



TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Rajasthan LSA

October 2024

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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 Rajasthan License Service Area (LSA) during the month October, 2024 under the supervision of TRAI Regional Office (RO), Jaipur. 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 | Jaipur | City | 490 | 14-Oct-2024 | 18-Oct-2024 |
| 2 | Jaipur | City (Inter-operator calling) | 15 | 15-Oct-2024 | 15-Oct-2024 |
| 3 | Jaipur | Hotspot | 13 Locations | 18-Oct-2024 | 19-Oct-2024 |
| 4 | Jaipur | Walk test | 3 | 17-Oct -2024 | 18-Oct-2024 |
| 5 | Mansarovar to Badi Chaupar | Metro | 12 | 17-Oct-2024 | 17-Oct-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, walk test and metro as per the legends shown on the map.

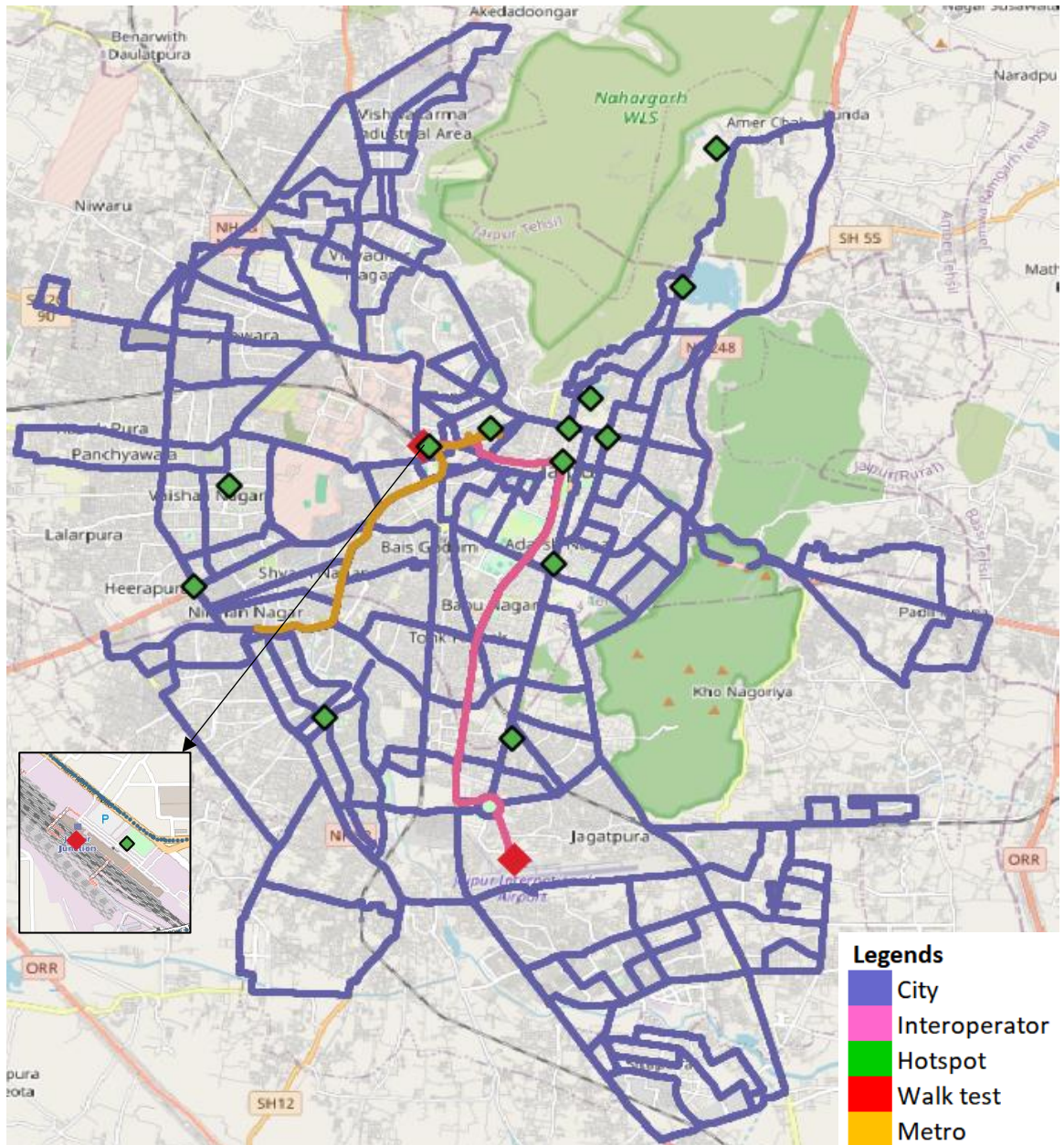


Figure-1: Drive test routes

Note- Hotspot and walk test both testing have been performed at Jaipur Railway Station.

2.3 Summary of areas covered

a) City- Nearby Adarsh nagar, Babu nagar, Sitapura, Jagatpura, Vidyadhar nagar, Vishwakarma industrial area, Vaishali nagar, Padli meena, Amer road etc.

b) Hotspot-

1. Jaipur Railway Station
2. Sindhi Camp Bus Stand
3. Ajmeri Gate
4. Chhoti Chaupar
5. Badi Chaupar
6. Govind dev ji temple
7. Amer fort
8. Jal mahal
9. Gaurav tower, Malviya nagar
10. OTS circle JLN marg
11. City park mansarovar
12. 200 ft bypass circle Heerapura
13. Amrapali circle, Vaishali

c) Walk test-

1. Jaipur Railway Station
2. Jaipur Airport

d) Railway/ Metro-

1. Mansarover to Badi Chaupar

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 | 900,1800 |
| 2 | Bharti Airtel Ltd. | 4G | 900,1800,2100,2300 |
| 3 | Bharti Airtel Ltd. | 5G | 3500 |
| 4 | BSNL | 2G | 900 |
| 5 | BSNL | 3G | 2100 |
| 6 | BSNL | 4G | 700 |
| 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. | 3G | 2100 |
| 11 | Vodafone Idea Ltd. | 4G | 900,1800,2100,2500 |

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

QoS Performance Analysis- Rajasthan 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 October-2024 covering city, metro, walk test and hotspots. (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 | 722 | 732 | 731 |
| Call Setup Success Rate % | 99.45 | 99.45 | 98.08 |
| Drop Call Rate% | 0.00 | 1.37 | 0.14 |
| Call Setup Time-Average (Second) | 3.65 | 2.65 | 3.54 |
| Handover Success Rate % | 97.36 | 99.55 | 96.78 |

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

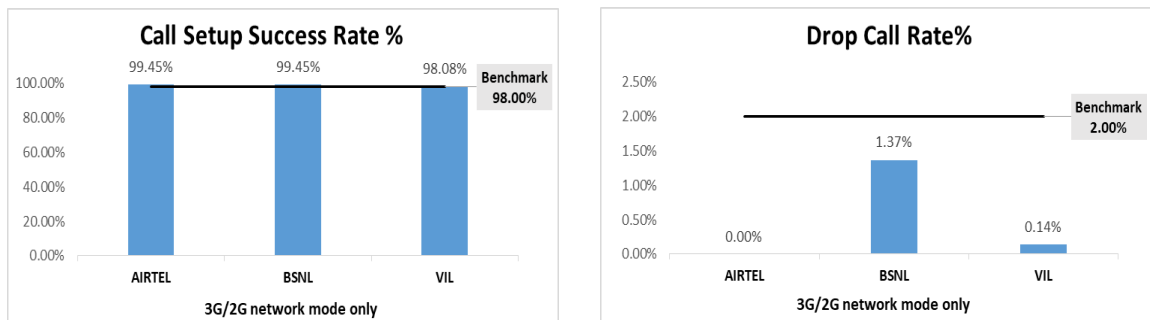


Figure-2: Call setup success rate and drop call rate performance

| 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 | 462 | 0 |
| 2G | 1301 | 565 | 1013 |

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 | 1024 | 1019 | 1035 | 1032 |
| Call Setup Success Rate % | 99.90 | 98.92 | 100.00 | 100.00 |
| Drop Call Rate% | 0.10 | 2.48 | 0.39 | 0.10 |
| Call Setup Time-Average (Second) | 1.90 | 3.33 | 0.69 | 0.39 |
| Handover Success Rate % | 97.14 | 99.05 | 96.98 | 97.63 |

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

| Parameter | Service Provider | | | |
|--|--------------------------------------|------|------|------|
| | Mobile-to-Mobile (5G/4G - Open Mode) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Call Established (within service provider Network) | 829 | 870 | 828 | 838 |
| Number of silence call for >4 Sec | 2 | NA | 1 | 2 |
| Silence Call Rate % | 0.24 | NA | 0.12 | 0.24 |
| Number of silence instances for >4 Sec | 2 | NA | 1 | 4 |
| Number of silence instances for >3 Sec | 5 | NA | 1 | 8 |
| Number of silence instances for >2 sec | 14 | NA | 8 | 57 |
| RTP Jitter (4G & 5G) in ms | 4.63 | NA | 7.26 | 5.74 |
| Packet loss Rate Downlink % | 0.47 | NA | 0.13 | 0.30 |
| Packet loss Rate Uplink % | 0.31 | NA | 0.17 | 0.31 |

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

Note-

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

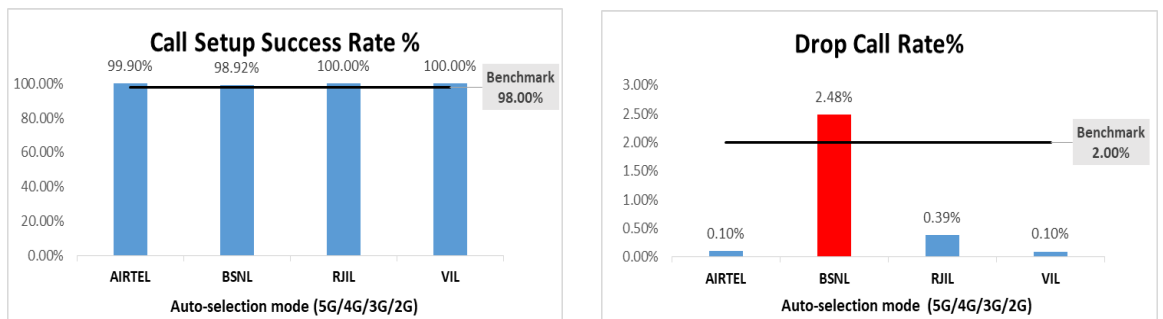


Figure-3: Performance for call setup success rate and drop call rate

| 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 | 1207 | NA |
| 4G | 2220 | 133 | 2734 | 2760 |
| 3G | NA | 386 | NA | 0 |
| 2G | 0 | 624 | NA | 0 |

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 | 4926 | 4331 | 4869 | 4922 |
| Speech Quality (Average MOS Score) | 4.02 | 2.18 | 3.96 | 4.63 |
| Number of samples with MOS >=4 to <5 (Excellent) | 4146 | 0 | 3702 | 4633 |
| Number of samples with MOS >=3 to <4(Good) | 695 | 0 | 968 | 221 |
| Number of samples with MOS >=2 to <3 (Fair) | 56 | 3307 | 164 | 42 |
| Number of samples with MOS >=1 to <2 (Poor) | 29 | 1024 | 35 | 26 |
| %age of samples with MOS >=4 to <5 (Excellent) | 84.17% | 0.00% | 76.03% | 94.13% |
| %age of samples with MOS >=3 to <4(Good) | 14.11% | 0.00% | 19.88% | 4.49% |
| %age of samples with MOS >=2 to <3 (Fair) | 1.14% | 76.36% | 3.37% | 0.85% |
| %age of samples with MOS >=1 to <2 (Poor) | 0.59% | 23.64% | 0.72% | 0.53% |

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

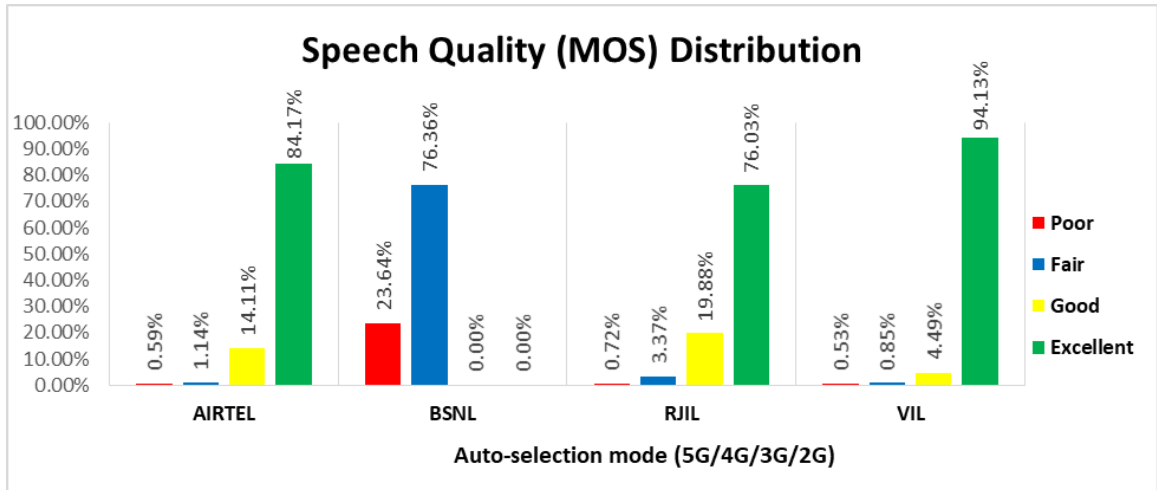


Figure- 4: Distribution of samples in MOS score range

(d) Inter-service provider voice call performance: To check the performance of inter-service provider call setup success rate, total 44 to 56 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 | 97.92 | NA | 100.00 | 97.96 |
| RJIL | 98.18 | 93.18 | NA | 100.00 |
| VIL | 100.00 | 85.42 | 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 | 4.89 | 2.81 | 2.87 |
| BSNL | 3.65 | NA | 4.75 | 4.28 |
| RJIL | 2.09 | 5.64 | NA | 4.12 |
| VIL | 2.02 | 3.74 | 1.97 | 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 | 216.93 | 3.12 | 356.68 | 32.40 |
| | 80th Percentile | 299.27 | 3.56 | 552.43 | 46.57 |
| | 20th Percentile | 106.30 | 0.31 | 164.38 | 13.83 |
| Upload Throughput (Mbits/s) | Average | 44.83 | 2.37 | 46.17 | 14.27 |
| | 80th Percentile | 76.27 | 2.73 | 74.09 | 24.47 |
| | 20th Percentile | 14.12 | 1.04 | 14.93 | 3.92 |
| Ping (ms) | Average | 24.88 | 565.76 | 20.54 | 24.13 |

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

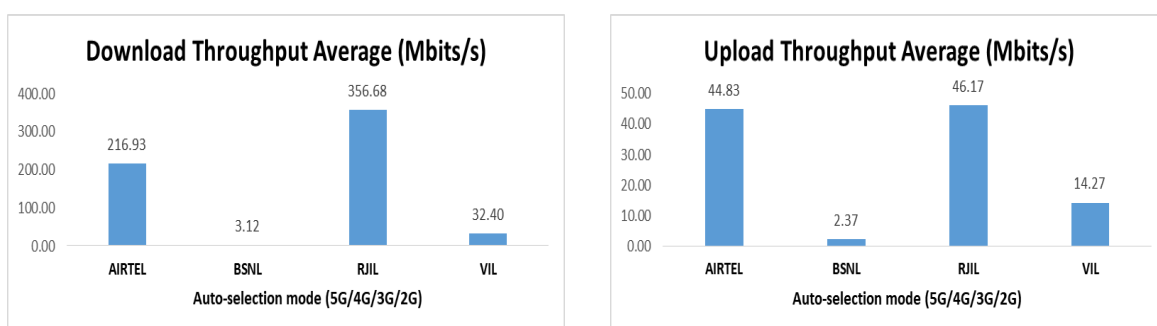


Figure- 5: Download and upload throughput

| 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 | 1817 | NA |
| 4G | 2147 | 103 | 213 | 2348 |
| 3G | NA | 267 | NA | 0 |
| 2G | 0 | 57 | NA | 3 |

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 & Metro 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 14th October 2024 to 18th October 2024 in Jaipur. (Refer Table-1)

4.2.1 Drive test route

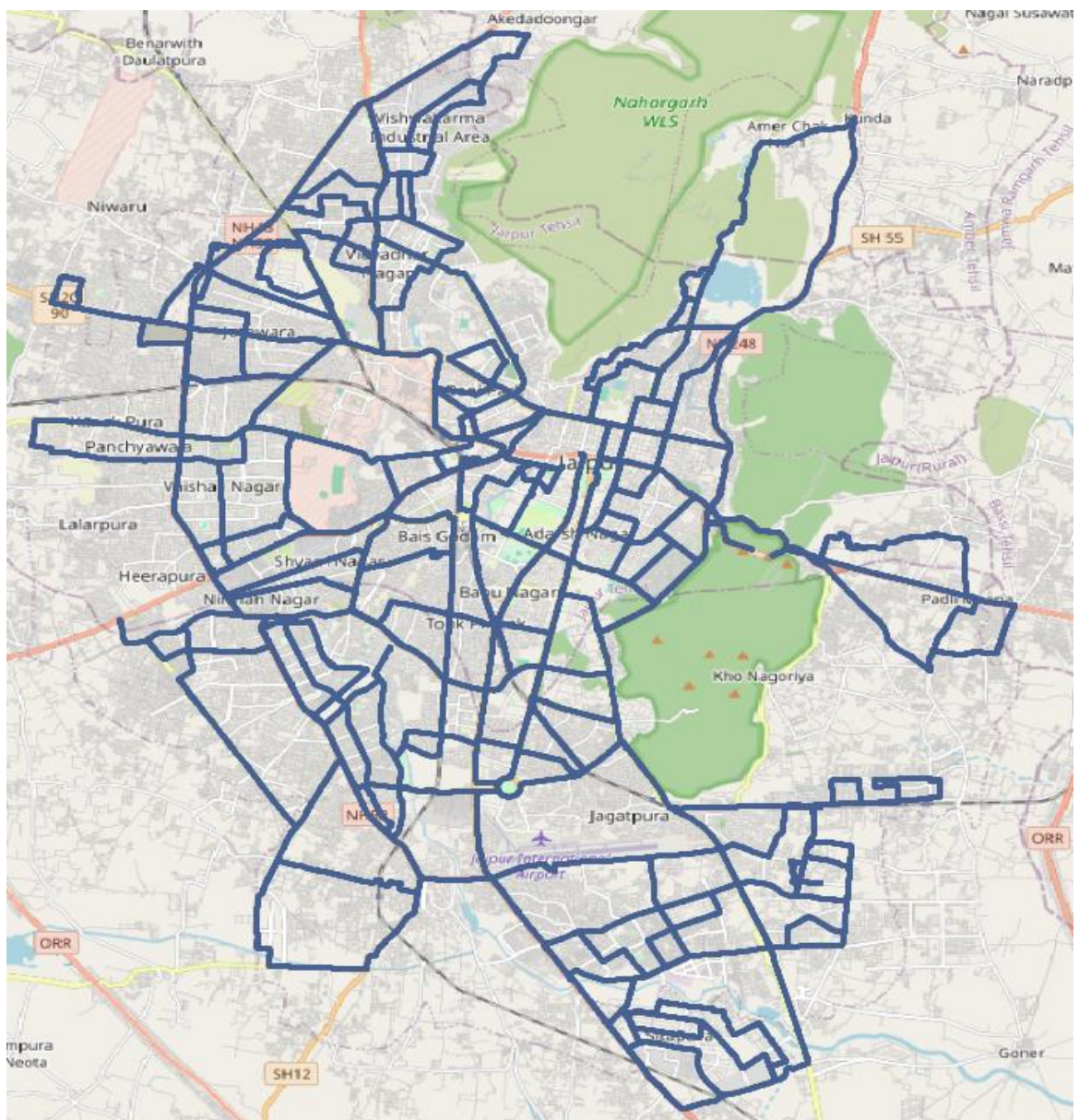


Figure- 6: Drive test routes

4.2.2 Areas covered

Nearby Adarsh Nagar, Babu Nagar, Sitapura, Jagatpura, Vidyadhar Nagar, Vishwakarma Industrial Area, Vaishali Nagar, Padli Meena, Amer Road 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 | 722 | 732 | 731 |
| Call Setup Success Rate % | 99.45 | 99.45 | 98.08 |
| Drop Call Rate% | 0.00 | 1.37 | 0.14 |
| Call Setup Time-Average (Second) | 3.65 | 2.65 | 3.54 |
| Handover Success Rate % | 97.36 | 99.55 | 96.78 |

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

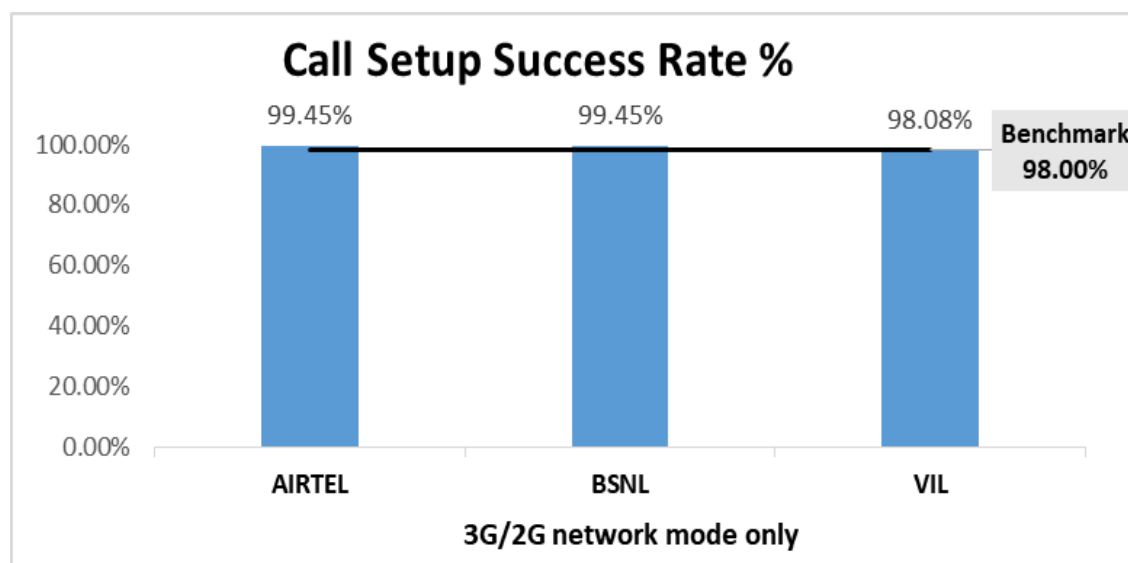


Figure-7: Performance for call setup success rate

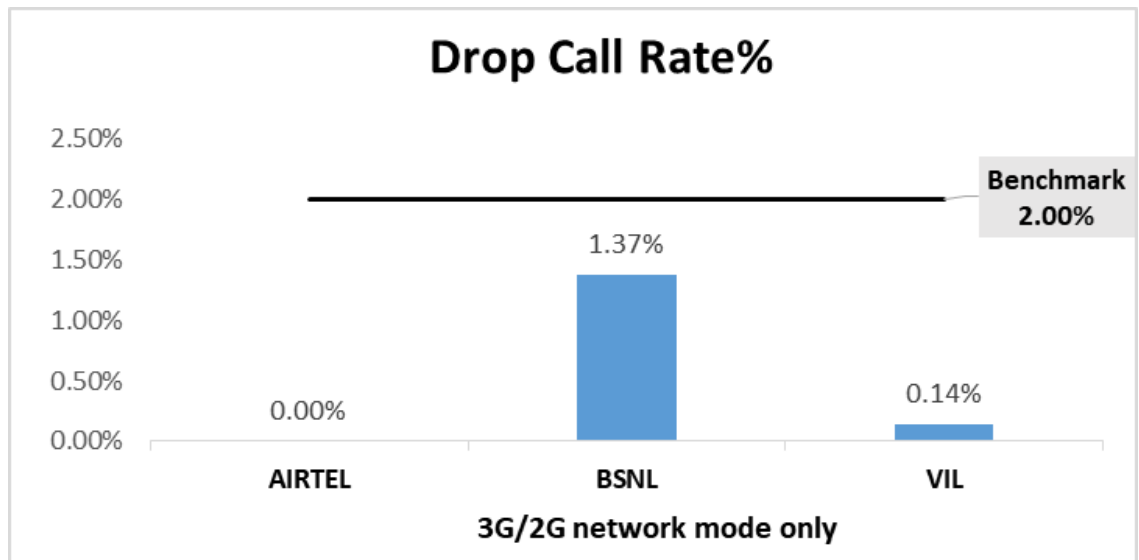


Figure-8: Performance for drop call rate

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

| Technology | Service Provider | | |
|------------|------------------|--------|--------|
| | AIRTEL | BSNL | VIL |
| 3G | NA | 36.12% | 0.16% |
| 2G | 100.00% | 63.86% | 99.84% |
| No service | 0.00% | 0.02% | 0.00% |

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

Note-

- No service- Limited service and not latched on any available technology.

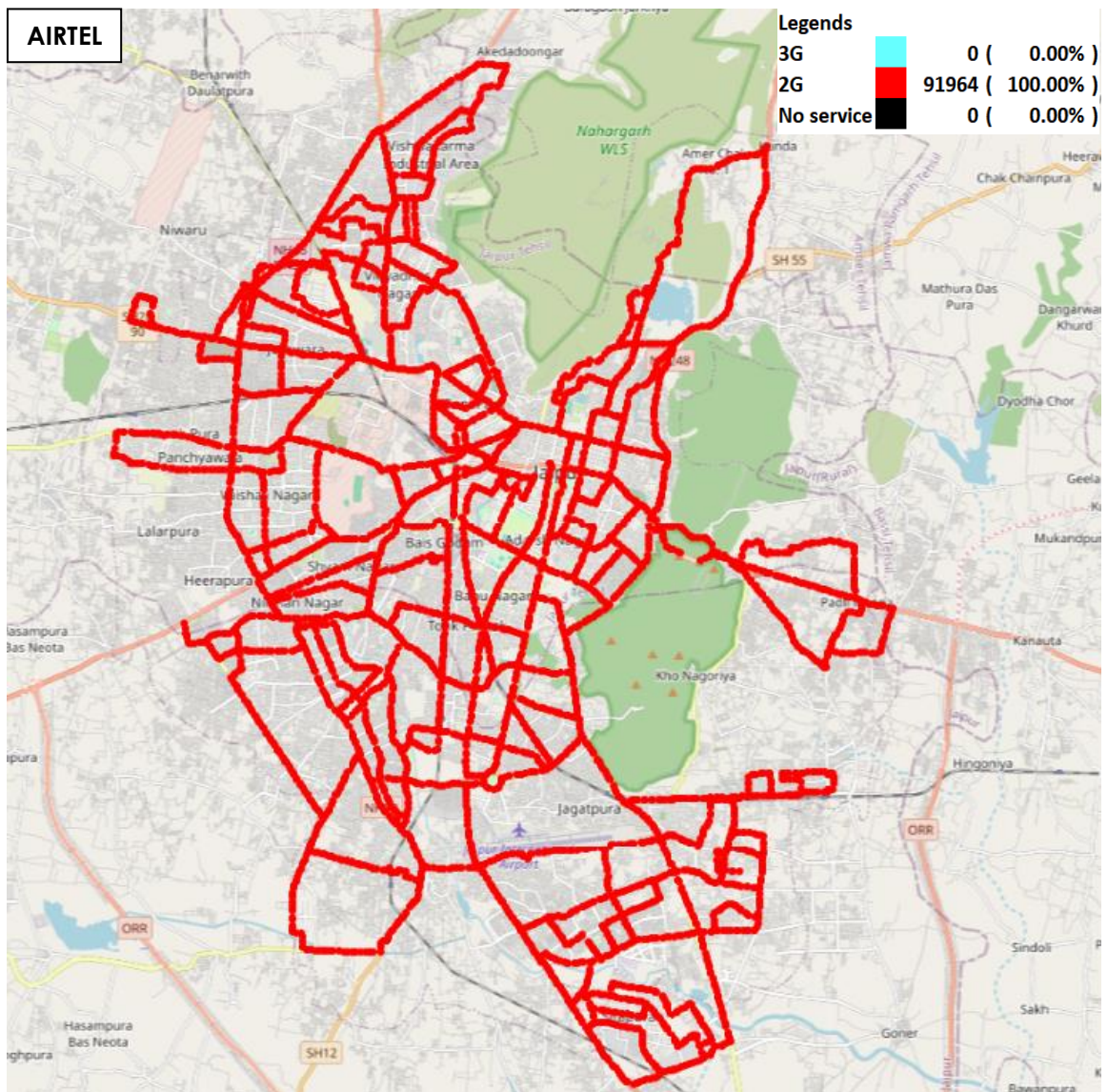


Figure-9: Serving technology plots 3G/2G network mode - AIRTEL

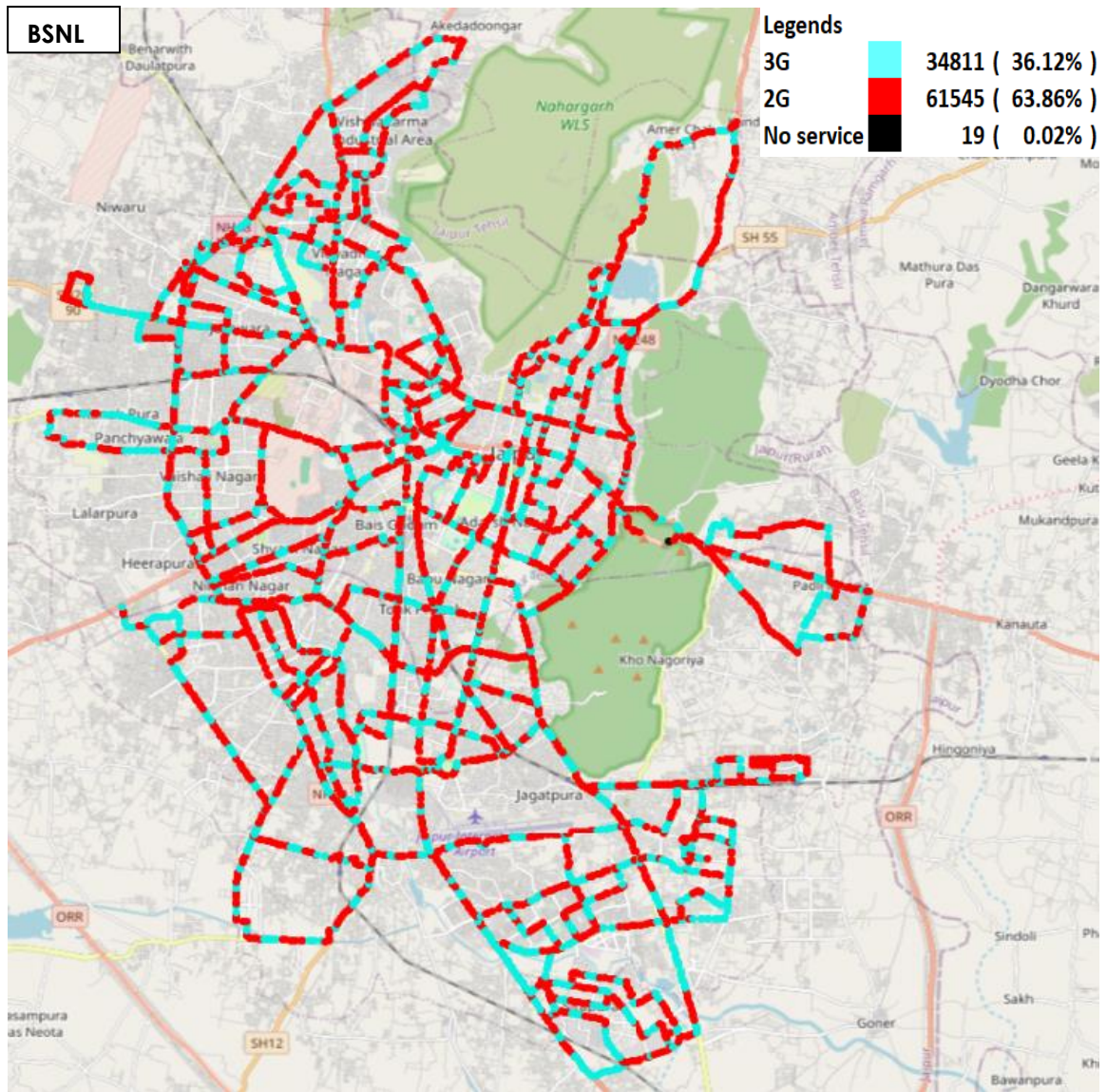


Figure-10: Serving technology plots 3G/2G network mode - BSNL

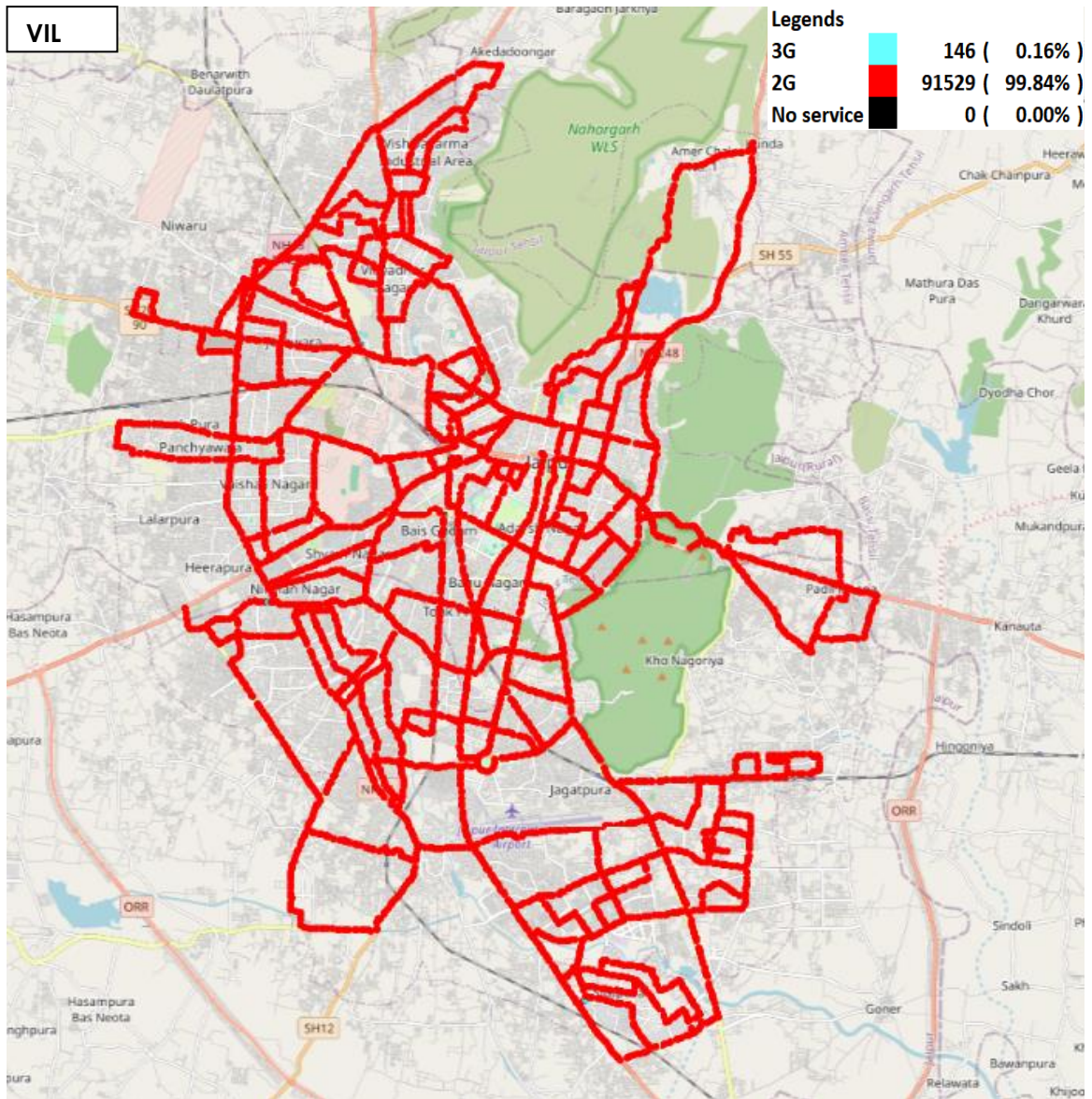


Figure-11: Serving technology plots 3G/2G network mode –VIL

(C) Network Signal Strength distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 43, 44 & 45 for map view)

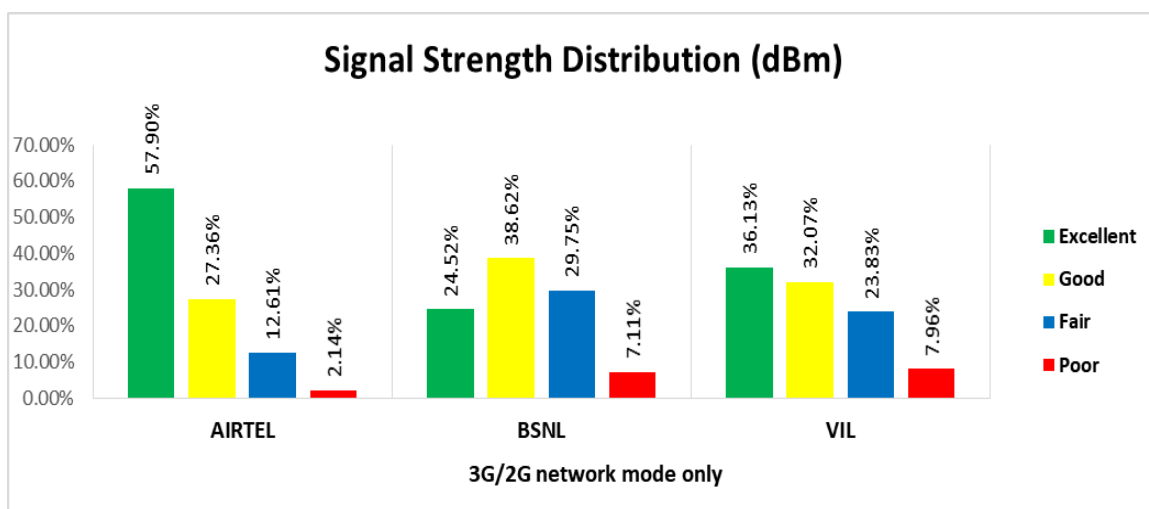


Figure-12: Signal strength distribution 3G/2G network mode only

Observations:

- Airtel has 58% of samples falling in excellent signal strength category.
- BSNL has 25% of samples falling in excellent signal strength category.
- VIL has 36% of samples falling in 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 | 854 | 849 | 861 | 858 |
| Call Setup Success Rate % | 99.88 | 98.82 | 100.00 | 100.00 |
| Drop Call Rate% | 0.12 | 2.50 | 0.35 | 0.12 |
| Call Setup Time Average (Second) | 1.91 | 3.18 | 0.69 | 0.39 |
| Handover Success Rate % | 97.14 | 99.04 | 96.93 | 97.62 |

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

| Parameter | Service Provider | | | |
|---|---|------|------|------|
| | Mobile-to-Mobile (5G/4G - Open Mode) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Call Established (within service provider Network) | 829 | 870 | 828 | 838 |
| Number of silence call for >4 Sec | 2 | NA | 1 | 2 |
| Silence Call Rate % | 0.24 | NA | 0.12 | 0.24 |
| Number of silence instances for >4 Sec | 2 | NA | 1 | 4 |
| Number of silence instances for >3 Sec | 5 | NA | 1 | 8 |
| Number of silence instances for >2 sec | 14 | NA | 8 | 57 |
| RTP Jitter (4G & 5G) in ms | 4.63 | NA | 7.26 | 5.74 |
| Packet loss Rate Downlink % | 0.47 | NA | 0.13 | 0.30 |
| Packet loss Rate Uplink % | 0.31 | NA | 0.17 | 0.31 |

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

Note-

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

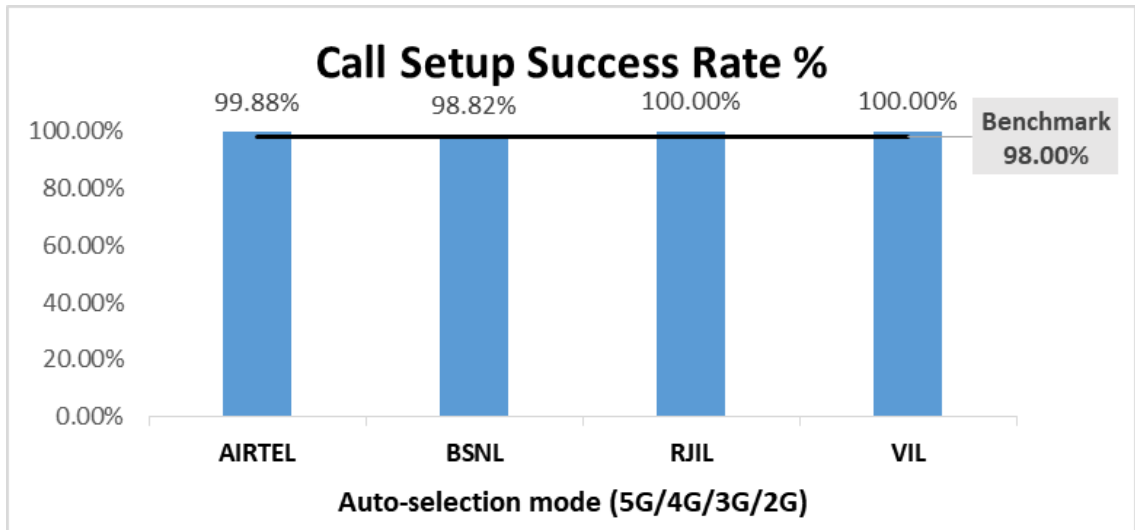


Figure-13: Performance for call setup success rate

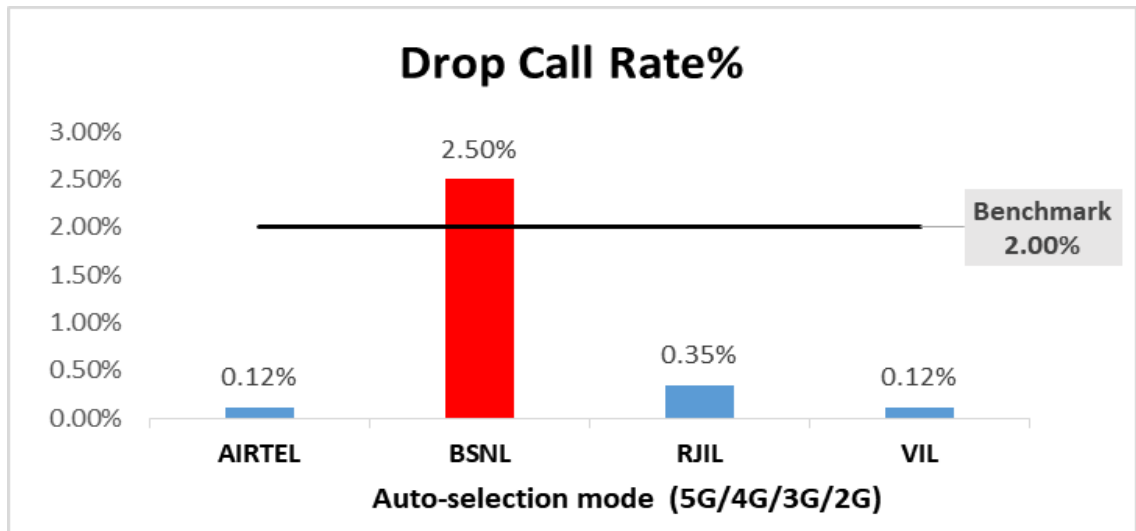


Figure-14: Performance for drop call rate

(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 | 4926 | 4331 | 4869 | 4922 |
| Speech Quality (Average MOS Score) | 4.02 | 2.18 | 3.96 | 4.63 |
| Number of samples with MOS >=4 to <5(Excellent) | 4146 | 0 | 3702 | 4633 |
| Number of samples with MOS >=3 to <4(Good) | 695 | 0 | 968 | 221 |
| Number of samples with MOS >=2 to <3 (Fair) | 56 | 3307 | 164 | 42 |
| Number of samples with MOS >=1 to <2 (Poor) | 29 | 1024 | 35 | 26 |
| %age of samples with MOS >=4 to <5 (Excellent) | 84.17% | 0.00% | 76.03% | 94.13% |
| %age of samples with MOS >=3 to <4(Good) | 14.11% | 0.00% | 19.88% | 4.49% |
| %age of samples with MOS >=2 to <3 (Fair) | 1.14% | 76.36% | 3.37% | 0.85% |
| %age of samples with MOS >=1 to <2 (Poor) | 0.59% | 23.64% | 0.72% | 0.53% |

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

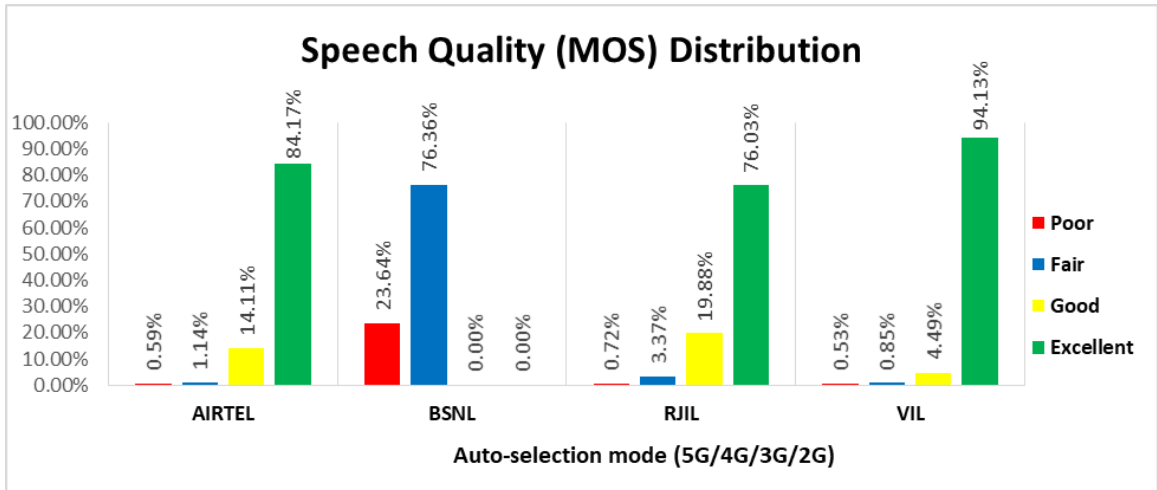


Figure-15: Distribution of samples in MOS score range

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

| Technology | Service Provider | | | |
|-------------------|------------------|--------|--------|---------|
| | AIRTEL | BSNL | RJIL | VIL |
| 5G | 3.64% | NA | 17.65% | NA |
| 4G | 96.36% | 3.92% | 82.34% | 100.00% |
| 3G | NA | 22.87% | NA | 0.00% |
| 2G | 0.00% | 72.82% | NA | 0.00% |
| No service | 0.00% | 0.39% | 0.00% | 0.00% |

Table-18: Time spent on technology during drive test

Note-

- No service- Limited service and not latched on any available technology.

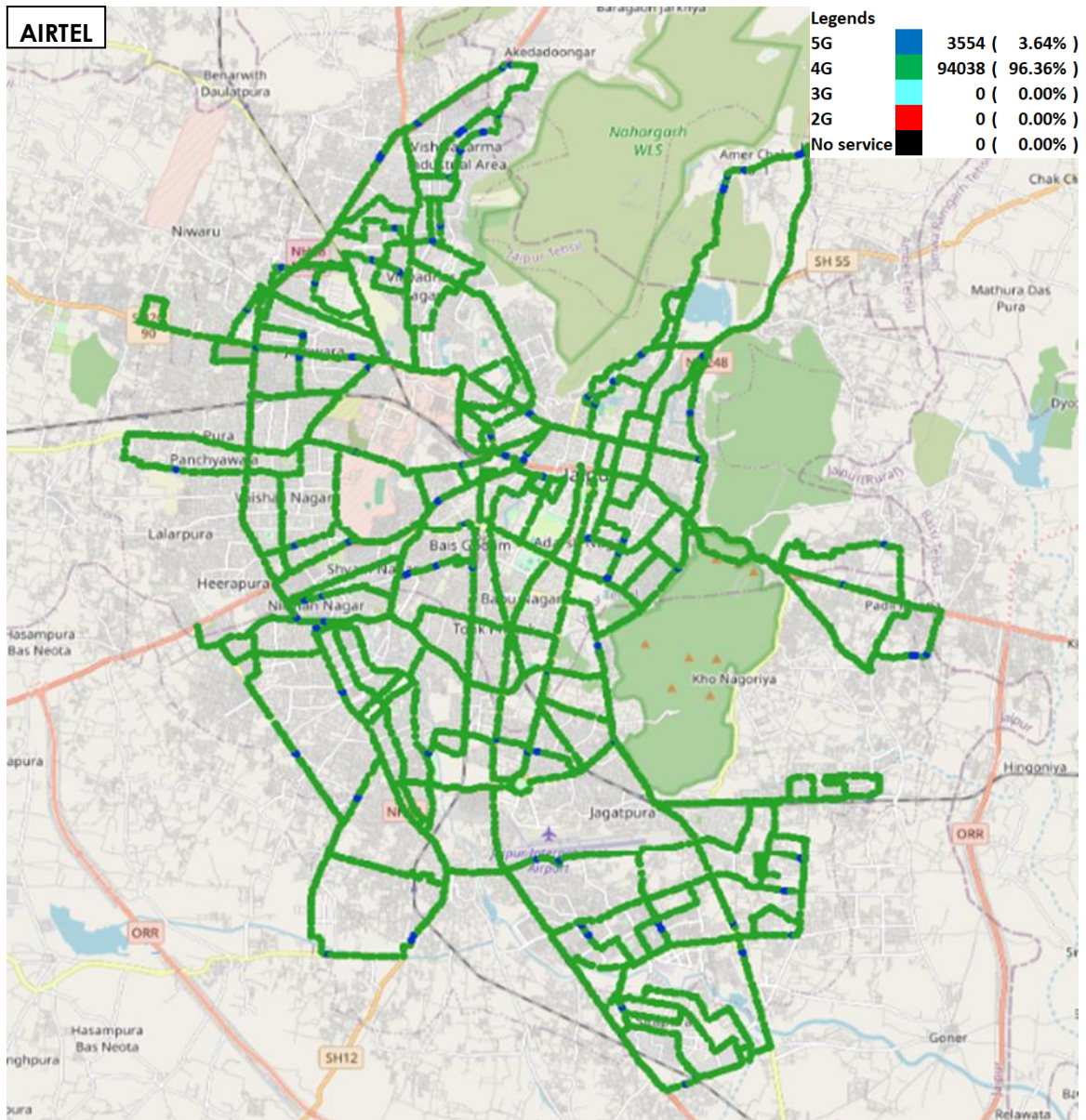


Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -Airtel

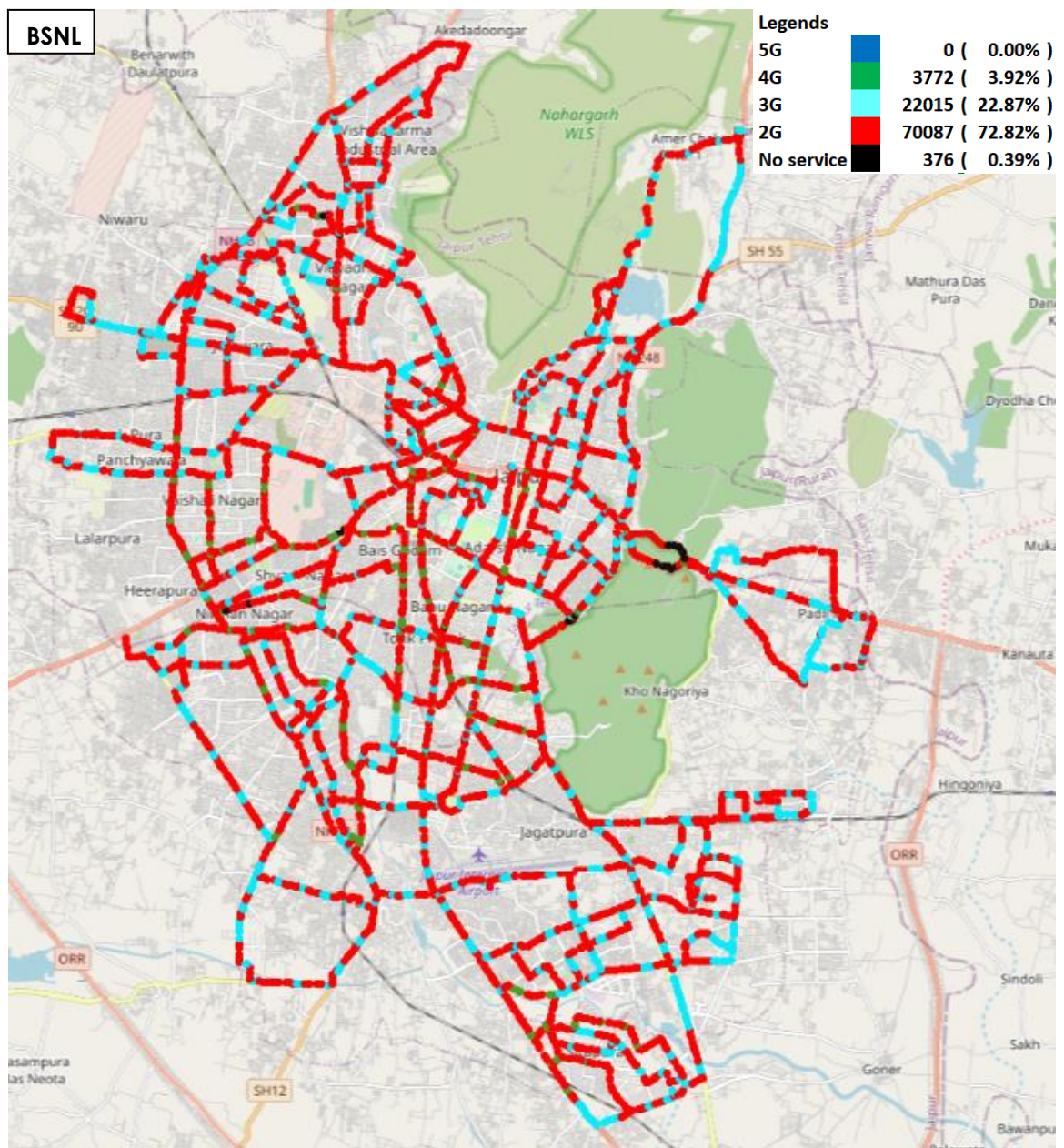


Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -BSNL

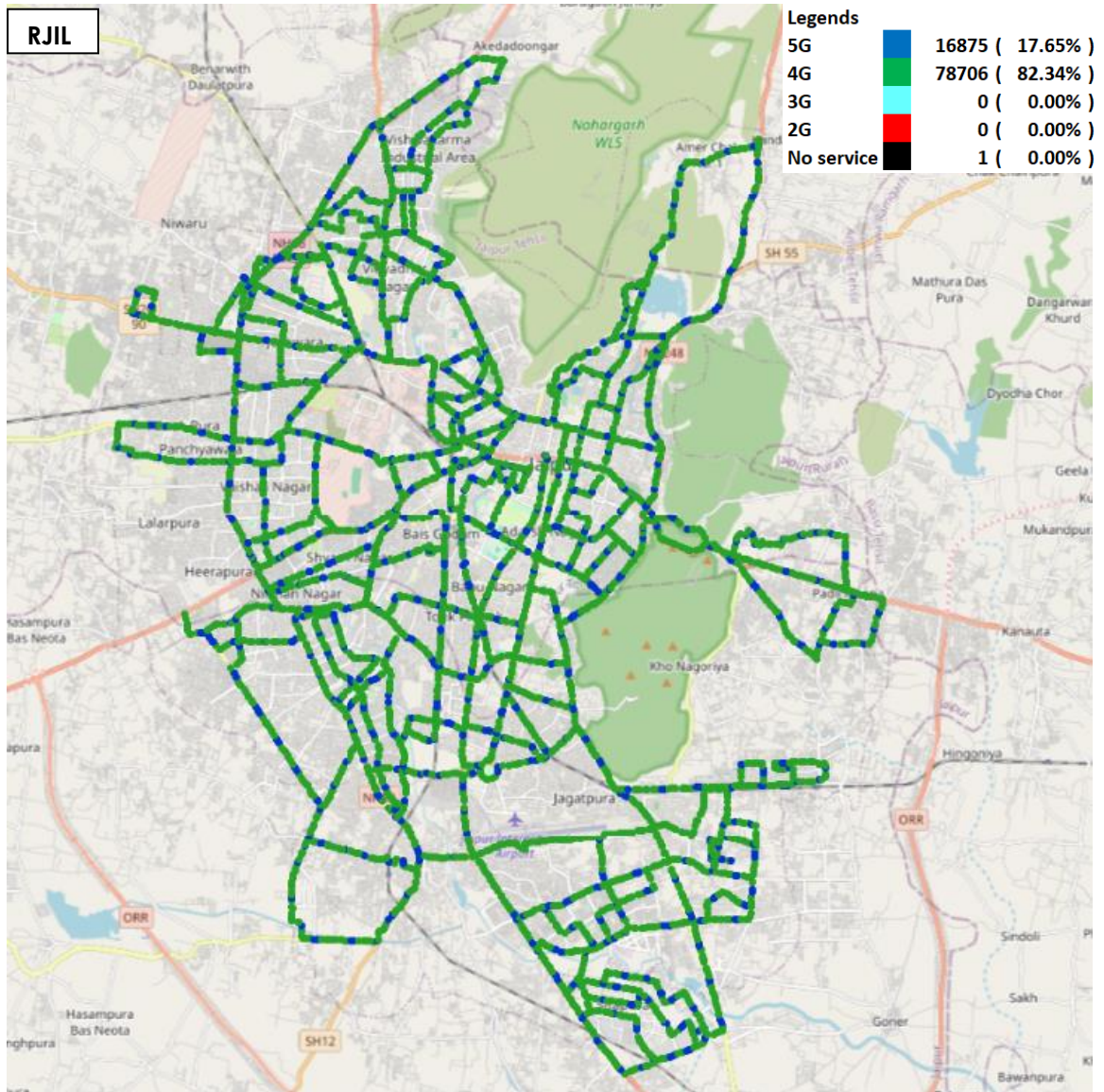


Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL

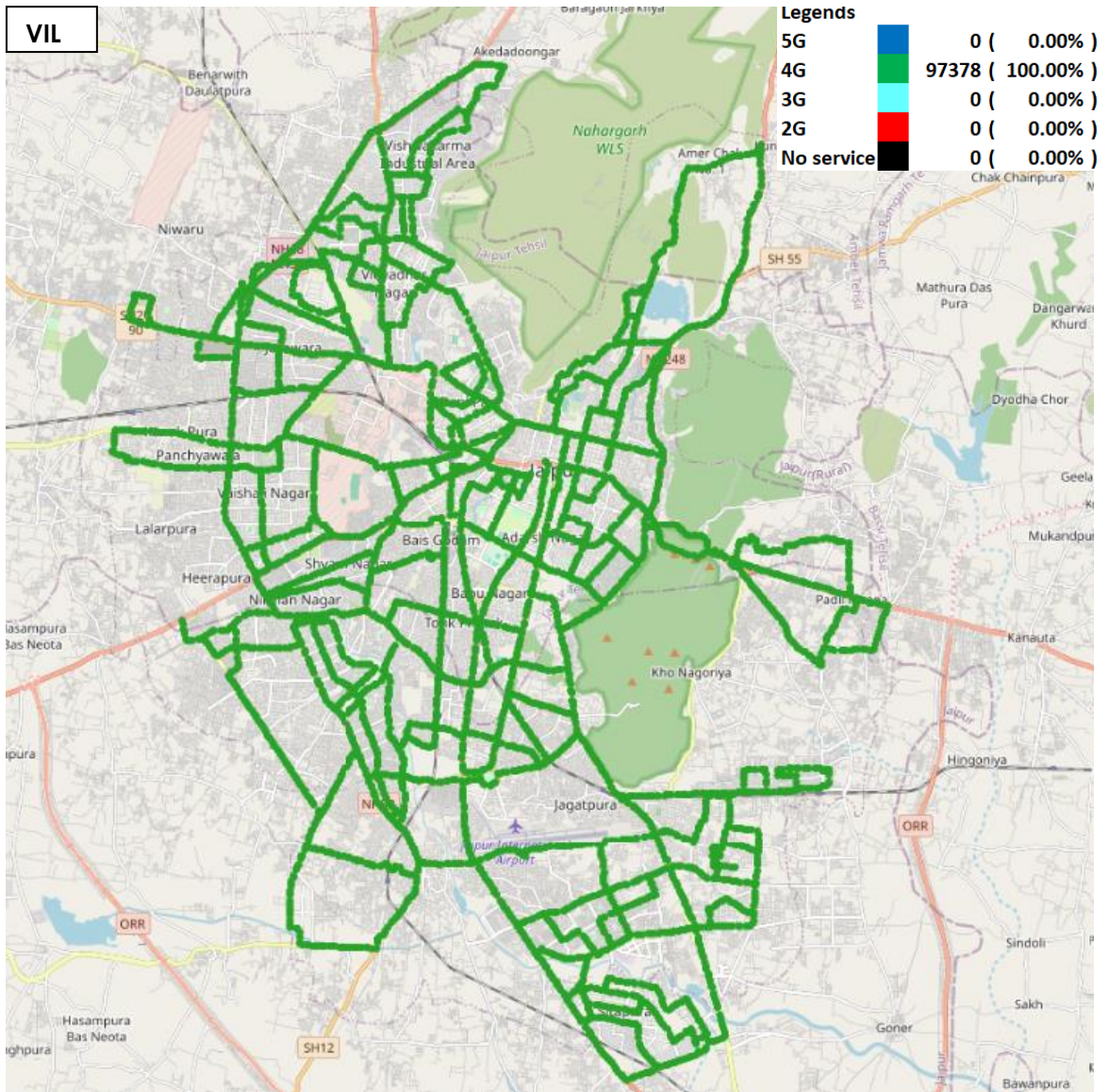


Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G) - VIL

(g) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-46, 47, 48 & 49 for plots)

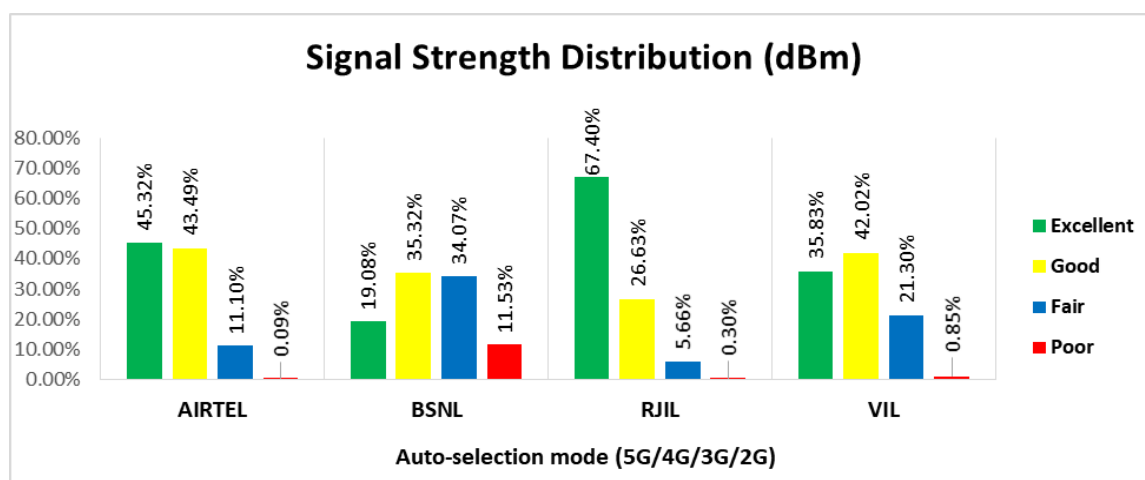


Figure-20: Signal strength distribution auto-selection mode 5G/4G/3G/2G

Observations:

- Airtel has 45% samples falling in excellent signal strength category.
- BSNL has 19% samples falling in excellent signal strength category.
- RJIL has 67% samples falling in excellent signal strength category.
- VIL has 36% samples falling in 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 | 224.39 | 2.96 | 358.37 | 32.03 |
| | 80th Percentile | 305.30 | 3.09 | 549.25 | 46.19 |
| | 20th Percentile | 119.86 | 0.30 | 166.67 | 14.01 |
| Upload Throughput (Mbits/s) | Average | 45.63 | 2.17 | 45.33 | 14.17 |
| | 80th Percentile | 76.90 | 2.59 | 73.04 | 24.42 |
| | 20th Percentile | 15.10 | 1.00 | 14.65 | 3.88 |
| Ping (ms) | Average | 26.50 | 605.55 | 22.01 | 25.24 |

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

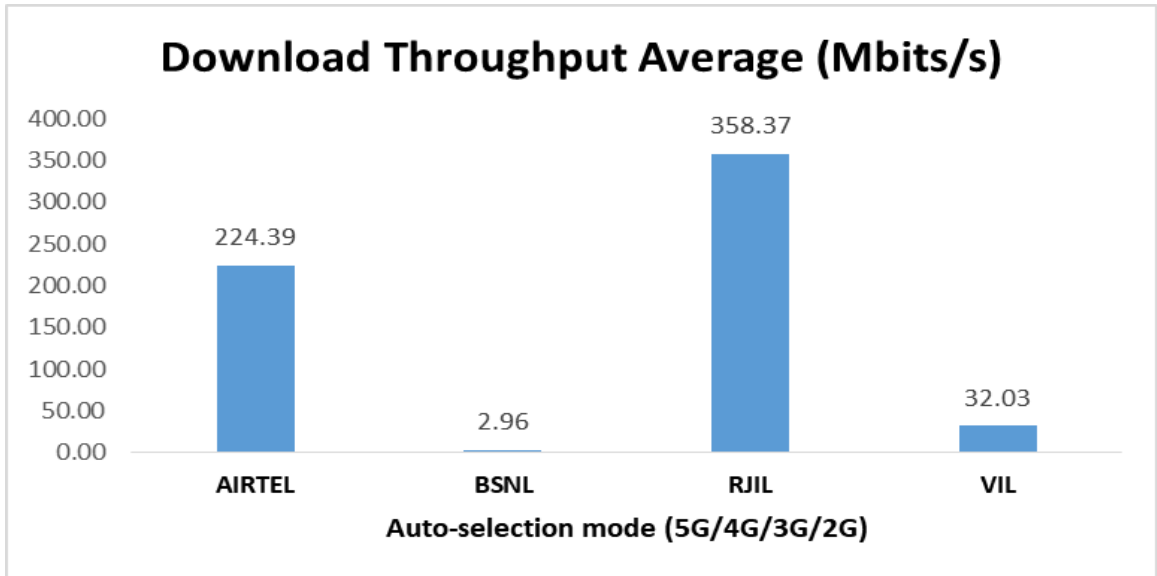


Figure- 21: Download throughput

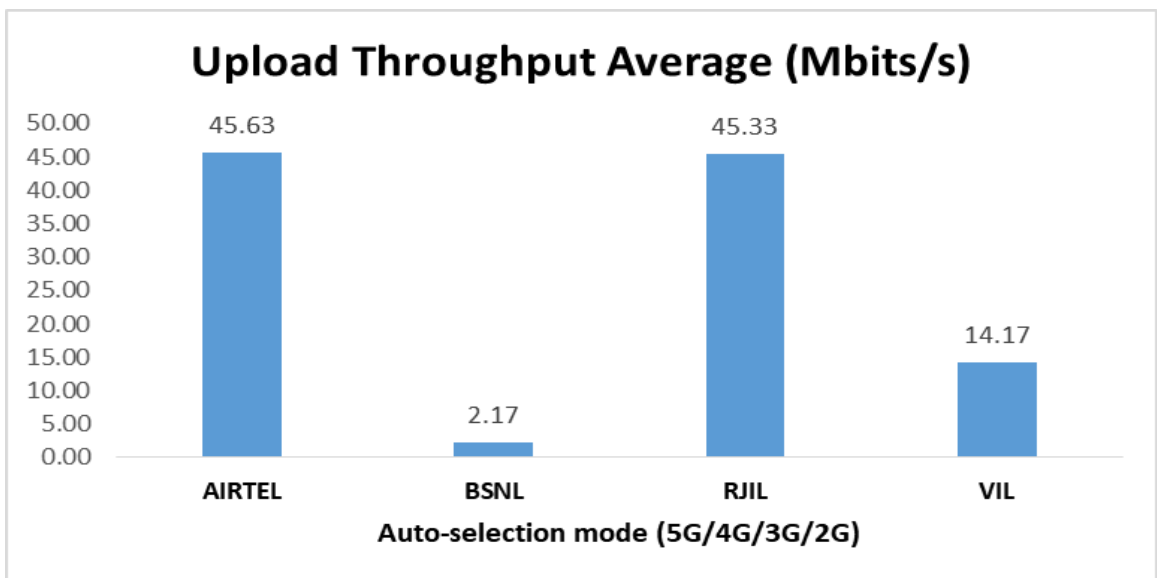


Figure- 22: Upload throughput

4.3 Hotspots

Hotspot testing has been done on 18th October 2024 to 19th October 2024. Thirteen locations has been tested in the city.

4.3.1 Locations

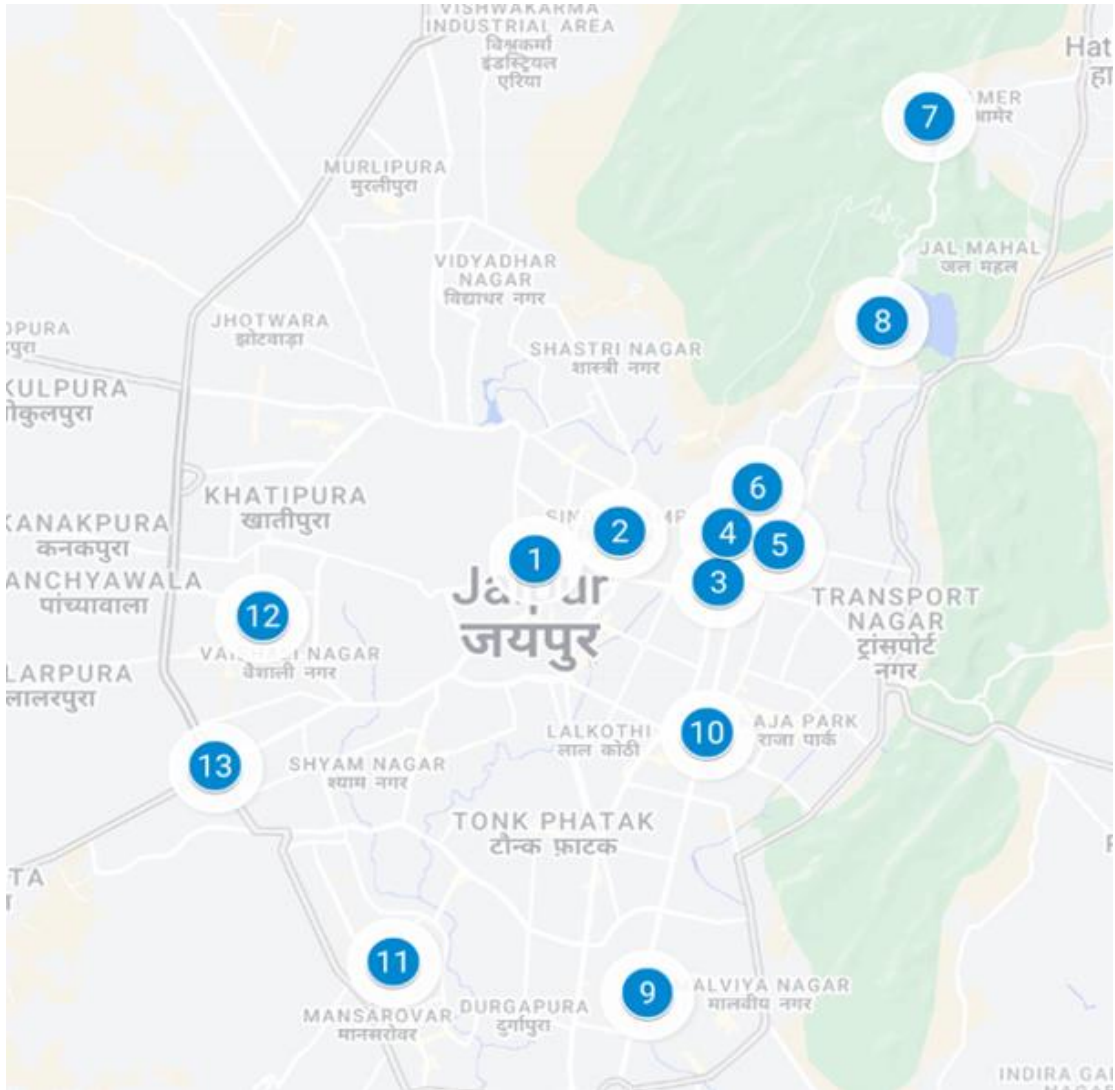


Figure- 23: Hotspot locations

4.3.2 Hotspot covered

1. Jaipur Railway Station
2. Sindhi Camp Bus Stand
3. Ajmeri Gate
4. Chhoti Chaupar
5. Badi Chaupar
6. Govind dev ji temple
7. Amer fort
8. Jal mahal
9. Gaurav tower, Malviya nagar

10. OTS circle JLN marg
11. City park mansarovar
12. Amrapali circle, Vaishali
13. 200 ft bypass circle Heerapura

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 | 99.23 | 100.00 | 100.00 |
| Drop Call Rate% | 0.00 | 0.78 | 0.00 | 0.00 |
| Call Setup Time-Average (Sec) | 1.89 | 4.07 | 0.65 | 0.41 |

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

| Jaipur Railway 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 (Sec) | 1.84 | 3.83 | 0.62 | 0.31 |

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

| Sindhi Camp Bus 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 (Sec) | 1.86 | 6.08 | 0.64 | 0.33 |

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

| Ajmeri Gate | | | | |
|-------------------------------|-----------------------------------|--------|--------|--------|
| 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) | 1.99 | 3.99 | 0.65 | 0.32 |

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

| Chhoti Chaupar | | | | |
|--------------------------------------|--------------------------------|-------------|-------------|------------|
| 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) | 1.87 | 3.58 | 0.69 | 0.32 |

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

| Badi Chaupar | | | | |
|--------------------------------------|--------------------------------|-------------|-------------|------------|
| 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) | 1.81 | 4.55 | 0.68 | 0.39 |

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

| Govind dev ji temple | | | | |
|--------------------------------------|--------------------------------|-------------|-------------|------------|
| 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 | 90.00 | 100.00 | 100.00 |
| Drop Call Rate% | 0.00 | 11.11 | 0.00 | 0.00 |
| Call Setup Time-Average (Sec) | 1.88 | 3.85 | 0.72 | 0.39 |

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

| Amer fort | | | | |
|--------------------------------------|--------------------------------|-------------|-------------|------------|
| 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) | 1.88 | 9.20 | 0.69 | 0.92 |

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

| Jal mahal | | | | |
|--------------------------------------|--------------------------------|-------------|-------------|------------|
| 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) | 2.00 | 2.47 | 0.63 | 0.40 |

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

| Gaurav tower , Malviya nagar | | | | |
|--------------------------------------|--------------------------------|-------------|-------------|------------|
| 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) | 1.88 | 2.12 | 0.64 | 0.40 |

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

| OTS circle JLN marg | | | | |
|--------------------------------------|--------------------------------|-------------|-------------|------------|
| 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) | 1.87 | 4.23 | 0.67 | 0.38 |

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

| City park mansarovar | | | | |
|--------------------------------------|--------------------------------|-------------|-------------|------------|
| 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) | 2.05 | 2.10 | 0.68 | 0.39 |

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

| Amrapali circle, Vaishali | | | | |
|-------------------------------|-------------------------|-------|-------|-------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Call Attempt | 10 | 10 | 10 | 10 |
| Call Setup Success Rate % | 100.0 | 100.0 | 100.0 | 100.0 |
| Drop Call Rate% | 0.00 | 0.00 | 0.00 | 0.00 |
| Call Setup Time-Average (Sec) | 1.83 | 3.86 | 0.57 | 0.35 |

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

| 200 ft bypass circle Heerapura | | | | |
|--------------------------------|-------------------------|-------|-------|-------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Call Attempt | 10 | 10 | 10 | 10 |
| Call Setup Success Rate % | 100.0 | 100.0 | 100.0 | 100.0 |
| Drop Call Rate% | 0.00 | 0.00 | 0.00 | 0.00 |
| Call Setup Time-Average (Sec) | 1.85 | 2.94 | 0.58 | 0.39 |

Table-33: 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) | 215.18 | 4.27 | 418.50 | 38.07 |
| Download Throughput 80th Percentile (Mbit/s) | 274.36 | 4.91 | 653.96 | 68.58 |
| Download Throughput 20th Percentile (Mbit/s) | 96.09 | 0.37 | 200.79 | 10.72 |
| Download Session Setup Success Rate % | 100.00 | 90.77 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 47.97 | 3.68 | 59.60 | 17.27 |
| Upload Throughput 80th Percentile (Mbit/s) | 78.59 | 3.52 | 79.97 | 30.51 |
| Upload Throughput 20th Percentile (Mbit/s) | 11.64 | 1.26 | 35.85 | 3.85 |
| Upload Session Setup Success Rate % | 100.00 | 93.85 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 2.89 | 6.80 | 2.33 | 2.76 |
| Youtube Initial Buffer Delay (Second) | 1.10 | 1.73 | 0.61 | 1.30 |
| Ping (ms) | 21.43 | 533.04 | 18.04 | 22.08 |
| Jitter (ms) | 6.34 | 48.42 | 8.16 | 15.38 |
| Packet Loss Rate-Ping % | 0.21 | 20.74 | 0.06 | 1.25 |

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

| Jaipur Railway Station | | | | |
|--|--|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto-selection mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 697.27 | 5.26 | 158.30 | 51.89 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 102.00 | 8.46 | 53.15 | 36.70 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 1.68 | 2.35 | 2.02 | 1.89 |
| Youtube Initial Buffer Delay (Second) | 0.56 | 0.96 | 0.57 | 0.92 |
| Ping (ms) | 19.68 | 31.53 | 18.02 | 19.80 |
| Jitter (ms) | 3.02 | 4.99 | 7.57 | 9.32 |
| Packet Loss Rate-Ping % | 0.00 | 0.30 | 0.00 | 0.90 |

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

| Sindhi Camp Bus Stand | | | | |
|--|--|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto-selection mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 300.83 | 5.04 | 685.23 | 34.78 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 105.24 | 2.39 | 74.84 | 18.57 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 2.27 | 3.92 | 2.35 | 3.06 |
| Youtube Initial Buffer Delay (Second) | 0.97 | 1.80 | 0.46 | 1.28 |
| Ping (ms) | 20.66 | 26.69 | 17.31 | 18.83 |
| Jitter (ms) | 4.85 | 16.6 | 6.84 | 5.85 |
| Packet Loss Rate-Ping % | 0.00 | 1.70 | 0.00 | 0.70 |

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

| Ajmeri Gate | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 141.5 | 0.8 | 818.98 | 77.53 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 24.54 | 2.94 | 69.33 | 32.00 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 2.08 | 12.12 | 2.96 | 2.38 |
| Youtube Initial Buffer Delay (Second) | 0.64 | 2.93 | 0.46 | 0.99 |
| Ping (ms) | 20.74 | 36.87 | 17.53 | 19.08 |
| Jitter (ms) | 8.33 | 8.60 | 6.28 | 14.74 |
| Packet Loss Rate-Ping % | 0.20 | 0.20 | 0.00 | 0.80 |

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

| Chhoti Chaupar | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average(Mbits/s) | 223.54 | 5.30 | 371.82 | 28.64 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 48.08 | 3.24 | 78.3 | 22.25 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 2.41 | 5.25 | 2.30 | 2.78 |
| Youtube Initial Buffer Delay (Second) | 0.50 | 1.52 | 0.47 | 0.90 |
| Ping (ms) | 16.01 | 33.54 | 17.17 | 18.31 |
| Jitter (ms) | 1.65 | 6.36 | 7.29 | 13.72 |
| Packet Loss Rate-Ping % | 0.00 | 3.20 | 0.00 | 0.30 |

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

| Badi Chaupar | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average(Mbits/s) | 236.02 | 25.34 | 649.04 | 32.01 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 65.91 | 15.10 | 104.03 | 4.24 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 2.70 | 5.08 | 2.49 | 2.57 |
| Youtube Initial Buffer Delay (Second) | 0.63 | 2.06 | 0.47 | 1.08 |
| Ping (ms) | 19.06 | 29.55 | 17.47 | 18.16 |
| Jitter (ms) | 3.88 | 4.04 | 6.69 | 8.86 |
| Packet Loss Rate-Ping % | 0.00 | 0.00 | 0.00 | 0.60 |

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

| Govind dev ji temple | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 166.86 | 3.80 | 192.88 | 70.22 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 2.52 | 2.73 | 2.58 | 47.97 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 2.44 | 5.53 | 2.26 | 2.44 |
| Youtube Initial Buffer Delay (Second) | 2.66 | 3.43 | 1.88 | 1.01 |
| Ping (ms) | 22.78 | 36.15 | 18.49 | 18.33 |
| Jitter (ms) | 7.05 | 7.62 | 8.74 | 13.14 |
| Packet Loss Rate-Ping % | 0.30 | 0.10 | 0.00 | 0.40 |

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

| Amer fort | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 7.81 | 0.02 | 474.28 | 39.77 |
| Download Session Setup Success Rate % | 100.00 | 60.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 1.06 | 0.04 | 79.27 | 5.94 |
| Upload Session Setup Success Rate % | 100.00 | 40.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 7.74 | - | 2.23 | 2.68 |
| Youtube Initial Buffer Delay (Second) | 1.58 | - | 0.48 | 1.20 |
| Ping (ms) | 26.52 | 4249.21 | 20.42 | 31.45 |
| Jitter (ms) | 16.74 | 238.90 | 13.63 | 22.29 |
| Packet Loss Rate-Ping % | 0.90 | 99.60 | 0.40 | 2.00 |

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

| |
|--|
| Note- |
| <ul style="list-style-type: none"> All web browsing and youtube tests failed in BSNL. |

| Jal mahal | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 167.66 | 0.24 | 646.48 | 11.97 |
| Download Session Setup Success Rate % | 100.00 | 80.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 45.07 | 1.53 | 82.99 | 14.32 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 3.18 | 17.10 | 2.35 | 5.20 |
| Youtube Initial Buffer Delay (Second) | 0.66 | - | 0.46 | 1.55 |
| Ping (ms) | 24.75 | 757.38 | 17.28 | 19.77 |
| Jitter (ms) | 5.30 | 52.37 | 6.92 | 16.17 |
| Packet Loss Rate-Ping % | 0.20 | 24.80 | 0.00 | 0.90 |

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

| |
|---|
| Note- |
| <ul style="list-style-type: none"> All youtube tests failed in BSNL. |

| Gaurav tower, Malviya nagar | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 54.26 | 0.21 | 385.23 | 10.94 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 13.22 | 1.34 | 58.72 | 3.68 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 2.33 | 11.37 | 2.03 | 2.46 |
| Youtube Initial Buffer Delay (Second) | 1.62 | - | 0.56 | 1.64 |
| Ping (ms) | 24.48 | 145.96 | 17.55 | 25.21 |
| Jitter (ms) | 16.03 | 92.62 | 6.61 | 13.49 |
| Packet Loss Rate-Ping | 1.00 | 23.50 | 0.00 | 0.40 |

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

| |
|---|
| Note- |
| <ul style="list-style-type: none"> All youtube tests failed in BSNL. |

| OTS circle JLN marg | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 211.32 | 1.19 | 427.21 | 32.82 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 69.06 | 3.14 | 48.68 | 10.19 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 2.26 | 11.26 | 2.24 | 2.13 |
| Youtube Initial Buffer Delay (Second) | 1.21 | 5.38 | 0.48 | 1.38 |
| Ping (ms) | 19.45 | 102.42 | 18.26 | 23.57 |
| Jitter (ms) | 3.31 | 25.14 | 8.22 | 16.26 |
| Packet Loss Rate-Ping % | 0.00 | 15.80 | 0.00 | 2.20 |

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

| City park mansarovar | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 260.52 | 0.93 | 263.13 | 72.86 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 77.96 | 1.19 | 34.29 | 22.02 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 1.92 | 14.54 | 1.99 | 2.55 |
| Youtube Initial Buffer Delay (Second) | 0.60 | - | 0.49 | 1.37 |
| Ping (ms) | 20.49 | 41.44 | 18.54 | 19.47 |
| Jitter (ms) | 3.36 | 10.26 | 9.23 | 14.13 |
| Packet Loss Rate-Ping % | 0.00 | 0.50 | 0.10 | 0.90 |

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

Note-

- All youtube tests failed in BSNL.

| Amrapali circle, Vaishali | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 73.24 | 2.11 | 173.26 | 24.60 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 24.29 | 2.32 | 58.45 | 4.52 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 3.83 | 7.63 | 2.77 | 2.89 |
| Youtube Initial Buffer Delay (Second) | 2.03 | 4.46 | 0.65 | 1.38 |
| Ping (ms) | 21.47 | 33.27 | 18.86 | 22.75 |
| Jitter (ms) | 2.84 | 18.42 | 11.38 | 14.79 |
| Packet Loss Rate-Ping % | 0.00 | 1.60 | 0.30 | 1.40 |

Table-46: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G)

| 200 ft bypass circle Heerapura | | | | |
|--|--------------------------------|-------------|-------------|------------|
| Parameters | Service Provider | | | |
| | Auto Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 256.54 | 0.37 | 194.63 | 6.84 |
| Download Session Setup Success Rate % | 100.00 | 40.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 44.72 | 0.70 | 30.14 | 2.12 |
| Upload Session Setup Success Rate % | 100.00 | 80.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 4.01 | - | 2.36 | 3.13 |
| Youtube Initial Buffer Delay (Second) | 0.64 | - | 0.52 | 2.17 |
| Ping (ms) | 22.45 | 3893.99 | 17.57 | 32.36 |
| Jitter (ms) | 6.06 | 414.03 | 6.70 | 37.25 |
| Packet Loss Rate-Ping % | 0.10 | 98.26 | 0.00 | 4.80 |

Table-47: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G)

Note-

- All web browsing and youtube tests failed in BSNL.

4.4 Walk Test

Drive test has been conducted on 17th October 2024 and 18th October covering two walk test. (Refer Table-1)

4.4.1 Walk-Test location map



Figure- 24: Walk test locations

4.4.2 Walk test Covered

- Jaipur Railway Station
- Jaipur Airport

4.4.2.1 Jaipur Railway Station

i) Voice performance

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

| Parameters | Service Provider | | | |
|----------------------------------|-----------------------------------|--------|--------|--------|
| | Auto-selection mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Call Attempts | 11 | 11 | 12 | 11 |
| Call Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Drop Call Rate% | 0.00 | 0.00 | 8.33 | 0.00 |
| Call Setup Time-Average (Second) | 1.80 | 3.88 | 0.68 | 0.32 |

Table-48: Summary of voice call performance in network auto-selection mode

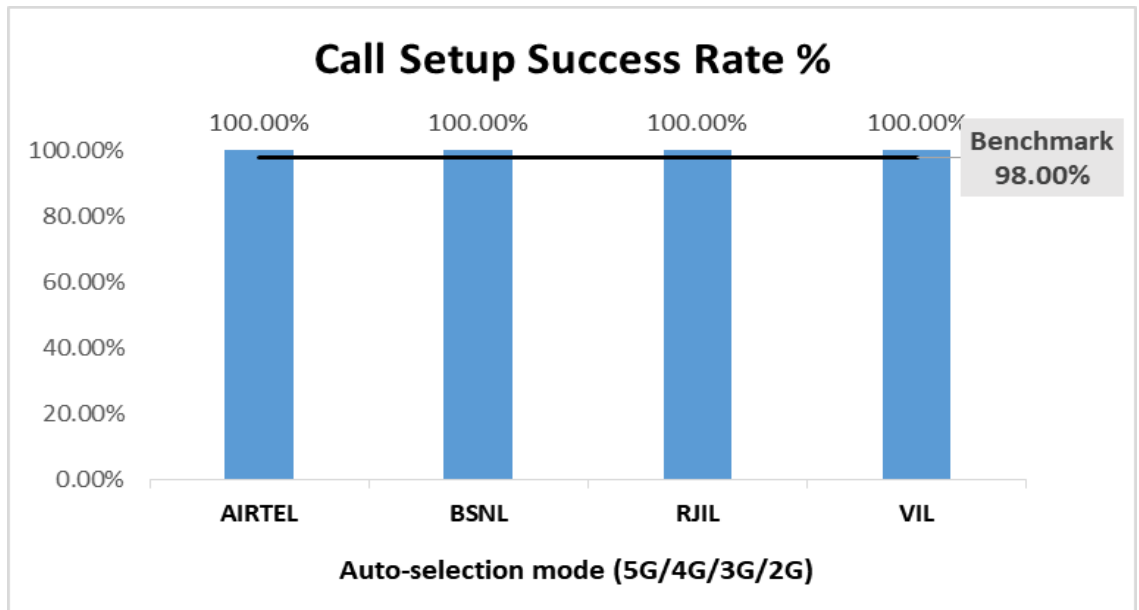


Figure-25: Performance for call setup success rate

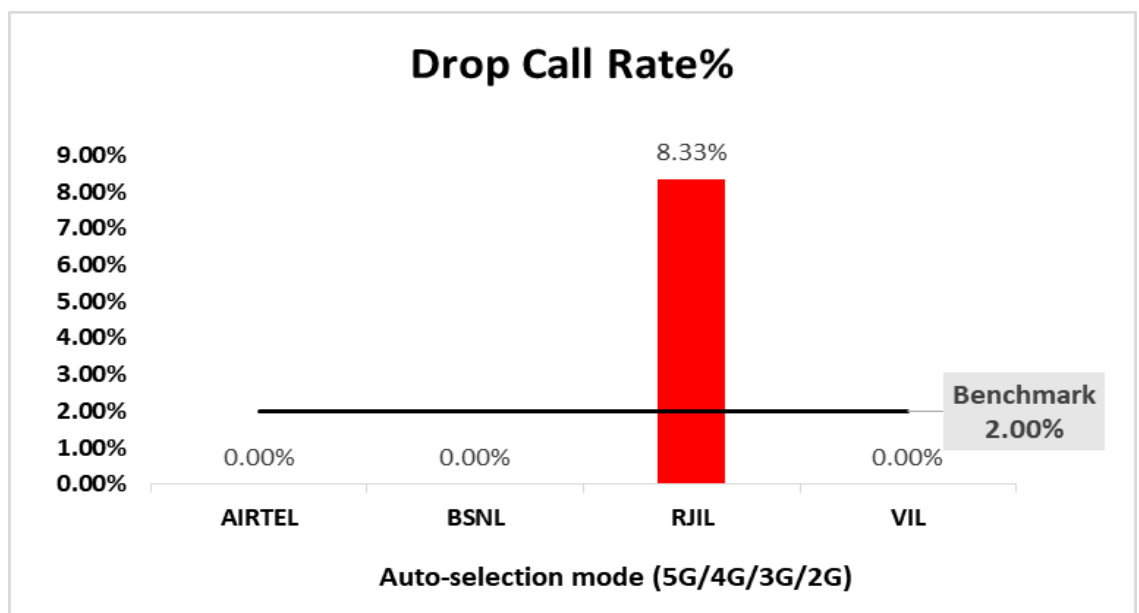


Figure-26: Performance for drop call rate

ii) Data performance

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

| Parameters | | Service Provider | | | |
|-------------------------------|-----------------|-----------------------------------|-------|--------|-------|
| | | Auto-selection mode (5G/4G/3G/2G) | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput (Mbits/s) | Average | 35.06 | 0.88 | 229.80 | 33.20 |
| | 80th Percentile | 0.54 | 1.28 | 292.57 | 43.90 |
| | 20th Percentile | 0.41 | 0.30 | 132.57 | 25.73 |
| Upload Throughput (Mbits/s) | Average | 9.98 | 2.67 | 36.52 | 14.16 |
| | 80th Percentile | 1.91 | 2.92 | 46.84 | 17.07 |
| | 20th Percentile | 1.56 | 2.28 | 23.79 | 5.15 |
| Ping (ms) | Average | 17.50 | 72.79 | 18.56 | 21.01 |

Table-49: Summary of Data performance in network auto-selection mode

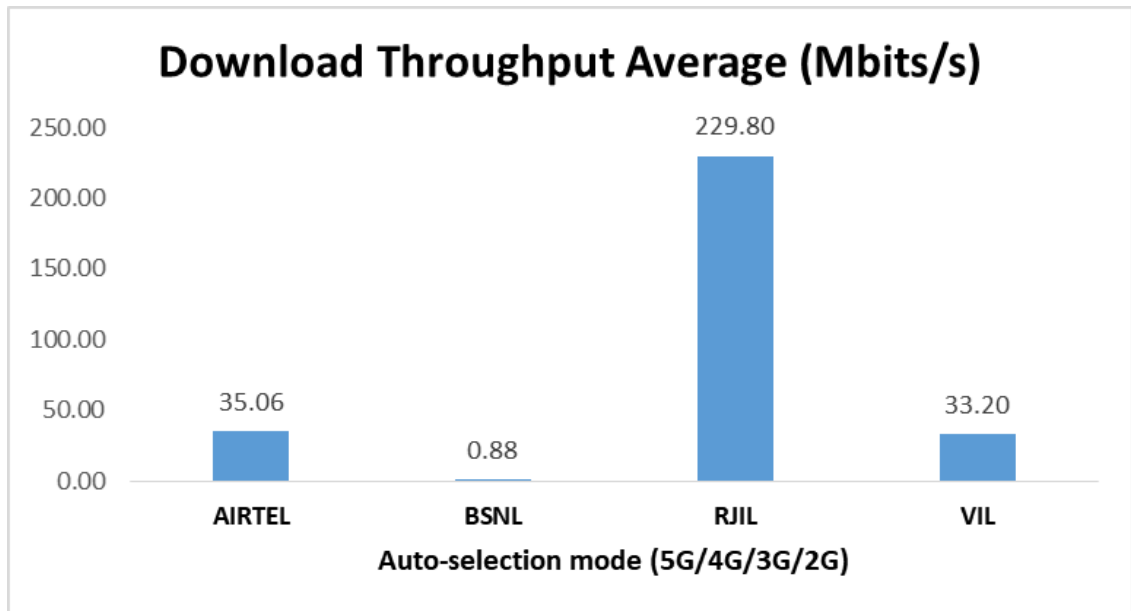


Figure-27: Download throughput

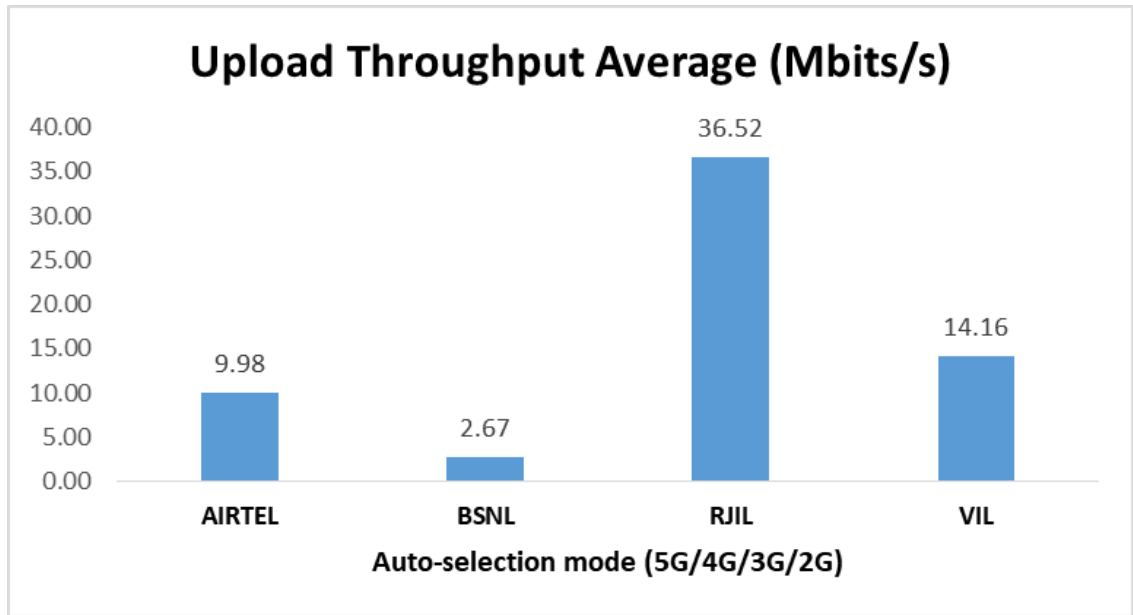


Figure-28: Upload throughput

4.4.2.2 Jaipur Airport

i) Voice performance

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

| Parameters | Service Provider | | | |
|---|-----------------------------------|--------|--------|--------|
| | Auto-selection mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Call Attempts | 8 | 8 | 8 | 8 |
| 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) | 1.77 | 2.33 | 0.46 | 0.32 |

Table-50: Summary of voice call performance in network auto-selection mode

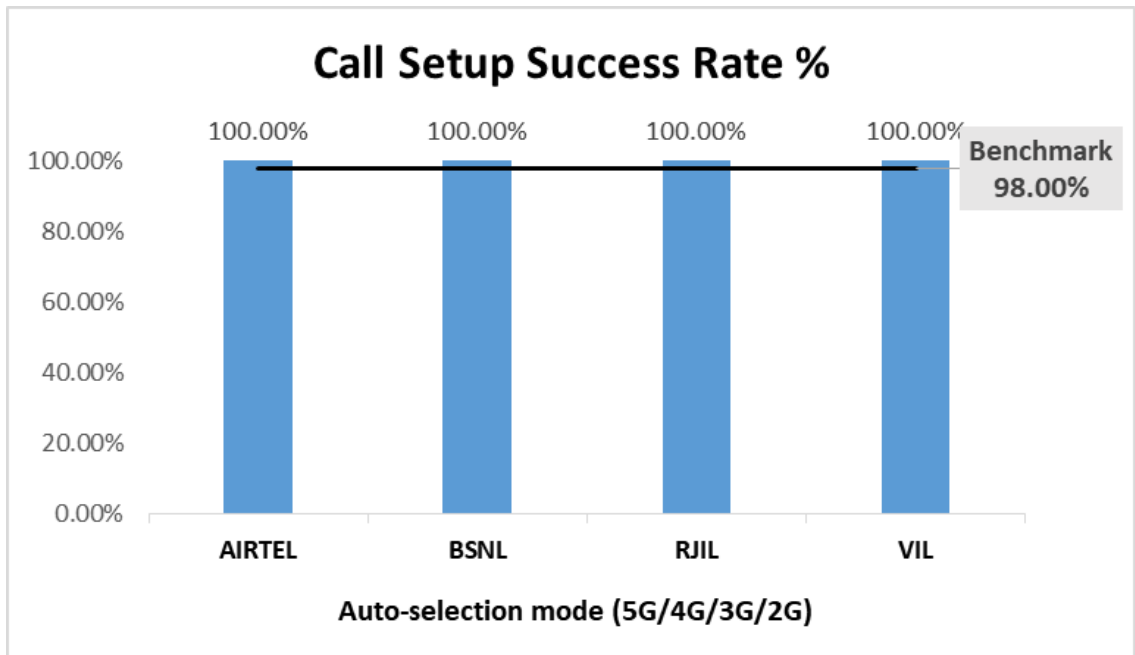


Figure-29: Performance for call setup success rate

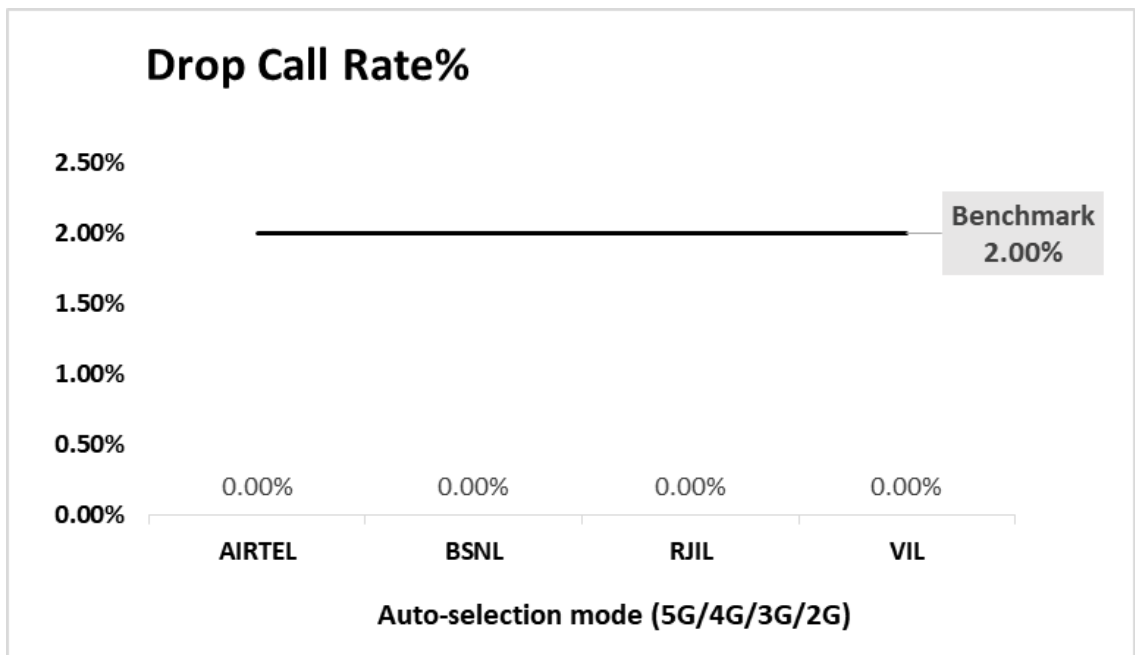


Figure-30: Performance for drop call rate

ii) Data performance

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

| Parameters | | Service Provider | | | |
|-------------------------------|-----------------|-----------------------------------|-------|-------|-------|
| | | Auto-selection mode (5G/4G/3G/2G) | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput (Mbits/s) | Average | 72.27 | 7.83 | 12.61 | 12.12 |
| | 80th Percentile | 86.48 | 10.69 | 15.62 | 15.21 |
| | 20th Percentile | 59.88 | 4.49 | 8.40 | 4.96 |
| Upload Throughput (Mbits/s) | Average | 24.76 | 3.58 | 4.70 | 7.22 |
| | 80th Percentile | 30.5 | 4.13 | 5.51 | 8.25 |
| | 20th Percentile | 19.96 | 3.38 | 3.85 | 5.67 |
| Ping (ms) | Average | 28.83 | 29.32 | 21.09 | 47.09 |

Table-51: Summary of Data performance in network auto-selection mode

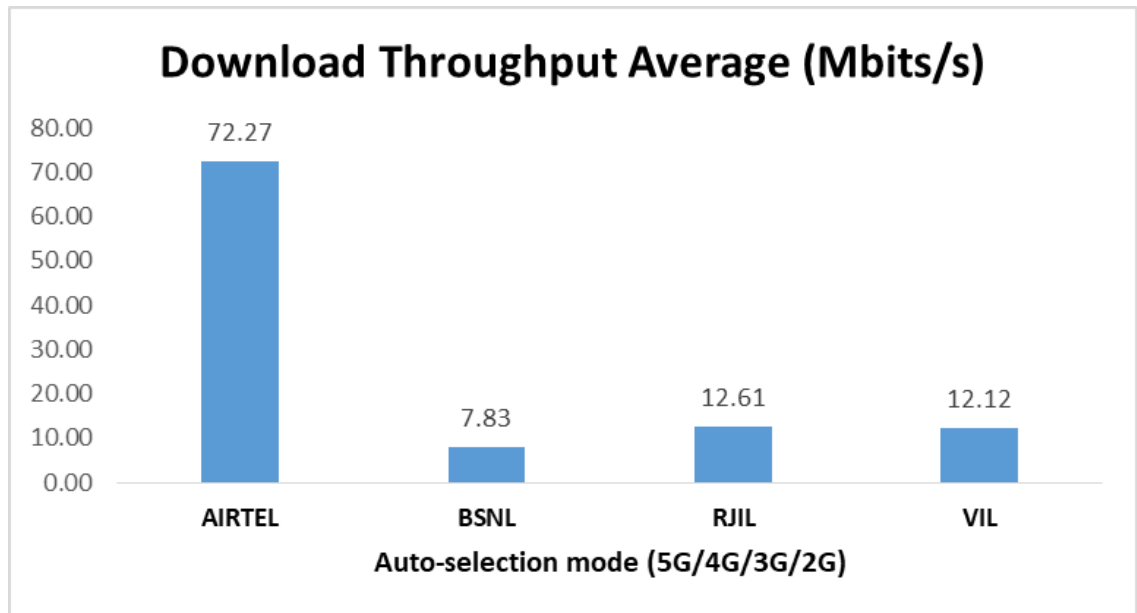


Figure-31: Download throughput

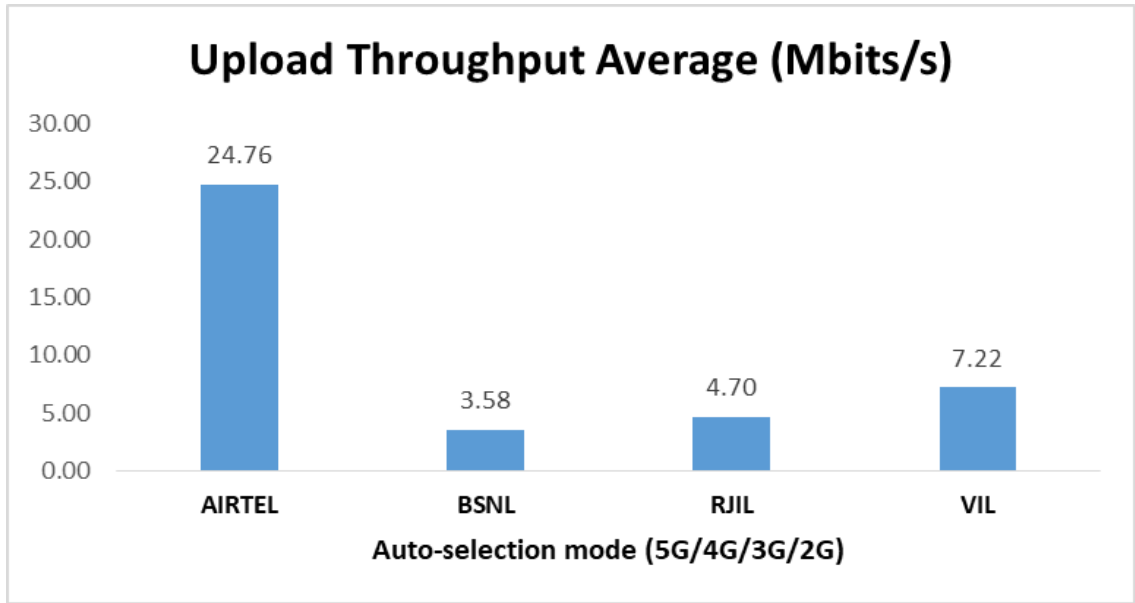


Figure-32: Upload throughput

4.5 Railways/Metro

Drive test has been conducted on 17th October 2024 covering one metro route. (Refer Table-1)

4.5.1 Drive test routes

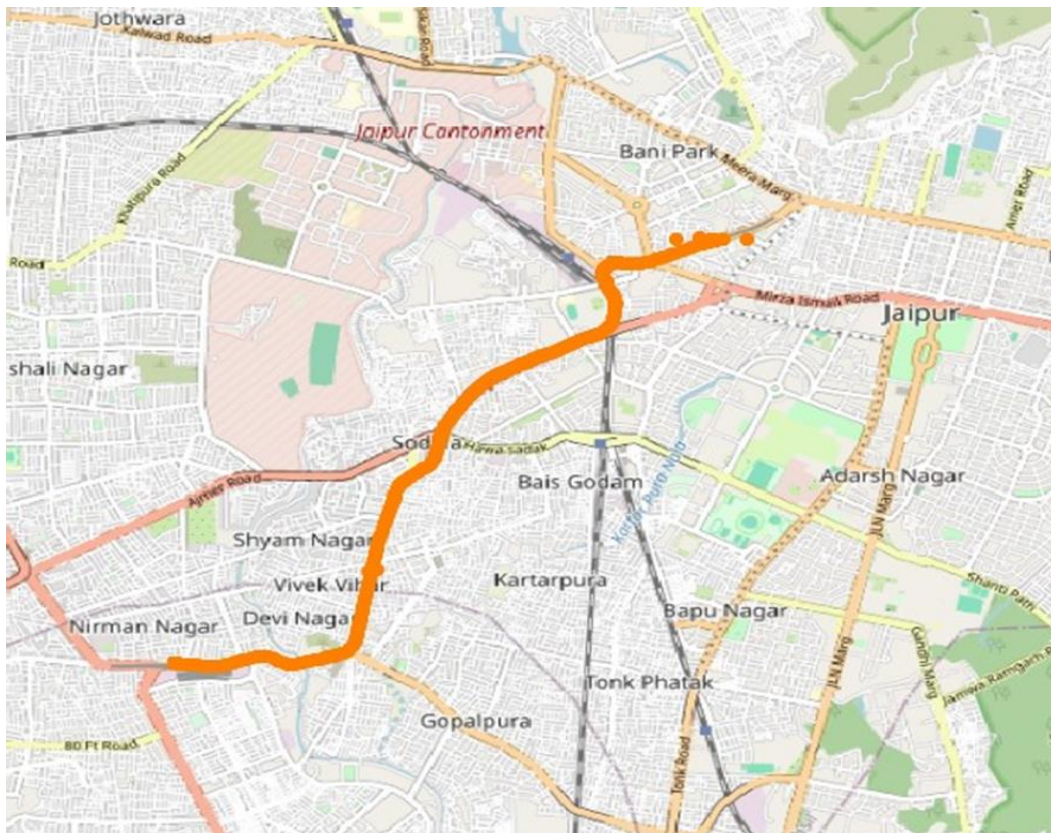


Figure-33: Drive test route metro

4.5.2 Routes Covered

- Mansarovar to Badi Chaupar

4.5.2.1 Mansarovar to Badi Chaupar

Drive test for this route has been conducted on 17th October 2024. This route has 11 metro stations, out of which 8 are elevated and 3 are underground.

i) Voice performance

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

| Parameters | Service Provider | | | |
|---|-----------------------------------|--------|--------|--------|
| | Auto-selection mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Call Attempts | 21 | 21 | 24 | 25 |
| Call Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Drop Call Rate% | 0.00 | 14.29 | 0.00 | 0.00 |
| Call Setup Time-Average (Second) | 1.81 | 4.92 | 1.04 | 0.33 |
| Handover Success Rate % | 96.94 | 100.00 | 99.23 | 98.31 |

Table-52: Summary of voice call performance in network auto-selection mode

Note-

- 5 call in Airtel and 7 calls in BSNL could not be initiated due to no coverage along some patches of metro route.

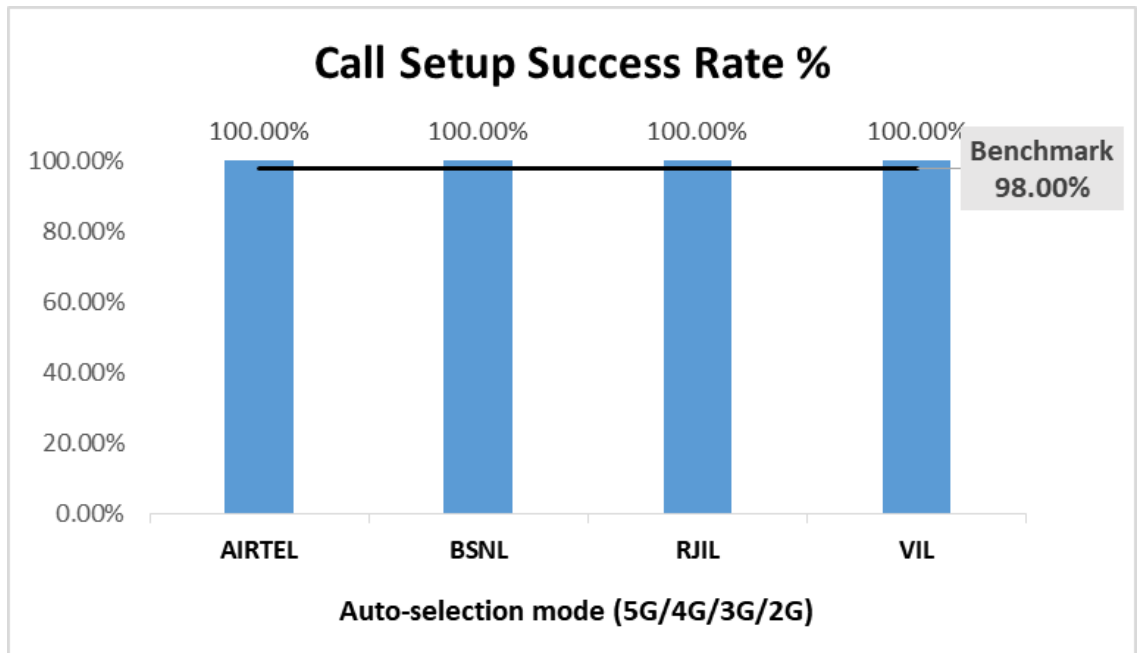


Figure-34: Performance for call setup success rate

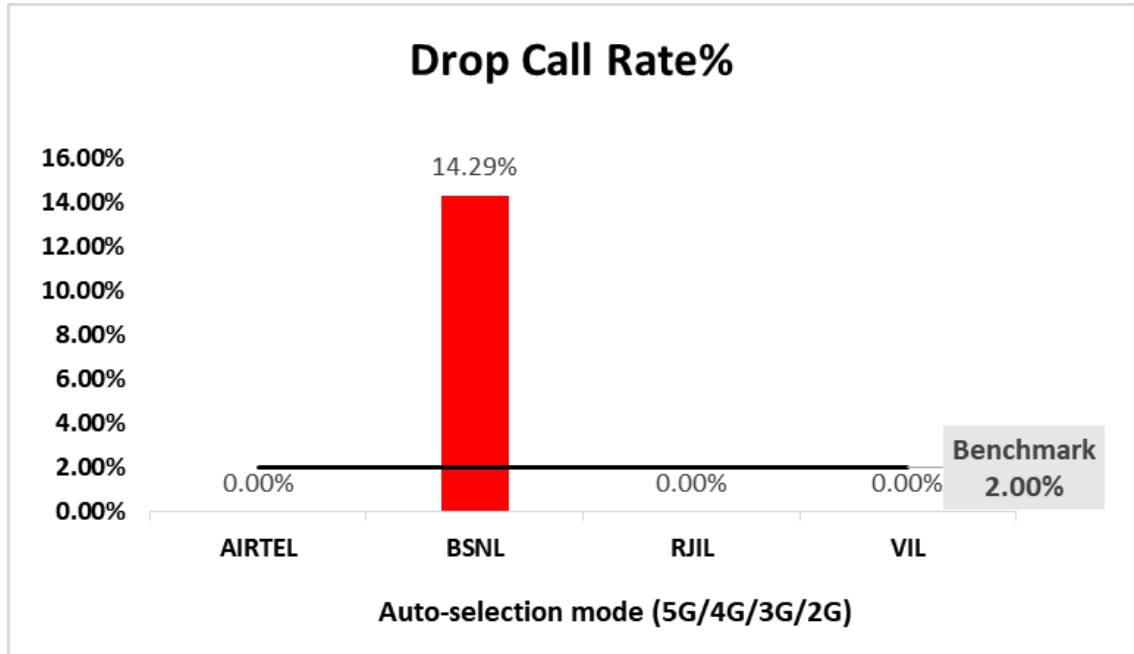


Figure-35: Performance for drop call rate

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

| Technology | Service Provider | | | |
|-------------------|------------------|--------|--------|---------|
| | AIRTEL | BSNL | RJIL | VIL |
| 5G | 2.85% | NA | 17.05% | NA |
| 4G | 89.05% | 12.02% | 82.95% | 100.00% |
| 3G | NA | 8.37% | NA | 0.00% |
| 2G | 0.00% | 65.17% | NA | 0.00% |
| No service | 8.10% | 14.45% | 0.00% | 0.00% |

Table-53:Time spent on technology during drive test

| |
|---|
| Note- |
| <ul style="list-style-type: none"> AIRTEL & BSNL have 8.10% & 14.45% no service/limited service samples in metro drive. NA- Service provider doesn't provide services in respective technology. |

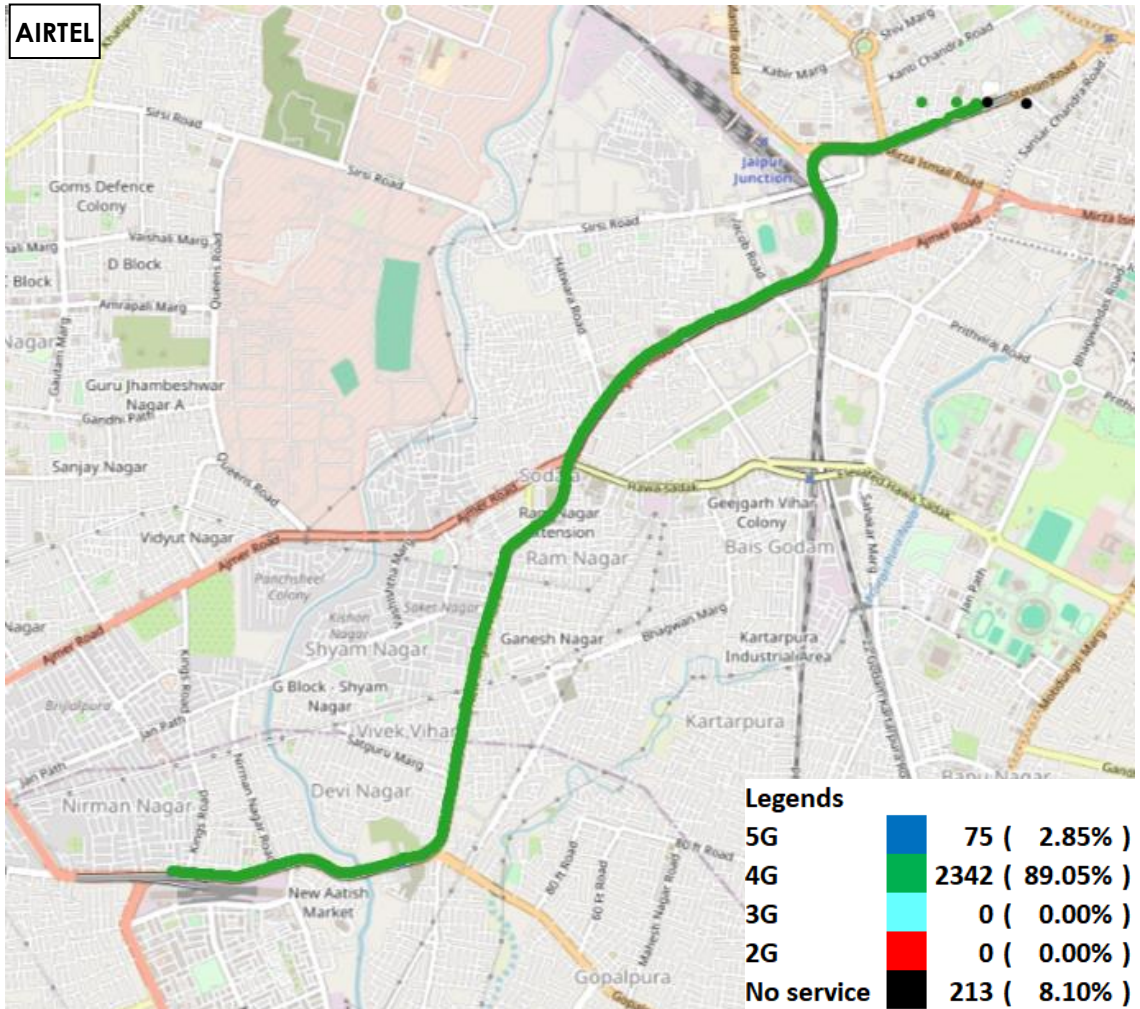


Figure-36: Serving technology plots auto-selection mode 5G/4G/3G/2G -Airtel

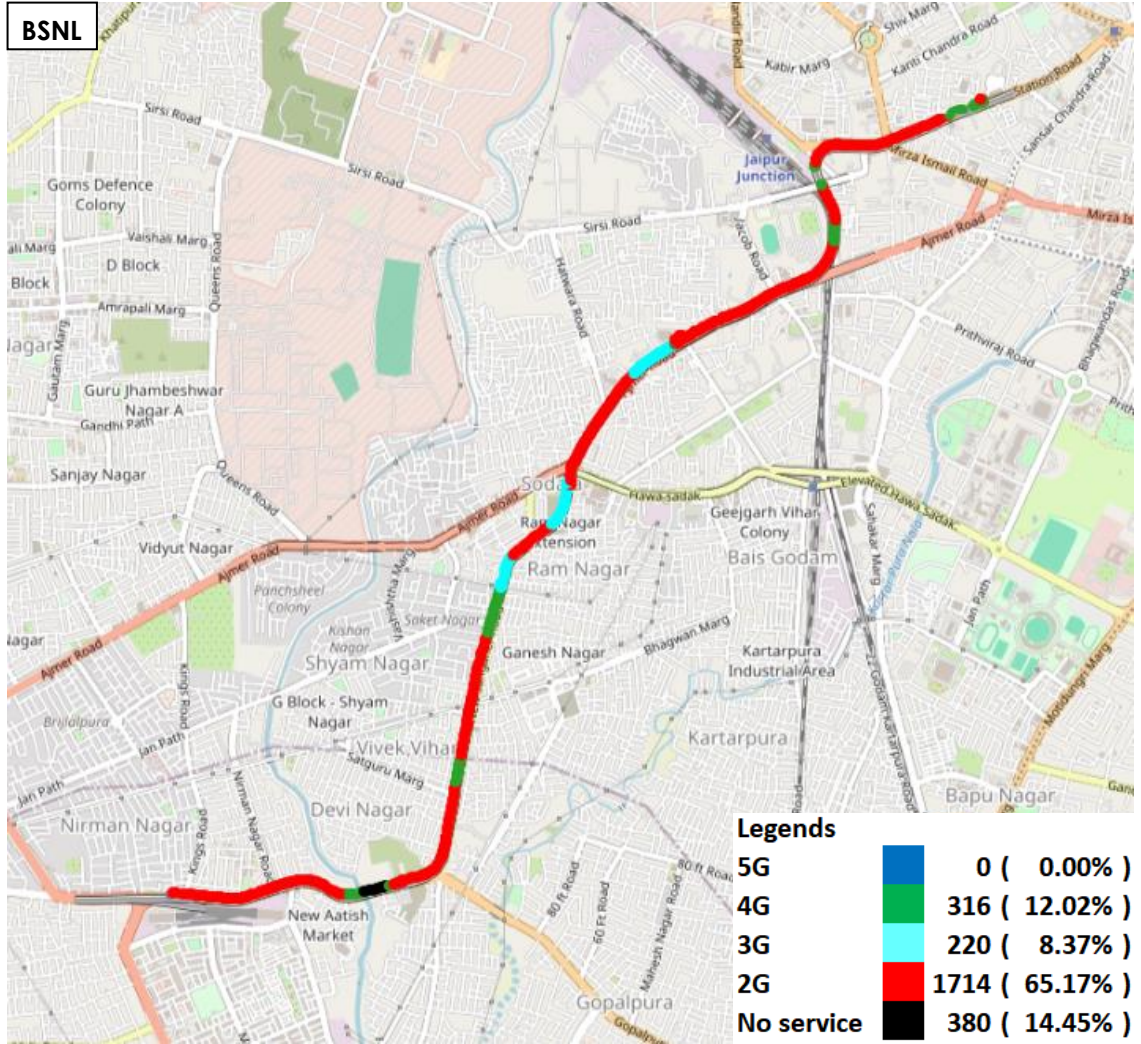


Figure-37: Serving technology plots auto-selection mode 5G/4G/3G/2G -BSNL

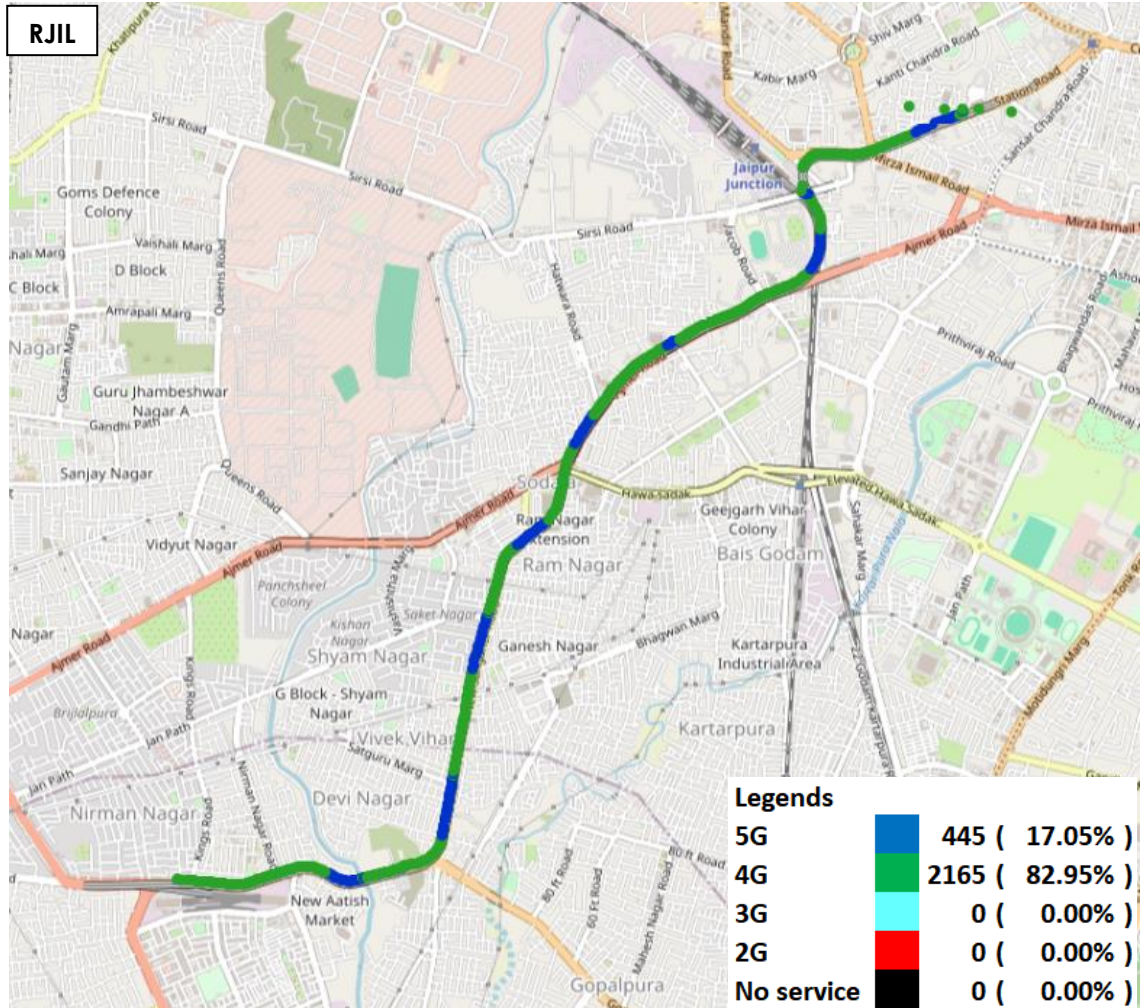


Figure-38: Serving technology plots auto-selection mode 5G/4G/3G/2G –RJIL

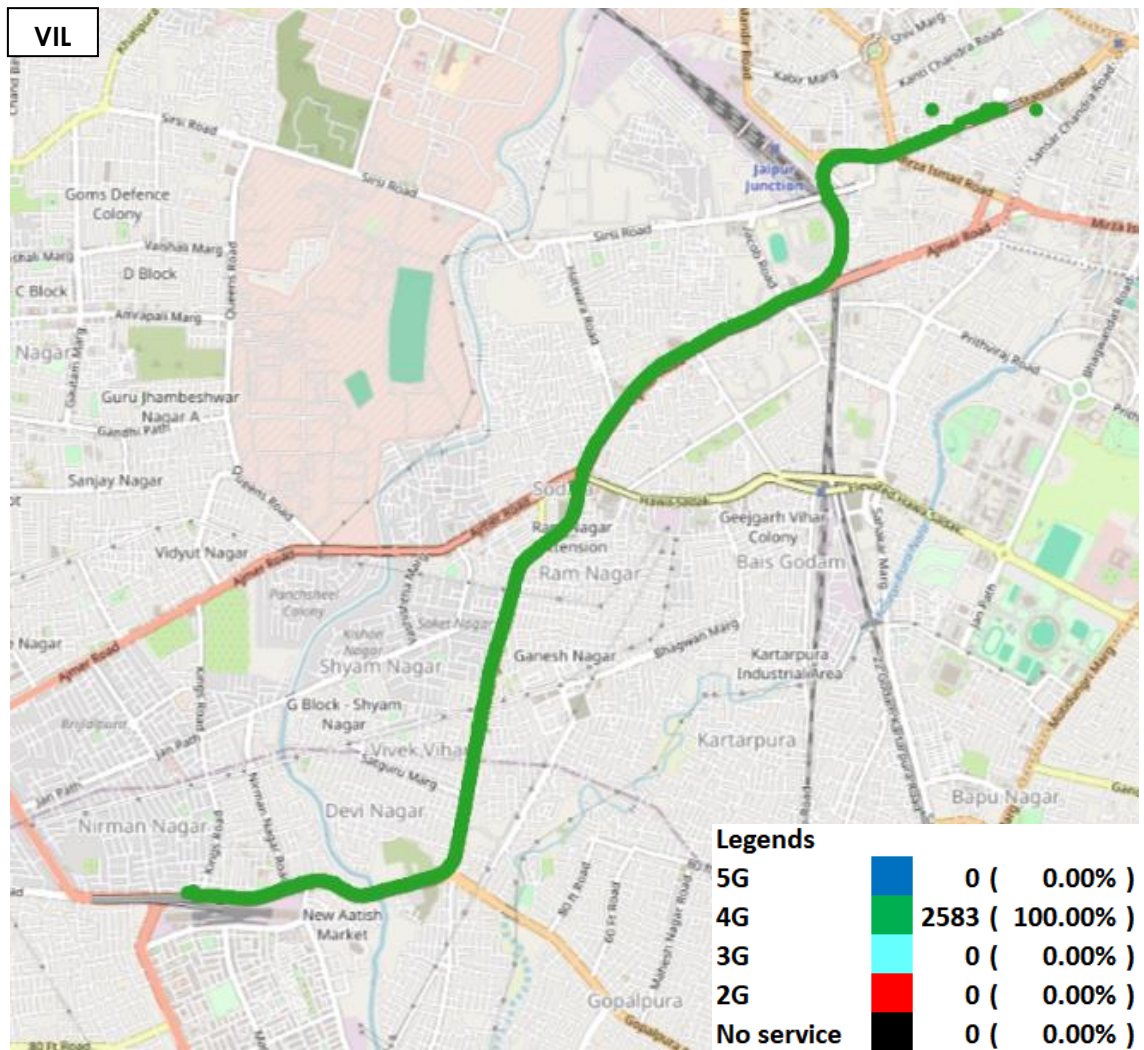


Figure-39: Serving technology plots auto-selection mode 5G/4G/3G/2G – VIL

Note-

- Complete plot could not be displayed on Geographic Information System (GIS) for underground metro route.

(c) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G) (Refer figure-50, 51, 52 & 53 for plots)

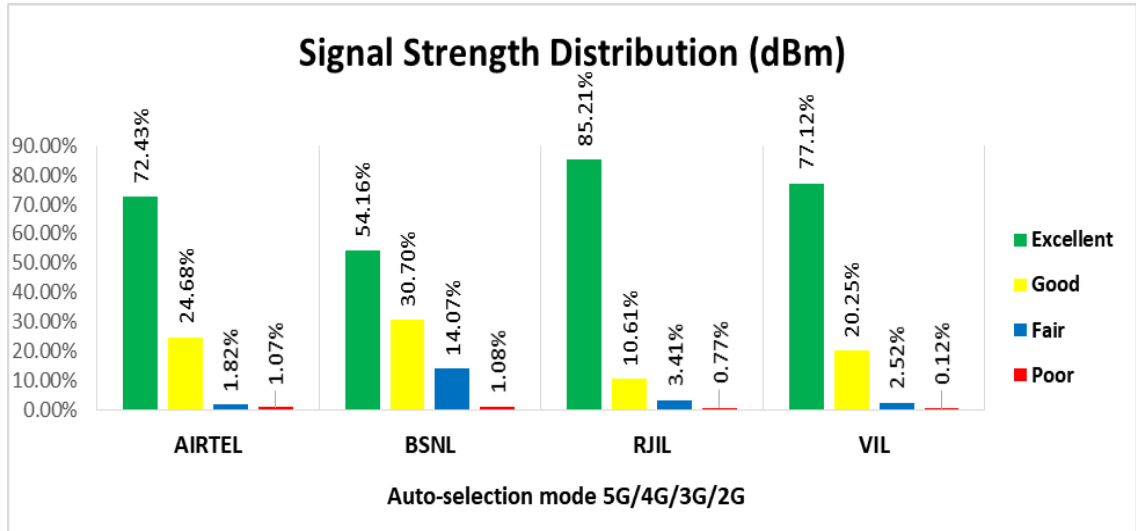


Figure-40: Signal strength distribution for auto-selection mode 5G/4G/3G/2G

ii) Data performance

(b) 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 | 58.87 | 4.20 | 322.01 | 39.57 |
| | 80th Percentile | 81.86 | 8.45 | 516.32 | 56.92 |
| | 20th Percentile | 20.66 | 0.68 | 151.27 | 26.14 |
| Upload Throughput (Mbits/s) | Average | 29.40 | 5.00 | 62.27 | 13.37 |
| | 80th Percentile | 44.87 | 11.06 | 101.21 | 20.02 |
| | 20th Percentile | 12.92 | 1.80 | 16.55 | 6.05 |
| Ping (ms) | Average | 27.36 | 280.72 | 21.29 | 21.36 |

Table-54: Summary of Data performance in network auto-selection mode

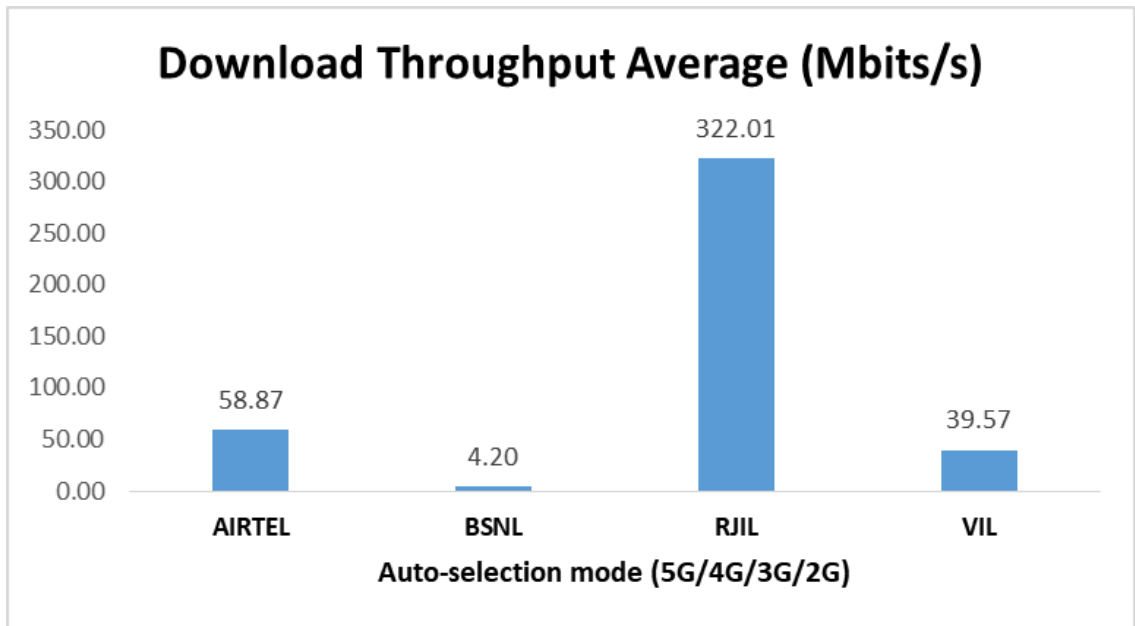


Figure-41: Download throughput

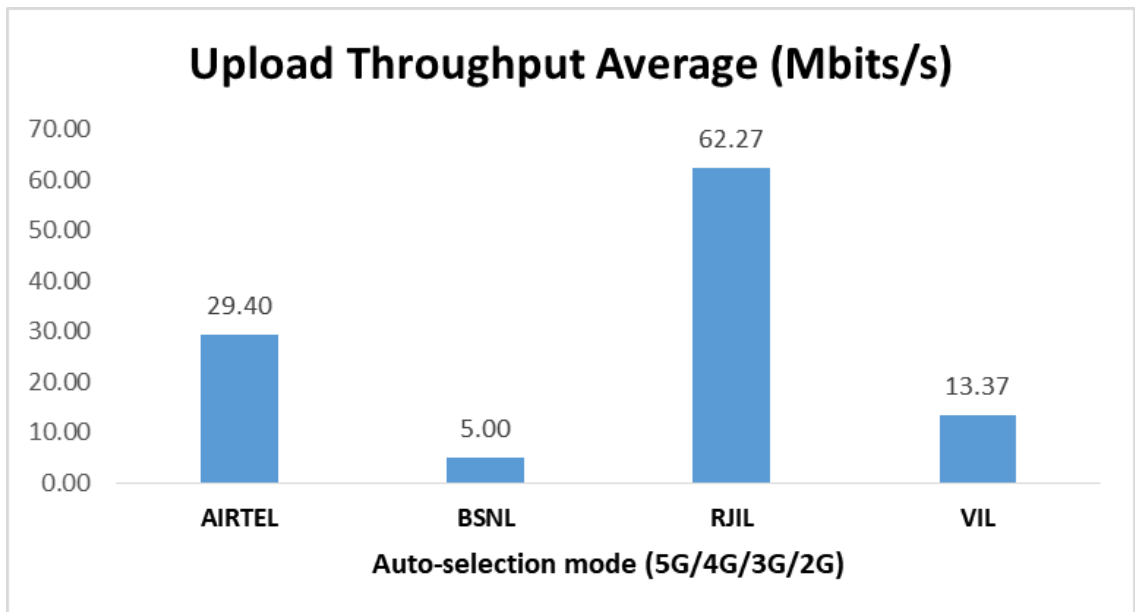


Figure-42: Upload throughput

5. Voice & Data Key findings

5.1 Overall Voice

1. Call setup success rate:

- a) Airtel, BSNL, RJIL and VIL have 99.90%, 98.92%, 100.00% and 100.00% call setup success rate respectively Auto selection mode (5G/4G/3G/2G).
- b) Airtel has 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.
- c) All service providers except BSNL have 100% call setup success rate on hotspots.
- d) All service providers have 100% call setup success rate across the Metro route.
- e) 5 calls in Airtel and 7 calls in BSNL could not be initiated due to no coverage along some patches of metro route.
- f) RJIL have 100 % terminating call setup success rate from all other peer service providers.

2. Call Setup time: Owing to circuit switched network (3G/2G), BSNL has taken comparatively longer time (3.33 second) to establish the voice call, whereas Airtel, RJIL and VIL call setup time is 1.90, 0.69 & 0.39 second respectively.

3. Call Silence/Mute Rate: In packet switched network (4G/5G), Airtel, RJIL and VIL have 0.24%, 0.12% and 0.24% silence call rate respectively. Further Airtel, RJIL & VIL have <0.5% RTP packet loss rate in downlink & uplink.

4. Call Drop Rate:

- a) Overall BSNL's call drop rate (2.48%) is higher (QoS benchmark of 2%), while Airtel, RJIL and VIL have 0.10%, 0.39% and 0.10% drop call rate respectively.
- b) On hotspots all service providers have 0.00% call drop rate except BSNL (0.78%).
- c) Except RJIL (8.33%) all operators are meeting QoS Benchmark for drop call rate in walk test (Railway station).

5.2 Overall Data

1. Data download and upload performance (Dynamic i.e. while moving) :

- a) BSNL (3.12 Mbps) and VIL (32.40 Mbps) being on 3G & 4G as top technology respectively, have comparatively lower data speeds. While Airtel and Jio have average download speed of 216.93 Mbps and 356.68 Mbps respectively.
- b) All service providers have lower average data download speeds on metro train routes for Airtel, BSNL, RJIL and VIL respectively with values of 58.87 Mbps, 4.20 Mbps, 322.01 Mbps & 39.57 Mbps compared with city routes where the average download speed is 224.39 Mbps, 2.96 Mbps, 358.37 Mbps & 32.03 Mbps.

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

- a) On hotspots, RJIL has better 5G QoS performance comparatively, with average download and upload speed of 418.50 Mbps and 59.60 Mbps respectively.
- b) Airtel has average download and upload speed of 215.18 Mbps and 47.97 Mbps respectively.

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

- a) Overall Airtel, RJIL and VIL have download session setup success rate 100% respectively. While BSNL's download setup success rate is 90.77%.
- b) Overall Airtel, RJIL and VIL have upload session setup success rate 100% respectively. While BSNL's upload setup success rate is 93.85%.

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 99.45% call setup success rate observed in 3G/2G network mode. Call drop rate (0.00%) performance is well within benchmark of 2%. (refer Table-3 and Table- 13)
- 99.90% call setup success rate and 0.10% drop call rate observed for auto-selection mode for LSA. (refer Table-5)
- 99.88% call setup success rate and 0.12% drop call rate observed for auto-selection mode for city drive.(refer Table-15)
- 8.10% no service samples are observed in Mansarovar to Badi Chaupar metro route in tunnel. (refer Table-53)

Data

- Airtel has 216.93 Mbps average download throughput & 44.83 Mbps average upload throughput across measured routes for LSA (refer Table-11)
- Airtel has 224.39 Mbps average download throughput & 45.63 Mbps average upload throughput across measured routes for city drive (refer Table- 19)
- Amer fort, Gaurav tower Malviya nagar and Amrapali circle Vaishali hotspots have less download speeds (less than 100 Mbps) out of total 13 hotspots. (refer Table- 41, 43 and 46)
- Govind Dev ji temple and Amer fort hotspots have less upload speed (less than 10 Mbps) out of total 13 hotspots. (refer Table- 40 and 41)
- Airtel has 35.06 Mbps average download throughput & 9.98 Mbps average upload throughput measured at Jaipur Railway Station walk test (refer Table-49)

- Airtel has 72.27 Mbps average download throughput & 24.76 Mbps average upload throughput measured at Jaipur Airport walk test (refer Table- 51)
- Airtel has 58.87 Mbps average download throughput & 29.40 Mbps average upload throughput across measured metro routes (refer Table- 54)

2. BSNL:

Voice

- BSNL 3G/2G network mode is experiencing a drop call rate of 1.37%, significantly well within benchmark of 2%. (refer Table- 3 and 13)
- BSNL auto-selection mode is experiencing a drop call rate of 2.48%, significantly higher than the acceptable benchmark of 2%. (refer Table-5)
- 2.50% drop call rate observed for auto-selection mode for city drive which is not meet the benchmark. (refer Table- 15)
- 14.29% drop call rate have been observed across Mansarovar to Badi Chaupar metro route which are higher than benchmark. (refer Table- 52)
- 14.45% no service samples are observed across Mansarovar to Badi Chaupar metro route. (refer Table- 53)

Data

- BSNL has 3.12 Mbps average download throughput & 2.37 Mbps average upload throughput across measured routes for LSA (refer Table-11)
- BSNL has 2.96 Mbps average download throughput & 2.17 Mbps average upload throughput across measured routes for city drive (refer Table-19)
- Ajmeri Gate, Govind Dev ji temple, Amer Fort, Jal Mahal, Gaurav tower Malviya nagar, OTS circle JLN marg, City park mansarovar, Amrapali circle Vaishali and 200 FT Bypass Heerapura hotspots have less download speeds (less than 5 Mbps) out of total 13 hotspots. (refer Table- 37, 40, 41, 42, 43, 44, 45, 46 and 47)
- Amer Fort, Jal Mahal, Gaurav tower Malviya nagar, City Park Mansarovar and 200 ft bypass circle Heerapura hotspots have less upload speed (less than 2 Mbps) out of total 13 hotspots. (refer Table-41, 42, 43, 45 and 47)
- BSNL has 0.88 Mbps average download throughput & 2.67 Mbps average upload throughput measured at Jaipur Railway Station walk test (refer Table-49)
- BSNL has 7.83 Mbps average download throughput & 3.58 Mbps average upload throughput measured at Jaipur Airport walk test (refer Table- 51)

- BSNL has 4.20 Mbps average download throughput & 5.00 Mbps average upload throughput across measured metro routes (refer Table- 54)

3. RJIL:

Voice

- 100% call setup success rate and 0.35% drop call rate observed for auto-selection mode for city drive.(refer Table-15)
- RJIL's drop call rate in walk test is 8.33% at jaipur railway Station, which is higher than the benchmark 2%. (refer Table-48)

Data

- RJIL has 356.68 Mbps average download throughput & 46.17 Mbps average upload throughput across measured routes in LSA. (refer Table-11)
- RJIL has 358.37 Mbps average download throughput & 45.33 Mbps average upload throughput across measured routes in city drive. (refer Table-19)
- Govind Dev ji temple hotspot have less upload speed (less than 10 Mbps) out of total 13 hotspots. (refer Table- 40)
- RJIL has 229.80 Mbps average download throughput & 36.52 Mbps average upload throughput measured at Jaipur Railway Station walk test (refer Table-49)
- RJIL has 12.61 Mbps average download throughput & 4.70 Mbps average upload throughput measured at Jaipur Airport walk test (refer Table- 51)
- RJIL has 322.01 Mbps average download throughput & 62.27 Mbps average upload throughput across measured metro routes (refer Table- 54)

4. VIL:

Voice

- VIL has 98.08% call setup success rate on 3G/2G network mode, while drop call rate is 0.14%. (refer Table-3 and refer Table-13)
- 100% call setup success rate and 0.12% drop call rate observed for auto-selection mode for city drive.(refer Table-15)

Data

- VIL has 32.40 Mbps average download throughput & 14.27 Mbps average upload throughput across measured routes in LSA. (refer Table-11)

- VIL has 32.03 Mbps average download throughput & 14.17 Mbps average upload throughput across measured routes in city drive. (refer Table-19)
- Jal Mahal, Gaurav tower Malviya nagar and 200 FT bypass Heerapura hotspots have less download speeds (less than 15 Mbps) out of total 13 hotspots. (refer Table-42, 43 and 47)
- Badi Chaupar, Gaurav tower Malviya nagar, Amrapali circle Vaishali and 200 FT bypass Heerapura hotspots have less upload speed (less than 5 Mbps) out of total 13 hotspots. (refer Table- 39, 43, 46 and 47)
- VIL has 33.20 Mbps average download throughput & 14.16 Mbps average upload throughput measured at Jaipur Railway Station walk test (refer Table-49)
- VIL has 12.12 Mbps average download throughput & 7.22 Mbps average upload throughput measured at Jaipur Airport walk test (refer Table- 51)
- VIL has 39.57 Mbps average download throughput & 13.37 Mbps average upload throughput across measured metro routes (refer Table- 54)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

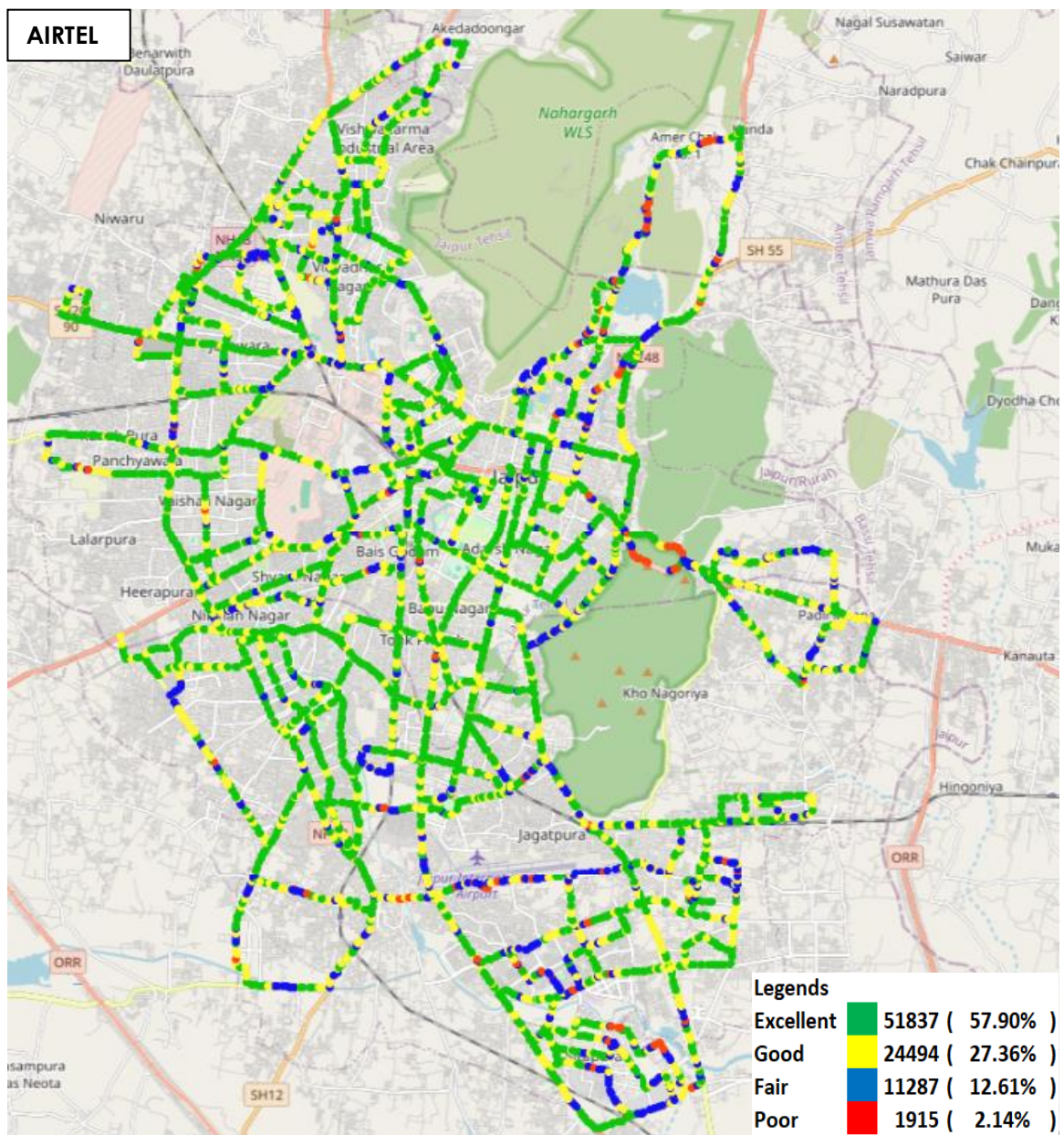


Figure-43: Signal strength 3G/2G network mode - AIRTEL

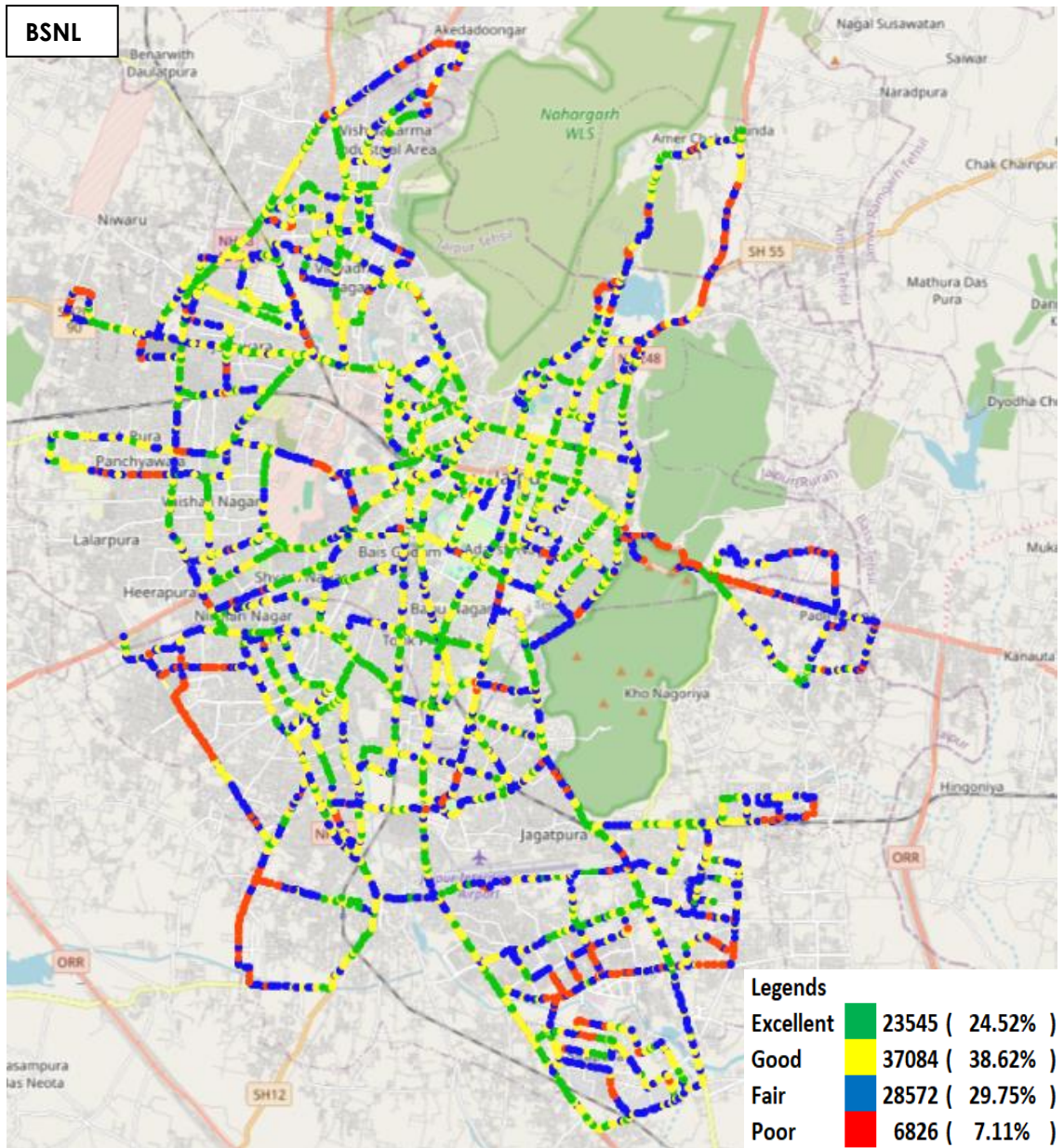


Figure-44: Signal strength 3G/2G network mode - BSNL

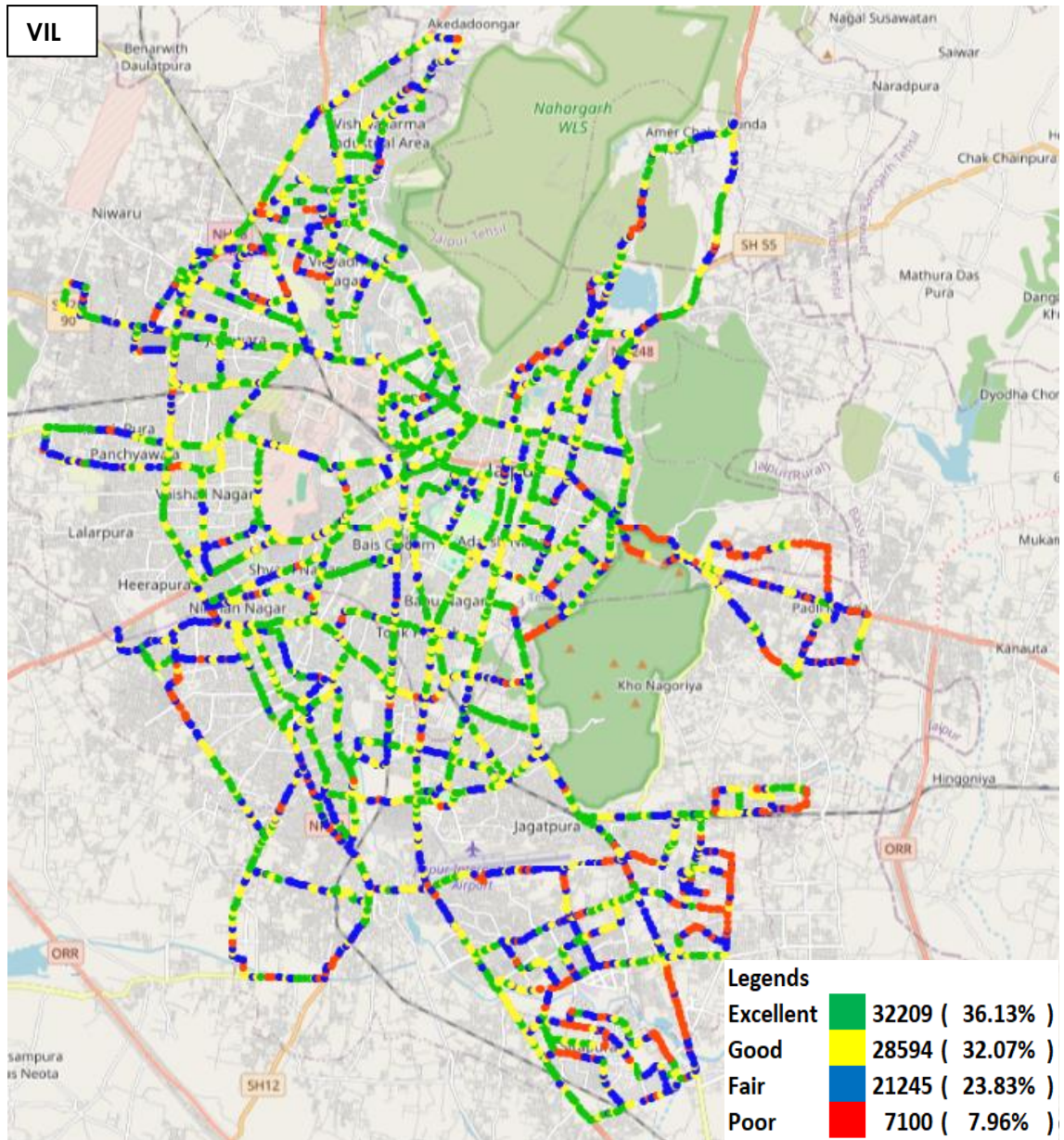


Figure-45: Signal strength 3G/2G network mode - VIL

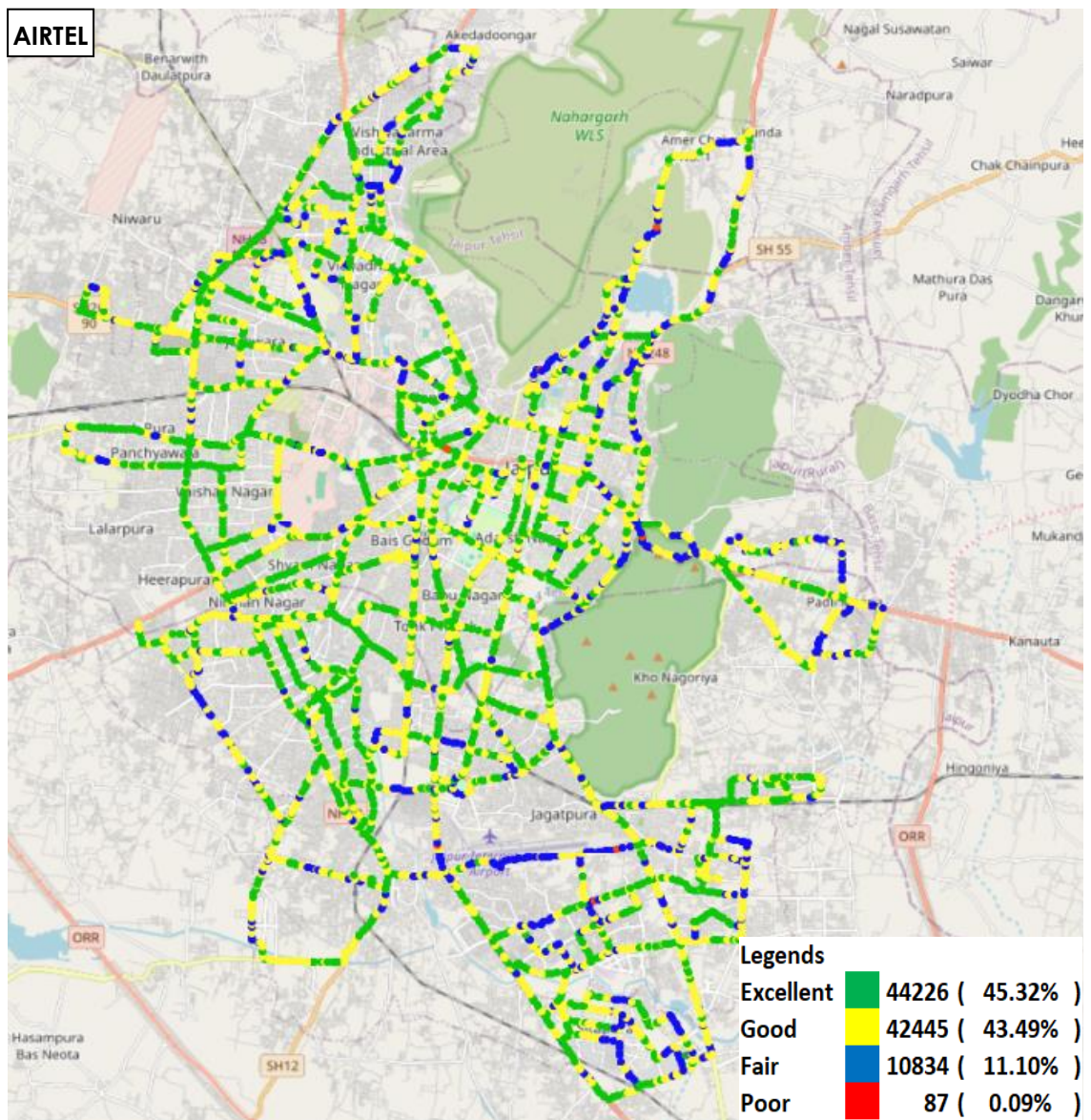


Figure-46: Signal strength auto-selection mode 5G/4G/3G/2G - Airtel

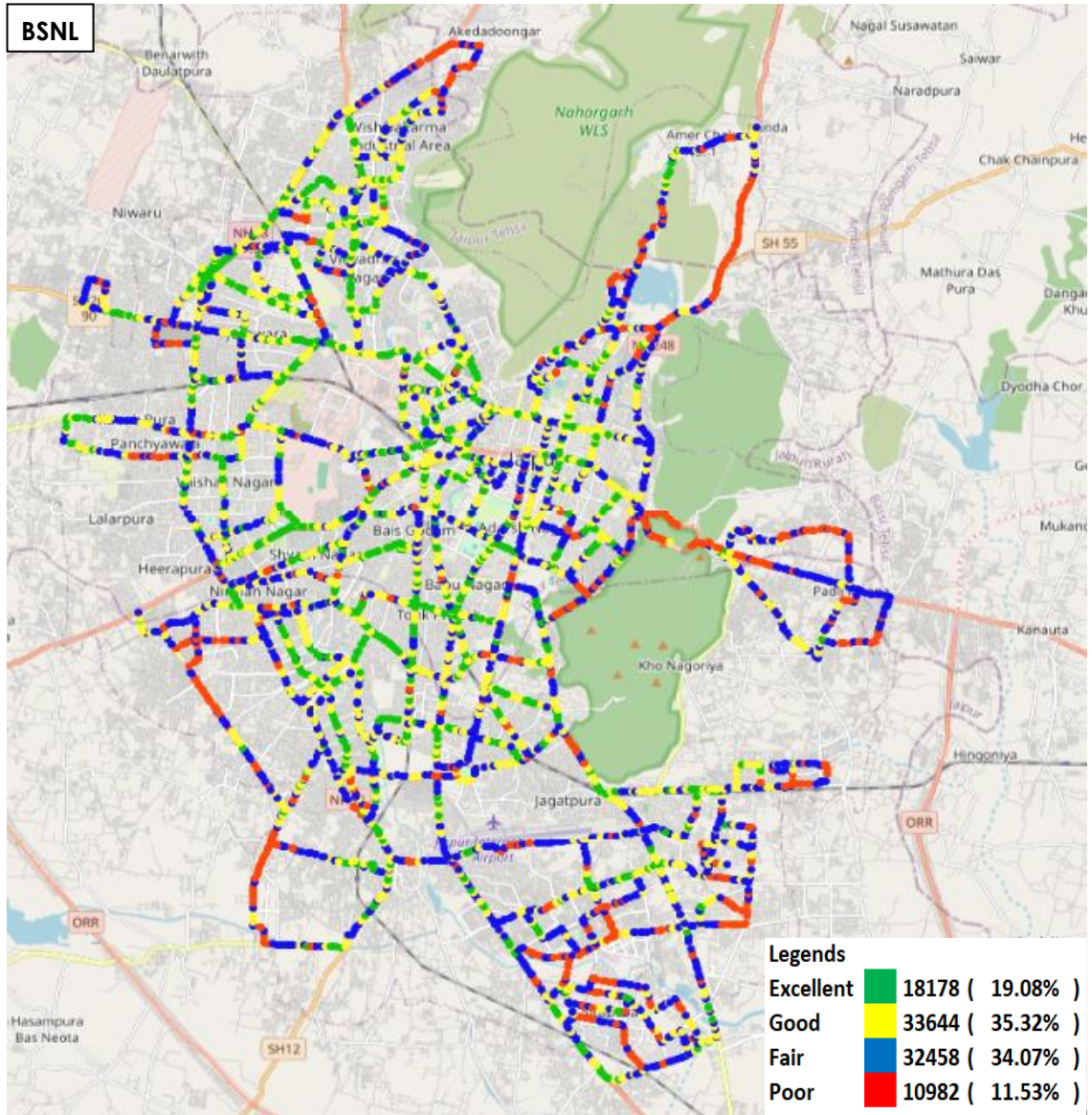


Figure-47: Signal strength auto-selection mode 5G/4G/3G/2G - BSNL

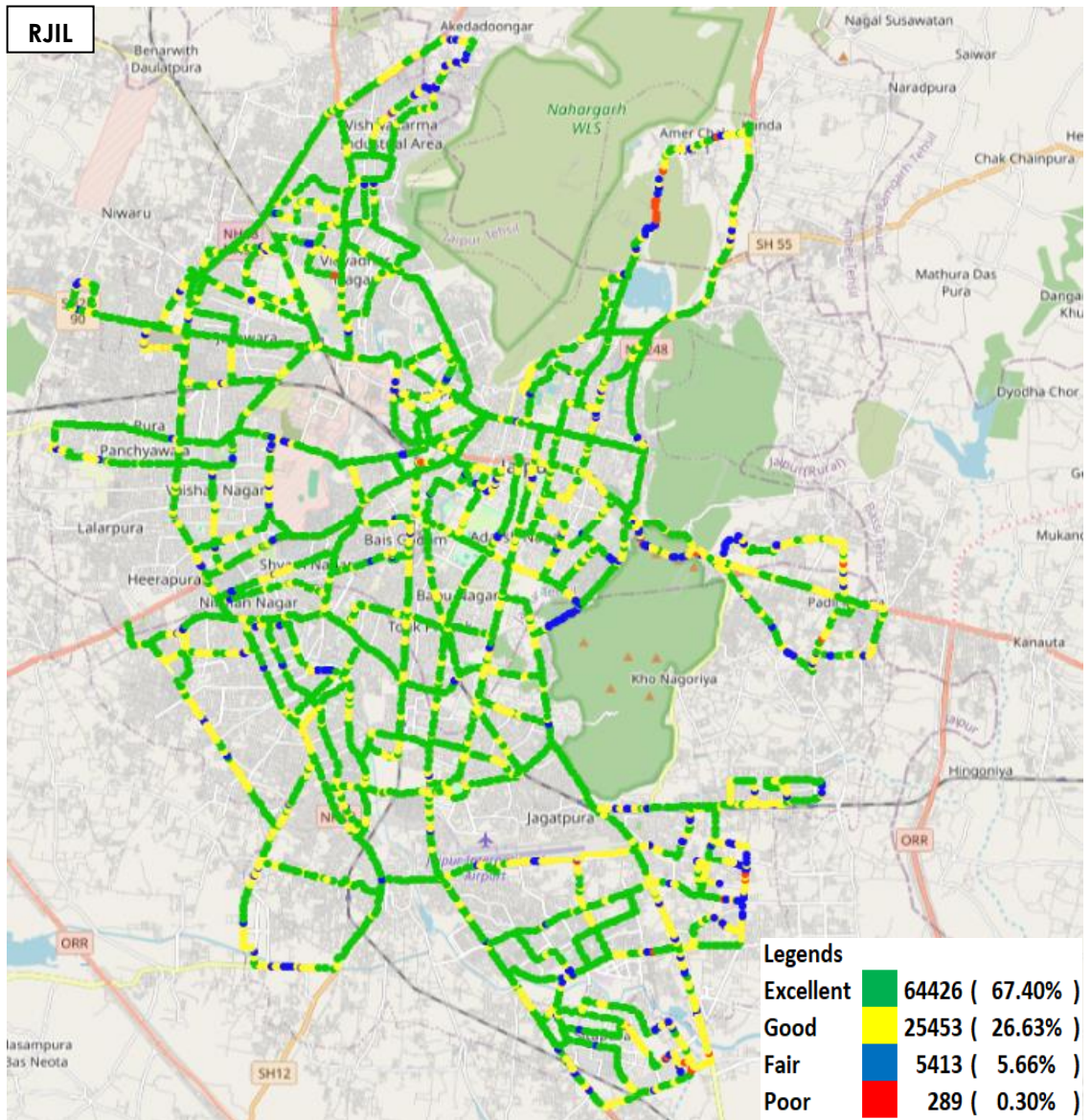


Figure-48: Signal strength auto-selection mode 5G/4G/3G/2G - RJIL

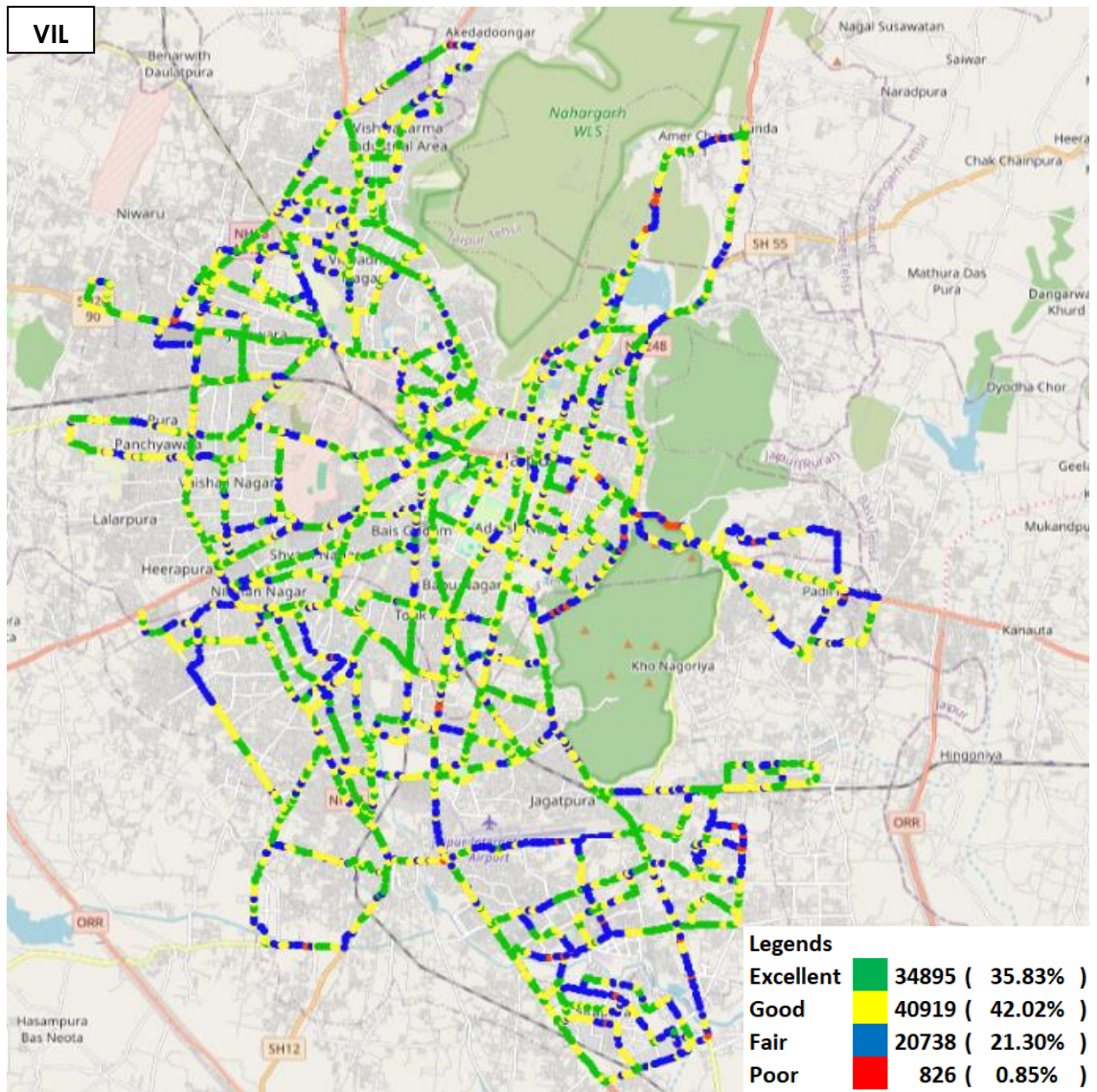


Figure-49: Signal strength auto-selection mode 5G/4G/3G/2G - VIL

6.1.2 Metro Route

i) Mansarovar to Badi Chaupar

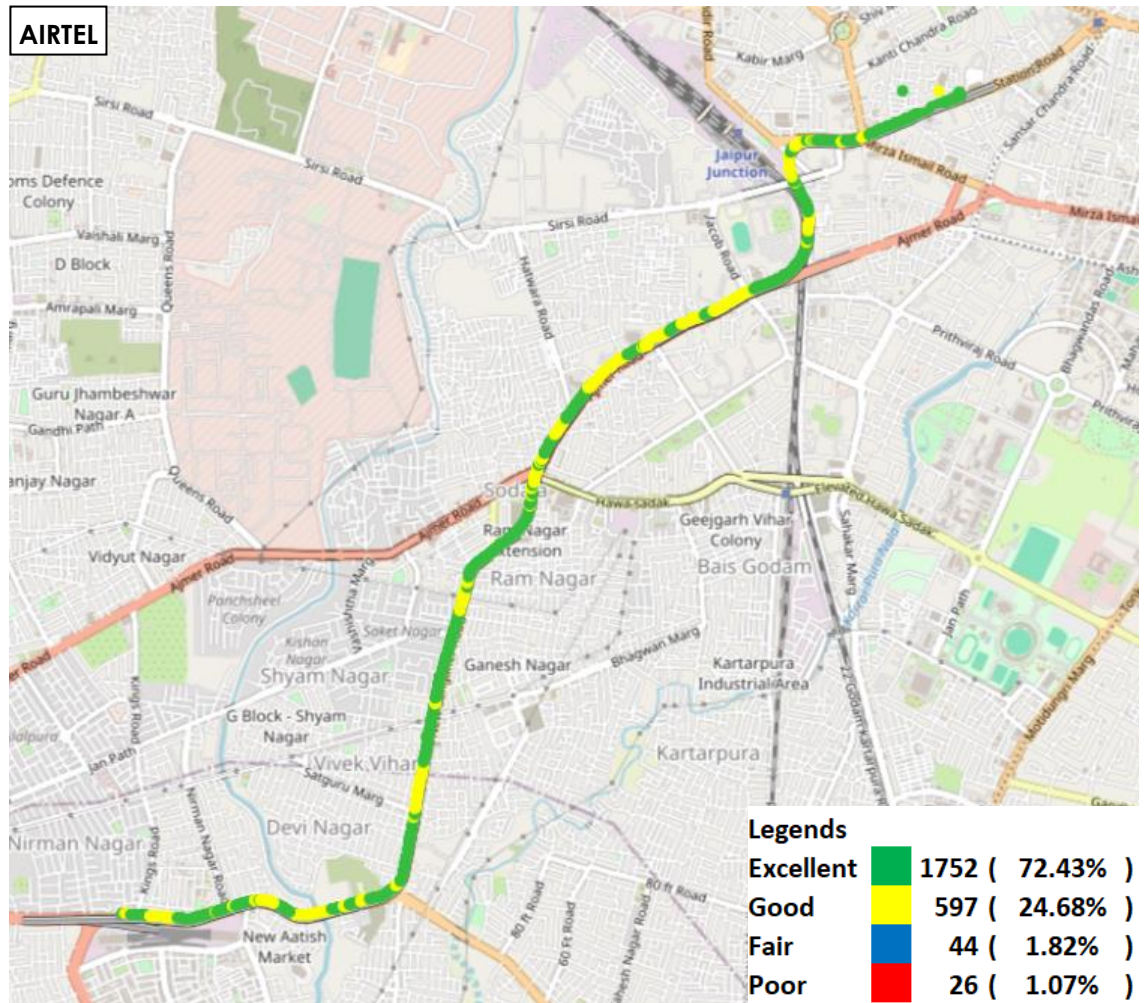


Figure-50: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL

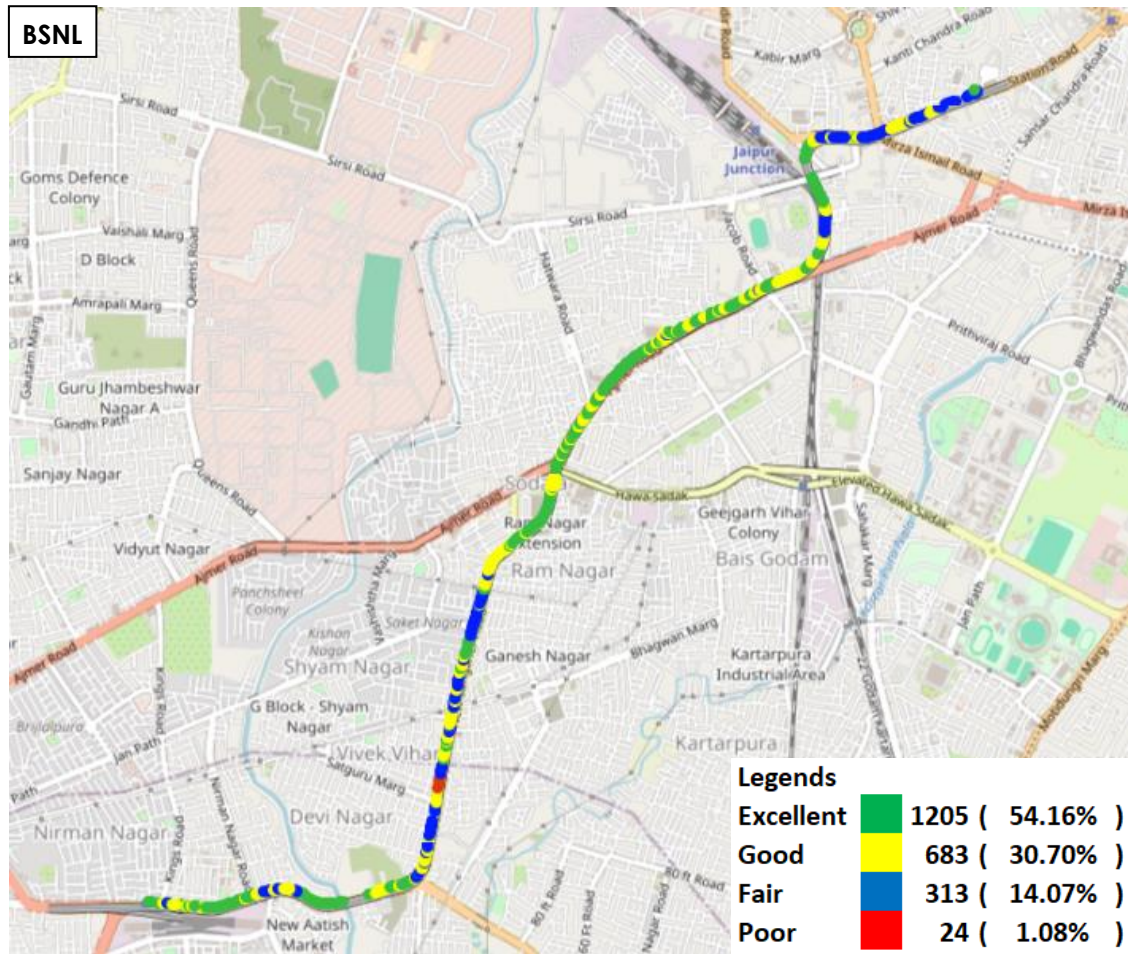


Figure-51: Signal strength auto-selection mode 5G/4G/3G/2G - BSNL

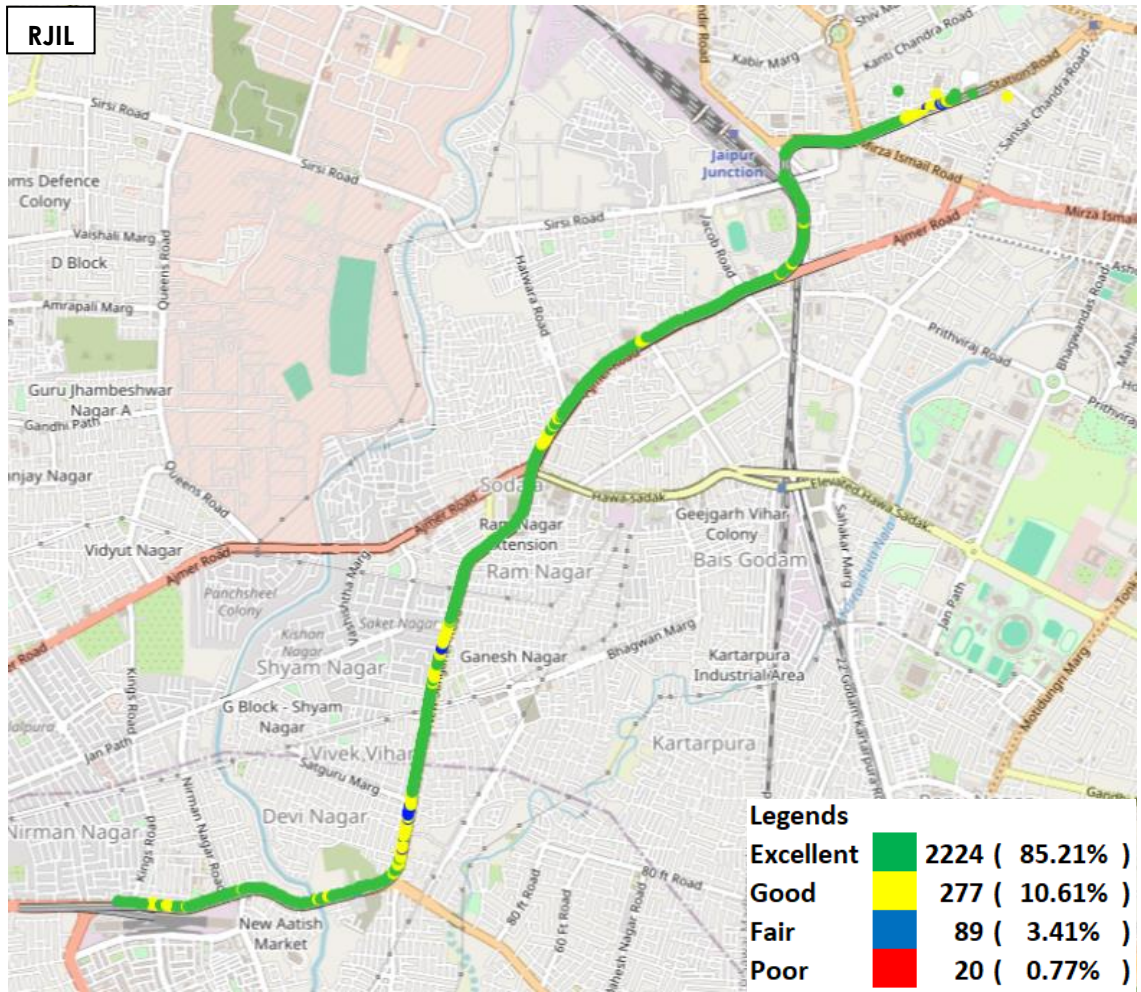


Figure-52: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL

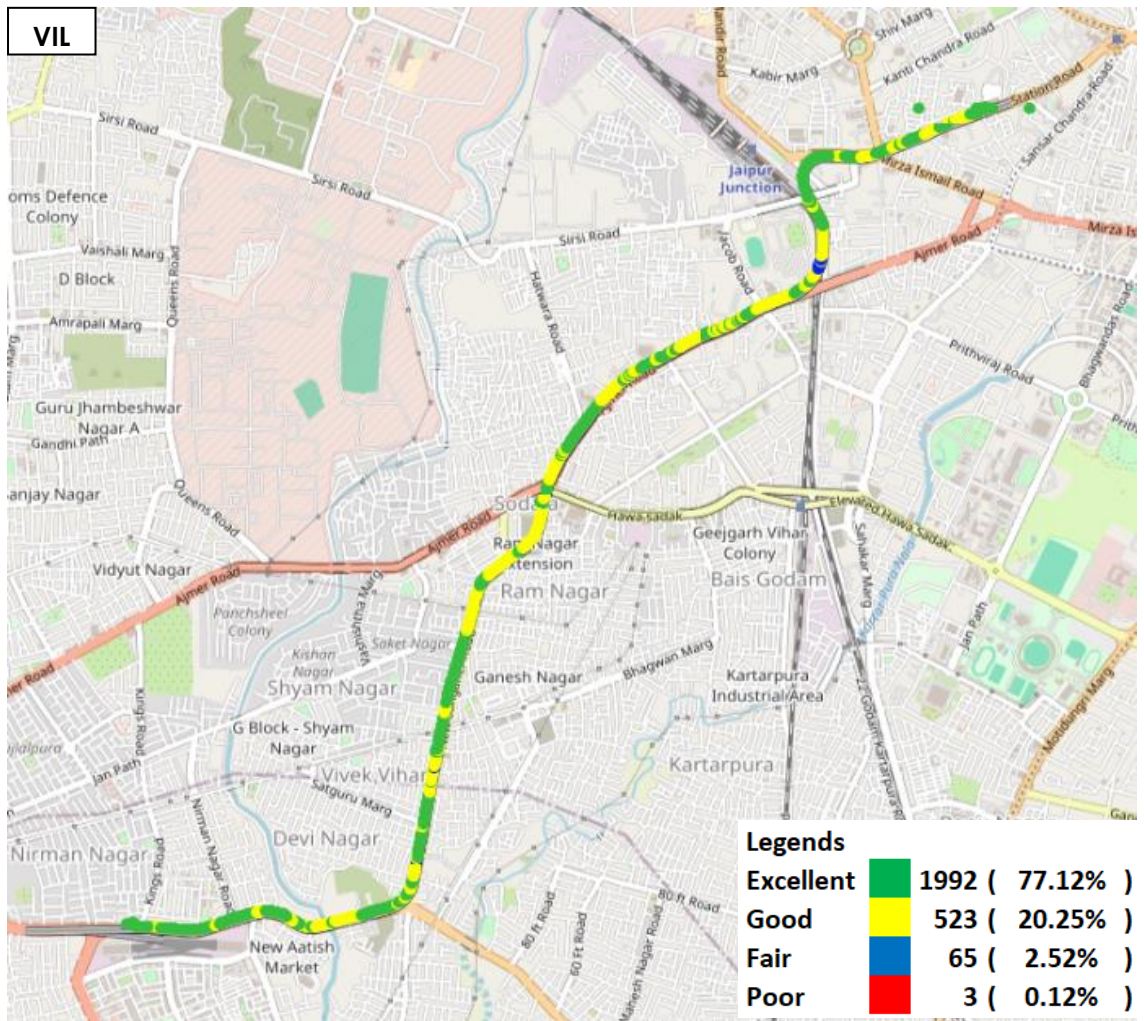


Figure-53: Signal strength auto-selection mode 5G/4G/3G/2G – VIL

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 | <ul style="list-style-type: none"> • 3G/2G auto mode- switch Call • 5G/4G/3G/2G auto mode- switch Call • 5G/4G MOS Call | 30 Sec |
| Call Duration | | 90 Sec /180 Sec |
| Wait/ Guard Time | | 15 Sec |

Table-55: Voice test detail

| | |
|--|--|
| Note- | |
| <ul style="list-style-type: none"> • 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. • 4G/3G/2G auto mode MOS call were made in BSNL as BSNL don't have 5G network availability across India. • 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.google.co.in , www.facebook.com , www.amazon.in) |
| Ping | | 20 sec timeout (only at Hotspot) |
| | | 25 count- Dynamic 1000 count- Hotspot |

Table-56: Data test detail

| |
|--|
| <p>Note-</p> <ul style="list-style-type: none"> • 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) |
|--|

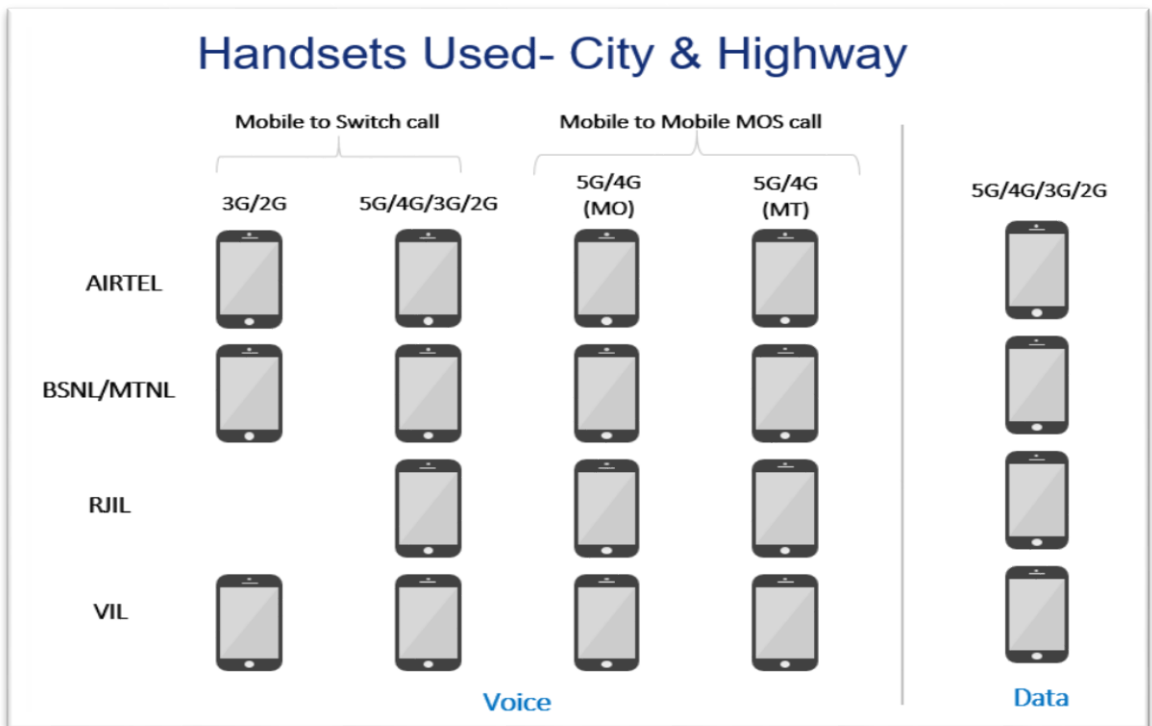


Figure-54: Number of handsets used in city & highway drive
MO: Mobile originating
MT: Mobile terminating

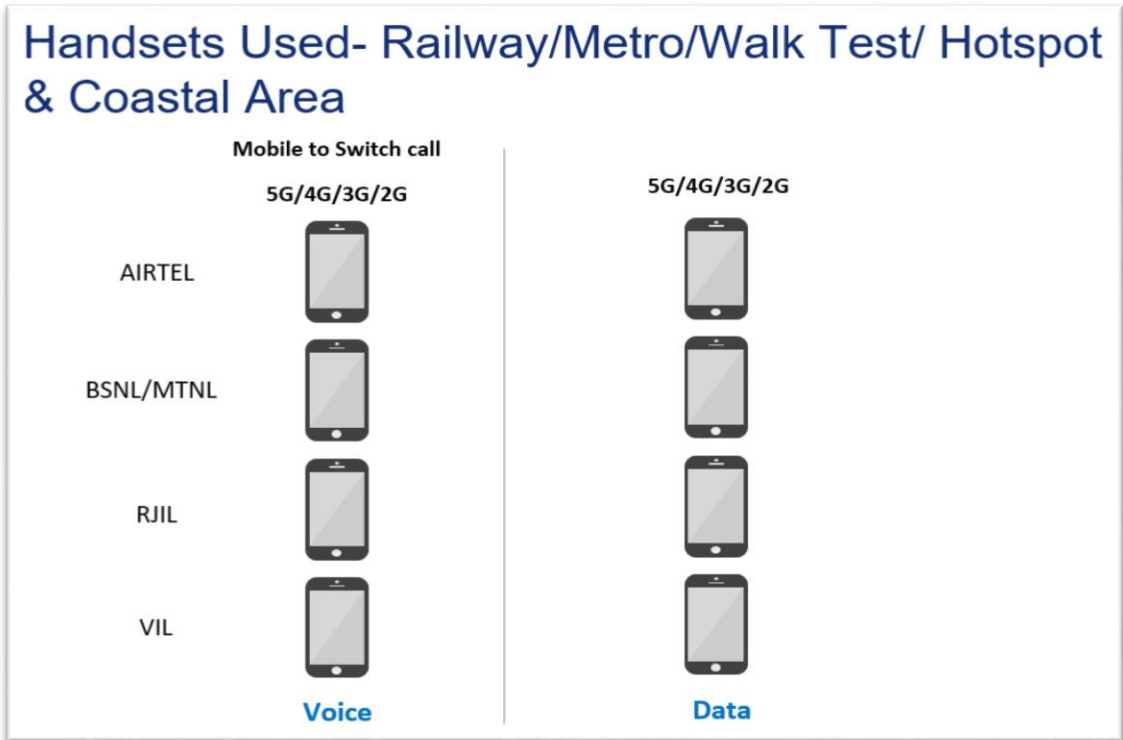


Figure-55: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)

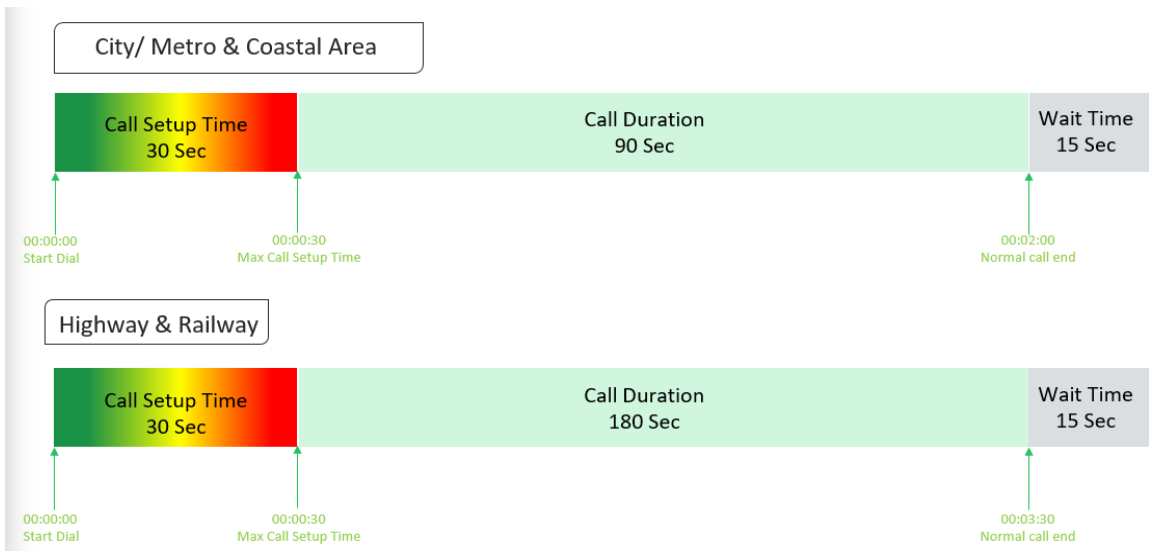


Figure-56: Voice test script for city/railway/metro/highway & coastal area

- 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

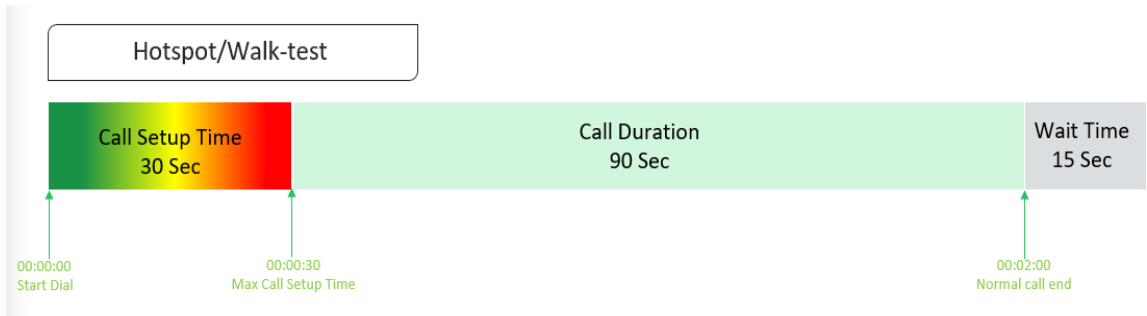


Figure-57: Voice test script for walktest/hotspot

- 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

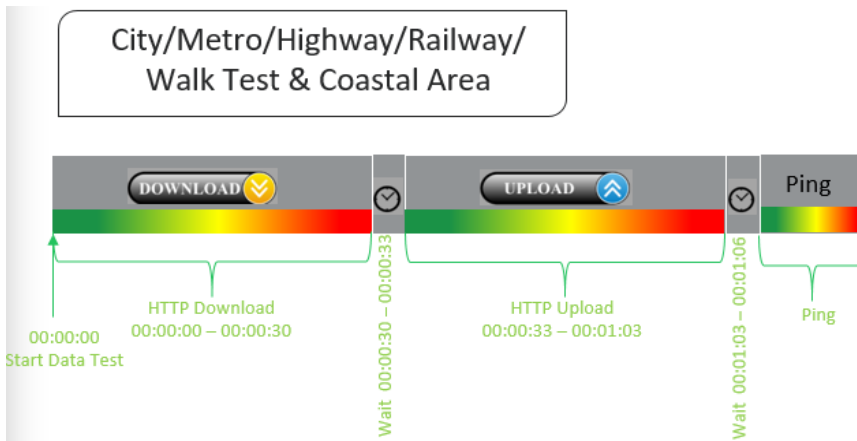


Figure-58: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

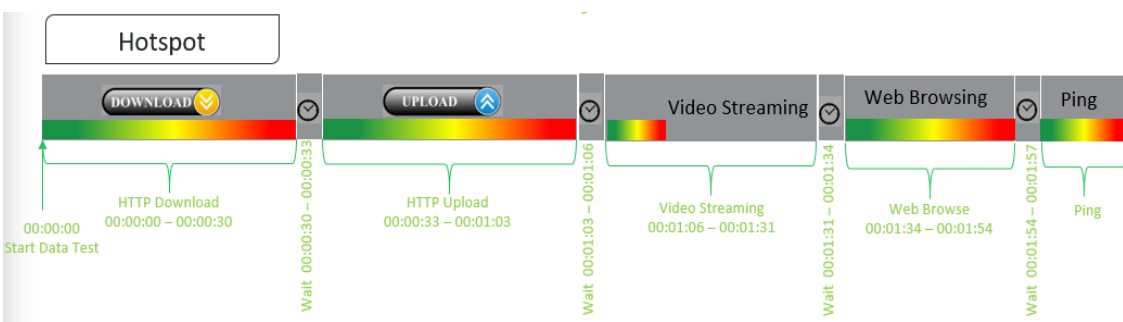


Figure-59: Data test script used at hotspot/walk test

- 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 | <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"> (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. <p> $CSSR = (\text{Total Call Established} / \text{Total Call Attempt}) * 100$ </p> <p>As per QoS Regulation 2024 benchmark value is >=98%</p> |
| Call Drop 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> $\text{Call Drop Rate} = (\text{Total Call Drop} / \text{Total Call Established}) * 100$ </p> <p>As per QoS Regulation 2024 benchmark value is <=2%</p> |
| Call Setup Time | <p>Time taken from call initiate to call alerting/ringing.</p> <p> $\text{Call Setup Time} = T2 - T1$ </p> <p>T2- Ringing (VoLTE/VoNR) & Alerting (for WCDMA & GSM), T1- Invite (VoLTE/VoNR) & CM Service Request (for WCDMA & 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: $MOS \geq 4$ and < 5 Good : $MOS \geq 3$ and < 4 Fair : $MOS \geq 2$ and < 3 Poor : $MOS \geq 1$ and < 2</p> |
| Handover Success Rate | <p> $\text{Handover Success Rate} = \text{Count of successful handovers (All Technology Handover combined)} / \text{Total count of Handover Attempt (All Technology Handover combined)} * 100$ </p> <p>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.</p> |
| Silence Call - | <p>A call which has ≥ 4 sec continuous RTP gap is considered as a Silence Call.</p> <p> $\text{Silence call rate} = (\text{count of silence} / \text{Total calls established}) * 100$ </p> <p>If a call observes multiple silence count ≥ 4 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 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: $D(i,j) = (R_j - R_i) - (S_j - S_i)$</p> <p>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</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------|---|-----------------|--------------------|-----------------------|--------------|--|--|-----------|------|------|------|----------|-----|-----------------|--------------------|--------------------|-------------|------|-------|-----------------|--------------------|--------------------|-------------|------|-----|-----------------|--------------------|---------------------|--------------|---------|----|-----------------|--------------------|---------------------|--------------|
| 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. This KPI will be 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 will be 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 border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Parameter Name</th> <th rowspan="2">Technology</th> <th colspan="4">Signal Strength (dBm)</th> </tr> <tr> <th style="background-color: #92D050;">Excellent</th> <th style="background-color: #FFD700;">Good</th> <th style="background-color: #FFA500;">Fair</th> <th style="background-color: #FF0000;">Poor</th> </tr> </thead> <tbody> <tr> <td>Rx Level</td> <td>GSM</td> <td>0 to \geq -65</td> <td><-65 to \geq -75</td> <td><-75 to \geq -85</td> <td><-85 to min</td> </tr> <tr> <td>RSCP</td> <td>WCDMA</td> <td>0 to \geq -70</td> <td><-70 to \geq -80</td> <td><-80 to \geq -90</td> <td><-90 to min</td> </tr> <tr> <td>RSRP</td> <td>LTE</td> <td>0 to \geq -80</td> <td><-80 to \geq -95</td> <td><-95 to \geq -110</td> <td><-110 to min</td> </tr> <tr> <td>SS_RSRP</td> <td>NR</td> <td>0 to \geq -80</td> <td><-80 to \geq -95</td> <td><-95 to \geq -110</td> <td><-110 to min</td> </tr> </tbody> </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 |
| Parameter Name | Technology | | | Signal Strength (dBm) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | Excellent | Good | Fair | Poor | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rx Level | GSM | 0 to \geq -65 | <-65 to \geq -75 | <-75 to \geq -85 | <-85 to min | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RSCP | WCDMA | 0 to \geq -70 | <-70 to \geq -80 | <-80 to \geq -90 | <-90 to min | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RSRP | LTE | 0 to \geq -80 | <-80 to \geq -95 | <-95 to \geq -110 | <-110 to min | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SS_RSRP | NR | 0 to \geq -80 | <-80 to \geq -95 | <-95 to \geq -110 | <-110 to min | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Table-57: Network performance parameter and definition voice

7.2.2 Network Performance Parameters Data tests

| Parameter Name | Definition |
|------------------------------|--|
| Download Speed (Mbps) | <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"> 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) | <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"> 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. |
| Ping Test & Latency | Ping (latency is the technically more correct term) 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 ping time is measured in milliseconds (ms). To calculate the one-way ping delay we just do half of the round-trip time |
| 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 can be calculated based on using ICMP/UDP/TCP or TWAMP. |

Table-58: Network performance parameter and definition Data