भादूविप्रा
TRAI

TELECOM REGULATORY AUTHORITY OF INDIA

Independent Drive Test Report

Assam LSA

September 2026

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1. Introduction

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

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

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

2. Executive Summary (LSA)

2.1 Drive test details

This report covers the findings of the IDT undertaken in Assam License Service Area (LSA) during the month of September-2026 under the supervision of TRAI Regional Office (RO) Kolkata. Details of route/area covered during the IDT are as given below:

S. No	Drive test route	Type of route	Distance covered (KMs)	From date	To date
1	New Tinsukia to Guwahati	Railway	515.9	11-Sep-2026	11-Sep-2026
2	New Tinsukia & Guwahati Railway Stations	Hotspot	2 Locations	11-Sep-2026	11-Sep-2026

Table-1: Drive test summary.

2.2 Drive test routes

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



Figure-1: Drive test routes.

2.3 Summary of areas covered

a) Hotspot

1. Guwahati Railway Station
2. New Tinsukia Railway Station

b) Railway- New Tinsukia to Guwahati passing through Simaluguri Junction, Mariani Junction, Furkating Junction, Dimapur, Diphu and Lumding Junction etc.

2.4 Telecom service providers detected frequency bands

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

S.no.	Name of TSP	Technology	Frequency Bands (In MHz)
1	Bharti Airtel Ltd.	2G	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	700,2100,2500
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.	4G	1800,2100

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

2.5 Key findings of Independent Drive Test

Drive Test Route: The overall mobile network performance on New Tinsukia to Guwahati railway route (Assam LSA) for the key Parameters has been summarized below:

a) Coverage Gap- The signal strength observed during voice testing on the drive test route in auto-selection mode (5G/4G/3G/2G). (refer figure- 17 to 20)

Parameter	AIRTEL	BSNL	RJIL	VIL
Total Number of Samples captured on Drive test route	32385	25698	33296	27285
Number of Samples having poor signal strength	4754	12486	4808	12738
Number of Samples having limited service (No Coverage)	631	2085	197	2703

b) Dropped Calls- The TSP-wise details of dropped calls in auto selection mode (5G/4G/3G/2G). (refer figure-8 to 11)

Parameter	AIRTEL	BSNL	RJIL	VIL
Number of successful Calls Established	166	205	175	164
Number of dropped Calls	5	65	9	34

c) Data Download and Upload Throughput:

i) Data Download Throughput: The TSP-wise details of **Average Download (DL) throughput** against declared typical DL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 22 to 25)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)	VIL (upto 5G)
Typical Download Throughput declared by TSP	(Mbits/s)	23.00	24.24	15.00	15.00
Average Download Throughput measured during IDT	(Mbits/s)	42.71	5.00	110.82	15.69

ii) Data Upload Throughput: The TSP-wise details of **Average Upload (UL) throughput** against declared typical UL Throughput for month, in Auto-selection mode (5G/4G/3G/2G). (refer figure- 26 to 29)

Parameter	Measured in	AIRTEL (upto 5G)	BSNL (upto 4G)	RJIL (upto 5G)	VIL (upto 5G)
Typical Upload Throughput declared by TSP	(Mbits/s)	10.00	4.33	7.00	8.00
Average Upload Throughput measured during IDT	(Mbits/s)	11.75	3.25	8.29	5.46

QoS Performance Analysis-Assam 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 Assam LSA during the month of September-2026 covering hotspots and railway. (Refer Table-1)

3.2 Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	230	456	210	293
Call Setup Success Rate %	80.87	48.46	92.86	62.80
Drop Call Rate %	2.69	30.77	4.62	18.48
Call Setup Time-Average (Second)	0.80	7.02	1.22	3.13
Handover Success Rate %	100.00	99.12	99.83	100.00

Table-3: Summary of voice call performance in network auto-selection mode.

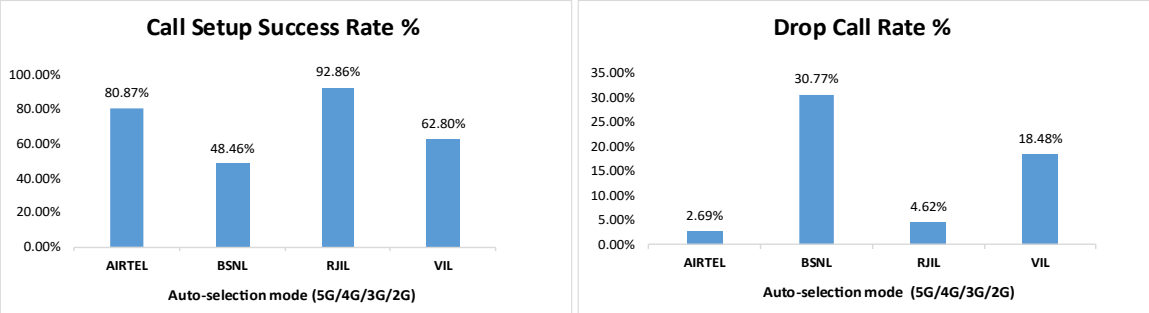


Figure-2: Performance for call setup success rate and drop call rate.

Number of unique cell Id's covered in Voice test- Technology wise				
Technology	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
5G	125	NA	349	NA
4G	1245	263	1242	346
3G	NA	28	NA	NA
2G	6	105	NA	174

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

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

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	44.22	5.36	110.33	16.38
	80th Percentile	82.50	8.71	230.82	30.93
	20th Percentile	2.89	1.00	2.44	2.38
Upload Throughput (Mbits/s)	Average	11.70	3.47	8.19	5.57
	80th Percentile	19.23	5.67	12.34	9.37
	20th Percentile	1.67	0.87	0.88	1.26
Latency (ms)	50th Percentile	61.61	55.64	40.60	56.44

Table-5: Summary of data performance in network auto-selection mode.

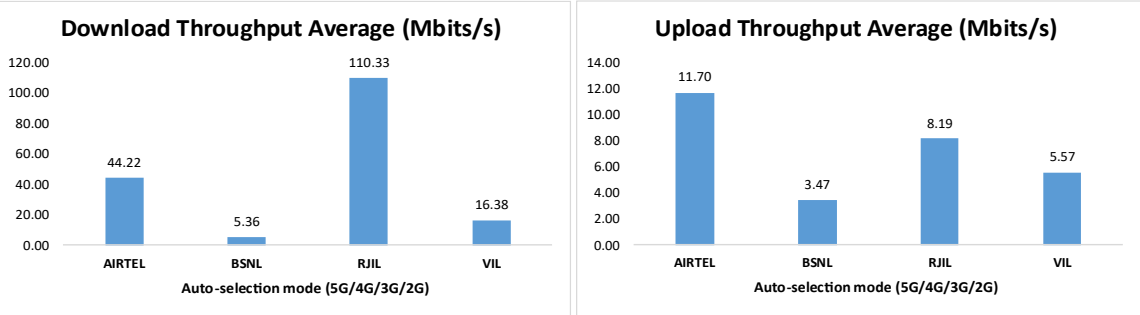


Figure- 3: Download and Upload throughput.

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	7	NA	512	NA
4G	1357	333	793	419
3G	NA	49	NA	NA
2G	2	59	NA	154

Table-6: Technology wise number of network cell Id's latched during drive test.

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

Detailed QoS Performance Analysis

4. Detailed QoS performance analysis

4.1 Overview

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

4.2 Hotspots

Hotspot testing has been conducted on 11th September 2026. Two locations have been tested in New Tinsukia and Guwahati railway stations. (Refer Table-1)

4.2.1 Locations

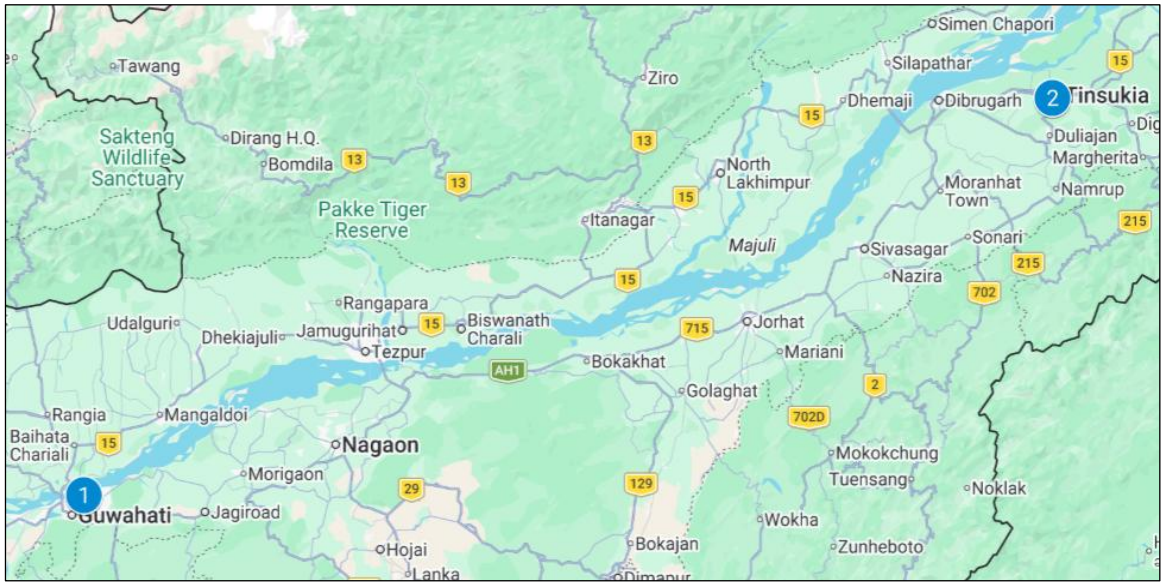


Figure- 4: Hotspot locations.

4.2.2 Hotspot covered

1. Guwahati Railway Station
2. New Tinsukia Railway Station

4.2.3 Voice performance

Overall Voice Performance				
Parameters	**Service Provider**			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Call Attempt	20	20	20	20
Call Setup Success Rate %	100.00	80.00	100.00	100.00
Drop Call Rate %	0.00	18.75	0.00	0.00
Call Setup Time-Average (Second)	0.37	7.62	0.52	1.08

Table-7: Overall summary of voice call performance in network auto-selection mode (5G/4G/3G/2G).

Guwahati 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	60.00	100.00	100.00
Drop Call Rate %	0.00	50.00	0.00	0.00
Call Setup Time-Average (Second)	0.30	8.10	0.46	0.99

Table-8: Summary of voice call performance in network auto-selection mode(5G/4G/3G/2G).

New Tinsukia Railway Station				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempt	10	10	10	10
Call Setup Success Rate %	100.00	100.00	100.00	100.00
Drop Call Rate %	0.00	0.00	0.00	0.00
Call Setup Time-Average (Second)	0.44	7.32	0.57	1.18

Table-9: Summary of voice call performance in network auto-selection mode(5G/4G/3G/2G).

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

Overall Data Performance				
Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	80.82	10.94	99.52	28.13
Download Throughput 80th Percentile (Mbit/s)	134.90	15.29	185.89	43.33
Download Throughput 20th Percentile (Mbit/s)	27.67	6.49	6.56	14.01
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	10.62	6.97	5.56	7.54
Upload Throughput 80th Percentile (Mbit/s)	21.80	9.98	7.72	9.52
Upload Throughput 20th Percentile (Mbit/s)	2.09	4.57	3.68	5.97
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	6.50	3.00	4.20	4.50
Youtube Initial Buffer Delay (Second)	3.28	0.91	1.36	1.12
Latency (ms) - 50th Percentile	86.73	52.89	37.56	57.00
Jitter (ms)	38.16	2.22	144.96	15.36
Packet Loss Rate%	43.75	0.25	19.80	1.60
Packet Loss Rate- 90th percentile	91.24	0.48	39.58	3.16

Table-10: Overall Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Guwahati Railway Station				
Parameters	Service Provider			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Download Throughput Average (Mbits/s)	93.37	13.42	7.28	19.54
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	18.26	9.24	3.45	5.70
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	9.78	2.62	4.58	4.17
Youtube Initial Buffer Delay (Second)	3.28	0.88	1.79	1.34
Latency (ms) - 50th Percentile	317.40	52.03	47.61	56.80
Jitter (ms)	50.02	2.19	283.87	23.20
Packet Loss Rate%	86.60	0.30	38.90	3.00

Table-11: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

New Tinsukia Railway Station				
Parameters	**Service Provider**			
	Auto-Selection Mode (5G/4G/3G/2G)			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
Download Throughput Average (Mbits/s)	68.27	8.46	191.77	36.72
Download Session Setup Success Rate %	100.00	100.00	100.00	100.00
Upload Throughput Average (Mbits/s)	2.98	4.70	7.24	9.38
Upload Session Setup Success Rate %	100.00	100.00	100.00	100.00
Web Browsing Delay (Second)	4.70	3.34	3.98	4.78
Youtube Initial Buffer Delay (Second)	-	0.93	1.10	0.89
Latency (ms) - 50th Percentile	50.92	53.64	35.99	57.03
Jitter (ms)	26.32	2.25	6.05	7.52
Packet Loss Rate%	0.90	0.20	0.70	0.20

Table-12: Summary of Data performance in network auto-selection mode (5G/4G/3G/2G).

Note- "-" Youtube tests were failed.

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

Overall Data Performance					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	67.46	-	175.47	-
	Upload Throughput Average (Mbits/s)	5.73	-	6.30	-
4G	**Download Throughput Average (Mbits/s)**	13.62	19.53	33.20	26.86
	Upload Throughput Average (Mbits/s)	2.30	5.48	2.42	6.21

Table-13: Overall Summary of 5G only & 4G only data download & upload speed.

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

Guwahati Railway Station					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	30.50	-	6.25	-
	Upload Throughput Average (Mbits/s)	8.36	-	4.37	-
4G	**Download Throughput Average (Mbits/s)**	17.63	14.90	20.25	6.02
	Upload Throughput Average (Mbits/s)	1.72	2.37	3.29	2.91

Table-14: Overall Summary of 5G only & 4G only data download & upload speed.

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

New Tinsukia Railway Station					
Parameters		**Service Provider**			
		AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	**Download Throughput Average (Mbits/s)**	92.10	-	344.68	-
	Upload Throughput Average (Mbits/s)	3.77	-	8.23	-
4G	**Download Throughput Average (Mbits/s)**	9.60	24.15	46.15	47.69
	Upload Throughput Average (Mbits/s)	2.87	8.58	1.55	9.51

Table-15: Overall Summary of 5G only & 4G only data download & upload speed.

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

4.3 Railway

Drive test has been conducted on 11th September 2026 covering one Railway route. (Refer Table-1)

4.3.1 Drive test route



Figure-5: Drive test route Railway.

4.3.2 Routes Covered

New Tinsukia to Guwahati passing through Simaluguri Junction, Mariani Junction, Furkating Junction, Dimapur, Diphu and Lumding Junction etc.

4.3.3 Voice performance

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

Parameters	Service Provider			
	Auto-selection mode (5G/4G/3G/2G)			
	AIRTEL	BSNL	RJIL	VIL
Call Attempts	210	436	190	273
Call Setup Success Rate %	79.05	47.02	92.11	60.07
Drop Call Rate %	3.01	31.71	5.14	20.73
Call Setup Time Average (Second)	0.85	6.97	1.30	3.38
Handover Success Rate %	100.00	99.12	99.83	100.00

Table-16: Summary of voice call performance in network auto-selection mode.

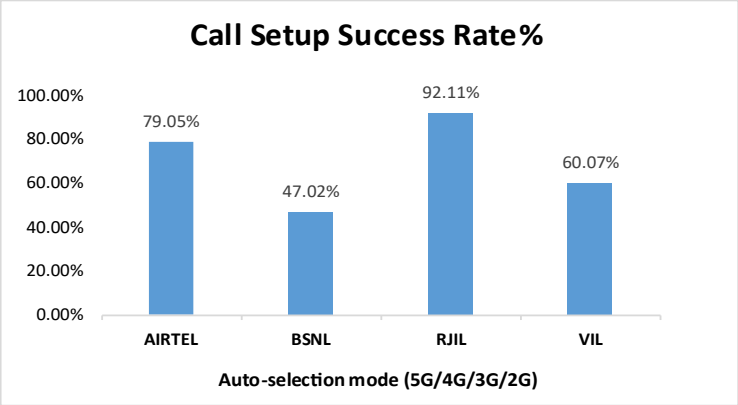


Figure-6: Performance for call setup success rate.

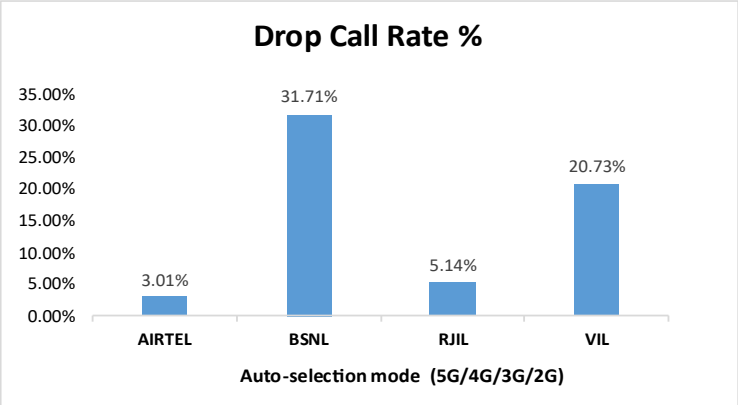


Figure-7: Performance for drop call rate.

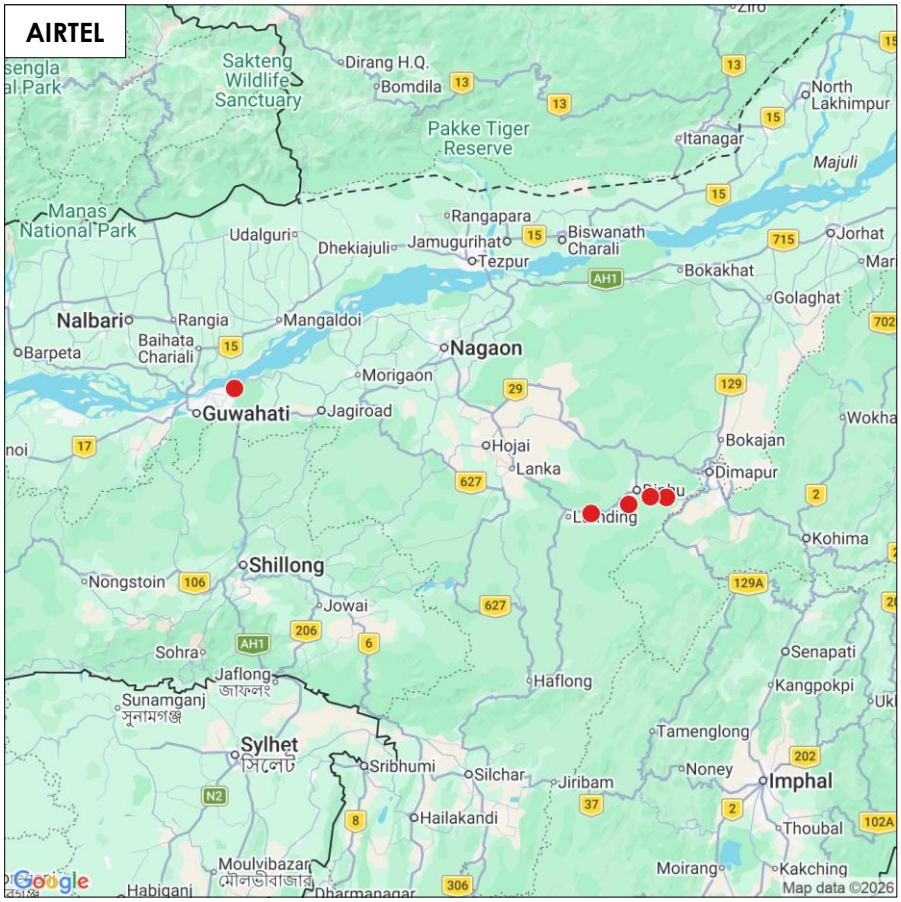


Figure-8: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL

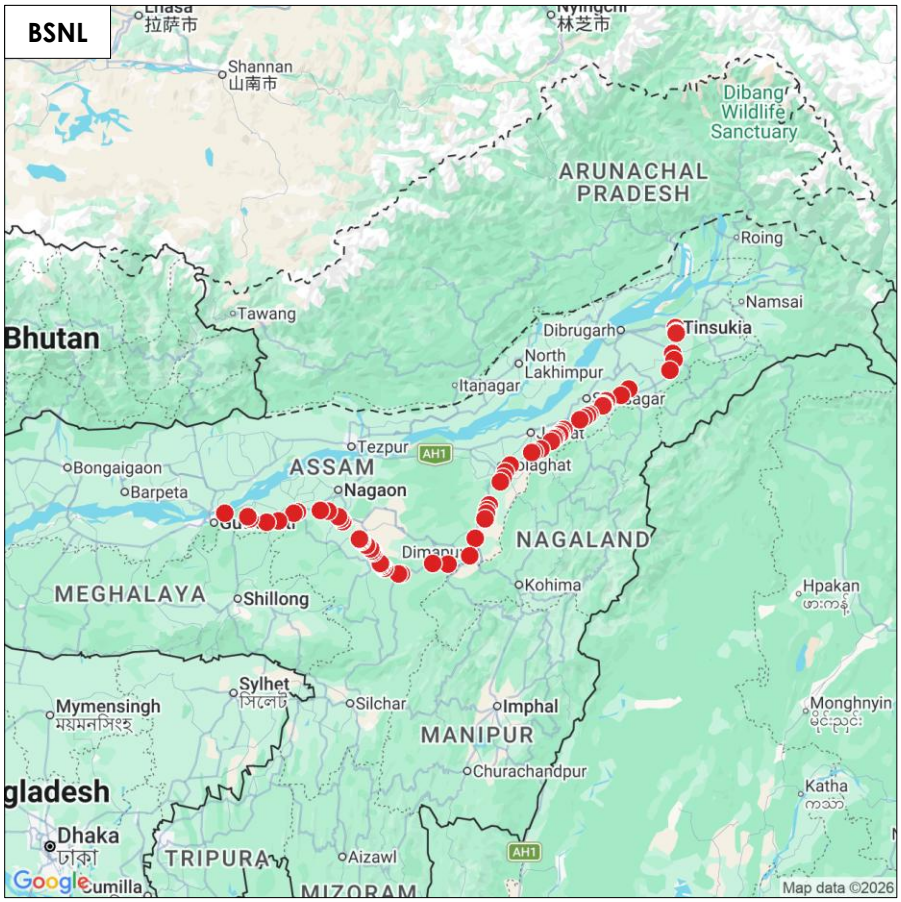


Figure-9: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice – BSNL

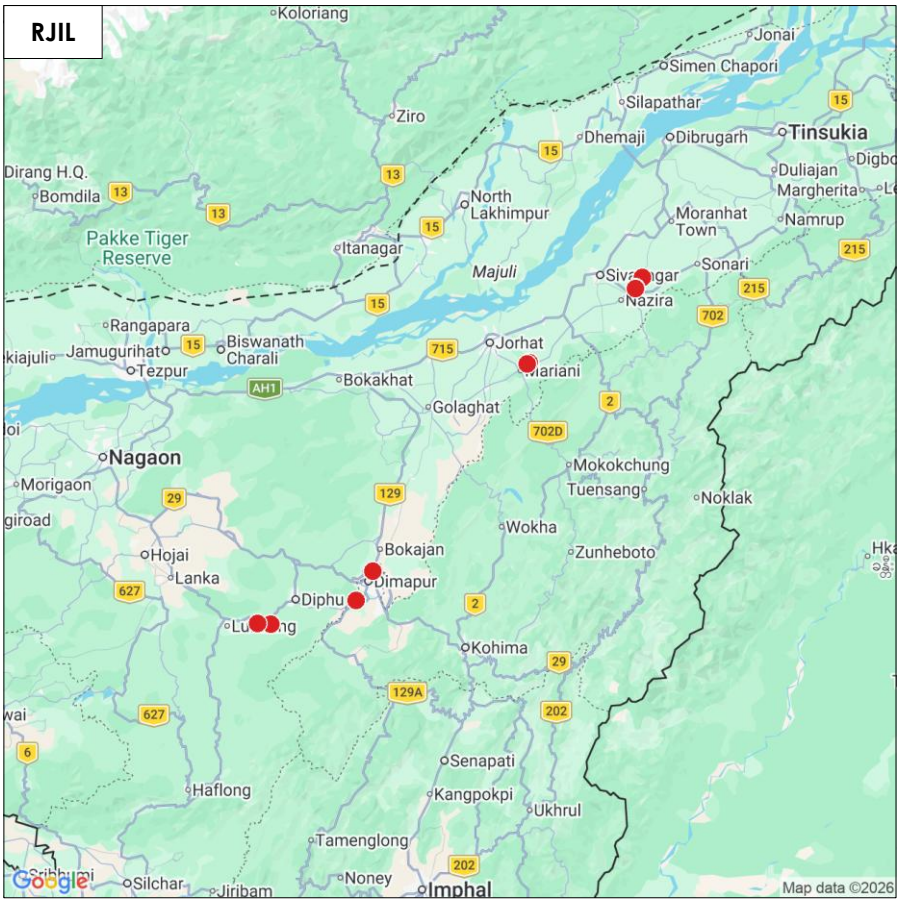


Figure-10: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice - RJIL

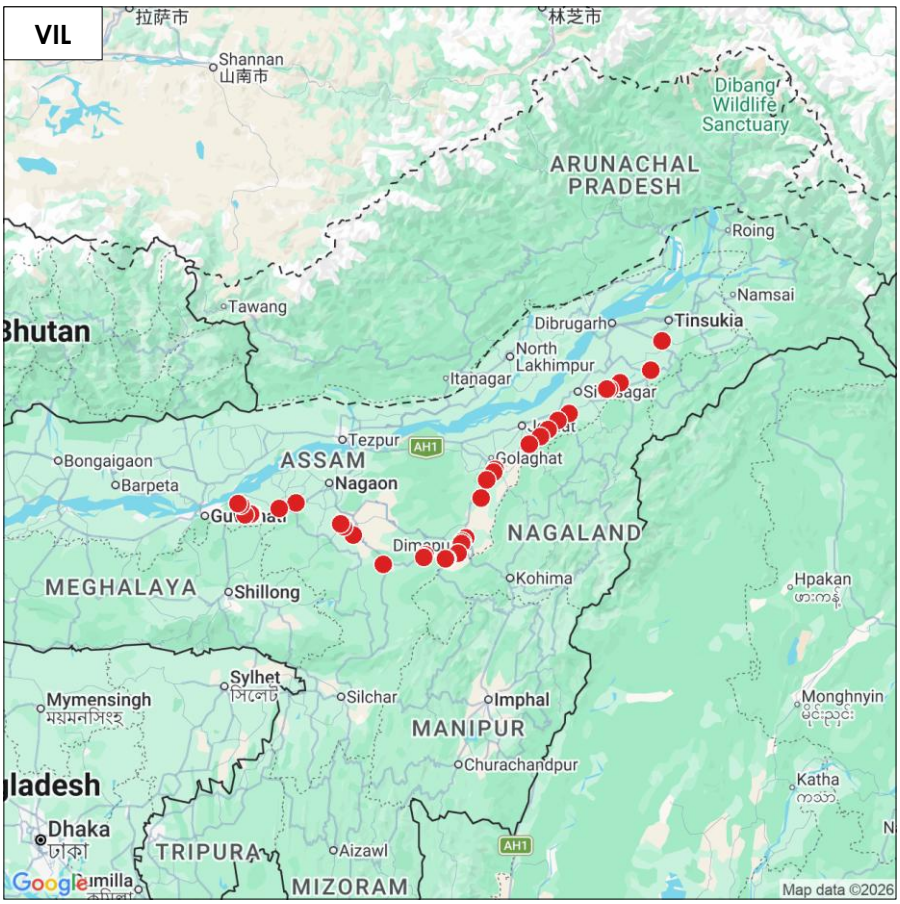


Figure-11: Drop call locations in auto-selection mode (5G/4G/3G/2G) voice – VIL

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	5.69%	NA	36.65%	NA
4G	91.30%	58.12%	62.77%	49.30%
3G	NA	6.62%	NA	NA
2G	1.14%	28.26%	NA	41.94%
Limited Service	1.87%	7.01%	0.58%	8.76%

Table-17: Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) voice.

Note-

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



Figure-12: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.



Figure-13: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - BSNL.



Figure-14: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - RJIL.

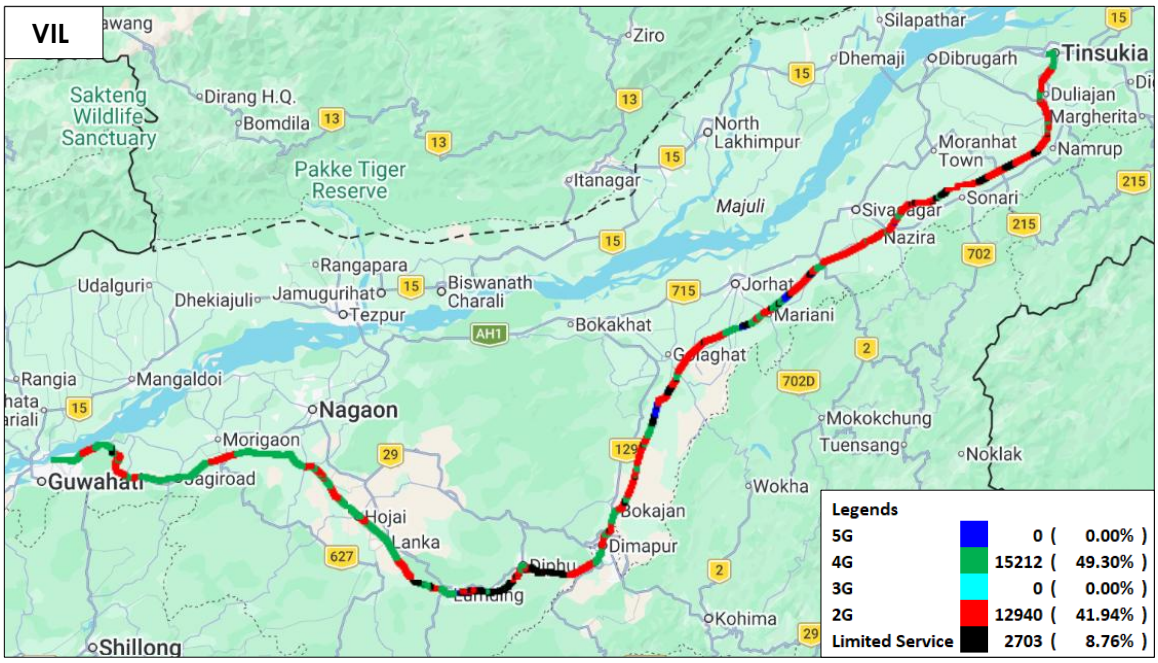


Figure-15: Serving technology plots in auto-selection mode (5G/4G/3G/2G) voice - VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) voice. (Refer figure-35, 36, 37 & 38 for map view)

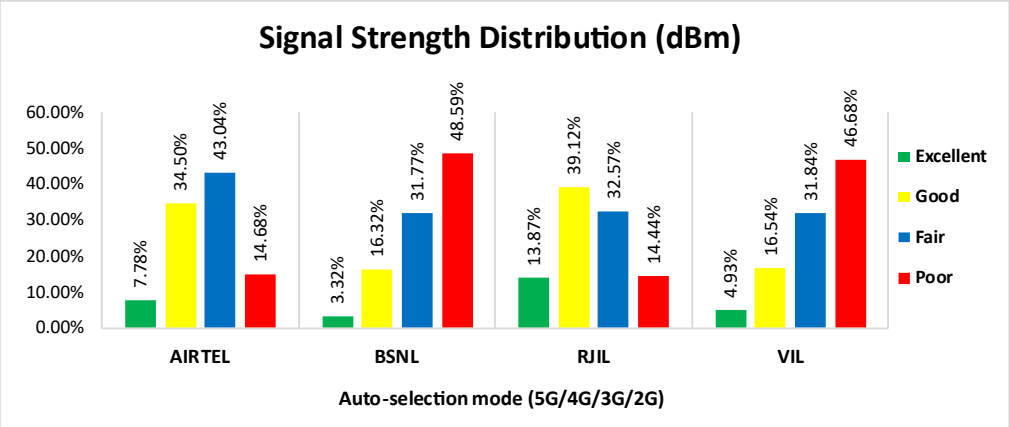


Figure-16: Signal strength distribution auto-selection mode (5G/4G/3G/2G) voice.

Observations:

- Airtel has 8% of samples falling in the excellent signal strength category.
- BSNL has 3% of samples falling in the excellent signal strength category.
- RJIL has 14% of samples falling in the excellent signal strength category.
- VIL has 5% of samples falling in the excellent signal strength category.

(d) Coverage Gap observed

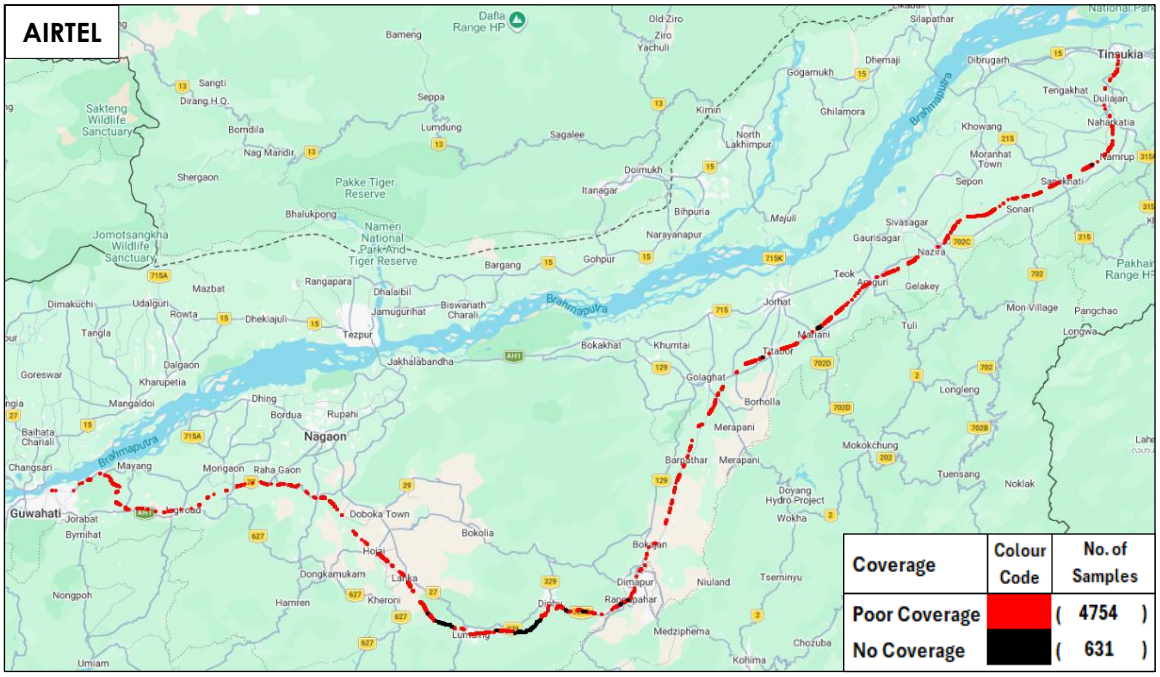


Figure-17: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-AIRTEL.

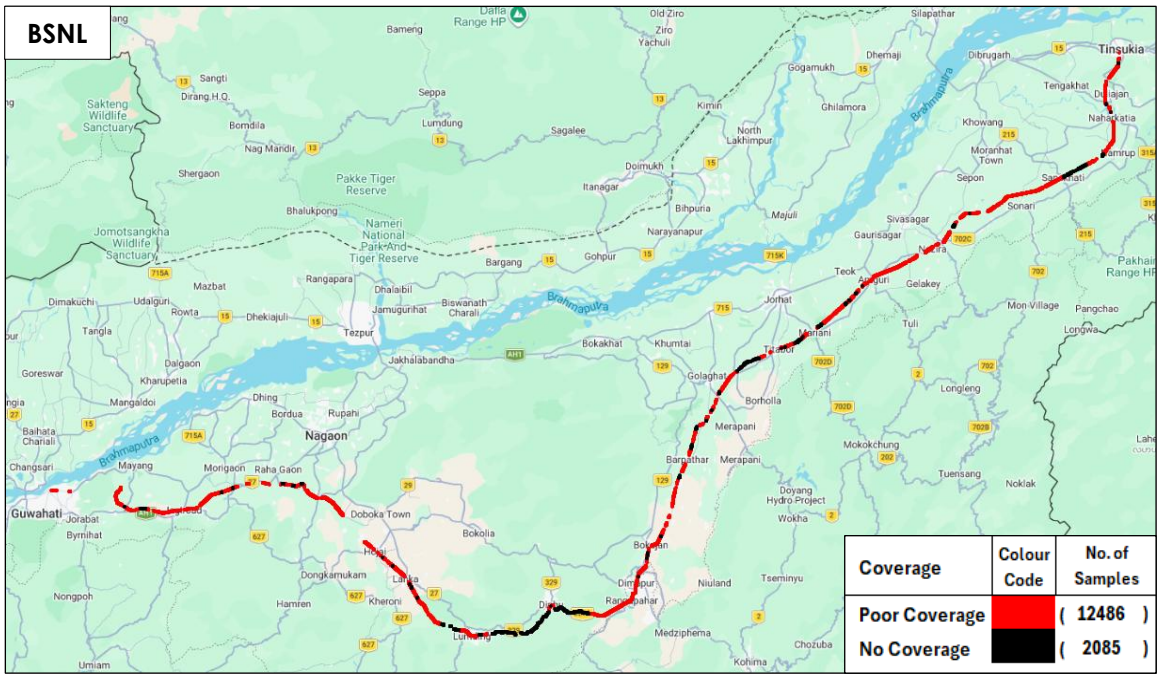


Figure-18: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-BSNL.



Figure-19: Poor coverage & no coverage locations in auto-selection mode (5G/4G/3G/2G) voice-RJIL.



Figure-20: Poor coverage & no coverage locations in auto-selection mode 5G/4G/3G/2G voice- VIL.

4.3.4 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	42.71	5.00	110.82	15.69
	80th Percentile	78.81	7.24	235.04	29.49
	20th Percentile	2.75	0.95	2.38	2.19
Upload Throughput (Mbits/s)	Average	11.75	3.25	8.29	5.46
	80th Percentile	18.42	4.99	13.01	9.37
	20th Percentile	1.62	0.86	0.87	1.23
Latency (ms)	50th Percentile	61.23	59.08	42.09	55.97

Table-18: Summary of Data performance in network auto-selection mode.

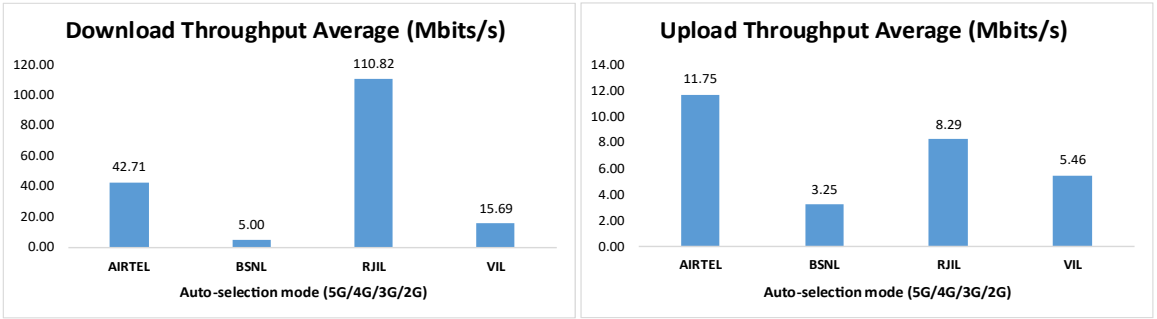


Figure-21: Download & Upload throughput.

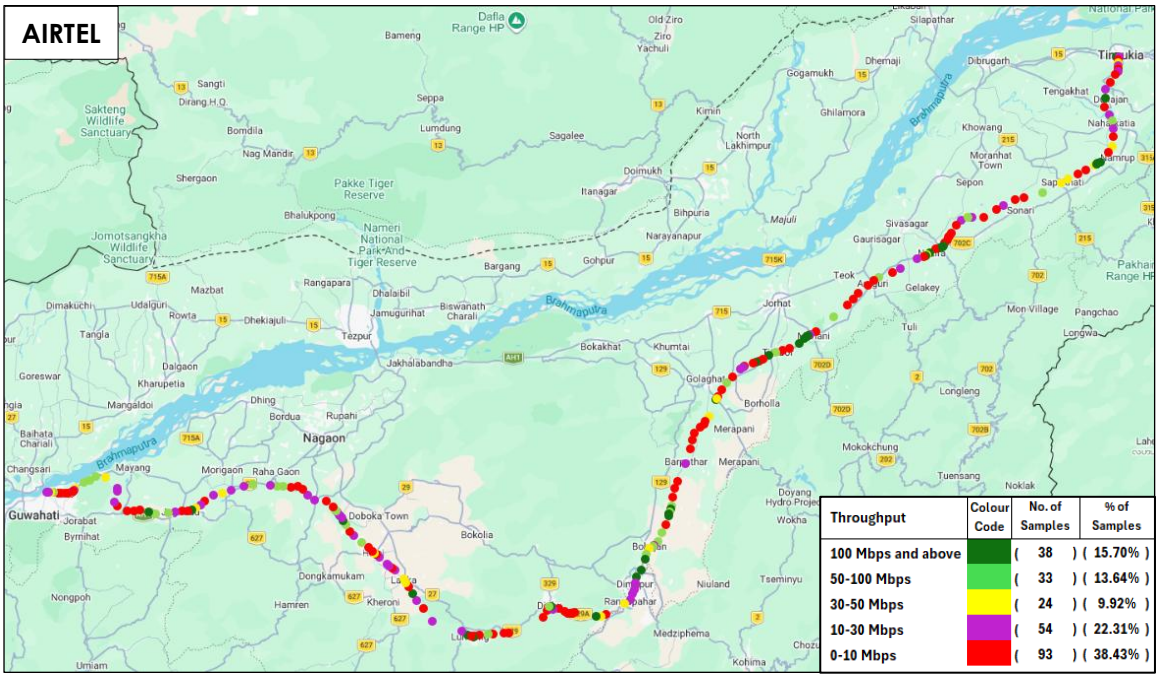


Figure-22: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

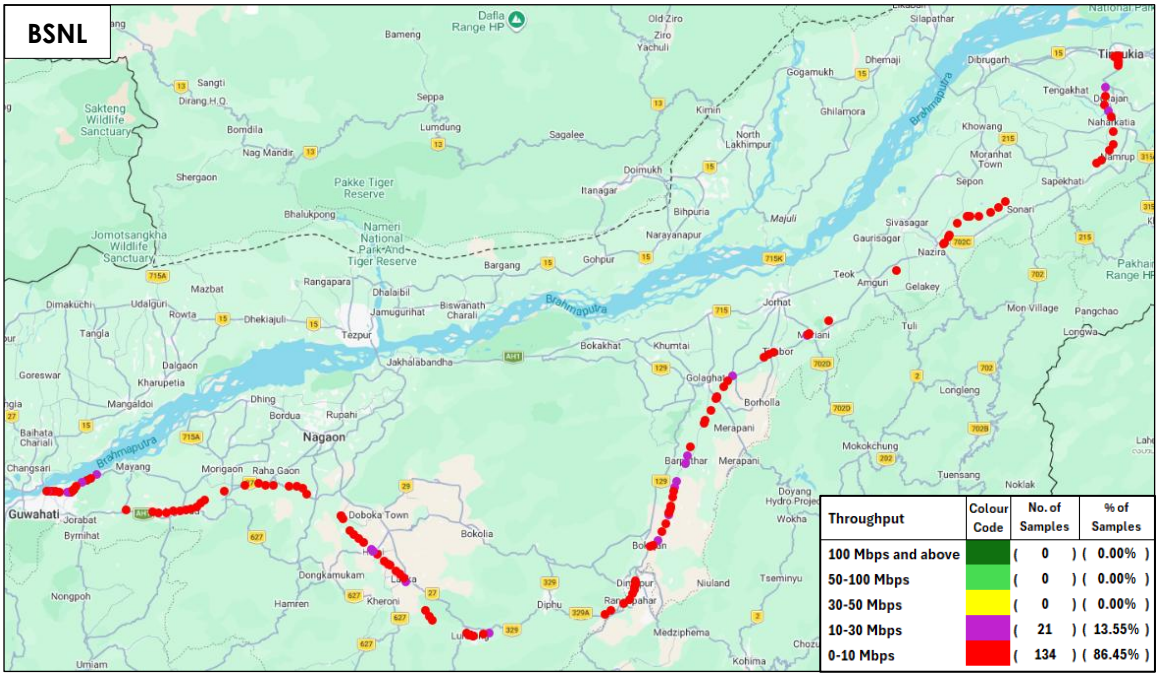


Figure-23: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

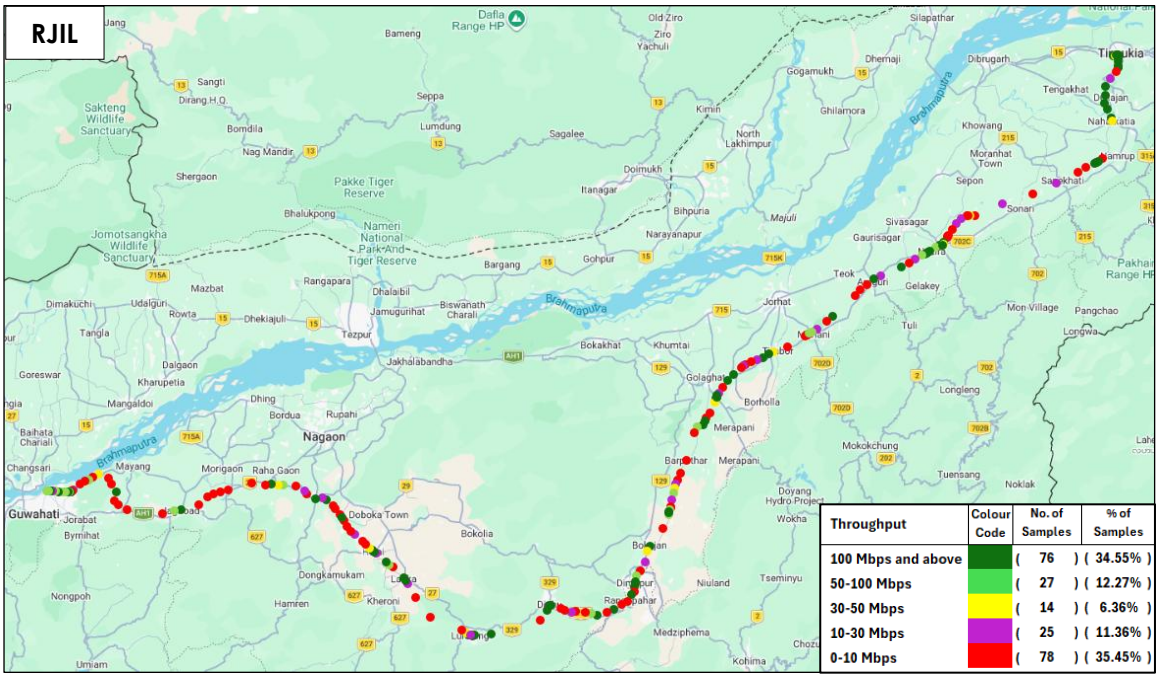


Figure-24: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

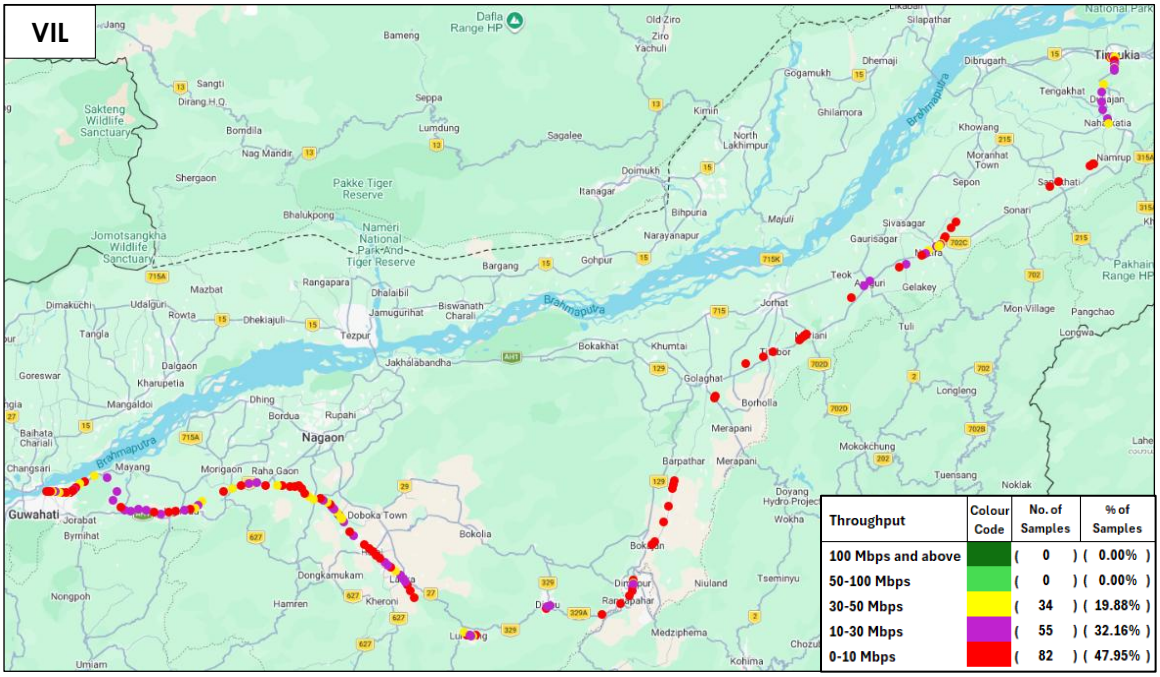


Figure-25: Download throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

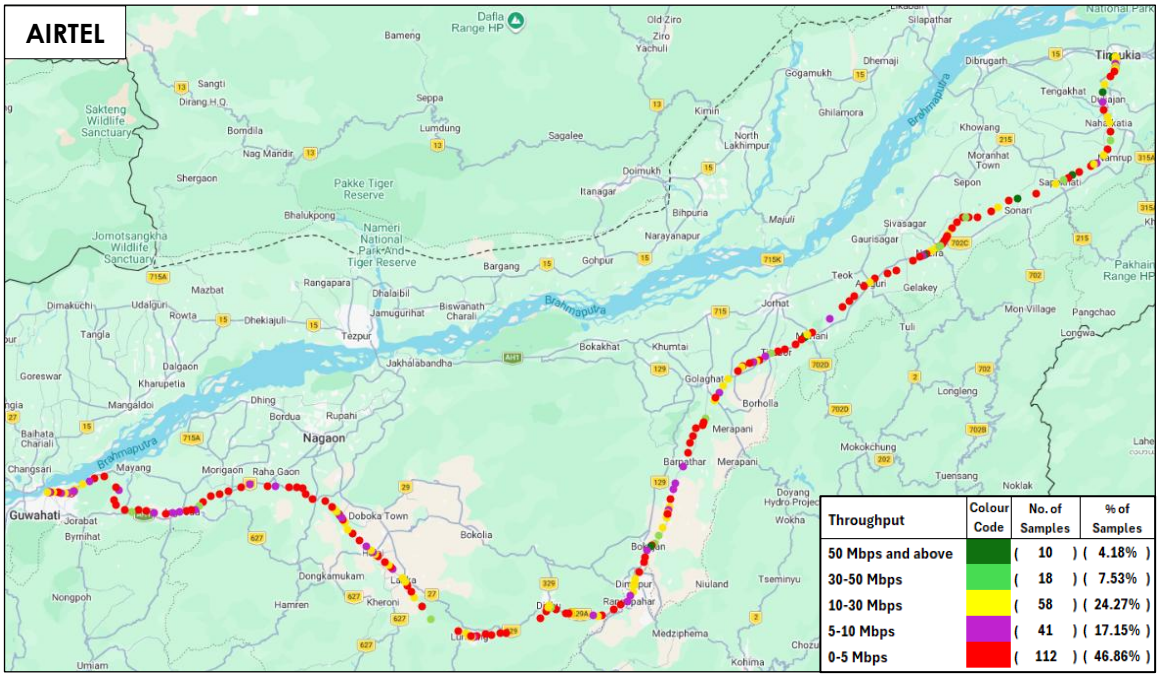


Figure-26: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - AIRTEL.

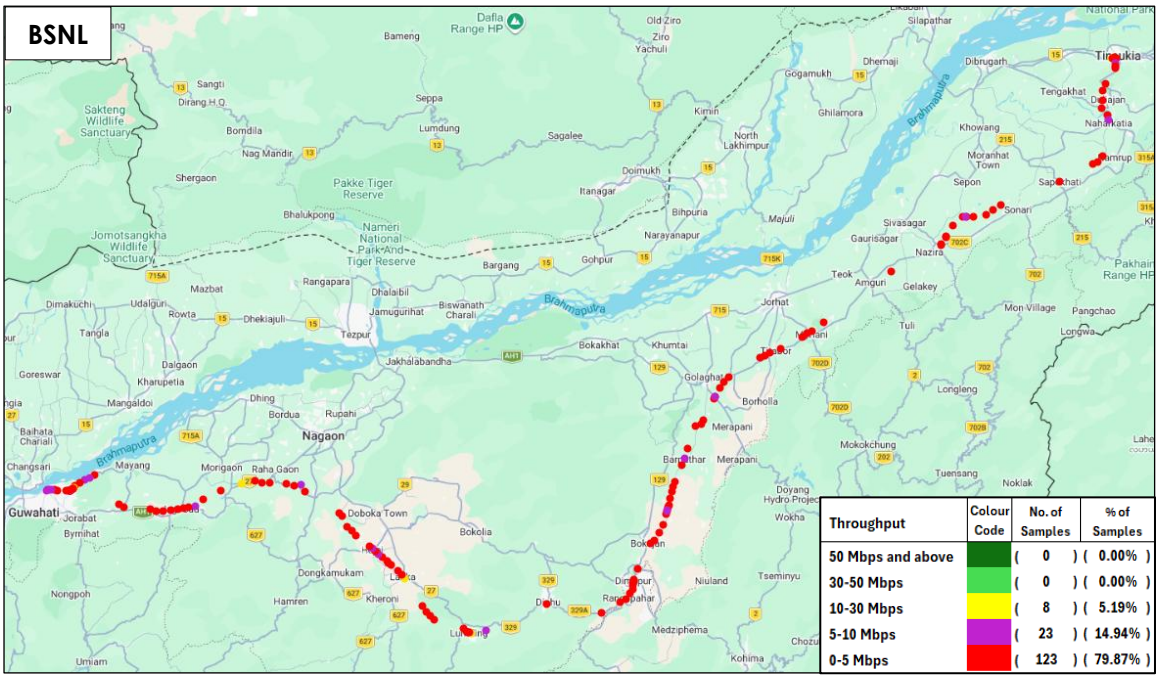


Figure-27: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - BSNL.

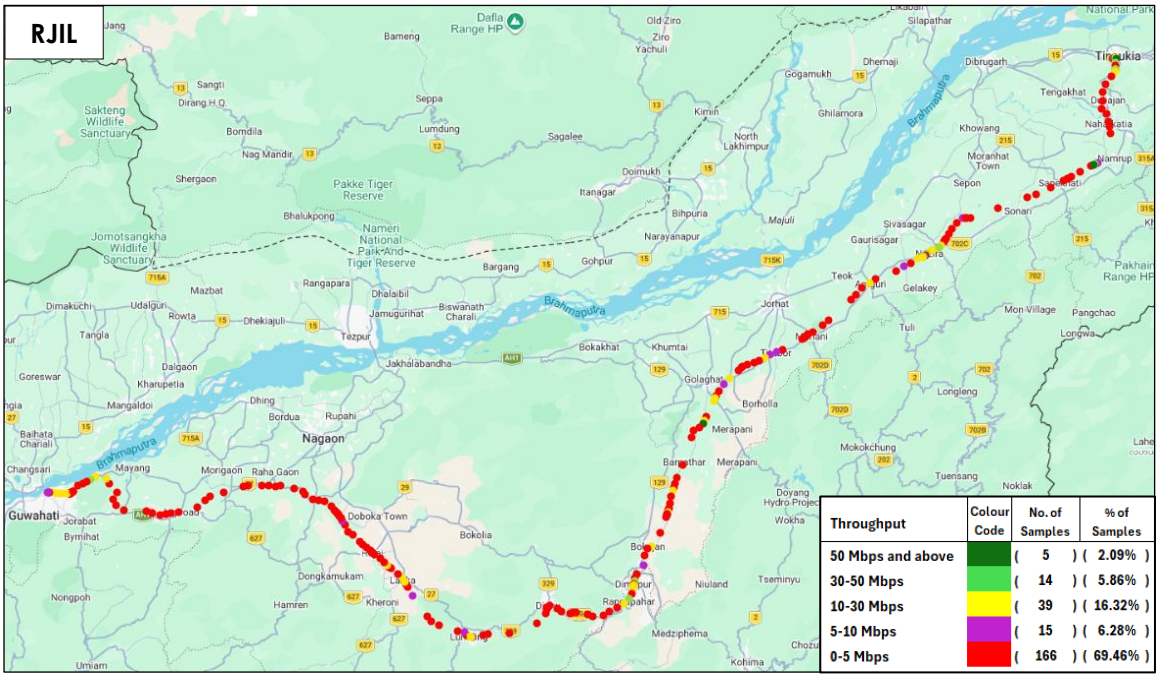


Figure-28: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - RJIL.

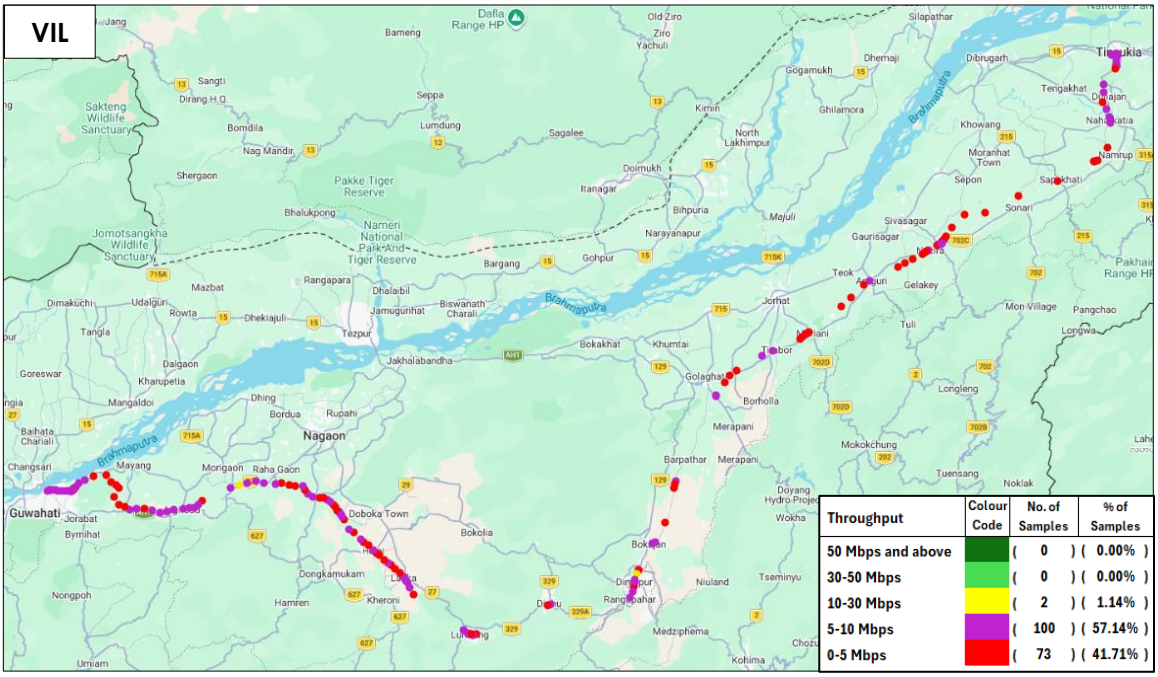


Figure-29: Upload throughput distribution auto-selection mode (5G/4G/3G/2G) - VIL.

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

Technology	Service Provider			
	AIRTEL	**BSNL**	**RJIL**	**VIL**
5G	50.80%	NA	57.76%	NA
4G	47.06%	71.60%	41.94%	66.75%
3G	NA	11.02%	NA	NA
2G	0.14%	7.62%	NA	22.52%
Limited Service	2.00%	9.75%	0.30%	10.73%

Table-19: Time spent on technology during drive test in auto-selection mode (5G/4G/3G/2G) data.

Note-

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



Figure-30: Serving technology plot in auto-selection mode (5G/4G/3G/2G) data – AIRTEL.



Figure-31: Serving technology plot in auto-selection mode (5G/4G/3G/2G) data - BSNL.



Figure-32: Serving technology plot in auto-selection mode (5G/4G/3G/2G) data - RJIL.



Figure-33: Serving technology plot in auto-selection mode (5G/4G/3G/2G) data - VIL.

(c) Network Signal Strength Distribution: The following chart provides signal strength distribution for auto-selection mode (5G/4G/3G/2G) data. (Refer figure-39, 40, 41 & 42 for map view)

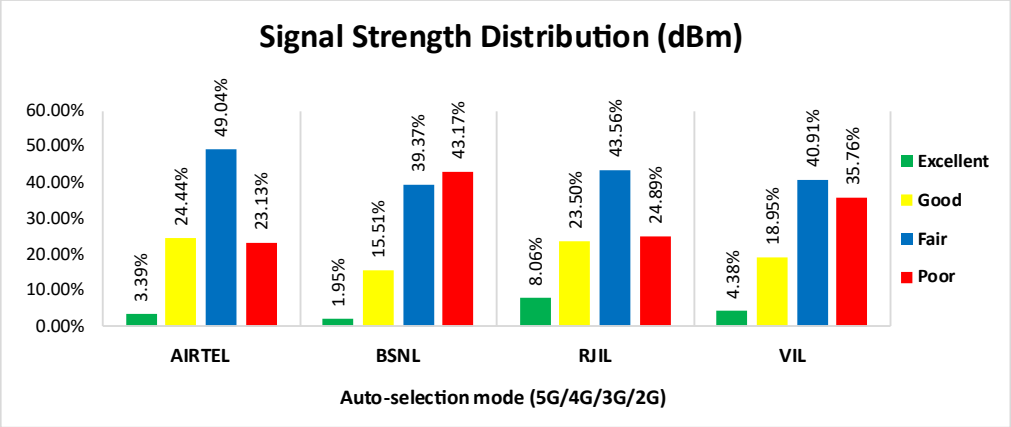


Figure-34: Signal strength distribution auto-selection mode (5G/4G/3G/2G) data.

Observations:

- Airtel has 3% of samples falling in the excellent signal strength category.
- BSNL has 2% of samples falling in the excellent signal strength category.
- RJIL has 8% of samples falling in the excellent signal strength category.
- VIL has 4% of samples falling in the excellent signal strength category.

5. Voice & Data Key findings

5.1 Overall Voice

1. Call Setup Success Rate:

a) Airtel, BSNL, RJIL and VIL have 80.87%, 48.46%, 92.86% and 62.80% call setup success rate respectively in auto-selection mode (5G/4G/3G/2G). (refer table-3)

2. Call Setup Time:

a) Airtel, BSNL, RJIL & VIL call setup time is 0.80, 7.02, 1.22 & 3.13 seconds respectively in auto-selection mode (5G/4G/3G/2G). (refer table-3)

3. Drop Call Rate:

a) Airtel, BSNL, RJIL and VIL drop call rate is 2.69%, 30.77%, 4.62% and 18.48% respectively in auto-selection mode (5G/4G/3G/2G). (refer table-3)

5.2 Overall Data

1. Data download and upload performance (Overall i.e. LSA):

a) Airtel, BSNL, RJIL and VIL average download speeds are 44.22 Mbps, 5.36 Mbps, 110.33 Mbps and 16.38 Mbps respectively. (refer table-5)

b) Airtel, BSNL, RJIL and VIL average upload speeds are 11.70 Mbps, 3.47 Mbps, 8.19 Mbps and 5.57 Mbps respectively. (refer table-5)

2. Data download and upload performance (static i.e. while stationary):

a) Airtel, BSNL, RJIL and VIL average download speeds are 80.82 Mbps, 10.94 Mbps, 99.52 Mbps and 28.13 Mbps respectively. (refer table-10)

b) Airtel, BSNL, RJIL and VIL average upload speeds are 10.62 Mbps, 6.97 Mbps, 5.56 Mbps and 7.54 Mbps respectively. (refer table-10)

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

a) All operators have 100.00% download session setup success rate. (refer table-10)

b) All operators have 100.00% upload session setup success rate. (refer table-10)

5.3 Operator wise Key Findings

1. Airtel:

Voice

- 80.87% call setup success rate and 2.69% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-3)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-7)
- 79.05% call setup success rate and 3.01% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for railway route. (refer table-16)

Data

- Airtel has 44.22 Mbps average download speed & 11.70 Mbps average upload speed for LSA. (refer table-5)
- Both hotspot locations have less download speed (less than 100 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-11 & 12)
- Both hotspot locations have less upload speed (less than 20 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-11 & 12)

- Airtel has 42.71 Mbps average download speed & 11.75 Mbps average upload speed across measured routes for railway drive. (refer table-18)

2. BSNL:

Voice

- 48.46% call setup success rate and 30.77% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-3)
- 80.00% call setup success rate and 18.75% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-7)
- 47.02% call setup success rate and 31.71% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for railway route. (refer table-16)

Data

- BSNL has 5.36 Mbps average download speed & 3.47 Mbps average upload speed for LSA. (refer table-5)
- New Tinsukia Railway Station has less download speed (less than 10 Mbps) out of total 2 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-12)
- BSNL has 5.00 Mbps average download speed & 3.25 Mbps average upload speed across measured routes for railway drive. (refer table-18)

3. RJIL:

Voice

- 92.86% call setup success rate and 4.62% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-3)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-7)
- 92.11% call setup success rate and 5.14% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for railway route. (refer table-16)

Data

- RJIL has 110.33 Mbps average download speed & 8.19 Mbps average upload speed for LSA. (refer table-5)
- Guwahati Railway Station has less download speed (less than 100 Mbps) out of total 2 hotspot locations for auto-selection mode (5G/4G/3G/2G). (refer table-11)
- Both hotspot locations have less upload speed (less than 20 Mbps) for auto-selection mode (5G/4G/3G/2G). (refer table-11 & 12)
- RJIL has 110.82 Mbps average download speed & 8.29 Mbps average upload speed across measured routes for railway drive. (refer table-18)

4. VIL:

Voice

- 62.80% call setup success rate and 18.48% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for LSA. (refer table-3)
- 100.00% call setup success rate and 0.00% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for all hotspot locations. (refer table-7)

- 60.07% call setup success rate and 20.73% drop call rate have been observed in auto-selection mode (5G/4G/3G/2G) for railway route. (refer table-16)

Data

- VIL has 16.38 Mbps average download speed & 5.57 Mbps average upload speed for LSA. (refer table-5)
- VIL has 15.69 Mbps average download speed & 5.46 Mbps average upload speed across measured routes for railway drive. (refer table-18)

6. Annexure

6.1 Route wise coverage map

6.1.1 Railway

i) New Tinsukia to Guwahati

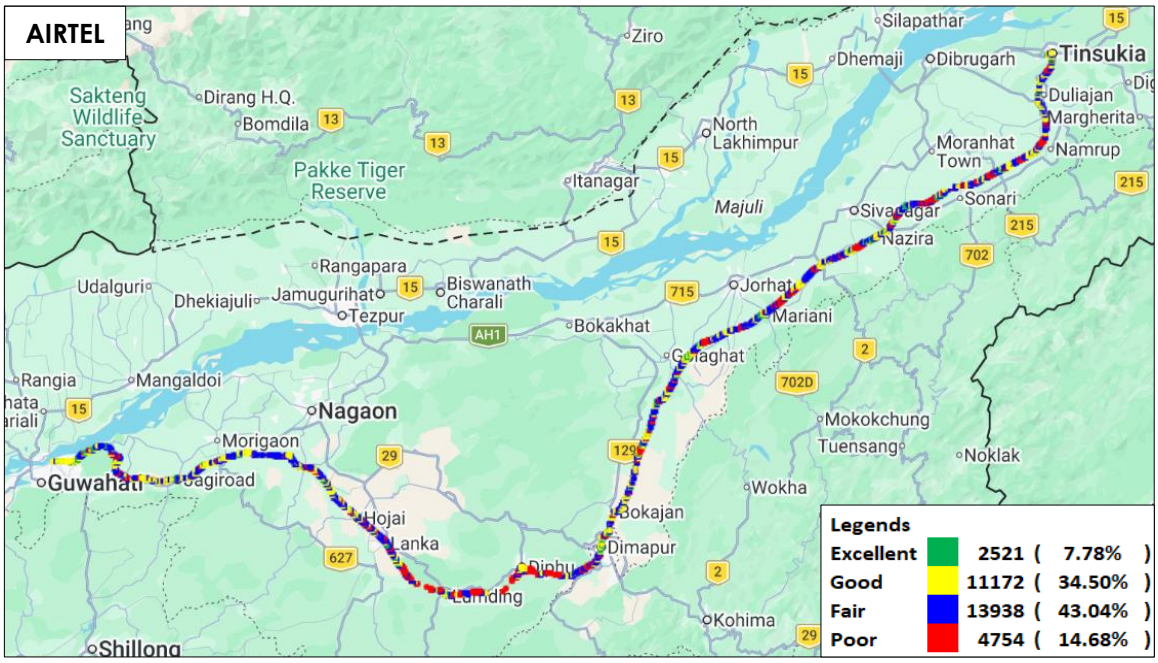


Figure-35: Signal strength auto-selection mode (5G/4G/3G/2G) voice - AIRTEL.



Figure-36: Signal strength auto-selection mode (5G/4G/3G/2G) voice - BSNL.



Figure-37: Signal strength auto-selection mode (5G/4G/3G/2G) voice - RJIL.



Figure-38: Signal strength auto-selection mode (5G/4G/3G/2G) voice - VIL.

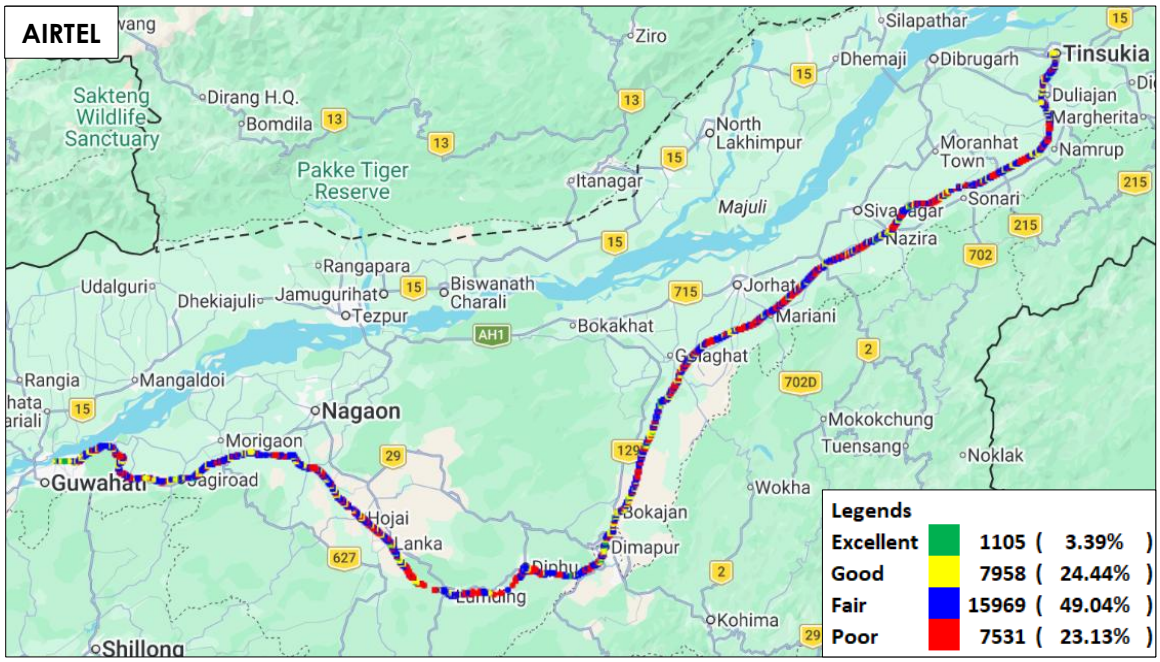


Figure-39: Signal strength auto-selection mode (5G/4G/3G/2G) data - AIRTEL.



Figure-40: Signal strength auto-selection mode (5G/4G/3G/2G) data - BSNL.



Figure-41: Signal strength auto-selection mode (5G/4G/3G/2G) data - RJIL.



Figure-42: Signal strength auto-selection mode (5G/4G/3G/2G) data - VIL.

7. Appendix

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

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

7.1 Appendix-I

7.1.1 Drive test setup

Voice Call		
Call details	**Technology**	**Detail**
Call Setup Timeout	• 3G/2G auto mode- switch Call • 5G/4G/3G/2G auto mode- switch Call • 5G/4G MOS Call	30 Sec
Call Duration		120/180 seconds
Wait/ Guard Time		15 Sec

Table-20: 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 in railway route drive.

Data Test		
Test Type	**Technology**	**Detail**
FTP/HTTP Download	5G/4G/3G/2G Auto Mode	500 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time)
FTP/HTTP Upload		250 MB File- 30 Sec Timeout, (Multithread 3- TCP Connection at a time)
YouTube Streaming		20 Sec Video & 25 sec Timeout (Only at Hotspot)
Web Browsing		3 popular websites (www.google.co.in, www.irctc.co.in, www.sbi.bank.in) 20 sec timeout (only at Hotspot)

Latency & Jitter (TWAMP-UDP)		25 count- Dynamic 500 count- Hotspot Payload- 512 bytes in all drive
Packet Loss Rate (TWAMP-UDP & TCP)		500 counts (TWAMP-UDP) 500 counts (TCP) at each hotspot Payload- 512 bytes in all drive

Table-21: Data test detail

Note-

- 5 Data iteration to be done at each hotspot location.
- Minimum 5 iteration to be made during the walk test. Iteration count will be increased based on walk test distance.
- TWAMP-UDP & TCP test to be performed only once at hotspot location.
- Youtube & Web browsing test to be performed at static location only.
- All values are taken up to two decimal places with round off.
- Delhi-based TRAI server was used for HTTP Download, HTTP Upload, TCP and TWAMP testing for Airtel, BSNL and RJIL.
- VIL server was used for HTTP Download, HTTP Upload, TCP and TWAMP testing, for VIL.

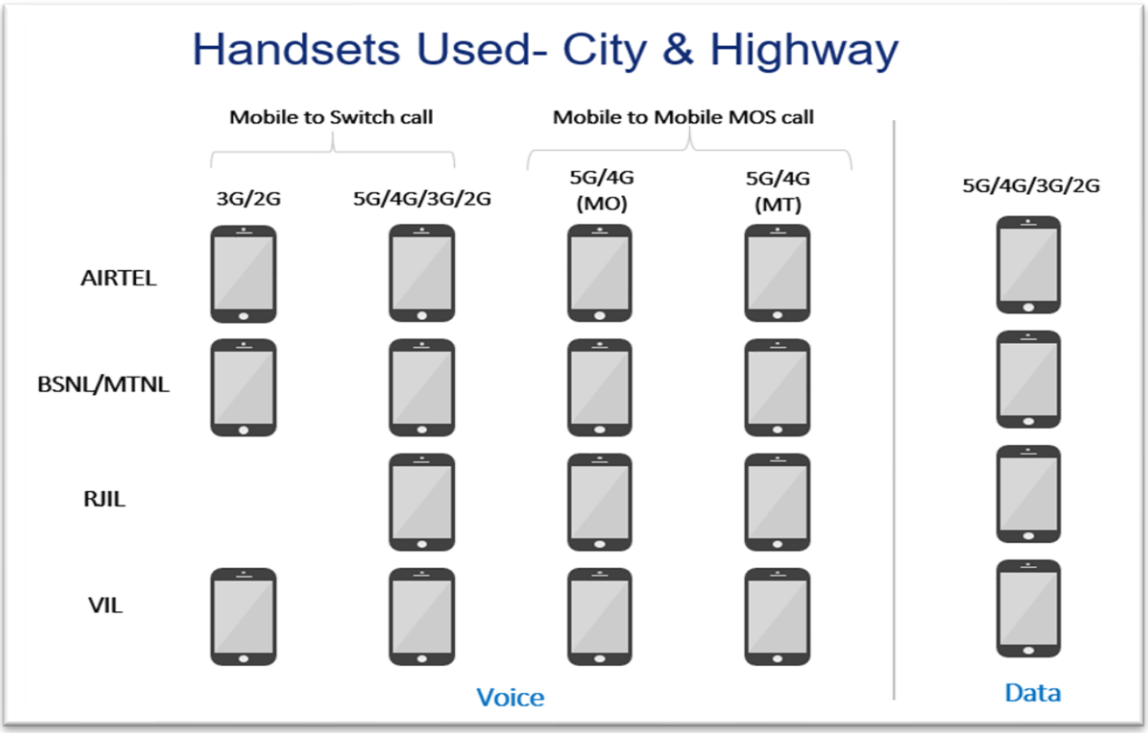


Figure-43: Number of handsets used in city & highway drive

MO: Mobile originating

MT: Mobile terminating

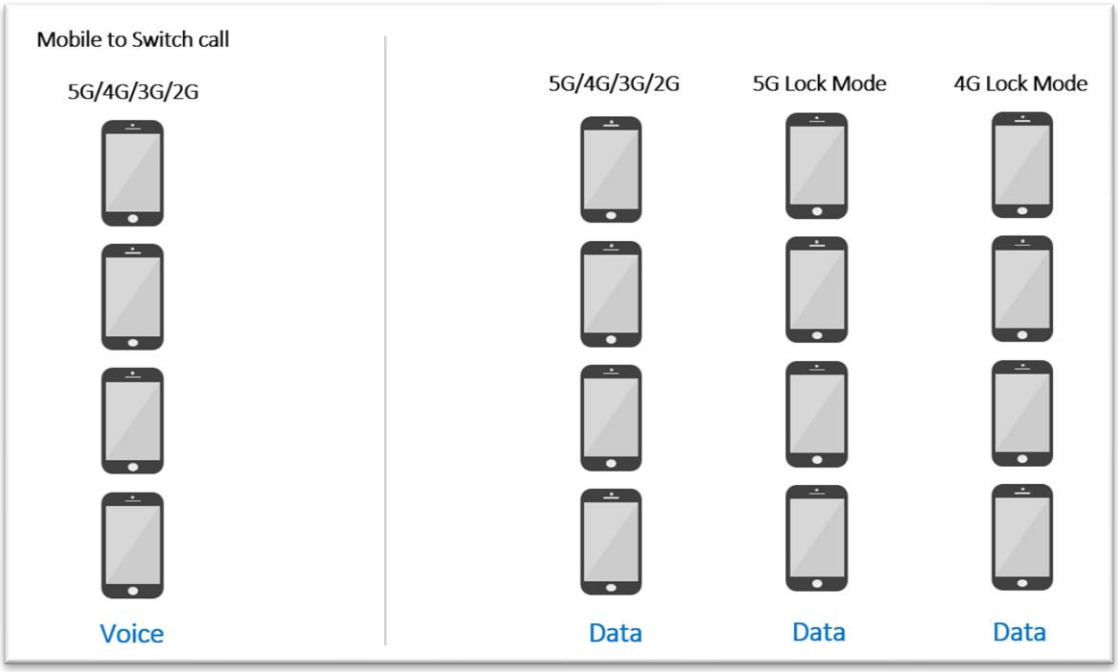


Figure-44: Number of handsets used in railway/metro/walktest/hotspot/ coastal area

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

7.1.2 Drive test Methodology

(a) Dynamic voice testing (on the move)

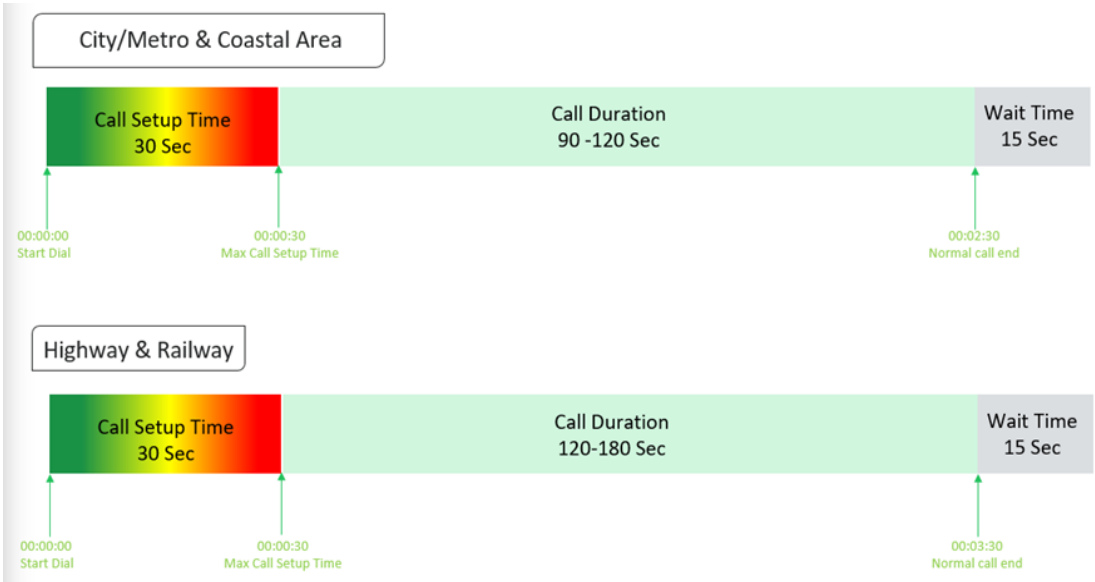


Figure-45: Voice test script for city/railway/metro/highway & coastal area

- 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-46: 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

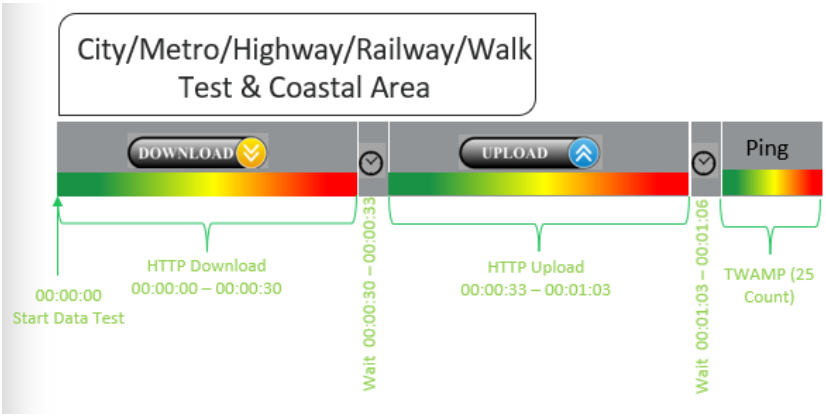


Figure-47: Data test script used in city/metro/railway/highway/walk test & coastal area

(d) Static Data(internet) testing

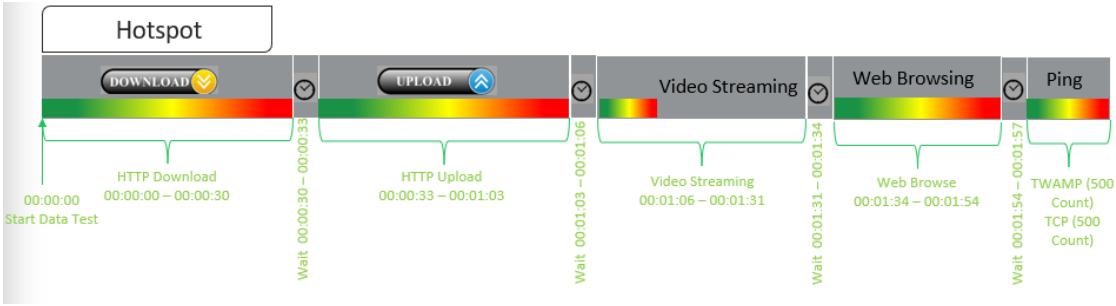


Figure-48: Data test script used at hotspot

- 5 Data iteration done at each hotspot location
- Min. 5 iteration made during the walk test.
- Web browsing duration mentioned above is for one web site only.
- One ping iteration (with 500 Count of each- TWAMP & TCP) done at hotspot location.

7.2 Appendix-II

7.2.1 Network Performance Parameters for Voice calls

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

<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 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 is calculated from MOS call for packet call only (VoNR/VoLTE)</td></tr>
<tr><td>Uplink Packet Drop Rate</td><td>Number of RTP (Real-time Transport Protocol) Packets lost divided by total RTP packet received (against each source_SSRC and sequence number) at call terminating handset. This KPI is calculated from MOS call for packet call only (VoNR/VoLTE).</td></tr>
<tr><td>Signal Strength</td><td>Signal strength is the signal power level received by the wireless user.

<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-22: Network performance parameter and definition voice

7.2.2 Network Performance Parameters Data tests

Parameter Name	Definition
Download Speed (Mbps)	The download speed is defined as the data transmission rate that is achieved for downloading a test file from a test server to a test device. Download Speed = Total bytes transferred during download / Total time for transfer • 80th percentile (upper range) & 20th percentile (lower range) value has been calculated for download throughput in dynamic drive and Hotspot combine data
Upload Speed (Mbps)	The upload speed is the data transmission rate that is achieved for uploading a test file from a test device to a test server. Upload Speed = Total bytes transferred during upload / Total time for transfer. • 80th percentile (upper range) & 20th percentile (lower range) value has been calculated for upload throughput in dynamic drive and Hotspot combine data.
Download Session Setup Success Rate	(total download session established (successfully connected to server)/ total download session attempt) *100. This KPI has been calculated for Hotspot only.

Upload Session Setup Success Rate	(total upload session established (successfully connected to server)/ total upload session attempt)*100. This KPI need to report for Hotspot only.
Web Page Download Time	Web browsing test is used to measure performance in terms of opening a web/HTTP page. Time taken to open the web page successfully is considered as web browsing delay/web page download time.
Video Streaming Delay	The Video streaming delay is time taken from start of video transfer to First video frame displayed in player.
Latency (TWAMP-UDP)	Latency is the time it takes for a small data set to be transmitted from a device to a server on the Internet and back to the same device again. 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 (TWAMP-UDP)	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 (TWAMP-UDP & TCP)	Number of packets lost out of total packet transferred during test. Packet loss rate = (Total packet lost / Total packet sent) *100 * Packet delay (using TWAMP-UDP & TCP) >90 ms considered as packet loss and included in packet loss rate. * Packet loss rate is calculated based on TWAMP-UDP & TCP. *90th percentile for Packet loss rate has been reported in overall Hotspot performance summary.

Table-23: Network performance parameter and definition Data

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

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