Email **Sushil Kumar Bansal**

Independent Drive Test (IDT) Report of Himachal Pradesh LSA for November 2024

From : Sushil Kumar Bansal <sro-rodelhi@trai.gov.in> Tue, Jan 21, 2025 03:32 PM

Subject : Independent Drive Test (IDT) Report of Himachal Pradesh LSA for November 2024 2 attachments

To : Satyenderpatwal <satyender.patwal@airtel.com>, Vishal Ambardar <vishal.ambardar@ril.com>, rajesh kumar66 <rajesh.kumar66@vodafoneidea.com>, PGM REGULATION <pgm-regulation@bsnl.co.in>

Cc : COL ROHITASHWA PANWAR <poabraham@trai.gov.in>, P.O. Abraham <srppssecy@trai.gov.in>, Raghubir Singh <raghubir.65@trai.gov.in>, Raghubir Singh <srpps-bcs@trai.gov.in>, vivek khare <adv.ca@trai.gov.in>, Sumeet Hemrajani <sumeet@trai.gov.in>

Sir/Madam,

Kindly find herewith attached this office letter dated 21.1.2025 regarding Independent Drive Test (IDT) conducted in Himachal Pradesh LSA for assessment of Quality of Service of Cellular Mobile Networks through a third party agency i.e. M/s Red Mango Pvt. Ltd w.e.f. 19.11.2024 to 20.11.2024.

Findings of said IDT of Himachal Pradesh LSA may be seen in the attached IDT report dated 18.12.2024. In this regard, you are requested to go through the IDT report dated 18.12.2024 and take time bound necessary action in respect of shortcomings or deficiencies observed in your network during IDT as per above provisions of the QoS Regulation and submit the compliance report.

With regards,

Sushil Kumar Bansal
Sr. Research Officer (RO- Delhi)
Telecom Regulatory Authority of India (TRAI)
5th Floor, Block - F, NBCC WTC Compound,
Nauroji Nagar, New Delhi-110029

TRAI Letter dated 21.1.2025.pdf
92 KB

IDT Report Himachal Pradesh LSA November 2024.pdf
3 MB

भारतीय दूरसंचार विनियामक प्राधिकरण
Telecom Regulatory Authority of India
[भारत सरकार / Government of India]

सं. AU-3/9/(1)/2025-RO_DLI (E-15018) दिनांक : 21-01-2025

To,

All Access Services (Wireless) Providers,
(M/s Airtel, M/s BSNL, M/s RJIL, M/s VIL)

Subject: Time bound remedial action to be taken by TSPs on shortcomings observed during Independent Drive Test (IDT) of Himachal Pradesh LSA during November 2024.

TRAI has conducted Independent Drive Test (IDT) in Himachal Pradesh LSA for assessment of Quality of Service of Cellular Mobile Networks through a third party agency.

2. Please refer to the meeting held with all TSP officers of TRAI Regional offices and IDT agency viz M/s Red Mango Pvt. Ltd at TRAI HQ on 21.08.2024 to explain methodology of IDT in detail, requirement of Test SIMs and Test Servers for conducting IDT to be provided by TSPs. Further, the methodology of IDT was shared with all TSPs on 11.09.2024.

3. IDT was conducted in Himachal Pradesh LSA from 19.11.2024 to 20.11.2024 covering around 148 kms of route in city Dharamshala and near by area along with 06 Hot spots. Findings of IDT may be seen in the attached IDT report dated 18.12.2024.

4. In this regard, the provisions of sub-regulation (5) of Regulation 7 under section IV of "The Standards of Quality of Service of Access (Wireline and Wireless) and Broadband (Wireline and Wireless) Service Regulations, 2024" may be referred which inter alia states that:

> *"In respect of drive test conducted by the Authority or joint drive tests under sub-regulation (3), the service provider shall submit to the Authority-*
>
> *(a) its action plan for removal of the shortcomings or deficiencies, within fifteen days of receipt of the communication from the Authority about such shortcomings or deficiencies; and*
>
> *(b) its compliance report, after completing the remedial action, within three months of submission of action plan, and in case, remedial action is not completed within three months of submission of action plan, then a quarterly compliance report shall be submitted till completion of the remedial action."*

5. Accordingly, you are requested to go through the IDT report and take time bound necessary action in respect of shortcomings or deficiencies observed in your network during IDT as per above provisions of the QoS Regulation and submit the compliance report.

Signed by Sumeet Hemrajani
Date: 21-01-2025 10:17:58

(सुमीत हेमराजानी)
संयुक्त सलाहकार(क्षे.का. दिल्ली)

Encl.: As above.

Copy to:

1. Sr. PPS to Secretary TRAI, New Delhi,
2. Sr. PPS to Pr. Advisor (QOS, IT & CA), TRAI New Delhi.

वर्ल्ड ट्रेड सेंटर, टावर-एफ, नौरोजी नगर, नई दिल्ली-110029
World Trade Centre, Tower-F, Nauroji Nagar New Delhi – 110029

भादूविप्रा
TRAI

TELECOM REGULATORY AUTHORITY OF INDIA

HARDIK RAJESHBHAI PATEL

Digitally signed by HARDIK RAJESHBHAI PATEL
Date: 2024.12.18 16:36:13 +05'30'

Independent Drive Test Report

Himachal Pradesh LSA

November 2024

Contents

1. Introduction

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

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

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

2. Executive Summary (LSA)

2.1 Drive test details

This report covers the findings of the IDT undertaken in Himachal Pradesh License Service Area (LSA) during November 2024 under the supervision of TRAI Regional Office (RO), Delhi. Details of the route/ area covered during the IDT are given below:

Sl. No	Drive test route	Type of route	Distance covered (Kms)	From date	To date
1	Dharamshala	City	148	19-Nov-2024	20-Nov-2024
2	Dharamshala	Hotspot	06 Locations	19-Nov-2024	20-Nov-2024

Table-1: Drive test summary

2.2 Drive test routes

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

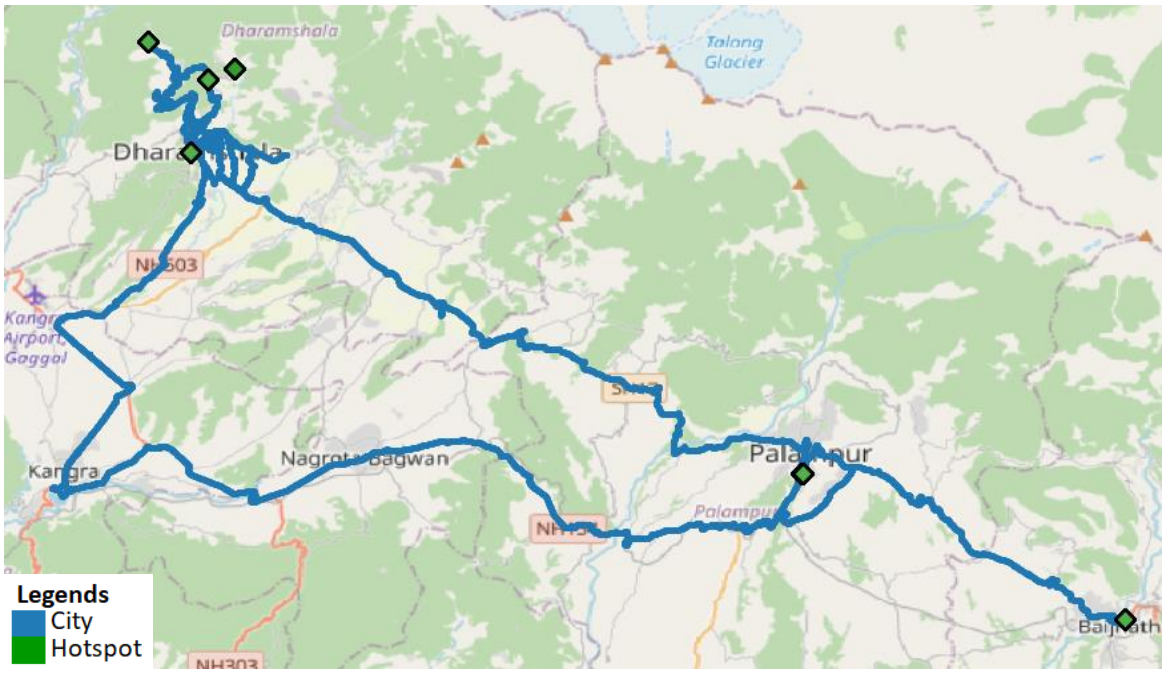


Figure-1: Drive test routes

2.3 Summary of areas covered

a) City- Dharamshala nearby Locations – Mcleodganj, Kotwali Bazar, Ram Nagar, Upper Shyam Nagar and Civil Line. Palampur nearby Locations – Ram Chowk and Nihang. Kangra nearby Locations – Tehsil Chowk and Mapel Leaf Hospital. Connecting roads Dharamshala to Baijnath Via Palampur and Palampur to Dharamshala Via Nagrota Bagwan and Kangra.

b) Hotspot-

1. Baijnath Temple, Baijnath
2. Bhagsu, Dharamshala
3. Maximus Mall, Dharamshala
4. Mcleodganj Market, Dharamshala
5. Naddi, Dharamshala
6. Palampur Market, Palampur

2.4 Telecom service providers detected frequency bands

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

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

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

Note-

- NA - Frequency band not detected during data collection.

QoS Performance Analysis- Himachal Pradesh LSA

3. QoS performance analysis-LSA level

3.1 Overview

This section provides summary of overall QoS performance of the telecom service provider's network in the LSA by aggregating the results of drive tests conducted in the LSA during November-2024 covering city and hotspots. (Refer Table-1)

3.2 Voice performance

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

Parameters	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
Call Attempts	213	216	204
Call Setup Success Rate %	99.53	100.00	99.51
Drop Call Rate%	0.00	0.93	0.00
Call Setup Time-Average (Second)	3.04	2.67	5.12
Handover Success Rate %	99.54	99.88	98.20

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

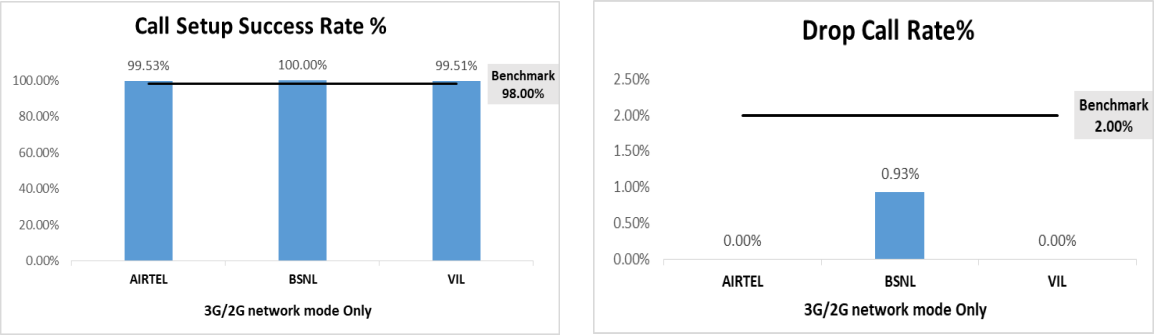


Figure-2: Call setup success rate and drop call rate performance

Number of unique cell ids covered in Voice call test- Technology wise			
Technology	Service Provider		
	3G/2G network mode only		
	AIRTEL	BSNL	VIL
3G	NA	33	NA
2G	244	47	161

Table-4: Technology wise number of network cell id's latched during drive test

Note-
- RJIL does not have 3G/2G network.
- NA- Service provider doesn't provide services in respective technology.

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	274	271	279	277
Call Setup Success Rate %	100.00	95.94	100.00	98.92
Drop Call Rate%	0.00	0.00	0.36	0.00
Call Setup Time-Average (Second)	1.20	3.77	0.96	2.09
Handover Success Rate %	96.89	99.83	97.14	96.90

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

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	210	219	217	211
Number of calls silent for >4 Sec	1	NA	0	1
Silence Call Rate %	0.48	NA	0.00	0.47
Number of silence instances for >4 Sec	1	NA	0	1
Number of silence instances for >3 Sec	4	NA	2	3
Number of silence instances for >2 sec	8	NA	6	9
RTP Jitter (4G & 5G) in ms	4.83	NA	9.17	16.12
Packet loss Rate Downlink %	0.25	NA	0.39	0.71
Packet loss Rate Uplink %	0.38	NA	0.39	0.57

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 BSNL silence instances are not captured.

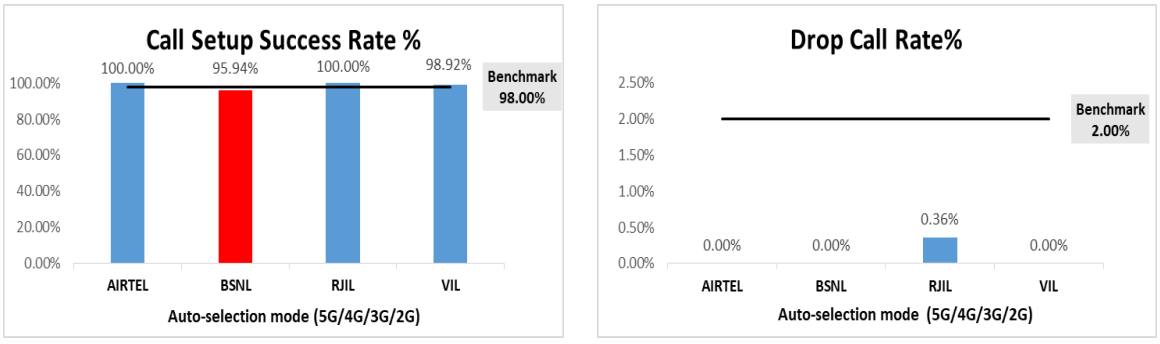


Figure-3: Performance for call setup success rate and drop call rate.

Number of unique cell ids covered in Voice test- Technology wise				
Technology	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	0	NA	228	NA
4G	470	80	455	240
3G	NA	31	NA	NA
2G	0	82	NA	11

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	**BSNL**	**RJIL**	**VIL**
Total Number of MOS Samples for calls in table-6	1248	1088	1170	1231
Speech Quality (Average MOS Score)	4.02	3.02	3.90	4.01
Number of samples with MOS ≥ 4 to <5 (Excellent)	1023	0	797	868
Number of samples with MOS ≥ 3 to <4(Good)	202	729	308	325
Number of samples with MOS ≥ 2 to <3 (Fair)	17	295	50	24
Number of samples with MOS ≥ 1 to <2 (Poor)	6	64	15	14
%age of samples with MOS ≥ 4 to <5 (Excellent)	81.97%	0.00%	68.12%	70.51%
%age of samples with MOS ≥ 3 to <4(Good)	16.19%	67.00%	26.32%	26.40%
%age of samples with MOS ≥ 2 to <3 (Fair)	1.36%	27.11%	4.27%	1.95%
%age of samples with MOS ≥1 to <2 (Poor)	0.48%	5.88%	1.28%	1.14%

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

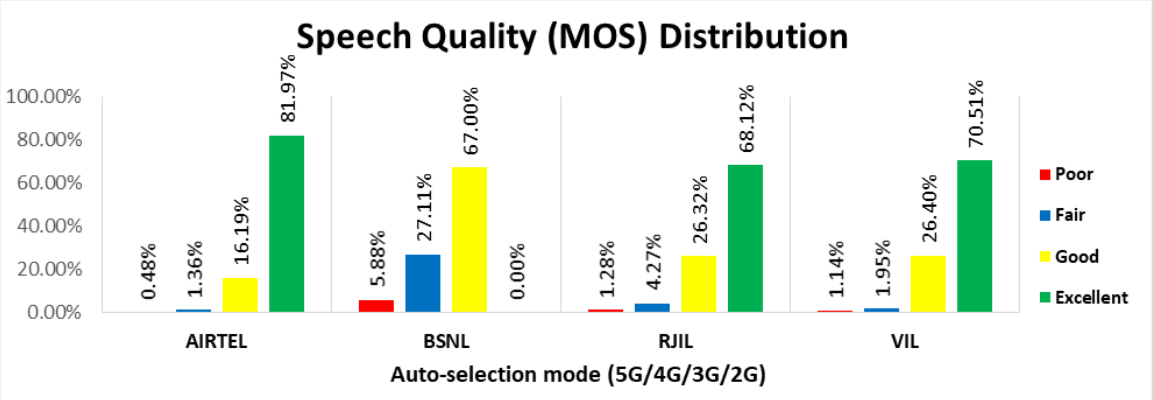


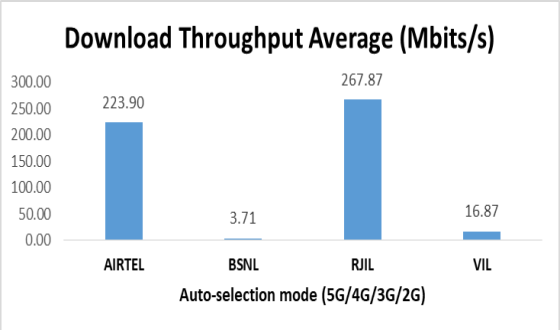
Figure- 4: Distribution of samples in MOS score range

3.3 Data performance

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

Parameters		Service Provider			
		Auto-selection mode (5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	223.90	3.71	267.87	16.87
	80th Percentile	348.70	4.61	478.54	24.92
	20th Percentile	57.40	0.72	43.86	6.74
Upload Throughput (Mbits/s)	Average	25.47	2.89	23.71	5.78
	80th Percentile	43.59	3.36	41.16	7.98
	20th Percentile	6.19	1.25	4.14	2.58
Ping (ms)	Average	23.55	189.45	31.23	48.62

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



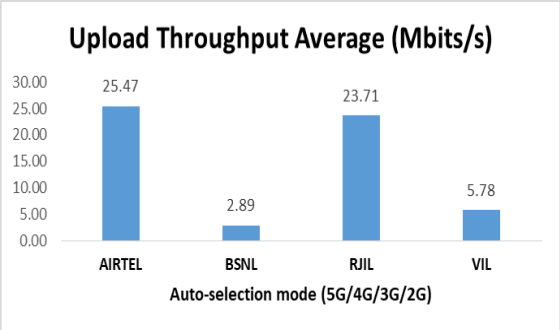


Figure- 5: Download and upload throughput

Number of unique cell ids covered in Data test- Technology wise				
Technology	Service Provider			
	Auto-selection mode 5G/4G/3G/2G			
	AIRTEL	BSNL	RJIL	VIL
5G	0	NA	273	NA
4G	470	74	179	230
3G	NA	62	NA	NA
2G	0	4	NA	8

Table-10: Technology wise number of network cell ids latched during drive test

Note-
- NA- Service provider doesn't provide services in respective technology.
- 0- No calls were found on 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 and Hotspots 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 19th November 2024 to 20th November 2024 in Dharamshala. (Refer Table-1)

4.2.1 Drive test route

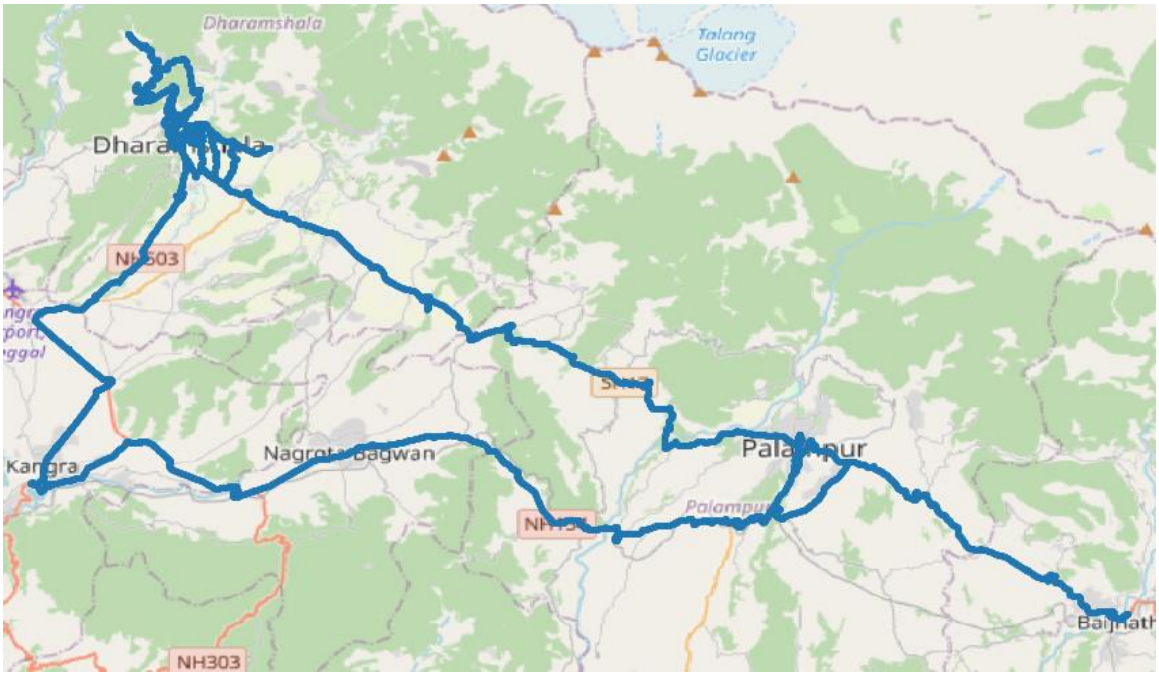


Figure- 6: Drive test routes

4.2.2 Areas covered

Dharamshala nearby Locations – Mcleodganj, Kotwali Bazar, Ram Nagar, Upper Shyam Nagar and Civil Line.
Palampur nearby Locations – Ram Chowk and Nihang.
Kangra nearby Locations – Tehsil Chowk and Mapel Leaf Hospital.

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	213	216	204
Call Setup Success Rate %	99.53	100.00	99.51
Drop Call Rate%	0.00%	0.93%	0.00%
Call Setup Time-Average (Second)	3.04	2.67	5.12
Handover Success Rate %	99.54	99.88	98.20

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

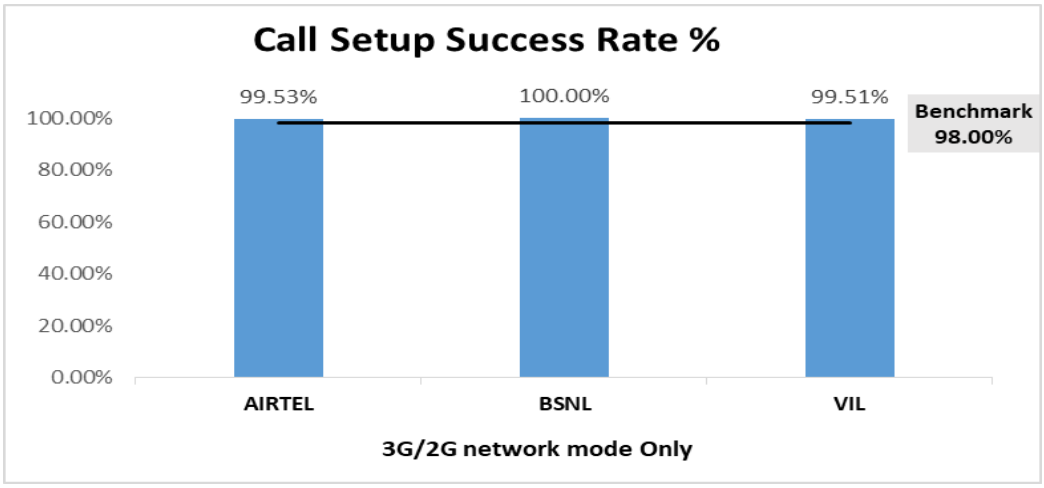


Figure-7: Performance for call setup success rate

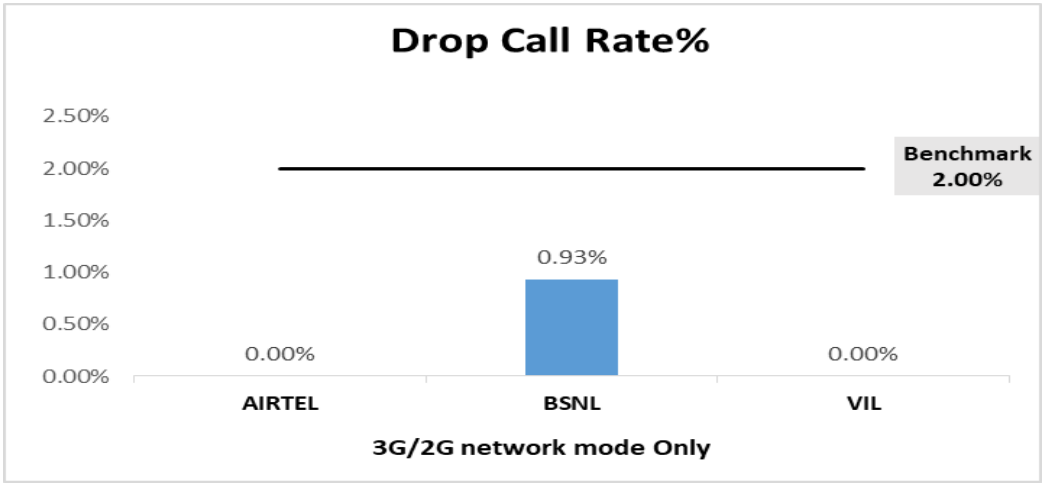


Figure-8: Performance for drop call rate

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

Technology	Service Provider		
	AIRTEL	**BSNL**	**VIL**
3G	NA	80.98%	NA
2G	100.00%	19.02%	100.00%
Limited Service	0.00%	0.00%	0.00%

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

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

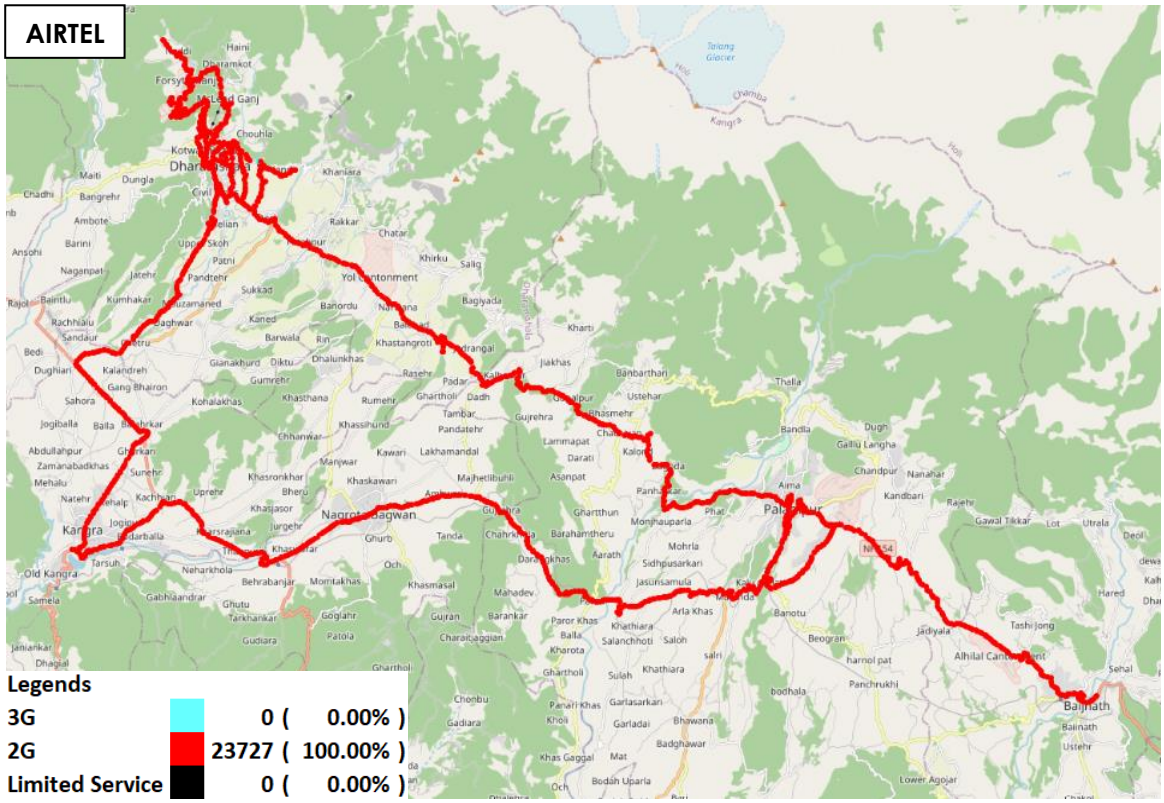


Figure-9: Serving technology plots 3G/2G network mode - AIRTEL

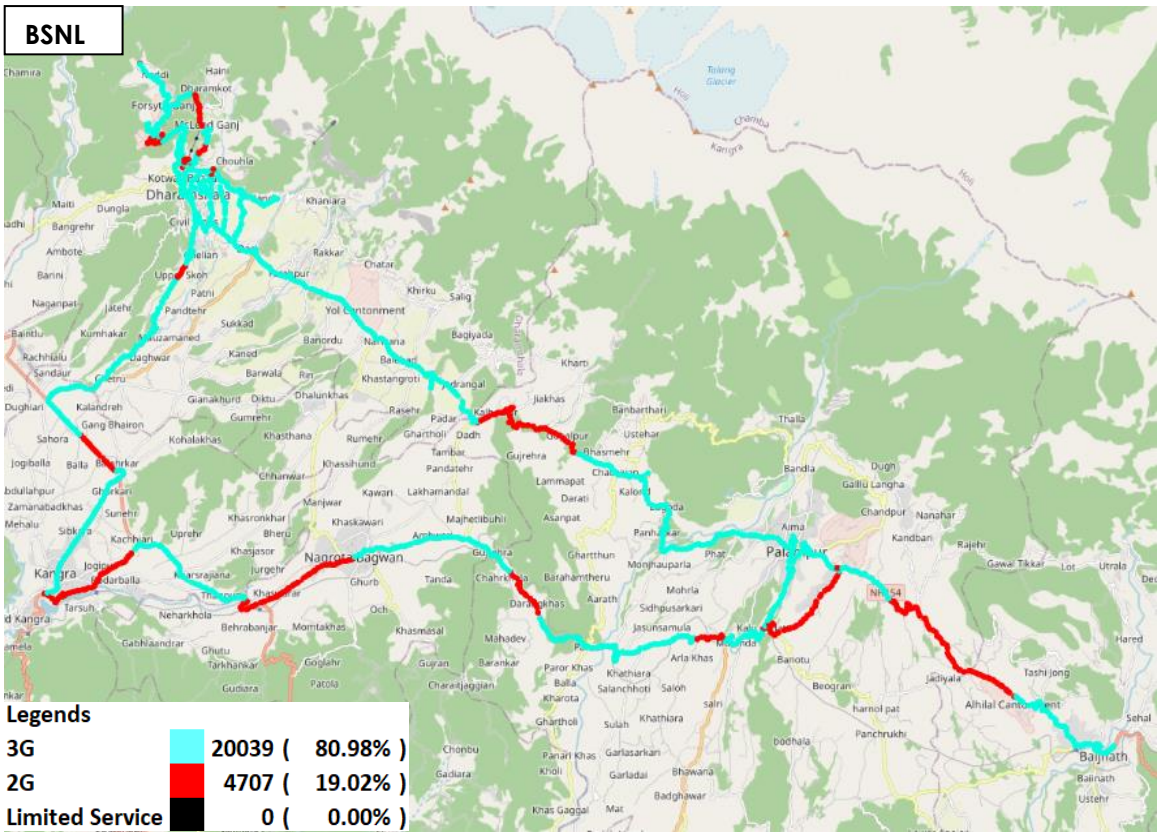


Figure-10: Serving technology plots 3G/2G network mode – BSNL

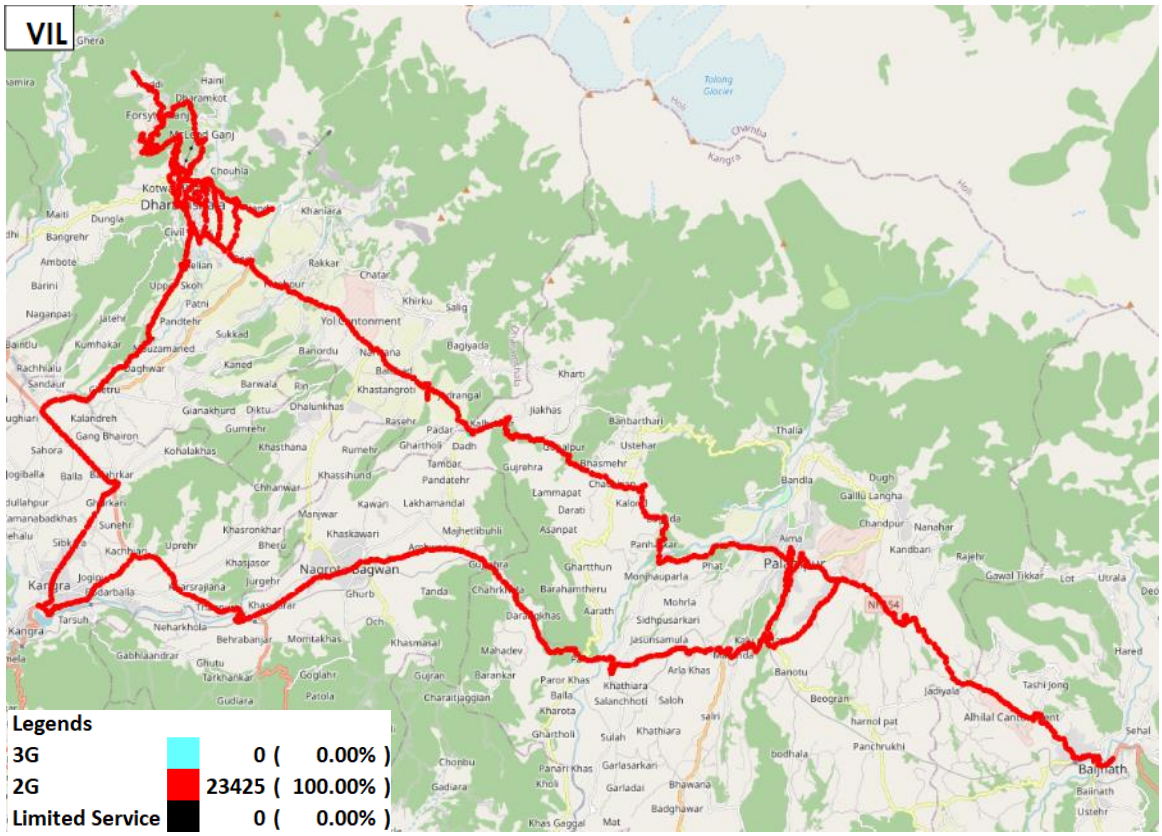


Figure-11: Serving technology plots 3G/2G network mode –VIL

(c) Network Signal Strength distribution: The following chart represents signal strength distribution for 3G/2G network mode only. (Refer figure-23, 24, and 25 for map view)

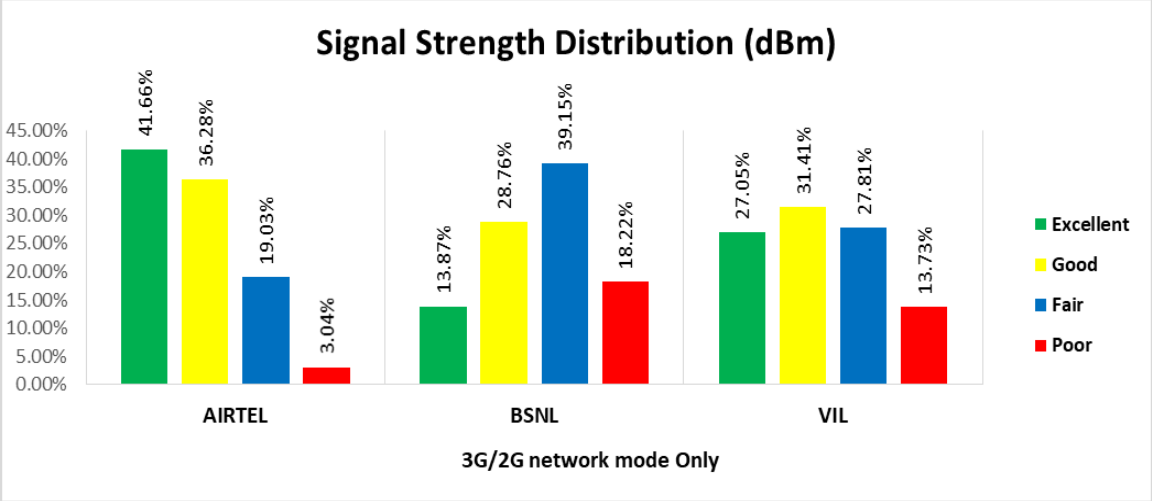


Figure-12: Signal strength distribution 3G/2G network mode only

Observations:

- Airtel's 42% of samples falling in excellent signal strength category.
- BSNL's has 14% of samples falling in excellent signal strength category.
- VIL's has 27% of samples falling in excellent signal strength category.

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	214	211	219	217
Call Setup Success Rate %	100.00	96.68	100.00	99.08
Drop Call Rate%	0.00	0.00	0.46	0.00
Call Setup Time Average (Second)	1.19	3.68	1.05	2.11
Handover Success Rate %	96.89	99.83	97.14	96.90

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

Parameter	Service Provider			
	Mobile-to-Mobile (5G/4G - Open Mode)			
	AIRTEL	BSNL	RJIL	VIL
Call Established (within service provider Network)	210	219	217	211
Number of silence call for >4 Sec	1	NA	0	1
Silence Call Rate %	0.48	NA	0.00	0.47
Number of silence instances for >4 Sec	1	NA	0	1
Number of silence instances for >3 Sec	4	NA	2	3
Number of silence instances for >2 sec	8	NA	6	9
RTP Jitter (4G & 5G) in ms	4.83	NA	9.17	16.12
Packet loss Rate Downlink %	0.25	NA	0.39	0.71
Packet loss Rate Uplink %	0.38	NA	0.39	0.57

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

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

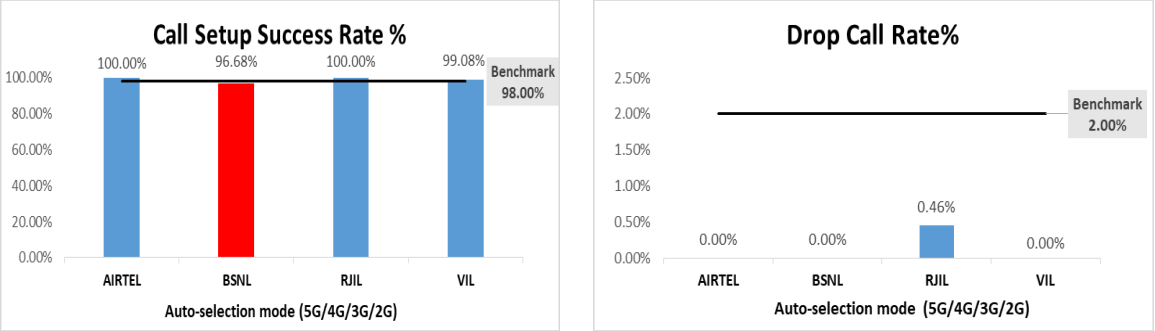


Figure-13: Performance for call setup success rate and Drop call rate.

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

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

Speech Quality (MOS) distribution	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
Total Number of MOS Samples for calls in table-14	1248	1088	1170	1231
Speech Quality (Average MOS Score)	4.02	3.02	3.90	4.01
Number of samples with MOS >=4 to <5 (Excellent)	1023	0	797	868
Number of samples with MOS >=3 to <4(Good)	202	729	308	325
Number of samples with MOS >=2 to <3 (Fair)	17	295	50	24
Number of samples with MOS >=1 to <2 (Poor)	6	64	15	14
%age of samples with MOS >=4 to <5 (Excellent)	81.97%	0.00%	68.12%	70.51%
%age of samples with MOS >=3 to <4(Good)	16.19%	67.00%	26.32%	26.40%
%age of samples with MOS >=2 to <3 (Fair)	1.36%	27.11%	4.27%	1.95%
%age of samples with MOS >=1 to <2 (Poor)	0.48%	5.88%	1.28%	1.14%

Table-15: Summary of speech quality (MOS) samples

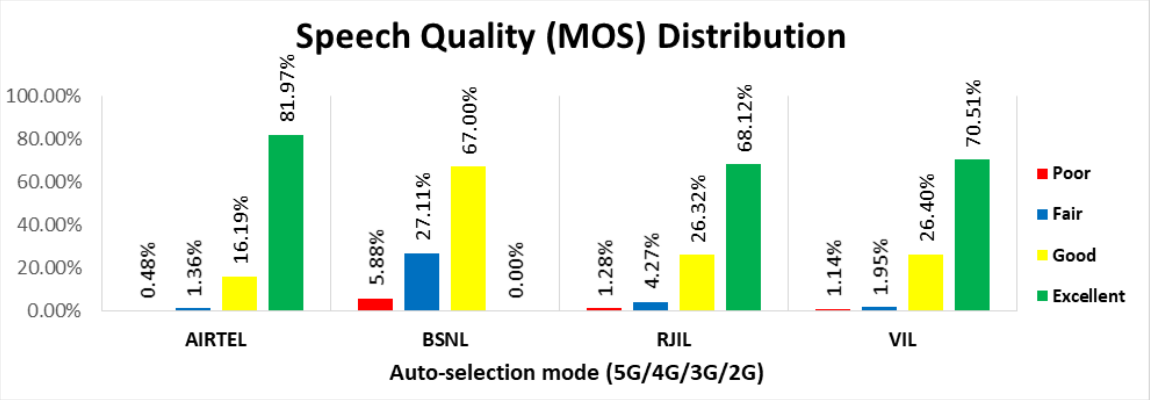


Figure-14: Distribution of samples in MOS score range

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

Technology	Service Provider			
	AIRTEL	BSNL	RJIL	VIL
5G	1.85%	NA	17.85%	NA
4G	98.15%	2.79%	82.15%	97.63%
3G	NA	54.22%	NA	NA
2G	0.00%	40.19%	NA	2.37%
Limited Service	0.00%	2.80%	0.00%	0.00%

Table-16: Time spent on technology during drive test

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

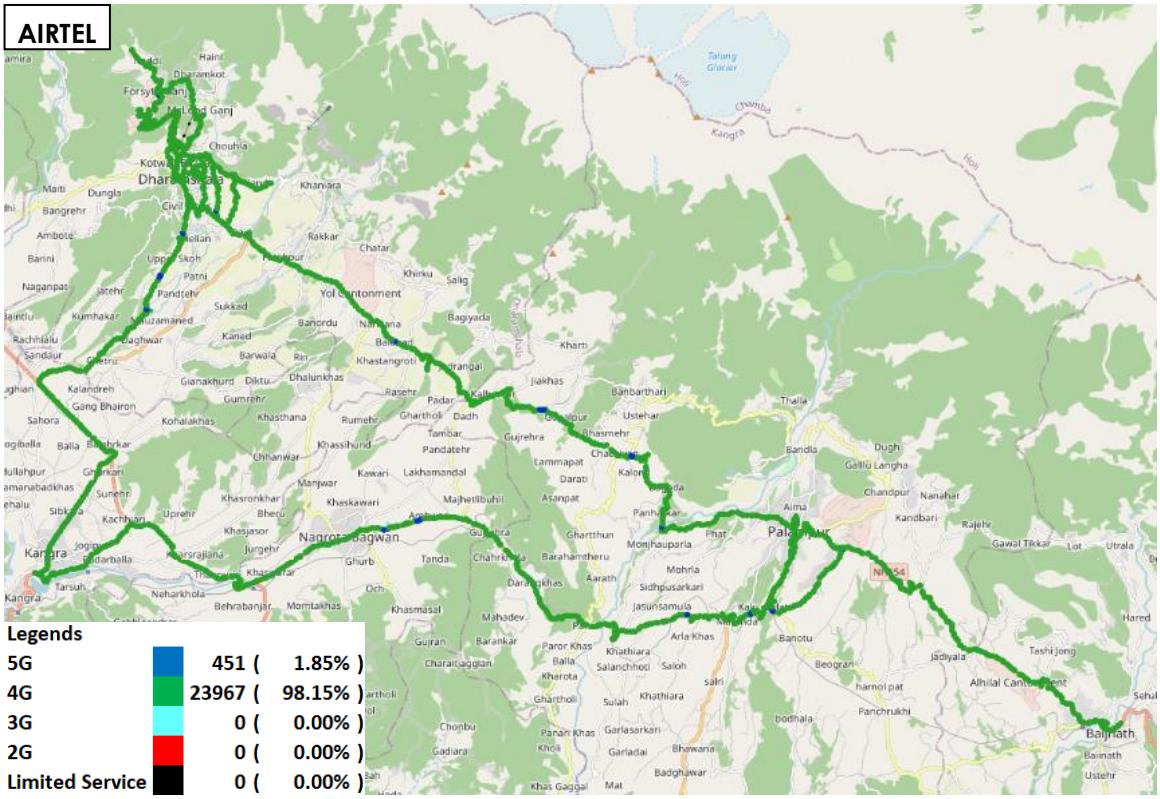


Figure-15: Serving technology plots in auto-selection mode (5G/4G/3G/2G) –Airtel

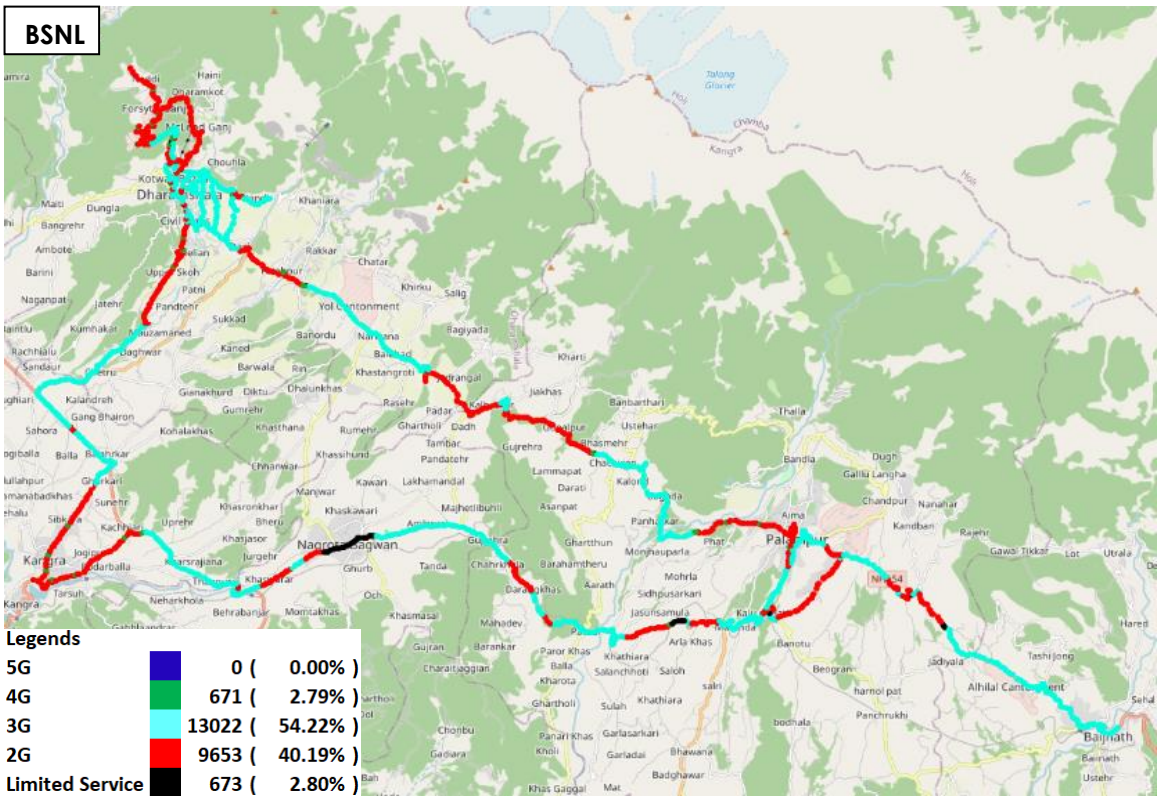


Figure-16: Serving technology plots in auto-selection mode (5G/4G/3G/2G) -BSNL

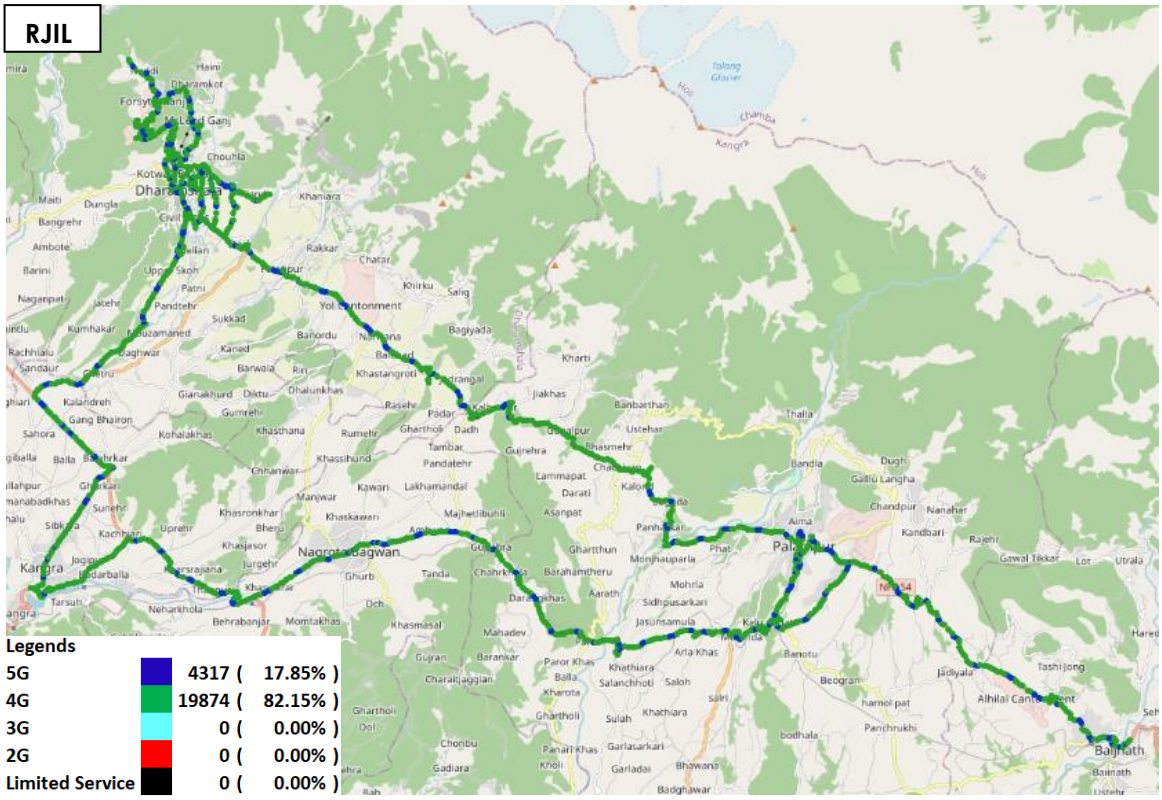


Figure-17: Serving technology plots in auto-selection mode (5G/4G/3G/2G)- RJIL

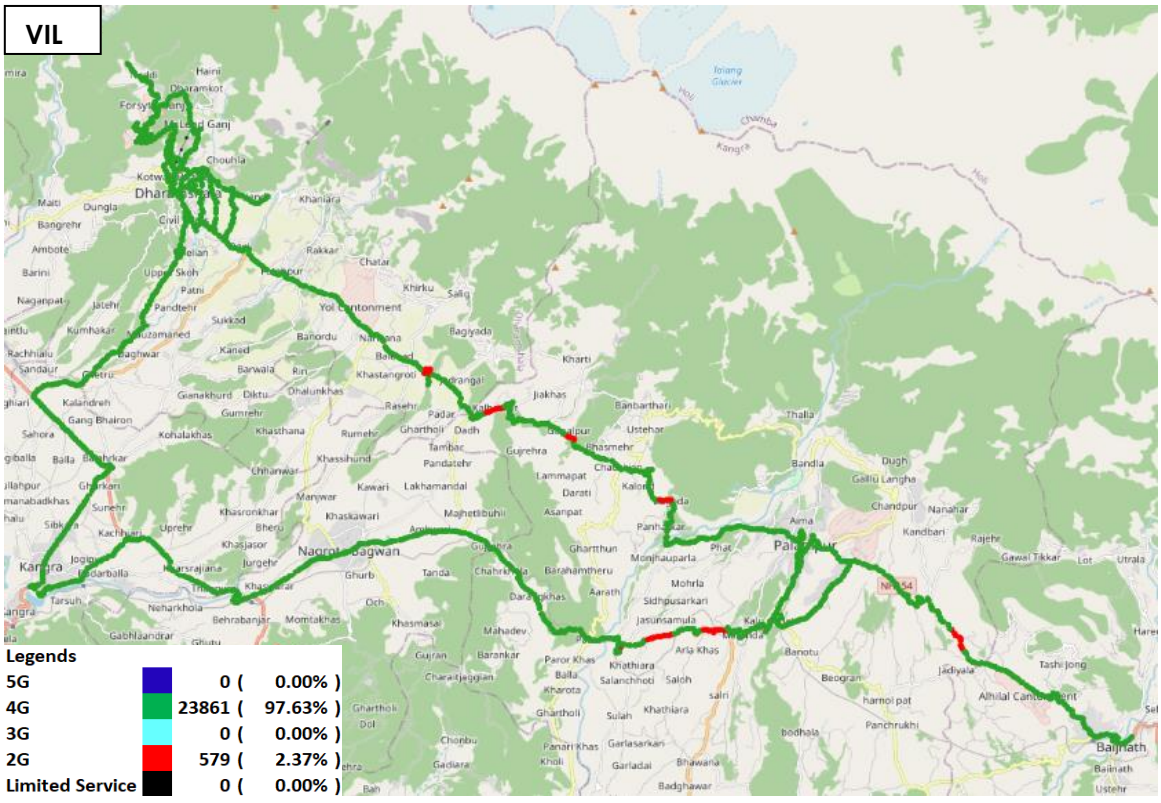


Figure-18: Serving technology plots in auto-selection mode (5G/4G/3G/2G) - VIL

(g) Network Signal Strength distribution: The following chart provide signal strength distribution for auto-selection mode (5G/4G/3G/2G). (Refer figure-26, 27, 28 & 29 for map view).

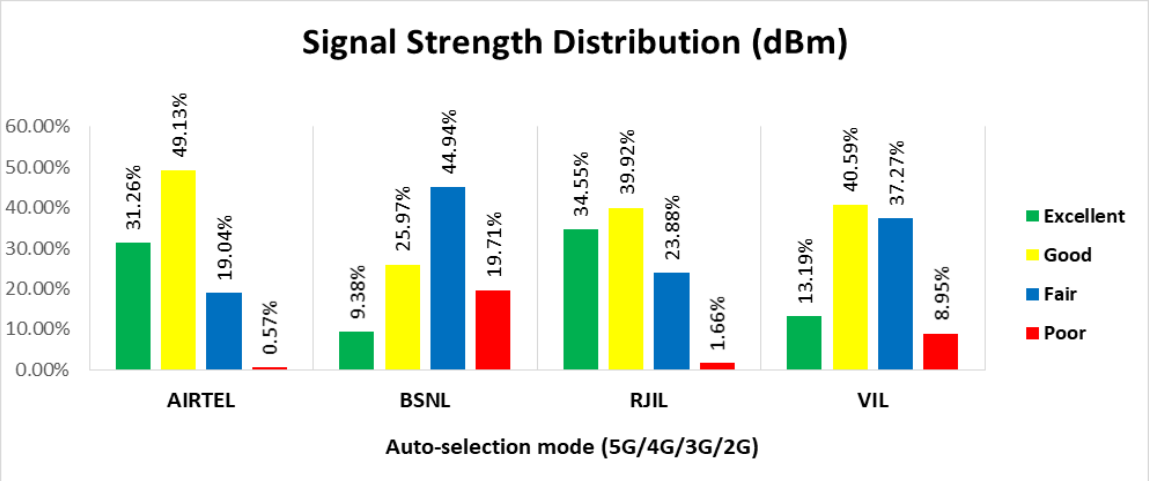


Figure-19: Signal strength distribution auto-selection mode 5G/4G/3G/2G

Observations:

- Airtel has 31% samples falling in excellent signal strength category.
- BSNL has 09% samples falling in excellent signal strength category.
- RJIL has 35% samples falling in excellent signal strength category.
- VIL has 13% samples falling in excellent signal strength category.

4.2.4 Data performance

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

Parameters		Service Provider			
		Auto-selection mode(5G/4G/3G/2G)			
		AIRTEL	BSNL	RJIL	VIL
Download Throughput (Mbits/s)	Average	209.63	3.31	255.75	16.48
	80th Percentile	313.07	4.66	422.60	24.48
	20th Percentile	45.59	0.68	43.65	6.41
Upload Throughput (Mbits/s)	Average	22.60	2.67	22.96	5.55
	80th Percentile	37.70	3.29	40.23	7.91
	20th Percentile	6.00	1.23	4.14	2.43
Ping (ms)	Average	28.49	372.40	34.80	63.48

Table-17: Summary of Data performance in network auto-selection mode

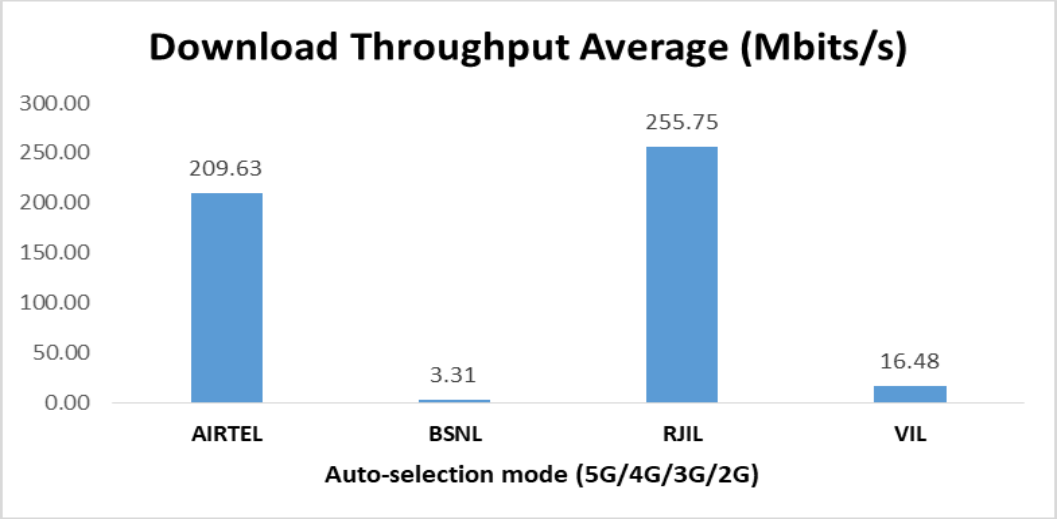


Figure- 20: Download throughput

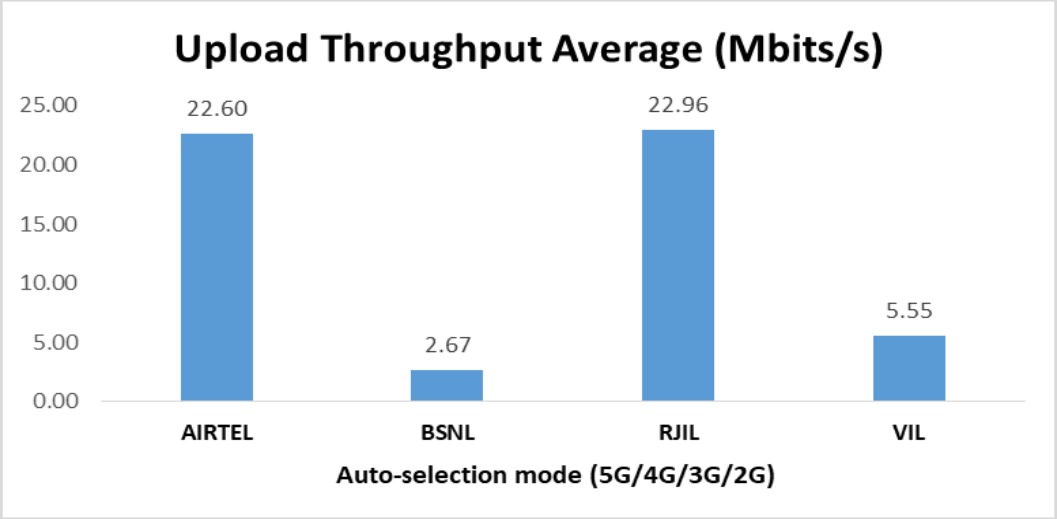


Figure- 21: Upload throughput

4.3 Hotspots

Hotspot testing has been done on 19th and 20th November 2024. Six locations have been tested across the covered route.

4.3.1 Locations

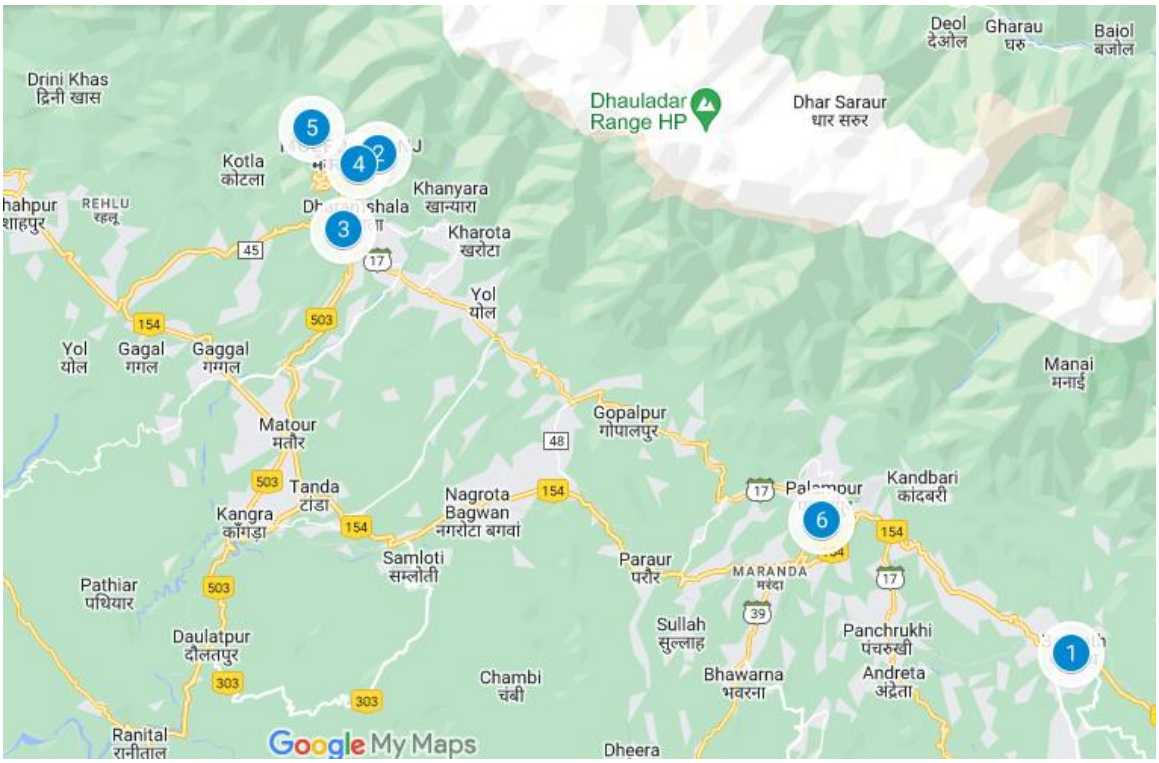


Figure- 22: Hotspot locations

4.3.2 Hotspot covered

1. Baijnath Temple, Baijnath
2. Bhagsu, Dharamshala
3. Maximus Mall, Dharamshala
4. Mcleodganj Market, Dharamshala
5. Naddi, Dharamshala
6. Palampur Market, Palampur

4.3.3 Voice performance

Overall Voice Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	60	60	60	60
Call Setup Success Rate %	100.00	93.33	100.00	98.33
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.22	4.08	0.64	2.04

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

Baijnath Temple, Baijnath				
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)	1.18	2.13	0.63	2.03

Table-19: Summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Bhagsu, Dharamshala				
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)	1.18	8.10	0.59	2.02

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

Maximux Mall, Dharamshala				
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	70.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.25	5.03	0.57	2.04

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

Mcleodganj Market				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.31	2.20	0.66	2.12

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

Naddi, Dharamshala				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.21	4.79	0.70	2.01

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

Palampur Market, Palampur				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	90.00	100.00	90.00
Drop Call Rate%	0.00	0.00	0.00	0.00
Call Setup Time-Average (Sec)	1.18	2.34	0.68	2.00

Table-24: 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)	363.34	6.65	367.00	20.10
Download Throughput 80th Percentile (Mbit/s)	586.88	3.32	530.73	28.17
Download Throughput 20th Percentile (Mbit/s)	138.14	0.93	250.06	8.56
Download Session Setup Success Rate %	100.00	93.33	93.33	100.00
Upload Throughput Average (Mbits/s)	52.65	4.44	29.57	7.67
Upload Throughput 80th Percentile (Mbit/s)	86.24	4.32	45.14	8.46
Upload Throughput 20th Percentile (Mbit/s)	24.81	1.67	11.04	5.66
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	3.03	6.51	3.11	3.50
Youtube Initial Buffer Delay (Second)	1.04	4.23	0.69	0.89
Ping (ms)	17.85	31.69	27.91	33.88
Jitter (ms)	7.16	10.31	17.60	2.69
Packet Loss Rate-Ping %	0.47	1.87	2.50	1.10

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

Baijnath Temple, Baijnath				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	148.99	0.85	300.62	22.91
Download Session Setup Success Rate %	100.00	100.00	80.00	100.00
Upload Throughput Average (Mbits/s)	47.18	2.69	40.25	7.32
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.60	5.26	2.73	3.15
Youtube Initial Buffer Delay (Second)	0.72	7.45	0.72	0.74
Ping (ms)	14.26	40.66	26.46	30.90
Jitter (ms)	2.27	22.50	12.56	3.43
Packet Loss Rate-Ping %	0.20	6.10	0.60	1.20

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

Bhagsu, Dharamshala				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	476.55	2.77	12.22	9.25
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	25.10	3.24	3.47	2.99
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	3.03	5.24	4.37	4.60
Youtube Initial Buffer Delay (Second)	0.58	2.26	0.95	1.39
Ping (ms)	17.22	37.83	52.00	39.70
Jitter (ms)	2.86	10.18	65.14	2.77
Packet Loss Rate-Ping %	0.00	4.00	14.40	1.50

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

Maximux Mall, Dharamshala				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	623.48	29.46	522.33	7.22
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	92.43	14.22	30.68	6.47
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.59	4.42	2.87	3.57
Youtube Initial Buffer Delay (Second)	0.57	2.28	0.58	1.07
Ping (ms)	17.46	27.38	18.81	36.54
Jitter (ms)	2.95	4.21	6.70	3.77
Packet Loss Rate-Ping %	0.00	0.00	0.00	1.10

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

Mcleodganj Market, Dharamshala				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	572.12	2.25	447.13	19.29
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	57.89	2.12	12.64	8.42
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.85	9.16	2.80	3.20
Youtube Initial Buffer Delay (Second)	0.60	4.42	0.52	0.68
Ping (ms)	17.60	27.13	19.11	35.23
Jitter (ms)	2.84	10.54	7.12	1.72
Packet Loss Rate-Ping %	0.00	0.10	0.00	0.70

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

Naddi, Dharamshala				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average(Mbits/s)	83.28	1.73	417.42	45.84
Download Session Setup Success Rate %	100.00	60.00	100.00	100.00
Upload Throughput Average (Mbits/s)	6.64	2.35	20.04	7.45
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.68	6.29	3.06	3.52
Youtube Initial Buffer Delay (Second)	3.04	5.13	0.65	0.69
Ping (ms)	26.42	31.12	23.04	30.41
Jitter (ms)	30.43	4.59	6.56	2.69
Packet Loss Rate-Ping %	2.60	0.80	0.00	0.80

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

Palampur Market, Palampur				
Parameters	**Service Provider**			
	Auto Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	275.64	0.85	519.50	16.10
Download Session Setup Success Rate %	100.00	100.00	80.00	100.00
Upload Throughput Average (Mbits/s)	86.67	2.05	70.31	13.37
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	2.40	9.79	2.86	2.98
Youtube Initial Buffer Delay (Second)	0.70	5.58	0.74	0.80
Ping (ms)	14.13	26.22	28.02	30.53
Jitter (ms)	1.60	9.80	7.51	1.76
Packet Loss Rate-Ping %	0.00	0.20	0.00	1.30

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

5. Voice & Data Key findings

5.1 Overall Voice

1. **Call setup success rate:**
   a) Airtel, BSNL, RJIL and VIL have 100.00%, 95.94%, 100.00% and 98.92% call setup success rate respectively.
   b) Airtel and RJIL have a 100.00% call setup success rate on hotspots.

2. **Call Setup time**: Owing to circuit switched network (3G/2G), BSNL has taken comparatively longer time (3.77 second) to establish the voice call, whereas Airtel, RJIL and VIL call setup time is 1.20, 0.96 & 2.09 second respectively in Auto-selection mode (5G/4G/3G/2G).

3. **Call Silence/Mute Rate**: In packet switched network (4G/5G), Airtel, RJIL and VIL have 0.48%, 0.00% and 0.47% silence call rate respectively. Further VIL has higher RTP packet loss rate in downlink (0.71%) compared to Airtel (0.25%) and RJIL (0.39%). In uplink the RTP packet loss rate is higher for VIL (0.57%) compared to RJIL (0.39%) and Airtel (0.38%).

4. **Call Drop Rate**:
   a) Overall RJIL call drop rate (0.36%) is lower than (QoS benchmark of 2%), while Airtel, BSNL and VIL have 0.00% drop call rate respectively.
   b) At hotspots all service providers have 0.00% call drop rate.

5.2 Overall Data

1. **Data download and upload performance (Dynamic i.e. while moving):**
   a) BSNL (3.71 Mbps) and VIL (16.87 Mbps) being on 3G & 4G as top technology respectively, have comparatively lower data speeds. While Airtel and RJIL have average download speed of 223.90 Mbps and 267.87 Mbps respectively.

   b) BSNL (2.89 Mbps) and VIL (5.78 Mbps), operating on 3G and 4G technologies respectively, have comparatively lower upload speeds. In contrast, Airtel and RJIL offer faster speeds of 25.47 Mbps and 23.71 Mbps, respectively.

2. **Data download and upload performance (static i.e. while stationary):**
   a) BSNL (6.65 Mbps) and VIL (20.10 Mbps) have lower data download speed at hotspots compared to Airtel and RJIL, which have values of 363.34 Mbps and 367.00 Mbps, respectively.

   b) BSNL (4.44 Mbps) and VIL (7.67 Mbps) have lower data upload speed at hotspots compared to Airtel and RJIL, which have speeds of 52.65 Mbps and 29.57 Mbps, respectively.

3. **Data session setup success rate (static i.e. while stationary):**
   a) Airtel and VIL have a 100% success rate for setting up download sessions. In comparison, BSNL and RJIL have a success rate of 93.33% for download sessions. For upload sessions, Airtel, BSNL, RJIL and VIL have a 100% success rate.

5.3 Operator wise Key Findings

1. Airtel:

Voice

- In 3G/2G network mode, a call setup success rate of 99.53% was observed. The call drop rate of 0.00% is well within the benchmark of 2%. (refer Table 3 and Table 11).

- In auto-selection mode for LSA, 100.00% call setup success rate and 0.00% call drop rate were observed (refer Table-5).

- There is a 100.00% call setup success rate and a 0.00% drop call rate observed for auto-selection mode during city drive (refer Table-13).

Data

- Airtel has an average download throughput of 223.90 Mbps and an average upload throughput of 25.47 Mbps across measured routes for LSA (refer Table-9).
- Airtel has an average download speed of 209.63 Mbps and an average upload speed of 22.60 Mbps across measured routes for the city drive (refer Table-17).
- Among the six hotspots, the Naddi hotspot has reported download speeds of less than 100 Mbps. (refer Table 30)
- Among the six hotspots, the Naddi hotspot's upload speeds are below 10 Mbps. (refer Table 30)

2. BSNL:

Voice

- Call drop rate of 0.93% has been observed in BSNL (refer Table 3 and 11).
- Call block rate of 95.94% in auto-selection mode for LSA is lower than the benchmark of 98.00% (refer Table 5).
- BSNL auto-selection mode call setup success rate is 96.68% which is lower than benchmark of 98.00%. (refer Table-13)
- BSNL drop call rate is 0.00%, which is well within benchmark of 2.00% (refer Table-13)

Data

- BSNL has 3.71 Mbps average download throughput & 2.89 Mbps average upload throughput across measured routes for LSA (refer Table-9)
- BSNL has 3.31 Mbps average download throughput & 2.67 Mbps average upload throughput across measured routes for city drive (refer Table-17)
- All hotspots have less download speeds expect Maximux mall (less than 15 Mbps) out of total 6 hotspots. (refer Table- 26, 27, 29, 30 & 31)
- All hotspots have less upload speed except Maximux mall (less than 5 Mbps). (refer Table- 26, 27, 29, 30 & 31)

3. RJIL:

Voice

- RJIL's call setup success rate stands at 100.00% and drop call rate is 0.36% in auto-selection mode within the LSA. (refer Table-5)

- RJIL's call setup success rate in auto-selection mode during the city drive test is at 100.00% and drop call rate is 0.46%. (refer Table-13)

Data

- RJIL has 267.87 Mbps average download throughput & 23.71 Mbps average upload throughput across measured routes in LSA. (refer Table-9)
- RJIL has 255.75 Mbps average download throughput & 22.96 Mbps average upload throughput across measured routes in city drive. (refer Table-17)
- Among the six hotspots, the Bhagsu hotspot’s download speed are below 100 Mbps (refer table 27)
- Among the six hotspots, the Bhagsu hotspot’s upload speed are below 10 Mbps (refer table 27)

4. VIL:

Voice

- In 3G/2G network mode, a call setup success rate of 99.51% was observed. The call drop rate is 0.00%, is well within the benchmarks of 98% and 2% (refer Table-3 and 11).
- In auto-selection mode in LSA, there was a call setup success rate of 98.92% and a drop call rate of 0.00%. (refer Table-5)
- In auto-selection mode, a call setup success rate of 99.08% was observed, with a drop call rate of 0.00% (refer Table-13).

Data

- VIL has 16.87 Mbps average download throughput & 5.78 Mbps average upload throughput across measured routes in LSA. (refer Table-9)
- VIL has 16.48 Mbps average download throughput & 5.55 Mbps average upload throughput across measured routes in city drive. (refer Table-17)
- Bhagsu and Maximux mall have less download speeds (less than 15 Mbps) out of total 6 hotspots. (refer Table-27 & 28)
- At Bhagsu hotspot upload speed (less than 5 Mbps) out of total 6 hotspots. (refer Table- 27)

6. Annexure

6.1 Route wise coverage map

6.1.1 City

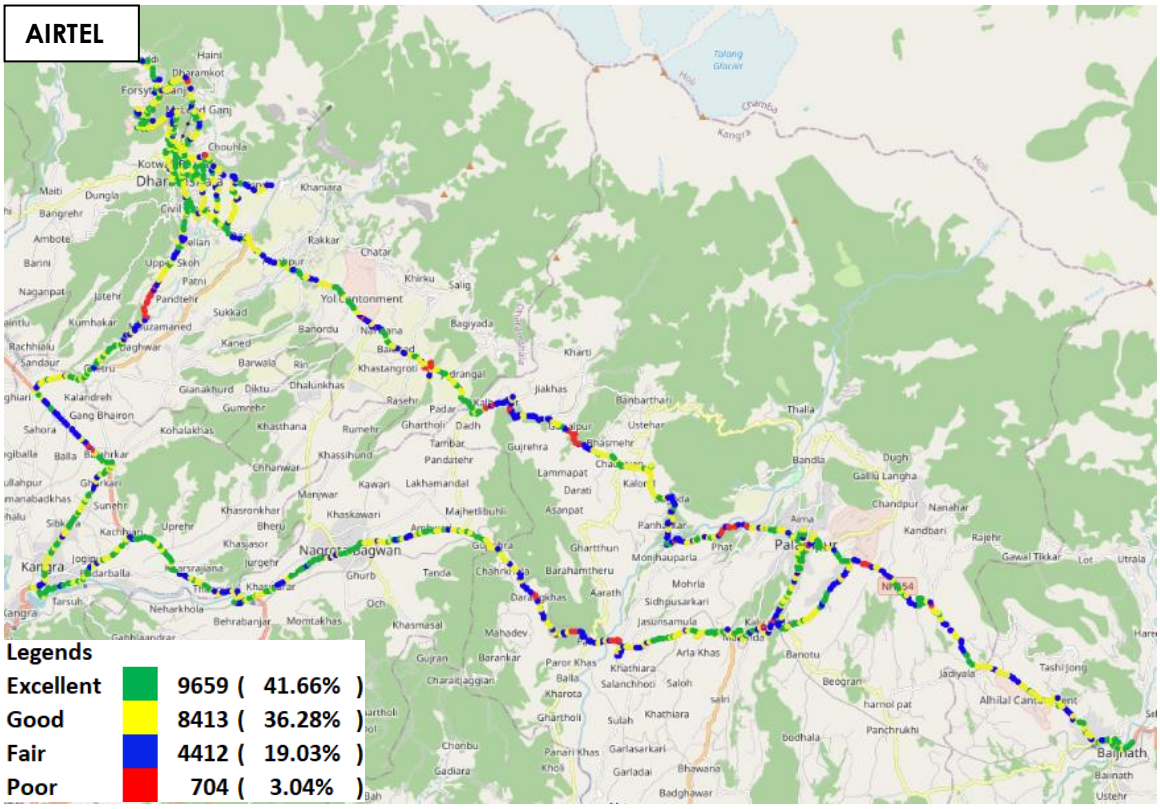

Figure-23: Signal strength 3G/2G network mode – AIRTEL

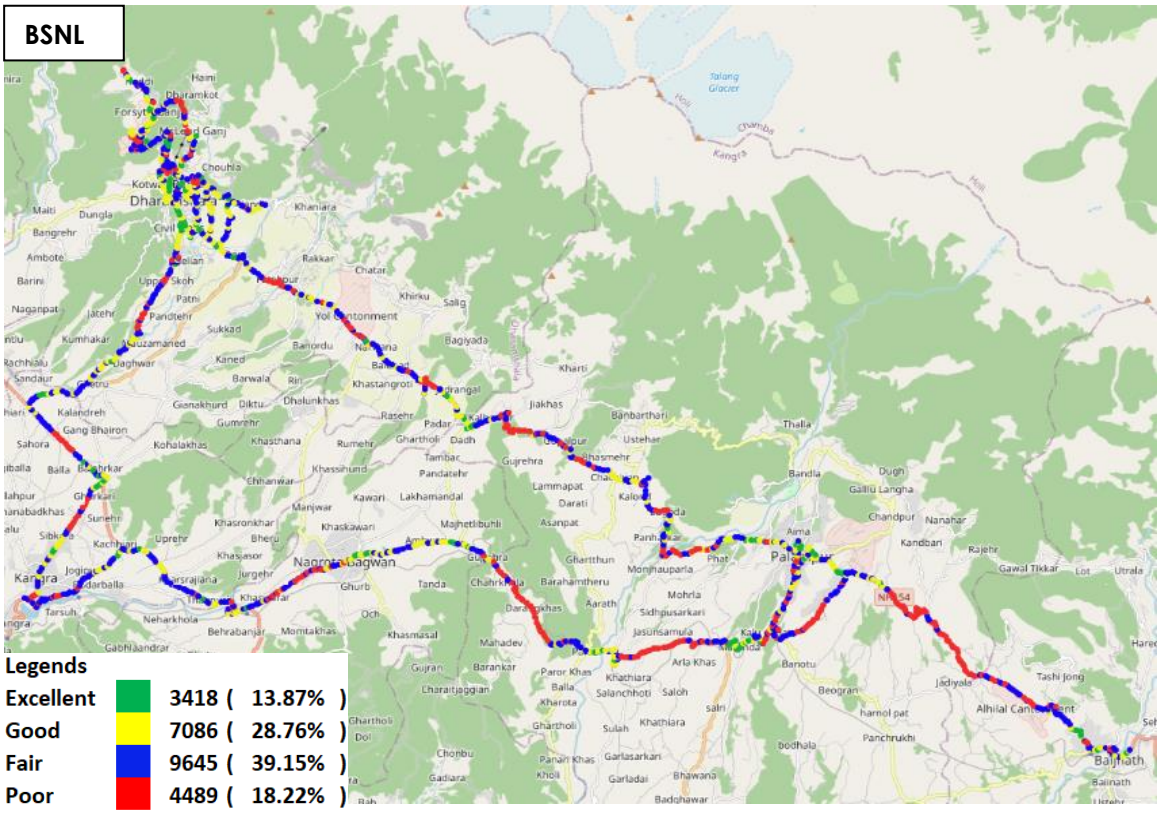

Figure-24: Signal strength 3G/2G network mode - BSNL

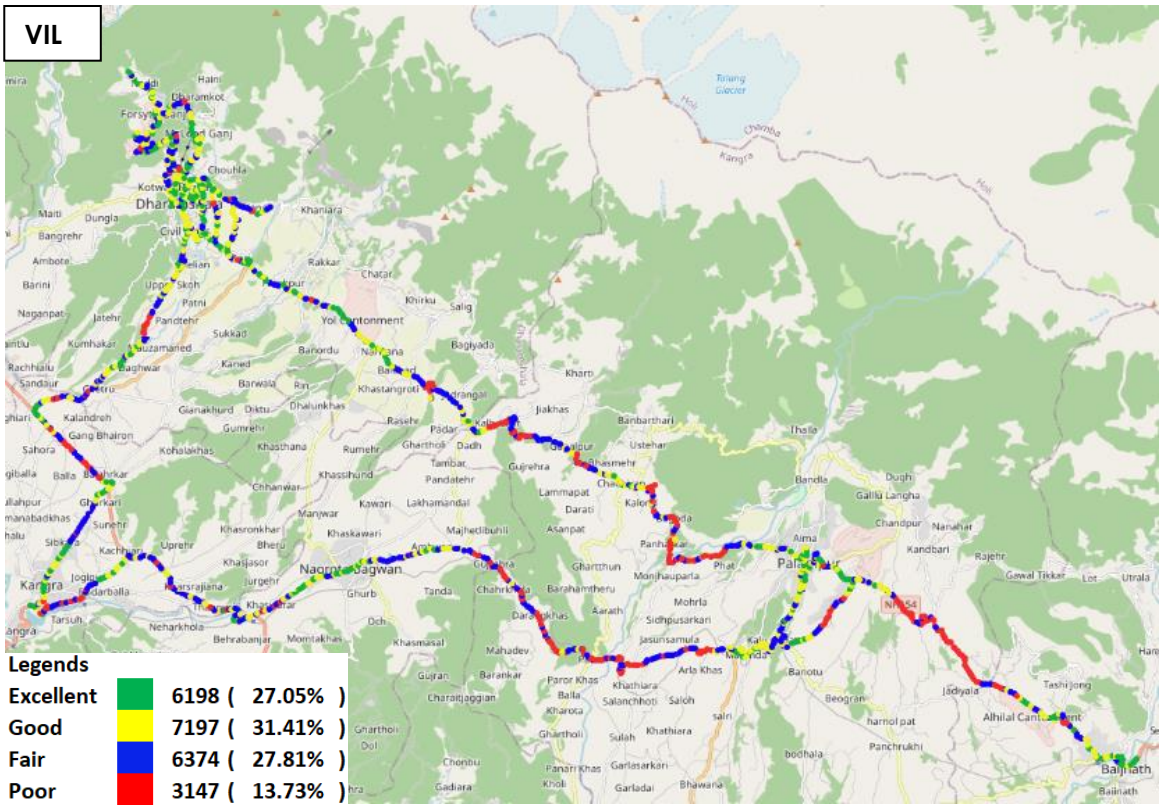

Figure-25: Signal strength 3G/2G network mode - VIL

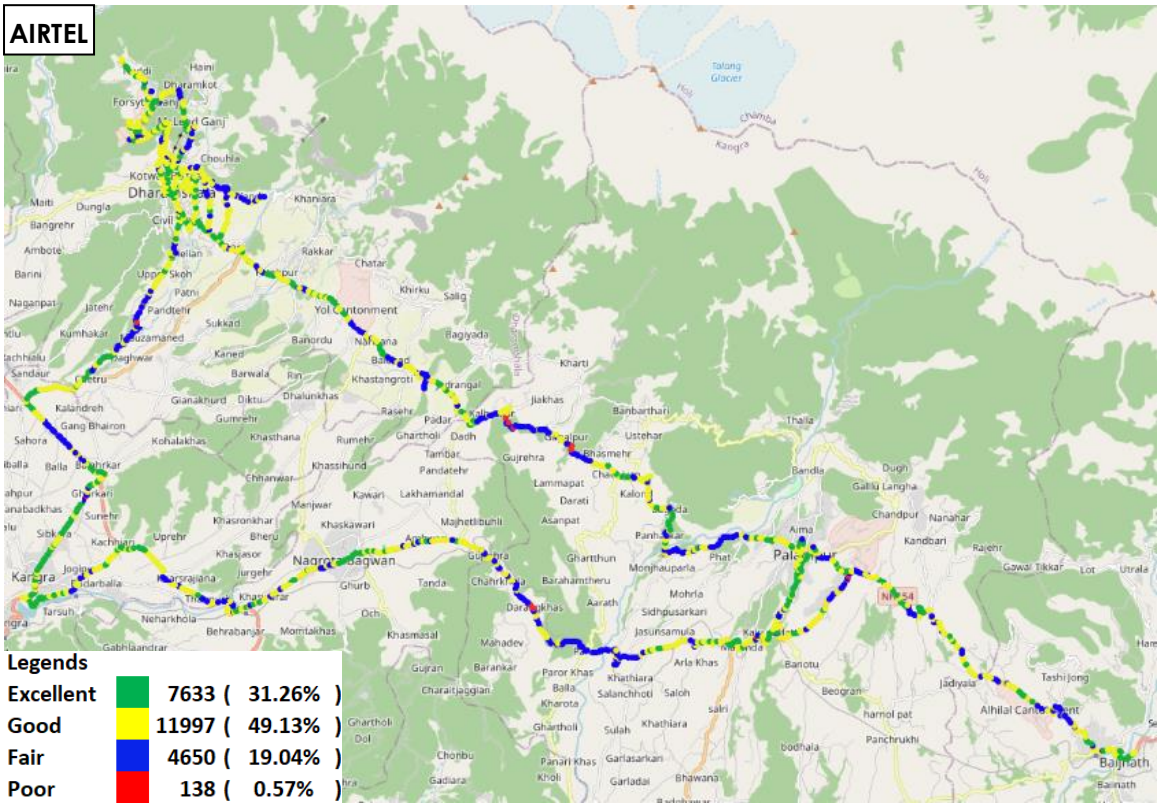

Figure-26: Signal strength auto-selection mode 5G/4G/3G/2G - Airtel

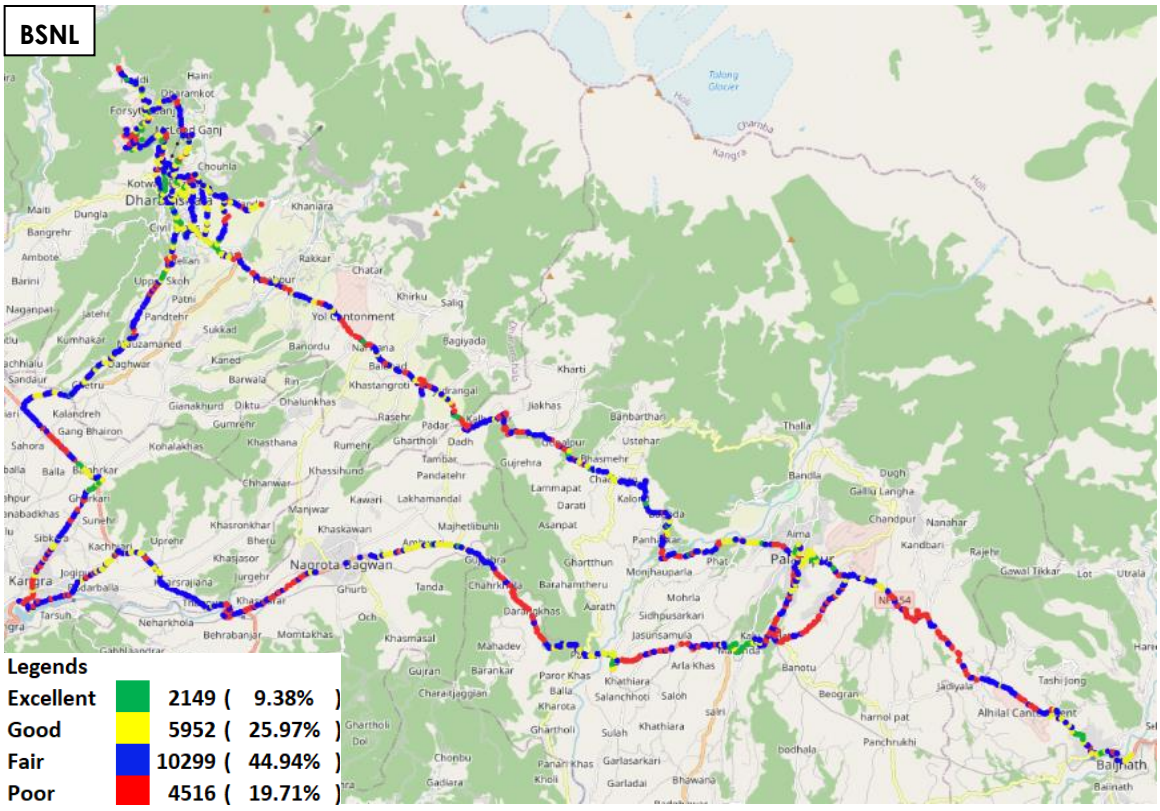

Figure-27: Signal strength auto-selection mode 5G/4G/3G/2G - BSNL

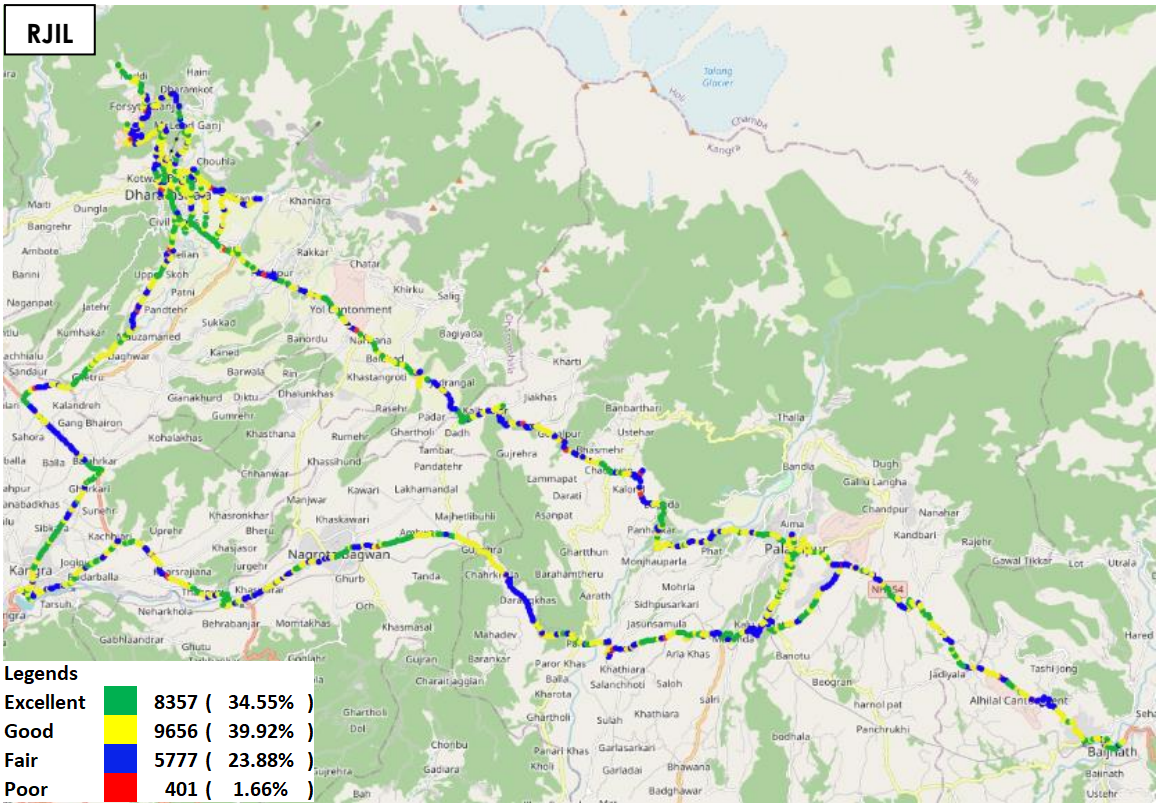

Figure-28: Signal strength auto-selection mode 5G/4G/3G/2G - RJIL

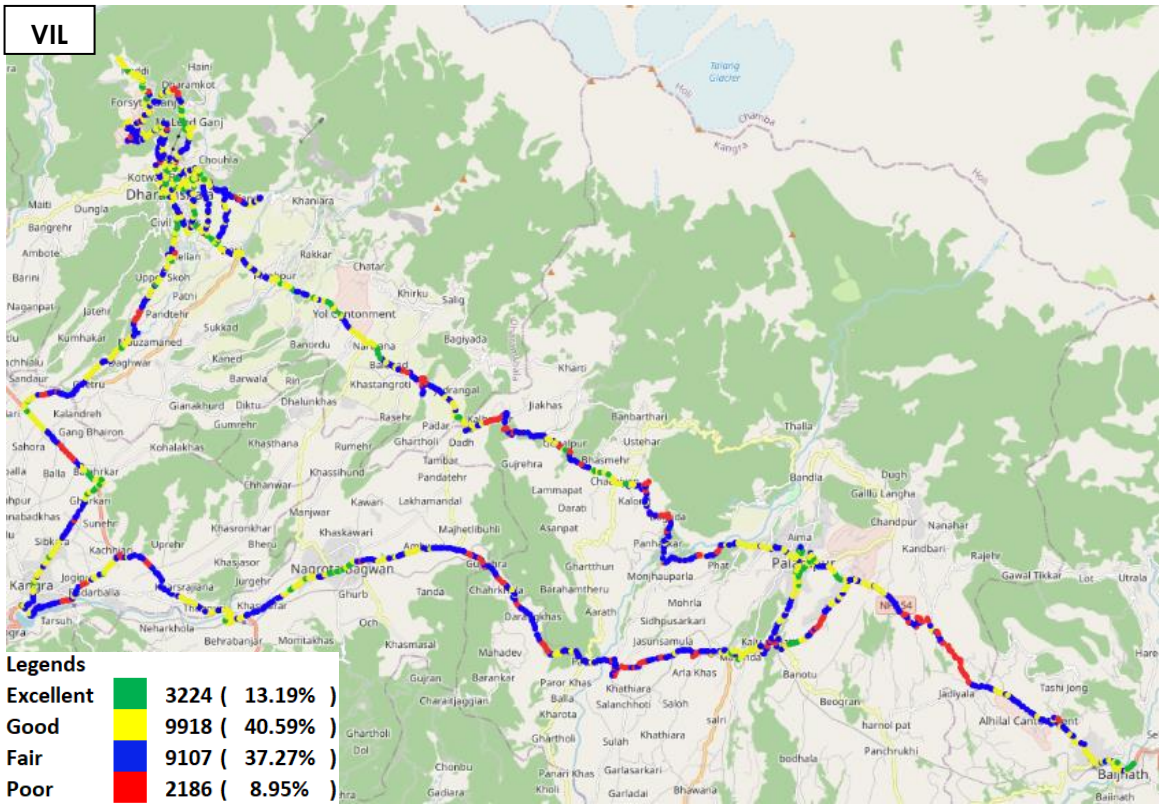

Figure-29: Signal strength auto-selection mode 5G/4G/3G/2G - VIL

7. Appendix

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

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

7.1 Appendix-I

7.1.1 Drive test setup

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

Table-32: 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 BSNL as BSNL don't have 5G network availability across India.
- All values are taken up to two decimal places with round off.

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

Web Browsing		3 popular websites (www.amazon.in, www.flipkart.com, www.google.co.in) 20 sec timeout (only at Hotspot)
Ping		25 count- Dynamic 1000 count- Hotspot

Table-33: 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)

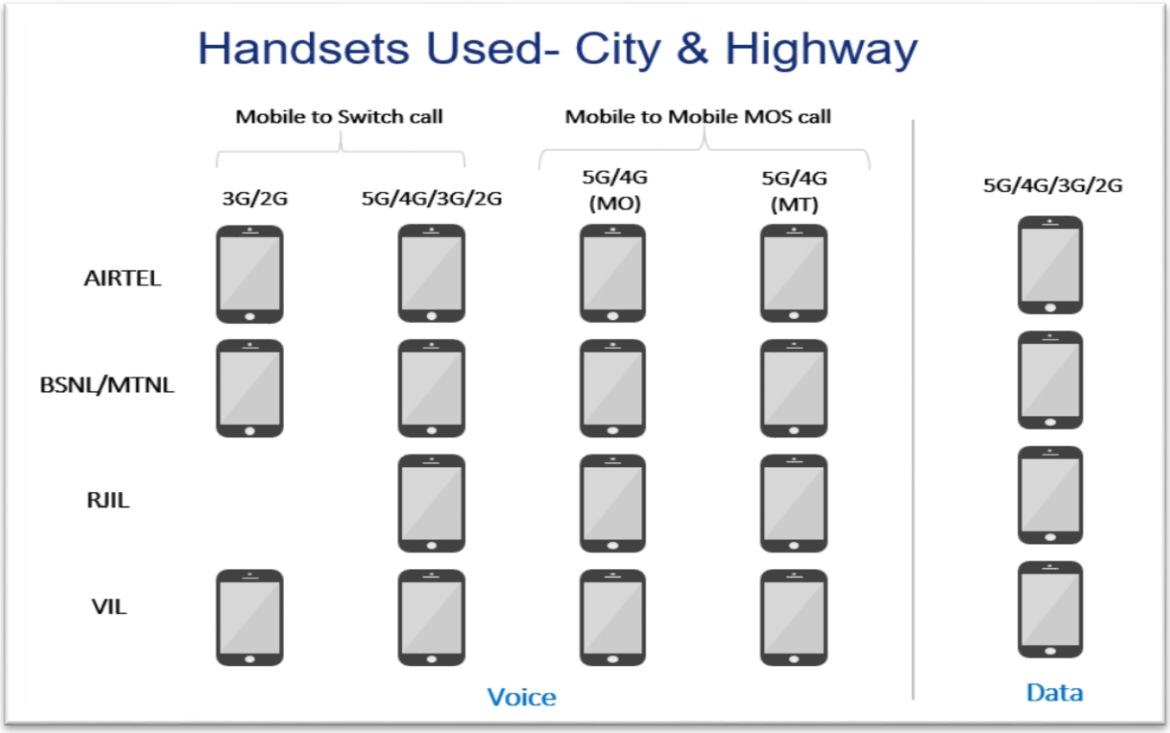

Figure-30: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

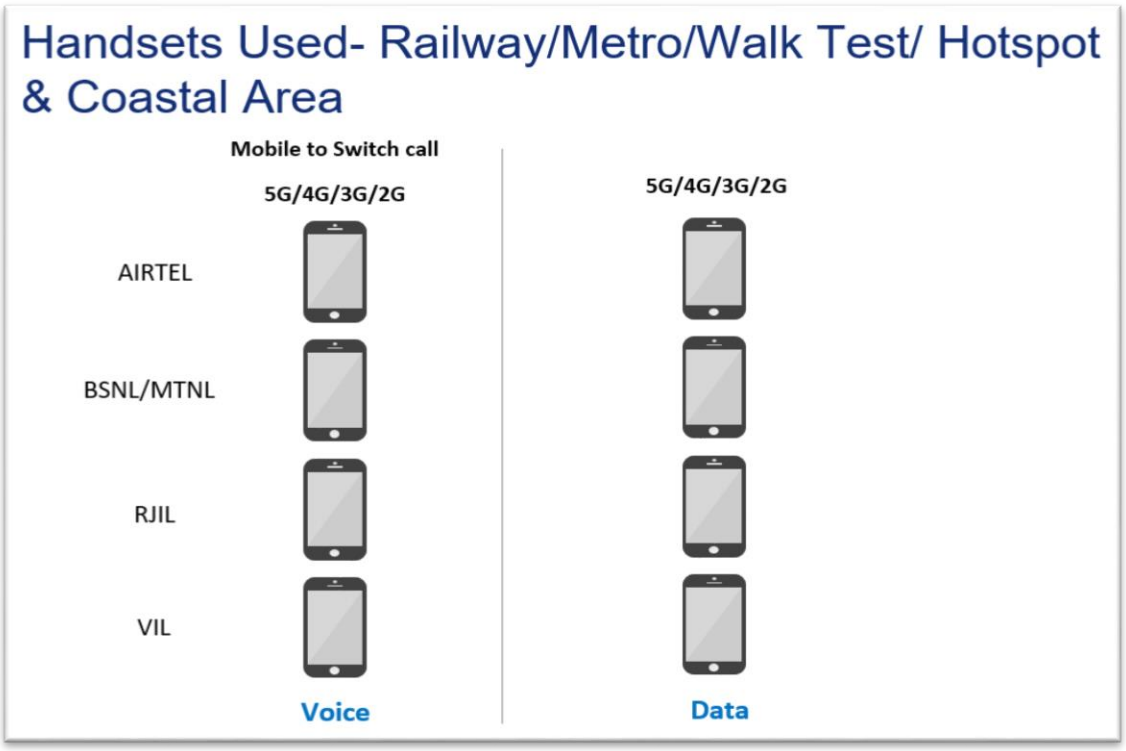

Figure-31: Number of handsets used in railway/metro/walktest/hotspot & coastal area

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)

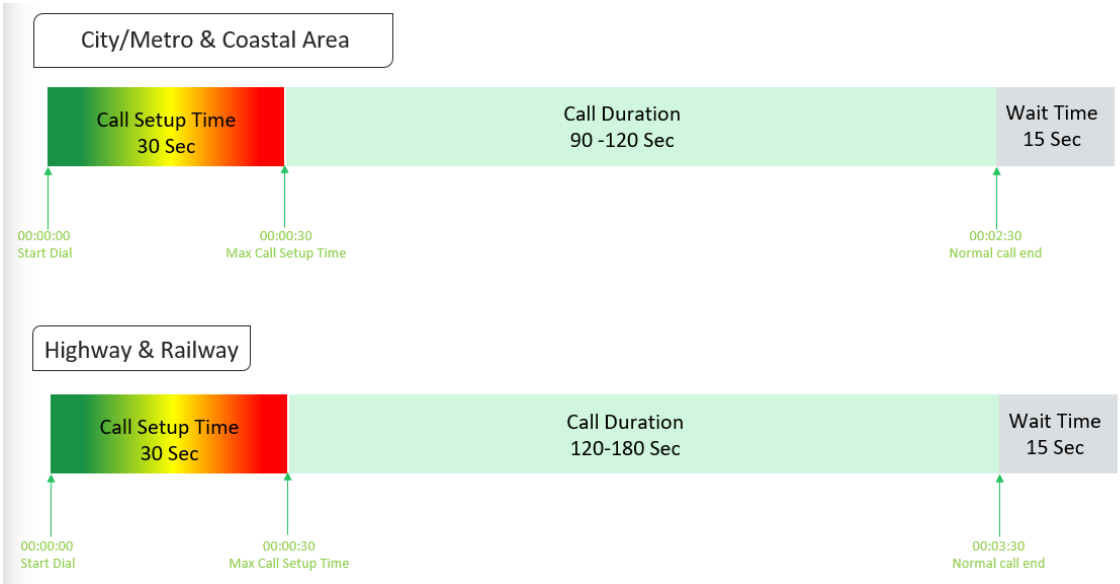

Figure-32: Voice test script for city/railway/metro/highway & coastal area

- 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-33: 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

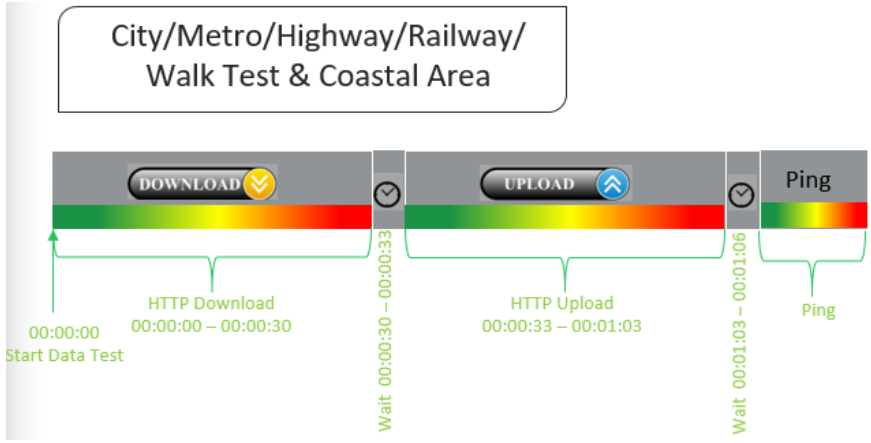

Figure-34: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

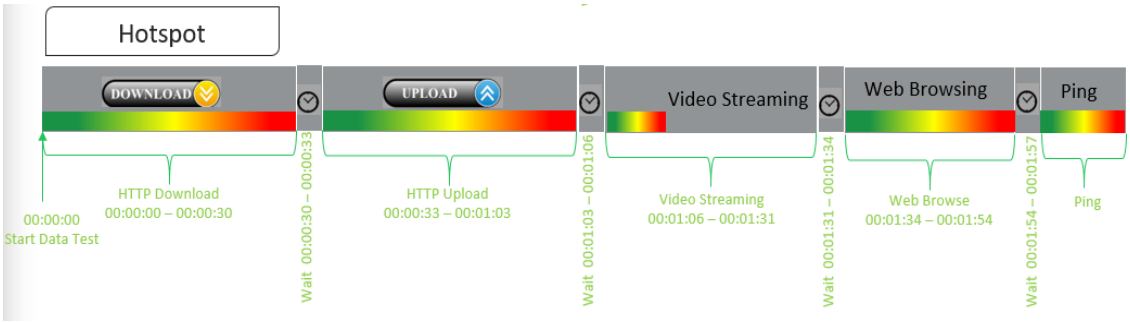

Figure-35: Data test script used at hotspot/walk test

- 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	(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 / Total calls established) *100

<table>
<tr><td></td><td>If a call observes multiple silence count >=4 sec in a particular established call it has been taken as one silent event.</td></tr>
<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 will be calculated continuously as each data packet i is received from source SSRC_n, using this difference D for that packet and the previous packet i-1 in order of arrival (not necessarily in sequence), according to the formula
J(i) = J(i-1) + (|D(i-1,i)| - J(i-1))/16 or 8</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 will be 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-34: Network performance parameter and definition voice

7.2.2 Network Performance Parameters Data tests

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

	• 80th percentile (upper range) & 20th percentile (lower range) value has been calculated for upload throughput in dynamic drive and Hotspot combine data.
Download Session Setup Success Rate	(total download session established (successfully connected to server)/ total download session attempt) *100. This KPI has been calculated for Hotspot only.
Upload Session Setup Success Rate	(total upload session established (successfully connected to server)/ total upload session attempt)*100. This KPI need to report for Hotspot only.
Web Page Download Time	Web browsing test is used to measure performance in terms of opening a web/HTTP page. Time taken to open the web page successfully is considered as web browsing delay/web page download time.
Video Streaming Delay	The Video streaming delay is time taken from start of video transfer to First video frame displayed in player.
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 is calculated based on ICMP.

Table-35: Network performance parameter and definition Data

HARDIK RAJESHBHAI PATEL

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