भादूविप्रा
TRAI

TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Madhya Pradesh LSA

December 2024

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 Madhya Pradesh License Service Area (LSA) during the month December 2024 under the supervision of TRAI Regional Office (RO), Bhopal. 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	Raipur	City	294.0	02-Dec-2024	04-Dec-2024
2	Raipur	City (Inter-operator calling)	21.0	04-Dec-2024	04-Dec-2024
3	Raipur	Hotspot	10 Locations	04-Dec-2024	05-Dec-2024
4	Raipur	Walk test	5.2	05-Dec-2024	05-Dec-2024

Table-1: Drive test summary

2.2 Drive test routes

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

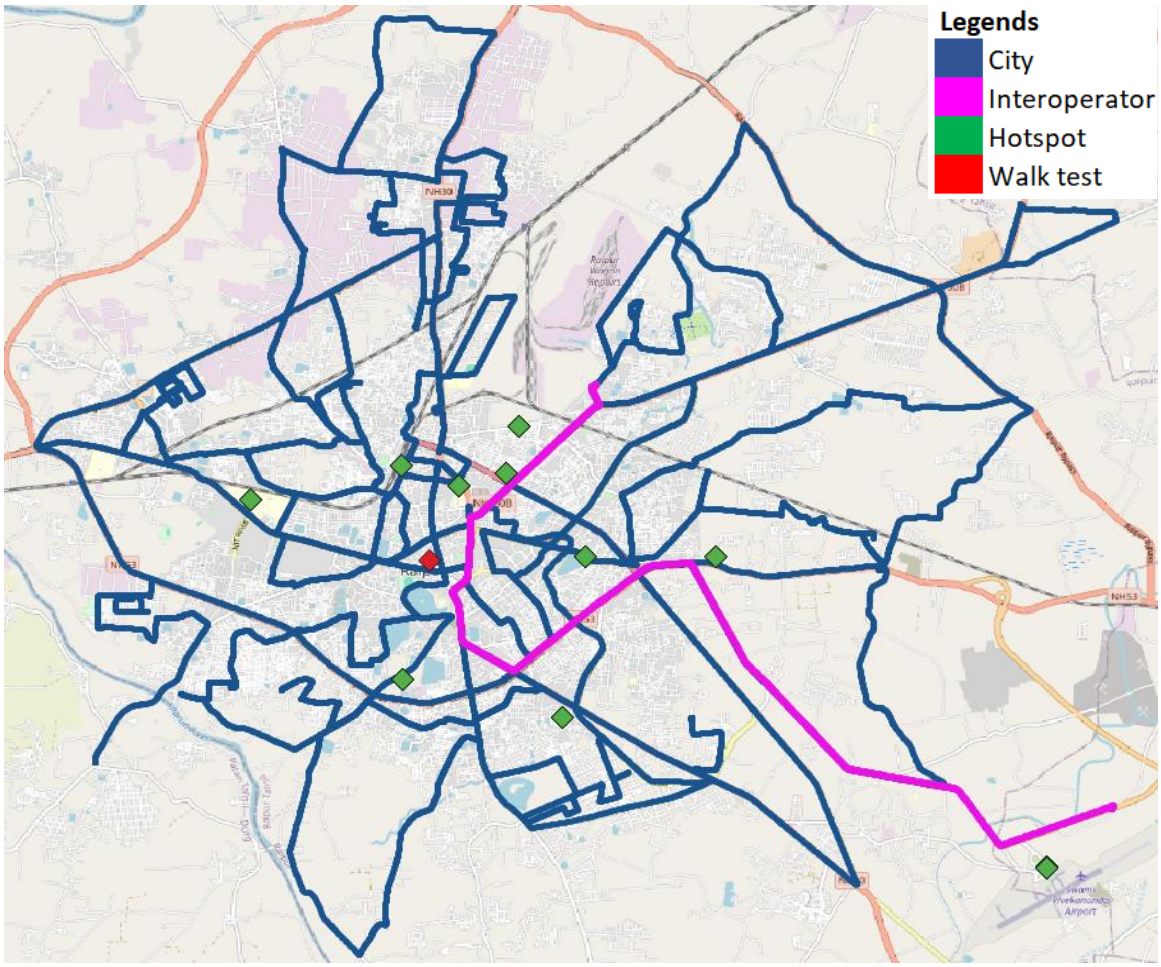


Figure-1: Drive test routes

2.3 Summary of areas covered

a) City- Bhanpuri, Kabir Nagar, Shrinagar, Tatibandh, Mowa, Bhatagaon, Kota, Sarona, Shankar Nagar, etc.

b) Hotspot-

1. Magneto Mall
2. Pt. Jawahar Lal Nehru Memorial Medical College, Raipur
3. MMI Narayana Hospital
4. New Interstate Bus Stand Bhatgaon
5. NIT Raipur
6. Pandri Market / City Centre Mall
7. Raipur Airport
8. Raipur Railway Station
9. Shri Narayana Hospital
10. Telibandha Talab

c) Walk test-

1. Gol Bazaar

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
10	Vodafone Idea Ltd.	4G	900,1800,2100,2300,2500

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

QoS Performance Analysis- Madhya Pradesh 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 December 2024 covering city, Inter-operator, 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	454	471	463
Call Setup Success Rate %	99.34	99.15	99.78
Drop Call Rate%	0.22	1.93	0.87
Call Setup Time-Average (Second)	5.97	3.73	3.49
Handover Success Rate %	98.16	100.00	97.92

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

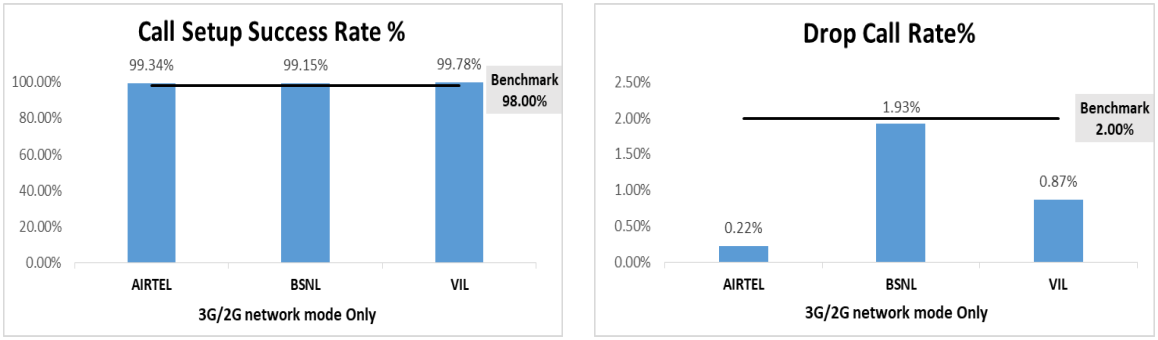


Figure-2: Call setup success rate and drop call rate performance

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	144	NA
2G	579	20	451

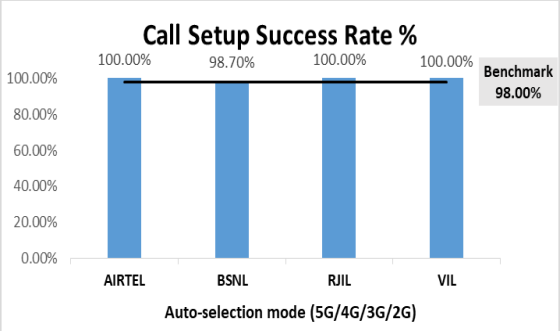
Table-4: Technology wise number of network cell id's latched during drive test

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	620	614	638	624
Call Setup Success Rate %	100.00	98.70	100.00	100.00
Drop Call Rate%	0.00	0.66	0.31	0.00
Call Setup Time-Average (Second)	1.28	4.62	0.75	0.80
Handover Success Rate %	99.93	99.84	99.91	99.95

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



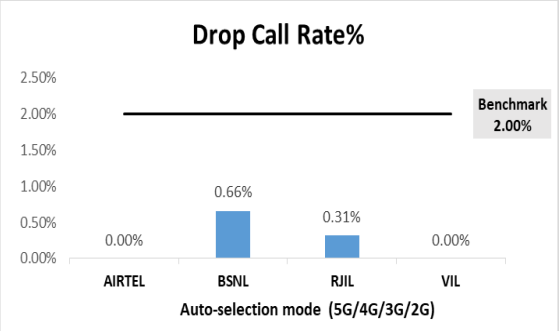


Figure-3: Performance for call setup success rate and drop call rate

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	486	467	485	475
Number of silence call for >4 Sec	5	12	1	4
Silence Call Rate %	1.03	2.57	0.21	0.84
Number of silence instances for >4 Sec	5	14	2	4
Number of silence instances for >3 Sec	7	20	2	13
Number of silence instances for >2 sec	16	23	17	25
RTP Jitter (4G & 5G) in ms	4.95	17.23	8.57	13.94
Packet loss Rate Downlink %	0.64	6.40	0.31	0.79
Packet loss Rate Uplink %	0.76	8.12	0.56	0.76

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	493	NA
4G	1110	230	1634	978
3G	NA	70	NA	NA
2G	0	205	NA	2

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 calls 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	2742	2514	2679	2799
Speech Quality (Average MOS Score)	3.99	2.94	3.88	3.96
Number of samples with MOS >=4 to <5 (Excellent)	2276	98	1811	1998
Number of samples with MOS >=3 to <4(Good)	379	1364	698	614
Number of samples with MOS >=2 to <3 (Fair)	38	802	133	130
Number of samples with MOS >=1 to <2 (Poor)	49	250	37	57
%age of samples with MOS >=4 to <5 (Excellent)	83.01%	3.90%	67.60%	71.38%
%age of samples with MOS >=3 to <4(Good)	13.82%	54.26%	26.05%	21.94%
%age of samples with MOS >=2 to <3 (Fair)	1.39%	31.90%	4.96%	4.64%
%age of samples with MOS >=1 to <2 (Poor)	1.79%	9.94%	1.38%	2.04%

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

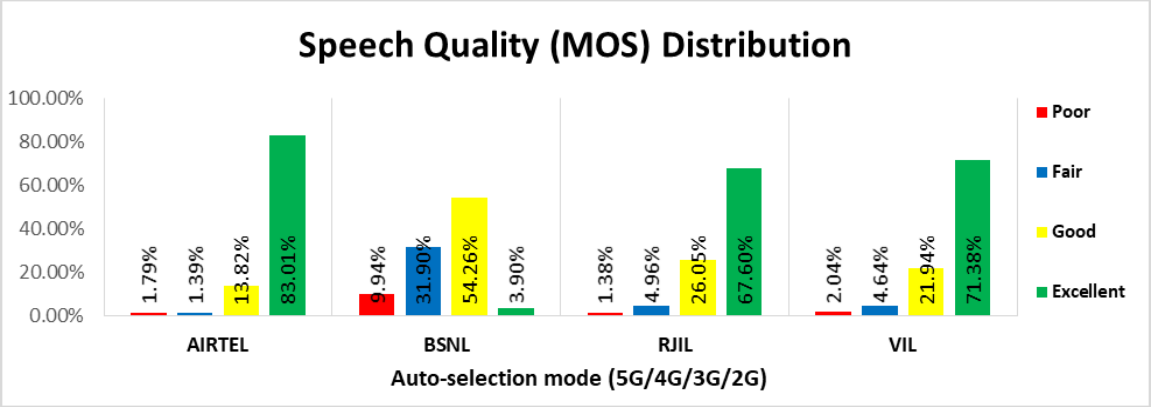


Figure- 4: Distribution of samples in MOS score range

(d) Inter-service provider voice call performance: To check the performance of inter-service provider call setup success rate, total 40 to 50 inter operator calls were attempted. The Call setup success rate and call setup time observation is as below.

Call setup success rate %				
From Service Provider	**To Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
AIRTEL	NA	100.00	100.00	100.00
BSNL	100.00	NA	100.00	100.00
RJIL	97.92	100.00	NA	100.00
VIL	100.00	97.67	100.00	NA

Table-9: Call setup success rate across service providers

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

Call setup time average (seconds)				
From Service Provider	**To Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
AIRTEL	NA	2.84	2.52	2.48
BSNL	5.49	NA	6.03	6.37
RJIL	2.11	2.36	NA	2.16
VIL	2.34	2.22	3.10	NA

Table-10: Call setup time across service providers

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

3.3 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	109.92	4.06	253.76	43.82
	80th Percentile	205.10	5.44	377.61	67.37
	20th Percentile	14.89	1.20	119.79	17.82
Upload Throughput (Mbits/s)	Average	32.27	2.48	24.91	19.86
	80th Percentile	55.61	3.36	41.99	33.82
	20th Percentile	9.88	1.24	6.67	6.38
Latency (ms)	50th Percentile	43.20	49.80	28.70	30.15

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

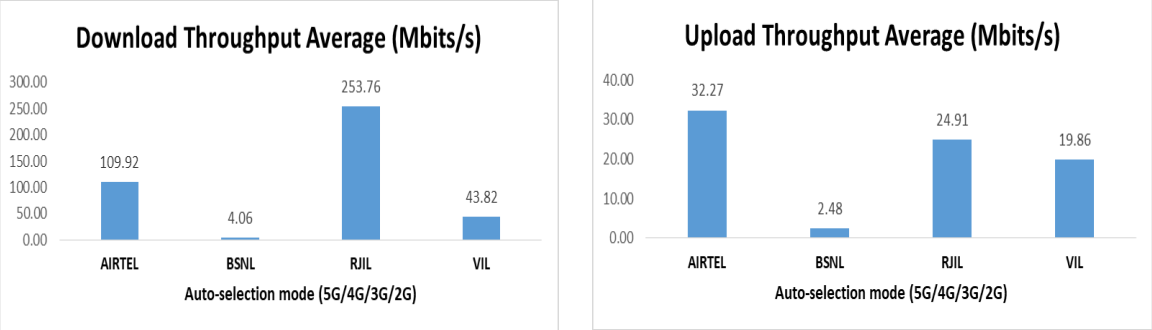


Figure- 5: Download and upload throughput

Number of unique cell id's covered in Data test- Technology wise				
Technology	Service Provider			
	Auto-selection mode 5G/4G/3G/2G			
	AIRTEL	BSNL	RJIL	VIL
5G	0	NA	597	NA
4G	1057	419	91	896
3G	NA	12	NA	NA
2G	0	4	NA	10

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

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

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis

4.1 Overview

This section covers analysis on performance of various categories of drives like City, Hotspots & Walk test 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 from 2nd December 2024 to 4th December 2024 in Raipur. (Refer Table-1)

4.2.1 Drive test route

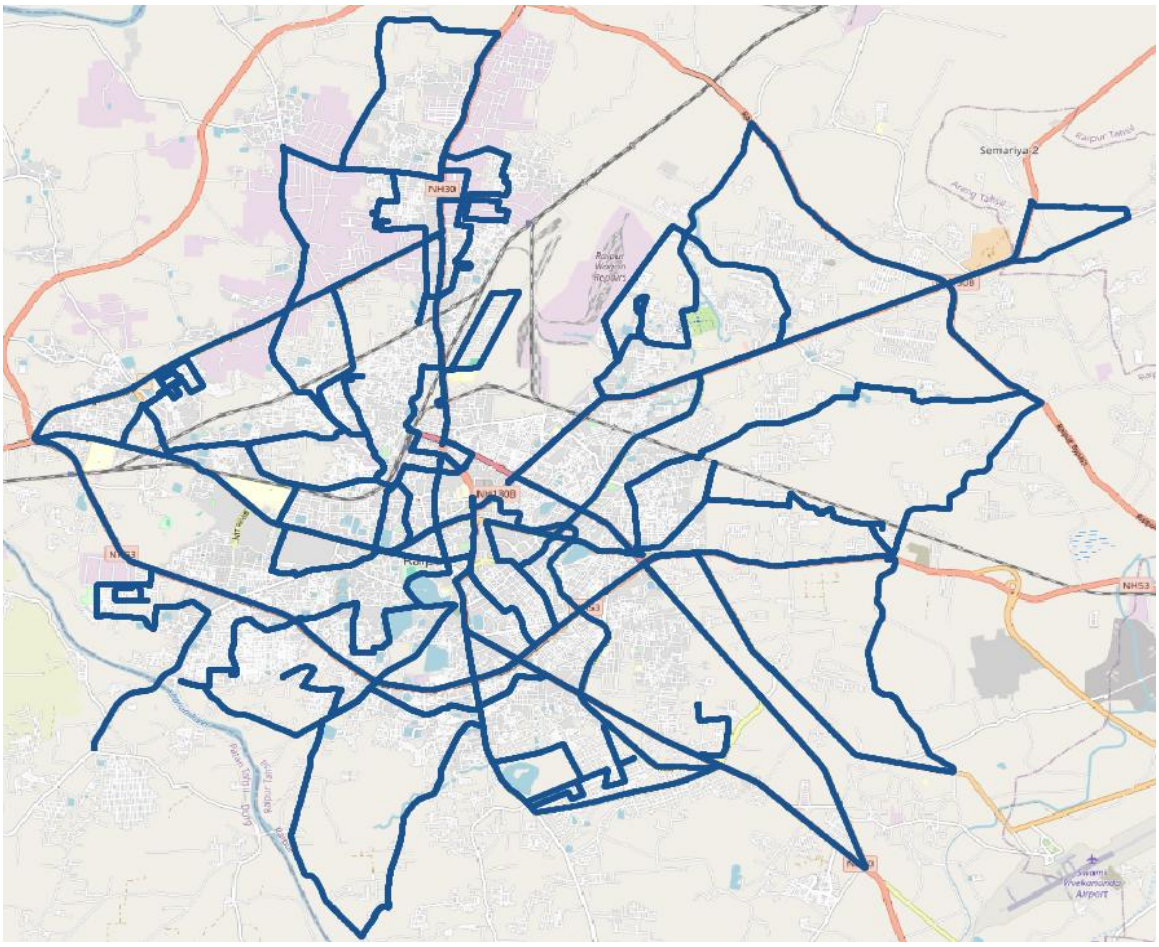


Figure- 6: Drive test routes

4.2.2 Areas covered

Bhanpuri, Kabir Nagar, Shrinagar, Tatibandh, Mowa, Bhatagaon, Kota, Sarona, Shankar Nagar, 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	454	471	463
Call Setup Success Rate %	99.34	99.15	99.78
Drop Call Rate%	0.22	1.93	0.87
Call Setup Time-Average (Second)	5.97	3.73	3.49
Handover Success Rate %	98.16	100.00	97.92

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

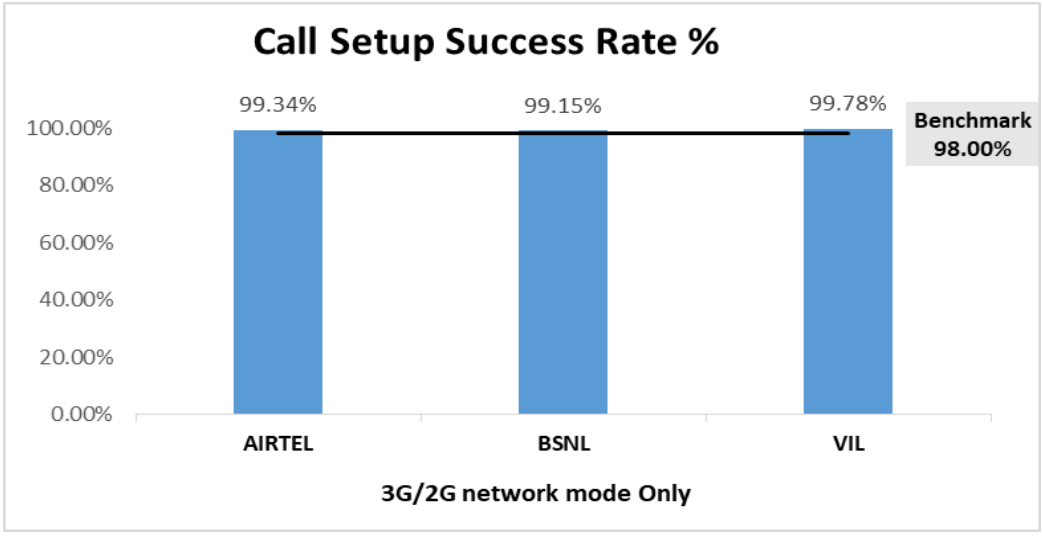


Figure-7: Performance for call setup success rate

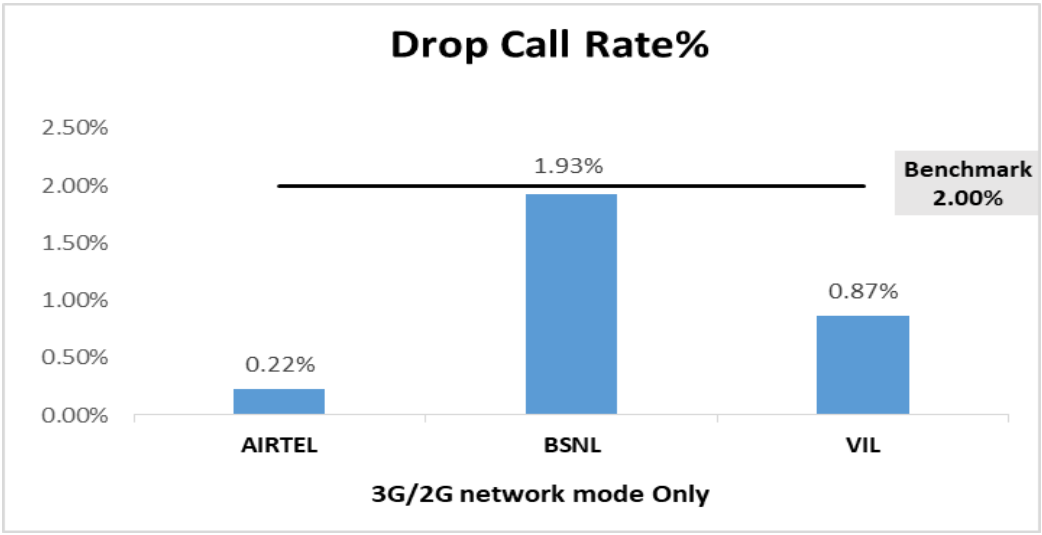


Figure-8: Performance for drop call rate

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

Technology	Service Provider		
	AIRTEL	BSNL	VIL
3G	NA	97.97%	NA
2G	99.94%	2.03%	100.00%
Limited service	0.06%	0.00%	0.00%

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

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

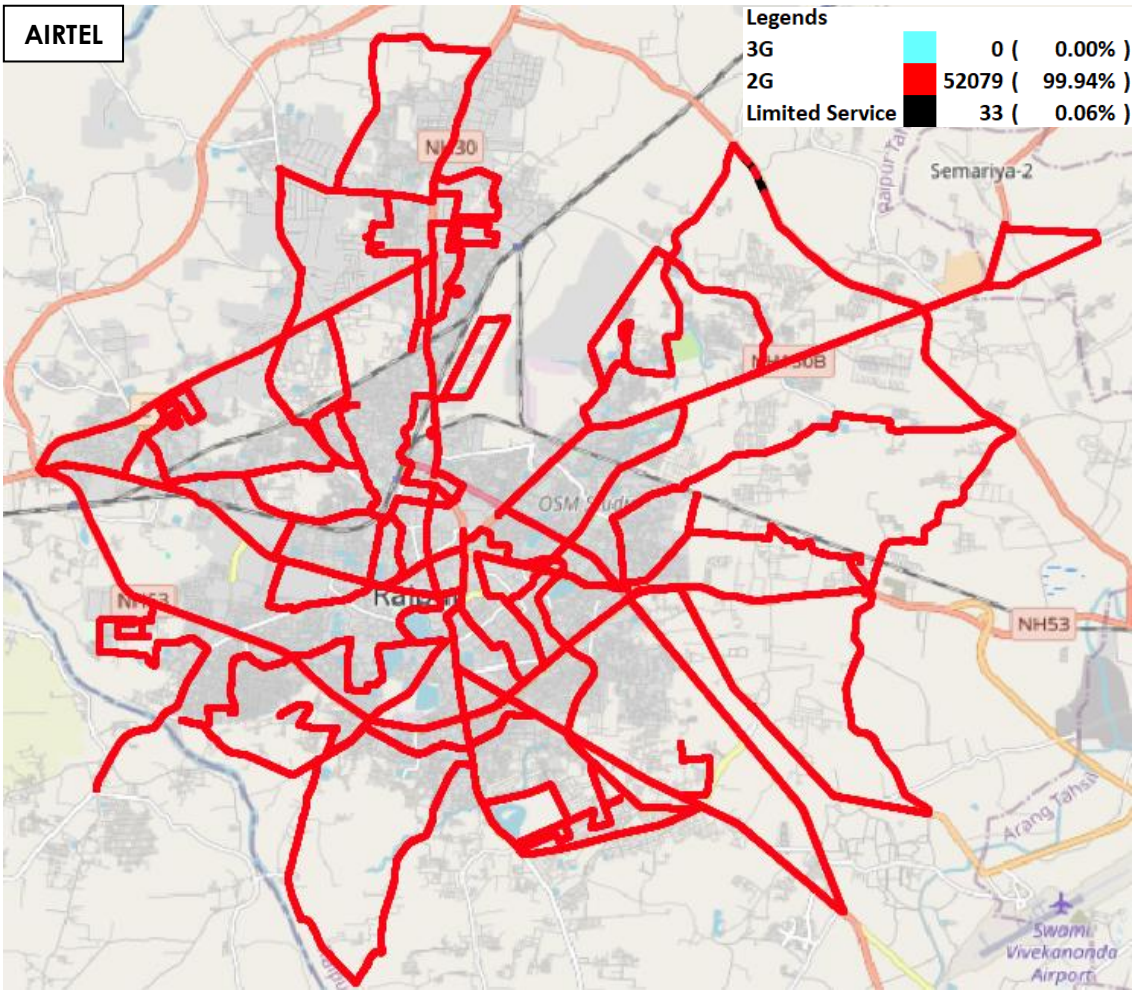


Figure-9: Serving technology plots 3G/2G network mode - AIRTEL

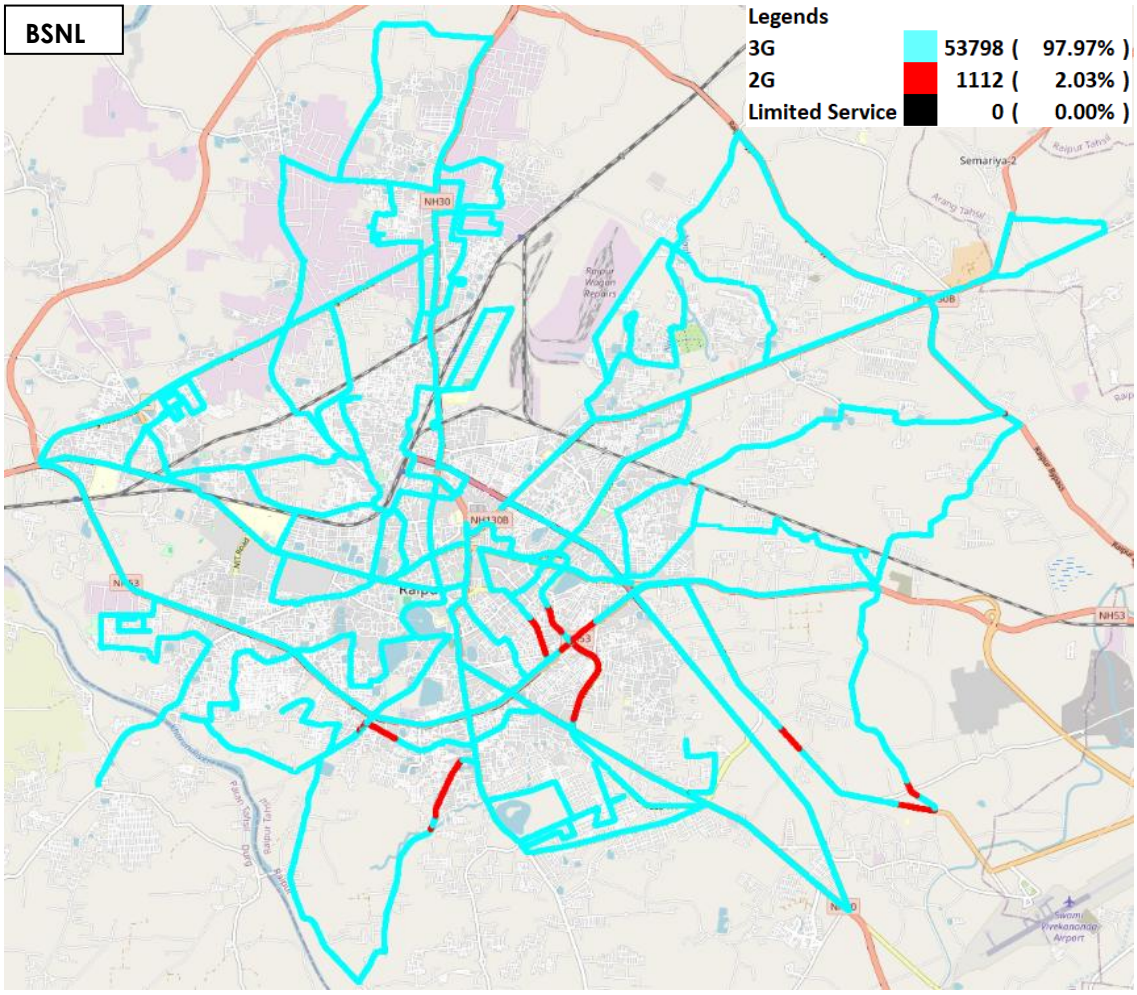


Figure-10: Serving technology plots 3G/2G network mode - BSNL

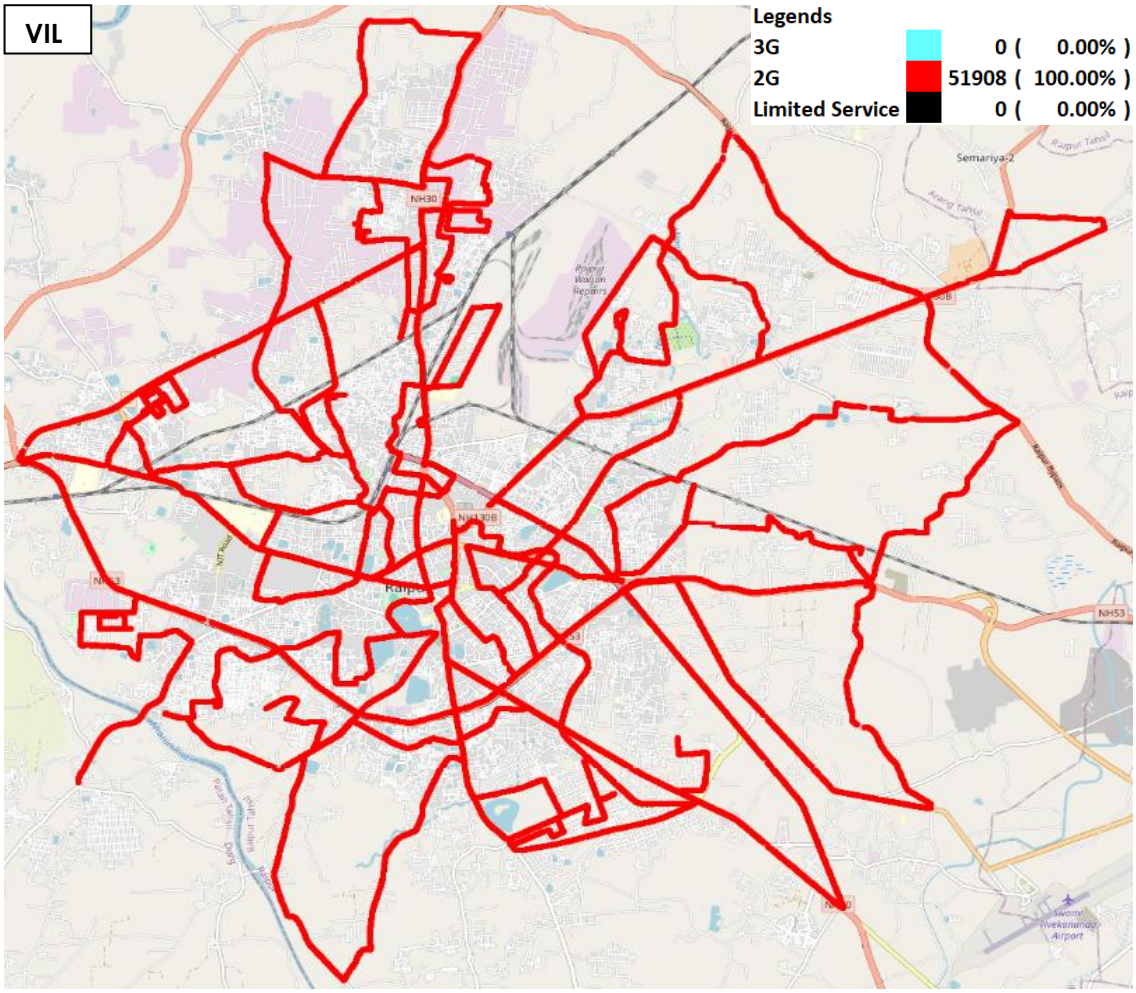


Figure-11: Serving technology plots 3G/2G network mode –VIL

(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)

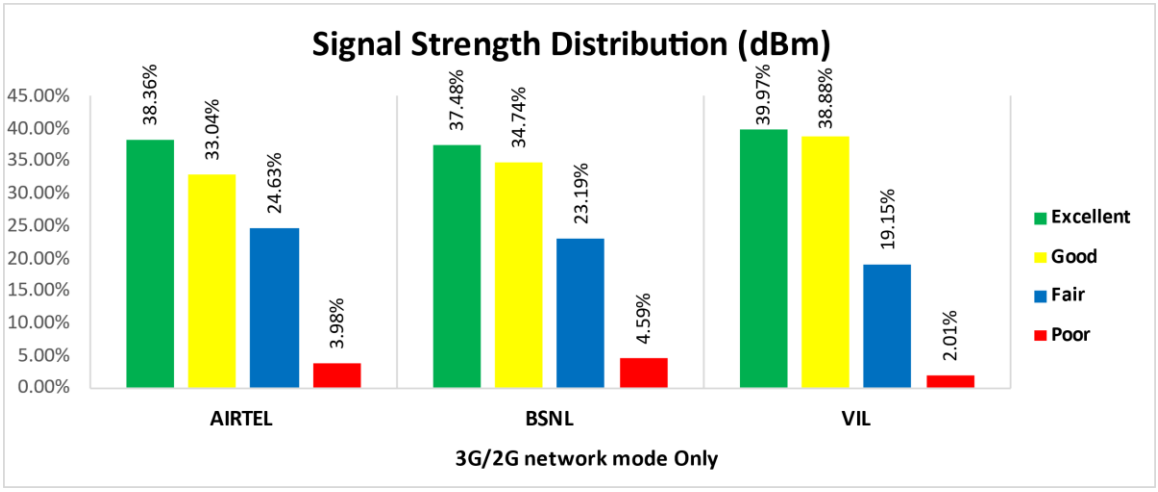


Figure-12: Signal strength distribution 3G/2G network mode only

Observations:

- Airtel has 38% of samples falling in the excellent signal strength category.
- BSNL has 37% of samples falling in the excellent signal strength category.
- VIL has 40% 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	482	477	499	485
Call Setup Success Rate %	100.00	98.32	100.00	100.00
Drop Call Rate%	0.00	0.85	0.40	0.00
Call Setup Time Average (Second)	1.28	4.56	0.76	0.80
Handover Success Rate %	99.93	99.84	99.91	99.95

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

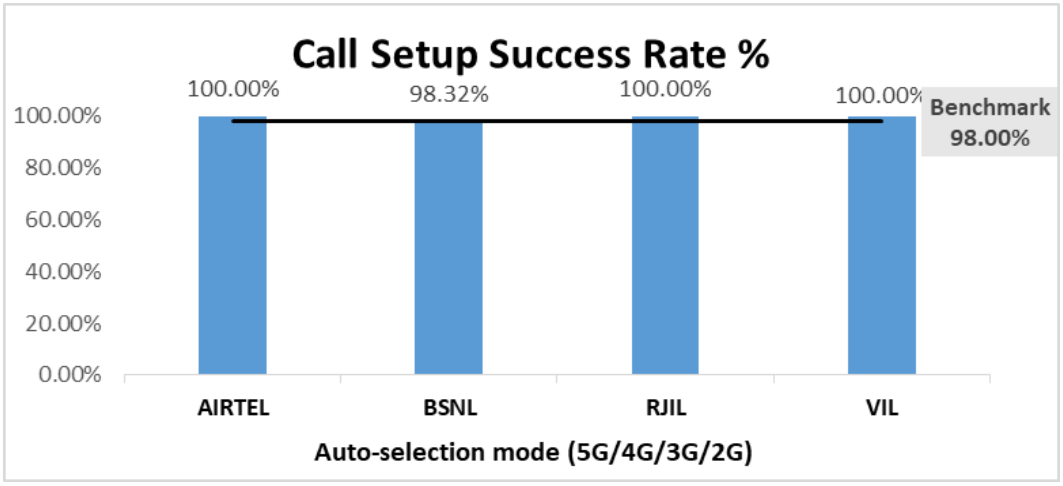


Figure-13: Performance for call setup success rate

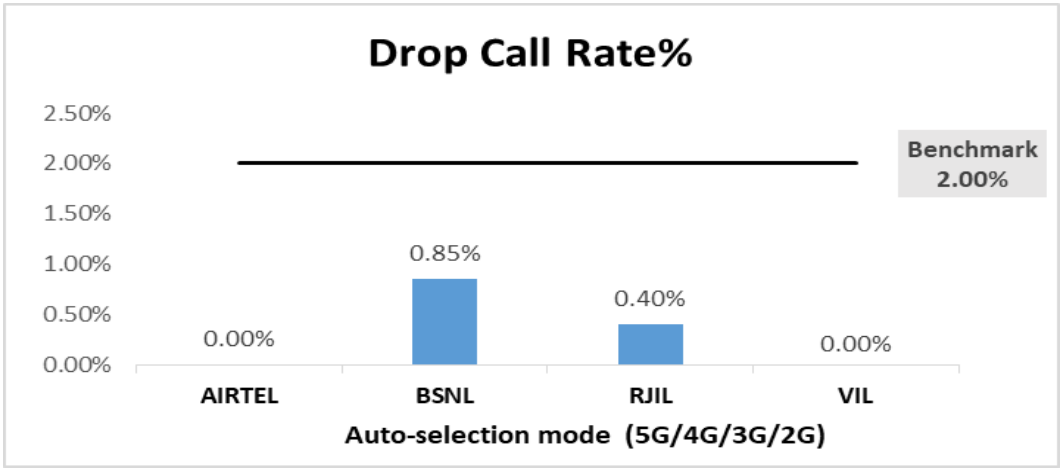


Figure-14: Performance for drop call rate

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	486	467	485	475
Number of silence call for >4 Sec	5	12	1	4
Silence Call Rate %	1.03	2.57	0.21	0.84
Number of silence instances for >4 Sec	5	14	2	4
Number of silence instances for >3 Sec	7	20	2	13
Number of silence instances for >2 sec	16	23	17	25
RTP Jitter (4G & 5G) in ms	4.95	17.23	8.57	13.94
Packet loss Rate Downlink %	0.64	6.40	0.31	0.79
Packet loss Rate Uplink %	0.76	8.12	0.56	0.76

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

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-16	2742	2514	2679	2799
Speech Quality (Average MOS Score)	3.99	2.94	3.88	3.96
Number of samples with MOS >=4 to <5(Excellent)	2276	98	1811	1998
Number of samples with MOS >=3 to <4 (Good)	379	1364	698	614
Number of samples with MOS >=2 to <3 (Fair)	38	802	133	130
Number of samples with MOS >=1 to <2 (Poor)	49	250	37	57
%age of samples with MOS >=4 to <5 (Excellent)	83.01%	3.90%	67.60%	71.38%
%age of samples with MOS >=3 to <4 (Good)	13.82%	54.26%	26.05%	21.94%
%age of samples with MOS >=2 to <3 (Fair)	1.39%	31.90%	4.96%	4.64%
%age of samples with MOS >=1 to <2 (Poor)	1.79%	9.94%	1.38%	2.04%

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

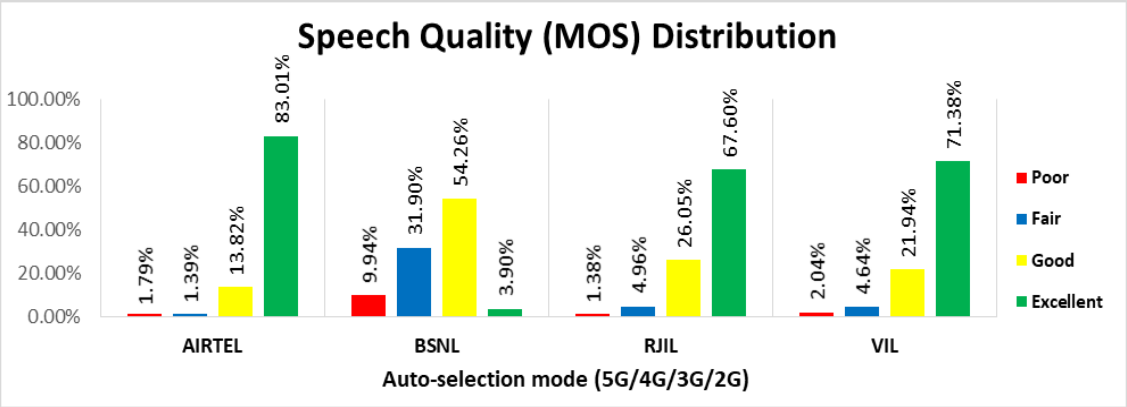


Figure-15: Distribution of samples in MOS score range

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	13.52%	NA	18.45%	NA
4G	86.48%	20.15%	81.54%	99.97%
3G	NA	34.09%	NA	NA
2G	0.00%	45.70%	NA	0.03%
Limited service	0.00%	0.06%	0.01%	0.00%

Table-18: Time spent on technology during drive test

Note-

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

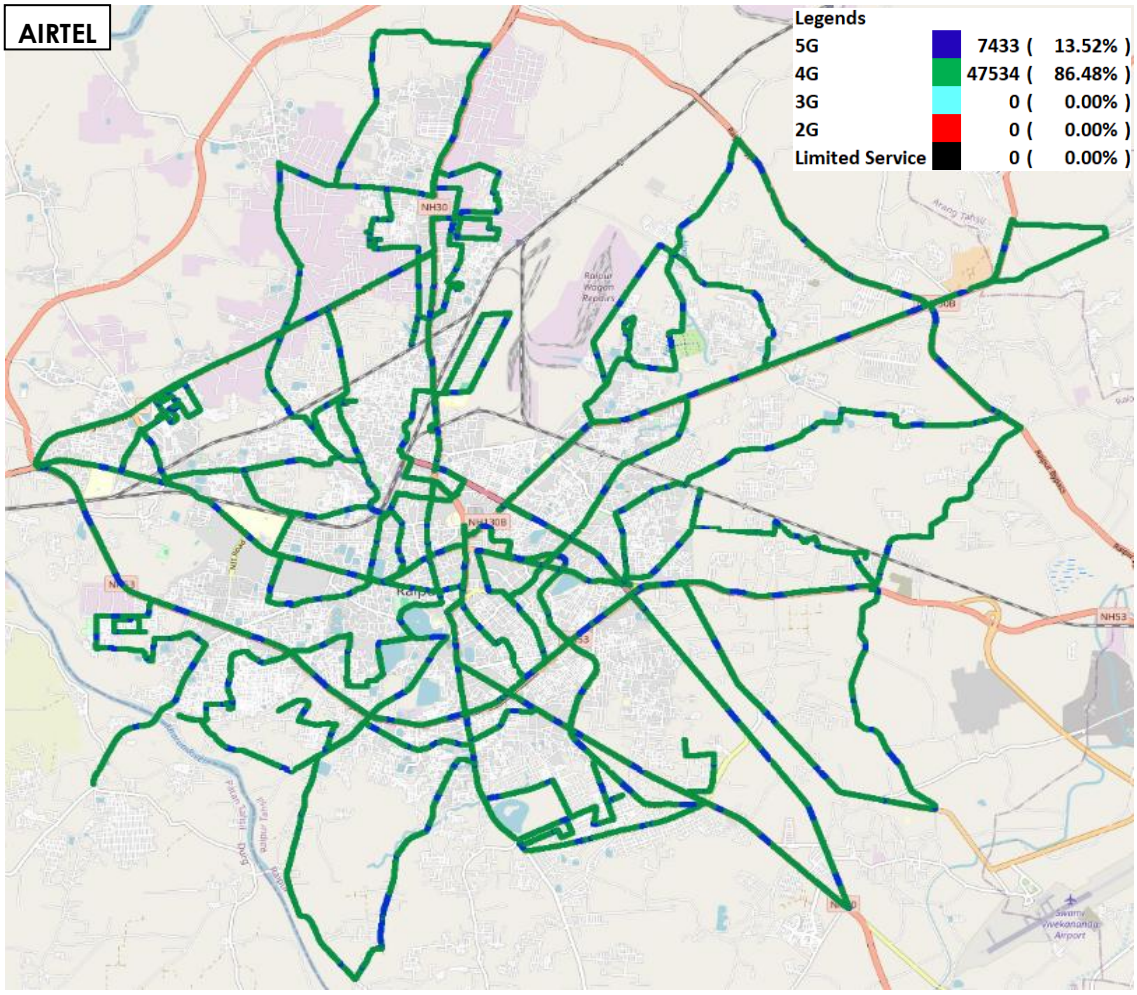


Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -AIRTEL

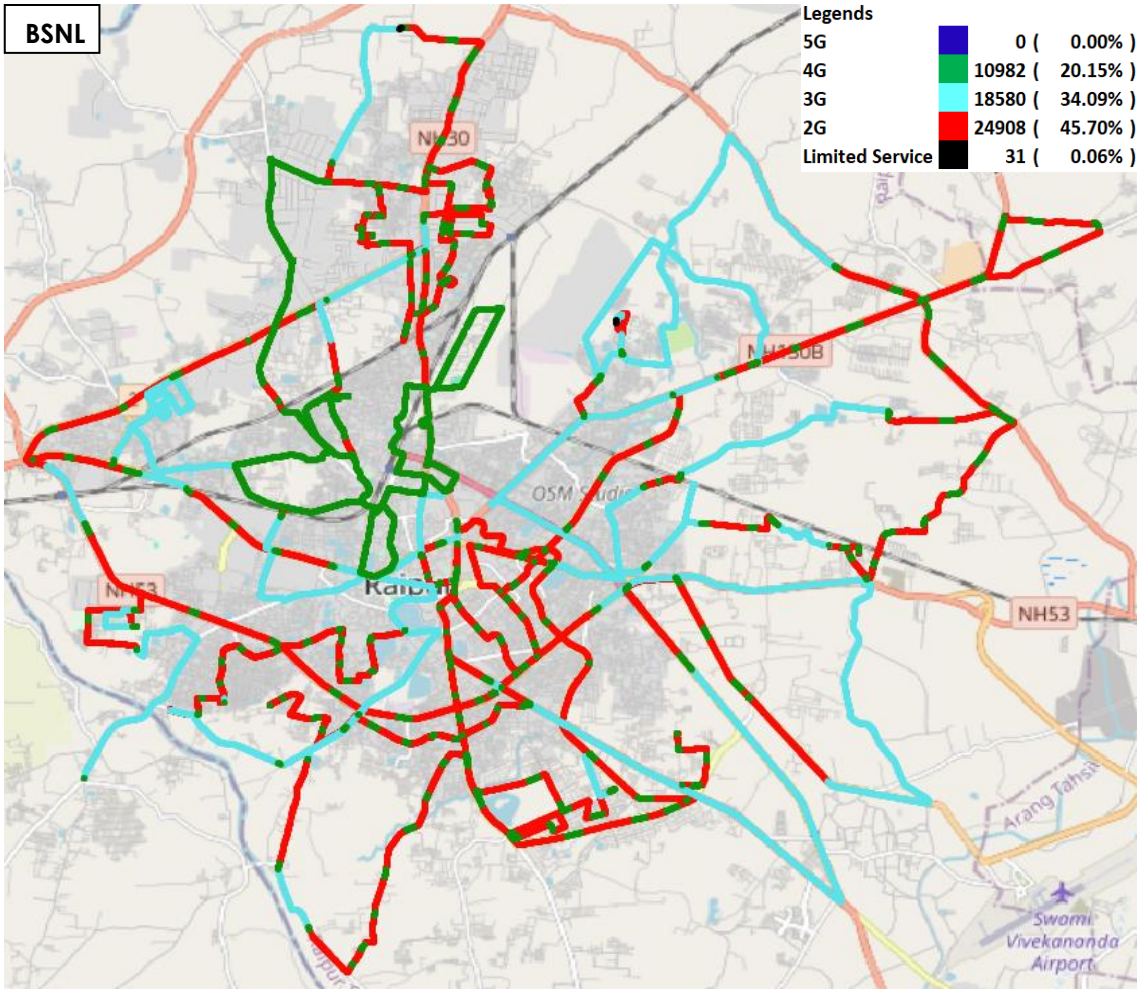


Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -BSNL

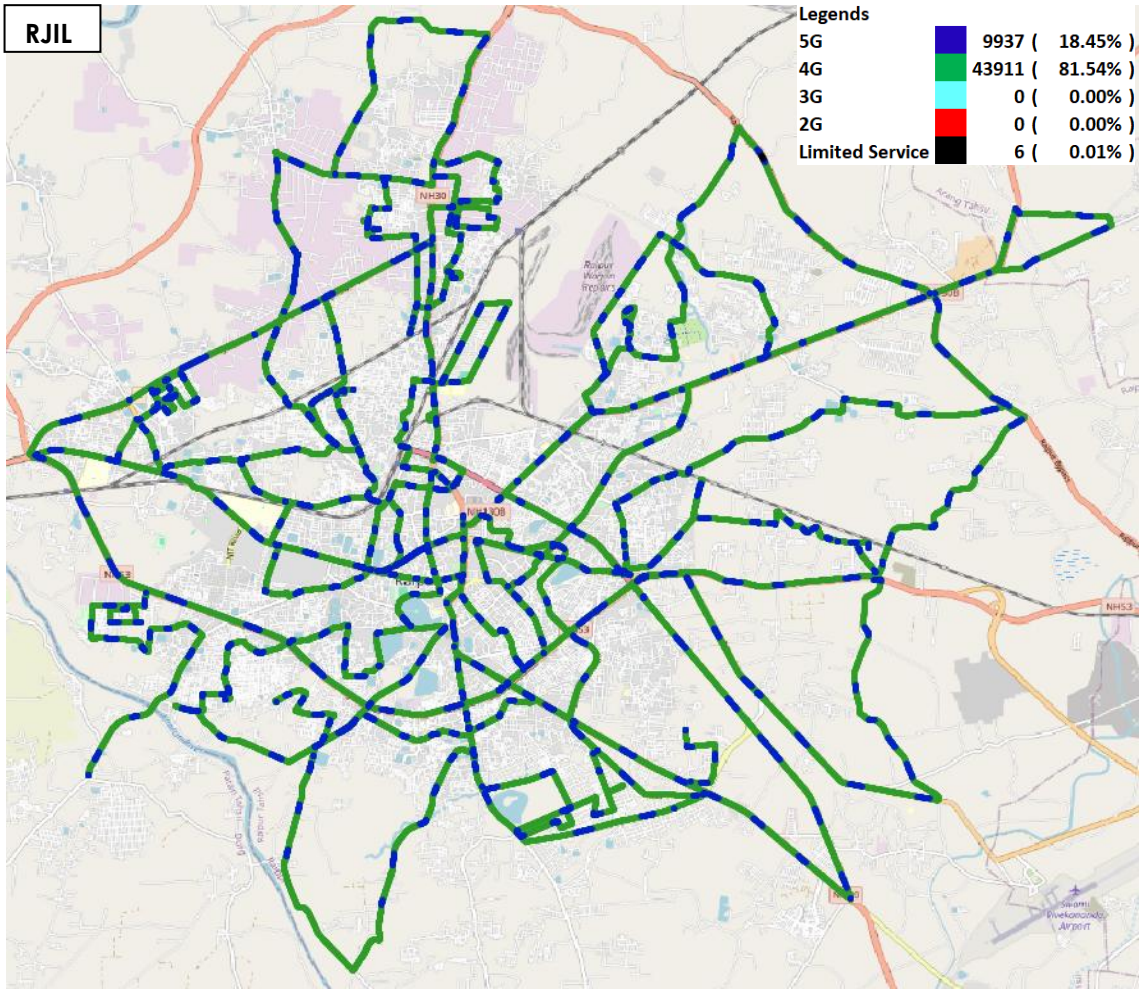


Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL

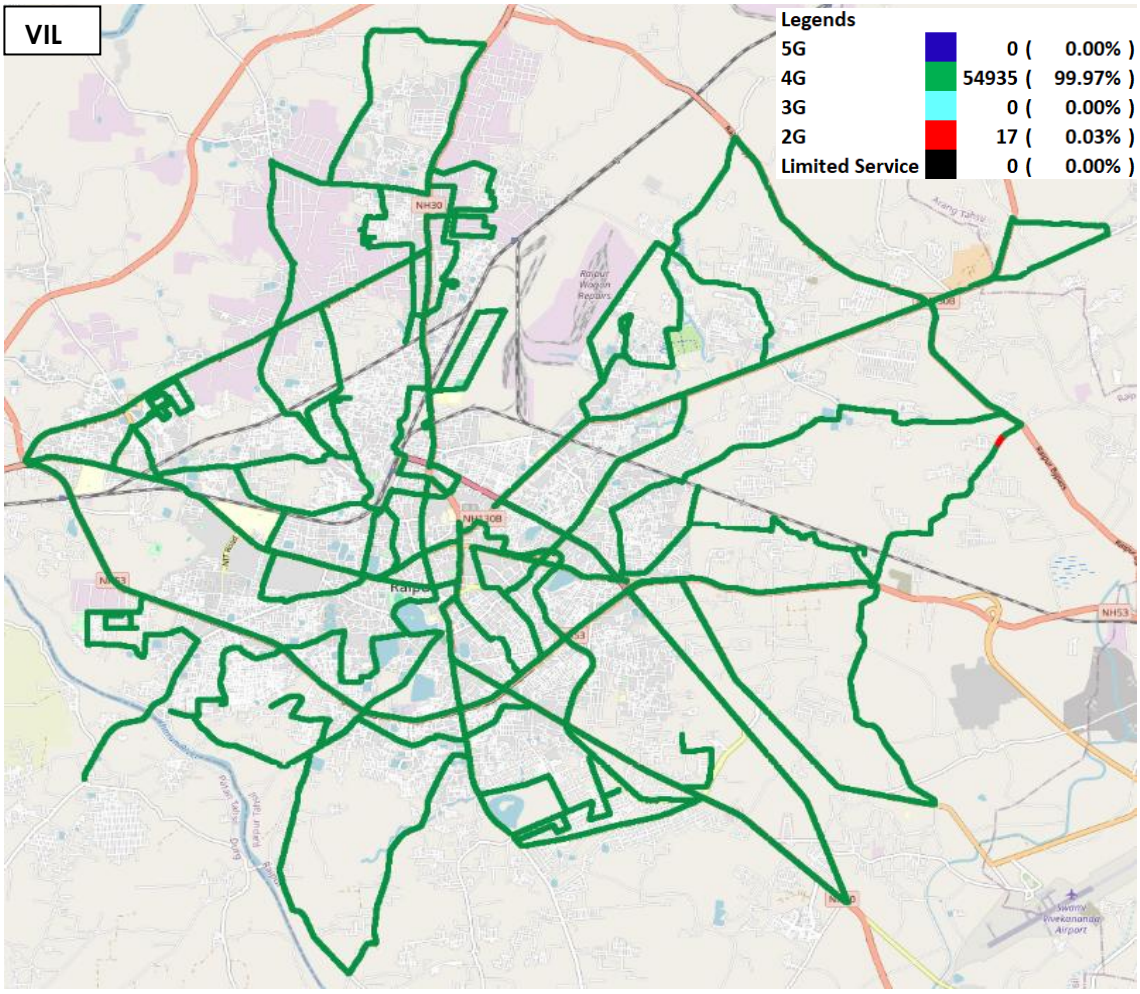


Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G) - VIL

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

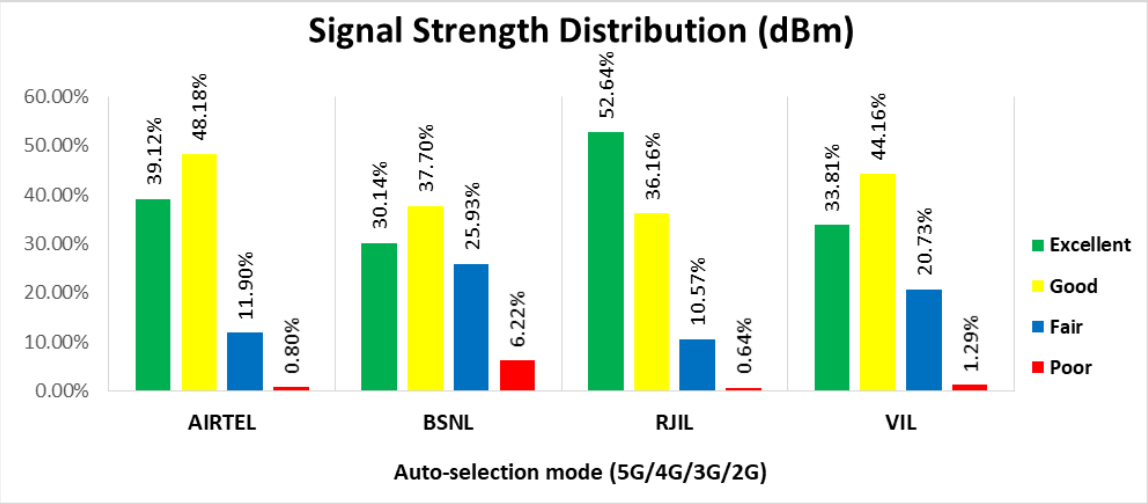


Figure-20: Signal strength distribution auto-selection mode 5G/4G/3G/2G

Observations:

- Airtel has 39% samples falling in the excellent signal strength category.
- BSNL has 30% samples falling in the excellent signal strength category.
- RJIL has 53% 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	116.94	4.21	259.69	41.44
	80th Percentile	215.65	5.70	383.20	61.03
	20th Percentile	15.10	1.17	120.97	16.63
Upload Throughput (Mbits/s)	Average	31.91	2.48	25.17	19.37
	80th Percentile	54.12	3.35	42.81	32.78
	20th Percentile	9.69	1.23	6.76	6.39
Latency (ms)	50th Percentile	45.65	46.60	26.85	36.30

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

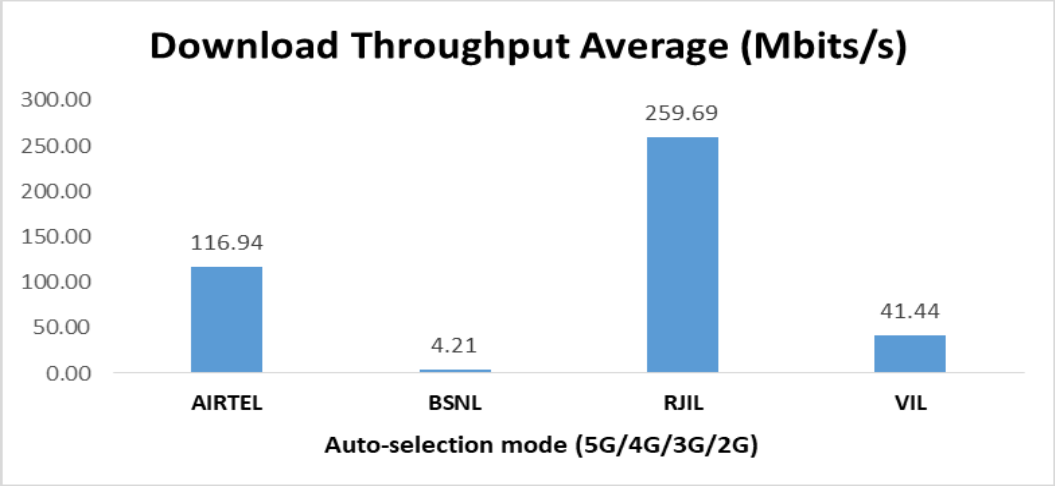


Figure- 21: Download throughput

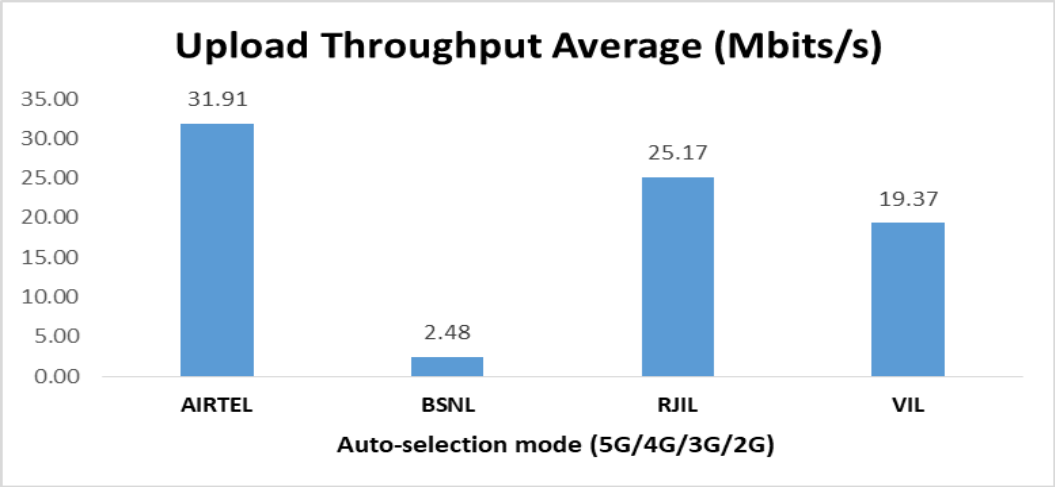


Figure- 22: Upload throughput

4.3 Hotspots

Hotspot testing has been done on 4th & 5th December 2024. Ten locations have been tested in the city.

4.3.1 Locations

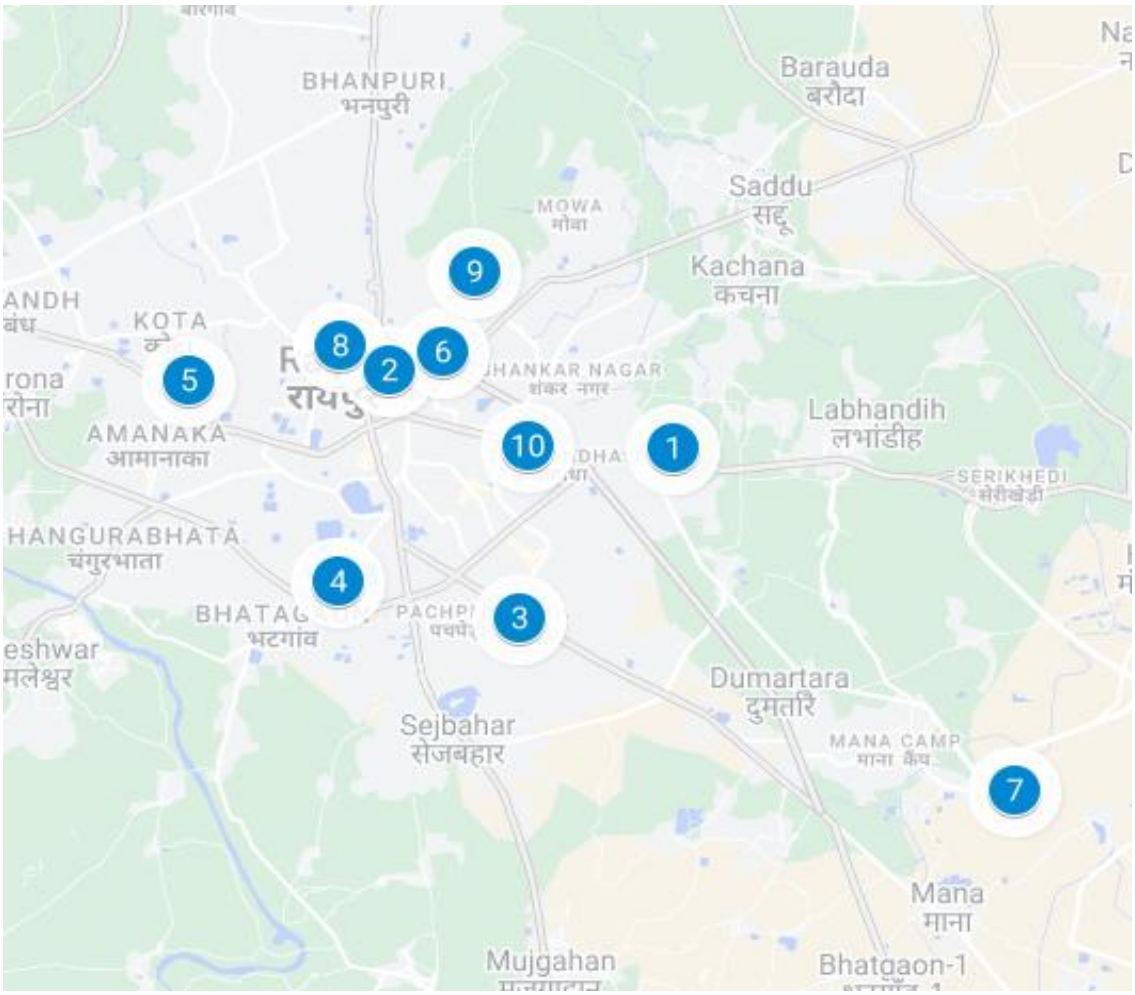


Figure- 23: Hotspot locations

4.3.2 Hotspot covered

1. Magneto Mall
2. Pt. Jawahar Lal Nehru Memorial Medical College, Raipur
3. MMI Narayana Hospital
4. New Interstate Bus Stand Bhatgaon
5. NIT Raipur
6. Pandri Market/City Centre Mall
7. Raipur Airport
8. Raipur Railway Station
9. Shri Narayana Hospital
10. Telibandha Talab

4.3.3 Voice performance

Overall Voice Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	100	100	100	100
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 (Sec)	1.24	4.94	0.73	0.82

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

Magneto Mall				
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 (Sec)	1.23	6.96	0.65	0.84

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

Pt. Jawahar Lal Nehru Memorial Medical College, Raipur				
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 (Sec)	1.23	4.18	0.66	0.84

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

MMI Narayana 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 (Sec)	1.18	5.99	0.89	0.89

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

New Interstate Bus Stand Bhatgaon				
Parameters	**Service Provider**			
	Auto 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 (Sec)	1.19	5.94	0.88	0.81

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

NIT Raipur				
Parameters	**Service Provider**			
	Auto 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 (Sec)	1.19	4.38	0.72	0.82

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

Pandri Market / City Centre Mall				
Parameters	**Service Provider**			
	Auto 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 (Sec)	1.18	4.10	0.72	0.72

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

Raipur Airport				
Parameters	**Service Provider**			
	Auto 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 (Sec)	1.17	5.67	0.88	0.93

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

Raipur Railway Station				
Parameters	**Service Provider**			
	Auto 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 (Sec)	1.51	4.15	0.62	0.83

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

Shri Narayana Hospital				
Parameters	**Service Provider**			
	Auto 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 (Sec)	1.25	4.20	0.67	0.65

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

Telibandha Talab				
Parameters	**Service Provider**			
	Auto 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 (Sec)	1.25	3.80	0.64	0.86

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

4.3.4 Data performance

Overall Data Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	75.59	3.67	225.94	68.59
Download Throughput 80th Percentile (Mbit/s)	135.44	4.82	309.75	91.52
Download Throughput 20th Percentile (Mbit/s)	15.34	2.32	123.11	29.83
Download Session Setup Success Rate %	100.00	84.00	92.00	100.00
Upload Throughput Average (Mbits/s)	35.61	2.63	23.15	27.14
Upload Throughput 80th Percentile (Mbit/s)	58.77	3.72	36.83	45.52
Upload Throughput 20th Percentile (Mbit/s)	9.30	1.47	5.75	7.49
Upload Session Setup Success Rate %	100.00	82.00	100.00	100.00
Web Browsing Delay (Second)	2.57	5.34	2.76	7.41
Youtube Initial Buffer Delay (Second)	0.76	1.90	0.73	1.18
Latency (ms)- 50th Percentile	40.55	52.50	30.80	24.60
Jitter (ms)	11.29	12.79	8.14	11.91
Packet Loss Rate %	7.52	5.20	0.44	2.11

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

Magneto Mall				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	119.10	5.05	263.32	81.85
Download Session Setup Success Rate %	100.00	60.00	60.00	100.00
Upload Throughput Average (Mbits/s)	18.56	2.29	33.82	22.66
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.54	5.07	2.59	6.59
Youtube Initial Buffer Delay (Second)	0.71	1.10	0.74	1.81
Latency (ms)- 50th Percentile	51.50	54.00	41.20	23.25
Jitter (ms)	21.85	8.76	6.65	13.30
Packet Loss Rate %	24.00	5.00	0.50	0.90

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

Pt. Jawahar Lal Nehru Memorial Medical College, Raipur				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	18.80	3.32	159.73	42.89
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	11.01	2.33	9.61	14.40
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.97	6.06	2.47	6.44
Youtube Initial Buffer Delay (Second)	0.68	4.00	0.69	0.64
Latency (ms)- 50th Percentile	53.50	48.45	30.40	23.00
Jitter (ms)	22.84	7.33	5.94	3.12
Packet Loss Rate %	24.10	1.80	0.20	0.70

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

MMI Narayana hospital				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	143.46	4.30	408.09	79.08
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	91.03	4.03	24.04	30.47
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.34	3.01	2.48	9.02
Youtube Initial Buffer Delay (Second)	0.79	1.10	0.66	0.73
Latency (ms)- 50th Percentile	36.95	48.55	26.50	24.55
Jitter (ms)	4.59	14.63	8.72	2.38
Packet Loss Rate %	0.10	4.80	0.00	0.70

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

New Interstate Bus Stand Bhatgaon				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	128.62	1.44	141.20	25.22
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	5.65	0.29	4.12	6.44
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	2.53	3.99	4.74	6.22
Youtube Initial Buffer Delay (Second)	0.81	4.24	0.76	2.85
Latency (ms)- 50th Percentile	44.85	60.00	27.65	24.45
Jitter (ms)	20.48	25.29	8.54	3.41
Packet Loss Rate %	2.90	13.70	0.10	0.30

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

NIT Raipur				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	15.50	2.23	62.32	83.51
Download Session Setup Success Rate %	100.00	80.00	80.00	100.00
Upload Throughput Average (Mbits/s)	38.88	2.10	37.21	39.97
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	2.24	6.60	2.83	5.01
Youtube Initial Buffer Delay (Second)	0.69	1.76	0.75	0.67
Latency (ms)- 50th Percentile	37.08	49.85	42.25	24.05
Jitter (ms)	5.43	7.43	13.17	2.28
Packet Loss Rate %	0.00	3.30	1.00	0.20

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

Pandri Market / City Centre Mall				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	12.35	3.44	484.63	98.59
Download Session Setup Success Rate %	100.00	60.00	80.00	100.00
Upload Throughput Average (Mbits/s)	57.27	3.03	51.03	47.80
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	2.59	6.03	2.48	9.81
Youtube Initial Buffer Delay (Second)	0.64	1.02	0.67	0.68
Latency (ms)- 50th Percentile	48.68	54.00	32.83	34.10
Jitter (ms)	6.67	5.07	10.78	46.29
Packet Loss Rate %	0.10	3.10	0.40	1.40

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

Raipur Airport				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	57.76	2.50	152.77	19.99
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	6.42	1.95	4.92	4.84
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.36	4.72	2.43	9.11
Youtube Initial Buffer Delay (Second)	0.96	2.67	0.84	2.42
Latency (ms)- 50th Percentile	53.50	55.50	25.80	33.30
Jitter (ms)	21.77	28.06	7.06	39.19
Packet Loss Rate %	23.90	8.60	1.40	15.10

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

Raipur Railway Station				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	15.27	5.82	179.25	79.61
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	18.93	4.68	31.62	46.93
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	3.30	4.08	2.69	7.28
Youtube Initial Buffer Delay (Second)	0.84	1.38	0.78	0.74
Latency (ms)- 50th Percentile	32.50	42.95	40.88	23.05
Jitter (ms)	3.93	12.90	3.55	2.09
Packet Loss Rate %	0.10	1.00	0.10	1.30

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

Shri Narayana Hospital				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	16.15	3.50	233.31	79.32
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	55.74	3.23	23.52	14.63
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	2.47	6.93	2.35	7.44
Youtube Initial Buffer Delay (Second)	0.69	0.90	0.67	0.74
Latency (ms)- 50th Percentile	41.43	52.50	32.25	25.05
Jitter (ms)	2.46	7.07	7.46	4.50
Packet Loss Rate %	0.00	4.70	0.30	0.30

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

Telibandha Talab				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	228.90	4.68	208.76	95.85
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	52.57	1.60	11.57	43.27
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.36	6.17	2.57	7.21
Youtube Initial Buffer Delay (Second)	0.82	2.07	0.73	0.73
Latency (ms)- 50th Percentile	39.10	61.50	32.95	23.60
Jitter (ms)	2.89	12.90	9.56	2.60
Packet Loss Rate %	0.00	6.00	0.40	0.20

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

4.4 Walk Test

Drive test has been conducted on 05th December 2024 covering one walk test. (Refer Table-1)

4.4.1 Walk-Test location map

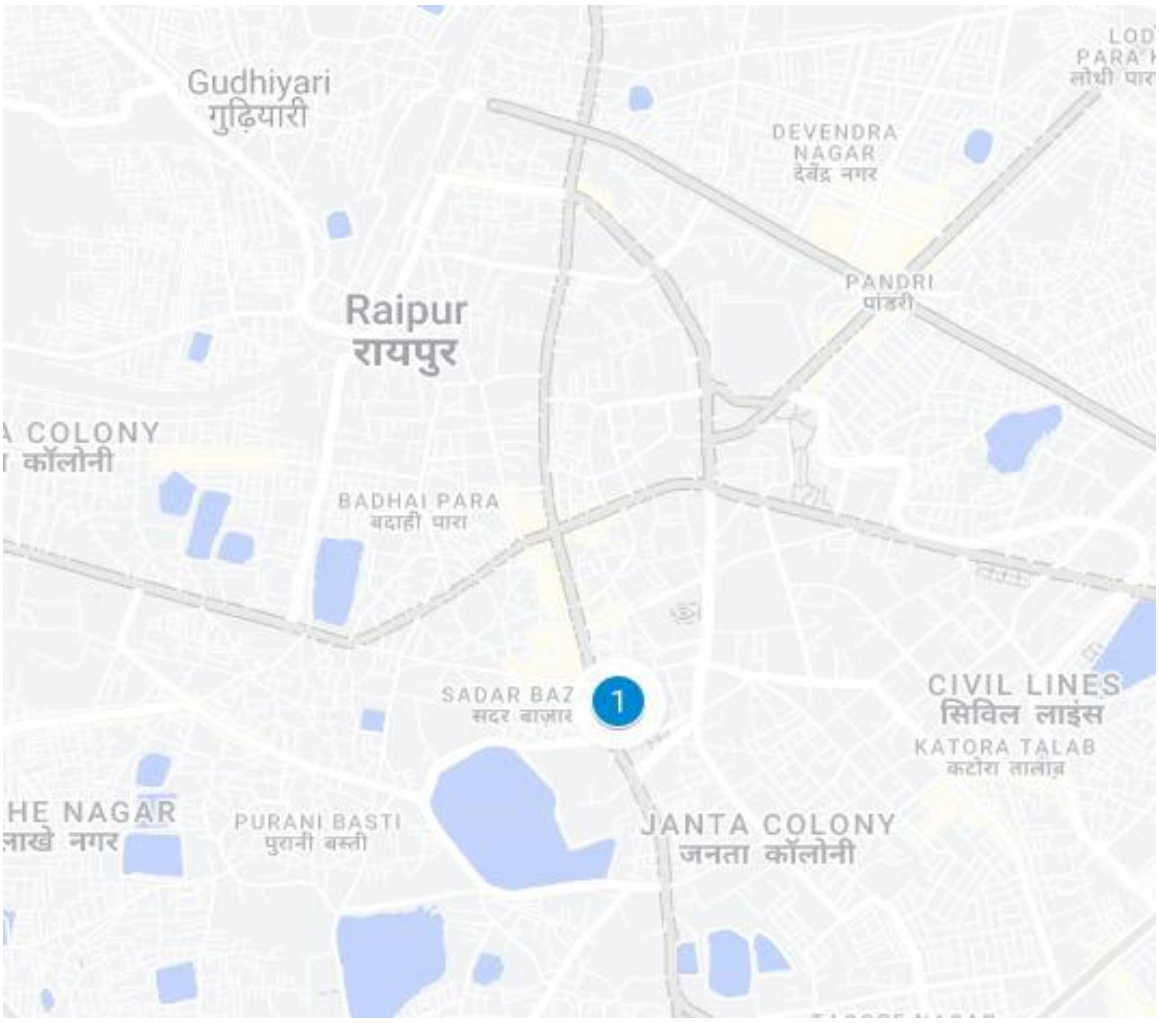

Figure- 24: Walk test locations

4.4.2 Walk test covered

- Gol Bazaar

4.4.3 Voice performance

Gol Bazaar				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempts	38	37	39	39
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)	1.44	4.54	0.74	0.77

Table-42: Summary of voice call performance in network auto-selection mode

4.4.4 Data performance

Gol Bazaar				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	52.50	2.65	214.49	48.08
Download Session Setup Success Rate %	98.00	69.09	85.71	100.00
Upload Throughput Average (Mbits/s)	33.50	2.30	23.95	18.42
Upload Session Setup Success Rate %	100.00	67.27	97.56	100.00
Latency (ms)- 50th Percentile	46.85	48.30	29.50	31.70

Table-43: Summary of Data performance in network auto-selection mode

5. Voice & Data Key findings

5.1 Overall Voice

1. **Call setup success rate:**
   a) Airtel, BSNL and VIL have 99.34%, 99.15% and 99.78 call setup success rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL have 100.00%, 98.70%, 100.00% and 100.00% call setup success rate respectively in Auto-selection mode (5G/4G/3G/2G). (refer table-5)

   c) Airtel and BSNL have 100% call setup success rate while calling on peer service provider's network, while remaining service providers have block call rate for inter-operator calls. (refer table-9)

2. **Call Setup time:**
   a) Airtel has taken comparatively longer time (5.97 second) to establish voice call, whereas BSNL and VIL call setup time is 3.73 & 3.49 seconds respectively in 3G/2G network mode. (refer table-3)

b) BSNL has taken comparatively longer time (4.62 second) to establish the voice call, whereas Airtel, VIL and RJIL call setup time is 1.28, 0.80 & 0.75 seconds respectively in Auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**:
   a) In packet switched network (4G/5G), BSNL, Airtel, VIL and RJIL have 2.57%, 1.03%, 0.84% & 0.21 silence call rate respectively. Further BSNL has higher RTP packet loss rate in downlink (6.40%) compared to VIL (0.79%), Airtel (0.64%) and RJIL (0.31%). In uplink the RTP packet loss rate is higher for BSNL (8.12%) compared to Airtel (0.76%), VIL (0.76%) and RJIL (0.56%). (refer table-6)

4. **Call Drop Rate**:
   a) BSNL, VIL and Airtel have 1.93%, 0.87% and 0.22% drop call rate respectively in 3G/2G network mode. (refer table-3)

   b) BSNL, RJIL, Airtel and VIL have 0.66%, 0.31%, 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 (Dynamic i.e. while moving) :**
   a) BSNL (4.06 Mbps) and VIL (43.82 Mbps) being on 3G & 4G as top technology respectively, have comparatively lower data speeds. While Airtel and Jio have average download speed of 109.92 Mbps and 253.76 Mbps respectively. (refer table-11)

   b) BSNL (2.48 Mbps) and VIL (19.86 Mbps) being on 3G & 4G as top technology respectively, have comparatively lower data speeds. While Airtel and Jio have average upload speed of 32.27 Mbps and 24.91 Mbps respectively. (refer table-11)

2. **Data download and upload performance (static i.e. while stationary):**
   a) At hotspots, RJIL has better 5G QoS performance comparatively, with average download speed of 225.94 Mbps. (refer table-31)

   b) Airtel has better 5G QoS performance comparatively, with average upload speed of 35.61 Mbps. (refer table-31)

3. **Data session setup success rate (static i.e. while stationary):**
   a) Airtel & VIL have 100.00% download session setup success rate. (refer table-31)

   b) Airtel, RJIL & VIL have 100.00% upload session setup success rate. (refer table-31)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 99.34% call setup success rate and 0.22% call drop rate have been observed in 3G/2G network mode. Performance is well within benchmark of 2%. (refer table-3 and 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 LSA and city drive. (refer table-5 and 15)

Data

- Airtel has 109.92 Mbps average download throughput & 32.27 Mbps average upload throughput across measured routes for LSA (refer Table-11).
- Airtel has 116.94 Mbps average download throughput & 31.91 Mbps average upload throughput across measured routes for city drive (refer Table- 19).
- Pt. Jawahar Lal Nehru Memorial Medical College Raipur, NIT Raipur, Pandri Market/City Centre Mall, Raipur Airport, Raipur Railway Station and Shri Narayana Hospital hotspots have less download speeds (less than 100 Mbps) out of total 10 hotspots. (refer table- 33, 36, 37, 38, 39 and 40).
- New Interstate Bus Stand Bhatgaon and Raipur Airport has (less than 10 Mbps) upload throughput out of total 10 hotspots. (refer Table- 35 and 38)
- Airtel has 52.50 Mbps average download throughput & 33.50 Mbps average upload throughput measured at Gol Bazaar walk test. (refer Table- 43)

2. BSNL:

Voice

- 99.15% call setup success rate and 1.93% call drop rate have been observed in 3G/2G network mode. Performance is well within benchmark of 2%. (refer table-3 and table- 13)
- 98.70% call setup success rate and 0.66% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)
- 98.32% call setup success rate and 0.85% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive.(refer table-15)

Data

- BSNL has 4.06 Mbps average download throughput & 2.48 Mbps average upload throughput across measured routes for LSA (refer Table-11)
- BSNL has 4.21 Mbps average download throughput & 2.48 Mbps average upload throughput across measured routes for city drive (refer Table-19)

- All locations have (less than 15 Mbps) download throughput out of total 10 hotspots. (refer table- 32 to 41).
- All locations have (less than 5 Mbps) upload throughput out of total 10 hotspots. (refer Table- 32 to 41)
- BSNL has 2.65 Mbps average download throughput & 2.30 Mbps average upload throughput measured in Gol Bazaar (refer Table- 43)

3. RJIL:

Voice

- 100.00% call setup success rate and 0.31% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA.(refer Table-5)
- 100.00% call setup success rate and 0.40% drop call rate observed for auto-selection mode (5G/4G/3G/2G) for city drive.(refer Table-15)

Data

- RJIL has 253.76 Mbps average download throughput & 24.91 Mbps average upload throughput across measured routes in LSA. (refer Table-11)
- RJIL has 259.69 Mbps average download throughput & 25.17 Mbps average upload throughput across measured routes in city drive. (refer Table-19)
- NIT Raipur hotspot location has less download speeds (less than 100 Mbps) out of total 10 hotspots. (refer Table- 36).
- Pt. Jawahar Lal Nehru Memorial Medical College Raipur, New Interstate Bus Stand Bhatgaon and Raipur Airport has (less than 10 Mbps) upload throughput out of total 10 hotspots. (refer table- 33, 35 and 38)
- RJIL has 214.49 Mbps average download throughput & 23.95 Mbps average upload throughput measured in Gol Bazaar (refer table- 43)

4. VIL:

Voice

- 99.78% call setup success rate and 0.87% call drop rate have been observed in 3G/2G network mode. Performance is well within benchmark of 2%. (refer table-3 and 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 LSA. (refer table-5 & 15)

Data

- VIL has 43.82 Mbps average download throughput & 19.86 Mbps average upload throughput across measured routes in LSA. (refer table-11)

- VIL has 41.44 Mbps average download throughput & 19.37 Mbps average upload throughput across measured routes in city drive. (refer table-19)
- No location have observed (less than 15 Mbps) download throughput out of total 10 hotspots.
- Raipur Airport has (less than 5 Mbps) upload throughput out of total 10 hotspots. (refer table- 38)
- VIL has 48.08 Mbps average download throughput & 18.42 Mbps average upload throughput measured at Gol Bazaar Walk test(refer table- 43)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

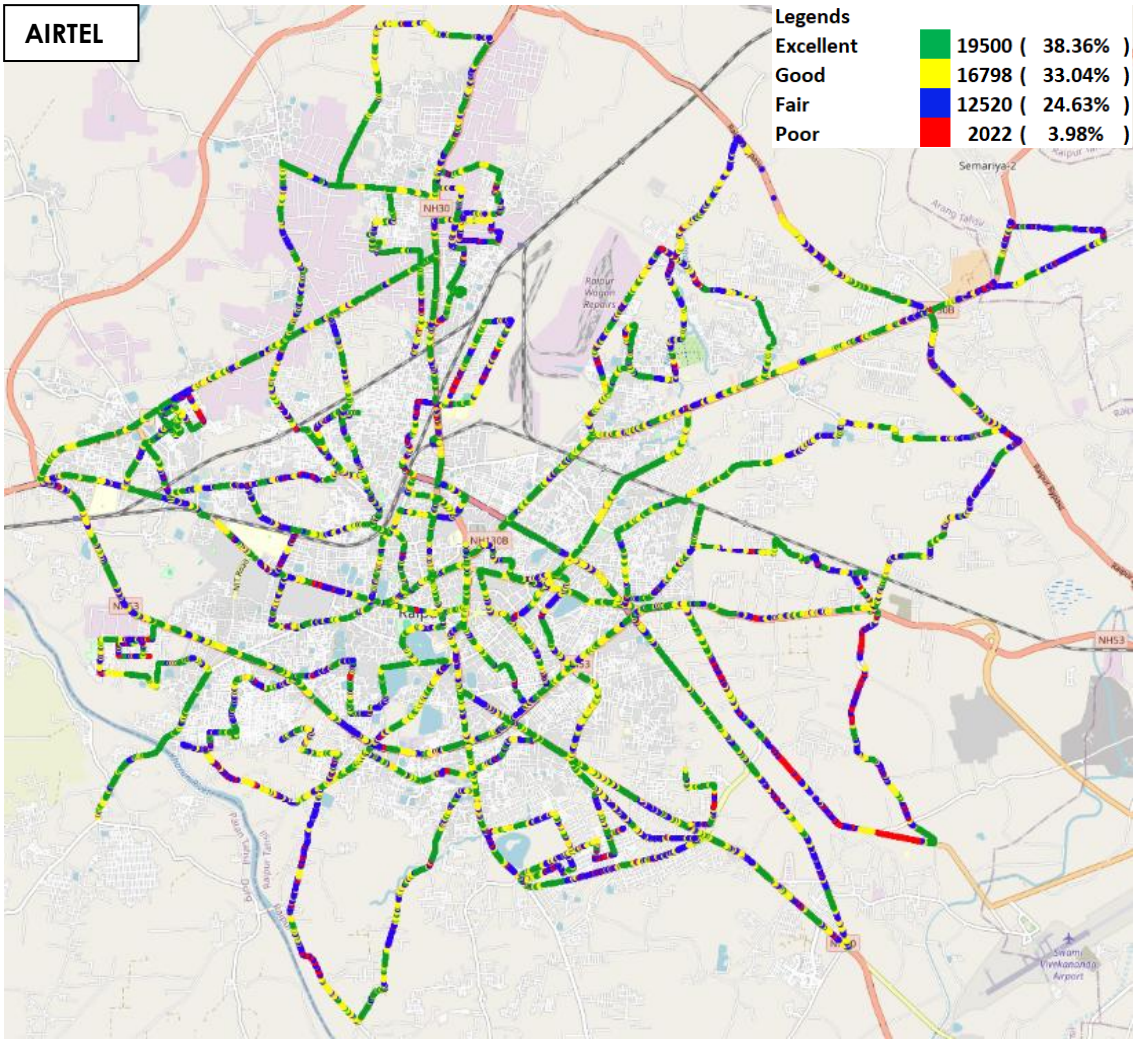

Figure-25: Signal strength 3G/2G network mode – AIRTEL

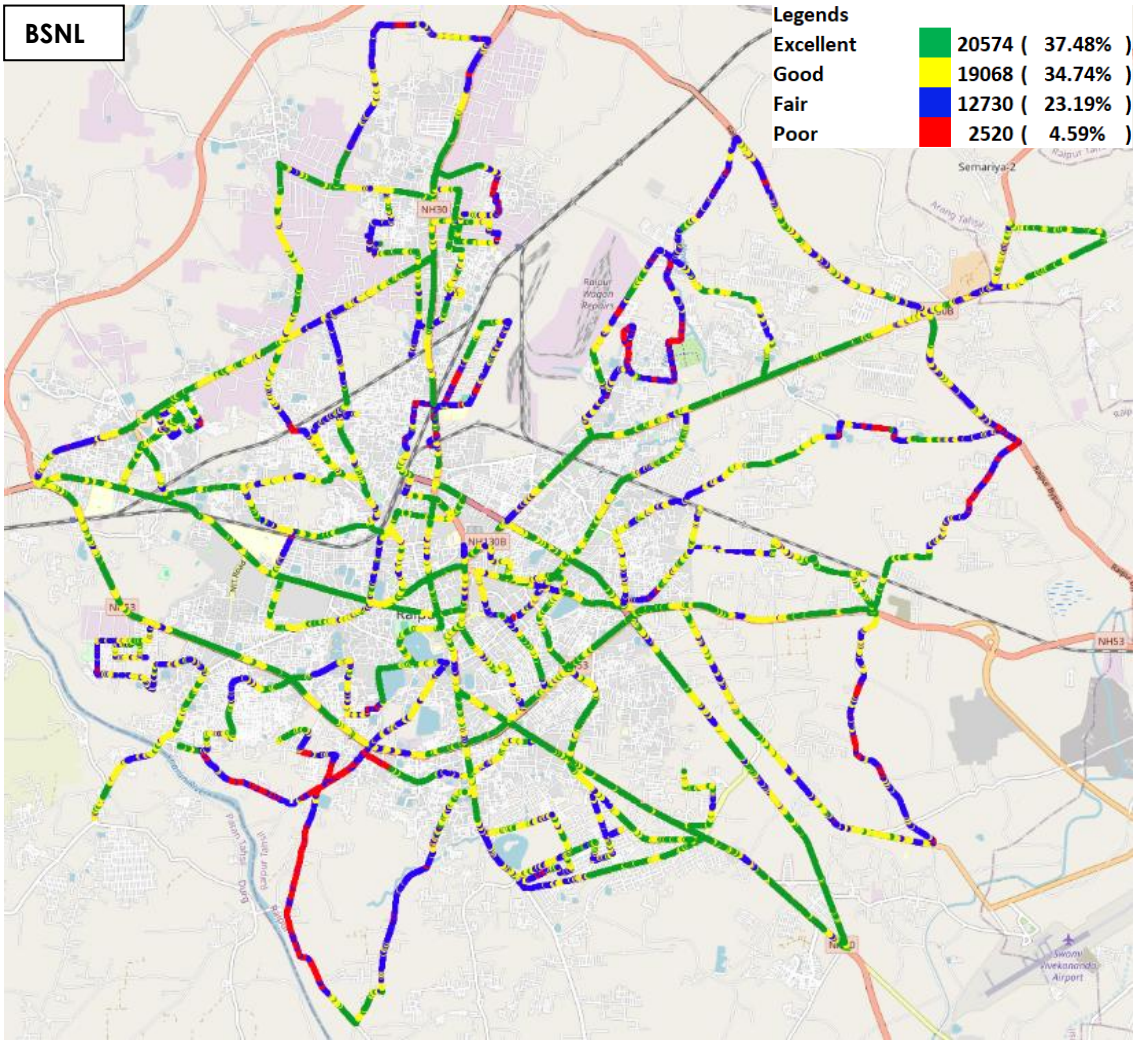

Figure-26: Signal strength 3G/2G network mode – BSNL

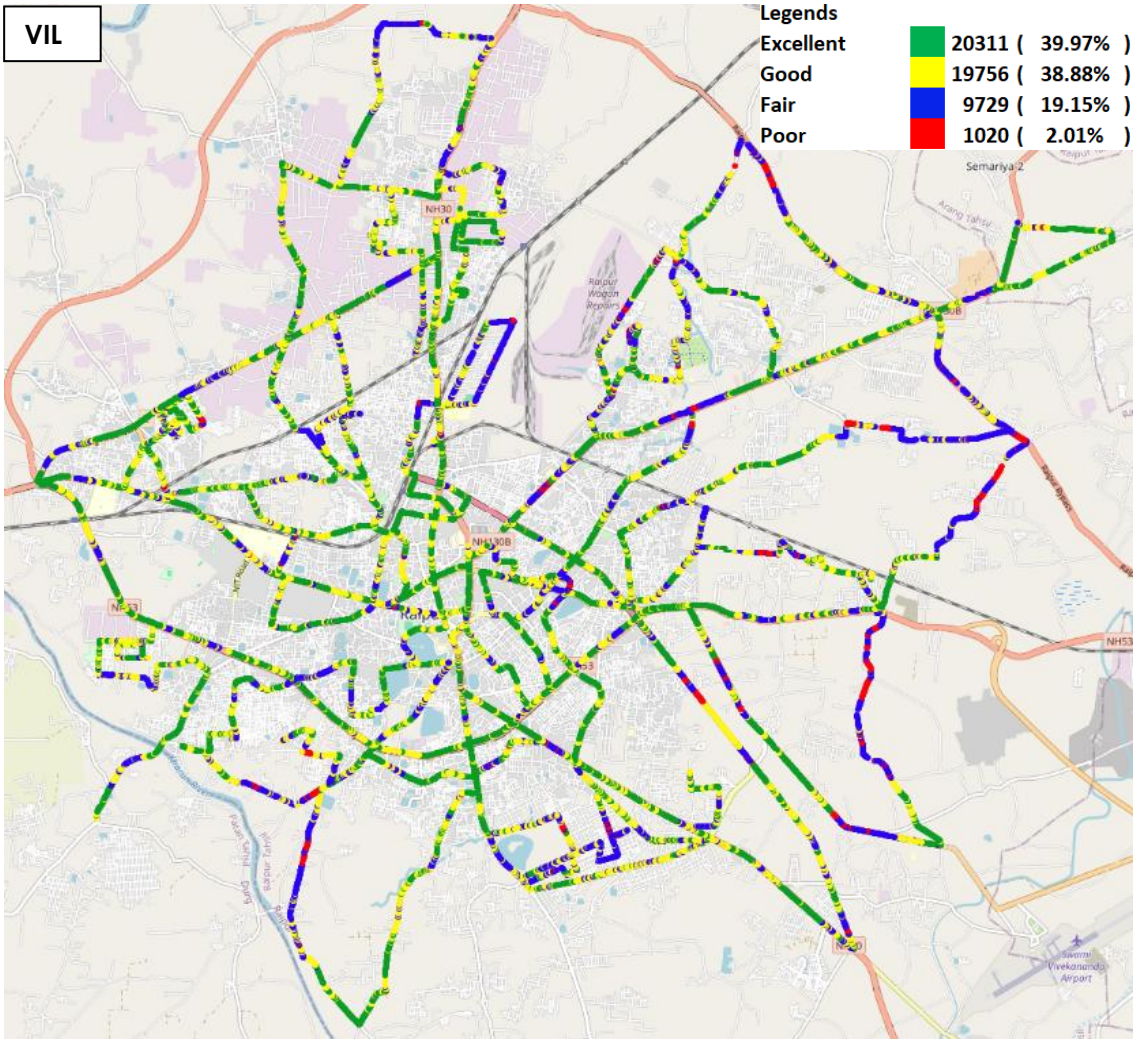

Figure-27: Signal strength 3G/2G network mode - VIL

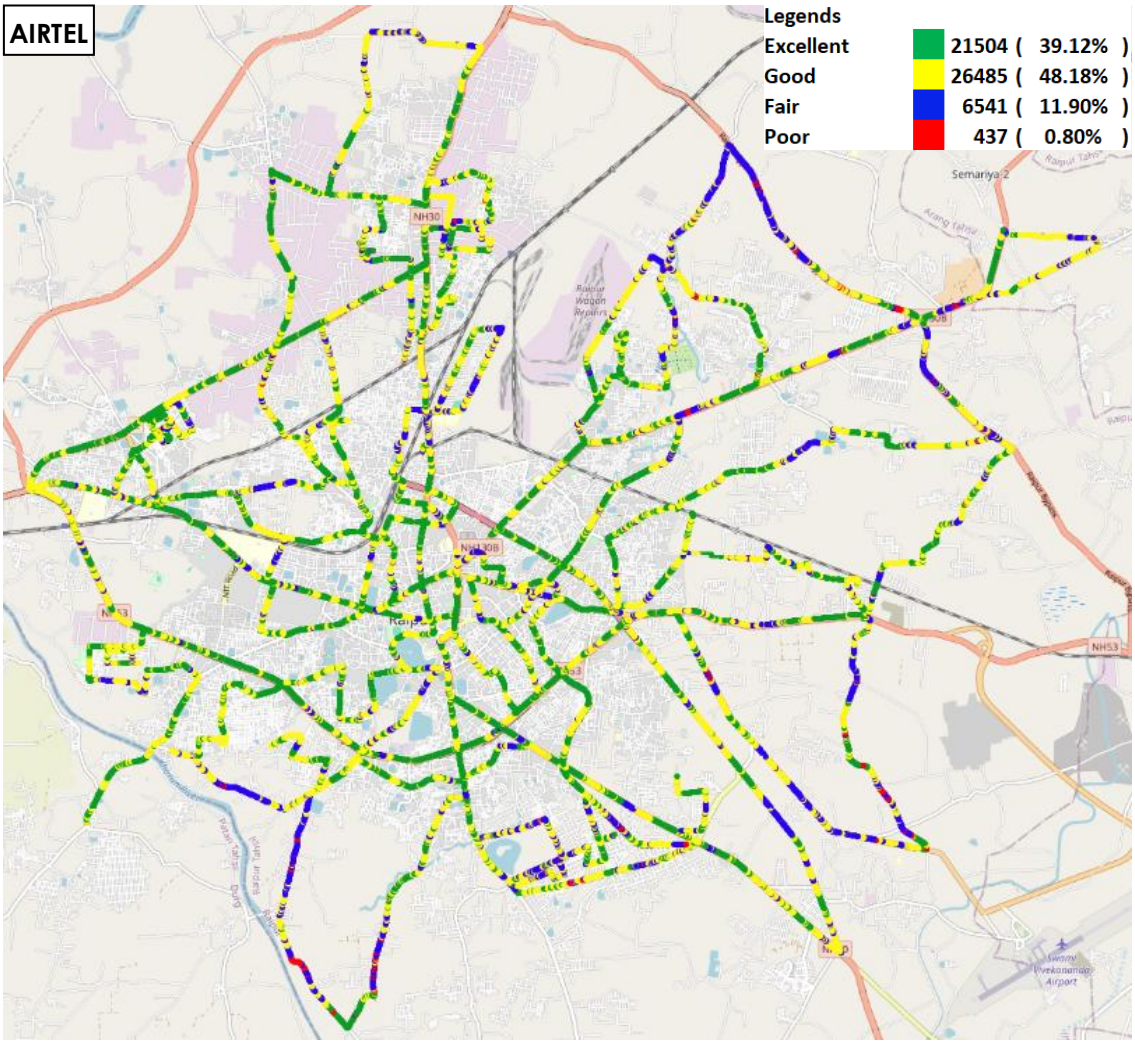

Figure-28: Signal strength auto-selection mode 5G/4G/3G/2G - Airtel

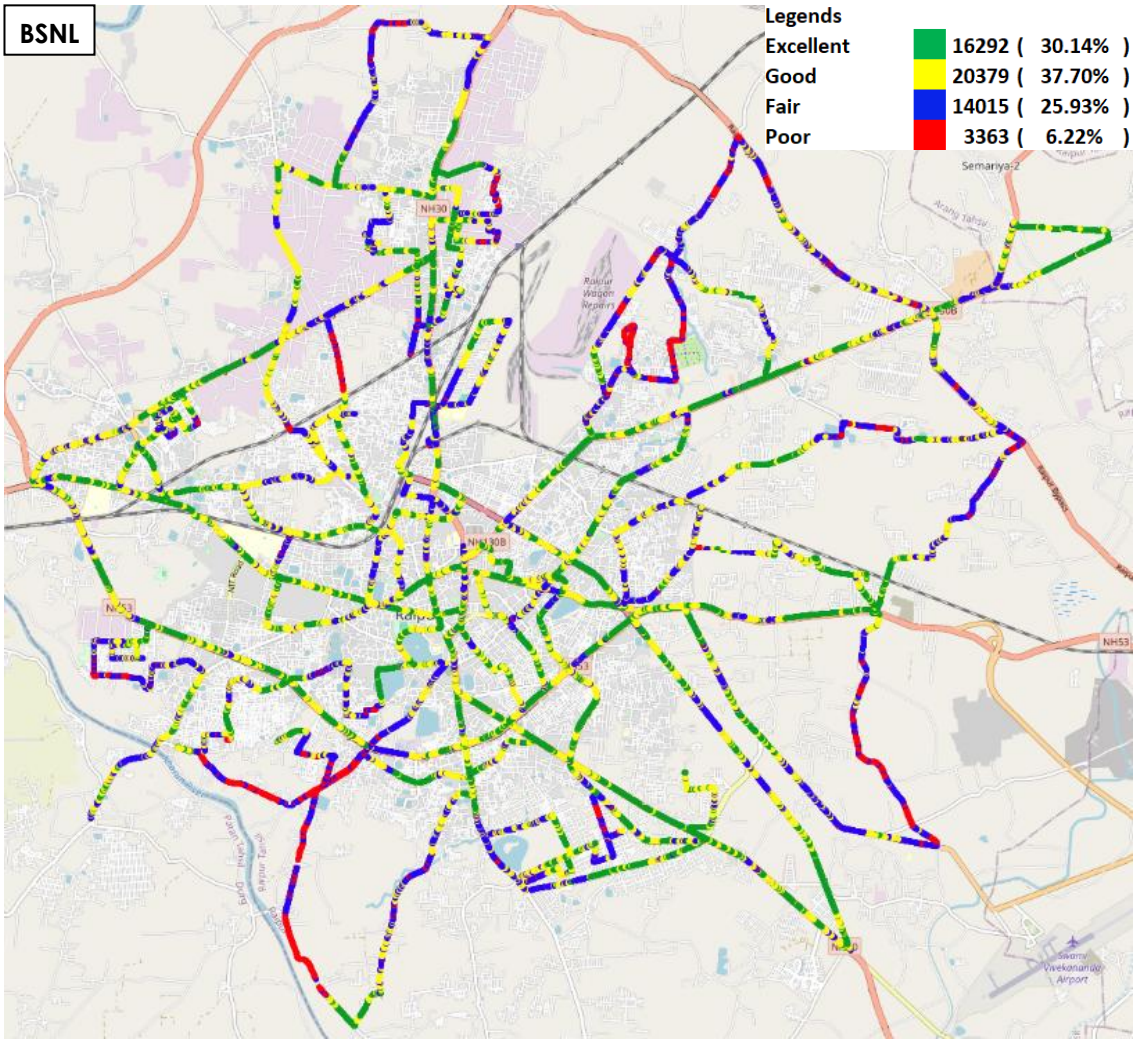

Figure-29: Signal strength auto-selection mode 5G/4G/3G/2G - BSNL

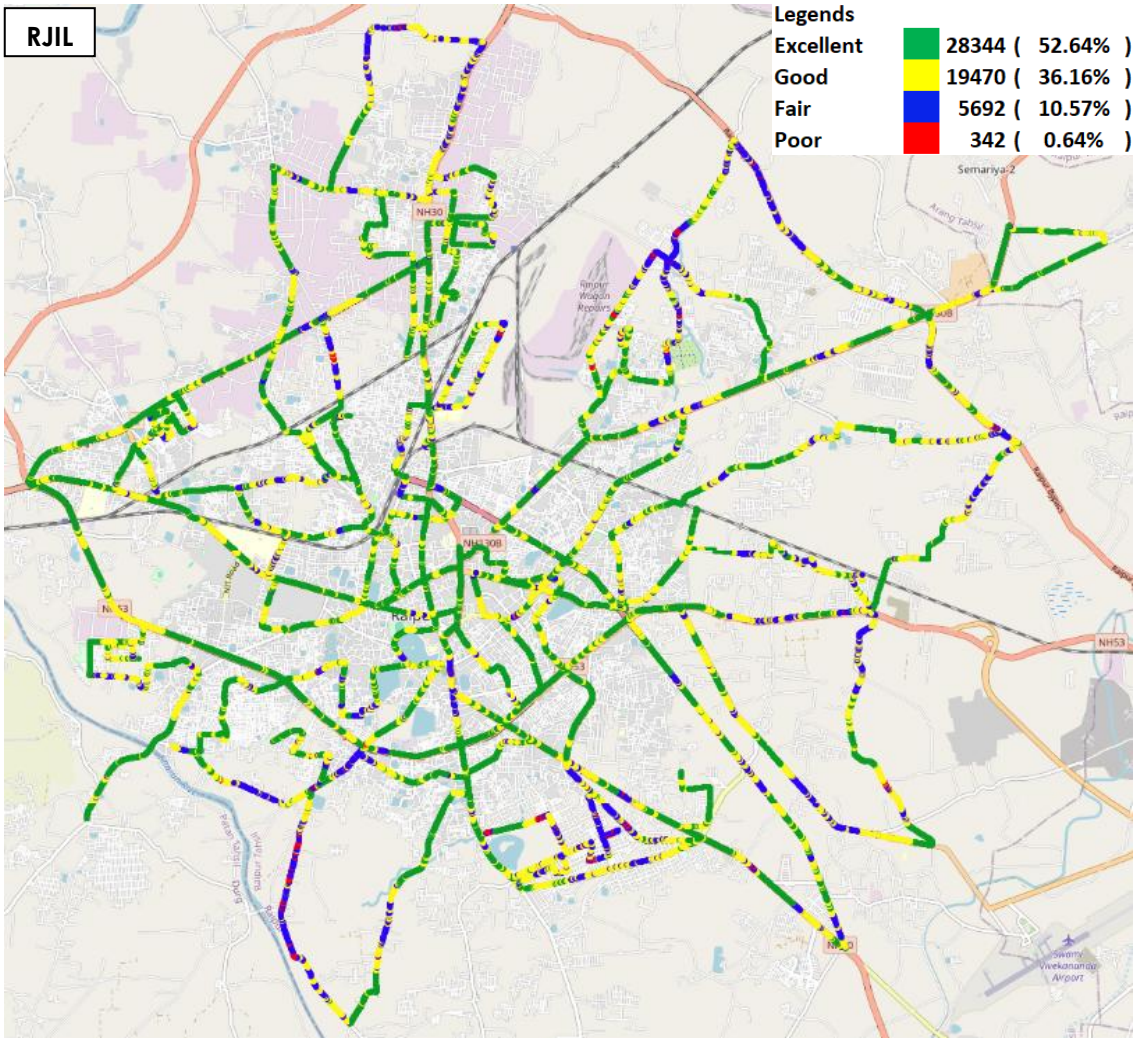

Figure-30: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL

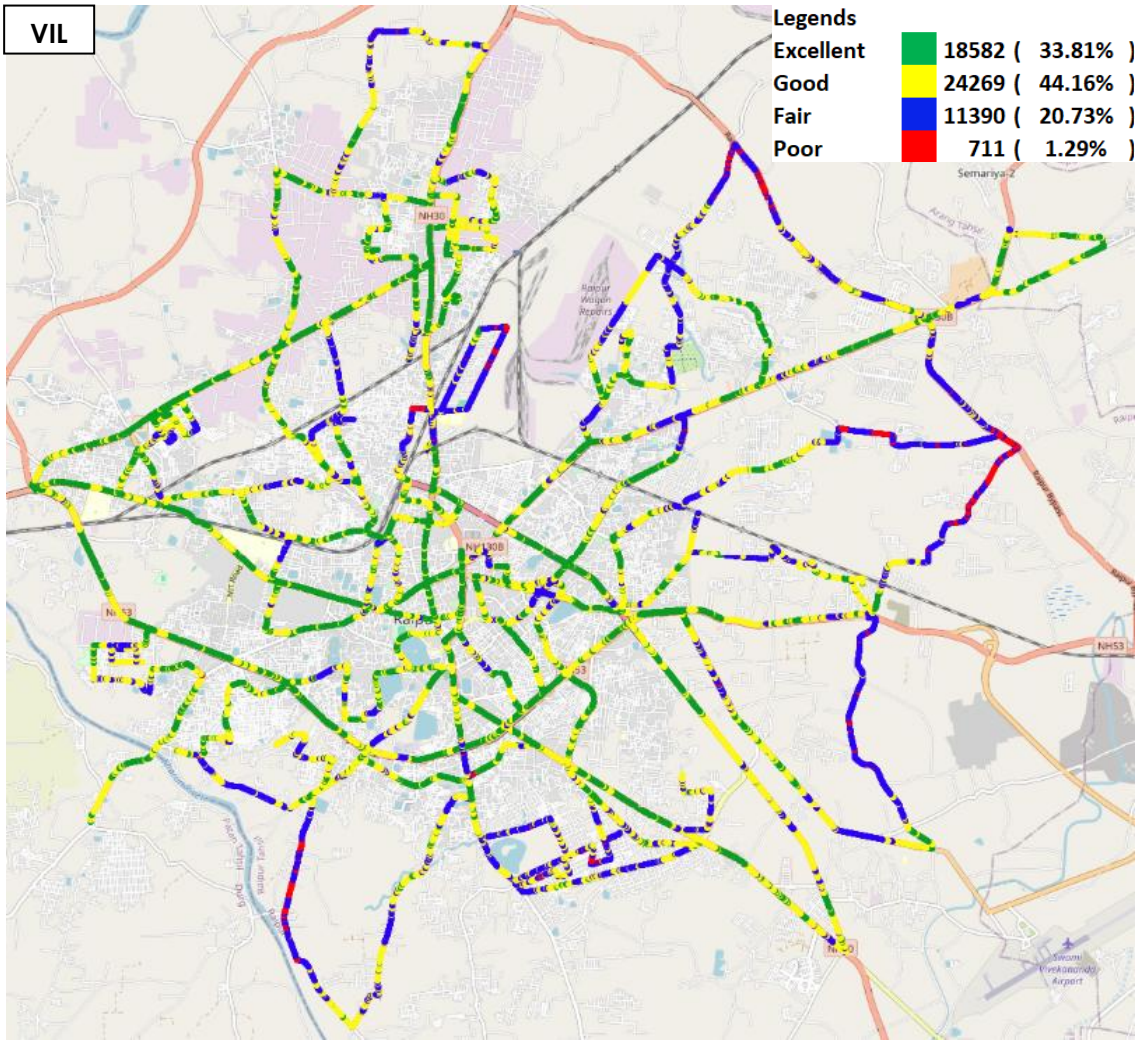

Figure-31: Signal strength auto-selection mode 5G/4G/3G/2G - VIL

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-44: 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.
- 5G/4G/3G/2G auto mode MOS call were made in BSNL as BSNL don't have VoLTE & VoNR network availability.
- All values are taken up to two decimal places with round off.

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.amazon.in, www.facebook.com, www.google.co.in) 20 sec timeout (only at Hotspot)
Ping		25 count- Dynamic 1000 count- Hotspot

Table-45: 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)

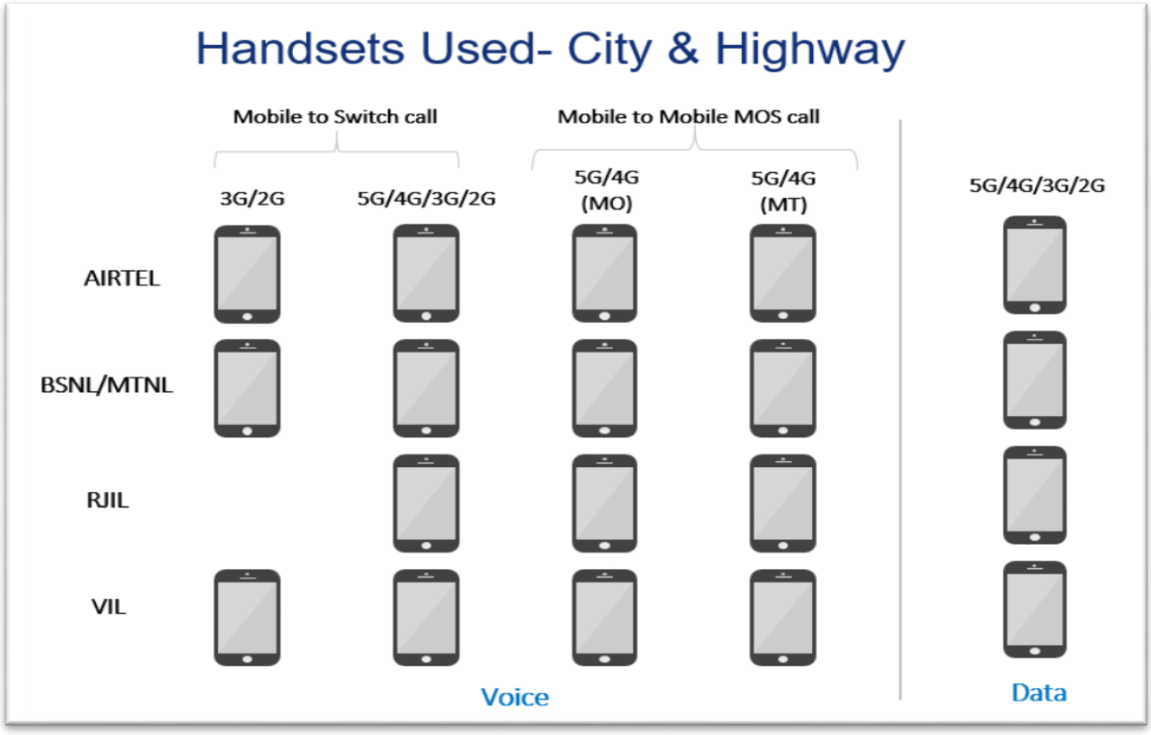

Figure-32: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

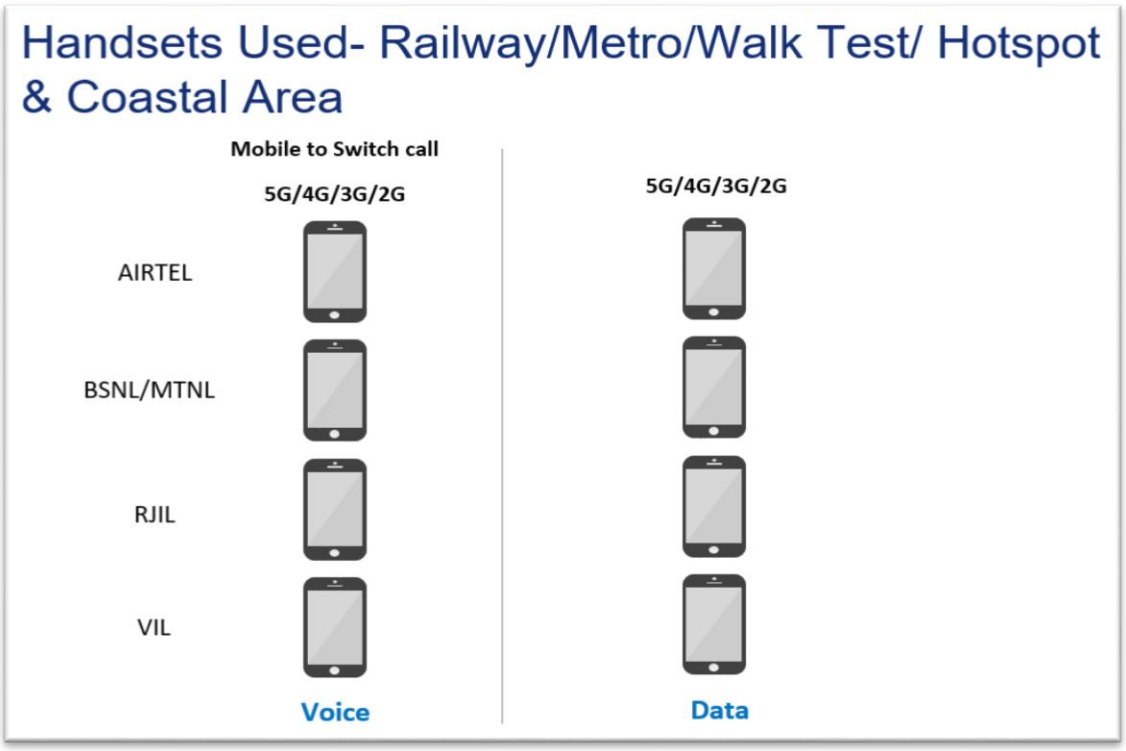

Figure-33: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)

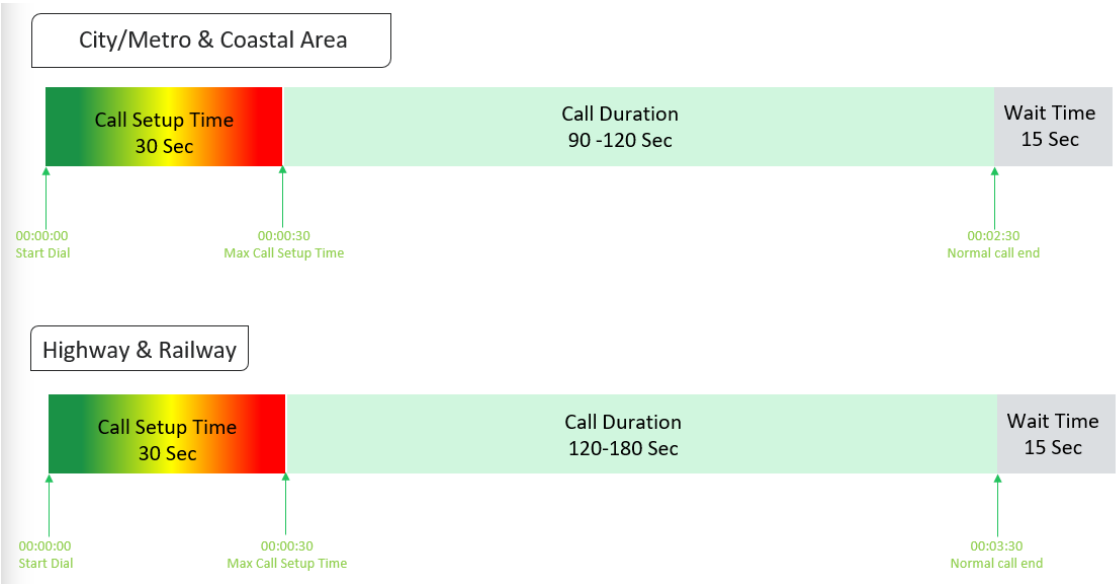

Figure-34: Voice test script for city/railway/metro/highway & coastal area

- 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

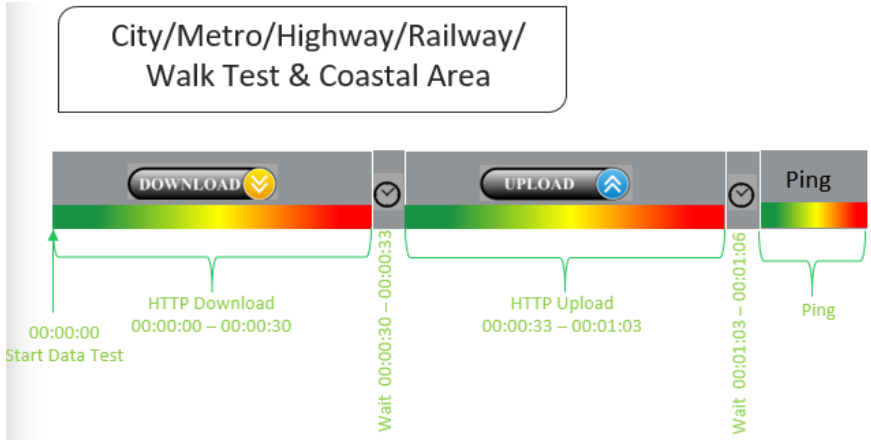

Figure-36: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

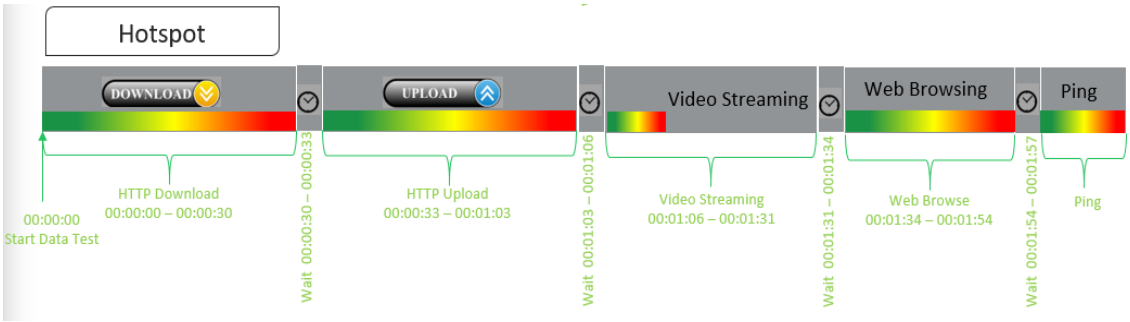

Figure-37: Data test script used at hotspot

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

7.2 Appendix-II

7.2.1 Network Performance Parameters for Voice calls

Parameter Name	Definition
Call Setup Success Rate	(i) Call Setup Success Rate is defined as the ratio of Established Calls to Call Attempts. 'Established Calls' mean the following events have happened in call setup: (a) Call attempt is made (b) The signaling channel is allocated (c) The call is routed to the outwards path of the terminating network (d) An alert signal is received by caller in the form of ring back tone, busy tone, or an announcement. CSSR = (Total Call Established/ Total Call Attempt) *100 As per QoS Regulation 2024 benchmark value is **>=98%**
Call Drop 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 Call Drop 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 / Total calls established) *100

<table>
<tr><td></td><td>If a call observes multiple silence count >=4 sec in a particular established call it has been taken as one silent event.</td></tr>
<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 will be 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 will be 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 will be calculated from MOS call for packet call only (VoNR/VoLTE).</td></tr>
<tr><td>Signal Strength</td><td>Signal strength is the signal power level received by the wireless user.
<table>
<tr><td rowspan="2">Parameter Name</td><td rowspan="2">Technology</td><td colspan="4">Signal Strength (dBm)</td></tr>
<tr><td>Excellent</td><td>Good</td><td>Fair</td><td>Poor</td></tr>
<tr><td>Rx Level</td><td>GSM</td><td>0 to ≥ -65</td><td><-65 to ≥ -75</td><td><-75 to ≥-85</td><td><-85 to min</td></tr>
<tr><td>RSCP</td><td>WCDMA</td><td>0 to ≥ -70</td><td><-70 to ≥ -80</td><td><-80 to ≥ -90</td><td><-90 to min</td></tr>
<tr><td>RSRP</td><td>LTE</td><td>0 to ≥ -80</td><td><-80 to ≥ -95</td><td><-95 to ≥-110</td><td><-110 to min</td></tr>
<tr><td>SS_RSRP</td><td>NR</td><td>0 to ≥ -80</td><td><-80 to ≥ -95</td><td><-95 to ≥-110</td><td><-110 to min</td></tr>
</table></td></tr>
</table>

Table-46: Network performance parmeter 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- Ping	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 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 the ping testing. Packet loss rate = (Total packet lost / Total packet sent) *100 * Packet delay (ping delay) >90 ms considered as packet loss and included in packet loss rate. * Packet loss rate is calculated based on ICMP

Table-47: Network performance parameter and definition Data