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 Paro, Haa, Thimphu and Sarpang.

2. Locations and date of monitoring

Sl. No	Indoor/Outdoor	Name of the places	Dzongkhag	Monitoring Month
1.	Outdoor	Dekiling	Sarpang	January
2.		Jigmeling		
3.		Sarpang Town and Dzong Area		
4		Senggey		
5		Senggey to Gelephu high road (Coverage)		
6		Tareythang		
7		Shompangkha		
8		Umiling		
9		Chhuzagang		
10		Norbuling (Sershong Gewog)		
11		Gelephu Thromde		
12		Zomlingthang and Airport Area		
13		Bhur and Airport Area		
		Jungshina	Thimphu	
		Bongdey	Paro	March

		Town		
		Shaba		
		Town	Haa	
		IMTRAT		

3. Results

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

1. *Dekiling Gewog (Sarpang)*

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.855	8.25	No issue
TICL	0	4.11	6.81	No issue

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

Operators	File Transfer Protocol		Remarks
	Download ($\geq$ 6 Mbps)	Upload ($\geq$ 2 Mbps)	
BTL	5.40235	13.057	Issue with Download throughput
TICL	20.37	4.28	No issue

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

Figure number 2: RSRP plot 4G Tashi Cell (QGIS) [Dekiling]

2. Jigmeling (Sarpang)

- ### Mobile Voice Service

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.565	11.511	Issues with setup time
TICL	0	3.72	8.216	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	11.37	12.54	No issue
TICL	27.027	9.88	No issue

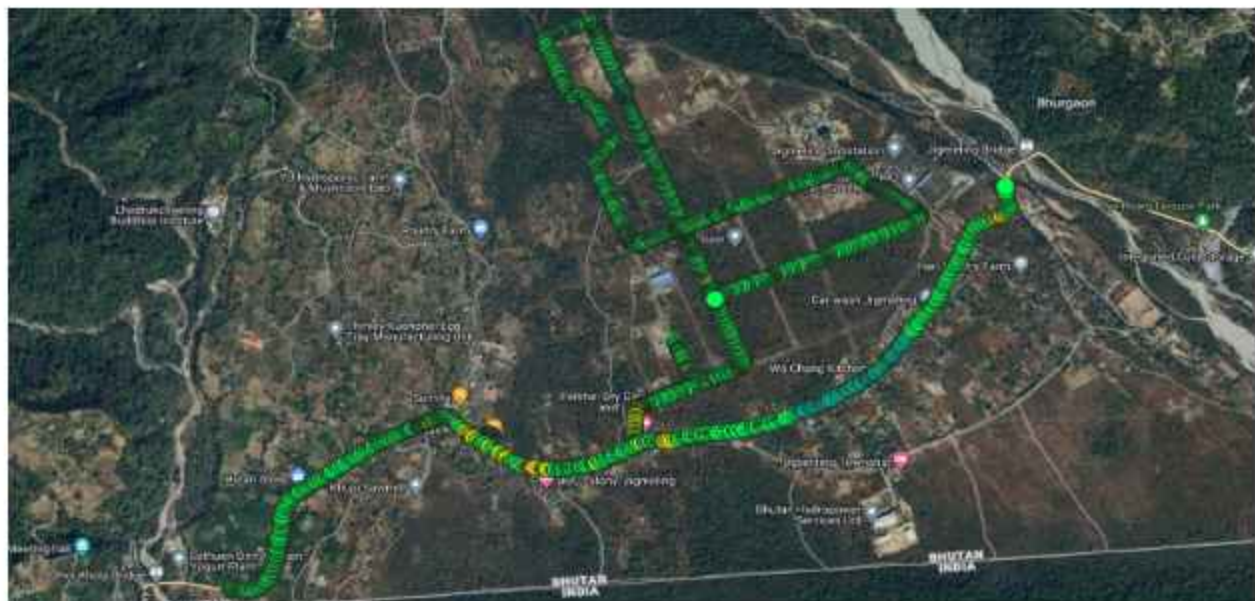*Figure number 3: RSRP plot 4G B-mobile (QGIS)[Jigmeling]*
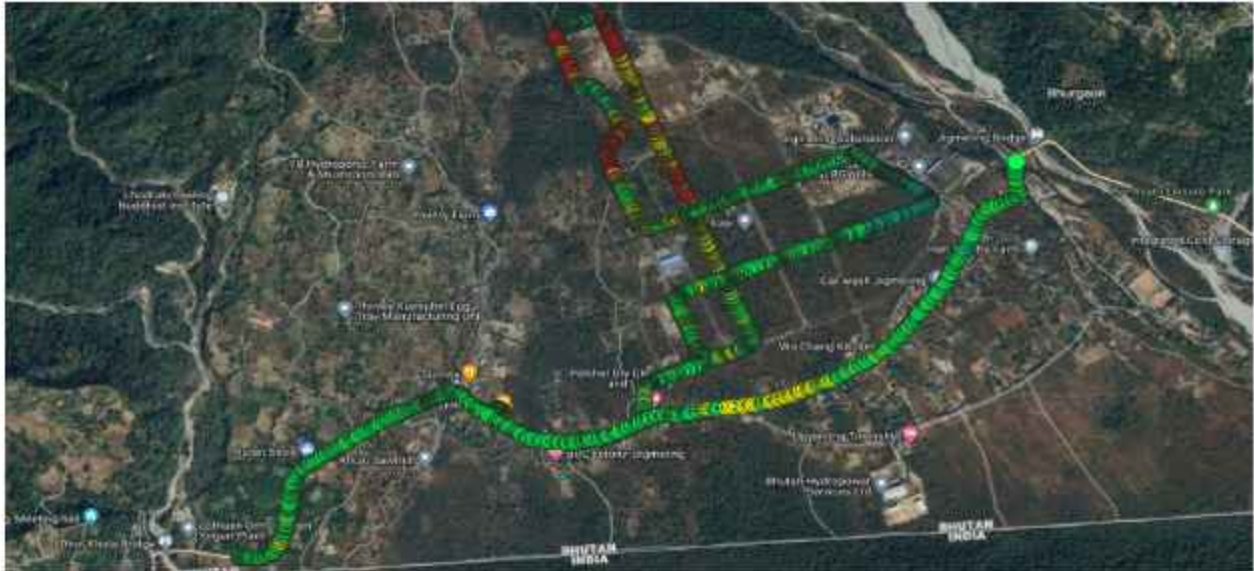
Figure number 4: RSRP plot 4G Tashi Cell (QGIS) [Jigmeling]

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3. Sarpang Town and Dzong Area

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.83	7.86	No issue
TICL	0	3.82	6.93	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	42.64	17.88	No issue
TICL	33.18	26.96	No issue

Figure number 5: RSRP plot 4G B-mobile (QGIS) [Sarpang Town and Dzong area]

Figure number 6: RSRP plot 4G Tashi Cell (QGIS) [Sarpang Town and Dzong area]

4. Senggey Gewog

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.67	**9.085**	Issue with setup time
TICL	0	3.785	7.446	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	27.34	10.49	No issue
TICL	33.68	40.06	No issue

Figure number 7: RSRP plot 4G B-mobile (QGIS) [Senggey Gewog]
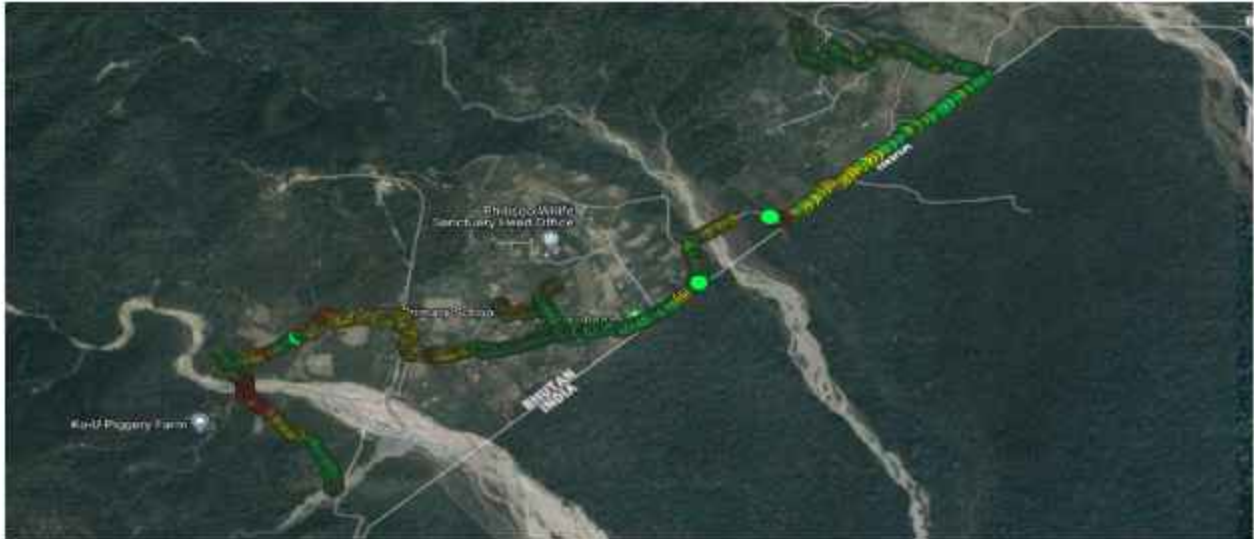
Figure number 8: RSRP plot 4G Tashi Cell (QGIS) [Senggey Gewog]

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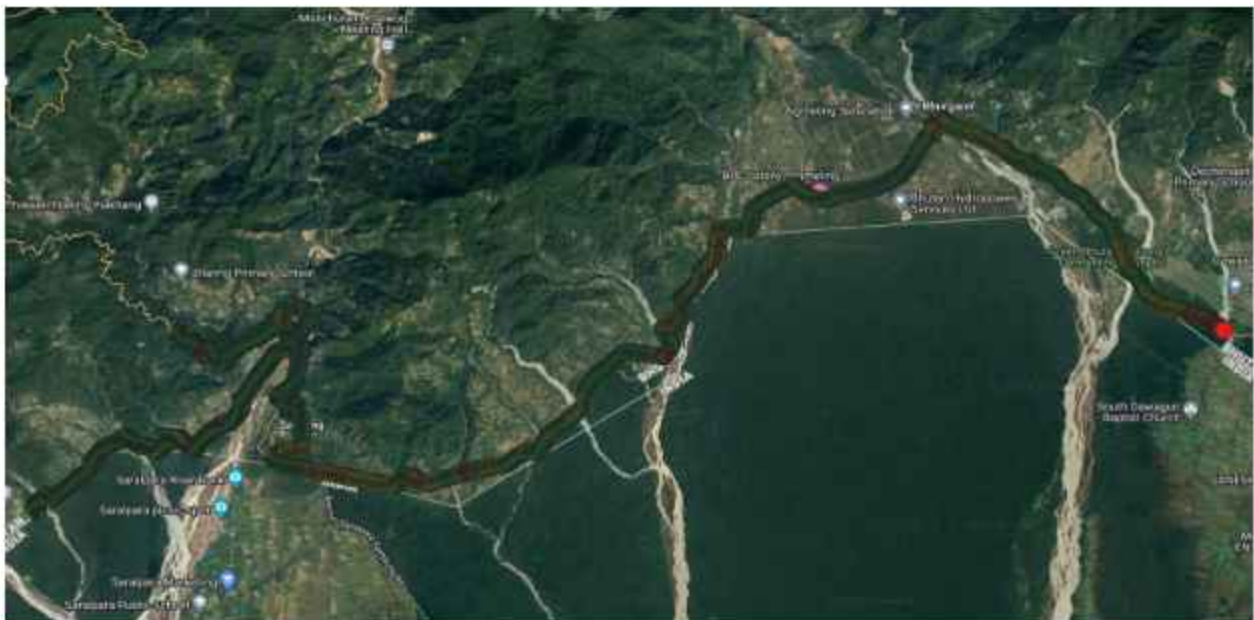5. *Senggey-Gelephu High Road Network Coverage*

Figure number 9: RSRP plot 4G B-mobile [Senggey-Gelephu High Road Network Coverage]

Figure number 10: RSRP plot 4G Tashi Cell (QGIS) [Senggey-Gelephu High Road Network Coverage]

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6. **Tareythang (Sarpang)**

- **Mobile Voice Service**

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.82	7.344	No issue
TICL	0	4.05	7.24	No issue

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

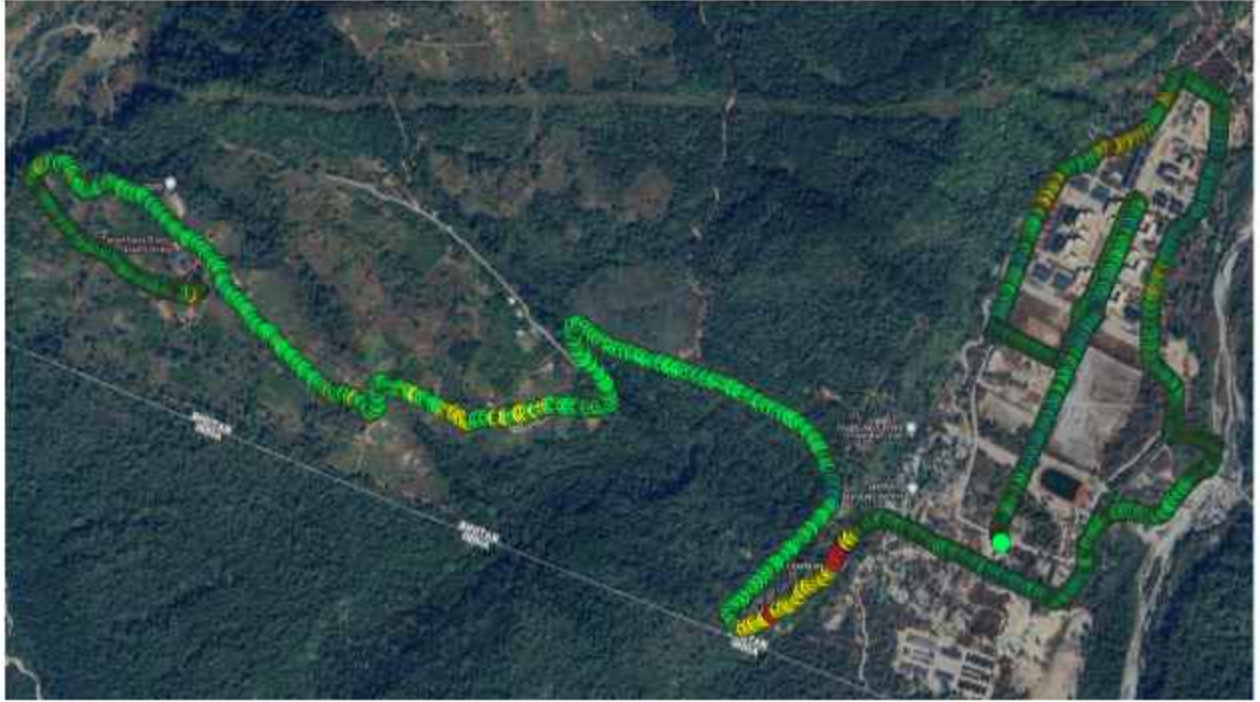| Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	47.44	14.80	No issue
TICL	32.0833	9.24	No issue

Figure number 11: RSRP plot 4G B-mobile (QGIS) [Tareythang]

Figure number 12: RSRP plot 4G Tashi Cell (QGIS) [Tareythang]

7. Shompangkha (Network Coverage)

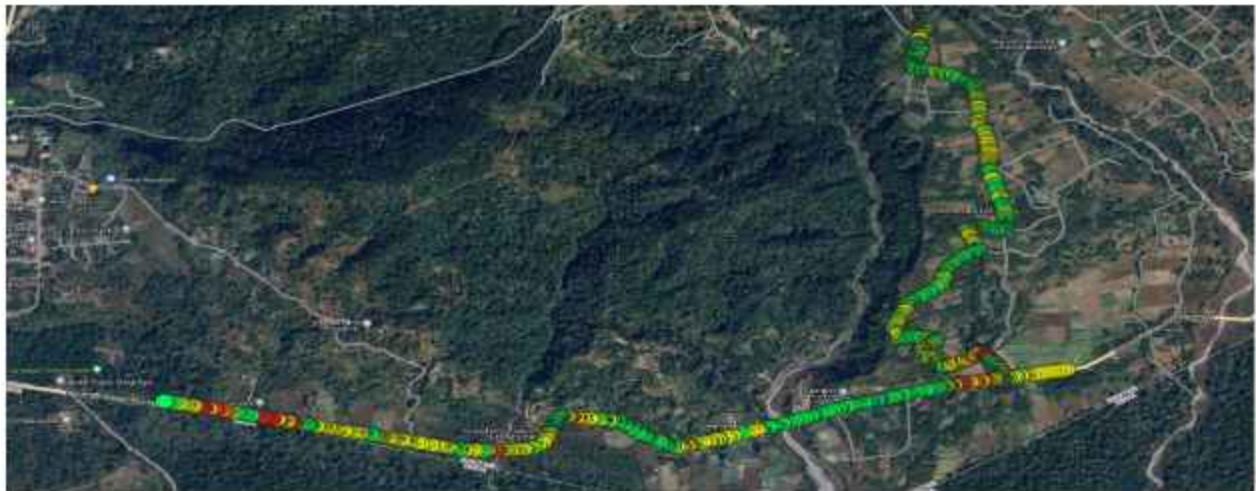
Figure number 13: RSRP plot 4G B-mobile (QGIS) [Shompangkha]

Figure number 14: RSRP plot 4G Tashi Cell (QGIS) [Shompangkha]

8. Umling (Sarpang)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.78	7.91	No issues
TICL	0	3.97	7.518	No issues

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	11.92	13.85	No issue
TICL	16.168	7.714	No issue

Figure number 15: RSRP plot 4G B-mobile (QGIS) [Umiling]

Figure number 16: RSRP plot 4G Tashi Cell (QGIS) [Umling]

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9. Chhuzagang (Sarpang)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.725	**9.311**	Issue with the setup time
TICL	0	3.87	7.83	No issues

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	9.81	4.988	No issues
TICL	24.59	6.8955	No issues

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

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

10. Norbuling and Sershong (Sarpang)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.81	7.8	No issues
TICL	0	3.955	7.65	No issues

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

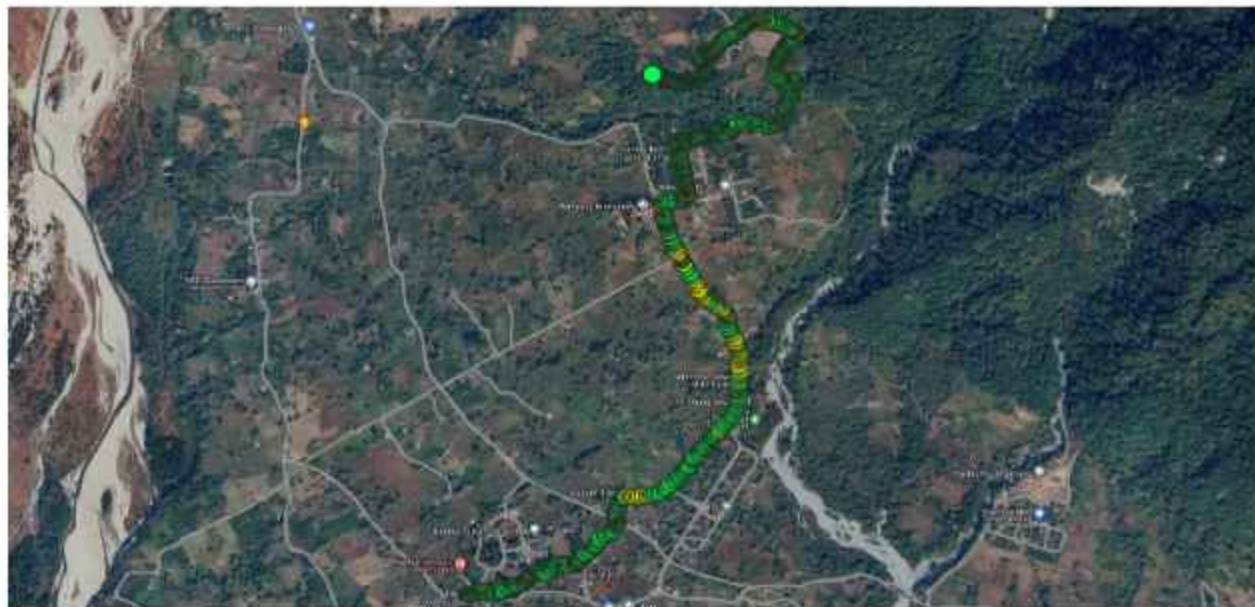| Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	19.72	13.19	No issues
TICL	26.088	21.40	No issues

Figure number 19: RSRP plot 4G B-mobile (QGIS) [Norbuling and Sershong]
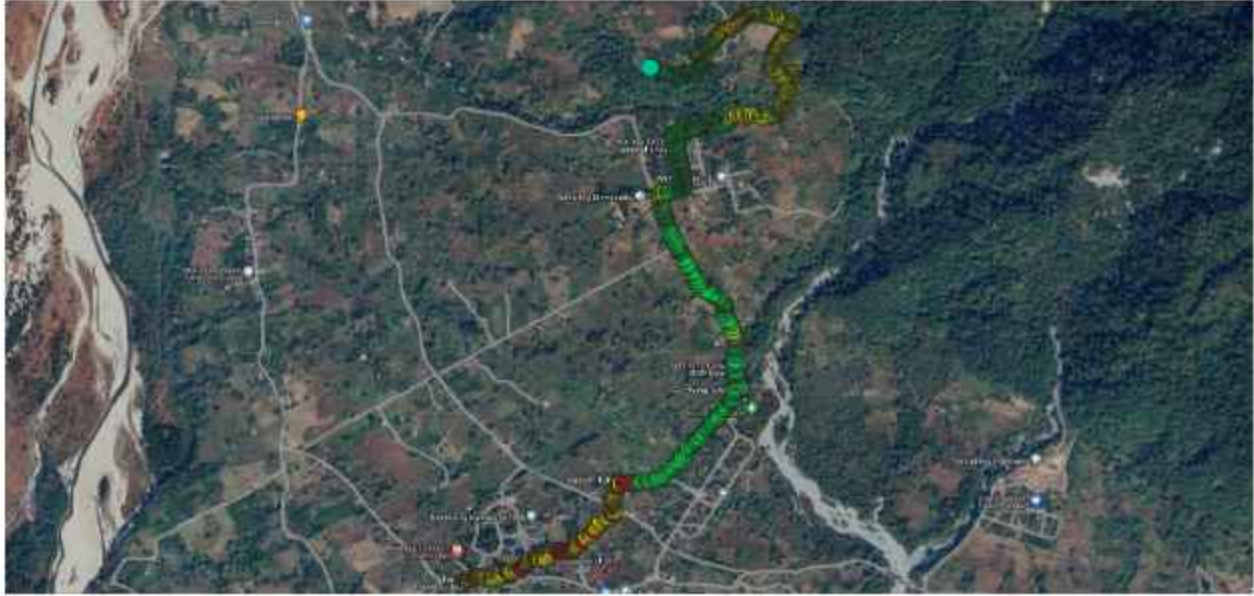
Figure number 20: RSRP plot 4G Tashi Cell (QGIS) [Norbuling and Sershong]

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11. Gelephu Thom (Sarpang)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.58	8.70	No issues
TICL	0	4.035	7.409	No issues

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	15.11	17.91	No issues
TICL	12.74	10.28	No issues

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

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

12. Zomlingthang and Airport Area (Sarpang)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.66	8.98	No issues
TICL	0	3.88	7.350	No issues

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

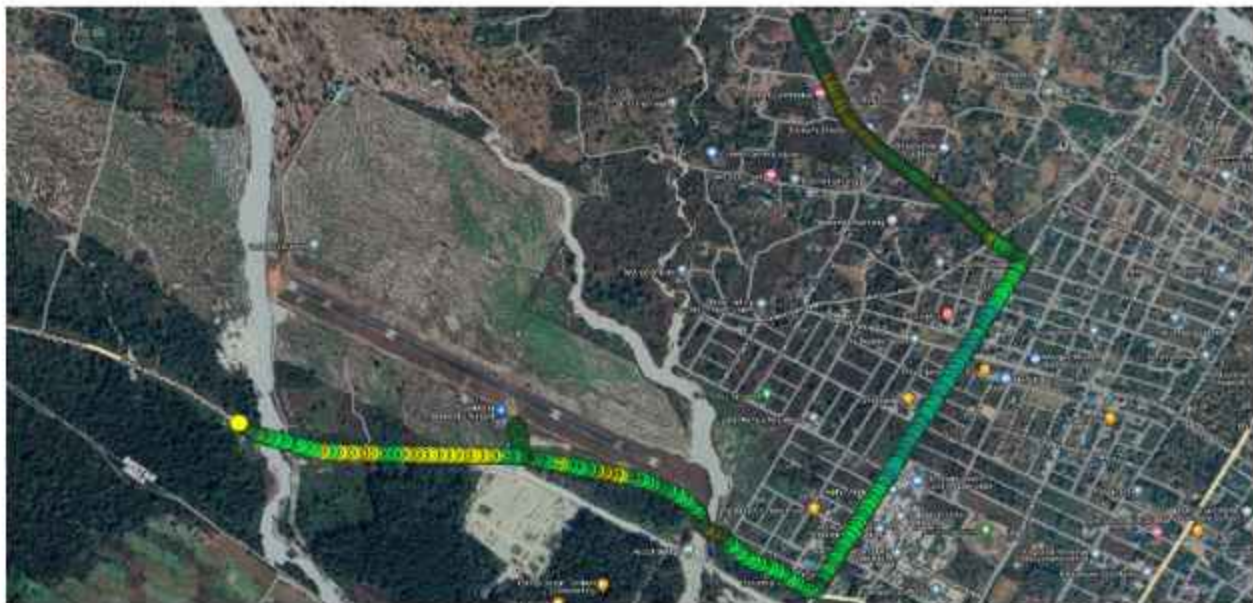| Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	15.29	6.96	No issues
TICL	22.17	18.932	No issues

Figure number 23: RSRP plot 4G B-mobile (QGIS) [Zomlingthang and Airport]
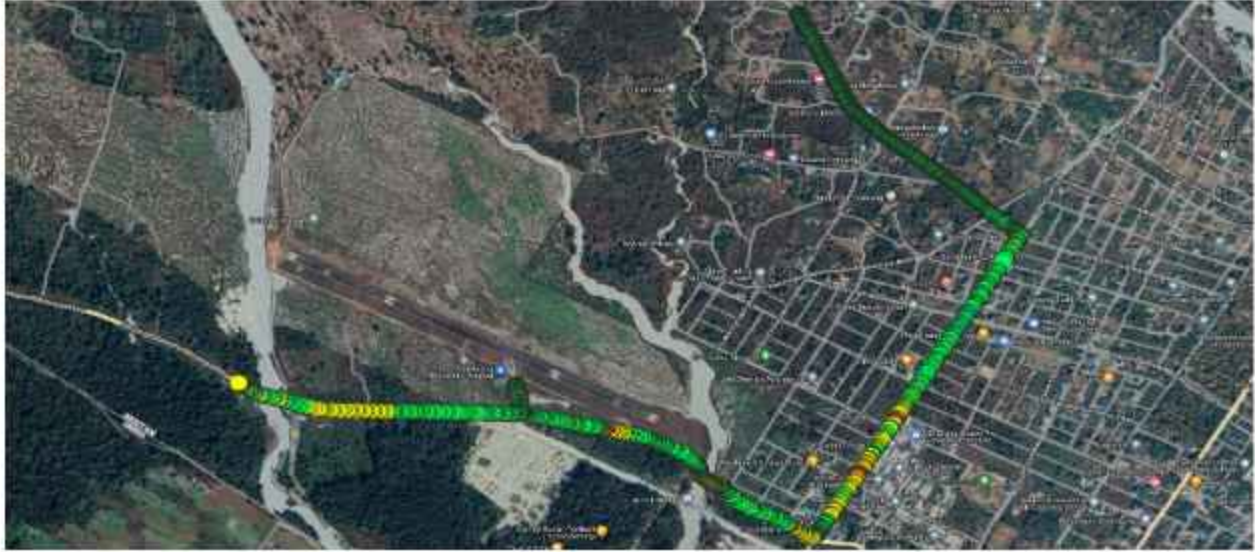
Figure number 24: RSRP plot 4G Tashi Cell (QGIS) [Zomlingthang and Airport]

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13. Bhur aad Airport Area (Sarpang)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.73	8.52	No issues
TICL	0	4.11	8.031	No issues

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

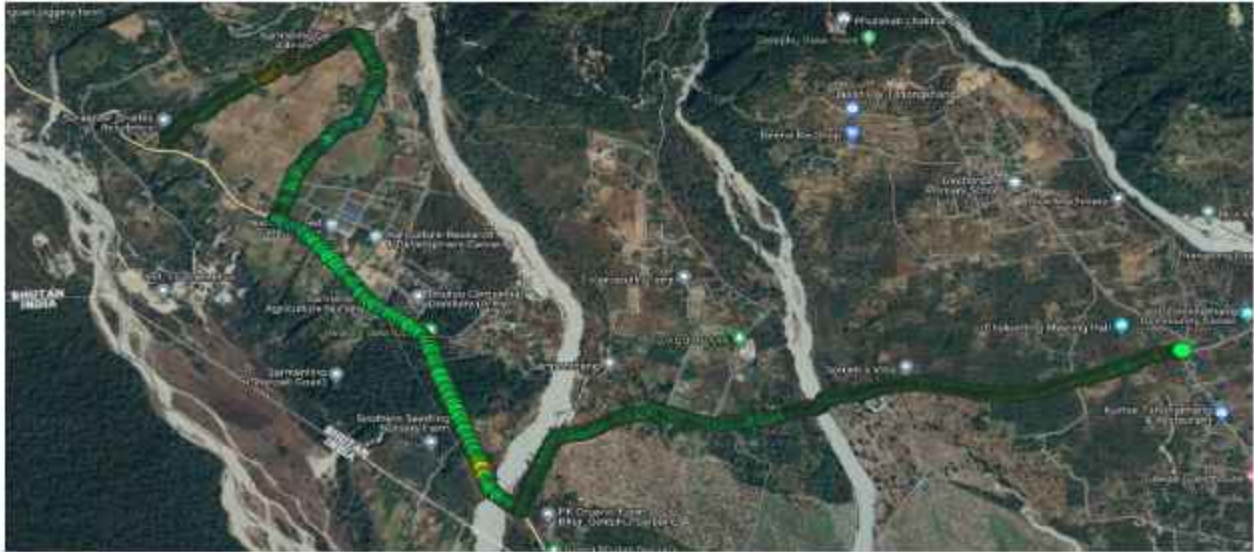| Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	8.72	12.96	No issues
TICL	15.18	11.26	No issues

Figure number 25: RSRP plot 4G B-mobile (QGIS) [Bhur and Airport Area]

Figure number 26: RSRP plot 4G Tashi Cell (QGIS) [Bhur and Airport area]

14. Jungshina

- **Mobile Voice Service**

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.7	8.19	No issue
TICL	0	4.02	7.25	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	47.28	14.39	No issue
TICL	17.02	12.75	No issue

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

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

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15. Bongdey (Paro)

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.93	8.8	No Issue
TICL	0	4.01	7.1	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	29.52	23.33	No issue
TICL	16.26	17.04	No issue

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

Figure number 30: RSRP plot 4G Tashi Cell (QGIS) [Bongdey]

16. Paro Town

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.81	8.02	No issue
TICL	10%	3.71	11.71	Issue with Call Drop and CFBST

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	14.12	10.50	No issue
TICL	26.23	22.61	No issue

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

Figure number 32 : RSRP plot 4G Tashi Cell (QGIS) [Paro Town]

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17. Shaba (Indoor)

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	53.69	17.67	No issue
TICL	3.87	4.89	Issue with both download and Upload Throughputs

18. Haa Town

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.78	8.36	Issue with setup time
TICL	0	4.16	6.75	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	44.51	16.18	No issue
TICL	33.29	24.22	No issue

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

Figure number 34 : RSRP plot 4G Tashi Cell (QGIS) [Haa Town]

19. Haa IMTRAT Area

- *Mobile Voice Service*

Operator	Call Drop rate (<2%)	Mean Opinion Score (>= 3.5)	Call Fallback Setup Time (<= 9 Seconds)	Remark
BTL	0	3.98	7.83	No issue
TICL	0	4.01	6.45	No issue

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

Operators	File Transfer Protocol		Remarks
	Download (≥ 6 Mbps)	Upload (≥ 2 Mbps)	
BTL	72.64	27.75	No issue
TICL	17.86	16.78	No issue

Figure number 35: RSRP plot 4G B-mobile (QGIS)[Haa IMTRAT Area]

Figure number 36: RSRP plot 4G Tashi Cell (QGIS) [Haa IMTRAT Area]

4. Summarized Findings

1. Average Throughput for both the telecom operators BTL and TICL meets the standard of the Authority in almost all the monitored places in Sarpang Dzongkhag but Average Download Throughput for BTL were found below the standard in Dekiling Gewog.

2. There were no call drop issues for the both operators.

3. Call Fallback Setup Time issues were found in Jemiling, Senggey and Chhuzagang for BTL.

4. Coverage Maps shown in some parts of Sengge Gewog, Senggey-Gelephu highway road, Taraythang Gewog, Umling, Norbuling(Sershong), Zomlinthang & Airport area, Chhuzagang, Sompangkha and Bhur & Airport area in Sarpang Dzongkhag were found to have poor network coverage for BTL in those vicinities.

5. Coverage Maps shown in some parts of Dekiling, Jigmeling, Sengge Gewog, Senggey-Gelephu highway road, Tareythang Gewog, Umling, Norbuling(Sershong), Gelephu(Pemathang and Army Colony), Zomlinthang & Airport area, Chhuzagang, Sompangkha Gewog and Bhur & Airport area in Sarpang Dzongkhag were found to have poor network coverage for TICL in those vicinities.

6. Average Throughput for both the telecom operators meets the standard of the Authority in most of the monitored places except for the indoor test done at Shaba, Paro for TICPL.

7. There were no call drop issues for the both operator in most places except at Paro Town for TICPL

8. There were no Call Fallback Setup Time issues for both the operators in most of the places except at Paro Town for TICPL.

9. No Coverage issues were present in the monitored places for both the operators.

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 has asked both the Telecom operators to send the densification/expansion plans in Sarpang and Gelephu area.

- Accordingly, the Authority has reviewed the submission from both the telcos and followed up closely for their execution and implementation.

- Followed up on the QoS complaint of Langchenphug Gewog (Asking BTL to submit any plans for commissioning new sites to resolve the issues).

- Asked Telcos to update the format of OSS report submission

6. Terminologies

I.   **Operator**: Refers to the respective mobile service providers

II. **Call Drop Rate:** Refers to the fraction of the telephone calls which, due to technical reasons, were cut off before the speaking parties had finished their conversation and before one of them had hung up (dropped calls).

III. **CDR** = (Number of Call drops/ Total number of attempted calls) x 100

IV. **Call Completion Rate:** Refers to the ratio of successfully completed calls to the total number of attempted calls.

V.   **CCR** = Number of successful calls / total number of attempted calls

VI. **Data Throughput Rate:** Refers to the actual amount of data transmitted or transferred in a period of time. It is used for measuring the speeds of data uploads or downloads.
   A. For 3G, the benchmark is: Uplink >= 1Mbps, Downlink >= 1.5 Mbps
   B. For 4G, the benchmark is: Uplink >= 2Mbps, Downlink >= 6Mbps

VII. **File Transfer Protocol (FTP):** Is a standard network protocol used for the transfer of computer files between a client and server on a computer network.

VIII. **Hypertext Transfer Protocol (HTP):** Is an application protocol for distributed, collaborative, and hypermedia information systems. HTTP is the foundation of data communication for the World Wide Web.

IX. **Mean Opinion Score (MOS)**: Is a numerical measure of quality of human speech at the destination end of the circuit and will determine the voice quality of user experience (QoE) while talking over the phone.To measure the quality of experience (QoE). It is

expressed as a single number in the range from 1 to 5, where the value of 1 corresponds to the lowest quality experienced by the end-users and 5 as the excellent quality experienced as shown below:

- A. 5: Excellent
- B. 4: Good
- C. 3: Fair
- D. 2: Poor
- E. 1: Bad

X. **Peak Hours:** Is a time period determined by Service provider where traffic or number of call attempts is the maximum. The peak hours for Bhutan Telecom limited (BTL) is 3 PM to 10 PM while a peak hour for Tashi InfoComm Limited (TICL) is from 6PM to 12 AM.

XI. **Off – Peak Hours:** Is a time period determined by Service provided where the traffic or call attempts is moderate. The Off- peak hours of BTL is from 6 AM to 3 PM and Off-peak hours for TICL is from 6 AM to 6 PM.

XII. **Latency:** Is a measure of delay. In a network, **latency** measures the time it takes for some data to get to its destination across the network. It is usually measured as a round trip delay - the time taken for information to get to its destination and back again.

XIII. **Mbps**: stands for "megabits per second." It is a measure of internet bandwidth. In simple terms, bandwidth is the download rate of your internet connection. It is the maximum speed at which you can download data from the internet onto to your computer or mobile device

XIV. **RxLeV:** RxLev represents the received signal strength level measured in dBm units. -105dBm represents the weakest/unusable signal and -80 dBm the strongest.

XV. **RSCP:** received signal code power denotes the power measured by a receiver on a particular physical communication channel.

XVI. **RSRP:** Reference Signal Received Power is a measurement of the received power level in an LTE cell network. The average power is a measurement of the power received from a single reference signal.

XVII. **Mobile Network Coverage (Signal Strength)**

Sl.No	QoS Parameters	Best dBm	Average dBm	Worst dBm

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