

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 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, Samste and Phuentsholing.

2. Locations and date of monitoring

Sl. No	Dzongkhag	Locations	Monitoring month
1	Thimphu	Chang Rigphel, Olakha	May 2022
2	Phuentsholing	Ahlay	
3		Damdara	
4		Toorsa Residential Area	
5		Pasakha Industrial Area	
6		Rinchending	
7		Phuentsholing Core Area	
8		Toorsa residential area	
9		Samtse	
10	Thimphu	Changzamtog	June 2022
		Olakha	
		Pamtsho	

3. Findings

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

A. Thimphu

a. (Chang Rigphel, Olakha)

Mobile Data Services (4G)

Drive test carried out at off peak (out door)

Operators	File Transfer Protocol		Hypertext Transfer Protocol	
	Download	Upload	Download	Upload
BTL	13.2	10.1	40.2	20.9

Drive Test carried out at peak hour (out door)

Operators	File Transfer Protocol		Hypertext Transfer Protocol	
	Download	Upload	Download	Upload
BTL	5.972	5.656	19.646	16.073

Drive Test carried out at peak hour (in-door)

Operators	File Transfer Protocol		Hypertext Transfer Protocol	
	Download	Upload	Download	Upload
BTL	1.075	1.12	2.343	6.1

b. Changzamtog

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.41	8.39
TICL	0	3.30	9.33

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥ 2Mbps)	Upload (≥ 1Mbps)
BTL	3.2	1.07
TICL	5.7	1.58

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5Mbps)
BTL	15.741	-
TICL	21.052	19.15

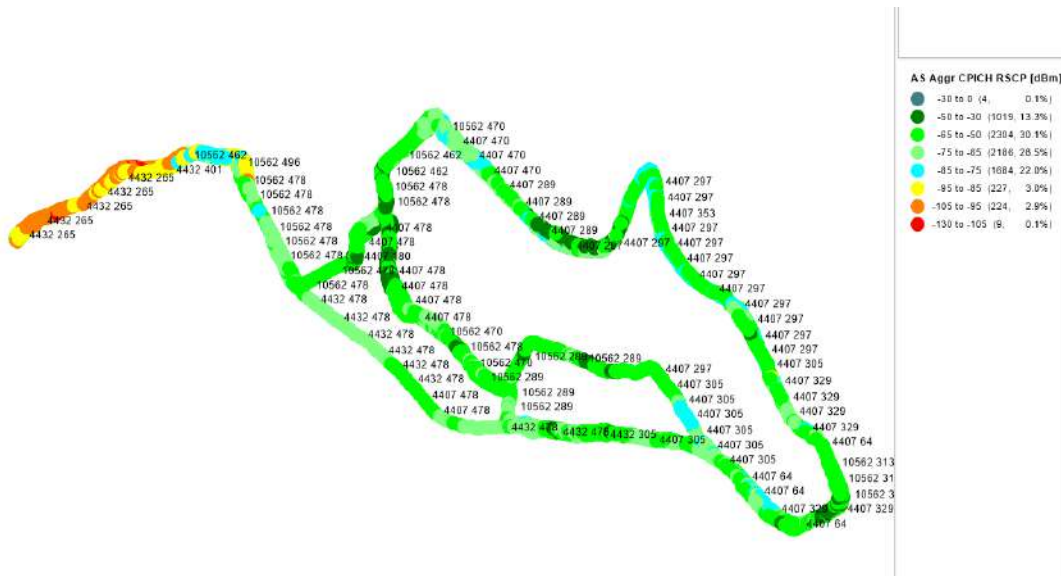


Figure number 1: 3G B-mobile (CPICH RSRP (dBm) plot)

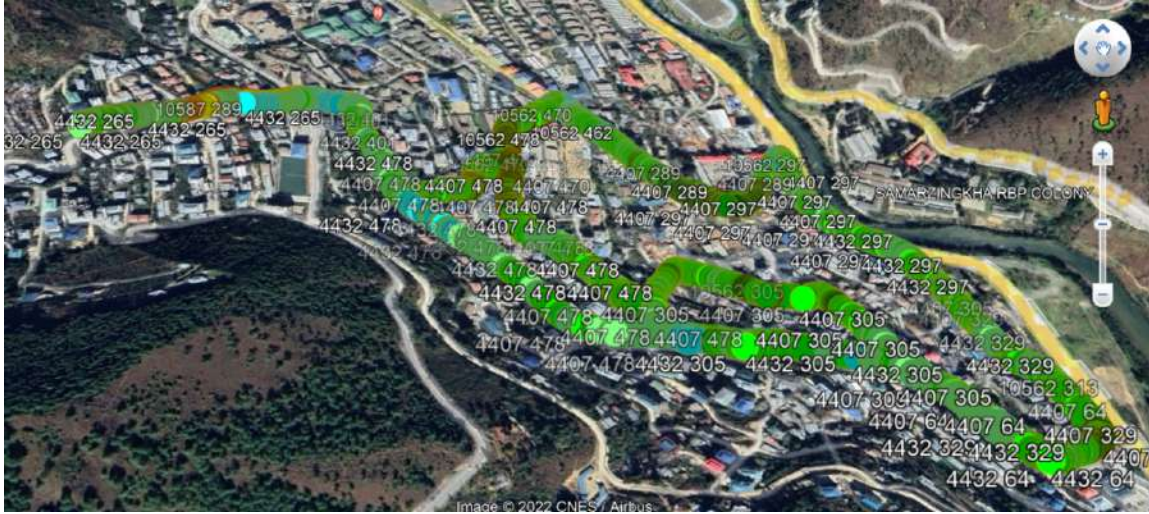


Figure number 2: RSRP plot 3G B-mobile (google earth)

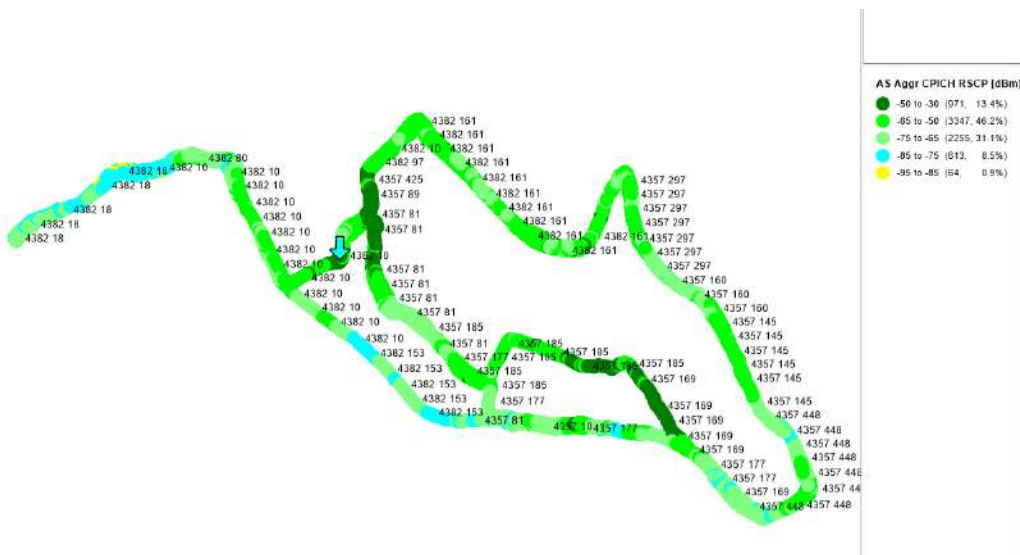


Figure number 3: 3G Tashi Cell (CPICH RSRP (dBm) plot)



Figure number 4: RSRP plot 3G Tashi Cell (google earth)

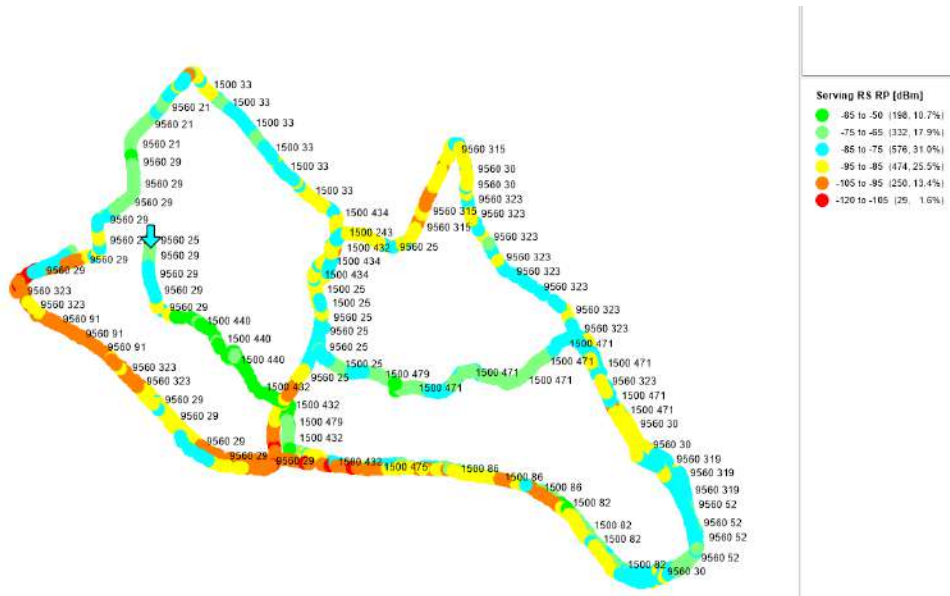


Figure number 5: 4G B-mobile (CPICH RSRP (dBm) plot)



Figure number 6: RSRP plot 4G B-mobile (Google earth)

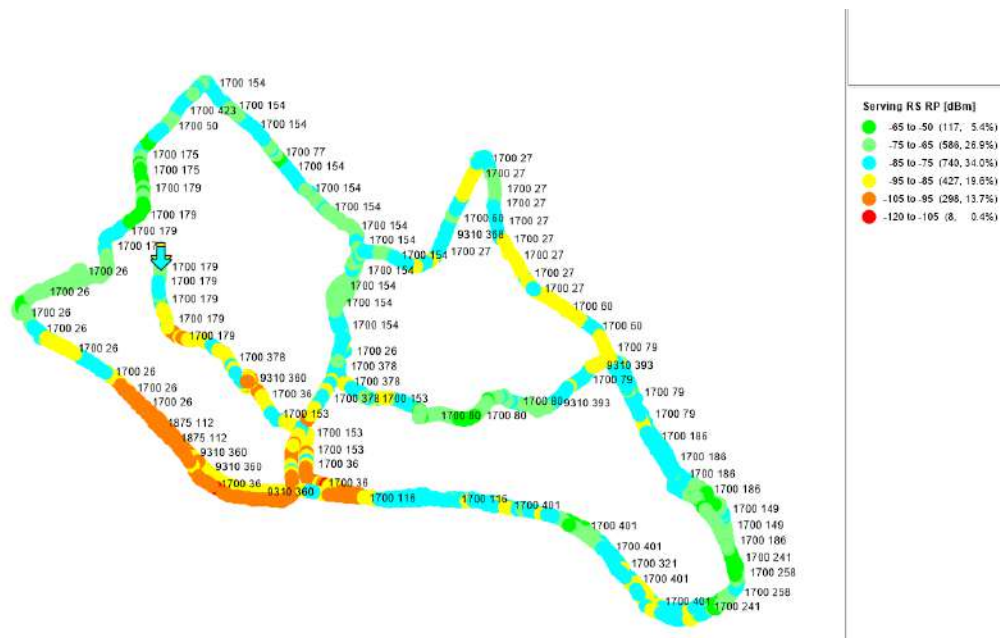


Figure number 7: 4G Tashi Cell (CPICH RSRP (dBm) plot)



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

c. Olakha

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.27	7.93
TICL	0	3.31	10.60

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥ 2Mbps)	Upload (≥ 1Mbps)
BTL	3.9	0.5
TICL	3.0	0.6

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5 Mbps)
BTL	7.2	24.44
TICL	15.4	19.581



Figure number 9: 3G B-mobile (CPICH RSRP (dBm) plot)

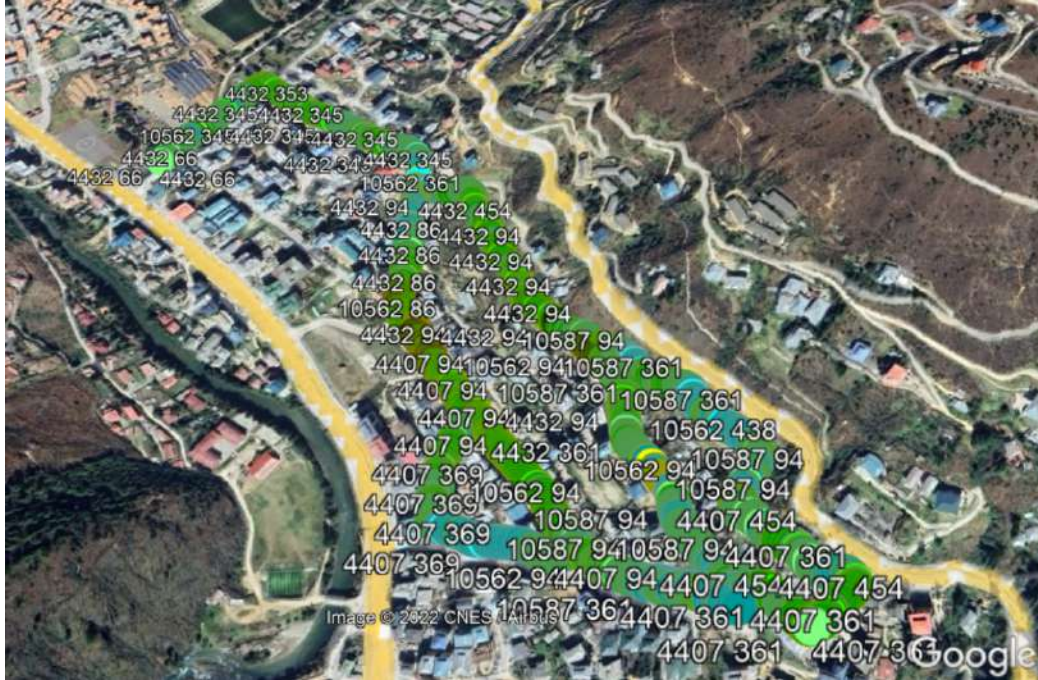


Figure number 10: RSRP plot 3G B-mobile (google earth)

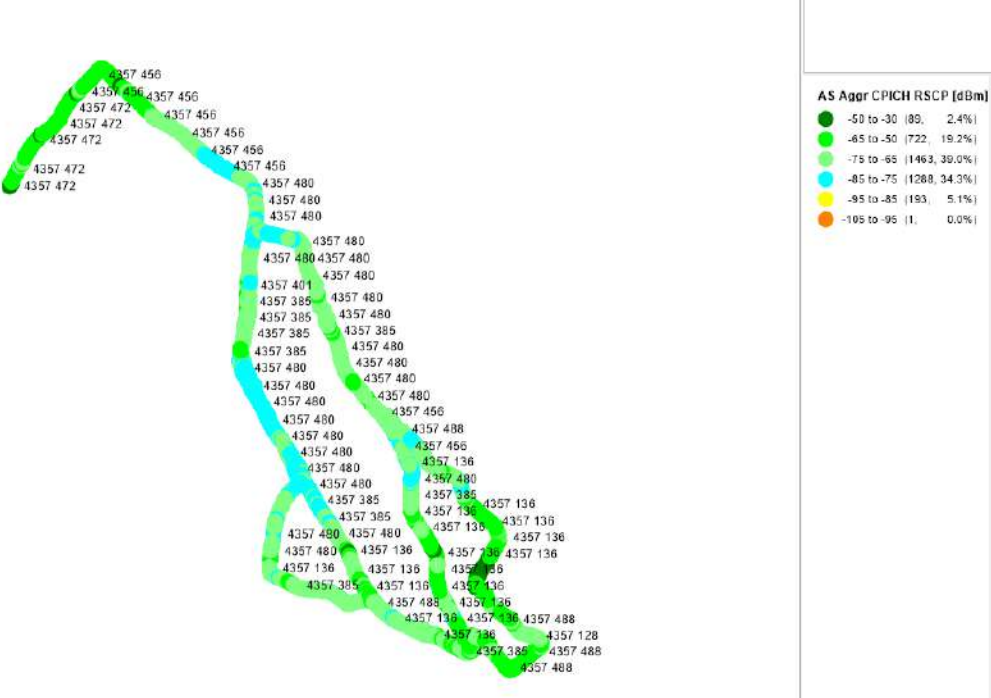


Figure number 11: 3G Tashi Cell (CPICH RSRP (dBm) plot)

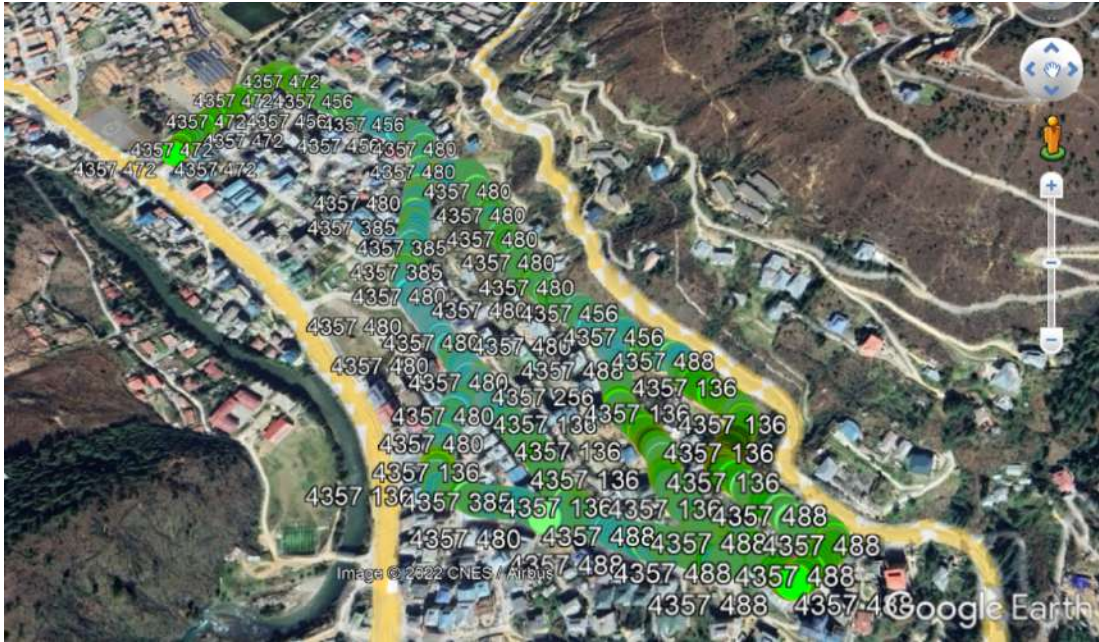


Figure number 12: RSRP plot 3G Tashi Cell (google earth)

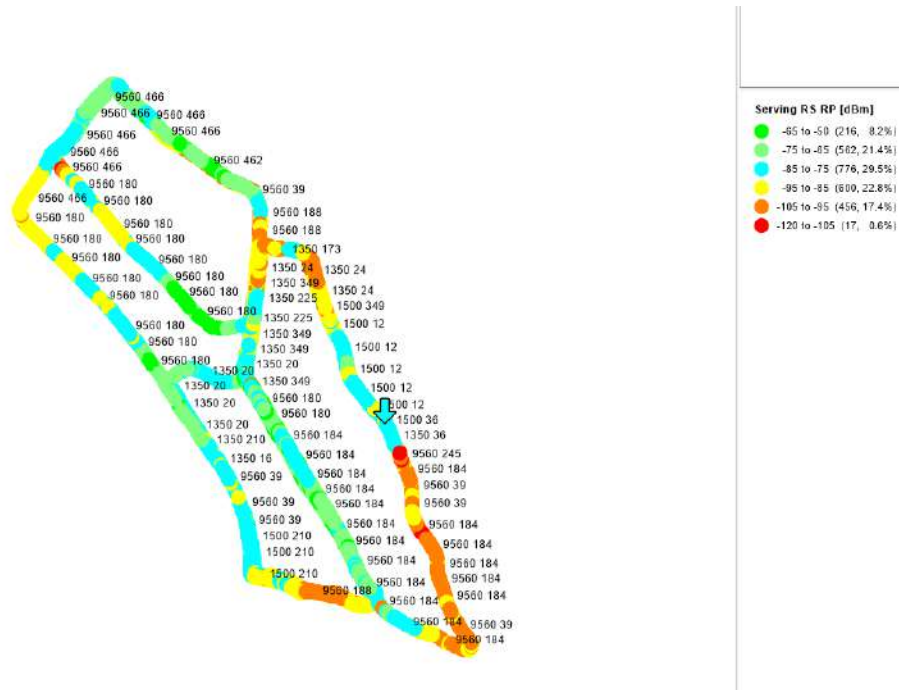


Figure number 13: 4G B-mobile (CPICH RSRP (dBm) plot)

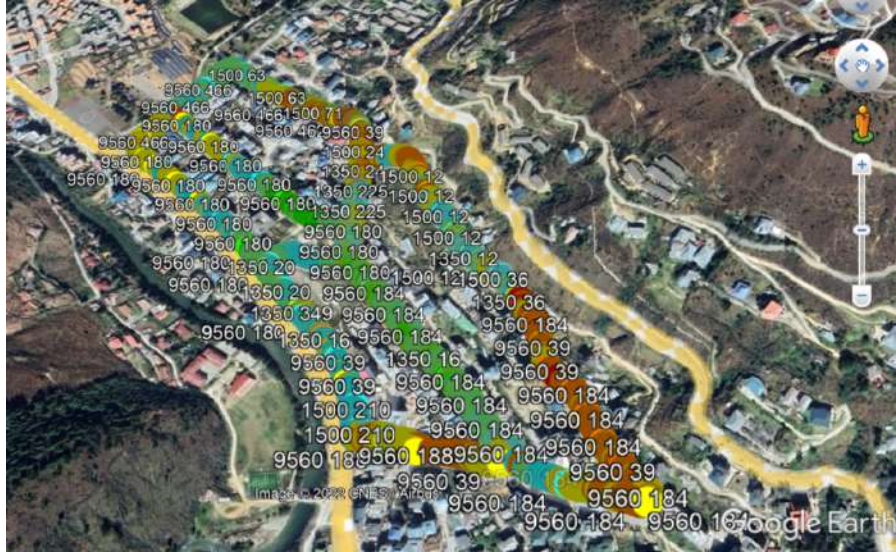


Figure number 14: RSRP plot 4G B-mobile (Google earth)

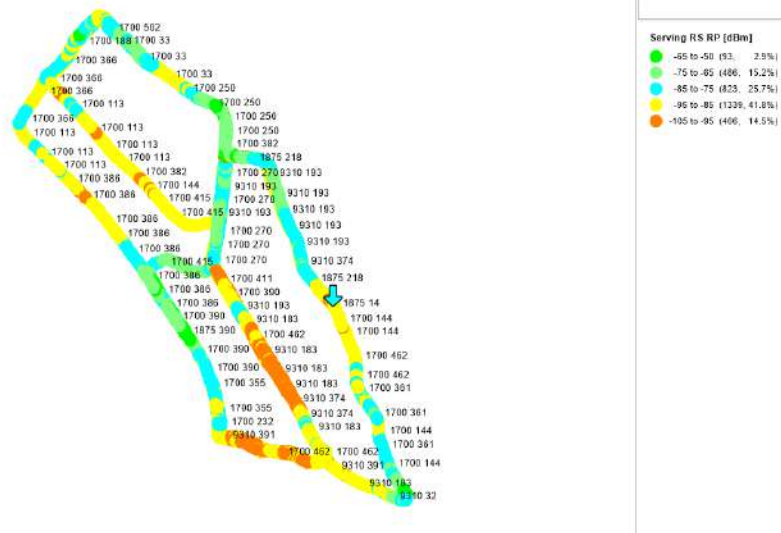


Figure number 15: 4G Tashi Cell (CPICH RSRP (dBm) plot)

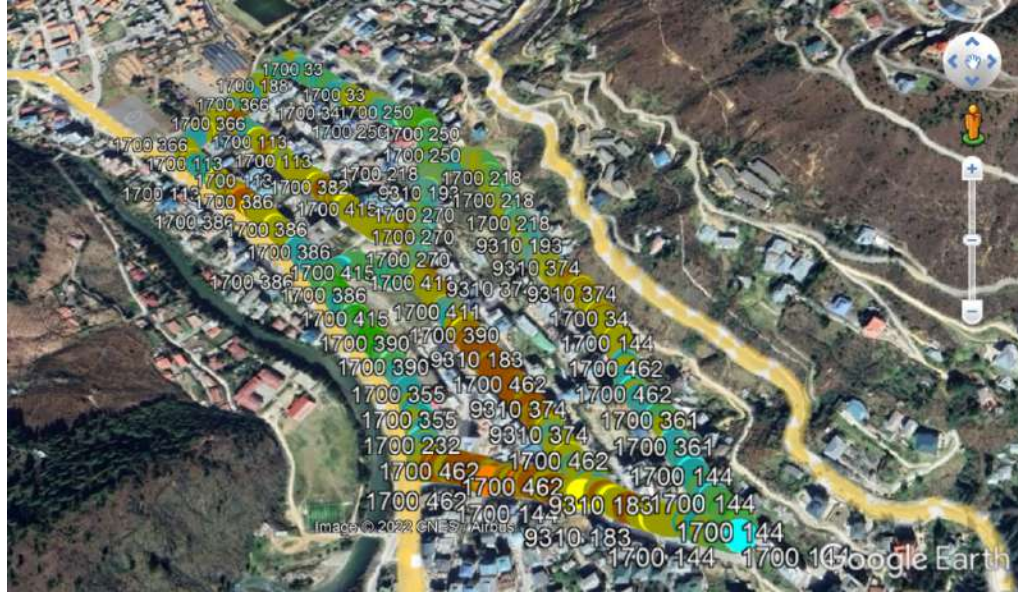


Figure number 16: RSRP plot 4G Tashi Cell (Google earth)

d. Pamtsho

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.53	8.29
TICL	0	3.59	-

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥ 2Mbps)	Upload (≥ 1Mbps)
BTL	4.204	1.235
TICL	5.017	1.596

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5 Mbps)
BTL	16.57	38.8
TICL	15.25	20.47

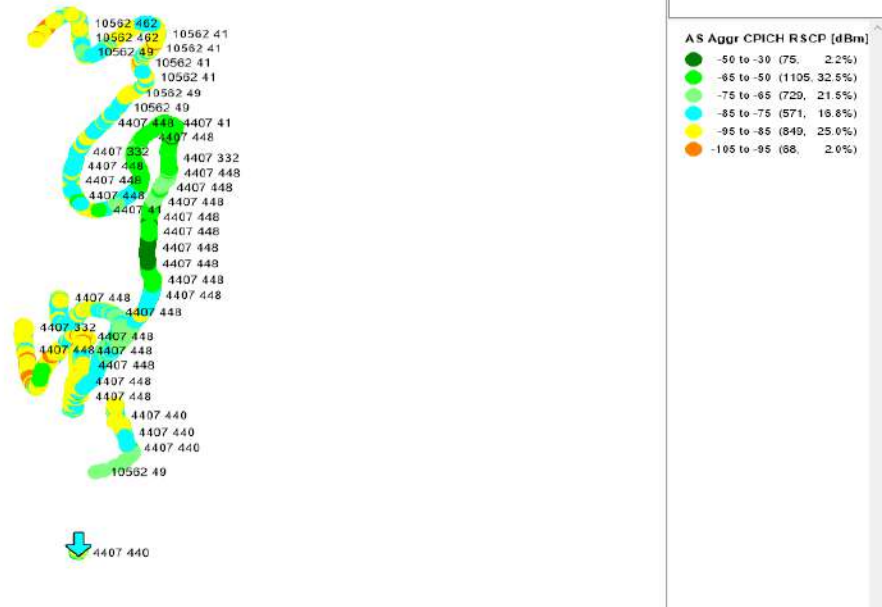


Figure number 17: 3G B-mobile (CPICH RSCP (dBm) plot)



Figure number 18: RSCP plot 3G B-mobile (google earth)

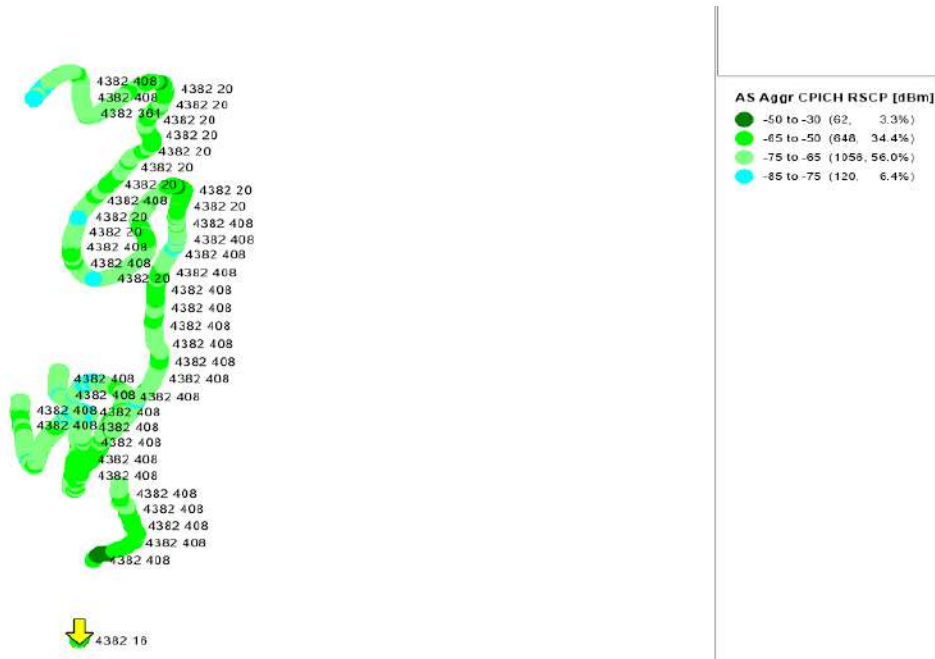


Figure number 19: 3G Tashi cell (CPICH RSCP (dBm) plot)

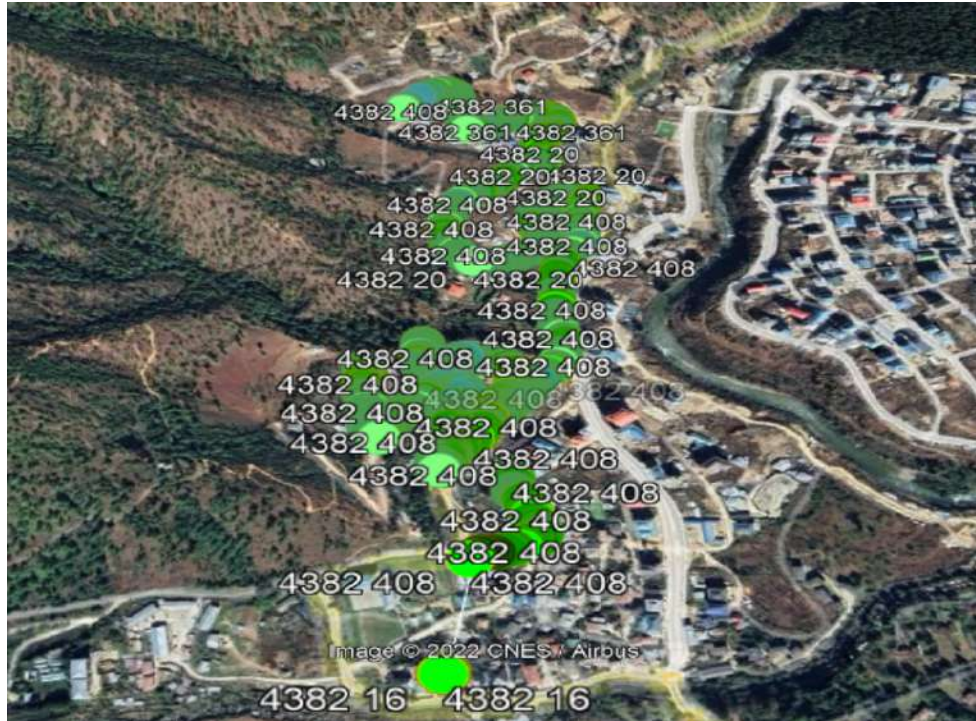


Figure number 20: RSCP plot 3G Tashi cell (Google earth)

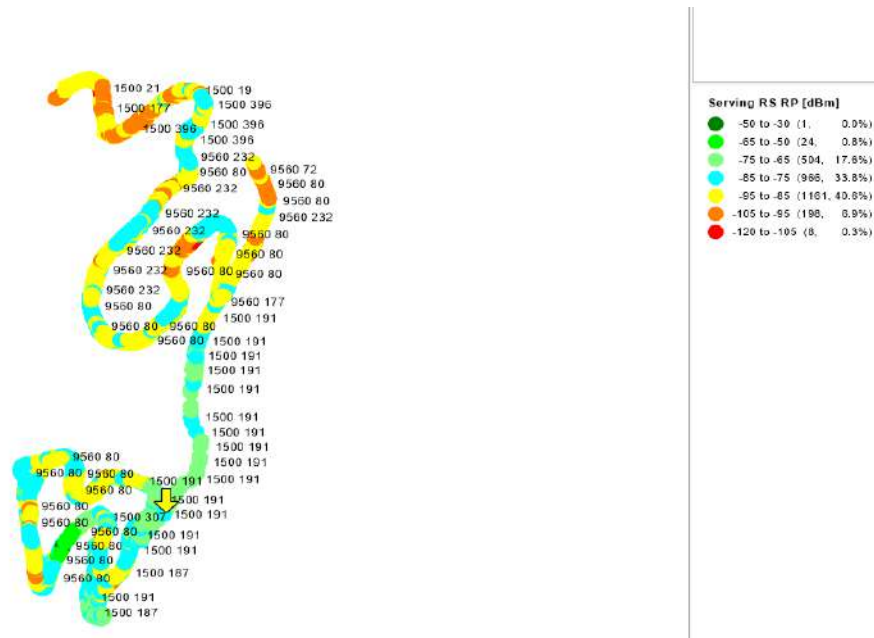


Figure number 21: 4G B-mobile (CPICH RSRP (dBm) plot)

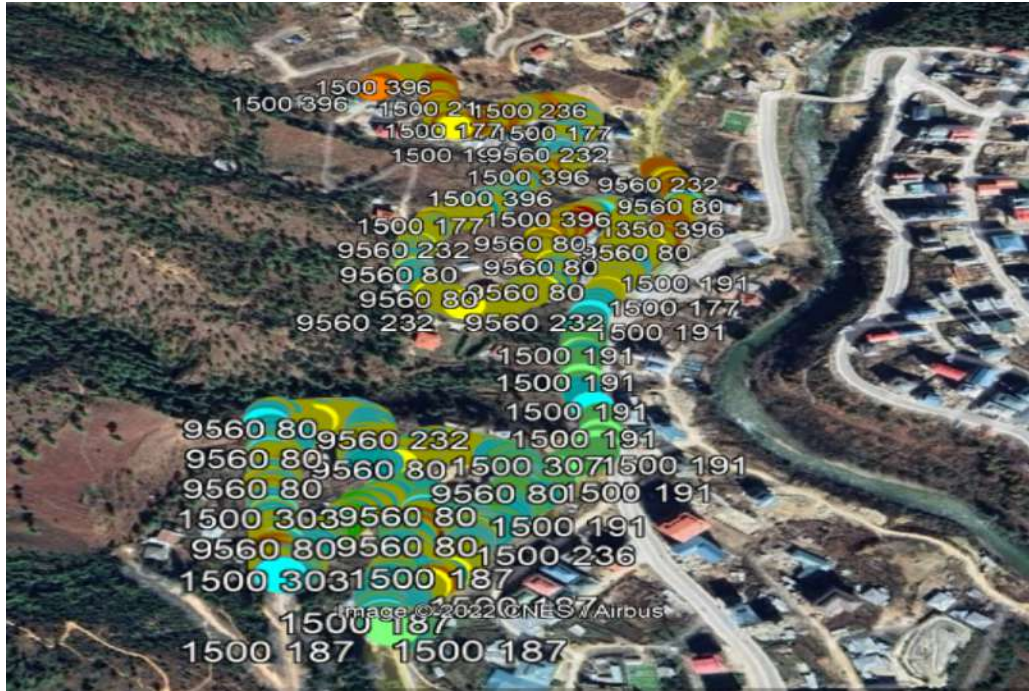


Figure number 22: RSRP plot 4G B-mobile (google earth)

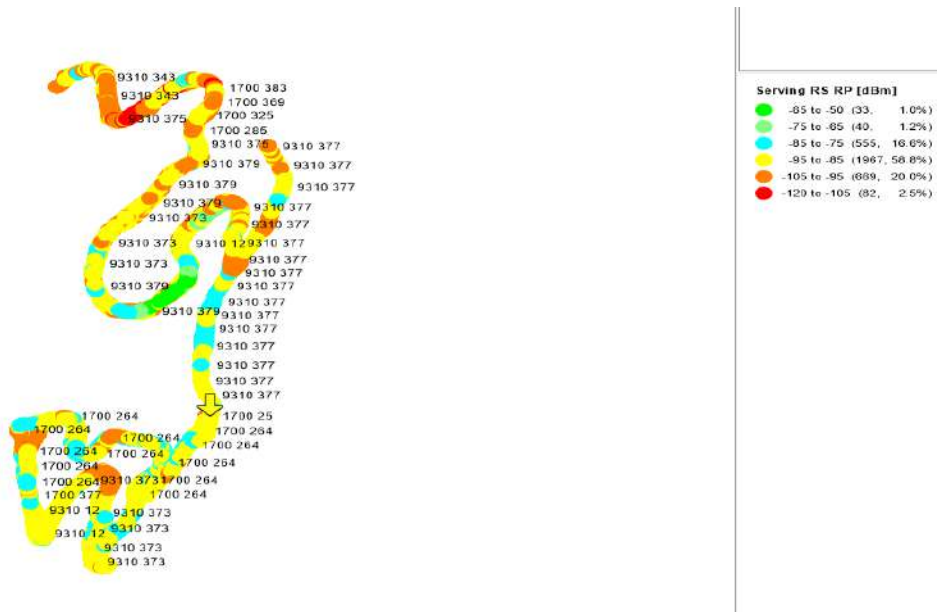


Figure number 23: 4G Tashi cell (CPICH RSRP (dBm) plot



Figure number 24: RSRP plot 4G Tashi cell (Google earth)

B. Phuentsholing

a. Ahlay (Chumeythangkha)

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.23	3.2
TICL	0	3.43	3.6

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥ 2Mbps)	Upload (≥ 1Mbps)
BTL	1.64	0.95
TICL	2.08	1.568

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5 Mbps)
BTL	7.7	5.81
TICL	6.6	7.79



Figure number 25: 3G B-mobile (CPICH RSCP (dBm) plot)

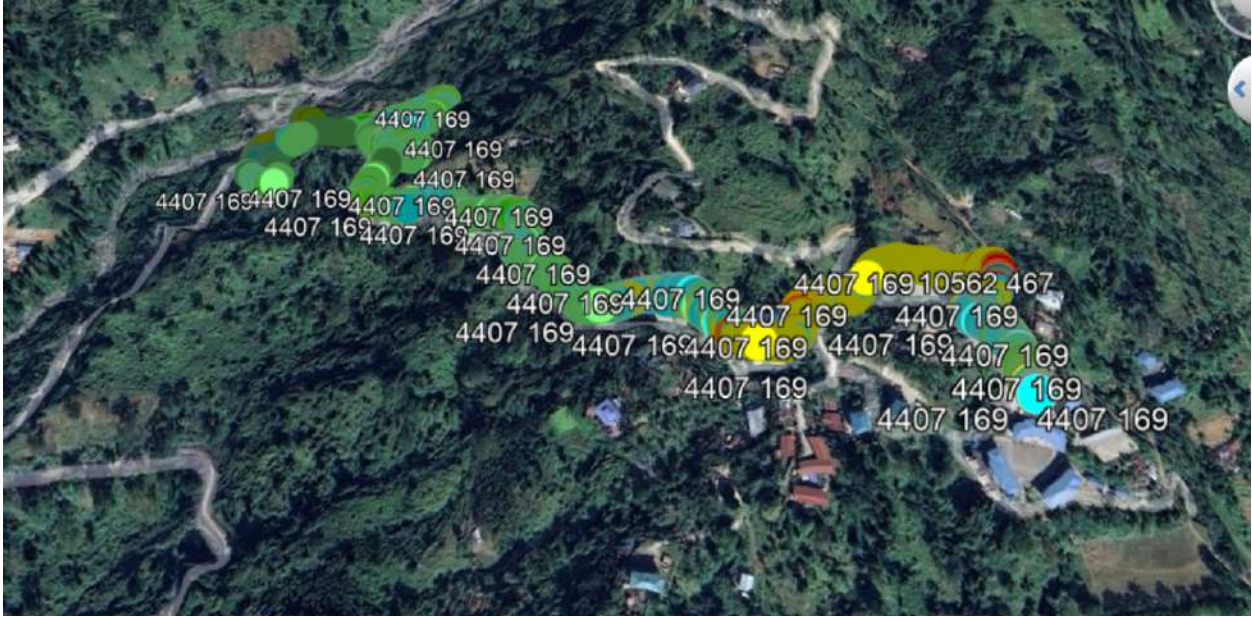


Figure number 26: RSCP plot 3G B-mobile (google earth)



Figure number 27: 3G Tashi cell (CPICH RSCP (dBm) plot)



Figure number 28: RSCP plot 3G Tashi cell (Google earth)

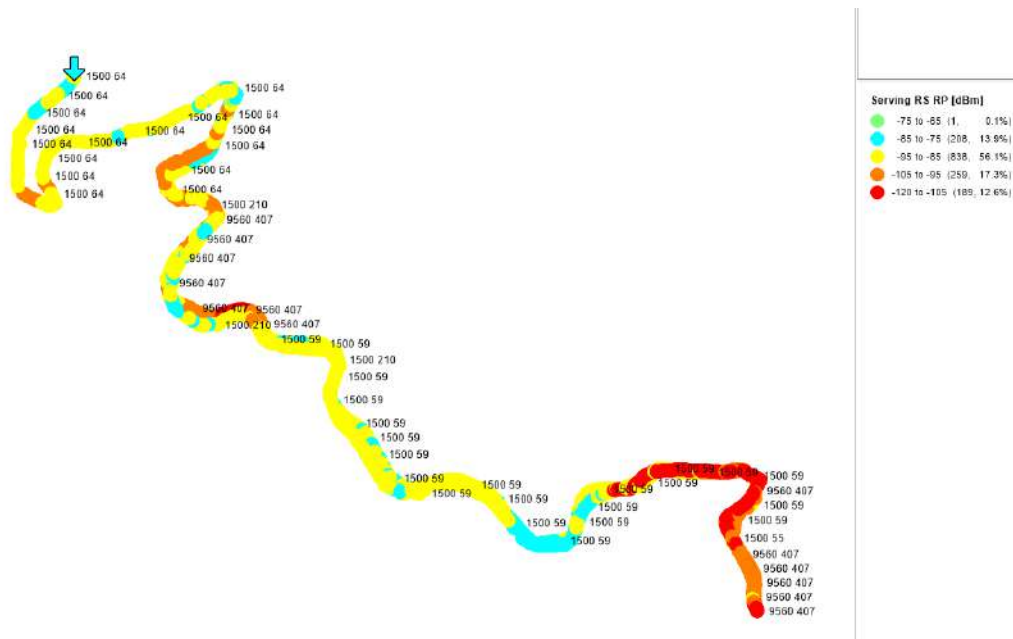


Figure number 29: 4G B-mobile (CPICH RSRP (dBm) plot)

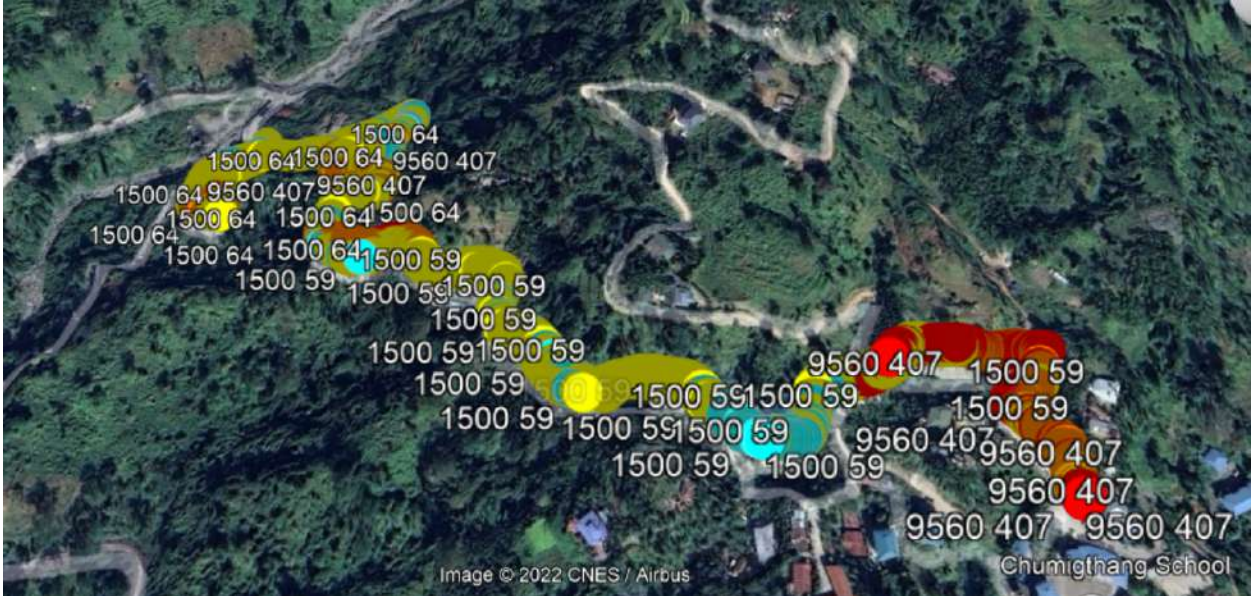


Figure number 30: RSRP plot 4G B-mobile (google earth)

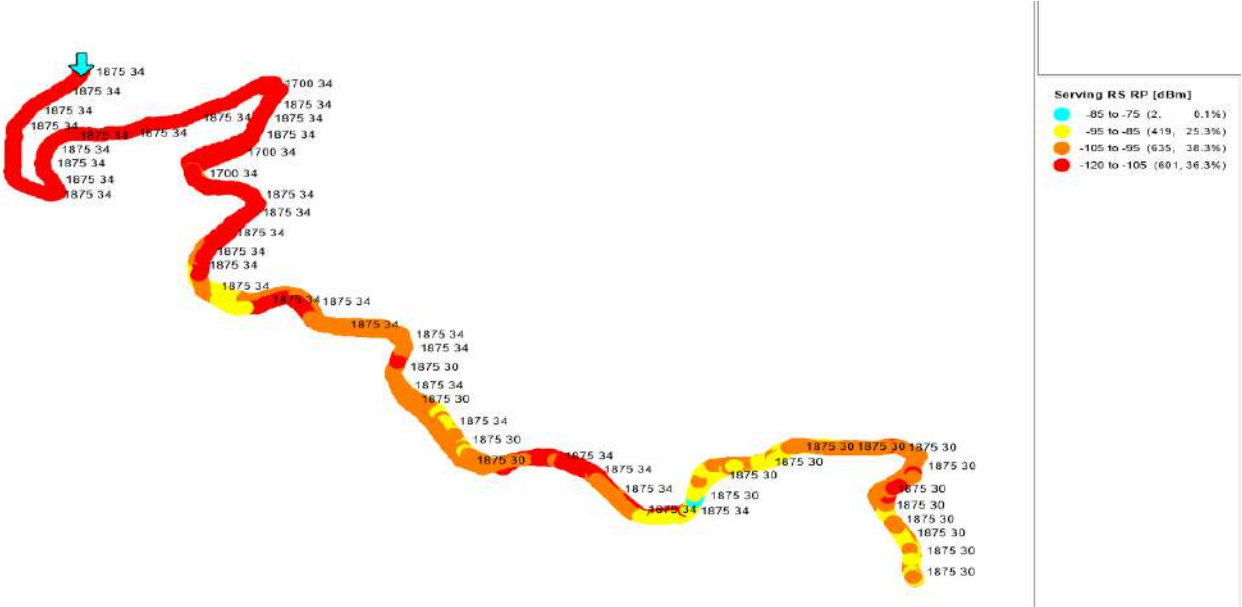


Figure number 7: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 8: RSRP plot 4G Tashi cell (Google earth)

b. Damdara

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.43	3.3
TICL	0	3.43	3.2

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥ 2Mbps)	Upload (≥ 1Mbps)
BTL	3.2	1.3
TICL	6.3	1.7

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5 Mbps)
BTL	6.1	20.3
TICL	11.54	20.9

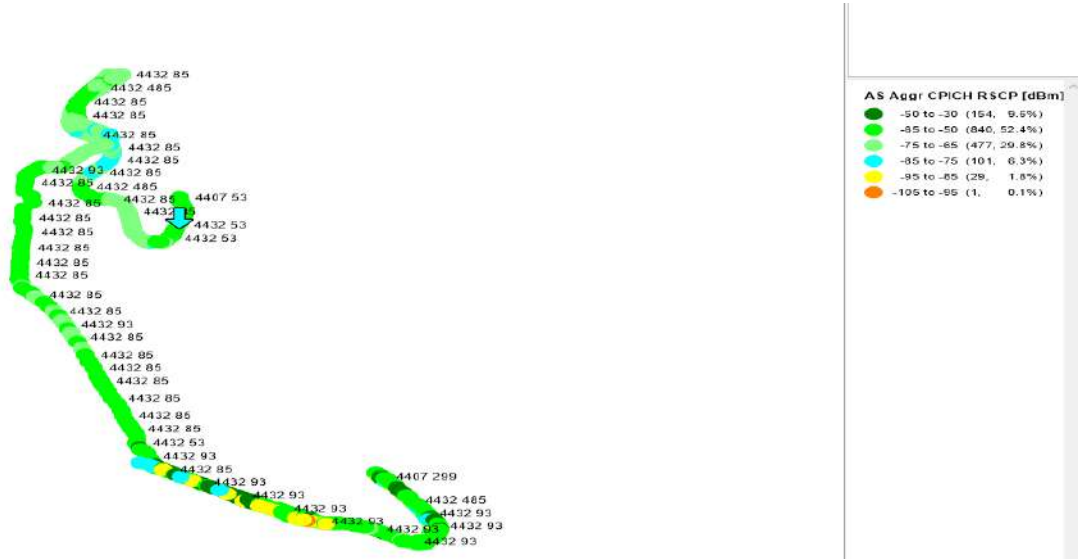


Figure number 9 3G B-mobile (CPICH RSCP (dBm) plot)

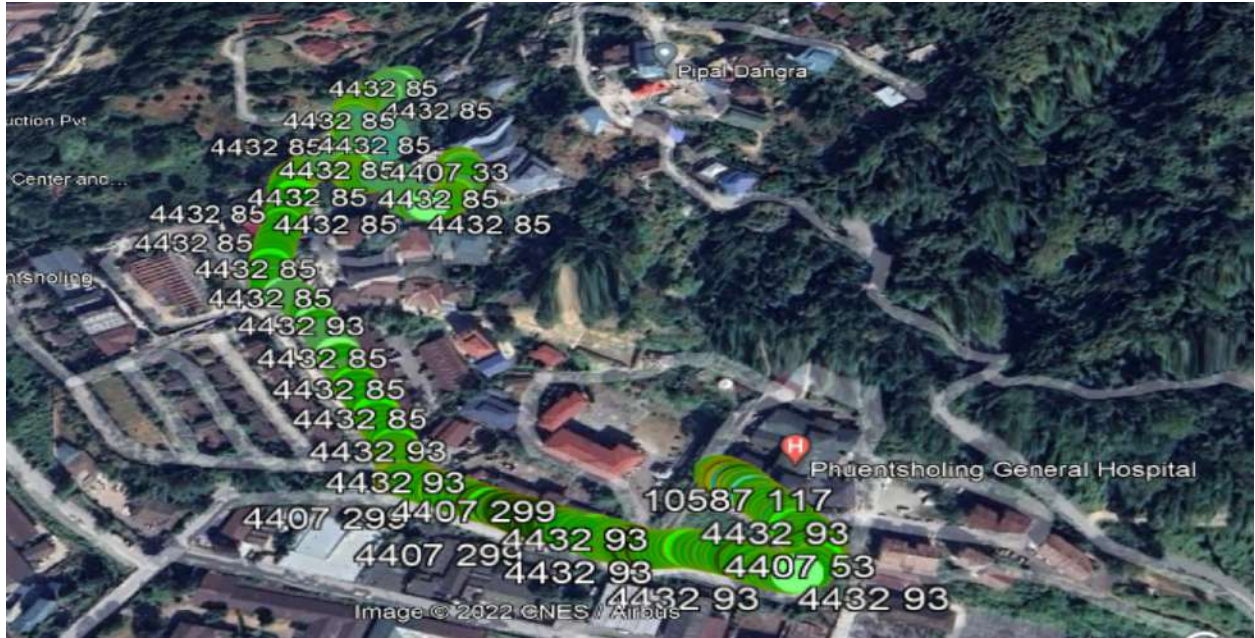


Figure number 10: RSCP plot 3G B-mobile (google earth)



Figure number 11: 3G Tashi cell (CPICH RSCP (dBm) plot)

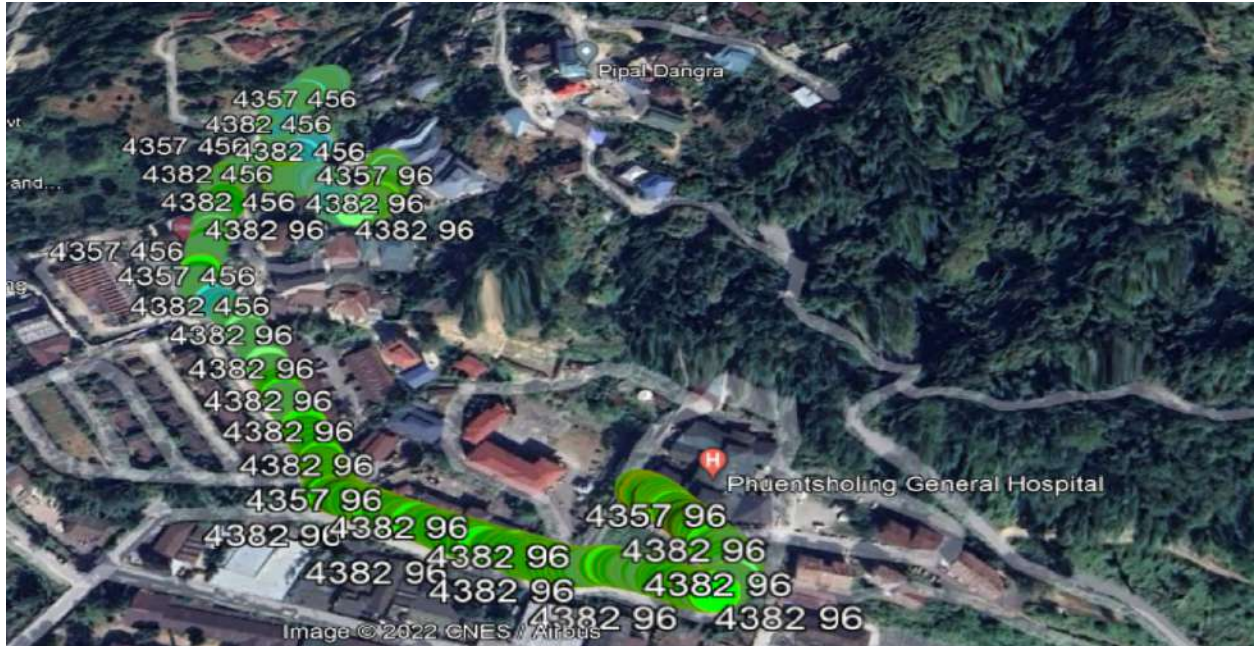


Figure number 12: RSCP plot 3G Tashi cell (Google earth)

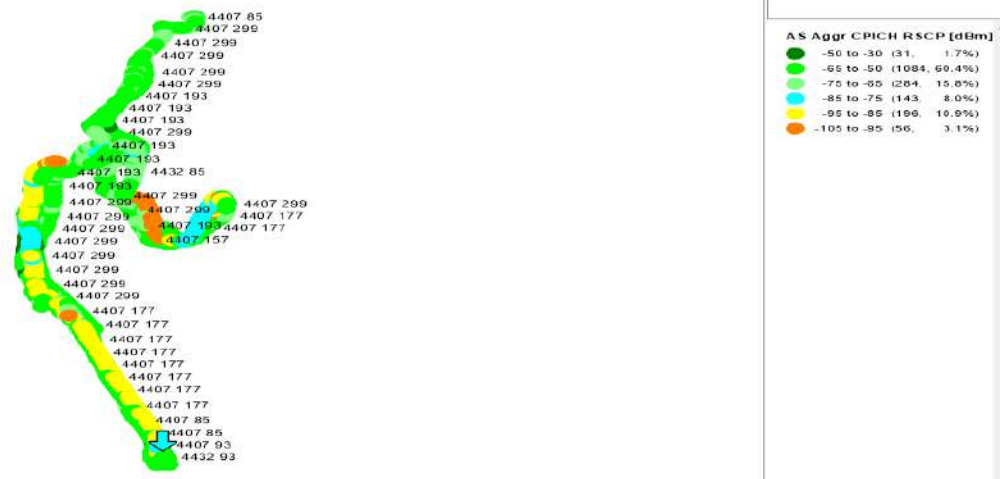


Figure number 13: 4G B-mobile (CPICH RSRP (dBm) plot)

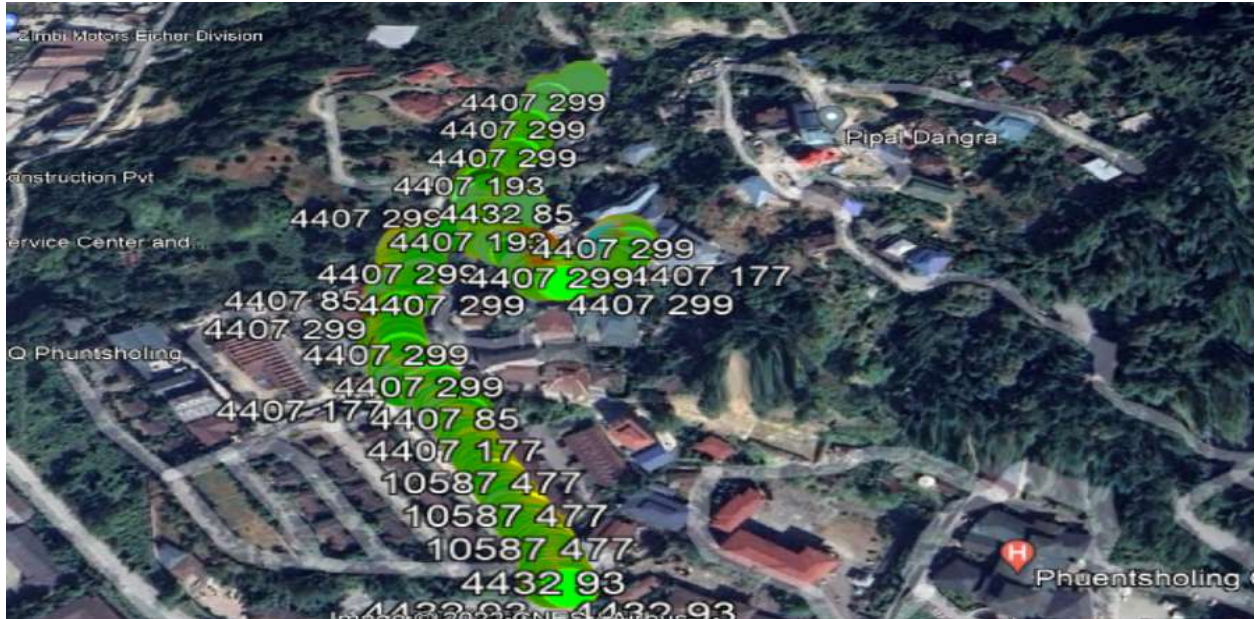


Figure number 14: RSRP plot 4G B-mobile (google earth)

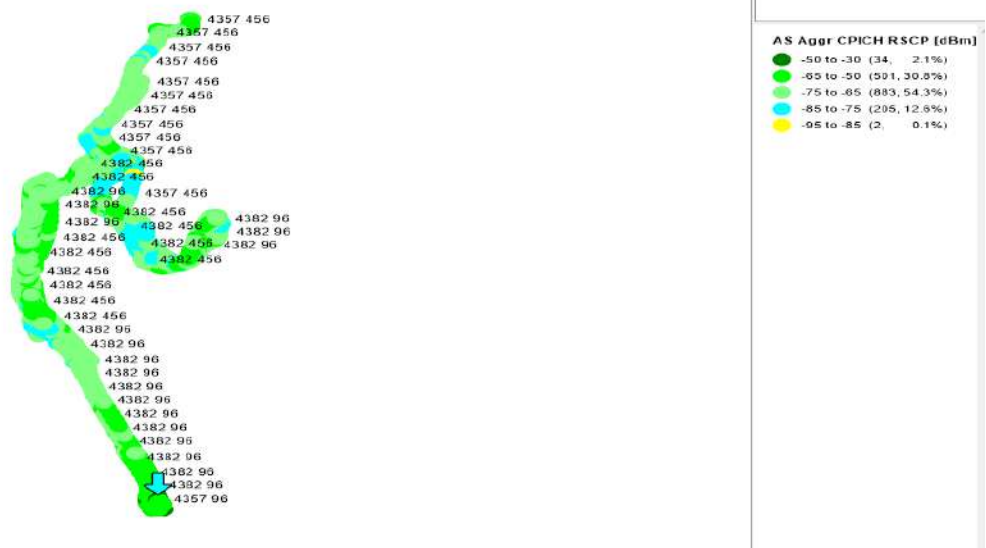


Figure number 15: 4G Tashi cell (CPICH RSRP (dBm) plot)

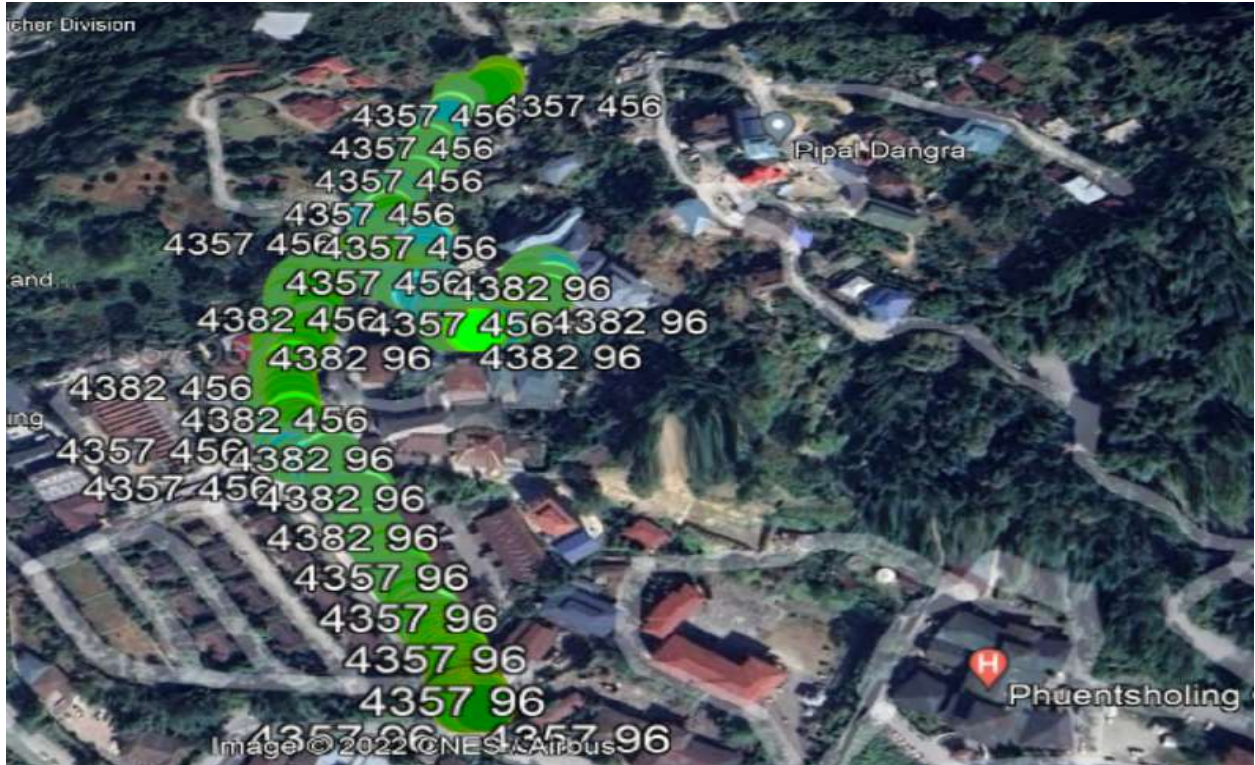


Figure number 16: RSRP plot 4G Tashi cell (Google earth)

c. Toorsa Residential Area

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.39	3.42
TICL	0	3.64	3.75

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥ 2Mbps)	Upload (≥ 1Mbps)
BTL	0.91	0.77
TICL	4.1	1.71

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5 Mbps)
BTL	10.4	11.15
TICL	12.5	23.59

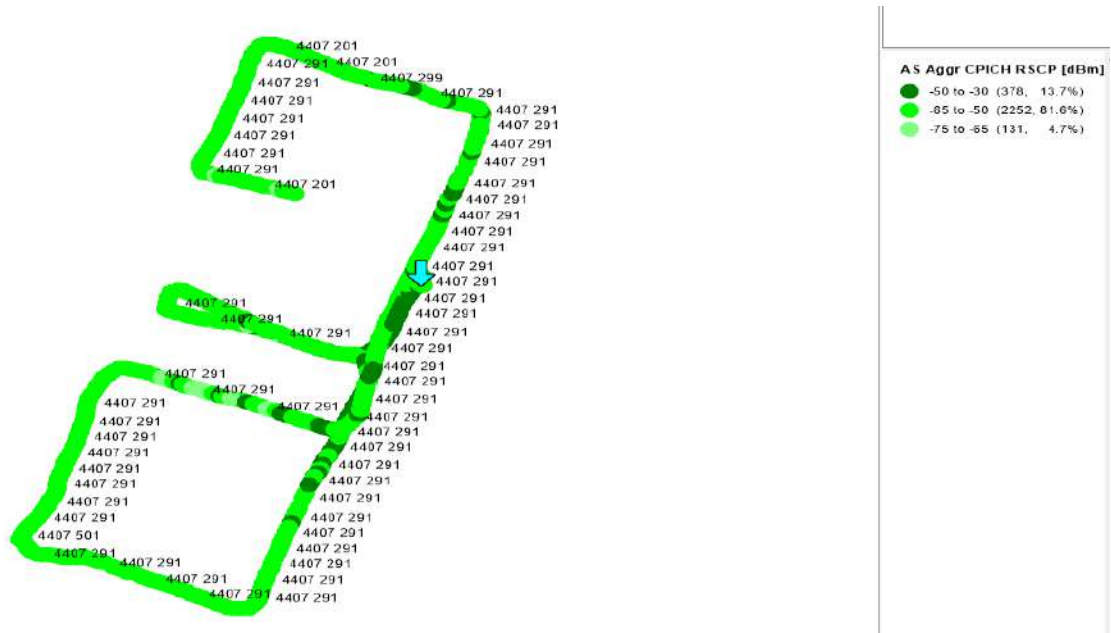


Figure number 17: 3G B-mobile (CPICH RSCP (dBm) plot)



Figure number 18: RSCP plot 3G B-mobile (google earth)

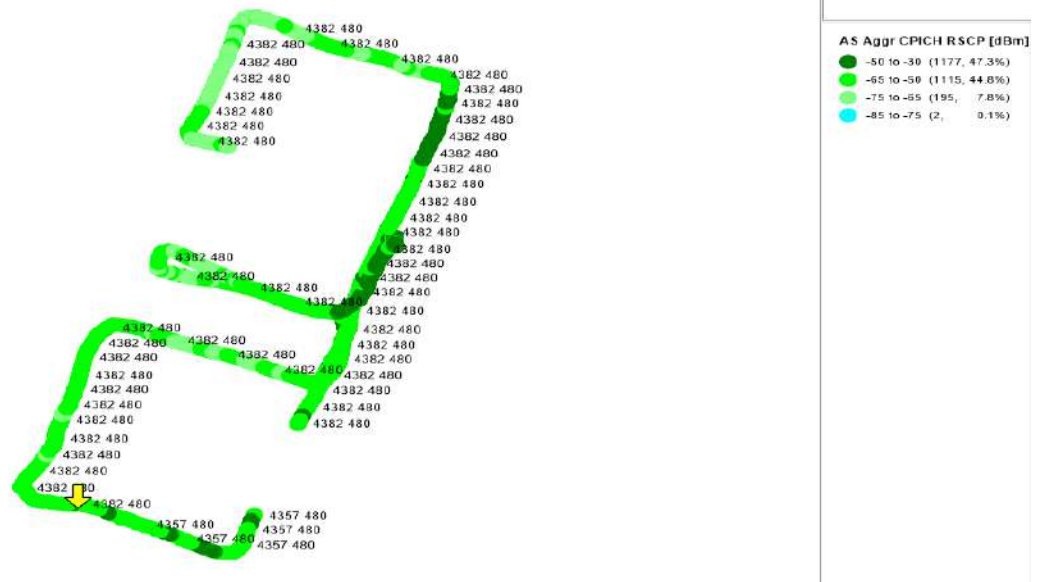


Figure number 19: 3G Tashi cell (CPICH RSCP (dBm) plot)

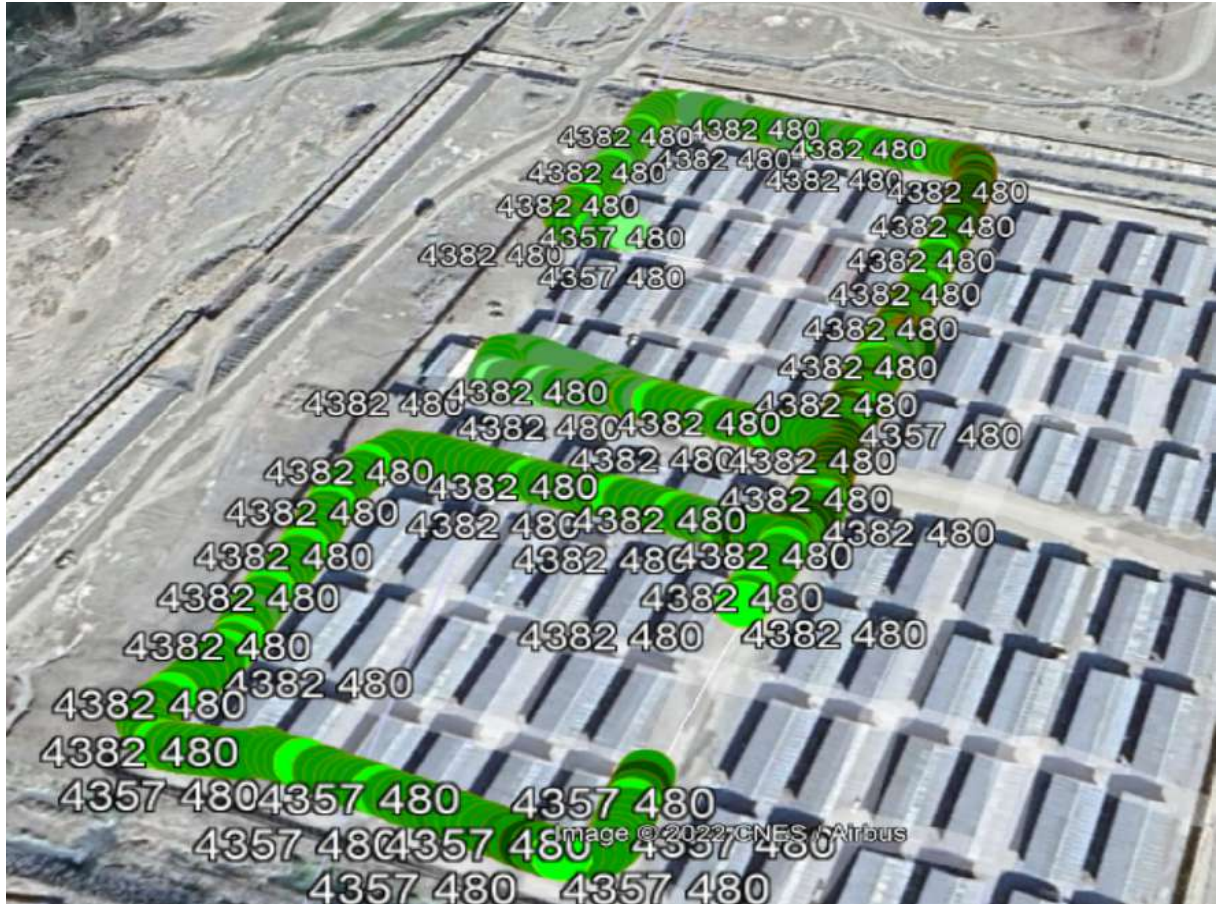


Figure number 20: RSCP plot 3G Tashi cell (Google earth)



Figure number 21: 4G B-mobile (CPICH RSRP (dBm) plot)



Figure number 22: RSRP plot 4G B-mobile (google earth)

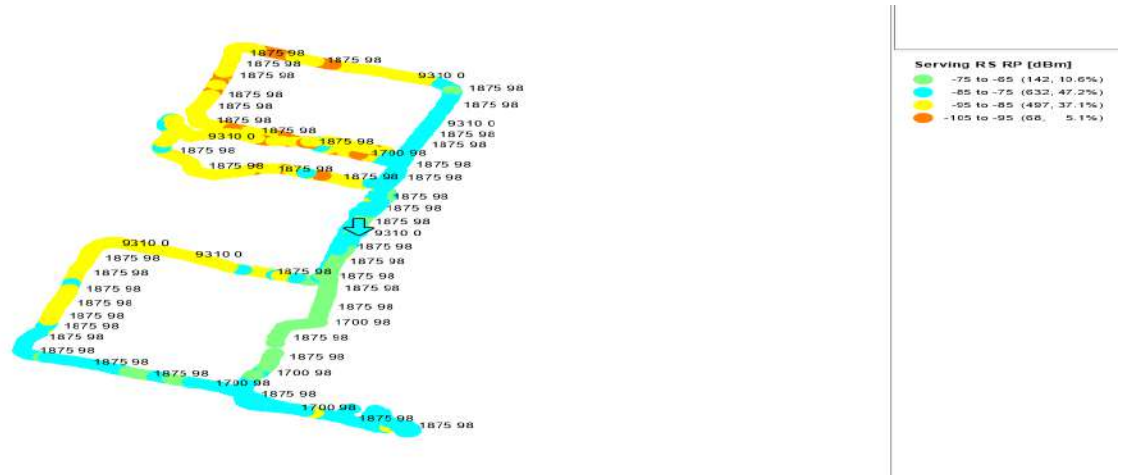


Figure number 23: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 24: RSRP plot 4G Tashi cell (Google earth)

d. Pasakha Industrial Area

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.36	3.1
TICL	0	3.43	4.29

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7Mbps)	Upload(≥ 5Mbps)
BTL	6.6	15.5
TICL	10.1	16.1

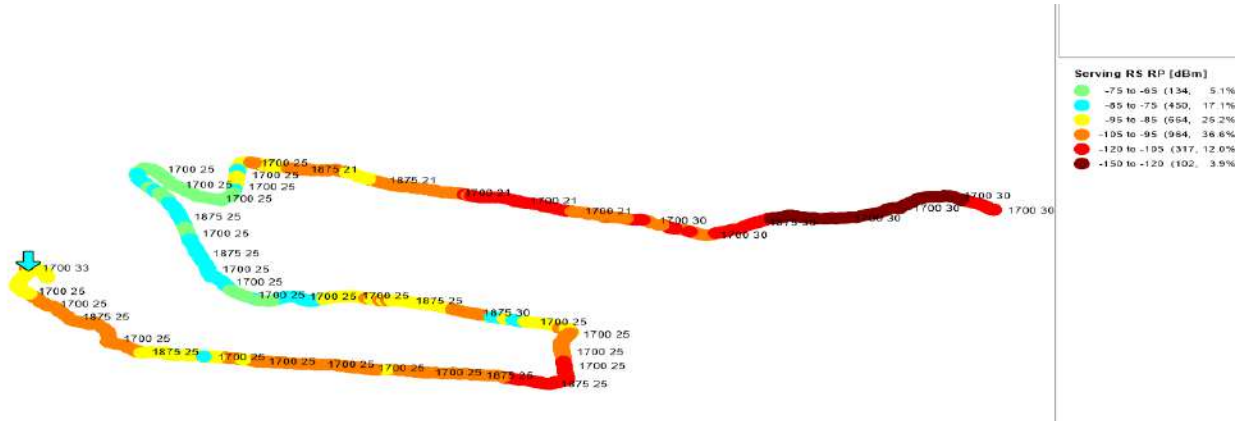


Figure number 27: 4G Tashi cell (CPICH RSRP (dBm) plot)

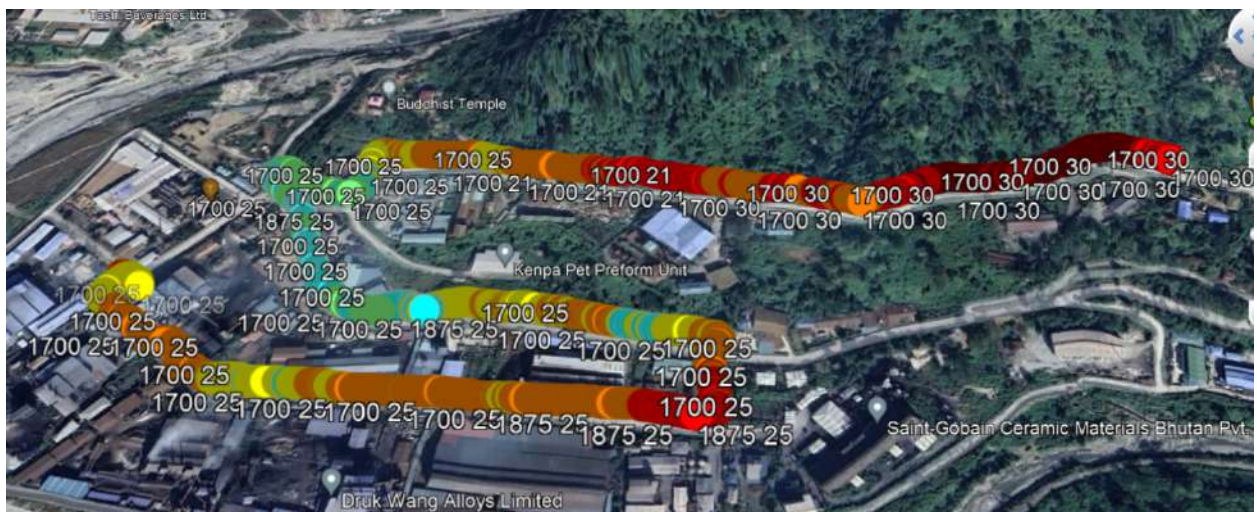


Figure number 28: RSRP plot 4G Tashi cell (Google earth)

e. Pemaling

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.39	3.6
TICL	0	3.51	3.7

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥ 2 Mbps)	Upload (≥ 1 Mbps)
BTL	1.7	1.5
TICL	4.2	1.7

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5 Mbps)
BTL	11.6	6.12
TICL	12.5	22.15



Figure number 29: 3G B-mobile (CPICH RSCP (dBm) plot)

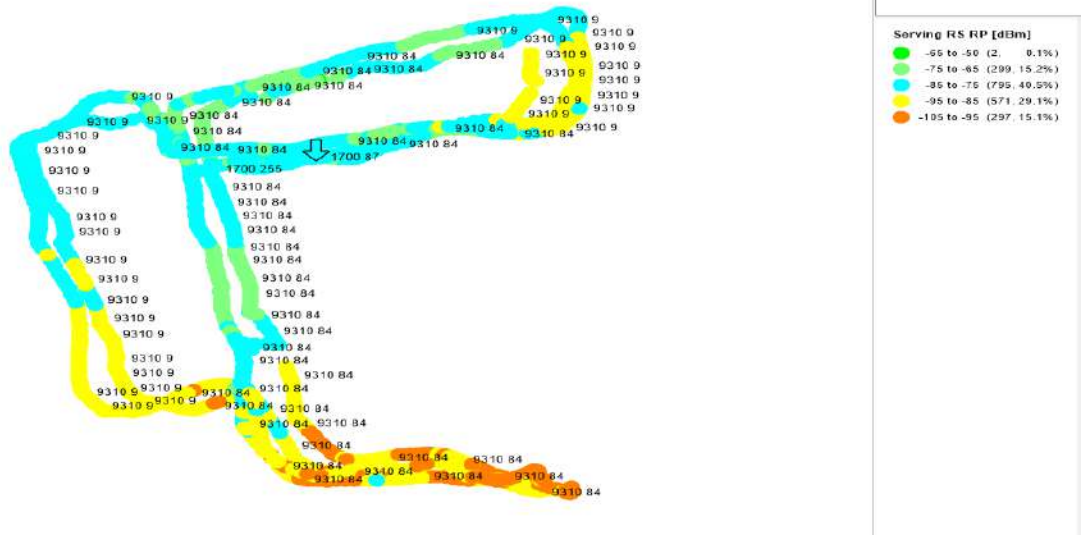


Figure number 32: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 33: RSRP plot 4G Tashi cell (Google earth)

f. Rinchending

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.47	3.56
TICL	0	3.47	5.45

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥ 2 Mbps)	Upload (≥ 1 Mbps)
BTL	2.05	0.8
TICL	5.17	1.66

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5 Mbps)
BTL	6.44	6.09
TICL	7.46	19.67

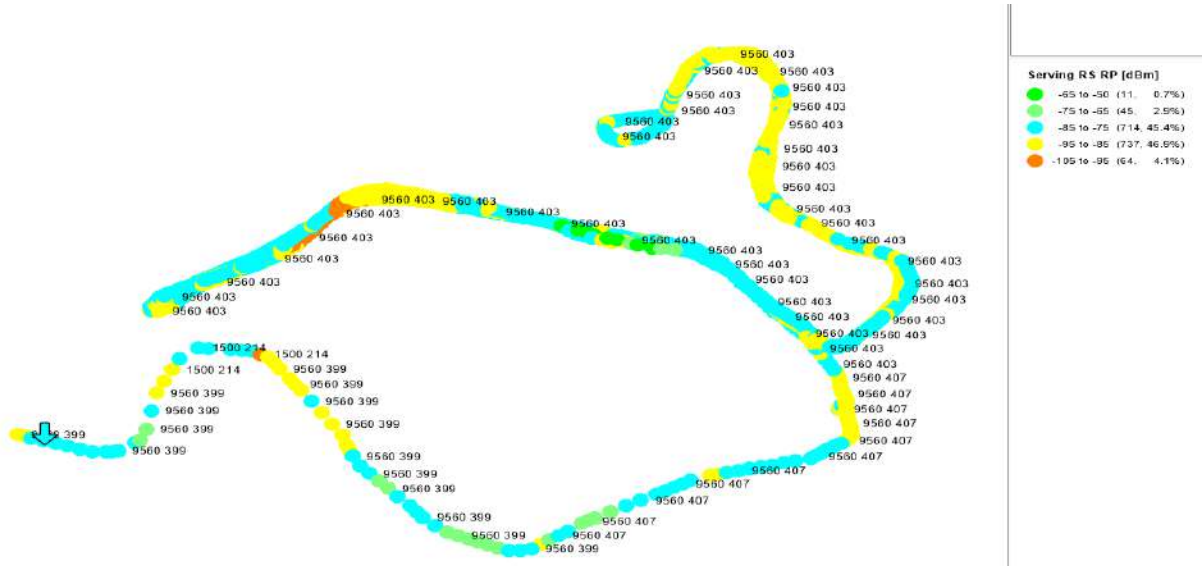


Figure number 38: 4G B-mobile (CPICH RSRP (dBm) plot)

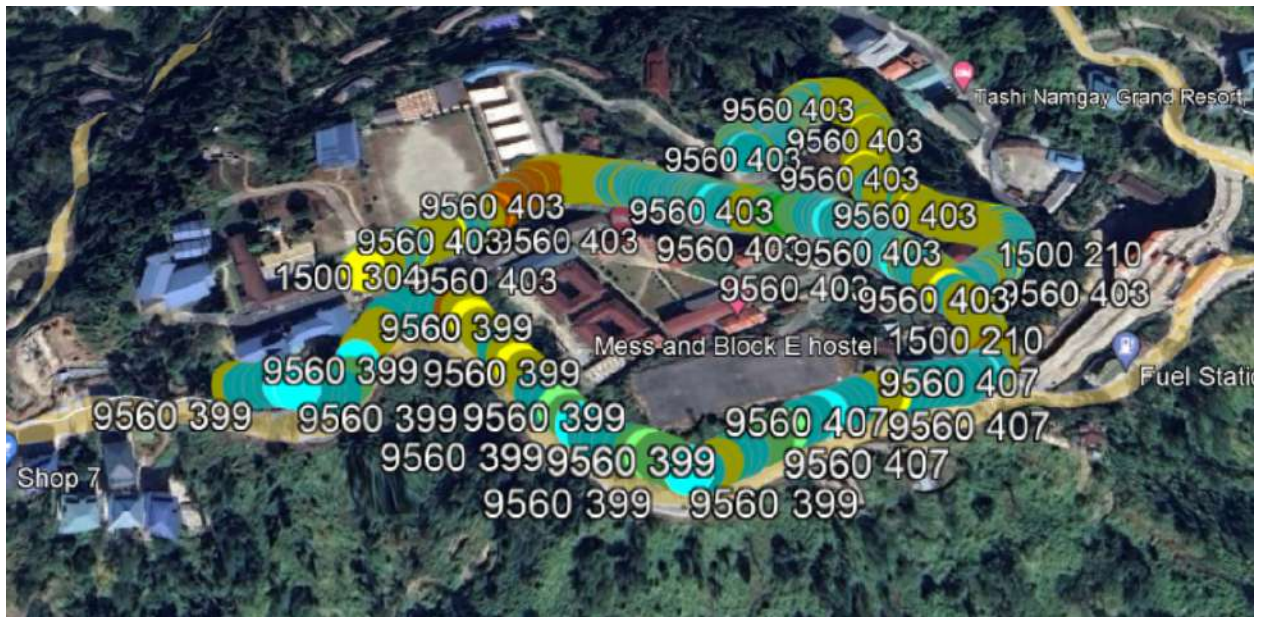


Figure number 39: RSRP plot 4G B-mobile (google earth)

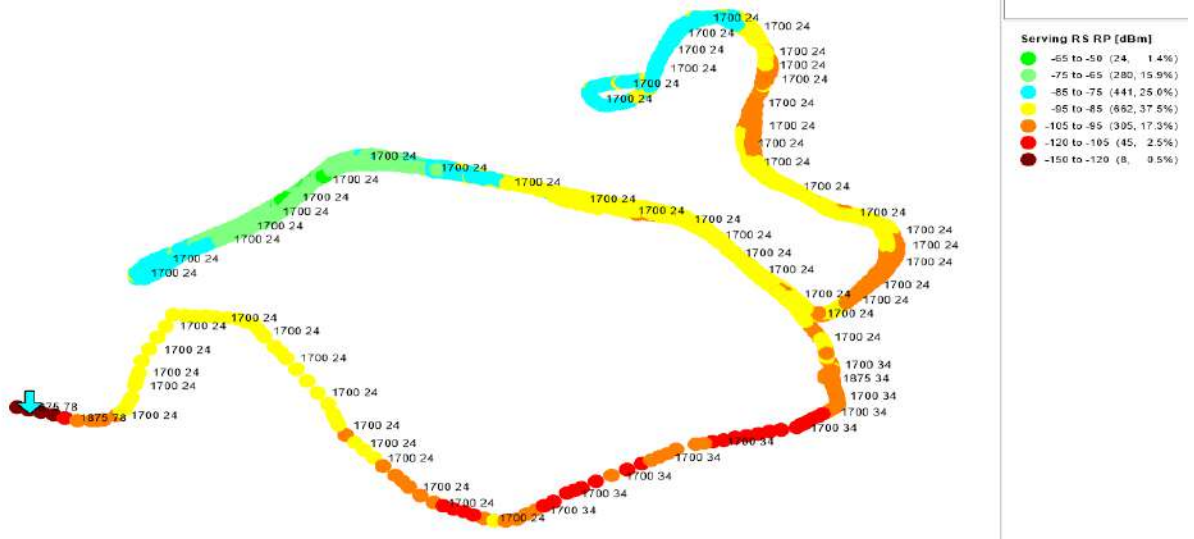


Figure number 40: 4G Tashi cell (CPICH RSRP (dBm)) plot



Figure number 41: RSRP plot 4G Tashi cell (Google earth)

g. Phuntsholing Core Area

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.37	3.3
TICL	0	3.15	3.7

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download (≥2Mbps)	Upload (≥1Mbps)
BTL	—	0.8
TICL	1.73	1.63

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥7 Mbps)	Upload (≥5 Mbps)
BTL	5.3	27.0
TICL	5.11	17.8

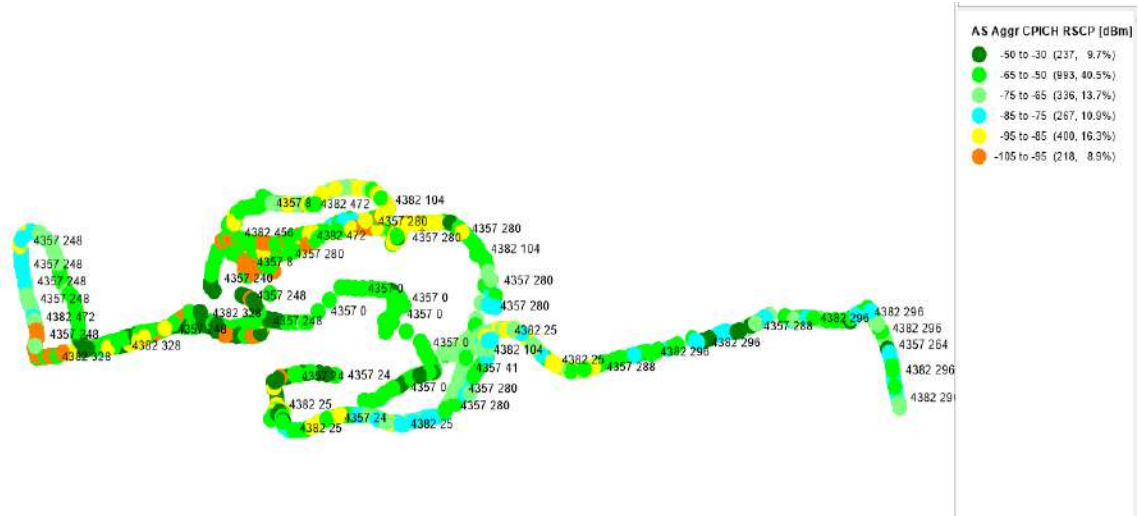


Figure number 44: 3G Tashi cell (CPICH RSCP (dBm) plot)



Figure number 45: RSCP plot 3G Tashi cell (Google earth)

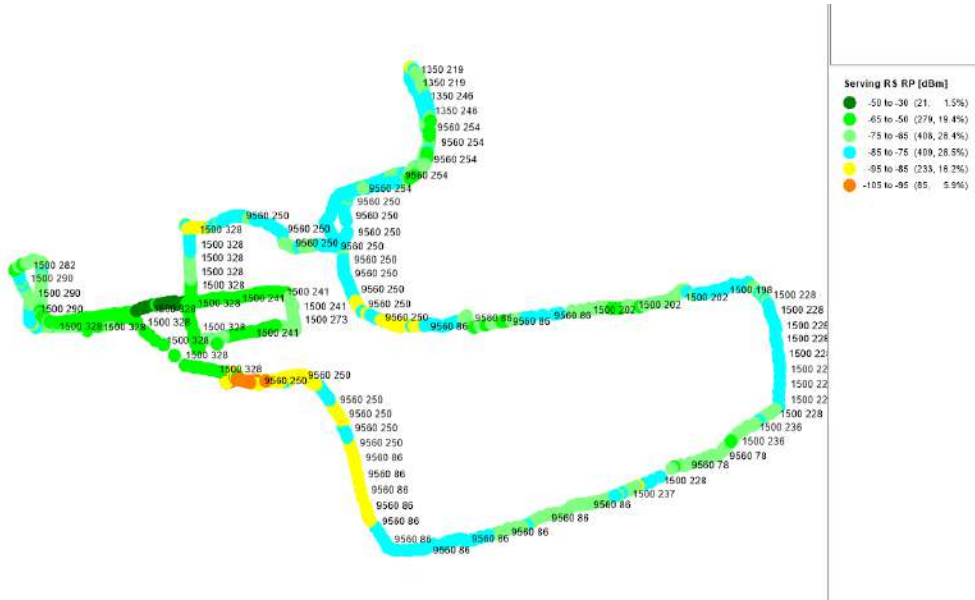


Figure number 46: 4G B-mobile (CPICH RSRP (dBm) plot)

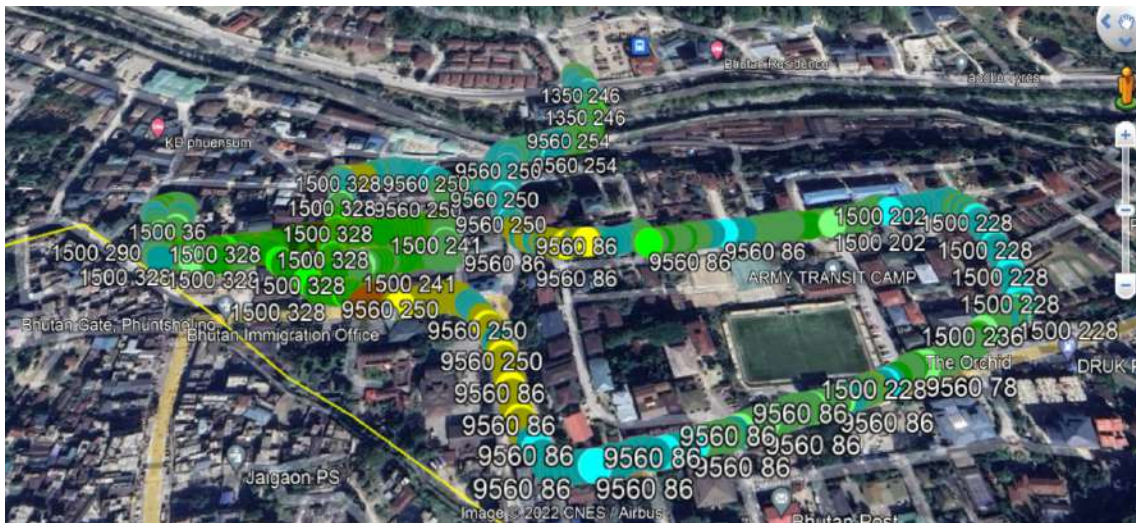


Figure number 47: RSRP plot 4G B-mobile (google earth)

C. Samste

a. Samtse Town

Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Setup Time (<= 7 Seconds)
BTL	0	3.39	3.5
TICL	0	3.2	5.6

Data Throughputs (Mbps) (3G)

Operators	File Transfer Protocol	
	Download(≥ 2 Mbps)	Upload (≥ 1 Mbps)
BTL	1.84	1.5
TICL	3.27	0.92

Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol	
	Download (≥ 7 Mbps)	Upload (≥ 5 Mbps)
BTL	6.7	37.1
TICL	57.7	6.53

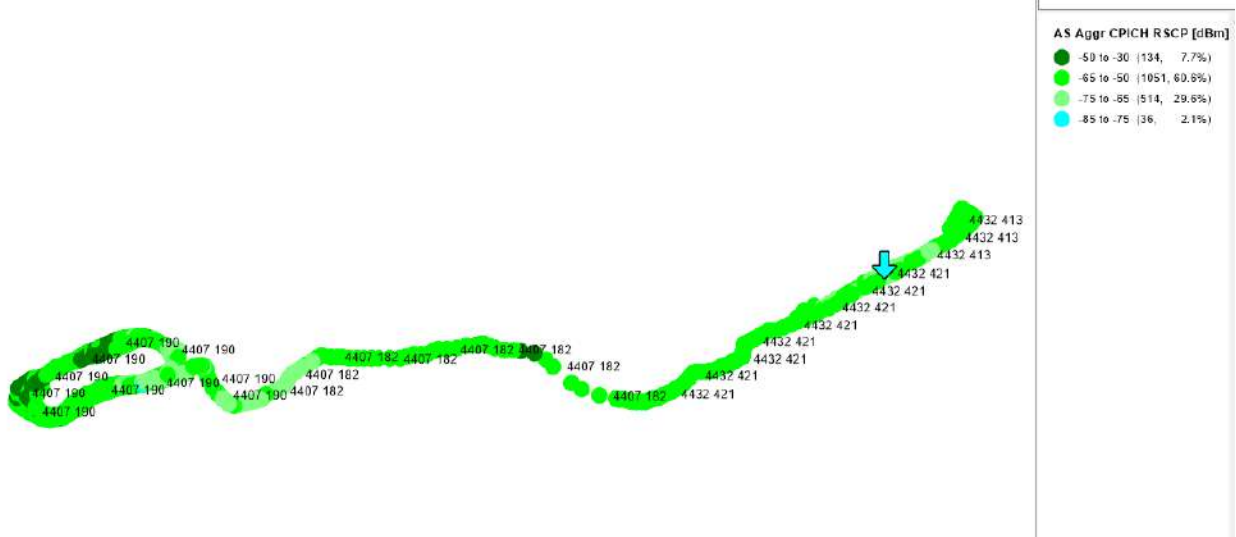


Figure number 50: 3G B-mobile (CPICH RSCP (dBm) plot)



Figure number 51: RSCP plot 3G B-mobile (google earth)



Figure number 52: 3G Tashi cell (CPICH RSCP (dBm) plot)

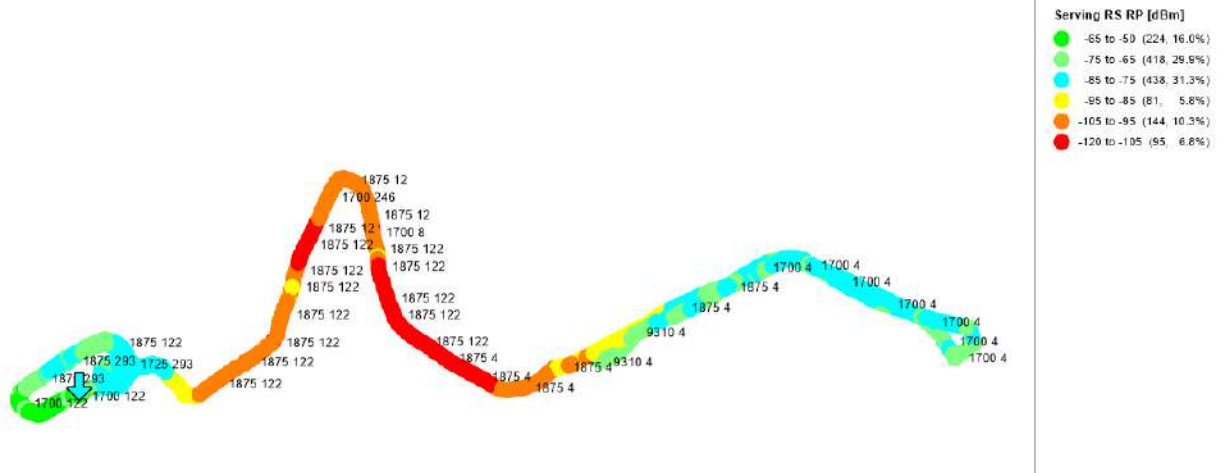


Figure number 56: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 57: RSRP plot 4G Tashi cell (Google earth)

4. Analysis

- a. The QoS monitoring/physical drive test in Olakha area in Thimphu was done upon a complaint received from the public/user. It was also found that during the off-peak hours, the quality of service (4G data) of BTL meets the required benchmark, however, the QoS during the peak hours was below the benchmark for both indoor and outdoor.
- b. Call setup time for all the monitored places of Thimphu (Changzamtog, Olakha and Pamtsho) are below the standards for both the operators.
- c. The quality of data services (3G throughputs) is below the standards in Toorsa residential area, Chumethangkha, Pemaling, Phuntsholing core, Rinchending and Samtse core areas for both the operators.
- d. The quality of data services (4G throughputs) is below the standards in Ahlay and Phuentsholing core for TICL and Damdara, Pasakha, Rinchending Toorsa residential area, Chumethangkha, Pemaling, Phuntsholing core, Rinchending and Samtse core areas for BTL.
- e. The quality of mobile voice service is up to the standards in all the areas of Phuentsholing and Samtse for both the operators.
- f. Meanwhile, wherever the 3G sites are co-located with the 4G sites, the QoS issues of 3G are taken care of by the presence of 4G services.

5. Follow up Actions Taken by the Authority

- a. Based on the monitoring report/physical drive test in Olakha area, the Authority has informed BTL to improve the QoS in that area of complaint since the result obtained shows that the data speed (4G) is below the benchmark during the peak hours. Accordingly BTL has shared the rectification/upgradation plan which includes deployment of 2 LTE TDD nodes on the Changzhongchu tower before the end of July 2022. The Authority will be following up accordingly.
- b. Based on the Quality of Service issues report findings in Samtse and Phuentsholing Thromde, both the operators were notified on the issue and directed to submit the OSS reports of each BTS in Phuentsholing Thromde and Samtse town.
- c. Both the operators submitted the OSS reports of Phuentsholing Thromde and Samtse town from which it is found that the Quality of Service has improved in most of the areas in both

the Thromdes except SAMKHA_LTE-41 BTS at Khandrothang for TICL and PHUTOOL BTS at Phuentsholing for BTL. The Authority will further require both the operators to submit the OSS report of June and July 2022.

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 $\geq 1.5\text{Mbps}$
 - B. For 4G, the benchmark is $\geq 6\text{Mbps}$
- 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 (HTTP):** 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.
 - A. 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:

- B. 5: Excellent
- C. 4: Good
- D. 3: Fair
- E. 2: Poor
- F. 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. **RSCP:** received signal code power denotes the power measured by a receiver on a particular physical communication channel.

Range (dBm)	Signal Strength Indication
-60 to 0	Very good
-75 to -60	Good
-75 to -85	Fair
-85 to -95	Poor
-124 tp -95	Very Poor

- XV. **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.

RF connectivity	RSRP (dBm)
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Excellent	≥ -80
Good	-80 to -90
Medium	-90 to -100