TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Jammu & Kashmir LSA

December 2024

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 December-2024 under the supervision of TRAI Regional Office (RO), Delhi. Details of route/ area covered during the IDT is as given below:

Sl. No	Drive test route	Type of route	Distance covered (KMs)	From date	To date
1	Jammu	City	257.5	09-Dec-2024	12-Dec-2024
2	Jammu	Hotspot	8 Locations	11-Dec-2024	11-Dec-2024
3	Jammu to Srinagar	Highway	295.0	13-Dec-2024	13-Dec-2024

Table-1: Drive test summary

2.2 Drive test routes

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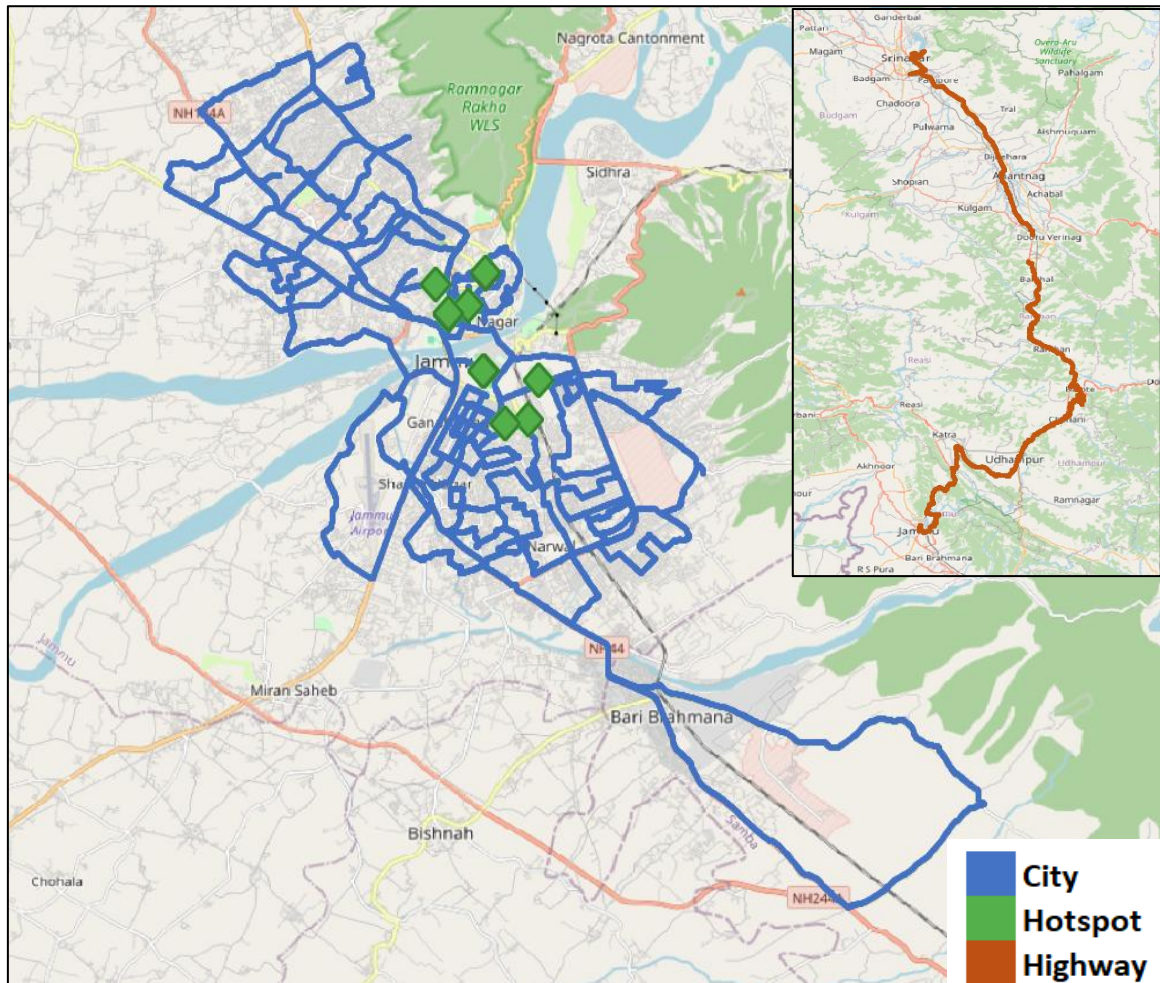
Figure-1: Drive test routes

2.3 Summary of areas covered

a) **City**- Nearby Gandhi Nagar, Satwari, Channi Himat, Bathindi, Birpur,Kartholi, Patoli, Kunjwani, Janipur, Paloura, Roop Nagar, Bohri, Lower Shiv Nagar, Chowadhi etc.

b) **Hotspot**-
1. Bahu Bazar
2. Fruit Mandi
3. Govt. Hospital Bakshi Nagar
4. Jammu Railway Station
5. Jammu University
6. K C Bus Stand
7. Raghunath Bazar
8. Rani Park

c) Highway

1. Jammu to Srinagar Via Katra, Udhampur, Patnitop, Banhal, Anantnag, Awantipora and Rampore.

2.4 Telecom service providers detected frequency bands

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

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	1800
10	Vodafone Idea Ltd.	3G	2100
11	Vodafone Idea Ltd.	4G	1800

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

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 LSA during the month of December-2024 covering City, Highway and Hotspots. (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	745	862	775
Call Setup Success Rate %	99.33	94.66	96.65
Drop Call Rate %	0.95	7.23	4.54
Call Setup Time-Average (Second)	2.92	3.15	3.23
Handover Success Rate %	98.57	95.77	97.00

Table-3: Summary of voice call performance in 3G/2G network mode only.
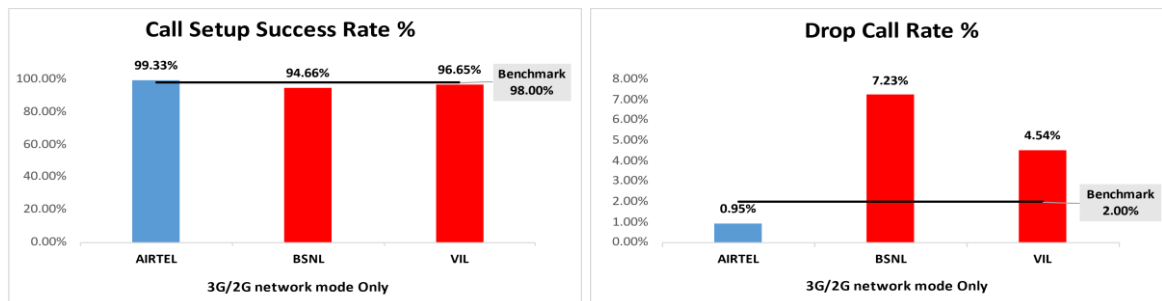
Figure-2: Call setup success rate and drop call rate performance.

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	215	437
2G	1123	269	149

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.

(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	854	959	873	876
Call Setup Success Rate %	99.06	94.06	99.20	96.35
Drop Call Rate %	0.24	4.99	0.23	1.78
Call Setup Time-Average (Second)	1.42	2.90	0.81	1.23
Handover Success Rate %	99.96	98.22	99.88	99.34

Table-5: Summary of voice call performance in network auto-selection mode.
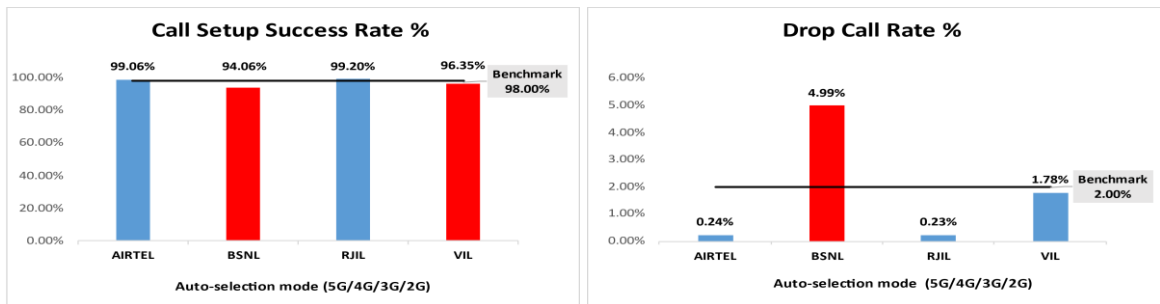
Figure-3: Performance for call setup success rate and drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	747	654	744	613
Number of silence call for >4 Sec	2	NA	7	6
Silence Call Rate %	0.27	NA	0.94	0.98
Number of silence instances for >4 Sec	2	NA	7	8
Number of silence instances for >3 Sec	5	NA	12	157
Number of silence instances for >2 sec	14	NA	30	559
RTP Jitter (4G & 5G) in ms	2.97	NA	15.54	16.90
Packet loss Rate Downlink %	0.34	NA	0.53	1.00
Packet loss Rate Uplink %	0.20	NA	0.67	1.20

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

Note-
- NA-Due to unavailability of packet switched (VoLTE & 5G) network in BSNL silence instances are not captured.
- VIL Call established count are very less as more number of block calls are reported in 5G/4G open mode during highway drive.

Number of unique cell Id's covered in Voice test- Technology wise				
Technology	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
5G	0	NA	894	NA
4G	1757	198	1586	593
3G	NA	96	NA	69
2G	3	389	NA	81

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.

## (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 score 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-6	5497	4394	5362	3791
Speech Quality (Average MOS Score)	4.04	2.78	3.88	3.83
Number of samples with MOS >=4 to <5 (Excellent)	4809	0	3565	2148
Number of samples with MOS >=3 to <4 (Good)	600	2252	1517	1261
Number of samples with MOS >=2 to <3 (Fair)	53	1630	167	283
Number of samples with MOS >=1 to <2 (Poor)	35	512	113	99
%age of samples with MOS >=4 to <5 (Excellent)	87.48%	0.00%	66.49%	56.66%
%age of samples with MOS >=3 to <4 (Good)	10.92%	51.25%	28.29%	33.26%
%age of samples with MOS >=2 to <3 (Fair)	0.96%	37.10%	3.11%	7.47%
%age of samples with MOS >=1 to <2 (Poor)	0.64%	11.65%	2.11%	2.61%

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

Note-
- MOS samples count are very less as more number of block calls are reported in 5G/4G open mode during highway drive for VIL.
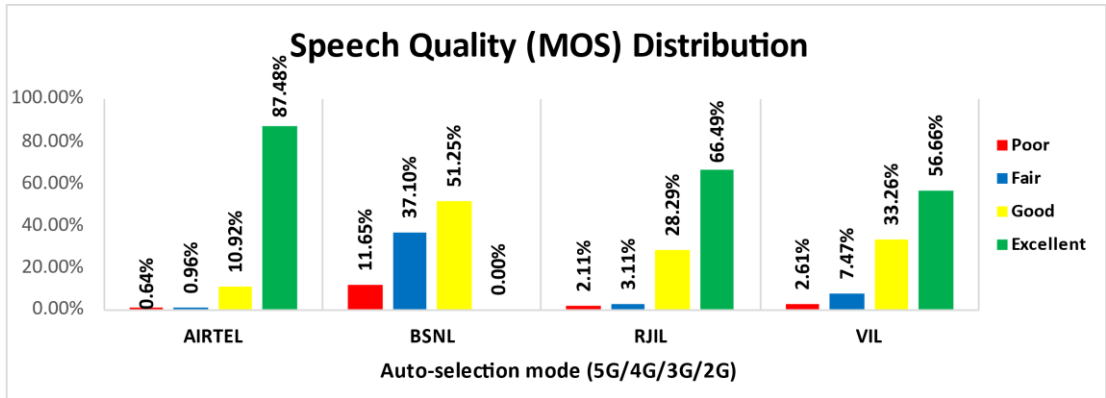
Figure- 4: Distribution of samples in MOS score range.

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	185.10	2.90	416.35	21.54
	80th Percentile	285.22	4.99	658.88	34.82
	20th Percentile	76.28	0.50	132.45	7.50
Upload Throughput (Mbits/s)	Average	28.39	2.45	38.69	13.02
	80th Percentile	45.86	4.23	67.45	22.21
	20th Percentile	9.72	0.57	8.78	3.75
Latency (ms)	50th Percentile	19.40	53.00	18.70	33.95

Table-9: Summary of data performance in network auto-selection mode.
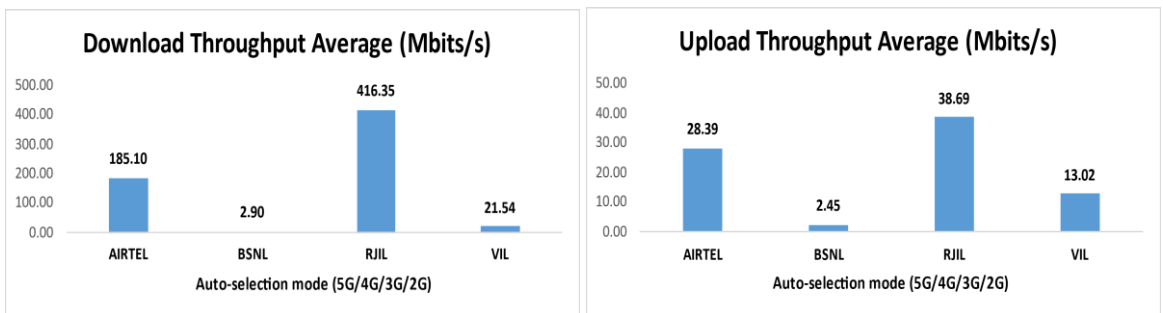
Figure- 5: Download and Upload throughput

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	1167	NA
4G	2021	120	388	578
3G	NA	315	NA	122
2G	1	109	NA	56

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.

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, Highway & Hotspots for all telecom service providers, the results of drive tests conducted is shown individually for respective areas/locations.

4.2 City

Drive test has been conducted from 9th December 2024 to 12th December 2024 in Jammu. (Refer Table-1)

4.2.1 Drive test route
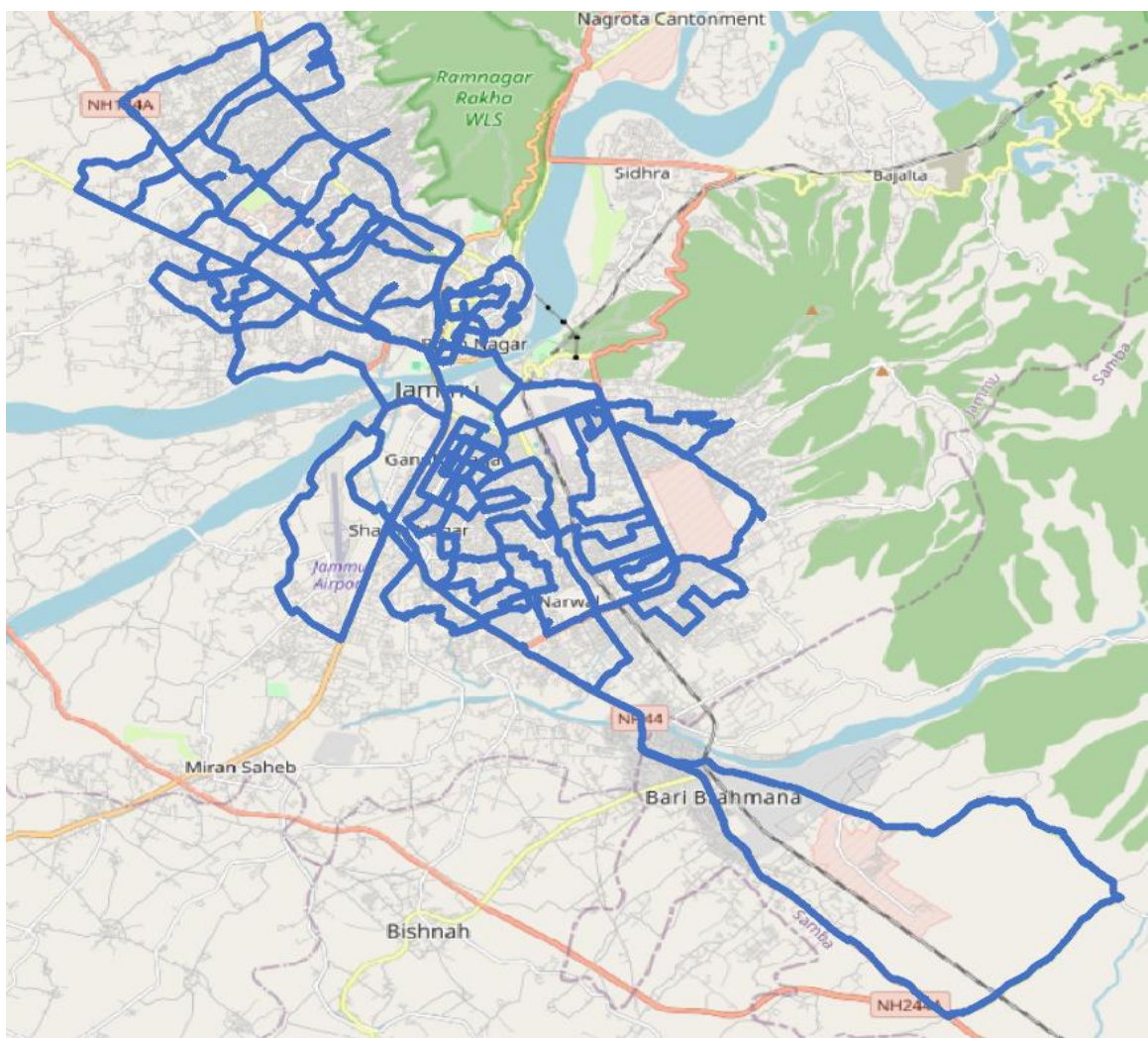
Figure- 6: Drive test routes

4.2.2 Areas covered

Nearby Gandhi Nagar, Satwari, Channi Himat, Bathindi, Birpur, Kartholi, Patoli, Kunjwani, Janipur, Paloura, Roop Nagar, Bohri, Lower Shiv Nagar, Chowadhi 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	577	591	598
Call Setup Success Rate %	100.00	98.65	97.83
Drop Call Rate %	0.17	3.26	3.42
Call Setup Time-Average (Second)	2.86	2.53	3.23
Handover Success Rate %	98.78	98.64	99.85

Table-11: Summary of voice call performance in 3G/2G network mode only**.**
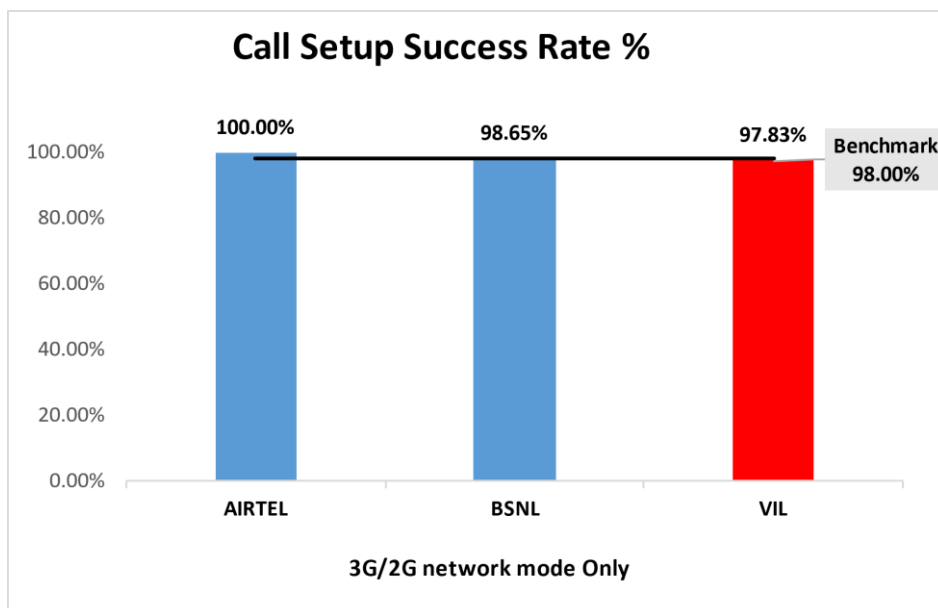
Figure-7: Performance for call setup success rate.
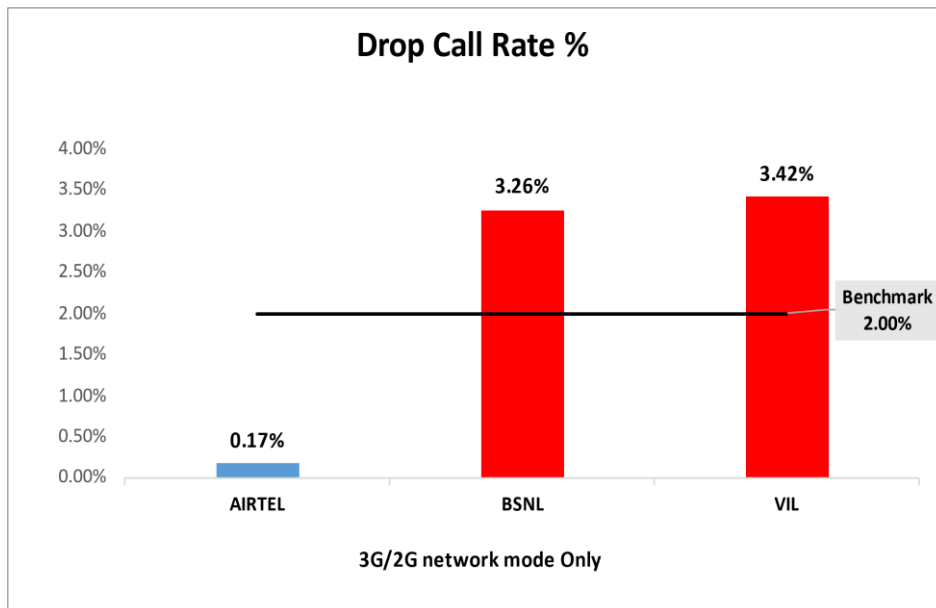
Figure-8: Performance for drop call rate.

(b) Network Technology: This section represent time spent on various network technologies.
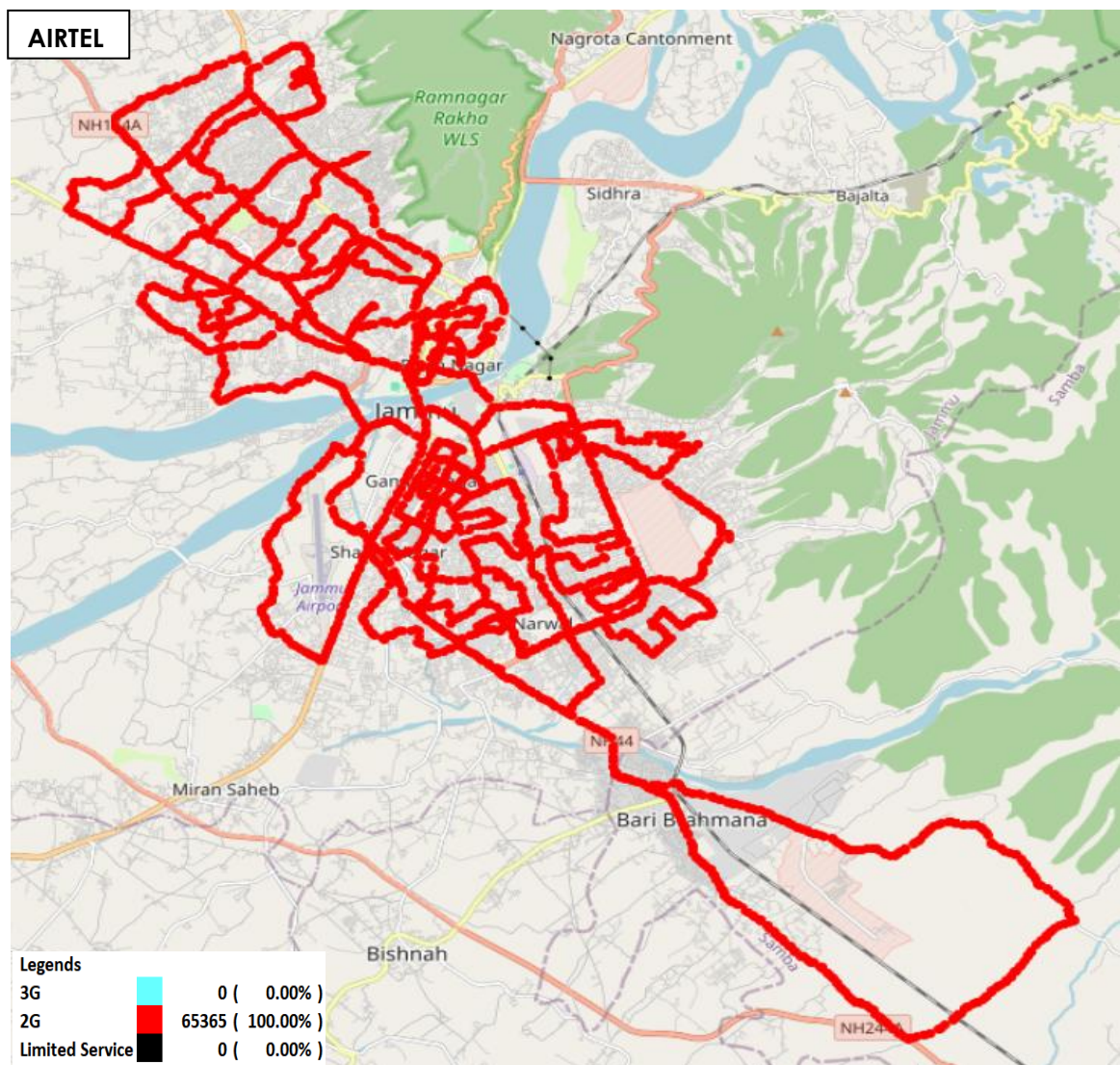
Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	67.93%	93.23%
2G	100.00%	32.07%	6.77%
Limited service	0.00%	0.00%	0.00%

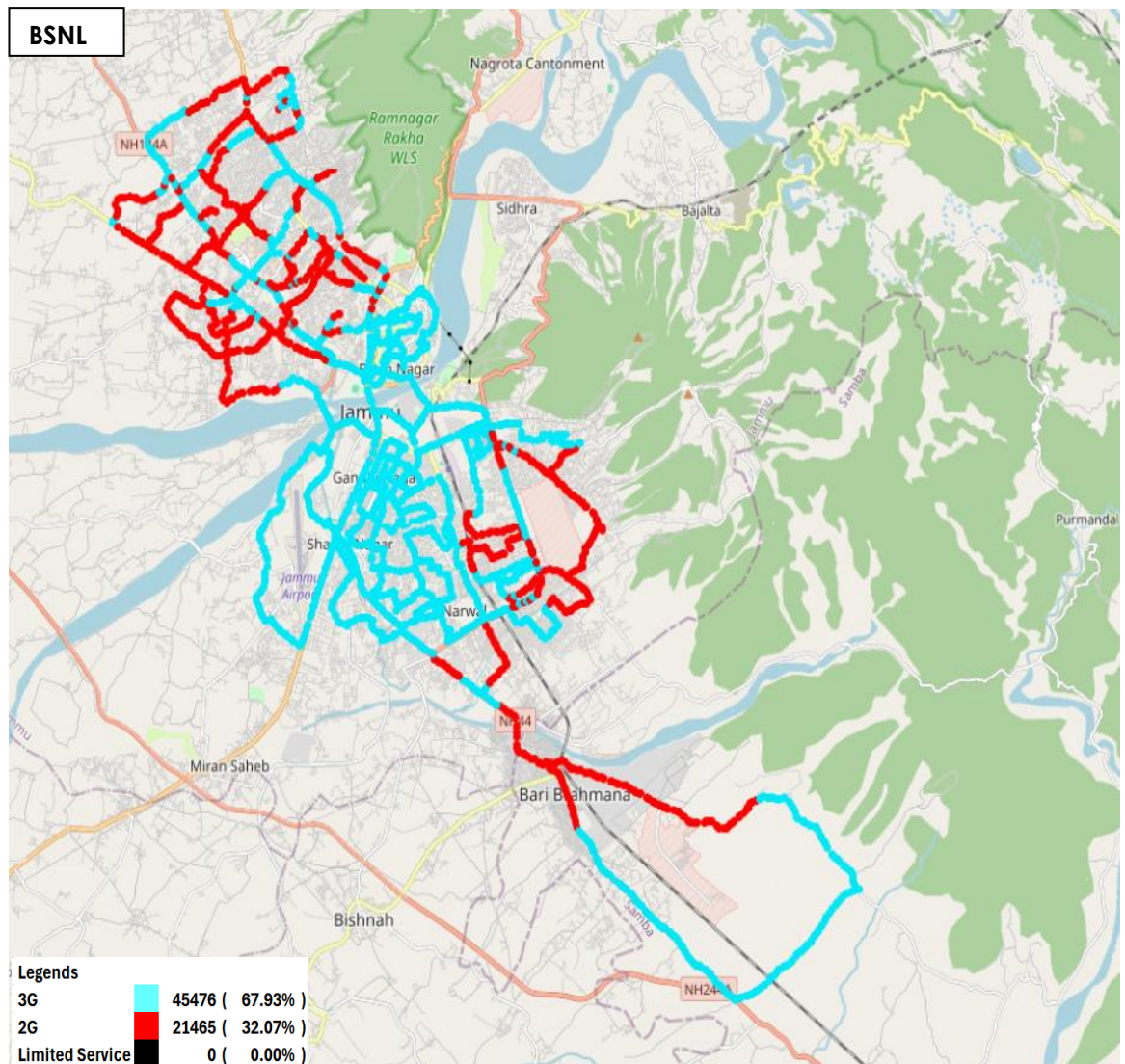**Table-12:** Time spent on technology during drive test 3G/2G network mode.

Note-
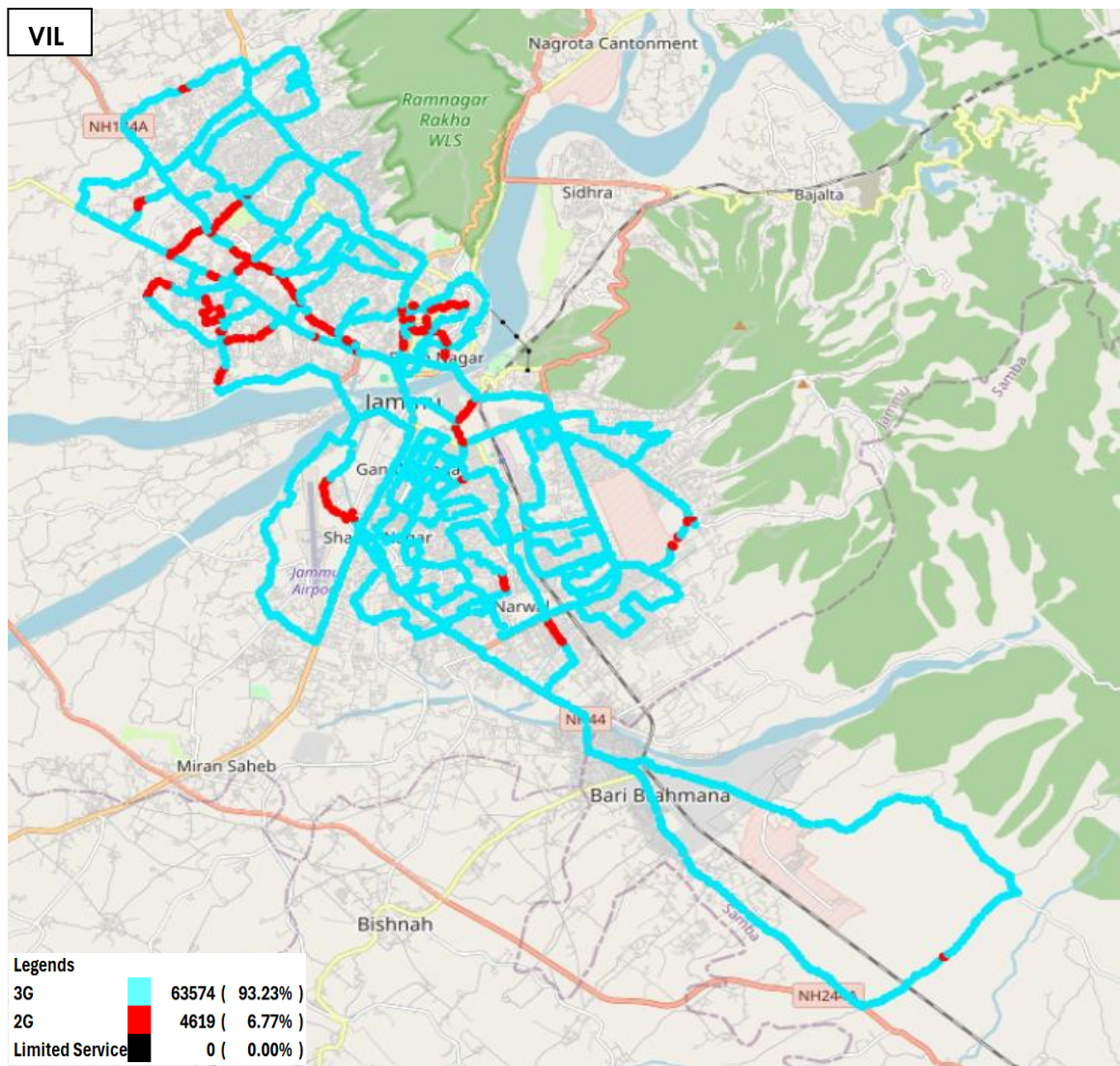- NA- Service provider doesn't provide services in respective technology.

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

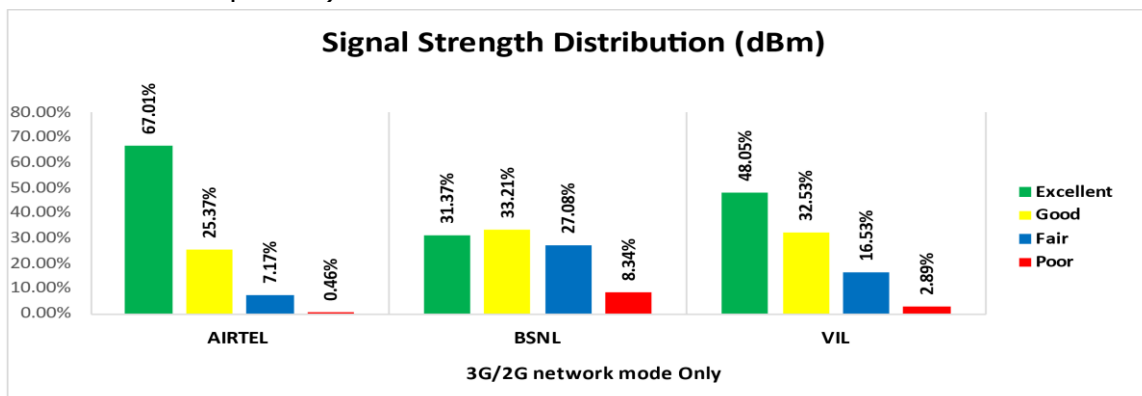**Figure-10:** Serving technology plots 3G/2G network mode –BSNL.

Legends			
3G		63574 (	93.23%)
2G		4619 (	6.77%)
Limited Service		0 (	0.00%)

Figure-11: Serving technology plots 3G/2G network mode –VIL.

(C) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 41, 42 & 43 for map view)

**Figure-12:** Signal strength distribution 3G/2G network mode only.

Observations:
- Airtel has 67% of samples falling in the excellent signal strength category.
- BSNL has 31% of samples falling in the excellent signal strength category.
- VIL has 48% 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	604	604	619	612
Call Setup Success Rate %	99.50	98.01	100.00	98.04
Drop Call Rate %	0.00	2.53	0.00	0.00
Call Setup Time Average (Second)	1.39	2.55	0.79	0.92
Handover Success Rate %	99.95	97.80	99.86	99.77

Table-13: Summary of voice call performance in network auto-selection mode.
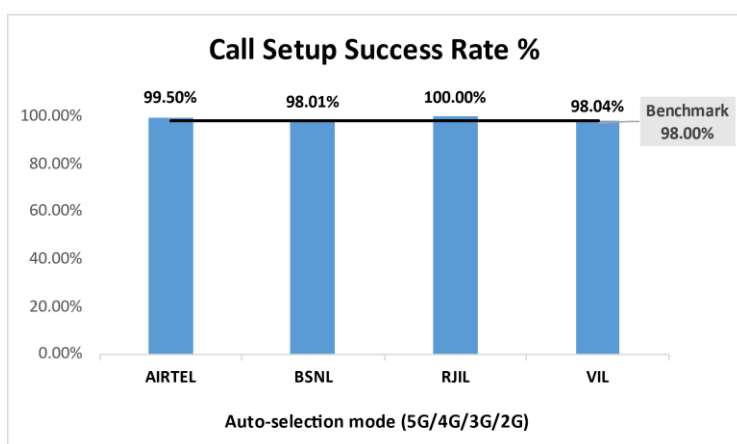
Figure-13: Performance for call setup success rate.
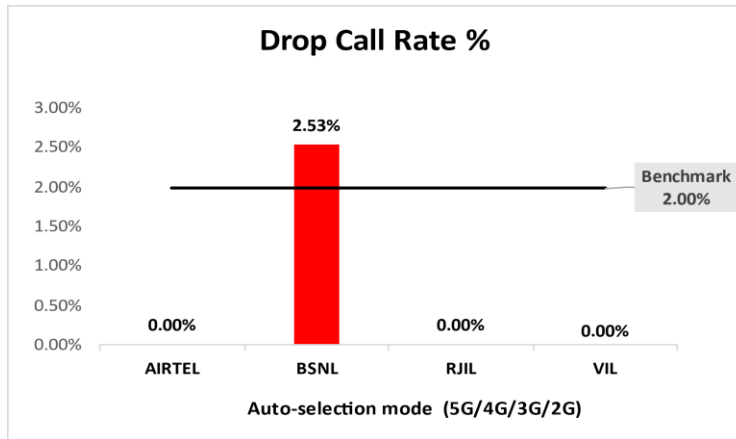
Figure-14: Performance for drop call rate.

Parameter	Service Provider Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Established (within service provider Network)	583	565	579	564
Number of silence call for >4 Sec	1	NA	3	3
Silence Call Rate %	0.17	NA	0.52	0.53
Number of silence instances for >4 Sec	1	NA	3	3
Number of silence instances for >3 Sec	1	NA	4	125
Number of silence instances for >2 sec	2	NA	10	520
RTP Jitter (4G & 5G) in ms	2.85	NA	19.25	17.00
Packet loss Rate Downlink %	0.11	NA	0.50	0.86
Packet loss Rate Uplink %	0.12	NA	0.52	0.89

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

Note-
- NA-Due to unavailability of packet switched (VoLTE & 5G) network in BSNL silence instances are not captured.

(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 score 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-16	3479	2983	3420	3332
Speech Quality (Average MOS Score)	4.06	2.79	3.88	3.90
Number of samples with MOS >=4 to <5 (Excellent)	3067	0	2179	1976
Number of samples with MOS >=3 to <4 (Good)	384	1553	1086	1126
Number of samples with MOS >=2 to <3 (Fair)	25	1118	96	173
Number of samples with MOS >=1 to <2 (Poor)	3	312	59	57
%age of samples with MOS >=4 to <5 (Excellent)	88.16%	0.00%	63.71%	59.30%
%age of samples with MOS >=3 to <4 (Good)	11.04%	52.06%	31.75%	33.79%
%age of samples with MOS >=2 to <3 (Fair)	0.72%	37.48%	2.81%	5.19%
%age of samples with MOS >=1 to <2 (Poor)	0.09%	10.46%	1.73%	1.71%

Table-15: Summary of speech quality (MOS) samples.
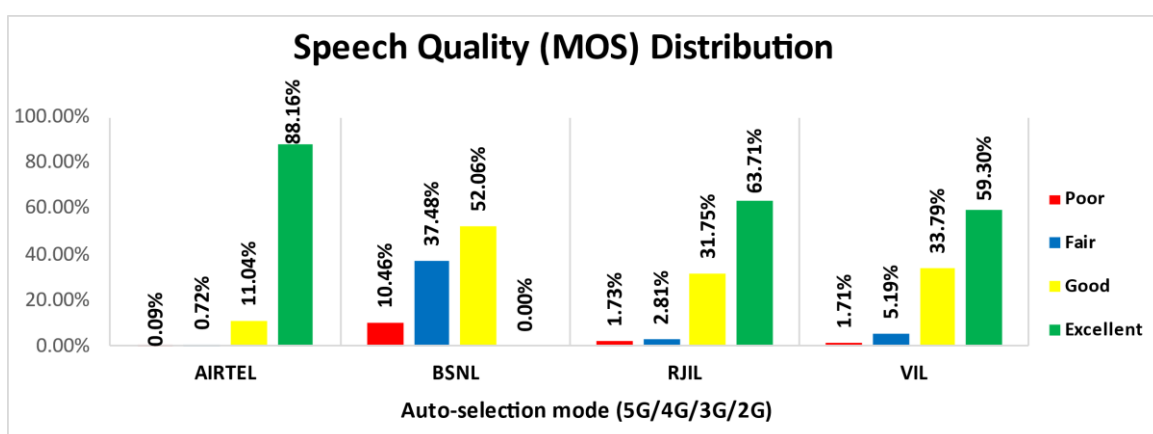
Figure-15: Distribution of samples in MOS score range.

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

Technology	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
5G	2.59%	NA	61.12%	NA
4G	97.41%	1.13%	38.88%	96.00%
3G	NA	49.37%	NA	3.12%
2G	0.00%	48.99%	NA	0.88%
Limited Service	0.00%	0.51%	0.00%	0.00%

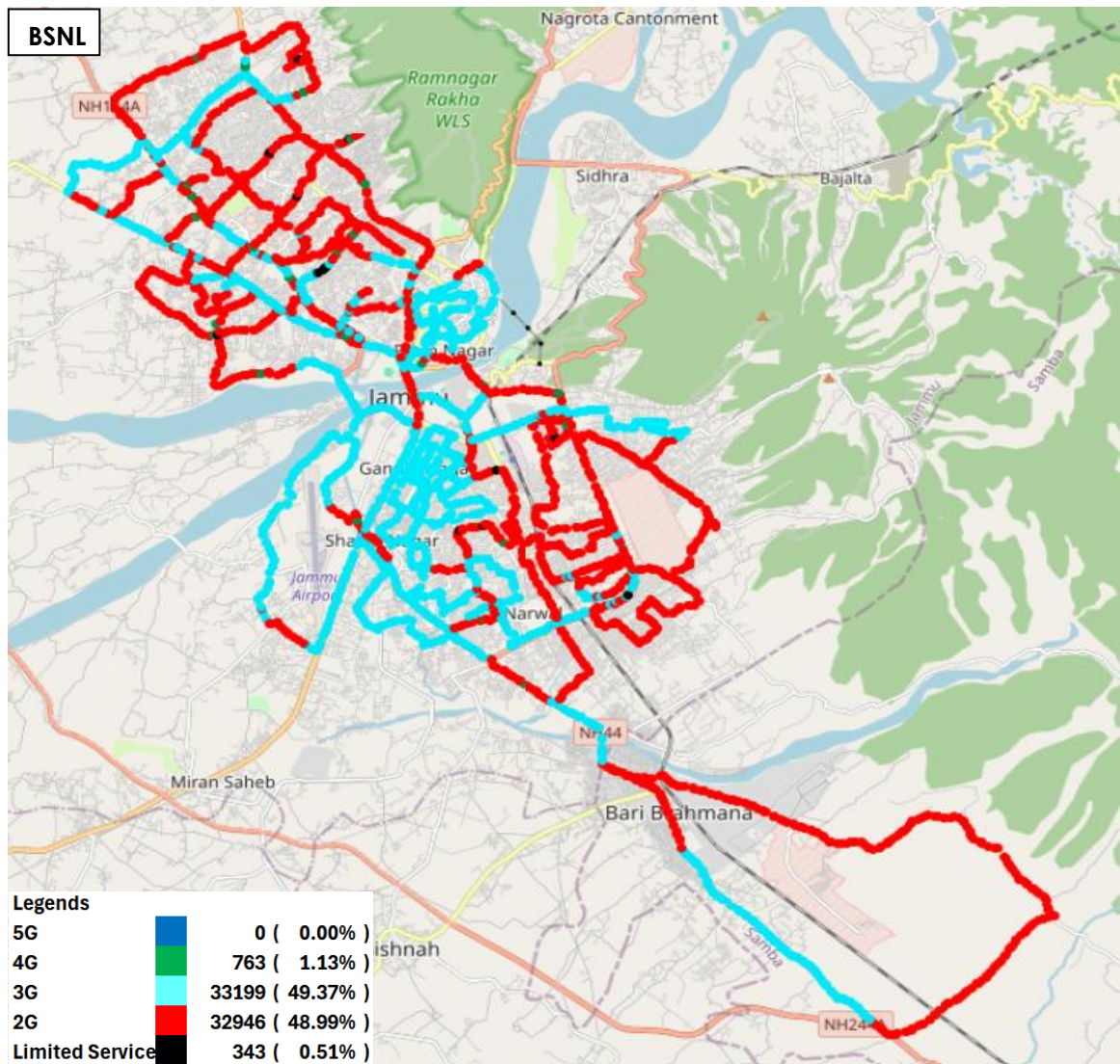**Table-16:** Time spent on technology during drive test.

Note-
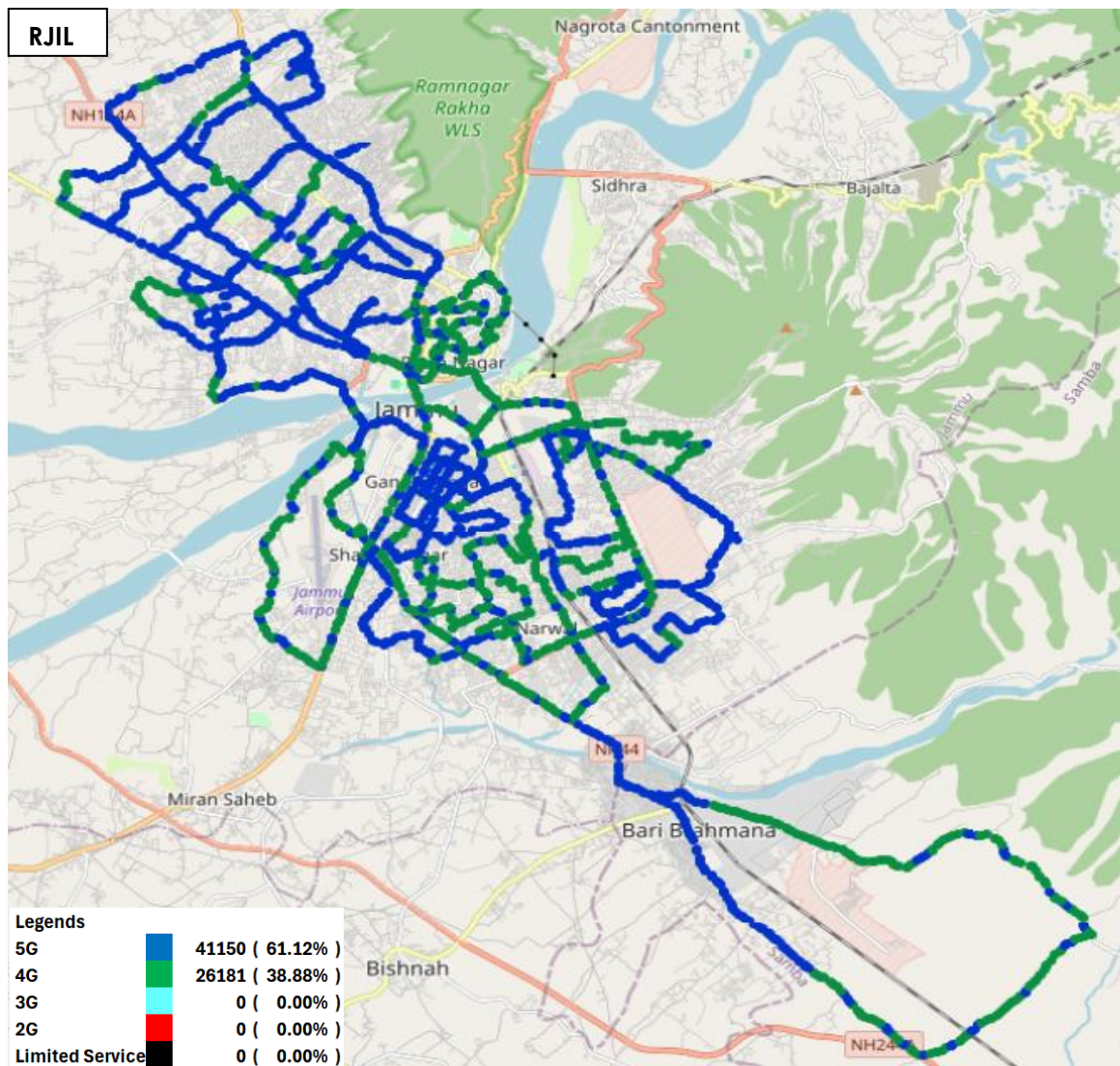* NA- Service provider doesn't provide services in respective technology.
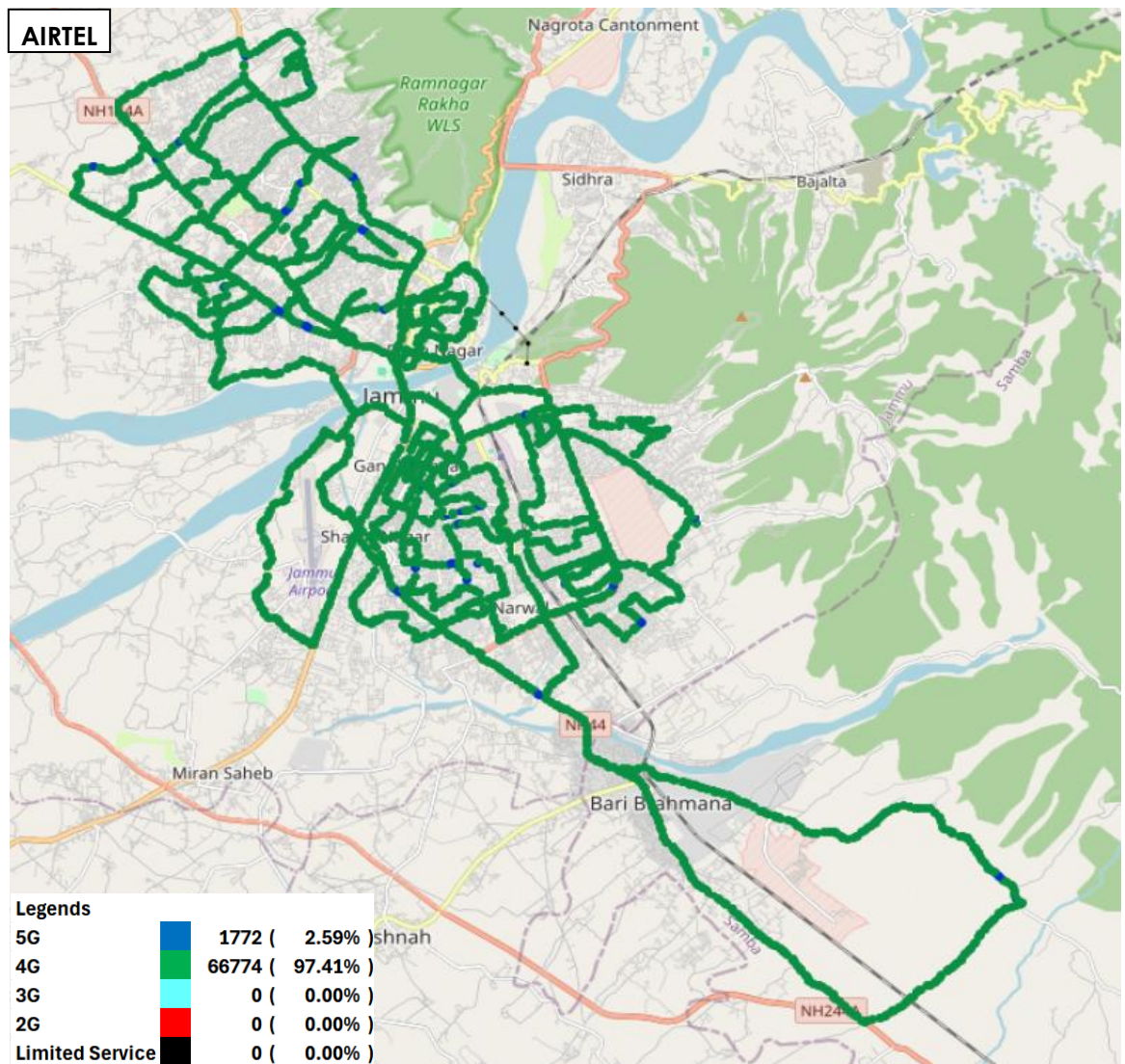
Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -AIRTEL.

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

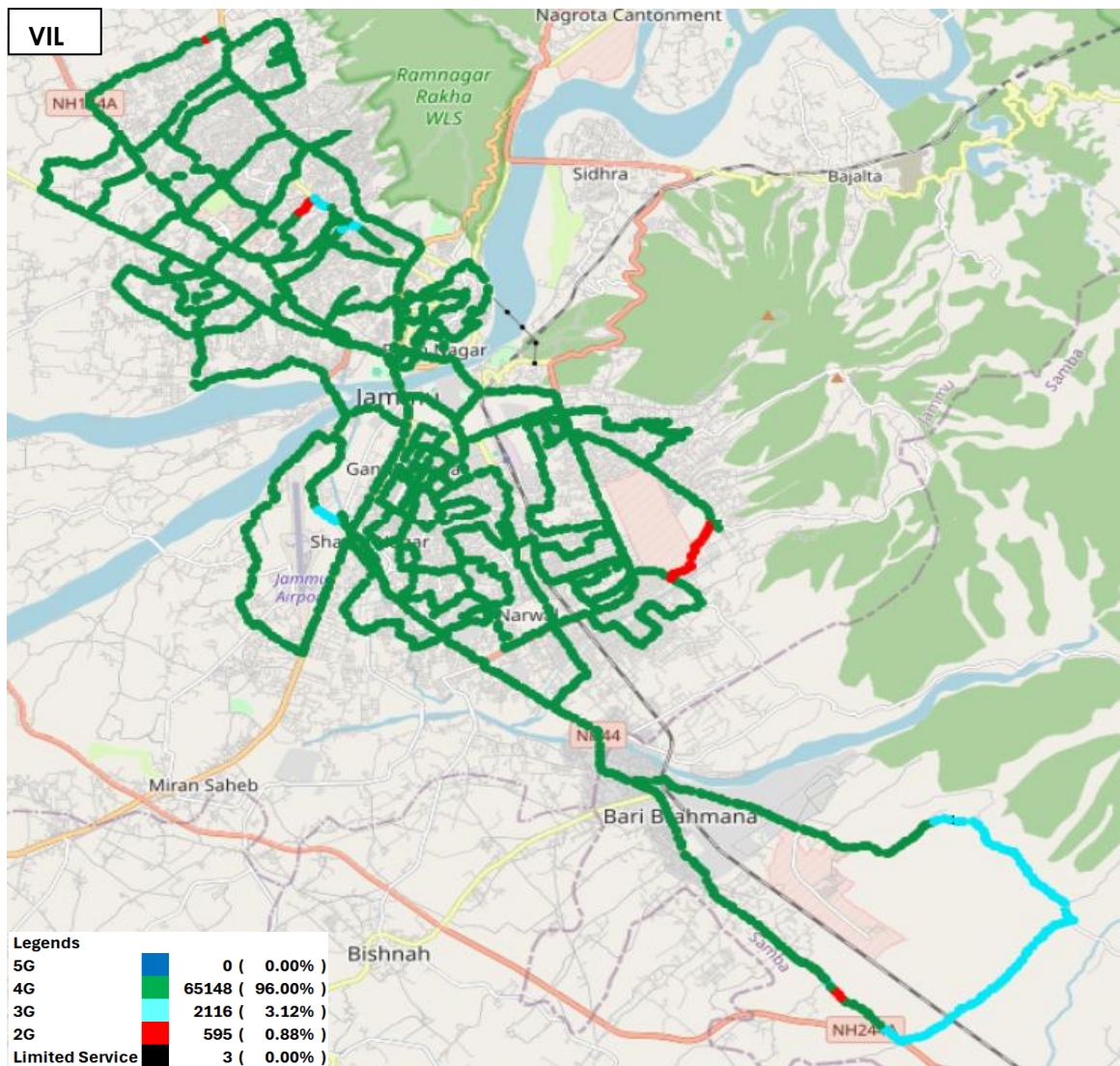| Legends		
5G		41150 (61.12%)
4G		26181 (38.88%)
3G		0 (0.00%)
2G		0 (0.00%)
Limited Service		0 (0.00%)

Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL.

Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G) – VIL.

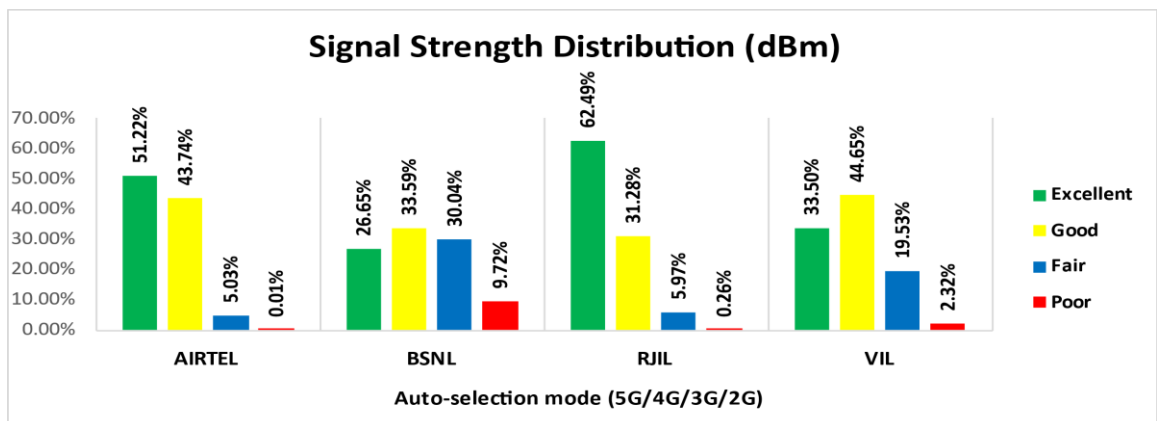**(g) Network Signal Strength Distribution:** The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-44, 45, 46 & 47 for map view)


Figure-20: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:
- Airtel has 51% samples falling in the excellent signal strength category.
- BSNL has 27% samples falling in the excellent signal strength category.
- RJIL has 62% samples falling in the excellent signal strength category.
- VIL has 34% 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	189.88	2.98	482.84	24.93
	80th Percentile	270.71	5.00	685.80	36.13
	20th Percentile	99.47	0.85	260.11	14.48
Upload Throughput (Mbits/s)	Average	29.05	2.73	44.89	15.51
	80th Percentile	44.61	5.11	73.40	23.41
	20th Percentile	12.07	1.00	14.48	7.95
Latency (ms)	50th Percentile	27.65	94.00	17.25	32.55

Table-17: Summary of Data performance in network auto-selection mode.
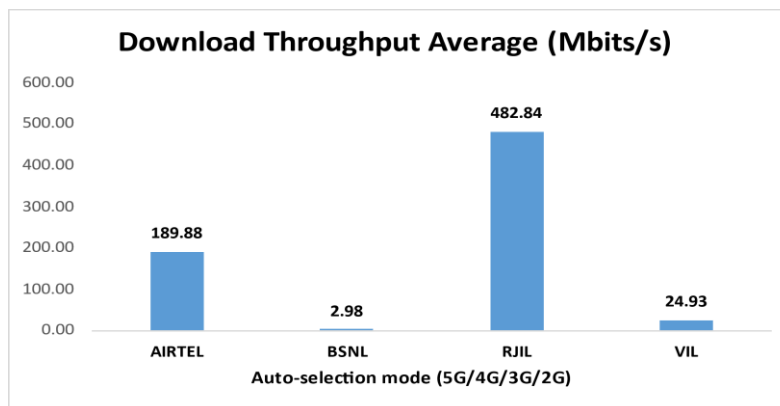
Figure- 21: Download throughput
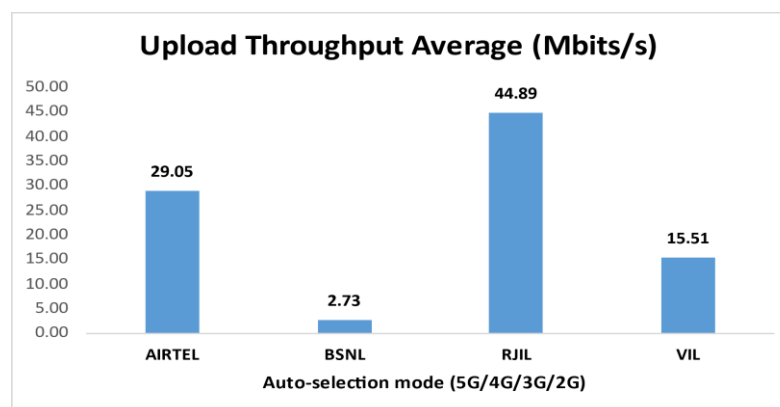
Figure- 22: Upload throughput

4.3 Hotspots

Hotspot testing have been done on 11th December 2024. Eight locations has been tested in the city.

4.3.1 Locations
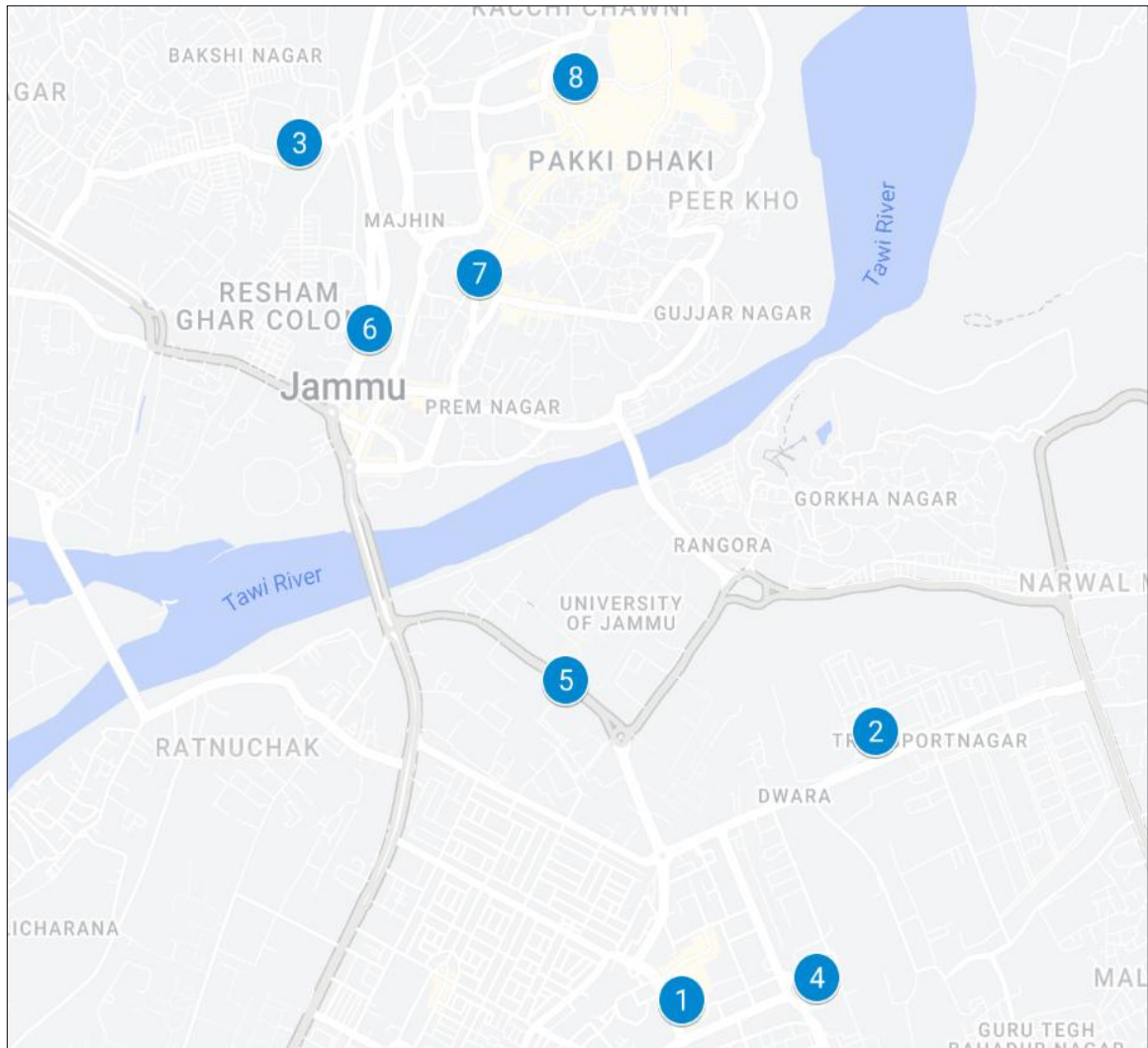
Figure- 23: Hotspot locations

4.3.2 Hotspot covered

1. Bahu Bazar
2. Fruit Mandi
3. Govt. Hospital Bakshi Nagar
4. Jammu Railway Station
5. Jammu University
6. K C Bus Stand
7. Raghunath Bazar
8. Rani Park

4.3.3 Voice performance

Overall Voice Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	80	80	80	80
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.41	2.31	0.66	0.78

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

Bahu Bazar				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.42	2.12	0.67	0.81

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

Fruit Mandi				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.45	1.99	0.66	0.87

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

Govt. Hospital Bakshi Nagar				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.41	2.02	0.68	0.75

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

Jammu Railway Station				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.38	2.46	0.62	0.75

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

Jammu University				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.38	2.72	0.67	0.87

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

K C Bus Stand				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.42	2.08	0.66	0.75

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

Raghunath Bazar				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.43	2.20	0.66	0.77

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

Rani Park				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.35	2.91	0.66	0.68

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

4.3.4 Data performance

Overall Data Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	184.88	4.15	299.80	25.89
Download Throughput 80th Percentile (Mbit/s)	288.50	5.46	548.81	38.33
Download Throughput 20th Percentile (Mbit/s)	75.54	2.69	26.44	6.51
Download Session Setup Success Rate %	100.00	97.50	100.00	100.00
Upload Throughput Average (Mbits/s)	26.20	2.47	39.10	14.51
Upload Throughput 80th Percentile (Mbit/s)	49.90	2.41	70.80	20.60
Upload Throughput 20th Percentile (Mbit/s)	6.71	1.53	14.43	3.29
Upload Session Setup Success Rate %	100.00	95.00	100.00	100.00
Web Browsing Delay (Second)	2.56	5.31	2.29	3.22
Youtube Initial Buffer Delay (Second)	1.11	3.08	0.55	0.95
Latency (ms)- 50th Percentile	18.80	31.43	18.90	35.50
Jitter (ms)	10.68	42.66	8.81	5.46
Packet Loss Rate%	0.98	4.99	0.30	0.95

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

Bahu Bazaar				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	66.83	4.67	17.09	32.11
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	8.14	1.89	3.46	10.91
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	1.91	2.68	4.10	1.36
Youtube Initial Buffer Delay (Second)	1.62	1.98	0.58	0.85
Latency (ms)- 50th Percentile	19.45	32.65	32.10	37.80
Jitter (ms)	4.53	28.38	8.72	2.95
Packet Loss Rate%	1.30	3.40	0.30	0.60

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

Fruit Mandi				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	223.76	2.78	23.81	4.54
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	63.03	1.46	20.07	2.42
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	3.08	10.95	2.20	6.30
Youtube Initial Buffer Delay (Second)	0.49	5.43	0.60	1.66
Latency (ms)- 50th Percentile	17.03	32.20	20.45	36.60
Jitter (ms)	2.95	20.02	6.33	14.14
Packet Loss Rate%	0.00	7.20	0.00	2.10

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

Govt. Hospital Bakshi Nagar				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	57.86	4.20	221.76	18.14
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	9.09	6.78	48.20	11.36
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	1.07	2.31	1.22	1.53
Youtube Initial Buffer Delay (Second)	0.87	3.70	0.55	0.86
Latency (ms)- 50th Percentile	27.10	27.08	17.18	36.95
Jitter (ms)	34.90	7.56	7.75	3.20
Packet Loss Rate%	5.80	0.00	0.00	0.30

Table-30: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Jammu Railway Station				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	311.02	1.28	376.65	38.77
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	48.31	1.50	72.42	17.73
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	3.33	8.59	1.96	4.19
Youtube Initial Buffer Delay (Second)	0.56	3.39	0.50	0.85
Latency (ms)- 50th Percentile	18.15	34.08	16.88	27.25
Jitter (ms)	3.37	225.11	6.10	1.76
Packet Loss Rate%	0.00	23.00	0.00	0.50

Table-31: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Jammu University				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	215.92	4.27	123.11	5.74
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	21.78	1.78	16.01	2.89
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	3.47	6.81	3.47	5.54
Youtube Initial Buffer Delay (Second)	0.64	1.81	0.60	1.26
Latency (ms)- 50th Percentile	22.80	31.30	19.30	36.05
Jitter (ms)	13.84	21.16	24.27	14.03
Packet Loss Rate%	0.10	2.63	2.10	2.20

Table-32: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

K C Bus Stand				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	302.00	7.24	559.20	40.06
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	48.35	1.86	76.00	30.15
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	3.05	4.93	2.26	4.16
Youtube Initial Buffer Delay (Second)	0.51	1.58	0.50	0.75
Latency (ms)- 50th Percentile	17.23	30.20	17.15	29.15
Jitter (ms)	18.09	9.51	5.96	1.52
Packet Loss Rate%	0.50	0.10	0.00	0.70

Table-33: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Raghunath Bazaar				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	131.63	4.95	439.43	36.42
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	4.53	2.38	16.09	20.09
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	3.58	5.33	2.26	4.49
Youtube Initial Buffer Delay (Second)	3.51	2.05	0.54	0.83
Latency (ms)- 50th Percentile	17.98	29.88	16.35	29.20
Jitter (ms)	2.92	9.92	5.70	2.05
Packet Loss Rate%	0.00	0.50	0.00	0.30

Table-34: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Rani Park				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	170.05	3.26	637.32	31.36
Download Session Setup Success Rate%	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	6.36	1.71	60.56	20.53
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	1.07	3.31	1.08	1.41
Youtube Initial Buffer Delay (Second)	0.67	5.57	0.54	0.81
Latency (ms)- 50th Percentile	16.10	40.28	16.43	37.55
Jitter (ms)	4.87	17.37	5.81	4.04
Packet Loss Rate%	0.10	3.10	0.00	0.90

Table-35: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

4.4 Highway

Drive test has been conducted on 13th December 2024 covering one Highway route. (Refer Table-1)

4.4.1 Drive test route
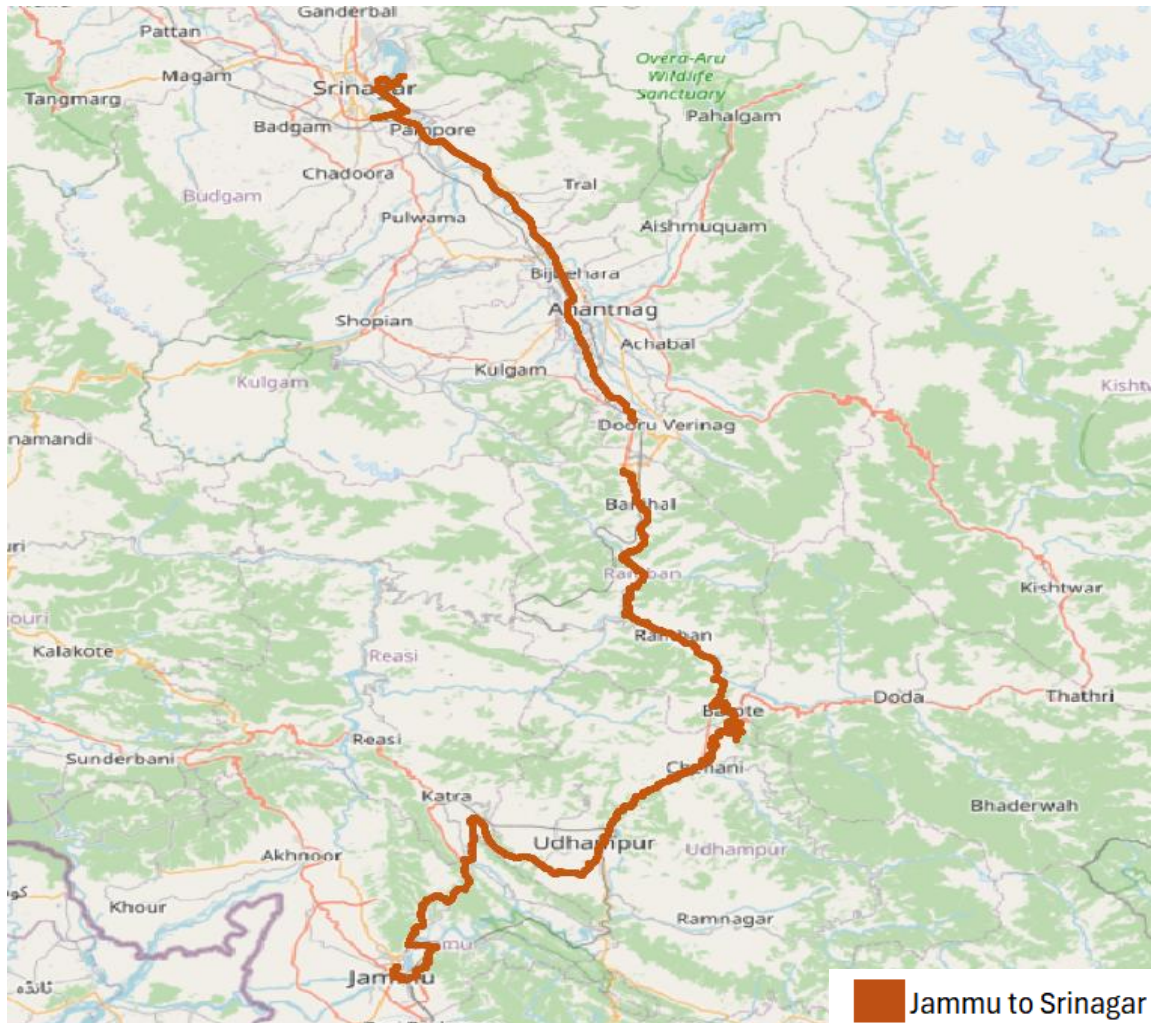
Figure-24: Drive test route highway

Note:- Missing route is caused due to Tunnel

4.4.2 Routes Covered

- Jammu to Srinagar Via Katra, Udhampur, Patnitop, Banhal, Anantnag, Awantipora and Rampore. Drive test for this route has been conducted on 13th December 2024

4.4.3 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	168	271	177
Call Setup Success Rate %	97.02	85.98	92.66
Drop Call Rate %	3.68	17.17	8.54
Call Setup Time-Average (Second)	3.14	4.68	3.24
Handover Success Rate %	98.19	91.18	99.77

Table-36: Summary of voice call performance in 3G/2G network mode only.
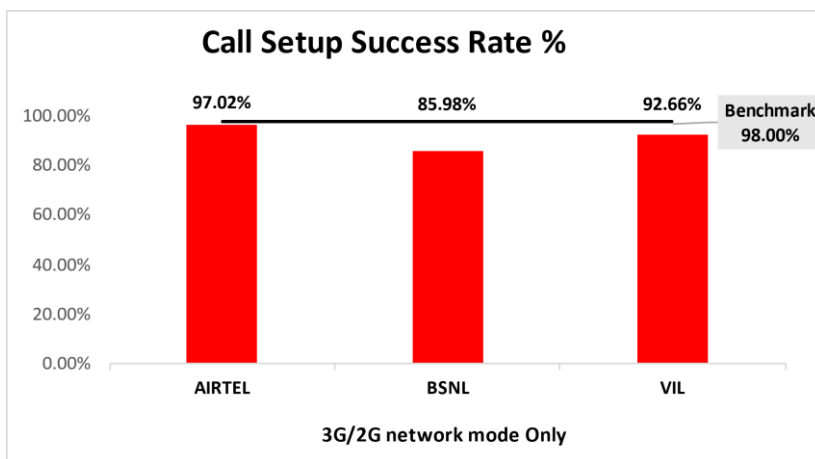
Figure-25: Performance for call setup success rate.
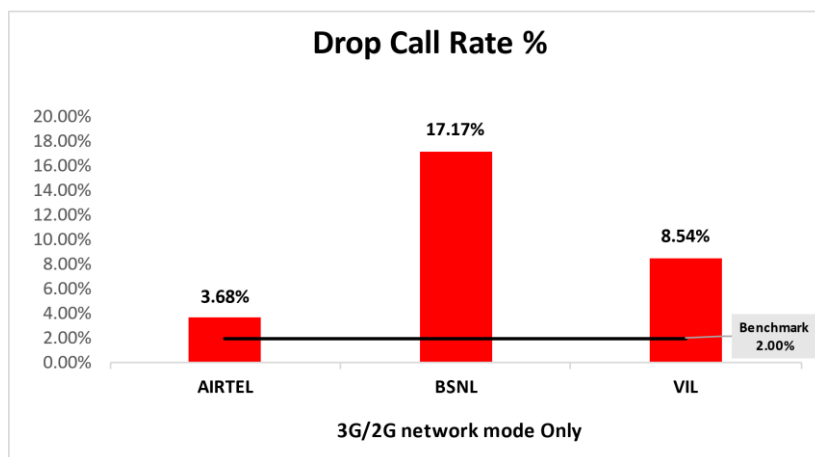
Figure-26: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	BSNL	VIL
3G	NA	51.51%	76.27%
2G	99.76%	45.39%	23.27%
Limited Service	0.24%	3.11%	0.46%

Table-37: Time spent on technology during drive test 3G/2G network mode only.
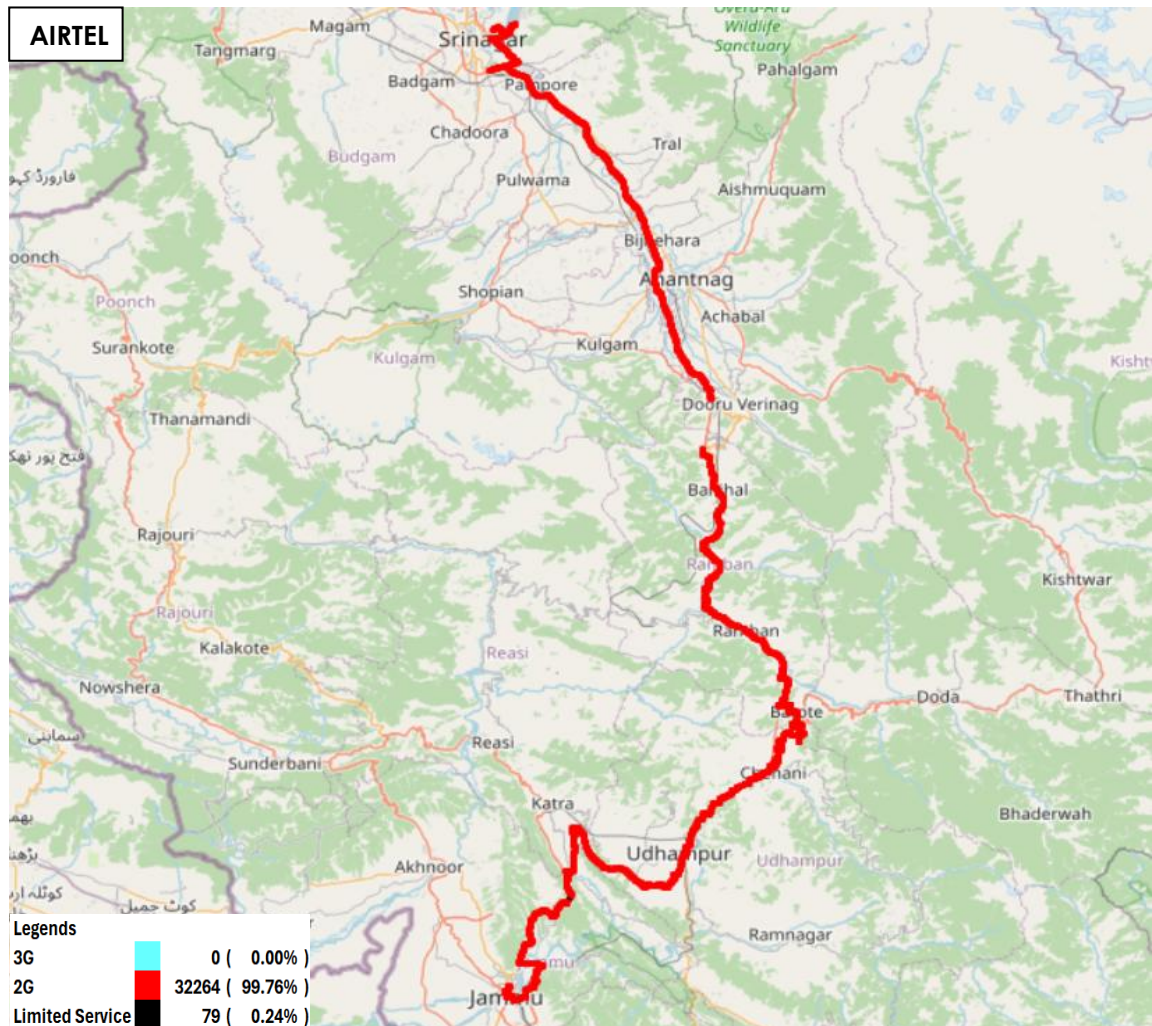
Figure-27: Serving technology plots 3G/2G network mode – AIRTEL.
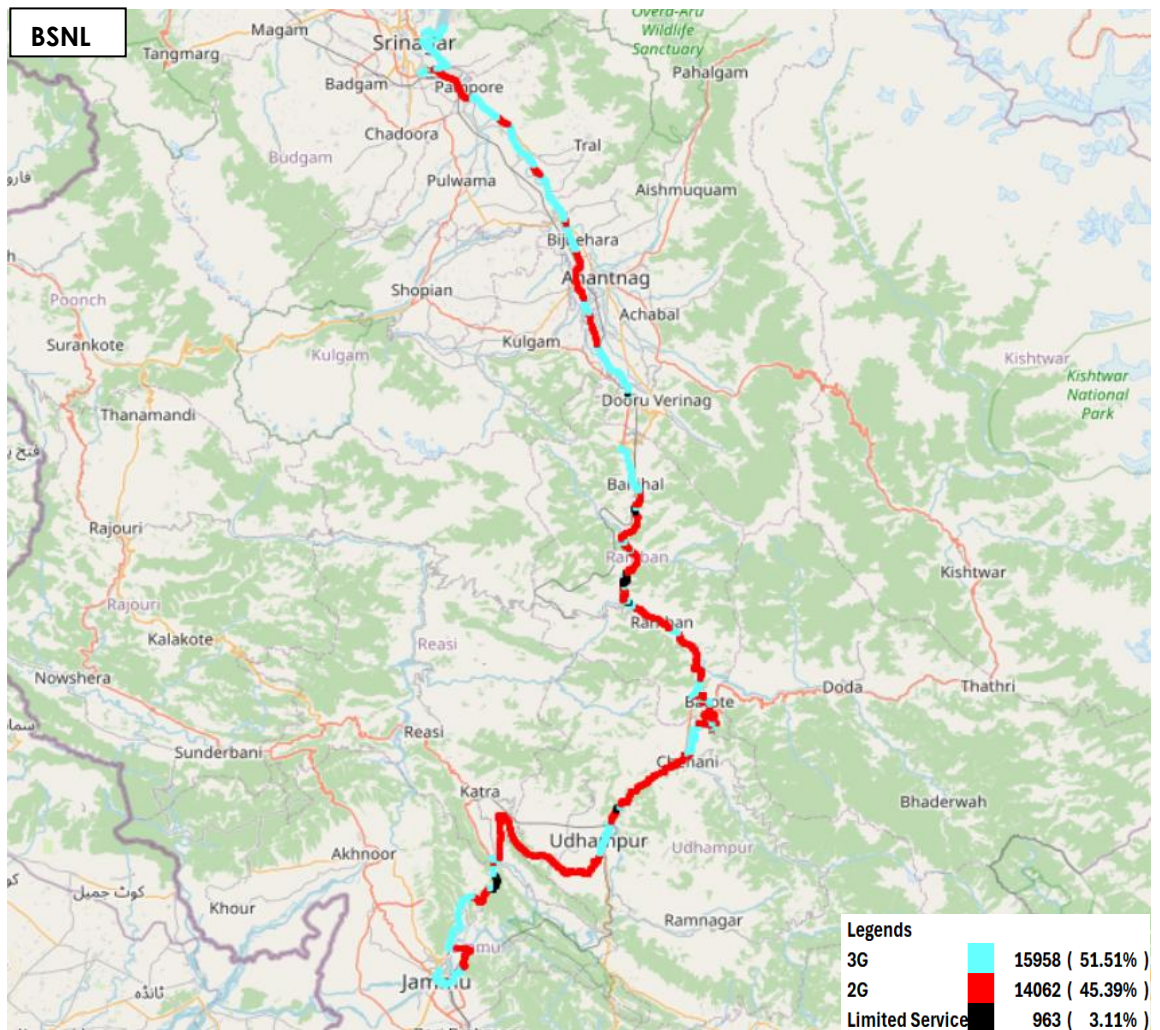
Figure-28: Serving technology plots 3G/2G network mode – BSNL.
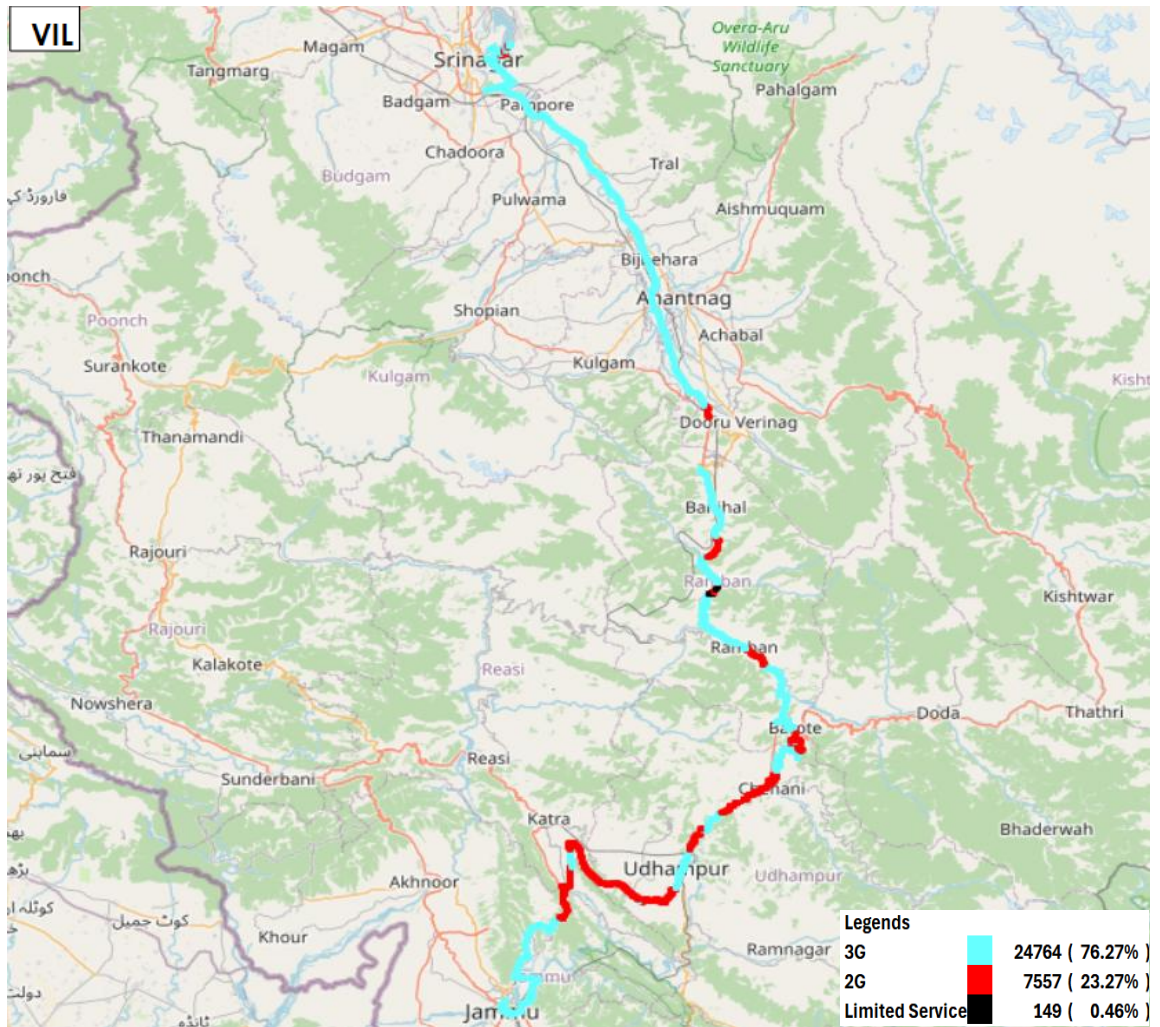
Figure-29: Serving technology plots 3G/2G network mode –VIL.

(C) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure-48, 49 & 50 for map view)
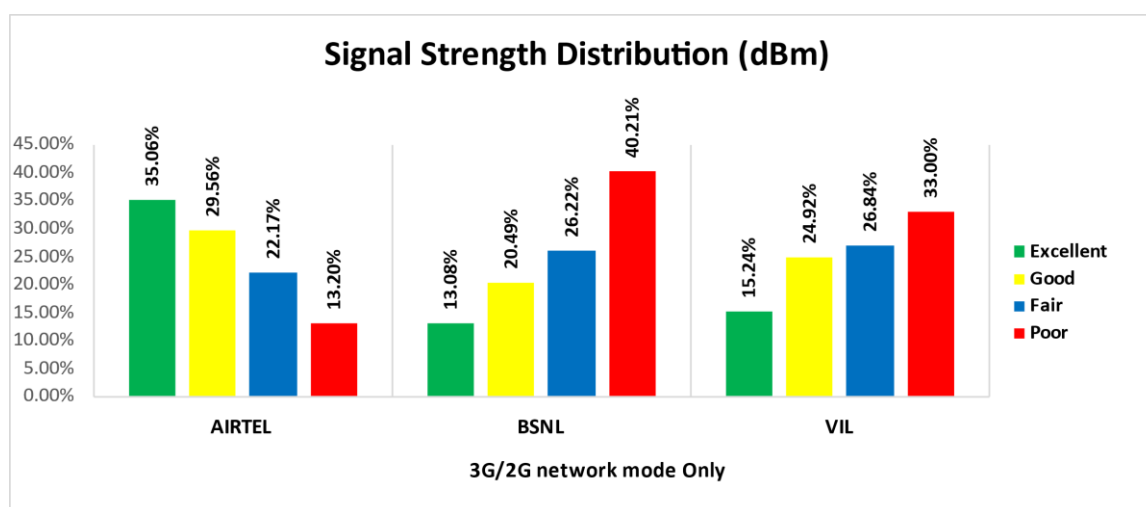
Figure-30: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 35% of samples falling in excellent signal strength category.
- BSNL has 13% of samples falling in excellent signal strength category.
- VIL has 15% of samples falling in 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	170	275	174	184
Call Setup Success Rate %	97.06	83.64	95.98	89.13
Drop Call Rate %	1.21	13.04	1.20	9.15
Call Setup Time Average (Second)	1.56	3.98	0.97	2.61
Handover Success Rate %	99.93	98.90	99.92	99.85

Table-38: Summary of voice call performance in network auto-selection mode.
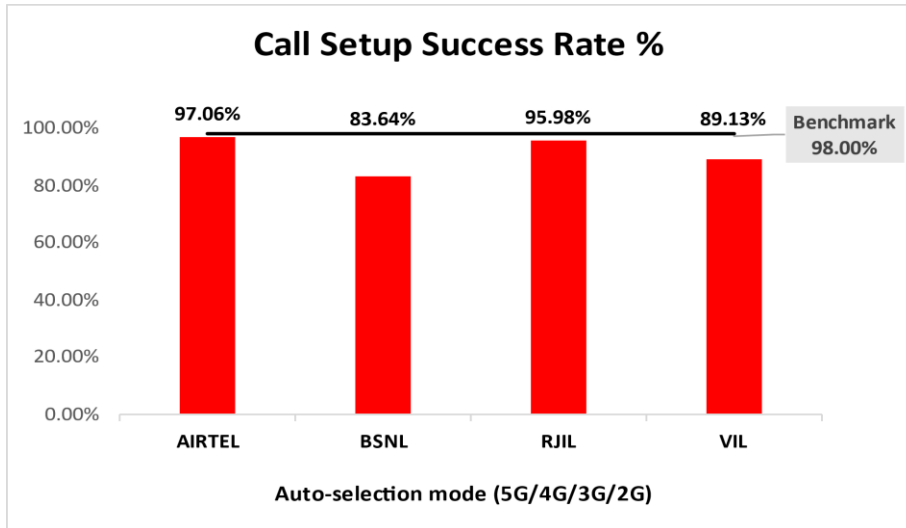
Figure-31: Performance for call setup success rate.
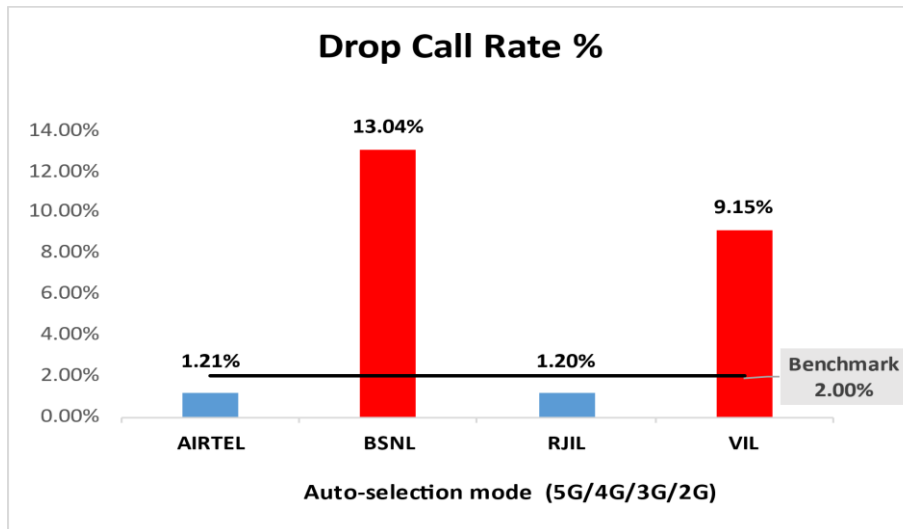
Figure-32: Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	164	89	165	49
Number of silence call for >4 Sec	1	NA	4	3
Silence Call Rate %	0.61	NA	2.42	6.12
Number of silence instances for >4 Sec	1	NA	4	5
Number of silence instances for >3 Sec	4	NA	8	32
Number of silence instances for >2 sec	12	NA	20	39
RTP Jitter (4G & 5G) in ms	3.18	NA	8.26	16.16
Packet loss Rate Downlink %	1.15	NA	0.65	2.15
Packet loss Rate Uplink %	0.48	NA	1.24	6.31

Table-39: Summary of silence instances & packet loss rate for mobile to mobile call.

(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 score 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-39	2018	1411	1942	459
Speech Quality (Average MOS Score)	4.01	2.77	3.88	3.36
Number of samples with MOS >=4 to <5 (Excellent)	1742	0	1386	172
Number of samples with MOS >=3 to <4 (Good)	216	699	431	135
Number of samples with MOS >=2 to <3 (Fair)	28	512	71	110
Number of samples with MOS >=1 to <2 (Poor)	32	200	54	42
%age of samples with MOS >=4 to <5 (Excellent)	86.32%	0.00%	71.37%	37.47%
%age of samples with MOS >=3 to <4 (Good)	10.70%	49.54%	22.19%	29.41%
%age of samples with MOS >=2 to <3 (Fair)	1.39%	36.29%	3.66%	23.97%
%age of samples with MOS >=1 to <2 (Poor)	1.59%	14.17%	2.78%	9.15%

Table-40: Summary of speech quality (MOS) samples.
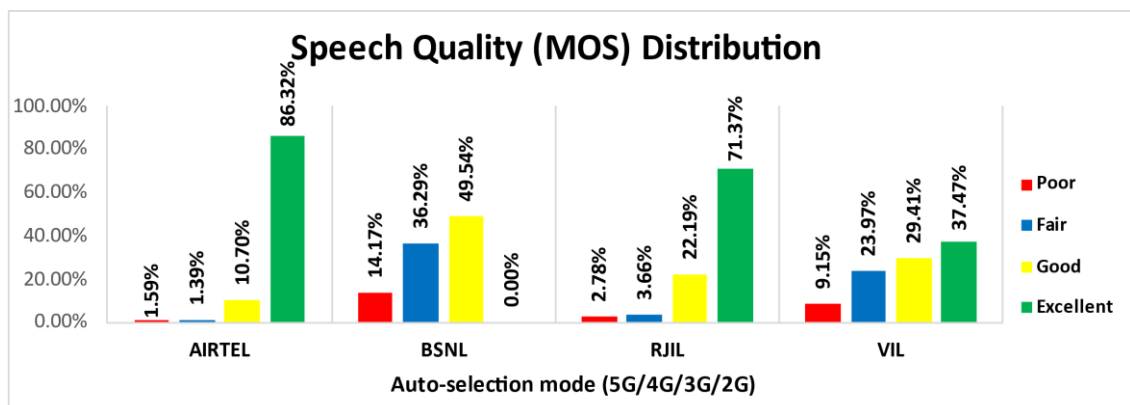
Figure-33: Distribution of samples in MOS score range.

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

Technology	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
5G	1.58%	NA	17.65%	NA
4G	97.72%	0.61%	81.38%	26.81%
3G	NA	33.21%	NA	46.21%
2G	0.58%	60.65%	NA	24.72%
Limited Service	0.13%	5.52%	0.97%	2.26%

Table-41: Time spent on technology during drive test.

Note-
- NA- Service provider doesn't provide services in respective technology.
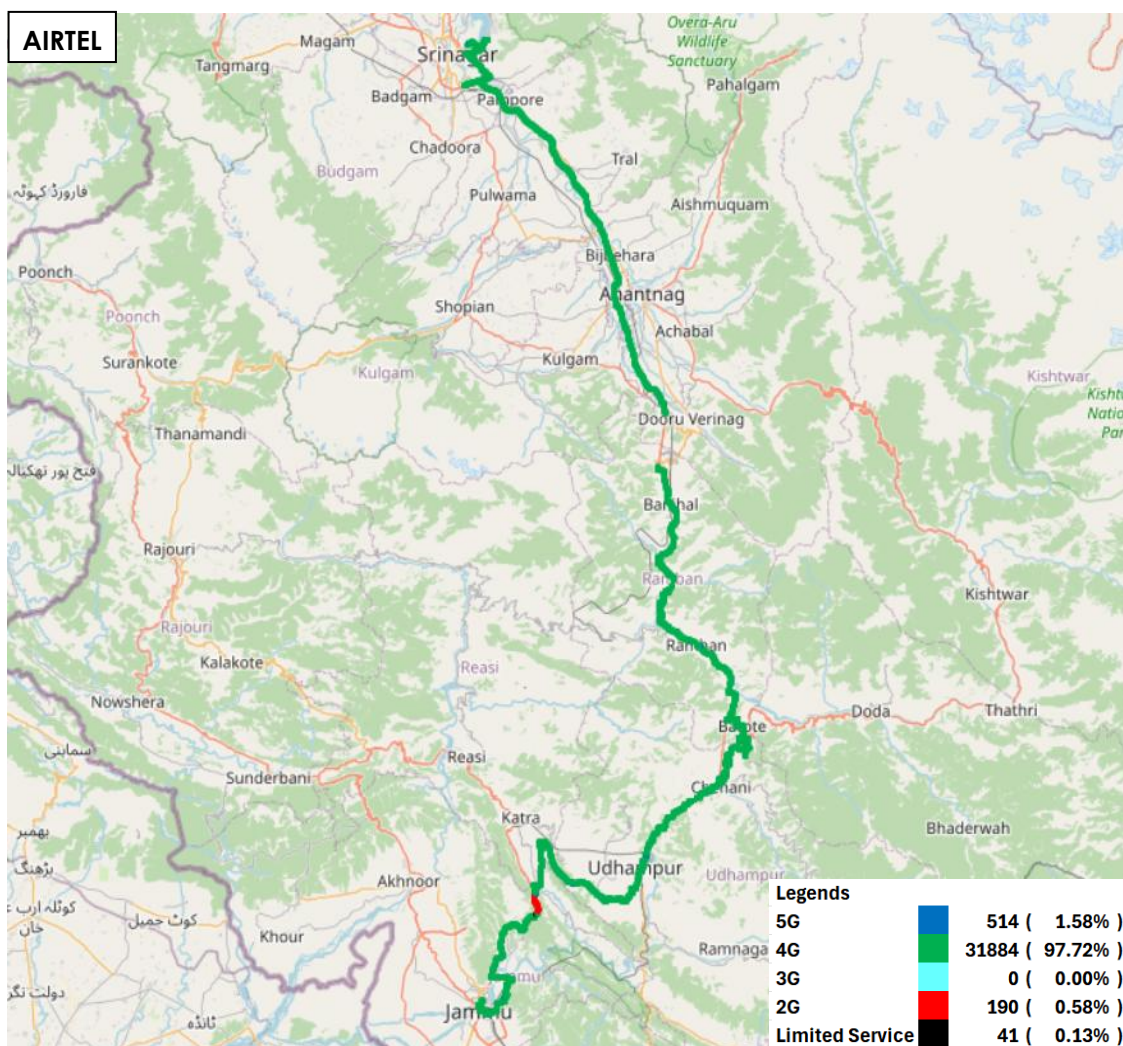
Figure-34: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-AIRTEL
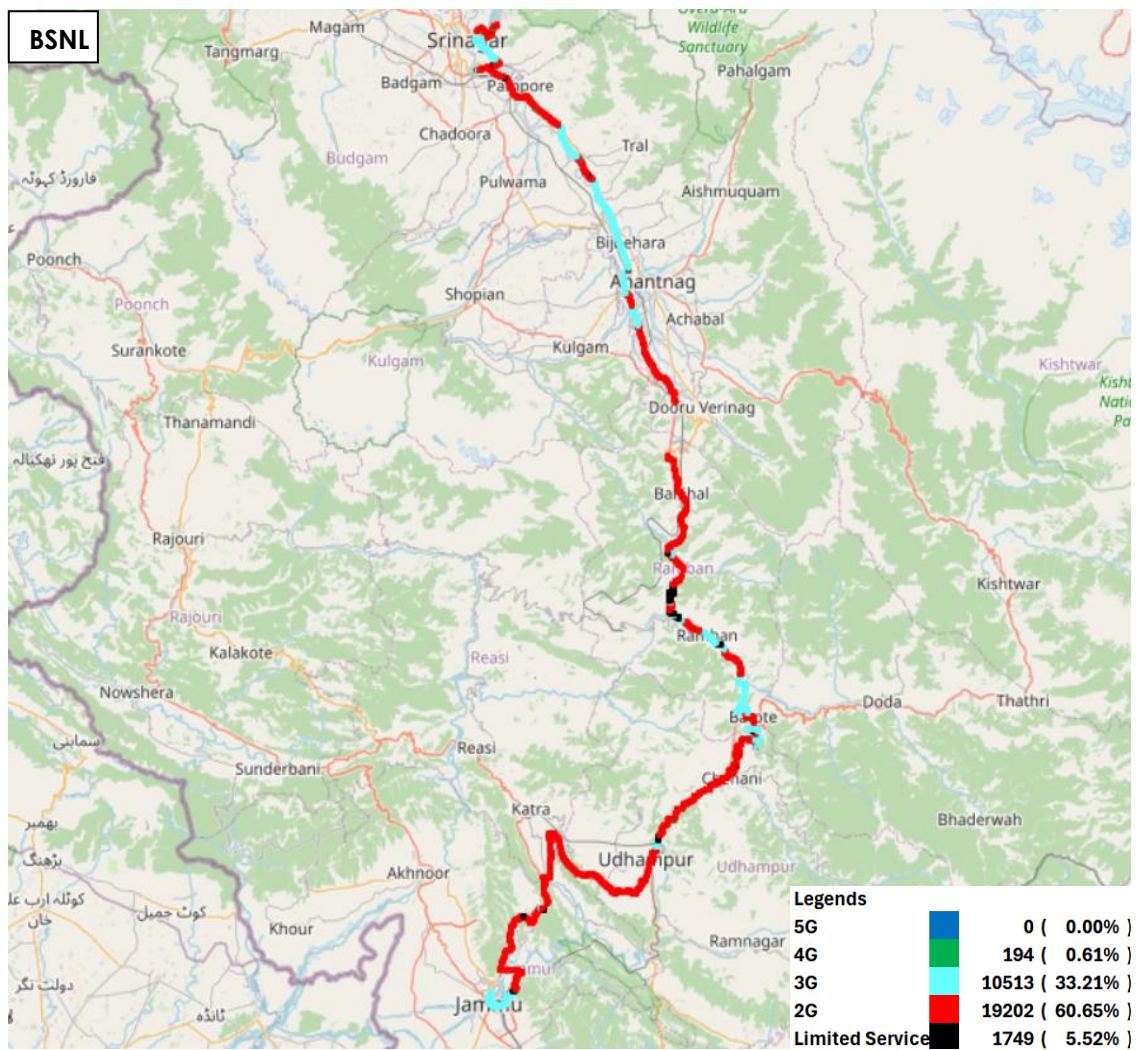
Figure-35: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-BSNL
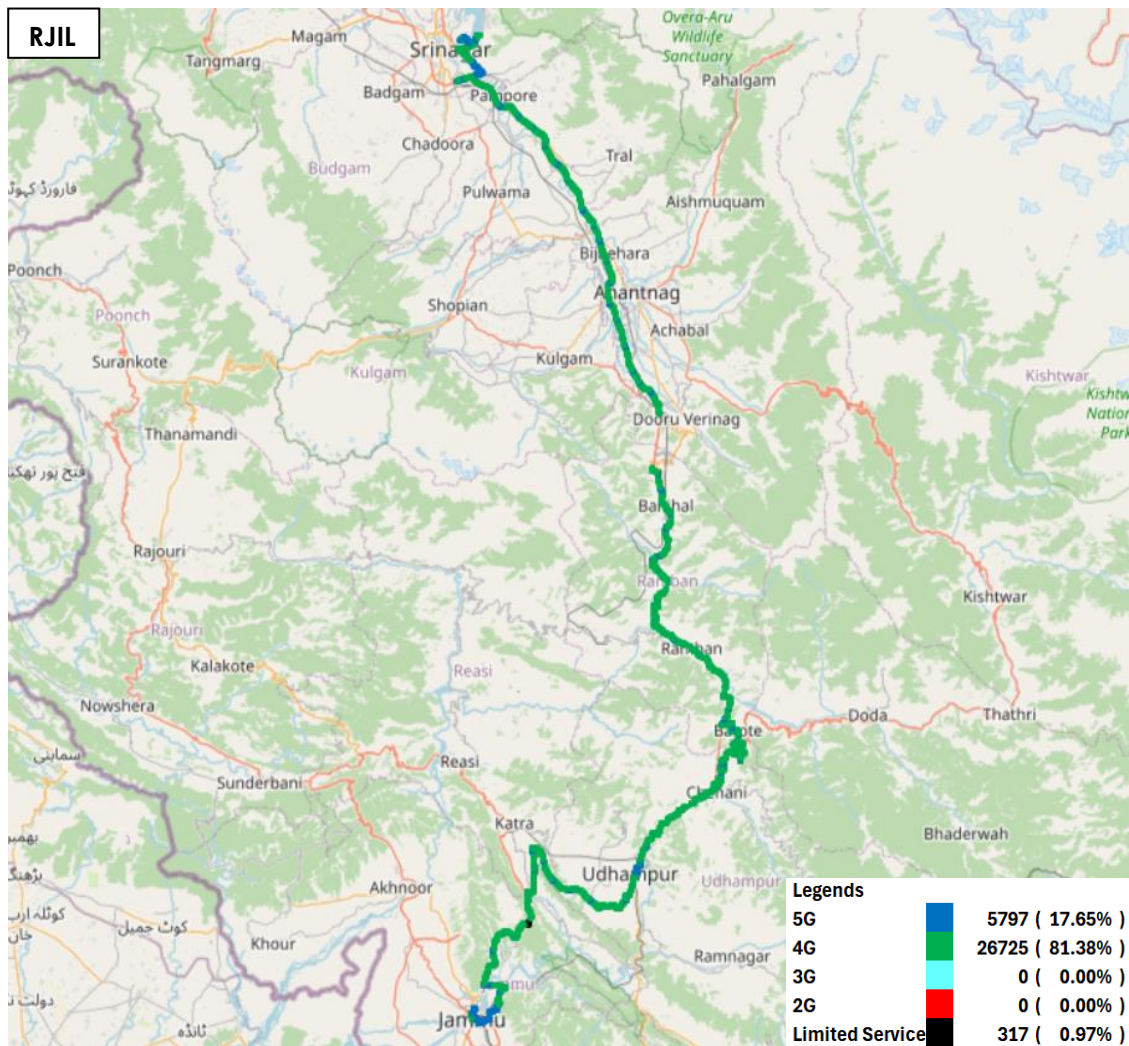
Figure-36: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-RJIL.
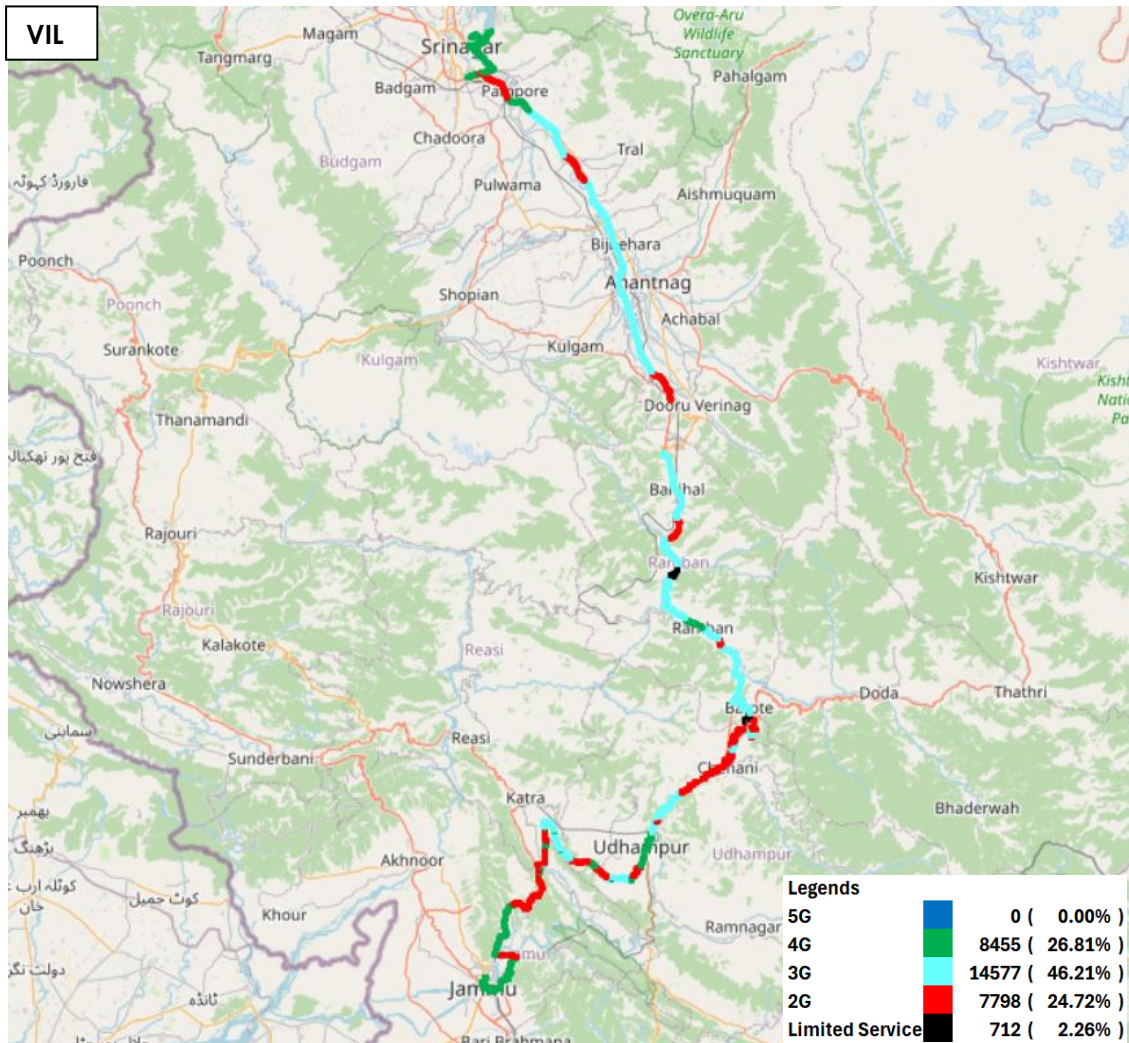
Figure-37: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -VIL.

(g) Network Signal Strength Distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-51, 52, 53 & 54 for map view)
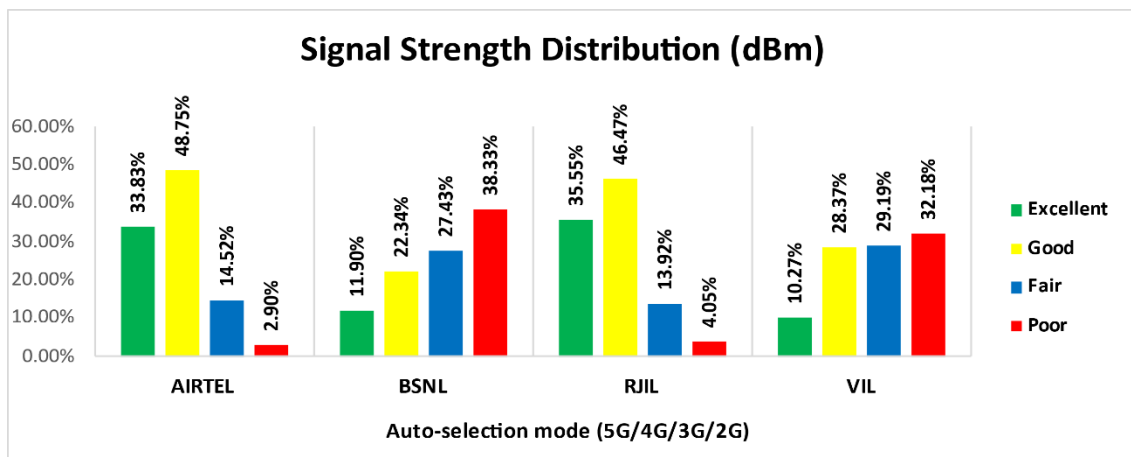
Figure-38: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:

- Airtel has 34% samples falling in excellent signal strength category.
- BSNL has 12% samples falling in excellent signal strength category.
- RJIL has 36% samples falling in excellent signal strength category.
- VIL has 10% samples falling in excellent signal strength category.

4.4.4 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	174.17	2.30	284.49	9.80
	80th Percentile	299.77	4.67	556.67	16.38
	20th Percentile	37.71	0.05	39.50	1.98
Upload Throughput (Mbits/s)	Average	27.12	1.47	24.93	4.91
	80th Percentile	46.48	2.13	44.80	5.63
	20th Percentile	5.51	0.08	3.62	1.23
Latency (ms)	50th Percentile	21.95	177.50	21.60	45.70

Table-42: Summary of Data performance in network auto-selection mode.
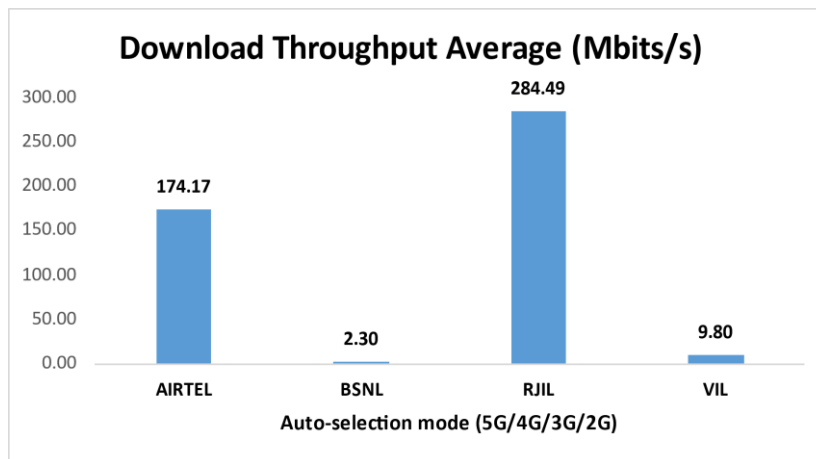
Figure-39: Download throughput
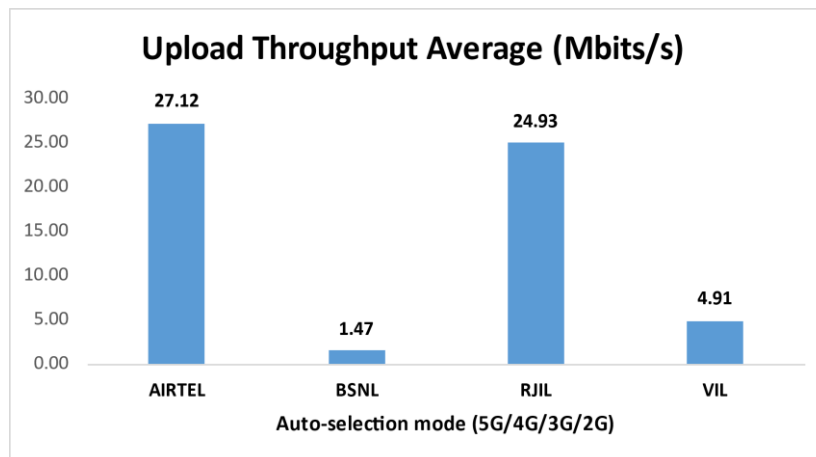
Figure-40: Upload throughput

5. Voice & Data Key findings

5.1 Overall Voice

1. **Call Setup Success Rate:**

    a) Airtel, BSNL and VIL have 99.33%, 94.66% and 96.65% call setup success rate respectively in 3G/2G network mode. (refer table-3)

    b) Airtel, BSNL, RJIL and VIL have 99.06%, 94.06%, 99.20% and 96.35% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

2. **Call Setup Time**:

    a) VIL has taken comparatively longer time (3.23 second) to establish the voice call, whereas Airtel and BSNL call setup time is 2.92 & 3.15 seconds respectively in 3G/2G network mode. (refer table-3)

    b) BSNL has taken comparatively longer time (2.90 second) to establish the voice call, whereas Airtel, RJIL & VIL call setup time is 1.42, 0.81 & 1.23 seconds respectively in Auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G), VIL, RJIL and Airtel have 0.98%, 0.94% & 0.27% silence call rate respectively. Further VIL has higher RTP packet loss rate in downlink (1.00%) compared to RJIL (0.53%) and Airtel (0.34%). In uplink the RTP packet loss rate is higher for VIL (1.20%) compared to RJIL (0.67%) and Airtel (0.20%). (refer table-6)

4. **Call Drop Rate**:

    a) Overall BSNL's and VIL's call drop rate 7.23% and 4.54% respectively higher than QoS benchmark of 2%, while Airtel has 0.95% drop call rate in 3G/2G network mode. (refer table-3)

    b) Overall BSNL's call drop rate 4.99% is higher than QoS benchmark of 2%, while Airtel, RJIL & VIL have 0.24%, 0.23% and 1.78% drop call rate respectively in Auto-selection mode (5G/4G/3G/2G). (refer table-5)

5.2 Overall Data

1. **Data download and upload performance (Dynamic i.e. while moving):**

    a) BSNL (2.90 Mbps) and VIL (21.54 Mbps) being on 3G & 4G as top technology, have comparatively lower data speeds respectively. While Airtel and RJIL have average download speed of 185.10 Mbps and 416.35 Mbps respectively. (refer table-9)

    b) BSNL (2.45 Mbps) and VIL (13.02 Mbps) being on 3G & 4G as top technology, have comparatively lower data speeds respectively. While Airtel and RJIL have average upload speed of 28.39 Mbps and 38.69 Mbps respectively. (refer table-9)

2. **Data download and upload performance (static i.e. while stationary):**
   a) At hotspots, RJIL has better 5G QoS performance comparatively, with average download speed of 299.80 Mbps. (refer table-27)

   b) At Hotspot, RJIL has better 5G QoS performance comparatively, with average upload speed of 39.10 Mbps. (refer table-27)

3. **Data session setup success rate (static i.e. while stationary):**
   a) Airtel, RJIL, VIL have 100% download and upload session setup success rate & BSNL has 97.50% & 95.00% download & upload session setup success rate respectively. (refer table-27)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 99.33% call setup success rate and 0.95% call drop rate have been observed in 3G/2G network mode. Performance is well within the benchmark of 98.00% & 2.00% respectively for LSA. (refer table-3)

- 99.06% call setup success rate and 0.24% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)

- 100.00% call setup success rate and 0.17% call drop rate have been observed in 3G/2G network mode. Performance is well within the benchmark of 98.00% & 2.00% respectively for City. (refer table-11)

- 99.50% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive. (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 all hotspot locations. (refer table-18)

- 97.02% call setup success rate and 3.68% call drop rate have been observed in 3G/2G network mode. Performance is not meeting the benchmark of 98.00% & 2.00% respectively, across the highway. (refer table-36)

- 97.06% call setup success rate and 1.21% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for highway drive. (refer table-38)

Data

- Airtel has 185.10 Mbps average download throughput & 28.39 Mbps average upload throughput across measured routes for LSA. (refer table-9).

- Airtel has 189.88 Mbps average download throughput & 29.05 Mbps average upload throughput across measured routes for city drive. (refer table- 17).

- Bahu Bazaar and Govt. Hospital Bakshi Nagar hotspots have less download speed (less than 100 Mbps) out of total 8 Hotspots. (refer table-28 and 30)

- Bahu Bazaar, Govt. Hospital Bakshi Nagar, Raghunath Bazaar and Rani Park hotspots have less upload speed (less than 20 Mbps) out of total 8 Hotspots. (refer table-28, 30, 34 and 35).

- Airtel has 174.17 Mbps average download throughput & 27.12 Mbps average upload throughput across measured routes for highway drive. (refer table-42)

2. BSNL:

Voice

- 94.66% call setup success rate and 7.23% call drop rate have been observed in 3G/2G network mode. Performance is not meeting the benchmark of 98.00% & 2.00% respectively for LSA. (refer table-3)

- 94.06% call setup success rate and 4.99% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not meeting the benchmark of 98.00% & 2.00% respectively for LSA. (refer table-5)

- 98.65% call setup success rate and 3.26% call drop rate have been observed in 3G/2G network mode for city drive. (refer table-11)

- 98.01% call setup success rate and 2.53% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. (refer table-13)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-18)

- 85.98% call setup success rate and 17.17% call drop rate have been observed in 3G/2G network mode. Performance is not meeting the benchmark of 98.00% & 2.00% respectively, across the highway. (refer table-36)

- 83.64% call setup success rate and 13.04% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not meeting the benchmark of 98.00% & 2.00% respectively for highway drive. (refer table-38)

Data

- BSNL has 2.90 Mbps average download throughput & 2.45 Mbps average upload throughput across measured routes for LSA. (refer table-9)

- BSNL has 2.98 Mbps average download throughput & 2.73 Mbps average upload throughput across measured routes for city drive. (refer table-17)

- All Hotspots have less download speed (less than 10 Mbps). (refer table-28, 29, 30, 31, 32, 33, 34 and 35)

- Bahu Bazaar, Fruit Mandi, Jammu Railway Station, Jammu University, K. C. Bus Stand and Rani Park hotspots have less upload speeds (less than 2 Mbps). (refer table-28, 29, 31, 32, 33 and 35)

- BSNL has 2.30 Mbps average download throughput & 1.47 Mbps average upload throughput across measured routes for highway drive. (refer table-42)

3. RJIL:
Voice
- 99.20% call setup success rate and 0.23% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is well within the benchmark of 98.00% & 2.00% respectively for LSA. (refer table-5)
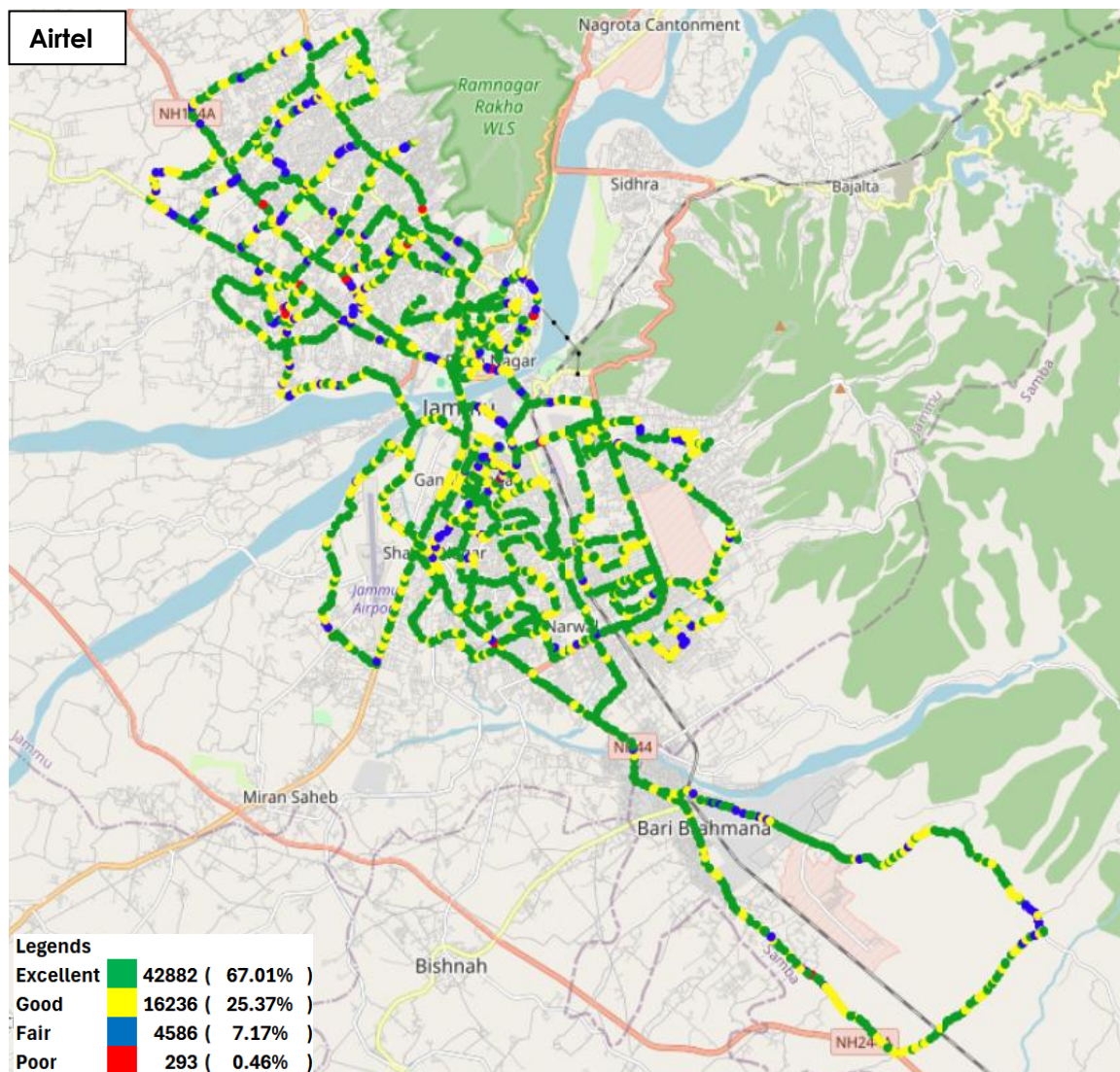
- 100.00% call setup success rate and 0.00% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is well within the benchmark of 98.00% & 2.00% respectively for city drive. (refer table-13)

- 100.00% call setup success rate and 0.00% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). for all hotspot locations. (refer table-18)

- 95.98% call setup success rate and 1.20% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G) for highway drive. (refer table-38)

Data
- RJIL has 416.35 Mbps average download speed & 38.69 Mbps average upload speed across measured routes in LSA. (refer table-9)

- RJIL has 482.84 Mbps average download speed & 44.89 Mbps average upload speed across measured routes in city drive. (refer table-17)
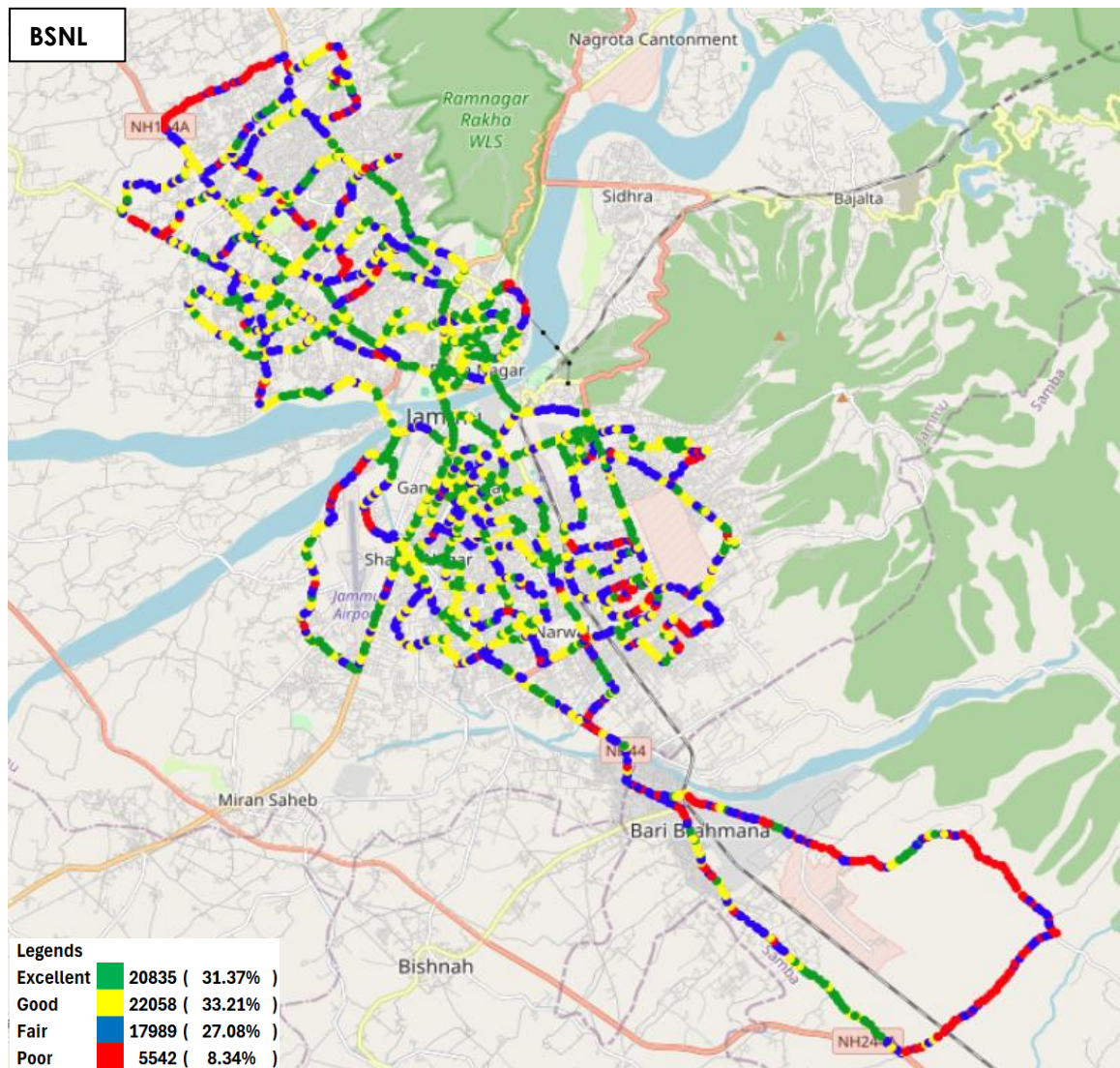
- Bahu Bazaar and Fruit Mandi hotspots have less download speed (less than 100 Mbps) out of total 8 Hotspots. (refer table-28 and 29)

- Bahu Bazaar, Jammu University and Raghunath Bazaar have less upload speed (less than 20 Mbps) out of total 8 hotspots. (refer table-28, 32 and 34)

- RJIL has 284.49 Mbps average download speed & 24.93 Mbps average upload speed across measured routes in highway drive. (refer table-42)

4. VIL:
Voice
- 96.65% call setup success rate and 4.54% call drop rate have been observed in 3G/2G network mode. Performance is not meeting the benchmark of 98.00% & 2.00% respectively for LSA. (refer table-3)

- 96.35% call setup success rate and 1.78% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)

- 97.83% call setup success rate and 3.42% call drop rate have been observed in 3G/2G network mode. Performance is not meeting the benchmark of 98.00% & 2.00% respectively for city drive. (refer table-11)

- 98.04% call setup success rate and 0.00% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is well within the benchmark of 98.00% & 2.00% respectively for city drive. (refer table-13)

- 100.00% call setup success rate and 0.00% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). for all hotspot locations. (refer table-18)

- 92.66% call setup success rate and 8.54% call drop rate have been observed in 3G/2G network mode. Performance is not meeting the benchmark of 98.00% & 2.00% respectively, across the highway. (refer table-36)

- 89.13% call setup success rate and 9.15% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not well within the benchmark of 98.00% & 2.00% respectively for highway drive. (refer table-38)

Data
- VIL has 21.54 Mbps average download speed & 13.02 Mbps average upload speed across measured routes in LSA. (refer table-9)

- VIL has 24.93 Mbps average download speed & 15.51 Mbps average upload speed across measured routes in city drive. (refer table-17)

- Fruit Mandi and Jammu University hotspots have less download speeds (less than 10 Mbps) out of total 8 hotspots. (refer table-29 and 32)

- VIL has 9.80 Mbps average download speed & 4.91 Mbps average upload speed across measured routes in highway drive. (refer table-42)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

Legends		
Excellent	42882	(67.01%)
Good	16236	(25.37%)
Fair	4586	(7.17%)
Poor	293	(0.46%)

Figure-41: Signal strength 3G/2G network mode – AIRTEL.

Legends			
Excellent		20835 (	31.37%)
Good		22058 (	33.21%)
Fair		17989 (	27.08%)
Poor		5542 (	8.34%)

Figure-42: Signal strength 3G/2G network mode – BSNL.
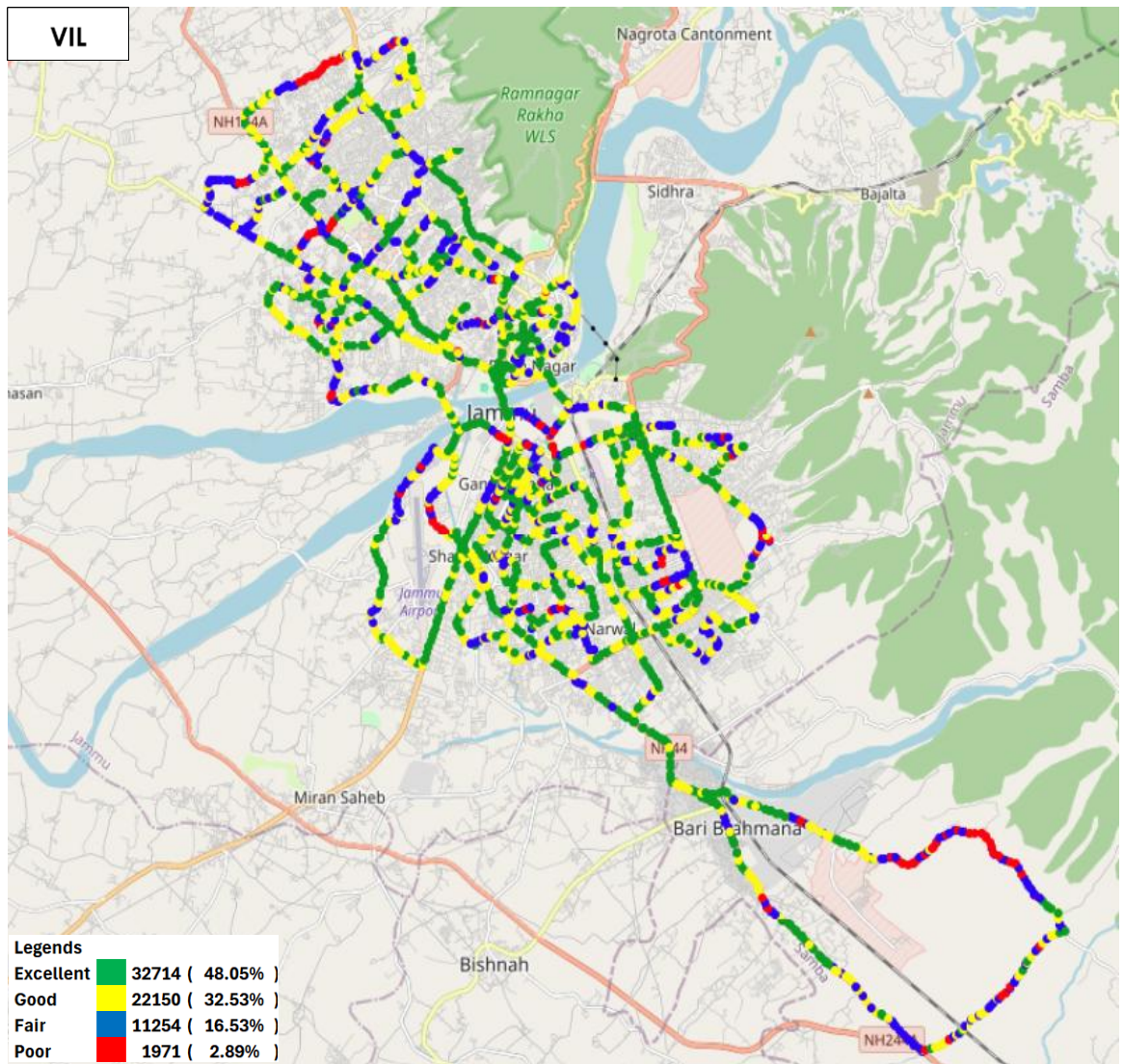
Figure-43: Signal strength 3G/2G network mode – VIL.
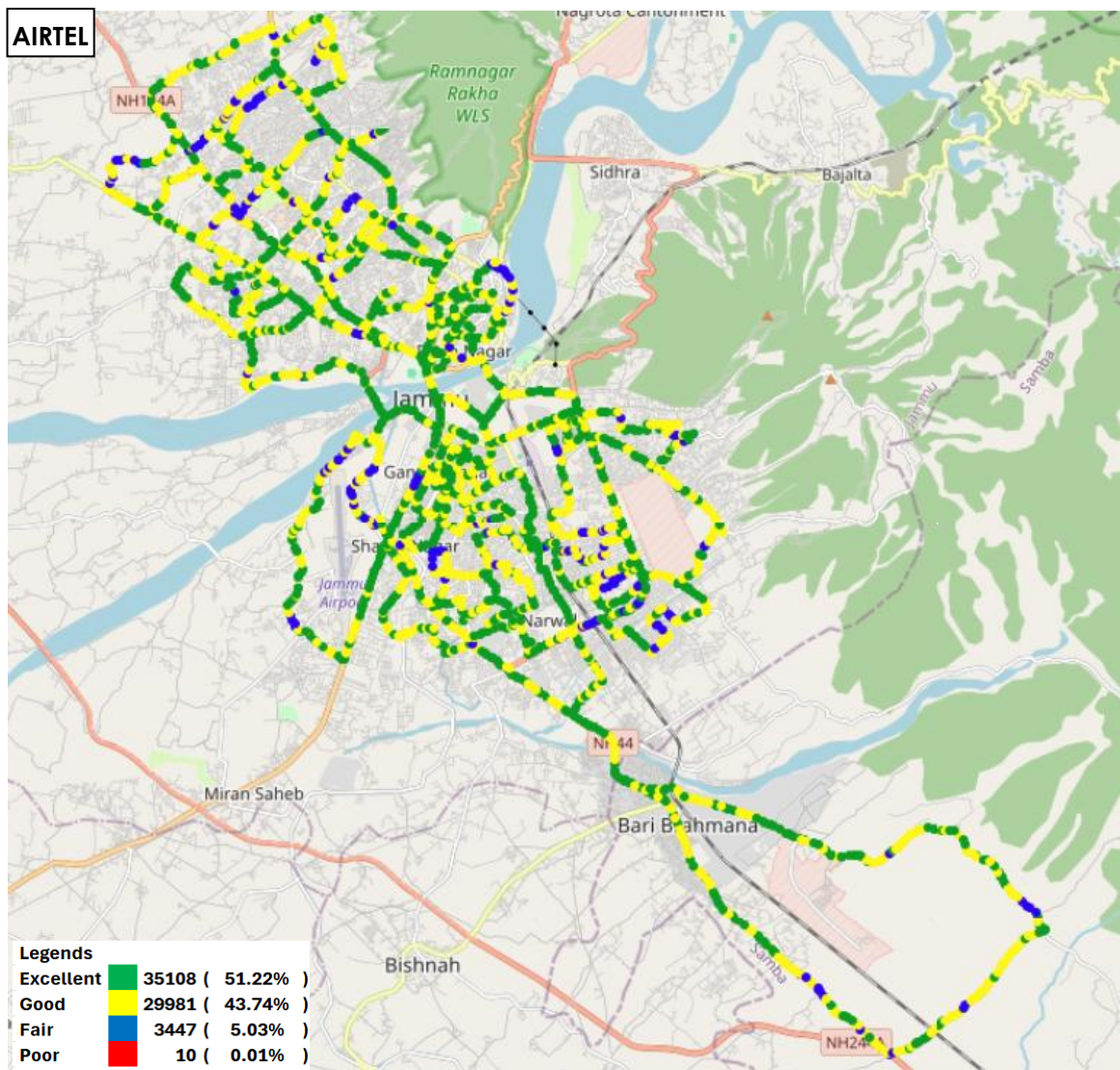
Figure-44: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.
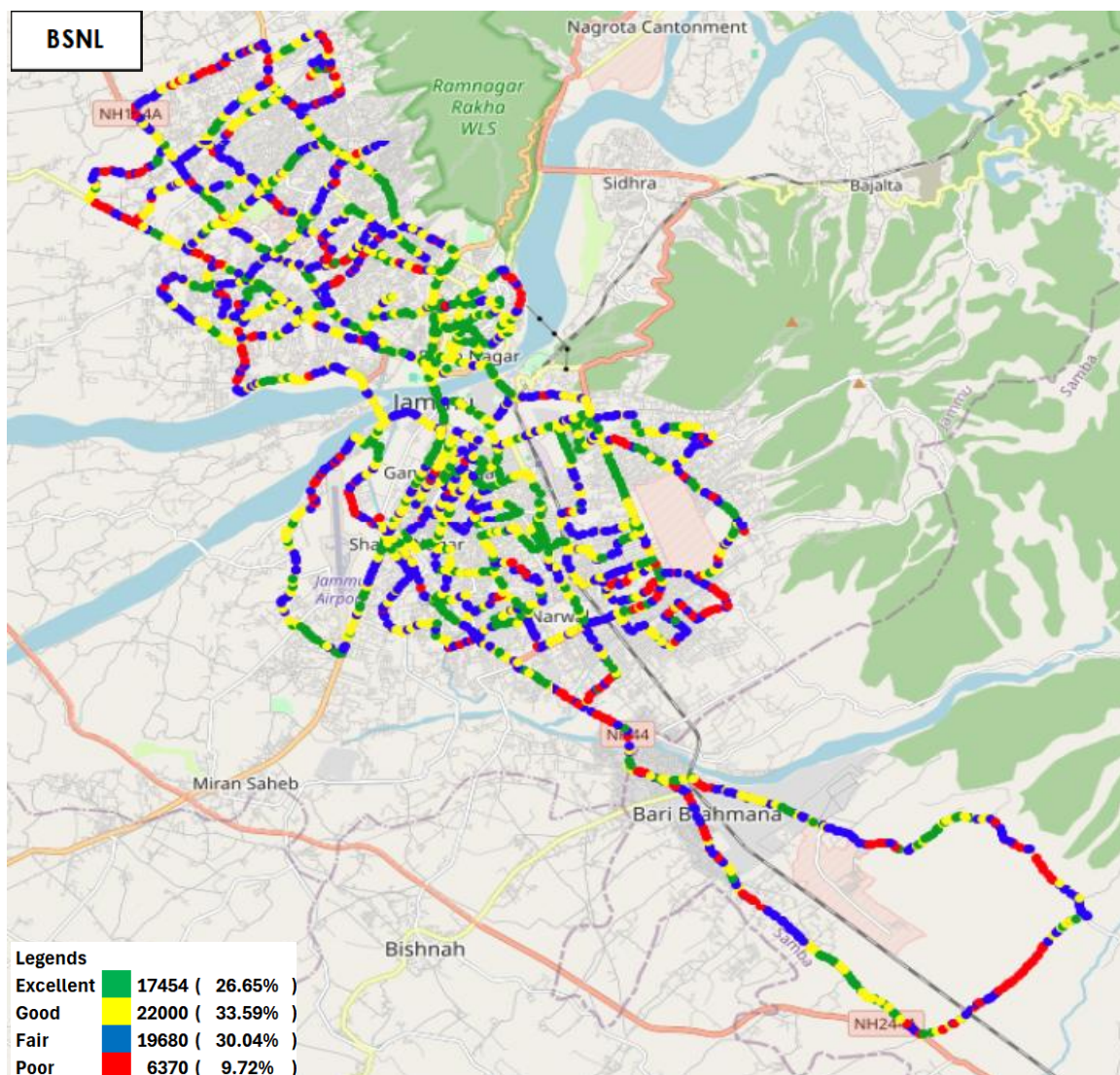
Figure-45: Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.
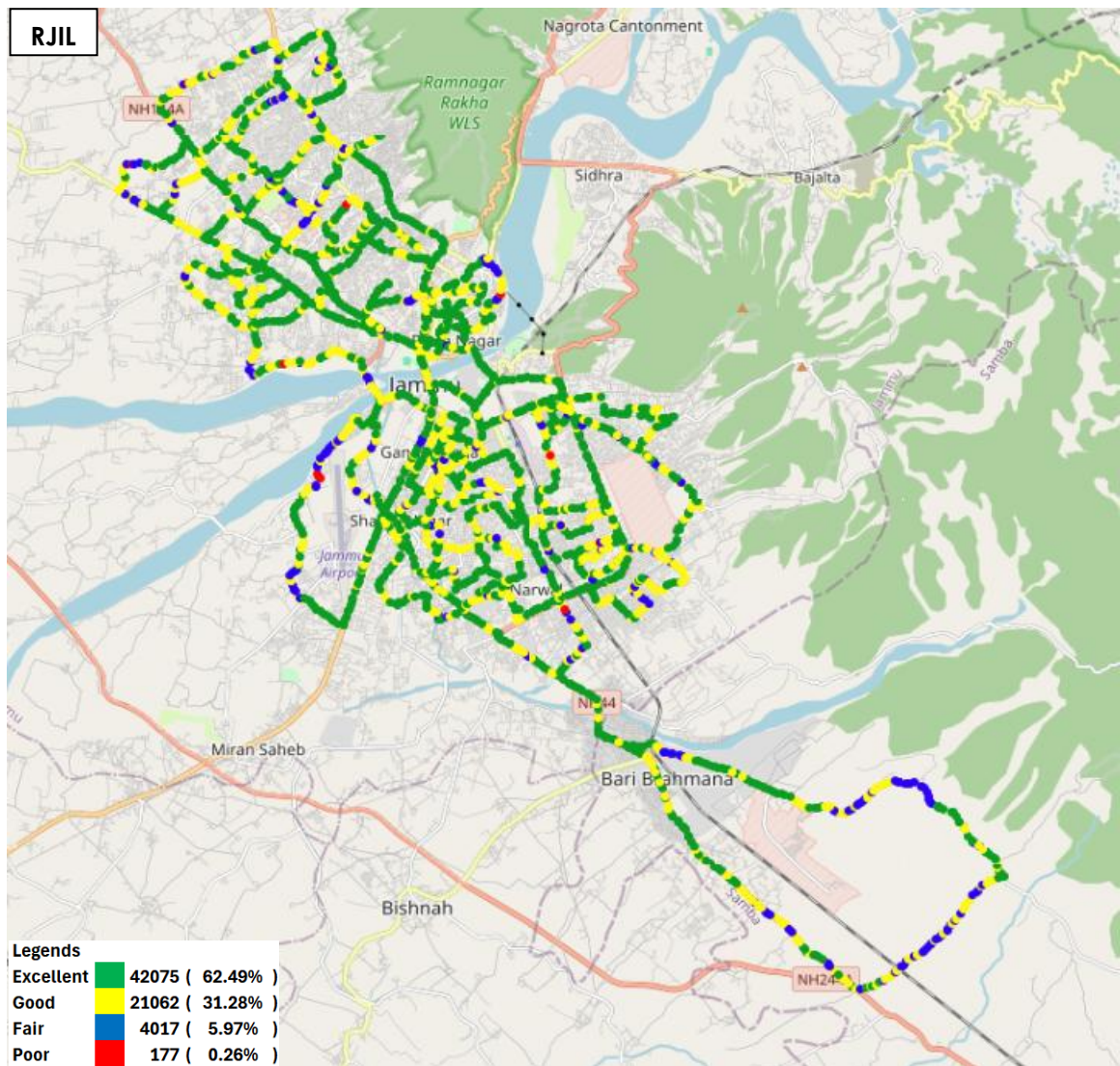
Figure-46: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.
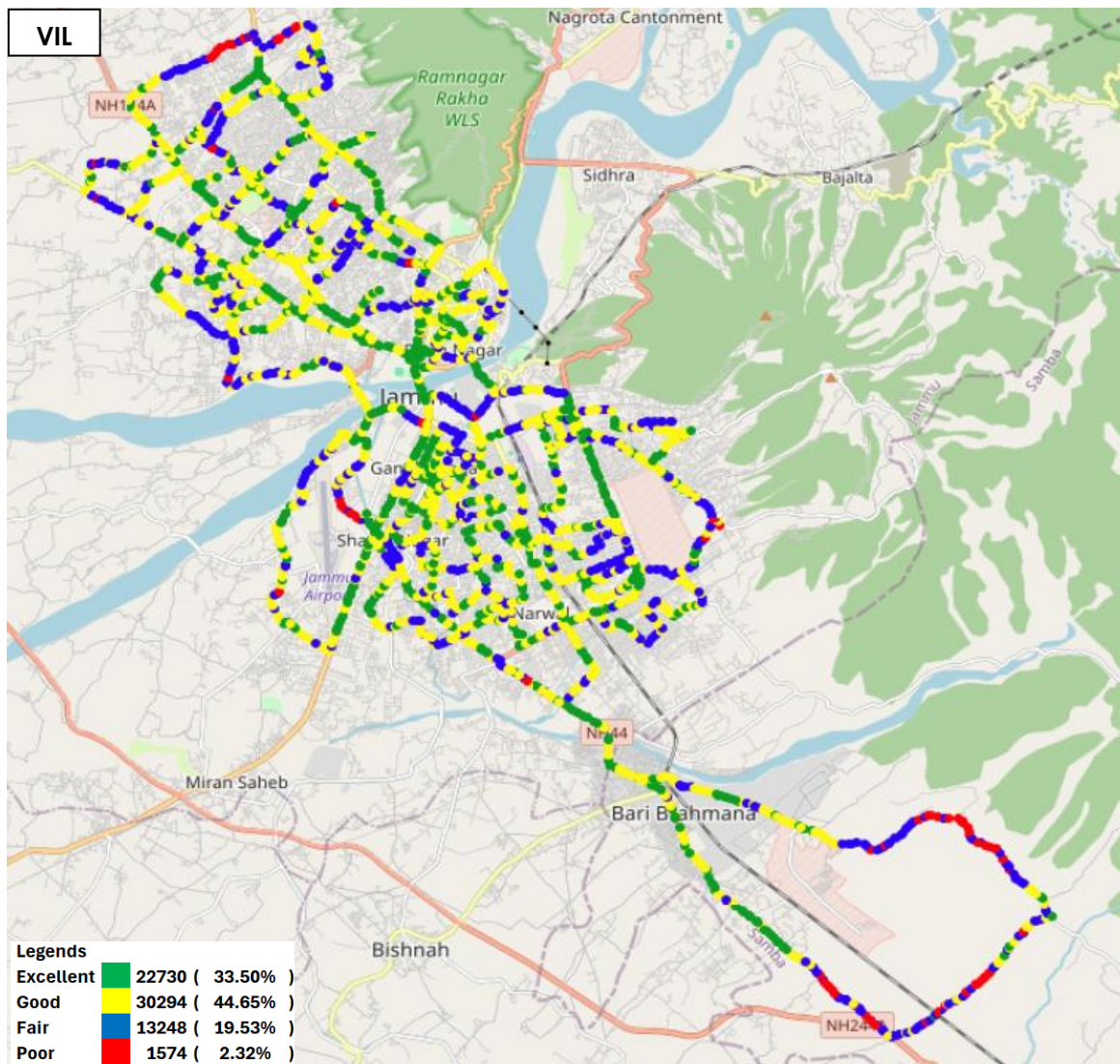
Figure-47: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

Legends
Excellent	22730 (	33.50%)
Good	30294 (	44.65%)
Fair	13248 (	19.53%)
Poor	1574 (	2.32%)

6.1.2 Highway

i) Jammu to Srinagar
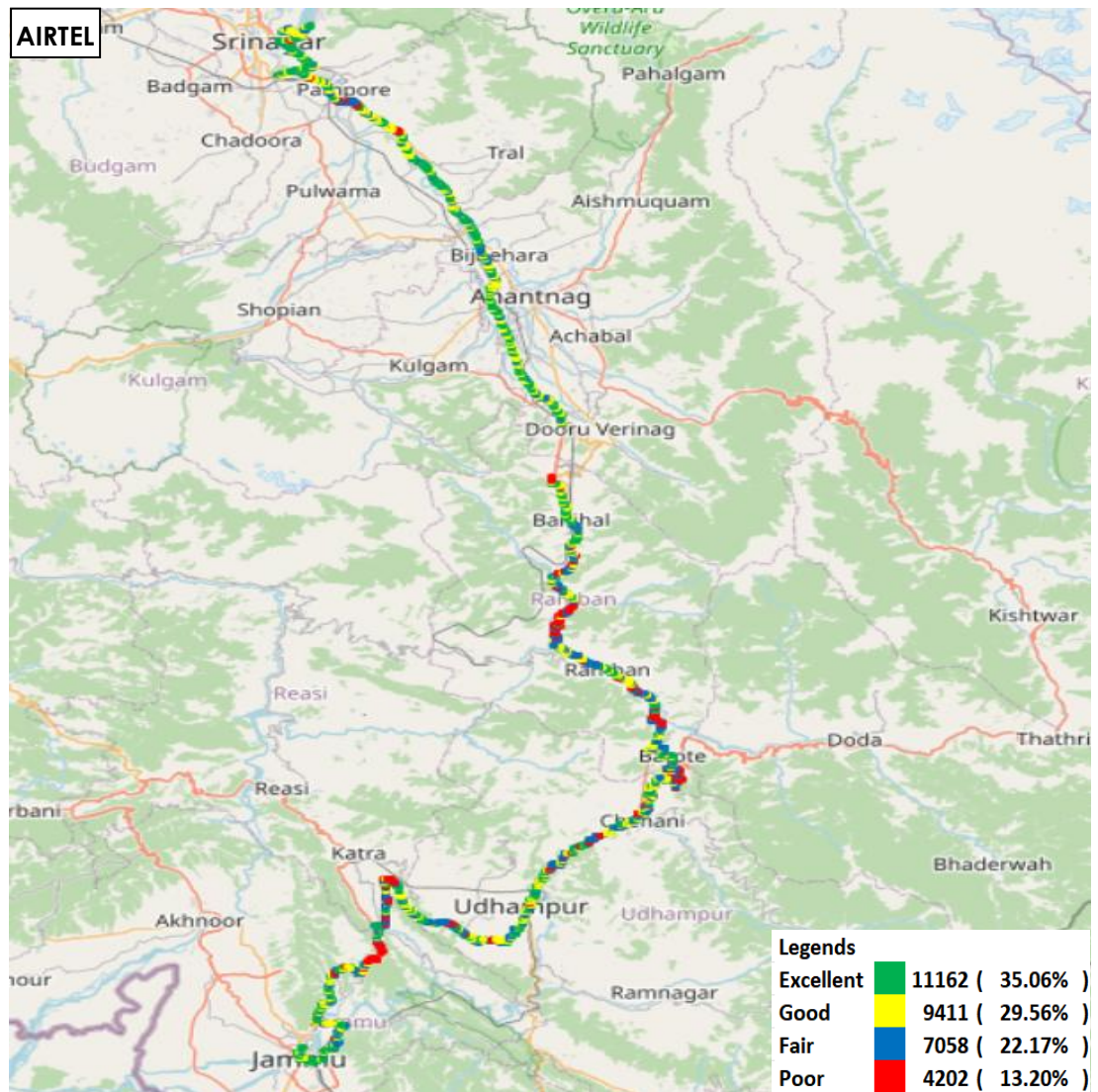
Figure-48: Signal strength 3G/2G network mode – AIRTEL.
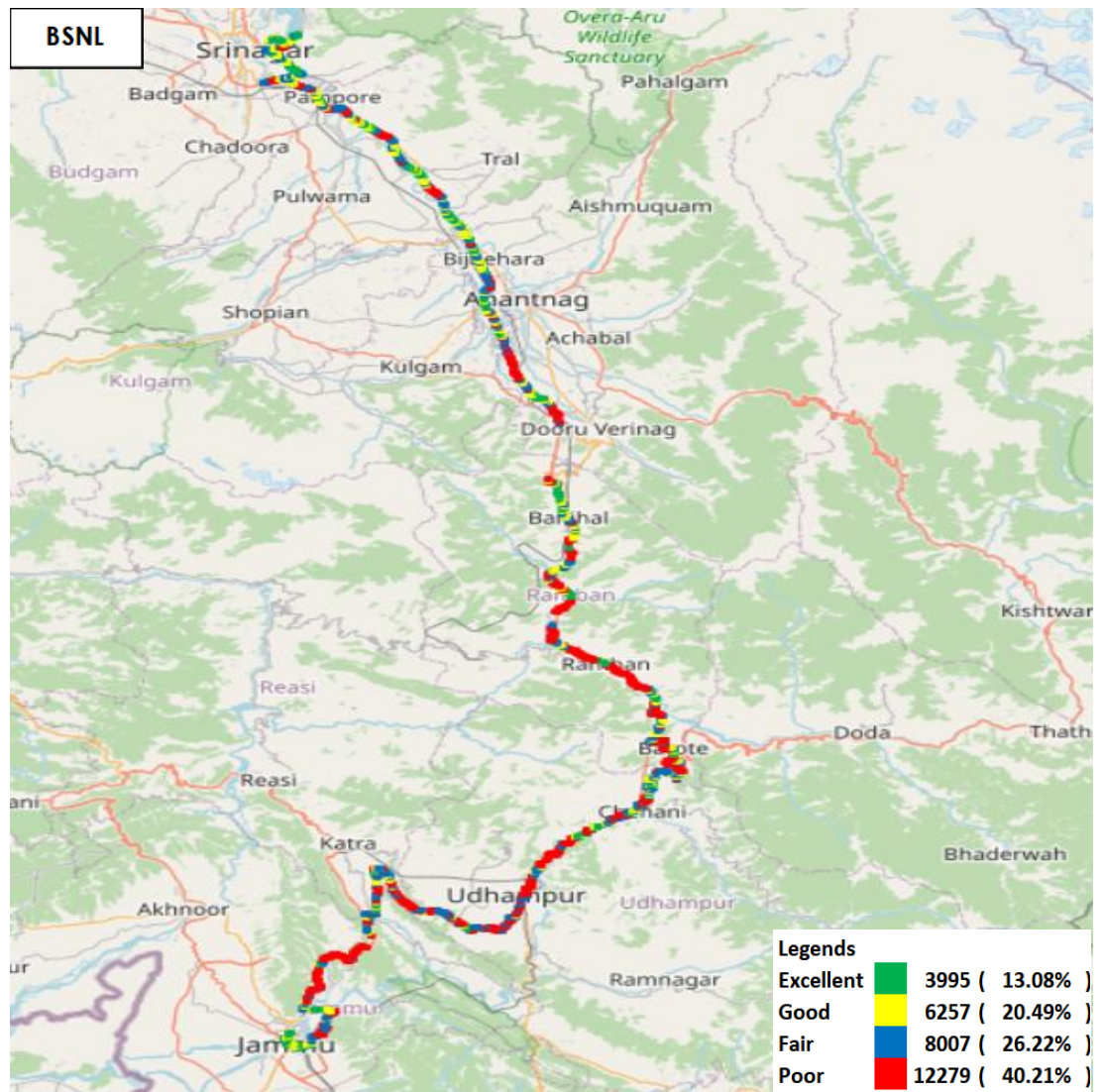
Figure-49: Signal strength 3G/2G network mode – BSNL.
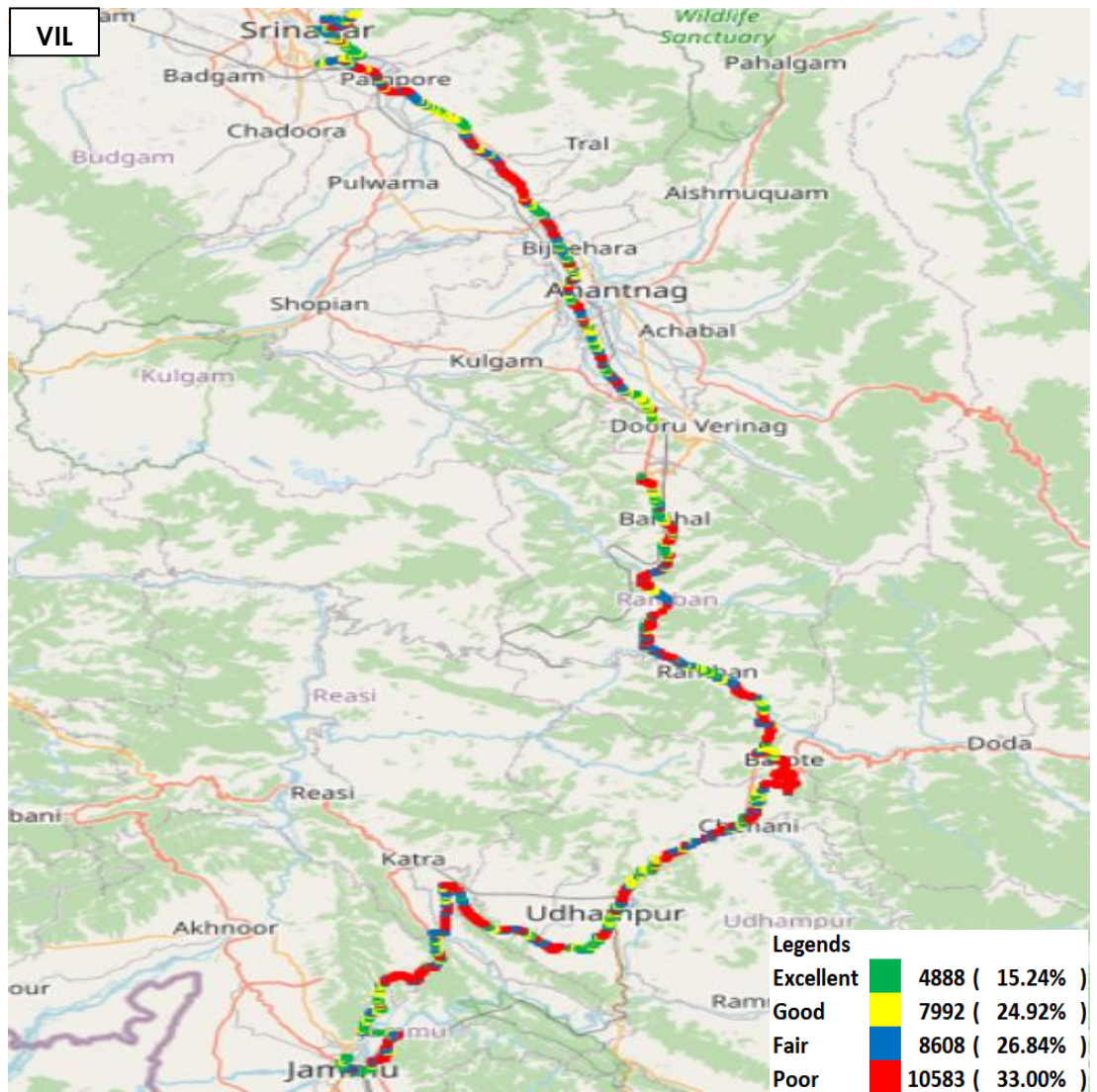
Figure-50: Signal strength 3G/2G network mode – VIL.
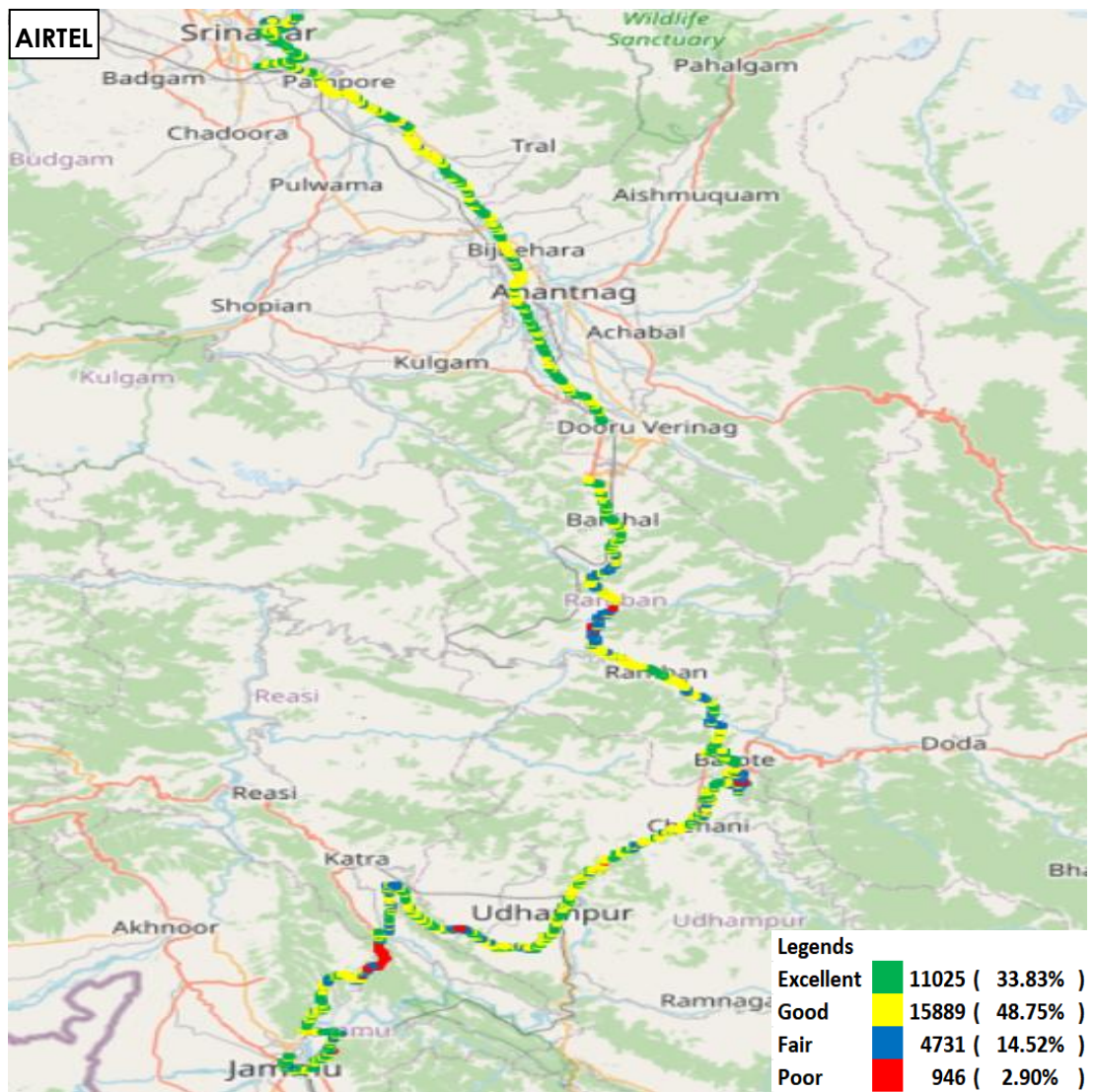
Figure-51: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.
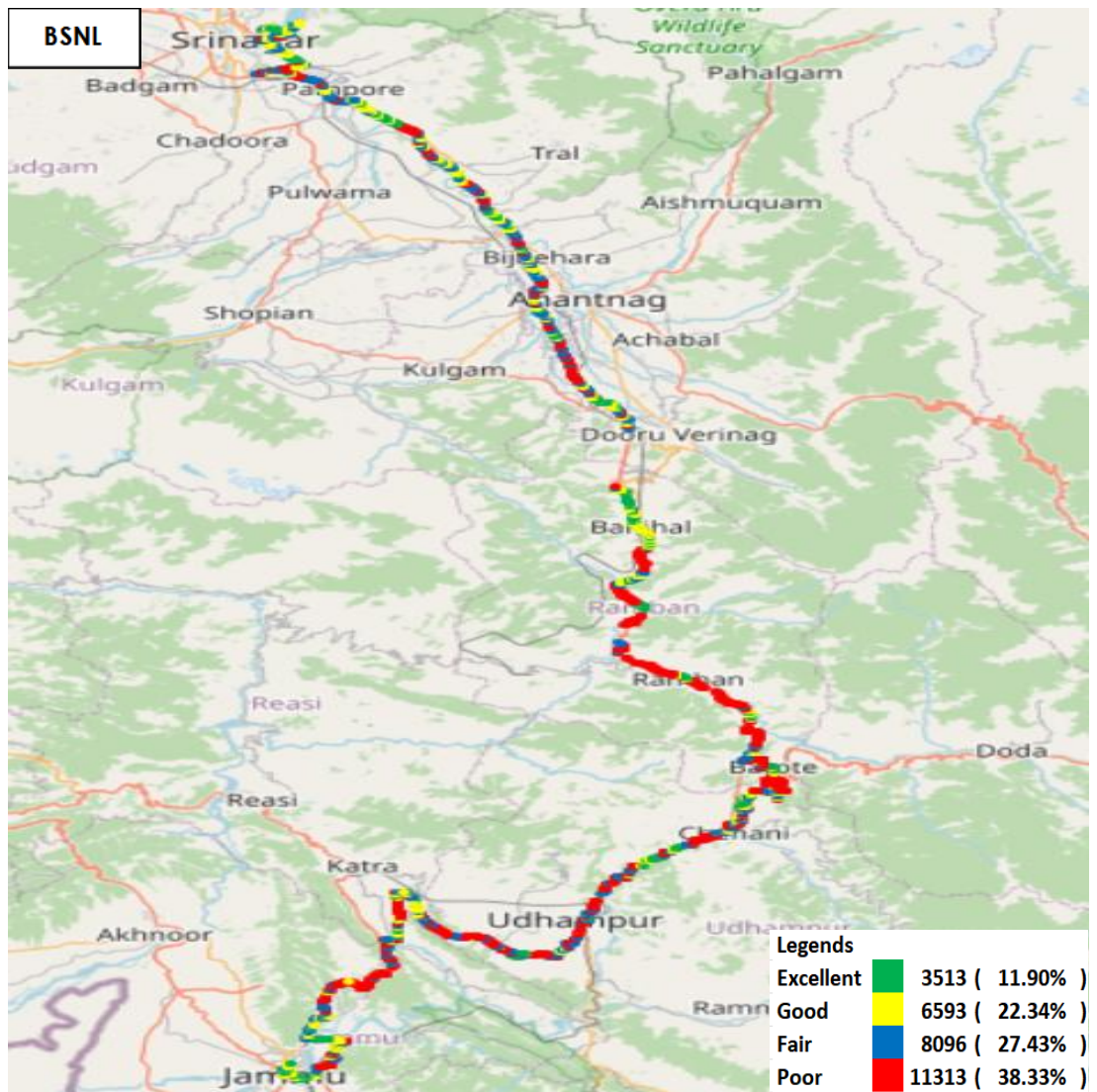
Figure-52: Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.
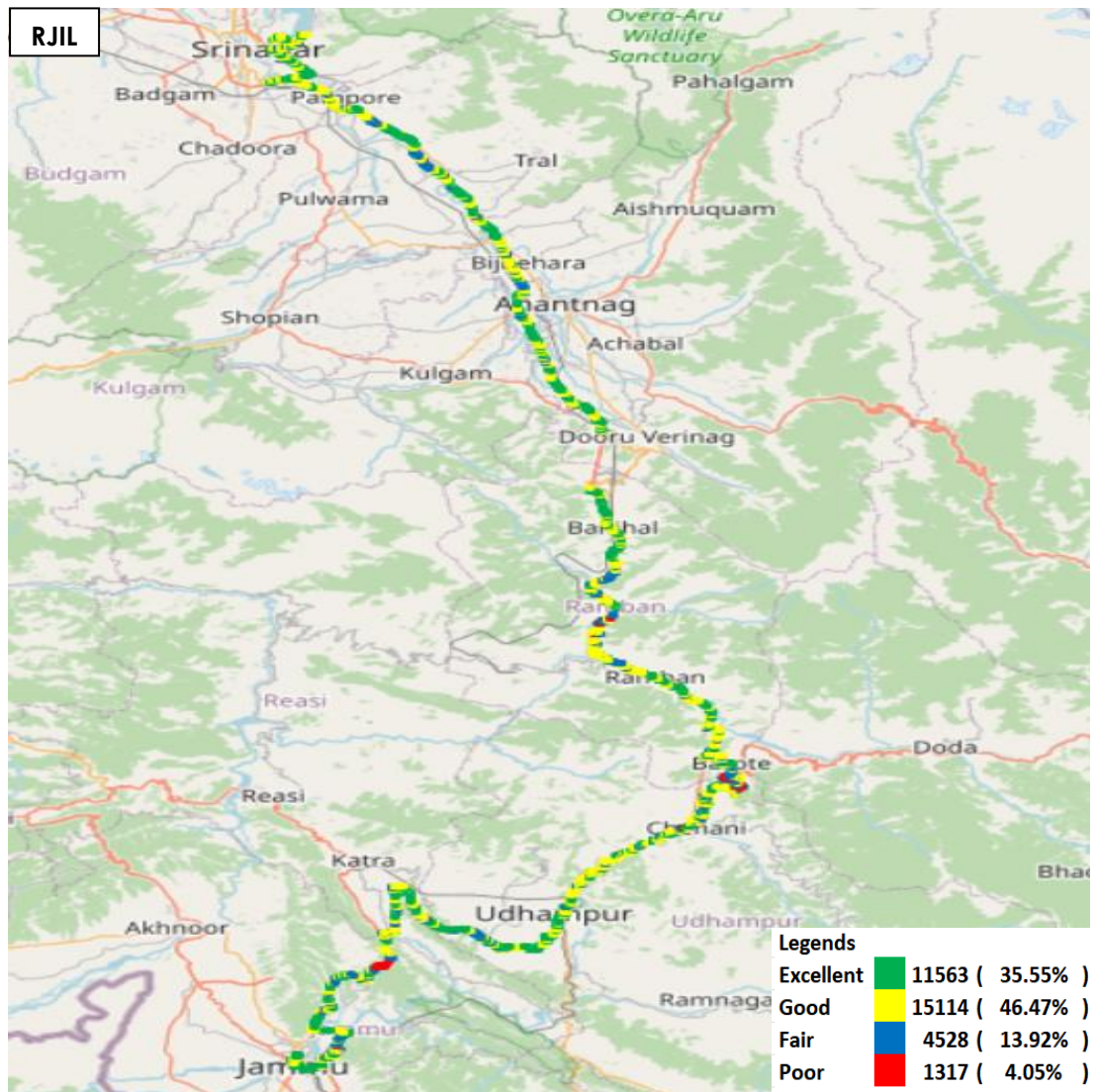
Figure-53: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.
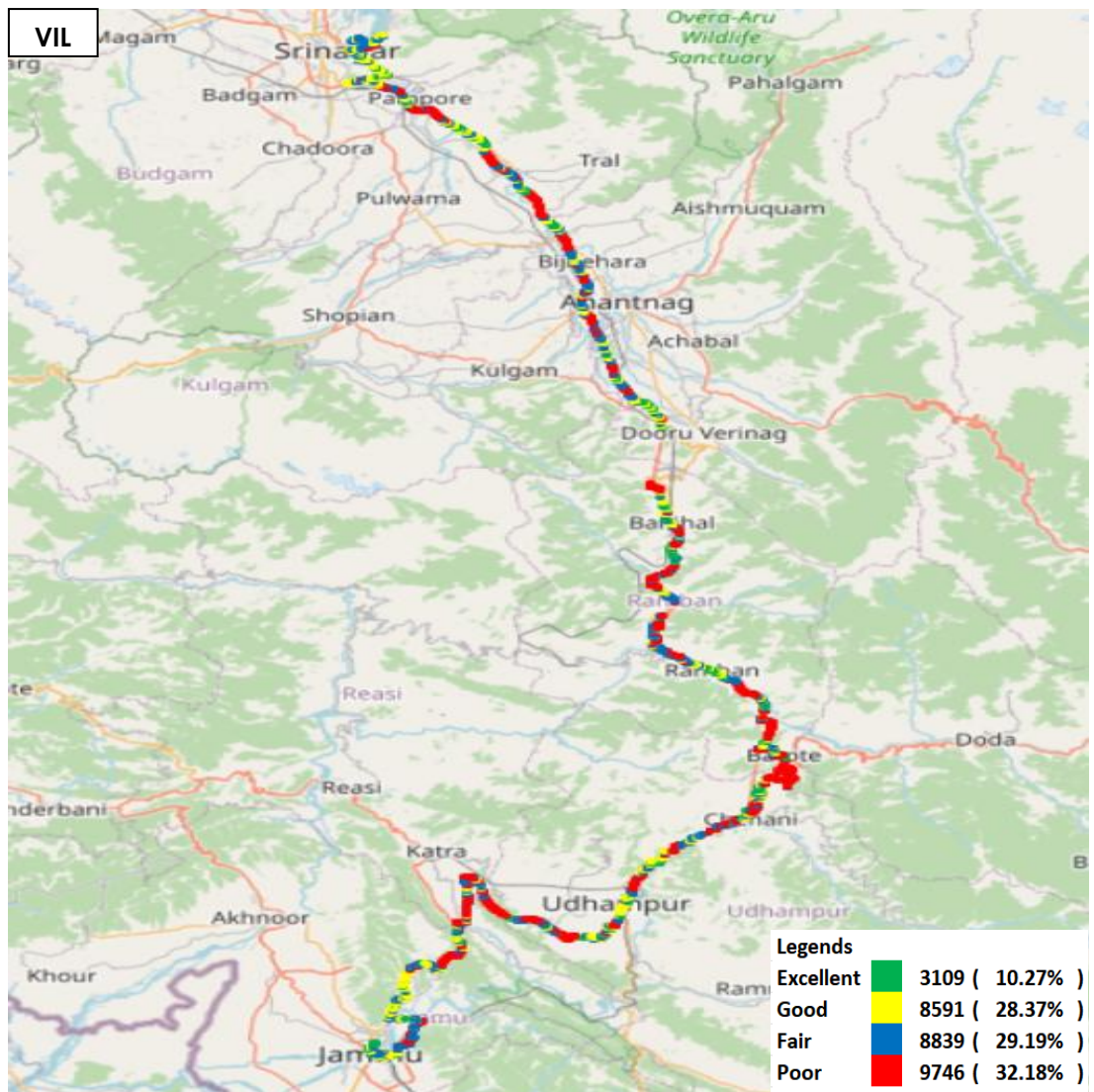
Figure-54: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

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 Sec/180 Sec
Wait/ Guard Time		15 Sec

Table-43: 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.
> - 5G/4G/3G/2G auto mode MOS call were made in BSNL as BSNL don't have VoLTE & VoNR network availability.

| 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-44: Data test detail

Note- At the initial stage, we tested three websites: Google, Amazon, and Flipkart. However, Amazon and Flipkart faced issues on JIO and VIL networks, respectively. As a result, we replaced these sites with SBI and IRCTC.

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.
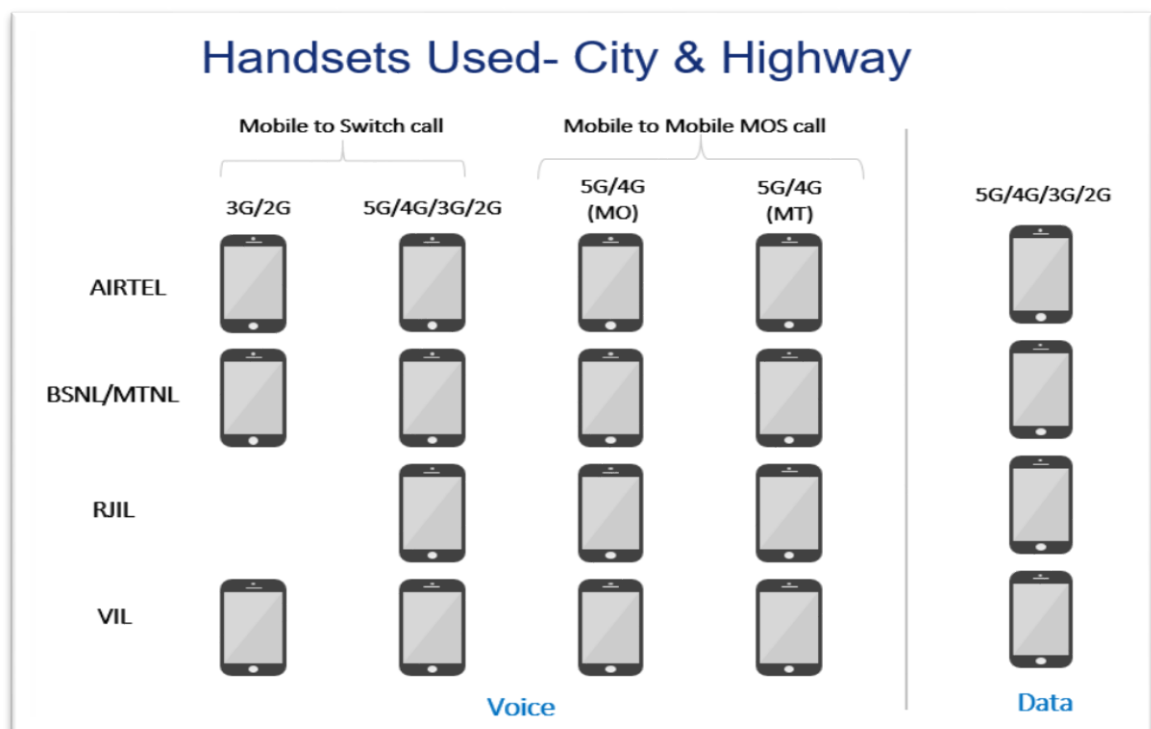
Figure-55: Number of handsets used in city & highway drive
MO: Mobile originating
MT: Mobile terminating
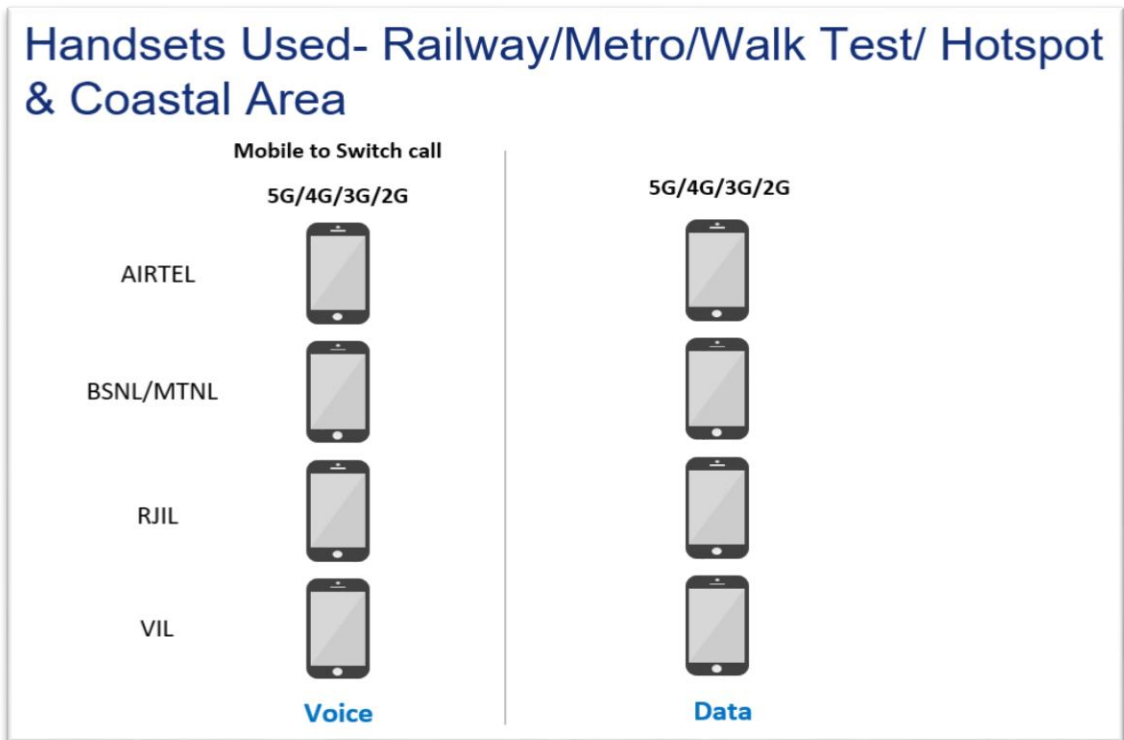
Figure-56: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)
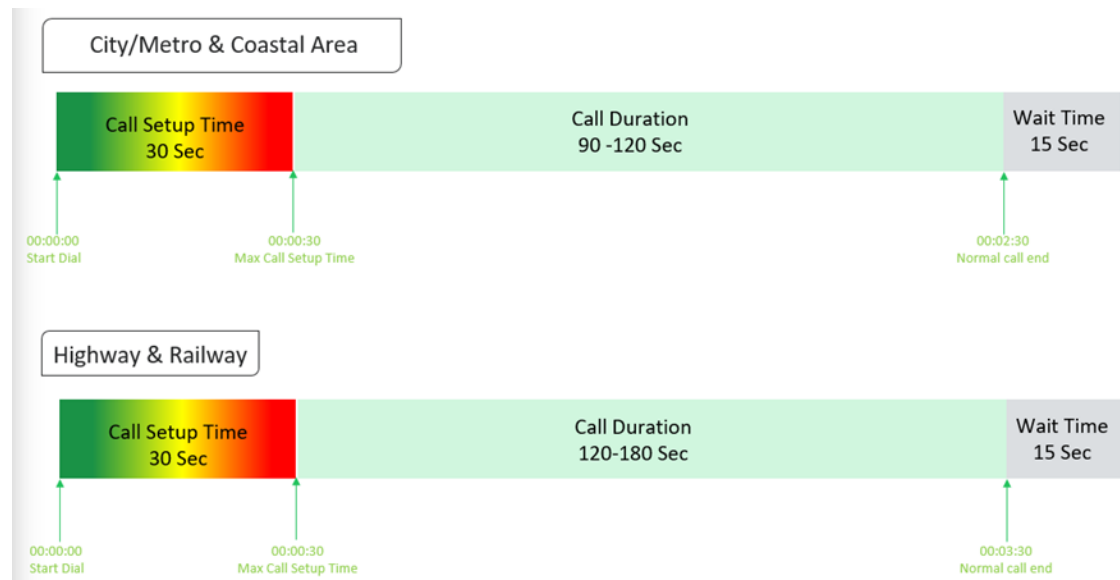
Figure-57: Voice test script for city/railway/metro/highway & coastal area

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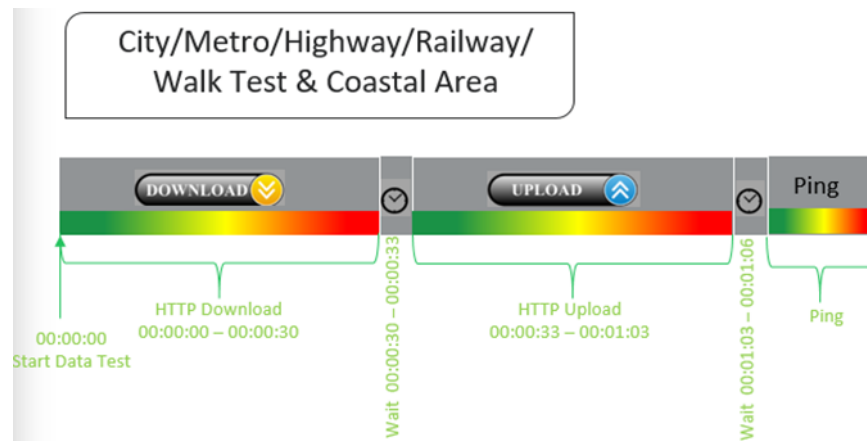- Speech quality (MOS) will be measured only City & Highway drive by making Mobile to Mobile calls.

(b) Hotspot voice testing

Figure-58: 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-59: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing
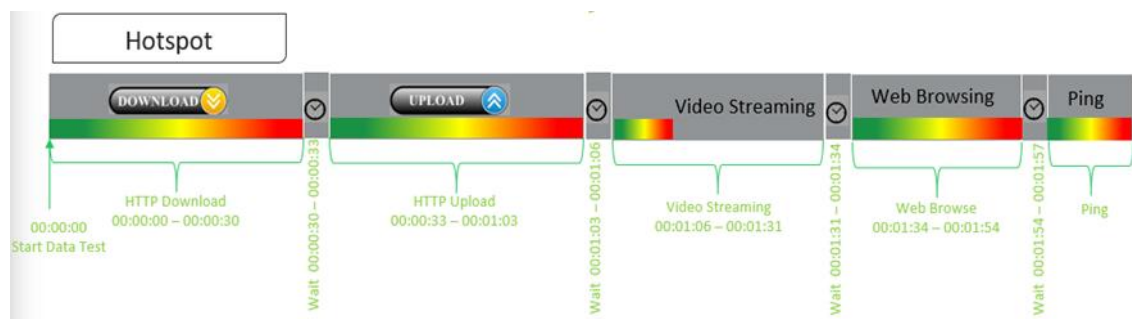
Figure-60: Data test script used at hotspot

- 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%**
Call Drop 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 Call Drop 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. Signal Strength table below

Signal Strength (dBm):

Parameter Name	Technology	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-45: 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

Table-46: Network performance parameter and definition Data