

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 Chukha (Phuentsholing) and Sarpang (Gelephu)

2. Locations and date of monitoring

Sl. No	Indoor/Outdoor	Name of the places	Dzongkhag	Monitoring Month
1.	Outdoor	Hospital Area	Chhukha	November
2.		Core Town		
3.		Toorsa		
4		Gelephu core Town	Sarpang	December
5		Zomlingthang and Airport Area		
6		Singye Gewog		
7		Sarpang Town and Dzong Area		
8		Taraythang		
9		Gelephu Core Town(Peak)		
10		Sarpang Town and Dzong area (Peak)		

3. Results

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

1. *Phuentsholing Hospital Area*

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0%	3.7	8.39 sec	No issues
TICL	0%	3.92	8.47 sec	No issues

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	63.65Mbps	28.99Mbps	No Issues
TICL	20.25Mbps	18.37Mbps	No Issues



Figure number 1.1 : RSRP plot 4G B-mobile (QGIS) [Phuntsholing Hospital Area]



Figure number 1.2 : RSRP plot 4G Tashi Cell (QGIS) [Phuntsholing Hospital Area]

2. Phuentsholing Core Town

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0%	3.86	9 sec	No issues
TICL	0%	3.72	8.99 sec	No issues

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	28.27Mbps	19.90Mbps	No Issues

TICL	23.67Mbps	21.79Mbps	No Issues
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Figure number 1.3 : RSRP plot 4G B-mobile (QGIS) [Phuntsholing Core Town]



Figure number 1.4 : RSRP plot 4G Tashi Cell (QGIS) [Phuntsholing Core Town]

3. Phuntsholing Toorsa

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0%	3.91	8.33 sec	No issues
TICL	0%	3.90	8.69 sec	No issues

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	23.40Mbps	9.021	No Issues
TICL	29.43Mbps	12.28Mbps	No Issues



Figure number 1.5 : RSRP plot 4G B-mobile (QGIS) [Phuntsholing Toorsa Area]



Figure number 1.6 : RSRP plot 4G Tashi Cell (QGIS) [Phuntsholing Toorsa Area]

4. Phuntsholing Core Area (HTTP tests)

• **Data Throughputs (Mbps) (4G)**

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	9Mbps (However, in some cycles, the DL throughput is as low as 1.738Mbps to 4.049Mbps, although the average of all cycles is 9Mbps)	6.5Mbps (However, in some cycles, the DL throughput is as low as 0.875Mbps to 1.09Mbps, although the average of all cycles is 6.5Mbps)	Some issues in individual cycle testing.
TICL	28.56Mbps	25,85Mbps	No Issues

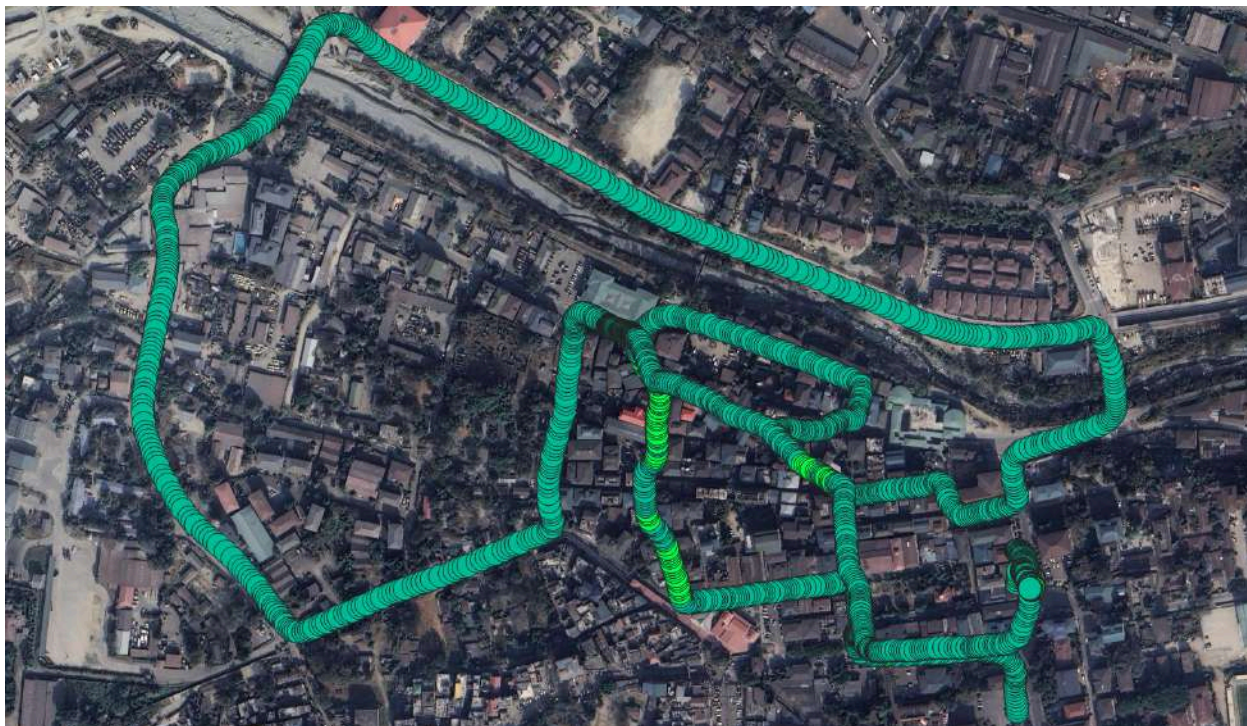


Figure number 1.7 : RSRP plot 4G B-mobile (QGIS) [Phuntsholing Core Area HTTP test]



Figure number 1.8 : RSRP plot 4G Tashi Cell (QGIS) [Phuntsholing Area HTTP test]

5. Gelephu Core Town Area

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	6.39	No issue
TICL	0	3.646	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	17.71	15.82	No issue
TICL	40.11	22.67	No issue

▲ Color Legends	
RSRP (dBm) [Time/s]	
>= -80	944 40.91% excellent
<= -80 and >= -90	860 37.29% good
<= -90 and > -105	466 20.19% acceptable
<= -105	37 1.60% poor

Legends for BTL

Serving RSRP-4G IDLE

- [-90,-30](1156,36.51%)
- [-100,-90)(1095,34.59%)
- [-110,-100)(777,24.54%)
- [-115,-110)(114,3.60%)
- [-140,-115)(24,0.76%)

Legends for TICL

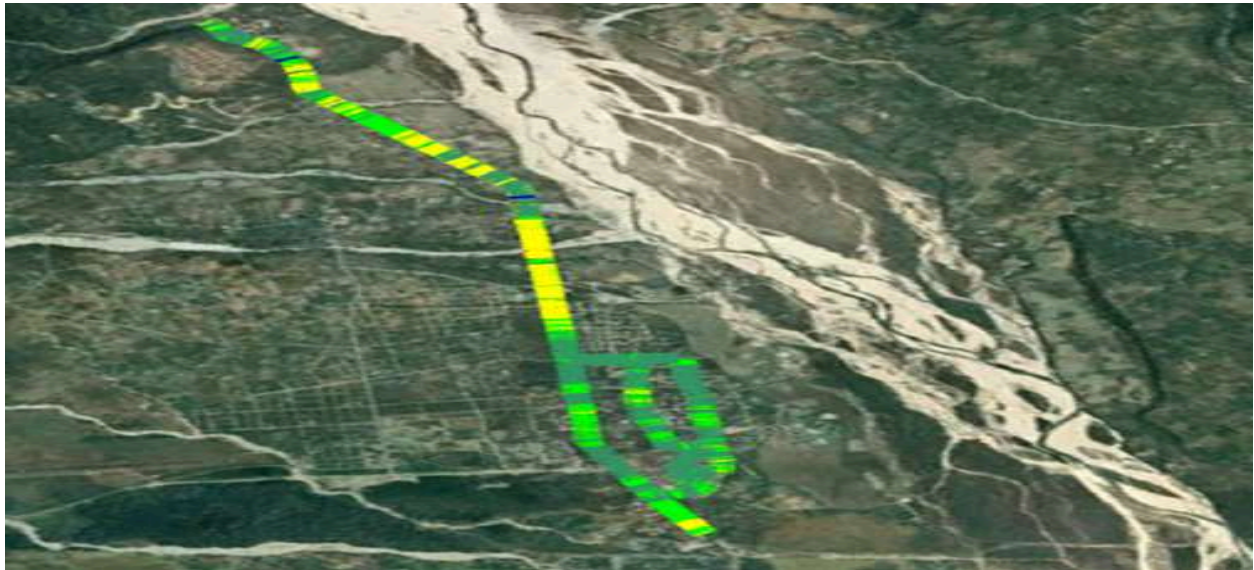


Figure number 1.9 : RSRP plot 4G B-mobile [Gelephu]

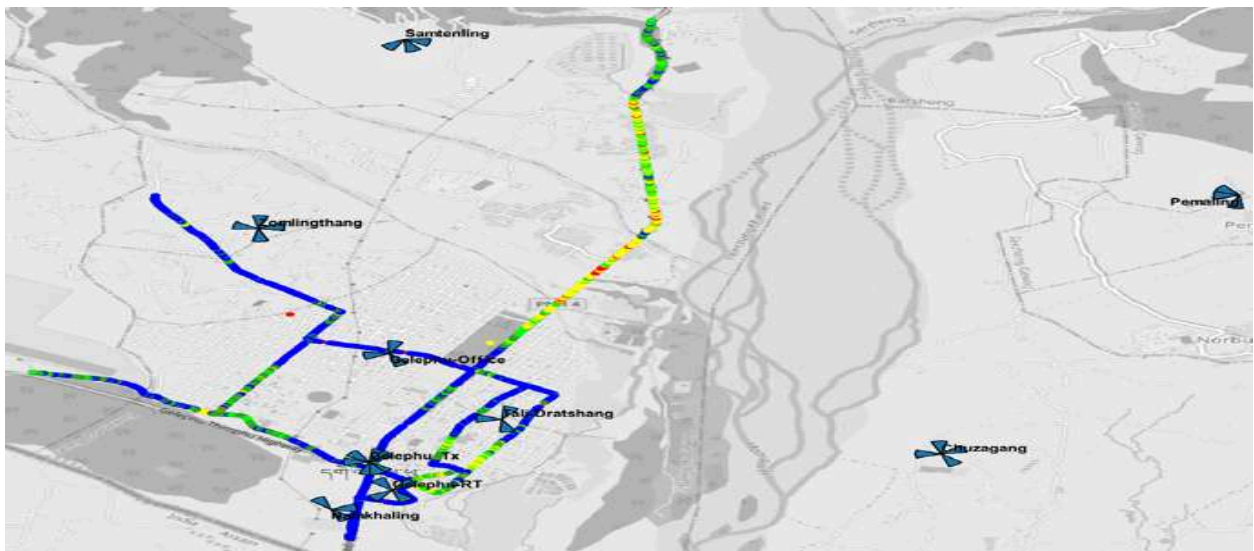


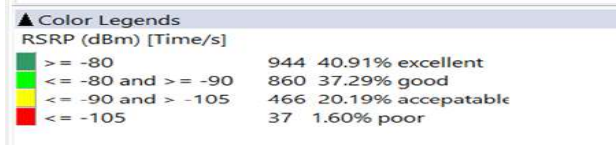
Figure number 1.10 : RSRP plot 4G Tashi Cell [Gelephu]

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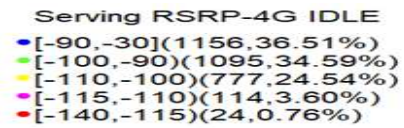
6. Gelephu Town (Peak Hour)

- Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	13.79	9.04	No issue
TICL	18.77	16.62	No issue



Legends for BTL



Legends for TICL



Figure number 1.11 : RSRP plot 4G B-mobile [Peak Hours Gelephu]

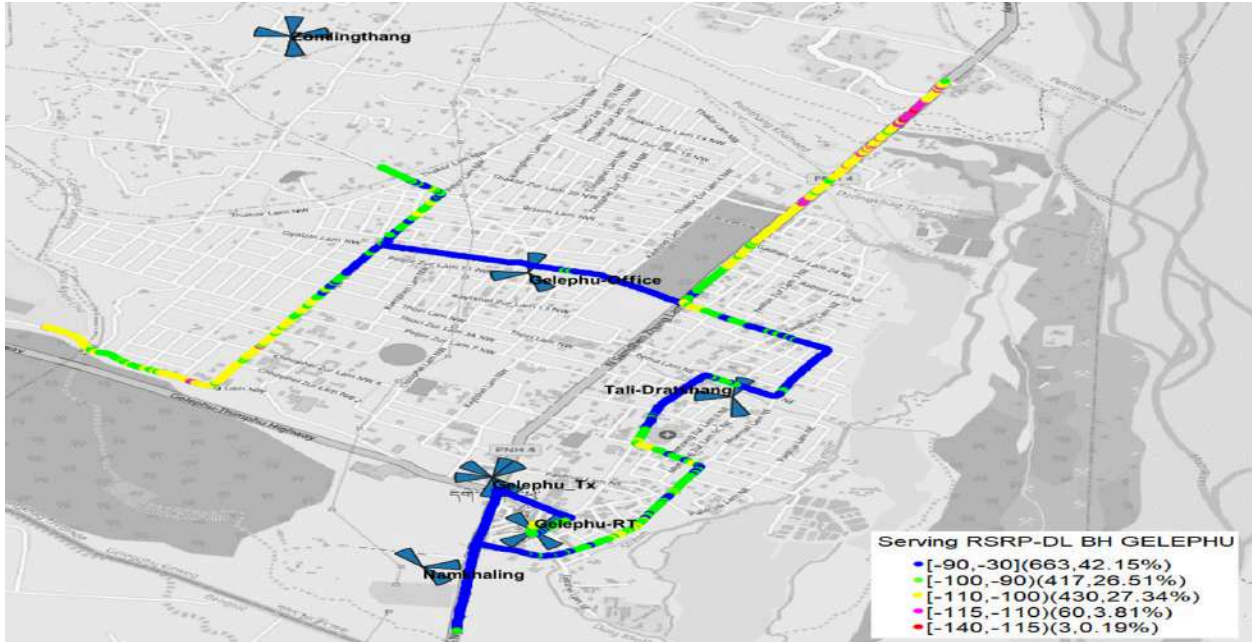


Figure number 1.12 : RSRP plot 4G Tashi Cell [Peak Hours Gelephu]

7. Gelephu Zomlingthang and Airport Area

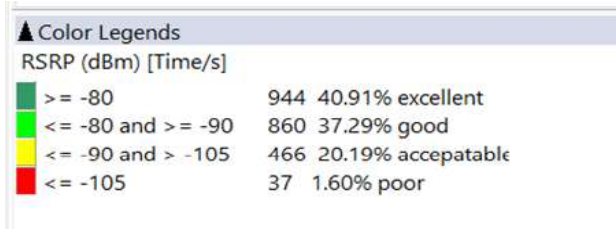
- Mobile Voice Service

Operator	Call Drop rate (<2%)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	6.21	No issue
TICL	0	3.61	No issue

- Data Throughputs (Mbps) (4G)

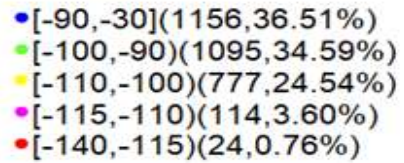
Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	15.46	9.12	No issue

TICL	42.79	24.45	No issue
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Legends for BTL

Serving RSRP-4G IDLE



Legends for TICL



Figure number 1.13 : RSRP plot 4G B-mobile [Zhomlingthang and Airport area]



Figure number 1.14 : RSRP plot 4G Tashi Cell [Zhomlingthang and Airport Area]

8. Singay Gewog, Sarpang

• Mobile Voice Service

Operator	Call Drop rate (<2%)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	5.93	No issue
TICL	8.33%	3.305	Out of 12 Call 1 call drop found

• Data Throughputs (Mbps) (4G)

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	11.88	8.05	No issue
TICL	60.53	14.25	No issue

▲ Color Legends

RSRP (dBm) [Time/s]	Count	Percentage	Quality
>= -80	944	40.91%	excellent
<= -80 and >= -90	860	37.29%	good
<= -90 and > -105	466	20.19%	acceptatable
<= -105	37	1.60%	poor

Legends for BTL

Serving RSRP-4G IDLE

• [-90, -30]	(1156, 36.51%)
• [-100, -90]	(1095, 34.59%)
• [-110, -100]	(777, 24.54%)
• [-115, -110]	(114, 3.60%)
• [-140, -115]	(24, 0.76%)

Legends for TICL



Figure number 1.15 : RSRP plot 4G B-mobile [Singay Gewog]

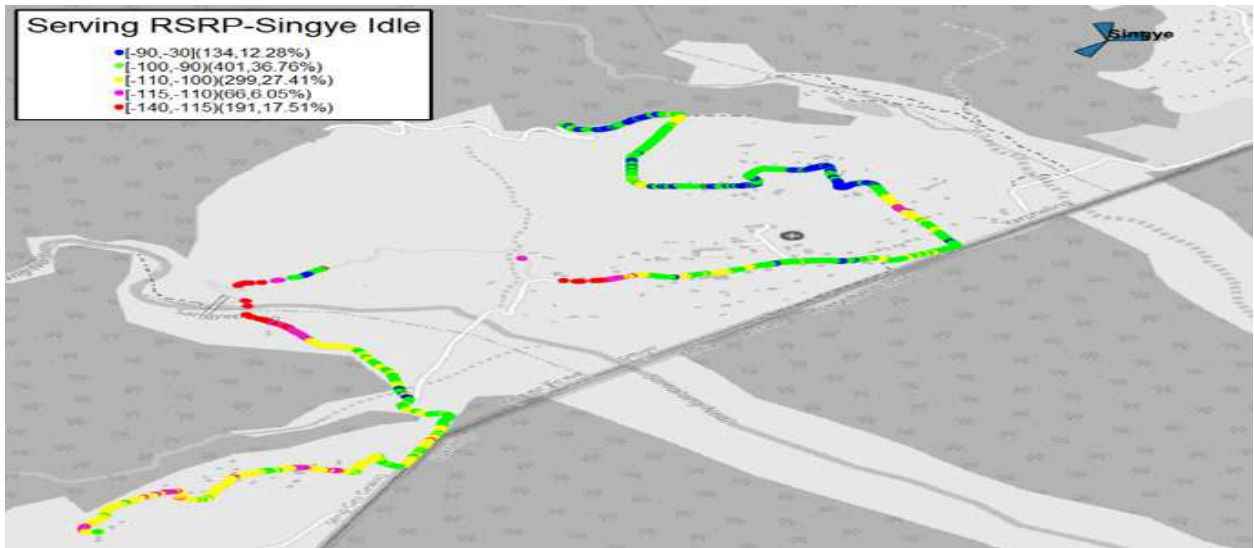


Figure number 1.16 : RSRP plot 4G Tashi Cell [Singye Gewog]

9. Sarpang Town (Dzong Area and Rani Tar)

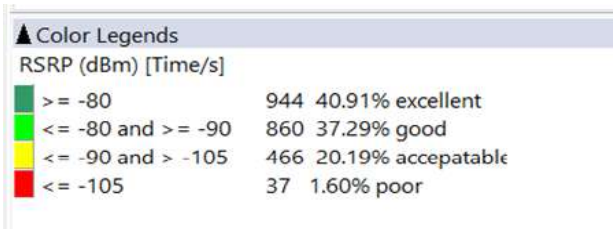
- Mobile Voice Service

Operator	Call Drop rate (<2%)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	6.7	No issue

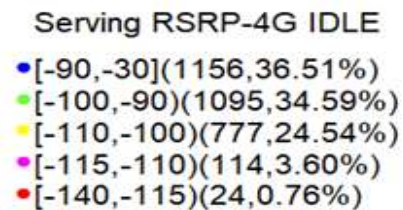
TICL	0	3.468	No issue
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• *Data Throughputs (Mbps) (4G)*

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	34.52	19.7	No issue
TICL	47.04	24.85	No issue



Legends for BTL



Legends for TICL



Figure number 1.17 : RSRP plot 4G B-mobile [Sarpang Town and Dzong]

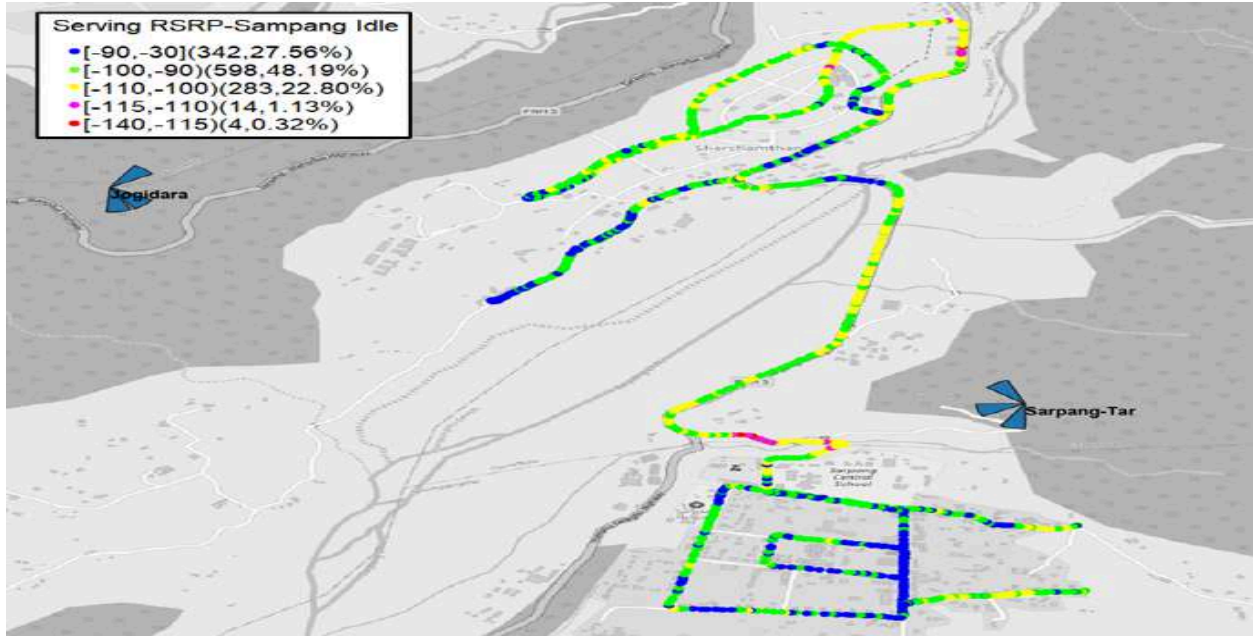


Figure number 1.18 : RSRP plot 4G Tashi Cell [Sarpang Town and Dzong Area]

10. Sarpang Town (Dzong Area and Rani Tar) peak hours

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	50.68	17.46	No issue
TICL	34.11	17.93	No issue

▲ Color Legends		
RSRP (dBm) [Time/s]		
>= -80	944	40.91% excellent
<= -80 and >= -90	860	37.29% good
<= -90 and > -105	466	20.19% acceptable
<= -105	37	1.60% poor

Legends for BTL

Serving RSRP-4G IDLE

[-90,-30]	(1156,36.51%)
[-100,-90]	(1095,34.59%)
[-110,-100]	(777,24.54%)
[-115,-110]	(114,3.60%)
[-140,-115]	(24,0.76%)

Legends for TICL



Figure number 1.19 : RSRP plot 4G B-mobile [Sarpang Town Peak Hours]

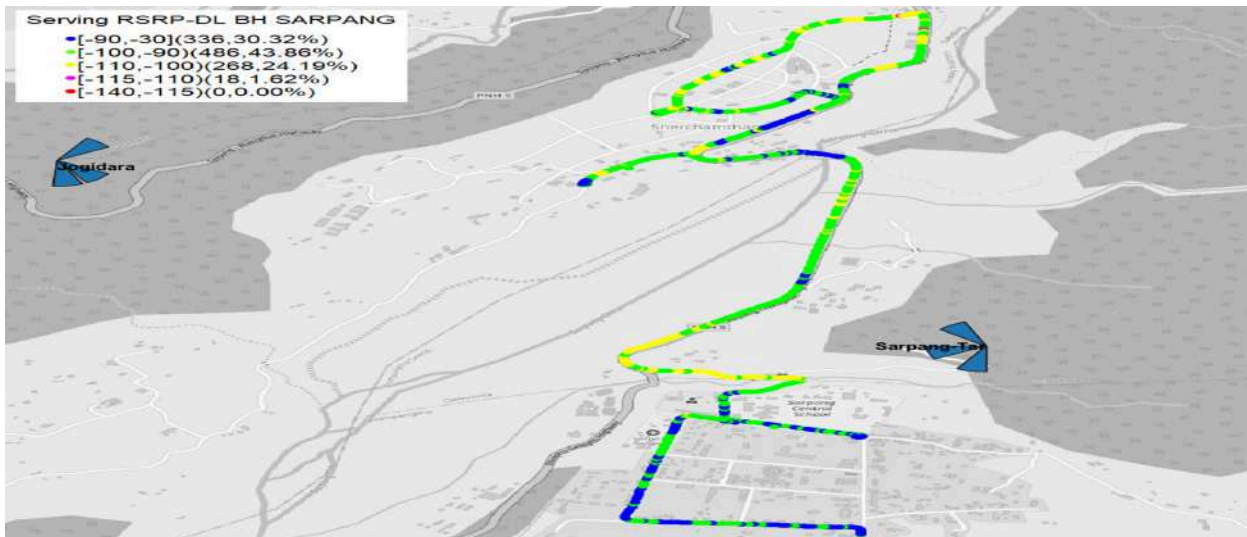


Figure number 1.20 : RSRP plot 4G Tashi Cell (QGIS) [Sarpang Town Peak Hours]

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11. Tharaythag Sarpang

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Call Fallback Setup Time (<= 9 Seconds)	Remarks
BTL	0	5.53	No issue
TICL	12.50%	3.162	Out of 8 Call 1 call drops found

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	27.08	8.231	No issue
TICL	44.79	7.55	No issue

▲ Color Legends	
RSRP (dBm) [Time/s]	
>= -80	944 40.91% excellent
<= -80 and >= -90	860 37.29% good
<= -90 and > -105	466 20.19% acceptable
<= -105	37 1.60% poor

Legends for BTL

Serving RSRP-4G IDLE

- [-90,-30](1156,36.51%)
- [-100,-90)(1095,34.59%)
- [-110,-100)(777,24.54%)
- [-115,-110)(114,3.60%)
- [-140,-115)(24,0.76%)

Legends for TICL

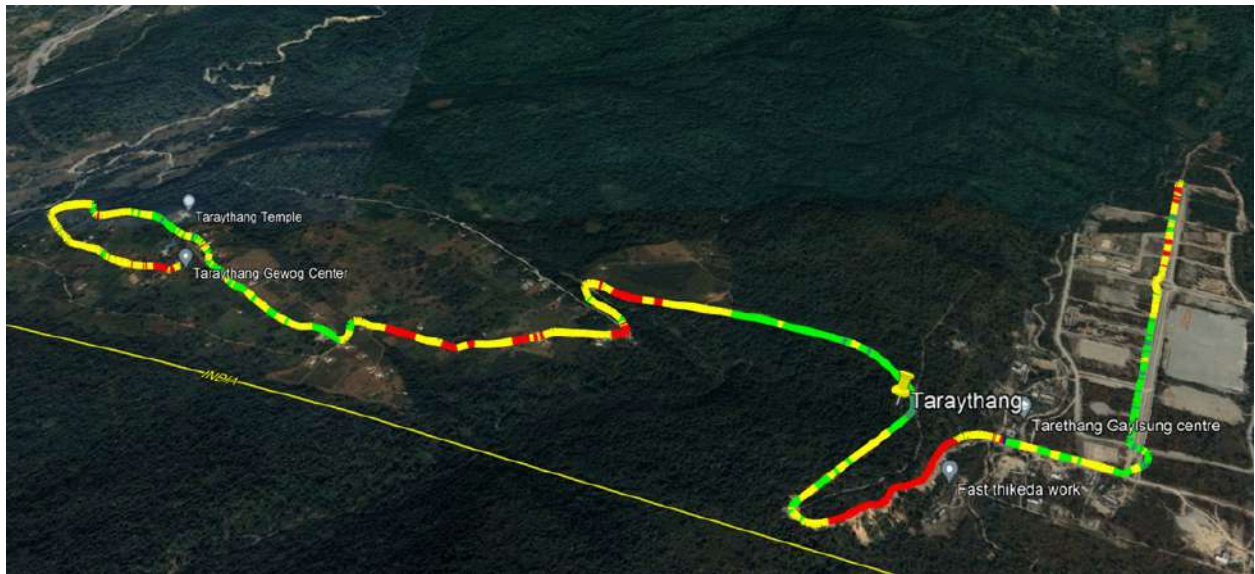


Figure number 1.21 : RSRP plot 4G B-mobile [Taraythang]

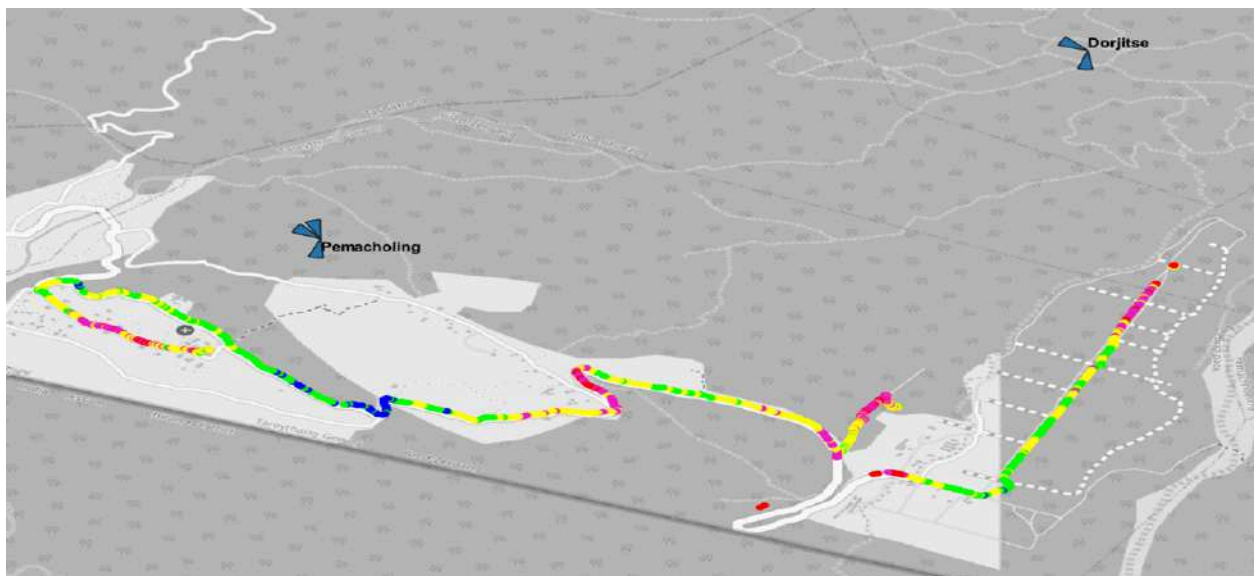


Figure number 1.21 : RSRP plot 4G Tashi Cell [Taraythang]

4. Findings

1. There were not many issues for both the operators in terms of local FTP throughput testing in the Phuentsholing area. However, in terms of HTTP open server testing, in some cycles, the DL throughput is as low as 1.738Mbps to 4.049Mbps, although the average of all cycles is 9Mbps.
2. Average Throughput for both the telecom operators BTL and TICL meets the standard of the Authority in all the monitored places in Sarpang Dzongkhag.
3. There were no call drop issues for BTL but for TICL were found call drop issues in Taraythang Gewog and Singye Gewog.
4. Coverage Maps shown in some parts of Taraythang Gewog and Singye Gewog in Sarpang Dzongkhag were found to have poor network coverage for both the telecom operators in those vicinities.

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 also initiated 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	$-80 \leq -95$	≤ -105
2	RSCP (UMTS)	≥ -80	$-80 \leq -100$	≤ -110
3	RSRP (LTE)	≥ -80	$-80 \leq -105$	≤ -115