

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 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 Thromde, Dagana, Gasa and Punakha Dzongkhags.

2. Locations and date of monitoring

Sl. No	Dzongkhag	Locations	Monitoring month
1	Thimphu	Babesa	January 2022
2		Changjiji	
3		Olakha	
4		Taba	
5		Langjophakha	
6		Changzamtog	
7		Changi Daphu	
8		Town	
9	Gasa	Gasa town	

10	Dagana	Dagana	
11	Punakha	Khuruthang town	

3. Findings

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

A. Thimphu

a. Thimphu (Babesa)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Off peak Hours)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	3.1	14.6	2.4	8.9
TICL	1.7	0.9	0.9	1.3



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

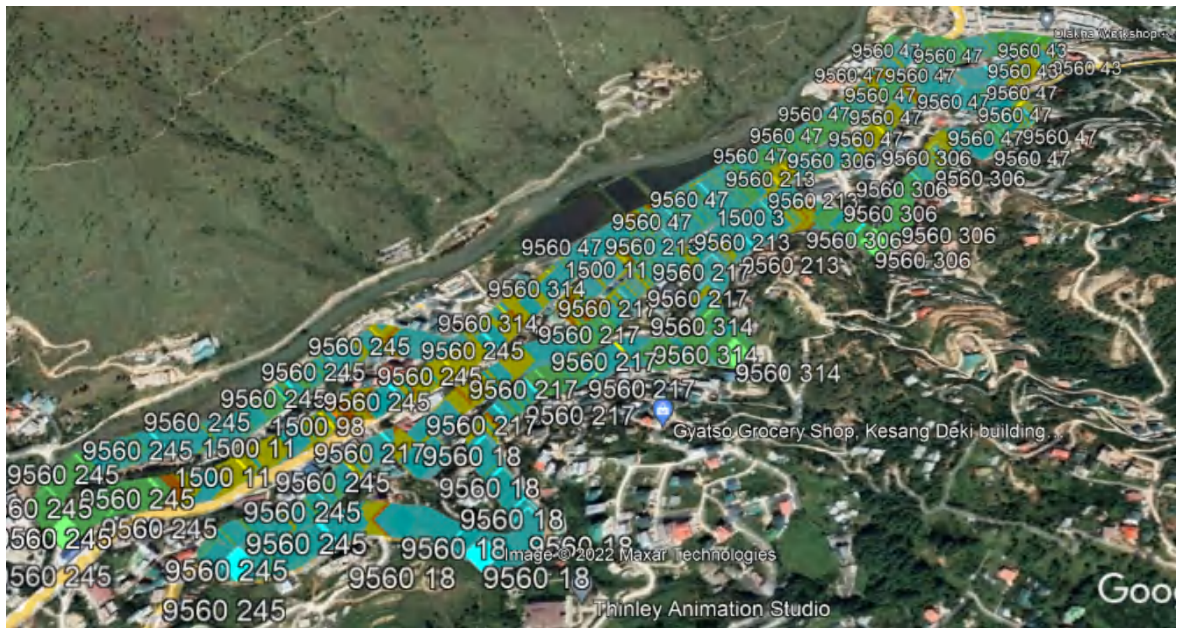


Figure number 2: RSRP plot 4G B-mobile (google earth)

Data Throughputs (Mbps) (Peak Hours)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	1.3	7.99	1.19	6.6
TICL	0.66	1.2	0.31	4.5

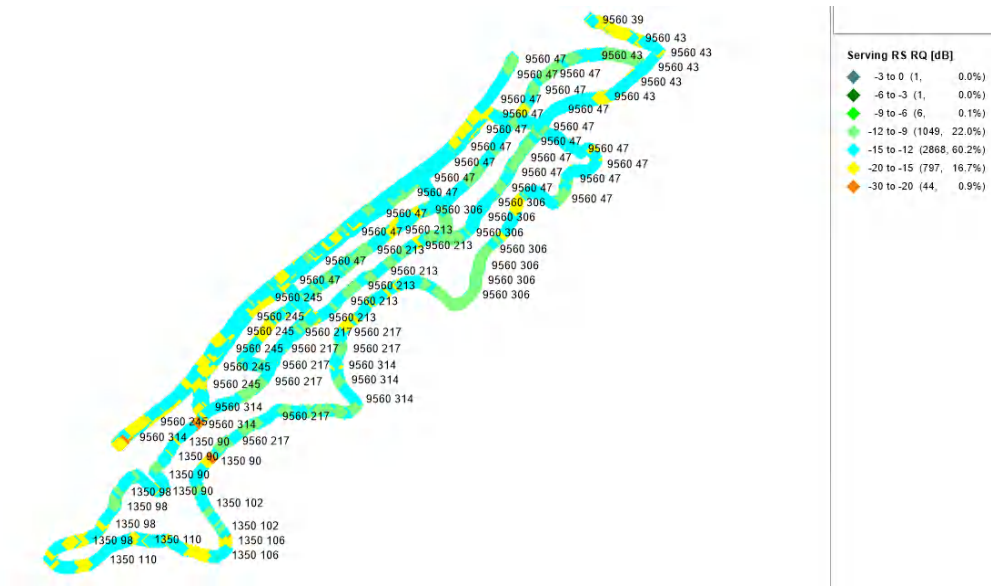


Figure number 5: 4G B-Mobile (CPICH RSRP (dBm) plot)

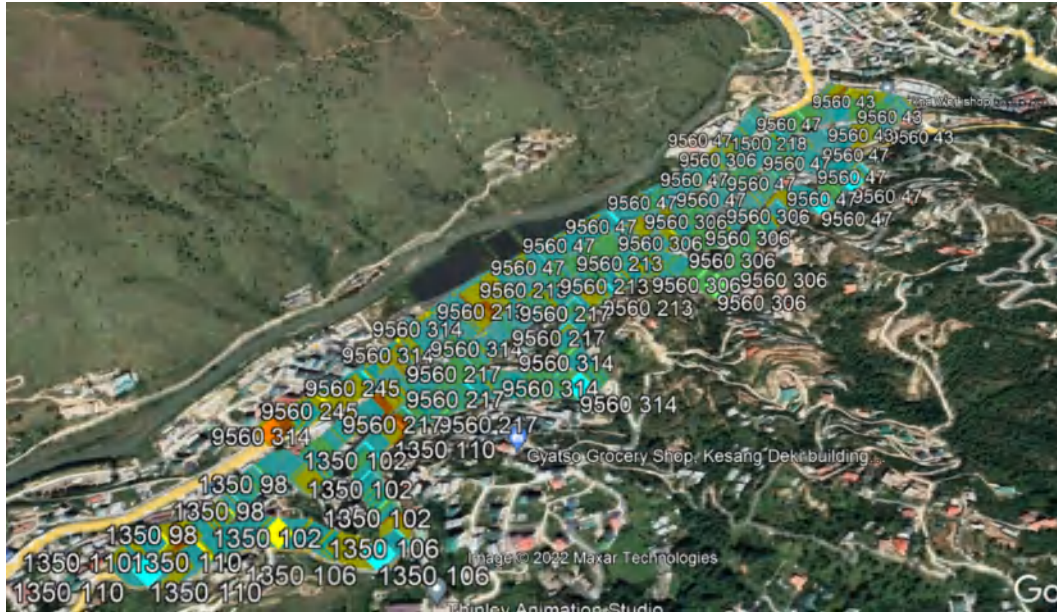


Figure number 6: RSRP plot 4G B-mobile (google earth)



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

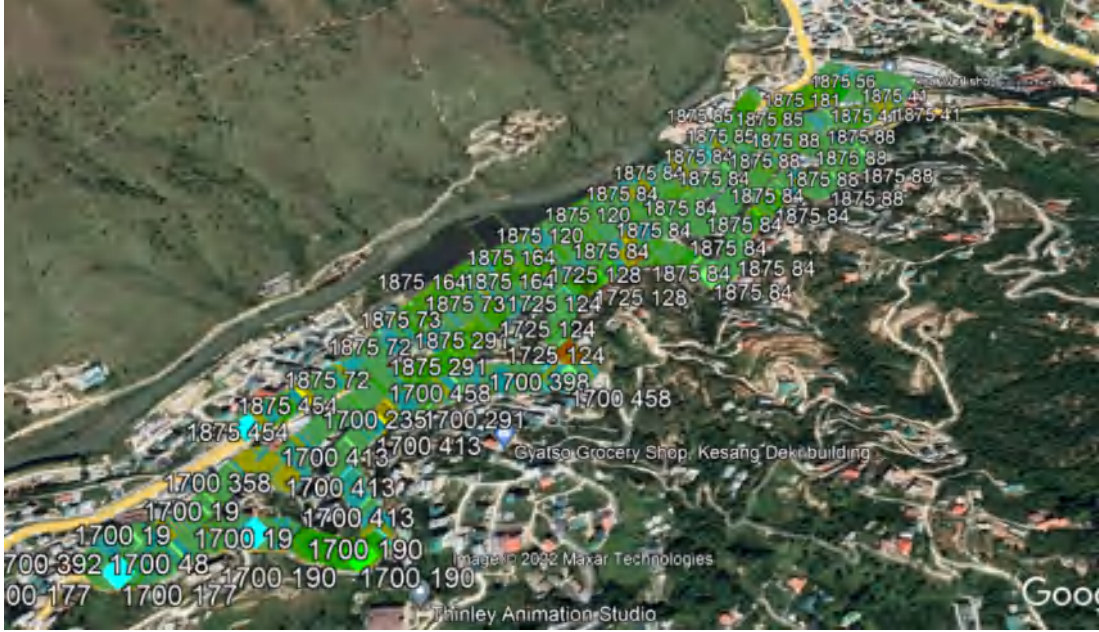


Figure number 8: RSRP plot 4G Tashi cell (Google earth)

b. Thimphu (Changji)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Off peak Hours)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	1.5	7.4	1.2	2.97
TICL	10.6	22	10.5	10.12

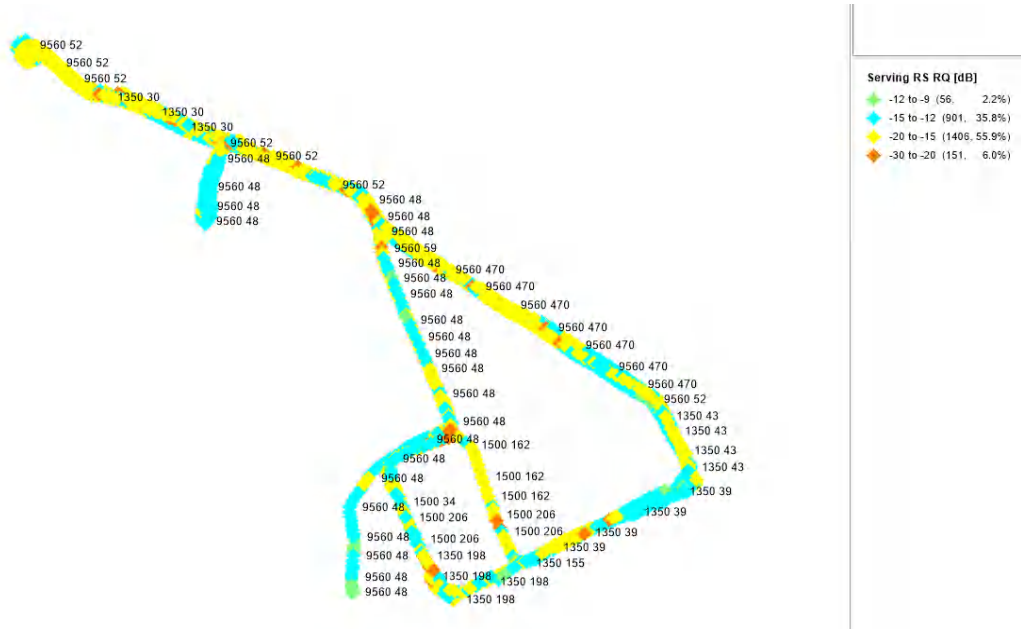


Figure number 9: 4G B-mobile (CPICH RSRP (dBm) plot)

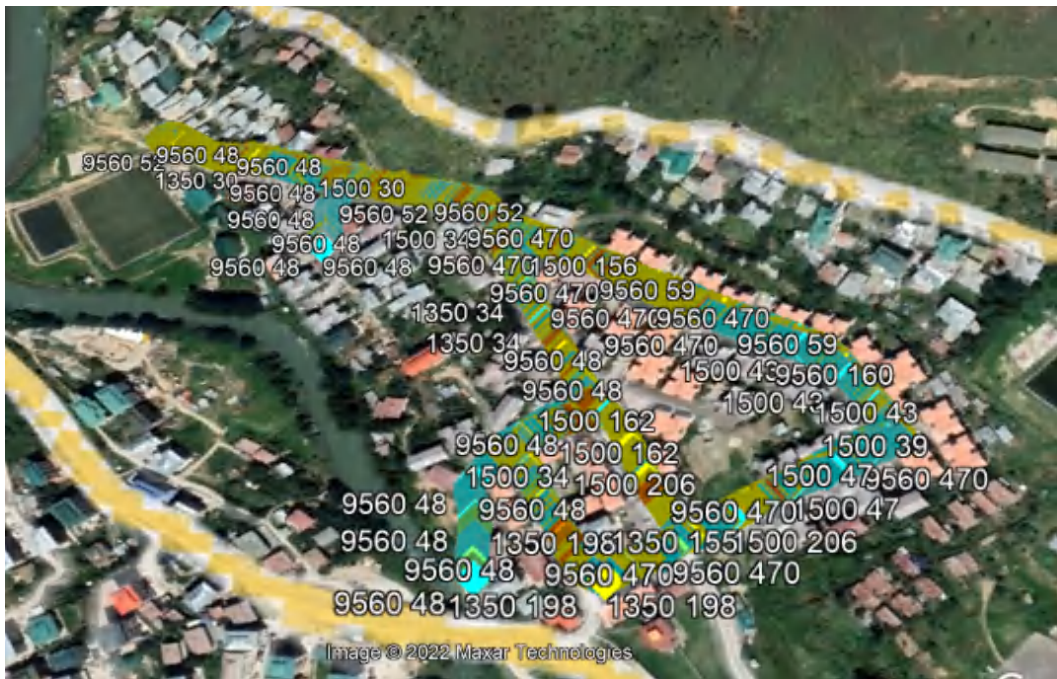


Figure number 10: RSRP plot 4G B-mobile (google earth)



Figure number 11: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 12: RSRP plot 4G Tashi cell (Google earth)

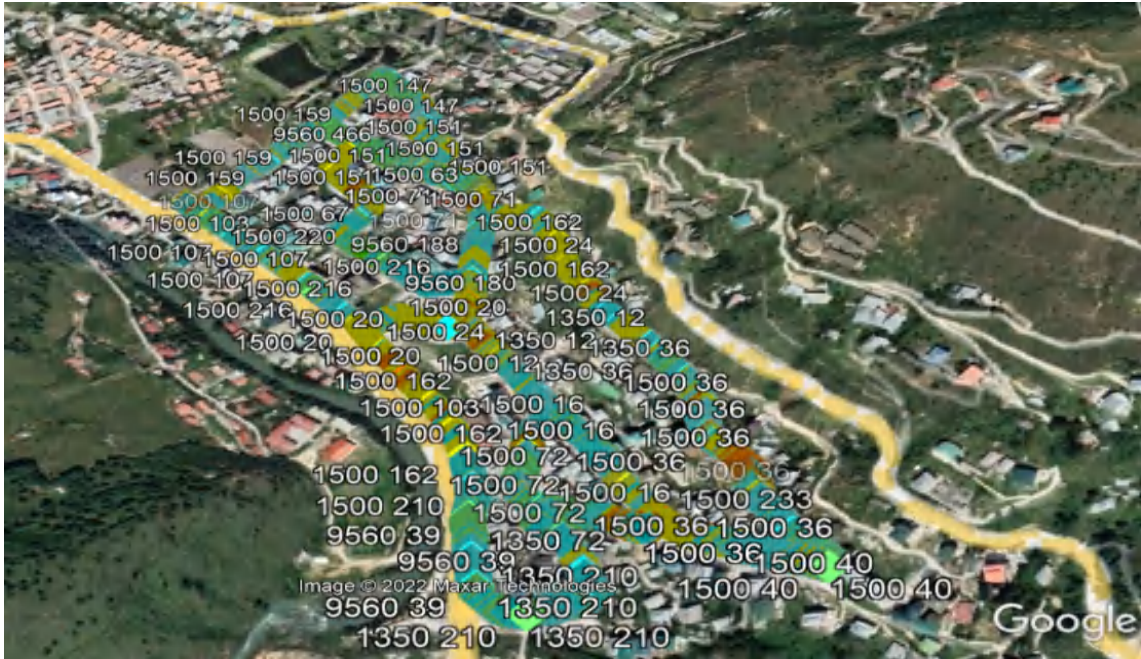


Figure number 14: RSRP plot 4G B-mobile (google earth)



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

e. Thimphu (Taba)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Off peak)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	3.92	8.05	4.02	7.37
TICL	9.56	19.7	10.59	7.82

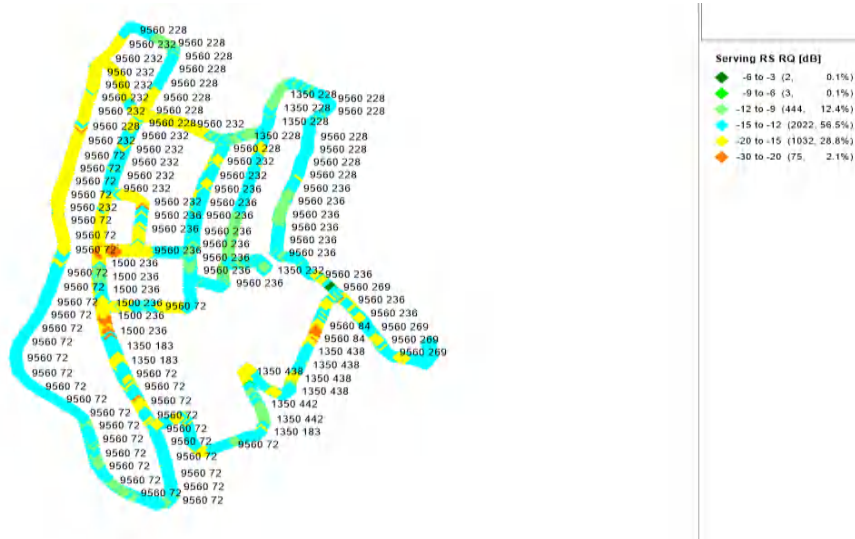


Figure number 21: 4G B-mobile (CPICH RSRP (dBm) plot)

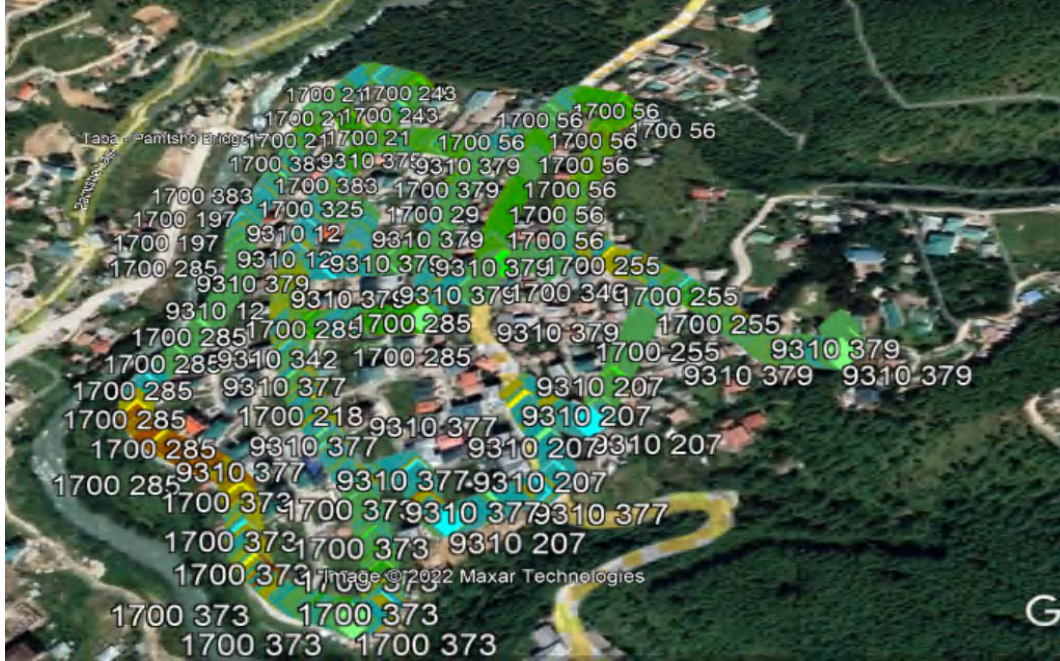


Figure number 24: RSRP plot 4G Tashi cell (Google earth)

f. Thimphu (Langjophakha)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Off peak)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	1.27	5.61	0.69	2.25
TICL	16.81	25.63	6.09	10.51



Figure number 25: 4G B-mobile (CPICH RSRP (dBm) plot)

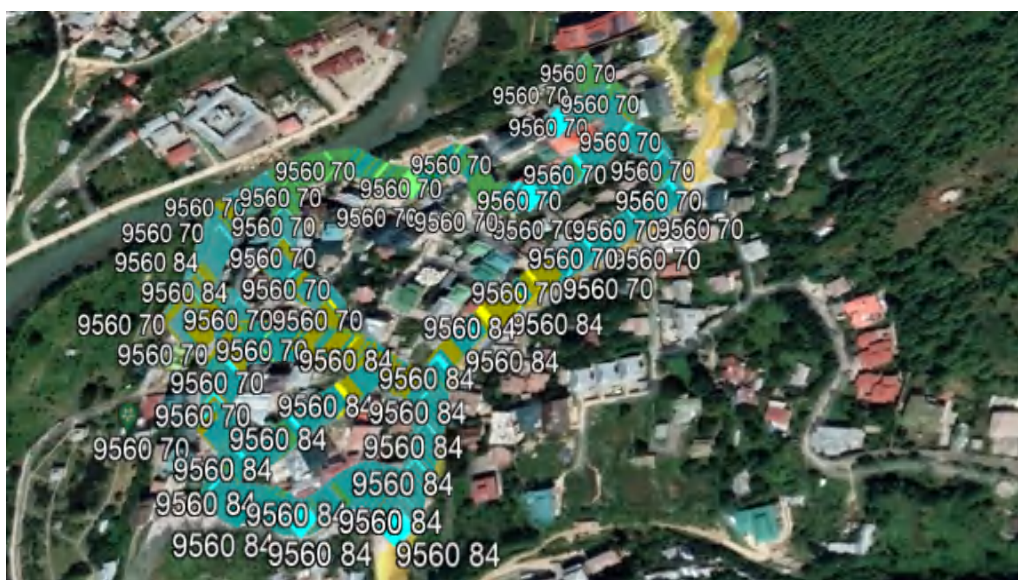


Figure number 26: RSRP plot 4G B-mobile (google earth)



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

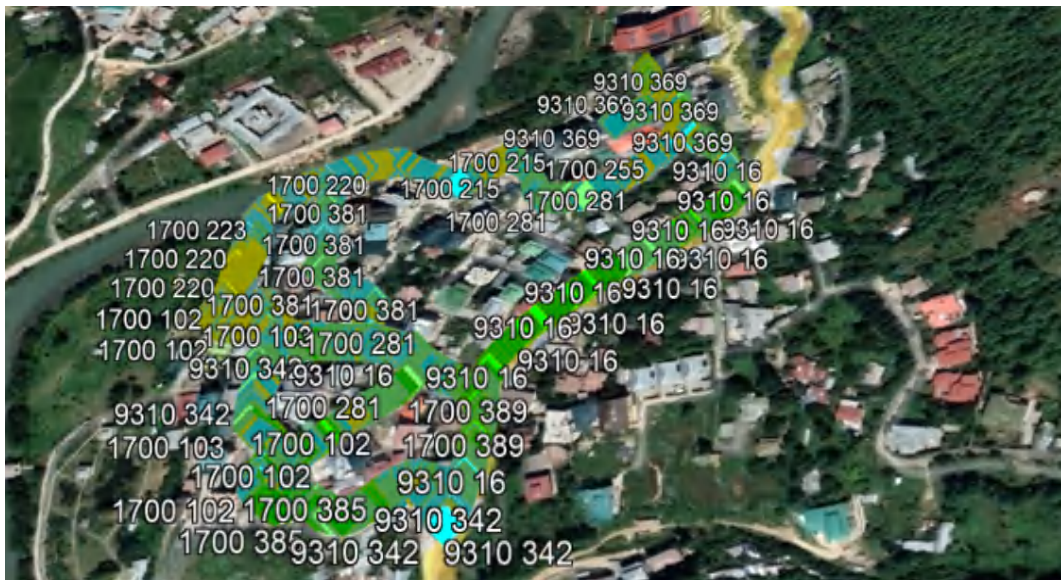


Figure number 28: RSRP plot 4G Tashi cell (Google earth)

g. Thimphu (Changzamtog)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Off peak)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	1.89	10.6	1.43	5.95
TICL	11.4	25.5	8.92	10.6



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

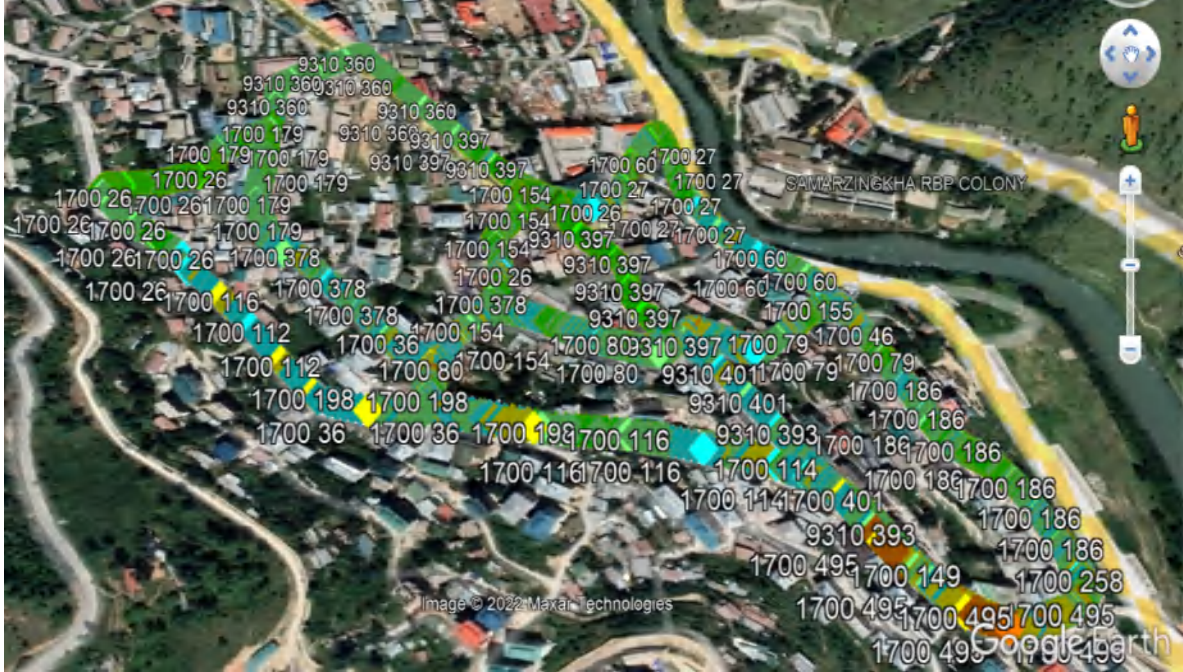


Figure number 32: RSRP plot 4G Tashi cell (Google earth)

h. Thimphu (Changedaphu)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Off peak)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	2.13	4.53	1.76	5.28
TICL	7.41	34.3	7.11	11.99



Figure number 33: 4G B-mobile (CPICH RSRP (dBm) plot)



Figure number 34: RSRP plot 4G B-mobile (google earth)



Figure number 35: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 36: RSRP plot 4G Tashi cell (Google earth)

i. Thimphu (Changedaphu)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Peak)

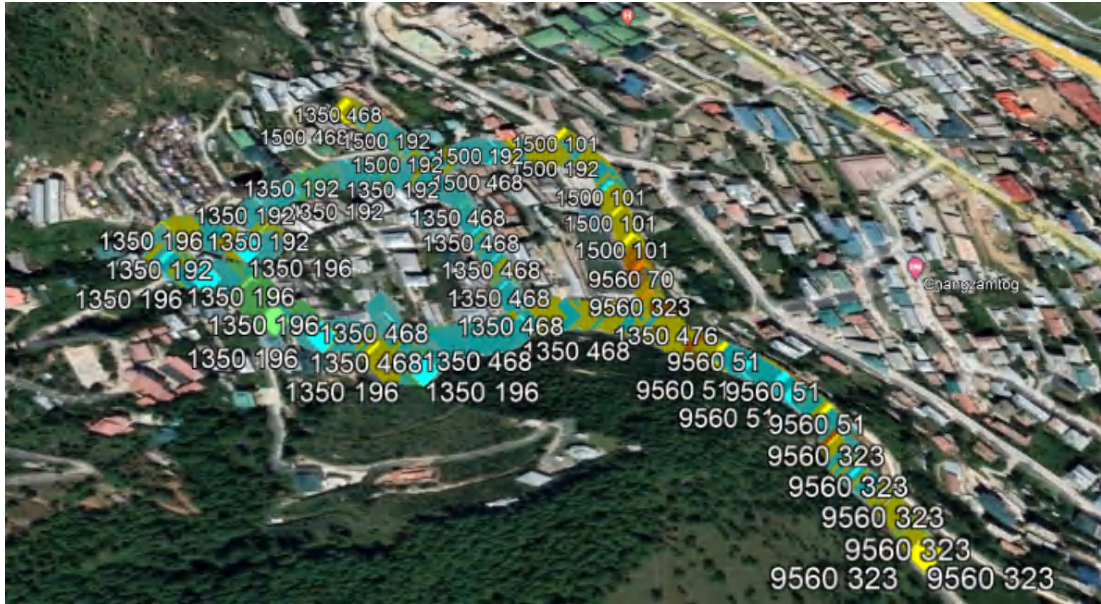


Figure number 38: RSRP plot 4G B-mobile (google earth)

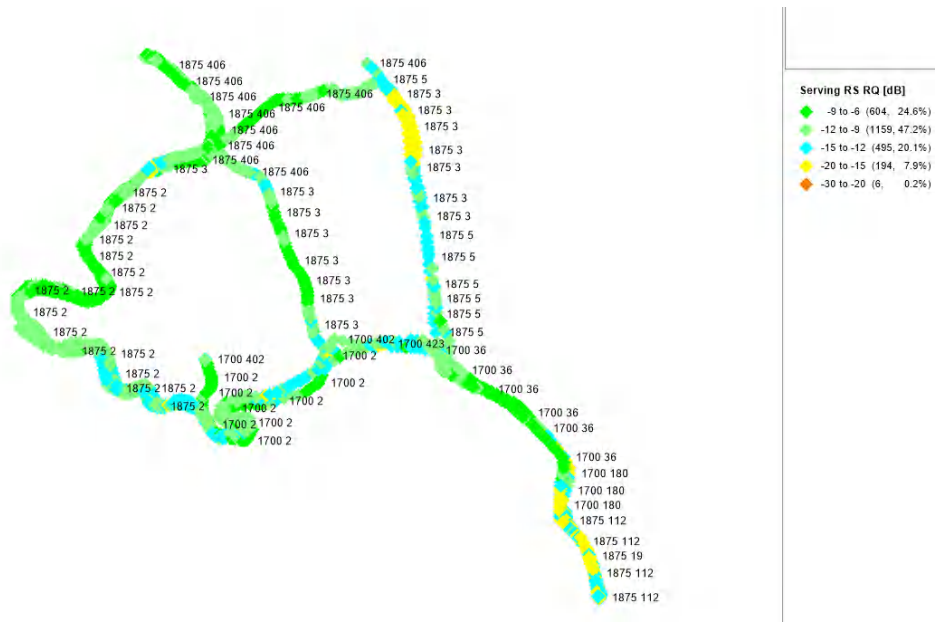


Figure number 39: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 40: RSRP plot 4G Tashi cell (Google earth)

j. Thimphu (Town)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Off peak)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	27.3	20.8	9.5	7.5
TICL	15.4	17.1	4.12	6.5



Serving RS RQ [dB]		
-3 to 0	(1)	0.0%
-8 to -5	(308)	9.2%
-12 to -9	(1083)	32.2%
-15 to -12	(1553)	48.2%
-20 to -15	(380)	11.3%
-30 to -20	(40)	1.2%

Figure number 41: 4G B-mobile (CPICH RSRP (dBm) plot)

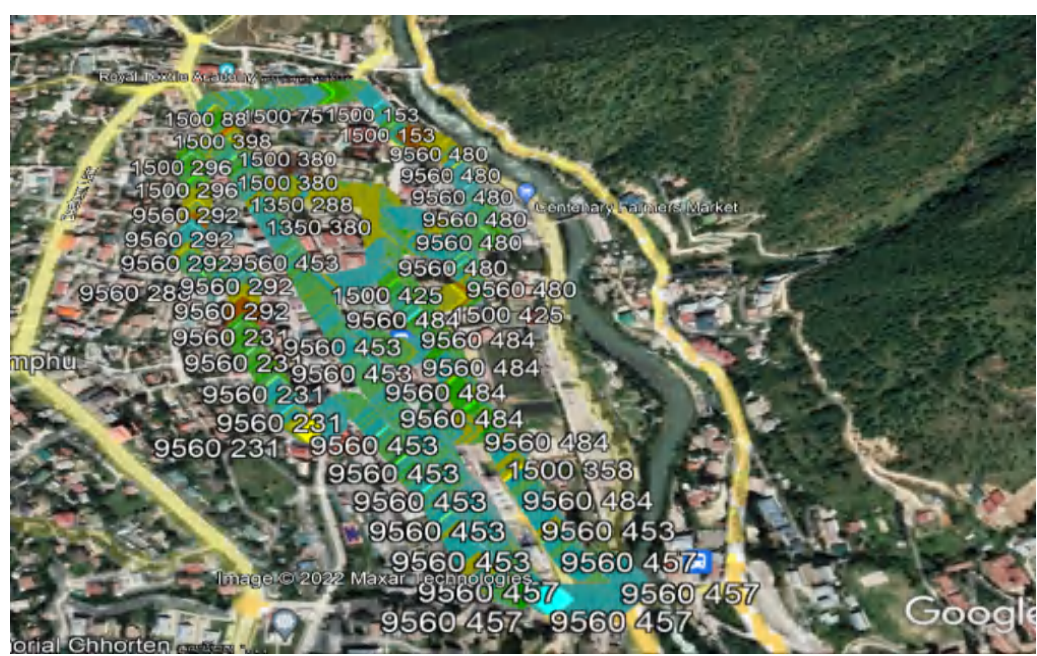


Figure number 42: RSRP plot 4G B-mobile (google earth)



Serving RS RQ [dB]	
◆	-6 to -3 (22, 0.8%)
◆	-9 to -6 (972, 35.9%)
◆	-12 to -9 (1175, 43.5%)
◆	-15 to -12 (457, 16.9%)
◆	-20 to -15 (78, 2.9%)

Figure number 43: 4G Tashi cell (CPICH RSRP (dBm) plot)

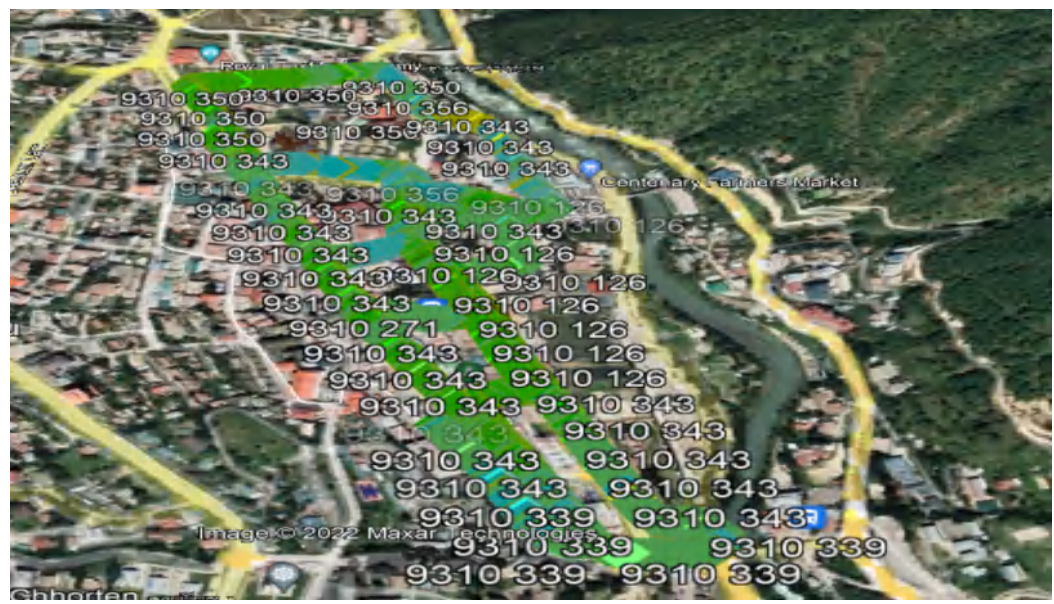


Figure number 44: RSRP plot 4G Tashi cell (Google earth)

k. Thimphu (Town)

Mobile Data Services (4G)

Data Throughputs (Mbps) (Peak)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	17.15	25.84	0.12	6.2
TICL	21.05	27.17	9.76	11.03



Figure number 45: 4G B-mobile (CPICH RSRP (dBm) plot)

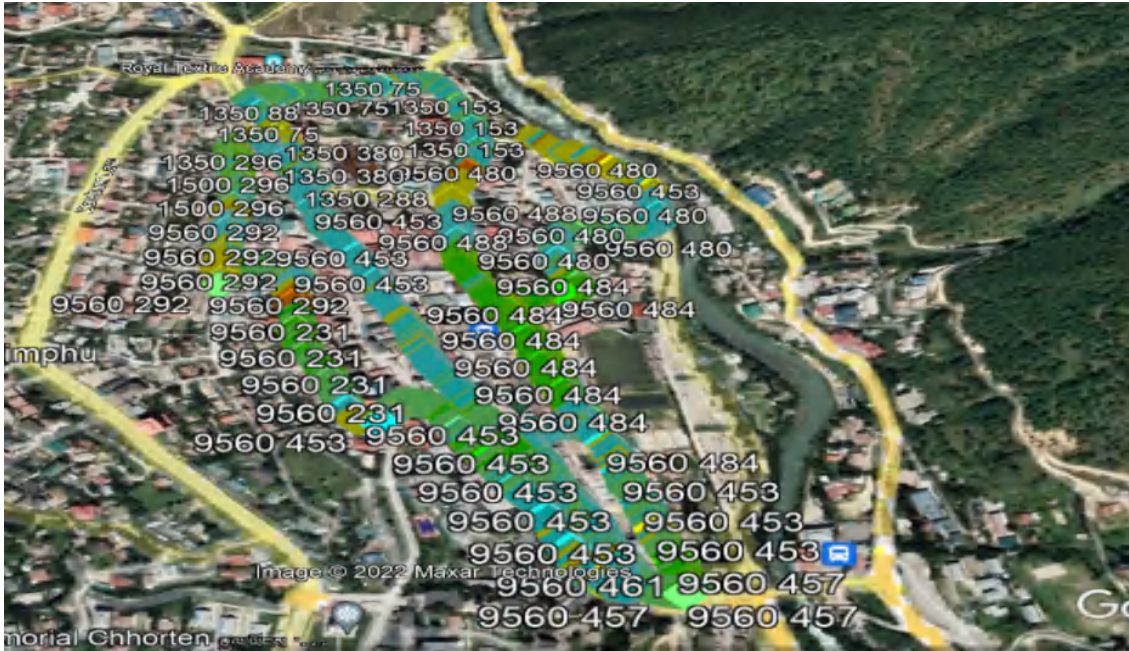


Figure number 46: RSRP plot 4G B-mobile (google earth)

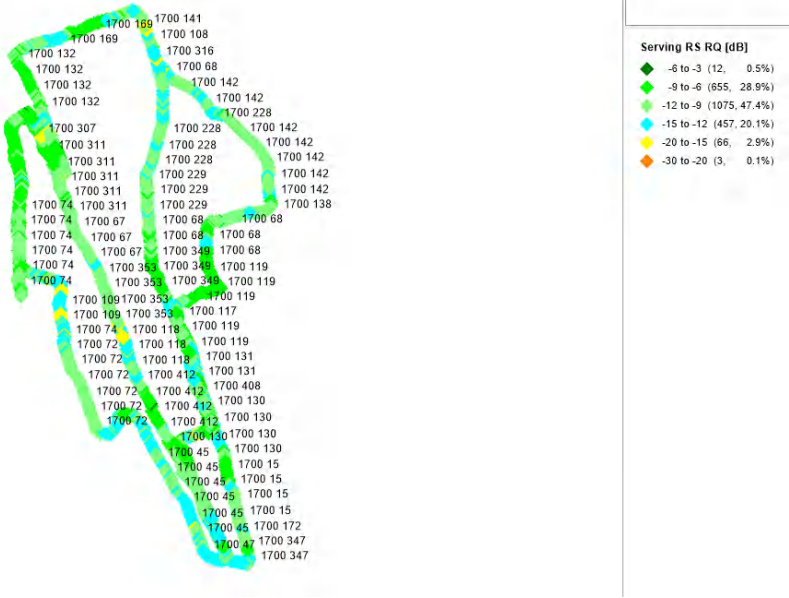


Figure number 47: 4G Tashi cell (CPICH RSRP (dBm) plot)

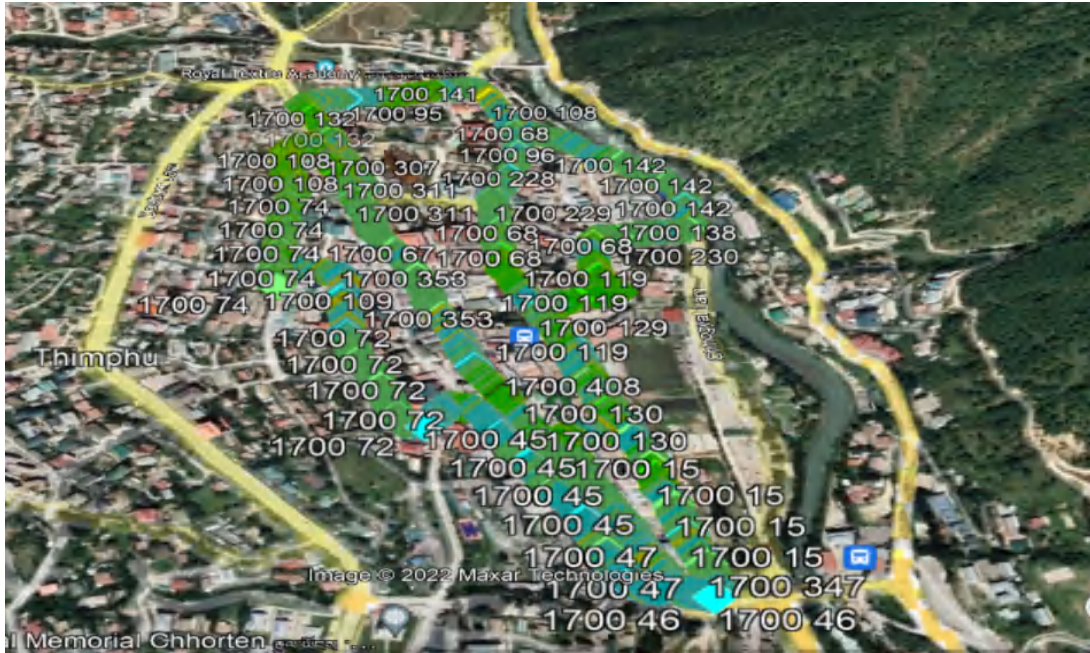


Figure number 48: RSRP plot 4G Tashi cell (Google earth)

B. Gasa

a. Gasa Town

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score	Call Setup Time
BTL	0.00	3.49	8.17
TICL	0.00	3.43	8.18

Mobile Data Services

Data Throughputs (3G)

Operators	File Transfer Protocol ($\geq 1.5\text{Mbps}$)		Hypertext Transfer Protocol ($\geq 1.5\text{Mbps}$)	
	Download	Upload	Download	Upload
BTL	5.6	0.95	4.5	0.8

TICL	4.64	0.95	4.1	0.81
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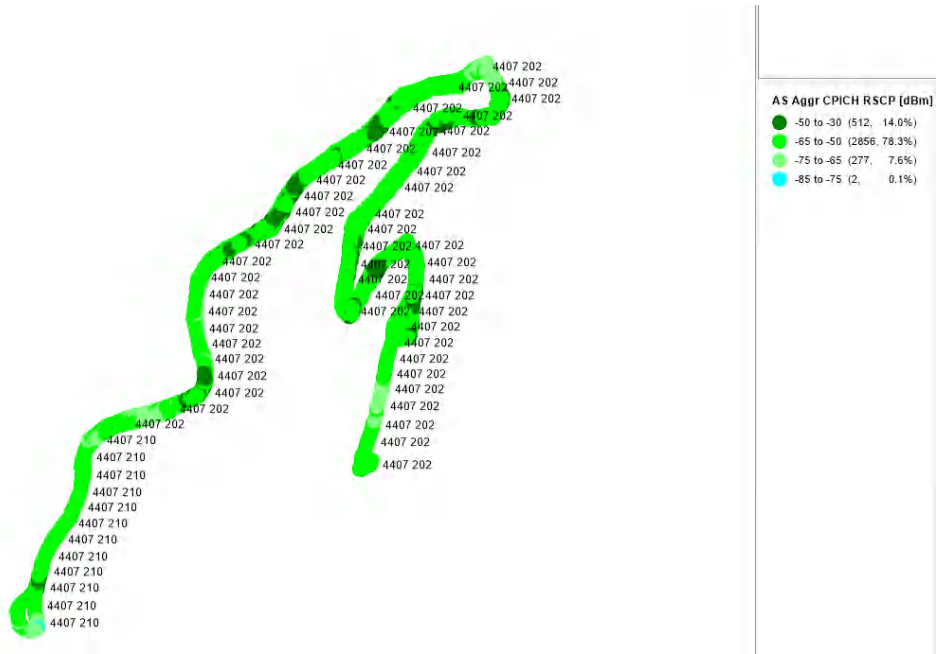


Figure number 49: 3G B-mobile (CPICH RSCP (dBm) plot)



Figure number 50: RSCP plot 3G B-mobile (google earth)

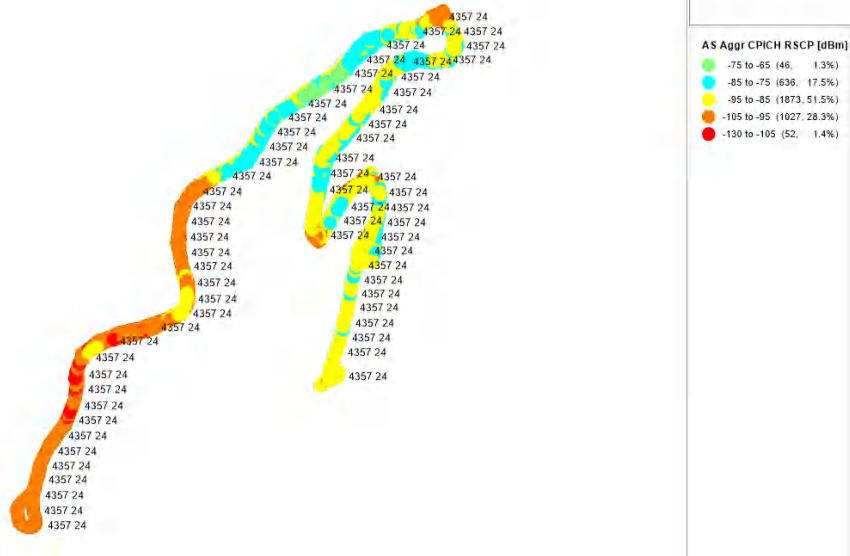


Figure number 51: 3G Tashi cell (CPICH RSCP (dBm) plot)

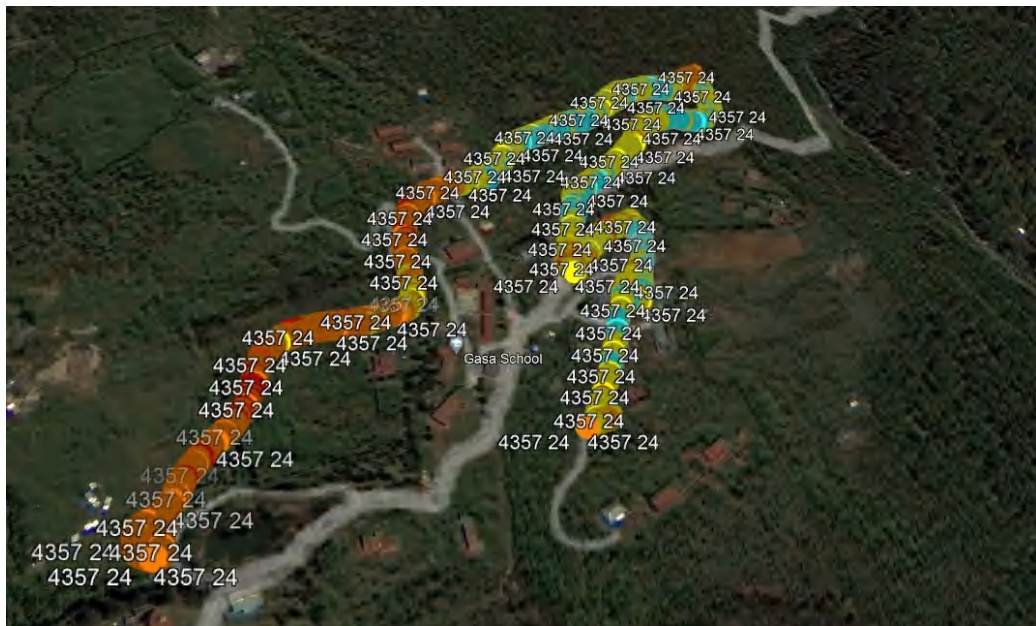


Figure number 52: RSCP plot 3G Tashi cell (Google earth)

Data Throughputs (4G)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	50	34.7	33.1	12.4
TICL	10.7	9.13	24.7	6.7



Figure number 53: 4G B-mobile (CPICH RSRP (dBm) plot)



Figure number 54: RSRP plot 4G B-mobile (google earth)



Figure number 55: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 56: RSRP plot 4G Tashi cell (Google earth)

C. Dagana

a. Dagana Town

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score	Call Setup Time
BTL	0	3.3	7.7
TICL	0	3.3	9.8

Data Throughputs (3G)

Operators	File Transfer Protocol ($\geq 1.5\text{Mbps}$)		Hypertext Transfer Protocol ($\geq 1.5\text{Mbps}$)	
	Download	Upload	Download	Upload
BTL	4.27	0.78	3.21	0.91

TICL	2.42	1.35	1.81	1.48
------	------	------	------	------

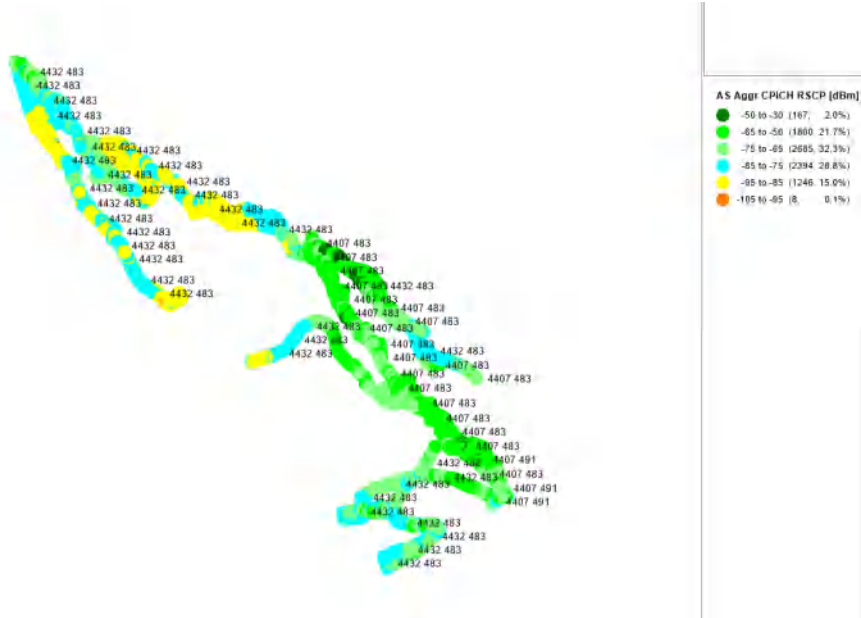


Figure number 57: 3G B-mobile (CPICH RSCP (dBm) plot)

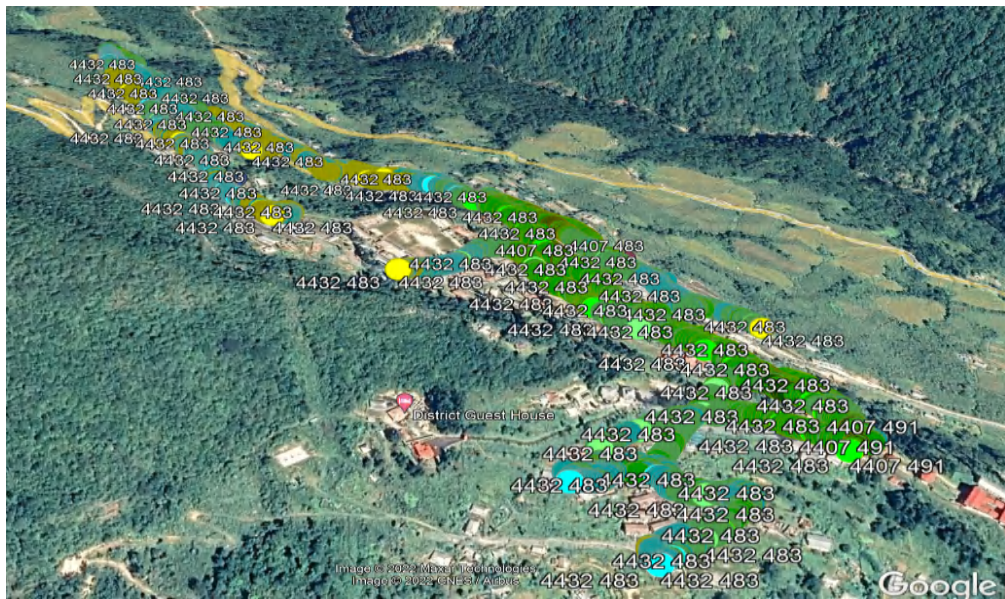


Figure number 58: RSCP plot 3G B-mobile (google earth)

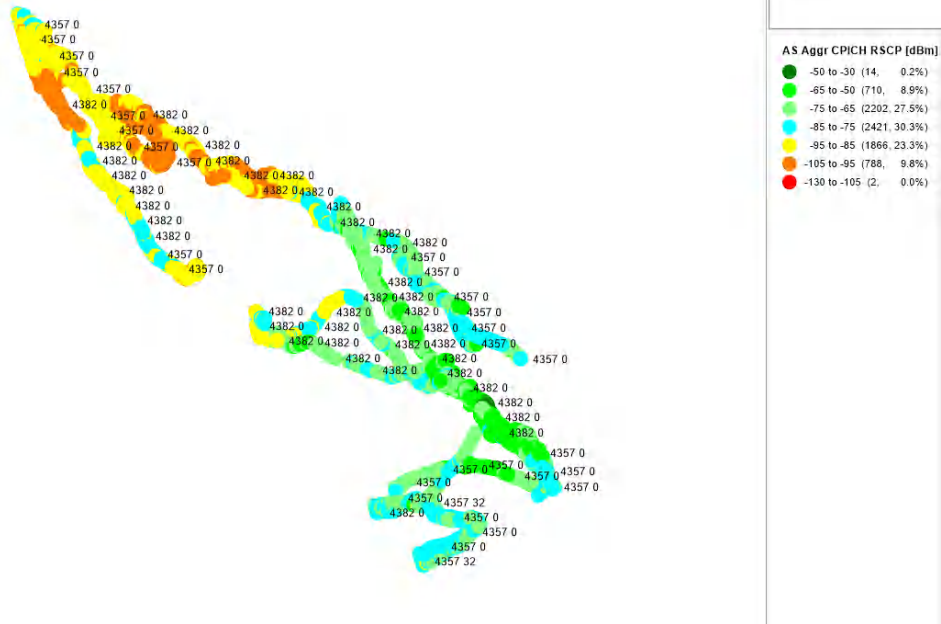


Figure number 59: 3G Tashi cell (CPICH RSCP (dBm) plot)



Figure number 61: 4G B-mobile (CPICH RSRP (dBm) plot)

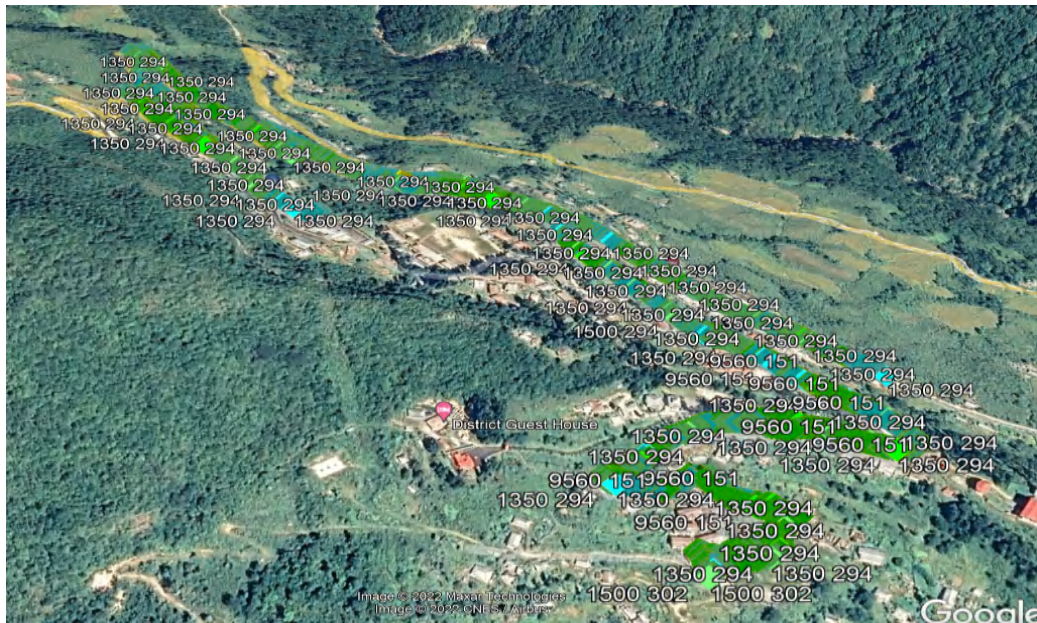


Figure number 62: RSRP plot 4G B-mobile (google earth)



Figure number 63: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 64: RSRP plot 4G Tashi cell (Google earth)

C. Punakha

a. Punakha Town

Mobile Voice Services

Operator	Call Drop rate (<2%)	Mean Opinion Score	Call Setup Time
BTL	0	3.29	8.07
TICL	0	3.25	7.49

Data Throughputs (3G)

Operators	File Transfer Protocol ($\geq 1.5\text{Mbps}$)		Hypertext Transfer Protocol ($\geq 1.5\text{Mbps}$)	
	Download	Upload	Download	Upload
BTL	2.25	1.1	1.6	0.86
TICL	4.6	1.6	3.4	0.92

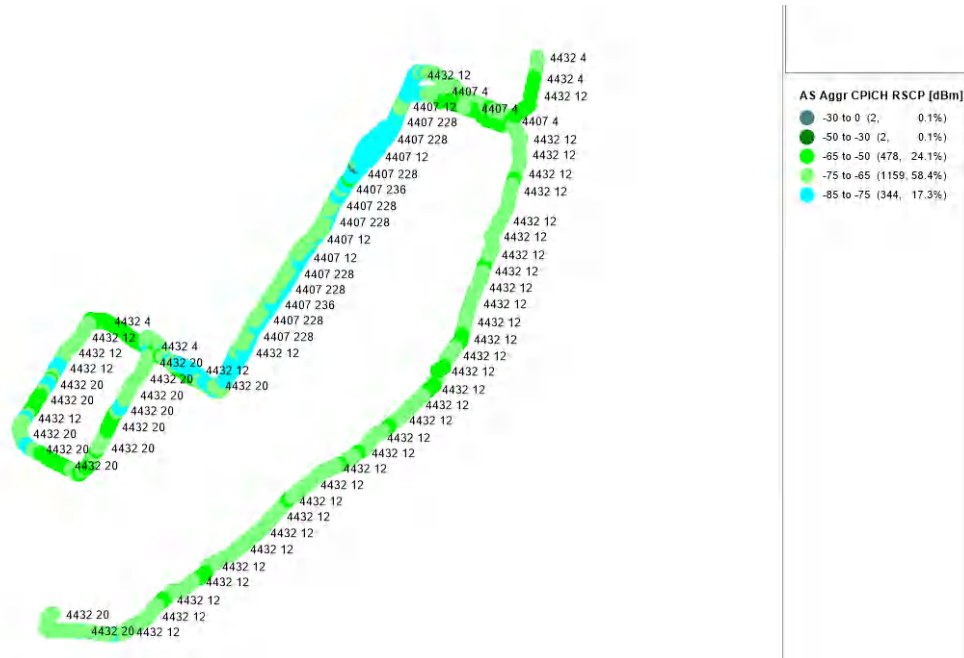


Figure number 65: 3G B-mobile (CPICH RSCP (dBm) plot)



Figure number 68: RSCP plot 3G Tashi cell (Google earth)

Data Throughputs (4G)

Operators	File Transfer Protocol (≥ 6 Mbps)		Hypertext Transfer Protocol (≥ 6 Mbps)	
	Download	Upload	Download	Upload
BTL	2.7	14.8	3.9	3.38
TICL	4.3	1.043	3.3	1.04



Figure number 69: 4G B-mobile (CPICH RSRP (dBm) plot)



Figure number 70: RSRP plot 4G B-mobile (google earth)

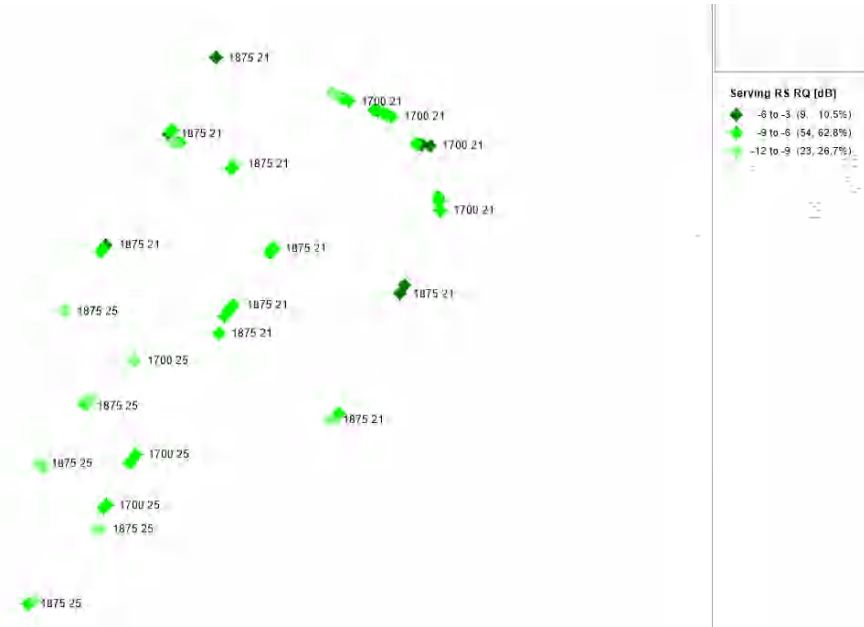


Figure number 71: 4G Tashi cell (CPICH RSRP (dBm) plot)



Figure number 72: RSRP plot 4G Tashi cell (Google earth)

4. Analysis:

- a. TICL has poor 4G data services compared to BTL in Dagana as per the network monitoring which had been carried out.
- b. Punakha town KPI monitoring was carried out during peak hour and the result of 4G data service for both the operators (TICL and BTL) are poor. Whereas, for 3G, the upload has lower throughput than the download throughput for both operators.
- c. BTL had 4G data services QoS below the benchmark when compared to TICL in all the areas of Thimphu where network monitoring has been carried out during the lockdown period in Thimphu.
- d. TICL also has its 4G services in Babesa, Olakha and Langjophakha during peak hours below the benchmark where network monitoring had been carried out during the lockdown period in Thimphu.

5. Follow up Actions Taken by the Authority

- a. Based on the QoS monitoring during the recent Lockdown, the Authority has imposed a penalty to the two Telecom Operators for not maintaining the KPI parameters to the minimum benchmarking.
- b. The Authority has recently released the additional frequency spectrum in 2300MHz to deploy 4G by the Telecom operator in order to enhance the capacity of the mobile networks in the country.
- c. The Authority has informed the operators wherever the cell site has throughput below the benchmarks to improve. The Telecom operators have also shared the expansion plans in order to enhance the quality of services.
- d. Both the operators have raised the issues of not being able to obtain the site clearance to install mobile network sites from relevant agencies. Therefore, the Authority has recently coordinated a physical meeting with the relevant agencies like Thimphu Thromde to enable required site clearance to expand the capacity and coverage of the telecom network.

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)
Excellent	≥ -80
Good	-80 to -90
Medium	-90 to -100