TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Jammu & Kashmir LSA

June 2025

Contents

1. Introduction

TRAI Act, 1997 mandates the Authority to ensure the services delivered through various telecommunications networks meet required quality standards prescribed, to protect the interest of the consumers of telecommunication services. TRAI is also responsible for conducting the periodical audit of such services provided by the service providers so as to protect the interest of the consumers of telecommunications service.

Accordingly, TRAI has engaged M/s RedMango Analytics Pvt. Ltd. to undertake assessment of Quality of Service of mobile service through Independent Drive Test (IDT).

In IDT, the performance of all service providers providing service in a Licensed Service Area (LSA) through various technologies (like 2G/ 3G/ 4G/ 5G) for voice and data are measured by conducting drive test. The drive test routes are finalised based on various objective criteria like reported network performance, consumer complaints etc. Methodology adopted for conducting IDT is elaborated in **APPENDIX-I**.

2. Executive Summary (LSA)
2.1 Drive test details

This report covers the findings of the IDT undertaken in Jammu & Kashmir License Service Area (LSA) during the month of June-2025 under the supervision of TRAI Regional Office (RO) Delhi. Details of route / area covered during the IDT is as given below:

S. No	Drive test route	Type of route	Distance covered (KMs)	From date	To date
1	Leh	City	41.3	10-Jun-2025	10-Jun-2025
2	Leh	Hotspot	5 Locations	12-Jun-2025	12-Jun-2025
3	Leh	Walk Test	2.0	12-Jun-2025	12-Jun-2025
4	Leh to Nubra Valley, Nubra Valley to Pangong and Pangong to Leh	Highway	302.0	10-Jun-2025	12-Jun-2025

Table-1: Drive test summary

2.2 Drive test routes

The map provides overview of drive test routes indicating city drive, hotspots, walk test and highway as per the legends shown on the map.
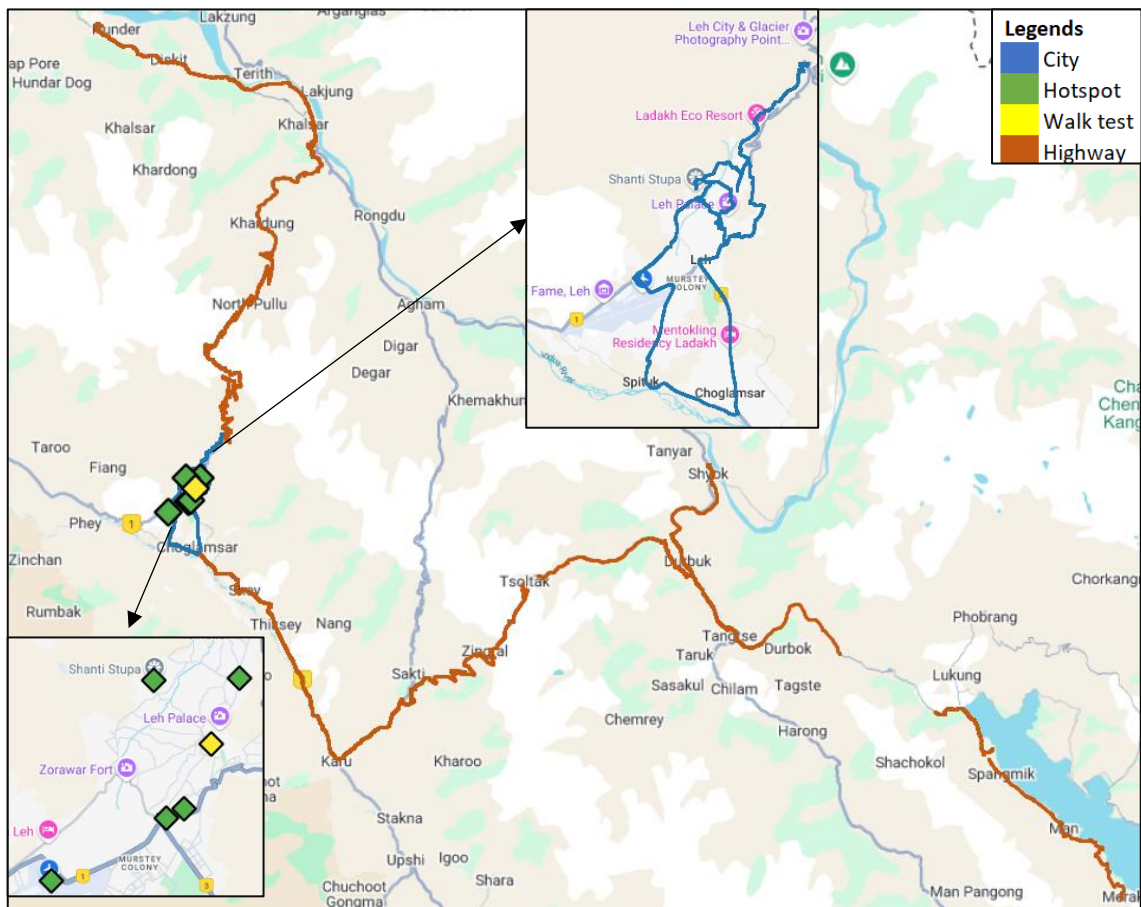
Figure-1: Drive test routes

2.3 Summary of areas covered

a) City-Choglamsar, Spituk and Yurtung etc.

b) Hotspot
1. EJM College
2. Lamdon School
3. Leh Airport
4. Shanti Stupa
5. SNM Hospital

c) Walk test
1. Leh Market

d) Highway
Leh to Nubra Valley passing through North Pullu, Khardung, Khalsar and Hunder etc.
Nubra Valley to Pangong passing through Shyok, Durbuk,Tangtse, Spangmik, Man and Merak etc.
Pangong to Leh passing through Tsoltak, Zingral, Karu, Thiksey and Shey etc.

2.4 Telecom service providers detected frequency bands

Technologies covered during the IDT and frequency bands in use are summarised in table below:

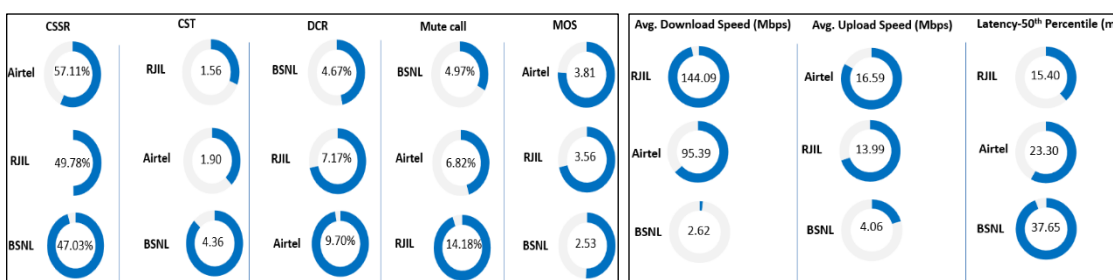| S.no.	Name of TSP	Technology	Frequency Bands (In MHz)
1	Bharti Airtel Ltd.	2G	900
2	Bharti Airtel Ltd.	4G	900,1800,2100,2300
3	Bharti Airtel Ltd.	5G	3500
4	BSNL	2G	900
5	BSNL	3G	2100
6	BSNL	4G	700,2100
7	Reliance JIO Infocomm Ltd.	4G	850,1800,2300
8	Reliance JIO Infocomm Ltd.	5G	700,3500
9	Vodafone Idea Ltd.	2G	-
10	Vodafone Idea Ltd.	3G	-
11	Vodafone Idea Ltd.	4G	-

Table-2: Telecom service provider (TSP) covered in IDT

Note- "-" There is no network of VIL across the measured route during the testing.

2.5 Performance against key QoS parameters

CSSR: Call Setup Success Rate (in %), **CST**: Call Setup Time (in seconds), **DCR**: Drop Call Rate (in %) & **MOS**: Mean Opinion Score.

	CSSR	CST	DCR	Mute call	MOS
	Airtel 57.11%	RJIL 1.56	BSNL 4.67%	BSNL 4.97%	Airtel 3.81
	RJIL 49.78%	Airtel 1.90	RJIL 7.17%	Airtel 6.82%	RJIL 3.56
	BSNL 47.03%	BSNL 4.36	Airtel 9.70%	RJIL 14.18%	BSNL 2.53

	Avg. Download Speed (Mbps)	Avg. Upload Speed (Mbps)	Latency-50th Percentile (ms)
	RJIL 144.09	Airtel 16.59	RJIL 15.40
	Airtel 95.39	RJIL 13.99	Airtel 23.30
	BSNL 2.62	BSNL 4.06	BSNL 37.65

Summary-Voice services

Call Setup Success Rate: Airtel, BSNL and RJIL have call setup success rate of 57.11%, 47.03% and 49.78% respectively in Auto-selection mode (5G/4G/3G/2G).

Call Setup Time: Airtel, BSNL and RJIL have call setup time of 1.90, 4.36 and 1.56 seconds respectively in Auto-selection mode (5G/4G/3G/2G).

Drop Call Rate: Airtel, BSNL and RJIL have drop call rate of 9.70%, 4.67% and 7.17% respectively in Auto-selection mode (5G/4G/3G/2G).

Call Silence/Mute Rate: Airtel, BSNL and RJIL have silence call rate of 6.82%, 4.97% and 14.18% respectively in packet switched network (4G/5G).

Mean Opinion Score (MOS): Airtel, BSNL and RJIL have average MOS of 3.81, 2.53 and 3.56 respectively.

Summary-Data services

Data Download performance (Overall): Average download speed of Airtel (5G/4G/2G) is 95.39 Mbps, BSNL (4G/3G/2G) is 2.62 Mbps and RJIL (5G/4G) is 144.09 Mbps.

Data Upload performance (Overall): Average upload speed of Airtel (5G/4G/2G) is 16.59 Mbps, BSNL (4G/3G/2G) is 4.06 Mbps and RJIL (5G/4G) is 13.99 Mbps.

Data performance - Hotspots (in Mbps):
Airtel- 4G D/L: 37.08   4G U/L: 13.29
          5G D/L: 152.00   5G U/L: 26.45
BSNL- 4G D/L: 2.29   4G U/L: 6.55
RJIL- 4G D/L: 15.53   4G U/L: 4.08
          5G D/L: 275.60   5G U/L: 32.73

Note- "D/L" Download speed, "U/L" Upload speed

Note- "-" There is no network of VIL across the measured route during the testing.

QoS Performance Analysis- Jammu & Kashmir LSA

3. QoS performance analysis-LSA level

3.1 Overview

This section provides summary of overall QoS performance of the telecom service provider's network in the LSA by aggregating the results of drive tests conducted in the Jammu & Kashmir LSA during the month of June-2025 covering city drive, hotspots, walk test and highway. (Refer Table 1)

3.2 Voice performance

(a) Voice Call Performance in 3G/2G network mode only: 3G/2G network mode testing has been done to reflect experience for respective users as they have only 3G/2G compatible handsets.

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	350	366	-
Call Setup Success Rate %	42.29	37.16	-
Drop Call Rate %	8.11	6.62	-
Call Setup Time-Average (Second)	3.36	6.27	-
Handover Success Rate %	96.55	99.51	-

Table-3: Summary of voice call performance in 3G/2G network mode only.

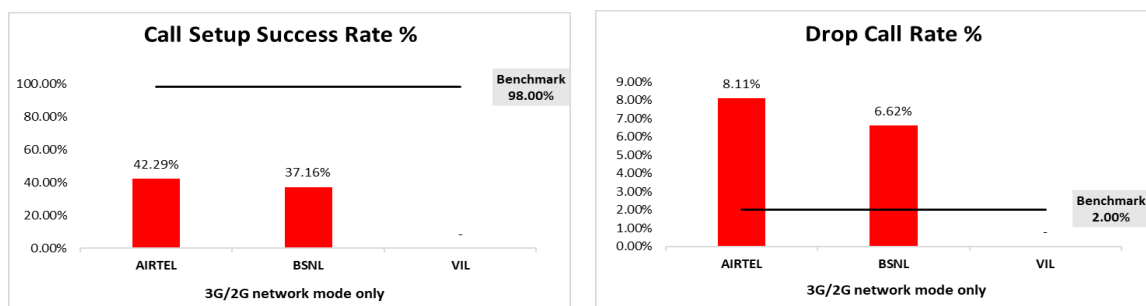**Note**- "-" There is no network of VIL across the measured route during the testing.

Figure-2: Call setup success rate and drop call rate performance.

Number of unique cell Id's covered in Voice test- Technology wise			
Technology	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
3G	NA	44	-
2G	132	42	-

Table-4: Technology wise number of network cell Id's latched during drive test.

Note-
- RJIL does not have 3G/2G network.
- NA- Service provider doesn't provide services in respective technology.
- "-" There is no network of VIL across the measured route during the testing.

(b) Voice Call Performance in auto network selection mode (5G/4G/3G/2G)

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	415	455	448	-
Call Setup Success Rate %	57.11	47.03	49.78	-
Drop Call Rate %	9.70	4.67	7.17	-
Call Setup Time-Average (Second)	1.90	4.36	1.56	-
Handover Success Rate %	99.89	99.84	99.71	-

Table-5: Summary of voice call performance in network auto-selection mode.

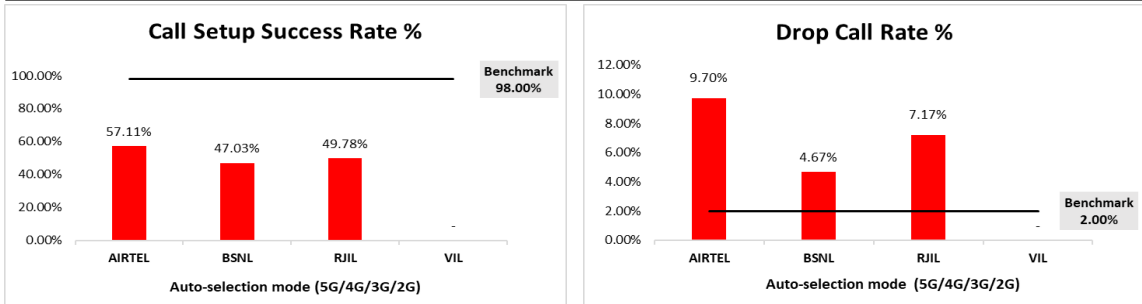> **Note**- "-" There is no network of VIL across the measured route during the testing.

Figure-3: Performance for call setup success rate and drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	176	161	134	-
Number of silence call for >4 Sec	12	8	19	-
Silence Call Rate %	6.82	4.97	14.18	-
Number of silence instances for >4 Sec	19	12	53	-
Number of silence instances for >3 Sec	27	18	66	-
Number of silence instances for >2 sec	43	30	94	-
RTP Jitter (4G & 5G) in ms	5.92	12.77	11.05	-
Packet loss Rate Downlink %	4.17	10.99	6.42	-
Packet loss Rate Uplink %	3.85	9.23	6.02	-

Table-6: Summary of silence instances & packet loss rate for mobile to mobile calls.

> **Note**- "-" There is no network of VIL across the measured route during the testing.

Number of unique cell Id's covered in Voice test- Technology wise				
Technology	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
5G	0	NA	71	-
4G	325	121	336	-
3G	NA	22	NA	-
2G	21	29	NA	-

Table-7: Technology wise number of network cell Id's latched during drive test.

> **Note**-
> * NA- Service provider doesn't provide services in respective technology.
> * 0- No cell Id's were found in respective technology.
> * "-" There is no network of VIL across the measured route during the testing.

(c) Mean Opinion Score (MOS) performance for speech quality:

Mean opinion score indicates quality of speech observed during the drive test across different technologies. This parameter has been calculated for mobile-to-mobile calls made within same operator network in auto mode (5G/4G/3G/2G). As per ITU-T Recommendation P.863.1, MOS values means: 5-Excellent, 4-Good, 3-Fair, 2-Poor, 1-Bad.

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls table-6	1437	886	1083	-
Speech Quality (Average MOS)	3.81	2.53	3.56	-
Number of samples with MOS >=4 to <5 (Excellent)	1077	45	640	-
Number of samples with MOS >=3 to <4 (Good)	211	138	258	-
Number of samples with MOS >=2 to <3 (Fair)	68	494	54	-
Number of samples with MOS >=1 to <2 (Poor)	81	209	131	-
%age of samples with MOS >=4 to <5 (Excellent)	74.95%	5.08%	59.10%	-
%age of samples with MOS >=3 to <4 (Good)	14.68%	15.58%	23.82%	-
%age of samples with MOS >=2 to <3 (Fair)	4.73%	55.76%	4.99%	-
%age of samples with MOS >=1 to <2 (Poor)	5.64%	23.59%	12.10%	-

Table-8: Summary of speech quality (MOS) samples.

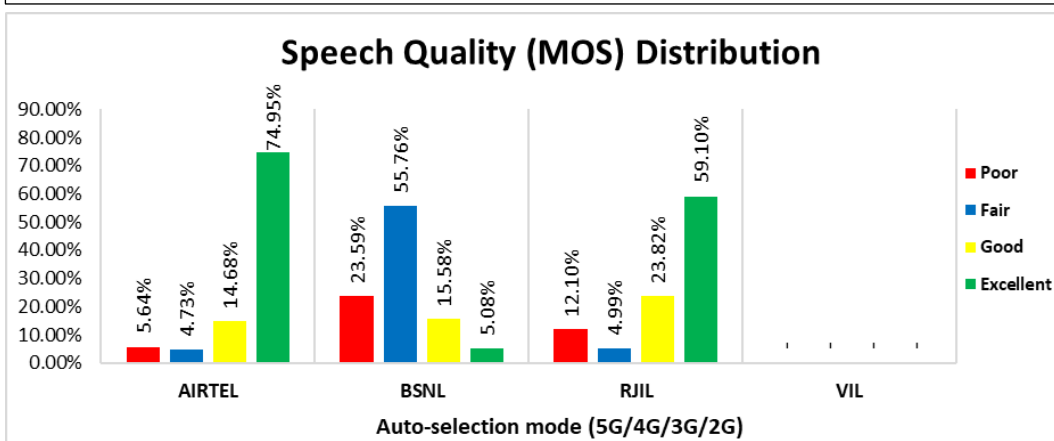**Note**- "-" There is no network of VIL across the measured route during the testing.

Figure- 4: Distribution of samples in MOS range.

3.3 Data performance

(a) Data Parameters (Auto-selection mode- 5G/4G/3G/2G)

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	95.39	2.62	144.09	-
	80th Percentile	197.35	4.69	307.85	-
	20th Percentile	9.81	0.23	3.67	-
Upload Throughput (Mbits/s)	Average	16.59	4.06	13.99	-
	80th Percentile	30.53	6.46	21.44	-
	20th Percentile	1.66	1.24	1.18	-
Latency (ms)	50th Percentile	23.30	37.65	15.40	-

Table-9: Summary of data performance in network auto-selection mode.

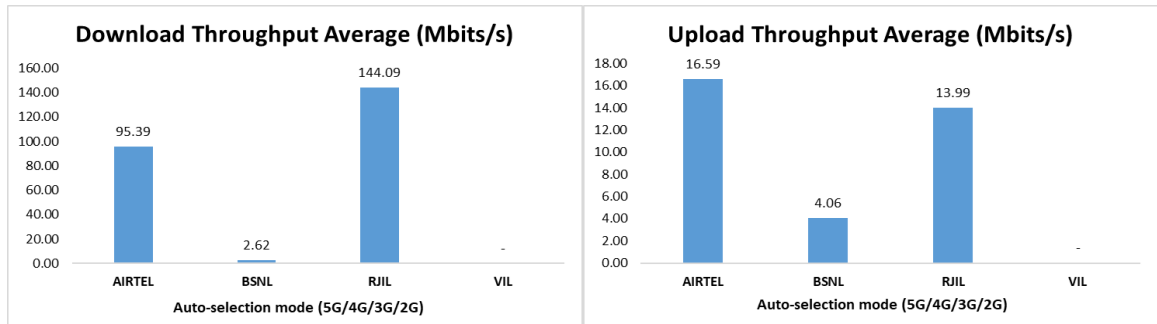**Note**- "-" There is no network of VIL across the measured route during the testing.

Figure- 5: Download and Upload throughput

Number of unique cell Id's covered in Data test- Technology wise				
Technology	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	0	NA	91	-
4G	387	97	256	-
3G	NA	44	NA	-
2G	9	19	NA	-

Table-10: Technology wise number of network cell Id's latched during drive test.

Note-
- NA**-** Service provider doesn't provide services in respective technology.
- 0- No cell Id's were found in respective technology.
- "-" There is no network of VIL across the measured route during the testing.

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis
4.1 Overview

This section covers analysis on performance of various categories of drives like city, hotspots, walktest and highway for all telecom service providers, the results of drive tests conducted are shown individually for respective areas/locations.

4.2 City

Drive test has been conducted on 10th June 2025 in Leh city. (Refer Table-1)
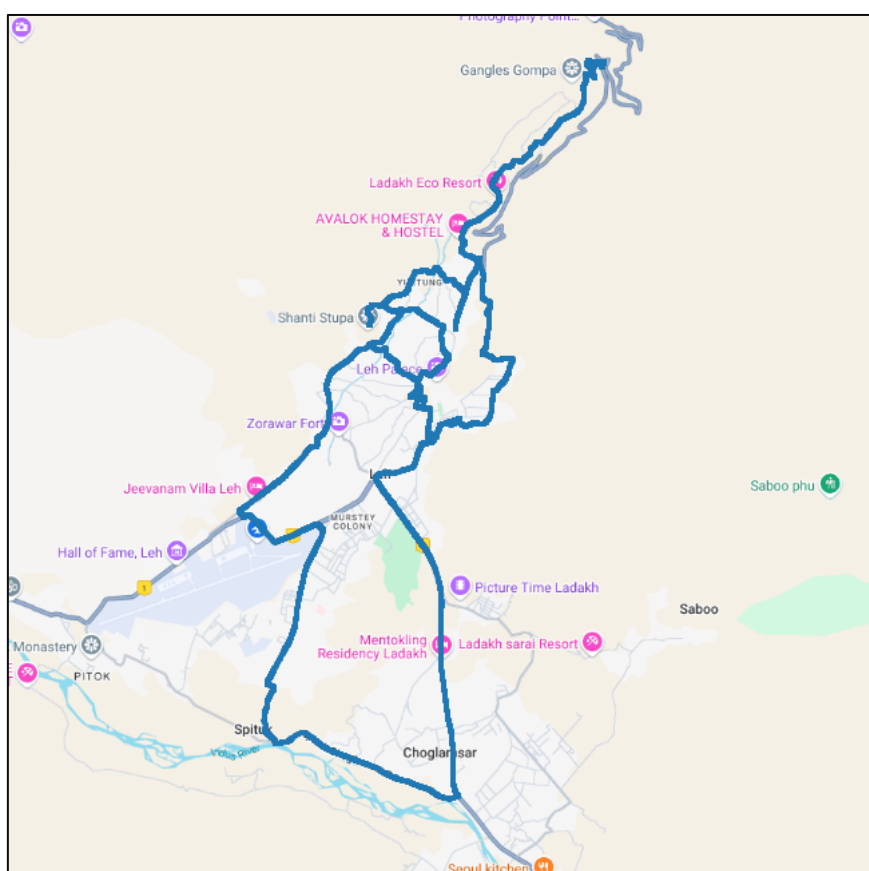
4.2.1 Drive test route

Figure- 6: Drive test routes

4.2.2 Areas covered

Choglamsar, Spituk and Yurtung etc.

4.2.3 Voice performance

(a) Voice Call Performance in 3G/2G network mode only: 3G/2G network mode testing has been done to reflect experience for respective users as they have only 3G/2G compatible handsets.

Parameters	Service Provider 3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	57	56	-
Call Setup Success Rate %	98.25	96.43	-
Drop Call Rate %	0.00	1.85	-
Call Setup Time-Average (Second)	2.91	5.84	-
Handover Success Rate %	91.20	100.00	-

Table-11: Summary of voice call performance in 3G/2G network mode only.

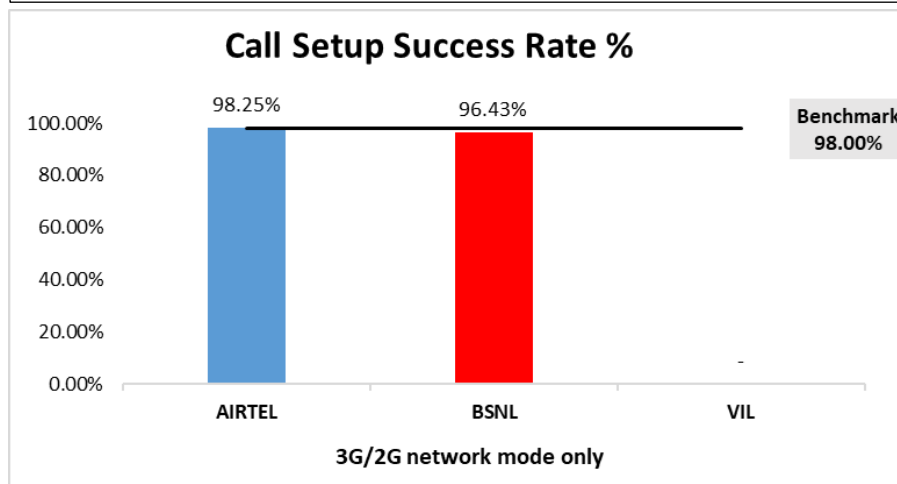**Note**- "-" There is no network of VIL across the measured route during the testing.

Figure-7: Performance for call setup success rate.
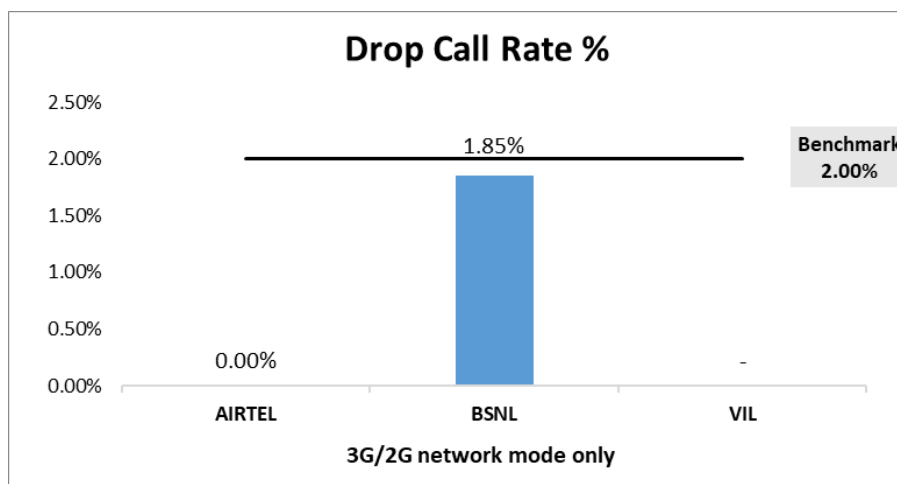

Figure-8: Performance for drop call rate.

(b) Network Technology: This section represents time spent on various network technologies.

Technology	Service Provider		
	AIRTEL	BSNL	VIL
3G	NA	80.68%	-
2G	100.00%	19.32%	-
Limited Service	0.00%	0.00%	-

Table-12: Time spent on technology during drive test 3G/2G network mode.

Note-
- NA**-** Service provider doesn't provide services in respective technology.
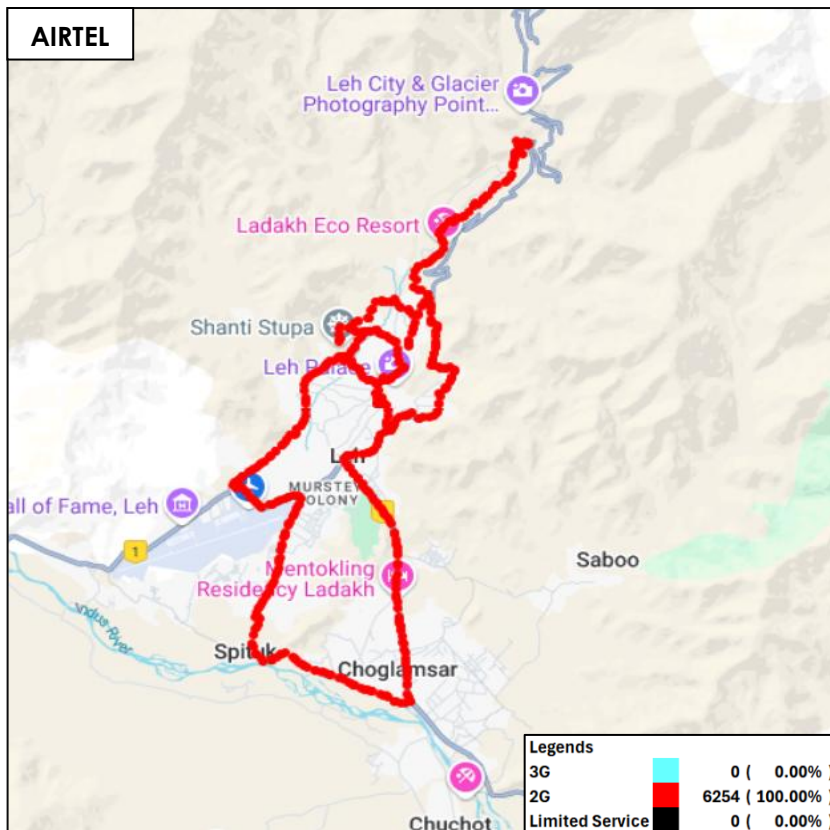- "-" There is no network of VIL across the measured route during the testing.

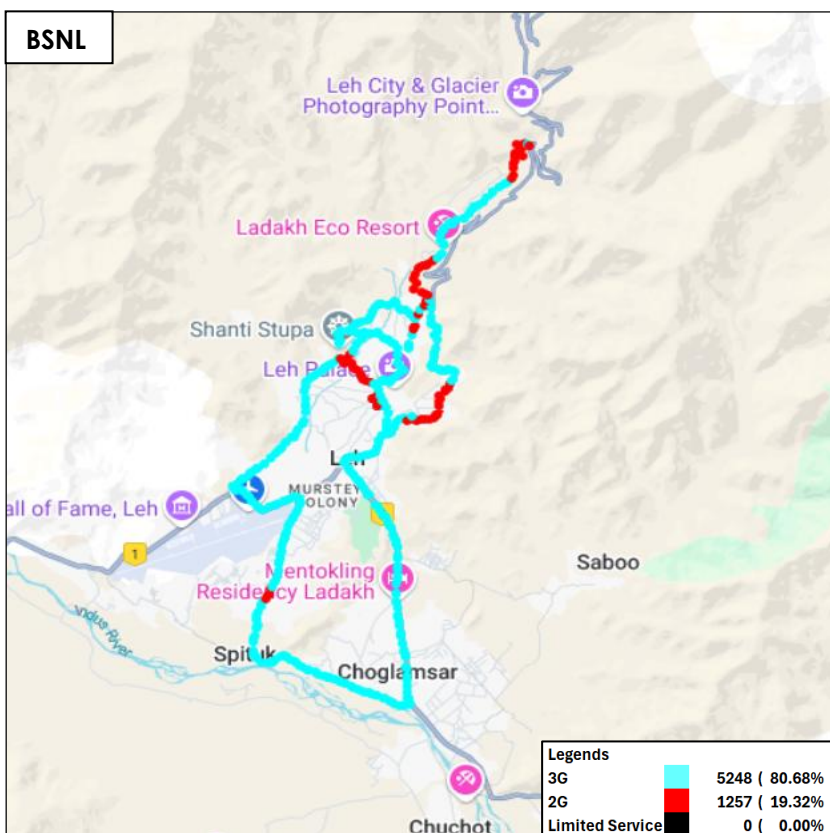**Figure-9:** Serving technology plots 3G/2G network mode – AIRTEL.

Figure-10: Serving technology plots 3G/2G network mode –BSNL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 38, & 39 for map view)
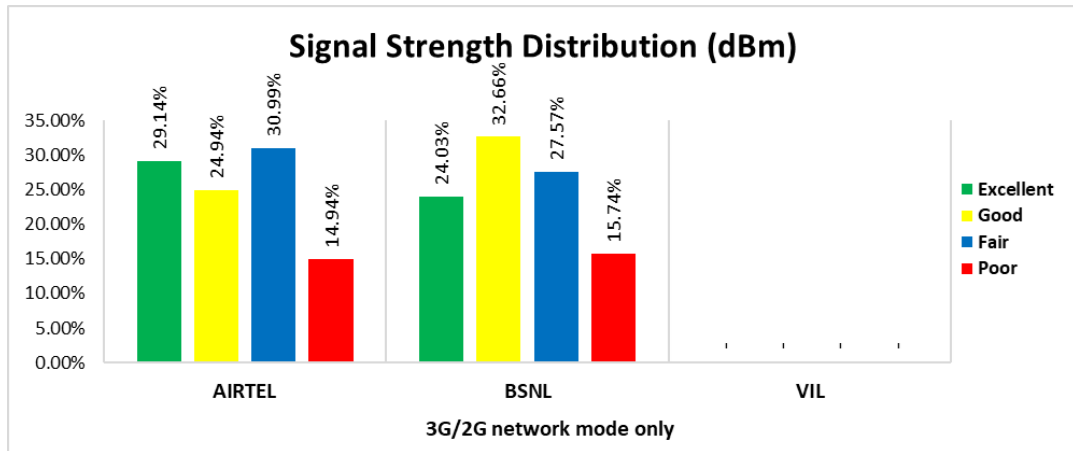

Figure-11: Signal strength distribution 3G/2G network mode only.

Note- "-" There is no network of VIL across the measured route during the testing.

Observations:
- Airtel has 29% of samples falling in the excellent signal strength category.
- BSNL has 24% of samples falling in the excellent signal strength category.

(d) Voice Call Performance in auto network selection mode (5G/4G/3G/2G)

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	59	59	60	-
Call Setup Success Rate %	100.00	98.31	100.00	-
Drop Call Rate %	0.00	1.72	0.00	-
Call Setup Time Average (Second)	2.17	3.92	0.88	-
Handover Success Rate %	100.00	100.00	100.00	-

Table-13: Summary of voice call performance in network auto-selection mode.

Note- "-" There is no network of VIL across the measured route during the testing.
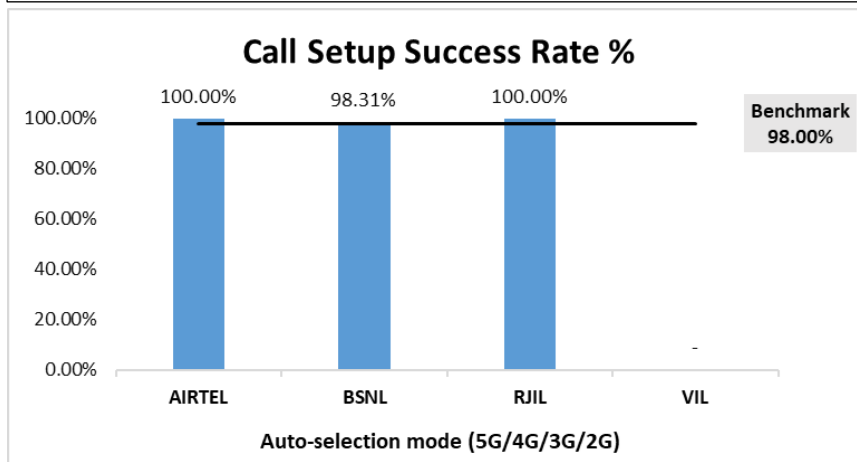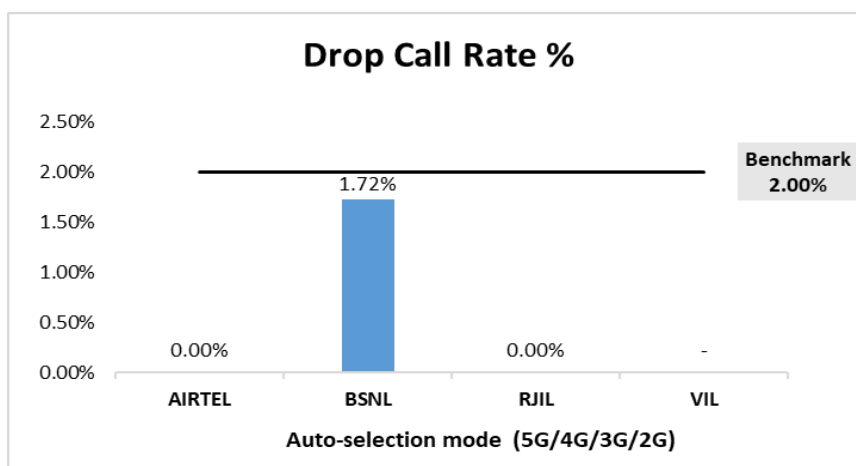

Figure-12: Performance for call setup success rate.

Figure-13: Performance for drop call rate.

Parameter	Service Provider Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Established (within service provider Network)	59	60	58	-
Number of silence call for >4 Sec	0	2	0	-
Silence Call Rate %	0.00	3.33	0.00	-
Number of silence instances for >4 Sec	0	2	0	-
Number of silence instances for >3 Sec	0	3	2	-
Number of silence instances for >2 sec	0	8	3	-
RTP Jitter (4G & 5G) in ms	5.03	12.63	7.54	-
Packet loss Rate Downlink %	0.16	11.72	0.83	-
Packet loss Rate Uplink %	0.25	9.26	1.24	-

Table-14: Summary of silence instances & packet loss rate for mobile to mobile call.

> **Note**- "-" There is no network of VIL across the measured route during the testing.

(e) Mean Opinion Score (MOS) performance for speech quality:

Mean opinion score indicate quality of speech observed during the drive test across different technologies. This parameter has been calculated for mobile to mobile calls made within same operator network in auto mode (5G/4G/3G/2G). As per ITU-T Recommendation P.863.1, MOS value means: 5-Excellent, 4-Good, 3-Fair, 2-Poor, 1-Bad.

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Total Number of MOS Samples for calls in table-14	344	293	326	-
Speech Quality (Average MOS)	4.04	2.53	3.81	-
Number of samples with MOS >=4 to <5(Excellent)	293	15	219	-
Number of samples with MOS >=3 to <4 (Good)	48	41	77	-
Number of samples with MOS >=2 to <3 (Fair)	1	168	17	-
Number of samples with MOS >=1 to <2 (Poor)	2	69	13	-
%age of samples with MOS >=4 to <5 (Excellent)	85.17%	5.12%	67.18%	-
%age of samples with MOS >=3 to <4 (Good)	13.95%	13.99%	23.62%	-
%age of samples with MOS >=2 to <3 (Fair)	0.29%	57.34%	5.21%	-
%age of samples with MOS >=1 to <2 (Poor)	0.58%	23.55%	3.99%	-

Table-15: Summary of speech quality (MOS) samples.

> **Note**- "-" There is no network of VIL across the measured route during the testing.
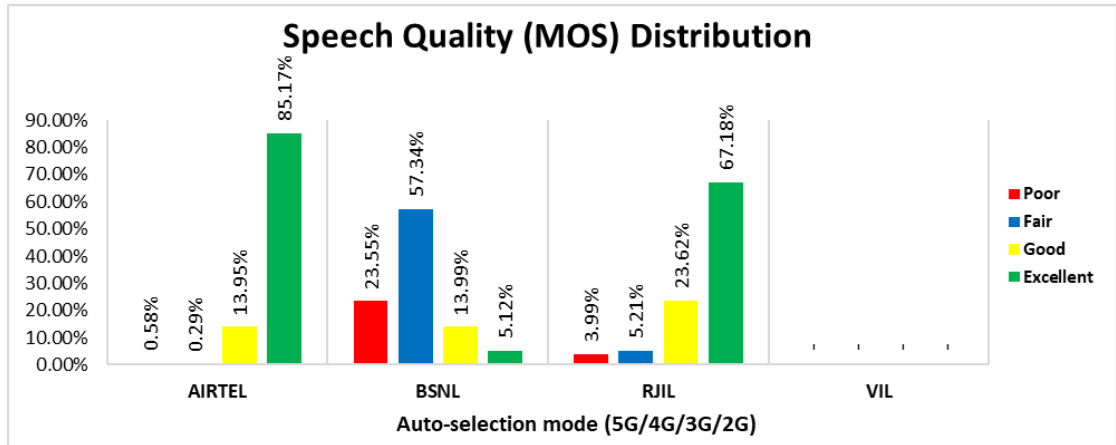
Figure-14: Distribution of samples in MOS range.

(f) Network Technology: This section represents time spent on various network technologies.

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	2.04%	NA	17.04%	-
4G	97.96%	67.88%	82.96%	-
3G	NA	20.68%	NA	-
2G	0.00%	10.91%	NA	-
Limited Service	0.00%	0.53%	0.00%	-

Table-16: Time spent on technology during drive test.

Note-
- NA**-** Service provider doesn't provide services in respective technology.
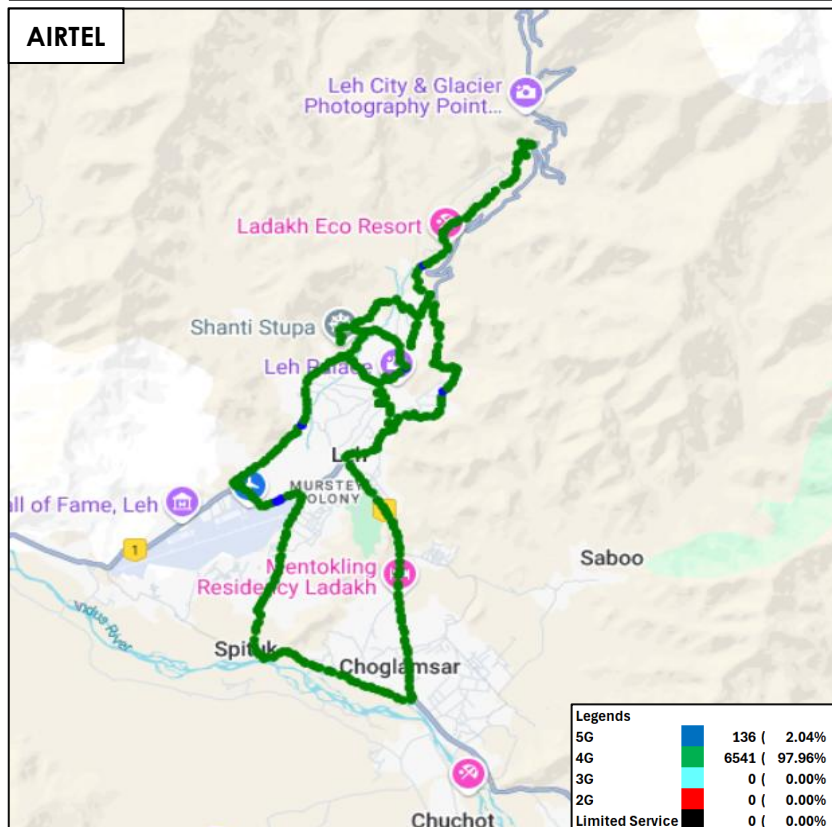- "-" There is no network in VIL across the measured route during the testing.

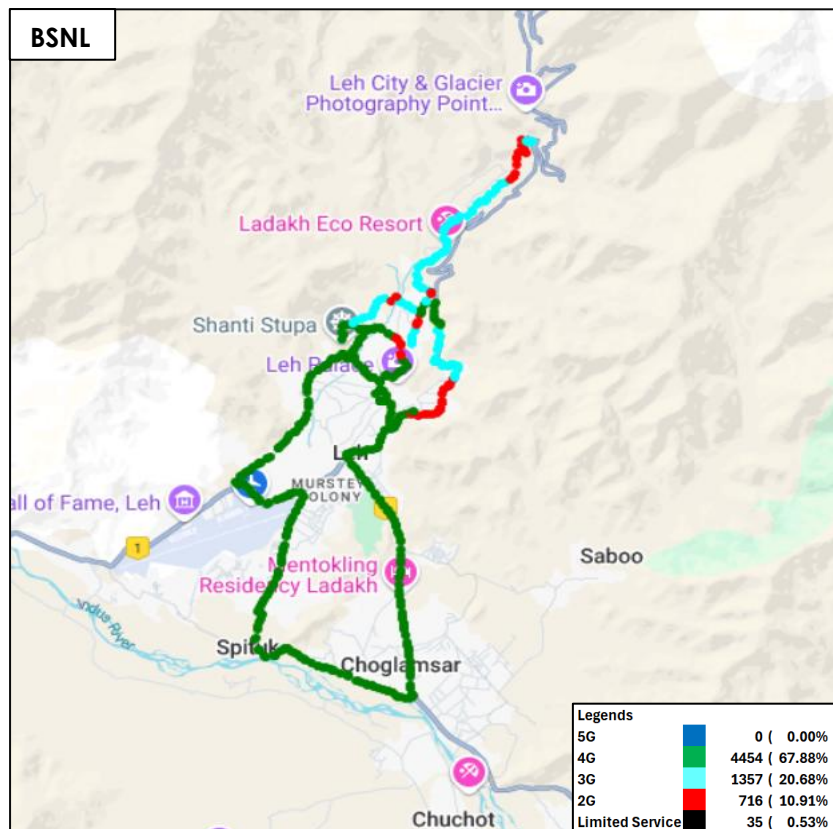**Figure-15:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) -AIRTEL.

Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -BSNL.
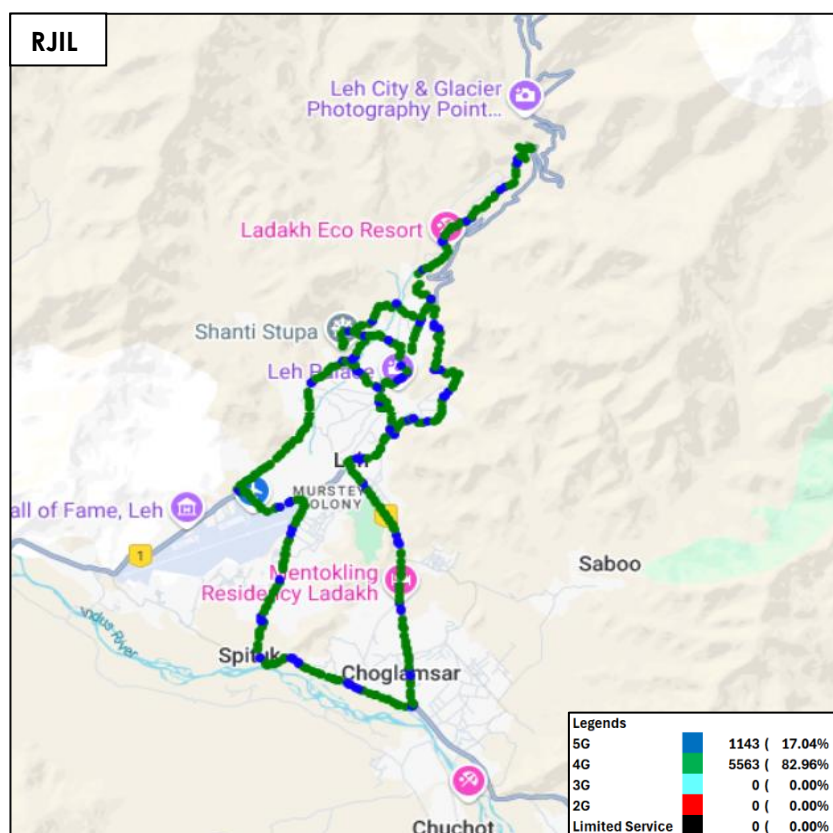

Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-40, 41 & 42 for map view)
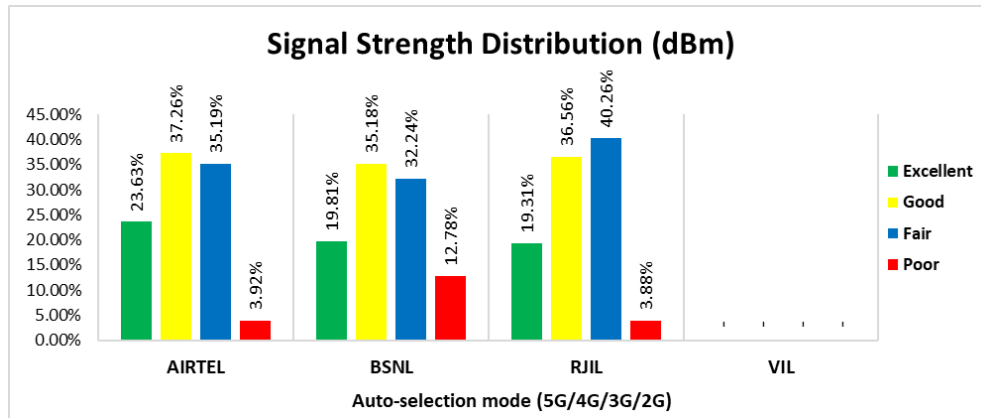

Figure-18: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Note- "-" There is no network of VIL across the measured route during the testing.

Observations:

- Airtel has 24% of samples falling in the excellent signal strength category.
- BSNL has 20% of samples falling in the excellent signal strength category.
- RJIL has 19% of samples falling in the excellent signal strength category.

4.2.4 Data performance

(a) Data Parameters (Auto-selection mode- 5G/4G/3G/2G)

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	114.97	2.29	168.57	-
	80th Percentile	248.79	4.40	367.98	-
	20th Percentile	24.93	0.43	7.90	-
Upload Throughput (Mbits/s)	Average	17.39	3.44	13.21	-
	80th Percentile	28.68	4.58	21.51	-
	20th Percentile	4.35	1.45	1.25	-
Latency (ms)	50th Percentile	23.20	47.90	14.80	-

Table-17: Summary of Data performance in network auto-selection mode.

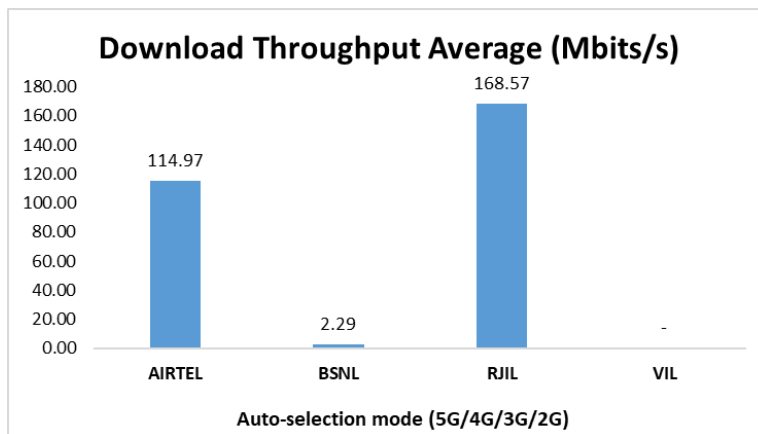**Note**- "-" There is no network of VIL across the measured route during the testing.
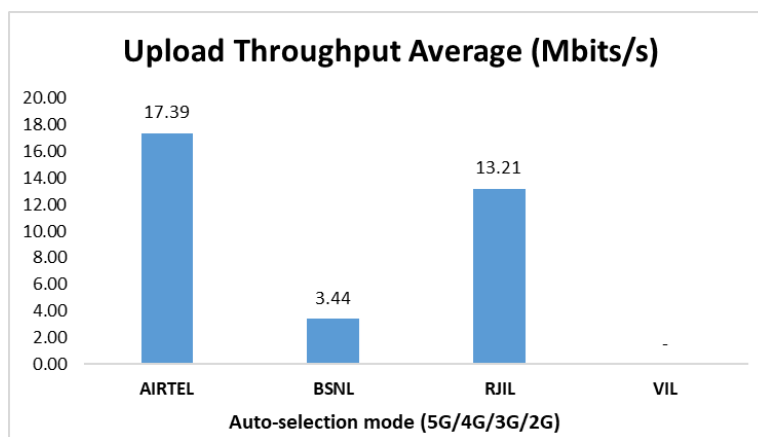
Figure- 19: Download throughput

Figure- 20: Upload throughput

4.3 Hotspots

Hotspots testing has been done on 12th June 2025. Five locations have been tested.

4.3.1 Locations
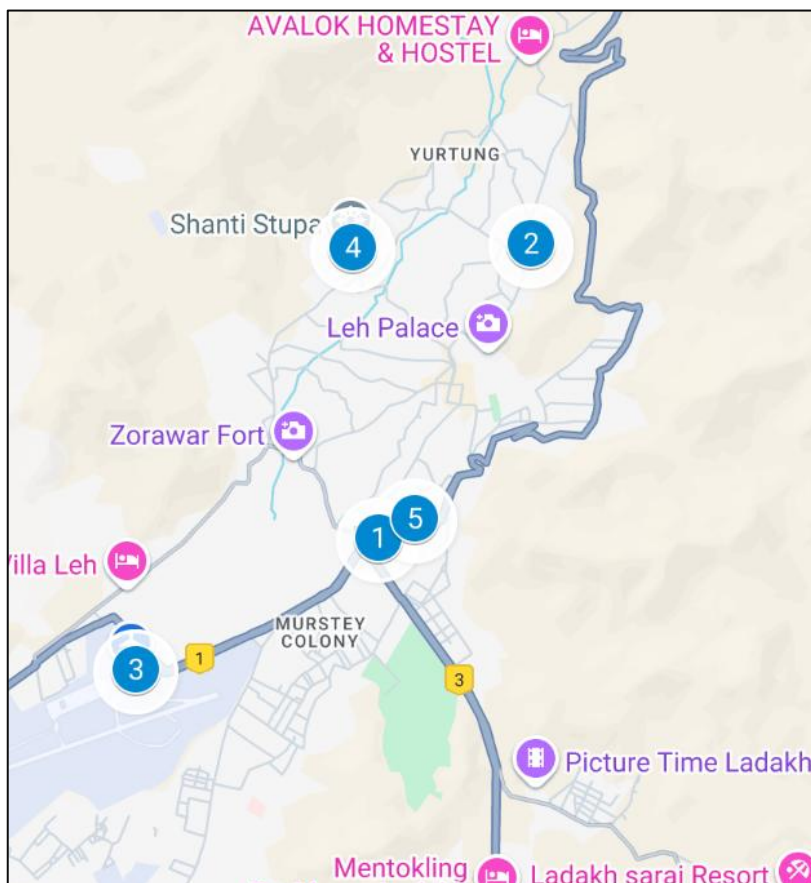
Figure- 21: Hotspot locations

4.3.2 Hotspot covered

1. EJM College
2. Lamdon School
3. Leh Airport
4. Shanti Stupa
5. SNM Hospital

4.3.3 Voice performance

Overall Voice Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	50	50	50	-
Call Setup Success Rate %	100.00	100.00	100.00	-
Drop Call Rate %	0.00	0.00	0.00	-
Call Setup Time-Average (Second)	1.42	3.38	0.65	-

Table-18: Overall summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Note- "-" There is no network of VIL across the measured hotspot locations during the testing.

EJM College				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	-
Call Setup Success Rate %	100.00	100.00	100.00	-
Drop Call Rate %	0.00	0.00	0.00	-
Call Setup Time-Average (Second)	1.42	2.47	0.63	-

Table-19: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Lamdon School				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	-
Call Setup Success Rate %	100.00	100.00	100.00	-
Drop Call Rate %	0.00	0.00	0.00	-
Call Setup Time-Average (Second)	1.44	5.42	0.60	-

Table-20: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Leh Airport				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	-
Call Setup Success Rate %	100.00	100.00	100.00	-
Drop Call Rate %	0.00	0.00	0.00	-
Call Setup Time-Average (Second)	1.42	2.88	0.69	-

Table-21: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Shanti Stupa				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	-
Call Setup Success Rate %	100.00	100.00	100.00	-
Drop Call Rate %	0.00	0.00	0.00	-
Call Setup Time-Average (Second)	1.42	3.30	0.74	-

Table-22: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

SNM Hospital				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	-
Call Setup Success Rate %	100.00	100.00	100.00	-
Drop Call Rate %	0.00	0.00	0.00	-
Call Setup Time-Average (Second)	1.41	2.84	0.59	-

Table-23: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

4.3.4 Data performance (Auto-selection mode 5G/4G/3G/2G)

Overall Data Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	166.37	3.13	200.79	-
Download Throughput 80th Percentile (Mbit/s)	253.88	4.85	344.53	-
Download Throughput 20th Percentile (Mbit/s)	74.79	2.00	36.47	-
Download Session Setup Success Rate %	100.00	84.00	100.00	-
Upload Throughput Average (Mbits/s)	31.18	3.50	23.17	-
Upload Throughput 80th Percentile (Mbit/s)	38.25	5.61	41.58	-
Upload Throughput 20th Percentile (Mbit/s)	26.91	2.30	6.46	-
Upload Session Setup Success Rate %	100.00	92.00	100.00	-
Web Browsing Delay (Second)	1.46	2.12	1.60	-
Youtube Initial Buffer Delay (Second)	0.72	1.75	1.04	-
Latency (ms) - 50th Percentile	22.45	35.45	14.35	-
Jitter (ms)	4.37	8.45	19.95	-
Packet Loss Rate%	0.16	4.36	1.30	-
Packet Loss Rate- 90th percentile	0.38	7.44	3.68	-

Table-24: Overall Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Note- "-" There is no network of VIL across the measured hotspot locations during the testing.

EJM College				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	221.93	2.85	378.50	-
Download Session Setup Success Rate %	100.00	80.00	100.00	-
Upload Throughput Average (Mbits/s)	31.29	6.01	66.43	-
Upload Session Setup Success Rate %	100.00	80.00	100.00	-
Web Browsing Delay (Second)	1.44	1.65	1.47	-
Youtube Initial Buffer Delay (Second)	0.63	2.44	0.71	-
Latency (ms) - 50th Percentile	23.85	33.80	12.70	-
Jitter (ms)	4.28	5.12	2.46	-
Packet Loss Rate%	0.20	4.20	0.00	-

Table-25: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Lamdon School				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	207.21	6.02	333.59	-
Download Session Setup Success Rate %	100.00	100.00	100.00	-
Upload Throughput Average (Mbits/s)	29.04	2.32	6.00	-
Upload Session Setup Success Rate %	100.00	100.00	100.00	-
Web Browsing Delay (Second)	1.41	2.19	1.52	-
Youtube Initial Buffer Delay (Second)	0.62	1.61	0.76	-
Latency (ms) - 50th Percentile	21.90	36.40	13.45	-
Jitter (ms)	5.05	9.79	10.85	-
Packet Loss Rate%	0.00	4.80	0.10	-

Table-26: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Leh Airport				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	99.67	2.42	37.16	-
Download Session Setup Success Rate %	100.00	100.00	100.00	-
Upload Throughput Average (Mbits/s)	40.19	4.54	19.63	-
Upload Session Setup Success Rate %	100.00	100.00	100.00	-
Web Browsing Delay (Second)	1.52	1.86	1.67	-
Youtube Initial Buffer Delay (Second)	0.89	1.19	0.85	-
Latency (ms) - 50th Percentile	23.50	38.40	13.50	-
Jitter (ms)	4.19	4.79	5.63	-
Packet Loss Rate%	0.50	2.20	0.10	-

Table-27: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G)

Shanti Stupa				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	257.75	1.10	219.64	-
Download Session Setup Success Rate %	100.00	40.00	100.00	-
Upload Throughput Average (Mbits/s)	35.24	1.03	7.20	-
Upload Session Setup Success Rate %	100.00	80.00	100.00	-
Web Browsing Delay (Second)	1.45	2.09	1.65	-
Youtube Initial Buffer Delay (Second)	0.60	1.46	1.00	-
Latency (ms) - 50th Percentile	21.00	36.55	14.25	-
Jitter (ms)	3.94	8.10	64.46	-
Packet Loss Rate%	0.10	1.40	5.80	-

Table-28: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

SNM Hospital				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	45.26	1.97	35.07	-
Download Session Setup Success Rate%	100.00	100.00	100.00	-
Upload Throughput Average (Mbits/s)	20.17	3.59	16.57	-
Upload Session Setup Success Rate %	100.00	100.00	100.00	-
Web Browsing Delay (Second)	1.50	2.69	1.68	-
Youtube Initial Buffer Delay (Second)	0.84	2.04	1.88	-
Latency (ms)- 50th Percentile	22.60	29.60	17.35	-
Jitter (ms)	4.40	14.76	17.04	-
Packet Loss Rate%	0.00	9.20	0.50	-

Table-29: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

4.3.5 Data performance (5G Only & 4G Only Download & Upload Speed)

Overall Data Performance					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	152.00	-	275.60	-
	Upload Throughput Average (Mbits/s)	26.45	-	32.73	-
4G	**Download Throughput Average (Mbits/s)**	37.08	2.29	15.53	-
	Upload Throughput Average (Mbits/s)	13.29	6.55	4.08	-

Table-30: Overall Summary of 5G only & 4G only data download & upload speed.

Note- "-"Respective technology was not observed during the test.
There is no network of VIL across the measured hotspot locations during the testing.

EJM College					
	Parameters	**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	100.76	-	549.73	-
	Upload Throughput Average (Mbits/s)	42.91	-	64.04	-
4G	**Download Throughput Average (Mbits/s)**	27.13	2.92	19.29	-
	Upload Throughput Average (Mbits/s)	10.12	9.68	4.04	-

Table-31: Overall Summary of 5G only & 4G only data download & upload speed.

Note- "-"Respective technology was not observed during the test.

Lamdon School					
	Parameters	**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	203.96	-	343.35	-
	Upload Throughput Average (Mbits/s)	18.18	-	5.64	-
4G	**Download Throughput Average (Mbits/s)**	30.55	1.22	6.57	-
	Upload Throughput Average (Mbits/s)	1.63	1.44	1.75	-

Table-32: Overall Summary of 5G only & 4G only data download & upload speed.

Note- "-"Respective technology was not observed during the test.

Leh Airport					
	Parameters	**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	102.75	-	83.44	-
	Upload Throughput Average (Mbits/s)	43.00	-	43.47	-
4G	**Download Throughput Average (Mbits/s)**	96.63	2.09	5.86	-
	Upload Throughput Average (Mbits/s)	15.90	6.97	2.25	-

Table-33: Overall Summary of 5G only & 4G only data download & upload speed.

Note- "-"Respective technology was not observed during the test.

Shanti Stupa					
	Parameters	**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	103.86	-	208.45	-
	Upload Throughput Average (Mbits/s)	11.29	-	12.56	-
4G	**Download Throughput Average (Mbits/s)**	8.42	2.76	20.97	-
	Upload Throughput Average (Mbits/s)	5.20	11.30	1.47	-

Table-34: Overall Summary of 5G only & 4G only data download & upload speed.

Note- "-"Respective technology was not observed during the test.

SNM Hospital					
	Parameters	**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	219.46	-	172.37	-
	Upload Throughput Average (Mbits/s)	31.98	-	37.92	-
4G	**Download Throughput Average (Mbits/s)**	22.67	2.22	24.98	-
	Upload Throughput Average (Mbits/s)	33.59	3.36	10.91	-

Table-35: Overall Summary of 5G only & 4G only data download & upload speed.

Note- "-"Respective technology was not observed during the test.

4.4 Walk Test

Walk test has been conducted on 12th June 2025. One location has been tested in the city.
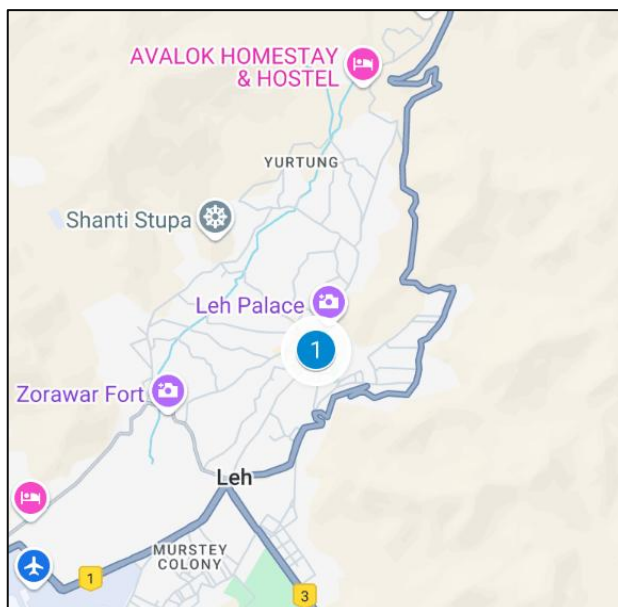
4.4.1 Drive test route

Figure-22: Walk Test location.

4.4.2 Walk Test Covered

1. Leh Market

4.4.3 Voice performance

Leh Market				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	18	19	19	-
Call Setup Success Rate %	100.00	100.00	100.00	-
Drop Call Rate %	0.00	0.00	0.00	-
Call Setup Time-Average (Second)	1.41	3.51	0.63	-

Table-36: Summary of voice call performance in network auto-selection mode 5G/4G/3G/2G).

> **Note**- "-" There is no network of VIL across the measured walk test location during the testing.

4.4.4 Data performance

(a) Data Parameters (Auto-selection mode- 5G/4G/3G/2G)

Leh Market				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	172.51	2.77	305.37	-
Download Session Setup Success Rate %	100.00	90.91	100.00	-
Upload Throughput Average (Mbits/s)	48.89	9.31	42.07	-
Upload Session Setup Success Rate %	100.00	90.91	100.00	-
Latency (ms) - 50th Percentile	25.78	38.40	13.43	-

Table-37: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

> **Note**- "-" There is no network of VIL across the measured walk test location during the testing.

4.5 Highway

Drive test has been conducted from 10th June 2025 to 12th June 2025 covering the Highway route. (Refer Table-1)

4.5.1 Drive test route

Figure-23: Drive test route Highway.

4.5.2 Routes Covered

Leh to Nubra Valley passing through North Pullu, Khardung, Khalsar and Hunder etc. Nubra Valley to Pangong passing through Shyok, Durbuk, Tangtse, Spangmik, Man and Merak etc.
Pangong to Leh passing through Tsoltak, Zingral, Karu, Thiksey and Shey etc.

4.5.3 Voice performance

(a) Voice Call Performance in 3G/2G network mode only: 3G/2G network mode testing has been done to reflect the experience for respective users as they have only 3G/2G compatible handsets.

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	293	310	-
Call Setup Success Rate %	31.40	26.45	-
Drop Call Rate %	13.04	9.76	-
Call Setup Time-Average (Second)	3.64	6.55	-
Handover Success Rate %	100.00	98.78	-

Table-38: Summary of voice call performance in 3G/2G network mode only.

**Note**- "-" There is no network of VIL across the measured route during the testing.
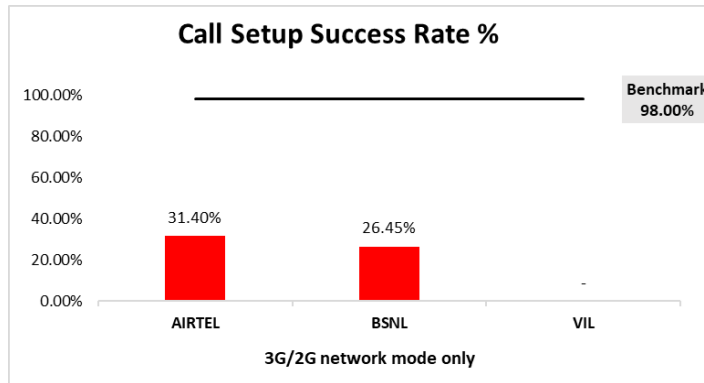
**Figure-24:** Performance for call setup success rate.
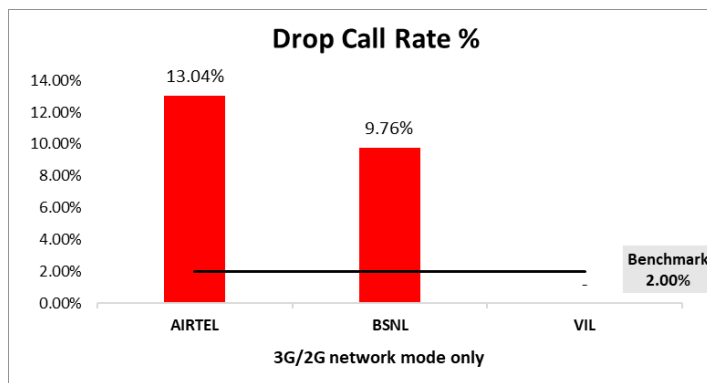
Figure-25: Performance for drop call rate.

(b) Network Technology: This section represents time spent on various network technologies.

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	33.22%	-
2G	80.03%	52.36%	-
Limited Service	19.97%	14.41%	-

Table-39: Time spent on technology during drive test 3G/2G network mode only.

Note- "-" There is no network of VIL across the measured route during the testing.

28
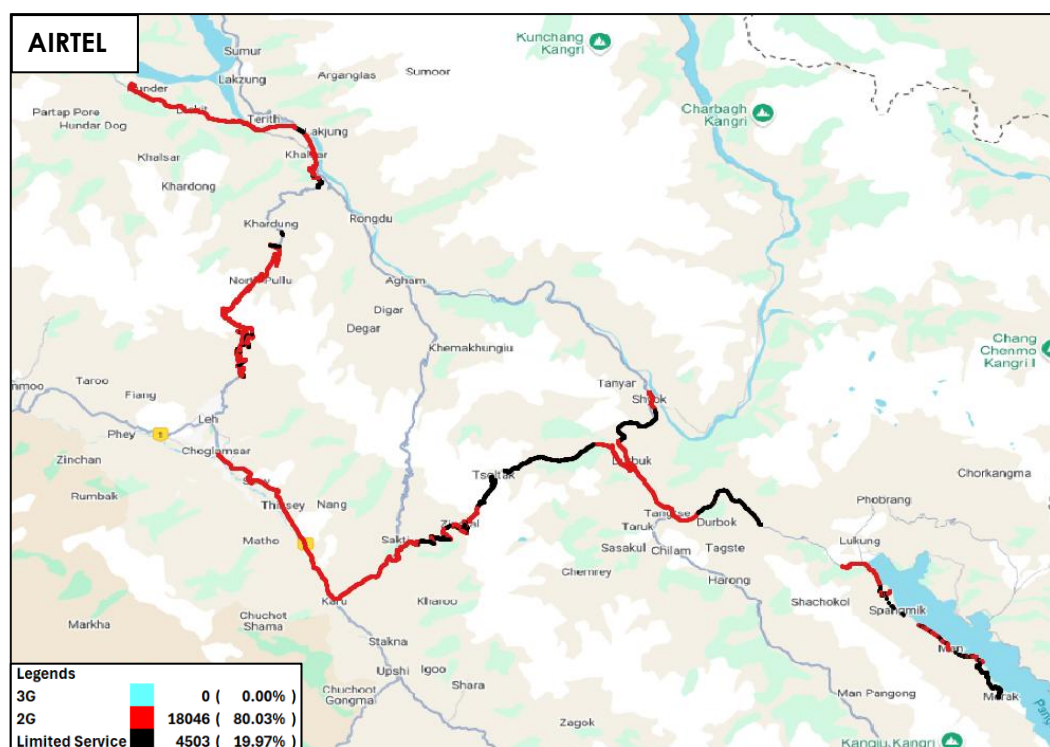
Figure-26: Serving technology plots 3G/2G network mode – AIRTEL.
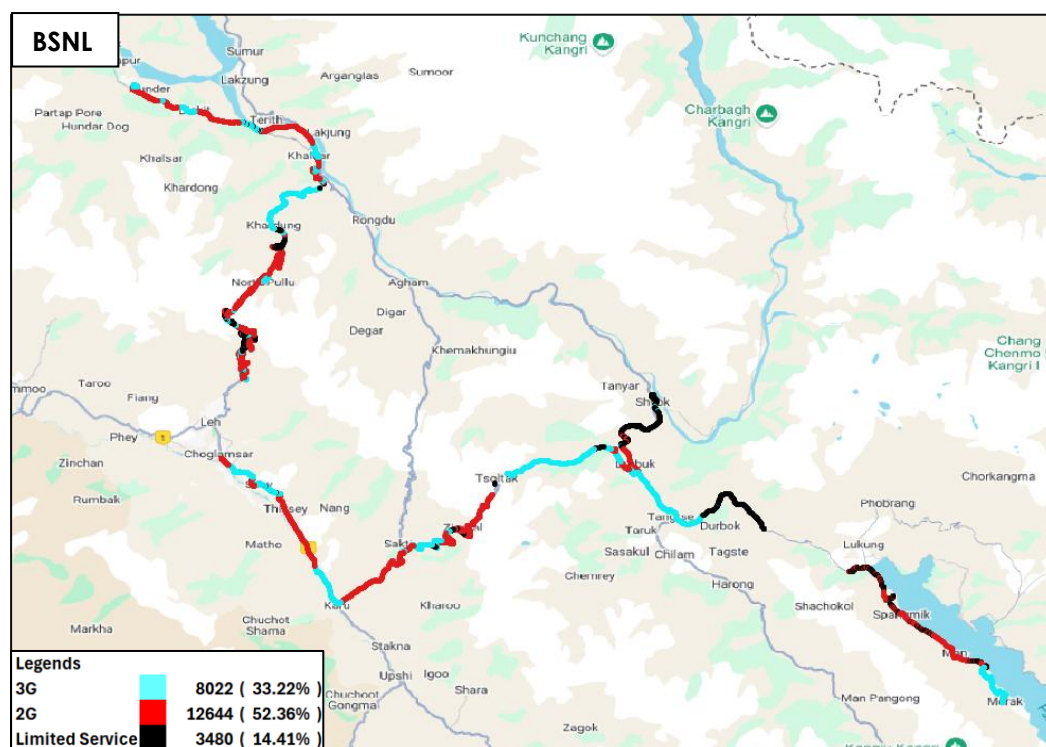
Figure-27: Serving technology plots 3G/2G network mode – BSNL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure-43 & 44 for map view)
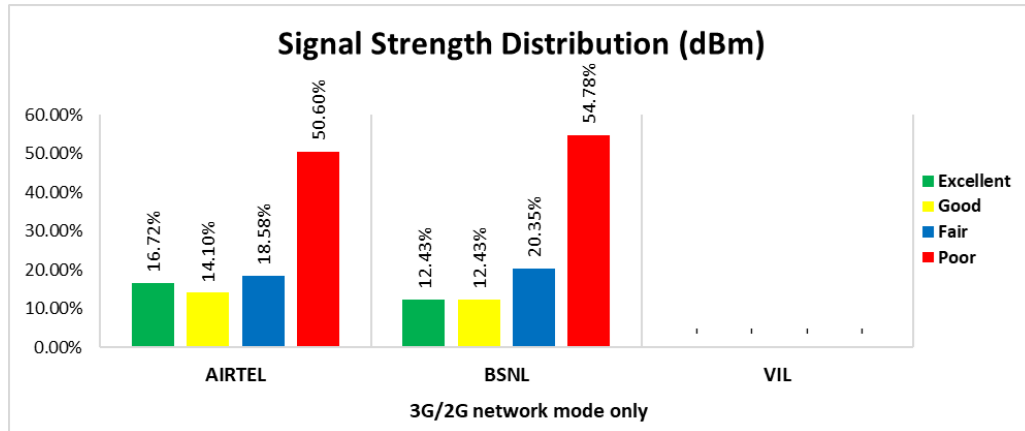
Figure-28: Signal strength distribution 3G/2G network mode only.

> **Note**- "-" There is no network of VIL across the measured route during the testing.

Observations:

- Airtel has 17% of samples falling in the excellent signal strength category.
- BSNL has 12% of samples falling in the excellent signal strength category.

(d) Voice Call Performance in auto network selection mode (5G/4G/3G/2G)

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	288	327	319	-
Call Setup Success Rate %	38.19	26.61	29.47	-
Drop Call Rate %	20.91	10.34	17.02	-
Call Setup Time Average (Second)	2.06	5.42	2.67	-
Handover Success Rate %	99.80	99.55	99.65	-

Table-40: Summary of voice call performance in network auto-selection mode.

> **Note**- "-" There is no network of VIL across the measured route during the testing.
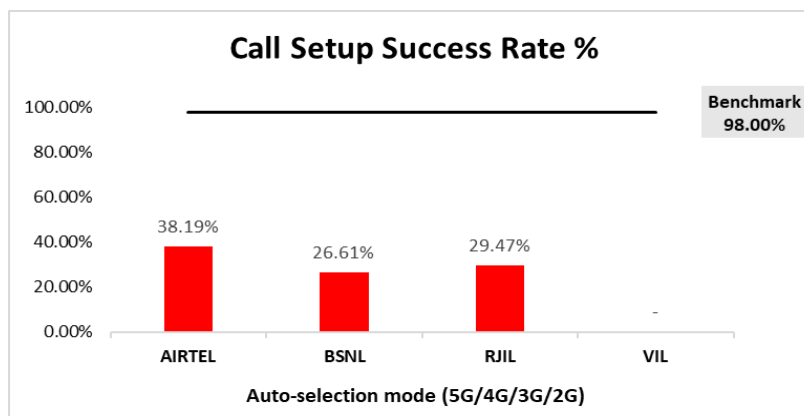
Figure-29: Performance for call setup success rate.
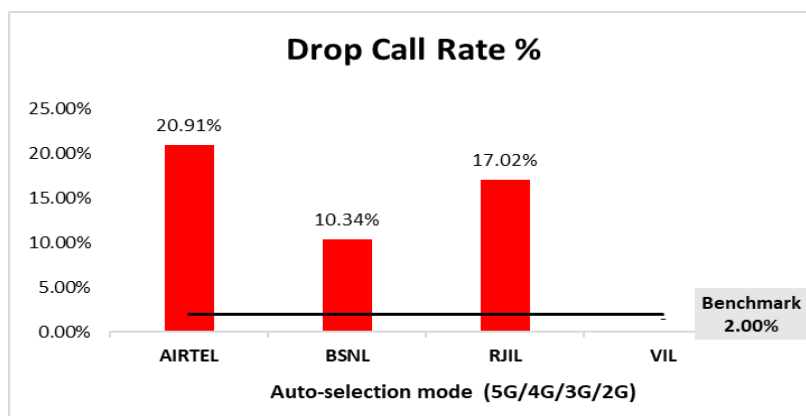
Figure-30: Performance for drop call rate.

Parameter	Service Provider Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Established (within service provider Network)	117	101	76	-
Number of silence call for >4 Sec	12	6	19	-
Silence Call Rate %	10.26	5.94	25.00	-
Number of silence instances for >4 Sec	19	10	53	-
Number of silence instances for >3 Sec	27	15	64	-
Number of silence instances for >2 sec	43	22	91	-
RTP Jitter (4G & 5G) in ms	6.24	12.86	12.74	-
Packet loss Rate Downlink %	6.22	10.30	10.77	-
Packet loss Rate Uplink %	6.01	9.21	9.92	-

Table-41: Summary of silence instances & packet loss rate for mobile to mobile call.

Note- "-" There is no network of VIL across the measured route during the testing.

(e) Mean Opinion Score (MOS) performance for speech quality:

Mean opinion score indicate quality of speech observed during the drive test across different technologies. This parameter has been calculated for mobile to mobile calls made within same operator network in auto mode (5G/4G/3G/2G). As per ITU-T Recommendation P.863.1, MOS values means: 5-Excellent, 4-Good, 3-Fair, 2-Poor, 1-Bad.

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Total Number of MOS Samples for calls in table-41	1093	593	757	-
Speech Quality (Average MOS)	3.75	2.52	3.45	-
Number of samples with MOS >=4 to <5 (Excellent)	784	30	421	-
Number of samples with MOS >=3 to <4 (Good)	163	97	181	-
Number of samples with MOS >=2 to <3 (Fair)	67	326	37	-
Number of samples with MOS >=1 to <2 (Poor)	79	140	118	-
%age of samples with MOS >=4 to <5 (Excellent)	71.73%	5.06%	55.61%	-
%age of samples with MOS >=3 to <4 (Good)	14.91%	16.36%	23.91%	-
%age of samples with MOS >=2 to <3 (Fair)	6.13%	54.97%	4.89%	-
%age of samples with MOS >=1 to <2 (Poor)	7.23%	23.61%	15.59%	-

Table-42: Summary of speech quality (MOS) samples.

Note- "-" There is no network of VIL across the measured route during the testing.
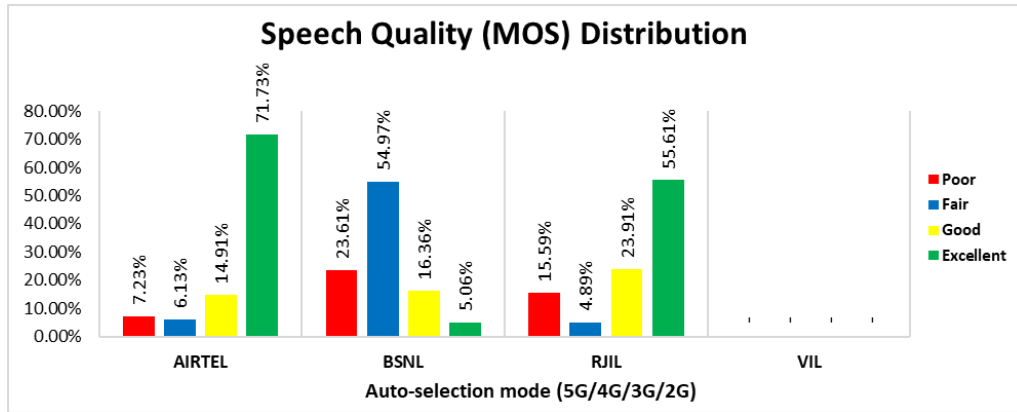
Figure-31: Distribution of samples in MOS range.

(f) Network Technology: This section represents time spent on various network technologies.

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	0.54%	NA	1.65%	-
4G	73.85%	47.70%	73.39%	-
3G	NA	6.92%	NA	-
2G	6.59%	28.76%	NA	-
Limited Service	19.02%	16.62%	24.97%	-

Table-43: Time spent on technology during drive test.

> **Note-**
> - NA- Service provider doesn't provide services in respective technology.
> - "-" There is no network of VIL across the measured route during the testing.
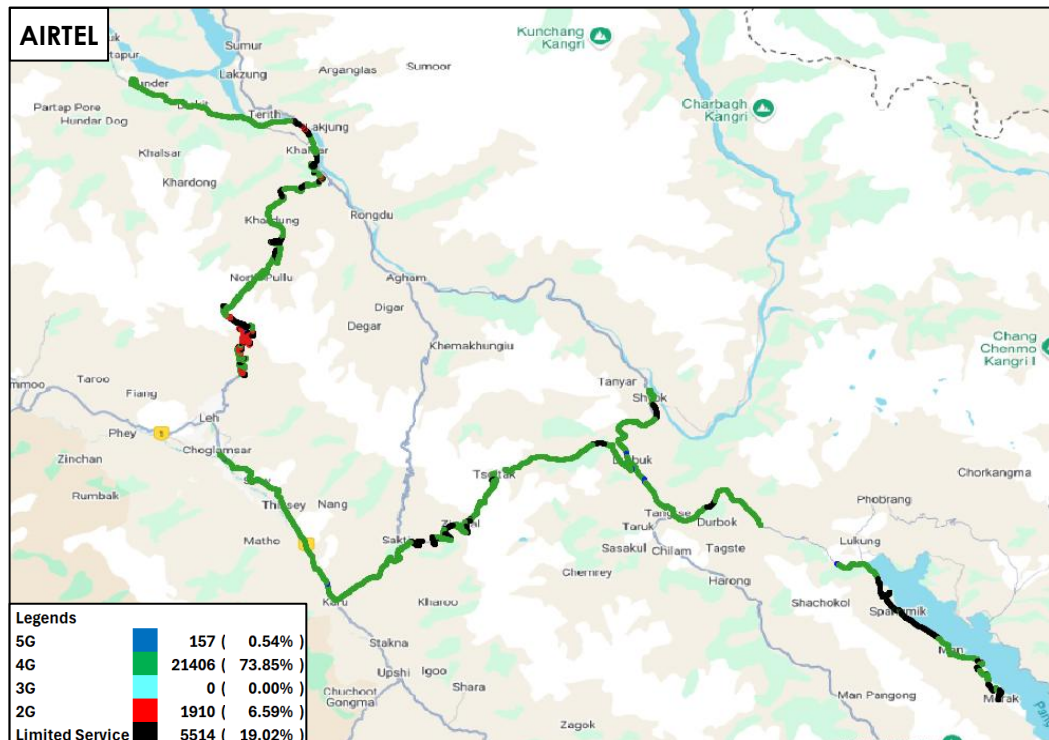
Figure-32: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-AIRTEL.
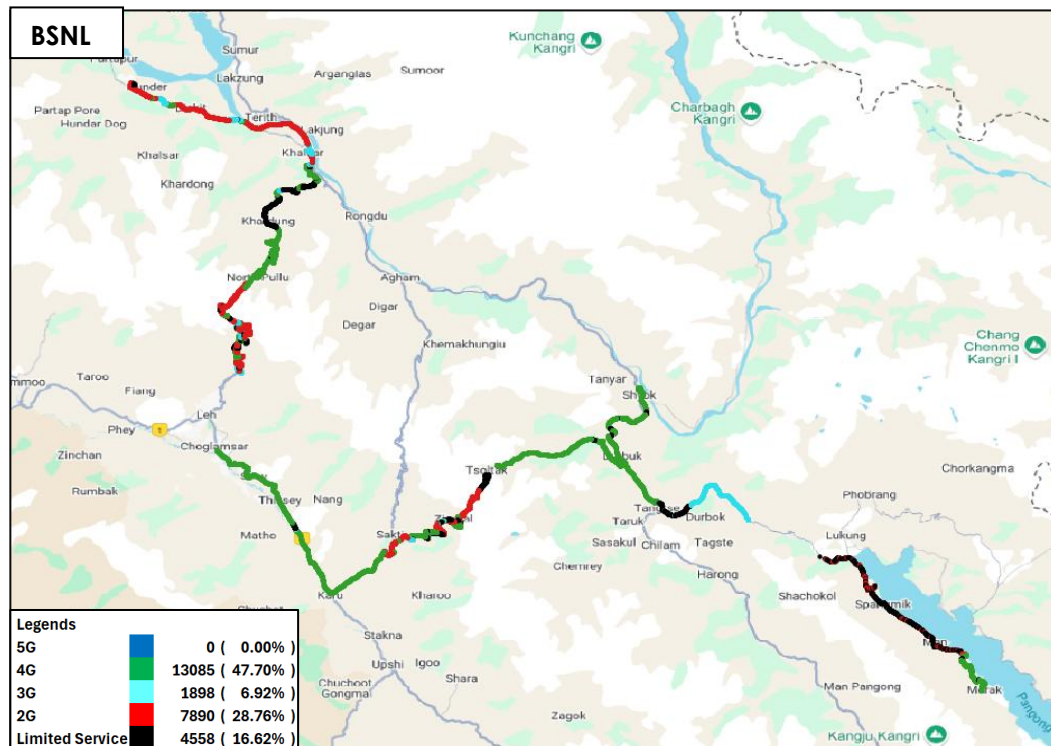
Figure-33: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-BSNL.
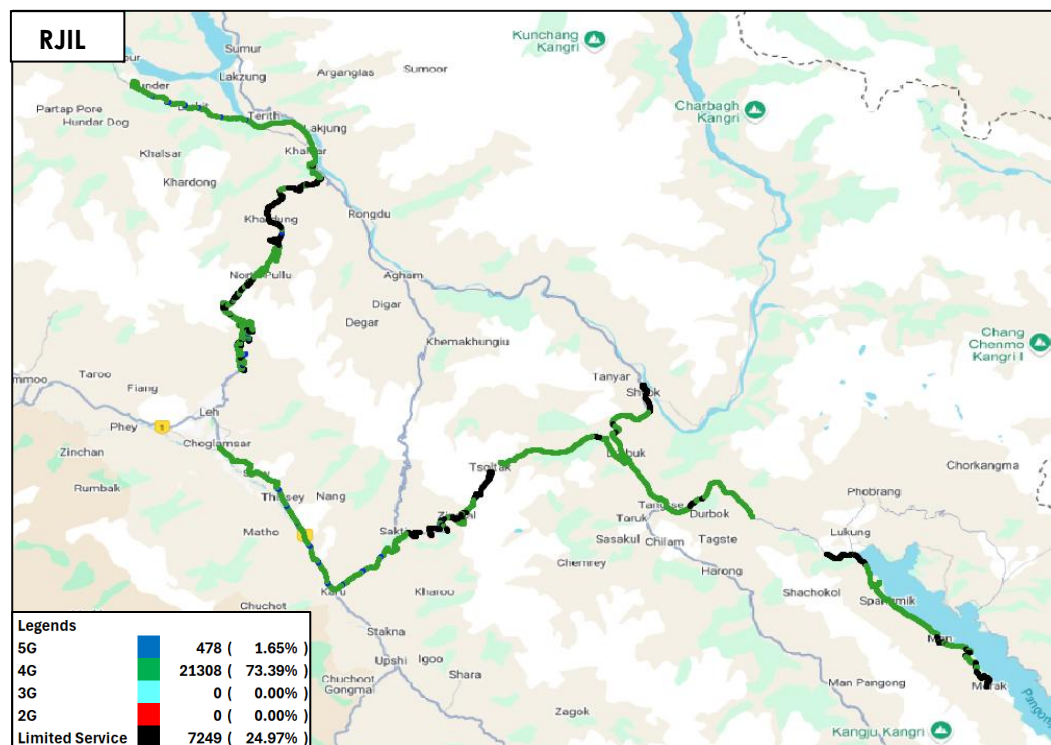
Figure-34: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-RJIL.

(g) Network Signal Strength Distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-45, 46 & 47 for map view)
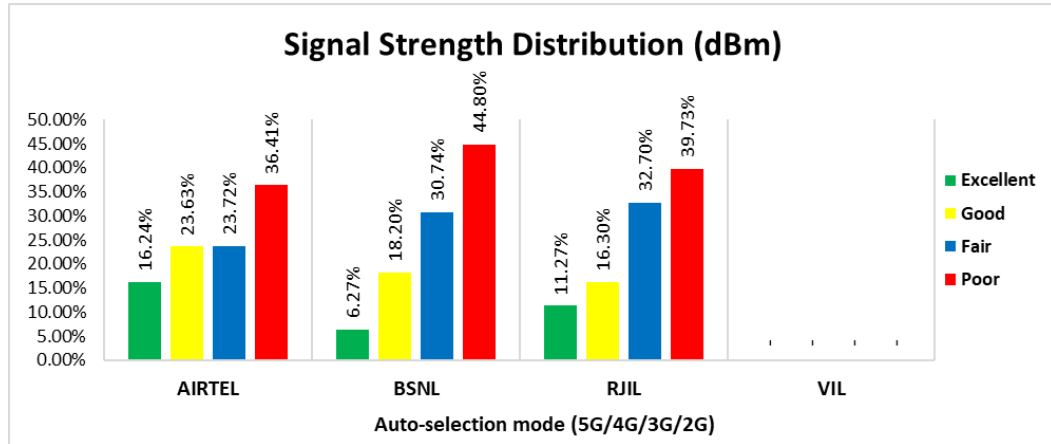
Figure-35: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Note- "-" There is no network of VIL across the measured route during the testing.

Observations:

- Airtel has 16% of samples falling in the excellent signal strength category.
- BSNL has 6% of samples falling in the excellent signal strength category.
- RJIL has 11% of samples falling in the excellent signal strength category.

4.5.4 Data performance

(a) Data Parameters (Auto-selection mode- 5G/4G/3G/2G)

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	67.05	2.66	88.74	-
	80th Percentile	95.04	5.42	112.59	-
	20th Percentile	3.58	0.12	1.37	-
Upload Throughput (Mbits/s)	Average	10.12	3.34	7.23	-
	80th Percentile	11.66	4.83	6.14	-
	20th Percentile	1.24	0.94	0.89	-
Latency (ms)	50th Percentile	25.10	63.50	27.95	-

Table-44: Summary of Data performance in network auto-selection mode.
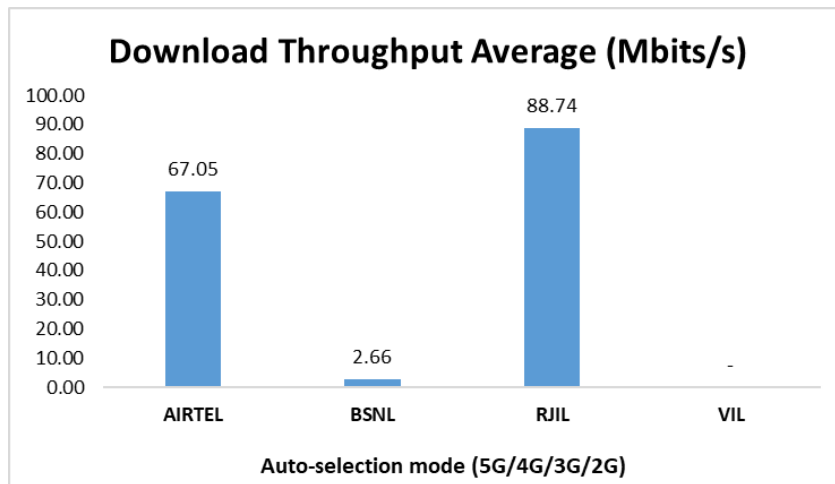
Figure 36: Download throughput.
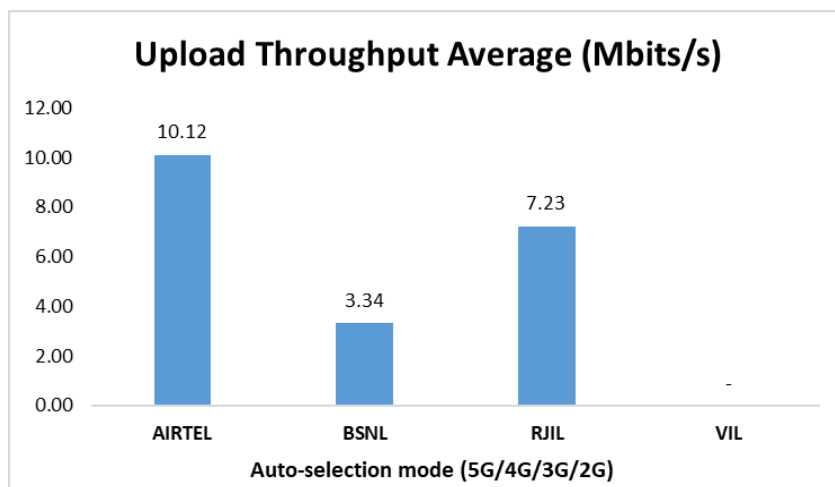
Figure-37: Upload throughput.

5. Voice & Data Key findings

5.1 Overall Voice

1. **Call Setup Success Rate:**
   a) Airtel and BSNL have 42.29% and 37.16% call setup success rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL and RJIL have 57.11%, 47.03% and 49.78% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

2. **Call Setup Time**:
   a) Airtel and BSNL call setup time is 3.36 & 6.27 seconds respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL & RJIL call setup time is 1.90, 4.36 & 1.56 seconds respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G) RJIL, Airtel and BSNL have 14.18%, 6.82% & 4.97% silence call rate respectively. Further BSNL has higher RTP packet loss rate in downlink (10.99%) compared to RJIL (6.42%) and Airtel (4.17%). In uplink the RTP packet loss rate is higher for BSNL (9.23%) compared to RJIL (6.02%) and Airtel (3.85%). (refer table-6)

4. **Drop Call Rate**:
   a) Airtel and BSNL drop call rate is 8.11% and 6.62% respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL and RJIL drop call rate is 9.70%, 4.67% and 7.17% respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

5.2 Overall Data

1. **Data download and upload performance (Overall i.e. LSA):**
   a) Airtel, BSNL and RJIL average download speeds are 95.39 Mbps, 2.62 Mbps and 144.09 Mbps respectively. (refer table-9)

   b) Airtel, BSNL and RJIL average upload speeds are 16.59 Mbps, 4.06 Mbps and 13.99 Mbps respectively. (refer table-9)

2. **Data download and upload performance (static i.e. while stationary):**
   a) Airtel, BSNL and RJIL average download speeds are 166.37 Mbps, 3.13 Mbps and 200.79 Mbps respectively. (refer table-24)

   b) Airtel, BSNL and RJIL average upload speeds are 31.18 Mbps, 3.50 Mbps and 23.17 Mbps respectively. (refer table-24)

3. **Data session setup success rate (static i.e. while stationary):**
   a) Airtel, BSNL and RJIL have 100.00%, 84.00% and 100.00% download session setup success rate respectively. (refer table-24)

   b) Airtel, BSNL and RJIL have 100.00%, 92.00% and 100.00% upload session setup success rate. (refer table-24)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 42.29% call setup success rate and 8.11% drop call rate have been observed for 3G/2G network mode for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-3)

- 57.11% call setup success rate and 9.70% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 98.25% call setup success rate and 0.00% drop call rate have been observed for 3G/2G network mode for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-11)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for overall hotspot locations. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-18)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for Leh Market Walk test location. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-36)

- 31.40% call setup success rate and 13.04% drop call rate have been observed for 3G/2G network mode for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-38)

- 38.19% call setup success rate and 20.91% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-40)

Data

- Airtel has 95.39 Mbps average download speed & 16.59 Mbps average upload speed for LSA. (refer table-9)

- Airtel has 114.97 Mbps average download speed & 17.39 Mbps average upload speed across measured routes for city drive. (refer table-17)

- Leh Airport and SNM Hospital hotspot locations have less download speed (less than 100 Mbps) out of total 5 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-27 & 29)

- Airtel has 67.05 Mbps average download speed & 10.12 Mbps average upload speed across measured routes for highway drive. (refer table-44)

2. BSNL:

Voice

- 37.16% call setup success rate and 6.62% drop call rate have been observed for 3G/2G network mode for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-3)

- 47.03% call setup success rate and 4.67% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 96.43% call setup success rate and 1.85% drop call rate have been observed for 3G/2G network mode for city drive. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-11)

- 98.31% call setup success rate and 1.72% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for overall hotspot locations. Performance is well within the benchmark of 98.00% for call setup success rate. (refer table-18)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for Leh Market Walk test location. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-36)

- 26.45% call setup success rate and 9.76% drop call rate have been observed for 3G/2G network mode for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-38)

- 26.61% call setup success rate and 10.34% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-40)

Data
- BSNL has 2.62 Mbps average download speed & 4.06 Mbps average upload speed for LSA. (refer table-9)

- BSNL has 2.29 Mbps average download speed & 3.44 Mbps average upload speed across measured routes for city drive. (refer table-17)

- All hotspot locations have less download speed (less than 10 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-25, 26, 27, 28 & 29)

- Shanti Stupa hotspot location has less upload speed (less than 2 Mbps) out of total 5 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-28)

- BSNL has 2.66 Mbps average download speed & 3.34 Mbps average upload speed across measured routes for highway drive. (refer table-44)

3. RJIL:
Voice
- 49.78% call setup success rate and 7.17% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for overall hotspot locations.

Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-18)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for Leh Market Walk test location. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-36)

- 29.47% call setup success rate and 17.02% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-40)

Data
- RJIL has 144.09 Mbps average download speed & 13.99 Mbps average upload speed for LSA. (refer table-9)

- RJIL has 168.57 Mbps average download speed & 13.21 Mbps average upload speed across measured routes in city drive. (refer table-17)

- Leh Airport and SNM Hospital have less download speed (less than 100 Mbps) out of total 5 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-27 & 29)

- Lamdon School, Leh Airport, Shanti Stupa and SNM Hospital have less upload speed (less than 20 Mbps) out of total 5 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-26, 27, 28 & 29)

- RJIL has 88.74 Mbps average download speed & 7.23 Mbps average upload speed across measured routes for highway drive. (refer table-44)

4. VIL:
Voice
- There is no network of VIL across the measured route/location during the testing.

Data
- There is no network of VIL across the measured route/location during the testing.

6. Annexure

6.1 Route wise coverage map

6.1.1 City
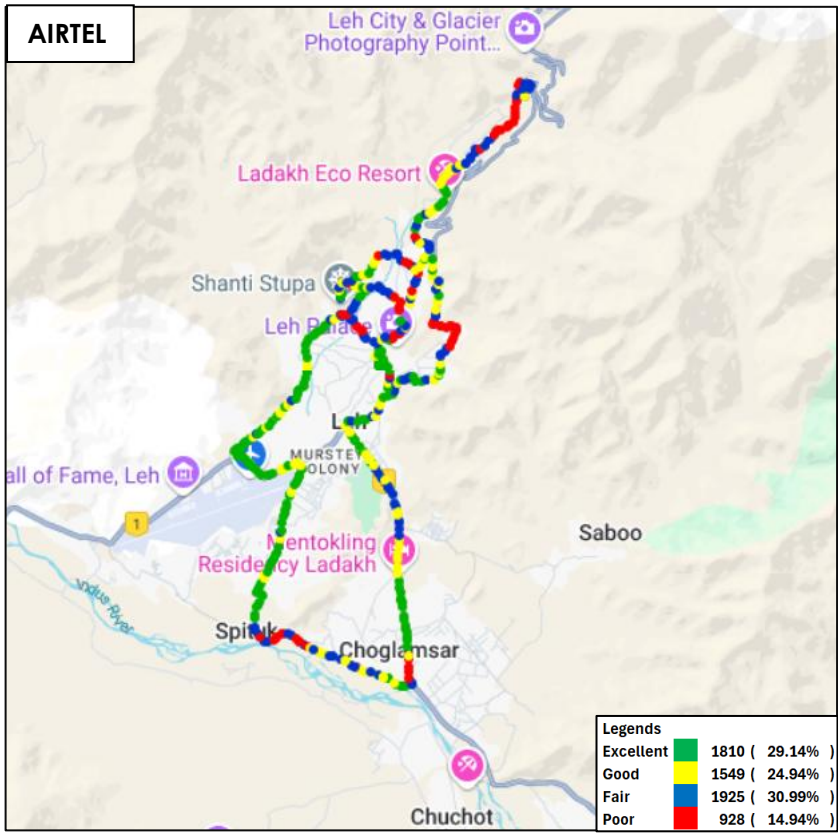
Figure-38: Signal strength 3G/2G network mode – AIRTEL.
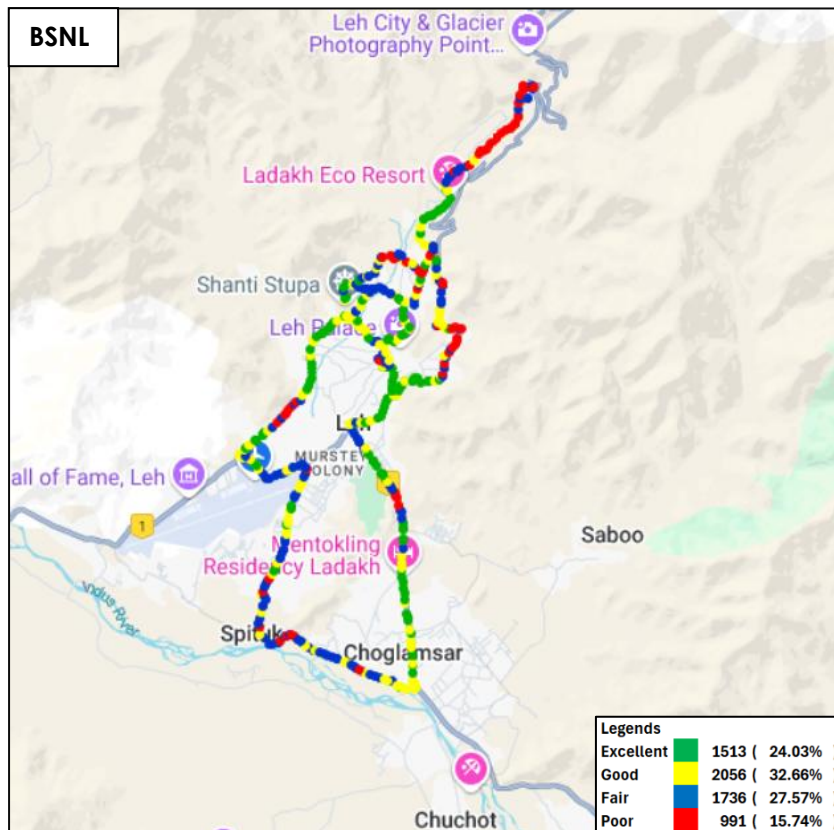
Figure-39: Signal strength 3G/2G network mode – BSNL.
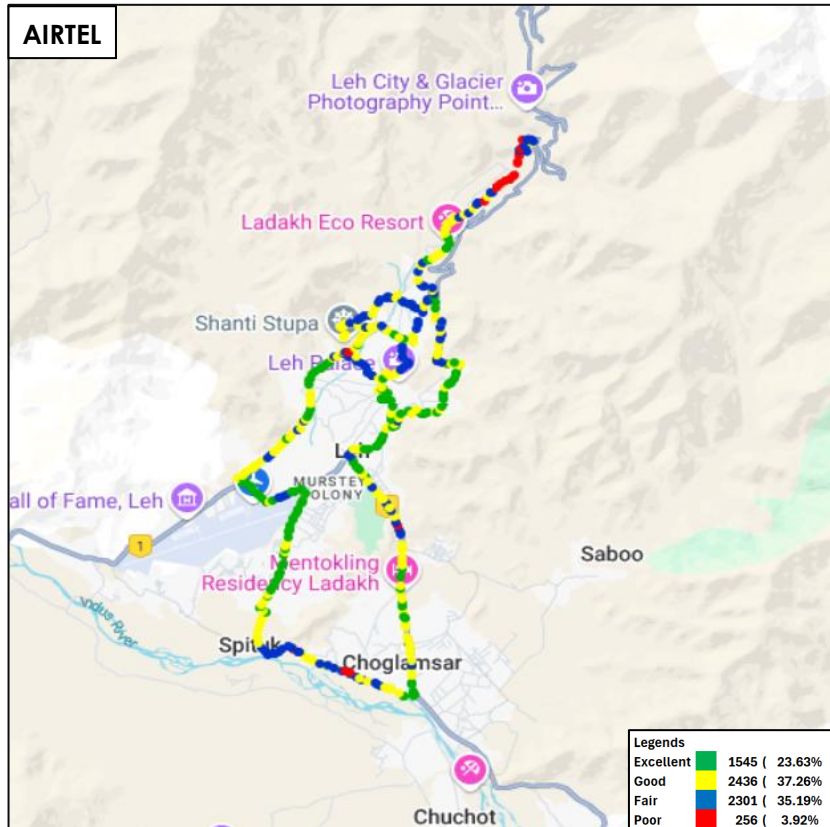
Figure-40: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.
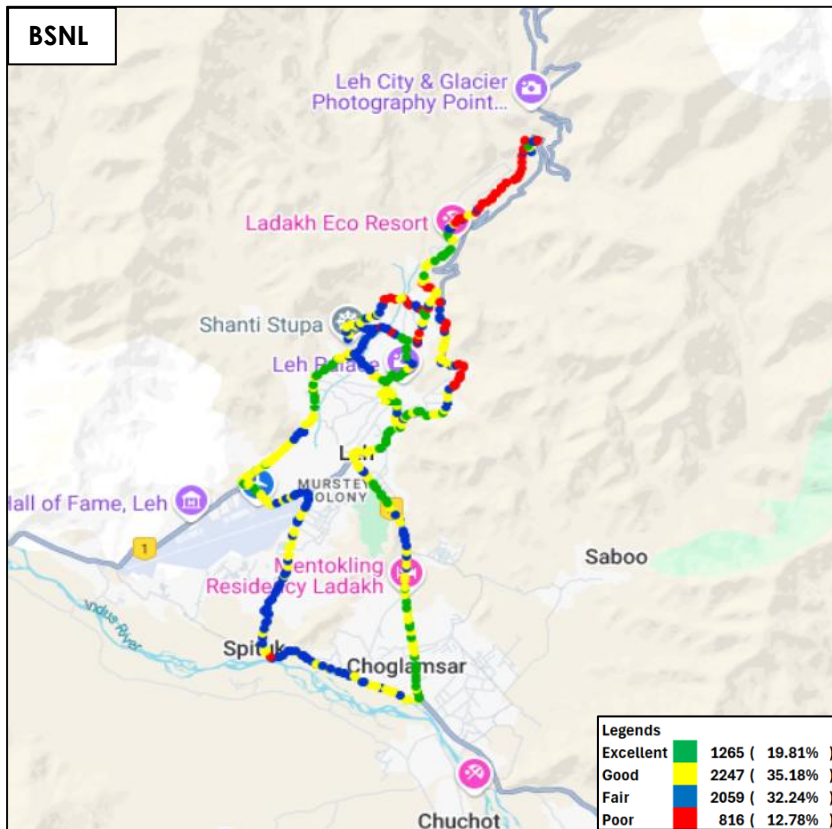
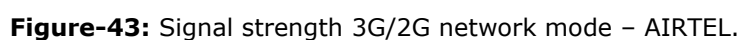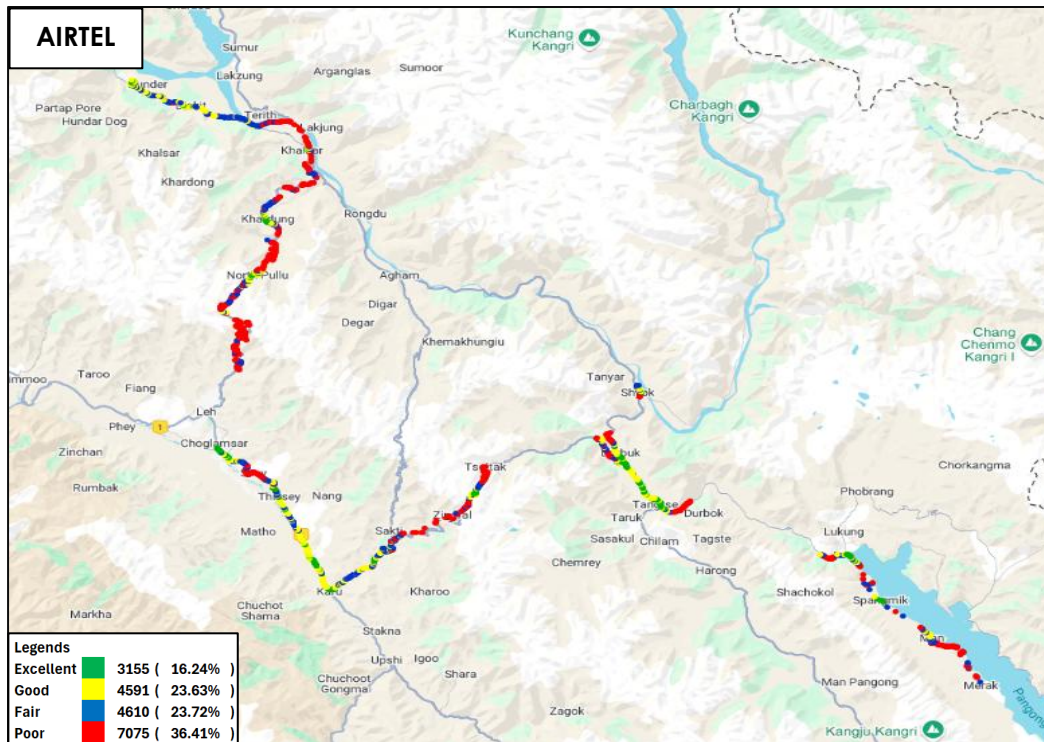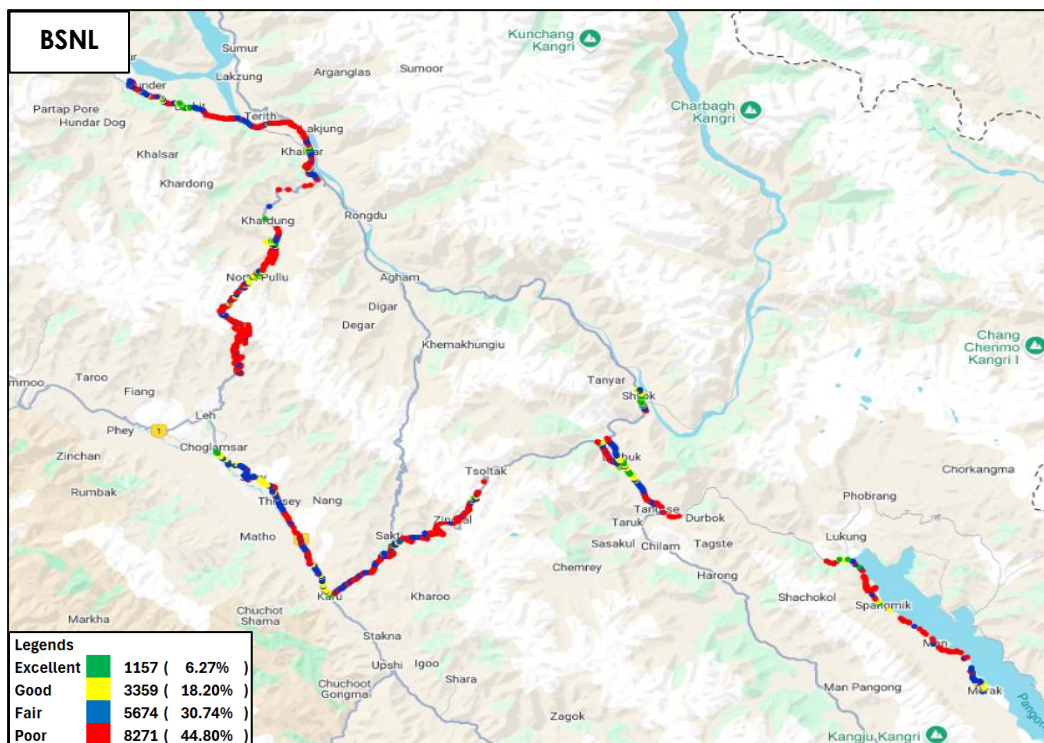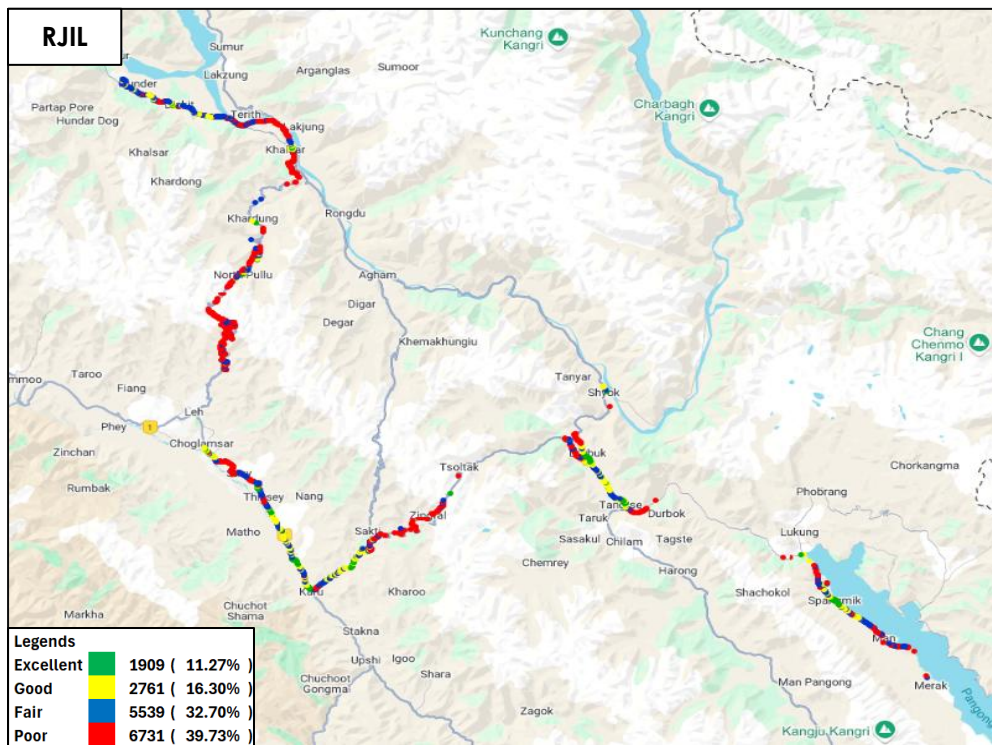**Figure-41:** Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.
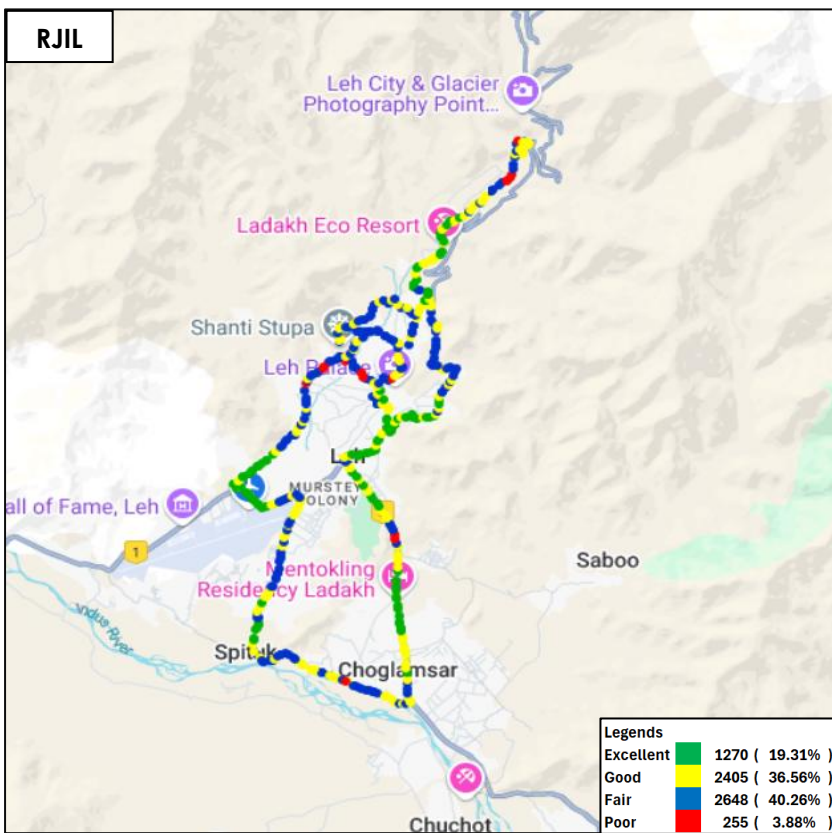
Figure-42: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.

6.1.2 Highway Route

i) Leh to Nubra Valley, Nubra Valley to Pangong and Pangong to Leh

Figure-43: Signal strength 3G/2G network mode – AIRTEL.

Figure-44: Signal strength 3G/2G network mode – BSNL.

Figure-45: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.

Figure-46: Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.

Figure-47: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.

7. Appendix

The details of the setup used for conducting the drive test and the network or performance parameters captured under different conditions may be seen at Appendix-I. The calculation method of each QoS parameter is given in Appendix-II of the report. The summary of key equipment used in technical setup is as under

- **Device-1**: OnePlus Nord CE3 for 3G/2G CAT-15 Smartphone.
- **Device-2**: Samsung Galaxy S23 for 5G/4G/3G/2G CAT-20 Smartphone
- **Drive test Software**: Azenqos Engineering capable Applications to capture actual user experience.

7.1 Appendix-I

7.1.1 Drive test setup

Voice Call		
Call details	**Technology**	**Detail**
Call Setup Timeout	• 3G/2G auto mode- switch Call • 5G/4G/3G/2G auto mode- switch Call • 5G/4G MOS Call	30 Sec
Call Duration		90/180 Sec
Wait/ Guard Time		15 Sec

Table-45: Voice test detail

> **Note-**
> - There is 15 sec wait time after locking and before starting first call in 3G/2G call.
> - 10 calls to be made at each Hotspot location.
> - Minimum 10 Calls to be made during the walk test. Call count will be increased based on walk test distance.
> - Speech quality (MOS) has been measured only in city drive & highway by making Mobile to Mobile call.
> - 180 Sec calls were made only in highway & railway route drive.

Data Test		
Test Type	**Technology**	**Detail**
HTTP/FTP Download	5G/4G/3G/2G Auto Mode	500 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time)
HTTP/FTP Upload		250 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time)
YouTube Streaming		20 Sec Video & 25 sec Timeout (Only at Hotspot)
Web Browsing		3 popular websites (www.google.co.in, www.irctc.co.in, www.sbi.co.in) 20 sec timeout (only at Hotspot)

Latency		25 count- Dynamic 1000 count- Hotspot Payload- 42 bytes in all drive

Table-46: Data test detail

Note-
- 5 Data iteration to be done at each hotspot location.
- Minimum 5 iteration to be made during the walk test. Iteration count will be increased based on walk test distance.
- Ping test to be performed only once at hotspot location.
- Youtube & Web browsing test to be performed at static location only.
- All values are taken up to two decimal places with round off.
- Download and upload testing has been done on FTP server for Airtel, BSNL & RJIL. (Airtel, BSNL & RJIL not provided HTTP server)
- VIL download and upload testing is done on HTTP Server.
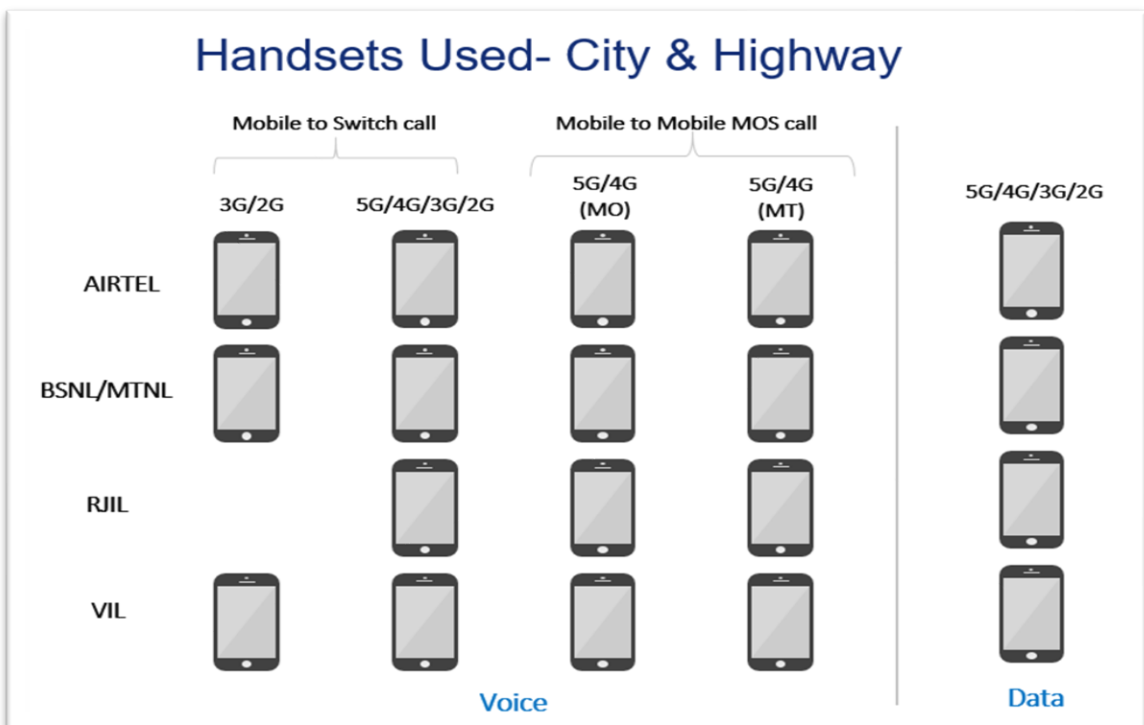
Figure-48: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating
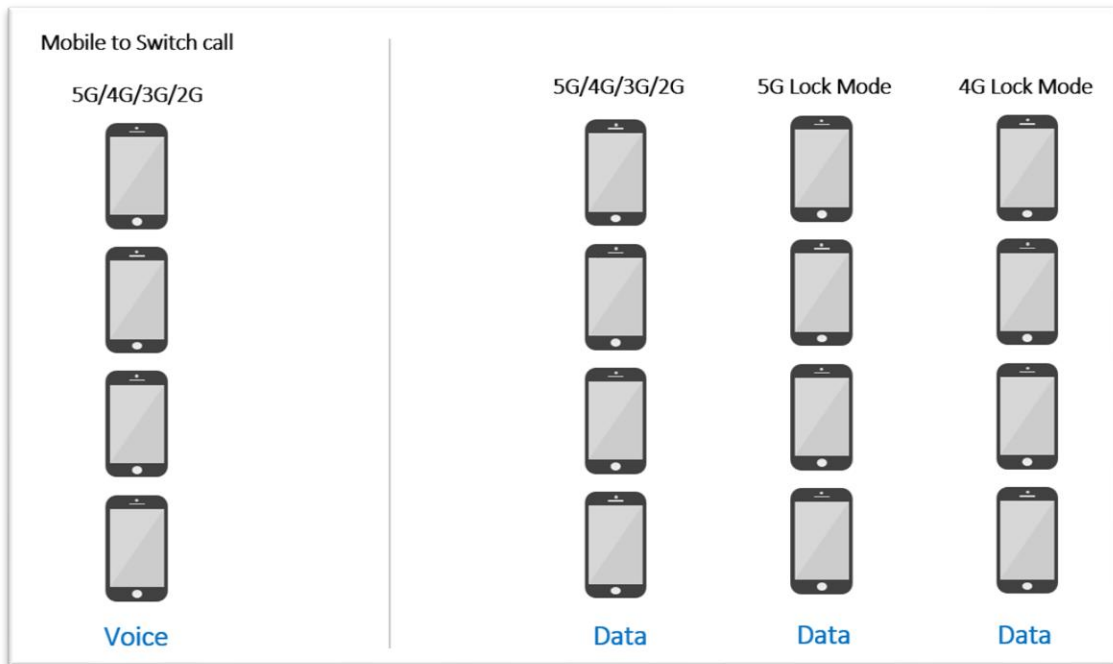
Figure-49: Number of handsets used in railway/metro/walktest/hotspot/
coastal area

Note- 5G & 4G Lock mode testing has been performed at hotspot locations only.

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)
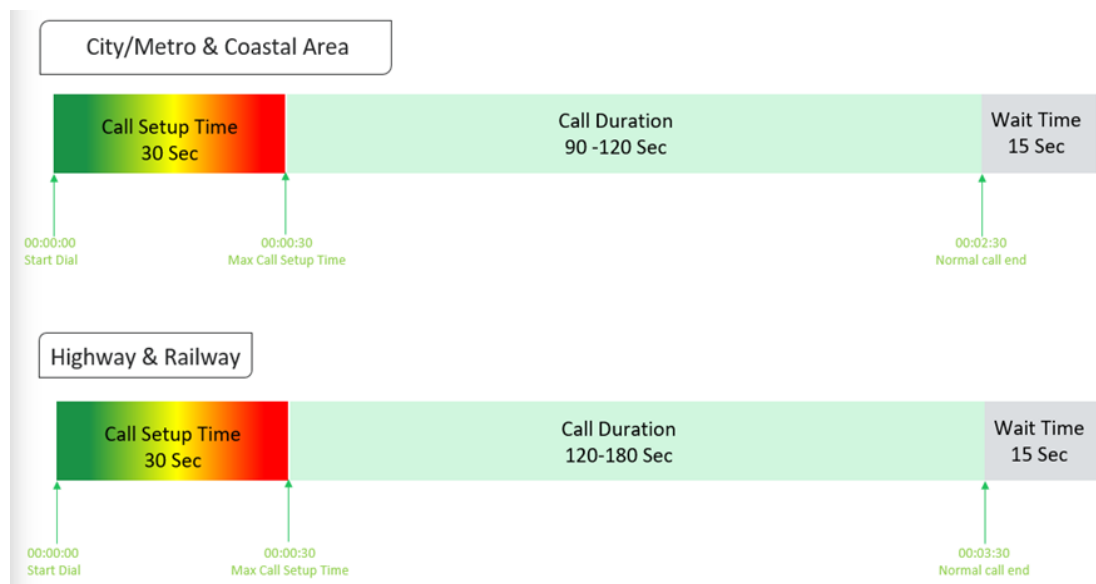
Figure-50: Voice test script for city/railway/metro/highway & coastal area

- 15 sec wait time is applied after locking Radio Access Technology (RAT) to 3G/2G and before starting first call in 3G/2G call.
- Speech quality (MOS) will be measured only City & Highway drive by making Mobile to Mobile calls.

(b) Hotspot voice testing

Figure-51: Voice test script for walktest/hotspot

- 10 calls to be made at each Hotspot location.
- Minimum 10 Calls to be made during the walk test. Call count will be increased based on walk test distance.

(c) Dynamic Data (internet) test
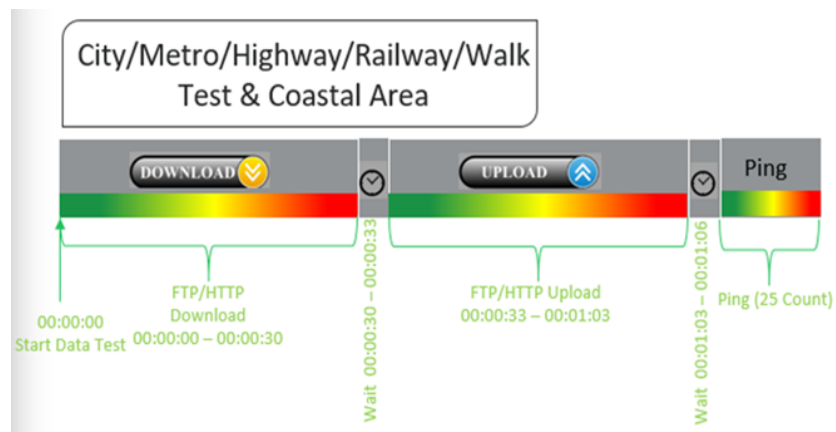
Figure-52: Data test script used in city/metro/railway/highway/walk test & coastal area
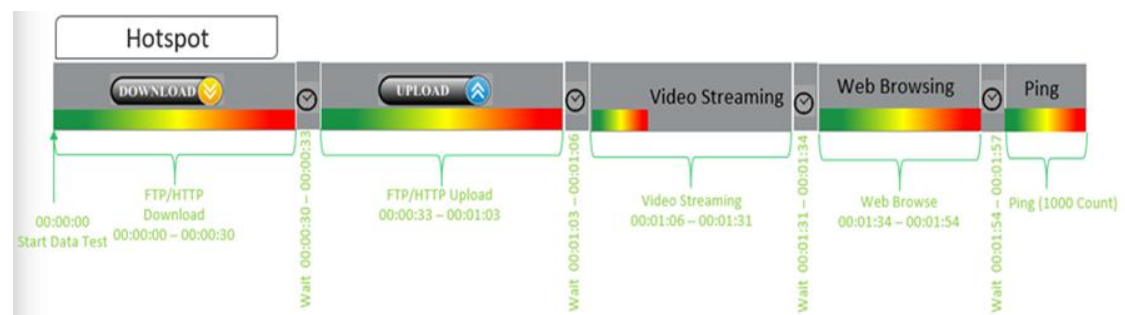
(d) Static Data(internet) testing

Figure-53: Data test script used at hotspot

- 5 Data iteration done at each hotspot location
- Min. 5 iteration made during the walk test.
- Web browsing duration mentioned above is for one web site only.
- Only 1 ping iteration (with 1000 Count) done at hotspot location.

7.2 Appendix-II

7.2.1 Network Performance Parameters for Voice calls

Parameter Name	Definition
Call Setup Success Rate	(i) Call Setup Success Rate is defined as the ratio of Established Calls to Call Attempts. 'Established Calls' mean the following events have happened in call setup: (a) Call attempt is made (b) The signaling channel is allocated (c) The call is routed to the outwards path of the terminating network (d) An alert signal is received by caller in the form of ring back tone, busy tone, or an announcement. CSSR = (Total Call Established/ Total Call Attempt) *100 As per QoS Regulation 2024 benchmark value is **>=98%**
Drop Call Rate	Call drop represents the service provider network's ability to maintain a call once it has been successfully established. This parameter shall include both incoming calls and outgoing calls which, once they have been established and have an assigned traffic channel/ bearer, are dropped, or interrupted before their normal completion by the user, the cause of the early termination being within the service provider's network Drop Call Rate = (Total Call Drop/Total Call Established) *100 As per QoS Regulation 2024 benchmark value is **<=2%**
Call Setup Time	Time taken from call initiate to call alerting/ringing. Call Setup Time = T2- T1 T2- Ringing (VoLTE/VoNR) & Alerting (for WCDMA & GSM), T1- Invite (VoLTE/VoNR) & CM Service Request (for WCDMA & GSM)
Voice Quality (MOS)	Voice quality in mobile networks is measured with algorithms based on ITU-T P.863 (POLQA). The grading for Voice quality has been given as: Excellent: MOS $\geq$ 4 and < 5 Good : MOS $\geq$ 3 and < 4 Fair : MOS $\geq$ 2 and < 3 Poor : MOS $\geq$ 1 and < 2
Handover Success Rate	Handover Success Rate = Count of successful handovers (All Technology Handover combined) / Total count of Handover Attempt (All Technology Handover combined) *100 Handover type which are considered- 2G Inter & Intra cell, 3G Soft & IRAT, 4G Inter & Intra frequency & SRVCC, 5G Inter & Intra frequency & 5G to 4G handovers.
Silence Call	A call which has $\geq$ 4 sec continuous RTP gap is considered as a Silence Call. Silence call rate = (count of silence call / Total calls established) *100 If a call observes multiple silence count >=4 sec in a particular established call it has been taken as one silent event.

Jitter	The inter arrival jitter is the difference in the relative transit time for two packets. The relative transit time is the difference between a packet's Real-time Transport Protocol (RTP) timestamp and the receiver's clock at the time of arrival, measured in the same units. If Si is the RTP timestamp from packet i, and Ri is the time of arrival in RTP timestamps units for packet i, then for two packets i and j the inter-arrival jitter D can be expressed as: **$D(i,j) = (Rj - Ri) - (Sj - Si)$** The interarrival jitter is calculated continuously as each data packet i is received from source SSRC_n, using this difference D for that packet and the previous packet i-1 in order of arrival (not necessarily in sequence), according to the formula **$J(i) = J(i-1) + (|D(i-1,i)| - J(i-1))/16$ or 8**
Downlink Packet Drop Rate	Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call originating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE)
Uplink Packet Drop Rate	Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call terminating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE).
Signal Strength	Signal strength is the signal power level received by the wireless user. _See table below_

Parameter Name	Technology	Signal Strength (dBm)			
		Excellent	Good	Fair	Poor
Rx Level	GSM	0 to $\geq$ -65	<-65 to $\geq$ -75	<-75 to $\geq$-85	<-85 to min
RSCP	WCDMA	0 to $\geq$ -70	<-70 to $\geq$ -80	<-80 to $\geq$ -90	<-90 to min
RSRP	LTE	0 to $\geq$ -80	<-80 to $\geq$ -95	<-95 to $\geq$-110	<-110 to min
SS_RSRP	NR	0 to $\geq$ -80	<-80 to $\geq$ -95	<-95 to $\geq$-110	<-110 to min

Table-47: Network performance parameter and definition voice

7.2.2 Network Performance Parameters Data tests

Parameter Name	Definition
Download Speed (Mbps)	The download speed is defined as the data transmission rate that is achieved for downloading a test file from a test server to a test device. Download Speed = Total bytes transferred during download / Total time for transfer • 80th percentile (upper range) & 20th percentile (lower range) value has been calculated for download throughput in dynamic drive and Hotspot combine data
Upload Speed (Mbps)	The upload speed is the data transmission rate that is achieved for uploading a test file from a test device to a test server. Upload Speed = Total bytes transferred during upload / Total time for transfer. • 80th percentile (upper range) & 20th percentile (lower range) value has been calculated for upload throughput in dynamic drive and Hotspot combine data.
Download Session Setup Success Rate	(total download session established (successfully connected to server)/ total download session attempt) *100. This KPI has been calculated for Hotspot only.

Upload Session Setup Success Rate	(total upload session established (successfully connected to server)/ total upload session attempt)*100. This KPI need to report for Hotspot only.
Web Page Download Time	Web browsing test is used to measure performance in terms of opening a web/HTTP page. Time taken to open the web page successfully is considered as web browsing delay/web page download time.
Video Streaming Delay	The Video streaming delay is time taken from start of video transfer to First video frame displayed in player.
Latency	Latency is the time it takes for a small data set to be transmitted from a device to a server on the Internet and back to the same device again. The Latency is measured in milliseconds (ms). To calculate the one-way latency we just do half of the round-trip time. 50th percentile of one-way latency has been reported.
Jitter	Measure of variation in time in arrival of packets from a source to destination The consideration of packet delay jitter is considered by standard deviation of Inter Packet Delay Variation. If IPDV is used. By standard deviation is meant the average of standard deviation of IPDV on DL $IPDV(i) = D(i) - D(i-1)$ then Stdvs of IPDV is considered as jitter.
Packet Loss Rate	Number of packets lost out of total packet transferred during test. Packet loss rate = (Total packet lost / Total packet sent) *100 * Packet delay (using ping) >90 ms considered as packet loss and included in packet loss rate. * Packet loss rate is calculated based on ICMP *90th percentile for Packet loss rate has been reported in overall Hotspot performance summary.

Table-48: Network performance parameter and definition Data

Disclaimer: The observations presented above and, in the reports, represent the performance of the service providers on the area/route under test on the day/time of conducting the drive test and no inference whatsoever may be drawn regarding the quality of the telecom service by the service providers in the whole city/state/licensed service area.