भादूविप्रा
TRAI

TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Himachal Pradesh LSA

September 2026

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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 Himachal Pradesh License Service Area (LSA) during the month of September-2026 under the supervision of TRAI Regional Office (RO) Delhi. 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	Una, Mandi, Joginder Nagar and nearby areas	City	373.0	15-Sep-2026	18-Sep-2026
2	Una	Inter Operator Calling	1 Location	19-Sep-2026	19-Sep-2026
3	Una & Mandi	Hotspot	6 Locations	17-Sep-2026	18-Sep-2026
4	Una & Mandi	Walk test	5.2	17-Sep-2026	18-Sep-2026
5	Una to Mandi	Highway	130.7	16-Sep-2026	16-Sep-2026
6	Mandi to Una	Highway	94.4	18-Sep-2026	18-Sep-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, walk test and highway as per the legends shown on the map.

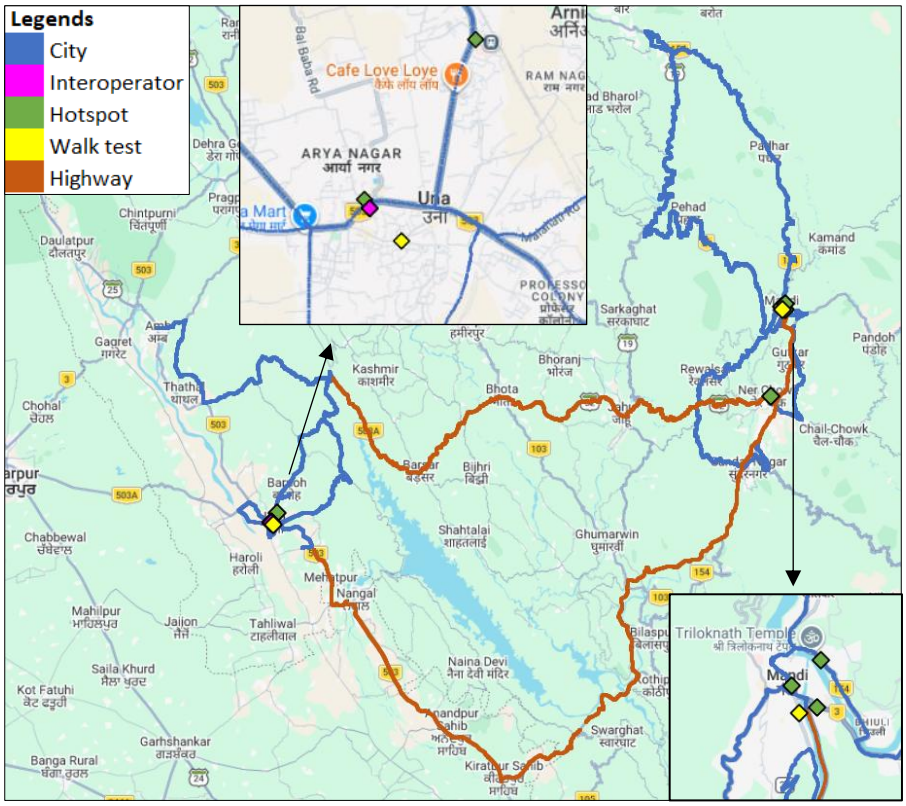


Figure-1: Drive test routes.

2.3 Summary of areas covered

a) City- Una, Lal Singhi, Jhelara, Jal Gran, Dangoli, Bhadwar, Barnoh, Matyana, Shiv Nagar, Takoli, Bharmar, Chauki Maniar, Baruhi, Akrot, Kutheram, Amb, Mandi, Randhara, Rewalsar, Dhalwan, Kapahi, Sundar Nagar, Dadour, Gutkar, Mehar, Kunnu, Narla, Padhar, Kotropi, Urla, Ghatasani, Harabhag, Joginder Nagar, Chauntra, Machial, Baroti, Giun, and Kotli etc.

b) Hotspot

1. Lal Bahadur Shastri Government Hospital Mandi
2. Mandi Bus Stand
3. Mandi Mall Road
4. Purani Mandi-Mandi
5. Regional Hospital Una
6. Una Bus Stand

c) Walk Test

1. Jivan Market Una
2. Mandi Mall Road

d) Highway-

i) Una to Mandi- Passing through Gutkar, Ner Chowk, Sundar Nagar, Bilaspur, Kothipura, Kiratpur Sahib, Anandpur Sahib, Nangal and Mehatpur etc.

ii) Mandi to Una- Passing through Ner Chowk, Jahu, Ladrpur, Bhota, Salouni, Barsar and Bangana etc.

2.4 Telecom service providers detected frequency bands

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

S.no.	Name of TSP	Technology	Frequency Bands (In MHz)
1	Bharti Airtel Ltd.	2G	900
2	Bharti Airtel Ltd.	4G	900,1800,2300
3	Bharti Airtel Ltd.	5G	3500
4	BSNL	2G	900
5	BSNL	3G	2100
6	BSNL	4G	700,2100,2500
7	Reliance JIO Infocomm Ltd.	4G	850,1800,2300
8	Reliance JIO Infocomm Ltd.	5G	700,3500
9	Vodafone Idea Ltd.	2G	1800
10	Vodafone Idea Ltd.	4G	900,1800,2100,2500

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

2.5 Key findings of Independent Drive Test

1. **Drive Test Area:** The overall mobile network performance across Una, Mandi & Joginder Nagar city (Himachal Pradesh LSA) for the key Parameters have been summarized below:

a) Coverage Gap – The signal strength observed during voice testing on the drive test route in auto-selection mode (5G/4G/3G/2G). (refer figure- 29 to 32)

Parameter	AIRTEL	BSNL	RJIL	VIL
Total Number of Samples captured on Drive test route	64200	60813	63875	63375
Number of Samples having poor signal strength	3846	20158	2174	16902
Number of Samples having limited service (No Coverage)	31	632	23	169

b) Dropped Calls – The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure-15 to 18)

Parameter	AIRTEL	BSNL	RJIL	VIL
Number of successful Calls Established	570	538	565	560
Number of dropped Calls	5	49	3	13

c) Call Silence Instance – The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure-19 to 22)

Parameter	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider network)	536	433	539	497
Number of silences calls for >3 Sec	14	4	9	12
Total number of silence instances for >3 Sec	15	4	9	12

d) Packet loss rate Downlink & Uplink- The TSP-wise details of packet loss rate in downlink & uplink for Auto-selection mode (5G/4G).

Parameter	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider network)	536	433	539	497
Packet loss Rate Downlink %	1.71	3.76	0.96	1.29
Packet loss Rate Uplink %	1.81	3.98	1.04	1.19

e) Data Download and Upload Throughput-

i) Data Download Throughput: The TSP-wise details of **Average Download (DL) throughput** against declared typical DL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 34 to 37)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)	VIL (upto 4G)
Typical Download Throughput declared by TSP	(Mbits/s)	23.00	3.00	15.00	15.00
Average Download Throughput measured during IDT	(Mbits/s)	122.28	9.49	171.68	12.18

ii) Data Upload Throughput – The TSP-wise details of **Average Upload (UL) throughput** against declared typical UL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 38 to 41)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)	VIL (upto 4G)
Typical Upload Throughput declared by TSP	(Mbits/s)	10.00	3.00	7.00	8.00
Average Upload Throughput measured during IDT	(Mbits/s)	13.44	4.57	18.01	5.45

2. **Drive Test Route:** The overall mobile network performance on Una to Mandi highway route (Himachal Pradesh LSA) for the key Parameters has been summarized below:

a) Coverage Gap- The signal strength observed during voice testing on the drive test route in auto-selection mode (5G/4G/3G/2G). (refer figure- 72 to 75)

Parameter	AIRTEL	BSNL	RJIL	VIL
Total Number of Samples captured on Drive test route	13127	12473	12972	12923
Number of Samples having poor signal strength	387	3173	344	3206
Number of Samples having limited service (No Coverage)	12	170	0	119

b) Dropped Calls- The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure-58 to 61)

Parameter	AIRTEL	BSNL	RJIL	VIL
Number of successful Calls Established	67	63	65	65
Number of dropped Calls	2	7	2	6

c) Call Silence Instance- The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure-62 to 65)

Parameter	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider network)	66	61	65	64
Number of silences calls for >3 Sec	1	2	2	2
Total number of silence instances for >3 Sec	1	2	4	2

d) Packet loss rate Downlink & Uplink- The TSP-wise details of packet loss rate in downlink & uplink for Auto-selection mode (5G/4G).

Parameter	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider network)	66	61	65	64
Packet loss Rate Downlink %	1.45	5.45	2.24	2.91
Packet loss Rate Uplink %	1.93	5.44	2.64	2.97

e) Data Download and Upload Throughput-

i) **Data Download Throughput:** The TSP-wise details of **Average Download (DL) throughput** against declared typical DL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 77 to 80)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)	VIL (upto 4G)
Typical Download Throughput declared by TSP	(Mbits/s)	23.00	3.00	15.00	15.00
Average Download Throughput measured during IDT	(Mbits/s)	169.31	9.32	193.46	10.36

ii) **Data Upload Throughput:** The TSP-wise details of **Average Upload (UL) throughput** against declared typical UL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 81 to 84)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)	VIL (upto 4G)
Typical Upload Throughput declared by TSP	(Mbits/s)	10.00	3.00	7.00	8.00
Average Upload Throughput measured during IDT	(Mbits/s)	15.54	6.29	21.43	5.30

3. **Drive Test Route:** The overall mobile network performance on Mandi to Una highway route (Himachal Pradesh LSA) for the key Parameters has been summarized below:

a) Coverage Gap- The signal strength observed during voice testing on the drive test route in auto-selection mode (5G/4G/3G/2G). (refer figure- 112 to 115)

Parameter	AIRTEL	BSNL	RJIL	VIL
Total Number of Samples captured on Drive test route	12455	12632	11892	12200
Number of Samples having poor signal strength	396	3403	334	2466
Number of Samples having limited service (No Coverage)	0	0	0	62

b) Dropped Calls- The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure-99 to 102)

Parameter	AIRTEL	BSNL	RJIL	VIL
Number of successful Calls Established	62	67	61	61
Number of dropped Calls	1	13	2	3

c) Call Silence Instance- The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure-103 & 105)

Parameter	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider network)	60	58	60	61
Number of silences calls for >3 Sec	1	1	2	0
Total number of silence instances for >3 Sec	1	1	2	0

d) Packet loss rate Downlink & Uplink- The TSP-wise details of packet loss rate in downlink & uplink for Auto-selection mode (5G/4G).

Parameter	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider network)	60	58	60	61
Packet loss Rate Downlink %	1.57	3.09	2.56	1.47
Packet loss Rate Uplink %	1.56	3.75	2.07	1.75

e) Data Download and Upload Throughput-

i) **Data Download Throughput:** The TSP-wise details of **Average Download (DL) throughput** against declared typical DL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 117 to 120)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)	VIL (upto 4G)
Typical Download Throughput declared by TSP	(Mbits/s)	23.00	3.00	15.00	15.00
Average Download Throughput measured during IDT	(Mbits/s)	209.98	10.15	194.88	9.63

ii) **Data Upload Throughput:** The TSP-wise details of **Average Upload (UL) throughput** against declared typical UL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 121 to 124)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)	VIL (upto 4G)
Typical Upload Throughput declared by TSP	(Mbits/s)	10.00	3.00	7.00	8.00
Average Upload Throughput measured during IDT	(Mbits/s)	14.67	5.59	14.40	4.36

QoS Performance Analysis- Himachal Pradesh 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 Himachal Pradesh LSA during the month of September-2026 covering city drive, hotspots, walk test and highway. (Refer Table-1)

3.2 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	679	718	679
Call Setup Success Rate %	98.97	93.45	98.53
Drop Call Rate %	1.64	8.20	1.94
Call Setup Time-Average (Second)	2.78	3.68	4.45
Handover Success Rate %	97.51	98.18	94.99

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

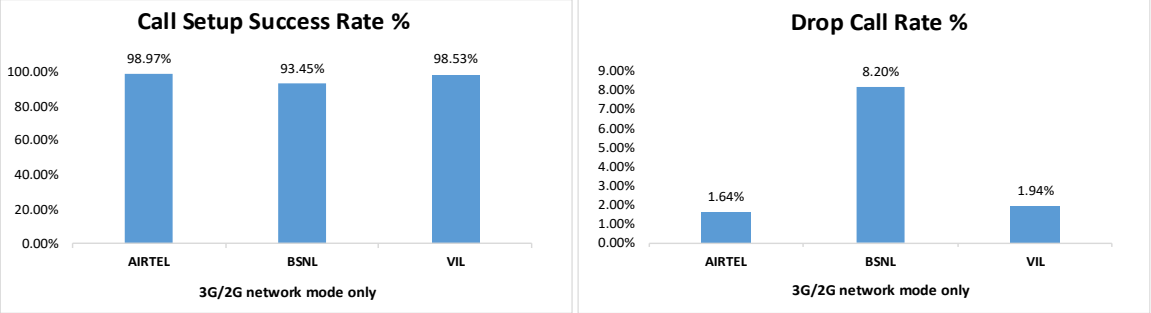


Figure-2: Call setup success rate and drop call rate performance.

Number of unique cell Id's covered in Voice test- Technology wise			
Technology	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
3G	NA	105	NA
2G	676	287	362

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	811	879	794	815
Call Setup Success Rate %	98.77	86.46	99.87	96.69
Drop Call Rate %	1.00	9.21	0.88	2.79
Call Setup Time-Average (Second)	0.62	2.91	0.72	1.67
Handover Success Rate %	99.78	99.56	99.87	99.76

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

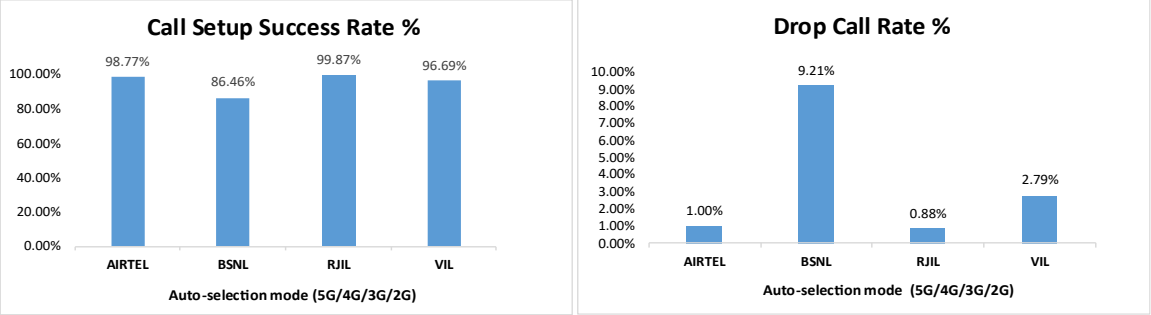


Figure-3: Performance for call setup success rate and drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G – Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	662	552	664	622
Number of silences call for >4 Sec	6	2	7	11
Silence Call Rate %	0.91	0.36	1.05	1.77
Number of silence instances for >4 Sec	7	2	7	11
Number of silence instances for >3 Sec	17	7	15	14
Number of silence instances for >2 sec	39	18	31	25
RTP Jitter (4G & 5G) in ms	3.89	5.59	14.88	15.02
Packet loss Rate Downlink %	1.67	3.88	1.23	1.46
Packet loss Rate Uplink %	1.80	4.12	1.29	1.41

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

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	186	NA	717	NA
4G	1336	576	1180	582
3G	NA	92	NA	NA
2G	0	202	NA	119

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	4976	3764	5173	4775
Speech Quality (Average MOS)	3.91	2.88	4.46	3.72
Number of samples with MOS >=4 to <5 (Excellent)	4043	967	4510	2750
Number of samples with MOS >=3 to <4 (Good)	620	620	415	1423
Number of samples with MOS >=2 to <3 (Fair)	88	1408	123	275
Number of samples with MOS >=1 to <2 (Poor)	225	769	125	327
%age of samples with MOS >=4 to <5 (Excellent)	81.25%	25.69%	87.18%	57.59%
%age of samples with MOS >=3 to <4 (Good)	12.46%	16.47%	8.02%	29.80%
%age of samples with MOS >=2 to <3 (Fair)	1.77%	37.41%	2.38%	5.76%
%age of samples with MOS >=1 to <2 (Poor)	4.52%	20.43%	2.42%	6.85%

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

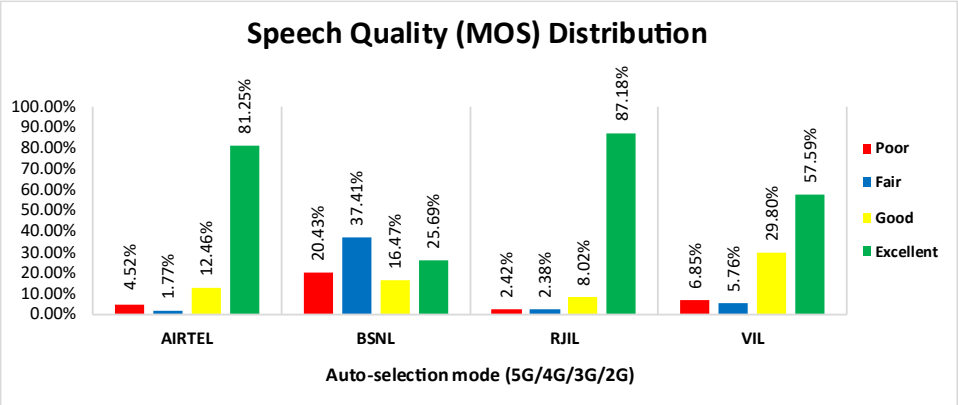


Figure- 4: Distribution of samples in MOS range.

(d) Inter-service provider voice call performance: To check the performance of inter-service providers call setup success rate, total 8 to 15 inter operator calls were attempted at one location which is ISBT Una. 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	93.33
RJIL	100.00	100.00	NA	100.00
VIL	100.00	100.00	100.00	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	3.05	1.41	2.15
BSNL	2.88	NA	2.40	3.13
RJIL	1.99	2.21	NA	1.39
VIL	3.34	16.33	1.84	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	148.97	9.60	188.24	11.93
	80th Percentile	243.56	15.37	352.66	18.84
	20th Percentile	23.34	2.46	24.33	3.73
Upload Throughput (Mbits/s)	Average	15.96	5.20	20.18	5.44
	80th Percentile	24.85	9.41	35.57	8.12
	20th Percentile	2.66	0.90	2.96	1.68
Latency (ms)	50th Percentile	44.38	30.34	27.51	44.83

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

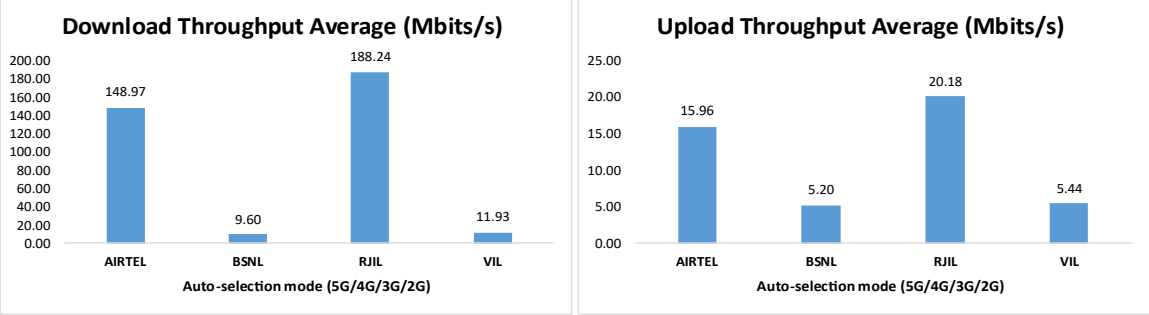


Figure- 5: Download and Upload throughput.

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	213	NA	818	NA
4G	1257	788	929	607
3G	NA	78	NA	NA
2G	10	56	NA	102

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, walk test and highway for all telecom service providers, the results of drive tests conducted are shown individually for respective areas/locations.

4.2 City

Drive test has been conducted from 15th September 2026 to 18th September 2026 in Una, Mandi, Joginder Nagar and nearby areas. (Refer Table-1)

4.2.1 Drive test route

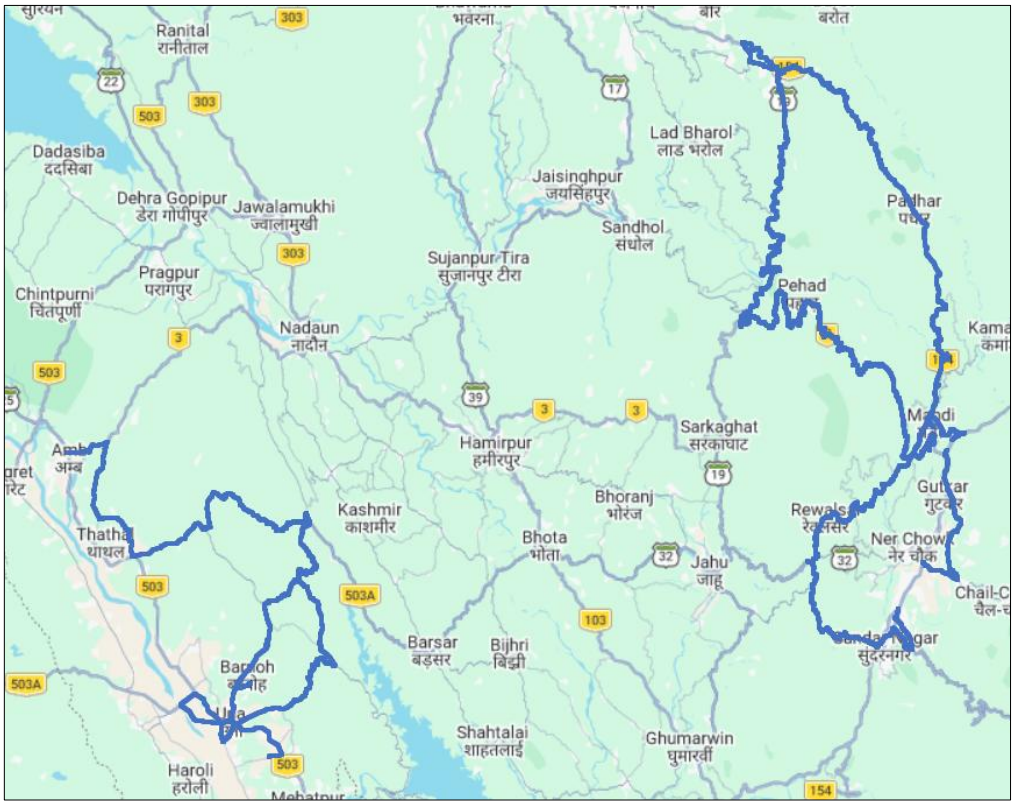


Figure- 6: Drive test routes.

4.2.2 Areas covered

Una, Lal Singhi, Jhelara, Jal Gran, Dangoli, Bhadwar, Barnoh, Matyana, Shiv Nagar, Takoli, Bharmar, Chauki Maniar, Baruhi, Akrot, Kutheram, Amb, Mandi, Randhara, Rewalsar, Dhalwan, Kapahi, Sundar Nagar, Dadour, Gutkar, Mehar, Kunnu, Narla, Padhar, Kotropi, Urla, Ghatasani, Harabhag, Joginder Nagar, Chauntra, Machial, Baroti, Giun, and Kotli etc.

4.2.3 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	549	585	547
Call Setup Success Rate %	99.45	92.99	99.45
Drop Call Rate %	0.92	6.80	0.74
Call Setup Time-Average (Second)	2.71	3.60	4.42
Handover Success Rate %	98.69	97.85	94.59

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

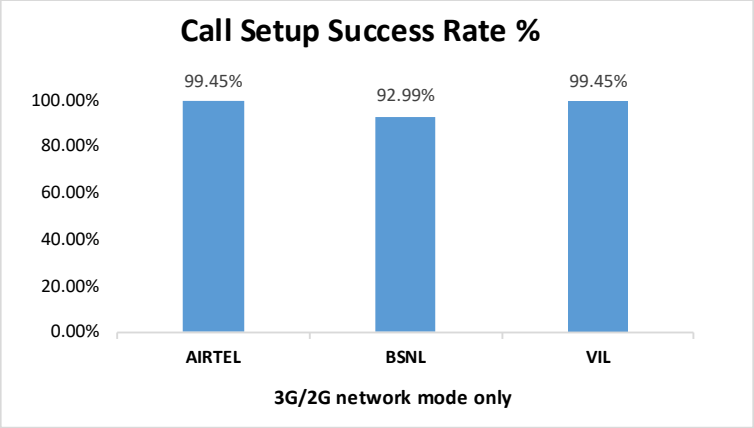


Figure-7: Performance for call setup success rate.

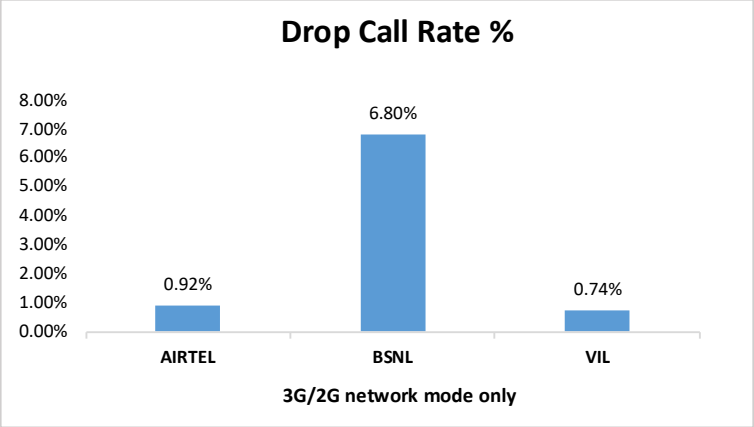


Figure-8: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	BSNL	VIL
3G	NA	48.62%	NA
2G	100.00%	51.26%	99.96%
Limited Service	0.00%	0.12%	0.04%

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

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

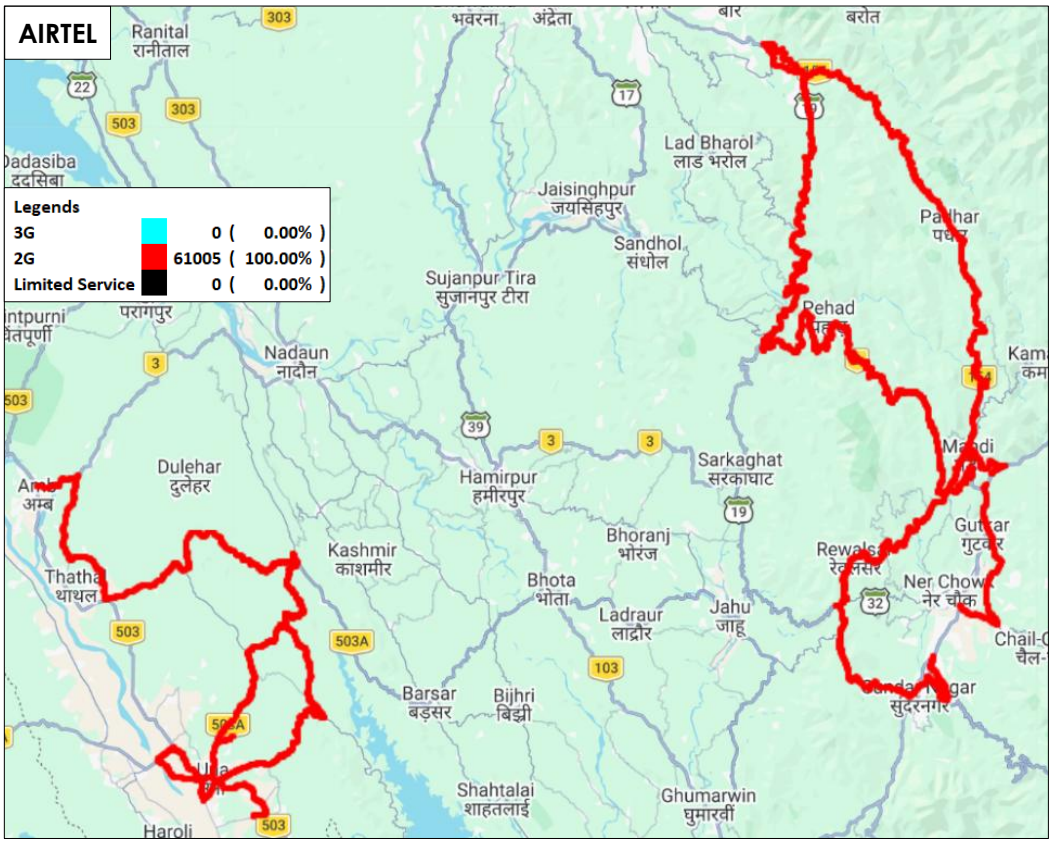


Figure-9: Serving technology plots 3G/2G network mode - AIRTEL.

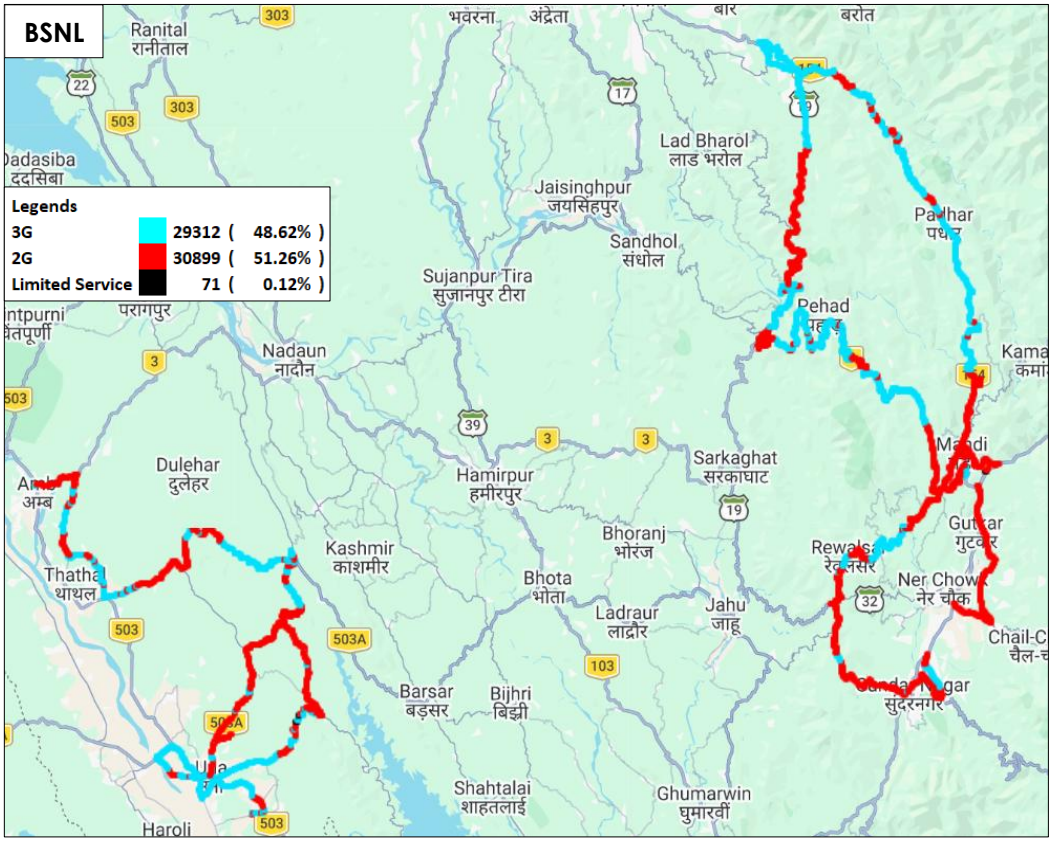


Figure-10: Serving technology plots 3G/2G network mode - BSNL.

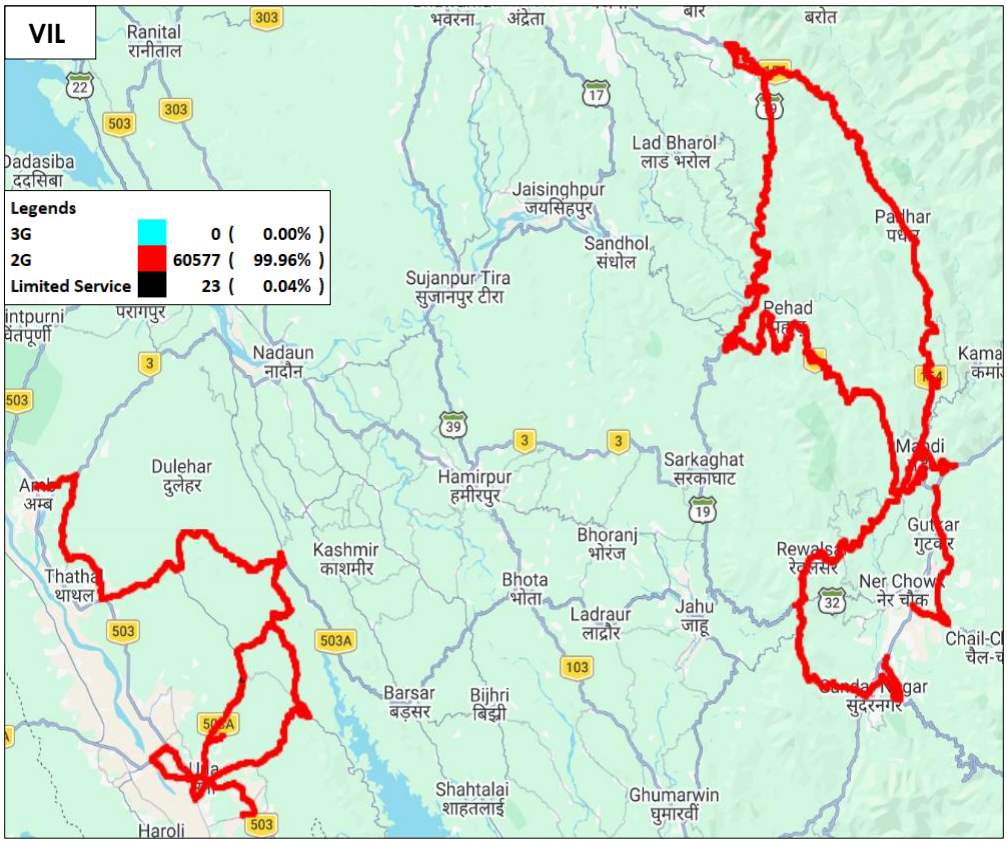


Figure-11: Serving technology plots 3G/2G network mode - VIL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 130, 131 & 132 for map view)

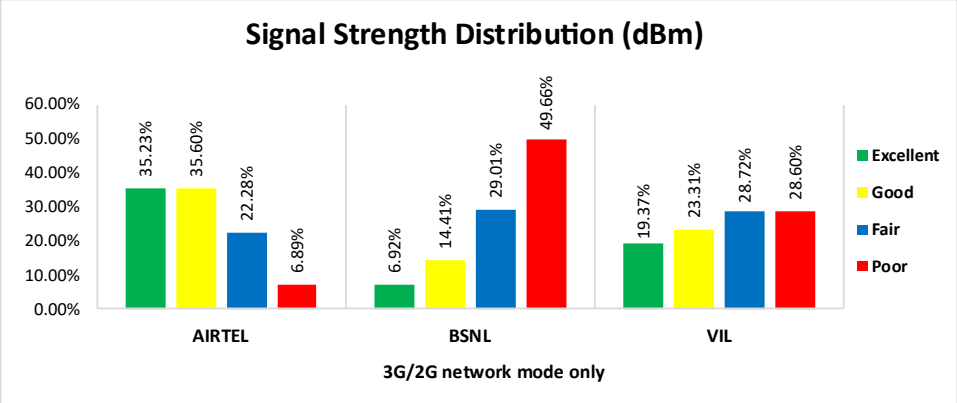


Figure-12: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 35% of samples falling in the excellent signal strength category.
- BSNL has 7% of samples falling in the excellent signal strength category.
- VIL has 19% 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	572	622	566	577
Call Setup Success Rate %	99.65	86.50	99.82	97.05
Drop Call Rate %	0.88	9.11	0.53	2.32
Call Setup Time Average (Second)	0.59	3.12	0.76	1.67
Handover Success Rate %	99.69	99.48	99.87	99.76

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

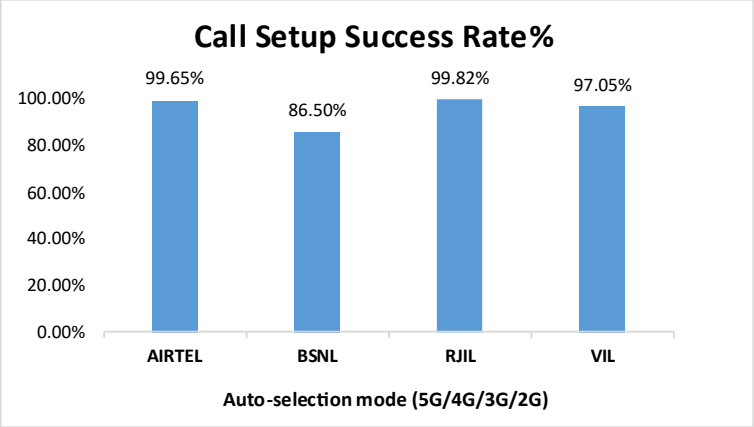


Figure-13: Performance for call setup success rate.

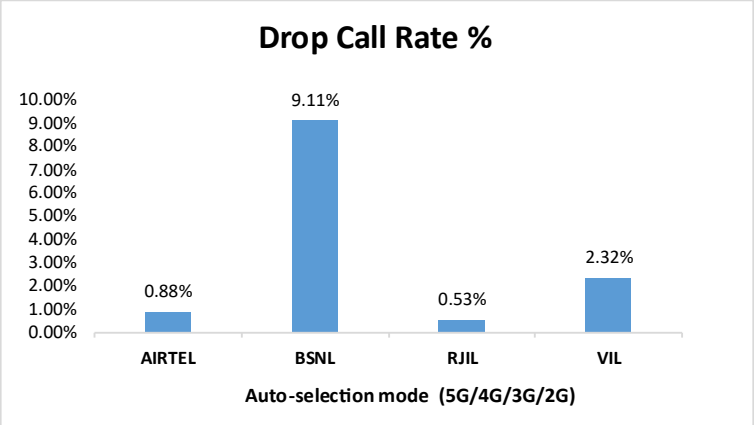


Figure-14: Performance for drop call rate.

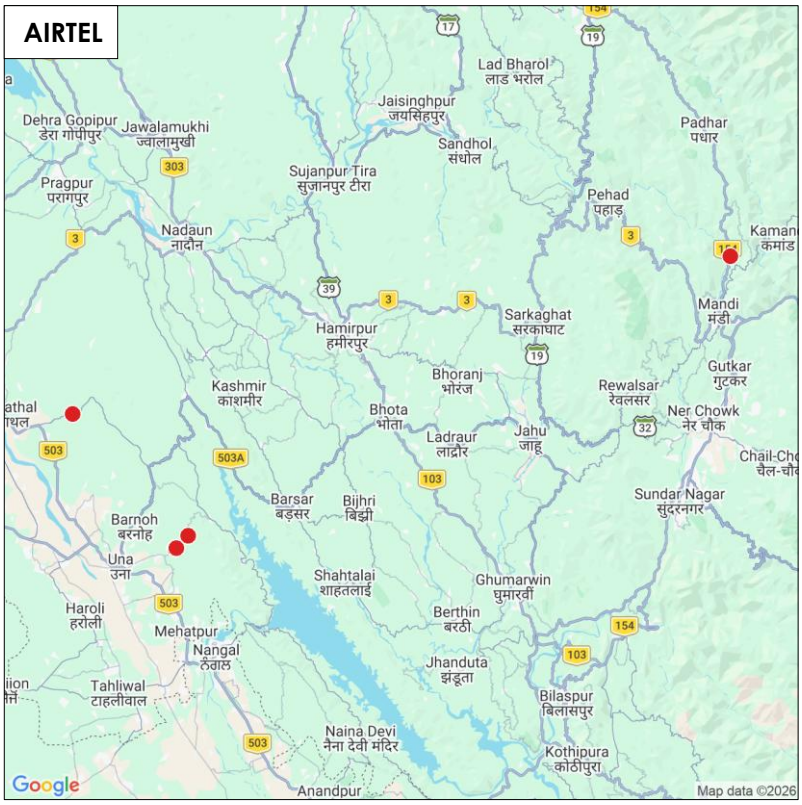


Figure-15: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

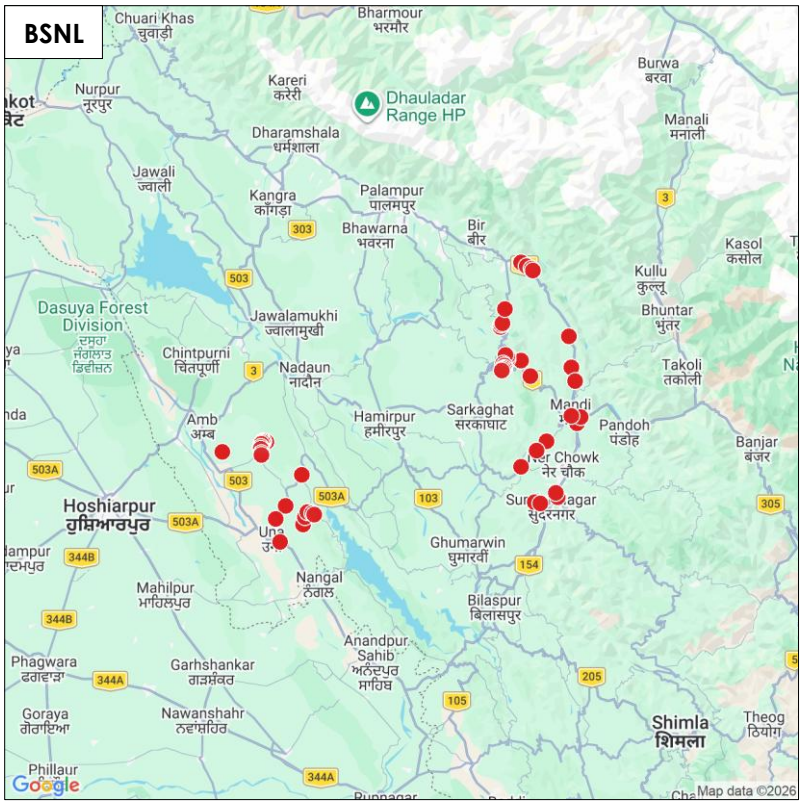


Figure-16: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

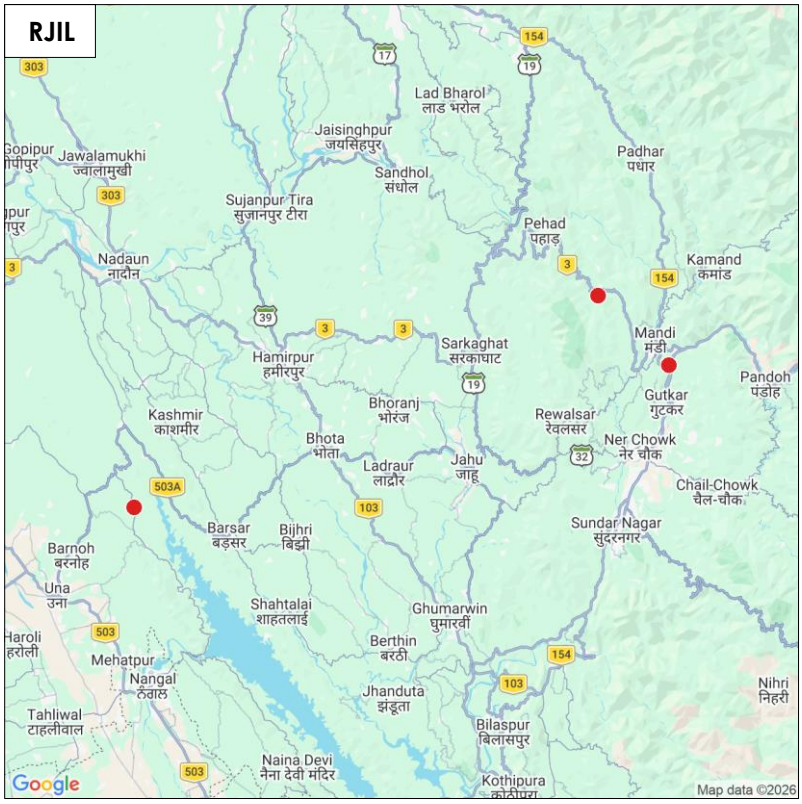


Figure-17: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

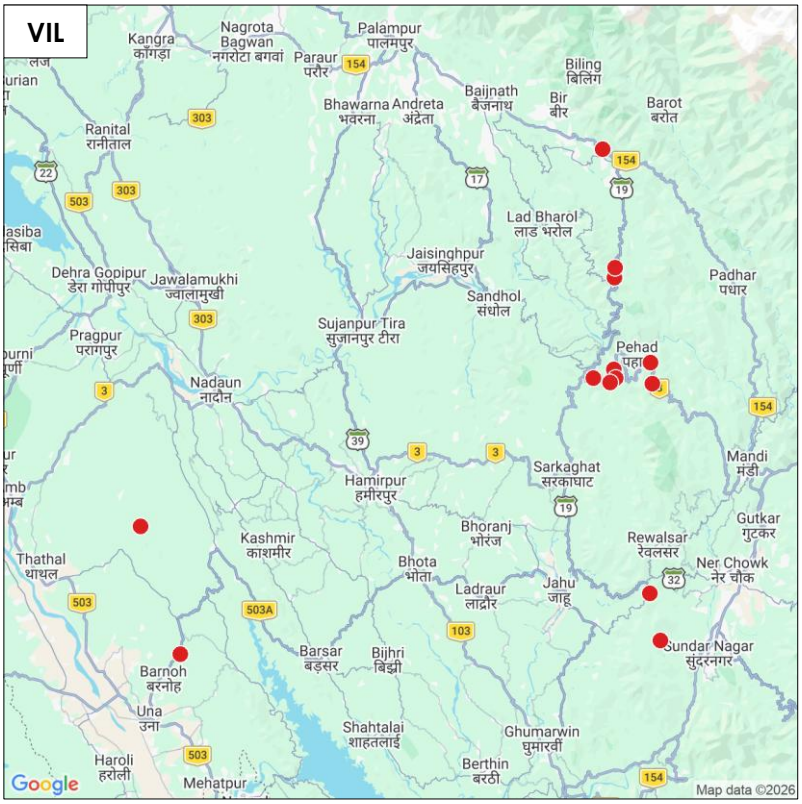


Figure-18: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - VIL.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G – Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	536	433	539	497
Number of silences call for >4 Sec	5	1	4	9
Silence Call Rate %	0.93	0.23	0.74	1.81
Number of silence instances for >4 Sec	6	1	4	9
Number of silence instances for >3 Sec	15	4	9	12
Number of silence instances for >2 sec	32	9	18	19
RTP Jitter (4G & 5G) in ms	3.98	5.17	14.99	15.22
Packet loss Rate Downlink %	1.71	3.76	0.96	1.29
Packet loss Rate Uplink %	1.81	3.98	1.04	1.19

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

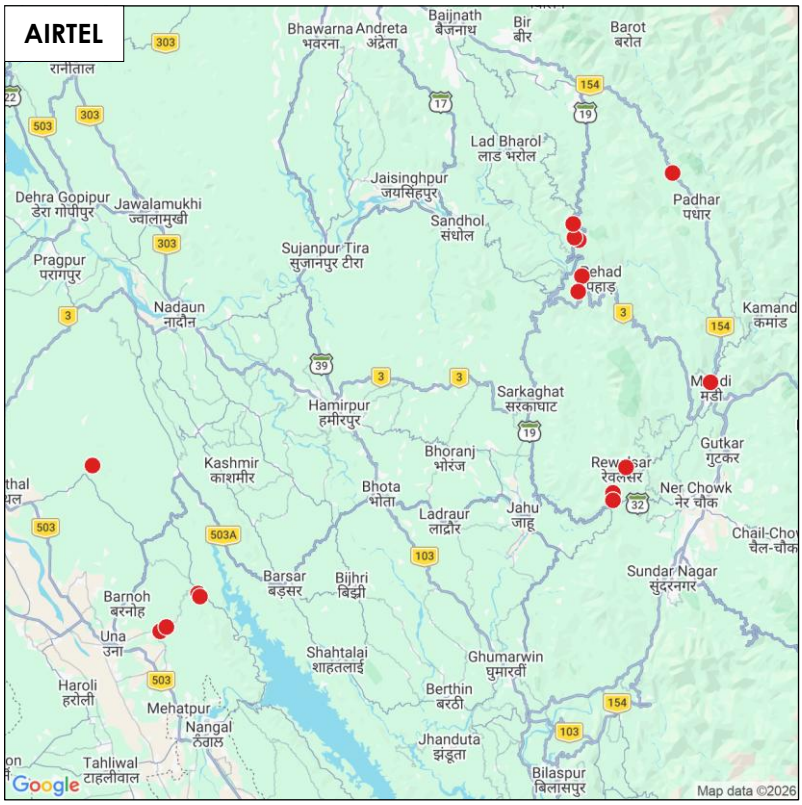


Figure-19: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - AIRTEL.

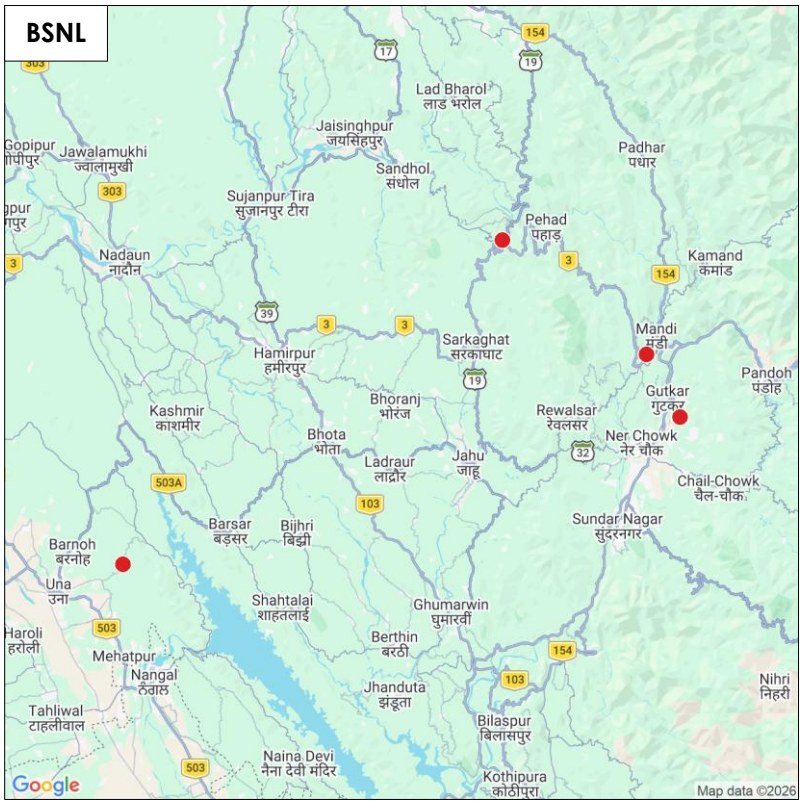


Figure-20: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - BSNL.

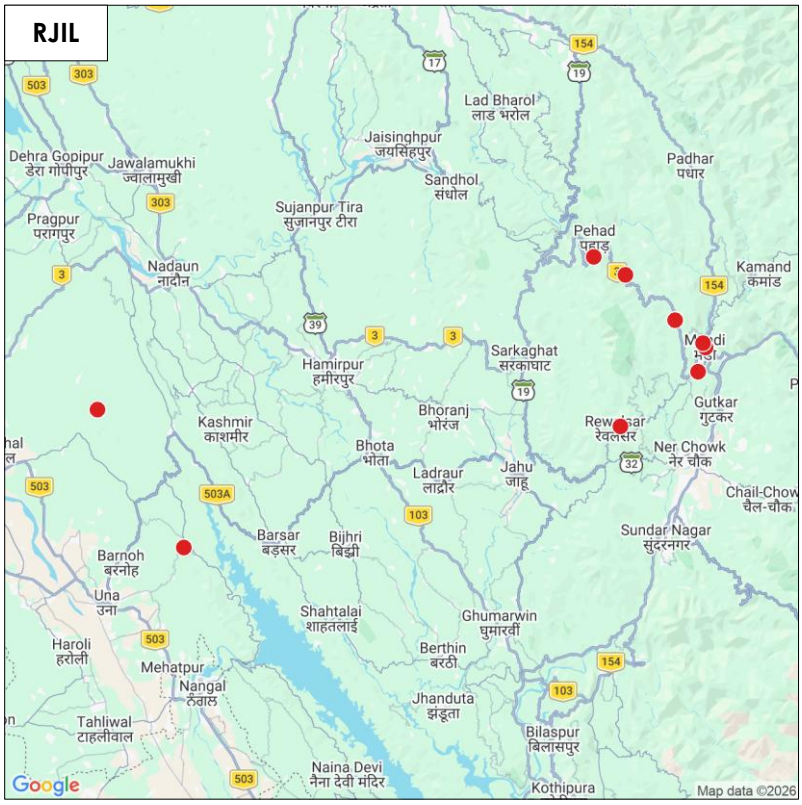


Figure-21: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - RJIL.

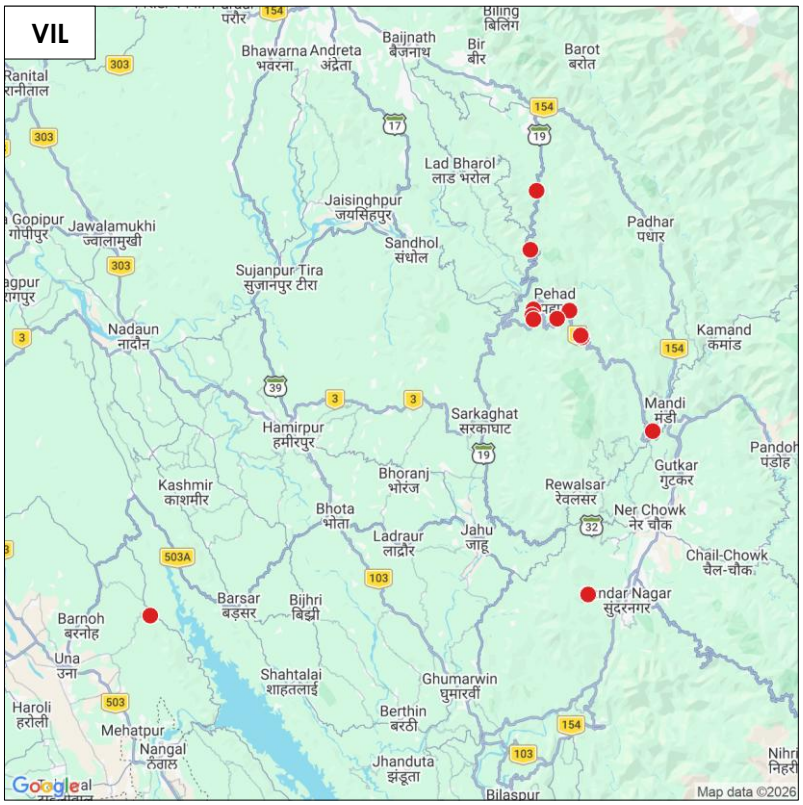


Figure-22: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - VIL.

(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	3367	2497	3592	3317
Speech Quality (Average MOS)	3.90	2.92	4.47	3.87
Number of samples with MOS >=4 to <5 (Excellent)	2714	634	3118	2054
Number of samples with MOS >=3 to <4 (Good)	435	462	314	1091
Number of samples with MOS >=2 to <3 (Fair)	57	955	86	82
Number of samples with MOS >=1 to <2 (Poor)	161	446	74	90
%age of samples with MOS >=4 to <5 (Excellent)	80.61%	25.39%	86.80%	61.92%
%age of samples with MOS >=3 to <4 (Good)	12.92%	18.50%	8.74%	32.89%
%age of samples with MOS >=2 to <3 (Fair)	1.69%	38.25%	2.39%	2.47%
%age of samples with MOS >=1 to <2 (Poor)	4.78%	17.86%	2.06%	2.71%

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

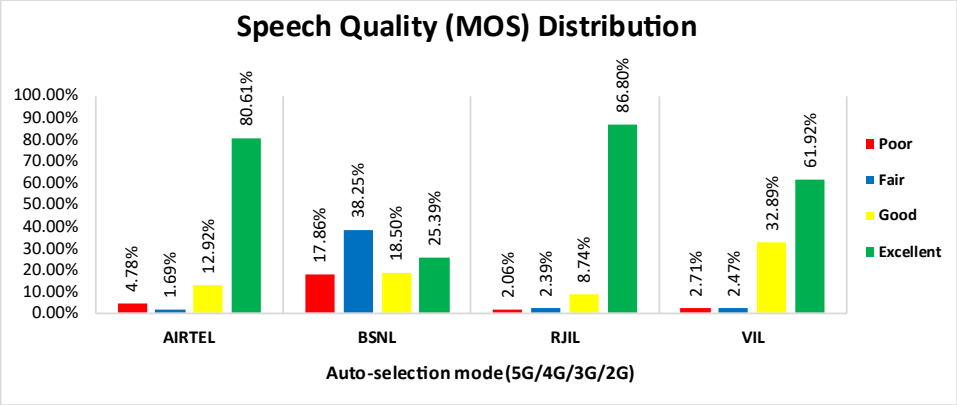


Figure-23: Distribution of samples in MOS range.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	7.02%	NA	57.15%	NA
4G	92.93%	54.44%	42.82%	83.78%
3G	NA	24.46%	NA	NA
2G	0.00%	20.07%	NA	15.96%
Limited Service	0.05%	1.02%	0.04%	0.26%

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.

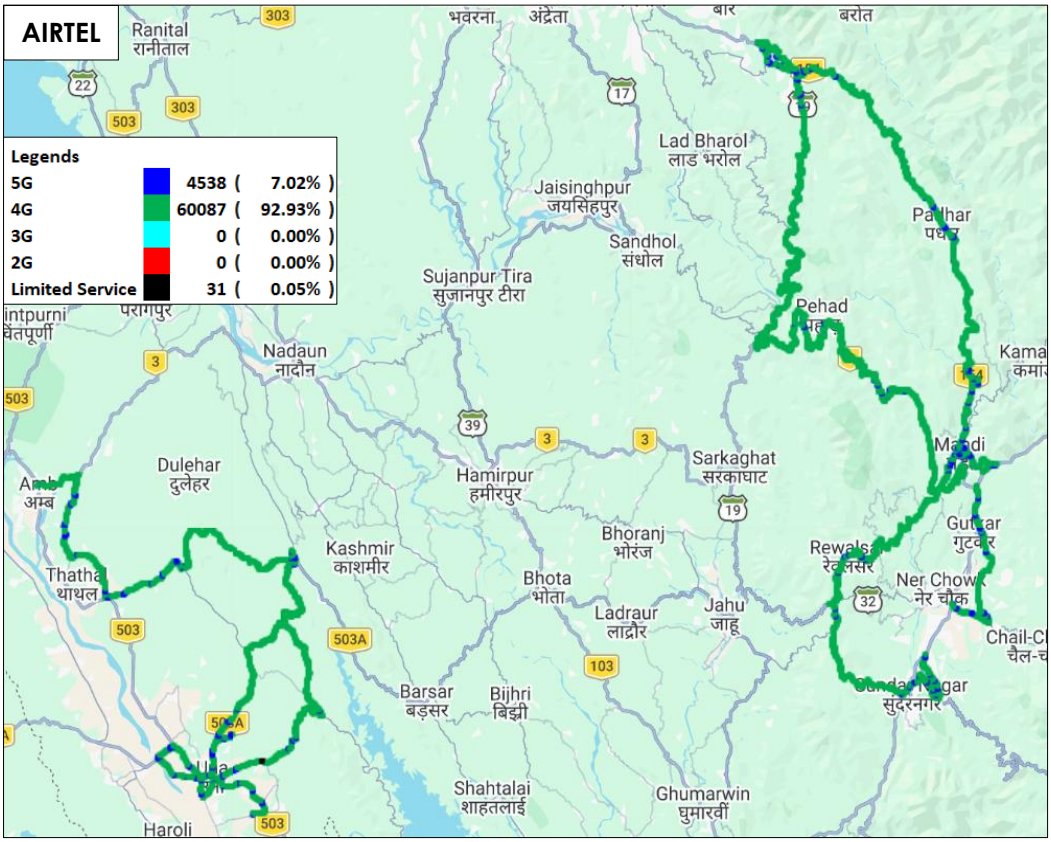


Figure-24: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

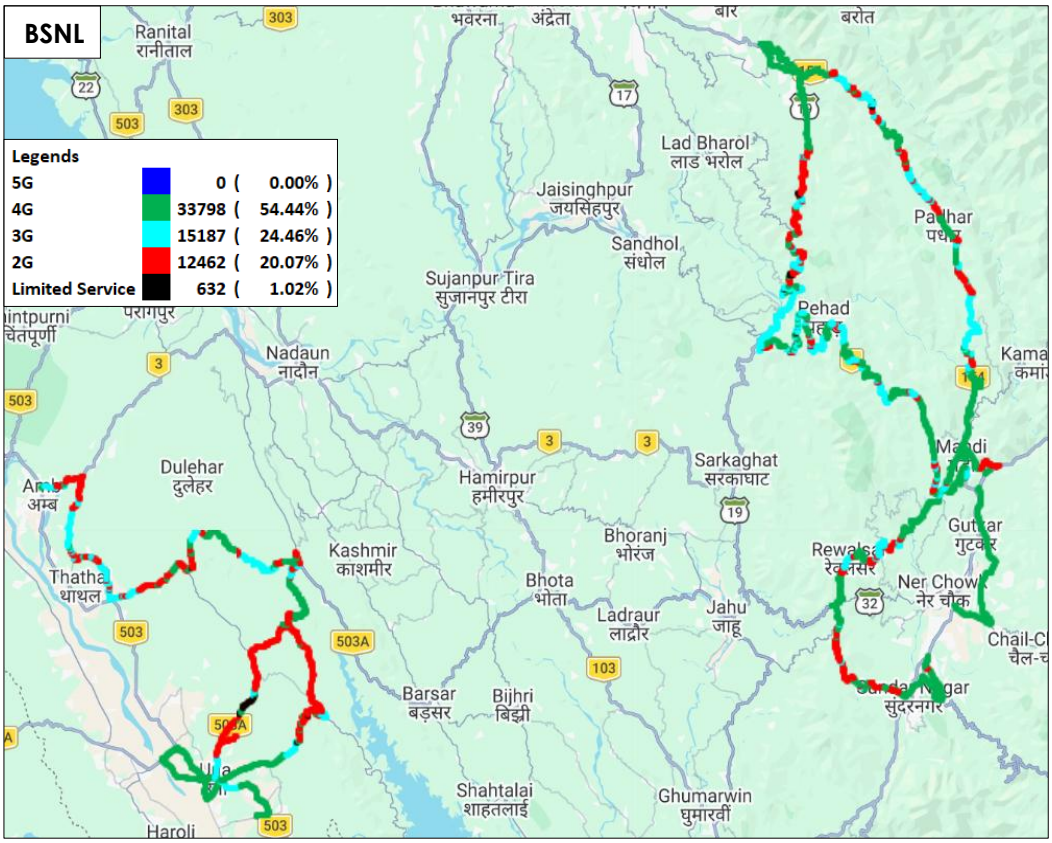


Figure-25: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

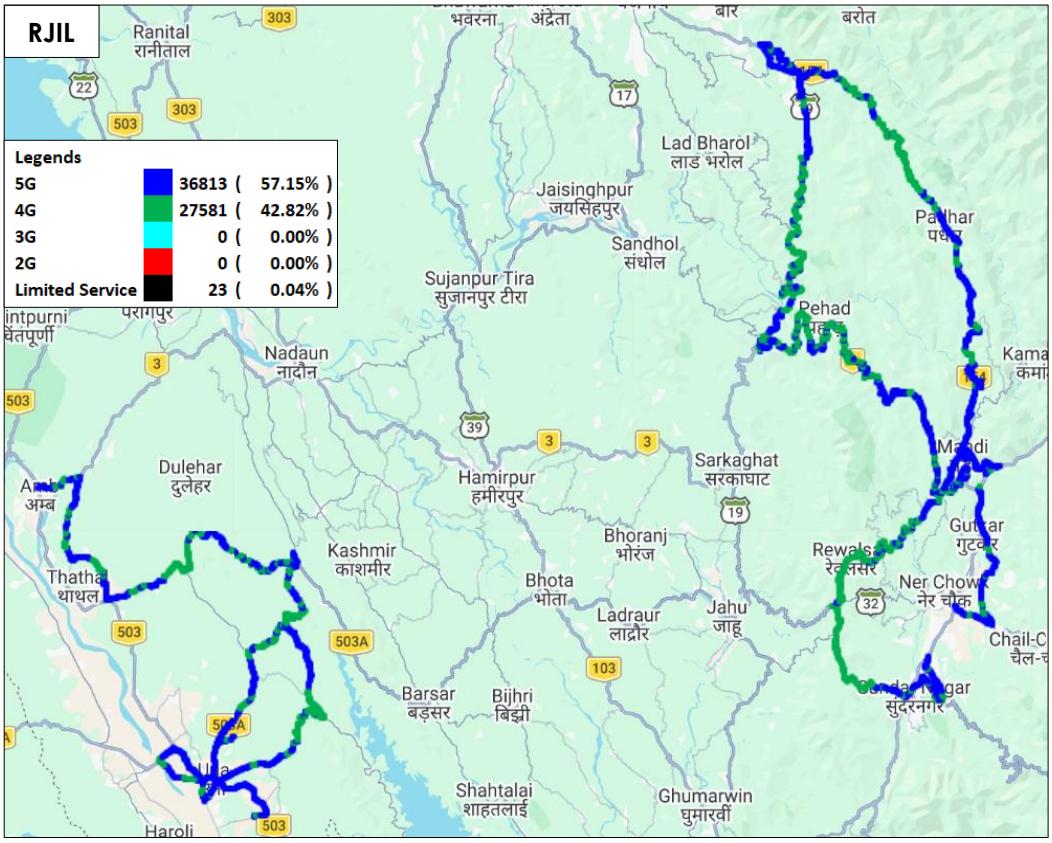


Figure-26: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

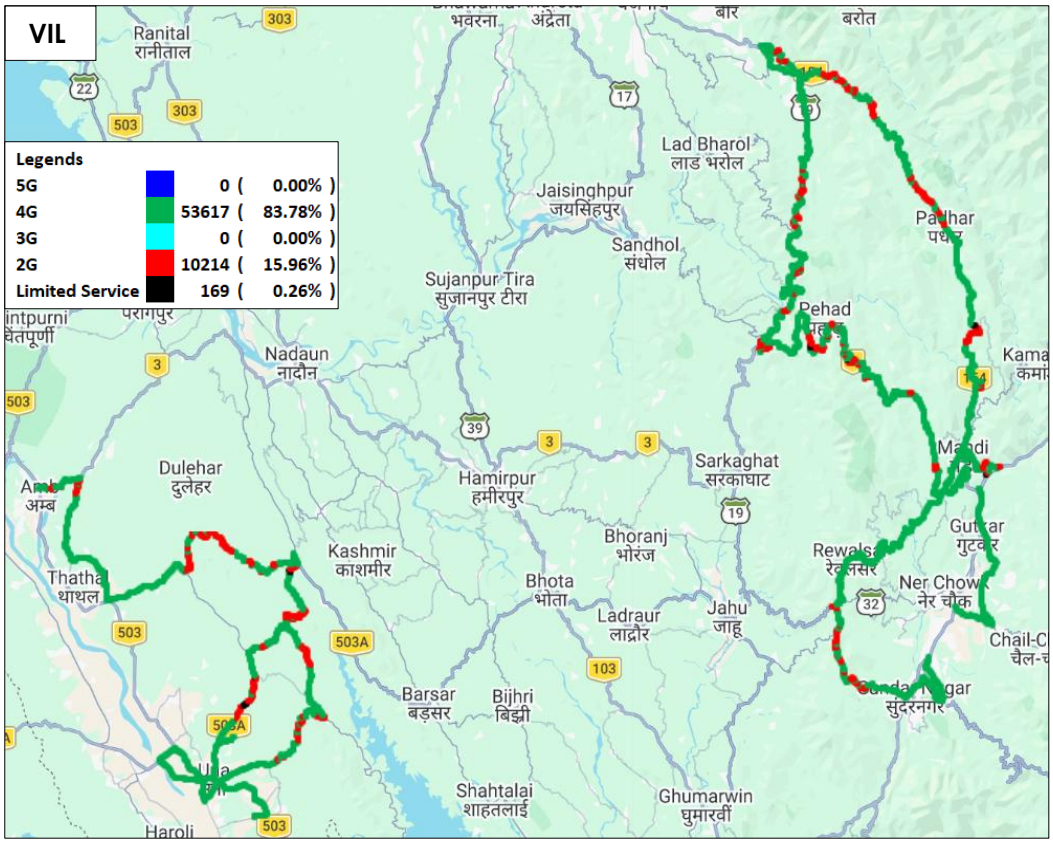


Figure-27: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-133, 134, 135 & 136 for map view)

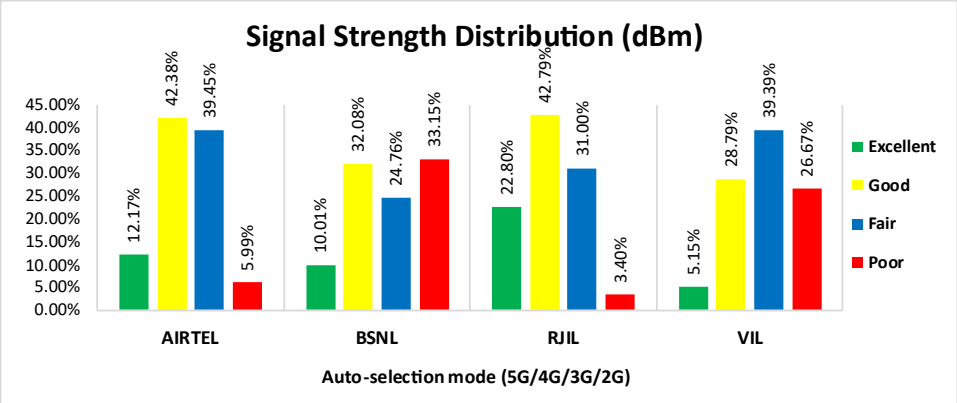


Figure-28: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 12% of samples falling in the excellent signal strength category.
- BSNL has 10% of samples falling in the excellent signal strength category.
- RJIL has 23% of samples falling in the excellent signal strength category.
- VIL has 5% of samples falling in the excellent signal strength category.

(h) Coverage Gap observed

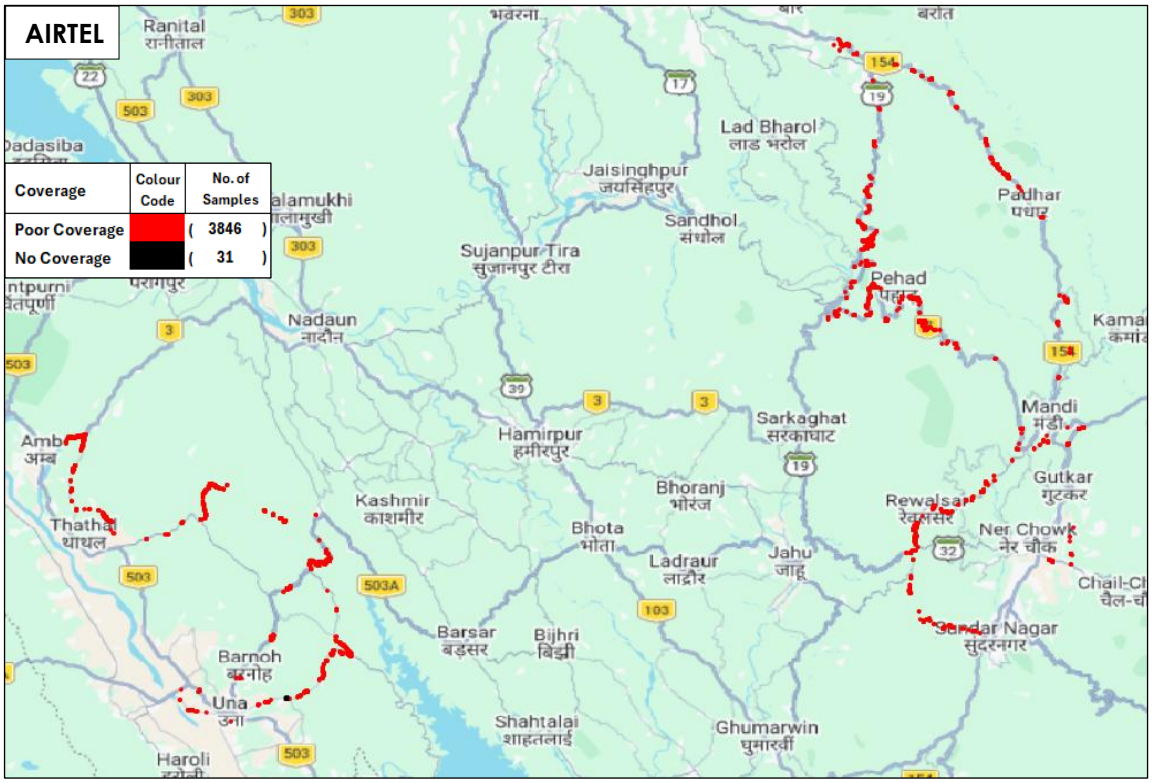


Figure-29: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

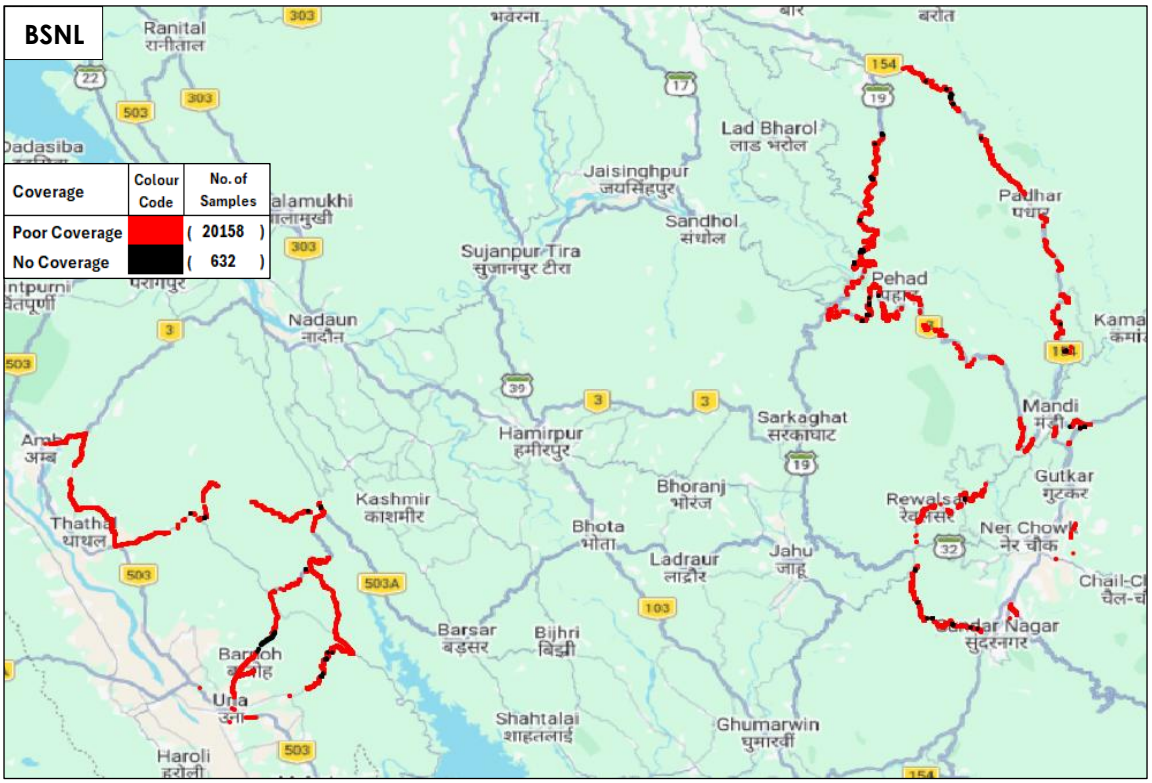


Figure-30: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

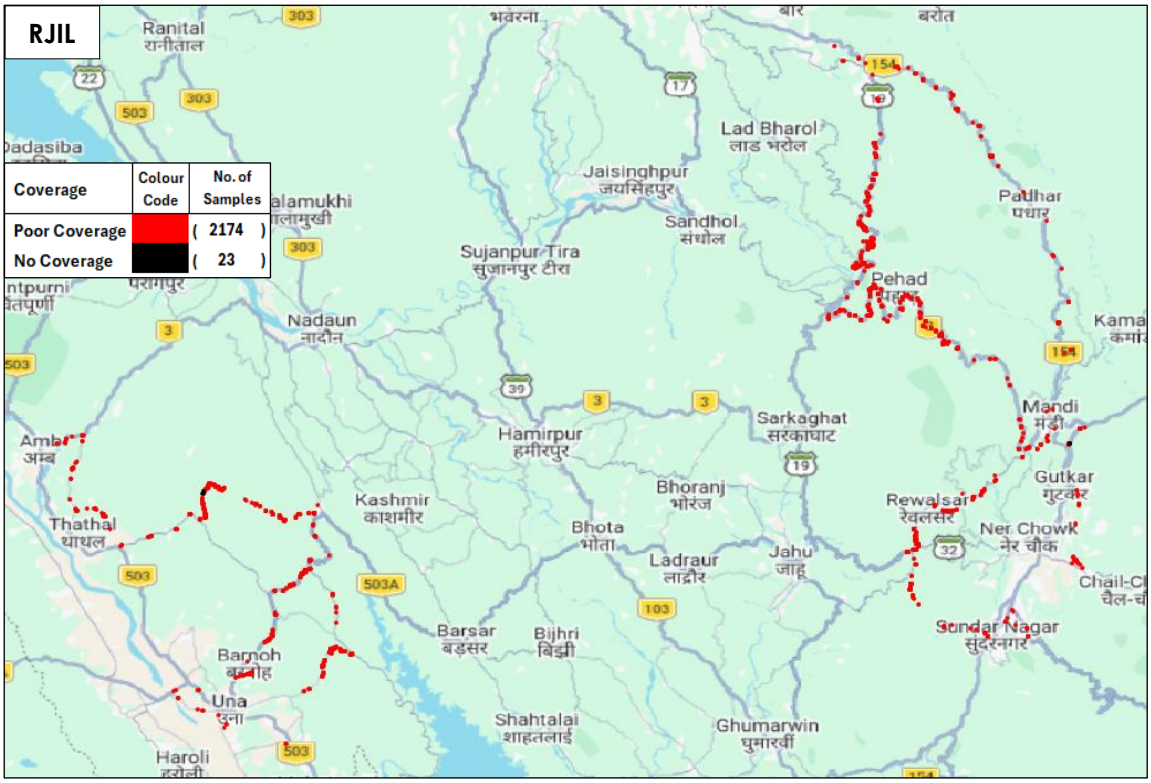


Figure-31: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

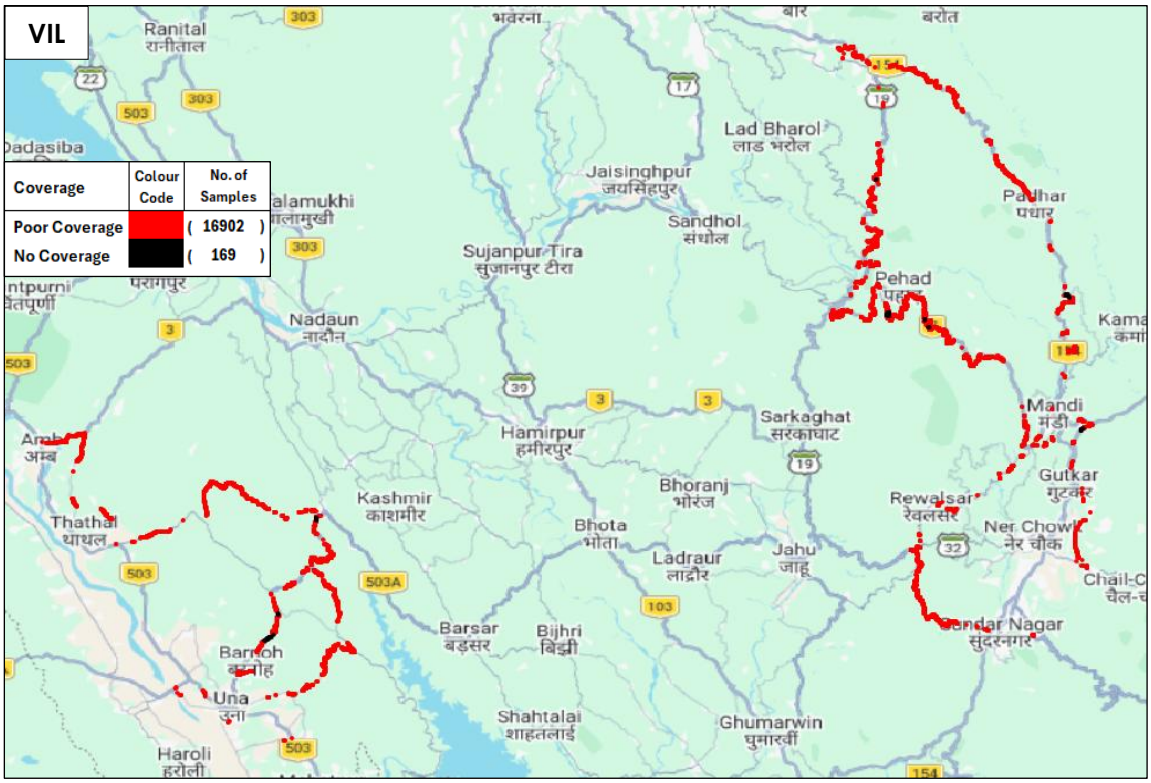


Figure-32: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - VIL.

4.2.4 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	122.28	9.49	171.68	12.18
	80th Percentile	207.17	15.74	306.01	18.73
	20th Percentile	19.31	2.19	20.24	4.36
Upload Throughput (Mbits/s)	Average	13.44	4.57	18.01	5.45
	80th Percentile	18.99	7.65	30.71	8.25
	20th Percentile	2.25	0.85	2.65	1.81
Latency (ms)	50th Percentile	46.18	30.16	27.89	44.66

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

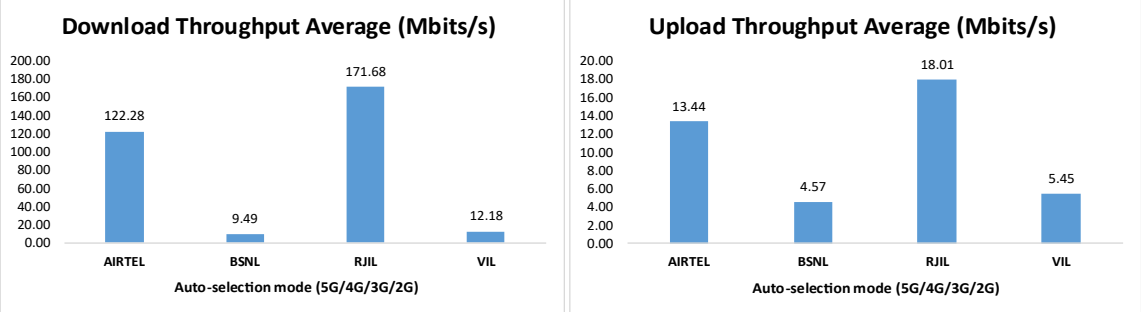


Figure- 33: Download & Upload throughput.

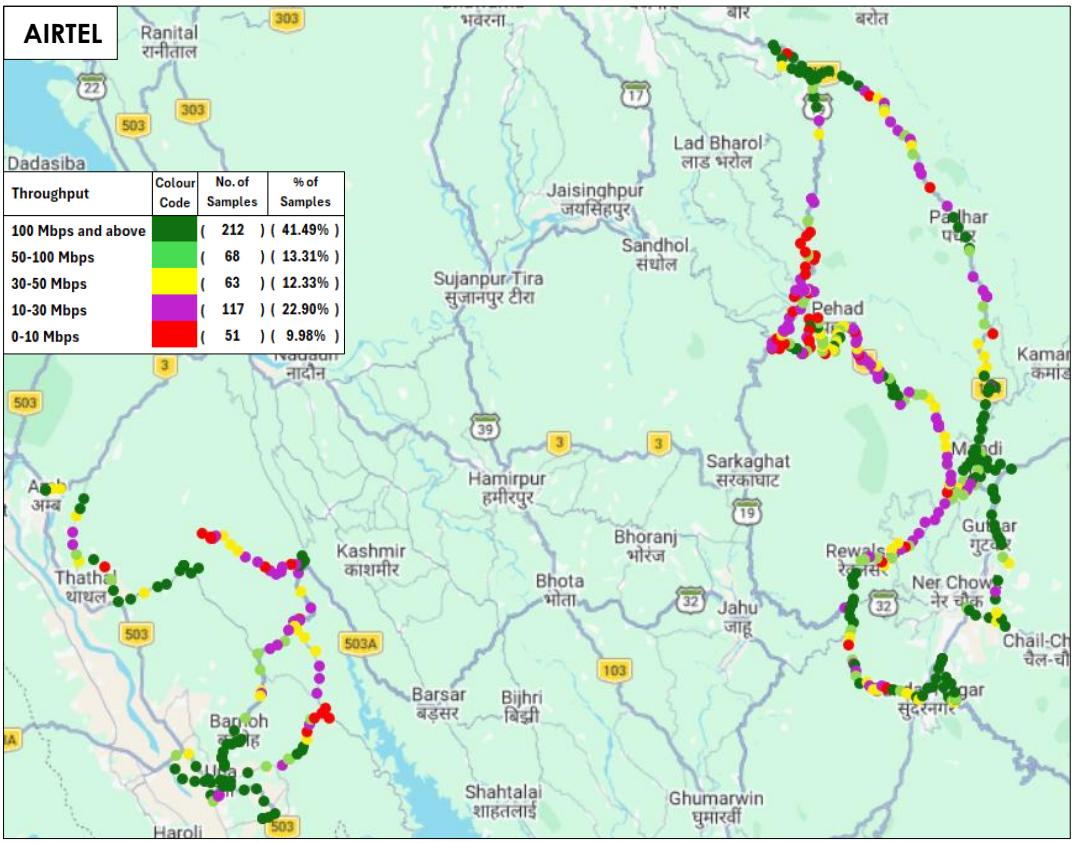


Figure-34: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

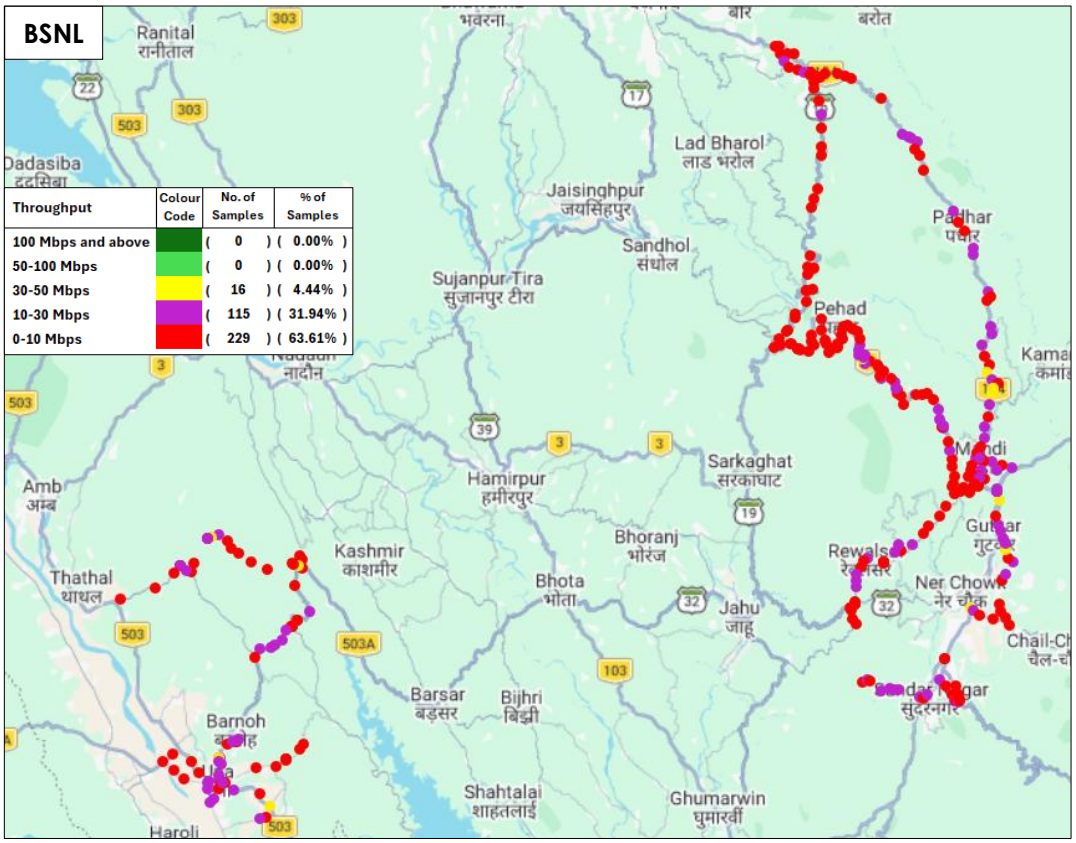


Figure-35: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

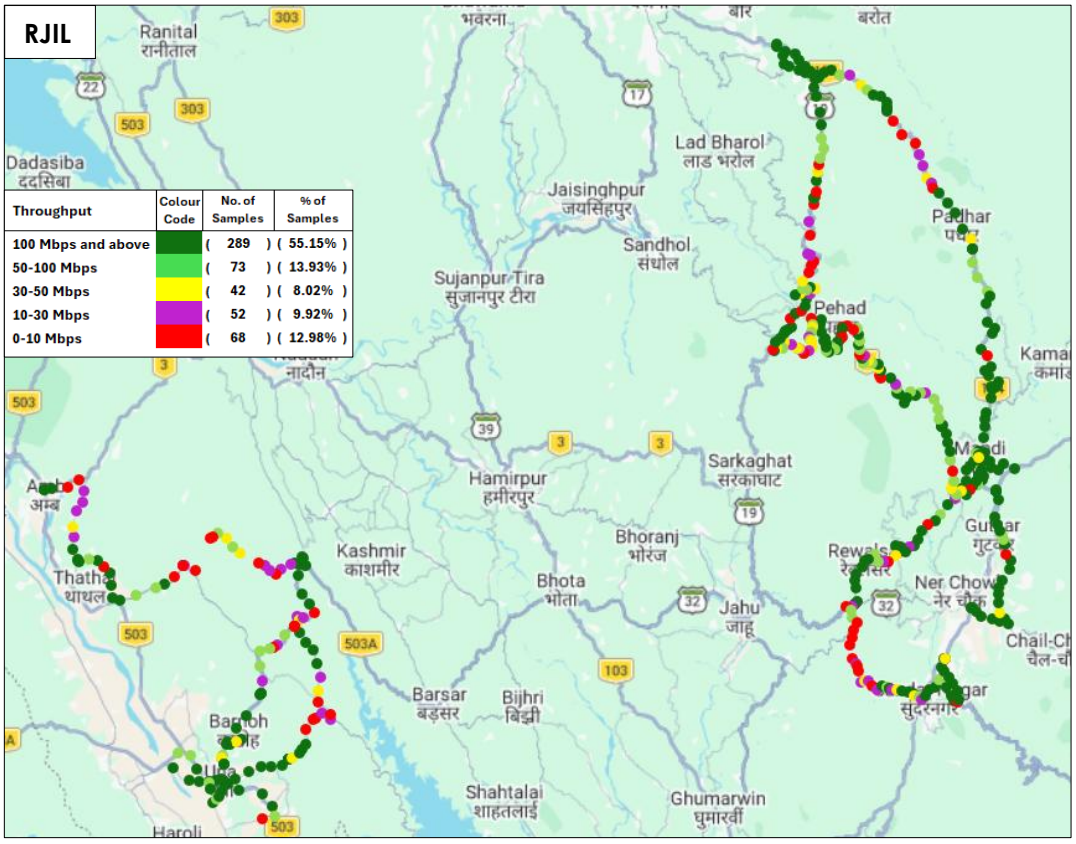


Figure-36: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

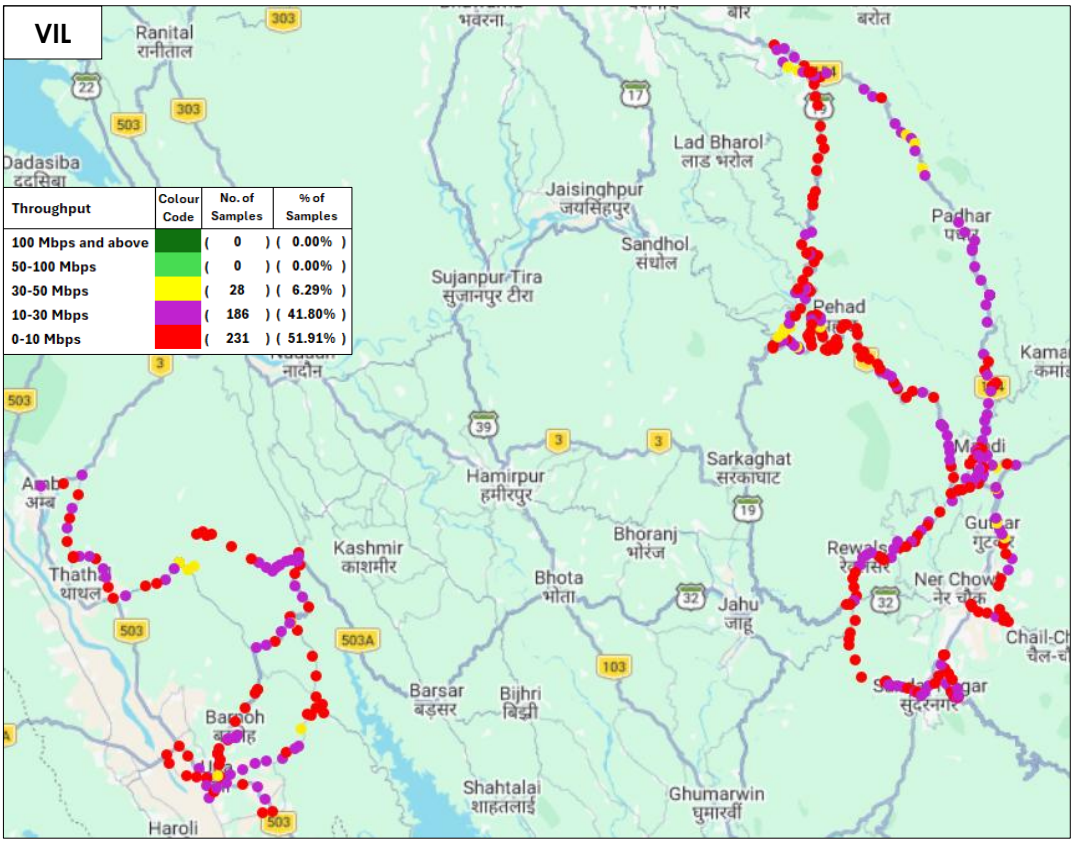


Figure-37: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

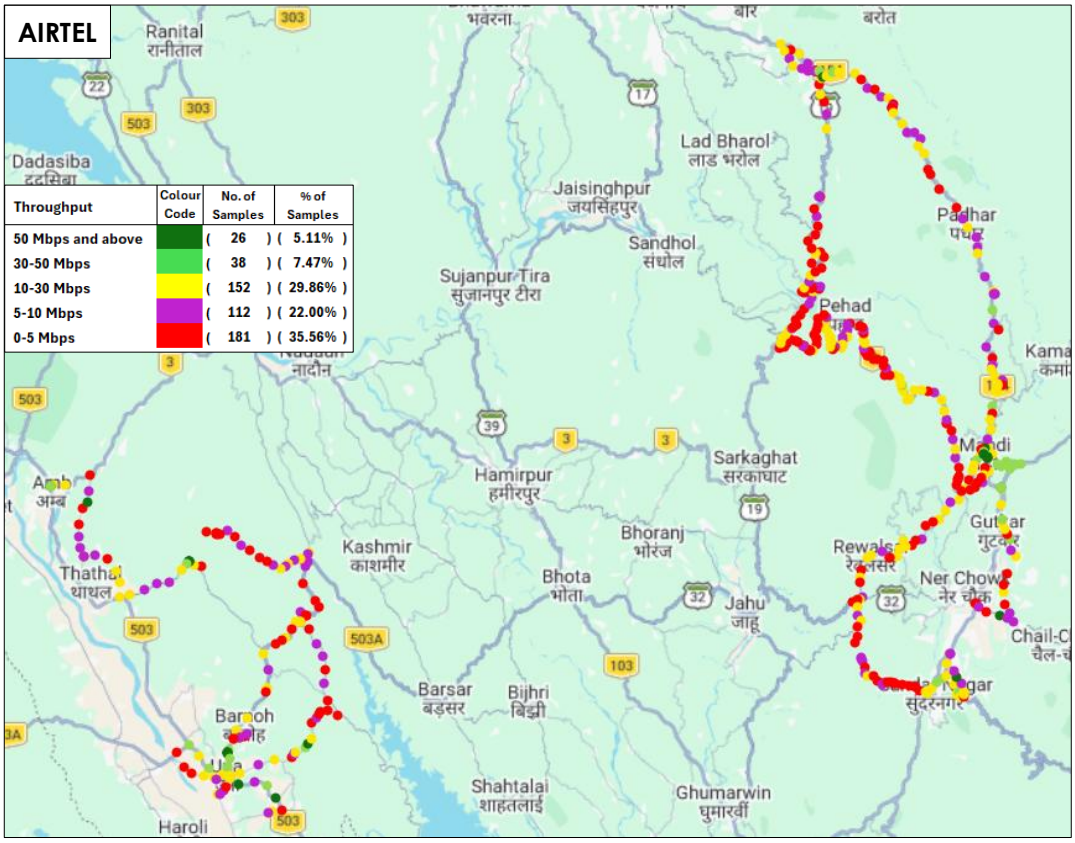


Figure-38: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

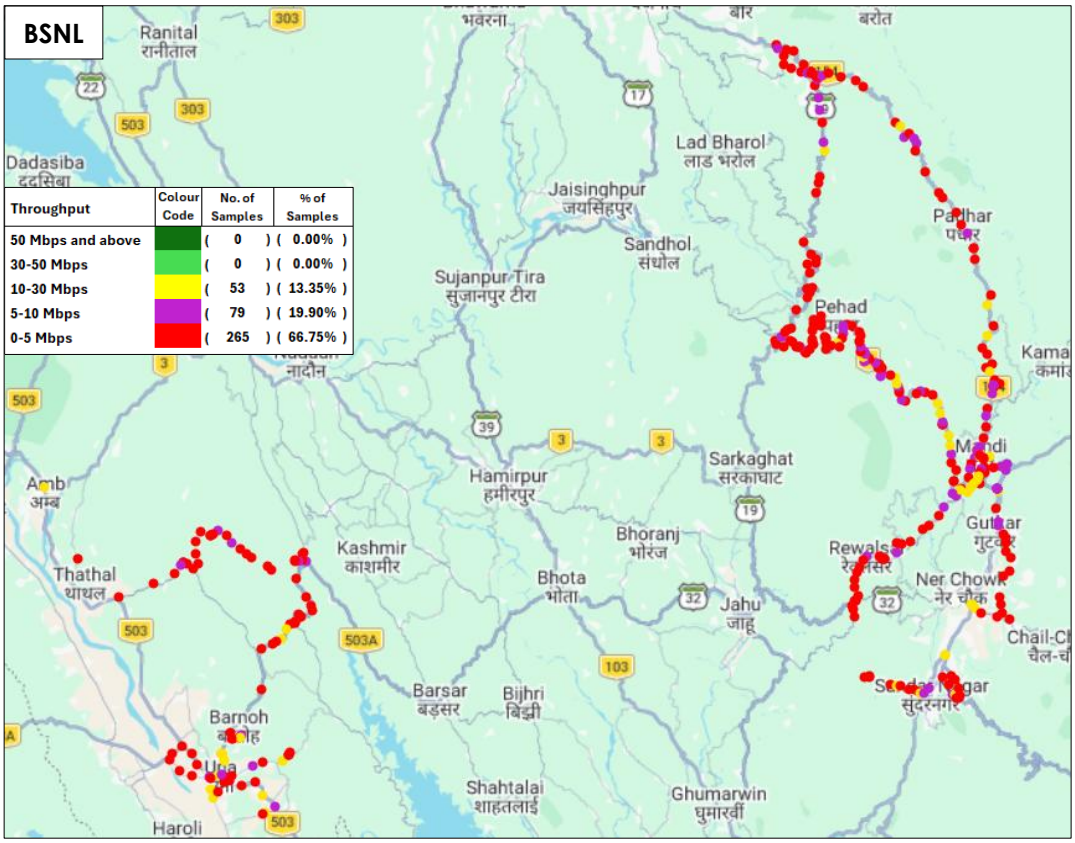


Figure-39: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) – BSNL.

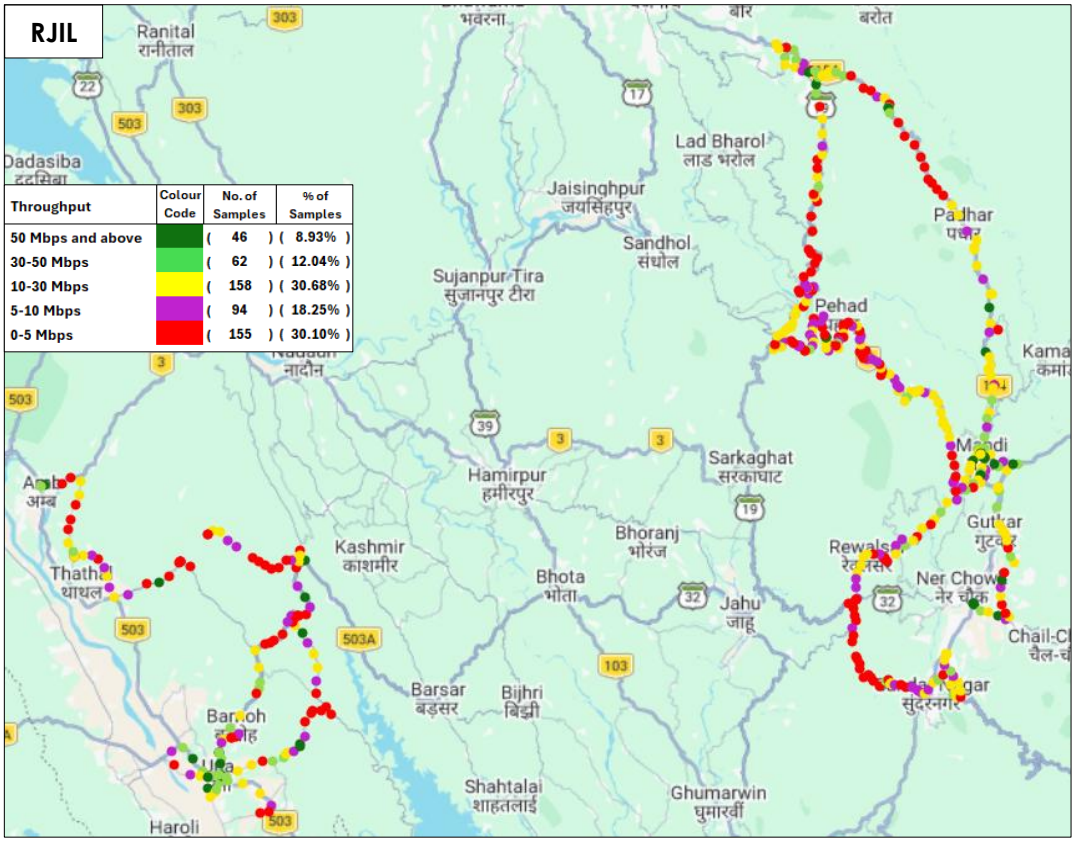


Figure-40: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

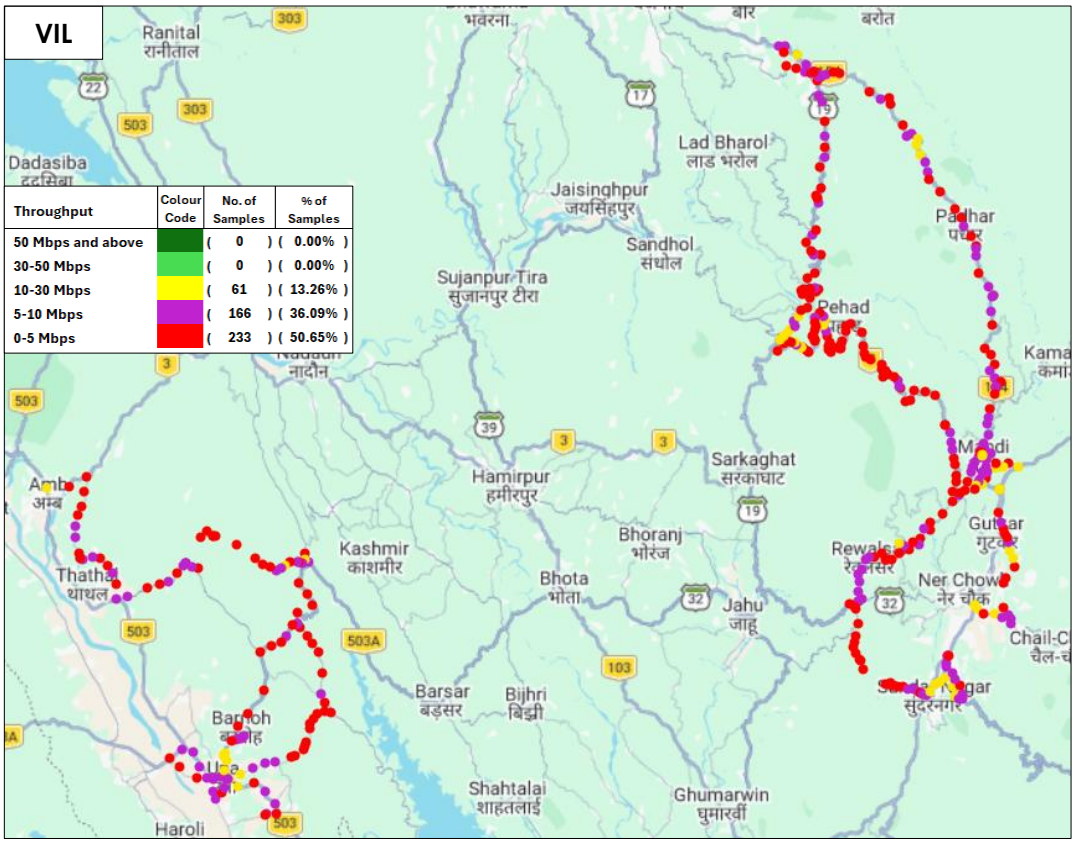


Figure-41: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	41.33%	NA	73.78%	NA
4G	58.11%	78.53%	26.17%	88.43%
3G	NA	14.32%	NA	NA
2G	0.02%	2.45%	NA	10.34%
Limited Service	0.54%	4.69%	0.05%	1.23%

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.

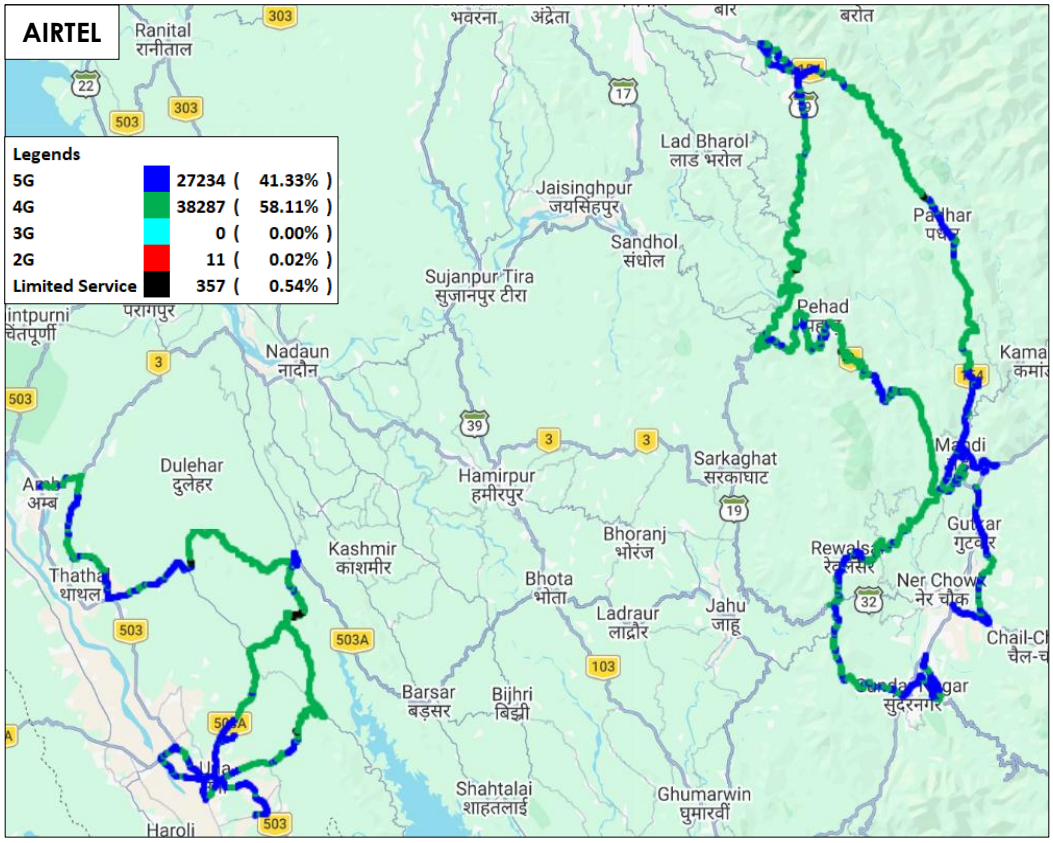


Figure-42: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

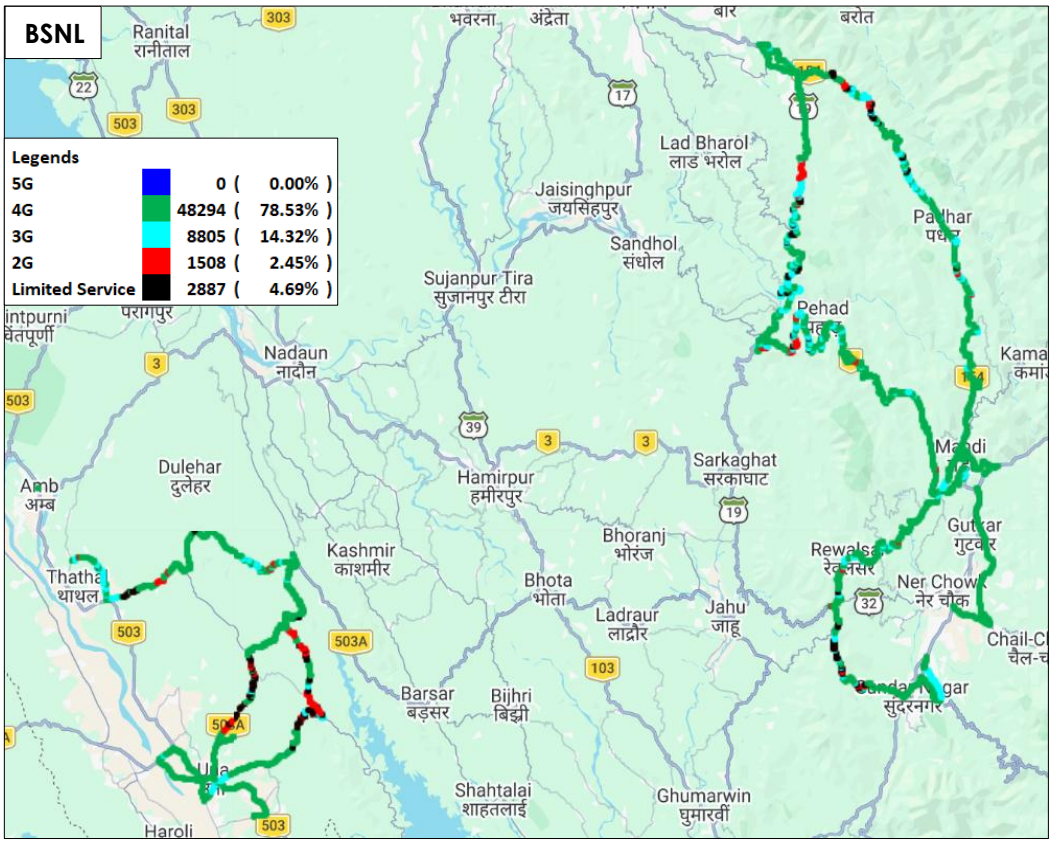


Figure-43: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - BSNL.

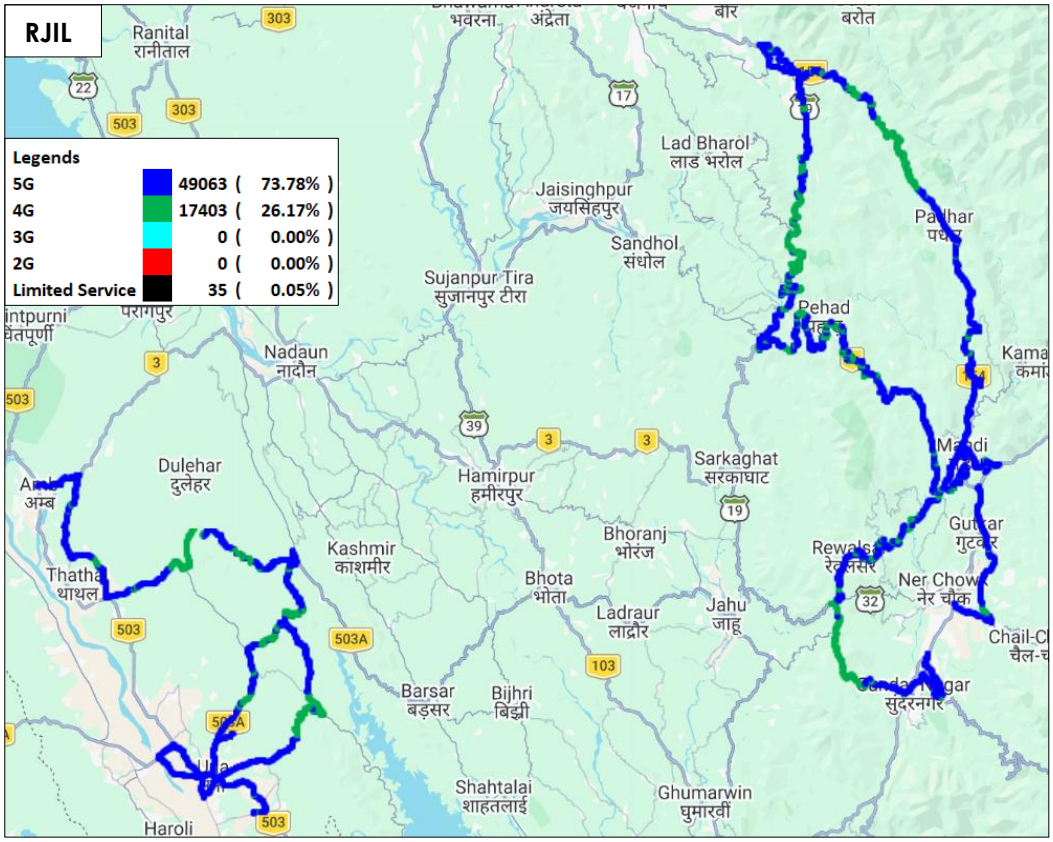


Figure-44: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - RJIL.

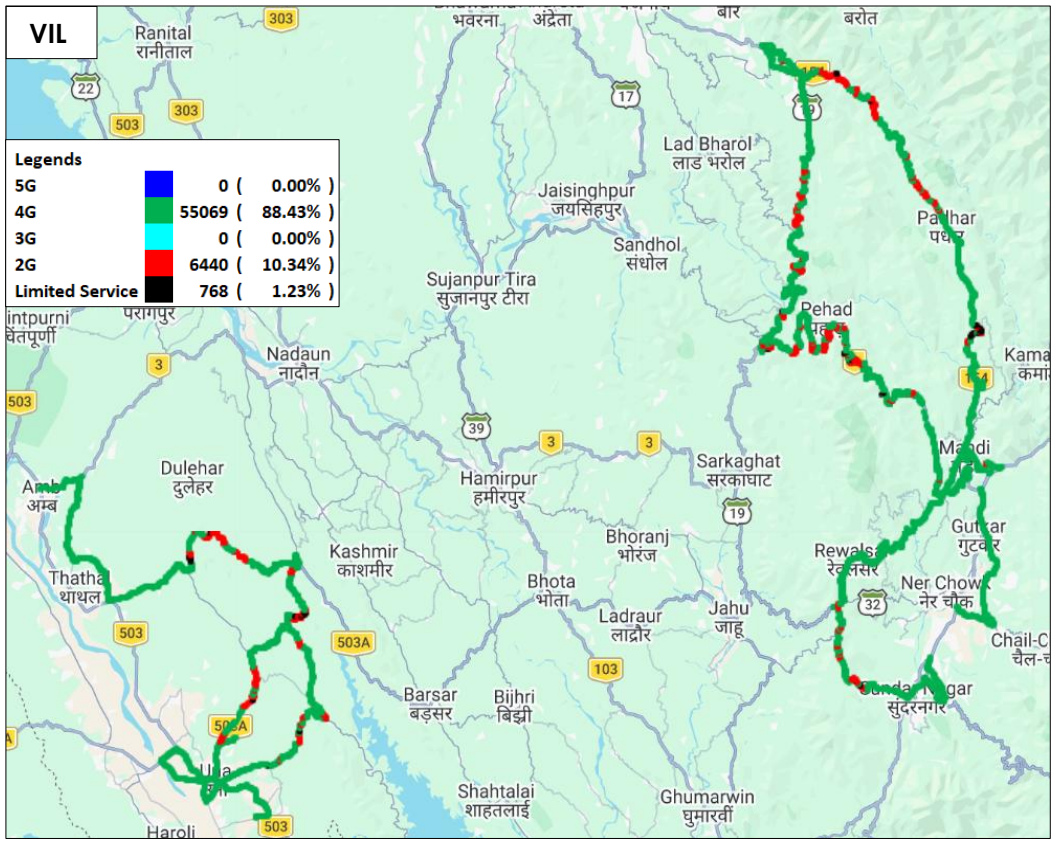


Figure-45: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-137, 138, 139 & 140 for map view)

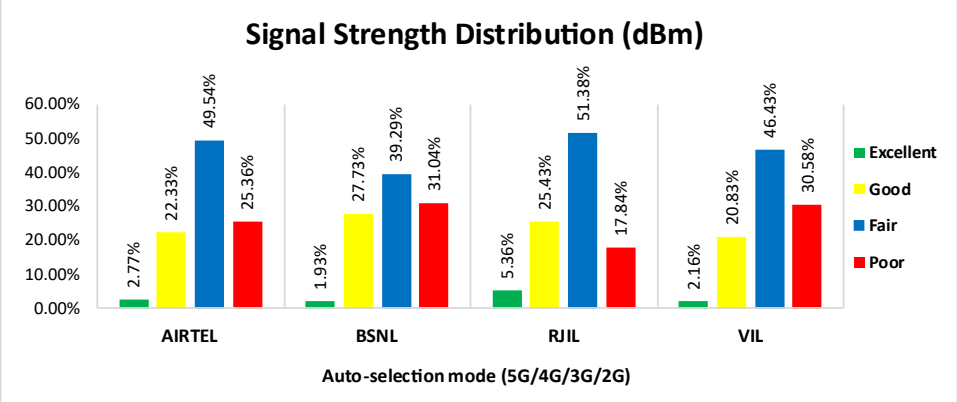


Figure-46: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 3% of samples falling in the excellent signal strength category.
- BSNL has 2% of samples falling in the excellent signal strength category.
- RJIL has 5% of samples falling in the excellent signal strength category.
- VIL has 2% of samples falling in the excellent signal strength category.

4.3 Hotspots

Hotspot testing has been done on 17th September 2026 and 18th September 2026. Six locations have been tested in the Una & Mandi. (Refer Table-1)

4.3.1 Locations

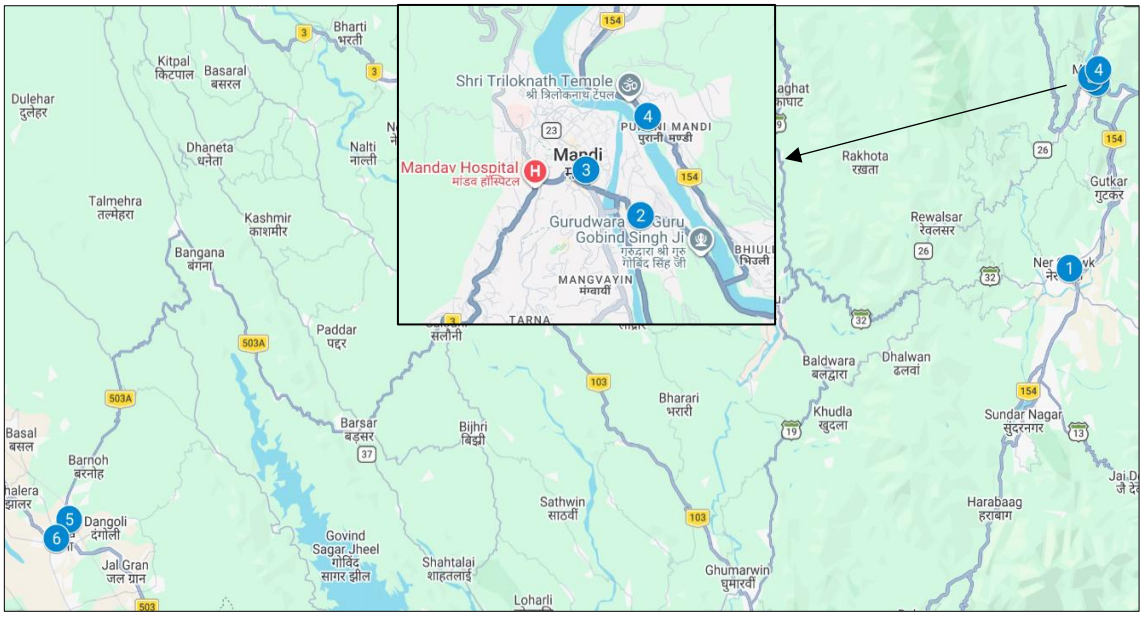


Figure- 47: Hotspot locations.

4.3.2 Hotspot covered

1. Lal Bahadur Shastri Government Hospital Mandi
2. Mandi Bus Stand
3. Mandi Mall Road
4. Purani Mandi-Mandi
5. Regional Hospital Una
6. Una Bus Stand

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	90.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.42	1.87	0.51	1.15

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

Lal Bahadur Shastri Government Hospital Mandi				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	80.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.41	1.90	0.53	1.11

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

Mandi Bus Stand				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.53	2.28	0.52	1.11

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

Mandi Mall Road				
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)	0.34	1.56	0.48	1.21

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

Purani Mandi-Mandi				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.50	2.37	0.54	1.08

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

Regional Hospital Una				
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	70.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.30	1.49	0.50	1.17

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

Una Bus Stand				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	90.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.45	1.46	0.50	1.24

Table-27: 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)	254.20	7.06	246.53	17.32
Download Throughput 80th Percentile (Mbit/s)	356.54	10.46	449.08	29.12
Download Throughput 20th Percentile (Mbit/s)	165.22	3.87	83.23	5.02
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	44.65	4.79	36.99	7.01
Upload Throughput 80th Percentile (Mbit/s)	61.83	8.80	76.71	8.36
Upload Throughput 20th Percentile (Mbit/s)	30.17	1.64	9.97	5.14
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	9.11	3.64	4.20	2.52
Youtube Initial Buffer Delay (Second)	4.04	1.68	0.98	1.24
Latency (ms) – 50th Percentile	38.74	32.66	26.39	45.50
Jitter (ms)	4.15	7.12	6.92	11.52
Packet Loss Rate%	0.22	1.32	1.42	0.35
Packet Loss Rate- 90th percentile	0.76	2.00	2.74	0.60

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

Lal Bahadur Shastri Government Hospital Mandi				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	408.01	5.38	68.19	24.06
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	62.82	1.26	6.81	4.47
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	7.68	5.79	4.23	2.46
Youtube Initial Buffer Delay (Second)	2.38	2.92	0.86	0.90
Latency (ms) – 50th Percentile	48.36	41.24	26.51	43.96
Jitter (ms)	6.55	9.24	3.94	16.28
Packet Loss Rate%	0.40	1.70	0.00	0.20

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

Mandi Bus Stand				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	231.37	7.79	98.44	20.31
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	31.50	1.77	28.48	5.73
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	8.43	11.49	4.76	2.89
Youtube Initial Buffer Delay (Second)	4.59	-	0.95	0.94
Latency (ms) – 50th Percentile	39.60	50.53	26.60	45.39
Jitter (ms)	3.68	13.83	6.45	5.52
Packet Loss Rate%	0.40	1.90	1.20	0.40

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

Note- "-" Youtube tests were failed.

Mandi Mall Road				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	205.26	6.98	140.01	21.33
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	60.10	2.36	14.04	8.78
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	9.54	2.72	5.16	2.56
Youtube Initial Buffer Delay (Second)	3.49	1.58	1.21	1.27
Latency (ms) – 50th Percentile	41.35	30.78	24.80	49.15
Jitter (ms)	4.28	5.96	22.43	5.48
Packet Loss Rate%	0.30	0.60	7.30	0.20

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

Purani Mandi-Mandi				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	142.75	6.37	210.88	26.47
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	29.27	8.11	28.01	7.57
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	7.21	2.73	3.40	2.03
Youtube Initial Buffer Delay (Second)	4.28	1.25	0.96	0.94
Latency (ms) – 50th Percentile	36.45	33.68	26.17	45.04
Jitter (ms)	2.97	8.80	3.15	18.21
Packet Loss Rate%	0.10	2.50	0.00	0.20

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

Regional Hospital Una				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	239.49	6.20	587.69	4.18
Download Session Setup Success Rate%	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	48.49	4.58	77.62	8.45
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	15.62	2.56	3.84	2.85
Youtube Initial Buffer Delay (Second)	3.22	1.18	0.91	2.13
Latency (ms)- 50th Percentile	37.66	26.05	25.47	45.01
Jitter (ms)	5.26	2.50	2.37	6.98
Packet Loss Rate%	0.00	1.10	0.00	0.50

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

Una Bus Stand				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	298.32	9.65	373.96	7.61
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	35.71	10.67	66.96	7.05
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	10.70	2.11	3.73	2.36
Youtube Initial Buffer Delay (Second)	8.43	1.21	0.96	1.25
Latency (ms) – 50th Percentile	36.39	27.20	28.66	48.96
Jitter (ms)	2.18	2.45	3.31	16.66
Packet Loss Rate%	0.10	0.10	0.00	0.60

Table-34: 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)	275.26	-	240.70	-
	Upload Throughput Average (Mbits/s)	50.40	-	35.99	-
4G	Download Throughput Average (Mbits/s)	49.21	7.25	35.11	8.96
	Upload Throughput Average (Mbits/s)	17.29	6.14	9.91	8.40

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

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

Lal Bahadur Shastri Government Hospital Mandi					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	420.51	-	73.54	-
	Upload Throughput Average (Mbits/s)	70.09	-	6.12	-
4G	Download Throughput Average (Mbits/s)	24.22	8.62	1.59	20.57
	Upload Throughput Average (Mbits/s)	1.84	4.37	0.92	4.22

Table-36: Overall Summary of 5G only & 4G only data download & upload speed.

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

Mandi Bus Stand					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	115.08	-	94.50	-
	Upload Throughput Average (Mbits/s)	28.71	-	7.66	-
4G	Download Throughput Average (Mbits/s)	31.69	7.53	7.39	4.36
	Upload Throughput Average (Mbits/s)	27.47	1.65	1.38	6.22

Table-37: Overall Summary of 5G only & 4G only data download & upload speed.

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

Mandi Mall Road					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	189.17	-	91.60	-
	Upload Throughput Average (Mbits/s)	67.15	-	14.09	-
4G	Download Throughput Average (Mbits/s)	17.33	7.71	45.55	13.56
	Upload Throughput Average (Mbits/s)	23.39	2.95	10.33	9.81

Table-38: Overall Summary of 5G only & 4G only data download & upload speed.

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

Purani Mandi-Mandi					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	176.88	-	159.90	-
	Upload Throughput Average (Mbits/s)	30.79	-	37.04	-
4G	Download Throughput Average (Mbits/s)	28.65	5.76	25.74	6.93
	Upload Throughput Average (Mbits/s)	17.45	3.54	7.68	12.68

Table-39: Overall Summary of 5G only & 4G only data download & upload speed.

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

Regional Hospital Una					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	422.59	-	624.09	-
	Upload Throughput Average (Mbits/s)	68.95	-	75.00	-
4G	Download Throughput Average (Mbits/s)	30.58	2.66	104.91	3.99
	Upload Throughput Average (Mbits/s)	24.86	13.29	27.46	6.76

Table-40: Overall Summary of 5G only & 4G only data download & upload speed.

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

Una Bus Stand					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	327.31	-	400.54	-
	Upload Throughput Average (Mbits/s)	36.73	-	76.02	-
4G	Download Throughput Average (Mbits/s)	162.79	11.28	25.47	3.34
	Upload Throughput Average (Mbits/s)	8.72	11.06	11.69	10.68

Table-41: Overall Summary of 5G only & 4G only data download & upload speed.

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

4.4 Walk Test

Walk Test has been conducted on 17th September 2026 and 18th September 2026. Two locations have been tested in Una & Mandi. (Refer Table-1)

4.4.1 Walk test locations

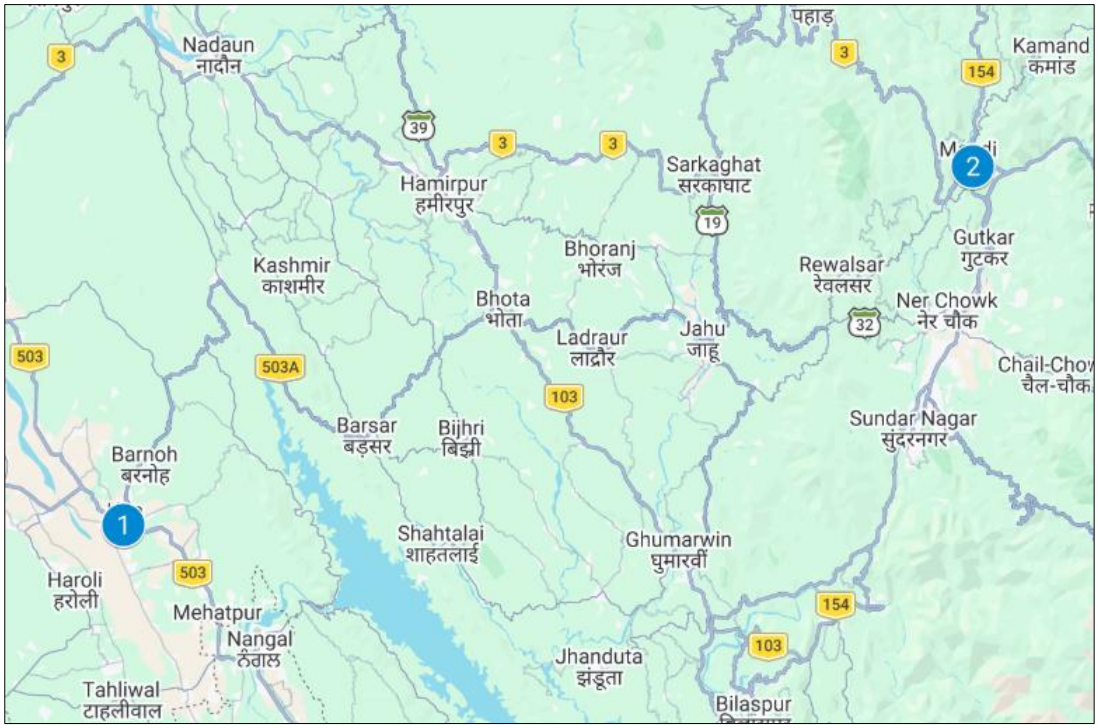


Figure-48: Walk Test locations.

4.4.2 Walk Test Covered

1. Jivan Market Una
2. Mandi Mall Road

4.4.3 Voice Performance

Jivan Market Una				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	17	16	17	17
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)	0.37	1.45	0.56	1.09

Table-42: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Mandi Mall Road				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	25	27	25	25
Call Setup Success Rate %	100.00	81.48	100.00	100.00
Drop Call Rate %	0.00	4.55	0.00	0.00
Call Setup Time-Average (Second)	0.53	2.57	0.55	1.25

Table-43: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

4.4.4 Data Performance

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

Jivan Market Una				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	218.86	15.67	413.13	13.98
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	28.70	6.48	63.23	6.73
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Latency (ms) – 50th Percentile	39.08	30.68	25.90	47.75

Table-44: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Mandi Mall Road				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	176.36	9.73	306.00	13.79
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	37.68	10.82	40.22	7.50
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Latency (ms) – 50th Percentile	40.94	27.47	24.44	45.79

Table-45: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

4.5 Highway

Drive test has been conducted on 16th September 2026 and 18th September 2026 covering two highway routes. (Refer Table-1)

4.5.1 Una to Mandi

4.5.1.1 Drive test route

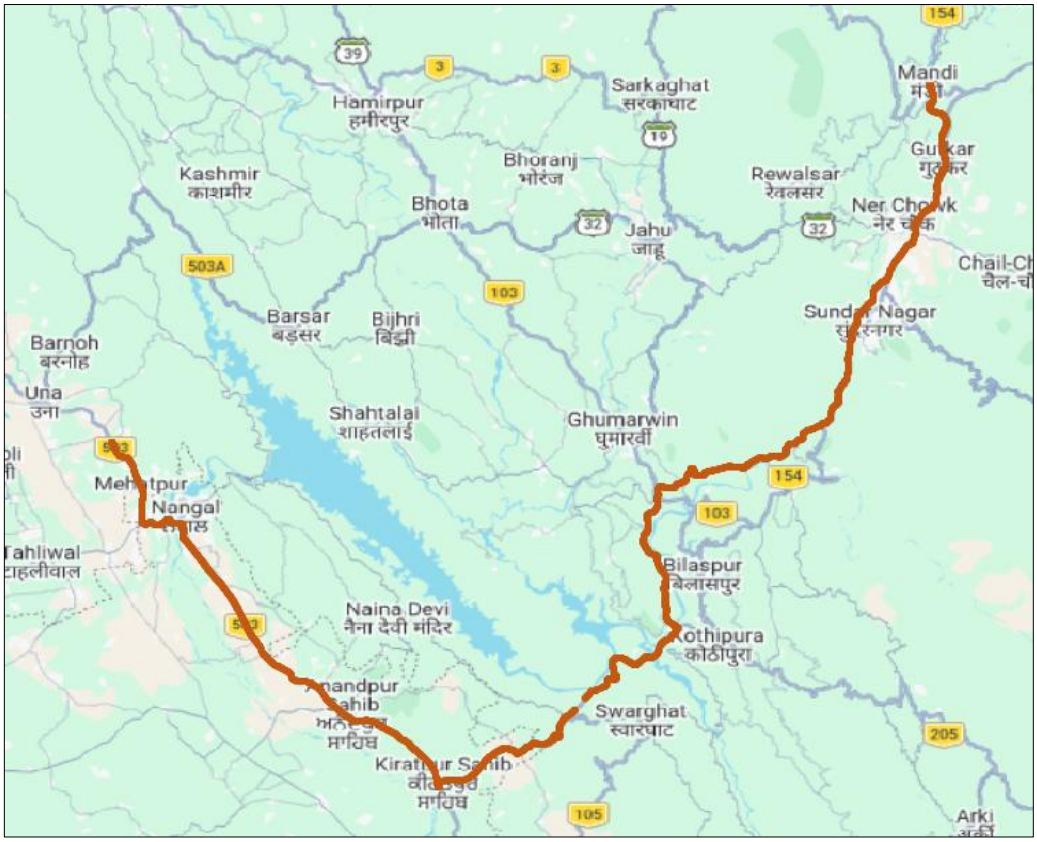


Figure-49: Drive test route Highway.

4.5.1.2 Areas covered

Una to Mandi Passing through Gutkar, Ner Chowk, Sundar Nagar, Bilaspur, Kothipura, Kiratpur Sahib, Anandpur Sahib, Nangal and Mehatpur etc.

4.5.1.3 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	69	72	70
Call Setup Success Rate %	94.20	91.67	90.00
Drop Call Rate %	9.23	19.70	9.52
Call Setup Time-Average (Second)	3.41	4.51	4.56
Handover Success Rate %	98.88	100.00	97.55

Table-46: Summary of voice call performance in 3G/2G network mode only.

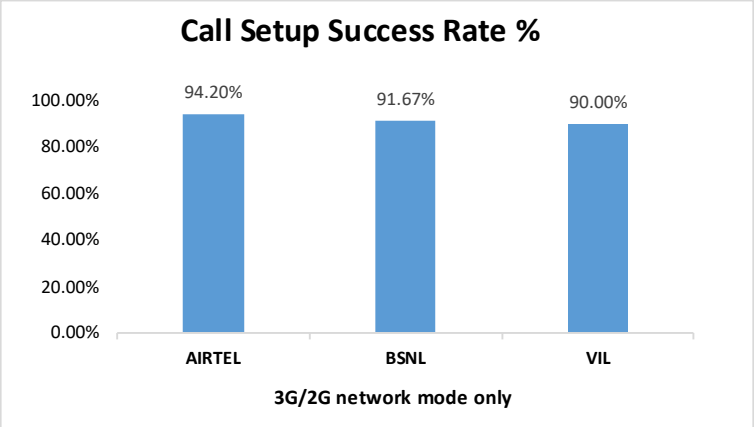


Figure-50: Performance for call setup success rate.

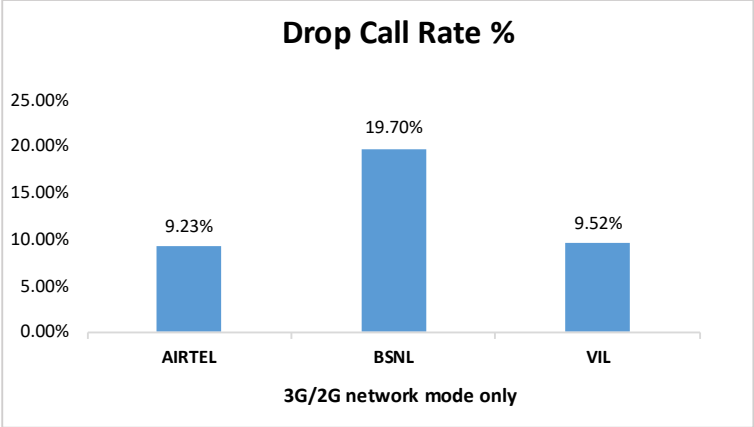


Figure-51: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	15.15%	NA
2G	99.82%	84.55%	99.62%
Limited Service	0.18%	0.30%	0.38%

Table-47: Time spent on technology during drive test 3G/2G network mode only.

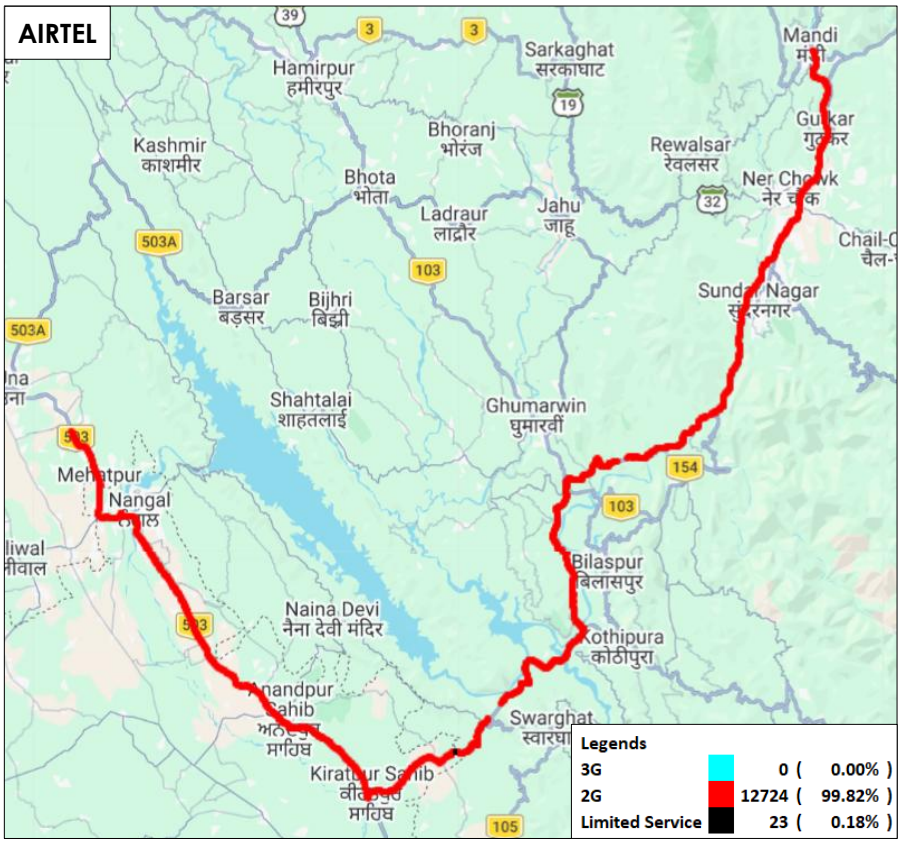


Figure-52: Serving technology plots 3G/2G network mode - AIRTEL.

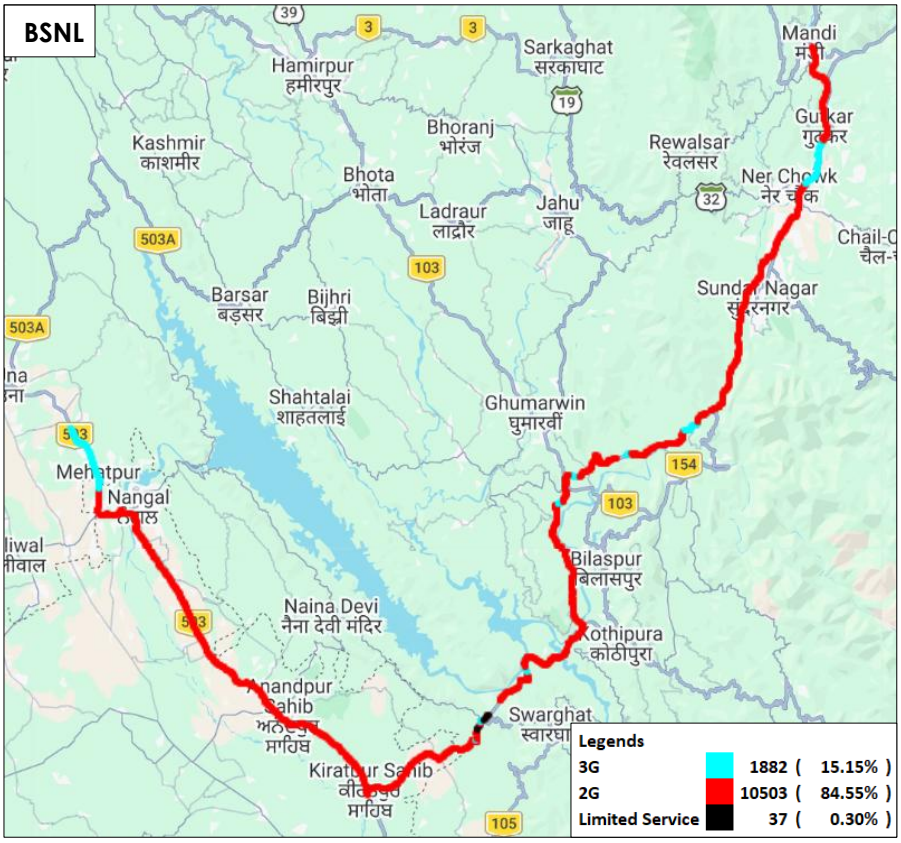


Figure-53: Serving technology plots 3G/2G network mode - BSNL.

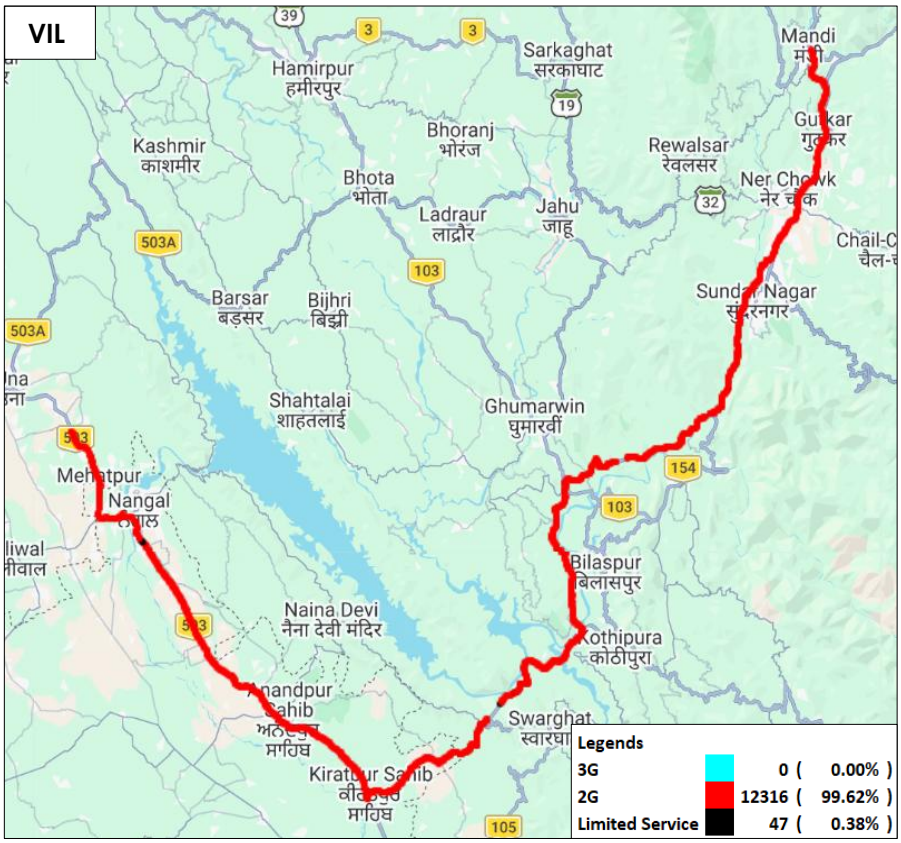


Figure-54: Serving technology plots 3G/2G network mode - VIL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure-141, 142 & 143 for map view)

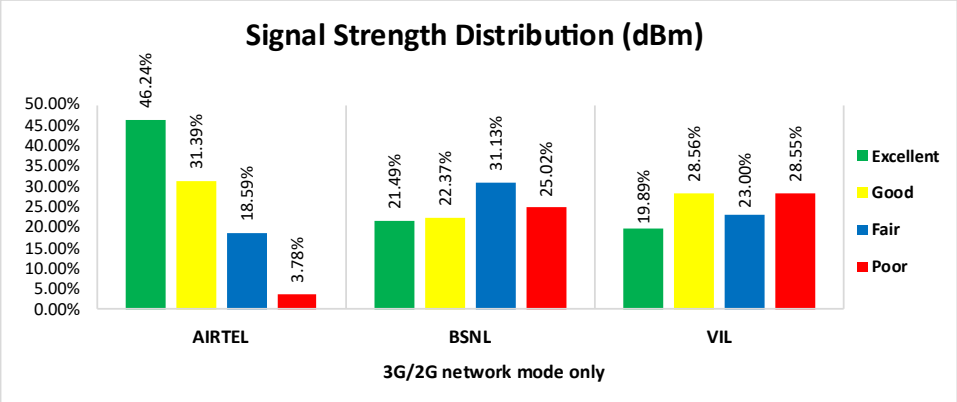


Figure-55: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 46% of samples falling in the excellent signal strength category.
- BSNL has 21% of samples falling in the excellent signal strength category.
- VIL has 20% 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	75	82	65	72
Call Setup Success Rate %	89.33	76.83	100.00	90.28
Drop Call Rate %	2.99	11.11	3.08	9.23
Call Setup Time Average (Second)	1.36	2.57	0.69	2.36
Handover Success Rate %	100.00	99.71	99.89	99.75

Table-48: Summary of voice call performance in network auto-selection mode.

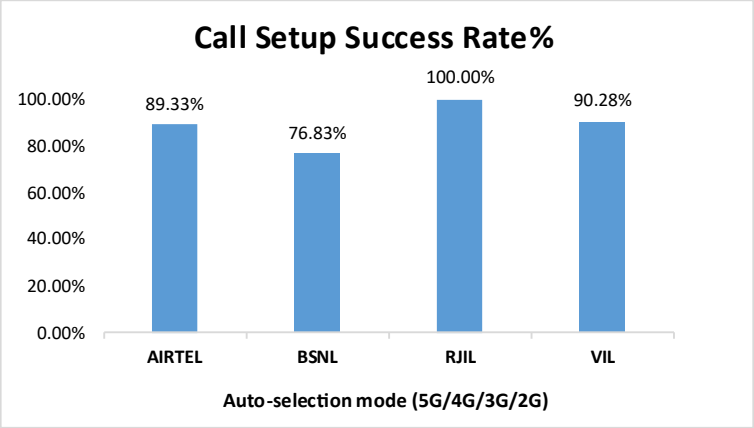


Figure-56: Performance for call setup success rate.

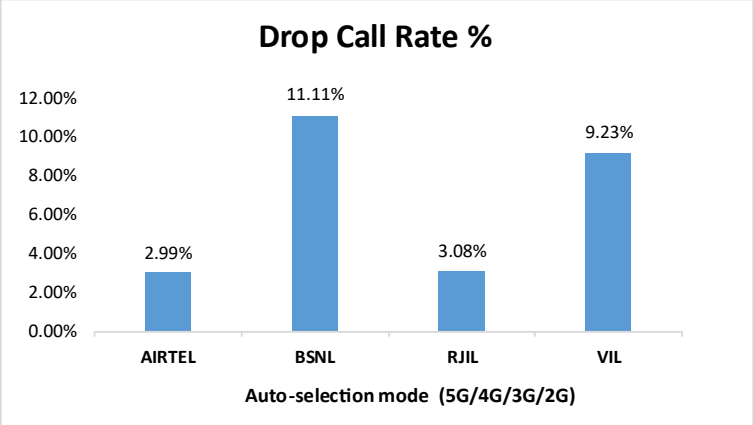


Figure-57: Performance for drop call rate.

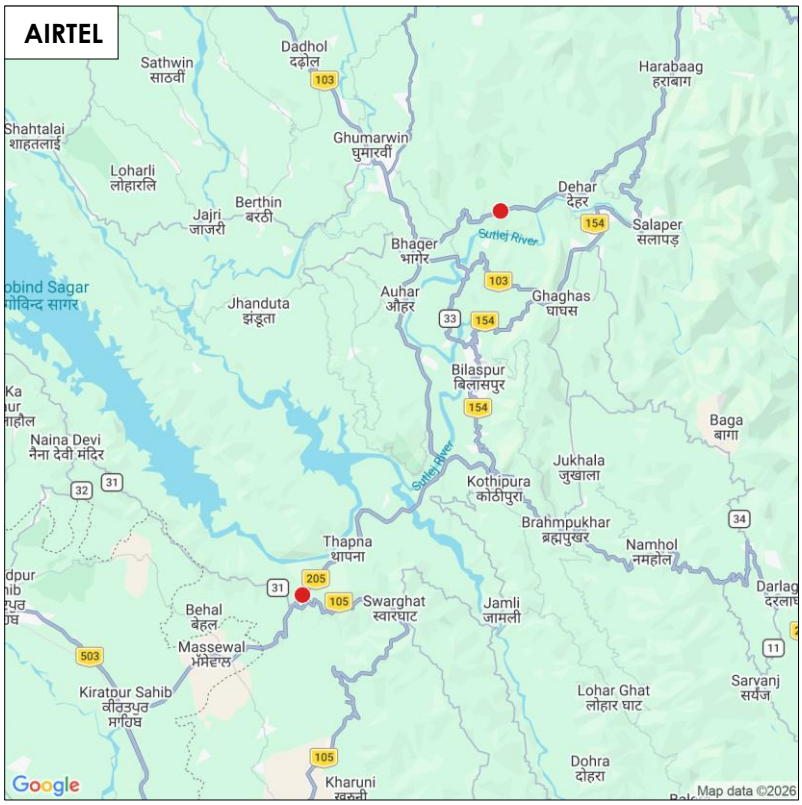


Figure-58: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

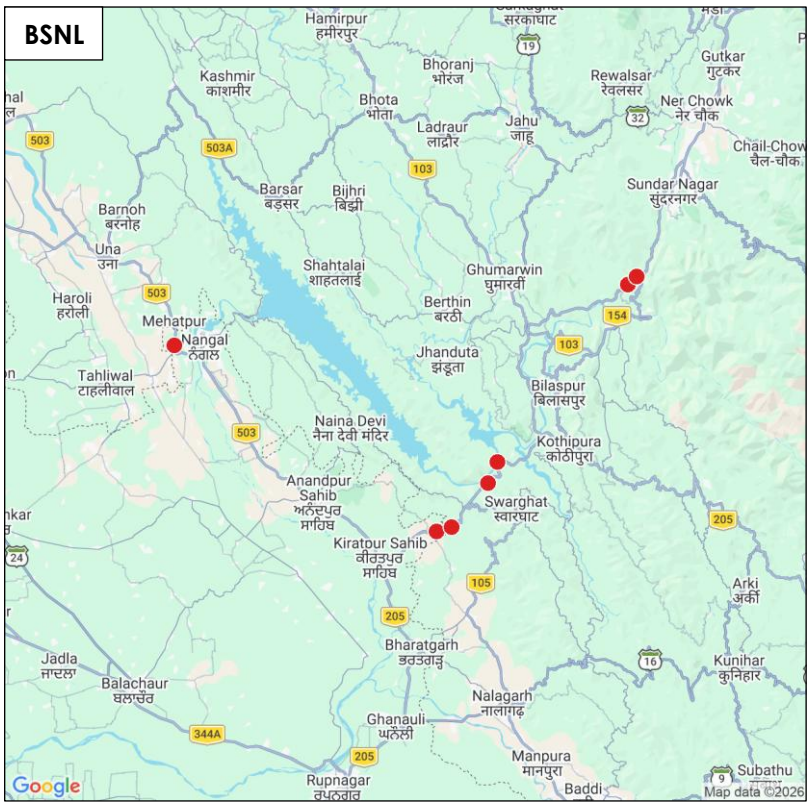


Figure-59: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice – BSNL.



Figure-60: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice – RJIL.



Figure-61: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice – VIL.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G – Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	66	61	65	64
Number of silence call for >4 Sec	0	1	2	2
Silence Call Rate %	0.00	1.64	3.08	3.13
Number of silence instances for >4 Sec	0	1	2	2
Number of silence instances for >3 Sec	1	2	4	2
Number of silence instances for >2 sec	2	6	6	4
RTP Jitter (4G & 5G) in ms	4.23	7.14	16.28	15.99
Packet loss Rate Downlink %	1.45	5.45	2.24	2.91
Packet loss Rate Uplink %	1.93	5.44	2.64	2.97

Table-49: Summary of silence instances & packet loss rate for mobile to mobile call.

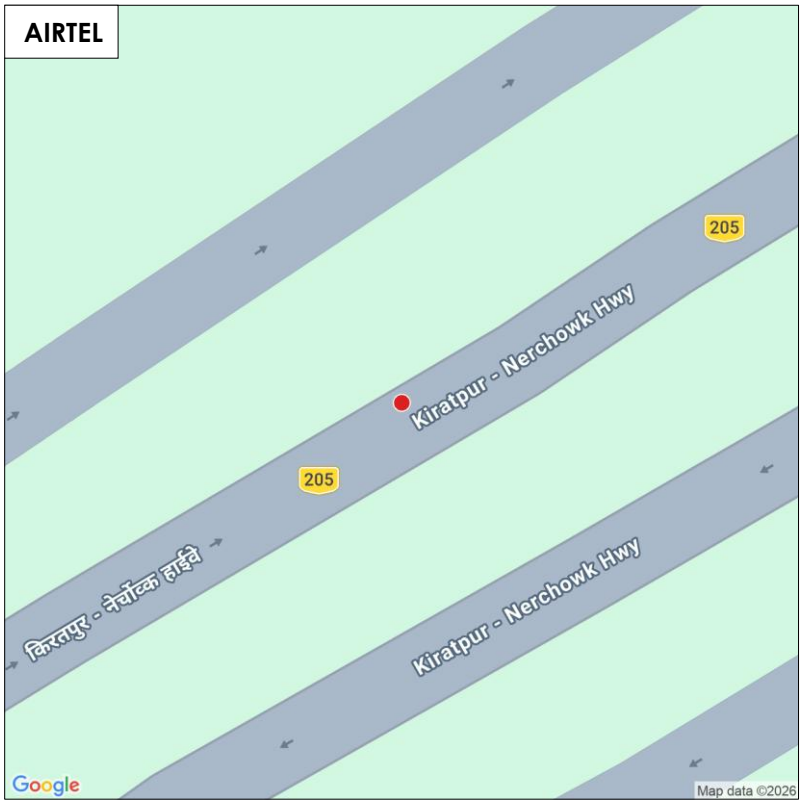


Figure-62: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)-AIRTEL.

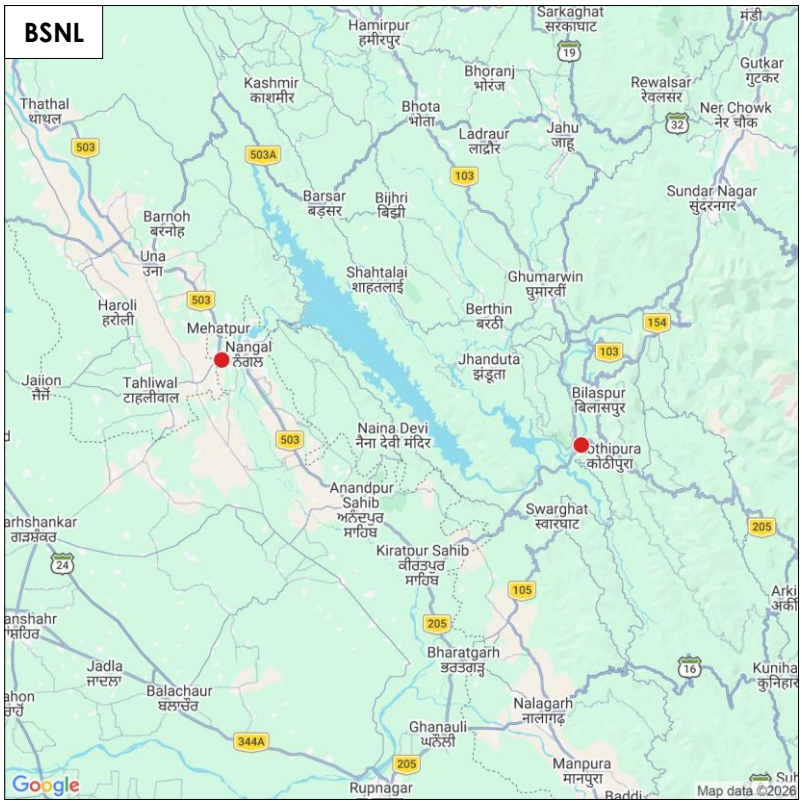


Figure-63: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)-BSNL.



Figure-64: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)-RJIL.

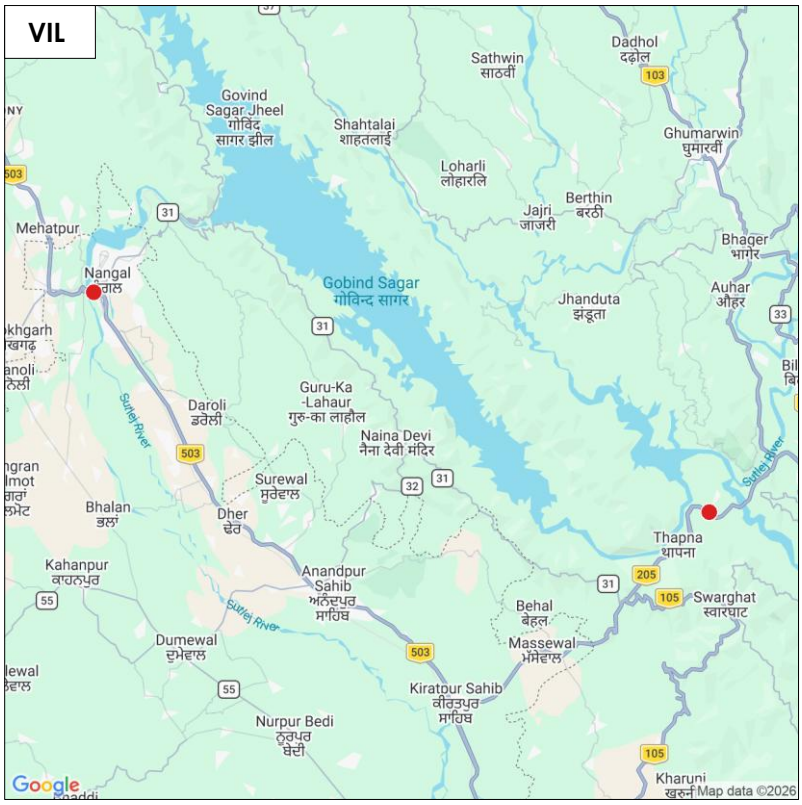


Figure-65: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)-VIL.

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-49	838	608	802	736
Speech Quality (Average MOS)	3.96	2.64	4.46	3.40
Number of samples with MOS >=4 to <5 (Excellent)	698	117	710	350
Number of samples with MOS >=3 to <4 (Good)	105	65	54	185
Number of samples with MOS >=2 to <3 (Fair)	8	250	17	86
Number of samples with MOS >=1 to <2 (Poor)	27	176	21	115
%age of samples with MOS >=4 to <5 (Excellent)	83.29%	19.24%	88.53%	47.55%
%age of samples with MOS >=3 to <4 (Good)	12.53%	10.69%	6.73%	25.14%
%age of samples with MOS >=2 to <3 (Fair)	0.95%	41.12%	2.12%	11.68%
%age of samples with MOS >=1 to <2 (Poor)	3.22%	28.95%	2.62%	15.63%

Table-50: Summary of speech quality (MOS) samples.

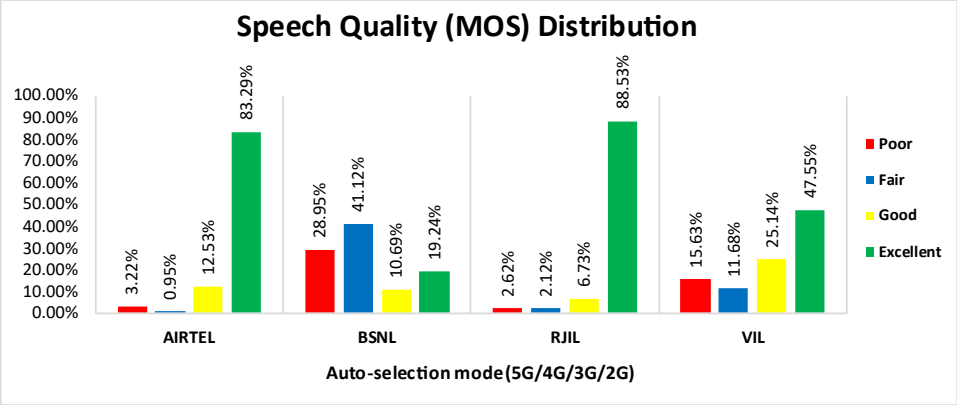


Figure-66: Distribution of samples in MOS range.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	3.81%	NA	55.48%	NA
4G	96.10%	57.41%	44.52%	75.78%
3G	NA	10.24%	NA	NA
2G	0.00%	31.03%	NA	23.32%
Limited Service	0.09%	1.32%	0.00%	0.91%

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.

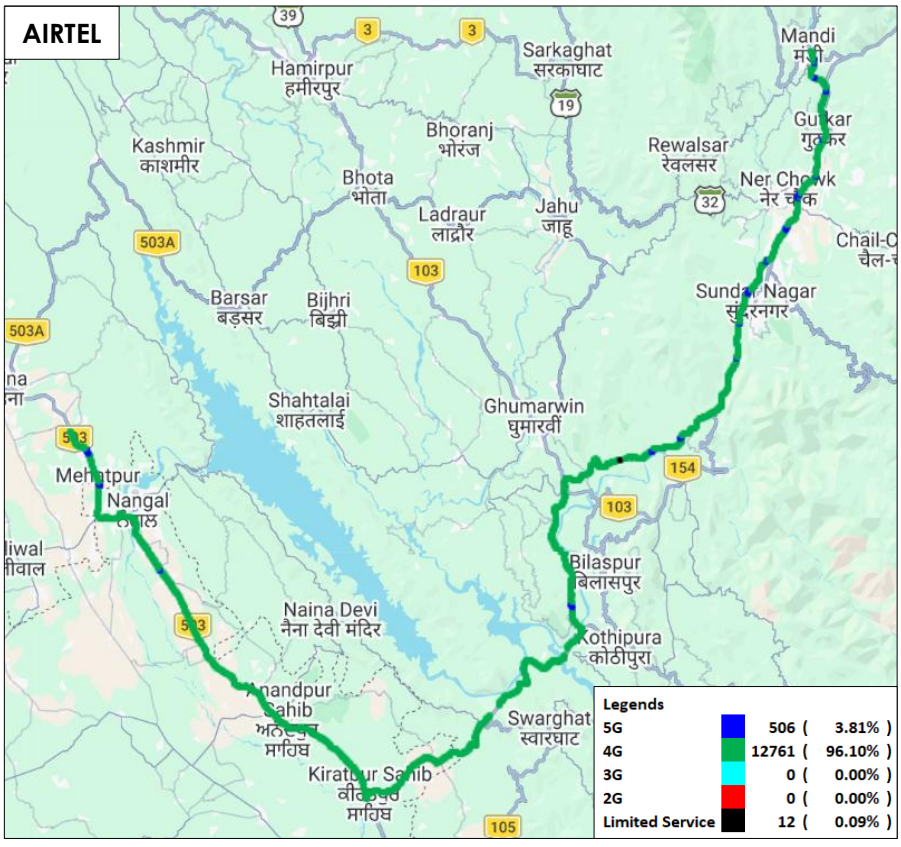


Figure-67: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

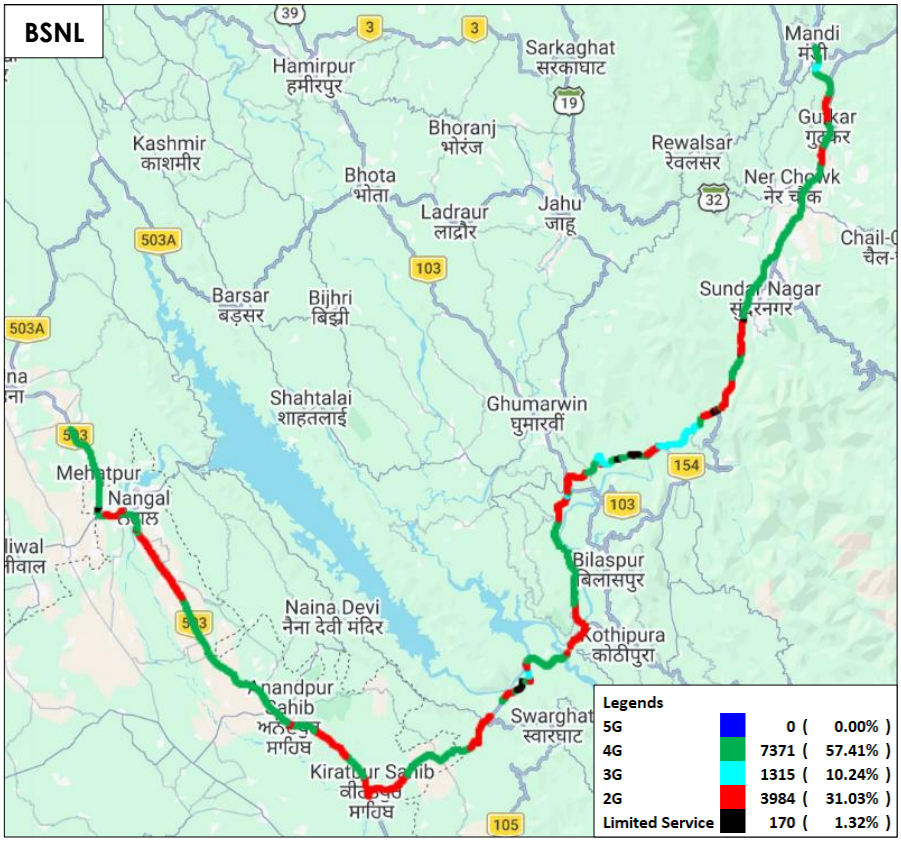


Figure-68: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

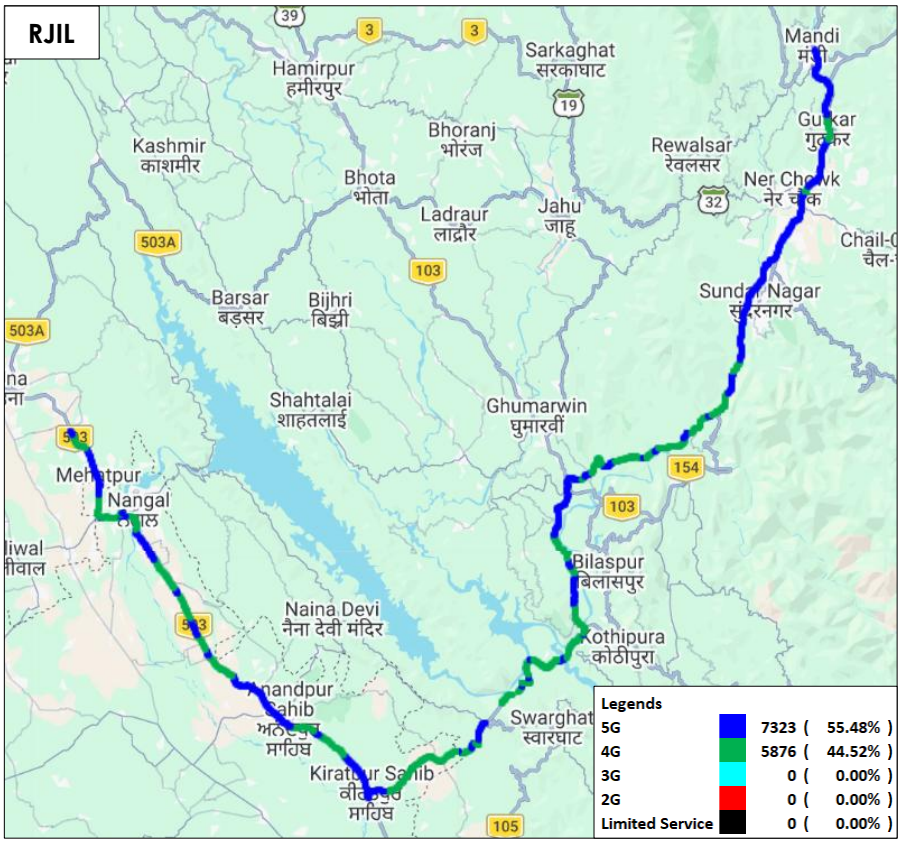


Figure-69: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

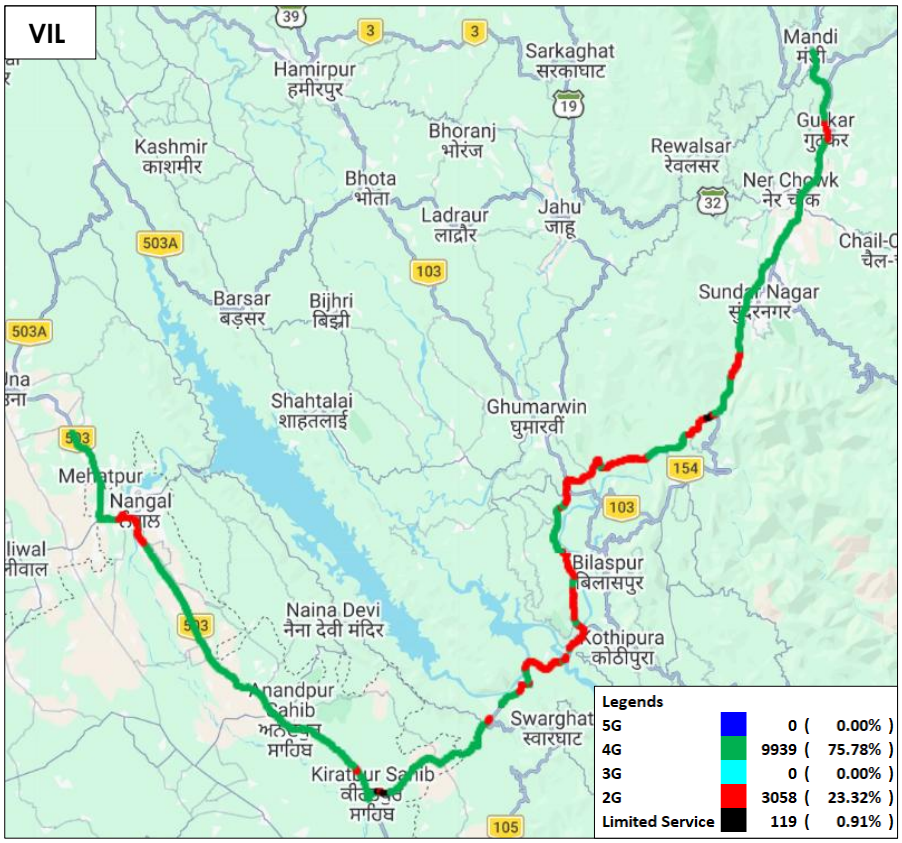


Figure-70: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-144, 145, 146 & 147 for map view)

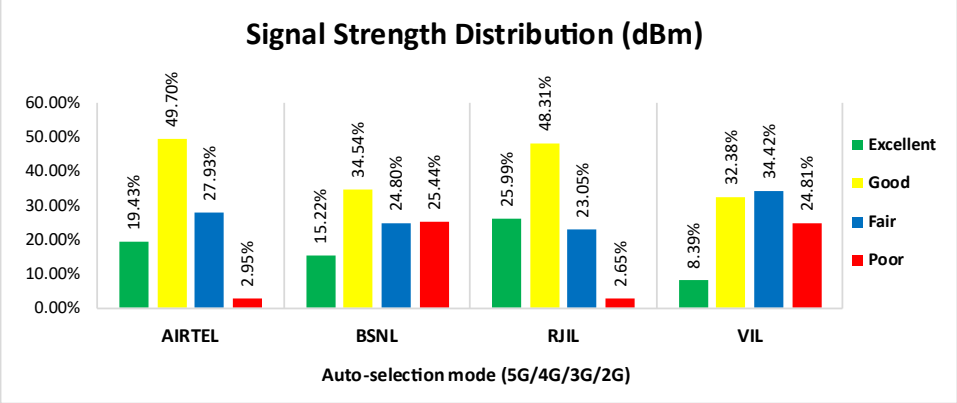


Figure-71: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 19% of samples falling in the excellent signal strength category.
- BSNL has 15% of samples falling in the excellent signal strength category.
- RJIL has 26% of samples falling in the excellent signal strength category.
- VIL has 8% of samples falling in the excellent signal strength category.

(h) Coverage Gap observed

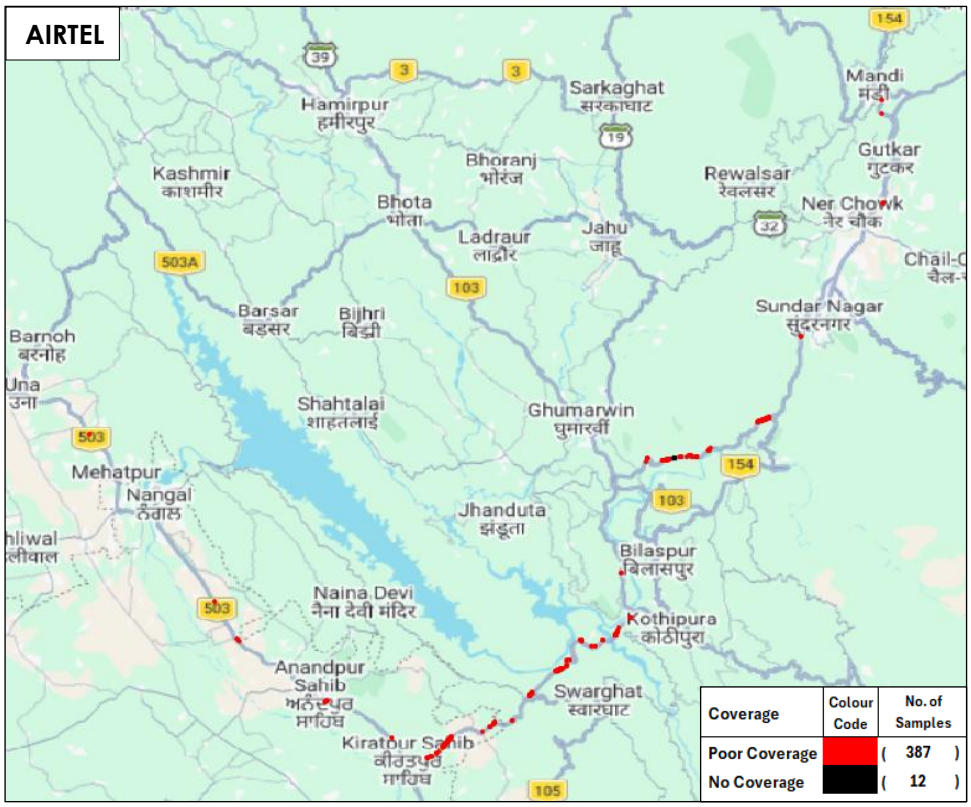


Figure-72: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

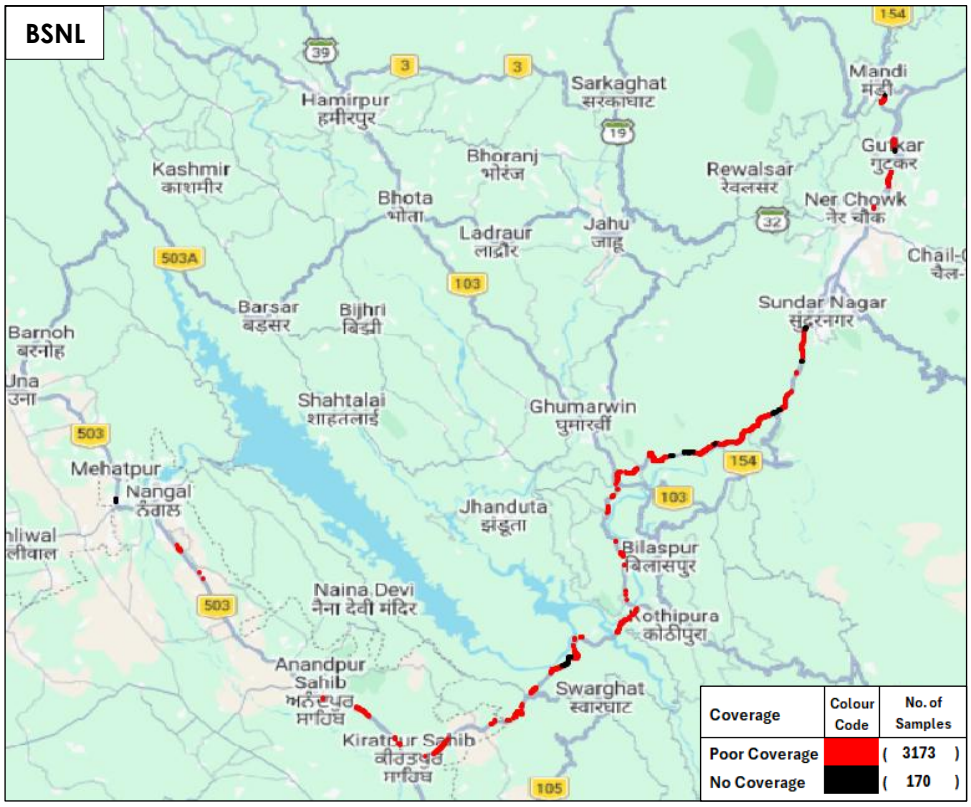


Figure-73: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

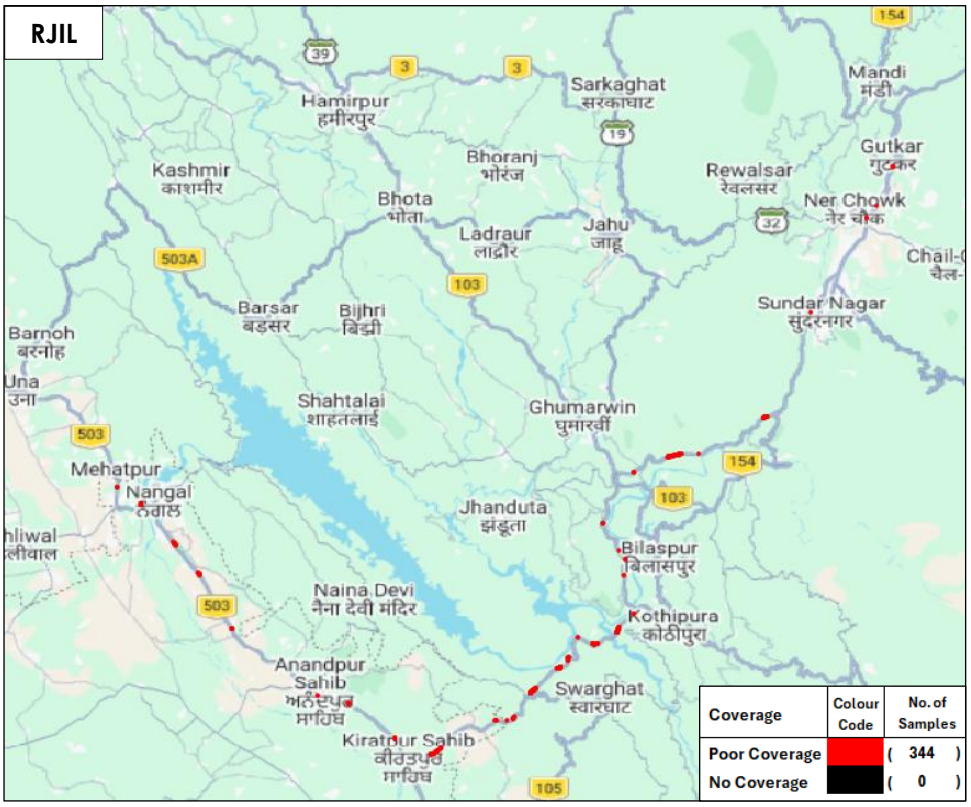


Figure-74: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

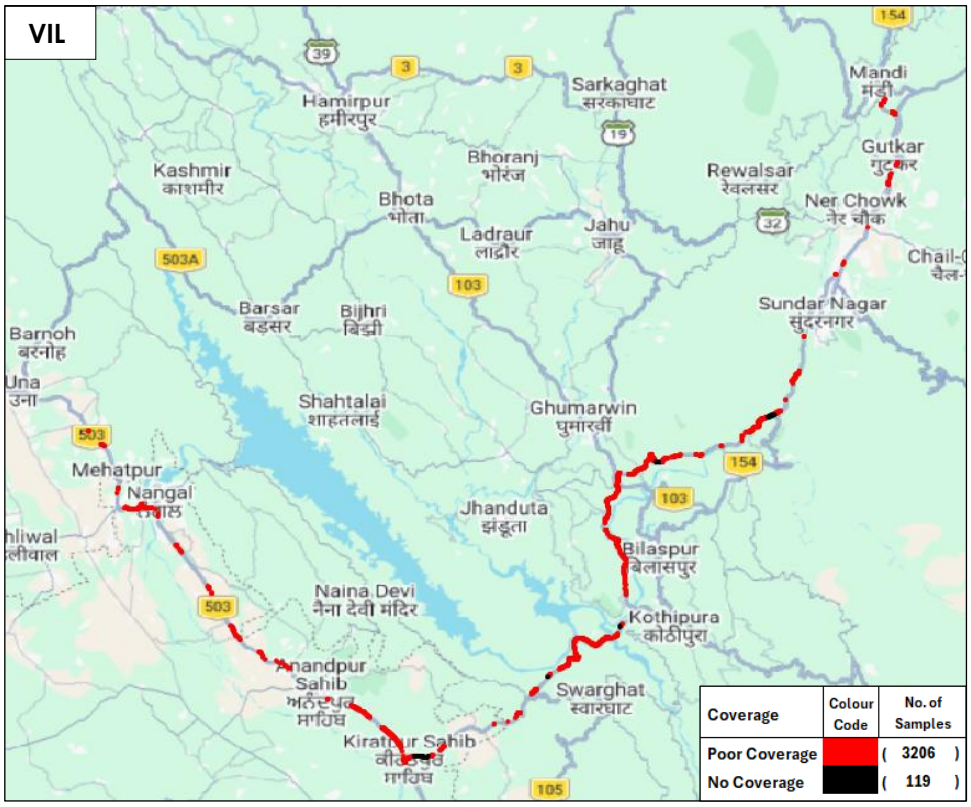


Figure-75: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - VIL.

4.5.1.4 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	169.31	9.32	193.46	10.36
	80th Percentile	244.52	13.68	356.86	16.09
	20th Percentile	45.60	3.02	30.76	0.34
Upload Throughput (Mbits/s)	Average	15.54	6.29	21.43	5.30
	80th Percentile	23.21	12.28	36.62	7.97
	20th Percentile	3.30	1.02	4.99	0.98
Latency (ms)	50th Percentile	44.65	28.39	27.80	42.39

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

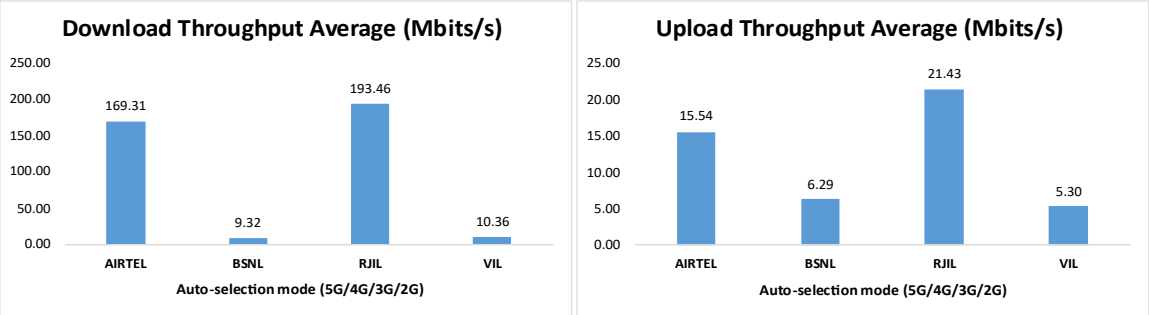


Figure-76: Download & Upload throughput.

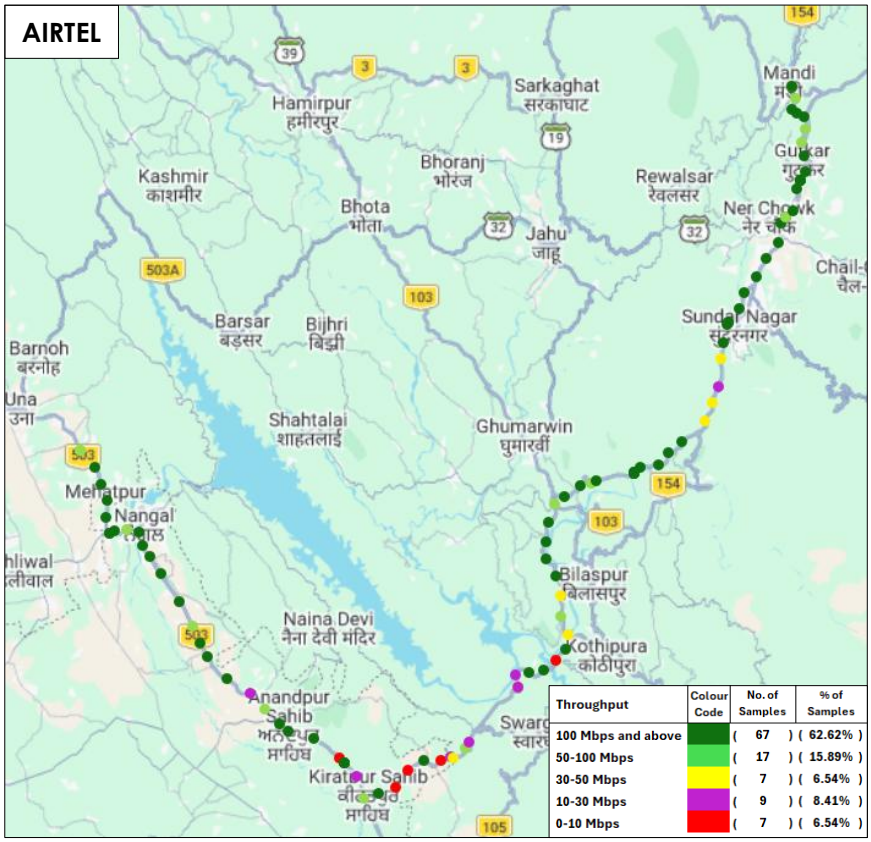


Figure-77: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

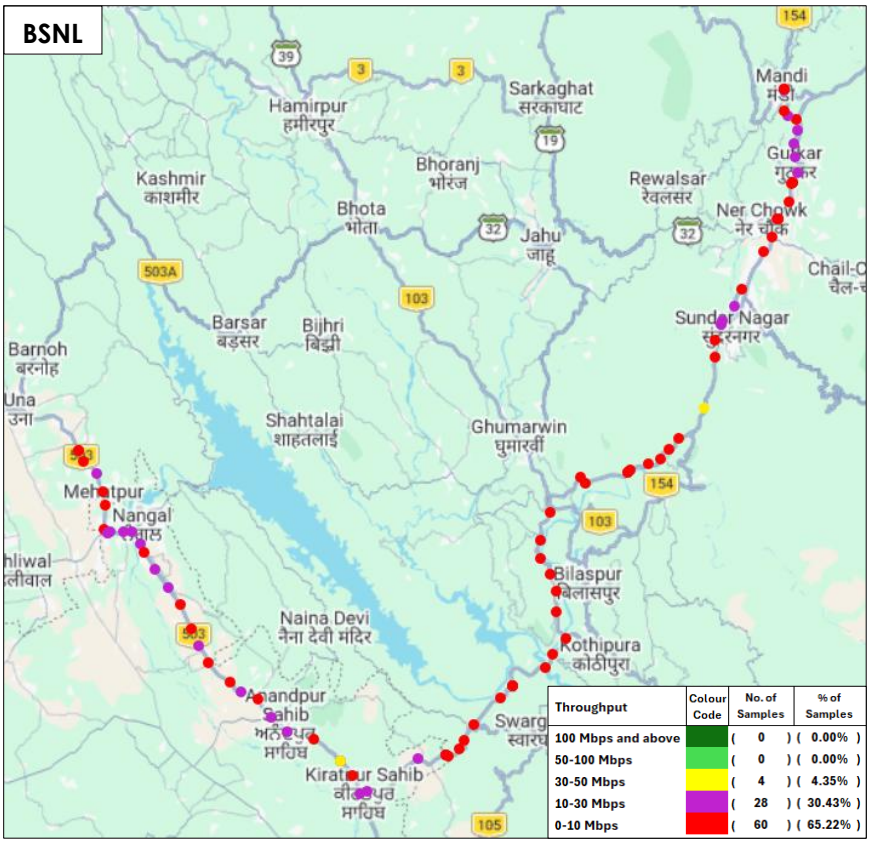


Figure-78: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

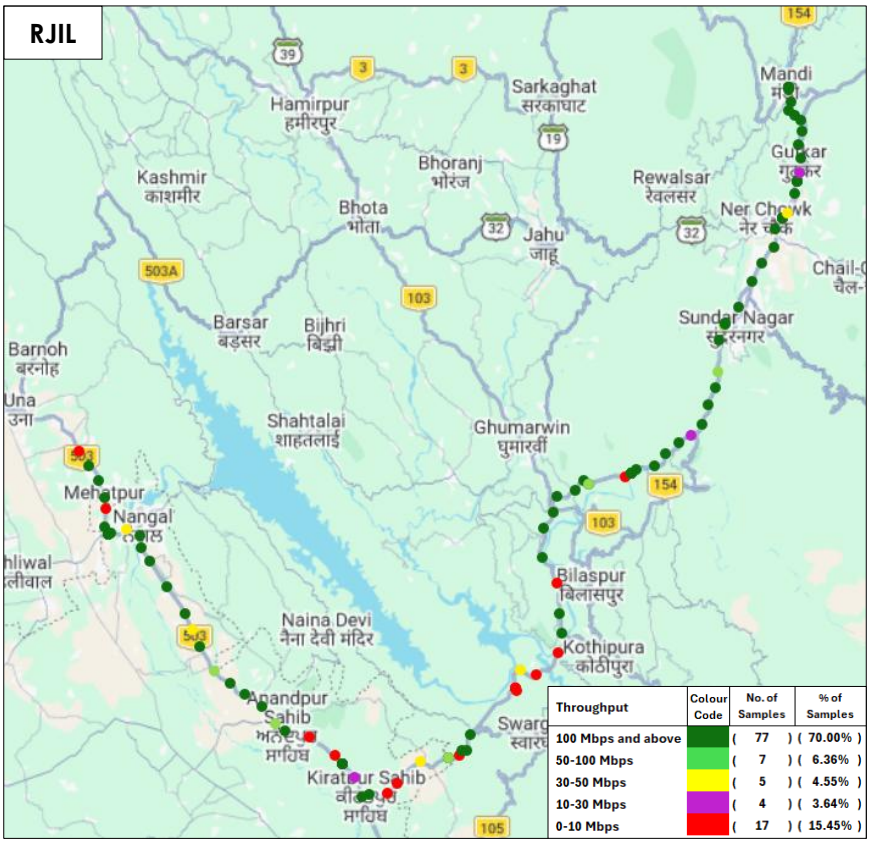


Figure-79: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

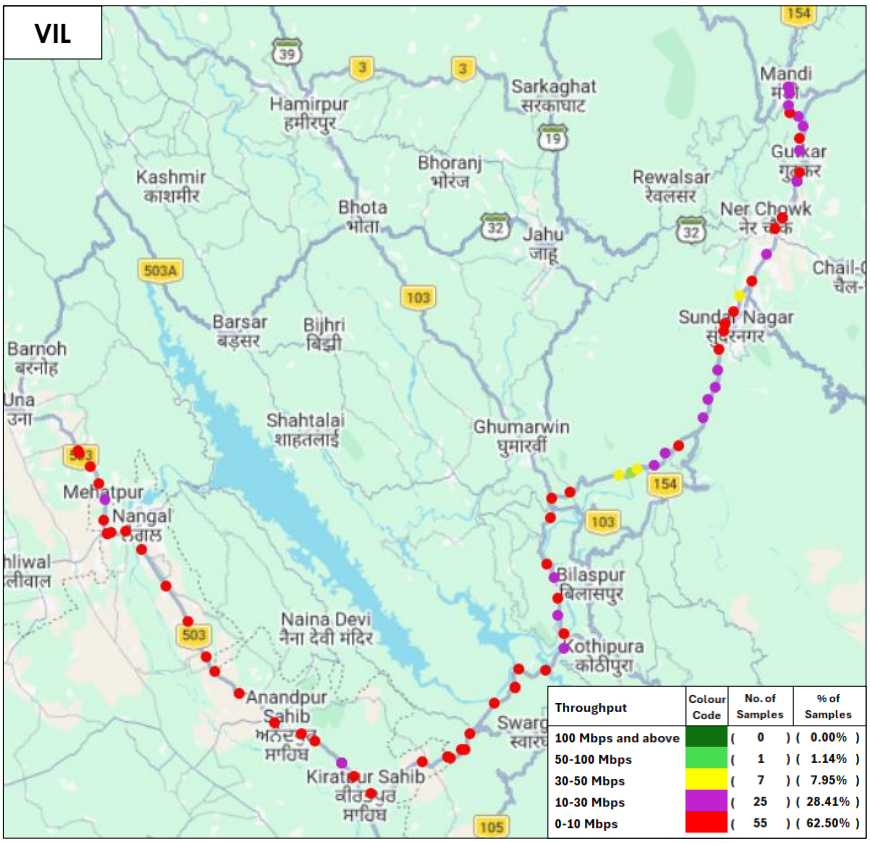


Figure-80: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

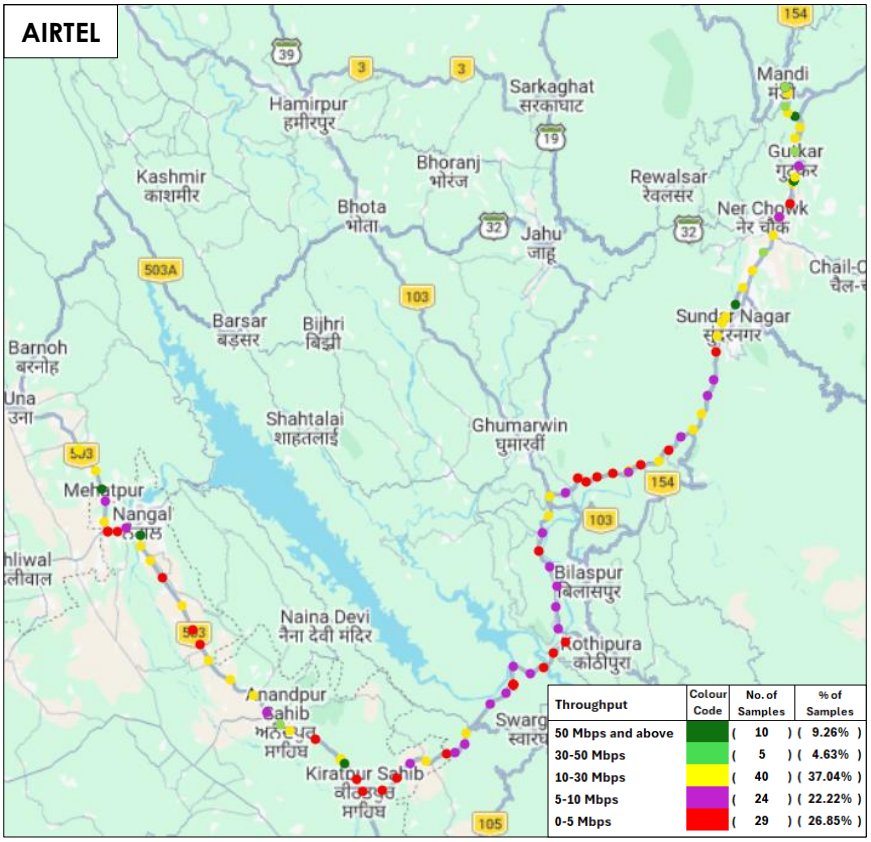


Figure-81: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

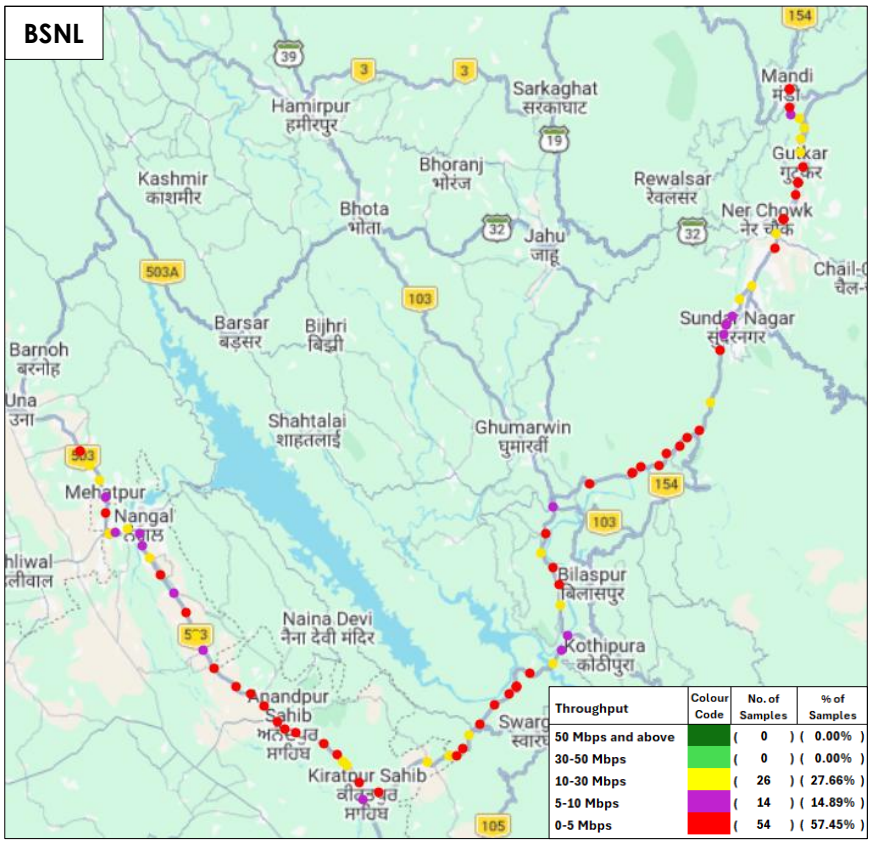


Figure-82: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

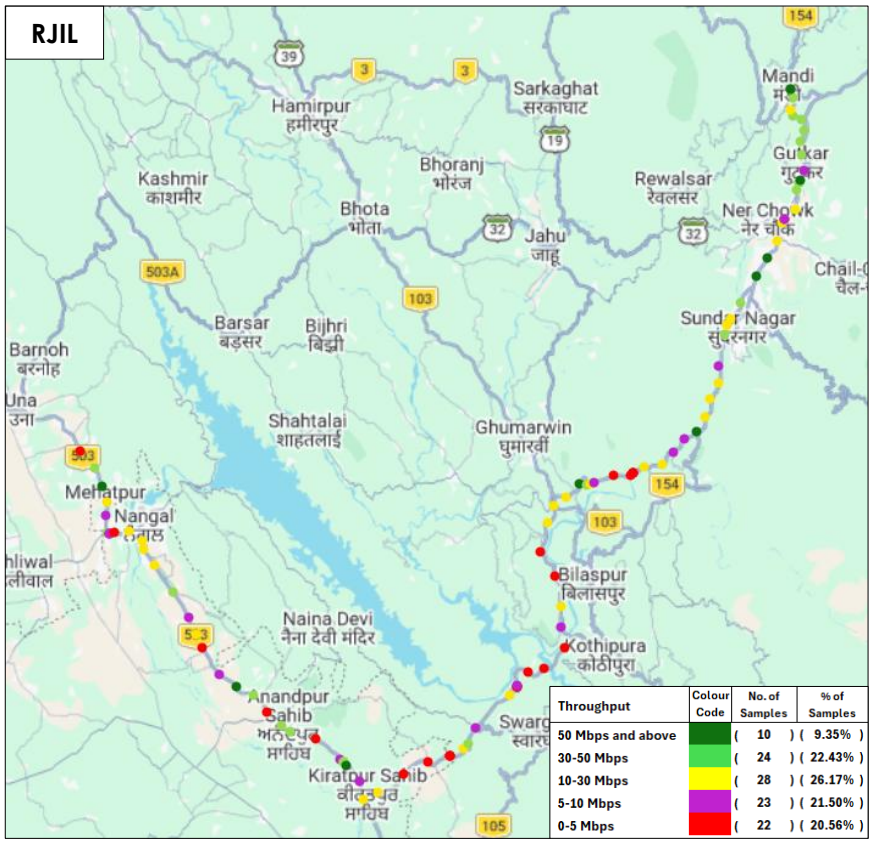


Figure-83: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

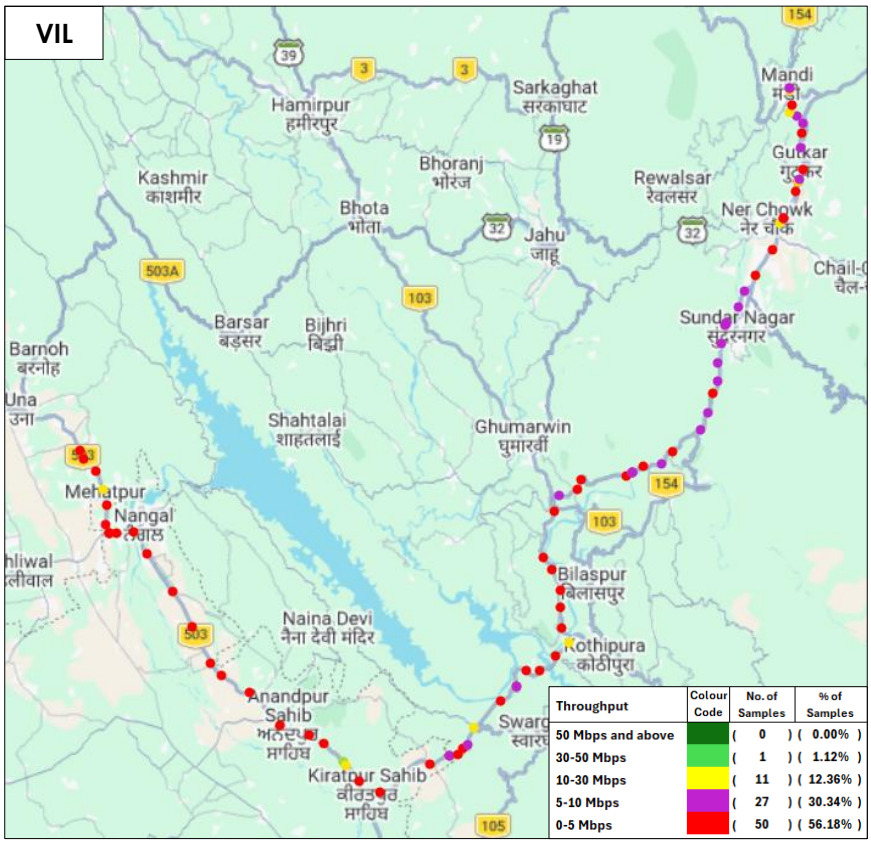


Figure-84: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	64.91%	NA	86.67%	NA
4G	33.20%	89.49%	12.94%	90.45%
3G	NA	6.80%	NA	NA
2G	0.48%	1.89%	NA	7.22%
Limited Service	1.41%	1.82%	0.39%	2.32%

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.

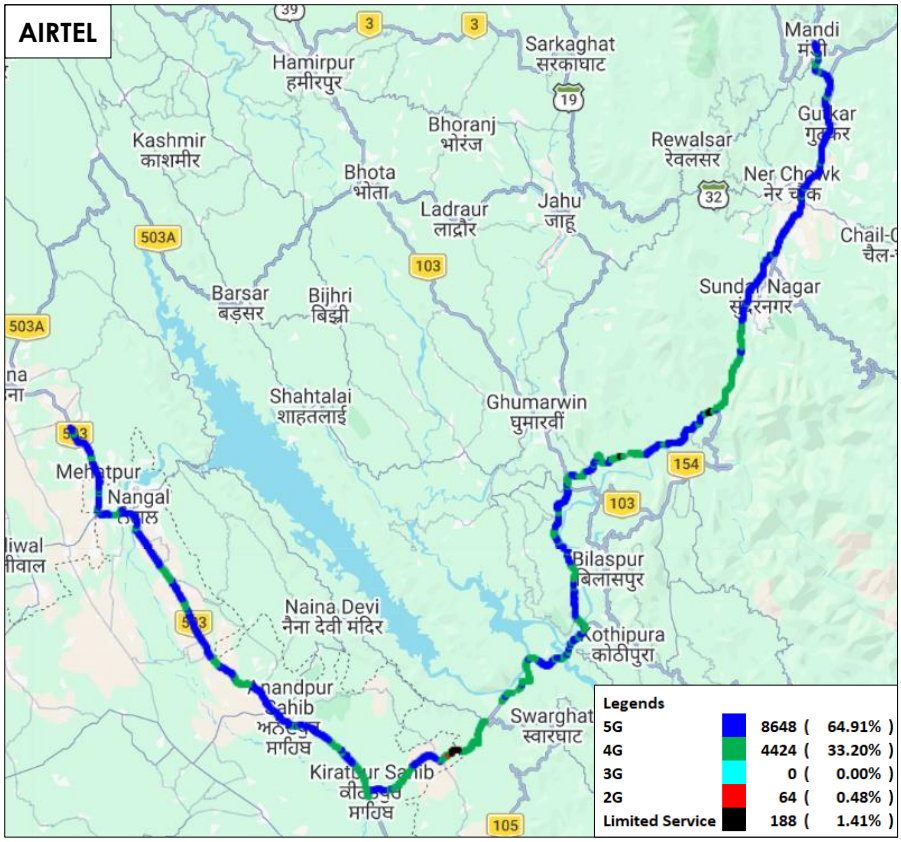


Figure-85: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

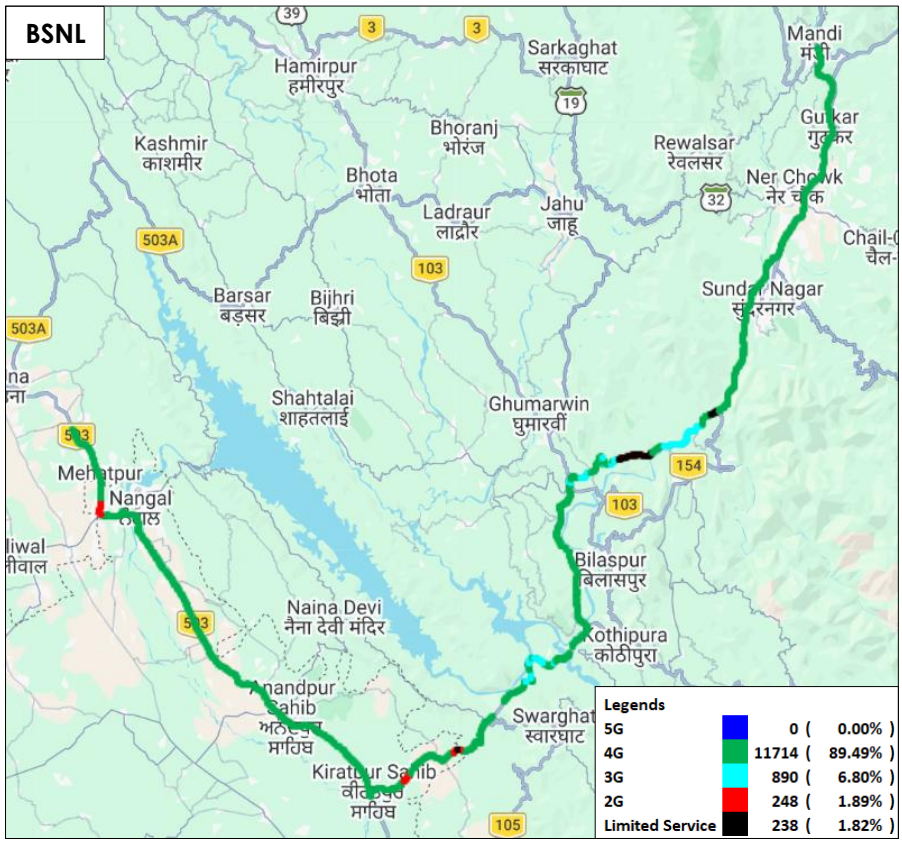


Figure-86: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - BSNL.

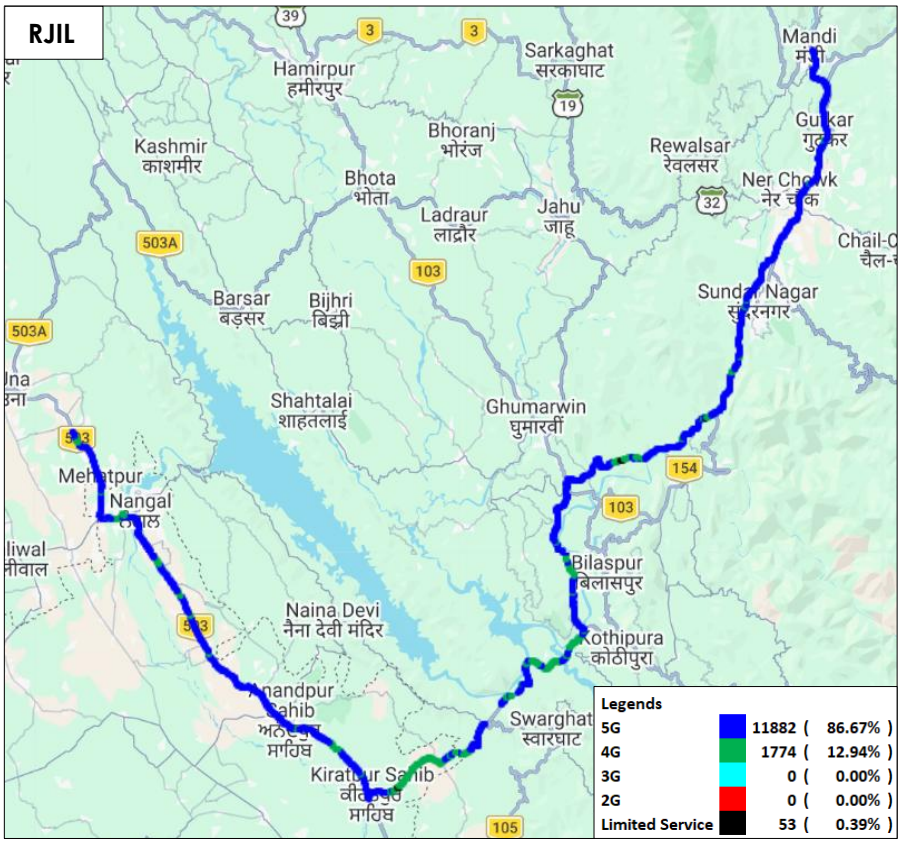


Figure-87: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - RJIL.

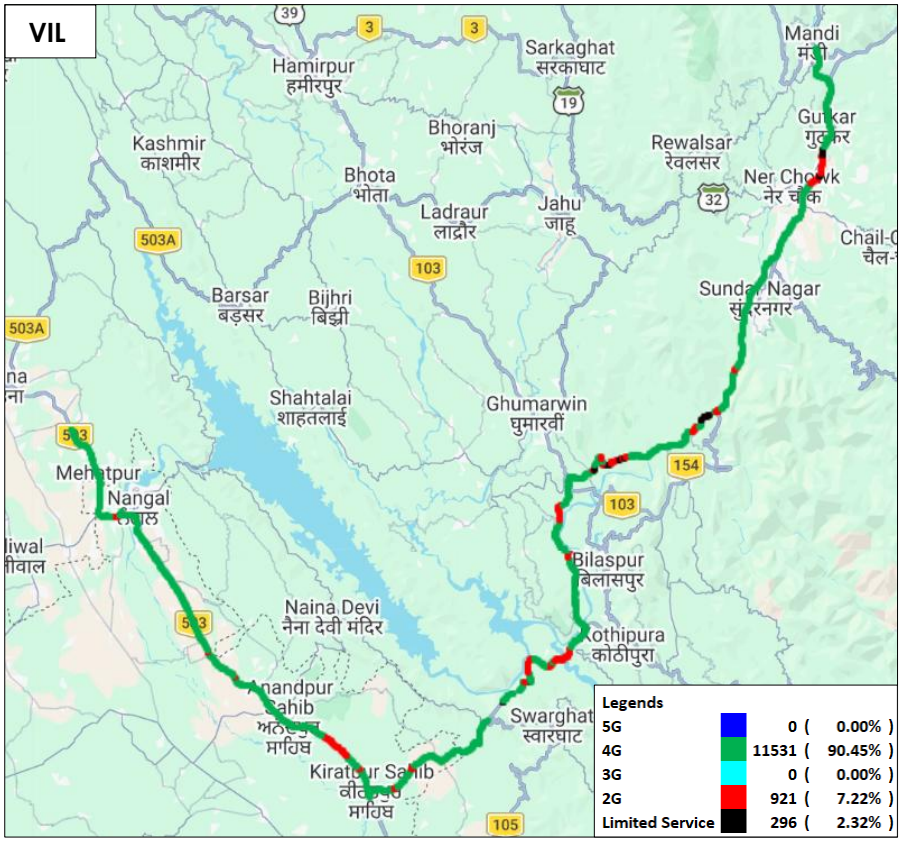


Figure-88: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-148, 149, 150 & 151 for map view)

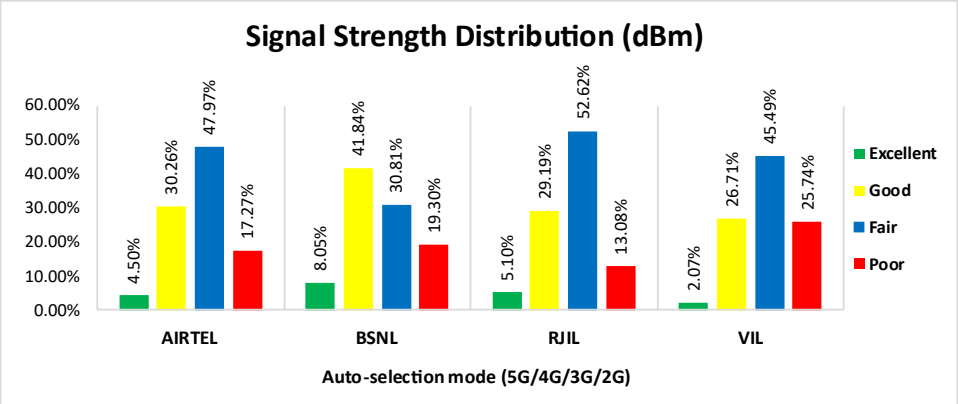


Figure-89: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 5% of samples falling in the excellent signal strength category.
- BSNL has 8% of samples falling in the excellent signal strength category.
- RJIL has 5% of samples falling in the excellent signal strength category.
- VIL has 2% of samples falling in the excellent signal strength category.

4.5.2 Mandi to Una

4.5.2.1 Drive test route

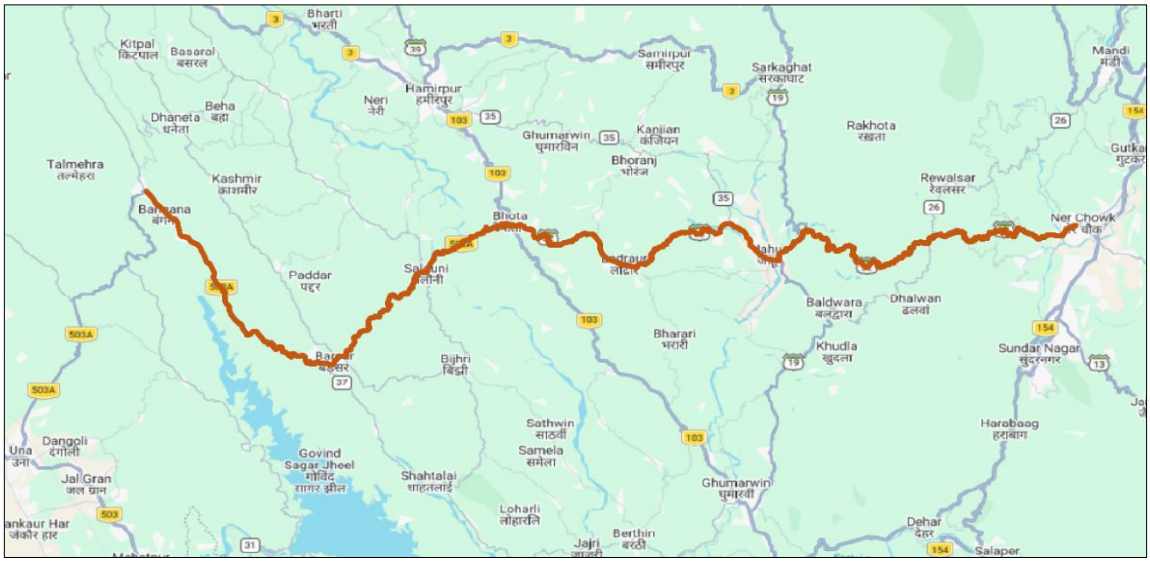


Figure- 90: Drive test routes.

4.5.2.2 Areas covered

Mandi to Una Passing through Ner Chowk, Jahu, Ladrpur, Bhota, Salouni, Barsar and Bangana etc.

4.5.2.3 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	61	61	62
Call Setup Success Rate %	100.00	100.00	100.00
Drop Call Rate %	0.00	8.20	4.84
Call Setup Time-Average (Second)	2.74	3.44	4.59
Handover Success Rate %	91.14	99.04	94.39

Table-54: Summary of voice call performance in 3G/2G network mode only.

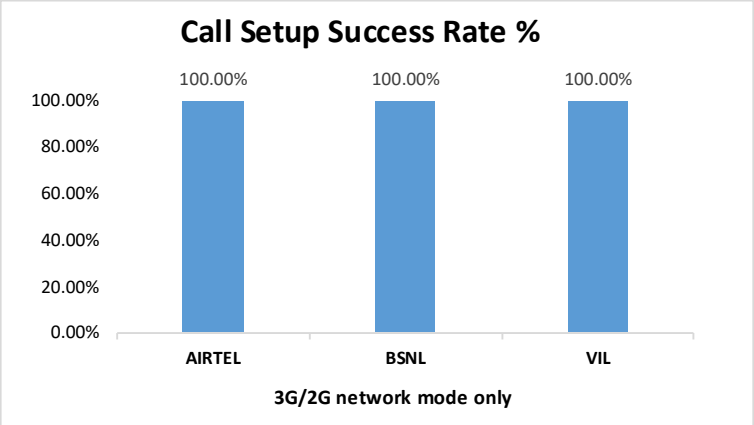


Figure-91: Performance for call setup success rate.

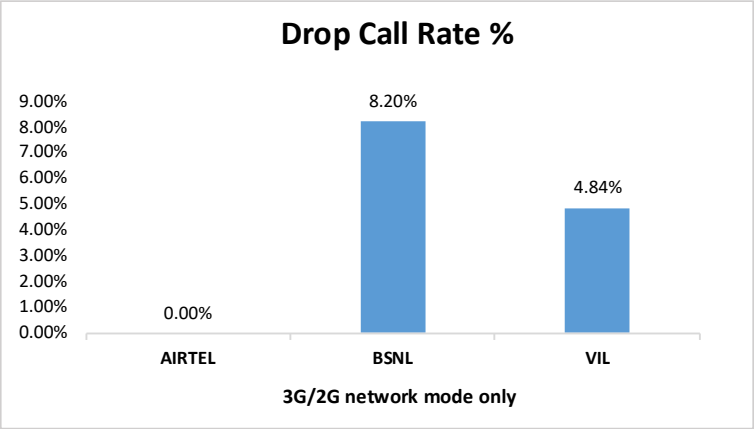


Figure-92: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	56.60%	NA
2G	100.00%	43.40%	100.00%
Limited Service	0.00%	0.00%	0.00%

Table-55: Time spent on technology during drive test 3G/2G network mode only.

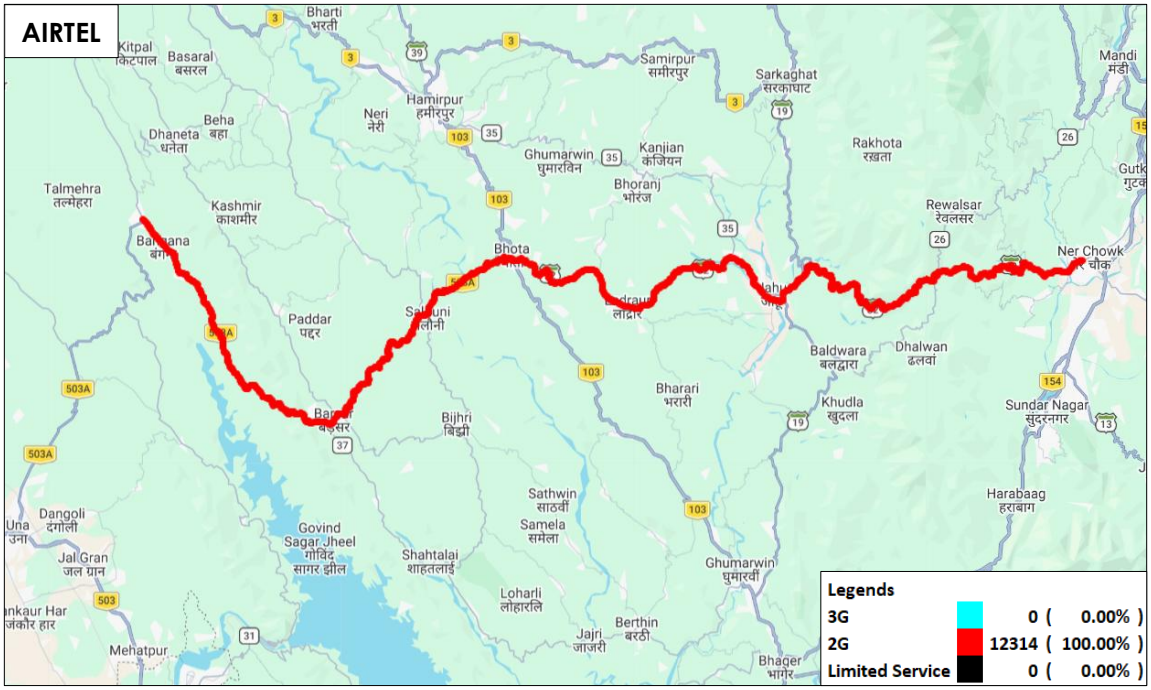


Figure-93: Serving technology plots 3G/2G network mode - AIRTEL.

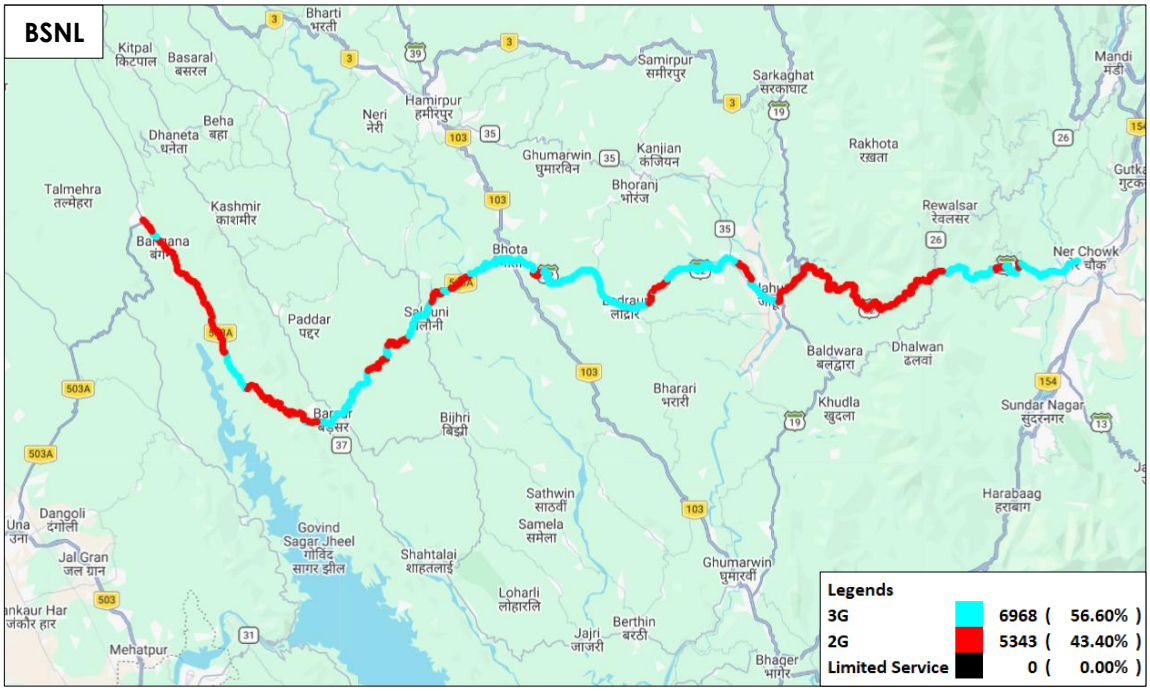


Figure-94: Serving technology plots 3G/2G network mode - BSNL.

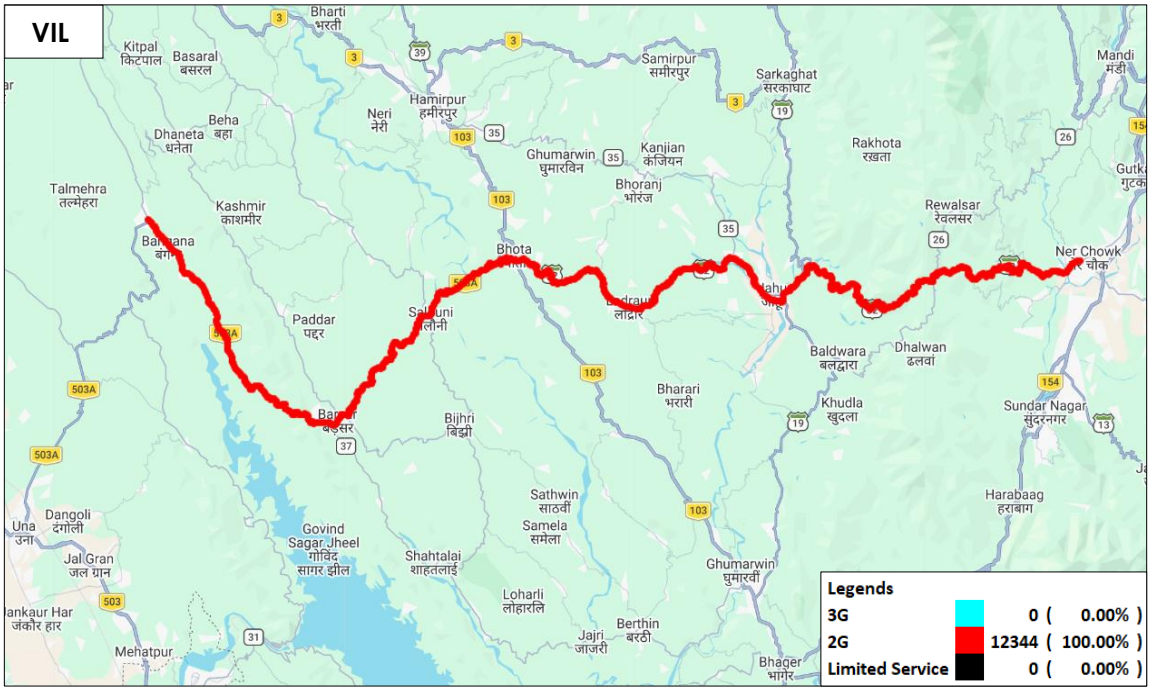


Figure-95: Serving technology plots 3G/2G network mode - VIL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure-152, 153 & 154 for map view)

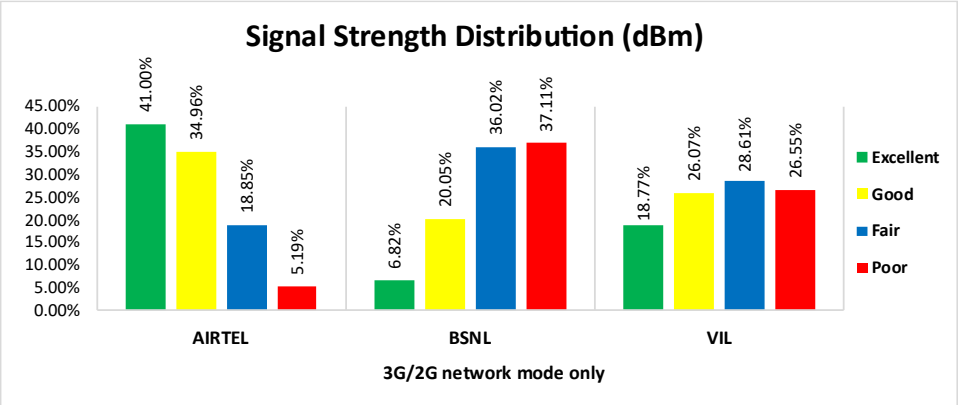


Figure-96: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 41% of samples falling in the excellent signal strength category.
- BSNL has 7% of samples falling in the excellent signal strength category.
- VIL has 19% 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	62	72	61	64
Call Setup Success Rate %	100.00	93.06	100.00	95.31
Drop Call Rate %	1.61	19.40	3.28	4.92
Call Setup Time Average (Second)	0.45	2.86	0.69	1.77
Handover Success Rate %	100.00	99.67	99.81	99.75

Table-56: Summary of voice call performance in network auto-selection mode.

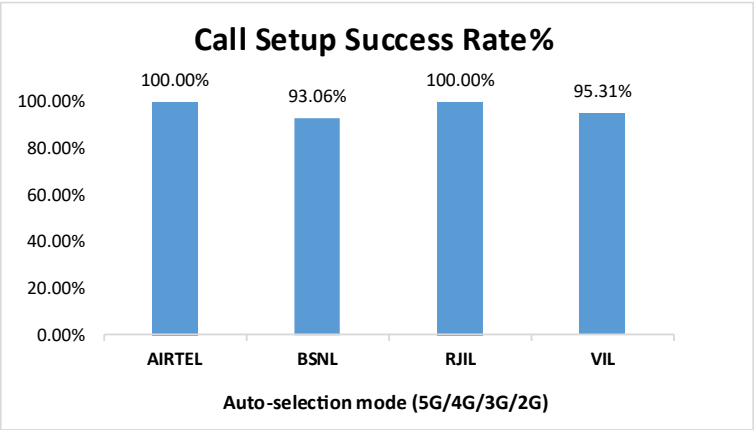


Figure-97: Performance for call setup success rate.

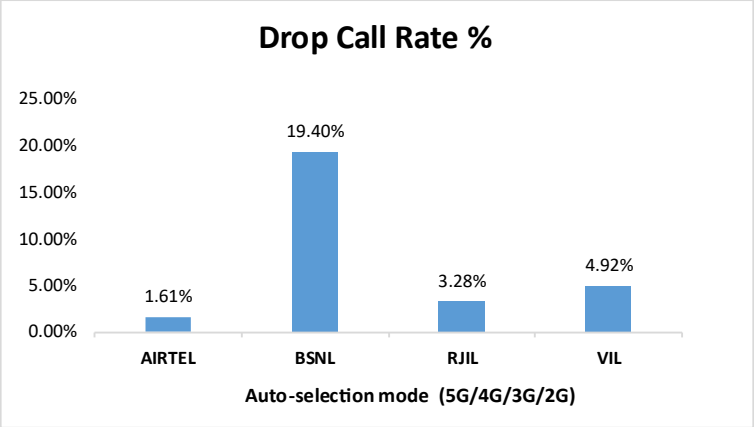


Figure-98: Performance for drop call rate.

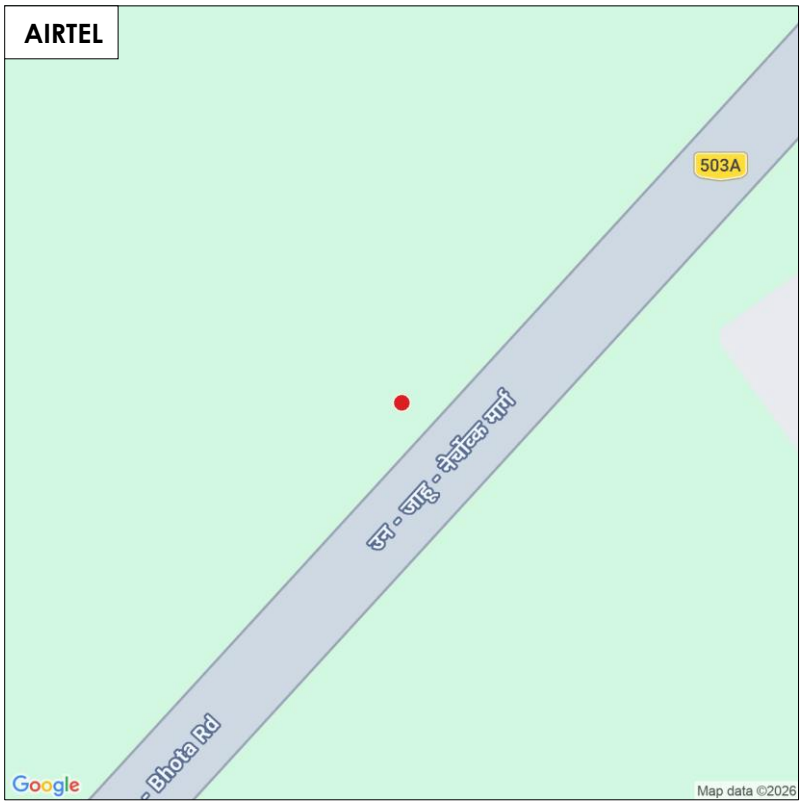


Figure-99: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

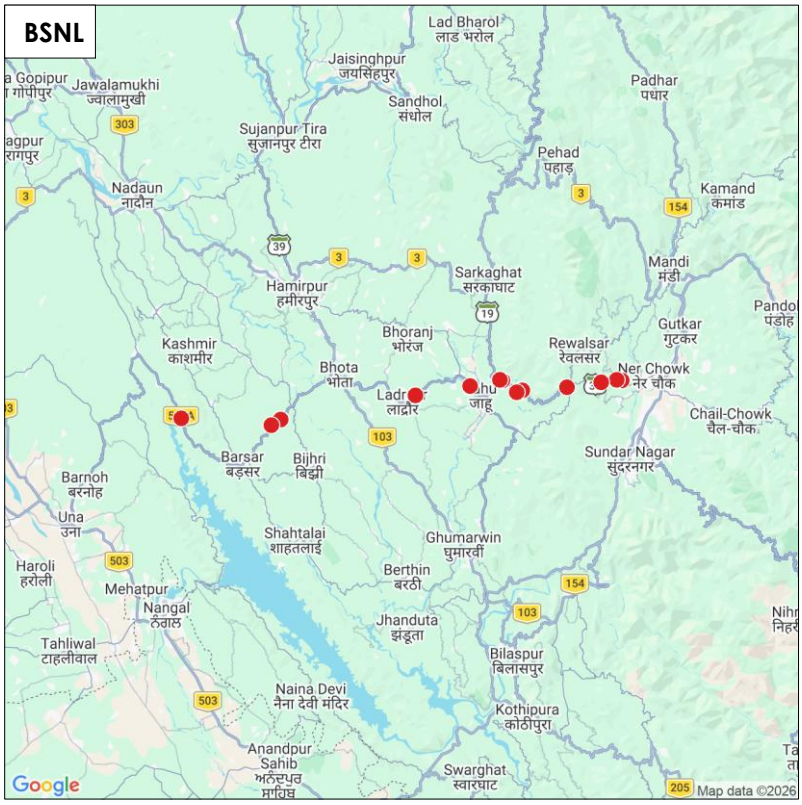


Figure-100: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

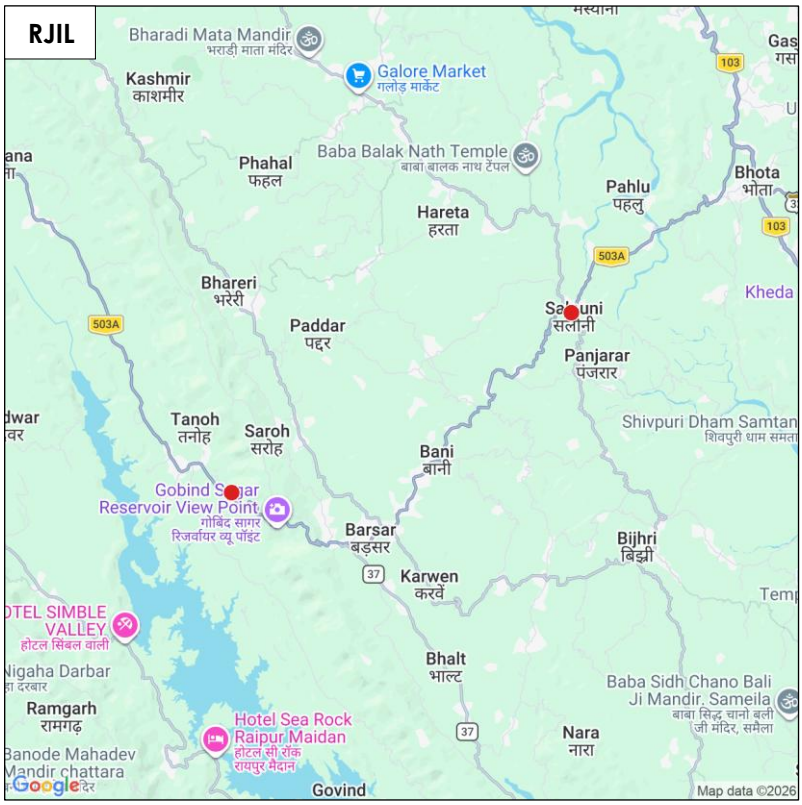


Figure-101: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

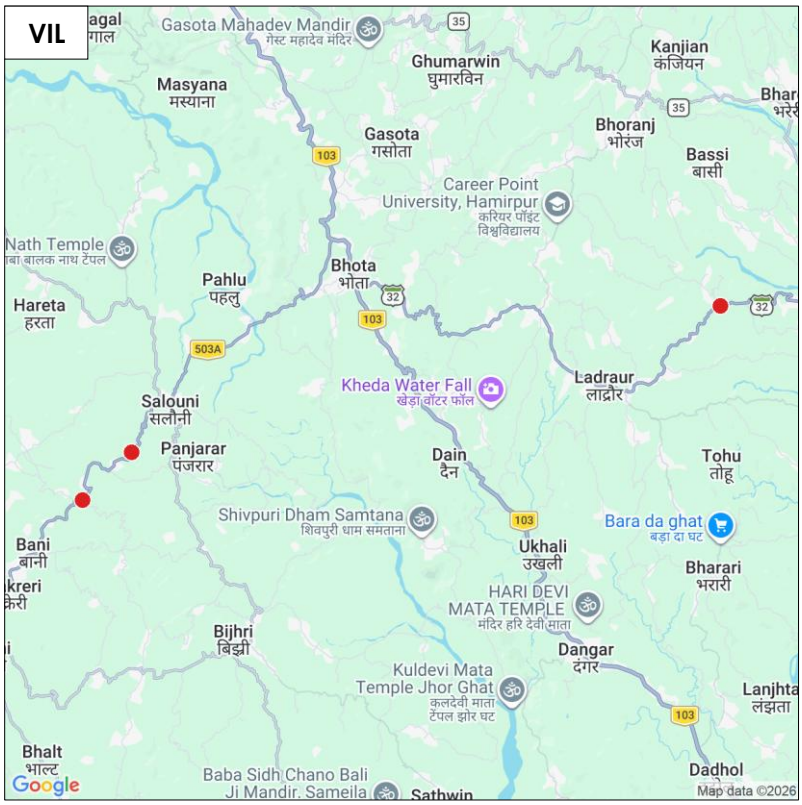


Figure-102: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - VIL.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G – Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	60	58	60	61
Number of silence call for >4 Sec	1	0	1	0
Silence Call Rate %	1.67	0.00	1.67	0.00
Number of silence instances for >4 Sec	1	0	1	0
Number of silence instances for >3 Sec	1	1	2	0
Number of silence instances for >2 sec	5	3	7	2
RTP Jitter (4G & 5G) in ms	3.14	6.04	12.88	13.04
Packet loss Rate Downlink %	1.57	3.09	2.56	1.47
Packet loss Rate Uplink %	1.56	3.75	2.07	1.75

Table-57: Summary of silence instances & packet loss rate for mobile to mobile call.

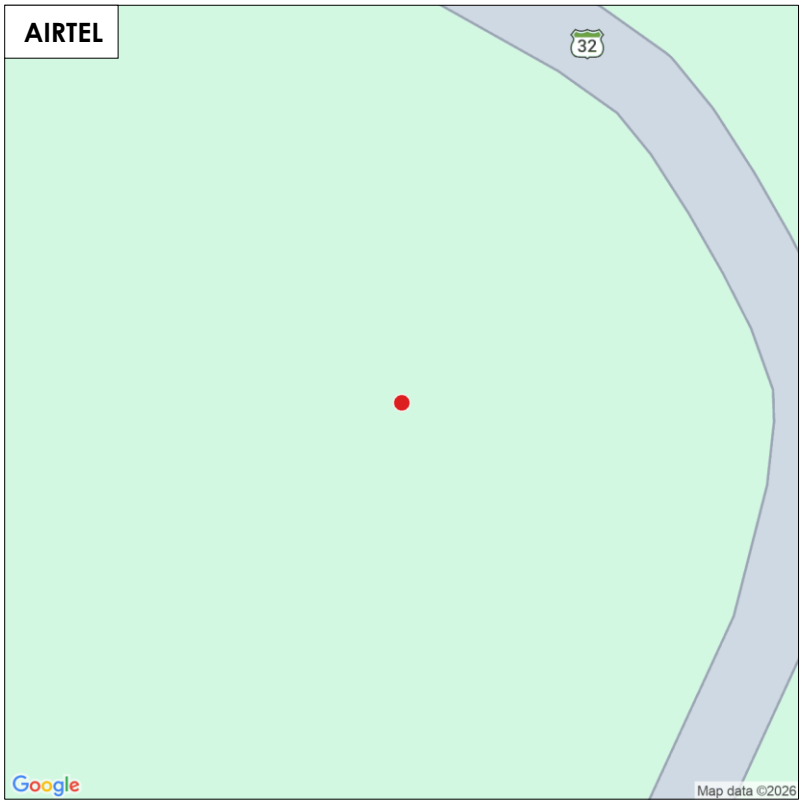


Figure-103: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)-AIRTEL.

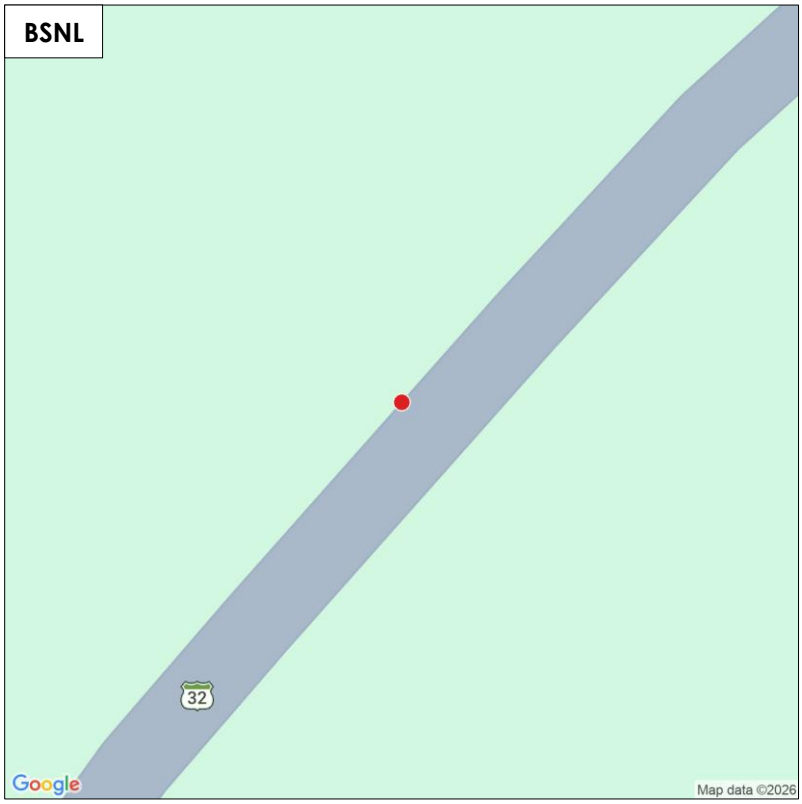


Figure-104: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)-BSNL.

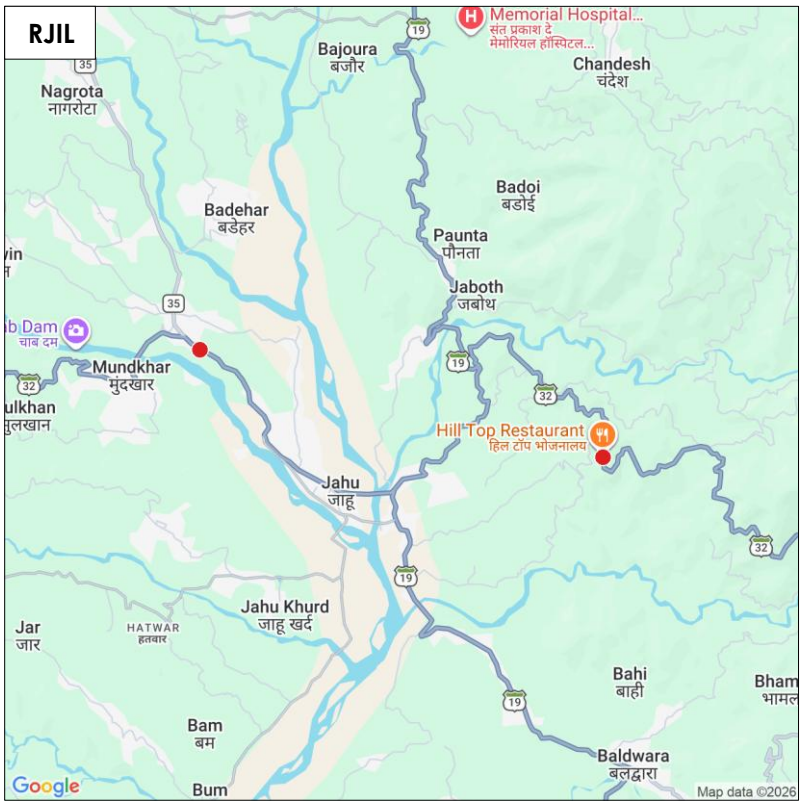


Figure-105: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)-RJIL.

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-57	771	659	779	722
Speech Quality (Average MOS)	3.90	2.97	4.44	3.33
Number of samples with MOS >=4 to <5 (Excellent)	631	216	682	346
Number of samples with MOS >=3 to <4 (Good)	80	93	47	147
Number of samples with MOS >=2 to <3 (Fair)	23	203	20	107
Number of samples with MOS >=1 to <2 (Poor)	37	147	30	122
%age of samples with MOS >=4 to <5 (Excellent)	81.84%	32.78%	87.55%	47.92%
%age of samples with MOS >=3 to <4 (Good)	10.38%	14.11%	6.03%	20.36%
%age of samples with MOS >=2 to <3 (Fair)	2.98%	30.80%	2.57%	14.82%
%age of samples with MOS >=1 to <2 (Poor)	4.80%	22.31%	3.85%	16.90%

Table-58: Summary of speech quality (MOS) samples.

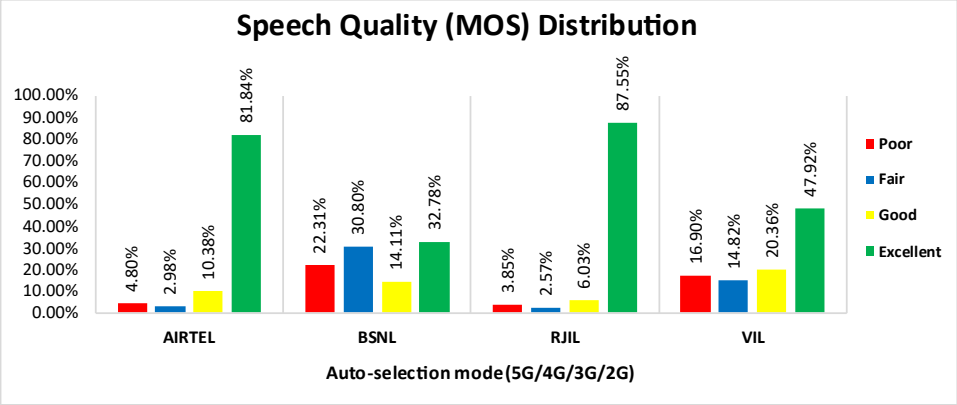


Figure-106: Distribution of samples in MOS range.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	5.09%	NA	31.15%	NA
4G	94.91%	58.96%	68.85%	82.28%
3G	NA	19.80%	NA	NA
2G	0.00%	21.25%	NA	17.21%
Limited Service	0.00%	0.00%	0.00%	0.50%

Table-59: 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.

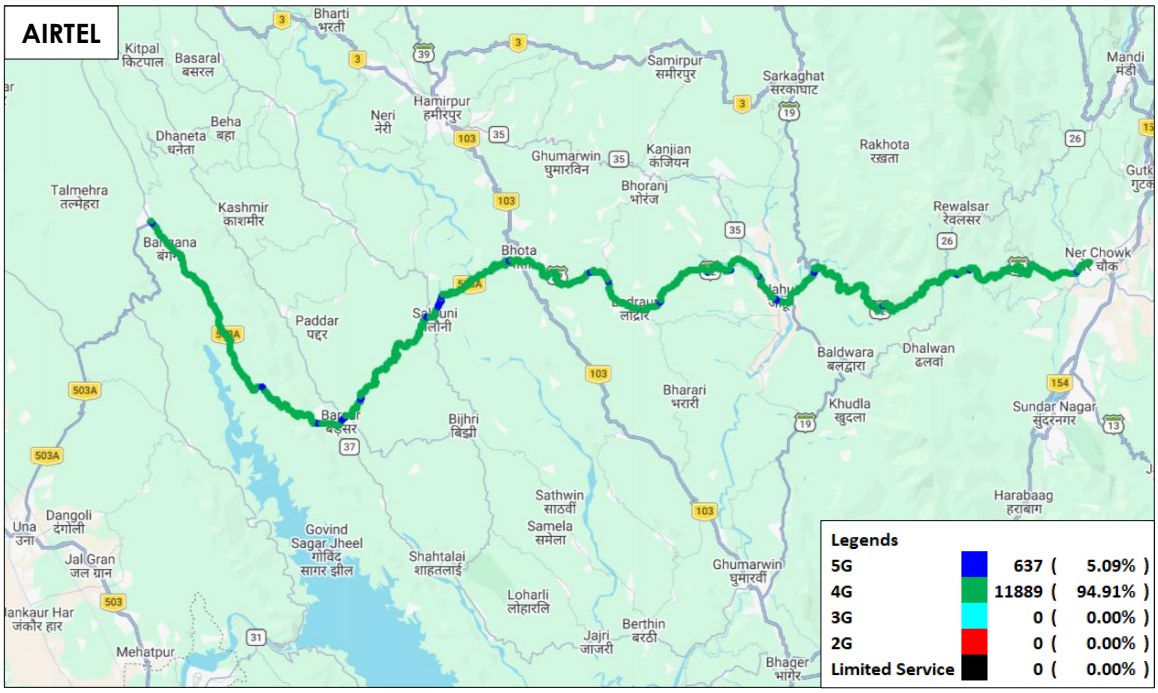


Figure-107: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

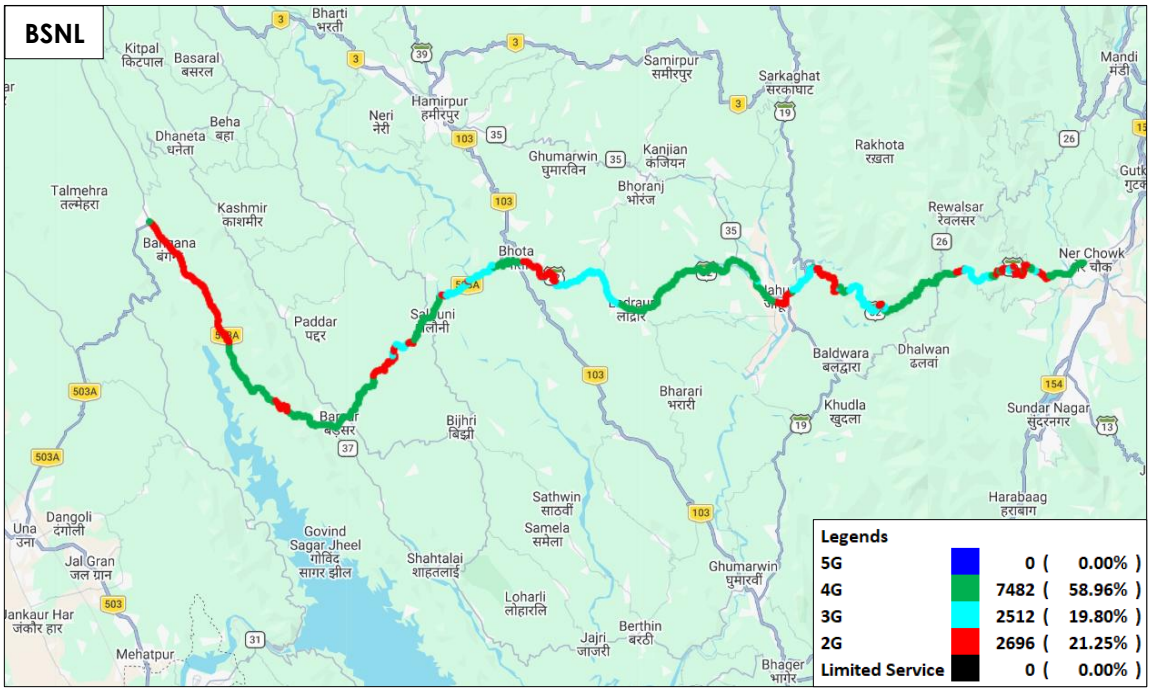


Figure-108: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

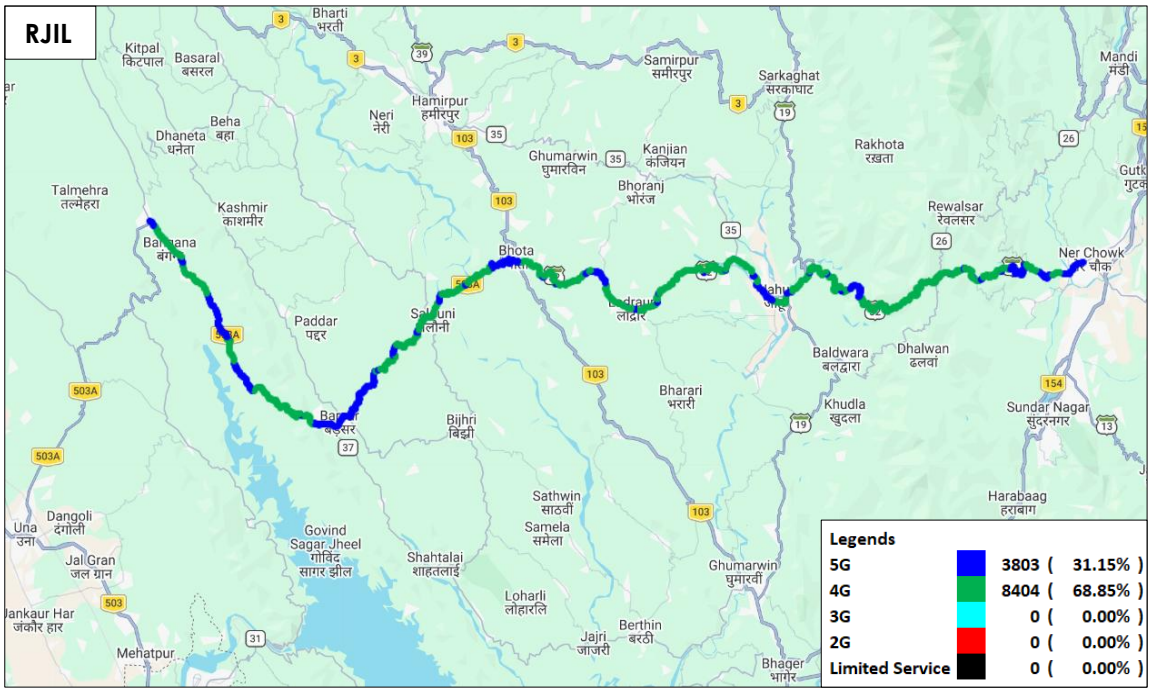


Figure-109: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

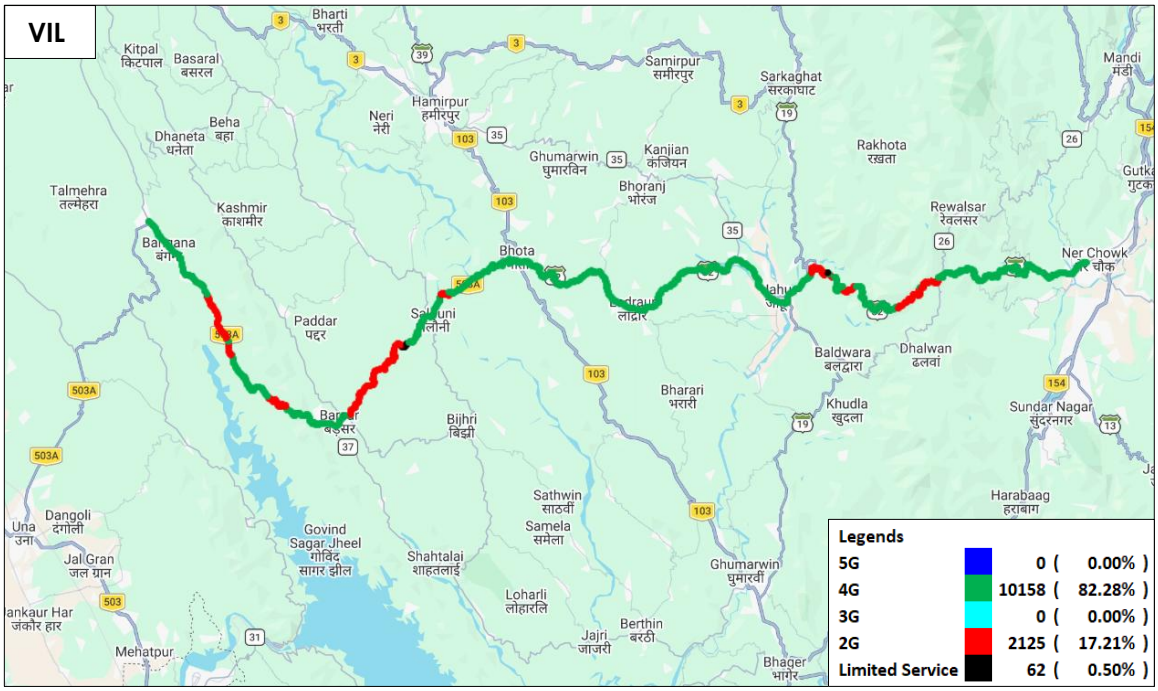


Figure-110: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-155, 156, 157 & 158 for map view)

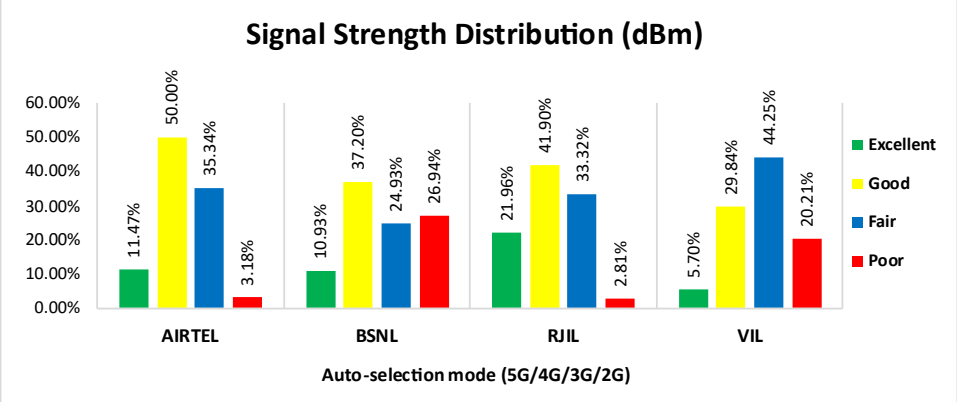


Figure-111: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

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 22% of samples falling in the excellent signal strength category.
- VIL has 6% of samples falling in the excellent signal strength category.

(h) Coverage Gap observed

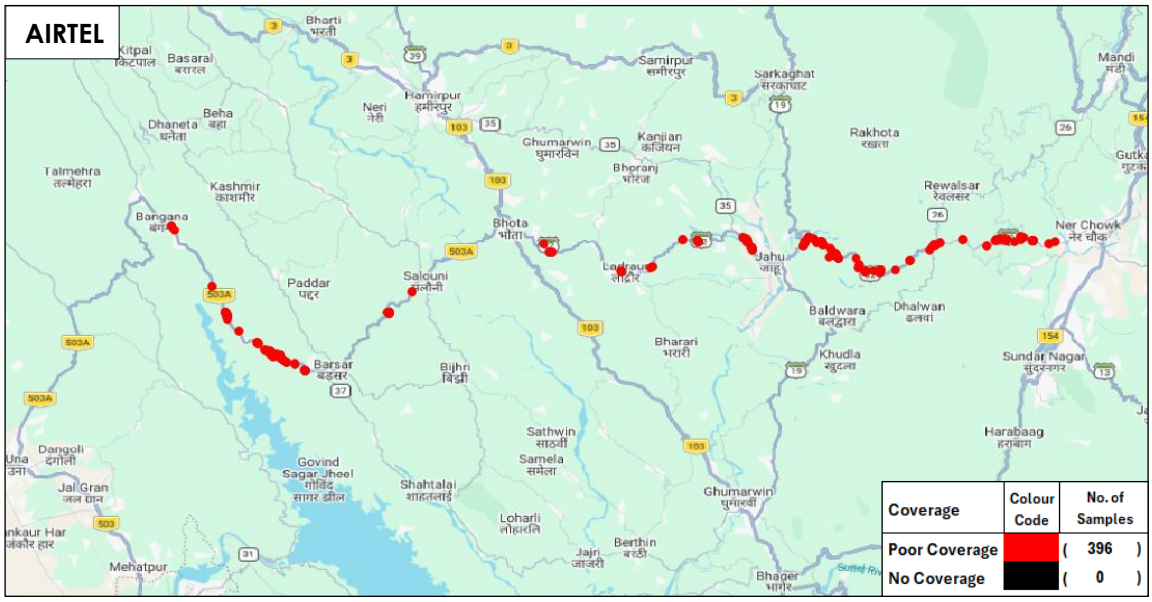


Figure-112: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.



Figure-113: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

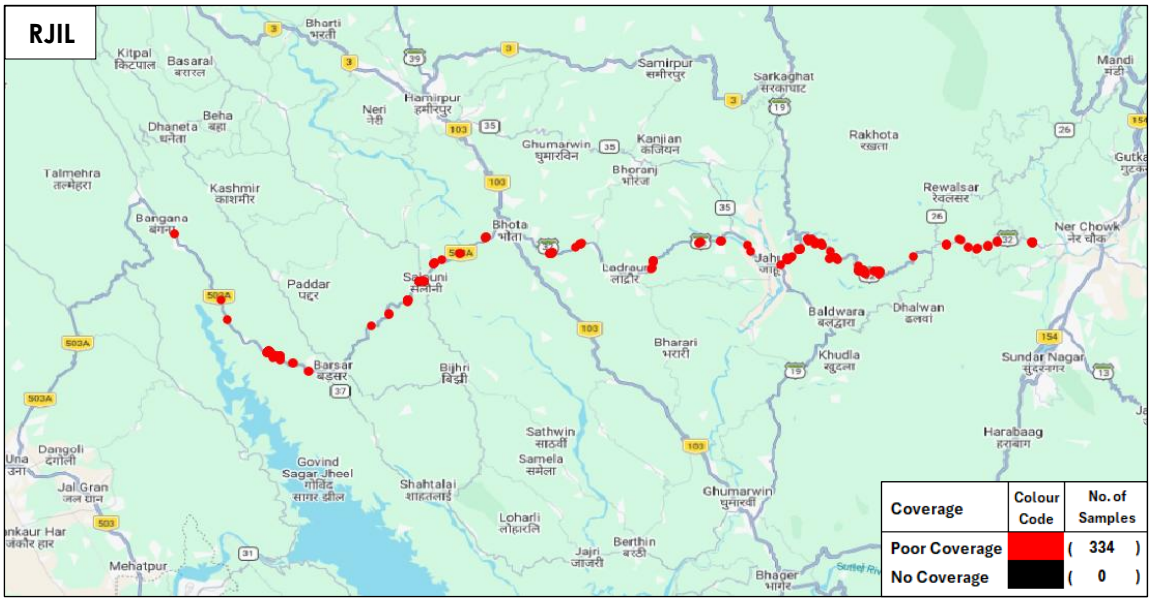


Figure-114: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

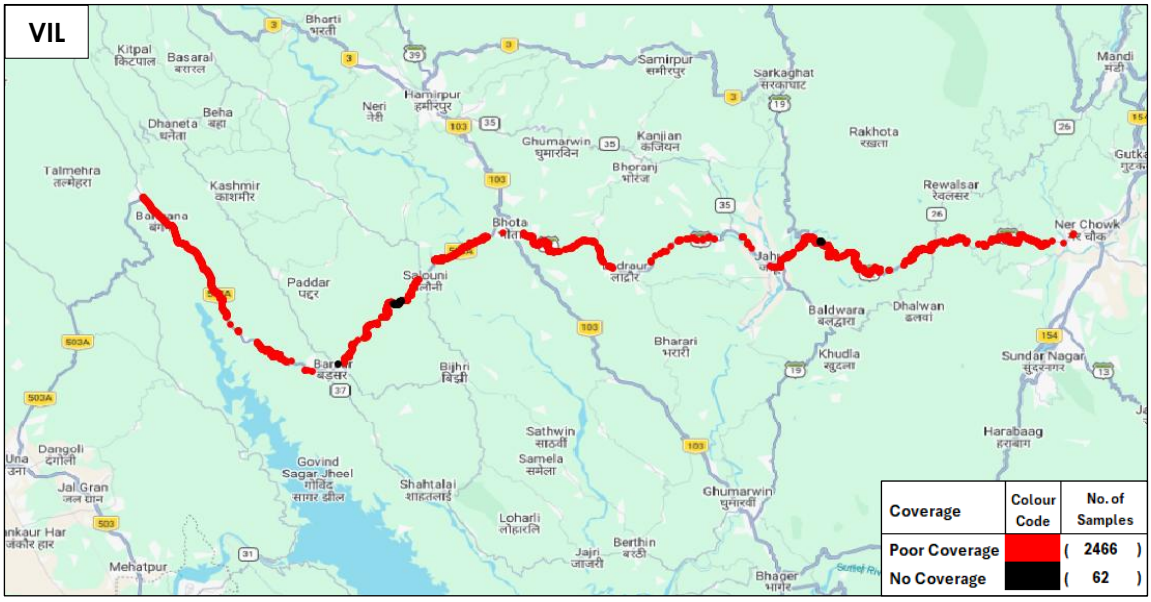


Figure-115: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice - VIL.

4.5.2.4 Data performance

(c) 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	209.98	10.15	194.88	9.63
	80th Percentile	417.21	17.18	386.65	14.78
	20th Percentile	35.92	2.20	14.05	3.40
Upload Throughput (Mbits/s)	Average	14.67	5.59	14.40	4.36
	80th Percentile	21.82	10.11	28.21	6.55
	20th Percentile	2.10	0.84	1.16	1.40
Latency (ms)	50th Percentile	43.90	28.70	29.03	44.18

Table-60: Summary of Data performance in network auto-selection mode.

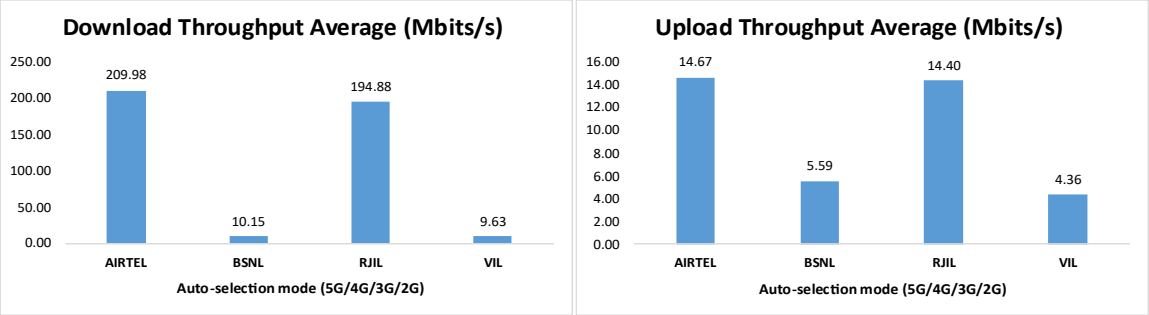


Figure-116: Download & Upload throughput.

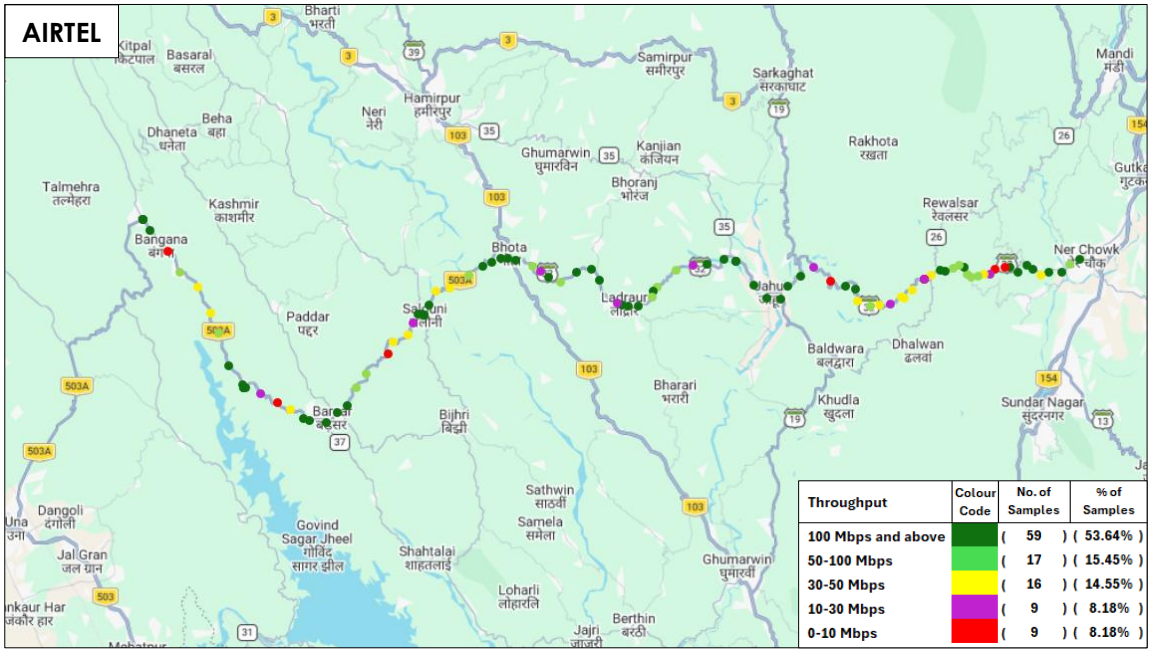


Figure-117: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

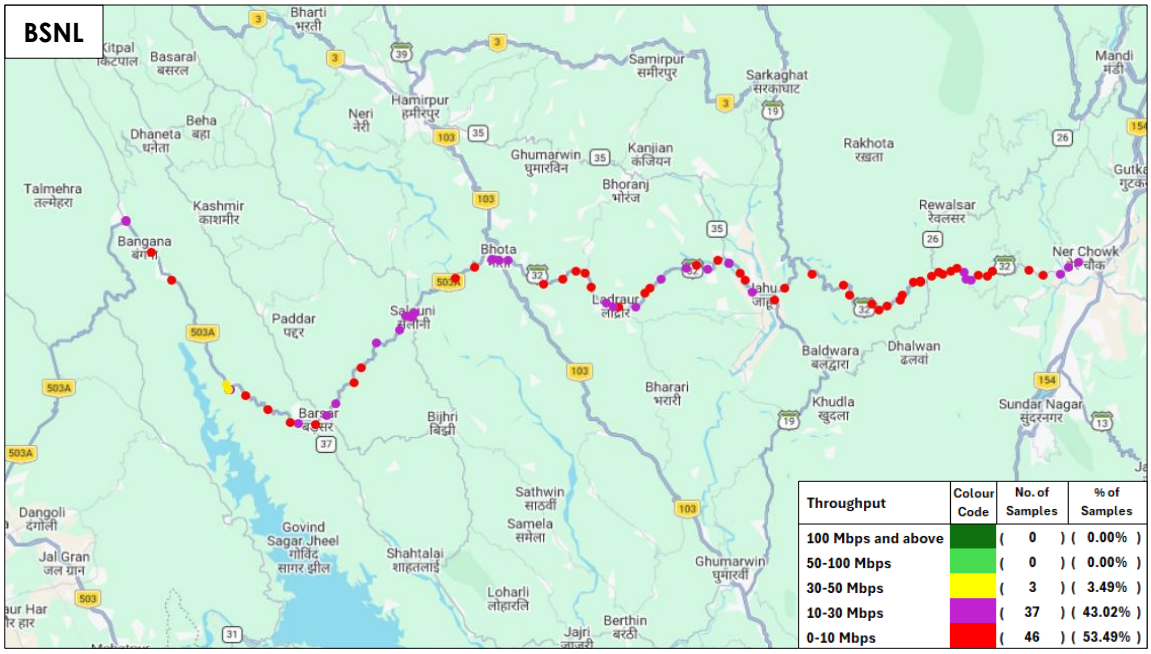


Figure-118: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

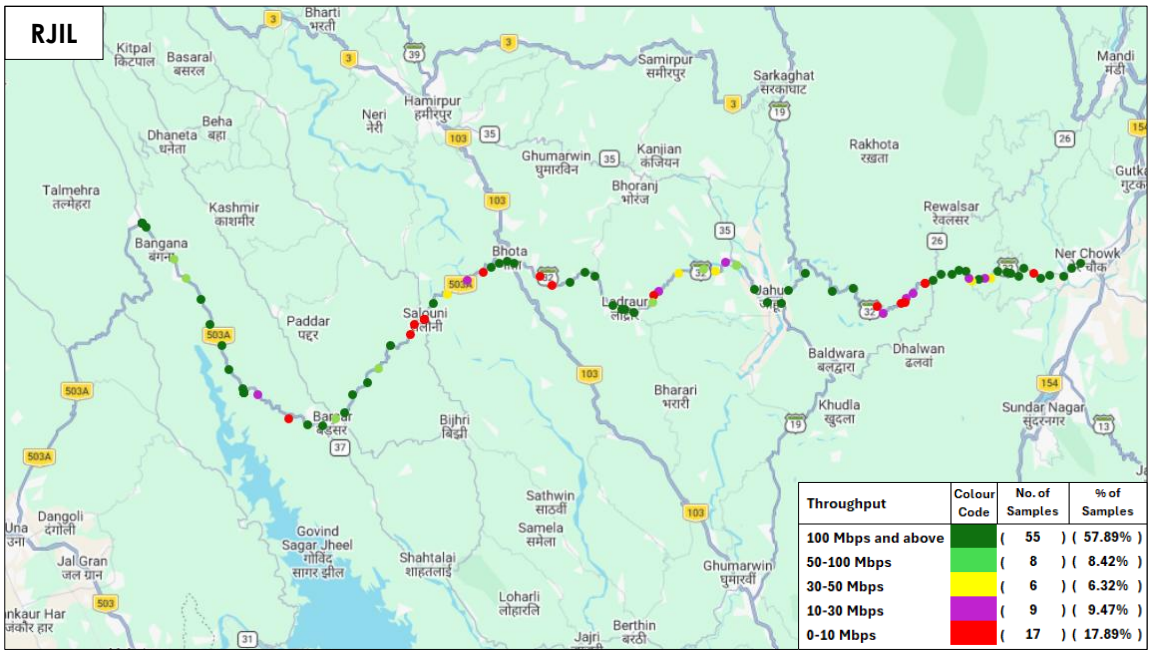


Figure-119: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

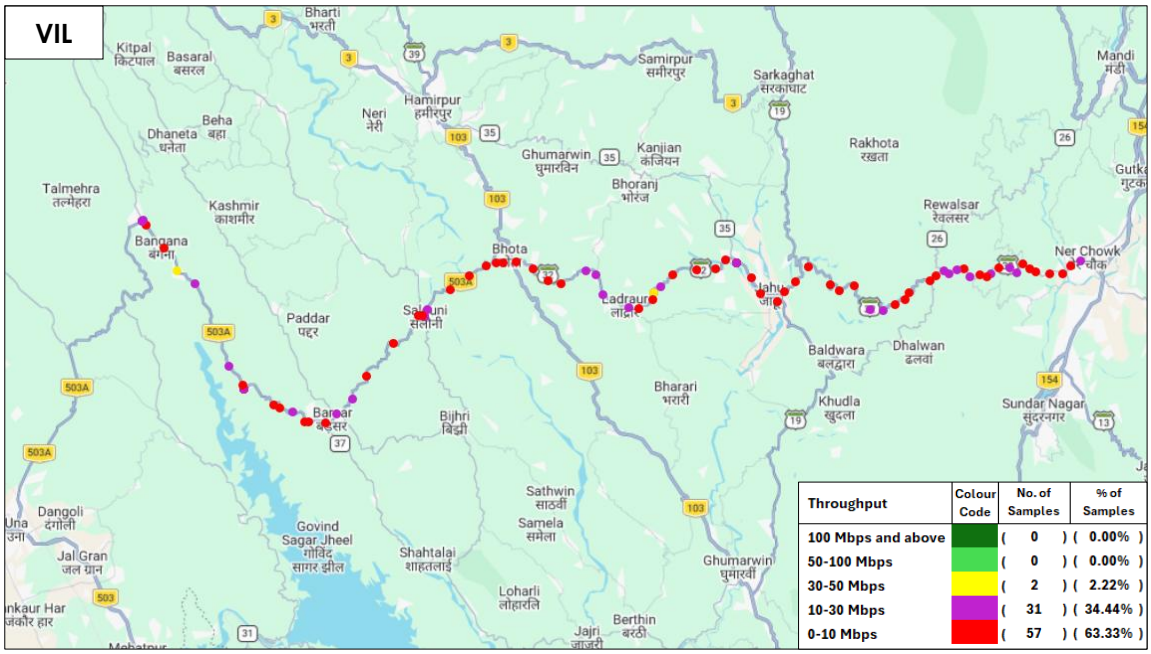


Figure-120: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

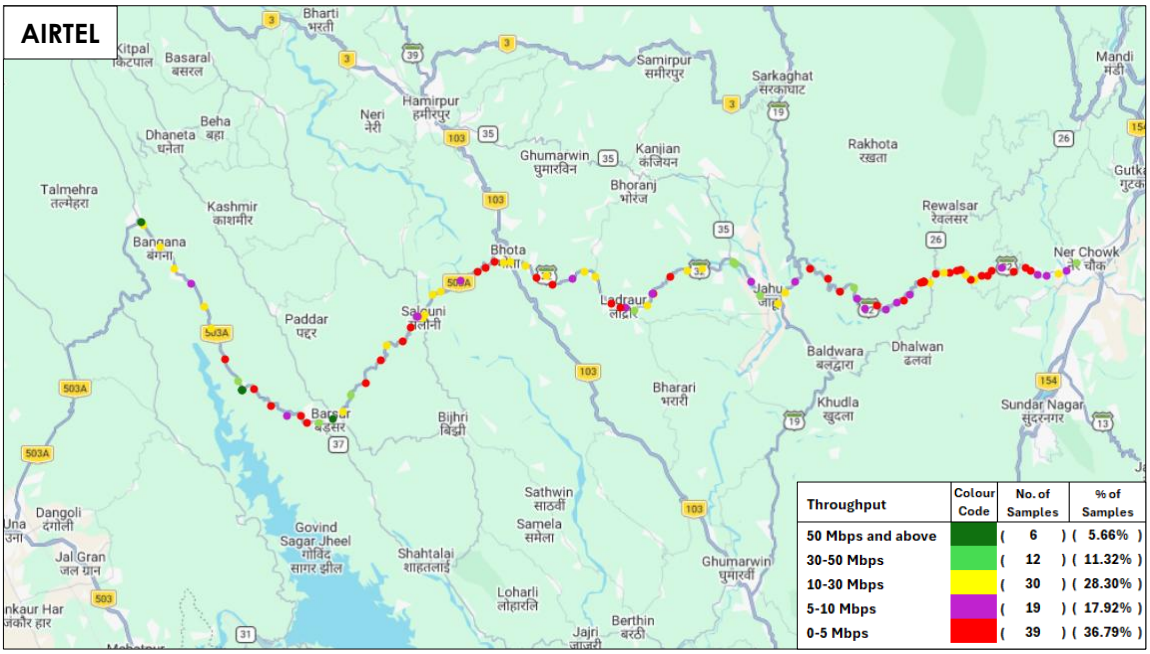


Figure-121: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

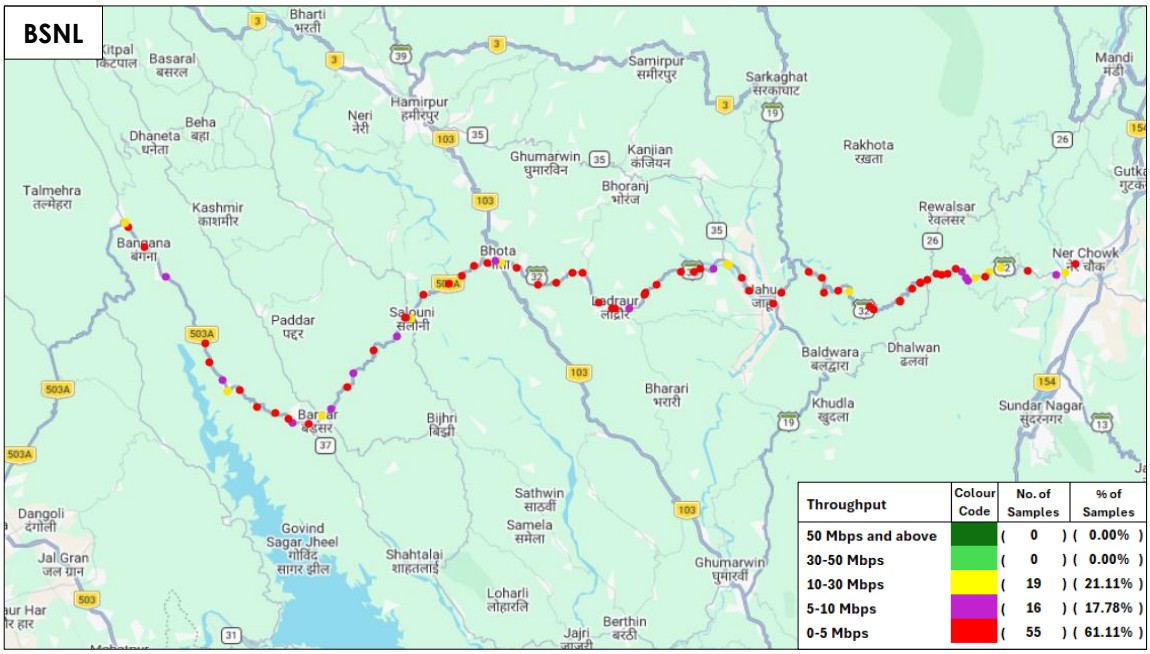


Figure-122: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

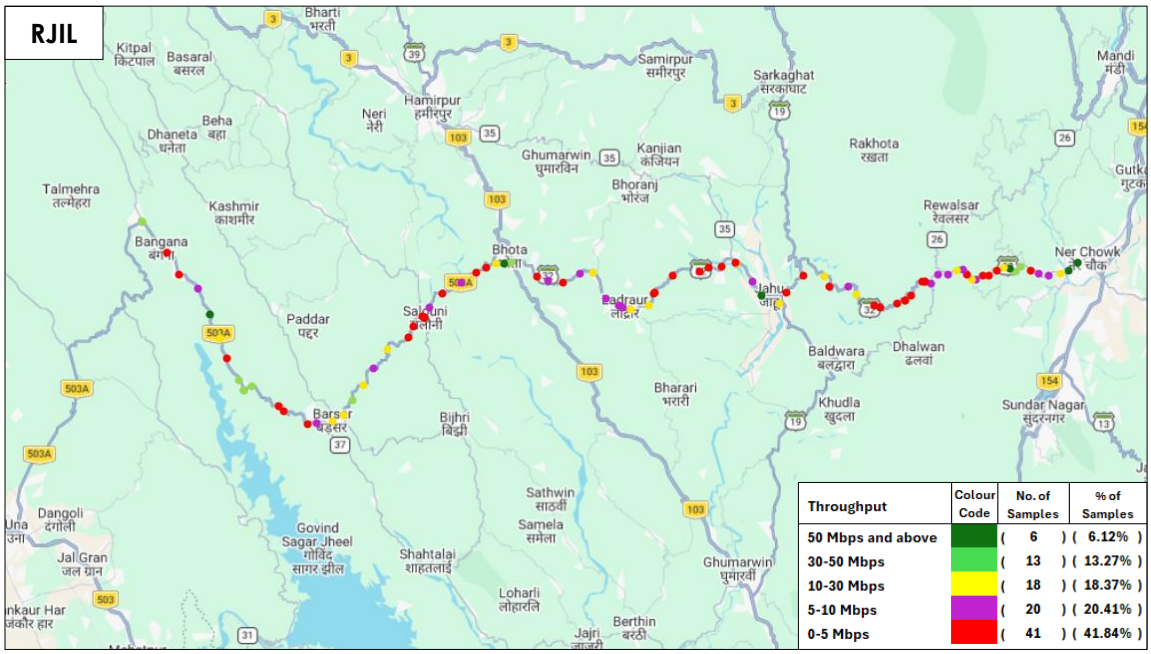


Figure-123: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

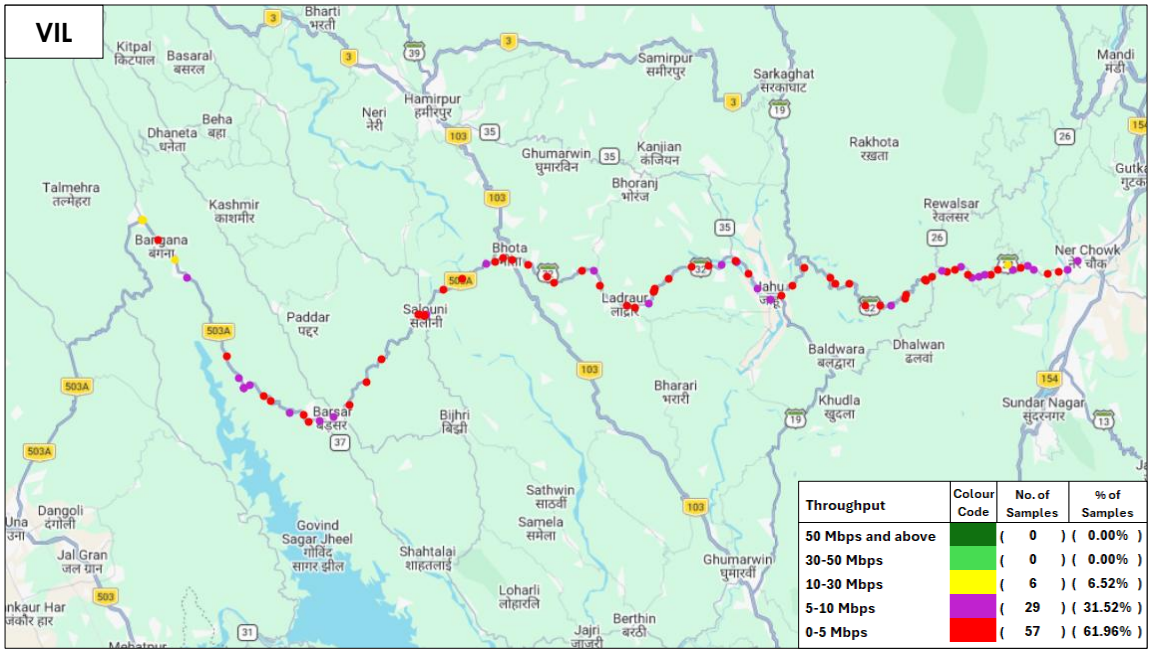


Figure-124: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	61.59%	NA	62.12%	NA
4G	38.40%	87.82%	37.67%	95.24%
3G	NA	9.04%	NA	NA
2G	0.02%	0.80%	NA	3.93%
Limited Service	0.00%	2.33%	0.21%	0.82%

Table-61: 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.

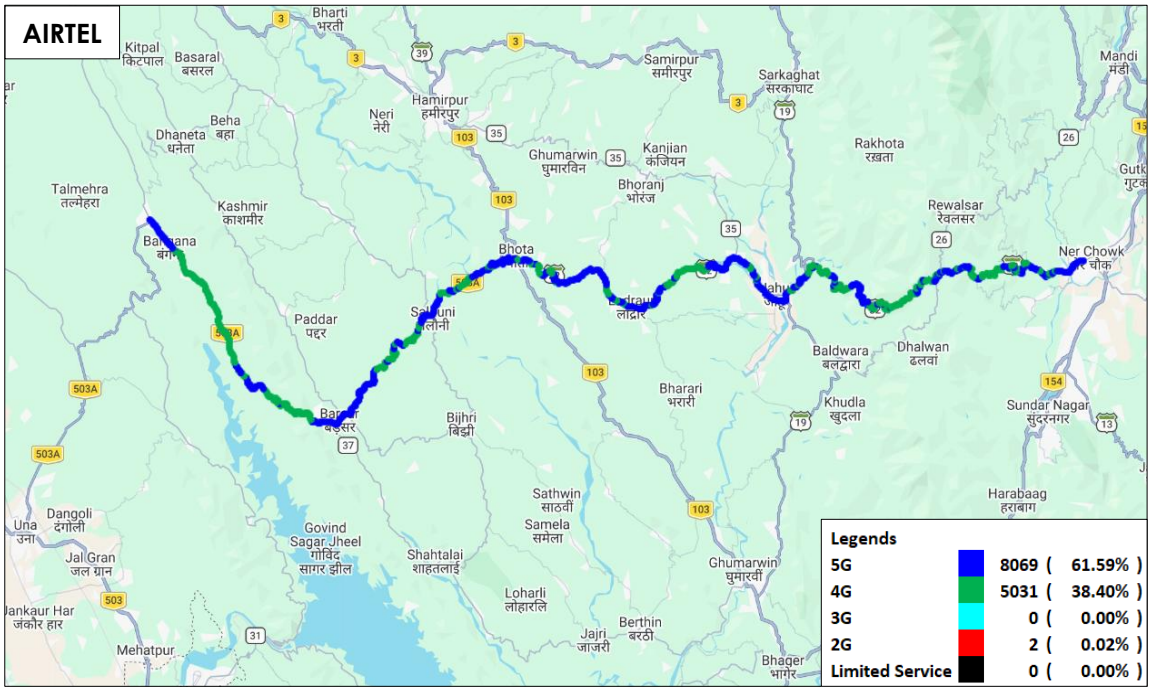


Figure-125: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

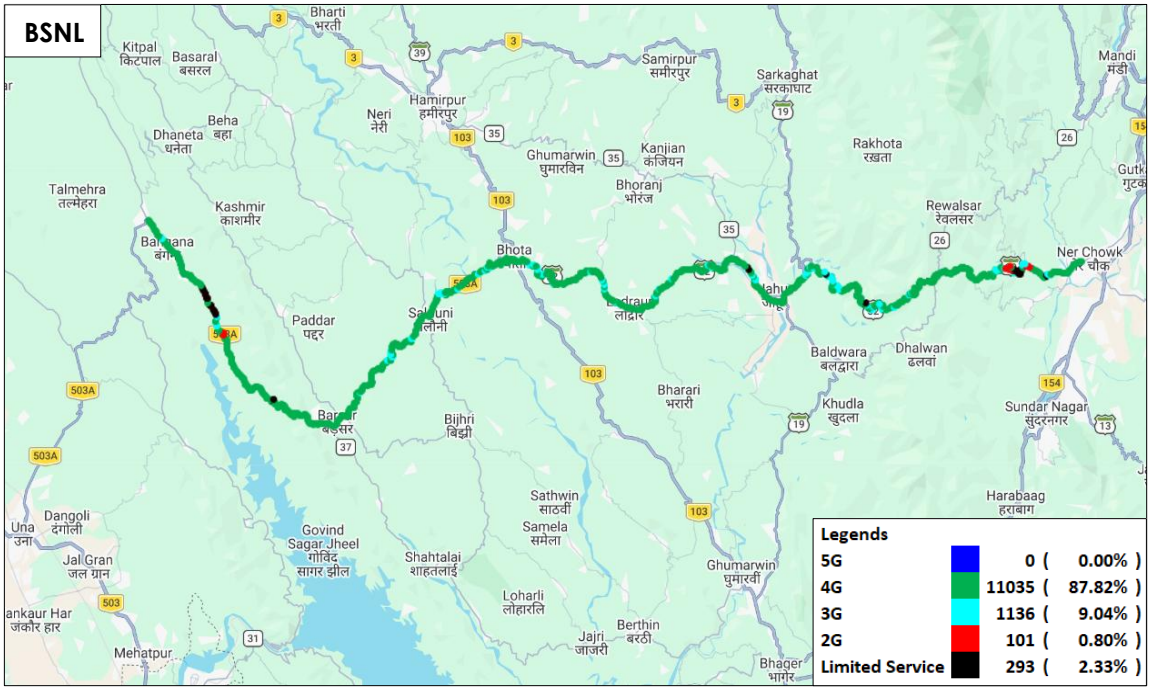


Figure-126: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - BSNL.

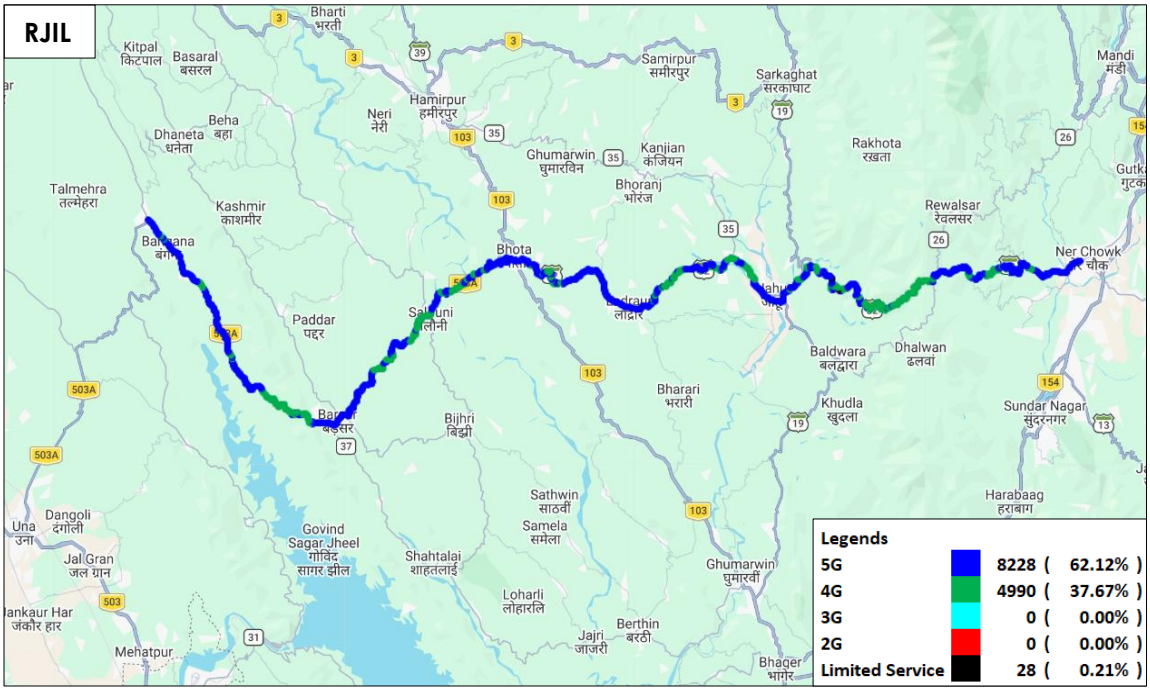


Figure-127: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - RJIL.

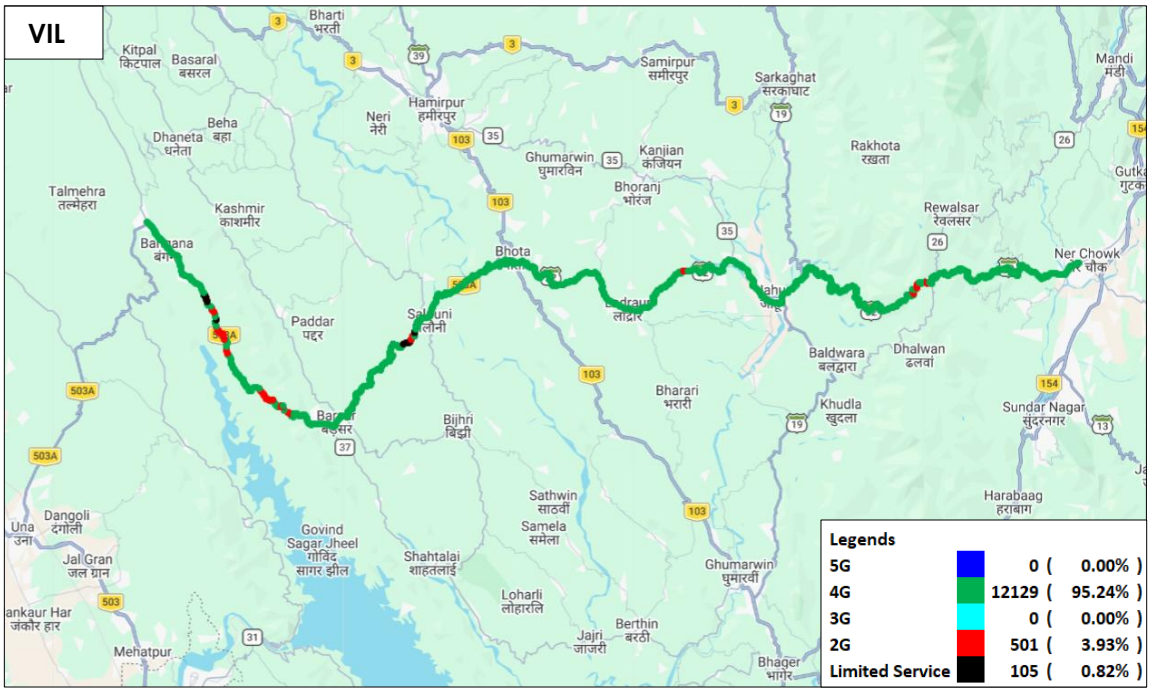


Figure-128: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-159, 160, 161 & 162 for map view)

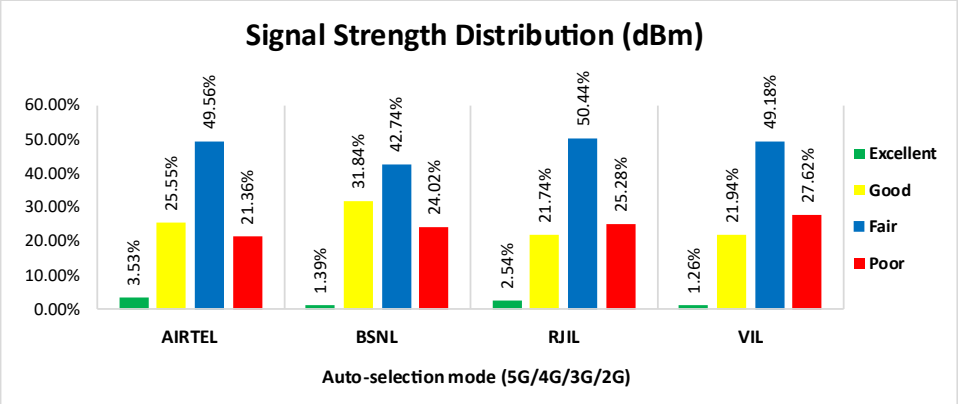


Figure-129: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 4% of samples falling in the excellent signal strength category.
- BSNL has 1% of samples falling in the excellent signal strength category.
- RJIL has 3% of samples falling in the excellent signal strength category.
- VIL has 1% 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 98.97%, 93.45% and 98.53% call setup success rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL have 98.77%, 86.46%, 99.87% and 96.69% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

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

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

2. **Call Setup Time**:
   a) Airtel, BSNL and VIL call setup time is 2.78, 3.68 & 4.45 seconds respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL & VIL call setup time is 0.62, 2.91, 0.72 & 1.67 seconds respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G) VIL, RJIL, Airtel & BSNL have 1.77%, 1.05%, 0.91% & 0.36 silence call rate respectively. Further BSNL has higher RTP packet loss rate in downlink (3.88%) compared to Airtel (1.67%), VIL (1.46%) & RJIL (1.23%). In uplink the RTP packet loss rate is higher for BSNL (4.12%) compared to Airtel (1.80%), VIL (1.41%) & Airtel (1.29%). (refer table-6)

4. **Drop Call Rate**:
   a) Airtel, BSNL and VIL drop call rate is 1.64%, 8.20% and 1.94% respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL drop call rate is 1.00%, 9.21%, 0.88% and 2.79% 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 148.97 Mbps, 9.60 Mbps, 188.24 Mbps and 11.93 Mbps respectively. (refer table-11)

   b) Airtel, BSNL, RJIL and VIL average upload speeds are 15.96 Mbps, 5.20 Mbps, 20.18 Mbps and 5.44 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 254.20 Mbps, 7.06 Mbps, 246.53 Mbps and 17.32 Mbps respectively. (refer table-28)

   b) Airtel, BSNL, RJIL and VIL average upload speeds are 44.65 Mbps, 4.79 Mbps, 36.99 Mbps and 7.01 Mbps respectively. (refer table-28)

3. **Data session setup success rate (static i.e. while stationary):**
   a) All operators have 100.00% download session setup success rate. (refer table-28)

   b) All operators have 100.00% upload session setup success rate. (refer table-28)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 98.97% call setup success rate and 1.64% drop call rate have been observed in 3G/2G network mode for LSA. (refer table-3)
- 98.77% call setup success rate and 1.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)
- 99.45% call setup success rate and 0.92% drop call rate have been observed in 3G/2G network mode for city drive. (refer table-13)
- 99.65% call setup success rate and 0.88% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. (refer table-15)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-21)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at both walk test locations. (refer table-42 & 43)
- 94.20% call setup success rate and 9.23% drop call rate have been observed in 3G/2G network mode across Una to Mandi highway route. (refer table-46)
- 89.33% call setup success rate and 2.99% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) across Una to Mandi highway route. (refer table-48)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode across Mandi to Una highway route. (refer table-54)
- 100.00% call setup success rate and 1.61% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) across Mandi to Una highway drive. (refer table-56)

Data

- Airtel has 148.97 Mbps average download speed & 15.96 Mbps average upload speed for LSA. (refer table-11)
- Airtel has 122.28 Mbps average download speed & 13.44 Mbps average upload speed across the measured routes for city drive. (refer table-19)
- Airtel has 169.31 Mbps average download speed & 15.54 Mbps average upload speed across the measured routes for Una to Mandi highway. (refer table- 52)
- Airtel has 209.98 Mbps average download speed & 14.67 Mbps average upload speed across the measured routes for Mandi to Una highway. (refer table- 60)

2. BSNL:

Voice

- 93.45% call setup success rate and 8.20% drop call rate have been observed in 3G/2G network mode for LSA. (refer table-3)
- 86.46% call setup success rate and 9.21% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)
- 92.99% call setup success rate and 6.80% drop call rate have been observed in 3G/2G network mode for city drive. (refer table-13)

- 86.50% call setup success rate and 9.11% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. (refer table-15)

- 90.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-21)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at Jivan Market Una walk test location. (refer table-42)

- 81.48% call setup success rate and 4.55% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at Mandi Mall Road walk test location. (refer table-43)

- 91.67% call setup success rate and 19.70% drop call rate have been observed in 3G/2G network mode across Una to Mandi highway route. (refer table-46)

- 76.83% call setup success rate and 11.11% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) across Una to Mandi highway route. (refer table-48)

- 100.00% call setup success rate and 8.20% drop call rate have been observed in 3G/2G network mode across Mandi to Una highway route. (refer table-54)

- 93.06% call setup success rate and 19.40% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) across Mandi to Una highway route. (refer table-56)

Data

- BSNL has 9.60 Mbps average download speed & 5.20 Mbps average upload speed for LSA. (refer table-11)

- BSNL has 9.49 Mbps average download speed & 4.57 Mbps average upload speed across the measured routes for city drive. (refer table-19)

- All hotspot locations have less download speed (less than 10 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-29 to 34)

- Lal Bahadur Shastri Government Hospital Mandi and Mandi Bus Stand have less upload speed (less than 2 Mbps) out of total 6 hotspots locations for auto-selection mode (5G/4G/3G/2G). (refer table-29 & 30)

- Mandi Mall Road has less download speed (less than 10 Mbps) out of total 2 walk test locations for auto-selection mode (5G/4G/3G/2G). (refer table-45)

- BSNL has 9.32 Mbps average download speed & 6.29 Mbps average upload speed across the measured routes for Una to Mandi highway. (refer table-52)

- BSNL has 10.15 Mbps average download speed & 5.59 Mbps average upload speed across the measured routes for Mandi to Una highway. (refer table-60)

3. RJIL:

Voice

- 99.87% call setup success rate and 0.88% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)

- 99.82% call setup success rate and 0.53% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. (refer table-15)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-21)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at both walk test locations. (refer table-42 & 43)

- 100.00% call setup success rate and 3.08% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) across Una to Mandi highway route. (refer table- 48)

- 100.00% call setup success rate and 3.28% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) across Mandi to Una highway route. (refer table- 56)

Data

- RJIL has 188.24 Mbps average download speed & 20.18 Mbps average upload speed for LSA. (refer table-11)

- RJIL has 171.68 Mbps average download speed & 18.01 Mbps average upload speed across the measured routes for city drive. (refer table-19)

- Lal Bahadur Shastri Government Hospital Mandi and Mandi Bus Stand have less download speed (less than 100 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-29 & 30)

- Lal Bahadur Shastri Government Hospital Mandi and Mandi Mall Road have less upload speed (less than 20 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-29 & 31)

- RJIL has 193.46 Mbps average download speed & 21.43 Mbps average upload speed across the measured routes for Una to Mandi highway. (refer table-52)

- RJIL has 194.88 Mbps average download speed & 14.40 Mbps average upload speed across the measured routes for Mandi to Una highway. (refer table-60)

4. VIL:

Voice

- 98.53% call setup success rate and 1.94% drop call rate have been observed in 3G/2G network mode for LSA. (refer table-3)

- 96.69% call setup success rate and 2.79% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)

- 99.45% call setup success rate and 0.74% drop call rate have been observed in 3G/2G network mode for city drive. (refer table-13)

- 97.05% call setup success rate and 2.32% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. (refer table-15)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-21)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at both walk test locations. (refer table-42 & 43)

- 90.00% call setup success rate and 9.52% drop call rate have been observed in 3G/2G network mode across Una to Mandi highway route. (refer table-46)
- 90.28% call setup success rate and 9.23% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) across Una to Mandi highway route. (refer table- 48)
- 100.00% call setup success rate and 4.84% drop call rate have been observed in 3G/2G network mode across Mandi to Una highway route. (refer table-54)
- 95.31% call setup success rate and 4.92% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) across Mandi to Una highway route. (refer table-56)

Data

- VIL has 11.93 Mbps average download speed & 5.44 Mbps average upload speed for LSA. (refer table-11)
- VIL has 12.18 Mbps average download speed & 5.45 Mbps average upload speed across the measured routes for city drive. (refer table-19)
- Regional Hospital Una and Una Bus Stand have less download speed (less than 10 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-33 & 34)
- VIL has 10.36 Mbps average download speed & 5.30 Mbps average upload speed across the measured routes for Una to Mandi highway. (refer table-52)
- VIL has 9.63 Mbps average download speed & 4.36 Mbps average upload speed across the measured routes for Mandi to Una highway. (refer table-60)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

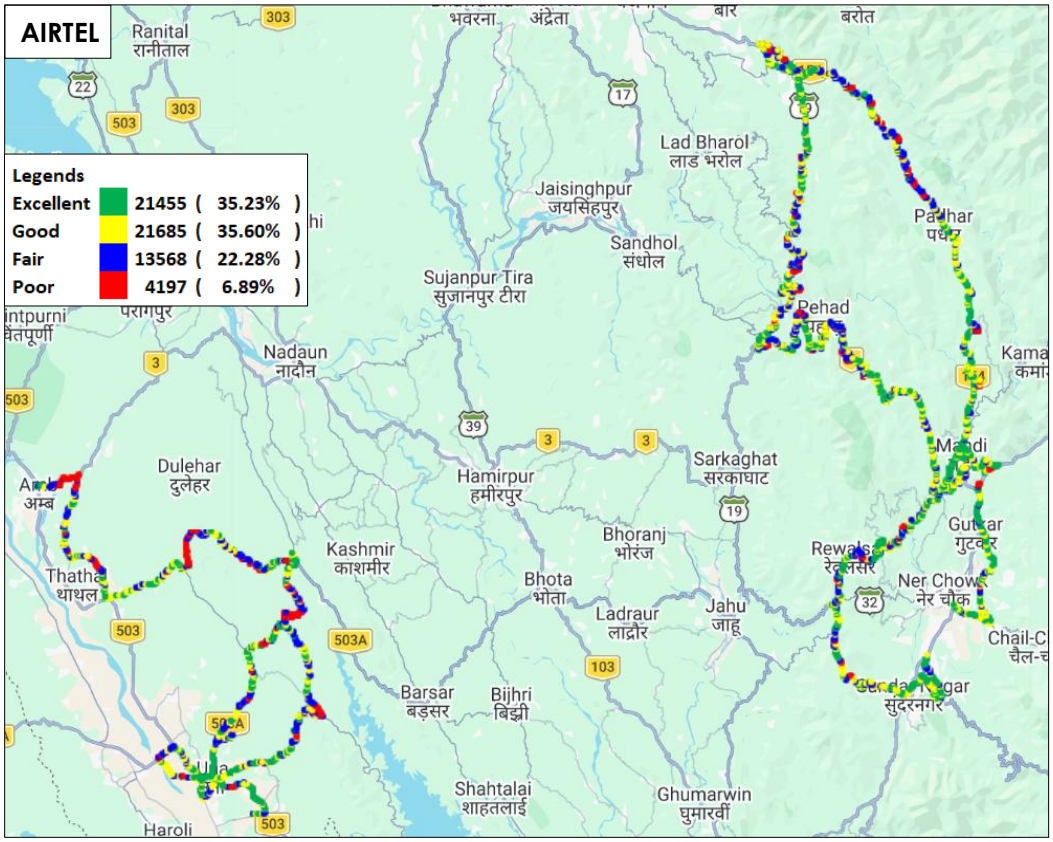


Figure-130: Signal strength 3G/2G network mode voice - AIRTEL.

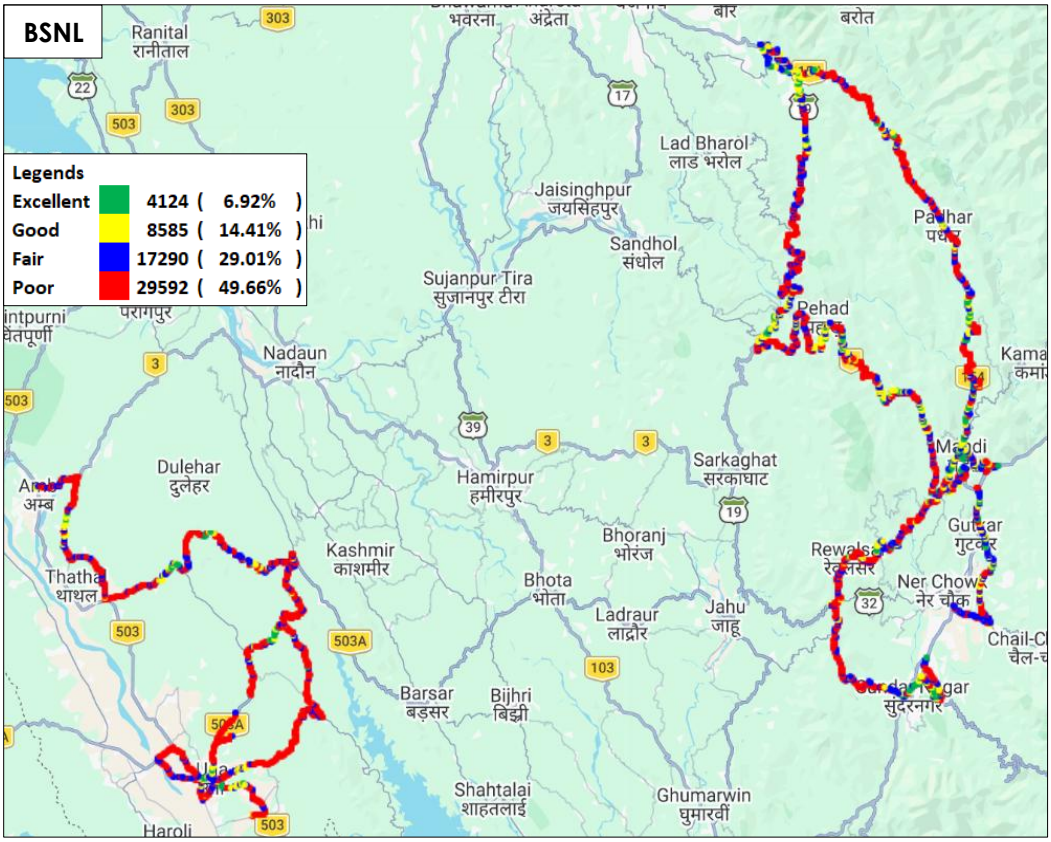


Figure-131: Signal strength 3G/2G network mode voice - BSNL.

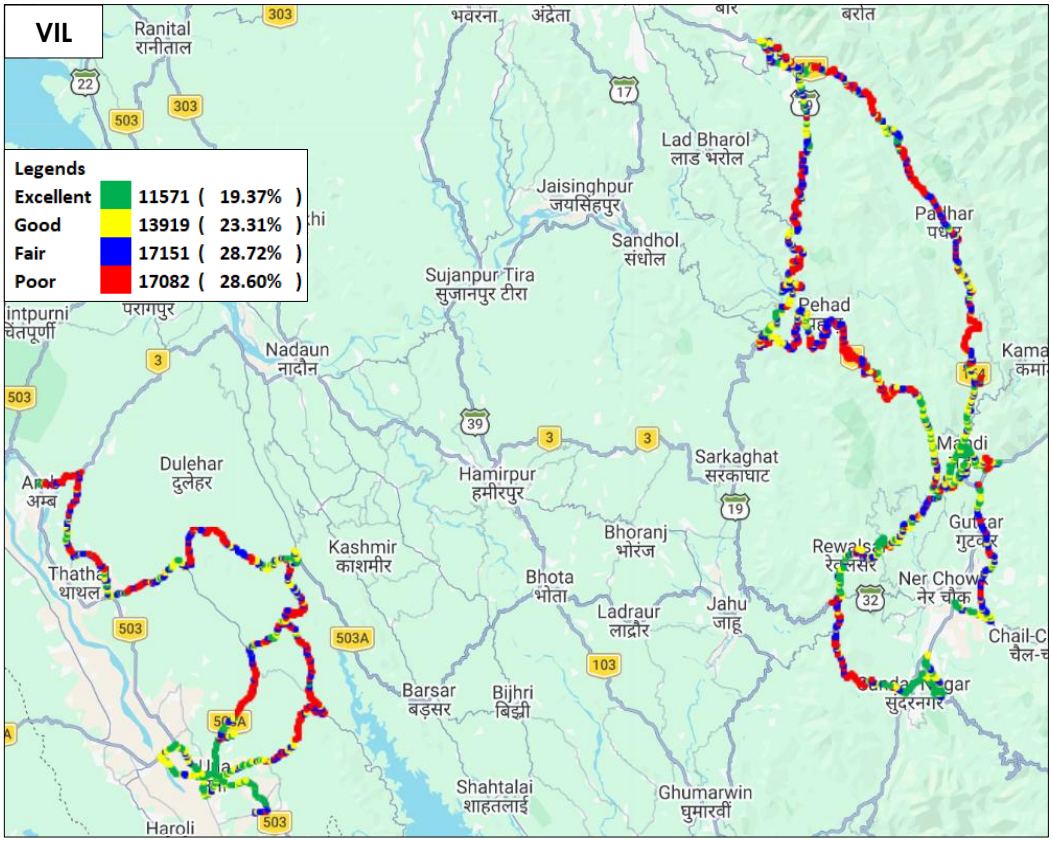


Figure-132: Signal strength 3G/2G network mode voice - VIL.

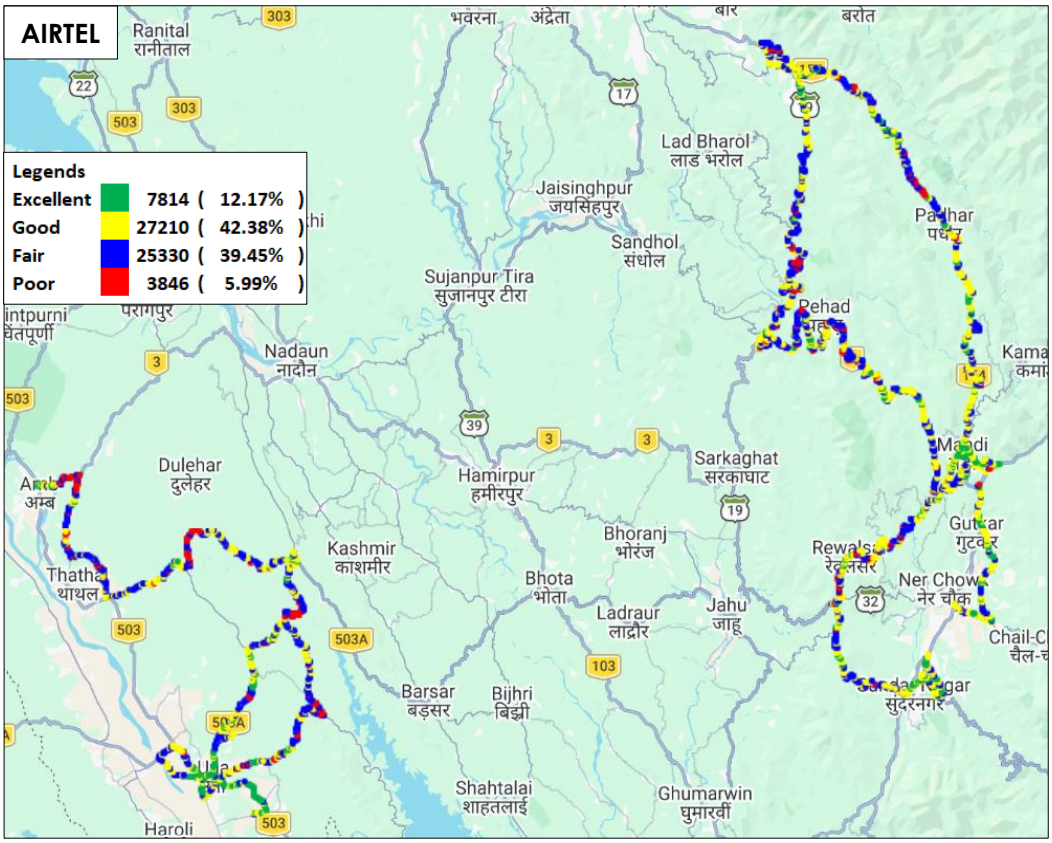


Figure-133: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

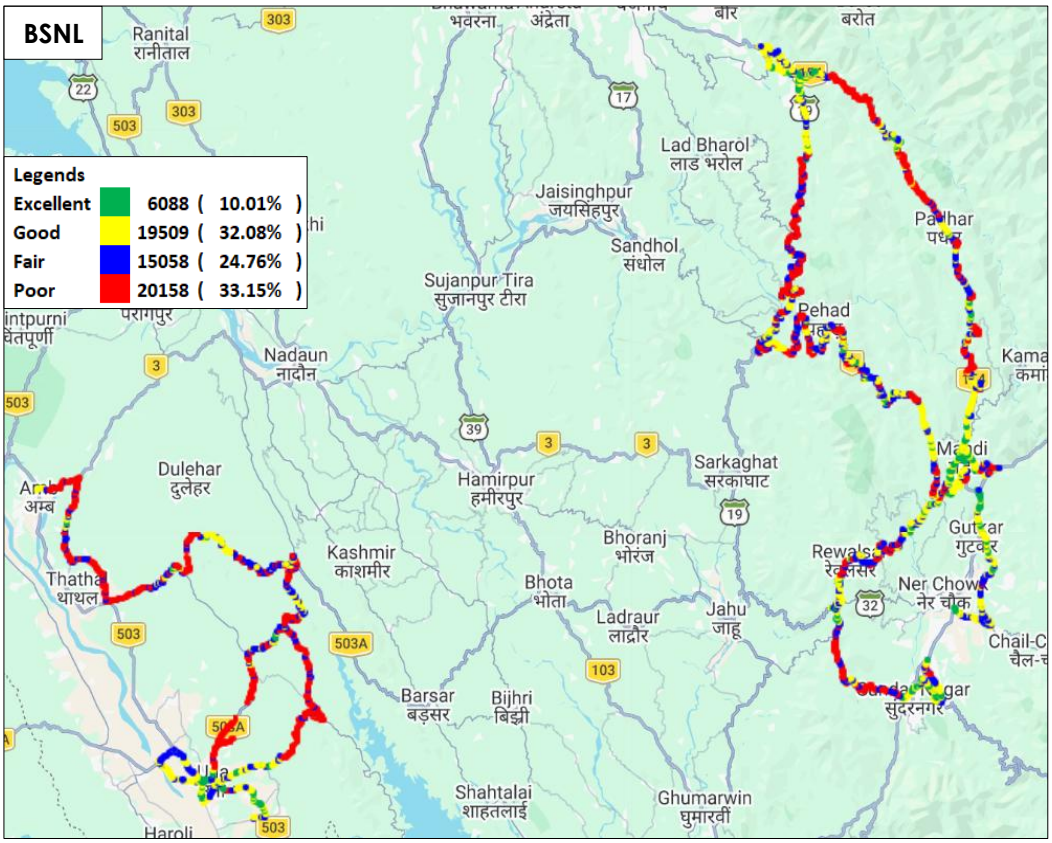


Figure-134: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

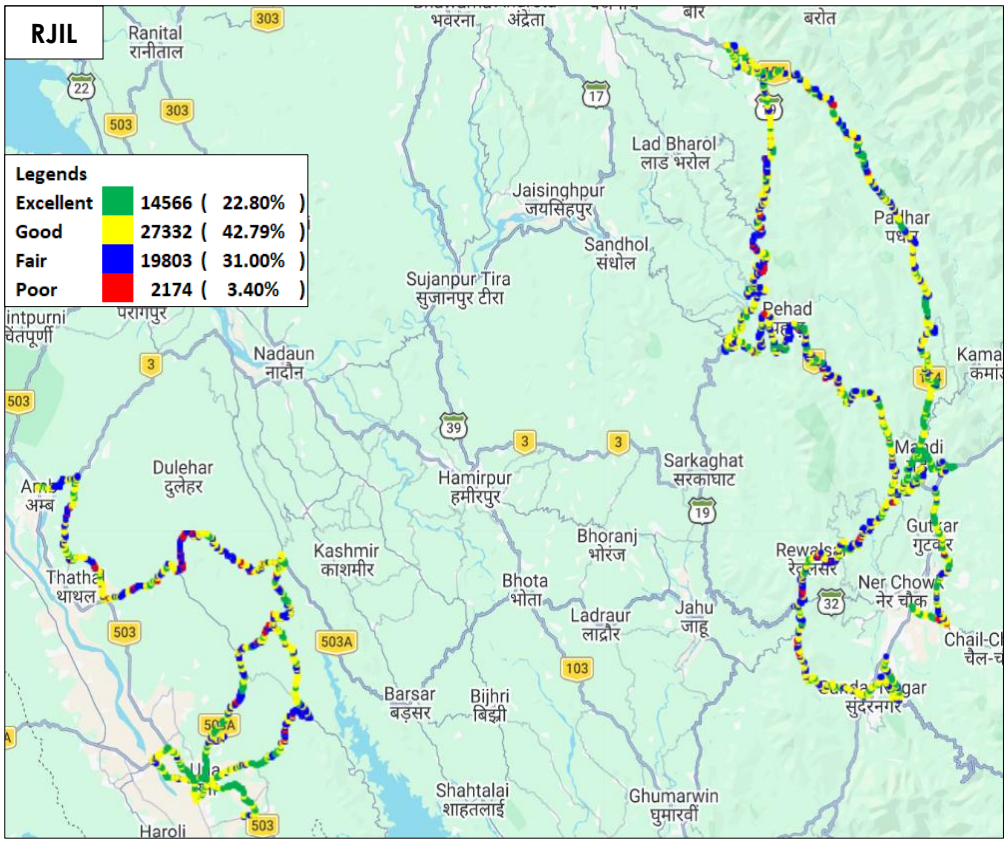


Figure-135: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

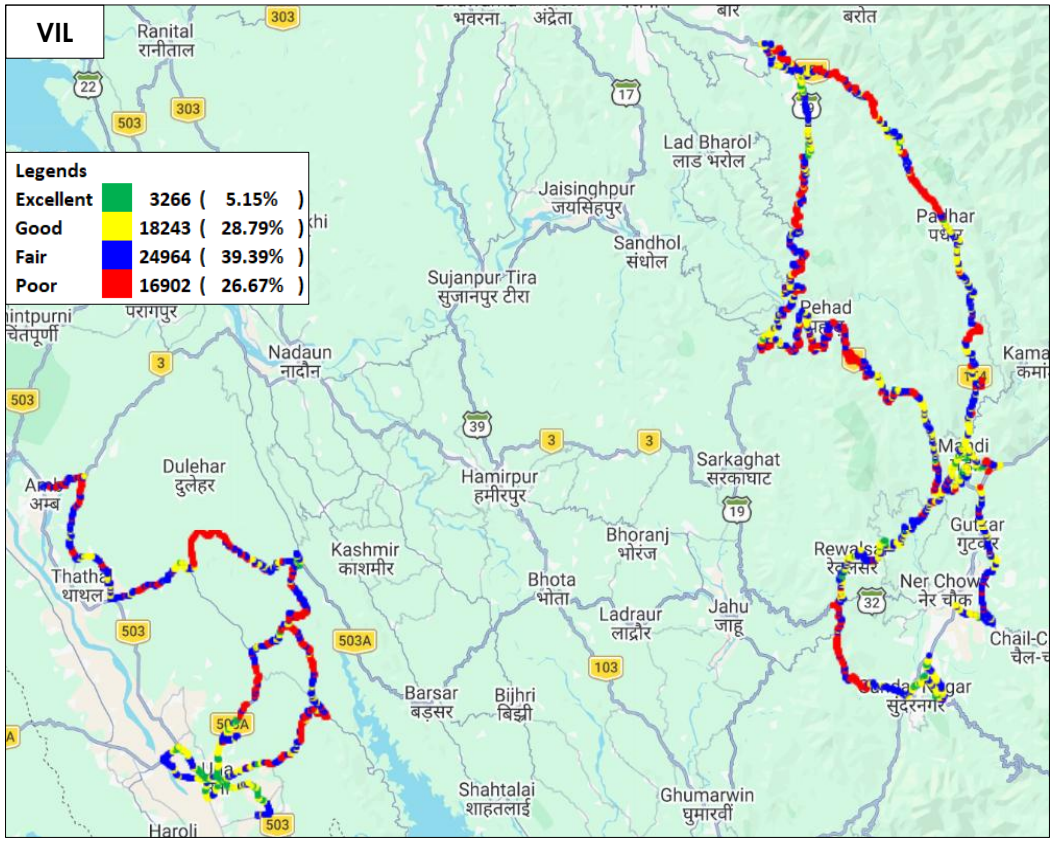


Figure-136: Signal strength auto-selection mode (5G/4G/3G/2G) voice - VIL.

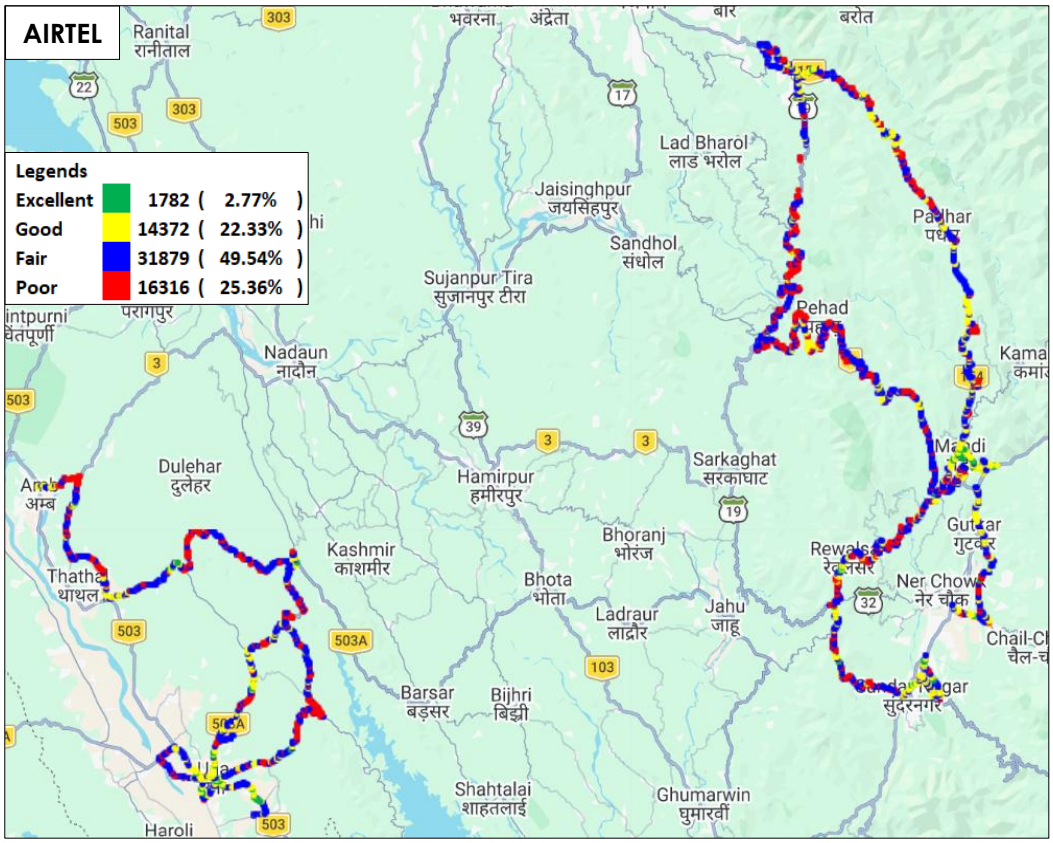


Figure-137: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

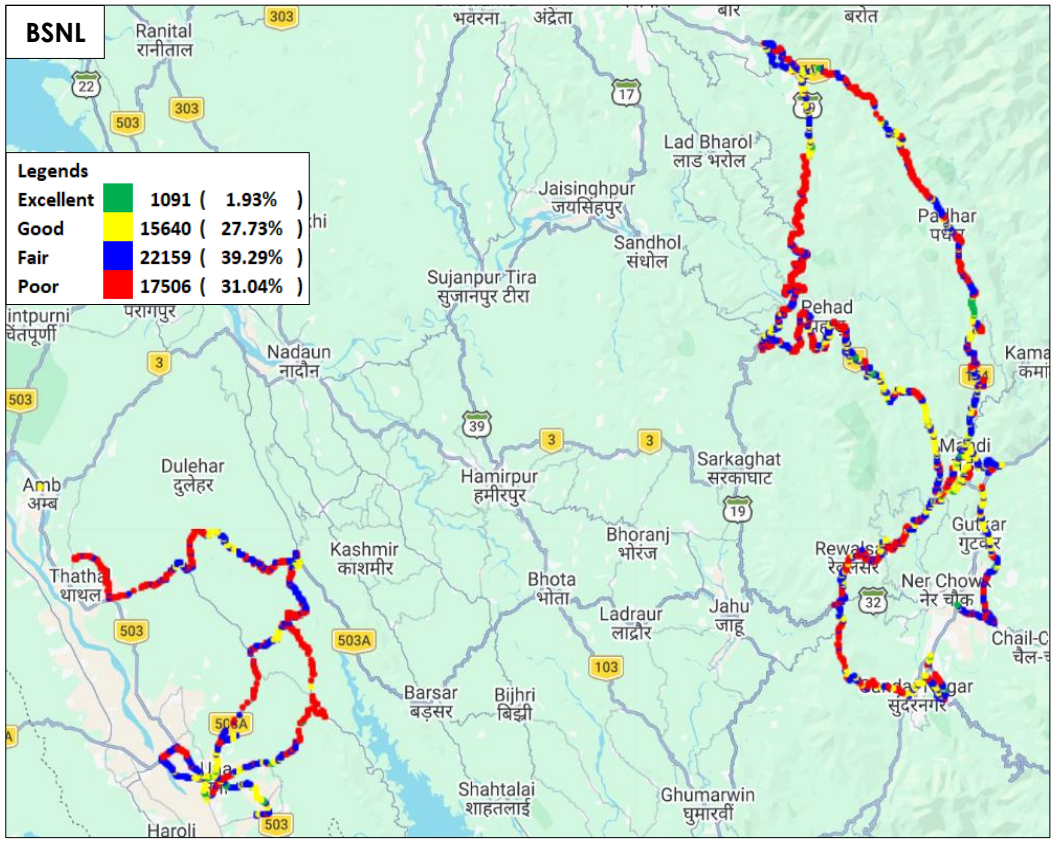


Figure-138: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

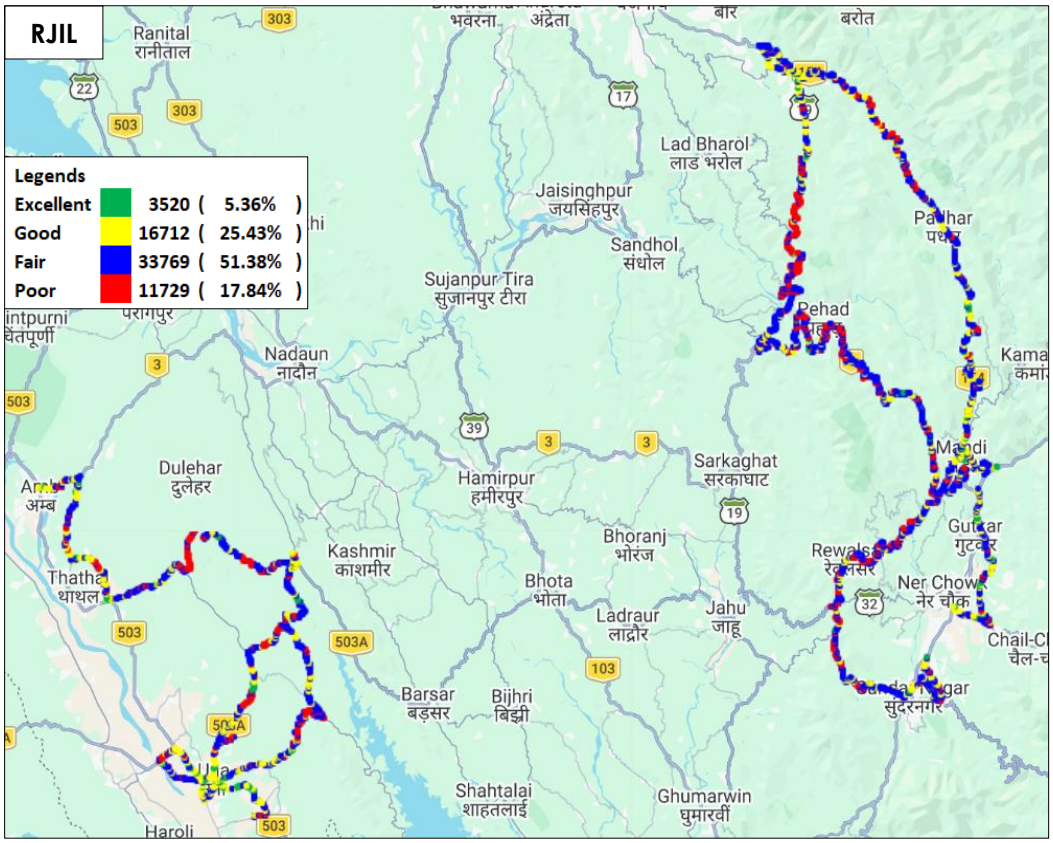


Figure-139: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

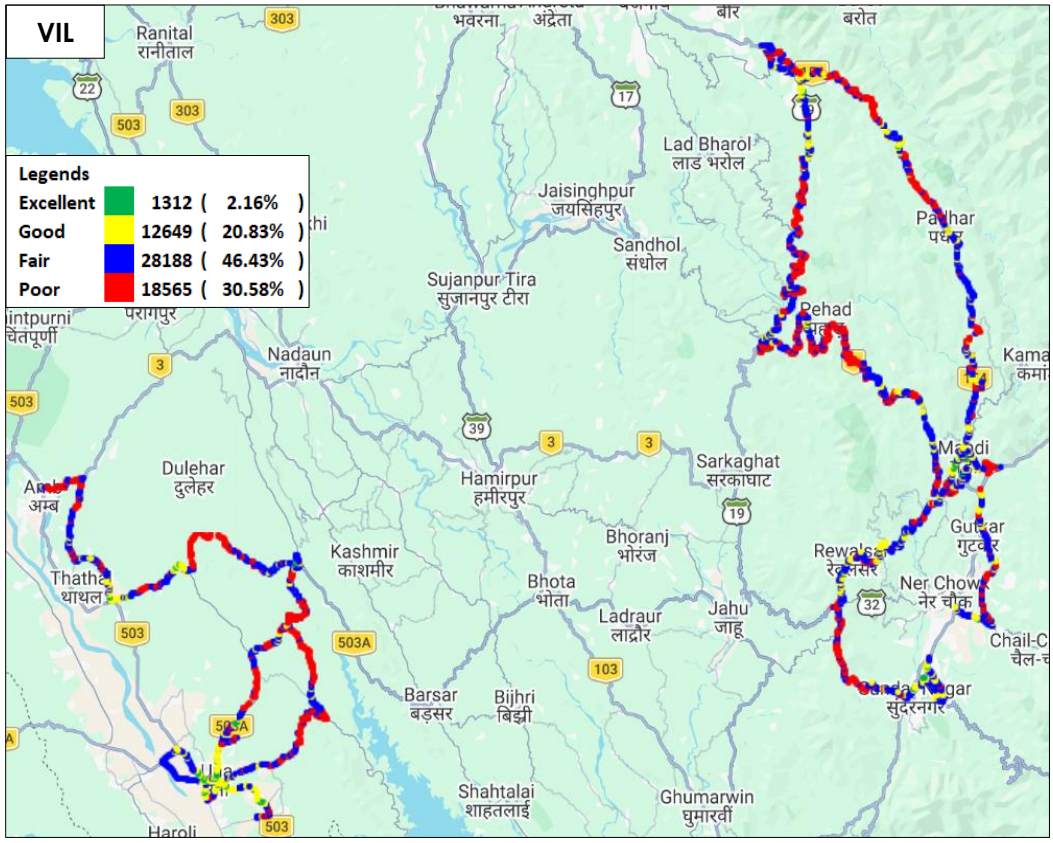


Figure-140: Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

6.1.2 Highway

i) Una to Mandi

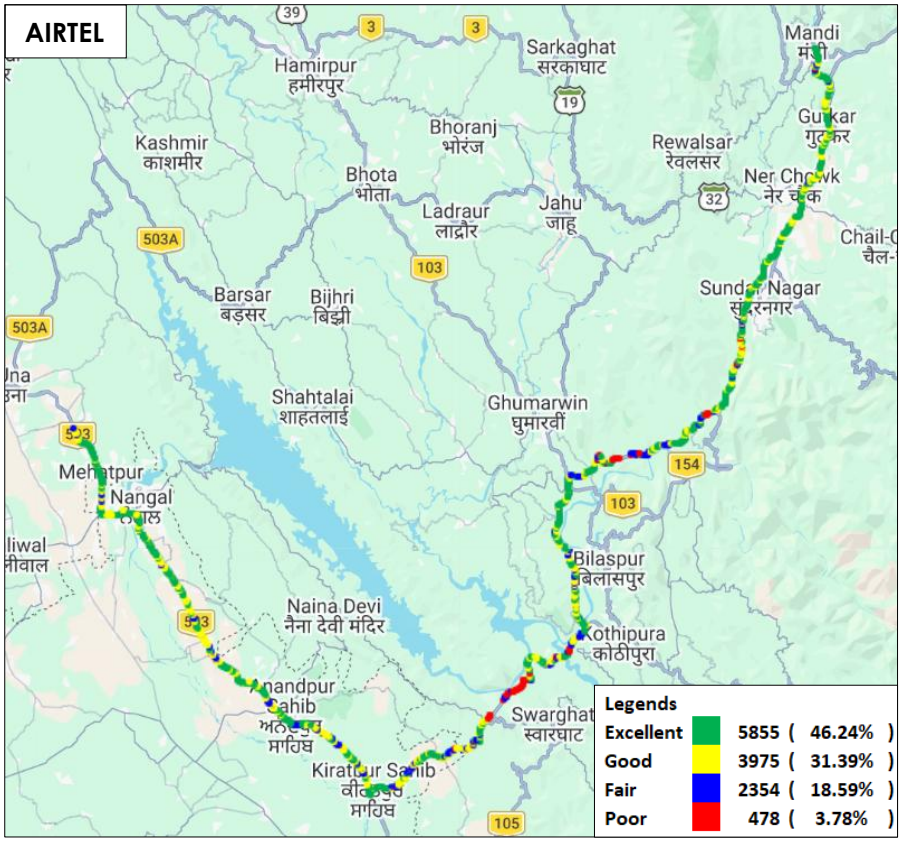


Figure-141: Signal strength 3G/2G network mode voice - AIRTEL.

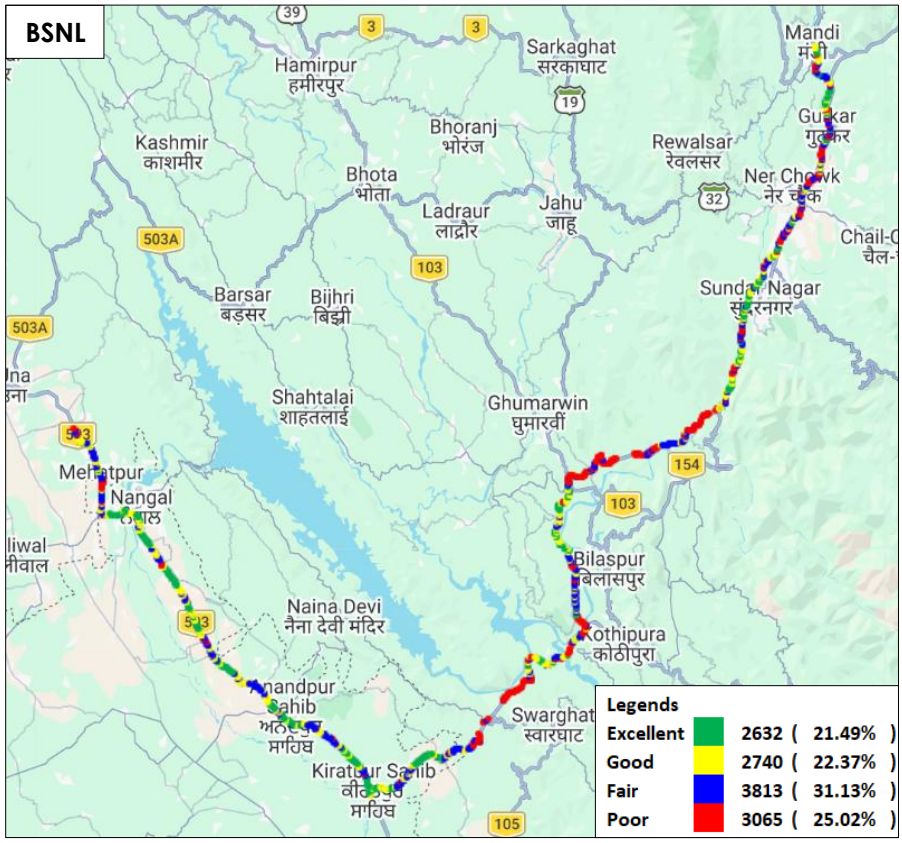


Figure-142: Signal strength 3G/2G network mode voice - BSNL.

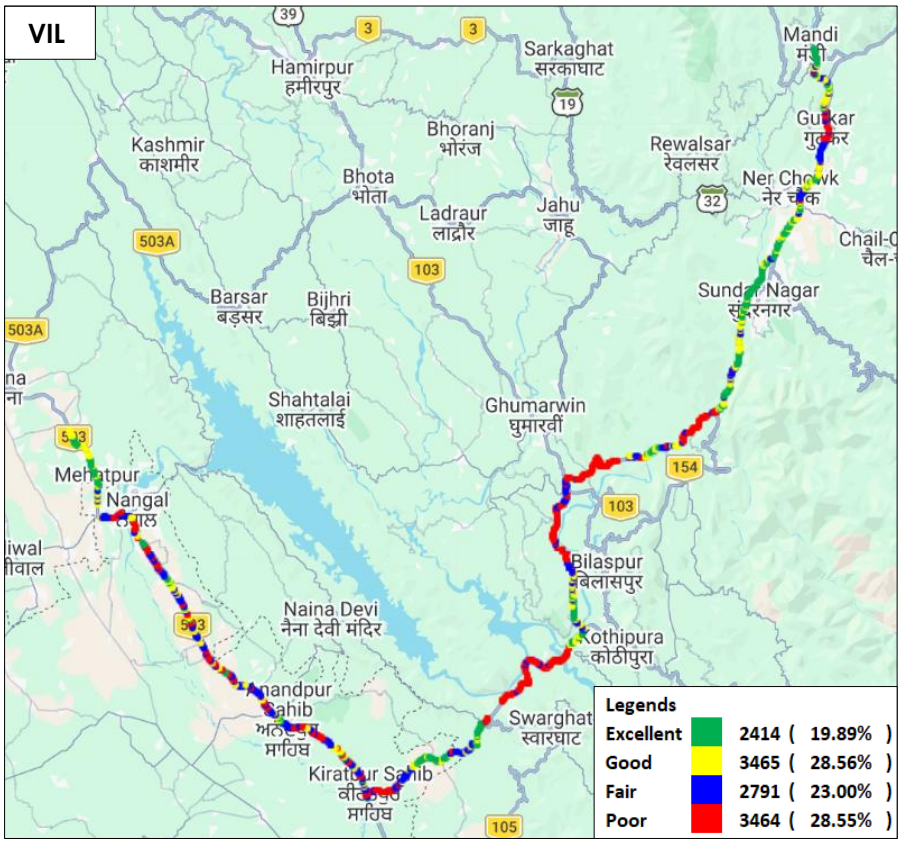


Figure-143: Signal strength 3G/2G network mode voice - VIL.

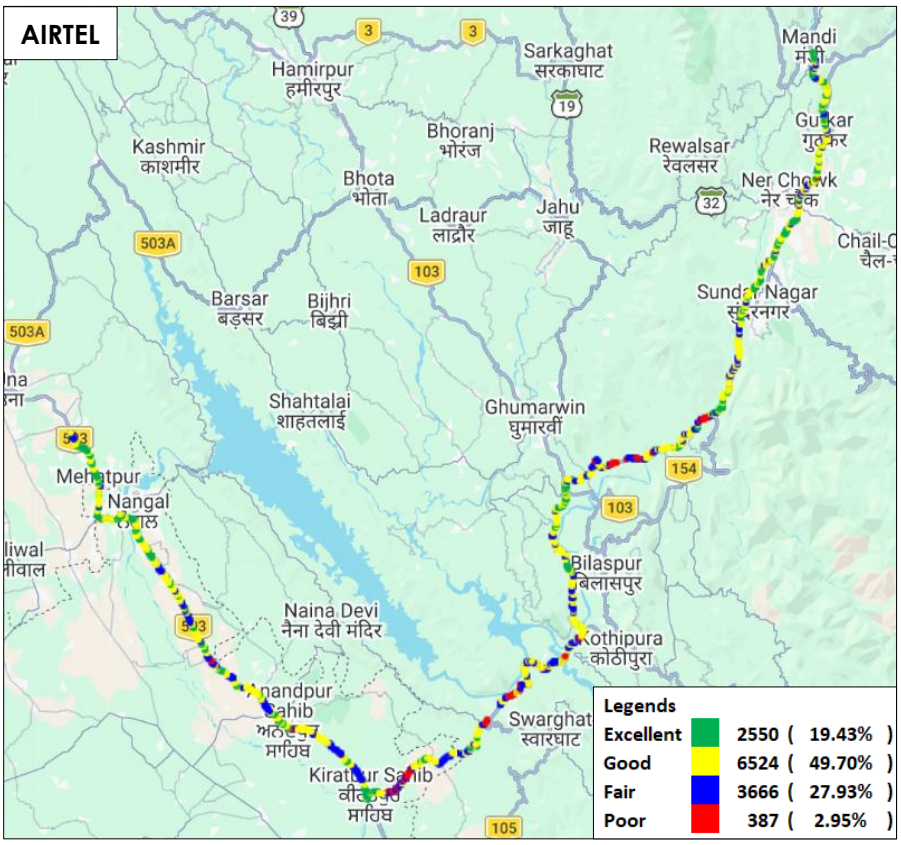


Figure-144: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

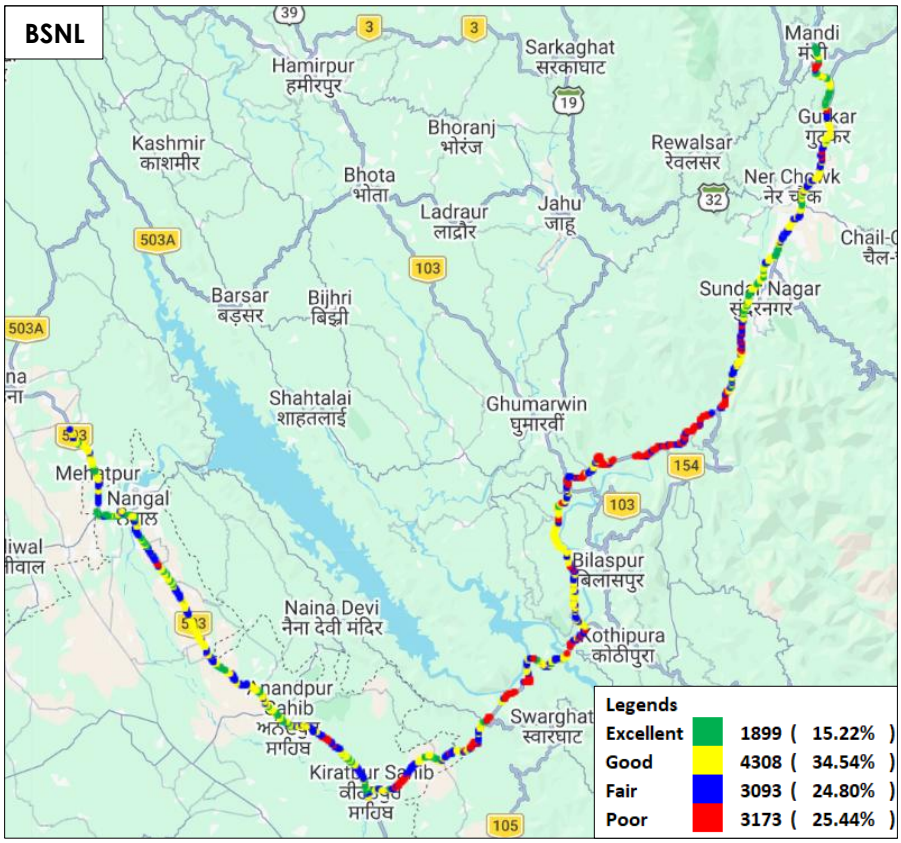


Figure-145: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

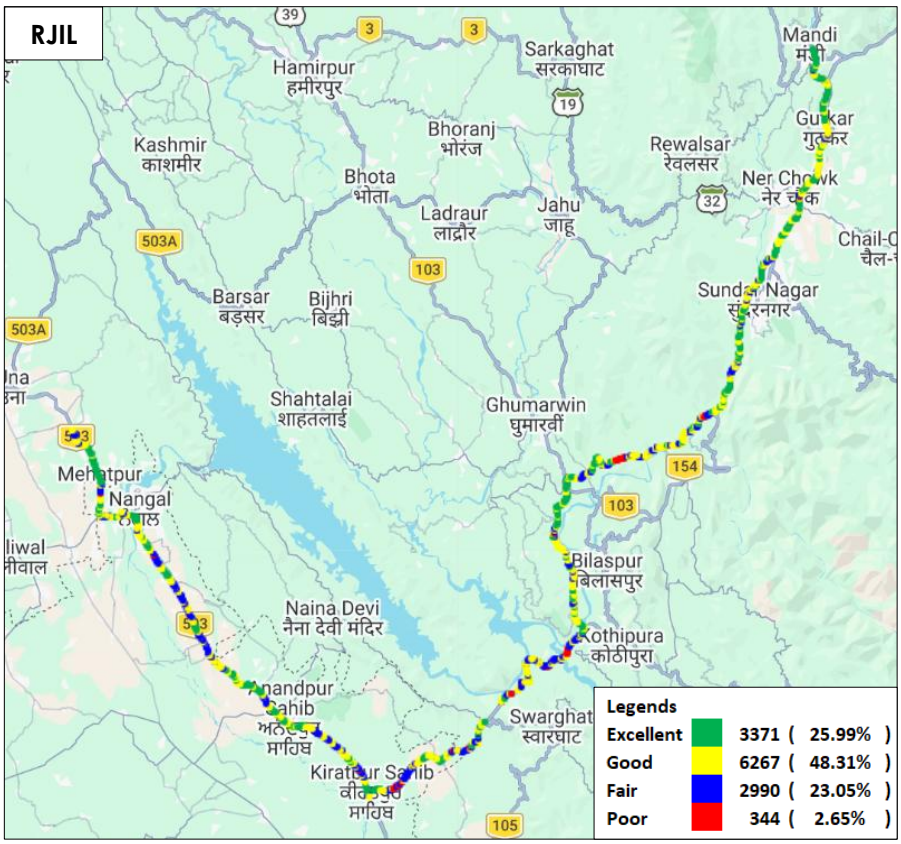


Figure-146: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

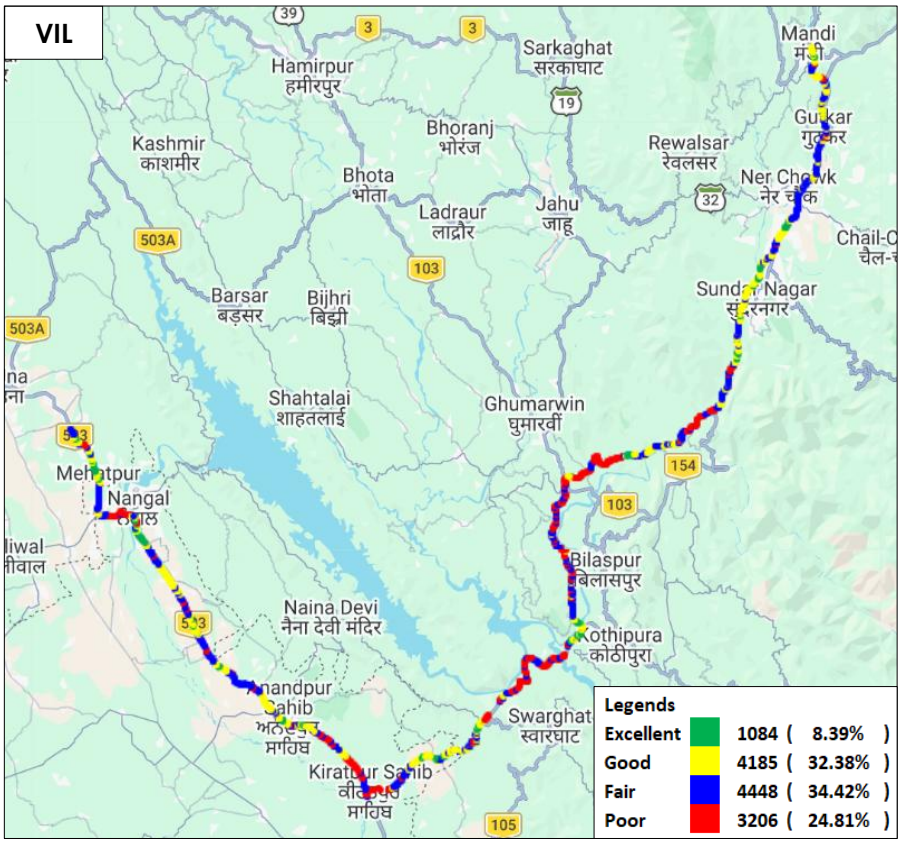


Figure-147: Signal strength auto-selection mode (5G/4G/3G/2G) voice - VIL.

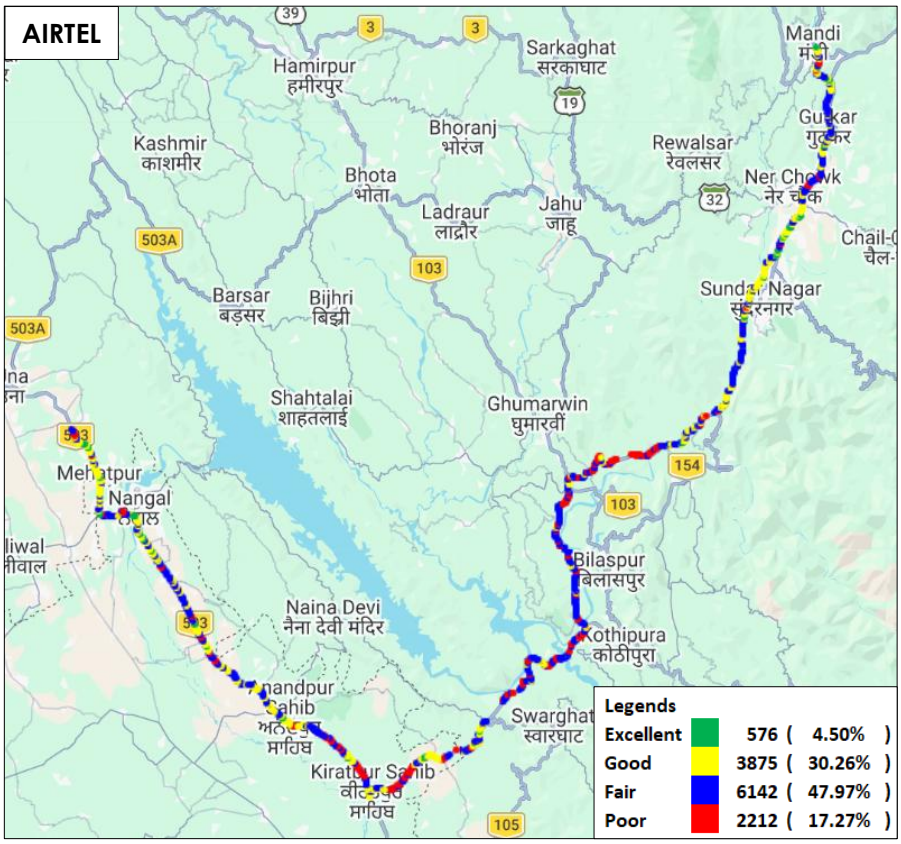


Figure-148: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

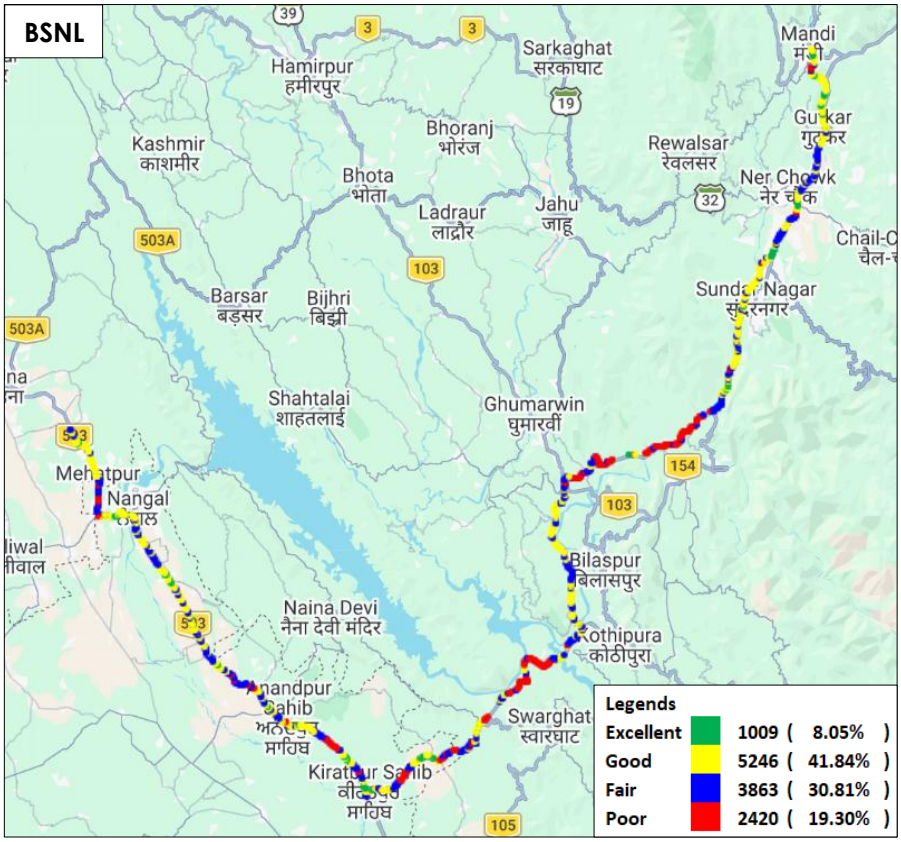


Figure-149: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

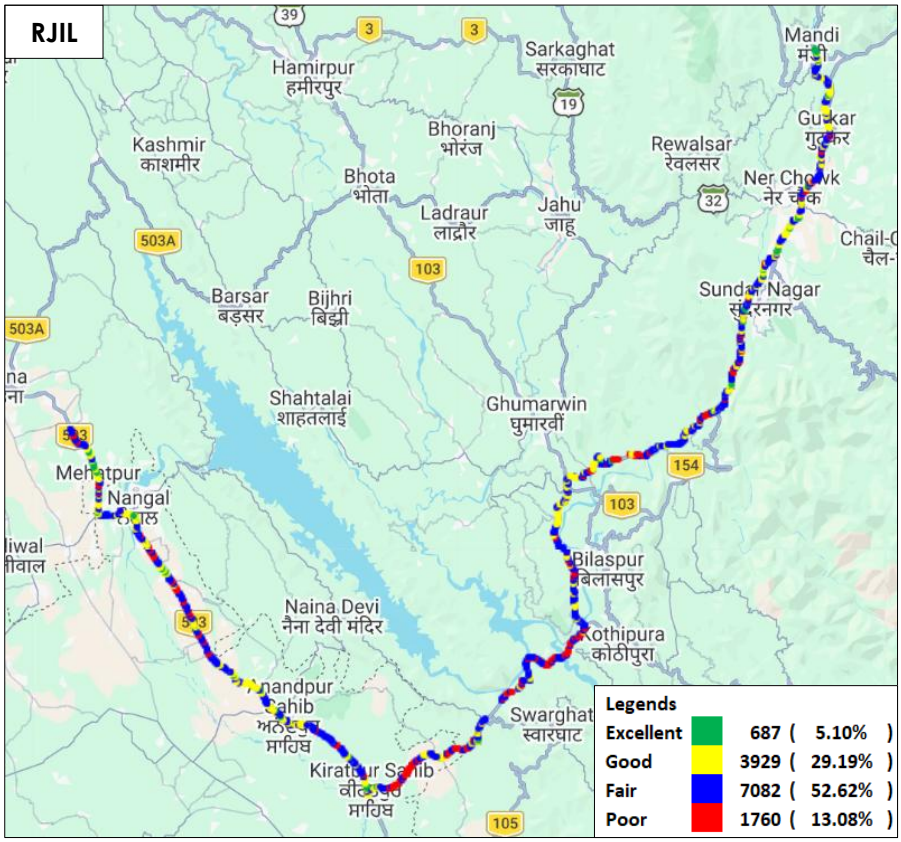


Figure-150: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

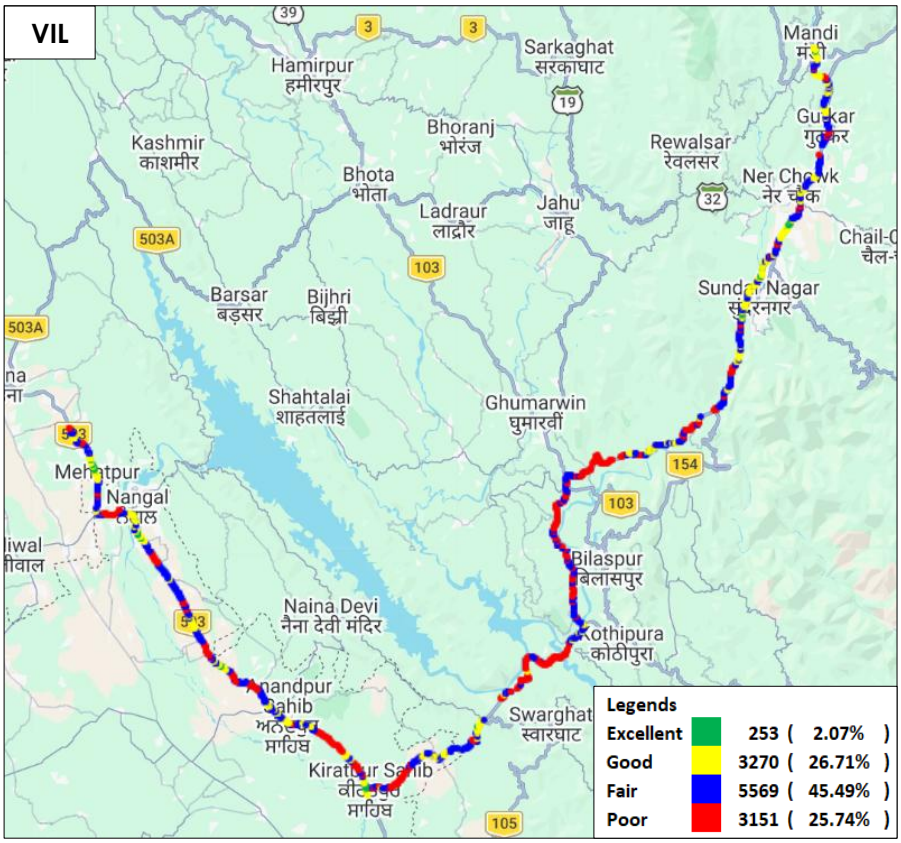


Figure-151: Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

ii) Mandi to Una



Figure-152: Signal strength 3G/2G network mode voice - AIRTEL.

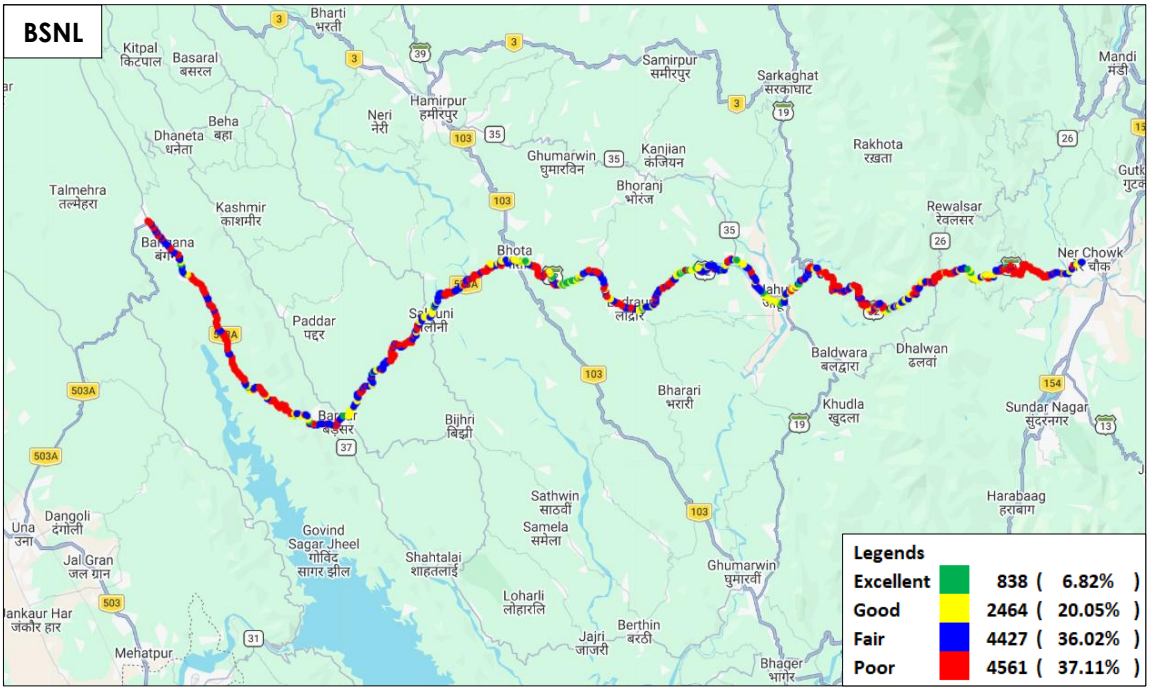


Figure-153: Signal strength 3G/2G network mode voice - BSNL.



Figure-154: Signal strength 3G/2G network mode voice - VIL.

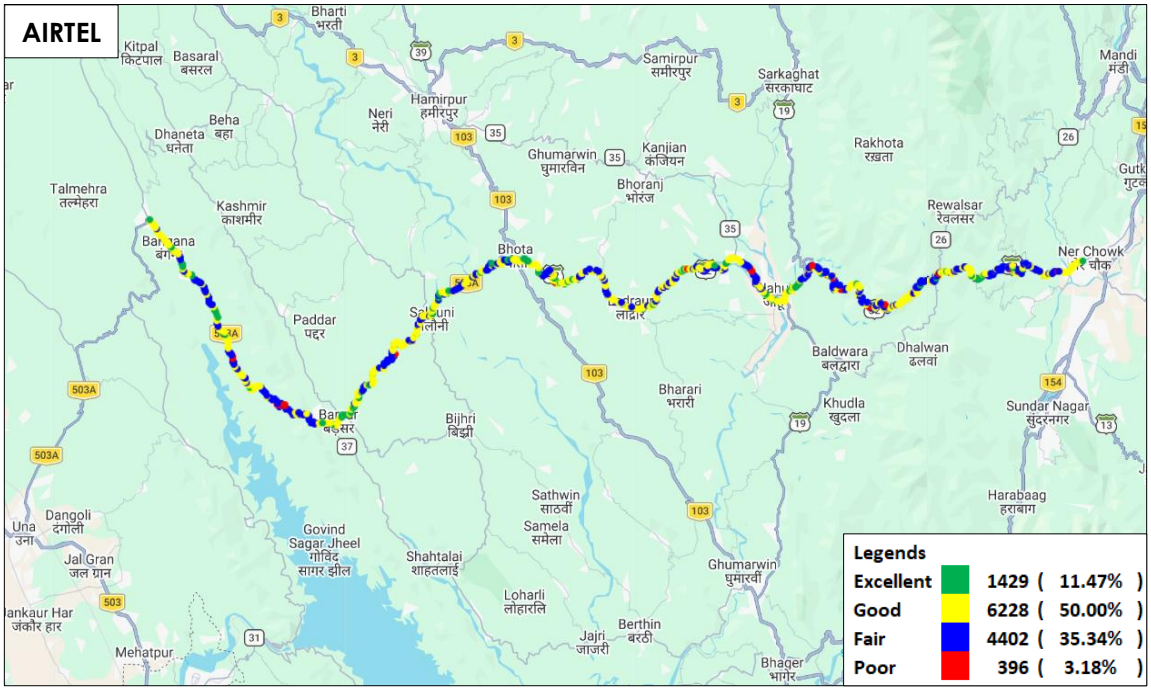


Figure-155: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.



Figure-156: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.



Figure-157: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

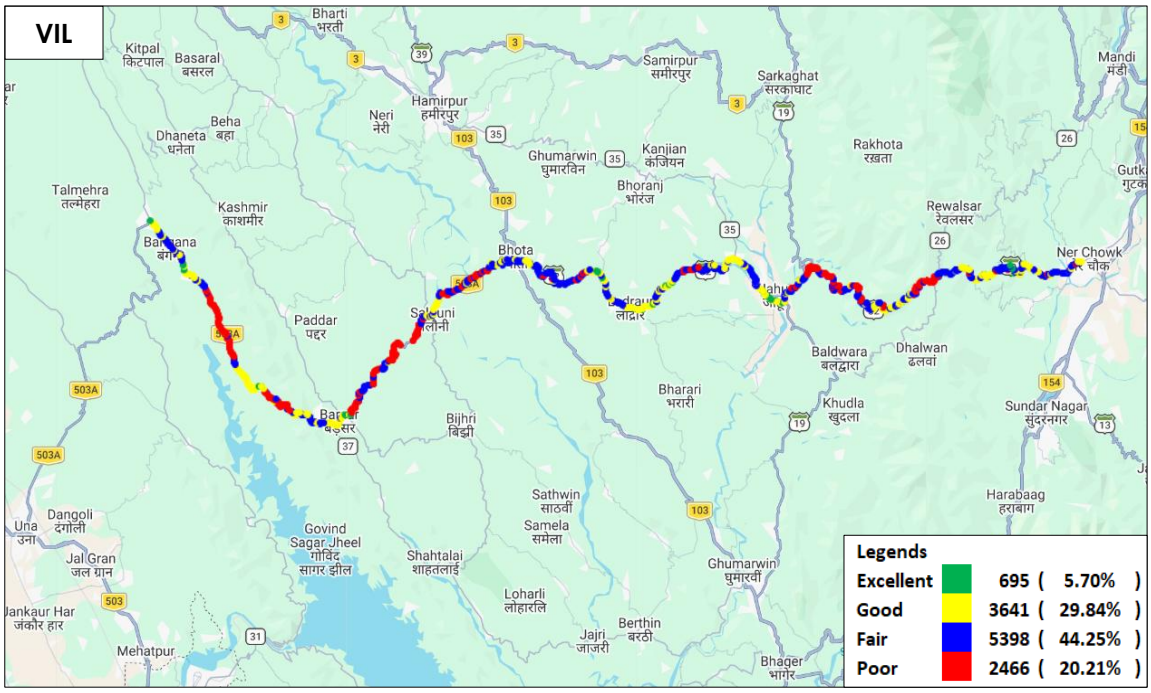


Figure-158: Signal strength auto-selection mode (5G/4G/3G/2G) voice - VIL.

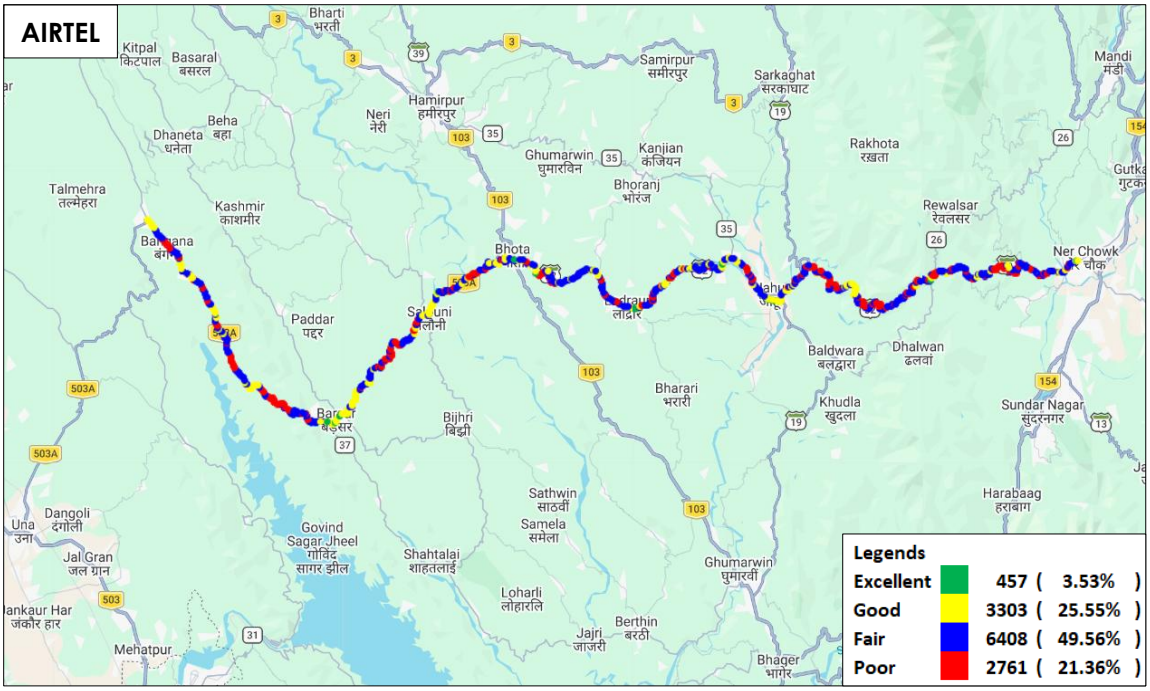


Figure-159: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

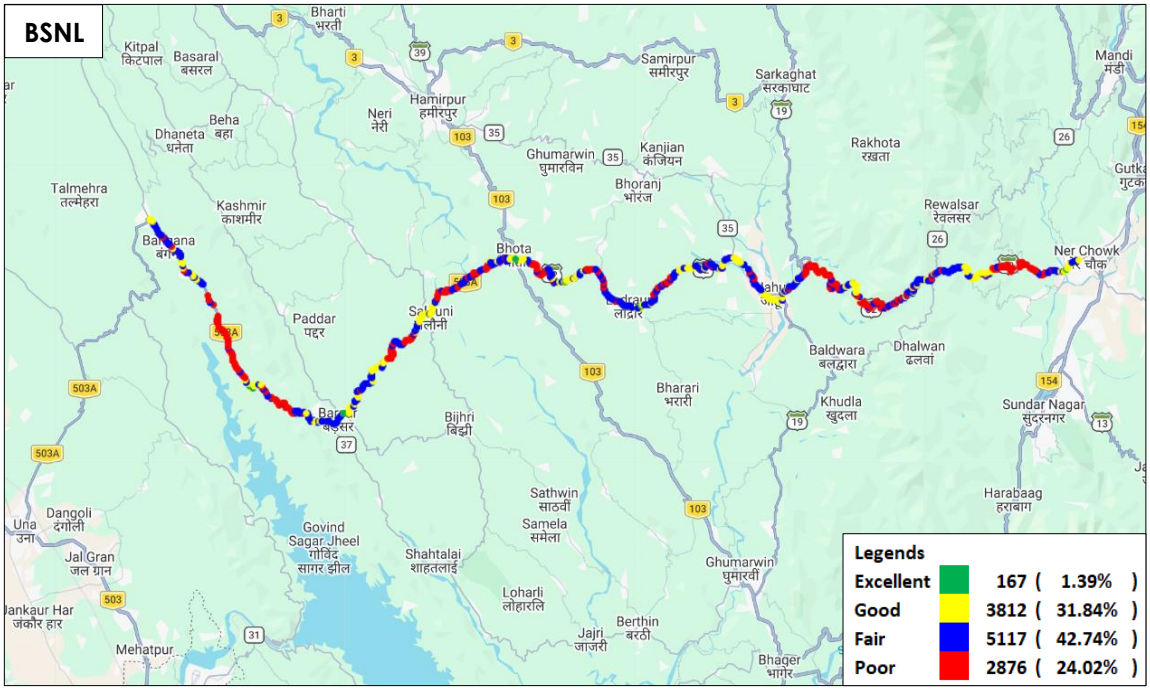


Figure-160: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

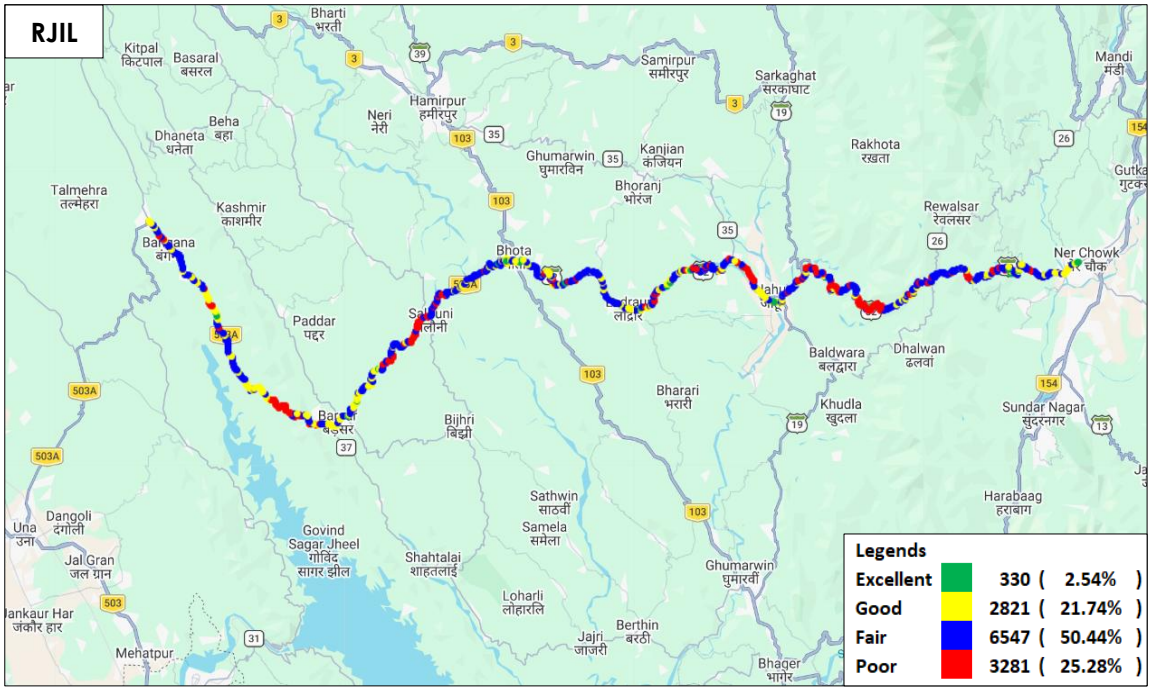


Figure-161: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

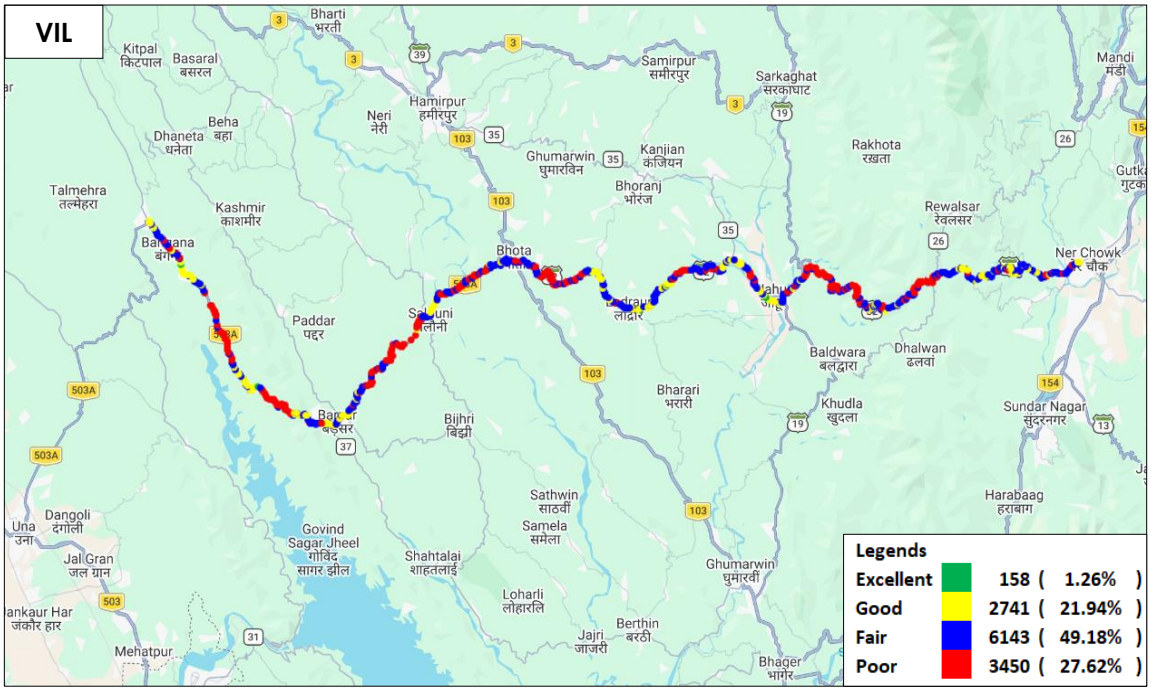


Figure-162: Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

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-62: Voice test detail

Note-

- There is 15 sec wait time after locking and before starting first call in 3G/2G call.
- 10 calls to be made at each Hotspot location.
- Minimum 10 Calls to be made during the walk test. Call count will be increased based on walk test distance.
- Speech quality (MOS) has been measured only in city drive & highway by making Mobile to Mobile call.
- 180 Sec calls were made 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, www.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-63: 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.

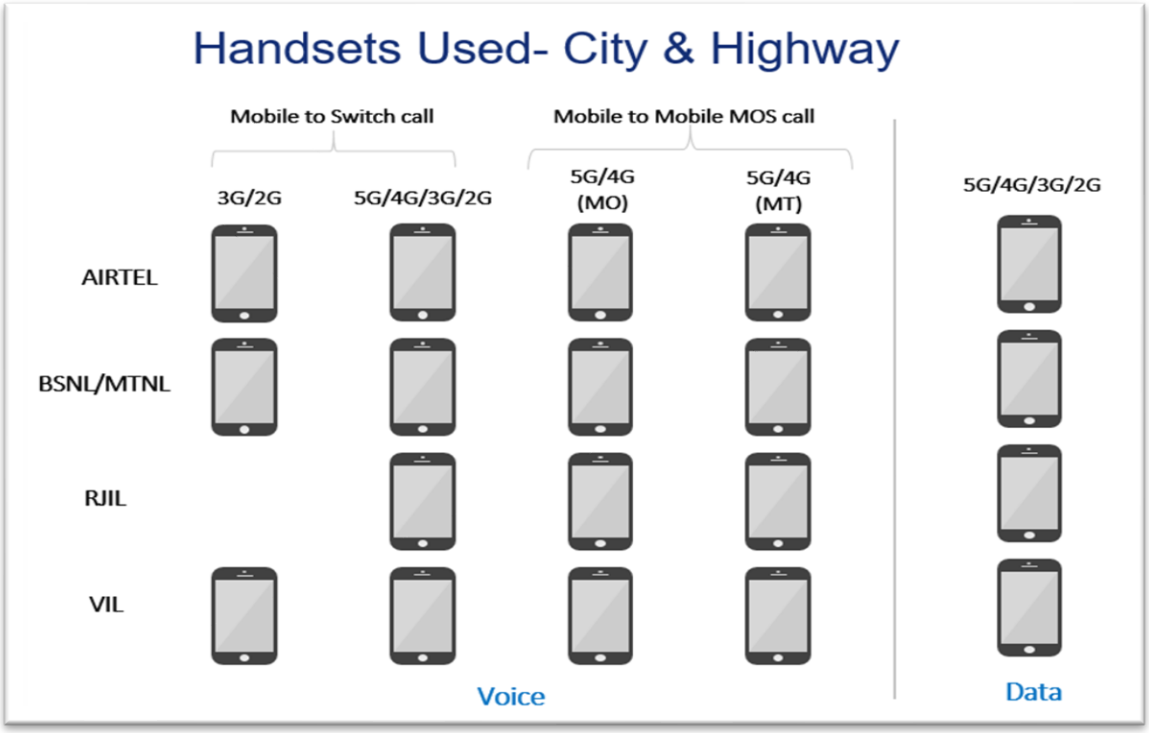


Figure-163: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

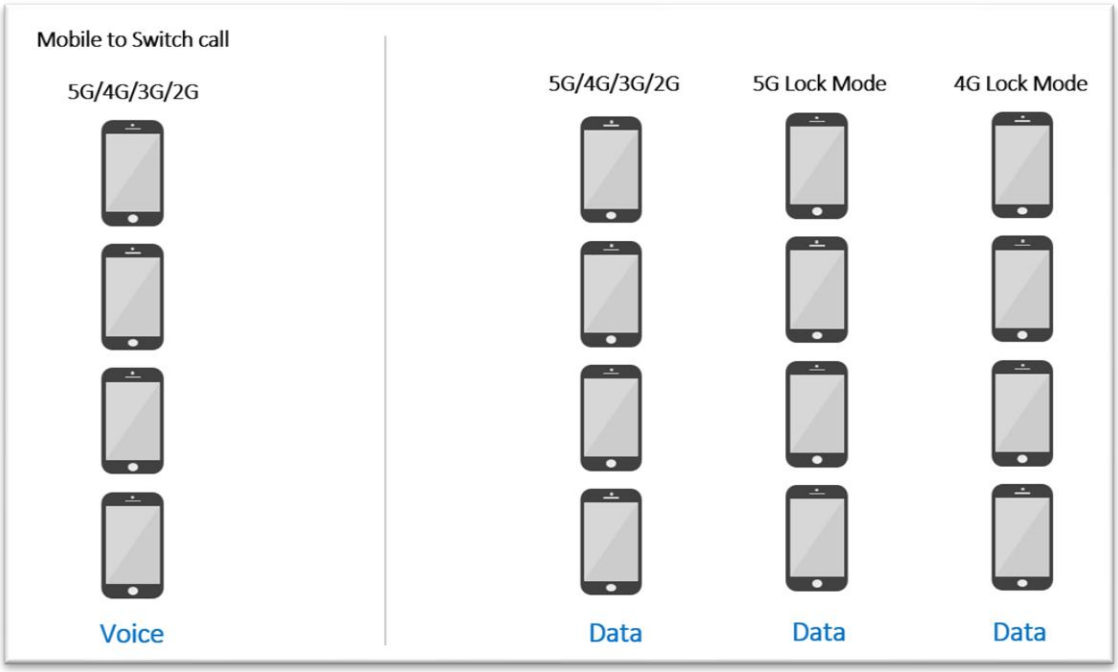


Figure-164: Number of handsets used in railway/metro/walktest/hotspot/ coastal area

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)

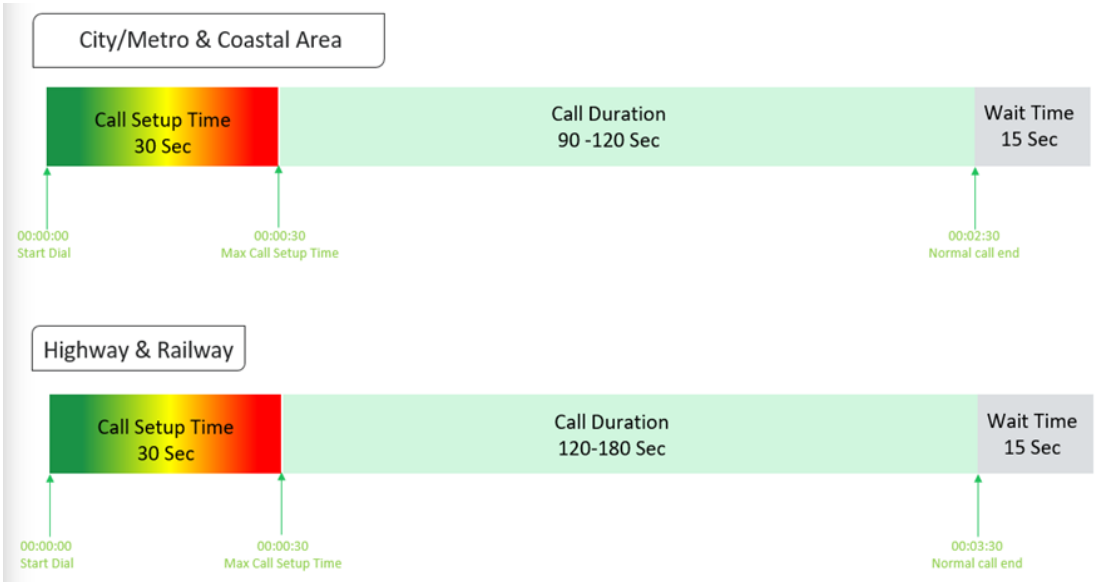


Figure-165: Voice test script for city/railway/metro/highway & coastal area

- 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-166: 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

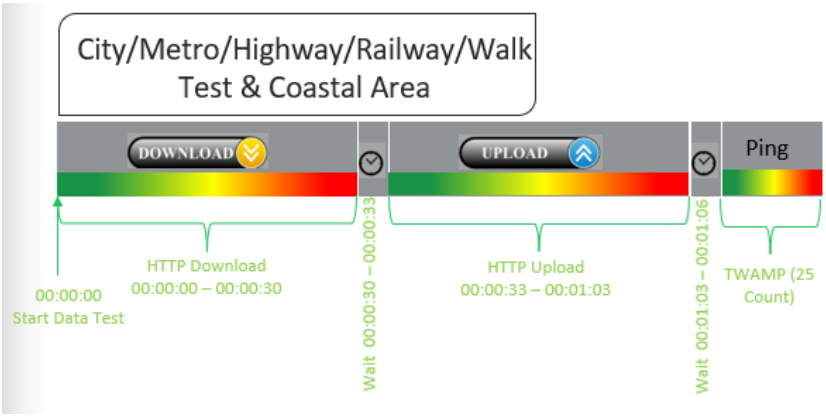


Figure-167: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

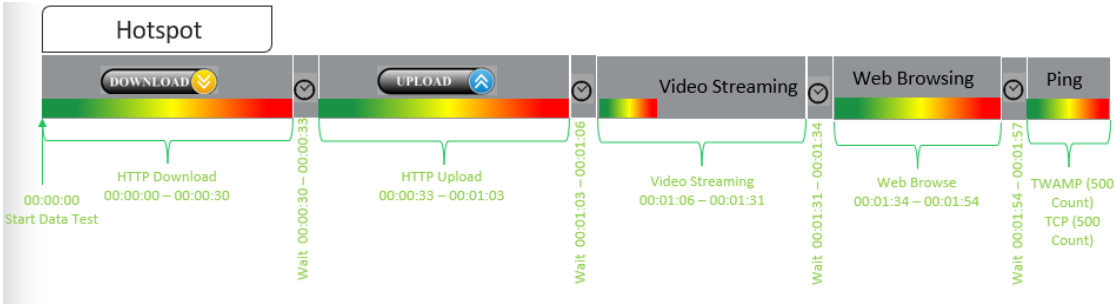


Figure-168: Data test script used at hotspot

- 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-64: 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-65: 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.