TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Tamil Nadu LSA

March 2025

Contents

1. Introduction

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

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

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

2. Executive Summary (LSA)

2.1 Drive test details

This report covers the findings of the IDT undertaken in Tamil Nadu License Service Area (LSA) during the month of March-2025 under the supervision of TRAI Regional Office (RO), Hyderabad. Details of route / area covered during the IDT is as given below:

Sl. No	Drive test route	Type of route	Distance covered (KMs)	From date	To date
1	Chennai	Walk test	7.0	26-March-2025	26-March-2025
2	Chennai to Coimbatore	Highway	545.7	26-March-2025	27-March-2025
3	Vijayawada to Chennai	Railway	430.0	25-March-2025	25-March-2025
4	Coimbatore to Chennai	Railway	496.3	28-March-2025	28-March-2025

Table-1: Drive test summary

2.2 Drive test routes

The map provides overview of drive test routes indicating Walk test, Highway and Railway as per the legends shown on the map.
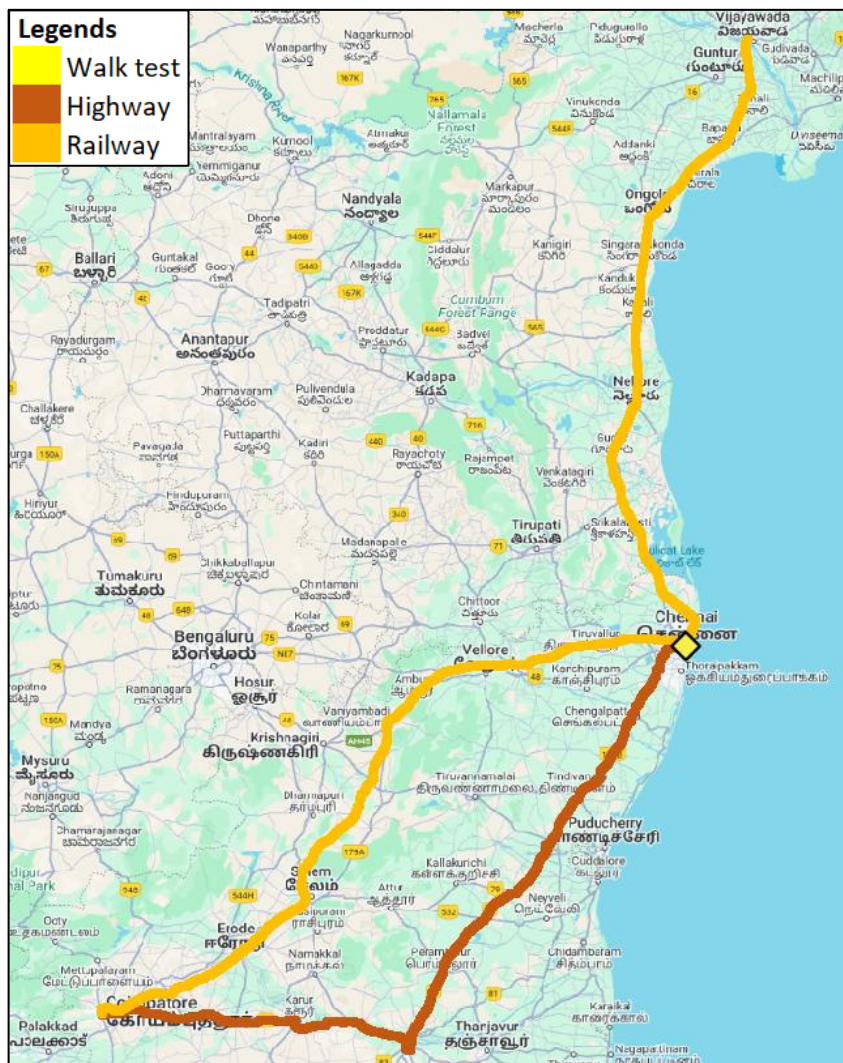

Figure-1: Drive test routes

2.3 Summary of areas covered

a) Walk test- MGR Chennai Central Railway Station to Egmore Railway Station to Hotel Ashoka (Platform area covered at both railway stations & Surrounding area covered at Hotel Ashoka)

b) Highway- Chennai to Coimbatore

c) Railway-

1. Vijayawada to Chennai
2. Coimbatore to Chennai
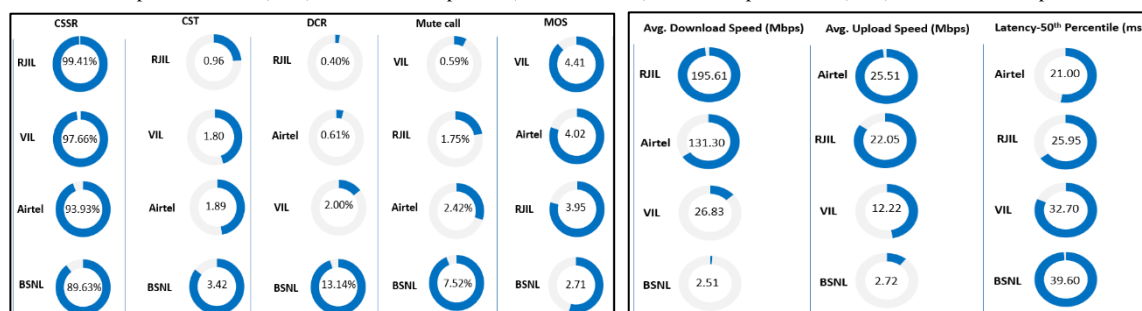
2.4 Telecom service providers detected frequency bands

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

S.no.	Name of TSP	Technology	Frequency Bands (In MHz)
1	Bharti Airtel Ltd.	2G	1800
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, 2500

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 milli seconds), **DCR:** Drop Call Rate (in %) & **MOS:** Mean Opinion Score.

CSSR	**CST**	**DCR**	**Mute call**	**MOS**	**Avg. Download Speed (Mbps)**	**Avg. Upload Speed (Mbps)**	**Latency-50th Percentile (ms)**	
RJIL 99.41%	RJIL 0.96	RJIL 0.40%	VIL 0.59%	VIL 4.41	RJIL 195.61	Airtel 25.51	Airtel 21.00	
VIL 97.66%	VIL 1.80	Airtel 0.61%	RJIL 1.75%	Airtel 4.02	Airtel 131.30	RJIL 22.05	RJIL 25.95	
Airtel 93.93%	Airtel 1.89	VIL 2.00%	Airtel 2.42%	RJIL 3.95	VIL 26.83	VIL 12.22	VIL 32.70	
BSNL 89.63%	BSNL 3.42	BSNL 13.14%	BSNL 7.52%	BSNL 2.71	BSNL 2.51	BSNL 2.72	BSNL 39.60	

Summary–Voice services

Call Setup Success Rate: Airtel, BSNL, RJIL and VIL have call setup success rate of 93.93%, 89.63%, 99.41% and 97.66% respectively in Auto-selection mode (5G/4G/3G/2G).

Call Setup Time: Airtel, BSNL, RJIL and VIL have call setup time of 1.89, 3.42, 0.96 & 1.80 seconds respectively in Auto-selection mode (5G/4G/3G/2G).

Drop Call Rate: Airtel, BSNL, RJIL and VIL have drop call rate of 0.61%, 13.14%, 0.40% & 2.00% respectively in Auto selection mode (5G/4G/3G/2G).

Call Silence/Mute Rate: Airtel, BSNL, RJIL and VIL have silence rate of 2.42%, 7.52%, 1.75% & 0.59% respectively in packet switched network (4G/5G).

Mean Opinion Score (MOS): Airtel, BSNL, RJIL and VIL have average MOS score of 4.02, 2.71, 3.95 & 4.41 respectively.

Summary–Data services

Data Download performance (Overall): Average download speed of Airtel (5G/4G/2G) is 131.30 Mbps, BSNL (4G/3G/2G) is 2.51 Mbps, RJIL (5G/4G) is 195.61 Mbps and VIL (4G/2G) is 26.83 Mbps.

Data Upload performance (Overall): Average upload speed of Airtel (5G/4G/2G) is 25.51 Mbps, BSNL (4G/3G/2G) is 2.72 Mbps, RJIL (5G/4G) is 22.05 Mbps and VIL (4G/2G) is 12.22 Mbps.

QoS Performance Analysis-Tamil Nadu 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 March-2025 covering walk test, Highway and Railway. (Refer Table 1)

3.2 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	217	195	197
Call Setup Success Rate %	83.87	98.46	98.48
Drop Call Rate %	3.30	4.69	3.61
Call Setup Time-Average (Second)	4.19	3.37	4.20
Handover Success Rate %	98.69	98.86	97.83

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

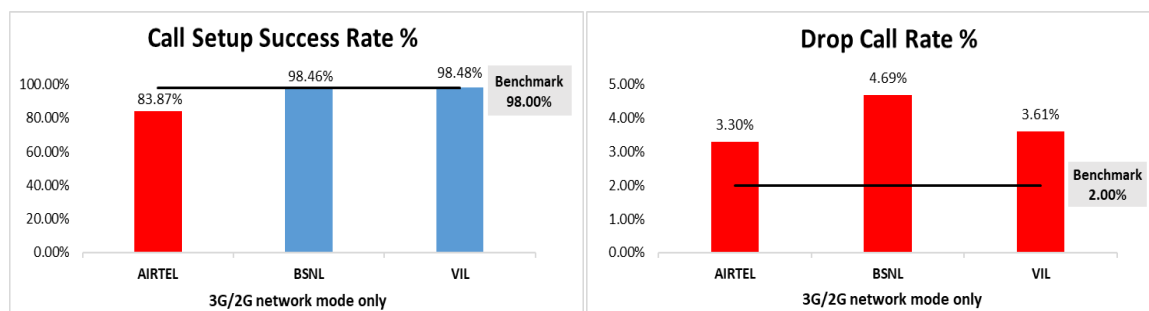**Figure-2:** Call setup success rate and drop call rate performance.

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	97	NA
2G	833	247	612

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	527	569	509	513
Call Setup Success Rate %	93.93	89.63	99.41	97.66
Drop Call Rate %	0.61	13.14	0.40	2.00
Call Setup Time-Average (Second)	1.89	3.42	0.96	1.80
Handover Success Rate %	99.92	99.25	99.90	99.93

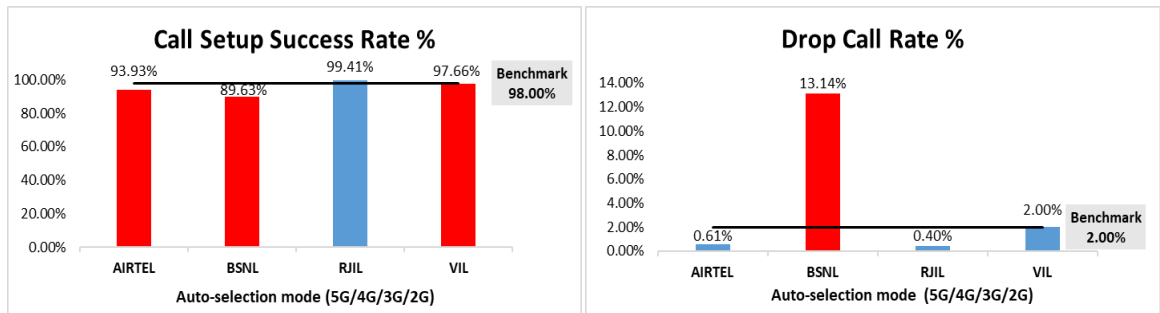**Table-5:** Summary of voice call performance in network auto-selection mode.

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)	165	226	171	170
Number of silence call for >4 Sec	4	17	3	1
Silence Call Rate %	2.42	7.52	1.75	0.59
Number of silence instances for >4 Sec	4	25	3	1
Number of silence instances for >3 Sec	9	34	6	5
Number of silence instances for >2 sec	14	49	12	32
RTP Jitter (4G & 5G) in ms	3.22	14.71	7.03	16.96
Packet loss Rate Downlink %	0.35	8.75	0.25	0.73
Packet loss Rate Uplink %	0.42	6.93	0.39	0.82

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

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	796	NA
4G	3372	817	3574	2514
3G	NA	138	NA	NA
2G	45	509	NA	141

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

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

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-6	2046	1882	2005	2053
Speech Quality (Average MOS Score)	4.02	2.71	3.95	4.41
Number of samples with MOS >=4 to <5 (Excellent)	1766	305	1552	1730
Number of samples with MOS >=3 to <4 (Good)	226	371	359	234
Number of samples with MOS >=2 to <3 (Fair)	38	722	65	65
Number of samples with MOS >=1 to <2 (Poor)	16	484	29	24
%age of samples with MOS >=4 to <5 (Excellent)	86.31%	16.21%	77.41%	84.27%
%age of samples with MOS >=3 to <4 (Good)	11.05%	19.71%	17.91%	11.40%
%age of samples with MOS >=2 to <3 (Fair)	1.86%	38.36%	3.24%	3.17%
%age of samples with MOS >=1 to <2 (Poor)	0.78%	25.72%	1.45%	1.17%

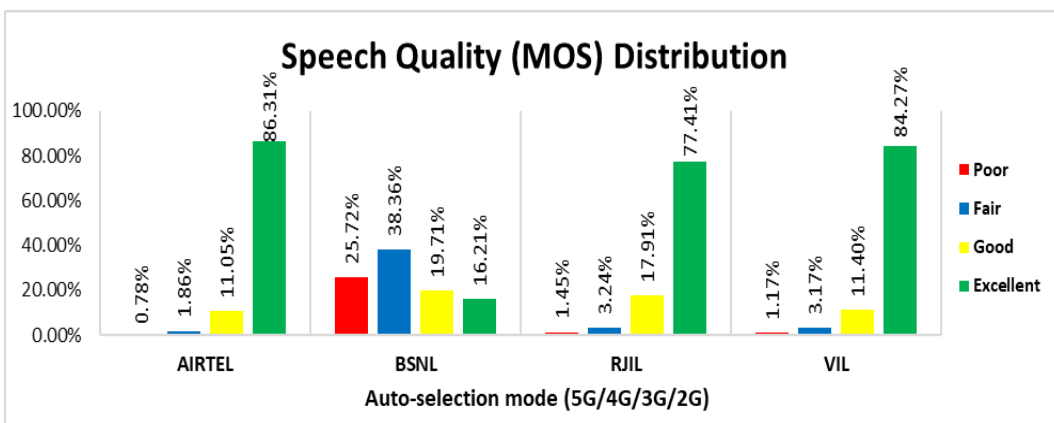**Table-8:** Summary of speech quality (MOS) samples.

Figure- 4: Distribution of samples in MOS score range.

3.3 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	131.30	2.51	195.61	26.83
	80th Percentile	215.29	4.08	353.32	45.45
	20th Percentile	20.13	0.39	37.68	7.69
Upload Throughput (Mbits/s)	Average	25.51	2.72	22.05	12.22
	80th Percentile	46.27	3.19	41.69	20.87
	20th Percentile	3.66	1.19	3.33	2.73
Latency (ms)	50th Percentile	21.00	39.60	25.95	32.70

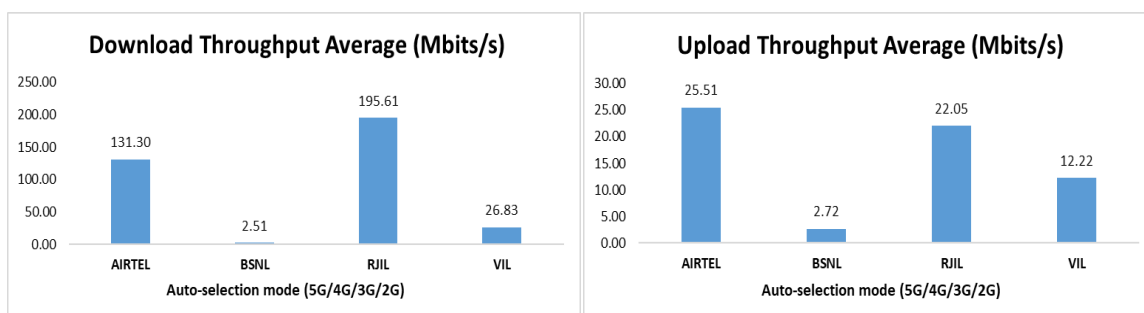**Table-9:** Summary of data performance in network auto-selection mode.

Figure- 5: Download and Upload throughput

Number of unique cell Id's covered in Data test- Technology wise				
Technology	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	0	NA	2628	NA
4G	3904	876	416	2796
3G	NA	208	NA	NA
2G	7	118	NA	64

Table-10: Technology wise number of network cell Id's latched during drive test.

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

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis

4.1 Overview

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

4.2 Walk Test

Walk Test has been conducted on 26th March 2025. One location has been tested in the city.

4.2.1 Drive test route
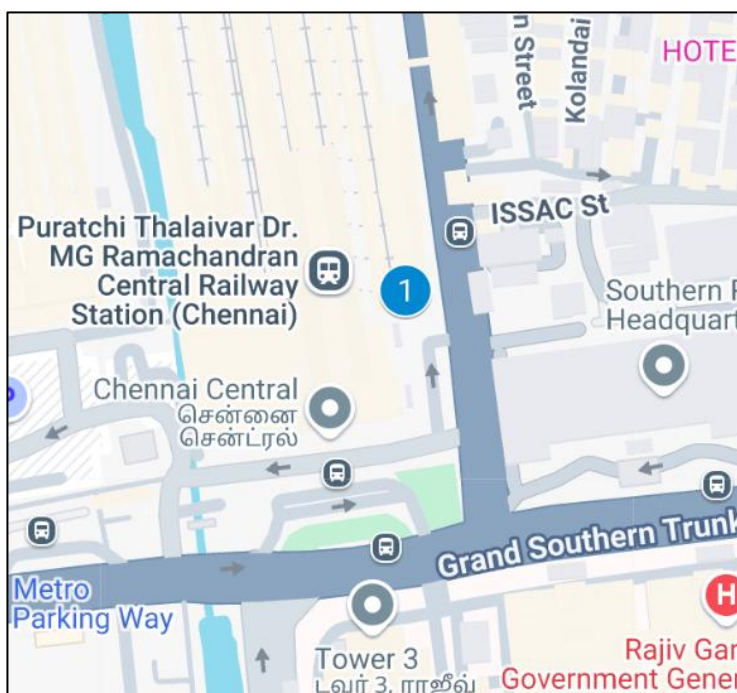
Figure-6: Walk Test location.

4.2.2 Walk Test Covered

MGR Chennai Central Railway Station to Egmore Railway Station to Hotel Ashoka (Platform area covered at both railway stations & Surrounding area covered at Hotel Ashoka)

4.2.3 Voice Performance

MGR Chennai Central Railway Station to Egmore Railway Station to Hotel Ashoka				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	53	54	52	52
Call Setup Success Rate %	100.00	96.30	100.00	100.00
Drop Call Rate %	0.00	1.92	0.00	0.00
Call Setup Time-Average (Second)	0.58	1.28	0.70	1.74

Table-11: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

4.2.4 Data Performance

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

MGR Chennai Central Railway Station to Egmore Railway Station to Hotel Ashoka				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	144.27	5.04	244.76	30.05
Download Session Setup Success Rate %	100.00	92.19	57.63	100.00
Upload Throughput Average (Mbits/s)	70.36	7.65	41.62	20.44
Upload Session Setup Success Rate %	100.00	92.06	86.21	100.00
Latency (ms) - 50th Percentile	14.35	23.40	21.75	21.85

Table-12: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

4.3 Highway

Drive test has been conducted on 26th March 2025 and 27th March 2025, covering one highway route. (refer table-1).

4.3.1 Drive test route
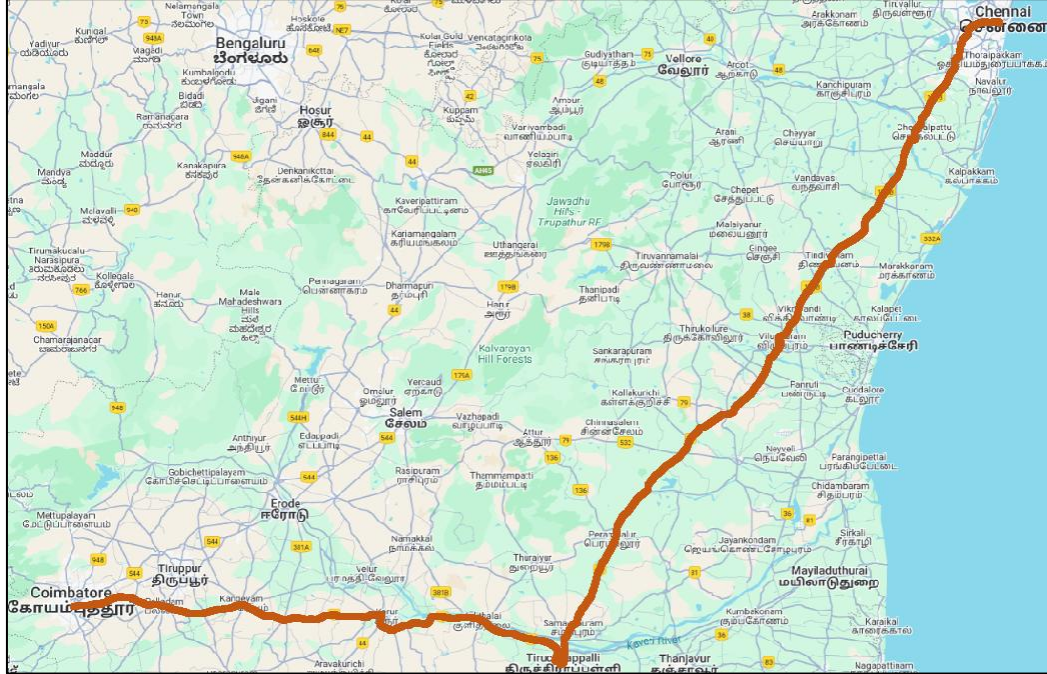
Figure- 7: Drive test routes.

4.3.2 Routes covered

Chennai to Coimbatore passing through Chengalpattu, Tindivanam, Ulundurpet, Tiruchirappalli, Karur, Vellakoil, Palladam, etc. Drive test for this route has been conducted on 27th March 2025.

4.3.3 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 network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	217	195	197
Call Setup Success Rate %	83.87	98.46	98.48
Drop Call Rate %	3.30	4.69	3.61
Call Setup Time-Average (Second)	4.19	3.37	4.20
Handover Success Rate %	98.69	98.86	97.83

Table-13: Summary of voice call performance in 3G/2G network mode only.
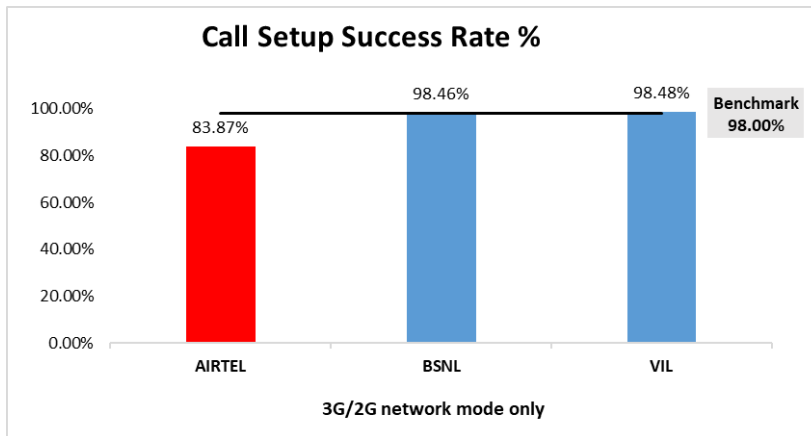
Figure-8: Performance for call setup success rate.
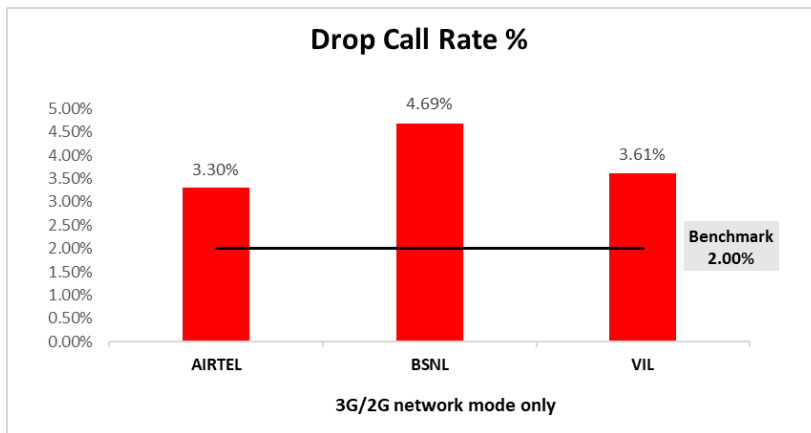
Figure-9: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	54.76%	NA
2G	99.99%	45.22%	99.96%
Limited Service	0.01%	0.02%	0.04%

Table-14: Time spent on technology during drive test 3G/2G network mode only.
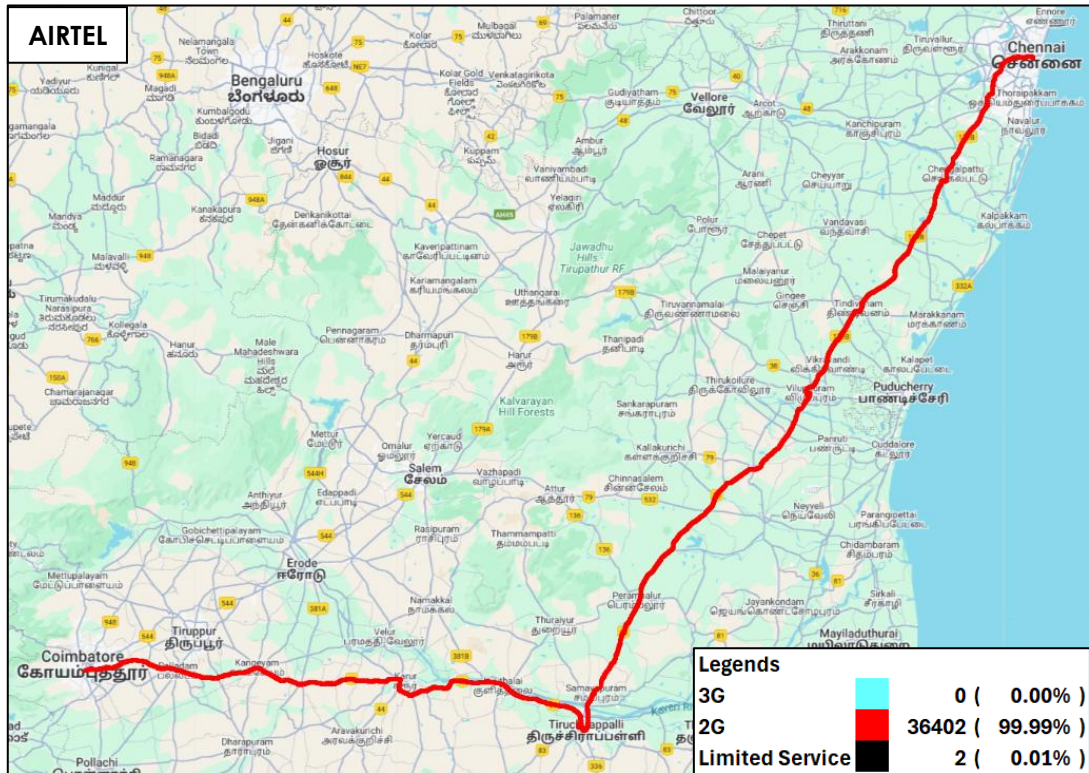
Figure-10: Serving technology plots 3G/2G network mode – AIRTEL.
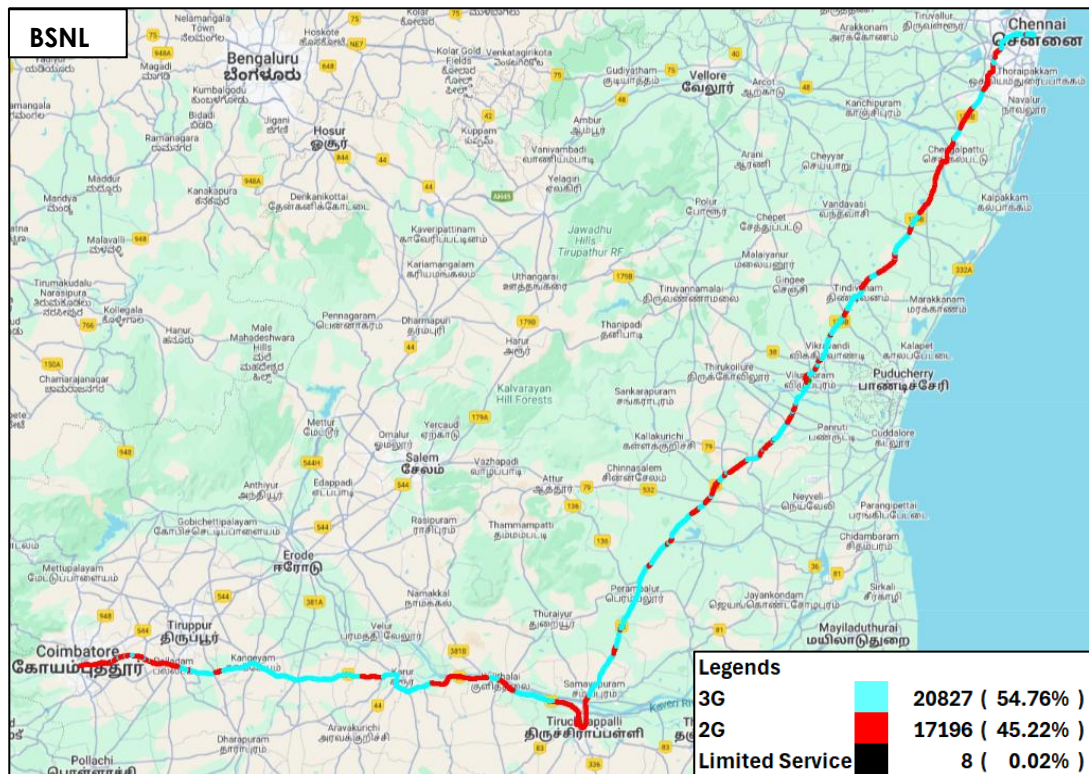
Figure-11: Serving technology plots 3G/2G network mode – BSNL.
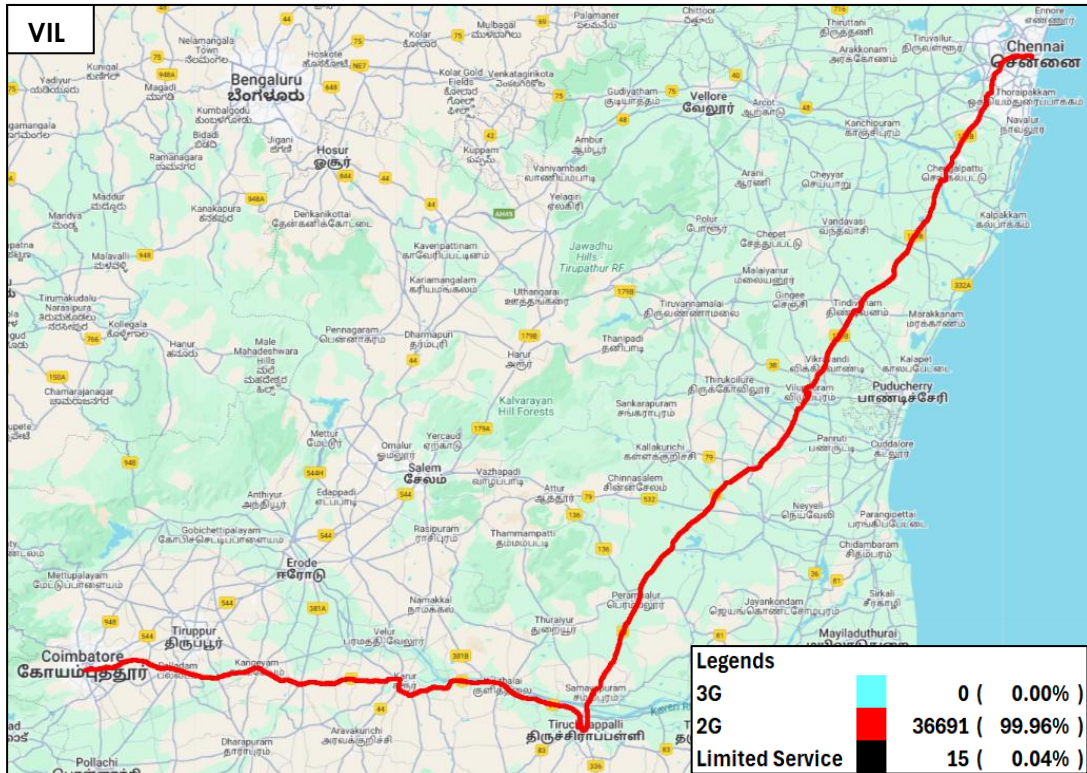
Figure-12: Serving technology plots 3G/2G network mode –VIL.

(c) Network Signal Strength distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (refer figure-44, 45 & 46 for map view)
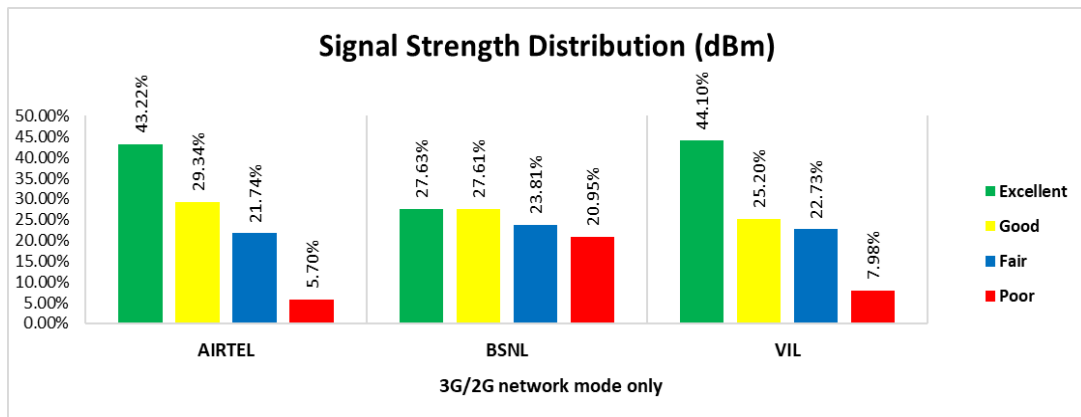
Figure-13: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 43% of samples falling in the excellent signal strength category.
- BSNL has 28% of samples falling in the excellent signal strength category.
- VIL has 44% 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	195	232	196	197
Call Setup Success Rate %	100.00	85.34	100.00	98.48
Drop Call Rate %	1.03	13.64	0.00	0.00
Call Setup Time Average (Second)	0.83	3.64	0.85	1.79
Handover Success Rate %	99.94	99.32	100.00	100.00

Table-15: Summary of voice call performance in network auto-selection mode.
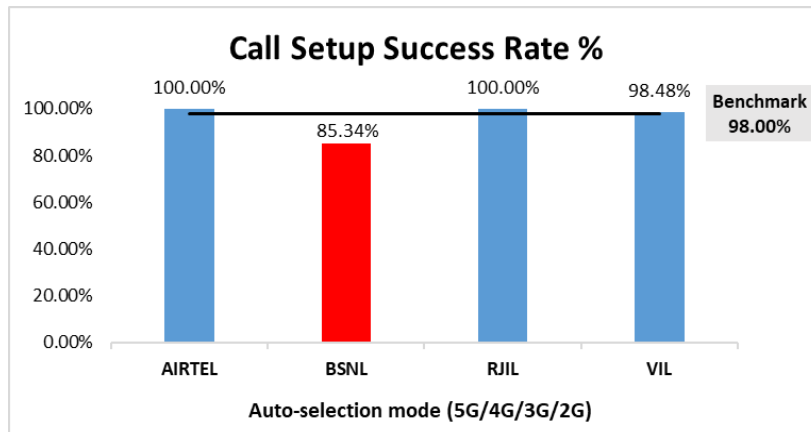
Figure-14: Performance for call setup success rate.
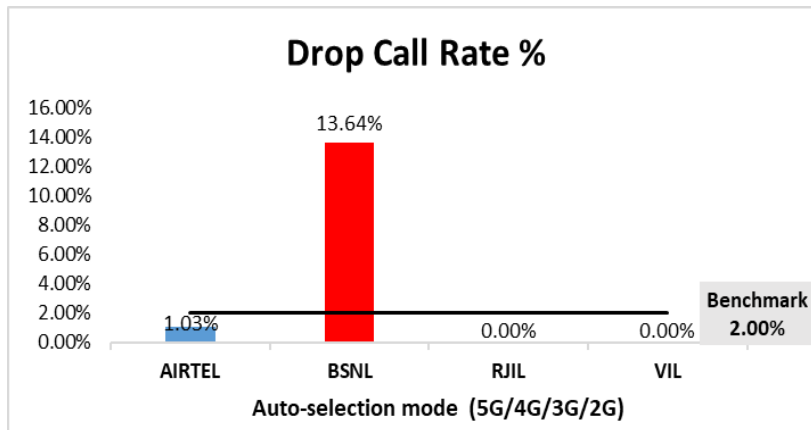
Figure-15: Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	165	226	171	170
Number of silence call for >4 Sec	4	17	3	1
Silence Call Rate %	2.42	7.52	1.75	0.59
Number of silence instances for >4 Sec	4	25	3	1
Number of silence instances for >3 Sec	9	34	6	5
Number of silence instances for >2 sec	14	49	12	32
RTP Jitter (4G & 5G) in ms	3.22	14.71	7.03	16.96

Packet loss Rate Downlink %	0.35	8.75	0.25	0.73
Packet loss Rate Uplink %	0.42	6.93	0.39	0.82

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 score values means: 5-Excellent, 4-Good, 3-Fair, 2-Poor, 1-Bad.

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Total Number of MOS Samples for calls in table-16	2046	1882	2005	2053
Speech Quality (Average MOS Score)	4.02	2.71	3.95	4.41
Number of samples with MOS >=4 to <5 (Excellent)	1766	305	1552	1730
Number of samples with MOS >=3 to <4 (Good)	226	371	359	234
Number of samples with MOS >=2 to <3 (Fair)	38	722	65	65
Number of samples with MOS >=1 to <2 (Poor)	16	484	29	24
%age of samples with MOS >=4 to <5 (Excellent)	86.31%	16.21%	77.41%	84.27%
%age of samples with MOS >=3 to <4 (Good)	11.05%	19.71%	17.91%	11.40%
%age of samples with MOS >=2 to <3 (Fair)	1.86%	38.36%	3.24%	3.17%
%age of samples with MOS >=1 to <2 (Poor)	0.78%	25.72%	1.45%	1.17%

Table-17: Summary of speech quality (MOS) samples.
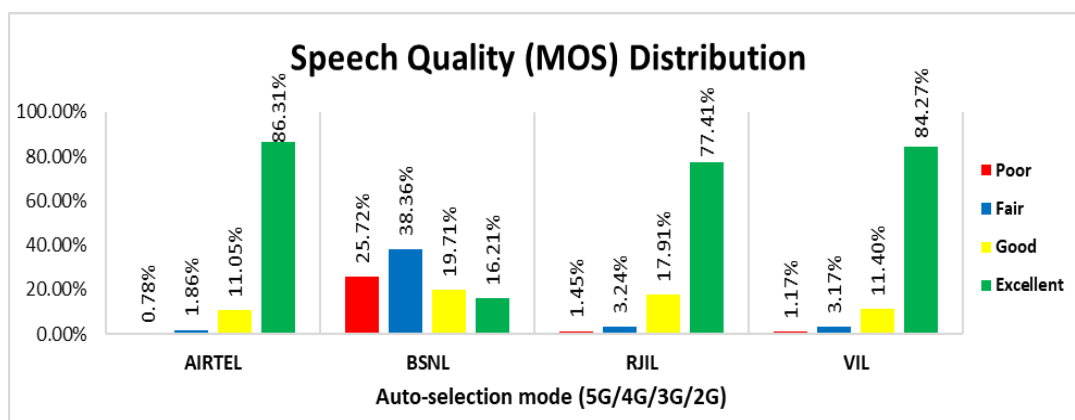
Figure-16: Distribution of samples in MOS score range.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	1.59%	NA	10.07%	NA
4G	93.74%	49.66%	89.93%	98.16%
3G	NA	18.76%	NA	NA
2G	4.66%	31.17%	NA	1.83%
Limited Service	0.00%	0.41%	0.00%	0.01%

Table-18: Time spent on technology during drive test.
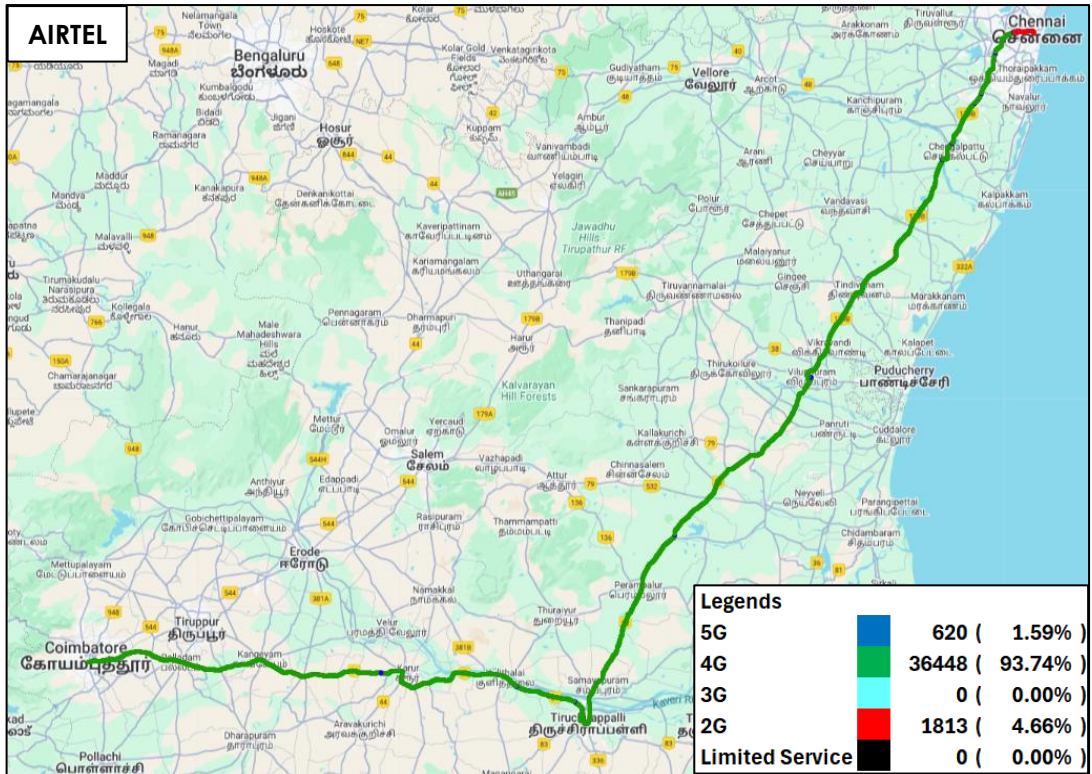
Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G) –AIRTEL.
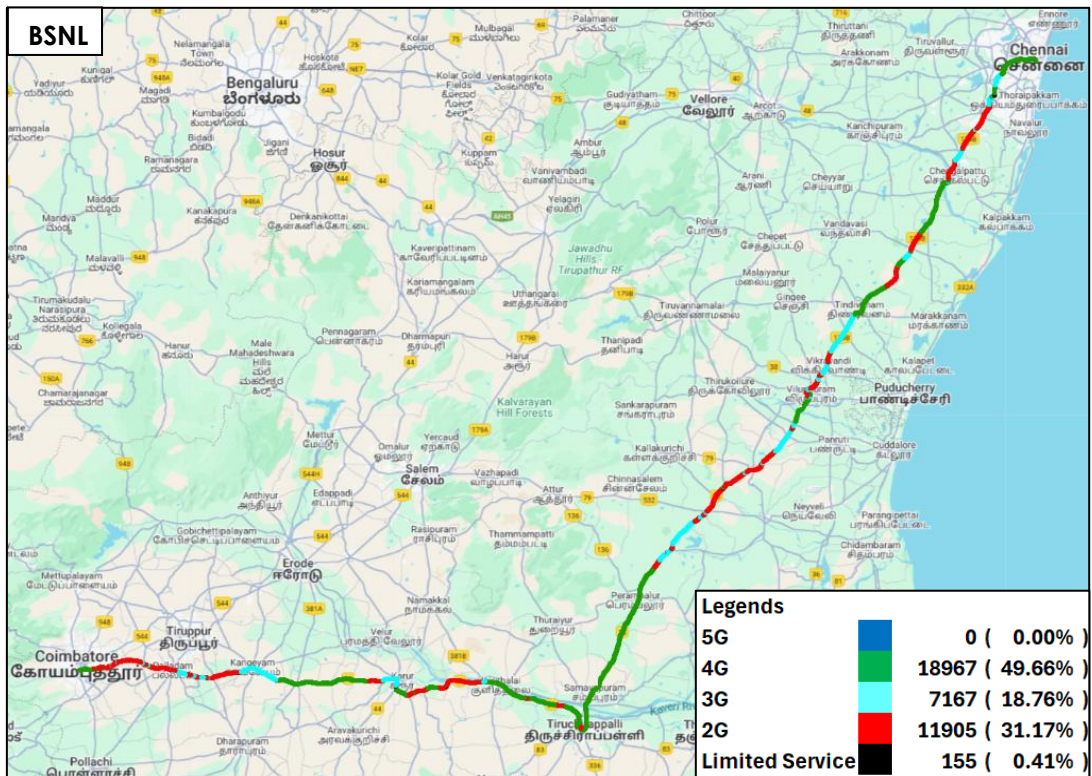
Legends for Figure-17:

Technology	Count	Percentage
5G	620	1.59%
4G	36448	93.74%
3G	0	0.00%
2G	1813	4.66%
Limited Service	0	0.00%

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

Legends for Figure-18:

Technology	Count	Percentage
5G	0	0.00%
4G	18967	49.66%
3G	7167	18.76%
2G	11905	31.17%
Limited Service	155	0.41%
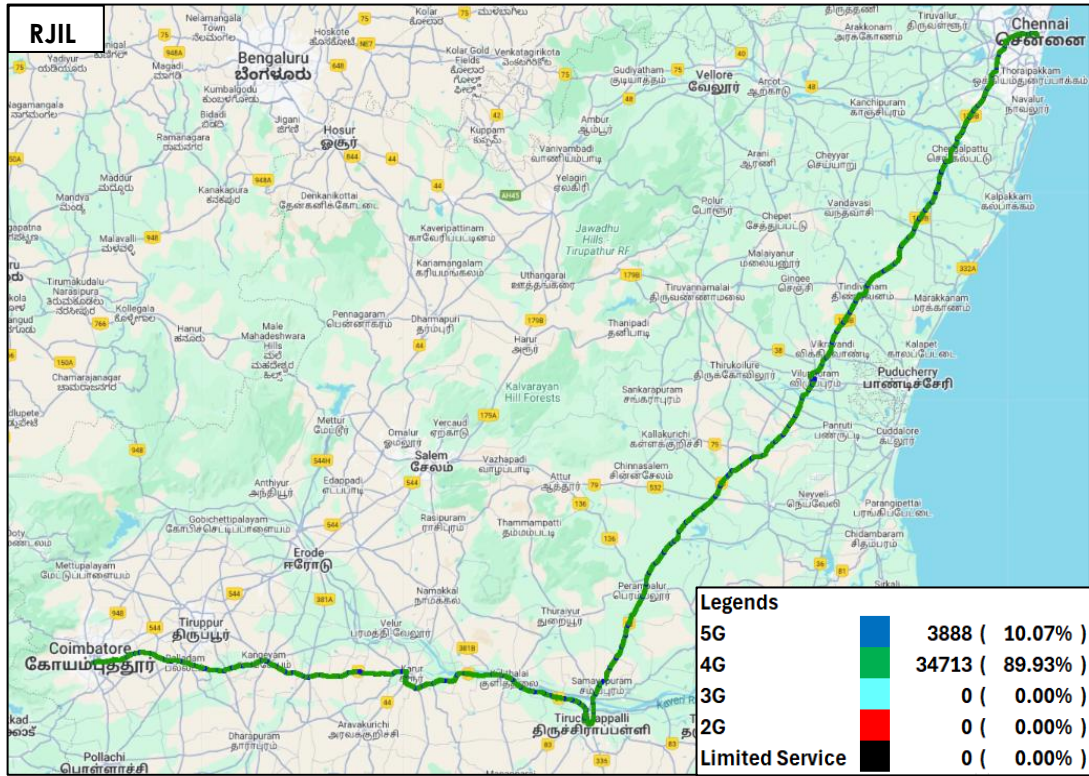
Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL
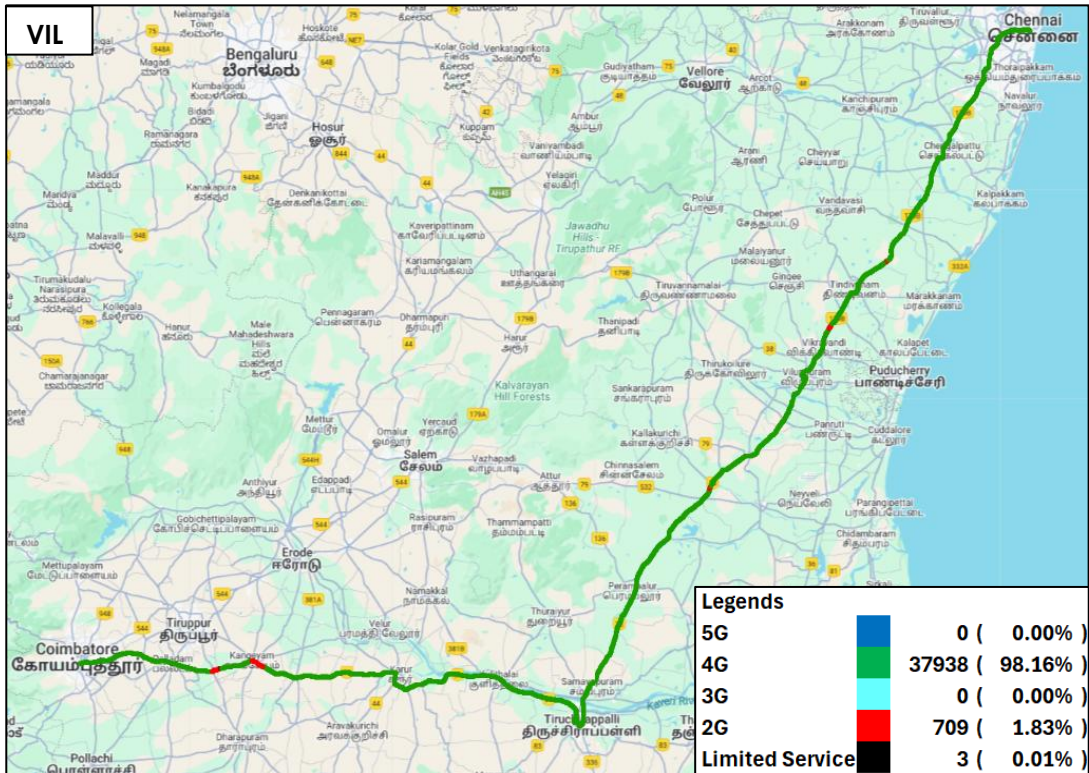
Figure-20: Serving technology plots in auto-selection mode (5G/4G/3G/2G) – VIL.

(g) Network Signal Strength distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G). (refer figure-47, 48, 49 & 50 for map view)
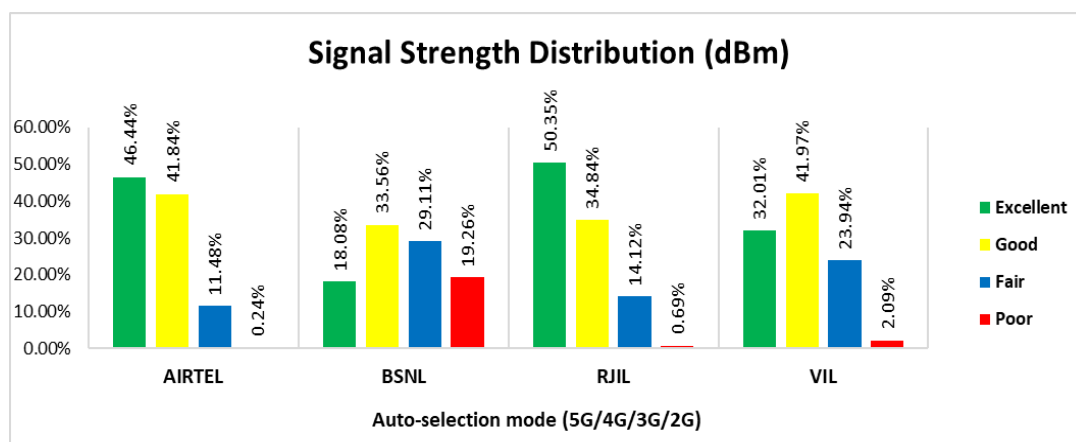
Figure-21: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:

- Airtel has 46% of samples falling in the excellent signal strength category.
- BSNL has 18% of samples falling in the excellent signal strength category.
- RJIL has 50% of samples falling in the excellent signal strength category.
- VIL has 32% of samples falling in the excellent signal strength category.

4.3.4 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	VIL
Download Throughput (Mbits/s)	Average	179.03	2.69	313.85	36.12
	80th Percentile	282.05	4.35	501.33	58.14
	20th Percentile	64.71	0.39	85.99	12.05
Upload Throughput (Mbits/s)	Average	28.51	2.29	28.71	12.82
	80th Percentile	48.95	2.95	52.83	22.08
	20th Percentile	6.58	1.04	4.98	2.63
Latency (ms)	50th Percentile	20.50	46.90	21.50	32.55

Table-19: Summary of Data performance in network auto-selection mode.
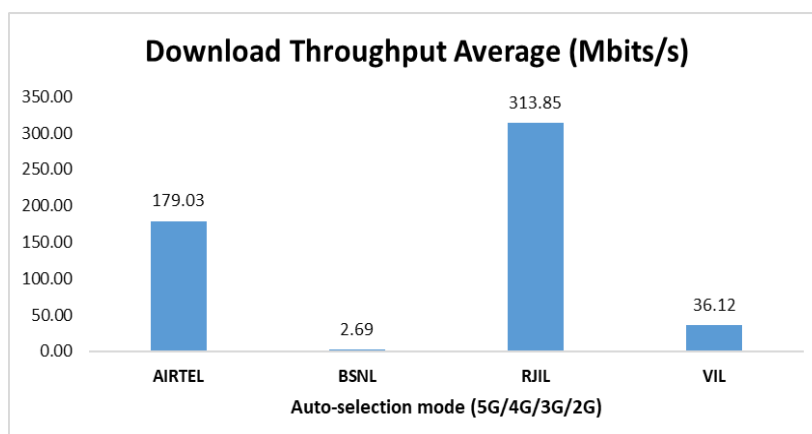
Figure- 22: Download throughput.
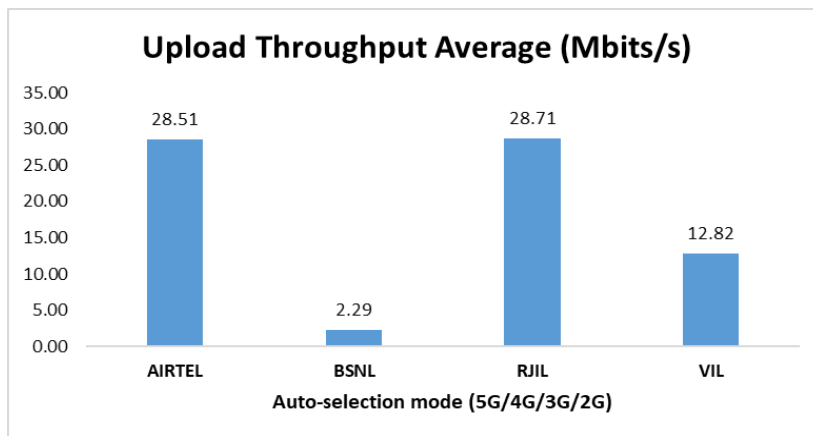
Figure- 23: Upload throughput.

4.4 Railways

Drive test has been conducted on 25th March 2025 and 28th March 2025, covering two railway routes. (refer table-1)
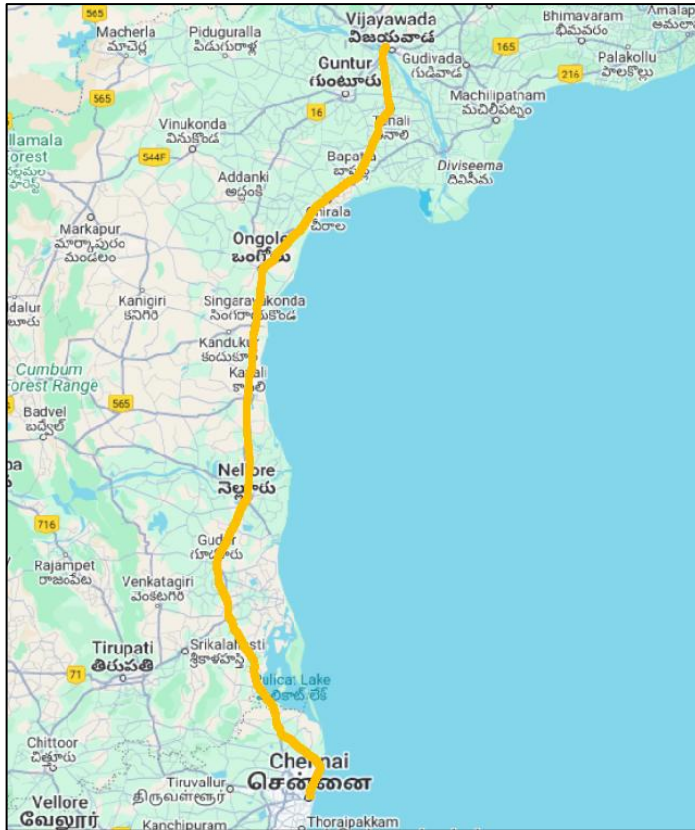
4.4.1 Drive test route

Figure-24: Drive test railway route Vijayawada to Chennai
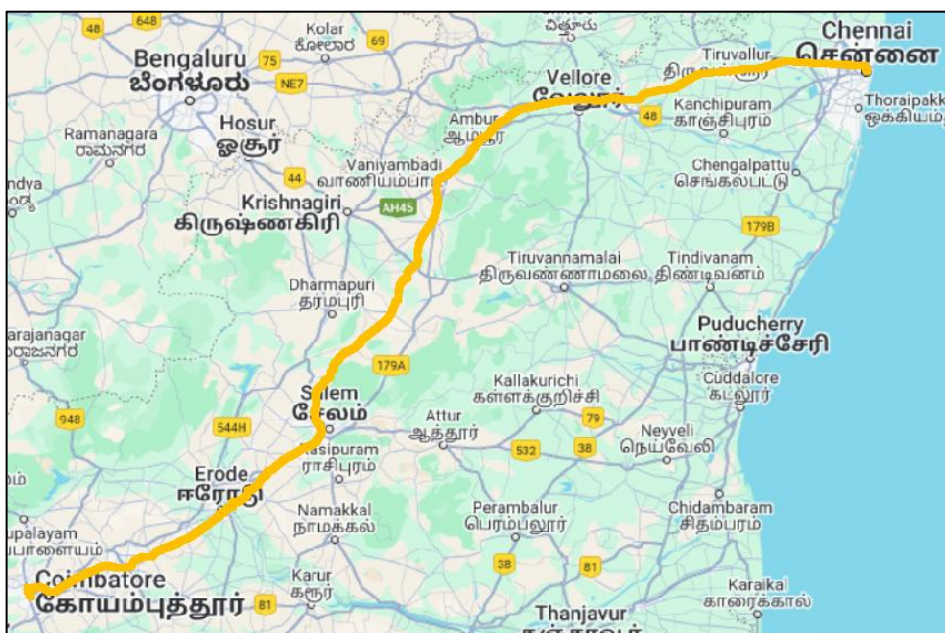

Figure-25: Drive test railway route Coimbatore to Chennai

4.4.2 Route Covered

1. Vijayawada to Chennai.

2. Coimbatore to Chennai.

4.4.2.1 Vijayawada to Chennai

i) Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	148	136	126	130
Call Setup Success Rate %	79.05	93.38	99.21	95.38
Drop Call Rate %	0.85	14.17	1.60	0.81
Call Setup Time-Average (Second)	5.20	2.61	1.18	1.16
Handover Success Rate %	99.86	98.77	99.76	99.87

Table-20: Summary of voice call performance in network auto-selection mode
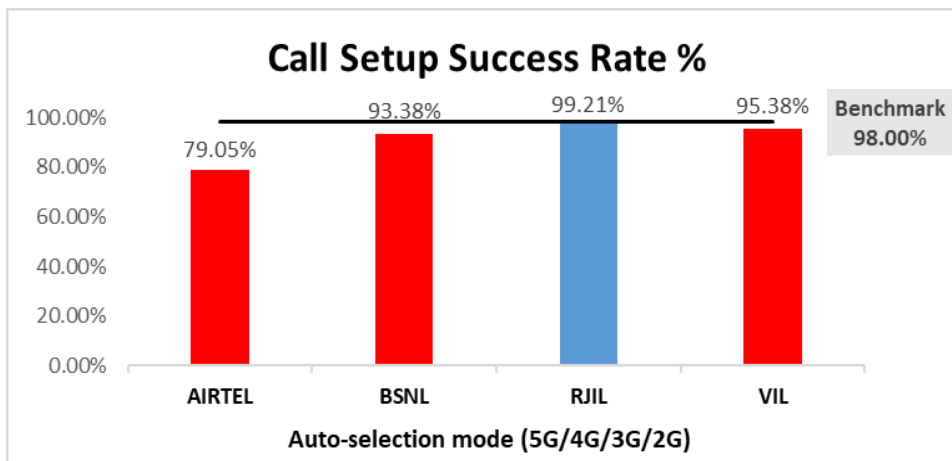
Figure-26: Performance for call setup success rate
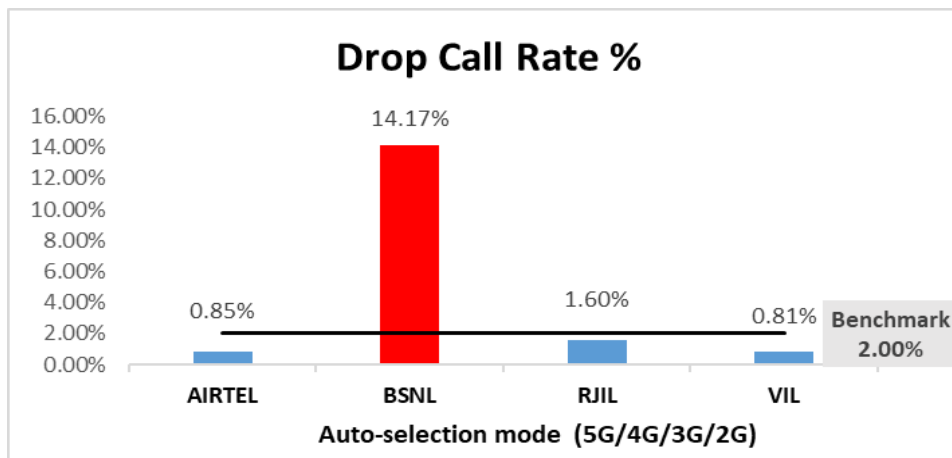
Figure-27: Performance for drop call rate

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	0.49%	NA	9.62%	NA
4G	99.40%	45.53%	90.36%	93.44%
3G	NA	5.27%	NA	NA
2G	0.02%	49.03%	NA	6.51%
Limited service	0.09%	0.18%	0.03%	0.05%

Table-21: Time spent on technology during drive test

> **Note**-
> - NA- Service provider doesn't provide services in respective technology.
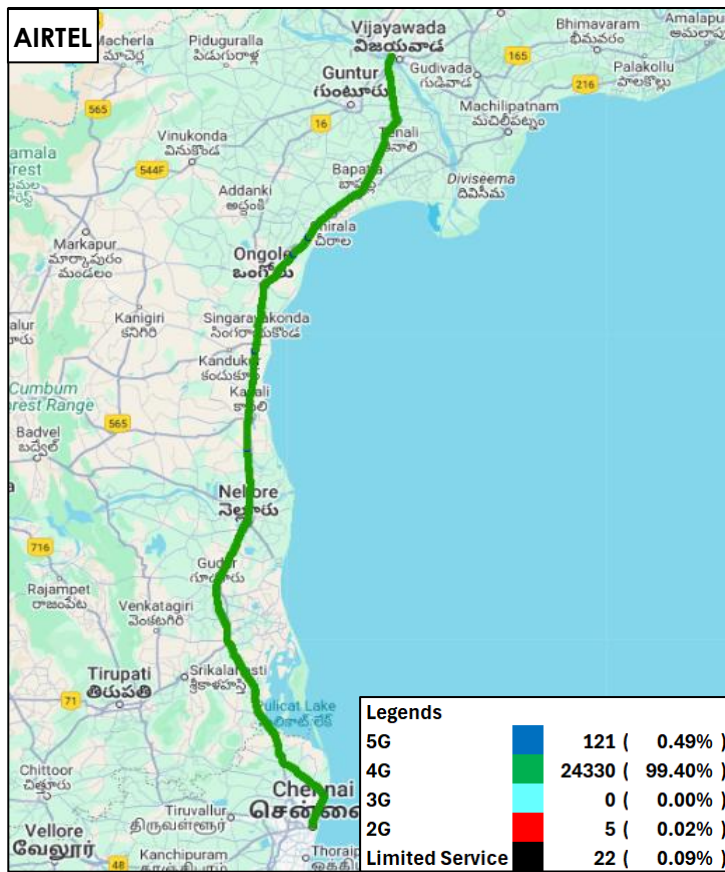
Figure-28: Serving technology plots auto-selection mode 5G/4G/3G/2G –AIRTEL.
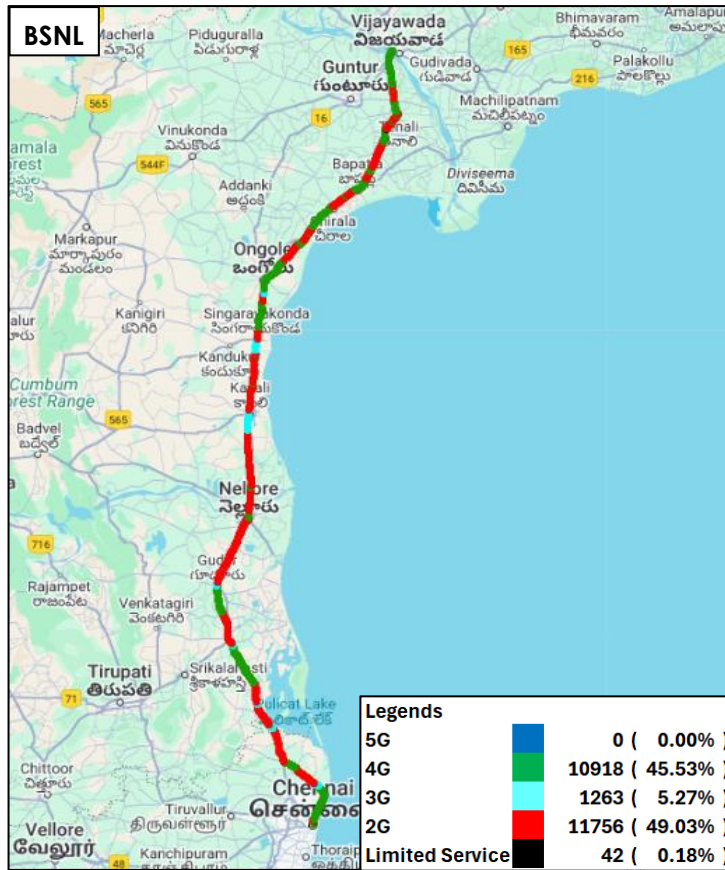
Figure-29: Serving technology plots auto-selection mode 5G/4G/3G/2G –BSNL.
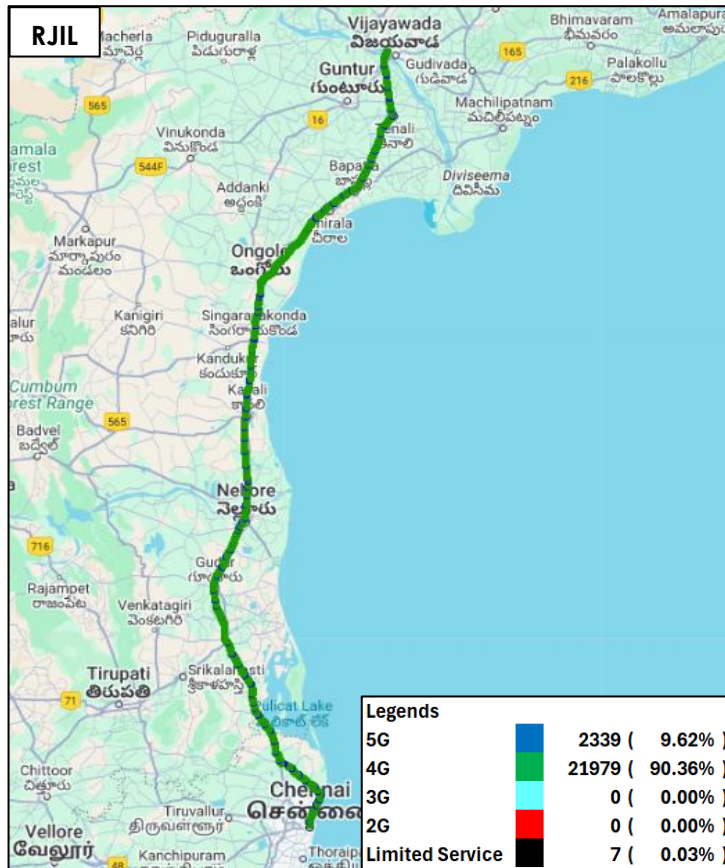
Figure-30: Serving technology plots auto-selection mode 5G/4G/3G/2G –RJIL.
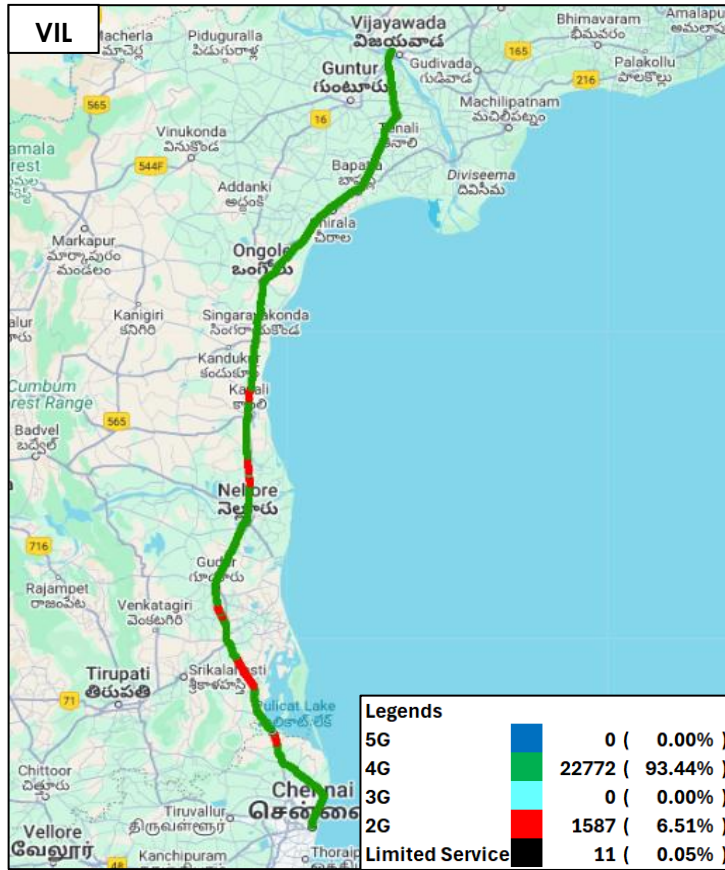
Figure-31: Serving technology plots auto-selection mode 5G/4G/3G/2G – VIL.

(c) Network Signal Strength distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) (refer figure-51, 52, 53 & 54 for map view)
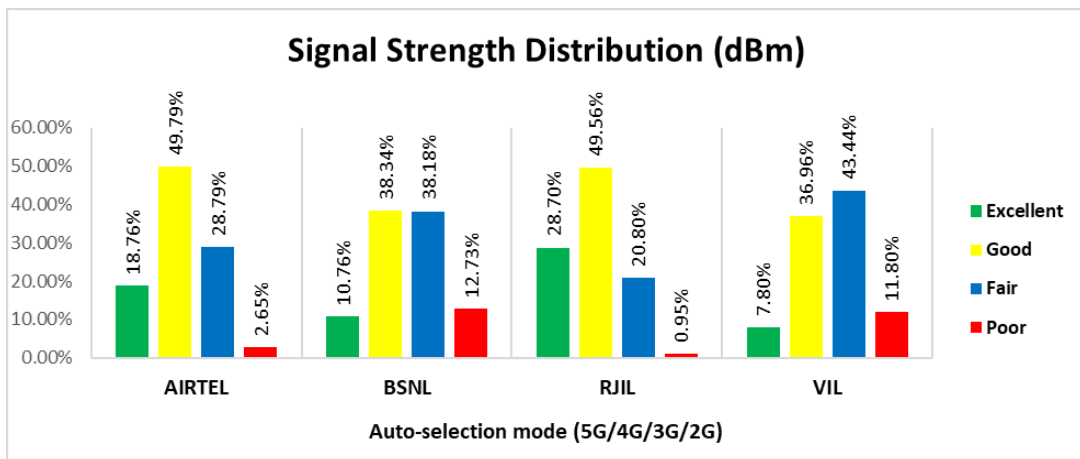

Figure-32: Signal strength distribution for auto-selection mode 5G/4G/3G/2G.

Observations:

- Airtel has 19% of samples falling in the excellent signal strength category.
- BSNL has 11% of samples falling in the excellent signal strength category.
- RJIL has 29% of samples falling in the excellent signal strength category.
- VIL has 8% of samples falling in the excellent signal strength category.

ii) 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	65.99	1.61	97.23	10.72
	80th Percentile	101.64	2.62	163.84	16.68
	20th Percentile	3.16	0.37	16.57	3.66
Upload Throughput (Mbits/s)	Average	11.22	2.54	10.22	6.75
	80th Percentile	16.71	2.98	17.28	10.84
	20th Percentile	1.95	1.35	1.80	1.70
Latency (ms)	50th Percentile	28.35	28.83	42.40	41.15

Table-22: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).
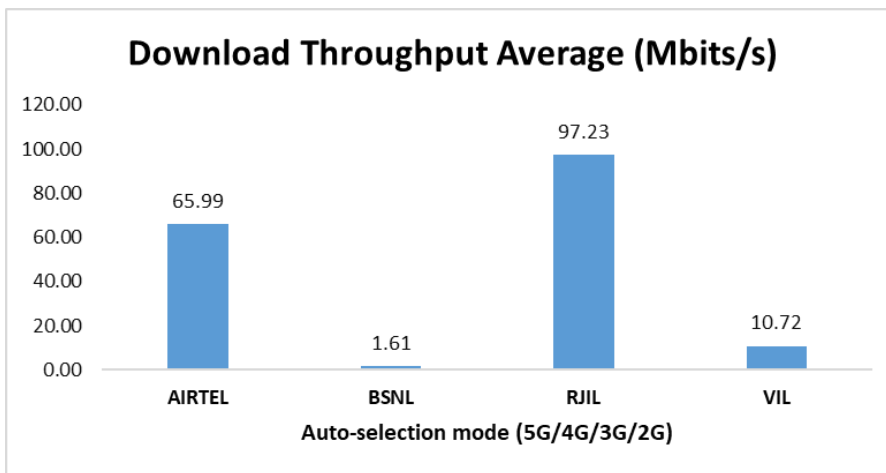
Figure-33: Download throughput
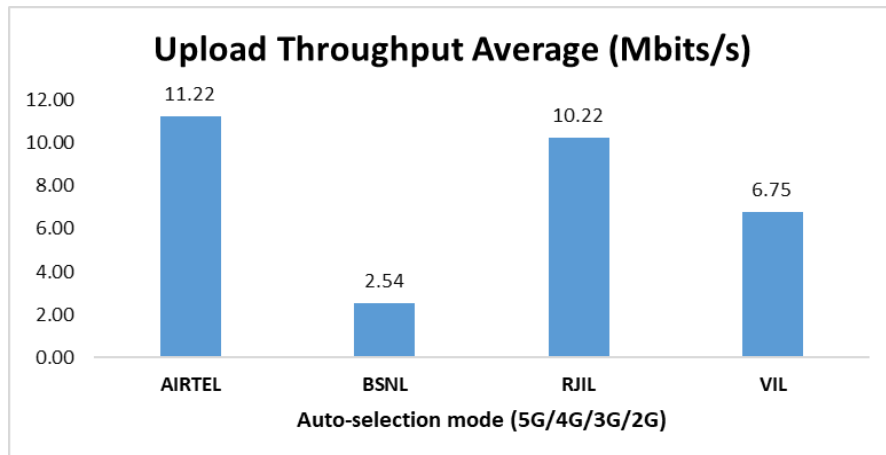
Figure-34: Upload throughput

4.4.2.2 Coimbatore to Chennai

i) Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	131	147	135	134
Call Setup Success Rate %	99.24	90.48	98.52	97.76
Drop Call Rate %	0.00	15.79	0.00	6.87
Call Setup Time-Average (Second)	1.13	4.70	1.01	2.46
Handover Success Rate %	99.94	99.39	99.91	99.88

Table-23: Summary of voice call performance in network auto-selection mode.
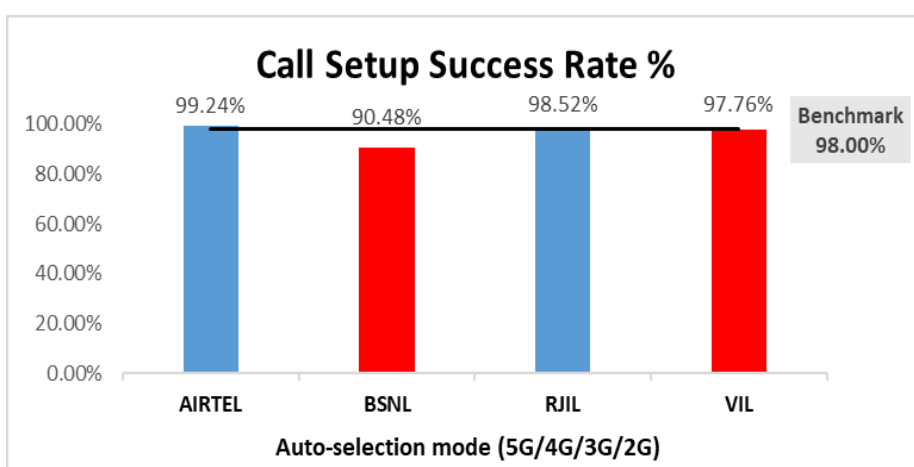
Figure-35: Performance for call setup success rate.
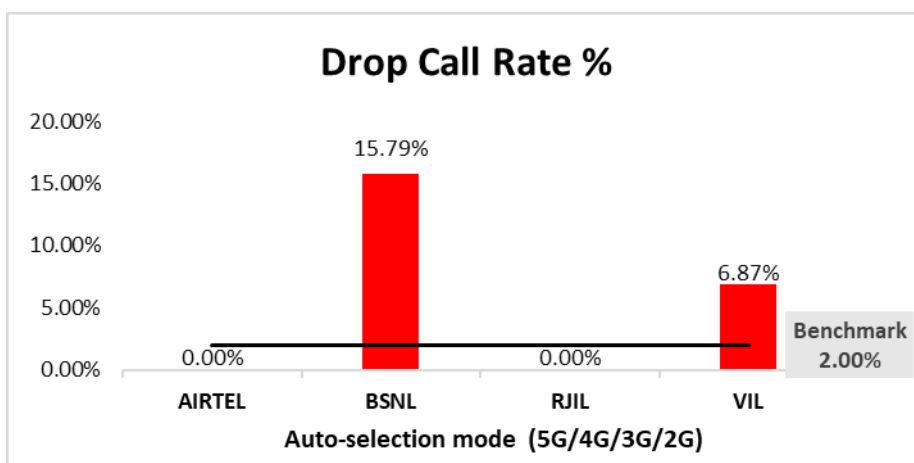
Figure-36: Performance for drop call rate.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	0.81%	NA	9.41%	NA
4G	98.45%	40.45%	90.58%	83.16%
3G	NA	23.82%	NA	NA
2G	0.73%	35.42%	NA	16.79%
Limited service	0.01%	0.30%	0.01%	0.05%

Table-24: Time spent on technology during drive test

> **Note**-
> - NA- Service provider doesn't provide services in respective technology.
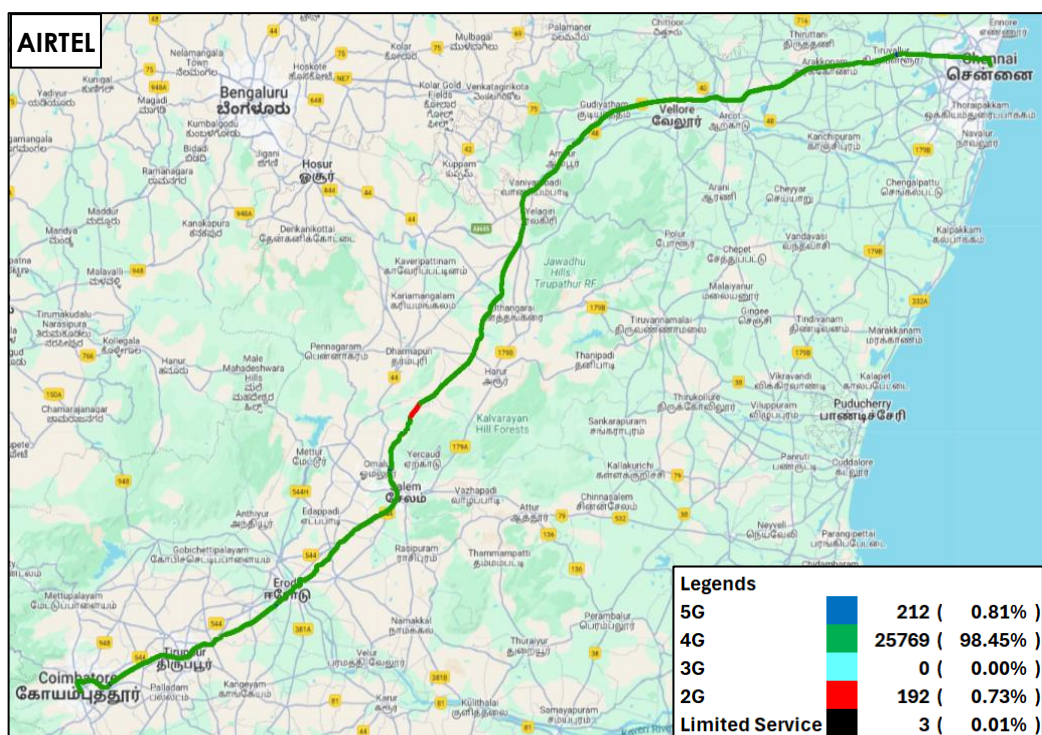
Figure-37: Serving technology plots auto-selection mode 5G/4G/3G/2G –AIRTEL.
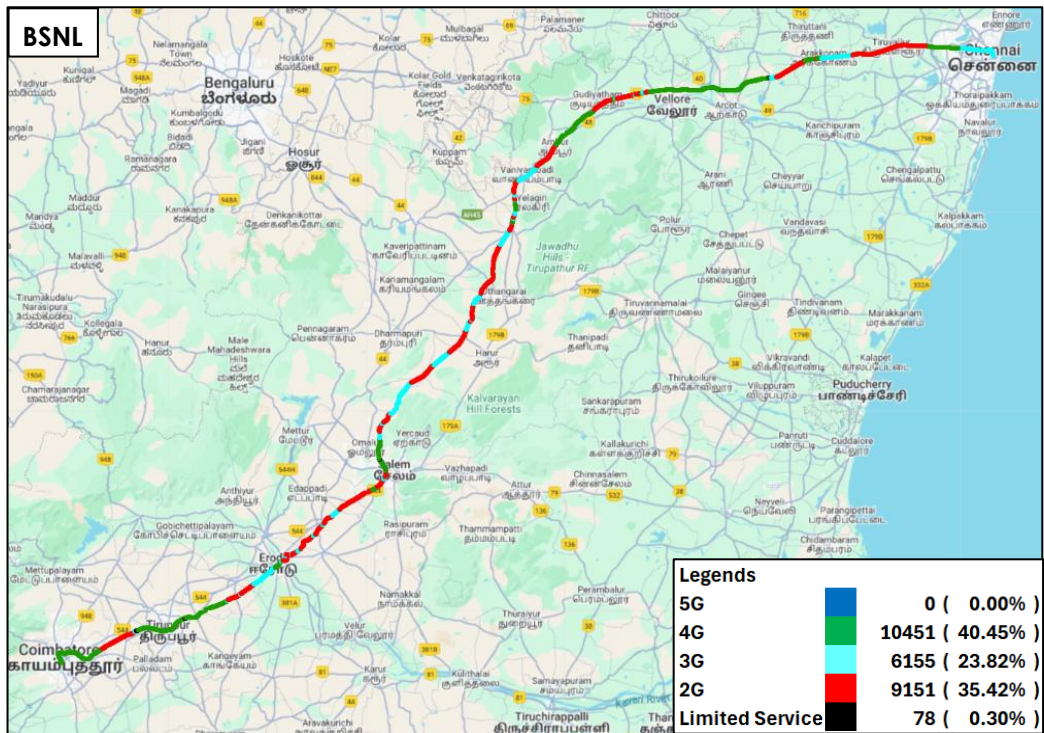
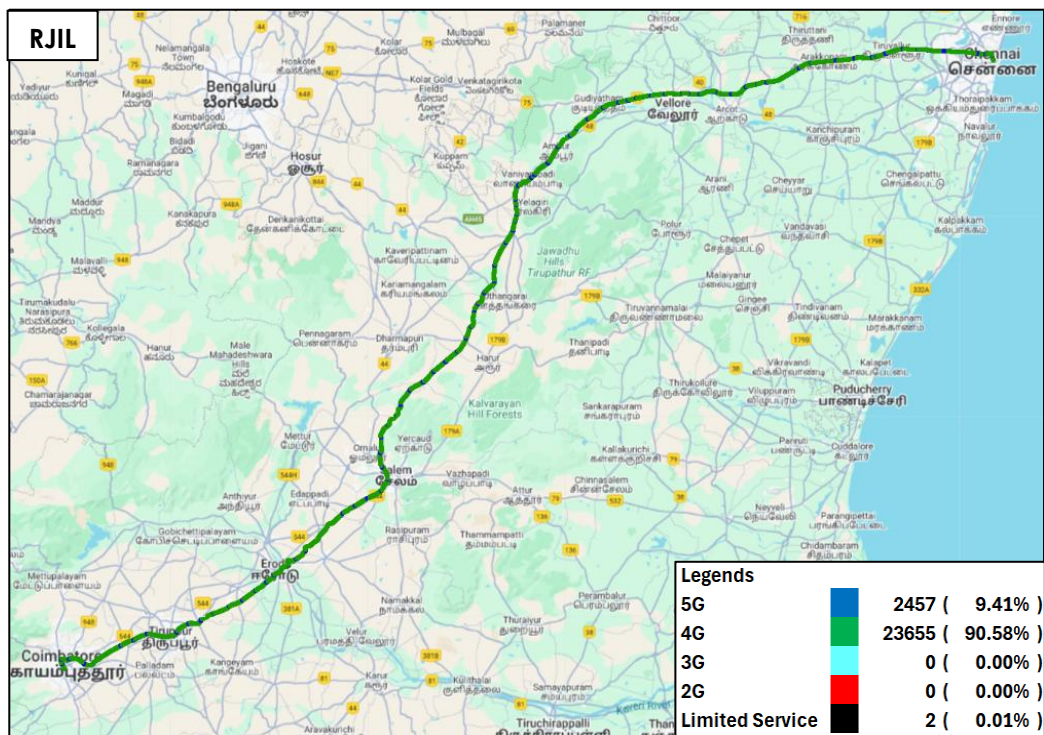**Figure-38:** Serving technology plots auto-selection mode 5G/4G/3G/2G –BSNL.

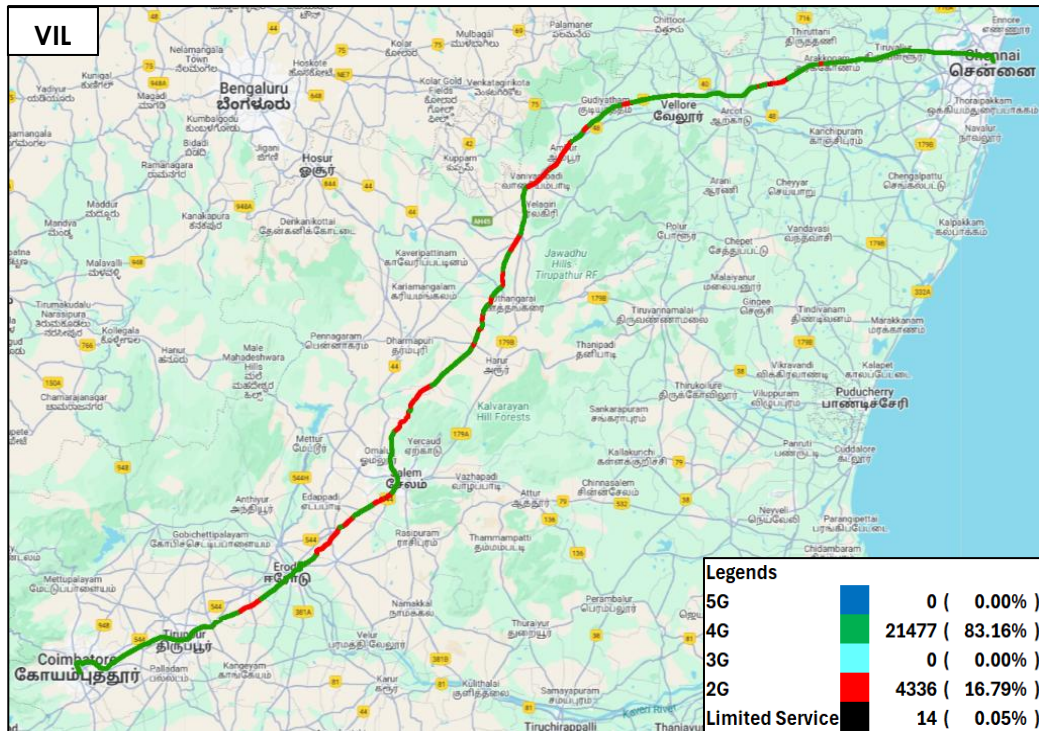**Figure-39:** Serving technology plots auto-selection mode 5G/4G/3G/2G –RJIL.

Figure-40: Serving technology plots auto-selection mode 5G/4G/3G/2G – VIL.

(c) Network Signal Strength distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) (refer figure-55, 56, 57 & 58 for map view)
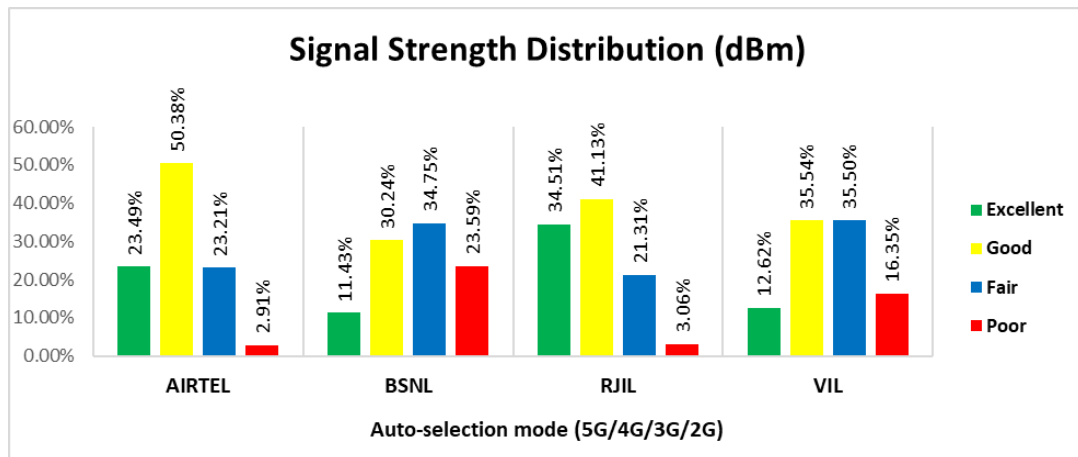

Figure-41: Signal strength distribution for auto-selection mode 5G/4G/3G/2G

Observations:

- Airtel has 23% of samples falling in the excellent signal strength category.
- BSNL has 11% of samples falling in the excellent signal strength category.
- RJIL has 35% of samples falling in the excellent signal strength category.
- VIL has 13% of samples falling in the excellent signal strength category.

ii) 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	98.69	2.55	160.51	24.79
	80th Percentile	172.41	4.04	292.25	37.42
	20th Percentile	7.03	0.28	25.85	10.67
Upload Throughput (Mbits/s)	Average	19.10	2.32	18.55	13.61
	80th Percentile	32.54	2.75	32.24	21.14
	20th Percentile	2.91	0.77	3.70	5.48
Latency (ms)	50th Percentile	19.95	50.25	29.50	31.25

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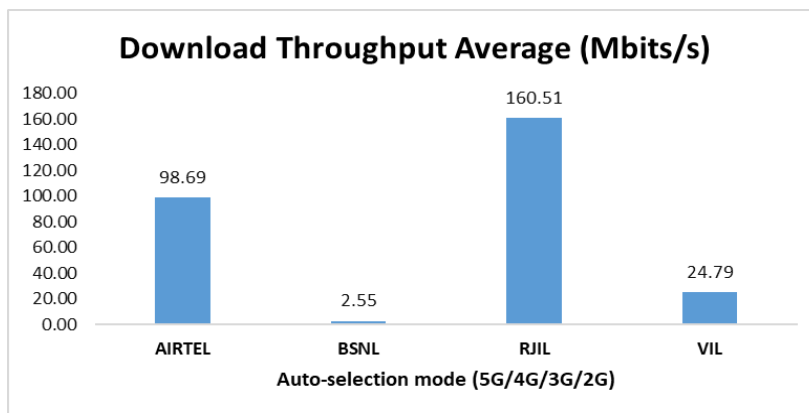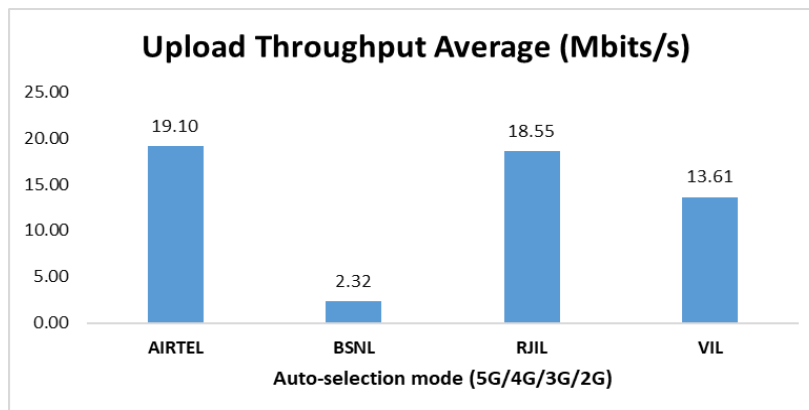

Figure-42: Download throughput

Figure-43: Upload throughput

5. Voice & Data Key findings

5.1 Overall Voice

1. **Call Setup Success Rate:**

   a) Airtel, BSNL and VIL have 83.87%, 98.46% and 98.48% call setup success rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL have 93.93%, 89.63%, 99.41% and 97.66% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

2. **Call Setup Time**:

   a) Airtel, BSNL and VIL have 4.19, 3.37 and 4.20 call setup time respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL have 1.89, 3.42, 0.96 and 1.80 seconds call setup time respectively in Auto-selection mode. (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G), BSNL, Airtel, RJIL and VIL have 7.52%, 2.42%, 1.75% & 0.59% silence call rate respectively. Further BSNL has higher RTP packet loss rate in downlink (8.75%) compared to VIL (0.73%), Airtel (0.35%) and RJIL (0.25%), In uplink the RTP packet loss rate is higher for BSNL (6.93%) compared to VIL (0.82%), Airtel (0.42%) and RJIL (0.39%). (refer table-6)

4. **Drop Call Rate**:

   a) Airtel, BSNL and VIL have 3.30%, 4.69% and 3.61% drop call rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL have 0.61%, 13.14%, 0.40% and 2.00% drop call rate respectively in Auto-selection mode. (5G/4G/3G/2G). (refer table-5)

5.2 Overall Data

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

   a) Airtel, BSNL, RJIL and VIL have 131.30 Mbps, 2.51 Mbps, 195.61 Mbps and 26.83 Mbps average download speed respectively. (refer table-9)

   b) Airtel, BSNL, RJIL and VIL have 25.51 Mbps, 2.72 Mbps, 22.05 Mbps and 12.22 Mbps average upload speed respectively. (refer table-9)

5.3 Operator wise Key Findings

1. **Airtel:**

   Voice

   - 83.87% call setup success rate and 3.30% drop call rate have been observed in 3G/2G network mode for LSA and highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-3 & 13)

   - 93.93% call setup success rate and 0.61% drop call rate have been observed for 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)

   - 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for Walk test. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-11)

- 100.00% call setup success rate and 1.03% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-15)

- 79.05% call setup success rate and 0.85% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for Vijayawada to Chennai Railway. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-20)

- 99.24% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for Coimbatore to Chennai Railway. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-23)

Data

- Airtel has 131.30 Mbps average download speed & 25.51 Mbps average upload speed for LSA. (refer table-9)

- Airtel has 144.27 Mbps average download speed & 70.36 Mbps average upload speed for walk test. (refer table-12)

- Airtel has 179.03 Mbps average download speed & 28.51 Mbps average upload speed for highway drive. (refer table-19)

- Airtel has 65.99 Mbps average download speed & 11.22 Mbps average upload speed for Vijayawada to Chennai Railway. (refer table-22)

- Airtel has 98.69 Mbps average download speed & 19.10 Mbps average upload speed for Coimbatore to Chennai Railway. (refer table-25)

2. BSNL:

Voice

- 98.46% call setup success rate and 4.69% drop call rate have been observed in 3G/2G network mode for LSA and Highway. Performance is not meeting the benchmark of 2.00% for drop call rate. (refer table-3 & 13)

- 89.63% call setup success rate and 13.14% 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)

- 96.30% call setup success rate and 1.92% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for walk test. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-11)

- 85.34% call setup success rate and 13.64% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is not meeting benchmark of 98.00% & 2.00% respectively. (refer table-15)

- 93.38% call setup success rate and 14.17% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Vijayawada to Chennai Railway. Performance is not meeting benchmark of 98.00% & 2.00% respectively. (refer table-20)

- 90.48% call setup success rate and 15.79% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Coimbatore to Chennai Railway. Performance is not meeting benchmark of 98.00% & 2.00% respectively. (refer table-23)

Data

- BSNL has 2.51 Mbps average download speed & 2.72 Mbps average upload speed for LSA. (refer table-9)

- BSNL has 5.04 Mbps average download speed & 7.65 Mbps average upload speed for walk test. (refer table-12)

- BSNL has 2.69 Mbps average download speed & 2.29 Mbps average upload speed for highway drive. (refer table-19)

- BSNL has 1.61 Mbps average download speed & 2.54 Mbps average upload speed for Vijayawada to Chennai Railway. (refer table-22)

- BSNL has 2.55 Mbps average download speed & 2.32 Mbps average upload speed for Coimbatore to Chennai Railway. (refer table-25)

3. RJIL:

Voice

- 99.41% call setup success rate and 0.40% 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 walk test. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-11)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-15)

- 99.21% call setup success rate and 1.60% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Vijayawada to Chennai Railway. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-20)

- 98.52% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Coimbatore to Chennai Railway. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-23)

Data

- RJIL has 195.61 Mbps average download speed & 22.05 Mbps average upload speed for LSA. (refer table-9)

- RJIL has 244.76 Mbps average download speed & 41.62 Mbps average upload speed in walk test. (refer table-12)

- RJIL has 313.85 Mbps average download speed & 28.71 Mbps average upload speed in highway drive. (refer table-19)

- RJIL has 97.23 Mbps average download speed & 10.22 Mbps average upload speed in Vijayawada to Chennai Railway. (refer table-22)

- RJIL has 160.51 Mbps average download speed & 18.55 Mbps average upload speed in Coimbatore to Chennai Railway. (refer table-25)

4. VIL:

Voice

- 98.48 % call setup success rate and 3.61% drop call rate have been observed in 3G/2G network mode for LSA and highway drive. Performance is not meeting the benchmark of 2.00% for drop call rate. (refer table-3 & 13)

- 97.66 % call setup success rate and 2.00% drop call rate have been observed for 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)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for walk test. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-11)

- 98.48% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for highway drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-15)

- 95.38% call setup success rate and 0.81% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for Vijayawada to Chennai Railway. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-20)

- 97.76% call setup success rate and 6.87% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for Coimbatore to Chennai Railway. Performance is not meeting the benchmark of 98.00% and 2.00% respectively. (refer table-23)

Data

- VIL has 26.83 Mbps average download speed & 12.22 Mbps average upload speed for LSA. (refer table-9)

- VIL has 30.05 Mbps average download speed & 20.44 Mbps average upload speed in walk test. (refer table-12)

- VIL has 36.12 Mbps average download speed & 12.82 Mbps average upload speed in highway drive. (refer table-19)

- VIL has 10.72 Mbps average download speed & 6.75 Mbps average upload speed in Vijayawada to Chennai Railway. (refer table-22)

- VIL has 24.79 Mbps average download speed & 13.61 Mbps average upload speed in Coimbatore to Chennai Railway. (refer table-25)

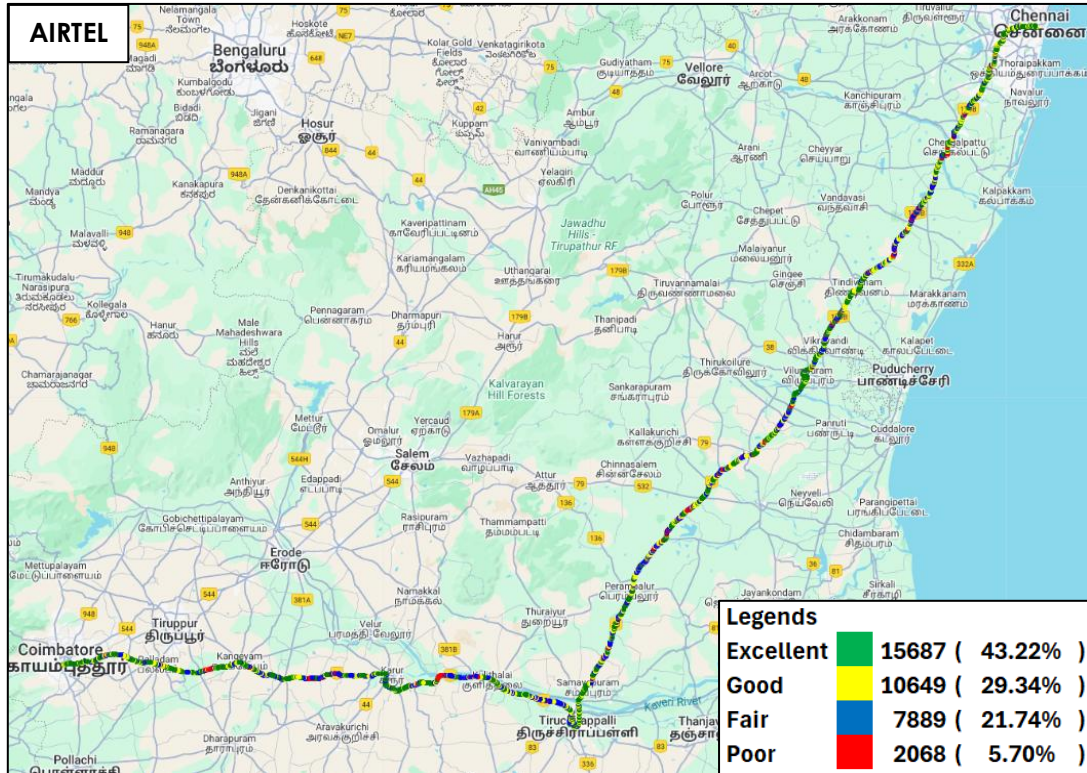# 6. Annexure

6.1 Route wise coverage map

6.1.1 Highway
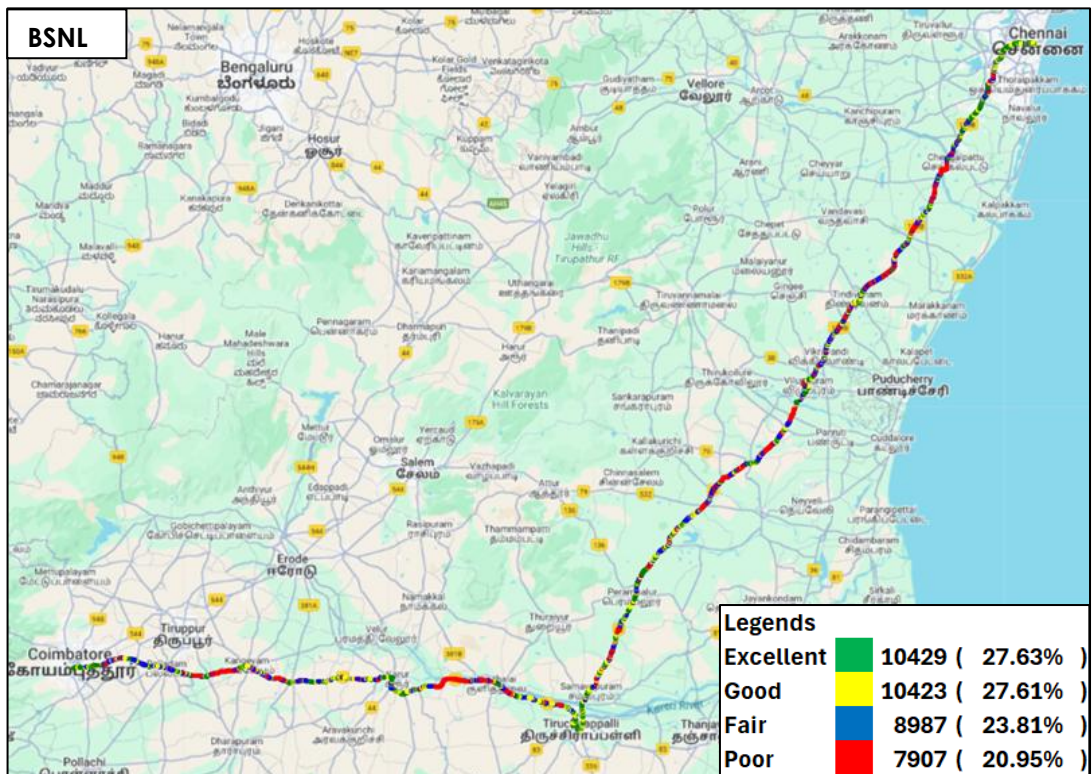

Figure-44: Signal strength 3G/2G network mode – AIRTEL.
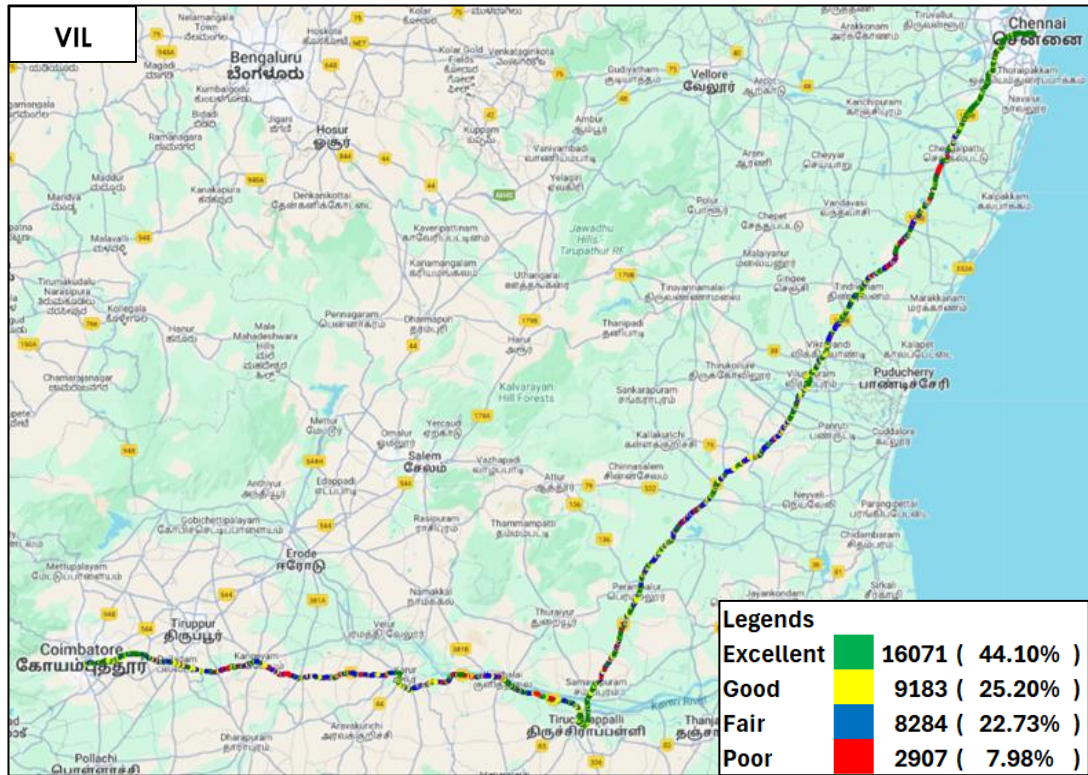

Figure-45: Signal strength 3G/2G network mode – BSNL.
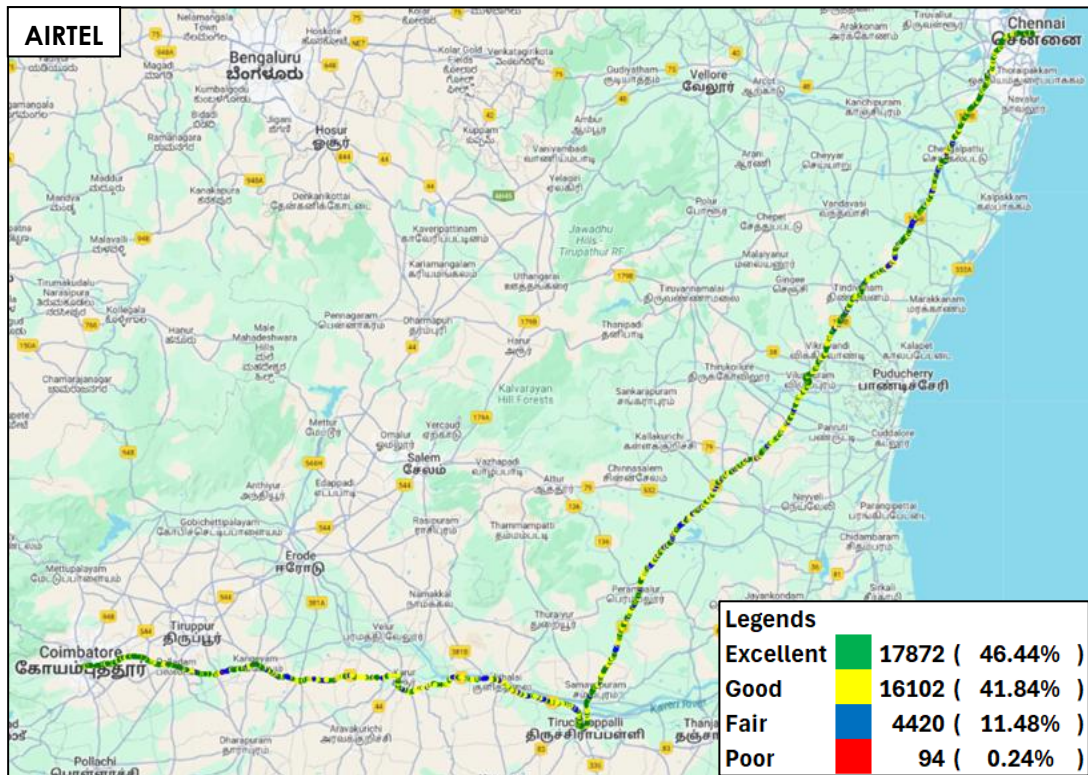
Figure-46: Signal strength 3G/2G network mode – VIL.

Legends		
Excellent	16071 (	44.10%)
Good	9183 (	25.20%)
Fair	8284 (	22.73%)
Poor	2907 (	7.98%)

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

Legends		
Excellent	17872 (	46.44%)
Good	16102 (	41.84%)
Fair	4420 (	11.48%)
Poor	94 (	0.24%)
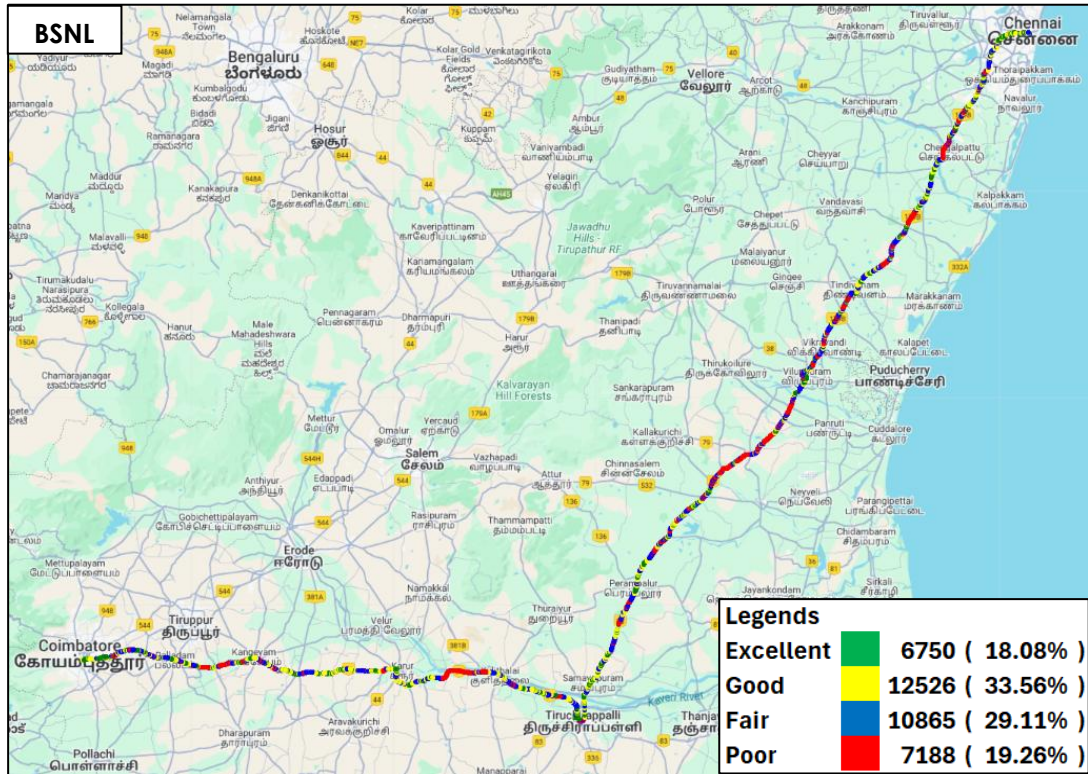
Figure-48: Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.
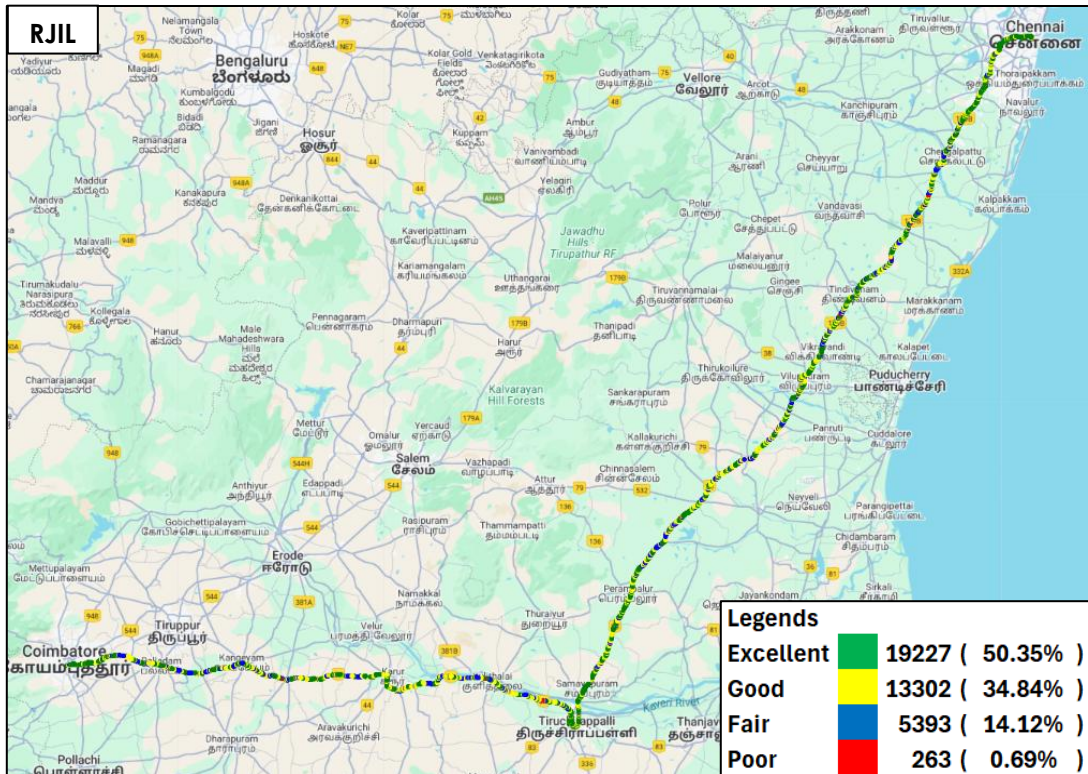
Figure-49: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.
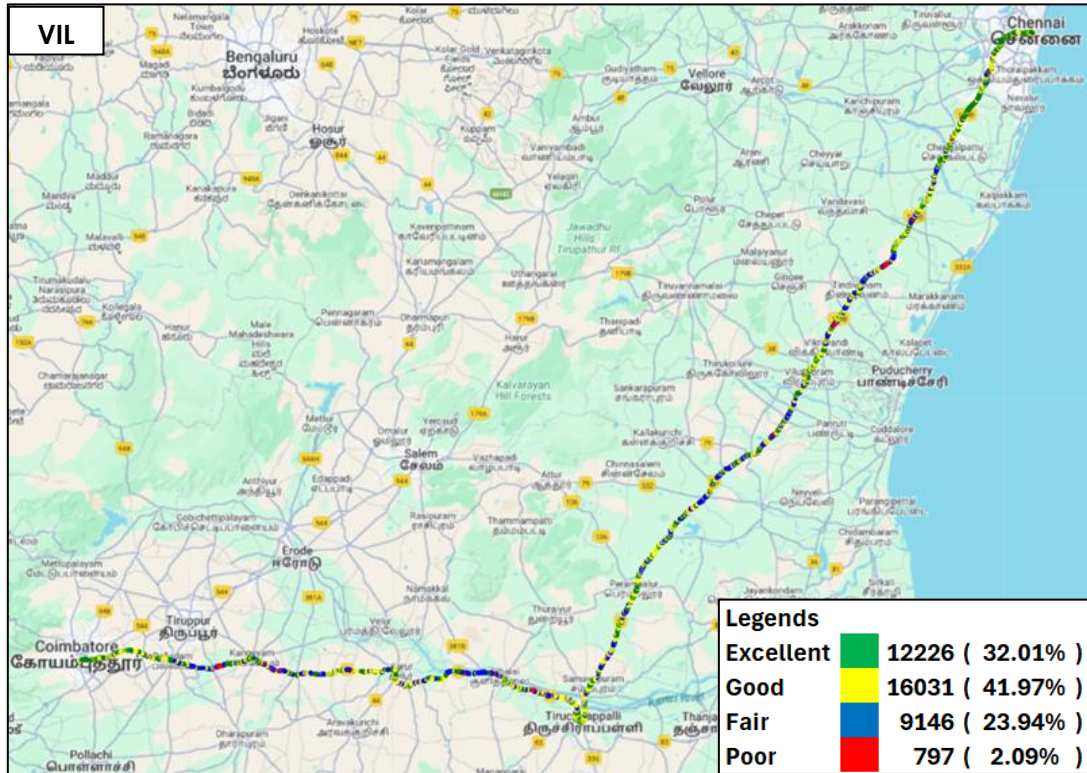
Figure-50: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

6.1.2 Railway

i) Vijayawada to Coimbatore
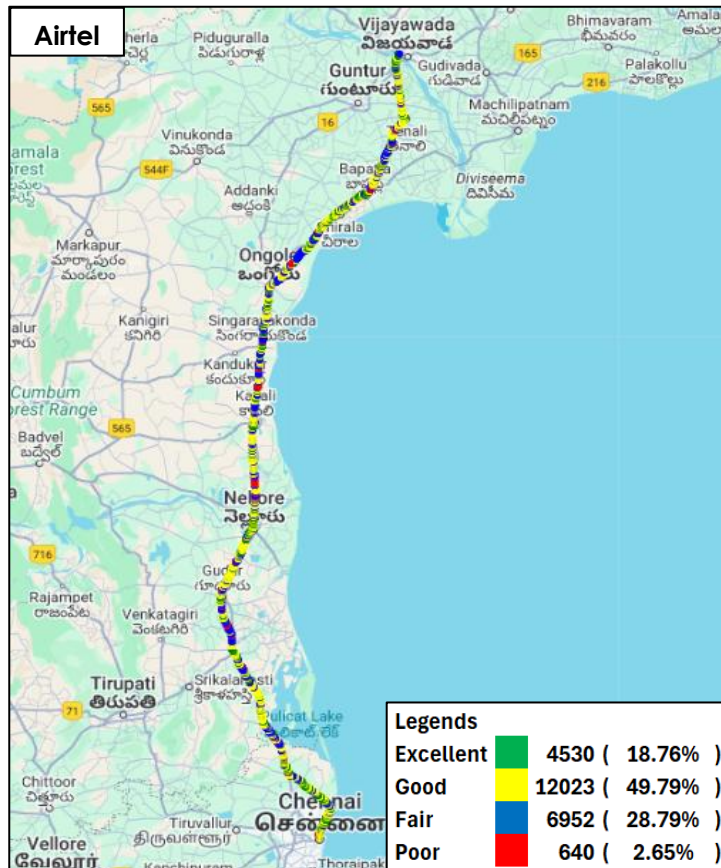
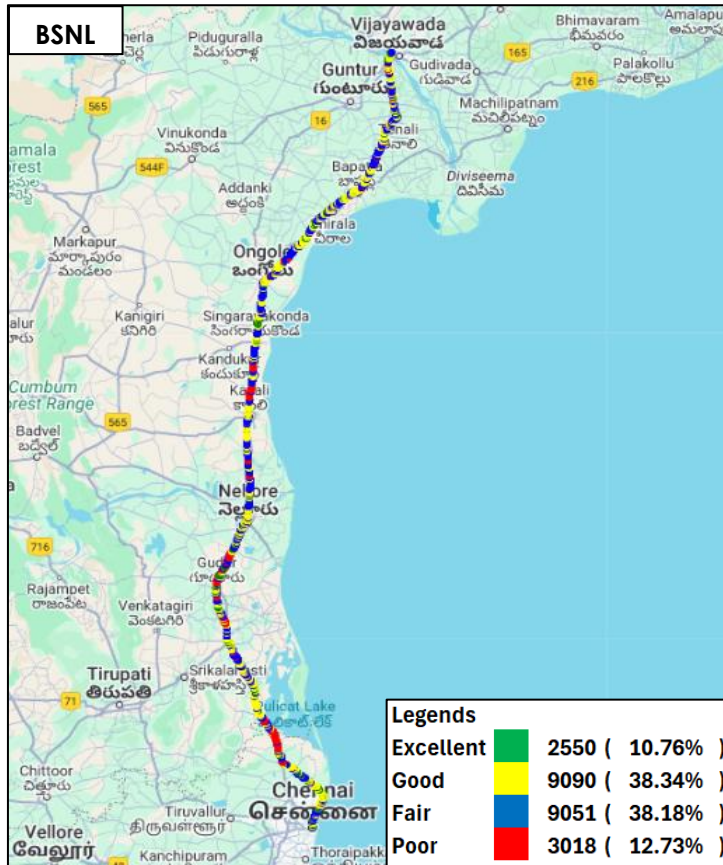**Figure-51:** Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL

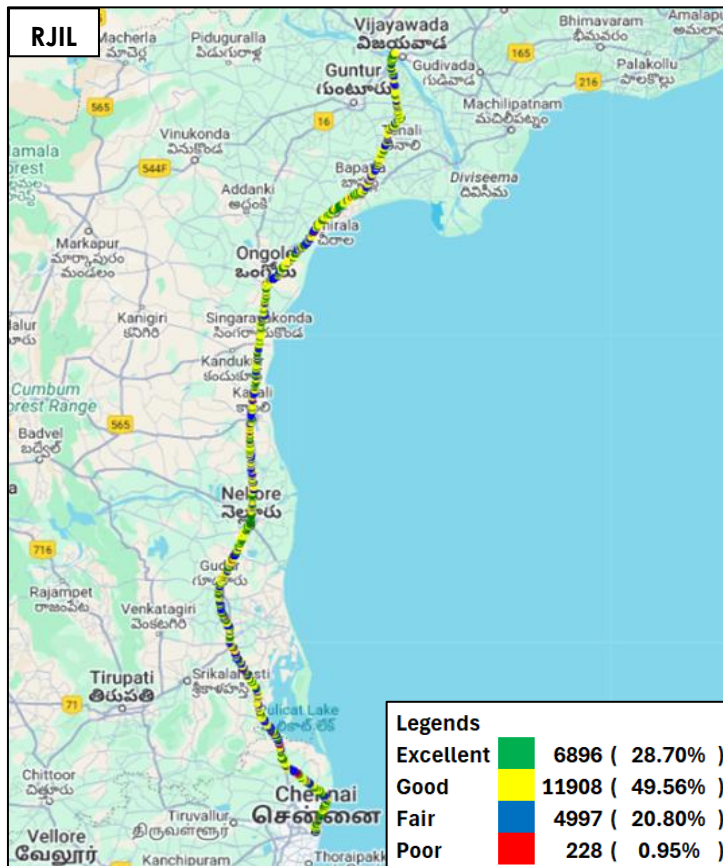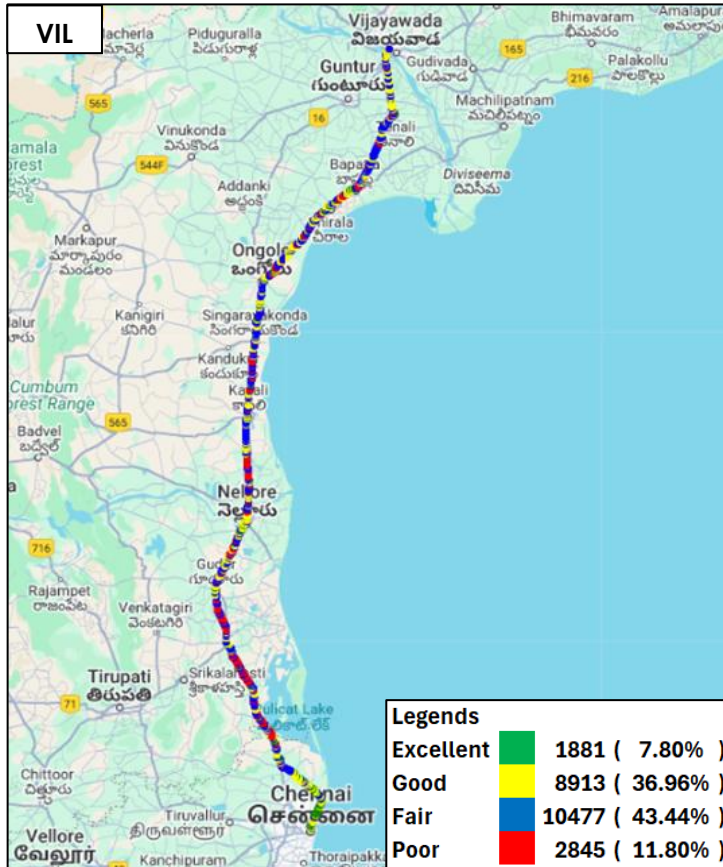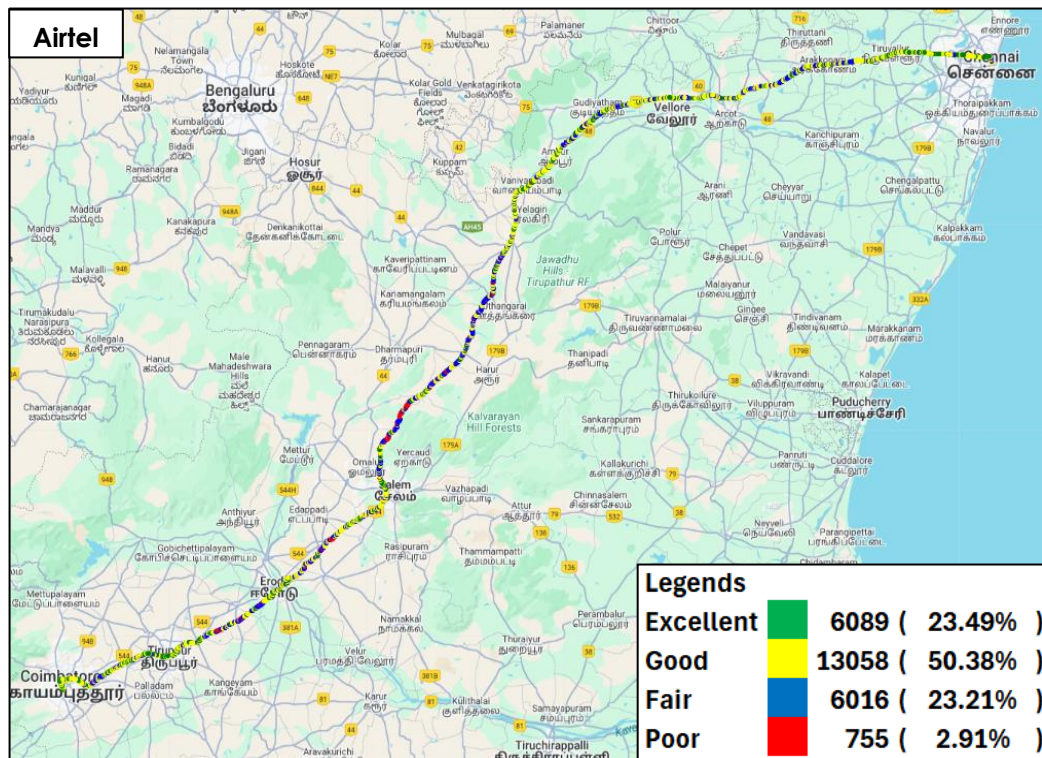**Figure-52:** Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.

Legends		
Excellent	2550 (	10.76%)
Good	9090 (	38.34%)
Fair	9051 (	38.18%)
Poor	3018 (	12.73%)

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

Legends		
Excellent	6896 (	28.70%)
Good	11908 (	49.56%)
Fair	4997 (	20.80%)
Poor	228 (	0.95%)

Figure-54: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

ii) Coimbatore to Chennai

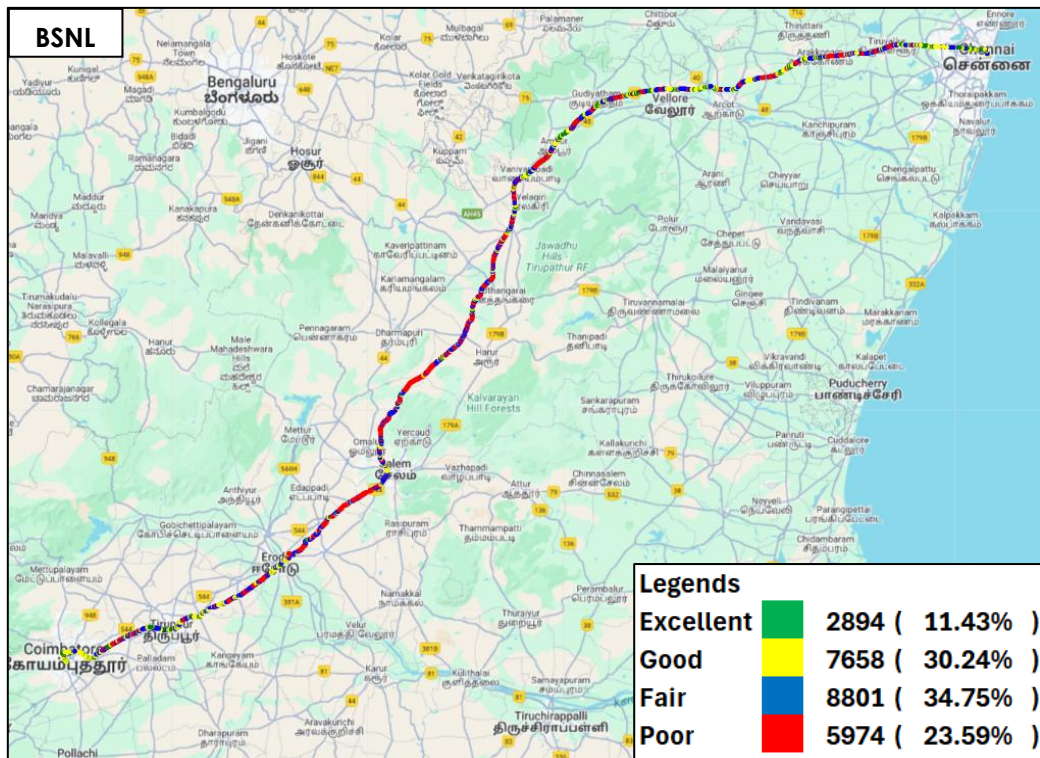**Figure-55:** Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL

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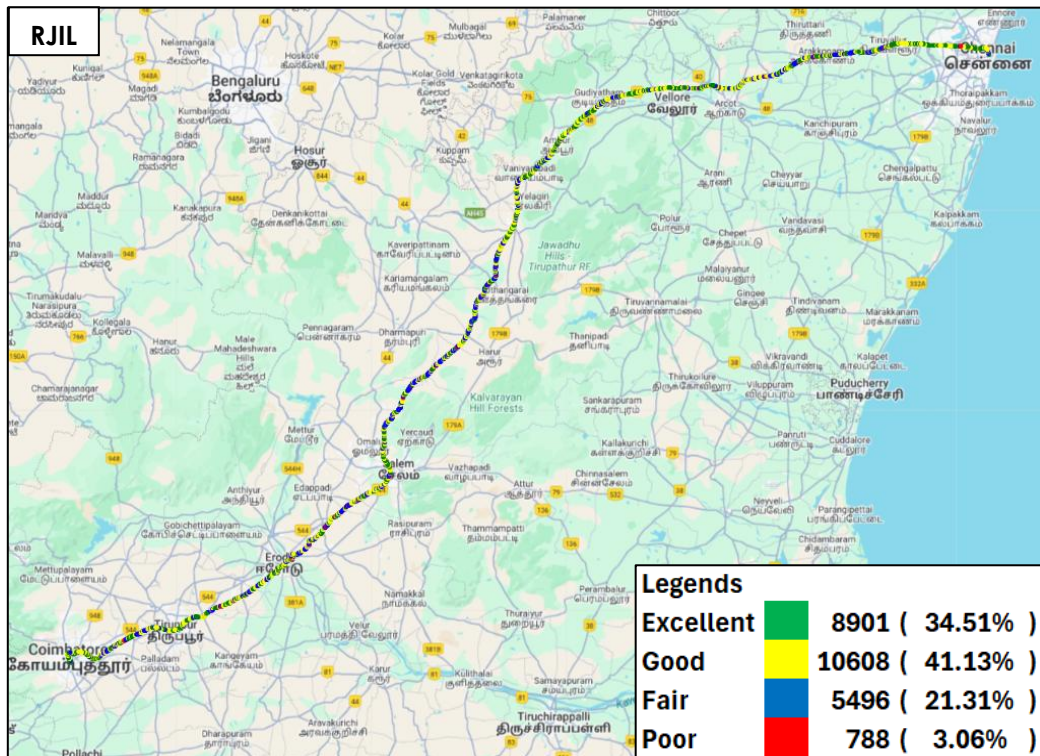**Figure-56:** Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.

Figure-57: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.
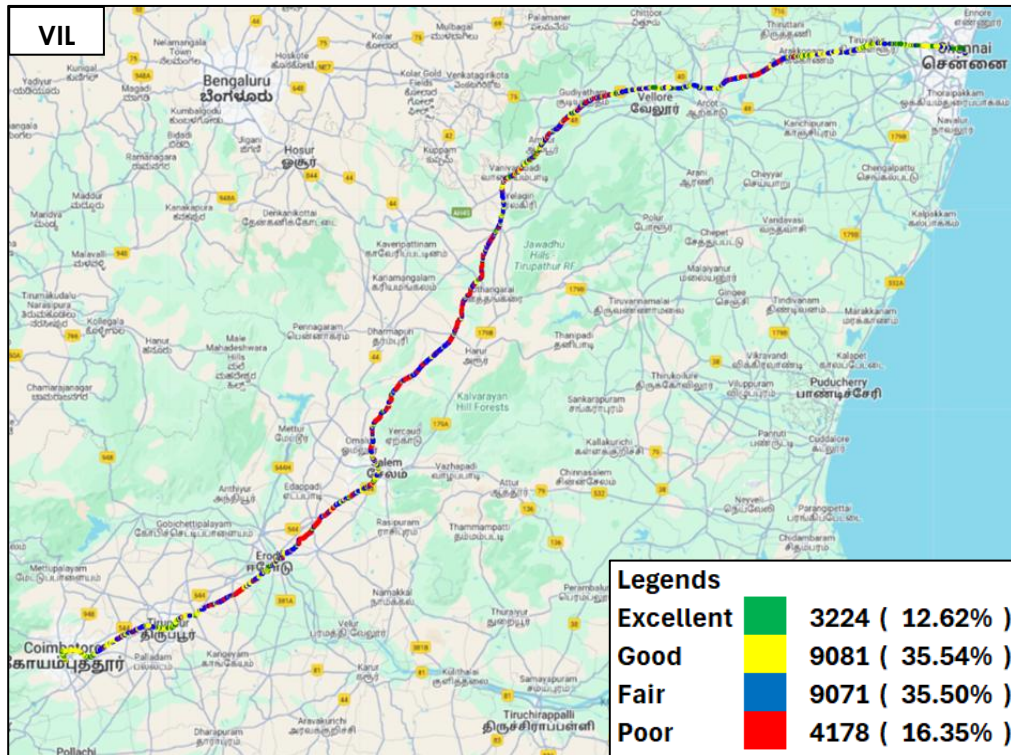
Figure-58: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

7. Appendix

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

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

7.1 Appendix-I

7.1.1 Drive test setup

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

Table-26: 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.amazon.in, www.facebook.com) 20 sec timeout (only at Hotspot)

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

Table-27: 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.
> - Download & Upload test performed at hotspot in 4G/3G/2G auto-selection also.
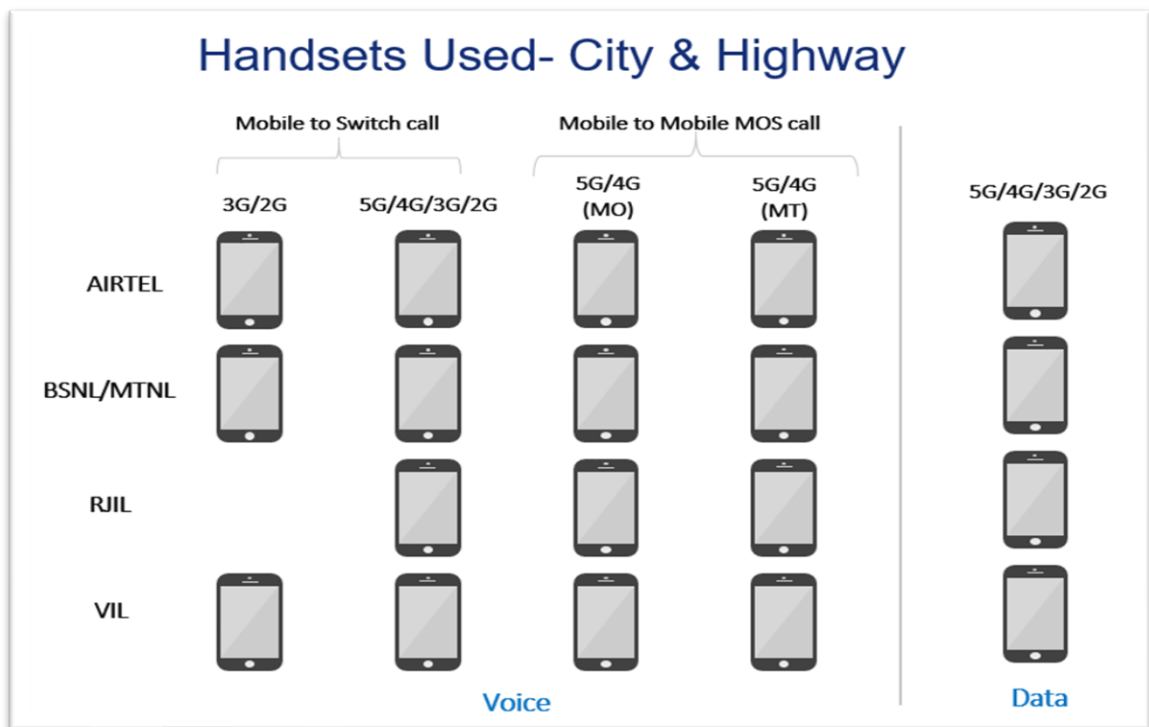

Figure-59: Number of handsets used in city & highway drive
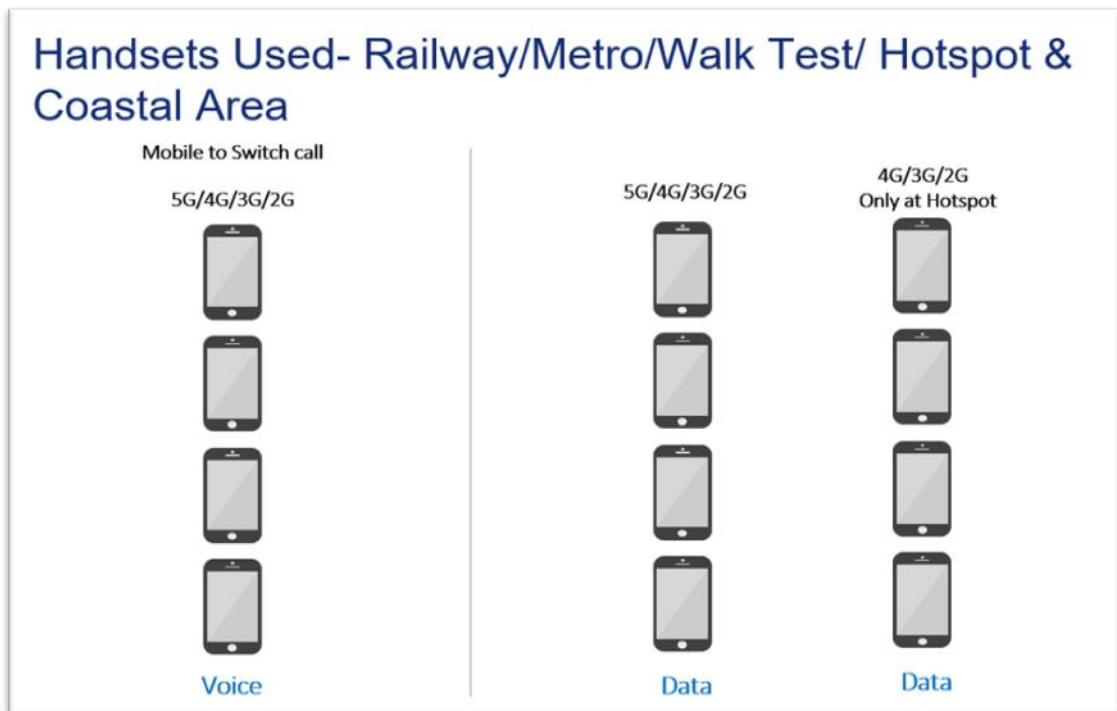
MO: Mobile originating

MT: Mobile terminating

Figure-60: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology
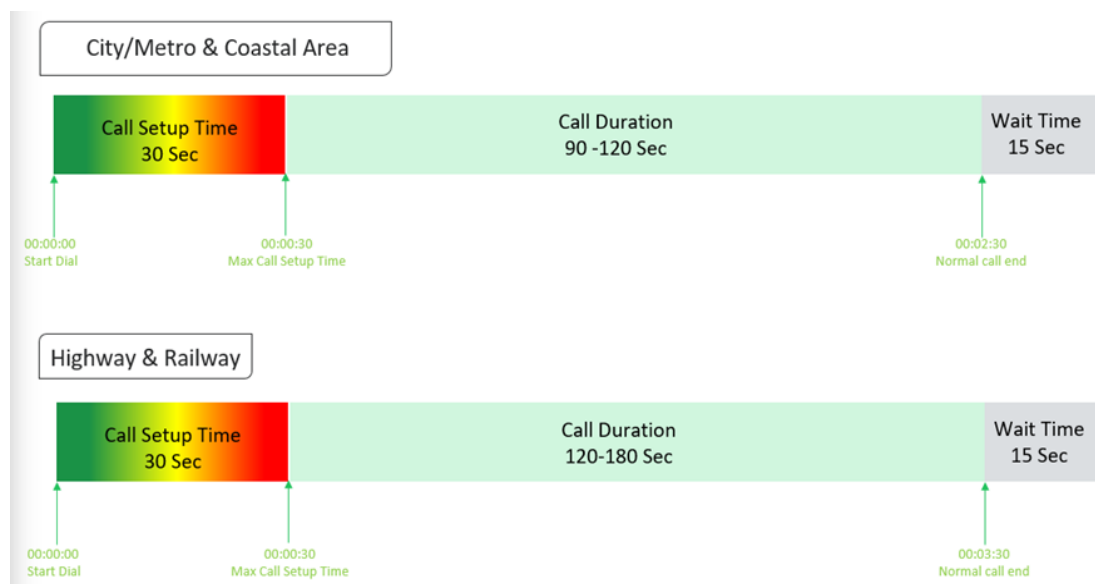
(a) Dynamic voice testing (on the move)

Figure-61: 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-62: 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.
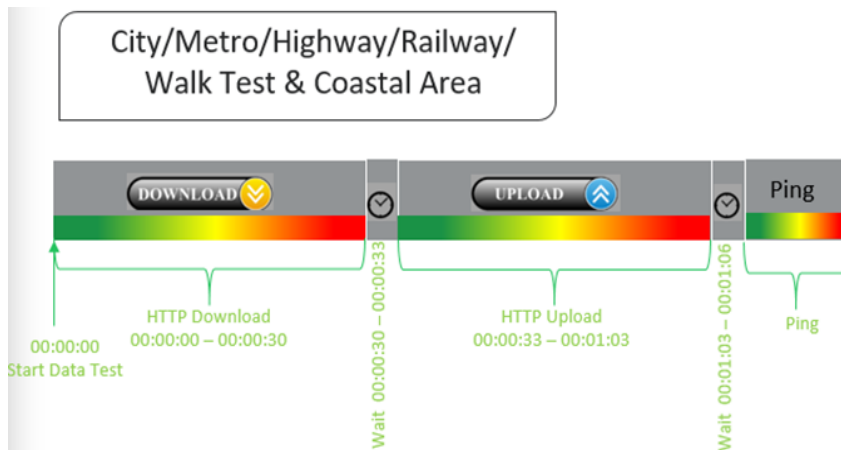
(c) Dynamic Data (internet) test

Figure-63: Data test script used in city/metro/railway/highway/walk test & coastal area

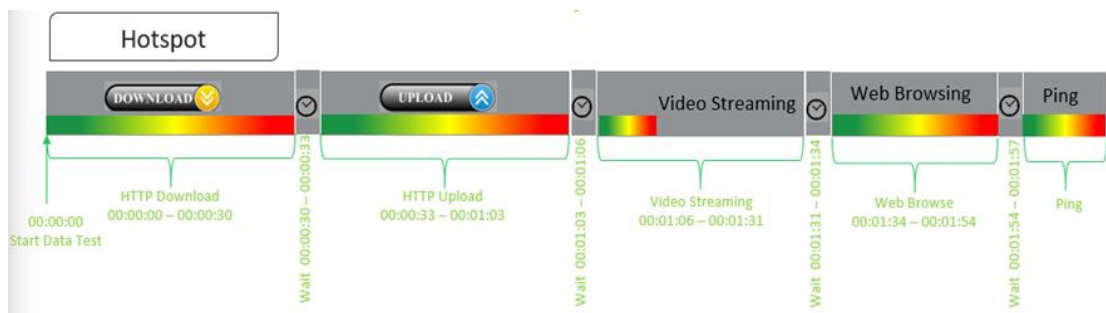## (d) Static Data(internet) testing

Figure-64: 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.
- Download & Upload test performed at hotspot in 4G/3G/2G auto-selection also.

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 $\geq$ 4 sec continuous RTP gap is considered as a Silence Call. Silence call rate = (count of silence call / Total calls established) *100 If a call observes multiple silence count >=4 sec in a particular established call it has been taken as one silent event.

Jitter	The inter arrival jitter is the difference in the relative transit time for two packets. The relative transit time is the difference between a packet's Real-time Transport Protocol (RTP) timestamp and the receiver's clock at the time of arrival, measured in the same units. If Si is the RTP timestamp from packet i, and Ri is the time of arrival in RTP timestamps units for packet i, then for two packets i and j the inter-arrival jitter D can be expressed as: **D(i,j) = (Rj - Ri) - (Sj - Si)** The interarrival jitter is calculated continuously as each data packet i is received from source SSRC_n, using this difference D for that packet and the previous packet i-1 in order of arrival (not necessarily in sequence), according to the formula **J(i) = J(i-1) + (|D(i-1,i)| - J(i-1))/16 or 8**
Downlink Packet Drop Rate	Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call originating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE)
Uplink Packet Drop Rate	Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call terminating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE).
Signal Strength	Signal strength is the signal power level received by the wireless user.

Parameter Name	Technology	Signal Strength (dBm)			
		Excellent	Good	Fair	Poor
Rx Level	GSM	0 to $\geq$ -65	<-65 to $\geq$ -75	<-75 to $\geq$-85	<-85 to min
RSCP	WCDMA	0 to $\geq$ -70	<-70 to $\geq$ -80	<-80 to $\geq$ -90	<-90 to min
RSRP	LTE	0 to $\geq$ -80	<-80 to $\geq$ -95	<-95 to $\geq$-110	<-110 to min
SS_RSRP	NR	0 to $\geq$ -80	<-80 to $\geq$ -95	<-95 to $\geq$-110	<-110 to min

Table-28: 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-29: 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.