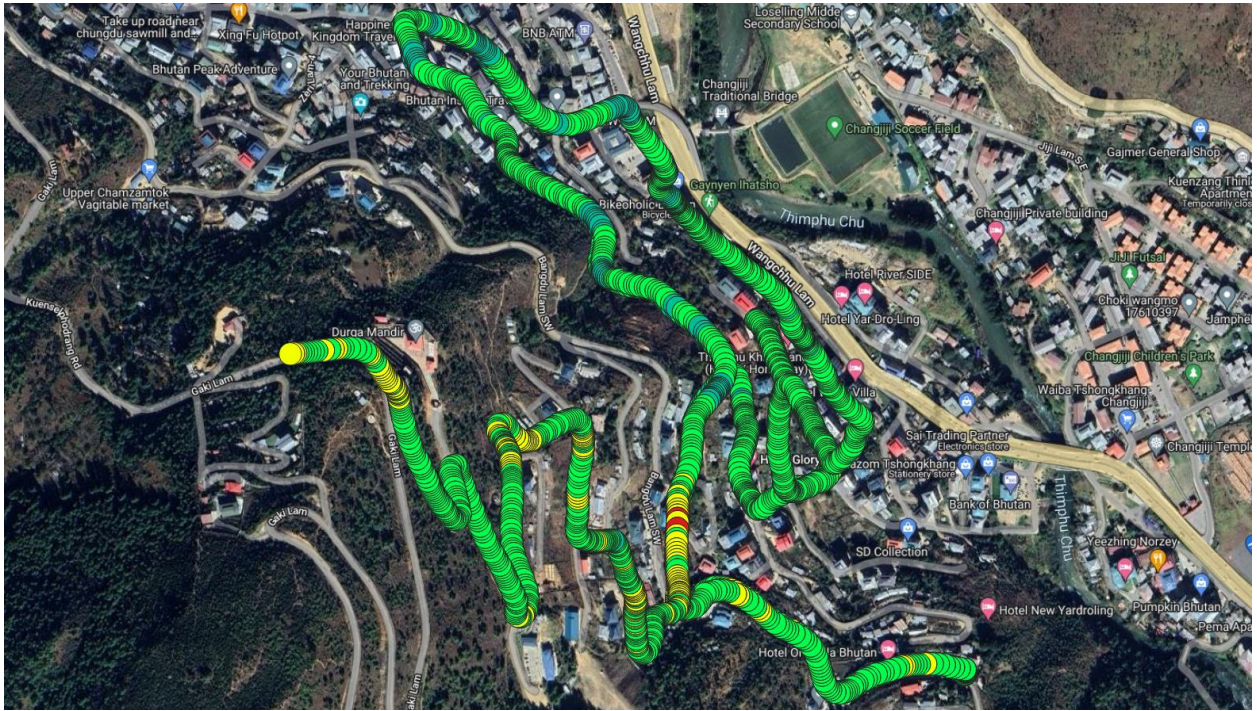


Figure number D.31.2: RSRP plot 4G Tashi cell (QGIS) [Changbandu]

## 32. Changzamtog

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.87	7.26	No issues
TICL	0	3.97	6.03	No issues

- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	24.3	16.82	No issues
TICL	14.04	21.06	No issues



Figure number D.32.1: RSRP plot 4G B-mobile (QGIS) [Changzamtog]





*Figure number D.32.2: RSRP plot 4G Tashi cell (QGIS) [Changzamtog]*

### 33. NPPF Colony

- *Mobile Voice Service*

Operators	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	3.82	6.46	No issues
TICL	0	3.88	6.52	No issues

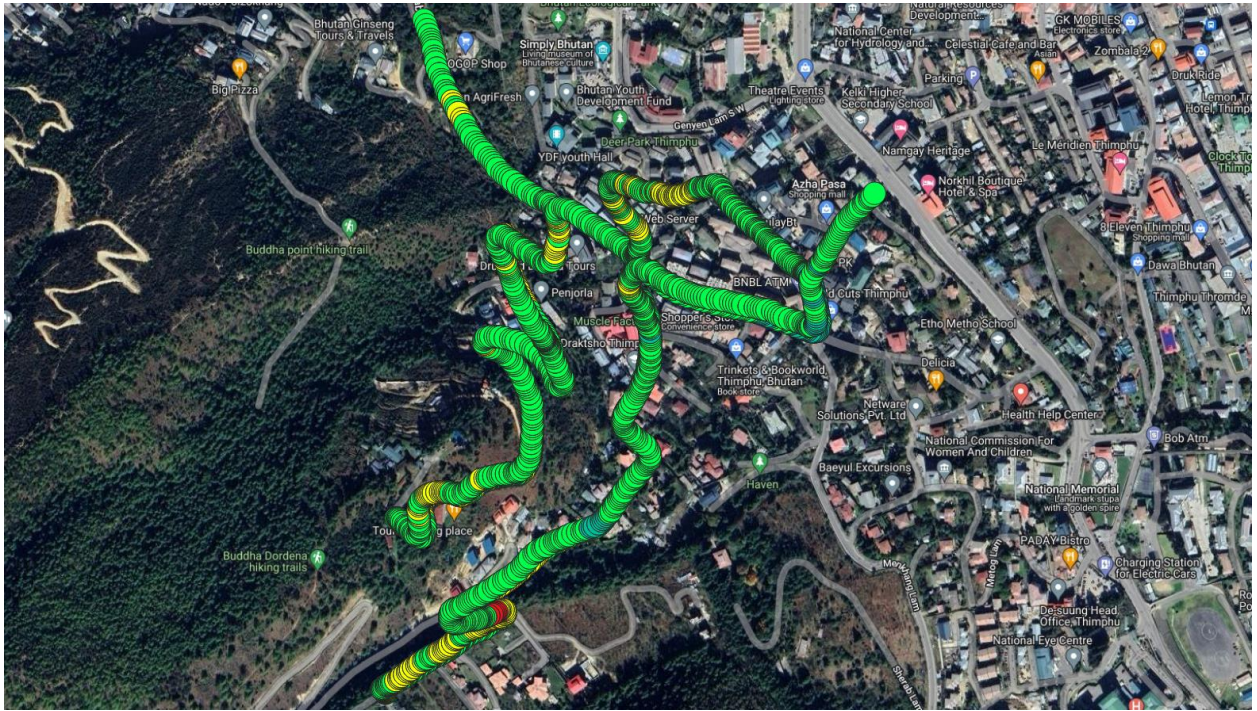
- *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	31.81	12.48	No issues
TICL	23.34	17.98	No issues



Figure number D.33.1: RSRP plot 4G B-mobile (QGIS) [NPPF Colony]





*Figure number D.33.2: RSRP plot 4G Tashi cell (QGIS) [NPPF Colony]*

## 4. Analysis

### a. Zhemgang, Pemagatshel and Samdrup Jongkhar:

The quality of Mobile voice in all of the areas monitored above are found to be meeting the QoS standards. The detailed analysis are as mentioned below:

- The 4G data services in the Tshenkhari area for both upload and download throughput were found to be extremely below the QoS standards for Bhutan Telecom Limited whereas the Tashi InfoComm Limited has issues only in upload throughput.
- The 4G average upload throughput for the Bhutan Telecom Limited (BTL) in Sonam Thang (Panbang) area is found to be below the QoS standard.
- The 4G average upload throughput for the Bhutan Telecom Limited in Nganglam core town is found to be below the QoS standard.
- The 4G average download throughput for Bhutan Telecom Limited in Bangtar core town is found to be below the QoS standard.

### b. Thimphu:

In general, the quality of average mobile voice and data services (3G and 4G) in most of the areas monitored in Thimphu are found to be meeting the QoS standard. The detailed analyses are as mentioned below:

- It is found that 4G data throughputs of both the Operators in the monitored areas are meeting the standards except for the following places:

<b>TICL</b>	<b>BTL</b>
Upper Pamtsho 1 (Download throughput)	Hejo (Download throughput)
YHSS area (Download throughput)	YHSS area (Download throughput)

- The call fallback setup time for both the operators in all the monitored places are meeting the standards except for the following places:

<b>TICL</b>	<b>BTL</b>
Bhutan kitchen and Village Restaurant area	Old Highway Babesa



Upper Pamtsho 1	
Lower Taba	
YHSS area	
Zilukha - Motithang Highway	

- The Mean Opinion Score for both the operators in all the monitored places are meeting the standards except for *Upper Pamtsho 1* for BTL.
- There are no issues of Call drop for both the operators, at all monitored places.

## 5. Follow up Actions Taken by the Authority

The general follow up actions and some of the rectifications actions taken by the Authority against the issues addressed above are mentioned below:

- The Authority shared and informed the telecom operators to improve their network coverage and QoS in those areas where the QoS standards are not fulfilled.
- The Bhutan Telecom Limited has submitted to the Authority the Action Taken Report on the QoS issues at Pemagatshel, Zhemgang and Samdrup Jongkhar as mentioned in the following:

Place	Action Taken
Tsenkhari	<ul style="list-style-type: none"><li>- Commissioned L700 in Tsenkhari town to ease traffic congestion,</li><li>- Changed the route of Backbone on 08/11/2022</li></ul>
Nganglam Town	
Samdrupchoeling (Bangtar) Town	Commissioned L1800 densifying site <b>(21/12/2022)</b> in the core of town mainly to decongest the traffic of the current serving cells.
Sonamthang, Panbang	Plan to commission one densifying site in the 2023

- The Telcos have commissioned new LTE TDD nodes at various places in Thimphu within the trial period approved by the Authority, with which the network QoS has improved.



## 6. Terminologies

- I. **Operator:** Refers to the respective mobile service providers
- II. **Call Drop Rate:** Refers to the fraction of the telephone calls which, due to technical reasons, were cut off before the speaking parties had finished their conversation and before one of them had hung up (dropped calls).
- III. **CDR** = (Number of Call drops/ Total number of attempted calls) x 100
- IV. **Call Completion Rate:** Refers to the ratio of successfully completed calls to the total number of attempted calls.
- V. **CCR** = Number of successful calls / total number of attempted calls
- VI. **Data Throughput Rate:** Refers to the actual amount of data transmitted or transferred in a period of time. It is used for measuring the speeds of data uploads or downloads.
  - A. For 3G, the benchmark is: Uplink  $\geq$  1Mbps, Downlink  $\geq$  1.5 Mbps
  - B. For 4G, the benchmark is: Uplink  $\geq$  2Mbps, Downlink  $\geq$  6Mbps
- VII. **File Transfer Protocol (FTP):** Is a standard network protocol used for the transfer of computer files between a client and server on a computer network.
- VIII. **Hypertext Transfer Protocol (HTP):** Is an application protocol for distributed, collaborative, and hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web.
- IX. **Mean Opinion Score (MOS):** Is a numerical measure of quality of human speech at the destination end of the circuit and will determine the voice quality of user experience (QoE) while talking over the phone. To measure the quality of experience (QoE). It is expressed as a single number in the range from 1 to 5, where the value of 1 corresponds to the lowest quality experienced by the end-users and 5 as the excellent quality experienced as shown below:
  - A. 5:      Excellent
  - B. 4:      Good
  - C. 3:      Fair
  - D. 2:      Poor
  - E. 1:      Bad

- X. **Peak Hours:** Is a time period determined by Service provider where traffic or number of call attempts is the maximum. The peak hours for Bhutan Telecom limited (BTL) is 3 PM to 10 PM while a peak hour for Tashi InfoComm Limited (TICL) is from 6PM to 12 AM.
- XI. **Off – Peak Hours:** Is a time period determined by Service provided where the traffic or call attempts is moderate. The Off- peak hours of BTL is from 6 AM to 3 PM and Off-peak hours for TICL is from 6 AM to 6 PM.
- XII. **Latency:** Is a measure of delay. In a network, **latency** measures the time it takes for some data to get to its destination across the network. It is usually measured as a round trip delay - the time taken for information to get to its destination and back again.
- XIII. **Mbps:** stands for “megabits per second.” It is a measure of internet bandwidth. In simple terms, bandwidth is the download rate of your internet connection. It is the maximum speed at which you can download data from the internet onto to your computer or mobile device
- XIV. **RxLeV:** RxLev represents the received signal strength level measured in dBm units. - 105dBm represents the weakest/unusable signal and -80 dBm the strongest.
- XV. **RSCP:** received signal code power denotes the power measured by a receiver on a particular physical communication channel.
- XVI. **RSRP:** Reference Signal Received Power is a measurement of the received power level in an LTE cell network. The average power is a measurement of the power received from a single reference signal.
- XVII. **Mobile Network Coverage (Signal Strength)**

Sl.No	QoS Parameters	Best dBm	Average dBm	Worst dBm
1	Rxlev (GSM)	$\geq -80$	$-80 \leq -95$	$\leq -105$
2	RSCP (UMTS)	$\geq -80$	$-80 \leq -100$	$\leq -110$
3	RSRP (LTE)	$\geq -80$	$-80 \leq -105$	$\leq -115$