

Quarterly Report on Mobile Quality of Service (QoS)



Bhutan InfoComm and Media Authority
Royal Government of Bhutan

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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 QoS for both voice and data through the various parameters of Key Performance Indicators (KPI). The test was carried out at Samdrup Jongkhar, Samtse, Chukha and Thimphu.

2. Locations and date of monitoring

Sl. No	Indoor/Outdoor	Name of the places	Dzongkhag	Monitoring Month	
1.	Outdoor	SJ Town area 1	Samdrup Jongkhar	April	
2.		SJ Town area 2			
3.		SJ Town area 3			
4		SJ Town area 4			
5		SJ Town area 5			
6		SJ Town area 6			
7		Jomotshankha town			
8		Langchengphu Gewog			
11	Indoor	SJ Town	Samdrup Jongkhar	April	
12		Langchengphu Gewog			
13	Outdoor	Phuentsholing Hospital	Chukha	May	
14		Phuentsholing Town			
15		Toorsa Area			
16		Samtse Town	Samtse		
17		Samtse Dzong Area			
18		Dawa store	Thimphu		June
19		Express Carwash			
20	Babesa Highway				

21		Babena - 1		
22		Babena -2		
23		Babena -3		
24		Babena - 4		
25		Babena - 5		
26		Pamtsho -1		
27		Pamtsho -2		
28		Jungshina		
29		Lungtenphu		
30		Changjalu		
31		MoH		
32		Cremation Ground		
33		Hejo		
34		Lower Taba -1		
35		Lower Taba - 2		

3. Results

The findings of the drive test of operators are as shown below:

I. Outdoor

1. SJ Town area 1

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.53	11.28	Issue with Call Setup time for both the operators
TICL	0	3.6	13.7	

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

Operators	File Transfer Protocol			Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	RSRP	
BTL	41.375	25.33		No issue
TICL	8.9	17.70		No issue

- **Legend for RSRP Plot**

$\leq -85\text{dBm}$	
$-85\text{dBm} \leq < -105\text{dBm}$	
$-105\text{dBm} = <$	

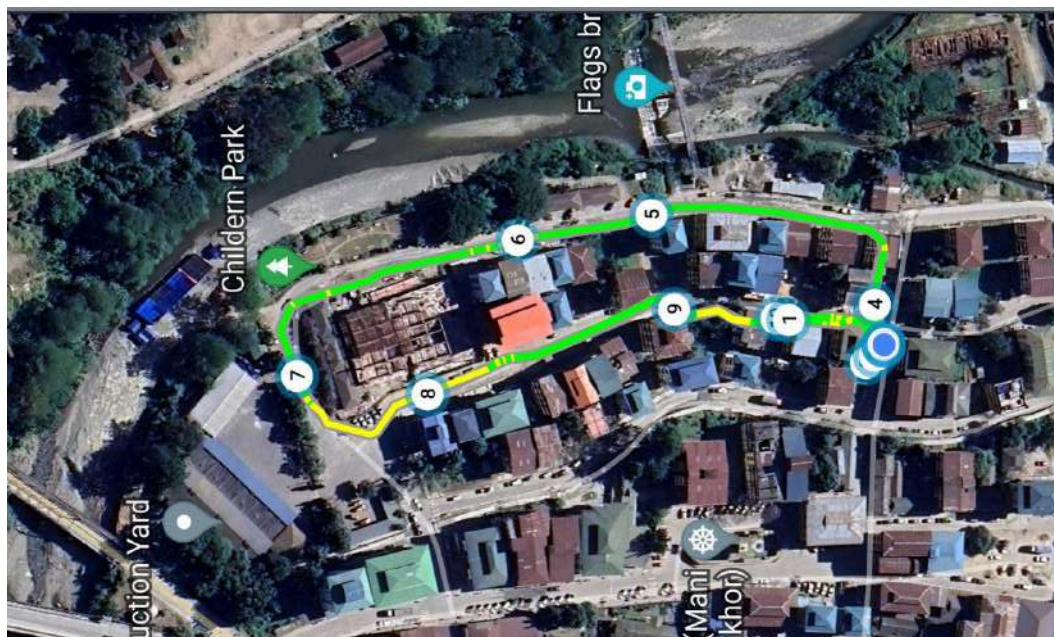


Figure number 1: RSRP plot 4G B-mobile (Route)

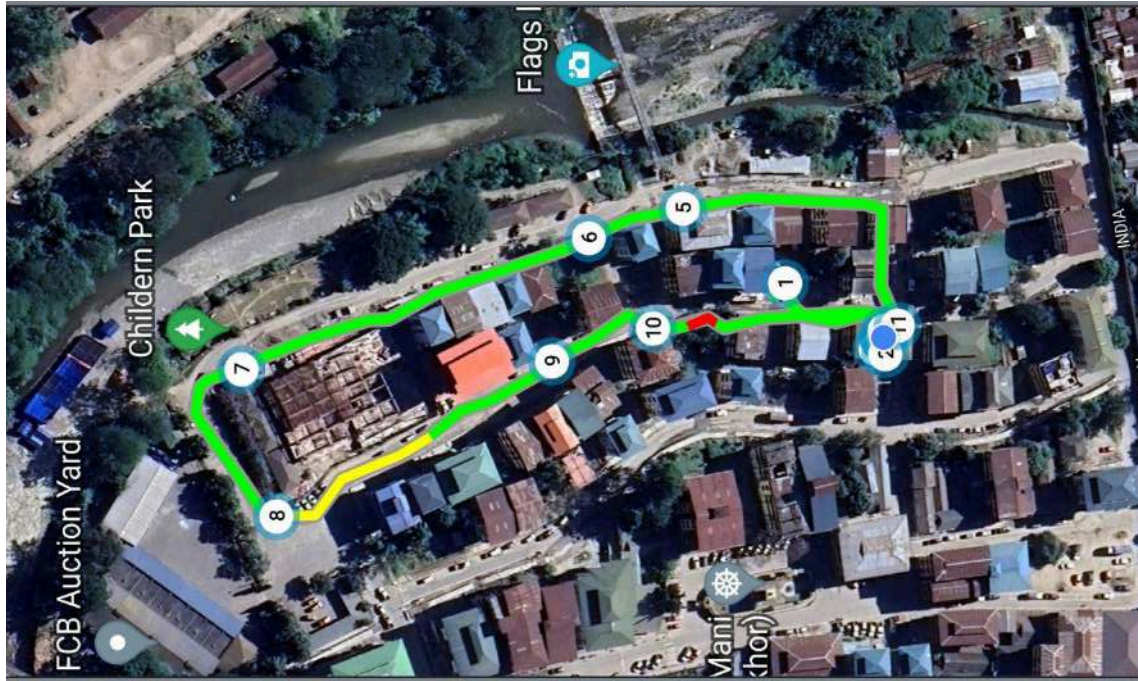


Figure number 2: RSRP plot 4G Tashi Cell (Route)

2. SJ Town area 2

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.6	15	Issue with Call Setup time for both the operators
TICL	0	3.53	12.9	

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	

BTL	20.11	17.30	No issue
TICL	19.05	11.465	No issue

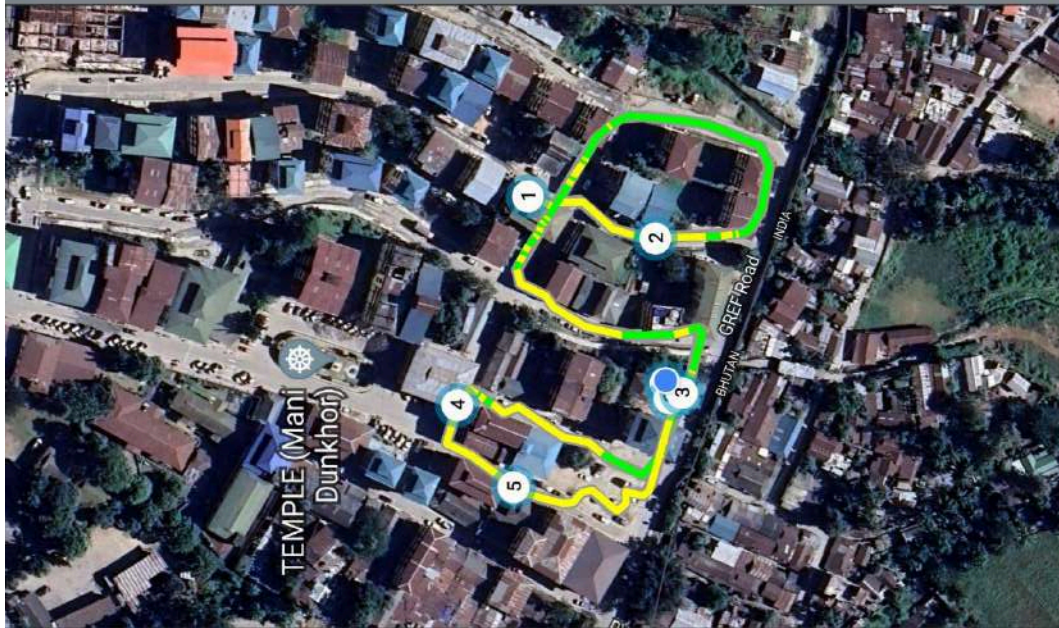


Figure number 3: RSRP plot 4G B-mobile (Route)

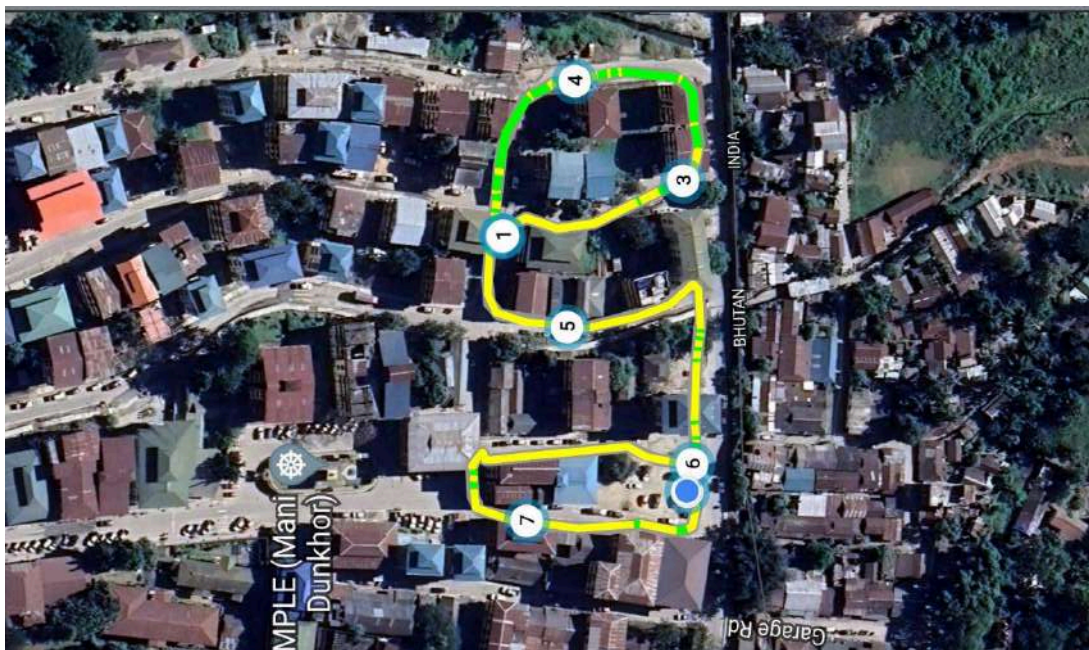


Figure number 4: RSRP plot 4G Tashi Cell (Route)

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3. SJ Town area 3

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.82	7.79	No Issue
TICL	0	3.15	12.8	Issue with MoS and Call setup time for TICL

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	20.37	20.79	No issue
TICL	11.7	10.86	No issue

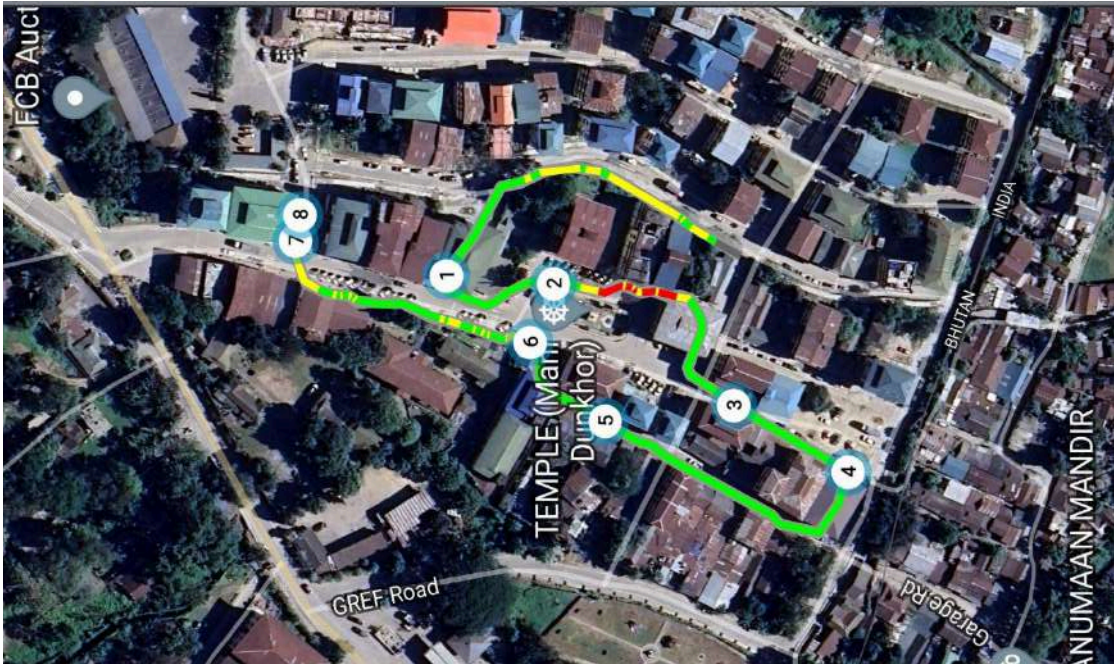


Figure number 5: RSRP plot 4G B-mobile (Route)

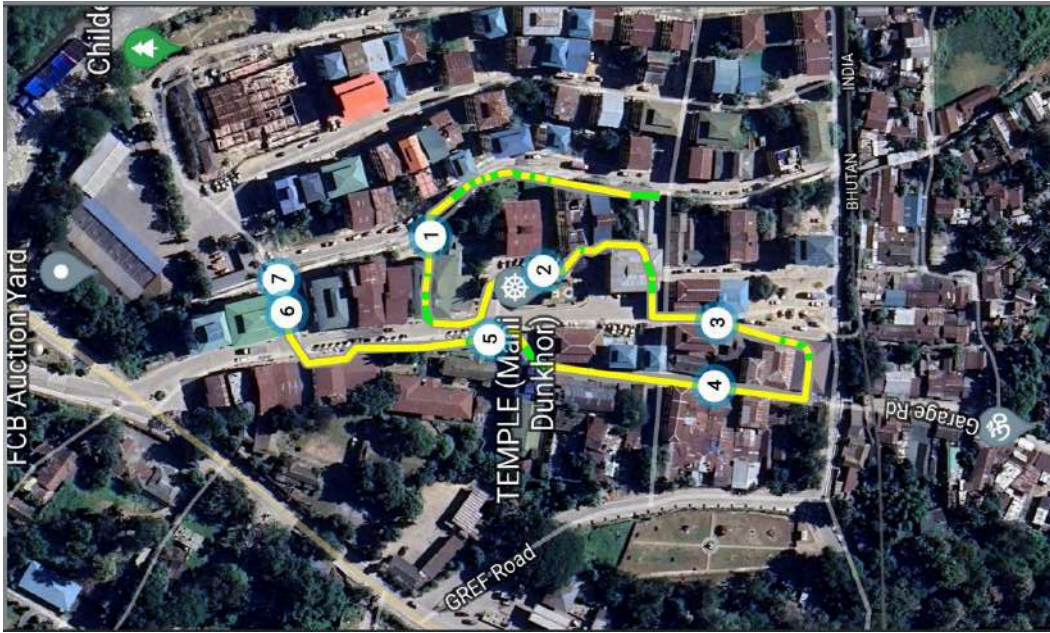


Figure number 6: RSRP plot 4G Tashi Cell (Route)



4. SJ Town area 4

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	8%	3.7	10.46	Issue with Call setup time
TICL	0	3.485	8.54	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	26.6	24.65	No issue
TICL	10.5	4.27	No issue



Figure number 7: RSRP plot 4G B-mobile (Route)

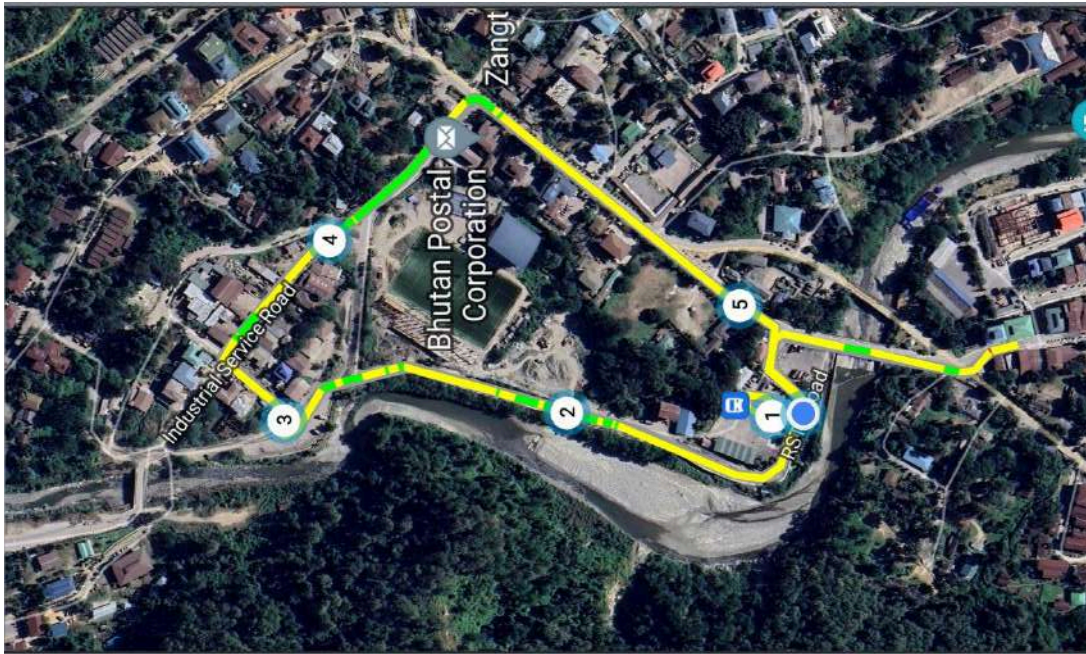


Figure number 8: RSRP plot 4G Tashi Cell (Route)

5. SJ Town area 5

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.7	10.7	Issue with Call Set up time
TICL	0	3.43	10.75	Issue with MoS and Call Set up time

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

Operators	File Transfer Protocol	Remarks
-----------	------------------------	---------

	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	17.5	14.8	No issue
TICL	18.5	15.6	No issue

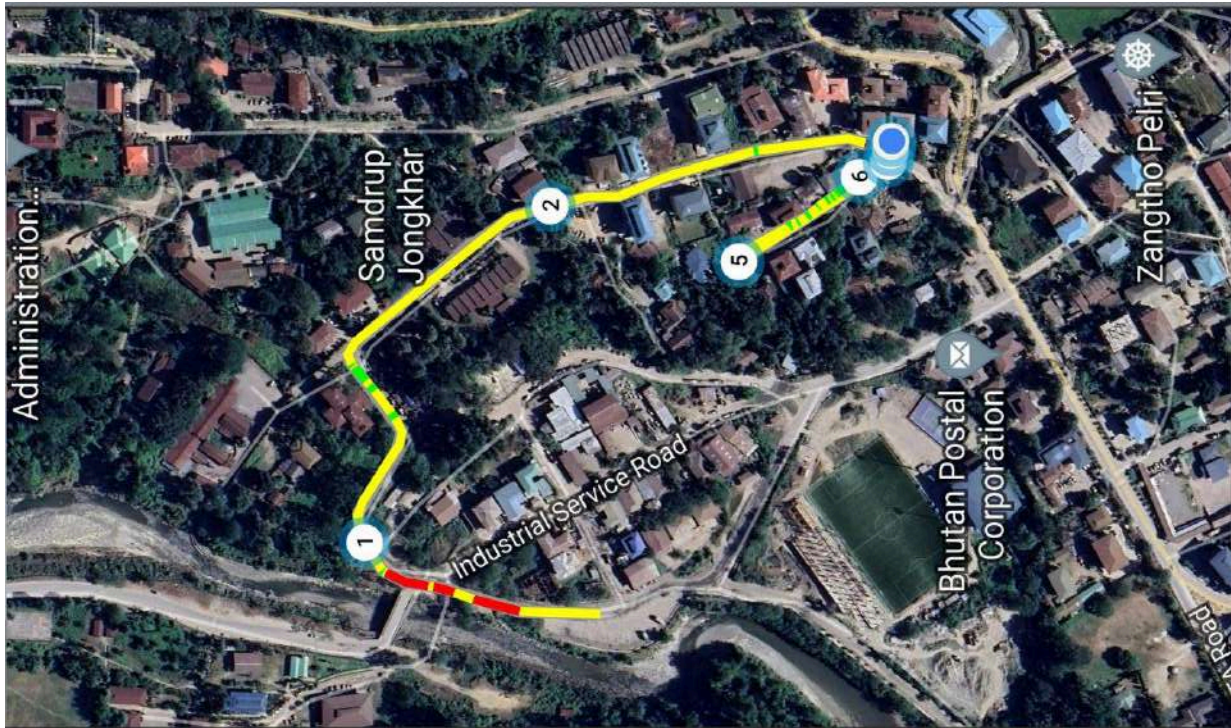


Figure number 9: RSRP plot 4G B-mobile (Route)

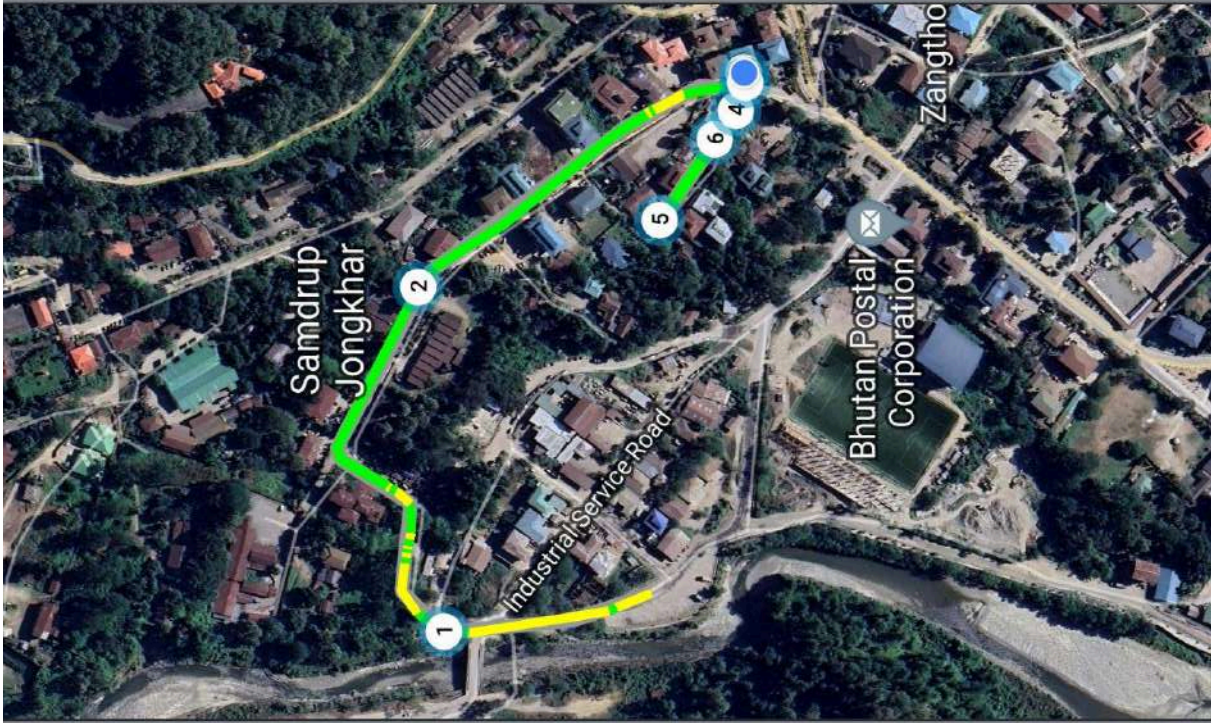


Figure number 10: RSRP plot 4G Tashi Cell (Route)

6. SJ Town area 6

- Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.95	9.10	Issue with Call Setup time
TICL	0	3.26	9.87	Issue with MoS and Call Set up time

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	18.5	38.2	No issue
TICL	9.6	3.01	No issue

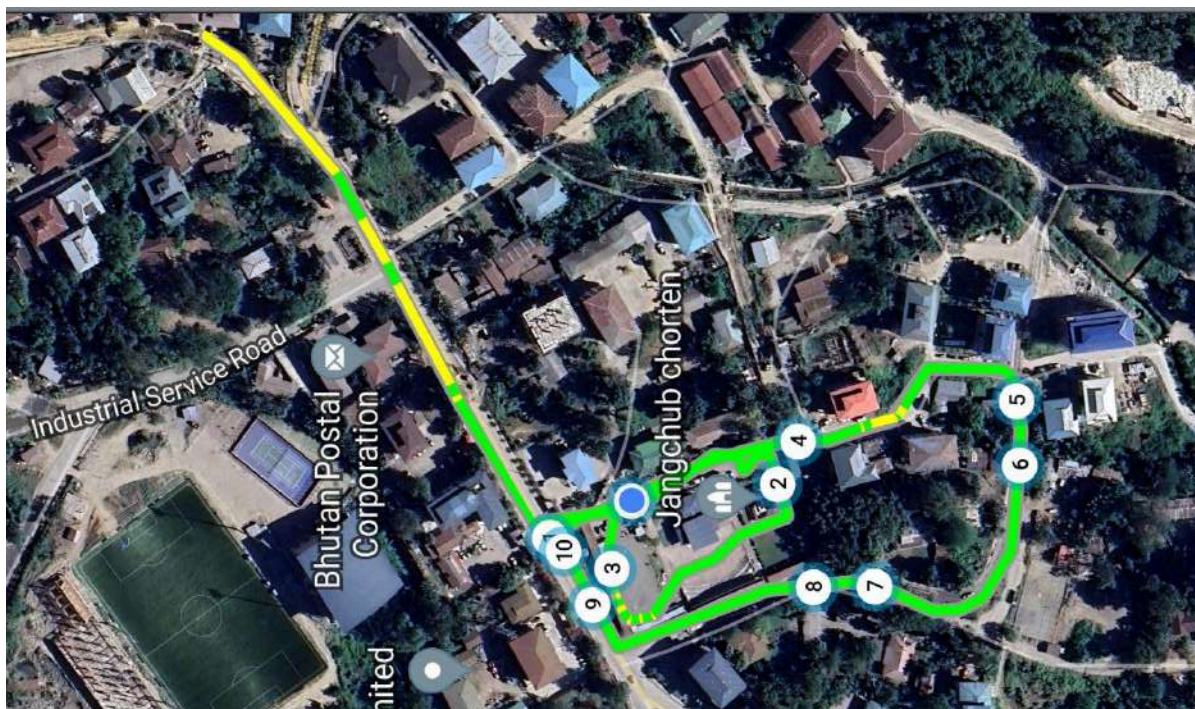


Figure number 11: RSRP plot 4G B-mobile (Route)

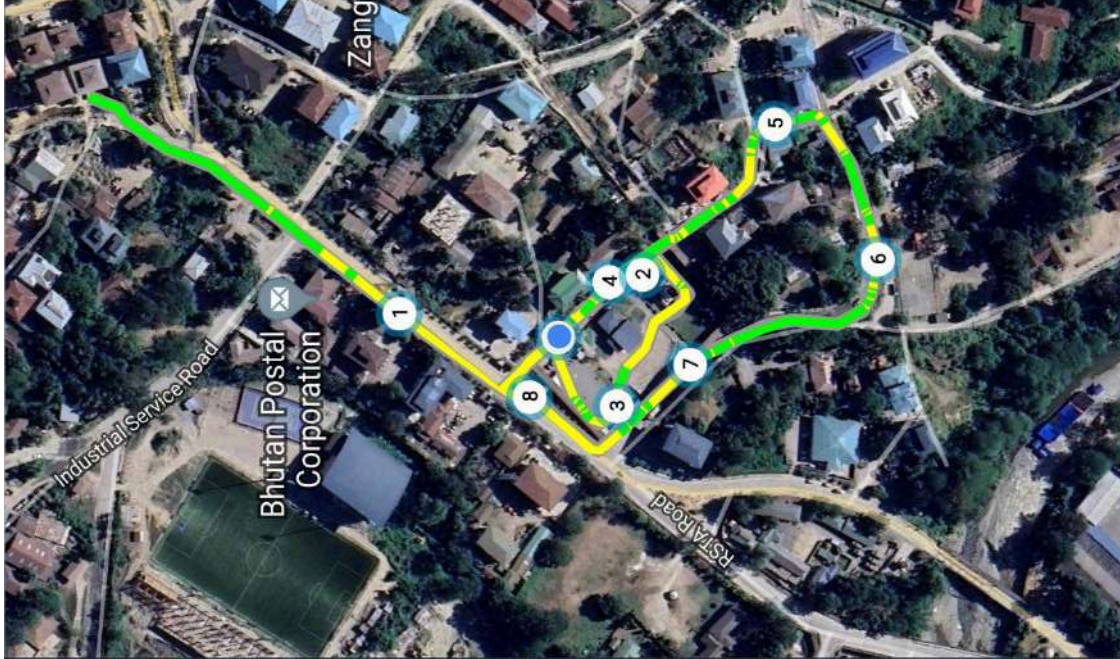


Figure number 12: RSRP plot 4G Tashi Cell (Route)

7. Jomotshangkha town

- Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.015	13.23	Issue with both MoS and Call Setup time
TICL	0	4.09	7.09	No Issue

- Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	50.28	25.2	No issue

TICL	51.2	19.5	No issue
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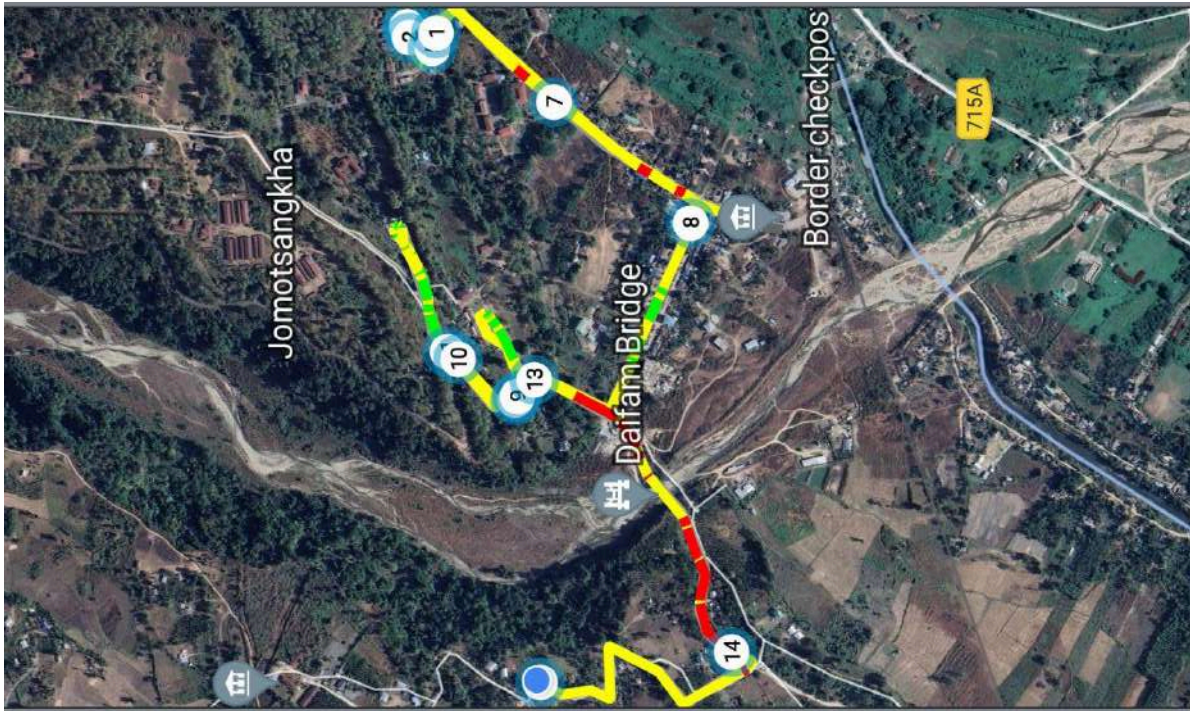


Figure number 13: RSRP plot 4G B-mobile (Route)

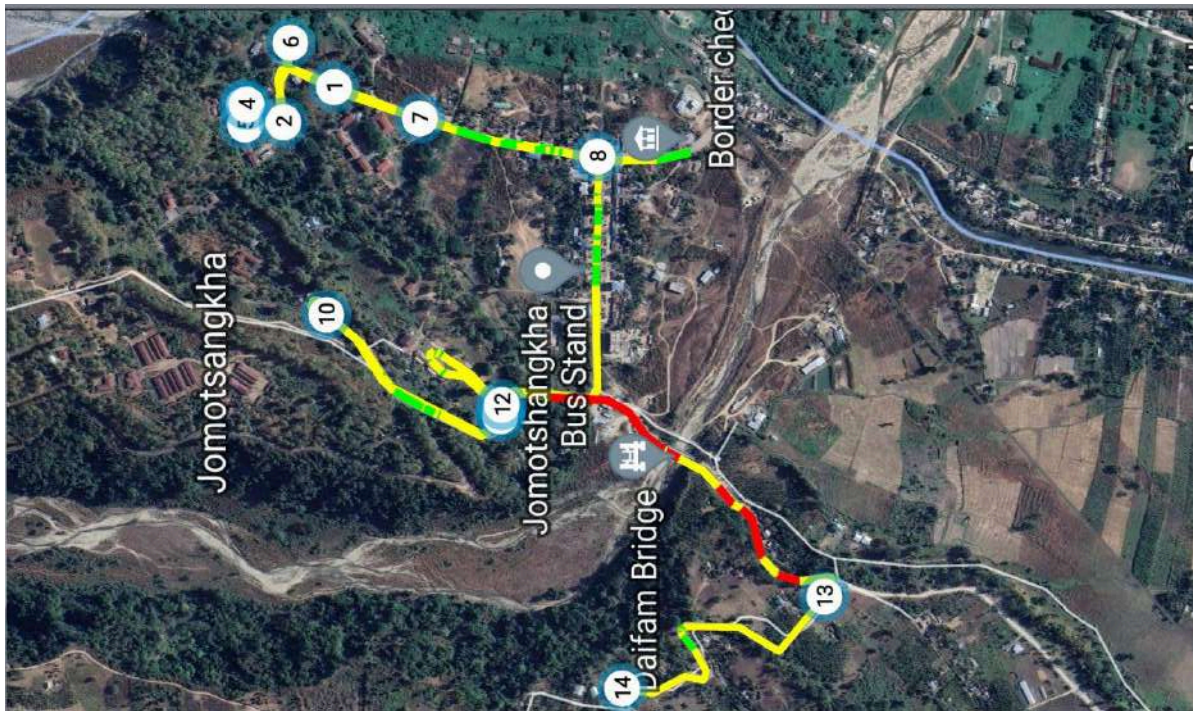


Figure number 14: RSRP plot 4G Tashi Cell (Route)

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8. Langchengphu Gewog

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.05	12.7	Issue with both MoS and Callsetup time
TICL	0	3.77	6.8	No Issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	60.8	25.3	No issue
TICL	43.25	3.81	No issue



Figure number 15: RSRP plot 4G B-mobile (Route)

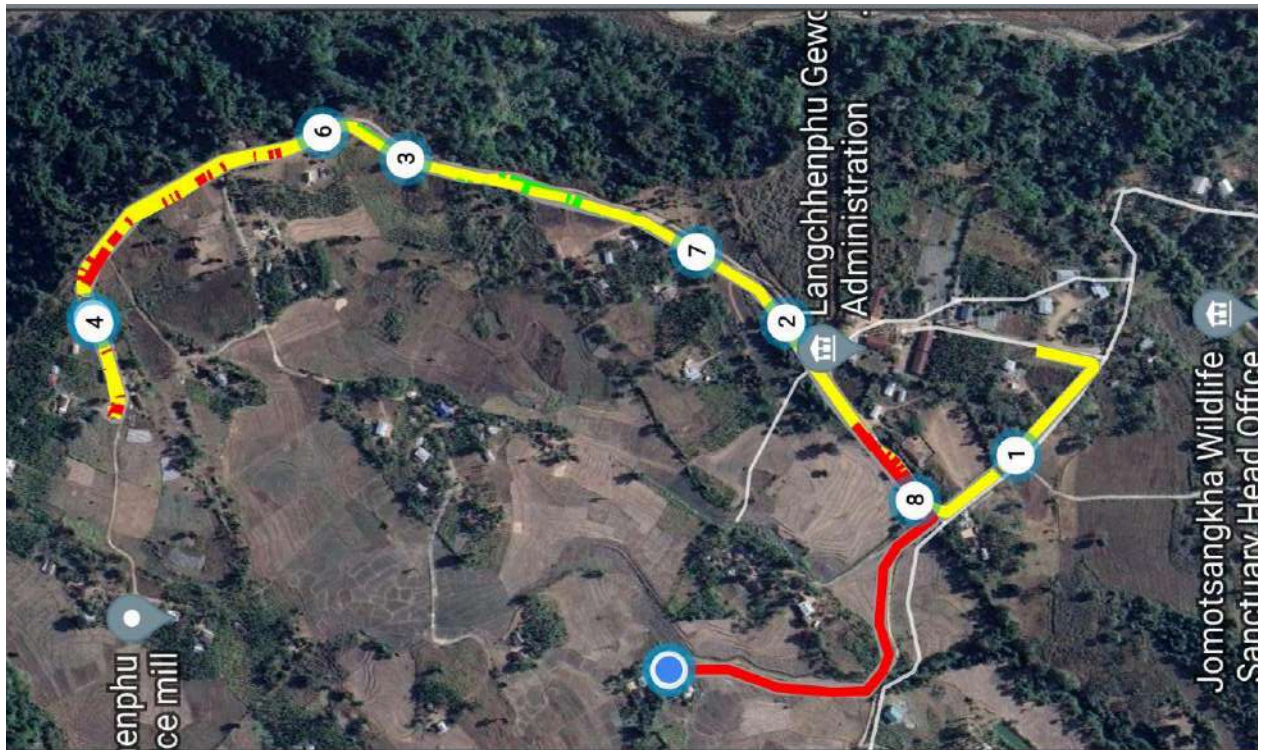


Figure number 16: RSRP plot 4G Tashi Cell (Route)

9. Phuentsholing Hospital (Chhukha)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.77	8.8	No issue
TICPL	0	3.89	7.5	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	16.80	23.53	No issue
TICPL	13.54	20.27	No issue

- ✓ ● -worst(<-115.0)
- ✓ ● -bad(-105.0 to -115.0)
- ✓ ● -good(-80.0 to -105.0)
- ✓ ● -best(>-80.0)

Legend for 4G



Figure number 17: RSRP plot 4G B-mobile (QGIS) [Phuentsholing Hospital]

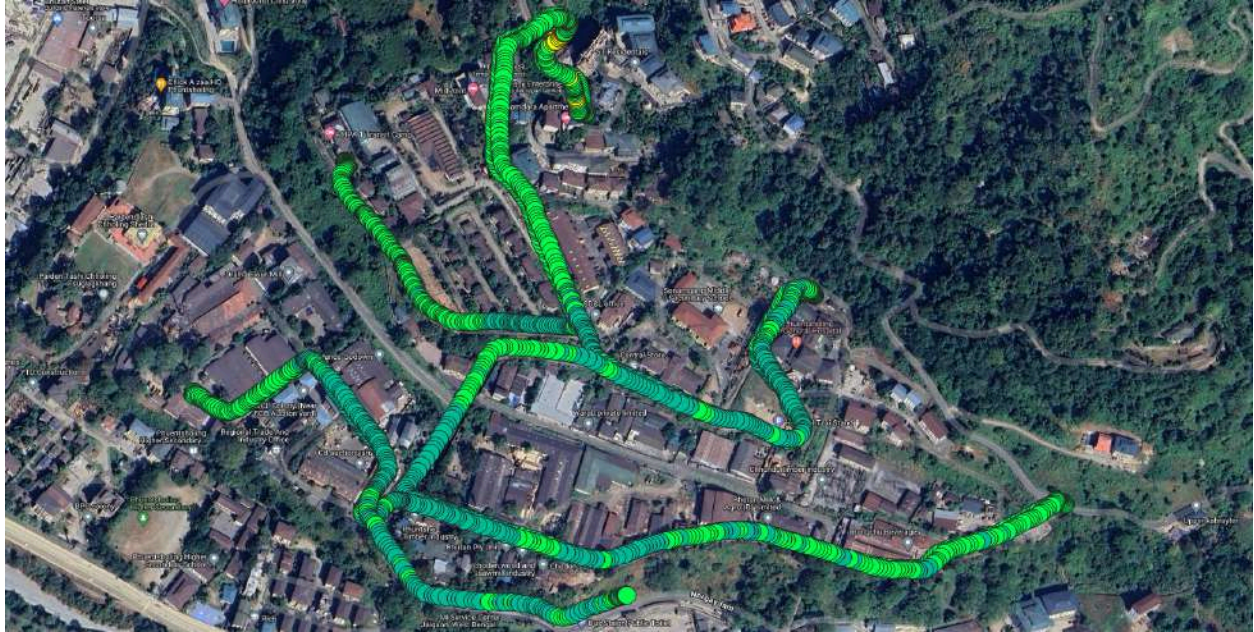


Figure number 18: RSRP plot 4G Tashi Cell (QGIS) [Phuentsholing Hospital]

10. Phuentsholing Town (Chukha)

- **Mobile Voice Service**

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.785	8.9	No issue
TICPL	0	3.7	8.84	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	15.72	11.63	No issue
TICPL	17.53	16.115	No issue

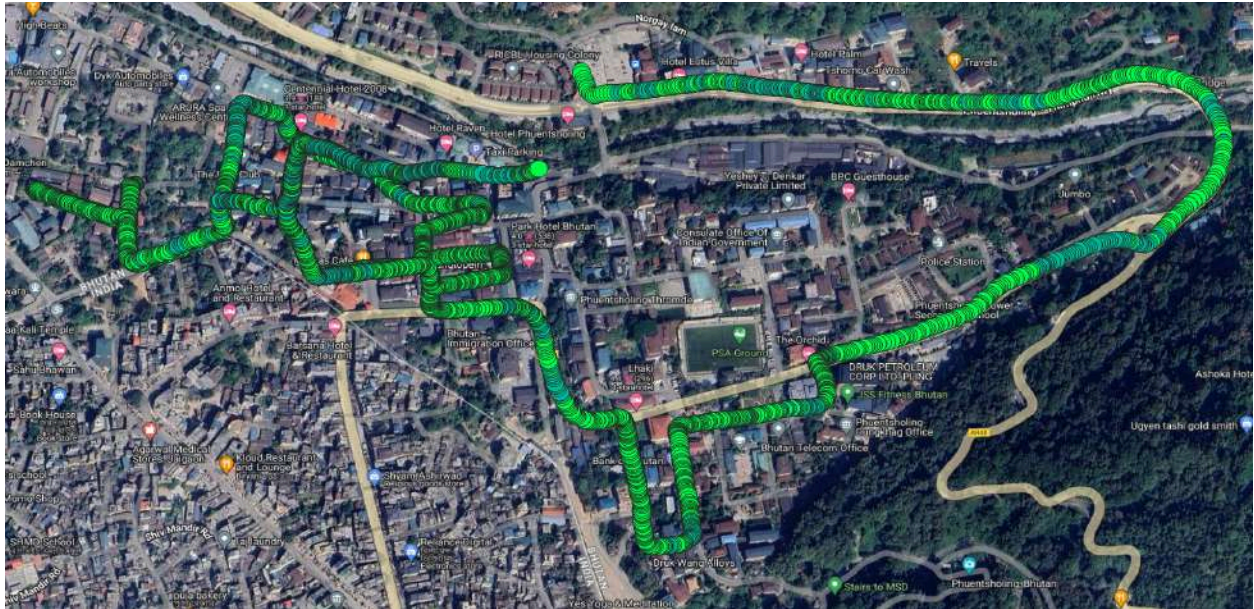


Figure number 19: RSRP plot 4G B-mobile (QGIS)[Phuentsholing Town]

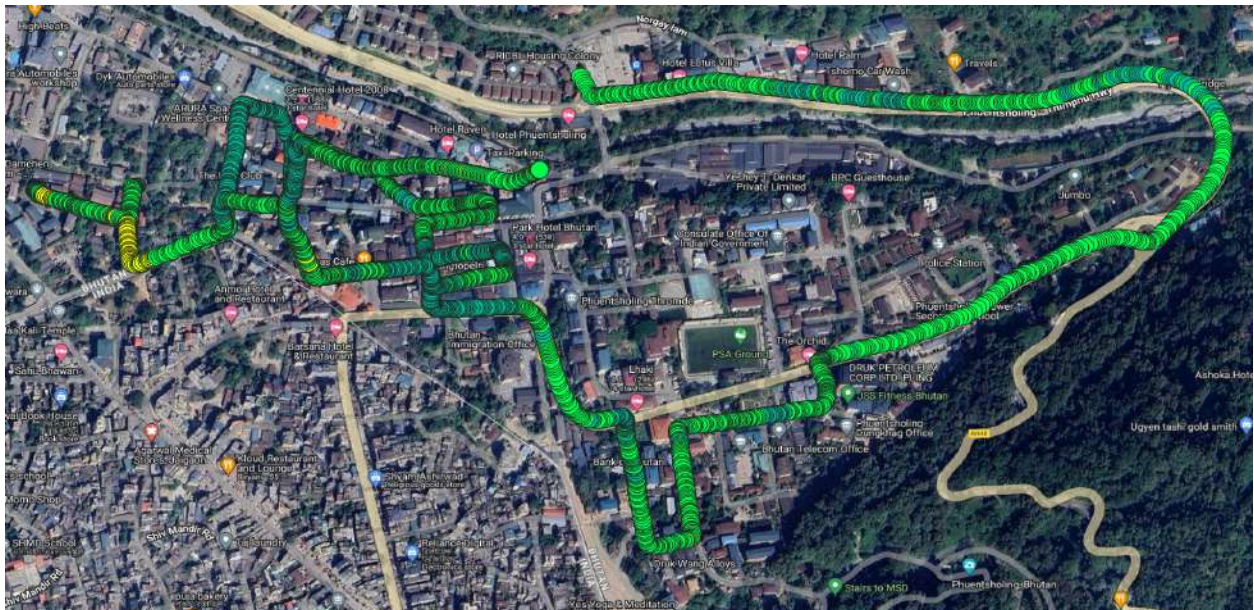


Figure number 20: RSRP plot 4G Tashi Cell (QGIS) [Phuentsholing Town]

11. Toorsa (Chhukha)

- Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.935	8.105	No issue
TICPL	0	3.715	7.51	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	24.50	17.65	No issue
TICPL	13.8	12.28	No issue



Figure number 21: RSRP plot 4G B-mobile (QGIS) [Toorsa]



Figure number 22: RSRP plot 4G Tashi Cell (QGIS) [Toorsa]

12. Samtse Dzong area

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.84	9.55	The issue with setup time
TICPL	0	4.235	13.34	The issue with setup time

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	

BTL	22.17	16.72	No issue
TICPL	22.10	3.356	No issue

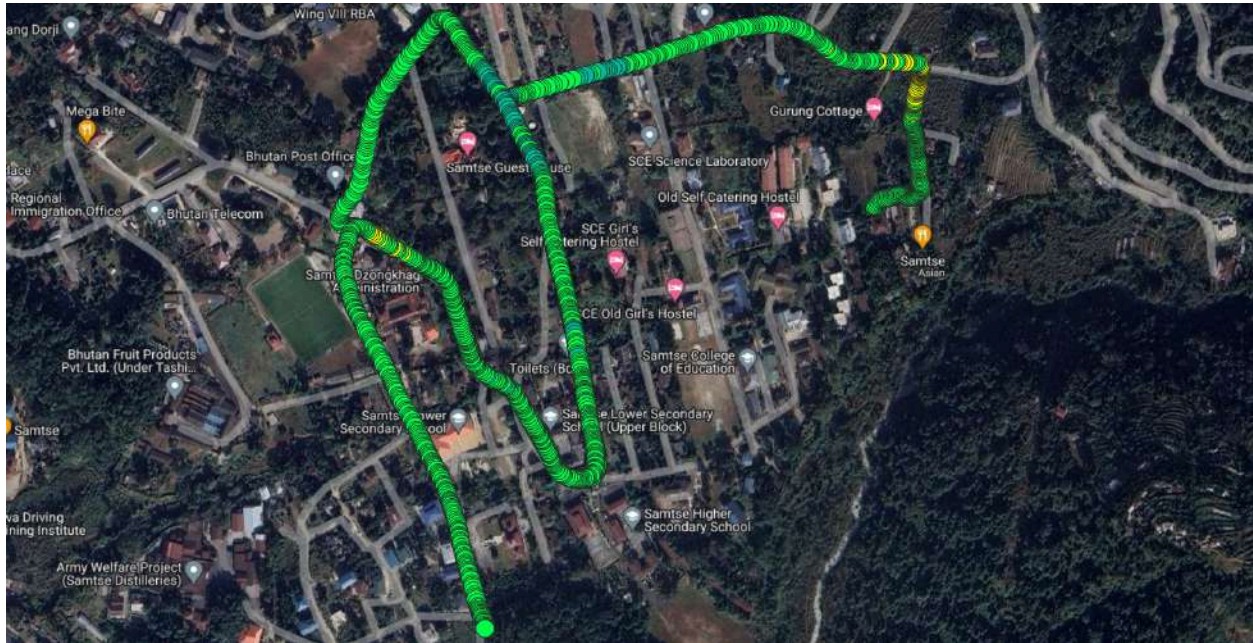


Figure number 23: RSRP plot 4G B-mobile (QGIS) [Samtse Dzong Area]

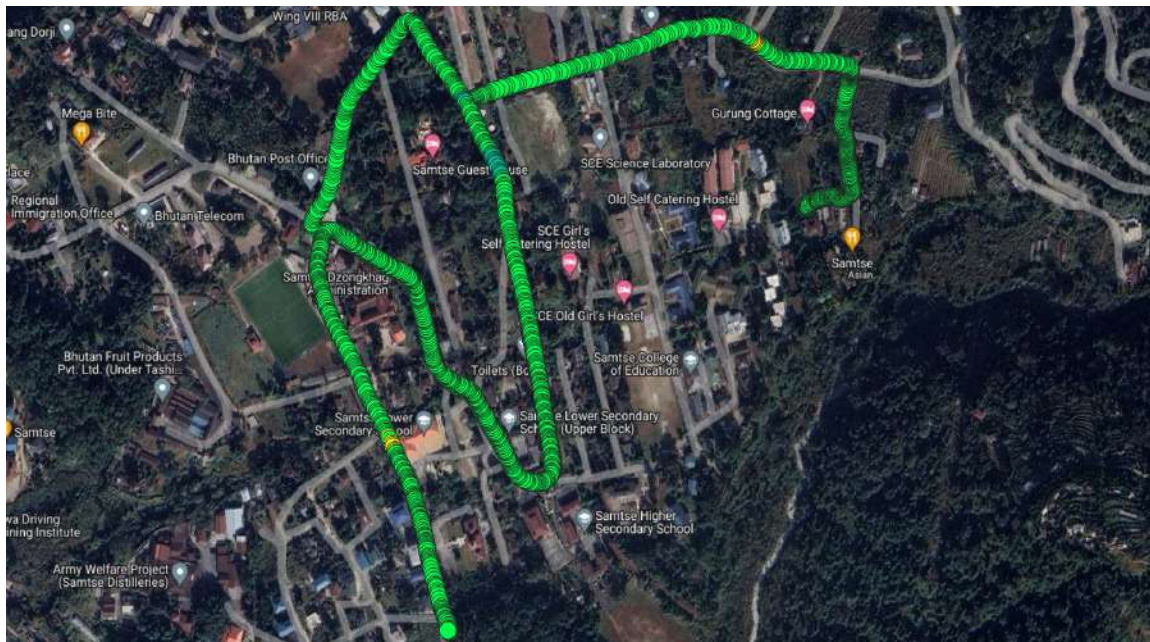


Figure number 24: RSRP plot 4G Tashi Cell (QGIS) [Samtse Dzong Area]

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13. Samtse Town (Samtse)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL		3.79	8.33	No issue
TICPL		4.13	13.3	Issue with setup time

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	6.722	16.58	No issue
TICPL	21.35	4.47	No issue

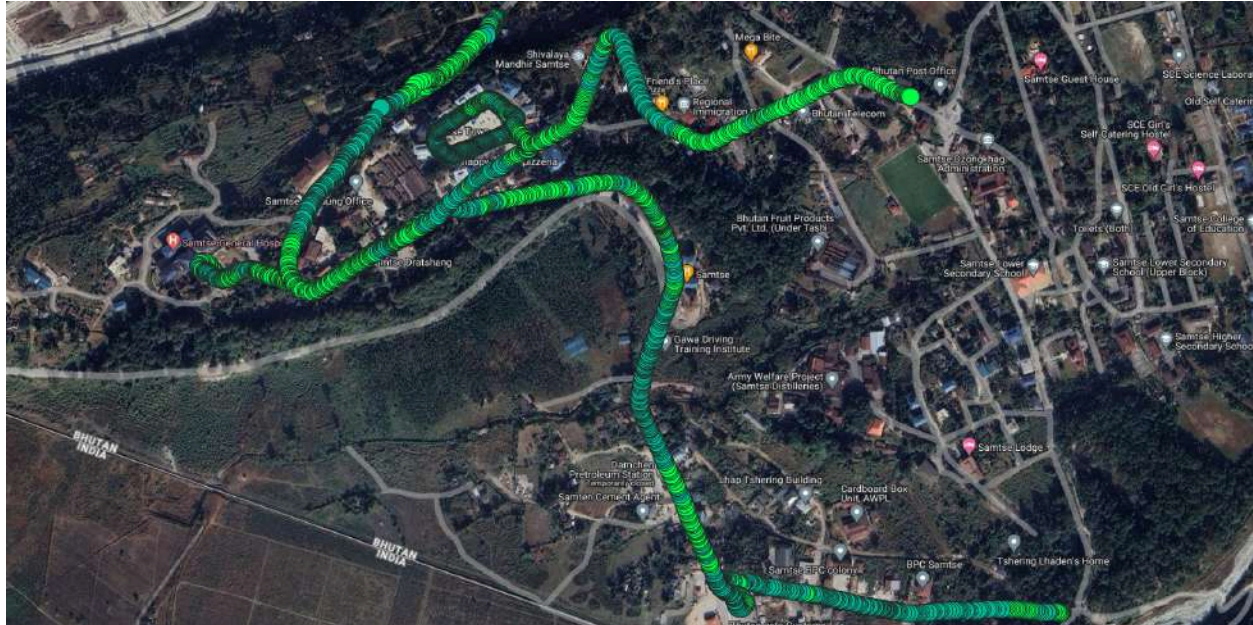


Figure number 25: RSRP plot 4G B-mobile (QGIS) [Satse Town]

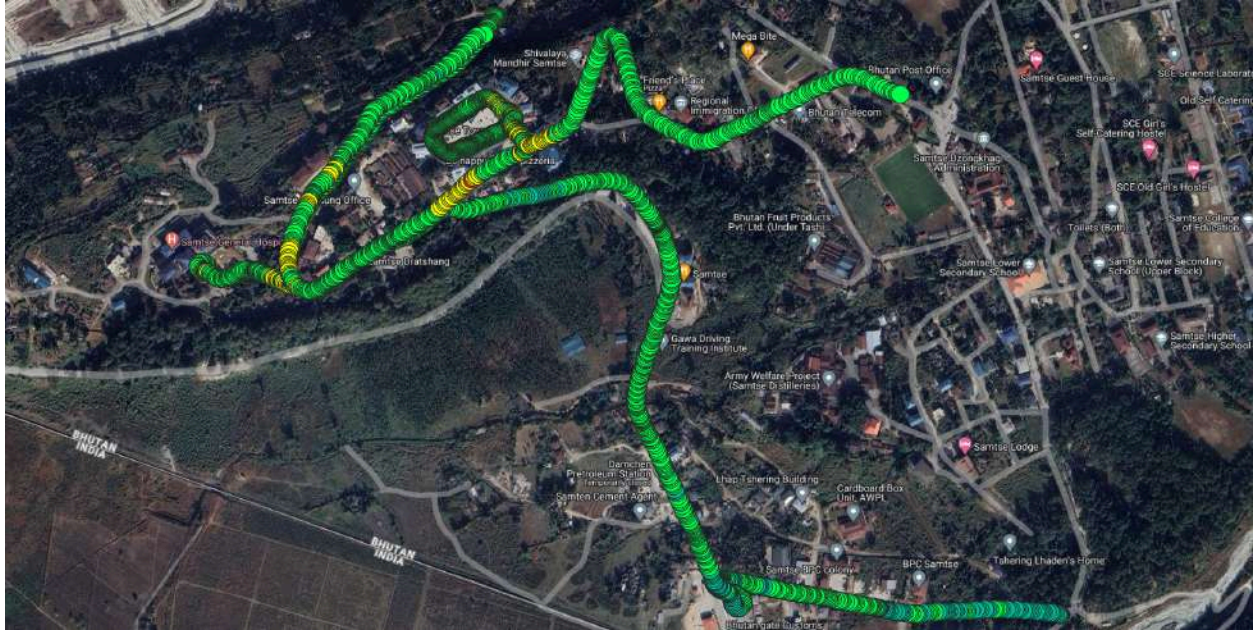


Figure number 26: RSRP plot 4G Tashi Cell (QGIS) [Samtse Town]

14. Dawa Store

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.71	8.3	No issue
TICPL	0	3.97	6.75	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	

BTL	11.89	15.71	No issue
TICPL	9.68	15.83	No issue



Figure number 27: RSRP plot 4G B-mobile (QGIS) [Dawa Store]



Figure number 28: RSRP plot 4G Tashi Cell (QGIS) [Dawa Store]

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15. Express Car Wash

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.87	8.67	No issue
TICPL	0	4	7.71	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	21.775	16.92	No issue
TICPL	11.44	13.06	No issue



Figure number 29: RSRP plot 4G B-mobile (QGIS)[Express Car Wash]



Figure number 30: RSRP plot 4G Tashi Cell (QGIS) [Express Car Wash]

16. Babesa Highway

- **Mobile Voice Service**

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.87	9.12	Issue with CFBST
TICPL	0	3.5	7.85	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	21.95	14.125	No issue
TICPL	9.01	15.14	No issue



Figure number 31: RSRP plot 4G B-mobile (QGIS) [Babesa Highway]



Figure number 32: RSRP plot 4G Tashi Cell (QGIS) [Babesa Highway]

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17. Babena - 1

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.57	7.72	No issue
TICPL	0	3.94	9.44	Issue with CFBST

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	13.27	19.19	No issue
TICPL	1.68	6.28	Issue with DL throughput



Figure number 33: RSRP plot 4G B-mobile (QGIS) [Babena - 1]

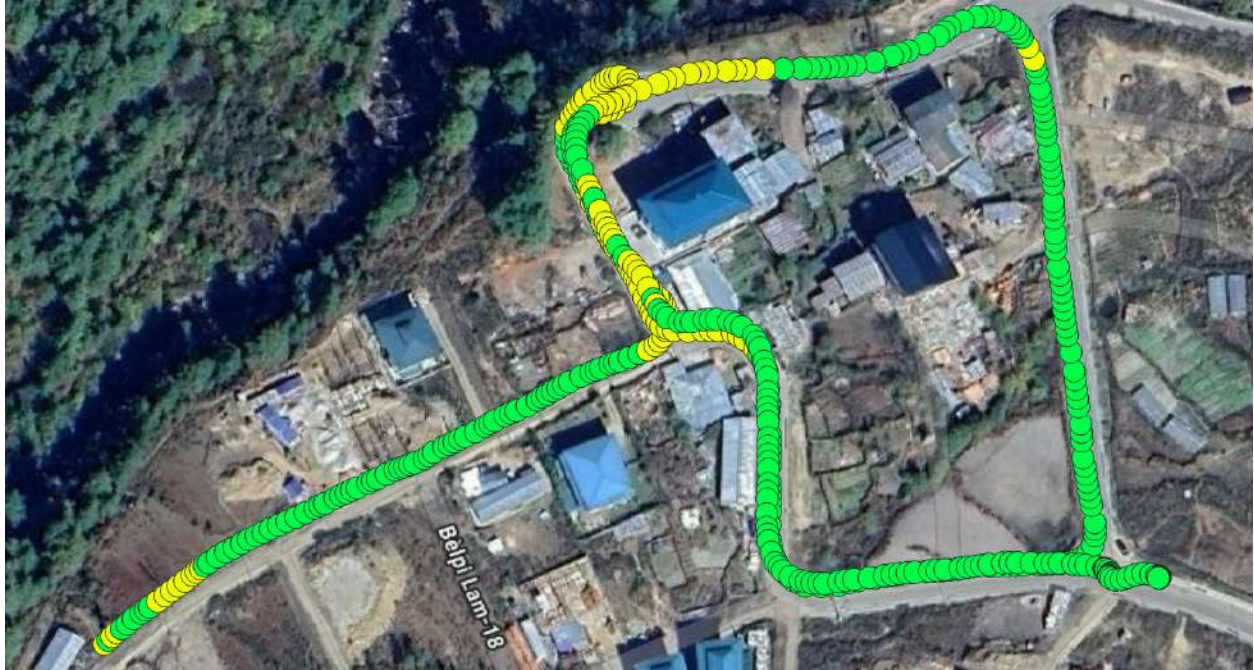


Figure number 34: RSRP plot 4G Tashi Cell (QGIS) [Babena - 1]

18. Babena - 2

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL		3.2	8.88	Issue with MOS
TICPL		3.92	6.61	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	3.43	7.56	No issue
TICPL	4.47	0.95	Issue with upload throughput



Figure number 35: RSRP plot 4G B-mobile (QGIS) [Babena - 2]



Figure number 36: RSRP plot 4G Tashi Cell (QGIS) [Babena - 2]

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19. Babena - 3

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.76	7.82	No issue
TICPL	0	3.95	6.66	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	14.42	6.39	No issue
TICPL	4.44	5.10	Issue with DL throughput



Figure number 37: RSRP plot 4G B-mobile (QGIS) [Babena - 3]



Figure number 38: RSRP plot 4G Tashi Cell (QGIS) [Babena - 3]

20. Babena - 4

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.89	8.32	No issue
TICPL	0	4.1	6.56	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	13.86	15.65	No issue
TICPL	25.54	10.63	No issue



Figure number 39: RSRP plot 4G B-mobile (QGIS) [Babena - 4]

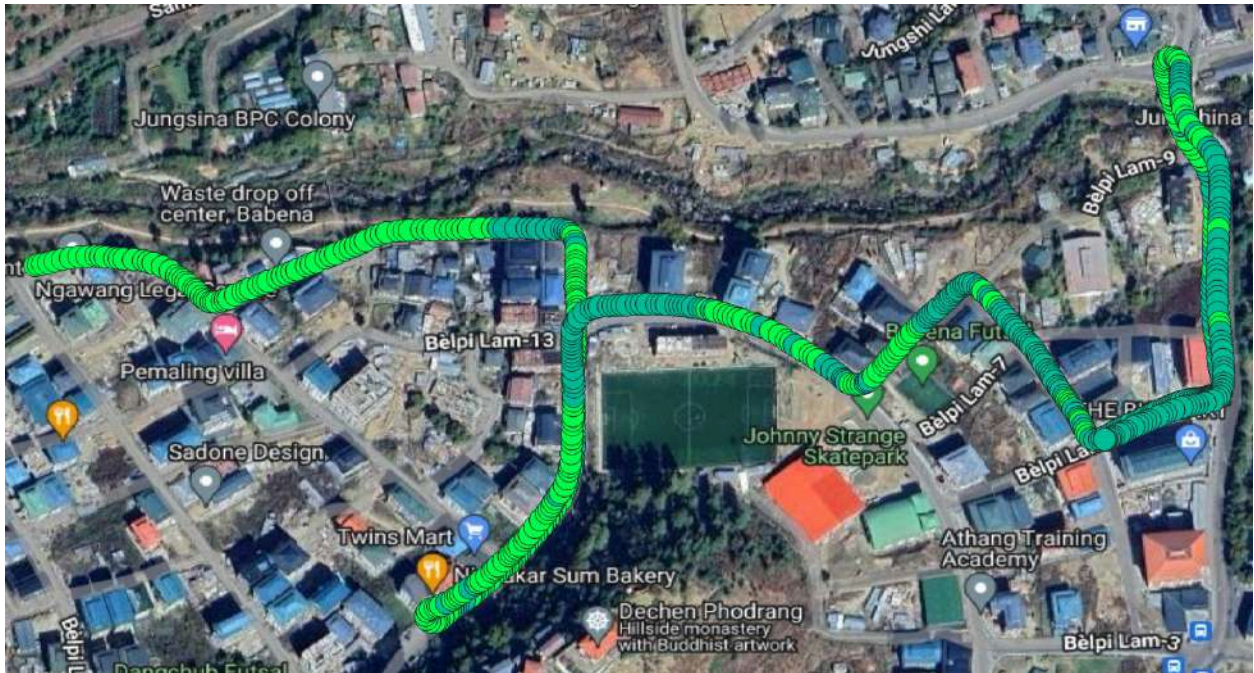


Figure number 40: RSRP plot 4G Tashi Cell (QGIS) [Babena - 4]

21. Babena - 5

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.93	7.98	No issue
TICPL	0	4.1	12.21	Issue with CFBST

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	13.63	11.15	No issue
TICPL	18.41	24.56	No issue

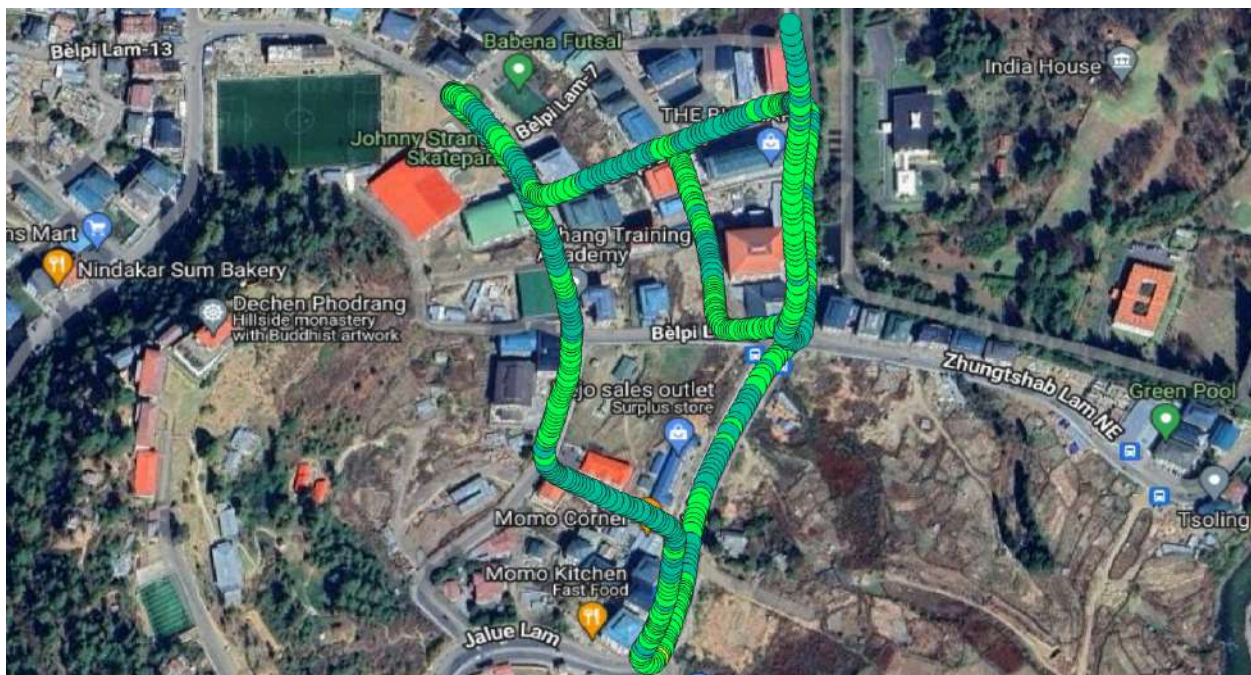


Figure number 41: RSRP plot 4G B-mobile (QGIS) [Babena - 5]

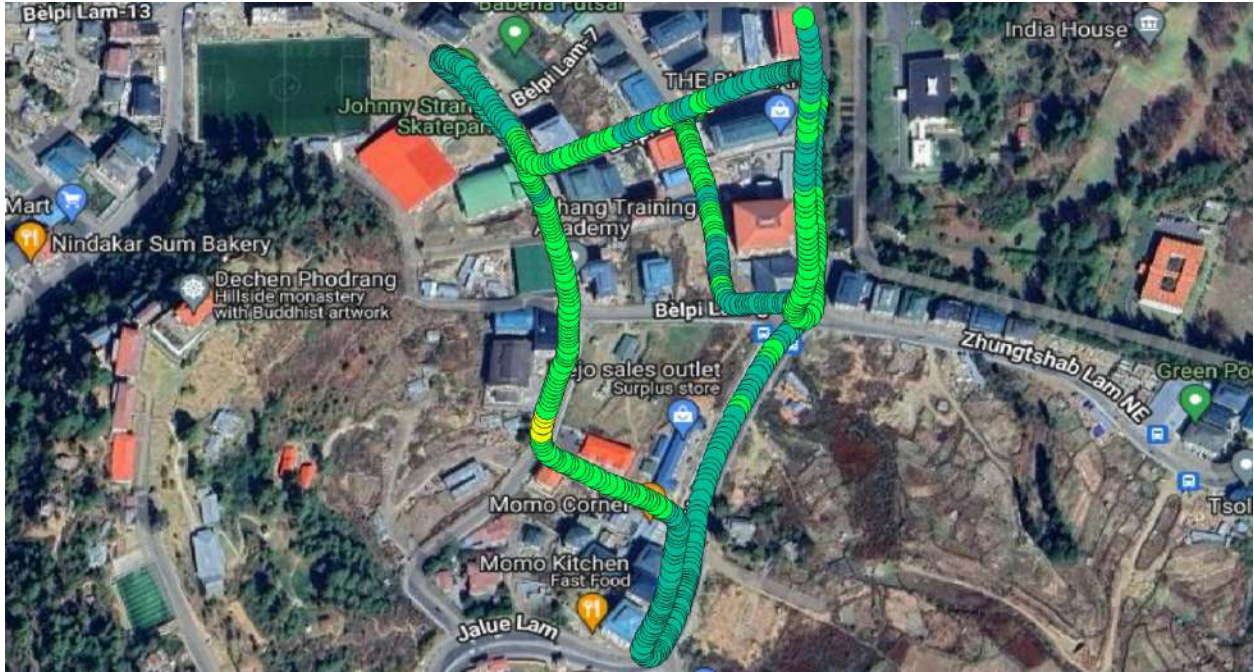


Figure number 42: RSRP plot 4G Tashi Cell (QGIS) [Babena - 5]

22. Pamtsho - 1

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.94	8.3	No issue
TICPL	0	3.89	8.18	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	15.95	8.62	No issue
TICPL	4.71	4.42	Issue with DL throughput



Figure number 43: RSRP plot 4G B-mobile (QGIS) [Pamtsho - 1]

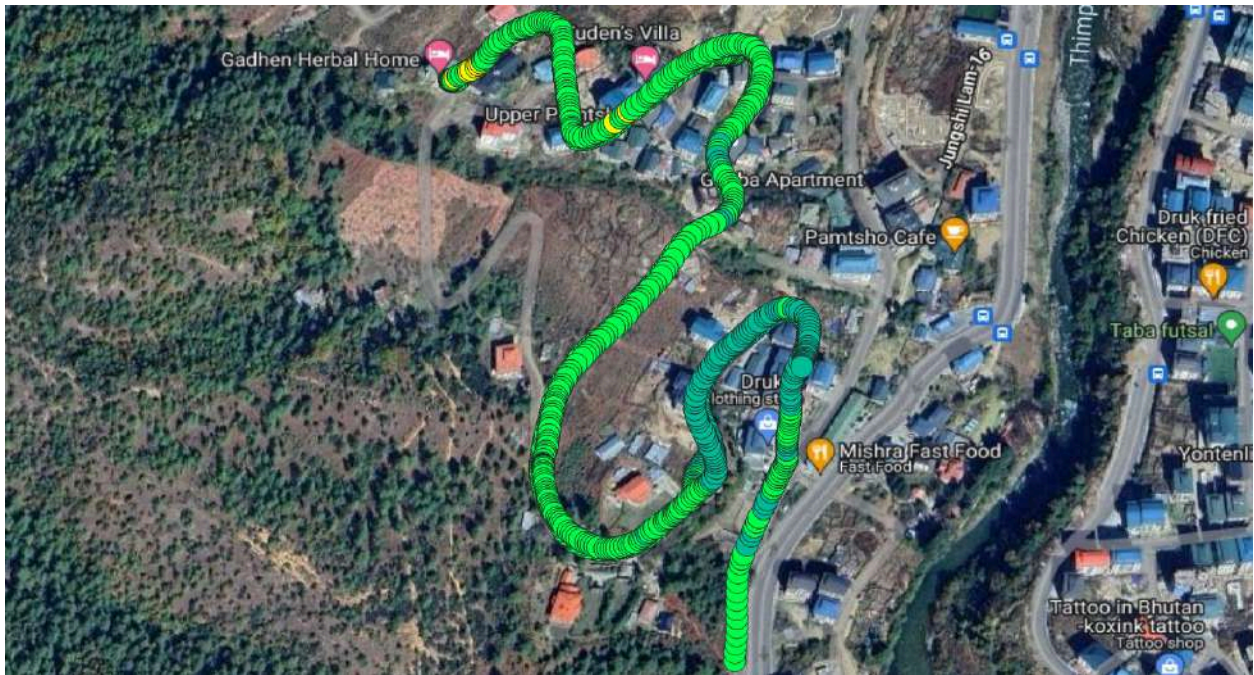


Figure number 44: RSRP plot 4G Tashi Cell (QGIS) [Pamtsho - 1]

23. Pamtsho - 2

- Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.84	9.84	No issue
TICPL	0	3.78	9.82	Issue with setup time

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	13.62	12.41	No issue
TICPL	7.16	4.04	No issue



Figure number 45: RSRP plot 4G B-mobile (QGIS) [Pamtsho - 2]

TICPL	32.51	21.89	No issue
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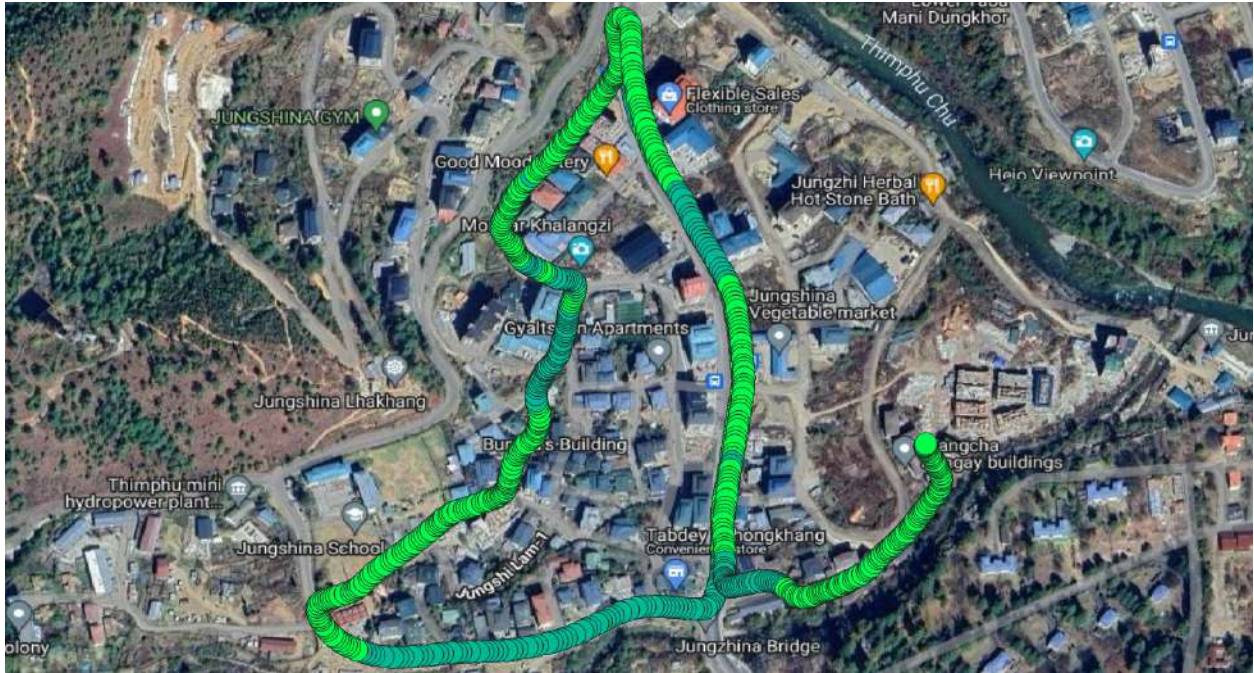


Figure number 47: RSRP plot 4G B-mobile (QGIS) [Jungshina]

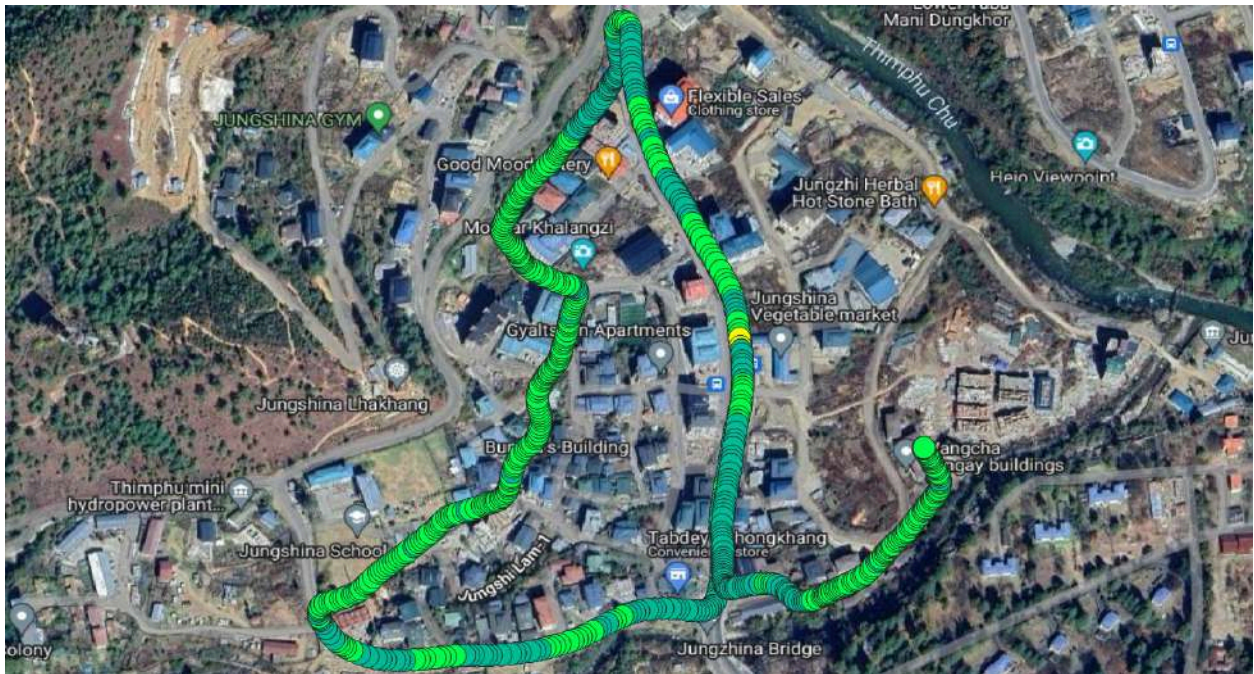


Figure number 48: RSRP plot 4G Tashi Cell (QGIS) [Jungshina]

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25. Lungtenphu

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.87	7.32	No issue
TICPL	0	3.96	6.94	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	29.34	17.97	No issue
TICPL	8.48	10.06	No issue



Figure number 49: RSRP plot 4G B-mobile (QGIS) [Lungtenphu]

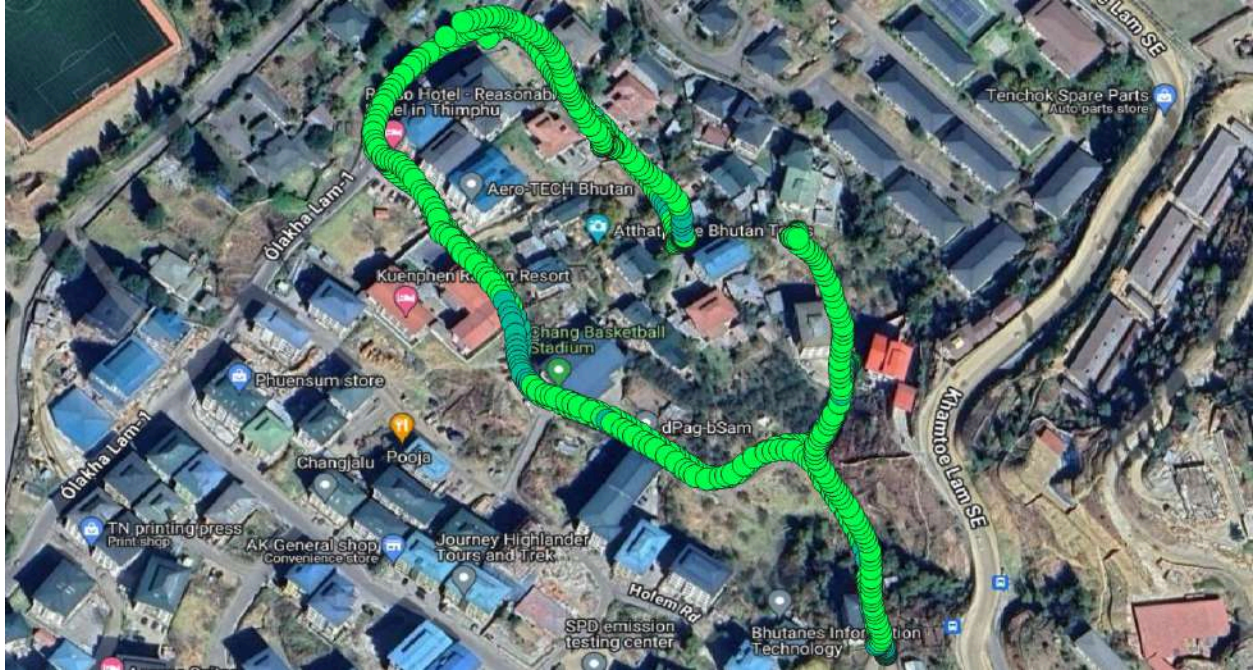


Figure number 50: RSRP plot 4G Tashi Cell (QGIS) [Lungtenphu]

26. Changjalu

- Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.55	9.33	Issue with setup time
TICPL	0	3.55	9.43	Issue with setup time

- Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	19.91	9.97	No issue

TICPL	10.91	14.2	No issue
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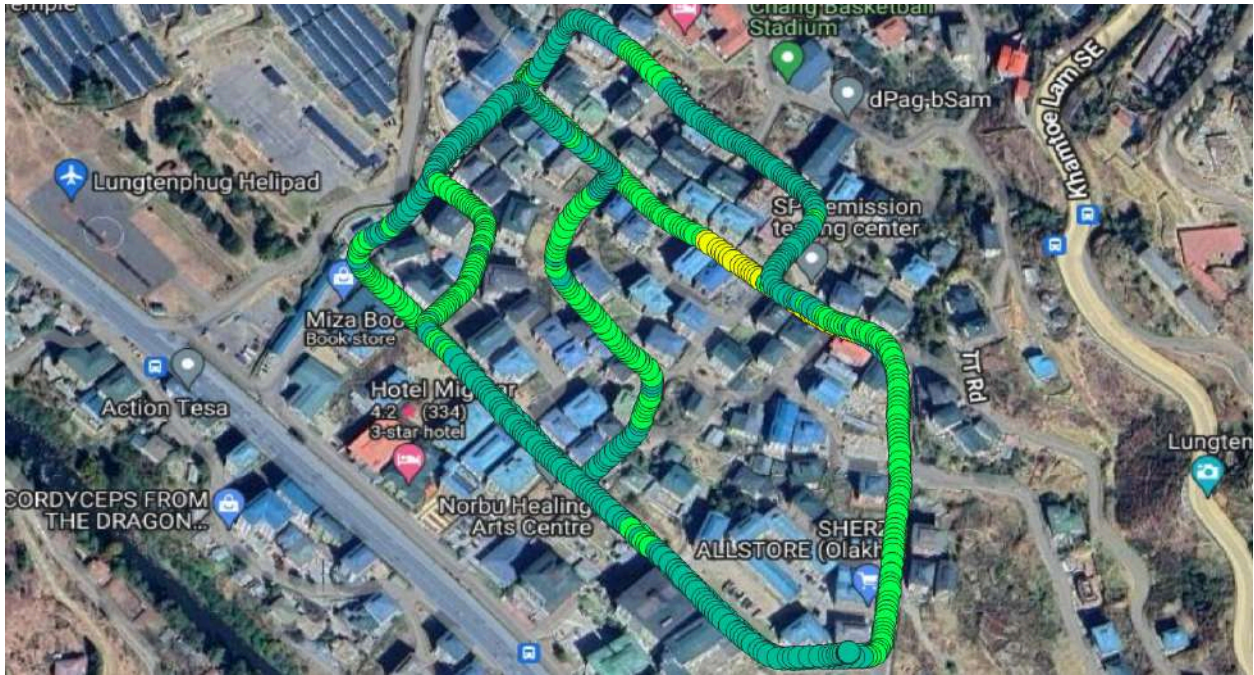


Figure number 51: RSRP plot 4G B-mobile (QGIS) [Changjalu]

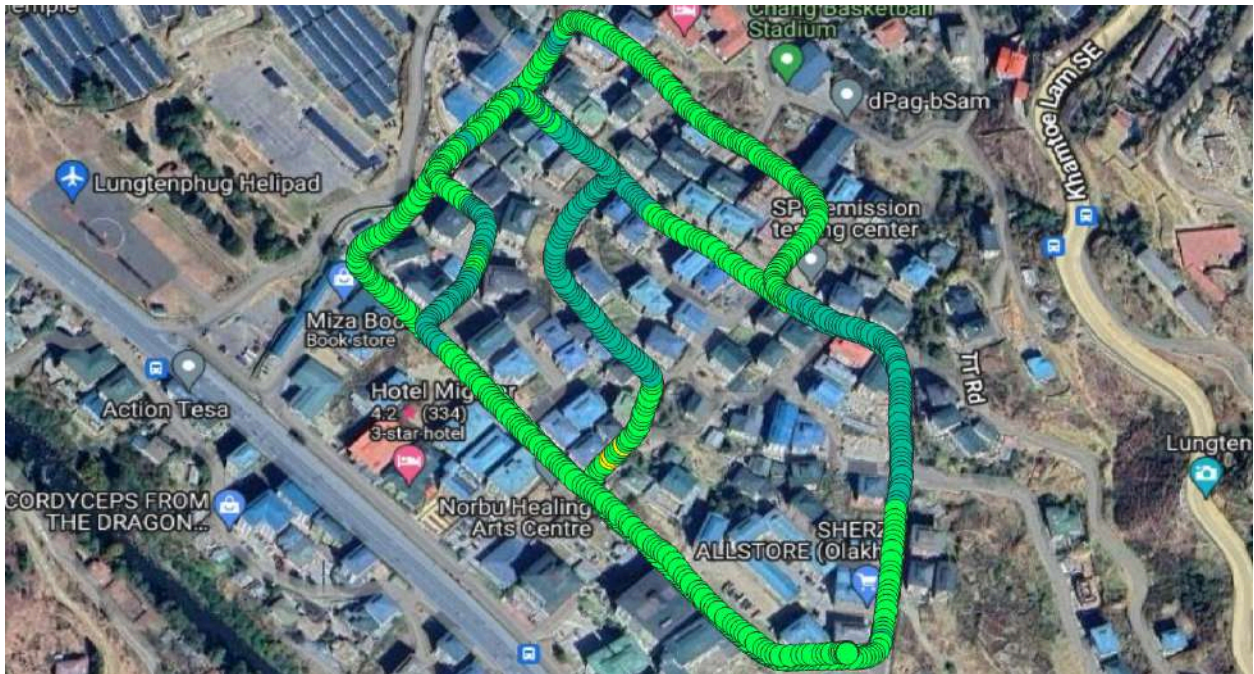


Figure number 52: RSRP plot 4G Tashi Cell (QGIS) [Changjalu]

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27. MoH

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.82	7.97	No issue
TICPL	0	3.74	6.72	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	32.42	20.27	No issue
TICPL	43.02	15.37	No issue

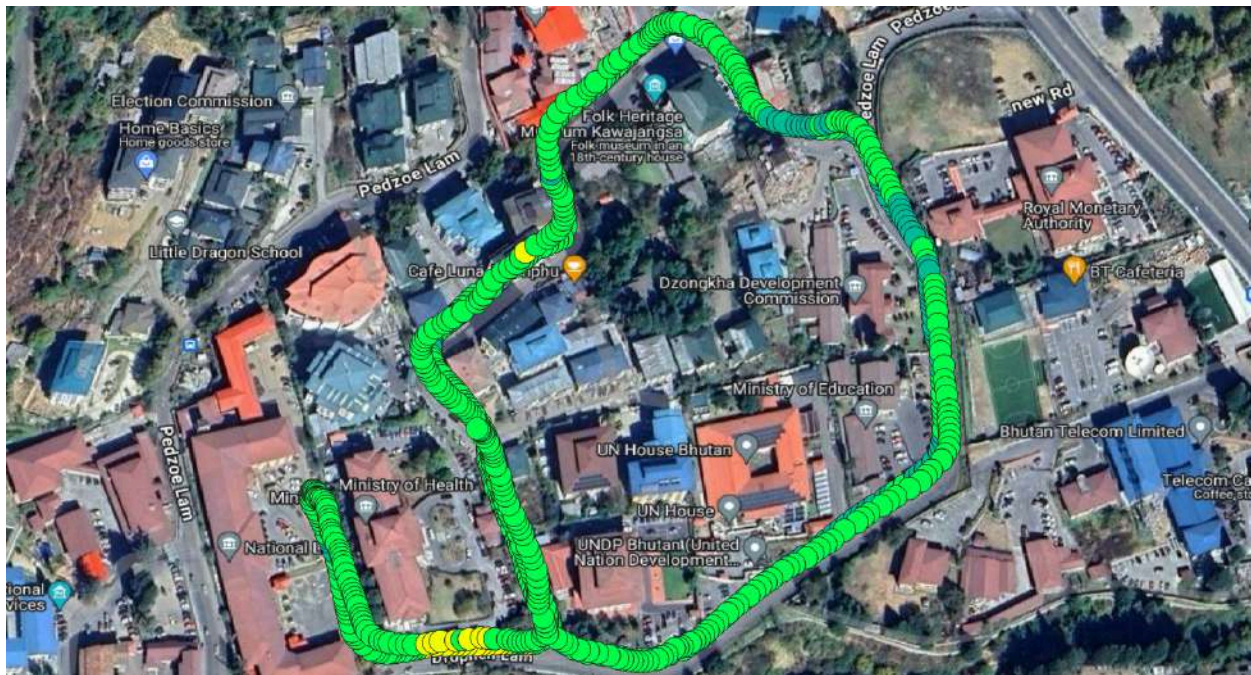


Figure number 53: RSRP plot 4G B-mobile (QGIS) [MoH]

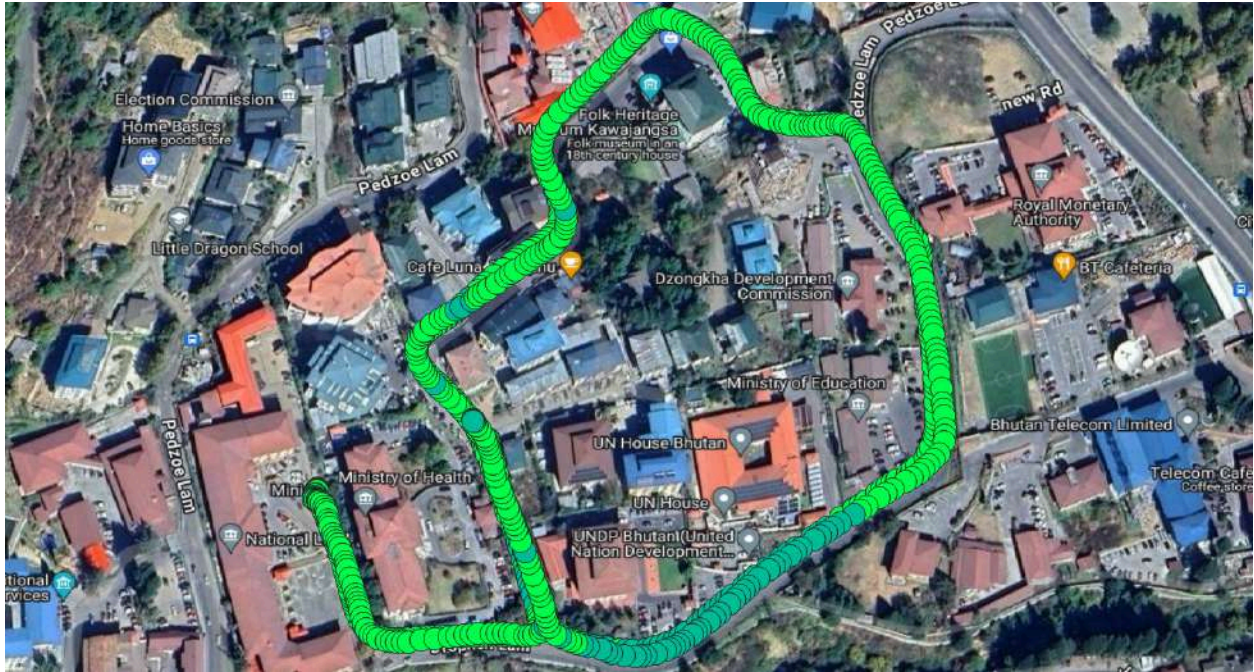


Figure number 54: RSRP plot 4G Tashi Cell (QGIS) [MoH]

28. Cremation Ground

- Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.76	8.56	No issue
TICPL	0	4.18	6.74	No issue

- Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	14.99	6.482	No issue
TICPL	17.33	4.00	No issue

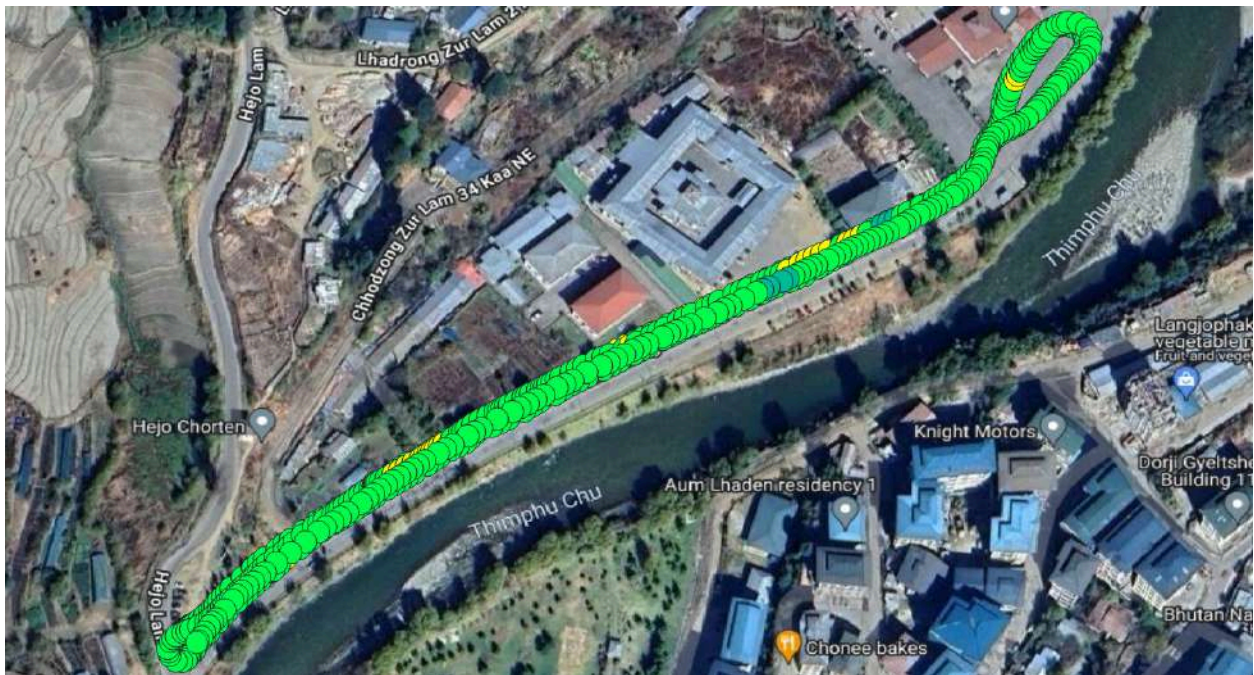


Figure number 55: RSRP plot 4G B-mobile (QGIS) [Cremation Ground]

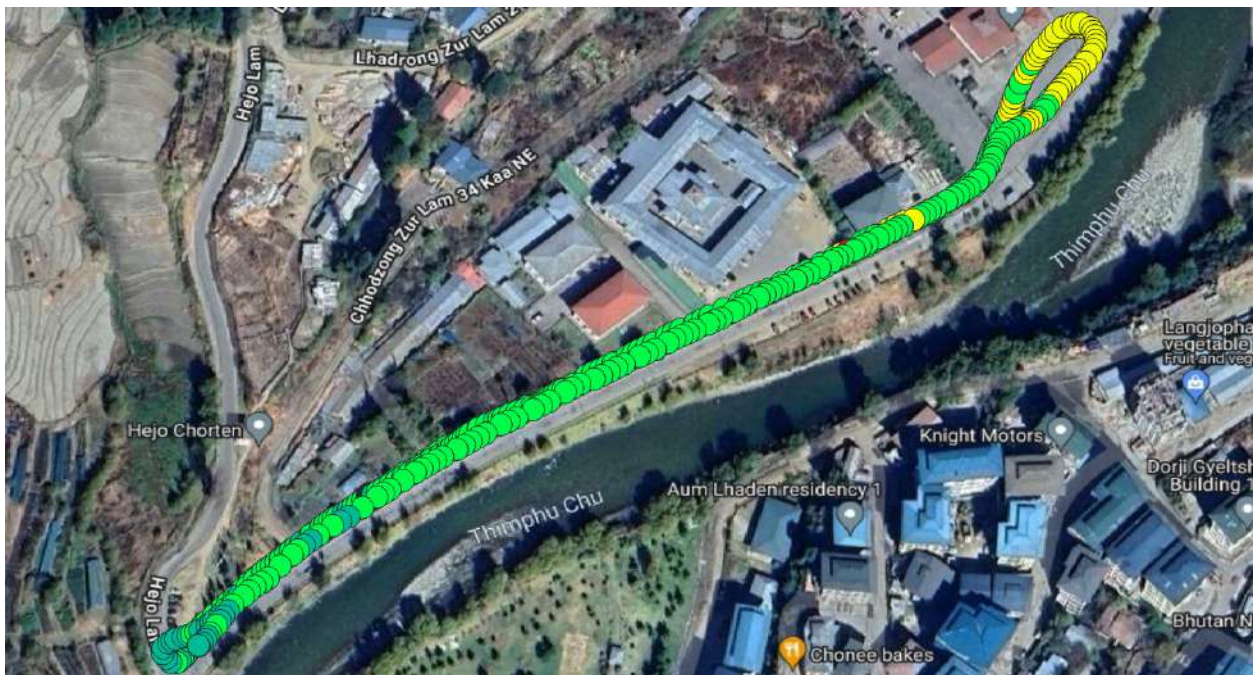


Figure number 56: RSRP plot 4G Tashi Cell (QGIS) [Cremation Ground]

29. Hejo

- Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.63	10.71	Issue with setup time
TICPL	0	3.99	6.6	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	10.84	12.05	No issue
TICPL	7.79	6.32	No issue



Figure number 57: RSRP plot 4G B-mobile (QGIS) [Hejo]

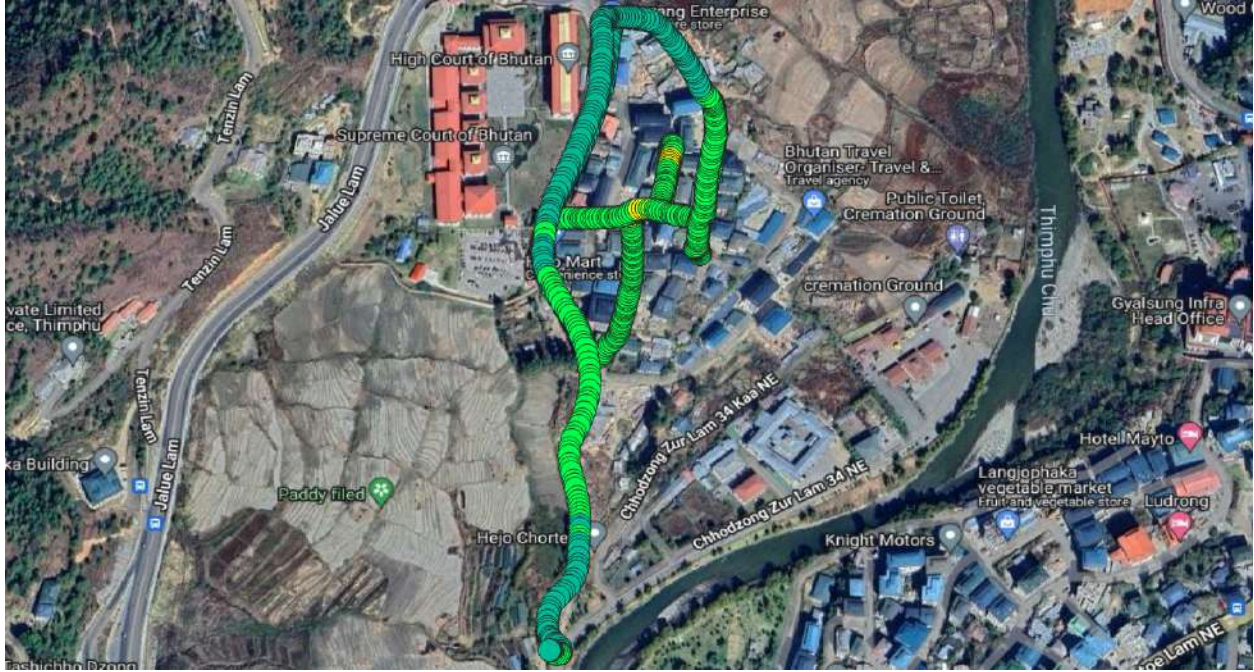


Figure number 58: RSRP plot 4G Tashi Cell (QGIS) [Hejo]

30. Lower Tab - 1

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.87	10.96	Issue with setup time
TICPL	0	4.04	6.65	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	15.29	11.653	No issue

TICPL	14.13	21.13	No issue
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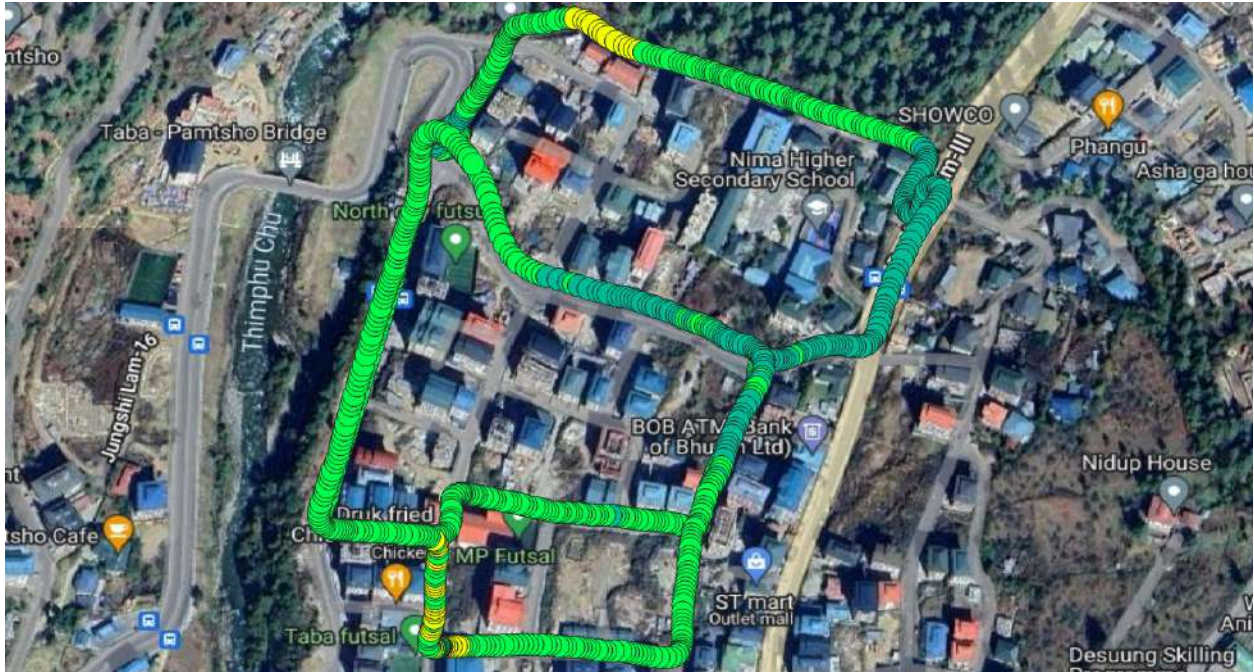


Figure number 59: RSRP plot 4G B-mobile (QGIS) [Lower Taba - 1]

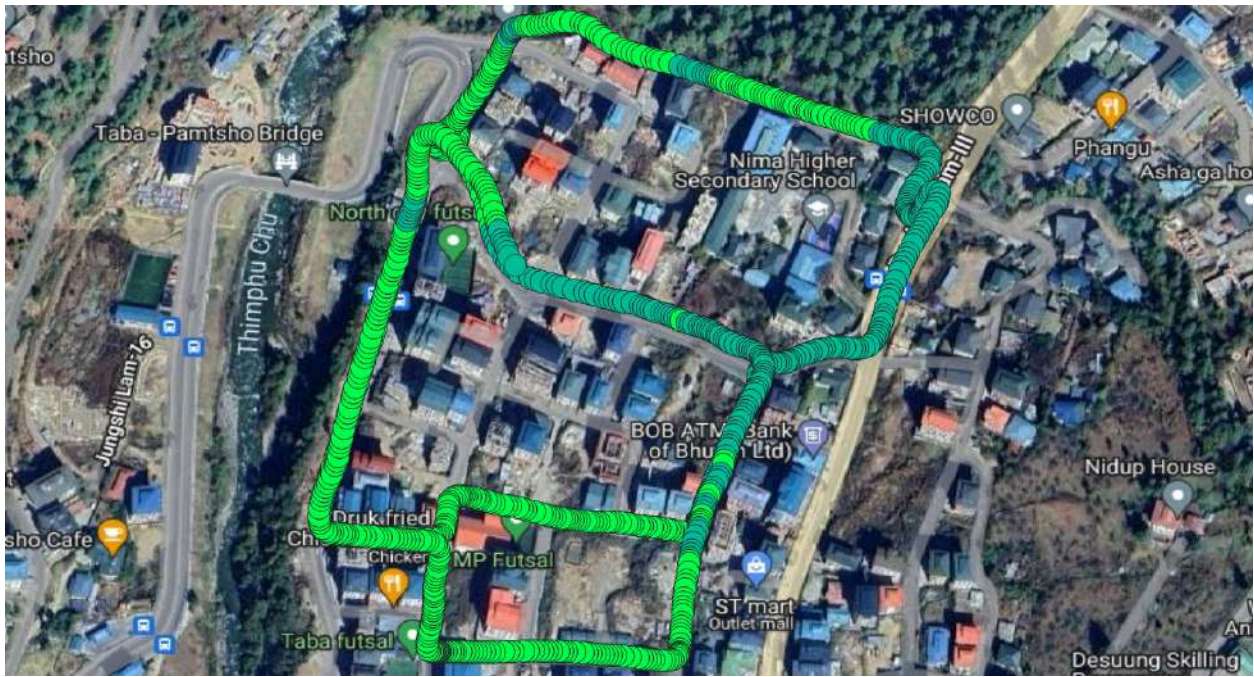


Figure number 60: RSRP plot 4G Tashi Cell (QGIS) [Lower Taba - 1]

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31. Lower Taba - 2

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.8	8.41	No issue
TICPL	0	3.88	11.41	Issue with setup time

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	9.9	14.74	No issue
TICPL	9.9	14.89	No issue



Figure number 61: RSRP plot 4G B-mobile (QGIS) [Lower Taba - 2]



Figure number 62: RSRP plot 4G Tashi Cell (QGIS) [Lower - Taba - 2]

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II. Indoor

1. Samdrup Jongkhar Town (Indoor)

- Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	4.96	0.6	Issue with both DL and UL throughputs
TICL	2.21	10.48	Issue with DL throughputs

Location:



2. Langchengphu Gewog (Indoor)

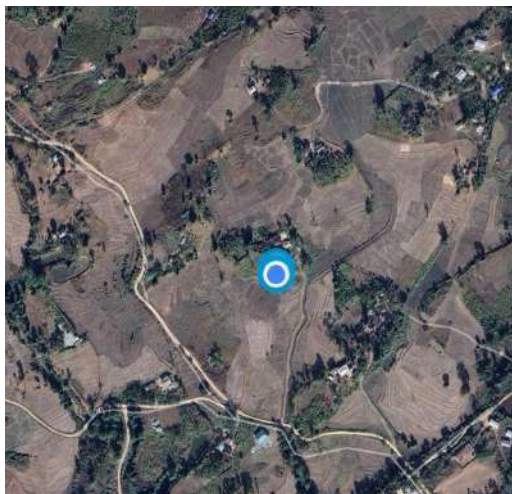
- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.36	11.93	Issue with both MoS and Call Setup time
TICL	0	3.46	6.35	Issue MoS

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	22.26	1.64	Issue with UL throughputs
TICL	2.404	1.16	Issue with both UL and DL throughputs

Location:



4. Findings

The Summarized findings for C hookah, Samtse and Samdrup Jongkhar are as follows:

1. *Mobile Voice service*

- There were issues of Call Setup time (outdoor) for both the operators in Samdrup Jongkhar town.
- BTL has an issue with both MoS and Call Setup time (outdoor and Indoor) in Jomotshangkha and Langchengphu Gewog.
- Call Fallback Setup Time issues were found in the Samtse Dzong Area for both the operators.

2. *Mobile Data Service*

- The Average DL and UL throughputs for both the telecom operators in Samdrup Jongkhar town, Jomotshnakha and Langchengphu Gewog (Outdoor) meet the standard.
- The average UL and DL throughputs for both operators in Samdrup Jongkhar town and Langchengphu Gewog (Indoor) do not meet the standard.

The following were the summarized findings in Thimphu town:

BTL	TICPL
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Babesa Highway (CFBST)	Babena -1 (CFBST and DL throughput)
Babena -2 (MOS)	Babena - 2 (UL throughput)
Changjalu (CFBST)	Babena - 3 (DL throughput)
Hejo (CFBST)	Babena - 5 (CFBST)
Lower Taba - 1 (CFBST)	Pamtsho - 1 (DL throughput)
	Pamtsho - 2 (CFBST)
	Jungshina (CFBST)
	Changjalu (CFBST)
	Lower Taba - 2 (CFBST)

Areas with issue for both the telcos

The following are the areas with network coverage problems:

- A major portion of area near the highway for TICPL
- Near the Express Carwash for TICPL
- Certain portion of the areas in Babena - 1 for TICPL
- Certain portion of the areas in Babena - 2 for TICPL
- Certain portion of the areas in Babena - 3 for both the telcos
- Certain portion of the areas in Pamtsho - 1 for BTL
- Certain portion of the areas in Pamtsho - 2 for BTL
- Certain portion of the areas in Changjalu for BTL
- Certain portion of the areas near Ministry of Health for BTL
- Certain portion of the areas near the cremation ground for both the telcos
- Certain portion of the areas in Hejo for TICPL
- Certain portion of the areas in Lower Taba - 1 for BTL
- Certain portion of the areas in Lower Taba - 2 for BTL

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 Authority has continuously monitored and follow up the QoS standards and network coverage in Gelephu region (SAR)
- The Authority has also carried out the complaint validation regarding the QoS issues.

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)	>=-80	-80<=-95	<=-105
2	RSCP (UMTS)	>=-80	-80<=-100	<=-110
3	RSRP (LTE)	>=-80	-80<=-105	<=-115