



TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Delhi LSA

September 2024

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1. Introduction

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

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

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

2. Executive Summary (LSA)

2.1 Drive test details

This report covers the findings of the IDT undertaken in Delhi License Service Area (LSA) during September-2024 under the supervision of TRAI Regional Office (RO), Delhi. 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	Delhi	City	600	17-Sep-2024	24-Sep-2024
2	Delhi	City (Inter-operator calling)	35	25-Sep-2024	25-Sep-2024
3	Delhi	City	16 Locations	26-Sep-2024	27-Sep-2024
3	Blue Line, Orange Line, Violet Line, Red Line & Yellow line	Metro	210	30-Sep-2024	1-Oct-2024

Table-1: Drive test summary

2.2 Drive test routes

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

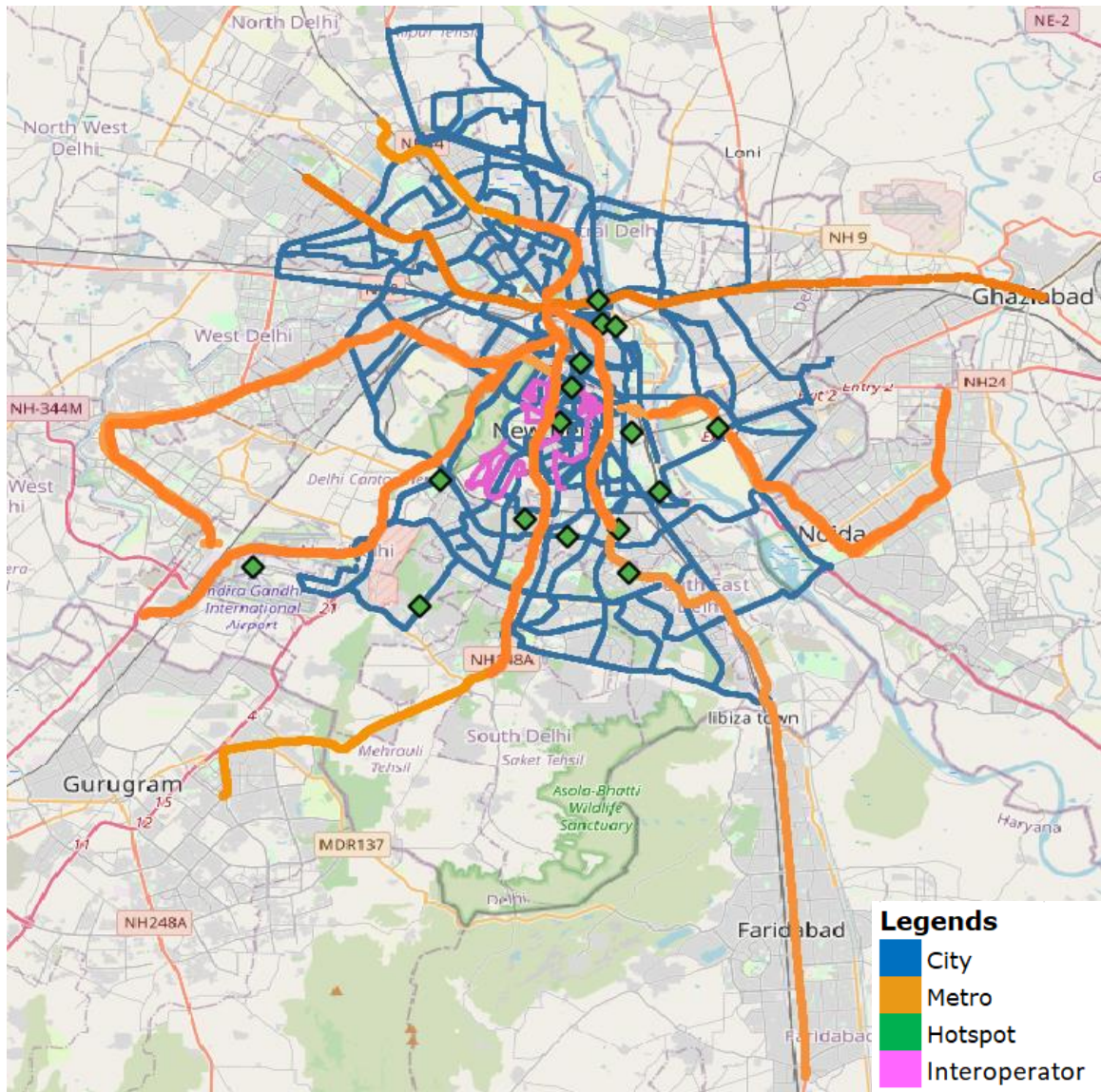


Figure-1: Drive test routes

2.3 Summary of areas covered

a) City- Central Delhi, Shalimar Bagh, Punjabi Bagh, Vasant Vihar, Greater Kailash, Shahdara, Laxmi Nagar & Yamuna Vihar.

b) Railway/ Metro-

1. Noida Electronic City to Dwarka Sector 21 (Blue Line).
2. Yashobhoomi Dwarka Sector 25 to New Delhi (Orange Line).

3. Kashmere Gate to Raja Nahar Singh (Violet line).
4. Shaheed Sthal to Rithala (Red Line).
5. Samaypur Badli to Millennium City Centre (Yellow Line).

c) Hotspot-

1. Connaught Place
2. Akshardham Temple
3. Chandni Chowk
4. Kashmere Gate Bus Stand
5. New Delhi Railway Station
6. Lal Qila
7. Pragati Maidan
8. North Block
9. Lajpat Nagar Market
10. All India Institute of Medical Sciences (AIIMS).
11. Greater Kailash Market
12. Hazrat Nizamuddin Railway Station
13. Vasant Kunj Mall
14. Sarojini Nagar Market
15. Dhaura Kuan Bus Stand
16. Indira Gandhi International Airport.

2.4 Telecom service providers detected frequency bands

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

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

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

Note-

- NA - 4G Frequency band not detected during data collection.

QoS Performance Analysis- Delhi 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 September-2024 covering city, metro and hotspots. (Refer Table-1)

3.2 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	MTNL	VIL
Call Attempts	1073	1091	1070
Call Setup Success Rate %	99.44	98.72	99.72
Drop Call Rate%	0.94	7.24	1.31
Call Setup Time-Average (Second)	3.17	2.83	3.47
Handover Success Rate %	97.69	99.98	99.70

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

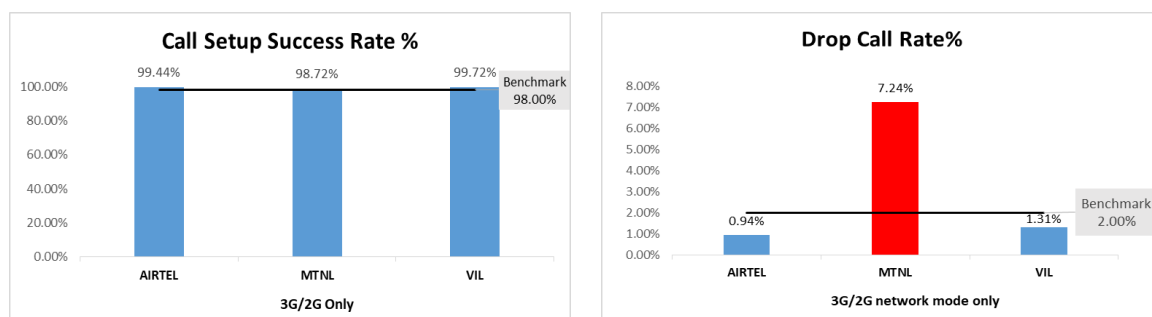


Figure-2: Call setup success rate and drop call rate performance

Number of unique cell ids covered in Voice call test- Technology wise			
Technology	Service Provider		
	3G/2G network mode only		
	AIRTEL	MTNL	VIL
3G	NA	627	1030
2G	1979	1	294

Table-4: Technology wise number of network cell ids 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	MTNL	RJIL	VIL
Call Attempts	1723	1673	1866	1729
Call Setup Success Rate %	99.25	97.49	94.00	99.25
Drop Call Rate%	0.12	7.23	0.23	0.23
Call Setup Time-Average (Second)	0.82	3.27	0.73	1.55
Handover Success Rate %	98.02	99.98	98.00	97.98

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

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	MTNL	RJIL	VIL
Call Established (within service provider Network)	1277	1287	1295	1282
Number of calls silent for >4 Sec	7	NA	39	30
Silence Call Rate %	0.55	NA	3.01	2.34
Number of silence instances for >4 Sec	12	NA	47	35
Number of silence instances for >3 Sec	19	NA	60	75
Number of silence instances for >2 sec	36	NA	116	278
RTP Jitter (4G & 5G) in ms	4.37	NA	11.34	22.02
Packet loss Rate Downlink %	1.11	NA	2.25	1.68
Packet loss Rate Uplink %	0.77	NA	1.84	2.01

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

Note-

- Due to unavailability of packet switched (4G & 5G) network in MTNL silence instances are not captured.

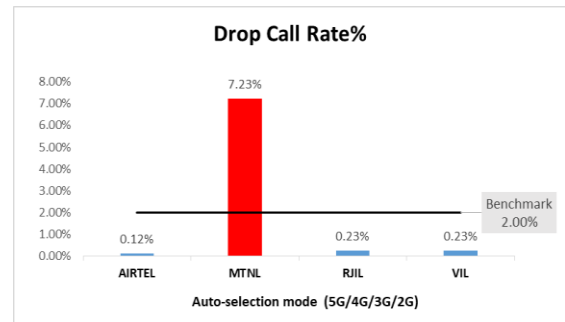
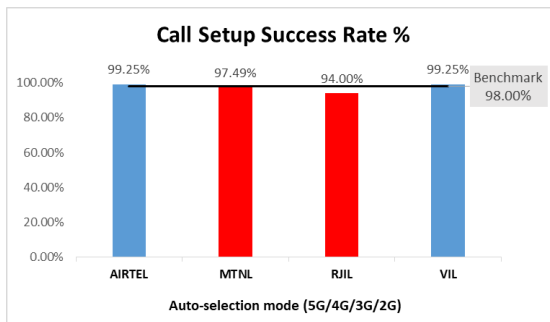


Figure-3: Performance for call setup success rate and drop call rate

Number of unique cell ids covered in Voice test- Technology wise				
Technology	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
5G	0	NA	2135	NA

4G	5596	NA	5701	5642
3G	NA	696	NA	16
2G	13	68	NA	5

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

Note-

- NA- Service provider doesn't provide services in respective technology.
- 0- No calls were found on 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's 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	MTNL	RJIL	VIL
Total Number of MOS Samples for calls in table-6	7542	6357	7326	7512
Speech Quality (Average MOS Score)	4.01	2.87	3.81	4.33
Number of samples with MOS ≥ 4 to <5 (Excellent)	6274	0	4641	5967
Number of samples with MOS ≥ 3 to <4 (Good)	1101	3383	2044	1091
Number of samples with MOS ≥ 2 to <3 (Fair)	98	2348	407	289
Number of samples with MOS ≥ 1 to <2 (Poor)	69	626	234	165
%age of samples with MOS ≥ 4 to <5 (Excellent)	83.19%	0.00%	63.35%	79.43%
%age of samples with MOS ≥ 3 to <4 (Good)	14.60%	53.22%	27.90%	14.52%
%age of samples with MOS ≥ 2 to <3 (Fair)	1.30%	36.94%	5.56%	3.85%
%age of samples with MOS ≥ 1 to <2 (Poor)	0.91%	9.85%	3.19%	2.20%

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

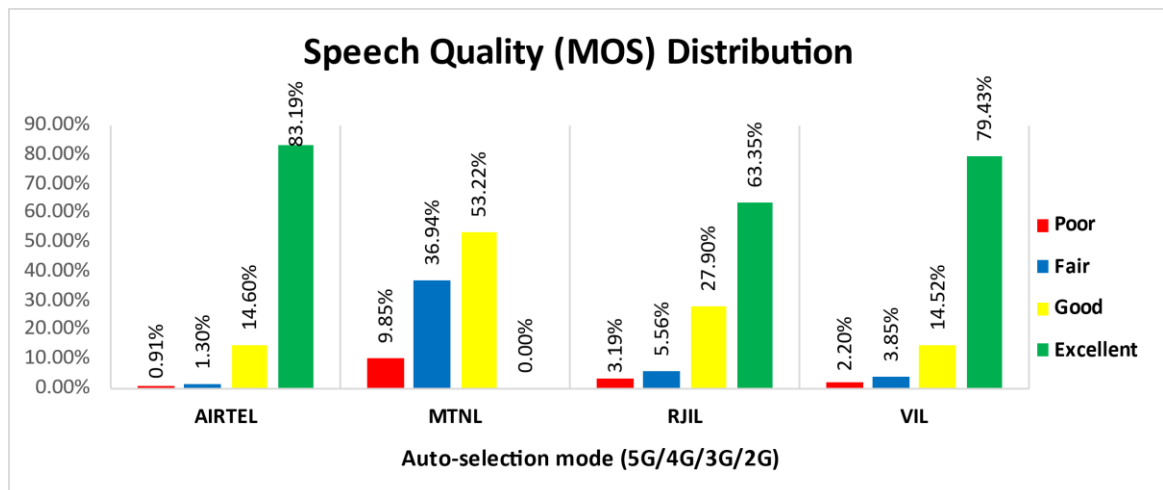


Figure- 4: Distribution of samples in MOS score range

(d) Inter-service provider voice call performance: To check the performance of inter-service provider call setup success rate, total 114 to 136 inter operator calls were attempted. The Call setup success rate and call setup time observation is as below.

Call setup success rate %				
From Service Provider	To Service Provider			
	AIRTEL	MTNL	RJIL	VIL
AIRTEL	NA	100.00	100.00	100.00
MTNL	99.12	NA	99.18	98.40
RJIL	98.47	100.00	NA	100.00
VIL	99.25	100.00	99.25	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	MTNL	RJIL	VIL
AIRTEL	NA	5.20	2.39	2.49
MTNL	3.36	NA	3.99	4.38
RJIL	2.03	4.24	NA	1.93
VIL	2.11	4.61	2.29	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	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	171.44	3.71	231.82	14.45
	80th Percentile	273.19	6.02	389.09	24.24
	20th Percentile	49.40	1.04	54.87	3.38
Upload Throughput (Mbits/s)	Average	34.37	1.67	23.91	4.59
	80th Percentile	61.70	2.63	42.27	6.78
	20th Percentile	6.98	0.66	4.96	1.93
Ping (ms)	Average	27.45	NA	NA	NA

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

Note-
• NA – Due to unavailability of TSP server details, testing could not be performed.

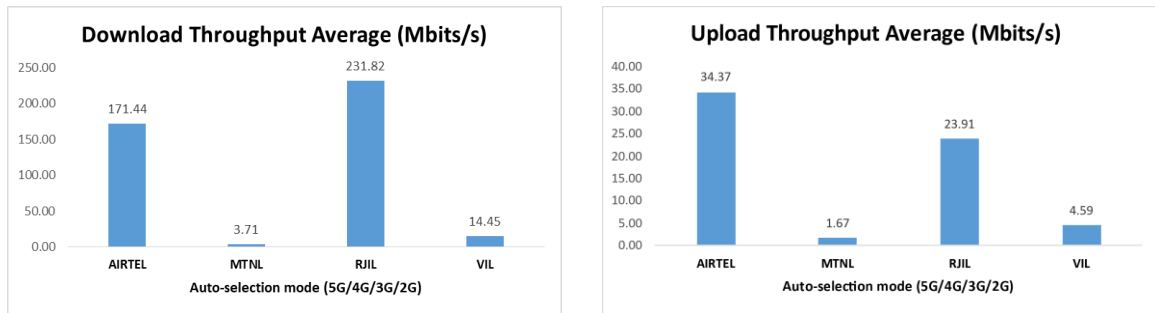


Figure- 5: Download and upload throughput

Number of unique cell ids covered in Data test- Technology wise				
Technology	Service Provider			
	Auto-selection mode 5G/4G/3G/2G			
	AIRTEL	MTNL	RJIL	VIL
5G	0	NA	3112	NA
4G	5766	NA	594	3323
3G	NA	730	NA	39
2G	1	70	NA	6

Table-12: Technology wise number of network cell ids latched during drive test

Note-

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

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis

4.1 Overview

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

4.2 City

Drive test has been conducted from 17th September 2024 to 24th September 2024 in Delhi. (Refer Table#1)

4.2.1 Drive test route

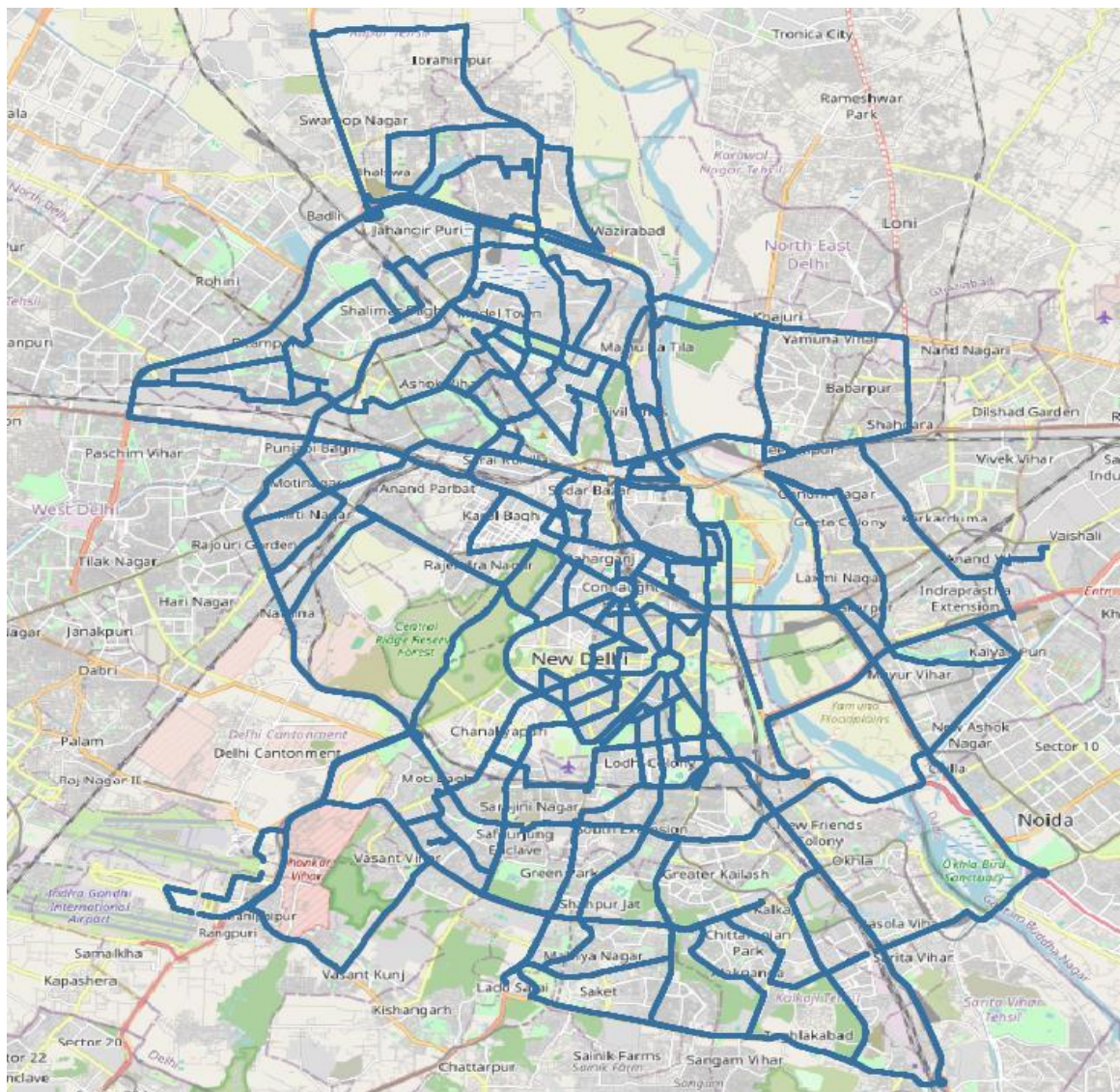


Figure- 6: Drive test routes

4.2.2 Areas covered

Nearby Central Delhi, Shalimar Bagh, Punjabi Bagh, Vasant Vihar, Greater Kailash, Shahdara, Laxmi Nagar, Yamuna Vihar 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	MTNL	VIL
Call Attempts	1073	1091	1070
Call Setup Success Rate %	99.44	98.72	99.72
Drop Call Rate%	0.94	7.24	1.31
Call Setup Time-Average (Second)	3.17	2.83	3.47
Handover Success Rate %	97.69	99.98	99.70

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

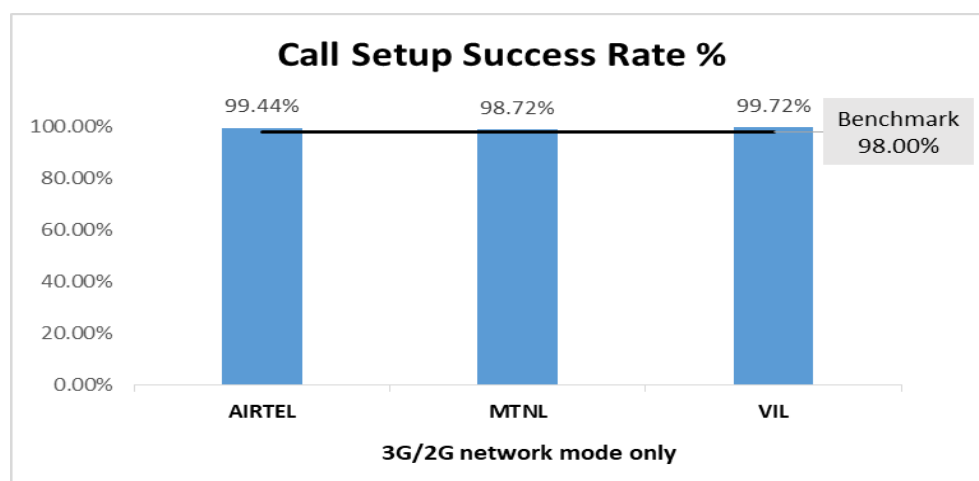


Figure-7: Performance for call setup success rate

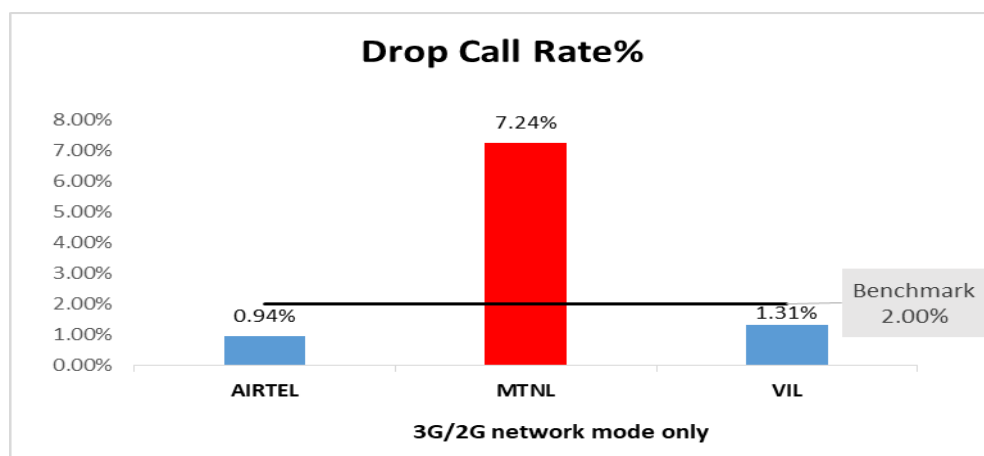


Figure-8: Performance for drop call rate

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

Technology	Service Provider		
	AIRTEL	MTNL	VIL
3G	NA	99.96%	89.67%
2G	100.00%	0.04%	10.33%

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

Note-

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

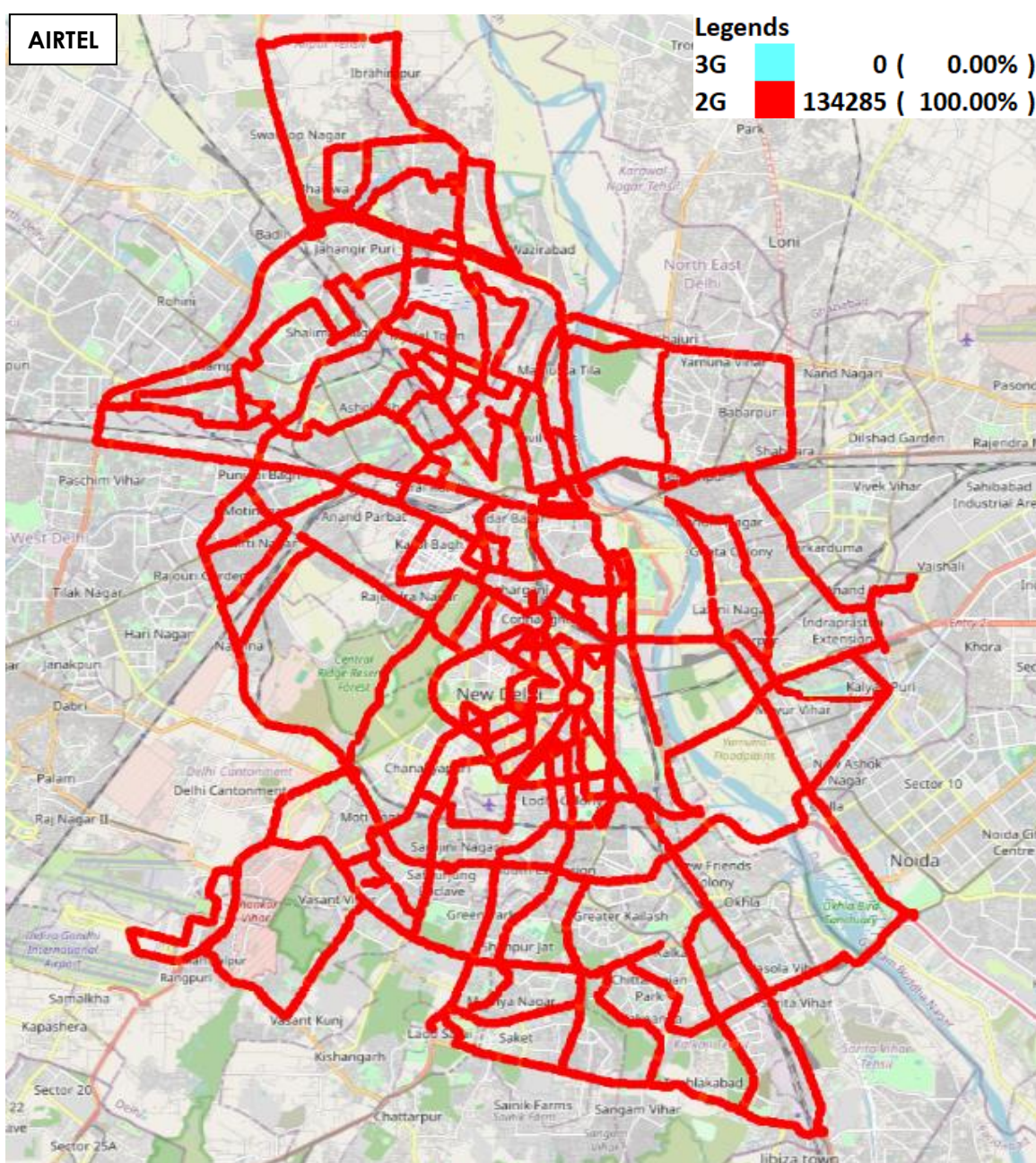


Figure-9: Serving technology plots 3G/2G network mode - AIRTEL

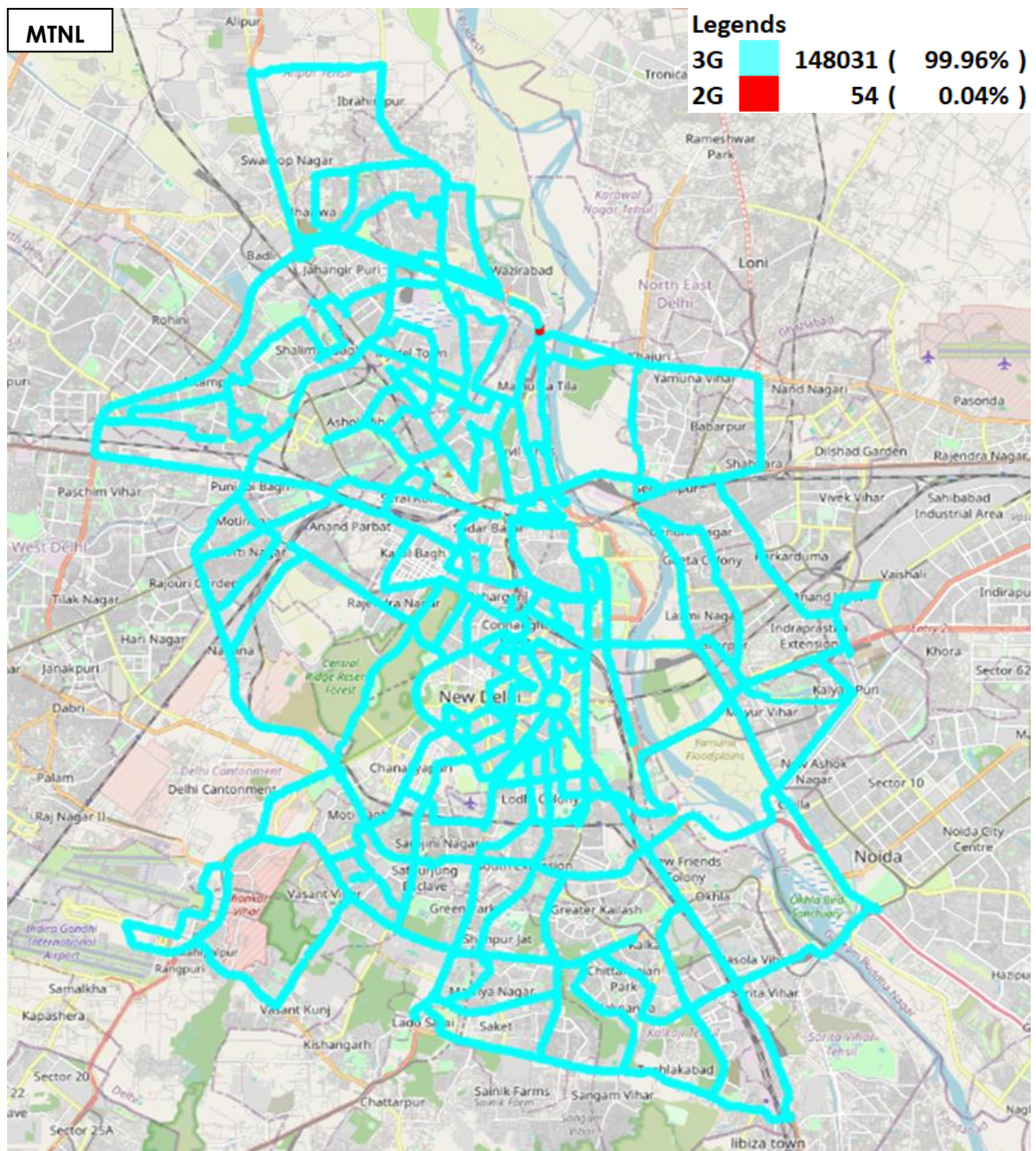


Figure-10: Serving technology plots 3G/2G network mode - MTNL

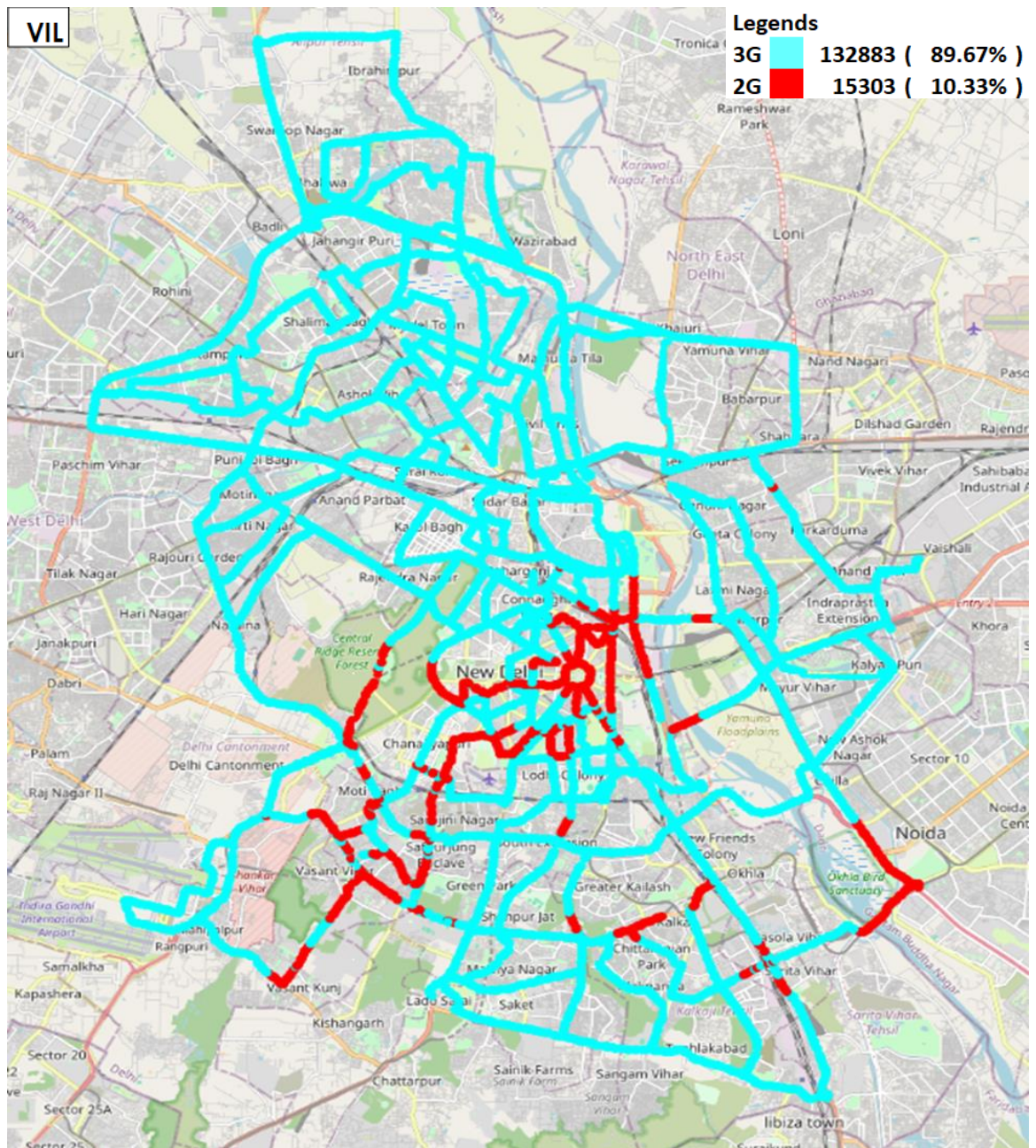


Figure-11: Serving technology plots 3G/2G network mode –VIL

(C) Network Signal Strength distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure-59,60,61 for map view)

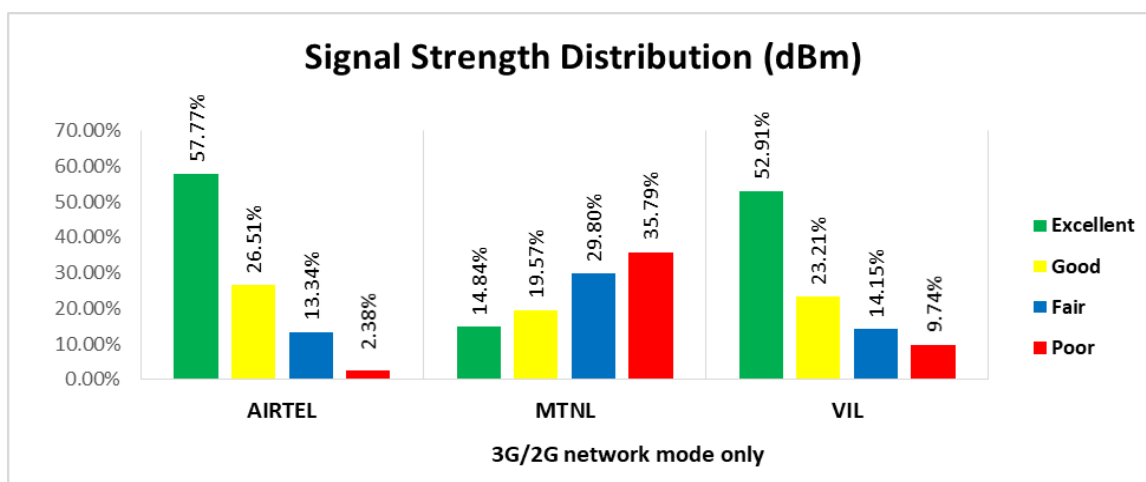


Figure-12: Signal strength distribution 3G/2G network mode only

Observations:

- Airtel's 58% of samples falling in excellent signal strength category.
- MTNL's has 15% of samples falling in excellent signal strength category.
- VIL's has 53% of samples falling in excellent signal strength category.

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempts	1320	1329	1463	1324
Call Setup Success Rate %	99.32	97.14	92.48	99.24
Drop Call Rate%	0.08	7.13	0.15	0.23
Call Setup Time Average (Second)	0.79	3.24	0.72	1.47
Handover Success Rate %	97.47	99.99	98.12	97.96

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

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	MTNL	RJIL	VIL
Call Established (within service provider Network)	1277	1287	1295	1282
Number of silence call for >4 Sec	7	NA	39	30
Silence Call Rate %	0.55	NA	3.01	2.34
Number of silence instances for >4 Sec	12	NA	47	35
Number of silence instances for >3 Sec	19	NA	60	75
Number of silence instances for >2 sec	36	NA	116	278

RTP Jitter (4G & 5G) in ms	4.37	NA	11.34	22.02
Packet loss Rate Downlink %	1.11	NA	2.25	1.68
Packet loss Rate Uplink %	0.77	NA	1.84	2.01

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

Note-

- Due to unavailability of packet switched (4G & 5G) network in MTNL silence instances are not captured.

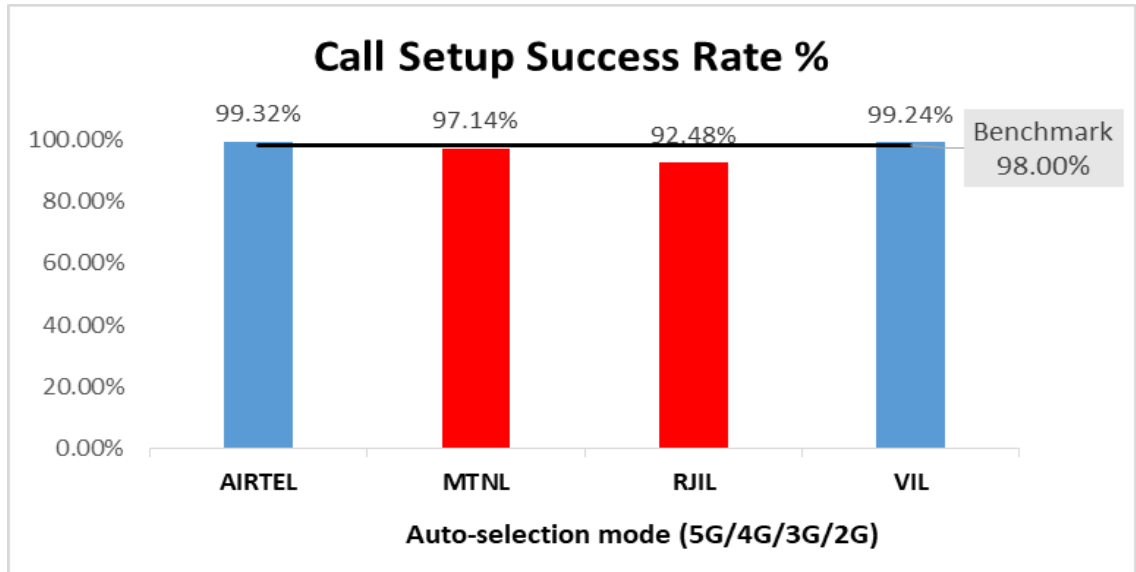


Figure-13: Performance for call setup success rate

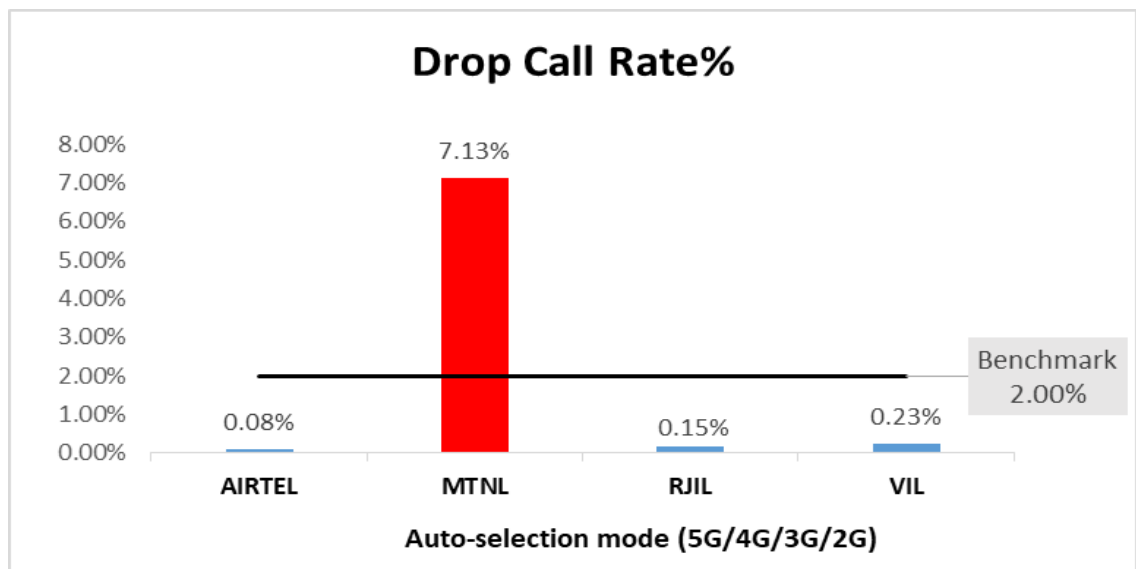


Figure-14: Performance for drop call rate

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
Total Number of MOS Samples for calls in table-16	7542	6357	7326	7512
Speech Quality (Average MOS Score)	4.01	2.87	3.81	4.33
Number of samples with MOS >=4 to <5 (Excellent)	6274	0	4641	5967
Number of samples with MOS >=3 to <4 (Good)	1101	3383	2044	1091
Number of samples with MOS >=2 to <3 (Fair)	98	2348	407	289
Number of samples with MOS >=1 to <2 (Poor)	69	626	234	165
%age of samples with MOS >=4 to <5 (Excellent)	83.19%	0.00%	63.35%	79.43%
%age of samples with MOS >=3 to <4 (Good)	14.60%	53.22%	27.90%	14.52%
%age of samples with MOS >=2 to <3 (Fair)	1.30%	36.94%	5.56%	3.85%
%age of samples with MOS >=1 to <2 (Poor)	0.91%	9.85%	3.19%	2.20%

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

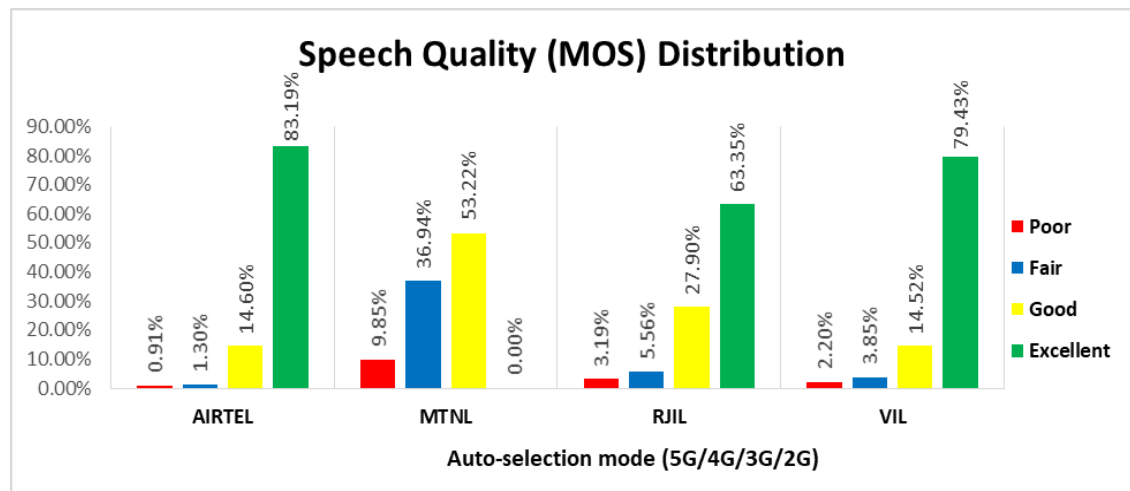


Figure-15: Distribution of samples in MOS score range

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

Technology	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
5G	7.05%	NA	38.11%	NA
4G	92.53%	0.00%	61.89%	99.57%
3G	NA	99.99%	NA	0.30%
2G	0.41%	0.01%	NA	0.13%

Table-18: Time spent on technology during drive test

Note-

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

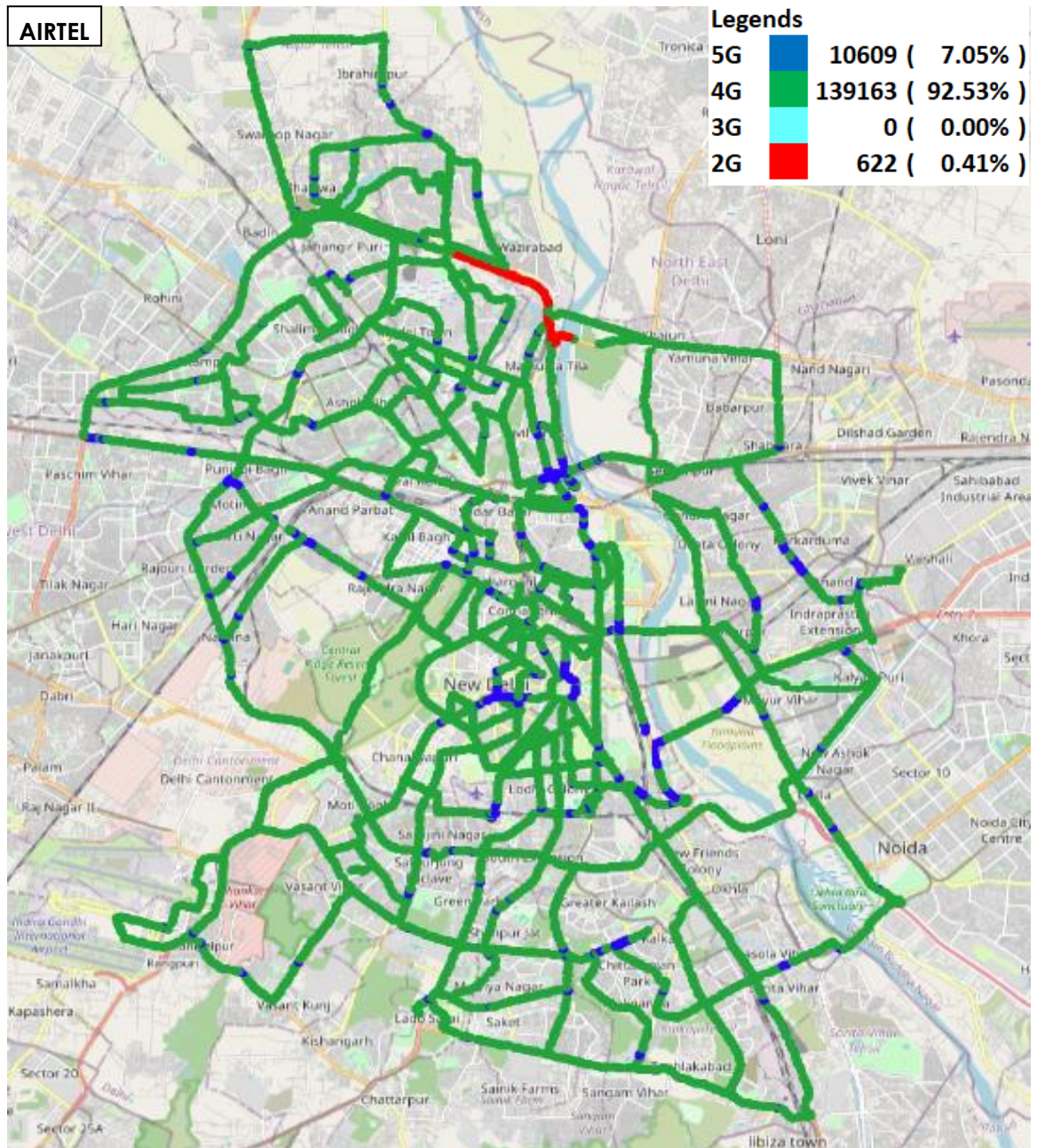


Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -Airtel

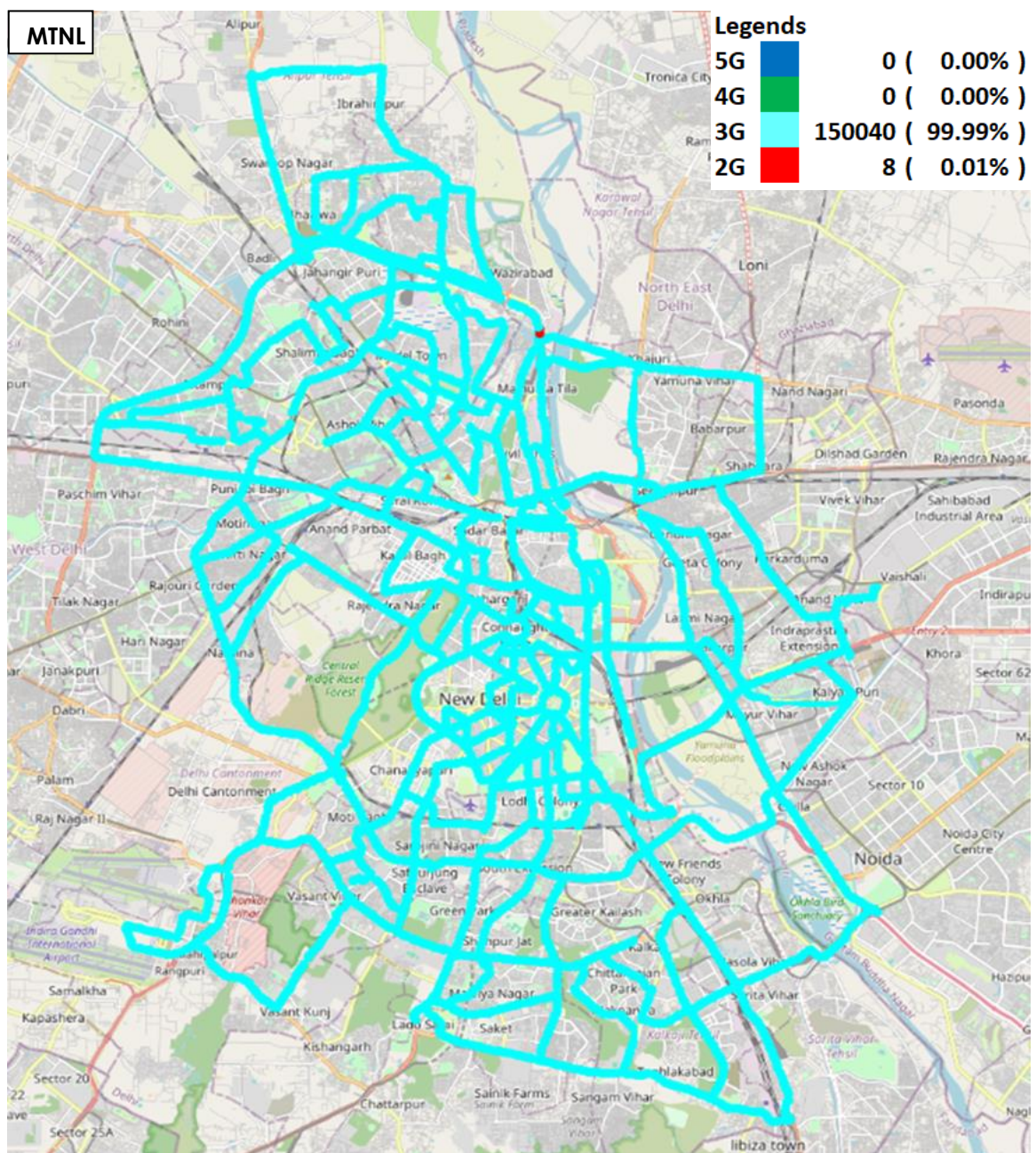


Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -MTNL

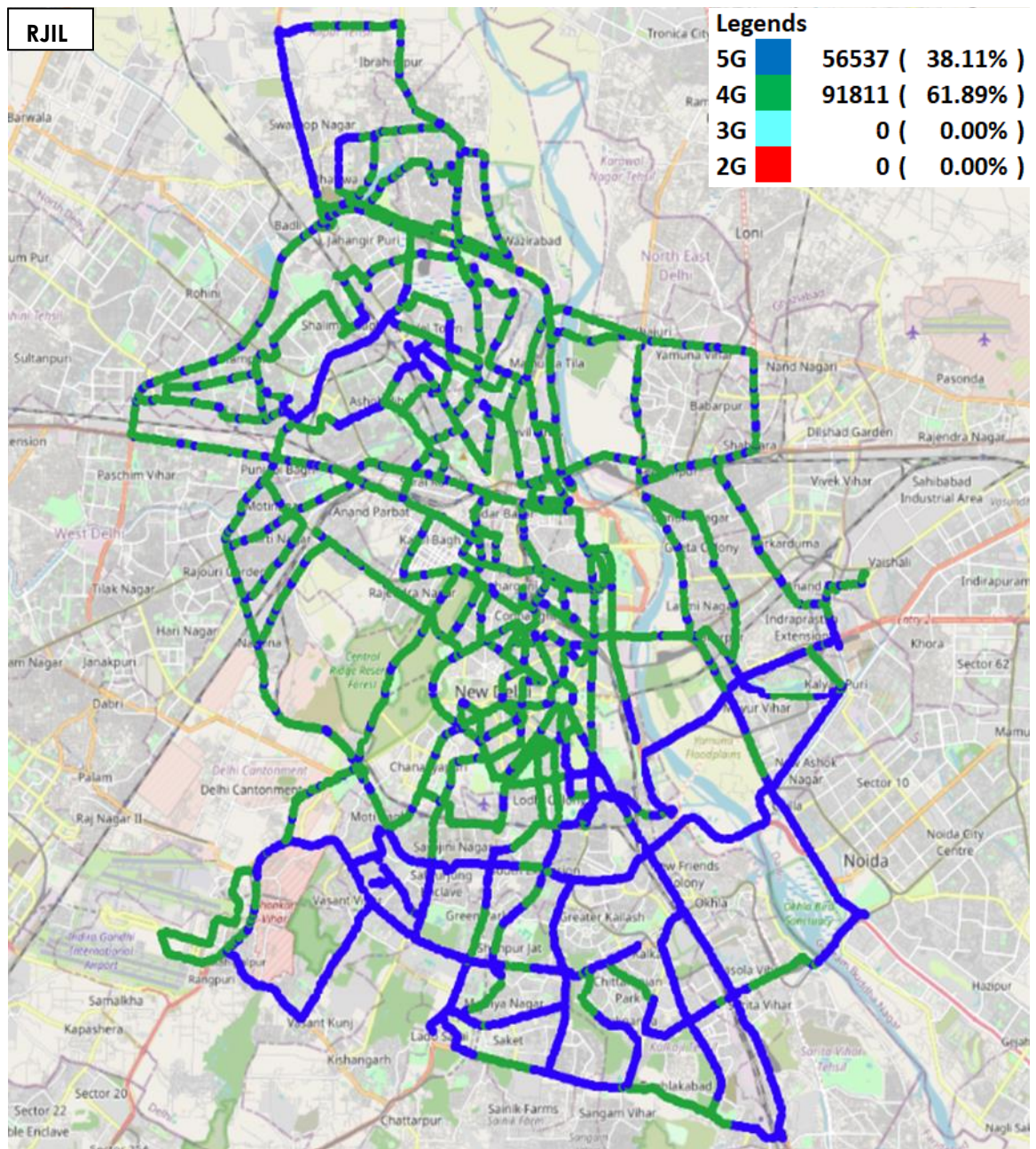


Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL

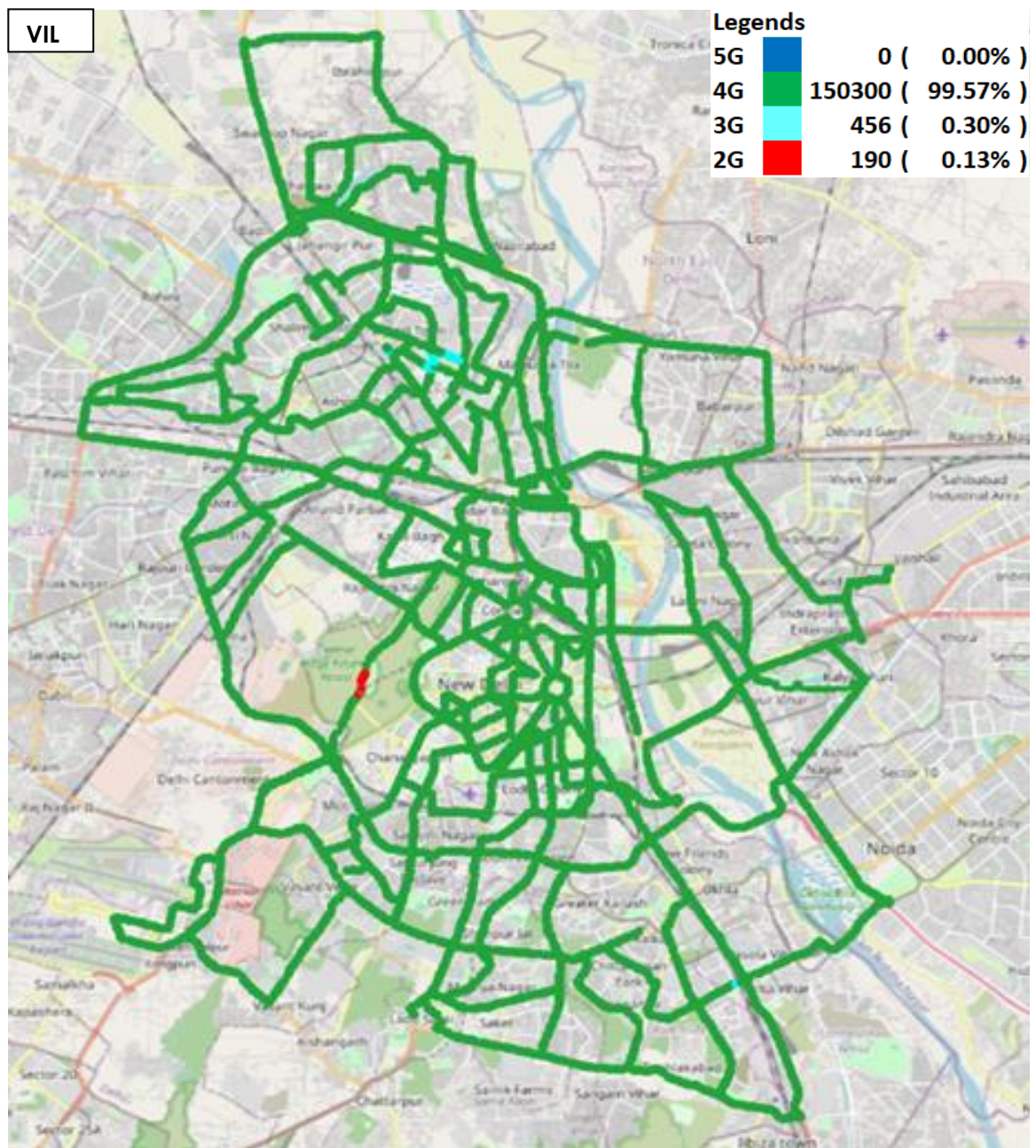


Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G) - VIL

(g)Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-62, 63, 64 for plots of Airtel, RJIL & VIL respectively , For MTNL refer figure 12 & 60)

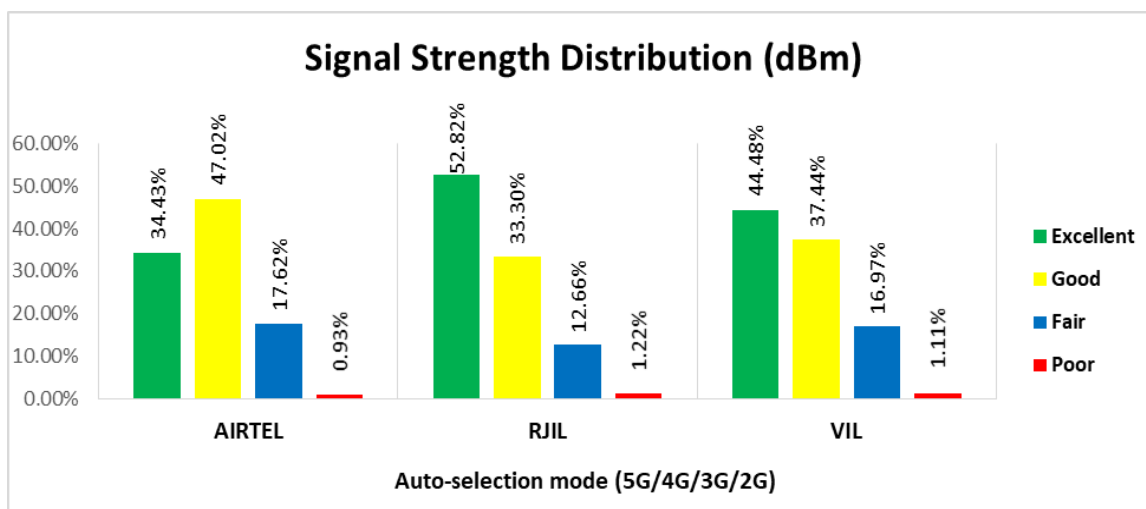


Figure-20: Signal strength distribution auto-selection mode 5G/4G/3G/2G

Observations:

- Airtel has 34% samples falling in excellent signal strength category.
- RJIL has 53% samples falling in excellent signal strength category.
- VIL has 44% samples falling in excellent signal strength category.

4.2.4 Data performance

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

Parameters		Service Provider			
		Auto-selection mode(5G/4G/3G/2G)			
		AIRTEL	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	181.06	3.76	254.83	15.73
	80th Percentile	280.54	6.03	411.91	25.82
	20th Percentile	61.23	1.21	78.51	4.36
Upload Throughput (Mbits/s)	Average	32.56	1.65	24.42	4.76
	80th Percentile	57.99	2.61	44.12	6.9
	20th Percentile	7.15	0.59	5.25	2.07
Ping (ms)	Average	27.88	NA	NA	NA

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

Note-

- NA – Due to unavailability of TSP server details, testing could not be performed.

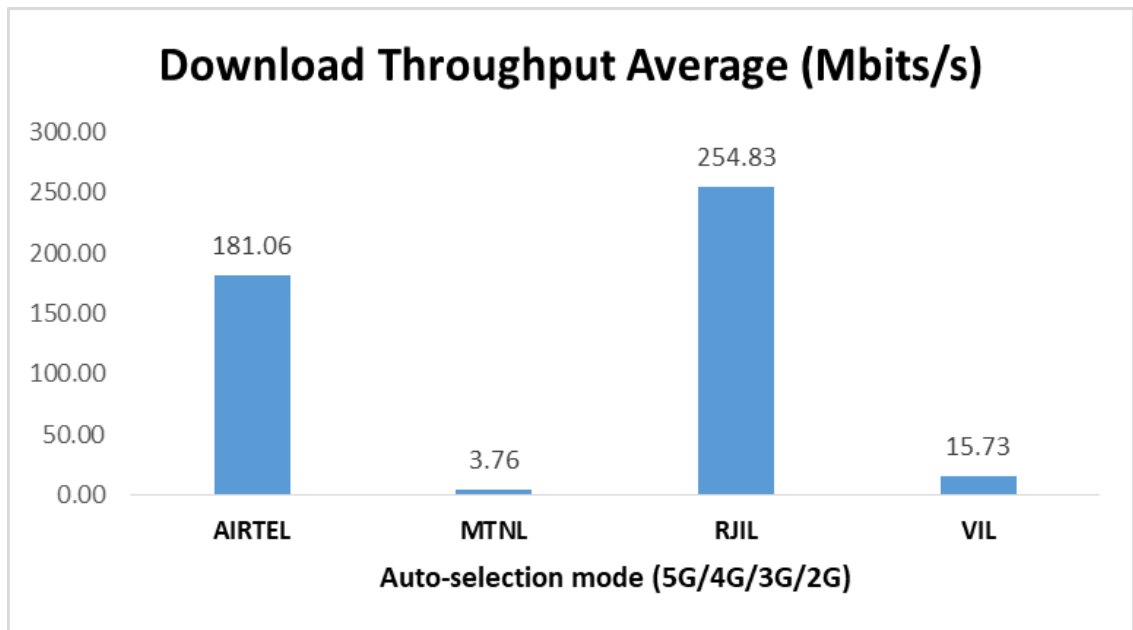


Figure- 21: Download throughput

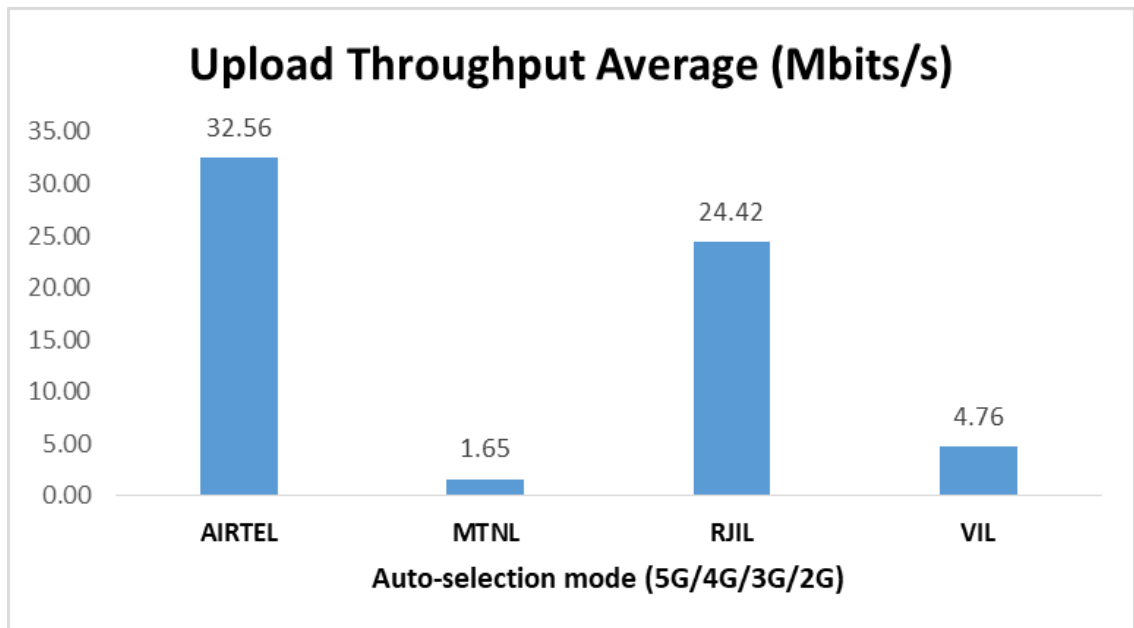


Figure- 22: Upload throughput

4.3 Hotspots

Hotspot testing has been done on 26th September 2024 & 27th September 2024. Sixteen locations has been tested in the city.

4.3.1 Locations

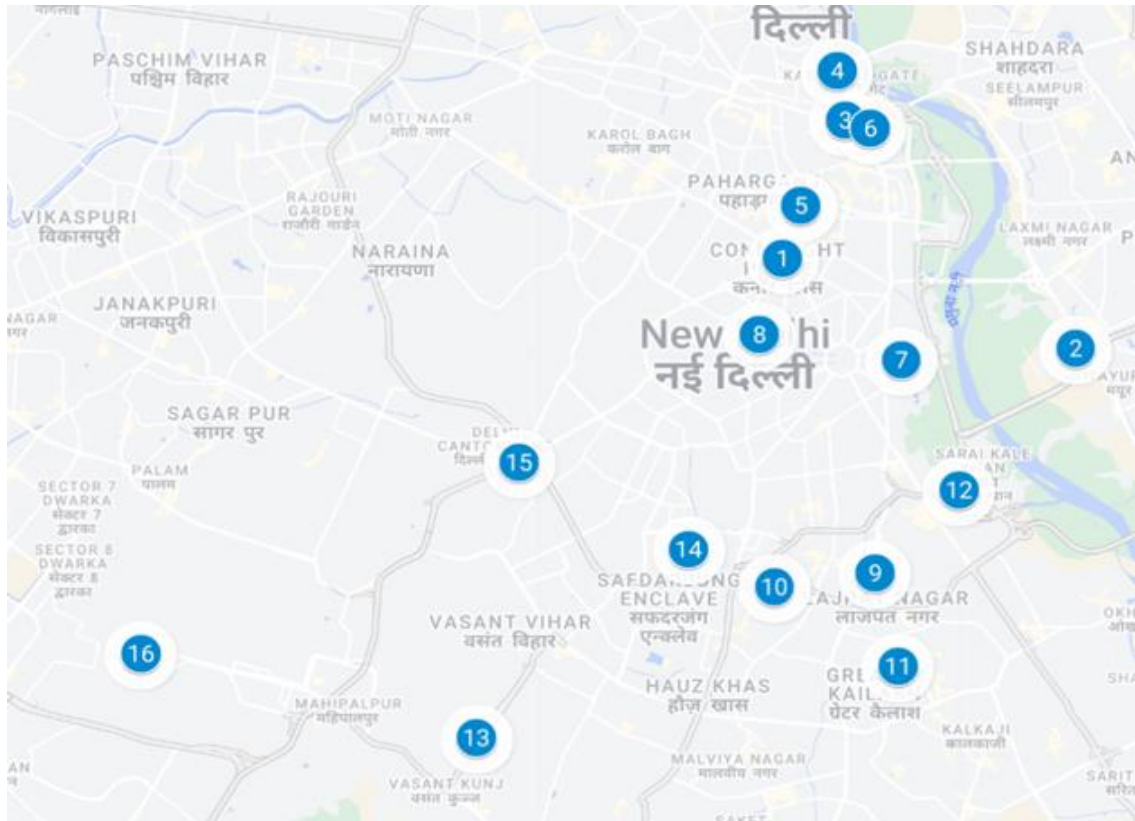


Figure- 23: Hotspot locations

4.3.2 Hotspot covered

1. Connaught Place
2. Akshardham Temple
3. Chandni Chowk
4. Kashmere Gate Bus Stand
5. New Delhi Railway Station
6. Lal Qila
7. Pragati Maidan
8. North Block
9. Lajpat Nagar Market
10. All India Institute of Medical Sciences (AIIMS).
11. Greater Kailash Market
12. Hazrat Nizamuddin Railway Station
13. Vasant Kunj Mall
14. Sarojini Nagar Market
15. Dhaura Kuan Bus Stand
16. Indira Gandhi International Airport.

4.3.3 Voice performance

Overall Voice Performance				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	160	160	160	160
Call Setup Success Rate %	100.00	100.00	100.00	99.38
Drop Call Rate%	0.00	3.13	0.00	0.00
Call Setup Time-Average (Sec)	0.77	2.97	0.63	1.66

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

Connaught Place				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.25	2.99	0.63	1.42

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

Akshardham Temple				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.72	2.74	0.59	1.31

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

Chandni Chowk				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.68	2.91	0.62	1.32

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

Kashmere Gate Bus Stand				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.90	2.66	0.81	1.39

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

New Delhi Railway Station				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.72	2.68	0.64	1.53

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

Lal Qila				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.65	2.79	0.64	1.38

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

Pragati Maidan				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.66	2.53	0.61	1.28

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

North Block				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.82	3.04	0.65	1.28

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

Lajpat Nagar Market				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.70	2.96	0.52	1.98

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

All India Institute of Medical Sciences (AIIMS)				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	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 (Sec)	0.69	3.18	0.73	2.18

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

Greater Kailash Market				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.0
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.73	2.92	0.56	1.38

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

Hazrat Nizamuddin Railway Station				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.75	2.54	0.59	1.56

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

Vasant Kunj Mall				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.70	2.74	0.63	4.21

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

Sarojini Nagar Market				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	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	20.00	0.00	0.00
Call Setup Time-Average (Sec)	0.92	5.05	0.55	1.65

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

Dhaura Kuan Bus Stand				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	0.67	3.10	0.60	1.33

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

Indira Gandhi International Airport				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	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	30.00	0.00	0.00
Call Setup Time-Average (Sec)	0.70	2.70	0.65	1.41

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

4.3.4 Data performance

Overall Data Performance				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	267.82	6.18	220.73	18.32
Download Throughput 80th Percentile (Mbit/s)	453.43	8.41	432.82	25.61
Download Throughput 20th Percentile (Mbit/s)	93.57	4.12	28.24	8.20
Download Session Setup Success Rate %	100.00	77.50	92.50	85.00
Upload Throughput Average (Mbits/s)	56.75	2.17	25.65	3.80
Upload Throughput 80th Percentile (Mbit/s)	97.94	3.32	41.18	6.70
Upload Throughput 20th Percentile (Mbit/s)	10.38	1.10	3.53	0.95
Upload Session Setup Success Rate %	100.00	78.75	95.00	86.25
Web Browsing Delay (Second)	6.90	10.59	6.13	8.94
Youtube Initial Buffer Delay (Second)	0.84	1.18	1.00	1.01
Ping (ms)	14.22	NA	NA	NA
Jitter (ms)	6.21	NA	NA	NA
Packet Loss Rate-Ping %	0.19	NA	NA	NA

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

Note-

- NA – Due to unavailability of TSP server details, testing could not be performed.

Connaught Place				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	74.85	4.51	57.66	17.96
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	7.86	0.37	23.39	8.30
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	9.16	9.02	6.1	9.17
Youtube Initial Buffer Delay (Second)	0.76	-	0.6	0.61
Ping (ms)	20.3	NA	NA	NA
Jitter (ms)	8.64	NA	NA	NA
Packet Loss Rate-Ping %	0.10	NA	NA	NA

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

Note-

- All youtube tests failed in MTNL.

Akshardham Temple				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	167.84	5.92	596.19	33.49
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	18.43	2.63	73.10	5.79
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	6.77	10.26	6.21	7.93
Youtube Initial Buffer Delay (Second)	0.79	0.86	0.65	0.82
Ping (ms)	13.88	NA	NA	NA
Jitter (ms)	6.36	NA	NA	NA
Packet Loss Rate-Ping %	0.50	NA	NA	NA

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

Chandni Chowk				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	551.77	7.87	440.54	20.25
Download Session Setup Success Rate %	100.00	100.00	100.00	60.00
Upload Throughput Average (Mbits/s)	97.21	2.80	21.67	1.62
Upload Session Setup Success Rate %	100.00	100.00	100.00	80.00
Web Browsing Delay (Second)	6.43	11.46	7.50	11.83
Youtube Initial Buffer Delay (Second)	0.7	1.02	0.89	1.61
Ping (ms)	11.87	NA	NA	NA
Jitter (ms)	4.12	NA	NA	NA
Packet Loss Rate-Ping %	0.0	NA	NA	NA

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

Kashmere Gate Bus Stand				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average(Mbits/s)	101.01	5.04	6.86	8.21
Download Session Setup Success Rate %	100.00	100.00	60.00	100.00
Upload Throughput Average (Mbits/s)	39.21	1.87	1.59	4.59
Upload Session Setup Success Rate %	100.00	100.00	80.00	100.00
Web Browsing Delay (Second)	5.82	12.28	9.98	9.43
Youtube Initial Buffer Delay (Second)	0.52	1.03	-	0.83
Ping (ms)	12.48	NA	NA	NA
Jitter (ms)	4.89	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

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

Note-

- All youtube tests failed in RJIL.

New Delhi Railway Station				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average(Mbits/s)	358.62	6.94	55.42	12.60
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	108.09	2.30	52.84	5.35
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	6.35	9.96	6.35	6.88
Youtube Initial Buffer Delay (Second)	0.53	1.62	0.58	0.69
Ping (ms)	11.98	NA	NA	NA
Jitter (ms)	3.82	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

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

Lal Qila				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	340.78	2.60	55.8	20.49
Download Session Setup Success Rate %	100.00	40.00	100.00	100.00
Upload Throughput Average (Mbits/s)	52.08	1.17	21.52	3.52
Upload Session Setup Success Rate %	100.00	20.00	100.00	100.00
Web Browsing Delay (Second)	6.34	16.68	6.45	7.38
Youtube Initial Buffer Delay (Second)	0.51	-	0.58	0.66
Ping (ms)	12.39	NA	NA	NA
Jitter (ms)	3.63	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

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

Note-

- All youtube tests failed in MTNL.

Pragati Maidan				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	428.62	2.8	221.56	48.09
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	86.97	1.96	37.17	8.22
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	6.89	11.97	5.87	6.24
Youtube Initial Buffer Delay (Second)	0.64	1.54	1.13	0.72
Ping (ms)	11.33	NA	NA	NA
Jitter (ms)	4.44	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

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

North Block				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	106.22	4.29	425.15	13.81
Download Session Setup Success Rate %	100.00	100.00	100.00	80.00
Upload Throughput Average (Mbits/s)	9.82	2.13	23.37	1.23
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	7.53	13.17	5.42	8.2
Youtube Initial Buffer Delay (Second)	0.97	1.6	0.74	1.01
Ping (ms)	12.50	NA	NA	NA
Jitter (ms)	6.91	NA	NA	NA
Packet Loss Rate-Ping	0.20	NA	NA	NA

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

Lajpat Nagar Market				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	236.76	5.83	82.59	-
Download Session Setup Success Rate %	100.00	100.00	100.00	0.00
Upload Throughput Average (Mbits/s)	66.31	1.08	25.81	-
Upload Session Setup Success Rate %	100.00	100.00	100.00	0.00
Web Browsing Delay (Second)	5.18	12.57	5.47	-
Youtube Initial Buffer Delay (Second)	0.57	-	0.83	-
Ping (ms)	13.46	NA	NA	NA
Jitter (ms)	5.07	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

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

Note-

- All youtube tests failed in MTNL.
- All download, upload, web browsing and youtube tests failed in VIL.

All India Institute of Medical Sciences (AIIMS)				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	273.76	6.49	13.92	1.98
Download Session Setup Success Rate %	100.00	100.00	20.00	100.00
Upload Throughput Average (Mbits/s)	89.35	3.64	0.79	0.85
Upload Session Setup Success Rate %	100.00	100.00	40.00	100.00
Web Browsing Delay (Second)	5.65	10.54	2.77	10.99
Youtube Initial Buffer Delay (Second)	0.71	0.87	5.16	2.27
Ping (ms)	14.62	NA	NA	NA
Jitter (ms)	3.9	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

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

Greater Kailash Market				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	532.7	9.47	354.59	9.54
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	112.2	1.08	11.79	1.3
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	7.57	9.6	5.99	10.14
Youtube Initial Buffer Delay (Second)	0.48	-	0.85	0.83
Ping (ms)	14.39	NA	NA	NA
Jitter (ms)	3.19	NA	NA	NA
Packet Loss Rate-Ping %	0	NA	NA	NA

Table-48: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G)

Note-

- All youtube tests failed in MTNL.

Hazrat Nizamuddin Railway Station				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	228.63	-	51.62	33.44
Download Session Setup Success Rate %	100.00	0.00	100.00	100.00
Upload Throughput Average (Mbits/s)	61.91	-	15.91	0.86
Upload Session Setup Success Rate %	100.00	0.00	100.00	100.00
Web Browsing Delay (Second)	6.66	-	5.88	9.62
Youtube Initial Buffer Delay (Second)	0.62	-	1.24	1.11
Ping (ms)	16.1	NA	NA	NA
Jitter (ms)	5.45	NA	NA	NA
Packet Loss Rate-Ping %	0.1	NA	NA	NA

Table-49: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G)

Note-

- All download, upload, web browsing & youtube tests failed in MTNL.

Vasant Kunj Mall				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	301.56	9.14	240.54	0.5
Download Session Setup Success Rate %	100.00	100.00	100.00	20.00
Upload Throughput Average (Mbits/s)	37.15	3.71	3.58	-
Upload Session Setup Success Rate %	100.00	100.00	100.00	0.00
Web Browsing Delay (Second)	7.06	7.97	5.74	-
Youtube Initial Buffer Delay (Second)	1.44	0.78	0.68	-
Ping (ms)	13.91	NA	NA	NA
Jitter (ms)	4.08	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

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

Note-

- All upload, web browsing and youtube tests failed in VIL.

Sarojini Nagar Market				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	47.29	-	3.78	9.90
Download Session Setup Success Rate %	100.00	0.00	100.00	100.00
Upload Throughput Average (Mbits/s)	2.14	0.58	1.38	0.92
Upload Session Setup Success Rate %	100.00	40.00	100.00	100.00
Web Browsing Delay (Second)	8.12	-	10.14	11.66
Youtube Initial Buffer Delay (Second)	0.41	-	1.74	1.58
Ping (ms)	22.24	NA	NA	NA
Jitter (ms)	25.21	NA	NA	NA
Packet Loss Rate-Ping %	2.10	NA	NA	NA

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

Note-

- All download, web browsing and youtube tests failed in MTNL.

Dhaura Kuan Bus Stand				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	483.52	7.30	647.74	13.50
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	110.02	3.32	66.1	6.39
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	8.22	10.29	5.04	8.52
Youtube Initial Buffer Delay (Second)	1.44	0.93	0.76	0.85
Ping (ms)	12.25	NA	NA	NA
Jitter (ms)	4.05	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

Table-52: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G)

Indira Gandhi International Airport				
Parameters	Service Provider			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Download Throughput Average (Mbits/s)	51.18	-	26.77	16.73
Download Session Setup Success Rate %	100.00	0.00	100.00	100.00
Upload Throughput Average (Mbits/s)	9.29	-	10.68	3.81
Upload Session Setup Success Rate %	100.00	0.00	100.00	100.00

Web Browsing Delay (Second)	10.94	-	7.17	11.12
Youtube Initial Buffer Delay (Second)	0.65	-	0.94	0.63
Ping (ms)	13.76	NA	NA	NA
Jitter (ms)	5.74	NA	NA	NA
Packet Loss Rate-Ping %	0.00	NA	NA	NA

Table-53: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G)

Note-

- All download, upload, web browsing and youtube tests failed in MTNL.

4.4 Railways/Metro

Drive test has been conducted on 30th September 2024 to 1st October 2024 covering five metro route. (Refer Table#1)

4.4.1 Drive test routes

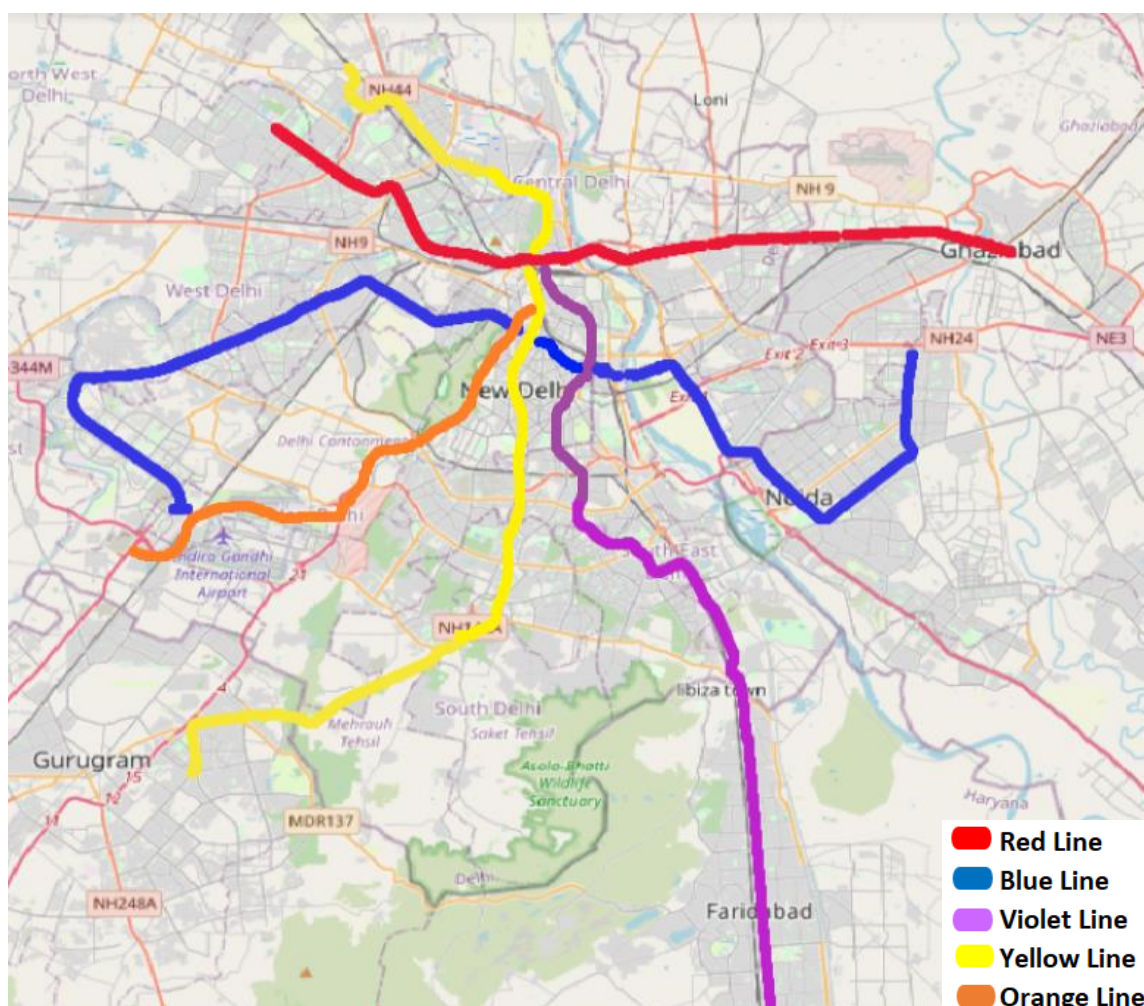


Figure-24: Drive test route metro

4.2.2 Routes Covered

- Noida Electronic City to Dwarka Sec -21 (Blue line).
- Yashobhoomi Dwarka Sec-25 to New Delhi (Orange line).
- Kashmere Gate to Raja Nahar Singh (Violet line).
- Shaheed Sthal to Rithala (Red line).
- Samaypur Badli to Millennium City Centre (Yellow line).

4.2.2.1 Noida Electronic City to Dwarka Sec -21

Drive test for this route has been conducted on 30th September 2024. This route has 50 metro stations, out of which 46 are elevated and 4 are underground.

i) Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempts	79	74	78	78
Call Setup Success Rate %	97.47	95.95	100.00	100.00
Drop Call Rate%	0.00	12.68	1.28	0.00
Call Setup Time-Average (Second)	0.84	4.13	0.88	1.6
Handover Success Rate %	97.44	99.87	98.22	97.64

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

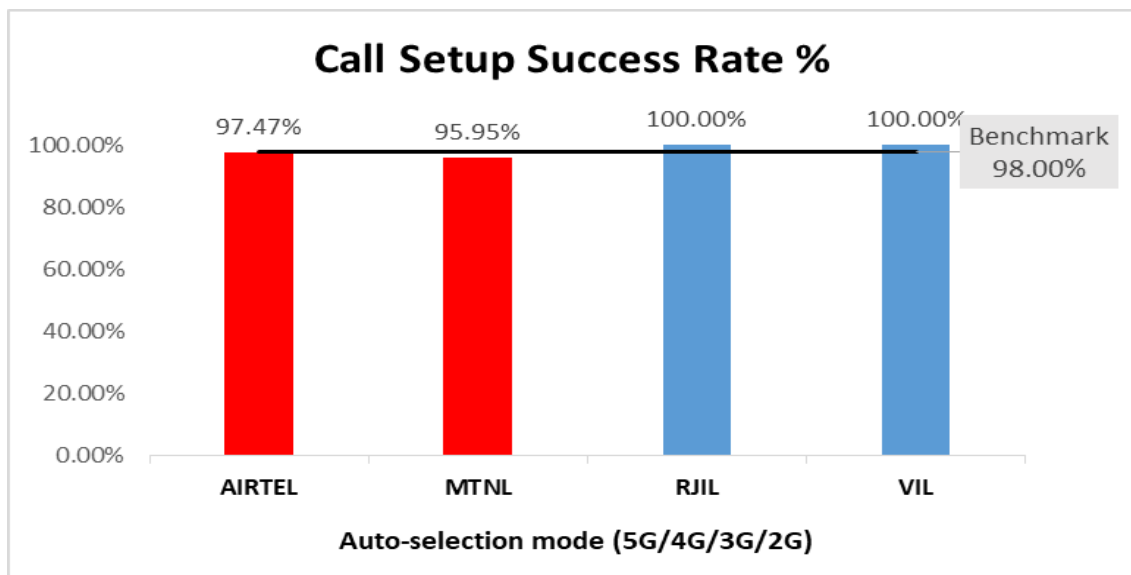


Figure-25: Performance for call setup success rate

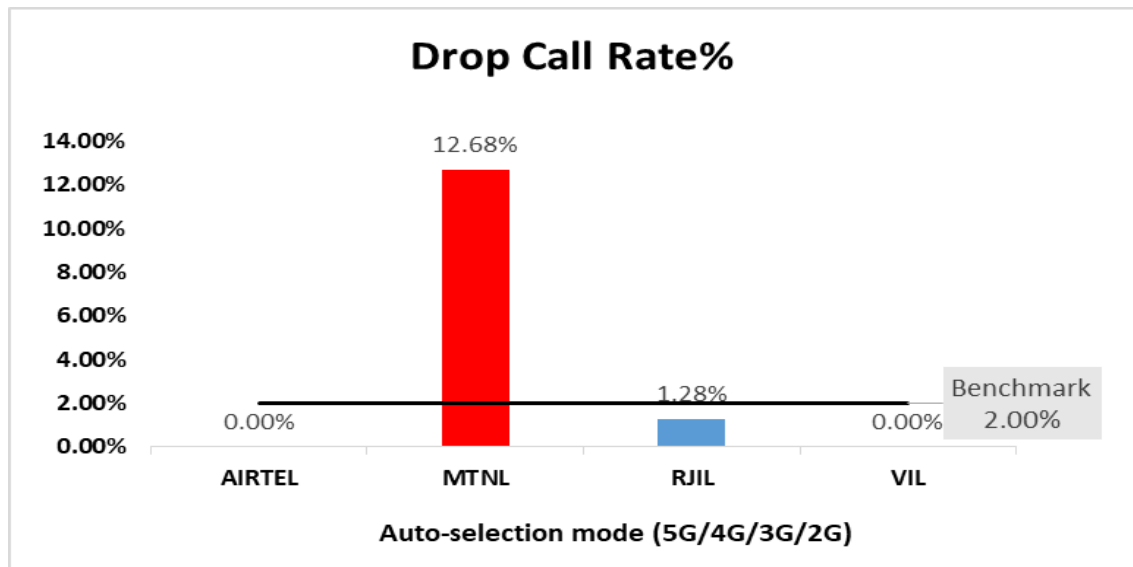


Figure-26: Performance for drop call rate

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

Technology	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
5G	6.49%	NA	44.08%	NA
4G	93.51%	0.00%	55.92%	100.00%
3G	NA	94.08%	NA	0.00%
2G	0.00%	0.00%	NA	0.00%
No service	0.00%	5.92%	0.00%	0.00%

Table-55:Time spent on technology during drive test

Note-

- MTNL has no service/limited service mode in metro tunnel where it was connected to network of other TSPs.
- NA- Service provider doesn't provide services in respective technology.

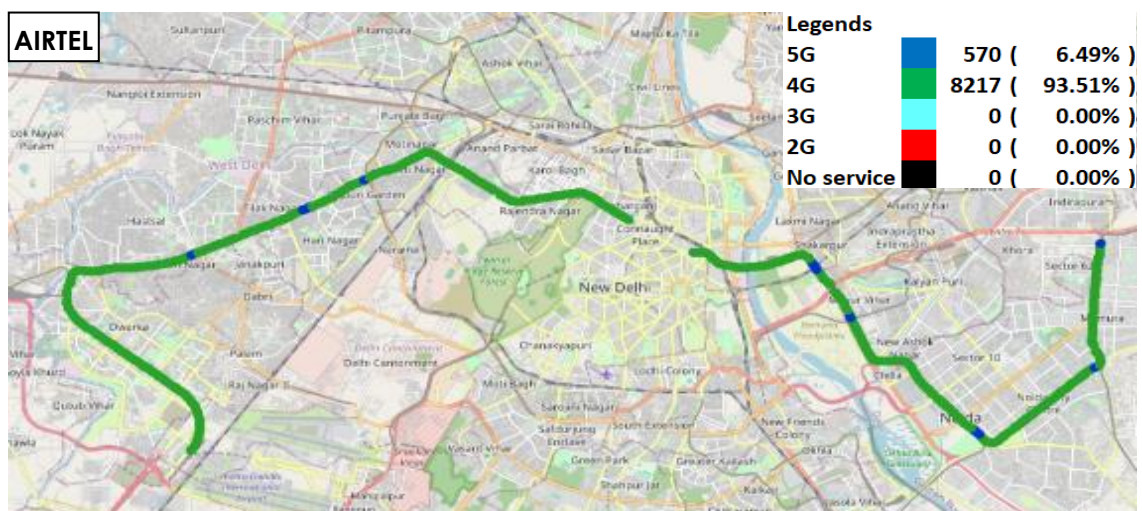


Figure-27: Serving technology plots auto-selection mode 5G/4G/3G/2G -Airtel

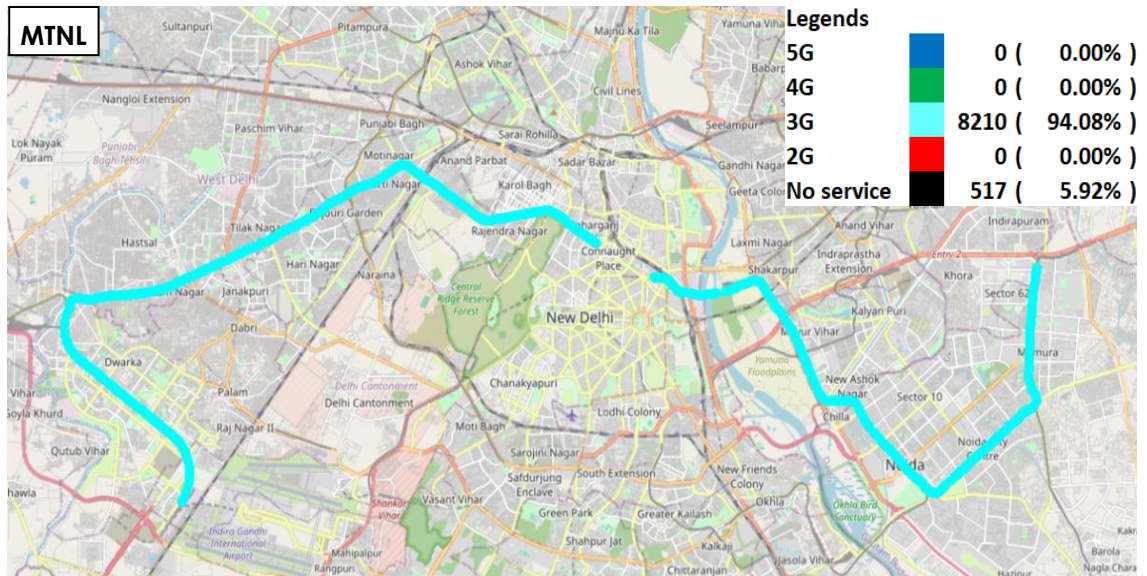


Figure-28: Serving technology plots auto-selection mode 5G/4G/3G/2G -MTNL

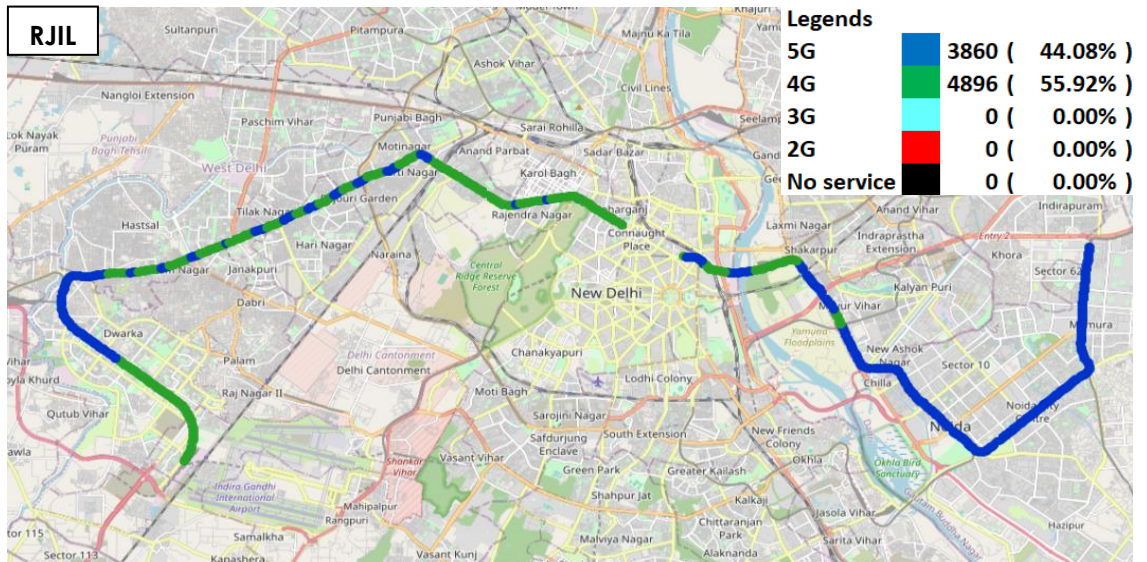


Figure-29: Serving technology plots auto-selection mode 5G/4G/3G/2G -RJIL

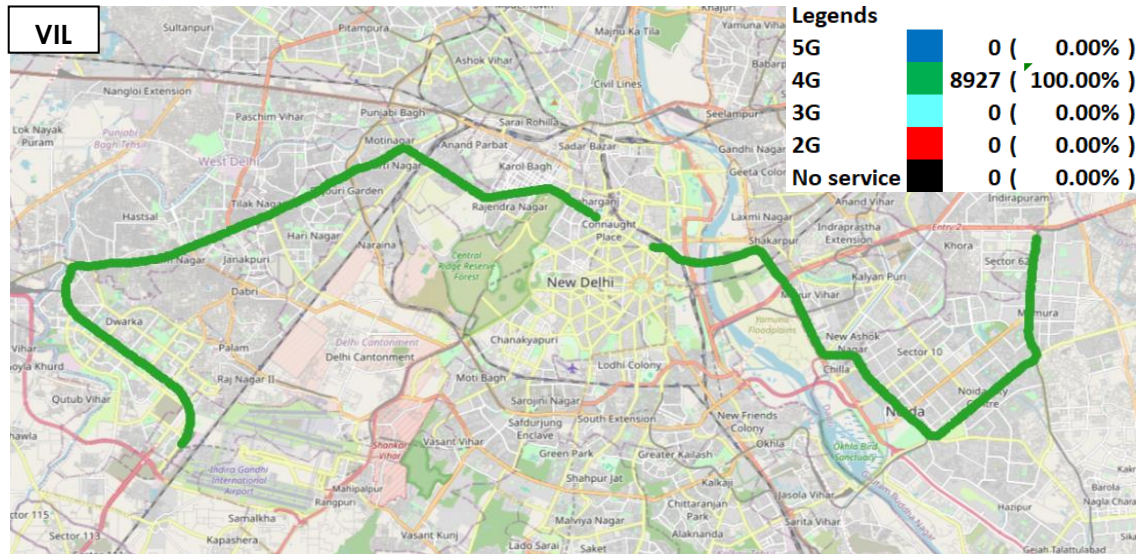


Figure-30: Serving technology plots auto-selection mode 5G/4G/3G/2G – VIL

Note-

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

(c) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G) (Refer figure-65, 66, 67 & 68 for plots)

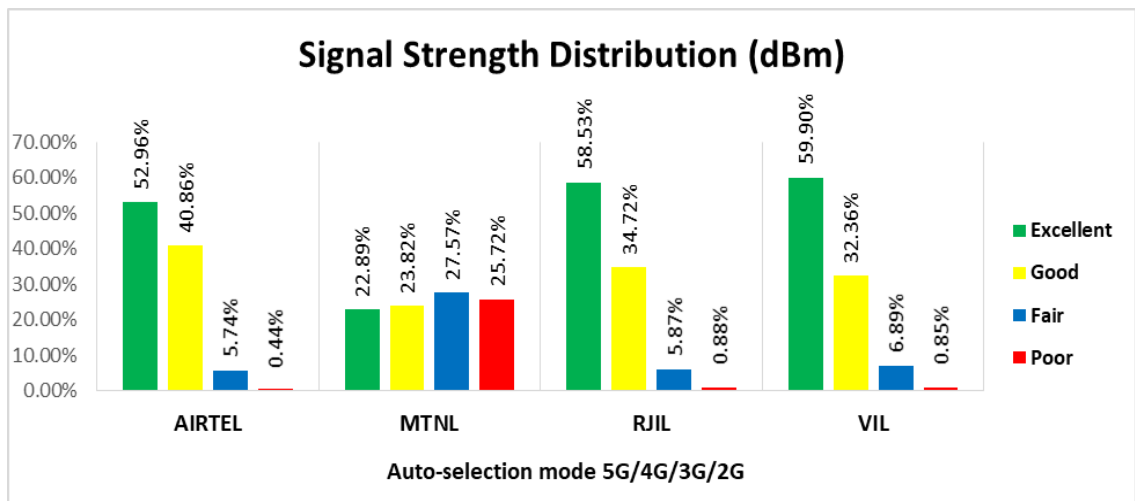


Figure-31: Signal strength distribution for auto-selection mode 5G/4G/3G/2G

ii) Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	96.86	1.89	151.19	7.71
	80th Percentile	139.14	3.66	227.20	8.48
	20th Percentile	23.01	0.48	54.34	2.22
Upload Throughput (Mbits/s)	Average	35.40	1.26	20.70	4.30
	80th Percentile	60.46	2.06	35.64	6.91
	20th Percentile	6.27	0.53	5.48	1.76
Ping (ms)	Average	32.85	NA	NA	NA

Table-56: Summary of Data performance in network auto-selection mode

Note-

- NA – Due to unavailability of TSP server details, testing could not be performed.

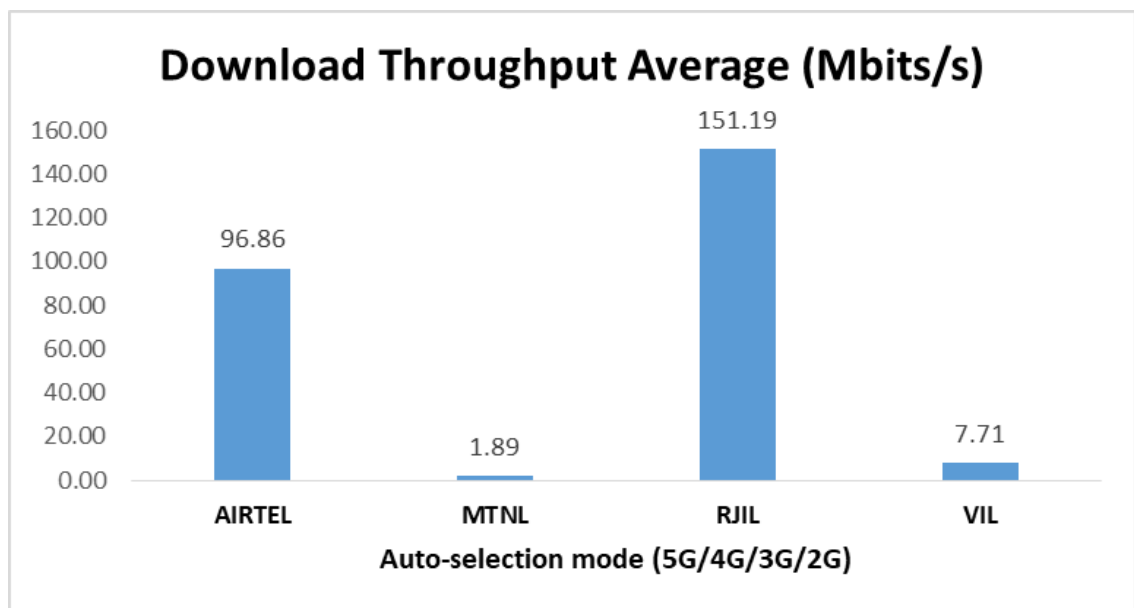


Figure-32: Download throughput

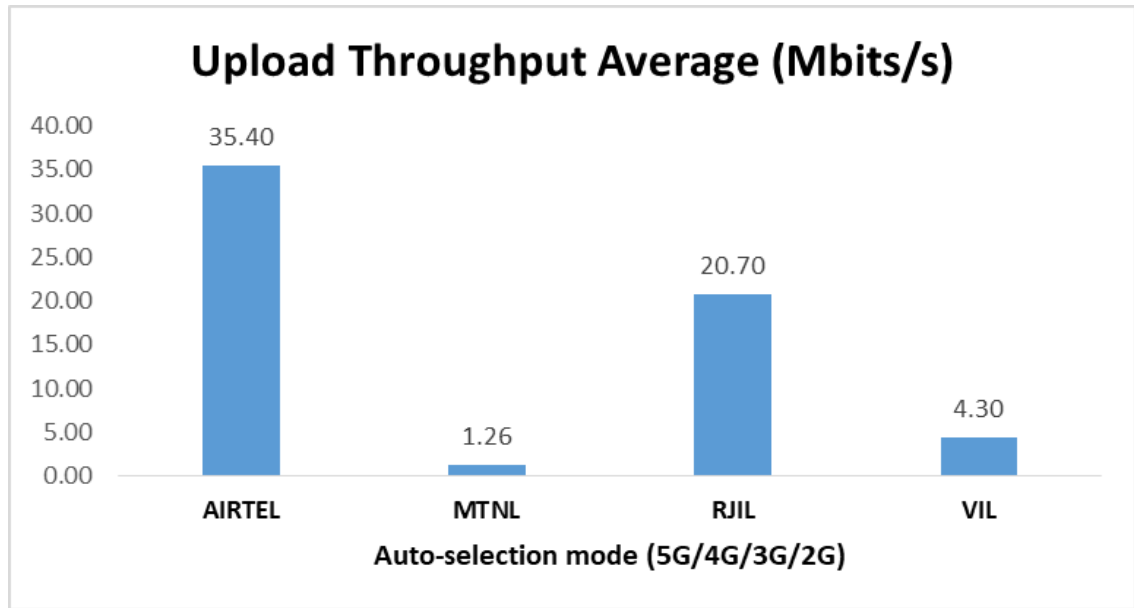


Figure-33: Upload throughput

4.2.2.2 Yashobhoomi Dwarka Sec-25 to New Delhi

Drive test for this route has been conducted on 30th September. This route has 7 metro stations, out of which 1 is elevated and 6 are underground.

i) Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempts	14	3	15	18
Call Setup Success Rate %	92.86	100.00	93.33	94.44
Drop Call Rate%	0.00	33.33	0.00	5.88
Call Setup Time-Average (Second)	1.74	4.69	0.92	6.16
Handover Success Rate %	97.65	100.00	96.19	100.00

Table-57: Summary of voice call performance in network auto-selection mode

Note-

- In MTNL due to no network/ limited service mode in tunnel, number of call attempts were only three.
- Unusual high drop call rate observed as number of call attempts are only 3 and out of which 1 call dropped in MTNL.

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

Technology	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
5G	0.00%	NA	2.95%	NA
4G	71.29%	0.00%	80.96%	32.27%
3G	NA	20.03%	NA	54.57%
2G	0.00%	0.11%	NA	12.18%
No service	28.71%	79.86%	16.10%	0.98%

Table-58:Time spent on technology during drive test

Note-

- All TSPs have no service/limited service mode observed in tunnel.
- NA- Service provider doesn't provide services in respective technology.

(c) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G)

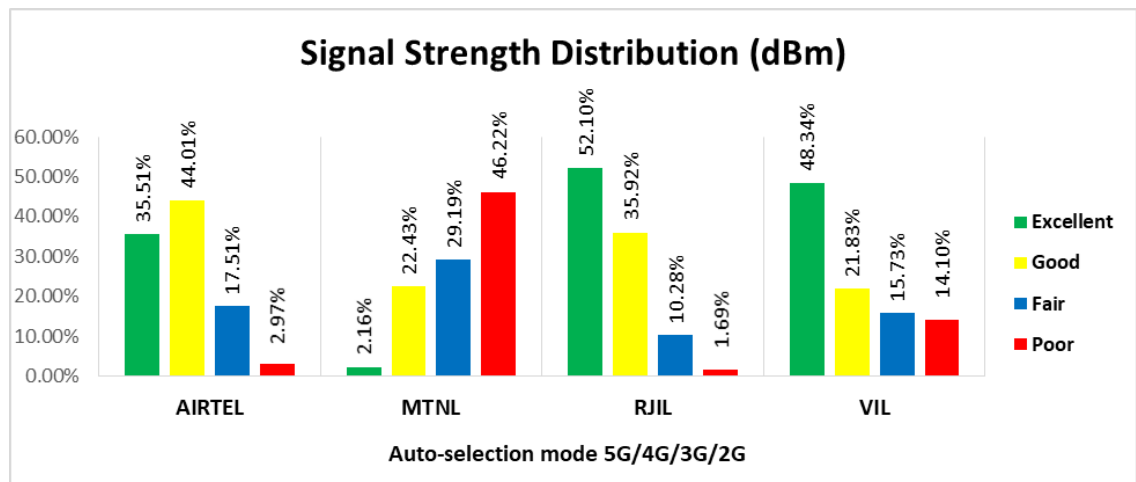


Figure-34: Signal strength distribution for auto-selection mode 5G/4G/3G/2G

ii) Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	91.95	5.97	24.32	11.68
	80th Percentile	151.90	7.70	35.52	16.76
	20th Percentile	2.88	4.25	15.29	8.47
Upload Throughput (Mbits/s)	Average	13.68	1.05	8.85	5.04
	80th Percentile	31.54	1.67	13.13	9.09
	20th Percentile	0.97	0.46	1.15	2.07
Ping (ms)	Average	80.04	NA	NA	NA

Table-59: Summary of Data performance in network auto-selection mode

Note-

- NA – Due to unavailability of TSP server details, testing could not be performed.

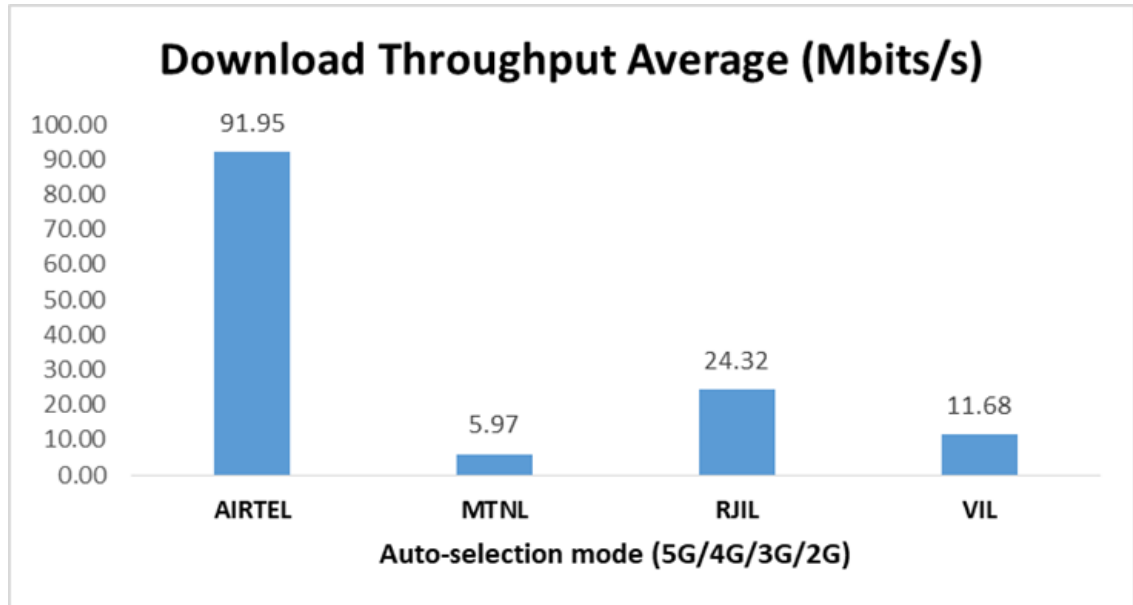


Figure-35: Download throughput

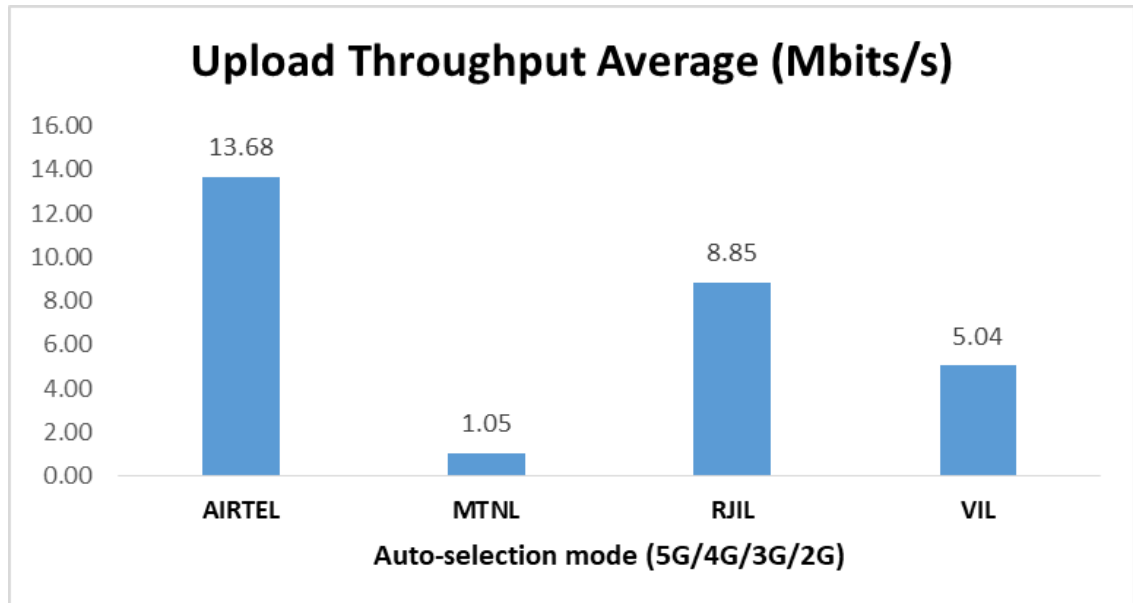


Figure-36: Upload throughput

4.2.2.3 Kashmere Gate to Raja Nahar Singh

Drive test for this route has been conducted on 30th september 2024. This route has 34 metro stations, out of which 23 are elevated and 11 are underground.

i) Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempts	49	33	51	49
Call Setup Success Rate %	100.00	100.00	98.04	100.00
Drop Call Rate%	2.04	6.06	2.00	0.00
Call Setup Time-Average (Second)	1.31	2.75	0.69	1.43
Handover Success Rate %	96.77	100.00	97.24	97.81

Table-60: Summary of voice call performance in network auto-selection mode.

Note-

- In MTNL, number of call attempt is less due to no network observed in tunnel

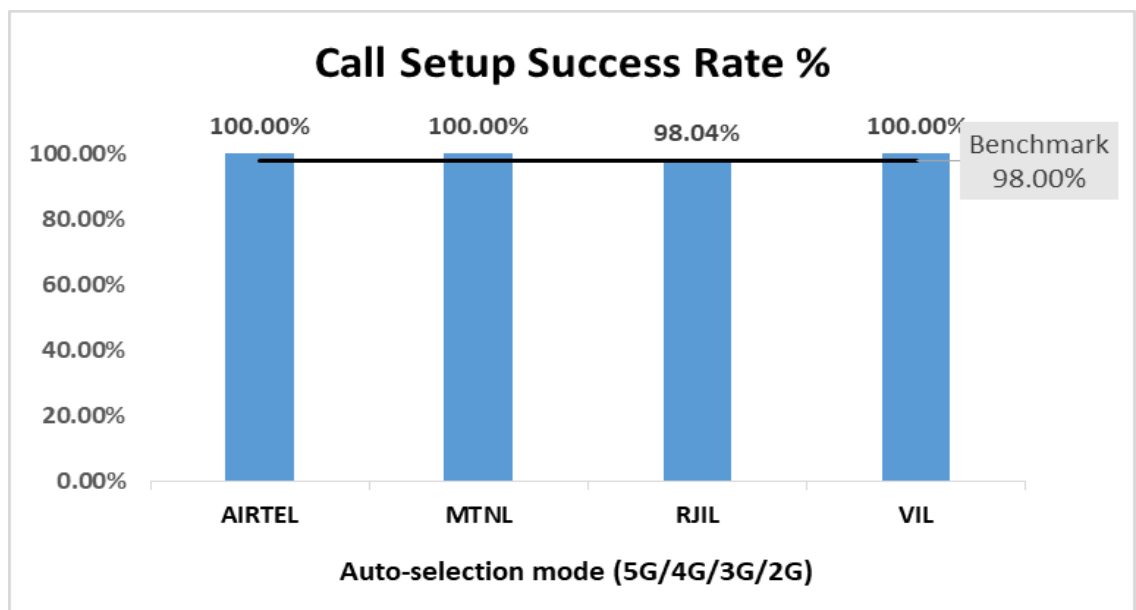


Figure-37: Performance for call setup success rate

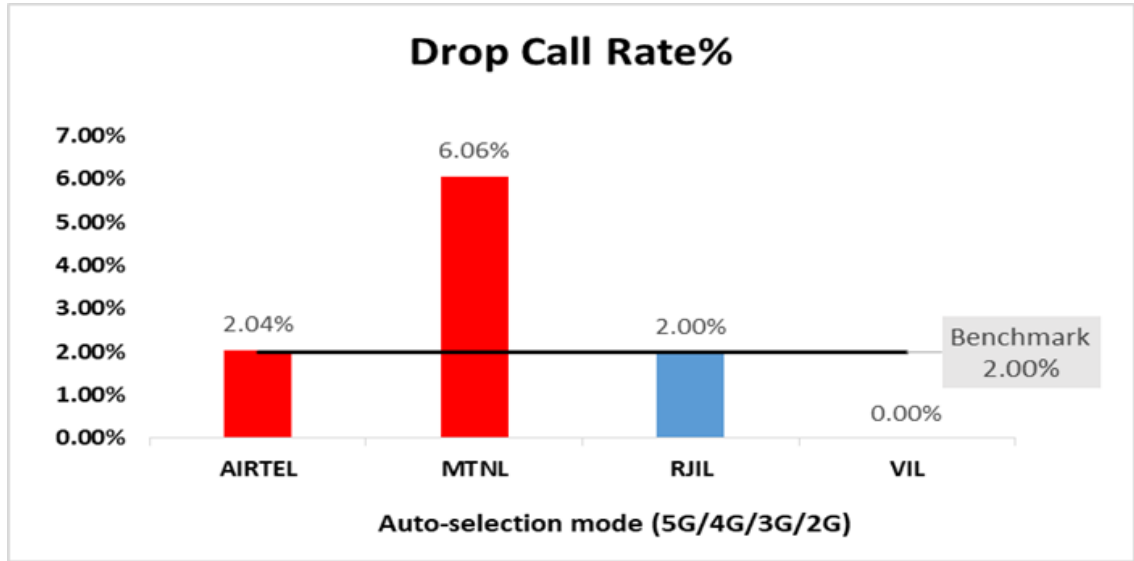


Figure-38: Performance for drop call rate

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

Technology	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
5G	1.01%	NA	0.02%	NA
4G	98.93%	0.00%	99.78%	100.00%
3G	NA	71.65%	NA	0.00%
2G	0.02%	0.00%	NA	0.00%
No service	0.04%	28.35%	0.20%	0.00%

Table-61: Time spent on technology during drive test

Note-

- MTNL has no service/limited service mode in metro tunnel where it was connected to network of other TSPs.
- NA- Service provider doesn't provide services in respective technology.

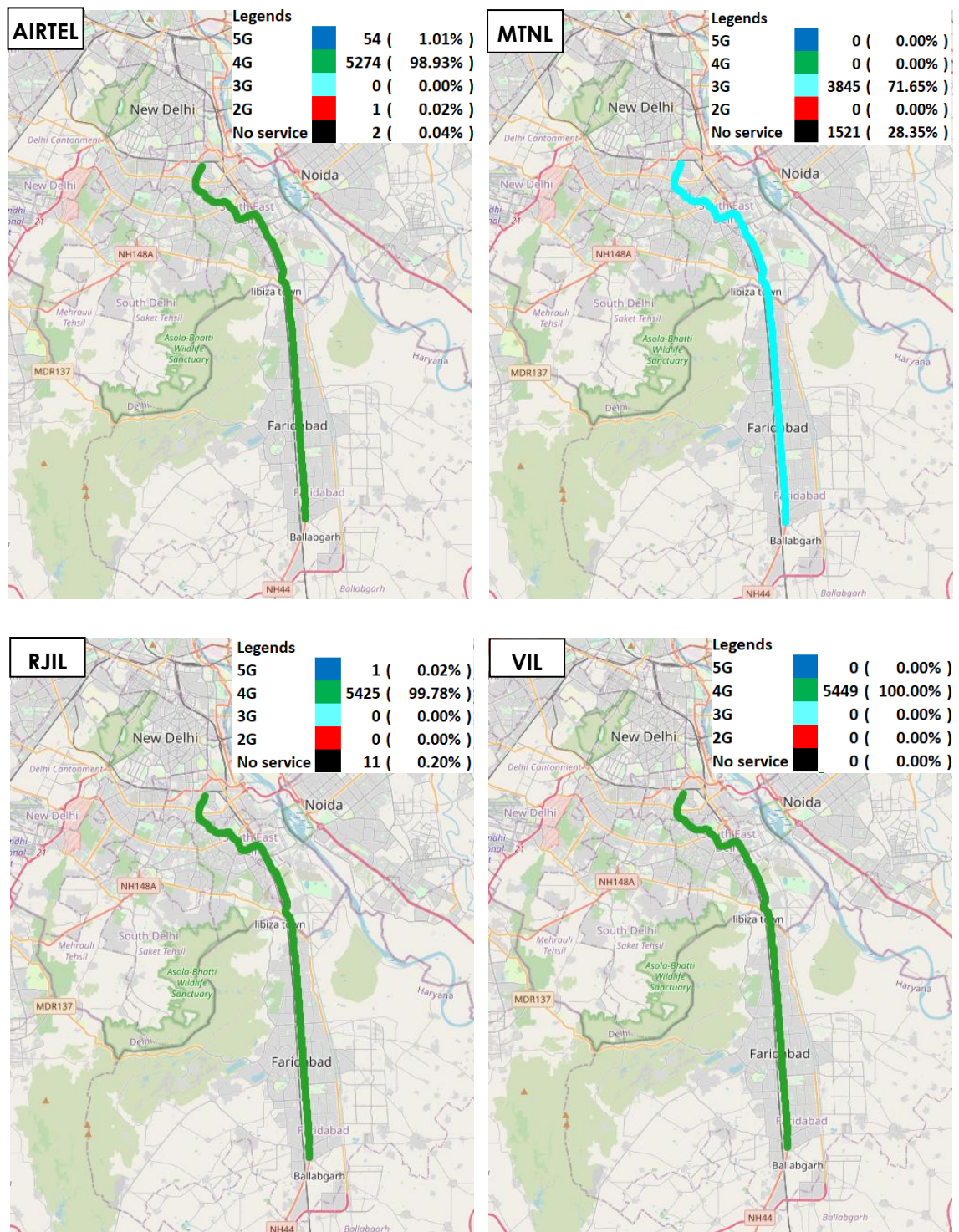


Figure-39: Serving technology plots auto-selection mode 5G/4G/3G/2G.

Note-

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

(c) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G) (Refer figure- 69 for plots)

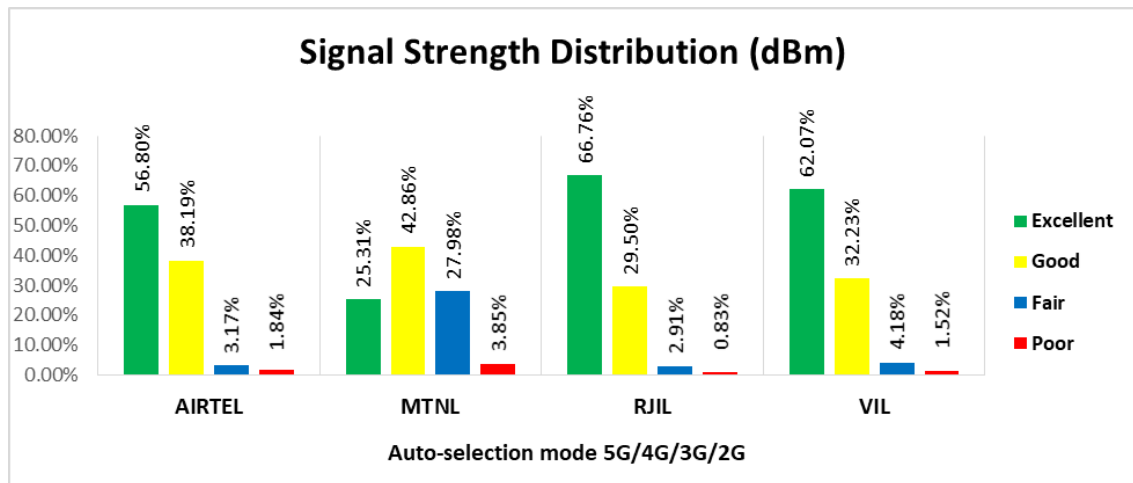


Figure-40: Signal strength distribution for auto-selection mode 5G/4G/3G/2G

ii) Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	111.71	2.49	42.27	5.19
	80th Percentile	179.14	4.36	58.63	7.46
	20th Percentile	27.09	0.49	26.96	0.84
Upload Throughput (Mbits/s)	Average	45.57	1.84	23.92	3.74
	80th Percentile	75.74	2.64	44.15	5.31
	20th Percentile	6.62	0.94	4.94	1.76
Ping (ms)	Average	75.34	NA	NA	NA

Table-62: Summary of Data performance in network auto-selection mode

Note-

- NA – Due to unavailability of TSP server details, testing could not be performed.

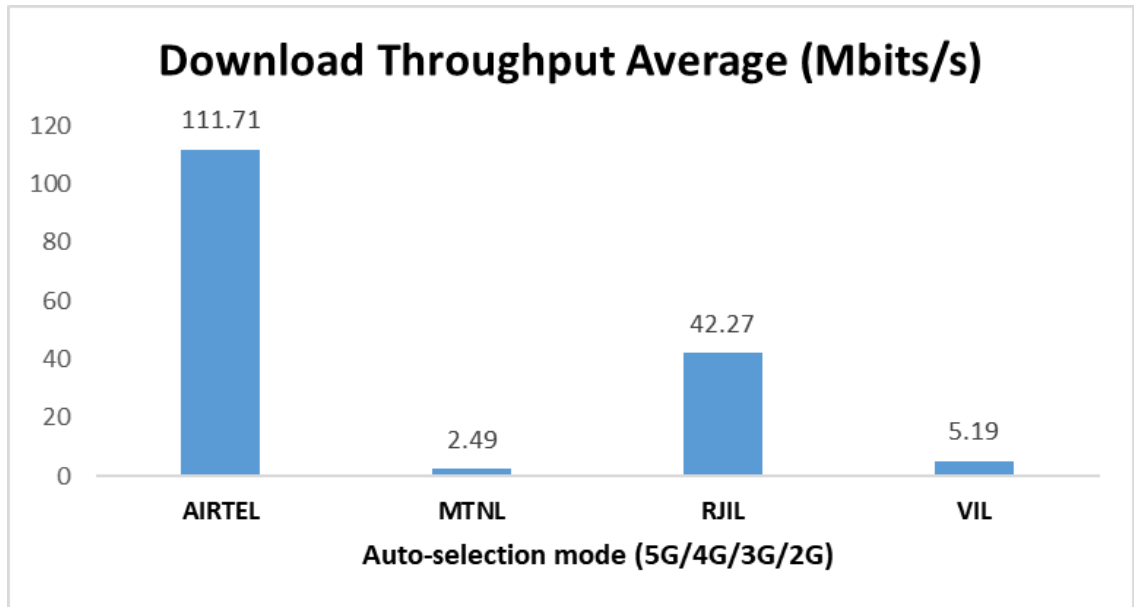


Figure-41: Download throughput

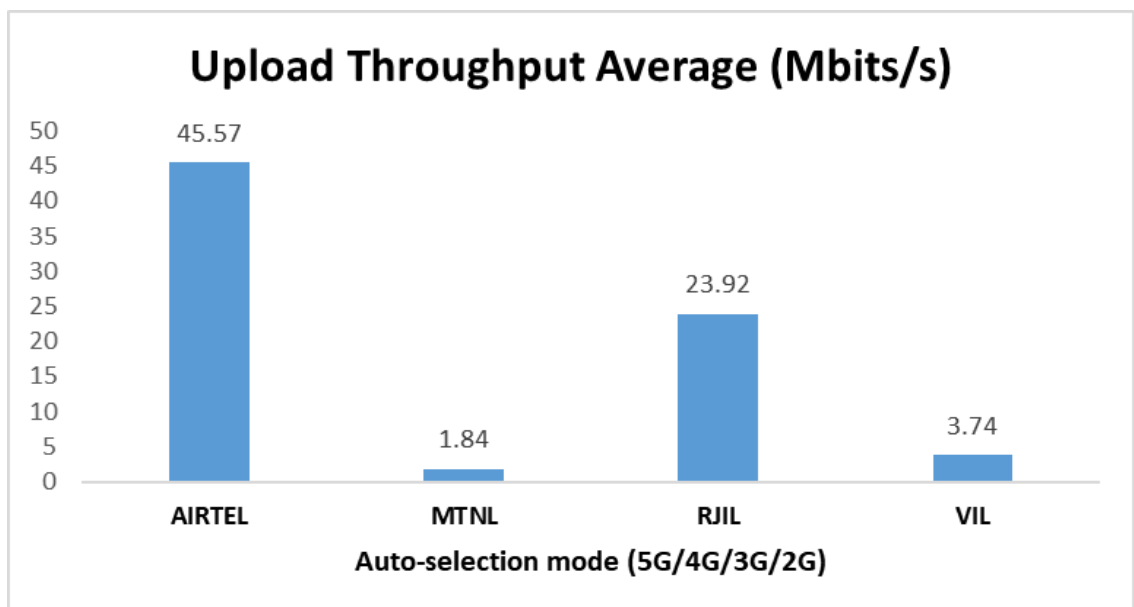


Figure-42: Upload throughput

4.4.4.4 Shaheed Sthal to Rithala

Drive test for this route has been conducted on 1st October 2024. This route has 29 metro stations which all are elevated.

i) Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempts	40	39	40	41
Call Setup Success Rate %	100.00	97.44	100.00	97.56
Drop Call Rate%	0.00	7.89	0.00	0.00
Call Setup Time-Average (Second)	0.83	4.03	0.65	1.69
Handover Success Rate %	95.89	100.00	97.13	98.21

Table-63: Summary of voice call performance in network auto-selection mode

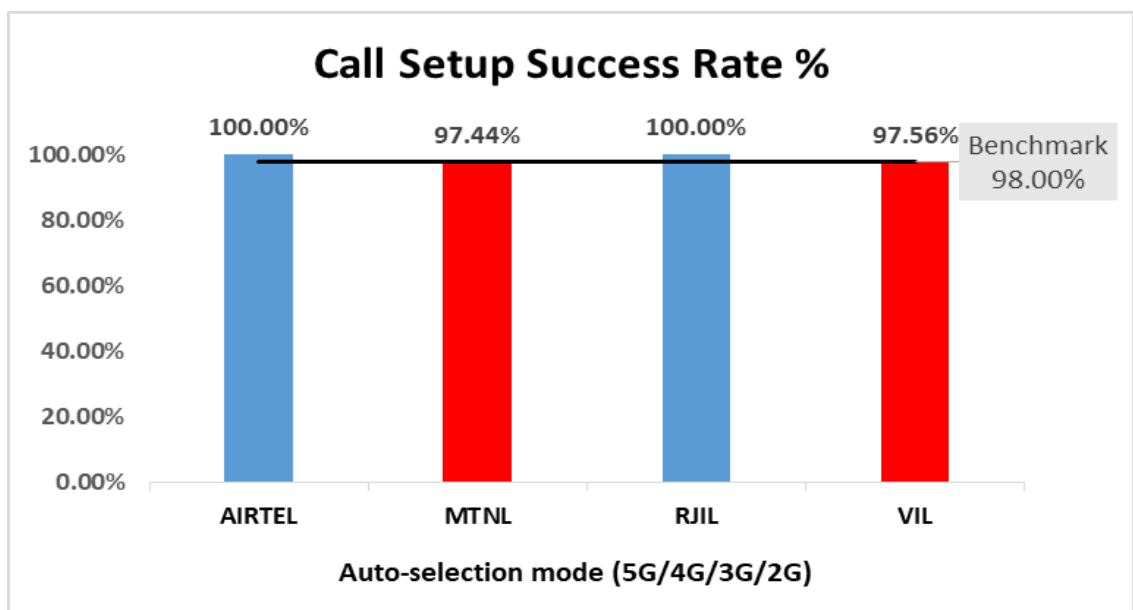


Figure-43: Performance for call setup success rate

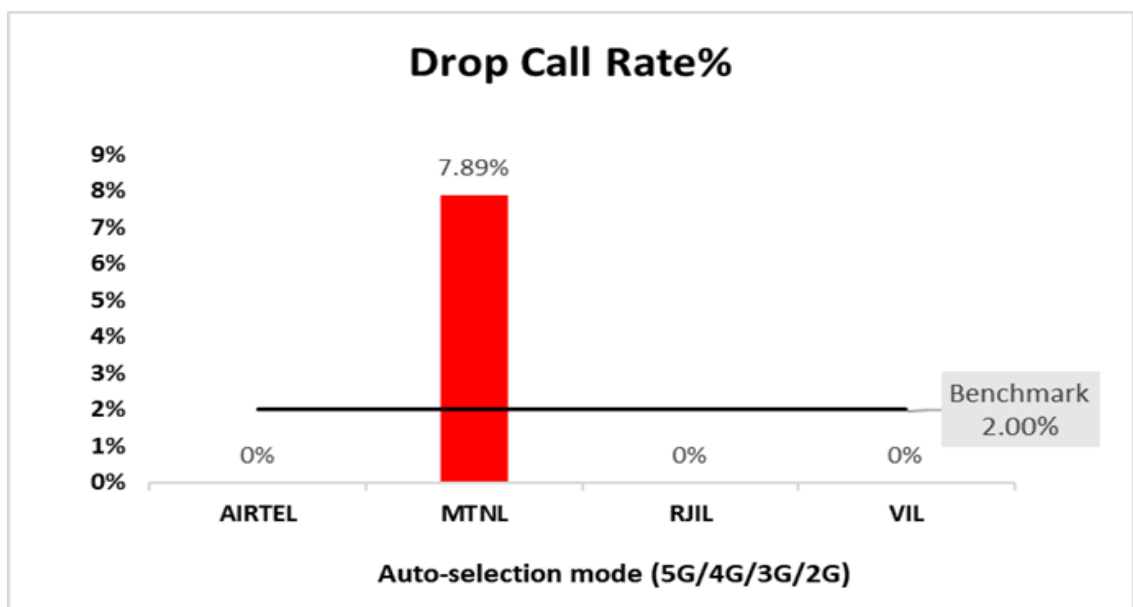


Figure-44: Performance for drop call rate

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

Technology	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
5G	0.60%	NA	26.26%	NA
4G	99.40%	0.00%	73.74%	100.00%
3G	NA	100.00%	NA	0.00%
2G	0.00%	0.00%	NA	0.00%
No service	0.00%	0.00%	0.00%	0.00%

Table-64:Time spent on technology during drive test

Note-

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

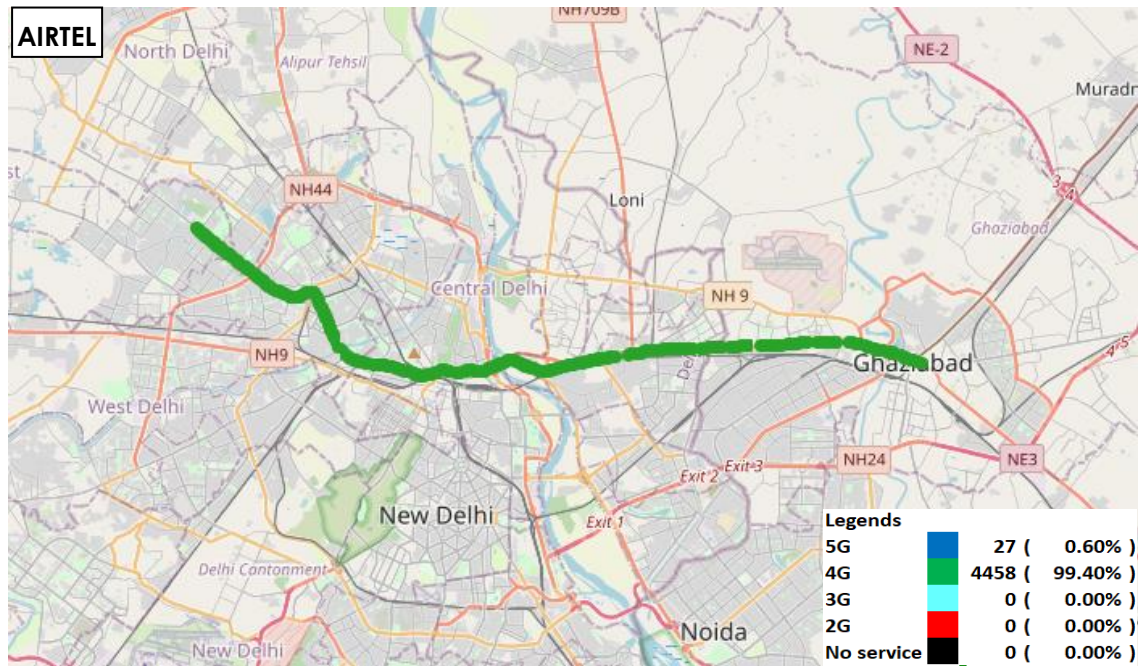


Figure-45: Serving technology plots auto-selection mode 5G/4G/3G/2G -AIRTEL

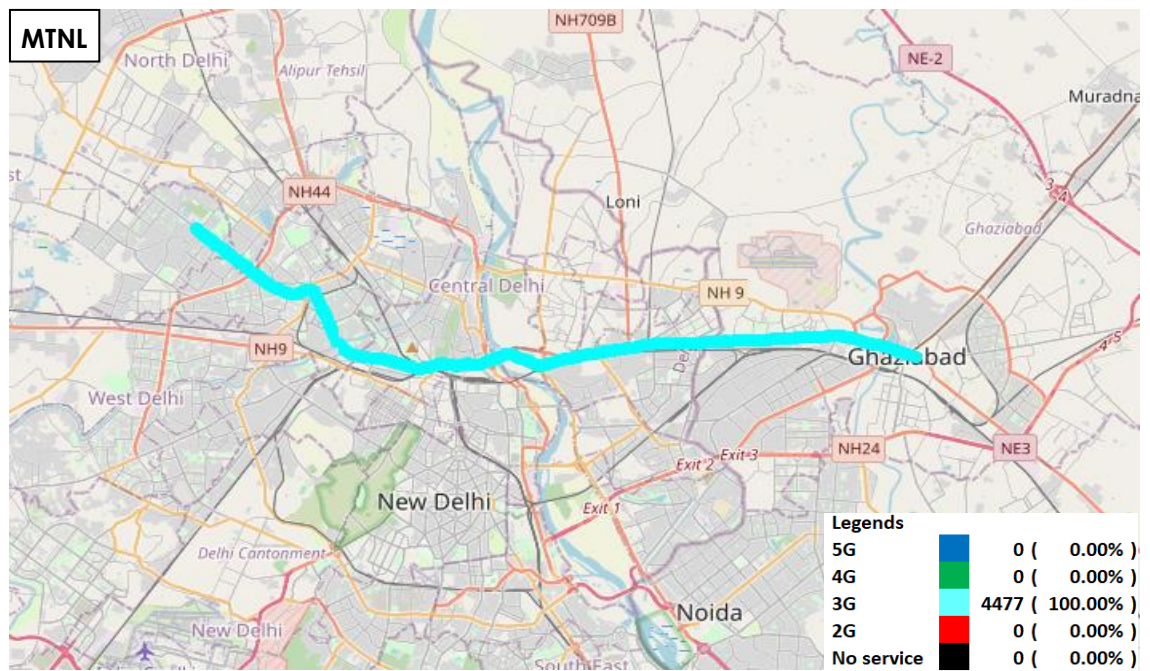


Figure-46: Serving technology plots auto-selection mode 5G/4G/3G/2G -MTNL

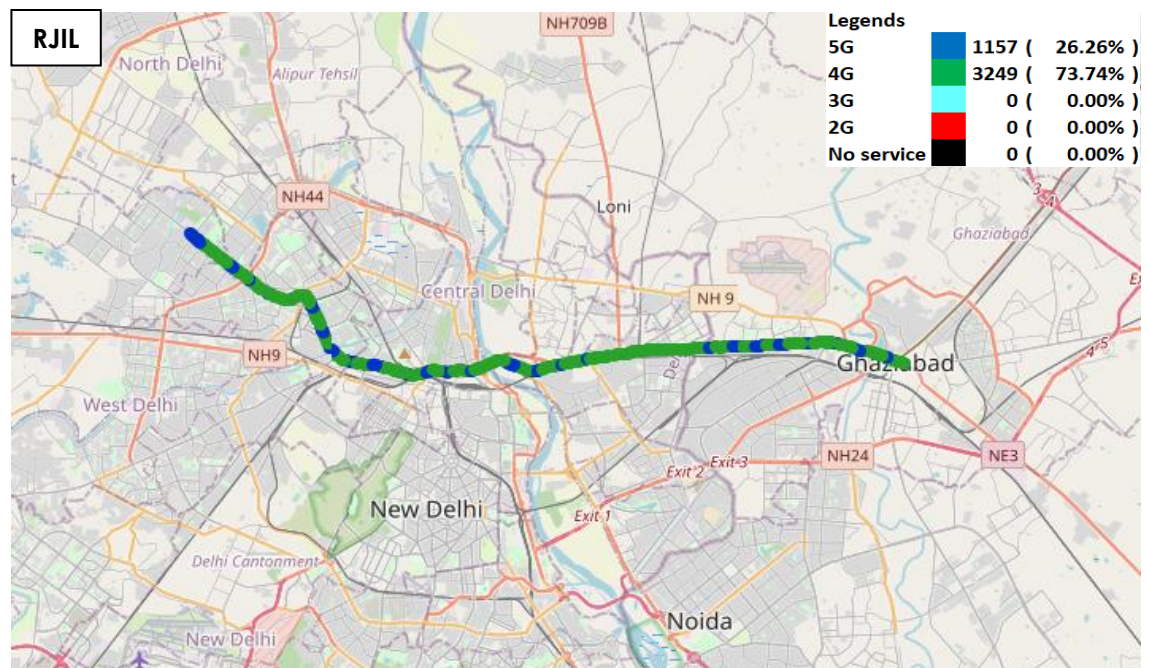


Figure-47: Serving technology plots auto-selection mode 5G/4G/3G/2G -RJIL

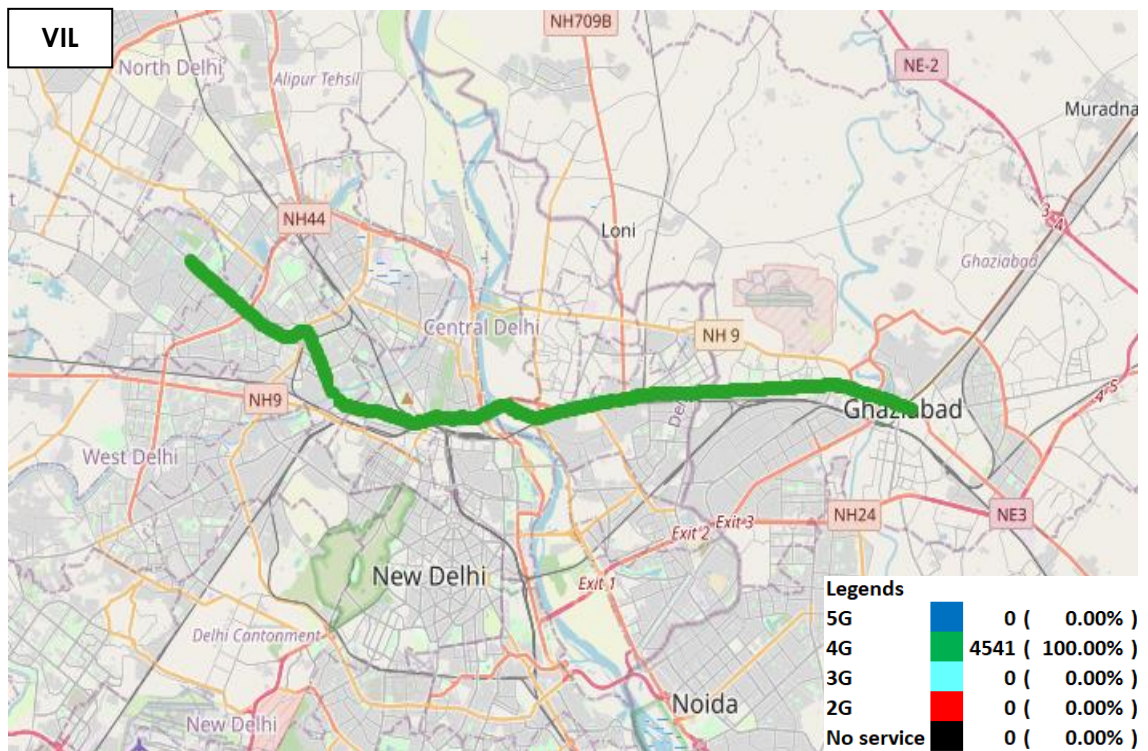


Figure-48: Serving technology plots auto-selection mode 5G/4G/3G/2G - VIL

(c) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G) (Refer figure-70,71, 72 & 73 for plots)

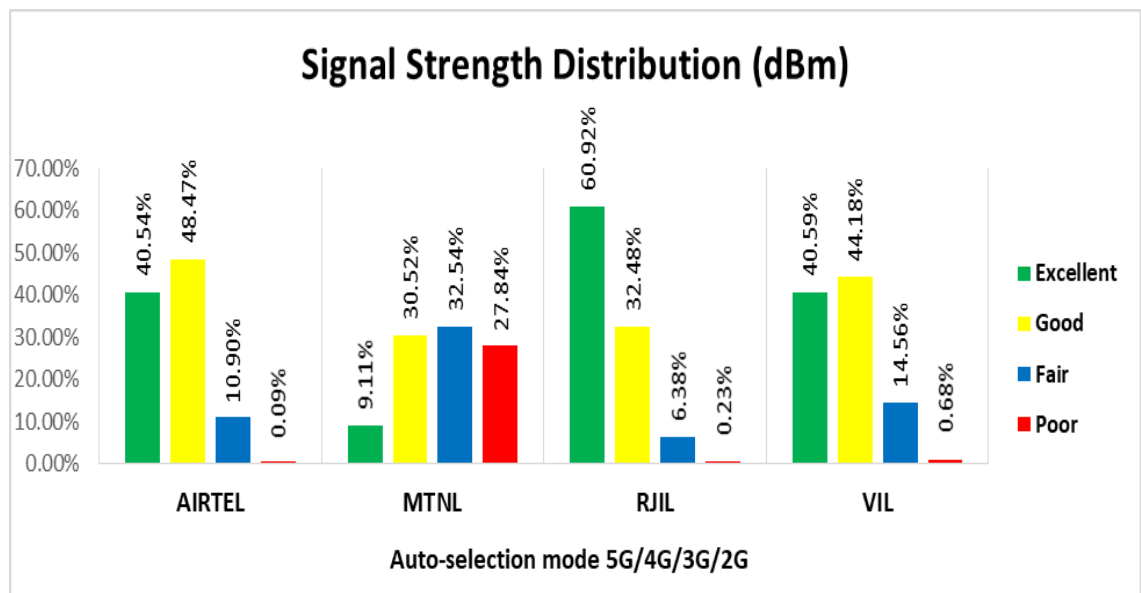


Figure-49: Signal strength distribution for auto-selection mode 5G/4G/3G/2G

ii) Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	99.14	2.13	198.78	8.77
	80th Percentile	143.63	3.41	308.55	11.79
	20th Percentile	38.58	0.71	108.17	0.99
Upload Throughput (Mbits/s)	Average	38.29	1.58	22.16	4.11
	80th Percentile	55.99	1.99	34.79	6.39
	20th Percentile	14.64	1.12	9.87	1.73
Ping (ms)	Average	39.49	NA	NA	NA

Table-65: Summary of Data performance in network auto-selection mode

Note-

- NA – Due to unavailability of TSP server details, testing could not be performed.

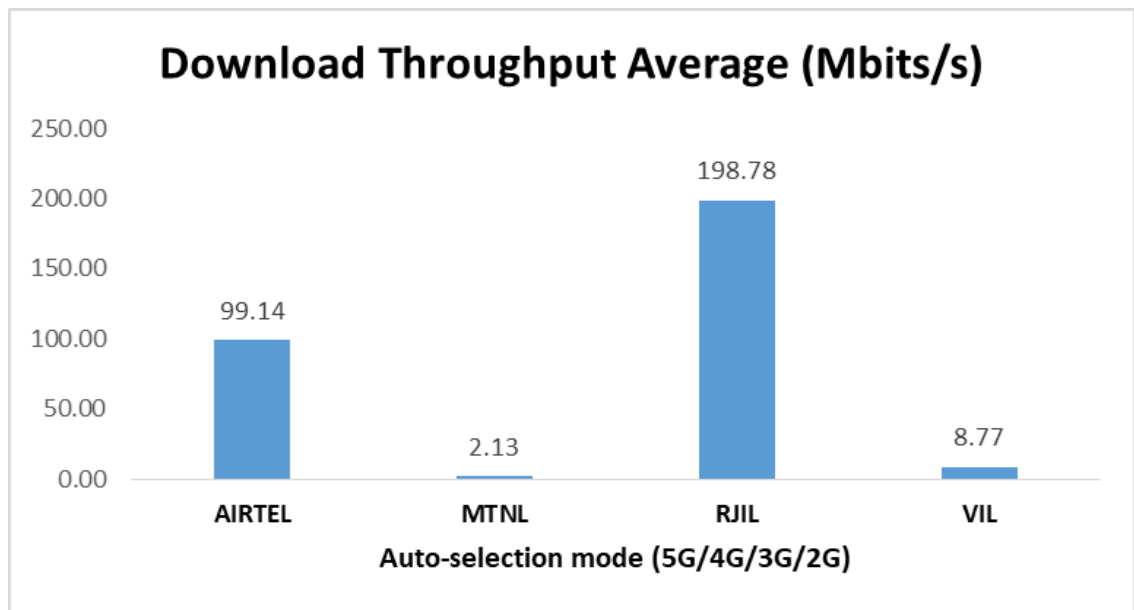


Figure-50: Download throughput

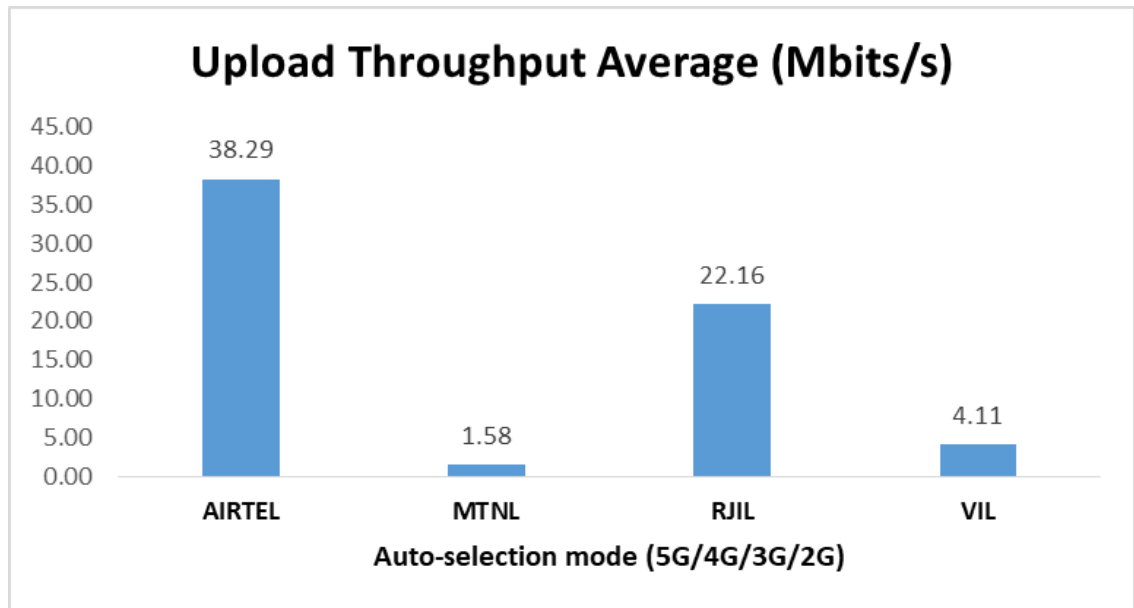


Figure-51: Upload throughput

4.4.4.5 Samaypur Badli to Millennium City Centre

Drive test for this route has been conducted on 1st october. This route has 37 metro stations, out of which 17 are elevated and 20 are underground.

i) Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	MTNL	RJIL	VIL
Call Attempts	61	35	59	59
Call Setup Success Rate %	98.36	100.00	100.00	100.00
Drop Call Rate%	0.00	11.43	0.00	0.00
Call Setup Time-Average (Second)	1.04	3.34	0.97	1.44
Handover Success Rate %	98.19	100.00	97.44	98.01

Table-66: Summary of voice call performance in network auto-selection mode

Note-

- In MTNL, number of call attempt is less due to no network observed in tunnel.

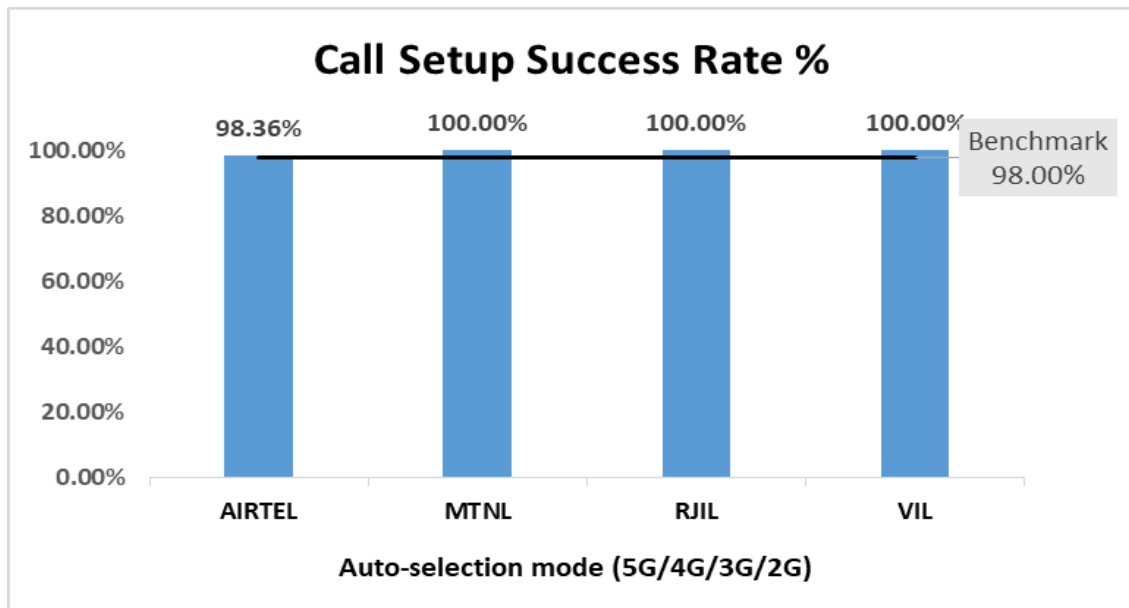


Figure-52: Performance for call setup success rate

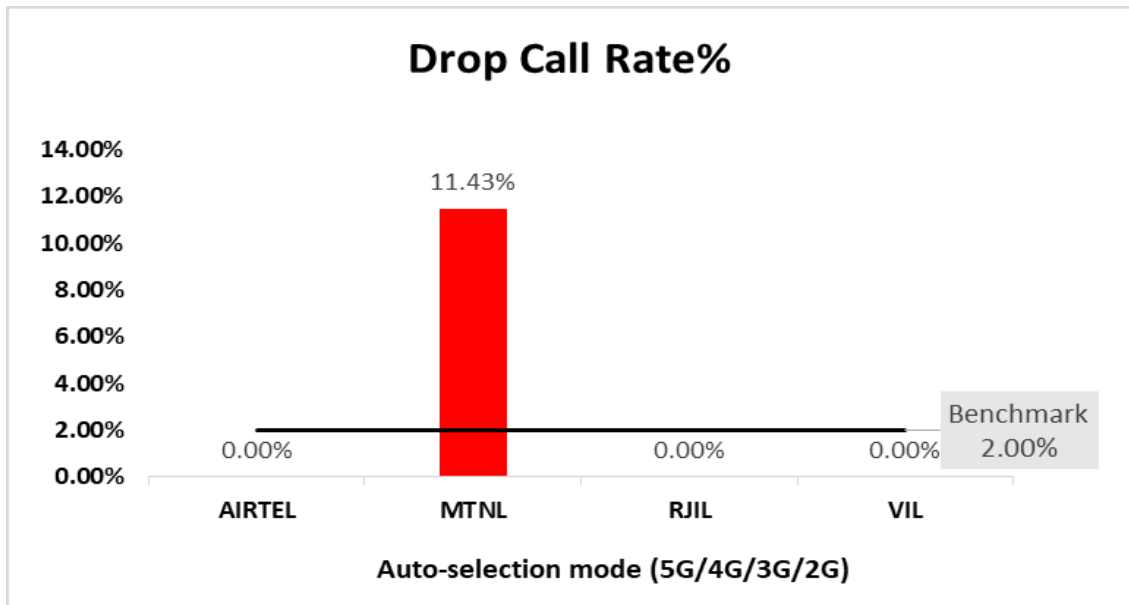


Figure-53: Performance for drop call rate

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

Technology	Service Provider			
	AIRTEL	MTNL	RJIL	VIL
5G	5.28%	NA	18.91%	NA
4G	94.72%	0.00%	81.09%	100.00%
3G	NA	58.93%	NA	0.00%
2G	0.00%	0.00%	NA	0.00%
No service	0.00%	41.07%	0.00%	0.00%

Table-67:Time spent on technology during drive test

Note-

- MTNL has no service/limited service mode in metro tunnel where it was connected to network of other TSPs.
- NA- Service provider doesn't provide services in respective technology.

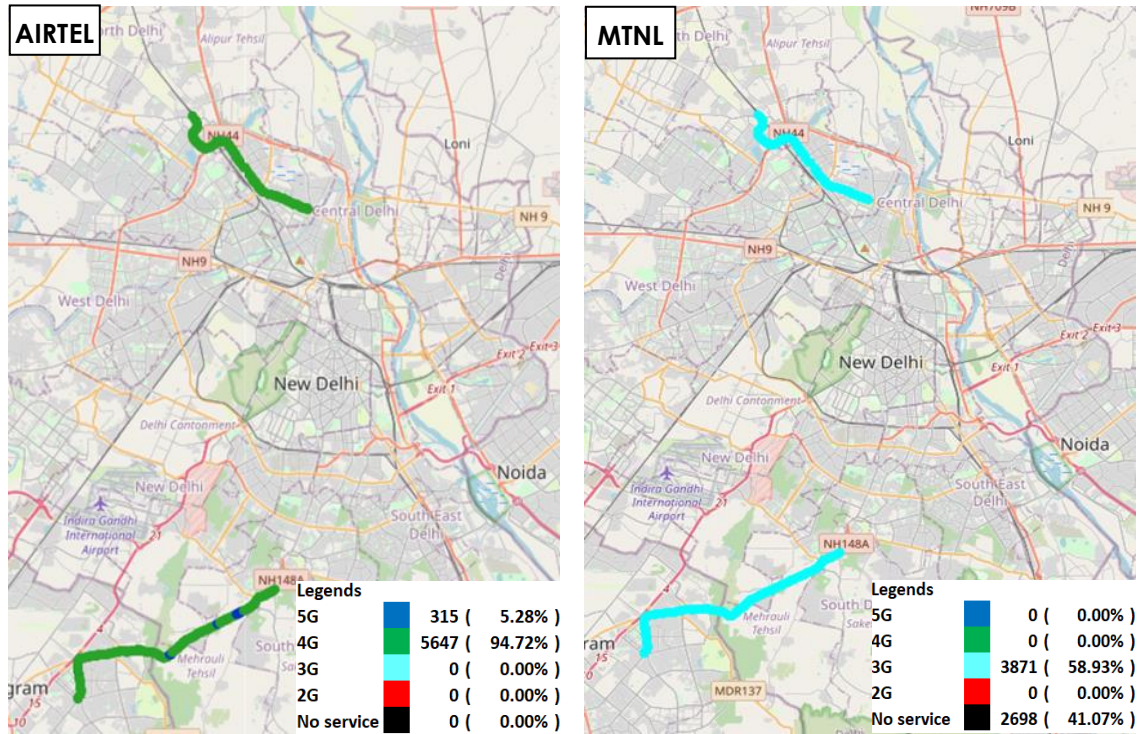


Figure-54: Serving technology plots auto-selection mode 5G/4G/3G/2G - AIRTEL & MTNL

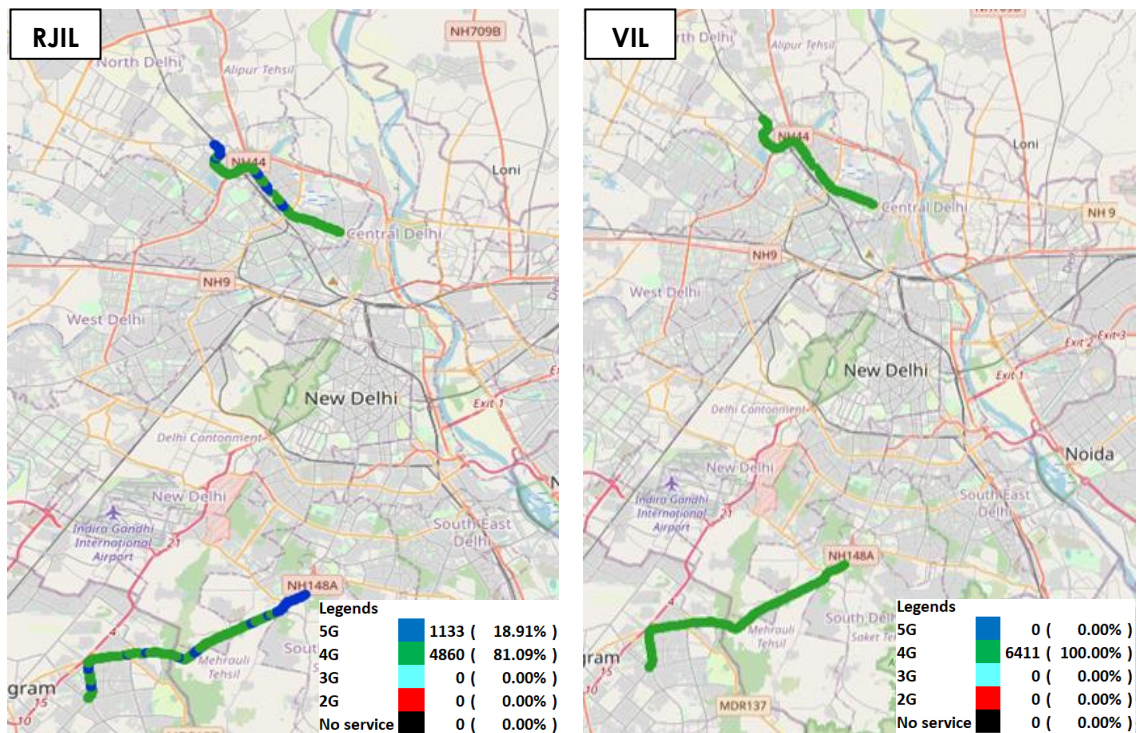


Figure-55: Serving technology plots auto-selection mode 5G/4G/3G/2G- RJIL & VIL

Note-

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

(c) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G) (Refer figure-74 for plots)

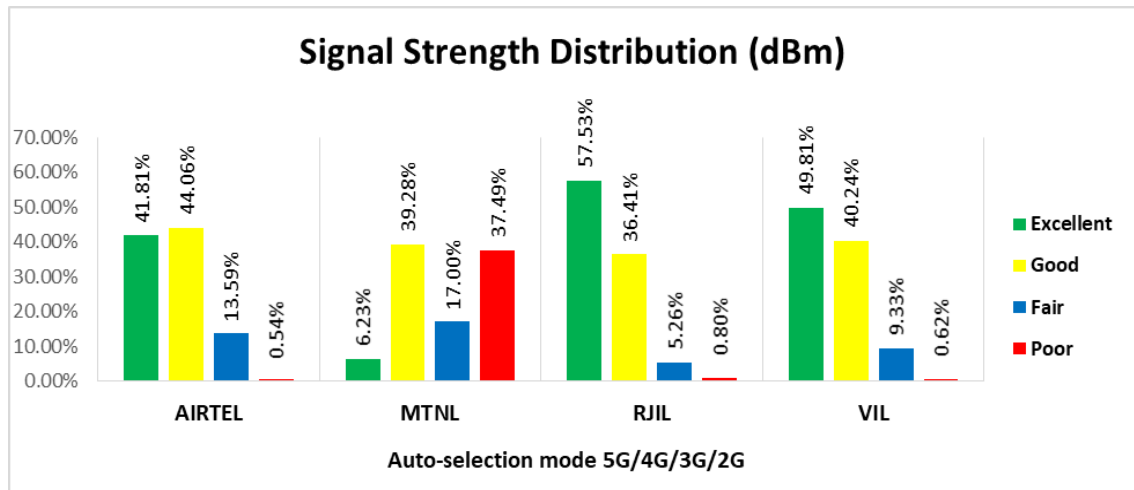


Figure-56: Signal strength distribution for auto-selection mode 5G/4G/3G/2G

ii) Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	MTNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	75.71	2.21	95.27	5.30
	80th Percentile	145.18	3.76	143.43	7.53
	20th Percentile	2.91	0.66	1.27	0.95
Upload Throughput (Mbits/s)	Average	35.46	2.01	20.03	3.42
	80th Percentile	69.74	2.88	38.12	4.49
	20th Percentile	1.76	1.17	0.9	1.6
Ping (ms)	Average	86.02	NA	NA	NA

Table-68: Summary of Data performance in network auto-selection mode

Note-

- NA – Due to unavailability of TSP server details, testing could not be performed.

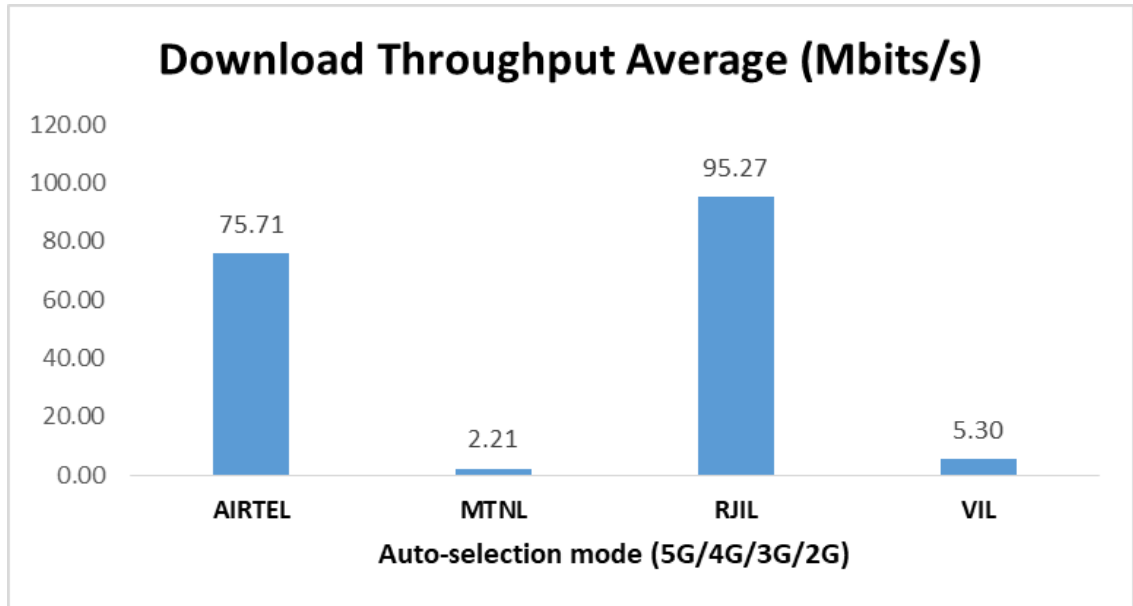


Figure-57: Download throughput

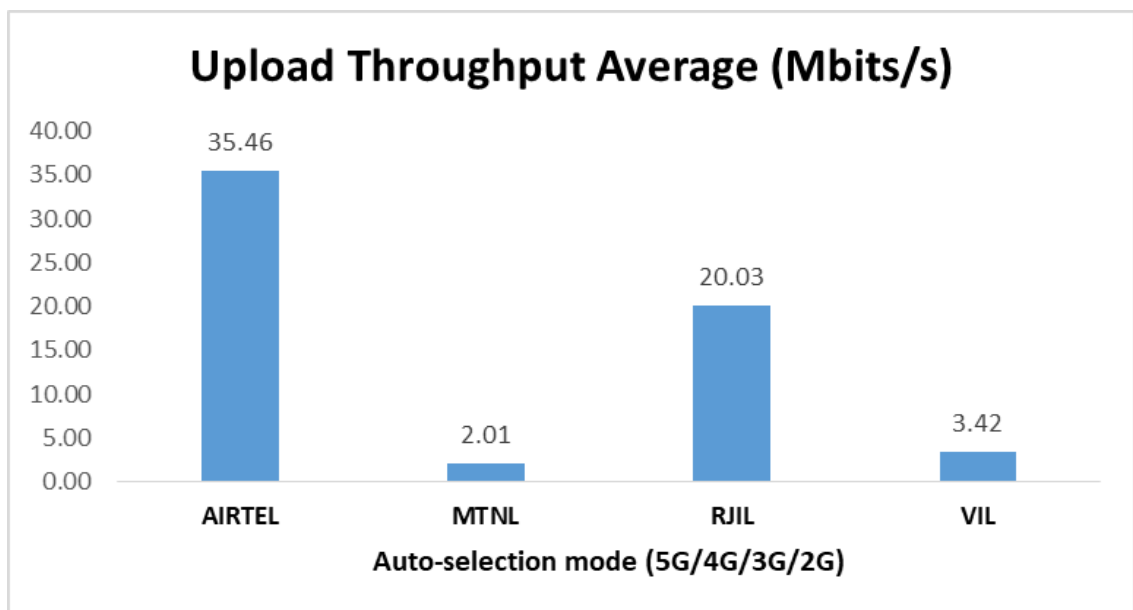


Figure-58: Upload throughput

5. Voice & Data Key findings

5.1 Overall Voice

1. Call setup success rate:

- RJIL has lower call setup success rate (94.00%), majorly due to block calls occurred on 17th September. Whereas Airtel, MTNL and VIL have 99.25%, 97.49% and 99.25% call setup success rate respectively.

- b) Airtel has 100% call setup success rate while calling on peer service provider's network, while remaining service providers have marginal block call rate for inter-operator calls.
 - c) All service providers except VIL have 100% call setup success rate on hotspots.
 - d) Except MTNL all operators are meeting QoS Benchmark for call setup success rate & drop call rate along Metro routes.
- 2. **Call Setup time:** Owing to circuit switched network (3G/2G), MTNL has taken comparatively longer time (3.27 second) to establish the voice call, whereas Airtel, RJIL and VIL call setup time is 0.82, 0.73 & 1.55 second respectively.
- 3. **Call Silence/Mute Rate:** In packet switched network (4G/5G), RJIL (3.01%) and VIL (2.34%) have comparatively higher silence call rate (> 2%) than Airtel (0.55%). Further RJIL has higher RTP packet loss rate in downlink (2.25%) compared to Airtel (1.11%) and VIL (1.68%). In the uplink the RTP packet loss rate is higher for VIL(2.01%) compared to RJIL(1.84%) and Airtel(0.77%).
- 4. **Call Drop Rate:**
 - a) Overall MTNL's call drop rate (7.23%) is higher (QoS benchmark of 2%), while Airtel, RJIL and VIL have 0.12%, 0.23% and 0.23% drop call rate respectively.
 - b) At hotspots all service providers have 0.00% call drop rate except MTNL (3.13%).

5.2 Overall Data

- 1. **Data download and upload performance (Dynamic i.e. while moving) :**
 - a) MTNL (3.71 Mbps) and VIL (14.45 Mbps) being on 3G & 4G as top technology respectively, have comparatively lower data speeds. While Airtel and Jio have average download speed of 171.44 Mbps and 231.82 Mbps respectively.
 - b) All service providers have lower Average data download speeds on metro train routes for Airtel, MTNL, RJIL and VIL respectively with values of 96.86 Mbps, 1.89 Mbps, 151.19 Mbps & 7.71 Mbps compared with city routes where the Average Download Speed is 171.44 Mbps, 3.71 Mbps, 231.82 & 14.45 Mbps.
- 2. **Data download and upload performance (static i.e. while stationary):**
 - a) On hotspots, Airtel has better 5G QoS performance comparatively, with average download and upload speed of 268 Mbps and 57 Mbps respectively.
 - b) RJIL has average download and upload speed of 221 Mbps and 26 Mbps respectively.
- 3. **Data session setup success rate (static i.e. while stationary):**
 - a) Over all Airtel have 100% download session setup success rate whereas RJIL have 92.50 %, VIL have 85.00 % & MTNL have 77.50 % respectively.
 - b) Over all Airtel have 100% upload session setup success rate whereas RJIL have 95.00 %, VIL have 86.25 % & MTNL have 78.75 % respectively.

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 99.44% call setup success rate observed in 3G/2G network mode. Call drop rate (0.94%) performance is well within benchmark of 2%. (refer Table-3 and Table- 13)
- 99.25% call setup success rate and 0.12% drop call rate observed for auto-selection mode for LSA. (refer Table-5)
- 99.32% call setup success rate and 0.08% drop call rate observed for auto-selection mode for city drive.(refer Table-15)
- 97.47% and 92.86% call setup success rate have been observed in Noida electronic city to Dwarka Sector 21 and Yashobhoomi Dwarka sector-25 to New Delhi metro route which is lower than benchmark. (refer Table-54 & 57)
- 2.04% call drop rate has been observed Kashmere gate to Raja nahar singh metro route which is higher than benchmark. (refer Table-60)
- 28.71% & 0.04% no service samples are observed in Yashobhoomi dwarka sector-25 to New Delhi and Kashmere gate to Raja Nahar Singh respectively in tunnel. (refer Table-58 & 61)

Data

- Airtel has 171.44 Mbps average download throughput & 34.37 Mbps average upload throughput across measured routes for LSA (refer Table-11)
- Airtel has 181.06 Mbps average download throughput & 32.56 Mbps average upload throughput across measured routes for city drive (refer Table-19)
- Connaught Place, Sarojini Nagar Market, and Indira Gandhi International Airport hotspots have less download speeds (less than 100 Mbps) out of total 16 hotspots. (refer Table- 38,51 & 53)
- Connaught Place, North block, Sarojini Nagar Market and Indira Gandhi International Airport hotspots have less upload speed (less than 10 Mbps) out of total 16 hotspots. (refer Table- 38, 45, 51 & 53)
- Samaypur Badli to Millennium City Centre metro route has less download speed out of 5 metro routes. (refer Table- 68)
- Yashobhoomi dwarka sector-25 to New Delhi metro route has the less upload speed out of 5 metro routes. (refer Table- 59)

2. MTNL:

Voice

- MTNL 3G/2G network mode is experiencing a drop call rate of 7.24%, significantly higher than the acceptable benchmark of 2% . (refer Table-3 and Table- 13)
- The call setup success rate for MTNL's auto-selection mode voice is currently at 97.49%, falling short of the benchmark of 98% in the LSA. (refer Table-5)
- MTNL auto-selection mode is experiencing a drop call rate of 7.23%, significantly higher than the acceptable benchmark of 2%. (refer Table-5)
- 97.14% call setup success rate and 7.13% drop call rate observed for auto-selection mode for city drive which is not meet the benchmark. (refer Table-15)
- 95.95% and 97.44% call setup success rate have been observed in Noida electronic city to Dwarka Sector 21 and Shaheed Sthal to Rithala metro route respectively which are lower than benchmark. (refer Table-54 & 63)
- 12.68%, 33.33%, 6.06%, 7.89%, 11.43% call drop rate has been observed in Noida electronic city to Dwarka Sector 21 , Yashobhoomi dwarka sector-25 to New Delhi, Kashmere gate to Raja nahar singh, Shaheed Sthal to Rithala & Samaypur Badli to Millennium City Centre metro route which are higher than benchmark. (refer Table-54, 57, 60, 63 & 66)
- 5.92%,79.86%, 28.35% & 41.07% no service samples are observed in Noida electronic city to Dwarka Sector 21 , Yashobhoomi dwarka sector-25 to New Delhi, Kashmere gate to Raja nahar singh and Samaypur Badli to Millennium City Centre metro route in tunnel. (refer Table-55, 56, 61 & 67)

Data

- MTNL has 3.71 Mbps average download throughput & 1.67 Mbps average upload throughput across measured routes for LSA (refer Table-11)
- MTNL has 3.76 Mbps average download throughput & 1.65 Mbps average upload throughput across measured routes for city drive (refer Table-19)
- Connaught Place, Lal Qila, Pragati Maidan, North Block, Hazrat Nizamuddin Railway Station, Sarojini Nagar Market, Indira Gandhi International Airport hotspots have less download speeds (less than 5 Mbps) out of total 16 hotspots. (refer Table- 38, 43, 44, 45, 49, 51 & 53)
- Connaught Place, Kashmere Gate Bus Stand, Lal Qila, Pragati Maidan, Lajpat Nagar Market, Greater Kailash Market, Hazrat Nizamuddin Railway Station,

Sarojini Nagar Market, Indira Gandhi International Airport hotspots have less upload speed (less than 2 Mbps) out of total 16 hotspots. (refer Table-38, 41, 43, 44, 46, 48, 49, 51 & 53)

- Noida electronic city to Dwarka sector-21 metro route has less download speed out of 5 metro routes. (refer Table- 56)
- Yashobhoomi Dwarka sector-25 to New Delhi metro route has the less upload speed out of 5 metro routes. (refer Table- 59)

3. RJIL:

Voice

- RJIL's call setup success rate stands at 94.0%, which does not meet the benchmark of 98% in auto-selection mode within the LSA. A significant number of blocks are observed on 17th September 2024 drive. (refer Table-5)
- 3.01% silence call rate is observed.(refer Table-5 & refer Table-15)
- RJIL's call setup success rate in auto-selection mode during the city drive test is at 92.48%, which is below the benchmark. (refer Table-15)
- 93.33% call setup success rate have been observed in Yashobhoomi dwarka sector-25 to New Delhi metro route which is lower than benchmark. (refer Table- 57)
- 16.10% & 0.20% no service samples are observed in Yashobhoomi dwarka sector-25 to New Delhi and Kashmere gate to Raja nahar singh respectively in tunnel. (refer Table-58 & 61)

Data

- RJIL has 231.82 Mbps average download throughput & 23.91 Mbps average upload throughput across measured routes in LSA. (refer Table-11)
- RJIL has 254.83 Mbps average download throughput & 24.42 Mbps average upload throughput across measured routes in city drive. (refer Table-19)
- Connaught Place, Kashmere Gate Bus Stand, New Delhi Railway Station, Lal Qila, Lajpat Nagar Market, All India Institute of Medical Science, Hazrat Nizamuddin Railway Station, Sarojini Nagar Market and Indira Gandhi International Airport hotspots have less download speeds (less than 100 Mbps) out of total 16 hotspots. (refer Table- 38, 41, 42, 43, 46, 47, 49, 51 & 53)
- Kashmere Gate Bus Stand, All India Institute of Medical Science, Vasant Kunj Mall, Sarojini Nagar Market hotspots have less upload speed (less than 10 Mbps) out of total 16 hotspots. (refer Table-41,47,50,51)
- Yashobhoomi Dwarka Sec-25 to New Delhi metro route has less download and upload speed out of 5 metro routes.(refer Table-59)

4. VIL:

Voice

- VIL has 99.72% call setup success rate on 3G/2G network mode, while drop call rate is 1.31%. (refer Table-3 and refer Table-13)
- 99.25% call setup success rate & 0.23% drop call rate observed in auto-selection mode in LSA. (refer Table-5)
- 90.0% call setup success rate (1 block call out of 10 call attempts) observed in auto-selection mode at All India Institute of Medical Sciences location.(refer Table-30)
- 94.44% and 97.56% call setup success rate have been observed in Yashobhoomi dwarka sector-25 to New Delhi and Shaheed Sthal to Rithal metro route which is lower than benchmark threshold. (refer Table-57 & 63)
- 5.88% call drop rate has been observed in Yashobhoomi dwarka sector-25 to New Delhi metro route which is higher than benchmark. (refer Table-57)
- 0.98% no service samples are observed in Yashobhoomi dwarka sector-25 to New Delhi in tunnel. (refer Table-58)

Data

- VIL has 14.45 Mbps average download throughput & 4.59 Mbps average upload throughput across measured routes in LSA. (refer Table-11)
- VIL has 15.73 Mbps average download throughput & 4.76 Mbps average upload throughput across measured routes in city drive. (refer Table-19)
- Kashmere Gate Bus Stand, New Delhi Railway Station, North Block, Lajpat Nagar Market, All India Institute of Medical Science, Greater Kailash Market, Vasant Kunj Mall, Sarojini Nagar Market and Dhaula Kuan Bus Stand have less download speeds (less than 15 Mbps) out of total 16 hotspots. (refer Table-41, 42, 45, 46, 47, 48, 50, 51 & 52)
- Chandni Chowk, Kashmere Gate Bus Stand, Lal Qila, North Block, Lajpat Nagar Market, All India Institute of Medical Science, Greater Kailash Market, Hazrat Nizamuddin Railway Station, Vasant Kunj Mall, Sarojini Nagar Market, Indira Gandhi International Airport hotspots have less upload speed (less than 5 Mbps) out of total 16 hotspots. (refer Table-40, 41, 43, 45, 46, 47, 48,49, 50, 51, 53)
- Kashmere gate to Raja nahar singh metro route has less download speed out of 5 metro routes. (refer Table-62)
- Samaypur badli to Millennium City Centre metro route has less upload speed out of 5 metro routes. (refer Table-68)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

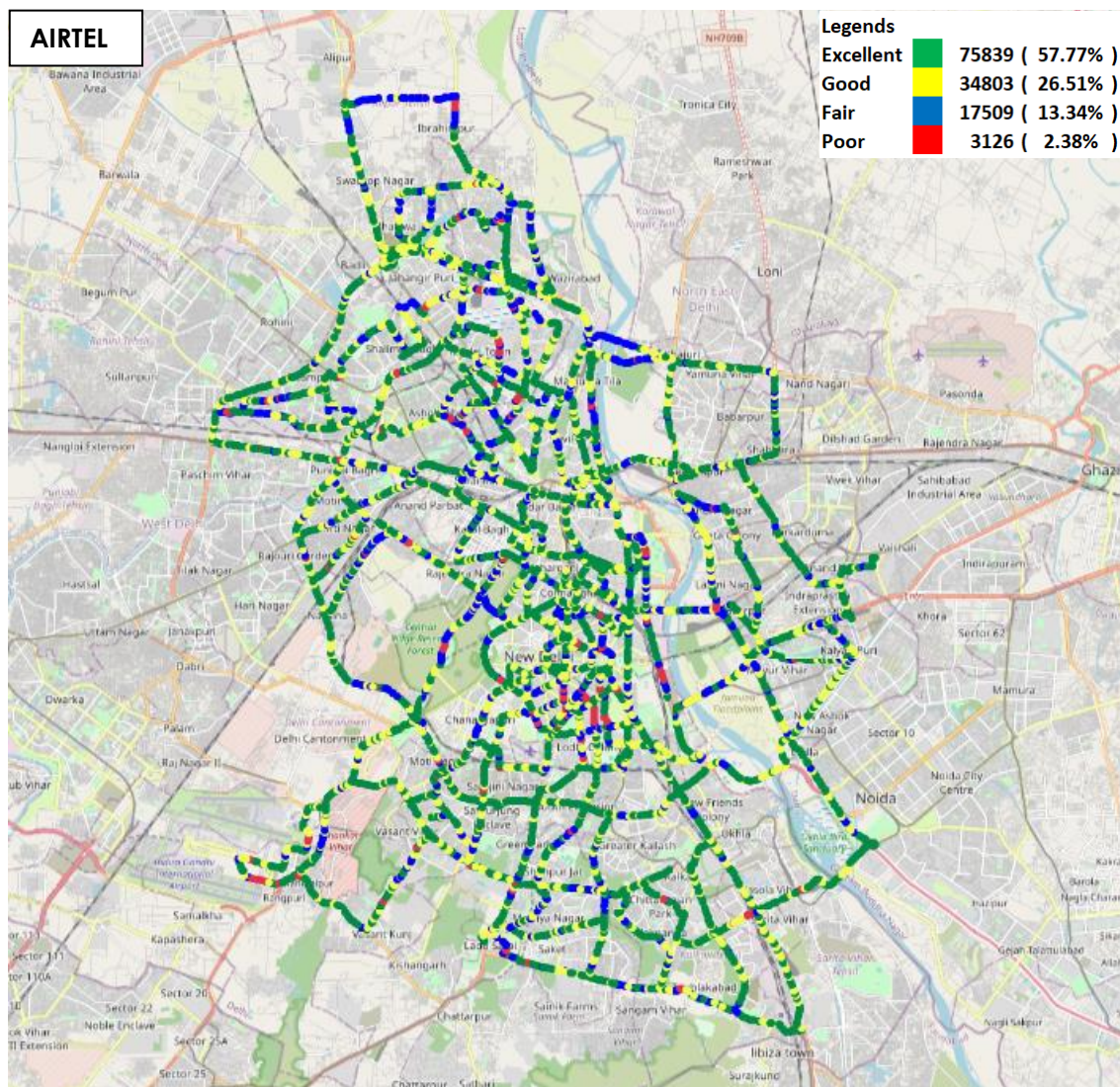


Figure-59: Signal strength 3G/2G network mode - AIRTEL

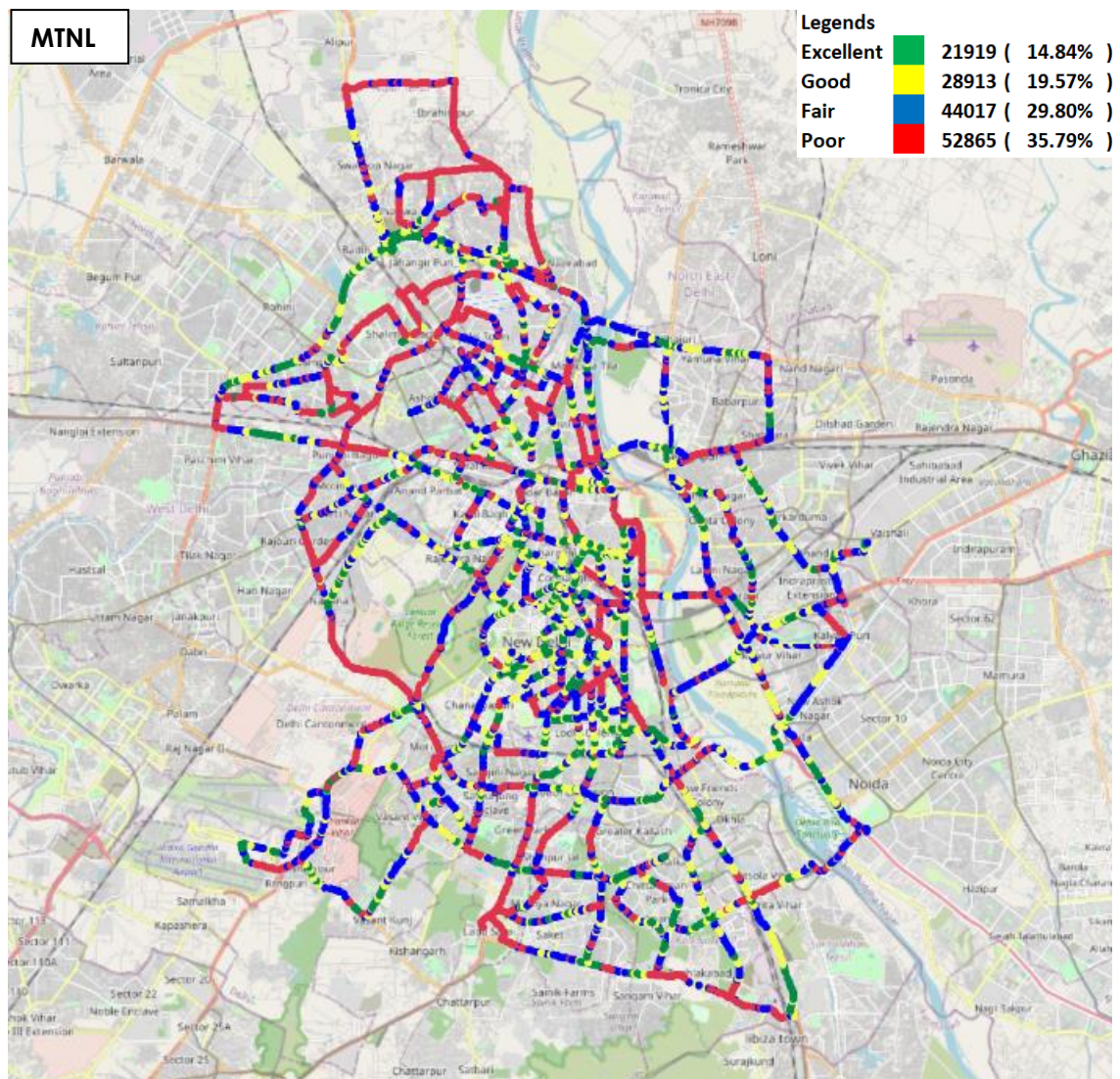


Figure-60: Signal strength 3G/2G network mode - MTNL

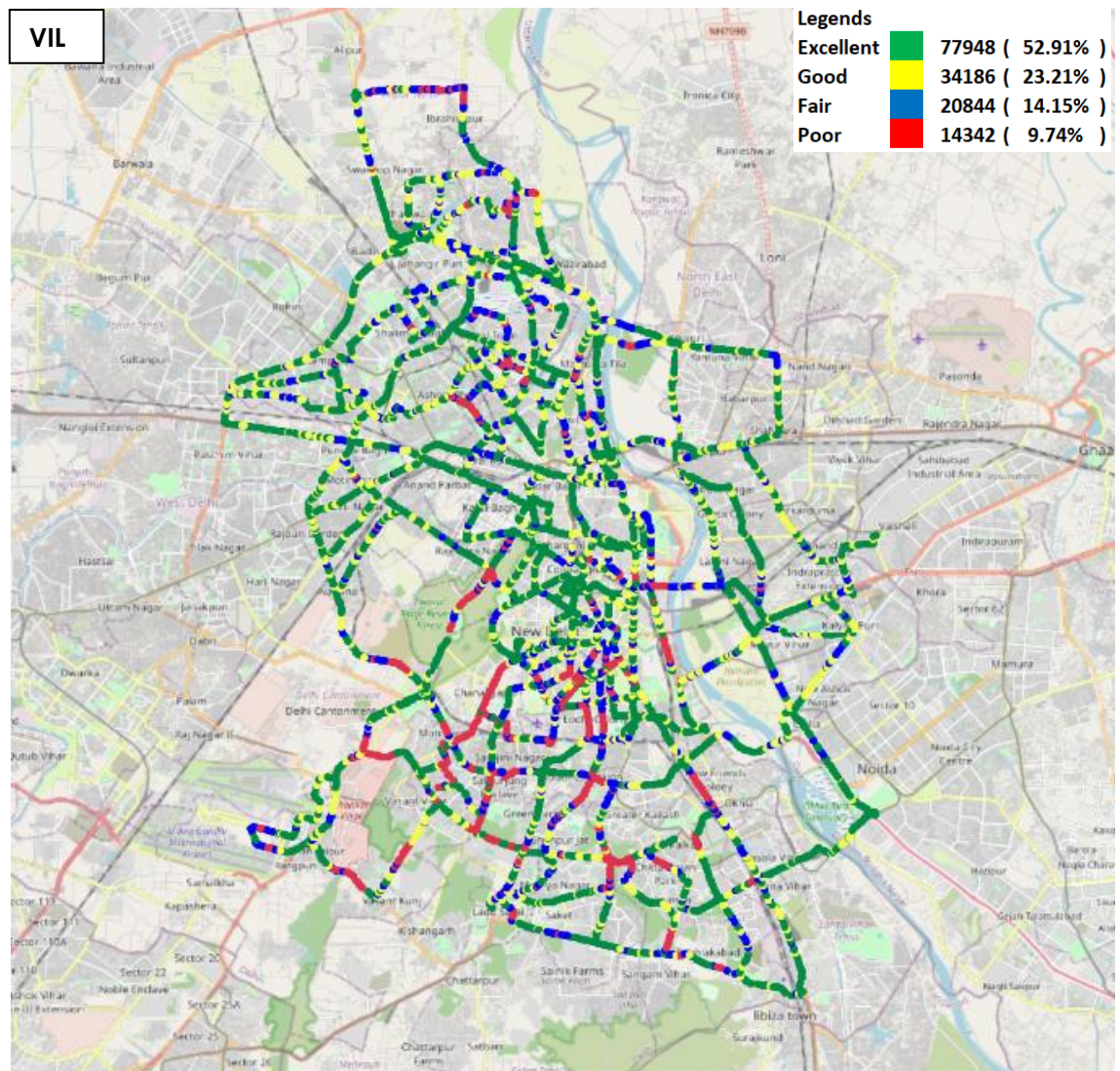


Figure-61: Signal strength 3G/2G network mode - VIL

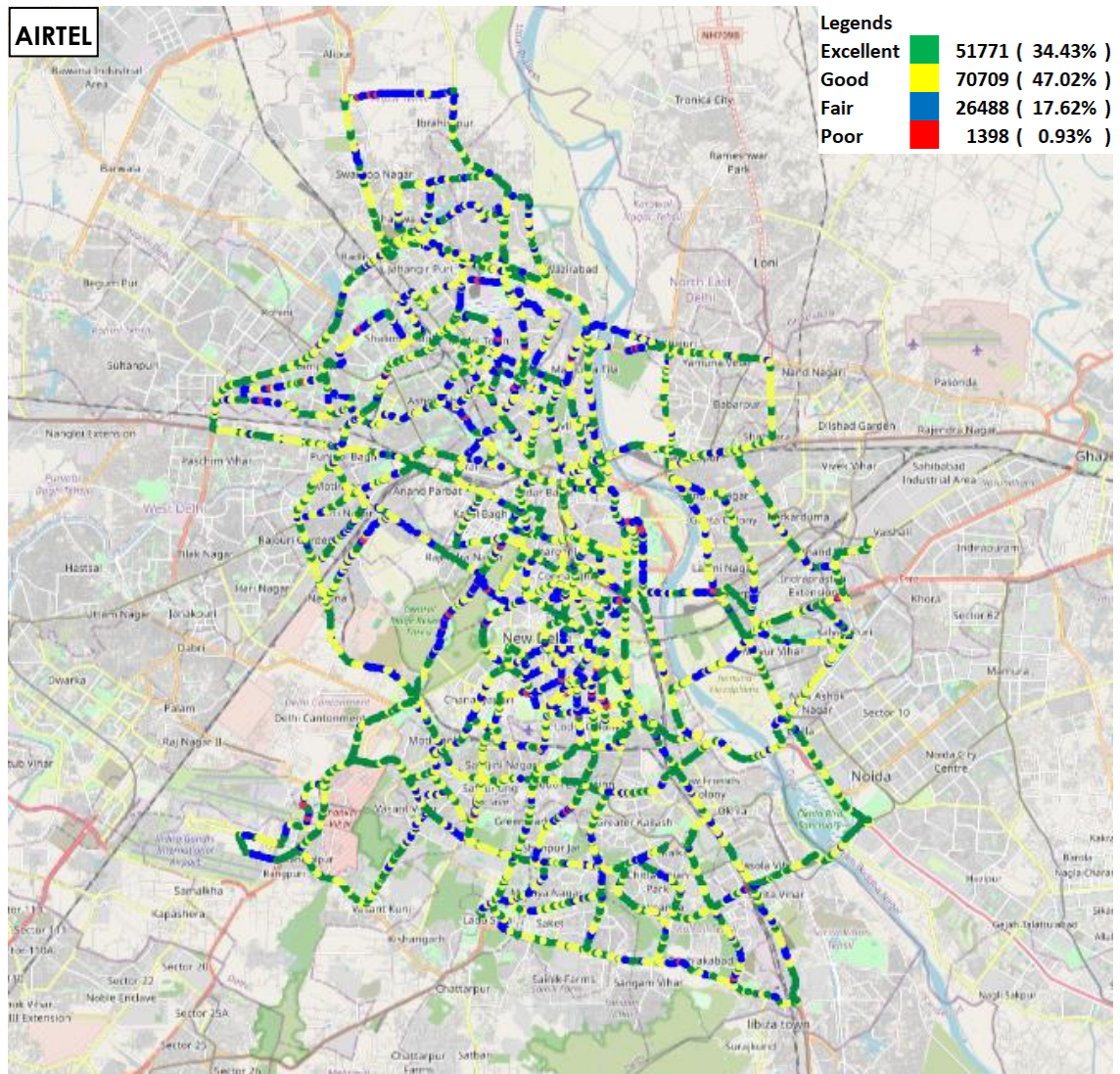


Figure-62: Signal strength auto-selection mode 5G/4G/3G/2G - Airtel

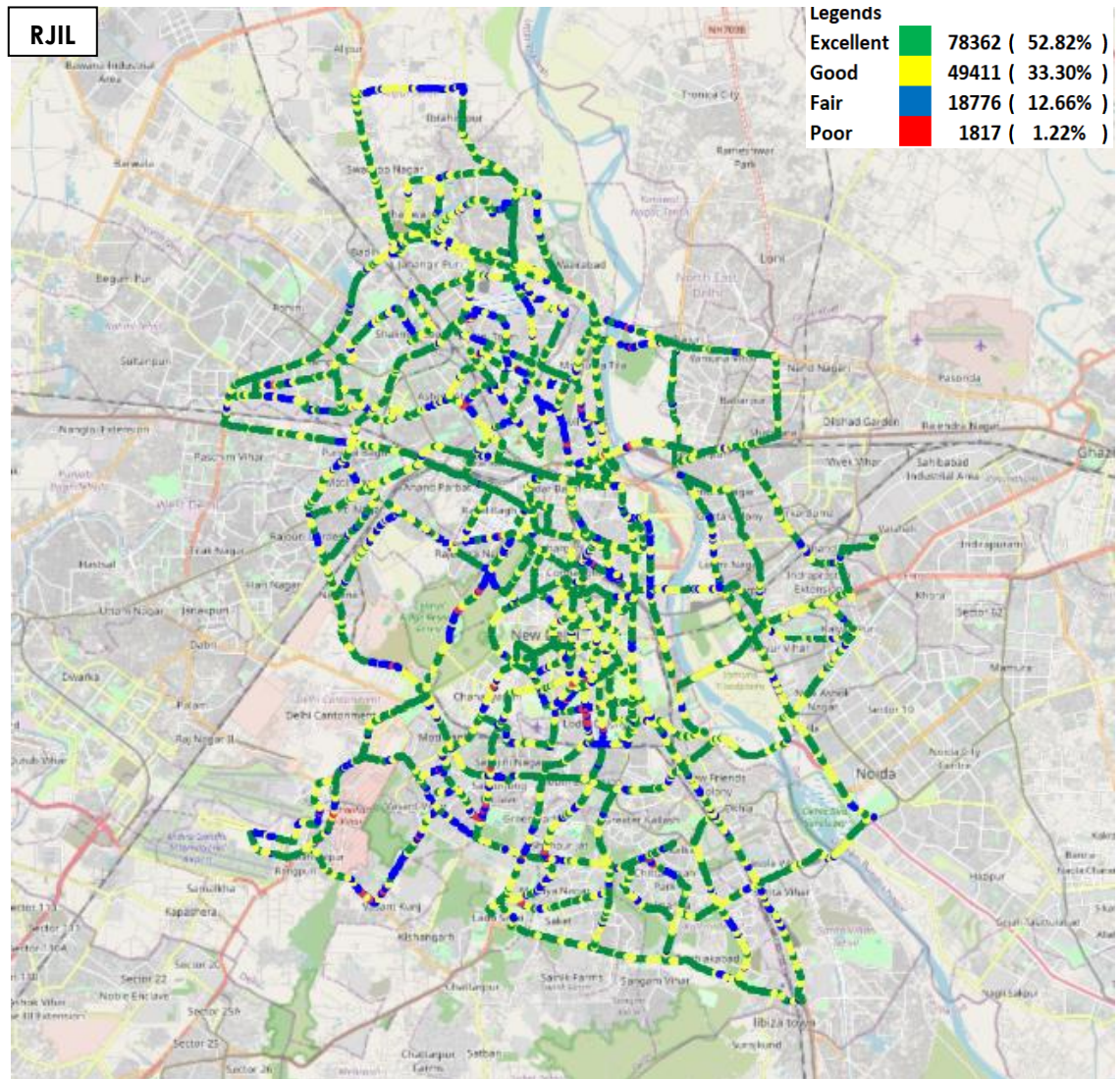


Figure-63: Signal strength auto-selection mode 5G/4G/3G/2G - RJIL

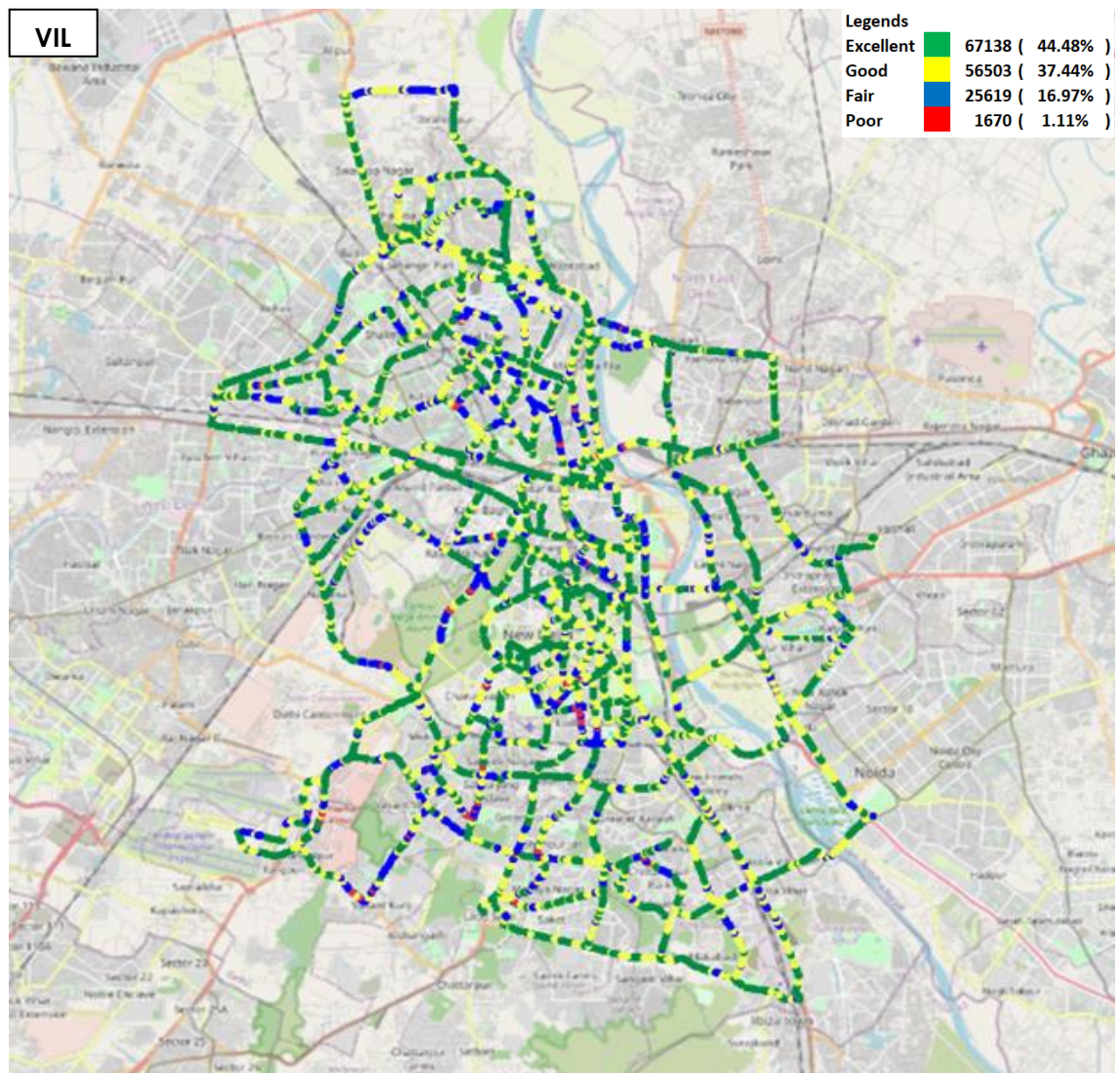


Figure-64: Signal strength auto-selection mode 5G/4G/3G/2G - VIL

6.1.2 Metro Route

i) Noida Electronic City to Dwarka Sec -21

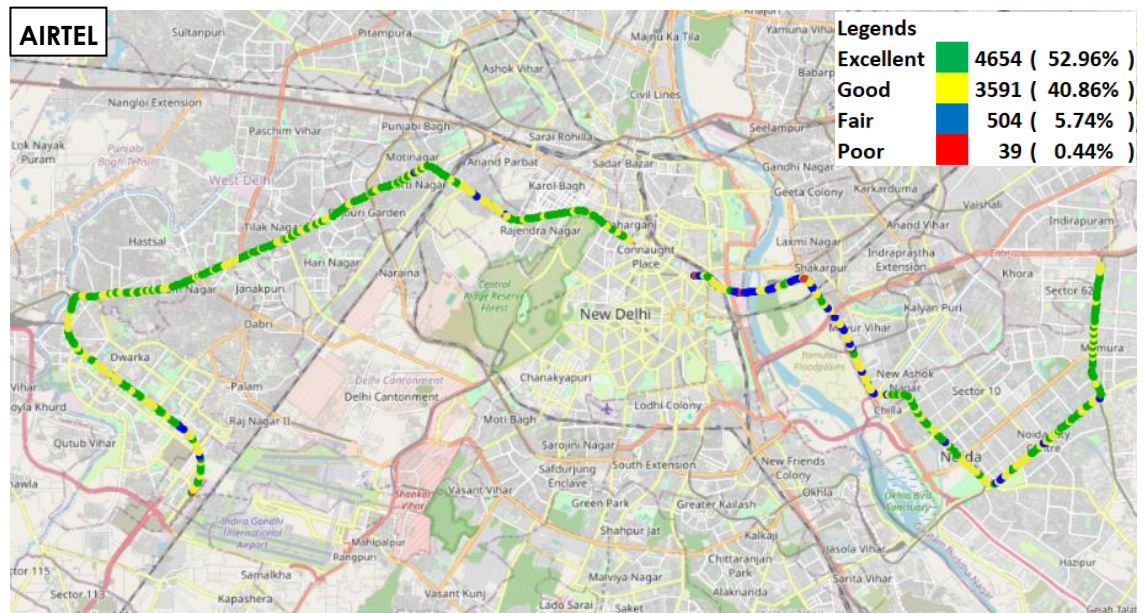


Figure-65: Signal strength auto-selection mode 5G/4G/3G/2G - AIRTEL

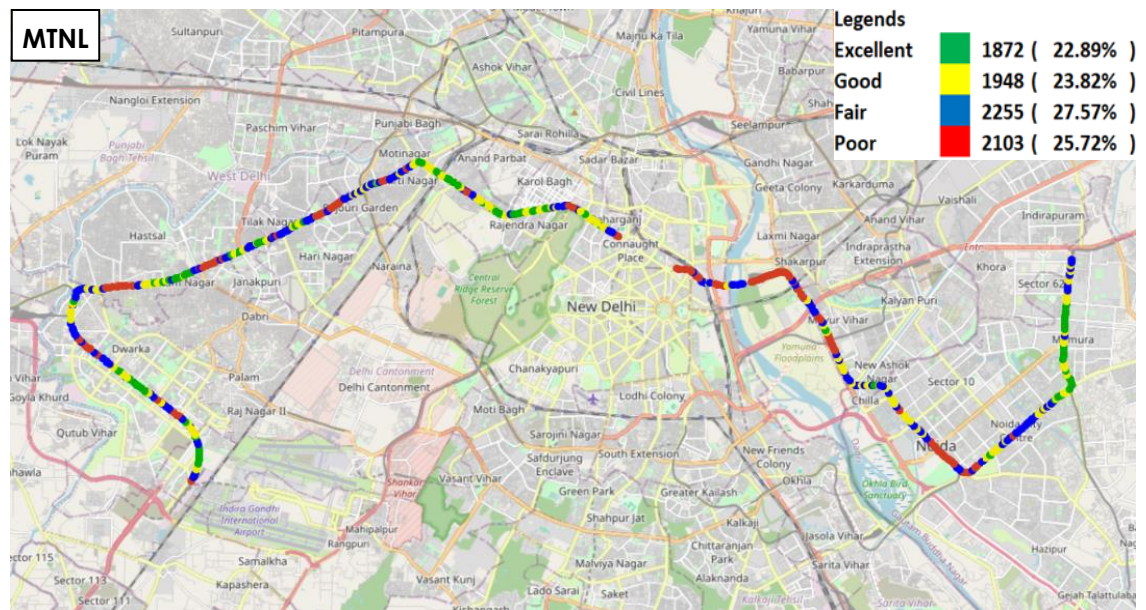


Figure-66: Signal strength auto-selection mode 5G/4G/3G/2G - MTNL

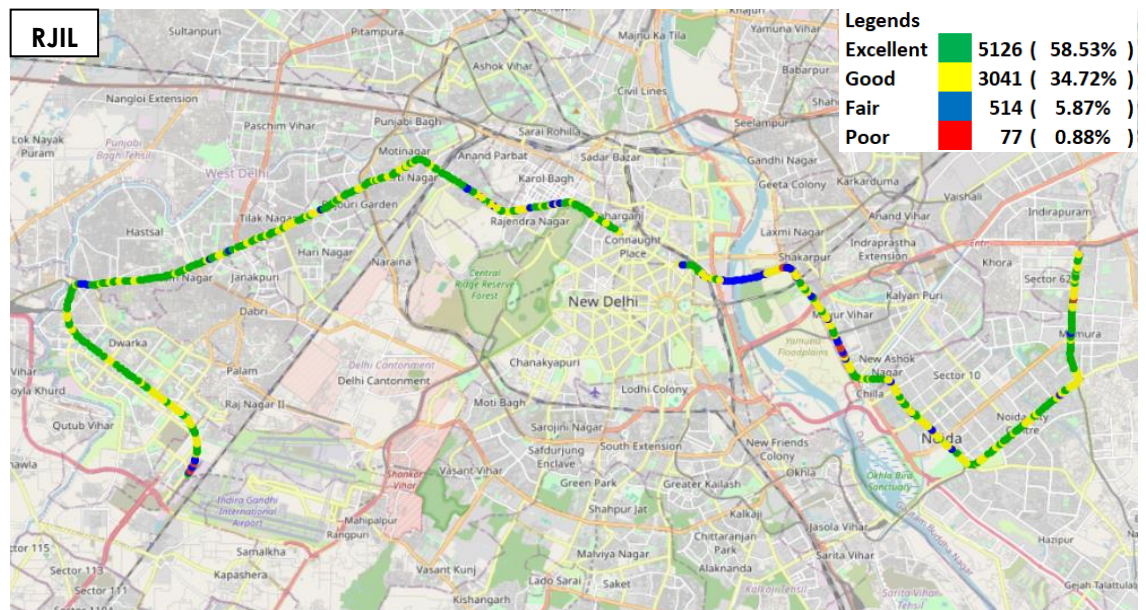


Figure-67: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL

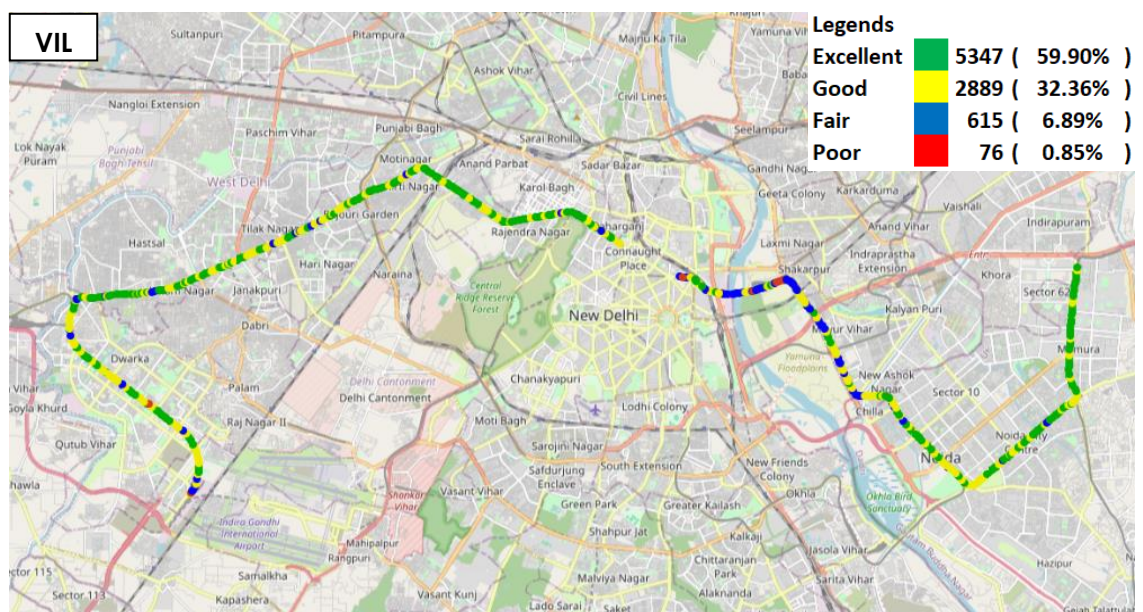


Figure-68: Signal strength auto-selection mode 5G/4G/3G/2G - VIL

ii) Yashbhoomi Dwarka sec 25 to New Delhi

Note- "The route from Yashobhoomi Dwarka Sector 25 to New Delhi is underground, that is why there is no coverage plot.

iii) Kashmiri Gate to Raja Nahar Singh

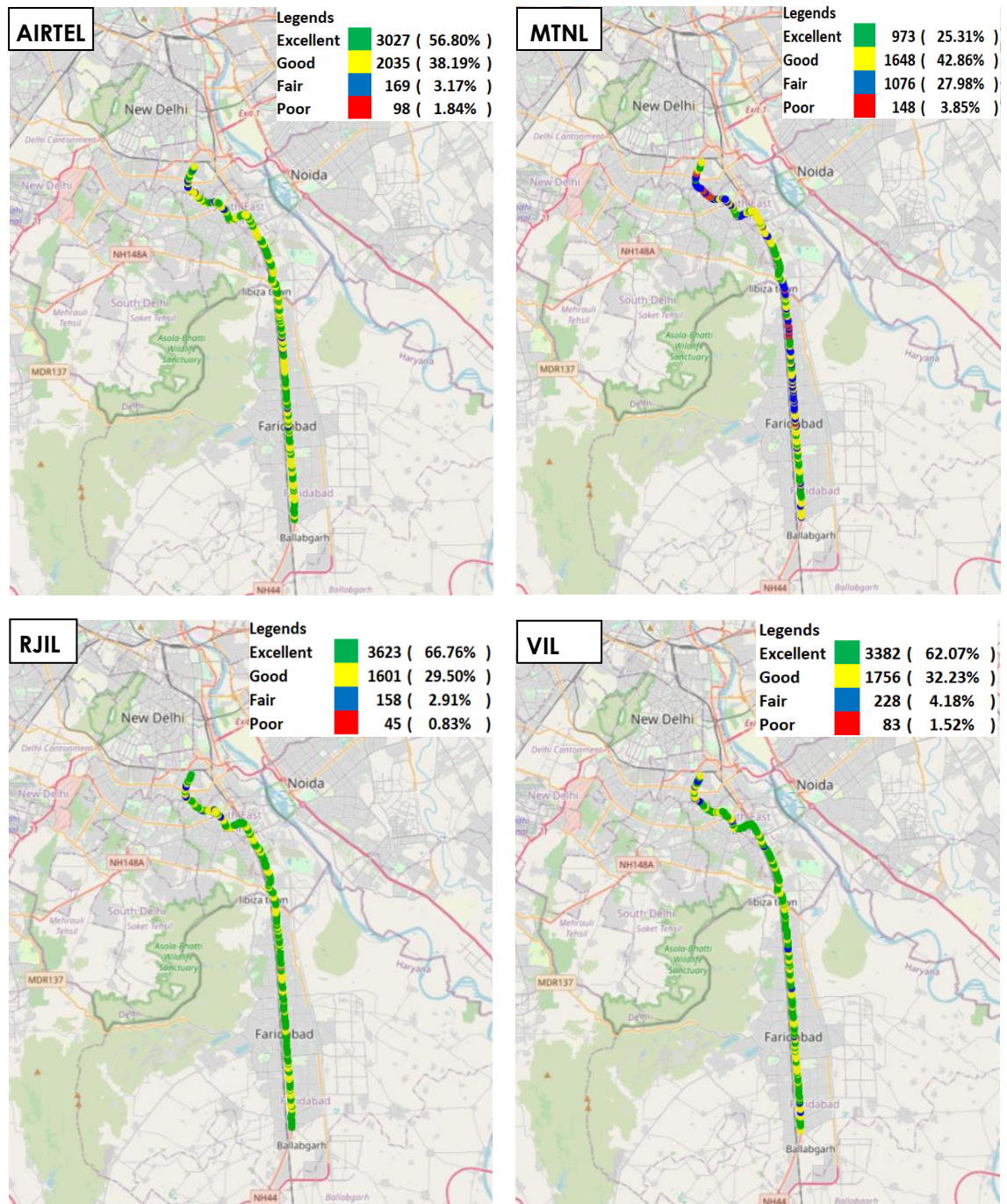


Figure-69: Signal strength auto-selection mode 5G/4G/3G/2G

iv) Shaheed Sthal to Rithala

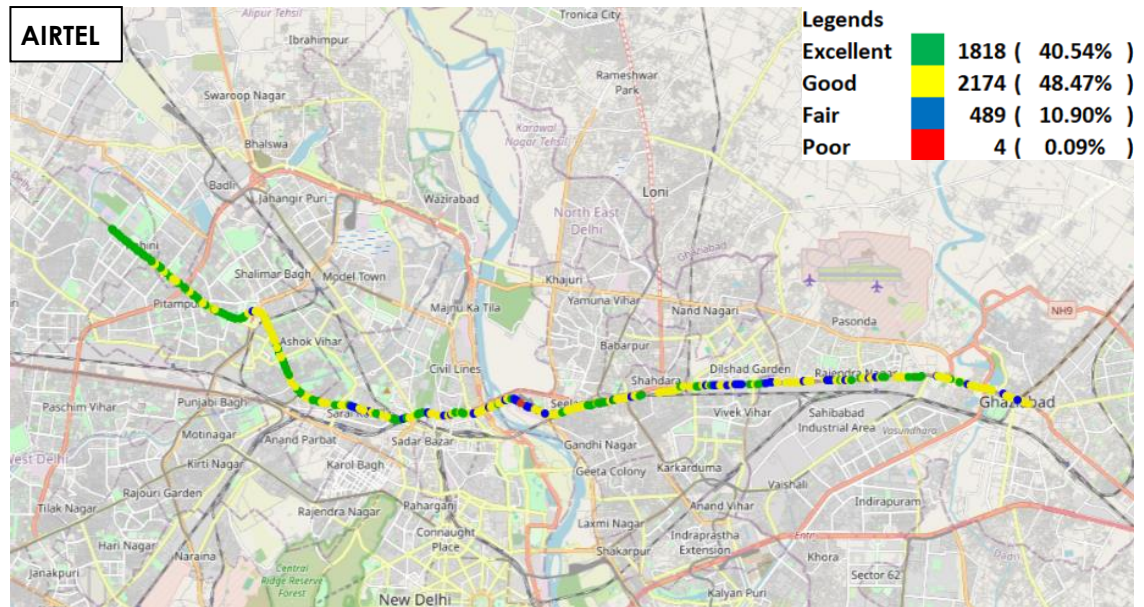


Figure-70: Signal strength auto-selection mode 5G/4G/3G/2G - Airtel

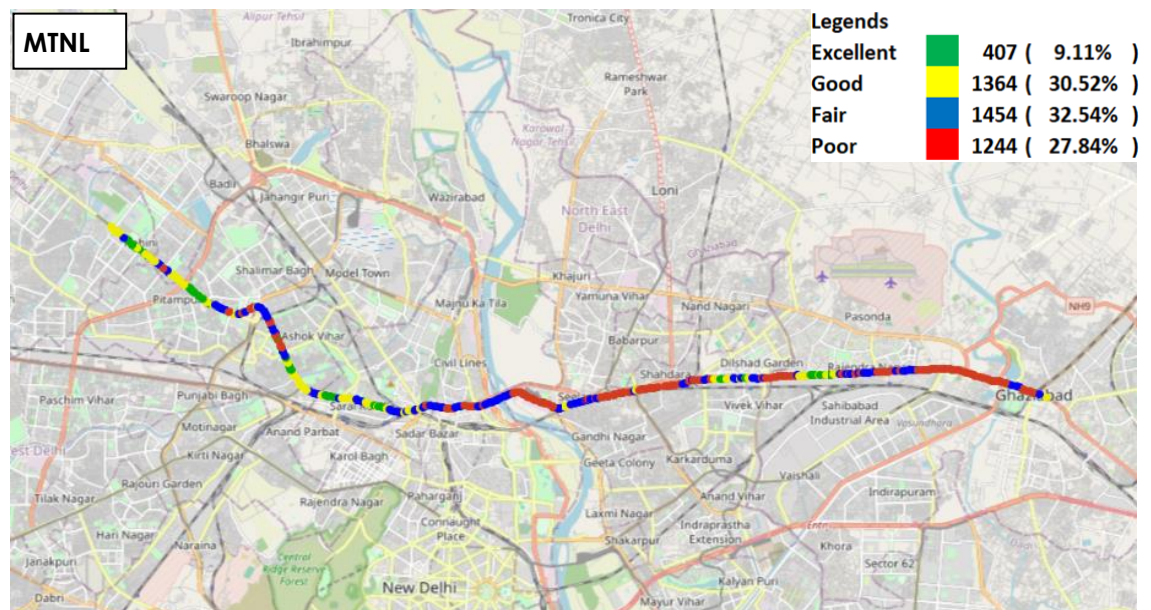


Figure-71: Signal strength auto-selection mode 5G/4G/3G/2G - MTNL

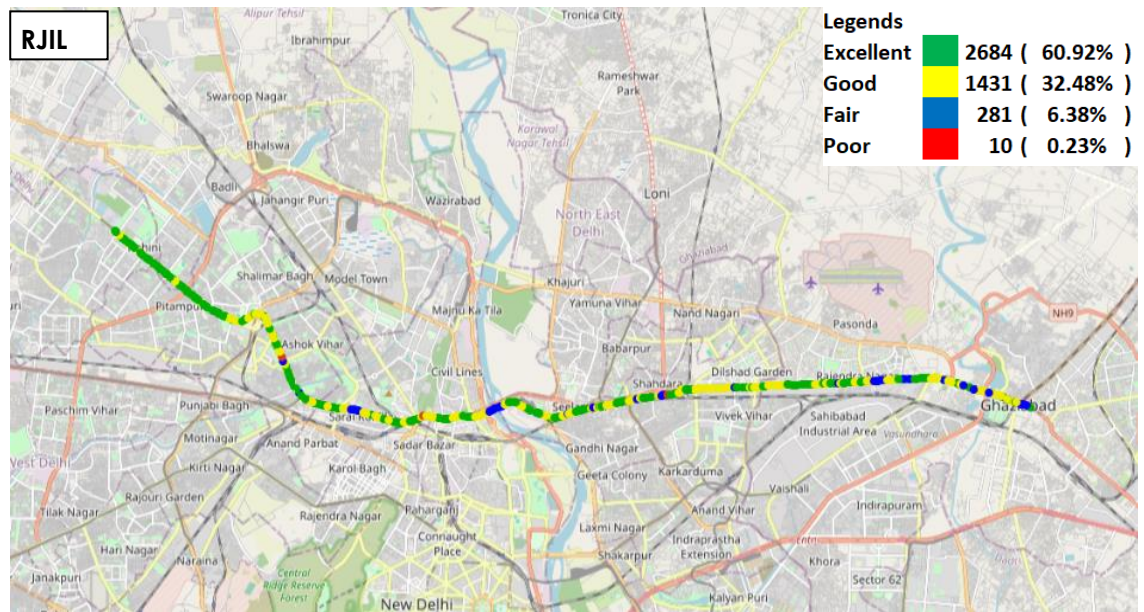


Figure-72: Signal strength auto-selection mode 5G/4G/3G/2G - RJIL

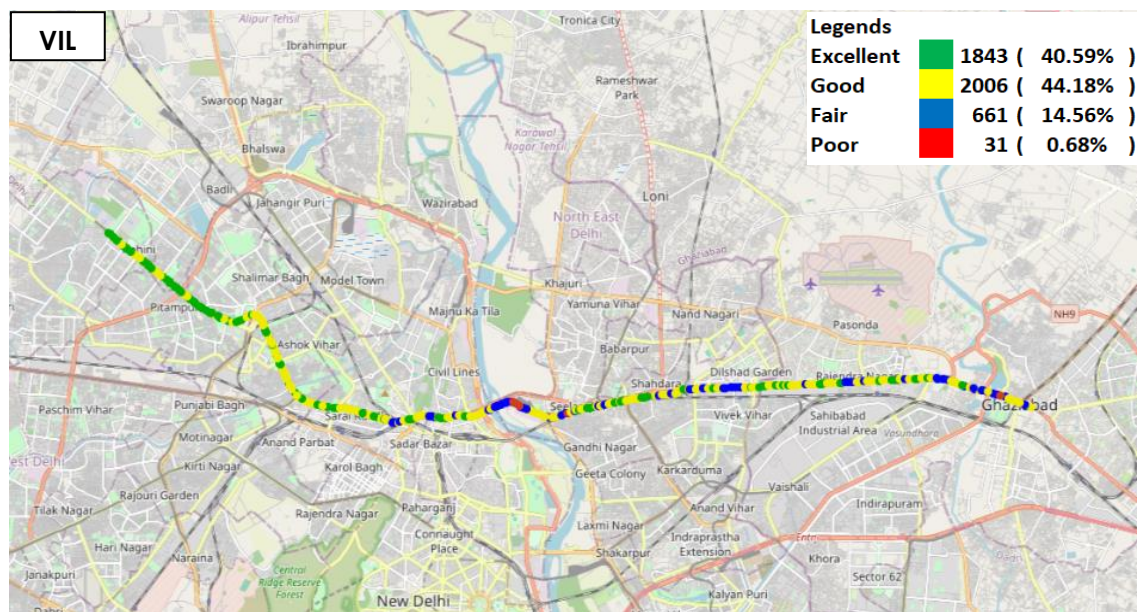


Figure-73: Signal strength auto-selection mode 5G/4G/3G/2G for VIL

v) Samaypur Badli to Millennium City Centre

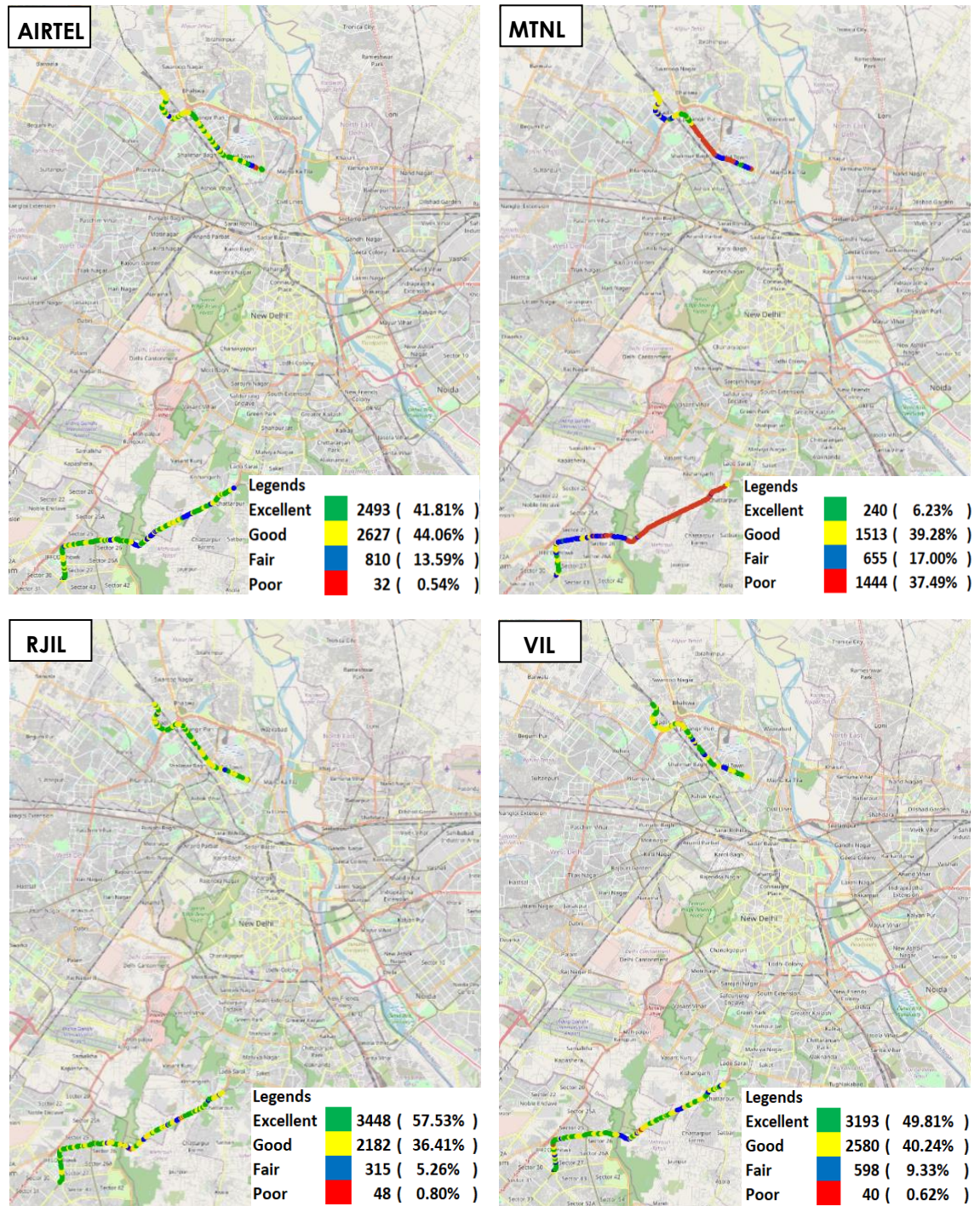


Figure-74: Signal strength auto-selection mode 5G/4G/3G/2G

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 /180 Sec
Wait/ Guard Time		15 Sec

Table-69: 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.
- 4G/3G/2G auto mode MOS call were made in MTNL as MTNL don't have 5G network availability across India.
- All values are taken up to two decimal places.

Data Test		
Test Type	Technology	Detail
HTTP Download	5G/4G/3G/2G Auto Mode	500 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time)
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.irctc.co.in , https://sbi.co.in , www.amazon.in) 20 sec timeout (only at Hotspot)
Ping		25 count- Dynamic 1000 count- Hotspot

Table-70: 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.

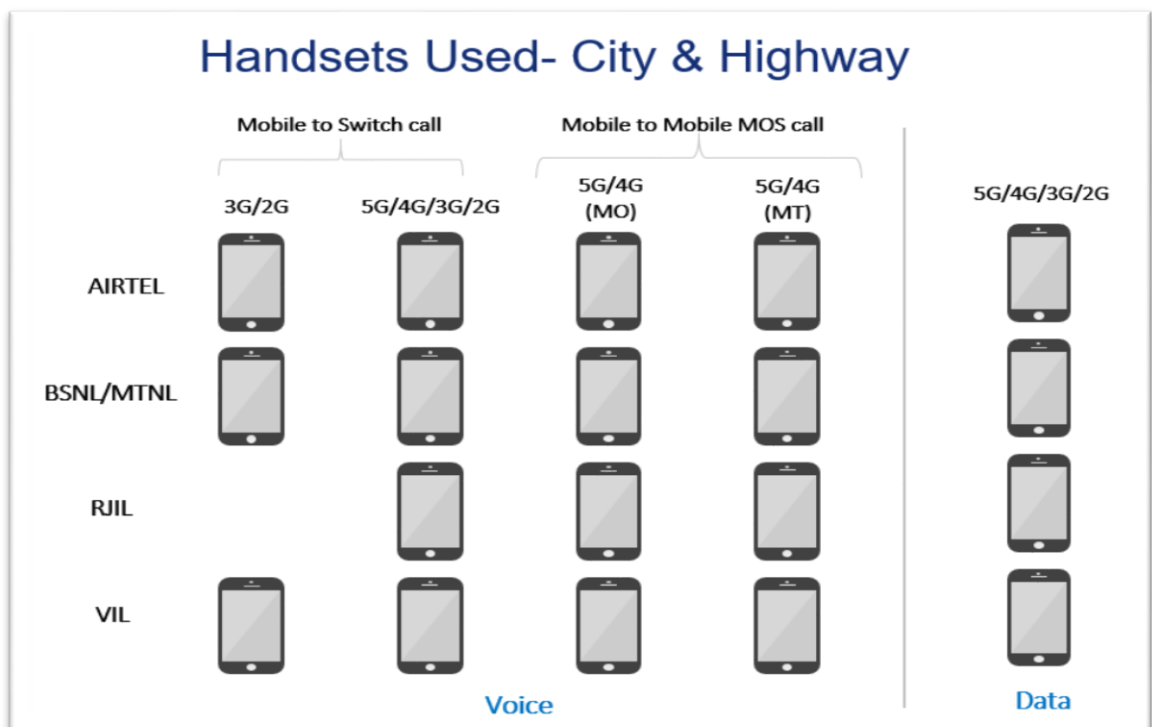


Figure-75: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

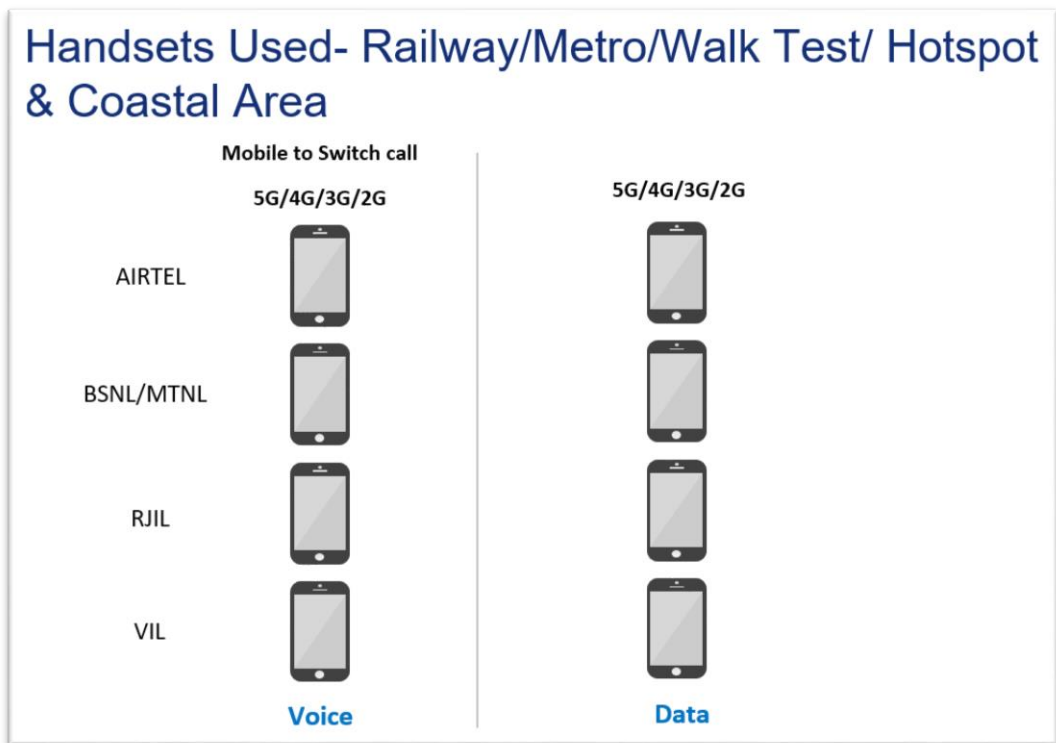


Figure-76: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)

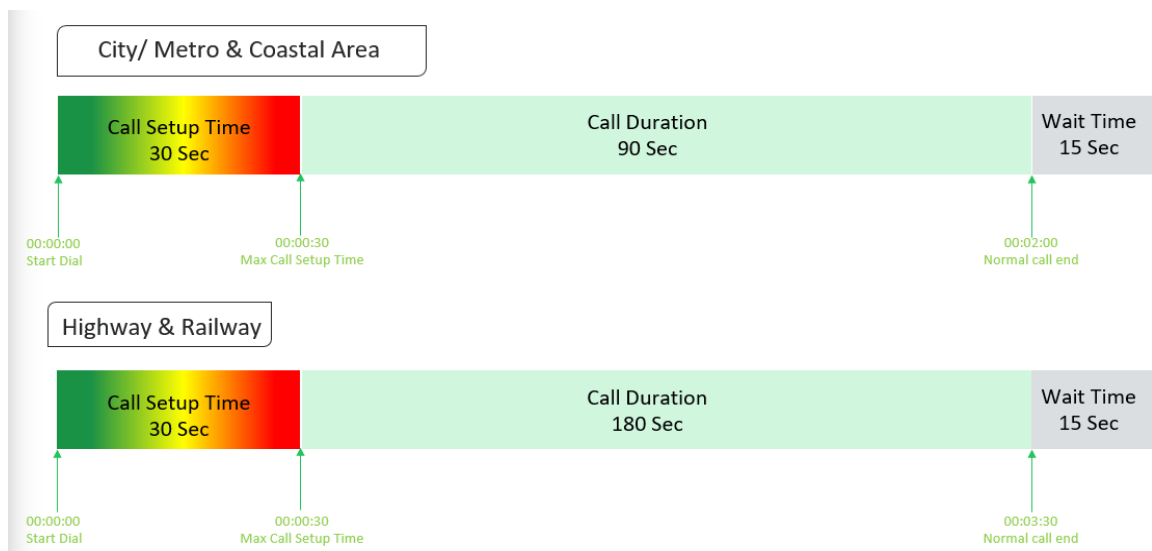


Figure-77: Voice test script for city/railway/metro/highway & coastal area

- 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

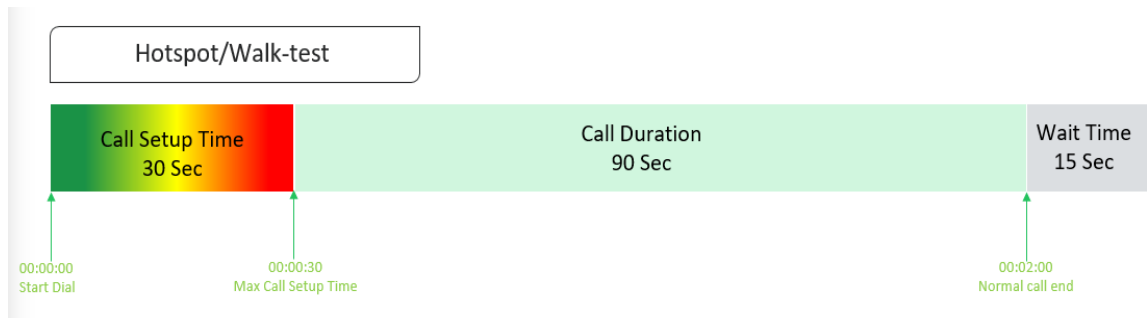


Figure-78: Voice test script for walktest/hotspot

- 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

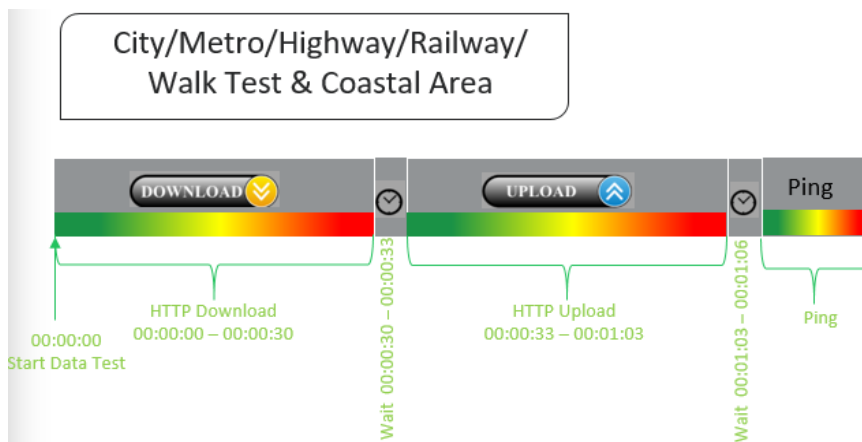


Figure-79: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

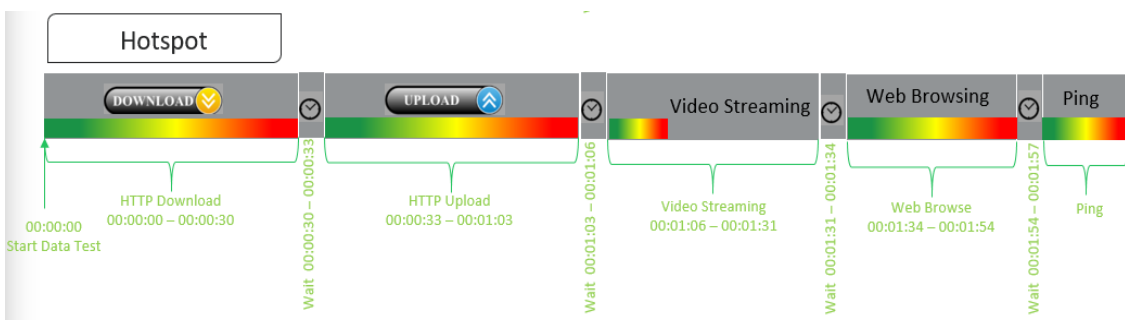


Figure-80: Data test script used at hotspot/walk test

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

7.2 Appendix-II

7.2.1 Network Performance Parameters for Voice calls

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

Jitter	<p>The inter arrival jitter is the difference in the relative transit time for two packets. The relative transit time is the difference between a packet's Real-time Transport Protocol (RTP) timestamp and the receiver's clock at the time of arrival, measured in the same units. If S_i is the RTP timestamp from packet i, and R_i 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:</p> <p>$D(i,j) = (R_j - R_i) - (S_j - S_i)$</p> <p>The interarrival jitter will be calculated continuously as each data packet i is received from source $SSRC_n$, using this difference D for that packet and the previous packet $i-1$ in order of arrival (not necessarily in sequence), according to the formula</p> <p>$J(i) = J(i-1) + (D(i-1,i) - J(i-1))/16$ or 8</p>																																		
Downlink Packet Drop Rate	<p>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call originating handset.</p> <p>This KPI will be calculated from MOS call for packet call only (VoNR/VoLTE)</p>																																		
Uplink Packet Drop Rate	<p>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call terminating handset. This KPI will be calculated from MOS call for packet call only (VoNR/VoLTE).</p>																																		
Signal Strength	<p>Signal strength is the signal power level received by the wireless user.</p> <table><tr><th rowspan="2">Parameter Name</th><th rowspan="2">Technology</th><th colspan="4">Signal Strength (dBm)</th></tr><tr><th>Excellent</th><th>Good</th><th>Fair</th><th>Poor</th></tr><tr><td>Rx Level</td><td>GSM</td><td>0 to ≥ -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>	Parameter Name	Technology	Signal Strength (dBm)				Excellent	Good	Fair	Poor	Rx Level	GSM	0 to ≥ -65	<-65 to ≥ -75	<-75 to ≥ -85	<-85 to min	RSCP	WCDMA	0 to ≥ -70	<-70 to ≥ -80	<-80 to ≥ -90	<-90 to min	RSRP	LTE	0 to ≥ -80	<-80 to ≥ -95	<-95 to ≥ -110	<-110 to min	SS_RSRP	NR	0 to ≥ -80	<-80 to ≥ -95	<-95 to ≥ -110	<-110 to min
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Table-71: Network performance parameter and definition voice

7.2.2 Network Performance Parameters Data tests

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

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

Table-72: Network performance parmeter and definition Data