भादूविप्रा
TRAI

TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report
West Bengal LSA
December 2024

File No. AU-3/5/1(1)/2024-RO_KOL-Part(1) (Computer No. 15081)
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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 West Bengal License Service Area (LSA) during the month December-2024 under the supervision of TRAI Regional Office (RO), Kolkata. 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	Siliguri City, Darjeeling & Kalimpong Districts	City	309.0	02-Dec-2024	06-Dec-2024
2	Darjeeling & Kalimpong Districts	City (Inter-operator calling)	158.0	01-Dec-2024	09-Dec-2024
3	Siliguri City, Darjeeling & Kalimpong Districts	Hotspot	10 Locations	01-Dec-2024	09-Dec-2024
4	Siliguri City, Darjeeling & Kalimpong Districts	Walk test	2.05	02-Dec-2024	06-Dec-2024

Table-1: Drive test summary

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2.2 Drive test routes

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

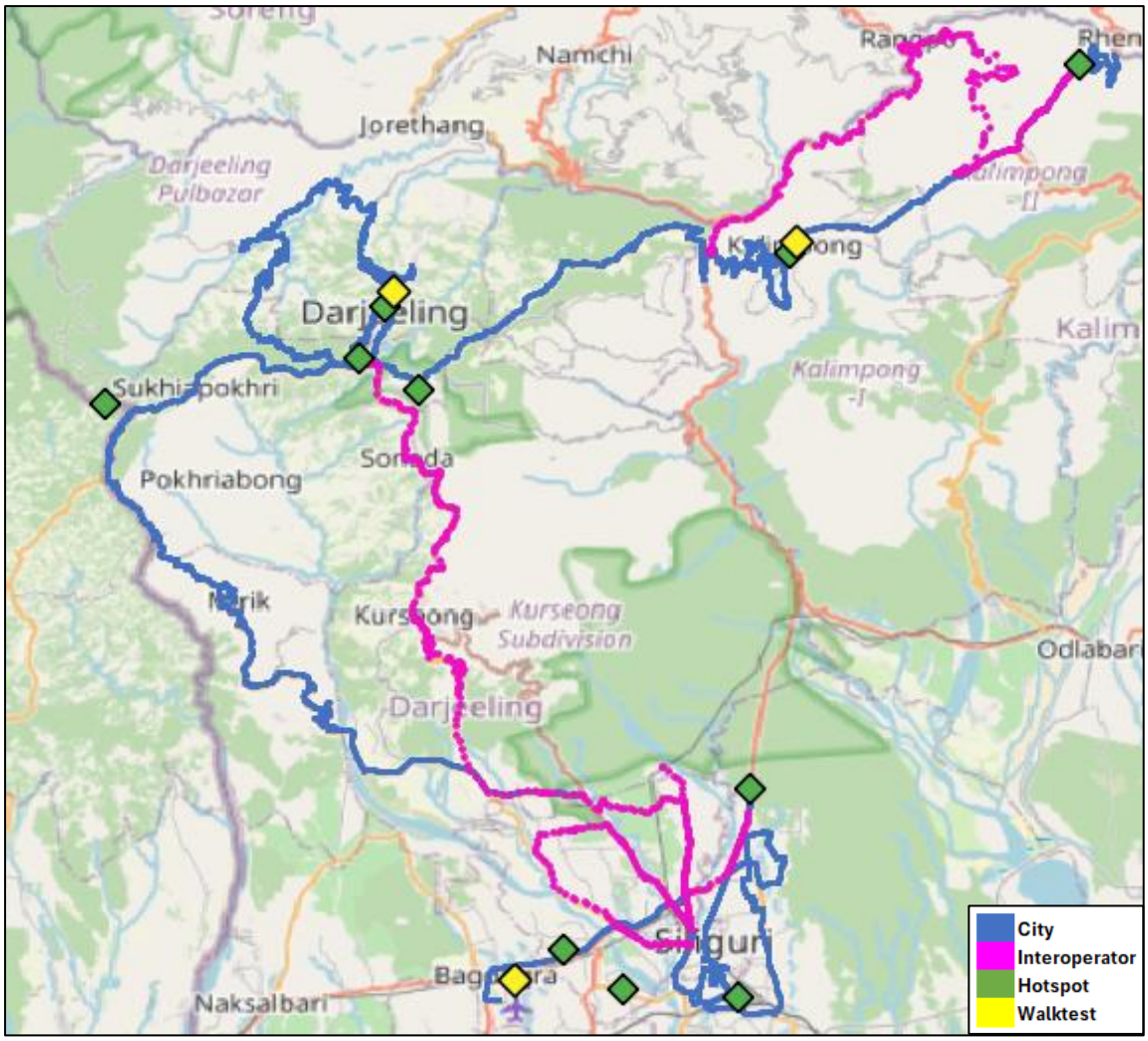

Figure-1: Drive test routes

2.3 Summary of areas covered

a) City- Nearby Bagdogra, Siliguri, Mirik, Pedong, Darjeeling, Tukdah Forest, Kalimpong, etc.

b) Hotspot-

1. Bengal Safari
2. Ghoom Monastery
3. Govt Degree College, Pedong
4. Mane Bhanjan Taxi Stand
5. NJP Railway Station
6. North Bengal Medical College and Hospital
7. North Bengal University
8. Office Of DM, Kalimpong

9. Tiger Hill
10. Toy Train Station Darjeeling

c) Walk test

1. Bagdogra Airport
2. Darjeeling Mall
3. Haat Bazaar Kalimpong

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	900,1800,2100,2300
3	Bharti Airtel Ltd.	5G	3500
4	BSNL	2G	900
5	BSNL	3G	2100
6	BSNL	4G	700,2100
7	Reliance JIO Infocomm Ltd.	4G	850,1800,2300
8	Reliance JIO Infocomm Ltd.	5G	700,3500
9	Vodafone Idea Ltd.	2G	900
10	Vodafone Idea Ltd.	4G	900,1800,2100,2500

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

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QoS Performance Analysis- West Bengal LSA

3. QoS performance analysis-LSA level

3.1 Overview

This section provides summary of overall QoS performance of the telecom service provider's network in the LSA by aggregating the results of drive tests conducted in the LSA during December-2024 covering city, 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	550	578	538
Call Setup Success Rate %	93.64	86.85	90.33
Drop Call Rate %	2.14	8.76	1.03
Call Setup Time-Average (Second)	5.20	3.04	5.15
Handover Success Rate %	98.19	99.72	98.73

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

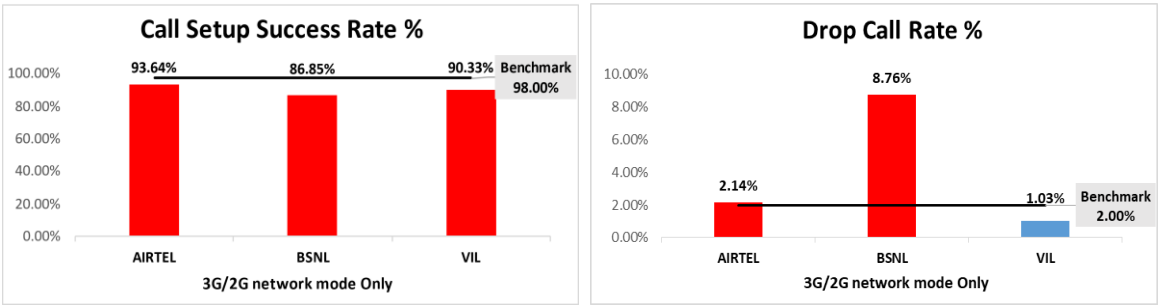

Figure-2: Call setup success rate and drop call rate performance

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	118	NA
2G	375	92	362

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.

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(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	692	705	716	695
Call Setup Success Rate %	98.55	88.65	98.60	95.54
Drop Call Rate %	0.15	6.56	2.69	2.41
Call Setup Time-Average (Second)	2.27	2.78	1.28	1.68
Handover Success Rate %	99.89	98.33	99.23	99.86

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

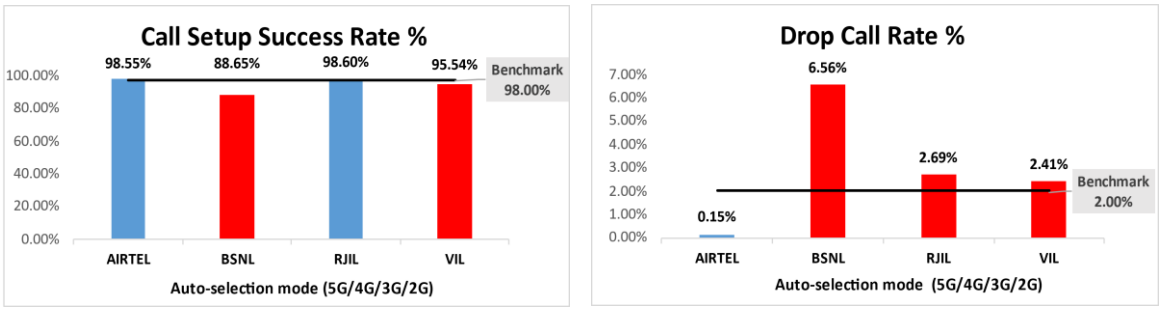


Figure-3: Performance for call setup success rate and drop call rate

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	532	547	567	549
Number of silence call for >4 Sec	35	5	46	46
Silence Call Rate %	6.58	0.91	8.11	8.38
Number of silence instances for >4 Sec	60	6	97	68
Number of silence instances for >3 Sec	109	10	132	104
Number of silence instances for >2 sec	197	18	233	197
RTP Jitter (4G & 5G) in ms	7.70	8.57	14.68	10.80
Packet loss Rate Downlink %	4.97	6.98	3.28	3.32
Packet loss Rate Uplink %	5.19	6.92	5.14	2.20

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

Note-
- BSNL has latched 17.53% on LTE technology. Silence call, Jitter and packet loss rate have been taken that duration only (Volte call).

Number of unique cell id's covered in Voice test- Technology wise				
Technology	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	NA	NA	352	NA
4G	1087	81	1440	577
3G	NA	95	NA	NA
2G	7	117	NA	99

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.

(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	4339	3160	4213	3872
Speech Quality (Average MOS Score)	3.78	2.16	3.68	4.22
Number of samples with MOS >=4 to <5 (Excellent)	3153	95	2665	3052
Number of samples with MOS >=3 to <4 (Good)	730	49	954	342
Number of samples with MOS >=2 to <3 (Fair)	156	1867	237	220
Number of samples with MOS >=1 to <2 (Poor)	300	1149	357	258
%age of samples with MOS >=4 to <5 (Excellent)	72.67%	3.01%	63.26%	78.82%
%age of samples with MOS >=3 to <4 (Good)	16.82%	1.55%	22.64%	8.83%
%age of samples with MOS >=2 to <3 (Fair)	3.60%	59.08%	5.63%	5.68%
%age of samples with MOS >=1 to <2 (Poor)	6.91%	36.36%	8.47%	6.66%

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

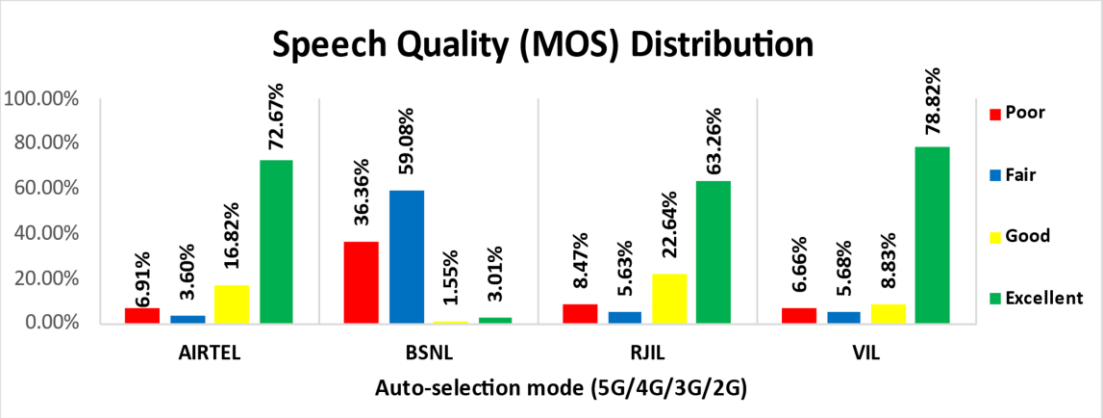


Figure- 4: Distribution of samples in MOS score range

(d) Inter-service provider voice call performance: To check the performance of inter-service provider call setup success rate, total 344 to 520 inter operator calls were attempted. The Call setup success rate and call setup time observation is as below.

Call setup success rate %				
From Service Provider	**To Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
AIRTEL	NA	75.72	96.13	93.57
BSNL	92.35	NA	87.21	96.63
RJIL	97.08	70.32	NA	93.65
VIL	97.76	76.57	95.98	NA

Table-9: Call setup success rate across service providers

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

Call setup time average (seconds)				
From Service Provider	**To Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
AIRTEL	NA	12.50	3.60	4.13
BSNL	3.17	NA	5.45	3.80
RJIL	2.69	8.64	NA	3.60
VIL	2.67	8.62	3.27	NA

Table-10: Call setup time across service providers

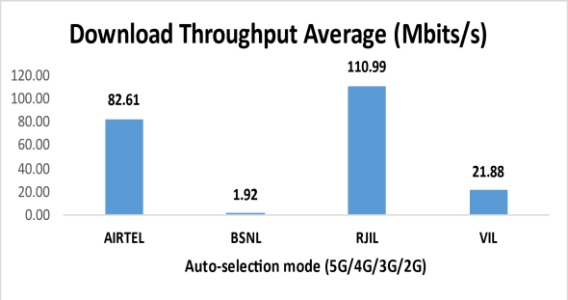
Note-
- NA- Only inter-operator calls were measured during test

3.3 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	82.61	1.92	110.99	21.88
	80th Percentile	149.67	3.54	185.35	38.20
	20th Percentile	1.68	0.07	1.60	7.13
Upload Throughput (Mbits/s)	Average	13.44	1.61	12.10	5.18
	80th Percentile	24.51	2.55	18.49	9.35
	20th Percentile	1.35	0.41	1.54	1.59
Latency (ms)	50th Percentile	26.55	59.50	29.65	57.00

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



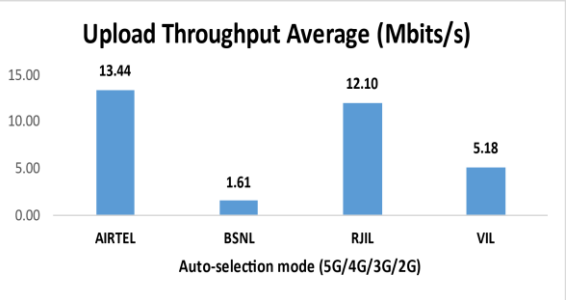


Figure- 5: Download and upload throughput

Number of unique cell id's covered in Data test- Technology wise				
Technology	Service Provider			
	Auto-selection mode 5G/4G/3G/2G			
	AIRTEL	BSNL	RJIL	VIL
5G	NA	NA	474	NA
4G	1062	97	684	605
3G	NA	143	NA	NA
2G	43	77	NA	135

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

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

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis

4.1 Overview

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

4.2 City

Drive test has been conducted from 2nd December 2024 to 6th December 2024 in West Bengal. (Refer Table-1)

4.2.1 Drive test route

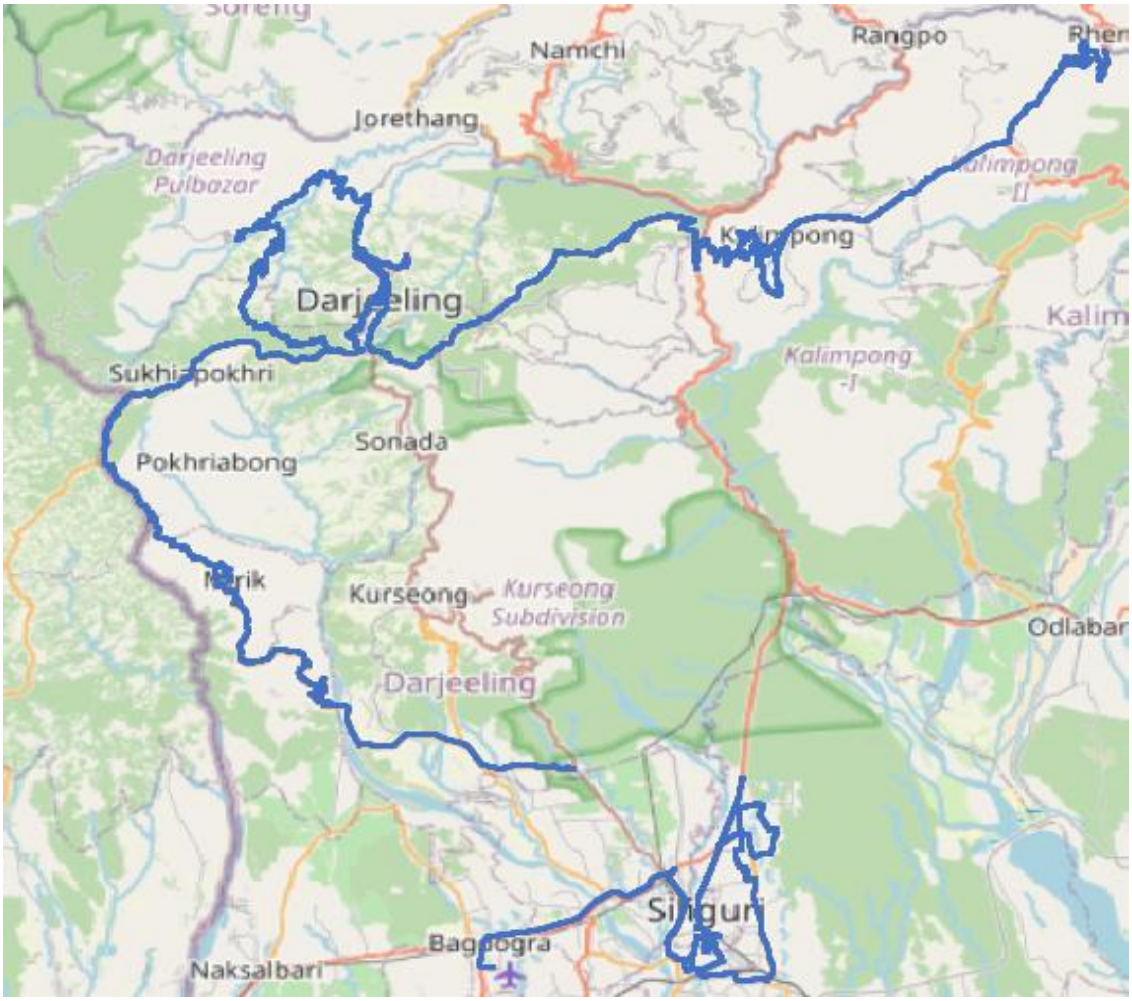


Figure- 6: Drive test routes

4.2.2 Areas covered

Nearby Bagdogra, Siliguri, Mirik, Pedong, Darjeeling, Tukdah Forest, Kalimpong etc.

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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	550	578	538
Call Setup Success Rate %	93.64	86.85	90.33
Drop Call Rate %	2.14	8.76	1.03
Call Setup Time-Average (Second)	5.20	3.04	5.15
Handover Success Rate %	98.19	99.72	98.73

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

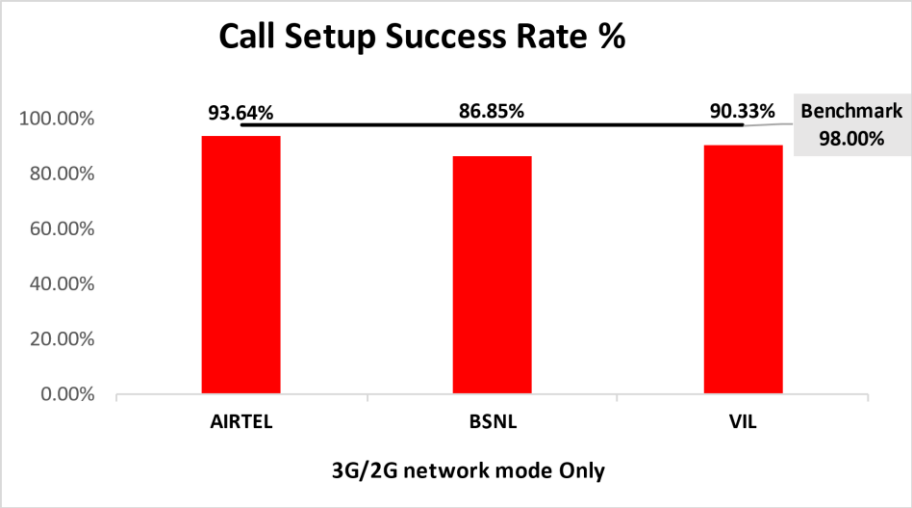

Figure-7: Performance for call setup success rate

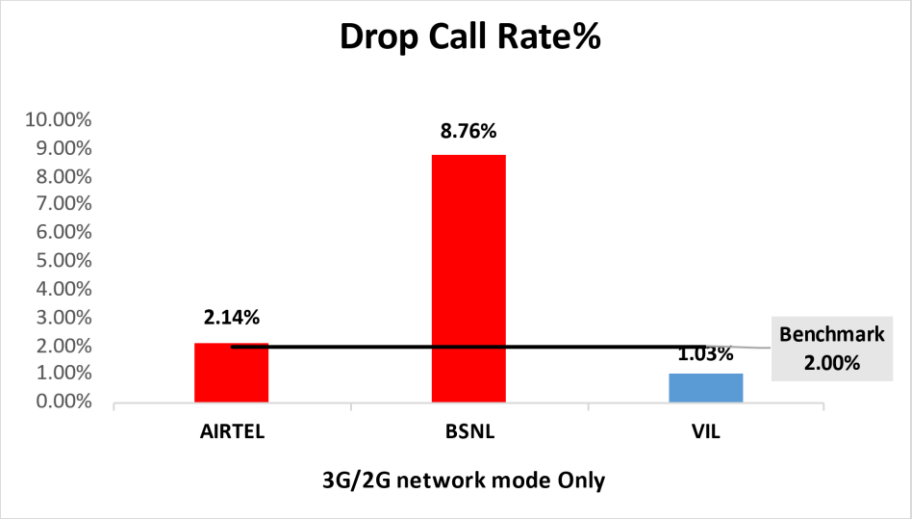

Figure-8: Performance for drop call rate

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	55.86%	NA
2G	98.45%	39.70%	93.84%
Limited service	1.55%	4.44%	6.16%

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

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

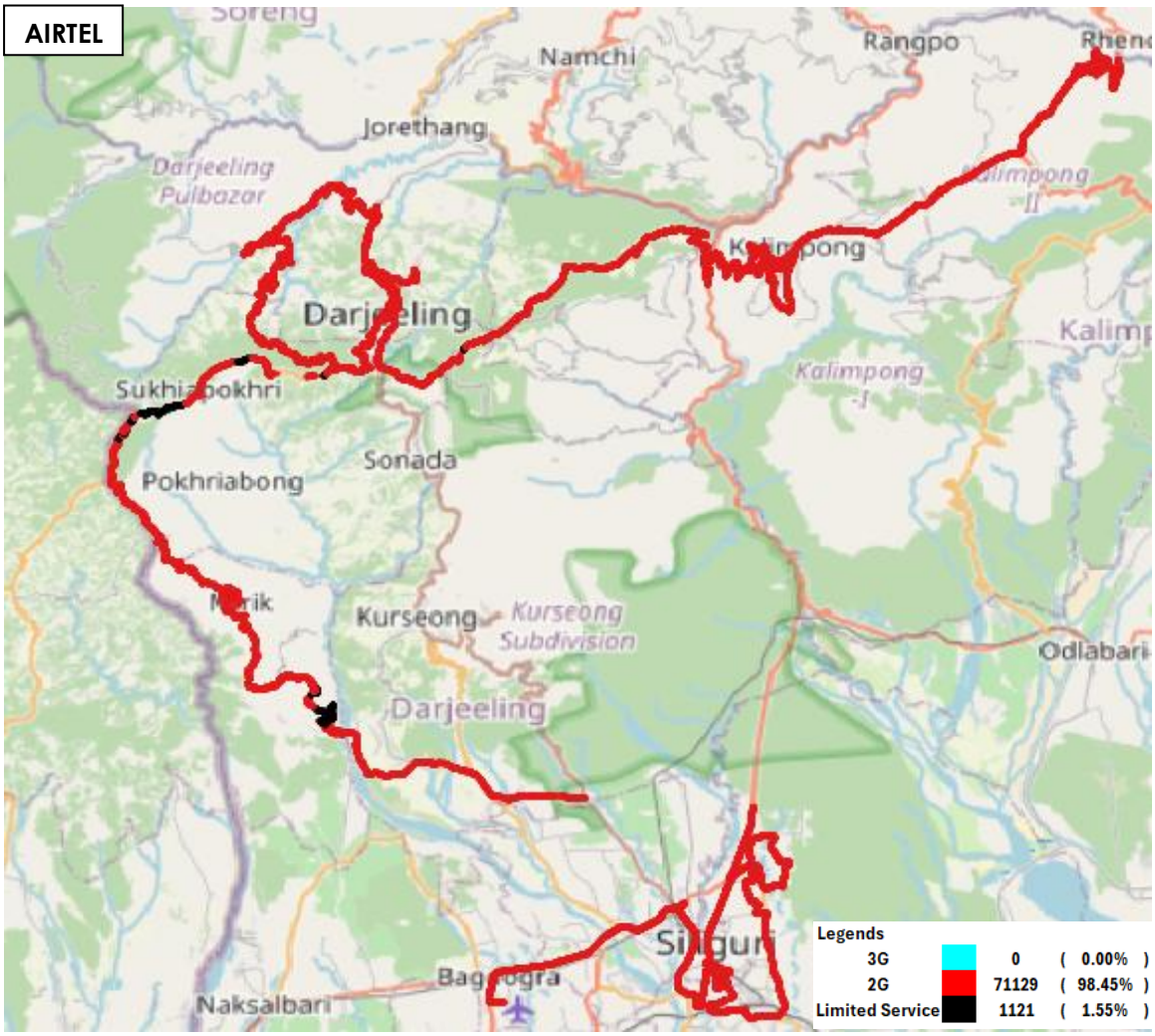

Figure-9: Serving technology plots 3G/2G network mode - Airtel

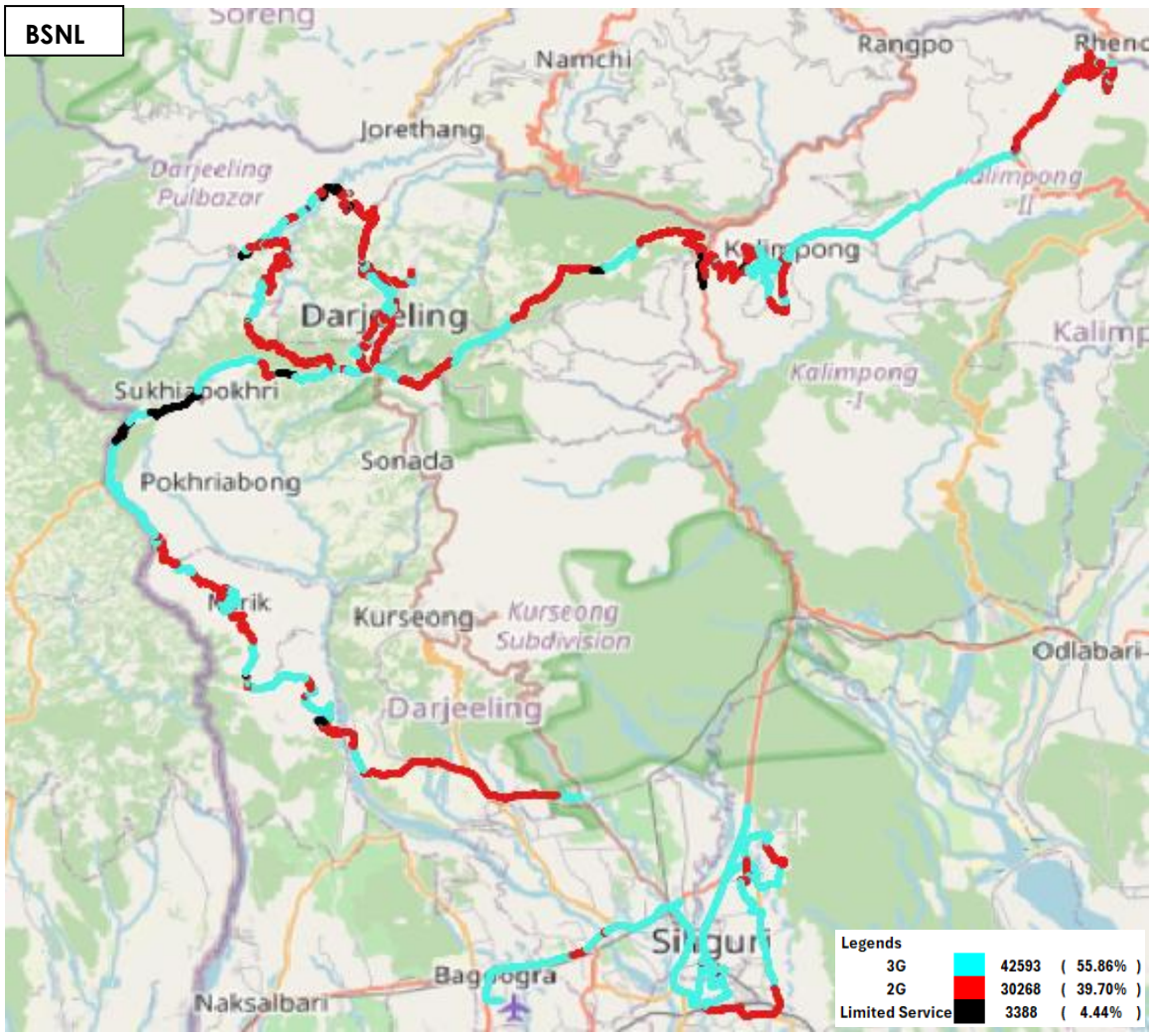

Figure-10: Serving technology plots 3G/2G network mode - BSNL

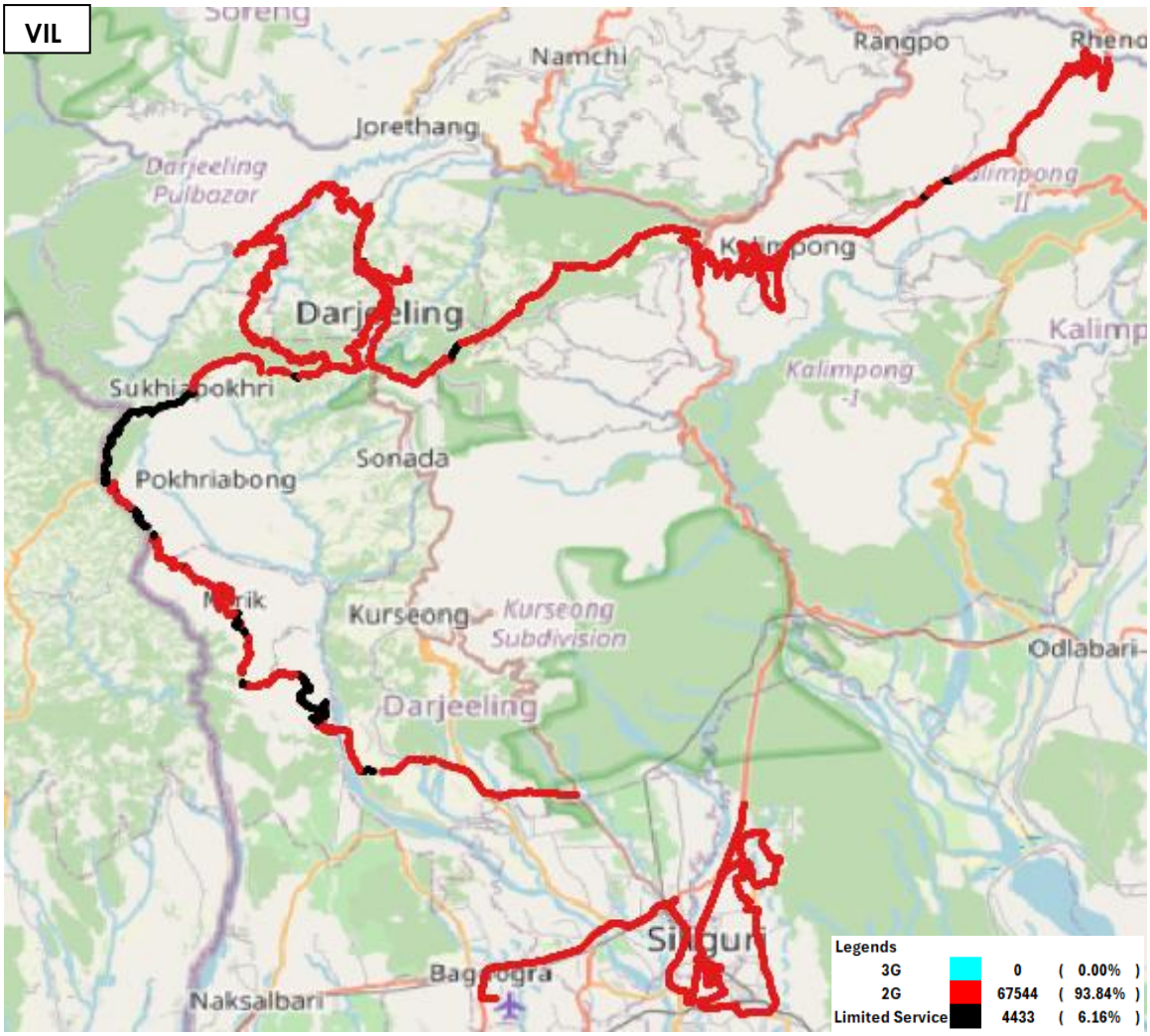

Figure-11: Serving technology plots 3G/2G network mode –VIL

(c) Network Signal Strength distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure- 34, 35 & 36 for map view)

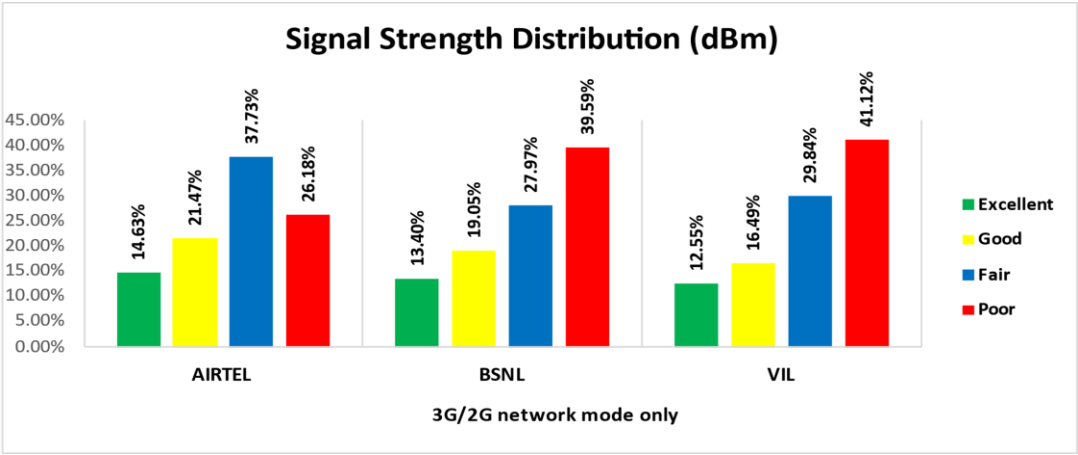

Figure-12: Signal strength distribution 3G/2G network mode only

Observations:

- Airtel has 15% of samples falling in the excellent signal strength category.
- BSNL has 13% of samples falling in the excellent signal strength category.
- VIL has 13% 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	553	567	579	557
Call Setup Success Rate %	98.19	85.89	98.62	94.43
Drop Call Rate %	0.18	8.42	3.33	2.85
Call Setup Time Average (Second)	2.33	2.88	1.40	1.80
Handover Success Rate %	97.65	97.83	98.63	99.12

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

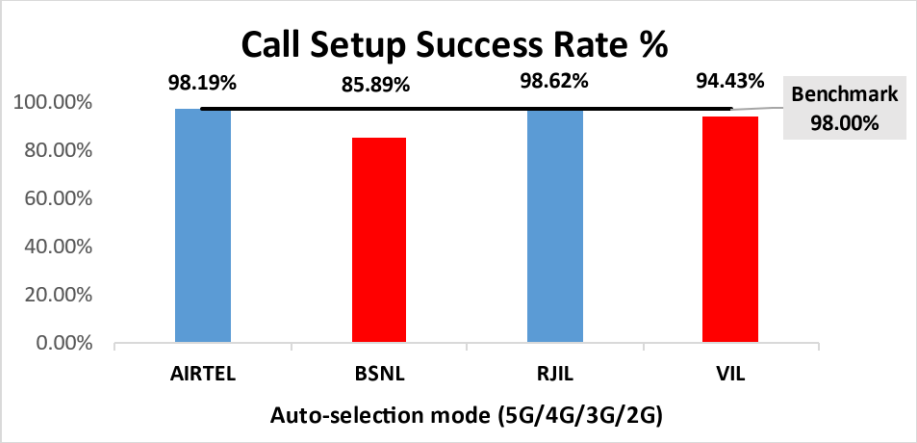

Figure-13: Performance for call setup success rate

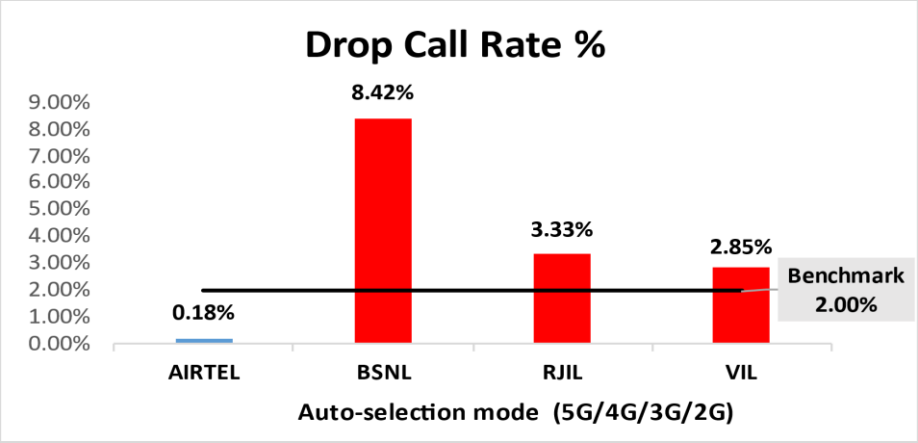

Figure-14: Performance for drop call rate

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	532	547	567	549
Number of silence call for >4 Sec	35	5	46	46
Silence Call Rate %	6.58	0.91	8.11	8.38
Number of silence instances for >4 Sec	60	6	97	68
Number of silence instances for >3 Sec	109	10	132	104
Number of silence instances for >2 sec	197	18	233	197
RTP Jitter (4G & 5G) in ms	7.70	8.57	14.68	10.80
Packet loss Rate Downlink %	4.97	6.98	3.28	3.32
Packet loss Rate Uplink %	5.19	6.92	5.14	2.20

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

Note-
- BSNL has latched 17.53% on LTE technology. Silence call, Jitter and packet loss rate have been taken that duration only (Volte call).

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-16	4339	3160	4213	3872
Speech Quality (Average MOS Score)	3.78	2.16	3.68	4.22
Number of samples with MOS >=4 to <5 (Excellent)	3153	95	2665	3052
Number of samples with MOS >=3 to <4 (Good)	730	49	954	342
Number of samples with MOS >=2 to <3 (Fair)	156	1867	237	220
Number of samples with MOS >=1 to <2 (Poor)	300	1149	357	258
%age of samples with MOS >=4 to <5 (Excellent)	72.67%	3.01%	63.26%	78.82%
%age of samples with MOS >=3 to <4 (Good)	16.82%	1.55%	22.64%	8.83%
%age of samples with MOS >=2 to <3 (Fair)	3.60%	59.08%	5.63%	5.68%
%age of samples with MOS >=1 to <2 (Poor)	6.91%	36.36%	8.47%	6.66%

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

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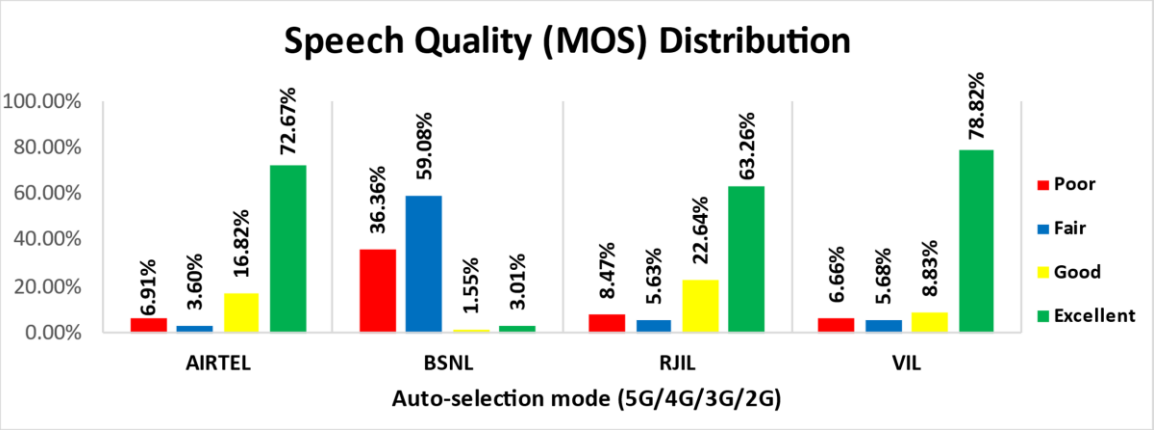

Figure-15: Distribution of samples in MOS score range

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	6.37%	NA	11.62%	NA
4G	90.26%	5.27%	87.77%	80.15%
3G	NA	44.66%	NA	NA
2G	1.41%	43.61%	NA	14.72%
Limited Service	1.96%	6.46%	0.61%	5.13%

Table-18: Time spent on technology during drive test

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

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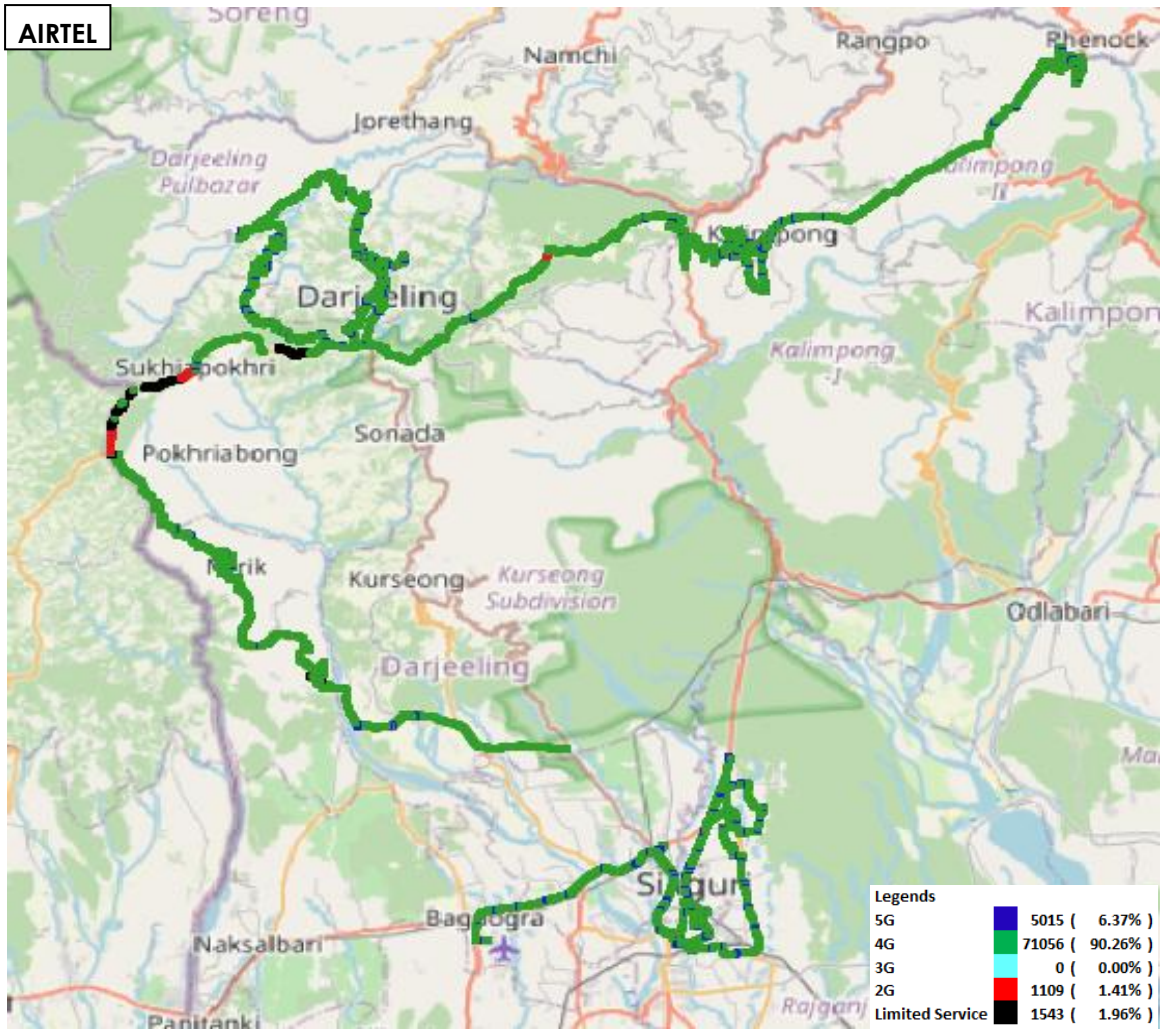

Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -Airtel

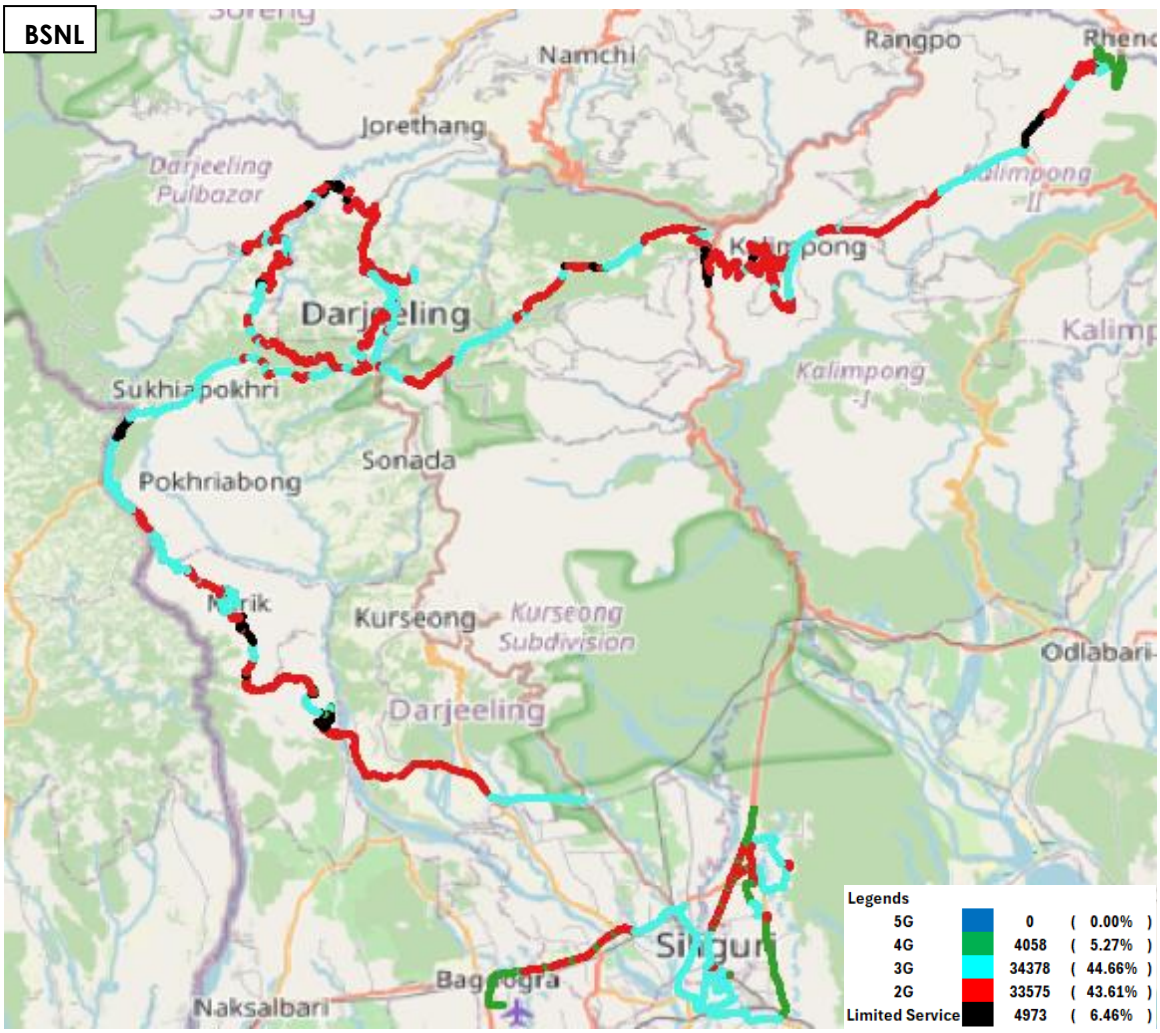

Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -BSNL

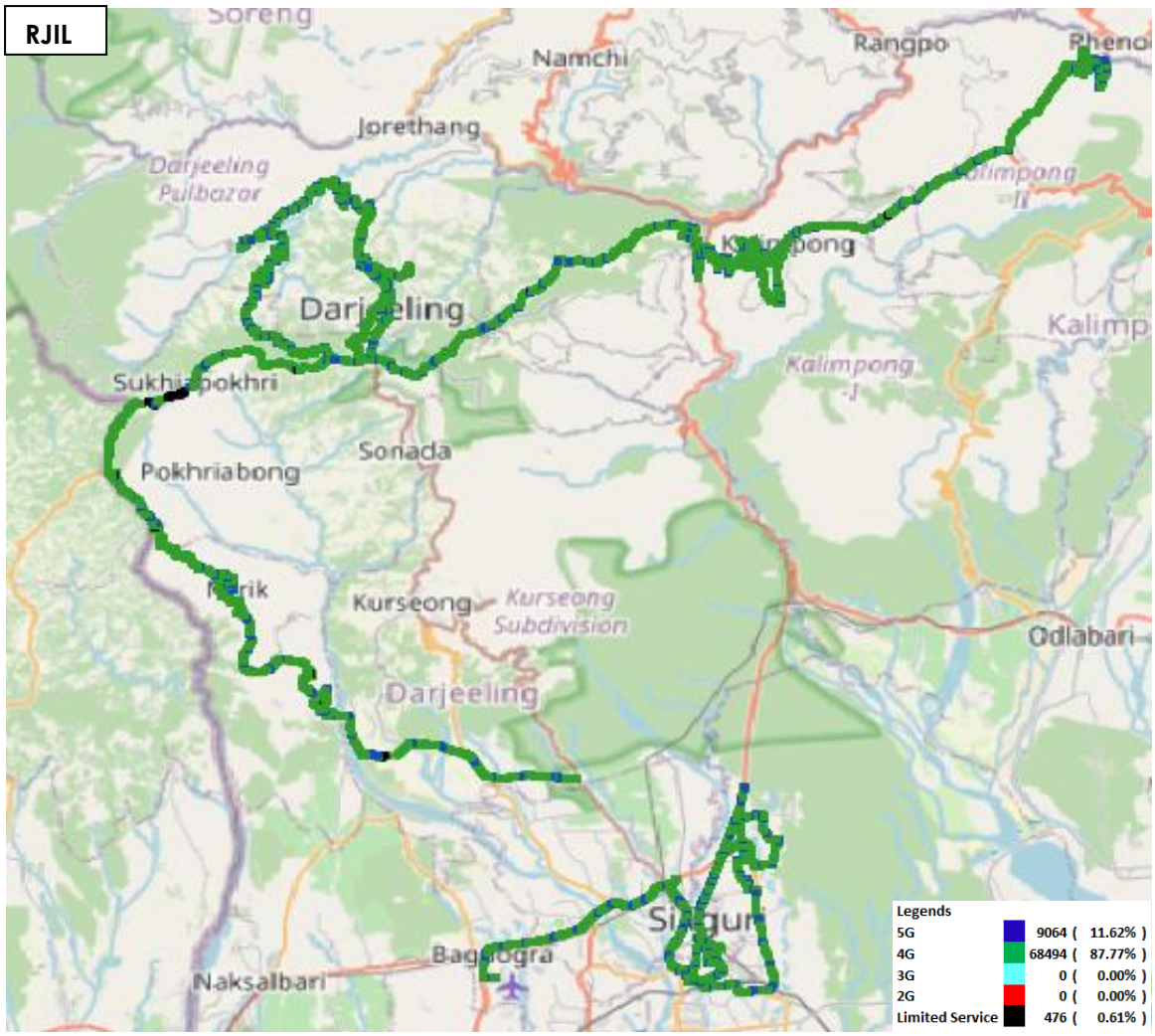

Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL

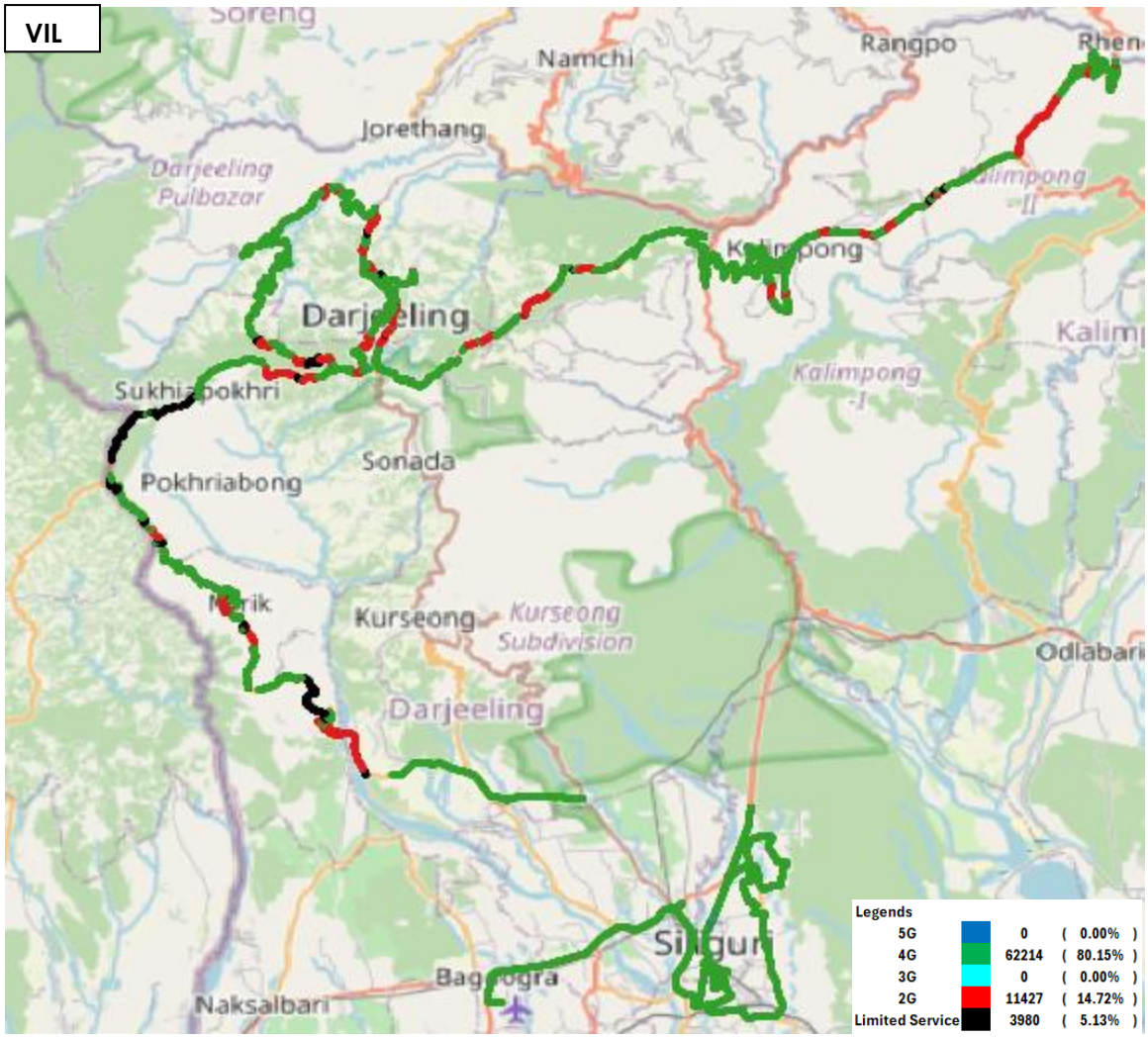

Figure-19: Serving technology plots in auto-selection mode (5G/4G/3G/2G) – VIL

(g) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-37, 38, 39 & 40 for map view)

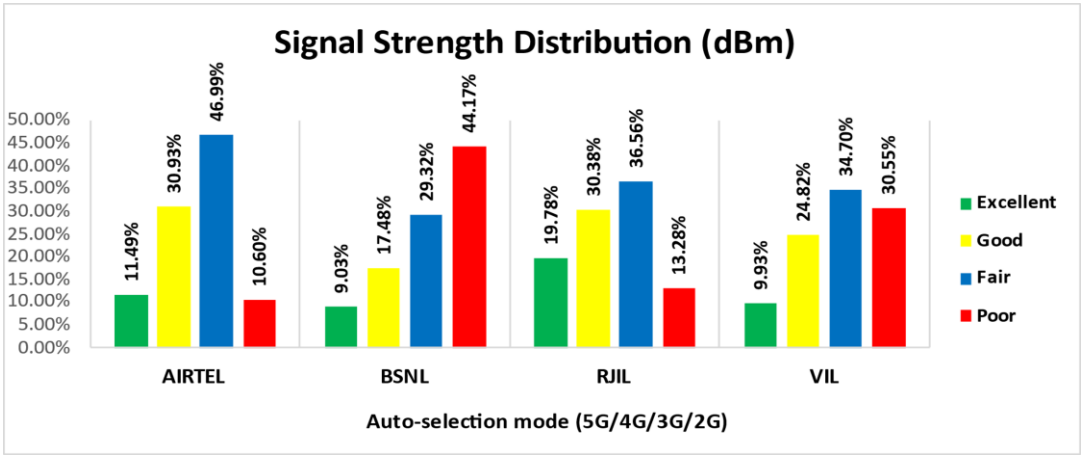

Figure-20: Signal strength distribution auto-selection mode 5G/4G/3G/2G

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Observations:

- Airtel has 11% samples falling in the excellent signal strength category.
- BSNL has 9% samples falling in the excellent signal strength category.
- RJIL has 20% samples falling in the excellent signal strength category.
- VIL has 10% 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	80.66	1.66	117.90	22.57
	80th Percentile	147.71	3.15	210.65	38.47
	20th Percentile	1.16	0.03	1.60	7.22
Upload Throughput (Mbits/s)	Average	12.44	1.37	12.49	5.04
	80th Percentile	21.57	2.39	20.14	9.32
	20th Percentile	1.29	0.31	1.44	1.59
Latency (ms)	50th Percentile	30.30	61.50	27.85	58.00

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

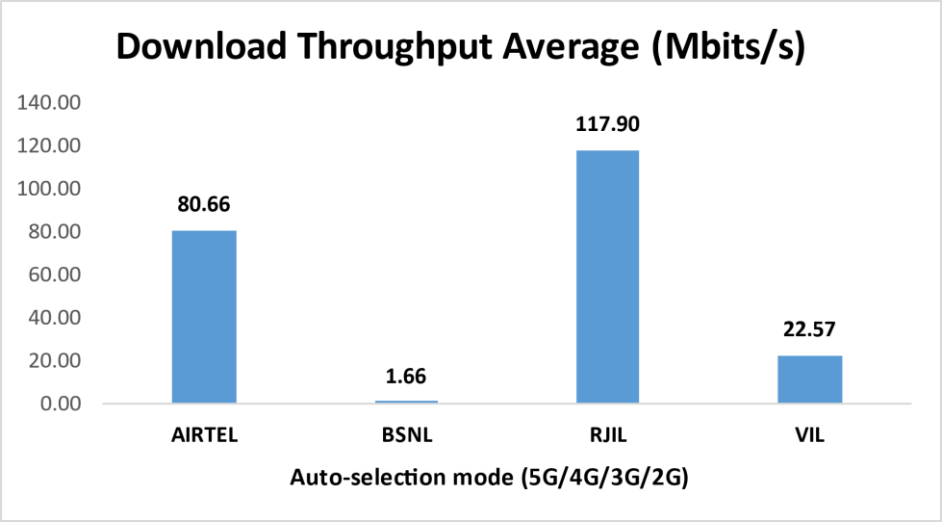

Figure- 21: Download throughput

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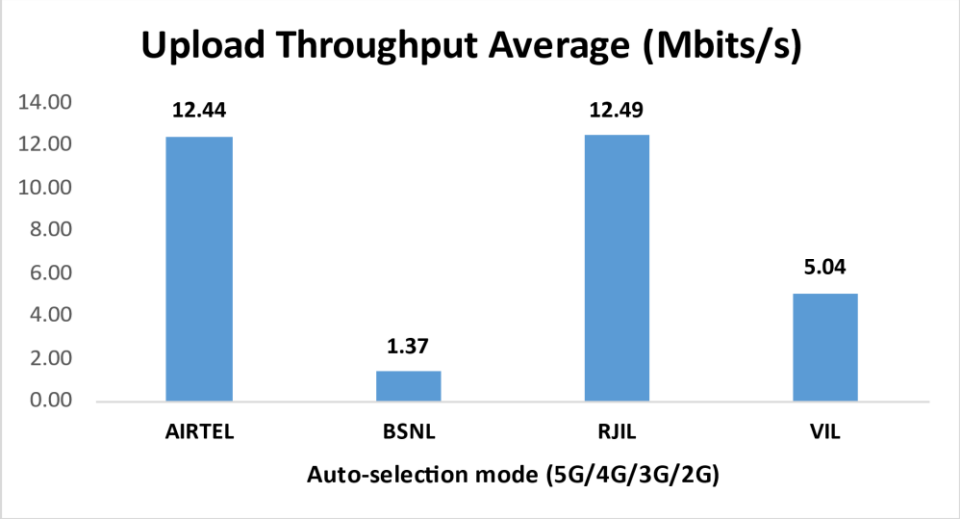

Figure- 22: Upload throughput

4.3 Hotspots

Hotspot testing was done from 1st December 2024 to 9th December. Ten locations have been tested in the city.

4.3.1 Locations

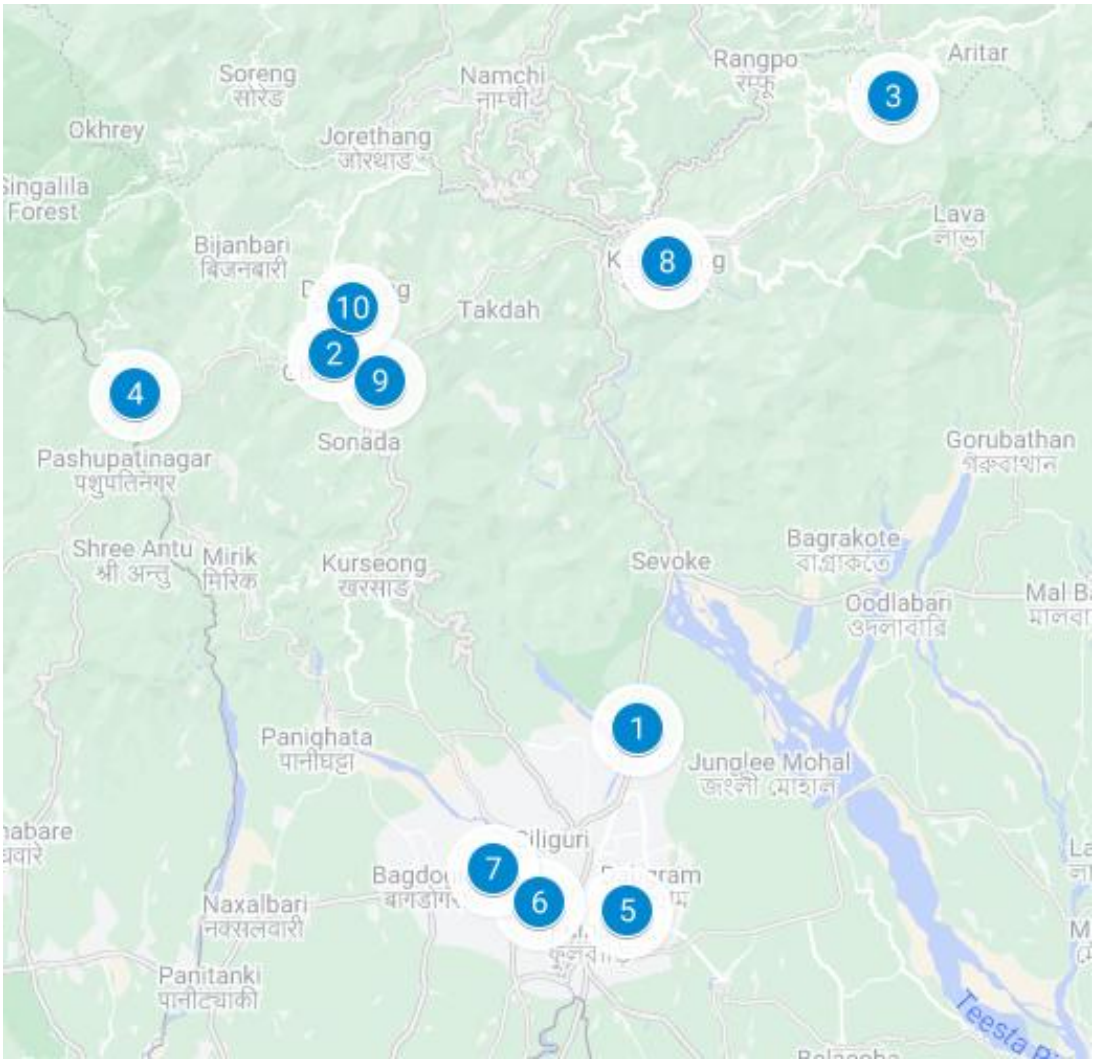

Figure- 23: Hotspot locations

4.3.2 Hotspot covered

1. Bengal Safari
2. Ghoom Monastery
3. Govt Degree College, Pedong
4. Mane Bhanjan Taxi Stand
5. NJP Railway Station
6. North Bengal Medical College and Hospital
7. North Bengal University
8. Office of DM, Kalimpong
9. Tiger Hill
10. Toy Train Station Darjeeling

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4.3.3 Voice performance

Overall Voice Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	101	100	100	100
Call Setup Success Rate %	100.00	100.00	98.00	100.00
Drop Call Rate %	0.00	0.00	0.00	1.00
Call Setup Time-Average (Sec)	2.00	2.41	0.82	1.27

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

Bengal Safari				
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	80.00	100.00
Drop Call Rate %	0.00	0.00	0.00	10.00
Call Setup Time-Average (Sec)	1.88	2.19	0.94	1.81

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

Ghoom Monastery				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.76	2.14	2.28	0.88

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

Govt Degree College, Pedong				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.87	2.43	0.55	0.96

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

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Mane Bhanjan Taxi Stand				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.83	2.31	0.53	3.41

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

NJP Railway Station				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.11	3.84	0.65	0.88

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

North Bengal Medical College and Hospital				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	11	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)	1.14	1.93	0.69	1.00

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

North Bengal University				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.20	4.10	0.62	0.97

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

Office of DM, Kalimpong				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	3.62	2.13	0.83	0.90

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

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Tiger Hill				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	2.19	2.59	0.56	0.89

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

Toy Train Station Darjeeling				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.81	2.15	0.60	1.04

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

4.3.4 Data performance

Overall Data Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	107.95	4.09	51.63	22.96
Download Throughput 80th Percentile (Mbit/s)	208.26	6.83	72.73	41.06
Download Throughput 20th Percentile (Mbit/s)	5.04	1.06	4.12	4.77
Download Session Setup Success Rate %	94.00	80.00	80.00	95.65
Upload Throughput Average (Mbits/s)	19.64	3.52	5.70	5.68
Upload Throughput 80th Percentile (Mbit/s)	38.61	5.64	7.26	9.44
Upload Throughput 20th Percentile (Mbit/s)	3.44	0.69	1.99	1.63
Upload Session Setup Success Rate %	94.00	82.00	100.00	90.00
Web Browsing Delay (Second)	4.72	6.98	4.77	6.08
Youtube Initial Buffer Delay (Second)	1.45	4.06	1.54	1.60
Latency (ms)-50th Percentile	23.00	58.00	32.10	56.00
Jitter (ms)	22.43	74.75	32.01	55.41
Packet Loss Rate %	11.51	18.56	9.34	11.80

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

Bengal Safari				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	4.04	7.43	2.61	1.65
Download Session Setup Success Rate %	100.00	100.00	80.00	80.00
Upload Throughput Average (Mbits/s)	5.31	3.03	0.99	1.43
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00

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Web Browsing Delay (Second)	6.59	4.64	17.39	15.32
Youtube Initial Buffer Delay (Second)	3.92	2.95	-	9.61
Latency (ms)-50th Percentile	20.50	55.50	43.35	61.00
Jitter (ms)	5.13	5.54	19.98	415.51
Packet Loss Rate %	1.30	3.60	3.60	62.20

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

Note-
- "-" Youtube tests failed at this location for RJIL.

Ghoom Monastery				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	215.28	2.74	37.48	18.37
Download Session Setup Success Rate %	100.00	60.00	60.00	100.00
Upload Throughput Average (Mbits/s)	16.74	0.00	7.06	8.54
Upload Session Setup Success Rate %	100.00	0.00	100.00	100.00
Web Browsing Delay (Second)	3.44	9.15	5.45	5.04
Youtube Initial Buffer Delay (Second)	1.02	2.45	1.49	0.93
Latency (ms)-50th Percentile	25.03	68.00	35.75	60.00
Jitter (ms)	5.47	25.74	37.65	4.49
Packet Loss Rate %	0.00	17.10	20.90	1.10

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

Govt Degree College, Pedong				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	6.62	1.66	10.65	15.82
Download Session Setup Success Rate %	100.00	80.00	100.00	100.00
Upload Throughput Average (Mbits/s)	4.06	1.19	2.15	9.58
Upload Session Setup Success Rate %	100.00	60.00	100.00	100.00
Web Browsing Delay (Second)	4.63	9.38	4.73	5.61
Youtube Initial Buffer Delay (Second)	1.46	4.15	1.10	0.98
Latency (ms)-50th Percentile	22.33	53.00	37.08	60.50
Jitter (ms)	6.41	42.02	19.48	2.86
Packet Loss Rate %	0.00	19.60	1.00	0.40

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

Mane Bhanjan Taxi Stand				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	390.93	0.41	34.68	-
Download Session Setup Success Rate %	100.00	20.00	60.00	0.00
Upload Throughput Average (Mbits/s)	73.16	0.69	2.99	-
Upload Session Setup Success Rate %	100.00	80.00	100.00	0.00
Web Browsing Delay (Second)	3.30	14.37	4.24	-
Youtube Initial Buffer Delay (Second)	0.89	10.15	1.06	-
Latency (ms)-50th Percentile	15.55	77.50	26.80	52.00
Jitter (ms)	2.08	517.78	13.71	659.15

Packet Loss Rate %	0.00	28.80	0.10	70.10

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

Note-
- "-" All data tests failed at this location for VIL.

NJP Railway Station				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	155.26	7.37	157.98	42.06
Download Session Setup Success Rate %	100.00	100.00	80.00	100.00
Upload Throughput Average (Mbits/s)	44.20	9.43	27.88	1.67
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.09	4.52	3.98	5.04
Youtube Initial Buffer Delay (Second)	0.94	1.69	0.65	0.87
Latency (ms)-50th Percentile	31.23	49.90	24.73	46.20
Jitter (ms)	7.15	11.47	42.63	1.47
Packet Loss Rate %	0.50	5.90	3.00	1.50

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

North Bengal Medical College and Hospital				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	97.43	0.02	115.82	43.97
Download Session Setup Success Rate %	100.00	80.00	80.00	100.00
Upload Throughput Average (Mbits/s)	13.63	0.11	5.99	5.28
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.16	-	6.12	4.75
Youtube Initial Buffer Delay (Second)	1.03	-	3.18	1.00
Latency (ms)-50th Percentile	29.65	173.00	33.93	55.50
Jitter (ms)	22.43	63.44	7.16	2.07
Packet Loss Rate %	3.30	80.40	0.00	1.40

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

Note-
- "-" Web Browsing & Youtube tests failed at this location for BSNL.

North Bengal University				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	121.93	6.59	51.89	15.46
Download Session Setup Success Rate %	100.00	100.00	60.00	100.00
Upload Throughput Average (Mbits/s)	10.03	10.34	3.90	5.40
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.49	5.19	4.81	5.59
Youtube Initial Buffer Delay (Second)	1.12	2.74	1.47	1.43
Latency (ms)-50th Percentile	34.68	56.50	26.80	51.00
Jitter (ms)	22.17	10.08	7.77	4.31
Packet Loss Rate %	6.40	8.10	0.20	0.80

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

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Office of DM, Kalimpong				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	0.19	2.72	0.04	3.74
Download Session Setup Success Rate%	40.00	100.00	80.00	100.00
Upload Throughput Average (Mbits/s)	27.90	1.49	1.15	1.50
Upload Session Setup Success Rate %	40.00	100.00	100.00	100.00
Web Browsing Delay (Second)	10.53	8.24	7.46	10.93
Youtube Initial Buffer Delay (Second)	-	2.50	-	3.90
Latency (ms)-50th Percentile	9195.00	50.00	115.50	54.50
Jitter (ms)	2784.70	15.39	116.48	3.27
Packet Loss Rate %	98.90	2.20	58.50	0.50

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

Note-

- "-" Youtube tests failed at this location for Airtel & RJIL.

Tiger Hill				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	13.90	3.95	59.65	39.50
Download Session Setup Success Rate%	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	4.10	1.37	2.16	8.32
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.56	6.62	3.99	4.75
Youtube Initial Buffer Delay (Second)	1.06	7.31	1.01	0.92
Latency (ms)-50th Percentile	20.55	57.00	29.15	56.00
Jitter (ms)	7.95	44.10	8.92	2.55
Packet Loss Rate %	0.10	3.30	0.20	0.30

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

Toy Train Station Darjeeling				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	9.33	2.67	47.16	21.84
Download Session Setup Success Rate%	100.00	60.00	100.00	100.00
Upload Throughput Average (Mbits/s)	2.23	2.27	2.73	9.39
Upload Session Setup Success Rate %	100.00	80.00	100.00	100.00
Web Browsing Delay (Second)	7.31	8.74	3.72	4.79
Youtube Initial Buffer Delay (Second)	1.81	5.72	2.30	0.94
Latency (ms)-50th Percentile	27.00	60.00	28.75	58.00
Jitter (ms)	9.37	20.19	49.16	2.40
Packet Loss Rate %	4.70	16.60	5.90	0.60

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

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4.4 Walk test

Walk test testing was done from 2nd December 2024 to 6th December. Three locations have been tested.

4.4.1 Locations

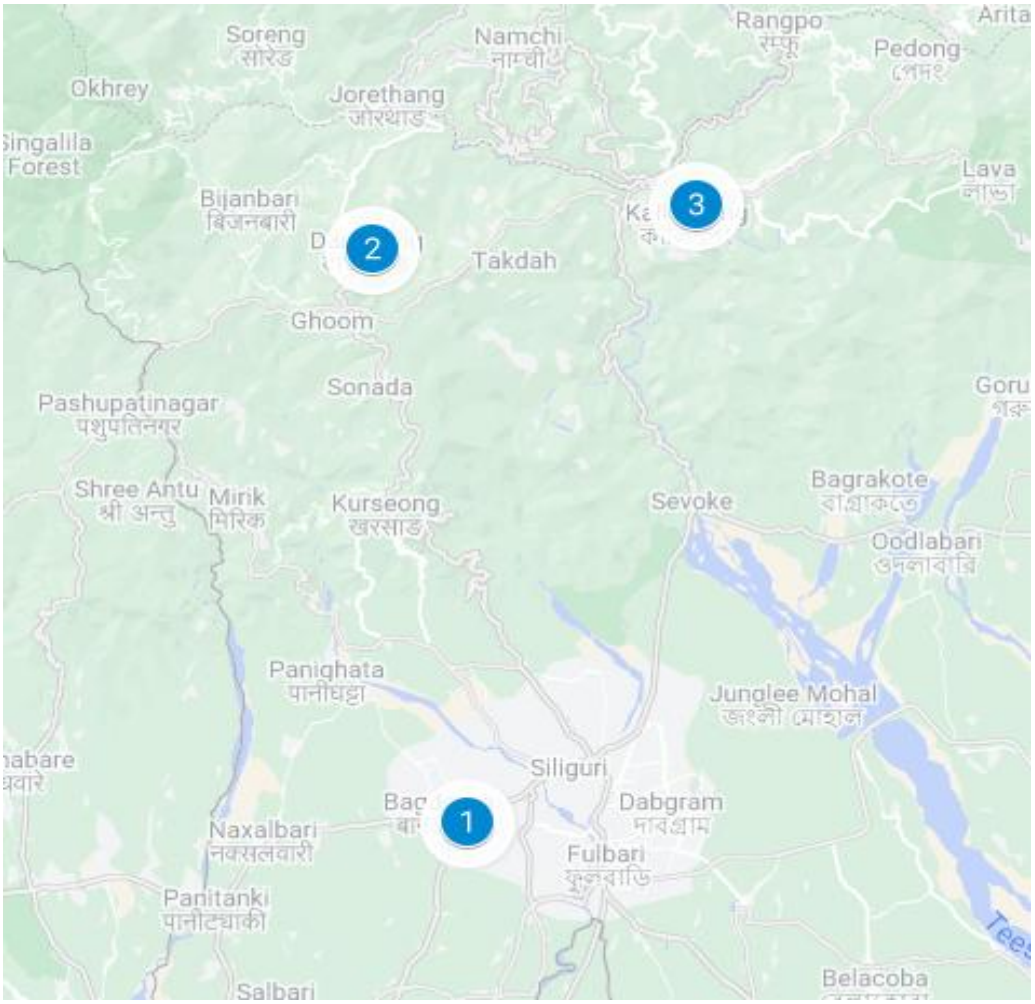

Figure- 24: Walk test locations

4.4.2 Walk test Covered

1. Bagdogra Airport
2. Darjeeling Mall
3. Haat Bazaar Kalimpong

4.4.3 Voice performance

i) Bagdogra Airport

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

Bagdogra Airport				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	17	18	16	16
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	2.11	2.39	0.67	1.02
Handover Success Rate %	100.00	100.00	100.00	100.00

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

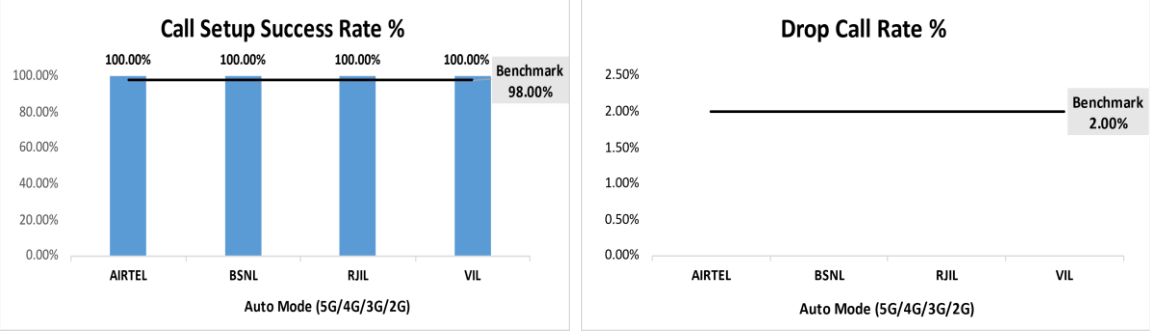

Figure- 25: Performance for call setup success rate and drop call rate

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

Bagdogra Airport				
Technology	**Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	9.44	NA	15.59	NA
4G	90.56	9.84	84.41	100.00
3G	NA	75.30	NA	NA
2G	0.00	14.85	NA	0.00
Limited service	0.00	0.00	0.00	0.00

Table-43: Time spent on technology during Walk test

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

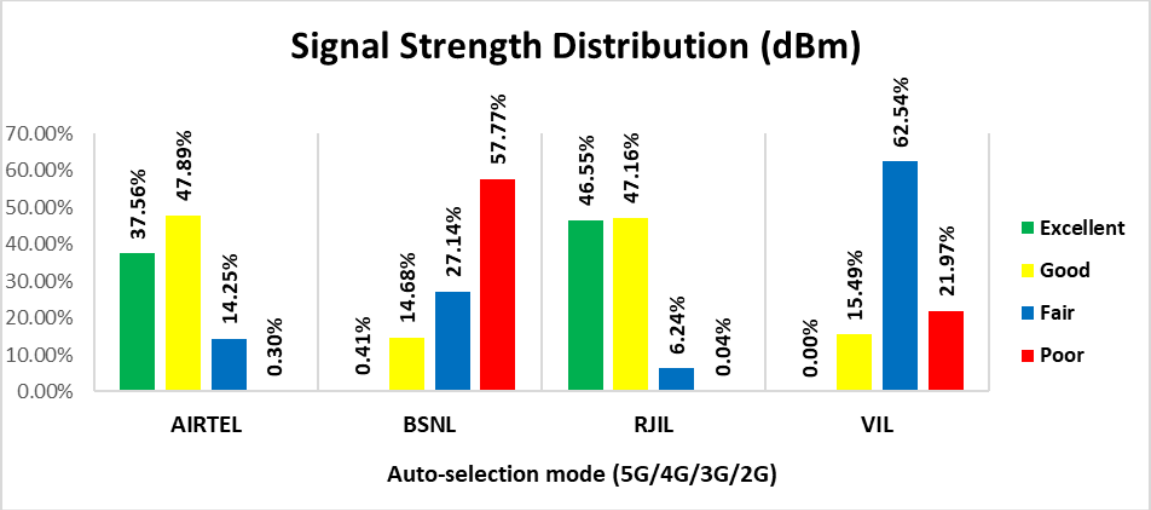

Figure-26: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

ii) Darjeeling Mall

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

Darjeeling Mall				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	9	10	11
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.87	2.22	0.55	1.27
Handover Success Rate %	100.00	100.00	100.00	100.00

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

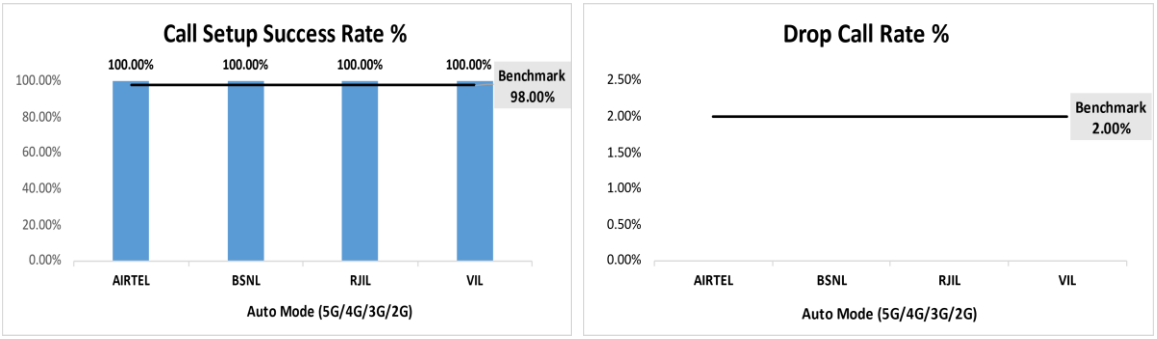

Figure- 27: Performance for call setup success rate and drop call rate

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

Darjeeling Mall				
Technology	**Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	3.57	NA	14.81	NA
4G	96.43	0.00	85.19	91.44
3G	NA	97.40	NA	NA
2G	0.00	2.60	NA	8.56
Limited service	0.00	0.00	0.00	0.00

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

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

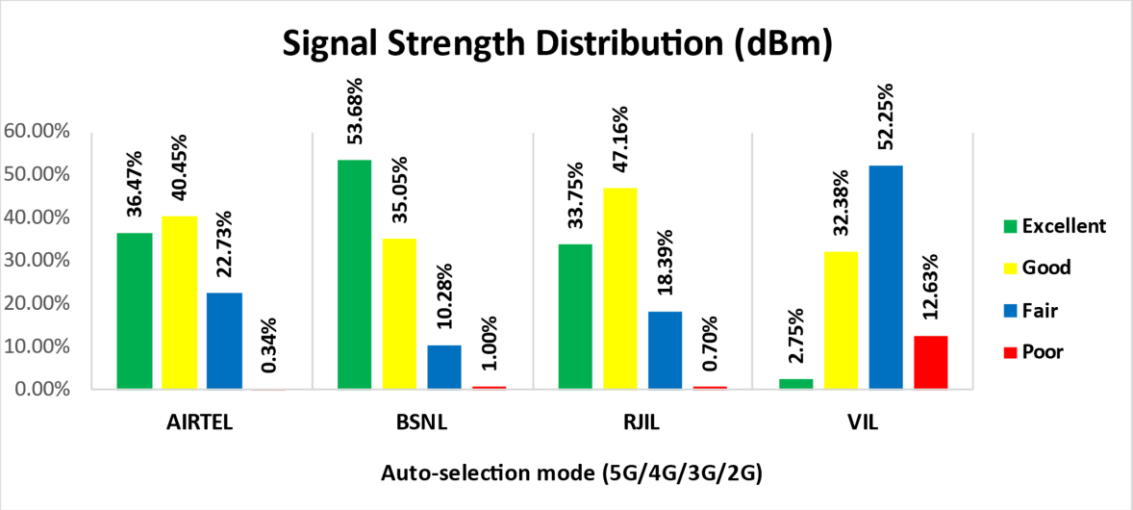

Figure-28: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

iii) Haat Bazaar Kalimpong

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

Haat Bazaar Kalimpong				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	11	11	11	11
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)	1.85	2.12	0.59	0.85
Handover Success Rate %	100.00	100.00	100.00	100.00

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

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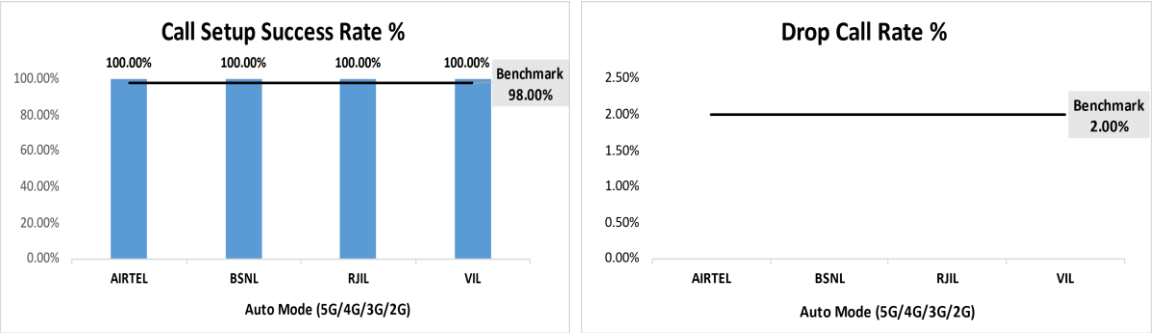

Figure- 29: Performance for call setup success rate and drop call rate

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

Darjeeling Mall				
Technology	**Service Provider**			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	3.60	0.00	5.76	NA
4G	96.40	0.00	94.24	100.00
3G	NA	100.00	NA	NA
2G	0.00	0.00	NA	0.00
Limited service	0.00	0.00	0.00%	0.00

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

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

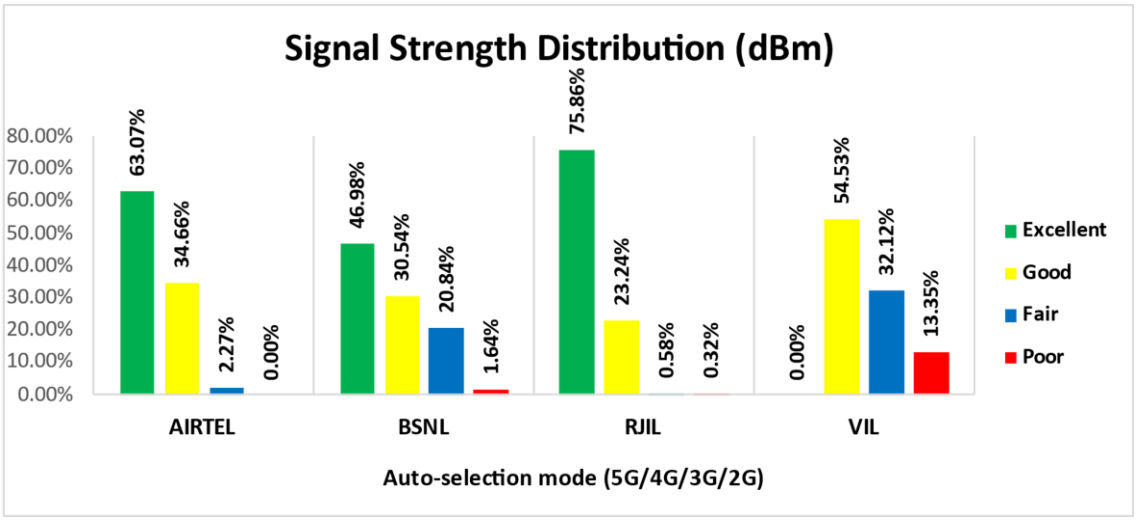

Figure-30: Signal strength distribution auto-selection mode 5G/4G/3G/2G.

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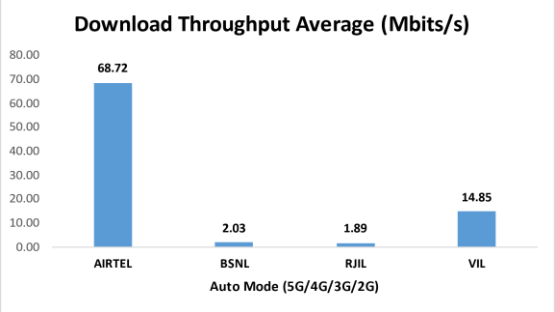
4.4.4 Data performance

i) Bagdogra Airport

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

Bagdogra Airport				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	68.72	2.03	1.89	14.85
Download Throughput 80th Percentile	131.05	3.17	2.58	21.80
Download Throughput 20th Percentile	5.11	0.95	1.11	5.57
Download Session Setup Success Rate %	100.00	75.00	32.00	100.00
Upload Throughput Average (Mbits/s)	15.03	1.12	13.30	3.76
Upload Throughput 80th Percentile	28.71	1.57	18.06	7.88
Upload Throughput 20th Percentile	4.16	0.51	7.82	1.11
Upload Session Setup Success Rate %	100.00	63.89	83.33	100.00
Latency (ms)-50th Percentile	21.10	61.50	29.40	63.00

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



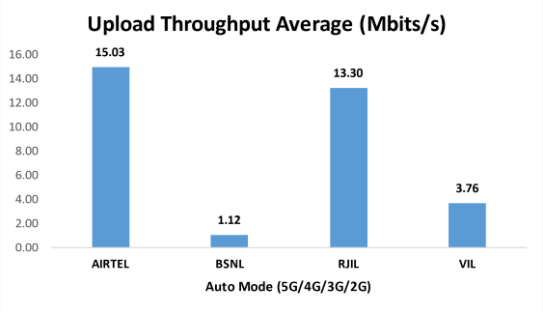


Figure- 31: Download and Upload throughput

ii) Darjeeling Mall

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

Darjeeling Mall				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	116.46	2.66	19.50	16.13
Download Throughput 80th Percentile	303.89	4.02	24.60	30.26
Download Throughput 20th Percentile	11.71	1.23	14.40	6.54
Download Session Setup Success Rate %	94.12	100.00	14.29	100.00
Upload Throughput Average (Mbits/s)	10.00	2.68	10.28	6.91
Upload Throughput 80th Percentile	25.44	3.20	13.46	9.33
Upload Throughput 20th Percentile	1.55	2.39	8.94	4.70
Upload Session Setup Success Rate %	94.12	100.00	78.57	100.00
Latency (ms)-50th Percentile	27.35	42.28	31.60	55.00

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

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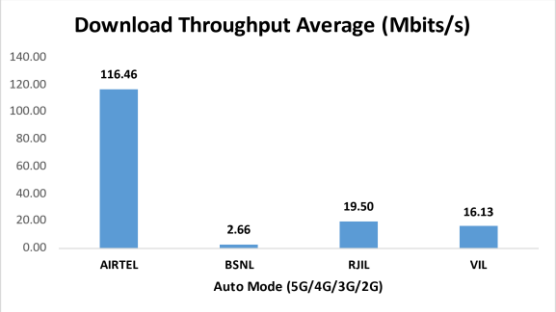


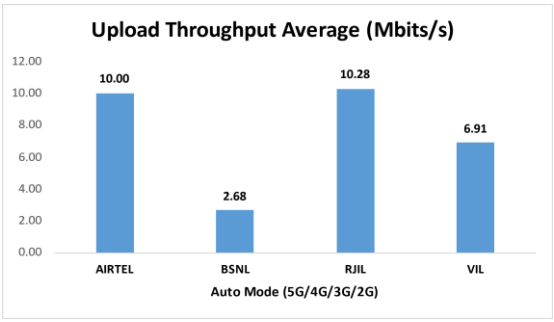


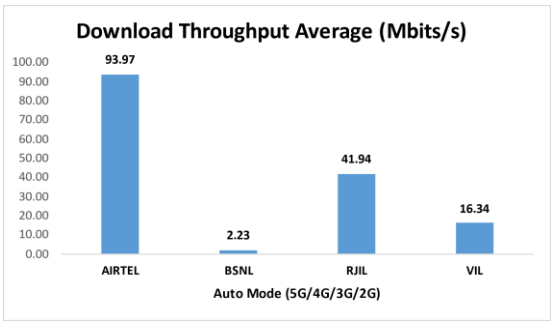
Figure- 32: Download and Upload throughput

iii) Haat Bazaar Kalimpong

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

Haat Bazaar Kalimpong				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	93.97	2.23	41.94	16.34
Download Throughput 80th Percentile	105.79	4.21	81.98	19.50
Download Throughput 20th Percentile	70.92	0.45	2.45	11.82
Download Session Setup Success Rate %	100.00	100.00	66.67	100.00
Upload Throughput Average (Mbits/s)	43.85	2.14	18.13	8.51
Upload Throughput 80th Percentile	48.66	2.35	24.38	9.63
Upload Throughput 20th Percentile	37.64	1.65	5.69	8.06
Upload Session Setup Success Rate %	100.00	100.00	83.33	100.00
Latency (ms)-50th Percentile	20.25	58.00	25.30	56.50

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



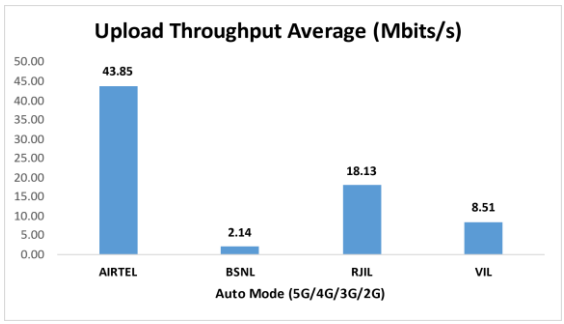


Figure- 33: Download and Upload throughput

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5. Voice & Data Key findings

5.1 Overall Voice

1. **Call Setup Success Rate:**
   a) Airtel, BSNL and VIL have 93.64%, 86.85% and 90.33% call setup success rate respectively in 3G/2G network mode. (refer Table-3)

   b) Airtel, BSNL, RJIL and VIL have 98.55%, 88.65%, 98.60% and 95.54% 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 (5.20 second) to establish the voice call, whereas BSNL and VIL call setup time is 3.04 & 5.15 seconds respectively in 3G/2G network mode. (refer Table-3)

   b) BSNL has taken comparatively longer time (2.78 second) to establish the voice call, whereas Airtel, RJIL and VIL call setup time is 2.27, 1.28 & 1.68 seconds respectively in Auto-selection mode (5G/4G/3G/2G). (refer Table-5)

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G), VIL, RJIL, Airtel and BSNL have 8.38%, 8.11%, 6.58% and 0.91% silence call rate respectively. Further BSNL has higher RTP packet loss rate in downlink (6.98%) compared to Airtel (4.97%), VIL (3.32%) and RJIL (3.28%). In uplink the RTP packet loss rate is higher for BSNL (6.92%) compared to Airtel (5.19%), RJIL (5.14%) and VIL (2.20%). (refer Table-6)

4. **Call Drop Rate**:
   a) Airtel, BSNL and VIL have 2.14%, 8.76% and 1.03% drop call rate respectively in 3G/2G network mode. (refer Table-3)

   b) Overall BSNL, RJIL, VIL call drop rate 6.56%, 2.69% and 2.41% is higher (QoS benchmark of 2%), while Airtel has 0.15% drop call rate 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 (1.92 Mbps) and VIL (21.88 Mbps) being on 3G & 4G as top technology respectively, have comparatively lower data speeds. While Airtel and RJIL have average download speed of 82.61 Mbps and 110.99 Mbps respectively. (refer Table-11)

   b) BSNL (1.61 Mbps) and VIL (5.18 Mbps) being on 3G & 4G as top technology respectively, have comparatively lower data speeds. While Airtel and RJIL have average upload speed of 13.44 Mbps and 12.10 Mbps respectively. (refer Table-11)

2. **Data download and upload performance (static i.e. while stationary):**
   a) Airtel, BSNL, RJIL and VIL have download speed i.e. 107.95 Mbps, 4.09 Mbps, 51.63 Mbps and 22.96 Mbps. (refer Table-31)

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b) Airtel, BSNL, RJIL and VIL have upload speed i.e. 19.64 Mbps, 3.52 Mbps, 5.70 Mbps and 5.68 Mbps. (refer Table-31)

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

a) Airtel, BSNL, RJIL and VIL have download session setup success rate i.e. 94.00%, 80.00%, 80.00% and 95.65%. (refer Table-31)

b) Airtel, BSNL, RJIL and VIL have Upload session setup success rate i.e. 94.00%, 82.00%, 100.00% and 90.00%. (refer Table-31)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 93.64% call setup success rate and 2.14% call drop rate have been observed in 3G/2G network mode. Performance is not well within the benchmark of 98.00% & 2.00% respectively for LSA and City drive. (refer Table-3 and Table-13)
- 98.55% call setup success rate and 0.15% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA drive. (refer Table-5)
- 98.19% call setup success rate and 0.18% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive. (refer Table-15)
- 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-20)
- 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 Walk test. (refer Table-42, 44 and 46)

Data

- Airtel has 82.61 Mbps average download throughput & 13.44 Mbps average upload throughput across measured routes for LSA. (refer Table-11)
- Airtel has 80.66 Mbps average download throughput & 12.44 Mbps average upload throughput across measured routes for city drive. (refer Table- 19)
- Bengal Safari, Govt Degree College, Pedong, North Bengal Medical College and Hospital, Office of DM Kalimpong, Tiger Hill and Toy Train Station Darjeeling hotspots have less download speeds (less than 100 Mbps). (refer Table -32, 34, 37, 39, 40 and 41)
- Bengal Safari, Ghoom Monastery, Govt Degree College, Pedong, North Bengal Medical College and Hospital, North Bengal University, Tiger Hill and Toy Train Station Darjeeling hotspots have less upload speeds (less than 20 Mbps). (refer Table -32, 33, 34, 37, 38, 40 and 41)

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- Bagdogra Airport, Darjeeling Mall and Haat Bazaar Kalimpong average download throughput is 68.72 Mbps, 116.46 Mbps and 93.97 Mbps respectively. (refer Table – 48, 49 and 50)

- Bagdogra Airport, Darjeeling Mall and Haat Bazaar Kalimpong average upload throughput is 15.03 Mbps, 10.00 Mbps and 43.85 Mbps respectively.(refer Table – 48, 49 and 50)

2. BSNL:

Voice

- 86.85% call setup success rate and 8.76% call drop rate have been observed in 3G/2G network mode. Performance is not meeting the benchmark of 98.00% & 2.00% respectively. (refer Table-3 and Table-13)

- 88.65% call setup success rate and 6.56% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not meeting the benchmark of 98.00% & 2.00% respectively for LSA. (refer Table-5)

- 85.89% call setup success rate and 8.42% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is not meeting the benchmark of 98.00% & 2.00% respectively for City. (refer Table-15)

- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is meeting the benchmark of 98.00% and 2.00% for Hotspots. (refer Table-20)

- 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 Walk test. (refer Table-42, 44 and 46)

Data

- BSNL has 1.92 Mbps average download throughput & 1.61 Mbps average upload throughput across measured routes for LSA (refer Table-11)

- BSNL has 1.66 Mbps average download throughput & 1.37 Mbps average upload throughput across measured routes for city drive (refer Table-19)

- All Hotspots have less download speed (less than 10 Mbps). (refer Table- 32, 33, 34, 35, 36, 37, 38, 39, 40 and 41)

- Ghoom Monastery, Govt Degree College, Pedong, Mane Bhanjan Taxi Stand, North Bengal Medical College and Hospital, Office of DM Kalimpong and Tiger Hill hotspots have less upload speeds (less than 2 Mbps). (refer Table -33, 34, 35, 37, 39 and 40)

- Bagdogra Airport, Darjeeling Mall and Haat Bazaar Kalimpong average download throughput is 2.03 Mbps, 2.66 Mbps and 2.23 Mbps respectively. (refer Table – 48, 49 and 50)

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- Bagdogra Airport, Darjeeling Mall and Haat Bazaar Kalimpong average upload throughput is 1.12 Mbps, 2.68 Mbps and 2.14 Mbps respectively. (refer Table – 48, 49 and 50)

3. RJIL:

Voice

- 98.60% call setup success rate and 2.69% call drop rate have been observed in auto-selection mode (5G/4G/3G/2G). Performance is well within the benchmark of 98.00% & 2.00% respectively for LSA. (refer Table-5)

- 98.62% call setup success rate has been observed in auto-selection mode (5G/4G/3G/2G). Performance is well within the benchmark of 98.00% for city drive. (refer Table-15)

- 3.33% call drop rate has been observed in auto-selection mode (5G/4G/3G/2G). Performance is not meeting benchmark of 2.00% for city drive. (refer Table-15)

- 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 Walk test. (refer Table-42, 44 and 46)

Data

- RJIL has 110.99 Mbps average download speed & 12.10 Mbps average upload speed across measured routes in LSA. (refer Table-11)

- RJIL has 117.90 Mbps average download speed & 12.49 Mbps average upload speed across measured routes in city drive. (refer Table-19)

- Bengal Safari, Ghoom Monastery, Govt Degree College, Pedong, Mane Bhanjan Taxi Stand, North Bengal University, Office of DM Kalimpong, Tiger Hill and Toy Train Station Darjeeling have less download speed (less than 100 Mbps). (refer Table- 32, 33, 34, 35, 38, 39, 40 and 41)

- Bengal Safari, Ghoom Monastery, Govt Degree College, Pedong, Mane Bhanjan Taxi Stand, North Bengal Medical College and Hospital, North Bengal University, Office Of Dm, Kalimpong, Tiger Hill and Toy Train Station Darjeeling have less upload speed (less than 20 Mbps). (refer Table- 32, 33, 34, 35, 37, 38, 39, 40 and 41)

- Bagdogra Airport, Darjeeling Mall and Haat Bazaar Kalimpong average download throughput is 1.89 Mbps, 19.50 Mbps and 41.94 Mbps respectively. (refer Table – 48, 49 and 50)

- Bagdogra Airport, Darjeeling Mall and Haat Bazaar Kalimpong average upload throughput is 13.30 Mbps, 10.28 Mbps and 18.13 Mbps respectively. (refer Table – 48, 49 and 50)

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4. VIL:

Voice

- 90.33% call setup success rate has been observed in 3G/2G network mode. Performance is not meeting benchmark of 98.00% for LSA and city drive. (refer Table-3 and Table- 13)

- 1.03% call drop rate has been observed in 3G/2G network mode. Performance is well within the benchmark of 2.00% for LSA and city drive. (refer Table-3 and Table- 13)

- 95.54% call setup success rate and 2.41% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for LSA. Performance is not meeting benchmark of 98.00% & 2.00% (refer Table-5).

- 94.43% call setup success rate and 2.85% drop call rate have been observed for auto-selection mode (5G/4G/3G/2G) for city drive. Performance is not meeting benchmark of 98.00% & 2.00% (refer Table-15).

- 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 Walk test. (refer Table-42, 44 and 46)

Data

- VIL has 21.88 Mbps average download speed & 5.18 Mbps average upload speed across measured routes in LSA. (refer Table-11)

- VIL has 22.57 Mbps average download speed & 5.04 Mbps average upload speed across measured routes in city drive. (refer Table-19)

- Bengal Safari, Mane Bhanjan Taxi Stand and Office of DM Kalimpong hotspots have less download speeds (less than 10 Mbps) out of total 10 hotspots. (refer Table- 32, 35 and 39)

- Bengal Safari, Mane Bhanjan Taxi Stand, NJP Railway Station, Office of DM Kalimpong hotspots have less upload speeds (less than 2 Mbps) out of total 10 hotspots. (refer Table- 32, 35, 36 and 39)

- Bagdogra Airport, Darjeeling Mall and Haat Bazaar Kalimpong average download throughput is 14.85 Mbps, 16.13 Mbps and 16.34 Mbps respectively. (refer Table – 48, 49 and 50)

- Bagdogra Airport, Darjeeling Mall and Haat Bazaar Kalimpong average upload throughput is 3.76 Mbps, 6.91 Mbps and 8.51 Mbps respectively. (refer Table – 48, 49 and 50)

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6. Annexure

6.1 Route wise coverage map

6.1.1 City

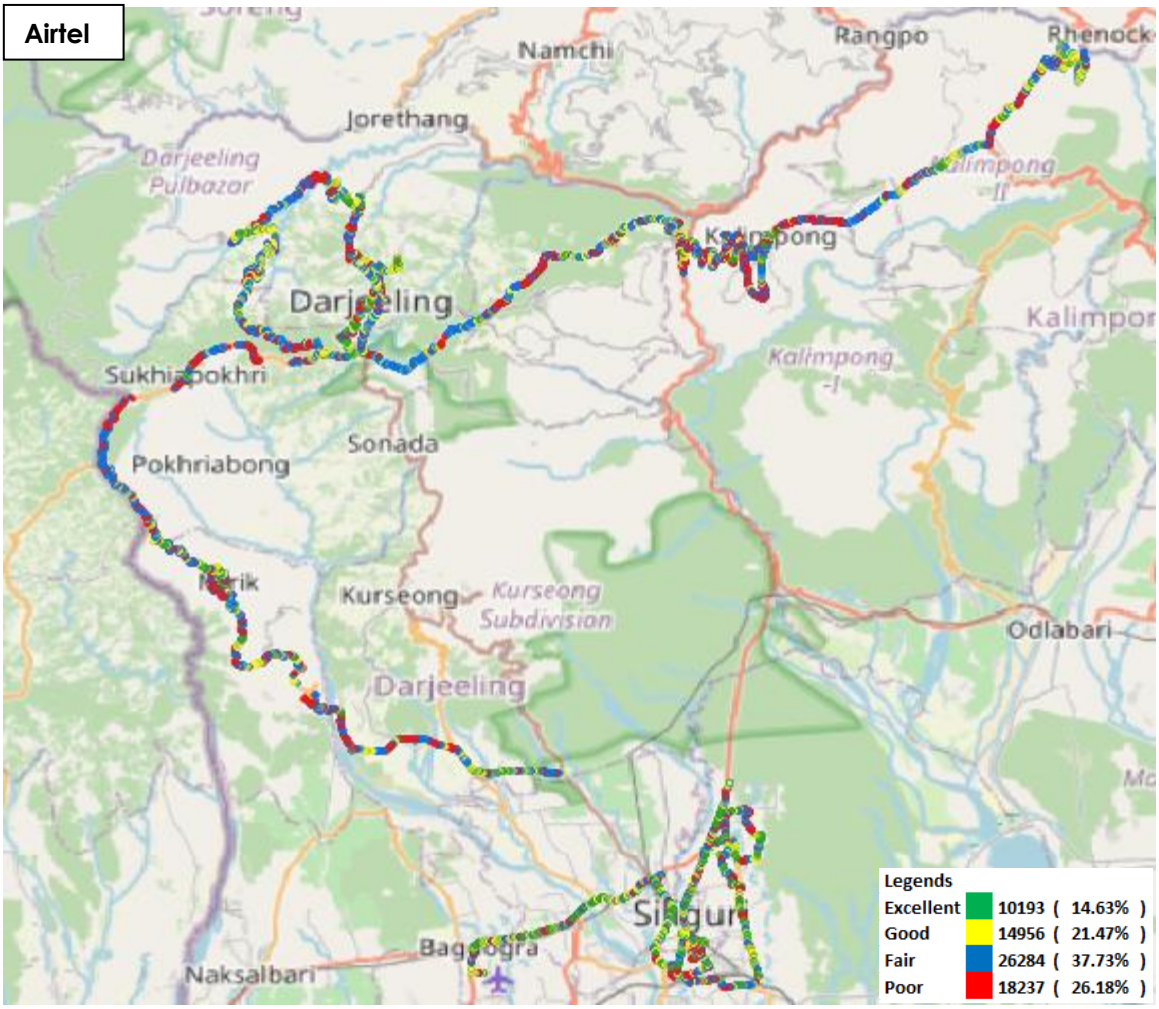

Figure-34: Signal strength 3G/2G network mode – Airtel

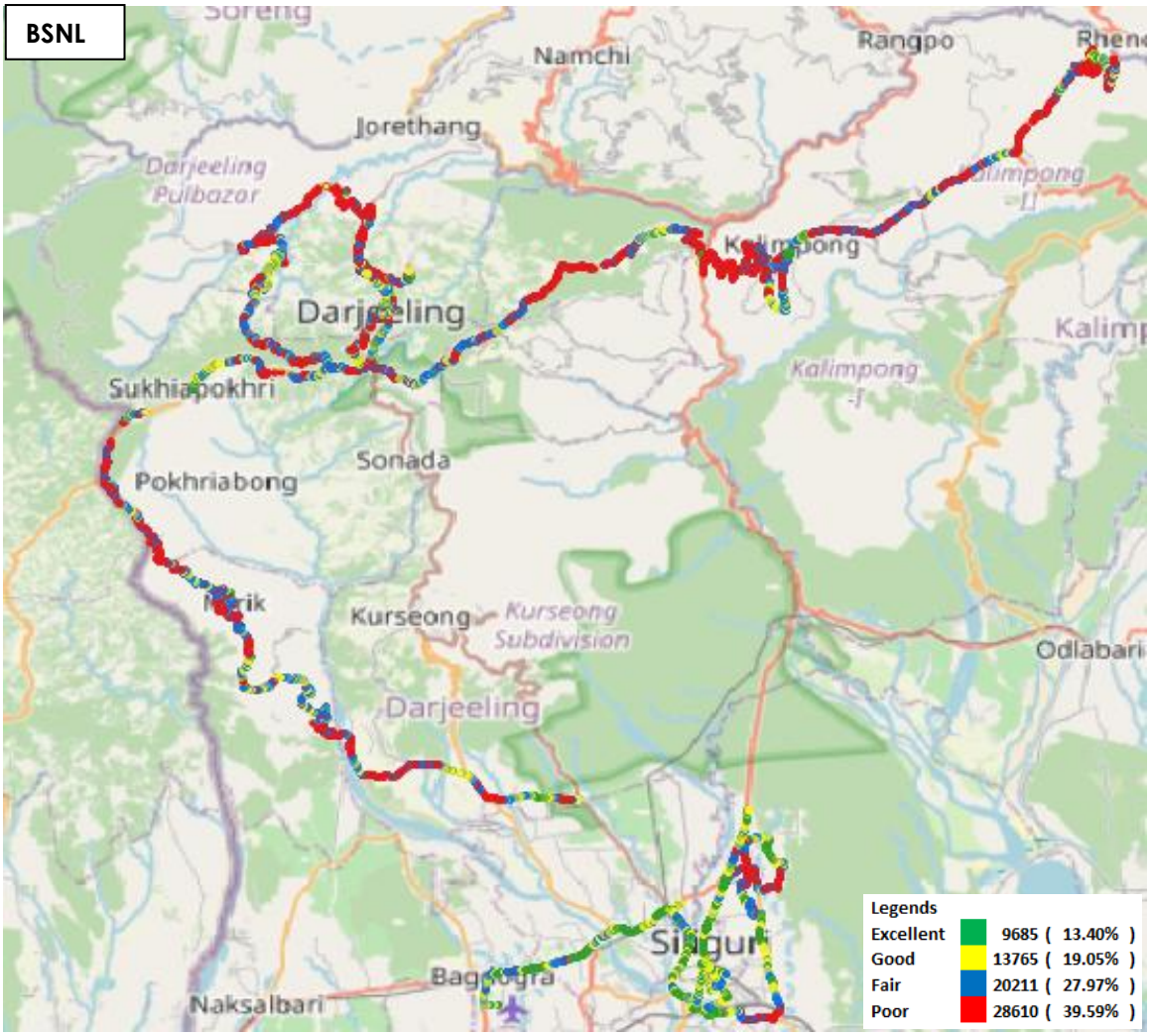

Figure-35: Signal strength 3G/2G network mode – BSNL

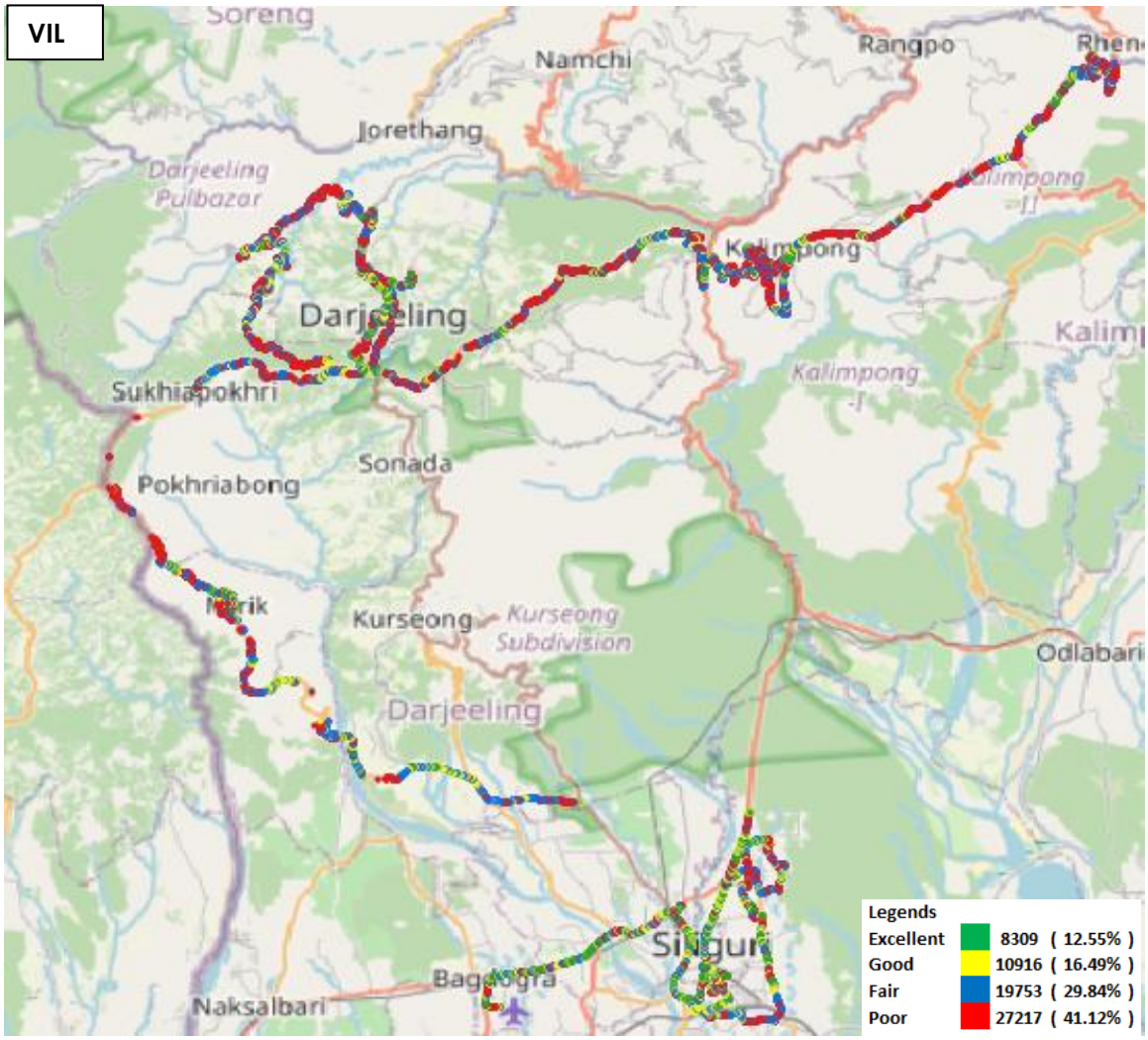

Figure-36: Signal strength 3G/2G network mode – VIL

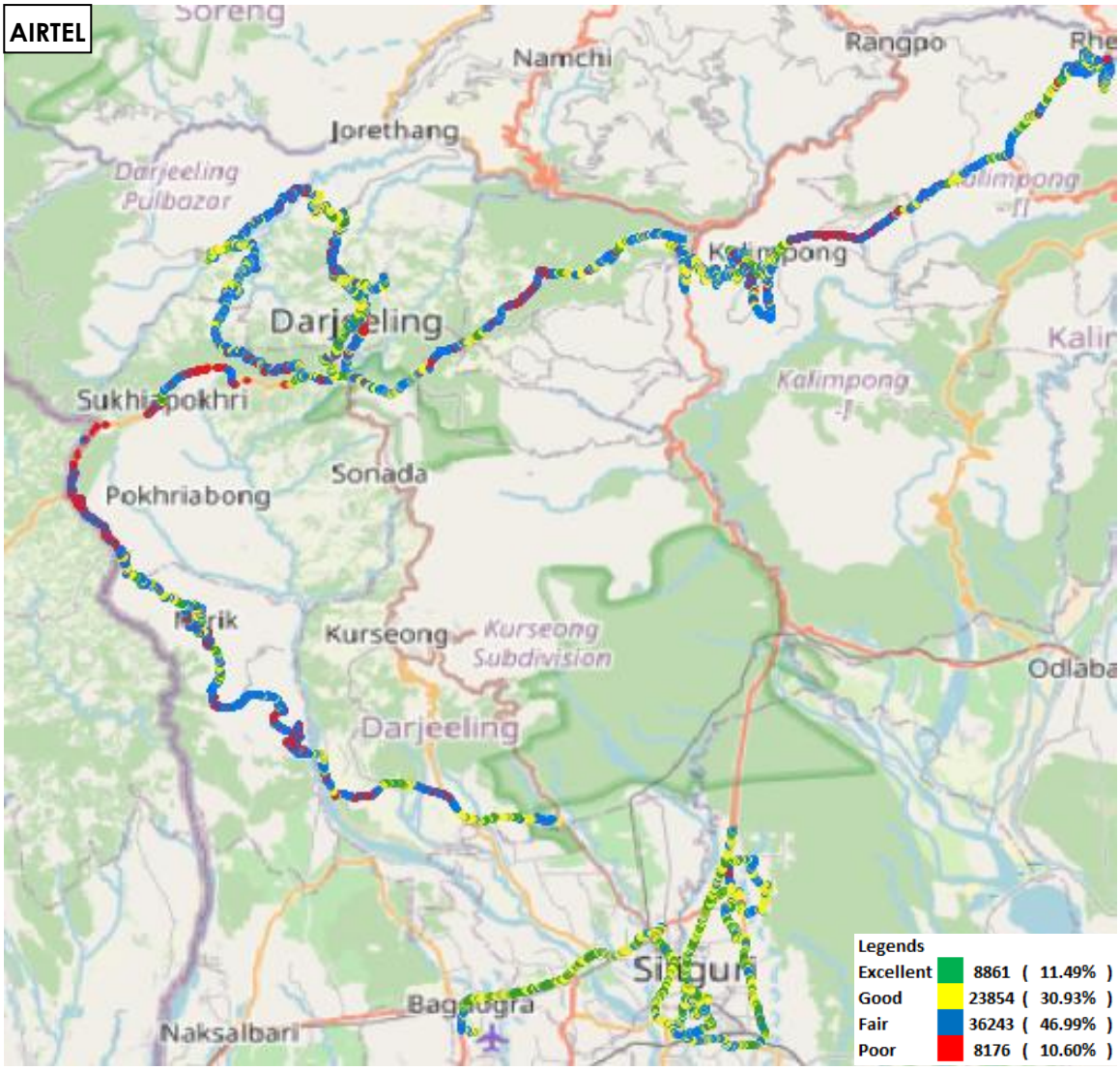

Figure-37: Signal strength auto-selection mode 5G/4G/3G/2G - Airtel

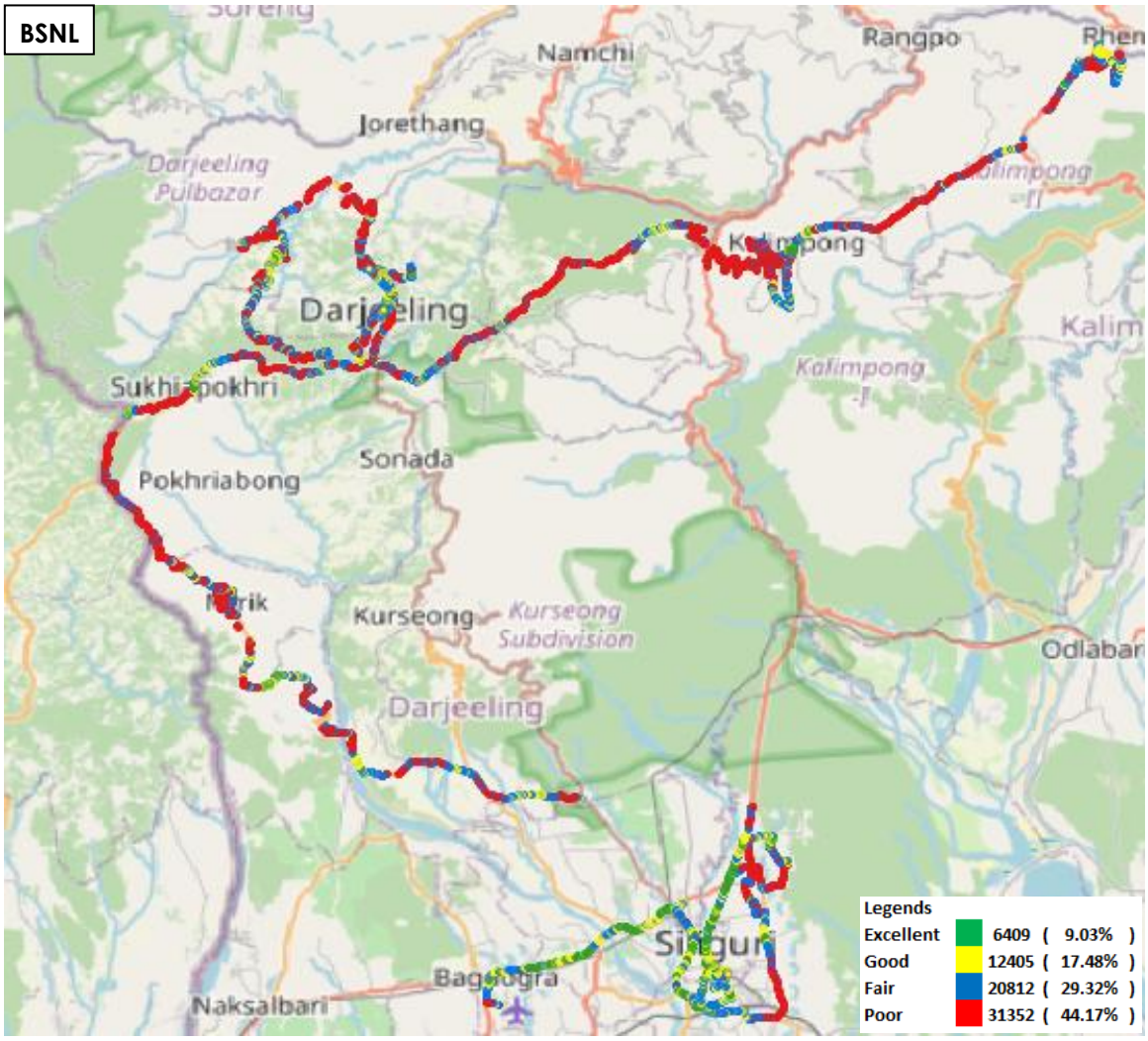

Figure-38: Signal strength auto-selection mode 5G/4G/3G/2G - BSNL

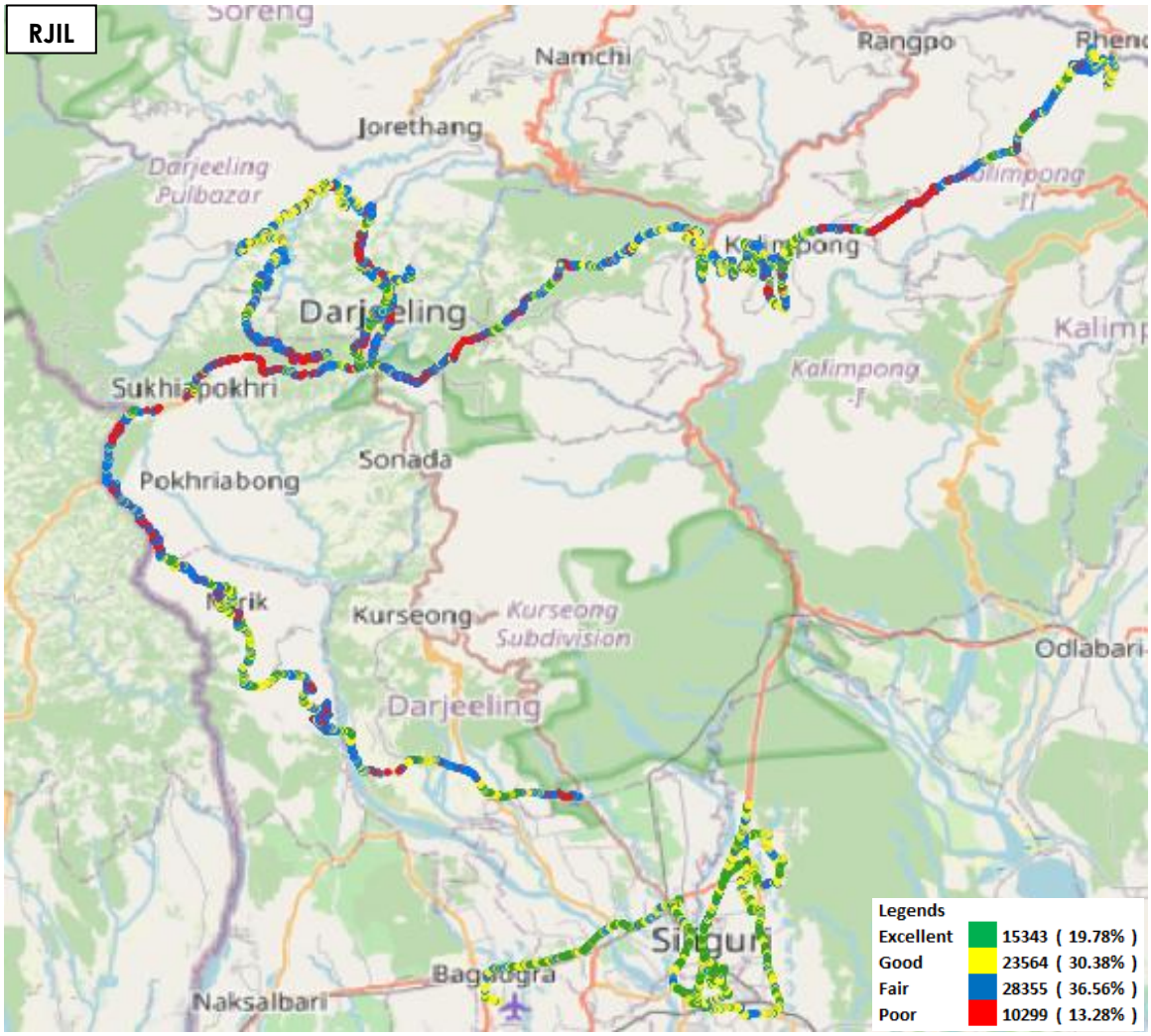

Figure-39: Signal strength auto-selection mode 5G/4G/3G/2G – RJIL

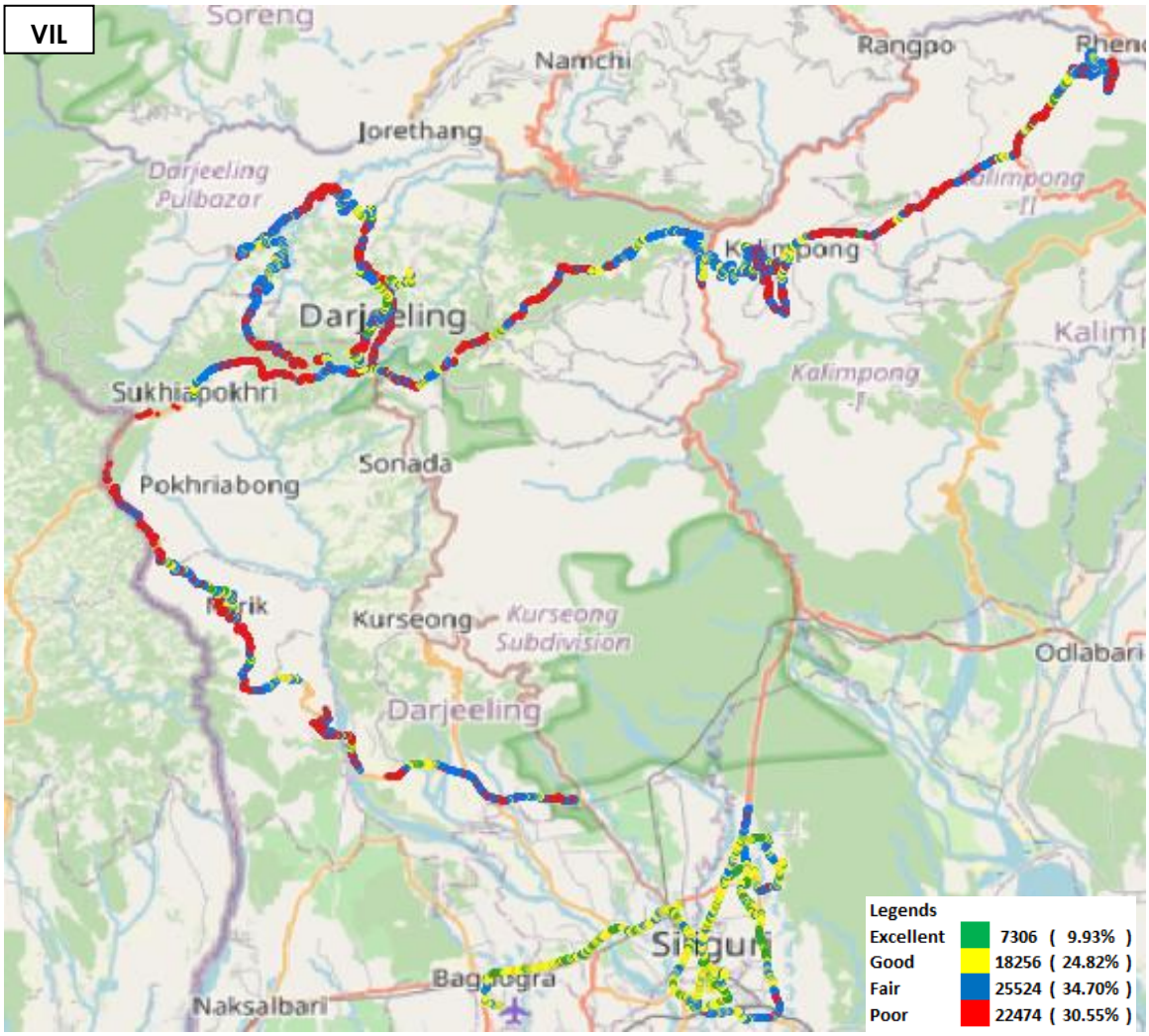

Figure-40: Signal strength auto-selection mode 5G/4G/3G/2G – VIL

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		120 Sec
Wait/ Guard Time		15 Sec

Table-51: 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.
- 120 Sec call were made for city drive, hotspot and walk test.
- 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)

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Web Browsing		3 popular websites (www.amazon.in, www.paytm.com, www.flipkart.com) 20 sec timeout (only at Hotspot)
Latency		25 count- Dynamic 1000 count- Hotspot Payload- 512 bytes in all drive

Table-52: 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.

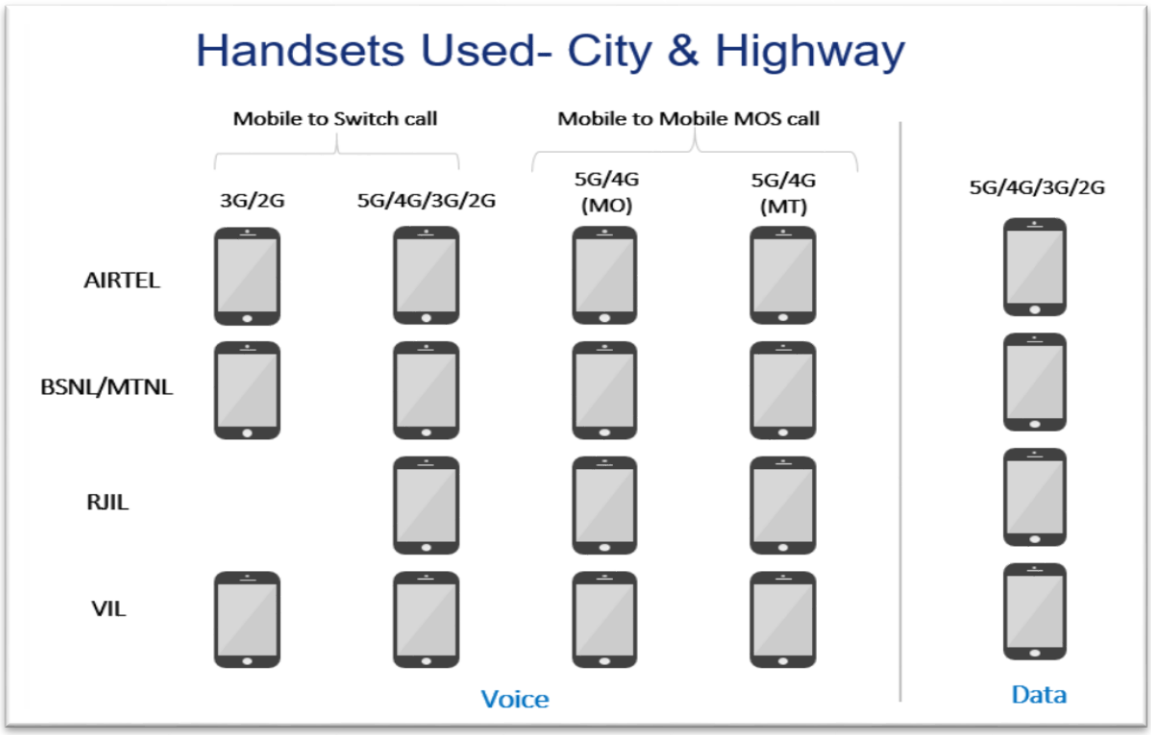

Figure-41: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

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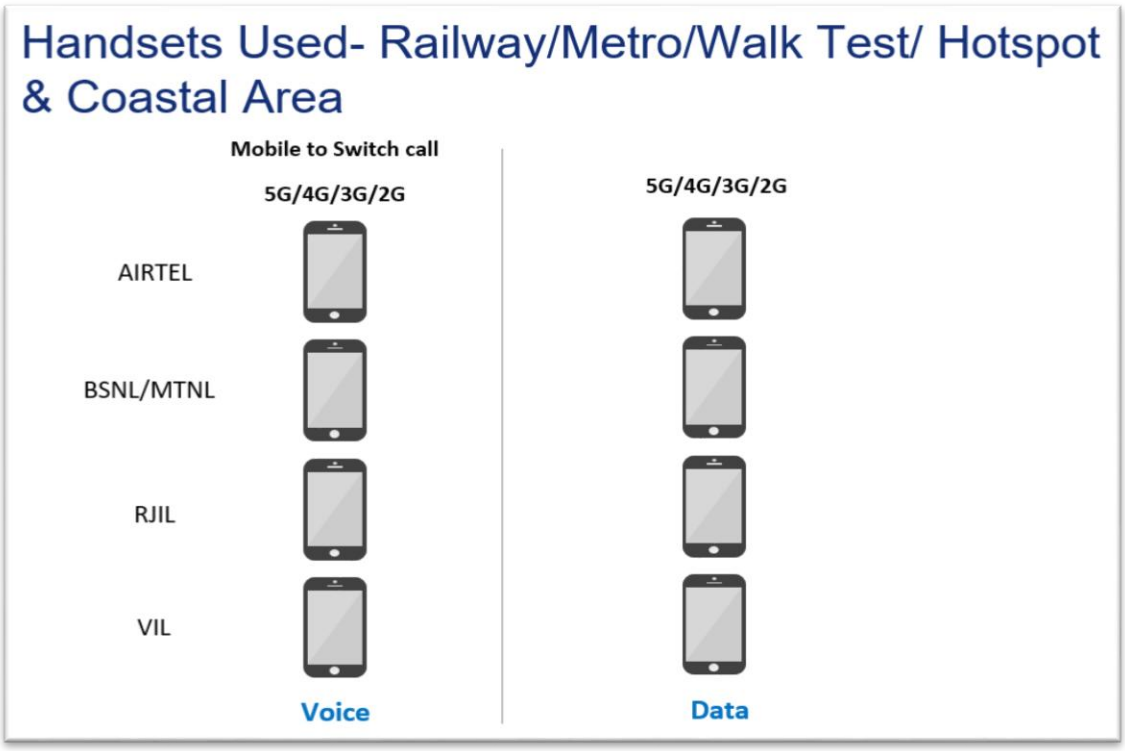

Figure-42: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)

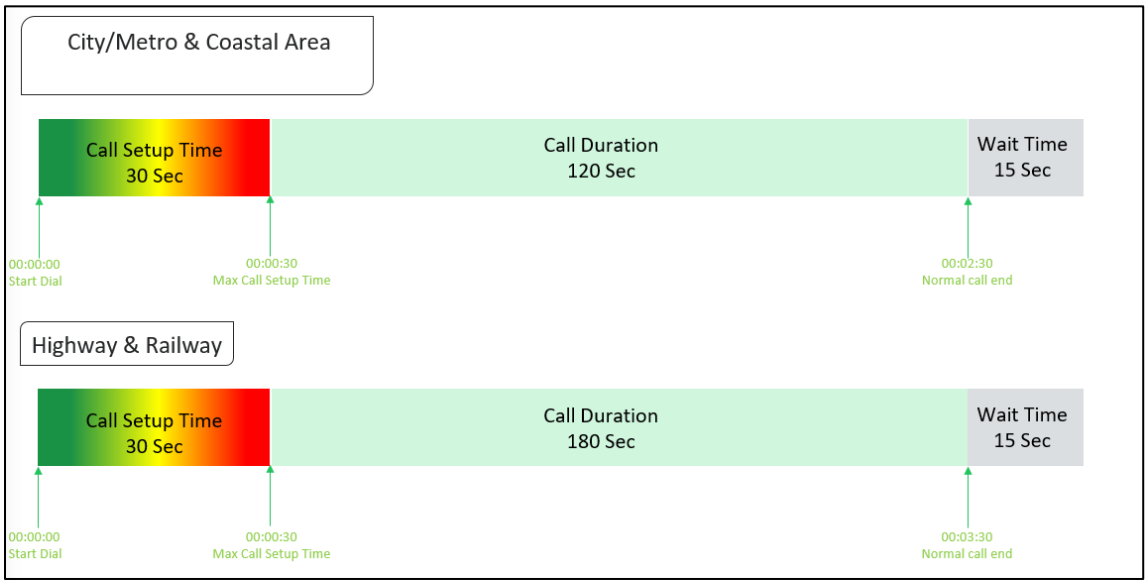

Figure-43: Voice test script for city/railway/metro/highway & coastal area

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

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

(b) Hotspot voice testing

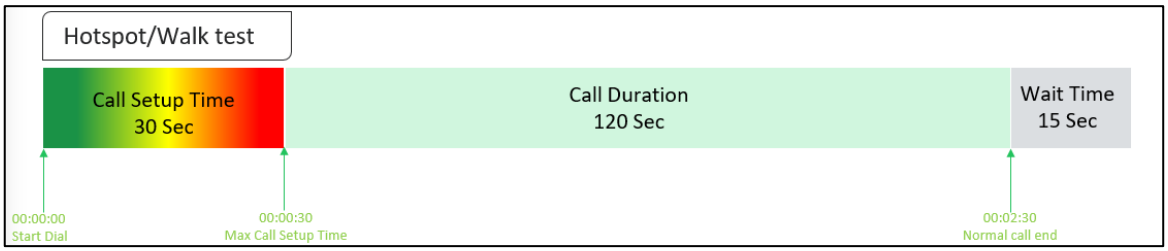

Figure-44: Voice test script for walktest/hotspot

- 10 calls are 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

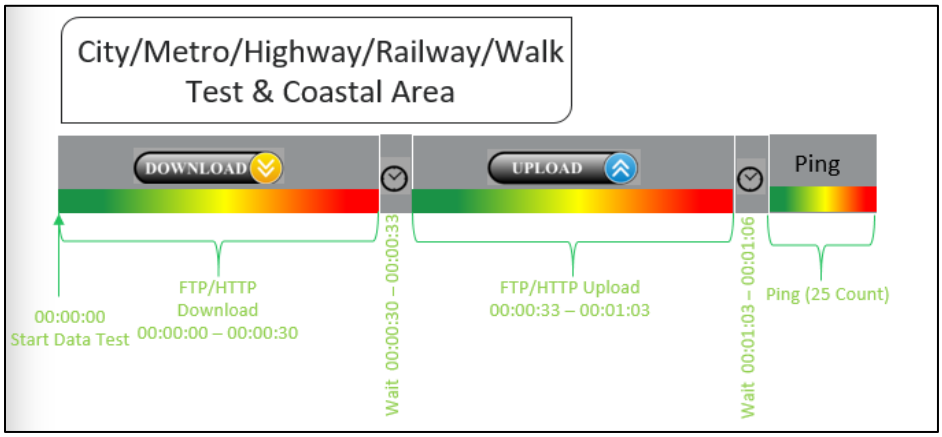

Figure-45: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

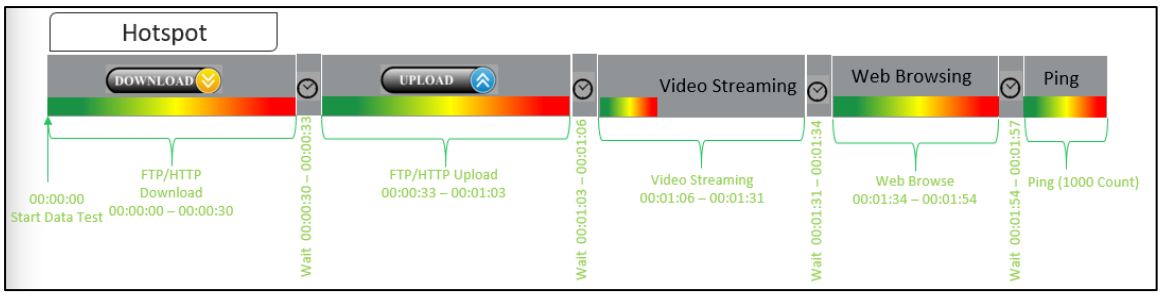

Figure-46: Data test script used at hotspot

- 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.

7.2 Appendix-II

7.2.1 Network Performance Parameters for Voice calls

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

<table>
<tr><td>Jitter</td><td>The inter arrival jitter is the difference in the relative transit time for two packets. The relative transit time is the difference between a packet's Real-time Transport Protocol (RTP) timestamp and the receiver's clock at the time of arrival, measured in the same units. If Si is the RTP timestamp from packet i, and Ri is the time of arrival in RTP timestamps units for packet i, then for two packets i and j the inter-arrival jitter D can be expressed as:
D(i,j) = (Rj - Ri) - (Sj - Si)

The interarrival jitter is calculated continuously as each data packet is received from source SSRC_n, using this difference D for that packet and the previous packet i-1 in order of arrival (not necessarily in sequence), according to the formula
J(i) = J(i-1) + (|D(i-1,i)| - J(i-1))/16 or 8</td></tr>
<tr><td>Downlink Packet Drop Rate</td><td>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call originating handset.
This KPI will be calculated from MOS call for packet call only (VoNR/VoLTE)</td></tr>
<tr><td>Uplink Packet Drop Rate</td><td>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call terminating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE).</td></tr>
<tr><td>Signal Strength</td><td>Signal strength is the signal power level received by the wireless user.
<table>
<tr><td rowspan="2">Parameter Name</td><td rowspan="2">Technology</td><td colspan="4">Signal Strength (dBm)</td></tr>
<tr><td>Excellent</td><td>Good</td><td>Fair</td><td>Poor</td></tr>
<tr><td>Rx Level</td><td>GSM</td><td>0 to ≥ -65</td><td><-65 to ≥ -75</td><td><-75 to ≥-85</td><td><-85 to min</td></tr>
<tr><td>RSCP</td><td>WCDMA</td><td>0 to ≥ -70</td><td><-70 to ≥ -80</td><td><-80 to ≥ -90</td><td><-90 to min</td></tr>
<tr><td>RSRP</td><td>LTE</td><td>0 to ≥ -80</td><td><-80 to ≥ -95</td><td><-95 to ≥-110</td><td><-110 to min</td></tr>
<tr><td>SS_RSRP</td><td>NR</td><td>0 to ≥ -80</td><td><-80 to ≥ -95</td><td><-95 to ≥-110</td><td><-110 to min</td></tr>
</table></td></tr>
</table>

Table-53: 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.

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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

Table-54: Network performance parameter and definition Data