भादूविप्रा
TRAI

TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Karnataka LSA

August 2025

Contents

1. Introduction

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

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

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

2. Executive Summary (LSA)

2.1 Drive test details

This report covers the findings of the IDT undertaken in Karnataka License Service Area (LSA) during the month of Aug-2025 under the supervision of TRAI Regional Office (RO) Bengaluru. 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	Hubballi	City	249.5	05-Aug-2025	06-Aug-2025
2	Hubballi	Inter Operator Calling	1 Location	08-Aug-2025	08-Aug-2025
3	Hubballi	Hotspot	9 Locations	07-Aug-2025	08-Aug-2025
4	Hubballi	Walk Test	10.5	05-Aug-2025	07-Aug-2025
5	Hubballi–Haveri–Sirsi–Yellapura Hubballi Junction	Highway	261.0	05-Aug-2025	05-Aug-2025

Table-1: Drive test summary

2.2 Drive test routes

The map provides overview of drive test routes indicating city drive, inter-operator calls test, hotspots, walk test and highway drive as per the legends shown on the map.

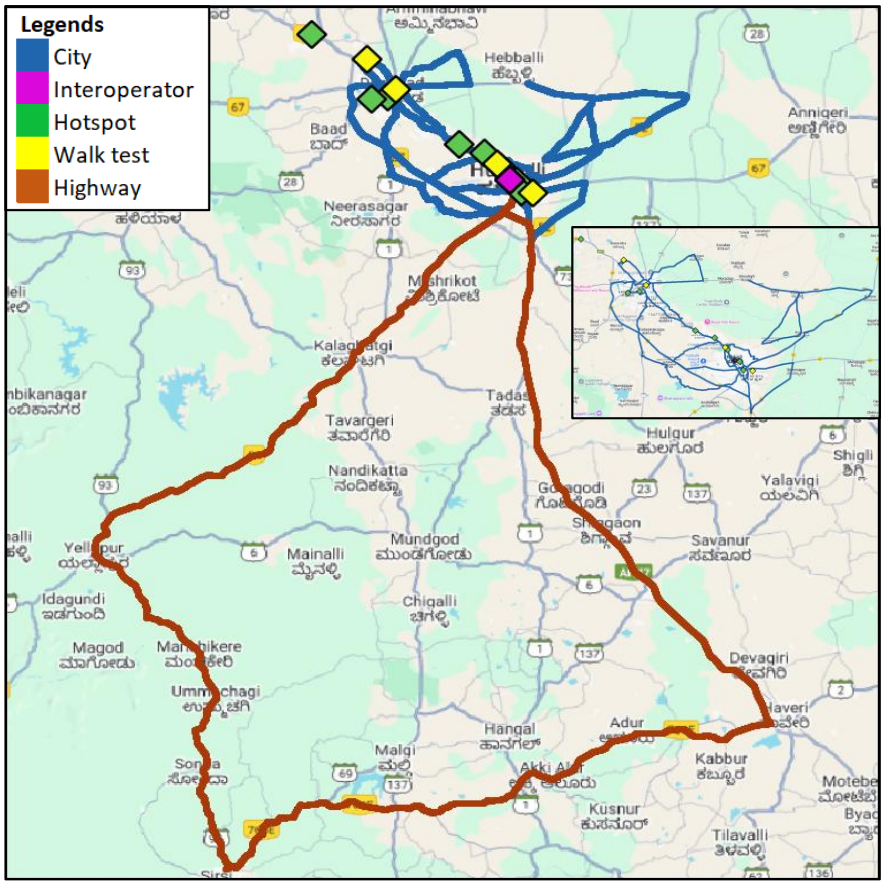


Figure-1: Drive test routes

2.3 Summary of areas covered

a) City-Kavalgeri, Dharwad, Kelgeri, Gulaganjikoppa, Malmaddi, Saptapur, Gandhi Nagar, Sattur Colony, Amargol, Rajnagar, Keshwapur, Durgad Bail, Kasugal, Hebsur, Byahatti, Shivahalli, Revadihal and Yerikoppa etc.

b) Hotspot-

1. APMC Market Hubballi
2. Chandramouleshwara Temple Unkal Hubballi
3. Deputy Commissioner office Dharwad
4. High Court Bench Dharwad
5. Hubballi-Dharwad Municipal Corporation (HDMC)
6. KIMS Hospital Hubballi
7. KSRTC Bus Stand Hubballi
8. RTO office Dharwad
9. Saptapur Circle Dharwad

c) Walk Test

1. Hubballi Railway Junction
2. KSRTC Old Bus Stand Dharwad
3. Unakal Lake
4. University Of Agricultural Sciences Dharwad

d) Highway

Hubballi–Haveri–Sirsi–Yellapur Hubballi Junction passing through Gabbur, Pale, Varur, Tadas Cross, Jigalur, Shiggaon, Aladakatti, Gourapura, Sangur, Balambeed, Goudalli, Sirsi, Agsal, Sonda, Chawadi and Yellapur Devikoppa etc.

2.4 Telecom service providers detected frequency bands

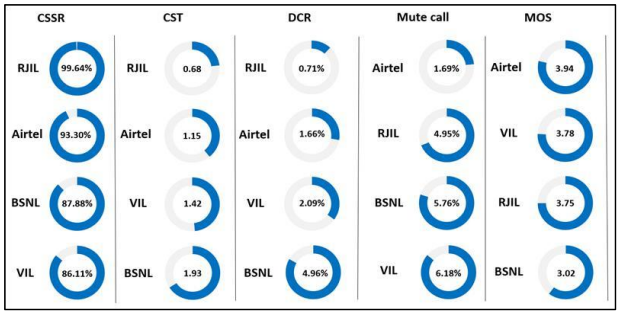
Technologies covered during the IDT and frequency bands in use are summarised in table below:

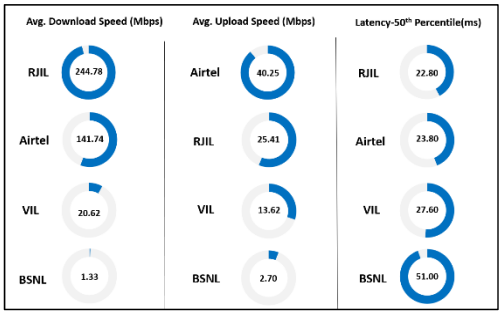
S.no.	Name of TSP	Technology	Frequency Bands (In MHz)
1	Bharti Airtel Ltd.	2G	900
2	Bharti Airtel Ltd.	4G	900,1800,2100,2300
3	Bharti Airtel Ltd.	5G	3500
4	BSNL	2G	900
5	BSNL	3G	2100
6	BSNL	4G	700,2100
7	Reliance JIO Infocomm Ltd.	4G	850,1800,2300
8	Reliance JIO Infocomm Ltd.	5G	700,3500
9	Vodafone Idea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

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

2.5 Performance against key QoS parameters

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





Summary-Voice services

Call Setup Success Rate: Airtel, BSNL, RJIL and VIL have 93.30%, 87.88%, 99.64% and 86.11% call setup success rate respectively in Auto-selection mode (5G/4G/3G/2G).

Call Setup Time: Airtel, BSNL, RJIL and VIL have call setup time of 1.15, 1.93, 0.68 and 1.42 seconds respectively in Auto-selection mode (5G/4G/3G/2G).

Drop Call Rate: Airtel, BSNL, RJIL and VIL have drop call rate of 1.66%, 4.96%, 0.71% and 2.09% respectively in Auto-selection mode (5G/4G/3G/2G).

Call Silence/Mute Rate: Airtel, BSNL, RJIL and VIL have silence call rate 1.69%, 5.76%, 4.95% and 6.18% respectively in packet switched network (4G/5G).

Mean Opinion Score (MOS): Airtel, BSNL, RJIL and VIL have average MOS of 3.94, 3.02, 3.75 and 3.78 respectively.

Summary-Data services

Data Download performance (Overall): Average download speed of Airtel (5G/4G/2G) is 141.74 Mbps, BSNL (4G/3G/2G) is 1.33 Mbps, RJIL (5G/4G) is 244.78 Mbps and VIL (4G/2G) is 20.62 Mbps.

Data Upload performance (Overall): Average upload speed of Airtel (5G/4G/2G) is 40.25 Mbps, BSNL (4G/3G/2G) is 2.70 Mbps, RJIL (5G/4G) is 25.41 Mbps and VIL (4G/2G) is 13.62 Mbps.

Latency (Overall): Airtel, BSNL, RJIL and VIL 50th percentile latency is 23.80 ms, 51.00 ms, 22.80 ms and 27.60 ms.

Data performance - Hotspots (in Mbps):

Airtel- 4G D/L: 53.39 4G U/L: 20.41
5G D/L: 177.98 5G U/L: 57.92
BSNL-4G D/L: 1.72 4G U/L: 4.45
RJIL- 4G D/L: 31.54 4G U/L: 6.34
5G D/L: 354.49 5G U/L: 31.01
VIL- 4G D/L: 31.65 4G U/L: 26.32

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

QoS Performance Analysis- Karnataka LSA

3. QoS performance analysis-LSA level

3.1 Overview

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

3.2 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	385	433	430
Call Setup Success Rate %	93.51	83.60	79.30
Drop Call Rate %	2.22	6.91	3.81
Call Setup Time-Average (Second)	4.92	3.07	3.98
Handover Success Rate %	98.20	99.79	96.69

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

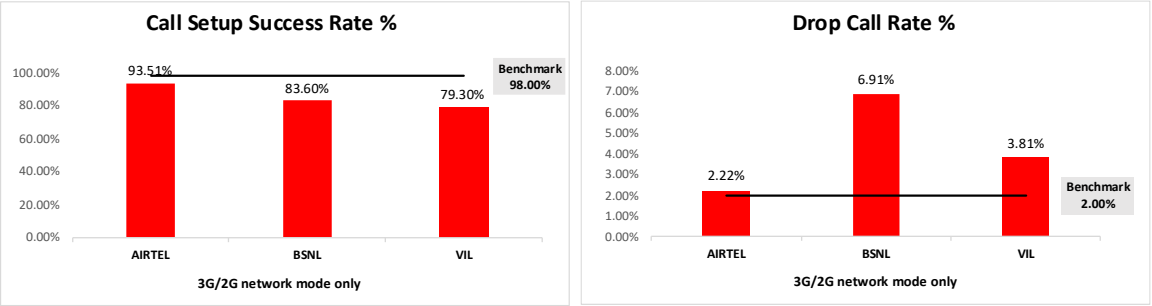


Figure-2: Call setup success rate and drop call rate performance.

Number of unique cell Id's covered in Voice test- Technology wise			
Technology	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
3G	NA	151	NA
2G	559	183	336

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

Note-
- RJIL does not have 3G/2G network.
- NA- Service provider doesn't provide services in respective technology.

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	582	619	562	612
Call Setup Success Rate %	93.30	87.88	99.64	86.11
Drop Call Rate %	1.66	4.96	0.71	2.09
Call Setup Time-Average (Second)	1.15	1.93	0.68	1.42
Handover Success Rate %	99.83	99.82	99.72	99.78

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

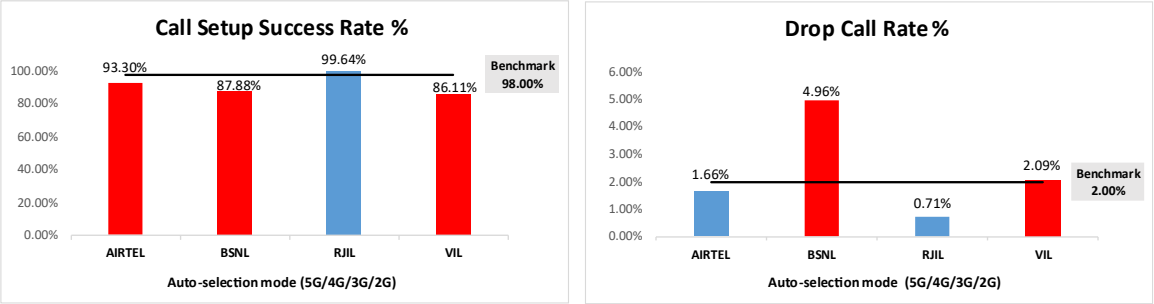


Figure-3: Performance for call setup success rate and drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	354	382	364	356
Number of silence call for >4 Sec	6	22	18	22
Silence Call Rate %	1.69	5.76	4.95	6.18
Number of silence instances for >4 Sec	9	28	29	33
Number of silence instances for >3 Sec	16	48	45	72
Number of silence instances for >2 sec	35	103	75	112
RTP Jitter (4G & 5G) in ms	3.93	8.16	9.54	14.34
Packet loss Rate Downlink %	1.05	7.08	2.16	2.97
Packet loss Rate Uplink %	1.04	8.28	2.39	2.36

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

Number of unique cell Id's covered in Voice test- Technology wise				
Technology	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
5G	0	NA	339	NA
4G	1006	342	1594	706
3G	NA	61	NA	NA
2G	5	169	NA	91

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

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

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls table-6	2491	1955	2561	2247
Speech Quality (Average MOS)	3.94	3.02	3.75	3.78
Number of samples with MOS >=4 to <5 (Excellent)	1940	567	1609	1387
Number of samples with MOS >=3 to <4 (Good)	439	478	682	595
Number of samples with MOS >=2 to <3 (Fair)	59	528	135	113
Number of samples with MOS >=1 to <2 (Poor)	53	382	135	152
%age of samples with MOS >=4 to <5 (Excellent)	77.88%	29.00%	62.83%	61.73%
%age of samples with MOS >=3 to <4 (Good)	17.62%	24.45%	26.63%	26.48%
%age of samples with MOS >=2 to <3 (Fair)	2.37%	27.01%	5.27%	5.03%
%age of samples with MOS >=1 to <2 (Poor)	2.13%	19.54%	5.27%	6.76%

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

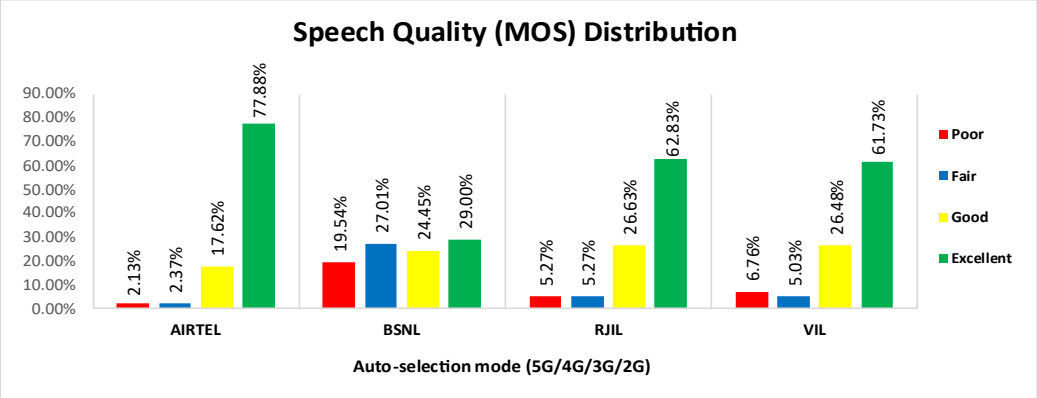


Figure-4: Distribution of samples in MOS range.

(d) Inter-service provider voice call performance: To check the performance of inter-service provider call setup success rate, total 12 to 16 inter operator calls were attempted at one location which is Hubballi-Dharwad Municipal Corporation (HDMC). The Call setup success rate and call setup time observation are as below.

Call Setup Success Rate %				
From Service Provider	To Service Provider			
	AIRTEL	BSNL	RJIL	VIL
AIRTEL	NA	100.00	100.00	100.00
BSNL	100.00	NA	93.75	100.00
RJIL	100.00	100.00	NA	100.00
VIL	100.00	100.00	100.00	NA

Table-9: Call setup success rate across service providers

Note-

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

Call setup time average (seconds)				
From Service Provider	To Service Provider			
	AIRTEL	BSNL	RJIL	VIL
AIRTEL	NA	2.19	2.22	1.95
BSNL	3.08	NA	2.80	2.99
RJIL	1.90	2.31	NA	1.90
VIL	3.33	2.47	2.85	NA

Table-10: Call setup time across service providers

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

3.3 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	141.74	1.33	244.78	20.62
	80th Percentile	230.09	2.03	425.25	31.99
	20th Percentile	39.80	0.45	46.78	4.79
Upload Throughput (Mbits/s)	Average	40.25	2.70	25.41	13.62
	80th Percentile	78.11	3.92	45.91	22.44
	20th Percentile	7.90	0.69	4.58	2.83
Latency (ms)	50th Percentile	23.80	51.00	22.80	27.60

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

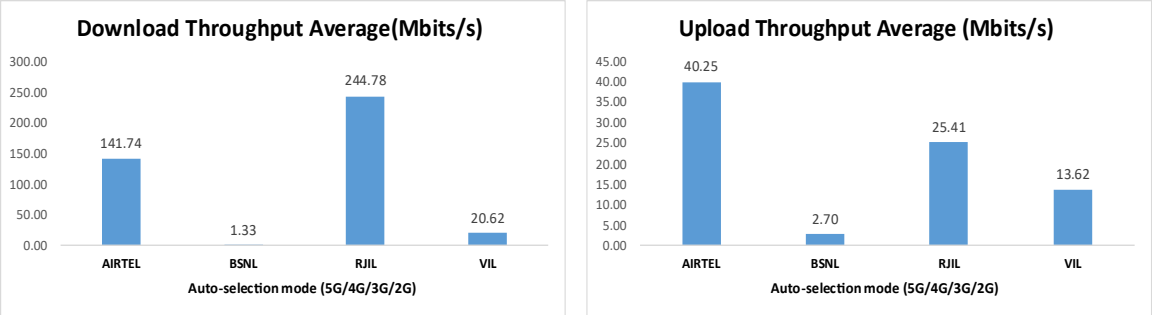


Figure- 5: Download and Upload throughput

Number of unique cell Id's covered in Data test- Technology wise				
Technology	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
5G	0	NA	604	NA
4G	1242	325	505	758
3G	NA	134	NA	NA
2G	5	43	NA	55

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

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

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis

4.1 Overview

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

4.2 City

Drive test has been conducted from 05th Aug 2025 to 06th Aug 2025 in Hubballi. (Refer Table-1)

4.2.1 Drive test route

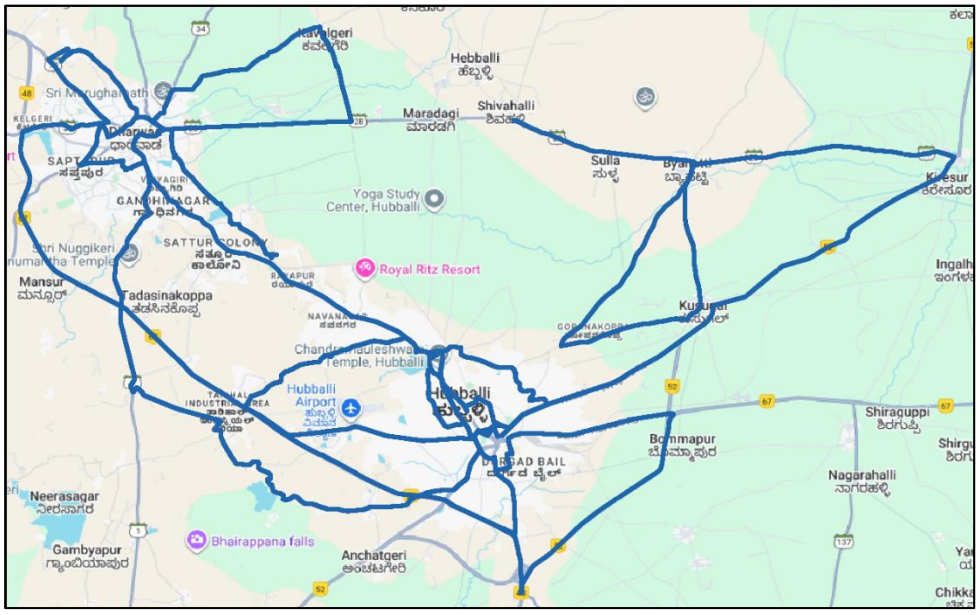


Figure- 6: Drive test routes

4.2.2 Areas covered

Nearby Kavalgeri, Dharwad, Kelgeri, Gulaganjikoppa, Malmaddi, Saptapur, Gandhi Nagar, Sattur Colony, Amargol, Rajnagar, Keshwapur, Durgad Bail, Kasugal, Hebsur, Byahatti, Shivahalli, Revadihal and Yerikoppa etc.

4.2.3 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	267	271	269
Call Setup Success Rate %	98.88	98.52	98.88
Drop Call Rate %	0.00	0.75	2.26
Call Setup Time-Average (Second)	4.83	2.99	3.70
Handover Success Rate %	98.44	99.78	96.99

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

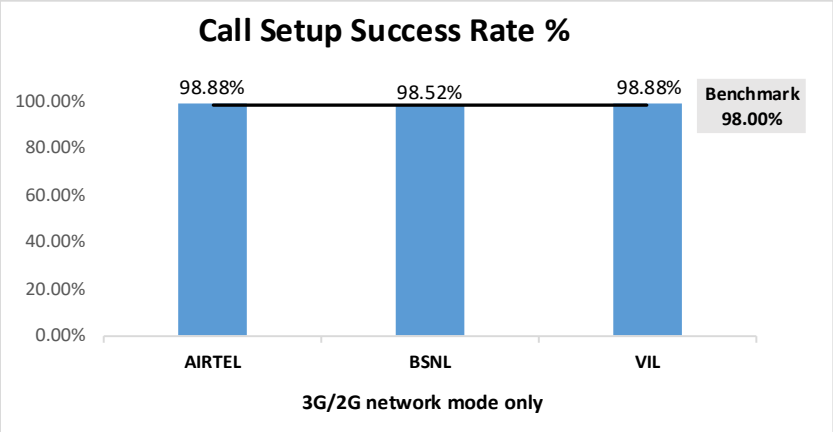


Figure-7: Performance for call setup success rate.

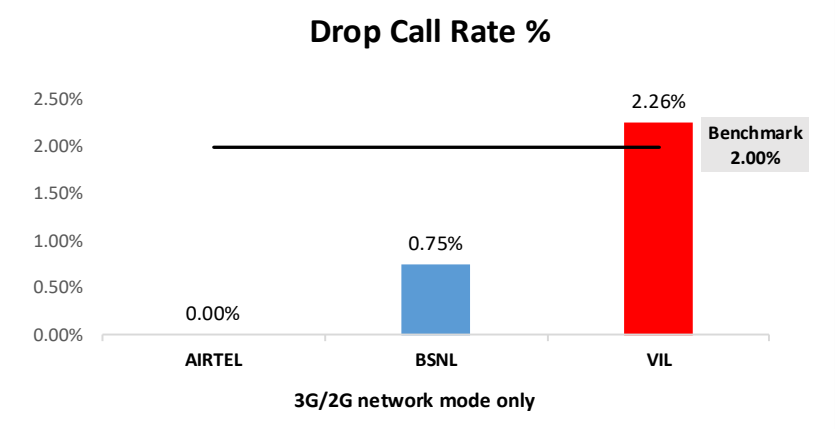


Figure-8: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	50.62%	NA
2G	99.97%	49.27%	99.98%
Limited Service	0.03%	0.11%	0.02%

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

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

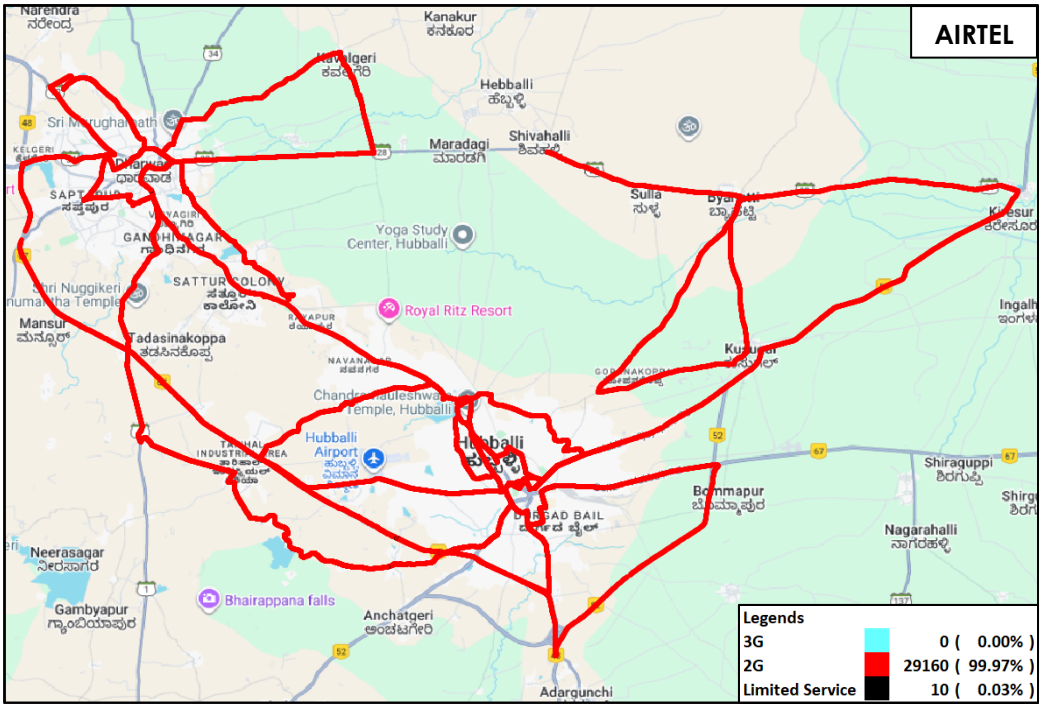


Figure-9: Serving technology plots 3G/2G network mode – AIRTEL

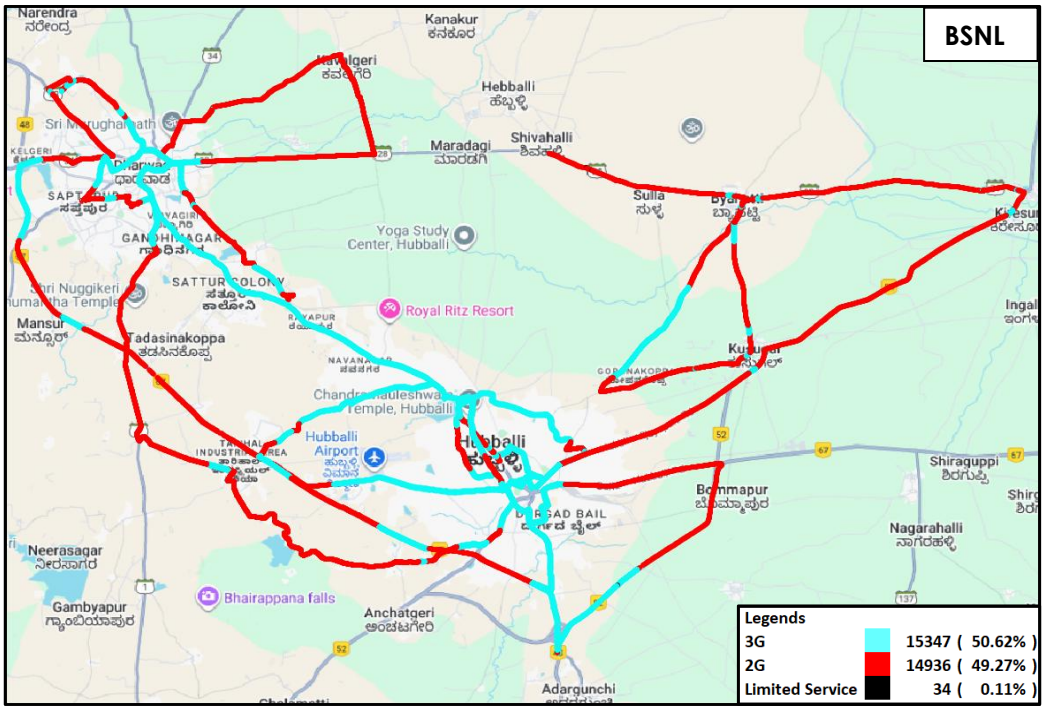


Figure-10: Serving technology plots 3G/2G network mode –BSNL.

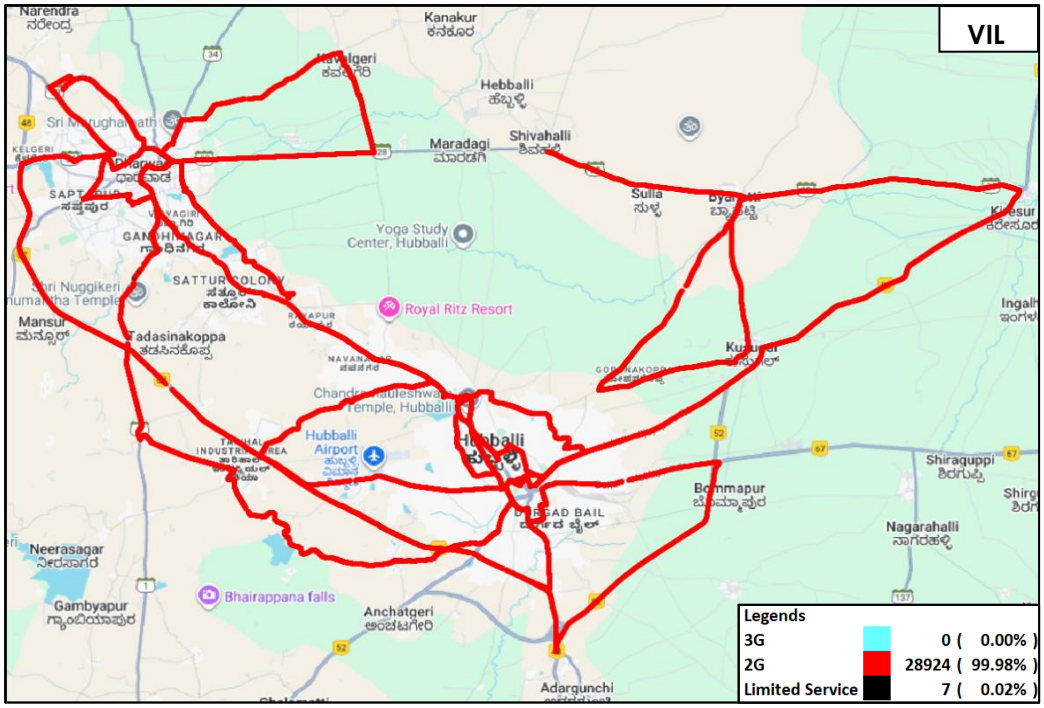


Figure-11: Serving technology plots 3G/2G network mode –VIL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 42, 43 & 44 for map view)

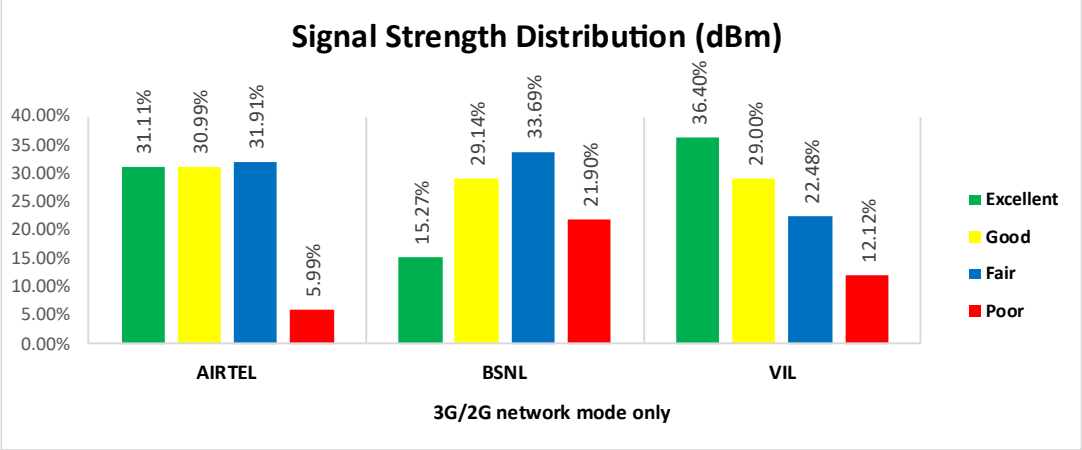


Figure-12: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 31% of samples falling in the excellent signal strength category.
- BSNL has 15% of samples falling in the excellent signal strength category.
- VIL has 36% of samples falling in the excellent signal strength category.

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	281	288	283	284
Call Setup Success Rate %	100.00	95.83	100.00	99.30
Drop Call Rate %	0.00	2.54	0.00	1.06
Call Setup Time Average (Second)	1.14	2.43	0.72	1.28
Handover Success Rate %	99.79	100.00	99.63	99.80

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

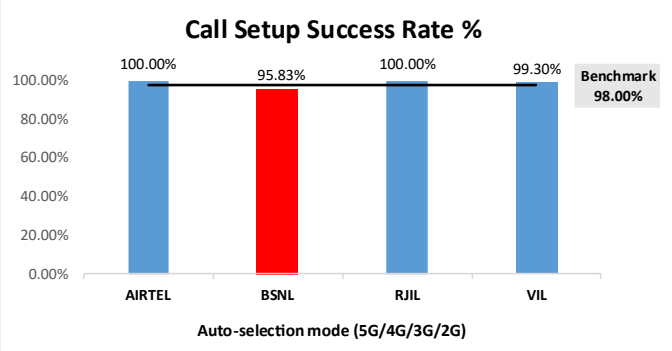


Figure-13: Performance for call setup success rate.

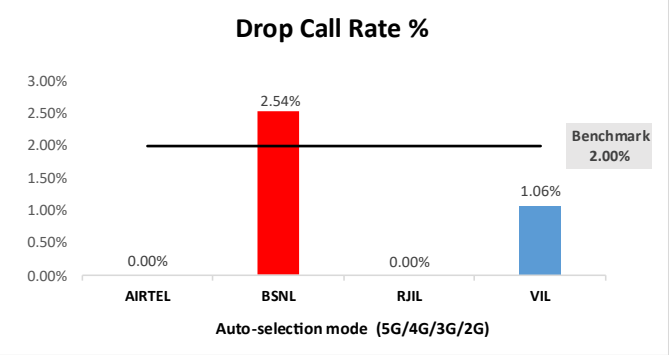


Figure-14: Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	271	268	274	285
Number of silence call for >4 Sec	3	13	4	8
Silence Call Rate %	1.11	4.85	1.46	2.81
Number of silence instances for >4 Sec	4	14	4	10
Number of silence instances for >3 Sec	8	30	9	22
Number of silence instances for >2 sec	16	62	22	41
RTP Jitter (4G & 5G) in ms	4.03	8.89	9.38	14.47
Packet loss Rate Downlink %	0.60	6.39	1.04	2.24
Packet loss Rate Uplink %	0.59	7.52	1.13	1.75

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

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-16	1585	1260	1547	1517
Speech Quality (Average MOS)	3.96	3.18	3.77	3.83
Number of samples with MOS >=4 to <5 (Excellent)	1233	424	939	972
Number of samples with MOS >=3 to <4 (Good)	292	374	457	387
Number of samples with MOS >=2 to <3 (Fair)	32	236	91	80
Number of samples with MOS >=1 to <2 (Poor)	28	226	60	78
%age of samples with MOS >=4 to <5 (Excellent)	77.79%	33.65%	60.70%	64.07%
%age of samples with MOS >=3 to <4 (Good)	18.42%	29.68%	29.54%	25.51%
%age of samples with MOS >=2 to <3 (Fair)	2.02%	18.73%	5.88%	5.27%
%age of samples with MOS >=1 to <2 (Poor)	1.77%	17.94%	3.88%	5.14%

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

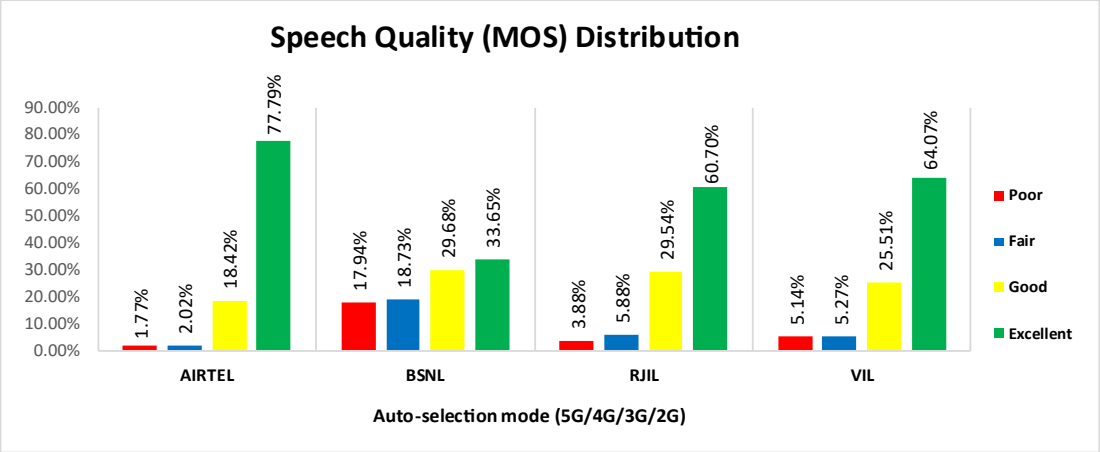


Figure-15: Distribution of samples in MOS range.

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

Technology	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
5G	2.38%	NA	13.17%	NA
4G	97.62%	50.94%	86.83%	89.22%
3G	NA	6.81%	NA	NA
2G	0.00%	41.95%	NA	10.78%
Limited Service	0.00%	0.31%	0.00%	0.00%

Table-18: Time spent on technology during drive test.

Note-

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

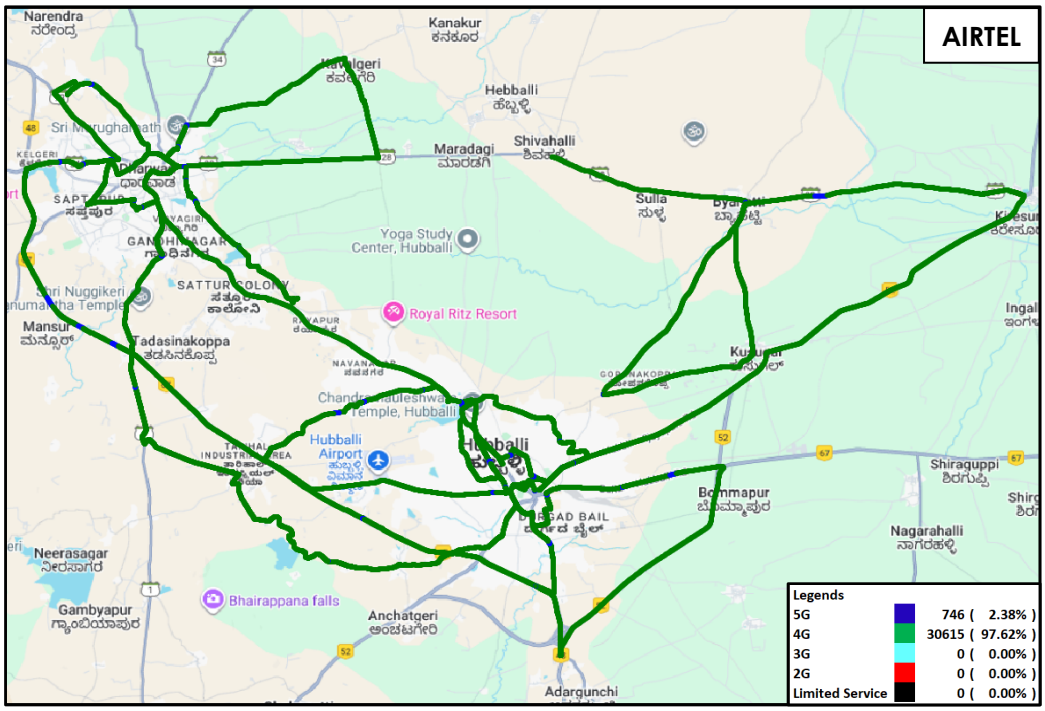


Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -AIRTEL.

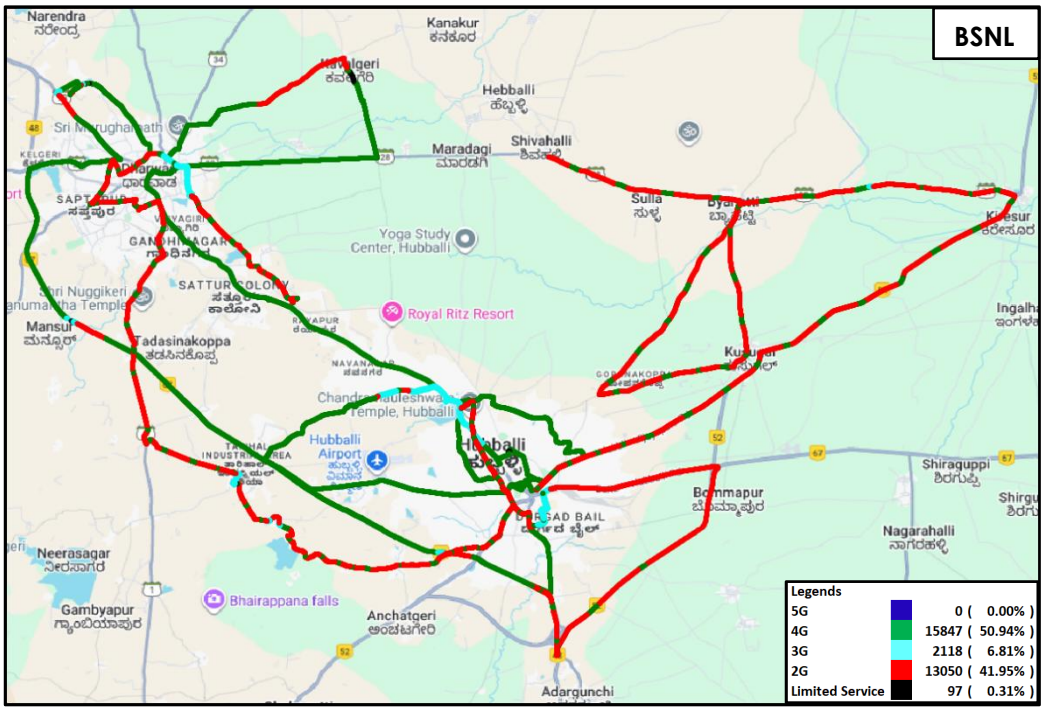


Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -BSNL.

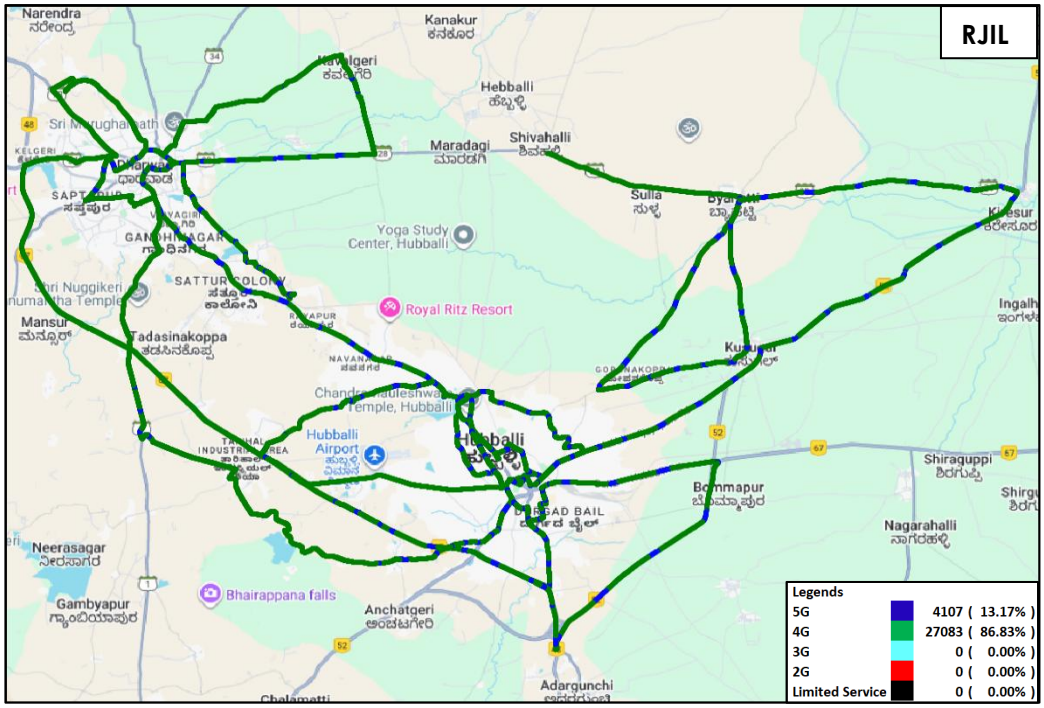


Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL.

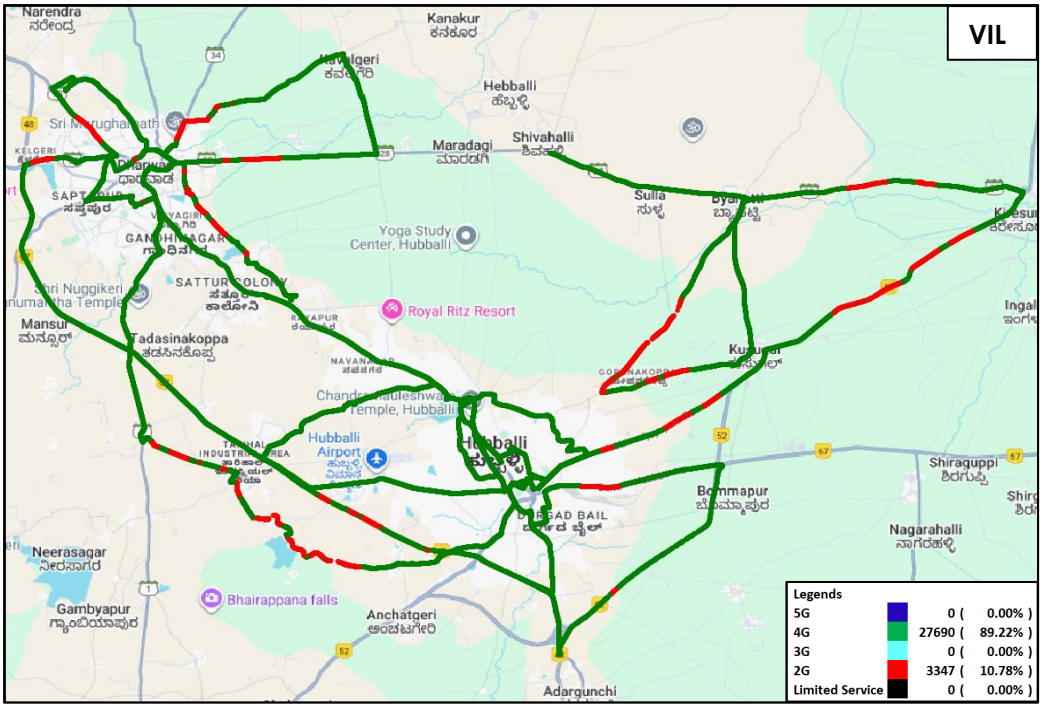


Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G) – VIL

(g) Network Signal Strength Distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-45, 46, 47 & 48 for map view)

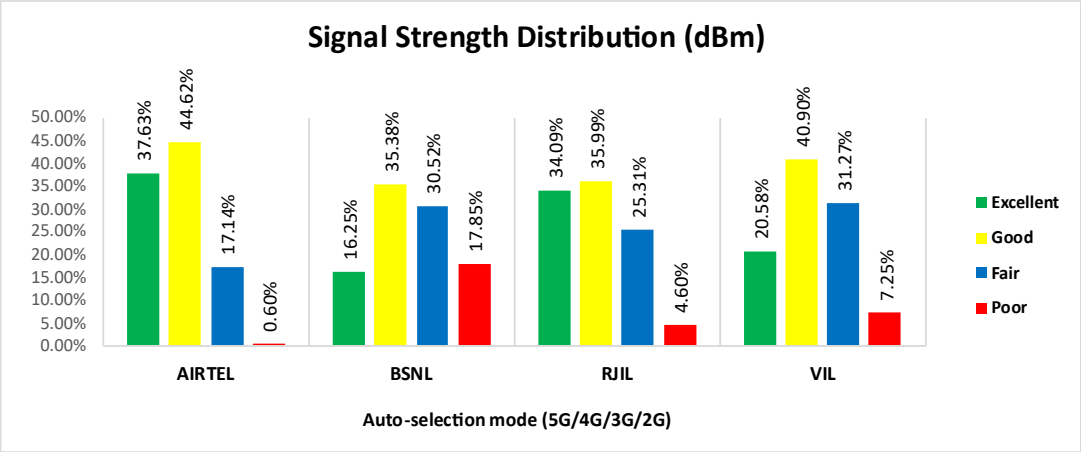


Figure-20: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:

- Airtel has 38% of samples falling in the excellent signal strength category.
- BSNL has 16% of samples falling in the excellent signal strength category.
- RJIL has 34% of samples falling in the excellent signal strength category.
- VIL has 21% of samples falling in the excellent signal strength category.

4.2.4 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	146.65	1.19	246.84	18.66
	80th Percentile	226.21	1.77	404.30	30.06
	20th Percentile	41.10	0.40	73.61	4.23
Upload Throughput (Mbits/s)	Average	36.19	2.27	25.55	10.58
	80th Percentile	65.30	3.26	47.65	16.97
	20th Percentile	8.19	0.76	4.53	2.42
Latency (ms)	50th Percentile	24.15	52.00	22.50	29.15

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

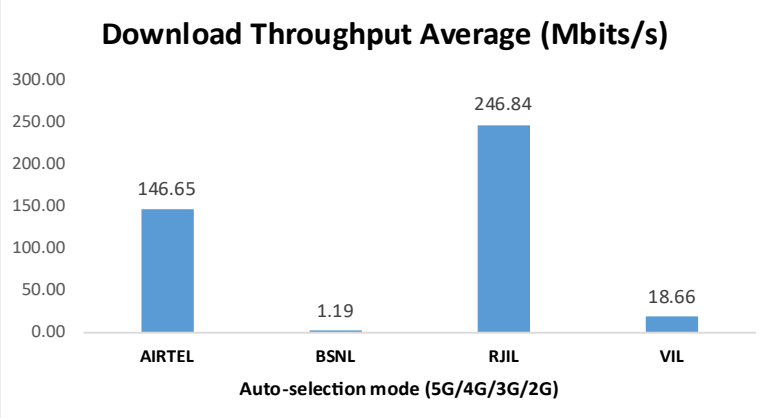


Figure- 21: Download throughput

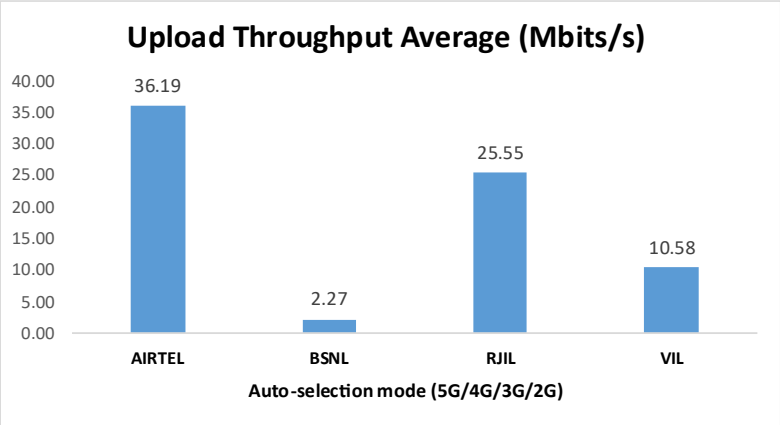


Figure- 22: Upload throughput

4.3 Hotspots

Hotspot testing has been done on 07th Aug 2025 and 08th Aug 2025. Nine locations have been tested in city.

4.3.1 Locations

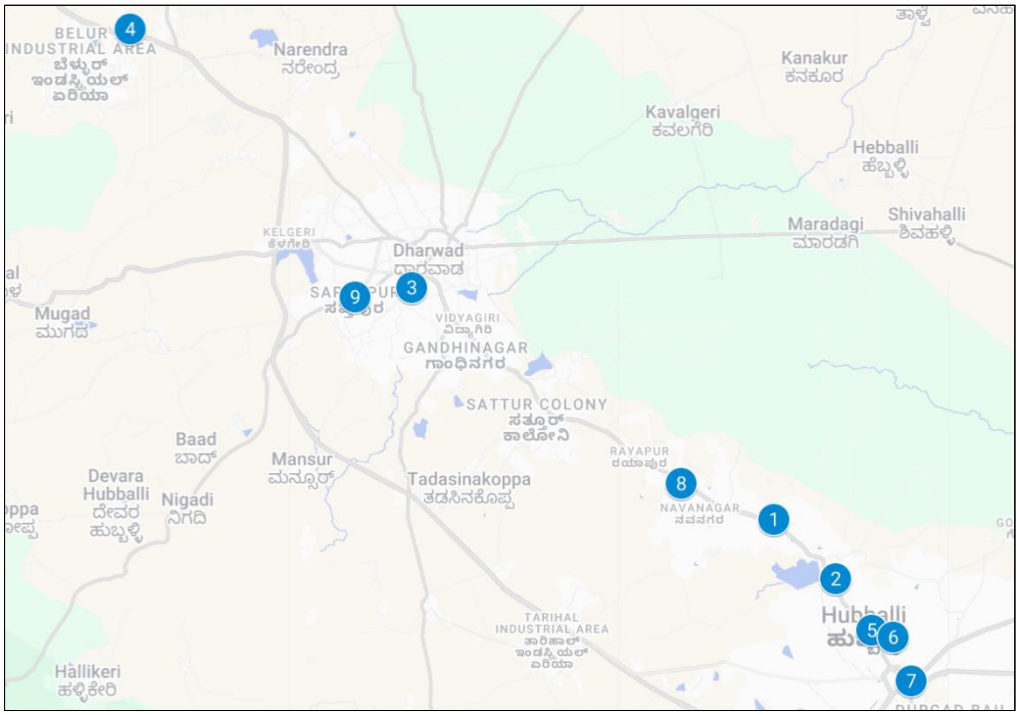


Figure- 23: Hotspot locations

4.3.2 Hotspot covered

1. APMC Market Hubballi
2. Chandramouleshwara Temple Unkal Hubballi
3. Deputy Commissioner office Dharwad
4. High Court Bench Dharwad
5. Hubballi-Dharwad Municipal Corporation (HDMC)
6. KIMS Hospital Hubballi
7. KSRTC Bus Stand Hubballi
8. RTO office Dharwad
9. Saptapur Circle Dharwad

4.3.3 Voice performance

Overall Voice Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	90	90	90	90
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.07	0.80	0.50	0.97

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

APMC Market Hubballi				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.08	0.62	0.46	0.85

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

Chandramouleshwara Temple Unkal Hubballi				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.10	0.68	0.49	0.85

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

Deputy Commissioner office Dharwad				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.03	0.66	0.49	0.75

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

High Court Bench Dharwad				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.09	0.69	0.51	0.89

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

Hubballi-Dharwad Municipal Corporation (HDMC)				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.01	0.71	0.47	0.82

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

KIMS Hospital Hubballi				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.03	0.84	0.51	0.86

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

KSRTC Bus Stand Hubballi				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.09	0.59	0.55	0.90

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

RTO office Dharwad				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.02	1.79	0.51	0.80

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

Saptapur Circle Dharwad				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.14	0.64	0.51	2.03

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

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

Overall Data Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	169.61	1.26	399.05	23.45
Download Throughput 80th Percentile (Mbit/s)	281.67	1.80	523.53	19.75
Download Throughput 20th Percentile (Mbit/s)	55.58	0.44	297.25	4.78
Download Session Setup Success Rate %	100.00	91.11	100.00	100.00
Upload Throughput Average (Mbits/s)	44.48	1.93	29.15	8.55
Upload Throughput 80th Percentile (Mbit/s)	71.42	2.79	43.83	11.03
Upload Throughput 20th Percentile (Mbit/s)	16.82	1.11	14.16	2.82
Upload Session Setup Success Rate %	100.00	91.11	100.00	100.00
Web Browsing Delay (Second)	3.75	6.56	2.40	4.66
Youtube Initial Buffer Delay (Second)	1.17	4.90	0.66	1.96
Latency (ms) - 50th Percentile	23.60	50.00	22.45	26.00
Jitter (ms)	7.25	12.08	13.91	5.35
Packet Loss Rate%	0.67	22.81	0.44	1.02
Packet Loss Rate- 90th percentile	2.04	47.86	1.02	2.24

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

APMC Market Hubballi				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	228.83	1.09	590.27	6.06
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	39.30	1.66	52.28	1.62
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	5.20	7.31	2.31	6.40
Youtube Initial Buffer Delay (Second)	1.66	6.20	0.62	4.02
Latency (ms) - 50th Percentile	20.80	46.60	18.15	40.05
Jitter (ms)	16.00	7.44	3.98	3.51
Packet Loss Rate%	2.60	0.90	0.00	1.20

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

Chandramouleshwara Temple Unkal Hubballi				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	208.33	0.75	388.38	16.43
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	78.10	1.83	34.35	12.79
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.87	11.01	2.14	4.73
Youtube Initial Buffer Delay (Second)	0.81	5.37	0.70	2.82
Latency (ms) - 50th Percentile	19.88	60.50	16.13	25.45
Jitter (ms)	6.85	18.68	4.25	1.71
Packet Loss Rate%	0.40	3.70	0.00	0.80

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

Deputy Commissioner office Dharwad				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	286.93	0.71	403.16	122.49
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	28.67	2.60	12.00	21.96
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	5.46	8.06	2.44	5.20
Youtube Initial Buffer Delay (Second)	0.67	7.39	0.65	0.65
Latency (ms) – 50th Percentile	24.10	44.60	22.45	25.10
Jitter (ms)	5.07	2.78	4.14	2.16
Packet Loss Rate%	0.20	0.10	0.10	0.00

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

High Court Bench Dharwad				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	55.18	4.13	553.30	13.69
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	6.06	3.06	44.00	11.18
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.38	3.62	2.40	3.23
Youtube Initial Buffer Delay (Second)	1.06	2.65	0.64	1.73
Latency (ms) - 50th Percentile	32.10	43.40	22.85	22.00
Jitter (ms)	4.85	5.13	2.44	3.55
Packet Loss Rate%	0.00	34.90	0.00	0.00

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

Hubballi-Dharwad Municipal Corporation (HDMC)				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	28.46	1.49	445.43	7.66
Download Session Setup Success Rate%	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	92.65	1.33	41.42	3.27
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	3.68	6.32	2.02	3.78
Youtube Initial Buffer Delay (Second)	2.02	2.48	0.67	1.37
Latency (ms)- 50th Percentile	21.28	53.50	27.85	28.50
Jitter (ms)	3.18	11.25	8.51	5.45
Packet Loss Rate%	0.20	0.30	0.40	0.10

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

KIMS Hospital Hubballi				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	138.94	0.51	169.54	4.26
Download Session Setup Success Rate%	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	58.02	1.73	6.31	8.03
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.25	5.19	2.77	4.21
Youtube Initial Buffer Delay (Second)	0.68	5.23	0.68	1.10
Latency (ms)- 50th Percentile	23.18	52.00	23.20	22.15
Jitter (ms)	5.34	22.62	87.46	1.51
Packet Loss Rate%	0.20	22.80	3.50	0.10

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

KSRTC Bus Stand Hubballi				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	98.60	0.38	314.85	21.68
Download Session Setup Success Rate%	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	17.90	0.00	30.48	7.31
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.73	11.25	2.66	5.97
Youtube Initial Buffer Delay (Second)	1.13	17.44	0.77	0.86
Latency (ms)- 50th Percentile	21.15	53.00	24.05	33.85
Jitter (ms)	3.09	26.33	6.86	18.96
Packet Loss Rate%	0.00	35.10	0.00	0.50

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

RTO office Dharwad				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	272.08	0.39	429.70	3.19
Download Session Setup Success Rate%	100.00	60.00	100.00	100.00
Upload Throughput Average (Mbits/s)	60.78	0.30	21.01	5.04
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	2.34	8.05	2.55	5.55
Youtube Initial Buffer Delay (Second)	0.63	3.17	0.65	2.35
Latency (ms)- 50th Percentile	27.40	56.00	27.45	24.65
Jitter (ms)	10.38	92.78	5.01	5.34
Packet Loss Rate%	1.90	98.90	0.00	6.40

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

Saptapur Circle Dharwad				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	209.15	1.39	296.82	15.54
Download Session Setup Success Rate%	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	18.83	2.55	20.46	5.72
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.82	2.77	2.34	2.90
Youtube Initial Buffer Delay (Second)	1.92	1.73	0.62	3.19
Latency (ms)- 50th Percentile	25.05	52.00	20.20	25.60
Jitter (ms)	10.59	5.09	3.74	5.87
Packet Loss Rate%	0.50	8.60	0.00	0.10

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

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

Overall Data Performance					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	177.98	-	354.49	-
	Upload Throughput Average (Mbits/s)	57.92	-	31.01	-
4G	Download Throughput Average (Mbits/s)	53.39	1.72	31.54	31.65
	Upload Throughput Average (Mbits/s)	20.41	4.45	6.34	26.32

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

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

APMC Market Hubballi					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	182.44	-	492.80	-
	Upload Throughput Average (Mbits/s)	37.73	-	29.48	-
4G	Download Throughput Average (Mbits/s)	72.51	1.25	6.47	6.51
	Upload Throughput Average (Mbits/s)	10.92	2.96	1.46	11.14

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

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

Chandramouleshwara Temple Unkal Hubballi					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	203.03	-	362.46	-
	Upload Throughput Average (Mbits/s)	93.10	-	40.97	-
4G	Download Throughput Average (Mbits/s)	18.49	1.78	22.11	17.54
	Upload Throughput Average (Mbits/s)	15.62	3.57	4.92	50.39

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

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

Deputy Commissioner office Dharwad					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	215.54	-	409.18	-
	Upload Throughput Average (Mbits/s)	41.27	-	18.57	-
4G	Download Throughput Average (Mbits/s)	82.40	1.52	57.05	57.83
	Upload Throughput Average (Mbits/s)	27.15	3.31	4.42	35.87

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

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

High Court Bench Dharwad					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	-	-	497.62	-
	Upload Throughput Average (Mbits/s)	-	-	61.12	-
4G	Download Throughput Average (Mbits/s)	32.90	3.55	76.85	77.19
	Upload Throughput Average (Mbits/s)	34.46	7.01	22.67	28.01

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

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

Hubballi-Dharwad Municipal Corporation (HDMC)					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	168.50	-	119.14	-
	Upload Throughput Average (Mbits/s)	84.56	-	20.96	-
4G	Download Throughput Average (Mbits/s)	128.74	1.92	33.39	75.97
	Upload Throughput Average (Mbits/s)	32.35	7.19	5.64	45.59

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

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

KIMS Hospital Hubballi					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	157.52	-	186.32	-
	Upload Throughput Average (Mbits/s)	73.36	-	5.92	-
4G	Download Throughput Average (Mbits/s)	61.21	0.99	1.66	17.68
	Upload Throughput Average (Mbits/s)	18.54	1.91	1.53	21.09

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

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

KSRTC Bus Stand Hubballi					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	77.08	-	292.27	-
	Upload Throughput Average (Mbits/s)	20.78	-	36.60	-
4G	Download Throughput Average (Mbits/s)	16.43	1.18	15.30	18.59
	Upload Throughput Average (Mbits/s)	11.48	4.08	4.24	30.78

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

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

RTO office Dharwad					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	267.00	-	493.75	-
	Upload Throughput Average (Mbits/s)	71.49	-	31.61	-
4G	Download Throughput Average (Mbits/s)	41.26	-	39.65	3.51
	Upload Throughput Average (Mbits/s)	14.96	2.54	5.41	8.11

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

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

Saptapur Circle Dharwad					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	152.73	-	336.91	-
	Upload Throughput Average (Mbits/s)	41.10	-	33.86	-
4G	Download Throughput Average (Mbits/s)	26.57	1.59	31.42	9.99
	Upload Throughput Average (Mbits/s)	18.22	4.88	3.84	5.92

Table-49: 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 05th Aug 2025 and 07th Aug 2025. Four locations have been tested in the city.

4.4.1 Walk test locations

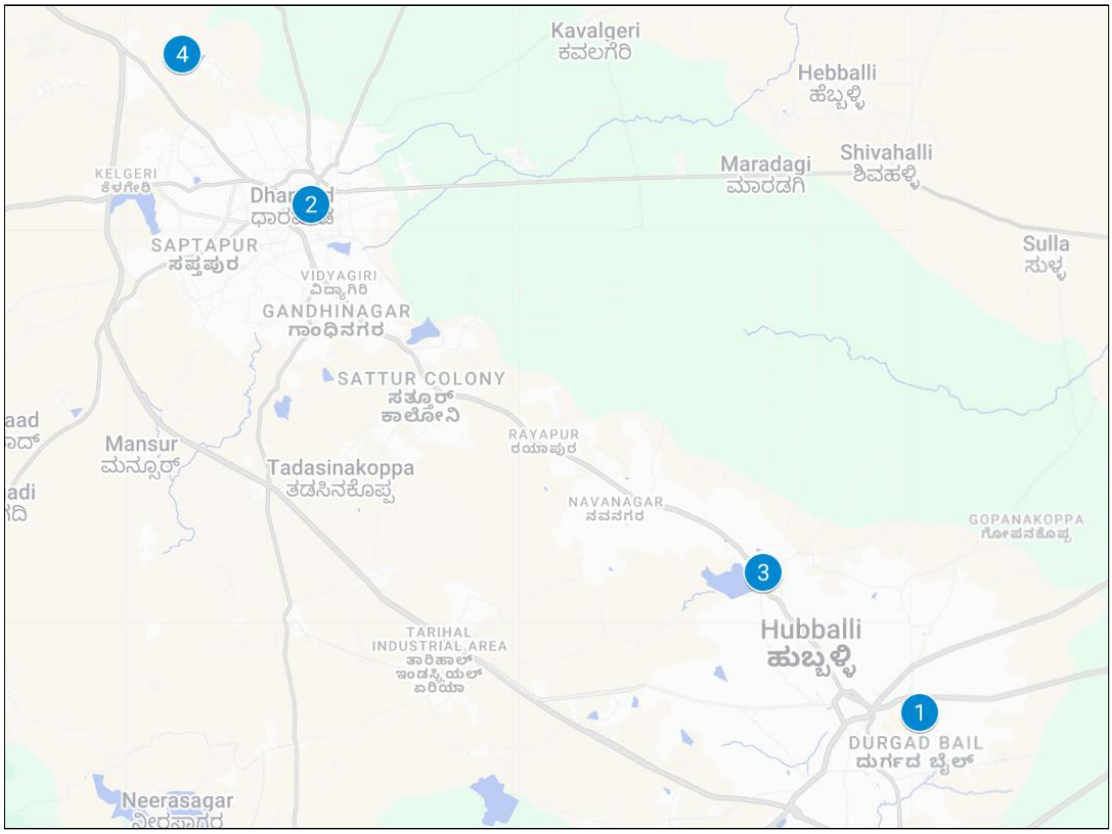


Figure-24: Walk Test locations.

4.4.2 Walk Test Covered

1. Hubballi Railway Junction
2. KSRTC Old Bus Stand Dharwad
3. Unakal Lake
4. University Of Agricultural Sciences Dharwad

4.4.3 Voice Performance

Hubballi Railway Junction				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	31	34	31	31
Call Setup Success Rate %	100.00	85.29	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.07	0.69	0.50	1.13

Table-50: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

KSRTC Old Bus Stand Dharwad				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	11	11	10	11
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.15	2.63	0.49	0.83

Table-51: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Unakal Lake				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	22	23	23	22
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.14	0.74	0.49	0.82

Table-52: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

University Of Agricultural Sciences Dharwad				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	12	12	12	12
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.22	2.44	0.80	0.92

Table-53: 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)

Hubballi Railway Junction				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	183.87	1.44	178.69	26.47
Download Session Setup Success Rate %	100.00	97.30	100.00	100.00
Upload Throughput Average (Mbits/s)	85.61	4.18	30.37	32.44
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Latency (ms) - 50th Percentile	23.05	47.65	23.35	26.50

Table-54: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

KSRTC Old Bus Stand Dharwad				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	183.39	1.22	332.50	13.65
Download Session Setup Success Rate %	100.00	85.71	100.00	100.00
Upload Throughput Average (Mbits/s)	82.12	1.57	38.13	14.70
Upload Session Setup Success Rate %	100.00	92.31	100.00	100.00
Latency (ms) - 50th Percentile	24.70	52.50	22.63	35.55

Table-55: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Unakal Lake				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	217.44	2.93	211.41	26.75
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	83.22	10.75	38.84	32.95
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Latency (ms) - 50th Percentile	18.88	47.73	17.73	26.95

Table-56: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

University Of Agricultural Sciences Dharwad				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	194.10	1.17	176.30	8.14
Download Session Setup Success Rate %	100.00	75.00	100.00	100.00
Upload Throughput Average (Mbits/s)	69.29	1.23	8.49	7.94
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Latency (ms) - 50th Percentile	22.70	52.00	20.55	28.38

Table-57: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

4.5 Highway

Drive test has been conducted on 05th Aug 2025 covering one highway route. (Refer Table-1)

4.5.1 Drive test route

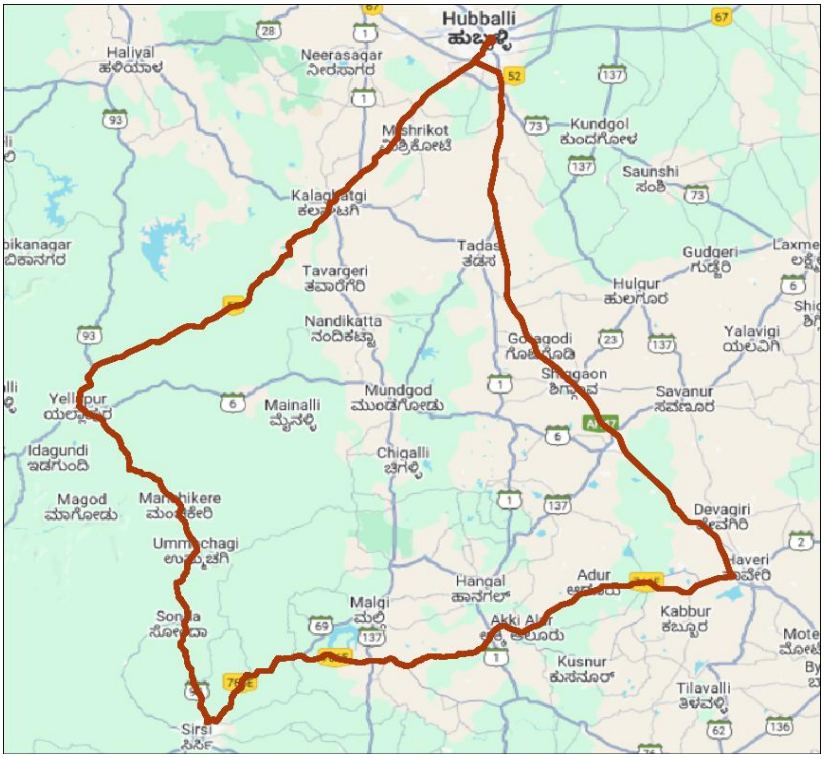


Figure-25: Drive test route highway.

4.5.2 Routes Covered

Hubballi–Haveri–Sirsi–Yellapur Hubballi Junction passing through Gabbur, Pale, Varur, Tadas Cross, Jigalur, Shiggaon, Aladakatti, Gourapura, Sangur, Balambeed, Goudalli, Sirsi, Agsal, Sonda, Chawadi and Yellapur Devikoppa etc.

4.5.3 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	118	162	161
Call Setup Success Rate %	81.36	58.64	46.58
Drop Call Rate %	8.33	24.21	9.33
Call Setup Time-Average (Second)	5.18	3.28	4.95
Handover Success Rate %	97.67	99.80	96.06

Table-58: Summary of voice call performance in 3G/2G network mode only.

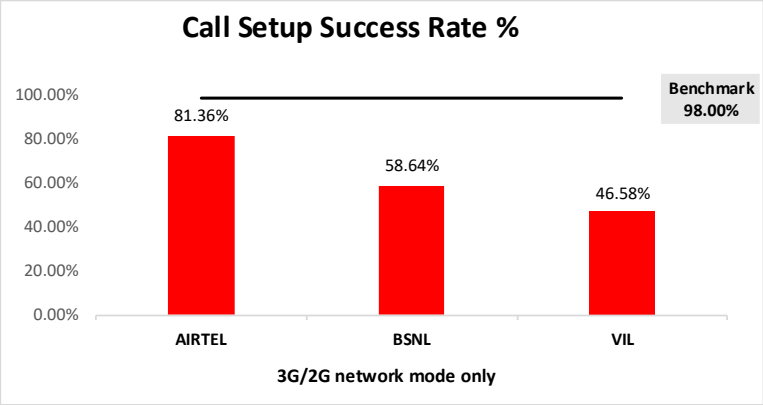


Figure-26: Performance for call setup success rate.

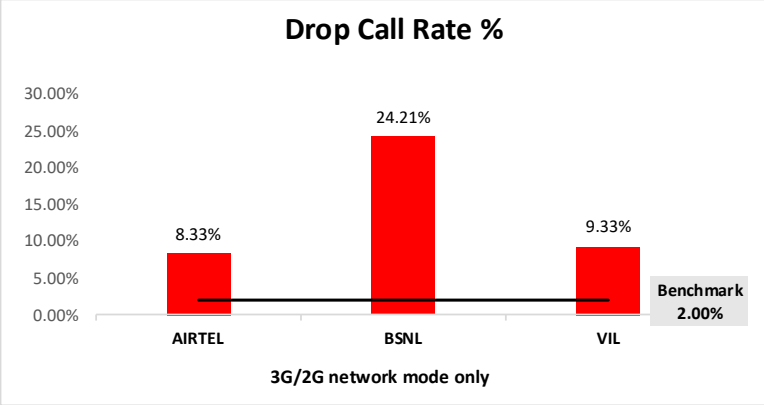


Figure-27: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	45.08%	NA
2G	96.39%	48.35%	85.41%
Limited Service	3.61%	6.57%	14.59%

Table-59: Time spent on technology during drive test 3G/2G network mode only.

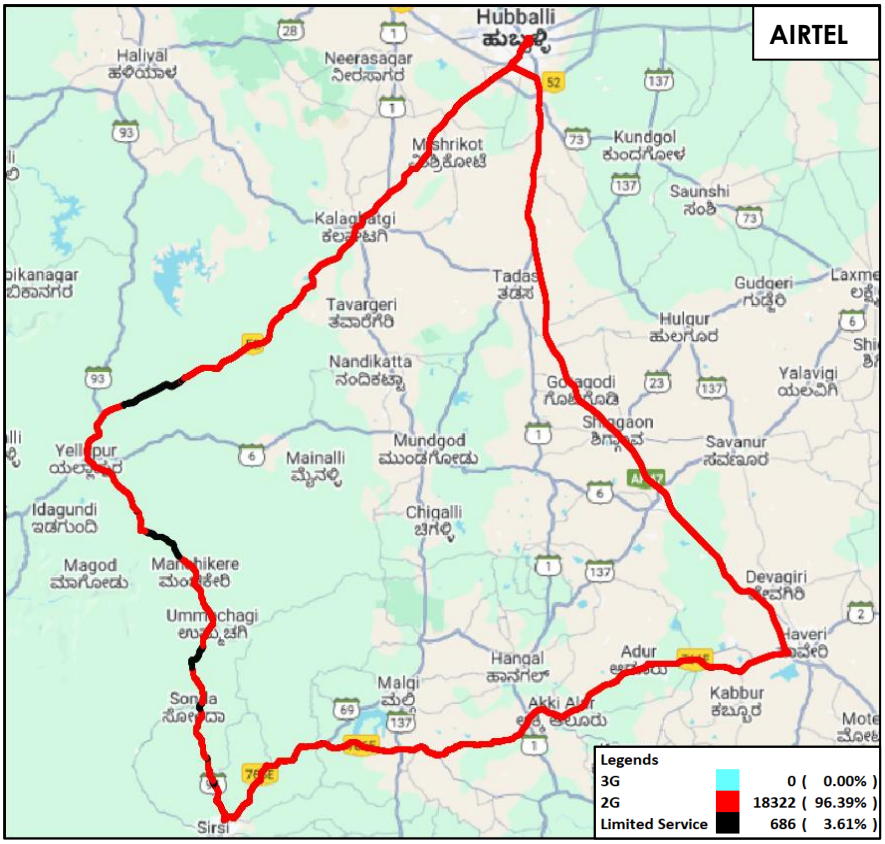


Figure-28: Serving technology plots 3G/2G network mode – AIRTEL.

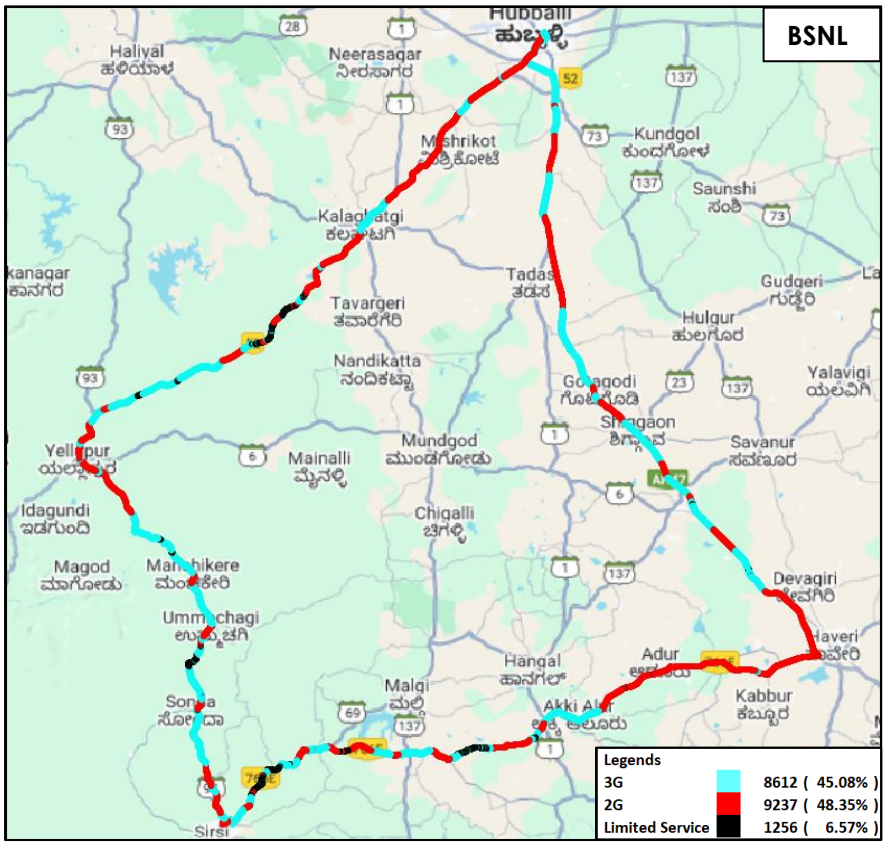


Figure-29: Serving technology plots 3G/2G network mode – BSNL.

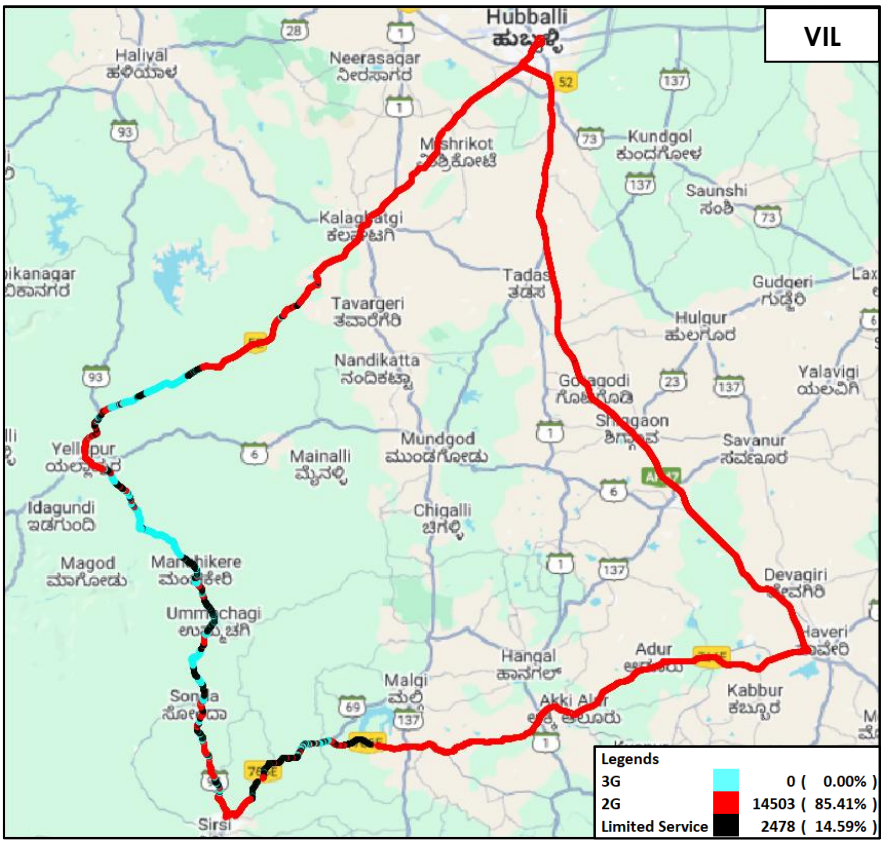
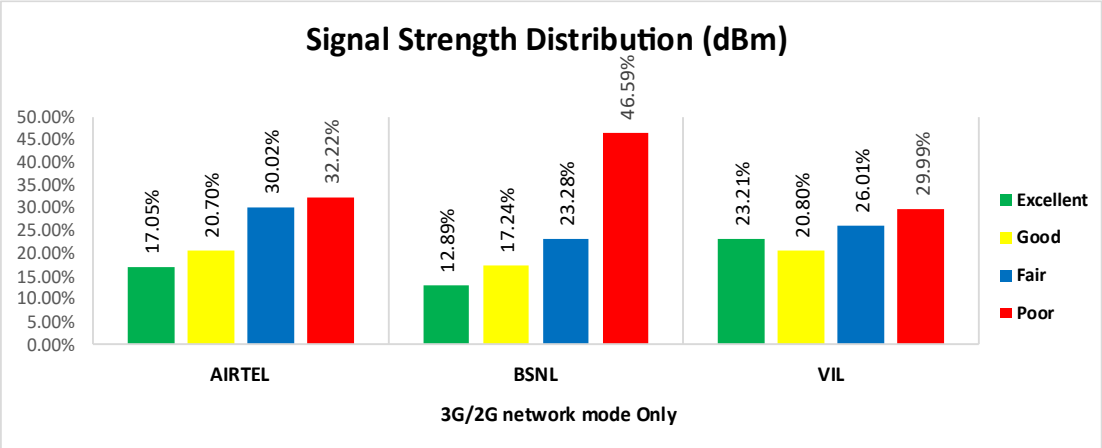


Figure 30: Serving technology plots 3G/2G network mode –VIL.

(c) Network Signal Strength distribution: The following chart represents



signal strength distribution for 3G/2G network mode only. (refer figure-49, 50 & 51 for map view)

Figure-31: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 17% of samples falling in the excellent signal strength category.
- BSNL has 13% of samples falling in the excellent signal strength category.
- VIL has 23% of samples falling in the excellent signal strength category.

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	135	161	113	162
Call Setup Success Rate %	71.11	63.98	98.23	48.77
Drop Call Rate %	9.38	19.42	3.60	10.13
Call Setup Time Average (Second)	1.29	2.04	0.79	2.86
Handover Success Rate %	99.85	99.26	99.79	99.79

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

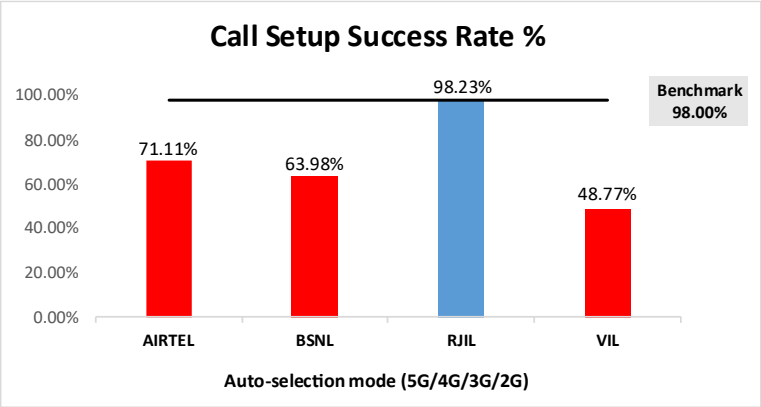


Figure-32: Performance for call setup success rate.

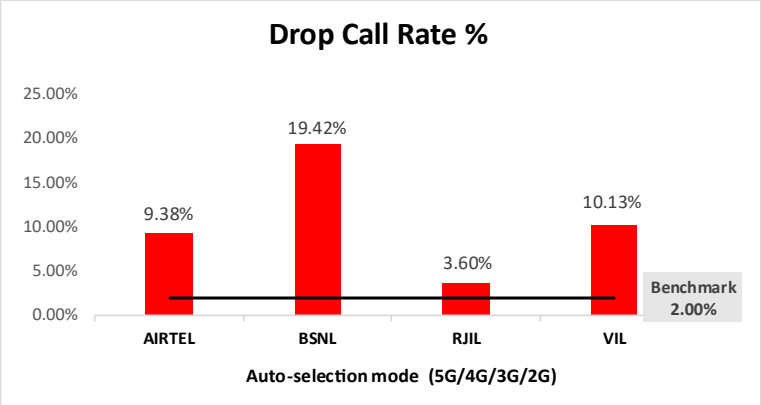


Figure-33: Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	83	114	90	71
Number of silence call for >4 Sec	3	9	14	14
Silence Call Rate %	3.61	7.89	15.56	19.72
Number of silence instances for >4 Sec	5	14	25	23
Number of silence instances for >3 Sec	8	18	36	50
Number of silence instances for >2 sec	19	41	53	71
RTP Jitter (4G & 5G) in ms	3.74	6.57	9.82	14.04
Packet loss Rate Downlink %	2.84	10.02	5.58	6.15
Packet loss Rate Uplink %	2.71	12.32	6.30	4.93

Table-61: Summary of silence instances & packet loss rate for mobile-to-mobile call.

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-53	906	695	1014	730
Speech Quality (Average MOS)	3.91	2.75	3.73	3.67
Number of samples with MOS >=4 to <5 (Excellent)	707	143	670	415
Number of samples with MOS >=3 to <4 (Good)	147	104	225	208
Number of samples with MOS >=2 to <3 (Fair)	27	292	44	33
Number of samples with MOS >=1 to <2 (Poor)	25	156	75	74
%age of samples with MOS >=4 to <5 (Excellent)	78.04%	20.58%	66.07%	56.85%
%age of samples with MOS >=3 to <4 (Good)	16.23%	14.96%	22.19%	28.49%
%age of samples with MOS >=2 to <3 (Fair)	2.98%	42.01%	4.34%	4.52%
%age of samples with MOS >=1 to <2 (Poor)	2.76%	22.45%	7.40%	10.14%

Table-62: Summary of speech quality (MOS) samples.

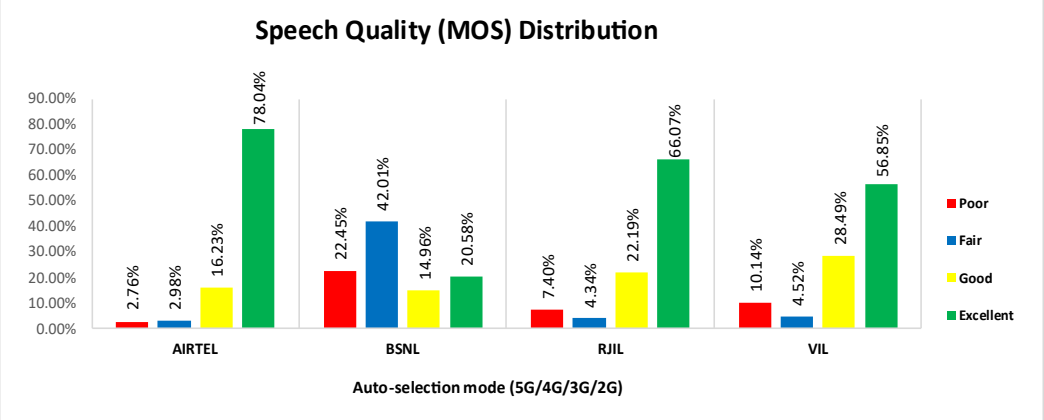


Figure-34: Distribution of samples in MOS range.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	0.55%	NA	4.33%	NA
4G	89.89%	47.36%	95.40%	56.45%
3G	NA	15.71%	NA	NA
2G	0.29%	27.27%	NA	23.29%
Limited Service	9.27%	9.66%	0.28%	20.26%

Table-63: Time spent on technology during drive test.

Note-

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

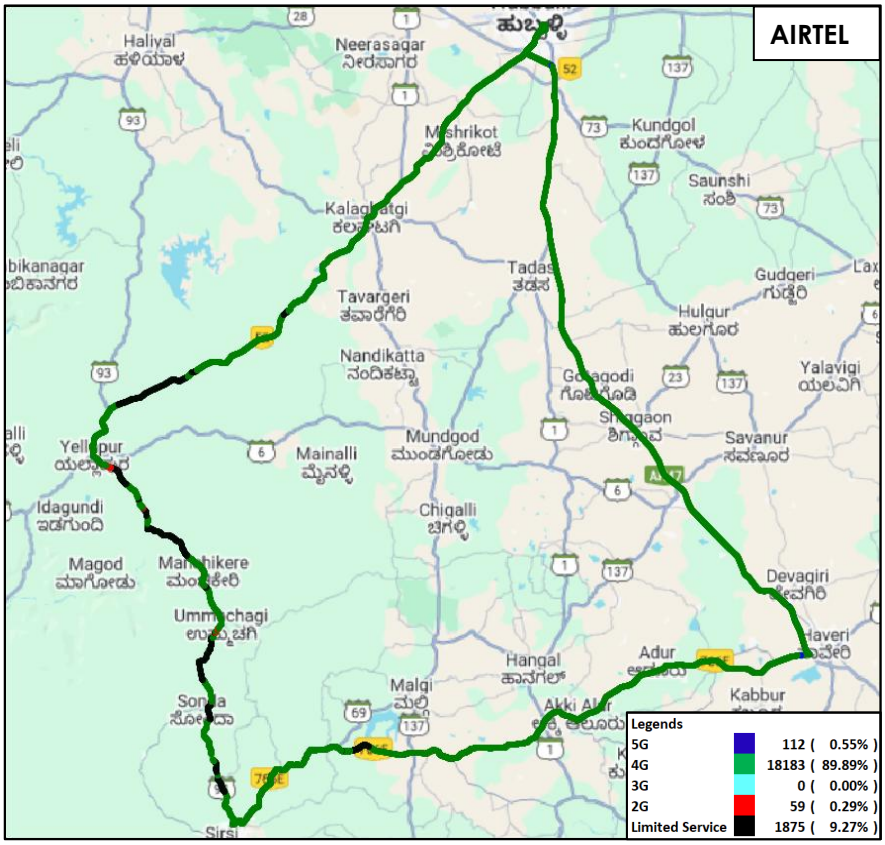


Figure-35: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-AIRTEL

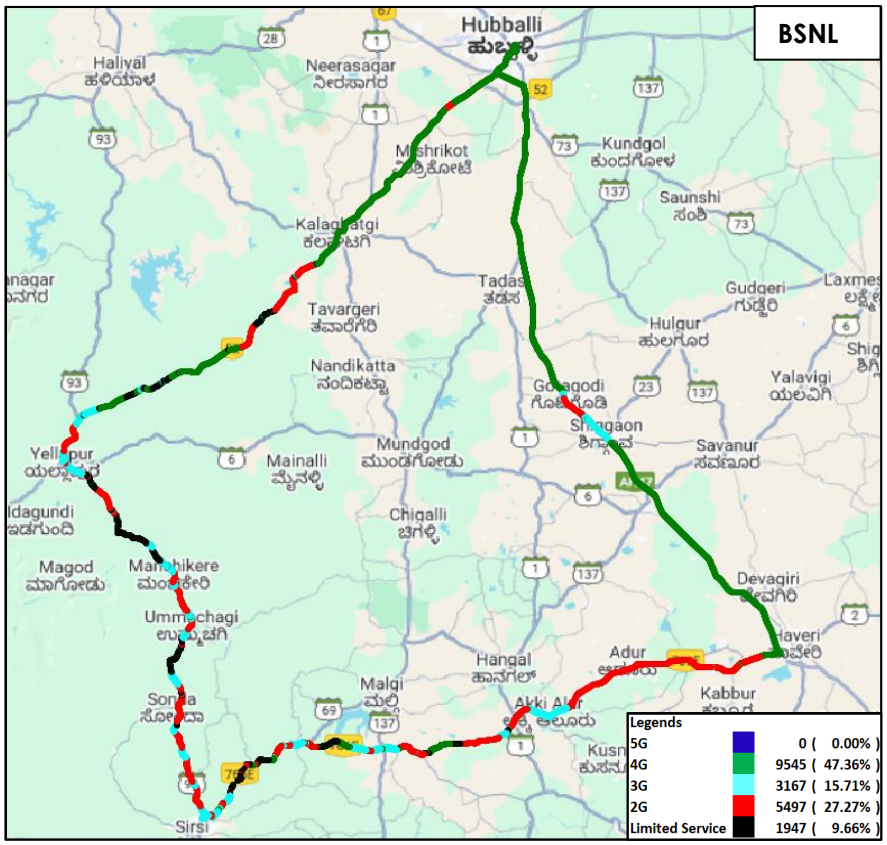


Figure-36: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-BSNL.

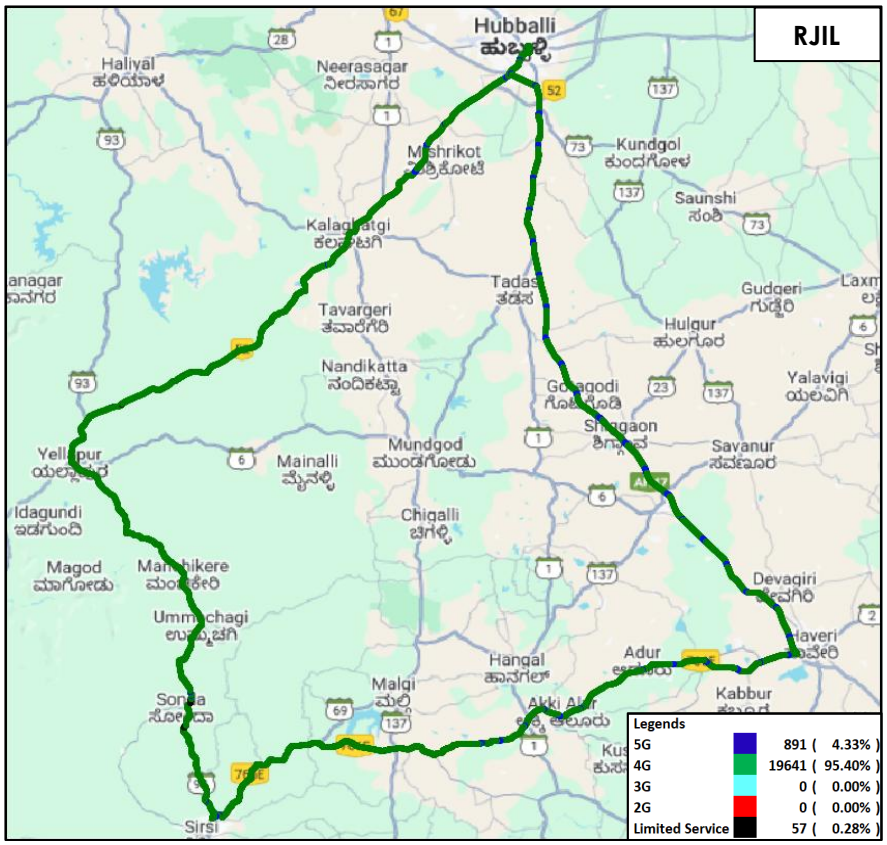


Figure-37: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-RJIL.

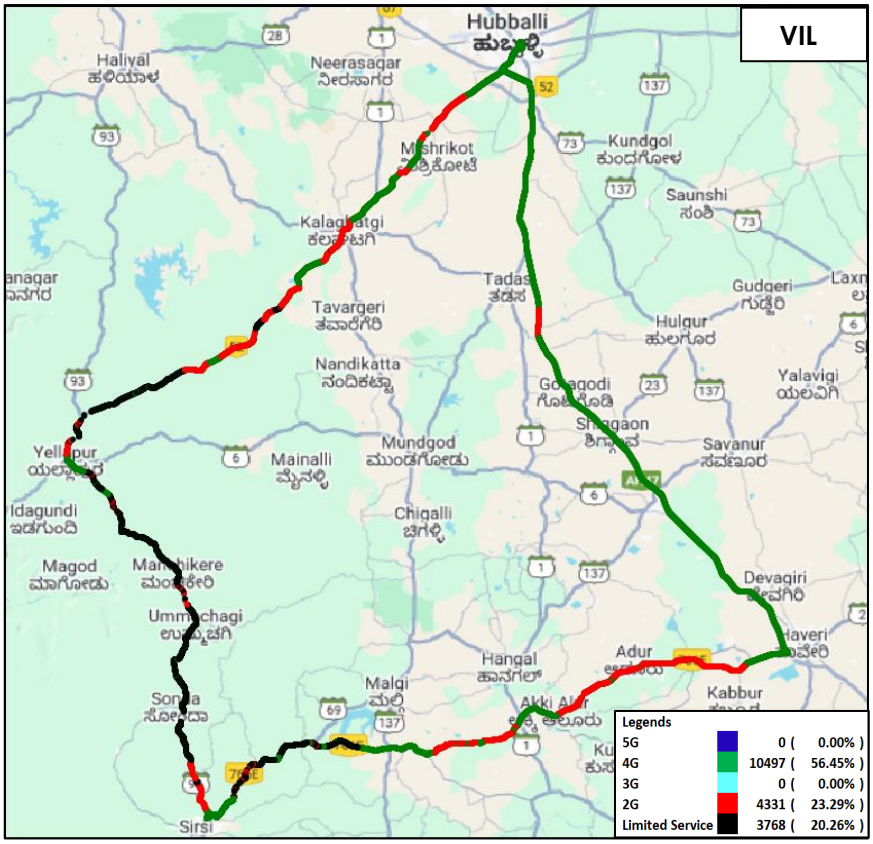


Figure-38: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-VIL.

(g) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (refer figure-52, 53, 54 & 55 for map view)

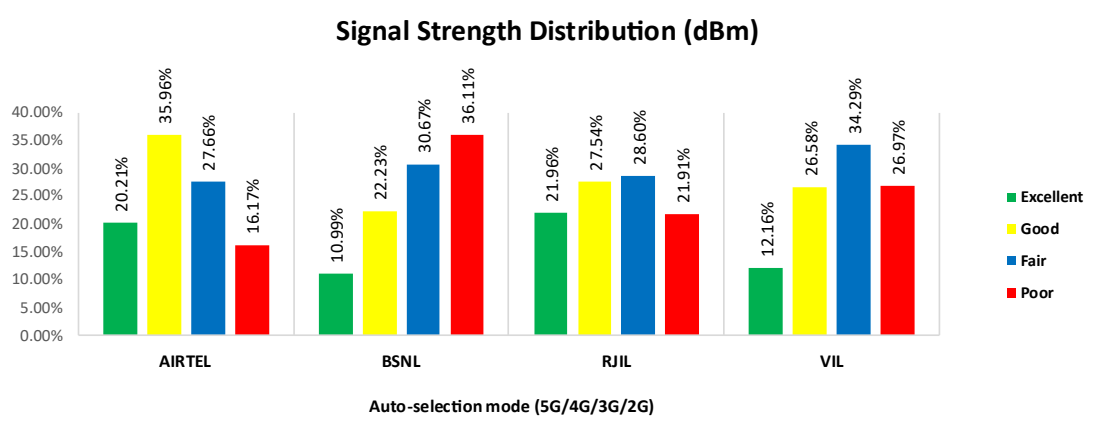


Figure-39: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:

- Airtel has 20% of samples falling in the excellent signal strength category.
- BSNL has 11% of samples falling in the excellent signal strength category.
- RJIL has 22% of samples falling in the excellent signal strength category.
- VIL has 12% of samples falling in the excellent signal strength category.

4.5.4 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	97.39	1.27	220.20	23.40
	80th Percentile	171.82	1.93	454.14	41.72
	20th Percentile	12.75	0.37	3.48	3.88
Upload Throughput (Mbits/s)	Average	25.25	2.01	20.75	10.91
	80th Percentile	44.38	3.01	42.23	20.87
	20th Percentile	3.28	0.23	1.81	2.23
Latency (ms)	50th Percentile	25.25	55.50	25.30	28.95

Table-64: Summary of Data performance in network auto-selection mode.

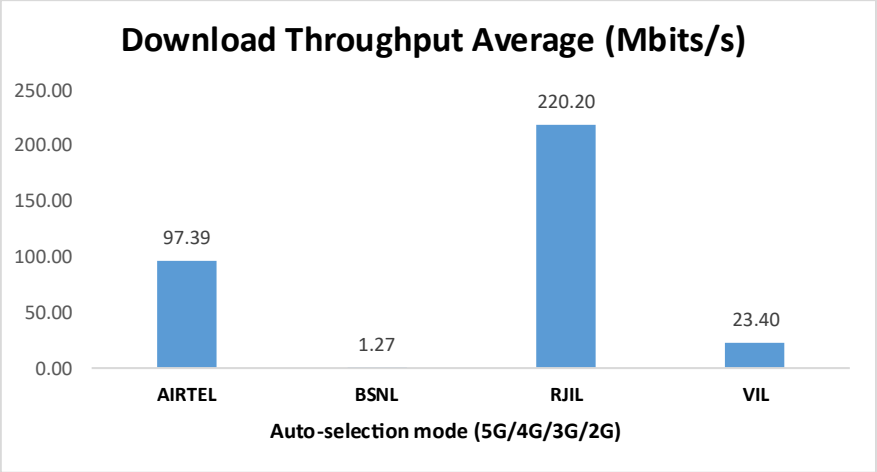


Figure-40: Download throughput.

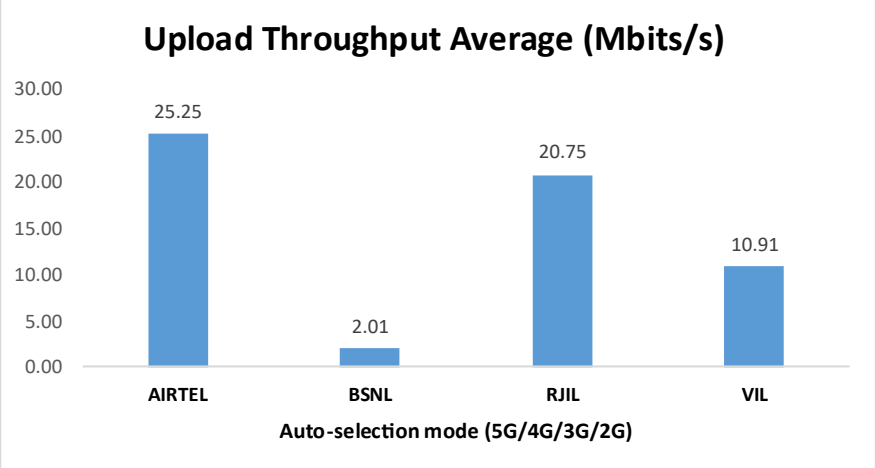


Figure-41: Upload throughput.

5. Voice & Data Key findings

5.1 Overall Voice

1. **Call Setup Success Rate:**
   a) Airtel, BSNL and VIL have 93.51%, 83.60% and 79.30% call setup success rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL have 93.30%, 87.88%, 99.64% and 86.11% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

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

2. **Call Setup Time**:
   a) Airtel, BSNL and VIL call setup time is 4.92, 3.07 and 3.98 seconds respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL & VIL call setup time is 1.15, 1.93, 0.68 & 1.42 seconds respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G) VIL, BSNL, RJIL and Airtel have 6.18%, 5.76%, 4.95%, 1.69% silence call rate respectively. Further BSNL has higher RTP packet loss rate in downlink (7.08%) compared to VIL (2.97%), RJIL (2.16%) & Airtel (1.05%). In uplink the RTP packet loss rate is higher for BSNL (8.28%) compared to RJIL (2.39%), VIL (2.36%) & Airtel (1.04%). (refer table-6)

4. **Drop Call Rate**:
   a) Airtel, BSNL and VIL drop call rate is 2.22%, 6.91% and 3.81% respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL drop call rate is 1.66%, 4.96%, 0.71% and 2.09% respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

5.2 Overall Data

1. **Data download and upload performance (Overall i.e. LSA):**
   a) Airtel, BSNL, RJIL and VIL average download speeds are 141.74 Mbps, 1.33 Mbps, 244.78 Mbps and 20.62 Mbps respectively. (refer table-11)

   b) Airtel, BSNL, RJIL and VIL average upload speeds are 40.25 Mbps, 2.70 Mbps, 25.41 Mbps and 13.62 Mbps respectively. (refer table-11)

2. **Data download and upload performance (static i.e. while stationary):**
   a) Airtel, BSNL, RJIL and VIL average download speeds are 169.61 Mbps, 1.26 Mbps, 399.05 Mbps and 23.45 Mbps respectively. (refer table-30)

   b) Airtel, BSNL, RJIL and VIL average upload speeds are 44.48 Mbps, 1.93 Mbps, 29.15 Mbps and 8.55 Mbps respectively. (refer table-30)

3. **Data session setup success rate (static i.e. while stationary):**
   a) Airtel, BSNL, RJIL and VIL have 100.00%, 91.11%, 100.00% and 100.00% download session setup success rate respectively. (refer table-30)

   b) Airtel, BSNL, RJIL and VIL have 100.00%, 91.11%, 100.00% and 100.00% upload session setup success rate respectively. (refer table-30)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 93.51% call setup success rate and 2.22% drop call rate have been observed in 3G/2G network mode for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-3)

- 93.30% call setup success rate and 1.66% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-5)

- 98.88% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-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. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-20)

- 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 walk test locations. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table- 50, 51, 52 & 53)

- 81.36% call setup success rate and 8.33% drop call rate have been observed in 3G/2G network mode for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-58)

- 71.11% call setup success rate and 9.38% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-60)

Data

- Airtel has 141.74 Mbps average download speed & 40.25 Mbps average upload speed for LSA. (refer table-11)

- Airtel has 146.65 Mbps average download speed & 36.19 Mbps average upload speed across the measured routes for city drive. (refer table-19)

- High Court Bench Dharwad, Hubballi-Dharwad Municipal Corporation (HDMC) and KSRTC Bus Stand Hubballi have less download speed (less than 100 Mbps) out of total 9 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-34, 35 & 37)

- High Court Bench Dharwad, KSRTC Bus Stand Hubballi, Saptapur Circle Dharwad have less upload speed (less than 20 Mbps) out of total 9 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-34, 37 & 39)

- Airtel has 97.39 Mbps average download speed & 25.25 Mbps average upload speed across the measured routes for highway drive. (refer table-64)

2. BSNL:

Voice

- 83.60% call setup success rate and 6.91% drop call rate have been observed in 3G/2G network mode for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-3)

- 87.88% call setup success rate and 4.96% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 98.52% call setup success rate and 0.75% drop call rate have been observed in 3G/2G network mode for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)

- 95.83% call setup success rate and 2.54% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (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. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-20)

- 85.29% call setup success rate and 0.00% drop call rate has been observed for auto-selection mode (5G/4G/3G/2G) at Hubballi Railway Junction Walk test locations. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-50)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) at all walk test locations except Hubballi Railway Junction. Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-51, 52 & 53)

- 58.64% call setup success rate and 24.21% drop call rate have been observed in 3G/2G network mode for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-58)

- 63.98% call setup success rate and 19.42% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-60)

Data

- BSNL has 1.33 Mbps average download speed & 2.70 Mbps average upload speed for LSA. (refer table-11)

- BSNL has 1.19 Mbps average download speed & 2.27 Mbps average upload speed across the measured routes for city drive. (refer table-19)

- All hotspot locations have less download speed (less than 10 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table- 31, 32, 33, 34, 35, 36, 37, 38 & 39)

- APMC Market Hubballi, Chandramouleshwara Temple Unkal Hubballi, Hubballi-Dharwad Municipal Corporation (HDMC), KIMS Hospital Hubballi, KSRTC Bus Stand Hubballi and RTO office Dharwad have less upload speed (less than 2 Mbps) out of total 9 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-31, 32, 35, 36, 37 & 38)

- All walk test locations have less download speed (less than 10 Mbps) for auto-selection mode (5G/4G/3G/2G) (refer table- 54, 55, 56 & 57)

- KSRTC Old Bus Stand Dharwad and University Of Agricultural Sciences Dharwad have less upload speed (less than 2 Mbps) out of total 4 walk test locations for auto-selection mode (5G/4G/3G/2G). (refer table-55 & 57)

- BSNL has 1.27 Mbps average download speed & 2.01 Mbps average upload speed across the measured routes for highway drive. (refer table-64)

3. RJIL:

Voice

- 99.64% call setup success rate and 0.71% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-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. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-20)

- 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 walk test locations. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table- 50, 51, 52 & 53)

- 98.23% call setup success rate and 3.60% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is not meeting the benchmark of 2.00% for call drop rate. (refer table-60)

Data

- RJIL has 244.78 Mbps average download speed & 25.41 Mbps average upload speed for LSA. (refer table-11)

- RJIL has 246.84 Mbps average download speed & 25.55 Mbps average upload speed across the measured routes for city drive. (refer table-19)

- Deputy Commissioner office Dharwad and KIMS Hospital Hubballi have less upload speed (less than 20 Mbps) out of total 9 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-33 & 36)

- University Of Agricultural Sciences Dharwad has less upload speed (less than 20 Mbps) out of total 4 walk test locations for auto-selection mode (5G/4G/3G/2G). (refer table-57)

- RJIL has 220.20 Mbps average download speed & 20.75 Mbps average upload speed across the measured routes for highway drive. (refer table-64)

4. VIL:

Voice

- 79.30% call setup success rate and 3.81% drop call rate have been observed in 3G/2G network mode for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-3)

- 86.11% call setup success rate and 2.09% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 98.88% call setup success rate and 2.26% drop call rate have been observed in 3G/2G network mode for city drive. Performance is not meeting the benchmark of 2.00% for call drop rate. (refer table-13)

- 99.30% call setup success rate and 1.06% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-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. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-20)

- 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 walk test locations. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table- 50, 51, 52 & 53)

- 46.58% call setup success rate and 9.33% drop call rate have been observed in 3G/2G network mode for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-58)

- 48.77% call setup success rate and 10.13% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-60)

Data

- VIL has 20.62 Mbps average download speed & 13.62 Mbps average upload speed for LSA. (refer table-11)

- VIL has 18.66 Mbps average download speed & 10.58 Mbps average upload speed across the measured routes for city drive. (refer table-19)

- APMC Market Hubballi, Hubballi-Dharwad Municipal Corporation (HDMC), KIMS Hospital Hubballi and RTO office Dharwad have less download speed (less than 10 Mbps) out of total 9 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-31, 35, 36 & 38)

- APMC Market Hubballi has less upload speed (less than 2 Mbps) out of total 9 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-31)

- University Of Agricultural Sciences Dharwad has less download speed (less than 10 Mbps) out of total 4 walk test locations for auto-selection mode (5G/4G/3G/2G). (refer table-57)

- VIL has 23.40 Mbps average download speed & 10.91 Mbps average upload speed across the measured routes for highway drive. (refer table-64)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

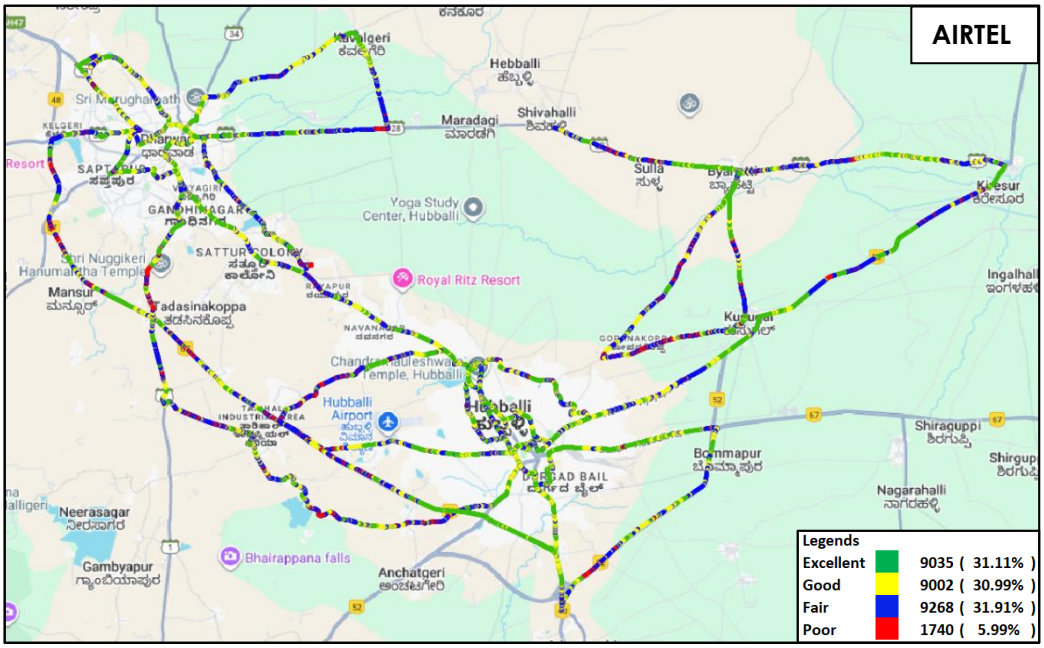


Figure-42: Signal strength 3G/2G network mode – AIRTEL.

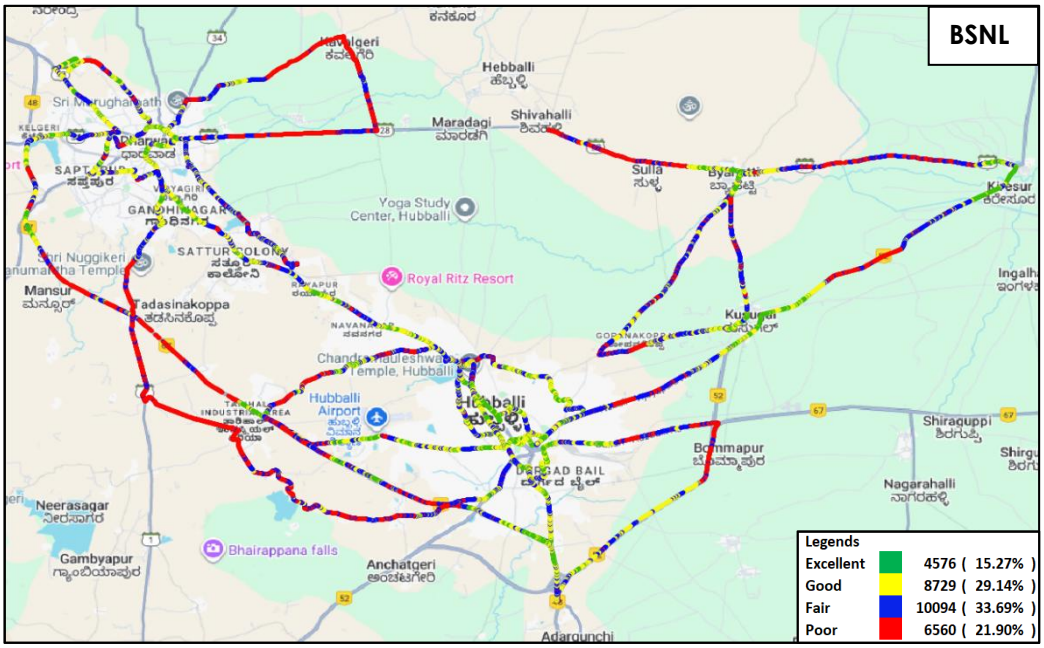


Figure-43: Signal strength 3G/2G network mode – BSNL.

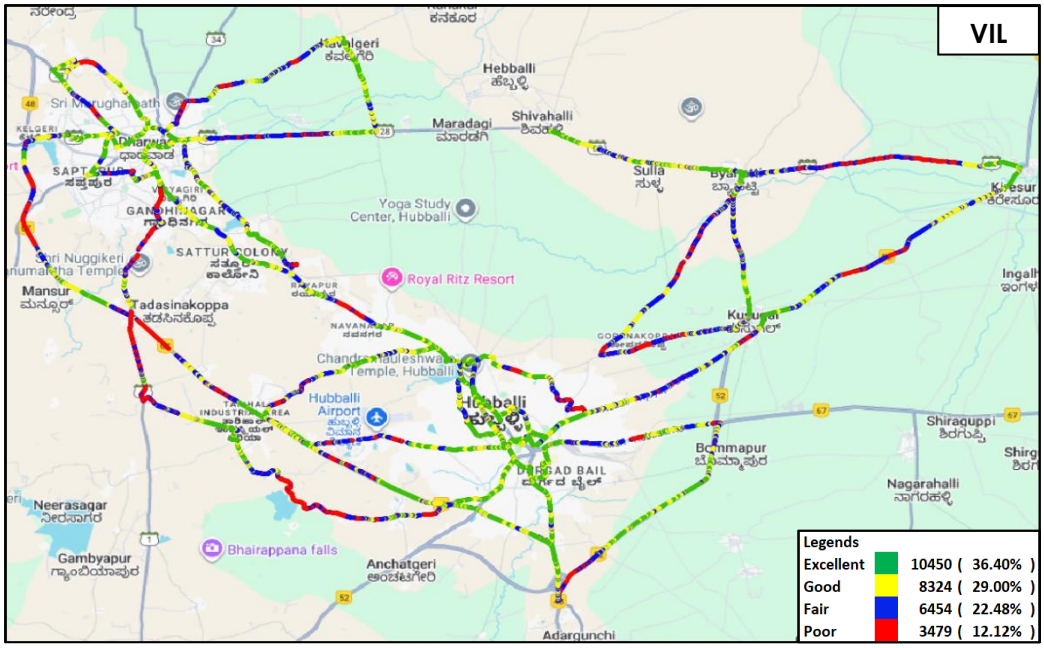


Figure-44: Signal strength 3G/2G network mode – VIL.

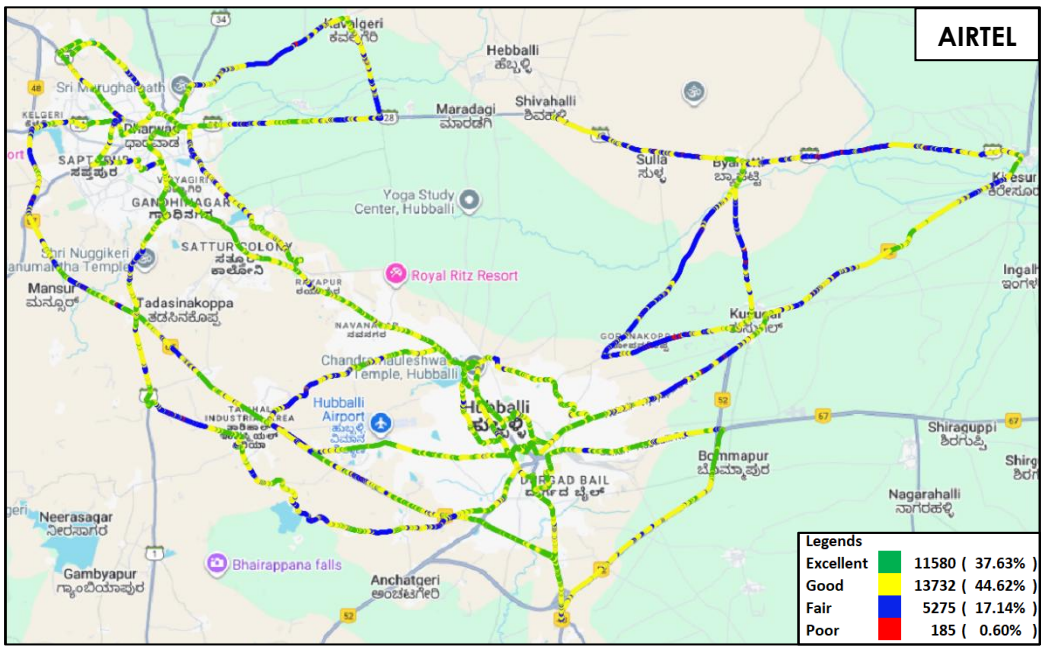


Figure-45: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.

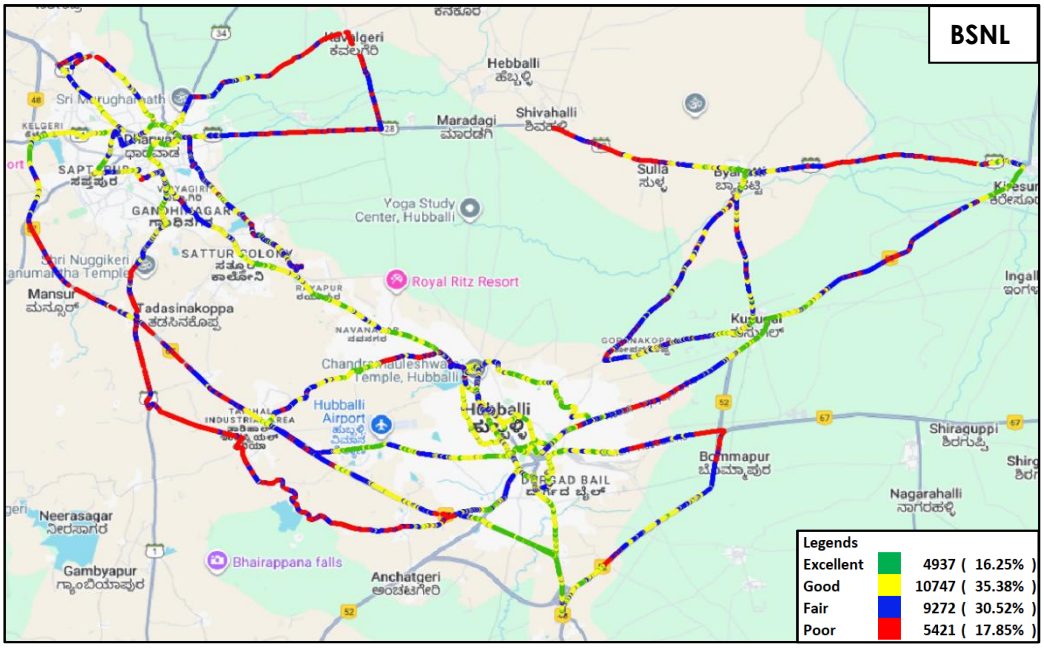


Figure-46: Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.

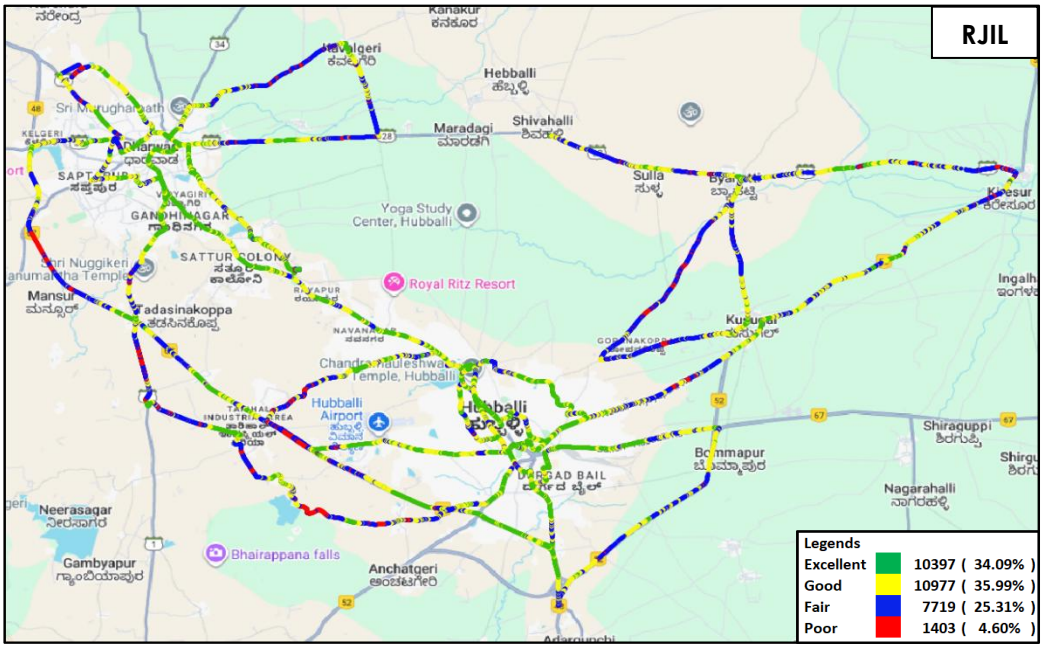


Figure-47: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.

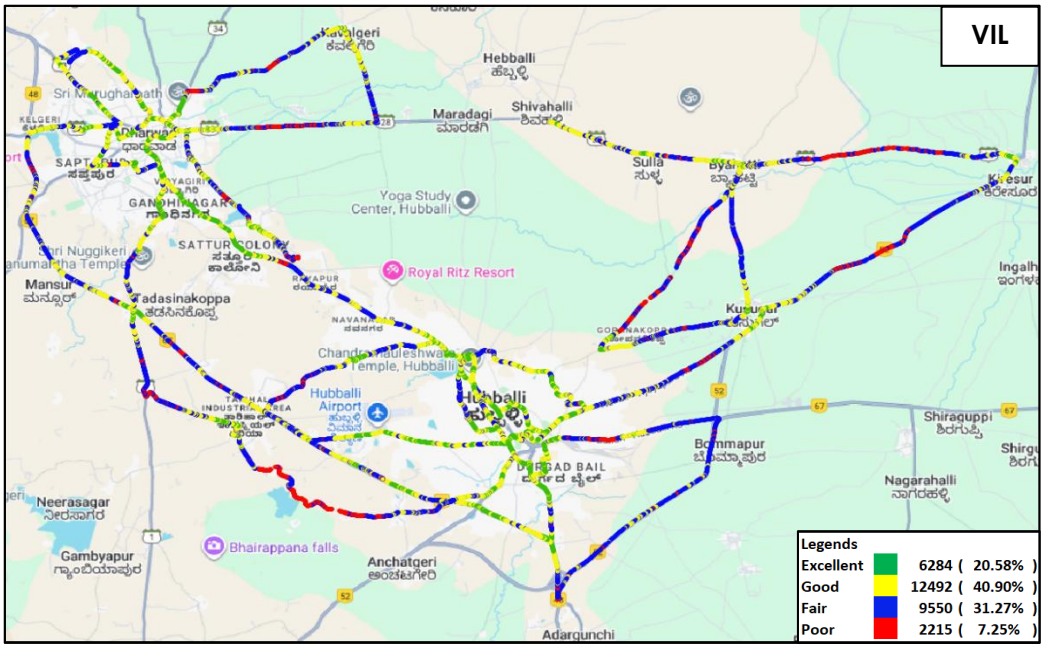


Figure-48: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

6.1.2 Highway

i) Hubballi–Haveri–Sirsi–Yellapur Hubballi Junction

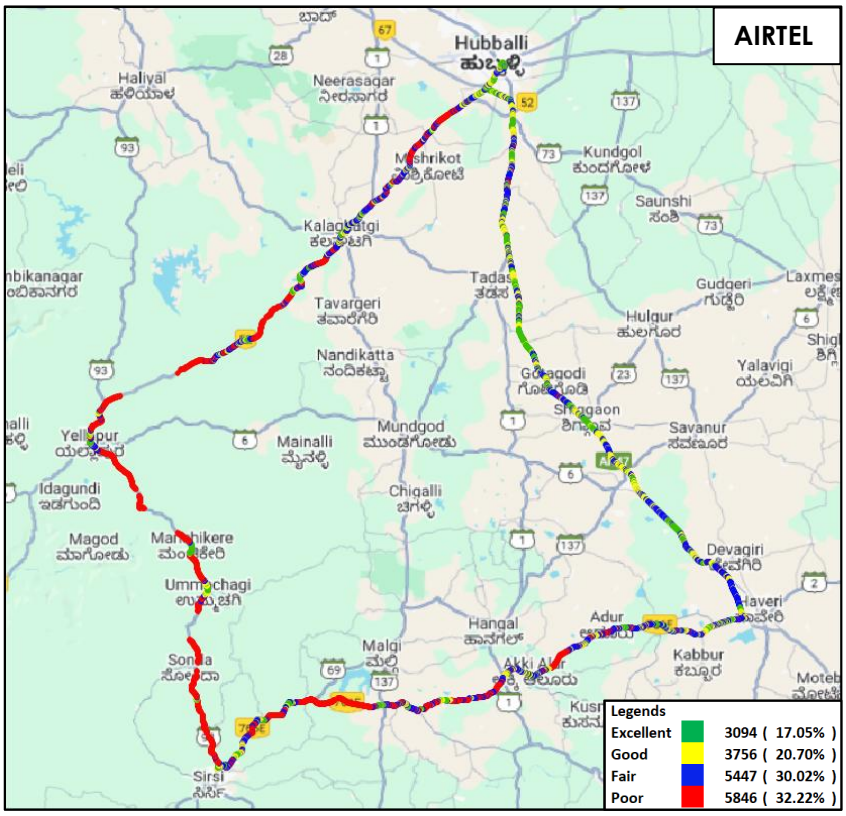


Figure-49: Signal strength 3G/2G network mode – AIRTEL.

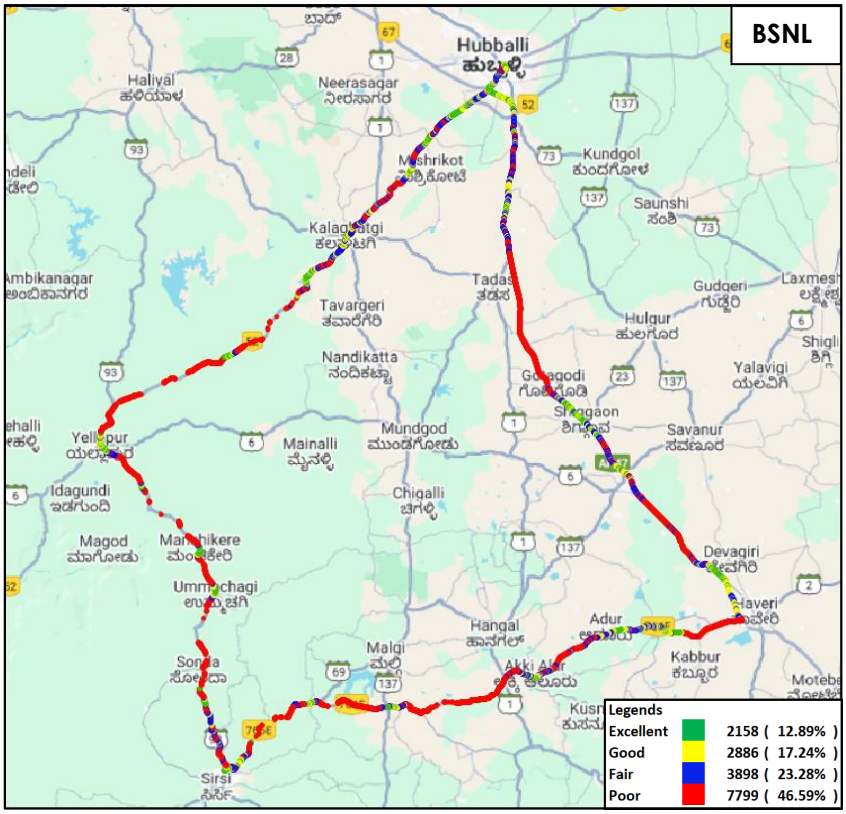


Figure-50: Signal strength 3G/2G network mode – BSNL.

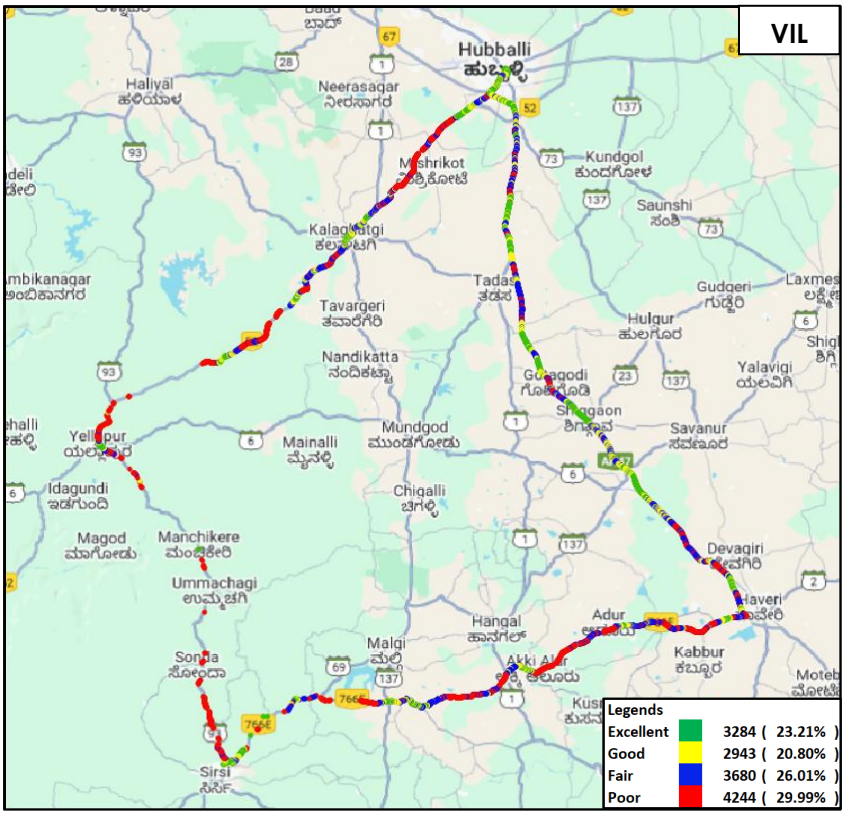


Figure-51: Signal strength 3G/2G network mode – VIL.

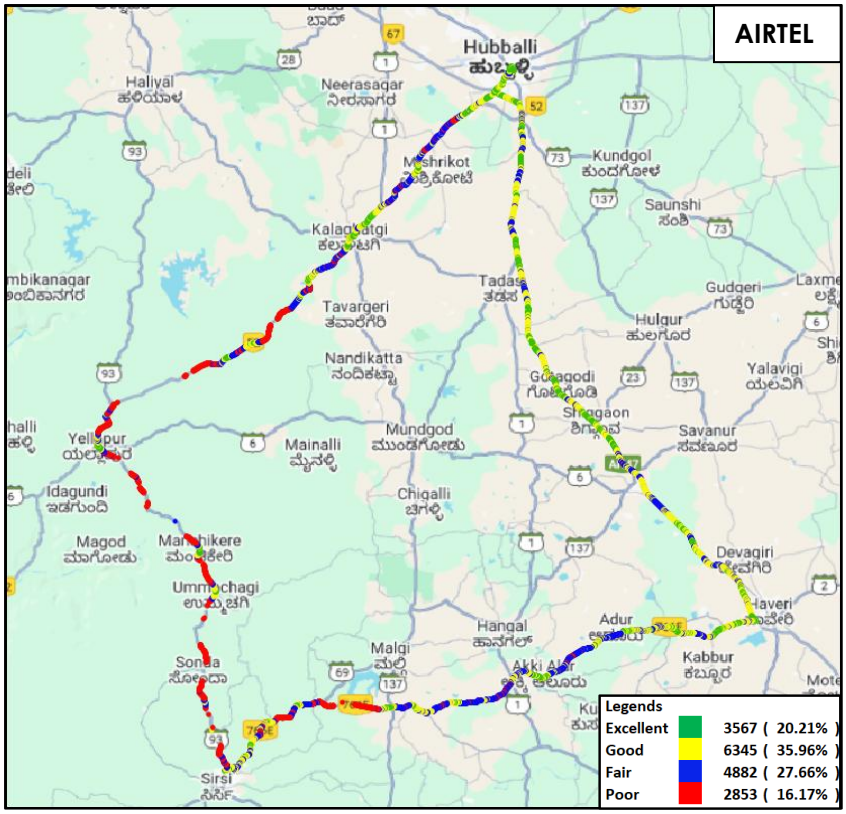


Figure-52: Signal strength auto-selection mode 5G/4G/3G/2G –AIRTEL

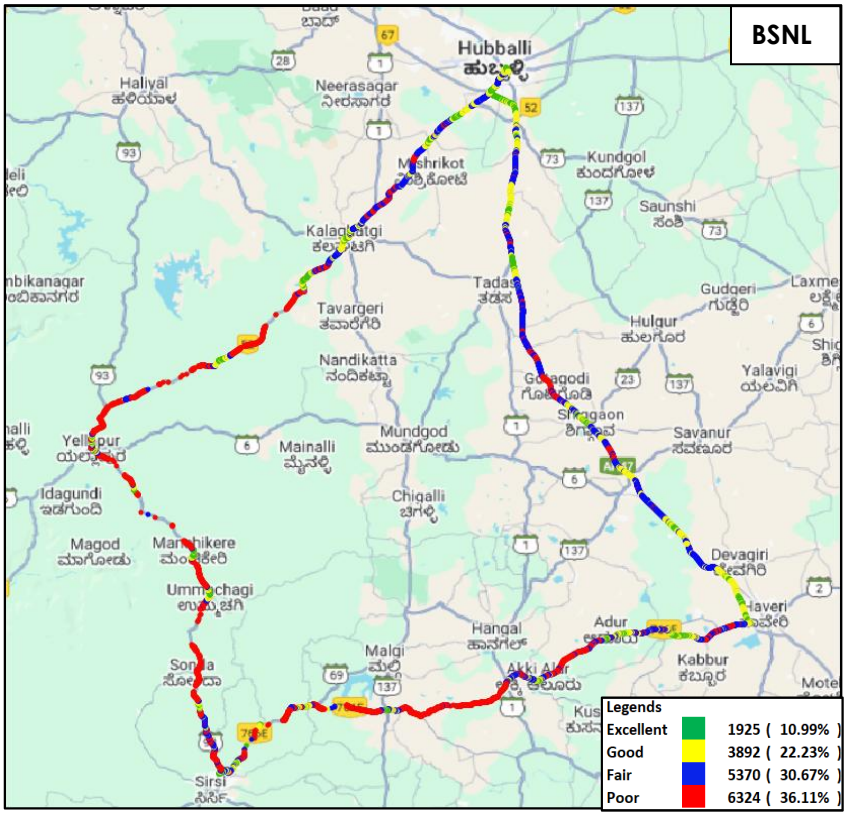


Figure-53: Signal strength auto-selection mode 5G/4G/3G/2G –BSNL.

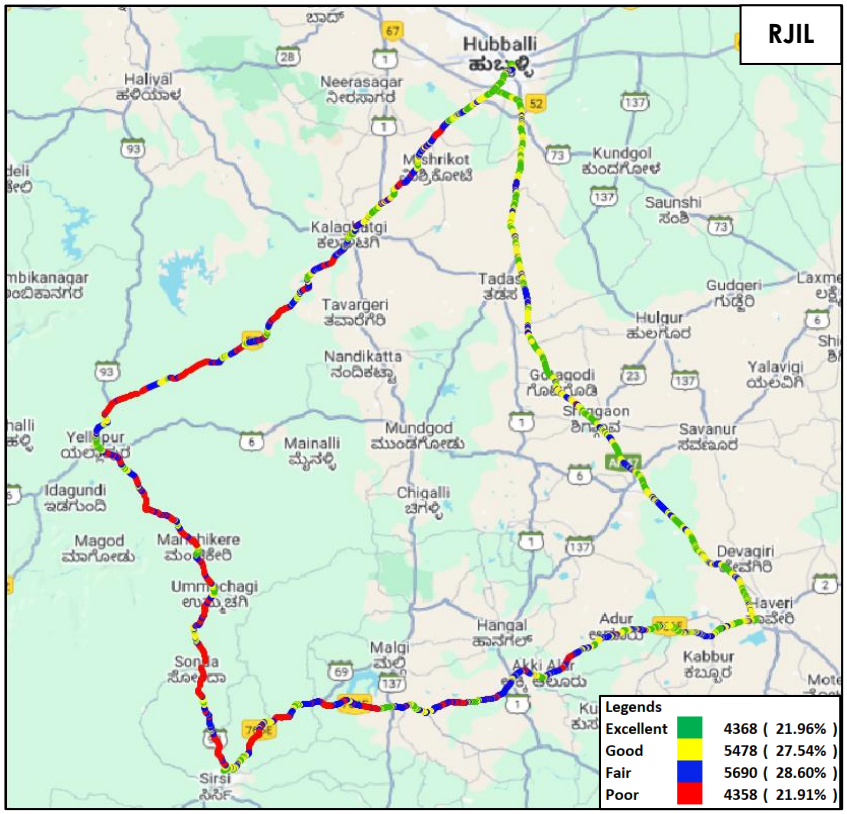


Figure-54: Signal strength auto-selection mode 5G/4G/3G/2G -RJIL

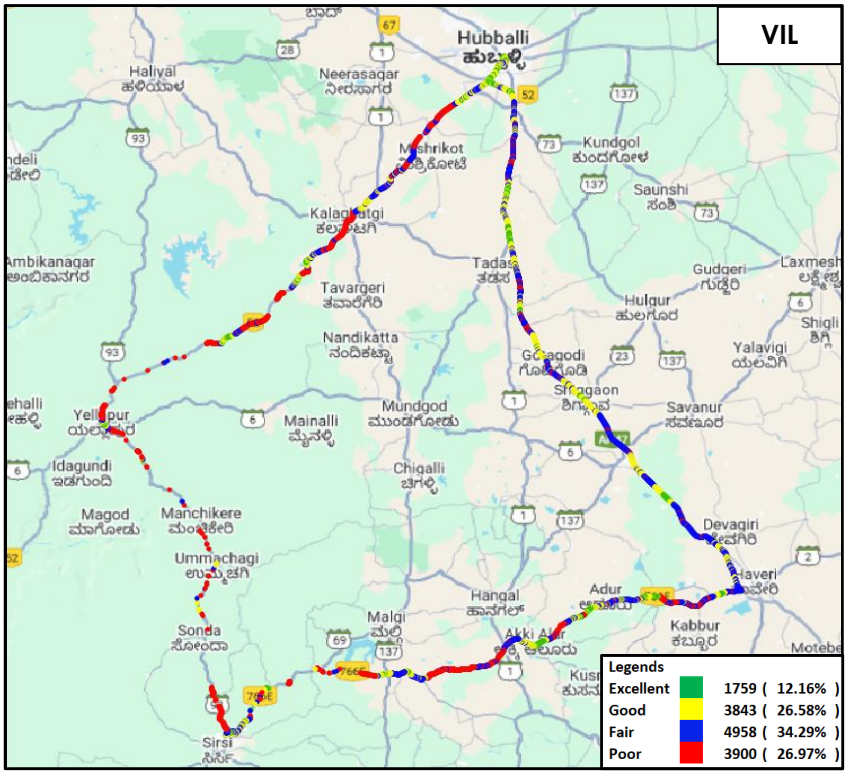


Figure-55: Signal strength auto-selection mode 5G/4G/3G/2G –VIL

7. Appendix

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

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

7.1 Appendix-I

7.1.1 Drive test setup

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

Table-65: Voice test detail

Note-

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

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

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

Table-66: Data test detail

Note-

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

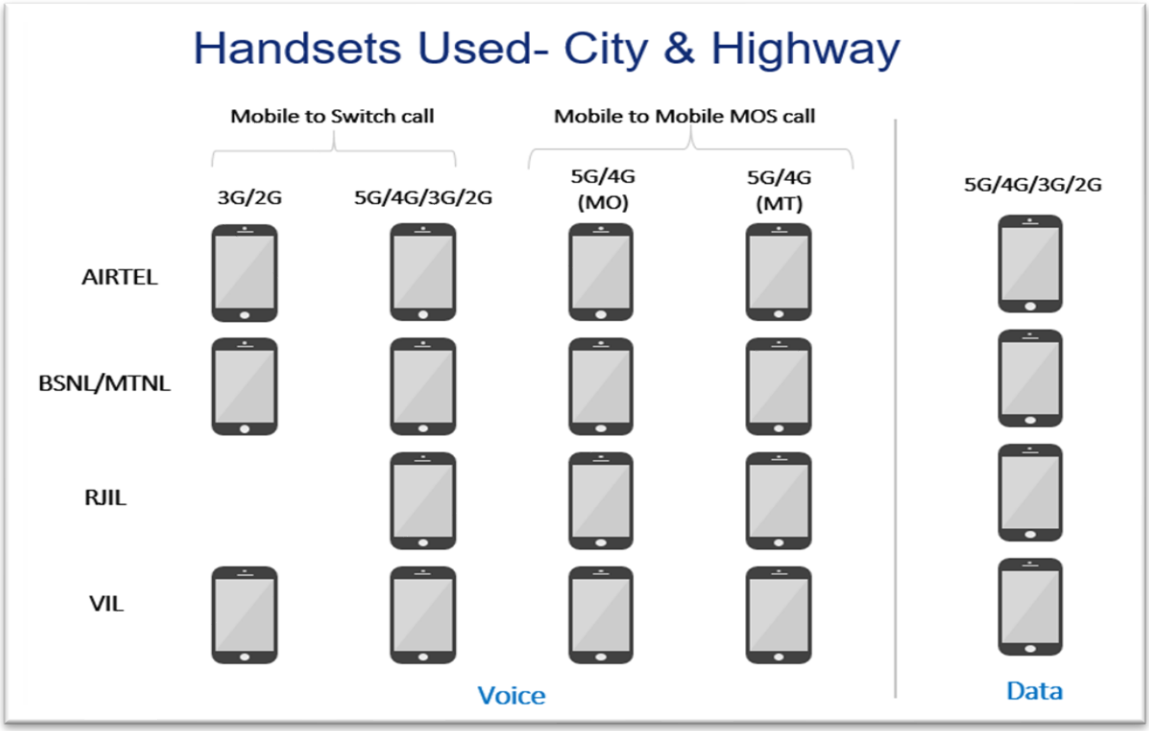


Figure-56: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

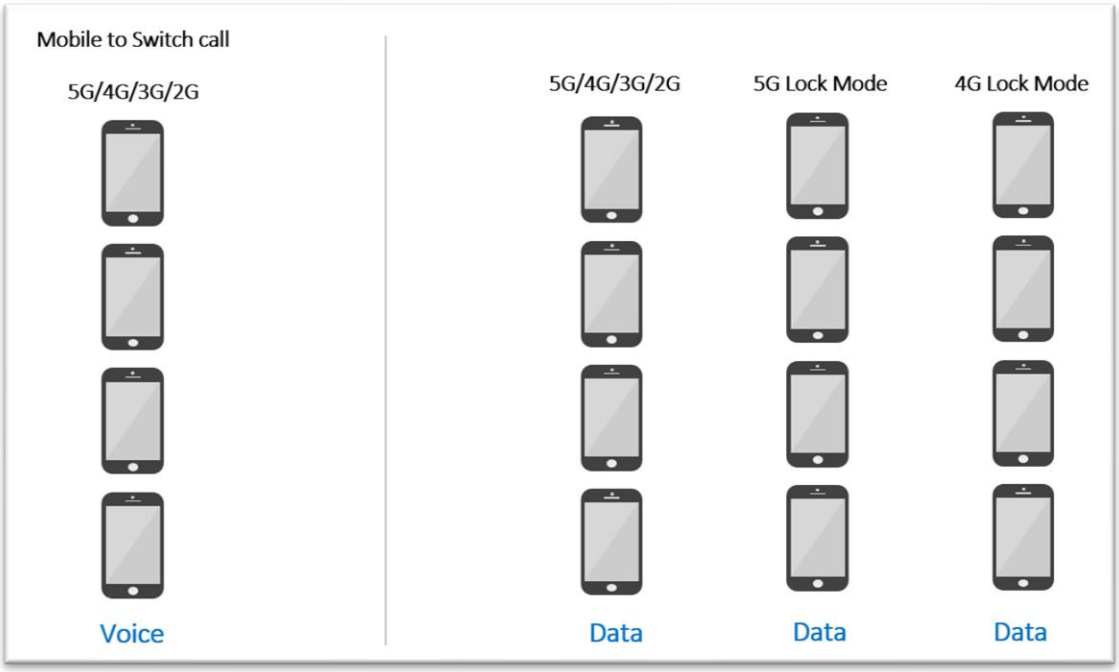


Figure-57: Number of handsets used in railway/metro/walktest/hotspot/ coastal area

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)

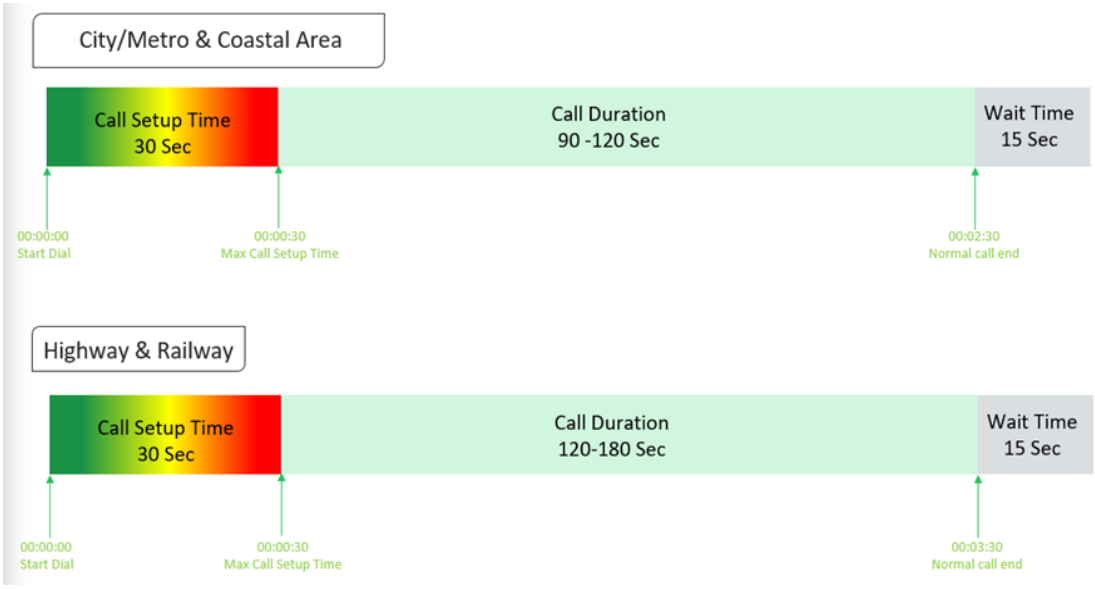


Figure-58: Voice test script for city/railway/metro/highway & coastal area

- 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-59: 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

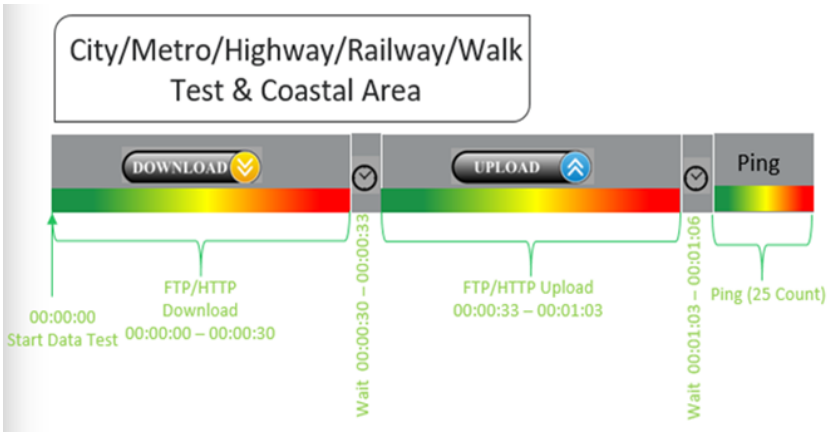


Figure-60: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

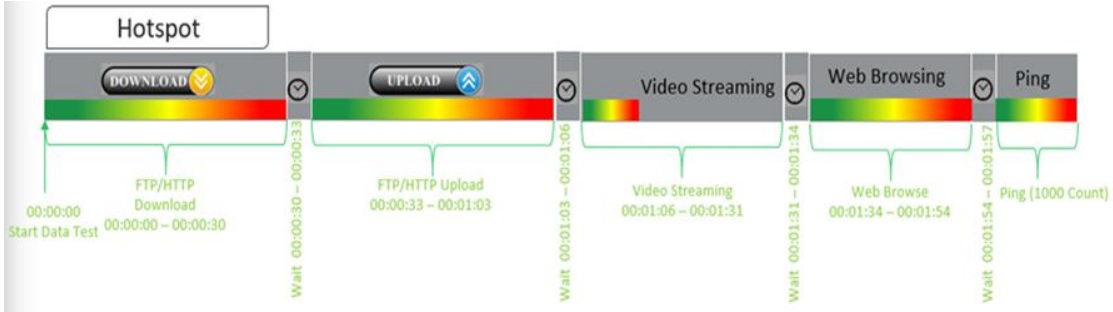


Figure-61: Data test script used at hotspot

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

7.2 Appendix-II

7.2.1 Network Performance Parameters for Voice calls

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

<table>
<tr><td>Jitter</td><td>The inter arrival jitter is the difference in the relative transit time for two packets. The relative transit time is the difference between a packet's Real-time Transport Protocol (RTP) timestamp and the receiver's clock at the time of arrival, measured in the same units. If Si is the RTP timestamp from packet i, and Ri is the time of arrival in RTP timestamps units for packet i, then for two packets i and j the inter-arrival jitter D can be expressed as:
D(i,j) = (Rj - Ri) - (Sj - Si)

The interarrival jitter is calculated continuously as each data packet i is received from source SSRC_n, using this difference D for that packet and the previous packet i-1 in order of arrival (not necessarily in sequence), according to the formula
J(i) = J(i-1) + (|D(i-1,i)| - J(i-1))/16 or 8</td></tr>
<tr><td>Downlink Packet Drop Rate</td><td>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call originating handset.
This KPI is calculated from MOS call for packet call only (VoNR/VoLTE)</td></tr>
<tr><td>Uplink Packet Drop Rate</td><td>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call terminating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE).</td></tr>
<tr><td>Signal Strength</td><td>Signal strength is the signal power level received by the wireless user.

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

Table-67: Network performance parameter and definition voice

7.2.2 Network Performance Parameters Data tests

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

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

Table-68: Network performance parameter and definition Data

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

Hardik Rajeshbhai Patel

Digitally signed by Hardik Rajeshbhai Patel
Date: 2025.08.26 12:48:05 +05'30'