TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Andhra Pradesh LSA

February 2025

Contents

1. Introduction

TRAI Act, 1997 mandates the Authority to ensure the services delivered through various telecommunications networks meet required quality standards prescribed, to protect the interest of the consumers of telecommunication services. TRAI is also responsible for conducting the periodical audit of such services provided by the service providers so as to protect the interest of the consumers of telecommunications service.

Accordingly, TRAI has engaged M/s RedMango Analytics Pvt. Ltd. to undertake assessment of Quality of Service of mobile service through Independent Drive Test (IDT).

In IDT, the performance of all service providers providing service in a Licensed Service Area (LSA) through various technologies (like 2G/ 3G/ 4G/ 5G) for voice and data are measured by conducting drive test. The drive test routes are finalised based on various objective criteria like reported network performance, consumer complaints etc. Methodology adopted for conducting IDT is elaborated in **APPENDIX-I**.

2. Executive Summary (LSA)

2.1 Drive test details

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

Sl. No	Drive test route	Type of route	Distance covered (KMs)	From date	To date
1	Hyderabad	City	391.0	03-Feb-2025	05-Feb-2025
2	Hyderabad	Hotspot	8 Locations	05-Feb-2025	06-Feb-2025
3	Hyderabad	Walk Test	5.0	06-Feb-2025	06-Feb-2025

Table-1: Drive test summary

2.2 Drive test routes

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

Figure-1: Drive test routes

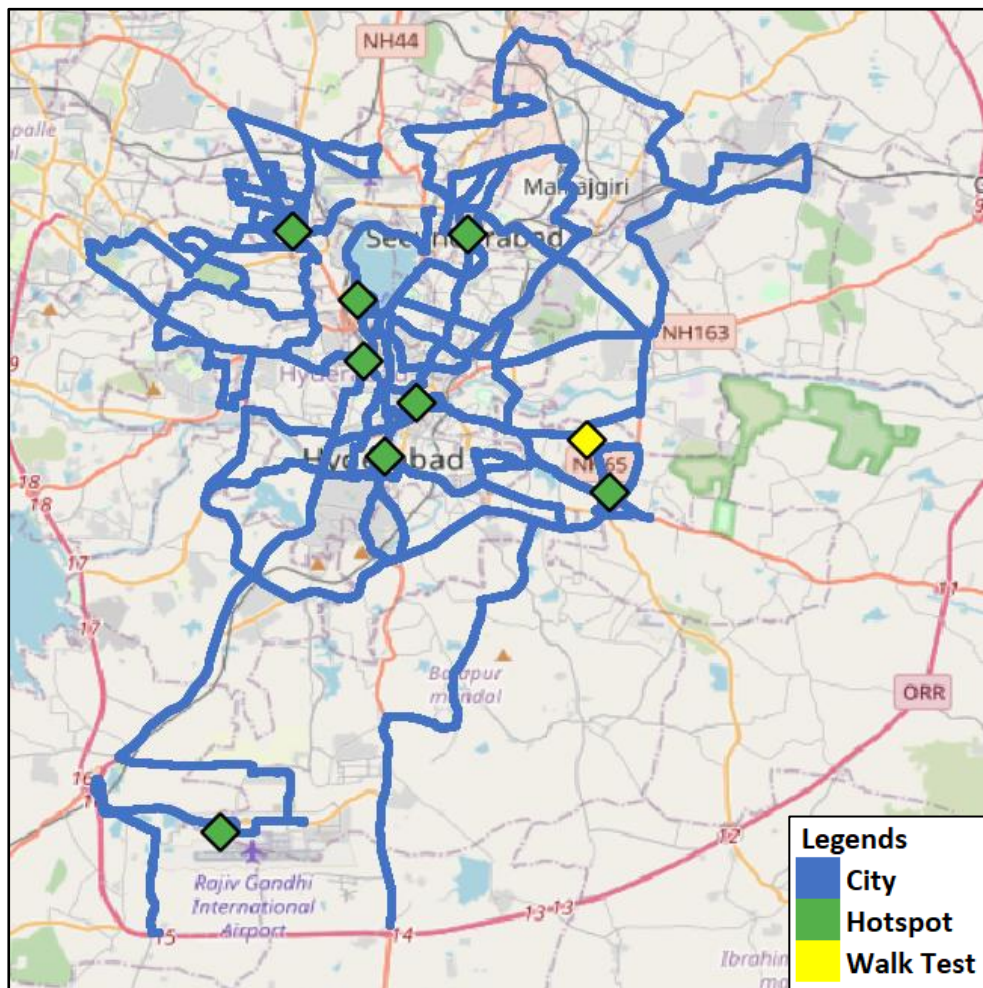## 2.3 Summary of areas covered

a) **City**- Nearby Balapur Mandal, Malkajagiri, Gandhi Nagar, Begum Bazaar, Himayat Nagar, Kanchan Bagh, Attapur, Langar Hauz, Banjara Hills, Bharath Nagar etc.

b) **Hotspot**-
1. MG Bus Station
2. Charminar
3. IMAX Theatre
4. L B Nagar Metro Junction
5. Nampally Railway Station
6. Ameerpet Metro Station
7. Hyderabad Airport Cargo Areas
8. Secunderabad Railway Junction

c) Walk Test

1. Saroor Nagar Market

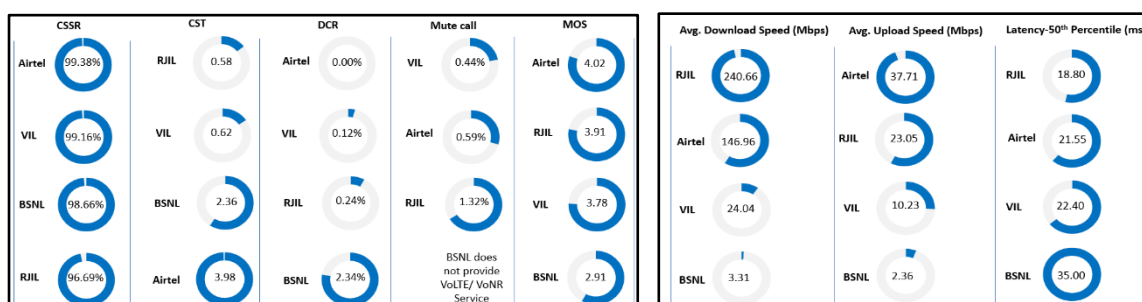## 2.4 Telecom service providers detected frequency bands

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

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

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

2.5 Performance against key QoS parameters

CSSR: Call setup success rate, **CST:** Call setup time, **DCR:** Drop call rate

	CSSR	CST	DCR	Mute call	MOS
	Airtel 99.38%	RJIL 0.58	Airtel 0.00%	VIL 0.44%	Airtel 4.02
	VIL 99.16%	VIL 0.62	VIL 0.12%	Airtel 0.59%	RJIL 3.91
	BSNL 98.66%	BSNL 2.36	RJIL 0.24%	RJIL 1.32%	VIL 3.78
	RJIL 96.69%	Airtel 3.98	BSNL 2.34%	BSNL does not provide VoLTE/ VoNR Service	BSNL 2.91

	Avg. Download Speed (Mbps)	Avg. Upload Speed (Mbps)	Latency-50th Percentile (ms)
	RJIL 240.66	Airtel 37.71	RJIL 18.80
	Airtel 146.96	RJIL 23.05	Airtel 21.55
	VIL 24.04	VIL 10.23	VIL 22.40
	BSNL 3.31	BSNL 2.36	BSNL 35.00

Summary-Voice services

Call Setup Success Rate: Airtel, VIL, BSNL & RJIL have 99.38%, 99.16%, 98.66% and 96.69% call setup success rate respectively in Auto-selection mode (5G/4G/3G/2G).

Call Setup Time: Airtel has taken comparatively longer time (3.98 seconds) to establish the voice call, whereas RJIL, VIL and Airtel call setup time is 0.58, 0.62 & 2.36 second respectively in Auto-selection mode (5G/4G/3G/2G).

Drop Call Rate: Overall BSNL's drop call rate (2.34%) is higher (QoS benchmark of 2%), while Airtel, VIL and RJIL have 0.00%, 0.12% and 0.24% respectively in Auto-selection mode (5G/4G/3G/2G).

Call Silence/Mute Rate: In packet switched network (4G/5G), VIL, Airtel and RJIL have 0.44%, 0.59% & 1.32% silence call rate respectively.

Mean Opinion Score (MOS): Quality of speech of Airtel (4.02) is having a MOS score >4, whereas RJIL (3.91), VIL (3.78) and BSNL (2.91) is having a MOS score <4.

Summary-Data services

Data Download performance (Dynamic): BSNL offers a download speed of 3.31 Mbps while VIL provides 24.04 Mbps, utilizing legacy technologies respectively. In contrast, Airtel and RJIL achieve significantly higher average download speeds of 146.96 Mbps and 240.66 Mbps.

Data Upload performance (Dynamic): BSNL (2.36 Mbps) and VIL (10.23 Mbps), operating on 4G/3G legacy technologies respectively, have comparatively lower upload speeds. In contrast, Airtel and RJIL offer faster speeds of 37.71 Mbps and 23.05 Mbps, respectively.

Data performance - Hotspots (in Mbps):

Airtel-	4G D/L: 35.18	4G U/L: 10.36
	5G D/L: 118.77	5G U/L: 41.90
RJIL-	4G D/L: 36.22	4G U/L: 6.64
	5G D/L: 232.09	5G U/L: 24.75
VIL-	4G D/L: 23.12	4G U/L: 16.70

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

QoS Performance Analysis- Andhra Pradesh LSA

3. QoS performance analysis-LSA level

3.1 Overview

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

3.2 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	658	691	677
Call Setup Success Rate %	99.54	99.42	98.23
Drop Call Rate %	0.15	1.60	1.20
Call Setup Time-Average (Second)	6.10	2.41	4.84
Handover Success Rate %	97.63	99.97	97.46

Table-3: Summary of voice call performance in 3G/2G network mode only.
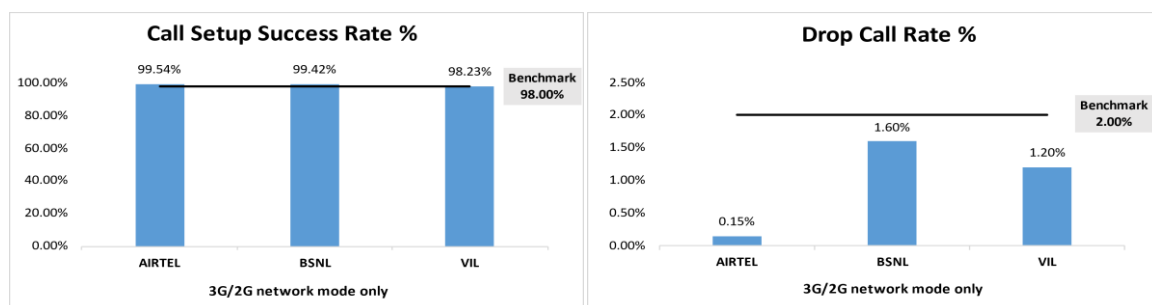
Figure-2: Call setup success rate and drop call rate performance.

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	256	NA
2G	1464	134	1041

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	808	822	845	830
Call Setup Success Rate %	99.38	98.66	96.69	99.16
Drop Call Rate %	0.00	2.34	0.24	0.12
Call Setup Time-Average (Second)	3.98	2.36	0.58	0.62
Handover Success Rate %	100.00	99.97	99.98	99.90

Table-5: Summary of voice call performance in network auto-selection mode.
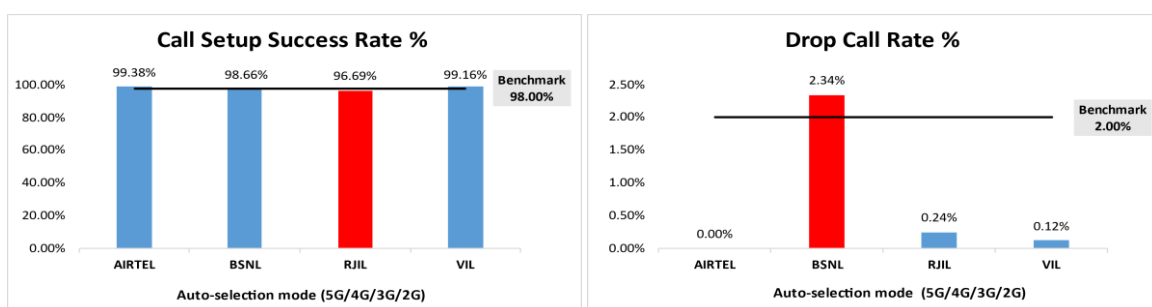
Figure-3: Performance for call setup success rate and drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	682	687	680	682
Number of silence call for >4 Sec	4	NA	9	3
Silence Call Rate %	0.59	NA	1.32	0.44
Number of silence instances for >4 Sec	4	NA	11	8
Number of silence instances for >3 Sec	11	NA	13	13
Number of silence instances for >2 sec	25	NA	24	20
RTP Jitter (4G & 5G) in ms	4.18	NA	10.54	16.83
Packet loss Rate Downlink %	0.50	NA	0.39	2.07
Packet loss Rate Uplink %	0.37	NA	0.53	0.83

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

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

Number of unique cell Id's covered in Voice test- Technology wise				
Technology	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
5G	0	NA	1288	NA
4G	2163	19	1266	1673
3G	NA	258	NA	NA
2G	0	170	NA	0

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

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

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-6	4064	3891	3990	4048
Speech Quality (Average MOS Score)	4.02	2.91	3.91	3.78
Number of samples with MOS >=4 to <5 (Excellent)	3485	0	2747	1756
Number of samples with MOS >=3 to <4 (Good)	486	2046	1060	2019
Number of samples with MOS >=2 to <3 (Fair)	46	1630	127	226
Number of samples with MOS >=1 to <2 (Poor)	47	215	56	47
%age of samples with MOS >=4 to <5 (Excellent)	85.75%	0.00%	68.85%	43.38%
%age of samples with MOS >=3 to <4 (Good)	11.96%	52.58%	26.57%	49.88%
%age of samples with MOS >=2 to <3 (Fair)	1.13%	41.89%	3.18%	5.58%
%age of samples with MOS >=1 to <2 (Poor)	1.16%	5.53%	1.40%	1.16%

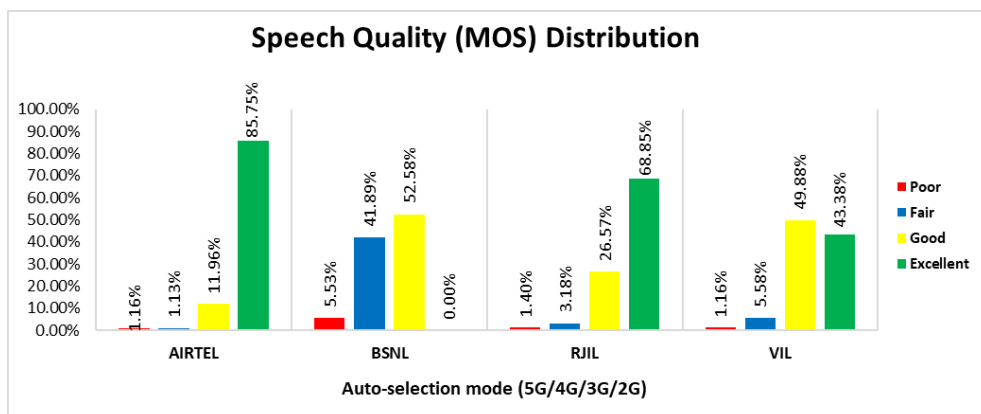**Table-8:** Summary of speech quality (MOS) samples.

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

3.3 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	146.96	3.31	240.66	24.04
	80th Percentile	235.36	4.90	316.65	37.58
	20th Percentile	56.98	1.13	102.81	8.09
Upload Throughput (Mbits/s)	Average	37.71	2.36	23.05	10.23
	80th Percentile	65.41	3.24	39.33	16.55
	20th Percentile	9.43	1.29	5.67	4.20
Latency (ms)	50th Percentile	21.55	35.00	18.80	22.40

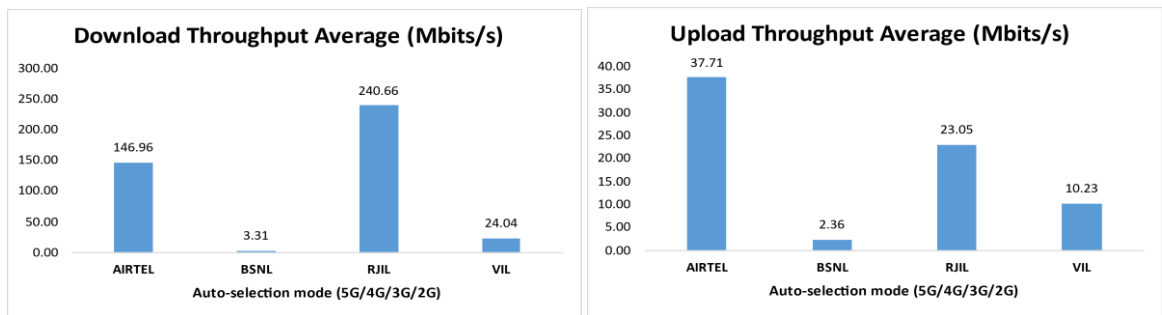**Table-9:** Summary of data performance in network auto-selection mode.

Figure- 5: Download and Upload throughput

Number of unique cell Id's covered in Data test- Technology wise					
Technology		Service Provider			
		Auto-selection mode 5G/4G/3G/2G			
		AIRTEL	BSNL	RJIL	VIL
5G		0	NA	1402	NA
4G		2370	190	362	1736
3G		NA	175	NA	NA
2G		0	30	NA	4

Table-10: Technology wise number of network cell Id's latched during drive test.

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

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis

4.1 Overview

This section covers analysis on performance of various categories of drives like City, Hotspots & Walk Tests for all telecom service providers, the results of drive tests conducted is shown individually for respective areas/locations.

4.2 City

Drive test has been conducted from 3rd February 2025 to 5th February 2025 in Hyderabad. (Refer Table-1)

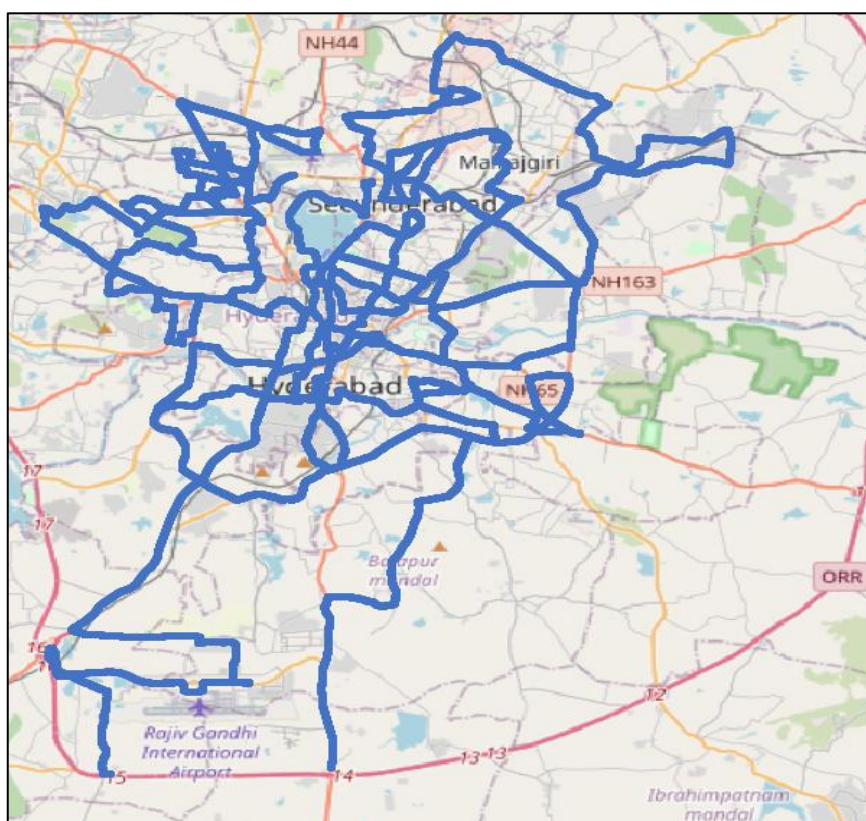### 4.2.1 Drive test route

Figure- 6: Drive test routes

4.2.2 Areas covered

Nearby Balapur Mandal, Malkajagiri, Gandhi Nagar, Begum Bazaar, Himayat Nagar, Kanchan Bagh, Attapur, Langar Hauz, Banjara Hills, Bharath Nagar etc.

4.2.3 Voice performance

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

Parameters	Service Provider 3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	658	691	677
Call Setup Success Rate %	99.54	99.42	98.23
Drop Call Rate %	0.15	1.60	1.20
Call Setup Time-Average (Second)	6.10	2.41	4.84
Handover Success Rate %	97.63	99.97	97.46

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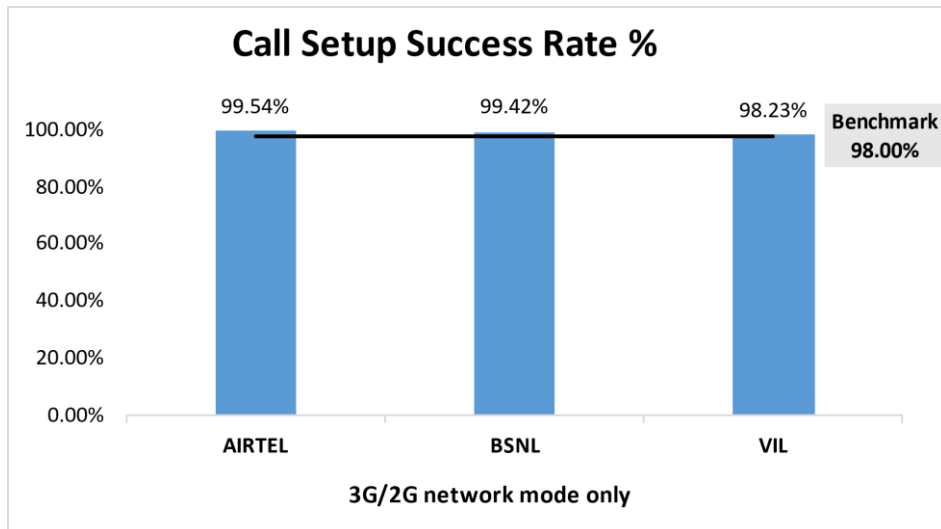

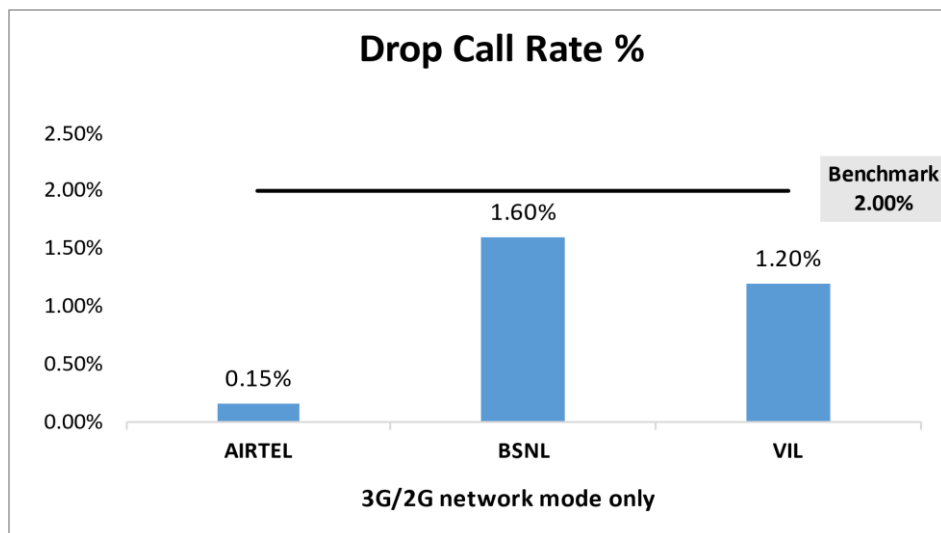**Figure-7:** Performance for call setup success rate.

Figure-8: Performance for drop call rate.

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	89.47%	NA
2G	99.99%	10.48%	99.94%
Limited Service	0.01%	0.05%	0.06%

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

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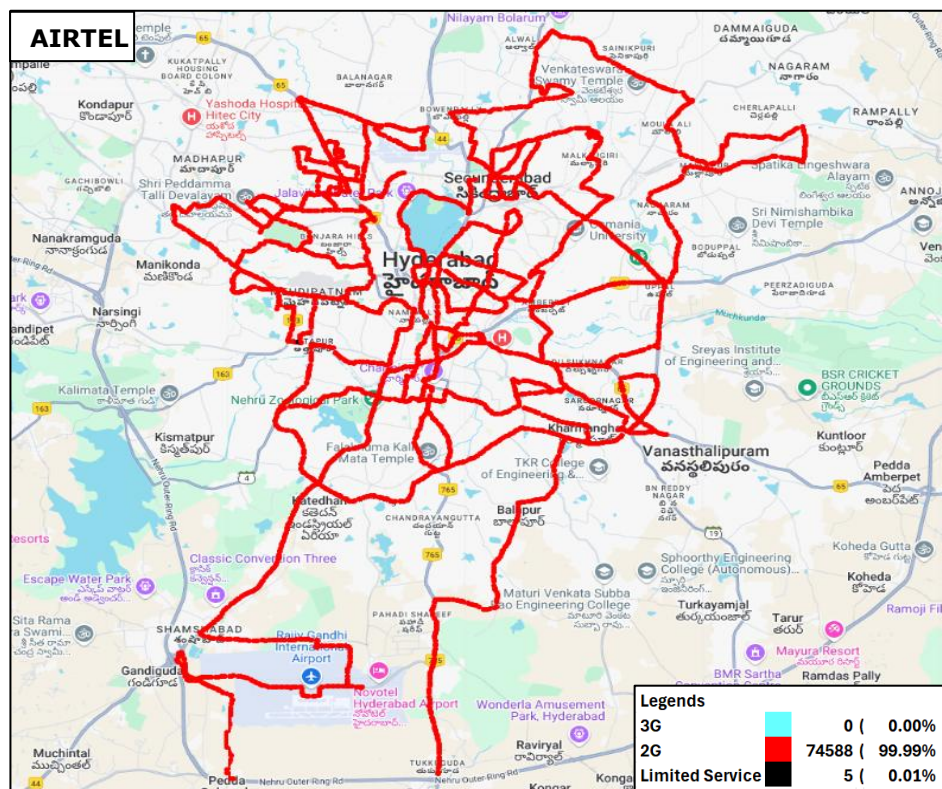

Figure-9: Serving technology plots 3G/2G network mode – AIRTEL.
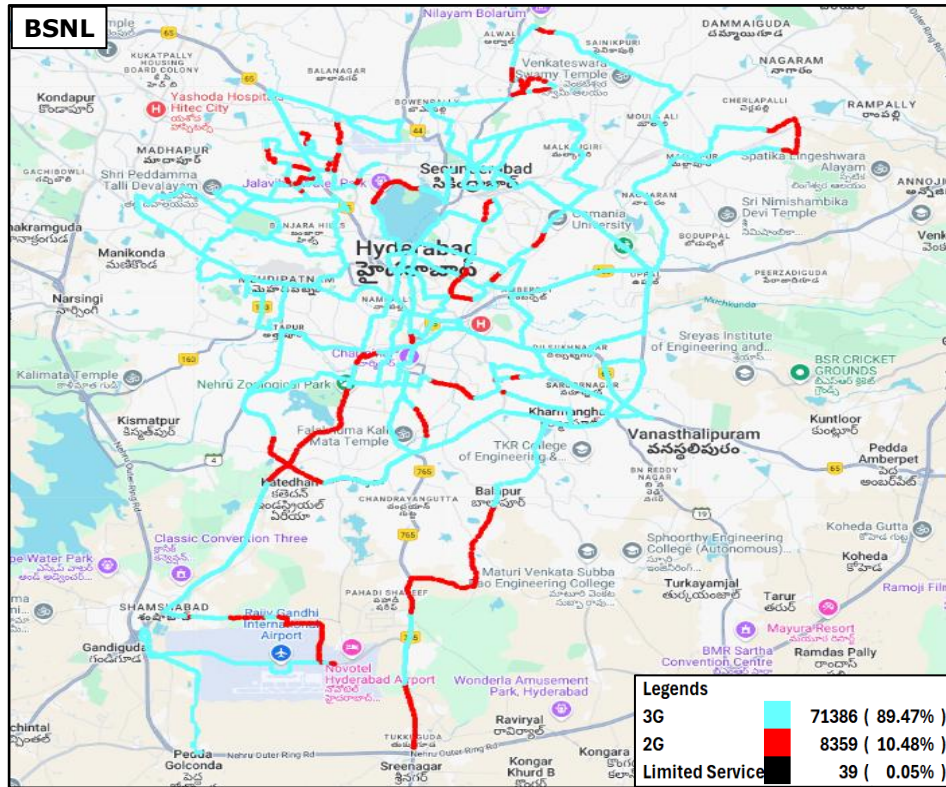
Figure-10: Serving technology plots 3G/2G network mode –BSNL.
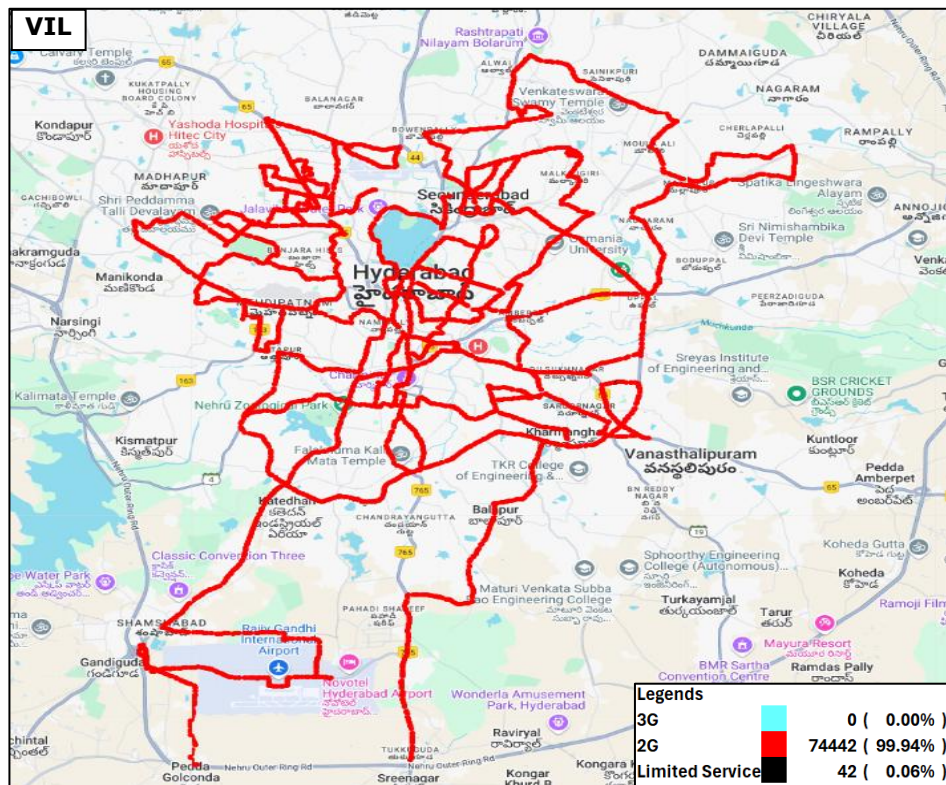

Figure-11: Serving technology plots 3G/2G network mode –VIL.

(c) Network Signal Strength Distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 25, 26 & 27 for map view)
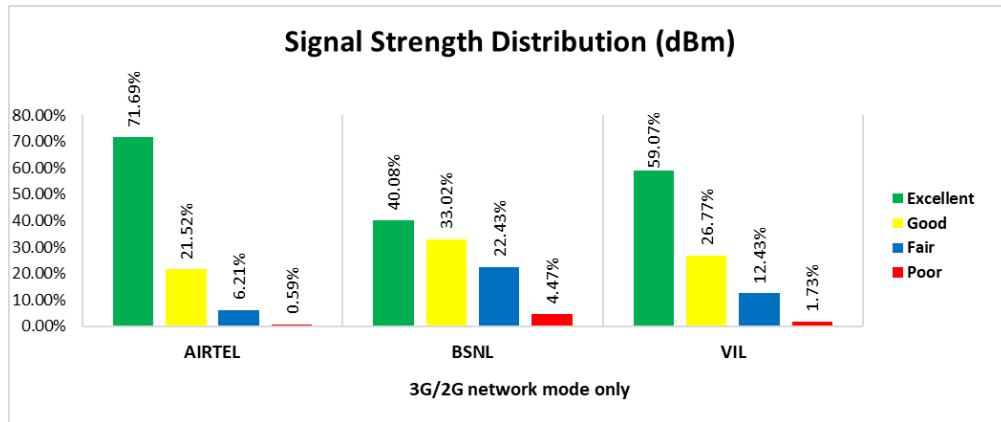
Figure-12: Signal strength distribution 3G/2G network mode only.

Observations:
- Airtel has 72% of samples falling in the excellent signal strength category.
- BSNL has 40% of samples falling in the excellent signal strength category.
- VIL has 59% 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	692	706	729	714
Call Setup Success Rate %	99.28	98.44	96.16	99.16
Drop Call Rate %	0.00	2.45	0.29	0.14
Call Setup Time Average (Second)	3.98	2.38	0.58	0.62
Handover Success Rate %	100.00	99.97	99.98	99.90

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

Figure-13: Performance for call setup success rate.

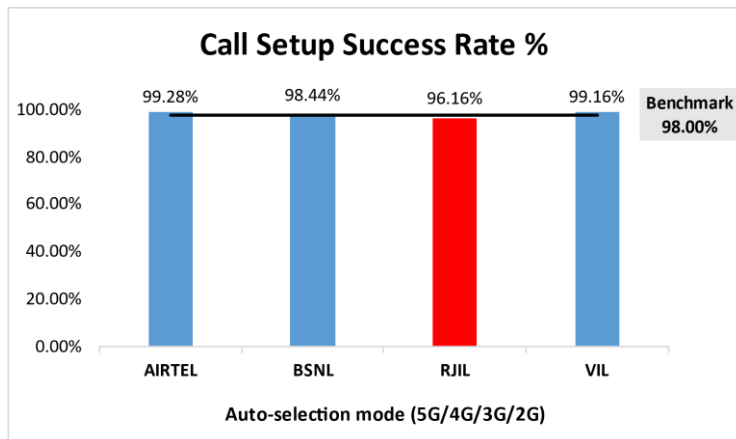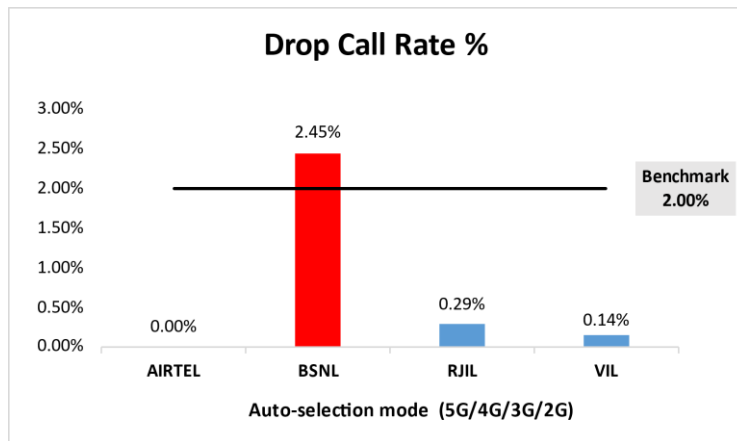**Figure-14:** Performance for drop call rate.

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Established (within service provider Network)	682	687	680	682
Number of silence call for >4 Sec	4	NA	9	3
Silence Call Rate %	0.59	NA	1.32	0.44
Number of silence instances for >4 Sec	4	NA	11	8
Number of silence instances for >3 Sec	11	NA	13	13
Number of silence instances for >2 sec	25	NA	24	20
RTP Jitter (4G & 5G) in ms	4.18	NA	10.54	16.83
Packet loss Rate Downlink %	0.5	NA	0.39	2.07
Packet loss Rate Uplink %	0.37	NA	0.53	0.83

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

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

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Total Number of MOS Samples for calls in table-16	4064	3891	3990	4048
Speech Quality (Average MOS Score)	4.02	2.91	3.91	3.78
Number of samples with MOS >=4 to <5 (Excellent)	3485	0	2747	1756
Number of samples with MOS >=3 to <4 (Good)	486	2046	1060	2019
Number of samples with MOS >=2 to <3 (Fair)	46	1630	127	226
Number of samples with MOS >=1 to <2 (Poor)	47	215	56	47
%age of samples with MOS >=4 to <5 (Excellent)	85.75%	0.00%	68.85%	43.38%
%age of samples with MOS >=3 to <4 (Good)	11.96%	52.58%	26.57%	49.88%
%age of samples with MOS >=2 to <3 (Fair)	1.13%	41.89%	3.18%	5.58%
%age of samples with MOS >=1 to <2 (Poor)	1.16%	5.53%	1.40%	1.16%

Table-15: Summary of speech quality (MOS) samples.
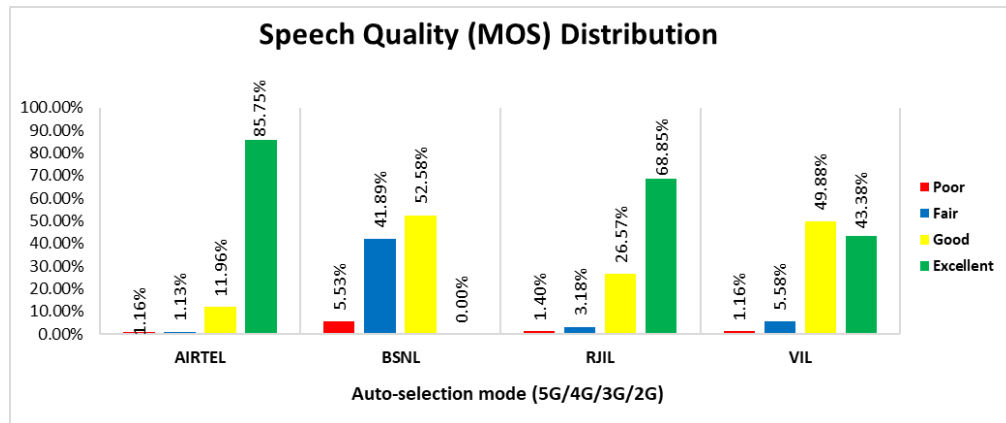
Figure-15: Distribution of samples in MOS score range.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	8.86%	NA	66.50%	NA
4G	91.14%	0.05%	33.49%	100.00%
3G	NA	85.54%	NA	NA
2G	0.00%	13.77%	NA	0.00%
Limited Service	0.00%	0.64%	0.01%	0.00%

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

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

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

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

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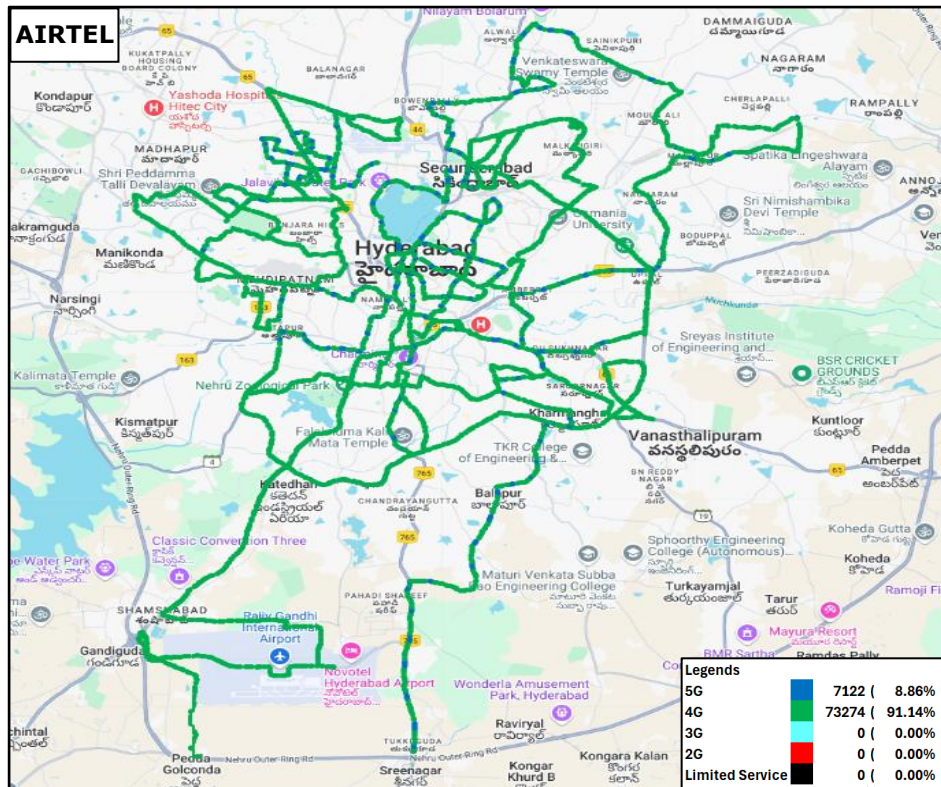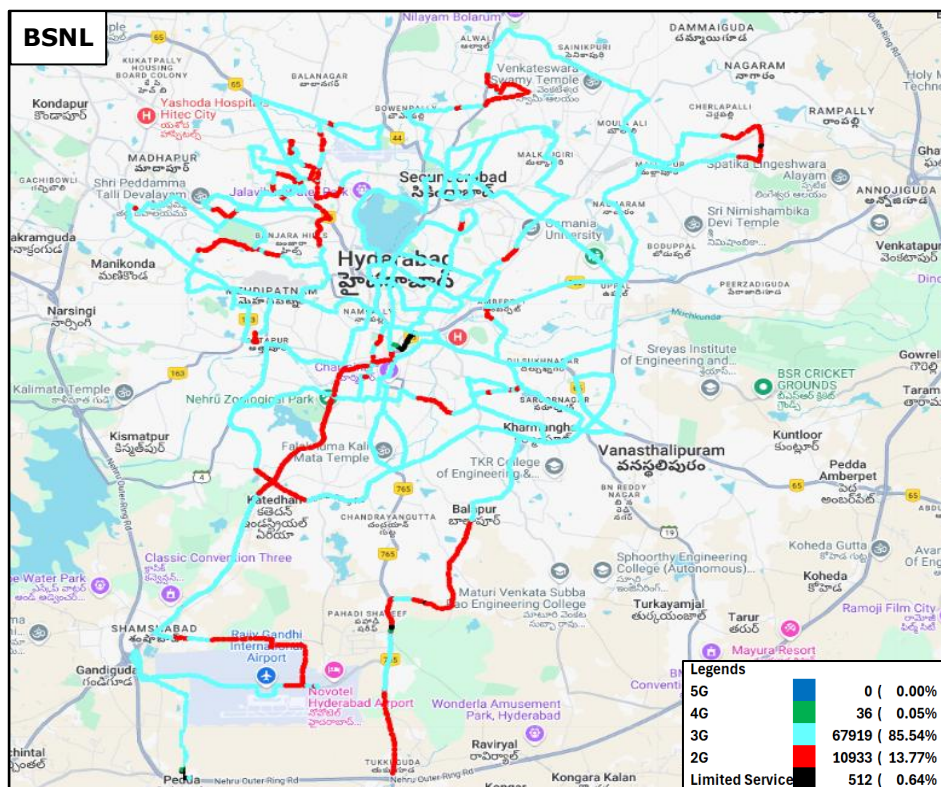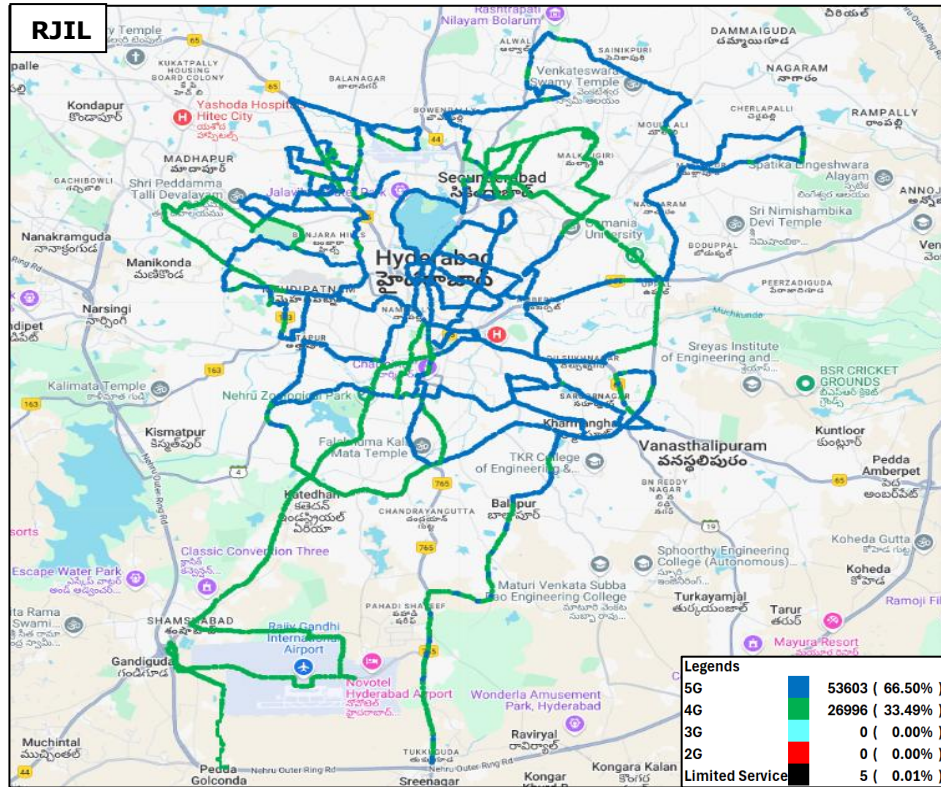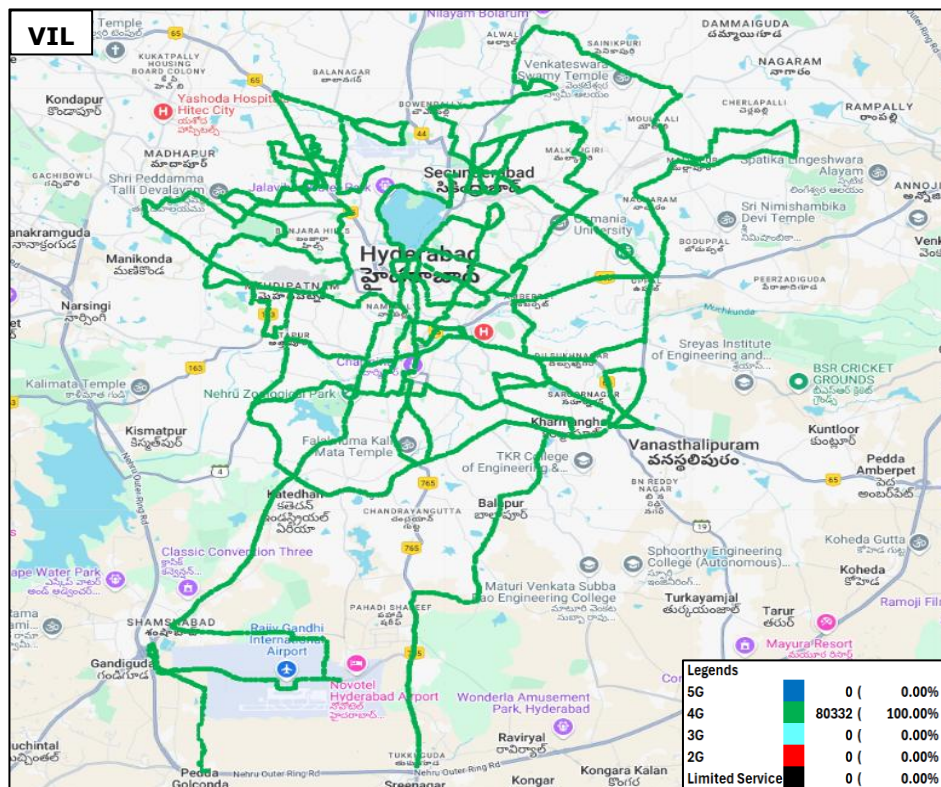

Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G) – VIL.

(g) Network Signal Strength Distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-28, 29, 30 & 31 for map view)
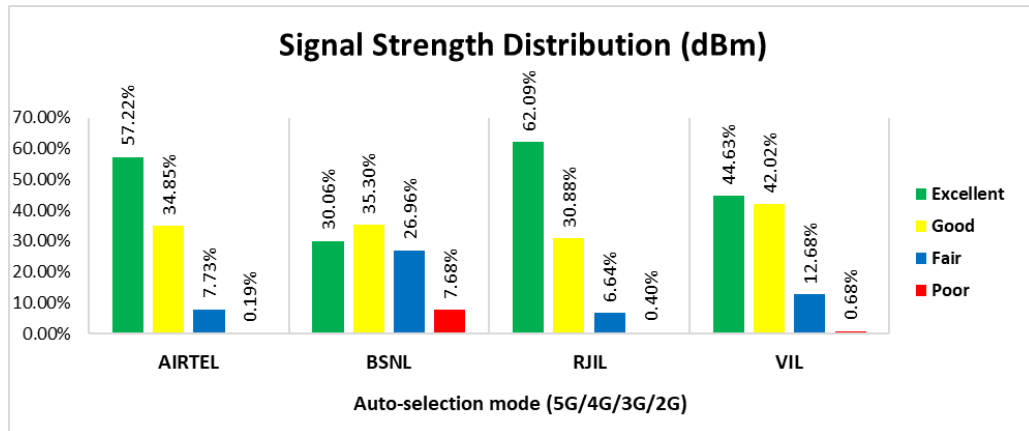
Figure-20: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

Observations:
- Airtel has 57% samples falling in the excellent signal strength category.
- BSNL has 30% samples falling in the excellent signal strength category.
- RJIL has 62% samples falling in the excellent signal strength category.
- VIL has 45% samples falling in the excellent signal strength category.

4.2.4 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	149.78	3.32	243.83	23.93
	80th Percentile	236.95	4.85	366.28	37.58
	20th Percentile	60.21	1.12	104.52	8.09
Upload Throughput (Mbits/s)	Average	37.32	2.35	23.01	9.70
	80th Percentile	64.16	3.21	40.09	15.62
	20th Percentile	9.76	1.26	5.10	4.03
Latency (ms)	50th Percentile	22.05	38.98	18.75	21.65

Table-17: Summary of Data performance in network auto-selection mode.
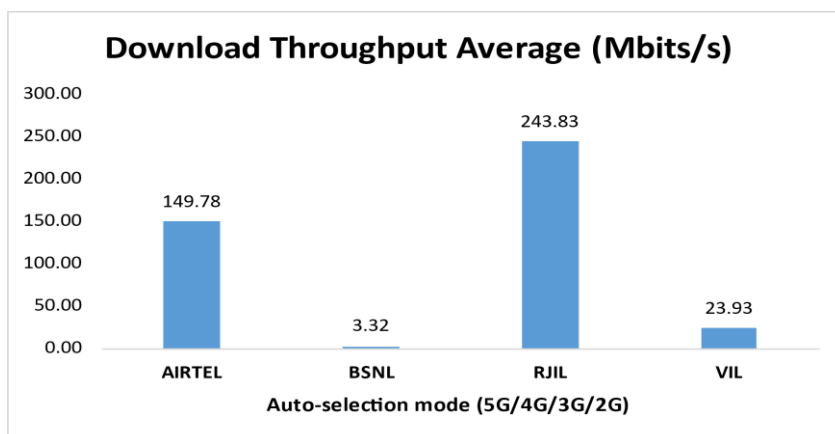
Figure- 21: Download throughput
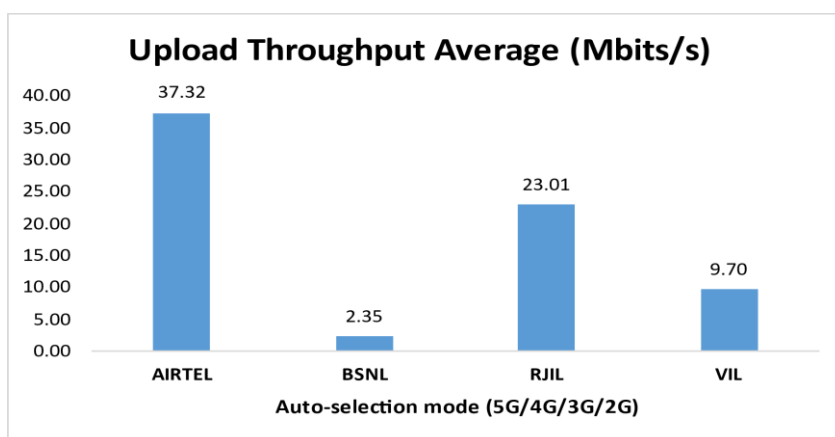
Figure- 22: Upload throughput

4.3 Hotspots

Hotspot testing have been done from 5th February 2025 to 6th February 2025. Eight locations have been tested in the city.

4.3.1 Locations

Figure- 23: Hotspot locations

4.3.2 Hotspot covered

1. MG Bus Station
2. Charminar
3. IMAX Theatre
4. L B Nagar Metro Junction
5. Nampally Railway Station
6. Ameerpet Metro Station
7. Hyderabad Airport Cargo Area
8. Secunderabad 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	80	80	80	80
Call Setup Success Rate %	100.00	100.00	100.00	98.75
Drop Call Rate %	0.00	2.50	0.00	0.00
Call Setup Time-Average (Second)	4.03	2.28	0.58	0.62

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

MG Bus 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	10.00	0.00	0.00
Call Setup Time-Average (Second)	4.03	2.25	0.53	0.54

Table-19: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).
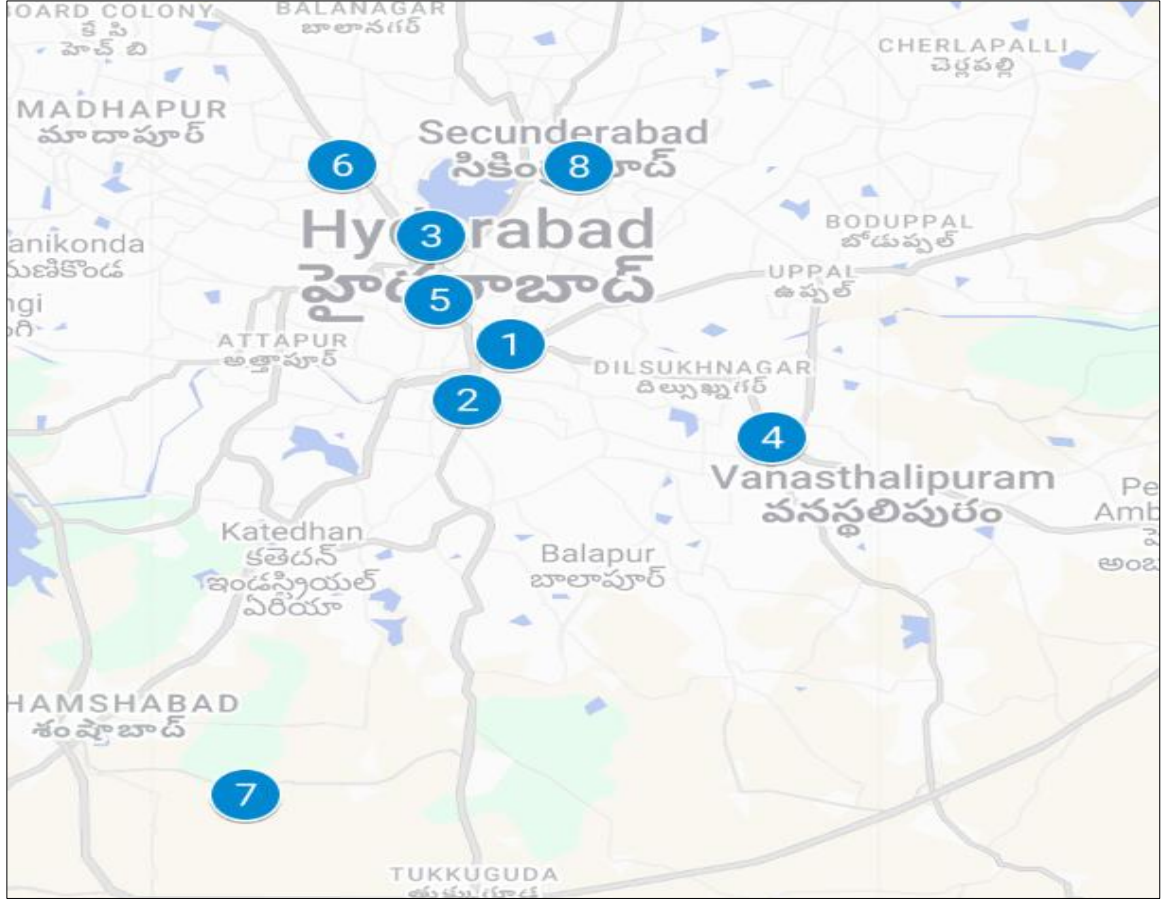
Charminar				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	4.03	2.02	0.57	0.64

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

IMAX Theatre				
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	10.00	0.00	0.00
Call Setup Time-Average (Second)	4.07	2.91	0.52	0.55

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

L B Nagar Metro Junction				
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	90.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	4.02	2.05	0.56	1.04

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

Nampally 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)	4.05	2.46	0.53	0.55

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

Ameerpet Metro Station				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	4.01	2.27	0.78	0.55

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

Hyderabad Airport Cargo Area				
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)	3.94	2.11	0.61	0.58

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

Secunderabad Railway Junction				
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)	4.06	2.21	0.58	0.53

Table-26: 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				
	Service Provider			
Parameters	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	82.19	2.9	209.72	22.25
Download Throughput 80th Percentile (Mbit/s)	103.03	5.00	317.19	35.81
Download Throughput 20th Percentile (Mbit/s)	22.42	0.87	17.12	4.58
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	29.05	2.16	22.86	13.56
Upload Throughput 80th Percentile (Mbit/s)	56.75	3.37	27.05	20.43
Upload Throughput 20th Percentile (Mbit/s)	4.40	0.74	8.70	6.17
Upload Session Setup Success Rate %	100.00	95.00	100.00	100.00
Web Browsing Delay (Second)	3.55	5.79	2.49	2.80
Youtube Initial Buffer Delay (Second)	1.02	3.63	0.73	1.58
Latency (ms) - 50th Percentile	20.53	31.15	18.50	23.30
Jitter (ms)	12.59	108.53	13.36	3.73
Packet Loss Rate%	0.89	14.71	4.51	3.26
Packet Loss Rate- 90th percentile	1.77	29.82	11.20	7.73

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

MG Bus Station				
	Service Provider			
Parameters	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	221.36	2.59	564.22	13.90
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	72.44	1.97	65.99	21.52
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.26	3.55	2.09	2.71
Youtube Initial Buffer Delay (Second)	1.25	2.98	0.66	0.94
Latency (ms)- 50th Percentile	18.30	47.50	13.05	33.13
Jitter (ms)	4.17	154.63	6.81	7.51
Packet Loss Rate%	0.00	23.40	0.00	1.40

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

Charminar				
	Service Provider			
Parameters	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	17.60	5.09	9.31	38.48
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	4.95	3.51	4.97	2.14
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.87	3.04	3.56	2.52
Youtube Initial Buffer Delay (Second)	0.90	1.82	1.08	4.17
Latency (ms) - 50th Percentile	19.70	26.33	74.50	25.95
Jitter (ms)	7.86	32.10	38.21	5.59
Packet Loss Rate%	0.10	6.60	32.20	0.30

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

IMAX Theatre				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	81.03	0.58	313.87	33.60
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	6.29	1.16	22.06	15.52
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	2.56	10.18	2.23	2.49
Youtube Initial Buffer Delay (Second)	0.73	9.88	0.51	0.70
Latency (ms) - 50th Percentile	19.20	27.83	15.53	21.55
Jitter (ms)	7.97	406.06	5.47	2.37
Packet Loss Rate%	0.20	17.50	0.00	0.50

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

L B Nagar Metro Junction				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	70.27	1.32	264.78	0.28
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	44.78	2.26	13.08	19.04
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.12	4.90	2.24	5.83
Youtube Initial Buffer Delay (Second)	0.47	6.39	0.73	0.88
Latency (ms) - 50th Percentile	19.08	34.35	31.13	32.55
Jitter (ms)	14.06	29.63	7.60	3.97
Packet Loss Rate%	0.80	3.20	0.40	22.50

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

Nampally Railway Station				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	124.05	4.54	73.19	22.41
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	71.31	3.86	15.98	18.75
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.57	3.18	2.18	2.51
Youtube Initial Buffer Delay (Second)	0.75	3.13	0.72	0.83
Latency (ms) - 50th Percentile	18.60	23.58	17.50	21.15
Jitter (ms)	7.97	23.20	8.09	2.10
Packet Loss Rate%	0.50	0.80	0.10	0.40

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

Ameerpet Metro Station				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	57.95	2.58	183.13	27.19
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	20.98	0.77	16.29	9.25
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.52	8.87	2.58	2.51
Youtube Initial Buffer Delay (Second)	1.64	-	0.64	0.69
Latency (ms) - 50th Percentile	19.40	28.95	35.50	18.10
Jitter (ms)	12.95	122.67	13.38	2.60
Packet Loss Rate%	0.90	20.50	1.10	0.40

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

Note-
- "-"All YouTube test were failed.

Hyderabad Airport Cargo Area				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	40.02	5.78	17.99	38.58
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	4.62	2.83	27.42	16.36
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.06	3.40	2.16	2.81
Youtube Initial Buffer Delay (Second)	0.68	1.78	0.81	0.75
Latency (ms) - 50th Percentile	28.05	25.53	14.65	33.00
Jitter (ms)	10.73	11.63	6.44	2.19
Packet Loss Rate%	0.80	0.90	0.10	0.10

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

Secunderabad Railway Junction				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	45.27	0.75	251.26	3.51
Download Session Setup Success Rate%	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	7.01	0.53	17.06	5.94
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	11.59	12.78	2.83	3.47
Youtube Initial Buffer Delay (Second)	1.94	-	0.76	3.12
Latency (ms)- 50th Percentile	25.50	63.50	23.13	18.65
Jitter (ms)	34.99	91.17	20.98	3.57
Packet Loss Rate%	3.80	44.80	2.20	0.50

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

Note
- "-"All YouTube test were failed.

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)	118.77	-	232.09	-
	Upload Throughput Average (Mbits/s)	41.90	-	24.75	-
4G	Download Throughput Average (Mbits/s)	35.18	-	36.22	23.12
	Upload Throughput Average (Mbits/s)	10.36	-	6.64	16.70

Table-36: Overall Summary of 5G only & 4G only data download & upload speed.

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

	MG Bus Station				
	Parameters	**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	Download Throughput Average (Mbits/s)	336.18	-	564.22	-
	Upload Throughput Average (Mbits/s)	88.17	-	65.99	-
4G	Download Throughput Average (Mbits/s)	33.79	-	34.93	18.74
	Upload Throughput Average (Mbits/s)	9.56	-	12.50	23.33

Table-37: Summary of 5G only & 4G only data download & upload speed.

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

	Charminar				
	Parameters	**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	Download Throughput Average (Mbits/s)	-	-	13.00	-
	Upload Throughput Average (Mbits/s)	-	-	1.58	-
4G	Download Throughput Average (Mbits/s)	34.29	-	19.08	49.20
	Upload Throughput Average (Mbits/s)	18.97	-	4.96	24.27

Table-38: Summary of 5G only & 4G only data download & upload speed.

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

	IMAX Theatre				
	Parameters	**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	Download Throughput Average (Mbits/s)	127.14	-	313.87	-
	Upload Throughput Average (Mbits/s)	7.27	-	22.06	-
4G	Download Throughput Average (Mbits/s)	51.77	-	74.68	33.79
	Upload Throughput Average (Mbits/s)	19.69	-	9.31	12.53

Table-39: Summary of 5G only & 4G only data download & upload speed.

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

L B Nagar Metro Junction					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	70.27	-	264.78	-
	Upload Throughput Average (Mbits/s)	44.78	-	13.08	-
4G	**Download Throughput Average (Mbits/s)**	24.35	-	50.31	0.22
	Upload Throughput Average (Mbits/s)	8.19	-	9.59	23.21

Table-40: Summary of 5G only & 4G only data download & upload speed.

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

Nampally Railway Station					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	132.74	-	73.19	-
	Upload Throughput Average (Mbits/s)	79.18	-	15.98	-
4G	**Download Throughput Average (Mbits/s)**	47.61	-	57.22	15.44
	Upload Throughput Average (Mbits/s)	9.52	-	8.29	12.47

Table-41: Summary of 5G only & 4G only data download & upload speed.

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

Ameerpet Metro Station					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	57.18	-	183.13	-
	Upload Throughput Average (Mbits/s)	29.88	-	16.29	-
4G	**Download Throughput Average (Mbits/s)**	39.94	-	31.18	28.99
	Upload Throughput Average (Mbits/s)	6.65	-	4.84	11.56

Table-42: Summary of 5G only & 4G only data download & upload speed.

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

Hyderabad Airport Cargo Area					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	-	-	17.99	-
	Upload Throughput Average (Mbits/s)	-	-	27.42	-
4G	**Download Throughput Average (Mbits/s)**	43.12	-	2.70	34.19
	Upload Throughput Average (Mbits/s)	9.11	-	1.68	16.90

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

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

Secunderabad Railway Junction					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	45.27	-	251.26	-
	Upload Throughput Average (Mbits/s)	7.01	-	17.06	-
4G	**Download Throughput Average (Mbits/s)**	6.58	-	19.63	4.35
	Upload Throughput Average (Mbits/s)	1.15	-	1.97	9.37

Table-44: 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 6th February 2025. One location has been tested in the city.
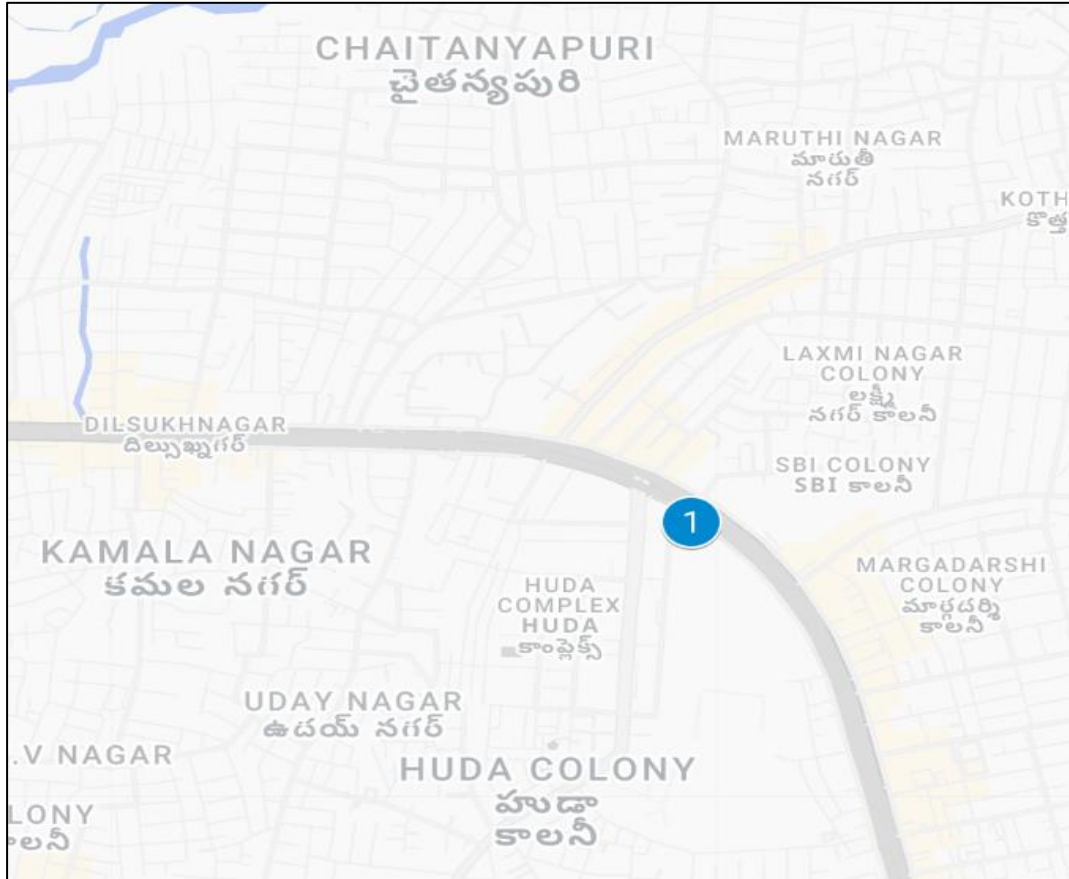
4.4.1 Drive test route

Figure-24: Walk Test location.

4.4.2 Walk Test Covered

1. Saroor Nagar Market

4.4.3 Voice Performance

Saroor Nagar Market				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	36	36	36	36
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)	4.01	2.21	0.58	0.55

Table-45: 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)

Saroor Nagar Market				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	150.25	3.48	211.79	27.49
Download Session Setup Success Rate %	100.00	95.56	100.00	100.00
Upload Throughput Average (Mbits/s)	53.24	2.74	23.97	16.73
Upload Session Setup Success Rate %	100.00	97.78	100.00	100.00
Latency (ms) - 50th Percentile	20.08	31.10	21.25	25.8

Table-46: 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 99.54%, 99.42% and 98.23% call setup success rate respectively in 3G/2G network mode. (refer table-3)

   b) Airtel, BSNL, RJIL and VIL have 99.38%, 98.66%, 96.69% and 99.16% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-5)

2. **Call Setup Time**:
   a) Airtel has taken comparatively longer time (6.10 second) to establish the voice call, whereas VIL and BSNL call setup time is 4.84 & 2.41 seconds respectively in 3G/2G network mode. (refer table-3)

   b) Airtel has taken comparatively longer time (3.98 second) to establish the voice call, whereas BSNL, VIL & RJIL call setup time is 2.36, 0.62 & 0.58 seconds respectively in Auto-selection mode (5G/4G/3G/2G). (refer table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G), RJIL, Airtel and VIL have 1.32%, 0.59% & 0.44% silence call rate respectively. Further VIL has higher RTP packet loss rate in downlink (2.07%) compared to Airtel (0.50%) and RJIL (0.39%). In uplink the RTP packet loss rate is higher for VIL (0.83%) compared to RJIL (0.53%) and Airtel (0.37%). (refer table-6)

4. **Call Drop Rate**:
   a) Airtel, BSNL and VIL have 0.15%, 1.60% and 1.20% drop call rate in 3G/2G network mode. (refer table-3)

   b) Overall BSNL's call drop rate 2.34% is higher than QoS benchmark of 2%, while Airtel, RJIL & VIL have 0.00%, 0.24% and 0.12% drop call rate respectively in Auto-selection mode (5G/4G/3G/2G). (refer table-5)

5.2 Overall Data

1. **Data download and upload performance (Dynamic i.e. while moving):**
   a) BSNL (3.31 Mbps) and VIL (24.04 Mbps) being on 4G as top technology, have comparatively lower data speeds respectively. While Airtel and RJIL have average download speed of 146.96 Mbps and 240.66 Mbps respectively. (refer table-9)

   b) BSNL (2.36 Mbps) and VIL (10.23 Mbps) being on 4G as top technology, have comparatively lower data speeds respectively. While Airtel and RJIL have average upload speed of 37.71 Mbps and 23.05 Mbps respectively. (refer table-9)

2. **Data download and upload performance (static i.e. while stationary):**
   a) At Hotspots, RJIL has better 5G QoS performance comparatively, with average download speed of 209.72 Mbps. (refer table-27)

b) At Hotspots, Airtel has better 5G QoS performance comparatively, with average upload speed of 29.05 Mbps. (refer table-27)

3. **Data session setup success rate (static i.e. while stationary):**
   a) Airtel, BSNL, RJIL & VIL have 100.00% download session setup success rate. (refer table-27)

   b) Airtel, RJIL & VIL have 100.00% while BSNL have 95.00% upload session setup success rate respectively. (refer table-27)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 99.54% call setup success rate and 0.15% call drop rate have been observed in 3G/2G network mode. Performance is well within the benchmark of 98.00% & 2.00% respectively for LSA and city drive. (refer table-3 & 11)

- 99.38% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-5)

- 99.28% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive. Performance is well within the benchmark of 98.00% & 2.00% respectively. (refer table-13)

- 100.00% call setup success rate and 0.00% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-18)

- 100.00% call setup success rate and 0.00% drop call rate has been observed for auto-selection mode (5G/4G/3G/2G) for walk test location. (refer table-45)

Data

- Airtel has 146.96 Mbps average download throughput & 37.71 Mbps average upload throughput across measured routes for LSA. (refer table-9)

- Airtel has 149.78 Mbps average download throughput & 37.32 Mbps average upload throughput across measured routes for city drive. (refer table-17)

- Charminar, IMAX Theatre, L B Nagar Metro Junction, Ameerpet Metro Station, Hyderabad Airport Cargo Area and Secunderabad Railway Junction have less download speed (less than 100 Mbps) out of total 8 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-29, 30, 31, 33, 34 & 35)

- Charminar, IMAX Theatre, Hyderabad Airport Cargo Area and Secunderabad Railway Junction have less upload speed (less than 20 Mbps) out of total 8 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-29, 30, 34 & 35)

- Airtel has 150.25 Mbps average download throughput & 53.24 Mbps average upload throughput for walk test location.

2. BSNL:
Voice
- 99.42% call setup success rate and 1.60% call drop rate have been observed in 3G/2G network mode. Performance is meeting the benchmark of 98.00% & 2.00% respectively for LSA and city drive. (refer table-3 & 11)

- 98.66% call setup success rate and 2.34% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not meeting the benchmark of 2.00% for drop call rate in LSA. (refer table-5)

- 98.44% call setup success rate and 2.45% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not meeting the benchmark of 2.00% for drop call rate in city drive. (refer table-13)

- 100.00% call setup success rate and 2.50% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. Performance is not meeting the benchmark of 2.00% for drop call rate. (refer table-18)

- 100.00% call setup success rate and 0.00% drop call rate has been observed in auto-selection mode (5G/4G/3G/2G) for walk test location. (refer table- 45)

Data
- BSNL has 3.31 Mbps average download throughput & 2.36 Mbps average upload throughput across measured routes for LSA. (refer table-9)

- BSNL has 3.32 Mbps average download throughput & 2.35 Mbps average upload throughput across measured routes for city drive. (refer table-17)

- All Hotspots have less download speed (less than 10 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-28 to 35)

- MG Bus Station, IMAX Theatre, Ameerpet Metro Station and Secunderabad Railway Junction hotspots have less upload speeds (less than 2 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-28, 30, 33 & 35)

- Saroor Nagar Market has less download speed (less than 10 Mbps) for walk test location. (refer table-46)

3. RJIL:
Voice
- 96.69% call setup success rate and 0.24% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not within the benchmark of 98.00% but within the benchmark of 2.00% respectively for LSA. (refer table-5)

- 96.16% call setup success rate and 0.29% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not within the

benchmark of 98.00% but within the benchmark of 2.00% respectively for city drive. (refer table-13)

- 100.00% call setup success rate and 0.00% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-18)

- 100.00% call setup success rate and 0.00% call drop rate has been observed in auto-selection mode (5G/4G/3G/2G) for walk test location. (refer table- 45)

Data
- RJIL has 240.66 Mbps average download speed & 23.05 Mbps average upload speed across measured routes in LSA. (refer table-9)

- RJIL has 243.83 Mbps average download speed & 23.01 Mbps average upload speed across measured routes in city drive. (refer table-17)

- Charminar, Nampally Railway Station and Hyderabad Airport Cargo Area hotspot have less download speed (less than 100 Mbps) out of total 8 Hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-29, 32 & 34)

- Charminar, L B Nagar Metro Junction, Nampally Railway Station, Ameerpet Metro Station and Secunderabad Railway Junction have less upload speed (less than 20 Mbps) out of total 8 hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-29, 31, 32, 33 & 35)

- RJIL has 211.79 Mbps average download throughput & 23.97 Mbps average upload throughput for walk test location.

4. VIL:
Voice
- 98.23% call setup success rate and 1.20% call drop rate have been observed in 3G/2G network mode. Performance is meeting the benchmark of 98.00% & 2.00% respectively for LSA and city drive. (refer table-3 & 11)

- 99.16% call setup success rate and 0.12% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G). Performance is meeting the benchmark of 98.00% & 2.00% respectively for LSA. (refer table-5)

- 99.16% call setup success rate and 0.14% call drop rate have been observed for auto-selection mode (5G/4G/3G/2G). Performance is meeting the benchmark of 98.00% & 2.00% respectively for city drive. (refer table-13)

- 98.75% call setup success rate and 0.00% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-18)

- 100.00% call setup success rate and 0.00% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G) for walk test location. (refer table-45)

Data

- VIL has 24.04 Mbps average download speed & 10.23 Mbps average upload speed across measured routes in LSA. (refer table-9)

- VIL has 23.93 Mbps average download speed & 9.70 Mbps average upload speed across measured routes in city drive. (refer table-17)

- L B Nagar Metro Junction and Secunderabad Railway Junction hotspots have less download speeds (less than 10 Mbps) out of total 8 hotspots for auto-selection mode (5G/4G/3G/2G). (refer table-31 & 35)

- VIL has 27.49 Mbps average download throughput & 16.73 Mbps average upload throughput for walk test location.

6. Annexure

6.1 Route wise coverage map

6.1.1 City
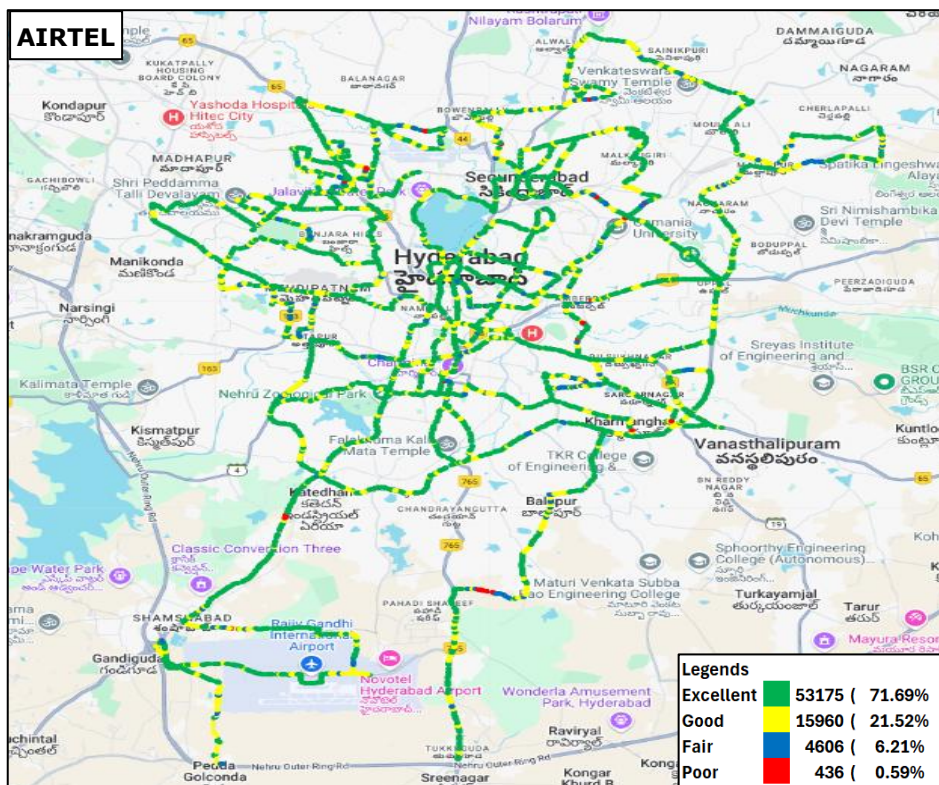
Figure-25: Signal strength 3G/2G network mode – AIRTEL.
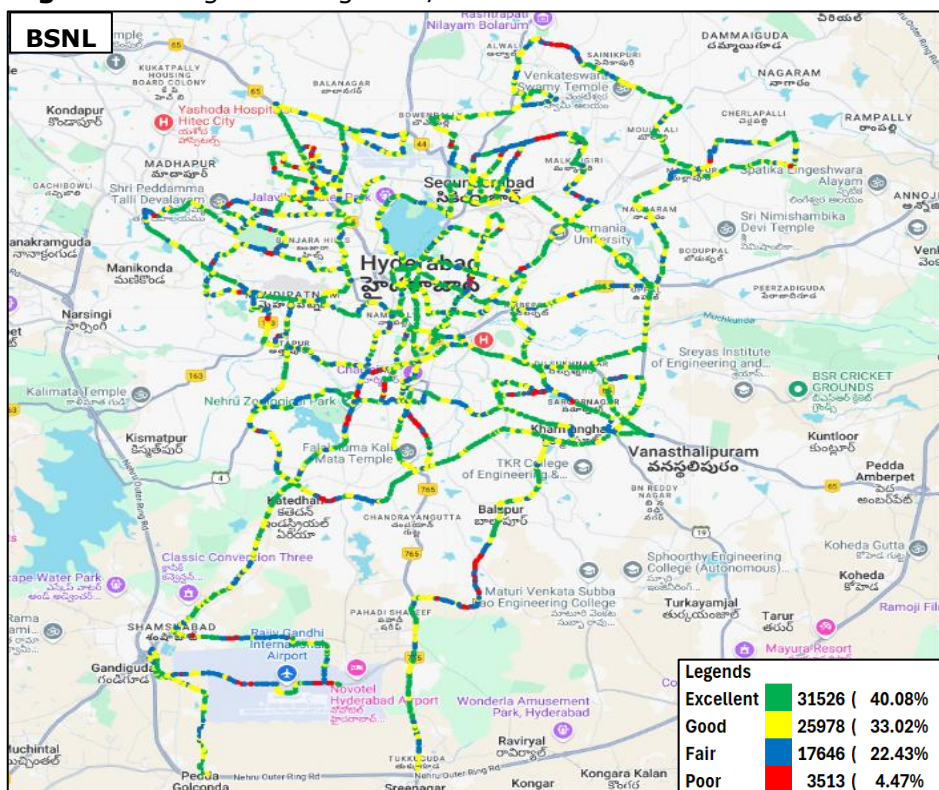
Figure-26: Signal strength 3G/2G network mode – BSNL.
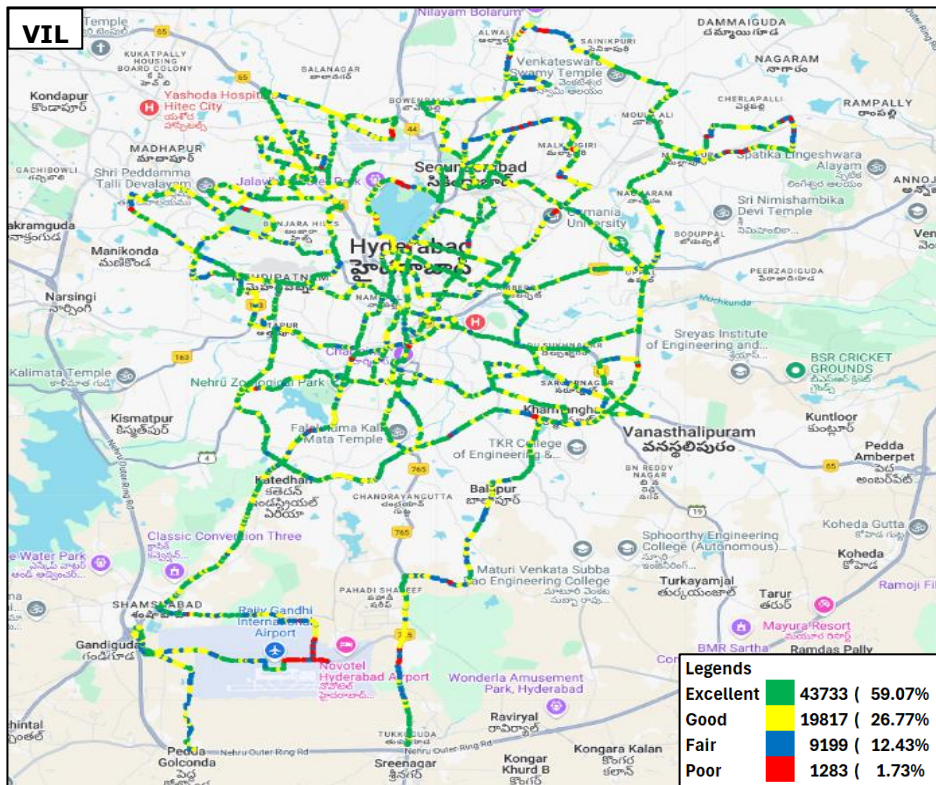
Figure-27: Signal strength 3G/2G network mode – VIL.
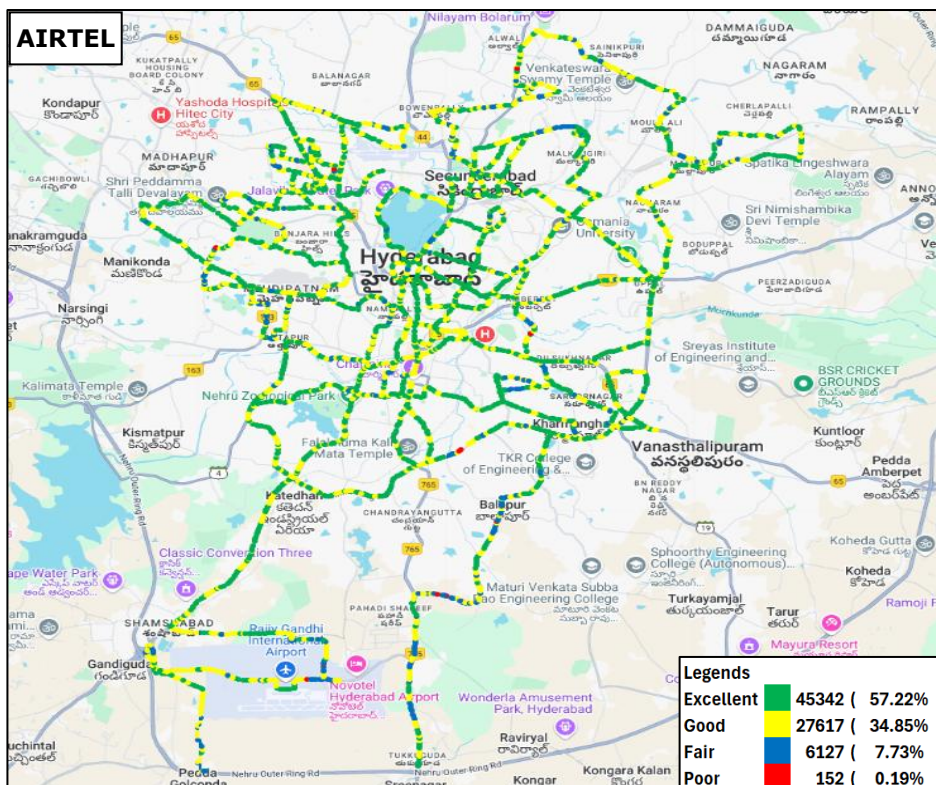
Figure-28: Signal strength auto-selection mode 5G/4G/3G/2G – AIRTEL.
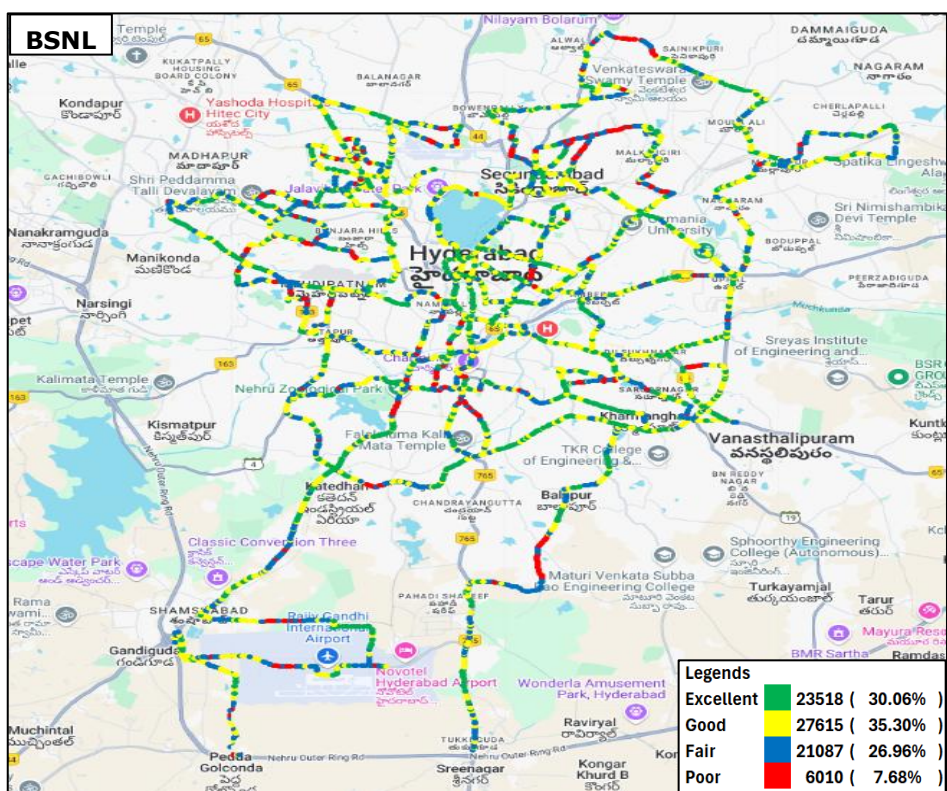
Figure-29: Signal strength auto-selection mode 5G/4G/3G/2G – BSNL.
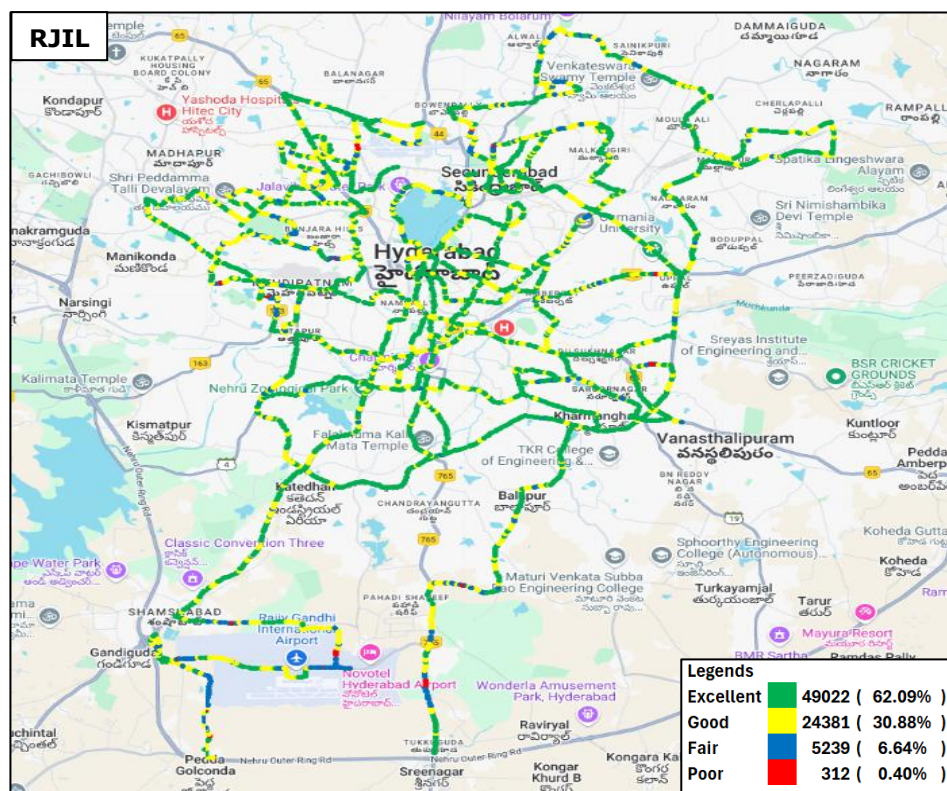
Figure-30: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL.
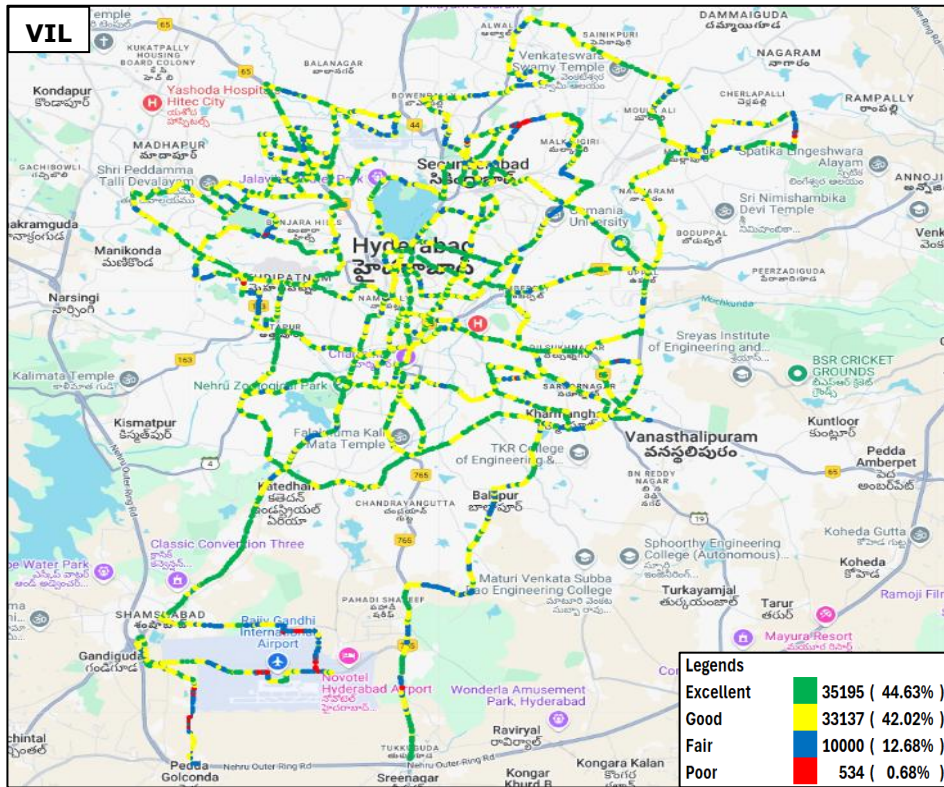
Figure-31: Signal strength auto-selection mode 5G/4G/3G/2G – VIL.

7. Appendix

The details of the setup used for conducting the drive test and the network or performance parameters captured under different conditions may be seen at Appendix-I. The calculation method of each QoS parameter is given in Appendix-II of the report. The summary of key equipment used in technical setup is as under

- **Device-1**: OnePlus Nord CE3 for 3G/2G CAT-15 Smartphone.
- **Device-2**: Samsung Galaxy S23 for 5G/4G/3G/2G CAT-20 Smartphone
- **Drive test Software**: Azenqos Engineering capable Applications to capture actual user experience.

7.1 Appendix-I
7.1.1 Drive test setup

Voice Call		
Call details	**Technology**	**Detail**
Call Setup Timeout	• 3G/2G auto mode- switch Call • 5G/4G/3G/2G auto mode- switch Call • 5G/4G MOS Call	30 Sec
Call Duration		90 Sec
Wait/ Guard Time		15 Sec

Table-47: Voice test detail

> **Note-**
> - There is 15 sec wait time after locking and before starting first call in 3G/2G call.
> - 10 calls to be made at each Hotspot location.
> - Minimum 10 Calls to be made during the walk test. Call count will be increased based on walk test distance.
> - Speech quality (MOS) has been measured only in city drive & highway by making Mobile to Mobile call.
> - 180 Sec calls were made only in highway & railway route drive.
> - 5G/4G/3G/2G auto mode MOS call were made in BSNL as BSNL don't have VoLTE & VoNR network availability.

Data Test		
Test Type	**Technology**	**Detail**
HTTP/FTP Download	5G/4G/3G/2G Auto Mode	500 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time)
HTTP/FTP Upload		250 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time)
YouTube Streaming		20 Sec Video & 25 sec Timeout (Only at Hotspot)

Web Browsing		3 popular websites (www.google.co.in, www.amazon.in, www.facebook.com) 20 sec timeout (only at Hotspot)
Latency		25 count- Dynamic 1000 count- Hotspot Payload- 42 bytes in all drive

Table-48: Data test detail

Note-
- 5 Data iteration to be done at each hotspot location.
- Minimum 5 iteration to be made during the walk test. Iteration count will be increased based on walk test distance.
- Ping test to be performed only once at hotspot location.
- Youtube & Web browsing test to be performed at static location only.
- All values are taken up to two decimal places with round off.
- Download and upload testing has been done on FTP server for Airtel, BSNL & RJIL. (Airtel, BSNL & RJIL not provided HTTP server)
- VIL download and upload testing is done on HTTP Server.
- Download & Upload test performed at hotspot in 4G/3G/2G auto-selection also.
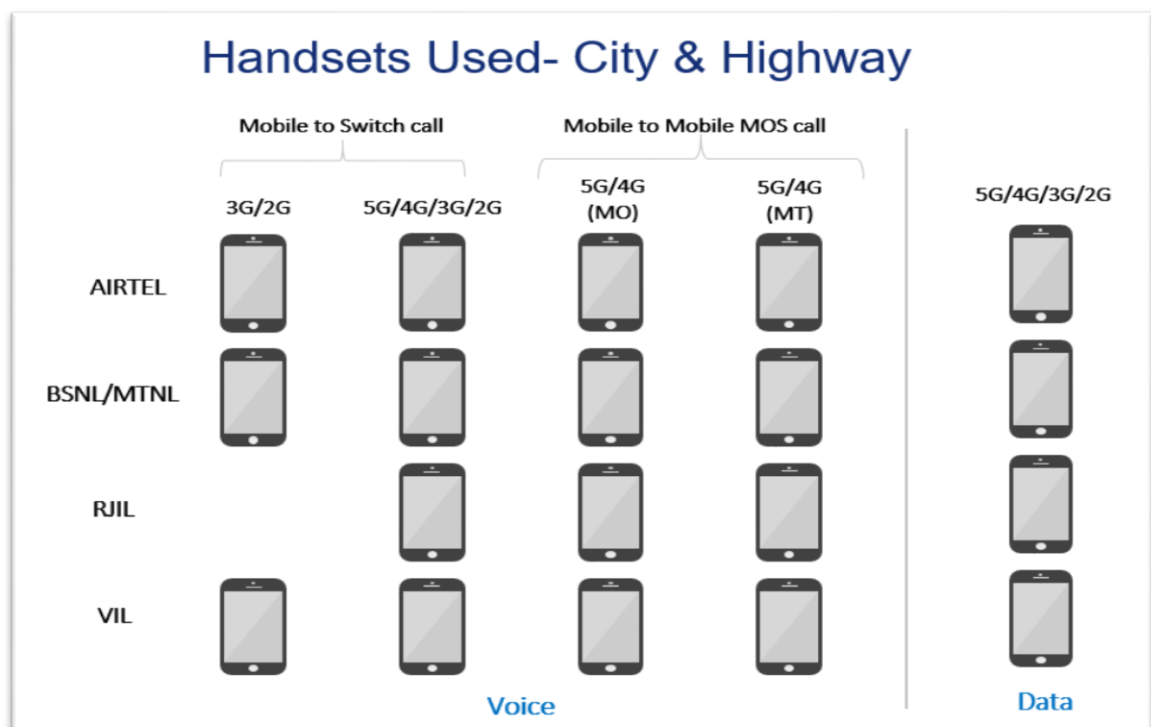
Figure-32: Number of handsets used in city & highway drive

MO: Mobile originating

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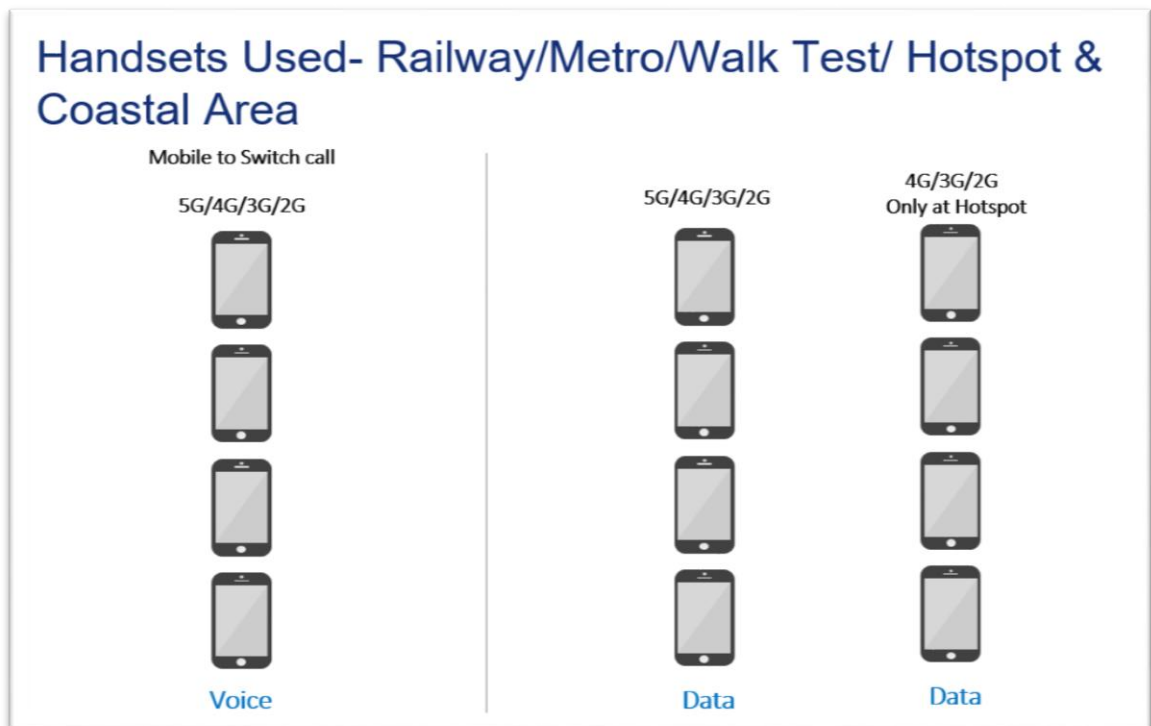
Figure-33: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)
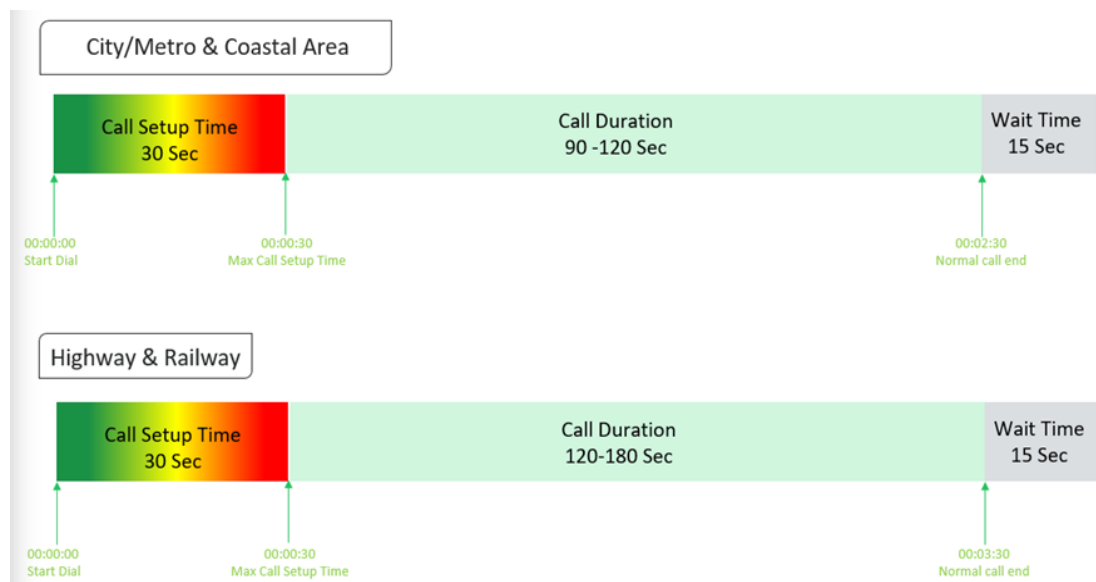
Figure-34: Voice test script for city/railway/metro/highway & coastal area

- 15 sec wait time is applied after locking Radio Access Technology (RAT) to 3G/2G and before starting first call in 3G/2G call.

- Speech quality (MOS) will be measured only City & Highway drive by making Mobile to Mobile calls.

(b) Hotspot voice testing

Figure-35: Voice test script for walktest/hotspot

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

(c) Dynamic Data (internet) test
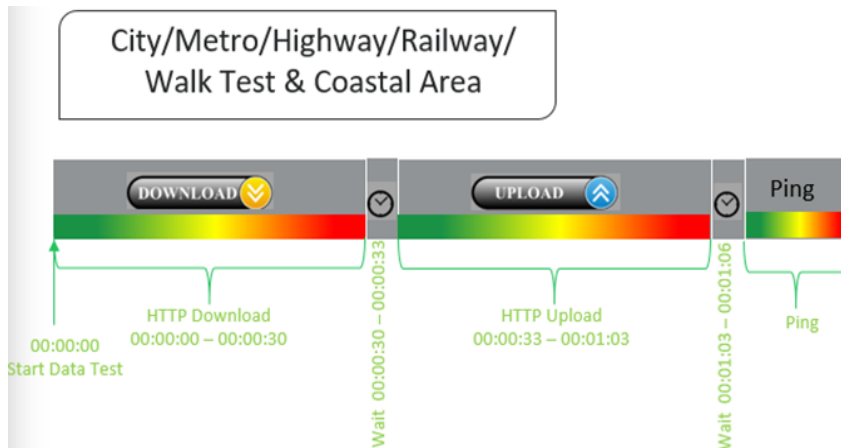
Figure-36: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing
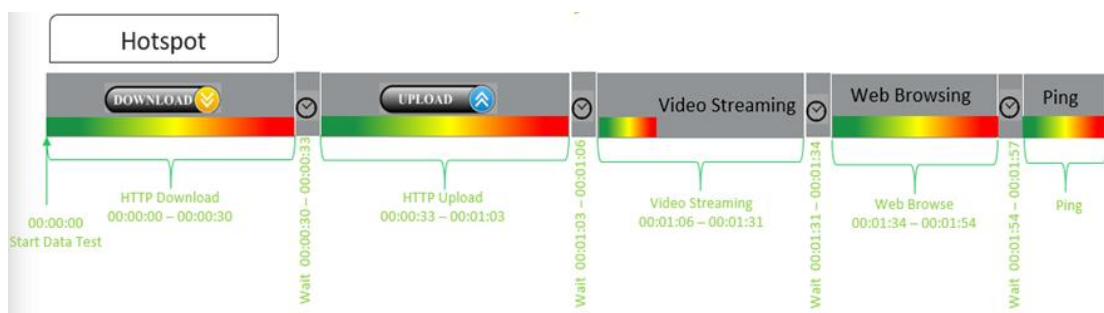
Figure-37: Data test script used at hotspot

- 5 Data iteration done at each hotspot location.
- Min. 5 iteration made during the walk test.
- Web browsing duration mentioned above is for one web site only.

- Only 1 ping iteration (with 1000 Count) done at hotspot location.
- Download & Upload test performed at hotspot in 4G/3G/2G auto-selection also.

7.2 Appendix-II

7.2.1 Network Performance Parameters for Voice calls

Parameter Name	Definition
Call Setup Success Rate	(i) Call Setup Success Rate is defined as the ratio of Established Calls to Call Attempts. 'Established Calls' mean the following events have happened in call setup: (a) Call attempt is made (b) The signaling channel is allocated (c) The call is routed to the outwards path of the terminating network (d) An alert signal is received by caller in the form of ring back tone, busy tone, or an announcement. CSSR = (Total Call Established/ Total Call Attempt) *100 As per QoS Regulation 2024 benchmark value is **>=98%**
Drop Call Rate	Call drop represents the service provider network's ability to maintain a call once it has been successfully established. This parameter shall include both incoming calls and outgoing calls which, once they have been established and have an assigned traffic channel/ bearer, are dropped, or interrupted before their normal completion by the user, the cause of the early termination being within the service provider's network Drop Call Rate = (Total Call Drop/Total Call Established) *100 As per QoS Regulation 2024 benchmark value is **<=2%**
Call Setup Time	Time taken from call initiate to call alerting/ringing. Call Setup Time = T2- T1 T2- Ringing (VoLTE/VoNR) & Alerting (for WCDMA & GSM), T1- Invite (VoLTE/VoNR) & CM Service Request (for WCDMA & GSM)
Voice Quality (MOS)	Voice quality in mobile networks is measured with algorithms based on ITU-T P.863 (POLQA). The grading for Voice quality has been given as: Excellent: $MOS \geq 4$ and < 5 Good : $MOS \geq 3$ and < 4 Fair : $MOS \geq 2$ and < 3 Poor : $MOS \geq 1$ and < 2
Handover Success Rate	Handover Success Rate = Count of successful handovers (All Technology Handover combined) / Total count of Handover Attempt (All Technology Handover combined) *100 Handover type which are considered- 2G Inter & Intra cell, 3G Soft & IRAT, 4G Inter & Intra frequency & SRVCC, 5G Inter & Intra frequency & 5G to 4G handovers.
Silence Call	A call which has ≥ 4 sec continuous RTP gap is considered as a Silence Call. Silence call rate = (count of silence call / Total calls established) *100 If a call observes multiple silence count >=4 sec in a particular established call it has been taken as one silent event.

Jitter	The inter arrival jitter is the difference in the relative transit time for two packets. The relative transit time is the difference between a packet's Real-time Transport Protocol (RTP) timestamp and the receiver's clock at the time of arrival, measured in the same units. If Si is the RTP timestamp from packet i, and Ri is the time of arrival in RTP timestamps units for packet i, then for two packets i and j the inter-arrival jitter D can be expressed as: **D(i,j) = (Rj - Ri) - (Sj - Si)** The interarrival jitter is calculated continuously as each data packet i is received from source SSRC_n, using this difference D for that packet and the previous packet i-1 in order of arrival (not necessarily in sequence), according to the formula **J(i) = J(i-1) + (|D(i-1,i)| - J(i-1))/16 or 8**
Downlink Packet Drop Rate	Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call originating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE)
Uplink Packet Drop Rate	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).
Signal Strength	Signal strength is the signal power level received by the wireless user. *(see table below)*

Parameter Name	Technology	Signal Strength (dBm)			
		Excellent	Good	Fair	Poor
Rx Level	GSM	0 to $\geq$ -65	<-65 to $\geq$ -75	<-75 to $\geq$-85	<-85 to min
RSCP	WCDMA	0 to $\geq$ -70	<-70 to $\geq$ -80	<-80 to $\geq$ -90	<-90 to min
RSRP	LTE	0 to $\geq$ -80	<-80 to $\geq$ -95	<-95 to $\geq$-110	<-110 to min
SS_RSRP	NR	0 to $\geq$ -80	<-80 to $\geq$ -95	<-95 to $\geq$-110	<-110 to min

Table-49: Network performance parameter and definition voice

7.2.2 Network Performance Parameters Data tests

Parameter Name	Definition
Download Speed (Mbps)	The download speed is defined as the data transmission rate that is achieved for downloading a test file from a test server to a test device. Download Speed = Total bytes transferred during download / Total time for transfer • 80th percentile (upper range) & 20th percentile (lower range) value has been calculated for download throughput in dynamic drive and Hotspot combine data
Upload Speed (Mbps)	The upload speed is the data transmission rate that is achieved for uploading a test file from a test device to a test server. Upload Speed = Total bytes transferred during upload / Total time for transfer. • 80th percentile (upper range) & 20th percentile (lower range) value has been calculated for upload throughput in dynamic drive and Hotspot combine data.

Download Session Setup Success Rate	(total download session established (successfully connected to server)/ total download session attempt) *100. This KPI has been calculated for Hotspot only.
Upload Session Setup Success Rate	(total upload session established (successfully connected to server)/ total upload session attempt)*100. This KPI need to report for Hotspot only.
Web Page Download Time	Web browsing test is used to measure performance in terms of opening a web/HTTP page. Time taken to open the web page successfully is considered as web browsing delay/web page download time.
Video Streaming Delay	The Video streaming delay is time taken from start of video transfer to First video frame displayed in player.
Latency	Latency is the time it takes for a small data set to be transmitted from a device to a server on the Internet and back to the same device again. The Latency is measured in milliseconds (ms). To calculate the one-way latency we just do half of the round-trip time. 50th percentile of one-way latency has been reported.
Jitter	Measure of variation in time in arrival of packets from a source to destination The consideration of packet delay jitter is considered by standard deviation of Inter Packet Delay Variation. If IPDV is used. By standard deviation is meant the average of standard deviation of IPDV on DL IPDV(i) = D(i) – D(i-1) then Stdvs of IPDV is considered as jitter.
Packet Loss Rate	Number of packets lost out of total packet transferred during test. Packet loss rate = (Total packet lost / Total packet sent) *100 * Packet delay (using ping) >90 ms considered as packet loss and included in packet loss rate. * Packet loss rate is calculated based on ICMP * 90th percentile for Packet loss rate has been reported in overall Hotspot performance summary.

Table-50: 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.