भादूविप्रा
TRAI

**TELECOM REGULATORY AUTHORITY OF INDIA**

# *Independent Drive Test Report*

## *Haryana LSA*

## *July 2026*

Contents

1. Introduction ..... 3
2. Executive Summary (LSA) ..... 3
2.1 Drive test details ..... 3
2.2 Drive test routes ..... 4
2.3 Summary of areas covered ..... 4
2.4 Telecom service providers detected frequency bands ..... 5
2.5 Key findings of Independent Drive Test ..... 6
3. QoS performance analysis-LSA level ..... 8
3.1 Overview ..... 9
3.2 Voice performance ..... 9
3.3 Data performance ..... 12
4. Detailed QoS performance analysis ..... 14
4.1 Overview ..... 14
4.2 City ..... 14
4.2.1 Nuh District ..... 14
4.2.1.1 Drive test route ..... 14
4.2.1.2 Areas covered ..... 14
4.2.1.3 Voice performance ..... 15
4.2.1.4 Data performance ..... 28
4.2.2 Palwal District ..... 36
4.2.2.1 Drive test route ..... 36
4.2.2.2 Areas covered ..... 36
4.2.2.3 Voice performance ..... 36
4.2.2.4 Data performance ..... 50
4.3 Hotspots ..... 58
4.3.1 Locations ..... 58
4.3.2 Hotspot covered ..... 58
4.3.3 Voice performance ..... 58
4.3.4 Data performance (Auto-selection mode 5G/4G/3G/2G) ..... 60
4.3.5 Data performance (5G Only & 4G Only Download & Upload Speed) ..... 62
4.4 Walk Test ..... 64
4.4.1 Walk test locations ..... 64
4.4.2 Walk Test Covered ..... 64
4.4.3 Voice Performance ..... 64

4.4.4 Data Performance ..... 64
5. Voice & Data Key findings ..... 65
5.1 Overall Voice ..... 65
5.2 Overall Data ..... 65
5.3 Operator wise Key Findings ..... 66
6. Annexure ..... 70
6.1 Route wise coverage map ..... 70
6.1.1 Nuh District ..... 70
6.1.2 Palwal District ..... 76
7. Appendix ..... 82
7.1 Appendix-I ..... 82
7.1.1 Drive test setup ..... 82
7.1.2 Drive test Methodology ..... 84
7.2 Appendix-II ..... 86
7.2.1 Network Performance Parameters for Voice calls ..... 86
7.2.2 Network Performance Parameters Data tests ..... 87

# 1. Introduction

TRAI Act, 1997 mandates the Authority to ensure the services delivered through various telecommunications networks meet the 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 interests of the consumers of telecommunications services.

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 Haryana License Service Area (LSA) during the month of July-2026 under the supervision of TRAI Regional Office (RO) Jaipur. Details of route/area covered during the IDT are as given below:

| S. No | Drive test route | Type of route | Distance covered (KMs) | From date | To date |
|---|---|---|---|---|---|
| 1 | Nuh and Palwal Districts | City | 295.2 | 13-July-2026 | 14-July-2026 |
| 2 | Palwal | Inter Operator Calling | 1 Locations | 15-July-2026 | 15-July-2026 |
| 3 | Nuh and Palwal Districts | Hotspot | 6 Locations | 14-July-2026 | 15-July-2026 |
| 4 | Palwal | Walk Test | 1.8 | 15-July-2026 | 15-July-2026 |

**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.

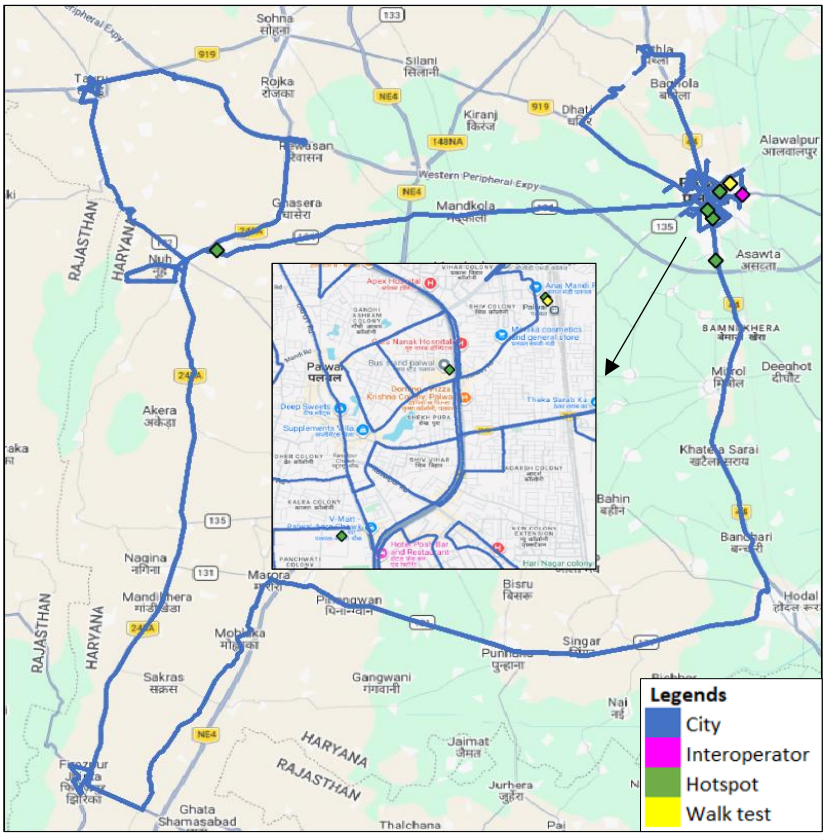



**Figure-1:** Drive test routes

## 2.3 Summary of areas covered

### a) City

**Nuh District-** Tauru, Rewasan, Ghasera, Nuh, Akera, Nagina, Mandkhera, Mohlaka, Sakras, Ferozpur and Jhirka etc.

**Palwal District-** Mandkola, Palwal Rural, Dhal, Baghola, Alawalpur, Deeghot, Khatela Sarai, Banchari, Hodal, Singar, Punhana and Phangwan etc.

### b) Hotspot

1. District and Session Court Palwal
2. District Collectorate Palwal
3. Govt. Bus Stand Palwal
4. Govt. Hospital Palwal
5. Nuh Court
6. Palwal Railway Station

### c) Walk Test

1. Palwal Railway Station

## 2.4 Telecom service providers detected frequency bands

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

| S.no. | Name of TSP | Technology | Frequency Bands (In MHz) |
|---|---|---|---|
| 1 | Bharti Airtel Ltd. | 2G | 1800 |
| 2 | Bharti Airtel Ltd. | 4G | 850,1800,2100,2300 |
| 3 | Bharti Airtel Ltd. | 5G | 3500 |
| 4 | BSNL | 2G | 900 |
| 5 | BSNL | 3G | 2100 |
| 6 | BSNL | 4G | 700,2100,2500 |
| 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 | 900,1800,2100,2500 |
| 11 | Vodafone Idea Ltd. | 5G | 3500 |

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

## 2.5 Key findings of Independent Drive Test

1. **Drive Test Area:** The overall mobile network performance across Nuh District (Haryana LSA) for the key parameters has been summarised below:

**a) Coverage Gap** - The signal strength observed during voice testing on the drive test route in auto-selection mode (5G/4G/3G/2G). (refer figure- 27 to 30)

| Parameter | AIRTEL | BSNL | RJIL | VIL |
|---|---|---|---|---|
| **Total Number of Samples captured on Drive test route** | 15867 | 15424 | 15626 | 15836 |
| **Number of Samples having poor signal strength** | 346 | 4021 | 784 | 327 |
| **Number of Samples having limited service (No Coverage)** | 0 | 28 | 0 | 9 |

**b) Dropped Calls** - The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure- 15 & 16)

| Parameter | AIRTEL | BSNL | RJIL | VIL |
|---|---|---|---|---|
| **Number of successful Calls Established** | 142 | 140 | 141 | 143 |
| **Number of dropped Calls** | 0 | 5 | 1 | 0 |

**c) Call Silence Instance** - The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure- 17 to 20)

| Parameter | AIRTEL | BSNL | RJIL | VIL |
|---|---|---|---|---|
| **Call Established (within service provider network)** | 136 | 131 | 135 | 139 |
| **Number of silences calls for >3 Sec** | 9 | 13 | 4 | 15 |
| **Total number of silence instances for >3 Sec** | 13 | 35 | 5 | 20 |

**d) Packet loss rate Downlink & Uplink-** The TSP-wise details of packet loss rate in downlink & uplink for Auto-selection mode (5G/4G).

| Parameter | AIRTEL | BSNL | RJIL | VIL |
|---|---|---|---|---|
| **Call Established (within service provider network)** | 136 | 131 | 135 | 139 |
| **Packet loss Rate Downlink %** | 1.84 | 5.35 | 2.11 | 3.33 |
| **Packet loss Rate Uplink %** | 2.06 | 3.12 | 2.84 | 2.21 |

**e) Data Download and Upload Throughput:**

**i) Data Download throughput:** The TSP-wise details of **Average Download (DL) throughput** against declared typical DL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 32 to 35)

| Parameter | Measured in | AIRTEL (upto 5G) | BSNL (upto 4G) | RJIL (upto 5G) | VIL (upto 4G) |
|---|---|---|---|---|---|
| **Typical Download Throughput declared by TSP** | (Mbits/s) | 23.00 | 15.50 | 15.00 | 15.00 |
| **Average Download Throughput measured during IDT** | (Mbits/s) | 75.70 | 6.78 | 130.28 | 20.03 |

**ii) Data Upload throughput:** The TSP-wise details of **Average Upload (UL) throughput** against declared typical UL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 36 to 39)

| Parameter | Measured in | AIRTEL (upto 5G) | BSNL (upto 4G) | RJIL (upto 5G) | VIL (upto 4G) |
|---|---|---|---|---|---|
| **Typical Upload Throughput declared by TSP** | (Mbits/s) | 10.00 | 7.84 | 7.00 | 8.00 |
| **Average Upload Throughput measured during IDT** | (Mbits/s) | 14.26 | 6.21 | 9.71 | 10.84 |

2. **Drive Test Area:** The overall mobile network performance across Palwal District (Haryana LSA) for the key parameters has been summarised below:

**a) Coverage Gap** - The signal strength observed during voice testing on the drive test route in auto-selection mode (5G/4G/3G/2G). (refer figure- 67 to 70)

| Parameter | AIRTEL | BSNL | RJIL | VIL |
|---|---|---|---|---|
| **Total Number of Samples captured on Drive test route** | 30406 | 29643 | 29489 | 30350 |
| **Number of Samples having poor signal strength** | 279 | 2239 | 768 | 241 |
| **Number of Samples having limited service (No Coverage)** | 0 | 26 | 0 | 0 |

**b) Dropped Calls** - The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure- 54 to 56)

| Parameter | AIRTEL | BSNL | RJIL | VIL |
|---|---|---|---|---|
| **Number of successful Calls Established** | 272 | 268 | 251 | 269 |
| **Number of dropped Calls** | 1 | 3 | 1 | 0 |

**c) Call Silence Instance** - The TSP-wise details of Call silence instance in Auto-selection mode (5G/4G). (refer figure- 57 to 60)

| Parameter | AIRTEL | BSNL | RJIL | VIL |
|---|---|---|---|---|
| **Call Established (within service provider network)** | 259 | 258 | 250 | 265 |
| **Number of silences calls for >3 Sec** | 7 | 5 | 6 | 10 |
| **Total number of silence instances for >3 Sec** | 10 | 11 | 9 | 17 |

**d) Packet loss rate Downlink & Uplink-** The TSP-wise details of packet loss rate in downlink & uplink for Auto-selection mode (5G/4G).

| Parameter | AIRTEL | BSNL | RJIL | VIL |
|---|---|---|---|---|
| **Call Established (within service provider network)** | 259 | 258 | 250 | 265 |
| **Packet loss Rate Downlink %** | 0.79 | 2.57 | 1.62 | 1.22 |
| **Packet loss Rate Uplink %** | 0.96 | 1.40 | 1.78 | 1.35 |

**e) Data Download and Upload Throughput:**

**i) Data Download throughput:** The TSP-wise details of **Average Download (DL) throughput** against declared typical DL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 72 to 75)

| Parameter | Measured in | AIRTEL (upto 5G) | BSNL (upto 4G) | RJIL (upto 5G) | VIL (upto 5G) |
|---|---|---|---|---|---|
| **Typical Download Throughput declared by TSP** | (Mbits/s) | 23.00 | 15.50 | 15.00 | 15.00 |
| **Average Download Throughput measured during IDT** | (Mbits/s) | 105.00 | 13.92 | 212.03 | 40.70 |

**ii) Data Upload throughput:** The TSP-wise details of **Average Upload (UL) throughput** against declared typical UL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 76 to 79)

| Parameter | Measured in | AIRTEL (upto 5G) | BSNL (upto 4G) | RJIL (upto 5G) | VIL (upto 5G) |
|---|---|---|---|---|---|
| **Typical Upload Throughput declared by TSP** | (Mbits/s) | 10.00 | 7.84 | 7.00 | 8.00 |
| **Average Upload Throughput measured during IDT** | (Mbits/s) | 20.96 | 7.20 | 14.52 | 13.03 |

# QoS Performance Analysis- Haryana 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 Haryana LSA during the month of July-2026 covering city drive, 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** | 347 | 358 | 340 |
| **Call Setup Success Rate %** | 99.42 | 98.04 | 99.41 |
| **Drop Call Rate %** | 0.58 | 2.28 | 1.18 |
| **Call Setup Time-Average (Second)** | 3.37 | 3.29 | 5.08 |
| **Handover Success Rate %** | 97.16 | 99.68 | 97.19 |

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

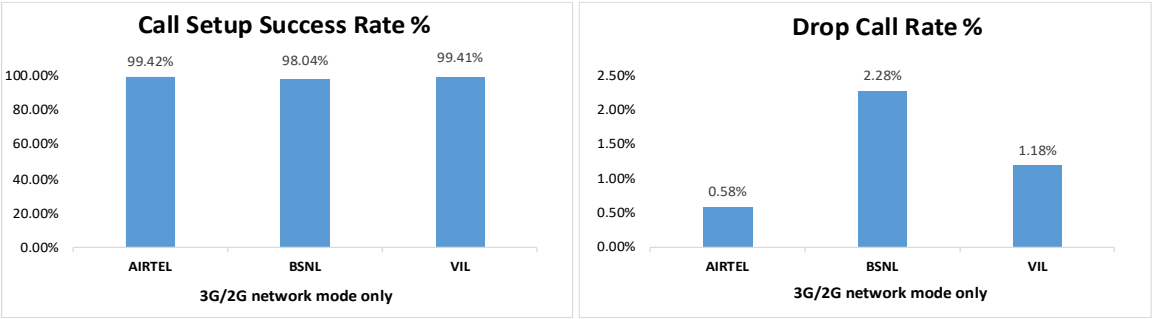



**Figure-2:** Call setup success rate and drop call rate performance.

| 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 | 18 | NA |
| **2G** | 384 | 125 | 376 |

**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** | 487 | 493 | 506 | 488 |
| **Call Setup Success Rate %** | 100.00 | 97.36 | 92.29 | 99.80 |
| **Drop Call Rate %** | 0.21 | 1.67 | 0.43 | 0.00 |
| **Call Setup Time-Average (Second)** | 1.25 | 1.64 | 0.66 | 1.60 |
| **Handover Success Rate %** | 99.85 | 99.29 | 99.74 | 99.96 |

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

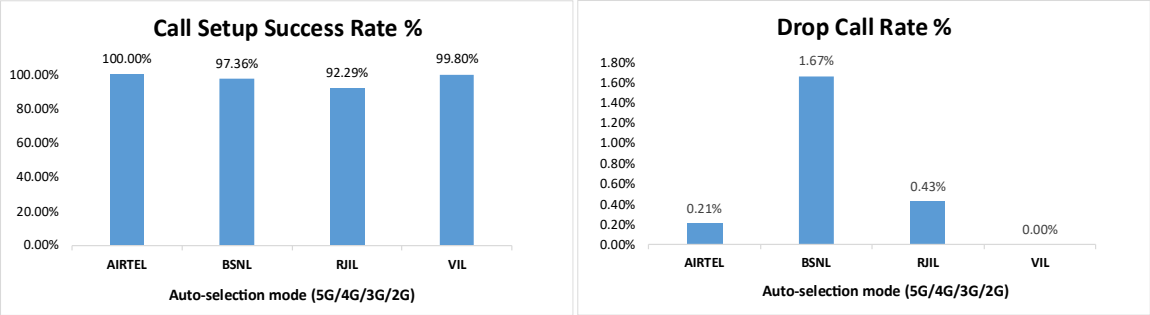



**Figure-3:** Performance for call setup success rate and drop call rate.

| Parameter | Service Provider | | | |
|---|---|---|---|---|
| | Mobile-to-Mobile (5G/4G - Open Mode) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| **Call Established (within service provider Network)** | 395 | 389 | 385 | 404 |
| **Number of silences call for >4 Sec** | 7 | 16 | 7 | 16 |
| **Silence Call Rate %** | 1.77 | 4.11 | 1.82 | 3.96 |
| **Number of silence instances for >4 Sec** | 9 | 42 | 8 | 22 |
| **Number of silence instances for >3 Sec** | 23 | 46 | 15 | 37 |
| **Number of silence instances for >2 sec** | 56 | 53 | 30 | 92 |
| **RTP Jitter (4G & 5G) in ms** | 5.06 | 6.01 | 15.70 | 16.01 |
| **Packet loss Rate Downlink %** | 1.15 | 3.41 | 1.79 | 1.94 |
| **Packet loss Rate Uplink %** | 1.34 | 1.88 | 2.15 | 1.64 |

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

| Number of unique cell Id's covered in Voice test- Technology wise | | | | |
|---|---|---|---|---|
| Technology | Service Provider | | | |
| | Auto-selection mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| **5G** | 0 | 0 | 621 | 0 |
| **4G** | 904 | 189 | 478 | 797 |
| **3G** | 0 | 5 | 0 | 0 |
| **2G** | 0 | 40 | 0 | 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 cell Id's were found in respective technology.

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

Mean opinion score indicates quality of speech observed during the drive test across different technologies. This parameter has been calculated for mobile-to-mobile calls made within same operator network in auto mode (5G/4G/3G/2G). As per ITU-T Recommendation P.863.1, MOS 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 table-6** | 2366 | 2068 | 2245 | 2357 |
| **Speech Quality (Average MOS)** | 3.90 | 3.63 | 4.38 | 4.37 |
| **Number of samples with MOS >=4 to <5 (Excellent)** | 1807 | 1281 | 1889 | 1987 |
| **Number of samples with MOS >=3 to <4 (Good)** | 406 | 310 | 193 | 250 |
| **Number of samples with MOS >=2 to <3 (Fair)** | 90 | 256 | 72 | 44 |
| **Number of samples with MOS >=1 to <2 (Poor)** | 63 | 221 | 91 | 76 |
| **%age of samples with MOS >=4 to <5 (Excellent)** | 76.37% | 61.94% | 84.14% | 84.30% |
| **%age of samples with MOS >=3 to <4 (Good)** | 17.16% | 14.99% | 8.60% | 10.61% |
| **%age of samples with MOS >=2 to <3 (Fair)** | 3.80% | 12.38% | 3.21% | 1.87% |
| **%age of samples with MOS >=1 to <2 (Poor)** | 2.66% | 10.69% | 4.05% | 3.22% |

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

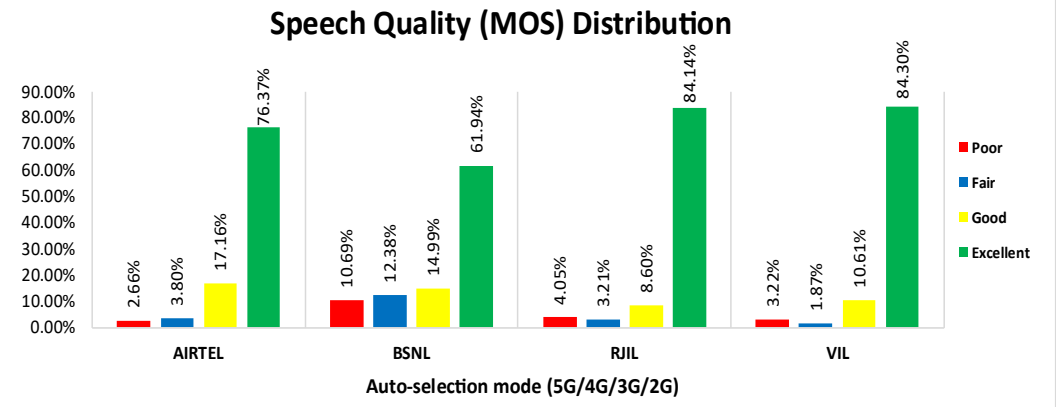



**Figure- 4:** Distribution of samples in MOS range.

**(d) Inter-service provider voice call performance:** To check the performance of inter-service providers, call setup success rate, total 15 inter operator calls were attempted at one location which is Hotel Peepal Tree in Palwal city. The call setup success rate and call setup time observation are 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** | 100.00 | 100.00 | NA | 100.00 |
| **VIL** | 100.00 | 100.00 | 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 | 6.18 | 1.57 | 1.48 |
| BSNL | 2.56 | NA | 1.95 | 3.72 |
| RJIL | 2.30 | 6.75 | NA | 1.47 |
| VIL | 1.50 | 6.60 | 1.26 | 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 | 96.28 | 11.97 | 182.30 | 36.54 |
| | 80th Percentile | 173.73 | 19.33 | 343.32 | 53.75 |
| | 20th Percentile | 10.61 | 2.07 | 17.02 | 8.18 |
| Upload Throughput (Mbits/s) | Average | 19.65 | 6.58 | 12.71 | 12.33 |
| | 80th Percentile | 34.98 | 13.29 | 21.56 | 19.45 |
| | 20th Percentile | 4.41 | 1.34 | 2.04 | 4.61 |
| Latency (ms) | 50th Percentile | 51.88 | 28.32 | 27.40 | 30.69 |

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

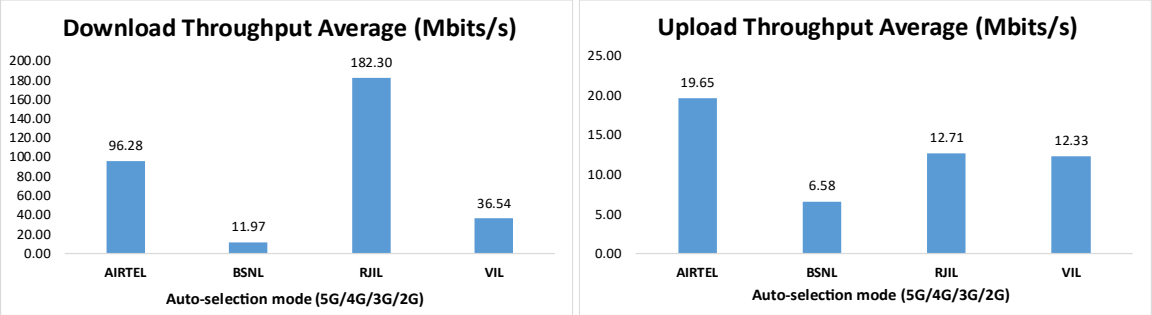



**Figure- 5:** Download and Upload throughput

| 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 | 526 | 0 |
| 4G | 1008 | 225 | 458 | 967 |
| 3G | NA | 8 | NA | NA |
| 2G | 2 | 28 | NA | 29 |

**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.
- 0- No cell Id's were found in respective technology.

# Detailed QoS Performance Analysis

# 4. Detailed QoS performance analysis

## 4.1 Overview

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

## 4.2 City

Drive test has been conducted from 13th July 2026 and 14th July 2026 in Nuh & Palwal Districts. (Refer Table-1)

### 4.2.1 Nuh District

#### 4.2.1.1 Drive test route

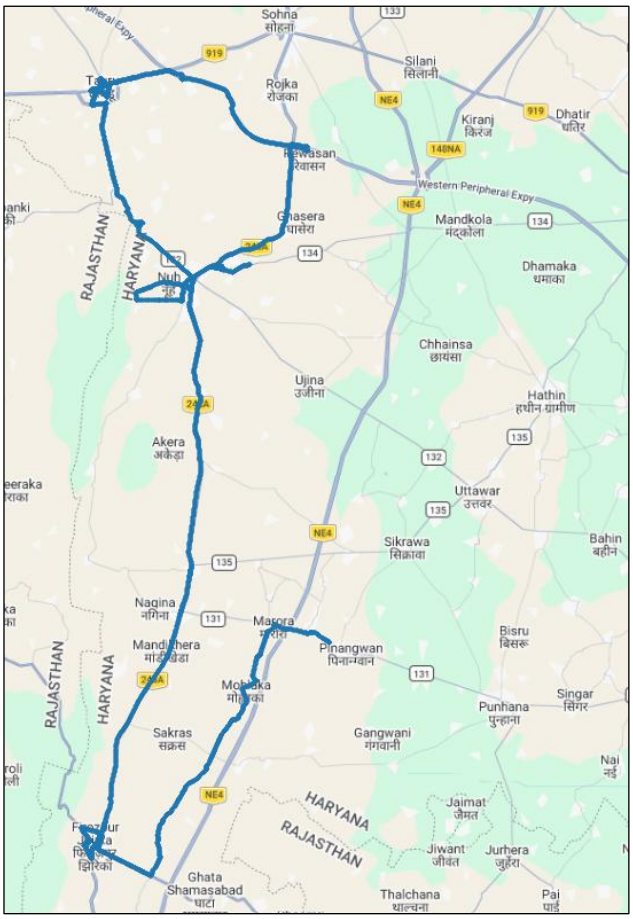



**Figure- 6:** Drive test routes

#### 4.2.1.2 Areas covered

Tauru, Rewasan, Ghasera, Nuh, Akera, Nagina, Mandkhera, Mohlaka, Sakras, Ferozpur and Jhirka etc.

### 4.2.1.3 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** | 122 | 127 | 118 |
| **Call Setup Success Rate %** | 98.36 | 95.28 | 99.15 |
| **Drop Call Rate %** | 1.67 | 4.13 | 2.56 |
| **Call Setup Time-Average (Second)** | 3.39 | 3.37 | 5.39 |
| **Handover Success Rate %** | 96.51 | 99.41 | 99.52 |

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

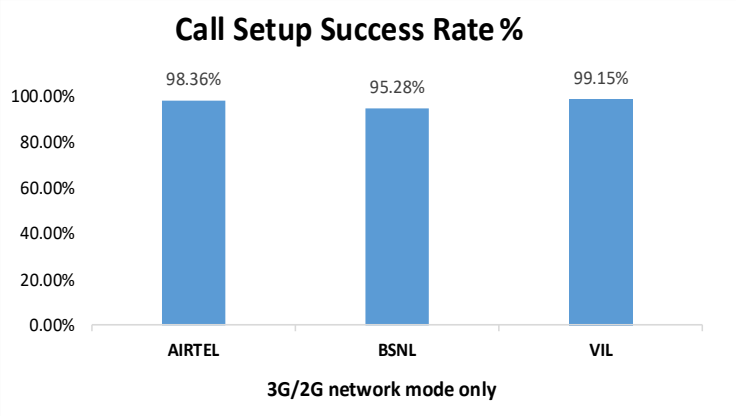



**Figure-7:** Performance for call setup success rate.

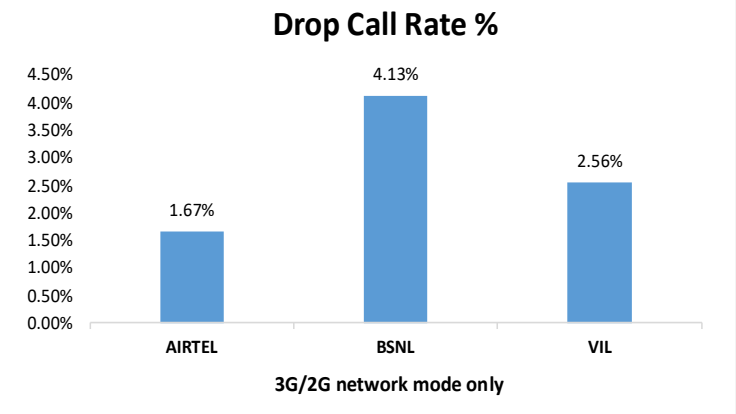



**Figure-8:** Performance for drop call rate.

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

| Technology | Service Provider | | |
|---|---|---|---|
| | AIRTEL | BSNL | VIL |
| **3G** | NA | 46.25% | NA |
| **2G** | 99.66% | 53.36% | 99.84% |
| **Limited Service** | 0.34% | 0.39% | 0.16% |

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

**Note**-

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

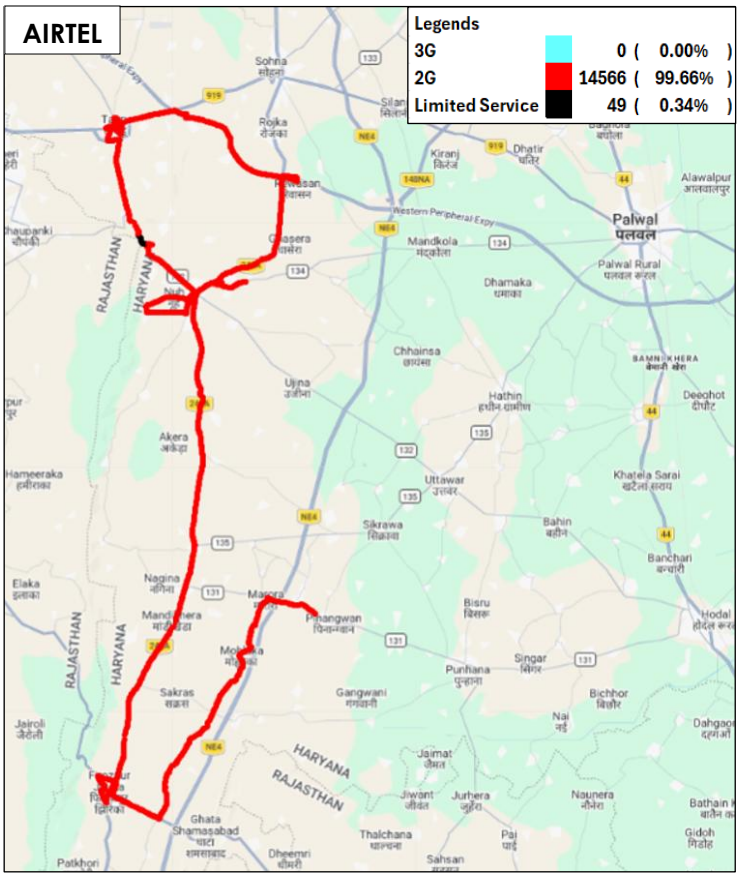



**Figure-9:** Serving technology plots 3G/2G network mode – AIRTEL.

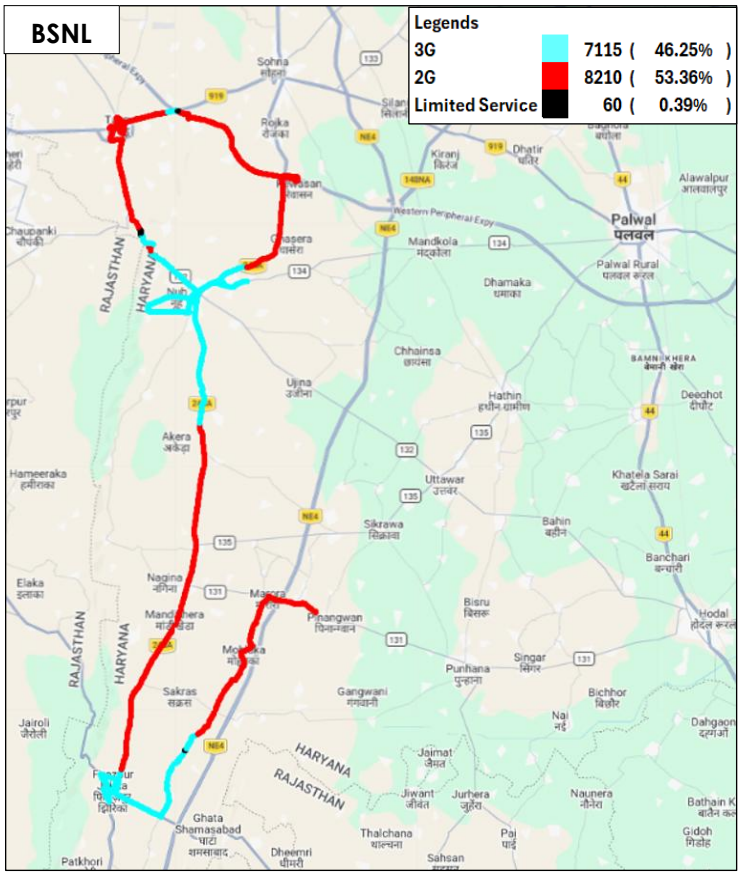



**Figure-10:** Serving technology plots 3G/2G network mode - BSNL.

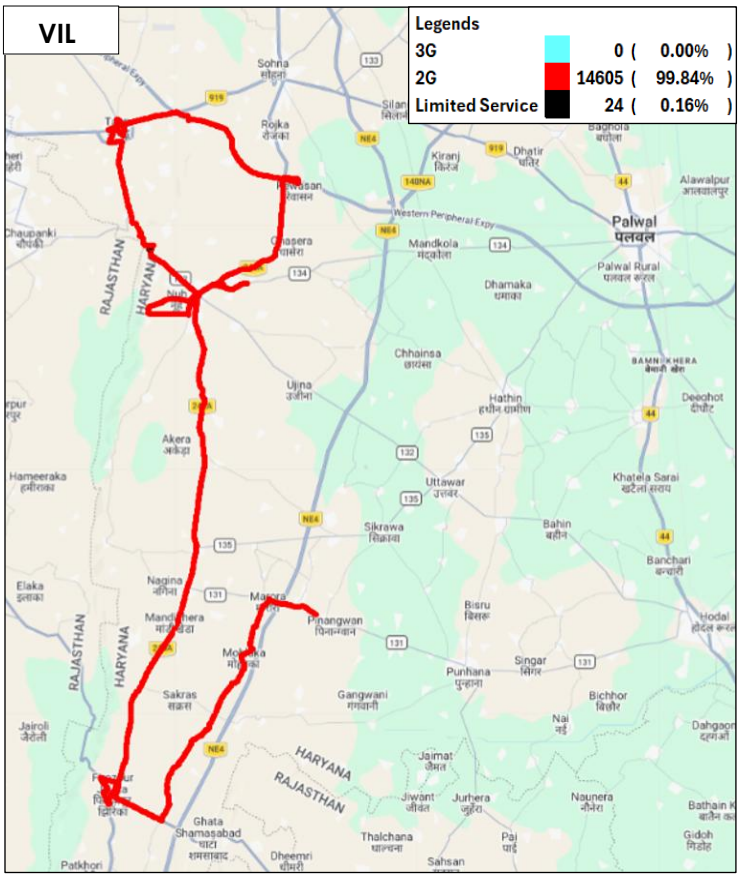



**Figure-11:** Serving technology plots 3G/2G network mode - VIL.

**(c) Network Signal Strength Distribution:** The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 87, 88, & 89 for map view)

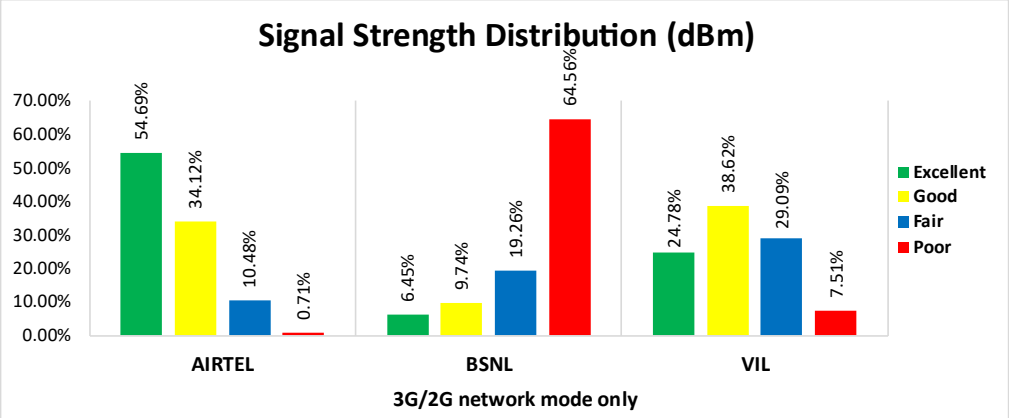



**Figure-12:** Signal strength distribution 3G/2G network mode only.

**Observations:**

- Airtel has 55% of samples falling in the excellent signal strength category.
- BSNL has 6% of samples falling in the excellent signal strength category.
- VIL has 25% 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** | 142 | 147 | 143 | 143 |
| **Call Setup Success Rate %** | 100.00 | 95.24 | 98.60 | 100.00 |
| **Drop Call Rate %** | 0.00 | 3.57 | 0.71 | 0.00 |
| **Call Setup Time Average (Second)** | 1.26 | 2.12 | 0.65 | 1.76 |
| **Handover Success Rate %** | 99.86 | 98.94 | 99.57 | 99.91 |

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

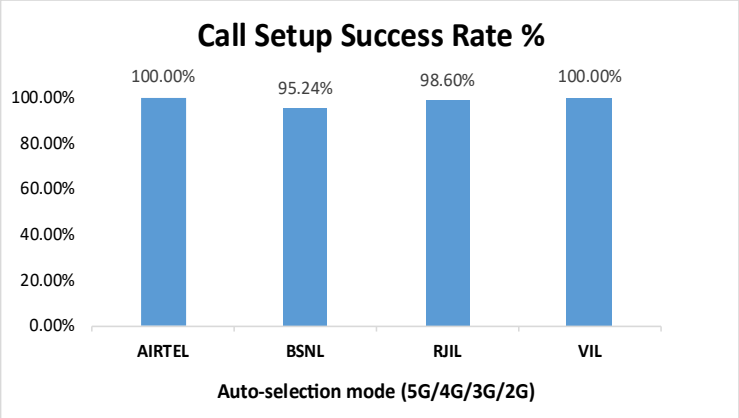



**Figure-13:** Performance for call setup success rate.

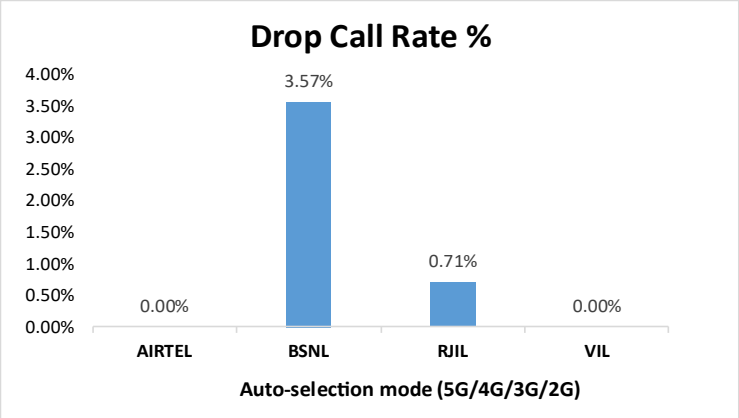



**Figure-14:** Performance for drop call rate.

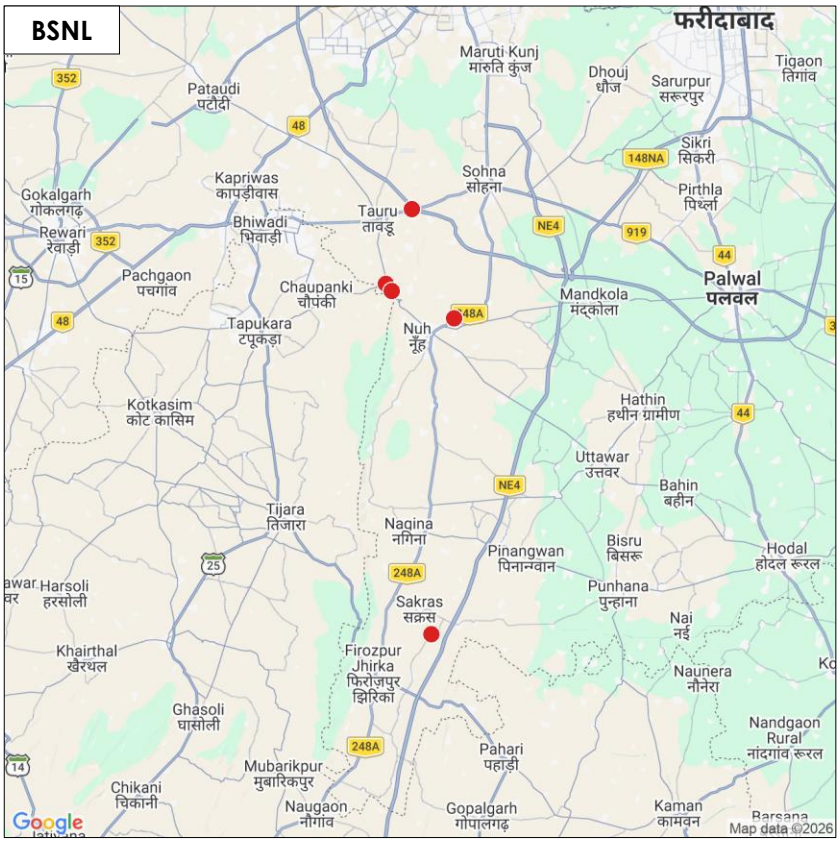



**Figure-15:** Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.




**Figure-16:** Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

| Parameter | Service Provider | | | |
|---|---|---|---|---|
| | Mobile-to-Mobile (5G/4G - Open Mode) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| **Call Established (within service provider Network)** | 136 | 131 | 135 | 139 |
| **Number of silences call for >4 Sec** | 4 | 12 | 3 | 8 |
| **Silence Call Rate %** | 2.94 | 9.16 | 2.22 | 5.76 |
| **Number of silence instances for >4 Sec** | 6 | 32 | 3 | 12 |
| **Number of silence instances for >3 Sec** | 13 | 35 | 6 | 20 |
| **Number of silence instances for >2 sec** | 30 | 36 | 13 | 54 |
| **RTP Jitter (4G & 5G) in ms** | 5.67 | 6.25 | 15.58 | 15.12 |
| **Packet loss Rate Downlink %** | 1.84 | 5.35 | 2.11 | 3.33 |
| **Packet loss Rate Uplink %** | 2.06 | 3.12 | 2.84 | 2.21 |

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

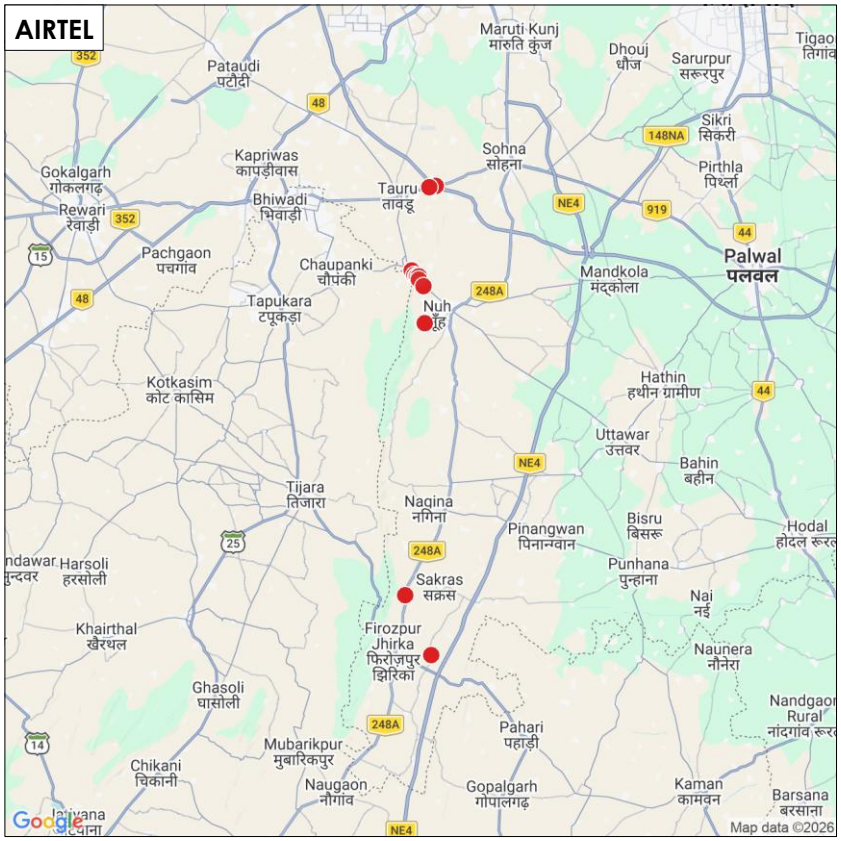



**Figure-17**: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)- AIRTEL.

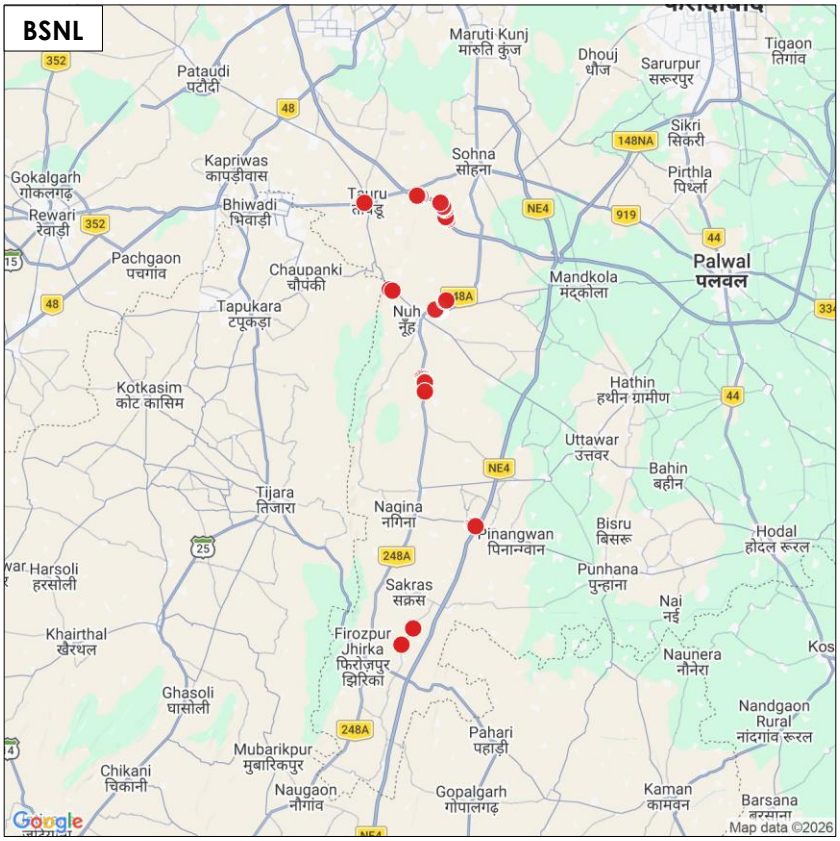



**Figure-18:** Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - BSNL.

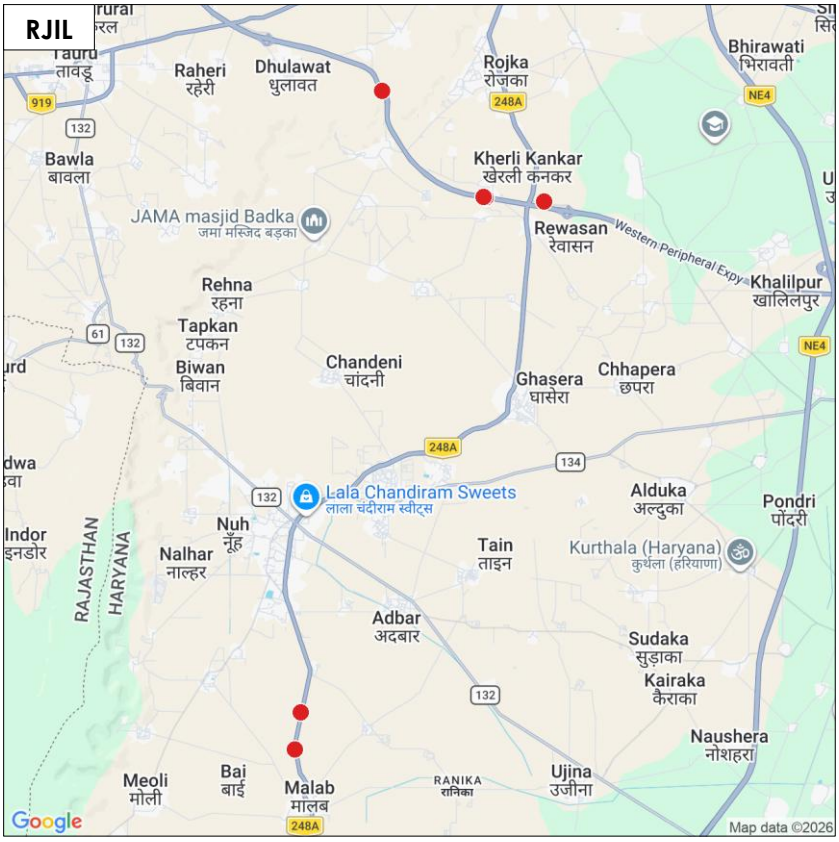



**Figure-19:** Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - RJIL.

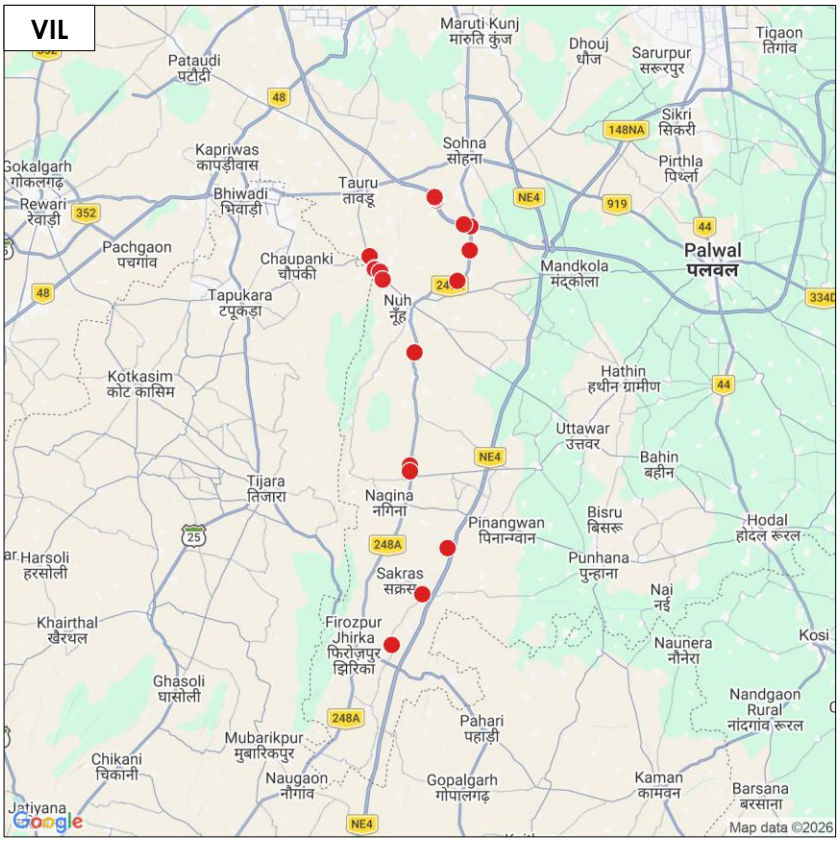



**Figure-20:** Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - VIL.

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

| Speech Quality (MOS) distribution | Service Provider | | | |
|---|---|---|---|---|
| | AIRTEL | BSNL | RJIL | VIL |
| **Total Number of MOS Samples for calls in table-16** | 812 | 648 | 781 | 795 |
| **Speech Quality (Average MOS)** | 3.82 | 3.26 | 4.31 | 4.26 |
| **Number of samples with MOS >=4 to <5 (Excellent)** | 585 | 268 | 640 | 646 |
| **Number of samples with MOS >=3 to <4 (Good)** | 152 | 164 | 66 | 85 |
| **Number of samples with MOS >=2 to <3 (Fair)** | 38 | 98 | 32 | 17 |
| **Number of samples with MOS >=1 to <2 (Poor)** | 37 | 118 | 43 | 47 |
| **%age of samples with MOS >=4 to <5 (Excellent)** | 72.04% | 41.36% | 81.95% | 81.26% |
| **%age of samples with MOS >=3 to <4 (Good)** | 18.72% | 25.31% | 8.45% | 10.69% |
| **%age of samples with MOS >=2 to <3 (Fair)** | 4.68% | 15.12% | 4.10% | 2.14% |
| **%age of samples with MOS >=1 to <2 (Poor)** | 4.56% | 18.21% | 5.51% | 5.91% |

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

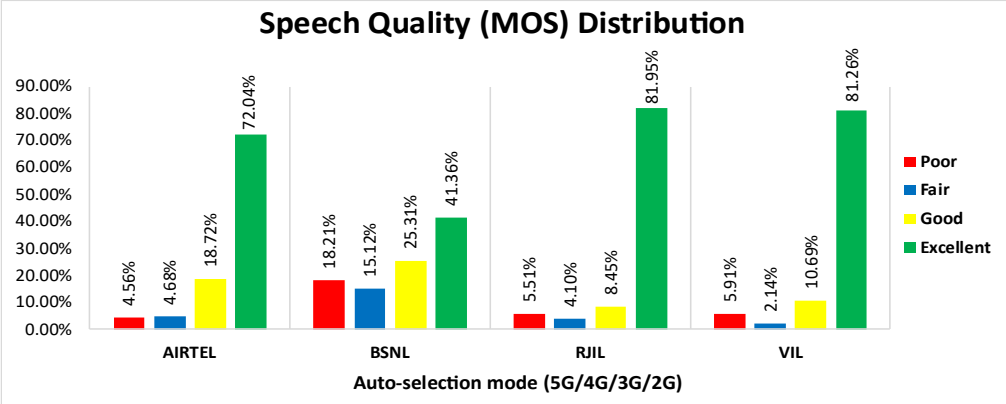



**Figure-21:** Distribution of samples in MOS range.

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

| Technology | Service Provider | | | |
|---|---|---|---|---|
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **5G** | 1.65% | NA | 73.54% | NA |
| **4G** | 98.35% | 76.19% | 26.46% | 99.94% |
| **3G** | NA | 4.00% | NA | NA |
| **2G** | 0.00% | 19.64% | NA | 0.00% |
| **Limited Service** | 0.00% | 0.18% | 0.00% | 0.06% |

**Table-18:**Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) voice.

**Note**-

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

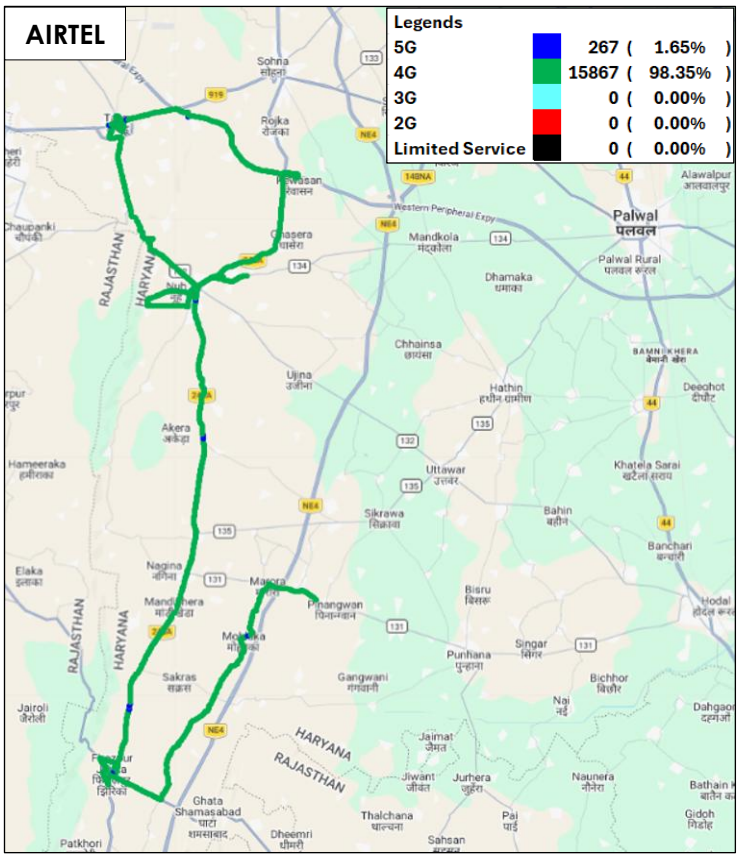



**Figure-22:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

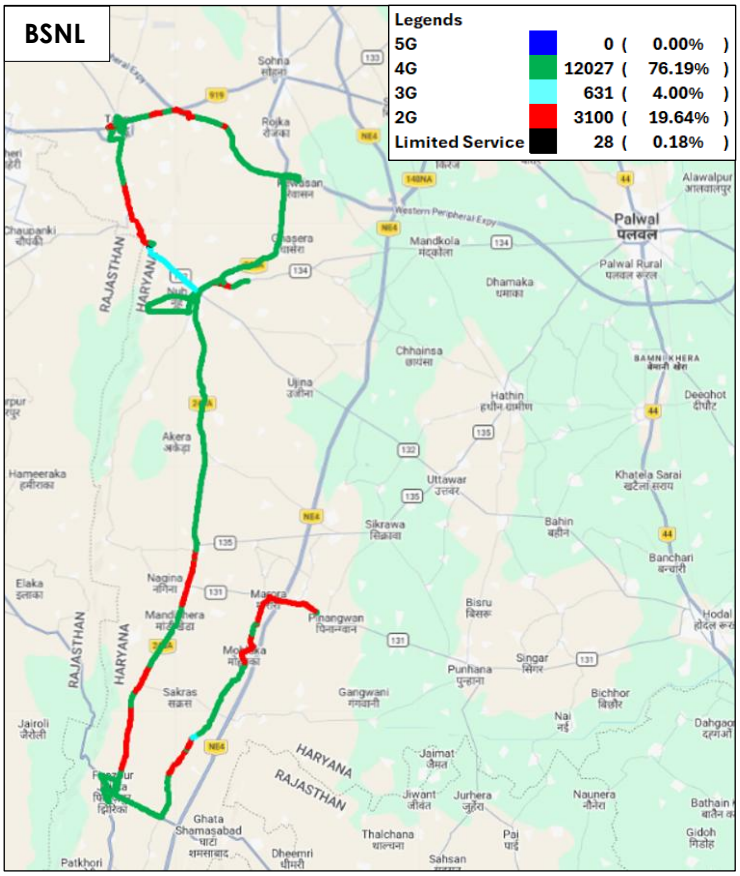



**Figure-23:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

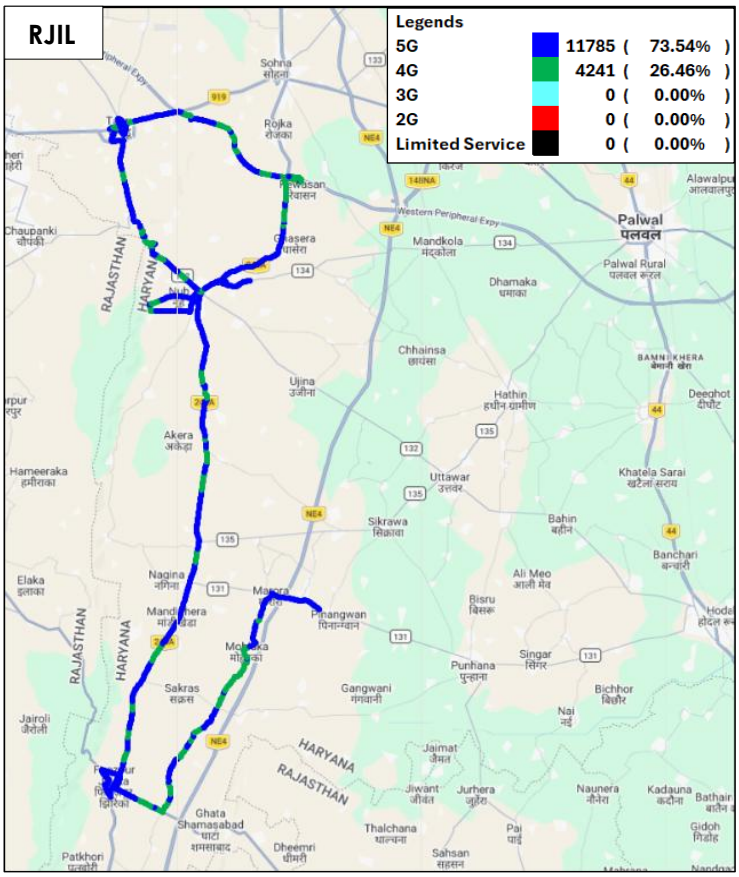



**Figure-24:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

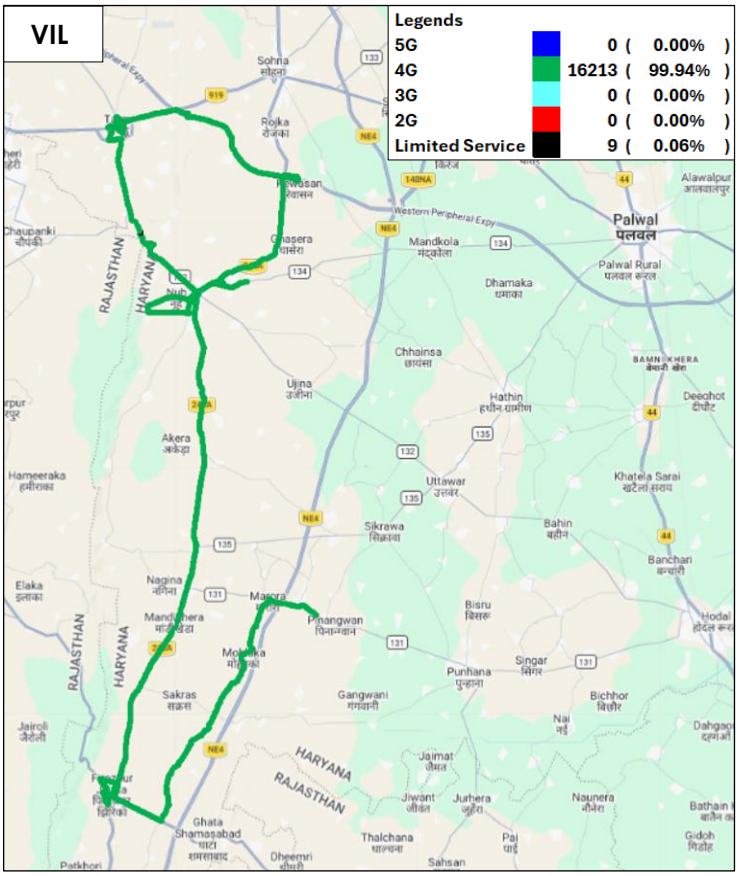



**Figure-25:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

**(g) Network Signal Strength Distribution:** The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-90, 91, 92 & 93 for map view)

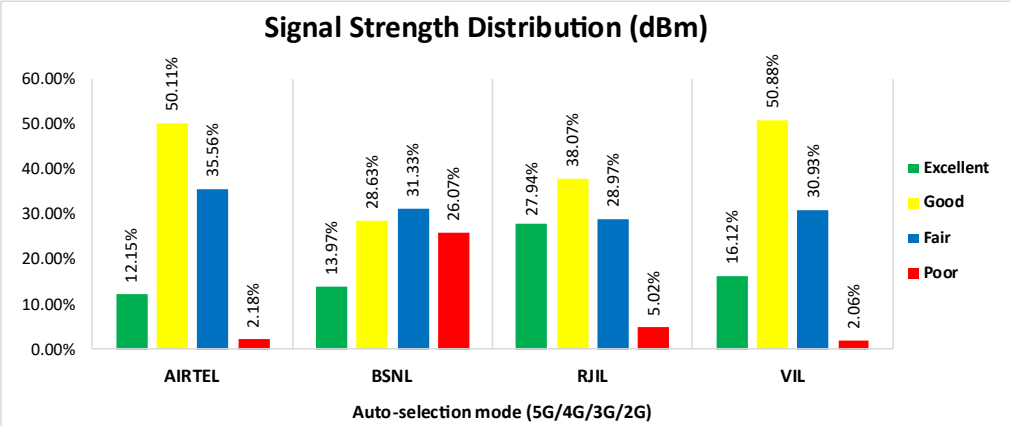



**Figure-26:** Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

## Observations:

- Airtel has 12% of samples falling in the excellent signal strength category.
- BSNL has 14% of samples falling in the excellent signal strength category.
- RJIL has 28% of samples falling in the excellent signal strength category.
- VIL has 16% of samples falling in the excellent signal strength category.

## (h) Coverage Gap observed

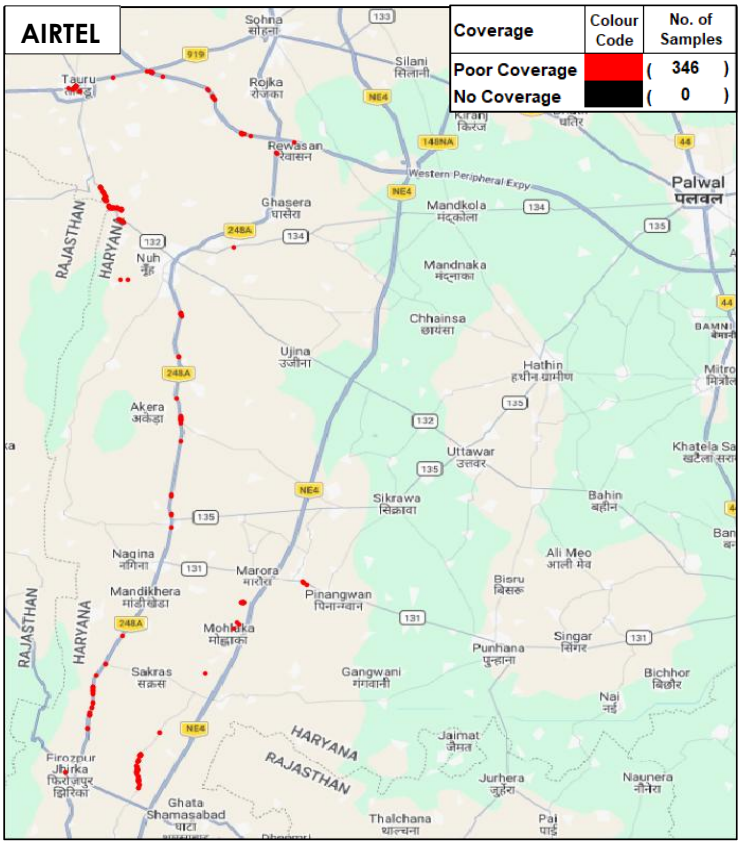



**Figure-27:** Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-AIRTEL.

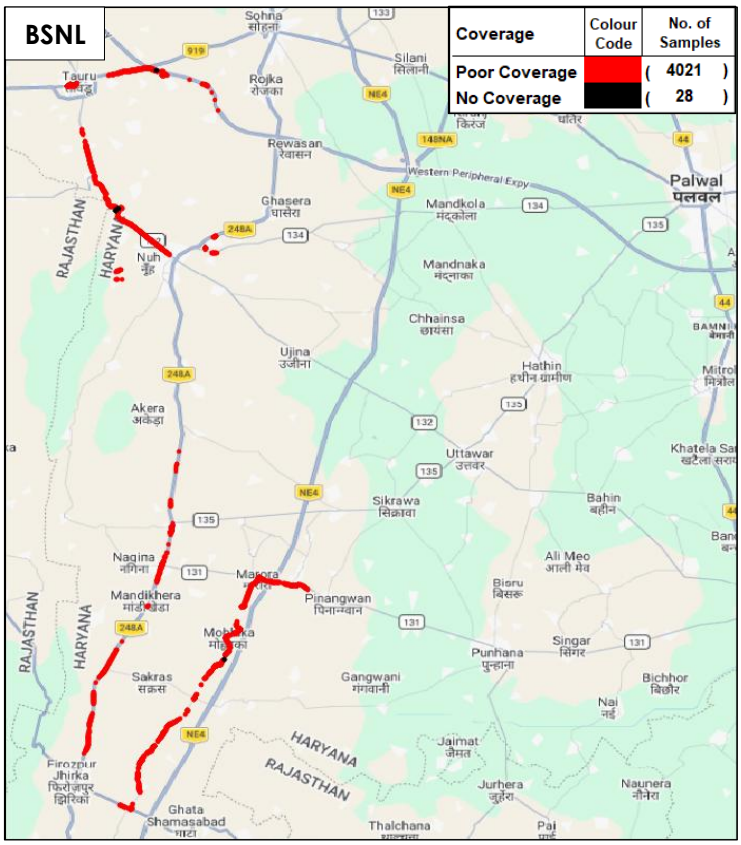



**Figure-28:** Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-BSNL.

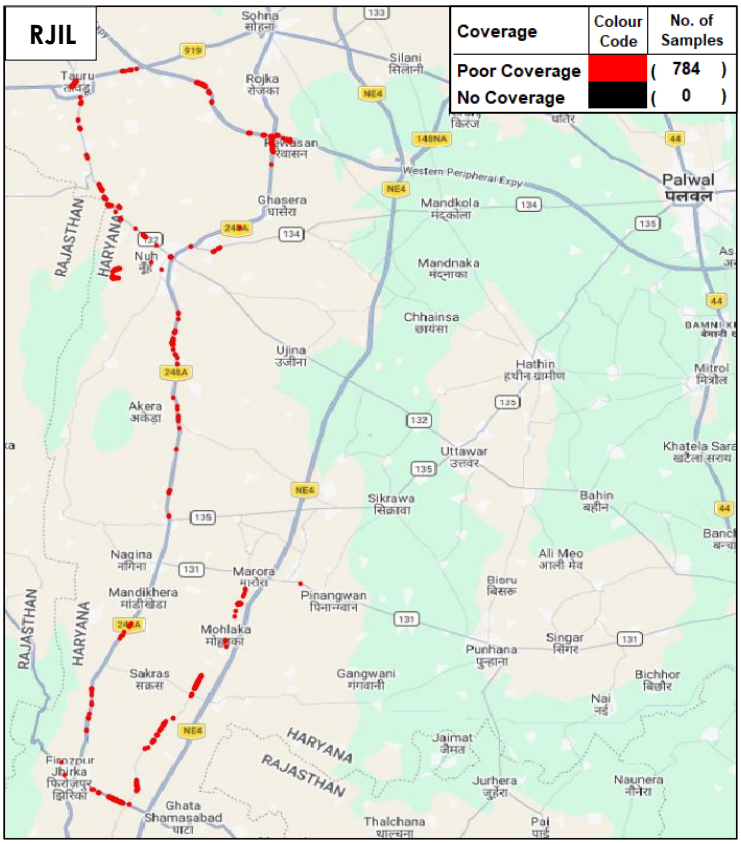



**Figure-29:** Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-RJIL.

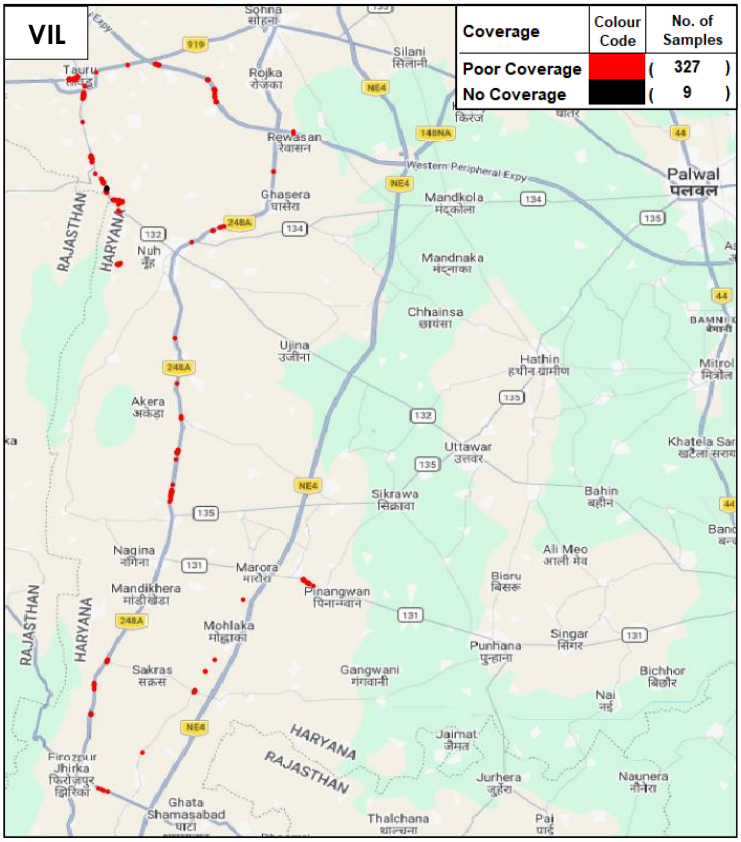



**Figure-30:** Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-VIL.

### 4.2.1.4 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 | 75.70 | 6.78 | 130.28 | 20.03 |
| | 80th Percentile | 134.08 | 11.33 | 226.03 | 29.38 |
| | 20th Percentile | 9.83 | 1.60 | 5.04 | 6.41 |
| Upload Throughput (Mbits/s) | Average | 14.26 | 6.21 | 9.71 | 10.84 |
| | 80th Percentile | 21.26 | 12.98 | 14.83 | 16.98 |
| | 20th Percentile | 3.39 | 1.22 | 1.67 | 3.63 |
| Latency (ms) | 50th Percentile | 54.52 | 25.61 | 31.21 | 30.99 |

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

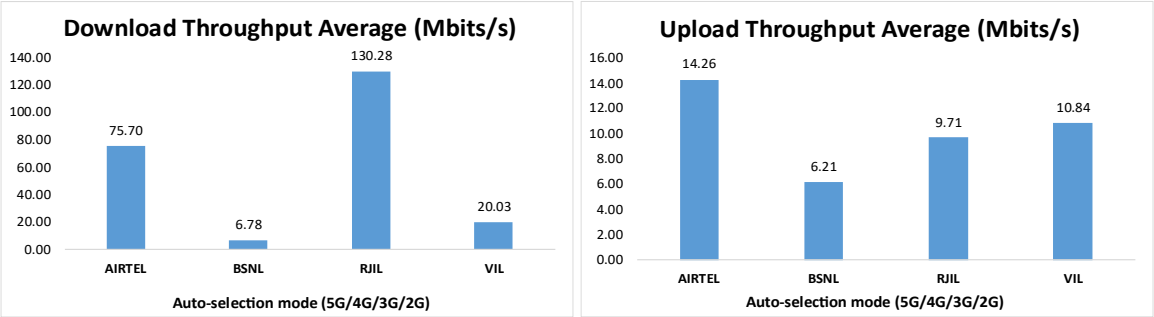



**Figure-31:** Download & Upload throughput

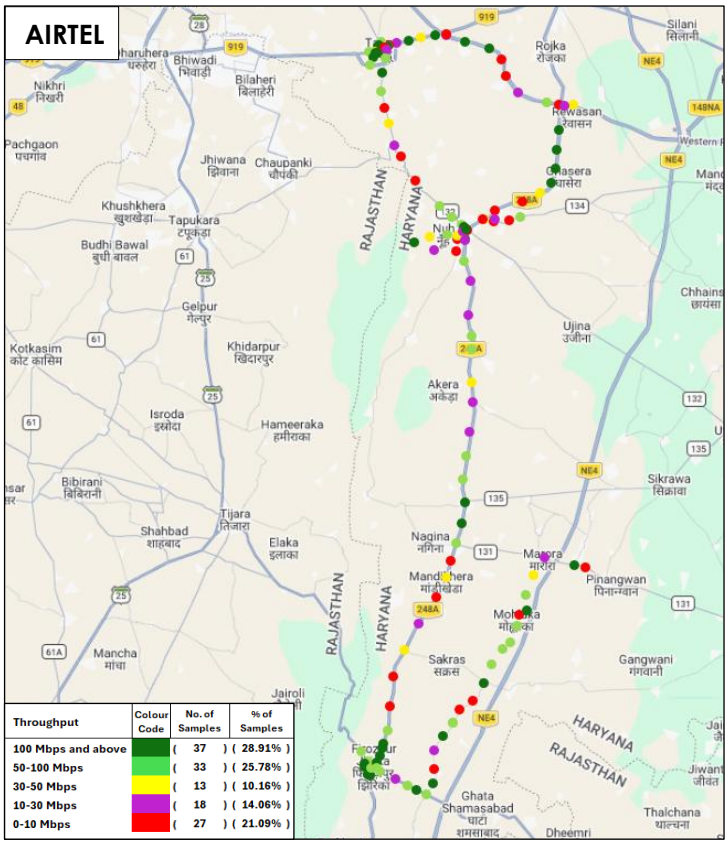



**Figure-32:** Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

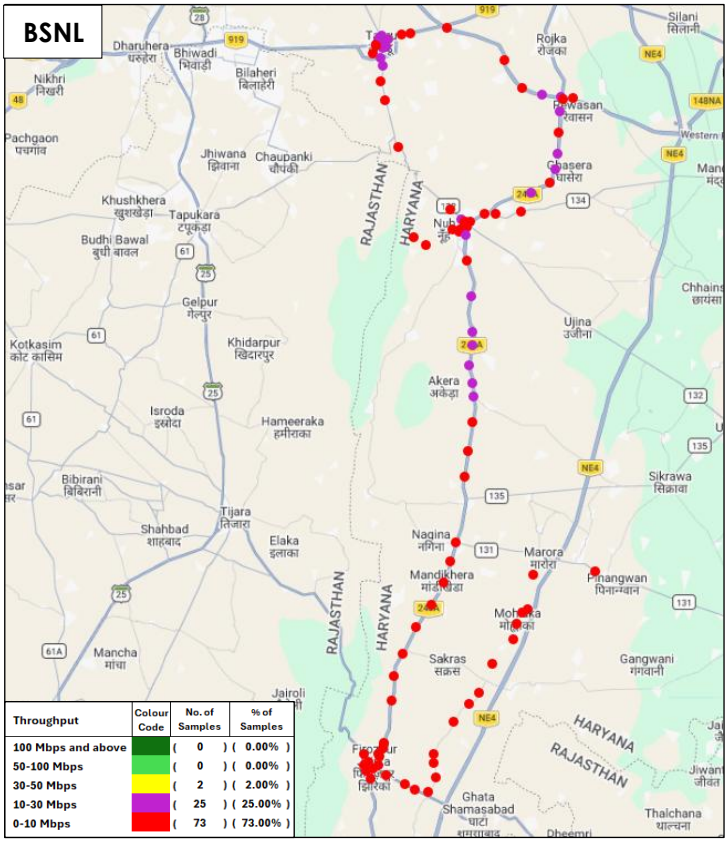



**Figure-33:** Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

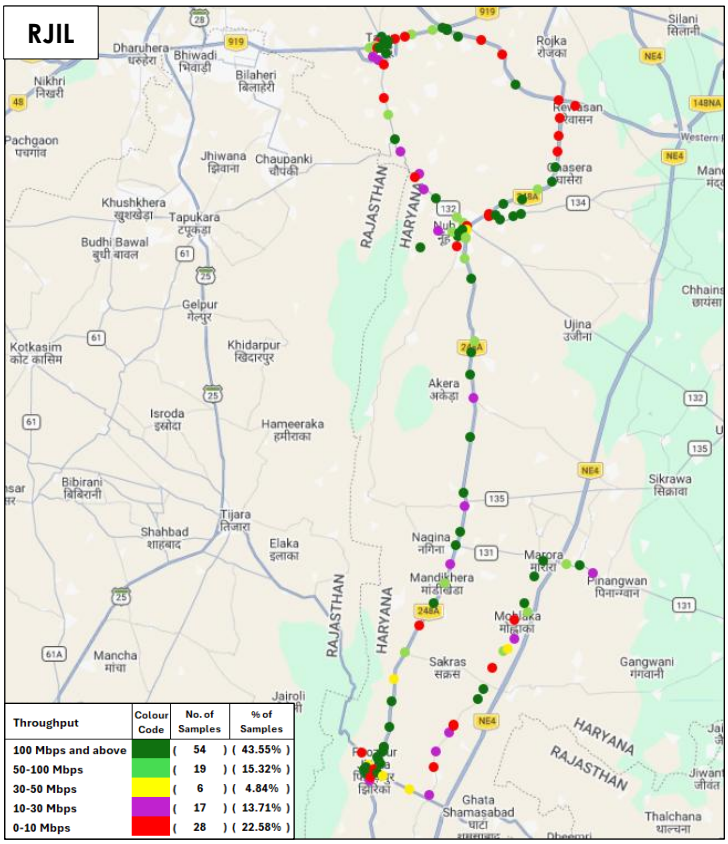



**Figure-34:** Download throughput distribution auto-selection mode (5G/4G/3G/2G) – RJIL.

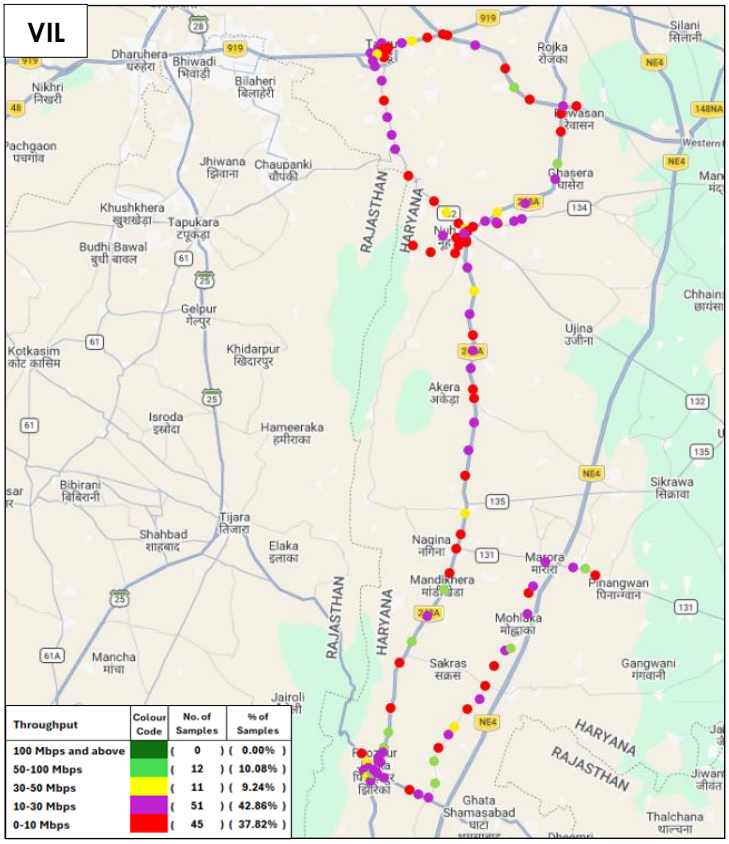



**Figure-35:** Download throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

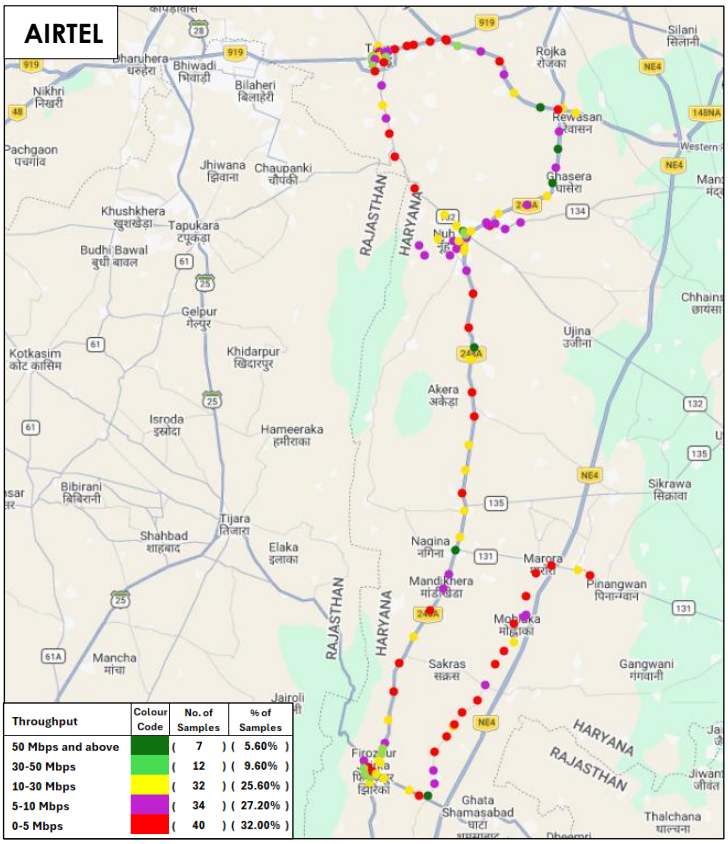



**Figure-36:** Upload throughput distribution auto-selection mode (5G/4G/3G/2G) – AIRTEL.

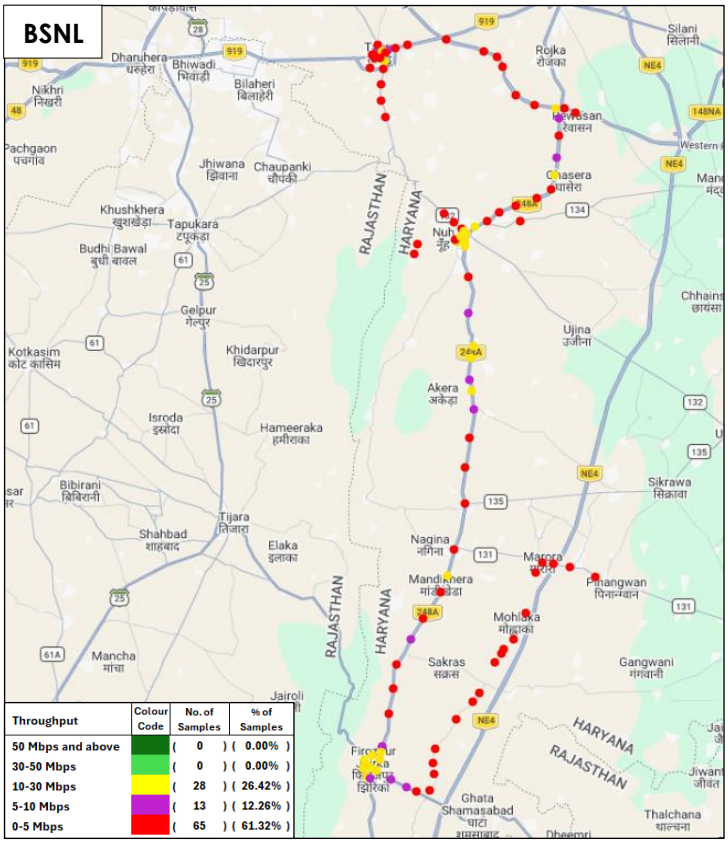



**Figure-37:** Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

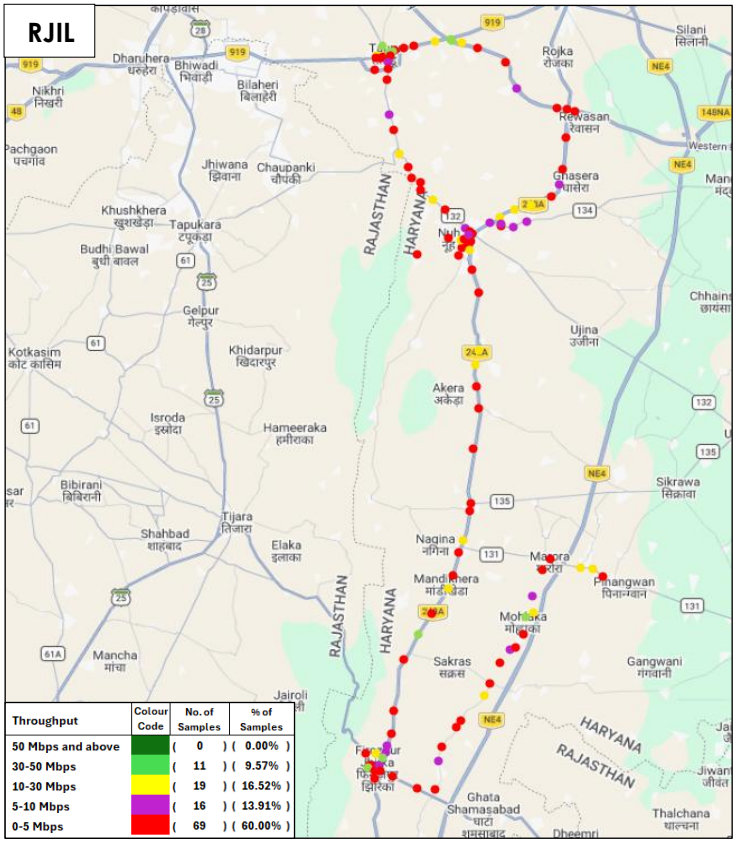



**Figure-38:** Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

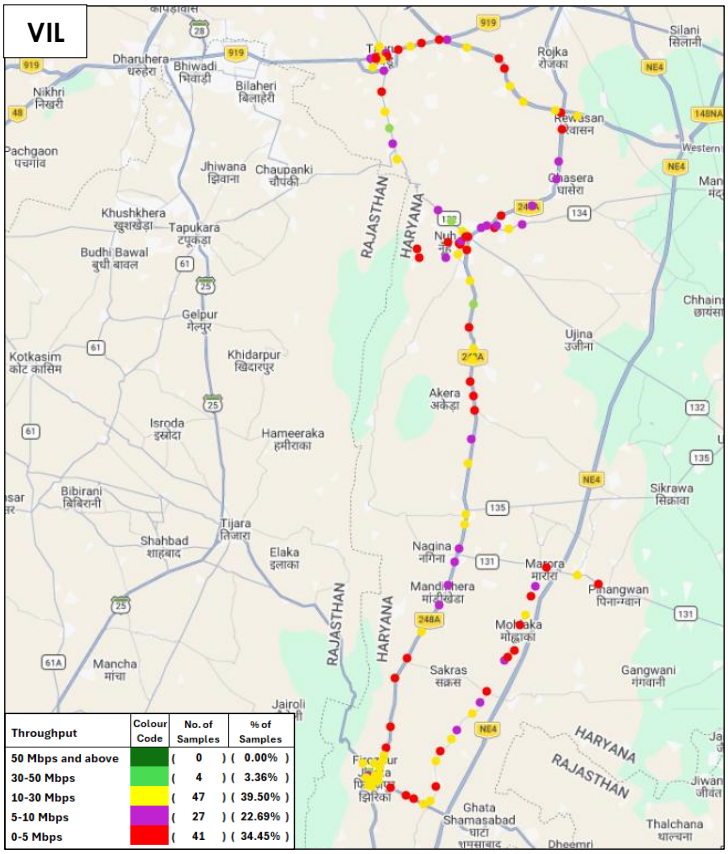



**Figure-39:** Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

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

| Technology | Service Provider | | | |
|---|---|---|---|---|
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **5G** | 54.22% | NA | 71.16% | NA |
| **4G** | 45.17% | 93.44% | 28.50% | 95.14% |
| **3G** | NA | 0.75% | NA | NA |
| **2G** | 0.21% | 2.19% | NA | 4.53% |
| **Limited Service** | 0.40% | 3.61% | 0.34% | 0.33% |

**Table-20:** Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) data.

**Note**-

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

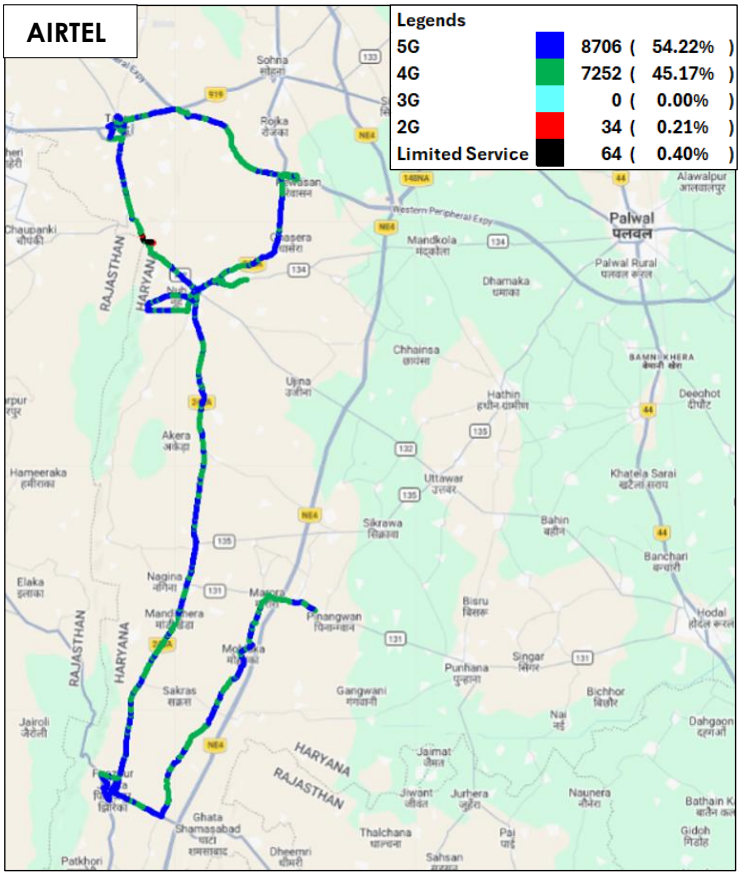



**Figure-40:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) data -AIRTEL.

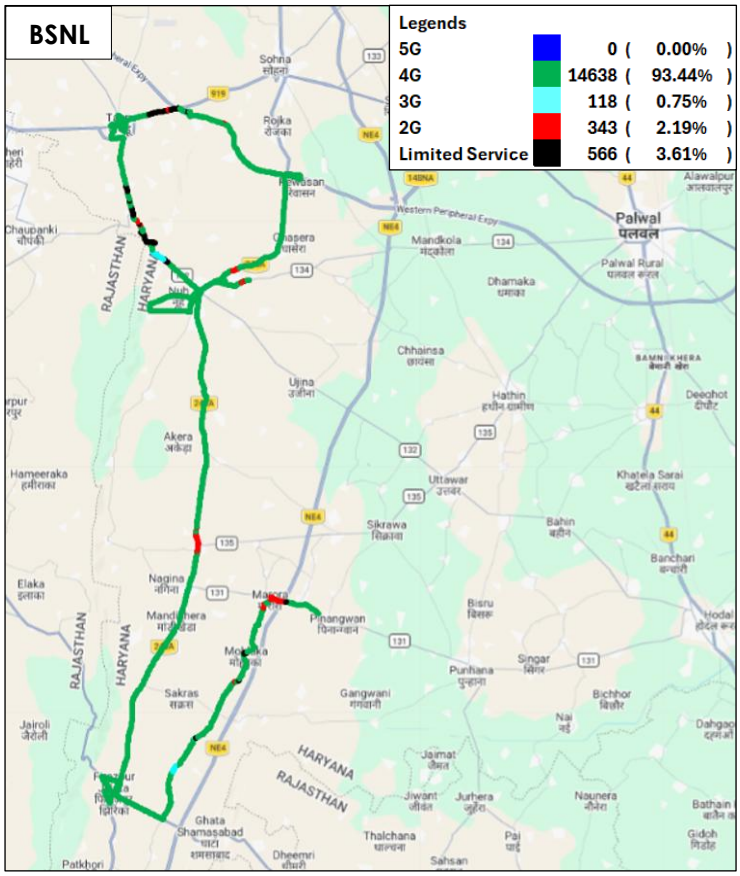



**Figure-41:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) data -BSNL.

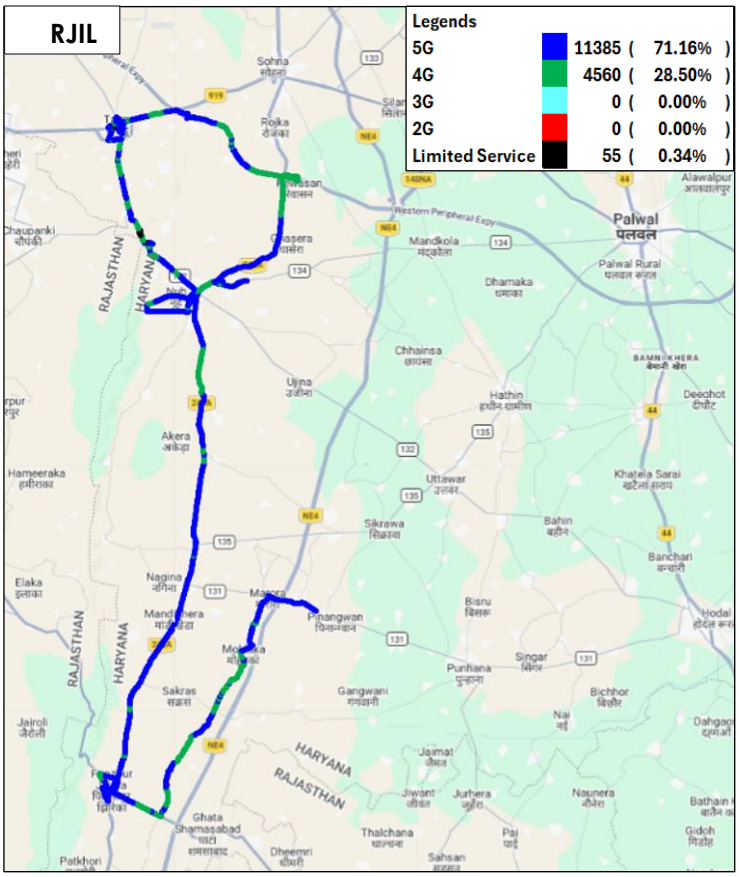



**Figure-42:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) data- RJIL.

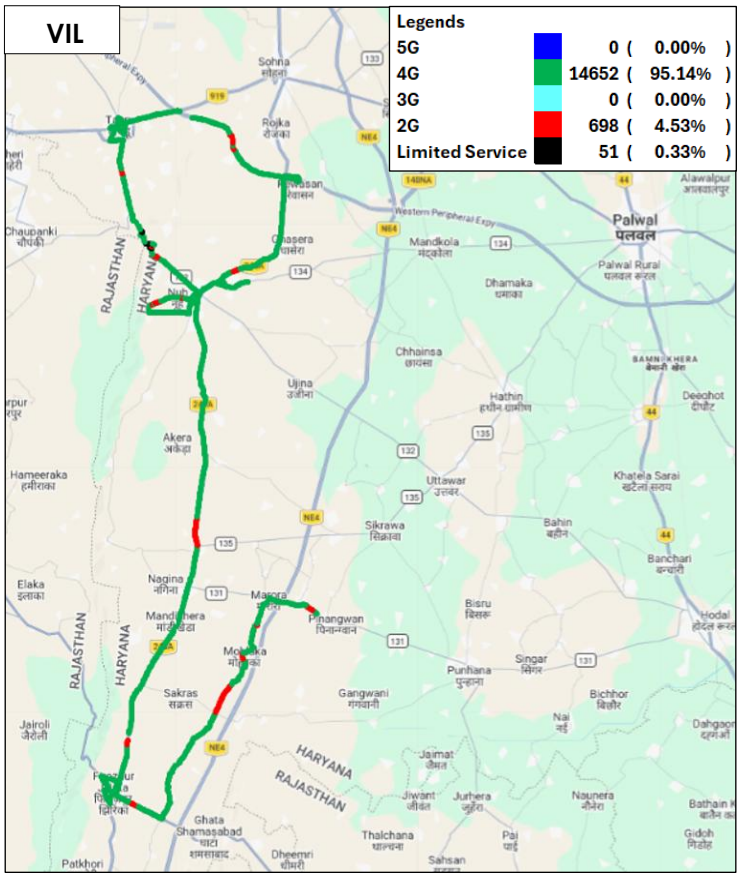



**Figure-43:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) data– VIL.

**(c) Network Signal Strength Distribution:** The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-94, 95, 96 & 97 for map view)

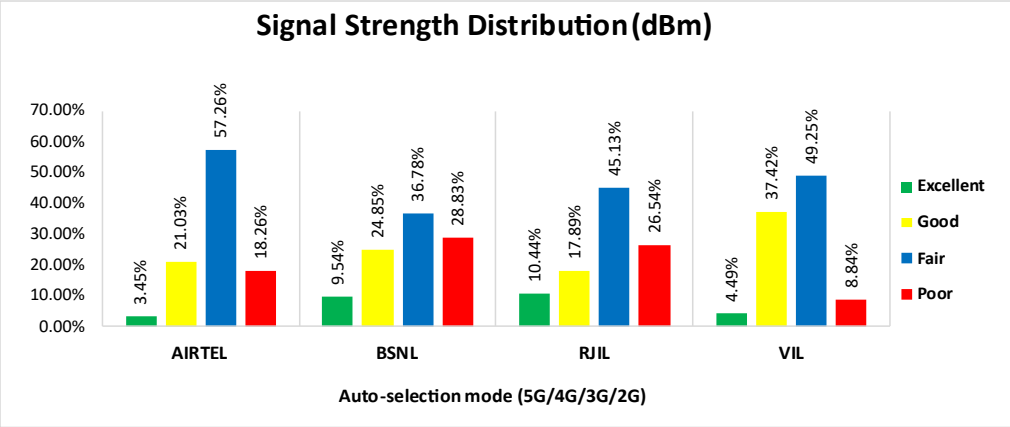



**Figure-44:** Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

## Observations:

- Airtel has 3% of samples falling in the excellent signal strength category.
- BSNL has 10% of samples falling in the excellent signal strength category.
- RJIL has 10% of samples falling in the excellent signal strength category.
- VIL has 4% of samples falling in the excellent signal strength category.

## 4.2.2 Palwal District

### 4.2.2.1 Drive test route

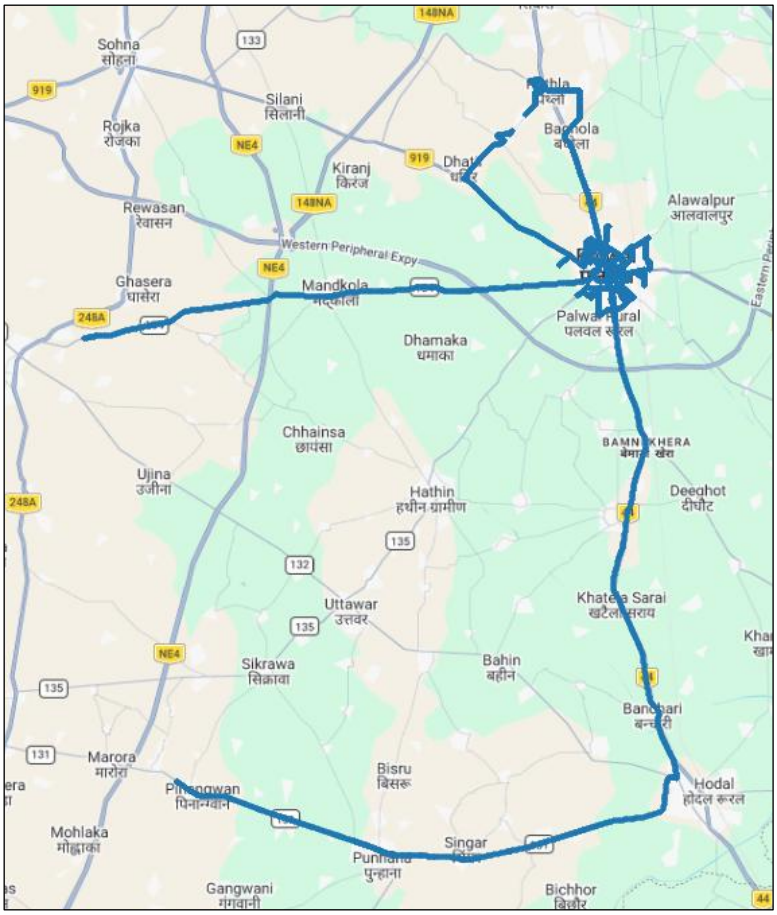



**Figure- 45:** Drive test routes

### 4.2.2.2 Areas covered

Mandkola, Palwal Rural, Dhal, Baghola, Alawalpur, Deeghot, Khatela Sarai, Banchari, Hodal, Singar, Punhana and Phangwan etc.

### 4.2.2.3 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** | 225 | 231 | 222 |
| **Call Setup Success Rate %** | 100.00 | 99.57 | 99.55 |
| **Drop Call Rate %** | 0.00 | 1.30 | 0.45 |
| **Call Setup Time-Average (Second)** | 3.36 | 3.24 | 4.92 |
| **Handover Success Rate %** | 97.53 | 99.78 | 95.18 |

**Table-21:** Summary of voice call performance in 3G/2G network mode only.

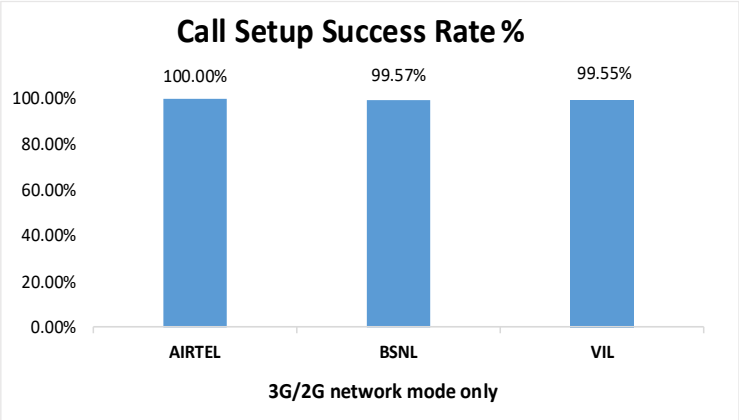



**Figure-46:** Performance for call setup success rate.

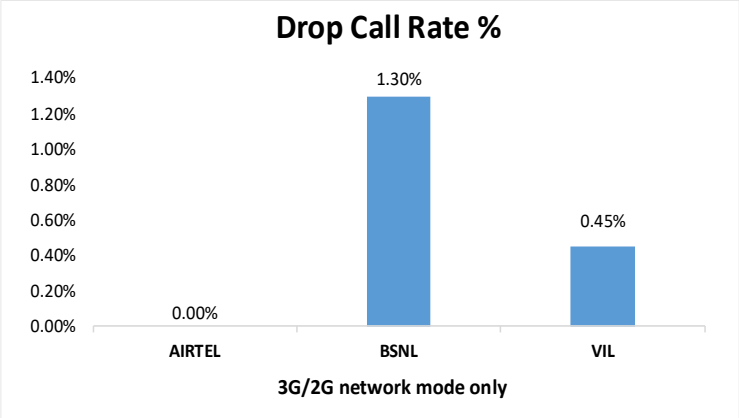



**Figure-47:** Performance for drop call rate.

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

| Technology | Service Provider | | |
|---|---|---|---|
| | **AIRTEL** | **BSNL** | **VIL** |
| **3G** | NA | 27.79% | NA |
| **2G** | 99.91% | 72.02% | 99.94% |
| **Limited Service** | 0.09% | 0.19% | 0.06% |

**Table-22:** Time spent on technology during drive test 3G/2G network mode.

**Note**-

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

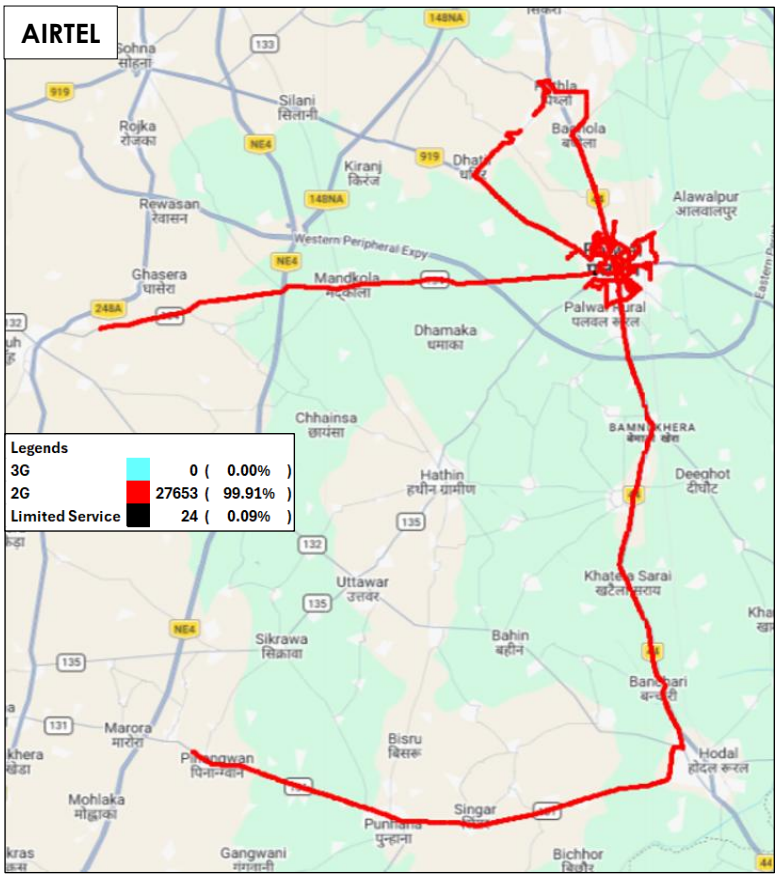



**Figure-48:** Serving technology plots 3G/2G network mode – AIRTEL.

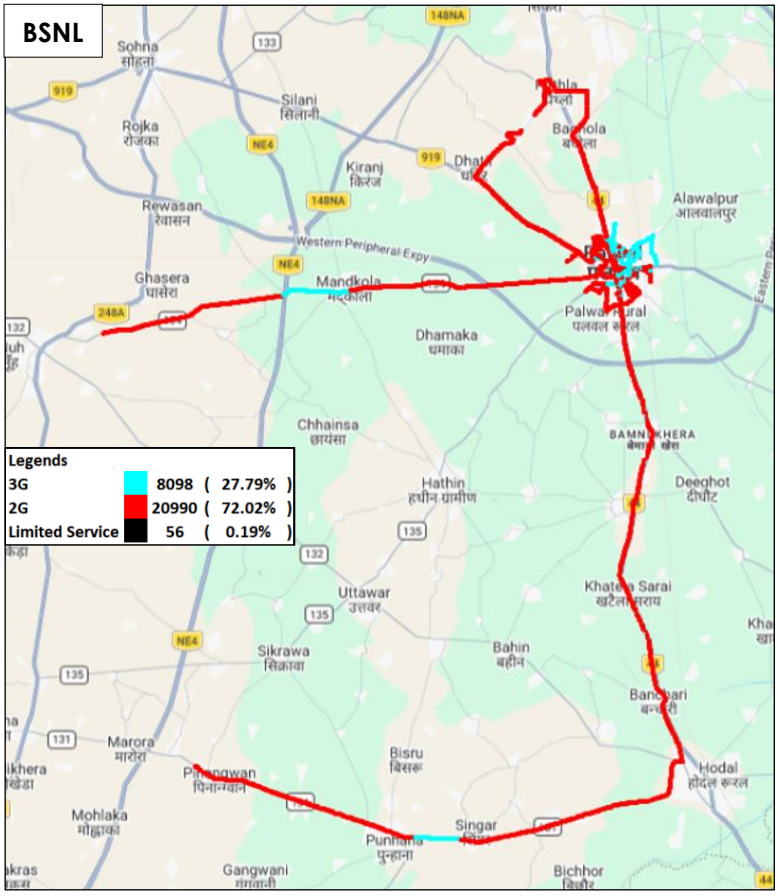



**Figure-49:** Serving technology plots 3G/2G network mode - BSNL.

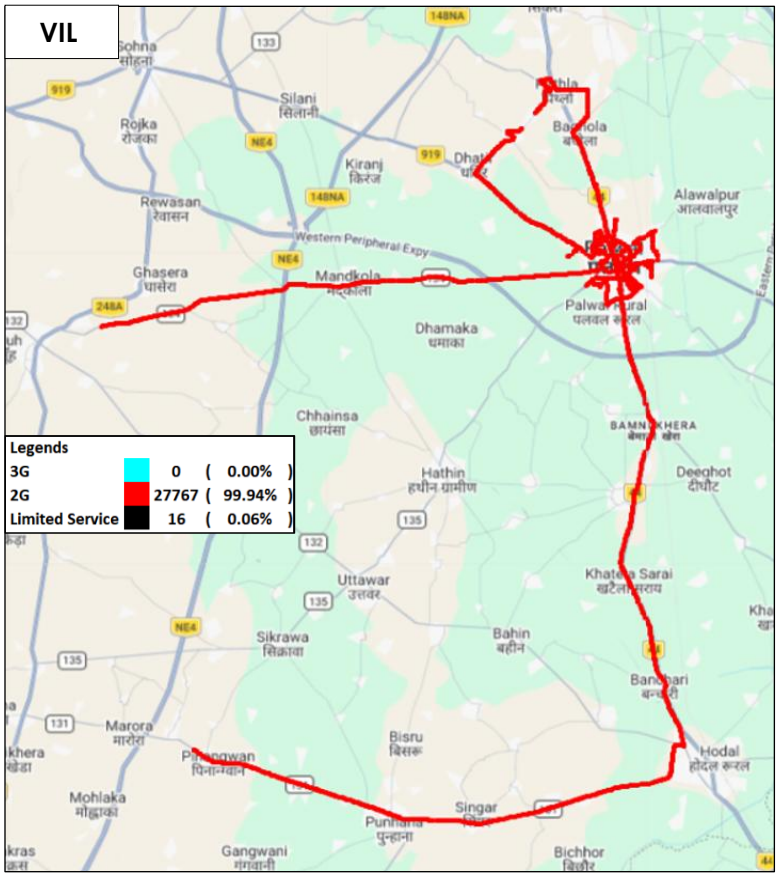



**Figure-50:** Serving technology plots 3G/2G network mode - VIL.

**(c) Network Signal Strength Distribution:** The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 98, 99 & 100 for map view)

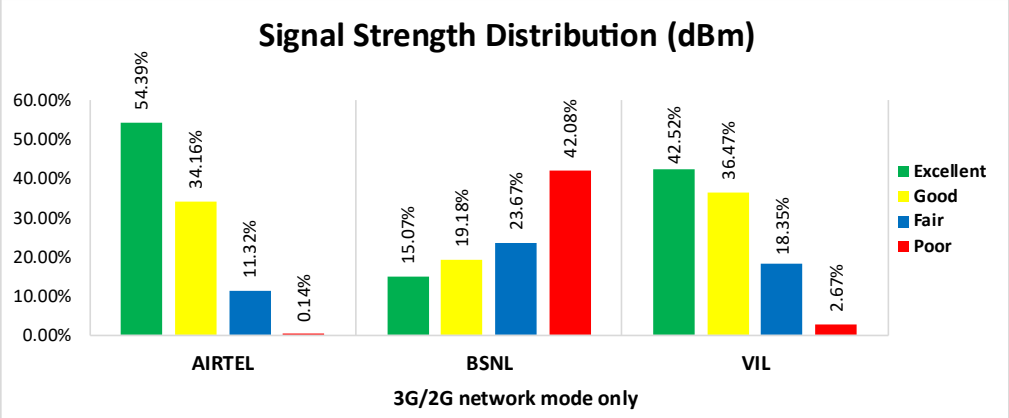



**Figure-51:** Signal strength distribution 3G/2G network mode only.

## Observations:

- Airtel has 54% of samples falling in the excellent signal strength category.
- BSNL has 15% of samples falling in the excellent signal strength category.
- VIL has 43% 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** | 272 | 271 | 288 | 270 |
| **Call Setup Success Rate %** | 100.00 | 98.89 | 87.15 | 99.63 |
| **Drop Call Rate %** | 0.37 | 1.12 | 0.40 | 0.00 |
| **Call Setup Time Average (Second)** | 1.25 | 1.46 | 0.70 | 1.53 |
| **Handover Success Rate %** | 99.83 | 99.36 | 99.85 | 100.00 |

**Table-23:** Summary of voice call performance in network auto-selection mode.

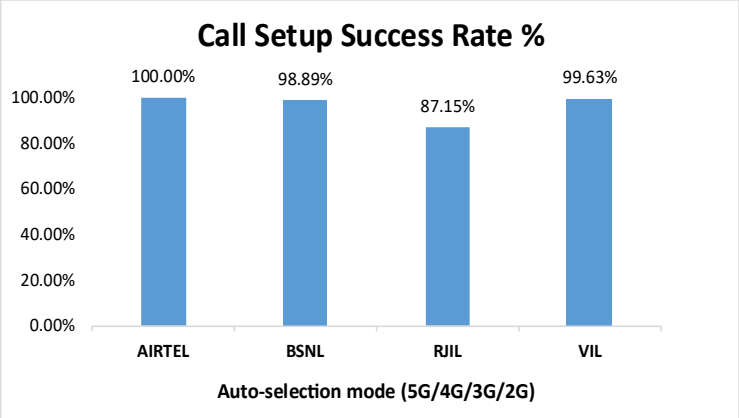



**Figure-52:** Performance for call setup success rate.

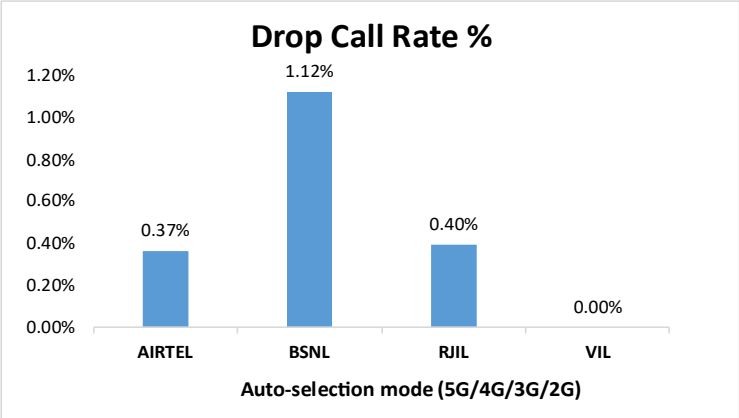



**Figure-53:** Performance for drop call rate.

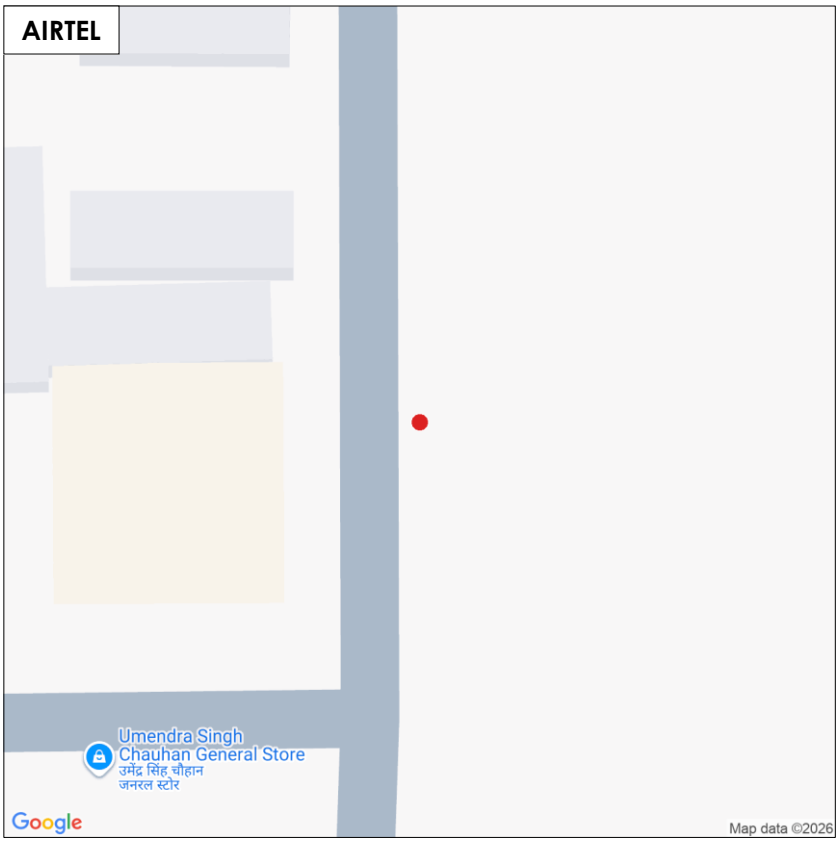



**Figure-54:** Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

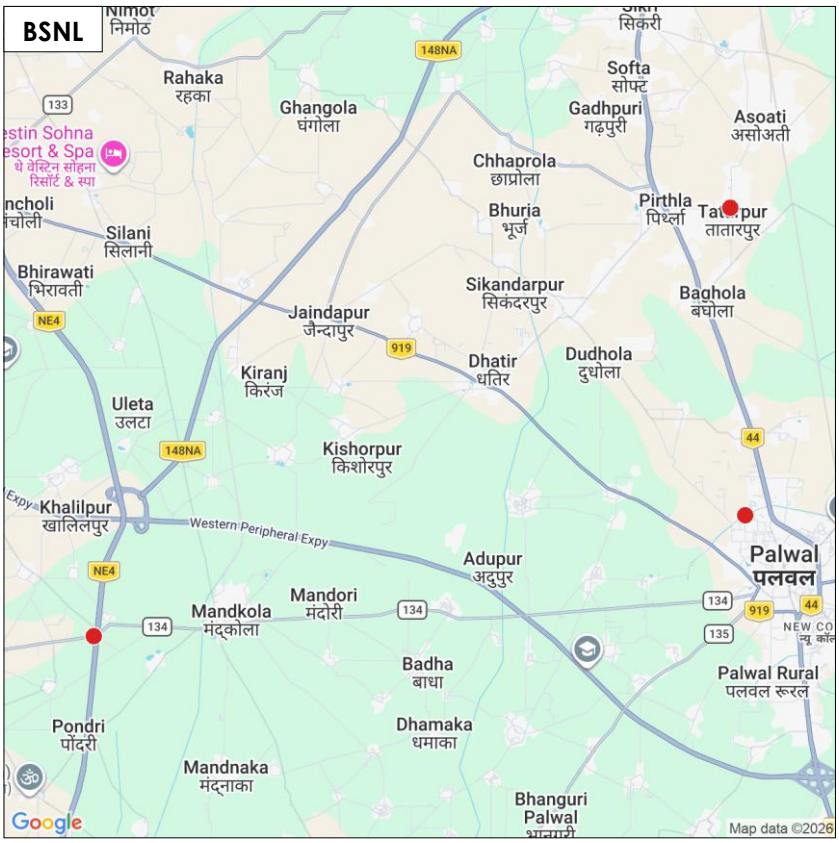



**Figure-55:** Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

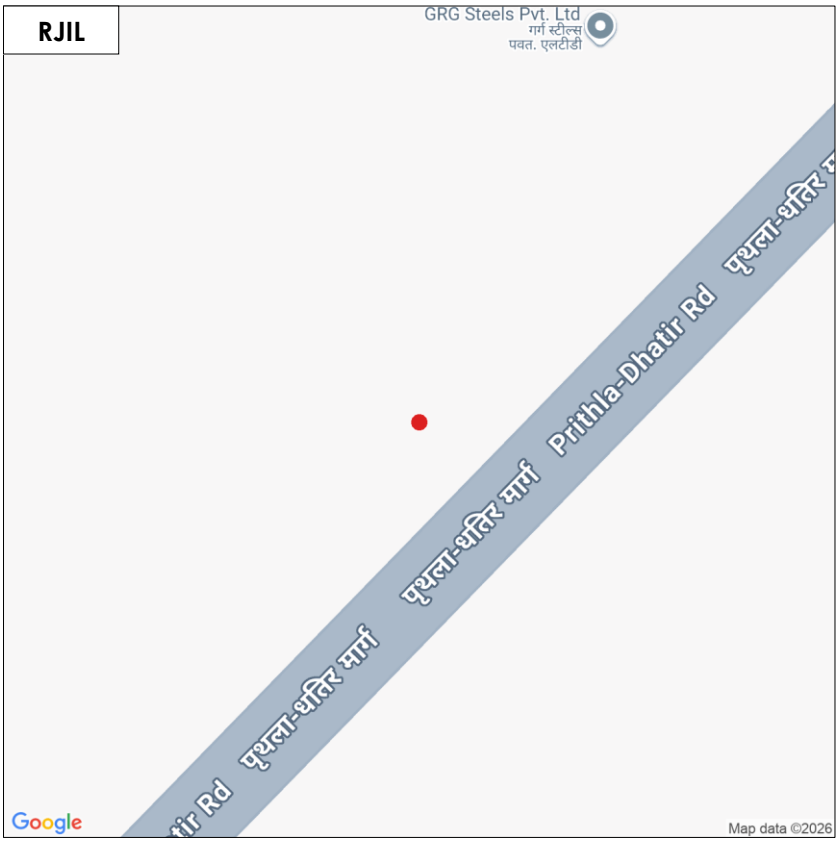



**Figure-56:** Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

| Parameter | Service Provider | | | |
|---|---|---|---|---|
| | Mobile-to-Mobile (5G/4G - Open Mode) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| **Call Established (within service provider Network)** | 259 | 258 | 250 | 265 |
| **Number of silences call for >4 Sec** | 3 | 4 | 4 | 8 |
| **Silence Call Rate %** | 1.16 | 1.55 | 1.60 | 3.02 |
| **Number of silence instances for >4 Sec** | 3 | 10 | 5 | 10 |
| **Number of silence instances for >3 Sec** | 10 | 11 | 9 | 17 |
| **Number of silence instances for >2 sec** | 26 | 17 | 17 | 38 |
| **RTP Jitter (4G & 5G) in ms** | 4.74 | 5.93 | 15.77 | 16.46 |
| **Packet loss Rate Downlink %** | 0.79 | 2.57 | 1.62 | 1.22 |
| **Packet loss Rate Uplink %** | 0.96 | 1.40 | 1.78 | 1.35 |

**Table-24:** Summary of silence instances & packet loss rate for mobile to mobile call.

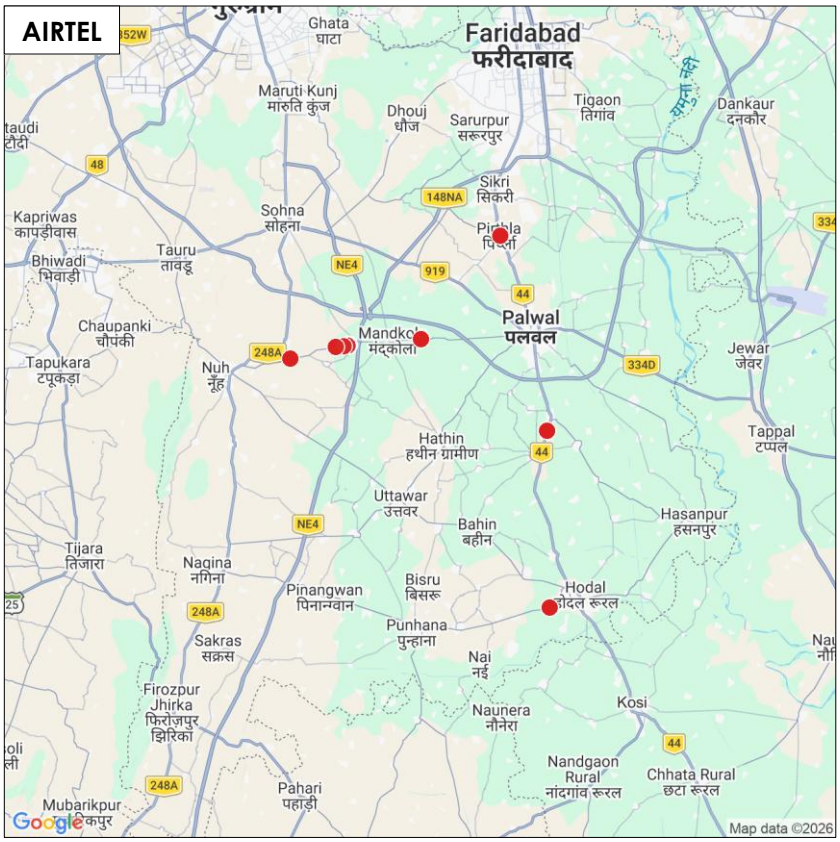



**Figure-57**: Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode)- AIRTEL.

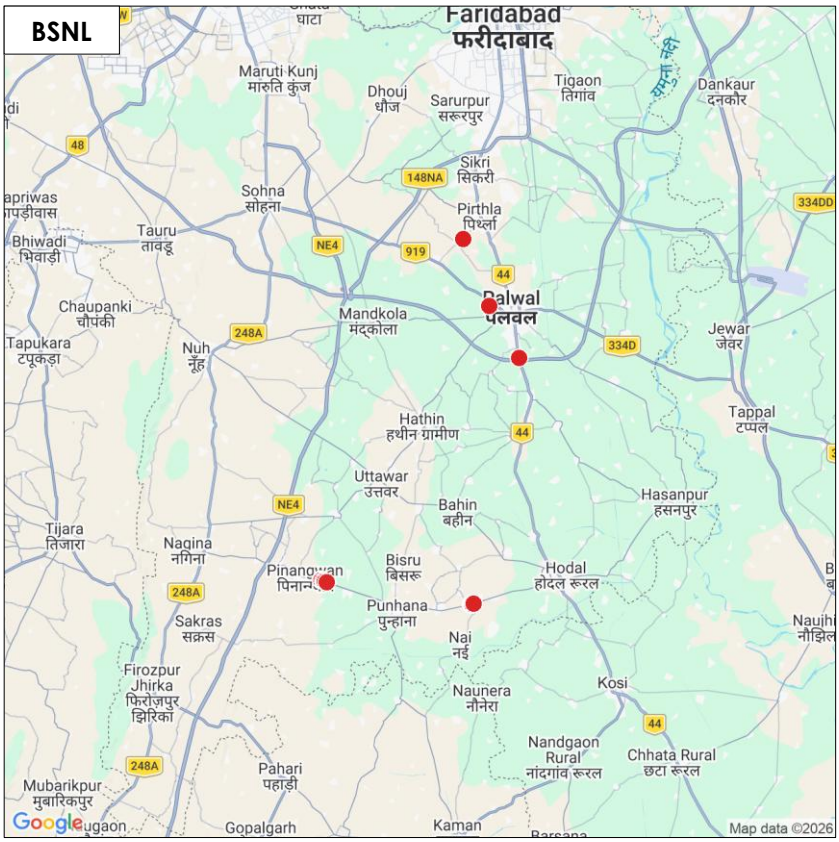



**Figure-58:** Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - BSNL.

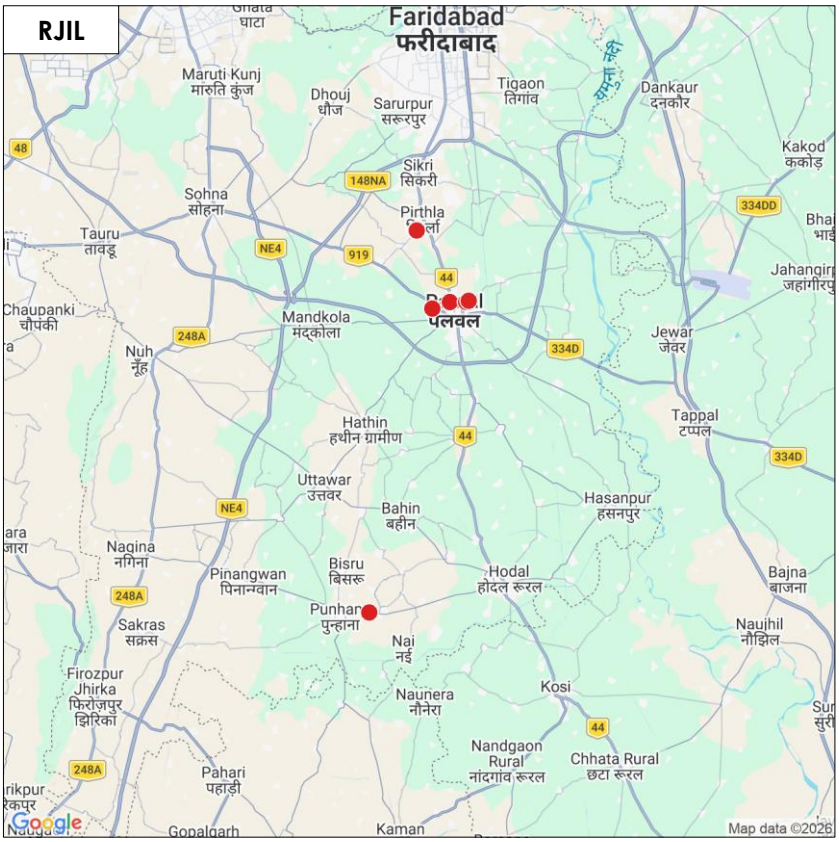



**Figure-59:** Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - RJIL.

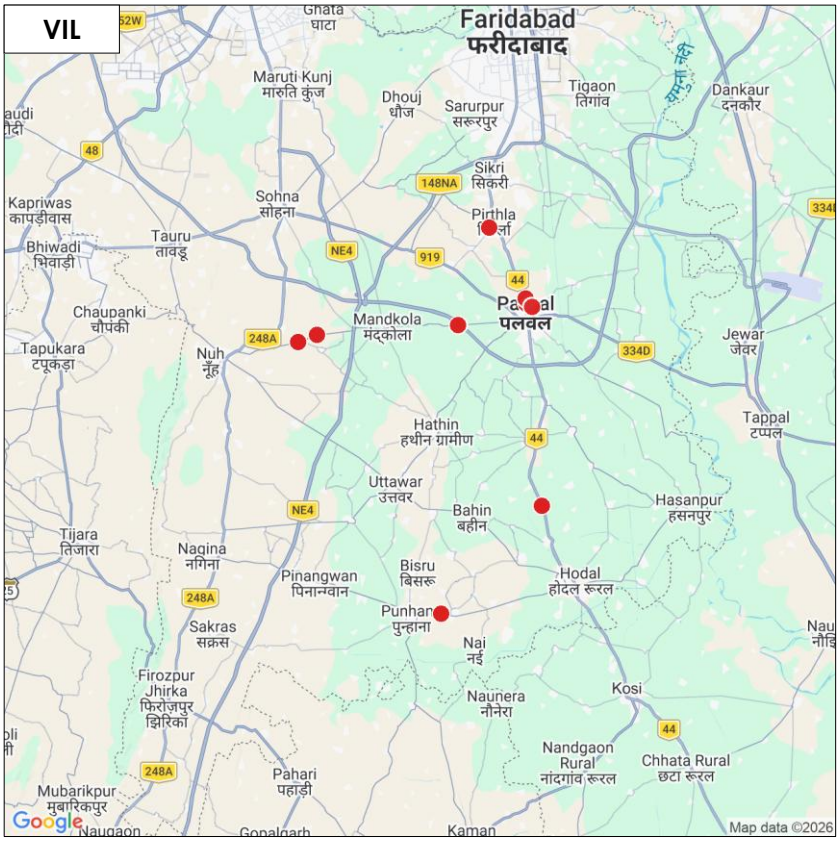



**Figure-60:** Number of silence instances for >3 Sec Mobile-to-Mobile (5G/4G-Open Mode) - VIL.

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

| Speech Quality (MOS) distribution | Service Provider | | | |
|---|---|---|---|---|
| | AIRTEL | BSNL | RJIL | VIL |
| **Total Number of MOS Samples for calls in table-24** | 1554 | 1420 | 1464 | 1562 |
| **Speech Quality (Average MOS)** | 3.94 | 3.80 | 4.41 | 4.42 |
| **Number of samples with MOS >=4 to <5 (Excellent)** | 1222 | 1013 | 1249 | 1341 |
| **Number of samples with MOS >=3 to <4 (Good)** | 254 | 146 | 127 | 165 |
| **Number of samples with MOS >=2 to <3 (Fair)** | 52 | 158 | 40 | 27 |
| **Number of samples with MOS >=1 to <2 (Poor)** | 26 | 103 | 48 | 29 |
| **%age of samples with MOS >=4 to <5 (Excellent)** | 78.64% | 71.34% | 85.31% | 85.85% |
| **%age of samples with MOS >=3 to <4 (Good)** | 16.34% | 10.28% | 8.67% | 10.56% |
| **%age of samples with MOS >=2 to <3 (Fair)** | 3.35% | 11.13% | 2.73% | 1.73% |
| **%age of samples with MOS >=1 to <2 (Poor)** | 1.67% | 7.25% | 3.28% | 1.86% |

**Table-25:** Summary of speech quality (MOS) samples.

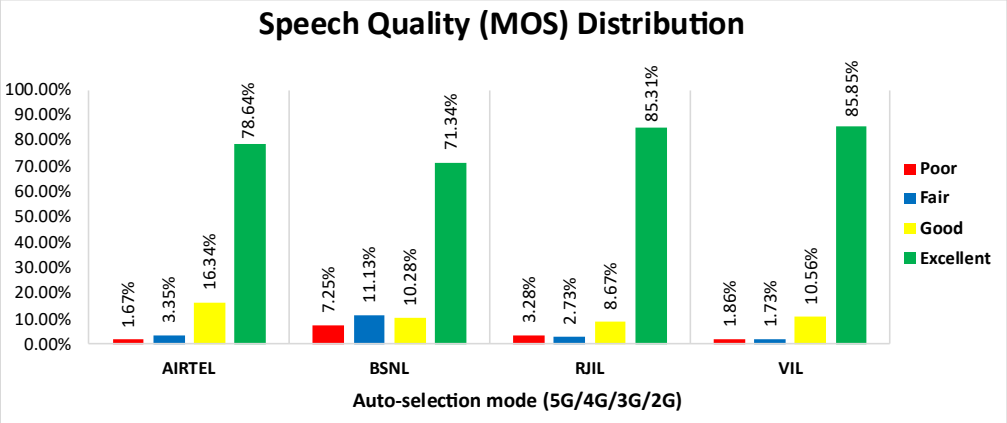



**Figure-61:** Distribution of samples in MOS range.

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

| Technology | Service Provider | | | |
|---|---|---|---|---|
| | AIRTEL | BSNL | RJIL | VIL |
| **5G** | 2.51% | NA | 83.39% | 2.50% |
| **4G** | 97.49% | 90.89% | 16.61% | 97.50% |
| **3G** | NA | 2.48% | NA | NA |
| **2G** | 0.00% | 6.54% | NA | 0.00% |
| **Limited Service** | 0.00% | 0.09% | 0.00% | 0.00% |

**Table-26:**Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) voice.

**Note**-

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

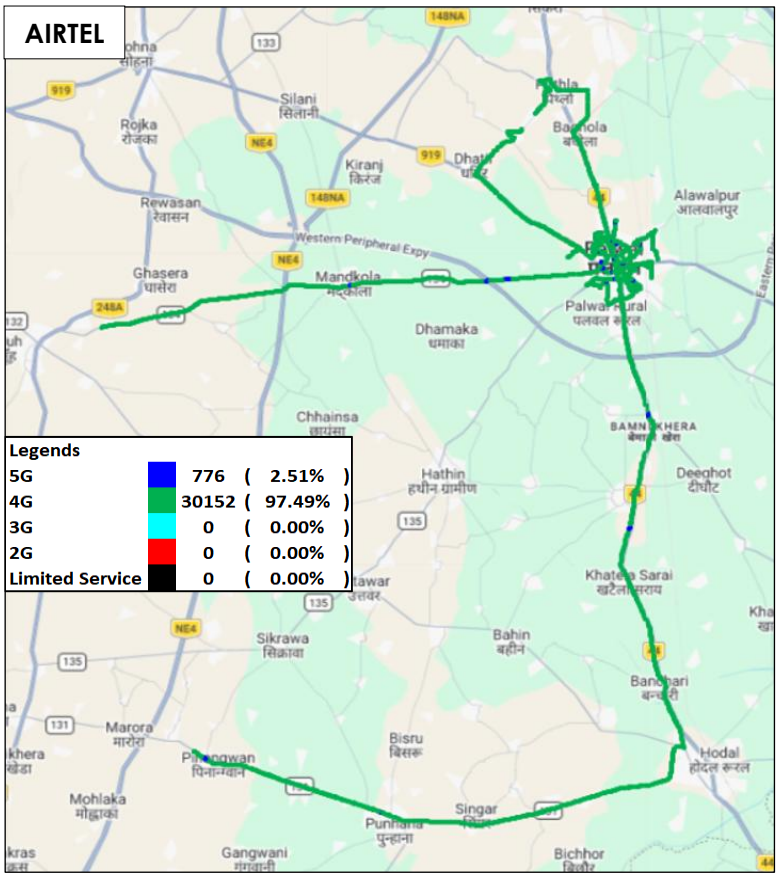



**Figure-62:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

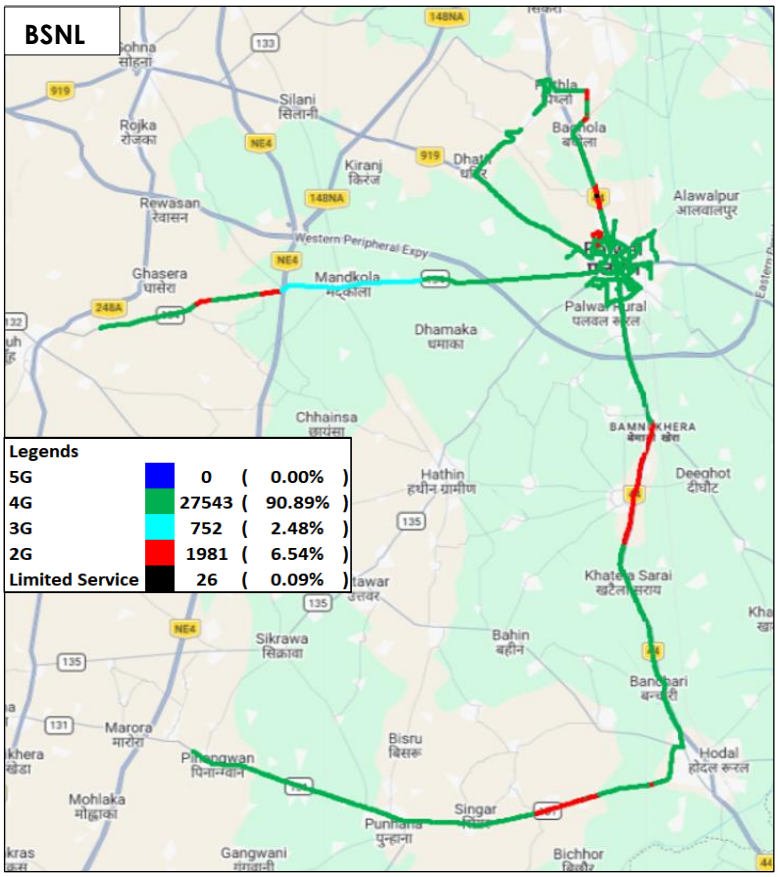



**Figure-63:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.

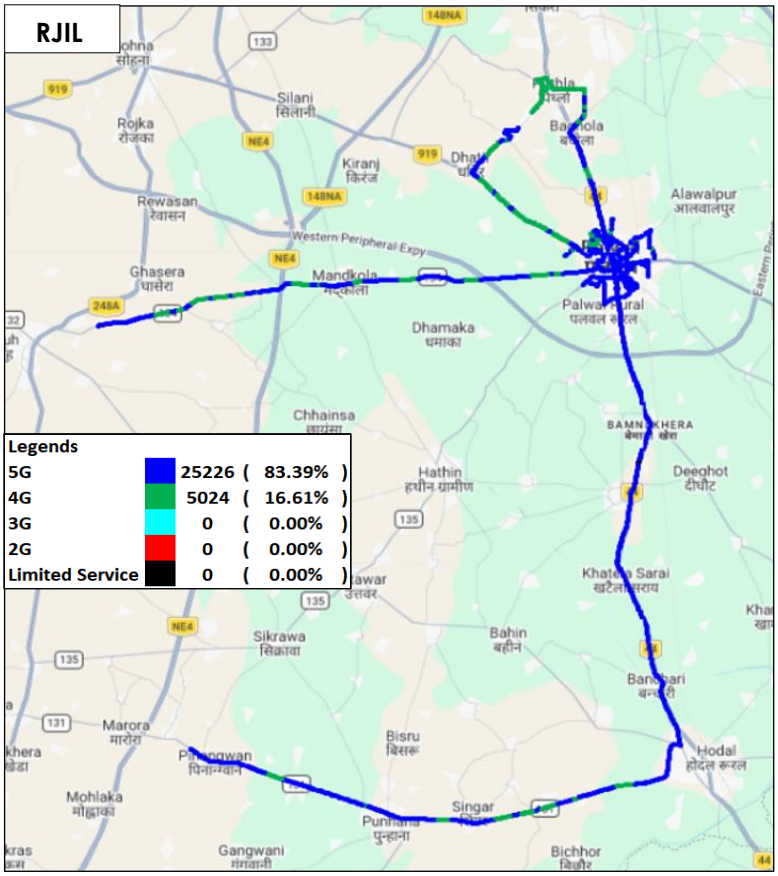



**Figure-64:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

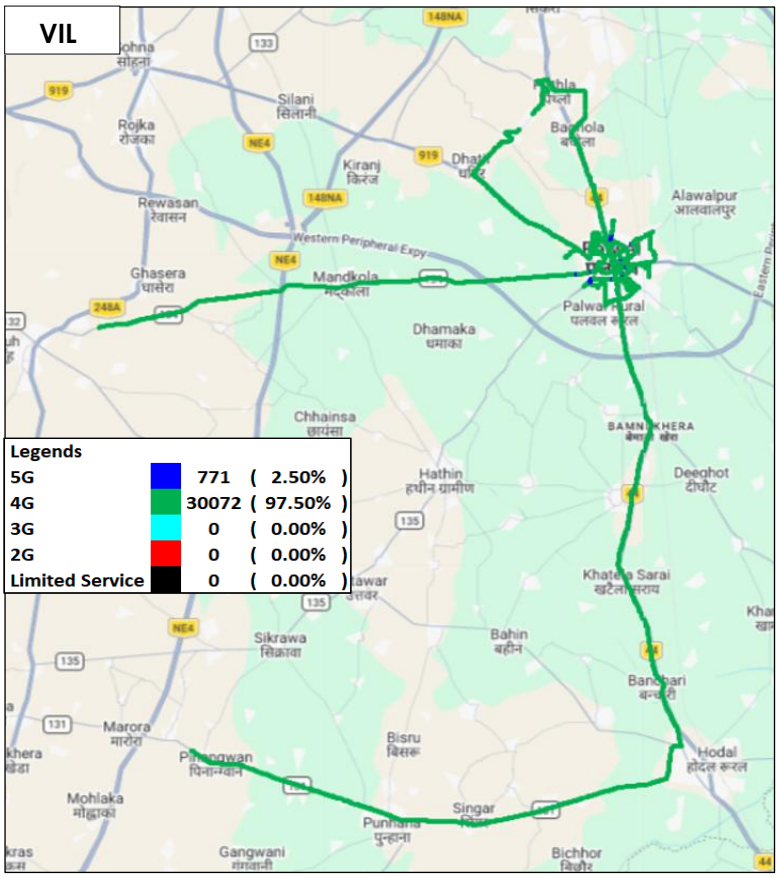



**Figure-65:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

**(g) Network Signal Strength Distribution:** The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-101, 102, 103 & 104 for map view)

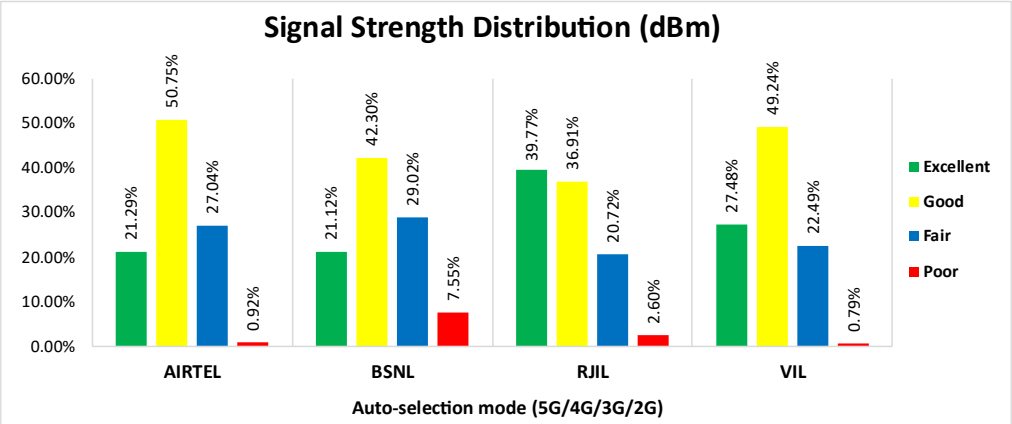



**Figure-66:** Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

## Observations:

- Airtel has 21% of samples falling in the excellent signal strength category.
- BSNL has 21% of samples falling in the excellent signal strength category.
- RJIL has 40% of samples falling in the excellent signal strength category.
- VIL has 27% of samples falling in the excellent signal strength category.

## (h) Coverage Gap observed

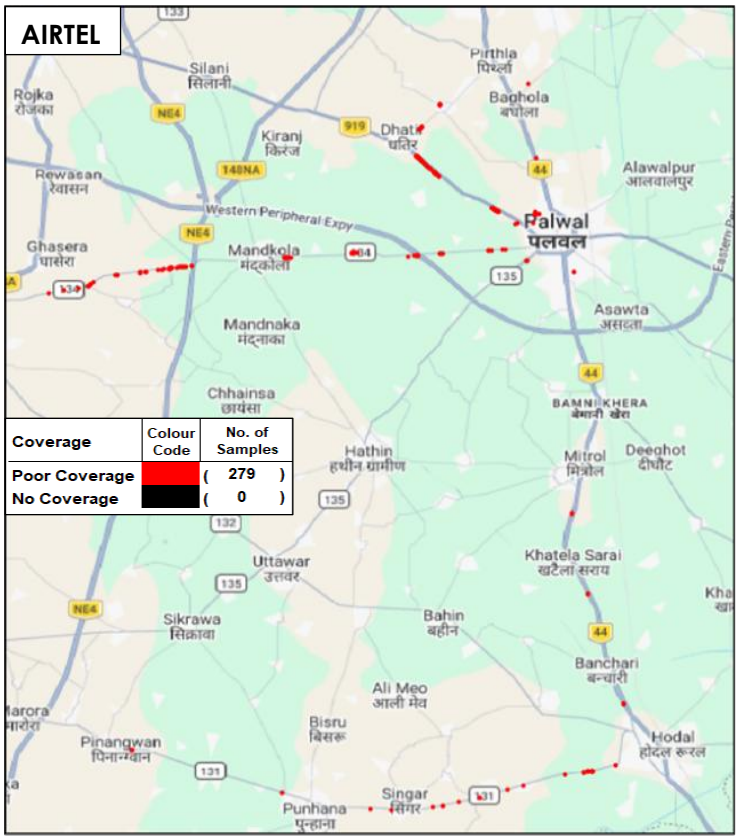



**Figure-67:** Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-AIRTEL.

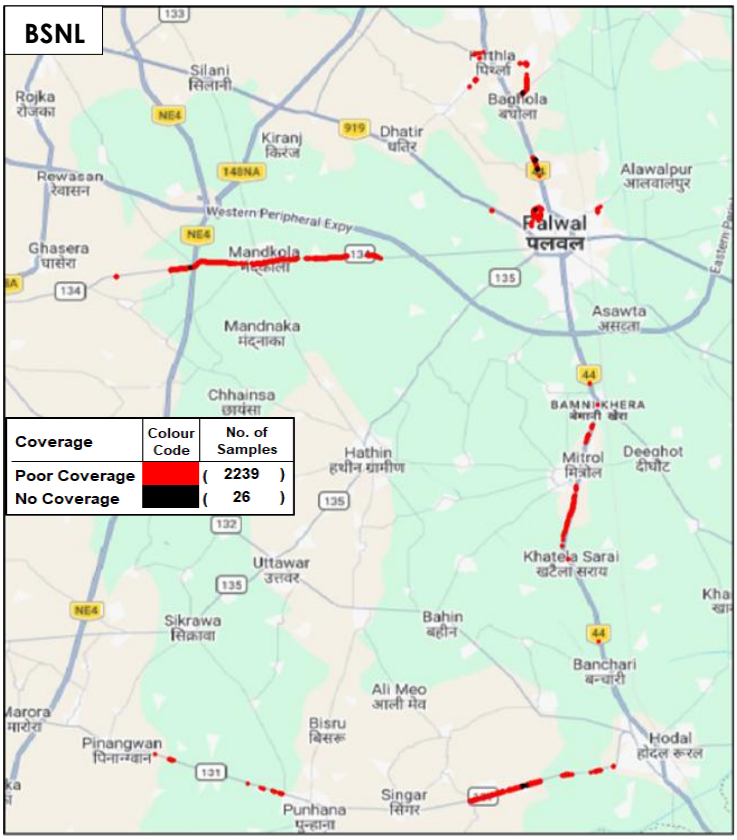



**Figure-68:** Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-BSNL.

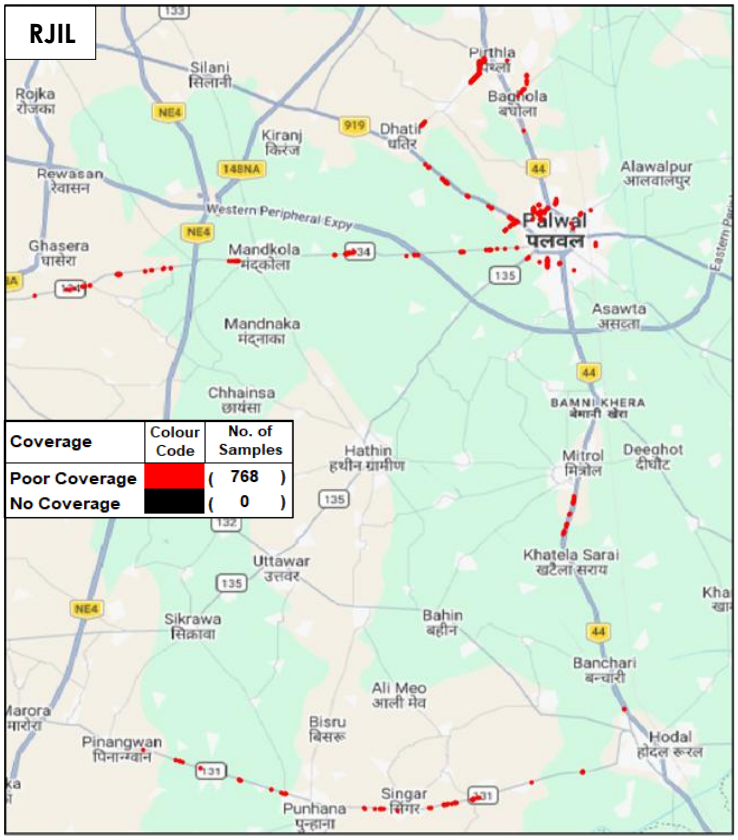



**Figure-69:** Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-RJIL.

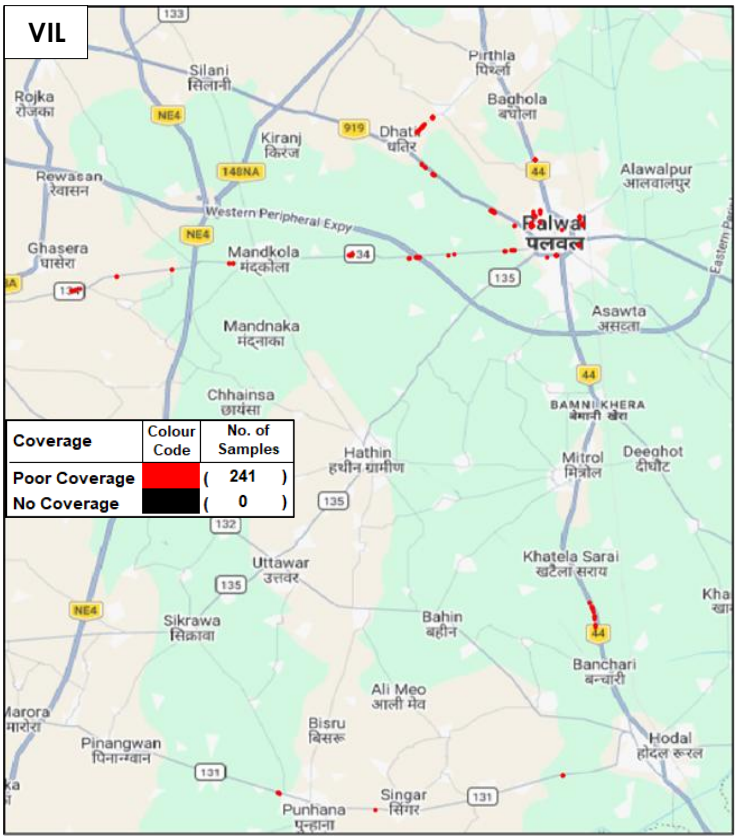



**Figure-70:** Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-VIL.

## 4.2.2.4 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 | 105.00 | 13.92 | 212.03 | 40.70 |
| | 80th Percentile | 189.51 | 21.65 | 376.18 | 62.08 |
| | 20th Percentile | 11.08 | 3.03 | 22.65 | 8.38 |
| Upload Throughput (Mbits/s) | Average | 20.96 | 7.20 | 14.52 | 13.03 |
| | 80th Percentile | 37.61 | 14.19 | 28.11 | 20.53 |
| | 20th Percentile | 4.74 | 1.39 | 2.04 | 5.01 |
| Latency (ms) | 50th Percentile | 51.70 | 26.33 | 26.47 | 29.88 |

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

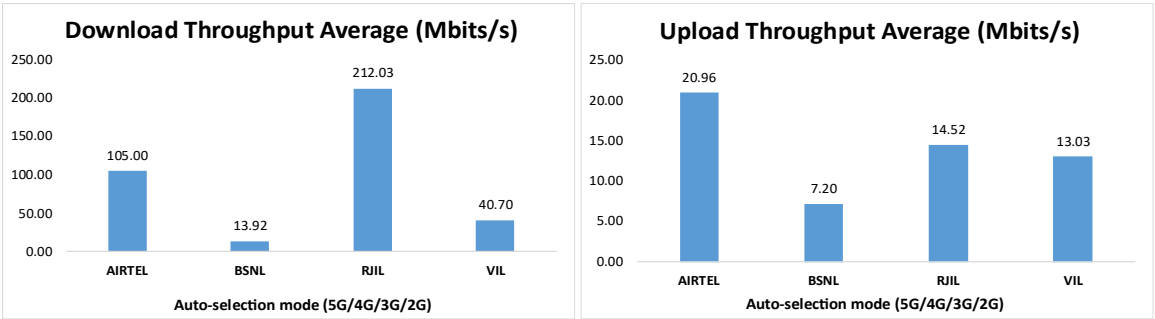



**Figure-71:** Download & Upload throughput.

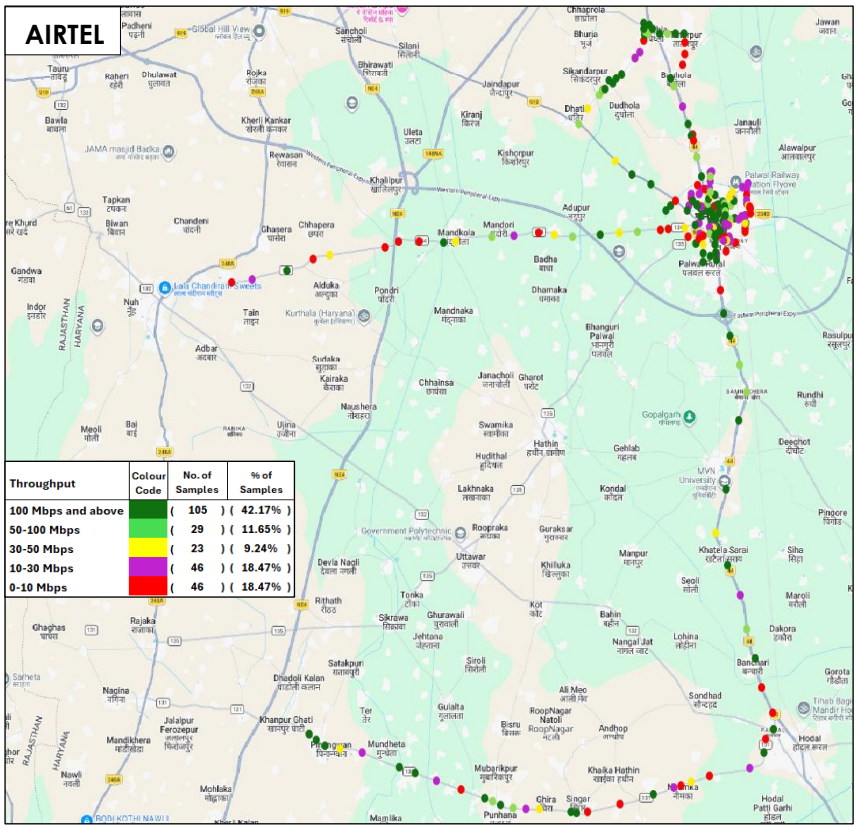



**Figure-72:** Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

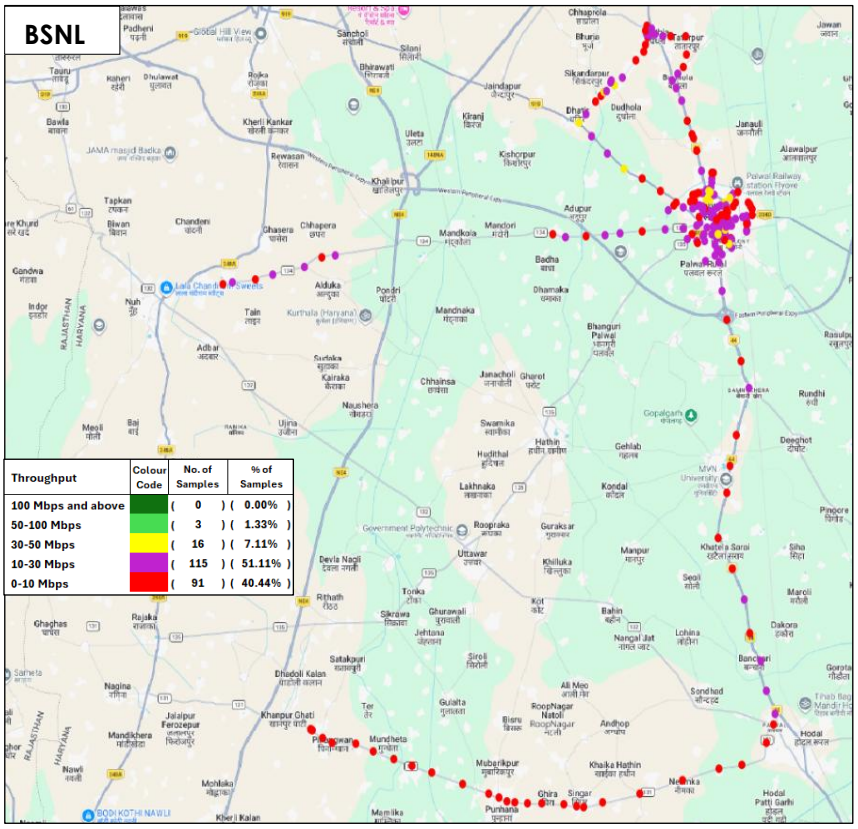



**Figure-73:** Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

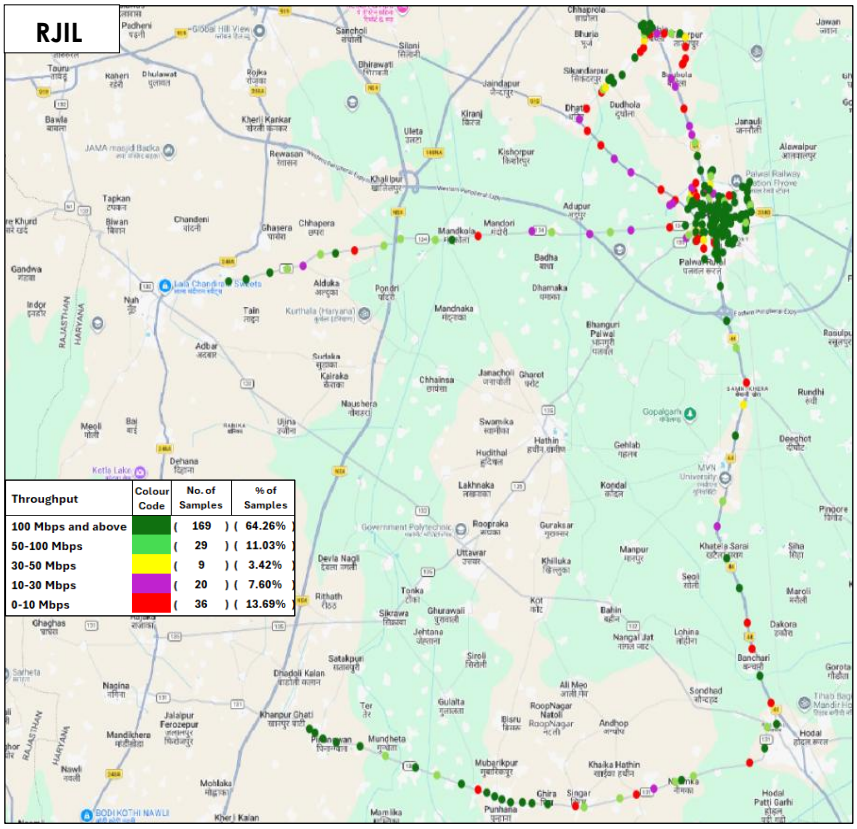



**Figure-74:** Download throughput distribution auto-selection mode (5G/4G/3G/2G) – RJIL.

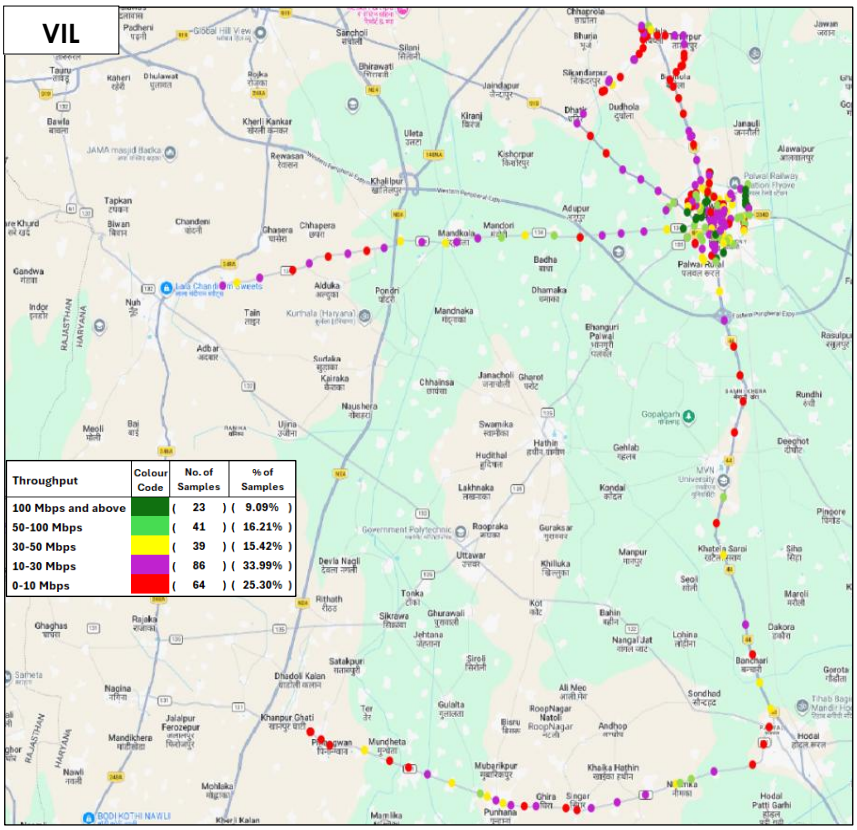



**Figure-75:** Download throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

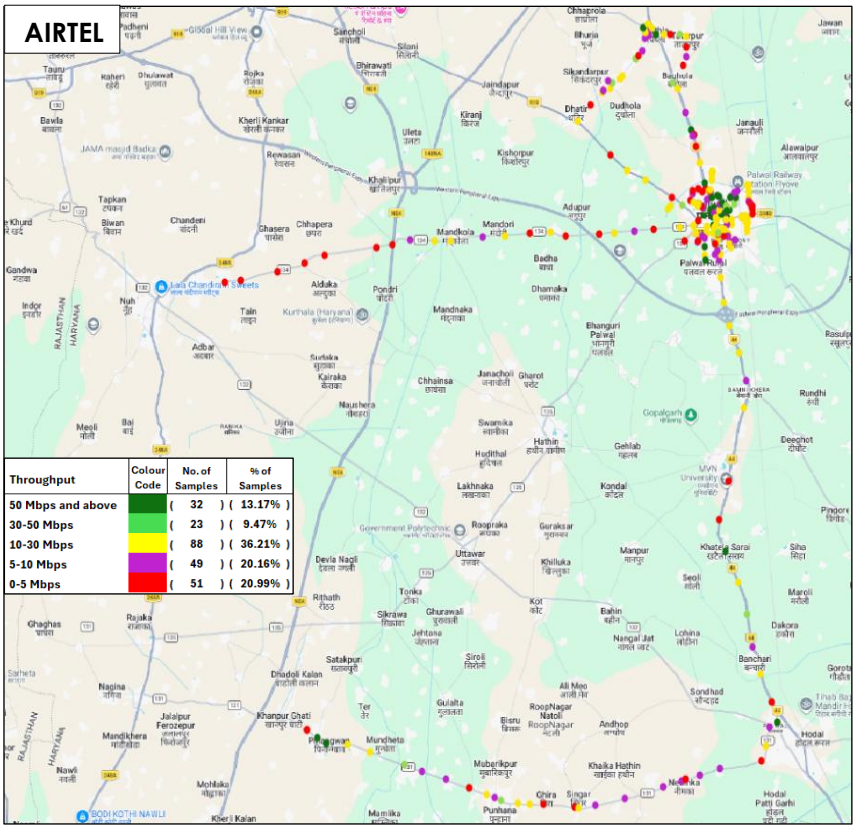



**Figure-76:** Upload throughput distribution auto-selection mode (5G/4G/3G/2G) – AIRTEL.

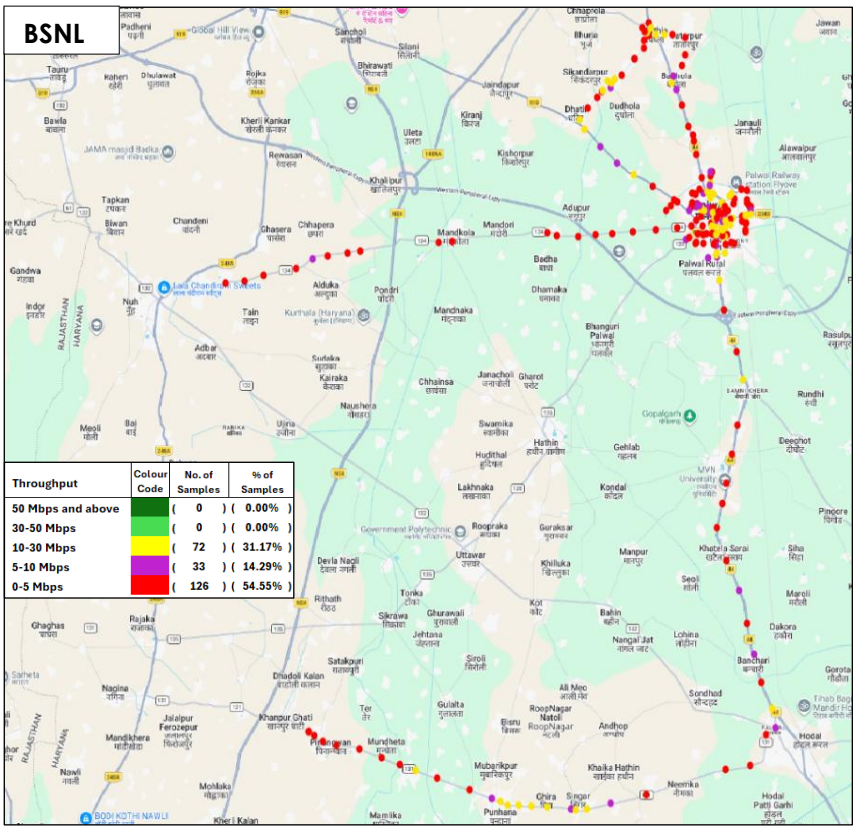



**Figure-77:** Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

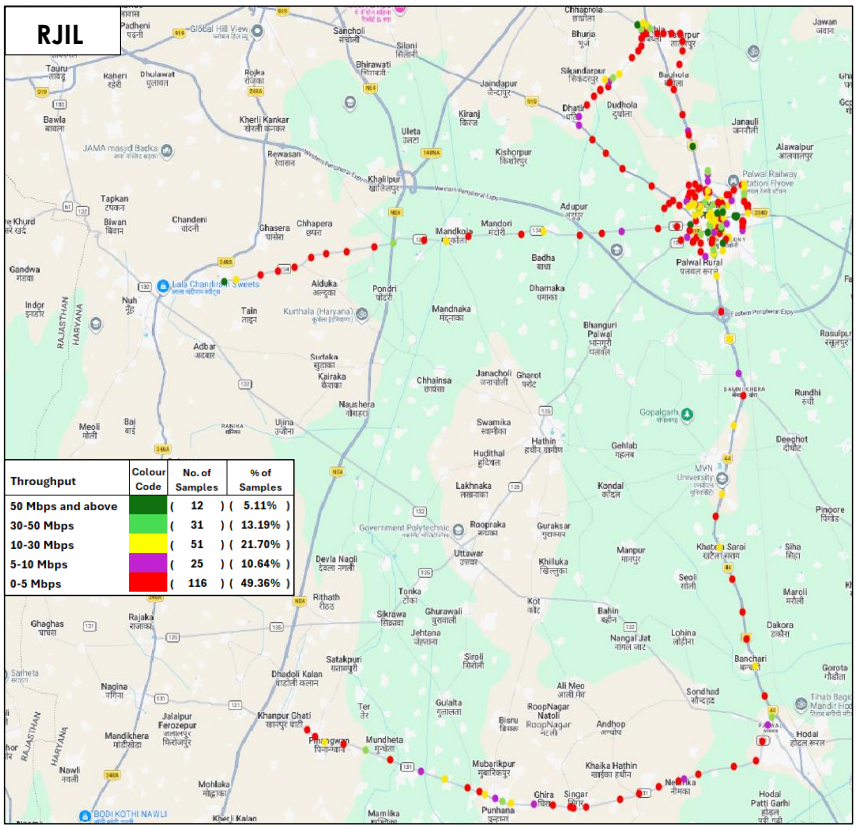



**Figure-78:** Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

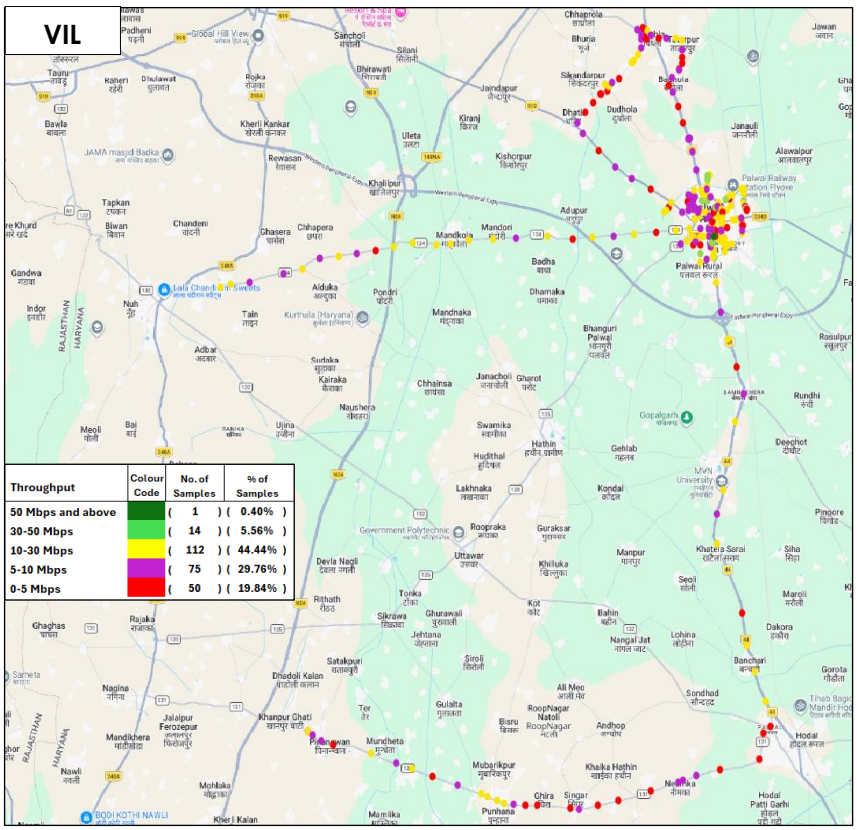



**Figure-79:** Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

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

| Technology | Service Provider | | | |
|---|---|---|---|---|
| | AIRTEL | BSNL | RJIL | VIL |
| **5G** | 48.82% | NA | 85.69% | 11.63% |
| **4G** | 51.18% | 91.84% | 14.31% | 88.05% |
| **3G** | NA | 6.85% | NA | NA |
| **2G** | 0.00% | 1.01% | NA | 0.24% |
| **Limited Service** | 0.00% | 0.30% | 0.00% | 0.08% |

**Table-28:** Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) data.

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

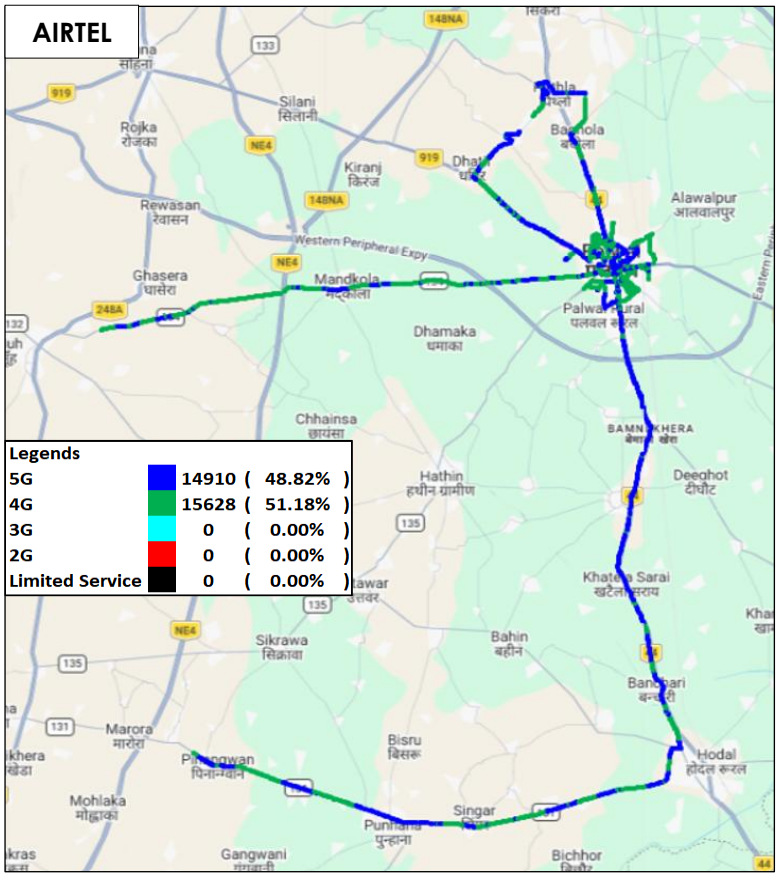



**Figure-80:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) data -AIRTEL.

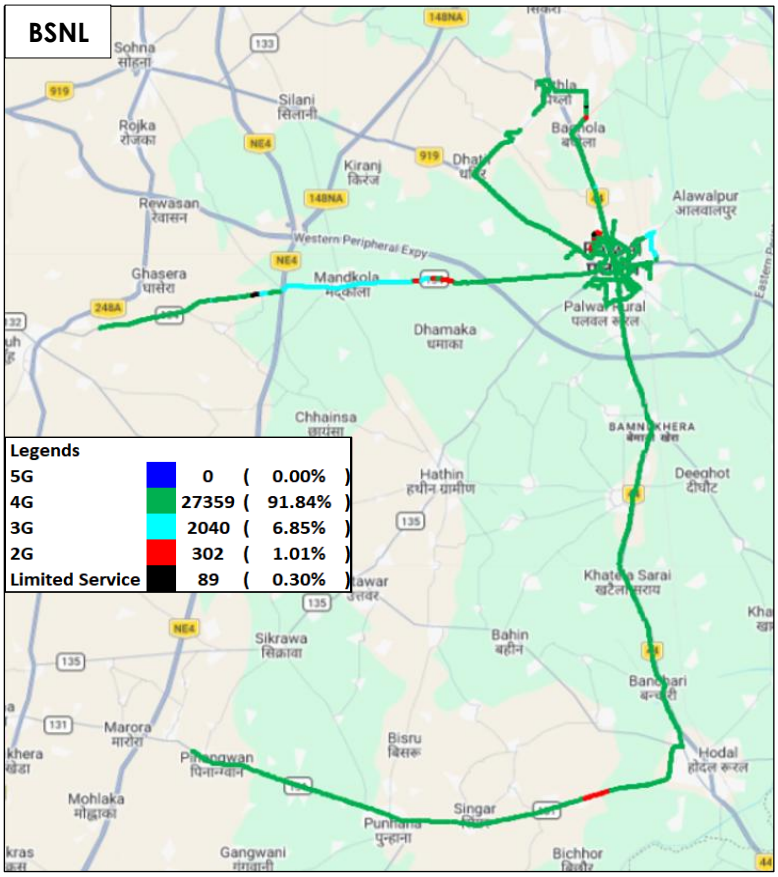



**Figure-81:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) data-BSNL.

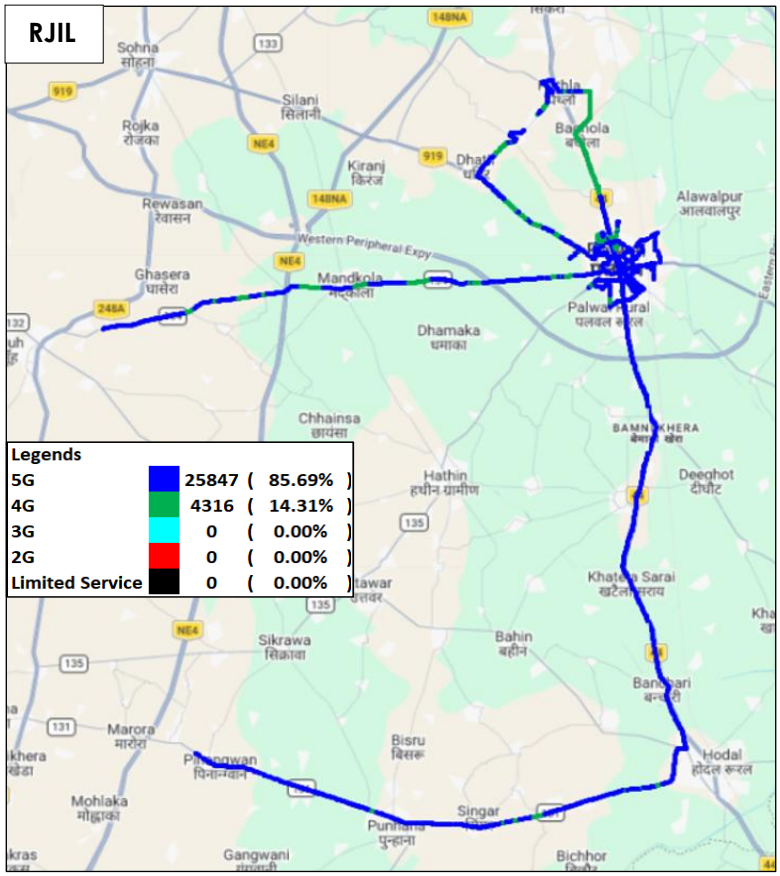



**Figure-82:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) data- RJIL.

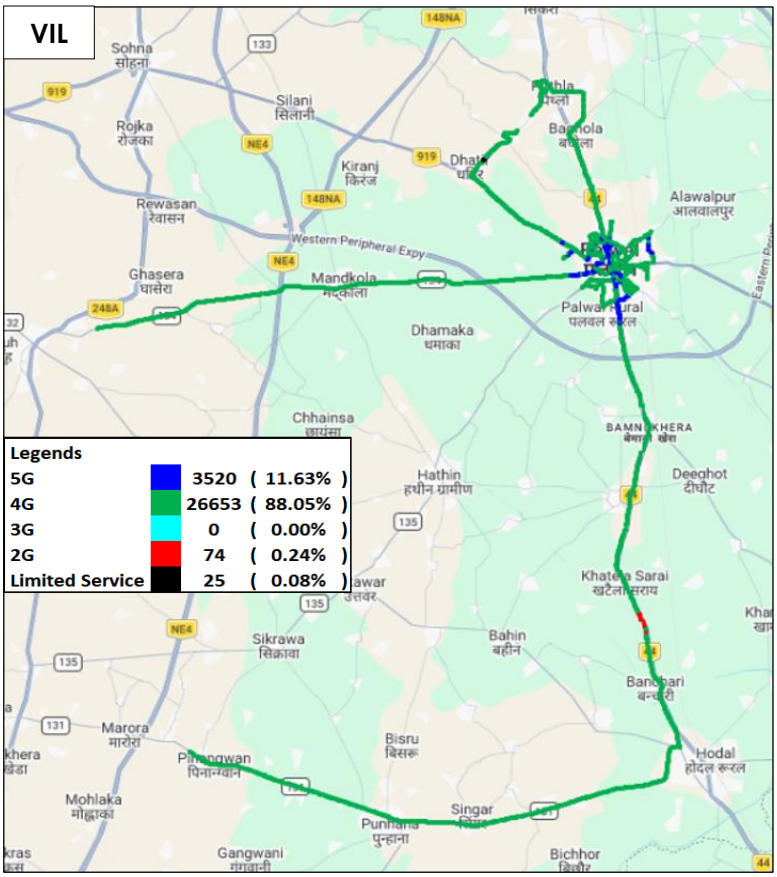



**Figure-83:** Serving technology plots in auto-selection mode (5G/4G/3G/2G) data– VIL.

**(c) Network Signal Strength Distribution:** The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-105, 106, 107 & 108 for map view)

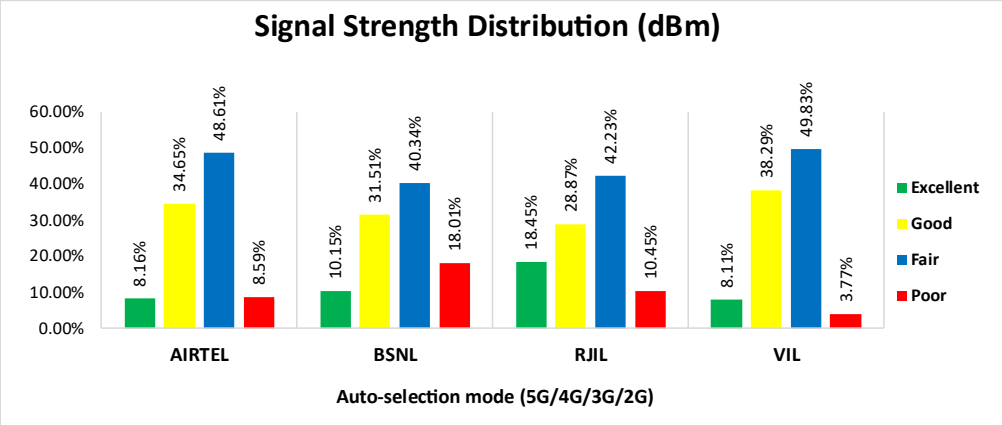



**Figure-84:** Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

## Observations:

- Airtel has 8% of samples falling in the excellent signal strength category.
- BSNL has 10% of samples falling in the excellent signal strength category.
- RJIL has 18% of samples falling in the excellent signal strength category.
- VIL has 8% of samples falling in the excellent signal strength category.

## 4.3 Hotspots

Hotspot testing has been conducted from 14th July 2026 and 15th July 2026. Six locations have been tested in Nuh and Palwal District. (Refer Table-1)

### 4.3.1 Locations




**Figure- 85:** Hotspot locations.

### 4.3.2 Hotspot covered

1. District and Session Court Palwal
2. District Collectorate Palwal
3. Govt. Bus Stand Palwal
4. Govt. Hospital Palwal
5. Nuh Court
6. Palwal Railway Station

### 4.3.3 Voice performance

| Overall Voice Performance | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-selection mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Call Attempt** | 60 | 60 | 60 | 60 |
| **Call Setup Success Rate %** | 100.00 | 95.00 | 100.00 | 100.00 |
| **Drop Call Rate %** | 0.00 | 0.00 | 0.00 | 0.00 |
| **Call Setup Time-Average (Second)** | 1.26 | 1.42 | 0.54 | 1.49 |

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

| District and Session Court Palwal | | | | |
|---|---|---|---|---|
| **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 | 90 | 100 | 100 |
| **Drop Call Rate %** | 0.00 | 0.00 | 0.00 | 0.00 |
| **Call Setup Time-Average (Second)** | 1.32 | 1.45 | 0.57 | 1.45 |

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

| District Collectorate Palwal | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-selection mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Call Attempt** | 10 | 10 | 10 | 10 |
| **Call Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Drop Call Rate %** | 0.00 | 0.00 | 0.00 | 0.00 |
| **Call Setup Time-Average (Second)** | 1.23 | 1.11 | 0.57 | 1.49 |

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

| Govt. Bus Stand Palwal | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-selection mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Call Attempt** | 10 | 10 | 10 | 10 |
| **Call Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Drop Call Rate %** | 0.00 | 0.00 | 0.00 | 0.00 |
| **Call Setup Time-Average (Second)** | 1.20 | 1.56 | 0.49 | 1.54 |

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

| Govt. Hospital Palwal | | | | |
|---|---|---|---|---|
| **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 | 90.00 | 100.00 | 100.00 |
| **Drop Call Rate %** | 0.00 | 0.00 | 0.00 | 0.00 |
| **Call Setup Time-Average (Second)** | 1.21 | 1.04 | 0.54 | 1.48 |

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

| Nuh Court | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-selection mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Call Attempt** | 10 | 10 | 10 | 10 |
| **Call Setup Success Rate %** | 100.00 | 90.00 | 100.00 | 100.00 |
| **Drop Call Rate %** | 0.00 | 0.00 | 0.00 | 0.00 |
| **Call Setup Time-Average (Second)** | 1.29 | 2.37 | 0.56 | 1.44 |

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

| Palwal 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 (Second)** | 1.30 | 1.04 | 0.52 | 1.57 |

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

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

| Overall Data Performance | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-selection mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Download Throughput Average (Mbits/s)** | 121.52 | 10.09 | 181.11 | 68.08 |
| **Download Throughput 80th Percentile (Mbit/s)** | 200.59 | 15.01 | 277.40 | 142.66 |
| **Download Throughput 20th Percentile (Mbit/s)** | 15.29 | 6.53 | 29.67 | 8.83 |
| **Download Session Setup Success Rate %** | 100.00 | 83.33 | 100.00 | 100.00 |
| **Upload Throughput Average (Mbits/s)** | 15.96 | 2.31 | 12.99 | 12.60 |
| **Upload Throughput 80th Percentile (Mbit/s)** | 31.69 | 2.77 | 14.98 | 18.39 |
| **Upload Throughput 20th Percentile (Mbit/s)** | 6.43 | 1.22 | 4.00 | 6.80 |
| **Upload Session Setup Success Rate %** | 100.00 | 86.67 | 100.00 | 100.00 |
| **Web Browsing Delay (Second)** | 4.10 | 4.71 | 3.86 | 3.93 |
| **Youtube Initial Buffer Delay (Second)** | 2.03 | 3.39 | 1.62 | 1.50 |
| **Latency (ms) - 50th Percentile** | 49.54 | 32.30 | 27.07 | 31.15 |
| **Jitter (ms)** | 25.01 | 134.86 | 14.39 | 9.25 |
| **Packet Loss Rate%** | 8.23 | 13.62 | 0.68 | 1.03 |
| **Packet Loss Rate- 90th percentile** | 13.58 | 27.32 | 1.38 | 3.00 |

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

| District and Session Court Palwal | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-Selection Mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Download Throughput Average (Mbits/s)** | 180.31 | 6.58 | 34.29 | 8.23 |
| **Download Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Upload Throughput Average (Mbits/s)** | 11.89 | 1.74 | 2.54 | 8.40 |
| **Upload Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Web Browsing Delay (Second)** | 3.14 | 5.25 | 4.57 | 2.01 |
| **Youtube Initial Buffer Delay (Second)** | 0.65 | 5.72 | 2.12 | 1.49 |
| **Latency (ms) - 50th Percentile** | 43.63 | 38.26 | 40.54 | 26.17 |
| **Jitter (ms)** | 2.71 | 156.14 | 39.49 | 6.93 |
| **Packet Loss Rate%** | 0.00 | 17.20 | 2.10 | 0.30 |

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

| District Collectorate Palwal | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-Selection Mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Download Throughput Average (Mbits/s)** | 207.09 | 14.78 | 171.86 | 108.66 |
| **Download Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Upload Throughput Average (Mbits/s)** | 8.40 | 2.04 | 5.55 | 9.31 |
| **Upload Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Web Browsing Delay (Second)** | 4.69 | 3.96 | 3.53 | 5.40 |
| **Youtube Initial Buffer Delay (Second)** | 3.42 | 3.36 | 2.33 | 1.63 |
| **Latency (ms) - 50th Percentile** | 61.93 | 29.56 | 24.15 | 27.81 |
| **Jitter (ms)** | 73.15 | 3.22 | 14.43 | 15.20 |
| **Packet Loss Rate%** | 9.00 | 0.30 | 1.20 | 0.60 |

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

| Govt. Bus Stand Palwal | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-Selection Mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Download Throughput Average (Mbits/s)** | 189.69 | 9.10 | 251.51 | 207.73 |
| **Download Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Upload Throughput Average (Mbits/s)** | 36.66 | 1.49 | 14.22 | 21.65 |
| **Upload Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Web Browsing Delay (Second)** | 2.77 | 3.22 | 3.29 | 5.95 |
| **Youtube Initial Buffer Delay (Second)** | 0.55 | 4.36 | 0.75 | 0.72 |
| **Latency (ms) – 50$^{th}$ Percentile** | 61.78 | 31.15 | 24.74 | 31.53 |
| **Jitter (ms)** | 13.99 | 55.69 | 10.21 | 2.05 |
| **Packet Loss Rate%** | 0.50 | 1.30 | 0.10 | 0.10 |

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

| Govt. Hospital Palwal | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-Selection Mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Download Throughput Average (Mbits/s)** | 71.67 | 5.93 | 474.58 | 41.45 |
| **Download Session Setup Success Rate %** | 100.00 | 80.00 | 100.00 | 100.00 |
| **Upload Throughput Average (Mbits/s)** | 8.02 | 1.25 | 47.24 | 8.53 |
| **Upload Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Web Browsing Delay (Second)** | 5.06 | 5.41 | 3.42 | 3.17 |
| **Youtube Initial Buffer Delay (Second)** | 1.60 | 6.32 | 0.81 | 0.86 |
| **Latency (ms) - 50th Percentile** | 51.01 | 31.94 | 40.66 | 33.01 |
| **Jitter (ms)** | 41.79 | 16.26 | 8.37 | 11.54 |
| **Packet Loss Rate%** | 8.70 | 2.80 | 0.10 | 4.00 |

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

| Nuh Court | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-Selection Mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Download Throughput Average (Mbits/s)** | 22.71 | 0.72 | 25.98 | 14.38 |
| **Download Session Setup Success Rate%** | 100.00 | 20.00 | 100.00 | 100.00 |
| **Upload Throughput Average (Mbits/s)** | 6.19 | 1.22 | 7.51 | 9.15 |
| **Upload Session Setup Success Rate %** | 100.00 | 20.00 | 100.00 | 100.00 |
| **Web Browsing Delay (Second)** | 3.95 | 8.22 | 4.17 | 1.98 |
| **Youtube Initial Buffer Delay (Second)** | 1.97 | - | 3.02 | 1.19 |
| **Latency (ms)- 50th Percentile** | 49.65 | 35.92 | 26.09 | 34.17 |
| **Jitter (ms)** | 12.05 | 654.96 | 7.35 | 9.76 |
| **Packet Loss Rate%** | 30.90 | 59.70 | 0.20 | 0.50 |

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

**Note**- "- " Youtube test were failed.

| Palwal Railway Station | | | | |
|---|---|---|---|---|
| Parameters | Service Provider | | | |
| | Auto-Selection Mode (5G/4G/3G/2G) | | | |
| | AIRTEL | BSNL | RJIL | VIL |
| Download Throughput Average (Mbits/s) | 57.64 | 15.12 | 128.42 | 28.03 |
| Download Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Upload Throughput Average (Mbits/s) | 24.62 | 5.24 | 7.71 | 18.57 |
| Upload Session Setup Success Rate % | 100.00 | 100.00 | 100.00 | 100.00 |
| Web Browsing Delay (Second) | 5.24 | 5.49 | 4.59 | 3.62 |
| Youtube Initial Buffer Delay (Second) | 3.93 | 1.14 | 0.87 | 3.07 |
| Latency (ms) - 50th Percentile | 44.25 | 31.84 | 26.86 | 32.94 |
| Jitter (ms) | 6.84 | 3.84 | 6.46 | 10.05 |
| Packet Loss Rate% | 0.30 | 0.40 | 0.40 | 0.70 |

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

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

| Overall Data Performance | | | | | |
|---|---|---|---|---|---|
| Parameters | | Service Provider | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| 5G | Download Throughput Average (Mbits/s) | 142.46 | - | 122.56 | 106.87 |
| | Upload Throughput Average (Mbits/s) | 27.85 | - | 9.26 | 13.64 |
| 4G | Download Throughput Average (Mbits/s) | 7.19 | 10.86 | 41.36 | 18.11 |
| | Upload Throughput Average (Mbits/s) | 6.74 | 2.54 | 9.52 | 10.24 |

**Table-43:** Overall Summary of 5G only & 4G only data download & upload speed.

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

| District and Session Court Palwal | | | | | |
|---|---|---|---|---|---|
| Parameters | | Service Provider | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| 5G | Download Throughput Average (Mbits/s) | 194.43 | - | 71.38 | - |
| | Upload Throughput Average (Mbits/s) | 19.72 | - | 2.62 | - |
| 4G | Download Throughput Average (Mbits/s) | 8.58 | 10.49 | 15.00 | 6.02 |
| | Upload Throughput Average (Mbits/s) | 4.18 | 1.78 | 2.33 | 8.37 |

**Table-44:** Overall Summary of 5G only & 4G only data download & upload speed.

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

| District Collectorate Palwal | | | | | |
|---|---|---|---|---|---|
| Parameters | | Service Provider | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| 5G | Download Throughput Average (Mbits/s) | 197.46 | - | 260.10 | 122.62 |
| | Upload Throughput Average (Mbits/s) | 14.34 | - | 11.39 | 13.19 |
| 4G | Download Throughput Average (Mbits/s) | 2.59 | 13.26 | 9.67 | 11.60 |
| | Upload Throughput Average (Mbits/s) | 5.90 | 4.09 | 2.44 | 5.80 |

**Table-45:** Overall Summary of 5G only & 4G only data download & upload speed.

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

| Govt. Bus Stand Palwal | | | | | |
|---|---|---|---|---|---|
| Parameters | | Service Provider | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| 5G | Download Throughput Average (Mbits/s) | 180.73 | - | 242.71 | 149.65 |
| | Upload Throughput Average (Mbits/s) | 65.44 | - | 22.86 | 13.01 |
| 4G | Download Throughput Average (Mbits/s) | 6.93 | 11.39 | 55.41 | 44.59 |
| | Upload Throughput Average (Mbits/s) | 8.15 | 3.03 | 17.33 | 15.57 |

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

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

| Govt. Hospital Palwal | | | | | |
|---|---|---|---|---|---|
| Parameters | | Service Provider | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| 5G | Download Throughput Average (Mbits/s) | 61.84 | - | 37.32 | 24.13 |
| | Upload Throughput Average (Mbits/s) | 10.11 | - | 9.29 | 10.00 |
| 4G | Download Throughput Average (Mbits/s) | 1.67 | 10.68 | 100.74 | 7.26 |
| | Upload Throughput Average (Mbits/s) | 2.10 | 2.25 | 13.88 | 5.98 |

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

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

| Nuh Court | | | | | |
|---|---|---|---|---|---|
| Parameters | | Service Provider | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| 5G | Download Throughput Average (Mbits/s) | 50.27 | - | 4.89 | - |
| | Upload Throughput Average (Mbits/s) | 4.70 | - | 7.88 | - |
| 4G | Download Throughput Average (Mbits/s) | 19.95 | 0.79 | 12.99 | 20.56 |
| | Upload Throughput Average (Mbits/s) | 14.59 | 1.12 | 11.20 | 15.68 |

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

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

| Palwal Railway Station | | | | | |
|---|---|---|---|---|---|
| Parameters | | Service Provider | | | |
| | | AIRTEL | BSNL | RJIL | VIL |
| 5G | Download Throughput Average (Mbits/s) | 122.25 | - | 118.95 | 68.33 |
| | Upload Throughput Average (Mbits/s) | 50.41 | - | 6.93 | 15.62 |
| 4G | Download Throughput Average (Mbits/s) | 3.44 | 16.53 | 54.35 | 18.64 |
| | Upload Throughput Average (Mbits/s) | 5.55 | 2.72 | 15.12 | 10.04 |

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

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

## 4.4 Walk Test

Walk test has been conducted on 15th July 2026. One location has been tested in the Palwal District. (Refer Table-1)

### 4.4.1 Walk test locations




**Figure-86:** Walk Test locations.

### 4.4.2 Walk Test Covered

1. Palwal Railway Station

### 4.4.3 Voice Performance

| Palwal Railway Station | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-selection mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Call Attempt** | 13 | 15 | 15 | 15 |
| **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)** | 1.19 | 1.37 | 0.62 | 1.60 |

**Table-50:** Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

### 4.4.4 Data Performance

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

| Palwal Railway Station | | | | |
|---|---|---|---|---|
| **Parameters** | **Service Provider** | | | |
| | **Auto-selection mode (5G/4G/3G/2G)** | | | |
| | **AIRTEL** | **BSNL** | **RJIL** | **VIL** |
| **Download Throughput Average (Mbits/s)** | 76.67 | 20.44 | 93.33 | 34.08 |
| **Download Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Upload Throughput Average (Mbits/s)** | 52.99 | 6.99 | 6.86 | 11.79 |
| **Upload Session Setup Success Rate %** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Latency (ms) - 50th Percentile** | 51.15 | 26.62 | 29.29 | 39.52 |

**Table-51:** Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

# 5. Voice & Data Key findings

## 5.1 Overall Voice

1. **Call Setup Success Rate:**
   a) Airtel, BSNL and VIL have 99.42%, 98.04% and 99.41% call setup success rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL have 100.00%, 97.36%, 92.29% and 99.80% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

   c) All operators had a 100.00% call setup success while calling on peer service provider's network for inter-operator calls. (refer table-9)

2. **Call Setup Time**:
   a) Airtel, BSNL and VIL call setup time is 3.37, 3.29 and 5.08 seconds respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL & VIL call setup time is 1.25, 1.64, 0.66 & 1.60 seconds respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G) BSNL, VIL, RJIL and Airtel have 4.11%, 3.96%, 1.82% and 1.77% silence call rate respectively. Further BSNL has higher RTP packet loss rate in downlink (3.41%) compared to VIL (1.94%), RJIL (1.79%) and Airtel (1.15%). In uplink the RTP packet loss rate is higher for RJIL (2.15%) compared to BSNL (1.88%), VIL (1.64%) and Airtel (1.34%). (refer table-6)

4. **Drop Call Rate**:
   a) Airtel, BSNL and VIL drop call rate is 0.58%, 2.28% and 1.18% respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL drop call rate is 0.21%, 1.67%, 0.43% and 0.00% respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

## 5.2 Overall Data

1. **Data download and upload performance (Overall i.e. LSA):**
   a) Airtel, BSNL, RJIL and VIL average download speeds are 96.28 Mbps, 11.97 Mbps, 182.30 Mbps and 36.54 Mbps respectively. (refer table-11)

   b) Airtel, BSNL, RJIL and VIL average upload speeds are 19.65 Mbps, 6.58 Mbps, 12.71 Mbps and 12.33 Mbps respectively. (refer table-11)

2. **Data download and upload performance (static i.e. while stationary):**
   a) Airtel, BSNL, RJIL and VIL average download speeds are 121.52 Mbps, 10.09 Mbps, 181.11 Mbps and 68.08 Mbps respectively. (refer table-36)

   b) Airtel, BSNL, RJIL and VIL average upload speeds are 15.96 Mbps, 2.31 Mbps, 12.99 Mbps and 12.60 Mbps respectively. (refer table-36)

3. **Data session setup success rate (static i.e. while stationary):**
   a) Airtel, BSNL, RJIL and VIL have 100.00%, 83.33%, 100.00% and 100.00% download session setup success rate respectively. (refer table-36)

   b) Airtel, BSNL, RJIL and VIL have 100.00%, 86.67%, 100.00% and 100.00% upload session setup success rate respectively. (refer table-36)

## 5.3 Operator wise Key Findings

### 1. Airtel:

**Voice**

- 99.42% call setup success rate and 0.58% drop call rate have been observed in 3G/2G network mode for LSA. (refer table-3)
- 100.00% call setup success rate and 0.21% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)
- 98.36% call setup success rate and 1.67% drop call rate have been observed in 3G/2G network mode for Nuh District. (refer table-13)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in 3G/2G network mode for Palwal District. (refer table-21)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Nuh District. (refer table-15)
- 100.00% call setup success rate and 0.37% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Palwal District. (refer table-23)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-29)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at walk test locations. (refer table- 50)

**Data**

- Airtel has 96.28 Mbps average download speed & 19.65 Mbps average upload speed for LSA. (refer table-11)
- Airtel has 75.70 Mbps average download speed & 14.26 Mbps average upload speed across measured routes for Nuh District. (refer table-19)
- Airtel has 105.00 Mbps average download speed & 20.96 Mbps average upload speed across measured routes for Palwal District. (refer table-27)
- Govt. Hospital Palwal, Nuh Court and Palwal Railway Station have less download speed (less than 100 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-40,41 & 42)
- District and Session Court Palwal, District Collectorate Palwal, Govt. Hospital Palwal and Nuh Court have less upload speed (less than 20 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-41, 37, 38, 40 & 41)
- Palwal Railway Station walk test location has less download speed (less than 100 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-51)

### 2. BSNL:

**Voice**

- 98.04% call setup success rate and 2.28% drop call rate have been observed in 3G/2G network mode for LSA. (refer table-3)
- 97.36% call setup success rate and 1.67% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)

- 95.28% call setup success rate and 4.13% drop call rate have been observed in 3G/2G network mode for Nuh District. (refer table-13)
- 99.57% call setup success rate and 1.30% drop call rate have been observed in 3G/2G network mode for Palwal District. (refer table-21)
- 95.24% call setup success rate and 3.57% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Nuh District. (refer table-15)
- 98.89% call setup success rate and 1.12% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Palwal District. (refer table-23)
- 95.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-29)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at walk test location. (refer table- 50)

**Data**

- BSNL has 11.97 Mbps average download speed & 6.58 Mbps average upload speed for LSA. (refer table-11)
- BSNL has 6.78 Mbps average download speed & 6.21 Mbps average upload speed across measured routes for Nuh District. (refer table-19)
- BSNL has 13.92 Mbps average download speed & 7.20 Mbps average upload speed across measured routes for Palwal District. (refer table-27)
- District and Session Court Palwal, Govt. Bus Stand Palwal, Govt. Hospital Palwal and Nuh Court have less download speed (less than 10 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-37, 39, 40 & 41)
- District and Session Court Palwal, Govt. Bus Stand Palwal, Govt. Hospital Palwal and Nuh Court have less upload speed (less than 2 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-37, 39, 40 & 41)

**3. RJIL:**

**Voice**

- 92.29% call setup success rate and 0.43% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)
- 98.60% call setup success rate and 0.71% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Nuh District. (refer table-15)
- 87.15% call setup success rate and 0.40% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Palwal District. (refer table-23)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-29)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at walk test location. (refer table- 50)

**Data**

- RJIL has 182.30 Mbps average download speed & 12.71 Mbps average upload speed for LSA. (refer table-11)

- RJIL has 130.28 Mbps average download speed & 9.71 Mbps average upload speed across measured routes for Nuh District. (refer table-19)

- RJIL has 212.03 Mbps average download speed & 14.52 Mbps average upload speed across measured routes for Palwal District. (refer table-27)

- District and Session Court Palwal and Nuh Court have less download speed (less than 100 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-37 & 41)

- District and Session Court Palwal, District Collectorate Palwal, Govt. Bus Stand Palwal, Nuh Court and Palwal Railway Station have less upload speed (less than 20 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-37, 38, 39, 41 & 42)

- Palwal Railway Station walk test location has less download speed (less than 100 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-51)

- Palwal Railway Station walk test location has less upload speed (less than 20 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-51)

**4. VIL:**

**Voice**

- 99.41% call setup success rate and 1.18% drop call rate have been observed in 3G/2G network mode for LSA. (refer table-3)

- 99.80% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-5)

- 99.15% call setup success rate and 2.56% drop call rate have been observed in 3G/2G network mode for Nuh District. (refer table-13)

- 99.55% call setup success rate and 0.45% drop call rate have been observed in 3G/2G network mode for Palwal District. (refer table-21)

- 100.00% call setup success rate and 0.00 drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Nuh District. (refer table-15)

- 99.63% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for Palwal District. (refer table-23)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-29)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) at walk test location. (refer table- 50)

**Data**

- VIL has 36.54 Mbps average download speed & 12.33 Mbps average upload speed for LSA. (refer table-11)

- VIL has 20.03 Mbps average download speed & 10.84 Mbps average upload speed across measured routes for Nuh District. (refer table-19)

- VIL has 40.70 Mbps average download speed & 13.03 Mbps average upload speed across measured routes for Palwal District. (refer table-27)

- District and Session Court Palwal, Govt. Hospital Palwal, Nuh Court and Palwal Railway Station have less download speed (less than 100 Mbps) out of total 6

hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-37, 40, 41 & 42)

- District and Session Court Palwal, District Collectorate Palwal, Govt. Hospital Palwal, Nuh Court and Palwal Railway Station have less upload speed (less than 20 Mbps) out of total 6 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-37, 38, 40, 41 & 42)

- Palwal Railway Station walk test location has less download speed (less than 100 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-51)

- Palwal Railway Station walk test location has less upload speed (less than 20 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-51)

# 6. Annexure

## 6.1 Route wise coverage map

### 6.1.1 Nuh District

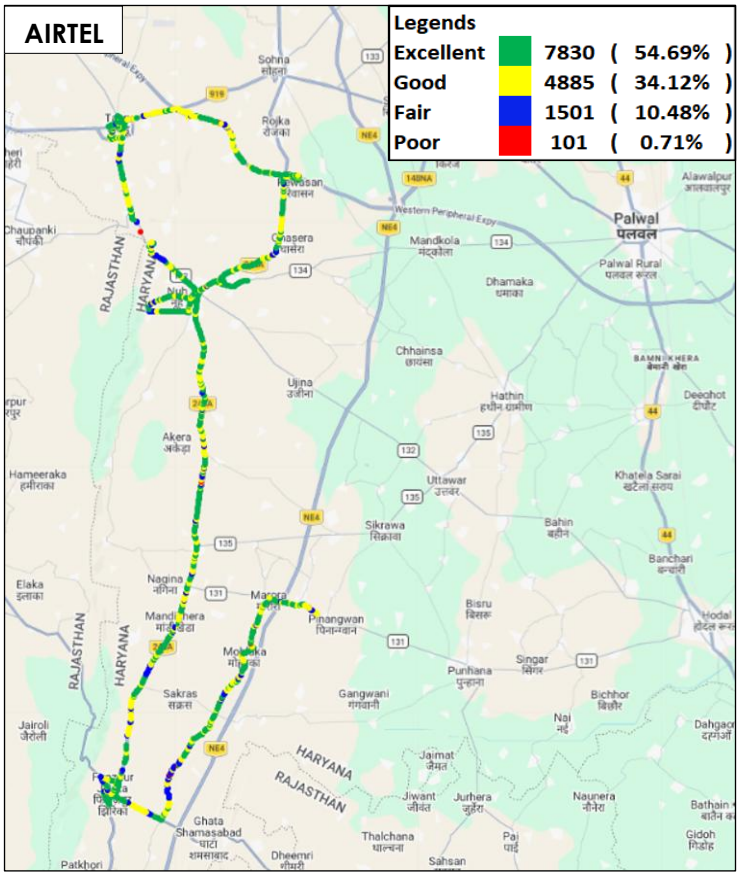



**Figure-87:** Signal strength 3G/2G network mode voice - AIRTEL.

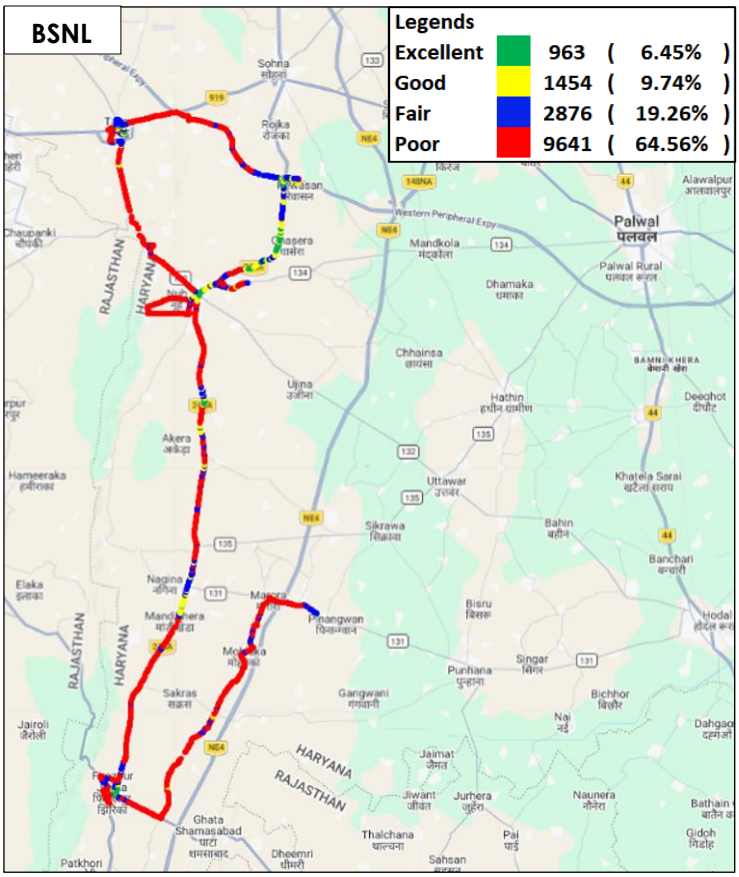



**Figure-88:** Signal strength 3G/2G network mode voice - BSNL.

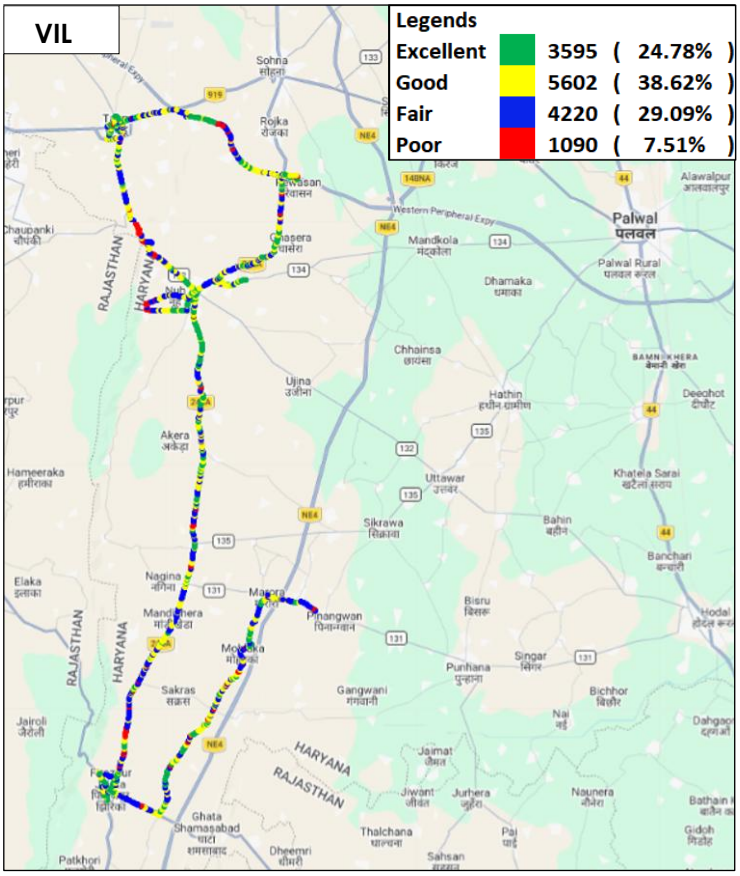



**Figure-89:** Signal strength 3G/2G network mode voice - VIL.

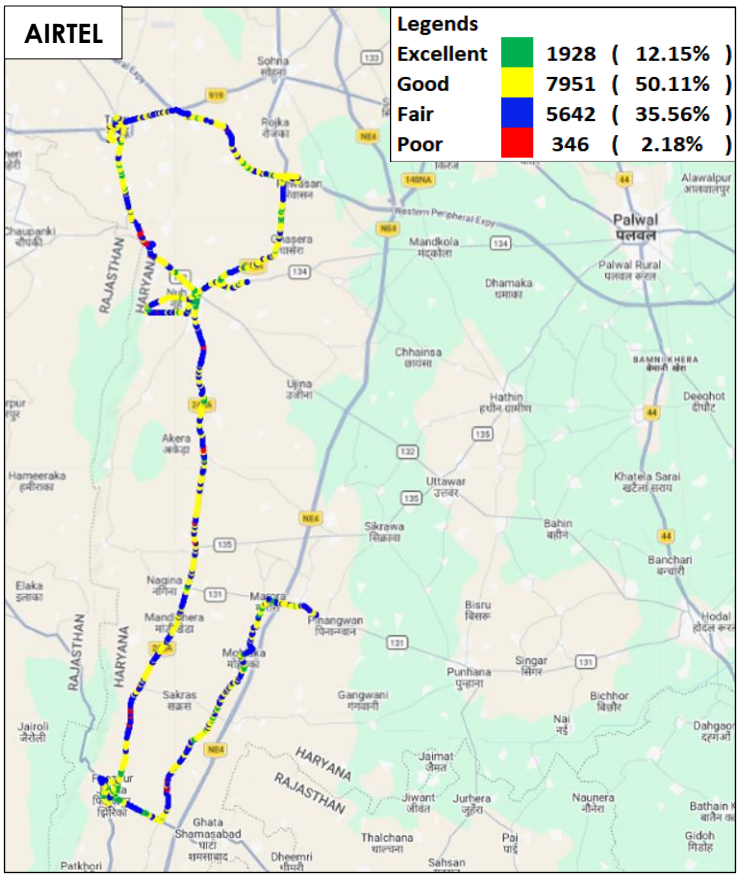



**Figure-90:** Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

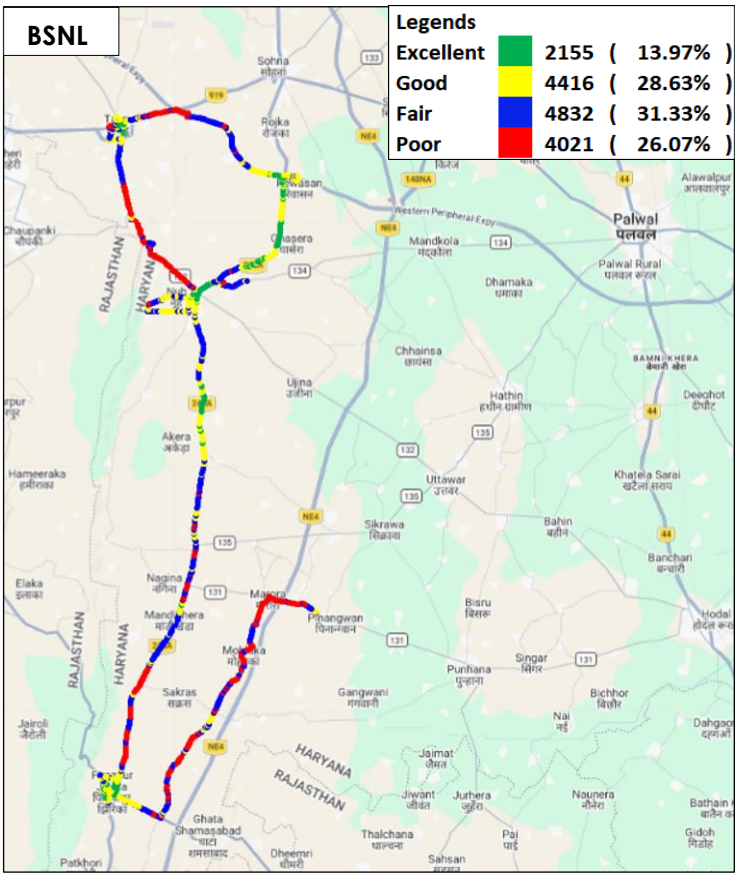



**Figure-91:** Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.

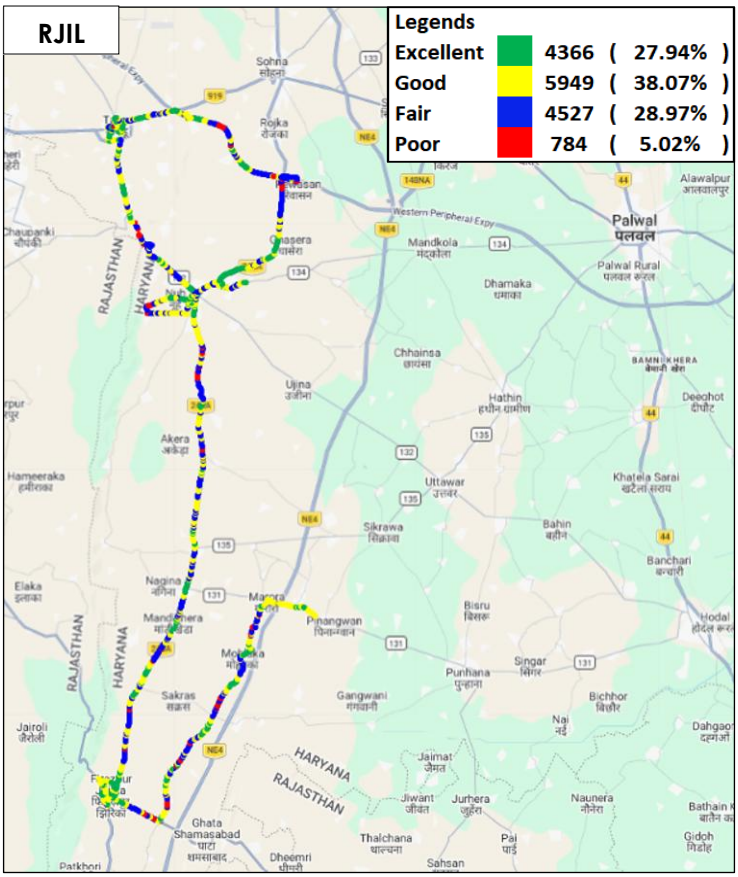



**Figure-92:** Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

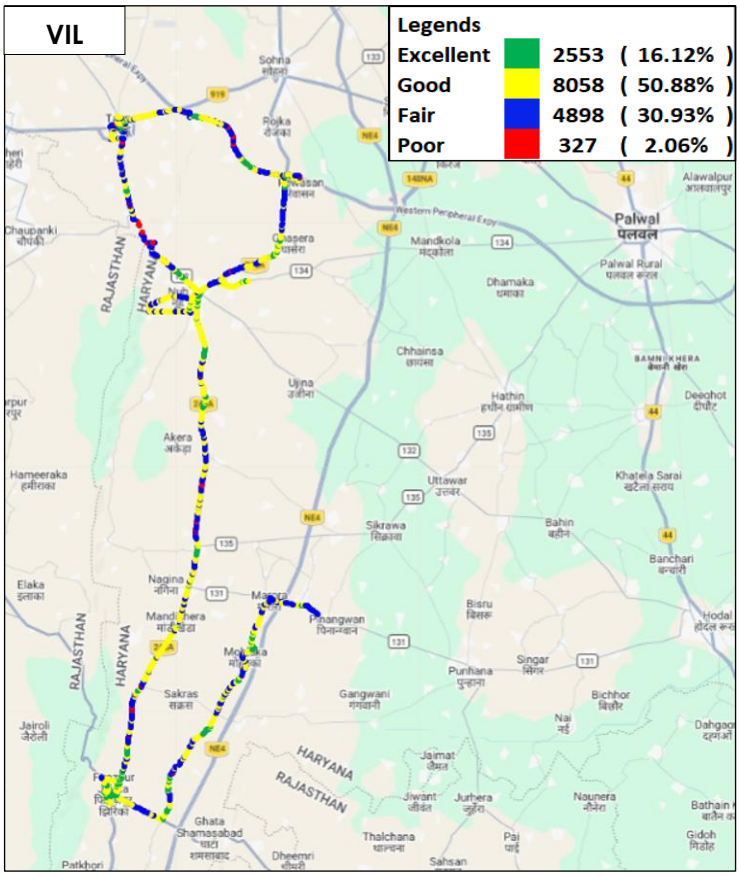



**Figure-93:** Signal strength auto-selection mode (5G/4G/3G/2G) voice – VIL.

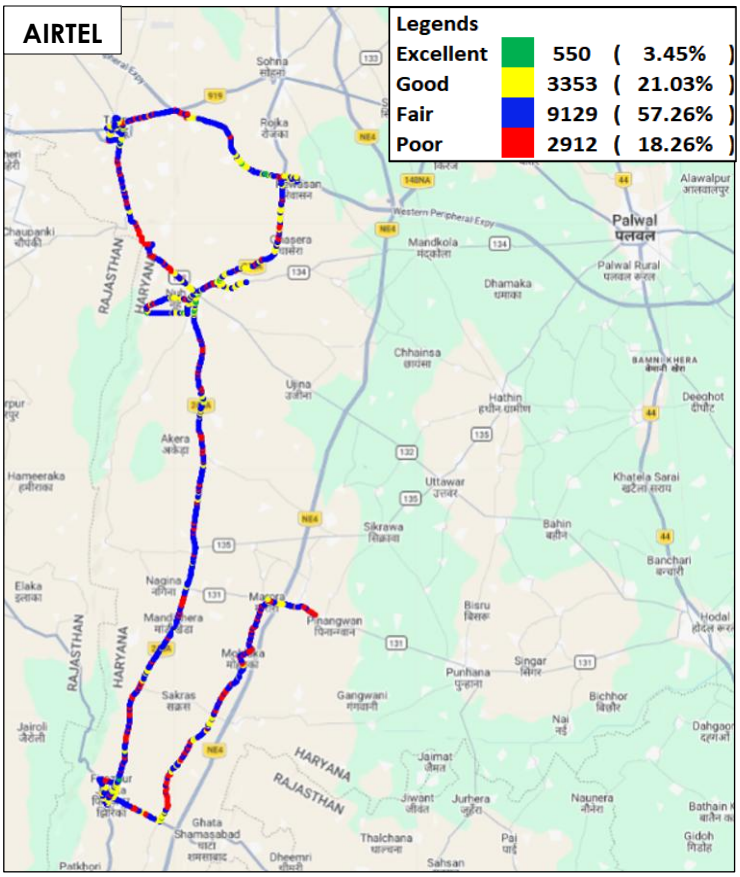



**Figure-94:** Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

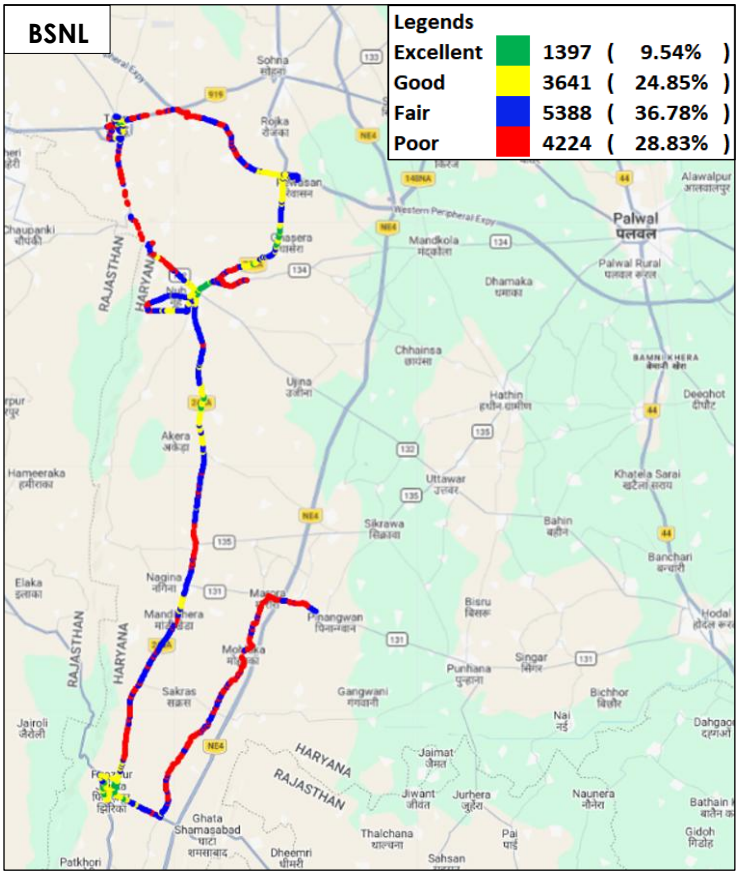



**Figure-95:** Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

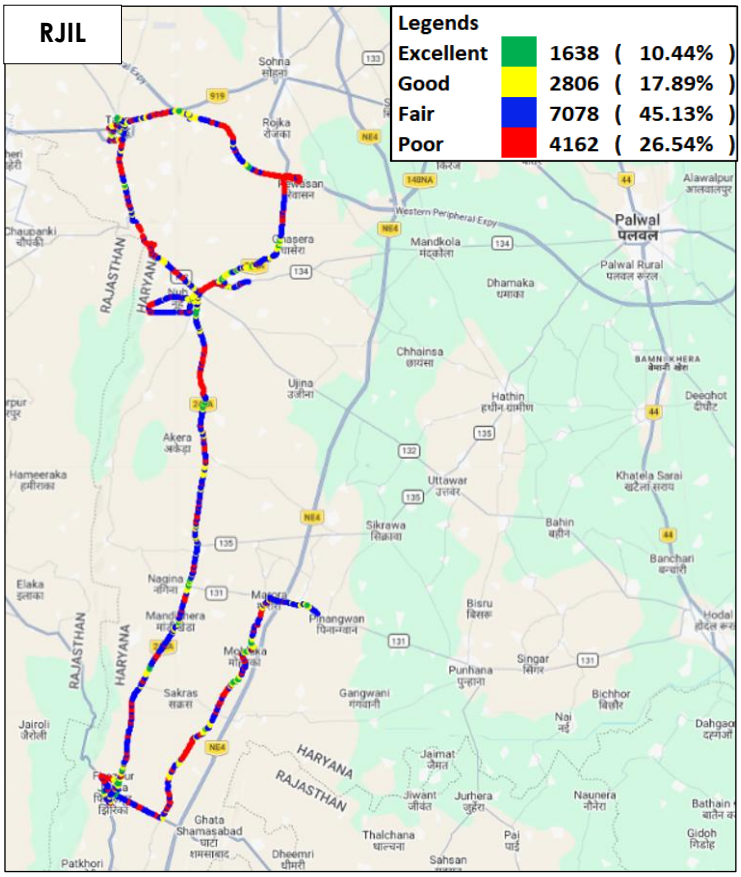



**Figure-96:** Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

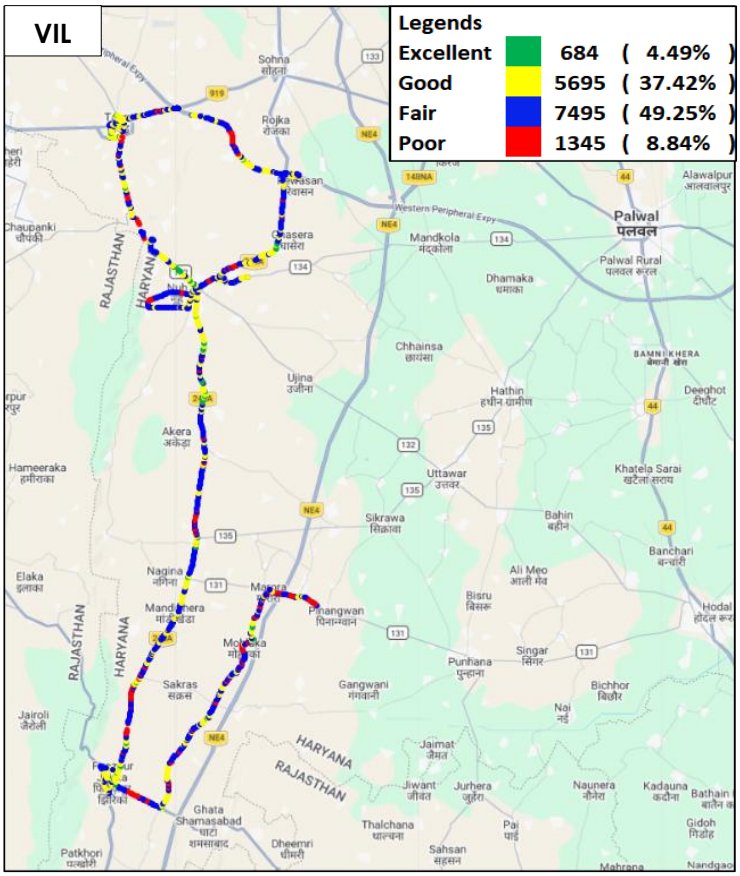



**Figure-97:** Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

## 6.1.2 Palwal District

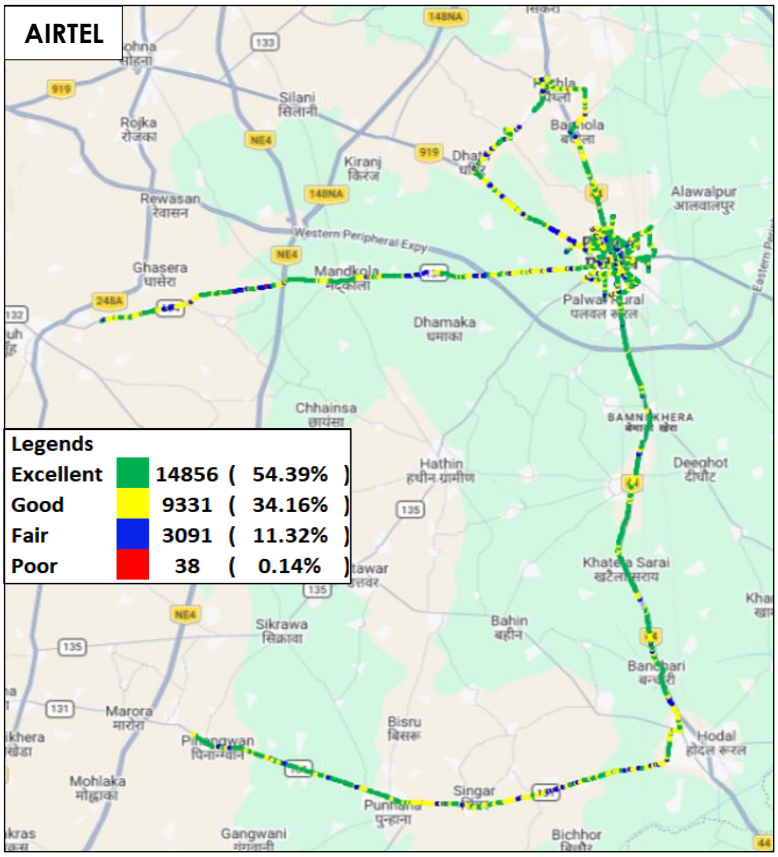



**Figure-98:** Signal strength 3G/2G network mode voice - AIRTEL.

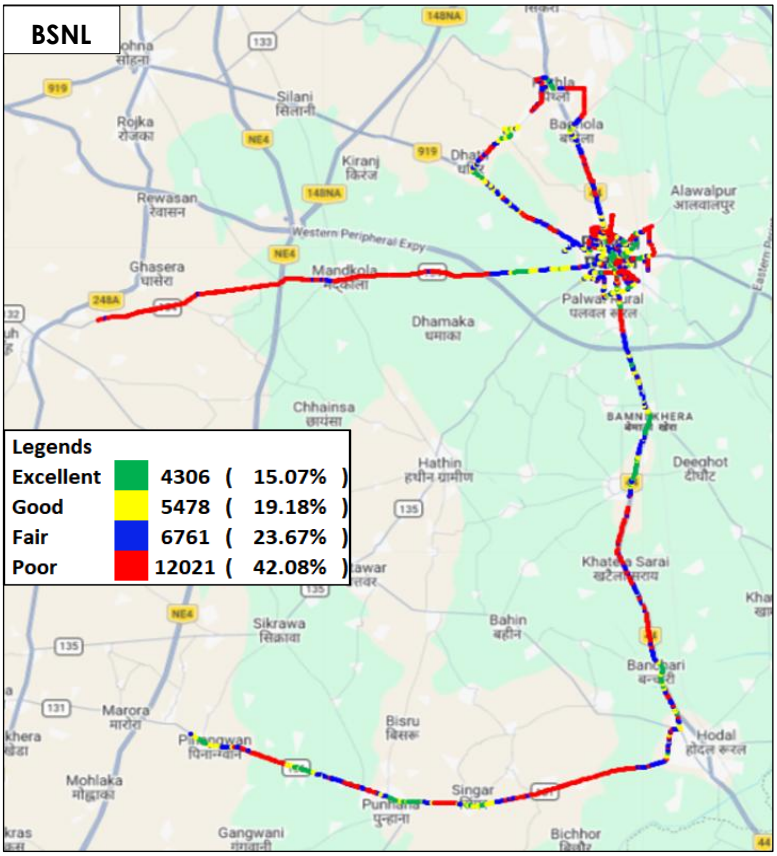



**Figure-99:** Signal strength 3G/2G network mode voice - BSNL.

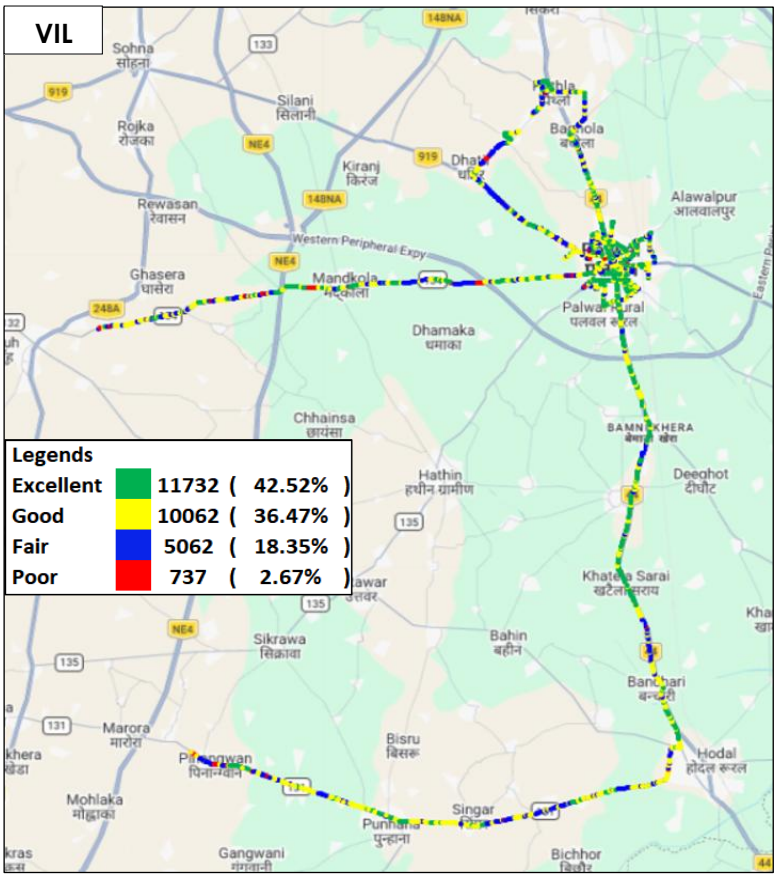



**Figure-100:** Signal strength 3G/2G network mode voice - VIL.

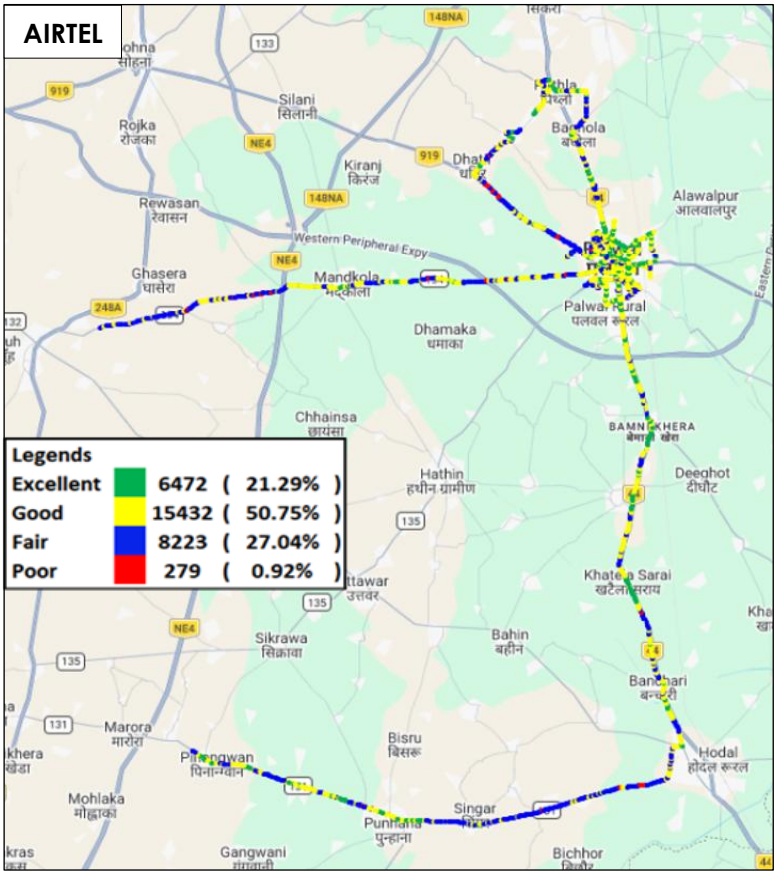



**Figure-101:** Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.

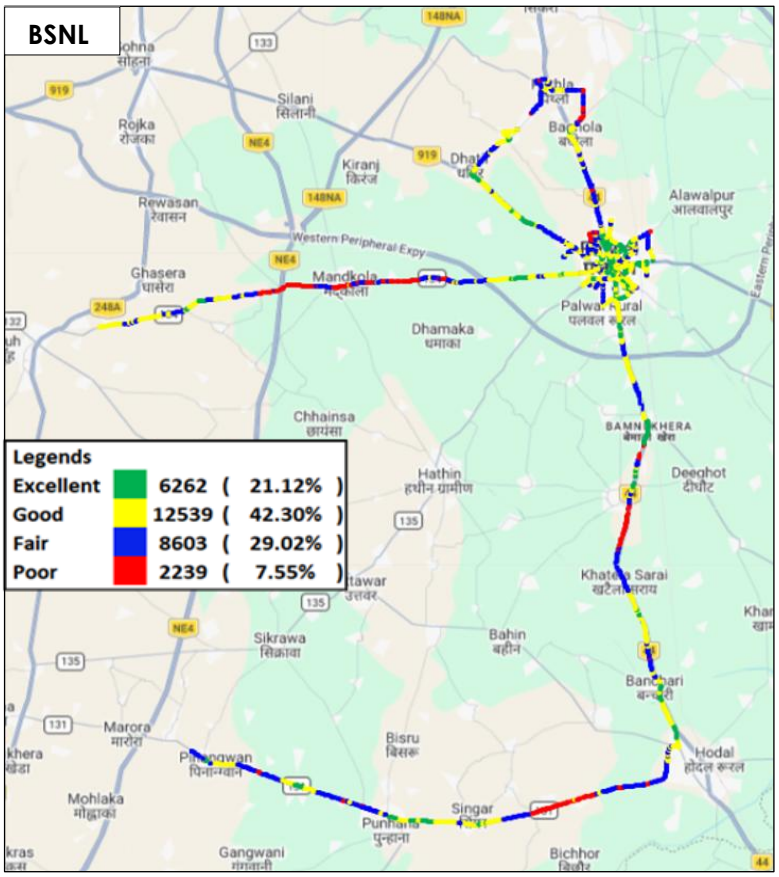



**Figure-102:** Signal strength auto-selection mode (5G/4G/3G/2G) voice – BSNL.

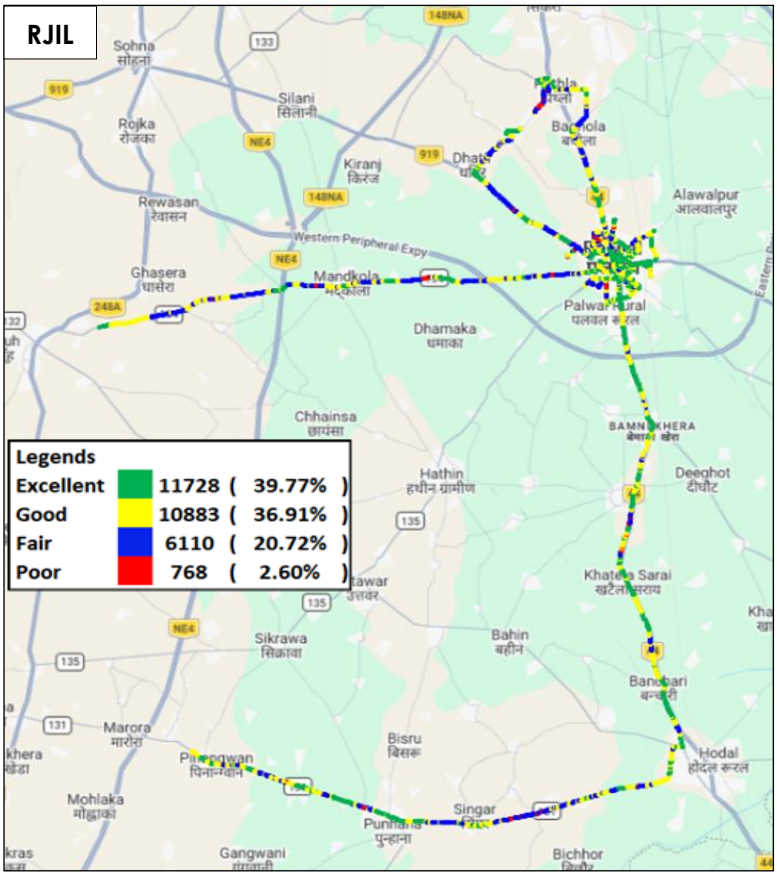



**Figure-103:** Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.

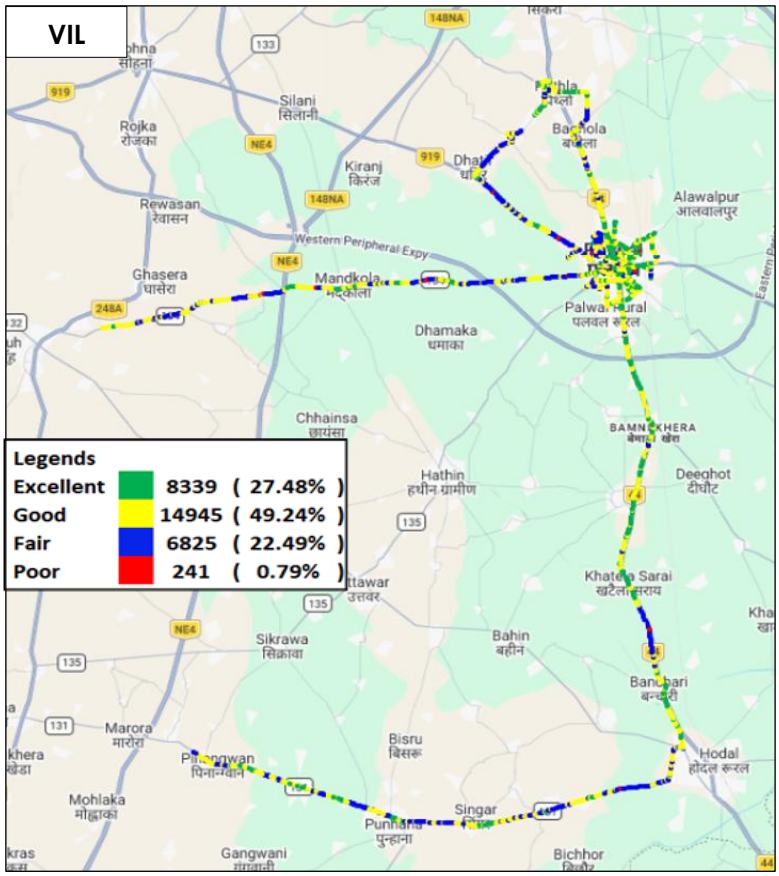



**Figure-104:** Signal strength auto-selection mode (5G/4G/3G/2G) voice – VIL.

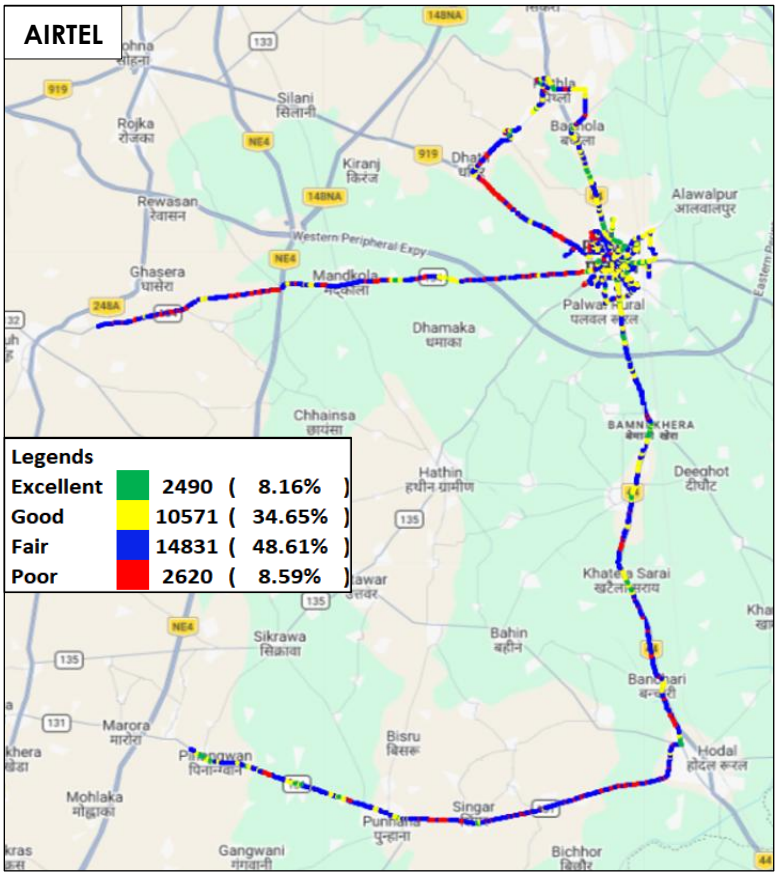



**Figure-105:** Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.

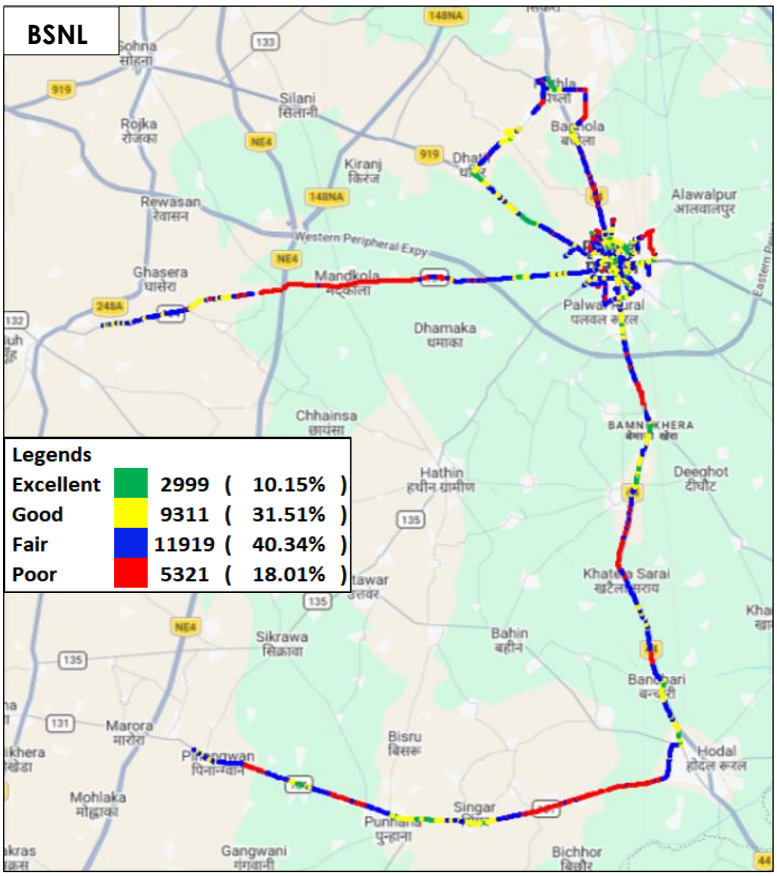



**Figure-106:** Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.

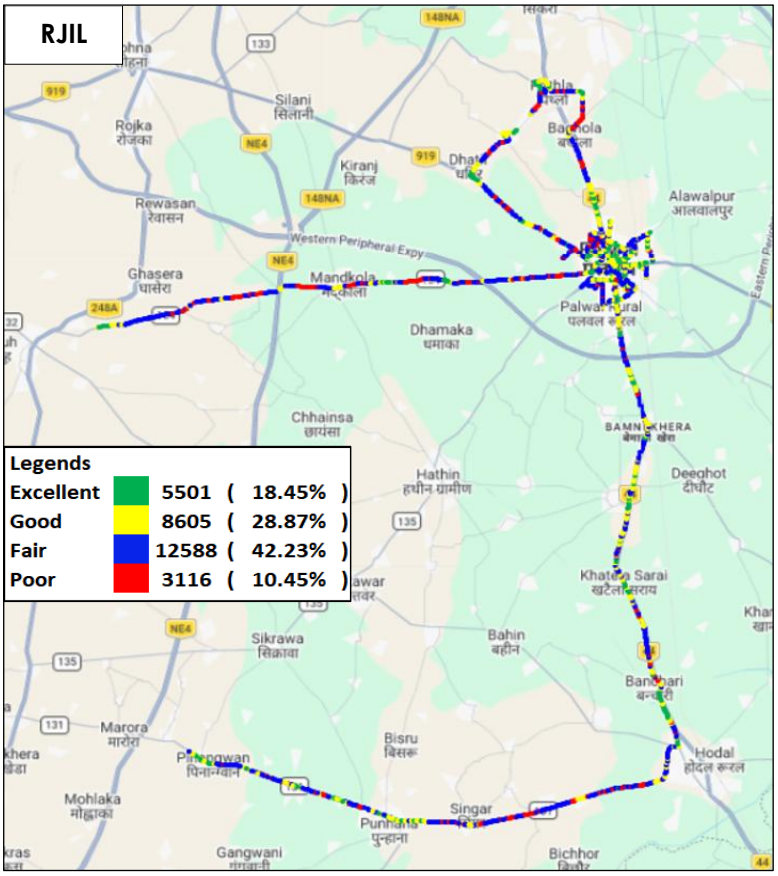



**Figure-107:** Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.

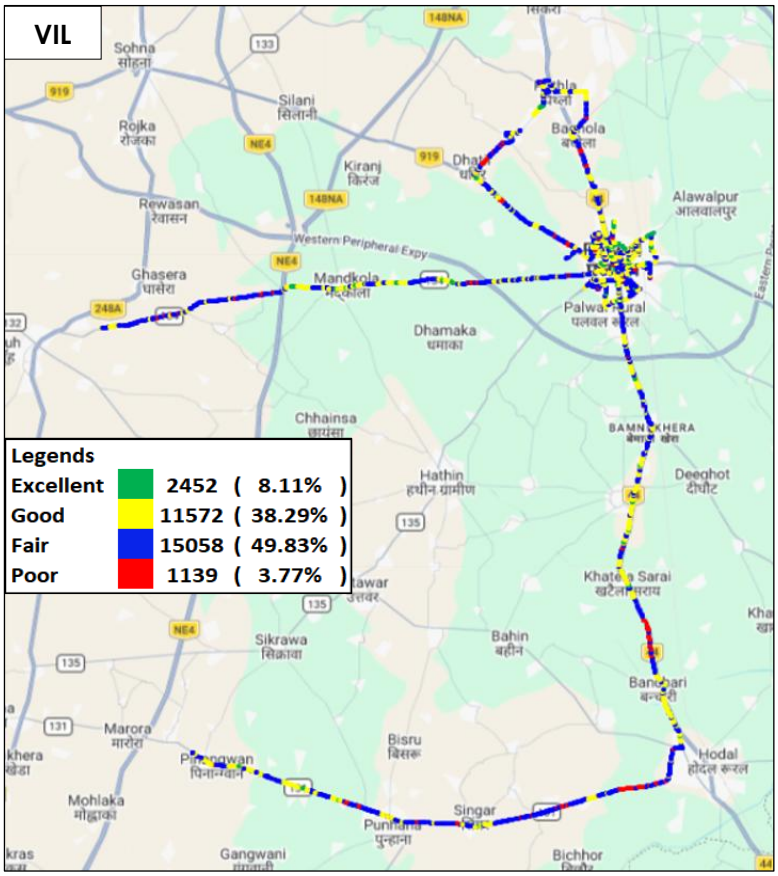



**Figure-108:** Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

# 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<br>• 5G/4G/3G/2G auto mode- switch Call<br>• 5G/4G MOS Call | 30 Sec |
| Call Duration | | 90 seconds |
| Wait/ Guard Time | | 15 Sec |

**Table-52:** 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.

| Data Test | | |
|---|---|---|
| **Test Type** | **Technology** | **Detail** |
| FTP/HTTP Download | 5G/4G/3G/2G Auto Mode | 500 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time) |
| FTP/HTTP 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.irctc.co.in, sbi.bank.in)<br><br>20 sec timeout (only at Hotspot) |

| | | |
|---|---|---|
| Latency & Jitter (TWAMP-UDP) | | 25 count- Dynamic<br>500 count- Hotspot<br>Payload- 42 bytes in all drive |
| Packet Loss Rate (TWAMP-UDP & TCP) | | 500 counts (TWAMP-UDP)<br>500 counts (TCP) at each hotspot<br>Payload- 42 bytes in all drive |

**Table-53:** 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.
- TWAMP-UDP & TCP 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.
- Airtel server was used for FTP Download, FTP Upload, TCP and TWAMP testing, for Airtel.
- Delhi-based TRAI server was used for HTTP Download, HTTP Upload, TCP and TWAMP testing, for BSNL.
- RJIL server was used for FTP Download, FTP Upload, TCP and TWAMP testing, for RJIL.
- VIL server was used for HTTP Download, HTTP Upload, TCP and TWAMP testing, for VIL.

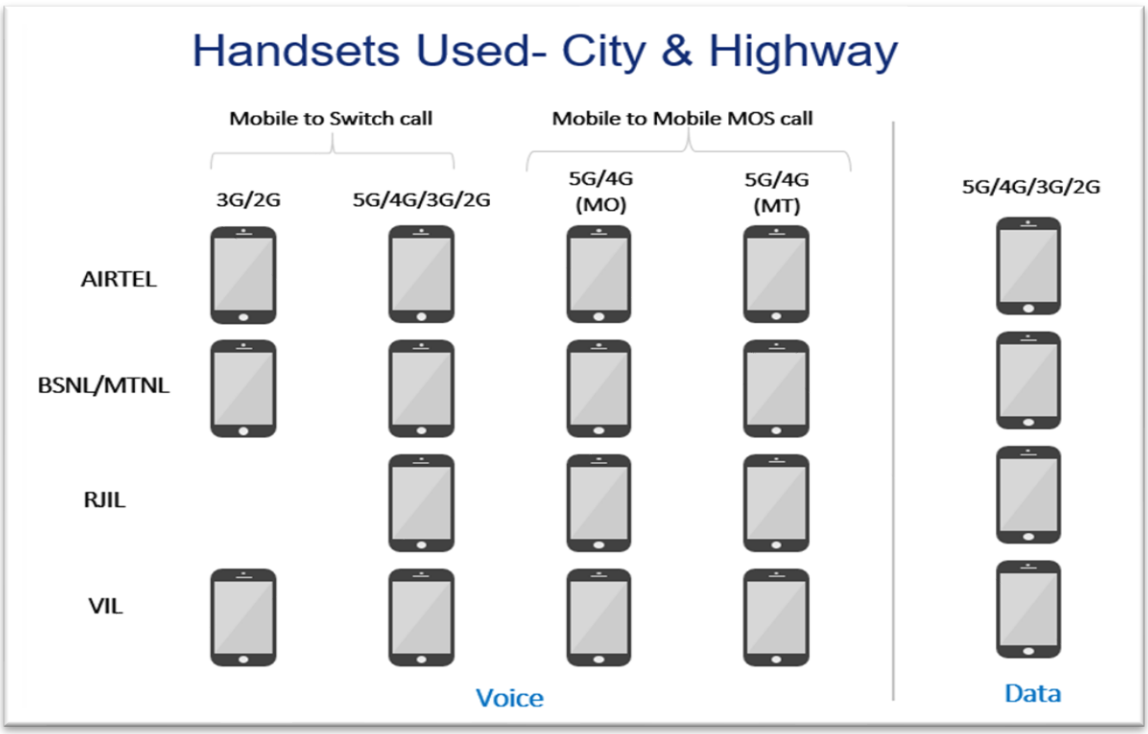



**Figure-109:** Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

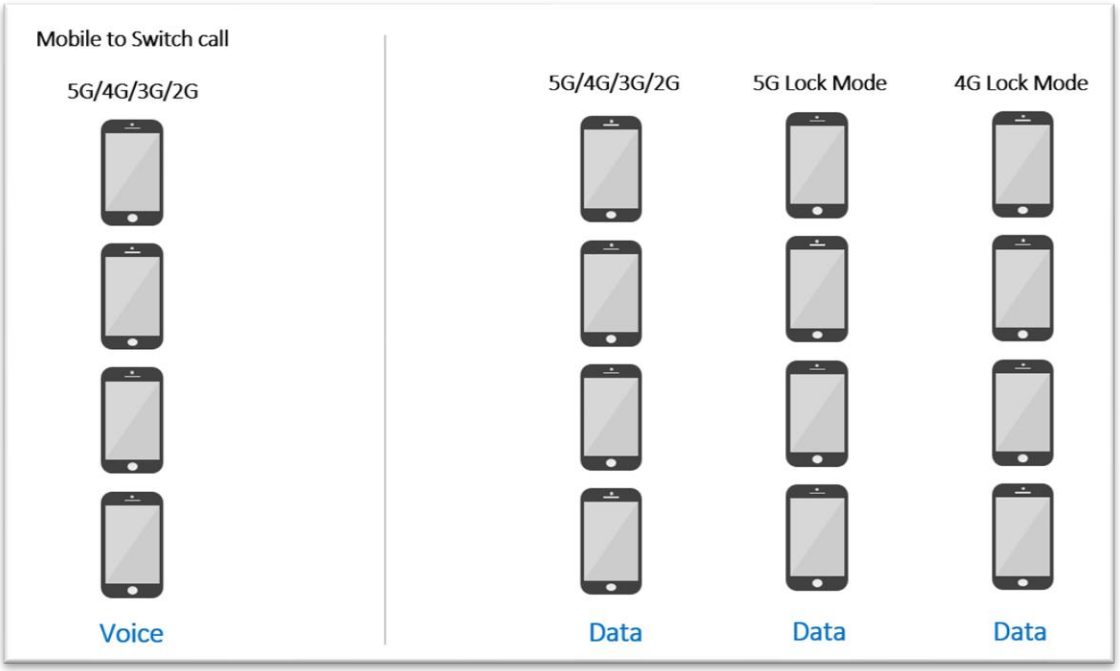



**Figure-110:** Number of handsets used in railway/metro/walktest/hotspot/coastal area.

**Note-** 5G & 4G Lock mode testing has been performed at hotspot locations only.

## 7.1.2 Drive test Methodology

### (a) Dynamic voice testing (on the move)

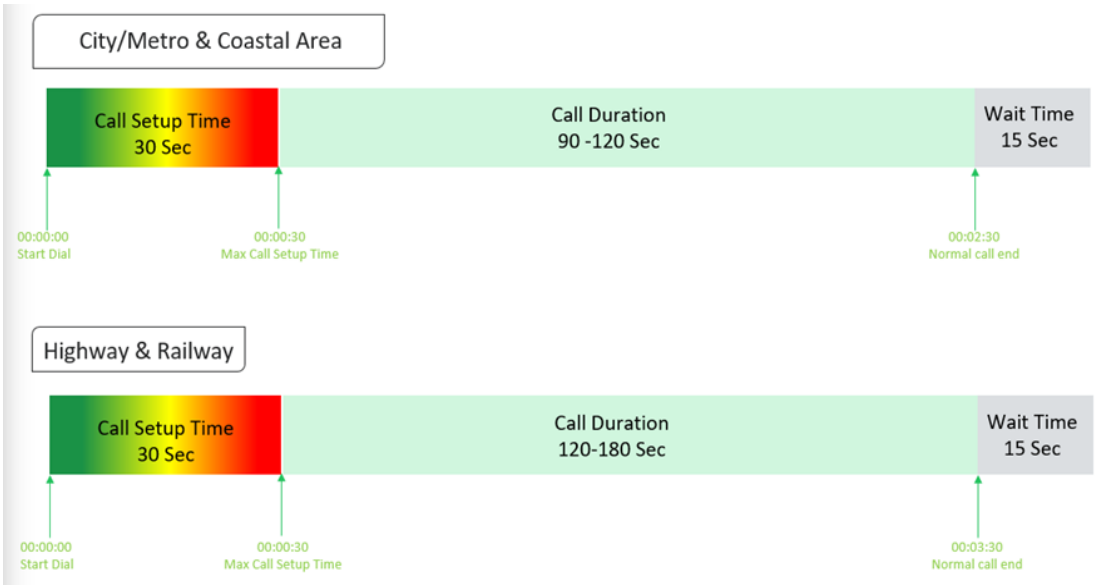



**Figure-111:** Voice test script for city/railway/metro/highway & coastal area

- 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-112:** 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

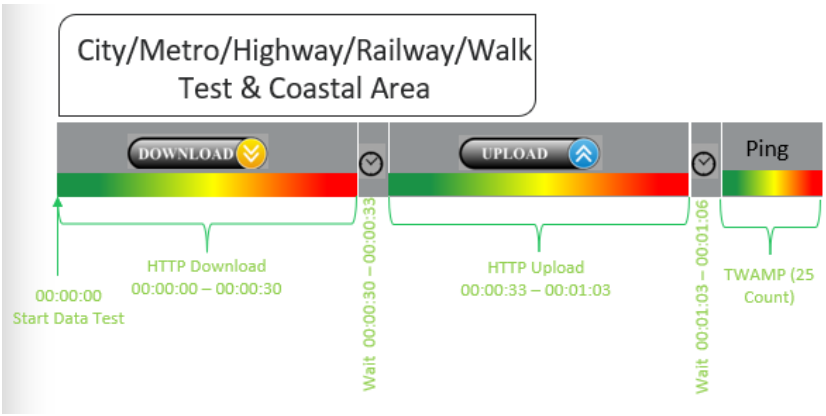



**Figure-113:** Data test script used in city/metro/railway/highway/walk test & coastal area

## (d) Static Data(internet) testing

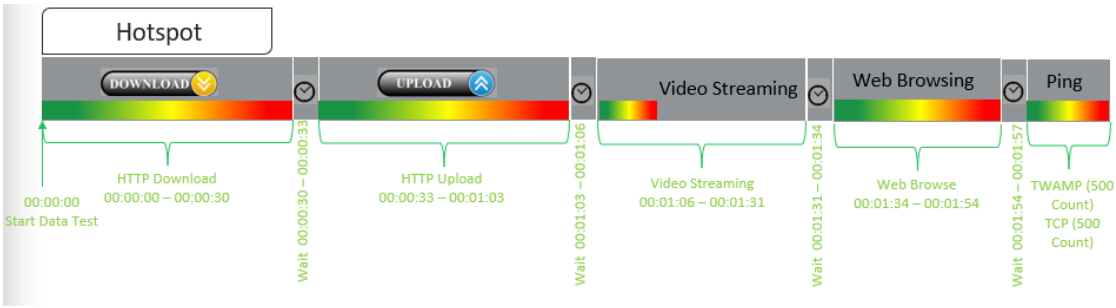



**Figure-114:** Data test script used at hotspot

- 5 Data iteration done at each hotspot location
- Min. 5 iteration made during the walk test.
- Web browsing duration mentioned above is for one web site only.
- One ping iteration (with 500 Count of each- TWAMP & TCP) 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:<br>(a) Call attempt is made<br>(b) The signaling channel is allocated<br>(c) The call is routed to the outwards path of the terminating network<br>(d) An alert signal is received by caller in the form of ring back tone, busy tone, or an announcement.<br><br>CSSR = (Total Call Established/ Total Call Attempt) *100<br><br>As per QoS Regulation 2024 benchmark value is **>=98%** |
| **Drop Call Rate** | Call drop represents the service provider network's ability to maintain a call once it has been successfully established. This parameter shall include both incoming calls and outgoing calls which, once they have been established and have an assigned traffic channel/ bearer, are dropped, or interrupted before their normal completion by the user, the cause of the early termination being within the service provider's network<br><br>Drop Call Rate = (Total Call Drop/Total Call Established) *100<br><br>As per QoS Regulation 2024 benchmark value is **<=2%** |
| **Call Setup Time** | Time taken from call initiate to call alerting/ringing.<br><br>Call Setup Time = T2- T1<br><br>T2- Ringing (VoLTE/VoNR) & Alerting (for WCDMA & GSM),<br>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:<br>Excellent: MOS $\geq$ 4 and < 5<br>Good : MOS $\geq$ 3 and < 4<br>Fair : MOS $\geq$ 2 and < 3<br>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<br><br>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.<br><br>Silence call rate = (count of silence call / Total calls established) *100<br><br>If a call observes multiple silence count >=4 sec in a particular established call it has been taken as one silent event. |

<table>
<tr><td>Jitter</td><td>The inter arrival jitter is the difference in the relative transit time for two packets. The relative transit time is the difference between a packet's Real-time Transport Protocol (RTP) timestamp and the receiver's clock at the time of arrival, measured in the same units. If Si is the RTP timestamp from packet i, and Ri is the time of arrival in RTP timestamps units for packet i, then for two packets i and j the inter-arrival jitter D can be expressed as:<br>D(i,j) = (Rj - Ri) - (Sj - Si)<br><br>The interarrival jitter is calculated continuously as each data packet i is received from source SSRC_n, using this difference D for that packet and the previous packet i-1 in order of arrival (not necessarily in sequence), according to the formula<br>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.<br>This KPI is calculated from MOS call for packet call only (VoNR/VoLTE)</td></tr>
<tr><td>Uplink Packet Drop Rate</td><td>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call terminating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE).</td></tr>
<tr><td>Signal Strength</td><td>Signal strength is the signal power level received by the wireless user.<br><br>
<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-54:** Network performance parameter and definition voice

## 7.2.2 Network Performance Parameters Data tests

| Parameter Name | Definition |
|---|---|
| **Download Speed (Mbps)** | The download speed is defined as the data transmission rate that is achieved for downloading a test file from a test server to a test device.<br><br>Download Speed = Total bytes transferred during download / Total time for transfer<br><br>• 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.<br><br>Upload Speed = Total bytes transferred during upload / Total time for transfer.<br><br>• 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.<br>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.<br><br>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 (TWAMP-UDP)** | 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.<br>The Latency is measured in milliseconds (ms).<br>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 (TWAMP-UDP)** | Measure of variation in time in arrival of packets from a source to destination<br><br>The consideration of packet delay jitter is considered by standard deviation of Inter Packet Delay Variation. If IPDV is used. By standard deviation is meant the average of standard deviation of IPDV on DL<br><br>IPDV(i) = D(i) – D(i-1)<br>then Stdvs of IPDV is considered as jitter. |
| **Packet Loss Rate (TWAMP-UDP & TCP)** | Number of packets lost out of total packet transferred during test.<br>Packet loss rate = (Total packet lost / Total packet sent) *100<br><br>* Packet delay (using TWAMP-UDP & TCP) >90 ms considered as packet loss and included in packet loss rate.<br><br>* Packet loss rate is calculated based on TWAMP-UDP & TCP.<br><br>*90$^{th}$ percentile for Packet loss rate has been reported in overall Hotspot performance summary. |

**Table-55:** Network performance parameter and definition Data

**Disclaimer:** The observations presented above and, in the reports, represent the performance of the service providers on the area/route under test on the day/time of conducting the drive test and no inference whatsoever may be drawn regarding the quality of the telecom service by the service providers in the whole city/state/licensed service area.

Hardik Rajeshbhai Patel

Digitally signed by Hardik Rajeshbhai Patel
Date: 2026.09.16 08:53:05 +05'30'