भादूविप्रा
TRAI

TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Mumbai 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 Mumbai and Maharashtra License Service Area (LSA) during the month of March-2025 under the supervision of TRAI Regional Office (RO) Bengaluru. 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	Mumbai	Hotspot	01 Location	20-Mar-2025	20-Mar-2025
2	Mumbai to Pune Express Highway & return via Old Highway	Highway	252.2	18-Mar-2025	18-Mar-2025
3	Mumbai Central to Vasai Road	Railway	47.6	19-Mar-2025	19-Mar-2025
4	Gateway of India to Elephanta Caves	Coastal	12.9	20-Mar-2025	20-Mar-2025

Table-1: Drive test summary.

2.2 Drive test routes

The map provides overview of drive test routes indicating hotspot, highway, railway and coastal as per the legends shown on the map.

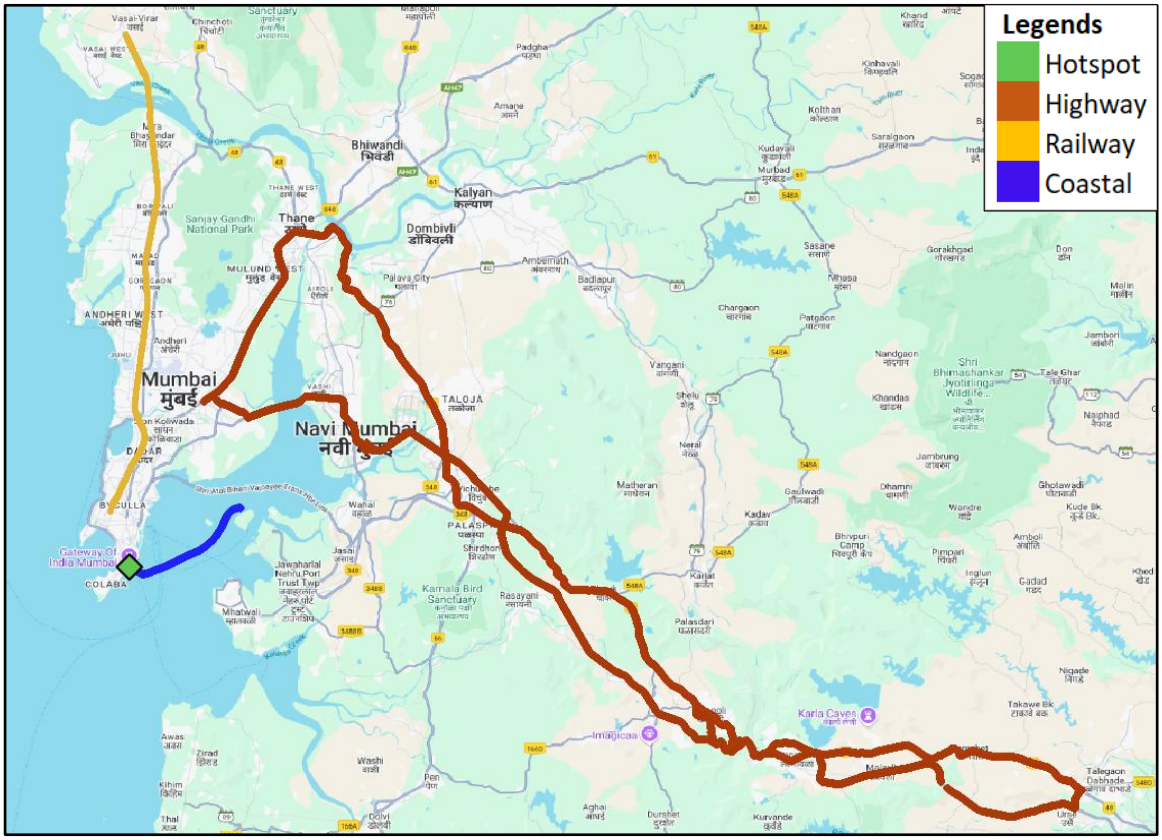


Figure-1: Drive test routes.

2.3 Summary of areas covered

a) Hotspot-

1. Gateway of India

b) Highway

Mumbai to Pune Express Highway and return via Old Highway passing through Thane, Taloja, Chouk, Khopoli, Kamshet, Urse, Malavli, Rasayani, Vichumbe etc.

c) Railway

Mumbai Central to Vasai Road passing through Dadar Western, Bandra, Andheri, Borivali, Dahisar, Mira Road, Bhayandar and Naigaon stations.

d) Coastal

Gateway of India to Elephanta Caves.

2.4 Telecom service providers detected frequency bands

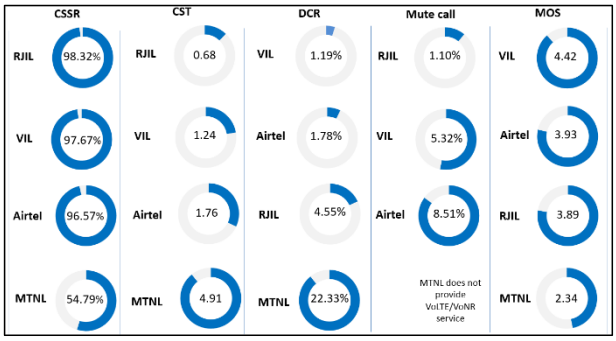
Technologies covered during the IDT and frequency bands in use are summarised in table below:

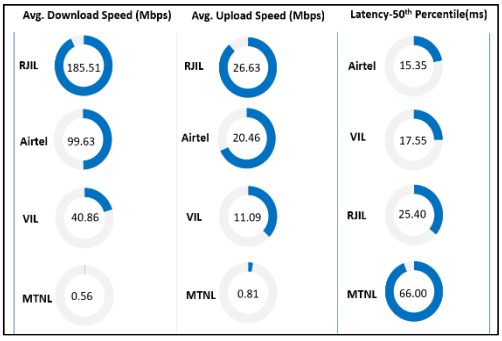
S.no.	Name of TSP	Technology	Frequency Bands (In MHz)
1	Bharti Airtel Ltd.	2G	1800
2	Bharti Airtel Ltd.	4G	850,900,1800,2100,2300
3	Bharti Airtel Ltd.	5G	3500
4	MTNL	2G	900,1800
5	MTNL	3G	2100
6	MTNL	4G	700,2100
7	Reliance JIO Infocomm Ltd.	4G	850,1800,2300
8	Reliance JIO Infocomm Ltd.	5G	700,3500
9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

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.





Summary-Voice services

Call Setup Success Rate: Airtel, MTNL, RJIL and VIL have 96.57%, 54.79%, 98.32% and 97.67% call setup success rate respectively in Auto-selection mode (5G/4G/3G/2G).

Call Setup Time: Airtel, MTNL, RJIL & VIL call setup time is 1.76, 4.91, 0.68 & 1.24 seconds respectively in Auto-selection mode (5G/4G/3G/2G).

Drop Call Rate: Airtel, MTNL, RJIL and VIL drop call rate is 1.78%, 22.33%, 4.55% and 1.19% respectively in Auto-selection mode (5G/4G/3G/2G).

Call Silence/Mute Rate: Airtel, RJIL and VIL have silence call rate of 8.51%, 1.10% & 5.32% respectively in packet switched network (4G/5G).

Mean Opinion Score (MOS): Airtel, MTNL, RJIL and VIL have average MOS score of 3.93, 2.34, 3.89 & 4.42 respectively.

Summary-Data services

Data Download performance (Overall): Average download speed of Airtel (5G/4G/2G) is 99.63 Mbps, MTNL (4G/3G/2G) is 0.56 Mbps, RJIL (5G/4G) is 185.51 Mbps and VIL (5G/4G/2G) is 40.86 Mbps.

Data Upload performance (Overall): Average upload speed of Airtel (5G/4G/2G) is 20.46 Mbps, MTNL (4G/3G/2G) is 0.81 Mbps, RJIL (5G/4G) is 26.63 Mbps and VIL (5G/4G/2G) is 11.09 Mbps.

Data performance - Hotspots (in Mbps):

Airtel- 4G D/L: 44.67 4G U/L: 6.57
5G D/L: 195.74 5G U/L: 58.74
RJIL- 4G D/L: 44.82 4G U/L: 6.01
5G D/L: 509.86 5G U/L: 43.56
VIL- 4G D/L: 58.29 4G U/L: 4.77
5G D/L: 218.18 5G U/L: 21.76

Note- "D/L" Download speed, "U/L" Upload speed 4G & 5G technology have not been observed in MTNL at hotspot locations.

QoS Performance Analysis- Mumbai 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 Hotspots, Highway, Railway and Coastal (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	MTNL	VIL
Call Attempts	108	157	110
Call Setup Success Rate %	99.07	51.59	98.18
Drop Call Rate %	1.87	28.40	3.70
Call Setup Time-Average (Second)	5.43	5.34	3.81
Handover Success Rate %	98.00	99.59	96.98

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

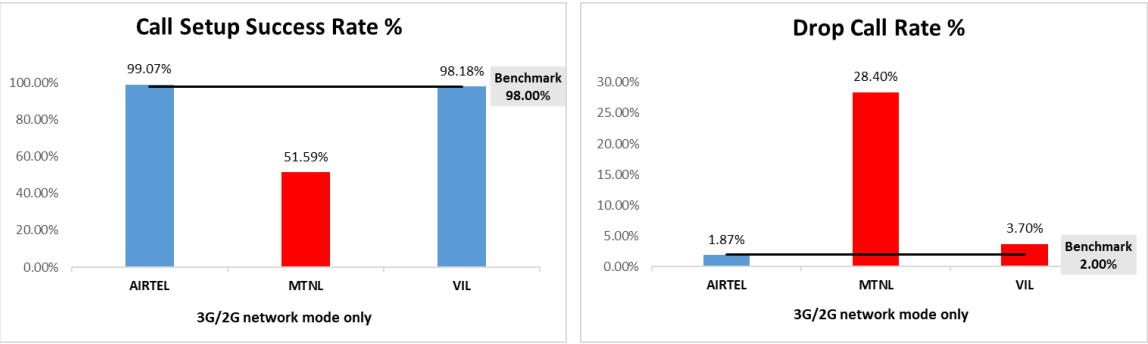


Figure-2: Call setup success rate and drop call rate performance.

Number of unique cell Id's covered in Voice test- Technology wise			
Technology	Service Provider		
	3G/2G network mode only		
	AIRTEL	MTNL	VIL
3G	NA	86	NA
2G	429	27	414

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	MTNL	RJIL	VIL
Call Attempts	175	188	179	172
Call Setup Success Rate %	96.57	54.79	98.32	97.67
Drop Call Rate %	1.78	22.33	4.55	1.19
Call Setup Time-Average (Second)	1.76	4.91	0.68	1.24
Handover Success Rate %	99.95	100.00	99.86	99.64

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

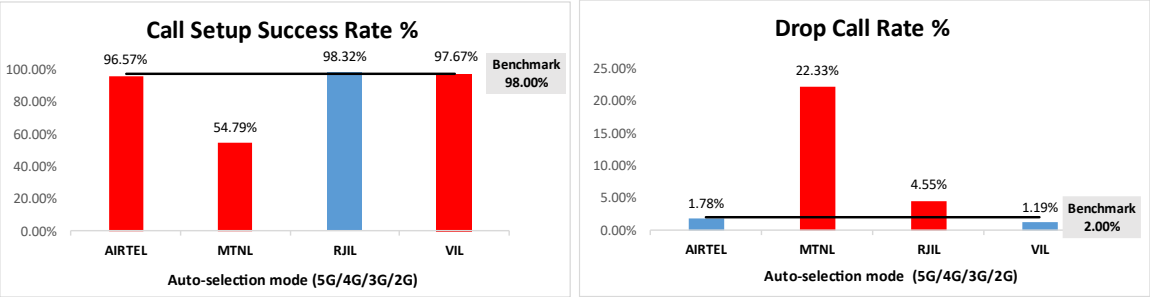


Figure-3: Performance for call setup success rate and drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	MTNL	RJIL	VIL
Call Established (within service provider Network)	94	51	91	94
Number of silence call for >4 Sec	8	NA	1	5
Silence Call Rate %	8.51	NA	1.10	5.32
Number of silence instances for >4 Sec	8	NA	1	6
Number of silence instances for >3 Sec	14	NA	1	8
Number of silence instances for >2 sec	29	NA	9	38
RTP Jitter (4G & 5G) in ms	5.43	NA	8.01	10.07
Packet loss Rate Downlink %	1.39	NA	0.33	1.50
Packet loss Rate Uplink %	1.49	NA	0.98	1.19

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

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

Number of unique cell Id's covered in Voice test- Technology wise				
Technology	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
5G	0	NA	238	NA
4G	1330	16	1584	1150
3G	NA	90	NA	NA
2G	2	85	NA	10

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	MTNL	RJIL	VIL
Total Number of MOS Samples for calls table-6	1200	573	1169	1193
Speech Quality (Average MOS Score)	3.93	2.34	3.89	4.42
Number of samples with MOS >=4 to <5 (Excellent)	935	0	811	1014
Number of samples with MOS >=3 to <4 (Good)	201	58	286	119
Number of samples with MOS >=2 to <3 (Fair)	35	394	50	24
Number of samples with MOS >=1 to <2 (Poor)	29	121	22	36
%age of samples with MOS >=4 to <5 (Excellent)	77.92%	0.00%	69.38%	85.00%
%age of samples with MOS >=3 to <4 (Good)	16.75%	10.12%	24.47%	9.97%
%age of samples with MOS >=2 to <3 (Fair)	2.92%	68.76%	4.28%	2.01%
%age of samples with MOS >=1 to <2 (Poor)	2.42%	21.12%	1.88%	3.02%

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

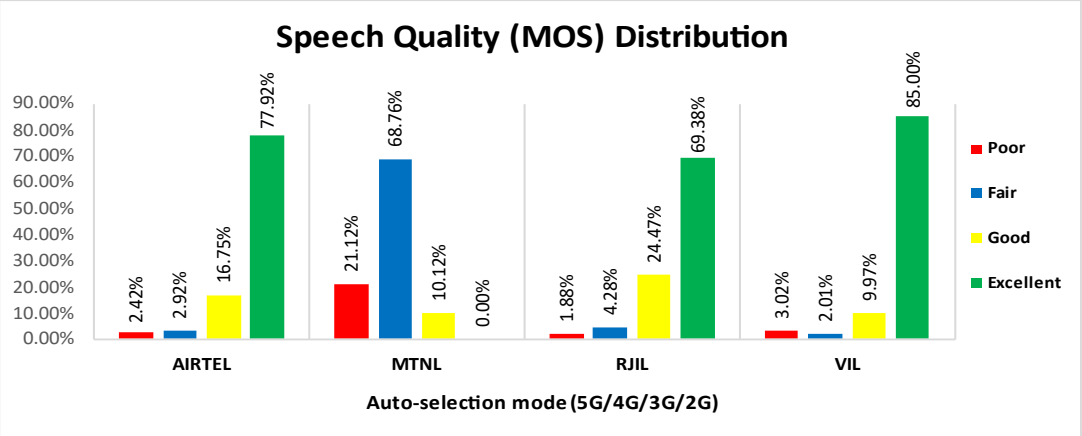


Figure- 4: Distribution of samples in MOS score range.

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	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	99.63	0.56	185.51	40.86
	80th Percentile	202.11	0.94	339.23	60.30
	20th Percentile	10.37	0.20	17.42	8.04
Upload Throughput (Mbits/s)	Average	20.46	0.81	26.63	11.09
	80th Percentile	38.98	1.31	49.85	18.28
	20th Percentile	3.64	0.22	3.42	3.36
Latency (ms)	50th Percentile	15.35	66.00	25.40	17.55

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

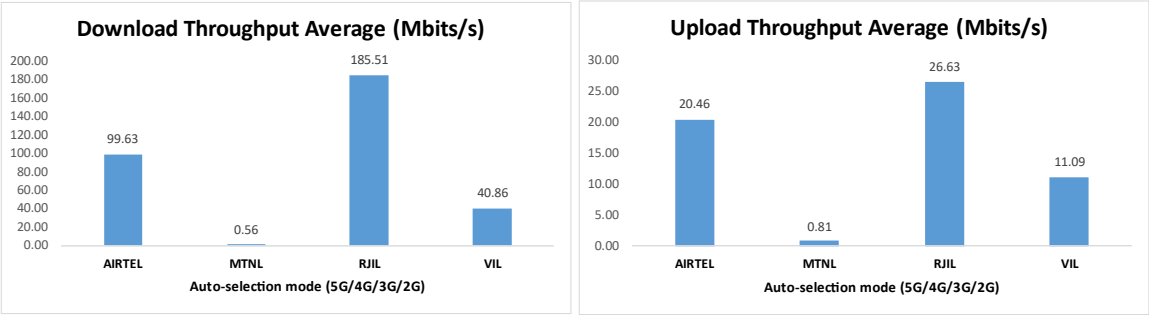


Figure- 5: Download and Upload throughput.

Number of unique cell Id's covered in Data test- Technology wise				
Technology	**Service Provider**			
	Auto-selection mode 5G/4G/3G/2G			
	AIRTEL	**MTNL**	**RJIL**	**VIL**
5G	0	NA	614	NA
4G	1350	16	280	981
3G	NA	100	NA	NA
2G	4	67	NA	9

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 Hotspots, Highway, Railway and Coastal for all telecom service providers, the results of drive tests conducted is shown individually for respective areas/locations.

4.2 Hotspots

Hotspot testing has been done on 20th March 2025. One location has been tested in the city & across the Coastal route.

4.2.1 Locations

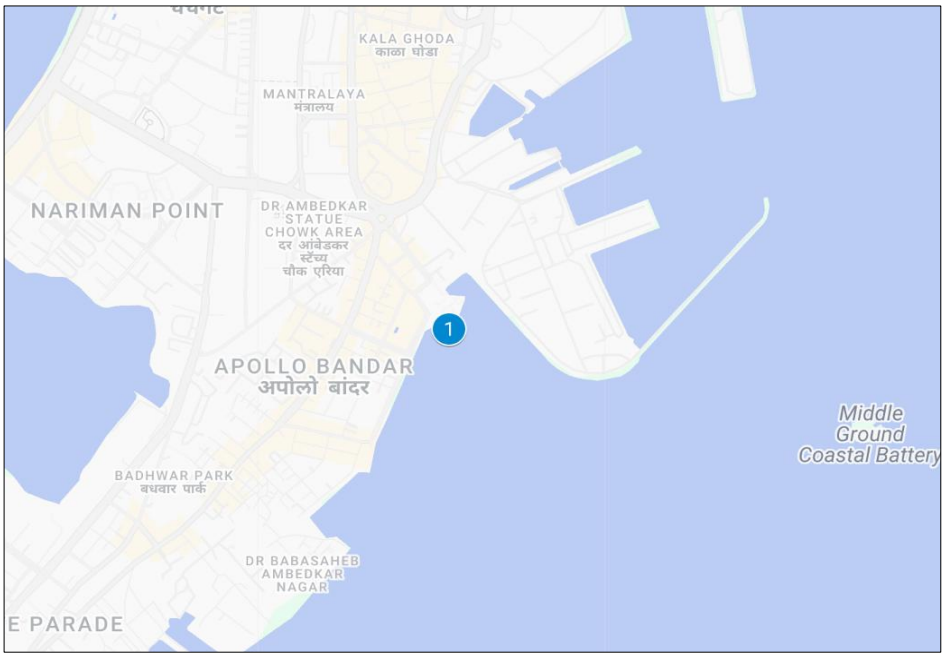


Figure- 6: Hotspot locations.

4.2.2 Hotspot covered

1. Gateway of India

4.2.3 Voice performance

Gateway of India				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**MTNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	50.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.18	4.49	0.57	0.89

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

Note- Overall Table has not been given as only single Hotspot location has been tested in Mumbai city.

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

Overall Data Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**MTNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	129.85	0.00	509.86	144.04
Download Throughput 80th Percentile (Mbit/s)	195.26	0.00	556.75	220.15
Download Throughput 20th Percentile (Mbit/s)	34.55	0.00	476.51	33.73
Download Session Setup Success Rate %	100.00	20.00	100.00	100.00
Upload Throughput Average (Mbits/s)	38.63	-	43.56	17.99
Upload Throughput 80th Percentile (Mbit/s)	60.93	-	61.64	21.42
Upload Throughput 20th Percentile (Mbit/s)	8.71	-	25.64	12.39
Upload Session Setup Success Rate %	100.00	0.00	100.00	100.00
Web Browsing Delay (Second)	2.23	-	1.95	2.06
Youtube Initial Buffer Delay (Second)	1.10	-	0.68	0.58
Latency (ms) - 50th Percentile	10.25	146.50	19.15	11.00
Jitter (ms)	4.16	380.64	3.81	2.02
Packet Loss Rate%	0.00	98.30	0.00	0.30

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

Note- "-" Upload, Web Browsing and Youtube tests were failed.

Gateway of India				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**MTNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	129.85	0.00	509.86	144.04
Download Session Setup Success Rate %	100.00	20.00	100.00	100.00
Upload Throughput Average (Mbits/s)	38.63	-	43.56	17.99
Upload Session Setup Success Rate %	100.00	-	100.00	100.00
Web Browsing Delay (Second)	2.23	-	1.95	2.06
Youtube Initial Buffer Delay (Second)	1.10	-	0.68	0.58
Latency (ms) - 50th Percentile	10.25	146.50	19.15	11.00
Jitter (ms)	4.16	380.64	3.81	2.02
Packet Loss Rate%	0.00	98.30	0.00	0.30

Table-13: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Note-"-"Upload, Web Browsing and Youtube tests were failed.

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

Gateway of India					
Parameters		**Service Provider**			
		AIRTEL	**MTNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	195.74	-	509.86	218.18
	Upload Throughput Average (Mbits/s)	58.74	-	43.56	21.76
4G	**Download Throughput Average (Mbits/s)**	44.67	-	44.82	58.29
	Upload Throughput Average (Mbits/s)	6.57	-	6.01	4.77

Table-14: Overall Summary of 5G only & 4G only data download & upload speed.

Note- "-"Respective technology was not observed during the test.
Overall Table has not been given as only single Hotspot location has been tested in Mumbai city.

4.3 Highway

Drive test has been conducted on 18th March 2025 covering one Highway route. (Refer Table-1)

4.3.1 Drive test route

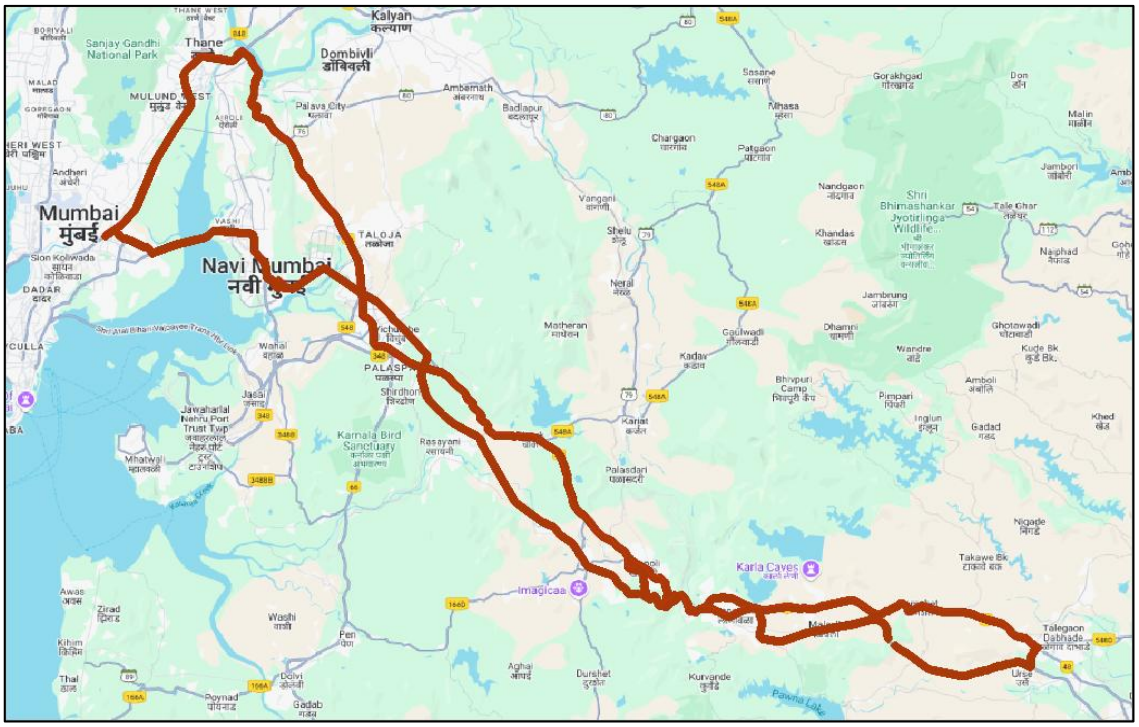


Figure-7: Drive test route Highway.

4.3.2 Routes Covered

Mumbai to Pune Express Highway and return via Old Highway passing through Thane, Taloja, Chouk, Khopoli, Kamshet, Urse, Malavli, Rasayani, Vichumbe etc. Drive test for this route has been conducted on 18th 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 the experience for respective users as they have only 3G/2G compatible handsets.

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	MTNL	VIL
Call Attempts	108	157	110
Call Setup Success Rate %	99.07	51.59	98.18
Drop Call Rate %	1.87	28.40	3.70
Call Setup Time-Average (Second)	5.43	5.34	3.81
Handover Success Rate %	98.00	99.59	96.98

Table-15: Summary of voice call performance in 3G/2G network mode only.

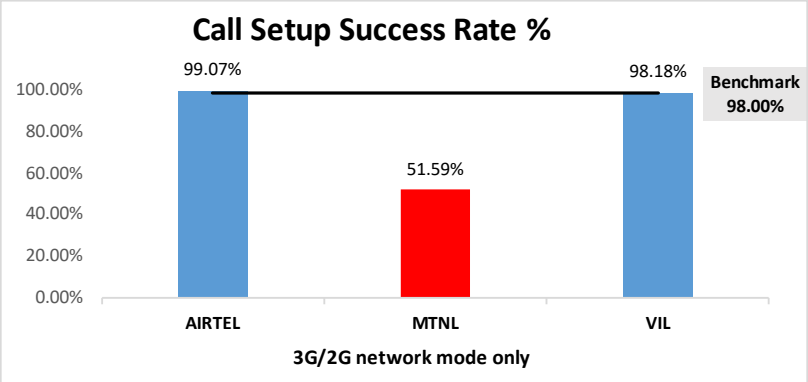


Figure-8: Performance for call setup success rate.

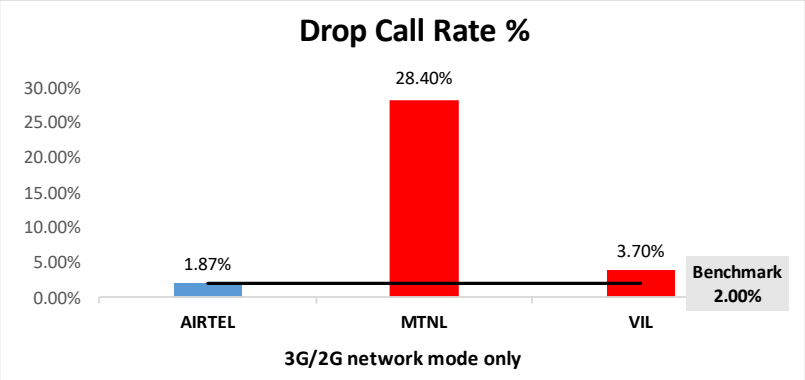


Figure-9: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**MTNL**	**VIL**
3G	NA	69.07%	NA
2G	100.00%	22.21%	100.00%
Limited Service	0.00%	8.72%	0.00%

Table-16: Time spent on technology during drive test 3G/2G network mode only.

Note-

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

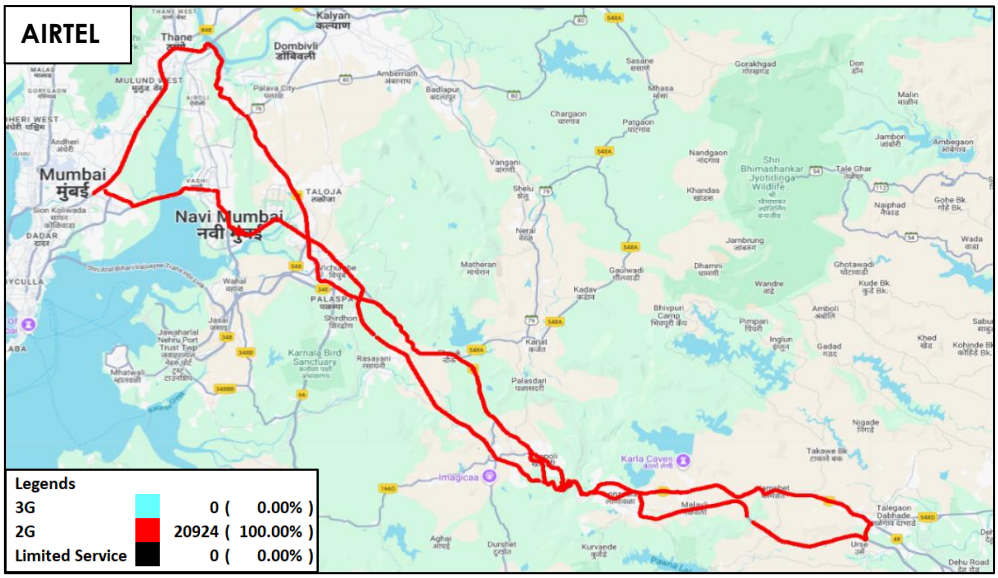


Figure-10: Serving technology plots 3G/2G network mode – AIRTEL.

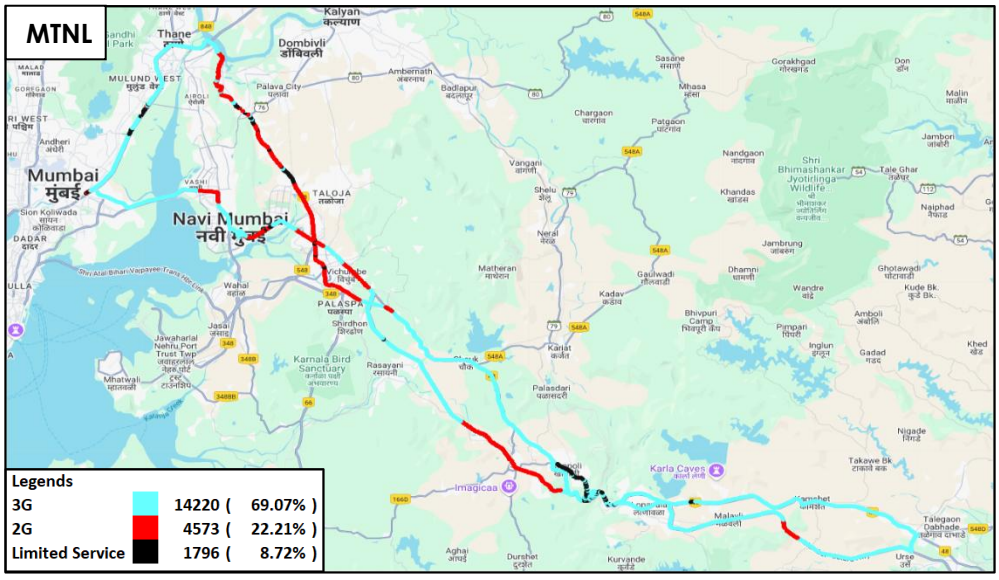


Figure-11: Serving technology plots 3G/2G network mode – MTNL.

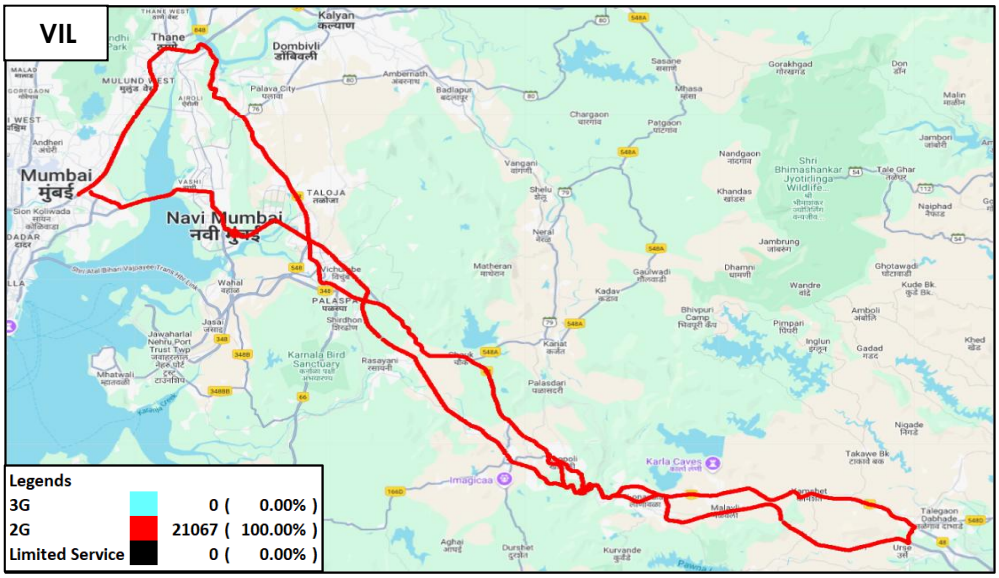


Figure-12: Serving technology plots 3G/2G network mode –VIL.

(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)

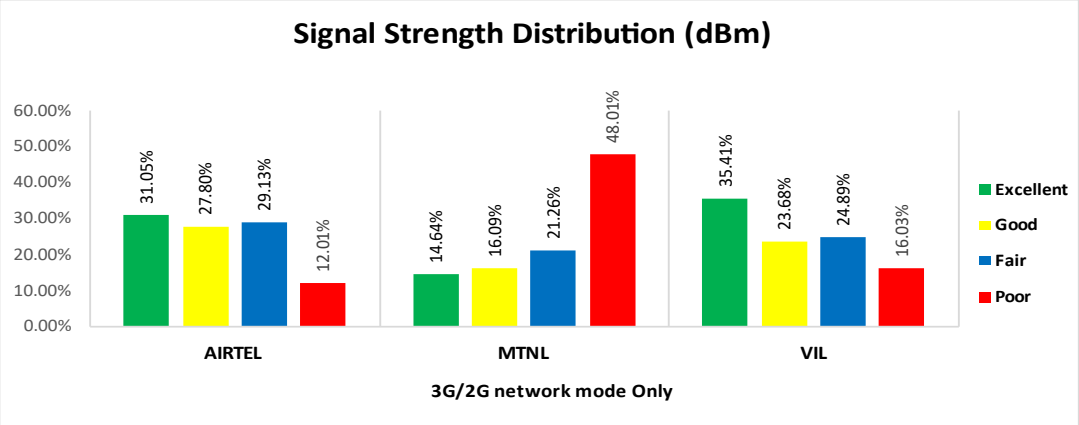


Figure-13: Signal strength distribution 3G/2G network mode only.

Observations:

- Airtel has 31% of samples falling in the excellent signal strength category.
- MTNL has 15% of samples falling in the excellent signal strength category.
- VIL has 35% 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	MTNL	RJIL	VIL
Call Attempts	110	115	114	111
Call Setup Success Rate %	100.00	61.74	100.00	99.10
Drop Call Rate %	0.00	18.31	1.75	0.91
Call Setup Time Average (Second)	1.19	4.99	0.62	1.09
Handover Success Rate %	100.00	100.00	100.00	99.74

Table-17: Summary of voice call performance in network auto-selection mode.

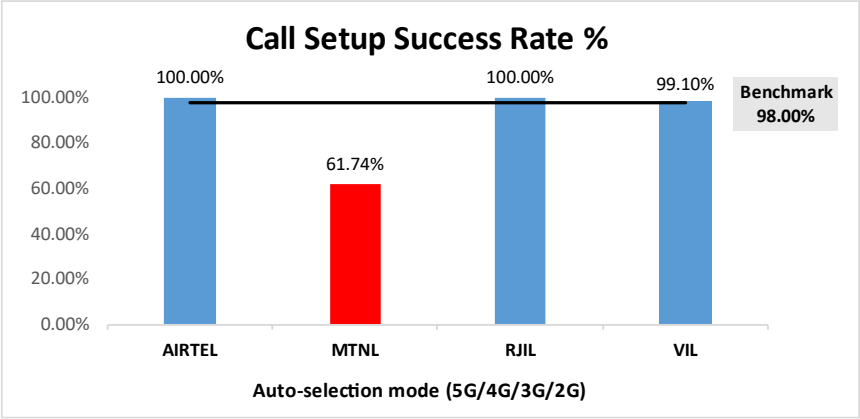


Figure-14: Performance for call setup success rate.

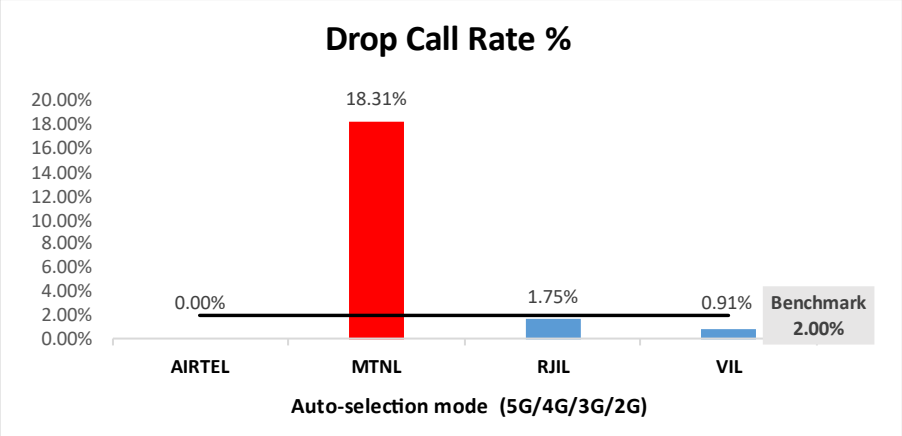


Figure-15: Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	MTNL	RJIL	VIL
Call Established (within service provider Network)	94	51	91	94
Number of silence call for >4 Sec	8	NA	1	5
Silence Call Rate %	8.51	NA	1.10	5.32
Number of silence instances for >4 Sec	8	NA	1	6
Number of silence instances for >3 Sec	14	NA	1	8
Number of silence instances for >2 sec	29	NA	9	38
RTP Jitter (4G & 5G) in ms	5.43	NA	8.01	10.07
Packet loss Rate Downlink %	1.39	NA	0.33	1.50
Packet loss Rate Uplink %	1.49	NA	0.98	1.19

Table-18: Summary of silence instances & packet loss rate for mobile to mobile call.

Note-

- NA- Due to unavailability of packet switched (VoLTE & 5G) network in MTNL silence instances are not captured.

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
Total Number of MOS Samples for calls in table-39	1200	573	1169	1193
Speech Quality (Average MOS Score)	3.93	2.34	3.89	4.42
Number of samples with MOS >=4 to <5 (Excellent)	935	0	811	1014
Number of samples with MOS >=3 to <4 (Good)	201	58	286	119
Number of samples with MOS >=2 to <3 (Fair)	35	394	50	24
Number of samples with MOS >=1 to <2 (Poor)	29	121	22	36
%age of samples with MOS >=4 to <5 (Excellent)	77.92%	0.00%	69.38%	85.00%
%age of samples with MOS >=3 to <4 (Good)	16.75%	10.12%	24.47%	9.97%
%age of samples with MOS >=2 to <3 (Fair)	2.92%	68.76%	4.28%	2.01%
%age of samples with MOS >=1 to <2 (Poor)	2.42%	21.12%	1.88%	3.02%

Table-19: Summary of speech quality (MOS) samples.

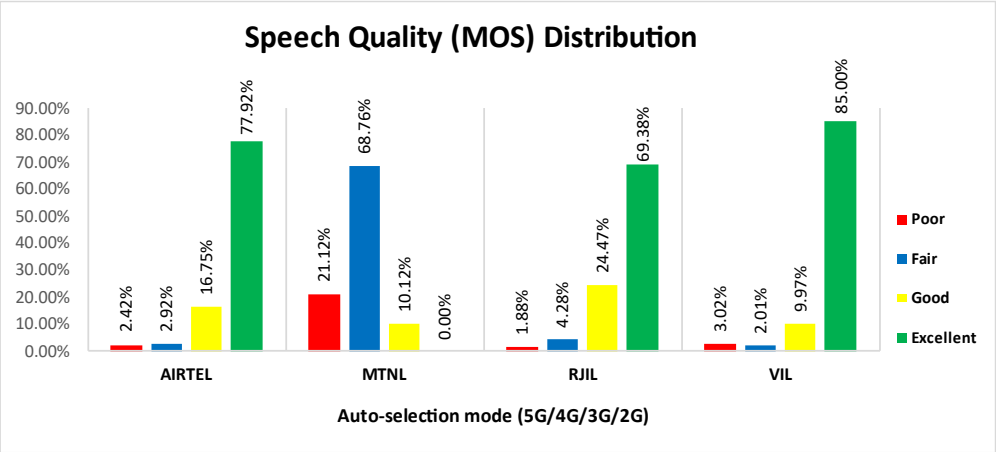


Figure-16: Distribution of samples in MOS score range.

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

Technology	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
5G	5.56%	NA	11.06%	NA
4G	94.44%	NA	88.94%	98.16%
3G	NA	33.60%	NA	NA
2G	0.00%	47.88%	NA	1.84%
Limited Service	0.00%	18.53%	0.00%	0.00%

Table-20: Time spent on technology during drive test.

Note-

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

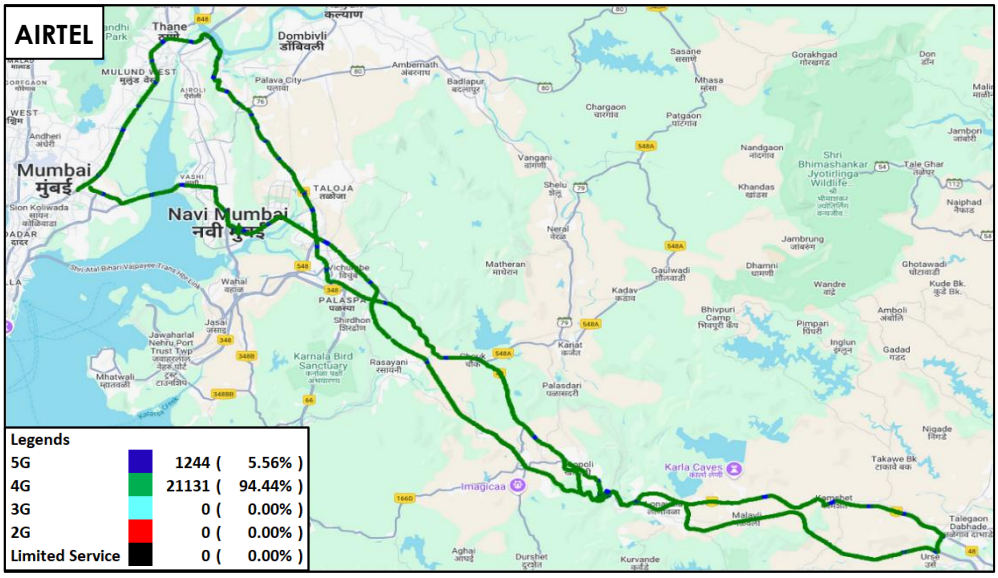


Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-AIRTEL.

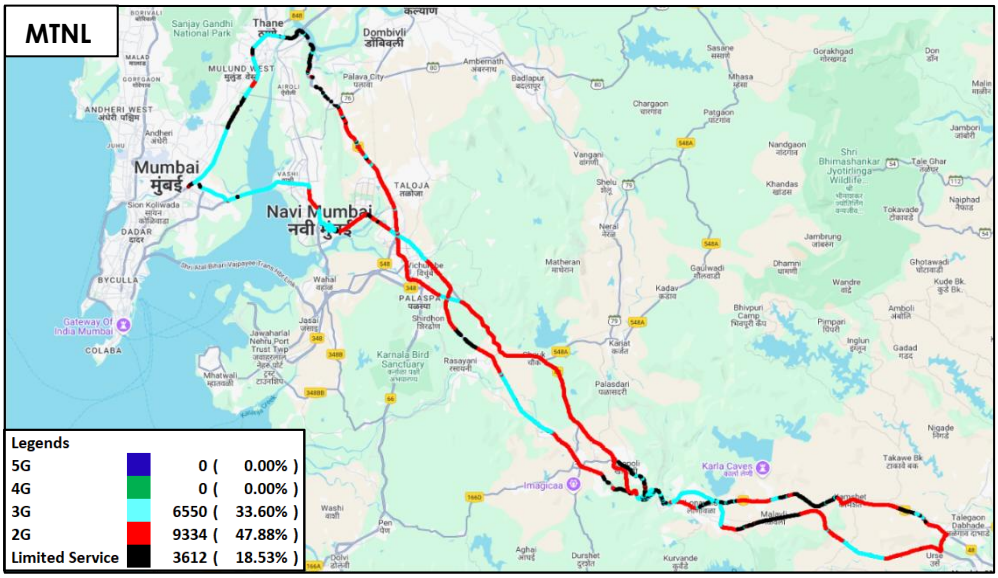


Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-MTNL.

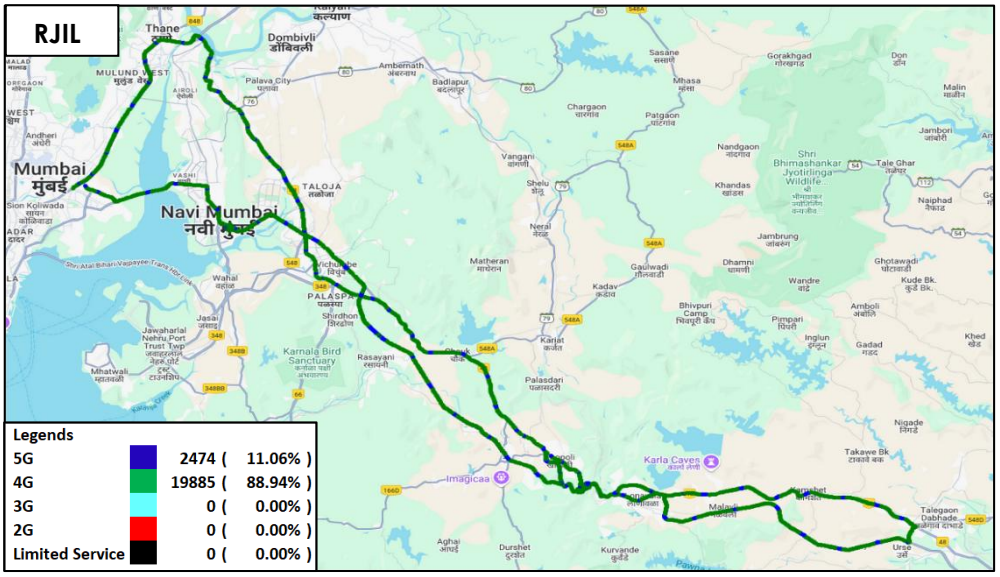


Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-RJIL.

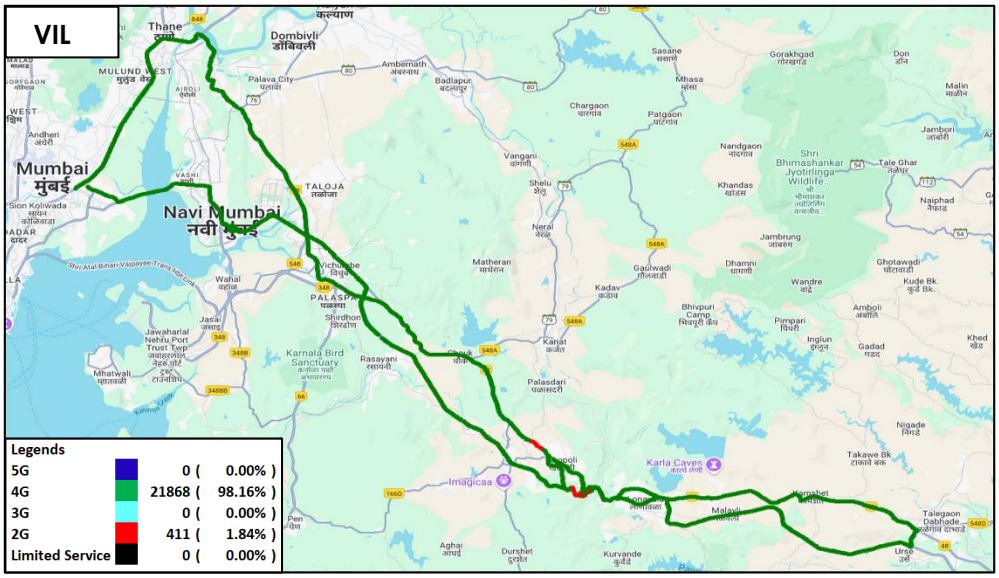


Figure-20: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-VIL.

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

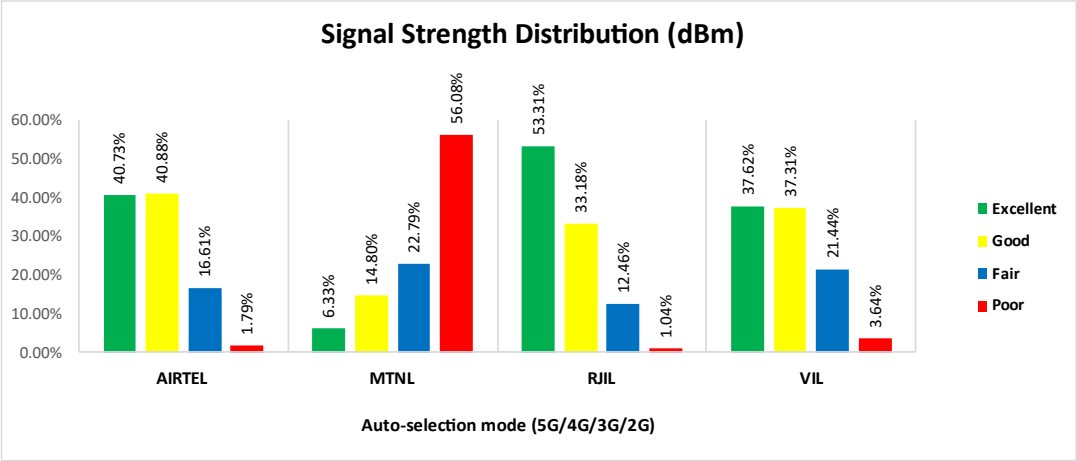


Figure-21: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:

- Airtel has 41% of samples falling in the excellent signal strength category.
- MTNL has 6% of samples falling in the excellent signal strength category.
- RJIL has 53% of samples falling in the excellent signal strength category.
- VIL has 38% 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	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	119.80	0.61	208.39	41.92
	80th Percentile	224.16	0.95	363.06	64.06
	20th Percentile	22.15	0.21	38.75	10.15
Upload Throughput (Mbits/s)	Average	24.20	0.91	31.10	12.12
	80th Percentile	45.35	1.49	55.25	19.16
	20th Percentile	5.79	0.27	5.76	3.82
Latency (ms)	50th Percentile	15.60	60.00	26.70	18.45

Table-21: Summary of Data performance in network auto-selection mode.

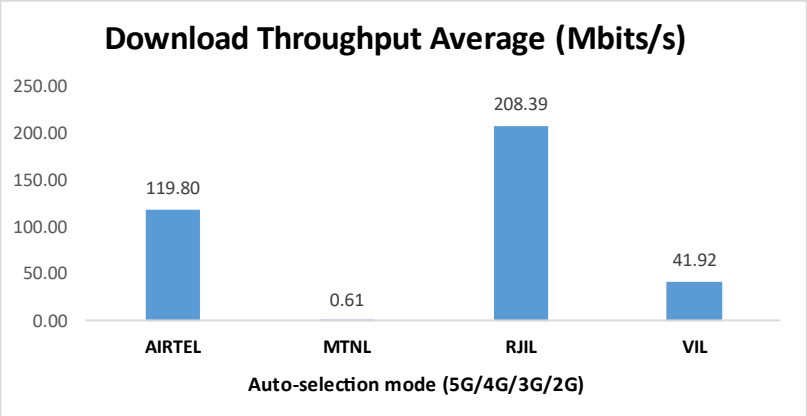


Figure-22: Download throughput.

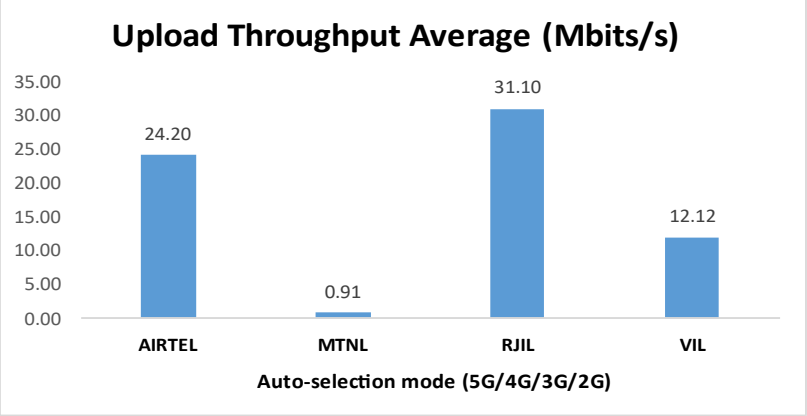


Figure-23: Upload throughput.

4.4 Railway

Drive test has been conducted on 19th March 2025 covering one Railway route. (Refer Table-1)

4.4.1 Drive test route

Figure-24: Drive test route railway.

4.4.2 Routes Covered

Mumbai Central to Vasai Road passing through Dadar Western, Bandra, Andheri, Borivali, Dahisar, Mira Road, Bhayandar, Naigaon.

4.4.3 Voice Performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempts	22	24	23	21
Call Setup Success Rate %	100.00	62.50	95.65	100.00
Drop Call Rate %	4.55	66.67	9.09	4.76
Call Setup Time Average (Second)	1.66	5.99	0.65	0.99
Handover Success Rate %	99.79	100.00	99.85	99.77

Table-22: Summary of voice call performance in network auto-selection mode.

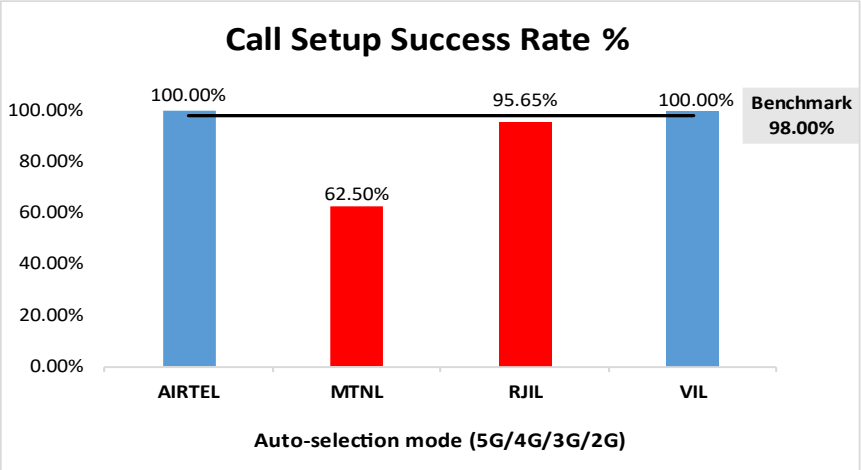


Figure-25: Performance for call setup success rate.

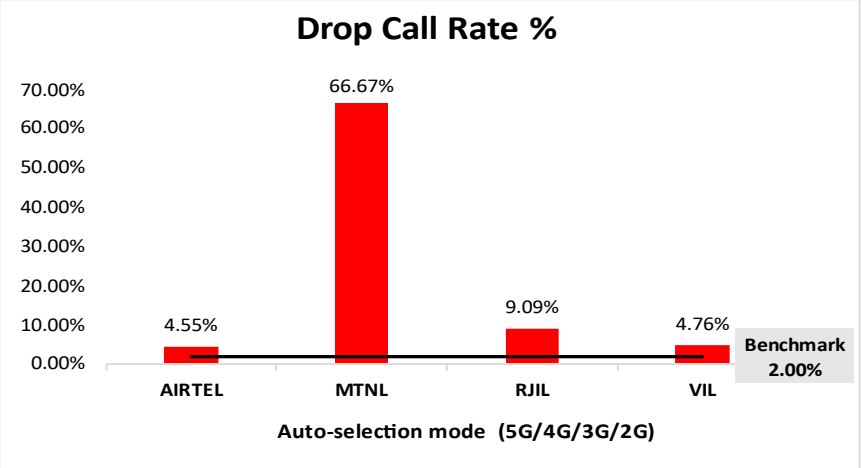


Figure-26: Performance for drop call rate.

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

Technology	Service Provider			
	AIRTEL	**MTNL**	**RJIL**	**VIL**
5G	2.07%	NA	9.71%	NA
4G	97.93%	NA	90.29%	100.00%
3G	NA	55.87%	NA	NA
2G	0.00%	19.39%	NA	0.00%
Limited Service	0.00%	24.74%	0.00%	0.00%

Table-23: Time spent on technology during drive test.

Note-

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

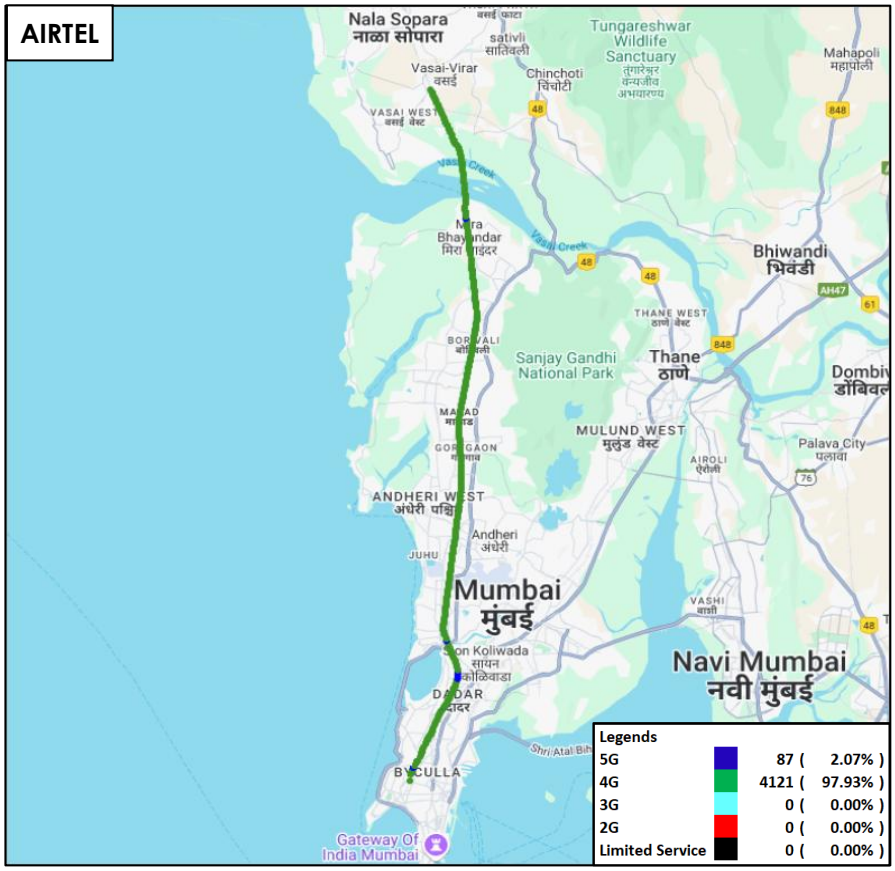


Figure-27: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-AIRTEL.

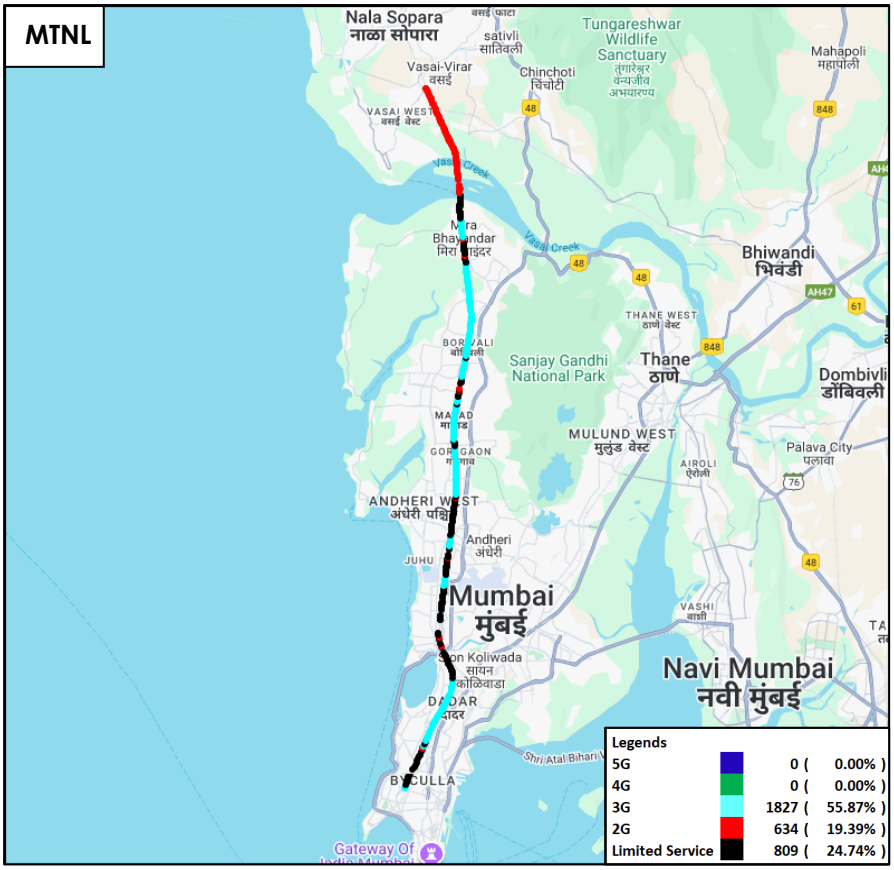


Figure-28: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-MTNL.

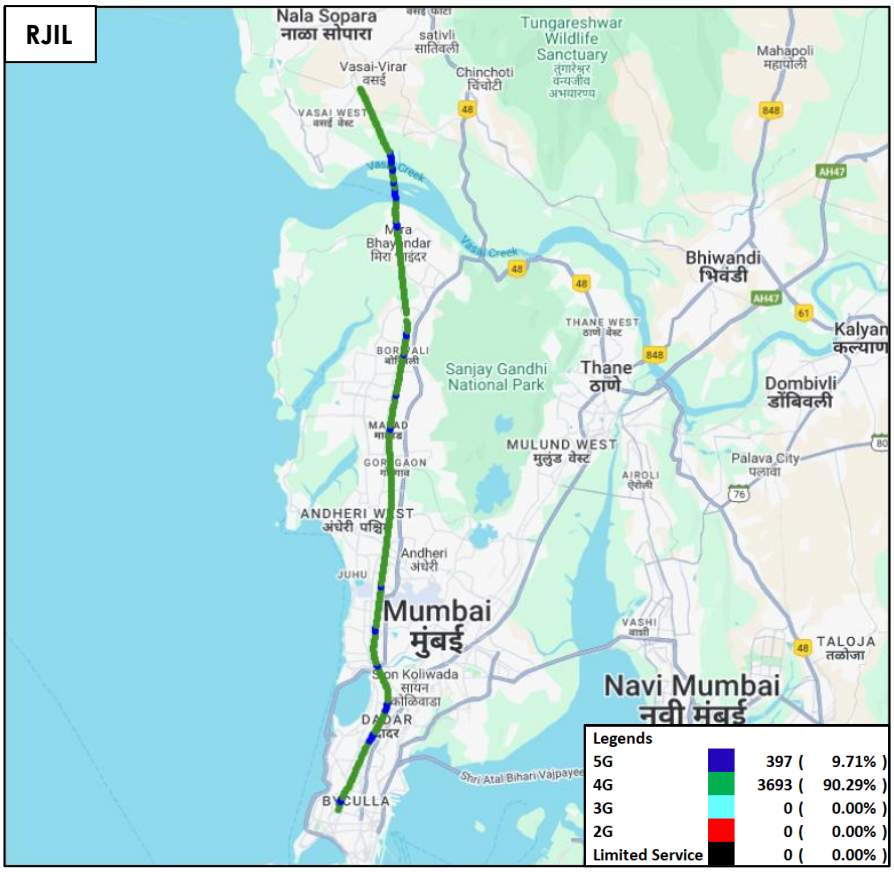


Figure-29: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-RJIL.

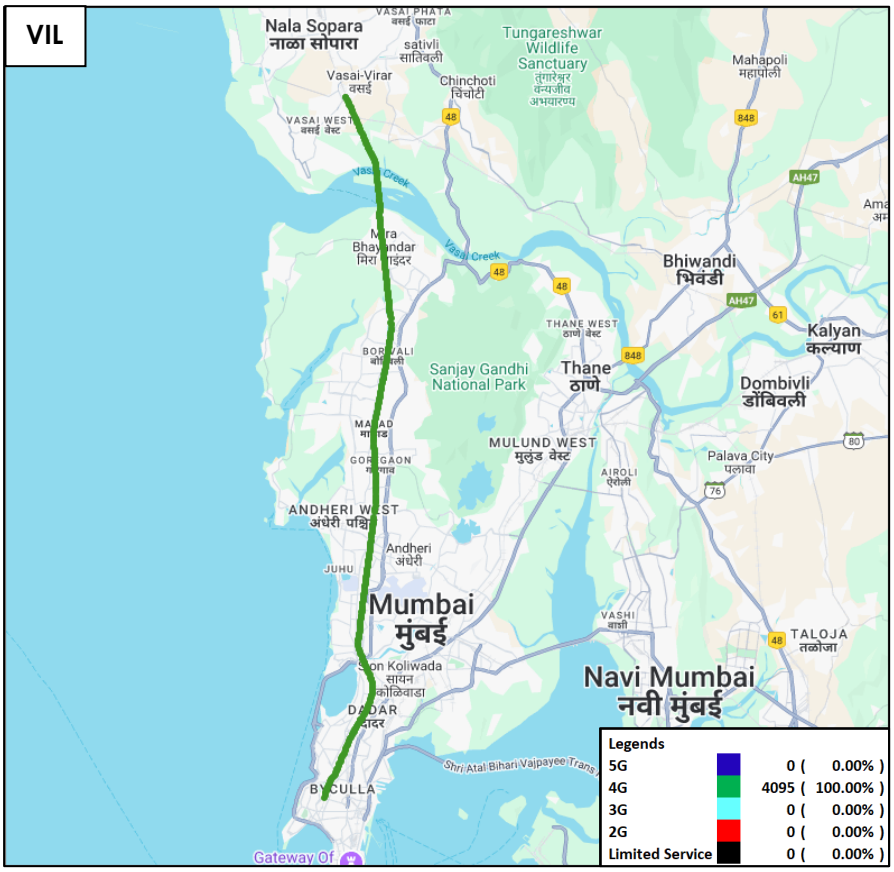


Figure-30: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -VIL.

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

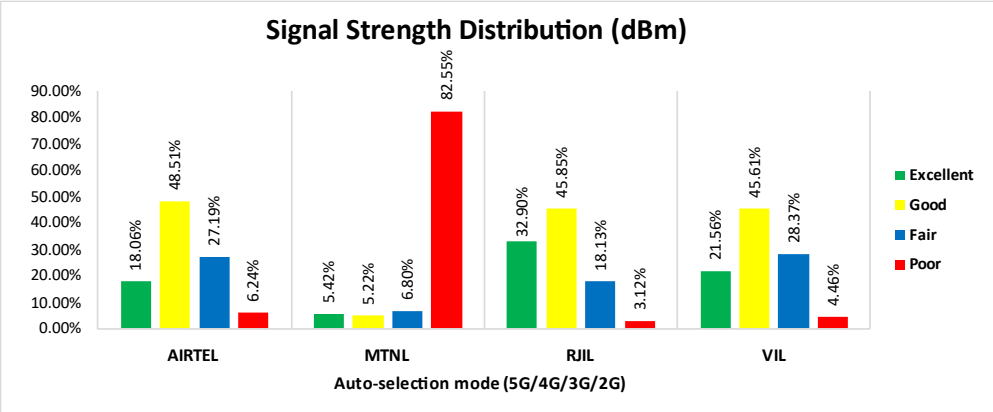


Figure-31: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:

- Airtel has 18% of samples falling in the excellent signal strength category.
- MTNL has 5% of samples falling in the excellent signal strength category.
- RJIL has 33% of samples falling in the excellent signal strength category.
- VIL has 22% of samples falling in the excellent signal strength category.

4.4.4 Data Performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	32.63	0.51	142.31	30.89
	80th Percentile	35.16	0.76	239.63	47.43
	20th Percentile	6.68	0.30	15.65	15.01
Upload Throughput (Mbits/s)	Average	8.15	0.42	19.46	9.94
	80th Percentile	9.74	0.79	31.47	13.01
	20th Percentile	2.79	0.08	5.46	5.18
Latency (ms)	50th Percentile	19.30	107.25	28.80	19.30

Table-24: Summary of Data performance in network auto-selection mode

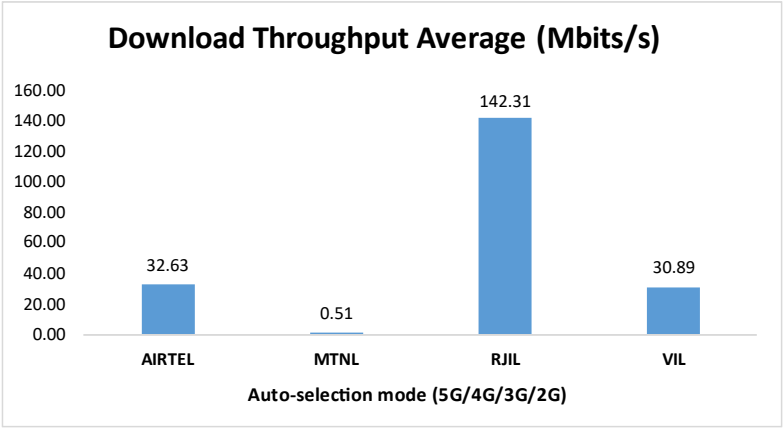


Figure-32: Download throughput.

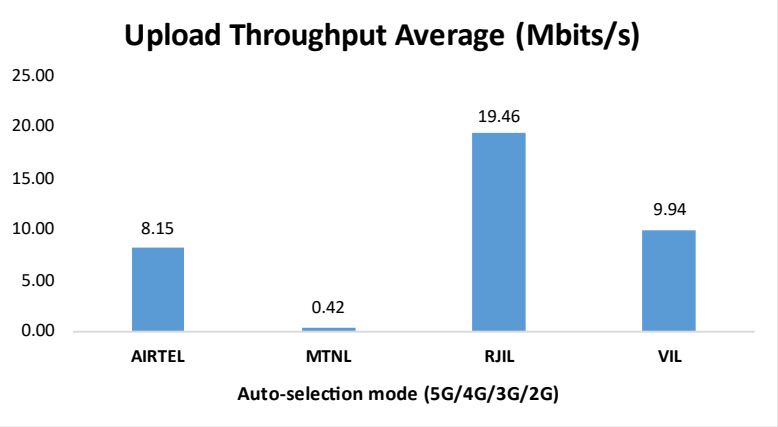


Figure-33: Upload throughput.

4.5 Coastal

Drive test has been conducted on 20th March 2025 covering one Coastal route. (Refer Table-1)

4.5.1 Drive test route

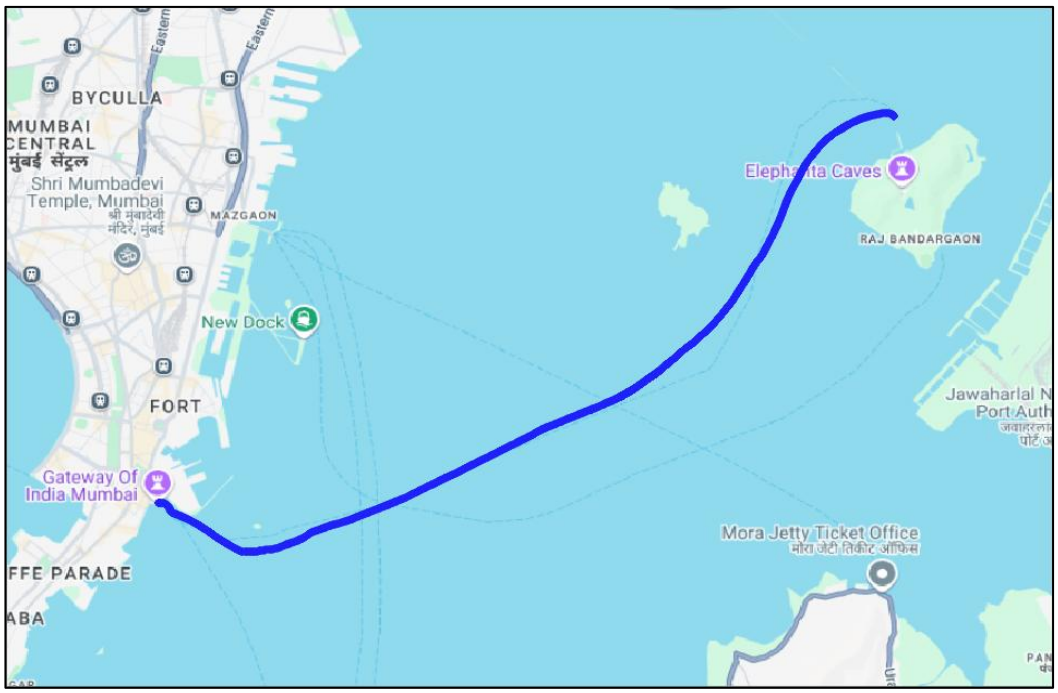


Figure-34: Drive test route coastal.

4.5.2 Routes Covered

Gateway of India to Elephanta Caves.

4.5.3 Voice Performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempts	33	39	32	30
Call Setup Success Rate %	81.82	30.77	93.75	90.00
Drop Call Rate %	7.41	0.00	13.33	0.00
Call Setup Time Average (Second)	4.38	3.18	0.94	2.12
Handover Success Rate %	100.00	100.00	99.08	97.62

Table-25: Summary of voice call performance in network auto-selection mode.

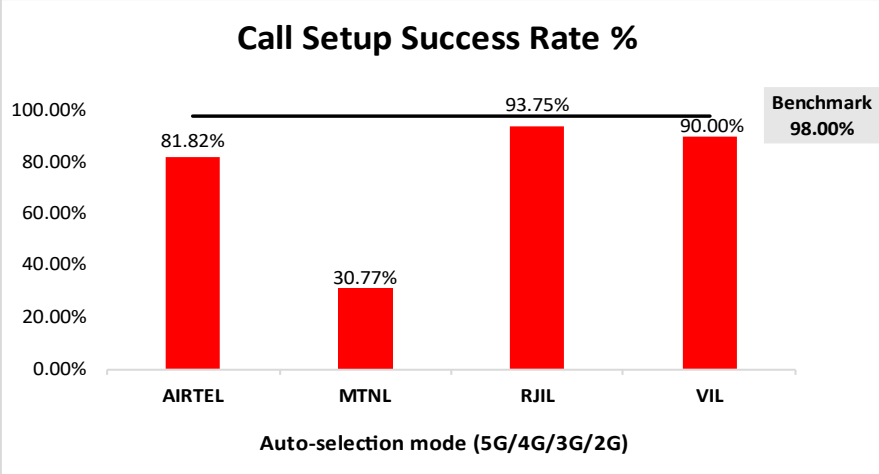


Figure-35: Performance for call setup success rate.

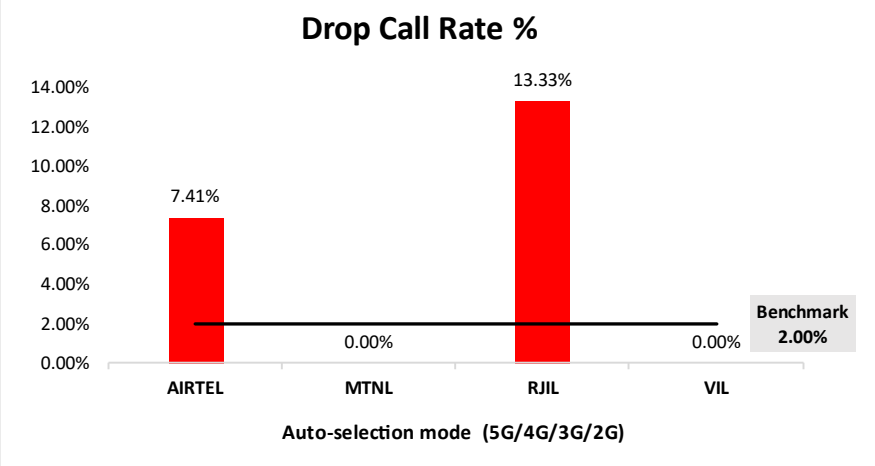


Figure-36: Performance for drop call rate.

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

Technology	Service Provider			
	AIRTEL	**MTNL**	**RJIL**	**VIL**
5G	0.00%	NA	11.10%	NA
4G	92.58%	NA	87.78%	74.93%
3G	NA	50.31%	NA	NA
2G	4.89%	4.38%	NA	21.24%
Limited Service	2.54%	45.31%	1.12%	3.83%

Table-26: Time spent on technology during drive test.

Note-

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

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

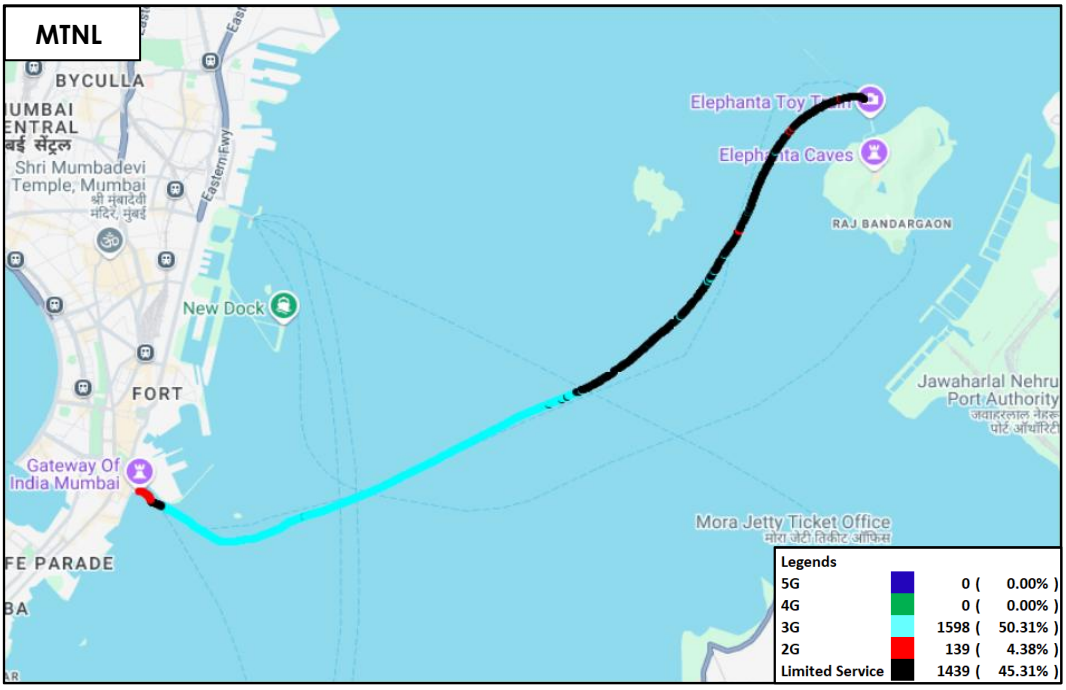


Figure-38: Serving technology plots in auto-selection mode (5G/4G/3G/2G)-MTNL.

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

Figure-40: 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-55, 56, 57 & 58 for map view)

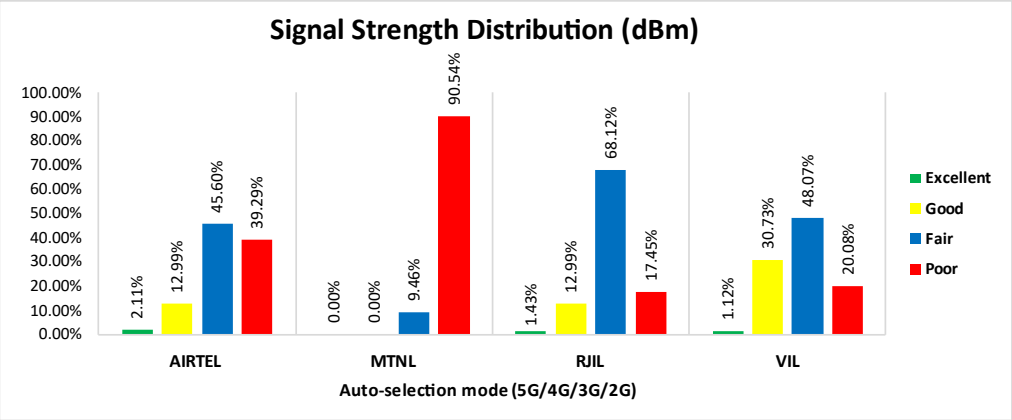


Figure-41: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:

- Airtel has 2% of samples falling in the excellent signal strength category.
- MTNL has 0% of samples falling in the excellent signal strength category.
- RJIL has 1% of samples falling in the excellent signal strength category.
- VIL has 1% of samples falling in the excellent signal strength category.

4.5.4 Data Performance

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

Parameters		Service Provider Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	34.82	0.24	30.34	29.38
	80th Percentile	15.46	0.36	42.57	11.95
	20th Percentile	0.52	0.17	1.32	2.75
Upload Throughput (Mbits/s)	Average	5.20	0.44	2.52	3.72
	80th Percentile	2.40	0.58	3.32	3.81
	20th Percentile	1.24	0.23	0.83	1.01
Latency (ms)	50th Percentile	29.48	91.50	36.25	20.63

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

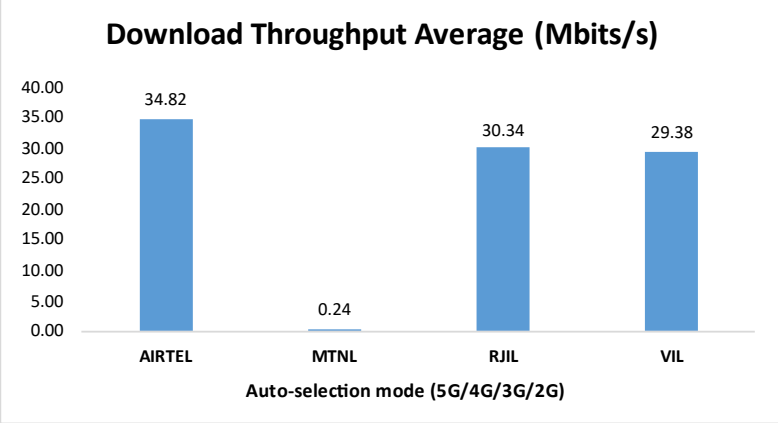


Figure-42: Download throughput.

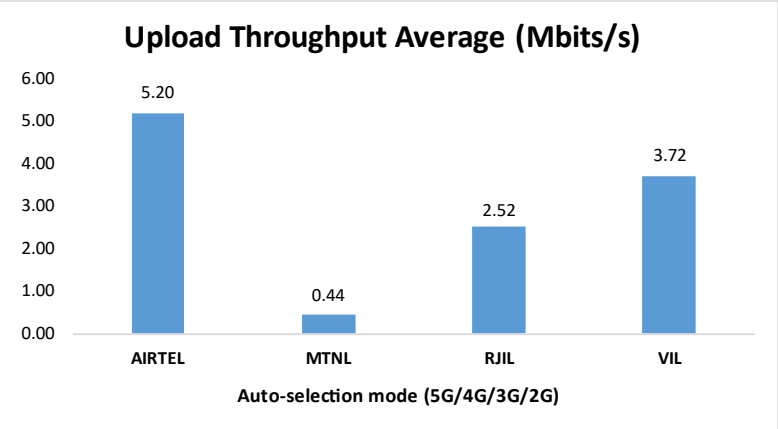


Figure-43: Upload throughput.

5. Voice & Data Key findings

5.1 Overall Voice

1. **Call Setup Success Rate:**
   a) Airtel, MTNL and VIL have 99.07%, 51.59% and 98.18% call setup success rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, MTNL, RJIL and VIL have 96.57%, 54.79%, 98.32% and 97.67% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

2. **Call Setup Time**:
   a) Airtel, MTNL and VIL call setup time is 5.43, 5.34 & 3.81 seconds respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, MTNL, RJIL & VIL call setup time is 1.76, 4.91, 0.68 & 1.24 seconds respectively in Auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G) Airtel, VIL and RJIL have 8.51%, 5.32% & 1.10% silence call rate respectively. Further VIL has higher RTP packet loss rate in downlink (1.50%) compared to Airtel (1.39%) and RJIL (0.33%), In uplink the RTP packet loss rate is higher for Airtel (1.49%) compared to VIL (1.19%) and RJIL (0.98%). (refer table-6)

4. **Drop Call Rate**:
   a) Airtel, MTNL and VIL drop call rate 1.87%, 28.40% and 3.70% respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, MTNL, RJIL and VIL drop call rate 1.78%, 22.33%, 4.55% and 1.19% respectively in Auto-selection mode (5G/4G/3G/2G). (refer table-5)

5.2 Overall Data

1. **Data download and upload performance (Overall i.e. LSA):**
   a) Airtel, MTNL, RJIL and VIL average download speeds are 99.63 Mbps, 0.56 Mbps, 185.51 Mbps and 40.86 Mbps respectively. (refer table-9)

   b) Airtel, MTNL, RJIL and VIL average upload speeds are 20.46 Mbps, 0.81 Mbps, 26.63 Mbps and 11.09 Mbps respectively. (refer table-9)

2. **Data download and upload performance (static i.e. while stationary):**
   a) Airtel, MTNL, RJIL and VIL average download speeds are 129.85 Mbps, 0.00 Mbps, 509.86 Mbps and 144.04 Mbps respectively. (refer table-12)

   b) Airtel, MTNL, RJIL and VIL average upload speeds are 38.63 Mbps, 0.00 Mbps, 43.56 Mbps and 17.99 Mbps respectively. (refer table-12)

3. **Data session setup success rate (static i.e. while stationary):**
   a) Airtel, MTNL, RJIL and VIL have 100.00%, 20.00%, 100.00% and 100.00% download session setup success rate respectively. (refer table-12)

b) Airtel, MTNL, RJIL and VIL have 100.00%, 0.00%, 100.00% and 100.00% upload session setup success rate. (refer table-12)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 99.07% call setup success rate and 1.87% drop call rate have been observed for 3G/2G network mode respectively for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-3)

- 96.57% call setup success rate and 1.78% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for LSA. Performance is not meeting the benchmark of 98.00% for call setup success rate while within the benchmark for 2.00% for drop call 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) respectively for hotspot location. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-11)

- 99.07% call setup success rate and 1.87% drop call rate have been observed for 3G/2G network mode respectively for highway 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 for auto-selection mode (5G/4G/3G/2G) respectively for highway drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-17)

- 100.00% call setup success rate and 4.55% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for Mumbai Central to Vasai Road railway drive. Whereas the call setup success rate is within the benchmark of 98.00% and the drop call rate is above the benchmark of 2.00%. (refer table-22)

- 81.82% call setup success rate and 7.41% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for Gateway of India to Elephanta Caves coastal drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-25)

Data

- Airtel has 99.63 Mbps average download throughput & 20.46 Mbps average upload throughput across measured routes for LSA. (refer table-9)

- Airtel has 119.80 Mbps average download throughput & 24.20 Mbps average upload throughput for highway drive. (refer table-21)

- Airtel has 32.63 Mbps average download throughput & 8.15 Mbps average upload throughput across measured routes for Mumbai Central to Vasai Road railway drive. (refer table-24)

- Airtel has 34.82 Mbps average download throughput & 5.20 Mbps average upload throughput across measured routes for Gateway of India to Elephanta Caves coastal drive. (refer table-27)

2. MTNL:

Voice

- 51.59% call setup success rate and 28.40% drop call rate have been observed for 3G/2G network mode respectively for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-3)

- 54.79% call setup success rate and 22.33% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for LSA. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 50.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for hotspot locations. Performance is not meeting the benchmark of 98.00% for call setup success rate while within the benchmark for 2.00% for drop call rate. (refer table-11)

- 51.59% call setup success rate and 28.40% drop call rate have been observed for 3G/2G network mode respectively for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-15)

- 61.74% call setup success rate and 18.31% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for highway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-17)

- 62.50% call setup success rate and 66.67% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for Mumbai Central to Vasai Road railway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-22)

- 30.77% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for Gateway of India to Elephanta Caves coastal drive. Performance is not meeting the benchmark of 98.00% for call setup success rate while within the benchmark for 2.00% for drop call rate. (refer table-25)

Data

- MTNL has 0.56 Mbps average download throughput & 0.81 Mbps average upload throughput across measured routes for LSA. (refer table-9)

- MTNL has 0.61 Mbps average download throughput & 0.91 Mbps average upload throughput for highway drive. (refer table-21)

- MTNL has 0.51 Mbps average download throughput & 0.42 Mbps average upload throughput across measured routes for Mumbai Central to Vasai Road railway drive. (refer table-24)

- MTNL has 0.24 Mbps average download throughput & 0.44 Mbps average upload throughput across measured routes for Gateway of India to Elephanta Caves coastal drive. (refer table-27)

3. RJIL:

Voice

- 98.32% call setup success rate and 4.55% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for LSA. Performance is not meeting the benchmark of 2.00% for drop call 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) respectively for hotspot location. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-11)

- 100.00% call setup success rate and 1.75% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for highway drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-17)

- 95.65% call setup success rate and 9.09% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for Mumbai Central to Vasai Road railway drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-22)

- 93.75% call setup success rate and 13.33% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for Gateway of India to Elephanta Caves coastal drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-25)

Data

- RJIL has 185.51 Mbps average download throughput & 26.63 Mbps average upload throughput across measured routes for LSA. (refer table-9)

- RJIL has 208.39 Mbps average download throughput & 31.10 Mbps average upload throughput for highway drive. (refer table-21)

- RJIL has 142.31 Mbps average download throughput & 19.46 Mbps average upload throughput across measured routes for Mumbai Central to Vasai Road railway drive. (refer table-24)

- RJIL has 30.34 Mbps average download throughput & 2.52 Mbps average upload throughput across measured routes for Gateway of India to Elephanta Caves coastal drive. (refer table-27)

4. VIL:

Voice

- 98.18% call setup success rate and 3.70% drop call rate have been observed for 3G/2G network mode respectively for LSA. Performance is not meeting the benchmark of 2.00% for drop call rate. (refer table-3)

- 97.67% call setup success rate and 1.19% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for LSA. Performance is not meeting the benchmark of 98.00% for call setup success rate while within the benchmark for 2.00% for drop call 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) respectively for hotspot location. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-11)

- 98.18% call setup success rate and 3.70% drop call rate have been observed for 3G/2G network mode respectively for highway drive. Whereas the call setup success rate is within the benchmark of 98.00% and the drop call rate is above the benchmark of 2.00%. (refer table-15)

- 99.10% call setup success rate and 0.91% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for highway drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-17)

- 100.00% call setup success rate and 4.76% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for Mumbai Central to Vasai Road railway drive. Whereas the call setup success rate is within the benchmark of 98.00% and the drop call rate is above the benchmark of 2.00%. (refer table-22)

- 90.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) respectively for Gateway of India to Elephanta Caves coastal drive. Performance is not meeting the benchmark of 98.00% for call setup success rate. (refer table-25)

Data

- VIL has 40.86 Mbps average download throughput & 11.09 Mbps average upload throughput across measured routes for LSA. (refer table-9)

- VIL has 41.92 Mbps average download throughput & 12.12 Mbps average upload throughput for highway drive. (refer table-21)

- VIL has 30.89 Mbps average download throughput & 9.94 Mbps average upload throughput across measured routes for Mumbai Central to Vasai Road railway drive. (refer table-24)

- VIL has 29.38 Mbps average download throughput & 3.72 Mbps average upload throughput across measured routes for Gateway of India to Elephanta Caves coastal drive. (refer table-27)

6. Annexure

6.1 Route wise coverage map

6.1.1 Highway

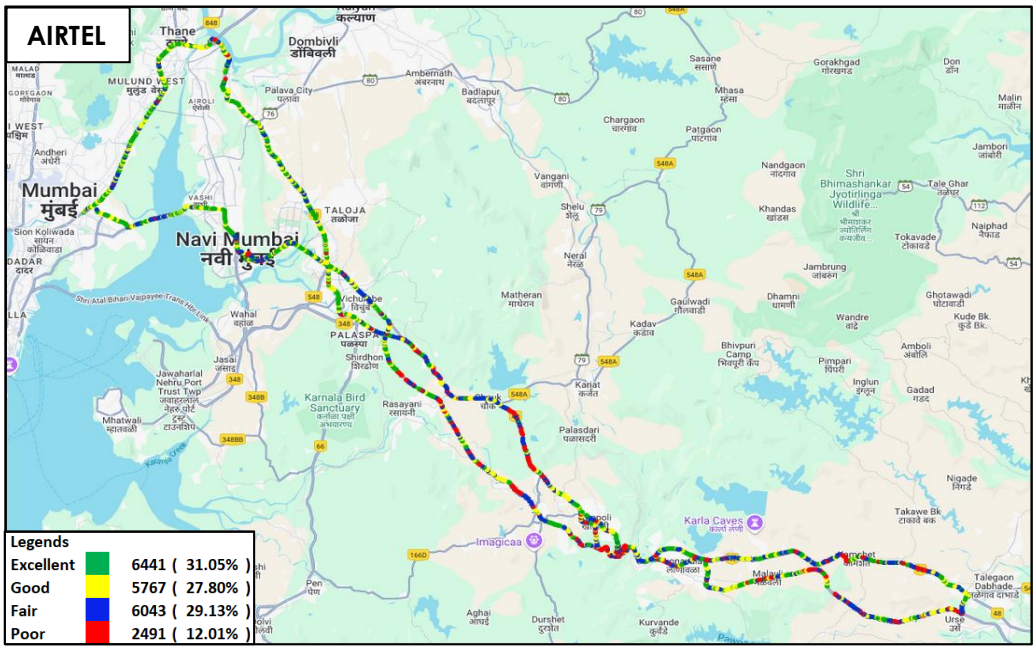


Figure-44: Signal strength 3G/2G network mode – AIRTEL.

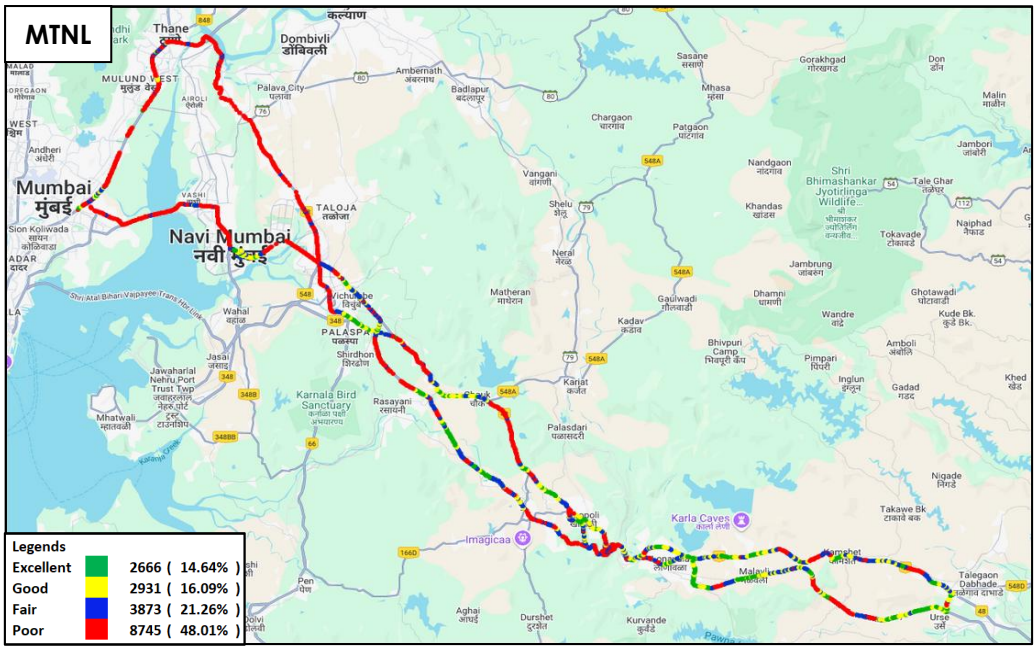


Figure-45: Signal strength 3G/2G network mode – MTNL.

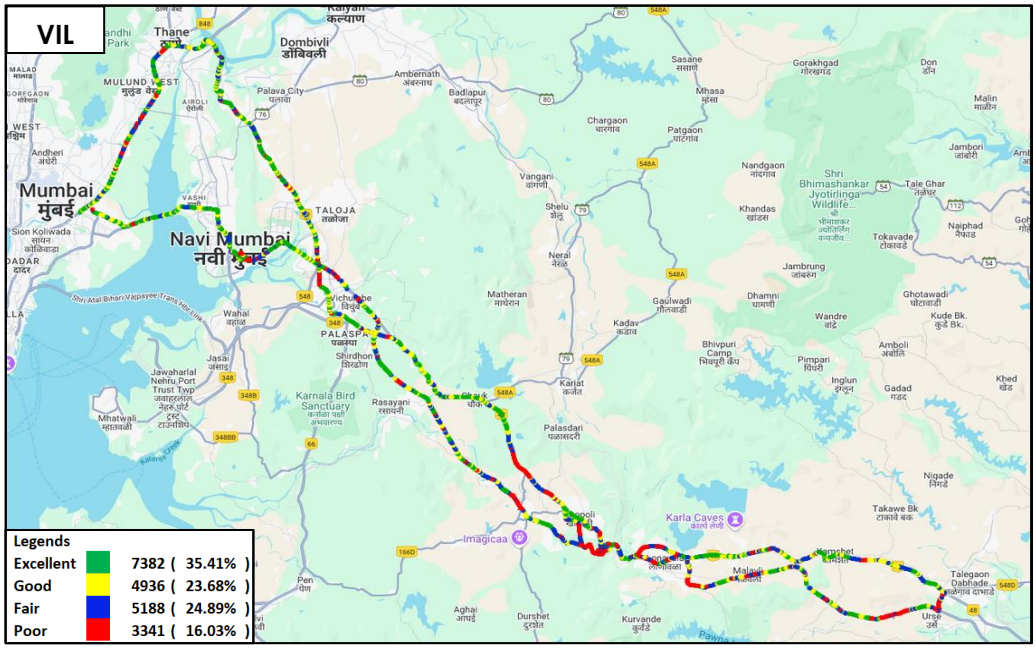


Figure-46: Signal strength 3G/2G network mode – VIL.

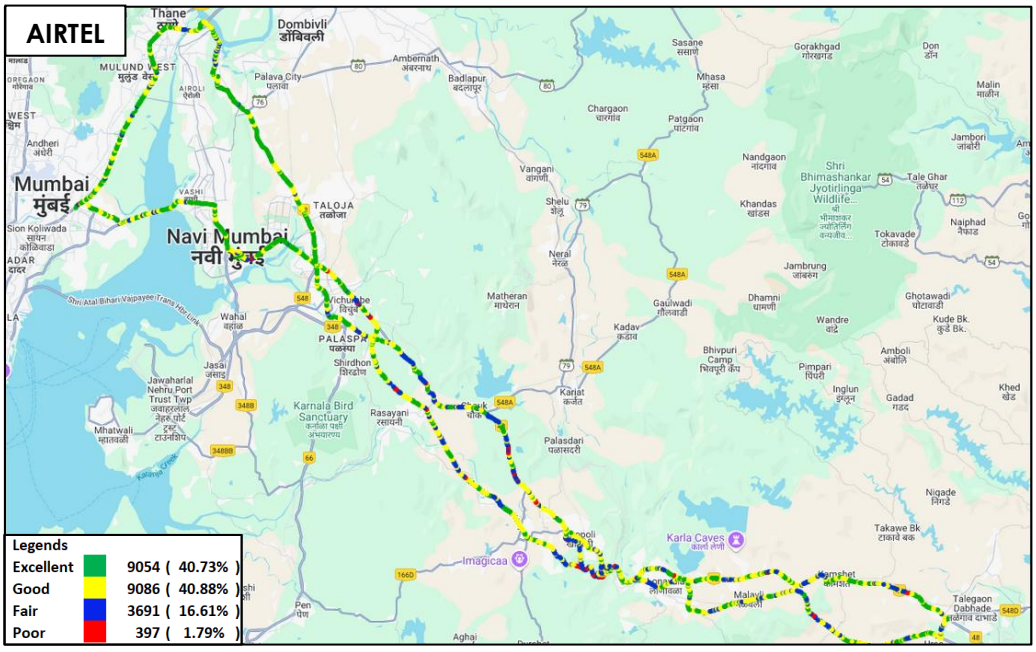


Figure-47: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.

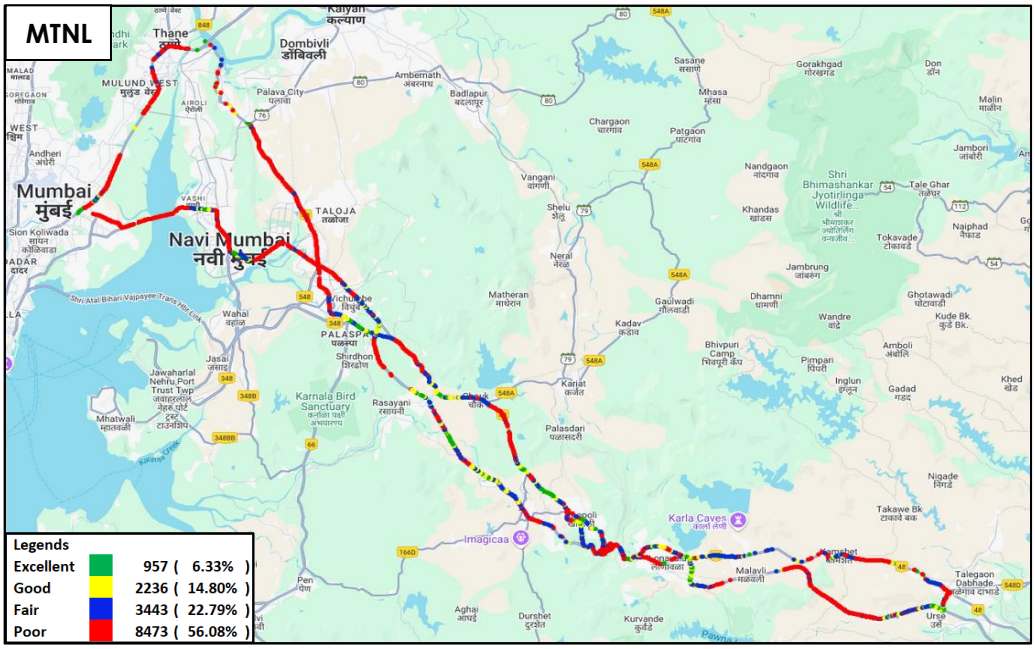


Figure-48: Signal strength auto-selection mode 5G/4G/3G/2G – MTNL.

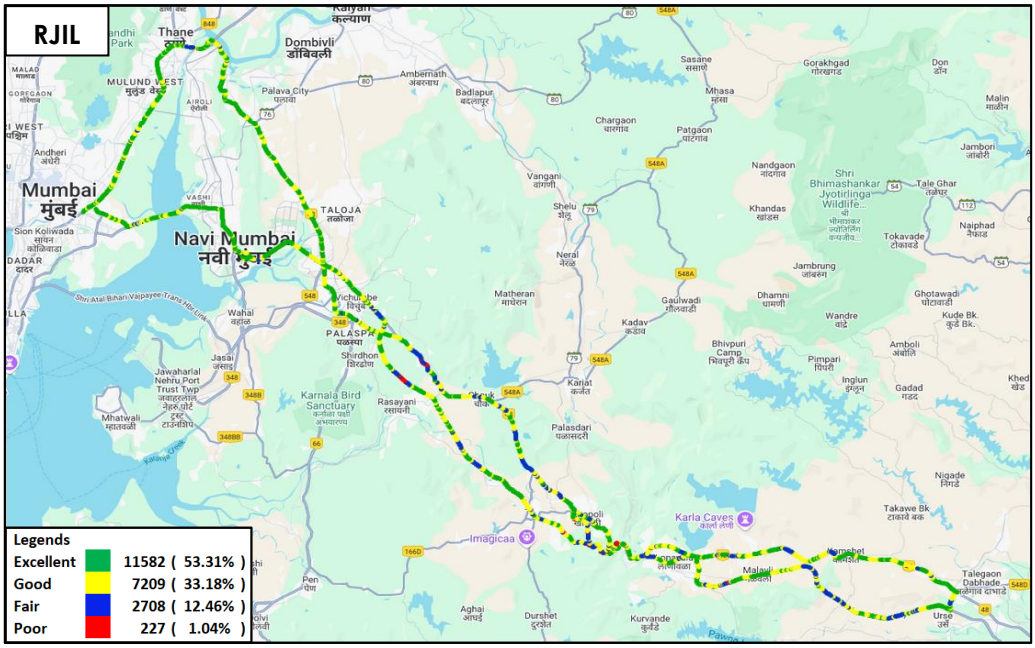


Figure-49: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.

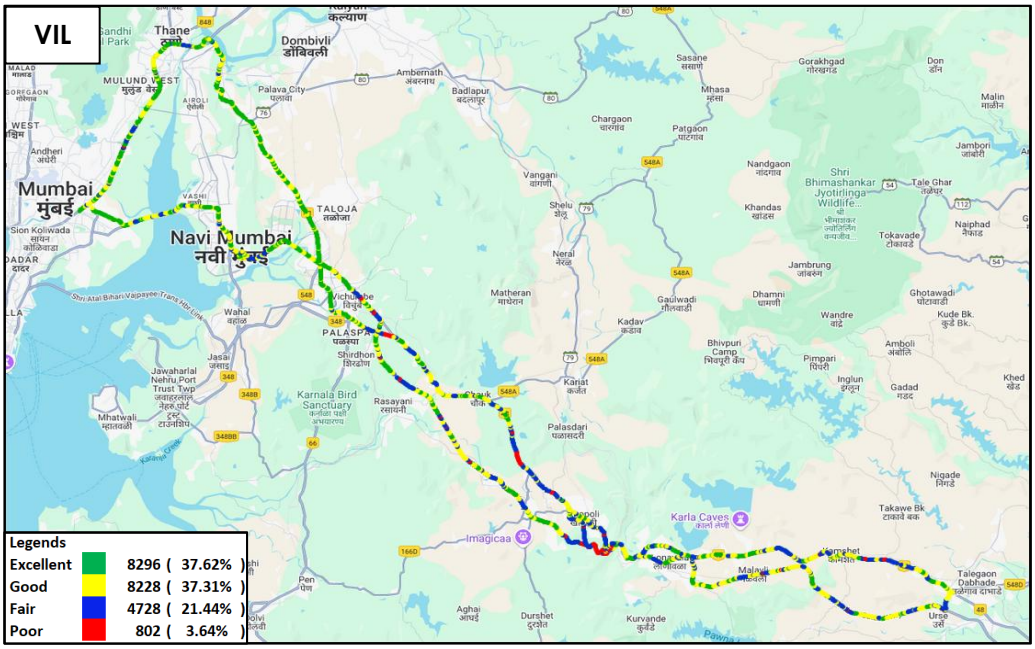


Figure-50: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

6.1.2 Railway

i) Mumbai Central to Vasai Road

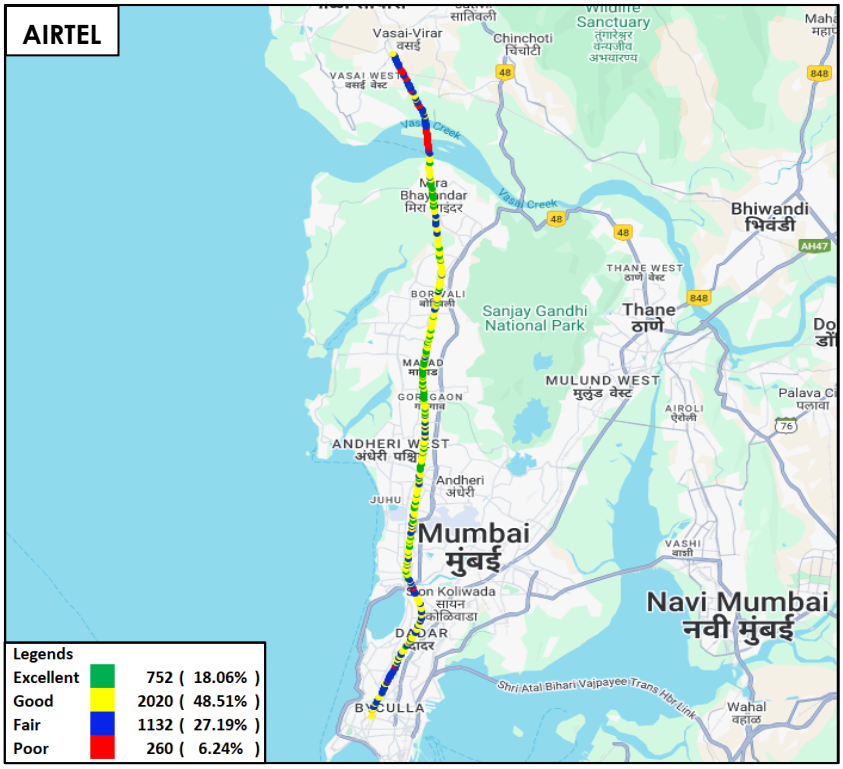


Figure-51: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.

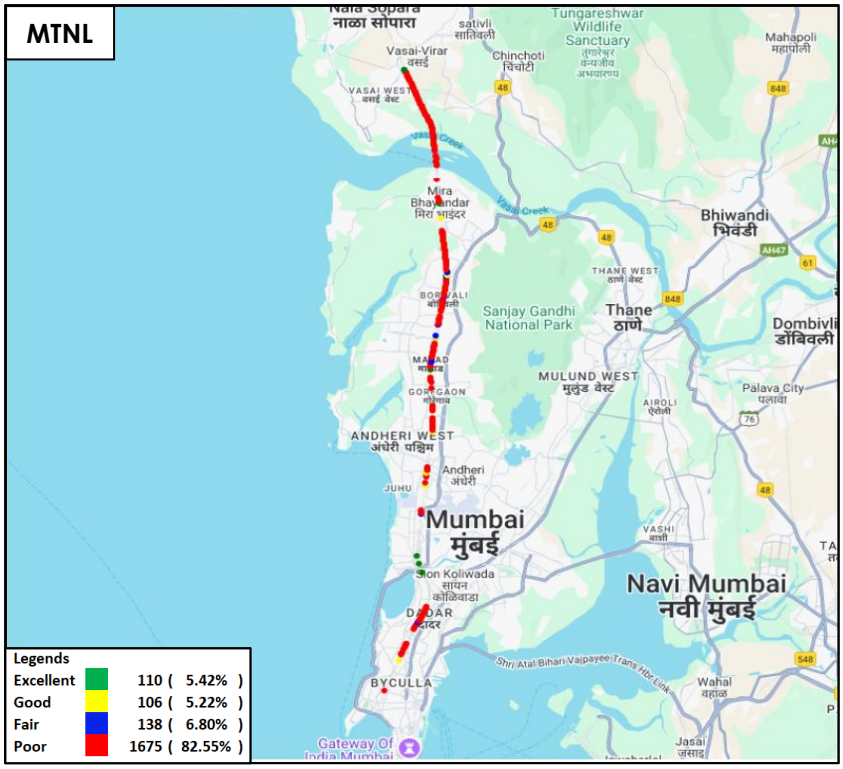


Figure-52: Signal strength auto-selection mode 5G/4G/3G/2G –MTNL

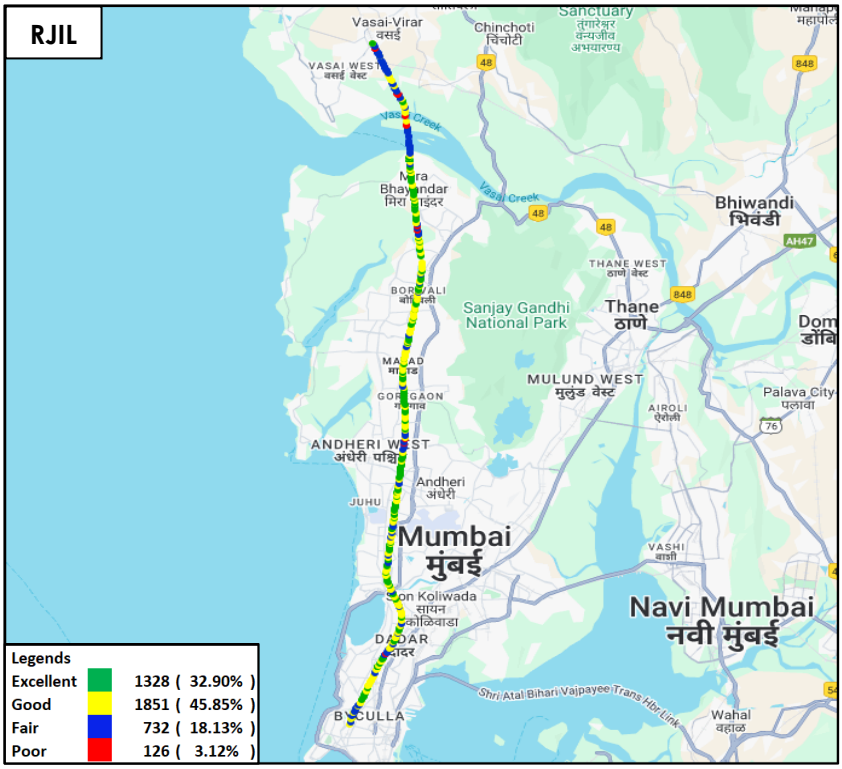


Figure-53: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL

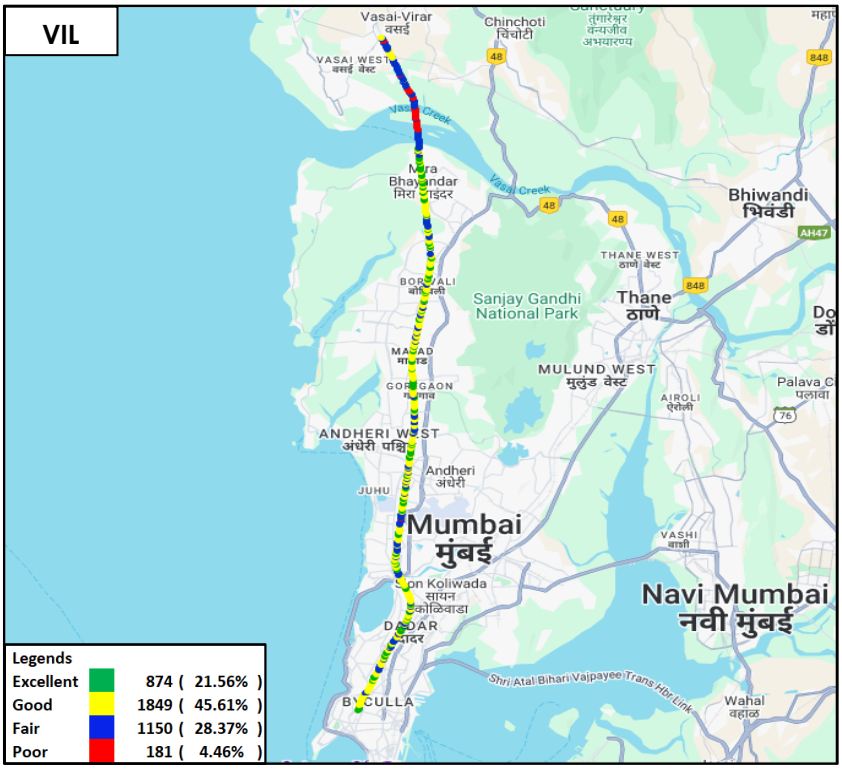


Figure-54: Signal strength auto-selection mode 5G/4G/3G/2G-VIL.

6.1.3 Coastal

i) Gateway of India to Elephanta Caves.

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

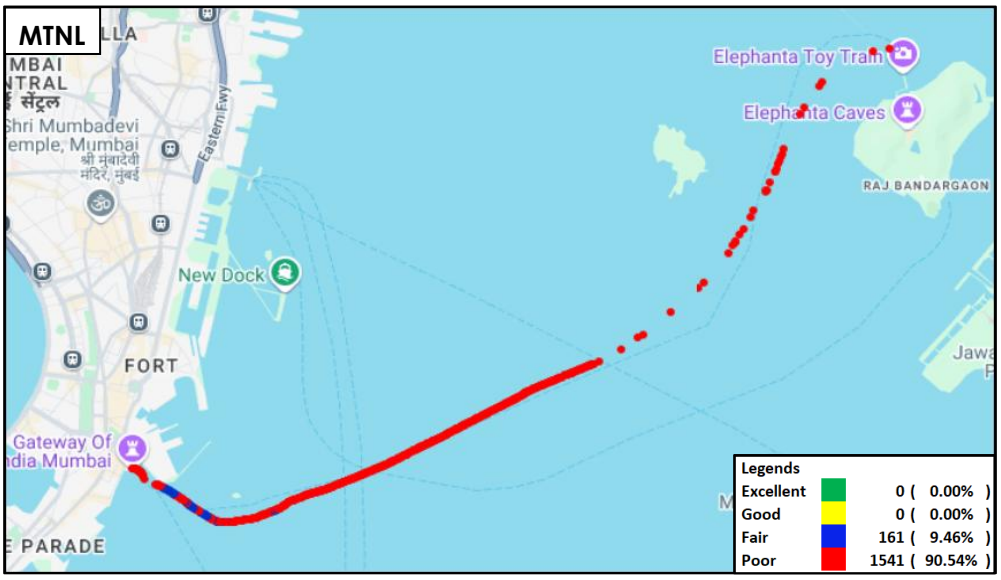


Figure-56: Signal strength auto-selection mode 5G/4G/3G/2G – MTNL.

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

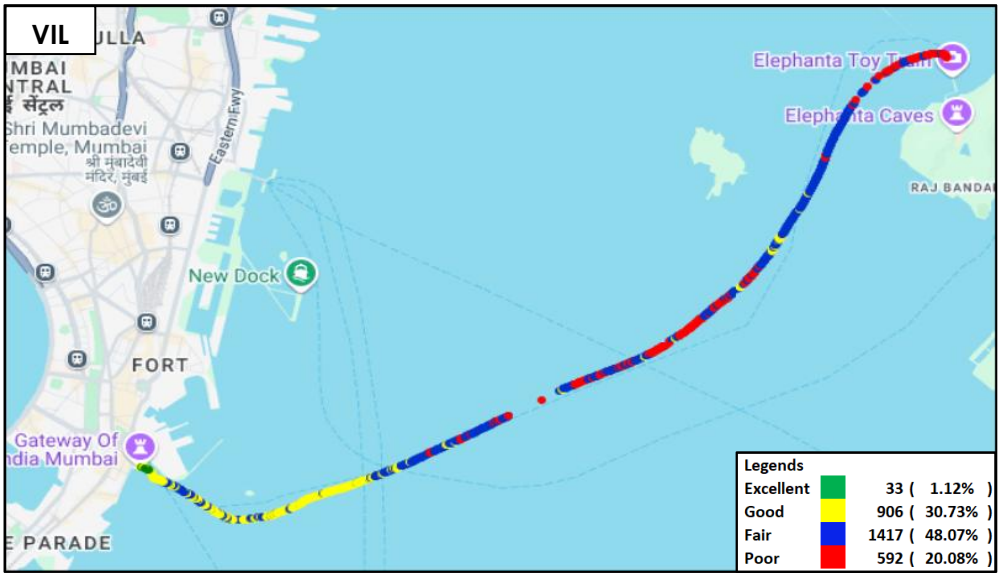


Figure-58: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

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-28: 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.facebook.com, www.amazon.in) 20 sec timeout (only at Hotspot)

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

Table-29: 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, MTNL & RJIL. (Airtel, MTNL & RJIL not provided HTTP server)
- VIL download and upload testing is done on HTTP Server.
- Download & Upload test performed at hotspot locations in 4G/3G/2G auto-selection also.

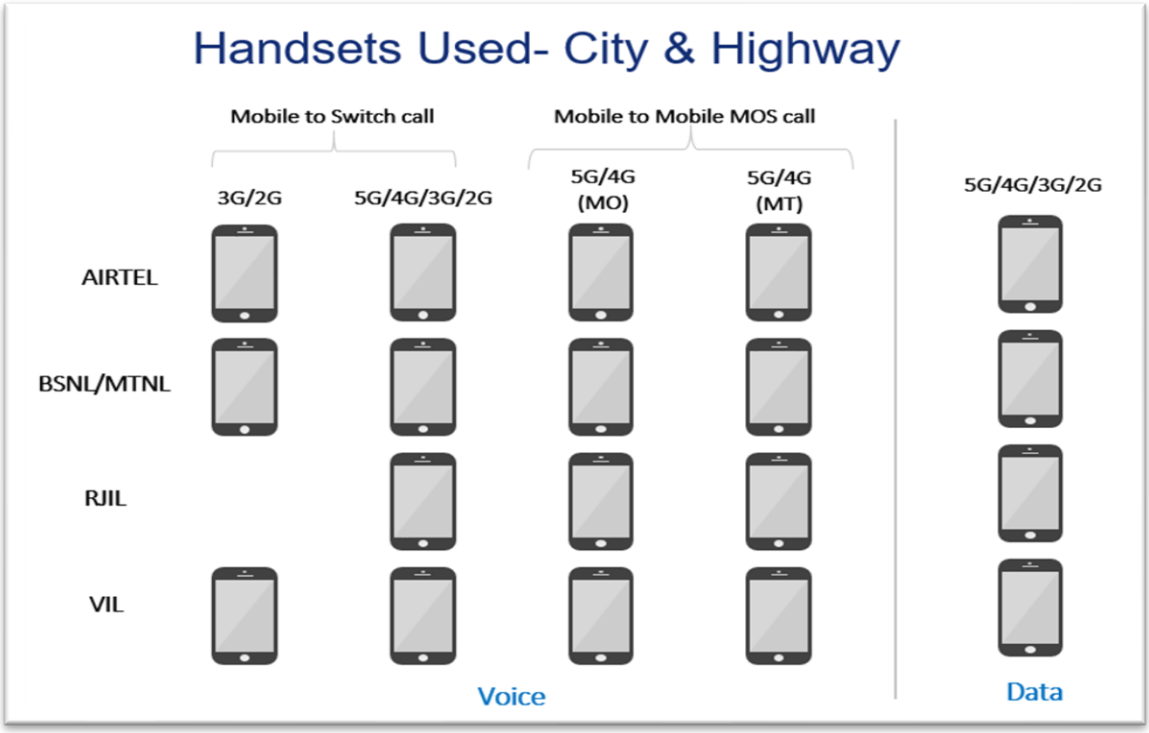


Figure-59: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

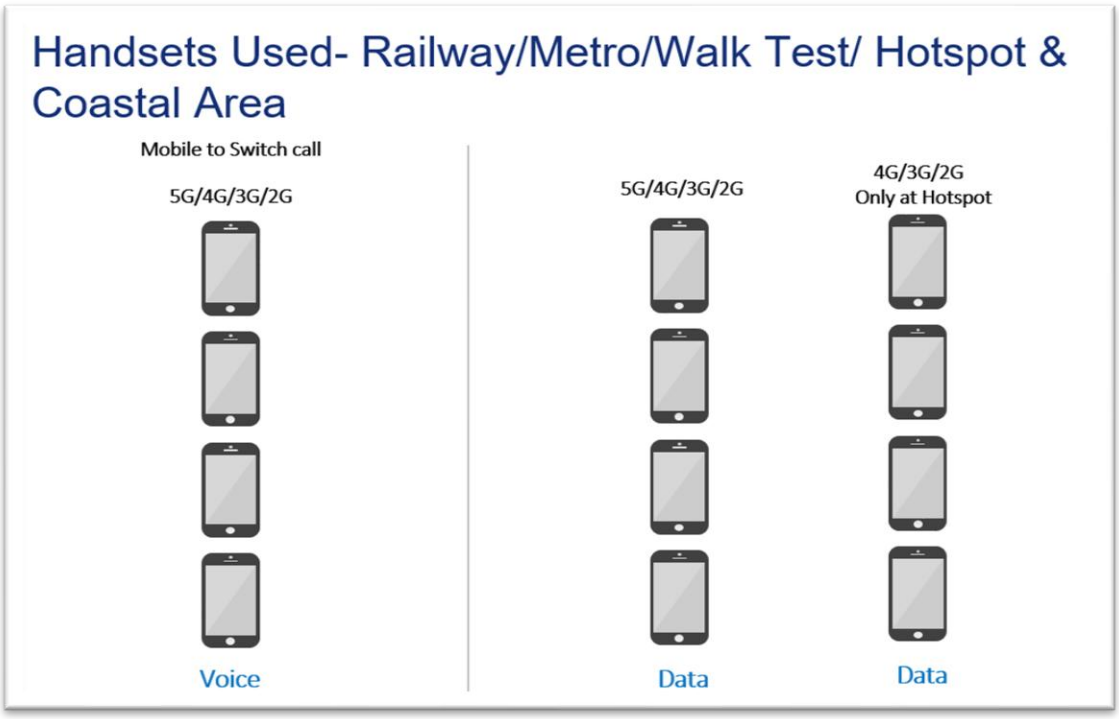


Figure-60: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)

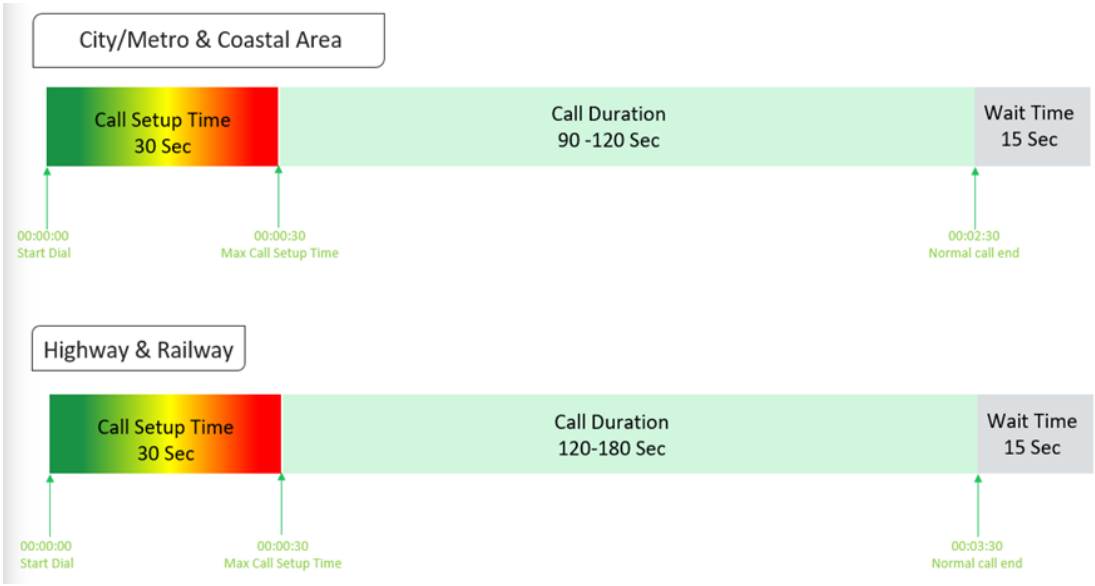


Figure-61: Voice test script for city/railway/metro/highway & coastal area

- 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

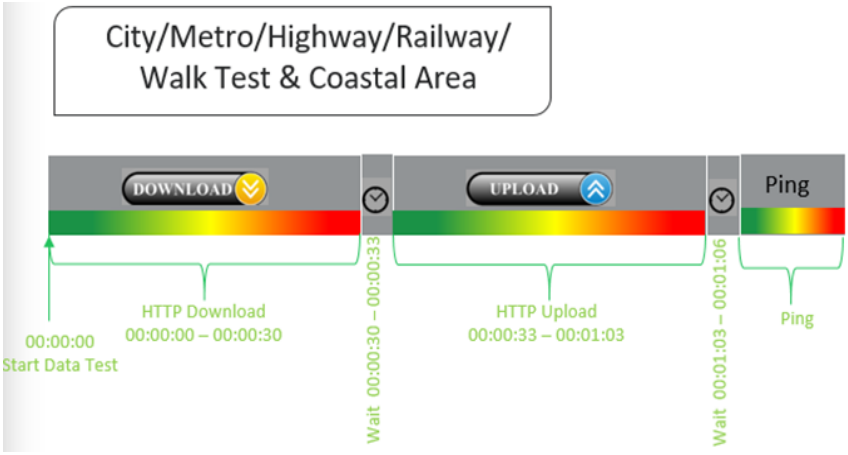


Figure-63: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

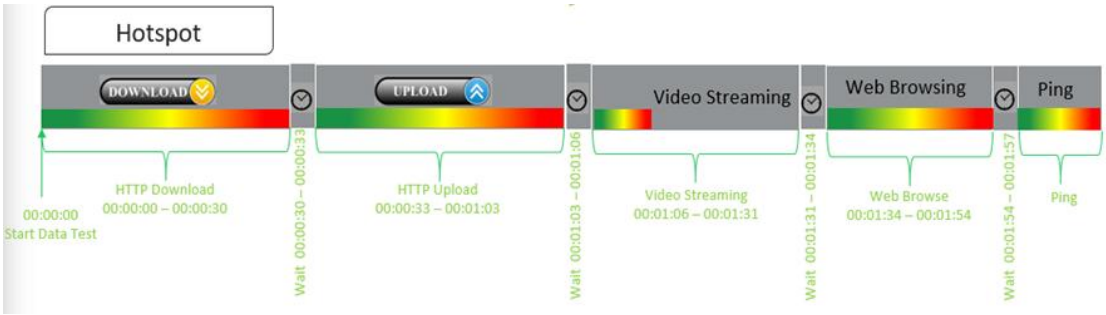


Figure-64: Data test script used at hotspot

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

Table-30: 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-31: 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: 2025.05.01 10:57:14 +05'30'