Quarterly Report on Mobile Quality of Service (QoS)

Bhutan InfoComm and Media Authority

Royal Government of Bhutan

(July - September) 2022

Table of contents

Report on Mobile Quality of Service (QoS) **4**

1. Background **4**

2. Locations and date of monitoring **4**

3. Findings **6**

Thimphu 6

Babesa 6

Babesa-Olakha Highway 8

Changzamtog 11

Changangkha (Housing, CMSS and RKPS) area 13

Lower Motithang 15

Ministers' Colony (including the road above MHSS) 16

MoIC (including ministry areas, BTL and Kawajangsa) 18

Sangaygang (RITH, Motithang Takin Preserve) 19

Upper Motithang 21

Motithang - Zilukha Highway 22

Samdrup Jongkhar **24**

Jigme Namgyel Engineering College area 24

Dewathang Core Town 27

Samdrup Jongkhar Dzong Area 30

Samdrup Jongkhar Town 33

Sarpang **36**

Gelephu Core Town 36

Pelrithang Area 39

Dechen Pelri 42

Gelephu Hospital Area 45

Zomlingthang 48

Shershong 51

Sarpang Tar 54

Sarpang Rani Bagan 57

4. Analysis **60**

5. Follow up Actions Taken by the Authority **61**

6. Terminologies **62**

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 Thimphu, Samdrup Jongkhar and Sarpang.

2. Locations and date of monitoring

Sl. No	Dzongkhag	Locations	Monitoring month
1	Thimphu	Babesa	July 2022
2		Olakha-Babesa Highway	
3		Changzamtog	
4		Changangkha (Housing, CMSS and RKPS)	September 2022
5		Lower Motithang	
6		Ministers' Colony (including the road above MHSS)	
7		MoIC areas (including ministry areas, BTL and Kawajangsa)	
8		Sangaygang (RITH, Motithang Takin Preserve)	
9		Upper Motithang	
10		Zilukha - Motithang Highway	
11	Samdrup Jongkhar	Jigme Namgyel Engineering College areas	

12		Dewathang core town	August 2022
13		S/Jongkhar Dzong	
14		S/Jongkhar Town	
15	Sarpang	Gelephu core Town	
16		Pelrithang	
17		Dechen Pelri	
18		Gelephu Hospital area	
19		Zomlingthang	
20		Shershong	
21		Sarpang Tar	
22		Sarpang Rani Bagan	

3. Findings

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

A. Thimphu

a. Babesa

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 9 Seconds)
BTL	0	3.87	9.44
TICL	0	3.48	8.81

Mobile Data Services (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	9.4	17.8
TICL	8.3	8.03

Figure number 1.1: RSCP plot B-mobile (QGIS) [Babesa]

Figure number 1.2: RSCP plot Tashi Cell (QGIS) [Babesa]

Figure number 1.3: RSRP plot 4G B-mobile (QGIS) [Babesa]

Figure number 1.4: RSRP plot 4G Tashi Cell (QGIS) [Babesa]

b. Babesa-Olakha Highway

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score (>= 3.5)**	**Call Setup Time (<= 9 Seconds)**
BTL	0	3.70	6.15
TICL	0	3.59	8.91

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	15.48	21.34
TICL	10.39	20.74

Figure number 1.5: RSCP plot B-mobile (QGIS) [Babesa-Olakha Highway]

Figure number 1.6: RSCP plot Tashi Cell (QGIS) [Babesa-Olakha Highway]

Figure number 1.7: RSRP plot 4G B-mobile (QGIS) [Babesa-Olakha Highway]

Figure number 1.8: RSRP plot 4G Tashi Cell (Google earth) [Babesa-Olakha Highway]

c. Changzamtog

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 9 Seconds)
BTL	0	3.83	7.91
TICL	0	3.92	9.47

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	24.4	16.1
TICL	10.5	15.1

Figure number 1.9: RSCP plot 3G B-mobile (QGIS) [Changzamtog]

Figure number 1.10: RSCP plot 3G Tashi cell (QGIS) [Changzamtog]

Figure number 1.11: RSRP plot 4G B-mobile (QGIS) [Changzamtog]

Figure number 1.12: RSRP plot 4G Tashi cell (QGIS) [Changzamtog]

d. Changangkha (Housing, CMSS and RKPS) area

Mobile Voice Services

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score (>= 3.5)**	**Call Setup Time (<= 9 Seconds)**
BTL	0	3.86	6.84
TICL	0	3.91	8.38

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	23.87	15.86
TICL	26.73	15.31

Figure number 1.13: RSRP plot 4G B-mobile (QGIS) [Changangkha (Housing, CMSS and RKPS)]

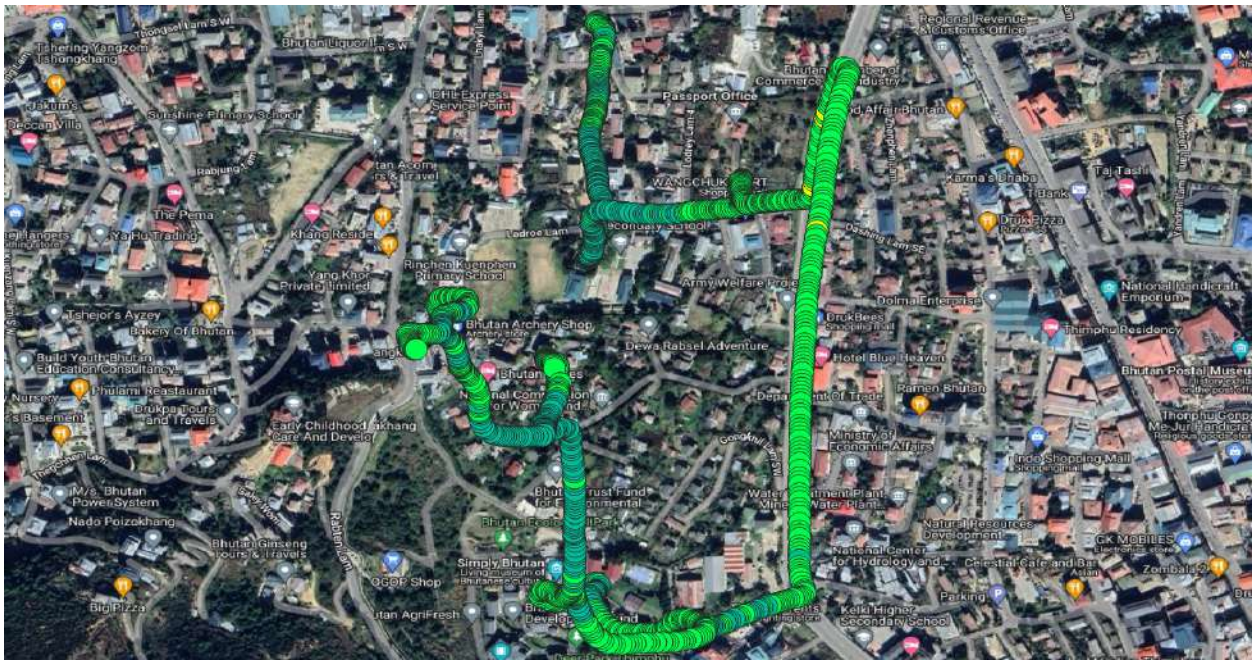

*Figure number 1.14: RSRP plot 4G Tashi Cell (QGIS) [*Changangkha (Housing, CMSS and RKPS)*]*

e. Lower Motithang

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 9 Seconds)
BTL	0	3.79	6.6
TICL	0	4.03	6.82

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	28.01	16.63
TICL	29.16	22.69

Figure number 1.15: RSRP plot 4G B-mobile (QGIS) - Lower Motithang

Figure number 1.16: RSRP plot 4G Tashi Cell (Google earth) - Lower Motithang

f. Ministers' Colony (including the road above MHSS)

Mobile Voice Services

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score (>= 3.5)**	**Call Setup Time (<= 9 Seconds)**
BTL	0	3.87	6.04
TICL	0	4.03	6.61

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	28.82	21.25
TICL	34.58	22.44

Figure number 1.17: RSRP plot 4G B-mobile (QGIS) - Ministers' colony (including the road above MHSS)

Figure number 1.18: RSRP plot 4G Tashi cell (QGIS) - Ministers' colony (including the road above MHSS)

g. MoIC (including ministry areas, BTL and Kawajangsa)

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 9 Seconds)
BTL	0	3.86	6.04
TICL	0	4	7.59

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	24.02	34.38
TICL	29.13	18.55

Figure number 1.19: RSRP plot 4G B-mobile (QGIS) - MoIC (including ministry areas, BTL and Kawajangsa)

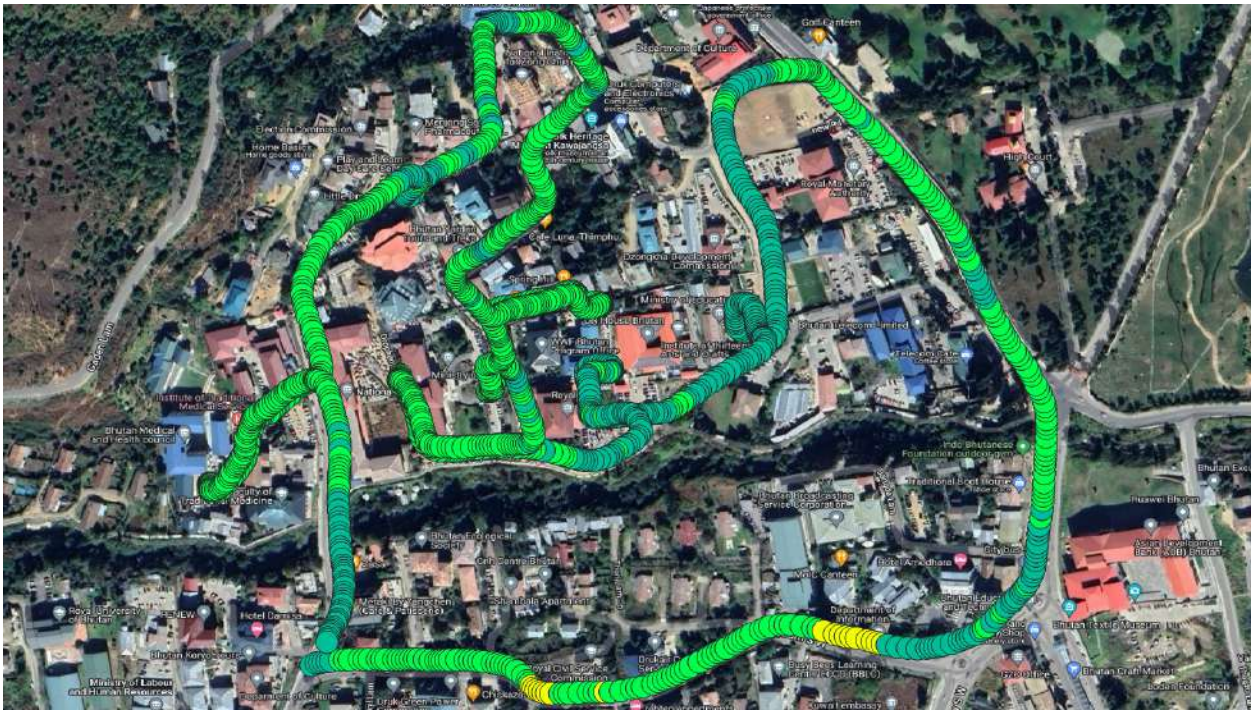

Figure number 1.20: RSRP plot 4G Tashi cell (QGIS) - MoIC (including ministry areas, BTL and Kawajangsa)

h. Sangaygang (RITH, Motithang Takin Preserve)

Mobile Voice Services

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score (>= 3.5)**	**Call Setup Time (<= 9 Seconds)**
BTL	0	3.82	6.27
TICL	0	3.61	7.86

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	24.14	16.34
TICL	34.46	13.17

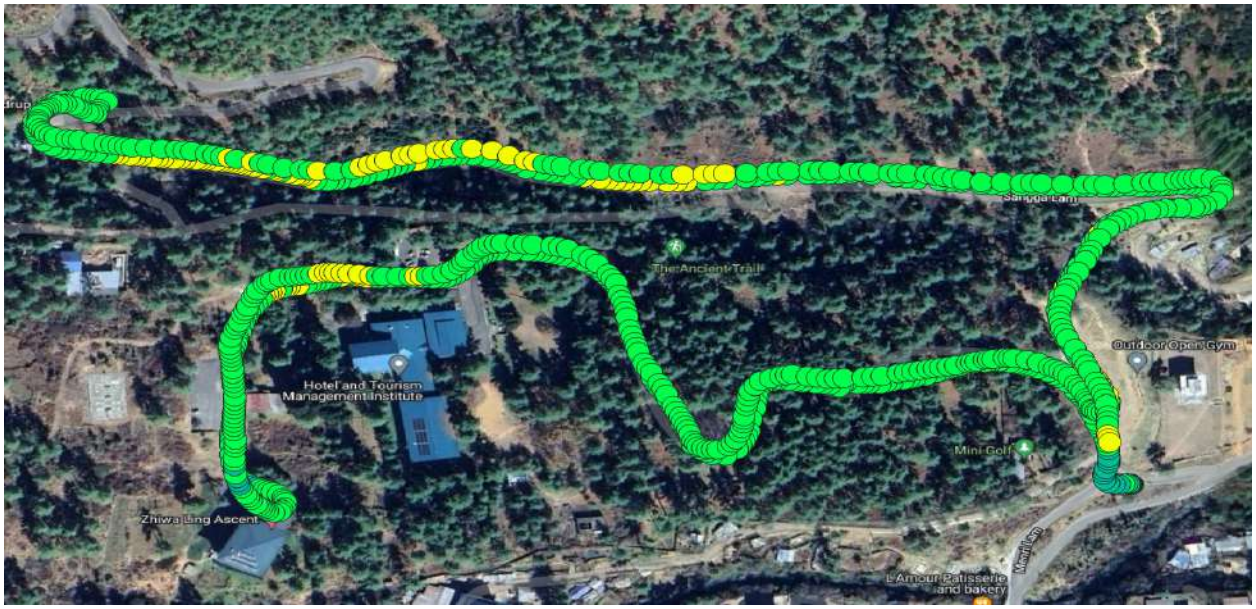

Figure number 1.21: RSRP plot 4G B-mobile (QGIS) - Sangaygang (RITH, Motithang Takin Preserve)

Figure number 1.22: RSRP plot 4G Tashi cell (QGIS) - Sangaygang (RITH, Motithang Takin Preserve)

i. Upper Motithang

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 9 Seconds)
BTL	0	3.89	6.01
TICL	0	3.62	7.91

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	41.58	30.89
TICL	45.64	28.24

Figure number 1.23: RSRP plot 4G B-mobile (QGIS) - Upper Motithang

Figure number 1.24: RSRP plot 4G Tashi cell (QGIS) - Upper Motithang

j. Motithang - Zilukha Highway

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 9 Seconds)
BTL	0	3.85	6.89
TICL	0	3.96	10.05

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	23.29	21.04
TICL	15.71	15.64

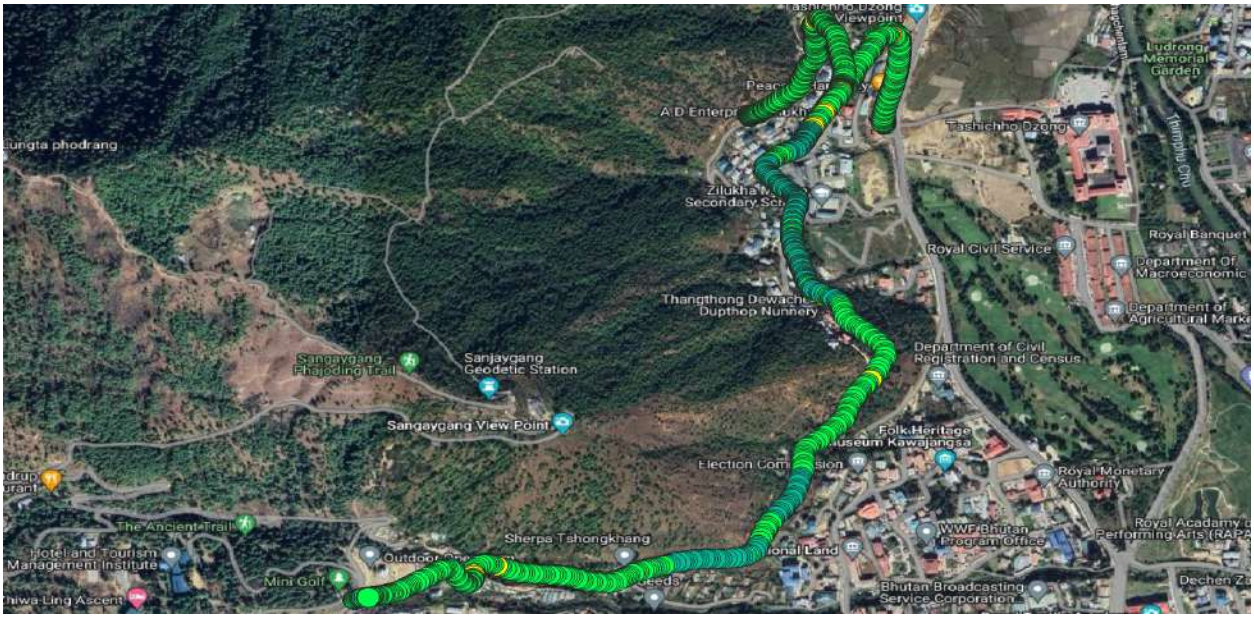

Figure number 1.25: RSRP plot 4G B-mobile (QGIS) - Motithang - Zilukha Highway

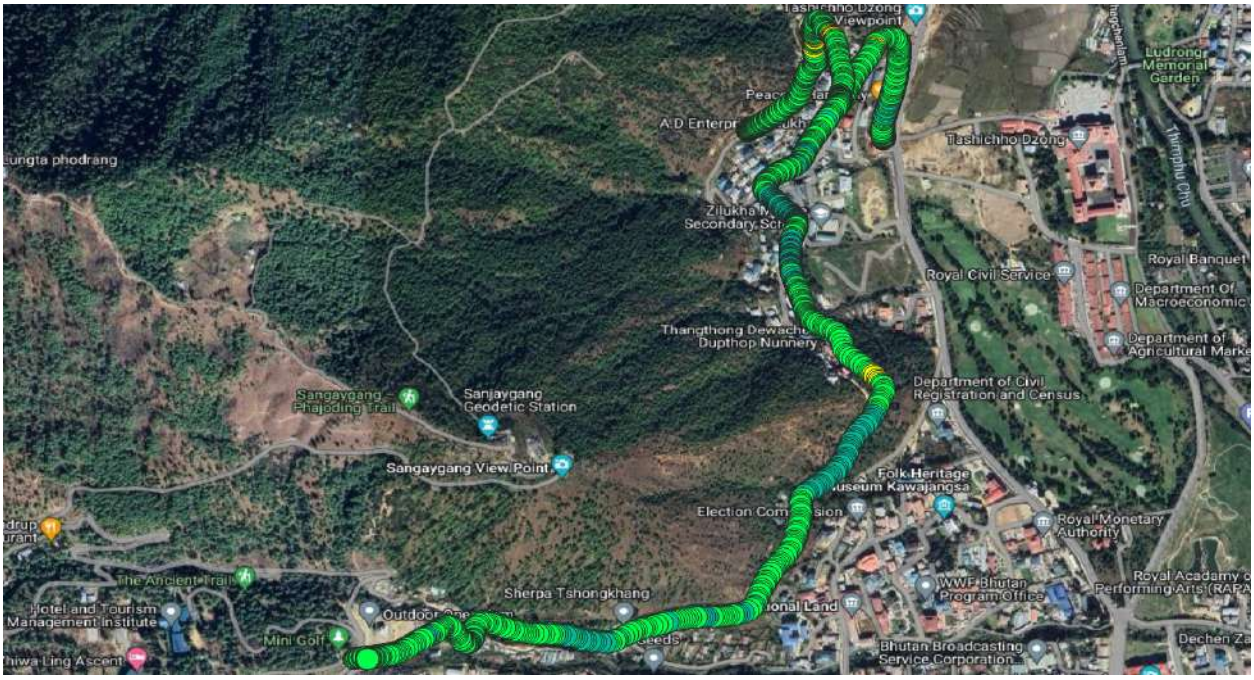

Figure number 1.26: RSRP plot 4G Tashi cell (QGIS) - Motithang - Zilukha Highway

.....

B. Samdrup Jongkhar

a. Jigme Namgyel Engineering College area

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 9 Seconds)
BTL	0	3.84	6.01
TICL	0	3.7	6.18

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download >=1.5 Mbps	Upload >=1 Mbps
BTL	4.96	1.16
TICL	2.1	1.41

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download >=6 Mbps	Upload >=2 Mbps
BTL	5.4	14.6
TICL	8.1	3.8

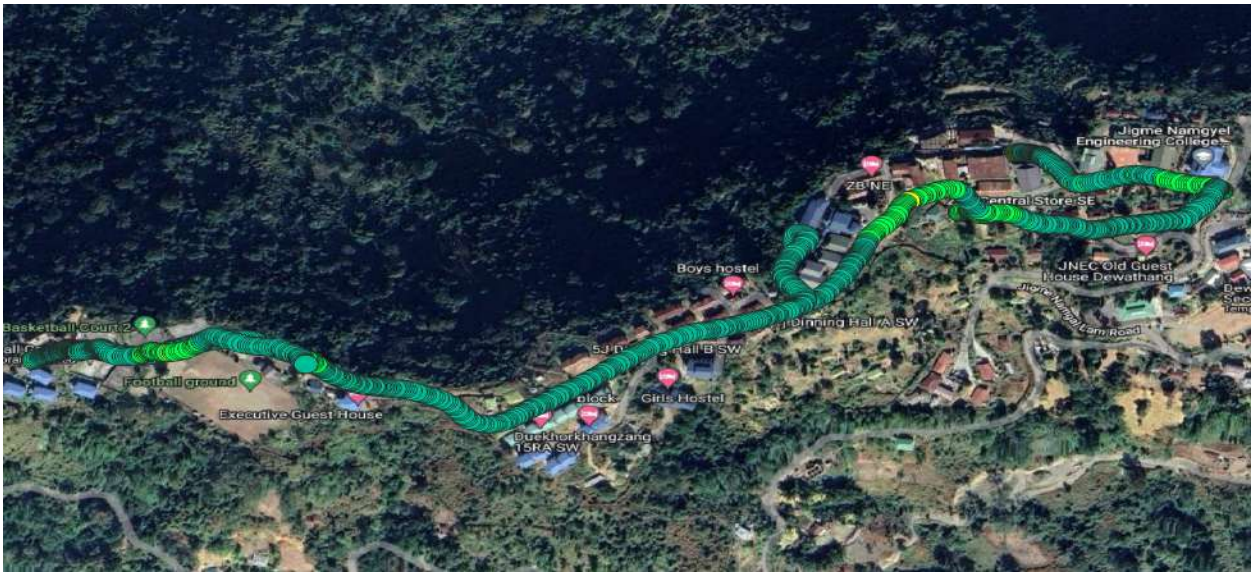

Figure 2.1: RSCP(3G) plot of B-mobile (QGIS) [JNEC]

Figure 2.2: RSRP(4G) plot of B-mobile (QGIS) [JNEC]

Figure 2.3: RSCP(3G) plot Tashi Cell (QGIS) [JNEC]

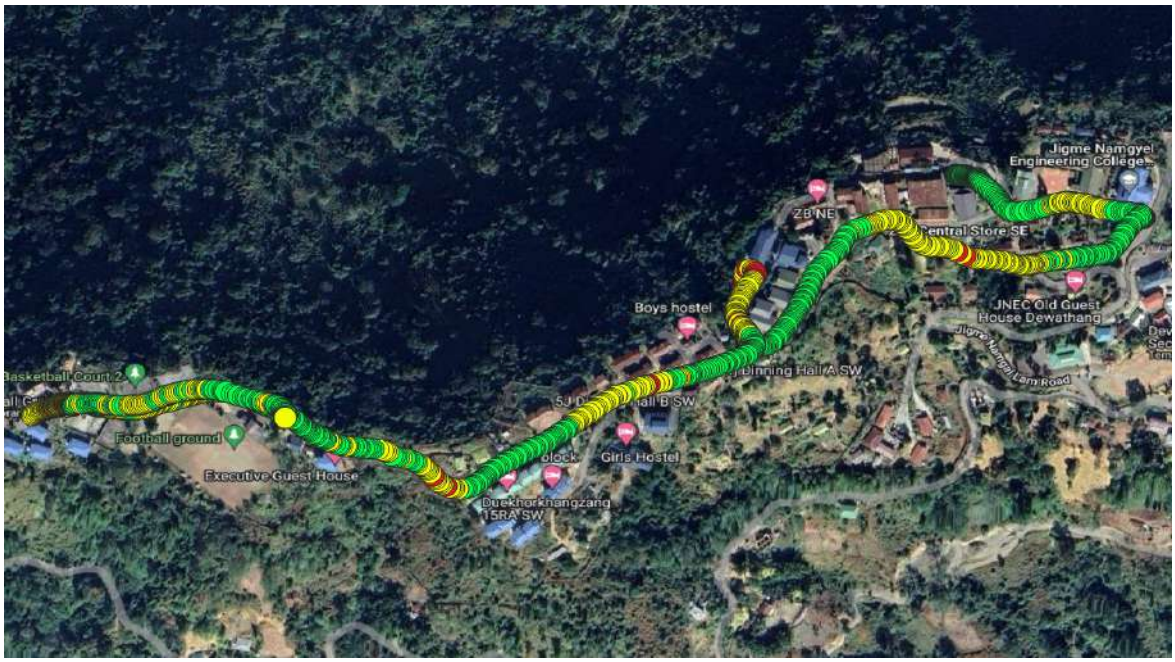

Figure 2.4:RSRP(4G) plot of Tashi Cell (QGIS) [JNEC]

b. Dewathang Core Town

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score >=3.5**	**CSFB Setup Time <=9**
BTL	0	3.79	5.93
TICL	0	3.88	8.52

Data Throughputs (Mbps) (3G)

Operators	**File Transfer Protocol**	
	Download >=1.5 Mbps	**Upload >=1 Mbps**
BTL	**0.411**	**0.12**
TICL	**1.32**	**0.86**

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	8.92	10.3
TICL	18.2	7.3

Figure 2.5: RSCP(3G) plot of B-mobile (QGIS) [Dewathang]

Figure 2.6: RSRP(4G) plot of B-mobile (QGIS) [Dewathang]

Figure 2.7: RSCP(3G) plot Tashi Cell (QGIS) [Dewathang]

Figure 2.8:RSRP(4G) plot of Tashi Cell (QGIS) [Dewathang]

c. Samdrup Jongkhar Dzong Area

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score >=3.5**	**CSFB Setup Time <=9**
BTL	0	3.79	5.69
TICL	0	4	5.24

Data Throughputs (Mbps) (3G)

Operators	**File Transfer Protocol**	
	Download >=1.5 Mbps	**Upload ≥ 1 Mbps**
BTL	4.2	1.01
TICL	6.2	1.57

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	14.9	5.5
TICL	28.1	10.9

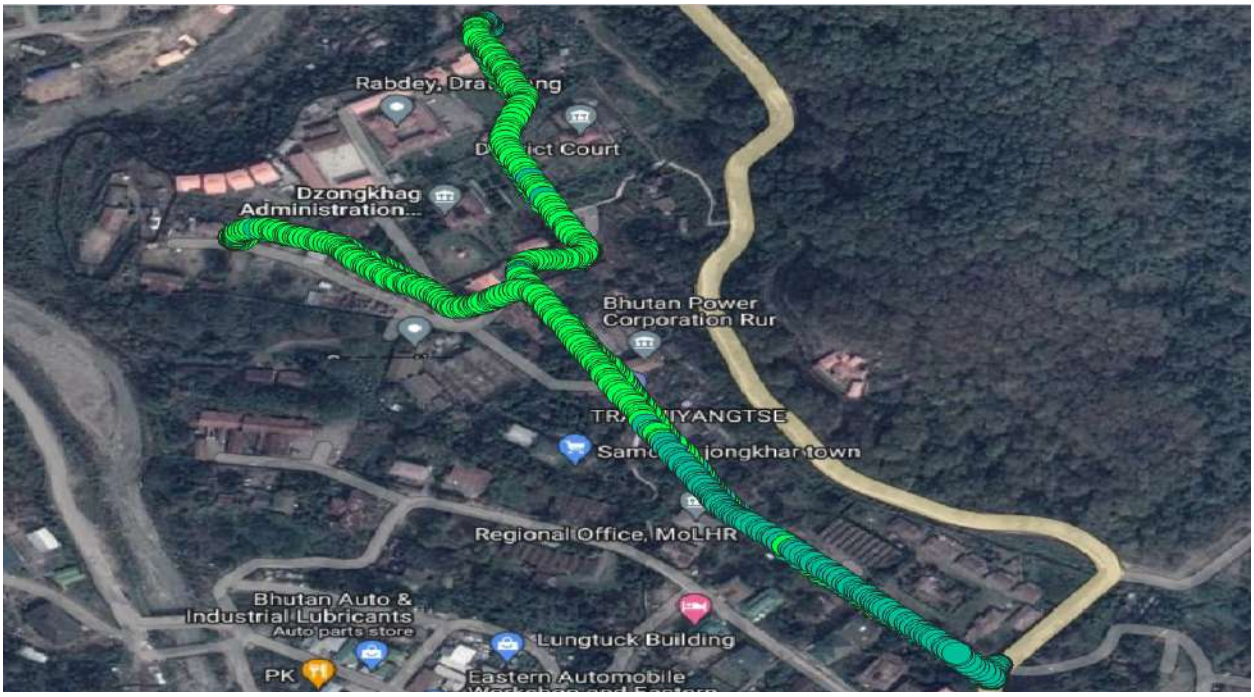

Figure 2.9: RSCP(3G) plot of B-mobile (QGIS) [Samdrup Jongkhar Dzong]

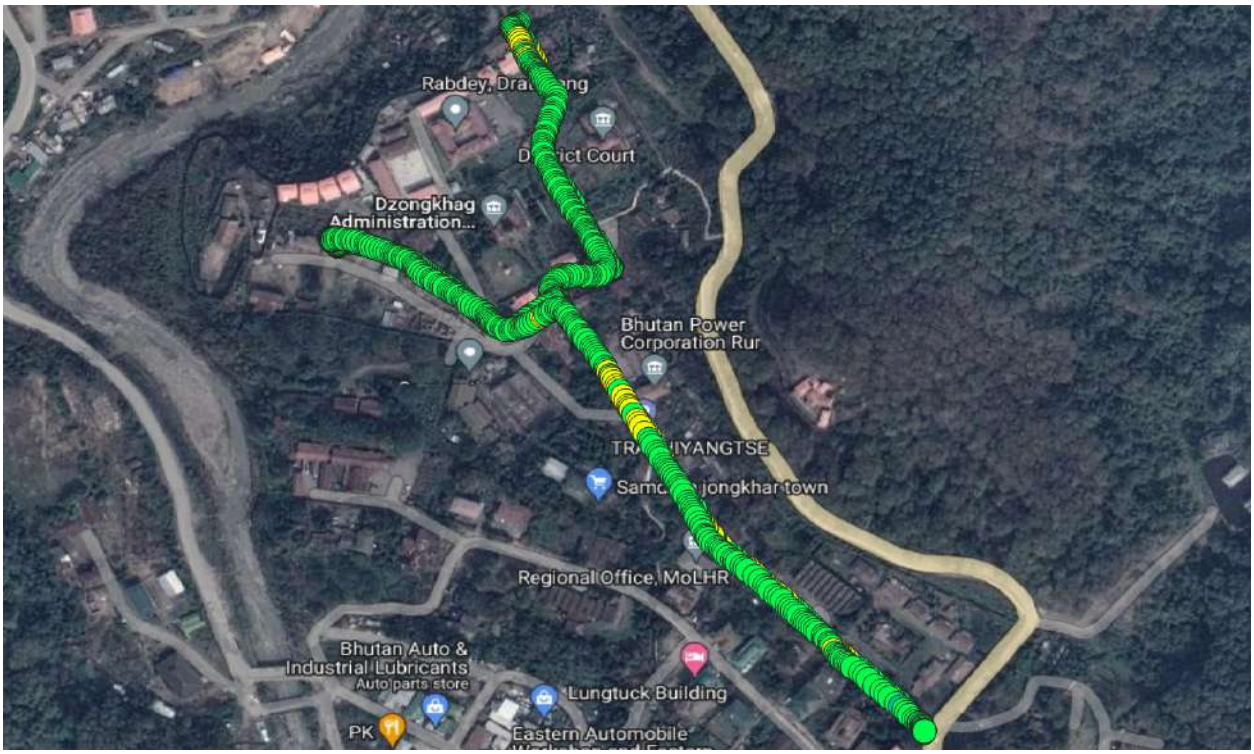

Figure 2.10: RSRP(4G) plot of B-mobile (QGIS) [Samdrup Jongkhar Dzong]

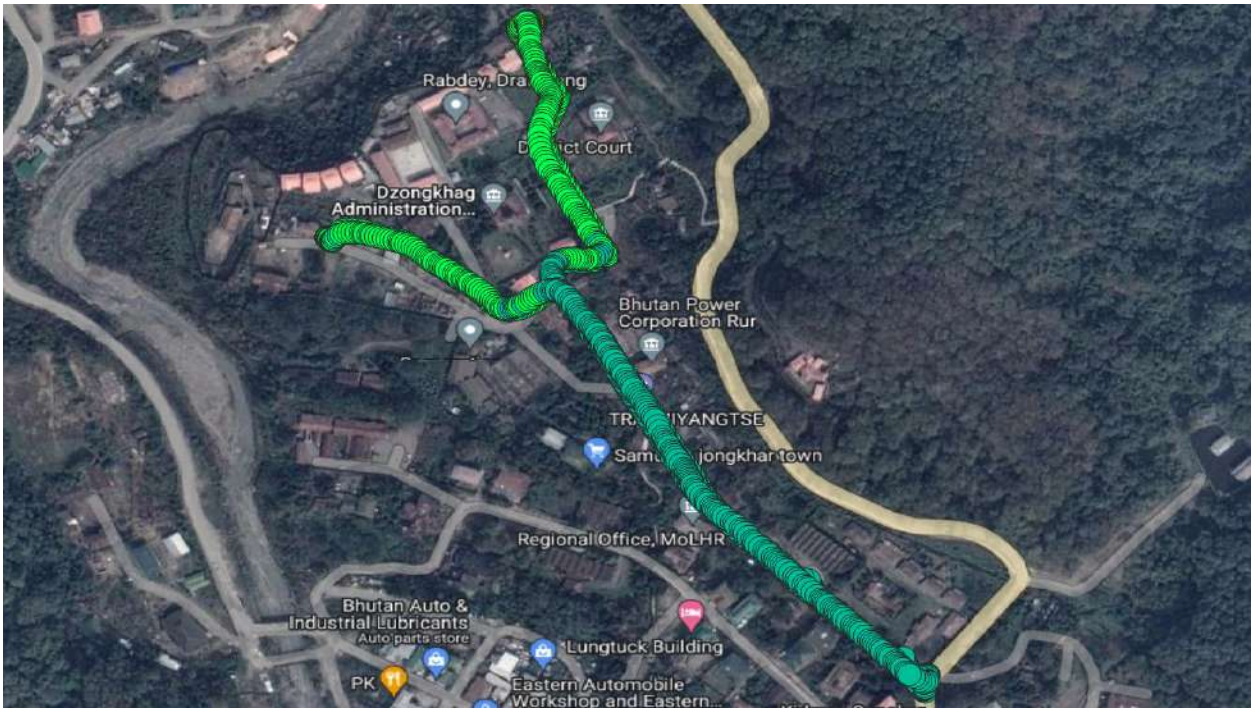

Figure 2.11: RSCP(3G) plot Tashi Cell (QGIS) [Samdrup Jongkhar Dzong]

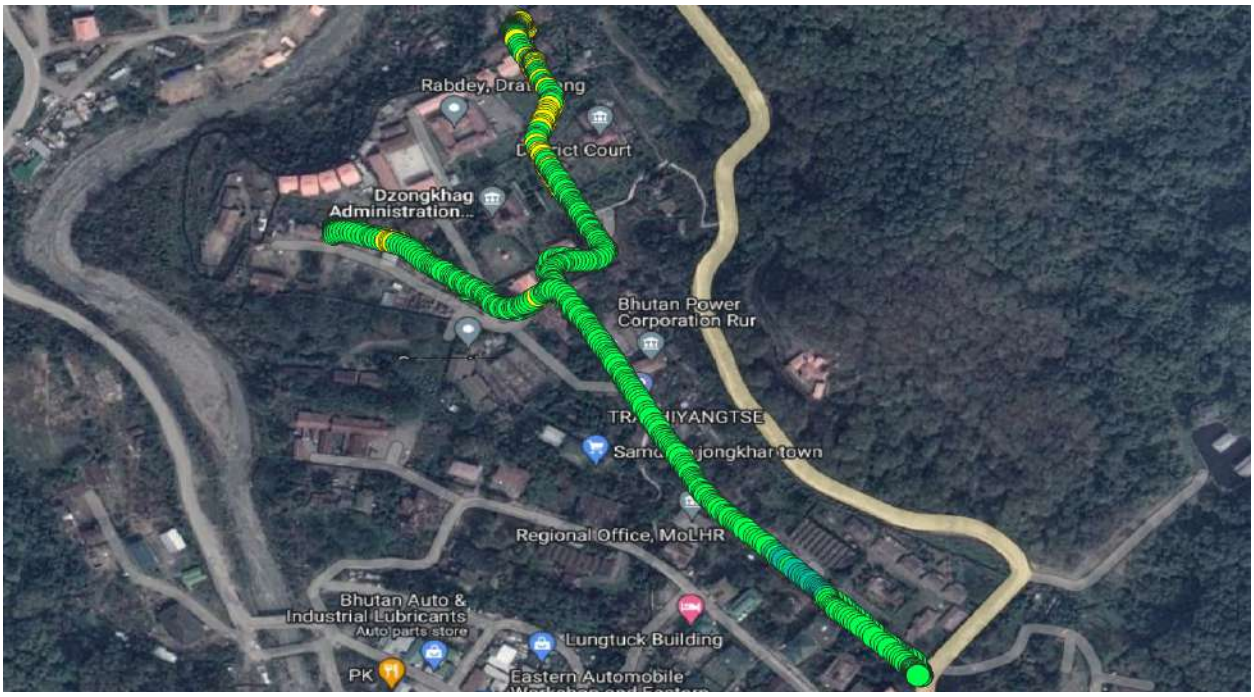

Figure 2.12: RSRP(4G) plot of Tashi Cell (QGIS) [Samdrup Jongkhar Dzong]

d. Samdrup Jongkhar Town

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score >=3.5**	**CSFB Setup Time <=9**
BTL	0	3.7	6.10
TICL	0	3.9	5.18

Data Throughputs (Mbps) (3G)

Operators	**File Transfer Protocol**	
	Download >=1.5 Mbps	**Upload (≥ 1 Mbps)**
BTL	3.7	1.34
TICL	5.52	1.67

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	20.5	3.81
TICL	31.1	9.74

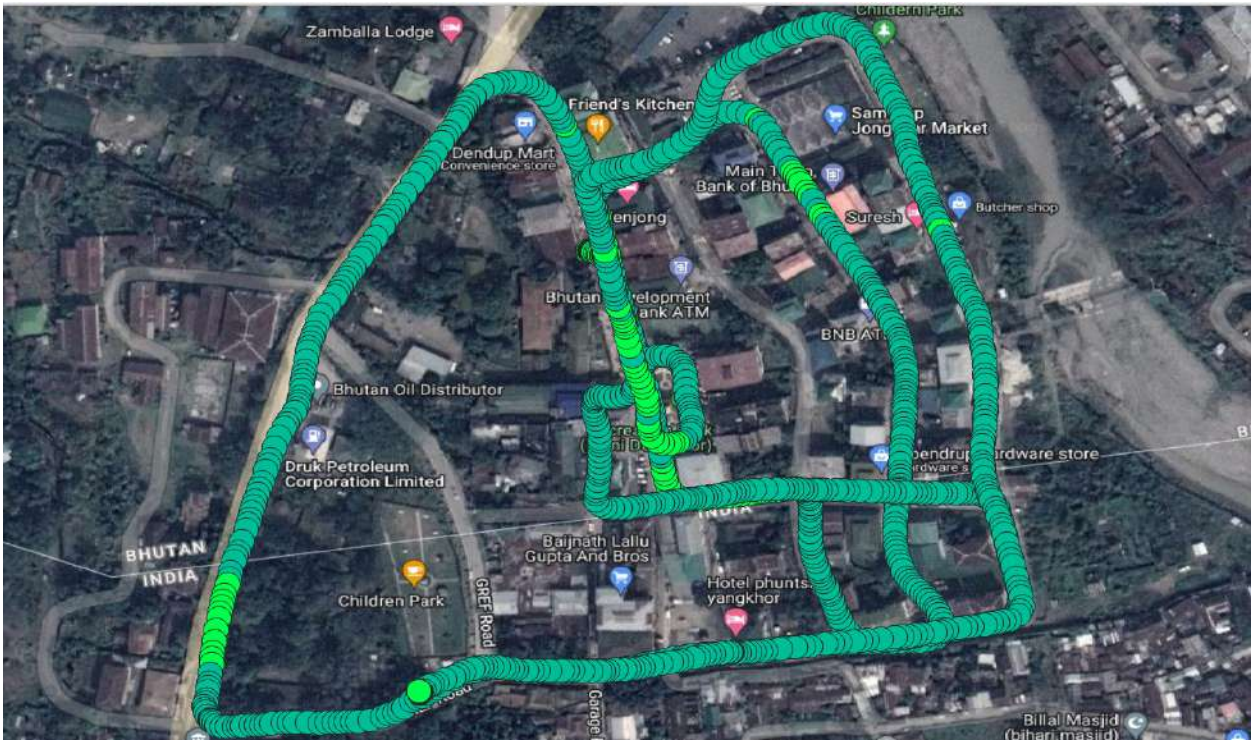

Figure 2.13: RSCP(3G) plot of B-mobile (QGIS) [Samdrup Jongkhar Town]

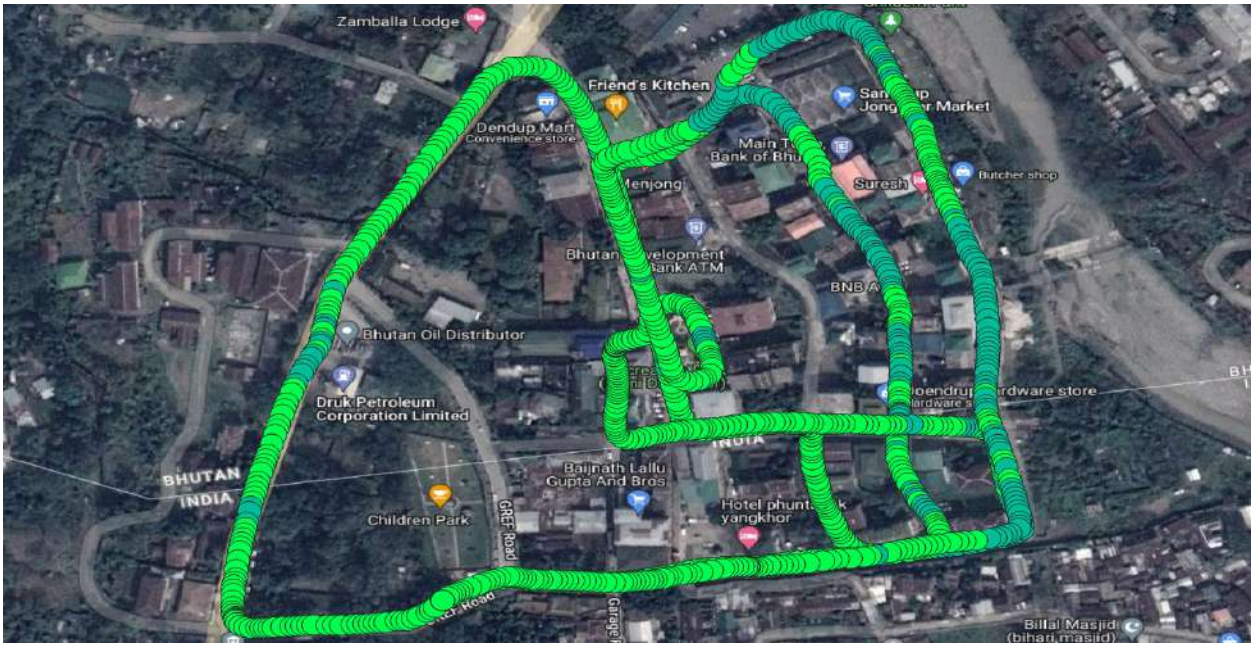

Figure 2.14: RSRP(4G) plot of B-mobile (QGIS) [Samdrup Jongkhar Town]

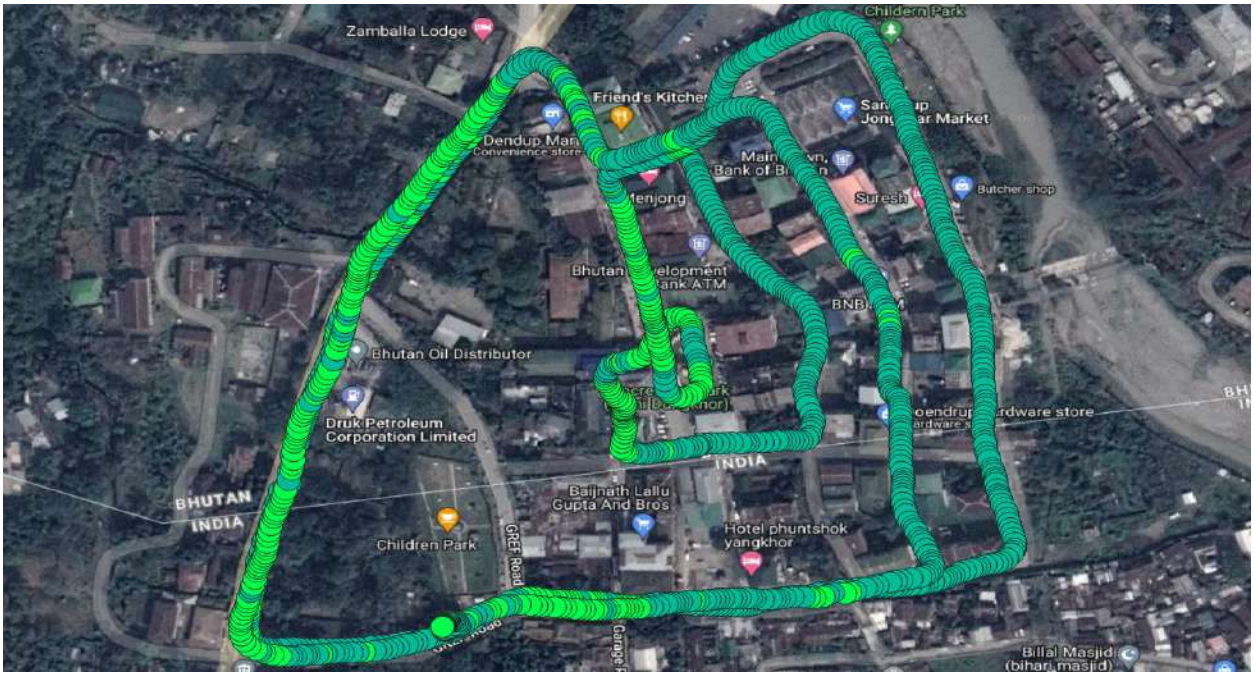

Figure 2.15: RSCP(3G) plot Tashi Cell (QGIS) [Samdrup Jongkhar Town]

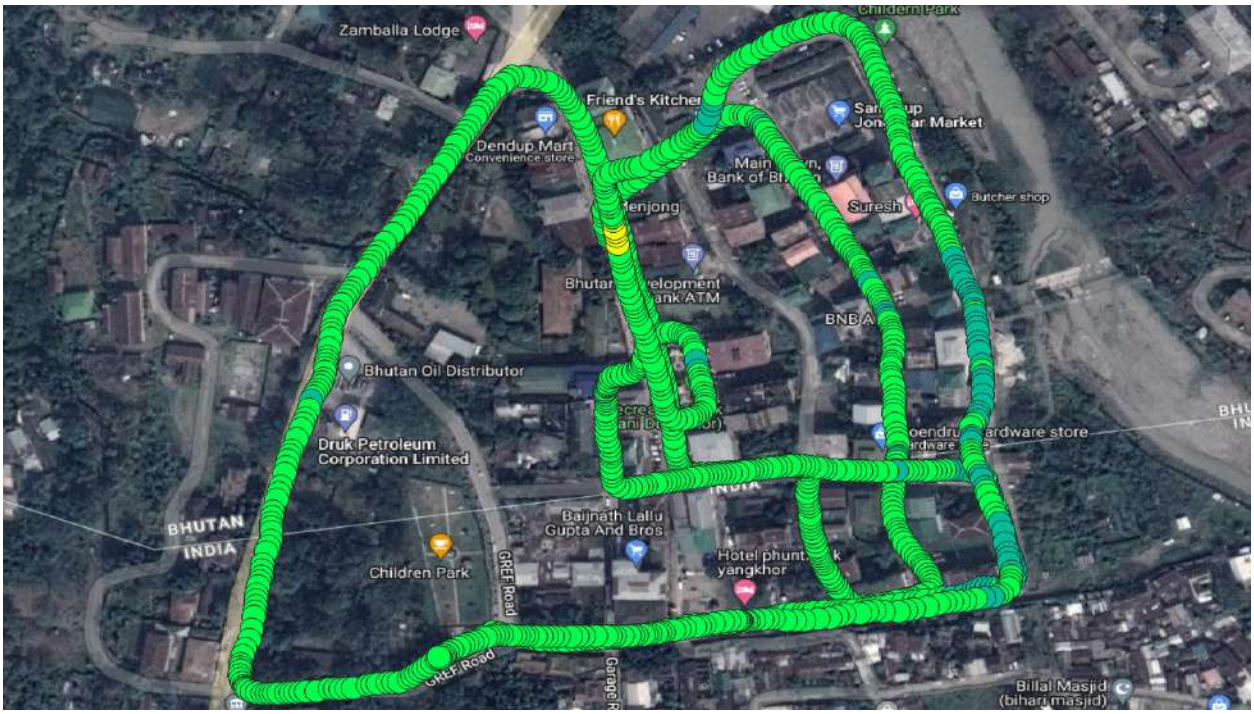

Figure 2.16:RSRP(4G) plot of Tashi Cell (QGIS) [Samdrup Jongkhar Town]

.....

C. Sarpang

a. Gelephu Core Town

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score >=3.5	CSFB Setup Time <=9
BTL	0	3.57	6.17
TICL	0	3.94	5.65

Mobile Data Services (3G)

Operators	File Transfer Protocol	
	Download >=1.5 Mbps	Upload (≥ 1 Mbps)
BTL	6.75	1.2
TICL	5.53	1.4

Mobile Data Services (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	28.6	17.12
TICL	59.2	27.6

Figure 3.1: RSCP(3G) plot of B-mobile (QGIS) [Gelephu Core Town]

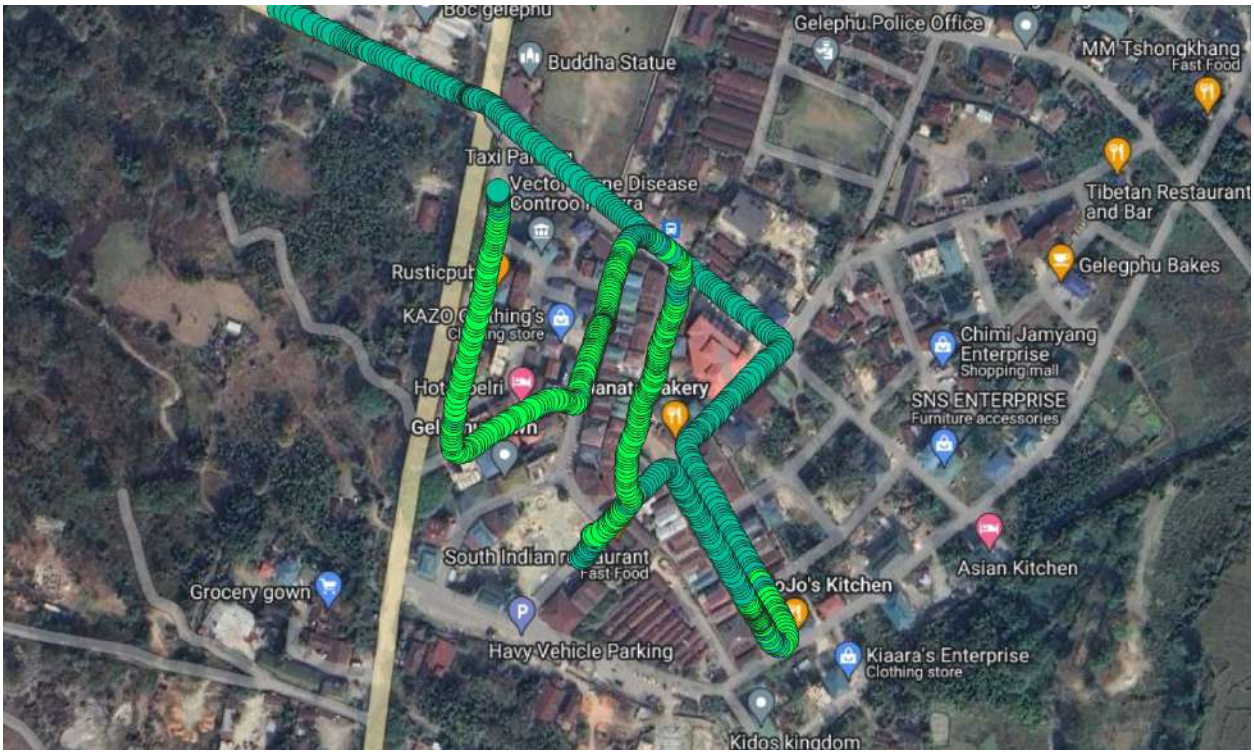

Figure 3.2: RSRP(4G) plot of B-mobile (QGIS) [Gelephu Core Town]

Figure 3.3: RSCP(3G) plot Tashi Cell (QGIS) [Gelephu Core Town]

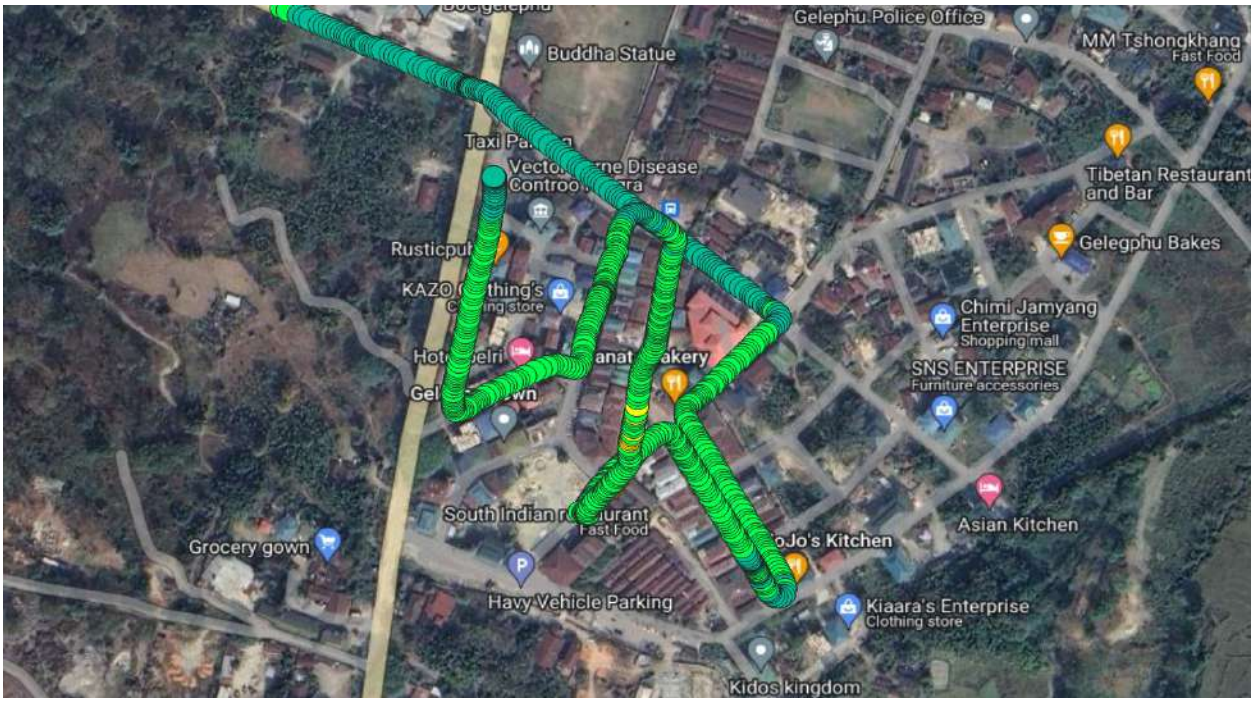

Figure 3.4:RSRP(4G) plot of Tashi Cell (QGIS) [Gelephu Core Town]

b. Pelrithang Area

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score >=3.5**	**CSFB Setup Time <=9**
BTL	0	3.82	6.30
TICL	0	3.84	6.26

Data Throughputs (Mbps) (3G)

Operators	**File Transfer Protocol**	
	Download >=1.5 Mbps	**Upload (≥ 1 Mbps)**
BTL	1.55	**0.61**
TICL	2.93	1.43

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	22.8	12.4
TICL	9.94	3.24

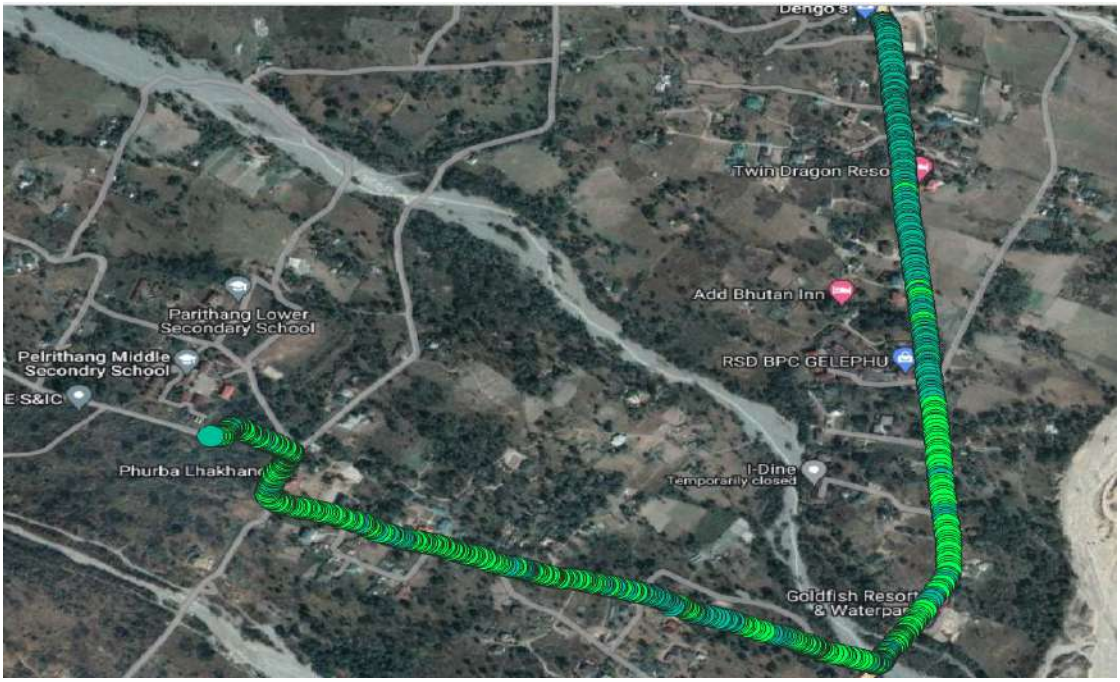

Figure 3.5: RSCP(3G) plot of B-mobile (QGIS) [Pelrithang]

Figure 3.6: RSRP(4G) plot of B-mobile (QGIS) [Pelrithang]

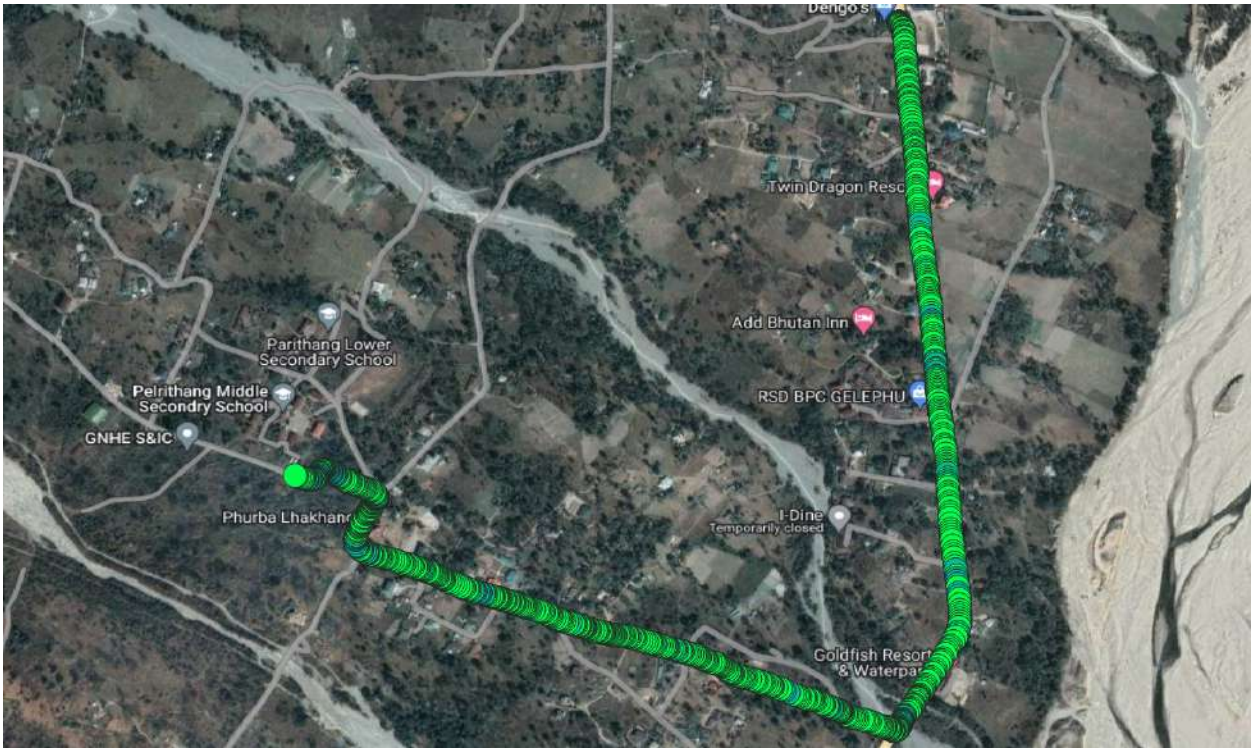

Figure 3.7: RSCP(3G) plot Tashi Cell (QGIS) [Pelrithang]

Figure 3.8:RSRP(4G) plot of Tashi Cell (QGIS) [Pelrithang]

c. **Dechen Pelri**

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score >=3.5**	**CSFB Setup Time <=9**
BTL	0	3.66	6.17
TICL	0	3.94	7.03

Data Throughputs (Mbps) (3G)

Operators	**File Transfer Protocol**	
	Download >=1.5 Mbps	**Upload >=1 Mbps**
BTL	**0.168**	**0.232**
TICL	**0.815**	**0.565**

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	**0.75**	**0.585**
TICL	**0.167**	**0.352**

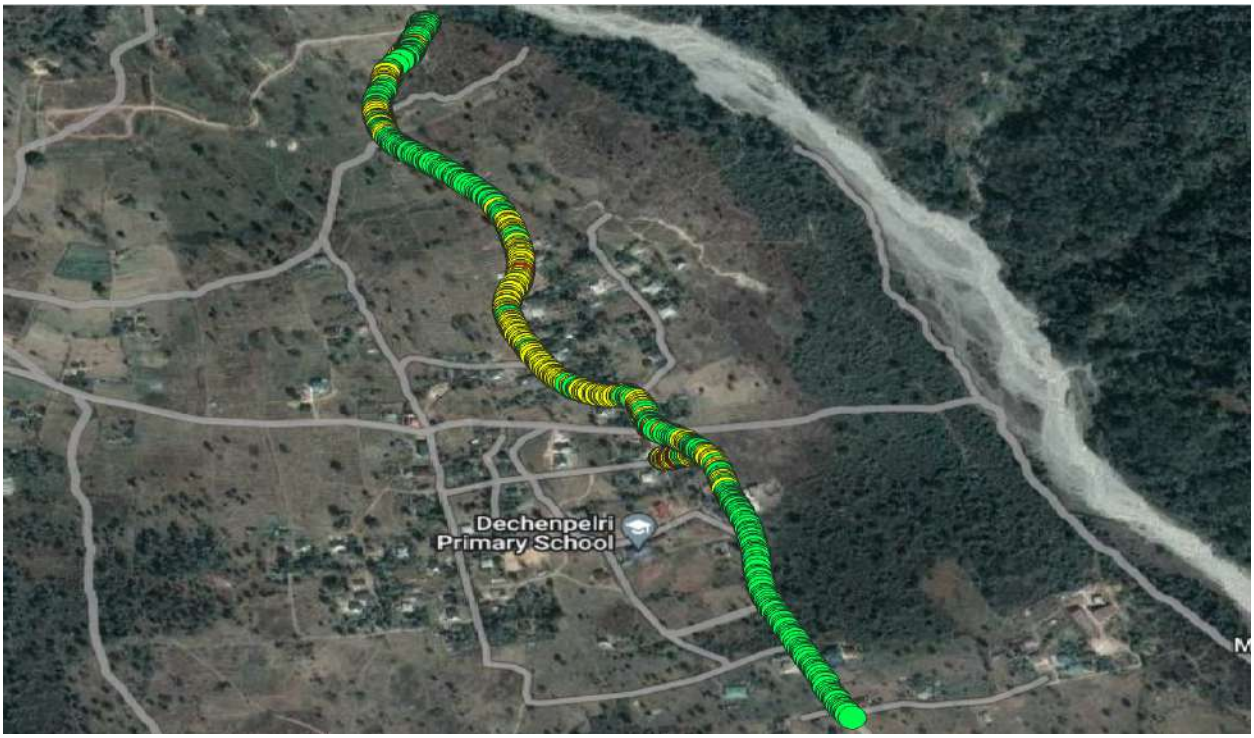

Figure 3.9: RSCP(3G) plot of B-mobile (QGIS) [Dechen Pelri]

Figure 3.10: RSRP(4G) plot of B-mobile (QGIS) [Dechen Pelri]

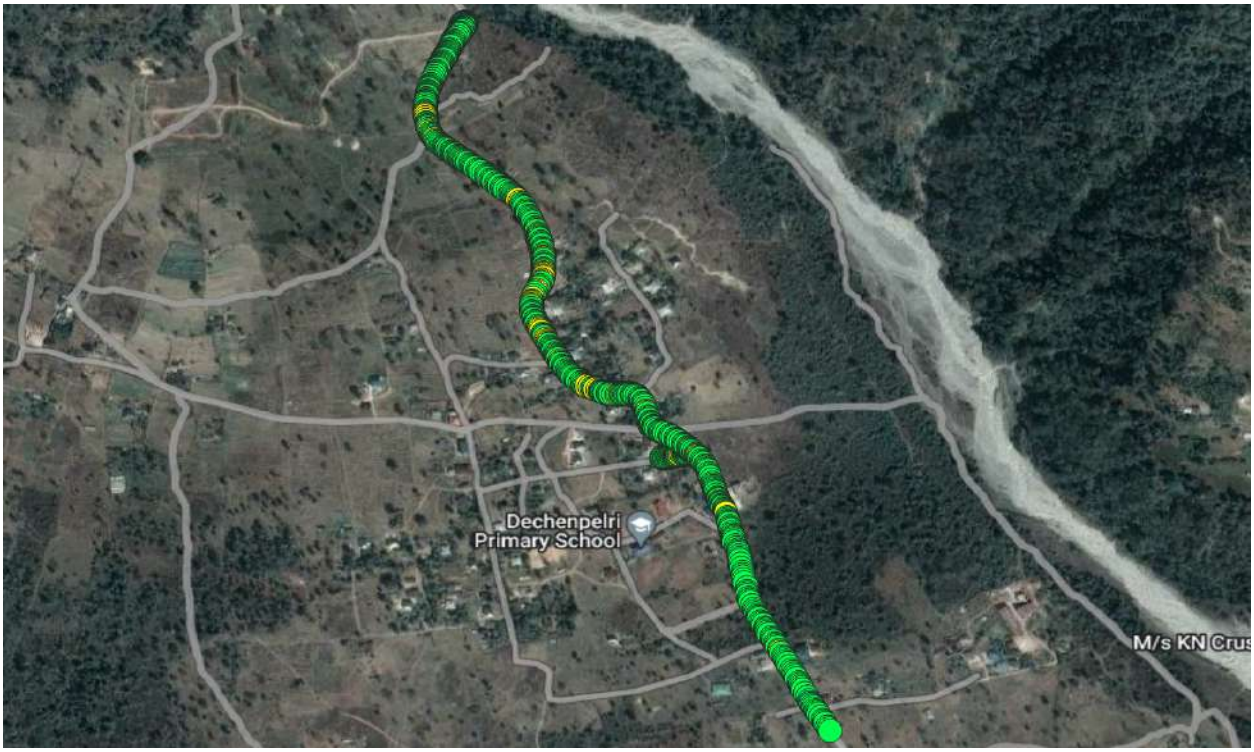

Figure 3.11: RSCP(3G) plot Tashi Cell (QGIS) [Dechen Pelri]

Figure 3.12:RSRP(4G) plot of Tashi Cell (QGIS) [Dechen Pelri]

d. **Gelephu Hospital Area**

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score >=3.5**	**CSFB Setup Time <=9**
BTL	0	3.84	5.87
TICL	0	3.84	5.99

Data Throughputs (Mbps) (3G)

Operators	**File Transfer Protocol**	
	Download >=1.5 Mbps	**Upload >=1 Mbps**
BTL	2.9	**0.652**
TICL	1.5	**0.778**

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	2.9	22.8
TICL	23.3	14.4

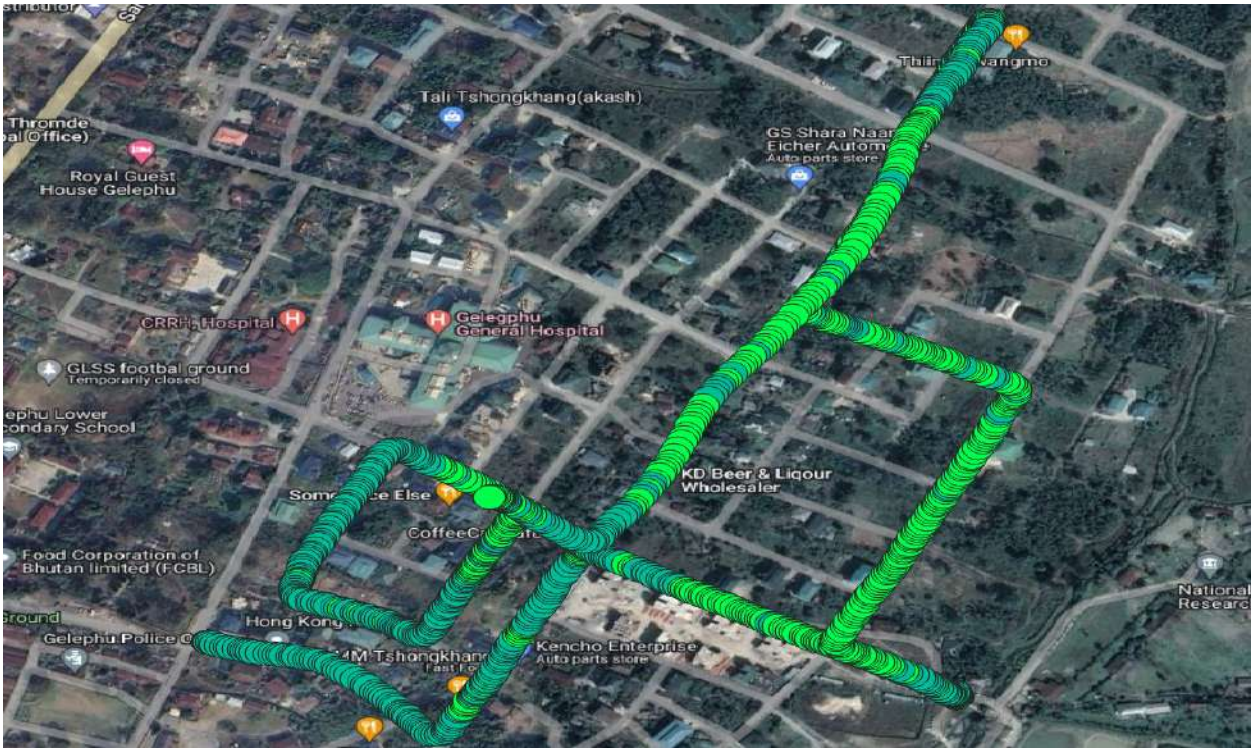

Figure 3.13: RSCP(3G) plot of B-mobile (QGIS) [Gelephu Hospital]

Figure 3.14: RSRP(4G) plot of B-mobile (QGIS) [Gelephu Hospital]

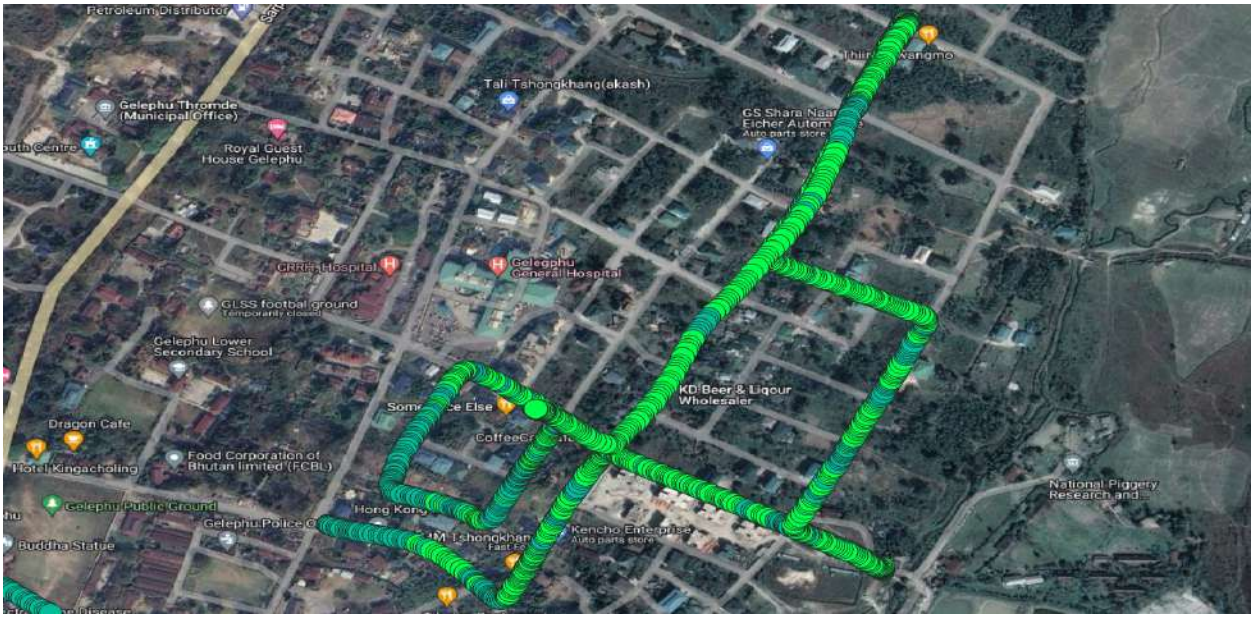

Figure 4.15: RSCP(3G) plot Tashi Cell (QGIS) [Gelephu Hospital]

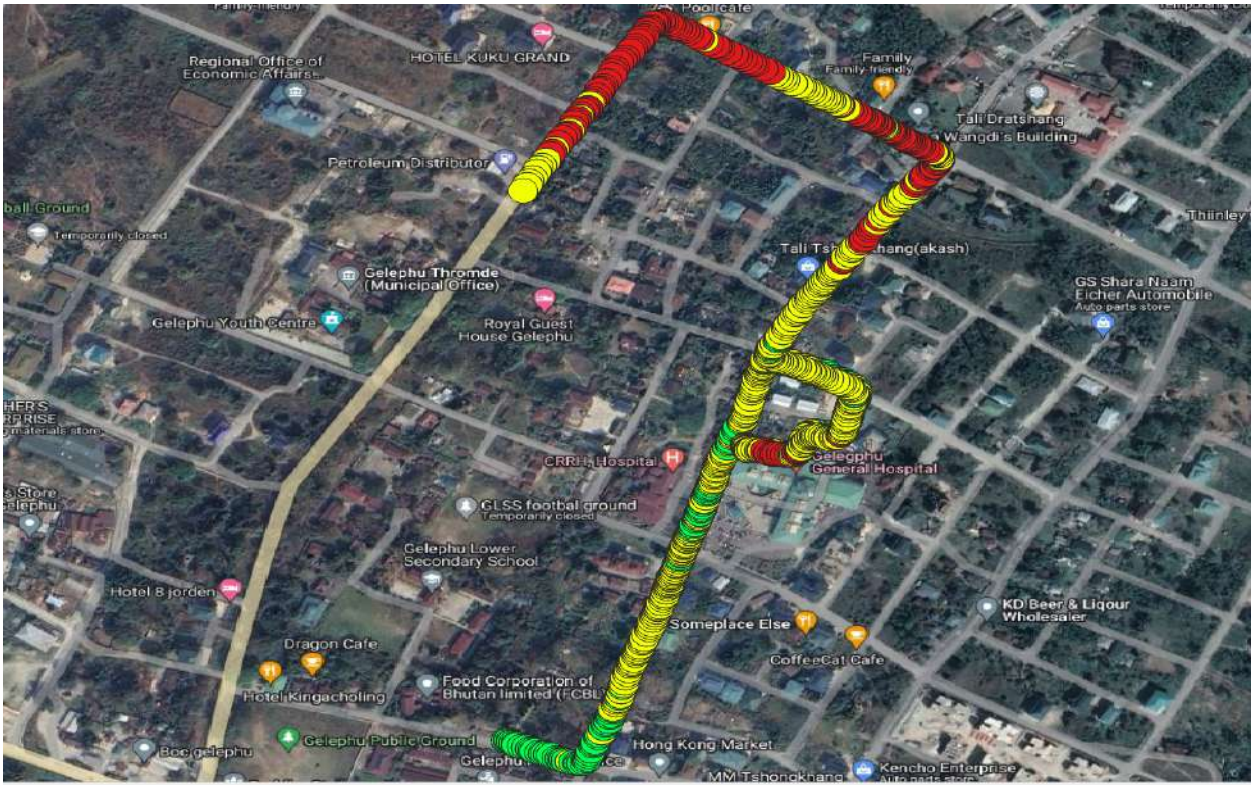

Figure 3.16:RSRP(4G) plot of Tashi Cell (QGIS) [Gelephu Hospital]

e. **Zomlingthang**

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score >=3.5**	**CSFB Setup Time <=9**
BTL	0	3.89	5.73
TICL	0	3.71	5.68

Data Throughputs (Mbps) (3G)

Operators	**File Transfer Protocol**	
	Download >=1.5 Mbps	**Upload >=1 Mbps**
BTL	2.9	1
TICL	4.1	1.63

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	6.3	9.1
TICL	14.2	21.2

Figure 3.17: RSCP(3G) plot of B-mobile (QGIS) [Zomlingthang]

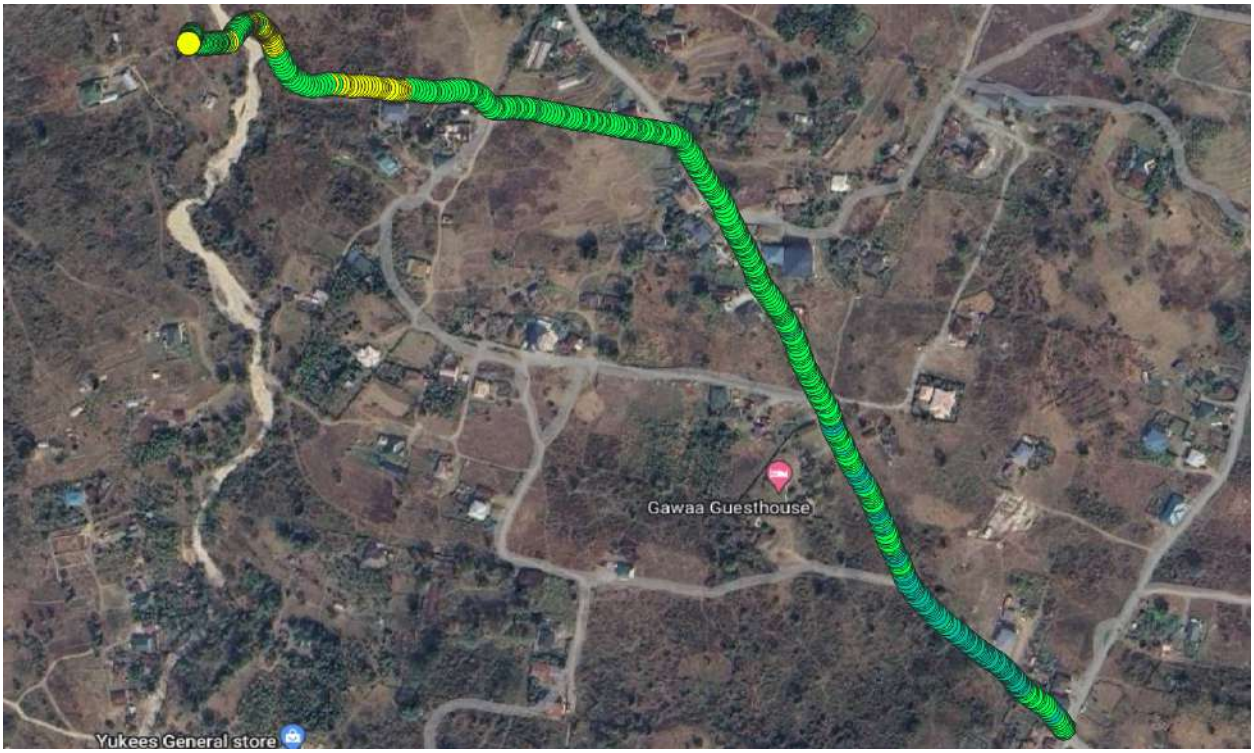

Figure 3.18: RSRP(4G) plot of B-mobile (QGIS) [Zomlingthang]

Figure 3.19: RSCP(3G) plot Tashi Cell (QGIS) [Zomlingthang]

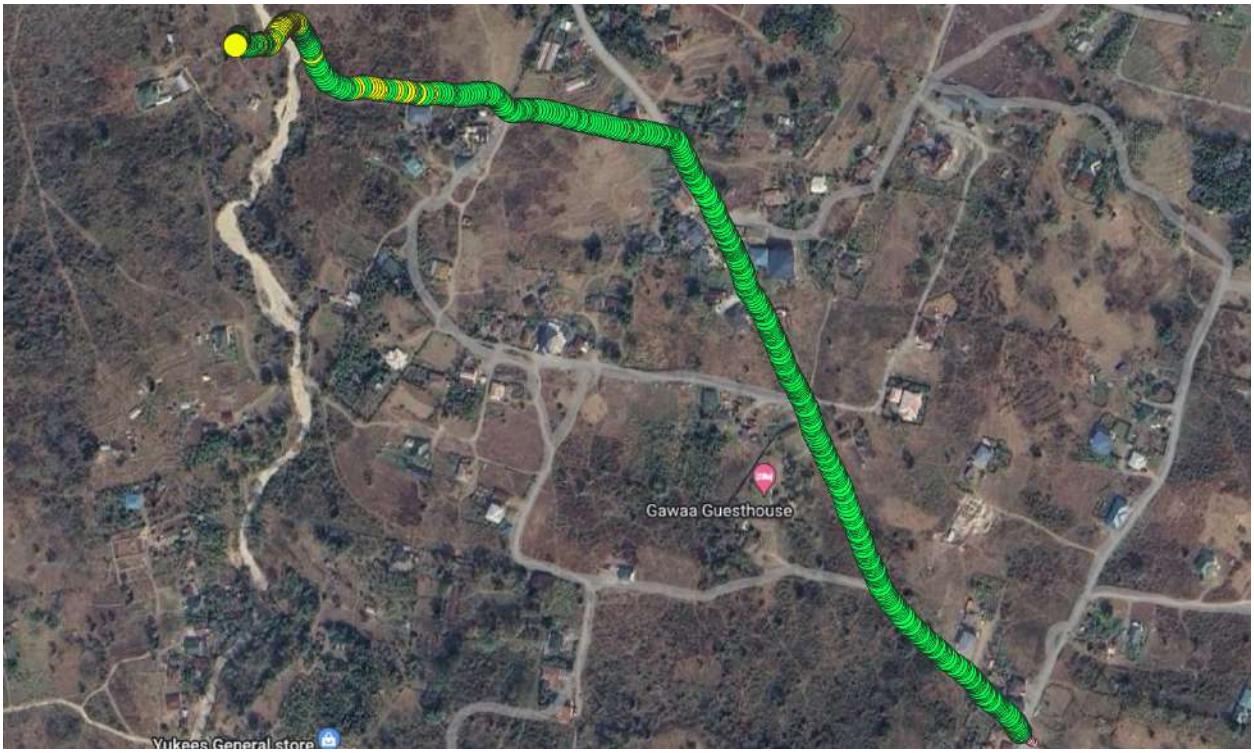

Figure 3.20:RSRP(4G) plot of Tashi Cell (QGIS) [Zomlingthang]

f. Shershong

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score >=3.5	CSFB Setup Time <=9
BTL	0	3.88	5.97
TICL	0	3.71	**9.49**

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download >=1.5 Mbps	Upload >=1 Mbps
BTL	2.2	**0.52**
TICL	2.93	**0.16**

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	14.2	3.1
TICL	35.4	7.65

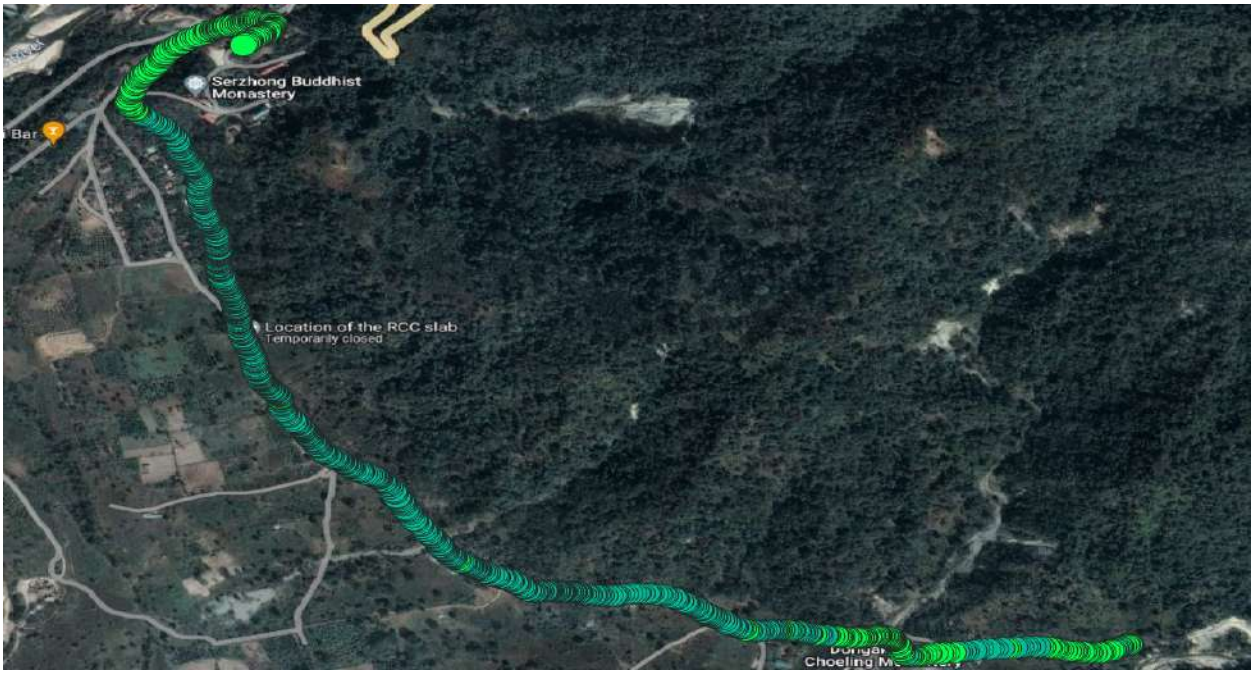

Figure 3.21: RSCP(3G) plot of B-mobile (QGIS) [Shershong]

Figure 3.22: RSRP(4G) plot of B-mobile (QGIS) [Shershong]

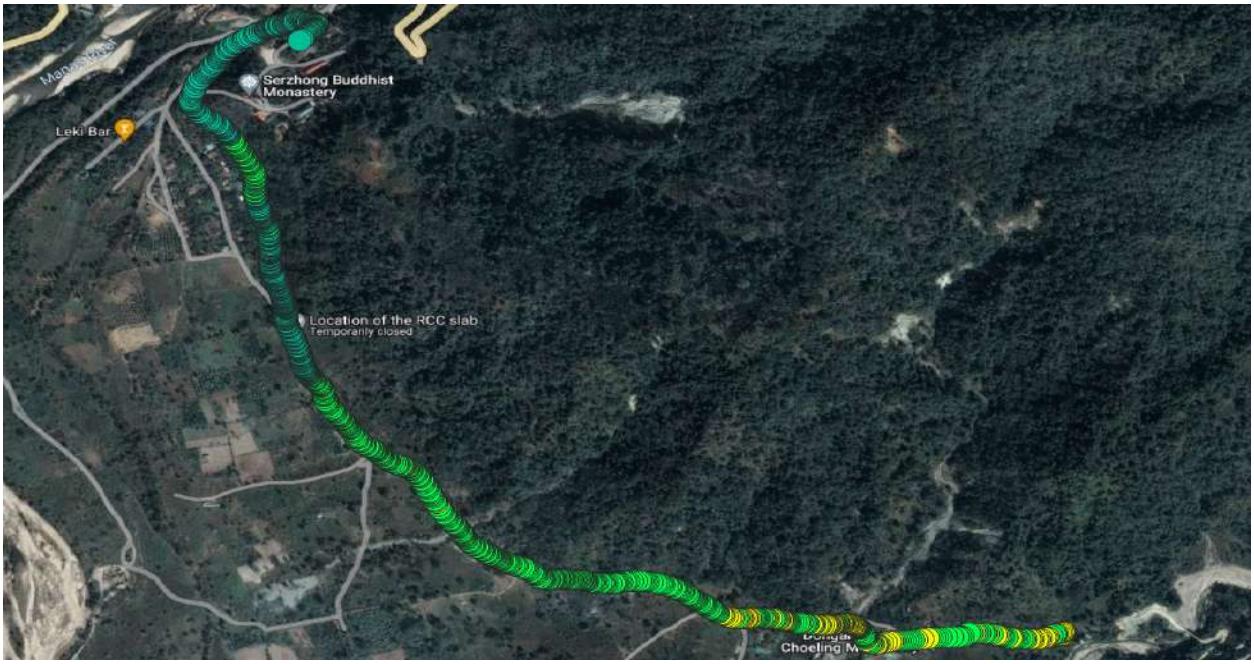

Figure 3.23: RSCP(3G) plot Tashi Cell (QGIS) [Shershong]

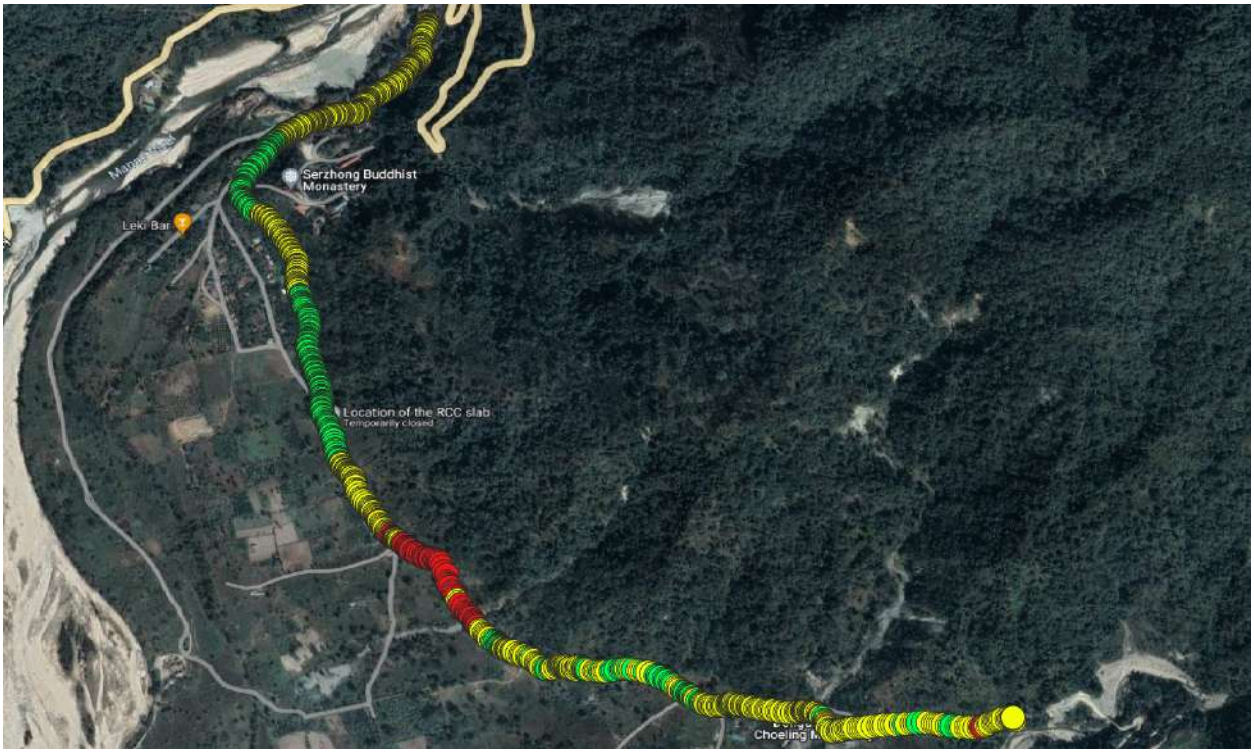

Figure 3.24:RSRP(4G) plot of Tashi Cell (QGIS) [Shershong]

g. Sarpang Tar

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score >=3.5	CSFB Setup Time <=9
BTL	0	3.86	6.13
TICL	0	3.67	6.75

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download >=1.5 Mbps	Upload >=1 Mbps
BTL	3.1	1
TICL	2.7	1.65

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)
BTL	**0.34**	**0.23**
TICL	16.5	10.4

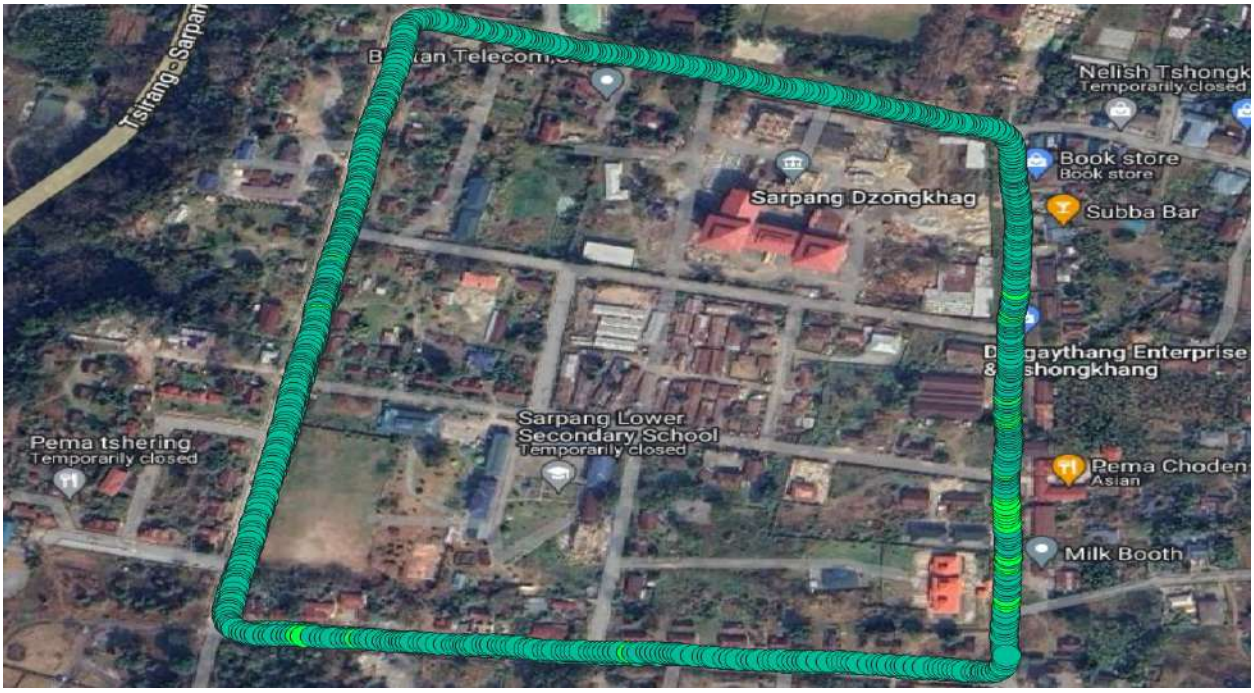

Figure 3.25: RSCP(3G) plot of B-mobile (QGIS) [Sarpang Tar]

Figure 3.26: RSRP(4G) plot of B-mobile (QGIS) [Sarpang Tar]

Figure 3.27: RSCP(3G) plot Tashi Cell (QGIS) [Sarpang Tar]

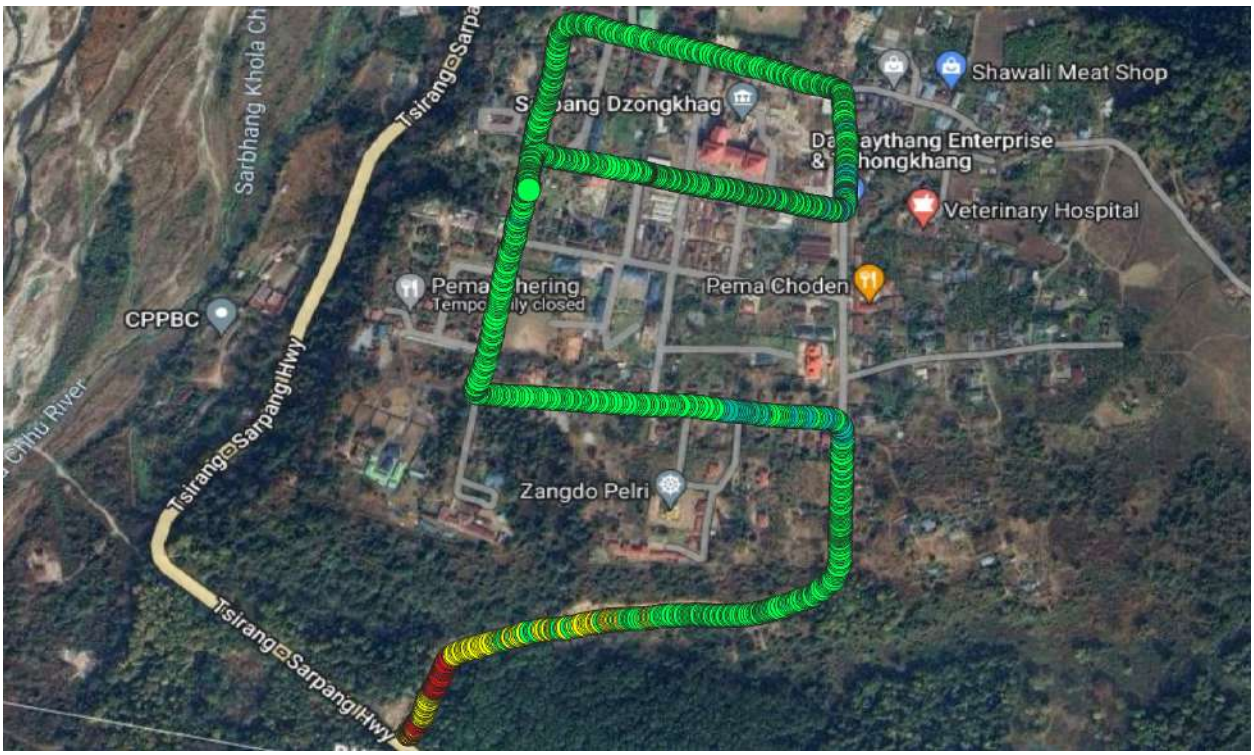

Figure 3.28:RSRP(4G) plot of Tashi Cell (QGIS) [Sarpang Tar]

h. Sarpang Rani Bagan

Mobile Voice Service

Operator	**Call Drop rate (<2%)**	**Mean Opinion Score >=3.5**	**CSFB Setup Time <=9**
BTL	0	3.82	6.16
TICL	0	3.73	5.49

Data Throughputs (Mbps) (3G)

Operators	**File Transfer Protocol**	
	Download >=1.5 Mbps	**Upload >=1 Mbps**
BTL	**0.39**	**0.44**
TICL	2.5	1.5

Data Throughputs (Mbps) (4G)

Operators	**File Transfer Protocol**	
	Download (≥ 6 Mbps)	**Upload (≥ 2 Mbps)**
BTL	43.7	14.7
TICL	32.5	20.7

Figure 3.29: RSCP(3G) plot of B-mobile (QGIS) [Sarpang Rani Bagan]

Figure 3.30: RSRP(4G) plot of B-mobile (QGIS) [Sarpang Rani Bagan]

Figure 3.31: RSCP(3G) plot Tashi Cell (QGIS) [Sarpang Rani Bagan]

Figure 3.32:RSRP(4G) plot of Tashi Cell (QGIS) [Sarpang Rani Bagan]

……

4. Analysis

a. **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 standards. The detailed analyses are as mentioned below:

- 4G data throughputs of both the operators in the monitored areas of Thimphu are up to the standards.
- The call setup time for both the operators in all the monitored places of Thimphu are up to the standards except for TICL at Motithang - Zilukha Highway, Changzamtog and BTL at Babesa.
- There are no issues of Call drop and Mean Opinion Score for both the operators at all monitored places of Thimphu.

b. **Samdrup Jongkhar:** In general, the quality of mobile voice and data services (3G and 4G) in most of the areas monitored in Samdrup Jongkhar are found meeting the QoS standards. The detailed analyses are as mentioned below:
   - The 4G average download throughput for the Bhutan Telecom Limited (BTL) in Jigme Namgyel Engineering College area is found to be below the QoS standard.
   - The 3G average throughput for both the operators in Dewathang core town is found to be below the QoS standards.

c. **Sarpang:** In general, the quality of mobile voice and data services (3G and 4G) in most of the areas monitored in Sarpang are found up to the QoS standards whereas in few locations, the QoS were extremely below the standard. The detailed analyses are as mentioned below:
   - 4G data throughput for BTL in Sarpang Tar is extremely below QoS standards.
   - 3G data throughput for BTL in Sarpang Rani Bagan is below the QoS standards, however, its 4G is within the standards.
   - The 3G and 4G data services in Dechen Pelri are found to be extremely below the QoS standards for both the operators (BTL and TICL).
   - It is found that the CSFB set up time of TICL for voice calls in Shershong is not fulfilling the standards

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 in all monitored places of above are mentioned below:

a. Based on BTL's rectification/upgradation plan on the issues of Olakha areas during the last follow up, BTL has deployed 2 LTE-TDD nodes at the Changzhongchu tower which have significantly improved the 4G download throughput in the area.

b. Based on the QoS monitoring carried out in Sarpang and Samdrup Jongkhar Thromde including its periphery areas, both the operators were notified on the issue and were directed to take immediate rectification and submit to the Authority on the improvement drive test reports / OSS reports of the sites with QoS issues.

c. As directed, the BTL has commissioned LTE 1800 at Phulari on 10th September for Denchen Pelri area and LTE700 at Sarpang Exchange on 20th September 2022 for Sarpang Tar respectively and has submitted their drive test reports which showed a significant improvement in the QoS at the sites.

d. TICL has shared that the QoS issue at Dechen Pelri could be solved by reorienting existing antenna which is to be completed by end of october or by addition on a new sectorial antenna dedicated to the site which could take some time. The Authority will follow up with TICL after the end of October.

e. TICL requested for the coordinates of the areas with QoS issues in Gelephu and Samdrup Jongkhar Thromde and also shared their plans to commission a new site in the areas which will be completed by the end of the year.

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 >= 1Mbps, Downlink >= 1.5 Mbps
   B. For 4G, the benchmark is: Uplink >= 2Mbps, Downlink >= 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)	>=-80	-80<=-95	<=-105
2	RSCP (UMTS)	>=-80	-80<=-100	<=-110
3	RSRP (LTE)	>=-80	-80<=-105	<=-115