भादूविप्रा
TRAI

TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Punjab LSA

March 2026

Contents

1. Introduction

TRAI Act, 1997 mandates the Authority to ensure the services delivered through various telecommunications networks meet the 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 interests of the consumers of telecommunications services.

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 Punjab License Service Area (LSA) during the month of March-2026 under the supervision of TRAI Regional Office (RO) Jaipur. Details of route/area covered during the IDT are as given below:

S. No	Drive test route	Type of route	Distance covered (KMs)	From date	To date
1	Bathinda & Sri Muktsar Sahib	City	276.8	17-Mar-2026	18-Mar-2026
2	Bathinda	Inter Operator Calling	1 Location	19-Mar-2026	19-Mar-2026
3	Bathinda & Sri Muktsar Sahib	Hotspot	6 Locations	18-Mar-2026	19-Mar-2026
4	Amritsar to Bathinda	Railway	282.8	16-Mar-2026	16-Mar-2026

Table-1: Drive test summary.

2.2 Drive test routes

The map provides overview of drive test routes indicating city drive, Inter-operator call test, hotspots and railway as per the legends shown on the map.

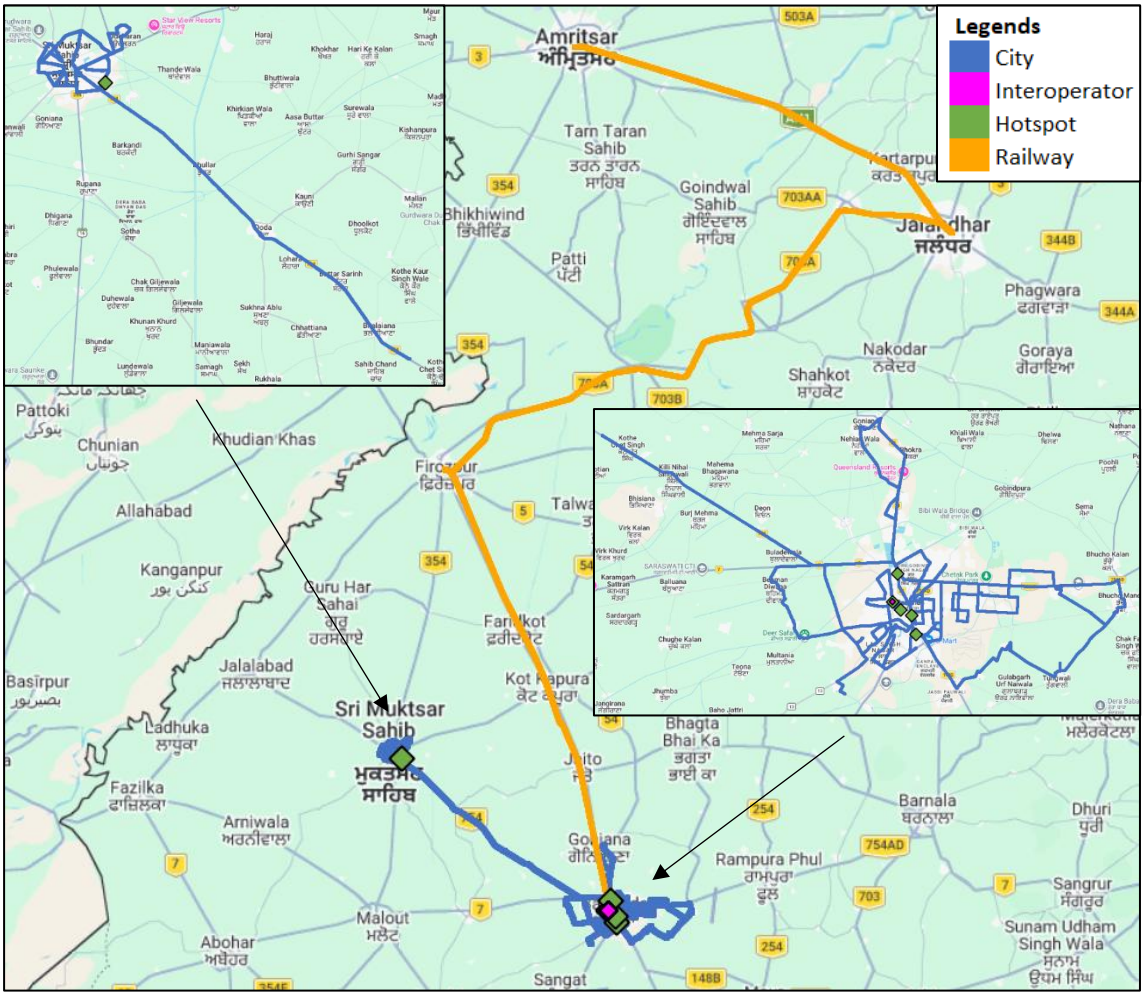


Figure-1: Drive test routes

2.3 Summary of areas covered

a) City

Bathinda - Behman Diwana, Lal Singh Nagar, Ganpati Enclave, Jassi Pauwali, Tungwali, Bhucho Mandi, Guru Gobind Singh Nagar, Bhokra, Goniana, Nehian Wala, Buladewala, Killi Nihal Singhwali and Kothe Chet Singh etc.

Sri Muktsar Sahib - Bhalaiana, Buttar Sarinh, Lohara, Doda, Bhullar, New Grain Market, Subash Nagar, Guru Teg Bahadur Nagar, Udekaran and Guru Anand Dev Nagar etc.

b) Hotspot

1. Bathinda Fort
2. Bathinda Jn Railway Station
3. Civil Hospital Bathinda
4. DC Office Sri Muktsar Sahib
5. District Court Bathinda
6. Mittal City Mall Bathinda

c) Railway - Amritsar to Bathinda Via Beas Jn, Jalandhar City Jn, Kapurthala, Kapurthala Rail Coach Factory, Sultanpur Lodhi, Lohian Khas Jn, Makhu, Firozpur Cantt Jn, Faridkot, Kot Kapura Jn and Gangsar Jaito.

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.	3G	2100
3	Bharti Airtel Ltd.	4G	900,1800,2300
4	Bharti Airtel Ltd.	5G	3500
5	BSNL	2G	900
6	BSNL	3G	2100
7	BSNL	4G	700,2100,2500
8	Reliance JIO Infocomm Ltd.	4G	850,1800,2300
9	Reliance JIO Infocomm Ltd.	5G	700,3500
10	Vodafone Idea Ltd.	2G	900,1800
11	Vodafone Idea Ltd.	4G	900,1800,2100,2500

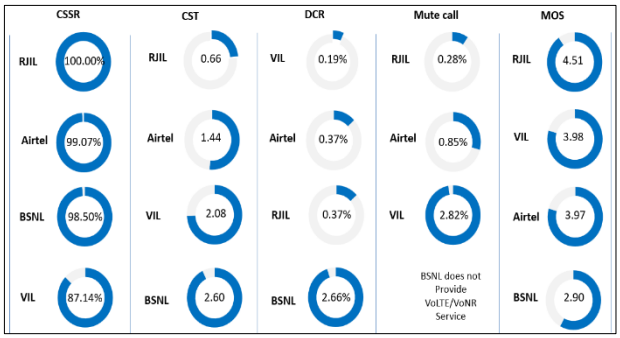
Table-2: Telecom service provider (TSP) covered in IDT

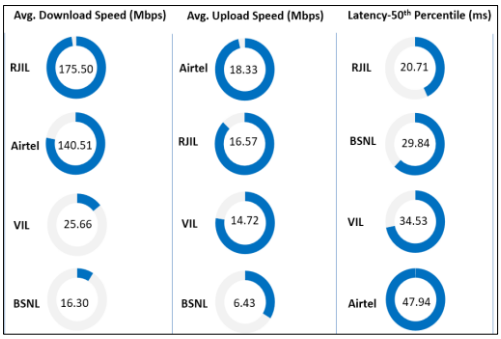
Note-

- Few samples of 3G technology have been observed for Airtel in Bathinda city.

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.





Summary-Voice services

Call Setup Success Rate: Airtel, BSNL, RJIL and VIL have 99.07%, 98.50%, 100.00% and 87.14% call setup success rate respectively in Auto-selection mode (5G/4G/3G/2G).

Call Setup Time: Airtel, BSNL, RJIL and VIL have call setup time of 1.44, 2.60, 0.66 and 2.08 seconds respectively in Auto-selection mode (5G/4G/3G/2G).

Drop Call Rate: Airtel, BSNL, RJIL and VIL have drop call rate of 0.37%, 2.66%, 0.37% and 0.19% respectively in Auto-selection mode (5G/4G/3G/2G).

Call Silence/Mute Rate: Airtel, RJIL and VIL have silence call rate of 0.85%, 0.28% and 2.82% respectively in packet switched network (4G/5G).

Mean Opinion Score (MOS): Airtel, BSNL, RJIL and VIL have average MOS of 3.97, 2.90, 4.51 and 3.98 respectively.

Summary-Data services

Data Download performance (Overall): Average download speed of Airtel (5G/4G/2G) is 140.51 Mbps, BSNL (4G/2G) is 16.30 Mbps, RJIL (5G/4G) is 175.50 Mbps and VIL (4G/2G) is 25.66 Mbps.

Data Upload performance (Overall): Average upload speed of Airtel (5G/4G/2G) is 18.33 Mbps, BSNL (4G/2G) is 6.43 Mbps, RJIL (5G/4G) is 16.57 Mbps and VIL (4G/2G) is 14.72 Mbps.

Latency (Overall): Airtel, BSNL, RJIL and VIL 50th percentile latency is 47.94 ms, 29.84 ms, 20.71 ms, 34.53 ms respectively.

Data performance - Hotspots (in Mbps):

Airtel-	4G D/L: 28.88	4G U/L: 13.55
	5G D/L: 203.84	5G U/L: 35.27
BSNL-	4G D/L: 18.55	4G U/L: 13.72
RJIL-	4G D/L: 38.42	4G U/L: 11.54
	5G D/L: 224.31	5G U/L: 24.61
VIL-	4G D/L: 28.44	4G U/L: 16.74

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

- The Poor signal strength in auto-selection mode (5G/4G/3G/2G) during **voice** testing has been observed in 0.94%, 25.70%, 1.23% & 0.93% of the **Bathinda City IDT route** in case of Airtel, BSNL, RJIL and VIL respectively. {refer **figure- 69 to 72** as per the **Section 6.1** under Para-6 (Annexure)}

- The Poor signal strength in auto-selection mode (5G/4G/3G/2G) during **data** testing has been observed in 7.98%, 14.61%, 9.47% & 6.98% of the **Bathinda City IDT route** in case of Airtel, BSNL, RJIL and VIL respectively. {refer **figure- 73 to 76** as per the **Section 6.1** under Para-6 (Annexure)}

- The Poor signal strength in auto-selection mode (5G/4G/3G/2G) during **voice** testing has been observed in 0.69%, 22.92%, 1.46% & 0.42% of the **Sri Muktsar Sahib City IDT route** in case of Airtel, BSNL, RJIL and VIL respectively. {refer **figure- 80 to 83** as per the **Section 6.1** under Para-6 (Annexure)}

- The Poor signal strength in auto-selection mode (5G/4G/3G/2G) during **data** testing has been observed in 7.61%, 6.43%, 10.50% & 2.85% of the **Sri Muktsar Sahib City IDT route** in case of Airtel, BSNL, RJIL and VIL respectively. {refer **figure- 84 to 87** as per the **Section 6.1** under Para-6 (Annexure)}

- The Poor signal strength in auto-selection mode (5G/4G/3G/2G) during **voice** testing has been observed in 2.58%, 23.86%, 1.35% & 2.74% of the **Railway IDT route** in case of Airtel, BSNL, RJIL and VIL respectively. {refer **figure- 88 to 91** as per the **Section 6.1** under Para-6 (Annexure)}

- The Poor signal strength in auto-selection mode (5G/4G/3G/2G) during **data** testing has been observed in 4.73%, 8.37%, 6.83% & 2.60% of the **Railway IDT route** in case of Airtel, BSNL, RJIL and VIL respectively. {refer **figure- 92 to 95** as per the **Section 6.1** under Para-6 (Annexure)}

QoS Performance Analysis-Punjab 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 Punjab LSA during the month of March-2026 covering city drive, hotspots and railway. (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	356	359	356
Call Setup Success Rate %	95.22	98.61	95.79
Drop Call Rate %	0.00	1.69	1.47
Call Setup Time-Average (Second)	4.83	2.65	4.34
Handover Success Rate %	99.23	97.28	98.33

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

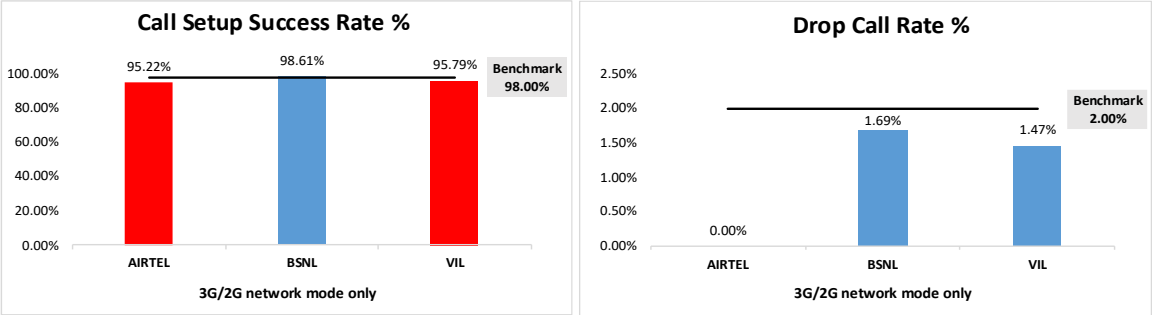


Figure-2: Call setup success rate and drop call rate performance.

Number of unique cell Id's covered in Voice test- Technology wise			
Technology	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
3G	1	0	NA
2G	317	178	331

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	539	534	535	591
Call Setup Success Rate %	99.07	98.50	100.00	87.14
Drop Call Rate %	0.37	2.66	0.37	0.19
Call Setup Time-Average (Second)	1.44	2.60	0.66	2.08
Handover Success Rate %	99.95	95.45	99.94	99.95

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

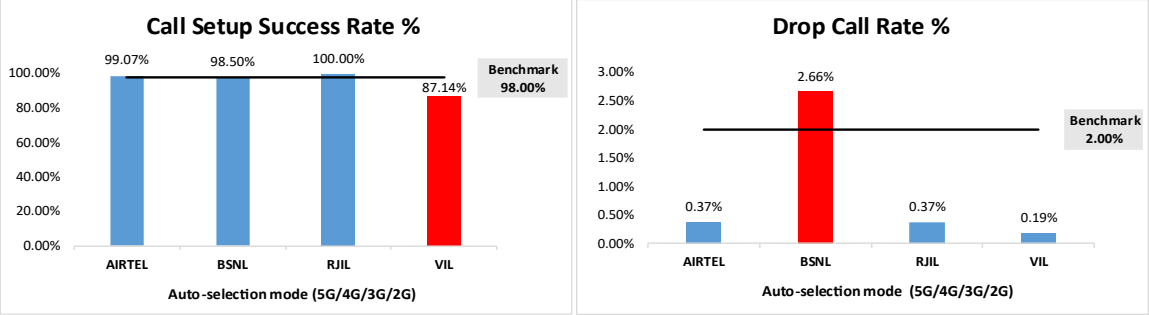


Figure-3: Performance for call setup success rate and drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	354	308	354	355
Number of silences call for >4 Sec	3	NA	1	10
Silence Call Rate %	0.85	NA	0.28	2.82
Number of silence instances for >4 Sec	3	NA	3	11
Number of silence instances for >3 Sec	5	NA	4	17
Number of silence instances for >2 sec	10	NA	6	31
RTP Jitter (4G & 5G) in ms	5.63	NA	17.14	15.95
Packet loss Rate Downlink %	0.54	NA	0.73	0.87
Packet loss Rate Uplink %	0.64	NA	0.80	0.67

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

Note-

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

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	788	NA
4G	1297	225	512	1082
3G	0	6	NA	NA
2G	0	361	NA	7

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 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	2122	1801	2103	2076
Speech Quality (Average MOS)	3.97	2.90	4.51	3.98
Number of samples with MOS >=4 to <5 (Excellent)	1586	0	1869	1457
Number of samples with MOS >=3 to <4 (Good)	483	1041	144	503
Number of samples with MOS >=2 to <3 (Fair)	27	561	47	76
Number of samples with MOS >=1 to <2 (Poor)	26	199	43	40
%age of samples with MOS >=4 to <5 (Excellent)	74.74%	0.00%	88.87%	70.18%
%age of samples with MOS >=3 to <4 (Good)	22.76%	57.80%	6.85%	24.23%
%age of samples with MOS >=2 to <3 (Fair)	1.27%	31.15%	2.23%	3.66%
%age of samples with MOS >=1 to <2 (Poor)	1.23%	11.05%	2.04%	1.93%

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

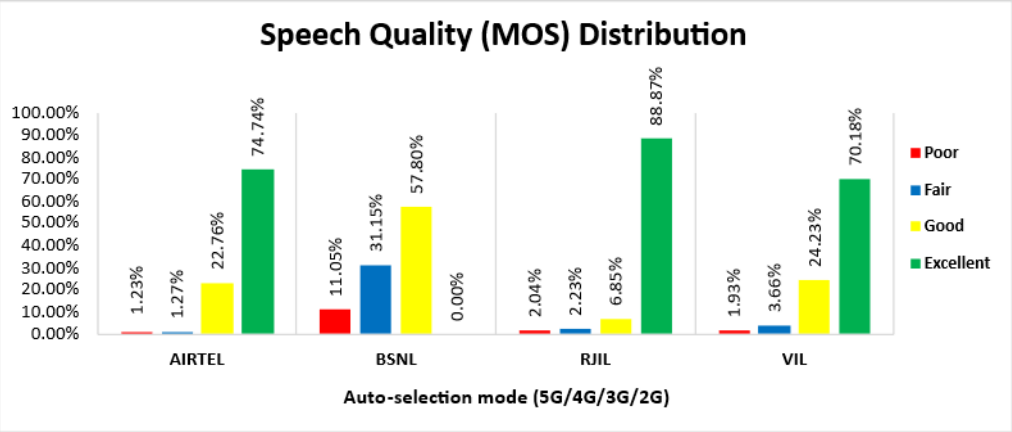


Figure- 4: Distribution of samples in MOS range.

(d) Inter-service provider voice call performance: To check the performance of inter-service providers call setup success rate, total 14 to 16 inter operator calls were attempted at one location which is Bathinda Jn Railway Station. The call setup success rate and call setup time observation is as below.

Call Setup Success Rate %				
From Service Provider	**To Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
AIRTEL	NA	100.00	100.00	100.00
BSNL	100.00	NA	100.00	100.00
RJIL	100.00	100.00	NA	100.00
VIL	100.00	100.00	92.86	NA

Table-9: Call setup success rate across service providers

Note-
- NA- Only inter-operator calls were measured during test.

Call setup time average (seconds)				
From Service Provider	**To Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
AIRTEL	NA	1.62	1.03	1.89
BSNL	4.62	NA	3.36	3.01
RJIL	1.53	1.49	NA	2.51
VIL	2.67	1.91	1.52	NA

Table-10: Call setup time across service providers.

Note-
- NA- Only inter-operator calls were measured during test.

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**	140.51	16.30	175.50	25.66
	80th Percentile	239.14	25.38	311.95	43.77
	20th Percentile	24.25	7.01	25.92	5.47
Upload Throughput (Mbits/s)	**Average**	18.33	6.43	16.57	14.72
	80th Percentile	29.62	10.89	24.21	25.13
	20th Percentile	2.36	1.66	9.32	5.63
Latency (ms)	**50th Percentile**	47.94	29.84	20.71	34.53

Table-11: Summary of data performance in network auto-selection mode.

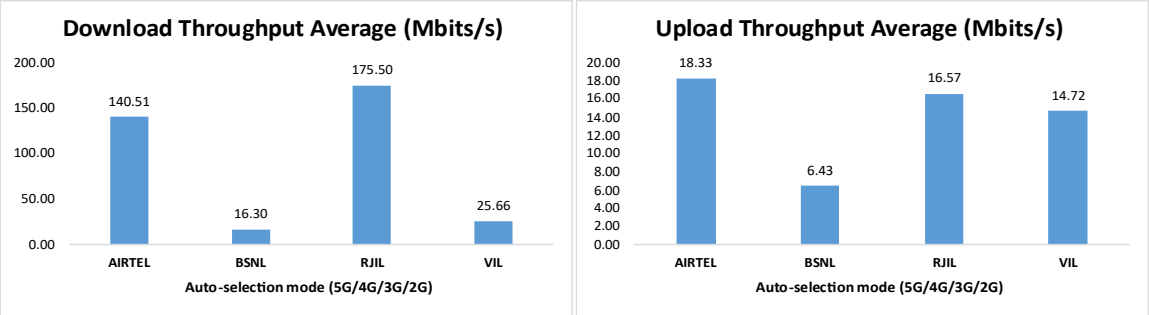


Figure- 5: Download and Upload throughput

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	838	NA
4G	1361	609	267	1155
3G	0	0	NA	NA
2G	4	16	NA	13

Table-12: 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, hotspots and railway 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 17th March 2026 and 18th March 2026 in Bathinda and Sri Muktsar Sahib city. (Refer Table-1)

4.2.1 Bathinda City

4.2.1.1 Drive test route

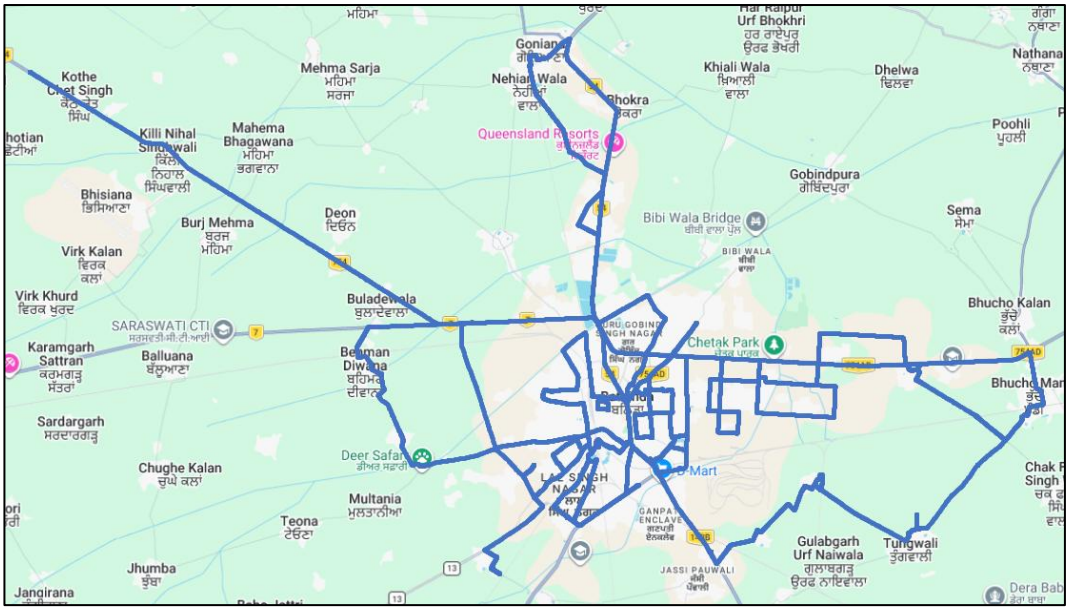


Figure- 6: Drive test routes

4.2.1.2 Areas covered

Behman Diwana, Lal Singh Nagar, Ganpati Enclave, Jassi Pauwali, Tungwali, Bhucho Mandi, Guru Gobind Singh Nagar, Bhokra, Goniana, Nehian Wala, Buladewala, Killi Nihal Singhwali and Kothe Chet Singh etc.

4.2.1.3 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	269	267	268
Call Setup Success Rate %	94.05	99.63	95.15
Drop Call Rate %	0.00	1.50	1.57
Call Setup Time-Average (Second)	4.84	2.73	4.36
Handover Success Rate %	99.24	95.64	98.17

Table-13: Summary of voice call performance in 3G/2G network mode only.

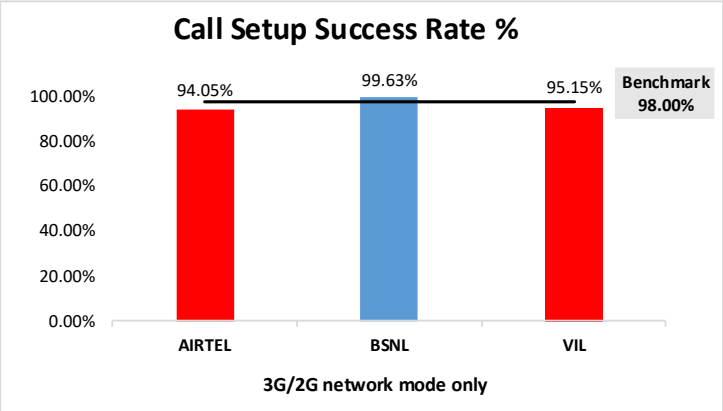


Figure-7: Performance for call setup success rate.

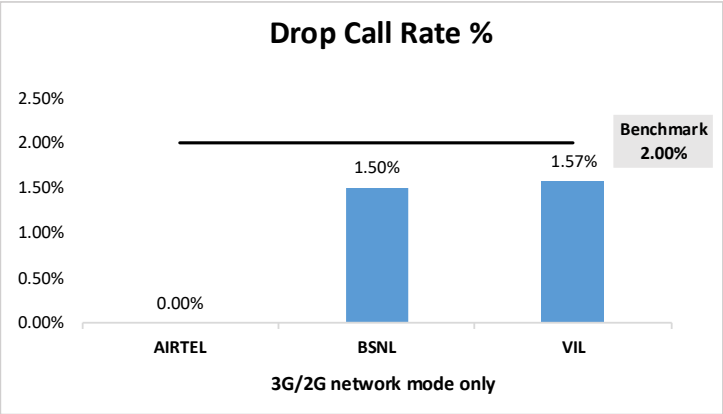


Figure-8: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	2.56%	0.25%	NA
2G	97.41%	99.61%	99.59%
Limited Service	0.03%	0.14%	0.41%

Table-14: Time spent on technology during drive test 3G/2G network mode.

Note-

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

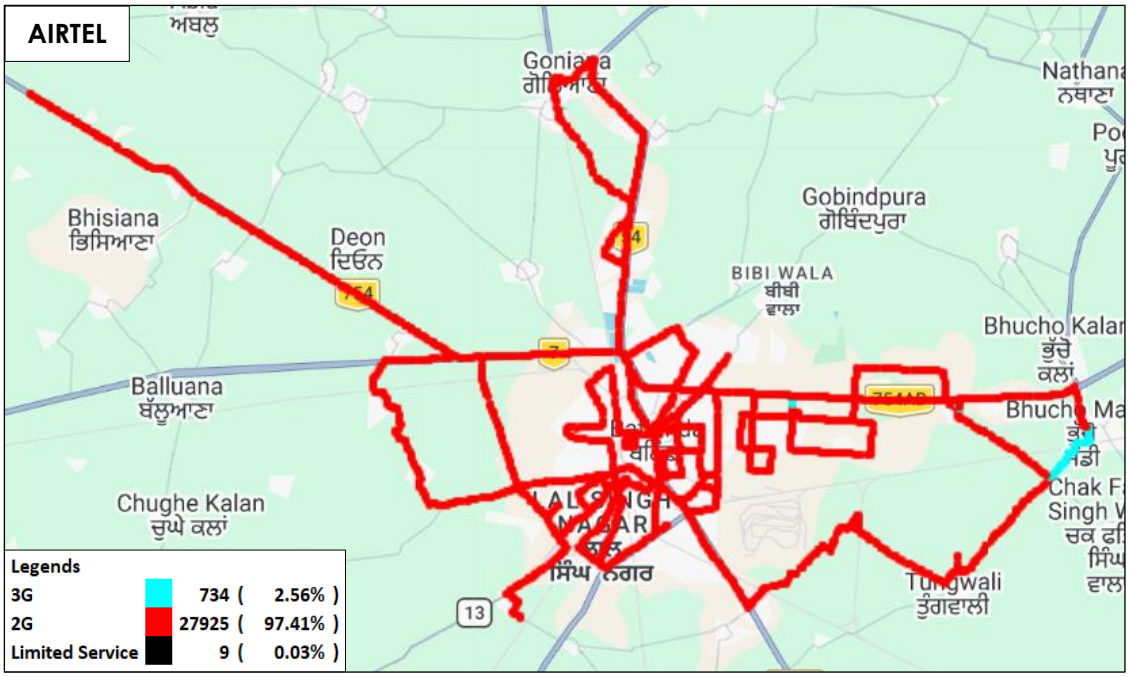


Figure-9: Serving technology plots 3G/2G network mode - AIRTEL

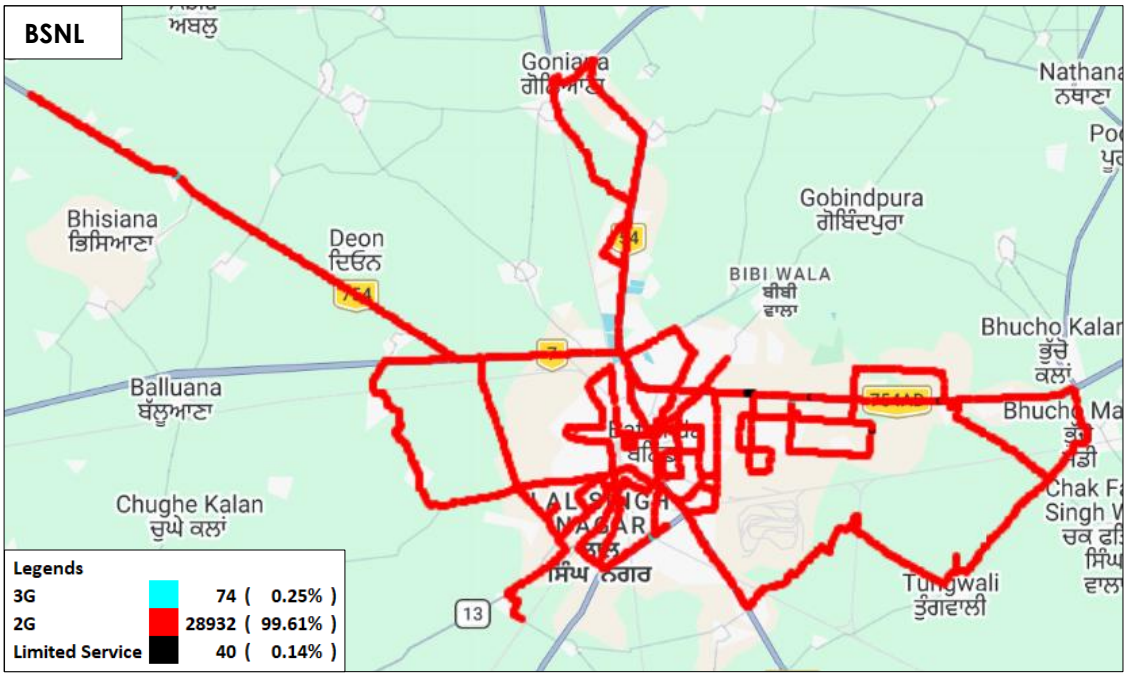


Figure-10: Serving technology plots 3G/2G network mode - BSNL.

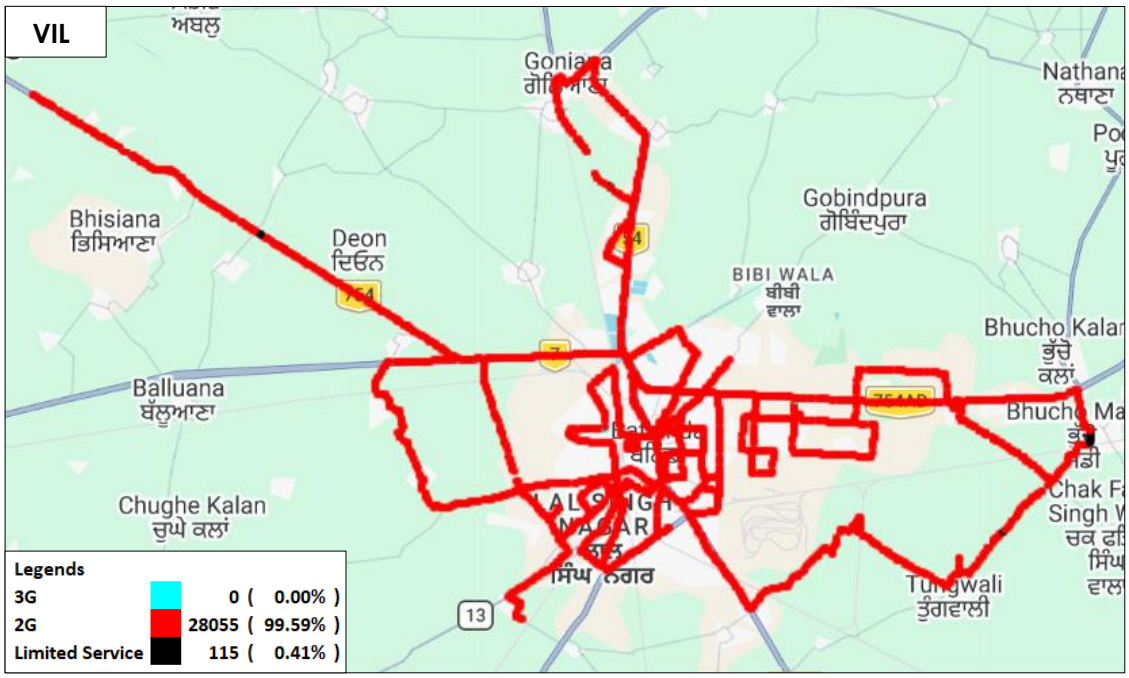


Figure-11: Serving technology plots 3G/2G network mode - VIL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 66, 67 & 68 for map view)

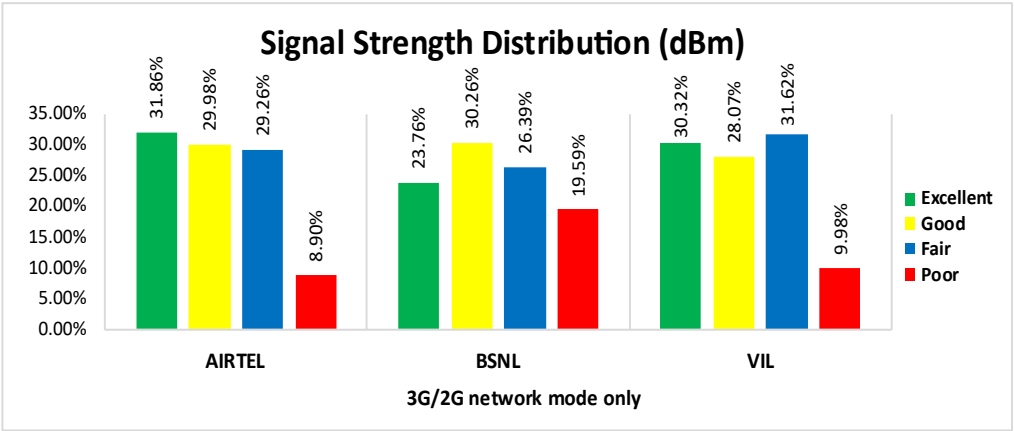


Figure-12: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 32% of samples falling in the excellent signal strength category.
- BSNL has 24% of samples falling in the excellent signal strength category.
- VIL has 30% 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	275	272	276	273
Call Setup Success Rate %	100.00	98.53	100.00	100.00
Drop Call Rate %	0.00	1.49	0.36	0.37
Call Setup Time Average (Second)	1.35	2.57	0.68	1.43
Handover Success Rate %	99.94	95.65	99.91	100.00

Table-15: Summary of voice call performance in network auto-selection mode.

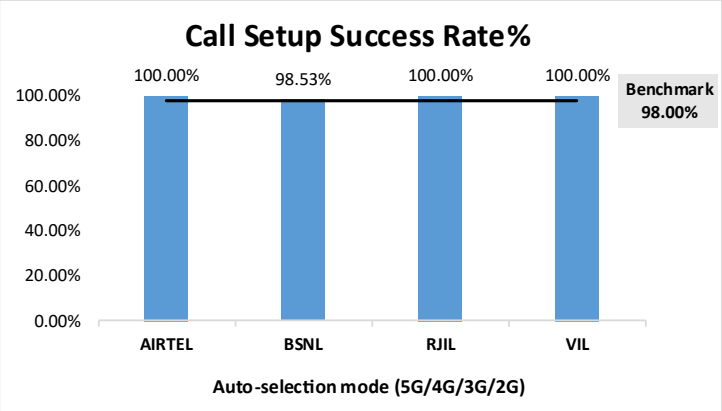


Figure-13: Performance for call setup success rate.

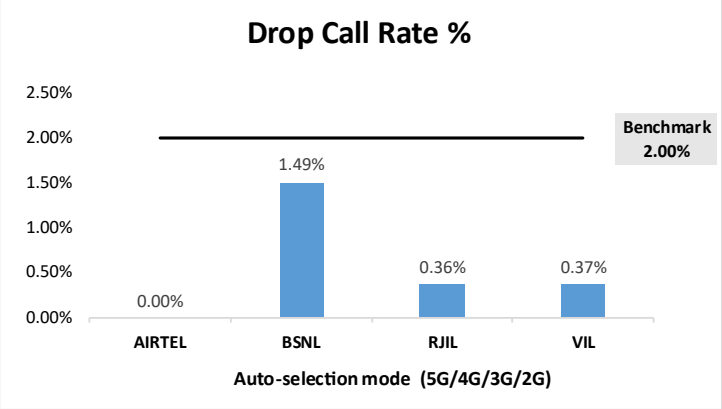


Figure-14: Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	267	230	266	268
Number of silences call for >4 Sec	3	NA	0	10
Silence Call Rate %	1.12	NA	0.00	3.73
Number of silence instances for >4 Sec	3	NA	0	11
Number of silence instances for >3 Sec	3	NA	1	17
Number of silence instances for >2 sec	6	NA	3	30
RTP Jitter (4G & 5G) in ms	5.50	NA	17.12	16.11
Packet loss Rate Downlink %	0.54	NA	0.68	1.06
Packet loss Rate Uplink %	0.71	NA	0.65	0.85

Table-16: Summary of silence instances & packet loss rate for mobile to mobile call.

Note-

- NA- Due to unavailability of packet switched (VoLTE & VoNR) 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 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	1600	1353	1581	1562
Speech Quality (Average MOS)	3.96	2.90	4.50	3.99
Number of samples with MOS >=4 to <5 (Excellent)	1184	0	1402	1128
Number of samples with MOS >=3 to <4 (Good)	371	776	108	347
Number of samples with MOS >=2 to <3 (Fair)	23	436	41	50
Number of samples with MOS >=1 to <2 (Poor)	22	141	30	37
%age of samples with MOS >=4 to <5 (Excellent)	74.00%	0.00%	88.68%	72.22%
%age of samples with MOS >=3 to <4 (Good)	23.19%	57.35%	6.83%	22.22%
%age of samples with MOS >=2 to <3 (Fair)	1.44%	32.22%	2.59%	3.20%
%age of samples with MOS >=1 to <2 (Poor)	1.38%	10.42%	1.90%	2.37%

Table-17: Summary of speech quality (MOS) samples.

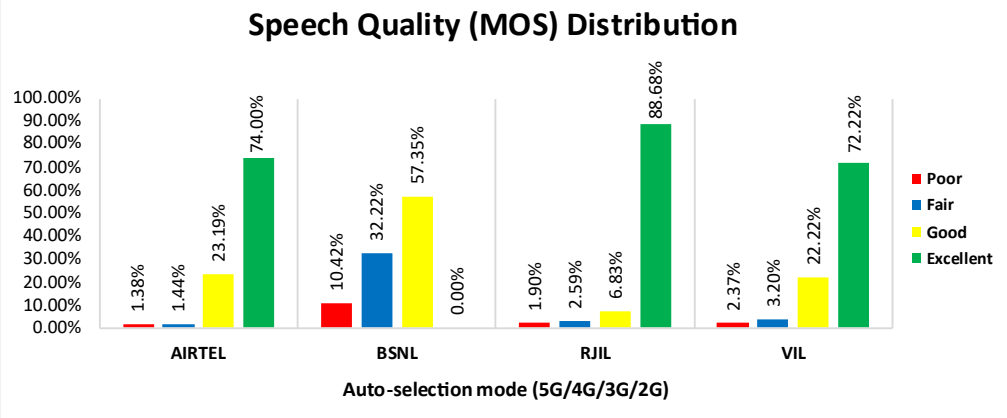


Figure-15: Distribution of samples in MOS range.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	3.37%	NA	80.91%	NA
4G	96.63%	13.39%	19.09%	100.00%
3G	0.00%	0.03%	NA	NA
2G	0.00%	86.51%	NA	0.00%
Limited Service	0.00%	0.07%	0.00%	0.00%

Table-18: Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) voice.

Note-

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

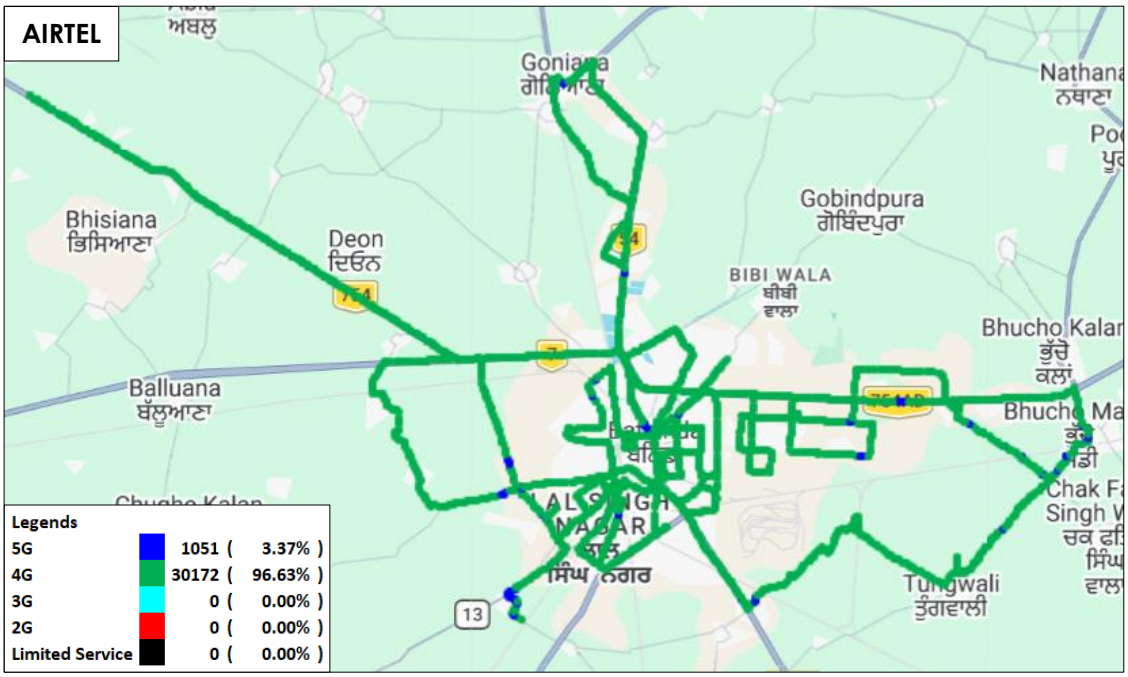


Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

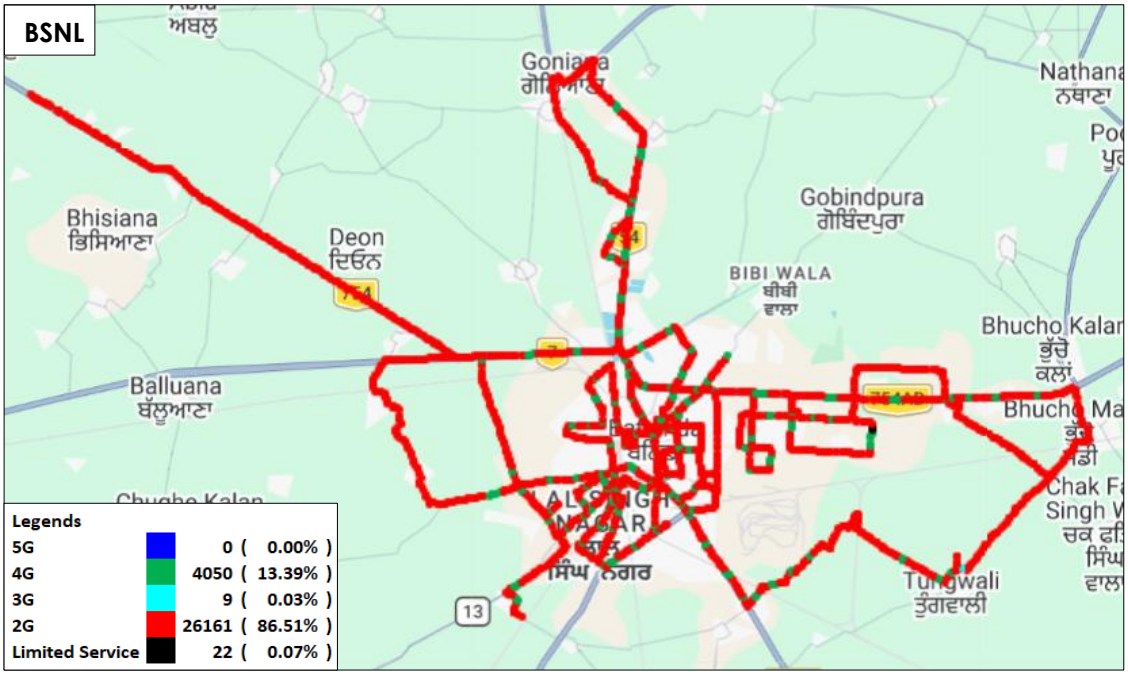


Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

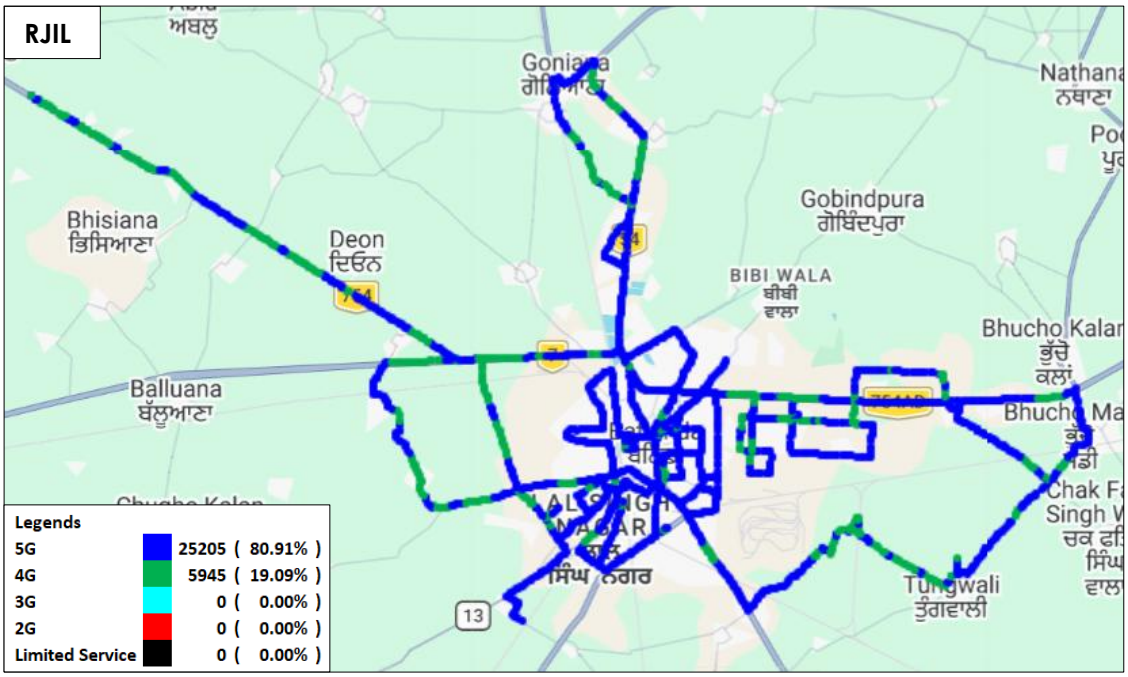


Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

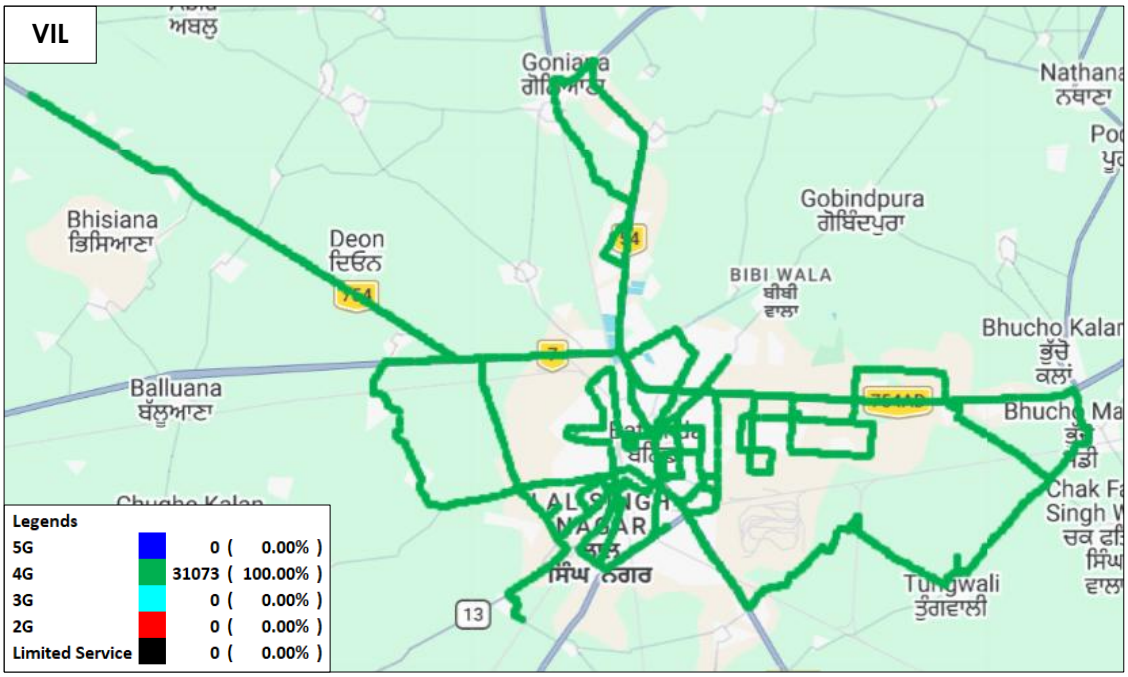


Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-69, 70, 71 & 72 for map view)

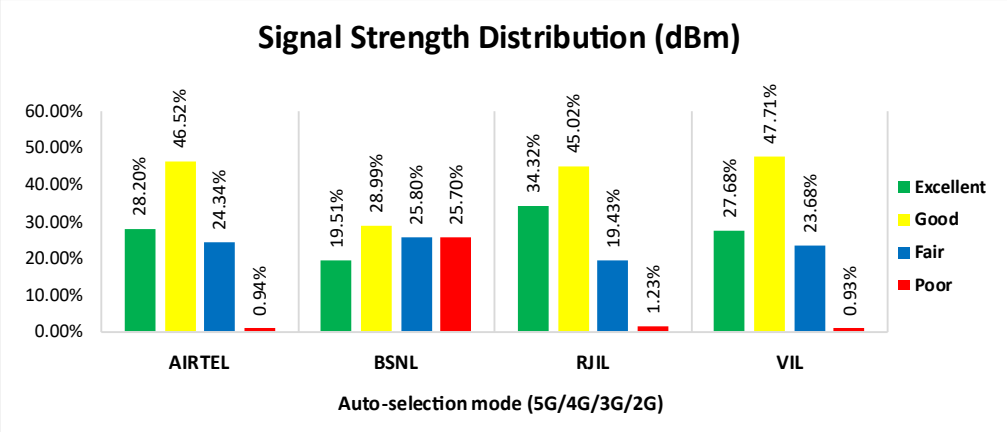


Figure-20: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 28% of samples falling in the excellent signal strength category.
- BSNL has 20% of samples falling in the excellent signal strength category.
- RJIL has 34% of samples falling in the excellent signal strength category.
- VIL has 28% of samples falling in the excellent signal strength category.

4.2.1.4 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	151.88	14.55	198.27	34.07
	80th Percentile	254.96	23.82	333.27	52.32
	20th Percentile	26.23	6.20	41.98	11.95
Upload Throughput (Mbits/s)	Average	18.53	5.70	14.19	15.97
	80th Percentile	29.61	8.90	19.76	27.06
	20th Percentile	2.36	1.64	9.35	5.84
Latency (ms)	50th Percentile	50.52	30.99	19.96	32.86

Table-19: Summary of Data performance in network auto-selection mode.

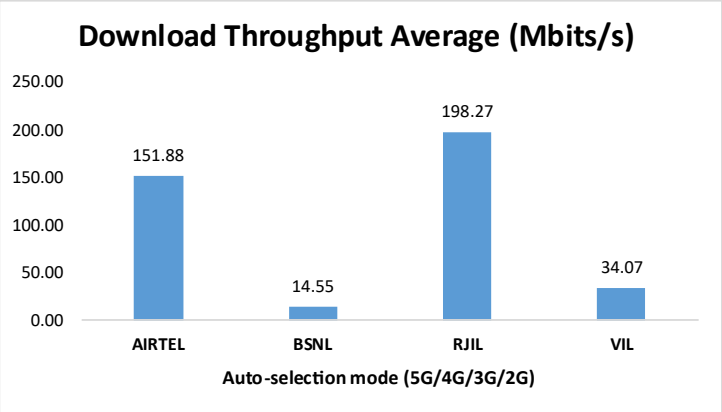


Figure- 21: Download throughput

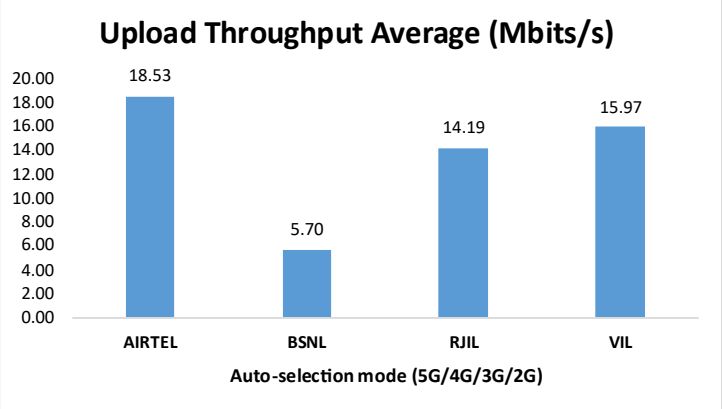


Figure- 22: Upload throughput

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	70.79%	NA	87.74%	NA
4G	29.21%	97.09%	12.24%	98.60%
3G	0.00%	0.03%	NA	NA
2G	0.00%	2.73%	NA	1.40%
Limited Service	0.00%	0.15%	0.03%	0.00%

Table-20: Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) data.

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

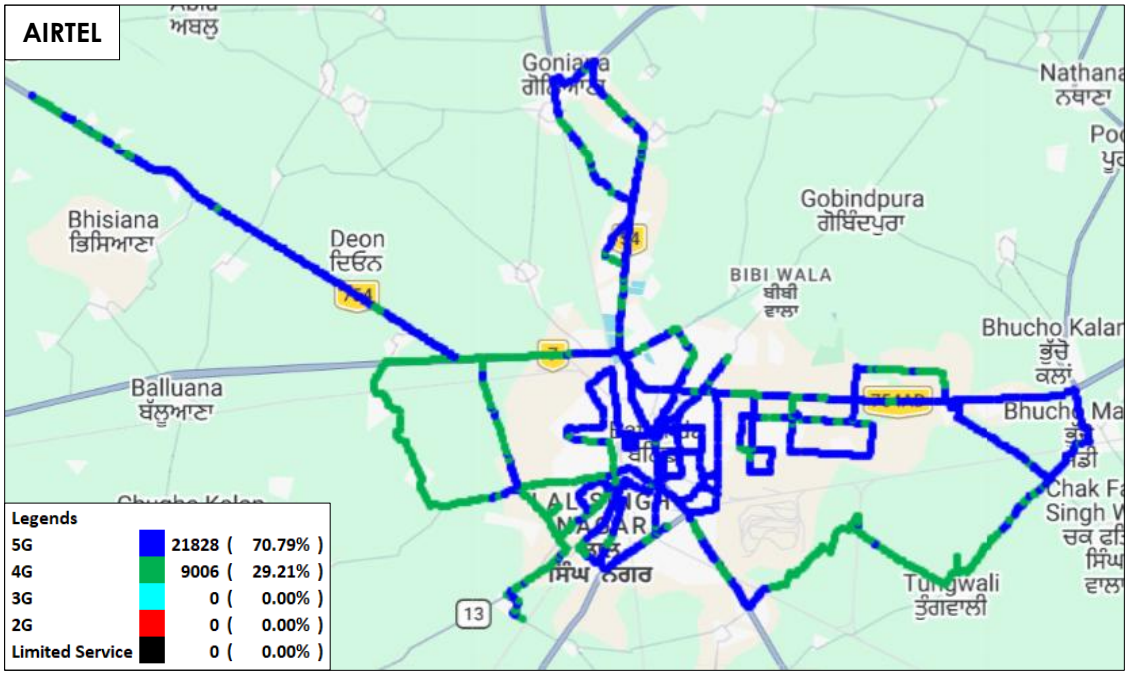


Figure-23: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data -AIRTEL.

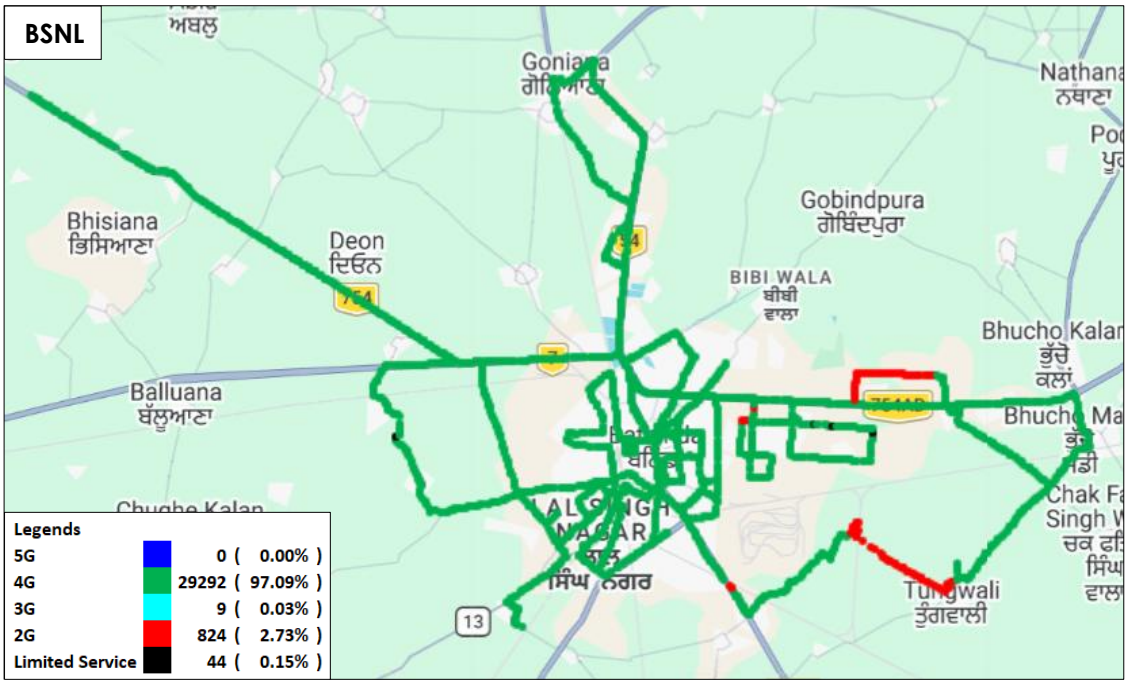


Figure-24: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data-BSNL.

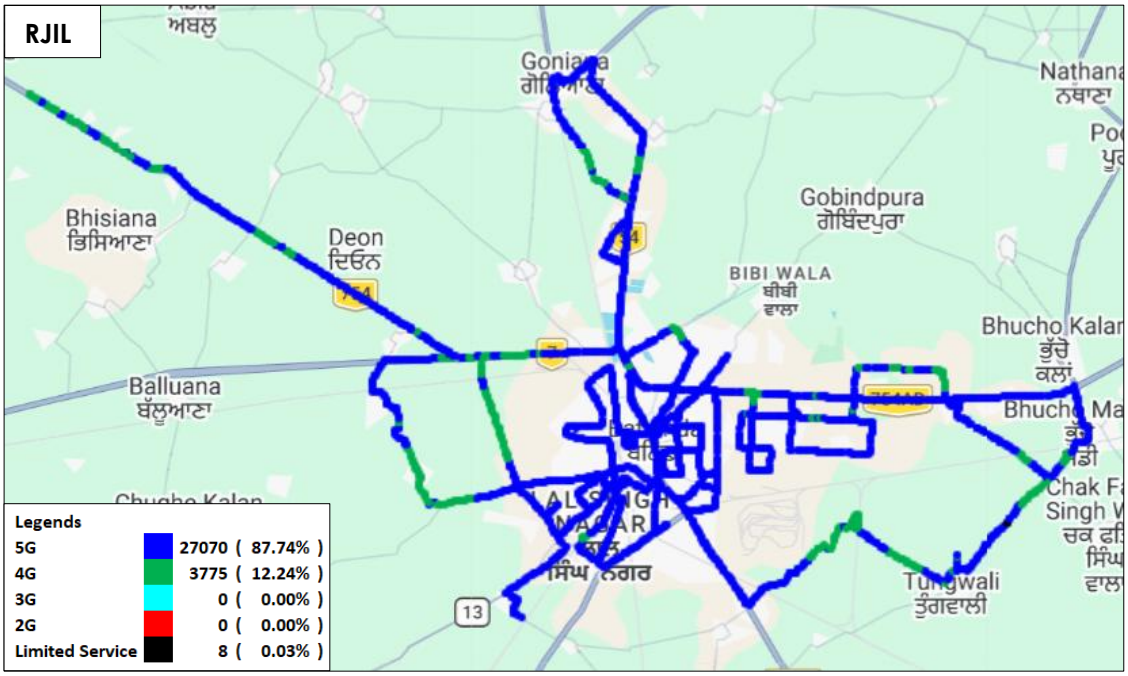


Figure-25: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data- RJIL.

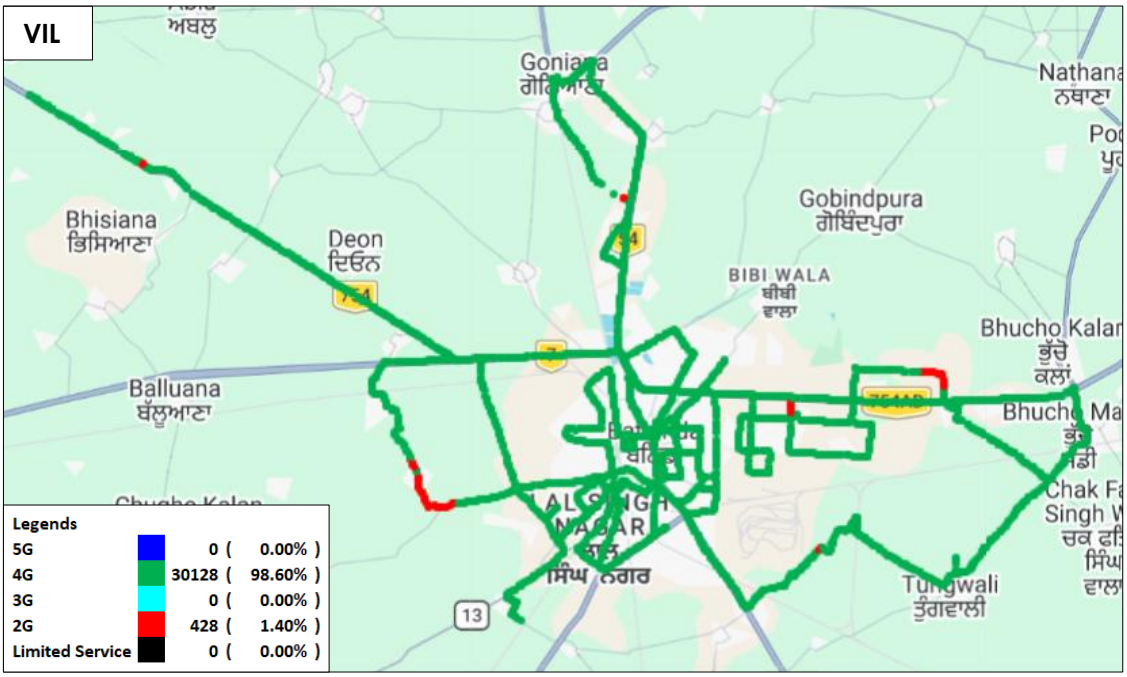


Figure-26: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data– VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-73, 74, 75 & 76 for map view)

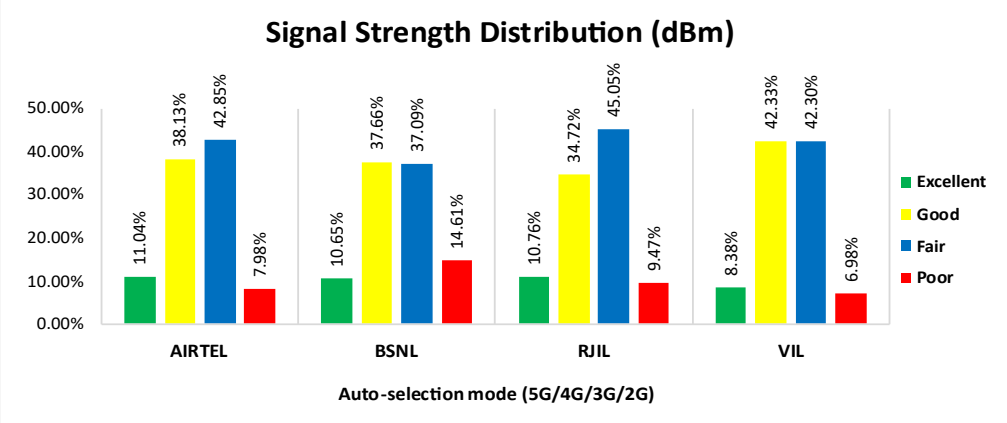


Figure-27: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 11% of samples falling in the excellent signal strength category.
- BSNL has 11% of samples falling in the excellent signal strength category.
- RJIL has 11% of samples falling in the excellent signal strength category.
- VIL has 8% of samples falling in the excellent signal strength category.

4.2.2 Sri Muktsar Sahib City

4.2.2.1 Drive test route

Figure- 28: Drive test routes

4.2.2.2 Areas covered

Bhalaiana, Buttar Sarinh, Lohara, Doda, Bhullar, New Grain Market, Subash Nagar, Guru Teg Bahadur Nagar, Udekaran and Guru Anand Dev Nagar etc.

4.2.2.3 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	87	92	88
Call Setup Success Rate %	98.85	95.65	97.73
Drop Call Rate %	0.00	2.27	1.16
Call Setup Time-Average (Second)	4.78	2.41	4.26
Handover Success Rate %	99.18	99.29	98.86

Table-21: Summary of voice call performance in 3G/2G network mode only.

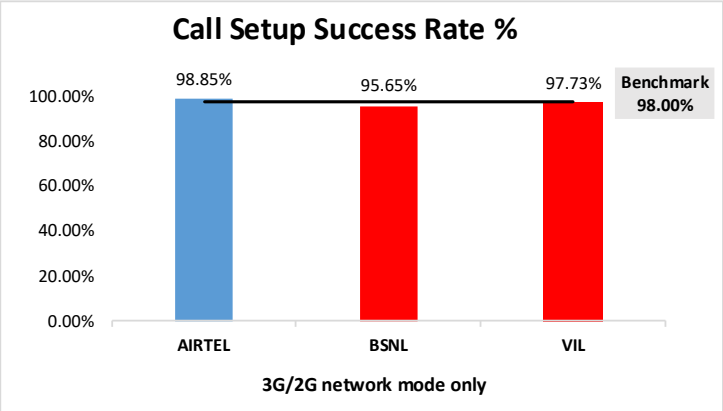


Figure-29: Performance for call setup success rate.

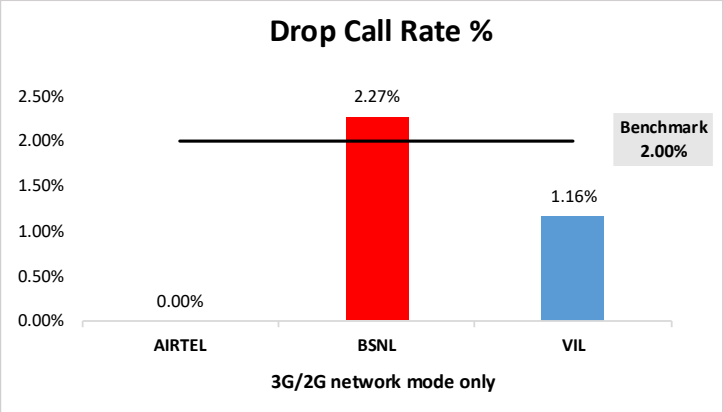


Figure-30: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	0.50%	NA
2G	99.80%	99.50%	100.00%
Limited Service	0.20%	0.00%	0.00%

Table-22: Time spent on technology during drive test 3G/2G network mode.

Note-

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

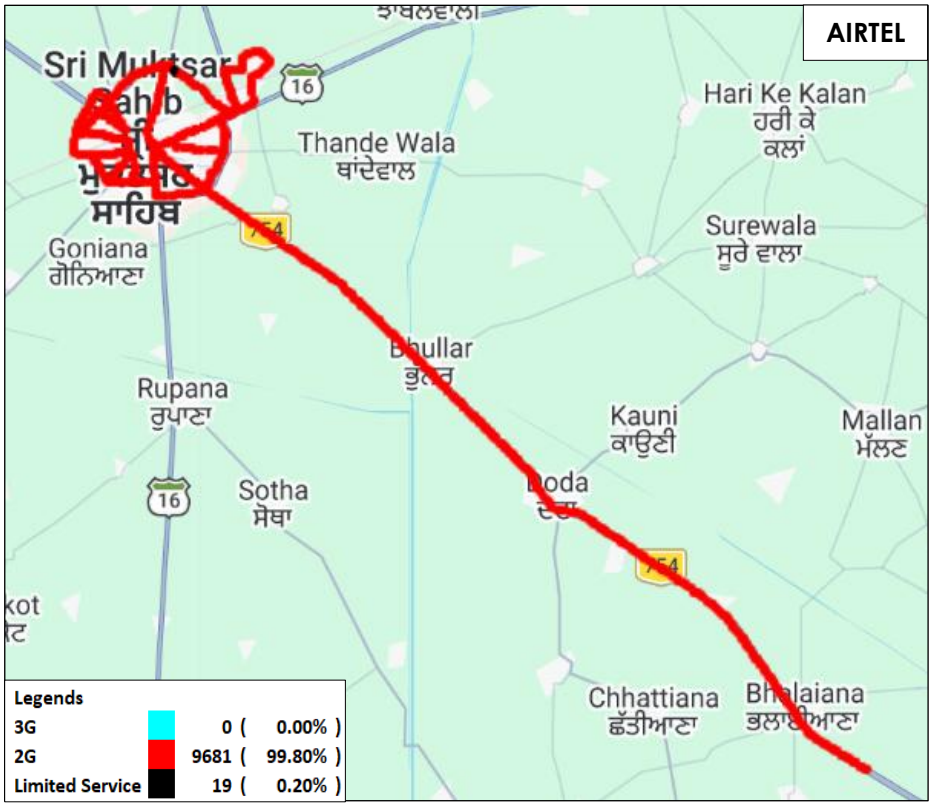


Figure-31: Serving technology plots 3G/2G network mode - AIRTEL

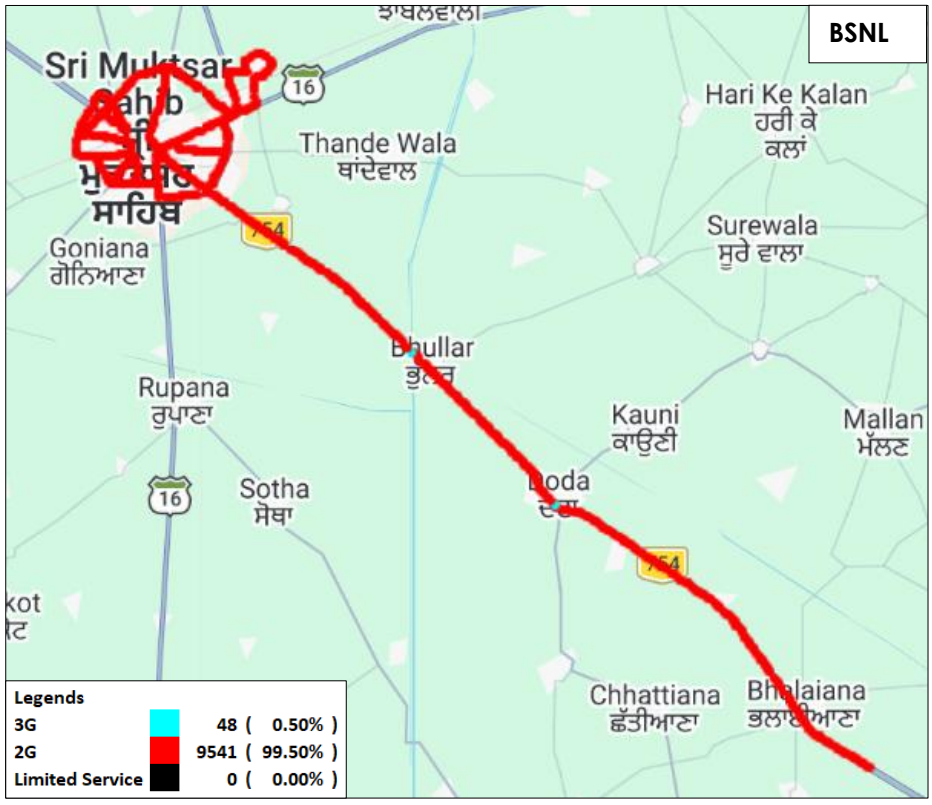


Figure-32: Serving technology plots 3G/2G network mode - BSNL.

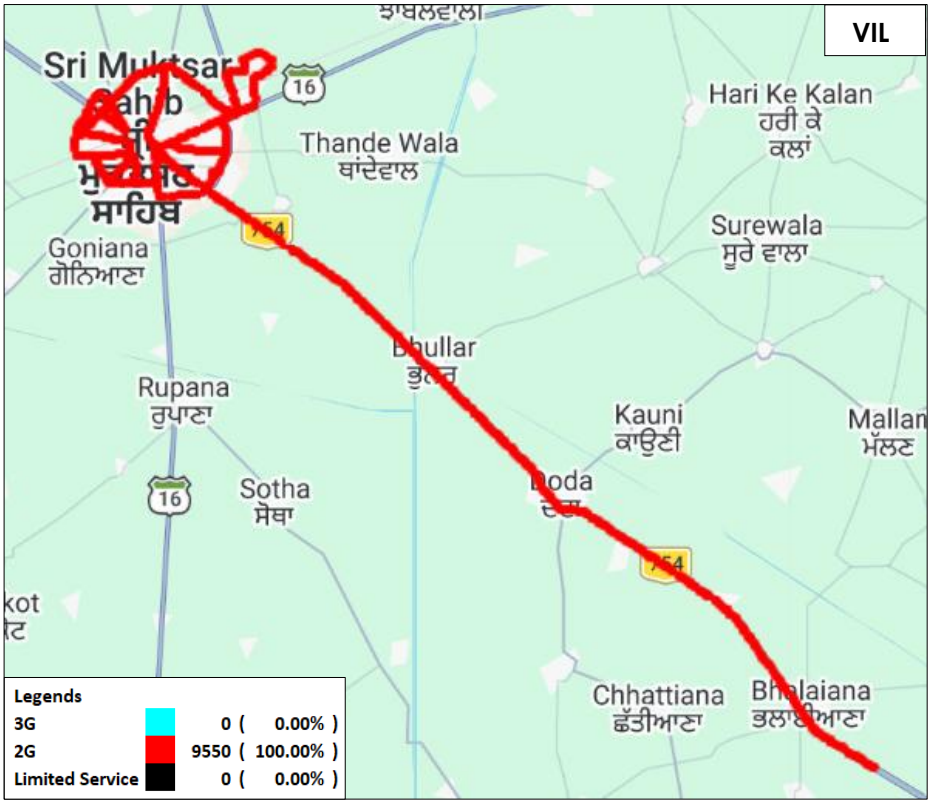


Figure-33: Serving technology plots 3G/2G network mode - VIL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 77, 78 & 79 for map view)

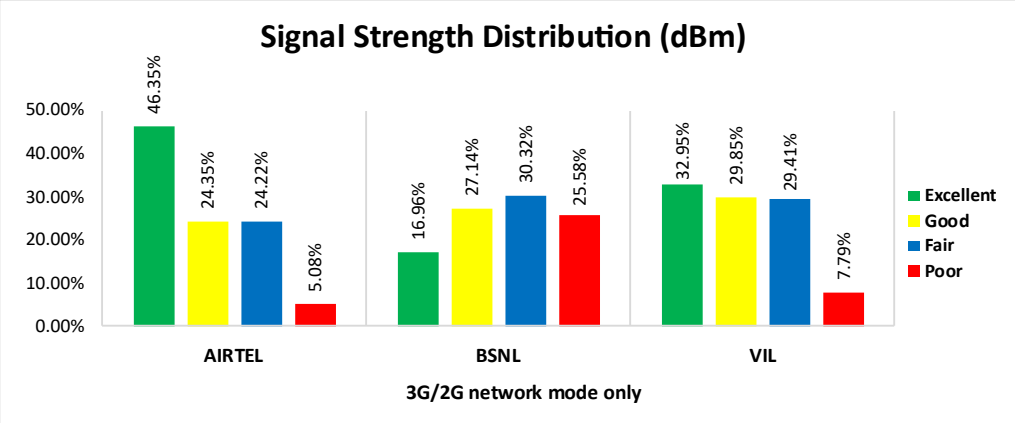


Figure-34: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 46% of samples falling in the excellent signal strength category.
- BSNL has 17% of samples falling in the excellent signal strength category.
- VIL has 33% 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	91	93	91	91
Call Setup Success Rate %	100.00	95.70	100.00	100.00
Drop Call Rate %	0.00	2.25	1.10	0.00
Call Setup Time Average (Second)	1.33	2.59	0.67	1.45
Handover Success Rate %	100.00	98.08	100.00	100.00

Table-23: Summary of voice call performance in network auto-selection mode.

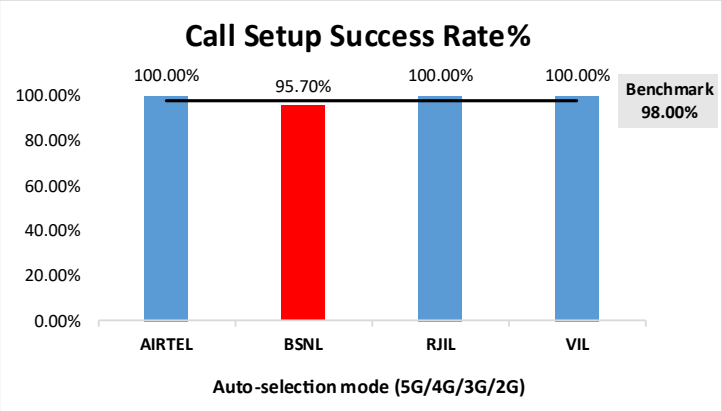


Figure-35: Performance for call setup success rate.

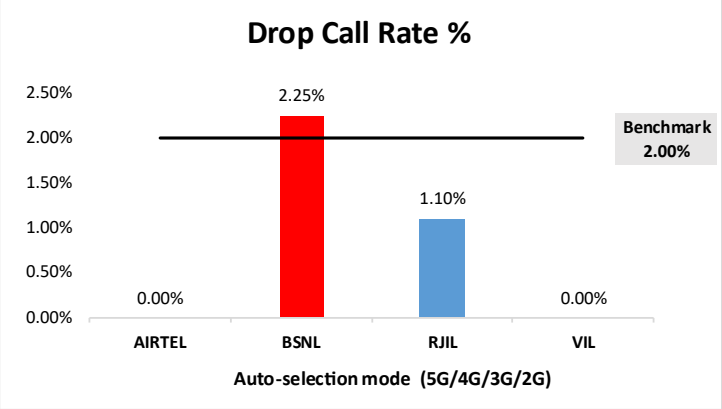


Figure-36: Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	87	78	88	87
Number of silences call for >4 Sec	0	NA	1	0
Silence Call Rate %	0.00	NA	1.14	0.00
Number of silence instances for >4 Sec	0	NA	3	0
Number of silence instances for >3 Sec	2	NA	3	0
Number of silence instances for >2 sec	4	NA	3	1
RTP Jitter (4G & 5G) in ms	6.02	NA	17.19	15.47
Packet loss Rate Downlink %	0.56	NA	0.89	0.27
Packet loss Rate Uplink %	0.43	NA	1.23	0.13

Table-24: Summary of silence instances & packet loss rate for mobile to mobile call.

Note-

- NA- Due to unavailability of packet switched (VoLTE & VoNR) 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 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-24	522	448	522	514
Speech Quality (Average MOS)	4.00	2.89	4.52	3.95
Number of samples with MOS >=4 to <5 (Excellent)	402	0	467	329
Number of samples with MOS >=3 to <4 (Good)	112	265	36	156
Number of samples with MOS >=2 to <3 (Fair)	4	125	6	26
Number of samples with MOS >=1 to <2 (Poor)	4	58	13	3
%age of samples with MOS >=4 to <5 (Excellent)	77.01%	0.00%	89.46%	64.01%
%age of samples with MOS >=3 to <4 (Good)	21.46%	59.15%	6.90%	30.35%
%age of samples with MOS >=2 to <3 (Fair)	0.77%	27.90%	1.15%	5.06%
%age of samples with MOS >=1 to <2 (Poor)	0.77%	12.95%	2.49%	0.58%

Table-25: Summary of speech quality (MOS) samples.

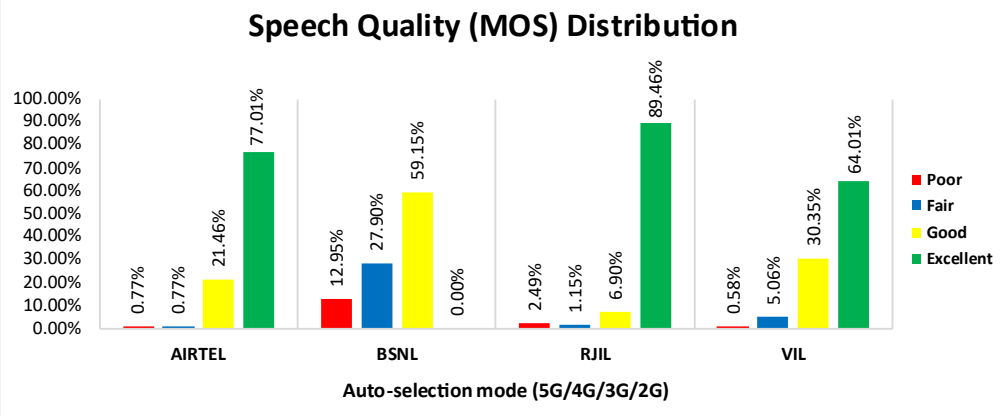


Figure-37: Distribution of samples in MOS range.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	2.71%	NA	79.78%	NA
4G	97.29%	0.16%	20.22%	100.00%
3G	NA	0.19%	NA	NA
2G	0.00%	99.65%	NA	0.00%
Limited Service	0.00%	0.00%	0.00%	0.00%

Table-26: Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) voice.

Note-

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

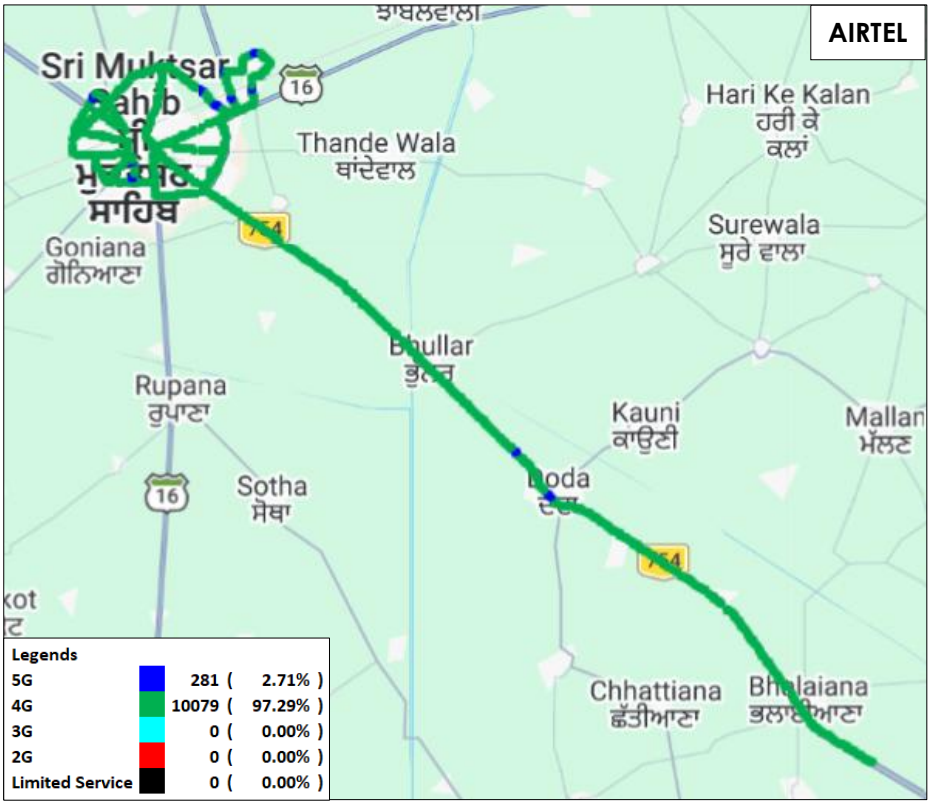


Figure-38: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

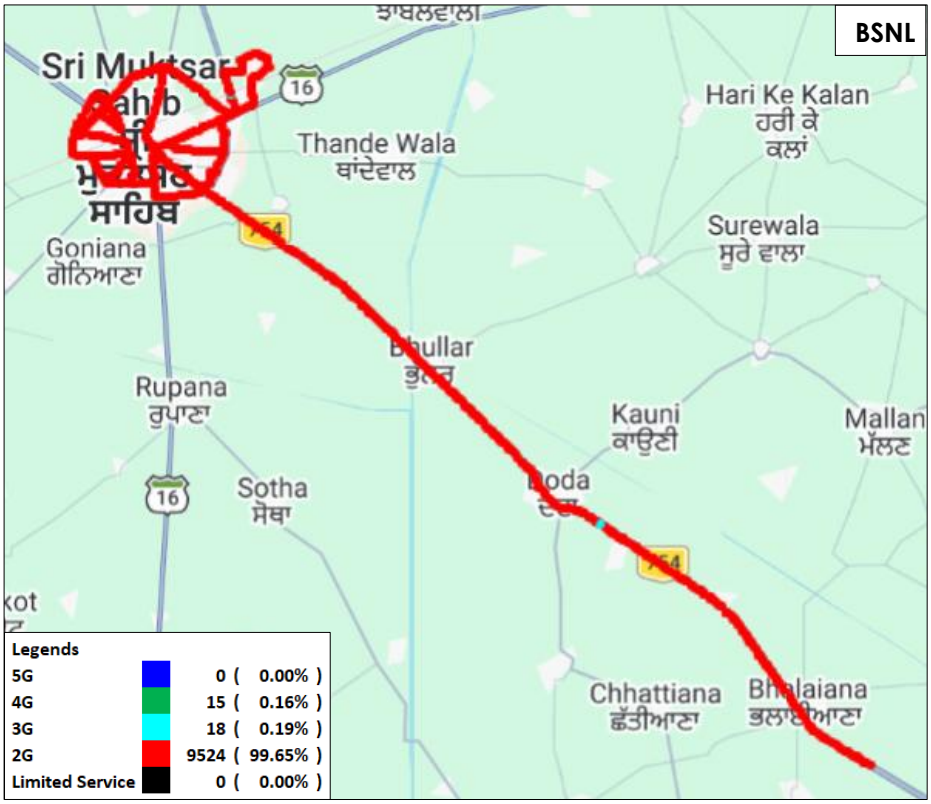


Figure-39: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

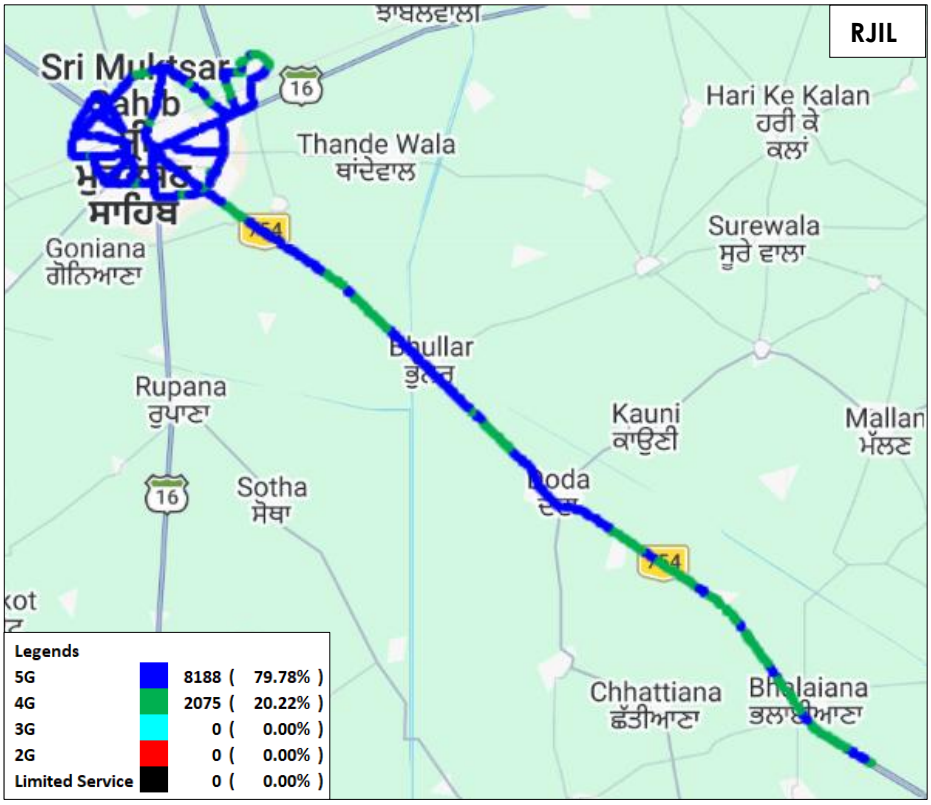


Figure-40: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

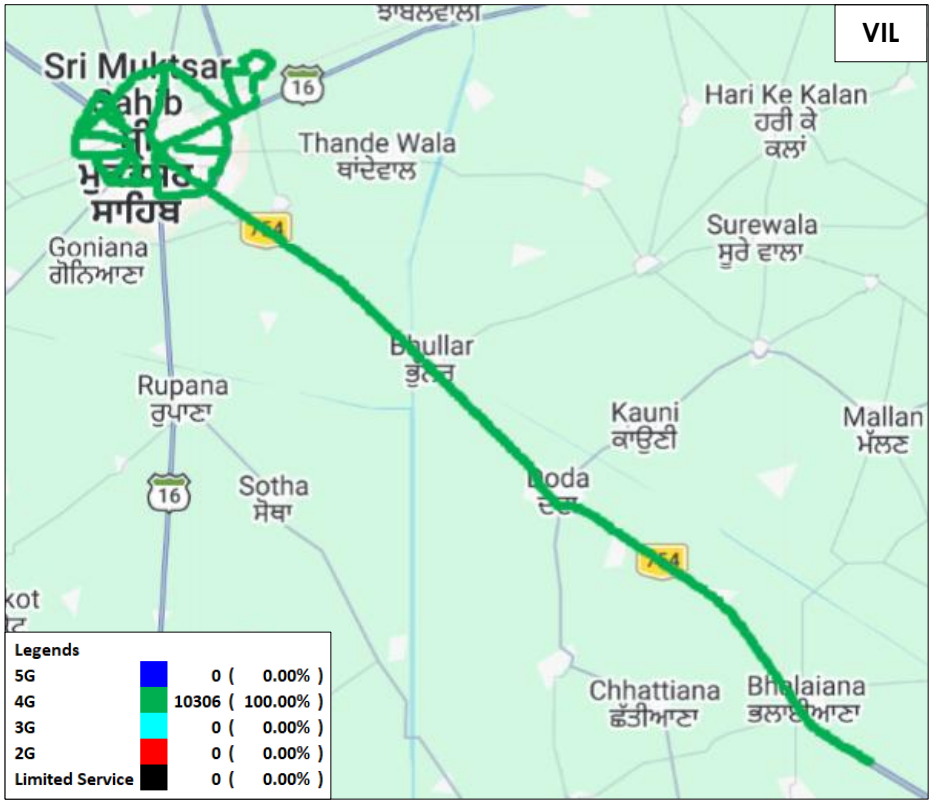


Figure-41: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-80, 81, 82 & 83 for map view)

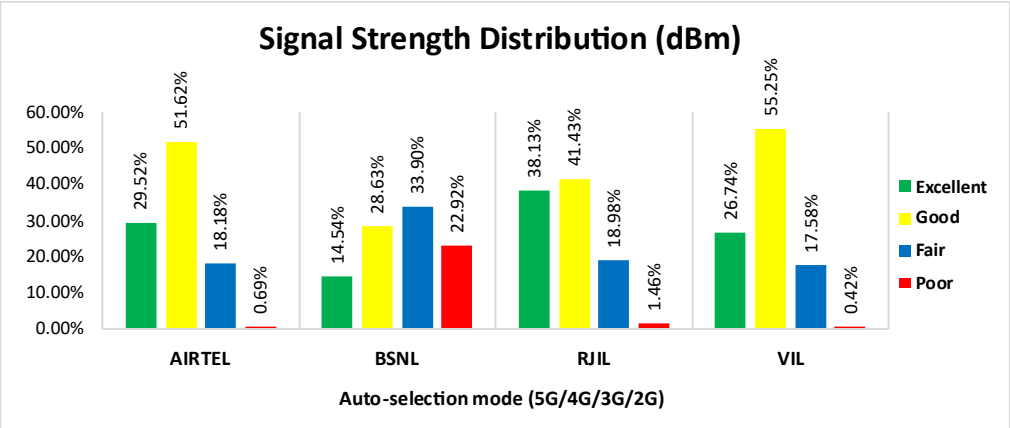


Figure-42: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 30% of samples falling in the excellent signal strength category.
- BSNL has 15% of samples falling in the excellent signal strength category.
- RJIL has 38% of samples falling in the excellent signal strength category.
- VIL has 27% of samples falling in the excellent signal strength category.

4.2.2.4 Data performance

(b) 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	172.32	18.20	222.90	26.51
	80th Percentile	255.38	27.33	369.67	45.89
	20th Percentile	64.36	8.47	53.73	6.91
Upload Throughput (Mbits/s)	Average	11.02	5.00	12.87	13.19
	80th Percentile	16.80	7.85	18.08	21.56
	20th Percentile	2.31	1.28	8.26	4.62
Latency (ms)	50th Percentile	50.53	29.51	22.05	33.96

Table-27: Summary of Data performance in network auto-selection mode.

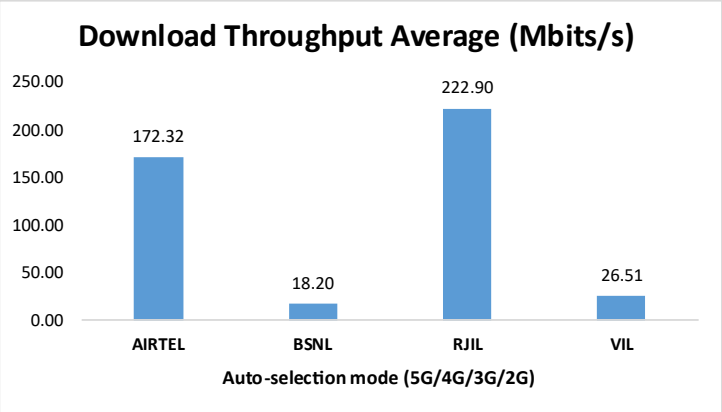


Figure- 43: Download throughput

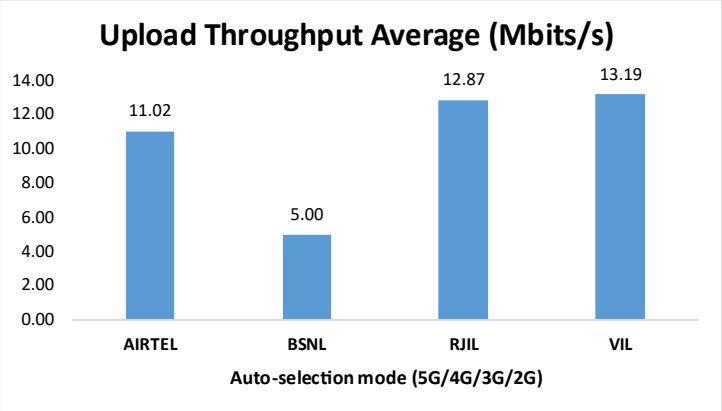


Figure- 44: Upload throughput

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	83.84%	NA	88.60%	NA
4G	15.91%	96.42%	11.40%	99.90%
3G	NA	0.04%	NA	NA
2G	0.24%	3.54%	NA	0.10%
Limited Service	0.00%	0.00%	0.00%	0.00%

Table-28: Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) data.

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

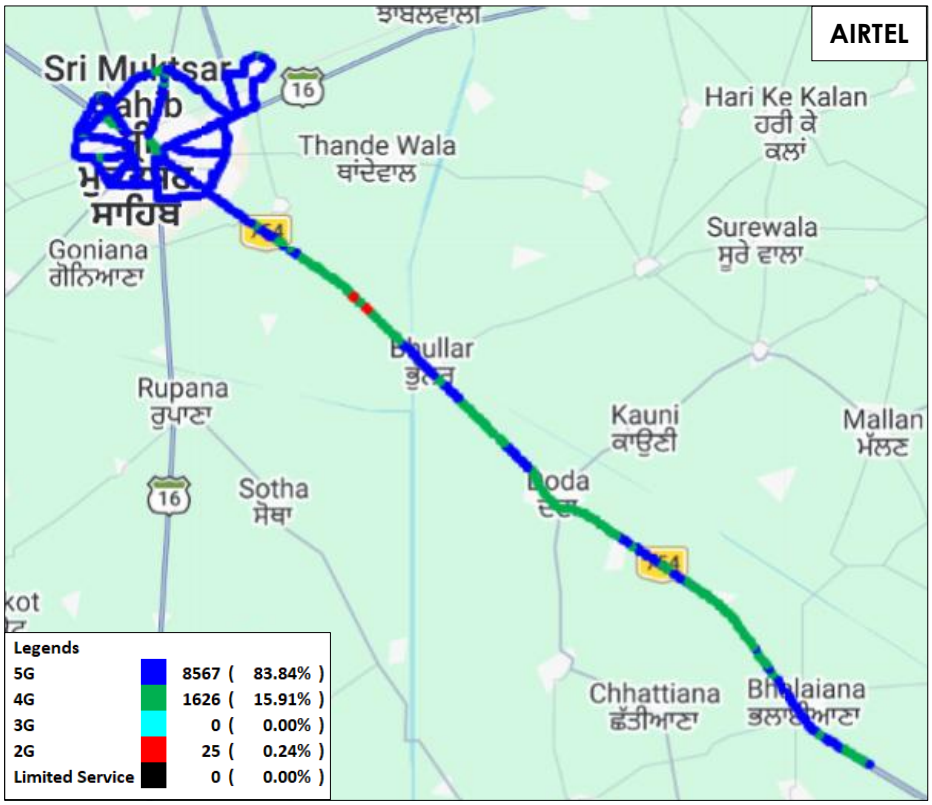


Figure-45: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data -AIRTEL.

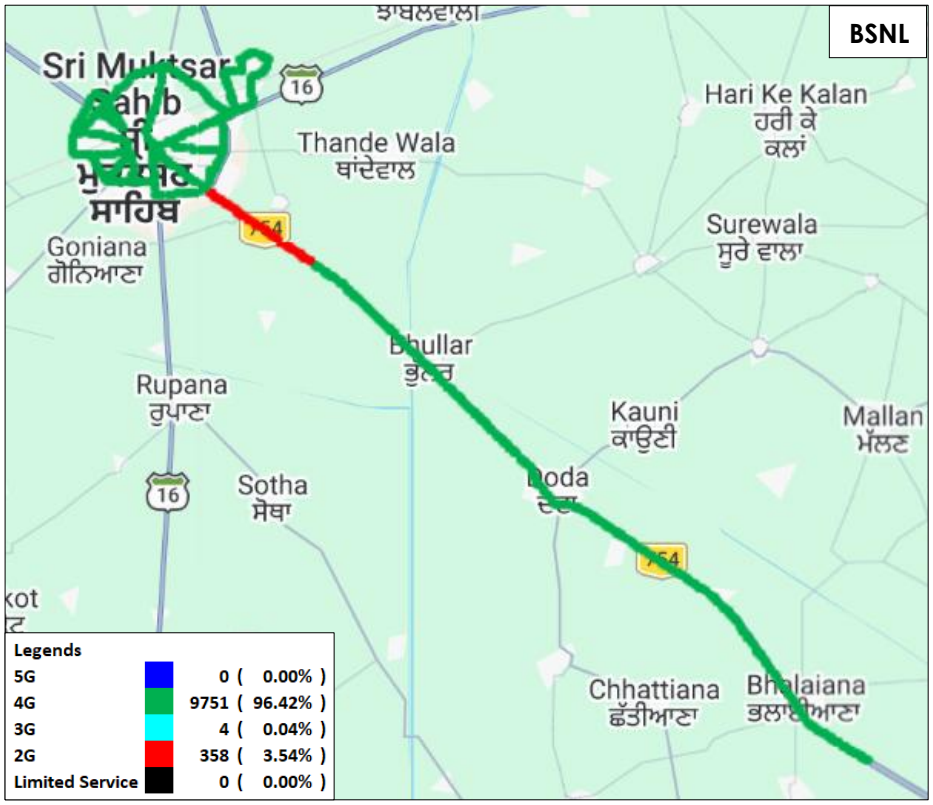


Figure-46: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - BSNL.

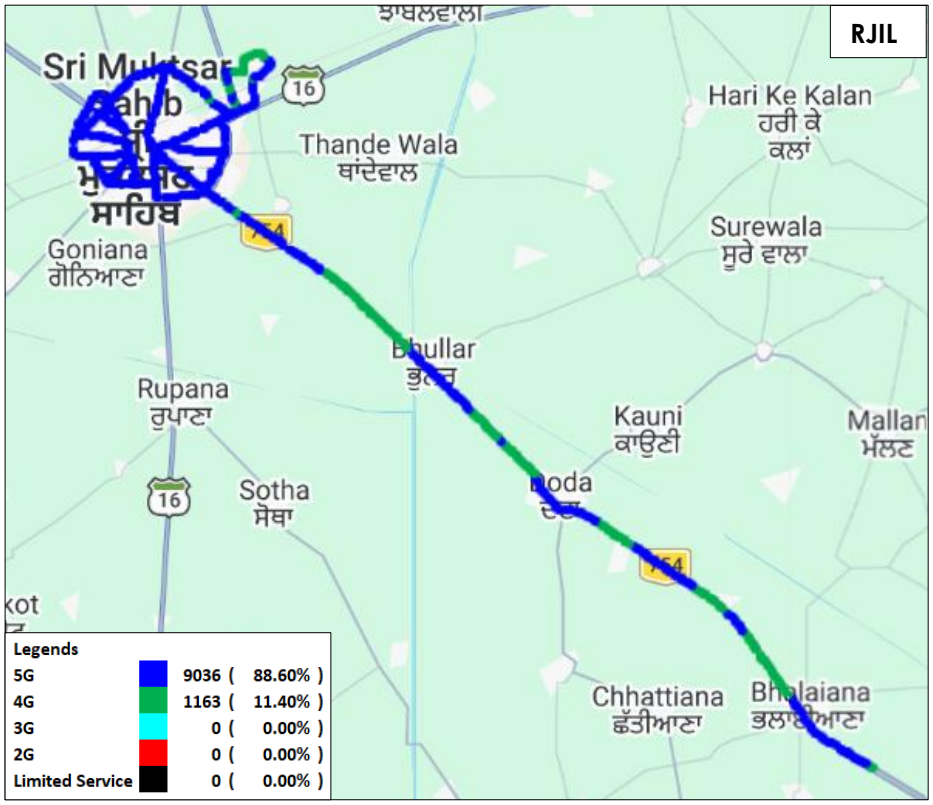


Figure-47: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - RJIL.

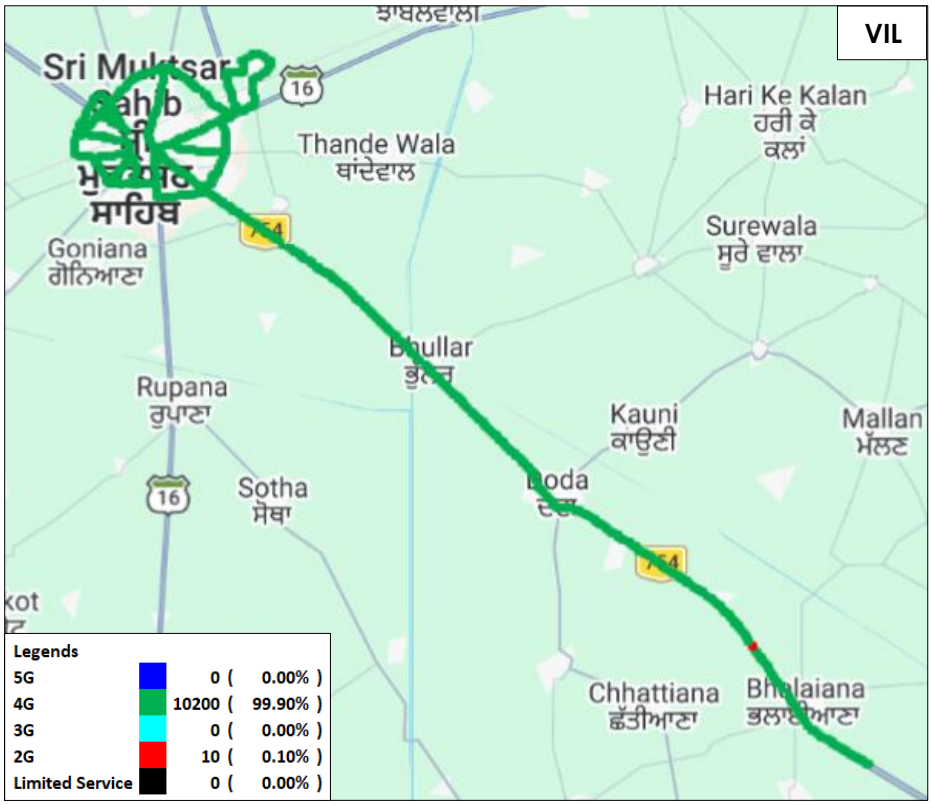


Figure-48: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data– VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-84, 85, 86 & 87 for map view)

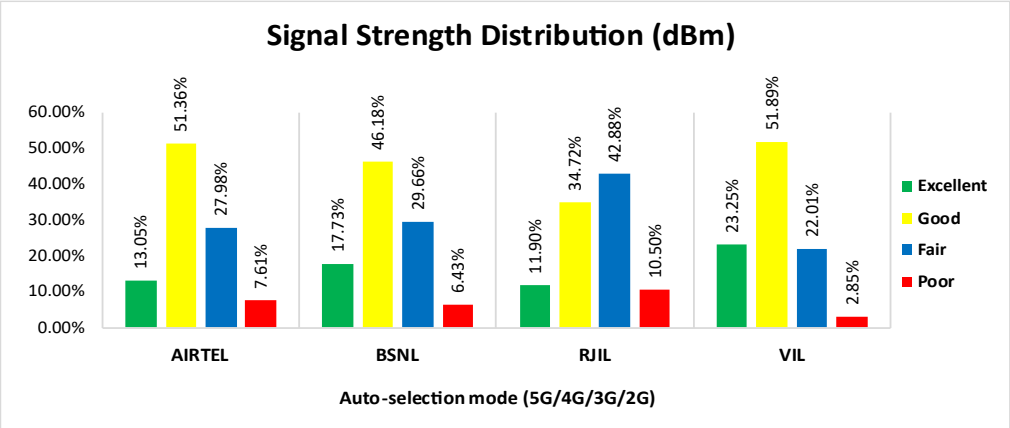


Figure-49: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 13% of samples falling in the excellent signal strength category.
- BSNL has 18% of samples falling in the excellent signal strength category.
- RJIL has 12% of samples falling in the excellent signal strength category.
- VIL has 23% of samples falling in the excellent signal strength category.

4.3 Hotspots

Hotspot testing has been conducted on 18th March 2026 and 19th March 2026. Six locations have been tested in Bathinda & Sri Muktsar Sahib cities. (Refer Table-1)

4.3.1 Locations

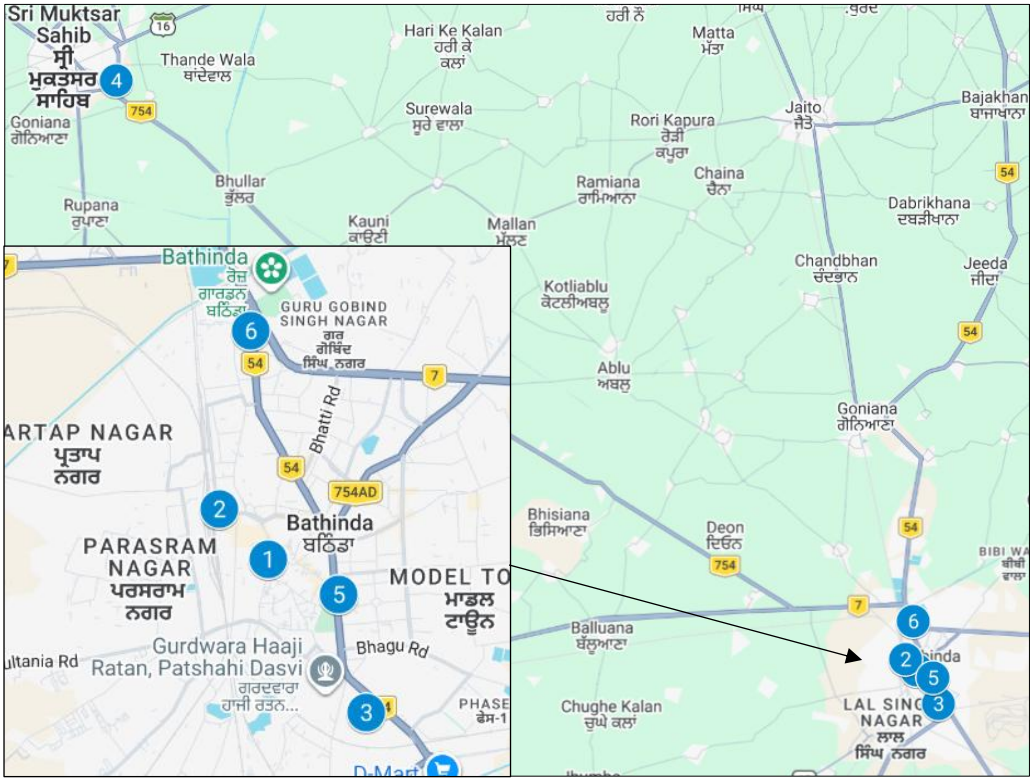


Figure- 50: Hotspot locations.

4.3.2 Hotspot covered

1. Bathinda Fort
2. Bathinda Jn Railway Station
3. Civil Hospital Bathinda
4. DC Office Sri Muktsar Sahib
5. District Court Bathinda
6. Mittal City Mall Bathinda

4.3.3 Voice performance

Overall Voice Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	60	60	60	60
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	2.46	0.51	1.42

Table-29: Overall summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Bathinda Fort				
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	2.59	0.57	1.45

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

Bathinda Jn 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)	1.35	2.50	0.48	1.37

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

Civil Hospital Bathinda				
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	2.47	0.51	1.43

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

DC Office Sri Muktsar Sahib				
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)	1.30	2.22	0.49	1.34

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

District Court Bathinda				
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)	1.30	2.54	0.48	1.42

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

Mittal City Mall Bathinda				
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)	1.33	2.45	0.51	1.52

Table-35: 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)	205.79	13.17	206.99	36.29
Download Throughput 80th Percentile (Mbit/s)	313.12	17.76	251.28	68.35
Download Throughput 20th Percentile (Mbit/s)	72.54	6.83	99.95	14.85
Download Session Setup Success Rate %	100.00	96.67	100.00	100.00
Upload Throughput Average (Mbits/s)	26.94	7.97	23.21	14.98
Upload Throughput 80th Percentile (Mbit/s)	48.14	15.98	30.33	29.01
Upload Throughput 20th Percentile (Mbit/s)	3.60	1.40	13.64	5.26
Upload Session Setup Success Rate %	96.67	100.00	100.00	100.00
Web Browsing Delay (Second)	6.95	5.10	4.34	1.96
Youtube Initial Buffer Delay (Second)	2.12	1.41	0.76	0.92
Latency (ms) - 50th Percentile	45.70	31.85	18.53	34.44
Jitter (ms)	10.31	53.56	3.26	48.82
Packet Loss Rate%	19.18	9.80	0.02	3.47
Packet Loss Rate- 90th percentile	34.98	10.28	0.00	1.38

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

Bathinda Fort				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	309.89	16.60	250.05	15.00
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	3.90	10.83	23.53	6.33
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	8.43	5.72	4.35	2.38
Youtube Initial Buffer Delay (Second)	2.47	0.79	0.57	0.88
Latency (ms) - 50th Percentile	78.23	29.29	19.56	73.48
Jitter (ms)	22.11	9.02	3.36	243.69
Packet Loss Rate%	34.90	0.60	0.10	19.40

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

Bathinda Jn Railway Station				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	183.61	12.02	56.33	17.57
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	18.06	3.66	4.81	5.78
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	5.52	3.30	4.71	2.17
Youtube Initial Buffer Delay (Second)	2.43	2.31	0.85	1.19
Latency (ms) - 50th Percentile	44.07	32.01	18.49	35.68
Jitter (ms)	4.29	10.13	3.77	10.12
Packet Loss Rate%	0.10	0.80	0.00	0.80

Table-38: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Civil Hospital Bathinda				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	55.11	11.64	216.24	25.08
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	1.97	1.87	23.02	5.74
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	11.48	7.02	3.44	1.84
Youtube Initial Buffer Delay (Second)	1.90	2.25	0.92	1.03
Latency (ms) – 50th Percentile	42.74	30.61	18.33	37.70
Jitter (ms)	14.48	64.03	3.90	35.40
Packet Loss Rate%	23.90	4.60	0.00	0.50

Table-39: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

DC Office Sri Muktsar Sahib				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	186.86	2.10	117.72	64.46
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	29.01	1.26	-	10.80
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.55	-	4.75	1.74
Youtube Initial Buffer Delay (Second)	0.77	-	1.04	0.86
Latency (ms) - 50th Percentile	43.60	39.61	19.63	32.86
Jitter (ms)	2.97	196.45	2.54	3.03
Packet Loss Rate%	0.60	51.00	0.00	0.00

Table-40: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Note-"-"Respective tests were failed.

District Court Bathinda				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	55.04	8.84	489.65	28.23
Download Session Setup Success Rate%	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	68.88	12.23	40.08	28.30
Upload Session Setup Success Rate %	80.00	100.00	100.00	100.00
Web Browsing Delay (Second)	7.58	1.98	4.49	1.72
Youtube Initial Buffer Delay (Second)	3.66	1.61	0.59	0.87
Latency (ms)- 50th Percentile	56.44	30.51	17.95	32.79
Jitter (ms)	14.48	18.81	2.13	3.22
Packet Loss Rate%	52.60	1.00	0.00	0.10

Table-41: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Mittal City Mall Bathinda				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	444.25	25.62	111.97	67.42
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	48.20	17.99	24.61	32.92
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	6.40	6.82	4.29	1.94
Youtube Initial Buffer Delay (Second)	1.63	0.76	0.58	0.66
Latency (ms) - 50th Percentile	45.80	32.86	17.60	34.56
Jitter (ms)	3.58	29.65	3.87	3.71
Packet Loss Rate%	3.00	0.80	0.00	0.00

Table-42: 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)**	203.84	-	224.31	-
	Upload Throughput Average (Mbits/s)	35.27	-	24.61	-
4G	**Download Throughput Average (Mbits/s)**	28.88	18.55	38.42	28.44
	Upload Throughput Average (Mbits/s)	13.55	13.72	11.54	16.74

Table-43: Overall Summary of 5G only & 4G only data download & upload speed.

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

Bathinda Fort					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	301.63	-	259.71	-
	Upload Throughput Average (Mbits/s)	13.31	-	20.63	-
4G	**Download Throughput Average (Mbits/s)**	47.25	18.50	33.42	38.46
	Upload Throughput Average (Mbits/s)	15.26	17.21	1.22	26.94

Table-44: Overall Summary of 5G only & 4G only data download & upload speed.

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

Bathinda Jn Railway Station					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	153.83	-	75.45	-
	Upload Throughput Average (Mbits/s)	22.07	-	10.31	-
4G	**Download Throughput Average (Mbits/s)**	30.97	14.16	39.04	17.94
	Upload Throughput Average (Mbits/s)	24.14	15.15	14.03	9.96

Table-45: Overall Summary of 5G only & 4G only data download & upload speed.

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

Civil Hospital Bathinda					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	37.62	-	195.81	-
	Upload Throughput Average (Mbits/s)	1.19	-	16.63	-
4G	Download Throughput Average (Mbits/s)	20.03	18.05	34.27	32.17
	Upload Throughput Average (Mbits/s)	1.84	10.50	4.81	5.32

Table-46: Overall Summary of 5G only & 4G only data download & upload speed.

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

DC Office Sri Muktsar Sahib					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	232.21	-	121.55	-
	Upload Throughput Average (Mbits/s)	38.69	-	-	-
4G	Download Throughput Average (Mbits/s)	8.57	12.72	11.39	37.08
	Upload Throughput Average (Mbits/s)	10.39	1.76	-	18.40

Table-47: Overall Summary of 5G only & 4G only data download & upload speed.

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

District Court Bathinda					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	57.63	-	540.07	-
	Upload Throughput Average (Mbits/s)	63.22	-	46.75	-
4G	Download Throughput Average (Mbits/s)	13.30	20.16	74.51	18.04
	Upload Throughput Average (Mbits/s)	12.49	17.72	24.28	16.97

Table-48: Overall Summary of 5G only & 4G only data download & upload speed.

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

Mittal City Mall Bathinda					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	440.09	-	153.25	-
	Upload Throughput Average (Mbits/s)	73.14	-	28.76	-
4G	Download Throughput Average (Mbits/s)	53.19	27.67	37.88	26.94
	Upload Throughput Average (Mbits/s)	17.17	19.97	13.36	22.84

Table-49: Overall Summary of 5G only & 4G only data download & upload speed.

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

4.4 Railway

Drive test has been conducted on 16th March 2026 covering one railway route. (Refer Table-1)

4.4.1 Drive test route

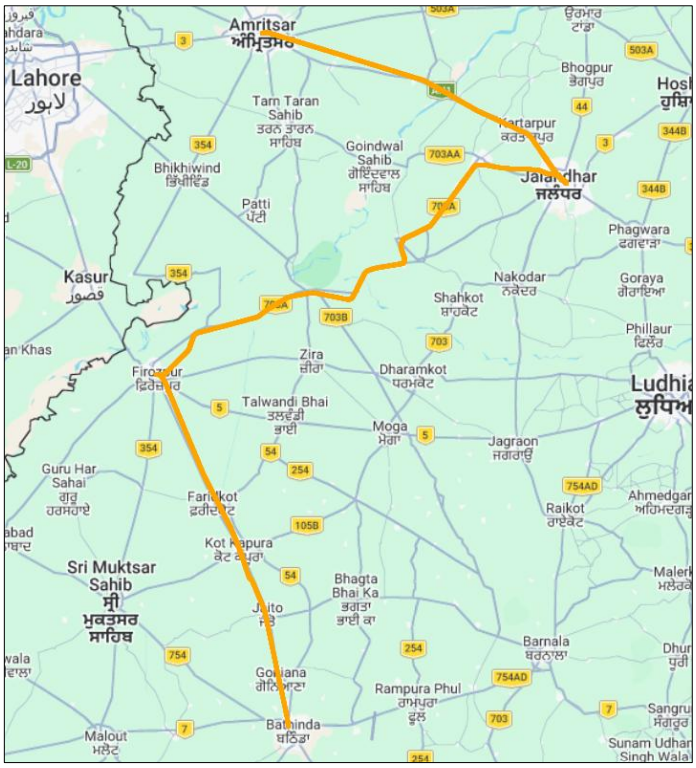


Figure-51: Drive test route railway.

4.4.2 Routes Covered

Amritsar to Bathinda Via Beas Jn, Jalandhar City Jn, Kapurthala, Kapurthala Rail Coach Factory, Sultanpur Lodhi, Lohian Khas Jn, Makhu, Firozpur Cantt Jn, Faridkot, Kot Kapura Jn and Gangsar Jaito.

4.4.3 Voice performance

(a) 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	113	109	108	167
Call Setup Success Rate %	95.58	100.00	100.00	54.49
Drop Call Rate %	1.85	7.34	0.00	0.00
Call Setup Time Average (Second)	1.79	2.76	0.69	5.10
Handover Success Rate %	99.94	93.56	99.94	99.87

Table-50: Summary of voice call performance in network auto-selection mode.

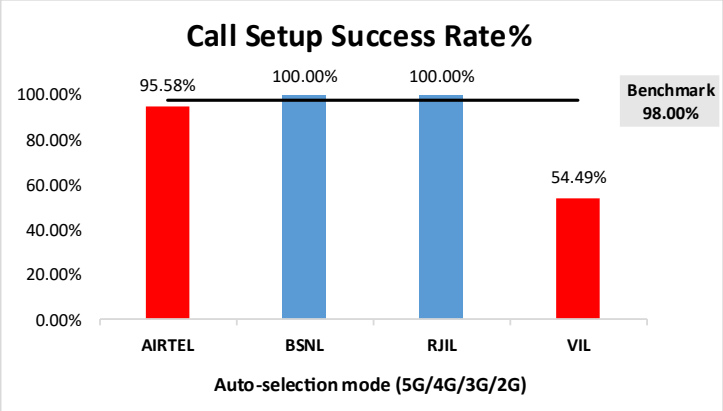


Figure-52: Performance for call setup success rate.

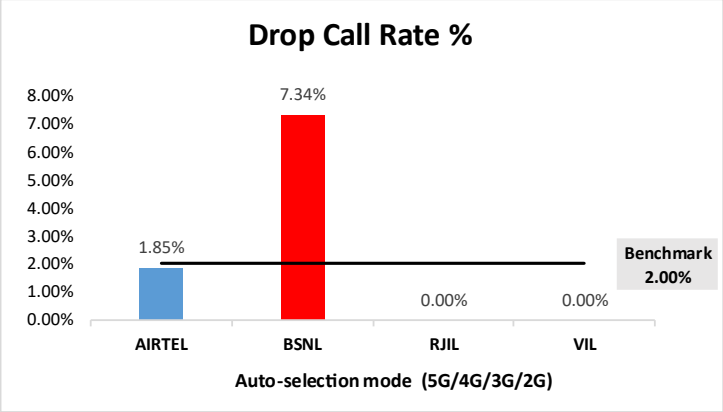


Figure-53: Performance for drop call rate.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	1.62%	NA	72.34%	NA
4G	98.38%	6.20%	27.66%	97.21%
3G	NA	3.14%	NA	NA
2G	0.00%	90.60%	NA	2.79%
Limited Service	0.00%	0.06%	0.00%	0.00%

Table-51: Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) voice.

Note-

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

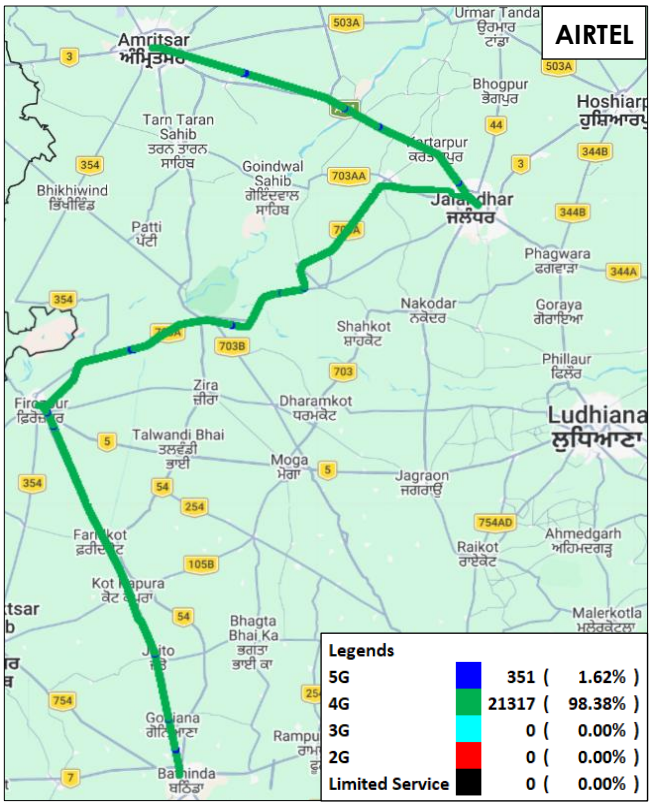


Figure-54: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice – AIRTEL.

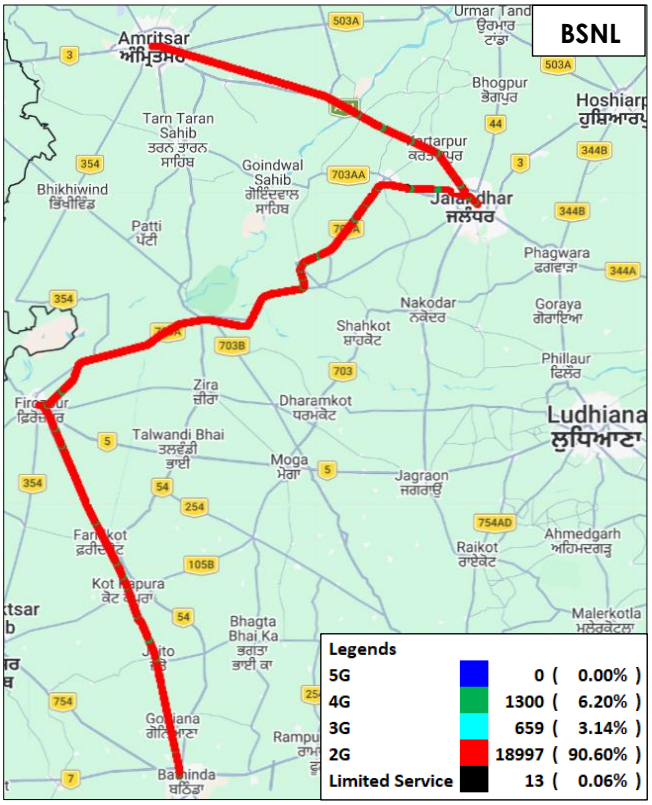


Figure-55: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

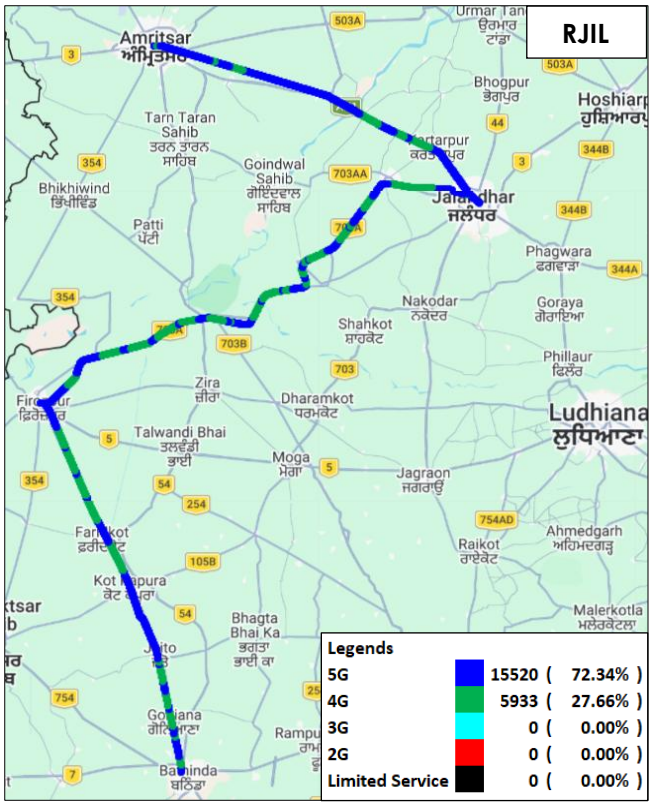


Figure-56: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

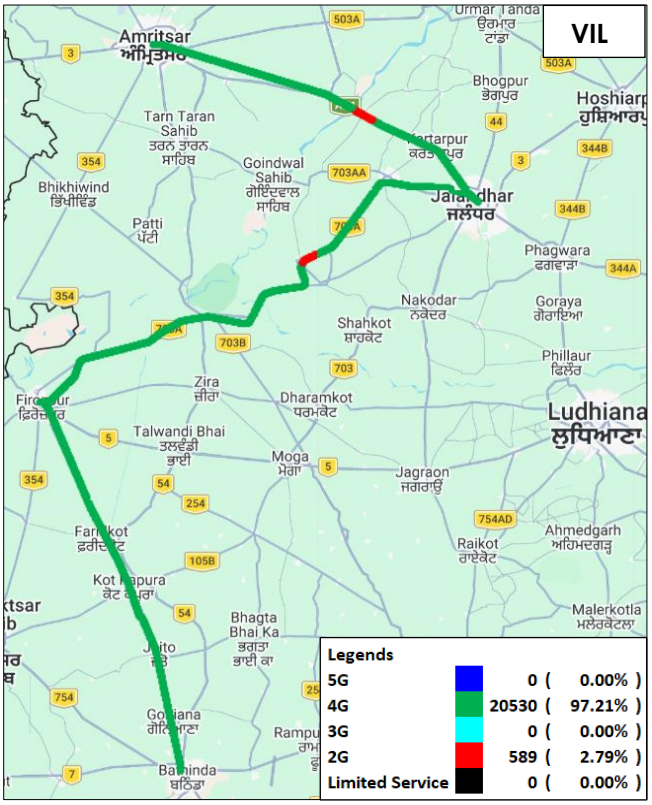


Figure-57: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-88, 89, 90 & 91 for map view)

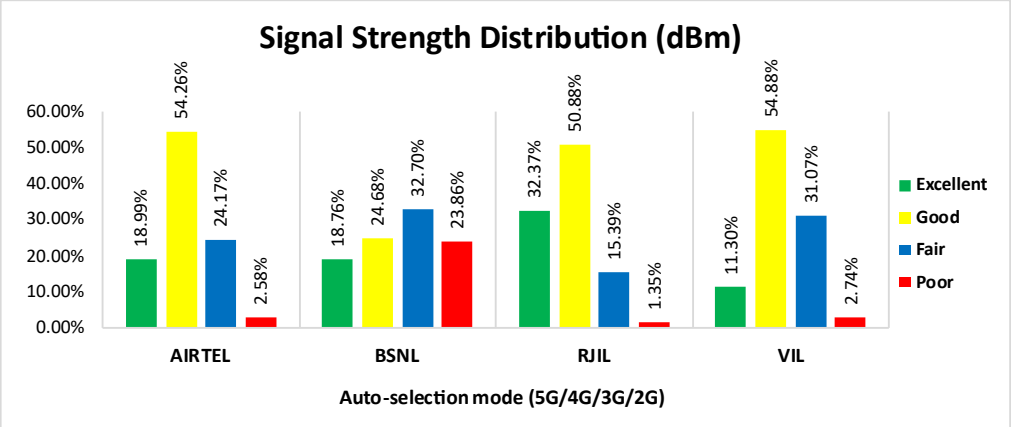


Figure-58: Signal strength distribution auto-selection mode 5G/4G/3G/2G voice.

Observations:

- Airtel has 19% of samples falling in the excellent signal strength category.
- BSNL has 19% of samples falling in the excellent signal strength category.
- RJIL has 32% of samples falling in the excellent signal strength category.
- VIL has 11% of samples falling in the 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	95.82	18.36	111.72	11.11
	80th Percentile	155.73	27.53	199.87	14.07
	20th Percentile	11.77	7.65	5.10	2.94
Upload Throughput (Mbits/s)	Average	19.89	7.82	16.93	13.60
	80th Percentile	32.83	12.04	23.03	20.98
	20th Percentile	2.34	2.56	11.25	6.21
Latency (ms)	50th Percentile	45.80	26.83	22.82	38.06

Table-52: Summary of Data performance in network auto-selection mode.

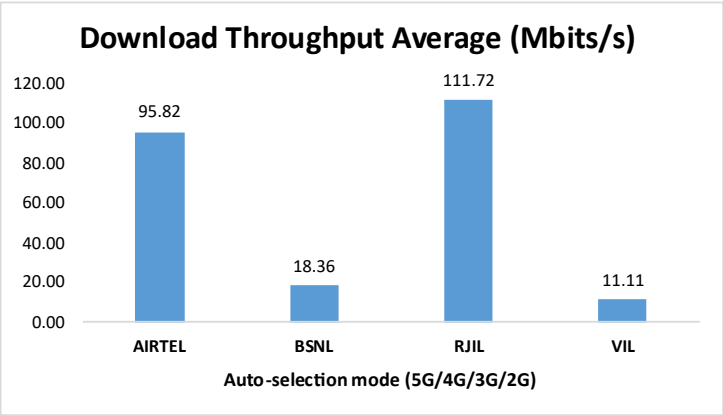


Figure 59: Download throughput.

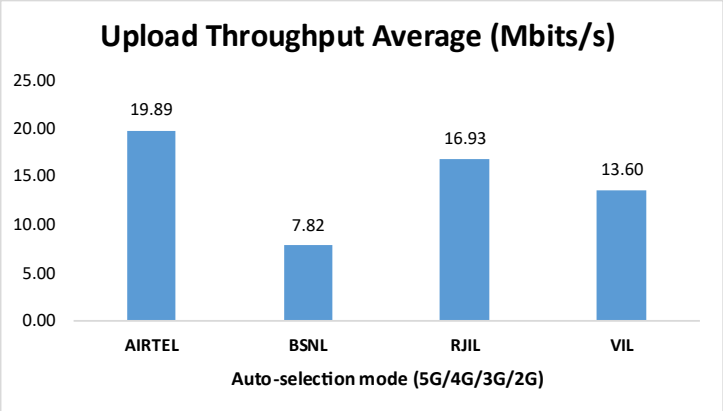


Figure-60: Upload throughput.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	64.30%	NA	98.46%	NA
4G	35.34%	100.00%	1.54%	99.92%
3G	NA	0.00%	NA	NA
2G	0.19%	0.00%	NA	0.08%
Limited Service	0.18%	0.00%	0.00%	0.00%

Table-53: Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) data.

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

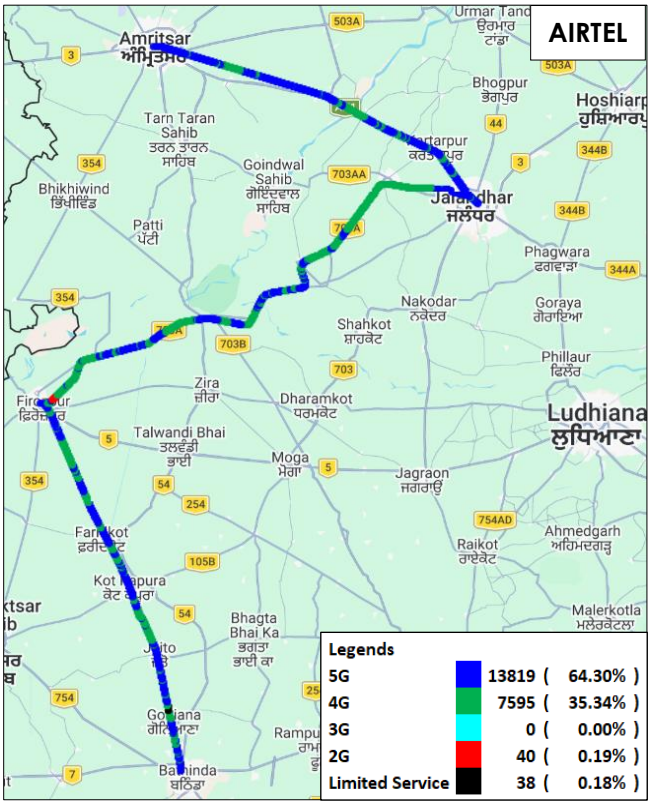


Figure-61: Serving technology plot in auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

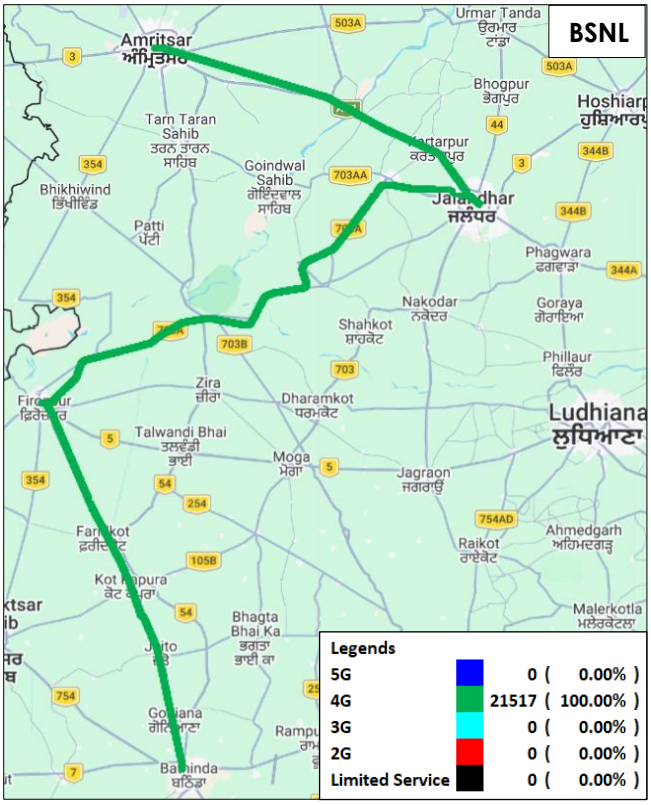


Figure-62: Serving technology plot in auto-selection mode (5G/4G/3G/2G) data - BSNL.

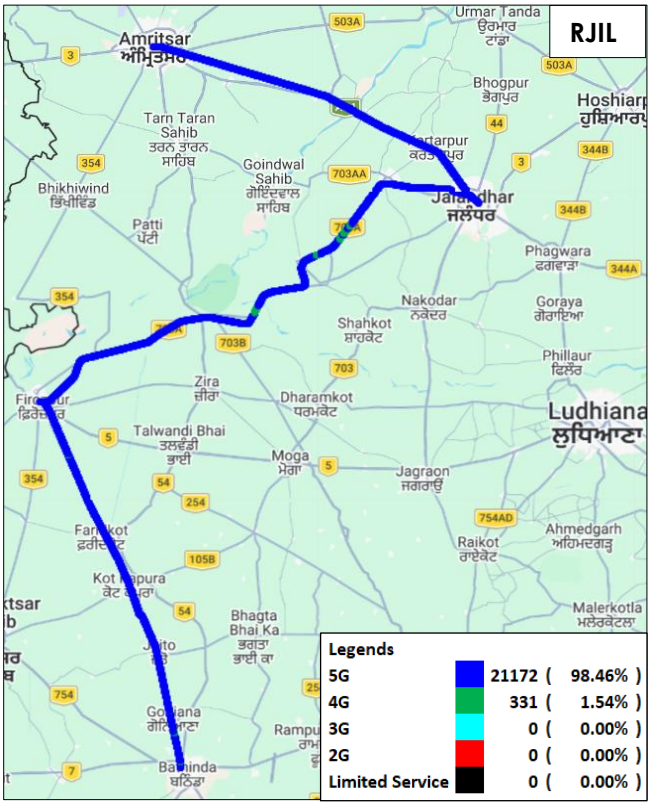


Figure-63: Serving technology plot in auto-selection mode (5G/4G/3G/2G) data - RJIL.

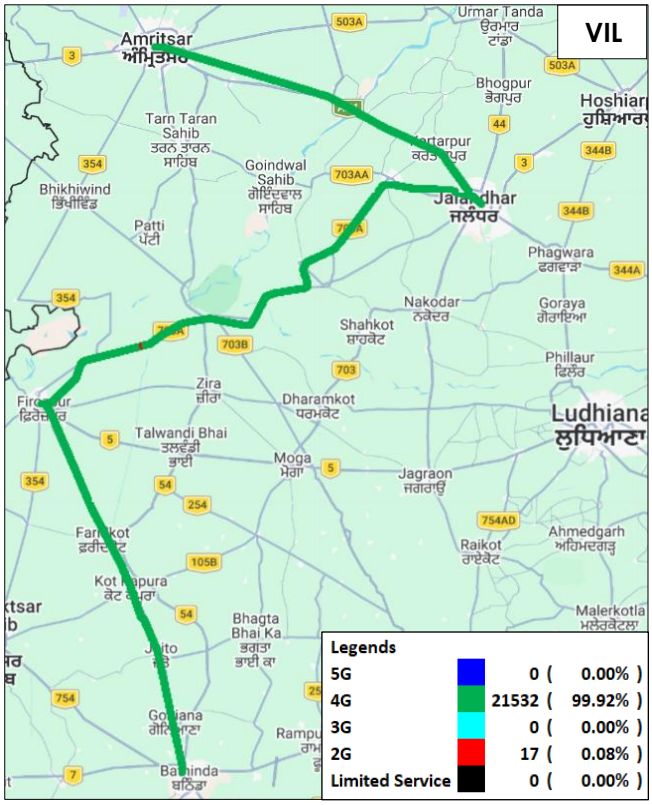


Figure-64: Serving technology plot in auto-selection mode (5G/4G/3G/2G) data – VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-92, 93, 94 & 95 for map view)

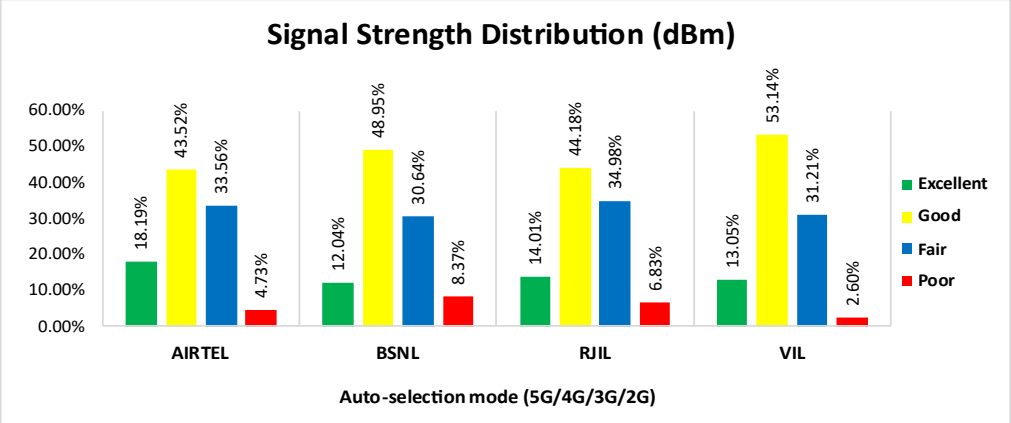


Figure-65: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 18% of samples falling in the excellent signal strength category.
- BSNL has 12% of samples falling in the excellent signal strength category.
- RJIL has 14% of samples falling in the excellent signal strength category.
- VIL has 13% of samples falling in the excellent signal strength category.

5. Voice & Data Key findings

5.1 Overall Voice

1. Call Setup Success Rate:

a) Airtel, BSNL and VIL have 95.22%, 98.61% and 95.79% call setup success rate respectively in 3G/2G network mode. (refer table-3)

b) Airtel, BSNL, RJIL and VIL have 99.07%, 98.50%, 100.00% and 87.14% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

c) Airtel, BSNL and RJIL have 100.00% call setup success rate while calling on peer service provider's network for inter-operator calls. (refer table-9)

d) VIL had a 100.00% call setup success rate while calling Airtel and BSNL whereas call blocking was observed when calling RJIL. (refer to Table-9)

2. Call Setup Time:

a) Airtel, BSNL and VIL call setup time is 4.83, 2.65 and 4.34 seconds respectively in 3G/2G network mode. (refer table-3)

b) Airtel, BSNL, RJIL & VIL call setup time is 1.44, 2.60, 0.66 & 2.08 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, Airtel and RJIL have 2.82%, 0.85%, 0.28% silence call rate respectively. Further VIL has higher RTP packet loss rate in downlink (0.87%) compared to RJIL (0.73%), Airtel (0.54%). In uplink the RTP packet loss rate is higher for RJIL (0.80%) compared to VIL (0.67%), Airtel (0.64%). (refer table-6)

4. Drop Call Rate:

a) Airtel, BSNL and VIL drop call rate is 0.00%, 1.69% and 1.47% respectively in 3G/2G network mode. (refer table-3)

b) Airtel, BSNL, RJIL and VIL drop call rate is 0.37%, 2.66%, 0.37% and 0.19% 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, RJIL and VIL average download speeds are 140.51 Mbps, 16.30 Mbps, 175.50 Mbps and 25.66 Mbps respectively. (refer table-11)

b) Airtel, BSNL, RJIL and VIL average upload speeds are 18.33 Mbps, 6.43 Mbps, 16.57 Mbps and 14.72 Mbps respectively. (refer table-11)

2. Data download and upload performance (static i.e. while stationary):

a) Airtel, BSNL, RJIL and VIL average download speeds are 205.79 Mbps, 13.17 Mbps, 206.99 Mbps and 36.29 Mbps respectively. (refer table-36)

b) Airtel, BSNL, RJIL and VIL average upload speeds are 26.94 Mbps, 7.97 Mbps, 23.21 Mbps and 14.98 Mbps respectively. (refer table-36)

3. Data session setup success rate (static i.e. while stationary):

a) Airtel, BSNL, RJIL and VIL have 100.00%, 96.67%, 100.00% and 100.00% download session setup success rate respectively. (refer table-36)

b) Airtel, BSNL, RJIL and VIL have 96.67%, 100.00%, 100.00% and 100.00% upload session setup success rate respectively. (refer table-36)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 95.22% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode for LSA. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-3)
- 99.07% call setup success rate and 0.37% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-5)
- 94.05% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode for Bathinda city drive. Performance is not meeting the benchmark of 98.00% for call setup success rate. (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 Bathinda city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-15)
- 98.85% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode for Sri Muktsar Sahib city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-21)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Sri Muktsar Sahib city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-23)
- 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. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-29)
- 95.58% call setup success rate and 1.85% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for railway drive. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-50)

Data

- Airtel has 140.51 Mbps average download speed & 18.33 Mbps average upload speed for LSA. (refer table-11)
- Airtel has 151.88 Mbps average download speed & 18.53 Mbps average upload speed across measured routes for Bathinda city drive. (refer table-19)
- Airtel has 172.32 Mbps average download speed & 11.02 Mbps average upload speed across measured routes for Sri Muktsar Sahib city drive. (refer table-27)
- Civil Hospital Bathinda and District Court Bathinda have less download speed (less than 100 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-39 & 41)
- Bathinda Fort, Bathinda Jn Railway Station and Civil Hospital Bathinda have less upload speed (less than 20 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-37, 38 & 39)
- Airtel has 95.82 Mbps average download speed & 19.89 Mbps average upload speed across measured routes for railway drive. (refer table-52)

2. BSNL:

Voice

- 98.61% call setup success rate and 1.69% drop call rate have been observed in 3G/2G network mode for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-3)

- 98.50% call setup success rate and 2.66% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is not meeting the benchmark of 2.00% for drop call rate. (refer table-5)

- 99.63% call setup success rate and 1.50% drop call rate have been observed in 3G/2G network mode for Bathinda city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)

- 98.53% call setup success rate and 1.49% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Bathinda city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-15)

- 95.65% call setup success rate and 2.27% drop call rate have been observed in 3G/2G network mode for Sri Muktsar Sahib city drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-21)

- 95.70% call setup success rate and 2.25% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Sri Muktsar Sahib city drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-23)

- 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. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-29)

- 100.00% call setup success rate and 7.34% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for railway drive. Performance is not meeting the benchmark of 2.00% for drop call rate. (refer table-50)

Data

- BSNL has 16.30 Mbps average download speed & 6.43 Mbps average upload speed for LSA. (refer table-11)

- BSNL has 14.55 Mbps average download speed & 5.70 Mbps average upload speed across measured routes for Bathinda city drive. (refer table-19)

- BSNL has 18.20 Mbps average download speed & 5.00 Mbps average upload speed across measured routes for Sri Muktsar Sahib city drive. (refer table-27)

- DC Office Sri Muktsar Sahib and District Court Bathinda have less download speed (less than 10 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-40 & 41)

- Civil Hospital Bathinda and DC Office Sri Muktsar Sahib have less upload speed (less than 2 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-39 & 40)

- BSNL has 18.36 Mbps average download speed & 7.82 Mbps average upload speed across measured routes for railway drive. (refer table-52)

3. RJIL:

Voice

- 100.00% call setup success rate and 0.37% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 100.00% call setup success rate and 0.36% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Bathinda city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-15)

- 100.00% call setup success rate and 1.10% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Sri Muktsar Sahib city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-23)

- 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. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-29)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for railway drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-50)

Data

- RJIL has 175.50 Mbps average download speed & 16.57 Mbps average upload speed for LSA. (refer table-11)

- RJIL has 198.27 Mbps average download speed & 14.19 Mbps average upload speed across measured routes for Bathinda city drive. (refer table-19)

- RJIL has 222.90 Mbps average download speed & 12.87 Mbps average upload speed across measured routes for Sri Muktsar Sahib city drive. (refer table-27)

- Bathinda Jn Railway Station has less download speed (less than 100 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-38)

- Bathinda Jn Railway Station and DC Office Sri Muktsar Sahib have less upload speed (less than 20 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-38 & 40)

- RJIL has 111.72 Mbps average download speed & 16.93 Mbps average upload speed across measured routes for railway drive. (refer table-52)

4. VIL:

Voice

- 95.79% call setup success rate and 1.47% drop call rate have been observed in 3G/2G network mode for LSA. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-3)

- 87.14% call setup success rate and 0.19% 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% for call setup success rate. (refer table-5)

- 95.15% call setup success rate and 1.57% drop call rate have been observed in 3G/2G network mode for Bathinda city drive. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-13)

- 100.00% call setup success rate and 0.37% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Bathinda city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-15)

- 97.73% call setup success rate and 1.16% drop call rate have been observed in 3G/2G network mode for Sri Muktsar Sahib city drive. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-21)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Sri Muktsar Sahib city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-23)

- 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. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-29)

- 54.49% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for railway drive. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-50)

Data

- VIL has 25.66 Mbps average download speed & 14.72 Mbps average upload speed for LSA. (refer table-11)

- VIL has 34.07 Mbps average download speed & 15.97 Mbps average upload speed across measured routes for Bathinda city drive. (refer table-19)

- VIL has 26.51 Mbps average download speed & 13.19 Mbps average upload speed across measured routes for Sri Muktsar Sahib city drive. (refer table-27)

- VIL has 11.11 Mbps average download speed & 13.60 Mbps average upload speed across measured routes for railway drive. (refer table-52)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

(i) Bathinda

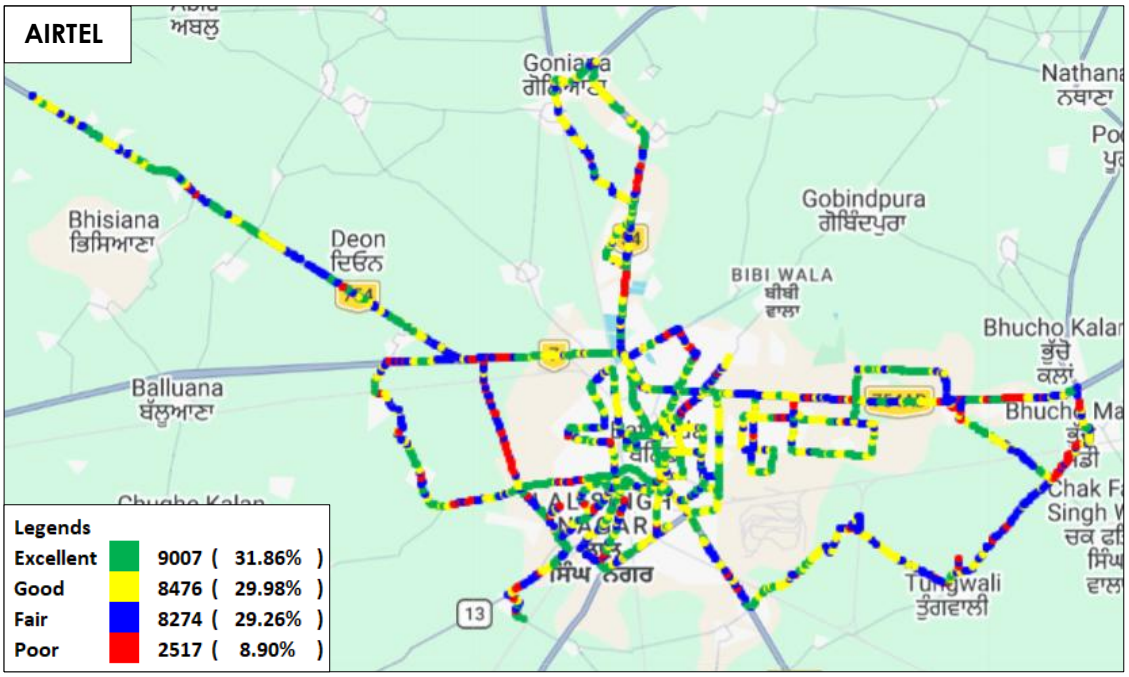


Figure-66: Signal strength 3G/2G network mode voice - AIRTEL.

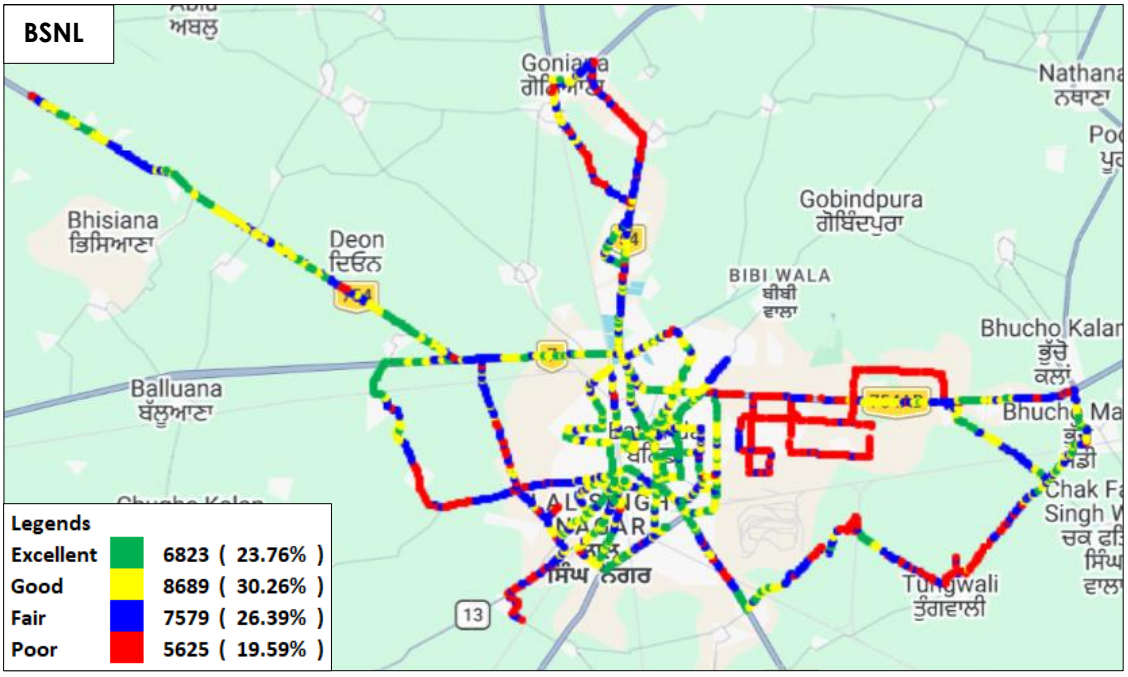


Figure-67: Signal strength 3G/2G network mode voice - BSNL.

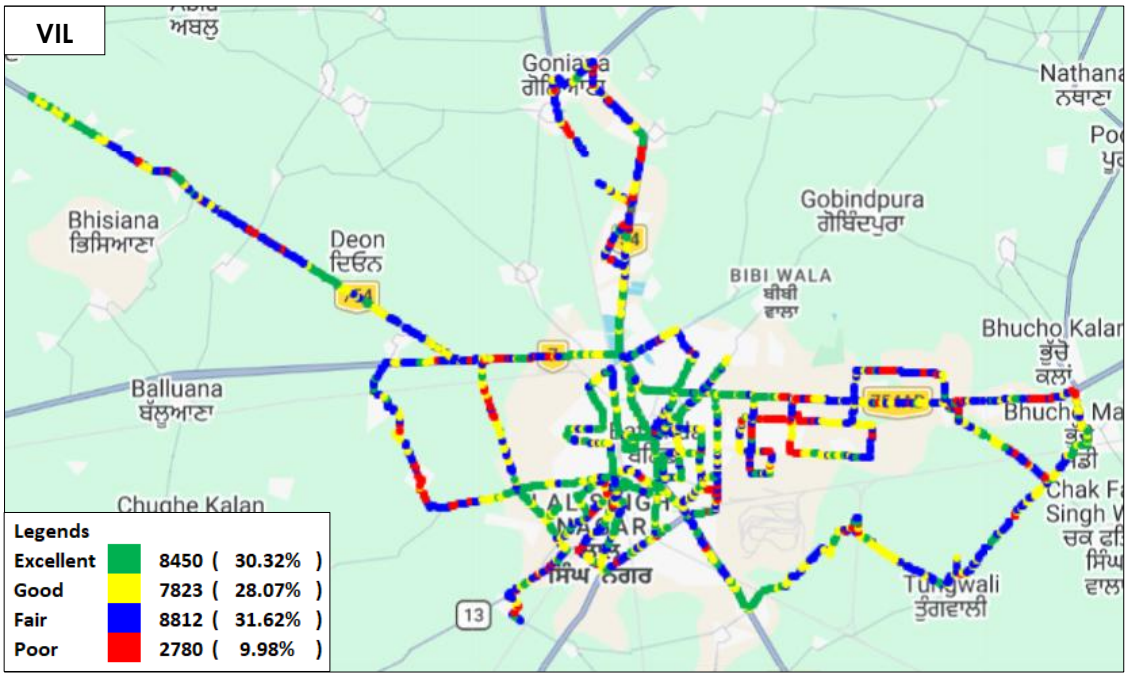


Figure-68: Signal strength 3G/2G network mode voice - VIL.

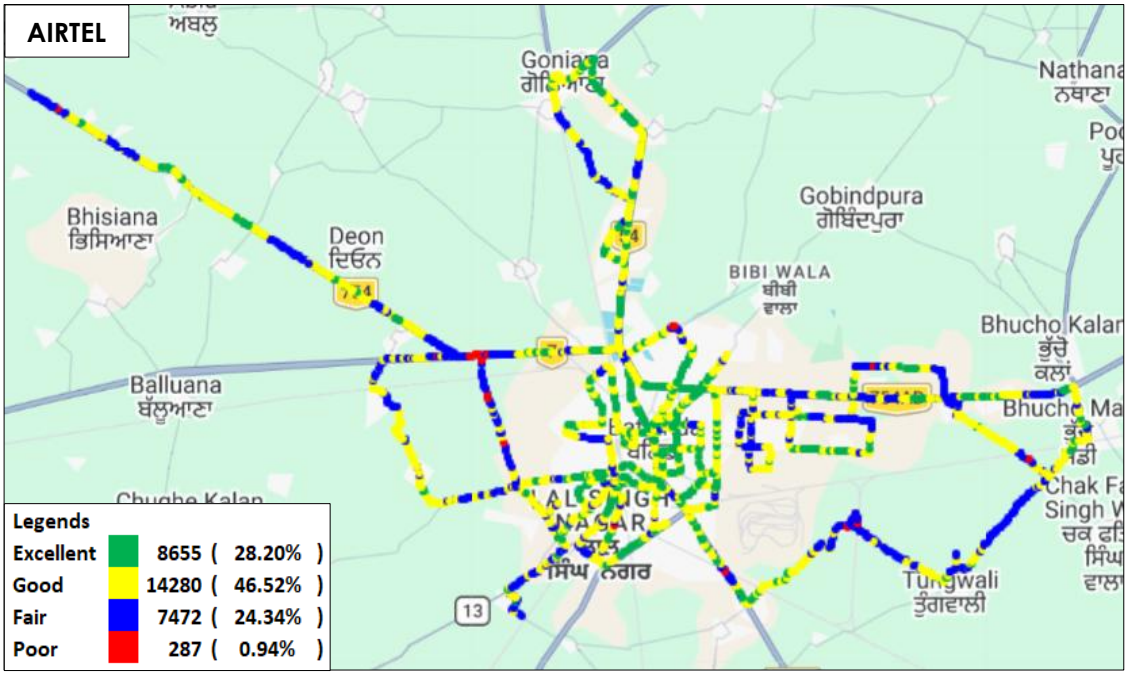


Figure-69: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

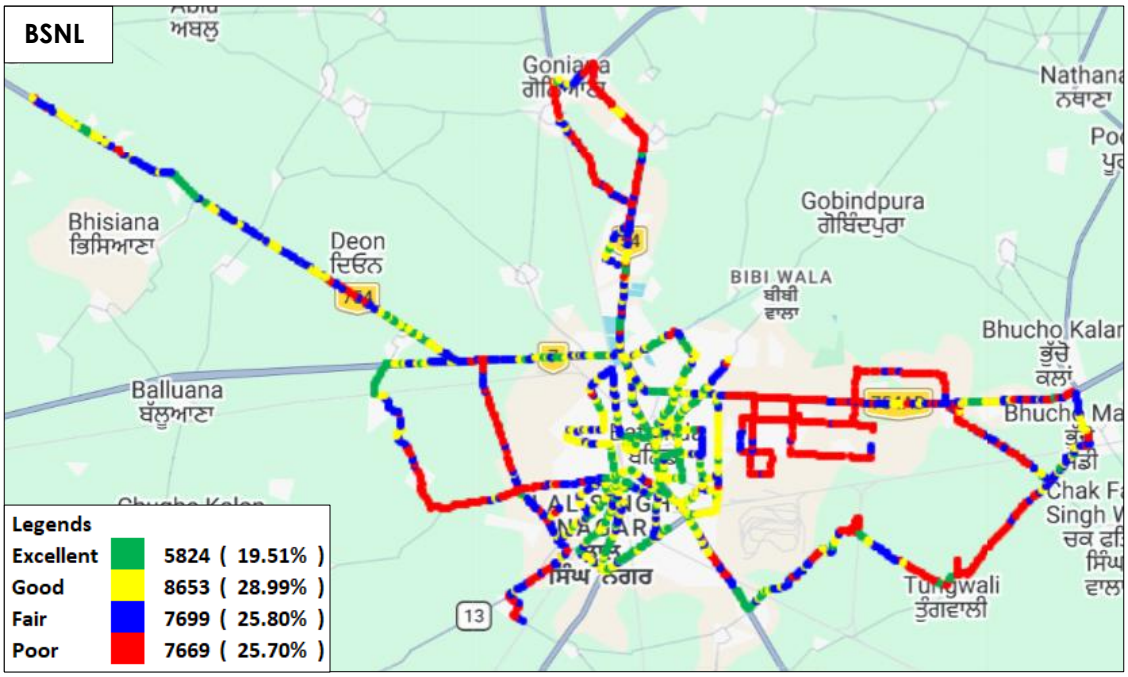


Figure-70: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

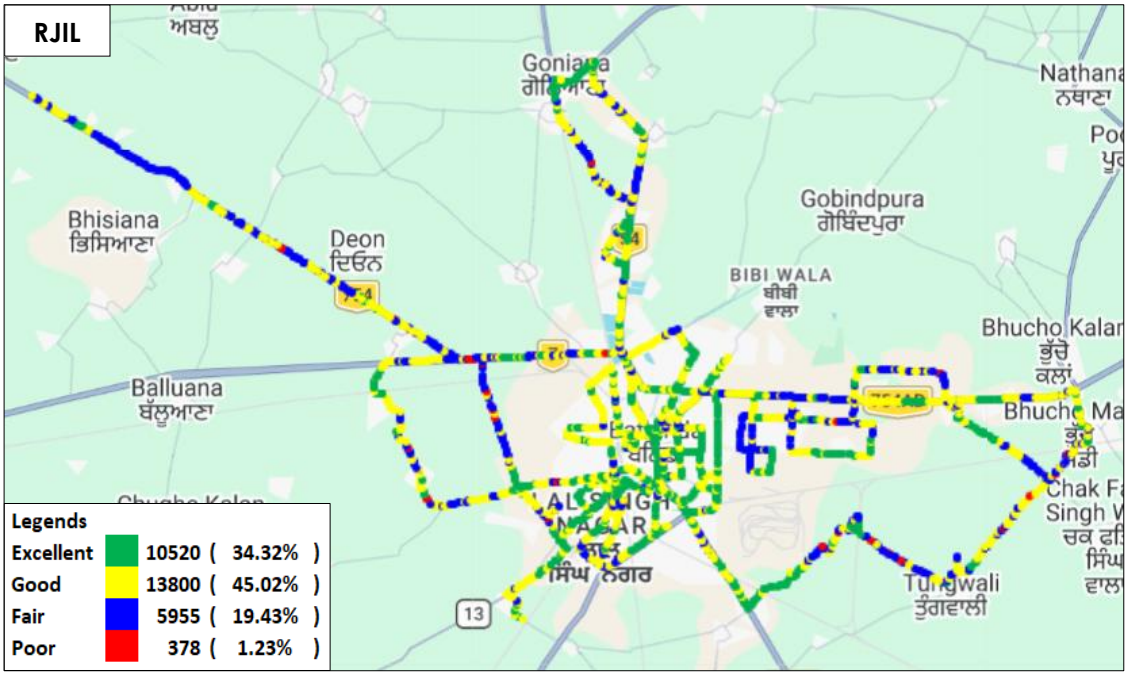


Figure-71: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

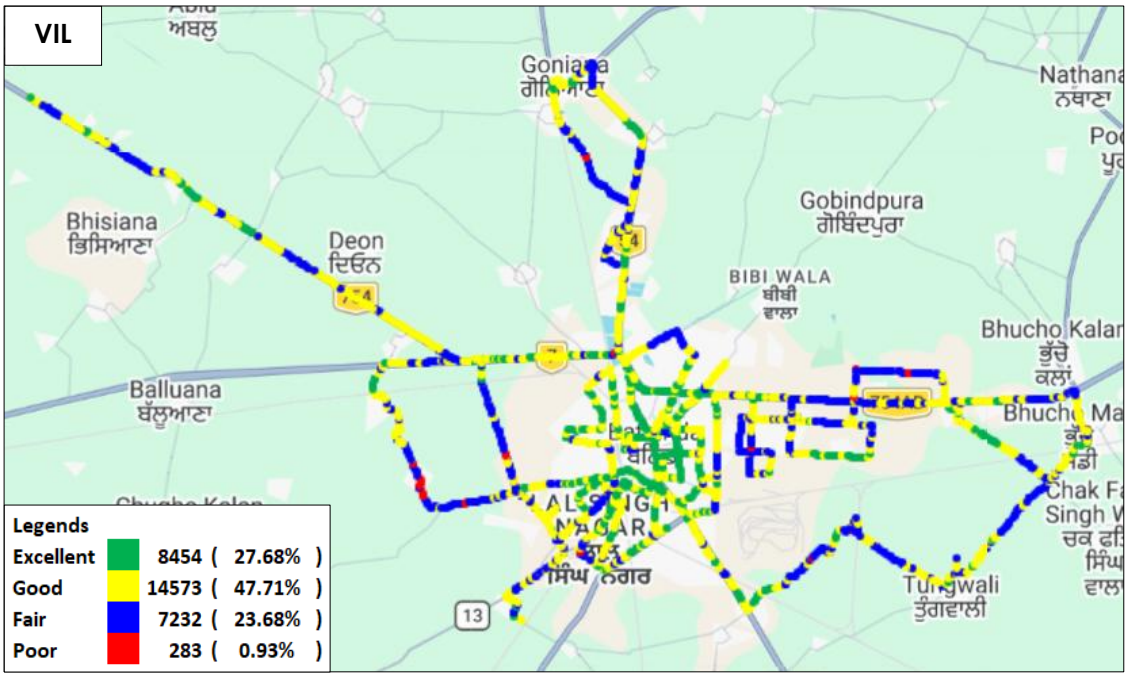


Figure-72: Signal strength auto-selection mode (5G/4G/3G/2G) voice - VIL.

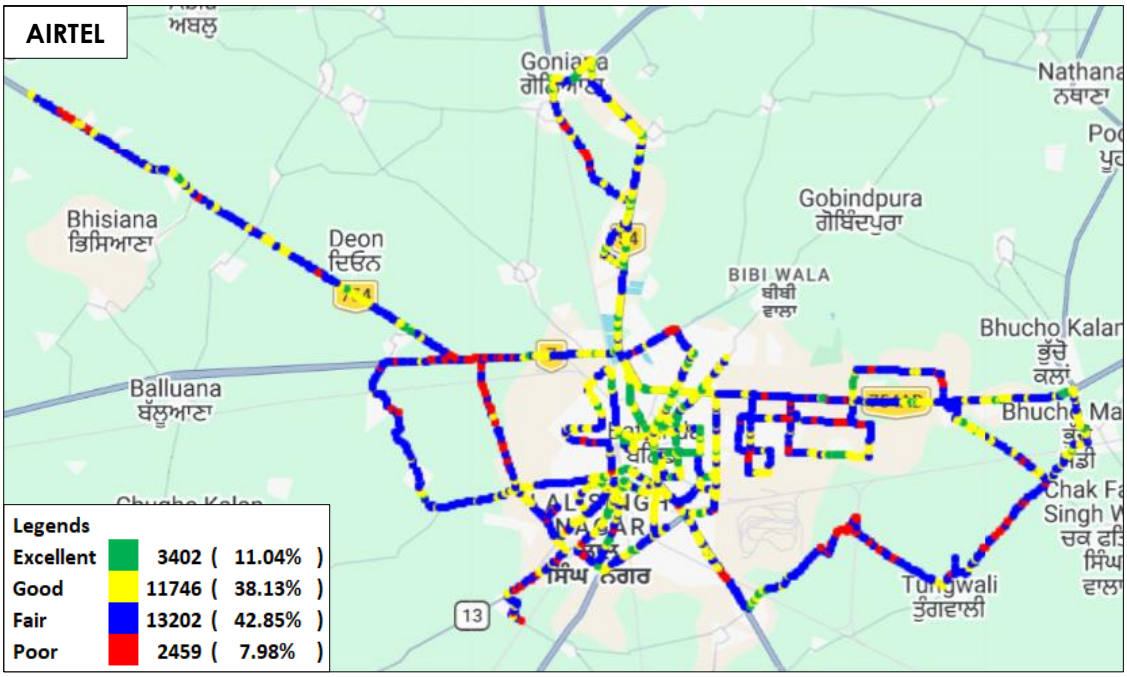


Figure-73: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

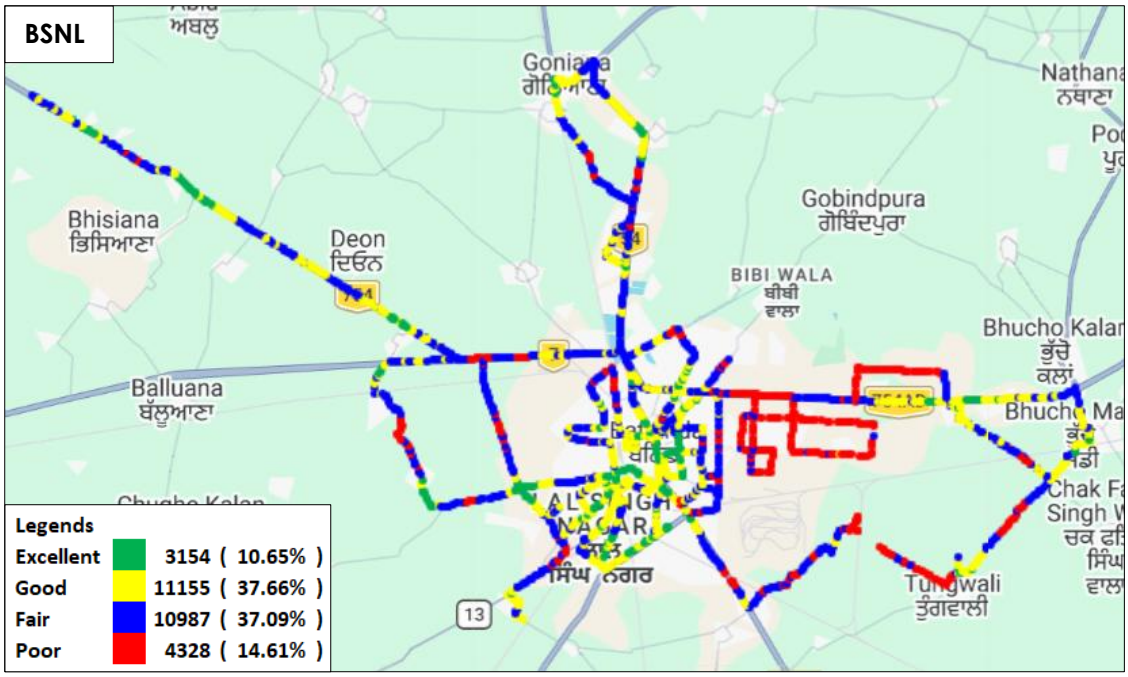


Figure-74: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

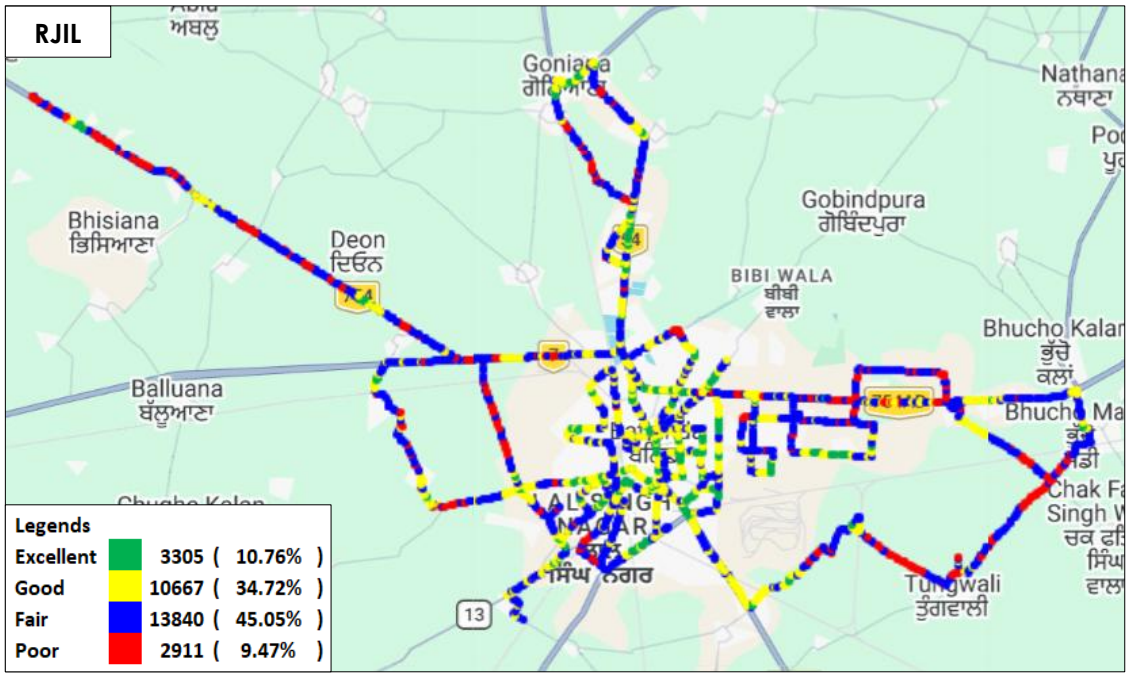


Figure-75: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

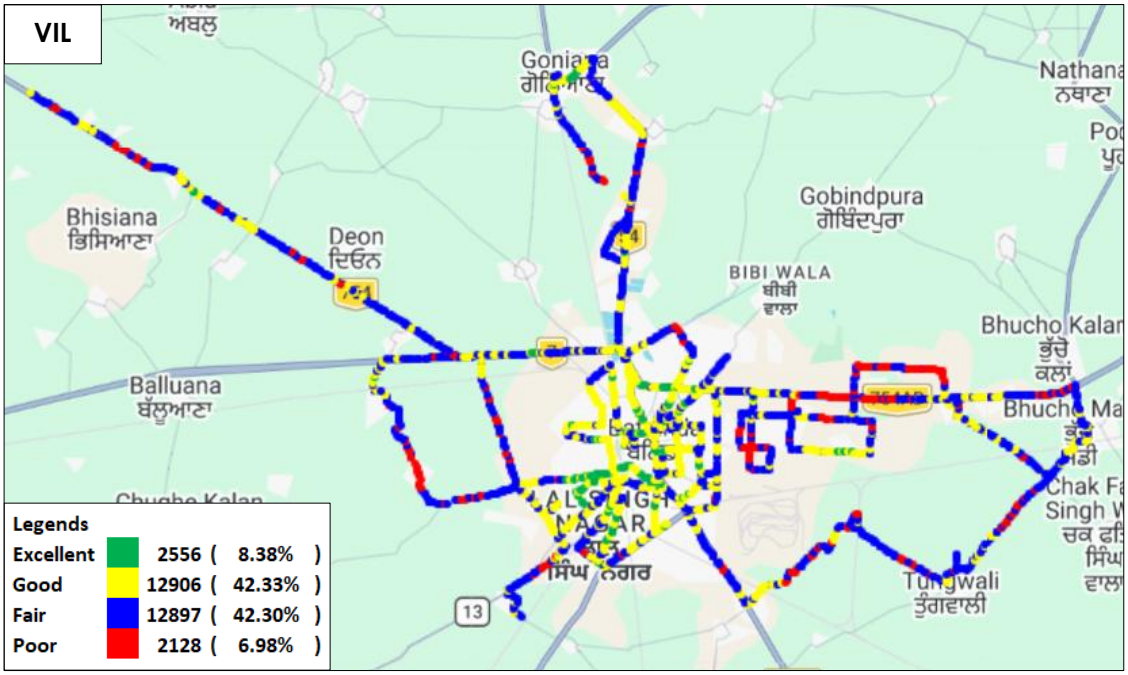


Figure-76: Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

(ii) Sri Muktsar Sahib

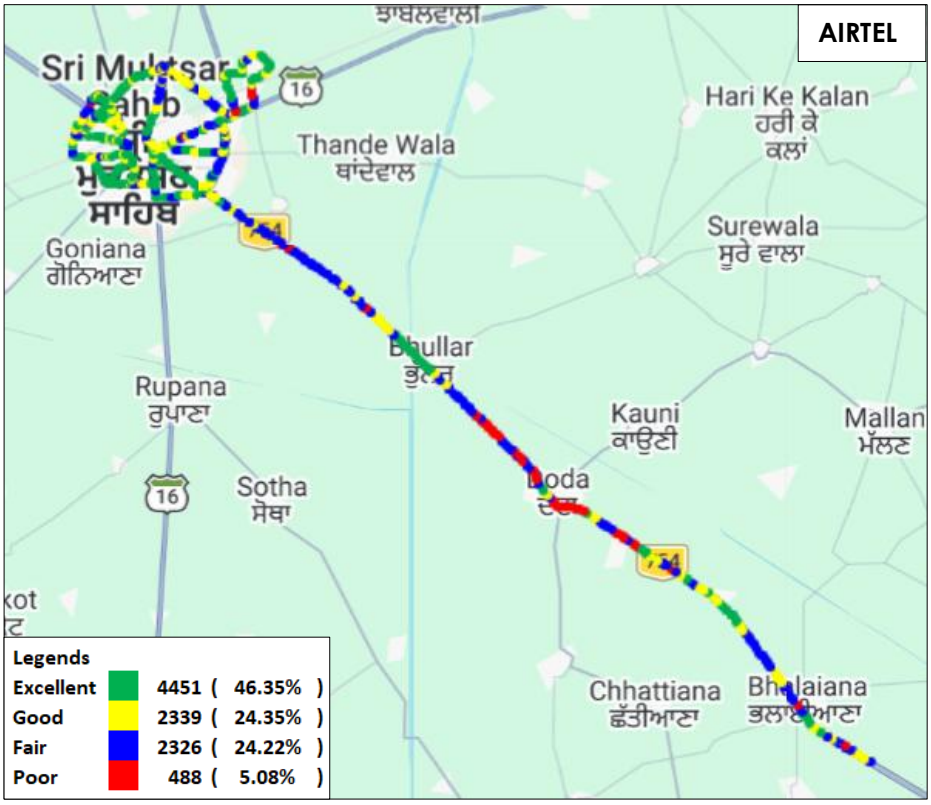


Figure-77: Signal strength 3G/2G network mode voice - AIRTEL.

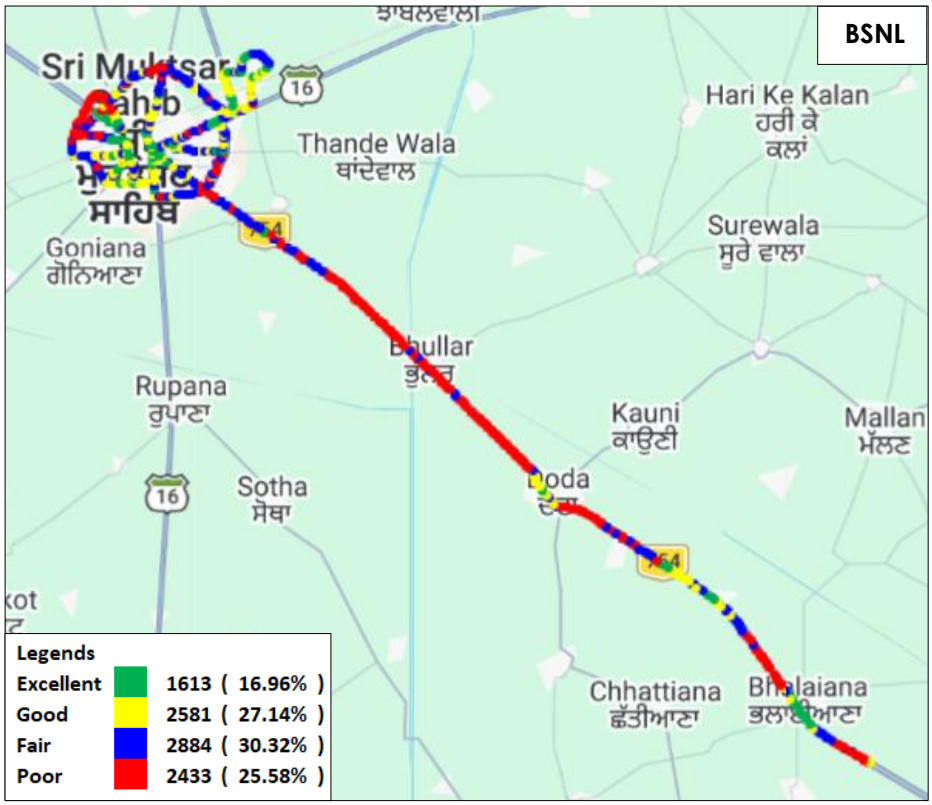


Figure-78: Signal strength 3G/2G network mode voice - BSNL.

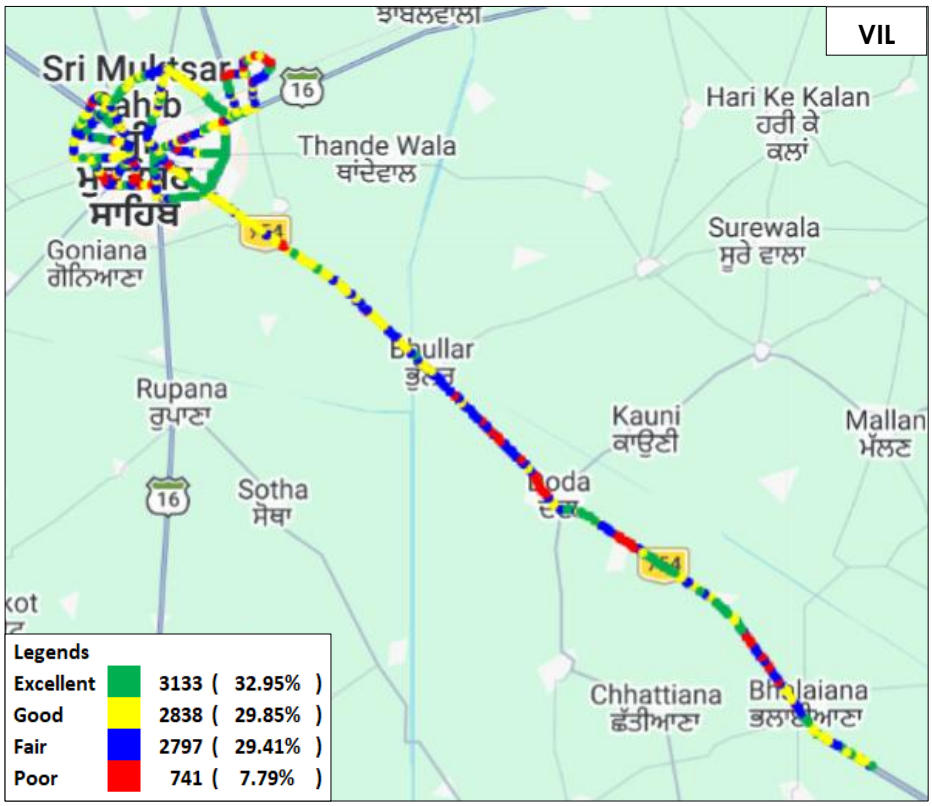


Figure-79: Signal strength 3G/2G network mode voice - VIL.

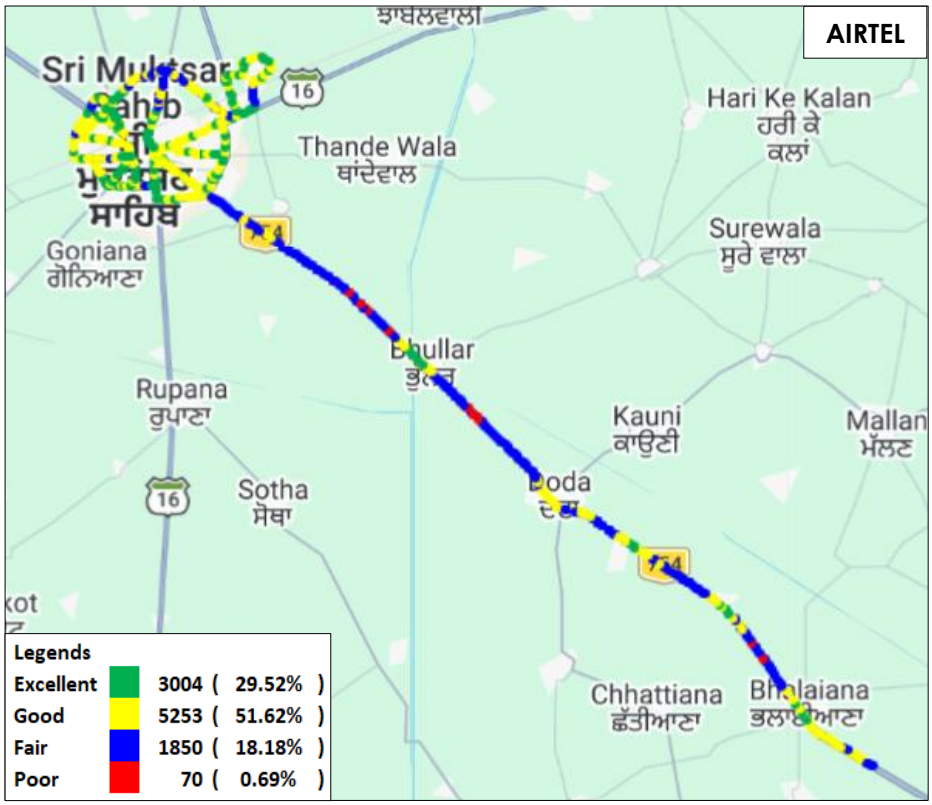


Figure-80: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

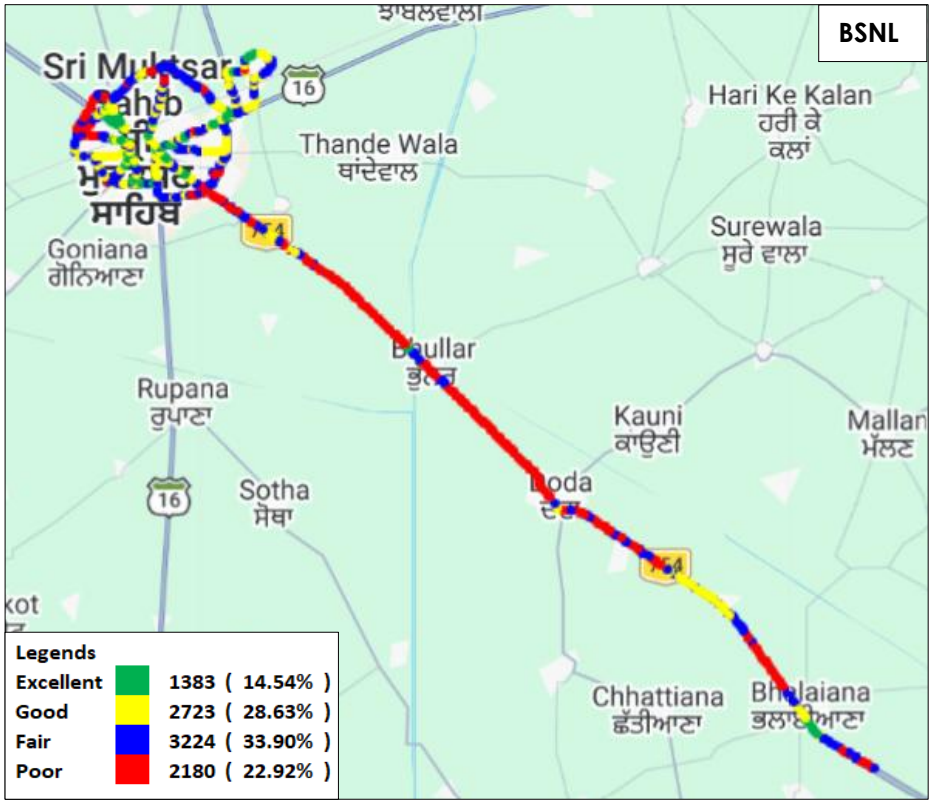


Figure-81: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

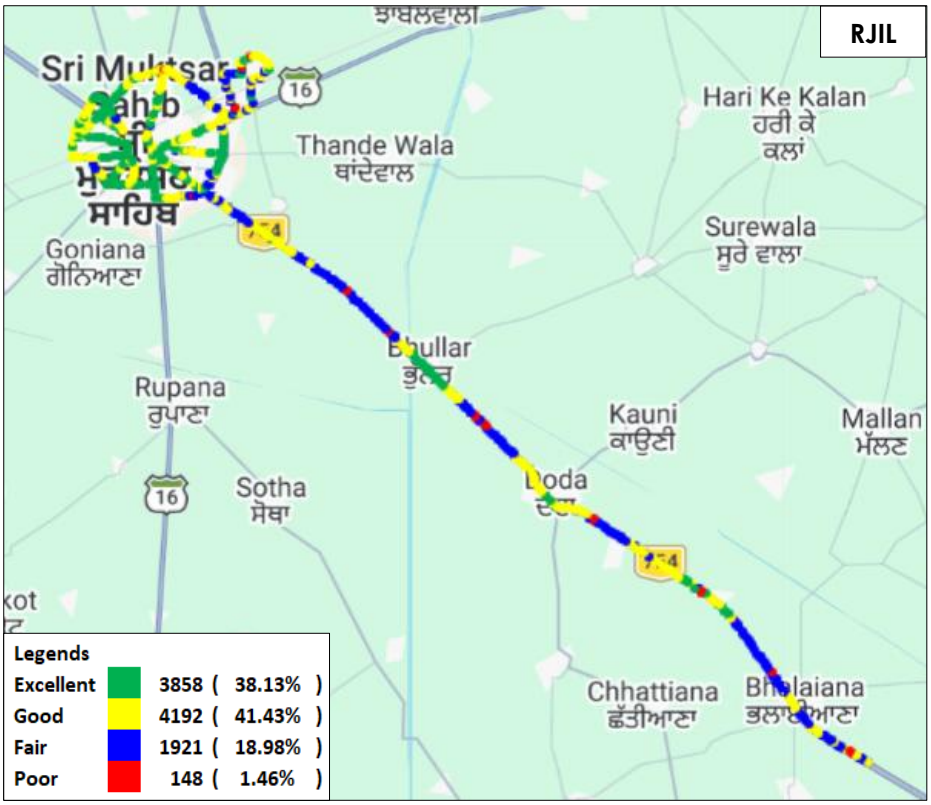


Figure-82: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

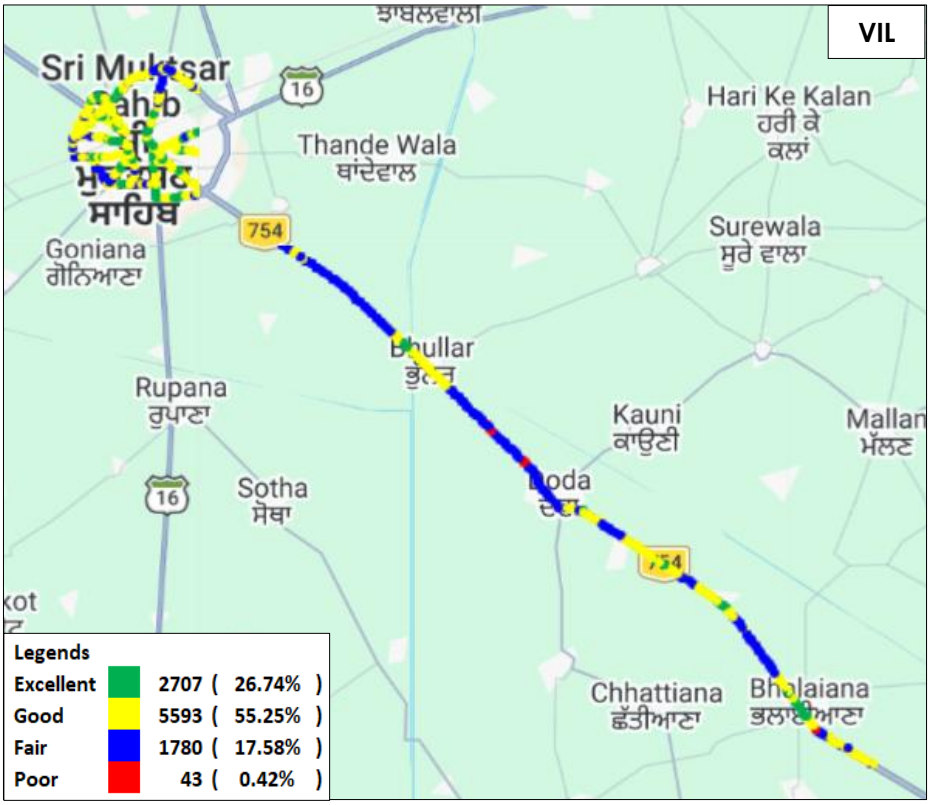


Figure-83: Signal strength auto-selection mode (5G/4G/3G/2G) voice - VIL.

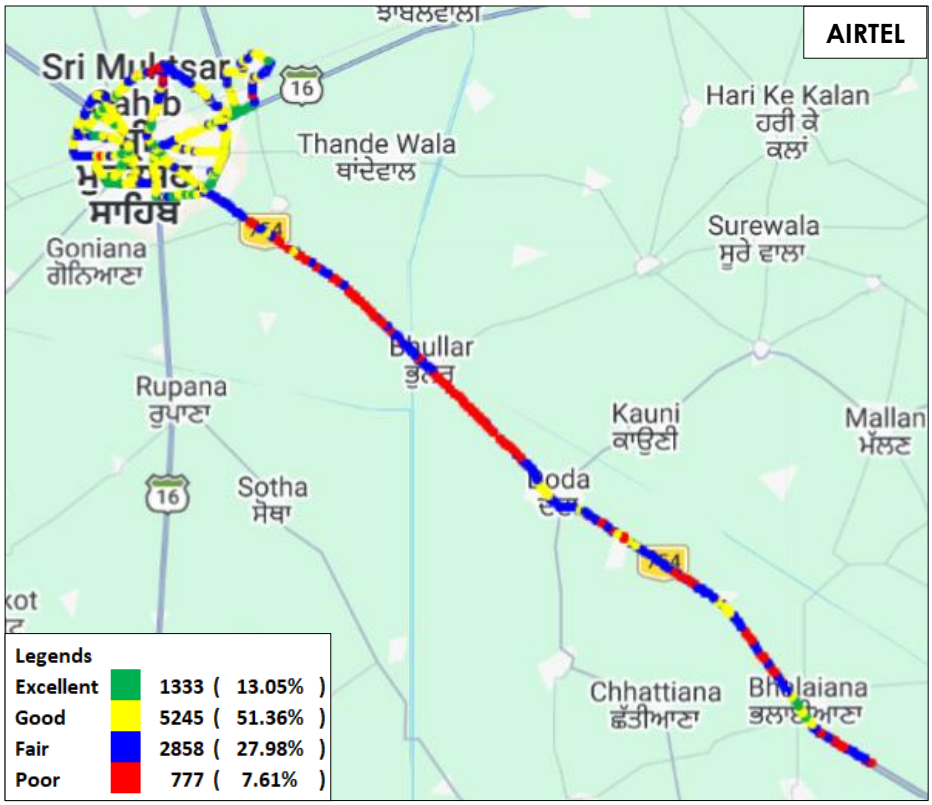


Figure-84: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

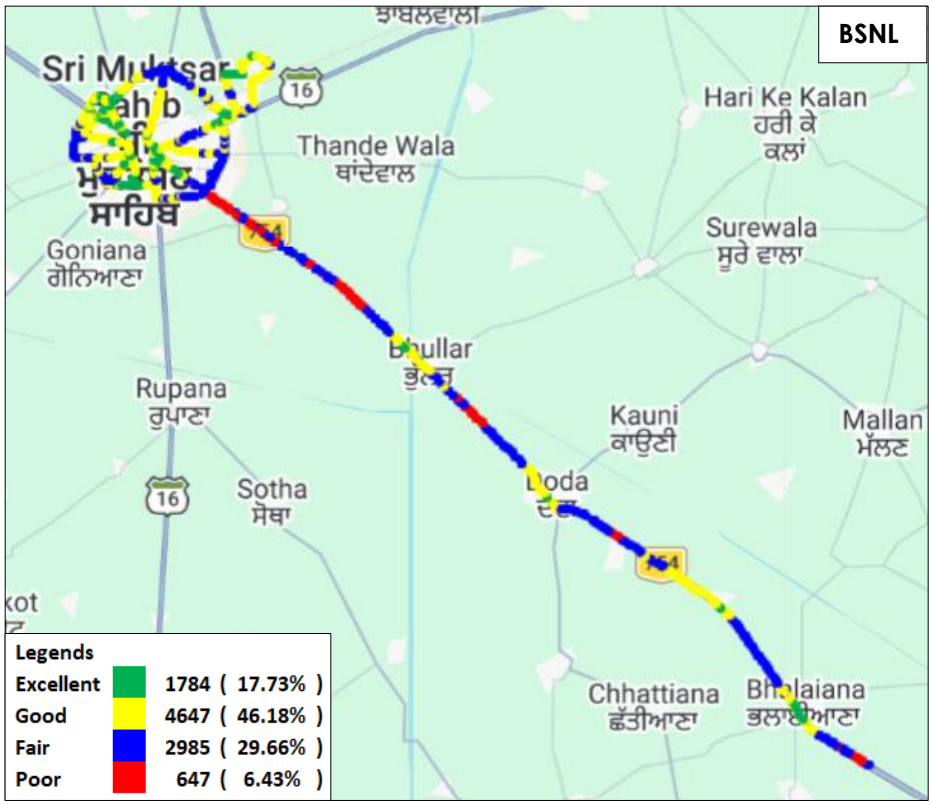


Figure-85: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

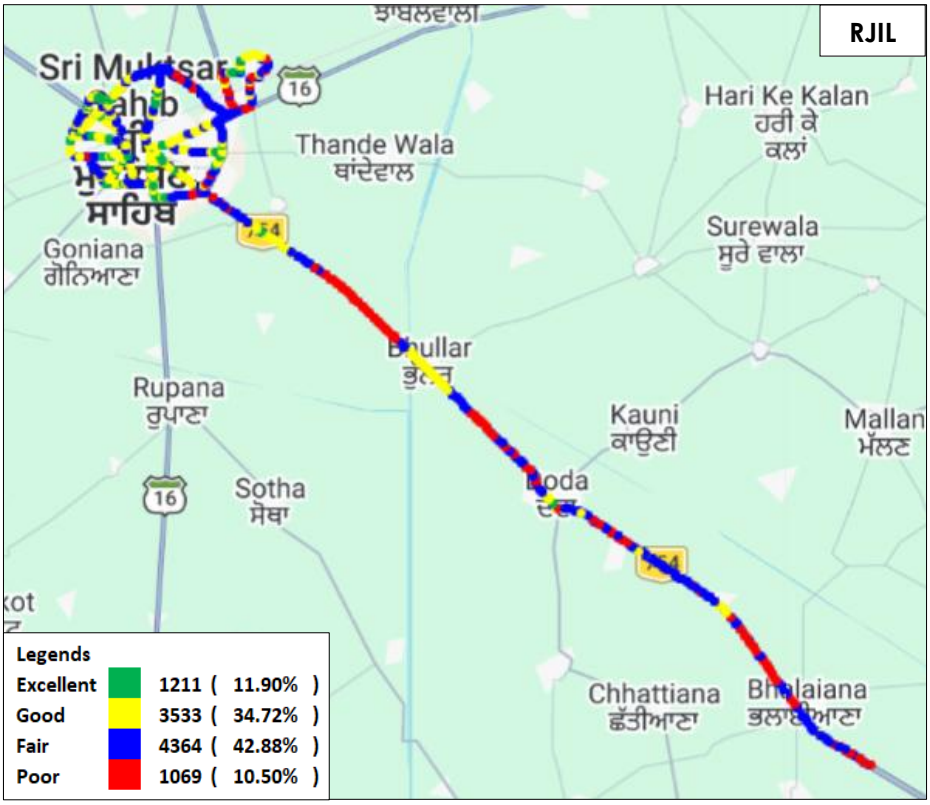


Figure-86: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

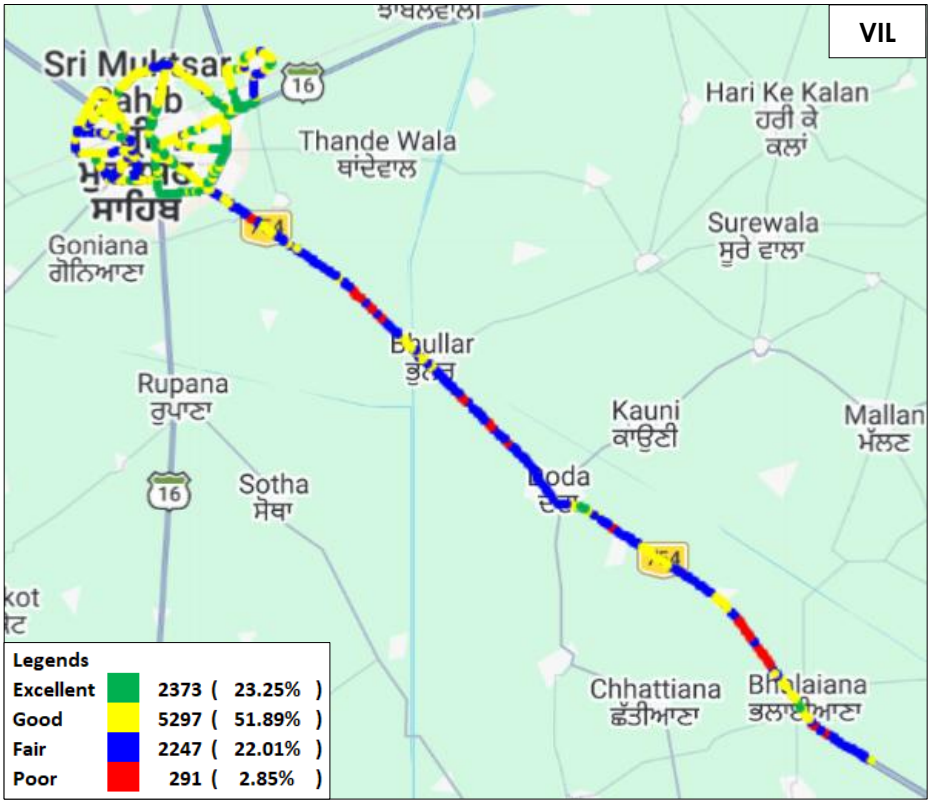


Figure-87: Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

6.1.2 Railway

i) Amritsar to Bathinda

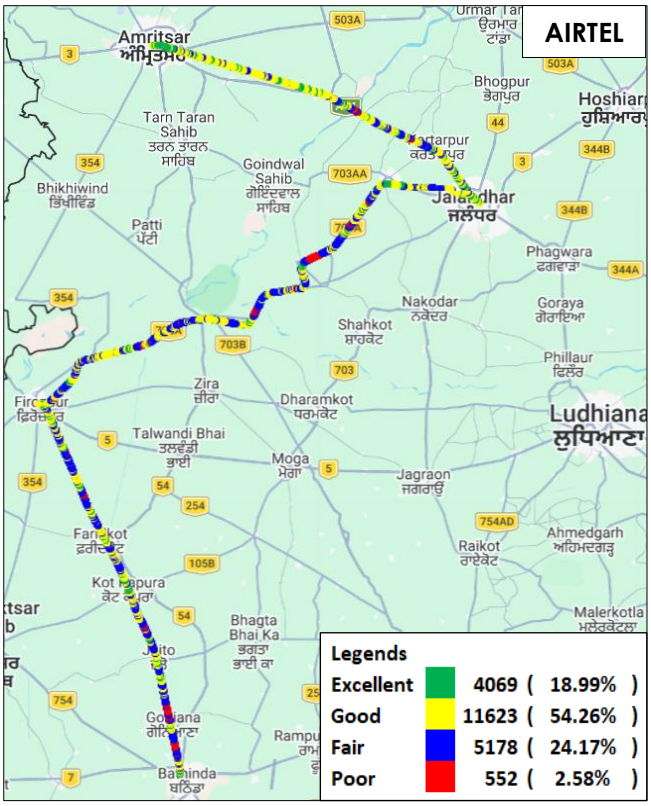


Figure-88: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

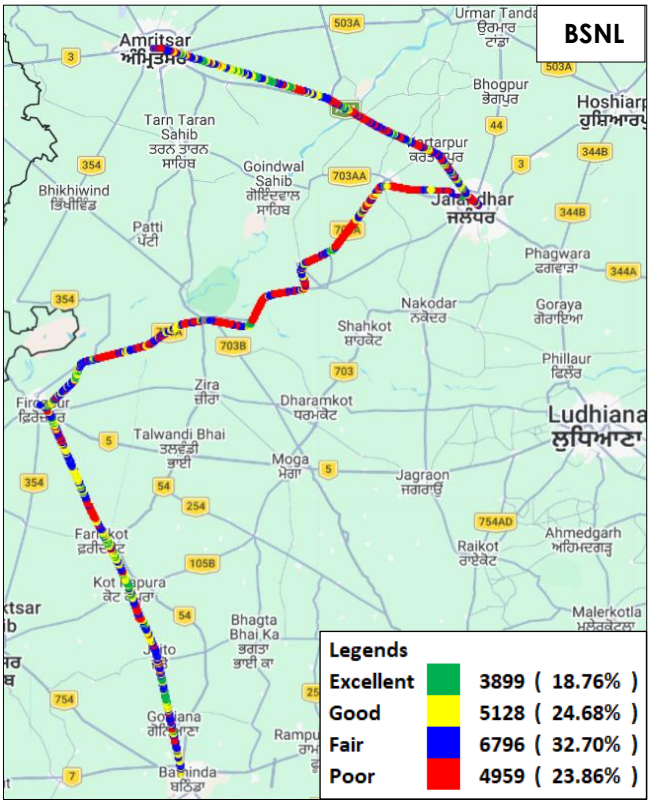


Figure-89: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

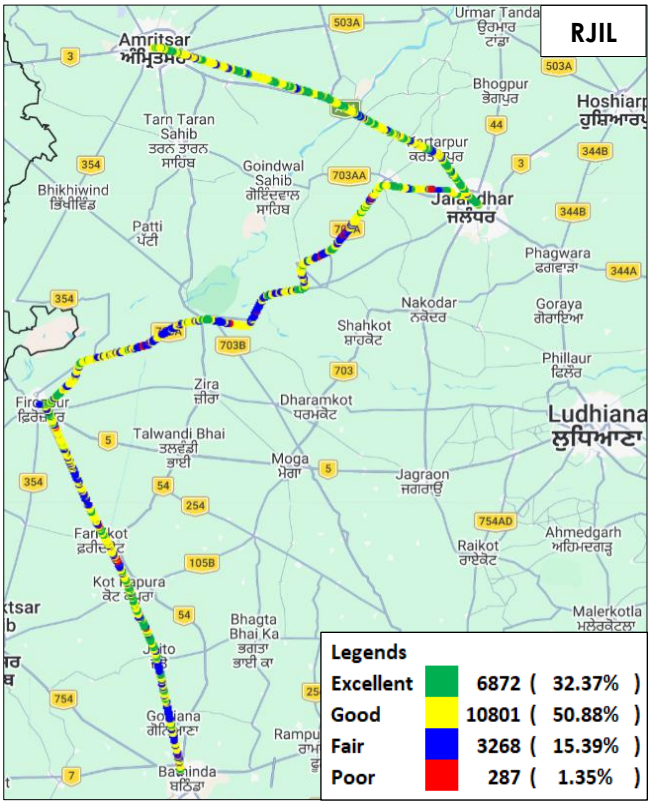


Figure-90: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

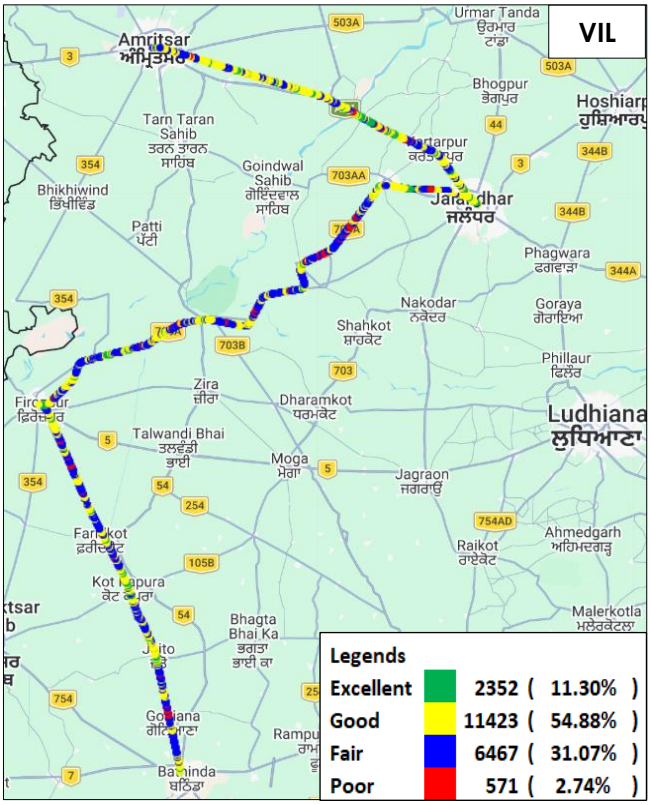


Figure-91: Signal strength auto-selection mode (5G/4G/3G/2G) voice - VIL.

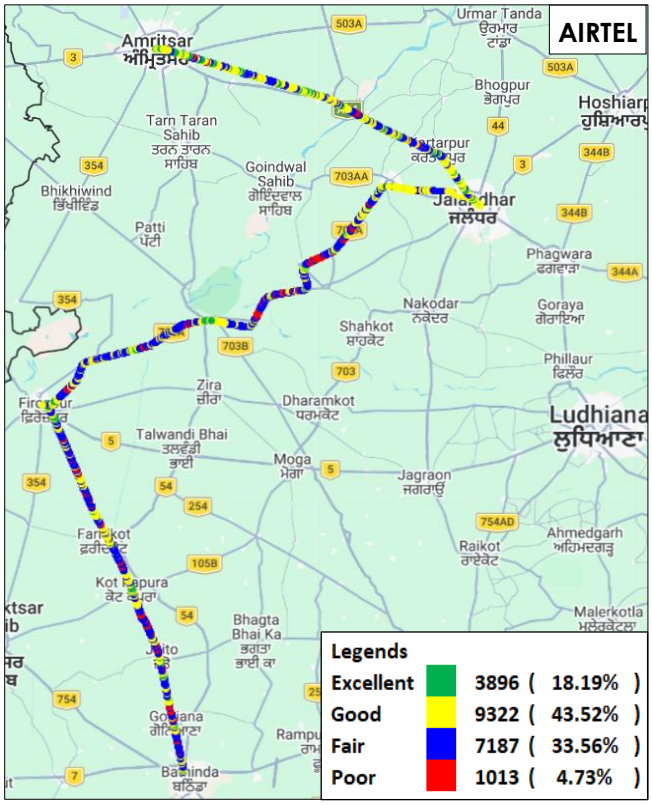


Figure-92: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

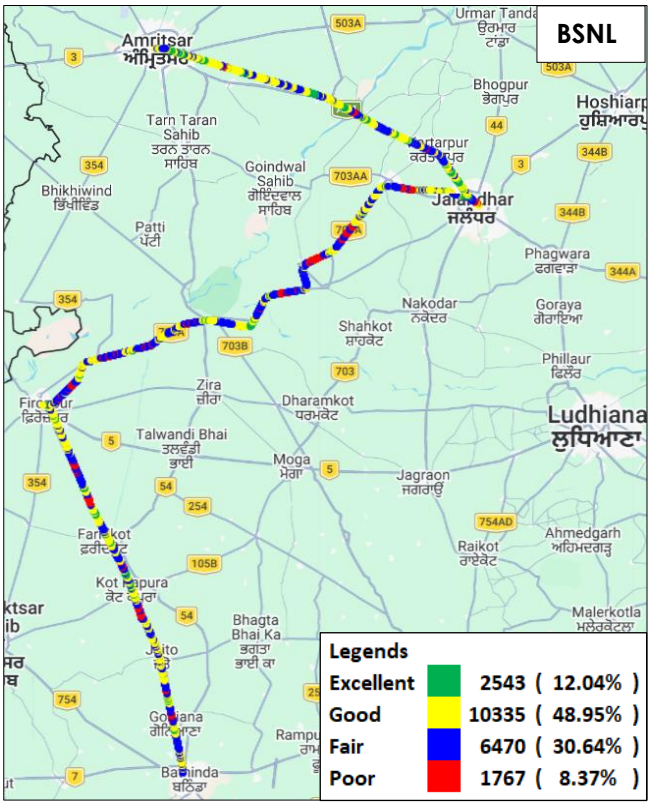


Figure-93: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

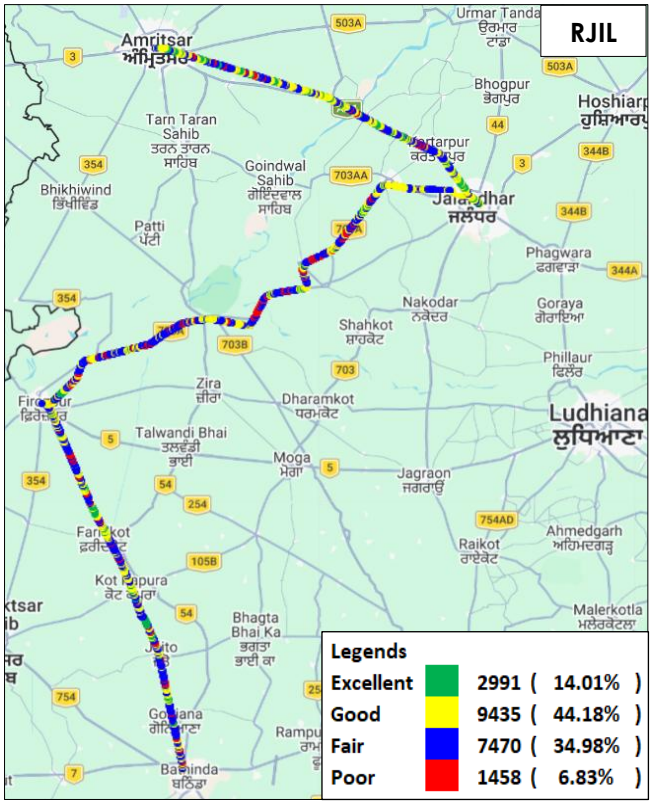


Figure-94: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

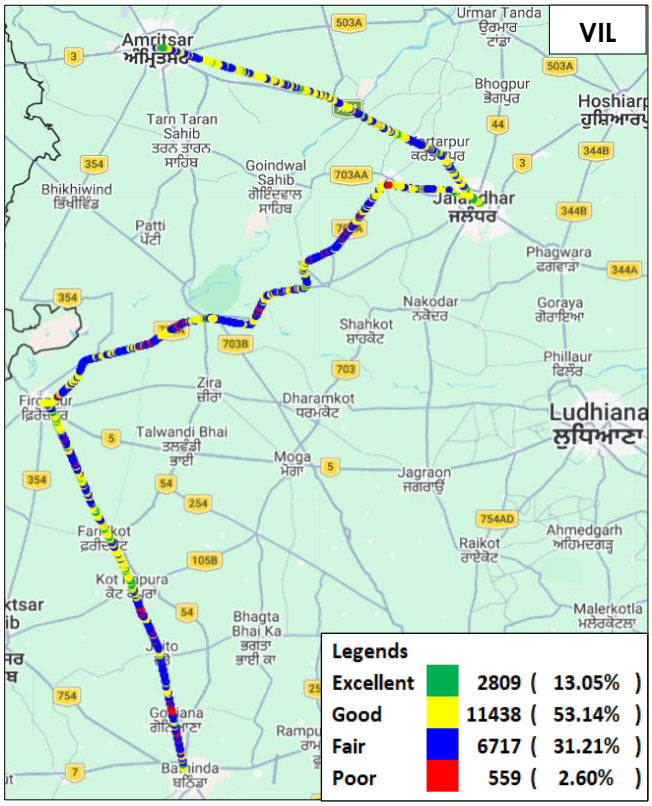


Figure-95: Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

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		90/180 seconds
Wait/ Guard Time		15 Sec

Table-54: 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.
- 90 Sec calls were made in highway route drive.

Data Test		
Test Type	**Technology**	**Detail**
FTP/HTTP Download	5G/4G/3G/2G Auto Mode	500 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time)
FTP/HTTP 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, sbi.bank.in) 20 sec timeout (only at Hotspot)

Latency & Jitter (TWAMP-UDP)		25 count- Dynamic 500 count- Hotspot Payload- 42 bytes in all drive
Packet Loss Rate (TWAMP-UDP & TCP)		500 counts (TWAMP-UDP) 500 counts (TCP) at each hotspot Payload- 42 bytes in all drive

Table-55: 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.
- TWAMP-UDP & TCP 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.
- Airtel server was used for FTP Download, FTP Upload, TCP and TWAMP testing, for Airtel.
- Delhi-based TRAI server was used for HTTP Download, HTTP Upload, TCP and TWAMP testing, for BSNL.
- RJIL server was used for FTP Download, FTP Upload, TCP and TWAMP testing, for RJIL.
- VIL server was used for HTTP Download, HTTP Upload, TCP and TWAMP testing, for VIL.

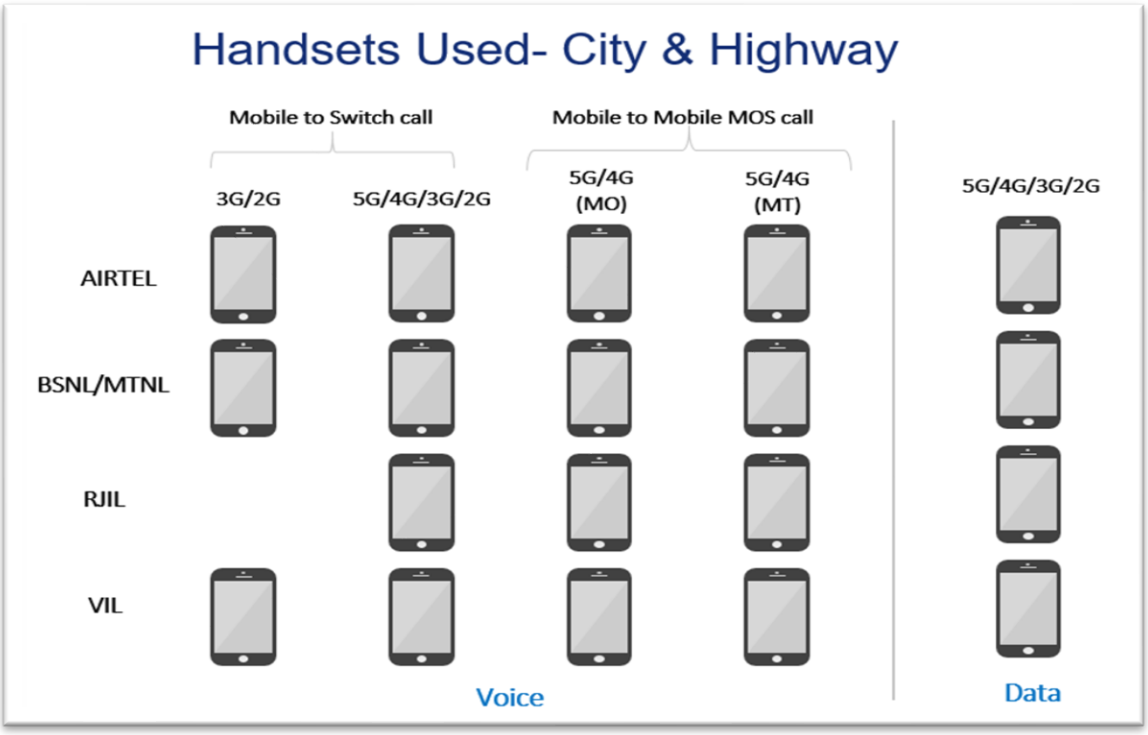


Figure-96: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

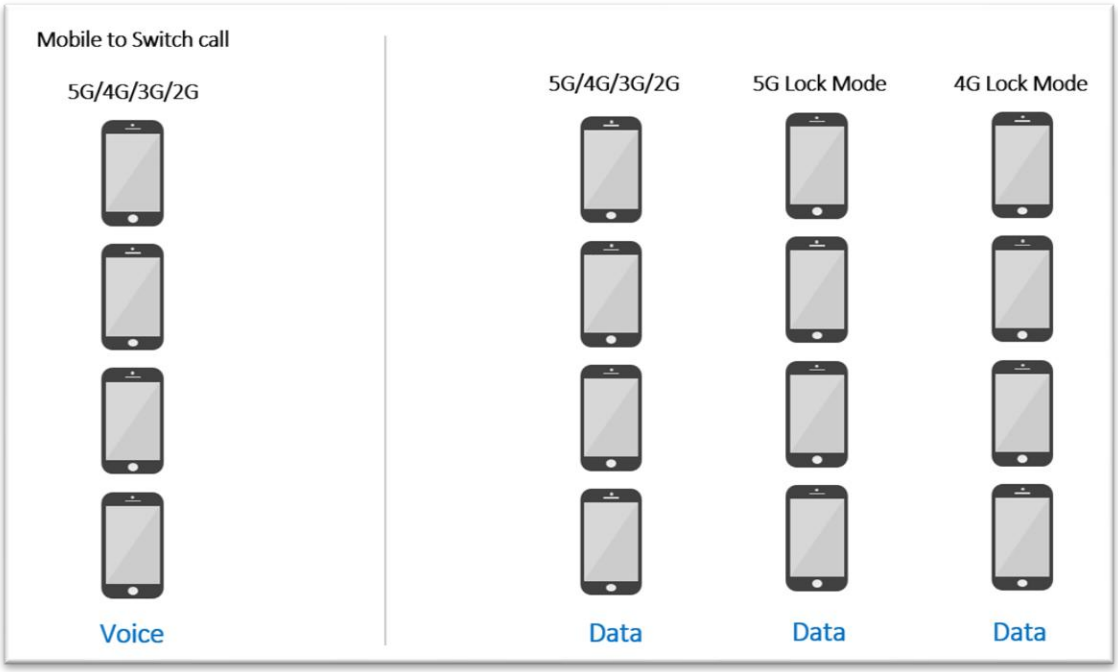


Figure-97: Number of handsets used in railway/metro/walktest/hotspot/coastal area.

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)

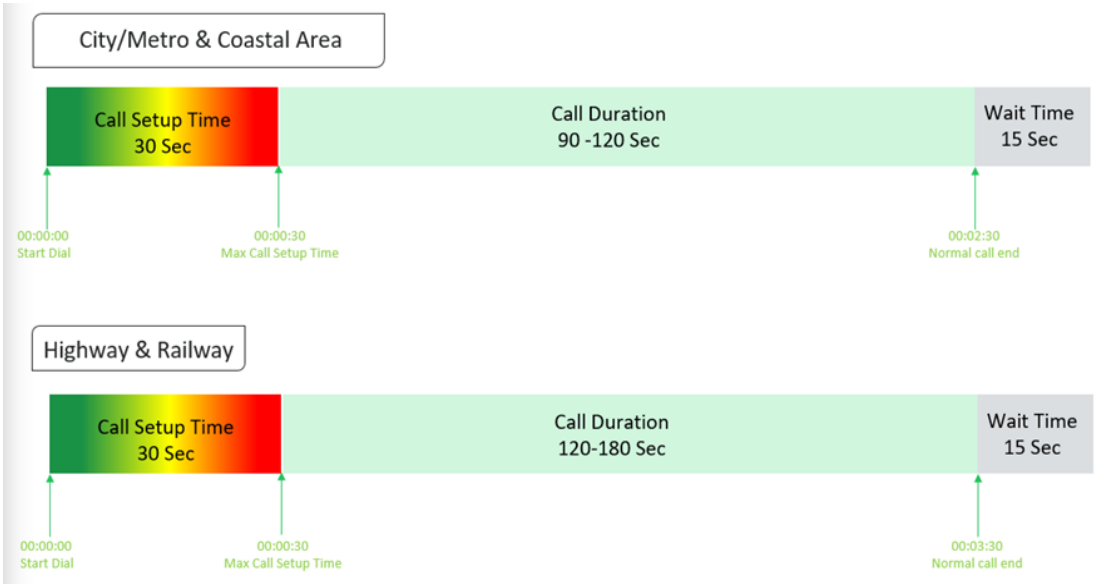


Figure-98: Voice test script for city/railway/metro/highway & coastal area

- 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-99: 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

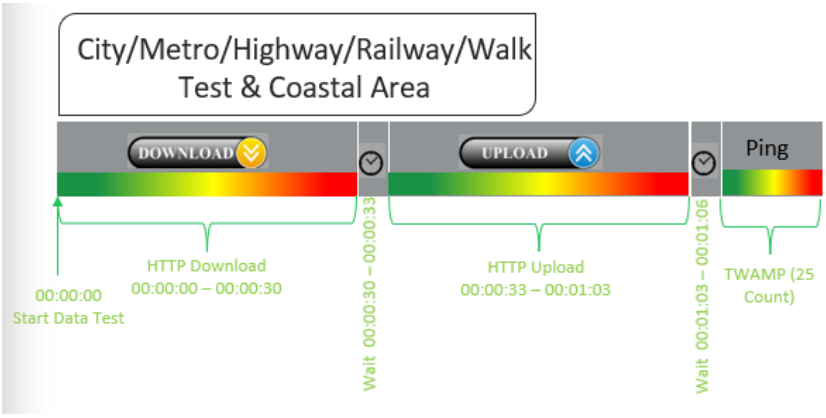


Figure-100: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

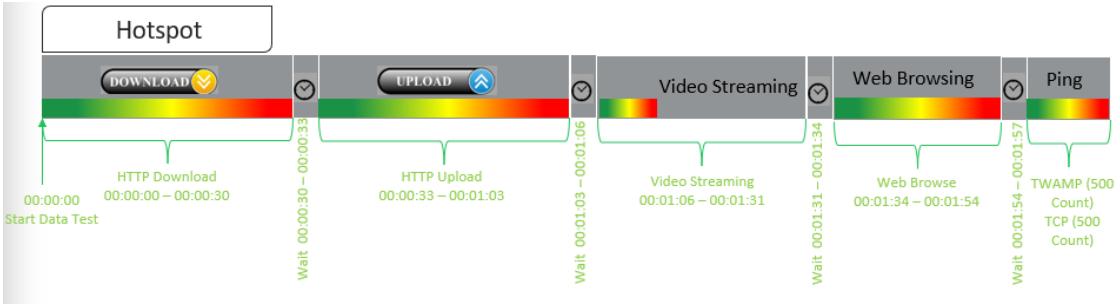


Figure-101: Data test script used at hotspot

- 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.
- One ping iteration (with 500 Count of each- TWAMP & TCP) 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 ≥ 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.

<table>
<tr><td>Jitter</td><td>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</td></tr>
<tr><td>Downlink Packet Drop Rate</td><td>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)</td></tr>
<tr><td>Uplink Packet Drop Rate</td><td>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).</td></tr>
<tr><td>Signal Strength</td><td>Signal strength is the signal power level received by the wireless user.

<table>
<tr><td rowspan="2">Parameter Name</td><td rowspan="2">Technology</td><td colspan="4">Signal Strength (dBm)</td></tr>
<tr><td>Excellent</td><td>Good</td><td>Fair</td><td>Poor</td></tr>
<tr><td>Rx Level</td><td>GSM</td><td>0 to ≥ -65</td><td><-65 to ≥ -75</td><td><-75 to ≥-85</td><td><-85 to min</td></tr>
<tr><td>RSCP</td><td>WCDMA</td><td>0 to ≥ -70</td><td><-70 to ≥ -80</td><td><-80 to ≥ -90</td><td><-90 to min</td></tr>
<tr><td>RSRP</td><td>LTE</td><td>0 to ≥ -80</td><td><-80 to ≥ -95</td><td><-95 to ≥-110</td><td><-110 to min</td></tr>
<tr><td>SS_RSRP</td><td>NR</td><td>0 to ≥ -80</td><td><-80 to ≥ -95</td><td><-95 to ≥-110</td><td><-110 to min</td></tr>
</table>
</td></tr>
</table>

Table-56: 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 (TWAMP-UDP)	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 (TWAMP-UDP)	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 (TWAMP-UDP & TCP)	Number of packets lost out of total packet transferred during test. Packet loss rate = (Total packet lost / Total packet sent) *100 * Packet delay (using TWAMP-UDP & TCP) >90 ms considered as packet loss and included in packet loss rate. * Packet loss rate is calculated based on TWAMP-UDP & TCP. *90th percentile for Packet loss rate has been reported in overall Hotspot performance summary.

Table-57: 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.

Hardik Rajeshbhai Patel

Digitally signed by Hardik Rajeshbhai Patel
Date: 2026.04.06 11:53:55 +05'30'