



TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Jammu & Kashmir LSA

August 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 Jammu & Kashmir License Service Area (LSA) during the month of August-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	Leh, Nubra Valley and Pangong	City	62.6	17-Aug-2026	19-Aug-2026
2	Leh	Inter Operator Calling	1 Location	21-Aug-2026	21-Aug-2026
3	Leh, Nubra Valley and nearby Sangam	Hotspot	7 Locations	17-Aug-2026	21-Aug-2026
4	Leh	Walk test	1.1	17-Aug-2026	17-Aug-2026
5	Leh to Nubra Valley	Highway	120.5	18-Aug-2026	18-Aug-2026
6	Nubra Valley to Pangong	Highway	206.3	19-Aug-2026	19-Aug-2026
7	Sakti to Sangam	Highway	69.5	20-Aug-2026	21-Aug-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 highways as per the legends shown on the map.

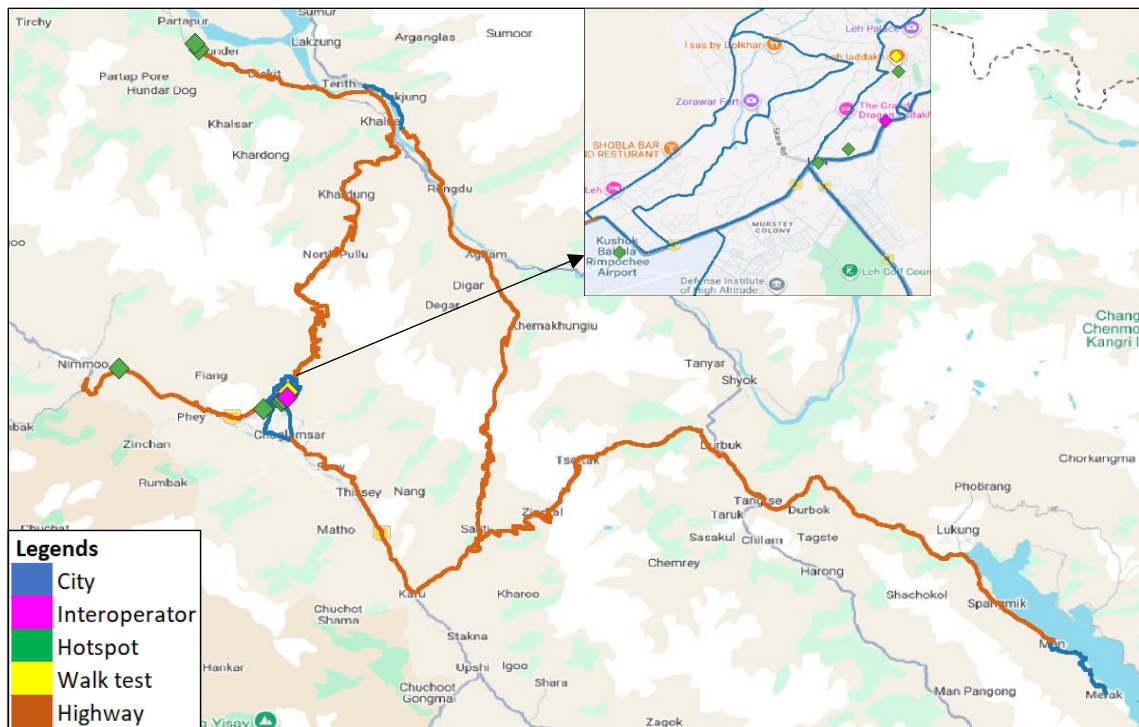


Figure-1: Drive test routes.

2.3 Summary of areas covered

a) City- Lakjung, Tsati, Yurtung, Kushok Bakula Rimpoochee Airport, Leh Palace, Sankar Gompa, Leh, Choglamsar and Spituk etc.

b) Hotspot

1. Army Hospital Hundar
2. Artisan Bazaar
3. EJM College
4. Gurudwara Sri Pathar Sahib
5. Leh Airport
6. Leh Market
7. SNM Hospital

c) Walk Test

1. Leh Market

d) Highway

- i) **Leh to Nubra Valley** – Power House, View Point Khadungla road, South Pullu, Shiv Shankar Temple, North Pullu, Khardung Viewpoint, Khalsar and Diskit etc.
- ii) **Nubra Valley to Pangong** – Tsati, Agham, Sakti, Zingral, Tsoltak, Tangtse, Muglib, Spangmik and Pangong beach etc.
- iii) **Sakti to Sangam** – Chemrey, Karu, Thiksey, Shey, Kushok Bakula Rimpoochee Airport, Indus Viewpoint and Sangam Point Leh Ladakh etc.

2.4 Telecom service providers detected frequency bands

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

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

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

Note-

- "VIL results have not been included in the IDT report, as the VIL network was not available along the covered route during the testing period."

2.5 Key findings of Independent Drive Test

- 1. Drive Test Area:** The overall mobile network performance across Leh, Nubra Valley and Pangong areas (Jammu & Kashmir 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- 24 to 26)

Parameter	AIRTEL	BSNL	RJIL
Total Number of Samples captured on Drive test route	9318	8977	8371
Number of Samples having poor signal strength	583	966	770
Number of Samples having limited service (No Coverage)	155	209	361

- b) Dropped Calls** - The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure 14 and 15)

Parameter	AIRTEL	BSNL	RJIL
Number of successful Calls Established	83	77	76
Number of dropped Calls	0	5	1

- c) Call Silence Instance** - The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure- 16 to 18)

Parameter	AIRTEL	BSNL	RJIL
Call Established (within service provider network)	75	75	72
Number of silences calls for >3 Sec	1	1	1
Total number of silence instances for >3 Sec	2	2	1

- 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
Call Established (within service provider network)	75	75	72
Packet loss Rate Downlink %	0.81	1.96	2.77
Packet loss Rate Uplink %	0.32	1.63	13.35

- 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- 28 to 30)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)
Typical Download Throughput declared by TSP	(Mbits/s)	23.00	5.00	15.00
Average Download Throughput measured during IDT	(Mbits/s)	121.65	8.00	267.13

- 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- 31 to 33)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)
Typical Upload Throughput declared by TSP	(Mbits/s)	10.00	3.00	7.00
Average Upload Throughput measured during IDT	(Mbits/s)	22.13	4.87	21.20

2. Drive Test Route: The overall mobile network performance on Leh to Nubra Valley highway route (Jammu & Kashmir 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- 59 to 61)

Parameter	AIRTEL	BSNL	RJIL
Total Number of Samples captured on Drive test route	11146	11313	9209
Number of Samples having poor signal strength	4040	3361	3530
Number of Samples having limited service (No Coverage)	1448	1208	2950

b) Dropped Calls - The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure 48 to 50)

Parameter	AIRTEL	BSNL	RJIL
Number of successful Calls Established	108	95	85
Number of dropped Calls	12	13	4

c) Call Silence Instance - The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure- 51 to 53)

Parameter	AIRTEL	BSNL	RJIL
Call Established (within service provider network)	91	71	78
Number of silences calls for >3 Sec	11	6	13
Total number of silence instances for >3 Sec	14	6	16

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
Call Established (within service provider network)	91	71	78
Packet loss Rate Downlink %	4.83	6.02	11.57
Packet loss Rate Uplink %	5.11	2.65	11.23

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- 63 to 65)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)
Typical Download Throughput declared by TSP	(Mbits/s)	23.00	5.00	15.00
Average Download Throughput measured during IDT	(Mbits/s)	109.57	16.39	122.16

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- 66 to 68)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)
Typical Upload Throughput declared by TSP	(Mbits/s)	10.00	3.00	7.00
Average Upload Throughput measured during IDT	(Mbits/s)	14.21	7.81	12.02

3. Drive Test Route: The overall mobile network performance on Nubra Valley to Pangong highway route (Jammu & Kashmir 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- 92 to 94)

Parameter	AIRTEL	BSNL	RJIL
Total Number of Samples captured on Drive test route	12272	12041	9930
Number of Samples having poor signal strength	4950	3203	5105
Number of Samples having limited service (No Coverage)	4491	3893	5979

b) Dropped Calls - The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure 81 to 83)

Parameter	AIRTEL	BSNL	RJIL
Number of successful Calls Established	67	64	60
Number of dropped Calls	11	17	16

c) Call Silence Instance - The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure- 84 to 86)

Parameter	AIRTEL	BSNL	RJIL
Call Established (within service provider network)	66	59	52
Number of silences calls for >3 Sec	14	11	14
Total number of silence instances for >3 Sec	18	16	24

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
Call Established (within service provider network)	66	59	52
Packet loss Rate Downlink %	4.98	9.12	16.27
Packet loss Rate Uplink %	3.75	6.43	12.33

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- 96 to 98)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)
Typical Download Throughput declared by TSP	(Mbits/s)	23.00	5.00	15.00
Average Download Throughput measured during IDT	(Mbits/s)	80.59	8.86	44.48

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- 99 to 101)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)
Typical Upload Throughput declared by TSP	(Mbits/s)	10.00	3.00	7.00
Average Upload Throughput measured during IDT	(Mbits/s)	14.69	3.51	3.94

4. Drive Test Route: The overall mobile network performance on Sakti to Sangam highway route (Jammu & Kashmir 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- 125 to 127)

Parameter	AIRTEL	BSNL	RJIL
Total Number of Samples captured on Drive test route	6295	6252	5597
Number of Samples having poor signal strength	800	2140	893
Number of Samples having limited service (No Coverage)	14	154	391

b) Dropped Calls - The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure 114 to 116)

Parameter	AIRTEL	BSNL	RJIL
Number of successful Calls Established	32	27	30
Number of dropped Calls	1	5	2

c) Call Silence Instance - The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure- 117 to 119)

Parameter	AIRTEL	BSNL	RJIL
Call Established (within service provider network)	31	26	30
Number of silences calls for >3 Sec	2	7	2
Total number of silence instances for >3 Sec	2	15	5

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
Call Established (within service provider network)	31	26	30
Packet loss Rate Downlink %	0.77	17.11	4.23
Packet loss Rate Uplink %	0.70	13.77	3.45

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- 129 to 131)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)
Typical Download Throughput declared by TSP	(Mbits/s)	23.00	5.00	15.00
Average Download Throughput measured during IDT	(Mbits/s)	96.97	6.00	203.25

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- 132 to 134)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)
Typical Upload Throughput declared by TSP	(Mbits/s)	10.00	3.00	7.00
Average Upload Throughput measured during IDT	(Mbits/s)	14.67	4.14	18.84

QoS Performance Analysis- Jammu & Kashmir LSA

3. QoS performance analysis-LSA level

3.1 Overview

This section provides summary of overall QoS performance of the telecom service provider's network in the LSA by aggregating the results of drive tests conducted in the Jammu & Kashmir LSA during the month of August-2026 covering city drive, hotspots, walk test and highways. (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 Only	
	AIRTEL	BSNL
Call Attempts	476	602
Call Setup Success Rate %	55.04	28.90
Drop Call Rate%	2.67	9.77
Call Setup Time-Average (Second)	3.64	5.53
Handover Success Rate %	99.55	99.55

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

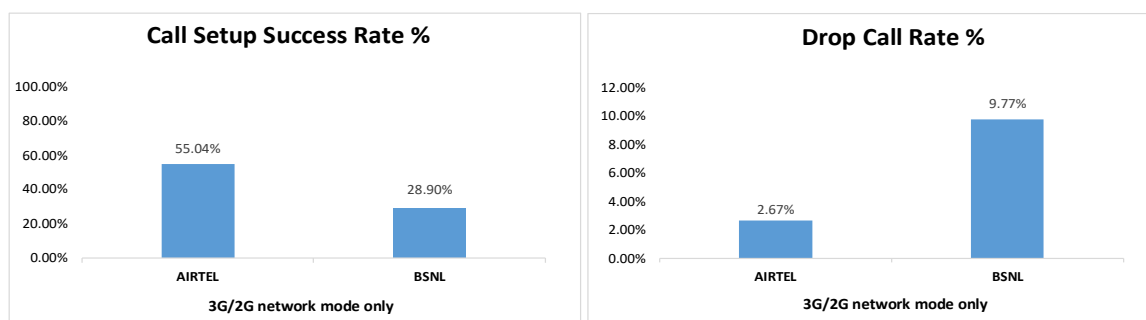


Figure-2: Call setup success rate and drop call rate performance.

Number of unique Cell Ids covered in Voice test- Technology wise		
Technology	Service Provider	
	3G/2G network mode only	
	AIRTEL	BSNL
3G	NA	54
2G	166	43

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
Call Attempts	600	655	630
Call Setup Success Rate %	62.33	50.99	52.70
Drop Call Rate %	6.42	12.28	7.83
Call Setup Time-Average (Second)	1.98	4.63	1.17
Handover Success Rate %	99.83	99.85	99.80

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

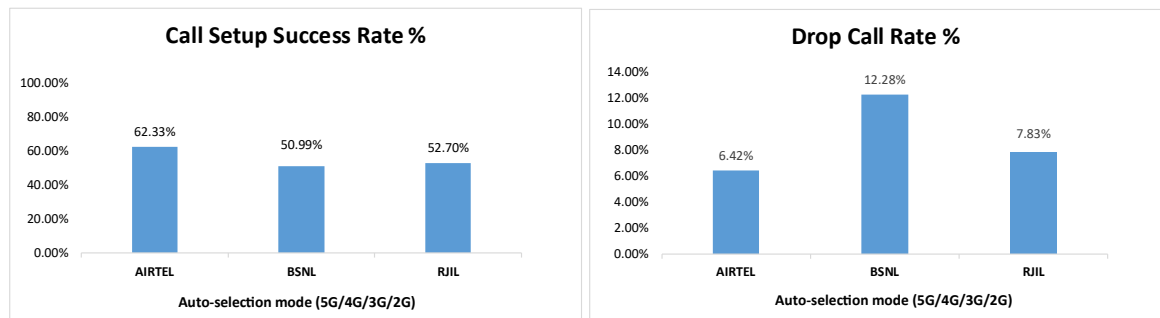


Figure-3: Performance for call setup success rate and drop call rate.

Parameter	Service Provider		
	Mobile-to-Mobile (5G/4G – Open Mode)		
	AIRTEL	BSNL	RJIL
Call Established (within service provider Network)	263	231	232
Number of silences call for >4 Sec	26	19	24
Silence Call Rate %	9.89	8.23	10.34
Number of silence instances for >4 Sec	32	30	30
Number of silence instances for >3 Sec	36	39	46
Number of silence instances for >2 sec	46	59	82
RTP Jitter (4G & 5G) in ms	7.17	5.96	15.97
Packet loss Rate Downlink %	3.22	6.73	8.93
Packet loss Rate Uplink %	2.86	4.32	10.33

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
5G	0	NA	122
4G	441	198	317
3G	NA	23	NA
2G	17	37	NA

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

Note-

- NA- Service provider doesn't provide services in respective technology.
- 0- No cell Id's were found in respective technology.

(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
Total Number of MOS Samples for calls table-6	2054	1603	1737
Speech Quality (Average MOS)	3.86	3.45	4.02
Number of samples with MOS ≥ 4 to < 5 (Excellent)	1530	802	1282
Number of samples with MOS ≥ 3 to < 4 (Good)	353	306	150
Number of samples with MOS ≥ 2 to < 3 (Fair)	84	316	74
Number of samples with MOS ≥ 1 to < 2 (Poor)	87	179	231
%age of samples with MOS ≥ 4 to < 5 (Excellent)	74.49%	50.03%	73.81%
%age of samples with MOS ≥ 3 to < 4 (Good)	17.19%	19.09%	8.64%
%age of samples with MOS ≥ 2 to < 3 (Fair)	4.09%	19.71%	4.26%
%age of samples with MOS ≥ 1 to < 2 (Poor)	4.24%	11.17%	13.30%

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

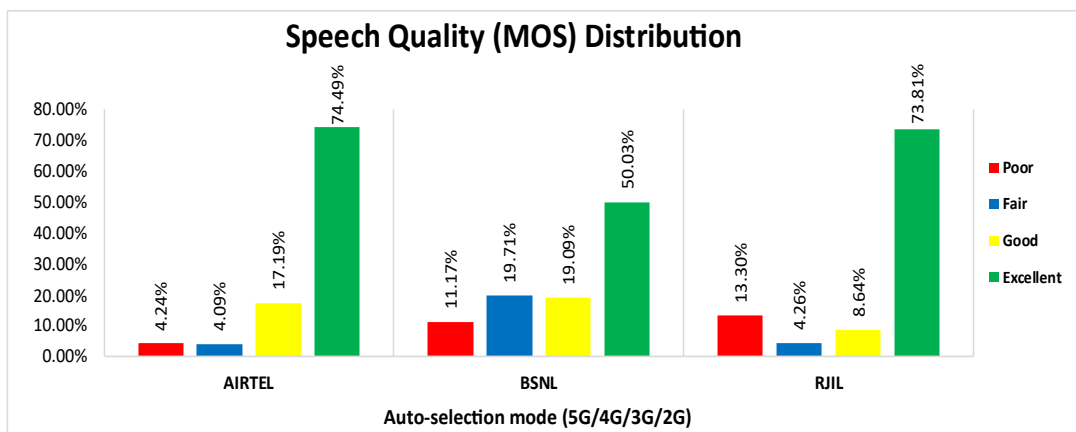


Figure- 4: Distribution of samples in MOS range.

(d) Inter-service provider voice call performance: To check the performance of inter-service providers call setup success rate, total 15 to 16 inter operator calls were attempted at one location which is New Bus Stand. 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
AIRTEL	NA	100.00	100.00
BSNL	100.00	NA	100.00
RJIL	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
AIRTEL	NA	5.65	1.72
BSNL	3.68	NA	5.57
RJIL	1.93	5.43	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
Download Throughput (Mbits/s)	Average	105.07	10.61	207.65
	80 th Percentile	174.15	16.64	428.40
	20 th Percentile	17.84	3.14	3.43
Upload Throughput (Mbits/s)	Average	17.36	6.33	20.50
	80 th Percentile	30.71	11.34	35.87
	20 th Percentile	2.10	1.26	1.26
Latency (ms)	50 th Percentile	50.68	32.92	30.81

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

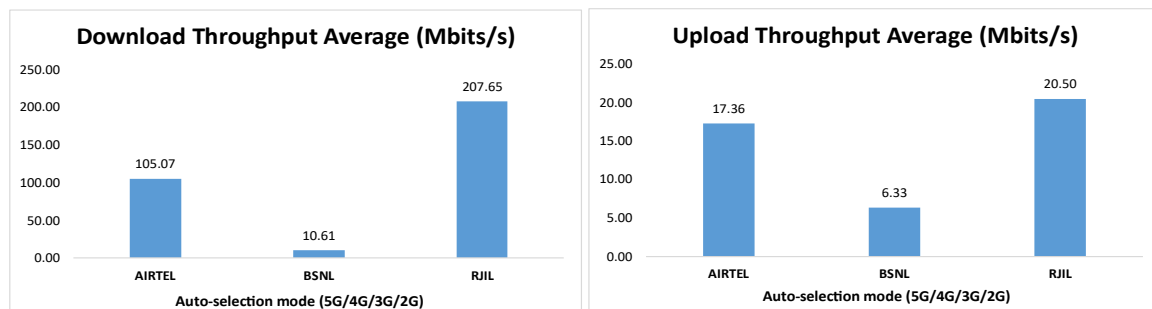


Figure- 5: Download and Upload throughput.

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
5G	0	NA	156
4G	488	209	272
3G	NA	33	NA
2G	25	26	NA

Table-12: Technology wise number of network cell Id's latched during drive test.

Note-

- NA- Service provider doesn't provide services in respective technology.
- 0- No cell Id's were found in respective technology.

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis

4.1 Overview

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

4.2 City

Drive test has been conducted on 17th August 2026 and 19th August 2026 in Leh, Nubra Valley and Pangong. (Refer Table-1)

4.2.1 Drive test route

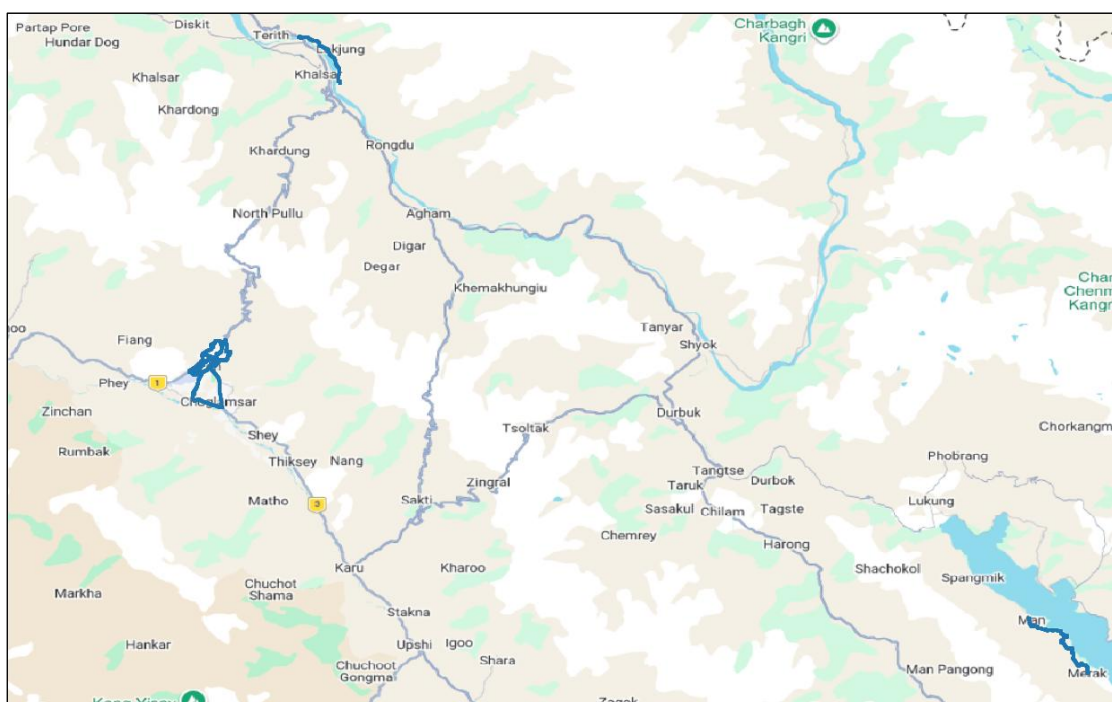


Figure- 6: Drive test routes.

4.2.2 Areas covered

Lakjung, Tsati, Yurtung, Kushok Bakula Rimpochee Airport, Leh Palace, Sankar Gompa, Leh, Choglamsar and Spituk 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 Only	
	AIRTEL	BSNL
Call Attempts	84	93
Call Setup Success Rate %	96.43	72.04
Drop Call Rate%	0.00	0.00
Call Setup Time-Average (Second)	3.51	5.41
Handover Success Rate %	98.64	99.57

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

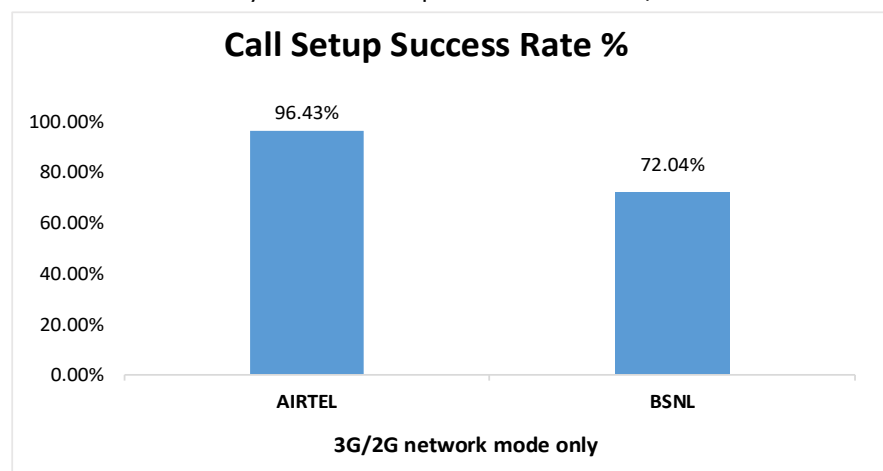


Figure-7: Performance for call setup success rate.

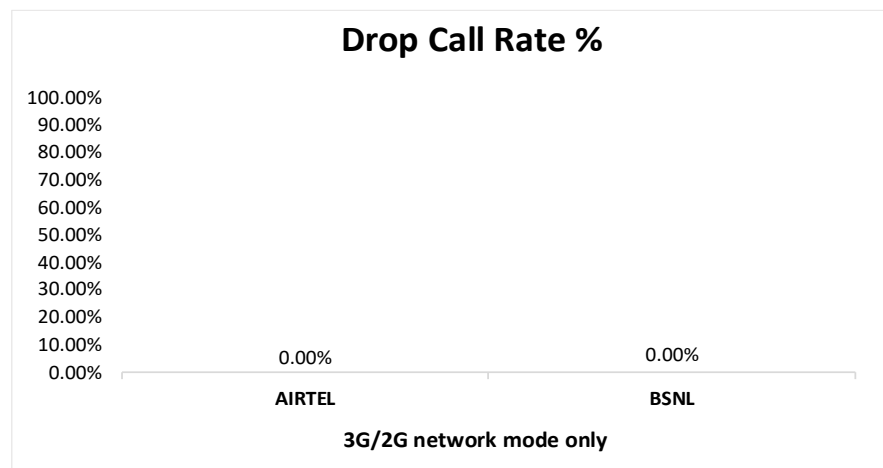


Figure-8: Performance for drop call rate.

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

Technology	Service Provider	
	AIRTEL	BSNL
3G	NA	82.75%
2G	99.45%	9.69%
Limited Service	0.55%	7.56%

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

Note-

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

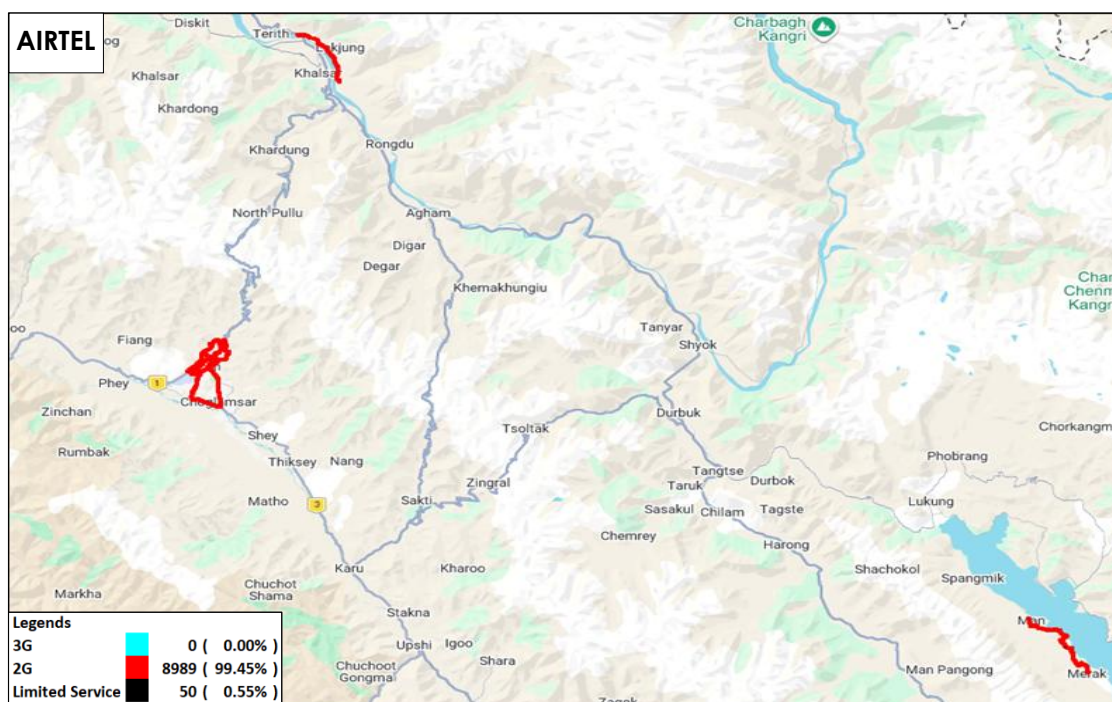


Figure-9: Serving technology plots 3G/2G network mode - AIRTEL.

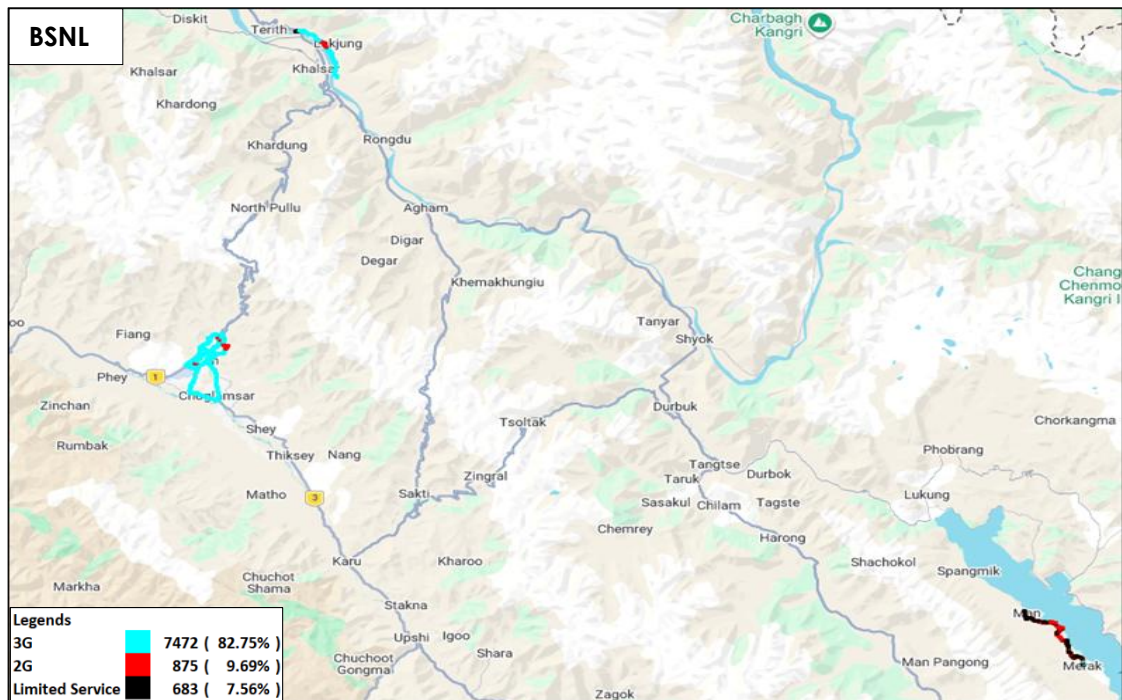


Figure-10: Serving technology plots 3G/2G network mode - BSNL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 139 & 140 for map view)

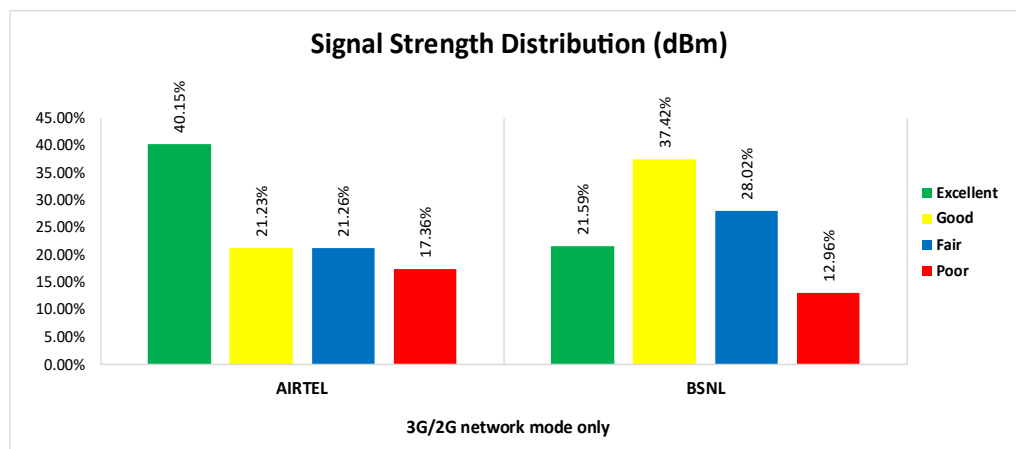


Figure-11: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 40% of samples falling in the excellent signal strength category.
- BSNL has 22% 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
Call Attempts	88	97	92
Call Setup Success Rate %	94.32	79.38	82.61
Drop Call Rate %	0.00	6.49	1.32
Call Setup Time-Average (Second)	1.87	3.36	1.13
Handover Success Rate %	99.69	99.61	99.71

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

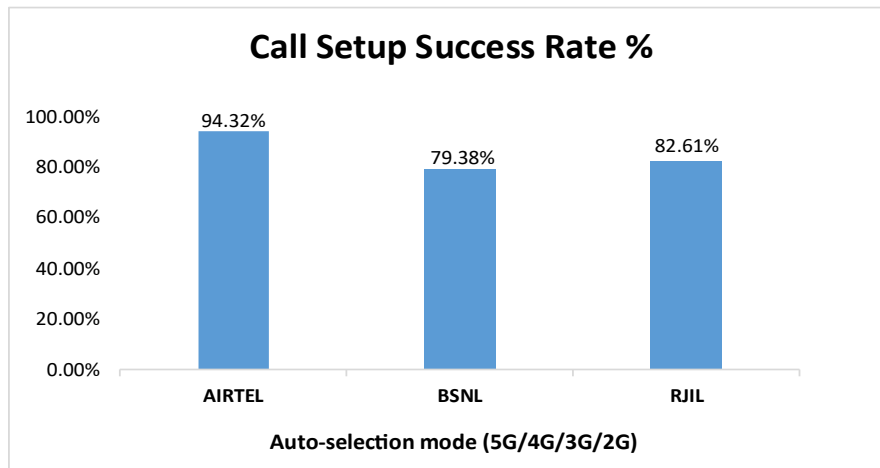


Figure-12: Performance for call setup success rate.

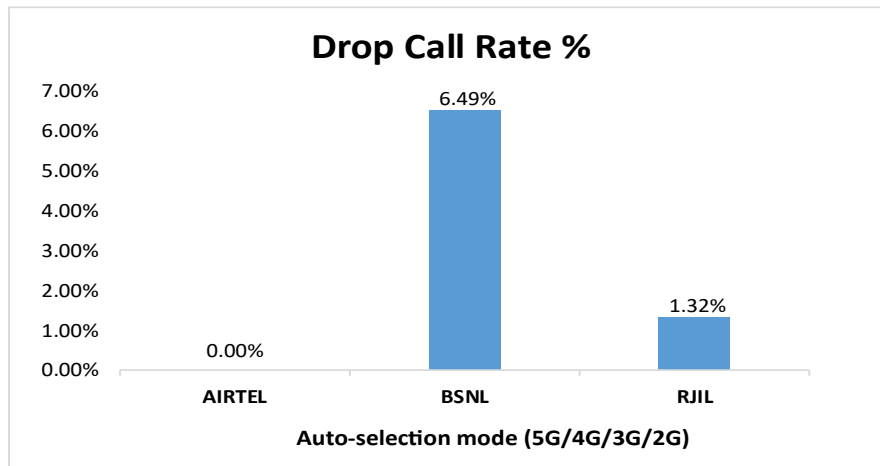


Figure-13: Performance for drop call rate.

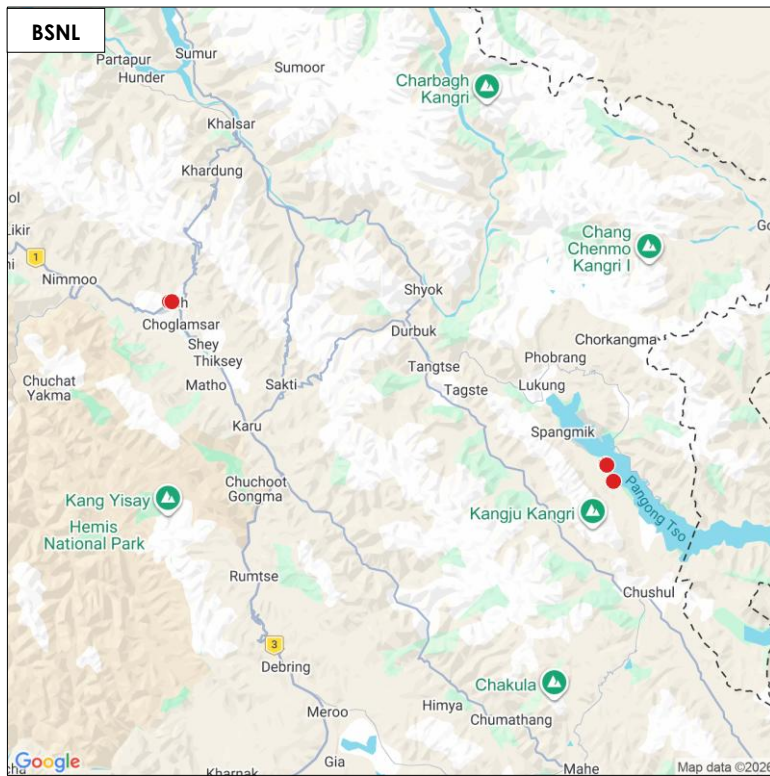


Figure-14: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

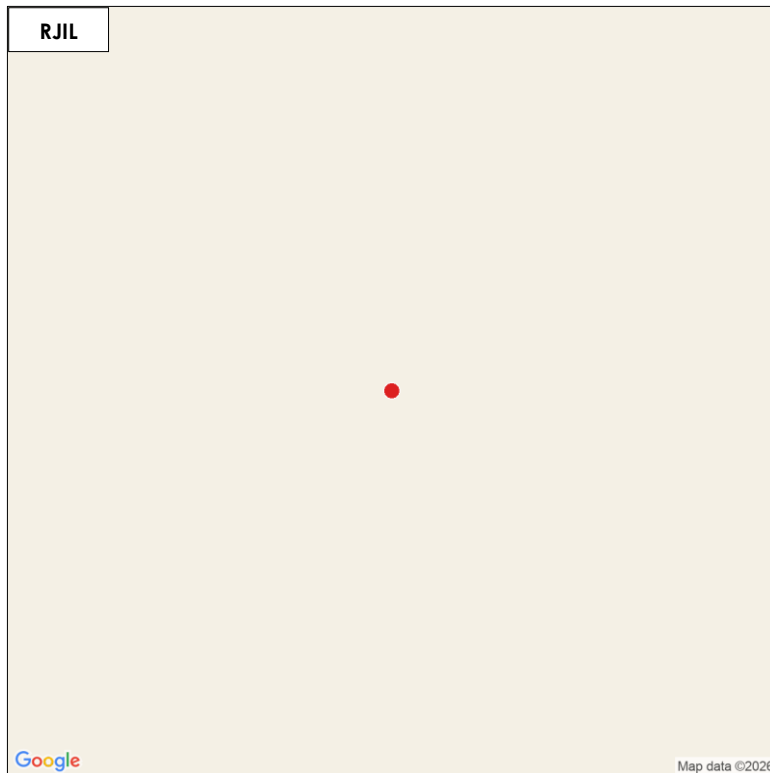


Figure-15: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

Parameter	Service Provider		
	Mobile-to-Mobile (5G/4G – Open Mode)		
	AIRTEL	BSNL	RJIL
Call Established (within service provider Network)	75	75	72
Number of silences call for >4 Sec	1	1	1
Silence Call Rate %	1.33	1.33	1.39
Number of silence instances for >4 Sec	2	1	1
Number of silence instances for >3 Sec	2	2	1
Number of silence instances for >2 sec	2	9	2
RTP Jitter (4G & 5G) in ms	6.00	4.60	15.47
Packet loss Rate Downlink %	0.81	1.96	2.77
Packet loss Rate Uplink %	0.32	1.63	13.35

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

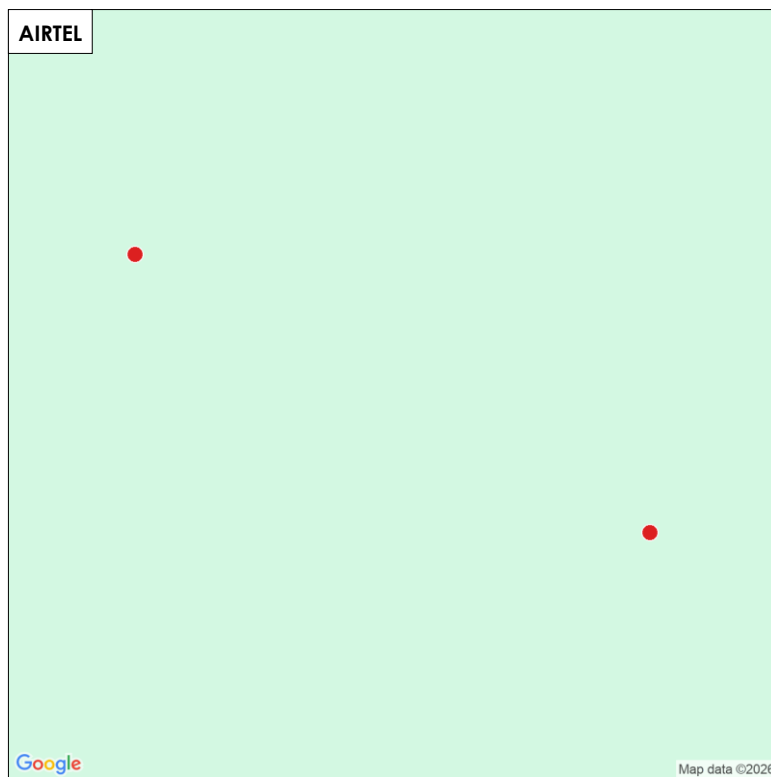


Figure-16: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - BSNL.

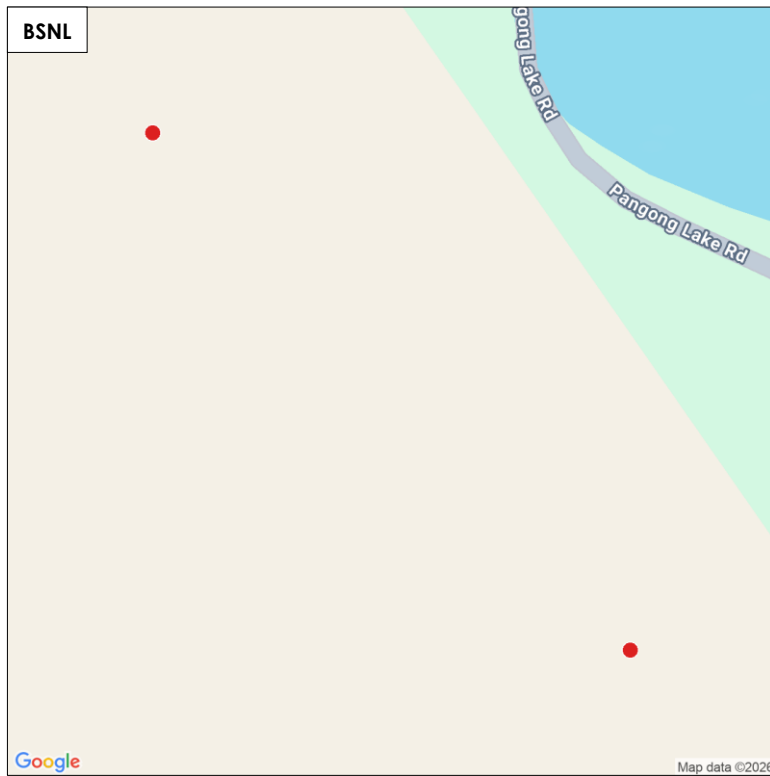


Figure-17: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - BSNL.

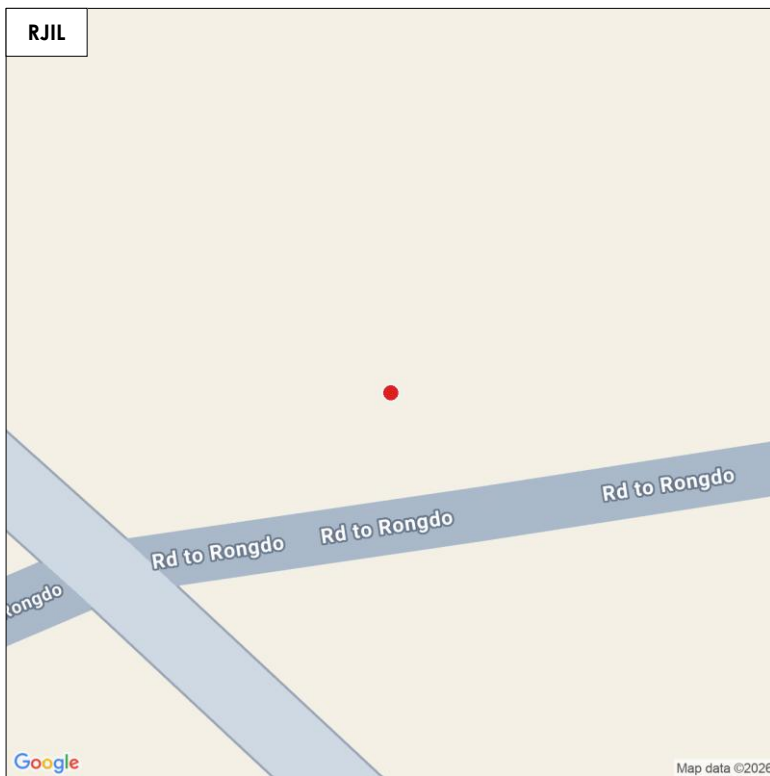


Figure-18: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - RJIL.

(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 value means: 5-Excellent, 4-Good, 3-Fair, 2-Poor, 1-Bad.

Speech Quality (MOS) distribution	Service Provider		
	AIRTEL	BSNL	RJIL
Total Number of MOS Samples for calls table-16	443	401	420
Speech Quality (Average MOS)	4.00	3.36	4.46
Number of samples with MOS ≥ 4 to <5 (Excellent)	363	166	365
Number of samples with MOS ≥ 3 to <4 (Good)	69	94	31
Number of samples with MOS ≥ 2 to <3 (Fair)	7	107	11
Number of samples with MOS ≥ 1 to <2 (Poor)	4	34	13
%age of samples with MOS ≥ 4 to <5 (Excellent)	81.94%	41.40%	86.90%
%age of samples with MOS ≥ 3 to <4 (Good)	15.58%	23.44%	7.38%
%age of samples with MOS ≥ 2 to <3 (Fair)	1.58%	26.68%	2.62%
%age of samples with MOS ≥ 1 to <2 (Poor)	0.90%	8.48%	3.10%

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

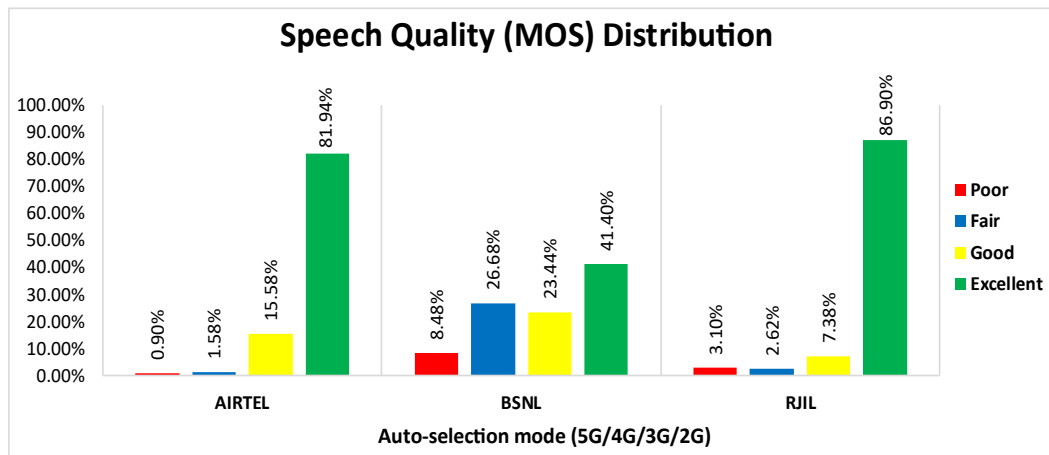


Figure-19: Distribution of samples in MOS range.

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

Technology	Service Provider		
	AIRTEL	BSNL	RJIL
5G	2.80%	NA	47.71%
4G	90.11%	75.82%	48.32%
3G	NA	14.33%	NA
2G	5.50%	7.65%	NA
Limited Service	1.59%	2.20%	3.97%

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.

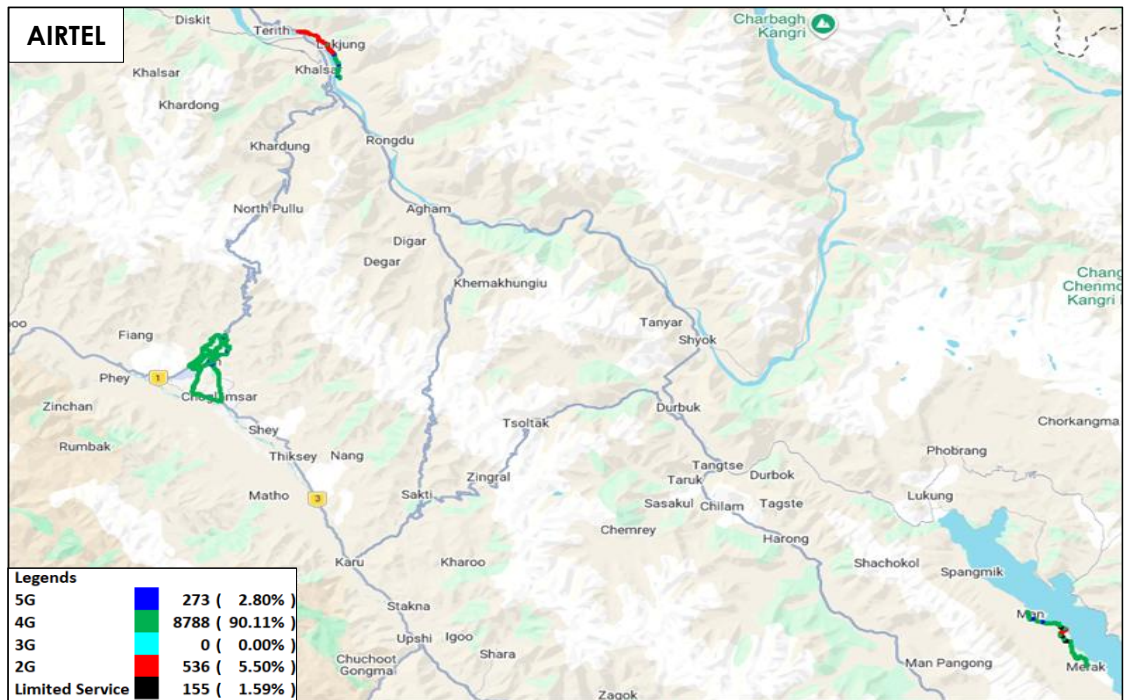


Figure-20: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

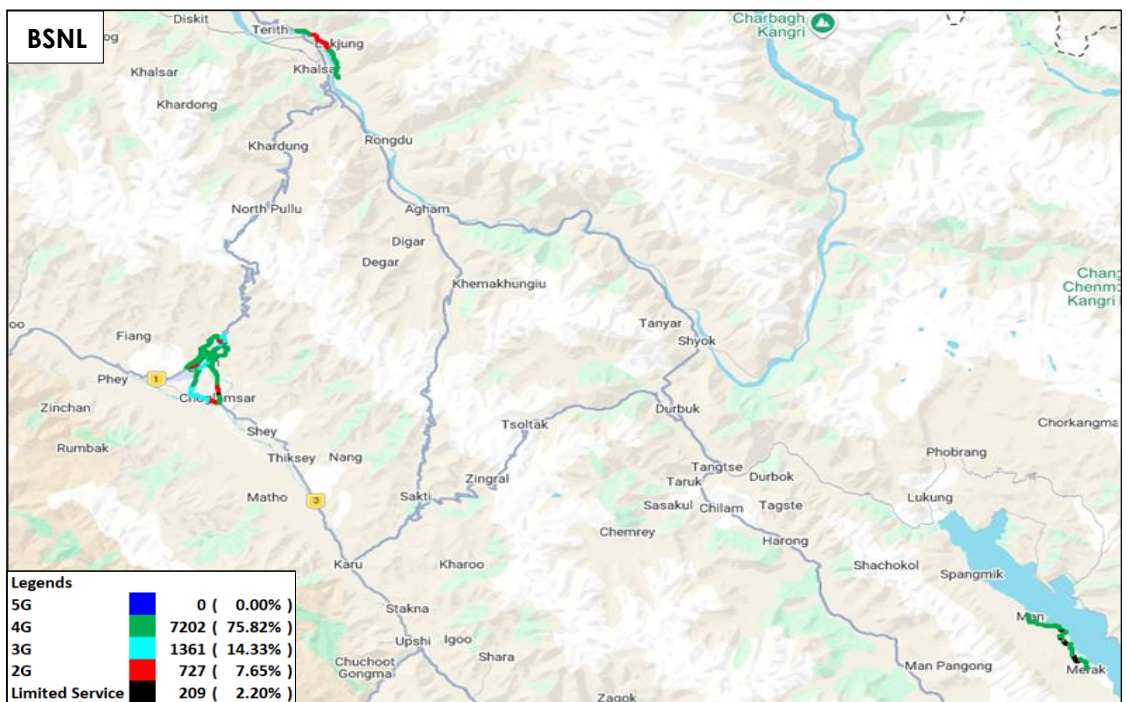


Figure-21: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

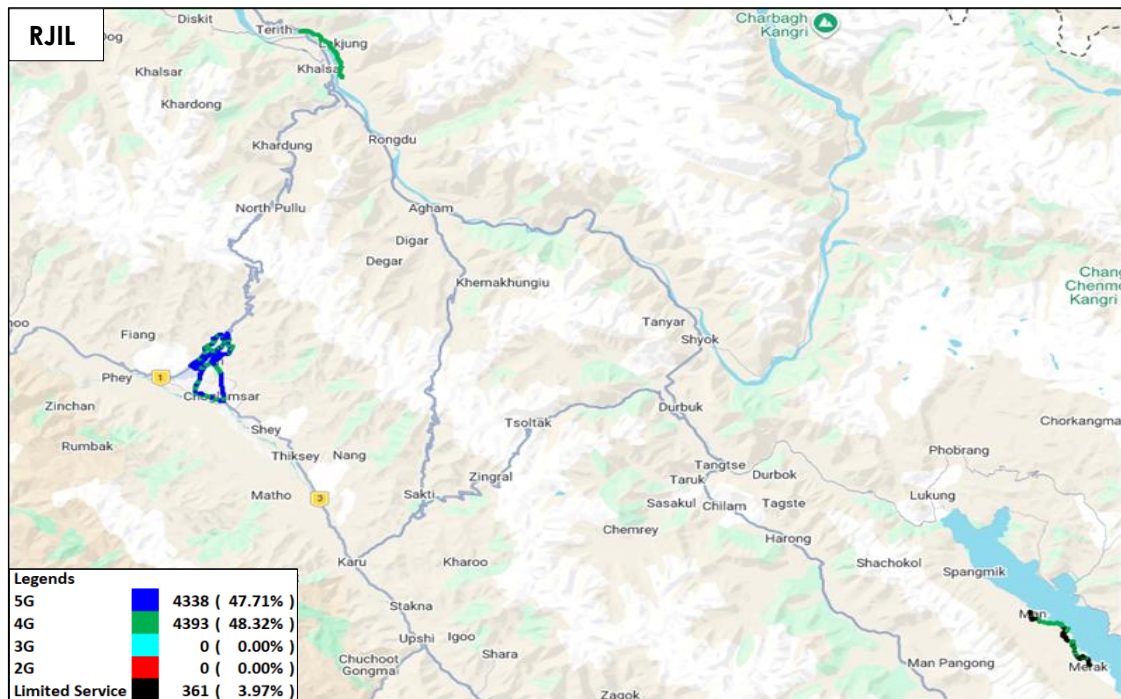


Figure-22: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-141, 142 & 143 for map view)

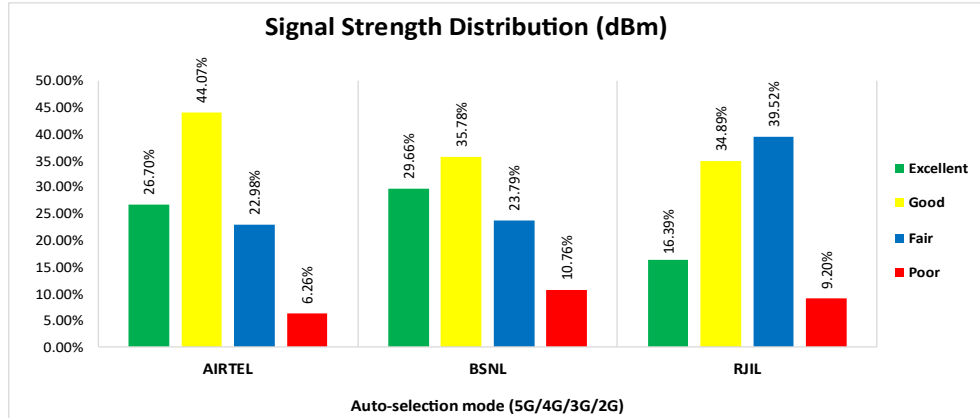


Figure-23: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 27% of samples falling in the excellent signal strength category.
- BSNL has 30% of samples falling in the excellent signal strength category.
- RJIL has 16% of samples falling in the excellent signal strength category.

(h) Coverage Gap observed

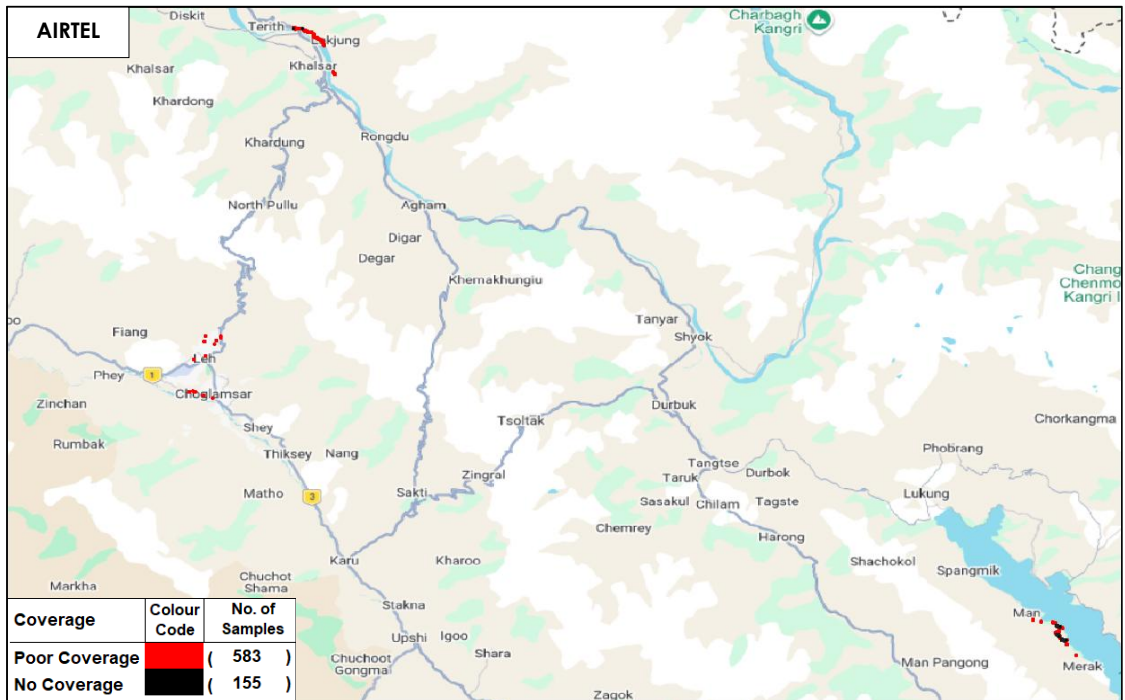


Figure-24: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-AIRTEL.

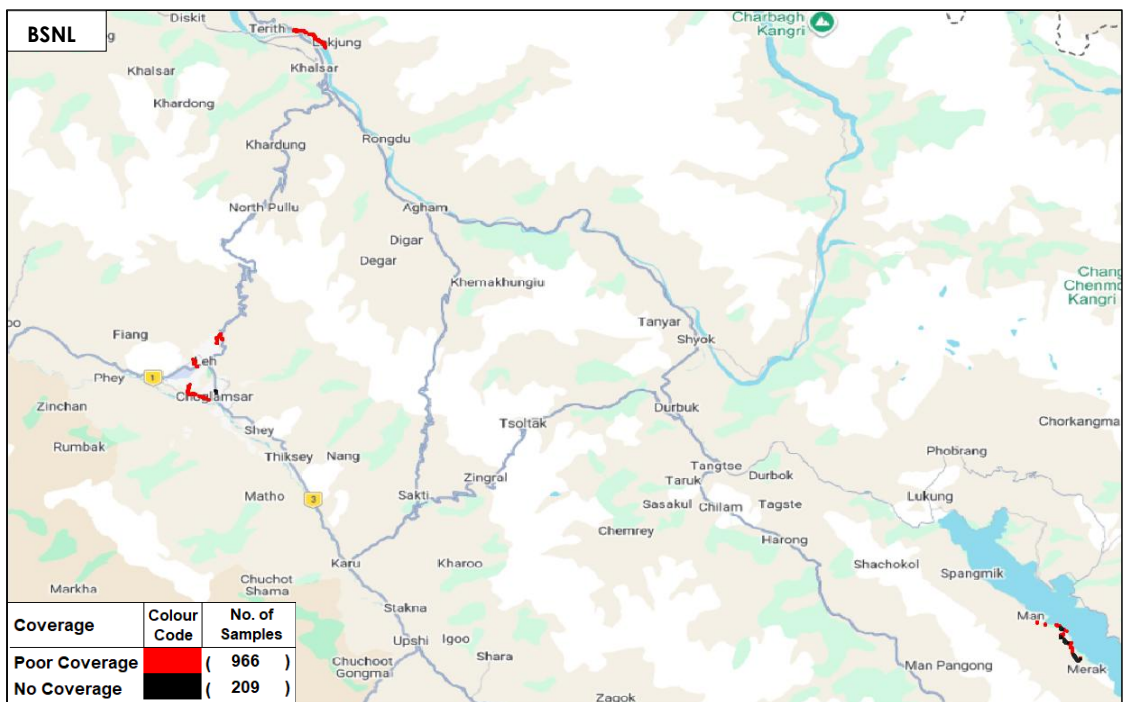


Figure-25: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-BSNL.

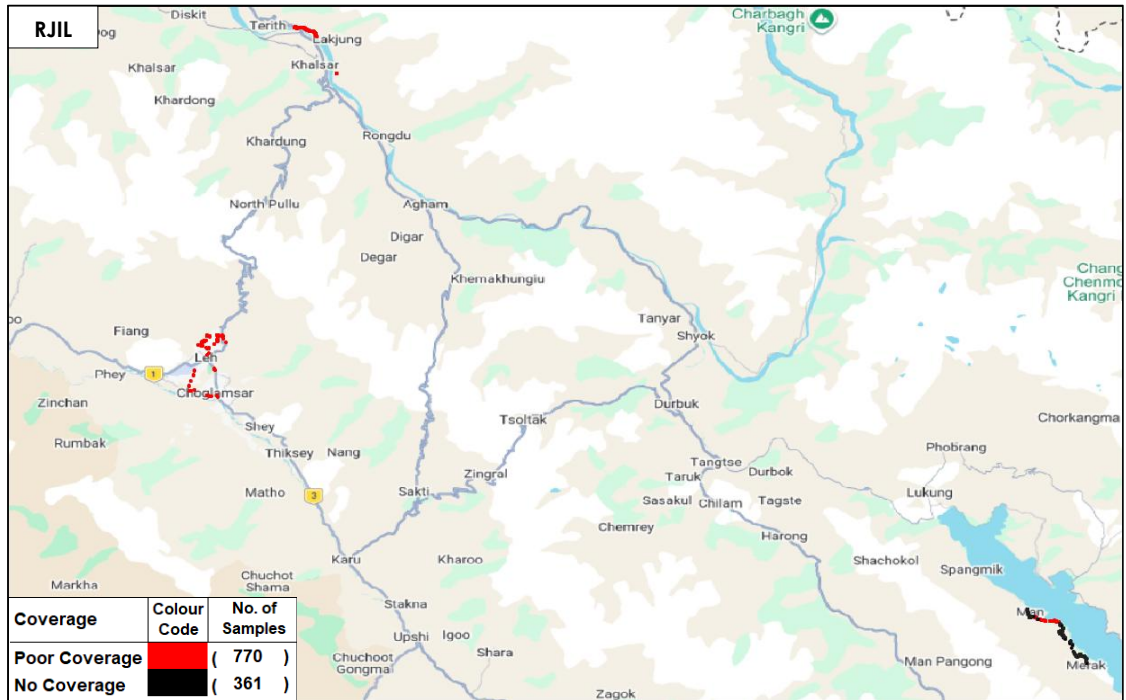


Figure-26: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-RJIL.

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
Download Throughput (Mbits/s)	Average	121.65	8.00	267.13
	80 th Percentile	196.06	12.31	405.76
	20 th Percentile	40.51	1.17	86.04
Upload Throughput (Mbits/s)	Average	22.13	4.87	21.20
	80 th Percentile	42.62	7.42	33.80
	20 th Percentile	6.06	1.21	4.53
Latency (ms)	50 th Percentile	50.01	32.01	29.98

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

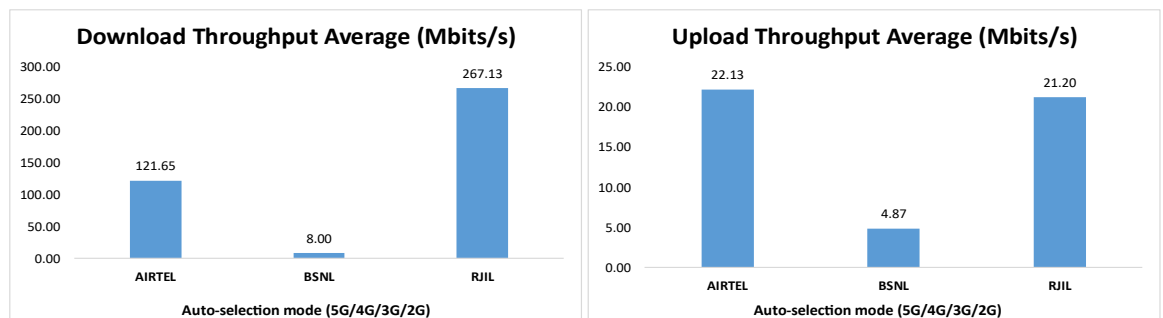


Figure- 27: Download & Upload throughput.

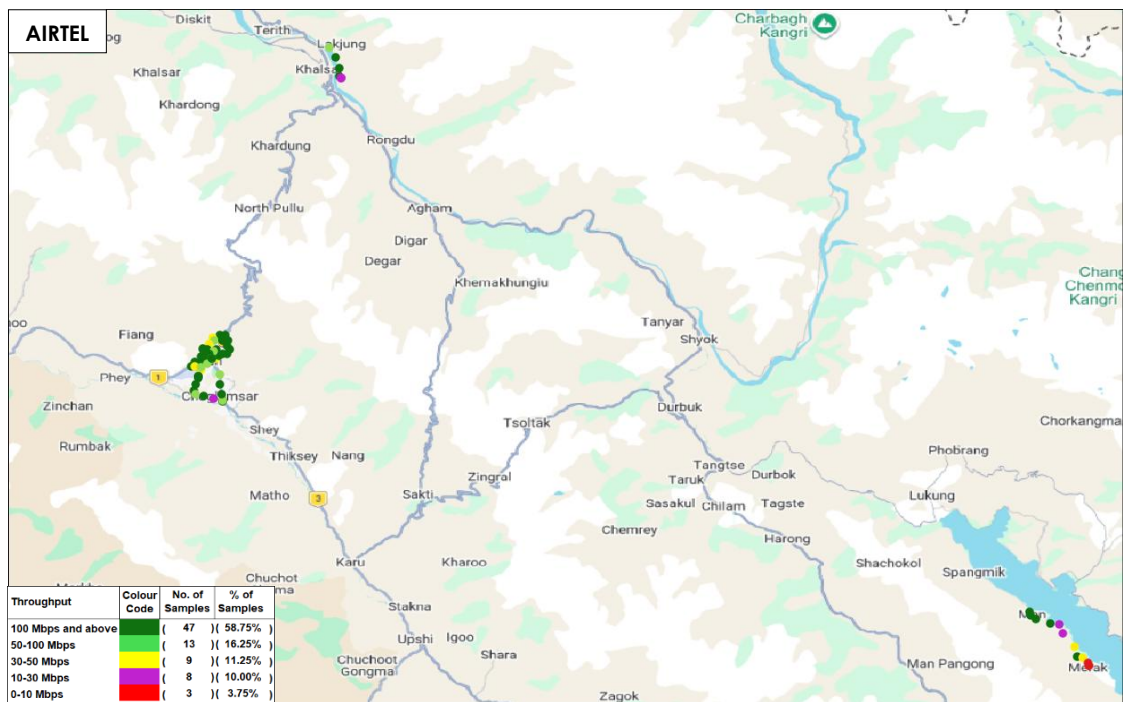


Figure-28: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

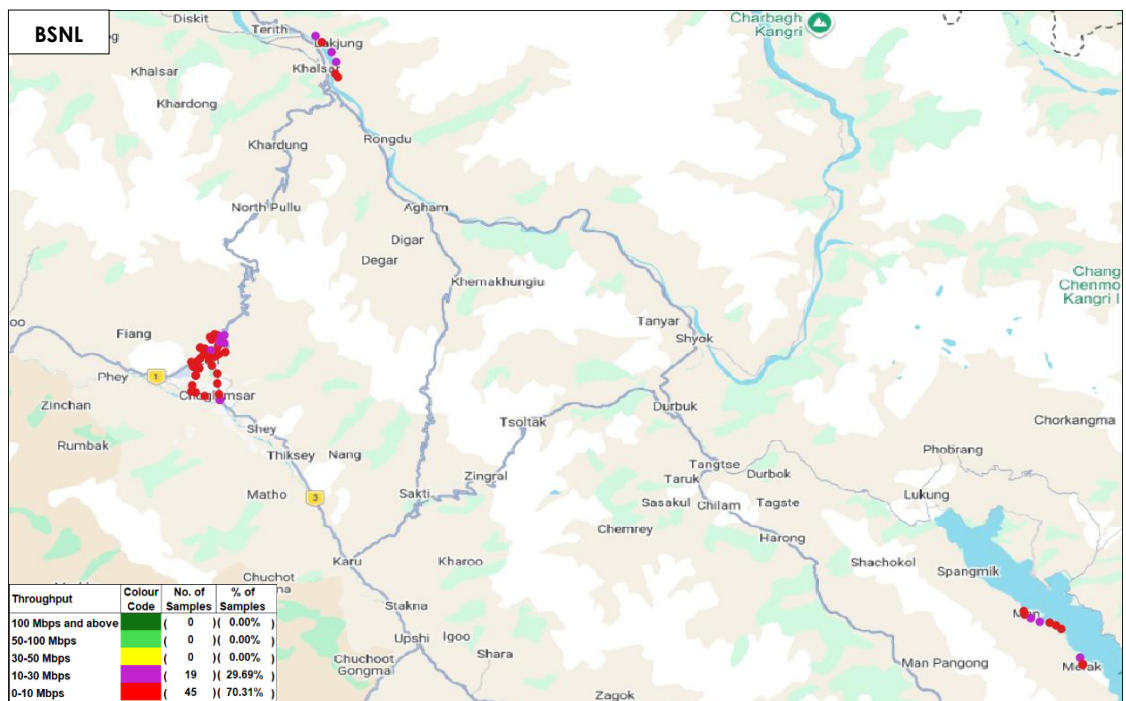


Figure-29: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

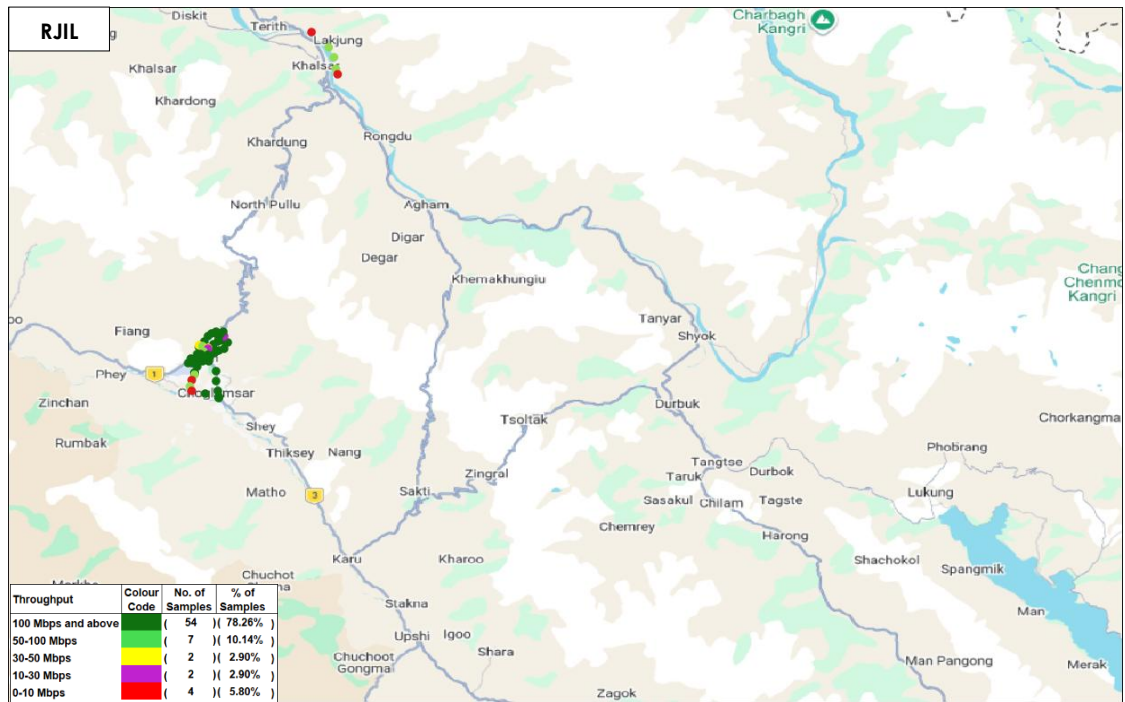


Figure-30: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

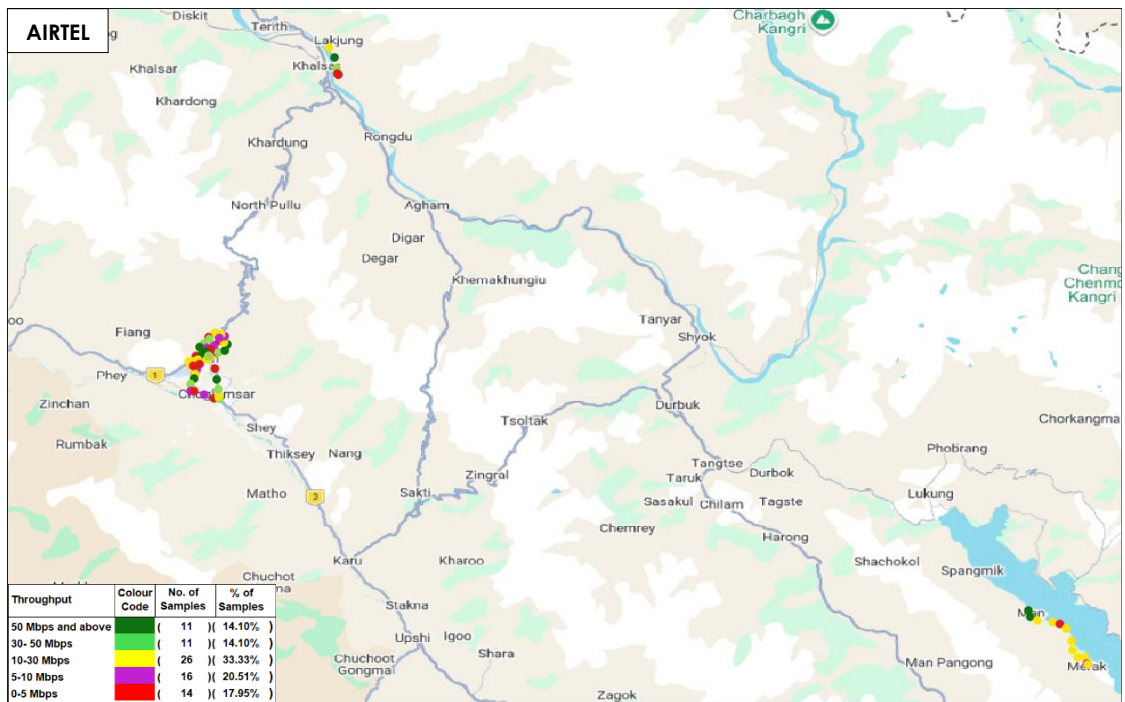


Figure-31: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

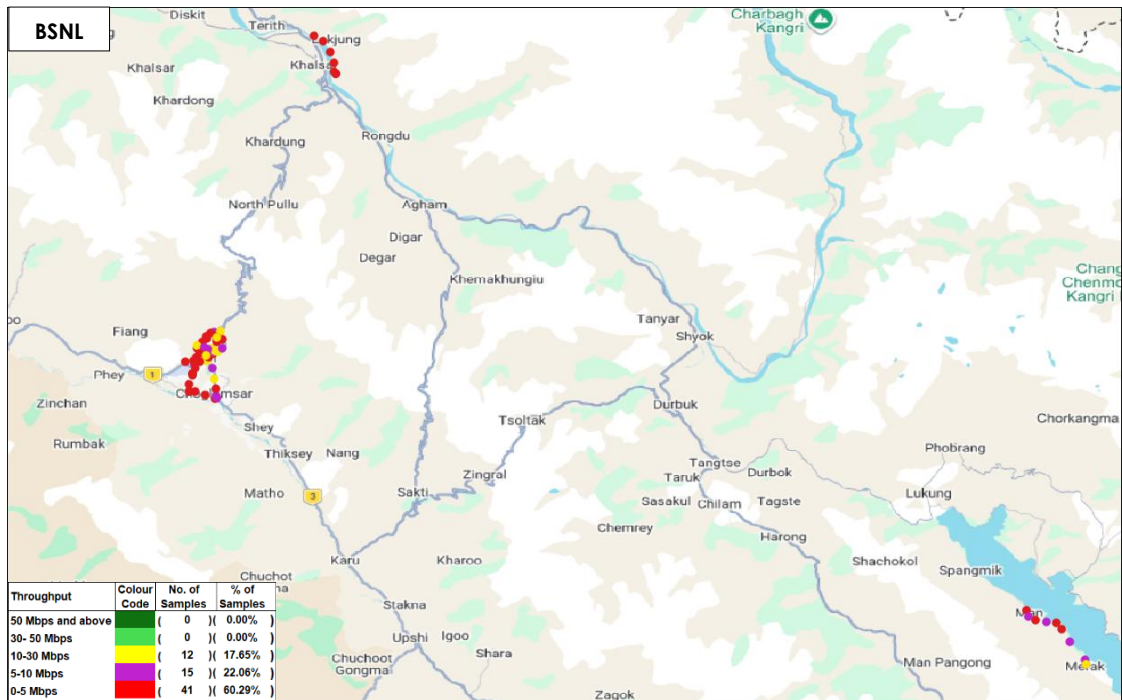


Figure-32: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

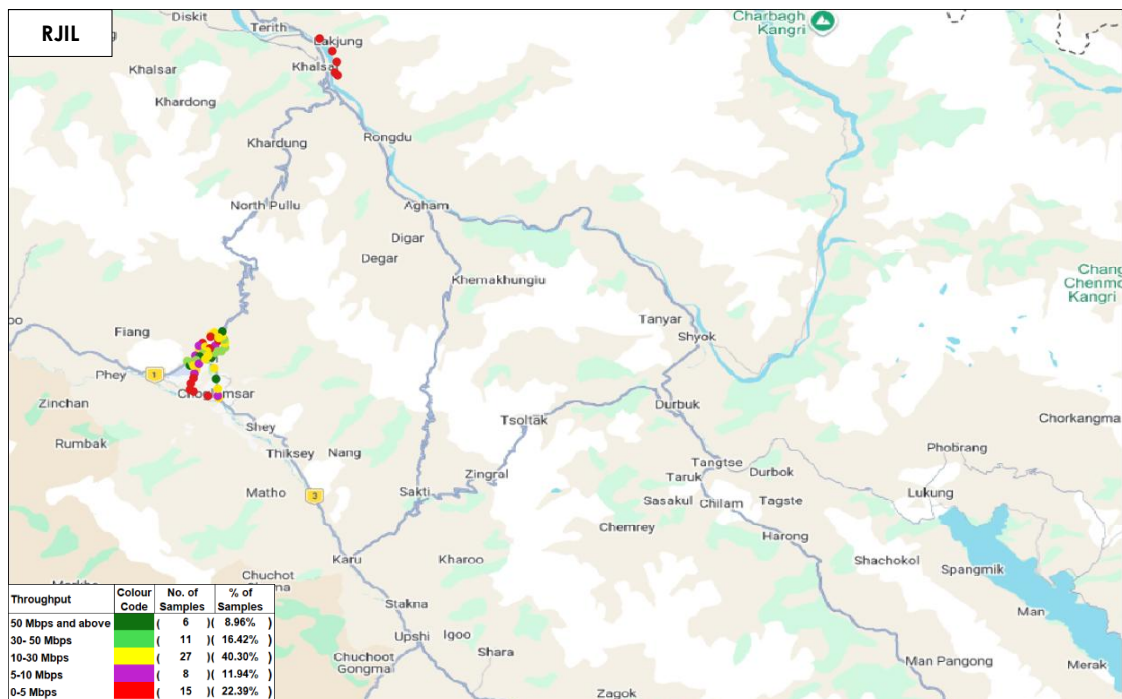


Figure-33: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

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

Technology	Service Provider		
	AIRTEL	BSNL	RJIL
5G	72.06%	NA	66.70%
4G	22.76%	87.71%	27.67%
3G	NA	9.85%	NA
2G	0.13%	0.25%	NA
Limited Service	5.05%	2.18%	5.62%

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.

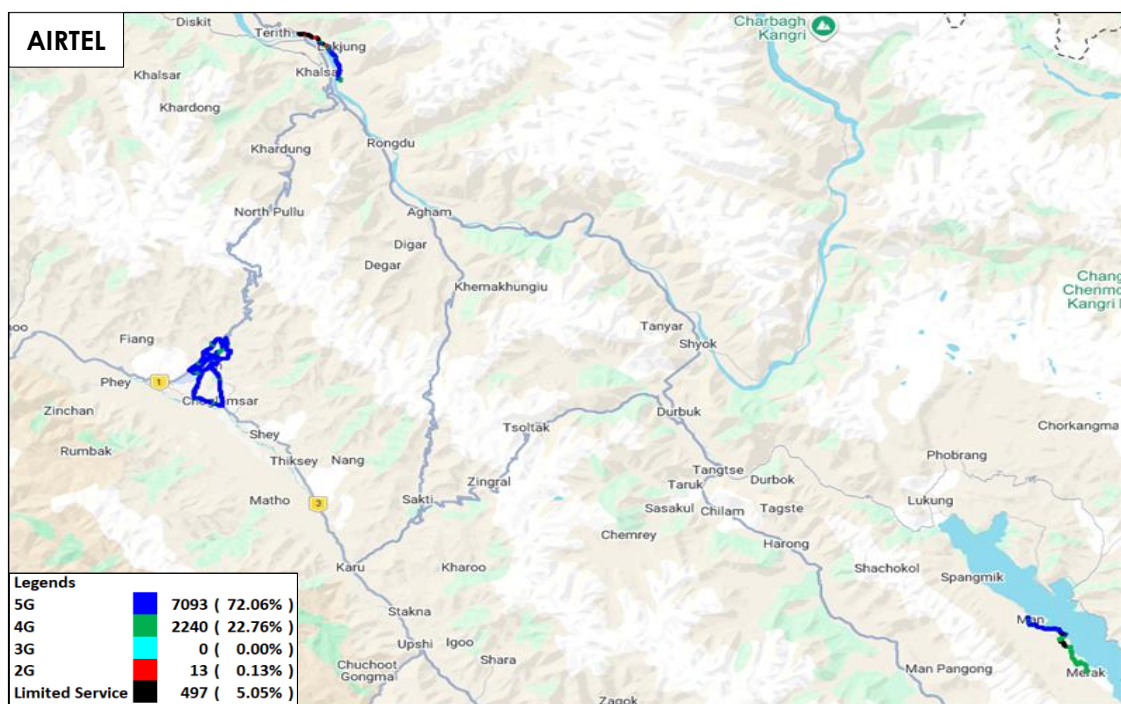


Figure-34: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

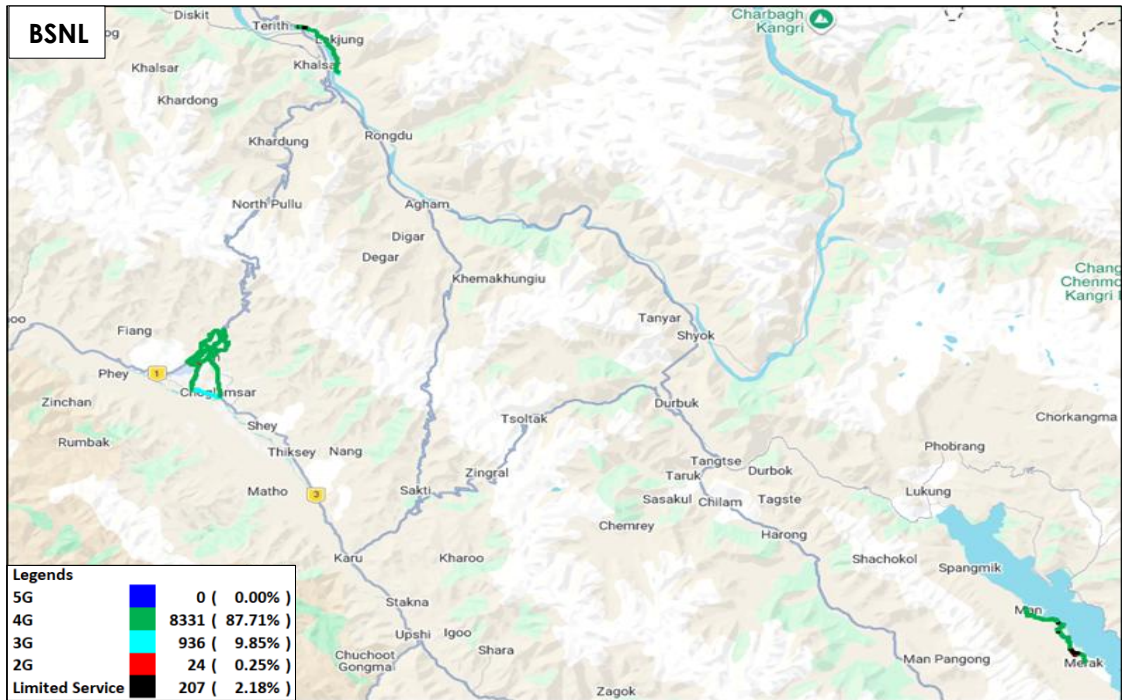


Figure-35: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - BSNL.

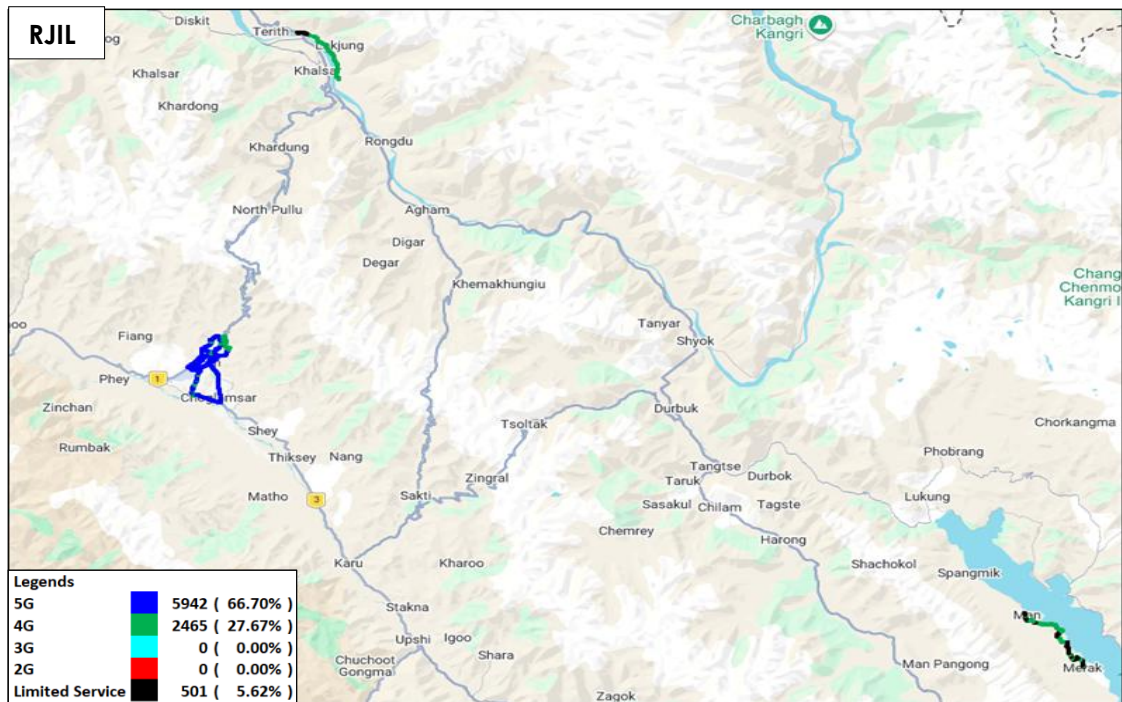


Figure-36: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - RJIL.

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

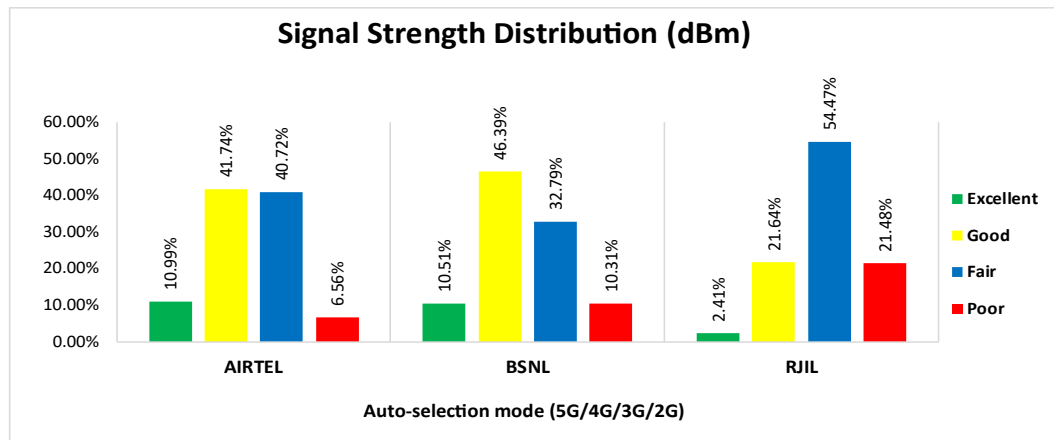


Figure-37: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 11% of samples falling in the excellent signal strength category.
- BSNL has 11% of samples falling in the excellent signal strength category.
- RJIL has 2% of samples falling in the excellent signal strength category.

4.3 Hotspots

Hotspot testing has been done from 17th August 2026 to 21st August 2026. Seven locations have been tested across the cities. (Refer Table-1)

4.3.1 Locations

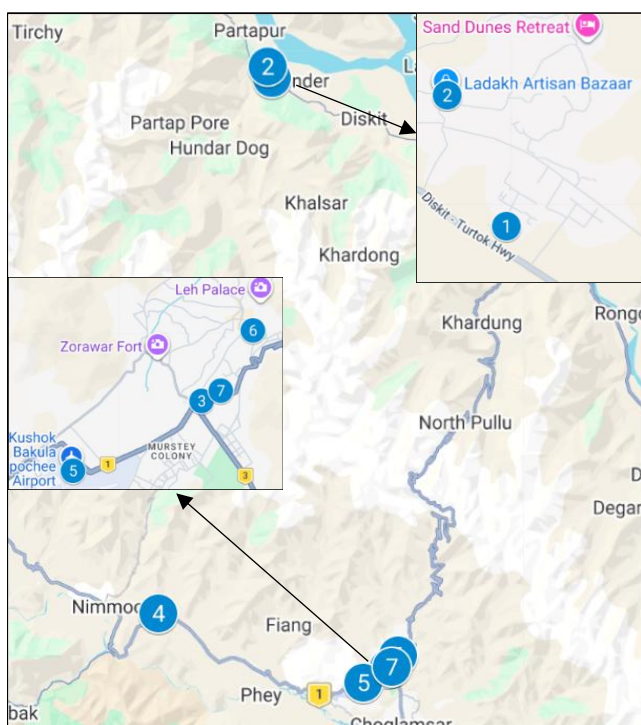


Figure- 38: Hotspot locations.

4.3.2 Hotspot covered

1. Army Hospital Hundar
2. Artisan Bazaar
3. EJM College
4. Gurudwara Sri Pathar Sahib
5. Leh Airport
6. Leh Market
7. SNM Hospital

4.3.3 Voice performance

Overall Voice Performance			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	70	70	70
Call Setup Success Rate %	100.00	81.43	97.14
Drop Call Rate %	0.00	1.75	4.41
Call Setup Time-Average (Second)	1.44	3.43	0.65

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

Army Hospital Hundar			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.39	2.31	0.60

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

Artisan Bazaar			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	10	10	10
Call Setup Success Rate %	100.00	70.00	100.00
Drop Call Rate %	0.00	14.29	0.00
Call Setup Time-Average (Second)	1.48	3.62	0.53

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

EJM College			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.50	2.81	0.51

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

Gurudwara Sri Pathar Sahib			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	10	10	10
Call Setup Success Rate %	100.00	0.00	80.00
Drop Call Rate %	0.00	-	37.50
Call Setup Time-Average (Second)	1.40	-	1.39

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

Leh Airport			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.44	4.30	0.55

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

Leh Market			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.42	3.85	0.53

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

SNM Hospital			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.42	3.83	0.60

Table-28: 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
Download Throughput Average (Mbits/s)	114.86	9.03	321.78
Download Throughput 80 th Percentile (Mbit/s)	175.45	16.57	486.69
Download Throughput 20 th Percentile (Mbit/s)	39.19	4.73	122.03
Download Session Setup Success Rate %	100.00	85.71	94.29
Upload Throughput Average (Mbits/s)	20.78	12.20	38.79
Upload Throughput 80 th Percentile (Mbit/s)	32.85	20.47	72.17
Upload Throughput 20 th Percentile (Mbit/s)	12.14	2.11	13.57
Upload Session Setup Success Rate %	100.00	85.71	88.57
Web Browsing Delay (Second)	4.08	2.81	3.85
Youtube Initial Buffer Delay (Second)	1.14	1.67	0.91
Latency (ms) – 50 th Percentile	49.83	32.70	29.58
Jitter (ms)	6.86	3.12	4.01
Packet Loss Rate%	3.66	14.97	21.84
Packet Loss Rate- 90 th percentile	12.46	71.08	100.00

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

Army Hospital Hundar			
Parameters	Service Provider		
	Auto-Selection Mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Download Throughput Average (Mbits/s)	200.94	17.01	136.56
Download Session Setup Success Rate %	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	15.89	11.09	11.82
Upload Session Setup Success Rate %	100.00	100.00	100.00
Web Browsing Delay (Second)	3.20	3.08	4.11
Youtube Initial Buffer Delay (Second)	0.84	0.96	1.02
Latency (ms) – 50 th Percentile	50.45	32.40	31.20
Jitter (ms)	4.09	2.54	3.08
Packet Loss Rate%	0.50	1.80	2.90

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

Artisan Bazaar			
Parameters	Service Provider		
	Auto-Selection Mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Download Throughput Average (Mbits/s)	133.69	4.79	483.90
Download Session Setup Success Rate %	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	3.36	1.58	12.79
Upload Session Setup Success Rate %	100.00	100.00	100.00
Web Browsing Delay (Second)	3.28	5.94	3.91
Youtube Initial Buffer Delay (Second)	2.09	12.31	1.04
Latency (ms) – 50 th Percentile	47.23	32.78	34.14
Jitter (ms)	3.71	7.24	5.34
Packet Loss Rate%	0.00	0.50	0.00

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

EJM College			
Parameters	Service Provider		
	Auto-Selection Mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Download Throughput Average (Mbits/s)	172.04	5.58	315.87
Download Session Setup Success Rate %	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	49.29	25.10	64.99
Upload Session Setup Success Rate %	100.00	100.00	100.00
Web Browsing Delay (Second)	3.24	1.46	4.75
Youtube Initial Buffer Delay (Second)	0.73	0.90	0.84
Latency (ms) – 50 th Percentile	47.86	29.91	29.10
Jitter (ms)	4.94	2.67	4.16
Packet Loss Rate%	0.10	0.80	0.00

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

Gurudwara Sri Pathar Sahib			
Parameters	Service Provider		
	Auto-Selection Mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Download Throughput Average (Mbits/s)	141.27	-	0.43
Download Session Setup Success Rate %	100.00	0.00	60.00
Upload Throughput Average (Mbits/s)	30.50	-	1.31
Upload Session Setup Success Rate %	100.00	0.00	20.00
Web Browsing Delay (Second)	4.18	-	-
Youtube Initial Buffer Delay (Second)	1.13	-	-
Latency (ms) – 50 th Percentile	48.58	-	-
Jitter (ms)	5.94	-	-
Packet Loss Rate%	0.20	100.00	100.00

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

Note- “-” Respective tests were failed.

Leh Airport			
Parameters	Service Provider		
	Auto-Selection Mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Download Throughput Average (Mbits/s)	27.02	5.03	126.38
Download Session Setup Success Rate %	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	14.01	2.19	25.36
Upload Session Setup Success Rate %	100.00	100.00	100.00
Web Browsing Delay (Second)	5.87	1.75	3.93
Youtube Initial Buffer Delay (Second)	1.13	3.57	0.87
Latency (ms) – 50 th Percentile	56.54	33.12	-
Jitter (ms)	5.25	2.10	-
Packet Loss Rate%	0.80	1.10	50.00

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

Note- “-” Ping tests were failed.

Leh Market			
Parameters	Service Provider		
	Auto-Selection Mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Download Throughput Average (Mbits/s)	46.36	6.26	236.28
Download Session Setup Success Rate %	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	17.64	15.47	29.14
Upload Session Setup Success Rate %	100.00	100.00	100.00
Web Browsing Delay (Second)	4.56	1.26	3.12
Youtube Initial Buffer Delay (Second)	0.99	0.96	0.87
Latency (ms) – 50 th Percentile	43.58	33.02	27.43
Jitter (ms)	10.46	1.60	3.69
Packet Loss Rate%	14.30	0.40	0.00

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

SNM Hospital			
Parameters	Service Provider		
	Auto-Selection Mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Download Throughput Average (Mbits/s)	82.72	15.54	824.51
Download Session Setup Success Rate %	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	14.75	17.77	96.12
Upload Session Setup Success Rate %	100.00	100.00	100.00
Web Browsing Delay (Second)	4.21	4.30	3.39
Youtube Initial Buffer Delay (Second)	0.93	0.96	0.85
Latency (ms) – 50 th Percentile	55.71	33.50	28.93
Jitter (ms)	13.61	2.56	3.74
Packet Loss Rate%	9.70	0.20	0.00

Table-36: 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
5G	Download Throughput Average (Mbits/s)	123.37	-	329.03
	Upload Throughput Average (Mbits/s)	23.93	-	39.24
4G	Download Throughput Average (Mbits/s)	48.71	8.01	26.01
	Upload Throughput Average (Mbits/s)	10.81	9.56	5.64

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

Note- “-”Respective technology was not observed during the test.				
Army Hospital Hunder				
Parameters		Service Provider		
		AIRTEL	BSNL	RJIL
5G	Download Throughput Average (Mbits/s)	194.32	-	148.38
	Upload Throughput Average (Mbits/s)	19.46	-	14.60
4G	Download Throughput Average (Mbits/s)	37.85	17.36	14.32
	Upload Throughput Average (Mbits/s)	6.43	11.80	1.99

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

Note- “-”Respective technology was not observed during the test.				
Artisan Bazaar				
Parameters		Service Provider		
		AIRTEL	BSNL	RJIL
5G	Download Throughput Average (Mbits/s)	124.75	-	466.81
	Upload Throughput Average (Mbits/s)	3.59	-	13.77
4G	Download Throughput Average (Mbits/s)	63.33	5.75	24.90
	Upload Throughput Average (Mbits/s)	10.39	1.68	1.24

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

Note- “-”Respective technology was not observed during the test.				
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EJM College				
Parameters		Service Provider		
		AIRTEL	BSNL	RJIL
5G	Download Throughput Average (Mbits/s)	150.95	-	350.64
	Upload Throughput Average (Mbits/s)	55.12	-	70.01
4G	Download Throughput Average (Mbits/s)	28.78	4.49	37.94
	Upload Throughput Average (Mbits/s)	9.99	9.96	4.11

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

Note- “-”Respective technology was not observed during the test.

Gurudwara Sri Pathar Sahib				
Parameters		Service Provider		
		AIRTEL	BSNL	RJIL
5G	Download Throughput Average (Mbits/s)	-	-	0.05
	Upload Throughput Average (Mbits/s)	-	-	1.39
4G	Download Throughput Average (Mbits/s)	89.13	-	0.43
	Upload Throughput Average (Mbits/s)	21.80	-	0.85

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

Note- “-”Respective technology was not observed during the test.

Leh Airport				
Parameters		Service Provider		
		AIRTEL	BSNL	RJIL
5G	Download Throughput Average (Mbits/s)	-	-	117.58
	Upload Throughput Average (Mbits/s)	-	-	25.45
4G	Download Throughput Average (Mbits/s)	41.41	2.04	8.21
	Upload Throughput Average (Mbits/s)	5.76	3.15	3.05

Table-42: Overall Summary of 5G only & 4G only data download & upload speed.

Note- “-”Respective technology was not observed during the test.

Leh Market				
Parameters		Service Provider		
		AIRTEL	BSNL	RJIL
5G	Download Throughput Average (Mbits/s)	82.86	-	232.85
	Upload Throughput Average (Mbits/s)	23.29	-	29.46
4G	Download Throughput Average (Mbits/s)	34.70	5.32	44.95
	Upload Throughput Average (Mbits/s)	12.92	15.67	15.99

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

Note- “-”Respective technology was not observed during the test.

SNM Hospital				
Parameters		Service Provider		
		AIRTEL	BSNL	RJIL
5G	Download Throughput Average (Mbits/s)	63.97	-	855.33
	Upload Throughput Average (Mbits/s)	18.17	-	97.31
4G	Download Throughput Average (Mbits/s)	45.76	13.09	51.31
	Upload Throughput Average (Mbits/s)	8.40	15.13	11.33

Table-44: 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 August 2026. One location has been tested in Leh. (Refer Table-1)

4.4.1 Walk test locations

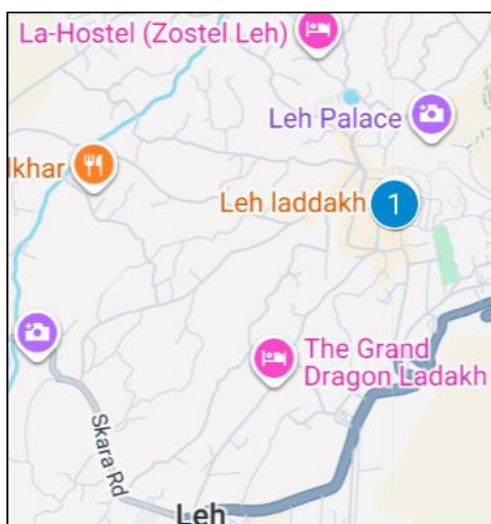


Figure-39: Walk Test locations.

4.4.2 Walk Test Covered

1. Lehar Market

4.4.3 Voice Performance

Lehar Market			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	14	14	13
Call Setup Success Rate %	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.48	4.53	0.54

Table-45: 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)

Lehar Market			
Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Download Throughput Average (Mbits/s)	127.07	19.50	616.94
Download Session Setup Success Rate %	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	26.98	15.08	78.85
Upload Session Setup Success Rate %	100.00	100.00	100.00
Latency (ms) – 50 th Percentile	47.20	29.10	27.56

Table-46: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

4.5 Highway

Drive test has been conducted from 19th August 2026 to 21st August 2026. Three highway route covered across the LSA. (Refer Table-1)

4.5.1 Leh to Nubra Valley

4.5.1.1 Drive test route



Figure-40: Drive test routes.

4.5.1.2 Areas covered

Power House, View Point Khadungla road, South Pullu, Shiv Shankar Temple, North Pullu, Khardung Viewpoint, Khalsar and Diskit 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 experience for respective users as they have only 3G/2G compatible handsets.

Parameters	Service Provider	
	3G/2G Only	
	AIRTEL	BSNL
Call Attempts	142	174
Call Setup Success Rate %	68.31	31.03
Drop Call Rate%	4.12	5.56
Call Setup Time-Average (Second)	3.79	5.62
Handover Success Rate %	100.00	98.99

Table-47: Summary of voice call performance in 3G/2G network mode only.

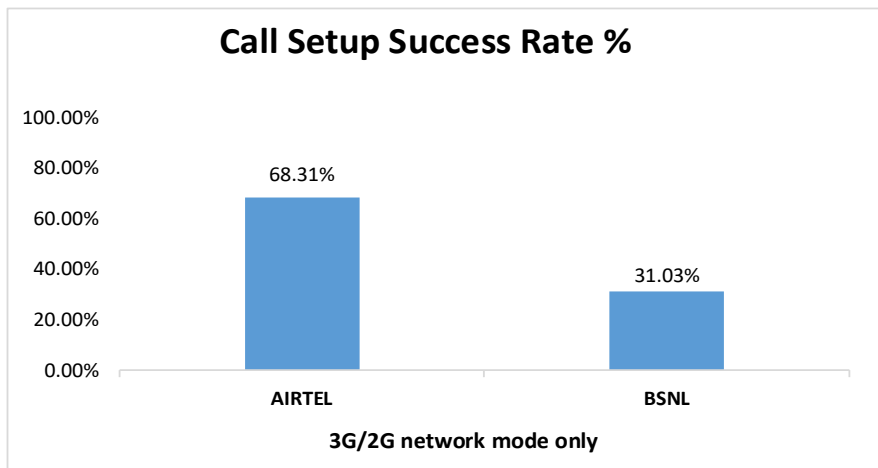


Figure-41: Performance for call setup success rate.

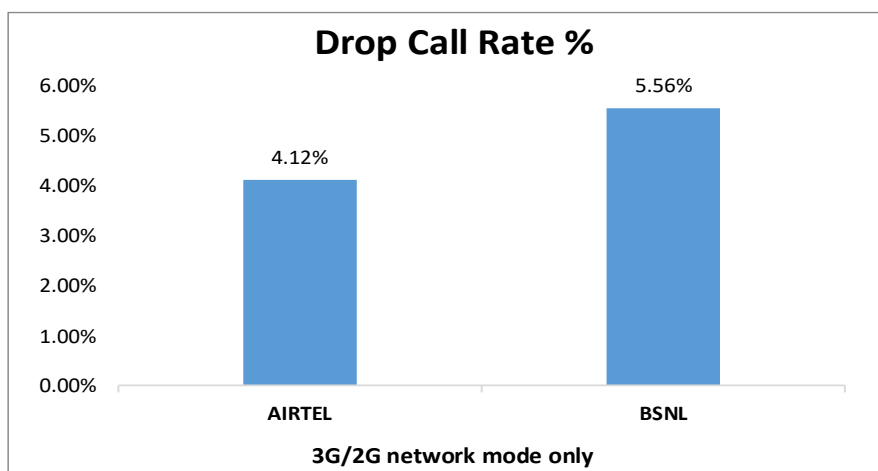


Figure-42: Performance for drop call rate.

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

Technology	Service Provider	
	AIRTEL	BSNL
3G	NA	37.60%
2G	93.13%	29.58%
Limited Service	6.87%	32.82%

Table-48: Time spent on technology during drive test 3G/2G network mode.

Note-

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

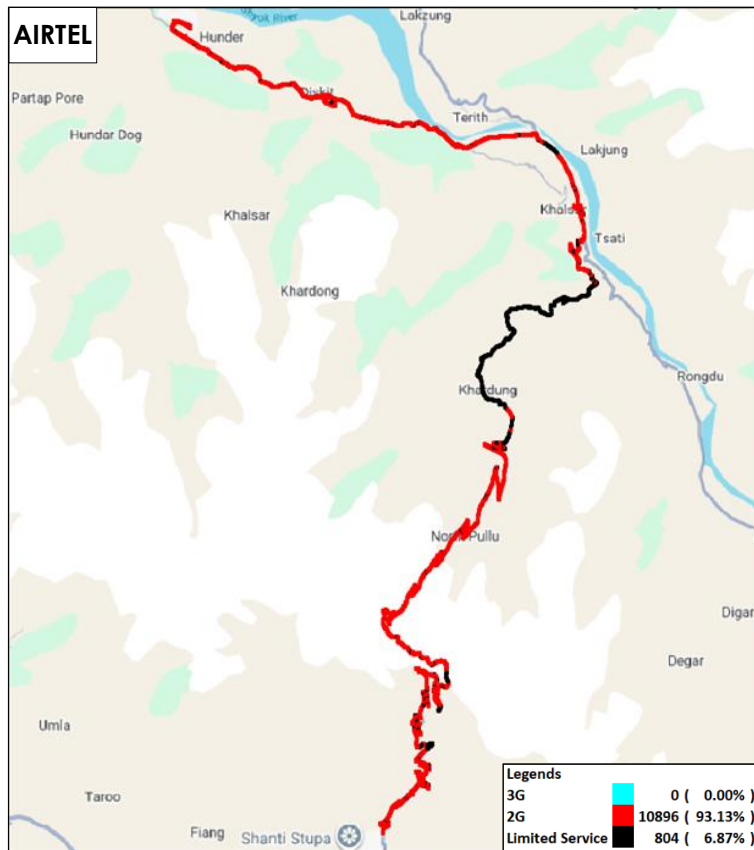


Figure-43: Serving technology plots 3G/2G network mode - AIRTEL.

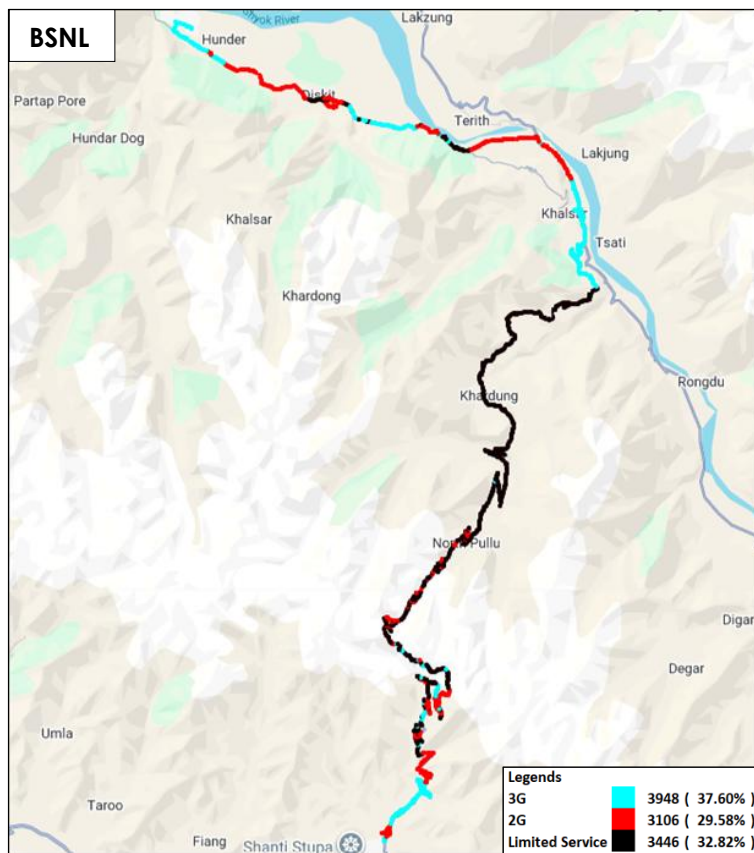


Figure-44: Serving technology plots 3G/2G network mode - BSNL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 147 & 148 for map view)

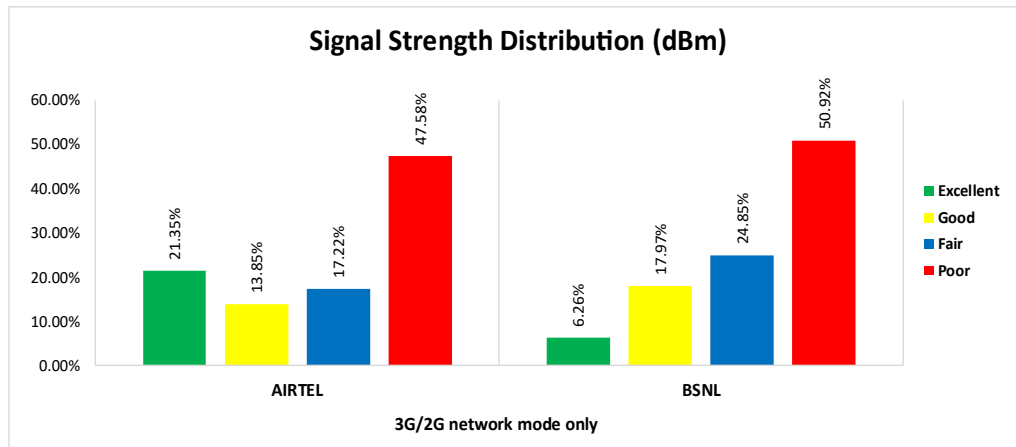


Figure-45: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 21% of samples falling in the excellent signal strength category.
- BSNL has 6% 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
Call Attempts	146	151	156
Call Setup Success Rate %	73.97	62.91	54.49
Drop Call Rate %	11.11	13.68	4.71
Call Setup Time-Average (Second)	2.54	5.40	1.26
Handover Success Rate %	100.00	100.00	99.79

Table-49: Summary of voice call performance in network auto-selection mode.

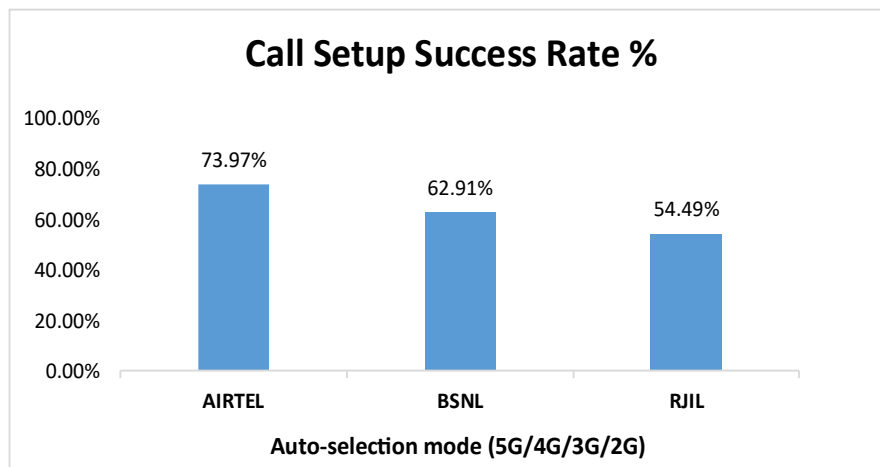


Figure-46: Performance for call setup success rate.

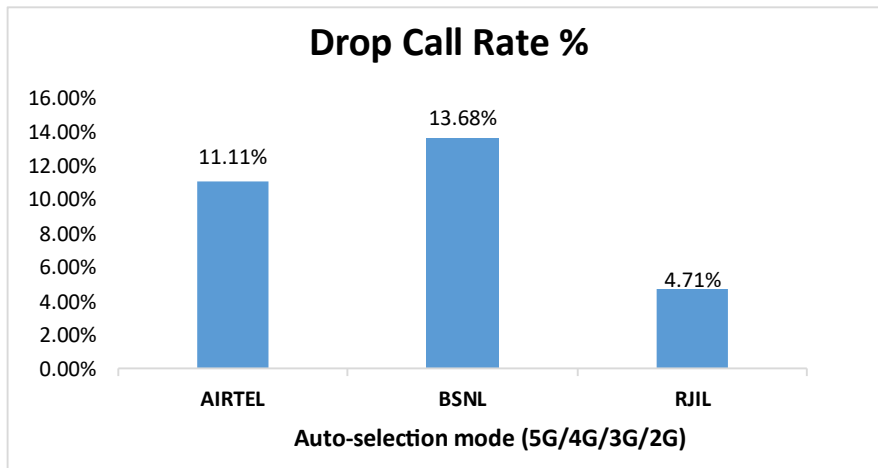


Figure-47: Performance for drop call rate.

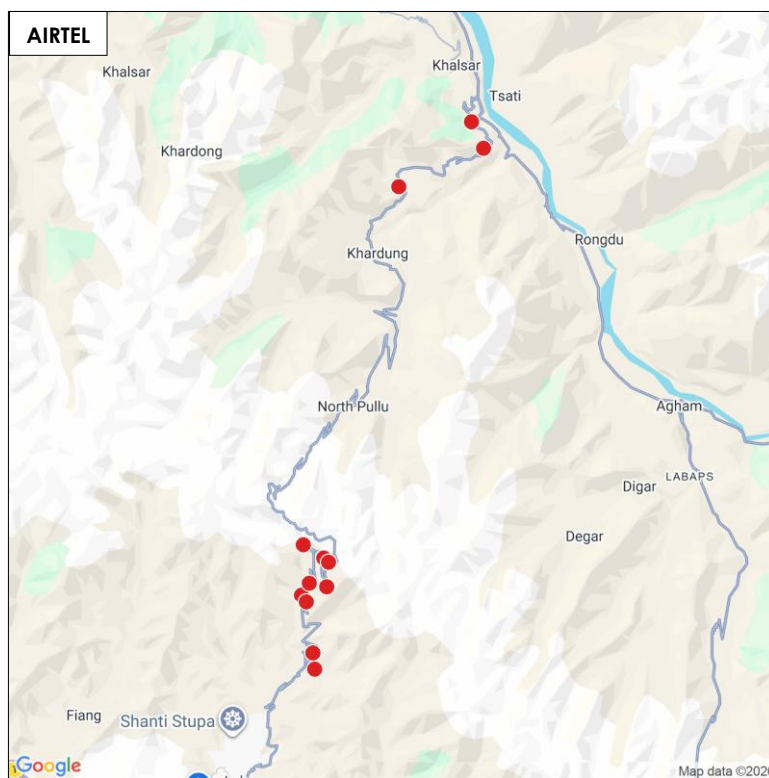


Figure-48: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

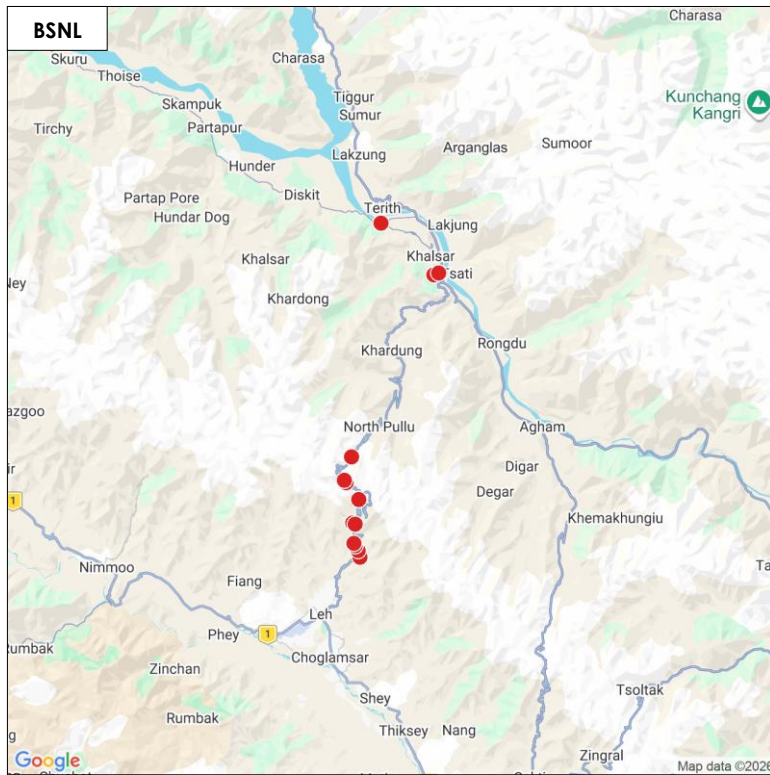


Figure-49: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

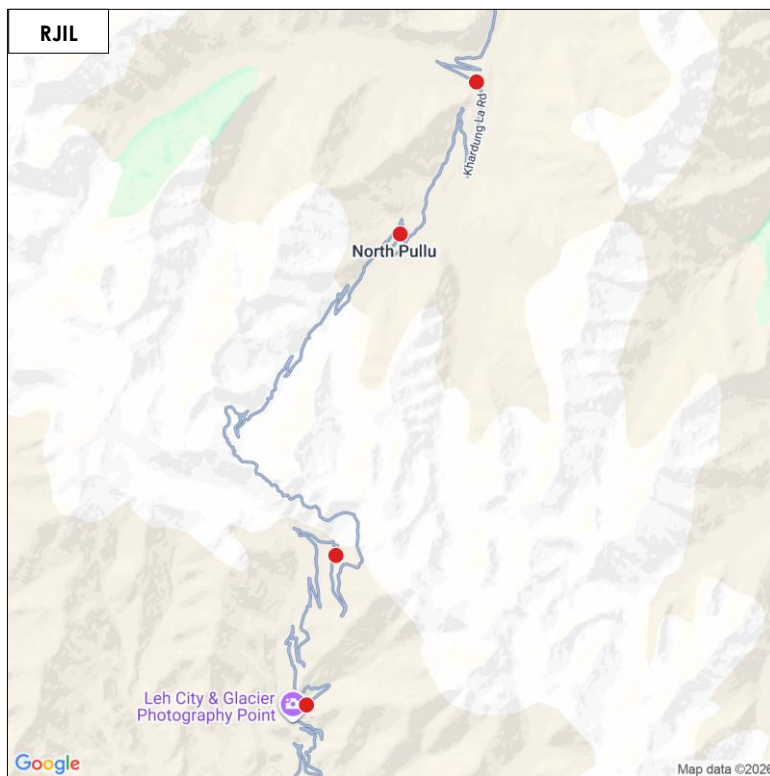


Figure-50: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

Parameter	Service Provider		
	Mobile-to-Mobile (5G/4G – Open Mode)		
	AIRTEL	BSNL	RJIL
Call Established (within service provider Network)	91	71	78
Number of silences call for >4 Sec	10	4	10
Silence Call Rate %	10.99	5.63	12.82
Number of silence instances for >4 Sec	13	4	11
Number of silence instances for >3 Sec	14	6	16
Number of silence instances for >2 sec	16	7	31
RTP Jitter (4G & 5G) in ms	5.93	5.98	16.52
Packet loss Rate Downlink %	4.83	6.02	11.57
Packet loss Rate Uplink %	5.11	2.65	11.23

Table-50: Summary of silence instances & packet loss rate for mobile to mobile call.

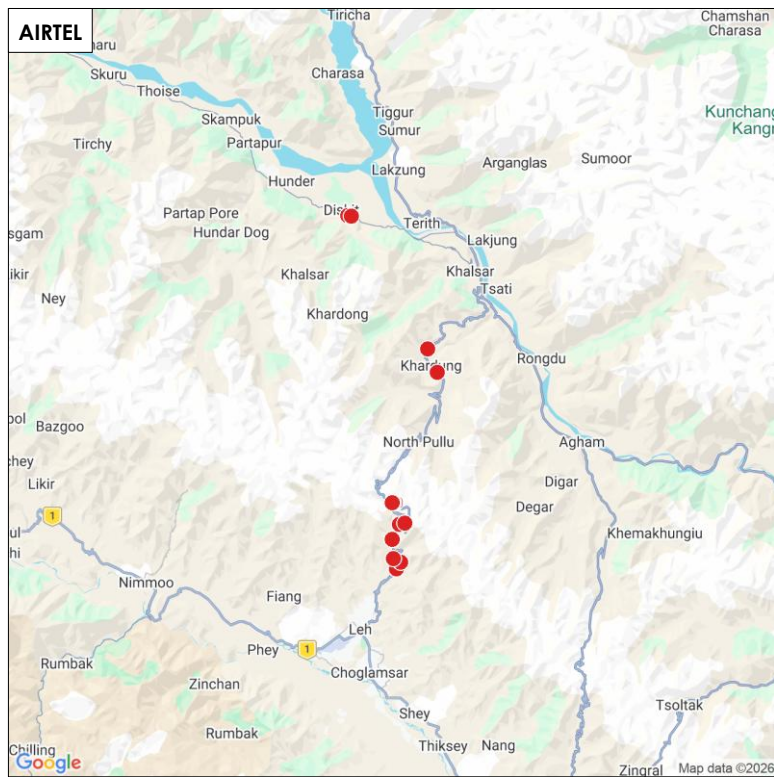


Figure-51: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - AIRTEL.

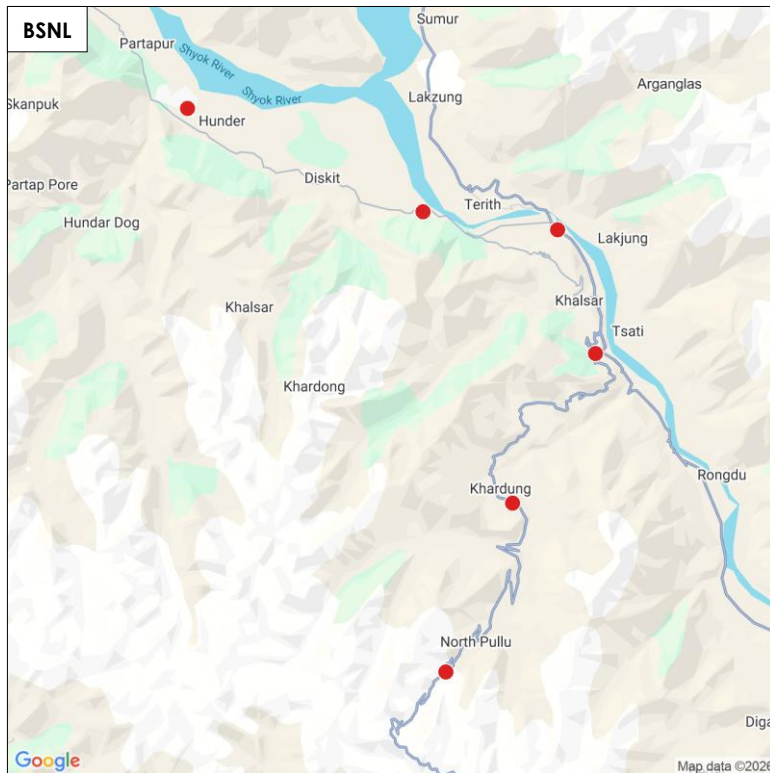


Figure-52: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - BSNL.

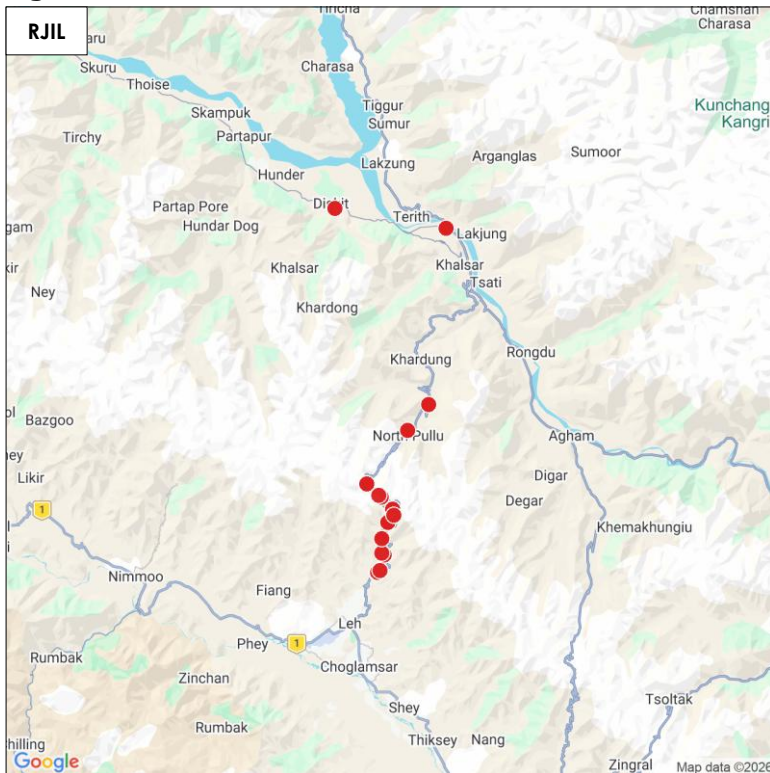


Figure-53: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - RJIL.

(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 value means: 5-Excellent, 4-Good, 3-Fair, 2-Poor, 1-Bad.

Speech Quality (MOS) distribution	Service Provider		
	AIRTEL	BSNL	RJIL
Total Number of MOS Samples for calls table-50	483	359	454
Speech Quality (Average MOS)	3.87	3.54	3.97
Number of samples with MOS ≥ 4 to < 5 (Excellent)	379	209	330
Number of samples with MOS ≥ 3 to < 4 (Good)	67	57	39
Number of samples with MOS ≥ 2 to < 3 (Fair)	12	54	20
Number of samples with MOS ≥ 1 to < 2 (Poor)	25	39	65
%age of samples with MOS ≥ 4 to < 5 (Excellent)	78.47%	58.22%	72.69%
%age of samples with MOS ≥ 3 to < 4 (Good)	13.87%	15.88%	8.59%
%age of samples with MOS ≥ 2 to < 3 (Fair)	2.48%	15.04%	4.41%
%age of samples with MOS ≥ 1 to < 2 (Poor)	5.18%	10.86%	14.32%

Table-51: Summary of speech quality (MOS) samples.

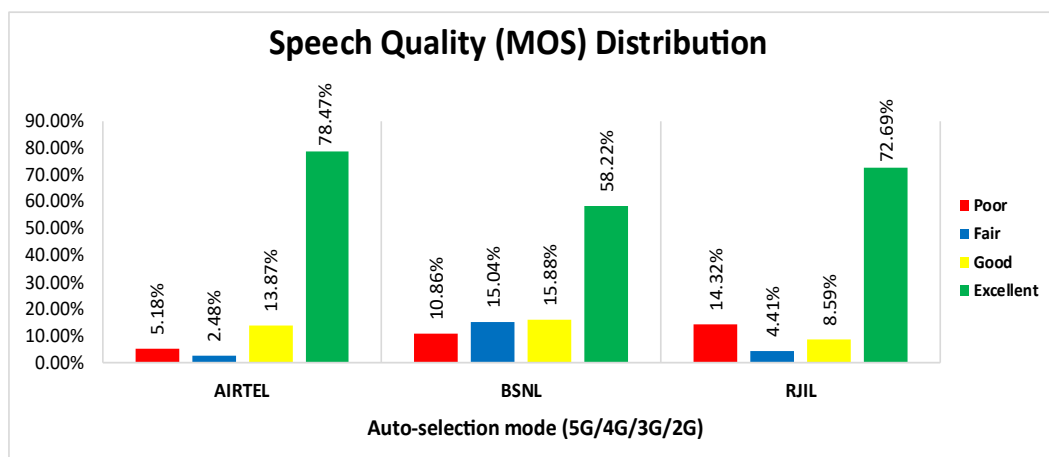


Figure-54: Distribution of samples in MOS range.

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

Technology	Service Provider		
	AIRTEL	BSNL	RJIL
5G	2.69%	NA	18.14%
4G	84.12%	78.24%	58.97%
3G	NA	2.09%	NA
2G	2.57%	10.57%	NA
Limited Service	10.63%	9.09%	22.89%

Table-52: 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.

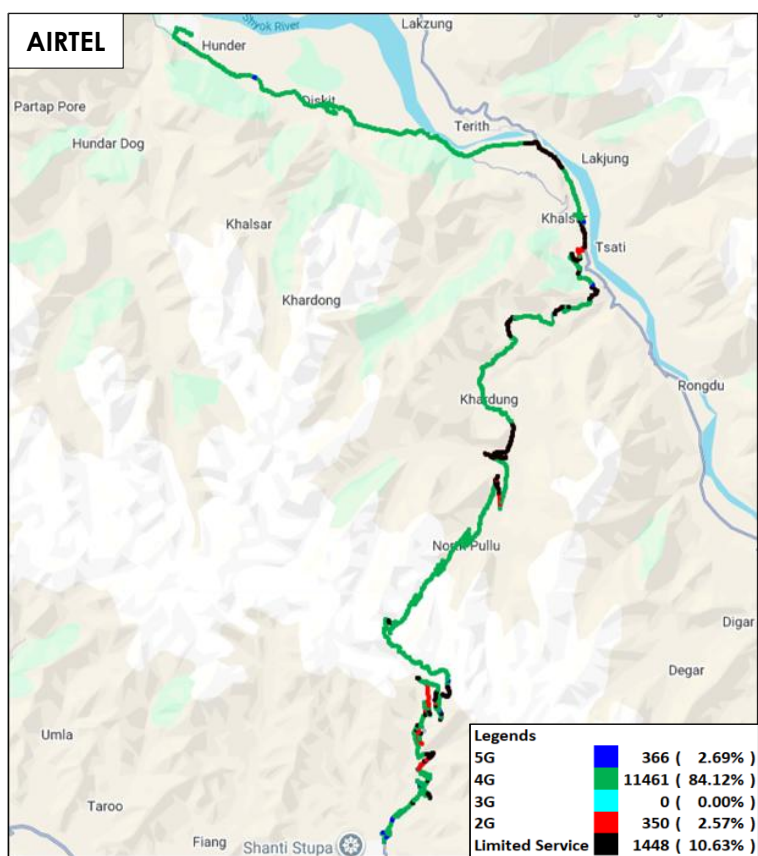


Figure-55: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

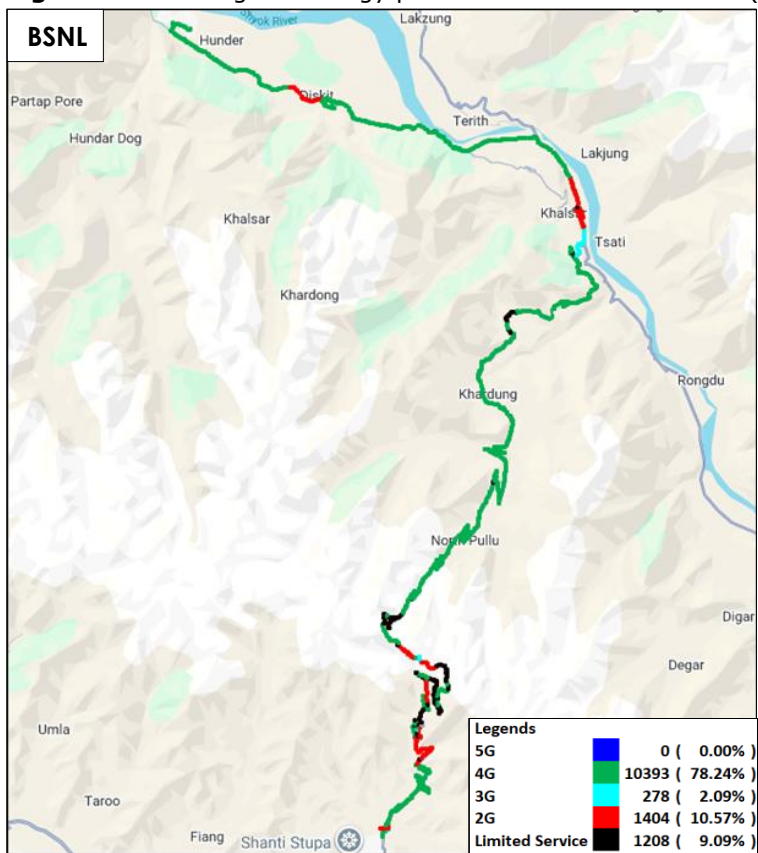


Figure-56: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

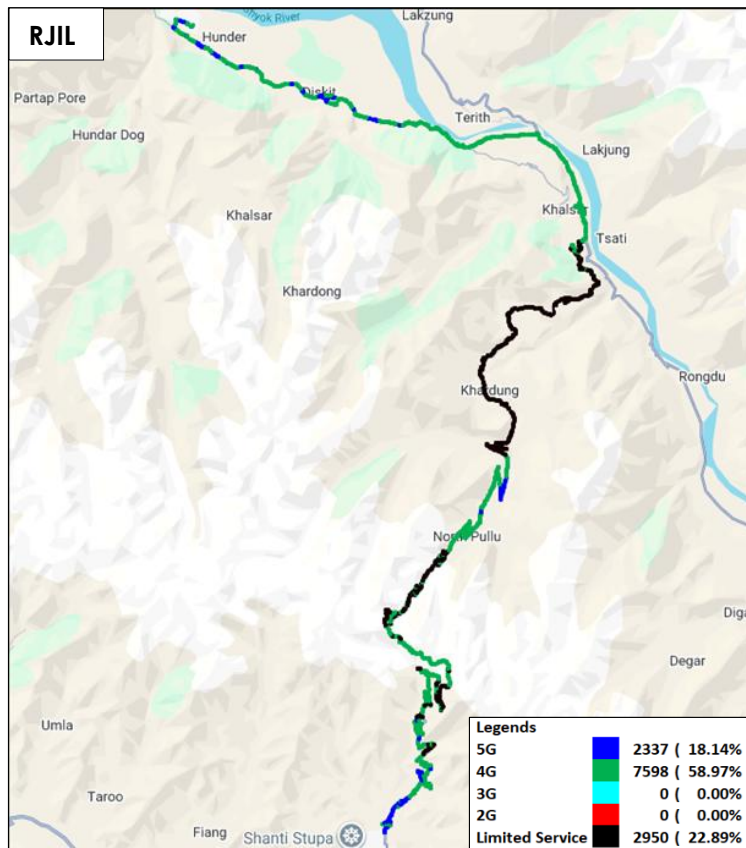


Figure-57: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

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

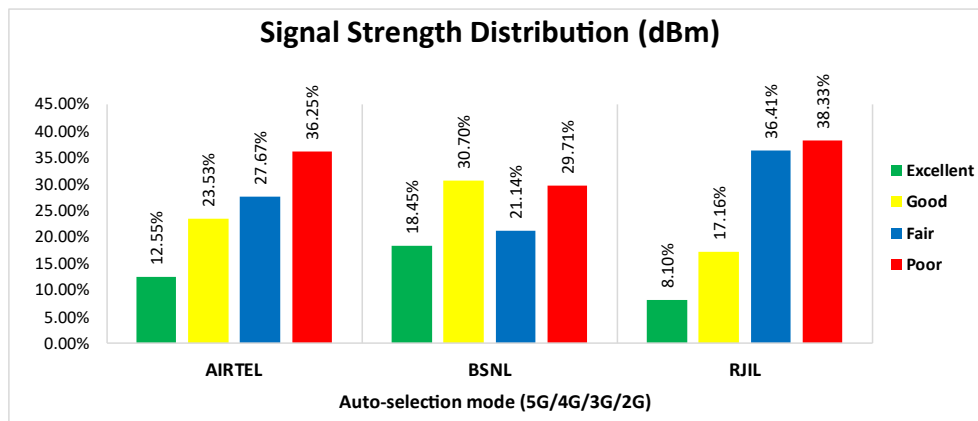


Figure-58: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 13% of samples falling in the excellent signal strength category.
- BSNL has 18% of samples falling in the excellent signal strength category.
- RJIL has 8% of samples falling in the excellent signal strength category.

(h) Coverage Gap observed

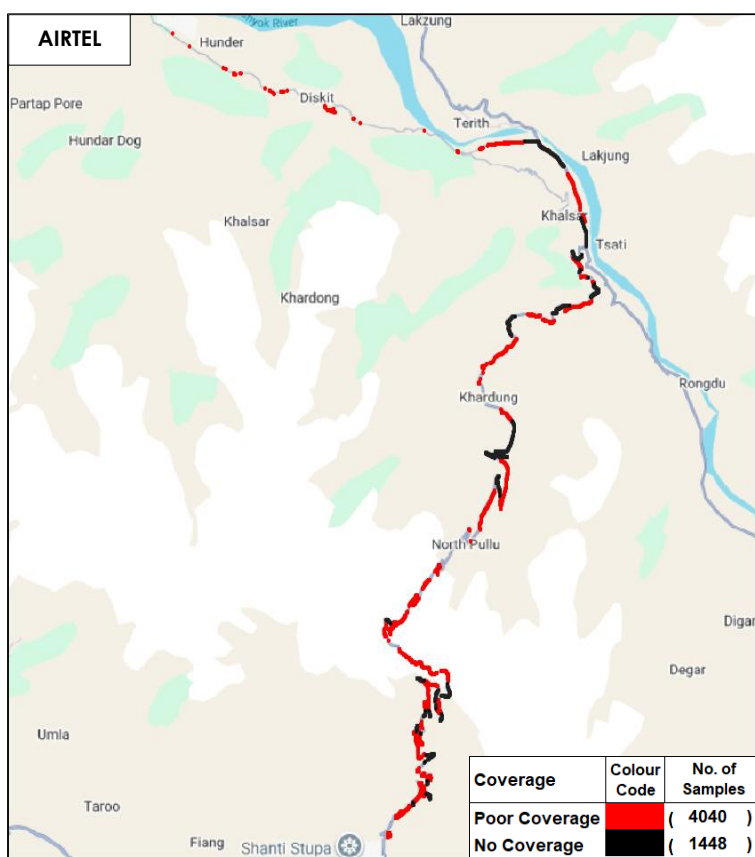


Figure-59: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-AIRTEL.

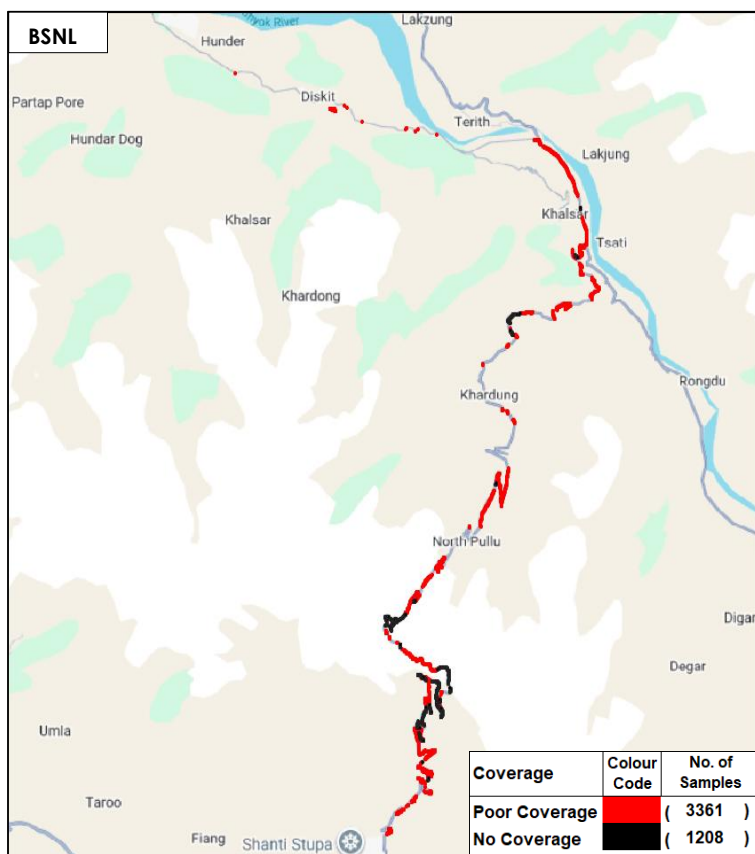


Figure-60: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-BSNL.

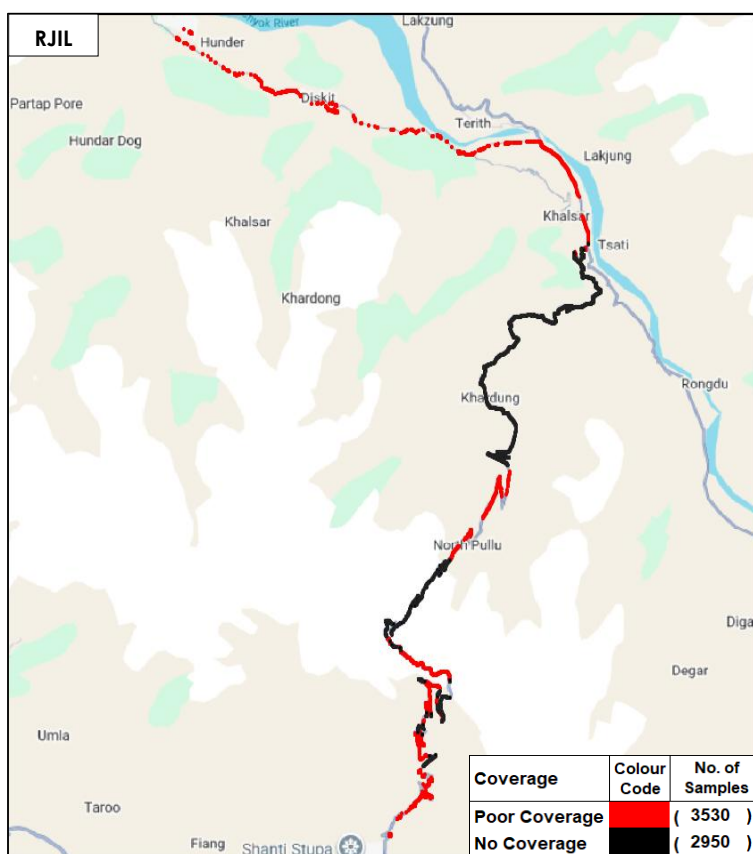


Figure-61: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-RJIL.

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
Download Throughput (Mbits/s)	Average	109.57	16.39	122.16
	80 th Percentile	203.46	26.84	97.26
	20 th Percentile	11.15	3.88	1.27
Upload Throughput (Mbits/s)	Average	14.21	7.81	12.02
	80 th Percentile	27.15	16.79	9.15
	20 th Percentile	1.55	1.52	1.02
Latency (ms)	50 th Percentile	55.36	32.55	39.82

Table-53: Summary of Data performance in network auto-selection mode.

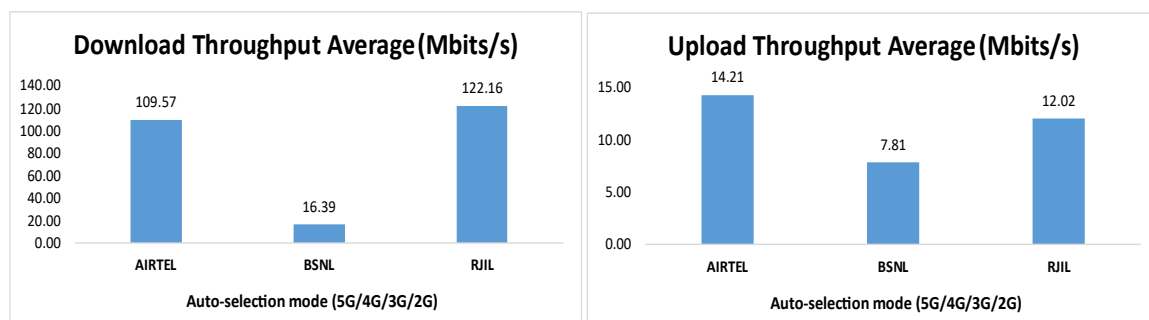


Figure- 62: Download & Upload throughput.

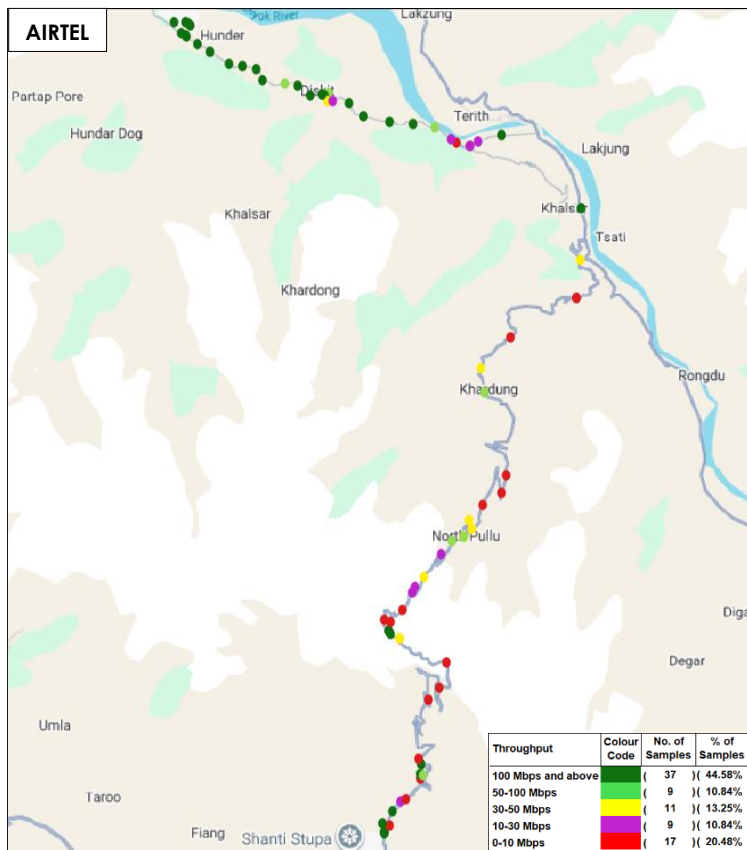


Figure-63: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

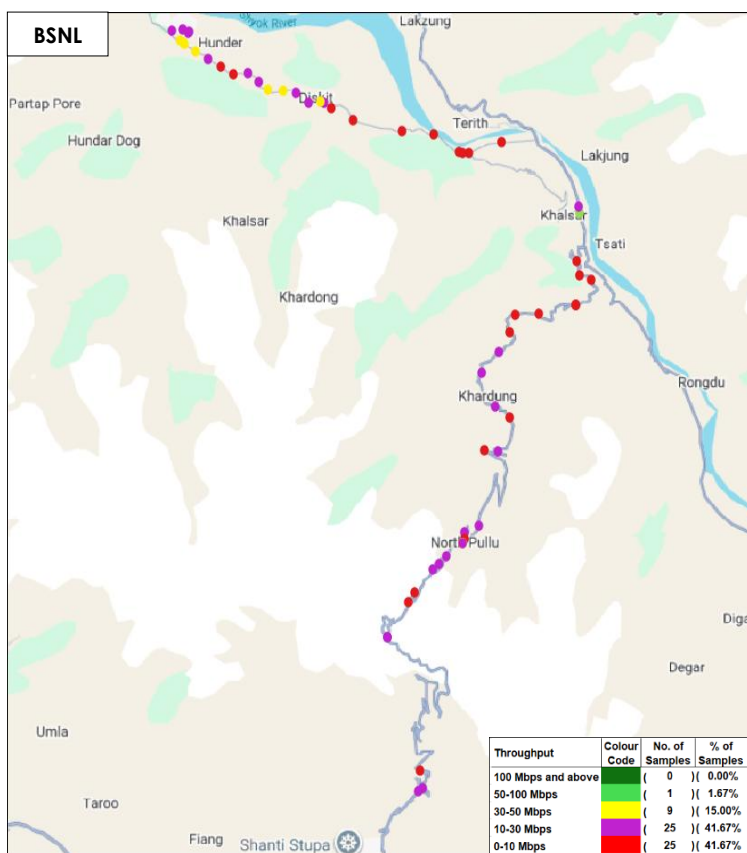


Figure-64: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

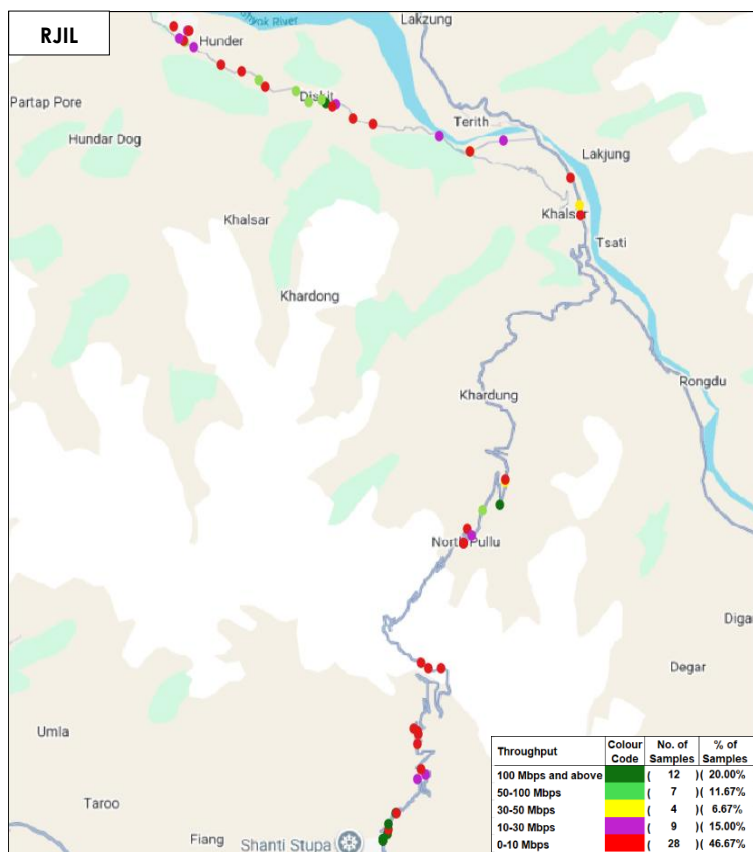


Figure-65: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

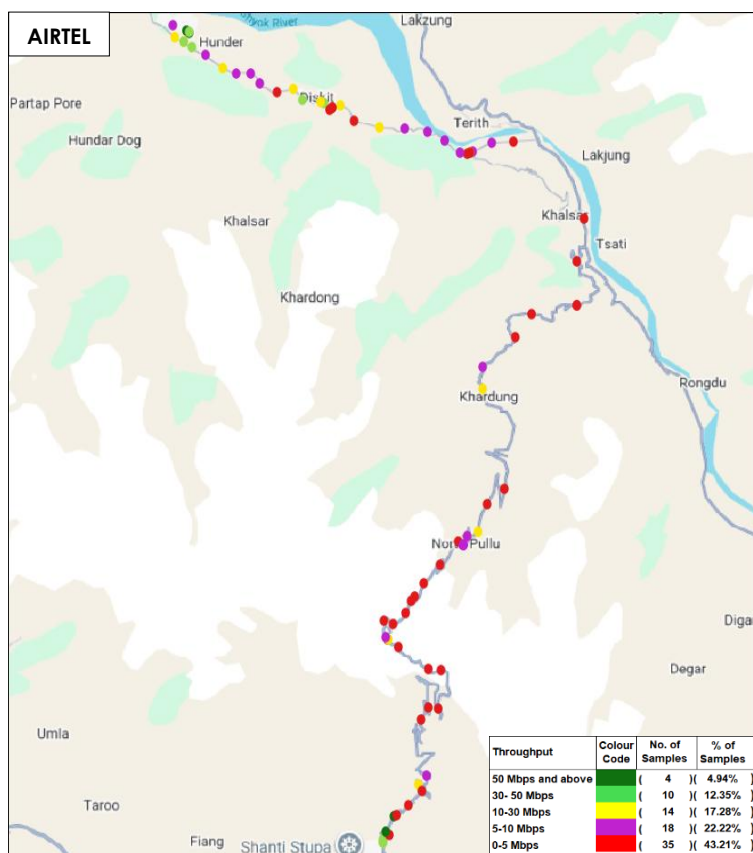


Figure-66: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

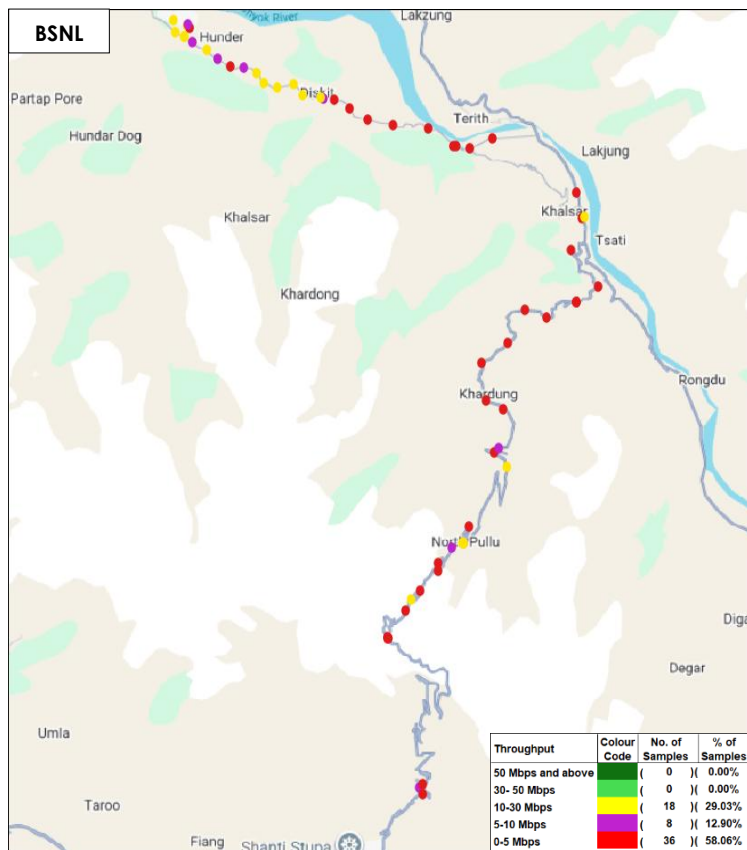


Figure-67: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

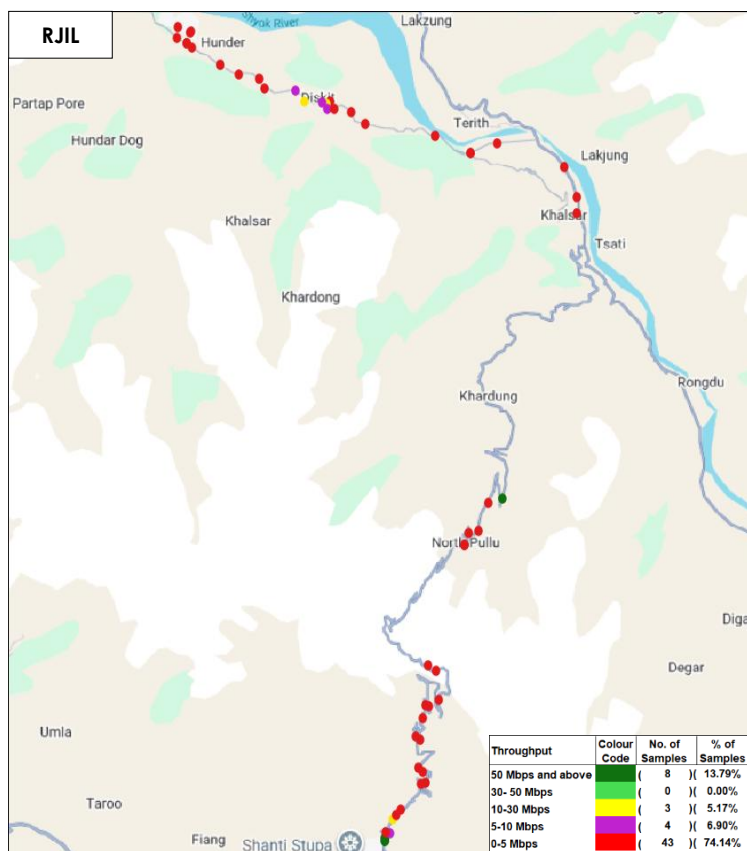


Figure-68: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

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

Technology	Service Provider		
	AIRTEL	BSNL	RJIL
5G	32.11%	NA	21.70%
4G	53.83%	73.79%	53.52%
3G	NA	6.02%	NA
2G	1.80%	1.52%	NA
Limited Service	12.26%	18.67%	24.78%

Table-54: 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.

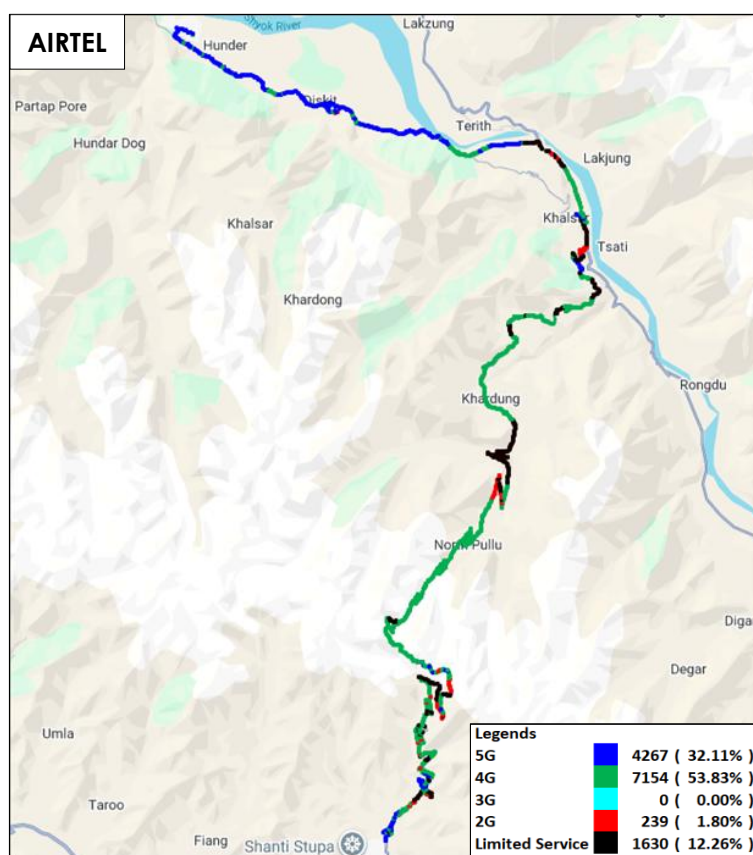


Figure-69: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

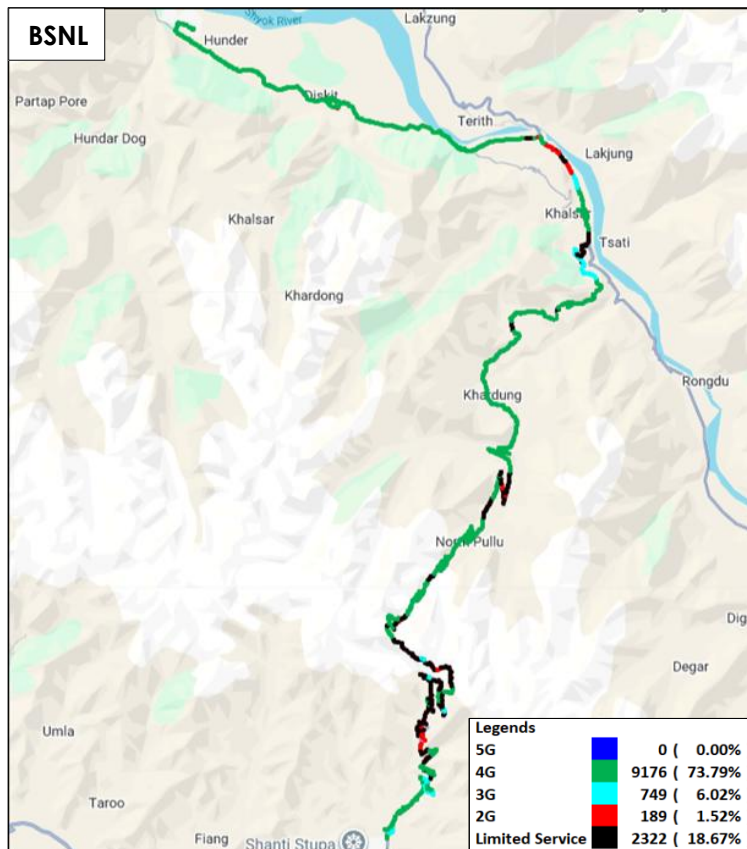


Figure-70: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - BSNL.

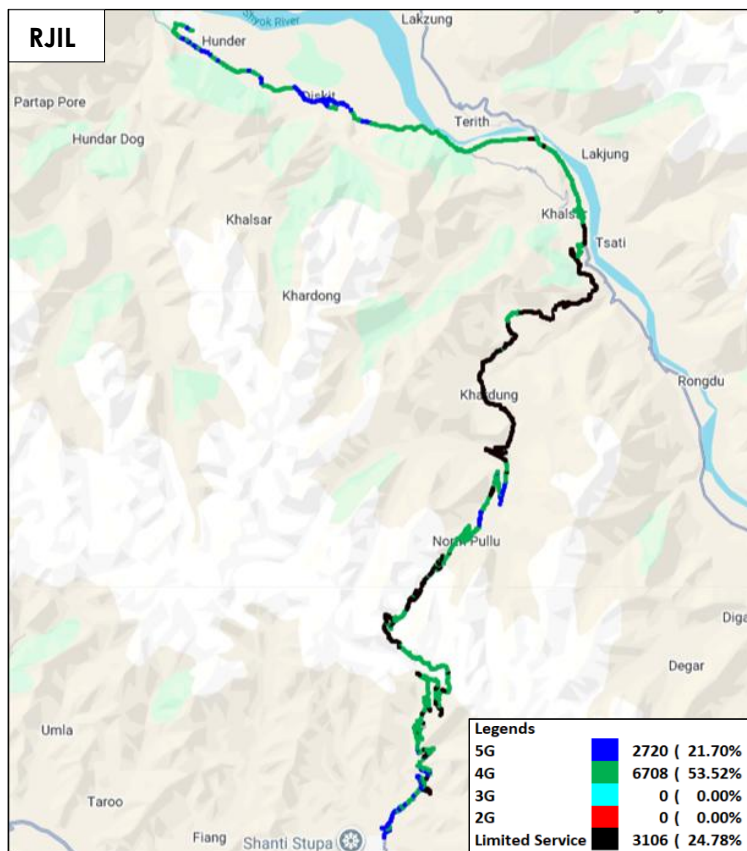


Figure-71: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - RJIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-152, 153 & 154 for map view)

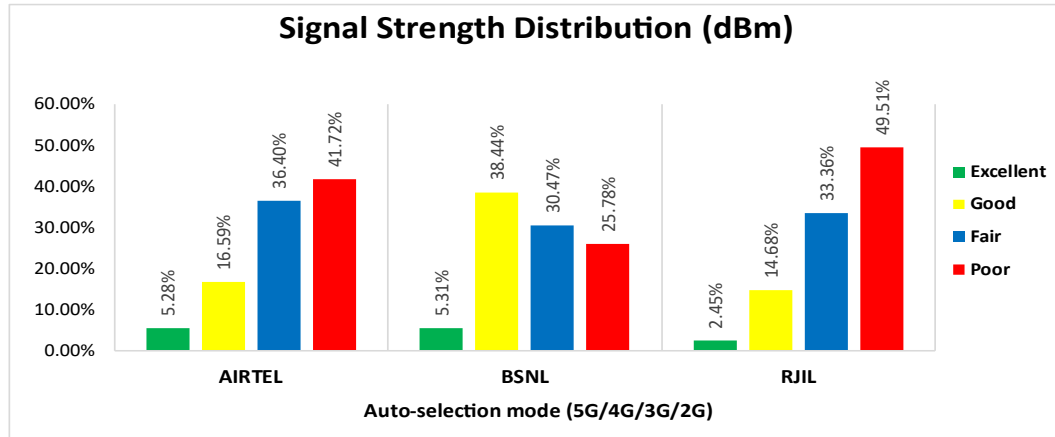


Figure-72: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

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

4.5.2 Nubra Valley to Pangong

4.5.2.1 Drive test route



Figure- 73: Drive test routes.

4.5.2.2 Areas covered

Tsati, Agham, Sakti, Zingral, Tsoltak, Tangtse, Muglib, Spangmik and Pangong beach 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 Only	
	AIRTEL	BSNL
Call Attempts	219	293
Call Setup Success Rate %	24.20	8.19
Drop Call Rate%	5.66	50.00
Call Setup Time-Average (Second)	4.05	5.63
Handover Success Rate %	100.00	100.00

Table-55: Summary of voice call performance in 3G/2G network mode only.

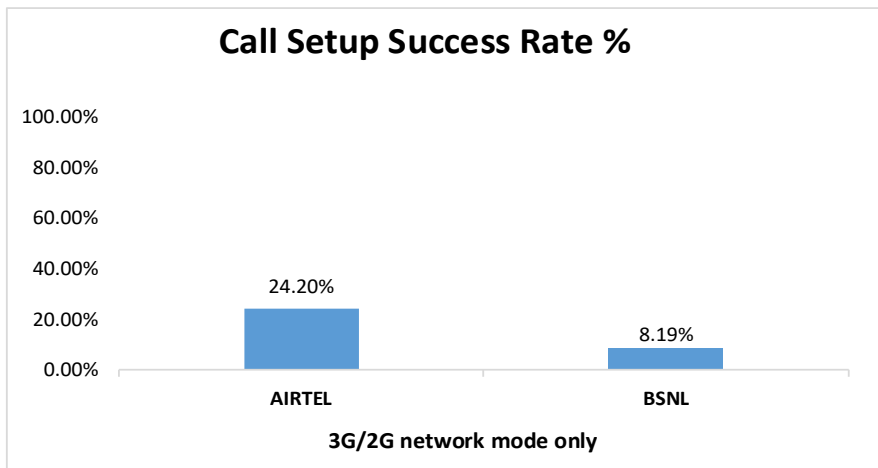


Figure-74: Performance for call setup success rate.

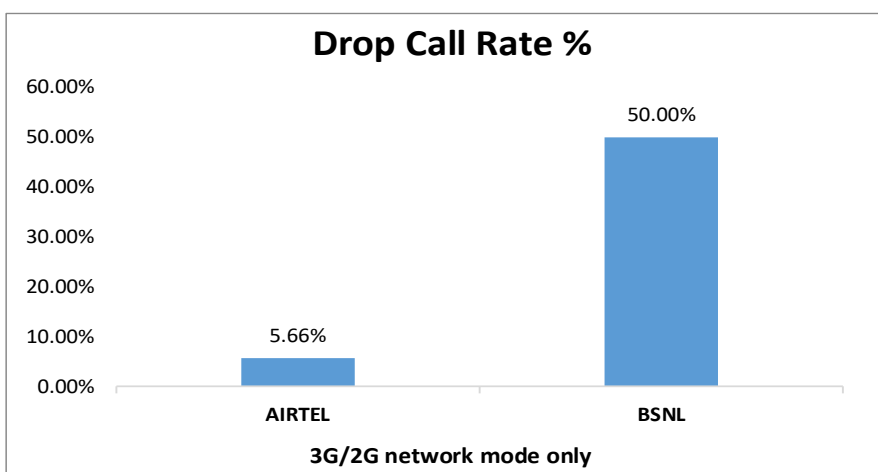


Figure-75: Performance for drop call rate.

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

Technology	Service Provider	
	AIRTEL	BSNL
3G	NA	41.37%
2G	90.73%	17.86%
Limited Service	9.27%	40.77%

Table-56: Time spent on technology during drive test 3G/2G network mode.

Note-

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

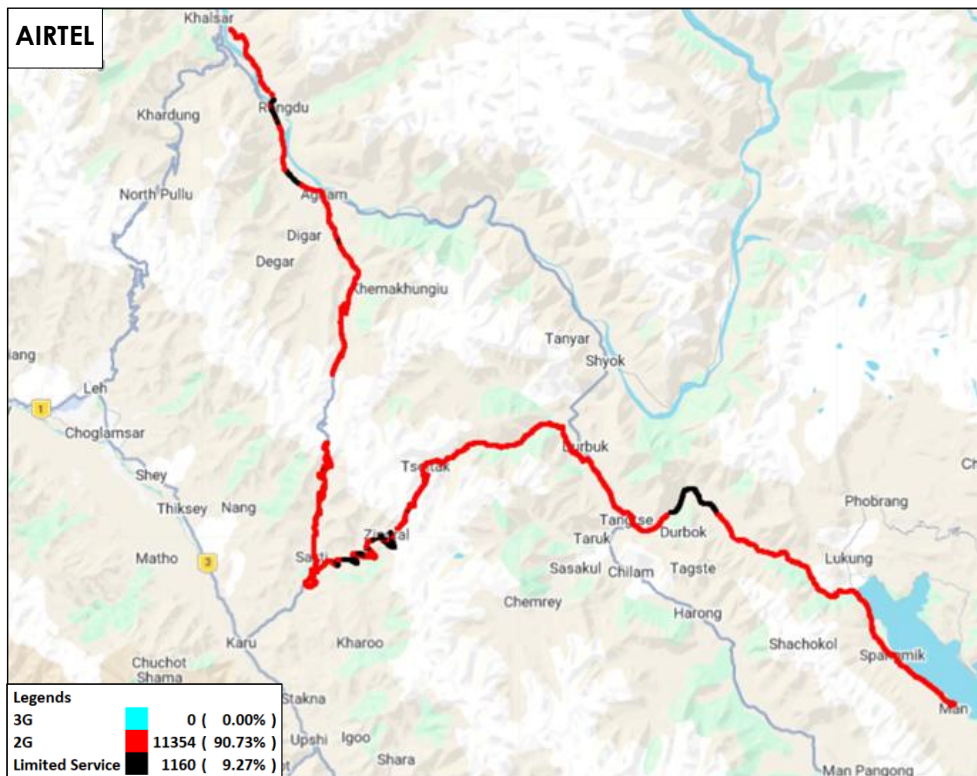


Figure-76: Serving technology plots 3G/2G network mode - AIRTEL.

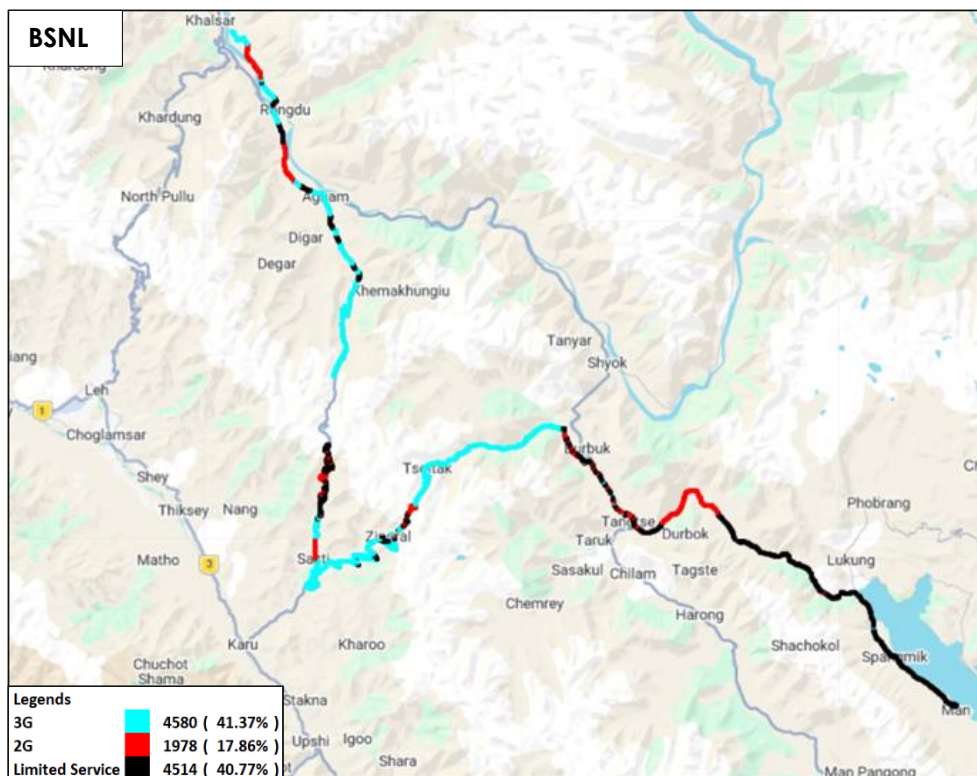


Figure-77: Serving technology plots 3G/2G network mode - BSNL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 155 & 156 for map view)

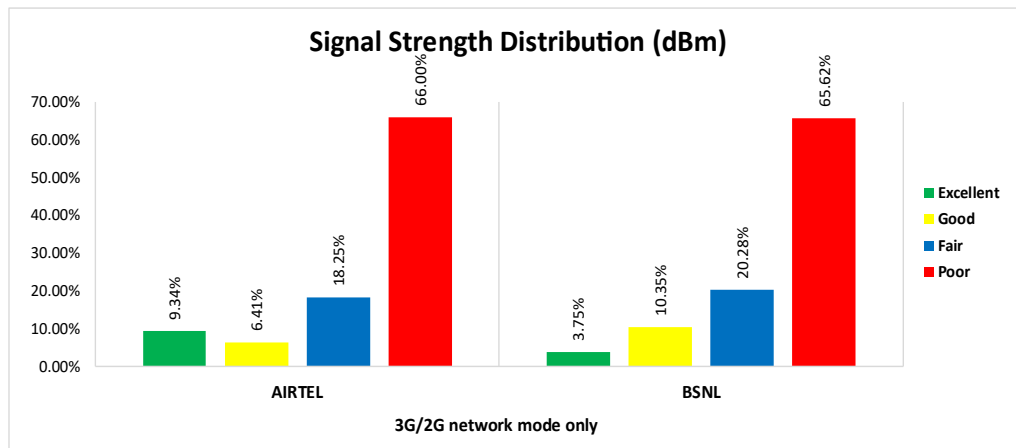


Figure-78: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 9% of samples falling in the excellent signal strength category.
- BSNL has 4% 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
Call Attempts	250	273	263
Call Setup Success Rate %	26.80	23.44	22.81
Drop Call Rate %	16.42	26.56	26.67
Call Setup Time-Average (Second)	2.11	5.60	1.82
Handover Success Rate %	100.00	100.00	99.81

Table-57: Summary of voice call performance in network auto-selection mode.

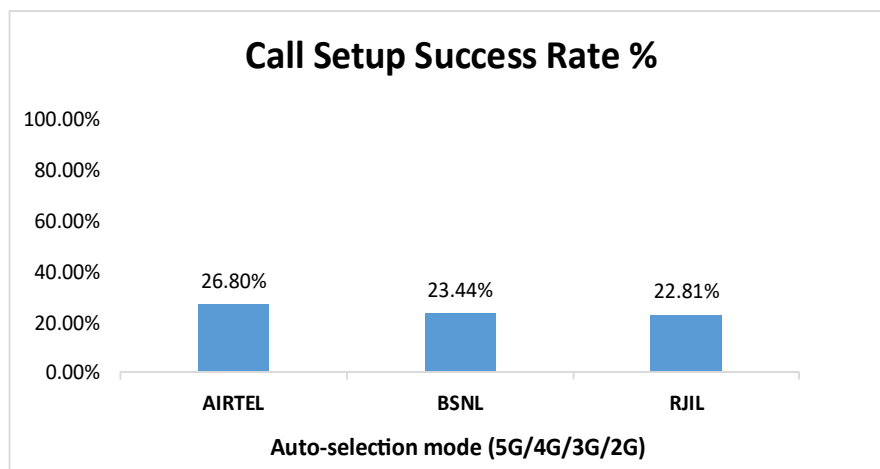


Figure-79: Performance for call setup success rate.

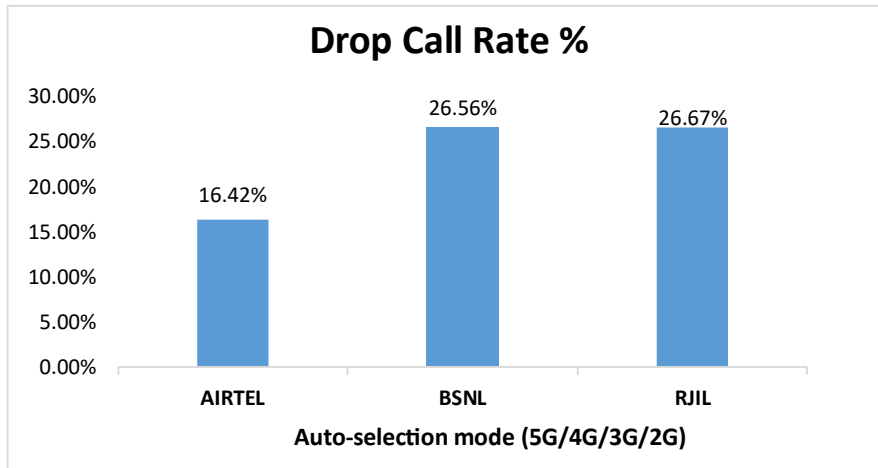


Figure-80: Performance for drop call rate.

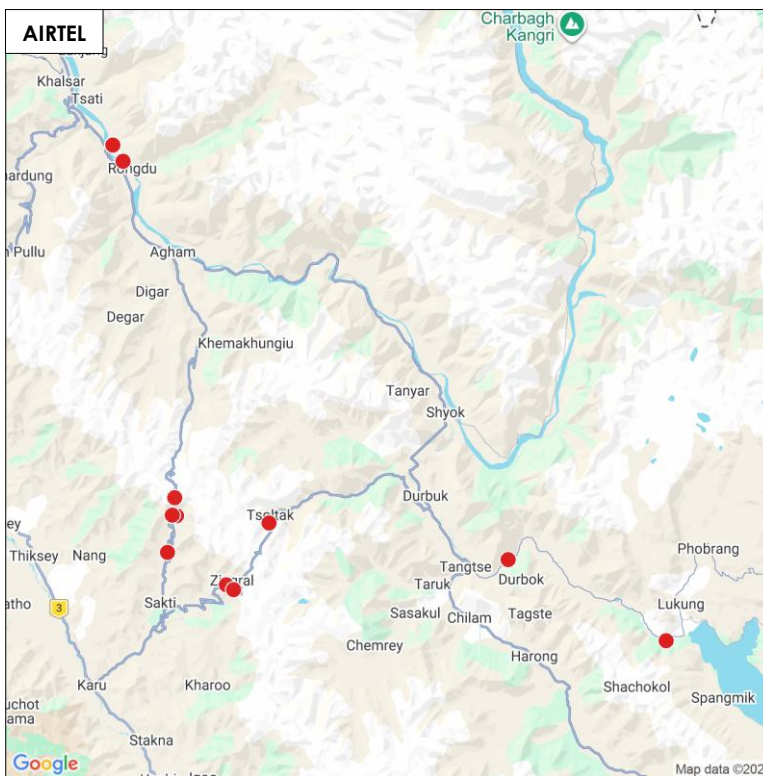


Figure-81: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

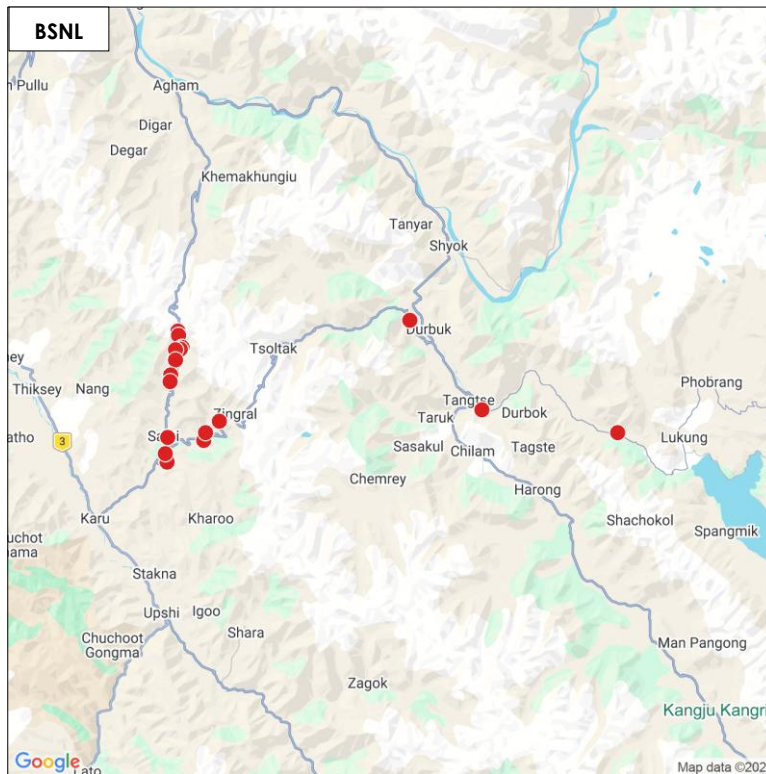


Figure-82: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

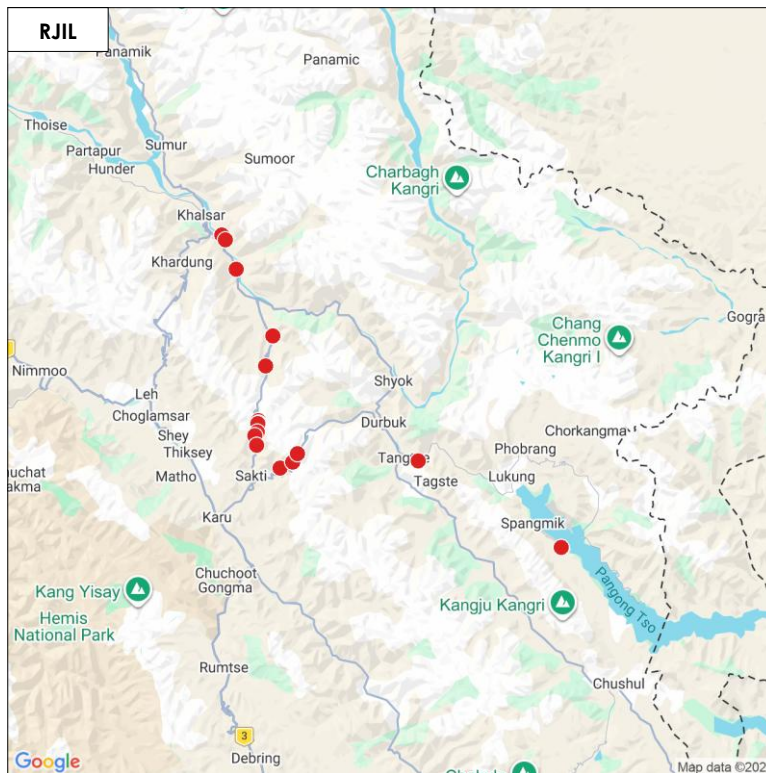


Figure-83: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

Parameter	Service Provider		
	Mobile-to-Mobile (5G/4G – Open Mode)		
	AIRTEL	BSNL	RJIL
Call Established (within service provider Network)	66	59	52
Number of silences call for >4 Sec	13	7	11
Silence Call Rate %	19.70	11.86	21.15
Number of silence instances for >4 Sec	15	10	15
Number of silence instances for >3 Sec	18	16	24
Number of silence instances for >2 sec	26	24	42
RTP Jitter (4G & 5G) in ms	9.29	6.25	17.55
Packet loss Rate Downlink %	4.98	9.12	16.27
Packet loss Rate Uplink %	3.75	6.43	12.33

Table-58: Summary of silence instances & packet loss rate for mobile to mobile call.

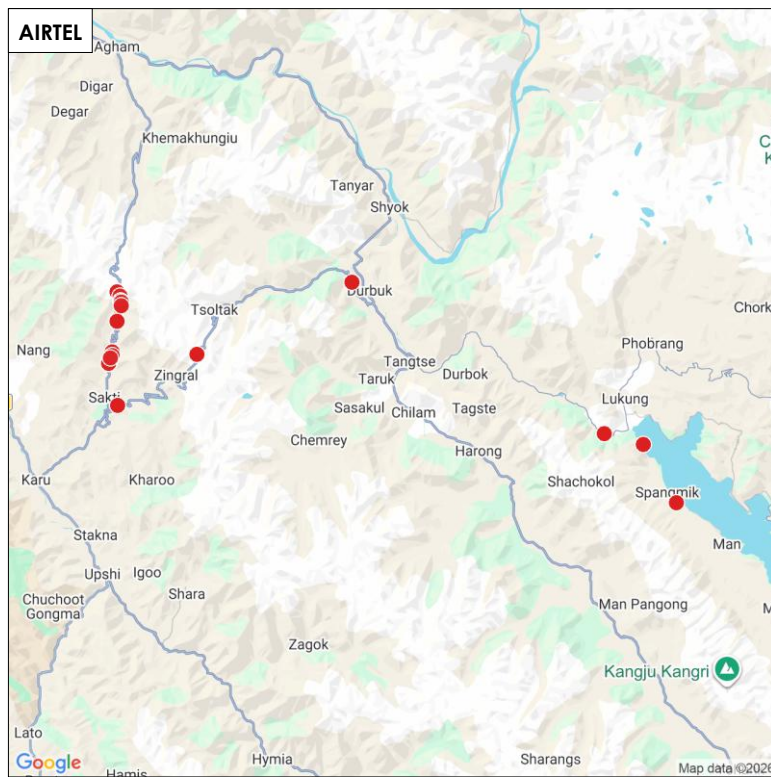


Figure-84: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - AIRTEL.

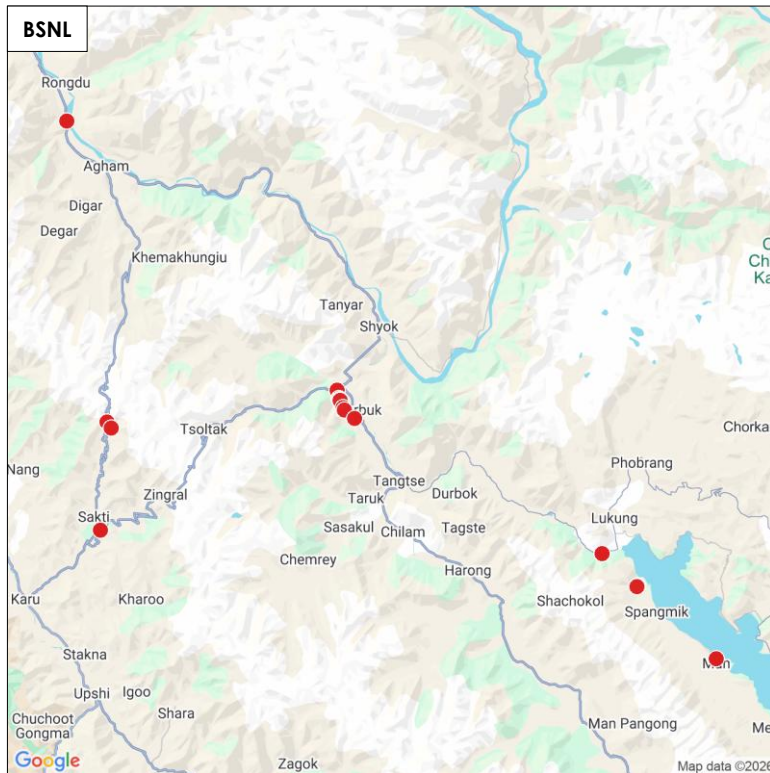


Figure-85: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - BSNL.

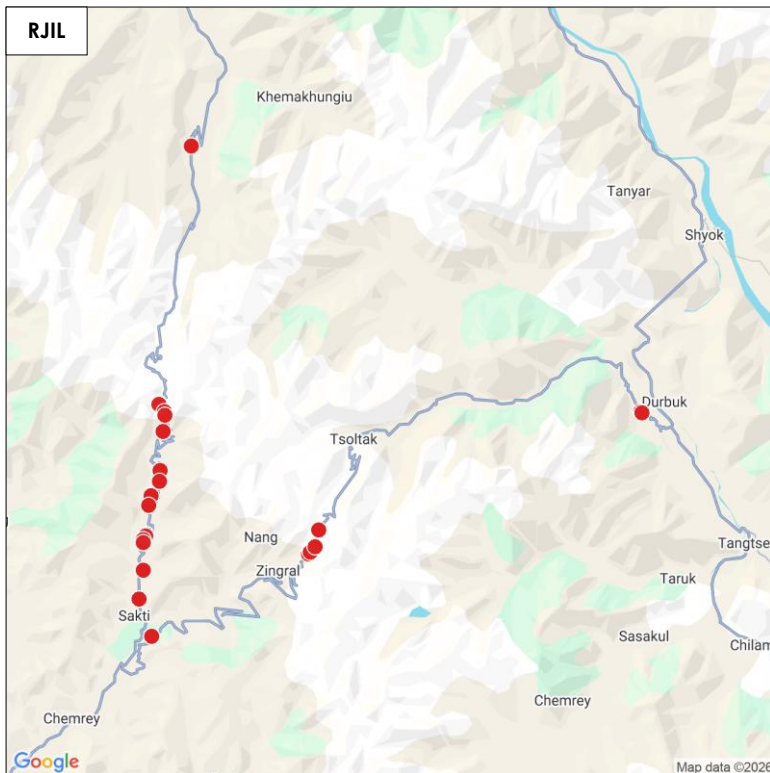


Figure-86: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - RJIL.

(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 value means: 5-Excellent, 4-Good, 3-Fair, 2-Poor, 1-Bad.

Speech Quality (MOS) distribution	Service Provider		
	AIRTEL	BSNL	RJIL
Total Number of MOS Samples for calls table-58	739	581	505
Speech Quality (Average MOS)	3.71	3.62	3.51
Number of samples with MOS ≥ 4 to <5 (Excellent)	475	352	294
Number of samples with MOS ≥ 3 to <4 (Good)	156	93	49
Number of samples with MOS ≥ 2 to <3 (Fair)	59	71	32
Number of samples with MOS ≥ 1 to <2 (Poor)	49	65	130
%age of samples with MOS ≥ 4 to <5 (Excellent)	64.28%	60.59%	58.22%
%age of samples with MOS ≥ 3 to <4 (Good)	21.11%	16.01%	9.70%
%age of samples with MOS ≥ 2 to <3 (Fair)	7.98%	12.22%	6.34%
%age of samples with MOS ≥ 1 to <2 (Poor)	6.63%	11.19%	25.74%

Table-59: Summary of speech quality (MOS) samples.

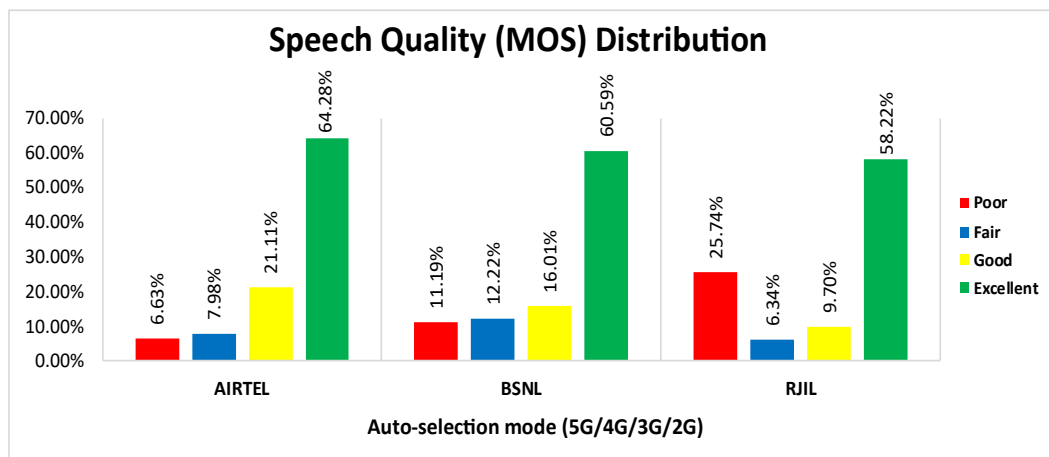


Figure-87: Distribution of samples in MOS range.

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

Technology	Service Provider		
	AIRTEL	BSNL	RJIL
5G	0.72%	NA	1.86%
4G	76.29%	70.50%	67.48%
3G	NA	10.88%	NA
2G	0.25%	0.10%	NA
Limited Service	22.74%	18.51%	30.66%

Table-60: 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.

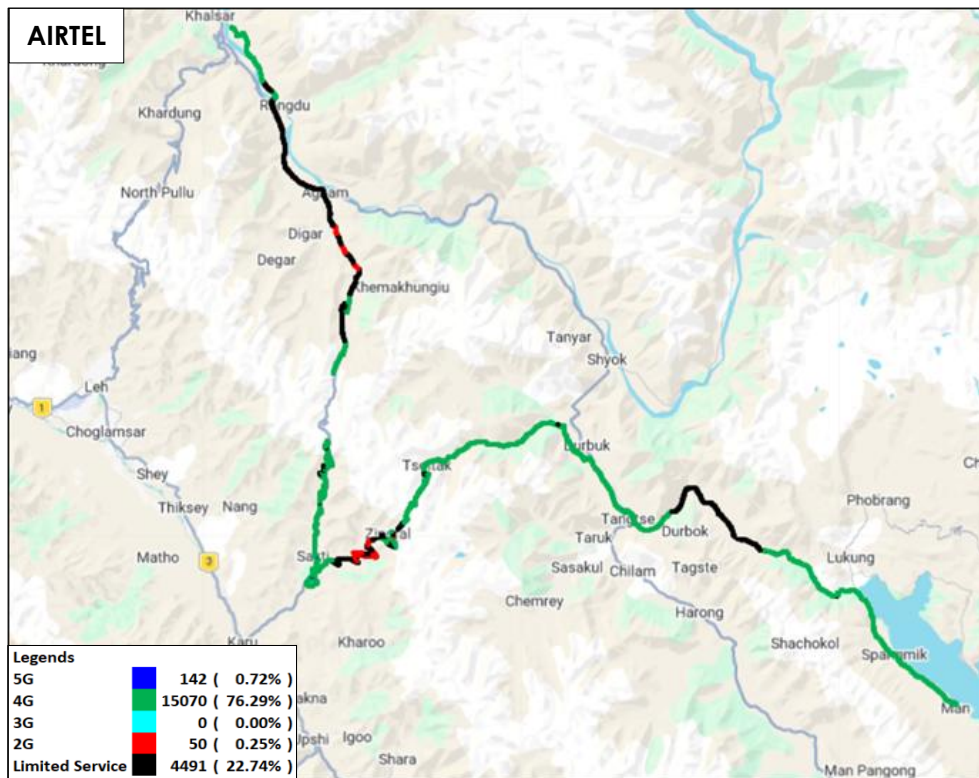


Figure-88: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

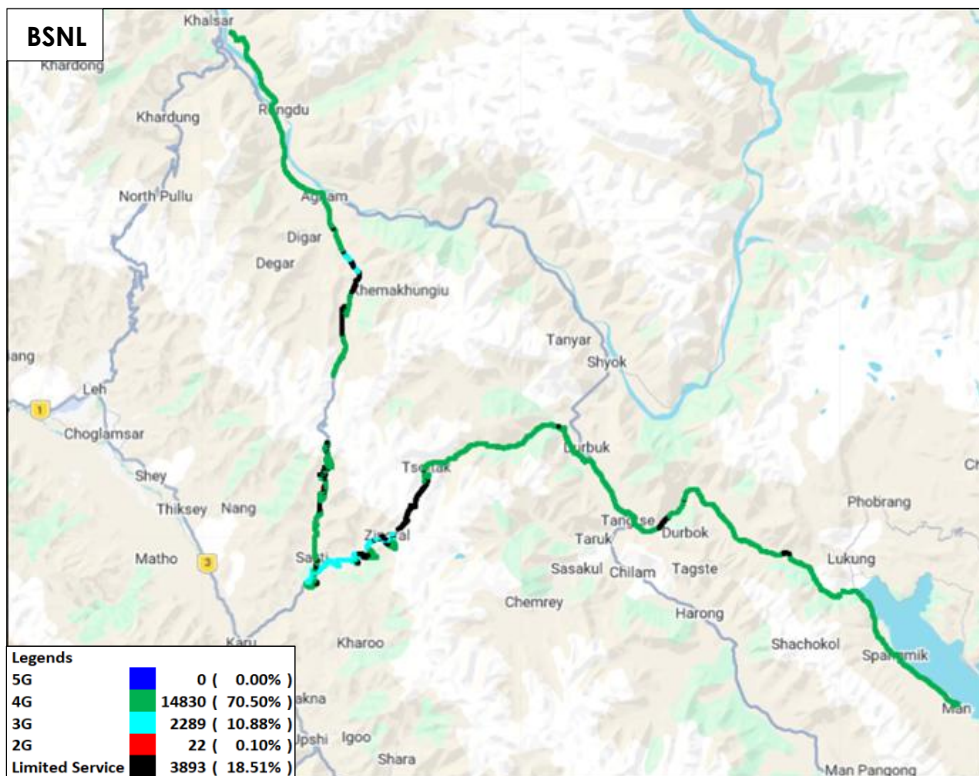


Figure-89: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

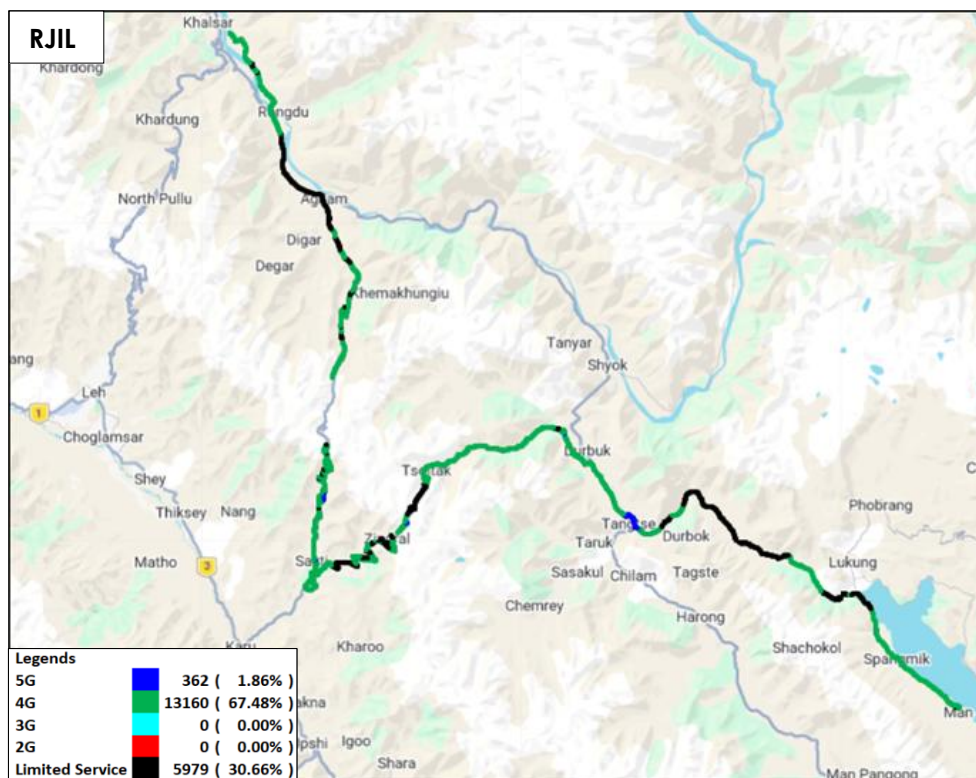


Figure-90: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-157, 158 & 159 for map view)

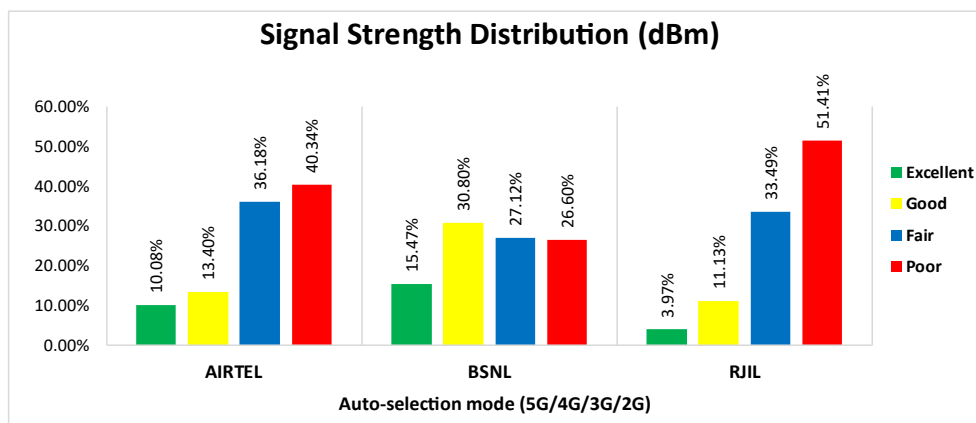


Figure-91: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 10% of samples falling in the excellent signal strength category.
- BSNL has 15% of samples falling in the excellent signal strength category.
- RJIL has 4% of samples falling in the excellent signal strength category.

(h) Coverage Gap observed

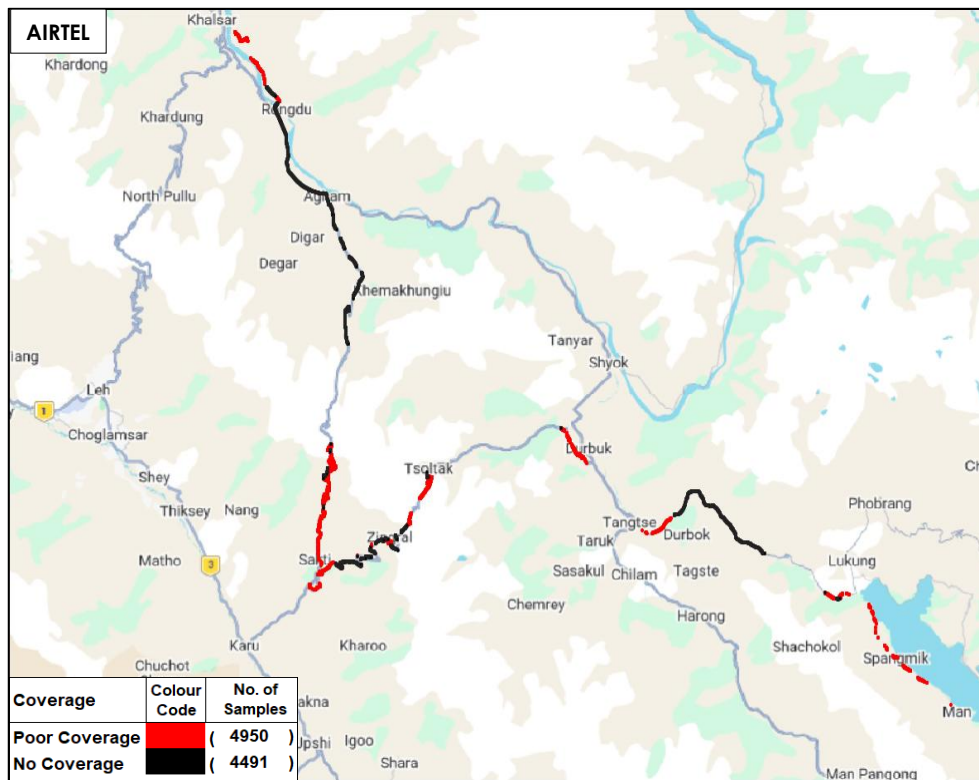


Figure-92: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-AIRTEL.

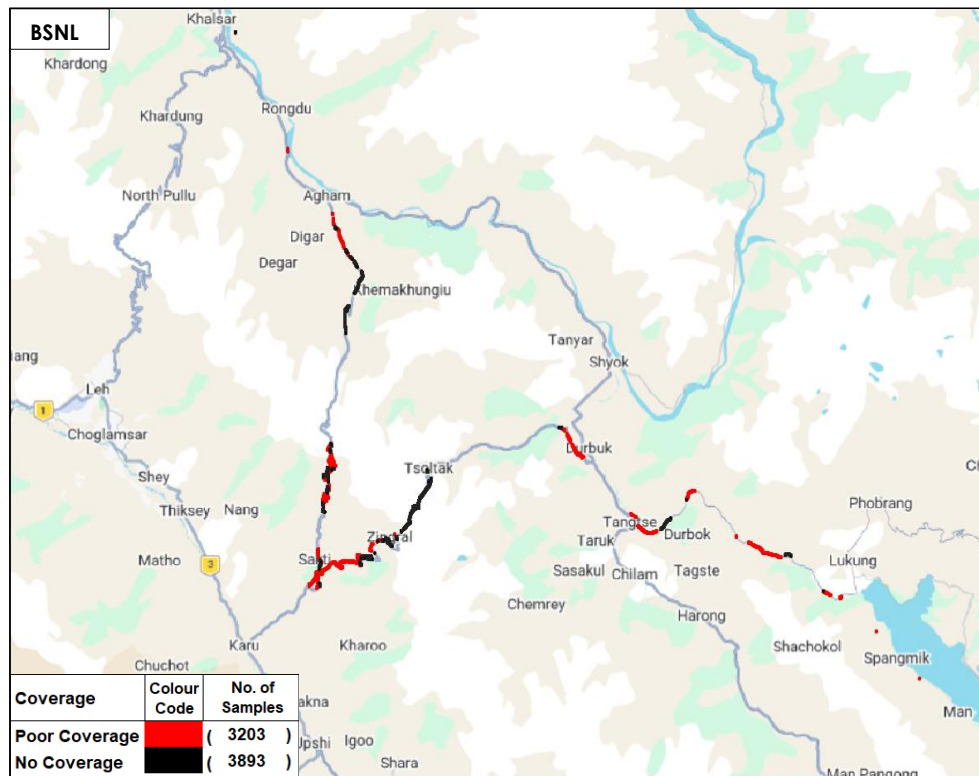


Figure-93: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-BSNL.

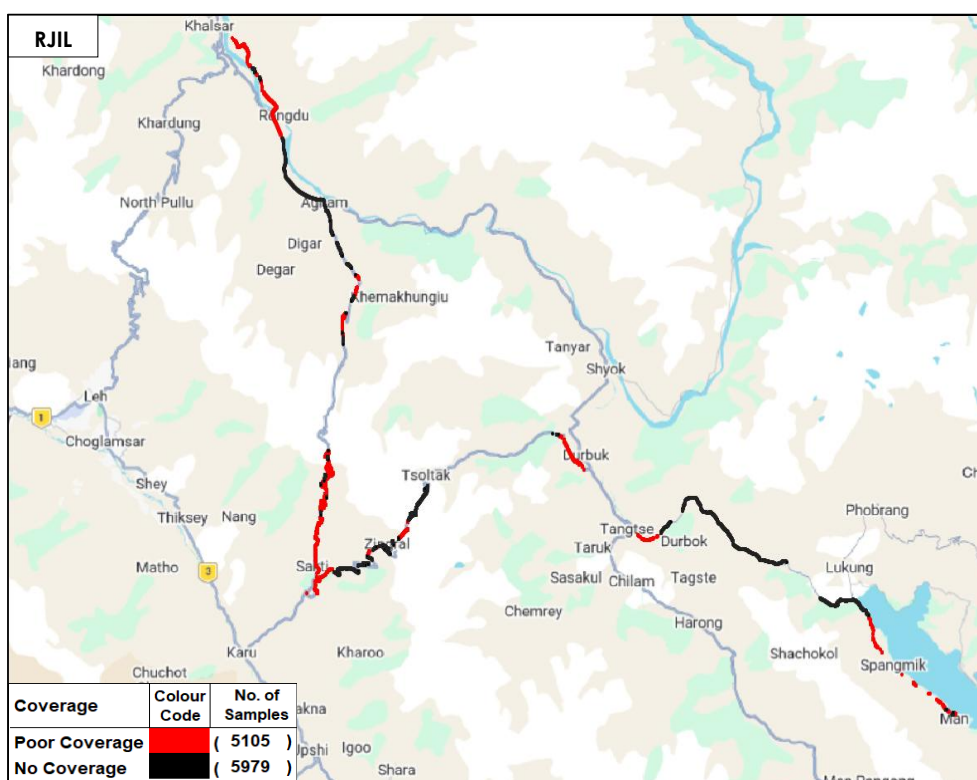


Figure-94: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-RJIL.

4.5.2.4 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
Download Throughput (Mbits/s)	Average	80.59	8.86	44.48
	80 th Percentile	134.02	13.49	19.75
	20 th Percentile	4.21	3.26	0.13
Upload Throughput (Mbits/s)	Average	14.69	3.51	3.94
	80 th Percentile	21.44	5.11	2.43
	20 th Percentile	1.53	1.23	0.85
Latency (ms)	50 th Percentile	54.53	36.48	78.64

Table-61: Summary of Data performance in network auto-selection mode.

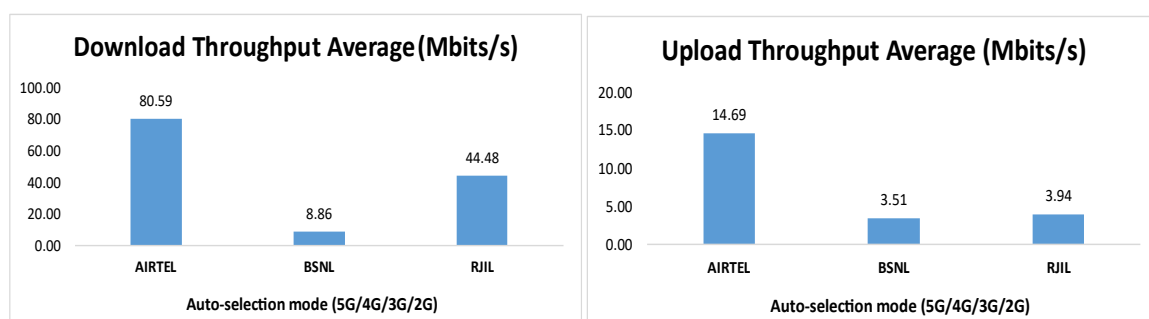


Figure- 95: Download & Upload throughput.

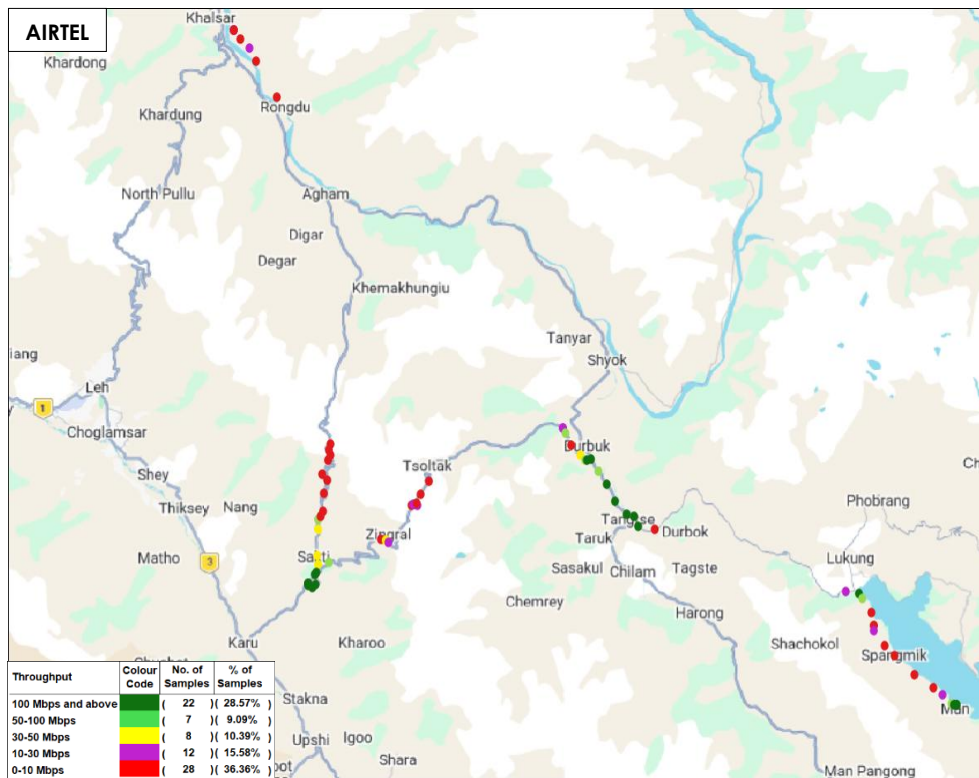


Figure-96: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

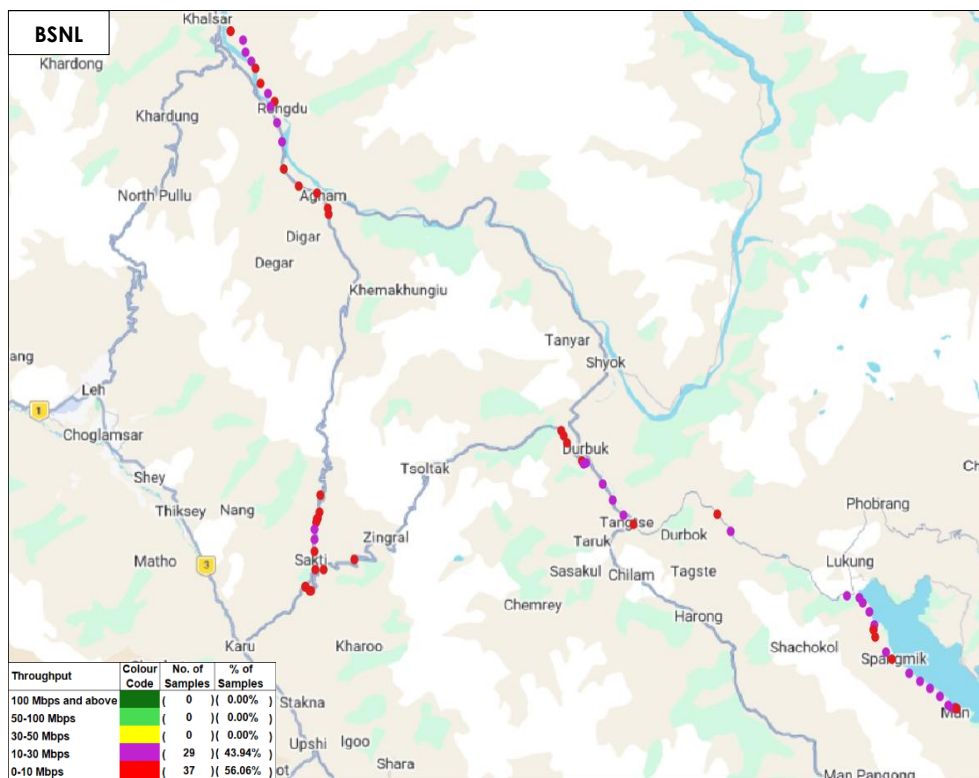


Figure-97: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

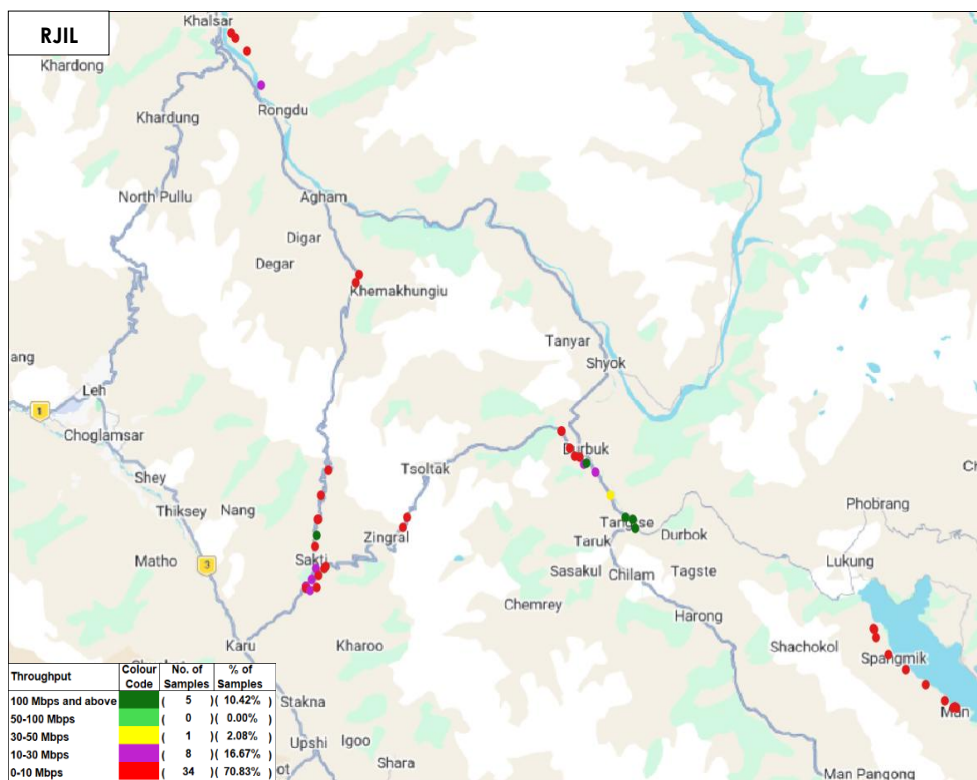


Figure-98: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

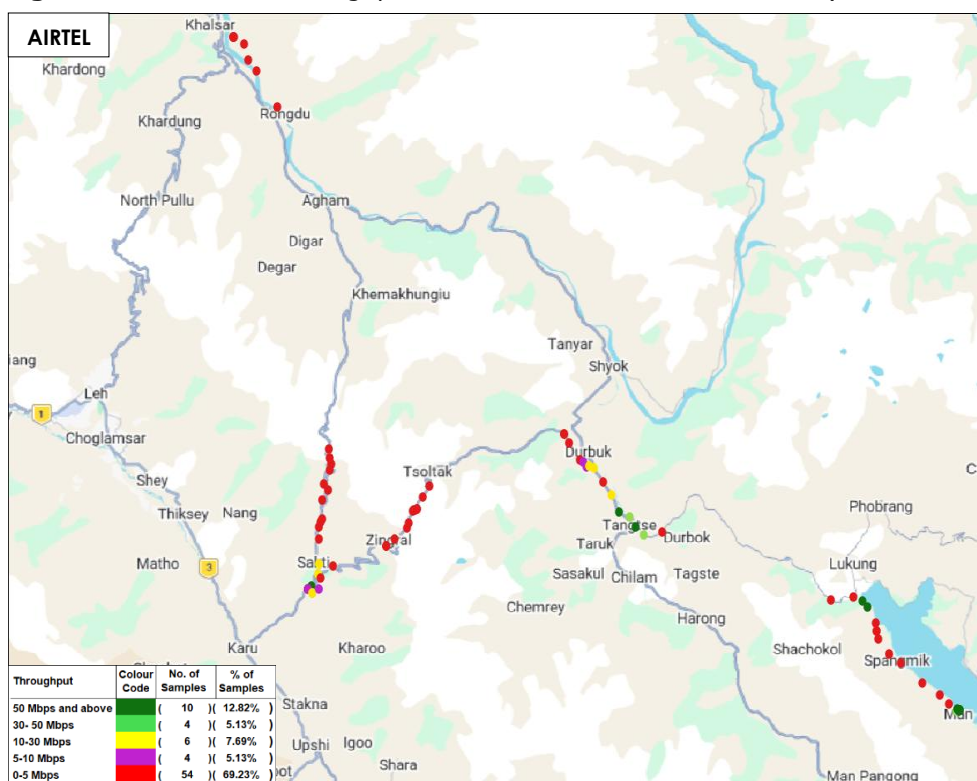


Figure-99: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

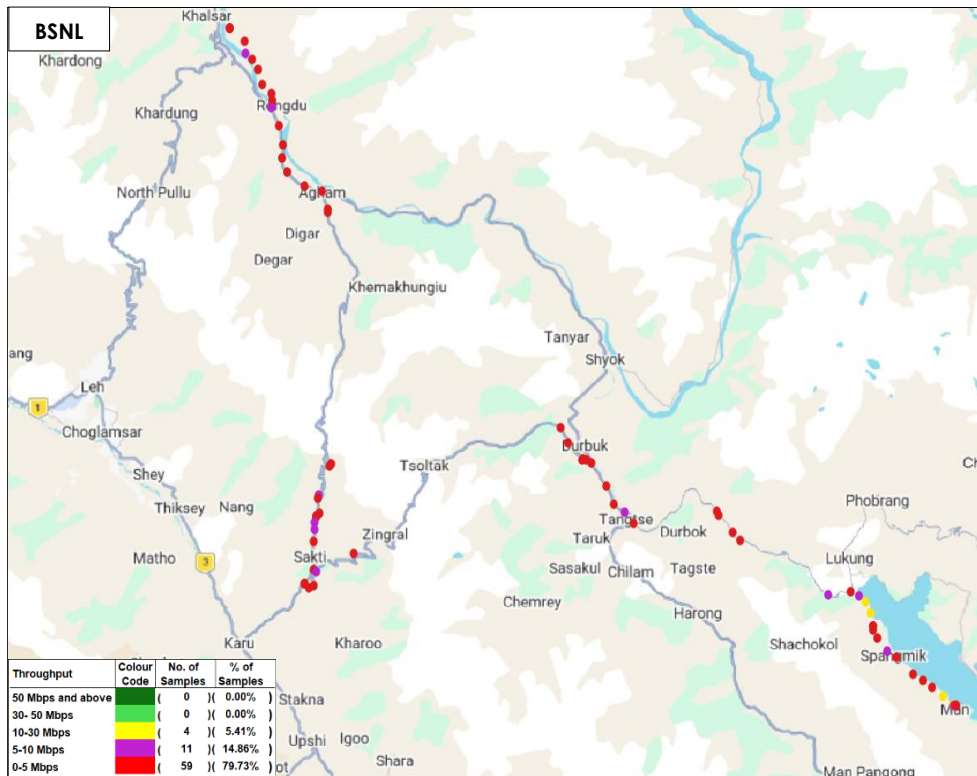


Figure-100: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

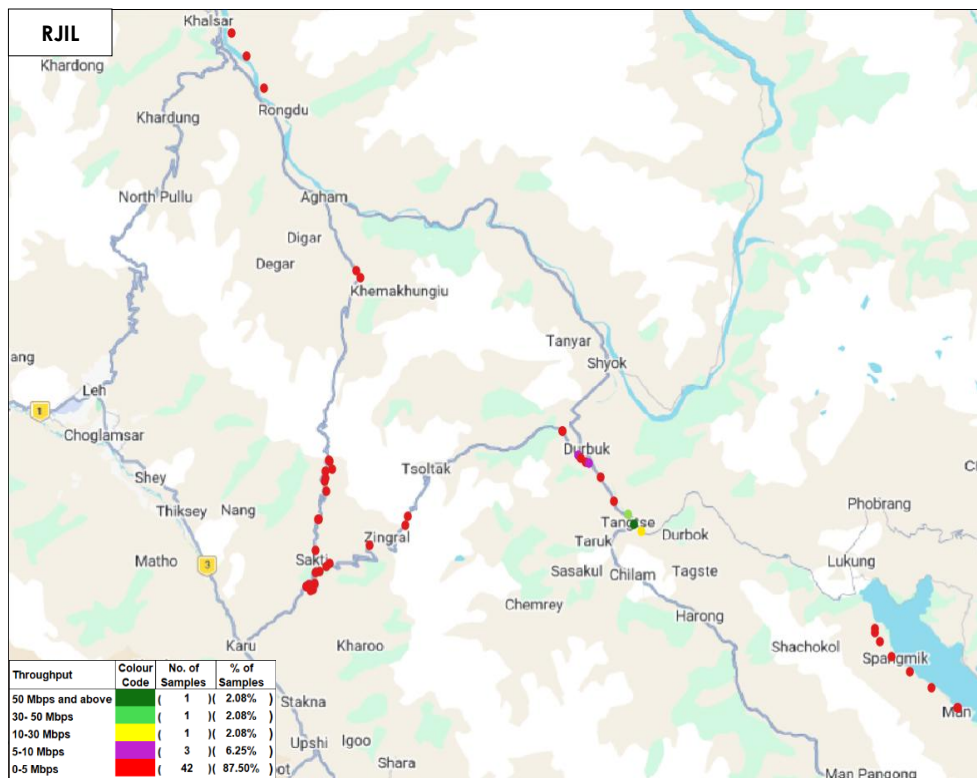


Figure-101: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

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

Technology	Service Provider		
	AIRTEL	BSNL	RJIL
5G	16.76%	NA	4.94%
4G	61.28%	69.67%	63.48%
3G	NA	8.91%	NA
2G	1.94%	0.30%	NA
Limited Service	20.02%	21.12%	31.58%

Table-62: 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.

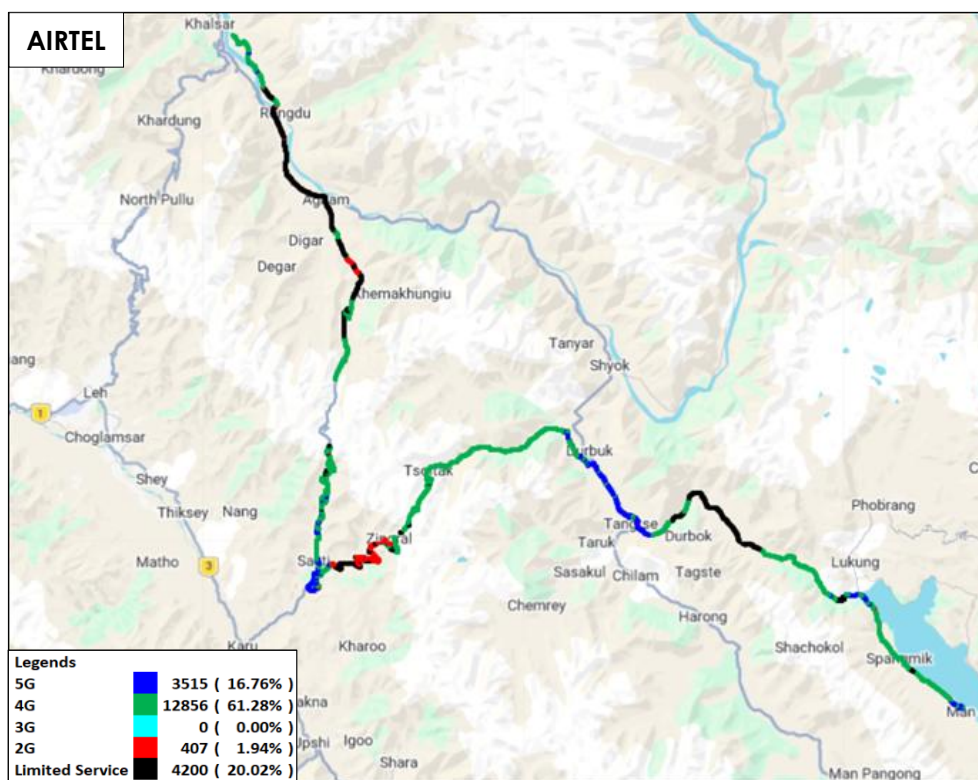


Figure-102: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

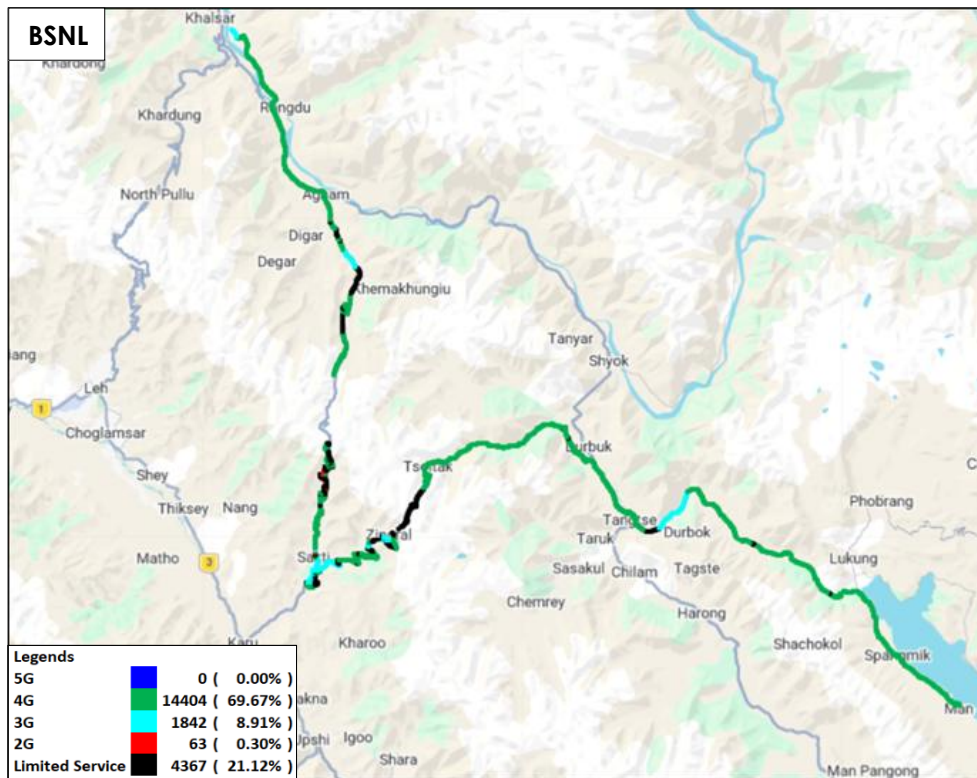


Figure-103: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - BSNL.

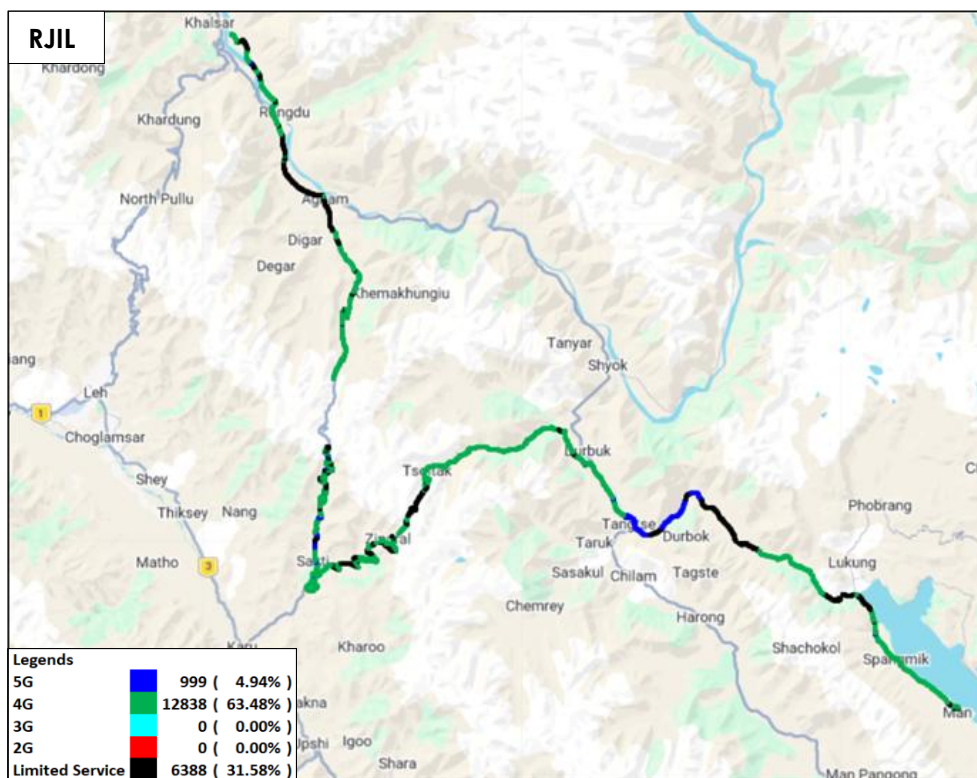


Figure-104: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - RJIL.

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

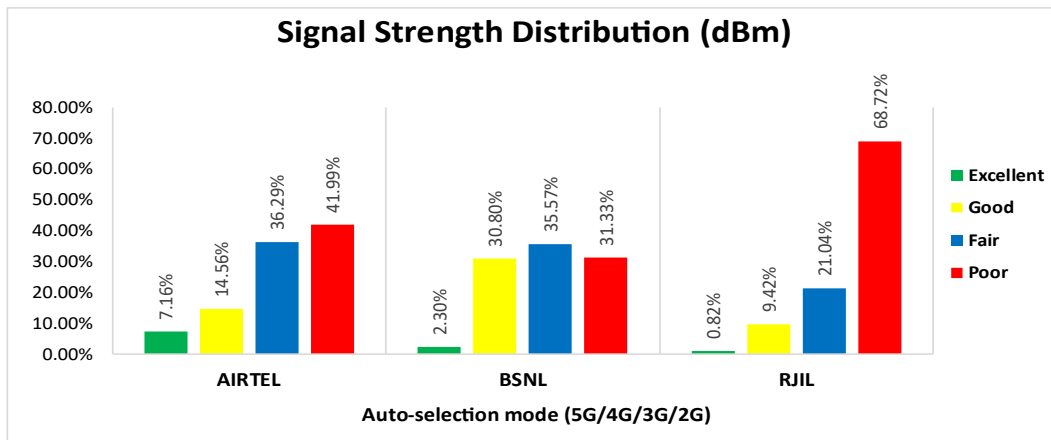


Figure-105: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 7% of samples falling in the excellent signal strength category.
- BSNL has 2% of samples falling in the excellent signal strength category.
- RJIL has 1% of samples falling in the excellent signal strength category.

4.5.3 Sakti to Sangam

4.5.3.1 Drive test route

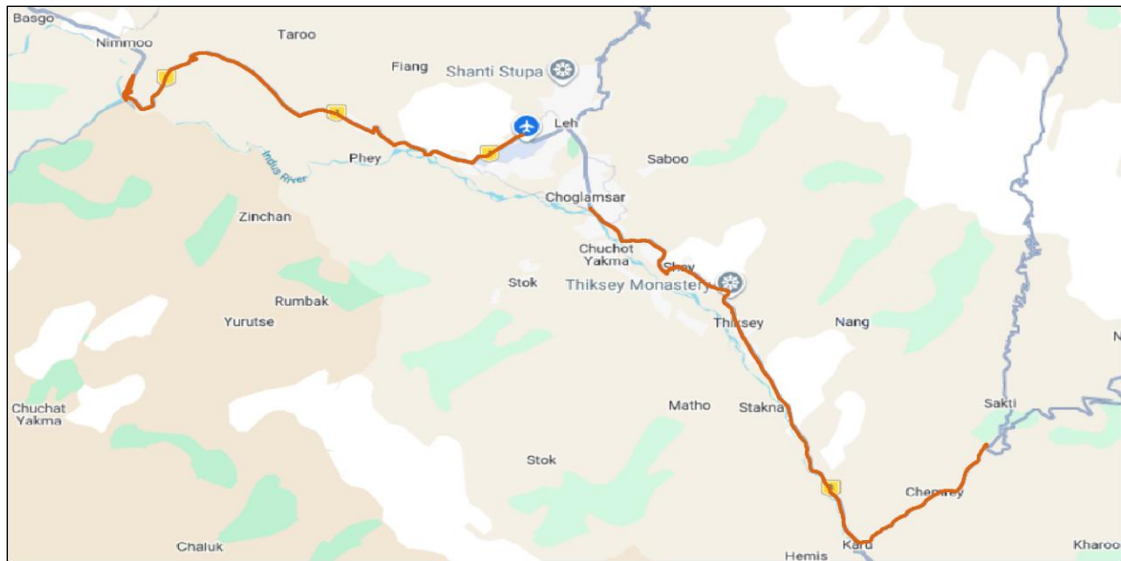


Figure- 106: Drive test routes.

4.5.3.2 Areas covered

Chemrey, Karu, Thiksey, Shey, Kushok Bakula Rimpoochee Airport, Indus Viewpoint and Sangam Point Leh Ladakh etc.

4.5.3.3 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 Only	
	AIRTEL	BSNL
Call Attempts	31	42
Call Setup Success Rate %	100.00	69.05
Drop Call Rate%	0.00	6.90
Call Setup Time-Average (Second)	2.77	5.55
Handover Success Rate %	100.00	100.00

Table-63: Summary of voice call performance in 3G/2G network mode only.

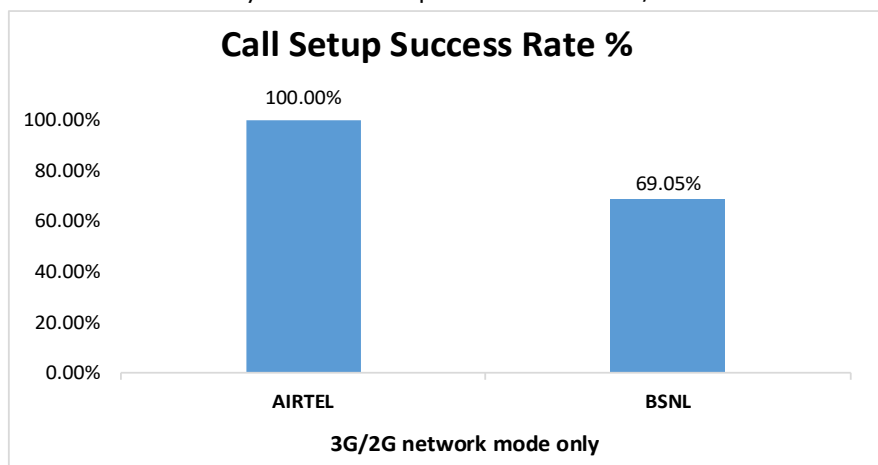


Figure-107: Performance for call setup success rate.

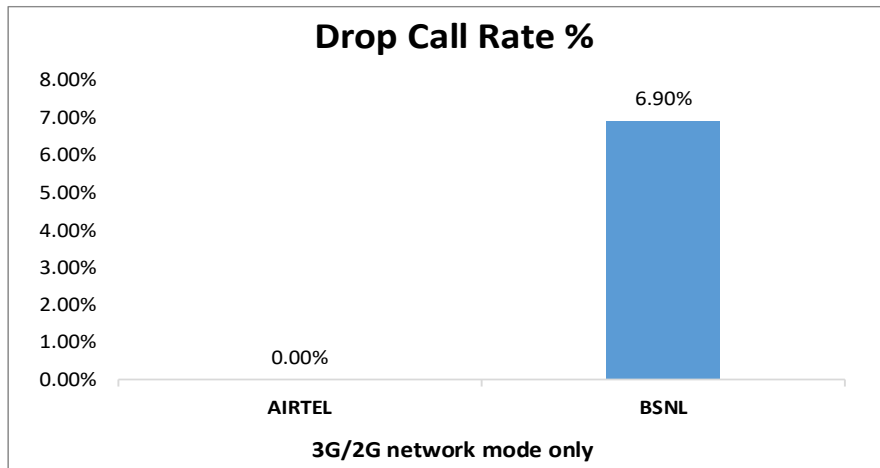


Figure-108: Performance for drop call rate.

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

Technology	Service Provider	
	AIRTEL	BSNL
3G	NA	89.85%
2G	100.00%	8.21%
Limited Service	0.00%	1.94%

Table-64: Time spent on technology during drive test 3G/2G network mode.

Note-

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

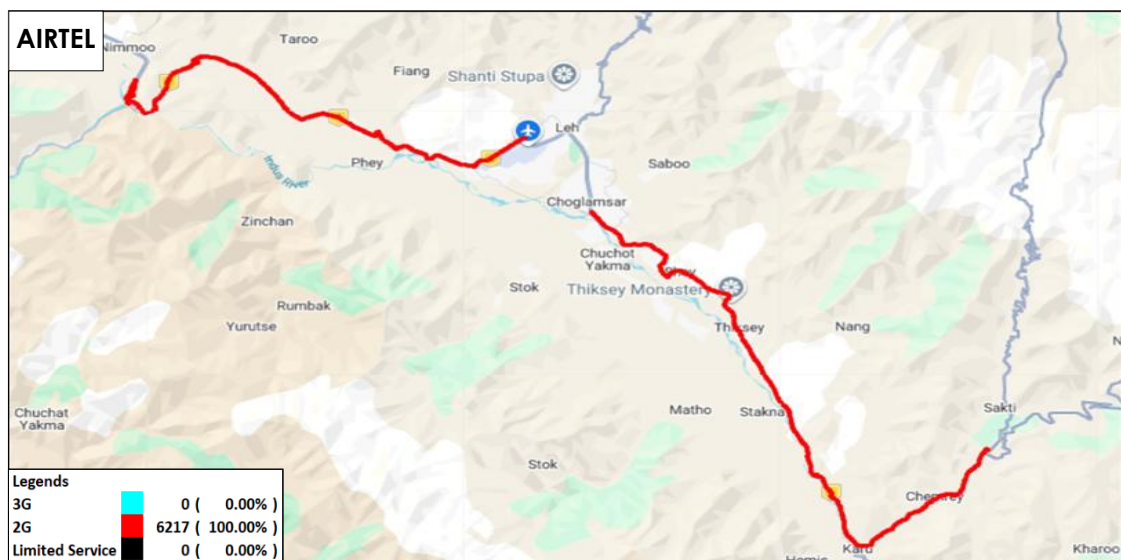


Figure-109: Serving technology plots 3G/2G network mode - AIRTEL.

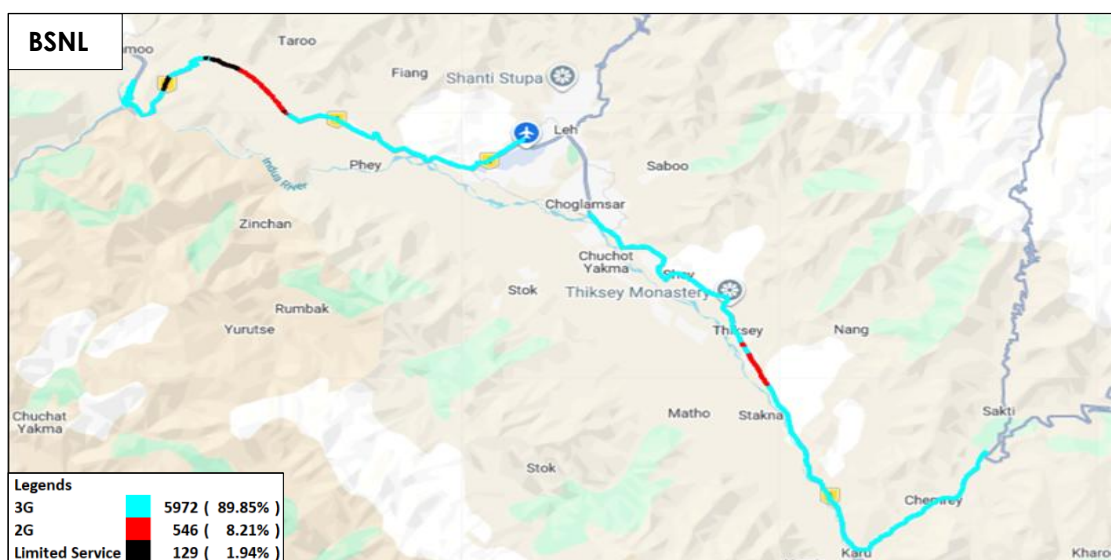


Figure-110: Serving technology plots 3G/2G network mode - BSNL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 163 & 164 for map view)

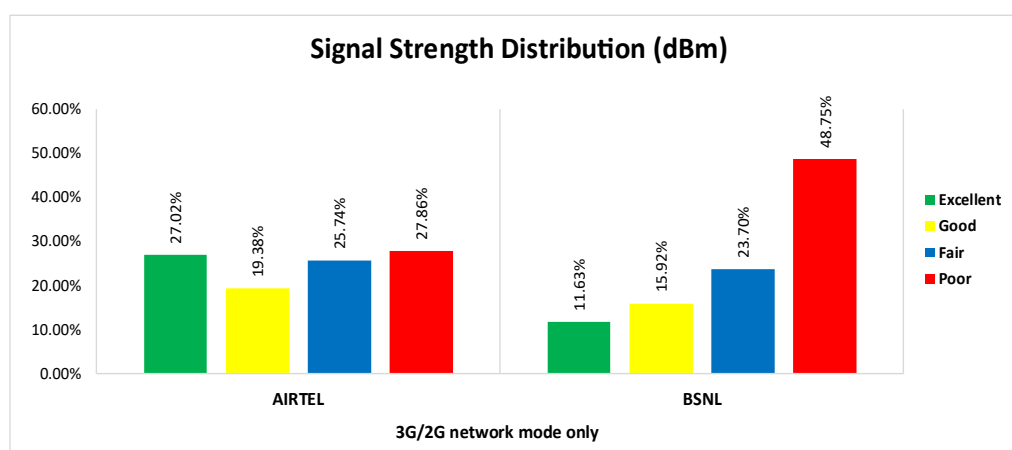


Figure-111: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 27% of samples falling in the excellent signal strength category.
- BSNL has 12% of samples falling in the excellent signal strength category.

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

Parameters	Service Provider		
	Auto-selection mode (5G/4G/3G/2G)		
	AIRTEL	BSNL	RJIL
Call Attempts	32	50	36
Call Setup Success Rate %	100.00	54.00	83.33
Drop Call Rate %	3.13	18.52	6.67
Call Setup Time-Average (Second)	1.50	5.74	1.20
Handover Success Rate %	100.00	100.00	99.84

Table-65: Summary of voice call performance in network auto-selection mode.

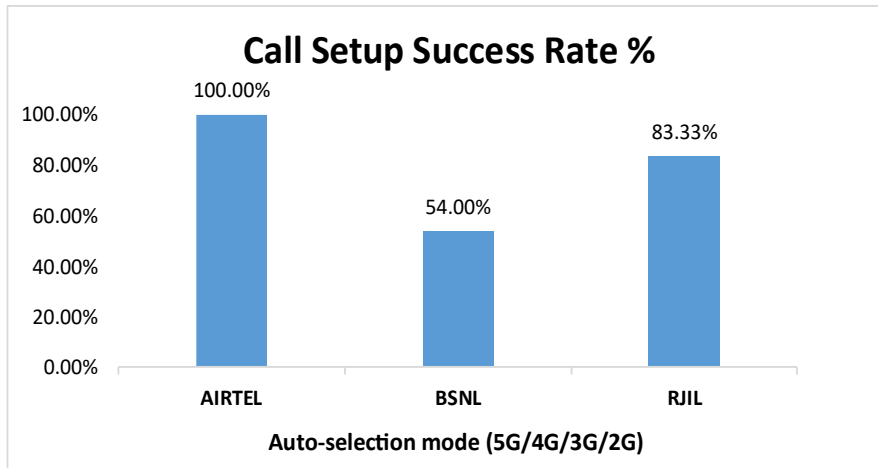


Figure-112: Performance for call setup success rate.

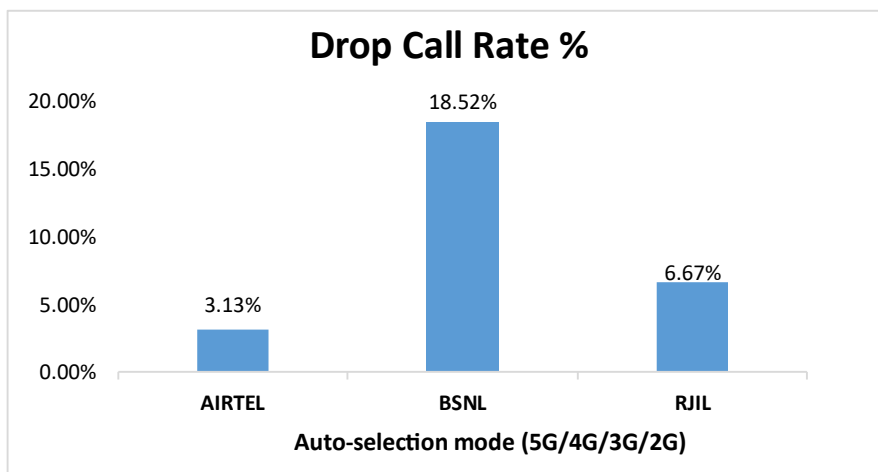


Figure-113: Performance for drop call rate.

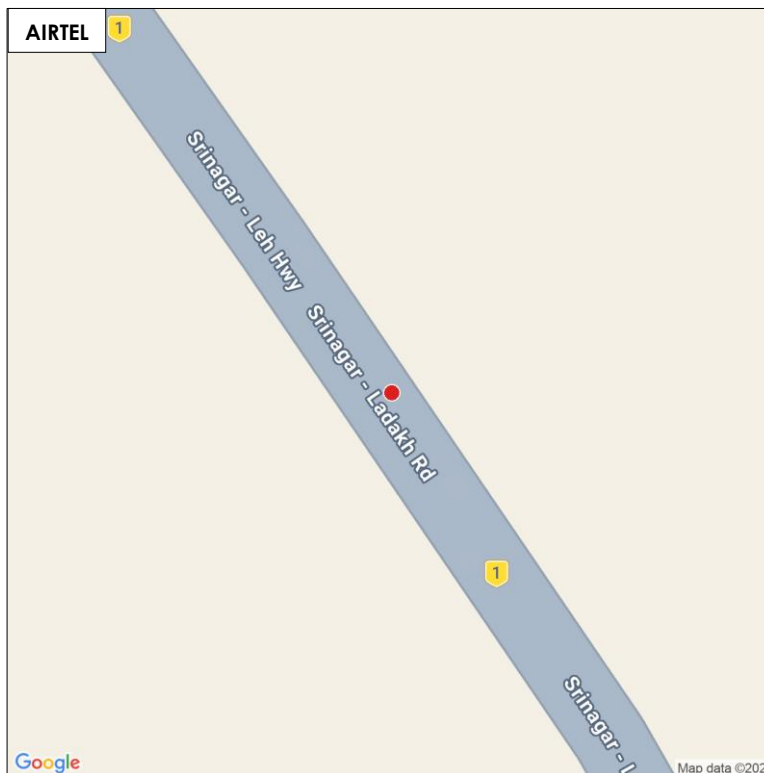


Figure-114: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

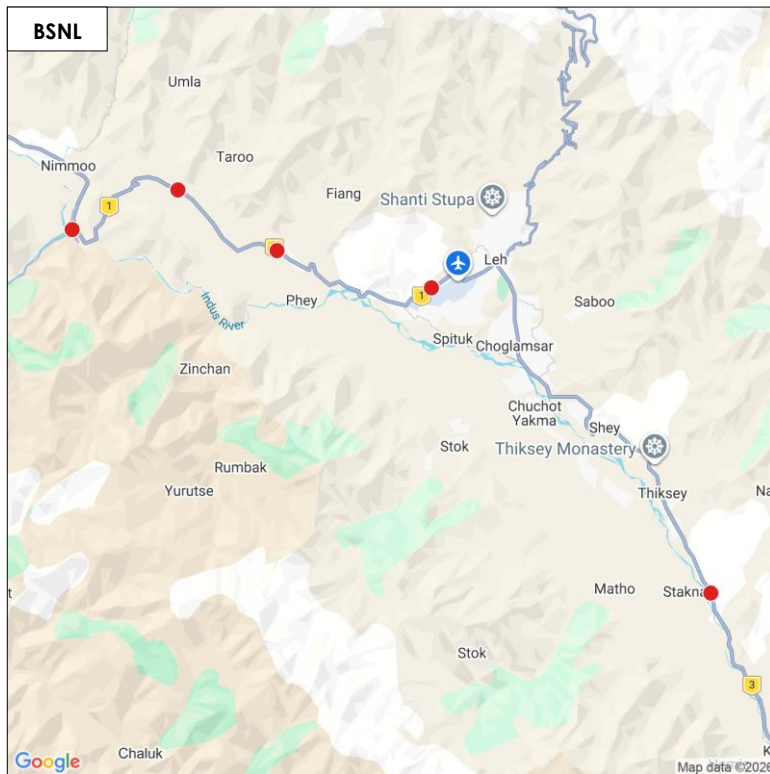


Figure-115: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

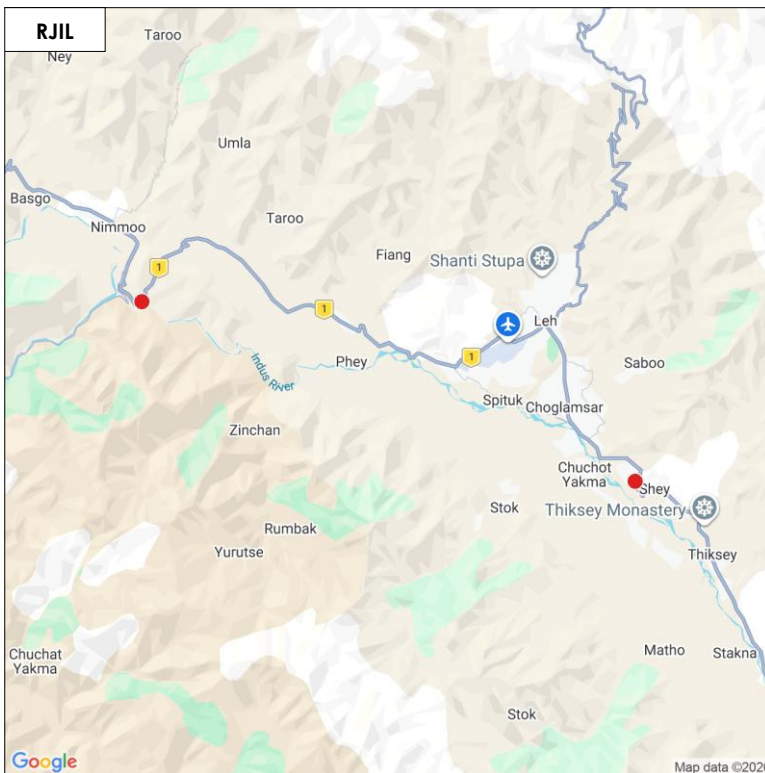


Figure-116: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

Parameter	Service Provider		
	Mobile-to-Mobile (5G/4G – Open Mode)		
	AIRTEL	BSNL	RJIL
Call Established (within service provider Network)	31	26	30
Number of silences call for >4 Sec	2	7	2
Silence Call Rate %	6.45	26.92	6.67
Number of silence instances for >4 Sec	2	15	3
Number of silence instances for >3 Sec	2	15	5
Number of silence instances for >2 sec	2	19	7
RTP Jitter (4G & 5G) in ms	6.53	7.61	13.85
Packet loss Rate Downlink %	0.77	17.11	4.23
Packet loss Rate Uplink %	0.70	13.77	3.45

Table-66: Summary of silence instances & packet loss rate for mobile to mobile call.

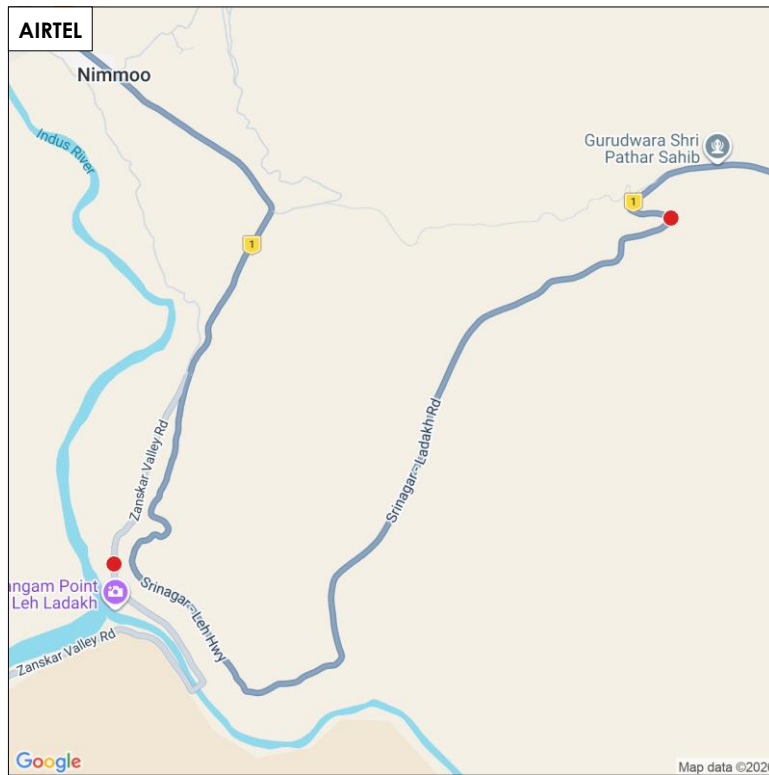


Figure-117: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - AIRTEL.

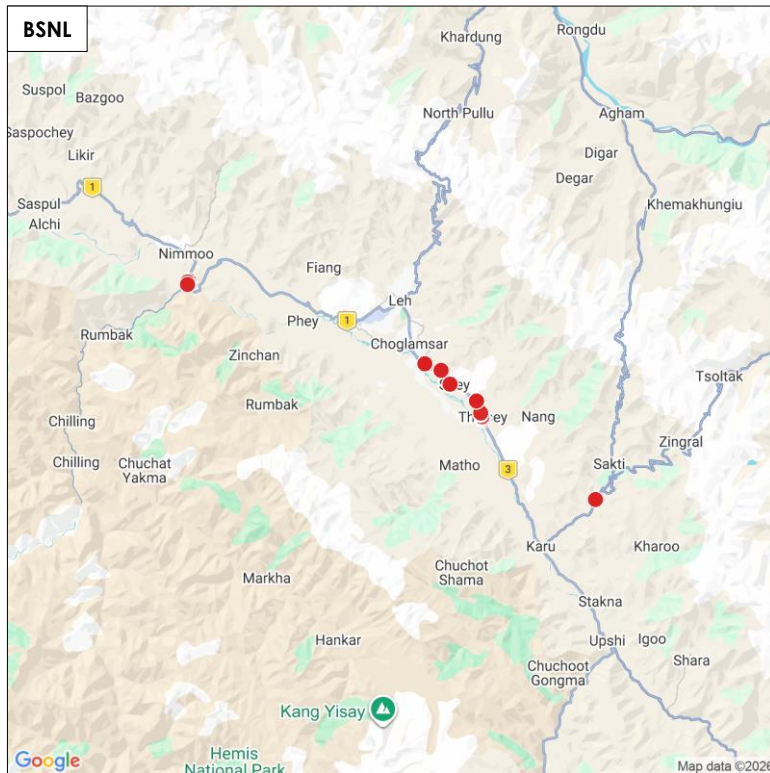


Figure-118: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - BSNL.



Figure-119: 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 value means: 5-Excellent, 4-Good, 3-Fair, 2-Poor, 1-Bad.

Speech Quality (MOS) distribution	Service Provider		
	AIRTEL	BSNL	RJIL
Total Number of MOS Samples for calls table-66	389	262	358
Speech Quality (Average MOS)	3.96	3.08	4.31
Number of samples with MOS ≥ 4 to < 5 (Excellent)	313	75	293
Number of samples with MOS ≥ 3 to < 4 (Good)	61	62	31
Number of samples with MOS ≥ 2 to < 3 (Fair)	6	84	11
Number of samples with MOS ≥ 1 to < 2 (Poor)	9	41	23
%age of samples with MOS ≥ 4 to < 5 (Excellent)	80.46%	28.63%	81.84%
%age of samples with MOS ≥ 3 to < 4 (Good)	15.68%	23.66%	8.66%
%age of samples with MOS ≥ 2 to < 3 (Fair)	1.54%	32.06%	3.07%
%age of samples with MOS ≥ 1 to < 2 (Poor)	2.31%	15.65%	6.42%

Table-67: Summary of speech quality (MOS) samples.

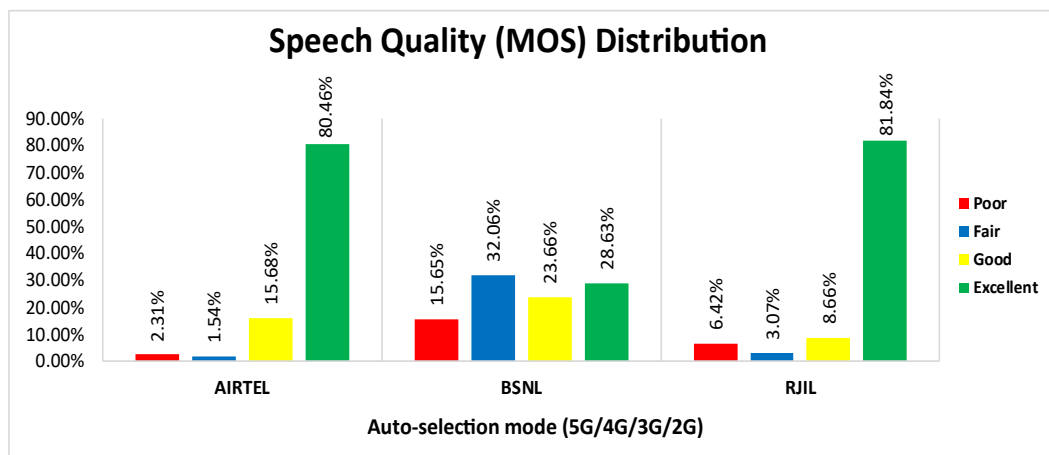


Figure-120: Distribution of samples in MOS range.

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

Technology	Service Provider		
	AIRTEL	BSNL	RJIL
5G	1.96%	NA	29.89%
4G	97.82%	33.43%	63.87%
3G	NA	49.27%	NA
2G	0.00%	14.97%	NA
Limited Service	0.22%	2.33%	6.24%

Table-68: 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.

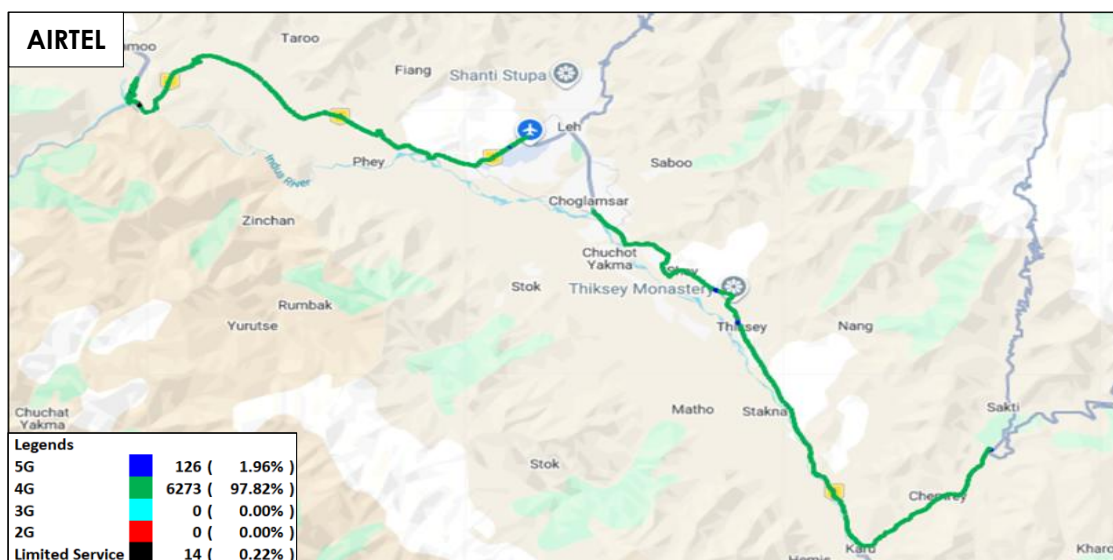


Figure-121: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.



Figure-122: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.



Figure-123: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

(g) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-165, 166 & 167 for map view)

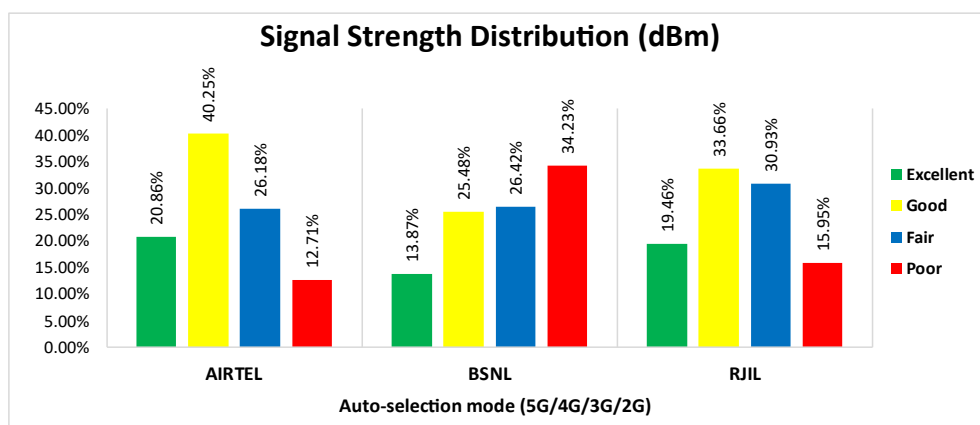


Figure-124: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 21% of samples falling in the excellent signal strength category.
- BSNL has 14% of samples falling in the excellent signal strength category.
- RJIL has 19% of samples falling in the excellent signal strength category.

(h) Coverage Gap observed



Figure-125: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-AIRTEL.



Figure-126: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-BSNL.



Figure-127: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-RJIL.

4.5.3.4 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
Download Throughput (Mbits/s)	Average	96.97	6.00	203.25
	80 th Percentile	144.85	7.10	433.84
	20 th Percentile	34.98	2.52	6.85
Upload Throughput (Mbits/s)	Average	14.67	4.14	18.84
	80 th Percentile	21.77	8.62	35.79
	20 th Percentile	2.65	0.91	1.71
Latency (ms)	50 th Percentile	50.03	35.97	29.66

Table-69: Summary of Data performance in network auto-selection mode.

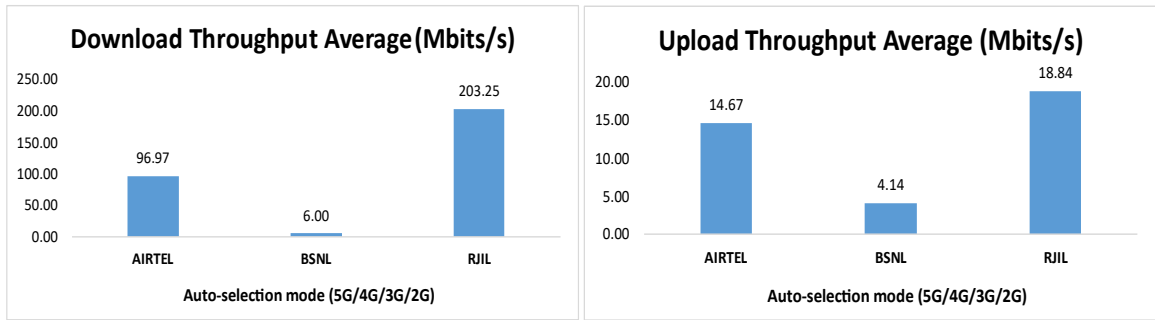


Figure-128: Download & Upload throughput.

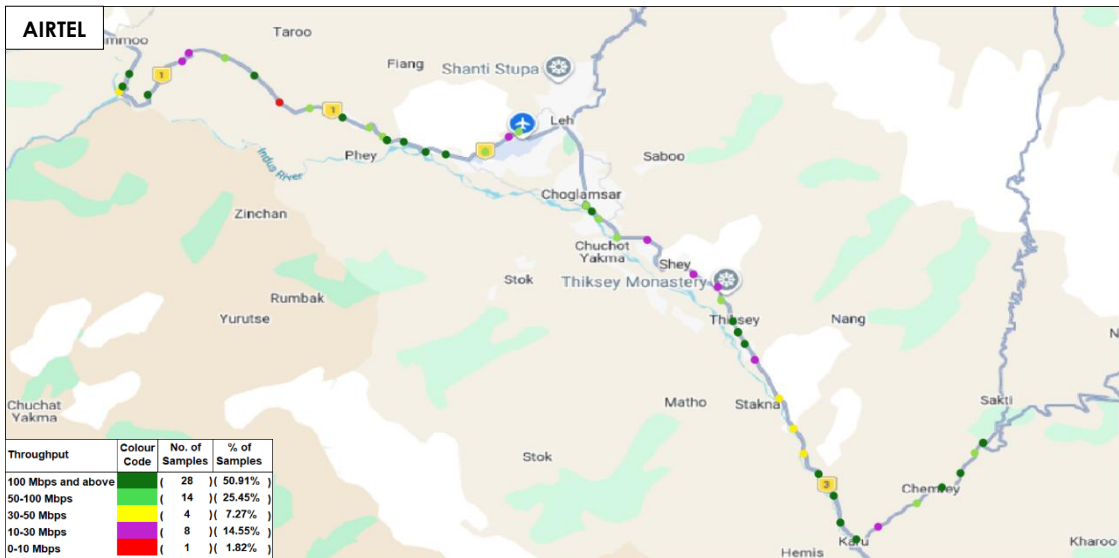


Figure-129: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.



Figure-130: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.



Figure-131: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.



Figure-132: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

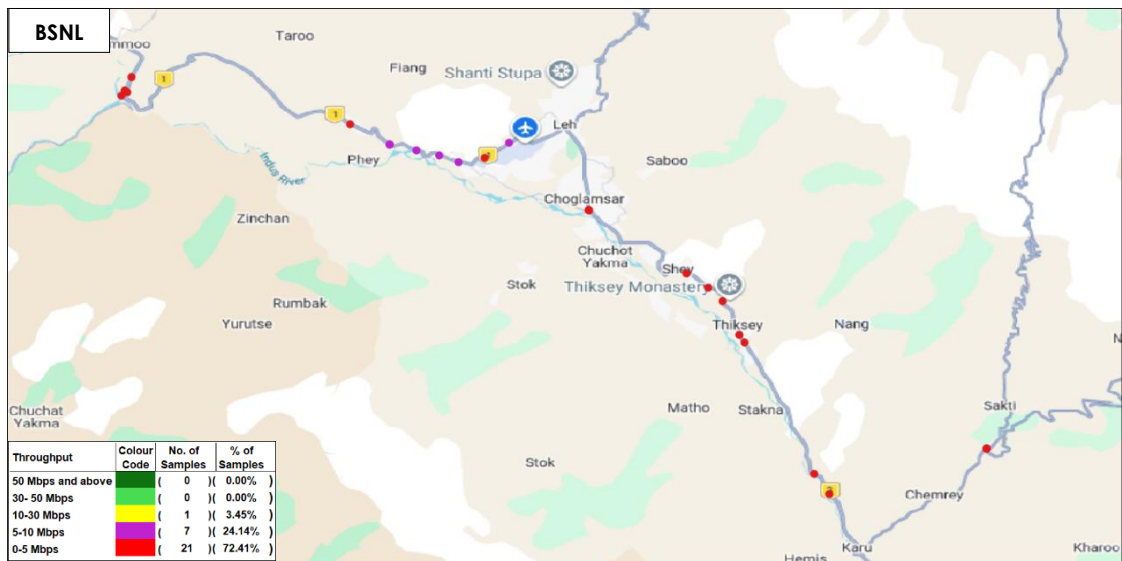


Figure-133: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

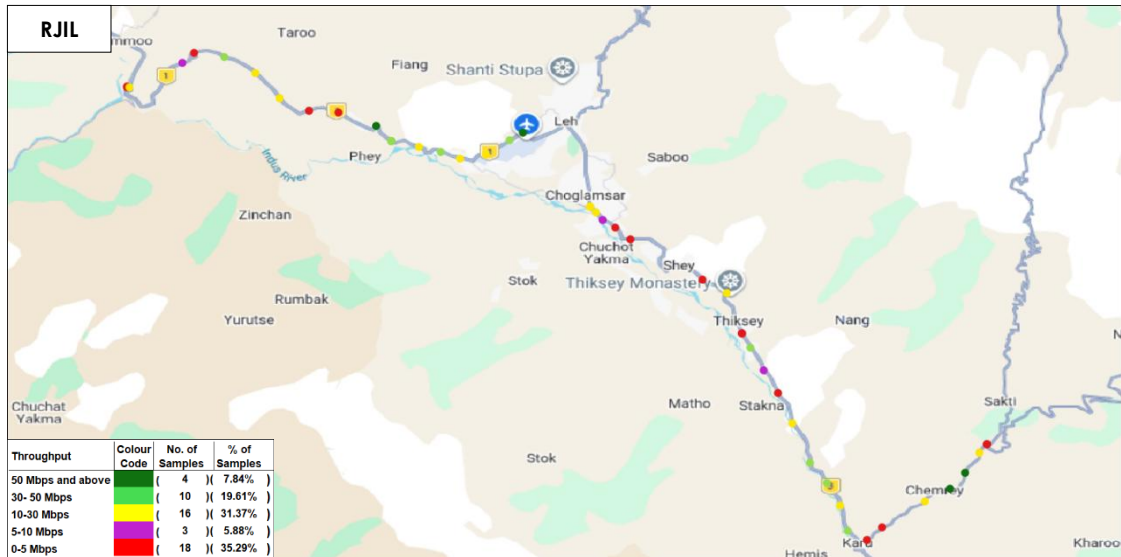


Figure-134: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

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

Technology	Service Provider		
	AIRTEL	BSNL	RJIL
5G	59.39%	NA	63.41%
4G	37.42%	27.19%	32.41%
3G	NA	64.41%	NA
2G	0.05%	3.35%	NA
Limited Service	3.15%	5.05%	4.18%

Table-70: 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-135: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

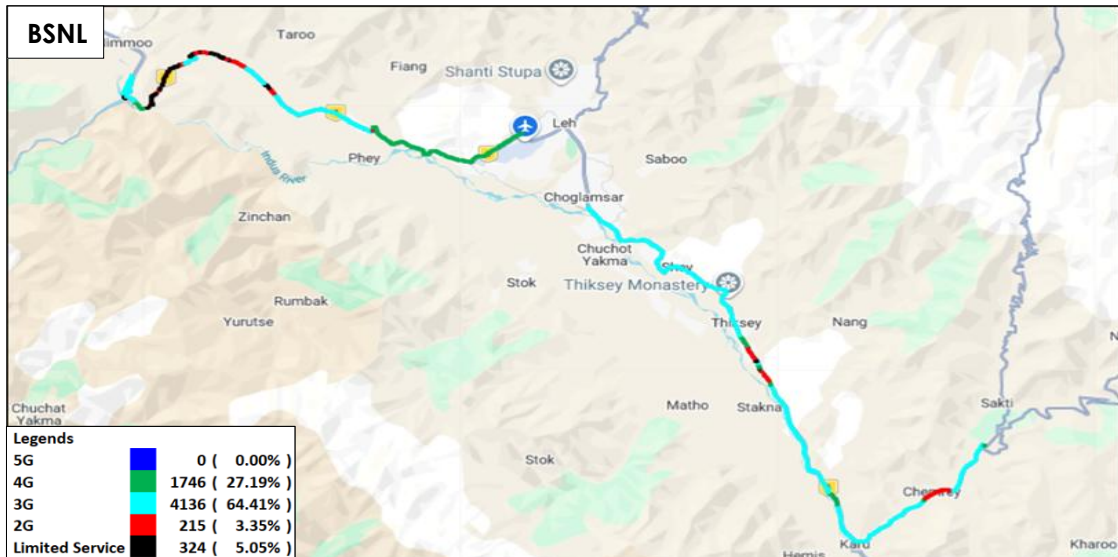


Figure-136: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - BSNL.

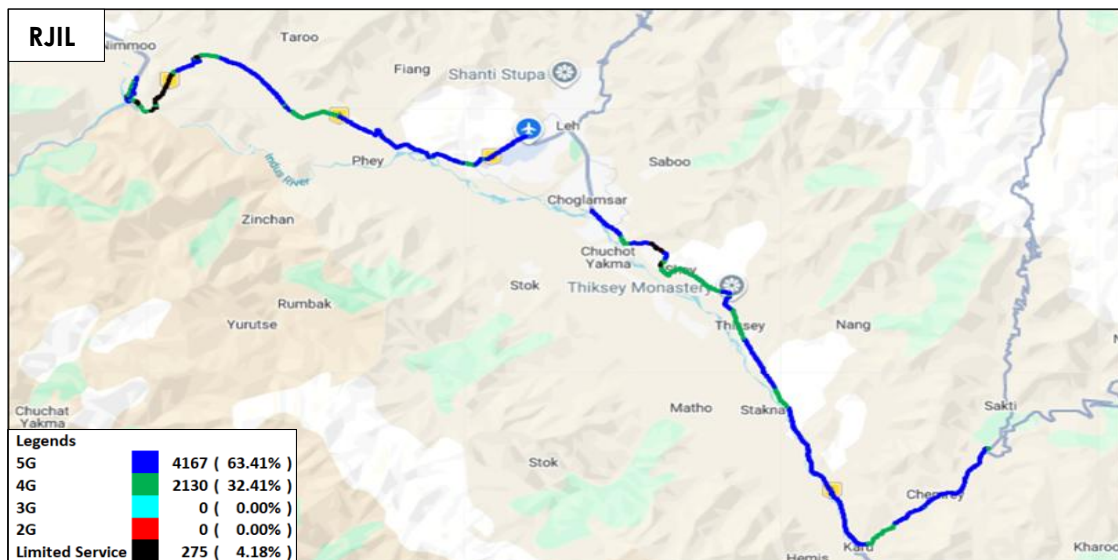


Figure-137: Serving technology plots in auto-selection mode (5G/4G/3G/2G) data - RJIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-168, 169 & 170 for map view)

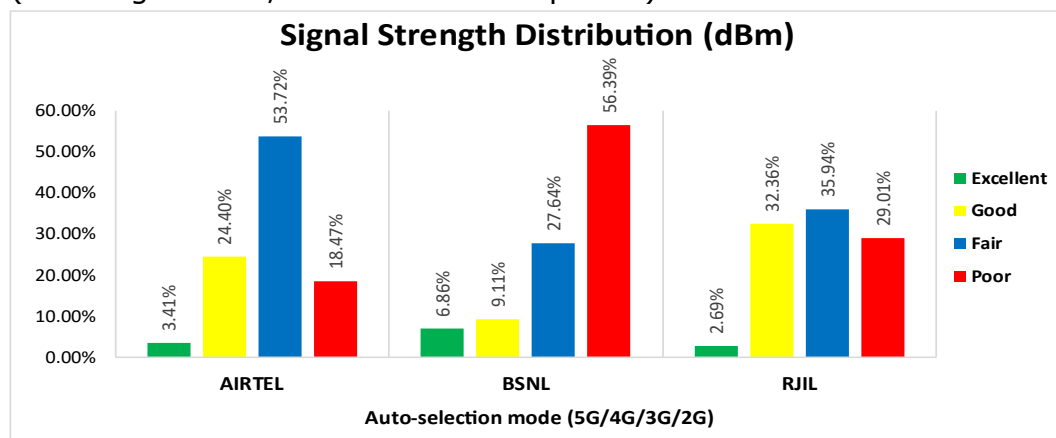


Figure-138: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 3% of samples falling in the excellent signal strength category.
- BSNL has 7% of samples falling in the excellent signal strength category.
- RJIL has 3% 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 and BSNL have 55.04% and 28.90% call setup success rate respectively in 3G/2G network mode. (refer table-3)
- b) Airtel, BSNL and RJIL have 62.33%, 50.99% and 52.70% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)
- c) Airtel, BSNL and RJIL have 100.00% call setup success rate while calling on peer service provider's network for inter-operator calls. (refer table-9)

2. Call Setup Time:

- a) Airtel and BSNL call setup time is 3.64 & 5.53 seconds respectively in 3G/2G network mode. (refer table-3)
- b) Airtel, BSNL and RJIL call setup time is 1.98, 4.63 & 1.17 seconds respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. Call Silence/Mute Rate:

In packet switched network (4G/5G) RJIL, Airtel and BSNL have 10.34%, 9.89% & 8.23% silence call rate respectively. Further RJIL has higher RTP packet loss rate in downlink (8.93%) compared to BSNL (6.73%) & Airtel (3.22%). In uplink the RTP packet loss rate is higher for RJIL (10.33%) compared to BSNL (4.32%) & Airtel (2.86%). (refer table-6)

4. Drop Call Rate:

- a) Airtel and BSNL drop call rate is 2.67% and 9.77% respectively in 3G/2G network mode. (refer table-3)
- b) Airtel, BSNL and RJIL drop call rate is 6.42%, 12.28% and 7.83% respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

5.2 Overall Data

1. Data download and upload performance (Overall i.e. LSA):

- a) Airtel, BSNL and RJIL average download speeds are 105.07 Mbps, 10.61 Mbps and 207.65 Mbps respectively. (refer table-11)
- b) Airtel, BSNL and RJIL average upload speeds are 17.36 Mbps, 6.33 Mbps and 20.50 Mbps respectively. (refer table-11)

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

- a) Airtel, BSNL and RJIL average download speeds are 114.86 Mbps, 9.03 Mbps and 321.78 Mbps respectively. (refer table-29)
- b) Airtel, BSNL and RJIL average upload speeds are 20.78 Mbps, 12.20 Mbps and 38.79 Mbps respectively. (refer table-29)

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

- a) Airtel, BSNL and RJIL download session setup success rate is 100.00%, 85.71% and 94.29% respectively. (refer table-29)
- b) Airtel, BSNL and RJIL upload session setup success rate is 100.00%, 85.71% and 88.57% respectively. (refer table-29)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 55.04% call setup success rate and 2.67% drop call rate have been observed in 3G/2G network mode for LSA. (refer table-3)
- 62.33% call setup success rate and 6.42% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)
- 96.43% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode for city drive. (refer table-13)
- 94.32% call setup success rate and 0.00% 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 walk test location. (refer table-45)
- 68.31% call setup success rate and 4.12% drop call rate have been observed in 3G/2G network mode for Leh to Nubra Valley highway drive. (refer table-47)
- 73.97% call setup success rate and 11.11% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Leh to Nubra Valley highway drive. (refer table-49)
- 24.20% call setup success rate and 5.66% drop call rate have been observed in 3G/2G network mode for Nubra Valley to Pangong highway drive. (refer table-55)
- 26.80% call setup success rate and 16.42% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Nubra Valley to Pangong highway drive. (refer table-57)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode for Sakti to Sangam highway drive. (refer table-63)
- 100.00% call setup success rate and 3.13% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Sakti to Sangam highway drive. (refer table-65)

Data

- Airtel has 105.07 Mbps average download speed & 17.36 Mbps average upload speed for LSA. (refer table-11)
- Airtel has 121.65 Mbps average download speed & 22.13 Mbps average upload speed across the measured routes for city drive. (refer table-19)
- Leh Airport, Leh Market and SNM Hospital have less download speed (less than 100 Mbps) out of total 7 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table- 34, 35 & 36)
- Army Hospital Hundar, Artisan Bazaar, Leh Airport, Leh Market and SNM Hospital have less upload speed (less than 20 Mbps) out of total 7 hotspot

locations for auto-selection mode (5G/4G/3G/2G). (refer table-30, 31, 34, 35 & 36)

- Airtel has 109.57 Mbps average download speed & 14.21 Mbps average upload speed across the measured routes for Leh to Nubra Valley highway drive. (refer table-53)
- Airtel has 80.59 Mbps average download speed & 14.69 Mbps average upload speed across the measured routes for Nubra Valley to Pangong highway drive. (refer table-61)
- Airtel has 96.97 Mbps average download speed & 14.67 Mbps average upload speed across the measured routes for Sakti to Sangam highway drive. (refer table-69)

2. BSNL:

Voice

- 28.90% call setup success rate and 9.77% drop call rate have been observed in 3G/2G network mode for LSA. (refer table-3)
- 50.99% call setup success rate and 12.28% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)
- 72.04% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode for city drive. (refer table-13)
- 79.38% call setup success rate and 6.49% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. (refer table-15)
- 81.43% call setup success rate and 1.75% 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 walk test location. (refer table-45)
- 31.03% call setup success rate and 5.56% drop call rate have been observed in 3G/2G network mode for Leh to Nubra Valley highway drive. (refer table-47)
- 62.91% call setup success rate and 13.68% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Leh to Nubra Valley highway drive. (refer table-49)
- 8.19% call setup success rate and 50.00% drop call rate have been observed in 3G/2G network mode for Nubra Valley to Pangong highway drive. (refer table-55)
- 23.44% call setup success rate and 26.56% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Nubra Valley to Pangong highway drive. (refer table-57)
- 69.05% call setup success rate and 6.90% drop call rate have been observed in 3G/2G network mode for Sakti to Sangam highway drive. (refer table-63)
- 54.00% call setup success rate and 18.52% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Sakti to Sangam highway drive. (refer table-65)

Data

- BSNL has 10.61 Mbps average download speed & 6.33 Mbps average upload speed for LSA. (refer table-11)
- BSNL has 8.00 Mbps average download speed & 4.87 Mbps average upload speed across the measured routes for city drive. (refer table-19)
- Artisan Bazaar, EJM College, Gurudwara Sri Pathar Sahib, Leh Airport and Leh Market have less download speed (less than 10 Mbps) out of total 7 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-31, 32, 33, 34 & 35)
- Artisan Bazaar and Gurudwara Sri Pathar Sahib have less upload speed (less than 2 Mbps) out of total 7 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-31 & 33)
- BSNL has 16.39 Mbps average download speed & 7.81 Mbps average upload speed across the measured routes for Leh to Nubra Valley highway drive. (refer table-53)
- BSNL has 8.86 Mbps average download speed & 3.51 Mbps average upload speed across the measured routes for Nubra Valley to Pangong highway drive. (refer table-61)
- BSNL has 6.00 Mbps average download speed & 4.14 Mbps average upload speed across the measured routes for Sakti to Sangam highway drive. (refer table-69)

3. RJIL:

Voice

- 52.70% call setup success rate and 7.83% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)
- 82.61% call setup success rate and 1.32% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. (refer table-15)
- 97.14% call setup success rate and 4.41% 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 walk test location. (refer table-45)
- 54.49% call setup success rate and 4.71% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Leh to Nubra Valley highway drive. (refer table-49)
- 22.81% call setup success rate and 26.67% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Nubra Valley to Pangong highway drive. (refer table-57)
- 83.33% call setup success rate and 6.67% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Sakti to Sangam highway drive. (refer table-65)

Data

- RJIL has 207.65 Mbps average download speed & 20.50 Mbps average upload speed for LSA. (refer table-11)

- RJIL has 267.13 Mbps average download speed & 21.20 Mbps average upload speed across the measured routes for city drive. (refer table-19)
- Gurudwara Sri Pathar Sahib has less download speed (less than 100 Mbps) out of total 7 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table- 33)
- Army Hospital Hundar, Artisan Bazaar and Gurudwara Sri Pathar Sahib have less upload speed (less than 20 Mbps) out of total 7 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-30, 31 & 33)
- RJIL has 122.16 Mbps average download speed & 12.02 Mbps average upload speed across the measured routes for Leh to Nubra Valley highway drive. (refer table-53)
- RJIL has 44.48 Mbps average download speed & 3.94 Mbps average upload speed across the measured routes for Nubra Valley to Pangong highway drive. (refer table-61)
- RJIL has 203.25 Mbps average download speed & 18.84 Mbps average upload speed across the measured routes for Sakti to Sangam highway drive. (refer table-69)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

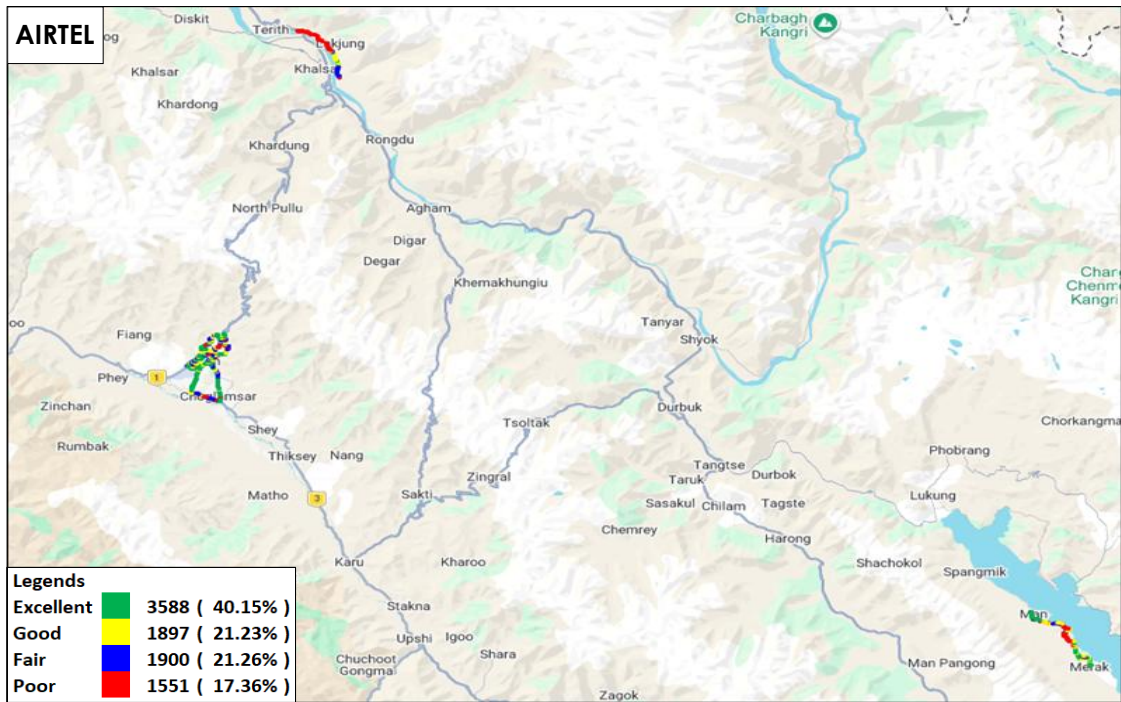


Figure-139: Signal strength 3G/2G network mode voice - AIRTEL.

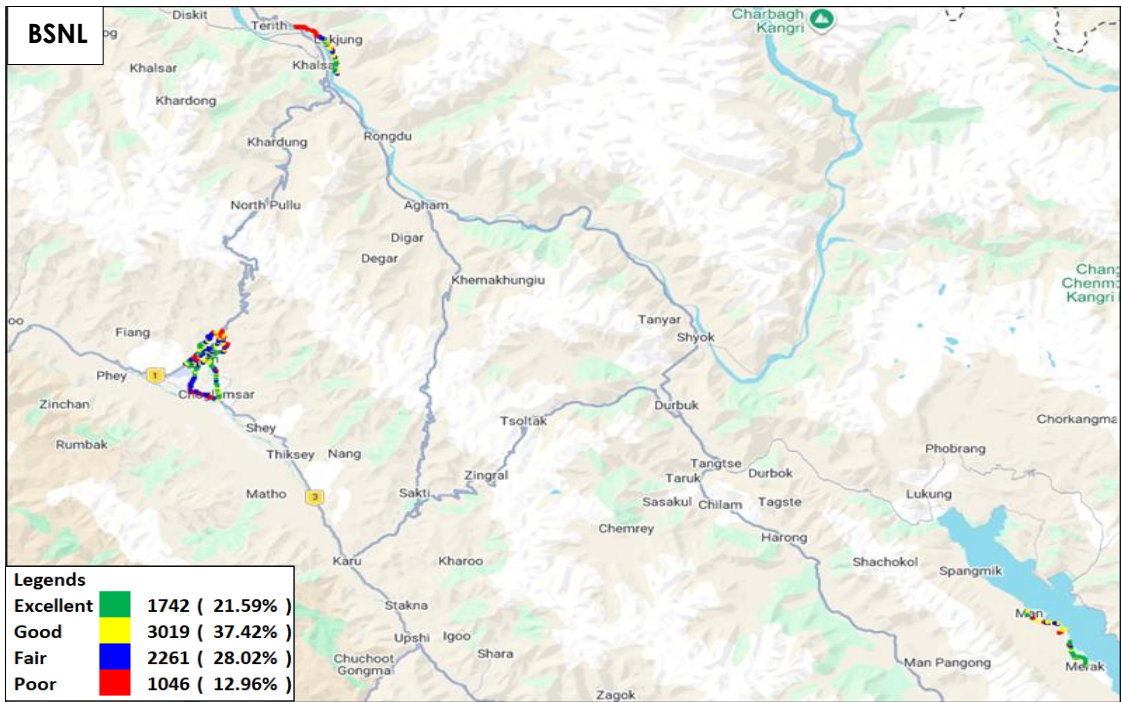


Figure-140: Signal strength 3G/2G network mode voice - BSNL.

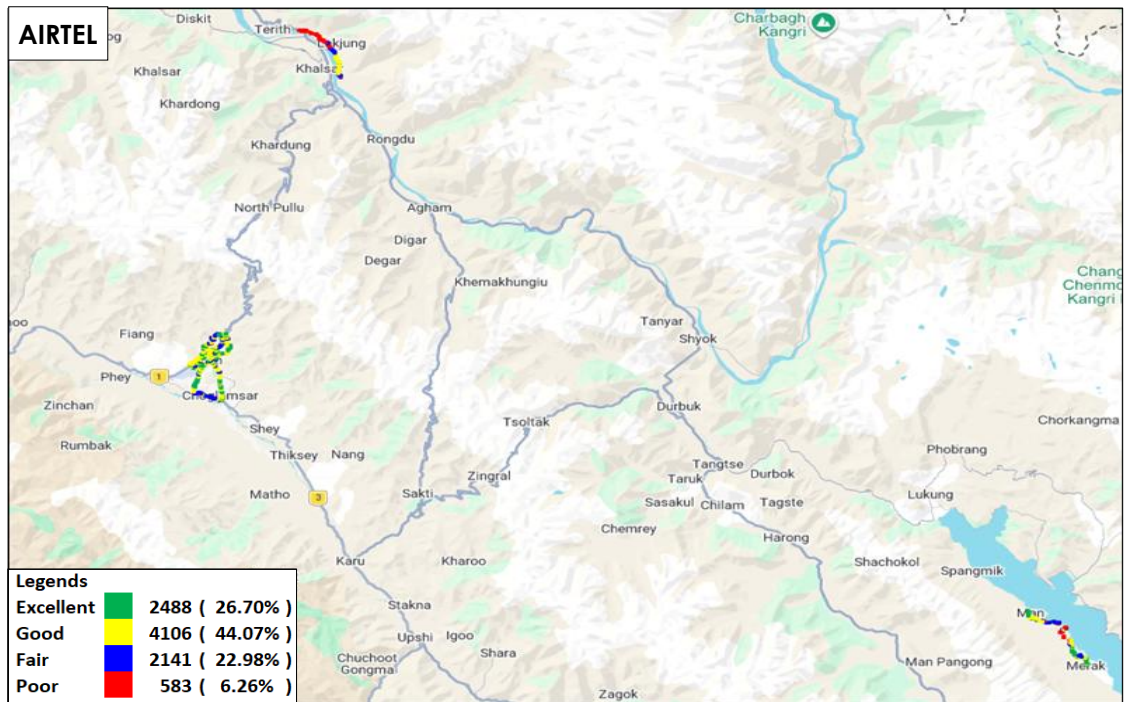


Figure-141: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

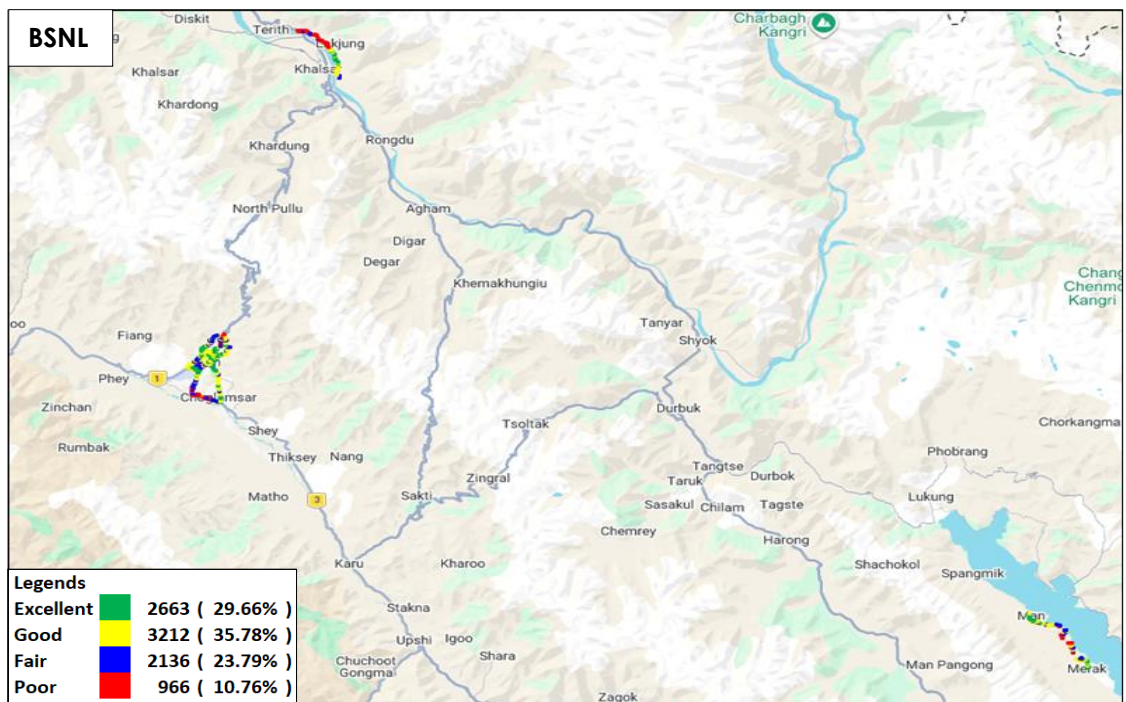


Figure-142: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

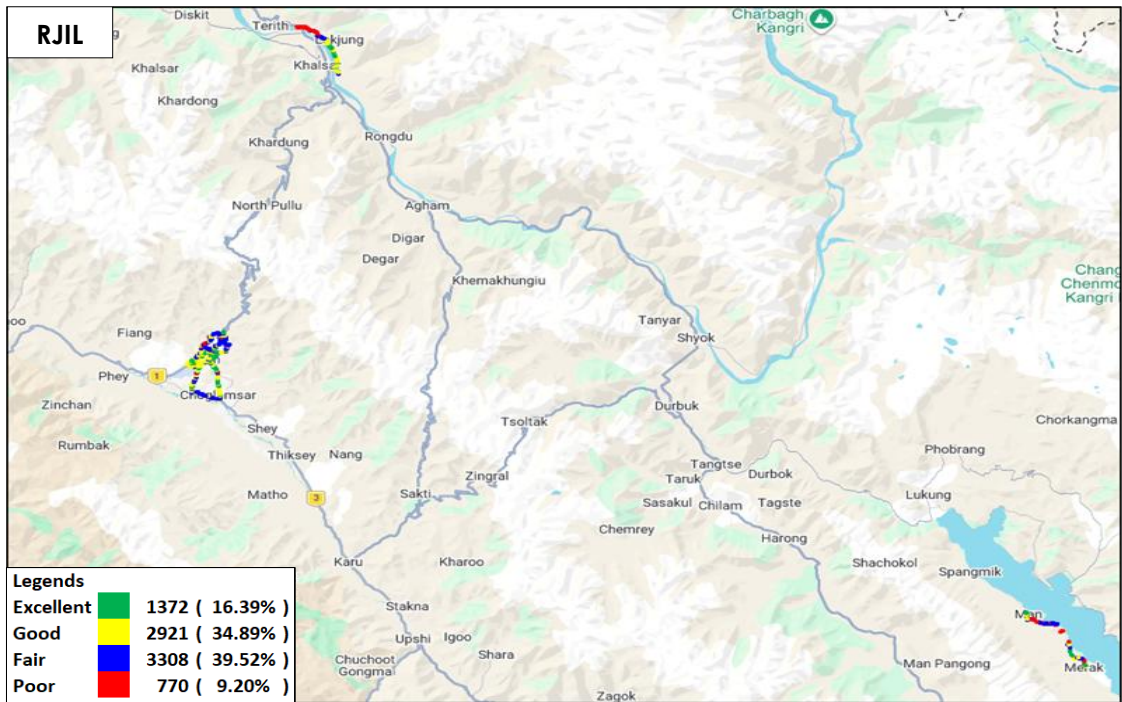


Figure-143: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

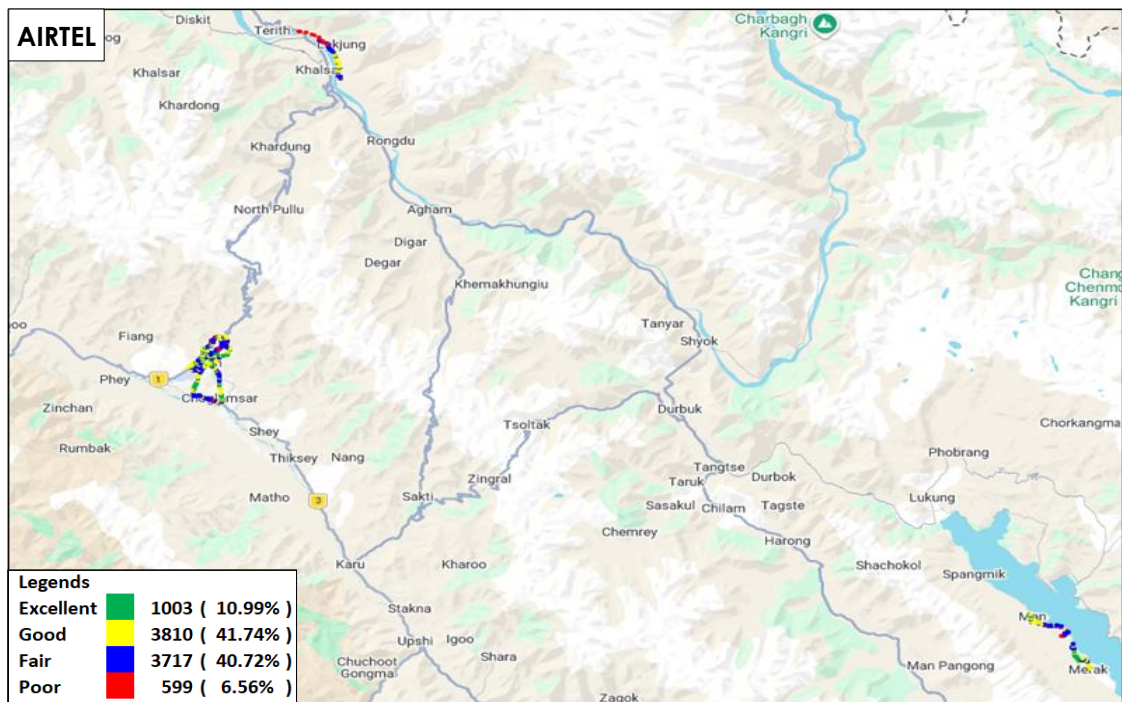


Figure-144: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

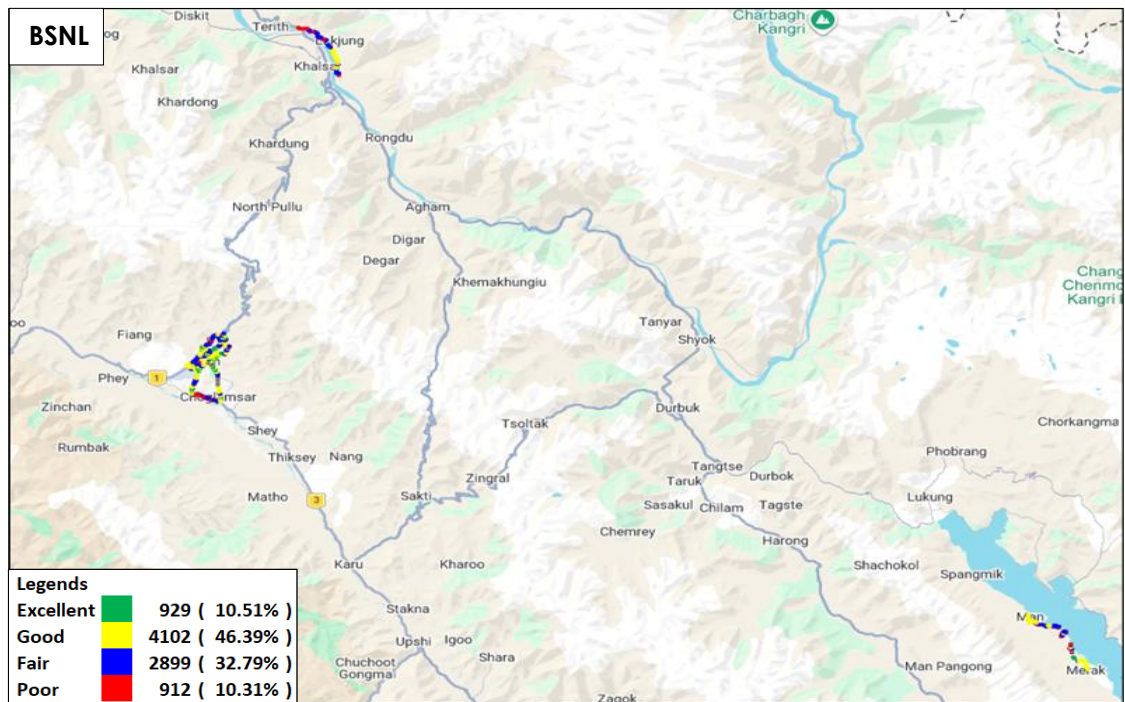


Figure-145: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

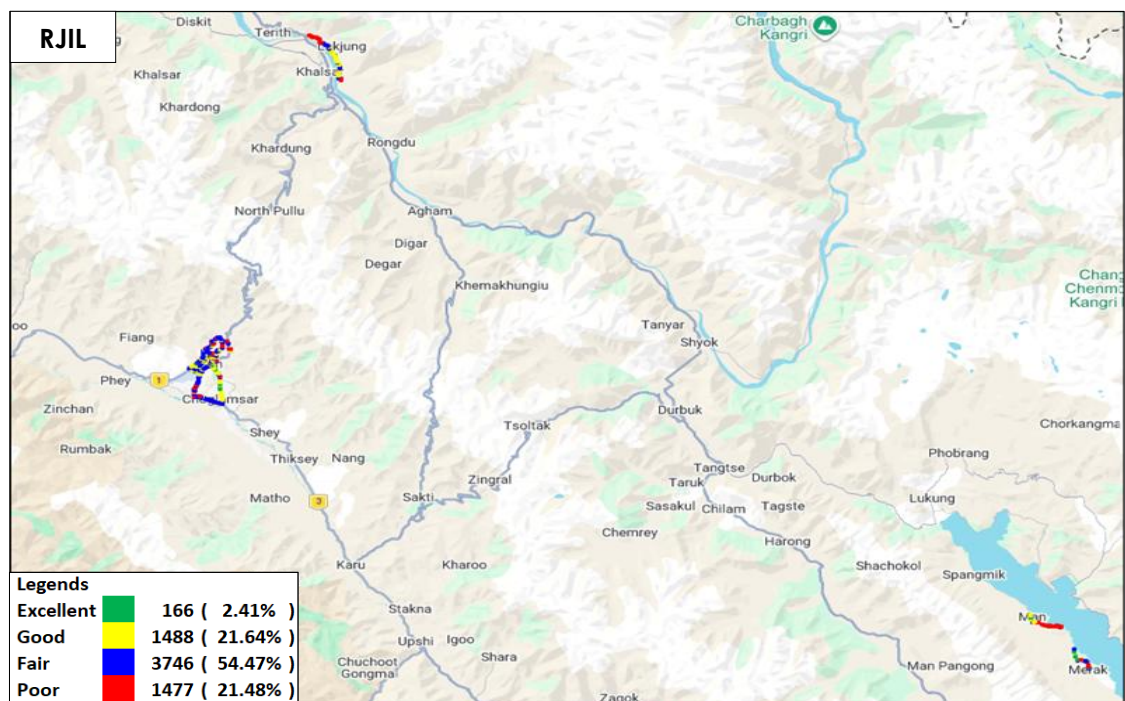


Figure-146: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

6.2.1 Highway

i) Leh to Nubra Valley

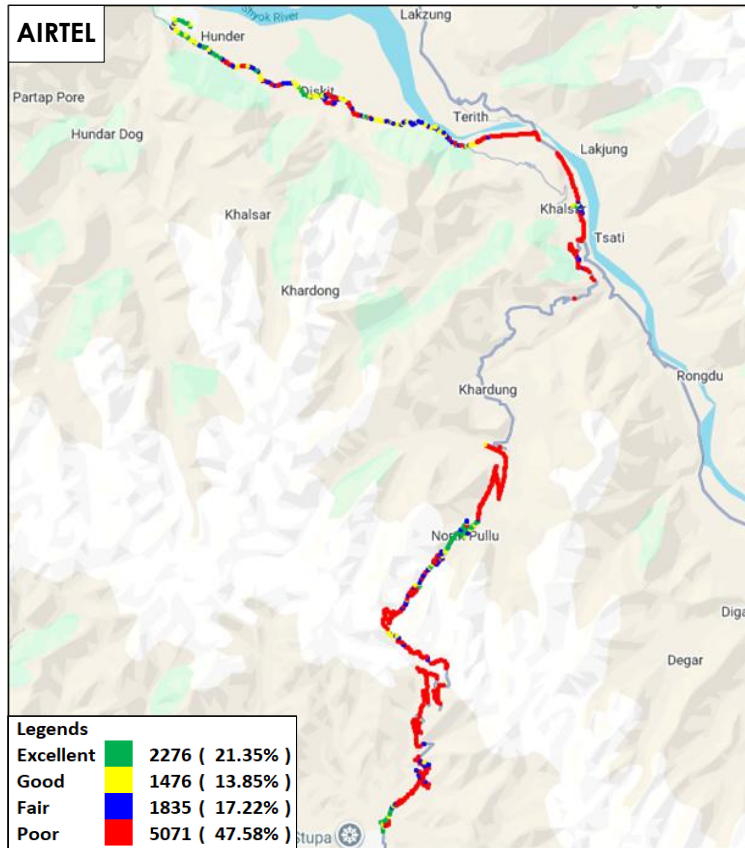


Figure-147: Signal strength 3G/2G network mode voice - AIRTEL.

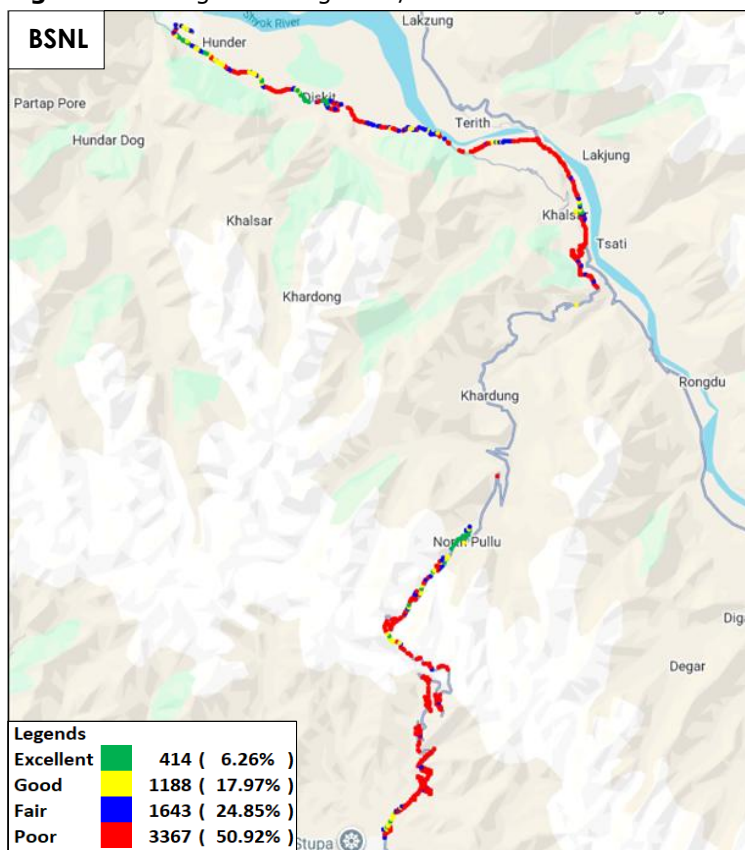


Figure-148: Signal strength 3G/2G network mode voice - BSNL.

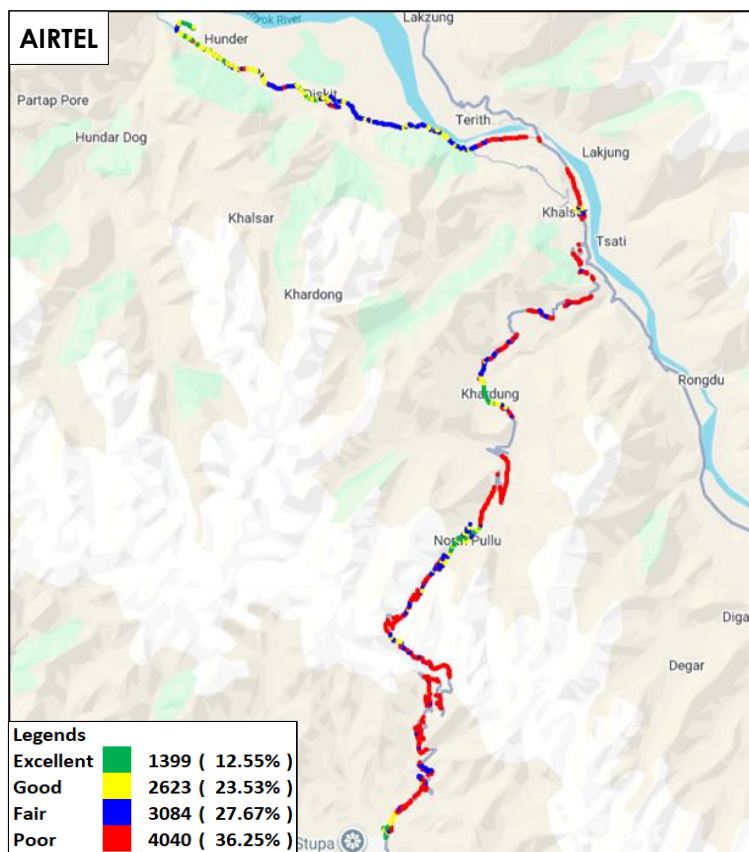


Figure-149: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

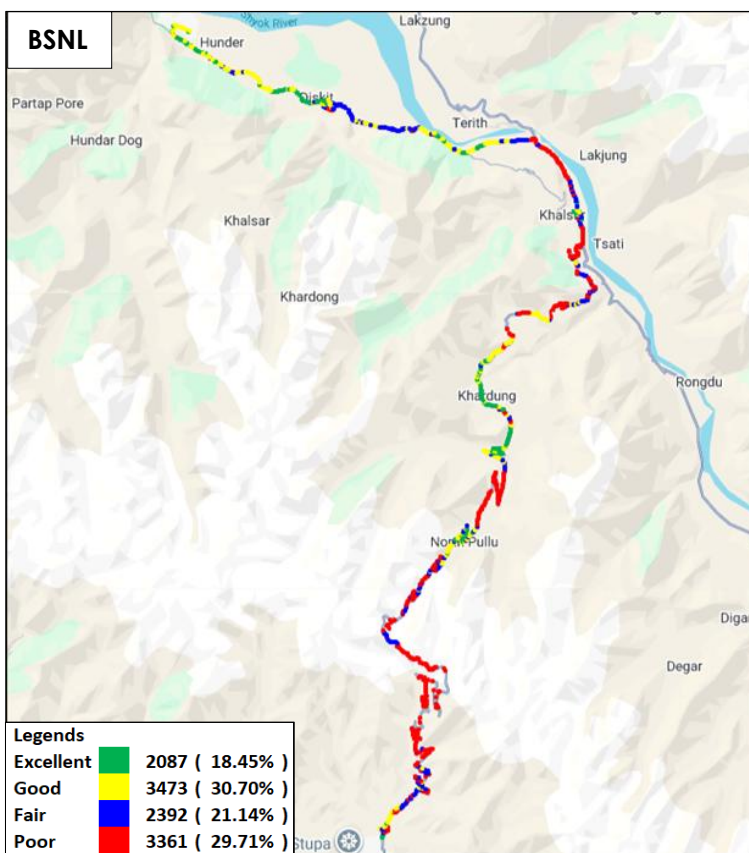


Figure-150: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

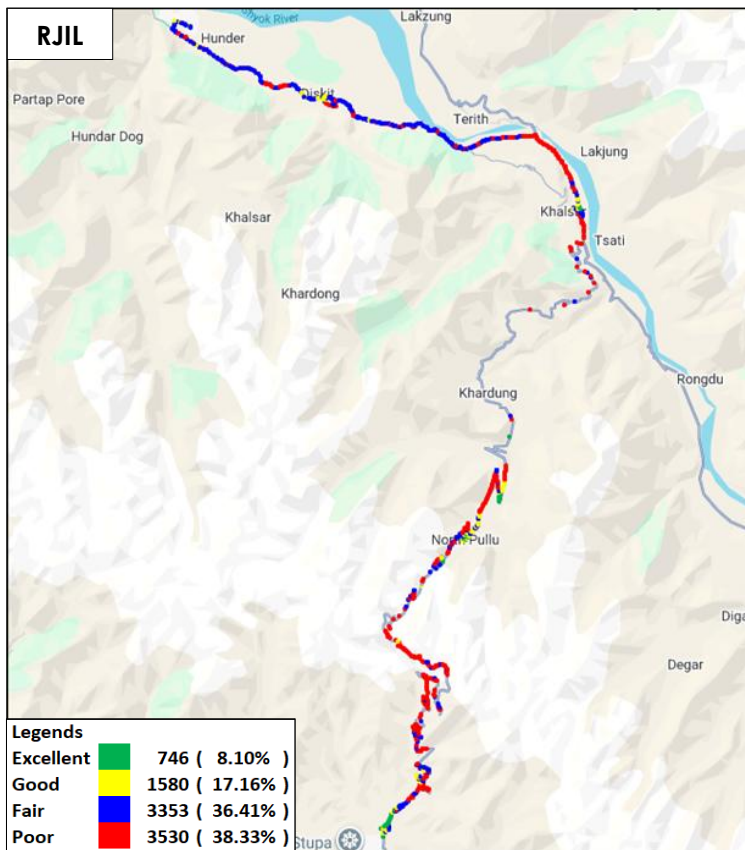


Figure-151: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

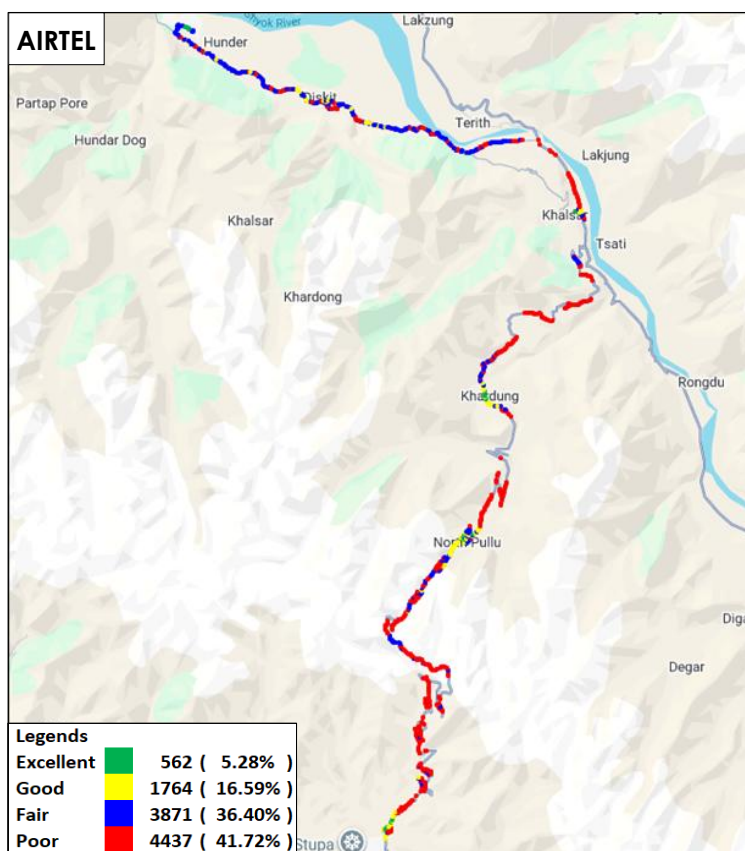


Figure-152: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

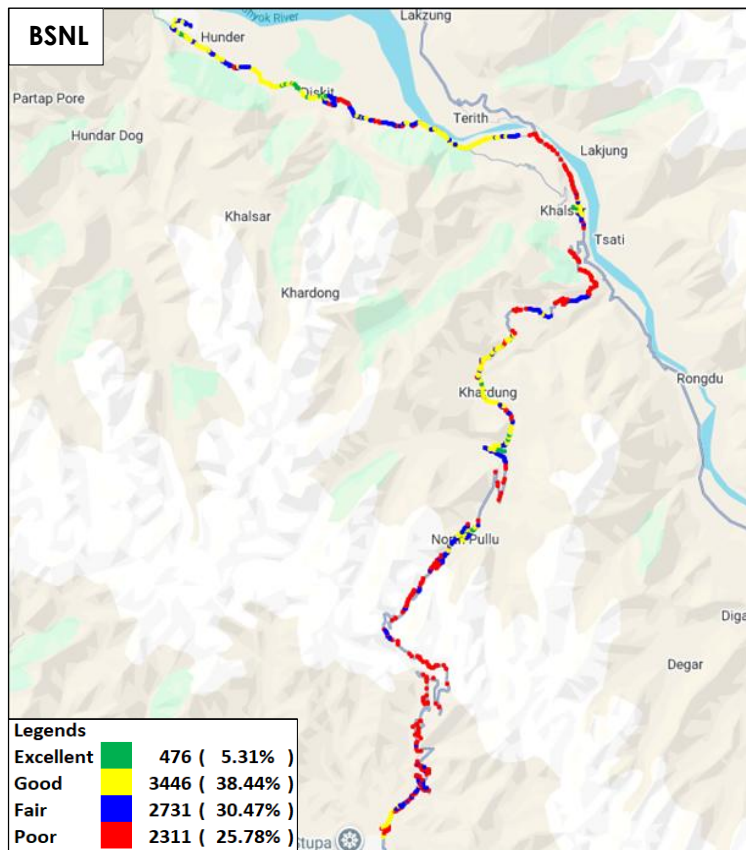


Figure-153: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

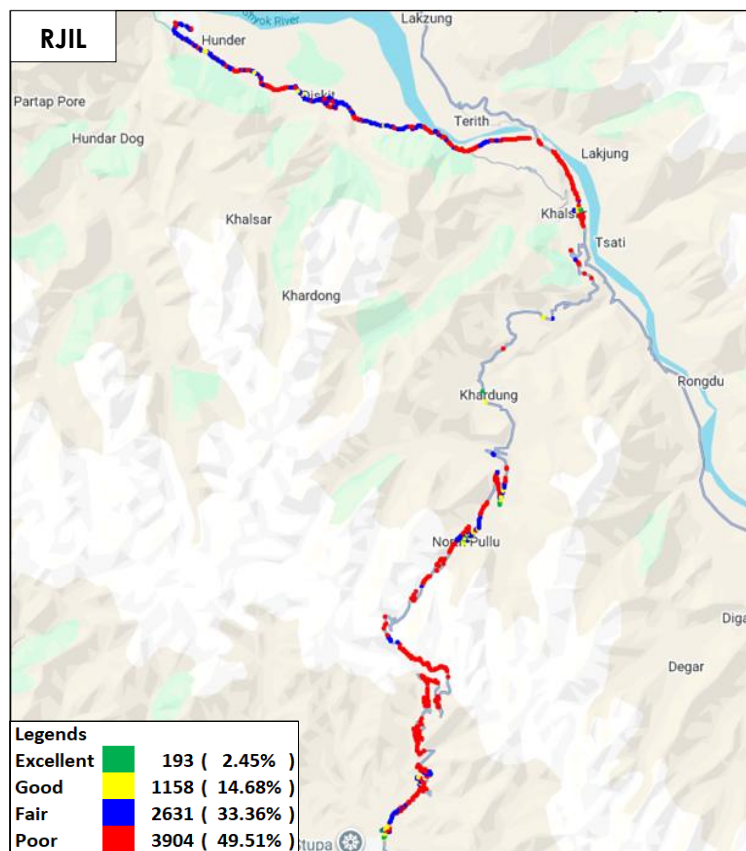


Figure-154: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

ii) Nubra Valley to Pangong

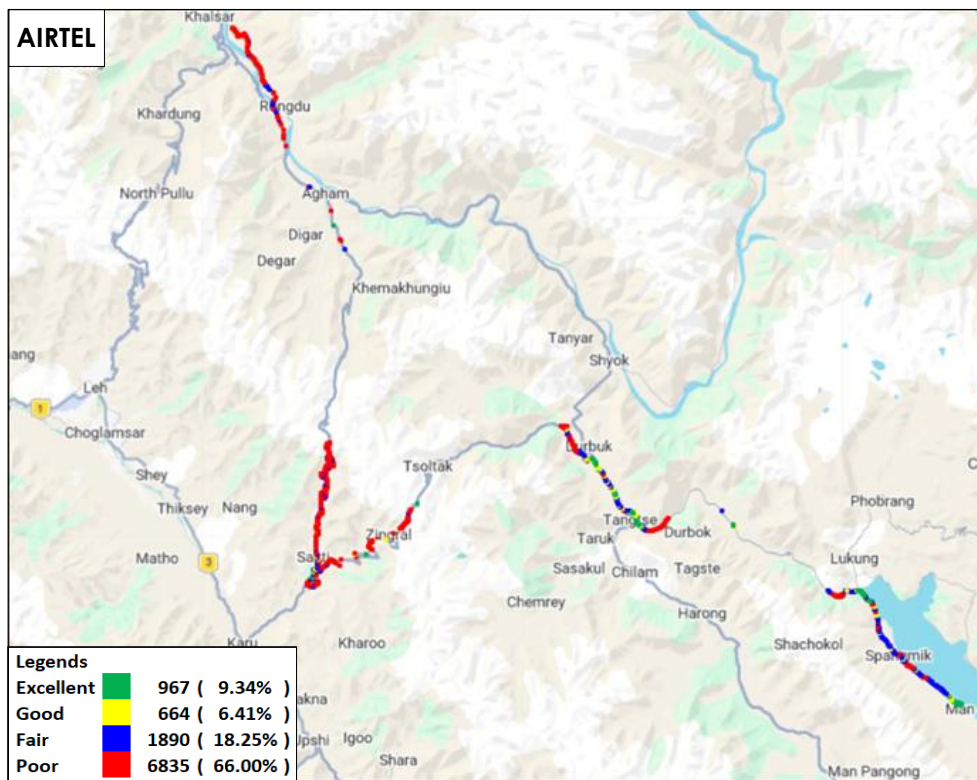


Figure-155: Signal strength 3G/2G network mode voice - AIRTEL.

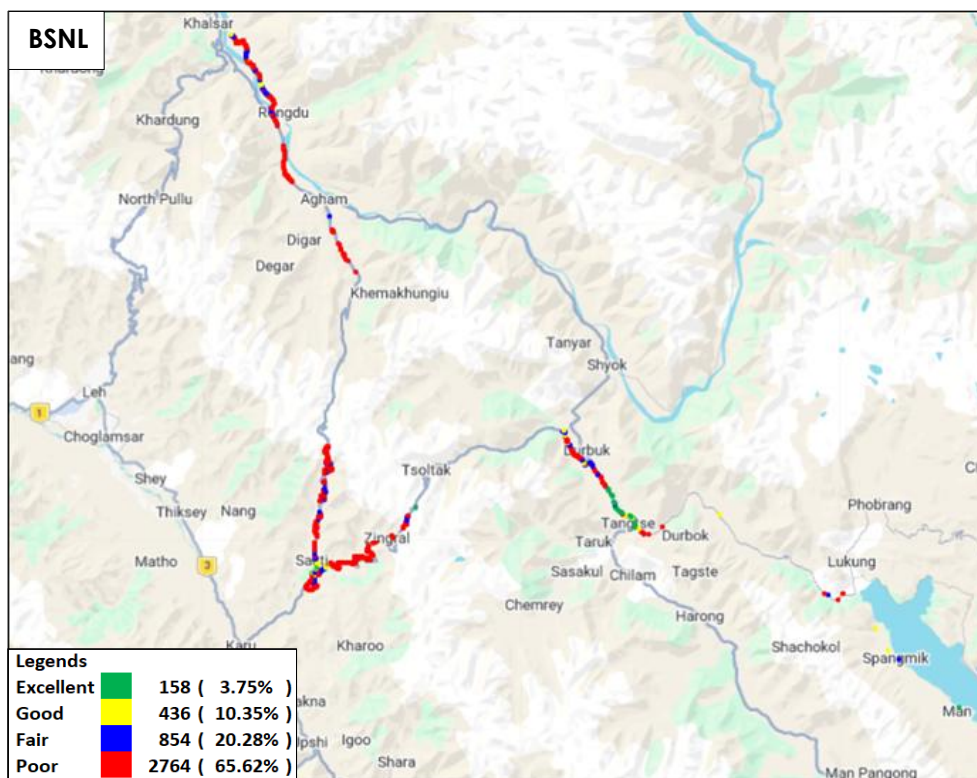


Figure-156: Signal strength 3G/2G network mode voice - BSNL.

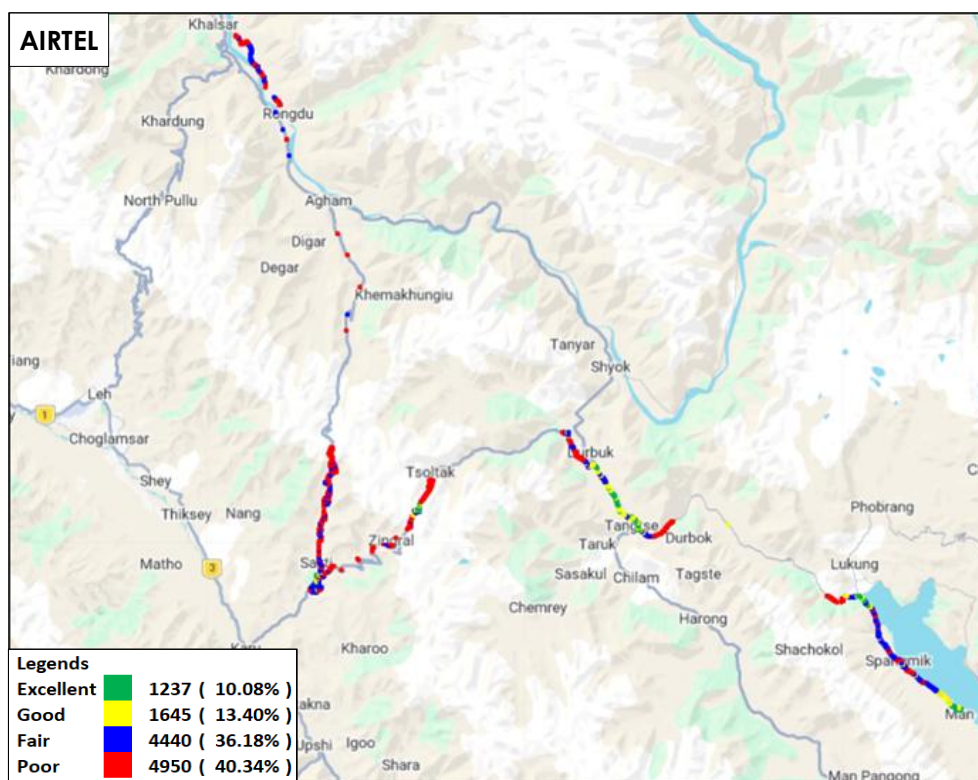


Figure-157: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

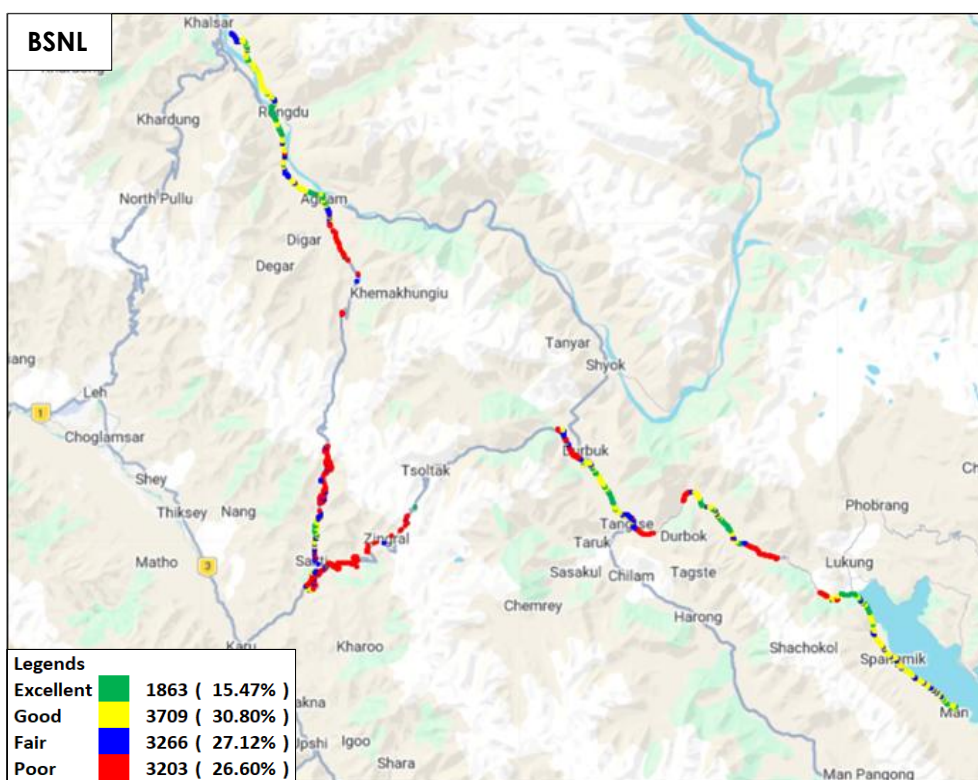


Figure-158: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

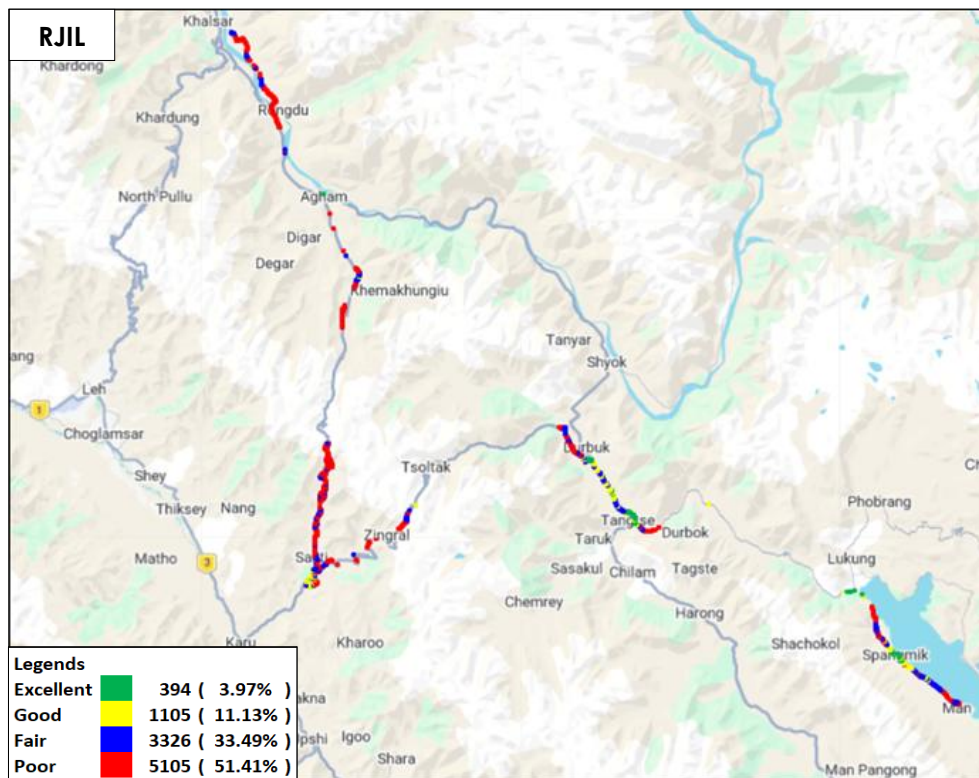


Figure-159: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

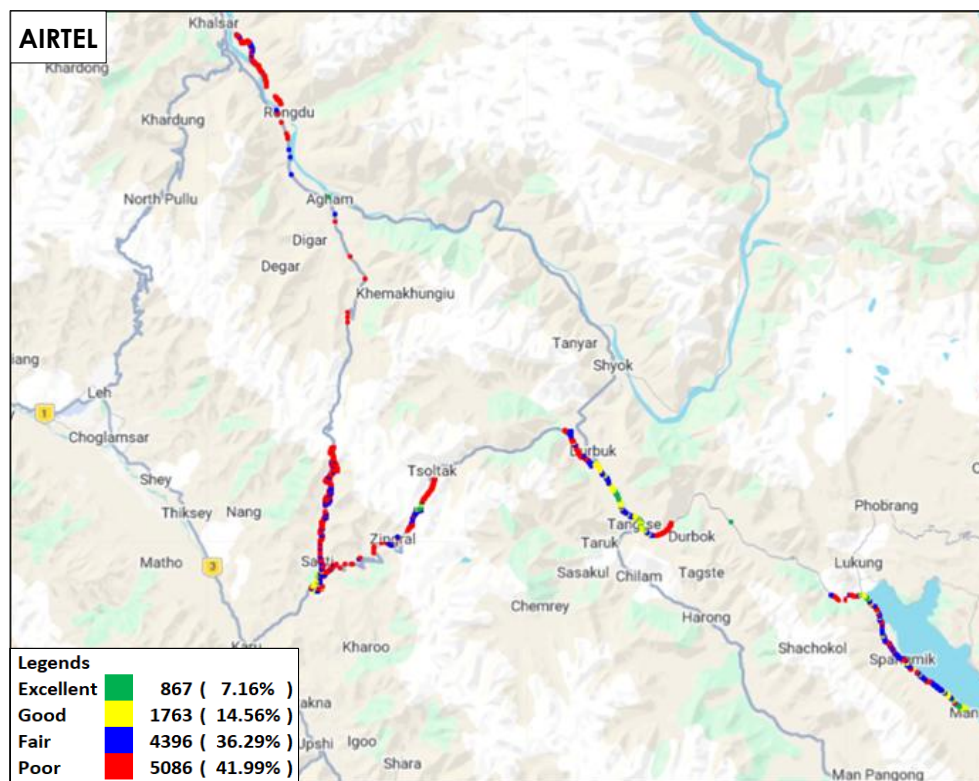
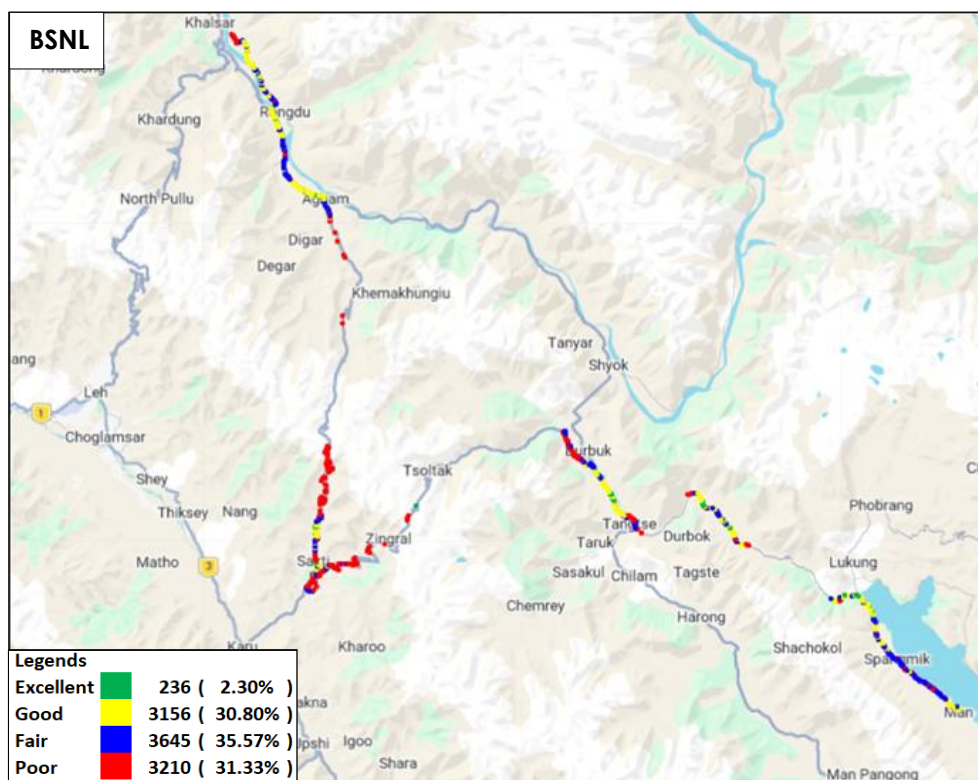
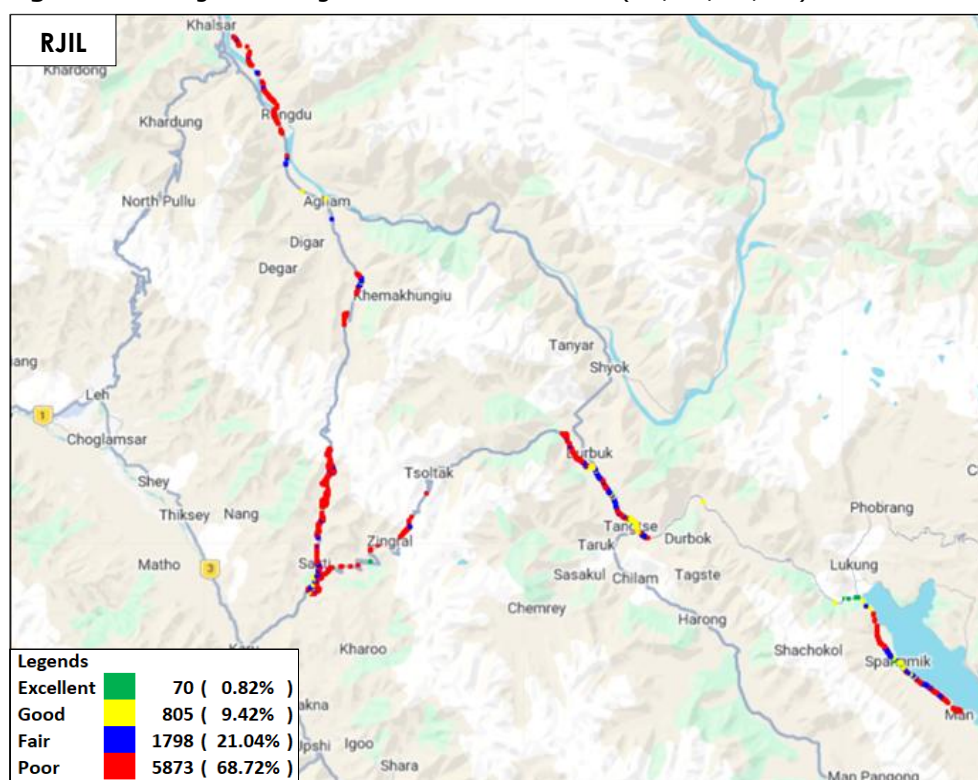


Figure-160: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.



iii) Sakti to Sangam



Figure-163: Signal strength 3G/2G network mode voice - AIRTEL.



Figure-164: Signal strength 3G/2G network mode voice - BSNL.



Figure-165: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.



Figure-166: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.



Figure-167: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.



Figure-168: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.



Figure-169: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.



Figure-170: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

7. Appendix

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

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

7.1 Appendix-I

7.1.1 Drive test setup

Voice Call		
Call details	Technology	Detail
Call Setup Timeout	<ul style="list-style-type: none"> • 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-71: Voice test detail

Note-

- There is 15 sec wait time after locking and before starting first call in 3G/2G call.
- 10 calls to be made at each Hotspot location.
- Minimum 10 Calls to be made during the walk test. Call count will be increased based on walk test distance.
- Speech quality (MOS) has been measured only in city drive & highway by making Mobile to Mobile call.
- 90/180 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-72: 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 and FTP Upload TCP and TWAMP testing, for Airtel
- Delhi-based TRAI server was used for HTTP Download, Upload, TCP and TWAMP testing for BSNL.
- RJIL server was used for FTP Download, FTP Upload, TCP and TWAMP testing, for RJIL.

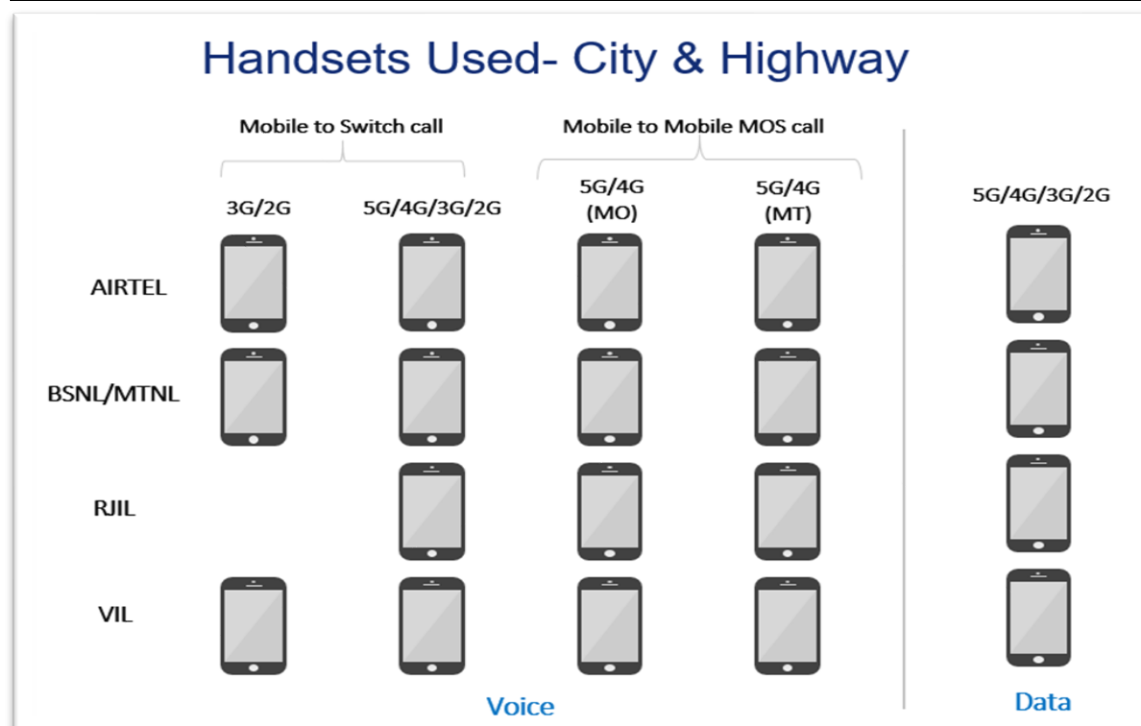


Figure-171: Number of handsets used in city & highway drive.

MO: Mobile originating

MT: Mobile terminating

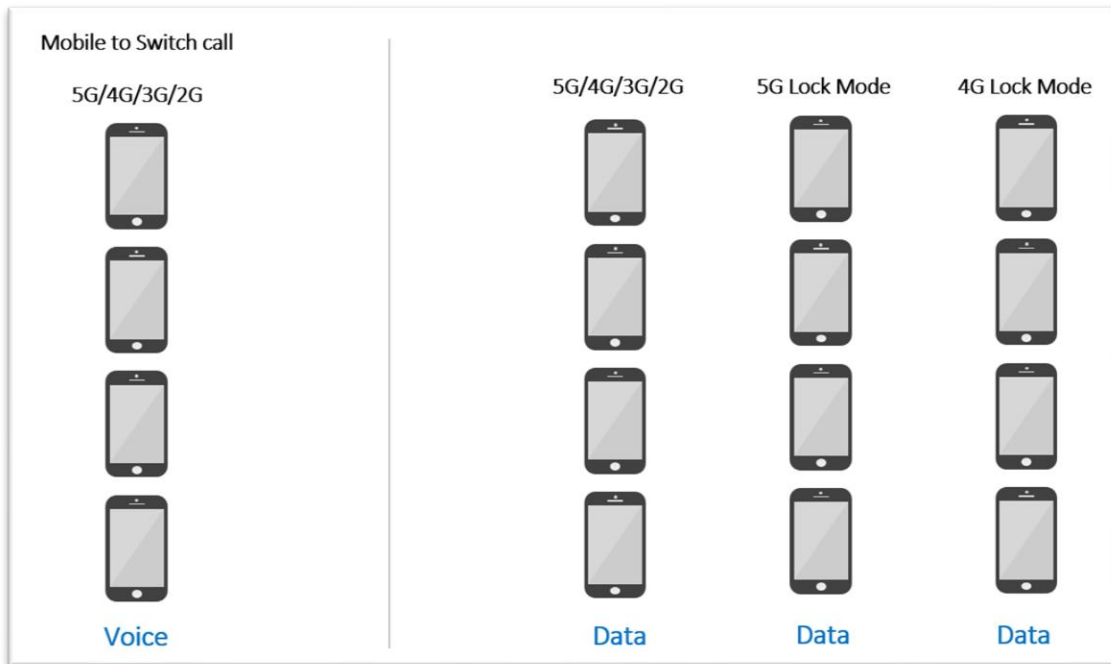


Figure-172: Number of handsets used in railway/metro/walktest/hotspot/ coastal area

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)

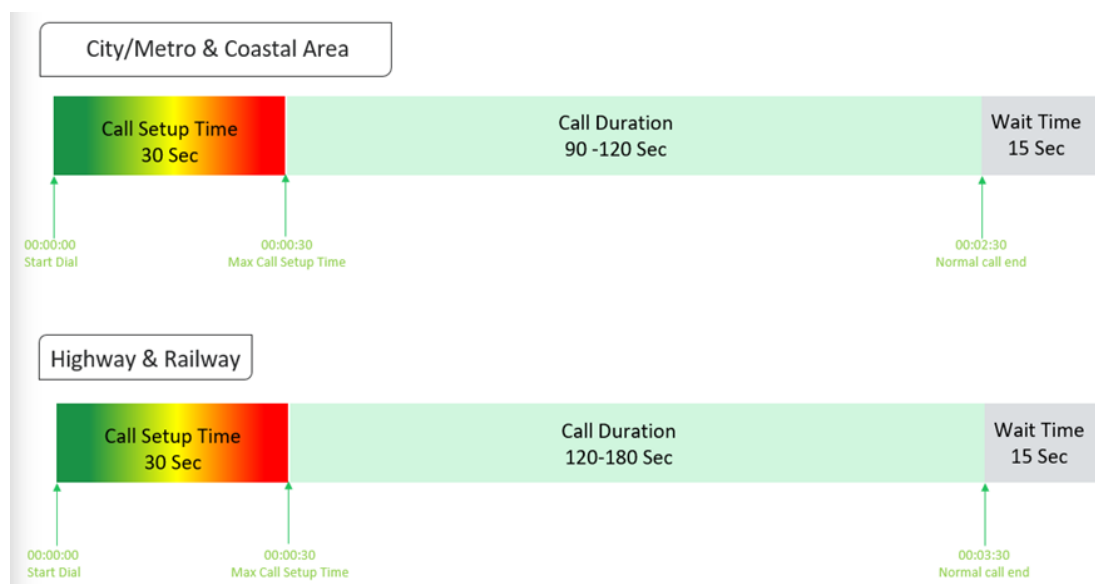


Figure-173: Voice test script for city/railway/metro/highway & coastal area

- 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-174: 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

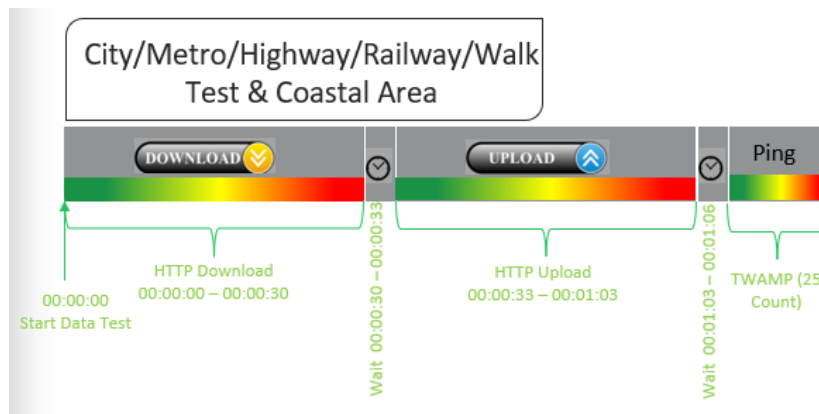


Figure-175: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

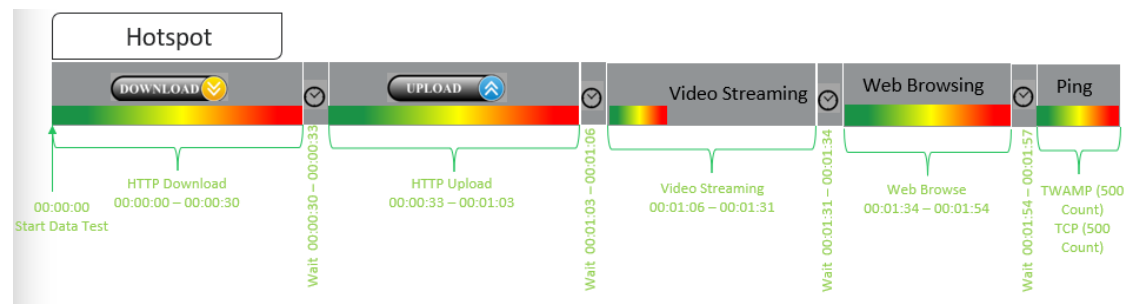


Figure-176: Data test script used at hotspot

- 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	<p>(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:</p> <ul style="list-style-type: none"> (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. <p>CSSR = (Total Call Established/ Total Call Attempt) *100</p> <p>As per QoS Regulation 2024 benchmark value is >=98%</p>
Drop Call Rate	<p>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</p> <p>Drop Call Rate = (Total Call Drop/Total Call Established) *100</p> <p>As per QoS Regulation 2024 benchmark value is <=2%</p>
Call Setup Time	<p>Time taken from call initiate to call alerting/ringing.</p> <p>Call Setup Time = T2- T1</p> <p>T2- Ringing (VoLTE/VoNR) & Alerting (for WCDMA & GSM), T1- Invite (VoLTE/VoNR) & CM Service Request (for WCDMA & GSM)</p>
Voice Quality (MOS)	<p>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:</p> <p>Excellent: MOS ≥ 4 and < 5 Good : MOS ≥ 3 and < 4 Fair : MOS ≥ 2 and < 3 Poor : MOS ≥ 1 and < 2</p>
Handover Success Rate	<p>Handover Success Rate = Count of successful handovers (All Technology Handover combined) / Total count of Handover Attempt (All Technology Handover combined) *100</p> <p>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.</p>
Silence Call	<p>A call which has ≥ 4 sec continuous RTP gap is considered as a Silence Call.</p> <p>Silence call rate = (count of silence call / Total calls established) *100</p> <p>If a call observes multiple silence count ≥ 4 sec in a particular established call it has been taken as one silent event.</p>

Jitter	<p>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 S_i is the RTP timestamp from packet i, and R_i 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:</p> <p>$D(i,j) = (R_j - R_i) - (S_j - S_i)$</p> <p>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</p> <p>$J(i) = J(i-1) + (D(i-1,i) - J(i-1))/16$ or 8</p>																																		
Downlink Packet Drop Rate	<p>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.</p> <p>This KPI is calculated from MOS call for packet call only (VoNR/VoLTE)</p>																																		
Uplink Packet Drop Rate	<p>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).</p>																																		
Signal Strength	<p>Signal strength is the signal power level received by the wireless user.</p> <table><tr><th rowspan="2">Parameter Name</th><th rowspan="2">Technology</th><th colspan="4">Signal Strength (dBm)</th></tr><tr><th>Excellent</th><th>Good</th><th>Fair</th><th>Poor</th></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>	Parameter Name	Technology	Signal Strength (dBm)				Excellent	Good	Fair	Poor	Rx Level	GSM	0 to ≥ -65	<-65 to ≥ -75	<-75 to ≥ -85	<-85 to min	RSCP	WCDMA	0 to ≥ -70	<-70 to ≥ -80	<-80 to ≥ -90	<-90 to min	RSRP	LTE	0 to ≥ -80	<-80 to ≥ -95	<-95 to ≥ -110	<-110 to min	SS_RSRP	NR	0 to ≥ -80	<-80 to ≥ -95	<-95 to ≥ -110	<-110 to min
Parameter Name	Technology			Signal Strength (dBm)																															
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RSCP	WCDMA	0 to ≥ -70	<-70 to ≥ -80	<-80 to ≥ -90	<-90 to min																														
RSRP	LTE	0 to ≥ -80	<-80 to ≥ -95	<-95 to ≥ -110	<-110 to min																														
SS_RSRP	NR	0 to ≥ -80	<-80 to ≥ -95	<-95 to ≥ -110	<-110 to min																														

Table-73: Network performance parameter and definition voice

7.2.2 Network Performance Parameters Data tests

Parameter Name	Definition
Download Speed (Mbps)	<p>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.</p> <p>Download Speed = Total bytes transferred during download / Total time for transfer</p> <ul style="list-style-type: none"> 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)	<p>The upload speed is the data transmission rate that is achieved for uploading a test file from a test device to a test server.</p> <p>Upload Speed = Total bytes transferred during upload / Total time for transfer.</p> <ul style="list-style-type: none"> 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	<p>(total download session established (successfully connected to server)/ total download session attempt) *100.</p> <p>This KPI has been calculated for Hotspot only.</p>

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	<p>Web browsing test is used to measure performance in terms of opening a web/HTTP page.</p> <p>Time taken to open the web page successfully is considered as web browsing delay/web page download time.</p>
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)	<p>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.</p> <p>The Latency is measured in milliseconds (ms).</p> <p>To calculate the one-way latency, we just do half of the round-trip time. 50th percentile of one-way latency has been reported.</p>
Jitter (TWAMP-UDP)	<p>Measure of variation in time in arrival of packets from a source to destination</p> <p>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</p> <p>$IPDV(i) = D(i) - D(i-1)$ then Stdvs of IPDV is considered as jitter.</p>
Packet Loss Rate (TWAMP-UDP & TCP)	<p>Number of packets lost out of total packet transferred during test. Packet loss rate = (Total packet lost / Total packet sent) *100</p> <p>* Packet delay (using TWAMP-UDP & TCP) >90 ms considered as packet loss and included in packet loss rate.</p> <p>* Packet loss rate is calculated based on TWAMP-UDP & TCP.</p> <p>*90th percentile for Packet loss rate has been reported in overall Hotspot performance summary.</p>

Table-74: Network performance parameter and definition Data

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

Hardik
Rajeshbhai
Patel

Digitally signed by
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Patel
Date: 2026.09.17
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