



**TELECOM REGULATORY AUTHORITY OF INDIA**

*Independent Drive Test Report*

*Maharashtra LSA*

*March 2025*

## Contents

1. Introduction.....	3
2. Executive Summary (LSA) .....	3
2.1 Drive test details .....	3
2.2 Drive test routes .....	4
2.3 Summary of areas covered .....	4
2.4 Telecom service providers detected frequency bands .....	5
2.5 Performance against key QoS parameters .....	5
3. QoS performance analysis-LSA level.....	7
3.1 Overview.....	7
3.2 Voice performance .....	7
3.3 Data performance.....	10
4. Detailed QoS performance analysis .....	12
4.1 Overview.....	12
4.2 City .....	12
4.2.1 Drive test route.....	12
4.2.2 Areas covered .....	12
4.2.3 Voice performance.....	12
4.2.4 Data performance.....	21
4.3 Hotspots .....	23
4.3.1 Locations.....	23
4.3.2 Hotspot covered .....	23
4.3.3 Voice performance.....	24
4.3.4 Data performance (Auto-selection mode 5G/4G/3G/2G) .....	27
4.3.5 Data performance (5G Only & 4G Only Download & Upload Speed) .....	31
4.4 Walk Test .....	35
4.4.1 Drive test route.....	35
4.4.2 Walk Test Covered.....	35
4.4.3 Voice Performance.....	35
4.4.4 Data Performance.....	36
5. Voice & Data Key findings.....	38
5.1 Overall Voice.....	38
5.2 Overall Data .....	38
5.3 Operator wise Key Findings.....	39
6. Annexure .....	43

6.1 Route wise coverage map .....	43
6.1.1 City .....	43
7. Appendix .....	47
7.1 Appendix-I .....	47
7.1.1 Drive test setup .....	47
7.1.2 Drive test Methodology .....	49
7.2 Appendix-II .....	51
7.2.1 Network Performance Parameters for Voice calls .....	51
7.2.2 Network Performance Parameters Data tests .....	52

## 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

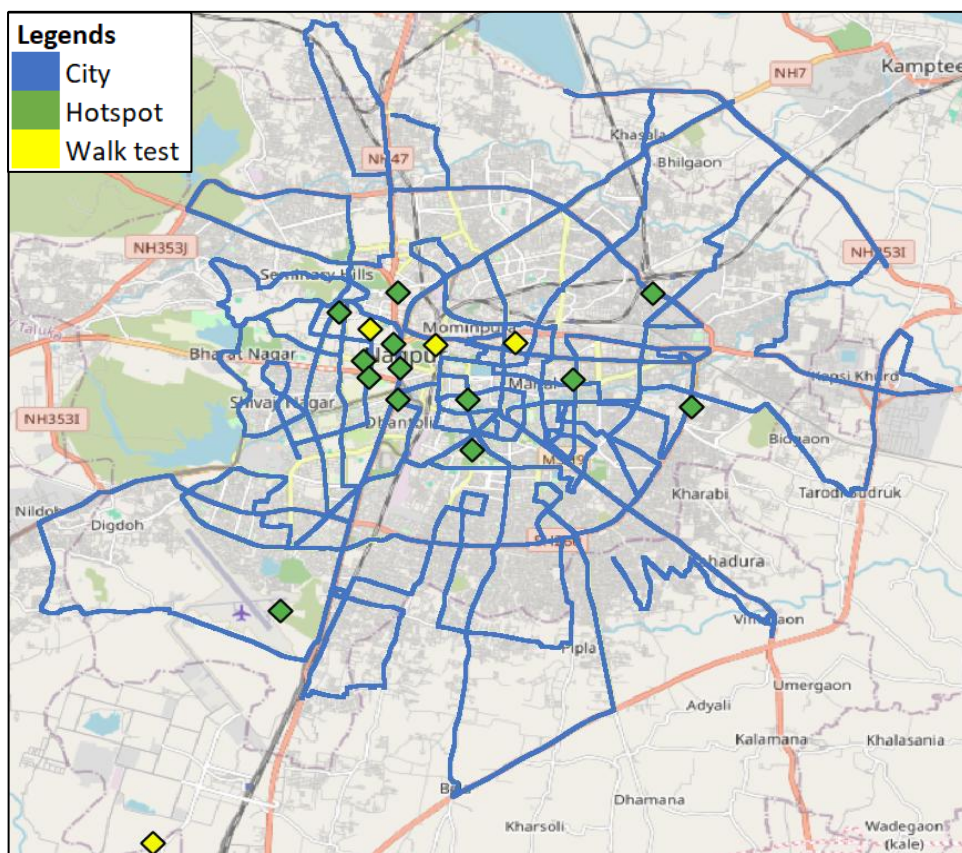
This report covers the findings of the IDT undertaken in Maharashtra License Service Area (LSA) during the month of March-2025 under the supervision of TRAI Regional Office (RO), Bengaluru. Details of route / area covered during the IDT is as given below:

Sl. No	Drive test route	Type of route	Distance covered (KMs)	From date	To date
1	Nagpur	City	338.7	4-March-2025	5-March-2025
2	Nagpur	Hotspot	13 Locations	6-March-2025	7-March-2025
3	Nagpur	Walk Test	9.4	6-March-2025	6-March-2025

**Table-1:** Drive test summary

## 2.2 Drive test routes

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



**Figure-1:** Drive test routes

## 2.3 Summary of areas covered

**a) City-** Nearby Khasala, Bhilgaon, Mominpura, Seminary Hills, Bharat Nagar, Shivaji Nagar, Dhantoli, Digdoh, Mahal, kapsi Khurd, Bahadura etc.

**b) Hotspot-**

1. Nagpur Municipal Corporation (NMC) Headquarters
2. Government Medical College and Hospital (GMCH)
3. Nagpur Bench of Bombay High Court
4. Vidhan Bhavan
5. Nagpur RTO Office
6. ESIC Hospital
7. Sadar Bazaar
8. Nagpur Bus Stand (Ganesh Peth St Stand)
9. Zero Mile Metro Station
10. Swaminarayan Temple
11. Nagpur Airport
12. Maharaj Bagh Zoo
13. Yashwant Stadium

### c) Walk Test-

1. All India Institute of Medical Sciences (AIIMS)
2. Nagpur Railway Station
3. Collector Office
4. Itwari Market

## 2.4 Telecom service providers detected frequency bands

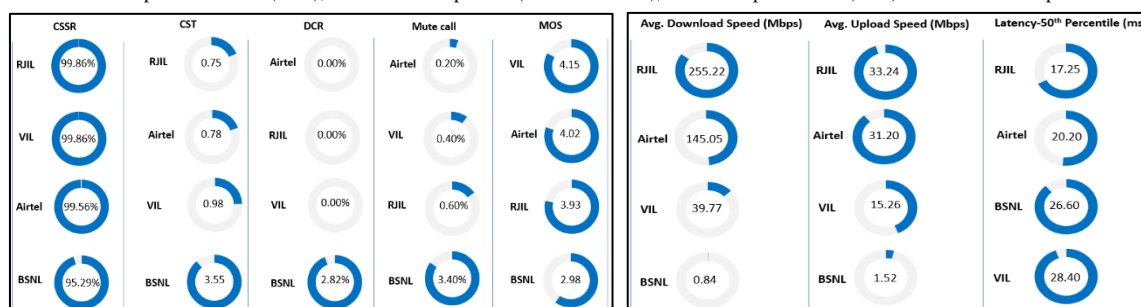
Technologies covered during the IDT and frequency bands in use are summarised in below table

S.no.	Name of TSP	Technology	Frequency Bands (In MHz)
1	Bharti Airtel Ltd.	2G	1800
2	Bharti Airtel Ltd.	4G	850, 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, 2300, 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.



### Summary-Voice Service

**Call Setup Success Rate:** Airtel, BSNL, RJIL and VIL have call setup success rate of 99.56%, 95.29%, 99.86% and 99.86% respectively in Auto-selection mode (5G/4G/3G/2G).

**Call Setup Time:** Airtel, BSNL, RJIL and VIL have call setup time of 0.78, 3.55, 0.75 & 0.98 seconds respectively in Auto-selection mode (5G/4G/3G/2G).

**Drop Call Rate:** Airtel, BSNL, RJIL and VIL have drop call rate of 0.00%, 2.82%, 0.00% and 0.00% respectively in Auto selection mode (5G/4G/3G/2G).

**Call Silence/Mute Rate:** Airtel, BSNL, RJIL and VIL have silence call rate of 0.20%, 3.40%, 0.60% & 0.40% respectively in packet switched network (4G/5G).

**Mean Opinion Score (MOS):** Airtel, BSNL, RJIL and VIL have average MOS score of 4.02, 2.98, 3.93 & 4.15 respectively.

### Summary-Data services

**Data Download performance (Overall):** Average download speed of Airtel (5G/4G) is 145.05 Mbps, BSNL (4G/3G/2G) is 0.84 Mbps, RJIL (5G/4G) is 255.22 Mbps and VIL (4G) is 39.77 Mbps.

**Data Upload performance (Overall):** Average upload speed of Airtel (5G/4G) is 31.20 Mbps, BSNL (4G/3G/2G) is 1.52 Mbps, RJIL (5G/4G) is 33.24 Mbps and VIL (4G) is 15.26 Mbps.

#### Data performance - Hotspots (in Mbps):

Airtel- 4G D/L: 37.92 4G U/L: 11.59  
5G D/L: 228.11 5G U/L: 36.59  
BSNL- 4G D/L: 0.89 4G U/L: 2.31  
RJIL- 4G D/L: 38.88 4G U/L: 13.15  
5G D/L: 317.60 5G U/L: 38.64  
VIL- 4G D/L: 47.91 4G U/L: 22.48

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

## QoS Performance Analysis- Maharashtra LSA

### 3. QoS performance analysis-LSA level

#### 3.1 Overview

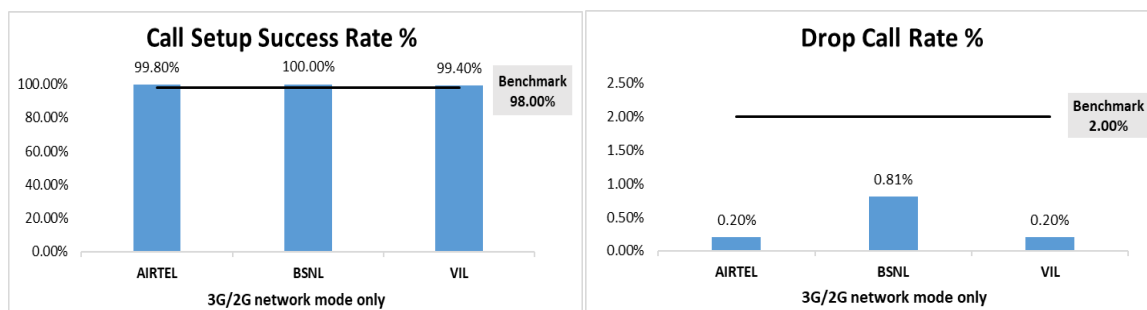
This section provides summary of overall QoS performance of the telecom service provider's network in the LSA by aggregating the results of drive tests conducted in the LSA during the month of March-2025 covering city, hotspots and walk test. (Refer Table 1)

#### 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	491	494	497
Call Setup Success Rate %	99.80	100.00	99.40
Drop Call Rate %	0.20	0.81	0.20
Call Setup Time-Average (Second)	4.70	3.48	3.03
Handover Success Rate %	98.43	99.93	98.16

**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	223	NA
2G	778	180	873

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

**Note-**

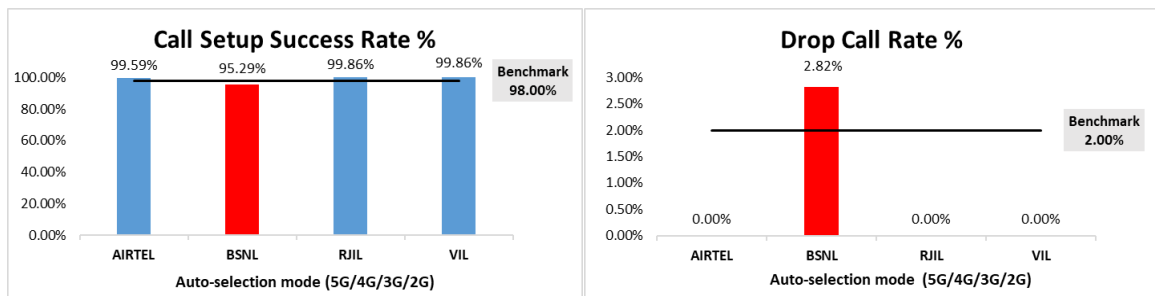
- RJIL does not have 3G/2G network.
- NA- Service provider doesn't provide services in respective technology.



**(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	728	743	732	723
Call Setup Success Rate %	99.59	95.29	99.86	99.86
Drop Call Rate %	0.00	2.82	0.00	0.00
Call Setup Time-Average (Second)	0.78	3.55	0.75	0.98
Handover Success Rate %	99.93	99.74	99.83	100.00

**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)	504	500	503	504
Number of silence call for >4 Sec	1	17	3	2
Silence Call Rate %	0.20	3.40	0.60	0.40
Number of silence instances for >4 Sec	1	19	3	3
Number of silence instances for >3 Sec	1	24	4	8
Number of silence instances for >2 sec	6	42	20	20
RTP Jitter (4G & 5G) in ms	4.62	9.81	7.62	3.89
Packet loss Rate Downlink %	0.20	3.73	0.17	0.42
Packet loss Rate Uplink %	0.26	2.43	0.32	0.46

**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 Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
5G	0	NA	637	NA
4G	1405	366	2102	1348
3G	NA	145	NA	NA
2G	0	96	NA	4

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

**Note-**

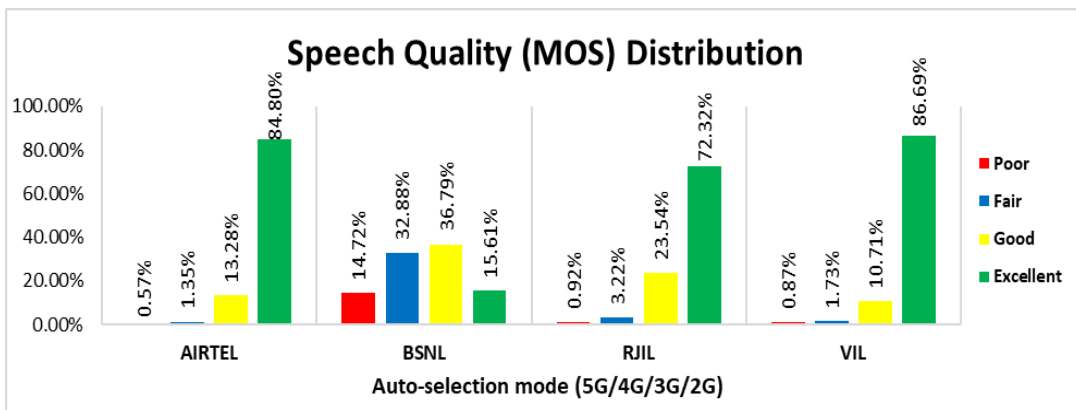
- NA- Service provider doesn't provide services in respective technology.
- 0- No cell Id's were found in respective technology.

**(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	2960	2588	2948	2998
Speech Quality (Average MOS Score)	4.02	2.98	3.93	4.15
Number of samples with MOS $\geq 4$ to $< 5$ (Excellent)	2510	404	2132	2599
Number of samples with MOS $\geq 3$ to $< 4$ (Good)	393	952	694	321
Number of samples with MOS $\geq 2$ to $< 3$ (Fair)	40	851	95	52
Number of samples with MOS $\geq 1$ to $< 2$ (Poor)	17	381	27	26
%age of samples with MOS $\geq 4$ to $< 5$ (Excellent)	84.80%	15.61%	72.32%	86.69%
%age of samples with MOS $\geq 3$ to $< 4$ (Good)	13.28%	36.79%	23.54%	10.71%
%age of samples with MOS $\geq 2$ to $< 3$ (Fair)	1.35%	32.88%	3.22%	1.73%
%age of samples with MOS $\geq 1$ to $< 2$ (Poor)	0.57%	14.72%	0.92%	0.87%

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



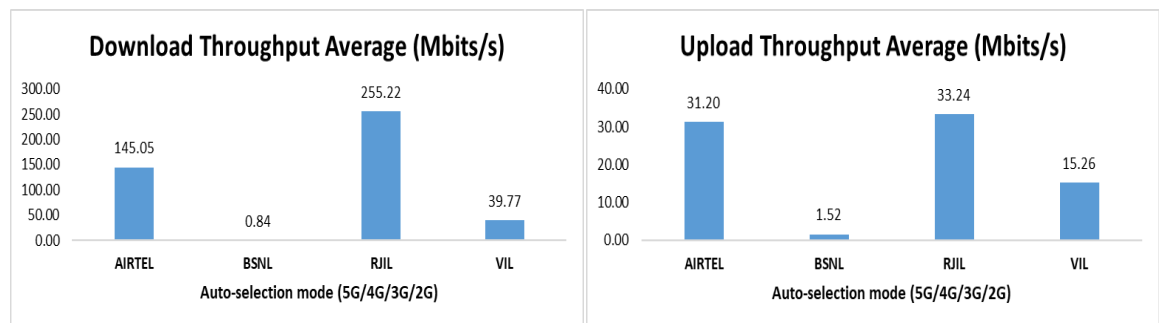
**Figure- 4:** Distribution of samples in MOS score range.

### 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	145.05	0.84	255.22	39.77
	80th Percentile	230.46	1.26	408.06	62.02
	20th Percentile	39.77	0.32	67.82	13.46
Upload Throughput (Mbits/s)	Average	31.20	1.52	33.24	15.26
	80th Percentile	55.27	2.14	61.04	23.66
	20th Percentile	7.51	0.78	6.86	5.93
Latency (ms)	50th Percentile	20.20	26.60	17.25	28.40

**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	901	NA
4G	1463	225	261	1354
3G	NA	198	NA	NA
2G	0	26	NA	0

**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

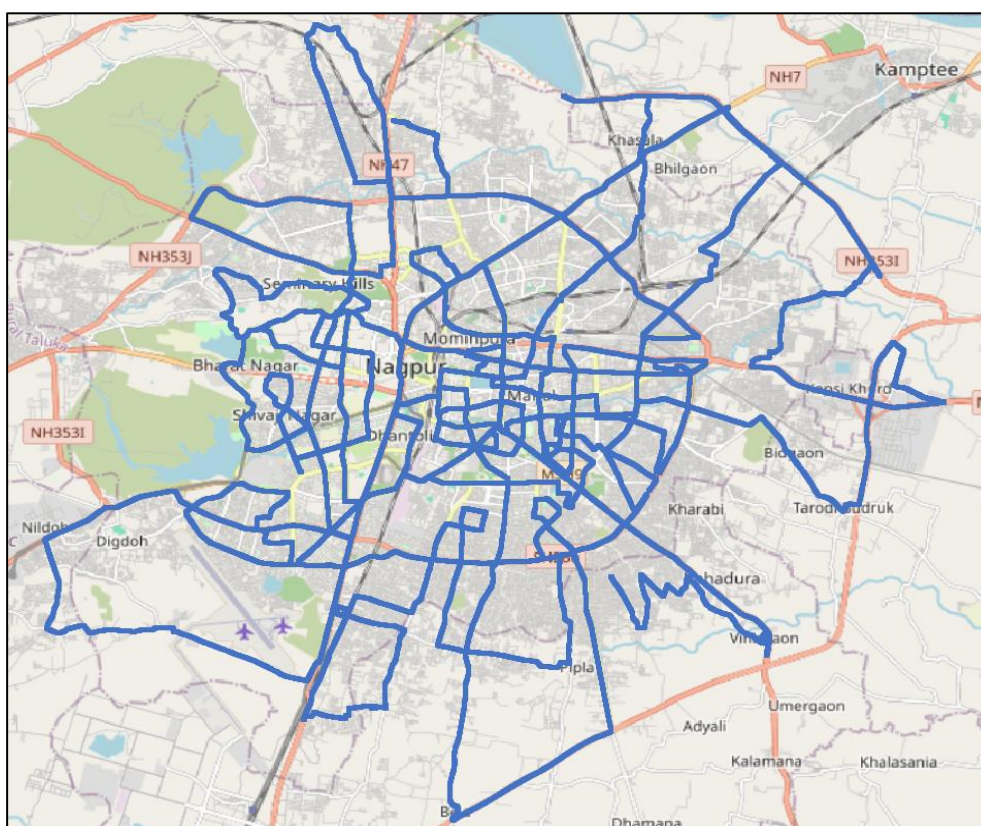
### 4.1 Overview

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

### 4.2 City

Drive test has been conducted on 4<sup>th</sup> March 2025 and 5<sup>th</sup> March 2025 in Nagpur. (Refer Table-1)

#### 4.2.1 Drive test route



**Figure- 6:** Drive test routes

#### 4.2.2 Areas covered

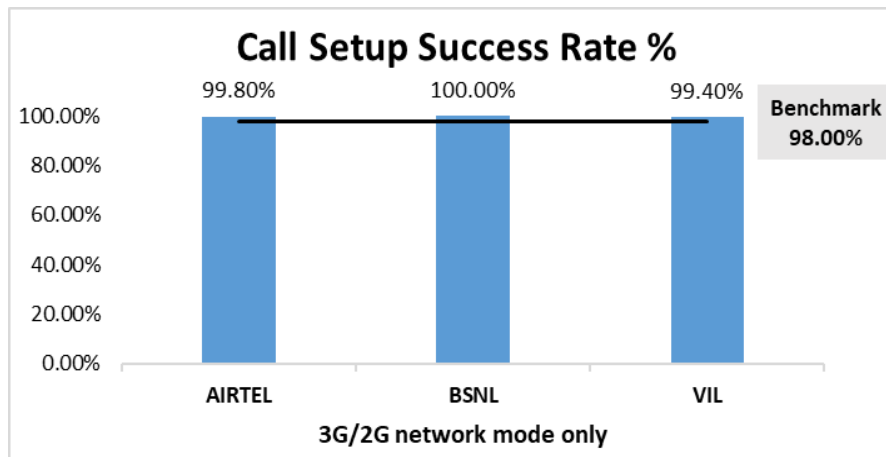
Nearby Khasala, Bhilgaon, Mominpura, Seminary Hills, Bharat Nagar, Shivaji Nagar, Dhanoli, Digdoh, Mahal, kapsi Khurd, Bahadura etc.

#### 4.2.3 Voice performance

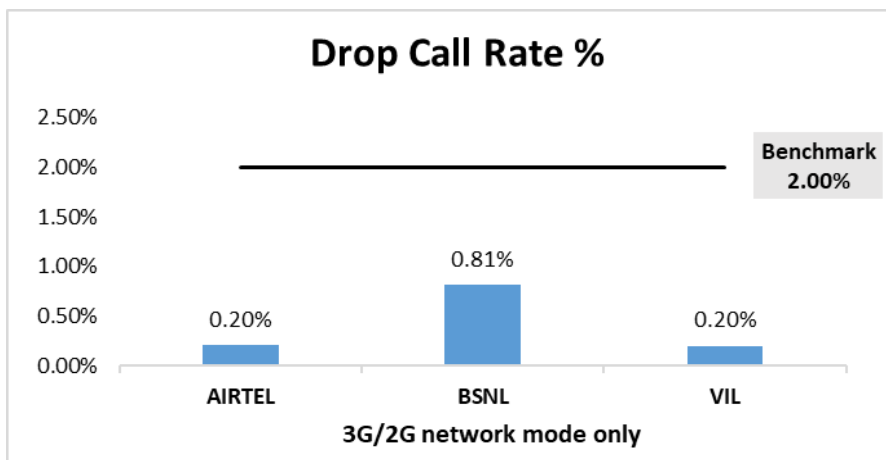
**(a) Voice Call Performance in 3G/2G network mode only:** 3G/2G network mode testing has been done to reflect experience for respective users as they have only 3G/2G compatible handsets.

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	491	494	497
Call Setup Success Rate %	99.80	100.00	99.40
Drop Call Rate %	0.20	0.81	0.20
Call Setup Time-Average (Second)	4.70	3.48	3.03
Handover Success Rate %	98.43	99.93	98.16

**Table-11:** Summary of voice call performance in 3G/2G network mode only.



**Figure-7:** Performance for call setup success rate.



**Figure-8:** Performance for drop call rate.

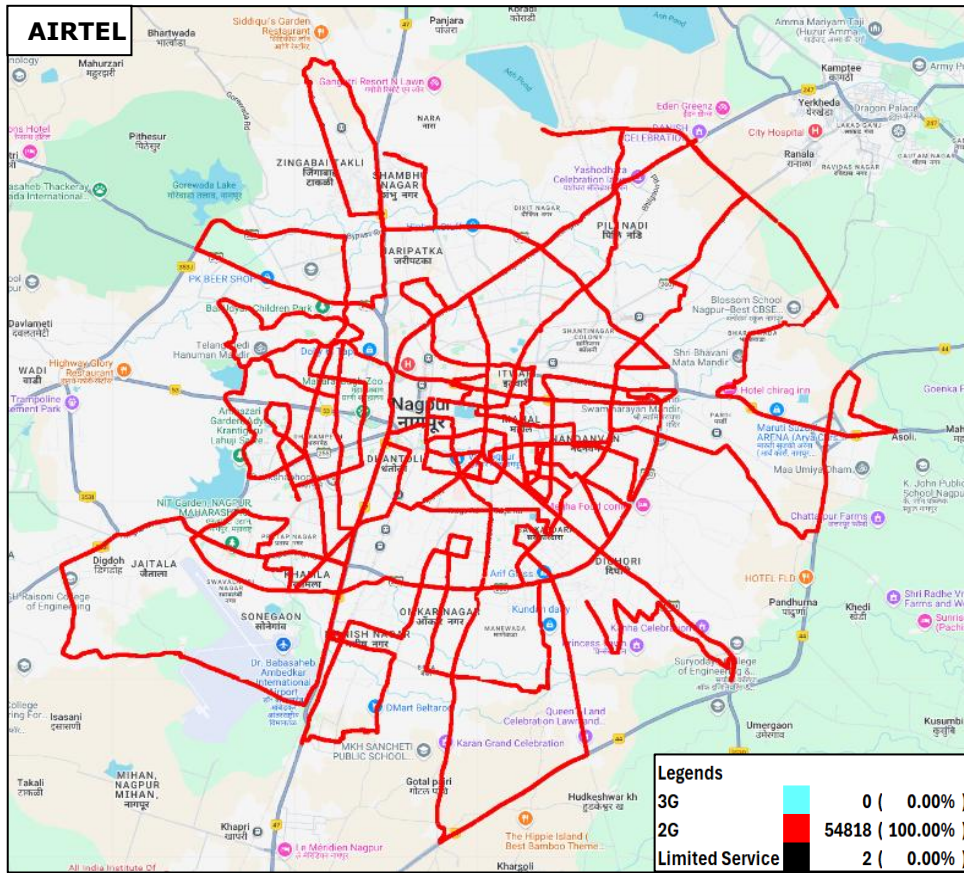
**(b) Network Technology:** This section represent time spent on various network technologies.

Technology	Service Provider		
	AIRTEL	BSNL	VIL
3G	NA	64.52%	NA
2G	100.00%	35.48%	99.98%
Limited Service	0.00%	0.00%	0.02%

**Table-12:** Time spent on technology during drive test 3G/2G network mode.

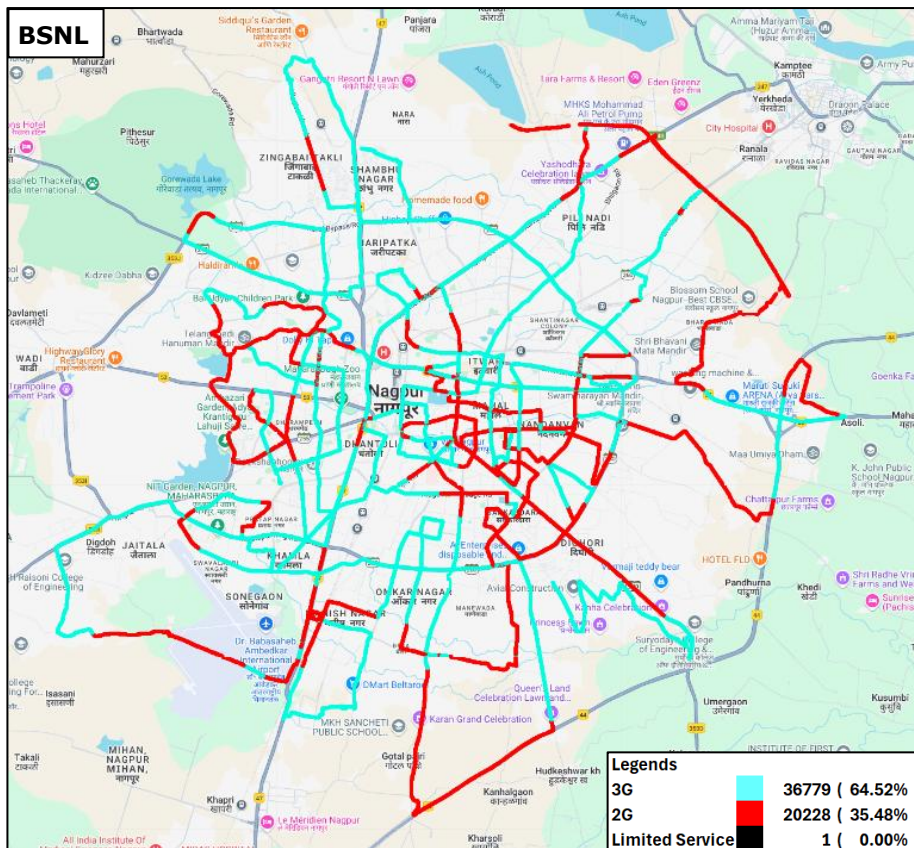
**Note-**

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

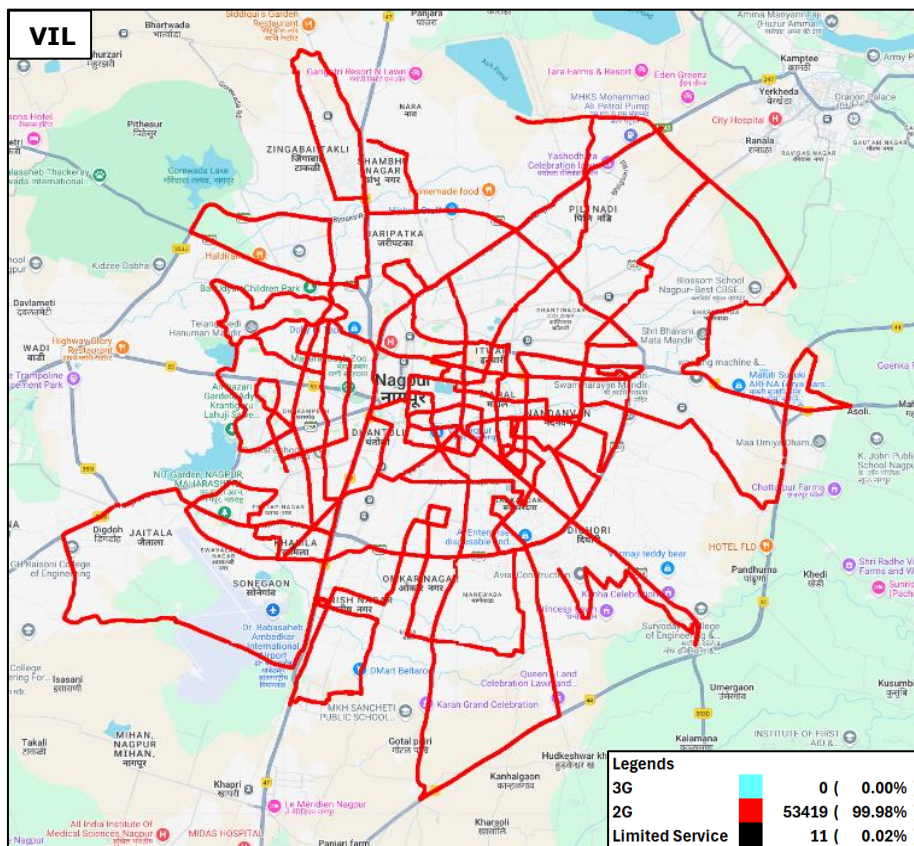


**Figure-9:** Serving technology plots 3G/2G network mode – AIRTEL.





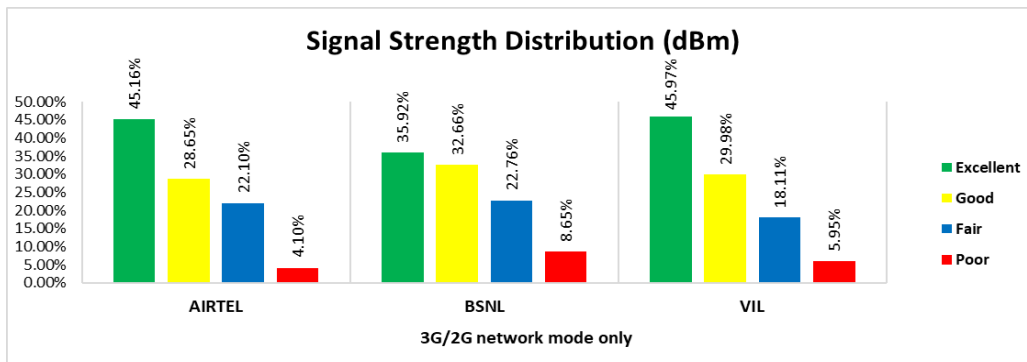
**Figure-10:** Serving technology plots 3G/2G network mode –BSNL.



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



**(c) Network Signal Strength Distribution:** The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 25, 26 & 27 for map view)



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

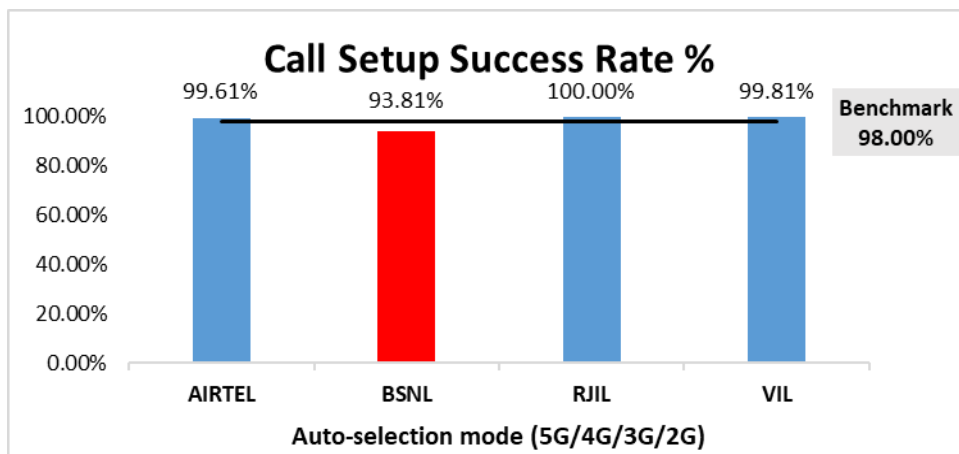
**Observations:**

- Airtel has 45% of samples falling in the excellent signal strength category.
- BSNL has 36% of samples falling in the excellent signal strength category.
- VIL has 46% of samples falling in the excellent signal strength category.

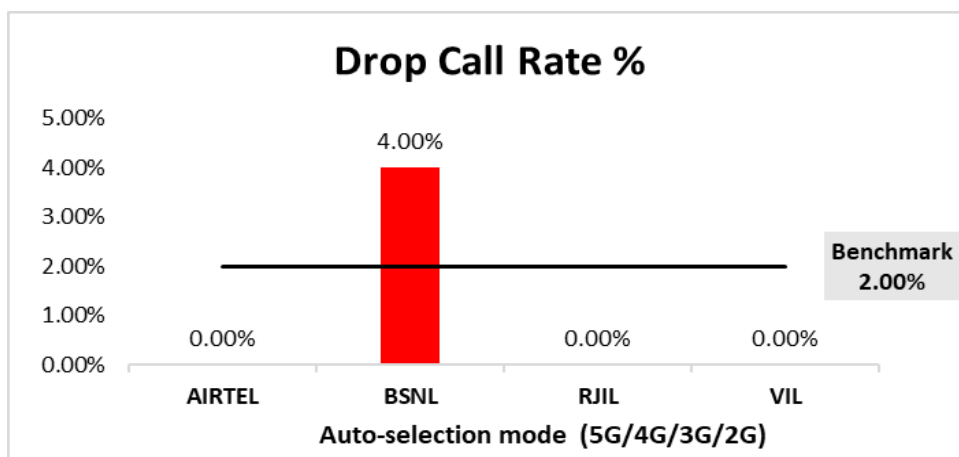
**(d) Voice Call Performance in auto network selection mode (5G/4G/3G/2G)**

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	517	533	521	515
Call Setup Success Rate %	99.61	93.81	100.00	99.81
Drop Call Rate %	0.00	4.00	0.00	0.00
Call Setup Time Average (Second)	0.75	2.57	0.80	1.01
Handover Success Rate %	99.96	99.72	99.80	100.00

**Table-13:** Summary of voice call performance in network auto-selection mode.



**Figure-13:** Performance for call setup success rate.



**Figure-14:** Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
<b>Call Established (within service provider Network)</b>	504	500	503	504
<b>Number of silence call for &gt;4 Sec</b>	1	17	3	2
<b>Silence Call Rate %</b>	0.20	3.40	0.60	0.40
<b>Number of silence instances for &gt;4 Sec</b>	1	19	3	3
<b>Number of silence instances for &gt;3 Sec</b>	1	24	4	8
<b>Number of silence instances for &gt;2 sec</b>	6	42	20	20
<b>RTP Jitter (4G &amp; 5G) in ms</b>	4.62	9.81	7.62	3.89
<b>Packet loss Rate Downlink %</b>	0.20	3.73	0.17	0.42
<b>Packet loss Rate Uplink %</b>	0.26	2.43	0.32	0.46

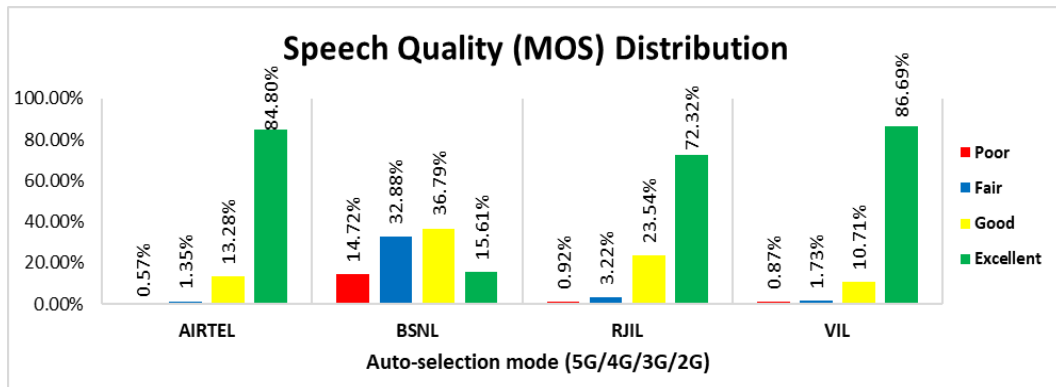
**Table-14:** Summary of silence instances & packet loss rate for mobile to mobile call.

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-16	2960	2588	2948	2998
Speech Quality (Average MOS Score)	4.02	2.98	3.93	4.15
Number of samples with MOS $\geq 4$ to $< 5$ (Excellent)	2510	404	2132	2599
Number of samples with MOS $\geq 3$ to $< 4$ (Good)	393	952	694	321
Number of samples with MOS $\geq 2$ to $< 3$ (Fair)	40	851	95	52
Number of samples with MOS $\geq 1$ to $< 2$ (Poor)	17	381	27	26
%age of samples with MOS $\geq 4$ to $< 5$ (Excellent)	84.80%	15.61%	72.32%	86.69%
%age of samples with MOS $\geq 3$ to $< 4$ (Good)	13.28%	36.79%	23.54%	10.71%
%age of samples with MOS $\geq 2$ to $< 3$ (Fair)	1.35%	32.88%	3.22%	1.73%
%age of samples with MOS $\geq 1$ to $< 2$ (Poor)	0.57%	14.72%	0.92%	0.87%

**Table-15:** Summary of speech quality (MOS) samples



**Figure-15:** Distribution of samples in MOS score range.

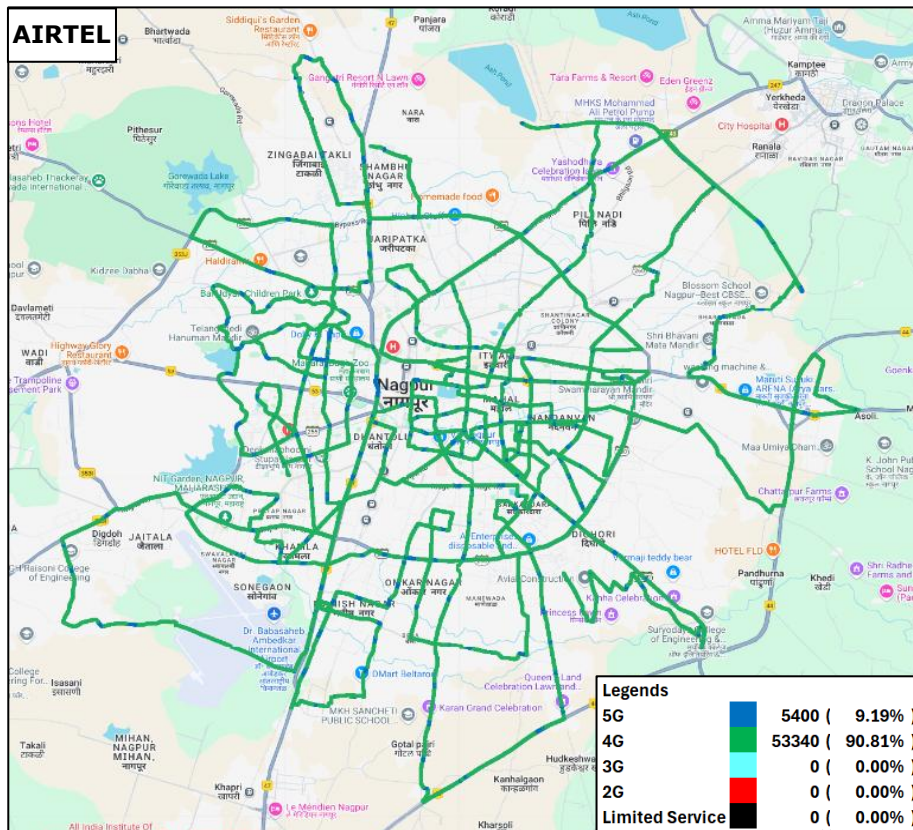
**(f) Network Technology:** This section represent time spent on various network technologies.

Technology	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
5G	9.19%	NA	17.78%	NA
4G	90.81%	47.18%	82.21%	99.73%
3G	NA	43.93%	NA	NA
2G	0.00%	8.64%	NA	0.27%
Limited Service	0.00%	0.25%	0.01%	0.00%

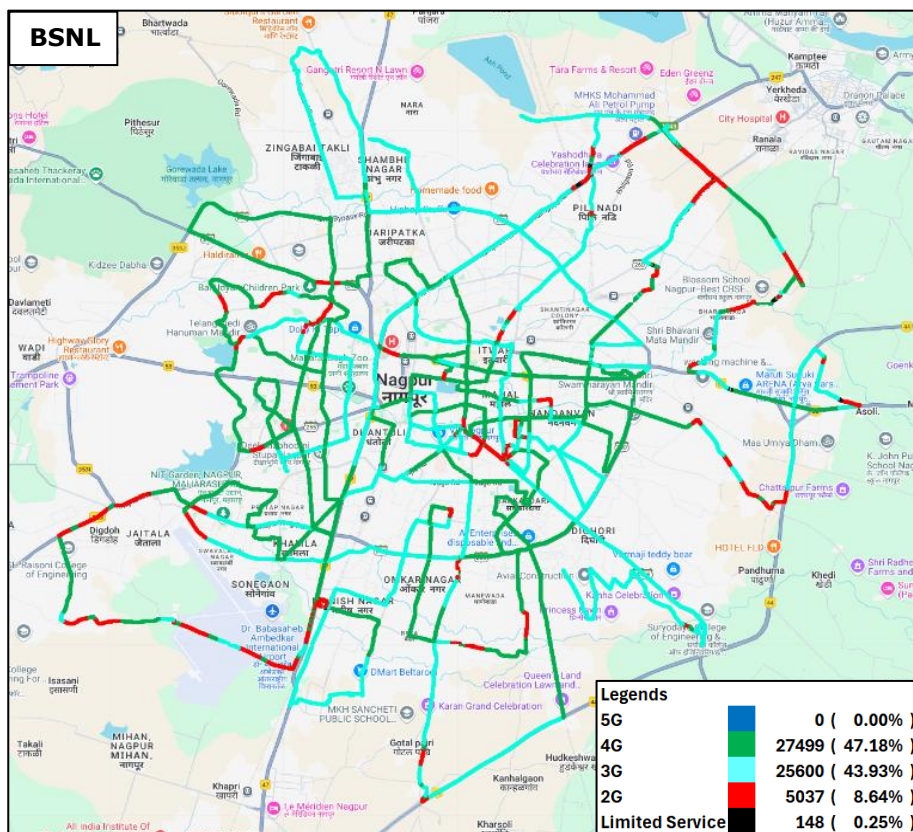
**Table-16:** Time spent on technology during drive test.

**Note-**

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

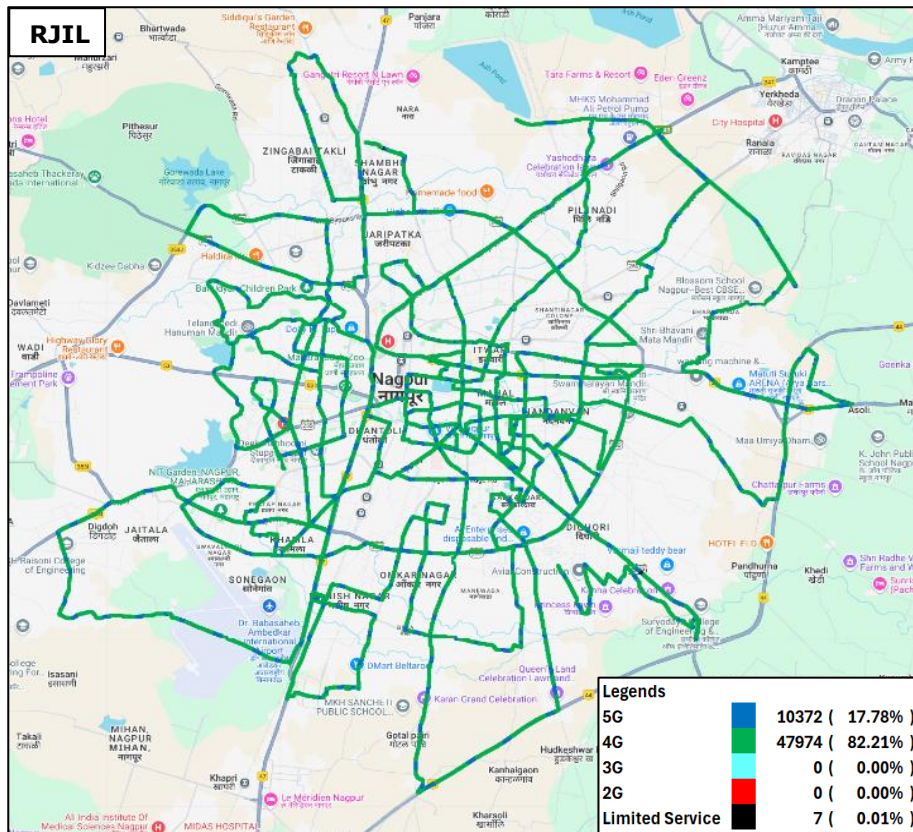


**Figure-16:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) -AIRTEL.

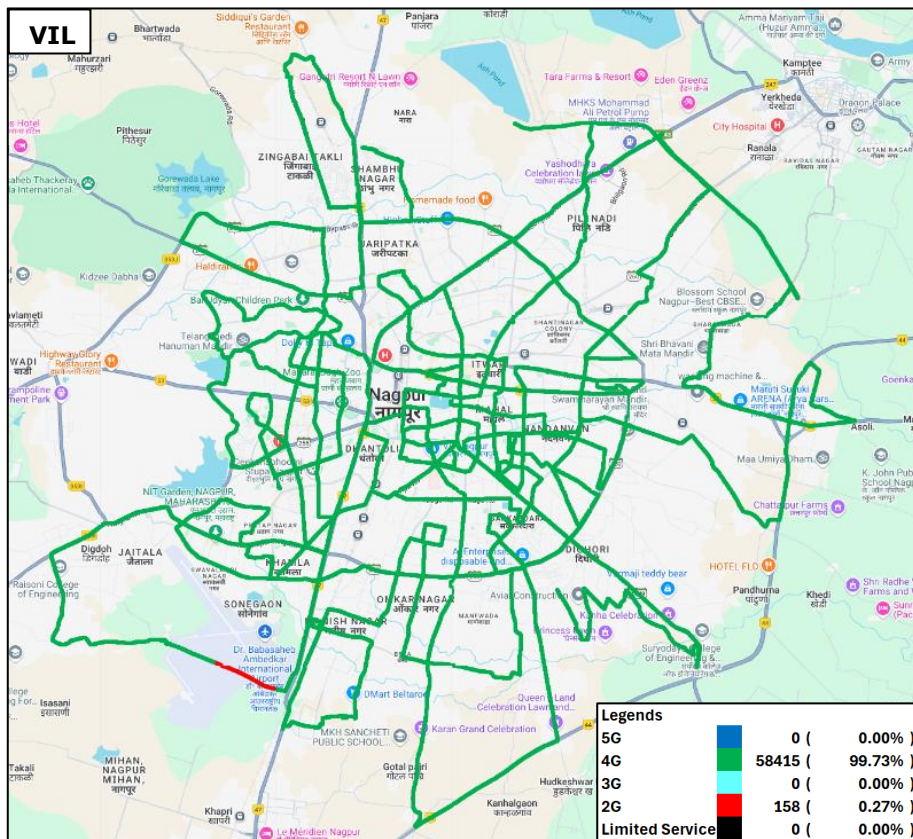


**Figure-17:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) -BSNL.



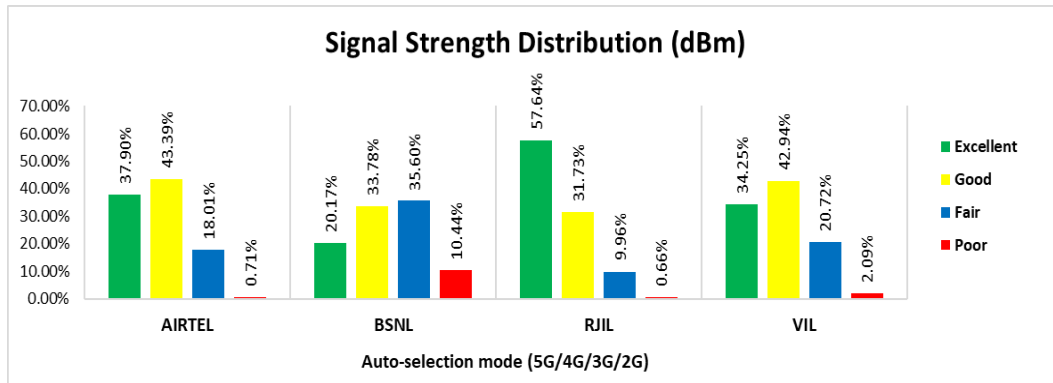


**Figure-18:** Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL.



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

**(g) Network Signal Strength Distribution:** The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-28, 29, 30 & 31 for map view)



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

**Observations:**

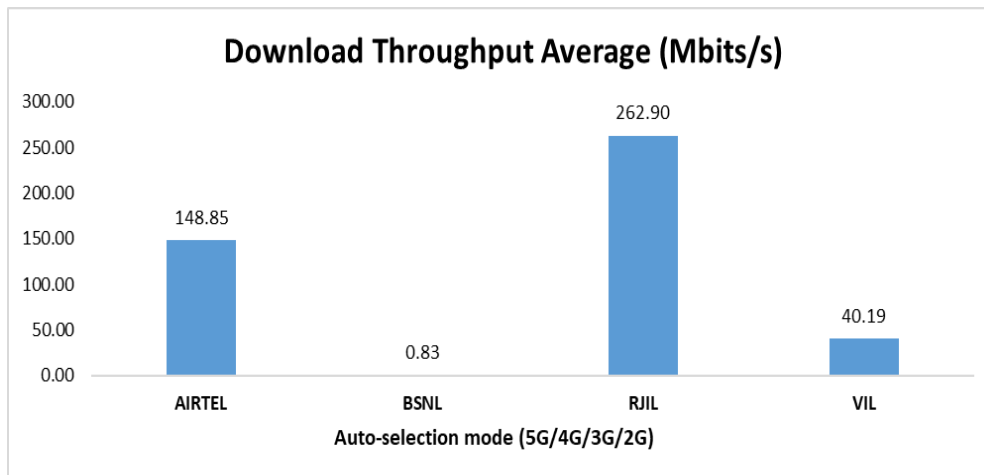
- Airtel has 38% samples falling in the excellent signal strength category.
- BSNL has 20% samples falling in the excellent signal strength category.
- RJIL has 58% samples falling in the excellent signal strength category.
- VIL has 34% samples falling in the excellent signal strength category.

## 4.2.4 Data performance

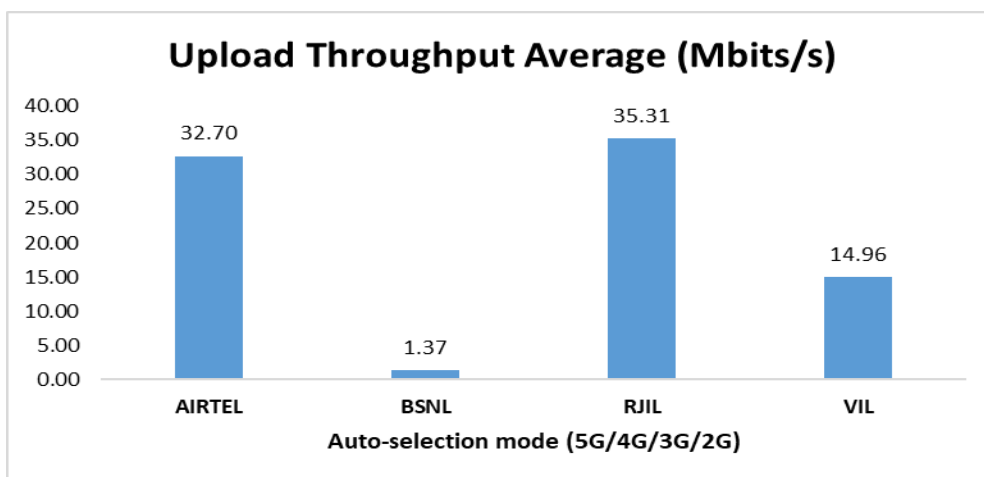
**(a) Data Parameters (Auto-selection mode- 5G/4G/3G/2G)**

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	148.85	0.83	262.90	40.19
	80th Percentile	238.31	1.26	430.36	62.63
	20th Percentile	46.92	0.31	72.68	12.76
Upload Throughput (Mbits/s)	Average	32.70	1.37	35.31	14.96
	80th Percentile	56.58	1.92	61.57	23.36
	20th Percentile	9.14	0.74	8.96	5.82
Latency (ms)	50th Percentile	19.80	26.05	17.00	27.00

**Table-17:** Summary of Data performance in network auto-selection mode.



**Figure- 21:** Download throughput

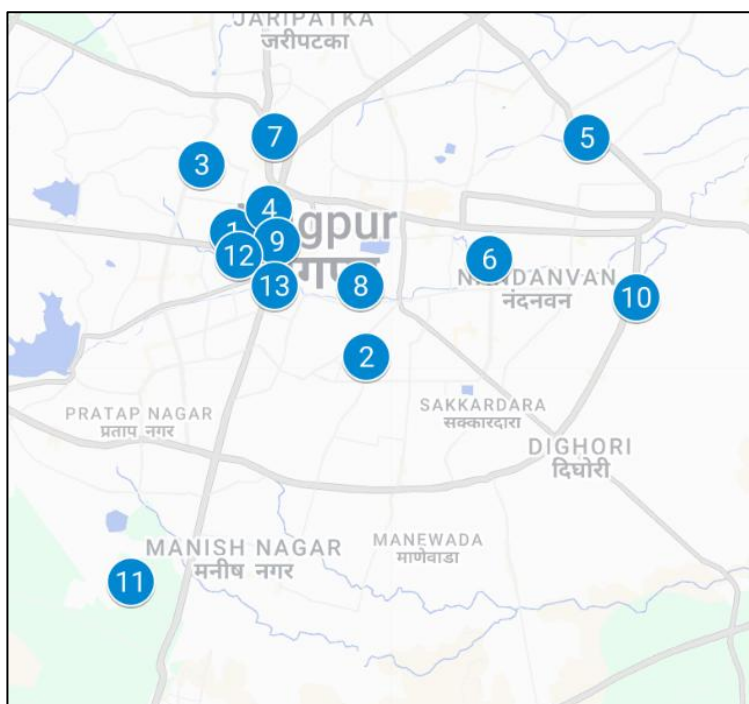


**Figure- 22:** Upload throughput

## 4.3 Hotspots

Hotspot testing has been done on 6<sup>th</sup> March 2025 and 7<sup>th</sup> March 2025. Thirteen locations have been tested in the city.

### 4.3.1 Locations



**Figure- 23:** Hotspot locations

### 4.3.2 Hotspot covered

1. Nagpur Municipal Corporation (NMC) Headquarters
2. Government Medical College and Hospital (GMCH)
3. Nagpur Bench of Bombay High Court
4. Vidhan Bhavan
5. Nagpur RTO Office
6. ESIC Hospital
7. Sadar Bazaar
8. Nagpur Bus Stand (Ganesh Peth St Stand)
9. Zero Mile Metro Station
10. Swaminarayan Temple
11. Nagpur Airport
12. Maharaj Bagh Zoo
13. Yashwant Stadium



### 4.3.3 Voice performance

Overall Voice Performance				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	130	130	130	130
Call Setup Success Rate %	100.00	100.00	99.23	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.53	8.27	0.60	0.89

**Table-18:** Overall summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Nagpur Municipal Corporation (NMC) Headquarters				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.53	1.11	0.57	0.95

**Table-19:** Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Government Medical College and Hospital (GMCH)				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.54	18.22	0.57	0.86

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

Nagpur Bench of Bombay High Court				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.45	0.94	0.56	0.93

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

Vidhan Bhavan				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.47	19.76	0.51	0.87

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

Nagpur RTO Office				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.47	18.31	0.81	0.86

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

ESIC Hospital				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.51	16.49	0.68	0.84

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

Sadar Bazaar				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.55	1.05	0.60	0.82

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

Nagpur Bus Stand (Ganeshpeth St Stand)				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.47	1.05	0.60	0.84

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

Zero Mile Metro Station				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.66	3.00	0.55	0.89

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

Swaminarayan Temple				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.58	9.64	0.63	0.90

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

Nagpur Airport				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.47	1.99	0.61	0.94

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

Maharaj Bagh Zoo				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.66	18.18	0.55	0.90

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

Yashwant Stadium				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	90.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.52	1.20	0.60	0.98

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

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

Overall Data Performance				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	194.63	0.85	294.42	45.97
Download Throughput 80th Percentile (Mbit/s)	415.07	1.24	438.64	90.70
Download Throughput 20th Percentile (Mbit/s)	37.34	0.45	63.34	16.01
Download Session Setup Success Rate %	100.00	76.92	100.00	100.00
Upload Throughput Average (Mbits/s)	33.60	1.98	36.01	16.23
Upload Throughput 80th Percentile (Mbit/s)	56.67	2.86	63.29	29.08
Upload Throughput 20th Percentile (Mbit/s)	5.50	1.16	8.44	5.07
Upload Session Setup Success Rate %	100.00	69.23	100.00	98.46
Web Browsing Delay (Second)	3.13	7.89	2.29	2.78
Youtube Initial Buffer Delay (Second)	1.27	2.91	0.85	1.35
Latency (ms) - 50th Percentile	20.50	27.50	17.20	29.55
Jitter (ms)	13.78	25.34	8.86	22.87
Packet Loss Rate%	9.79	11.05	0.22	2.19
Packet Loss Rate- 90th percentile	12.62	7.58	0.38	3.38

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

Nagpur Municipal Corporation (NMC) Headquarters				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	561.06	0.77	376.62	62.89
Download Session Setup Success Rate %	100.00	40.00	100.00	100.00
Upload Throughput Average (Mbits/s)	62.46	2.88	30.56	31.30
Upload Session Setup Success Rate %	100.00	40.00	100.00	100.00
Web Browsing Delay (Second)	2.08	9.93	2.24	2.42
Youtube Initial Buffer Delay (Second)	0.64	3.22	0.65	1.03
Latency (ms)- 50th Percentile	17.38	19.05	19.53	33.25
Jitter (ms)	3.76	12.49	7.31	28.70
Packet Loss Rate%	0.00	0.50	0.10	3.20

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

Government Medical College and Hospital (GMCH)				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	440.13	0.51	210.57	41.61
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	59.18	0.83	41.97	11.57
Upload Session Setup Success Rate %	100.00	60.00	100.00	80.00
Web Browsing Delay (Second)	2.07	9.36	2.27	2.48
Youtube Initial Buffer Delay (Second)	0.66	3.36	0.71	0.97
Latency (ms) - 50th Percentile	16.25	21.05	17.30	30.10
Jitter (ms)	3.00	71.06	6.87	26.27
Packet Loss Rate%	0.00	6.70	0.00	2.30

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

Nagpur Bench of Bombay High Court				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	92.46	0.74	411.89	8.18
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	7.37	1.33	34.19	7.70
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.40	10.78	2.16	3.40
Youtube Initial Buffer Delay (Second)	1.23	1.85	0.64	1.30
Latency (ms) - 50th Percentile	29.63	19.00	17.53	36.15
Jitter (ms)	10.74	11.75	5.95	37.22
Packet Loss Rate%	1.20	0.20	0.00	4.40

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

Vidhan Bhavan				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	63.29	0.14	388.47	21.48
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	4.42	1.64	24.48	9.19
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.89	12.02	2.12	2.53
Youtube Initial Buffer Delay (Second)	1.12	7.49	0.64	0.92
Latency (ms) - 50th Percentile	39.53	33.35	11.35	32.65
Jitter (ms)	19.68	26.85	4.68	26.12
Packet Loss Rate%	9.50	7.80	0.10	3.30

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

Nagpur RTO Office				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	42.13	0.92	54.06	3.88
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	43.66	2.39	7.22	4.37
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.34	6.55	2.29	3.74
Youtube Initial Buffer Delay (Second)	0.70	1.90	0.74	4.81
Latency (ms) - 50th Percentile	19.90	27.00	15.35	29.55
Jitter (ms)	2.41	27.49	13.94	6.62
Packet Loss Rate%	0.00	3.20	0.30	0.50

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

ESIC Hospital				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	366.72	0.71	586.69	26.08
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	46.08	1.76	63.78	3.10
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.24	7.21	2.07	3.12
Youtube Initial Buffer Delay (Second)	0.69	5.36	0.55	1.35
Latency (ms) - 50th Percentile	16.10	32.00	17.23	26.95
Jitter (ms)	1.84	14.88	9.17	13.54
Packet Loss Rate%	0.00	2.50	0.10	0.80

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

Sadar Bazaar				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	147.89	1.09	16.21	99.30
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	46.39	2.44	4.44	20.22
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.17	4.60	2.46	3.12
Youtube Initial Buffer Delay (Second)	0.77	1.05	0.90	0.98
Latency (ms) - 50th Percentile	16.30	31.90	17.15	24.75
Jitter (ms)	5.01	13.75	5.52	28.26
Packet Loss Rate%	0.00	2.80	0.20	2.40

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

Nagpur Bus Stand (Ganeshpeth St Stand)				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	398.30	1.84	391.20	96.47
Download Session Setup Success Rate%	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	61.75	3.40	61.49	39.23
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.34	3.05	2.25	2.36
Youtube Initial Buffer Delay (Second)	0.78	1.05	0.61	1.03
Latency (ms)- 50th Percentile	16.00	28.35	18.15	24.70
Jitter (ms)	2.42	22.30	6.22	4.76
Packet Loss Rate%	0.00	2.40	0.00	1.00

**Table-40:** Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Zero Mile Metro Station				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	6.51	0.63	361.36	24.59
Download Session Setup Success Rate%	100.00	60.00	100.00	100.00
Upload Throughput Average (Mbits/s)	15.81	1.76	84.08	15.63
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	10.73	8.55	2.23	2.78
Youtube Initial Buffer Delay (Second)	6.51	6.28	0.59	1.11
Latency (ms)- 50th Percentile	293.00	128.25	17.20	26.55
Jitter (ms)	52.47	9.77	9.79	22.41
Packet Loss Rate%	97.70	100.00	0.40	2.60

**Table-41:** Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Swaminarayan Temple				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	95.95	0.86	118.76	56.57
Download Session Setup Success Rate%	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	4.21	1.83	6.64	9.41
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.75	6.94	2.23	2.64
Youtube Initial Buffer Delay (Second)	0.84	1.97	0.64	1.18
Latency (ms)- 50th Percentile	46.48	29.65	19.38	30.35
Jitter (ms)	19.97	18.23	24.15	25.11
Packet Loss Rate%	13.40	6.10	1.70	1.50

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

Nagpur Airport				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	147.50	1.37	6.37	96.86
Download Session Setup Success Rate%	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	46.01	1.98	19.10	38.39
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	2.47	8.06	2.81	2.49
Youtube Initial Buffer Delay (Second)	0.69	0.90	3.16	0.92
Latency (ms)- 50th Percentile	36.23	19.00	20.58	35.50
Jitter (ms)	7.87	21.77	7.45	21.96
Packet Loss Rate%	0.30	0.20	0.00	1.90

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

Maharaj Bagh Zoo				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	61.37	0.54	280.96	40.99
Download Session Setup Success Rate%	100.00	60.00	100.00	100.00
Upload Throughput Average (Mbits/s)	1.89	0.91	11.71	12.64
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	5.45	9.15	2.23	2.56
Youtube Initial Buffer Delay (Second)	2.55	1.34	0.65	0.84
Latency (ms)- 50th Percentile	31.28	32.65	18.63	27.40
Jitter (ms)	41.34	44.94	7.47	32.34
Packet Loss Rate%	4.20	6.70	0.00	3.40

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

Yashwant Stadium				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	106.94	0.64	624.25	18.78
Download Session Setup Success Rate%	100.00	60.00	100.00	100.00
Upload Throughput Average (Mbits/s)	37.61	1.86	78.45	7.34
Upload Session Setup Success Rate %	100.00	20.00	100.00	100.00
Web Browsing Delay (Second)	2.07	10.31	2.45	2.57
Youtube Initial Buffer Delay (Second)	0.84	3.63	0.61	1.11
Latency (ms)- 50th Percentile	18.65	33.65	18.40	27.55
Jitter (ms)	9.14	30.34	6.68	24.10
Packet Loss Rate%	1.00	4.60	0.00	1.20

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

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

Overall Data Performance					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	228.11	-	317.60	-
	Upload Throughput Average (Mbits/s)	36.59	-	38.64	-
4G	Download Throughput Average (Mbits/s)	37.92	0.89	38.88	47.91
	Upload Throughput Average (Mbits/s)	11.59	2.31	13.15	22.48

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

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

Nagpur Municipal Corporation (NMC) Headquarters					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	561.06	-	376.62	-
	Upload Throughput Average (Mbits/s)	62.46	-	30.56	-
4G	Download Throughput Average (Mbits/s)	72.79	0.71	18.09	35.81
	Upload Throughput Average (Mbits/s)	9.10	1.94	6.32	17.19

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

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

Government Medical College and Hospital (GMCH)					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	440.13	-	210.57	-
	Upload Throughput Average (Mbits/s)	59.18	-	41.97	-
4G	Download Throughput Average (Mbits/s)	47.12	0.82	18.65	28.62
	Upload Throughput Average (Mbits/s)	4.31	1.22	6.79	12.07

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

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



Nagpur Bench of Bombay High Court					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	112.54	-	411.89	-
	Upload Throughput Average (Mbits/s)	7.37	-	34.19	-
4G	Download Throughput Average (Mbits/s)	4.39	0.66	43.45	10.27
	Upload Throughput Average (Mbits/s)	2.66	1.53	8.23	6.74

**Table-49:** Summary of 5G only & 4G only data download & upload speed.

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

Vidhan Bhavan					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	76.64	-	388.47	-
	Upload Throughput Average (Mbits/s)	4.41	-	24.48	-
4G	Download Throughput Average (Mbits/s)	14.93	1.02	62.23	12.48
	Upload Throughput Average (Mbits/s)	10.09	2.40	7.77	11.70

**Table-50:** Summary of 5G only & 4G only data download & upload speed.

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

Nagpur RTO Office					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	-	-	54.06	-
	Upload Throughput Average (Mbits/s)	-	-	7.22	-
4G	Download Throughput Average (Mbits/s)	65.71	0.68	8.65	6.89
	Upload Throughput Average (Mbits/s)	42.42	2.18	16.24	14.83

**Table-51:** Summary of 5G only & 4G only data download & upload speed.

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

ESIC Hospital					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	366.72	-	586.69	-
	Upload Throughput Average (Mbits/s)	46.08	-	63.78	-
4G	Download Throughput Average (Mbits/s)	31.96	1.26	21.25	94.73
	Upload Throughput Average (Mbits/s)	28.62	2.33	27.09	35.77

**Table-52:** Summary of 5G only & 4G only data download & upload speed.

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

Sadar Bazaar					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	147.89	-	-	-
	Upload Throughput Average (Mbits/s)	46.39	-	-	-
4G	Download Throughput Average (Mbits/s)	46.60	1.40	14.98	74.29
	Upload Throughput Average (Mbits/s)	6.84	1.67	7.74	15.02

**Table-53:** Summary of 5G only & 4G only data download & upload speed.

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

Nagpur Bus Stand (Ganeshpeth St Stand)					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	398.30	-	391.20	-
	Upload Throughput Average (Mbits/s)	61.75	-	61.49	-
4G	Download Throughput Average (Mbits/s)	61.81	1.59	123.32	82.83
	Upload Throughput Average (Mbits/s)	8.40	4.97	21.13	46.46

**Table-54:** Summary of 5G only & 4G only data download & upload speed.

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

Zero Mile Metro Station					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	6.51	-	361.36	-
	Upload Throughput Average (Mbits/s)	15.81	-	84.08	-
4G	Download Throughput Average (Mbits/s)	4.79	0.10	16.10	50.55
	Upload Throughput Average (Mbits/s)	13.72	2.01	16.62	14.84

**Table-55:** Summary of 5G only & 4G only data download & upload speed.

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

Swaminarayan Temple					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	95.95	-	118.76	-
	Upload Throughput Average (Mbits/s)	4.21	-	6.64	-
4G	Download Throughput Average (Mbits/s)	27.50	1.07	103.22	56.22
	Upload Throughput Average (Mbits/s)	5.47	2.21	15.51	36.88

**Table-56:** Summary of 5G only & 4G only data download & upload speed.

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

Nagpur Airport					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	147.50	-	6.37	-
	Upload Throughput Average (Mbits/s)	46.01	-	19.10	-
4G	Download Throughput Average (Mbits/s)	69.68	0.93	19.89	102.16
	Upload Throughput Average (Mbits/s)	10.20	1.73	11.95	47.78

**Table-57:** Summary of 5G only & 4G only data download & upload speed.

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

Maharaja Bagh Zoo					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	141.56	-	280.96	-
	Upload Throughput Average (Mbits/s)	1.79	-	11.71	-
4G	Download Throughput Average (Mbits/s)	7.06	0.23	34.24	41.42
	Upload Throughput Average (Mbits/s)	3.09	0.62	5.89	16.73

**Table-58:** Summary of 5G only & 4G only data download & upload speed.

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

Yashwant Stadium					
Parameters		Service Provider			
		AIRTEL	BSNL	RJIL	VIL
5G	Download Throughput Average (Mbits/s)	106.94	-	624.25	-
	Upload Throughput Average (Mbits/s)	37.61	-	78.45	-
4G	Download Throughput Average (Mbits/s)	38.66	0.50	21.36	26.60
	Upload Throughput Average (Mbits/s)	5.82	3.31	19.69	16.22

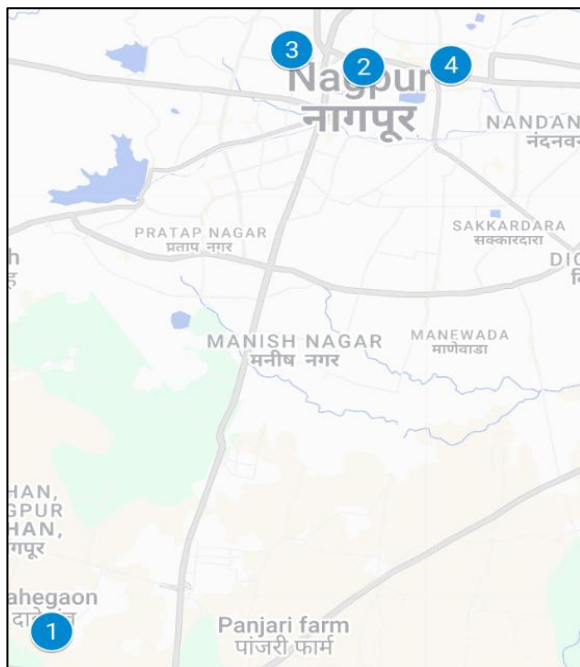
**Table-59:** Summary of 5G only & 4G only data download & upload speed.

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

## 4.4 Walk Test

Walk Test has been conducted on 6<sup>th</sup> March 2025. Four locations have been tested in the city.

### 4.4.1 Drive test route



**Figure-24:** Walk Test location.

### 4.4.2 Walk Test Covered

1. All India Institute of Medical Sciences (AIIMS)
2. Nagpur Railway Station
3. Collector Office
4. Itwari Market

### 4.4.3 Voice Performance

All India Institute Of Medical Sciences (AIIMS)				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	25	24	23	23
Call Setup Success Rate %	96.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.96	3.59	0.60	1.01

**Table-60:** Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Nagpur Railway Station				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	24	23	26	23
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.21	1.07	0.73	0.83

**Table-61:** Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Collector Office				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	12	12	12	12
Call Setup Success Rate %	100.00	91.67	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	1.64	1.79	0.84	1.00

**Table-62:** Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Itwari Market				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	20	21	20	20
Call Setup Success Rate %	100.00	95.24	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.58	1.84	0.55	0.84

**Table-63:** Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

#### 4.4.4 Data Performance

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

All India Institute of Medical Sciences (AIIMS)				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	35.83	0.73	148.12	23.20
Download Session Setup Success Rate %	96.00	72.41	100.00	100.00
Upload Throughput Average (Mbits/s)	13.76	1.04	6.83	14.68
Upload Session Setup Success Rate %	100.00	93.10	100.00	100.00
Latency (ms) - 50th Percentile	22.60	25.90	20.28	26.05

**Table-64:** Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Nagpur Railway Station				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	46.93	0.56	88.59	23.00
Download Session Setup Success Rate %	100.00	92.00	100.00	100.00
Upload Throughput Average (Mbits/s)	12.08	3.38	11.52	20.19
Upload Session Setup Success Rate %	100.00	88.00	100.00	100.00
Latency (ms) - 50th Percentile	28.83	30.03	18.05	29.15

**Table-65:** Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Collector Office				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	48.08	0.63	153.52	33.39
Download Session Setup Success Rate %	100.00	92.31	84.62	100.00
Upload Throughput Average (Mbits/s)	5.92	2.09	4.44	9.76
Upload Session Setup Success Rate %	100.00	92.31	100.00	100.00
Latency (ms) - 50th Percentile	28.15	27.80	20.65	30.60

**Table-66:** Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Itwari Market				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	176.11	1.40	299.18	50.62
Download Session Setup Success Rate %	100.00	96.00	100.00	100.00
Upload Throughput Average (Mbits/s)	40.32	2.51	41.33	16.83
Upload Session Setup Success Rate %	100.00	95.83	100.00	100.00
Latency (ms) - 50th Percentile	16.35	21.35	18.30	29.40

**Table-67:** Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

## 5. Voice & Data Key findings

### 5.1 Overall Voice

#### 1. Call Setup Success Rate:

- a) Airtel, BSNL and VIL have 99.80%, 100.00% and 99.40% call setup success rate respectively in 3G/2G network mode. (refer table-3)
- b) Airtel, BSNL, RJIL and VIL have 99.59%, 95.29%, 99.86% and 99.86% 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 4.70, 3.48 and 3.03 call setup time respectively in 3G/2G network mode. (refer table-3)
- b) Airtel, BSNL, RJIL and VIL have 0.78, 3.55, 0.75 and 0.98 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, RJIL, VIL and Airtel have 3.40%, 0.60%, 0.40% & 0.20% silence call rate respectively. Further BSNL has higher RTP packet loss rate in downlink (3.73%) compared to VIL (0.42%), Airtel (0.20%) and RJIL (0.17%), In uplink the RTP packet loss rate is higher for BSNL (2.43%) compared to VIL (0.46%), RJIL (0.32%) and Airtel (0.26%). (refer table-6)

#### 4. Drop Call Rate:

- a) Airtel, BSNL and VIL have 0.20%, 0.81% and 0.20% drop call rate respectively in 3G/2G network mode. (refer table-3)
- b) Airtel, BSNL, RJIL and VIL have 0.00%, 2.82%, 0.00% and 0.00% 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 145.05 Mbps, 0.84 Mbps, 255.22 Mbps and 39.77 Mbps average download speed respectively. (refer table-9)
- b) Airtel, BSNL, RJIL and VIL have 31.20 Mbps, 1.52 Mbps, 33.24 Mbps and 15.26 Mbps average upload speed respectively. (refer table-9)

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

- a) Airtel, BSNL, RJIL and VIL have 194.63 Mbps, 0.85 Mbps, 294.42 Mbps and 45.97 Mbps average download speed respectively. (refer table-32)
- b) Airtel, BSNL, RJIL and VIL have 33.60 Mbps, 1.98 Mbps, 36.01 Mbps and 16.23 Mbps average upload speed respectively. (refer table-32)

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

- a) Airtel, BSNL, RJIL and VIL have 100.00%, 76.92%, 100.00% and 100.00% download session setup success rate respectively. (refer table-32)
- b) Airtel, BSNL, RJIL and VIL have 100.00%, 69.23%, 100.00% and 98.46% upload session setup success rate. (refer table-32)

## 5.3 Operator wise Key Findings

### 1. Airtel:

#### Voice

- 99.80% call setup success rate and 0.20% drop call rate have been observed in 3G/2G network mode for LSA and city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-3 & 11)
- 99.59% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-5)
- 99.61% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)
- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for all hotspot locations. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-18)
- 96.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) at All India Institute of Medical Sciences (AIIMS) walk test location. Performance is not meeting benchmark of 98.00% for call setup success rate. (refer table-60)

#### Data

- Airtel has 145.05 Mbps average download speed & 31.20 Mbps average upload speed for LSA. (refer table-9)
- Airtel has 148.85 Mbps average download speed & 32.70 Mbps average upload speed for city drive. (refer table-17)
- Nagpur Bench of Bombay High Court, Vidhan Bhavan, Nagpur RTO Office, Zero Mile Metro Station, Swaminarayan Temple and Maharaj Bagh Zoo have less download speed (less than 100 Mbps) out of total 13 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-35, 36, 37, 41, 42 and 44)
- Nagpur Bench of Bombay High Court, Vidhan Bhavan, Zero Mile Metro Station, Swaminarayan Temple and Maharaj Bagh Zoo have less upload speed (less than 20 Mbps) out of total 13 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-35, 36, 41, 42 & 44)
- All India Institute of Medical Sciences (AIIMS), Nagpur Railway Station and Collector Office have less download speed (less than 100 Mbps) out of total 4 walk test for auto-selection mode (5G/4G/3G/2G). (refer table-64, 65 and 66)
- All India Institute of Medical Sciences (AIIMS), Nagpur Railway Station and Collector Office have less upload speed (less than 20 Mbps) out of total 4 walk test for auto-selection mode (5G/4G/3G/2G). (refer table-64, 65 & 66)

### 2. BSNL:

#### Voice

- 100.00% call setup success rate and 0.81% drop call rate have been observed in 3G/2G network mode for LSA and city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-3 & 11)



- 95.29% call setup success rate and 2.82% 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)
- 93.81% call setup success rate and 4.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer table-13)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-18)
- 91.67% & 95.24% call setup success rate has been observed in auto-selection mode (5G/4G/3G/2G) at collector office & Itwari Market respectively at walk test locations. Performance is not meeting the benchmark of 98.00%.(refer table-62 & 63)

#### **Data**

- BSNL has 0.84 Mbps average download speed & 1.52 Mbps average upload speed for LSA. (refer table-9)
- BSNL has 0.83 Mbps average download speed & 1.37 Mbps average upload speed for city drive. (refer table-17)
- All Hotspots have less download speed (less than 10 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44 and 45)
- Government Medical College and Hospital (GMCH), Nagpur Bench of Bombay High Court, Vidhan Bhavan, ESIC Hospital, Zero Mile Metro Station, Swaminarayan Temple, Nagpur Airport, Maharaj Bagh Zoo and Yashwant Stadium hotspots have less upload speed (less than 2 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-34, 35, 36, 38, 41, 42, 43, 44 and 45)
- All walk test locations have less download speeds (less than 10 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-64, 65, 66 and 67)
- All India Institute of Medical Sciences (AIIMS) walk test location has less upload speeds (less than 2 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table- 64)

### **3. RJIL:**

#### **Voice**

- 99.86% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-5)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)
- 99.23% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at overall hotspot locations.

Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-18)

- 100.00 call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at all walk test locations. Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-60, 61, 62 and 63)

#### **Data**

- RJIL has 255.22 Mbps average download speed & 33.24 Mbps average upload speed for LSA. (refer table-9)
- RJIL has 262.90 Mbps average download speed & 35.31 Mbps average upload speed in city drive. (refer table-17)
- Nagpur RTO Office, Sadar Bazaar and Nagpur Airport hotspot have less download speed (less than 100 Mbps) out of total 13 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-37, 39 and 43)
- Nagpur RTO Office, Sadar Bazaar, Swaminarayan Temple, Nagpur Airport and Maharaj Bagh Zoo hotspot have less upload speed (less than 20 Mbps) out of total 13 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-37, 39, 42, 43 and 44)
- Nagpur Railway Station walk test has less download speed (less than 100 Mbps) out of total 4 walk test for auto-selection mode (5G/4G/3G/2G). (refer table-65)
- All India Institute of Medical Sciences (AIIMS), Nagpur Railway Station and Collector Office walk test have less upload speed (less than 20 Mbps) out of total 4 walk test for auto-selection mode (5G/4G/3G/2G). (refer table- 64, 65 and 66)

#### **4. VIL:**

##### **Voice**

- 99.40% call setup success rate and 0.20% drop call rate have been observed in 3G/2G network mode for LSA and city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-3 & 11)
- 99.86% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-5)
- 99.81% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-13)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspots and walk test locations.

Performance is well within the benchmark of 98.00% & 2.00% respectively (refer table-18, 60, 61, 62 and 63)

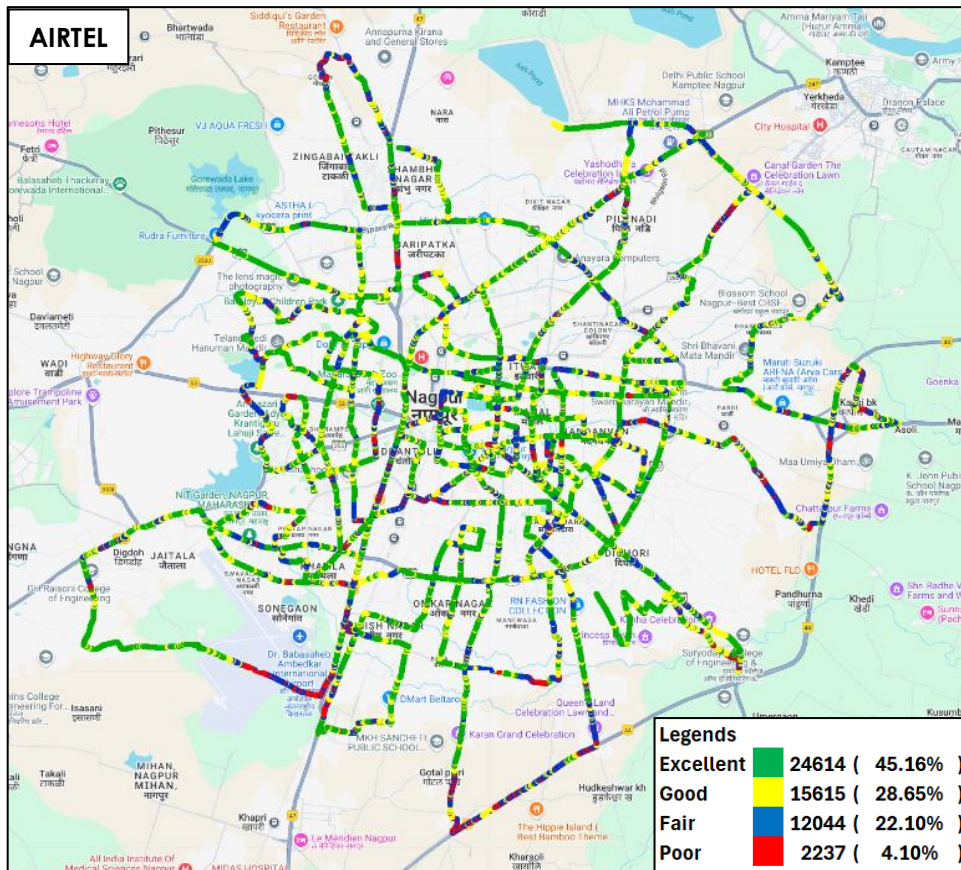
**Data**

- VIL has 39.77 Mbps average download speed & 15.26 Mbps average upload speed for LSA. (refer table-9)
- VIL has 40.19 Mbps average download speed & 14.96 Mbps average upload speed in city drive. (refer table-17)
- Nagpur Bench of Bombay High Court and Nagpur RTO Office hotspot have less download speed (less than 10 Mbps) out of total 13 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table- 35 and 37)

## 6. Annexure

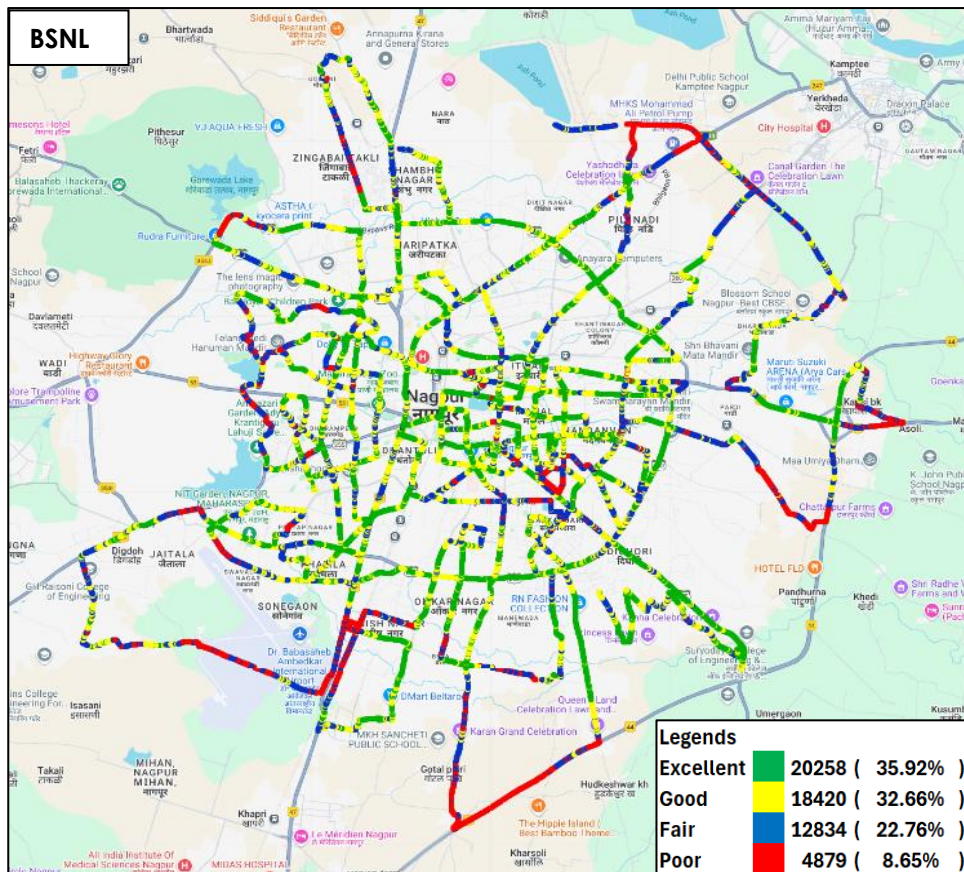
### 6.1 Route wise coverage map

#### 6.1.1 City

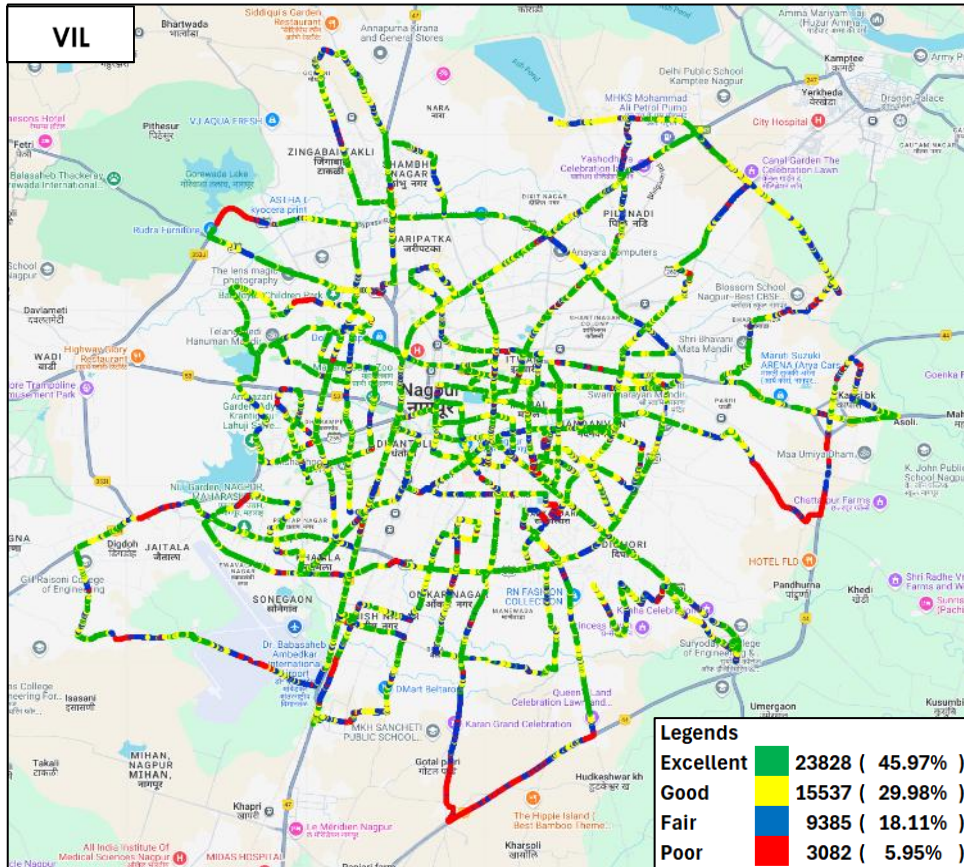


**Figure-25:** Signal strength 3G/2G network mode – AIRTEL.



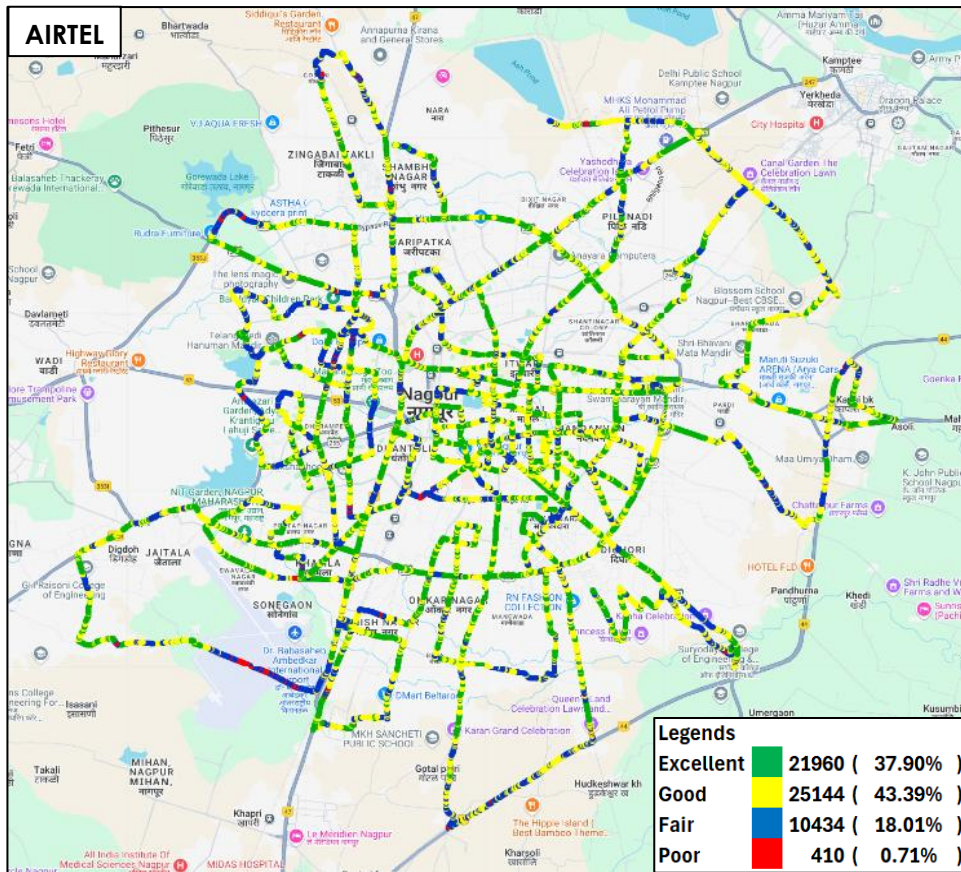


**Figure-26:** Signal strength 3G/2G network mode – BSNL.

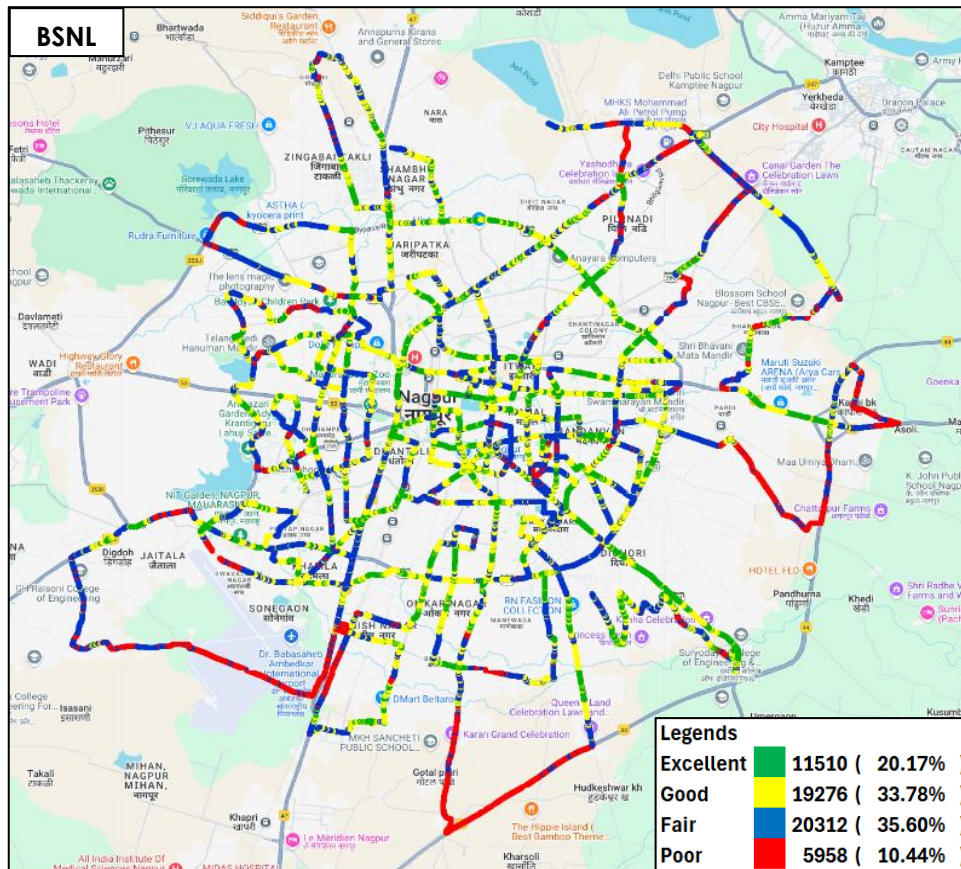


**Figure-27:** Signal strength 3G/2G network mode – VIL.



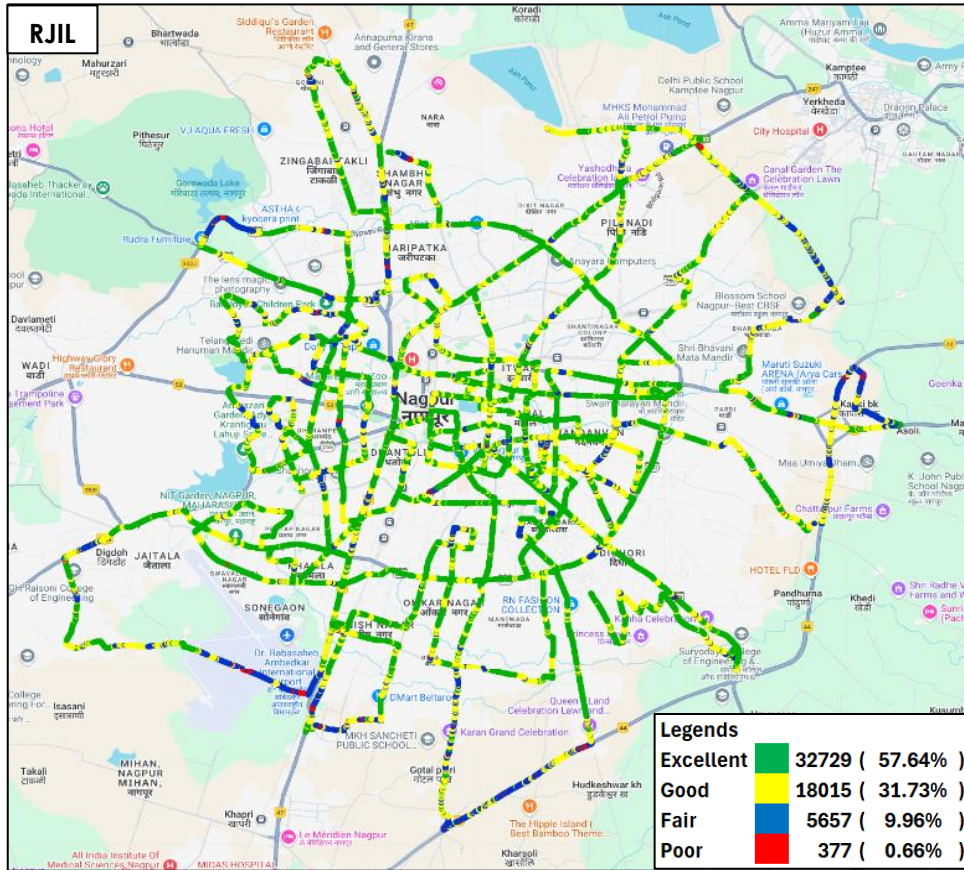


**Figure-28:** Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.

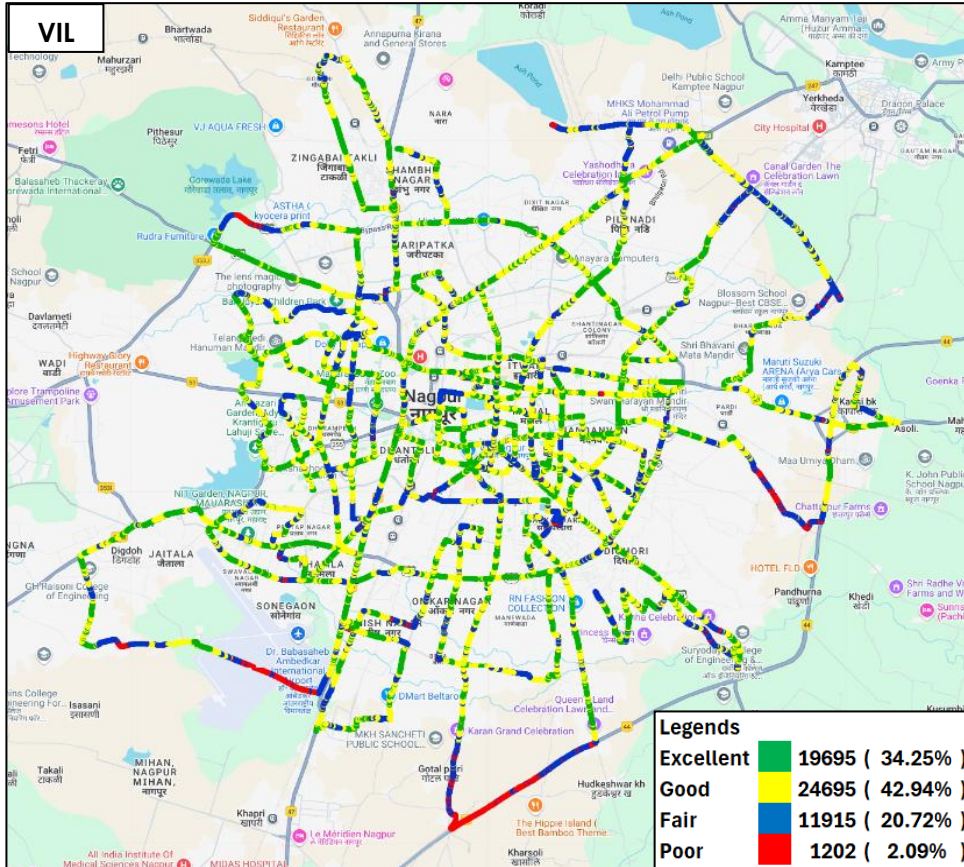


**Figure-29:** Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.





**Figure-30:** Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.



**Figure-31:** 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
Wait/ Guard Time		15 Sec

**Table-68:** 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 ( <a href="http://www.google.co.in">www.google.co.in</a> , <a href="http://www.amazon.in">www.amazon.in</a> , <a href="http://www.facebook.com">www.facebook.com</a> ) 20 sec timeout (only at Hotspot)

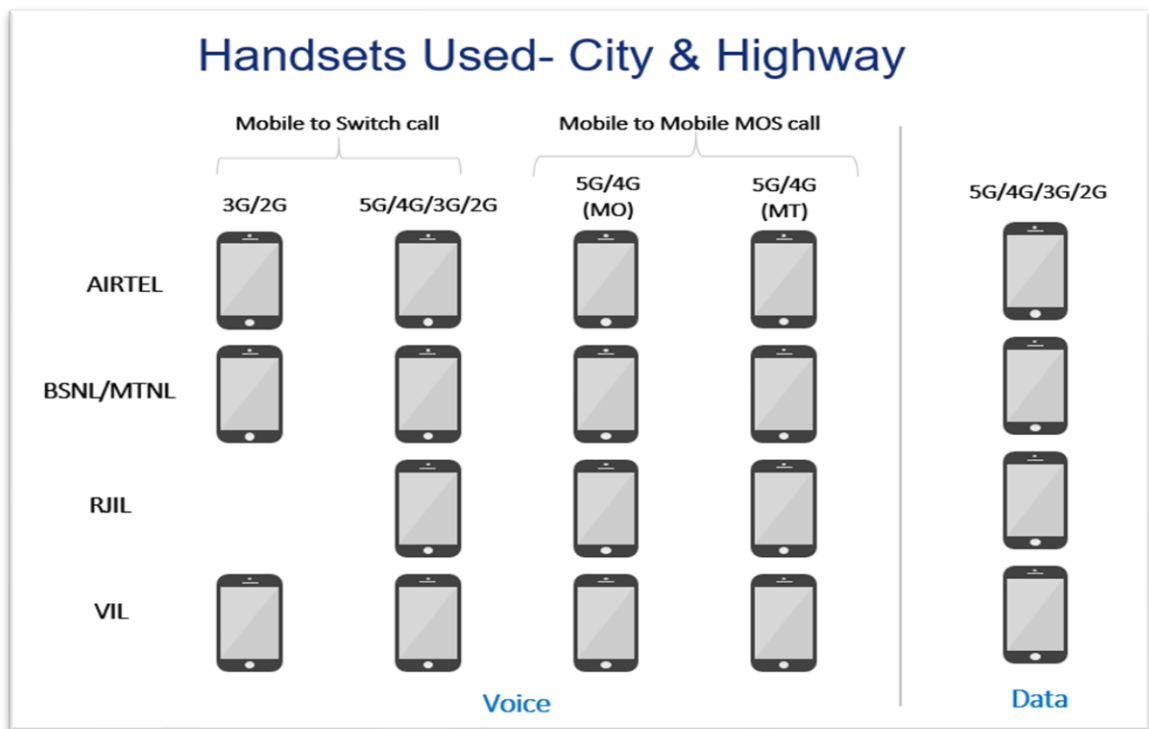


Latency		25 count- Dynamic 1000 count- Hotspot Payload- 42 bytes in all drive
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**Table-69:** Data test detail

**Note-**

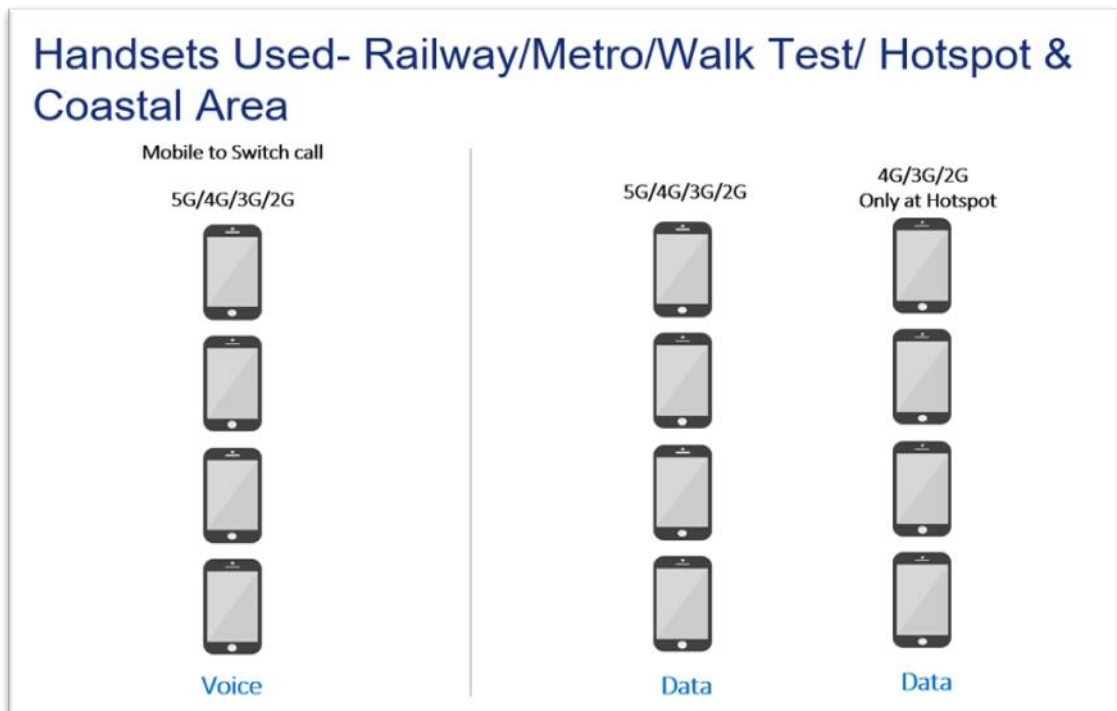
- 5 Data iteration to be done at each hotspot location.
- Minimum 5 iteration to be made during the walk test. Iteration count will be increased based on walk test distance.
- Ping test to be performed only once at hotspot location.
- Youtube & Web browsing test to be performed at static location only.
- 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-32:** Number of handsets used in city & highway drive

MO: Mobile originating

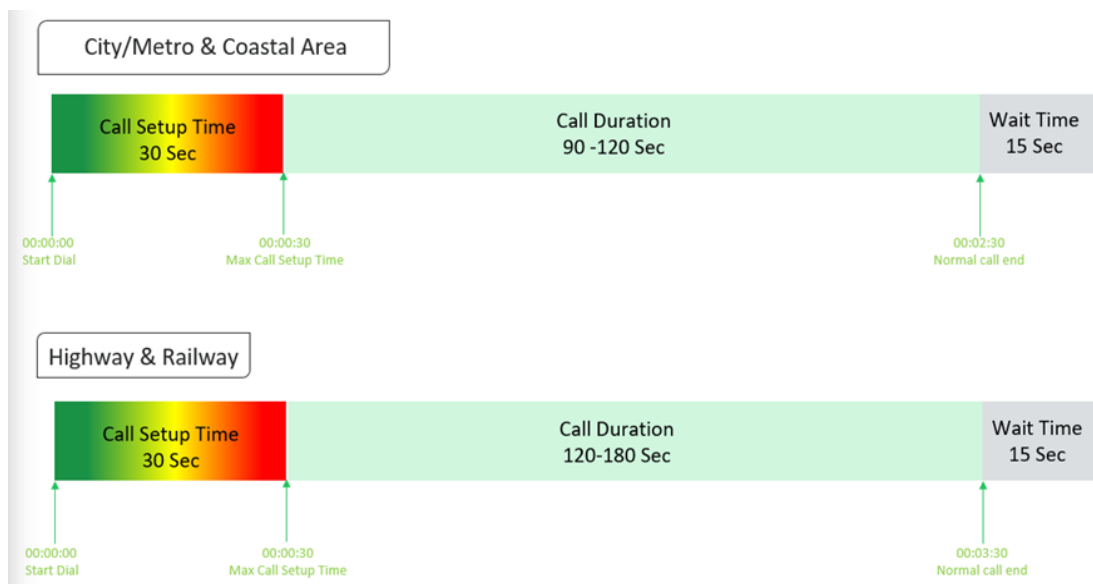
MT: Mobile terminating



**Figure-33:** 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-34:** 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.

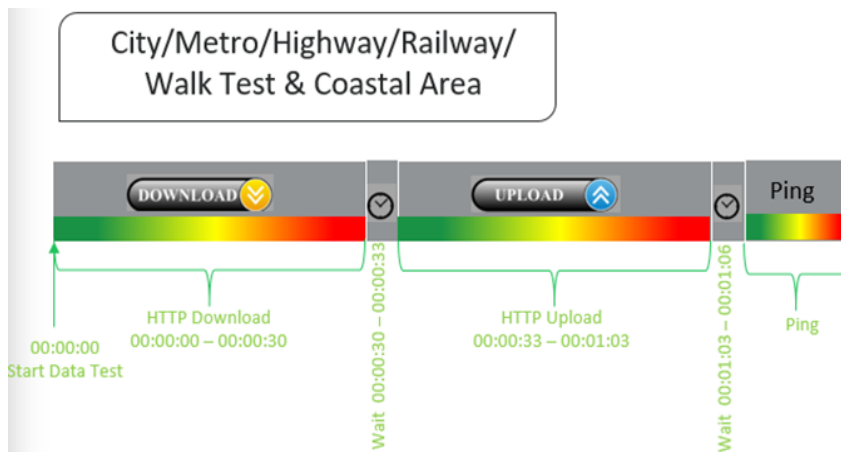
## (b) Hotspot voice testing



**Figure-35:** Voice test script for walktest/hotspot

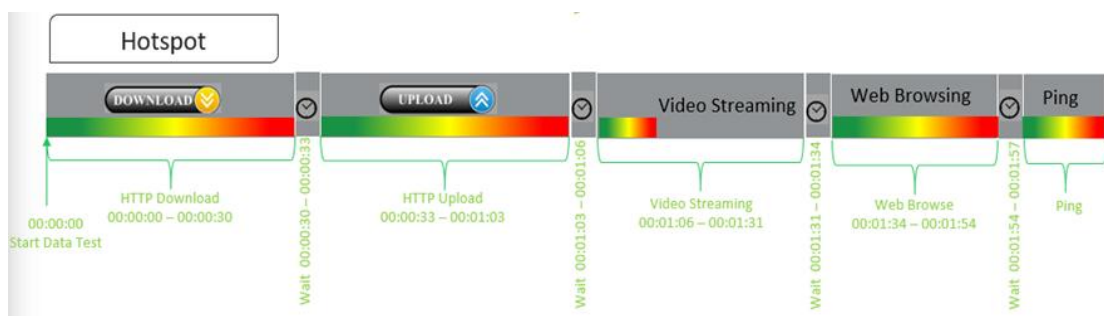
- 10 calls to be made at each Hotspot location.
- Minimum 10 Calls to be made during the walk test. Call count will be increased based on walk test distance.

## (c) Dynamic Data (internet) test



**Figure-36:** Data test script used in city/metro/railway/highway/walk test & coastal area

## (d) Static Data(internet) testing



**Figure-37:** 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	<p>(i) Call Setup Success Rate is defined as the ratio of Established Calls to Call Attempts. 'Established Calls' mean the following events have happened in call setup:</p> <ul style="list-style-type: none"> <li>(a) Call attempt is made</li> <li>(b) The signaling channel is allocated</li> <li>(c) The call is routed to the outwards path of the terminating network</li> <li>(d) An alert signal is received by caller in the form of ring back tone, busy tone, or an announcement.</li> </ul> <p>CSSR = (Total Call Established/ Total Call Attempt) *100</p> <p>As per QoS Regulation 2024 benchmark value is <b>&gt;=98%</b></p>
Drop Call Rate	<p>Call drop represents the service provider network's ability to maintain a call once it has been successfully established. This parameter shall include both incoming calls and outgoing calls which, once they have been established and have an assigned traffic channel/ bearer, are dropped, or interrupted before their normal completion by the user, the cause of the early termination being within the service provider's network</p> <p>Drop Call Rate = (Total Call Drop/Total Call Established) *100</p> <p>As per QoS Regulation 2024 benchmark value is <b>&lt;=2%</b></p>
Call Setup Time	<p>Time taken from call initiate to call alerting/ringing.</p> <p>Call Setup Time = T2- T1</p> <p>T2- Ringing (VoLTE/VoNR) &amp; Alerting (for WCDMA &amp; GSM), T1- Invite (VoLTE/VoNR) &amp; CM Service Request (for WCDMA &amp; GSM)</p>
Voice Quality (MOS)	<p>Voice quality in mobile networks is measured with algorithms based on ITU-T P.863 (POLQA). The grading for Voice quality has been given as:</p> <p>Excellent: MOS <math>\geq 4</math> and <math>&lt; 5</math>            Good : MOS <math>\geq 3</math> and <math>&lt; 4</math>            Fair : MOS <math>\geq 2</math> and <math>&lt; 3</math>            Poor : MOS <math>\geq 1</math> and <math>&lt; 2</math></p>
Handover Success Rate	<p>Handover Success Rate = Count of successful handovers (All Technology Handover combined) / Total count of Handover Attempt (All Technology Handover combined) *100</p> <p>Handover type which are considered- 2G Inter &amp; Intra cell, 3G Soft &amp; IRAT, 4G Inter &amp; Intra frequency &amp; SRVCC, 5G Inter &amp; Intra frequency &amp; 5G to 4G handovers.</p>
Silence Call	<p>A call which has <math>\geq 4</math> sec continuous RTP gap is considered as a Silence Call.</p> <p>Silence call rate = (count of silence call / Total calls established) *100</p> <p>If a call observes multiple silence count <math>\geq 4</math> sec in a particular established call it has been taken as one silent event.</p>

Jitter	<p>The inter arrival jitter is the difference in the relative transit time for two packets. The relative transit time is the difference between a packet's Real-time Transport Protocol (RTP) timestamp and the receiver's clock at the time of arrival, measured in the same units. If <math>S_i</math> is the RTP timestamp from packet <math>i</math>, and <math>R_i</math> is the time of arrival in RTP timestamps units for packet <math>i</math>, then for two packets <math>i</math> and <math>j</math> the inter-arrival jitter <math>D</math> can be expressed as:</p> $D(i,j) = (R_j - R_i) - (S_j - S_i)$ <p>The interarrival jitter is calculated continuously as each data packet <math>i</math> is received from source <math>SSRC\_n</math>, using this difference <math>D</math> for that packet and the previous packet <math>i-1</math> in order of arrival (not necessarily in sequence), according to the formula</p> $J(i) = J(i-1) + ( D(i-1,i)  - J(i-1))/16 \text{ or } 8$																																		
Downlink Packet Drop Rate	<p>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call originating handset.</p> <p>This KPI is calculated from MOS call for packet call only (VoNR/VoLTE)</p>																																		
Uplink Packet Drop Rate	<p>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call terminating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE).</p>																																		
Signal Strength	<p>Signal strength is the signal power level received by the wireless user.</p> <table><tr><th rowspan="2">Parameter Name</th><th rowspan="2">Technology</th><th colspan="4">Signal Strength (dBm)</th></tr><tr><th>Excellent</th><th>Good</th><th>Fair</th><th>Poor</th></tr><tr><td>Rx Level</td><td>GSM</td><td>0 to <math>\geq -65</math></td><td><math>&lt; -65</math> to <math>\geq -75</math></td><td><math>&lt; -75</math> to <math>\geq -85</math></td><td><math>&lt; -85</math> to min</td></tr><tr><td>RSCP</td><td>WCDMA</td><td>0 to <math>\geq -70</math></td><td><math>&lt; -70</math> to <math>\geq -80</math></td><td><math>&lt; -80</math> to <math>\geq -90</math></td><td><math>&lt; -90</math> to min</td></tr><tr><td>RSRP</td><td>LTE</td><td>0 to <math>\geq -80</math></td><td><math>&lt; -80</math> to <math>\geq -95</math></td><td><math>&lt; -95</math> to <math>\geq -110</math></td><td><math>&lt; -110</math> to min</td></tr><tr><td>SS_RSRP</td><td>NR</td><td>0 to <math>\geq -80</math></td><td><math>&lt; -80</math> to <math>\geq -95</math></td><td><math>&lt; -95</math> to <math>\geq -110</math></td><td><math>&lt; -110</math> to min</td></tr></table>	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
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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-70:** Network performance parameter and definition voice

## 7.2.2 Network Performance Parameters Data tests

Parameter Name	Definition
<b>Download Speed (Mbps)</b>	<p>The download speed is defined as the data transmission rate that is achieved for downloading a test file from a test server to a test device.</p> <p>Download Speed = Total bytes transferred during download / Total time for transfer</p> <ul style="list-style-type: none"> <li>80th percentile (upper range) &amp; 20th percentile (lower range) value has been calculated for download throughput in dynamic drive and Hotspot combine data</li> </ul>
<b>Upload Speed (Mbps)</b>	<p>The upload speed is the data transmission rate that is achieved for uploading a test file from a test device to a test server.</p> <p>Upload Speed = Total bytes transferred during upload / Total time for transfer.</p> <ul style="list-style-type: none"> <li>80th percentile (upper range) &amp; 20th percentile (lower range) value has been calculated for upload throughput in dynamic drive and Hotspot combine data.</li> </ul>

<b>Download Session Setup Success Rate</b>	(total download session established (successfully connected to server)/ total download session attempt) *100. This KPI has been calculated for Hotspot only.
<b>Upload Session Setup Success Rate</b>	(total upload session established (successfully connected to server)/ total upload session attempt)*100. This KPI need to report for Hotspot only.
<b>Web Page Download Time</b>	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.
<b>Video Streaming Delay</b>	The Video streaming delay is time taken from start of video transfer to First video frame displayed in player.
<b>Latency</b>	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.
<b>Jitter</b>	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.
<b>Packet Loss Rate</b>	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-71:** 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.