



# INDEPENDENT DRIVE TEST REPORT

*For*

# Chennai

2018-2019

December, January

**SOUTH ZONE**

**Key Performance Indicators: All TSPs have met the Drop Call Rate (DCR) benchmark of 2%. All TSPs have met the Call Setup Success Rate (CSSR) of 95%.**

The Independent Drive Test has been carried out by M/s PhiMetrics Technologies Pvt. Ltd. on behalf of TRAI in Chennai City & adjoining areas from 9:00 AM to 9:00 PM; 17<sup>th</sup> December 2018 to 2<sup>nd</sup> January 2019 . The drive test covered an drive route of 1450 KMs & 10 hotspot over a period of 12 days. Approximately 2330 calls were made for each of the 12 networks: five 2G networks, five 3G networks and Two LTE network covering 5 unique TSPs

Overview

Voice Summary

Data Summary

# Overview

## Overview:

Telecom Regulatory Authority of India has been entrusted with the task of laying down the standards of quality of service to be provided by the service providers and ensuring its enforcement; and also TRAI is 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

TRAI is regularly monitoring the performance of Telecom Service Providers (TSP) against the benchmarks for the various Quality of Service (QoS) parameters laid down by the Authority. TSPs submit Performance Monitoring Reports to TRAI every quarter. TRAI also undertakes audit and assessment of Quality of Service through independent agencies to verify the Quality of Service claimed. The Audit agencies conduct sample 'Drive tests' across various cities in the country as part of audit and assessment of the TSPs' performance.

In view of complaints on call drops and other network quality issues, on behalf of TRAI, an Independent Drive Test (IDT) was conducted by PhiMetrics Technologies Pvt. Ltd. From **17<sup>th</sup> December 2018 to 2<sup>nd</sup> January 2019** covering various locations in Chennai City & surrounding region. The performance of **Airtel, BSNL, Tata, Vodafone Idea Limited (VIL(Idea, Vodafone)) and Jio** were monitored across various technologies (2G, 3G, and 4G). The drive test route was defined on the basis of several factors that include - areas from where call drop complaints are commonly received; areas of heavy usage; residential areas away from arterial roads; office areas; areas where previous Drive tests showed network issues; etc.

The test results obtained from these drive tests were utilized to assess the network quality for Voice and Data services in terms of **Voice: Coverage, Quality, Handover Success Rate, Call Setup Success Rate, Drop Call Rate and Block Call Rate.**

**Data: Download and Upload Throughputs, Web Browsing Delay, Video Streaming Delay and Latency**

## Drive Test Details For Chennai:

Independent Drive test was conducted for a period of 12 days from 17<sup>th</sup> December 2018 to 2<sup>nd</sup> January 2019 in Chennai city & surrounding areas from 9:00 AM to 9:00 PM. Calls were made for 90 sec duration with wait time of 10 sec between calls in all technologies.

**Voice Tests:** The drive test covered a drive route of approximately 1450 KMs over a period of 10 days from 17<sup>th</sup> December 2018 to 2<sup>nd</sup> January 2019 . Approximately 2330 calls were made for each of the 12 networks: five 2G (Lock Mode) networks, five 3G (Free Mode) networks and two VoLTE network covering 5 unique TSPs.

\* In case of multiple call failure in similar geo location in given period of 60secs has been counted as one call failure

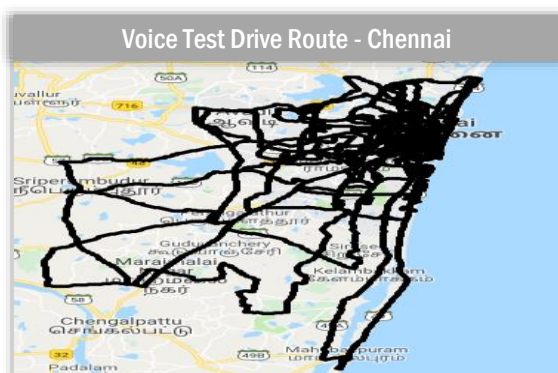
**Data Tests:** Data Tests were performed at 10 static locations for 2 days on 21<sup>st</sup> December and 28<sup>th</sup> December 2018 ; five 2G (Lock mode) networks, five 3G (Dual mode) networks and Four 4G (Dual mode) networks covering 5 unique TSPs were tested.

\* For Voice and Data KPI's, 2G measurement is done with UE locked on 2G, 3G measurement is done with UE in Dual mode (2G & 3G) and 4G measurement is done with UE in Dual mode.

\* 3G KPI's which are calculated from UE in Dual Mode (2G & 3G) includes samples and events of 2G.

\* 4G KPI's which are calculated from the UE in Dual mode included samples and events of 2G & 3G.

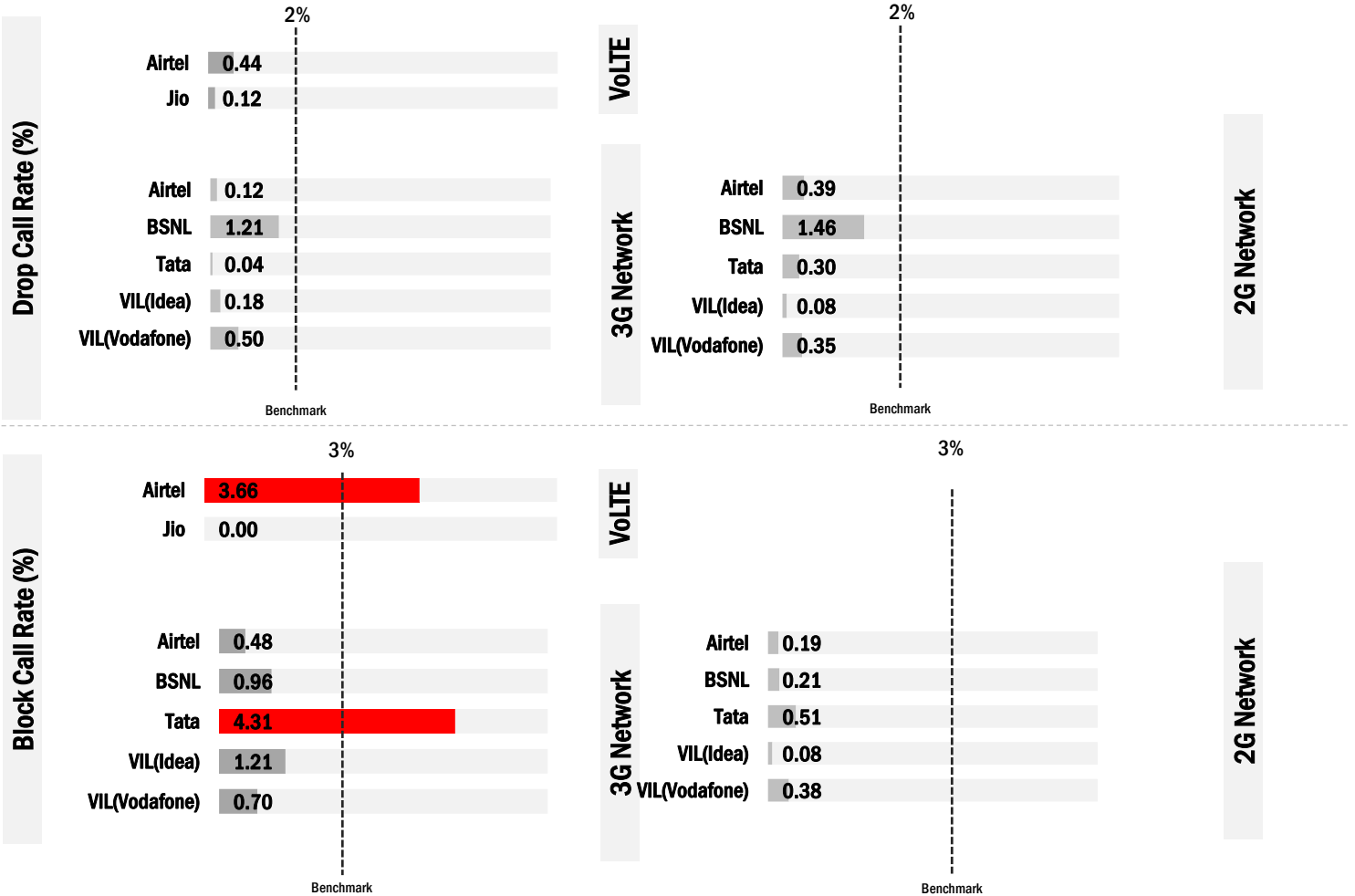
Service	Specifications
Download	2G (Locked) - 500KB, 3G (Dual) - 20 MB, 4G (Free) - 40 MB
Upload	2G (Locked) - 100KB, 3G (Dual) - 5 MB, 4G (Free) - 10 MB
Web Browsing	3 links of e/m commerce website www.amazon.in, www.flipkart.com and PayTm
Video Streaming	130 sec clip
Latency	32 Bytes on www.google.com



# Voice Calls

## Key Observations

QoS compliance of the TSPs in Chennai for Voice across technologies 2G/3G/4G-VoLTE is given below:



KPI	2G Networks				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
SDCCH Congestion%	0.19%	0.12%	0.25%	0.08%	0.23%
TCH Congestion %	0.00%	0.09%	0.26%	0.00%	0.15%

KPI	3G Networks				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
CSFB Failure %	0.04%	NA	NA	1.00%	0.04%
SDCCH Congestion%	0.04%	0.00%	0.00%	0.13%	0.04%
RRC Congestion%	0.32%	0.80%	4.27%	0.00%	0.33%
SDCCH & RRC Congestion%	0.36%	0.80%	4.27%	0.13%	0.37%
TCH Congestion %	0.00%	0.00%	0.00%	0.09%	0.00%
RAB Congestion %	0.08%	0.16%	0.04%	0.00%	0.29%
TCH & RAB Congestion %	0.08%	0.16%	0.04%	0.09%	0.29%

- a) All TSPs have met the 2% QOS benchmark of Drop Call Rate (DCR%).
- b) Call Block Rate (CBR%) benchmark of 3% was achieved by all TSP's except Tata 3G and Airtel VoLTE.

\*VIL= (Idea, Vodafone)

\*NA = Not Applicable

Not meeting Benchmark

# Voice Calls

## Key Observations

### Coverage

a) Percentage of coverage samples for 2G  $\geq$  -85 dBm.

TSPs	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Coverage%	93.82%	96.78%	92.98%	94.54%	90.03%

b) Percentage of coverage samples for 2G  $\geq$  -85 dBm, 3G  $\geq$  -90 dBm & LTE  $\geq$  -110 dBm.

TSPs	3G					VoLTE	
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio
Coverage %	97.98%	97.43%	98.04%	97.26%	95.90%	97.29%	99.10%

c) Percentage of time spent on 3G network:

TSPs	3G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Time Spent on 3G%	85.16%	72.15%	98.12%	1.11%	77.67%

d) Percentage of RLT  $\geq$  48:

TSPs	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
%RLT $\geq$ 48	7.15%	20.34%	7.02%	0.00%	0.00%

e) Average CST Second

TSPs	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
CST(sec)	2.85	3.10	3.06	3.14	2.43

TSPs	3G					VOLTE	
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio
CST(sec)	5.06	3.05	4.15	6.23	3.40	0.96	0.37

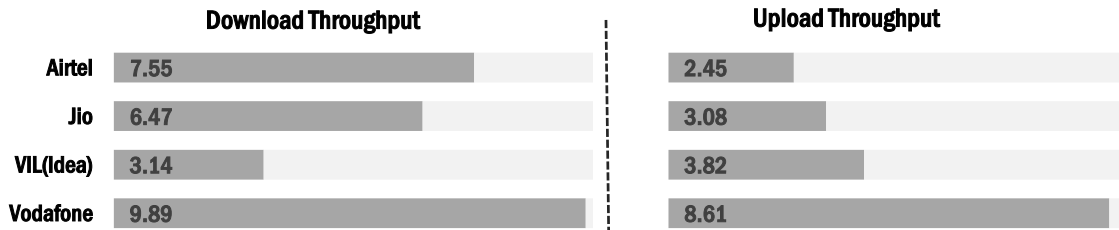
# Data Services Static

## Key Observations

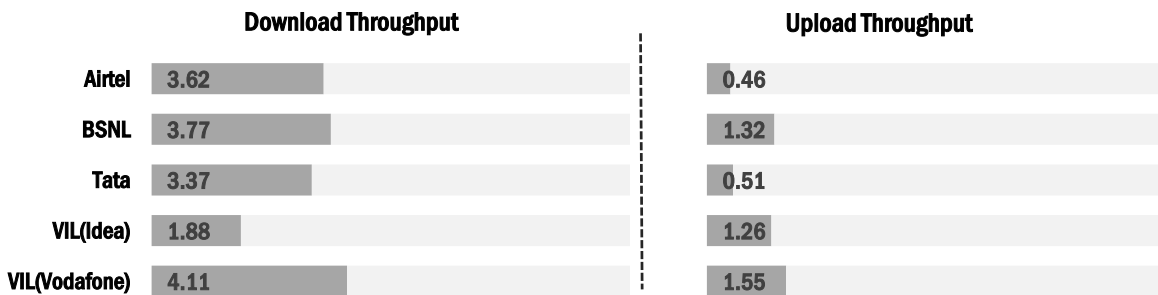
Data was tested at 10 locations .Following services were tested: Data Download/Upload, Latency (www.google.com), Video Streaming (YouTube) and Web browsing (Flipkart, Amazon, PayTm)

### Data Download and Upload Performance (Mbps)

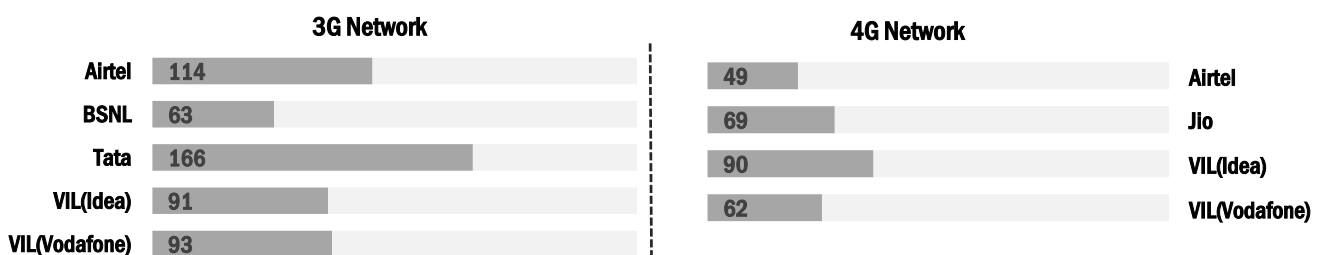
#### 4G Network:



#### 3G Network:



### Latency (msec)

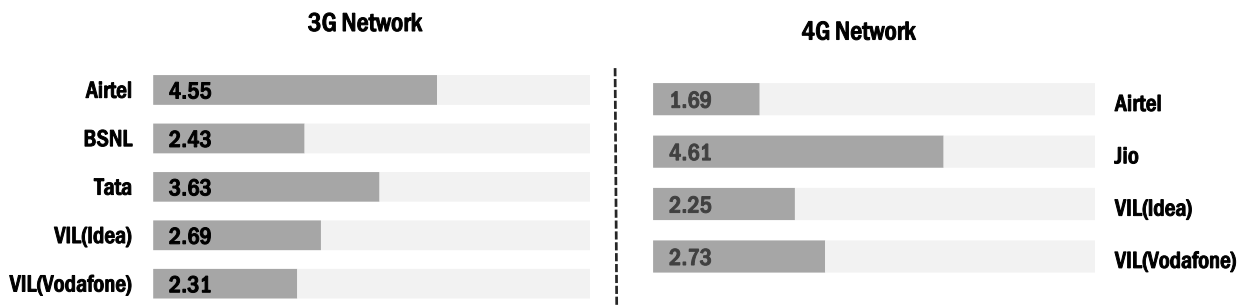


# Data Services Static

## Key Observations

### Video Streaming Performance (130 sec YouTube video sample sizes)

Streaming (sec)

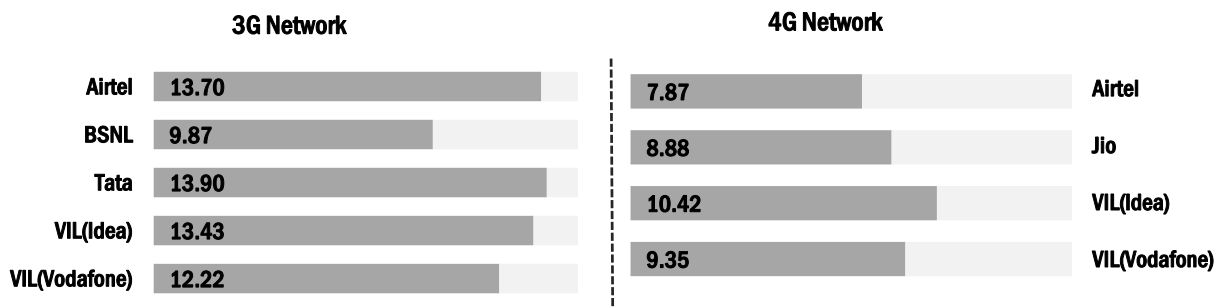


Streaming Delay further broken into 2 parameters which form the end-user perception to assess consistency on Video streaming.

- Initial Start time
- Interruption time while playing the video.

Video Streaming	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Avg. Initial Start Time (sec)	2.82	2.16	2.49	1.65	2.31	1.48	2.51	1.95	2.31
Avg. Interruption Time (sec)	1.73	0.27	1.14	1.04	0.00	0.21	2.10	0.30	0.42

### Web Page Download Time (sec)



Web browsing experience is the average time taken to fully load the websites tested.

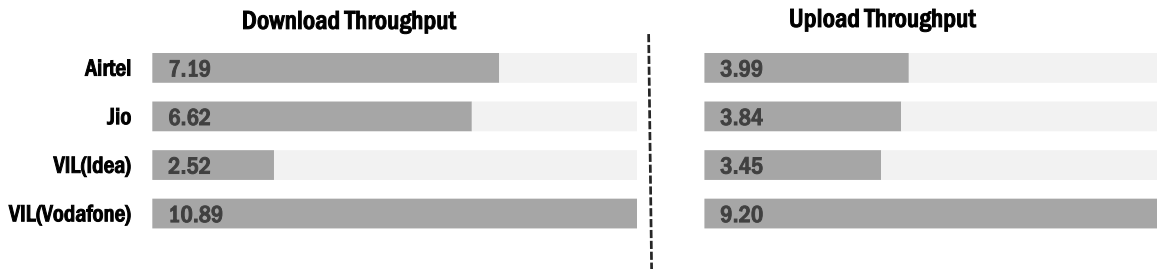
# Data Services Dynamic

## Key Observations

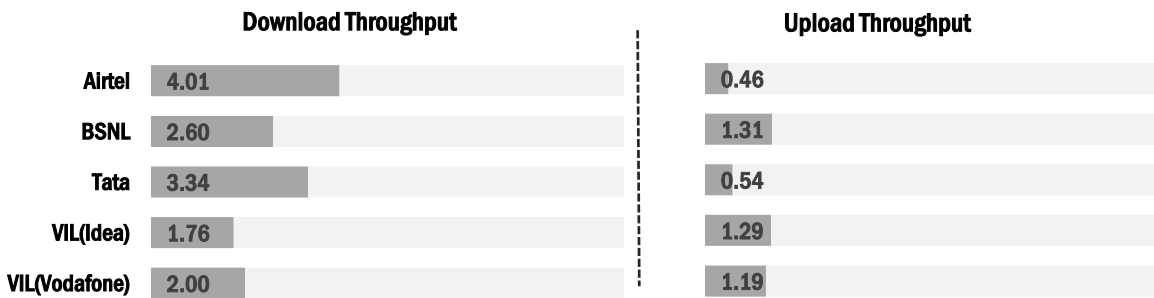
Data was tested between one location to another location .Following services were tested: Data Download/Upload, Latency (www.google.com), Video Streaming (YouTube) and Web browsing (Flipkart, Amazon, PayTm)

### Data Download and Upload Performance (Mbps)

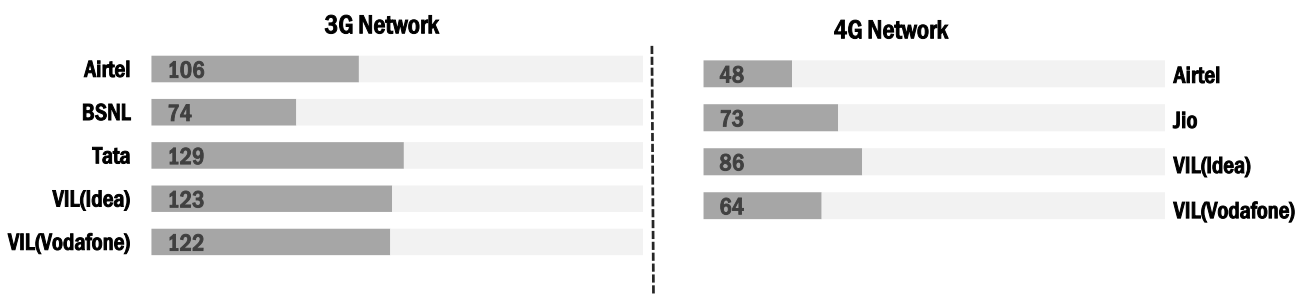
#### 4G Network:



#### 3G Network:



### Latency (msec)

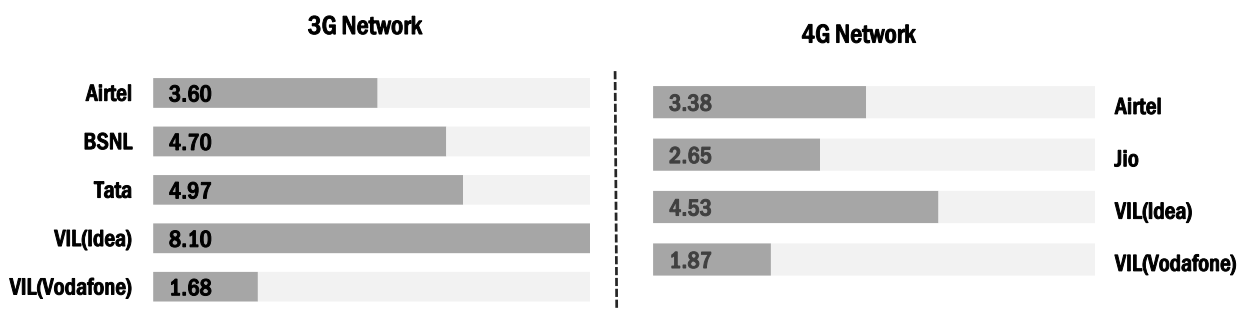


# Data Services Dynamic

## Key Observations

### Video Streaming Performance (130 sec YouTube video sample sizes)

Streaming (sec)

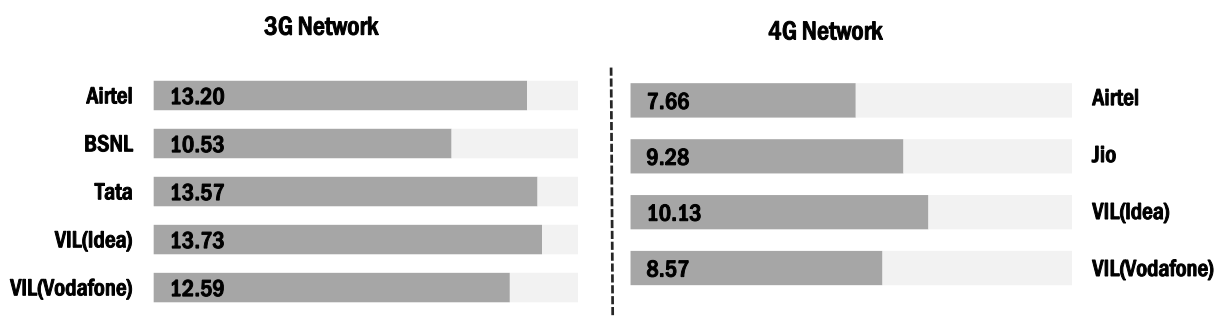


Streaming Delay further broken into 2 parameters which form the end-user perception to assess consistency on Video streaming.

- Initial Start time
- Interruption time while playing the video.

Video Streaming	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Avg. Initial Start Time (sec)	2.55	4.29	2.99	7.87	1.68	2.48	1.97	2.89	1.79
Avg. Interruption Time (sec)	1.05	0.41	1.98	0.23	0.00	0.90	0.68	1.64	0.08

### Web Page Download Time (sec)



Web browsing experience is the average time taken to fully load the websites tested.



# Summary

## City Level Summary

Voice Call	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Call Attempt	2567	2410	2374	2556	2615
Blocked Call Rate (%)	0.19%	0.21%	0.51%	0.08%	0.38%
CSSR% (Accessibility)	99.81%	99.79%	99.49%	99.92%	99.62%
Drop Call Rate (%)	0.39%	1.46%	0.30%	0.08%	0.35%
Mobility HOSR (%)	98.47%	97.76%	98.10%	99.02%	98.36%
Rx Quality (%)	98.06%	98.47%	97.86%	98.86%	98.65%

Voice Call	3G					VoLTE	
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio
Call Attempt	2480	2505	2364	2307	2439	710	2592
Blocked Call Rate (%)	0.48%	0.96%	4.31%	1.21%	0.70%	3.66%	0.00%
CSSR% (Accessibility)	99.52%	99.04%	95.69%	98.79%	99.30%	96.34%	100.00%
Drop Call Rate (%)	0.12%	1.21%	0.04%	0.18%	0.50%	0.44%	0.12%
Mobility HOSR (%)	99.97%	99.84%	99.97%	98.97%	99.88%	98.66%	99.76%
Rx Quality (%)	96.15%	98.13%	96.72%	96.35%	91.94%	70.87%	91.93%

# Summary

## City Level Summary(contd.)

### Data Test - Stationary

Data Services	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	146.95	117.10	111.13	138.98	120.58
Upload Throughput (kbps)	137.31	101.50	142.04	123.90	135.52
Web Browsing Delay (sec)	27.53	28.60	26.30	27.26	26.55
Latency (msec)	259	238	395	428	249

Data Services	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	3.62	3.77	1.88	1.88	4.11	7.55	6.47	3.14	9.89
Upload Throughput (Mbps)	0.46	1.32	1.26	1.26	1.55	2.45	3.08	3.82	8.61
Web Browsing Delay (sec)	13.70	9.87	13.43	13.43	12.22	7.87	8.88	10.42	9.35
Video Streaming Delay (sec)	4.55	2.43	2.69	2.69	2.31	1.69	4.61	2.25	2.73
Latency (msec)	114	63	91	91	93	49	69	90	62

### Data Test - Mobility

Data Services	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	4.01	2.60	3.34	1.76	2.00	7.19	6.62	2.52	10.89
Upload Throughput (Mbps)	0.46	1.31	0.54	1.29	1.19	3.99	3.84	3.45	9.20
Web Browsing Delay (sec)	13.20	10.53	13.57	13.73	12.59	7.66	9.28	10.13	8.57
Video Streaming Delay (sec)	3.60	4.70	4.97	8.10	1.68	3.38	2.65	4.53	1.87
Latency (msec)	106	74	129	123	122	48	73	86	64

\*T0=Timeout

# Summary

## City Level Summary(contd.)

Airport	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	188.93	11.48	89.17	179.51	188.93
Upload Throughput (kbps)	199.81	23.12	153.43	141.69	191.96
Web Browsing Delay (sec)	29.93	19.52	32.92	25.61	29.93
Latency (msec)	149	390	291	530	149

Airport	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	1.88	1.67	1.45	2.92	3.70	14.42	10.71	7.31	3.31
Upload Throughput (Mbps)	0.09	0.42	0.12	1.28	1.47	1.99	6.31	4.26	5.43
Web Browsing Delay (sec)	17.24	11.79	17.47	11.41	11.40	7.24	5.33	8.61	9.76
Video Streaming Delay (sec)	2.39	1.70	1.59	1.32	2.50	1.27	2.19	1.38	3.67
Latency (msec)	243	62	239	125	66	75	76	87	58

Forum Mall	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	115.85	157.14	115.85	161.62	80.98
Upload Throughput (kbps)	129.69	117.25	136.01	134.54	93.10
Web Browsing Delay (sec)	23.31	32.02	23.31	26.41	14.70
Latency (msec)	543	151	543	345	510

Forum Mall	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	0.67	4.91	0.76	0.23	0.18	2.31	15.70	2.35	1.99
Upload Throughput (Mbps)	0.01	2.27	0.03	1.23	0.16	1.15	4.28	3.95	4.75
Web Browsing Delay (sec)	19.35	8.63	16.11	14.40	28.16	5.93	8.03	9.91	11.03
Video Streaming Delay (sec)	18.55	3.05	10.23	9.96	T0	1.41	0.99	2.99	8.42
Latency (msec)	363	22	219	81	576	29	85	85	62

\*T0=Timeout

# Summary

## City Level Summary(contd.)

Government Hospital	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	88.58	72.96	46.77	119.19	88.58
Upload Throughput (kbps)	105.87	62.34	92.51	108.78	94.30
Web Browsing Delay (sec)	21.42	26.48	22.96	25.07	21.42
Latency (msec)	195	313	487	457	195

Government Hospital	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	2.84	1.28	1.41	1.36	1.80	0.56	0.98	1.20	11.39
Upload Throughput (Mbps)	TO	0.51	0.23	1.25	1.48	0.29	0.96	3.74	9.70
Web Browsing Delay (sec)	TO	15.84	13.39	15.36	12.82	10.25	11.19	9.86	11.84
Video Streaming Delay (sec)	TO	6.21	7.85	1.65	3.54	TO	11.55	3.80	1.27
Latency (msec)	TO	111	223	65	76	48	77	101	59

High Court	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	187.70	187.70	90.32	159.70	156.98
Upload Throughput (kbps)	147.78	151.81	156.96	118.28	157.40
Web Browsing Delay (sec)	31.73	31.73	27.82	30.27	22.88
Latency (msec)	133	133	461	480	181

High Court	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	5.88	3.06	6.84	1.95	3.69	15.07	9.95	5.11	7.97
Upload Throughput (Mbps)	1.59	2.28	1.50	1.57	1.68	7.57	6.03	4.76	7.06
Web Browsing Delay (sec)	8.62	8.93	10.12	13.13	9.50	6.57	5.74	11.12	8.77
Video Streaming Delay (sec)	1.47	1.53	1.21	0.99	1.34	1.16	0.96	0.97	1.50
Latency (msec)	62	22	122	99	71	34	57	94	64

\*TO=Timeout

# Summary

## City Level Summary(contd.)

Koyambedu Bus Stand	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	172.90	120.24	138.17	172.90	54.92
Upload Throughput (kbps)	151.15	161.39	156.84	152.56	116.28
Web Browsing Delay (sec)	27.18	27.40	19.83	27.18	30.47
Latency (msec)	369	156	337	369	231

Koyambedu Bus Stand	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	2.15	3.39	1.86	0.61	0.73	1.13	1.04	5.44	11.84
Upload Throughput (Mbps)	0.24	2.58	0.25	1.24	1.61	1.69	1.00	5.67	10.26
Web Browsing Delay (sec)	13.68	6.04	14.47	16.62	13.39	8.70	12.85	10.56	9.62
Video Streaming Delay (sec)	2.54	2.92	1.70	1.38	2.54	1.94	13.73	1.26	1.27
Latency (msec)	109	19	102	95	77	30	75	87	67

Marina Beach	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	181.20	151.90	183.48	145.95	181.20
Upload Throughput (kbps)	168.78	127.86	220.60	149.36	168.78
Web Browsing Delay (sec)	31.75	31.61	26.24	27.50	31.75
Latency (msec)	162	210	341	543	162

Marina Beach	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	13.02	4.30	9.68	4.81	7.40	8.59	18.06	3.05	19.86
Upload Throughput (Mbps)	1.74	1.44	1.76	1.11	0.93	2.76	5.10	4.73	12.16
Web Browsing Delay (sec)	10.90	8.22	7.99	12.96	9.55	9.10	5.23	9.25	7.14
Video Streaming Delay (sec)	1.30	3.56	0.81	0.74	2.07	1.16	0.91	1.04	0.86
Latency (msec)	38	66	215	56	62	31	90	88	59

\*T0=Timeout

# Summary

## City Level Summary(contd.)

Pacific Mall	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	35.71	71.88	66.34	58.03	35.71
Upload Throughput (kbps)	48.47	51.92	53.02	35.50	49.08
Web Browsing Delay (sec)	27.08	28.98	29.16	24.71	27.08
Latency (msec)	378	329	427	314	378

Pacific Mall	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	2.81	4.49	1.91	0.87	4.12	8.62	2.85	2.04	0.85
Upload Throughput (Mbps)	0.12	0.60	0.13	1.12	0.68	2.38	3.66	3.67	2.33
Web Browsing Delay (sec)	14.03	9.55	16.04	15.34	10.52	8.10	7.41	8.39	11.86
Video Streaming Delay (sec)	1.74	1.14	2.46	5.99	1.13	1.34	3.78	1.93	5.21
Latency (msec)	78	64	164	91	74	46	51	101	63

Railway Station	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	155.89	155.89	133.19	63.23	80.87
Upload Throughput (kbps)	91.99	91.99	92.32	79.64	110.87
Web Browsing Delay (sec)	23.85	23.85	31.69	21.19	24.28
Latency (msec)	306	306	505	350	168

Railway Station	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	2.16	3.40	2.52	2.07	12.54	0.21	1.61	0.41	5.84
Upload Throughput (Mbps)	0.05	0.37	0.13	1.01	6.04	1.69	0.70	1.50	11.24
Web Browsing Delay (sec)	13.09	11.86	19.97	13.21	12.87	10.56	12.36	13.97	8.74
Video Streaming Delay (sec)	13.65	1.64	4.80	2.41	1.41	9.92	6.48	T0	1.50
Latency (msec)	49	174	135	153	82	152	64	85	68

\*T0=Timeout

# Summary

## City Level Summary(contd.)

T Nagar	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	170.11	75.24	170.11	168.34	165.06
Upload Throughput (kbps)	150.31	74.64	149.56	169.87	189.26
Web Browsing Delay (sec)	27.50	32.70	27.50	29.74	28.96
Latency (msec)	329	195	329	372	405

T Nagar	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	1.15	6.54	2.10	1.19	3.47	12.42	2.64	3.41	21.17
Upload Throughput (Mbps)	0.08	1.52	0.23	1.71	1.61	3.25	1.75	3.77	13.82
Web Browsing Delay (sec)	14.59	10.48	10.70	11.74	9.59	5.81	8.77	11.88	7.13
Video Streaming Delay (sec)	2.94	1.47	6.28	1.06	1.61	0.91	8.80	2.55	0.87
Latency (msec)	71	72	130	90	75	22	63	91	61

Tamil Nadu Government Multi Super Speciality Hospital	2G				
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)
Download Throughput (Kbps)	172.60	137.52	86.87	134.32	172.60
Upload Throughput (kbps)	179.29	134.81	209.11	148.80	184.21
Web Browsing Delay (sec)	29.03	29.19	21.82	33.13	29.03
Latency (msec)	157	227	412	439	157

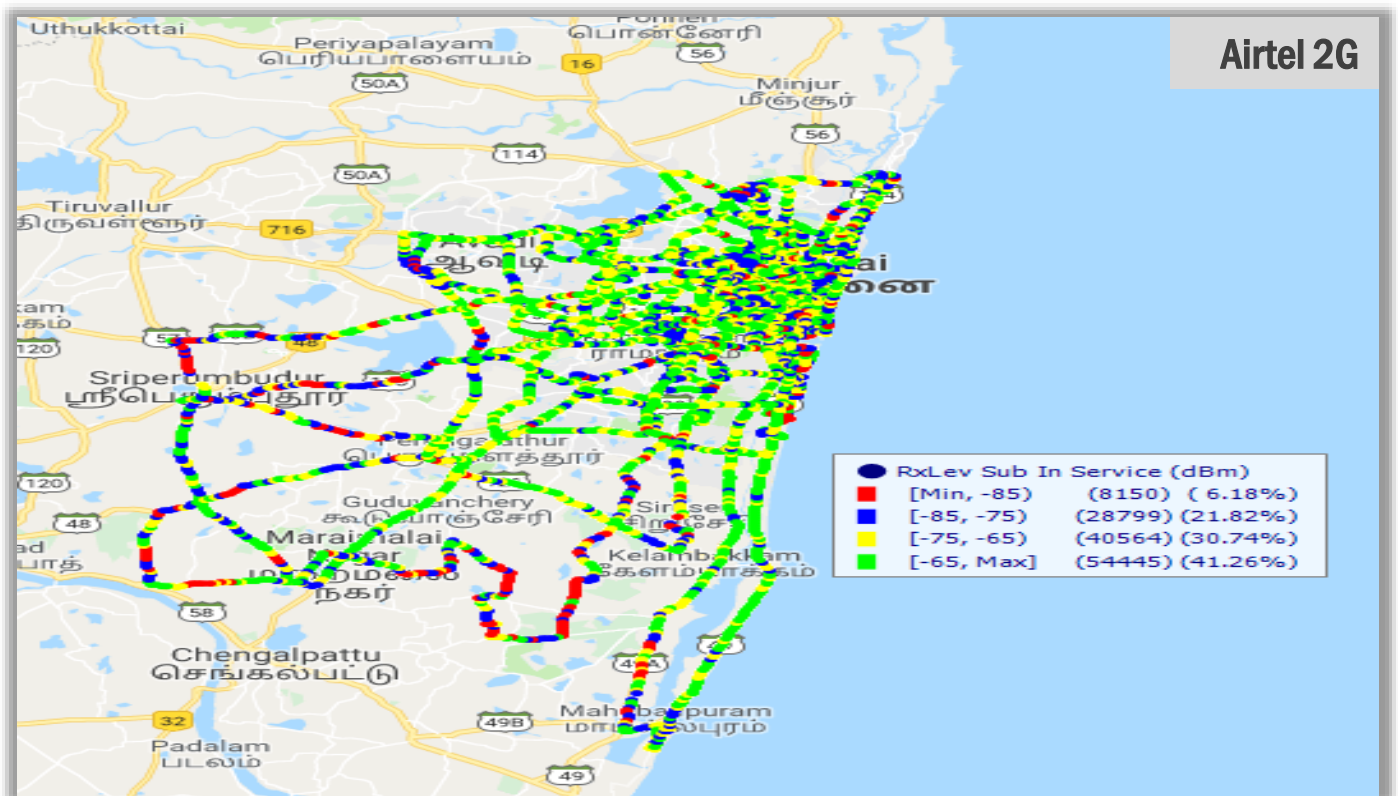
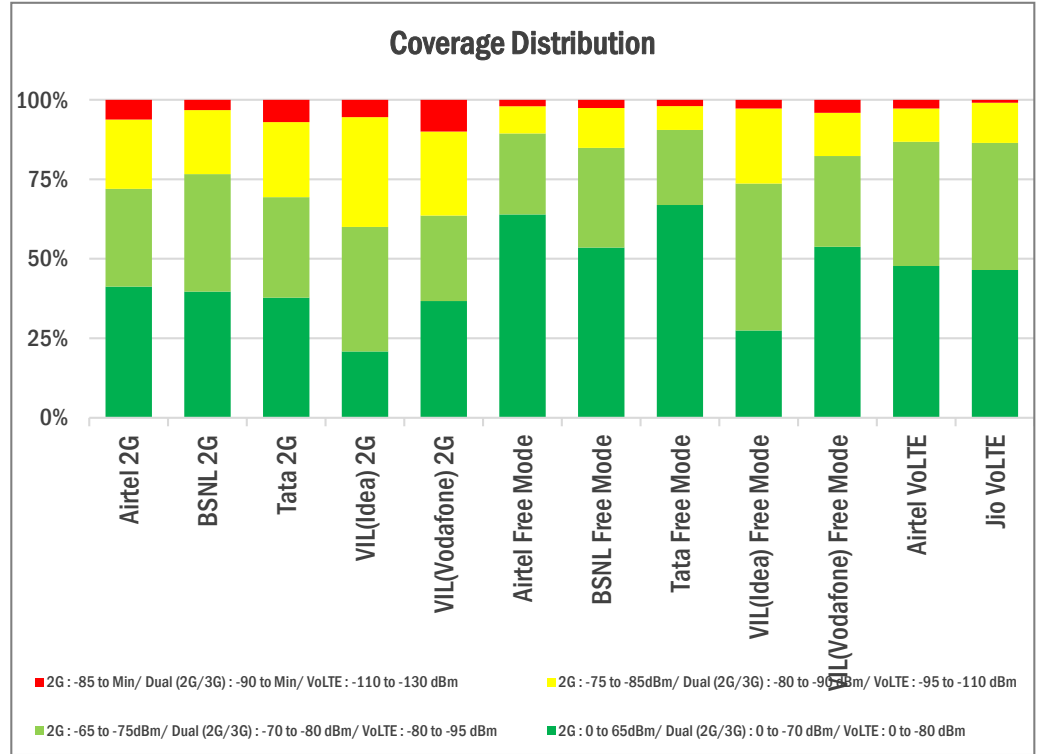
Tamil Nadu Government Multi Super Speciality Hospital	3G					4G			
	Airtel	BSNL	Tata	VIL(Idea)	VIL(Vodafone)	Airtel	Jio	VIL(Idea)	VIL(Vodafone)
Download Throughput (Mbps)	2.14	4.63	5.15	2.89	2.17	7.41	1.12	1.10	17.02
Upload Throughput (Mbps)	0.08	1.21	0.68	1.04	0.92	1.77	1.04	2.19	9.70
Web Browsing Delay (sec)	14.11	7.36	12.34	10.39	11.25	6.69	11.84	10.64	4.43
Video Streaming Delay (sec)	3.71	1.07	2.59	0.64	4.38	1.34	5.33	4.37	T0
Latency (msec)	208	29	99	101	79	48	58	82	T0

\*T0=Timeout

# I. Coverage Details

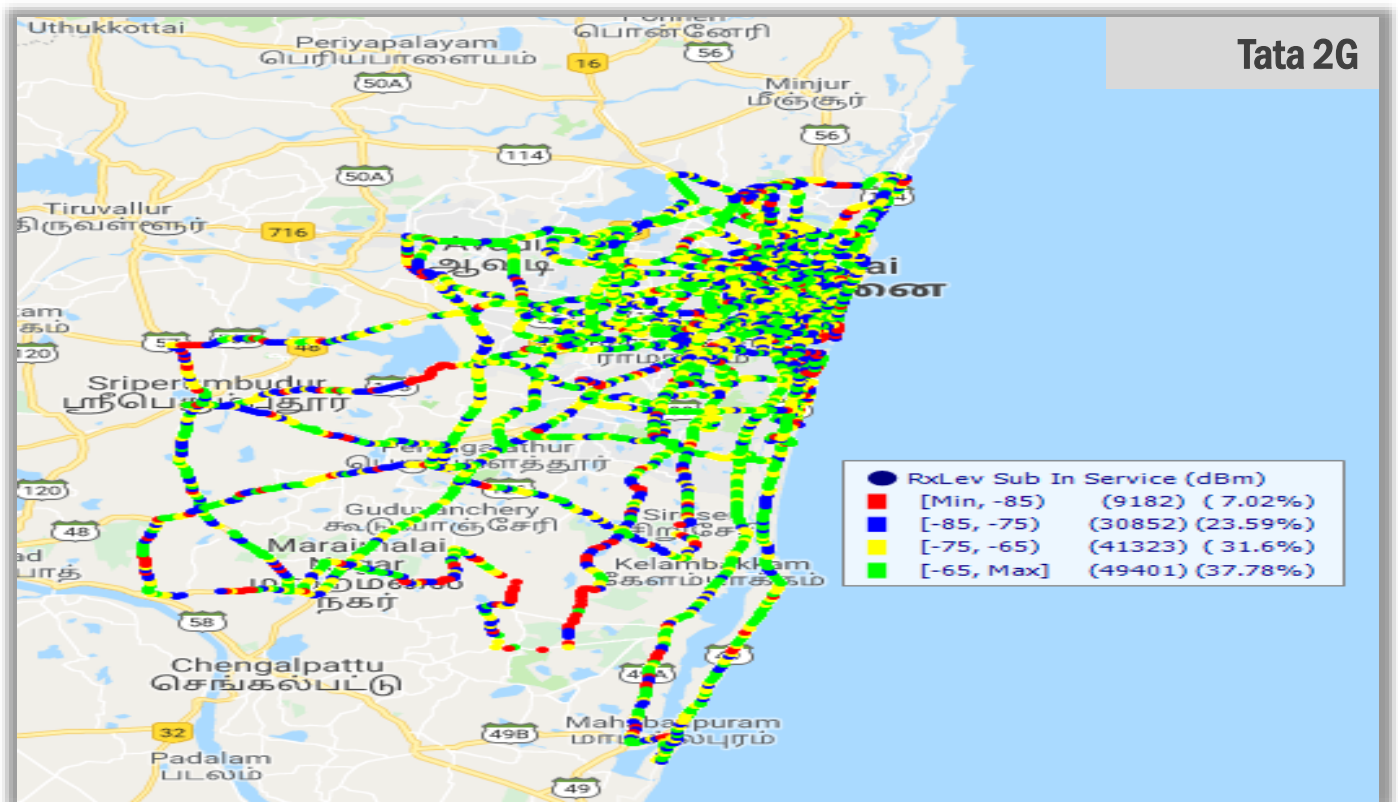
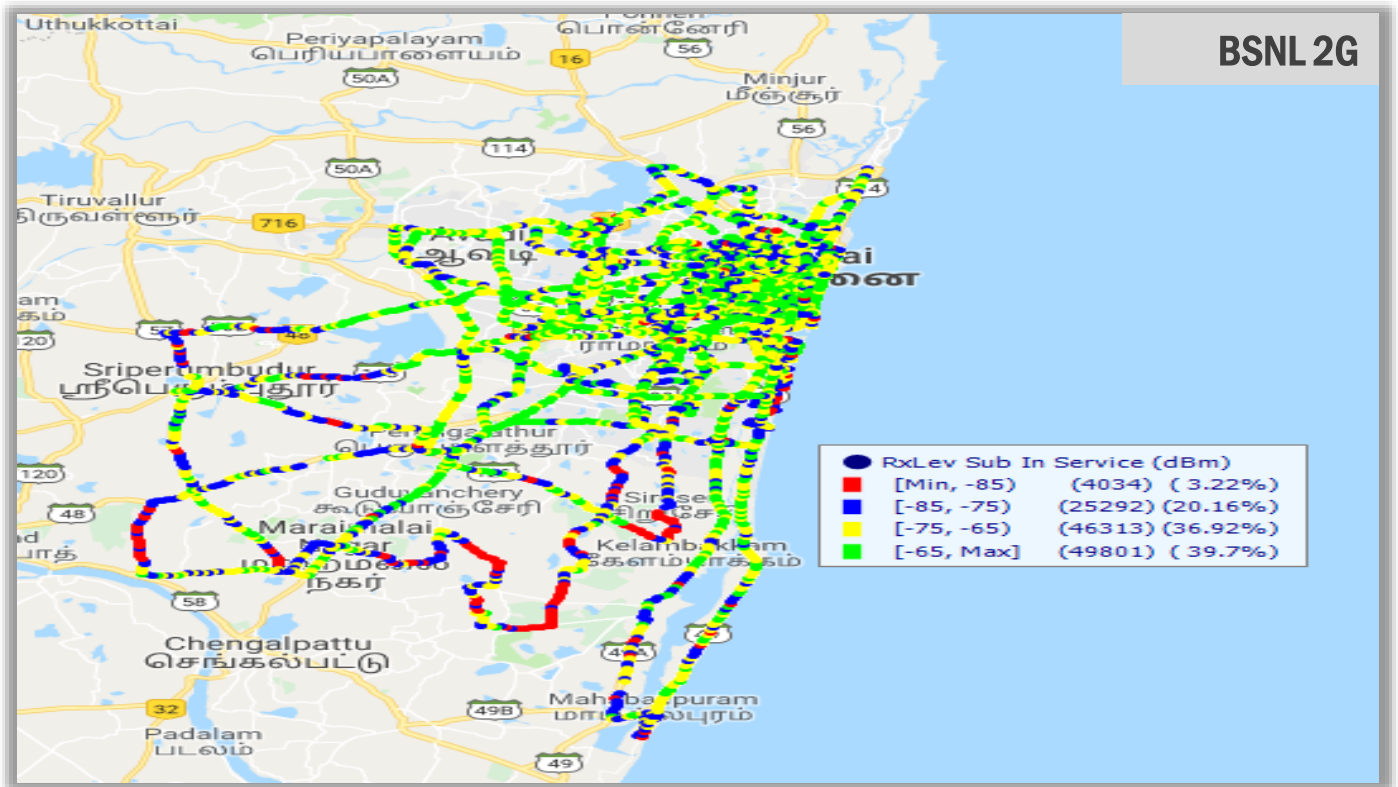
RF Coverage relates to the geographical footprint within the system that has sufficient RF signal strength to provide for a call/data session. The Coverage rate of an TSP is calculated on the basis of % of samples in which the Rx level  $\geq -85$  dBm, RSCP is  $\geq -90$  dBm & RSRP  $\geq -110$  dBm. The details are as follows.

TSP	Coverage Rate
Airtel 2G	93.82%
BSNL 2G	96.78%
Tata 2G	92.98%
VIL(Idea) 2G	94.54%
VIL(Vodafone) 2G	90.03%
Airtel Free Mode	97.98%
BSNL Free Mode	97.43%
Tata Free Mode	98.04%
VIL(Idea) Free Mode	97.26%
VIL(Vodafone) Free Mode	95.90%
Airtel VoLTE	97.29%
Jio VoLTE	99.10%

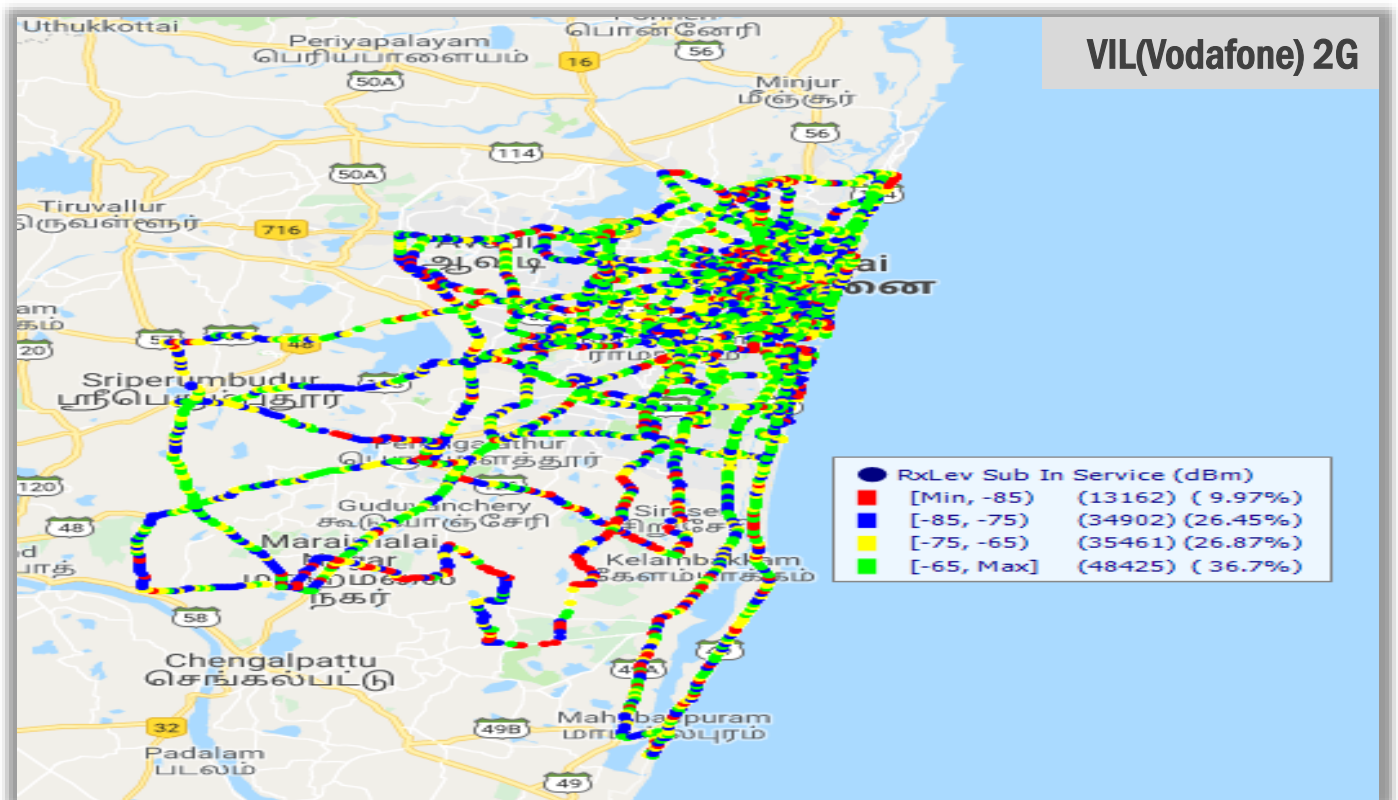
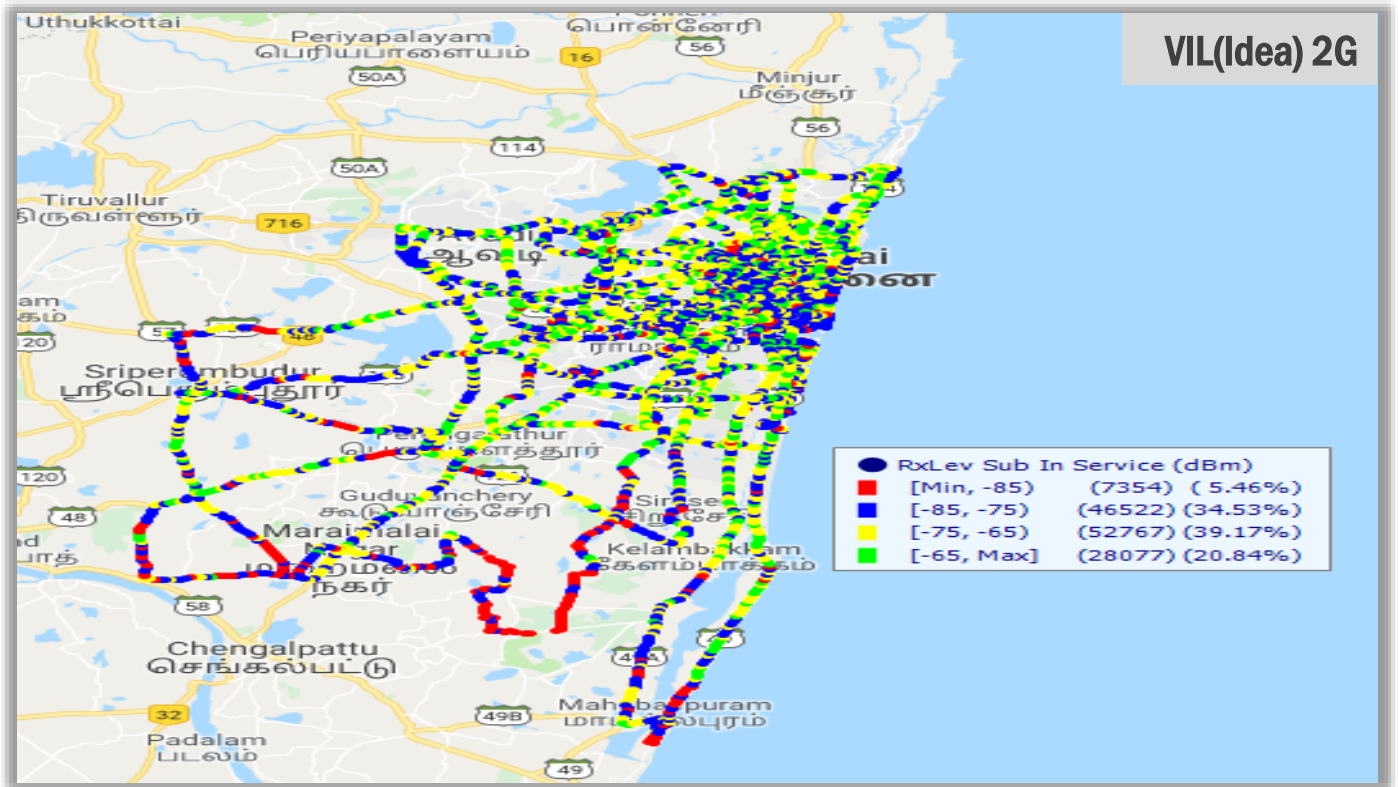




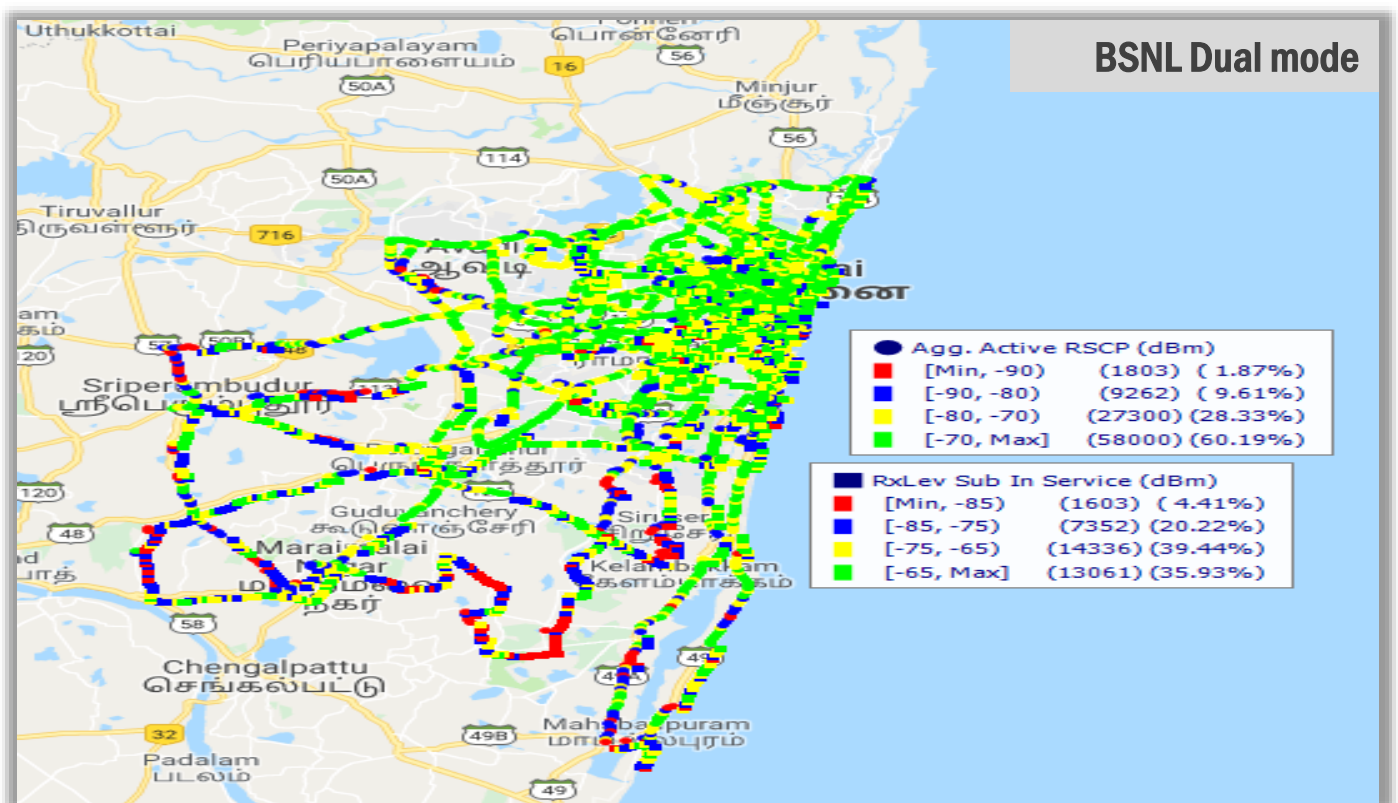
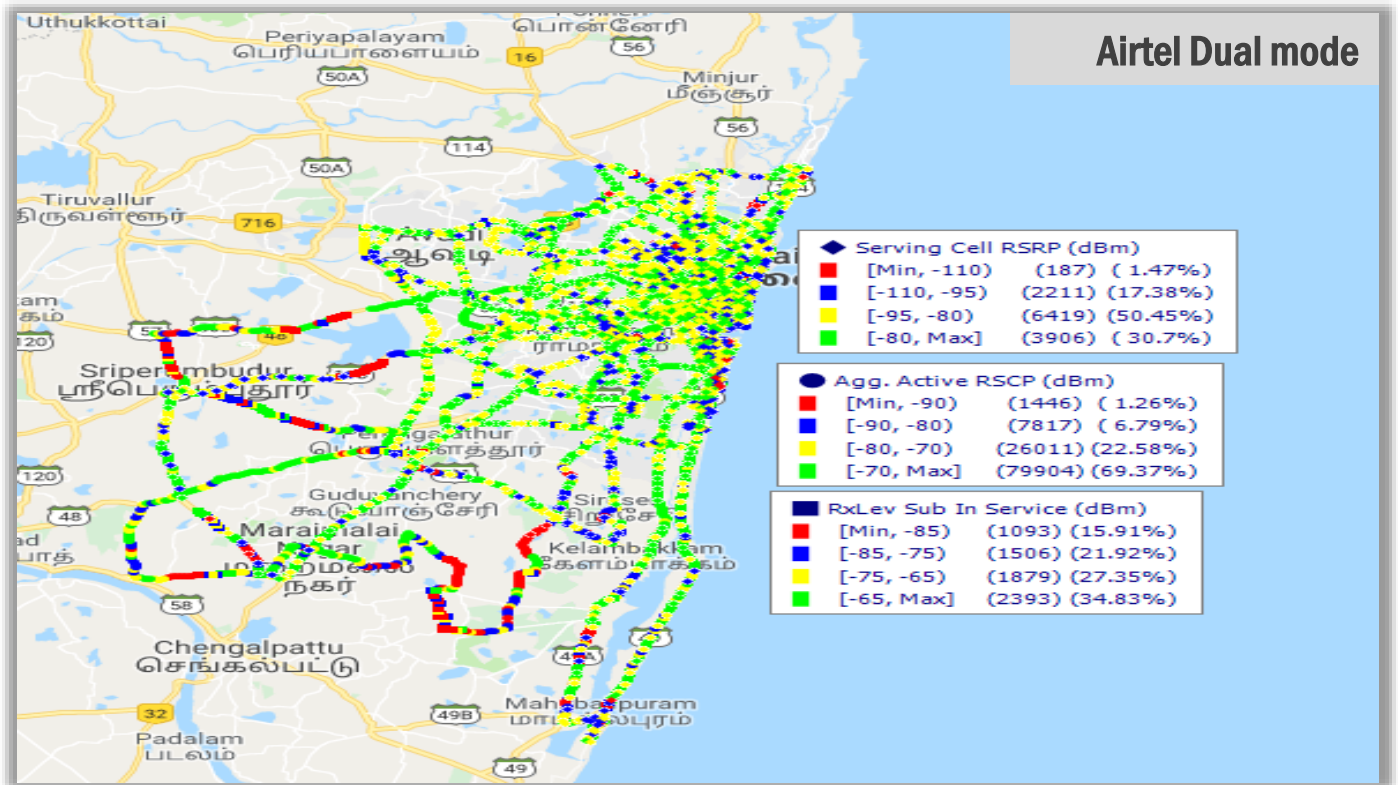
# I. Coverage Details (contd.)



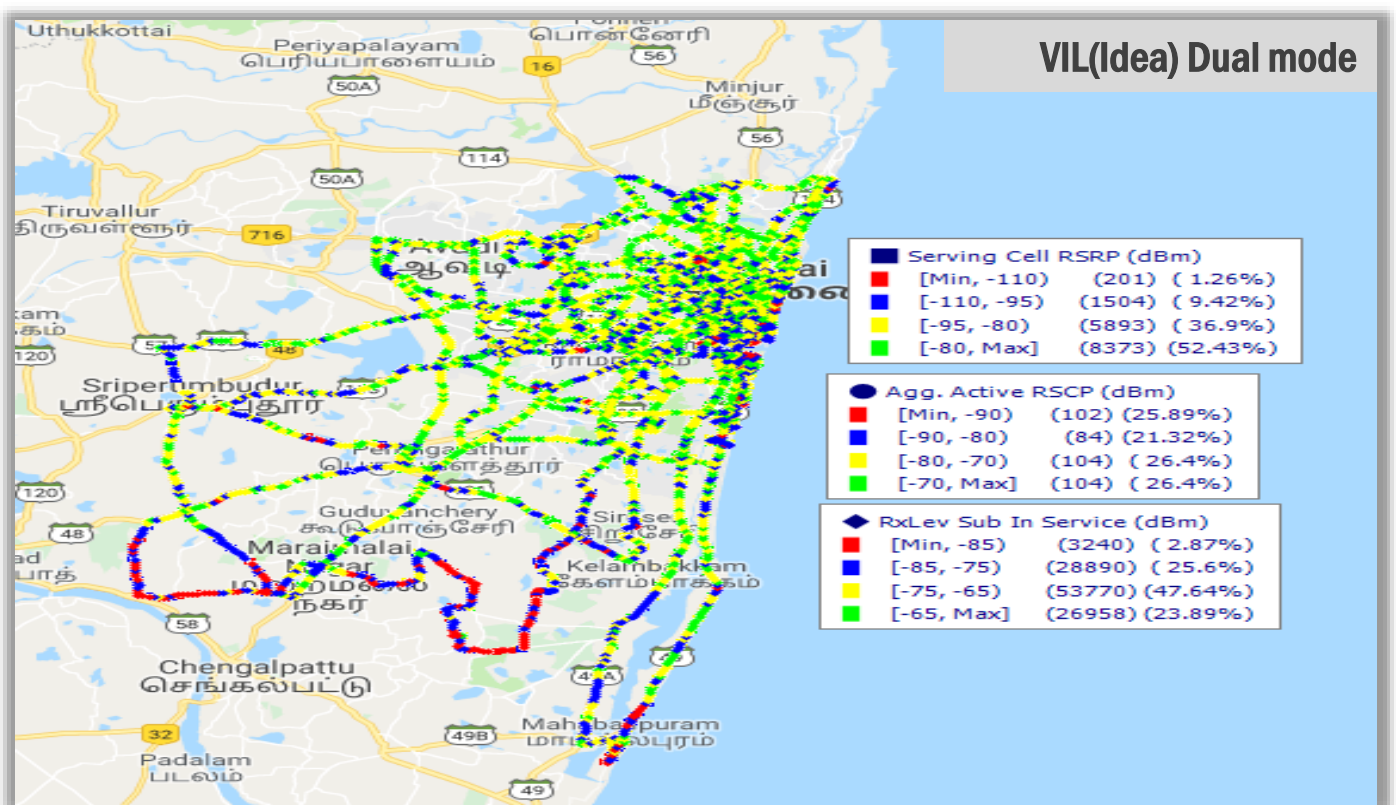
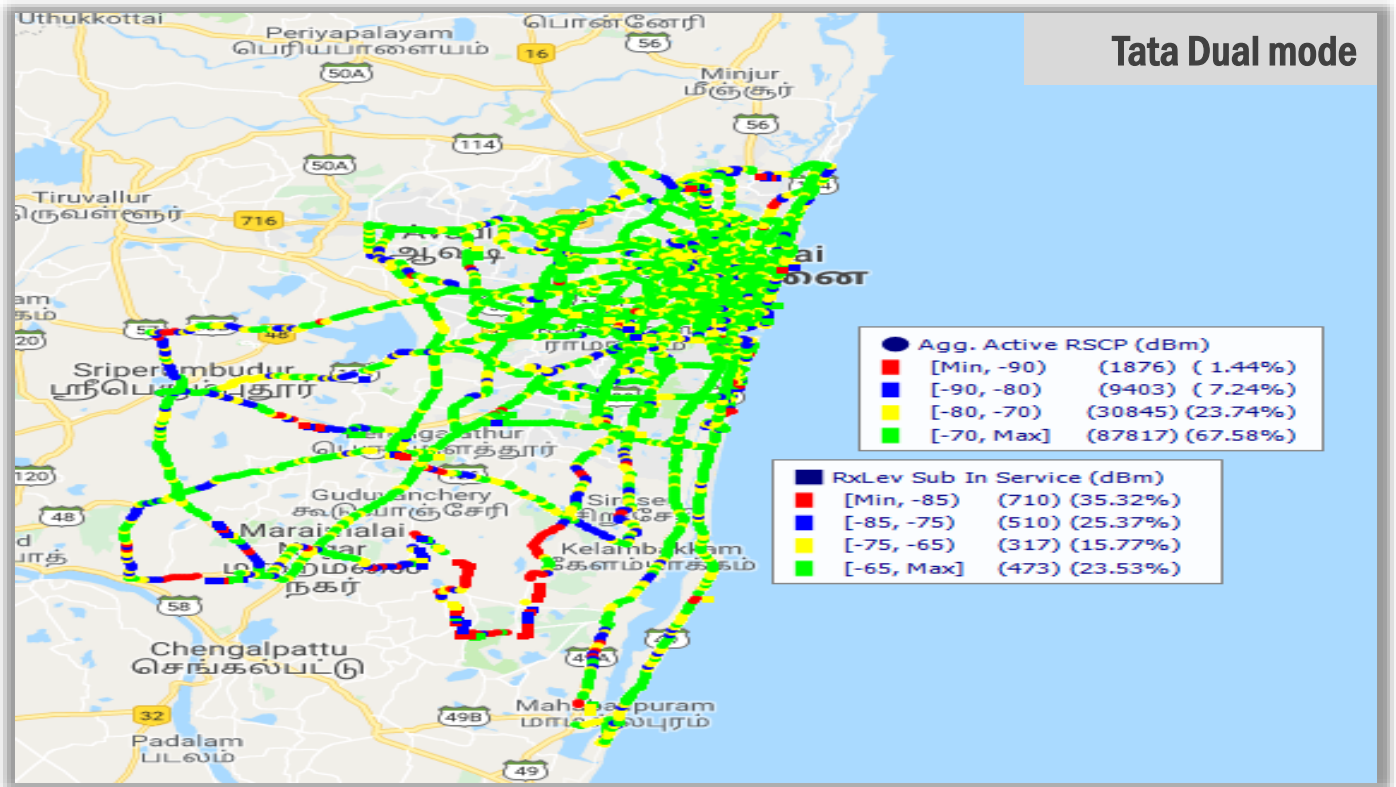
# I. Coverage Details (contd.)



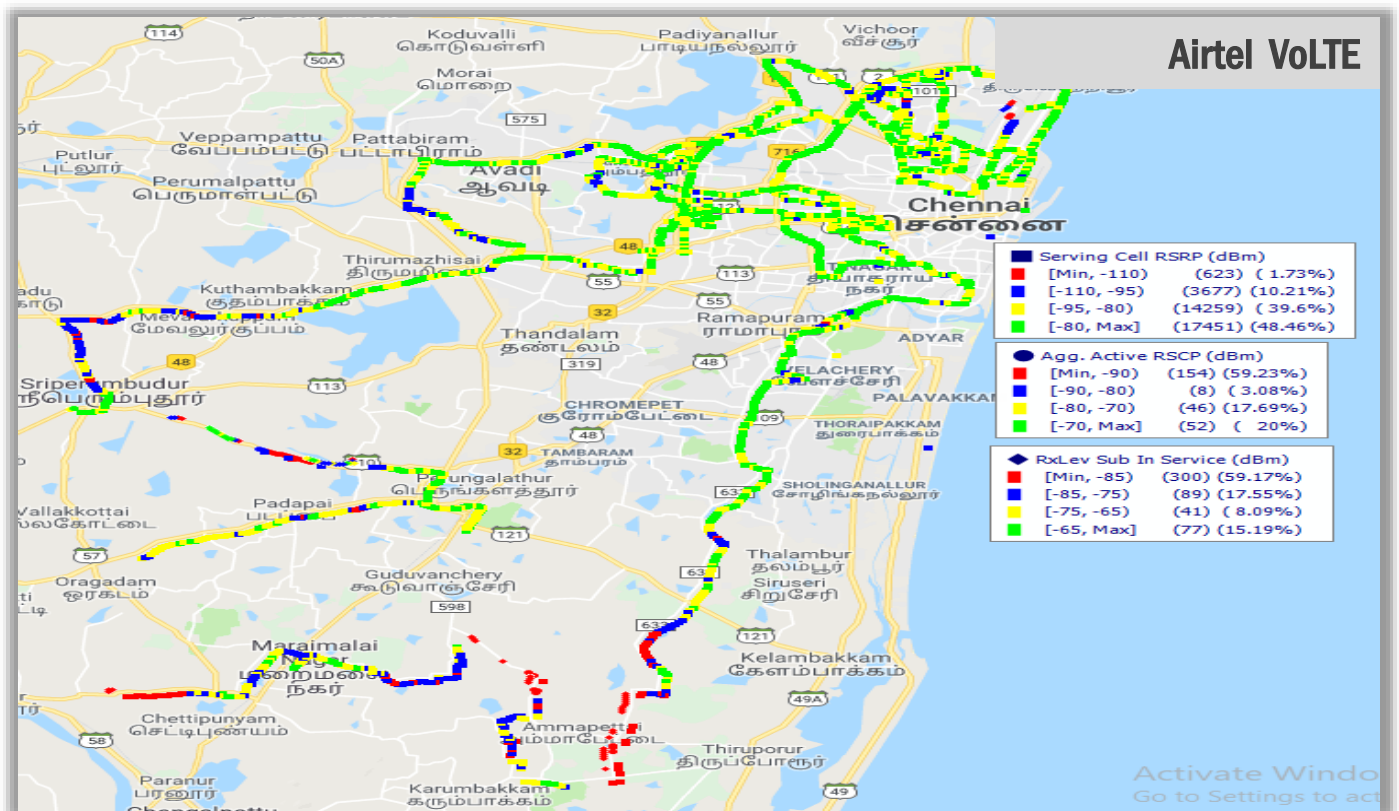
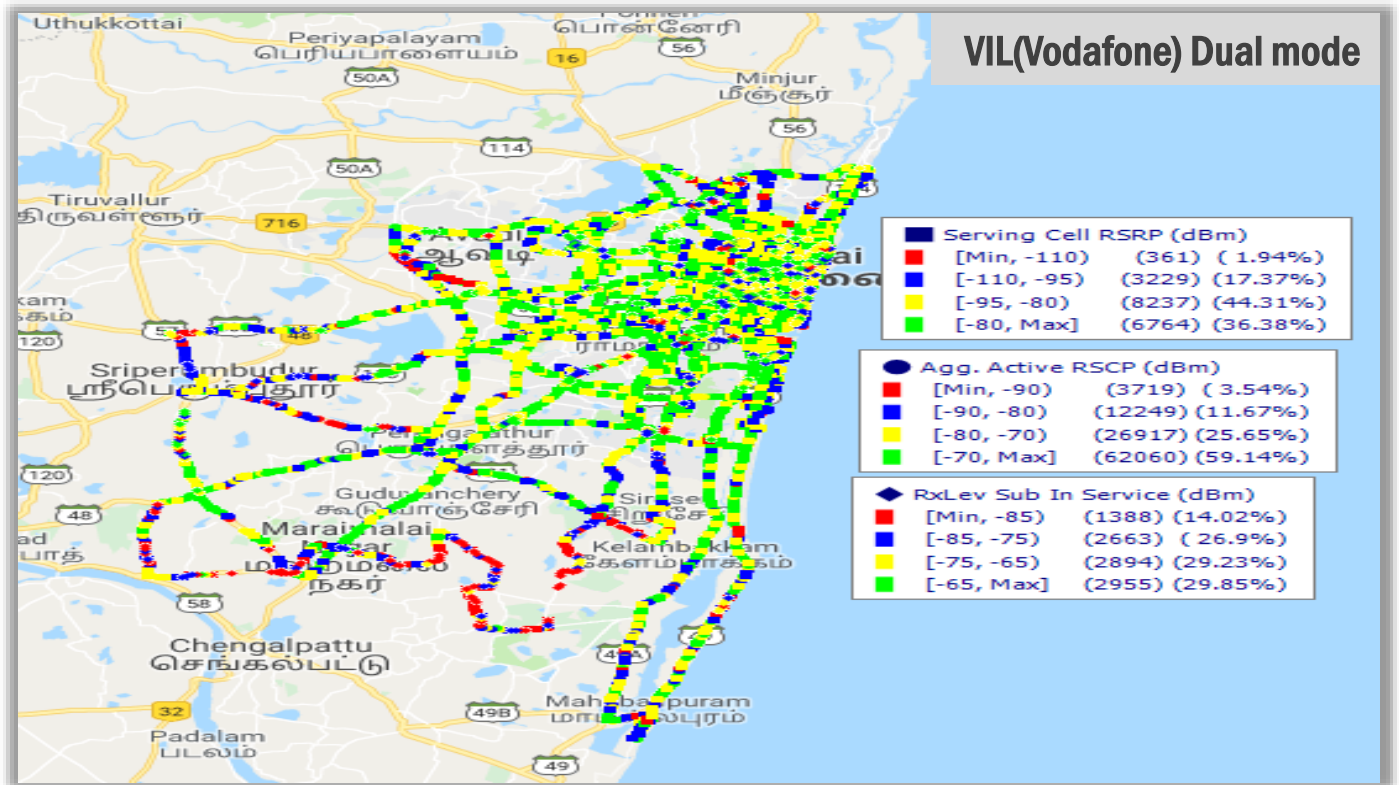
# I. Coverage Details (contd.)



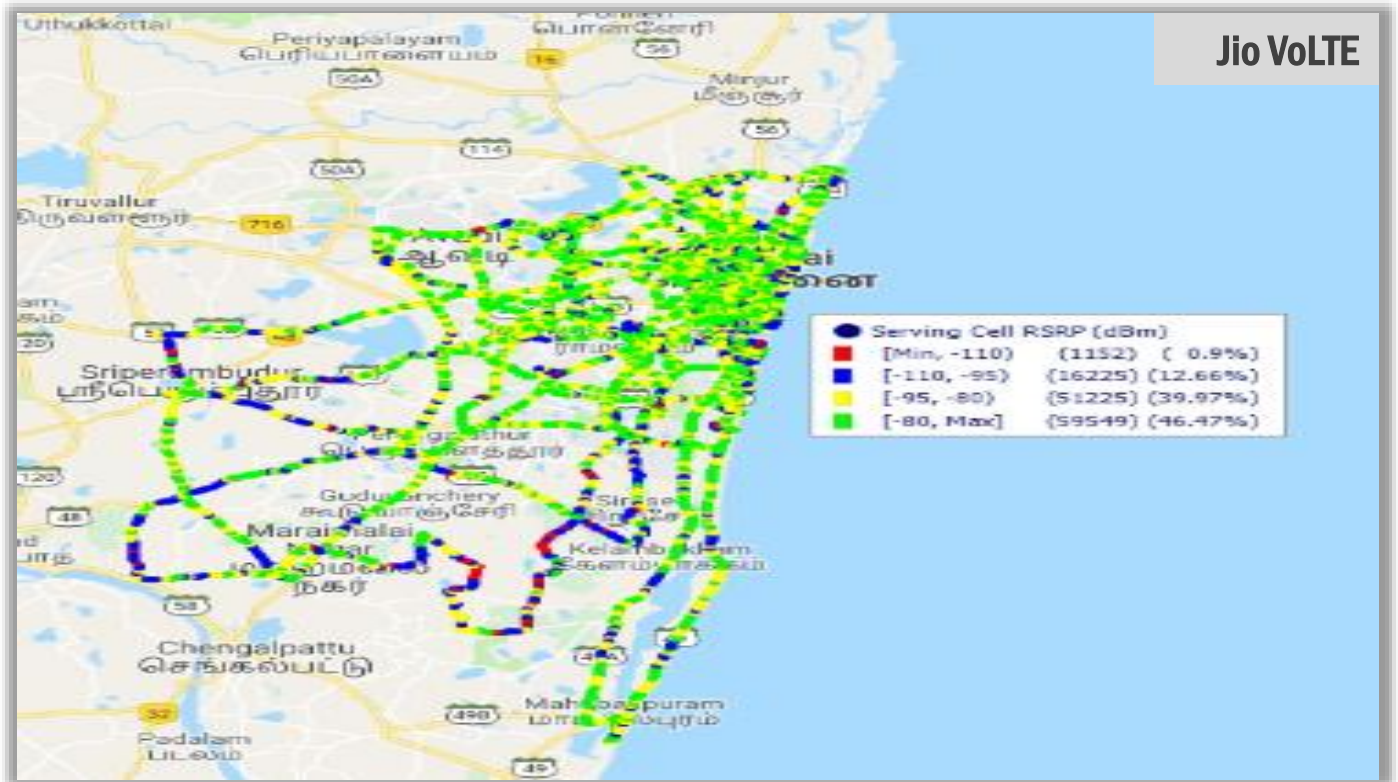
# I. Coverage Details (contd.)



# I. Coverage Details (contd.)



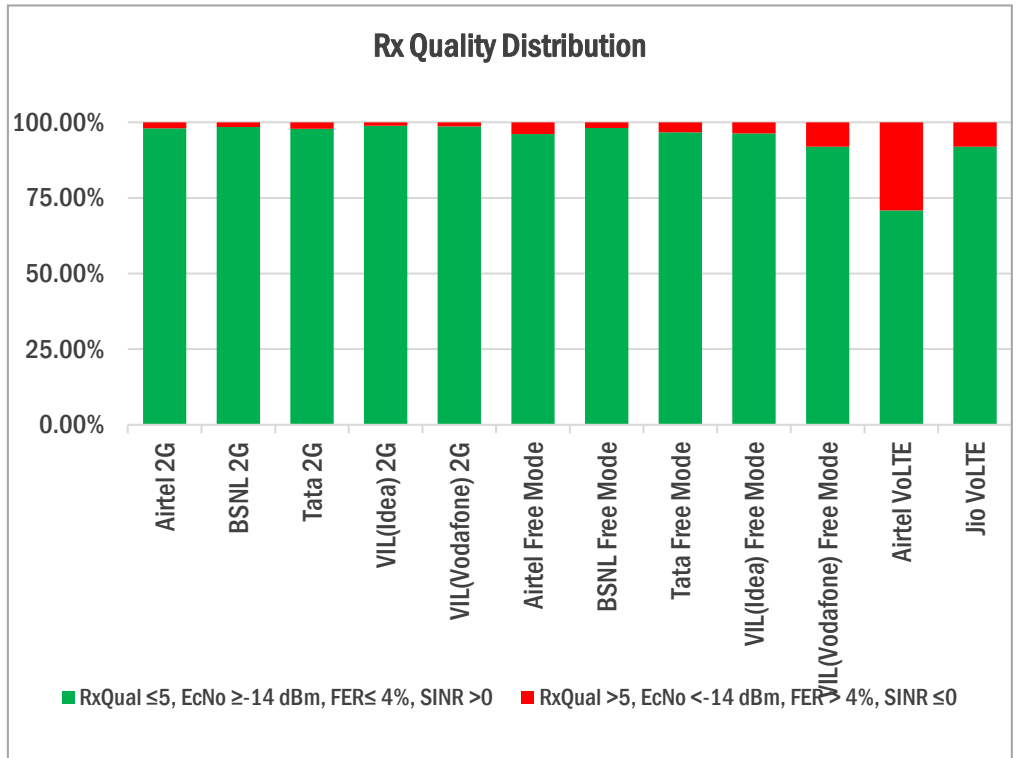
# I. Coverage Details (contd.)



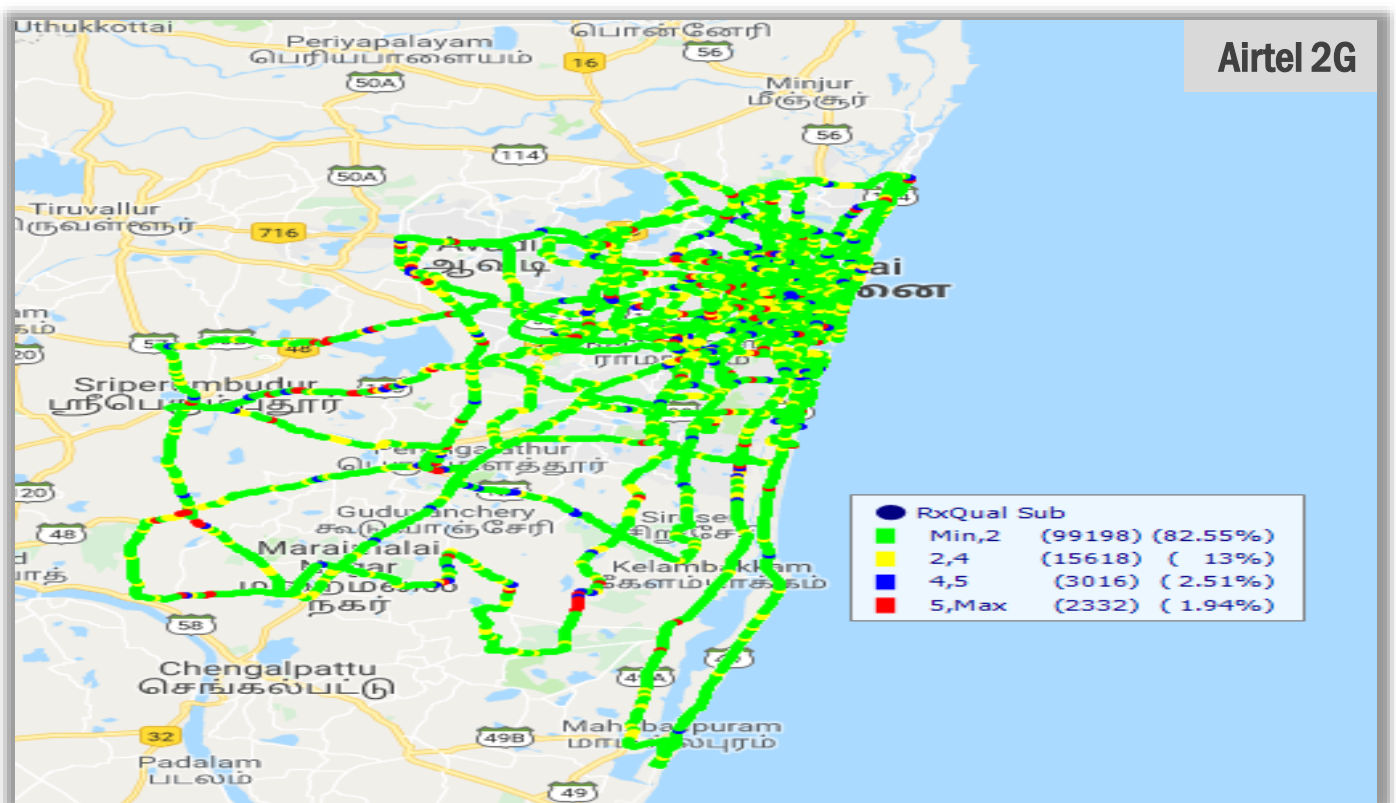
## II. Quality Details

For measuring voice quality, as per the QoS norms, RxQual  $\leq 5$  for GSM TSPs, EcNo  $\geq -14$  dBm for 3G TSP and SINR  $> 0$  in case of VoLTE is considered to be good, where as quality beyond this benchmark is considered to be bad. The benchmark should usually be  $\geq 95\%$ .

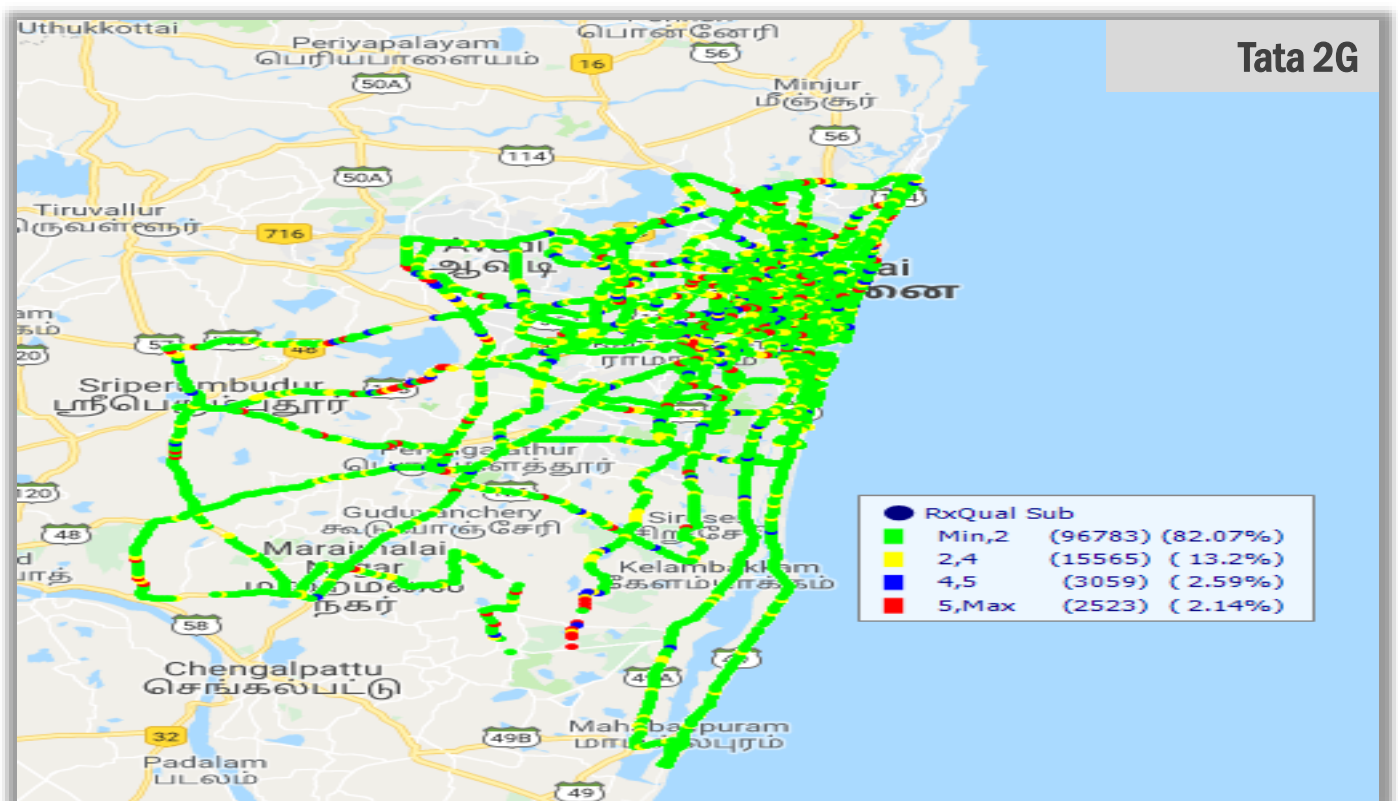
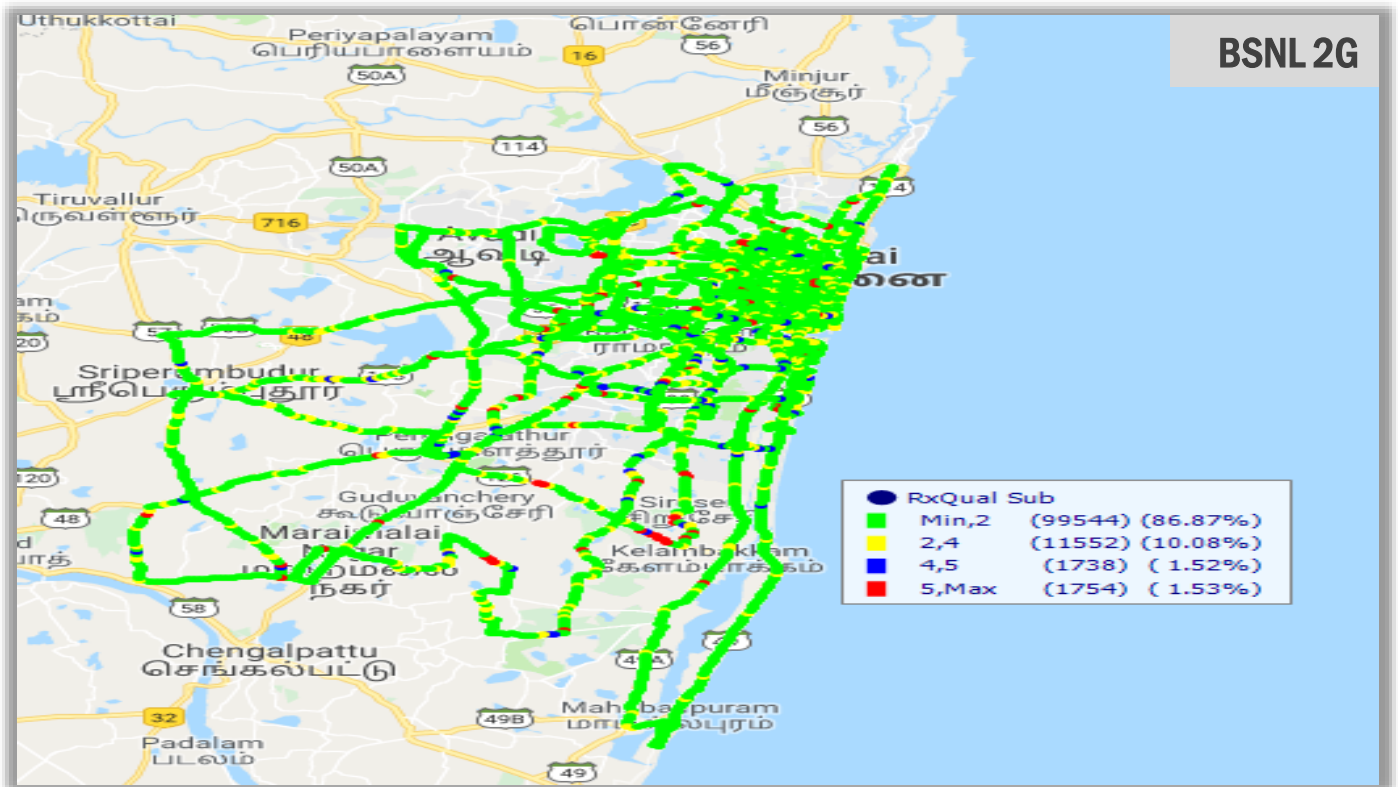
TSP	Rx Quality
Airtel 2G	98.06%
BSNL 2G	98.47%
Tata 2G	97.86%
VIL(Idea) 2G	98.86%
VIL(Vodafone) 2G	98.65%
Airtel Free Mode	96.15%
BSNL Free Mode	98.13%
Tata Free Mode	96.72%
VIL(Idea) Free Mode	96.35%
VIL(Vodafone) Free Mode	91.94%
Airtel VoLTE	70.87%
Jio VoLTE	91.93%



— TSPs not meeting the Benchmark

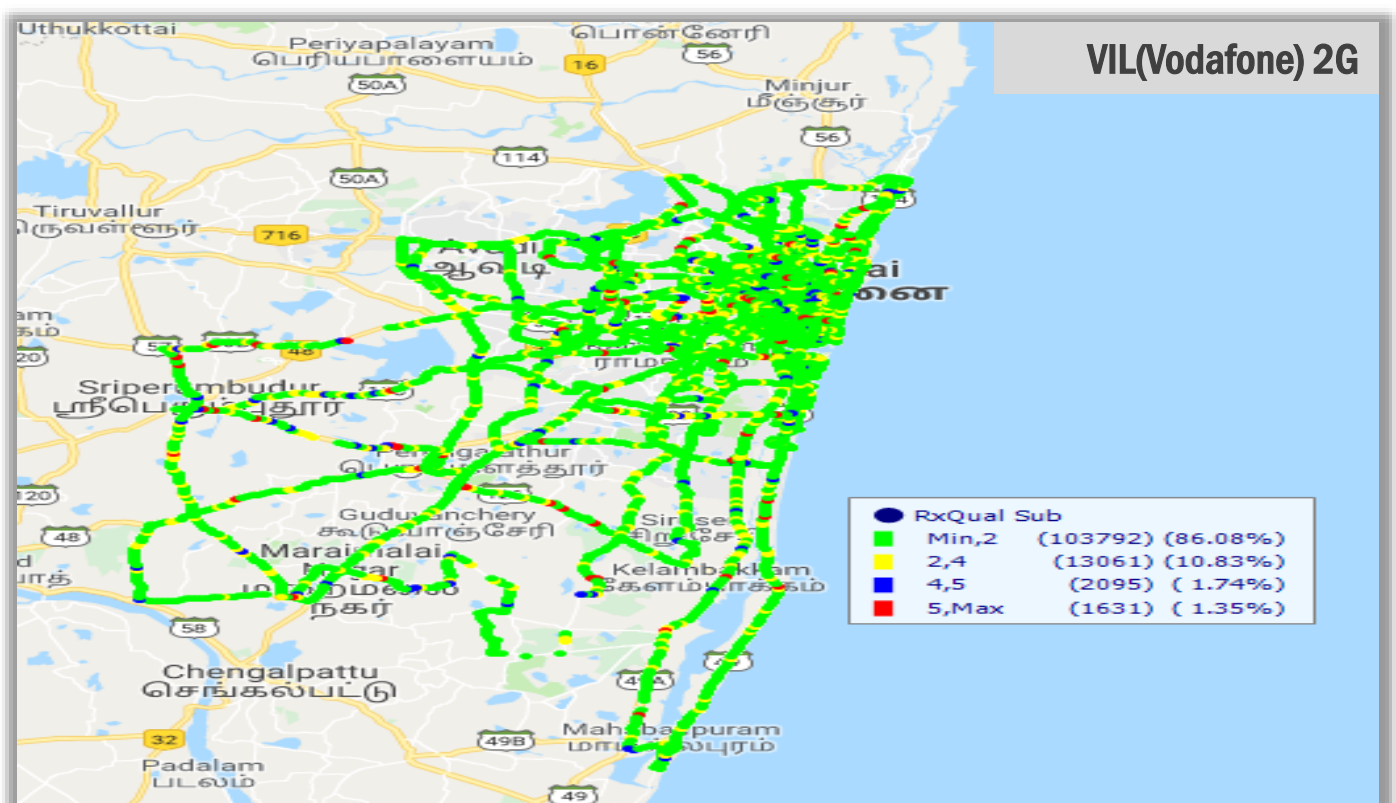
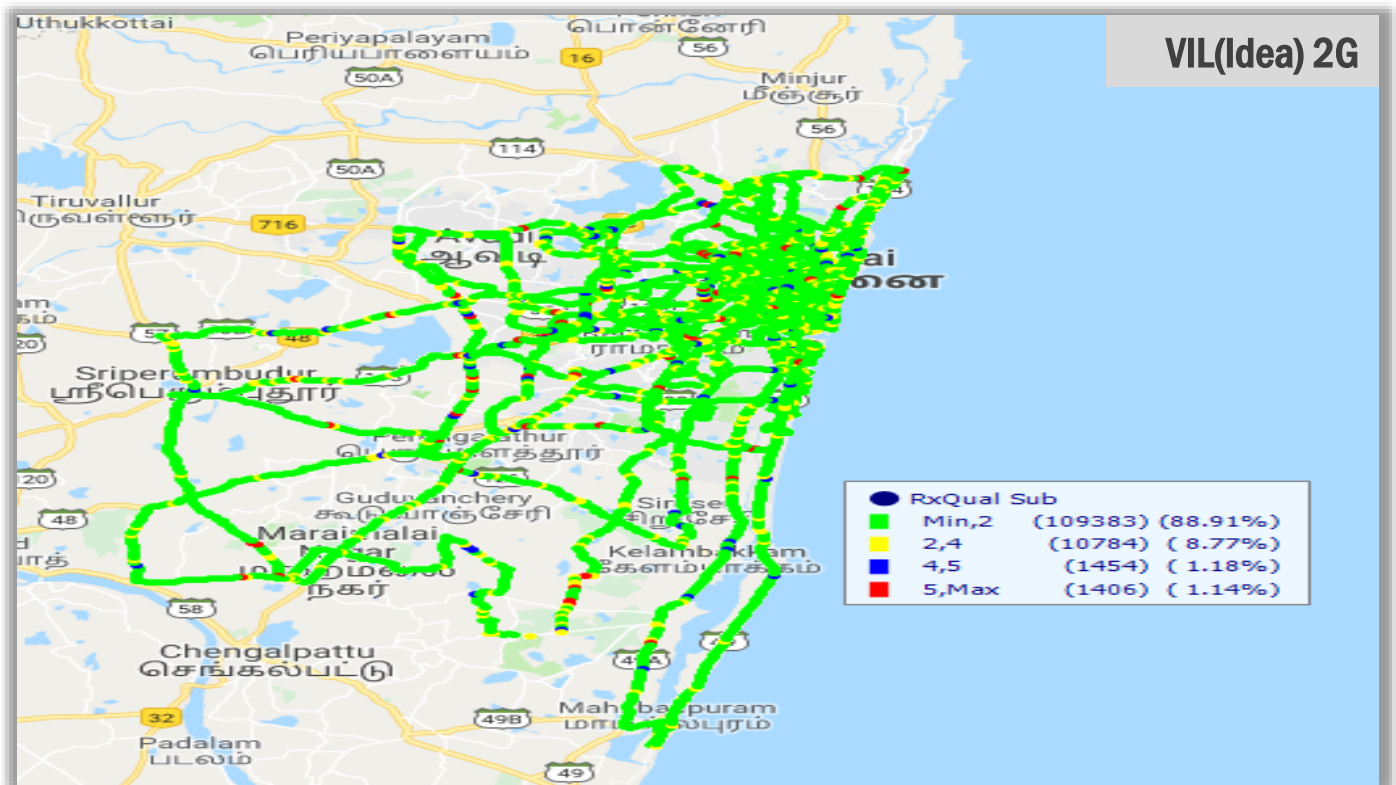


## II. Quality Details (contd.)

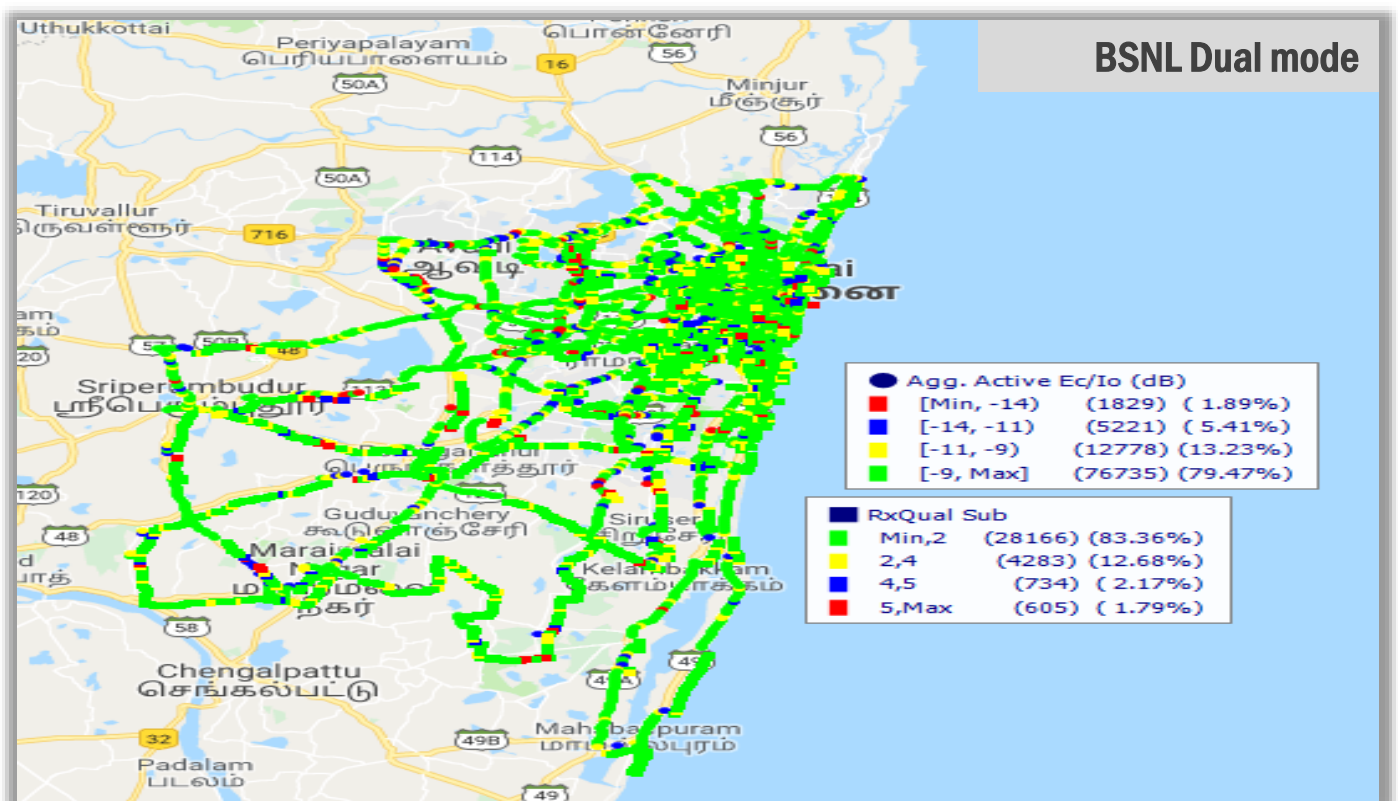
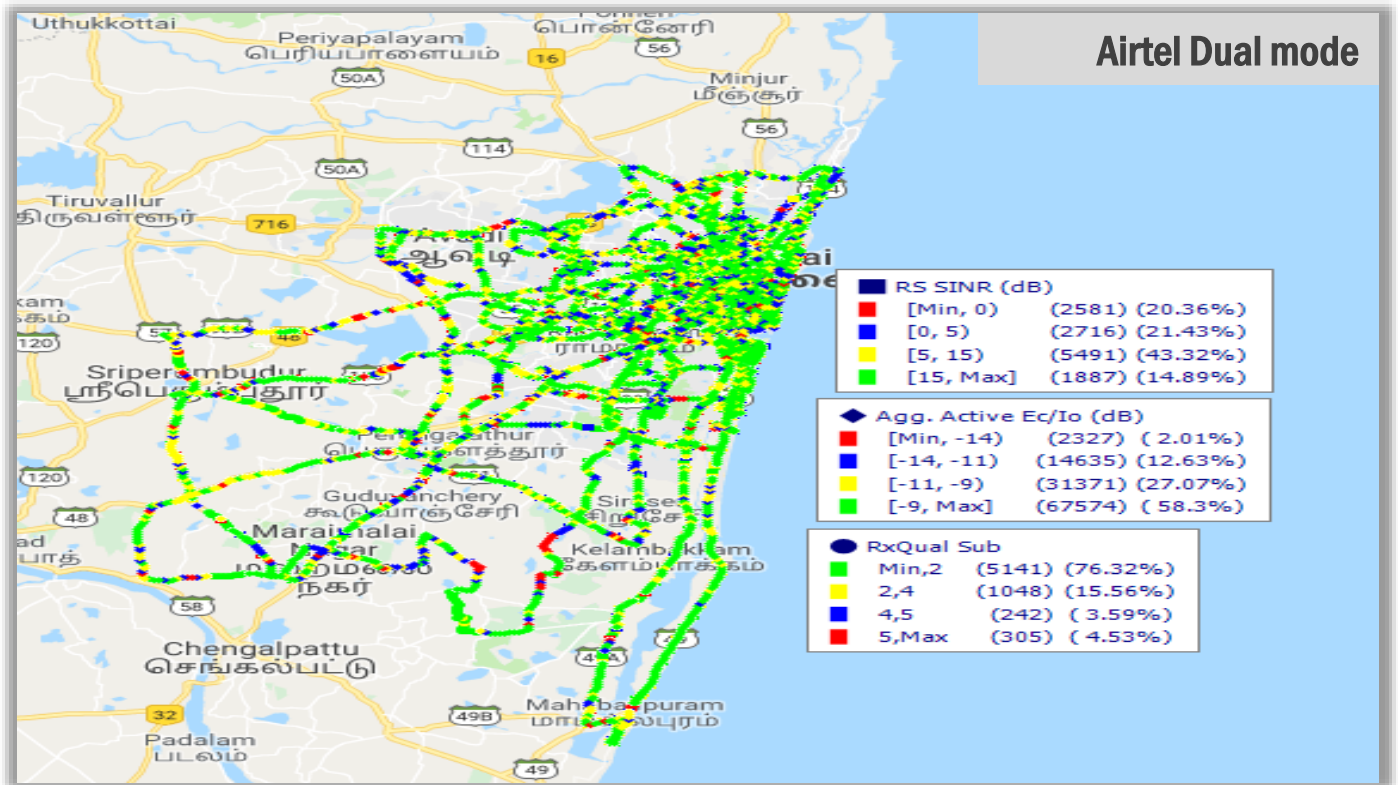




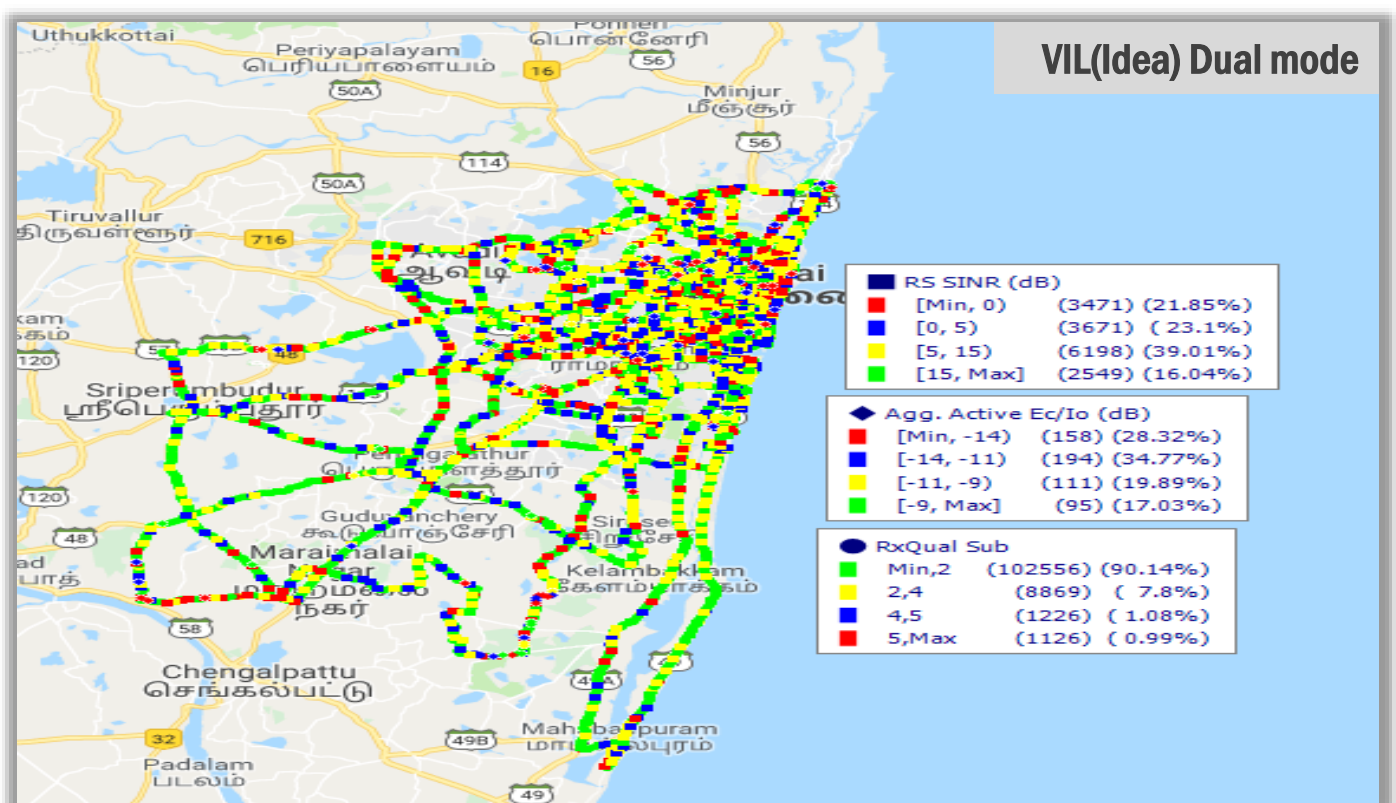
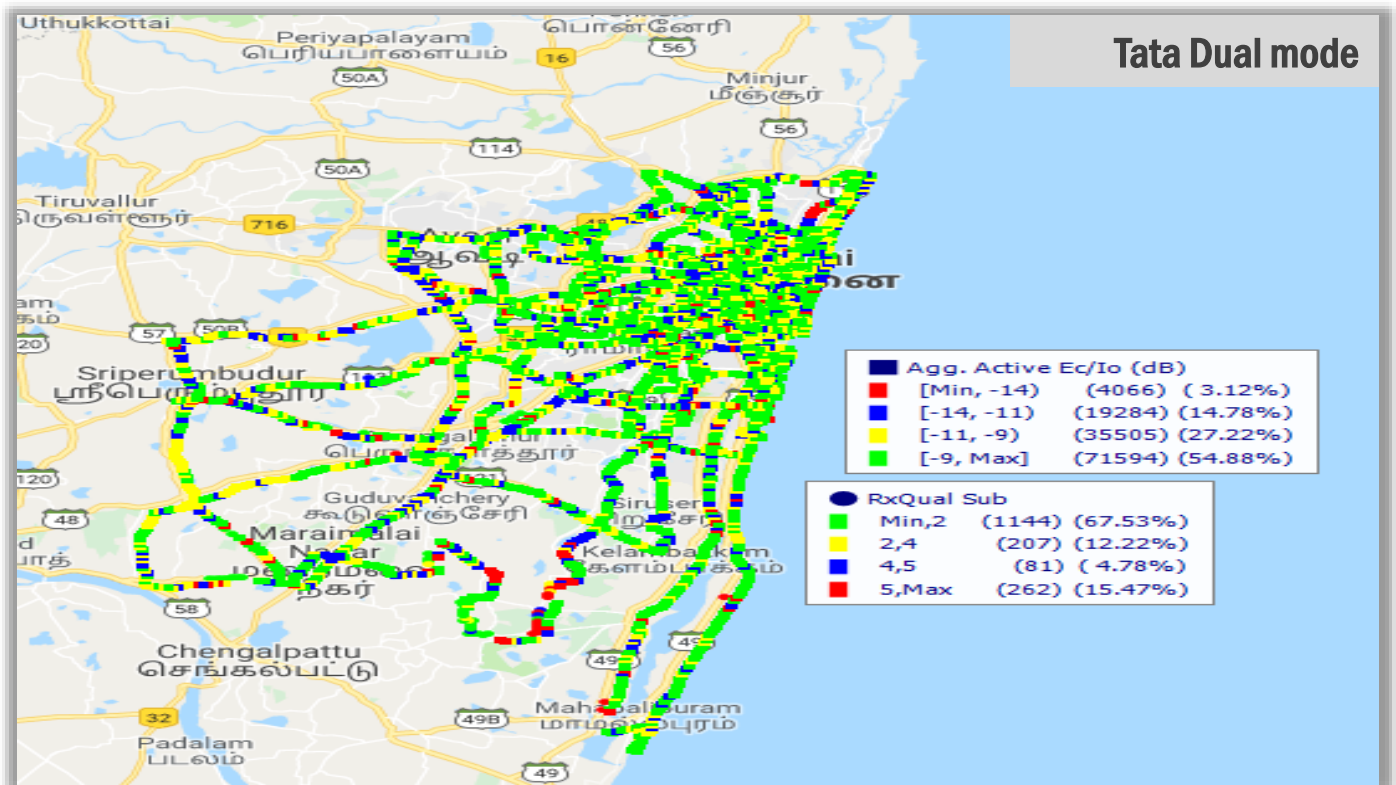
## II. Quality Details (contd.)



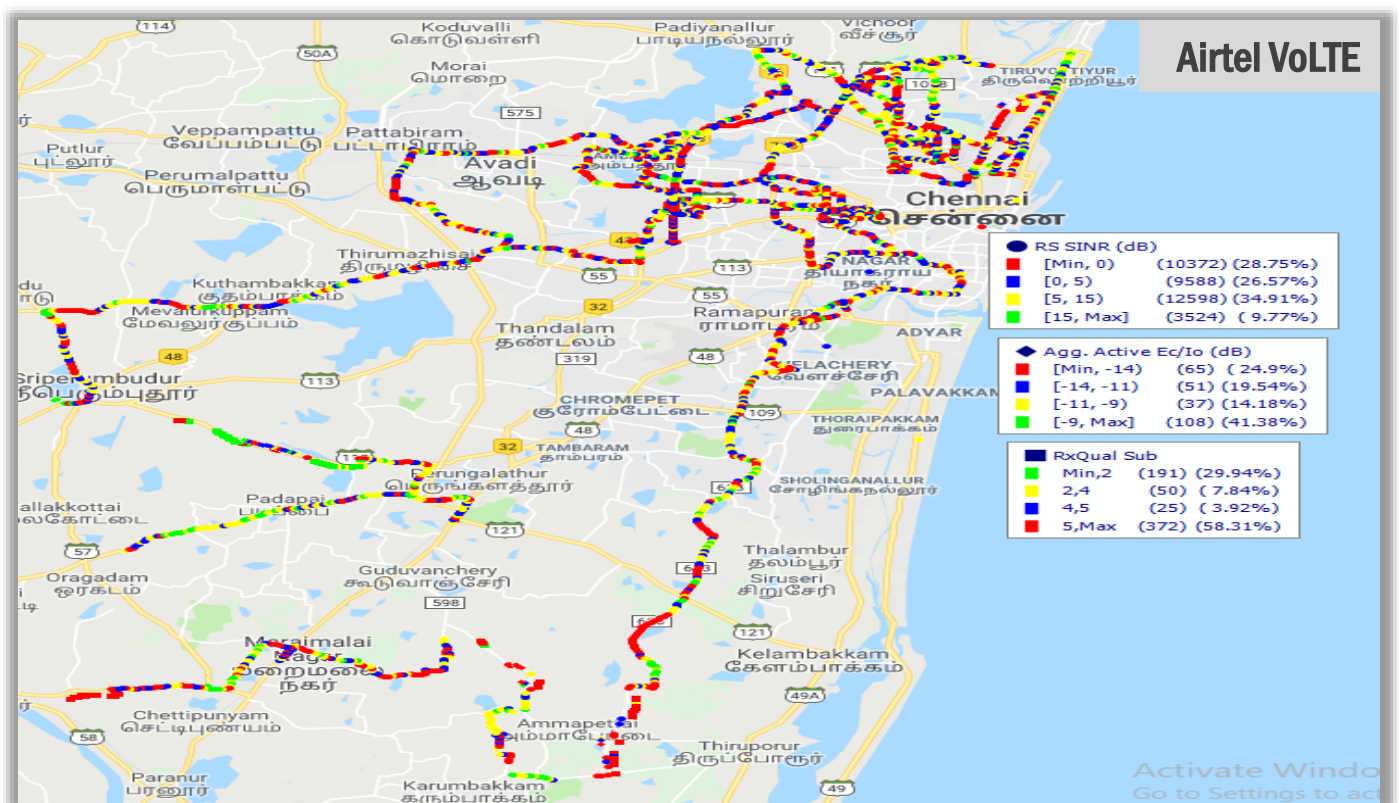
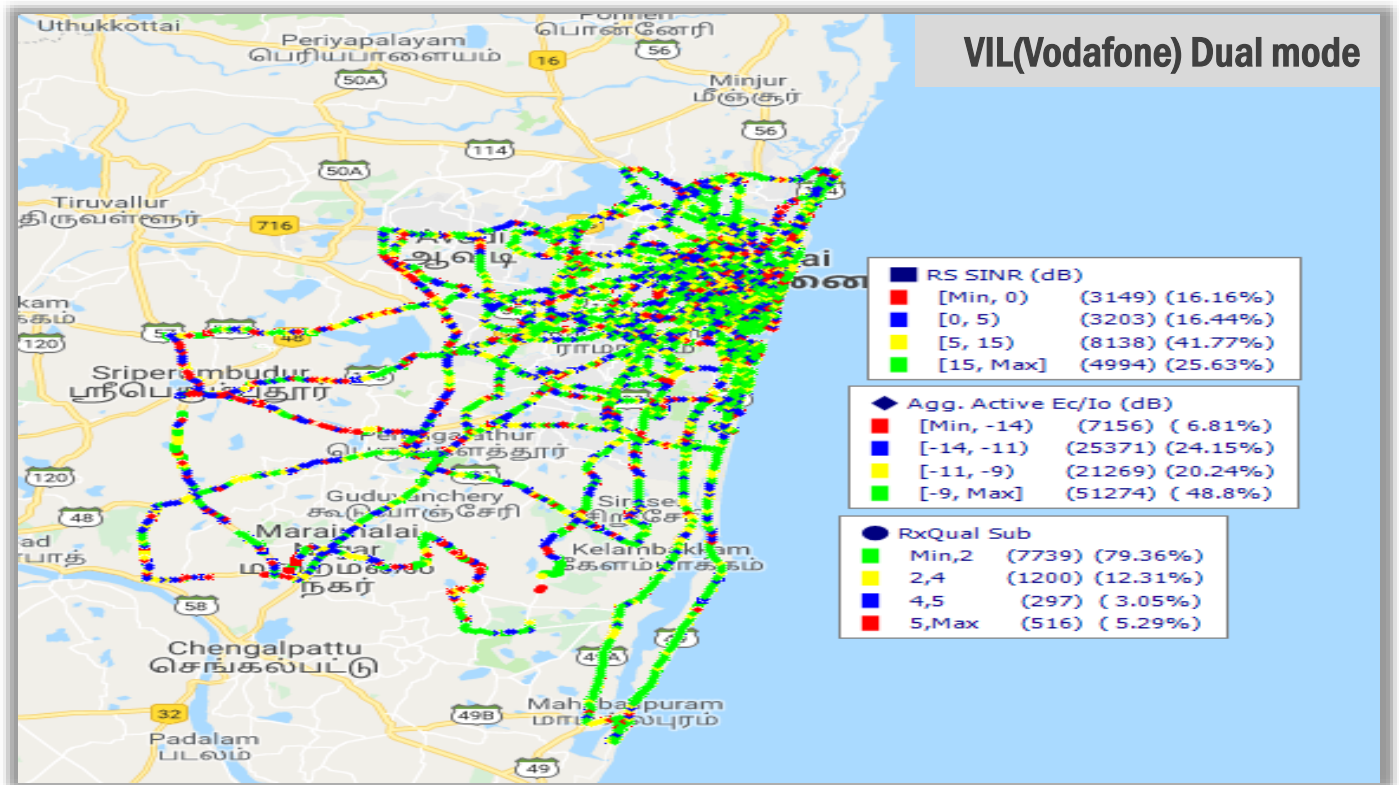
## II. Quality Details (contd.)



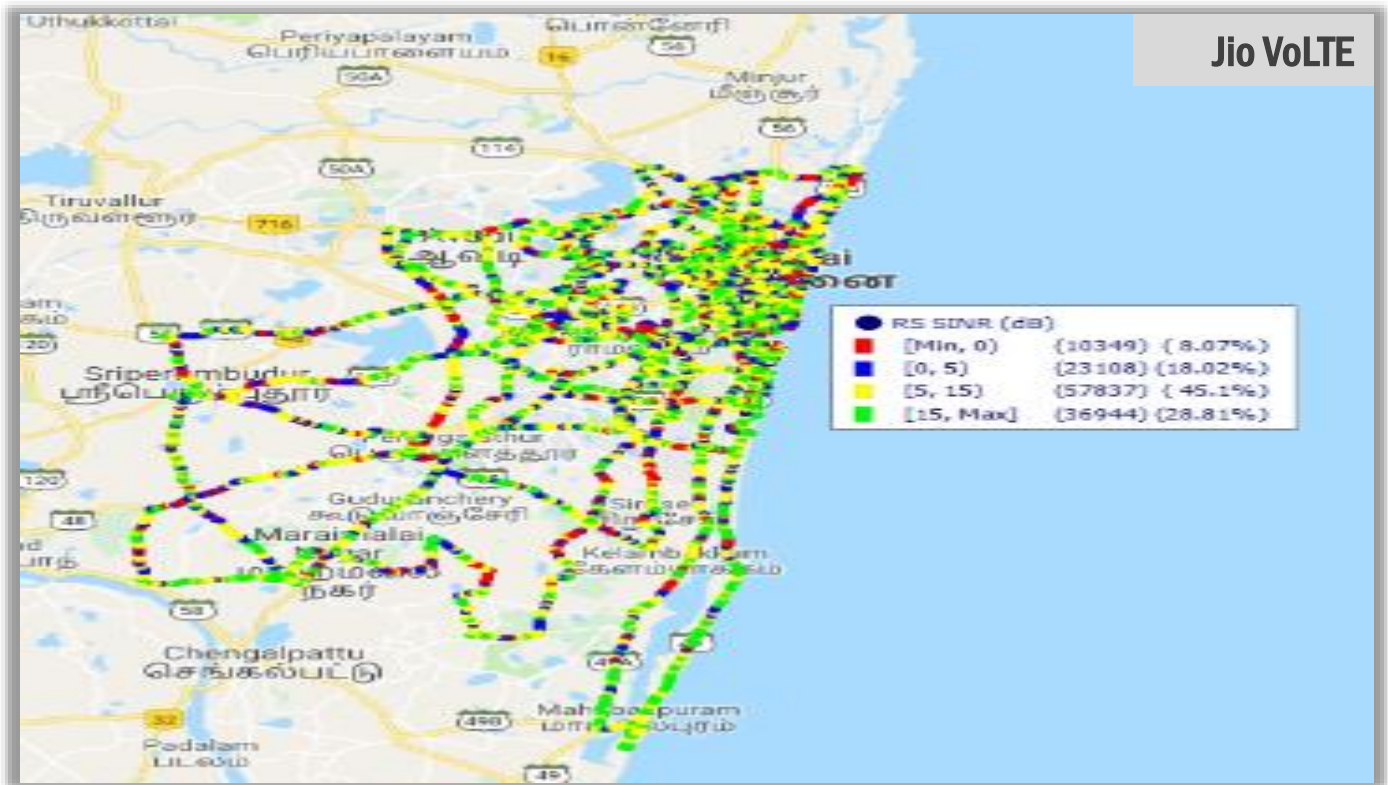
## II. Quality Details (contd.)



## II. Quality Details (contd.)

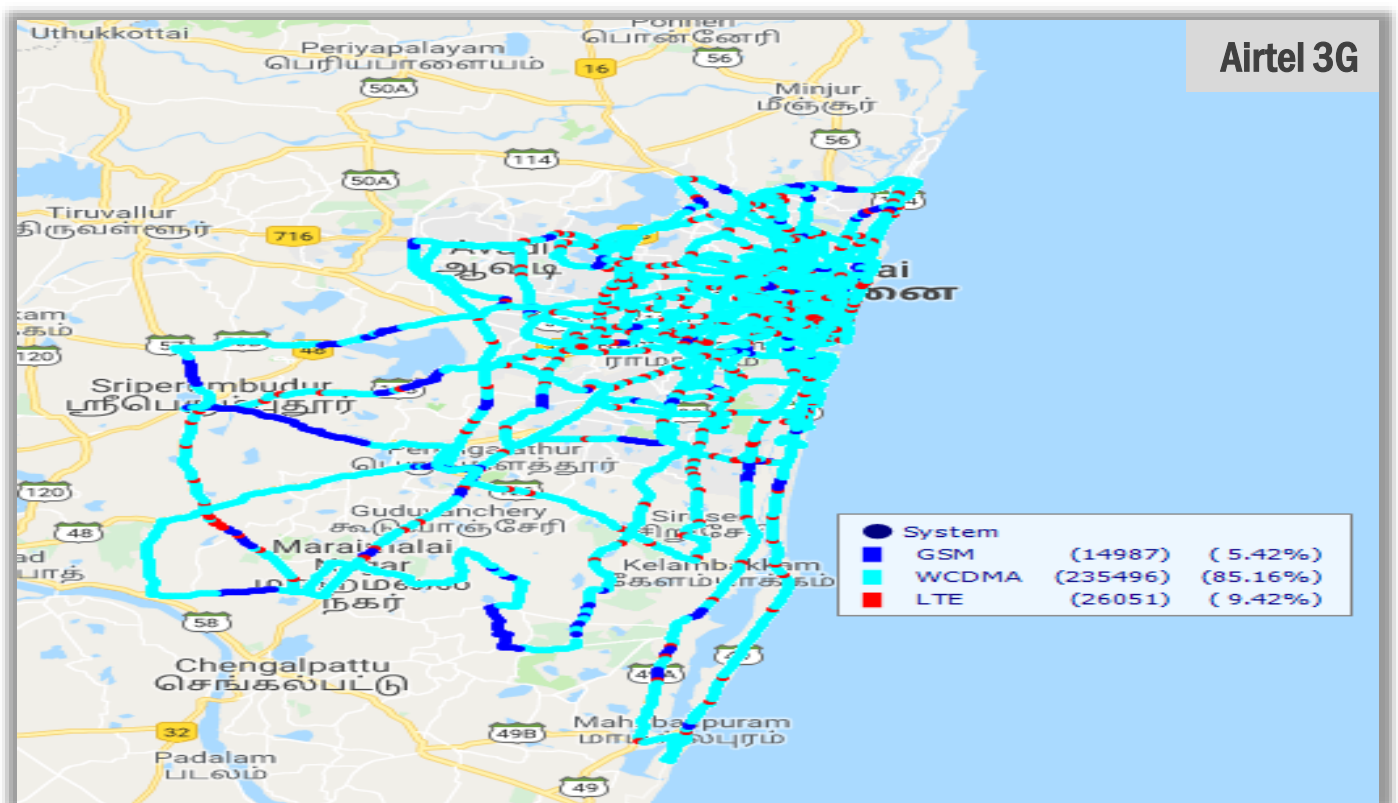
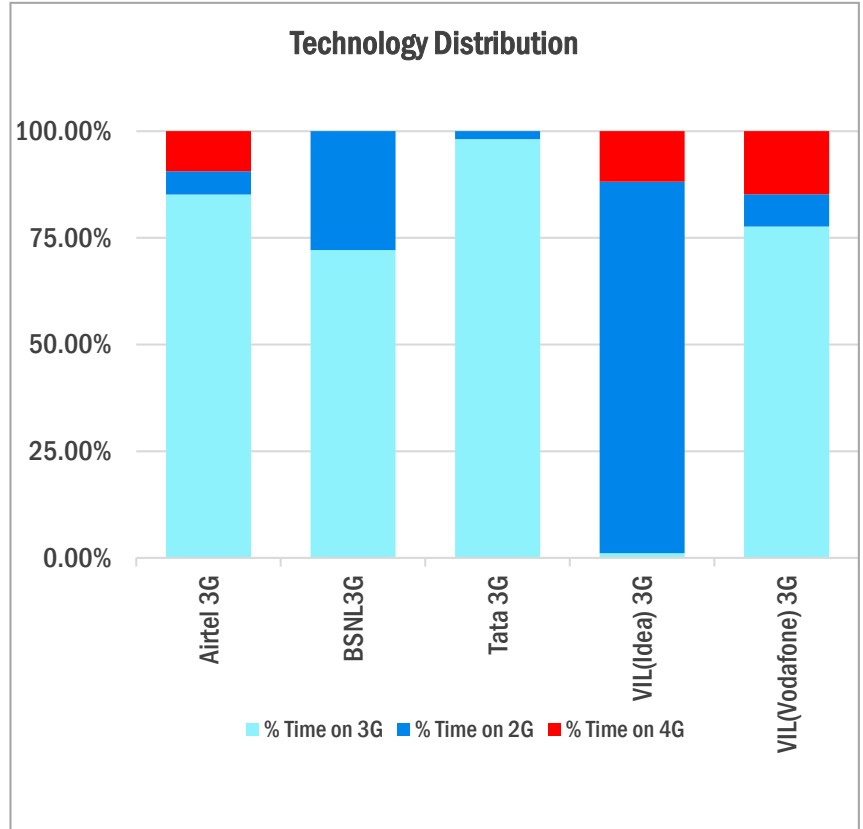


## II. Quality Details (contd.)

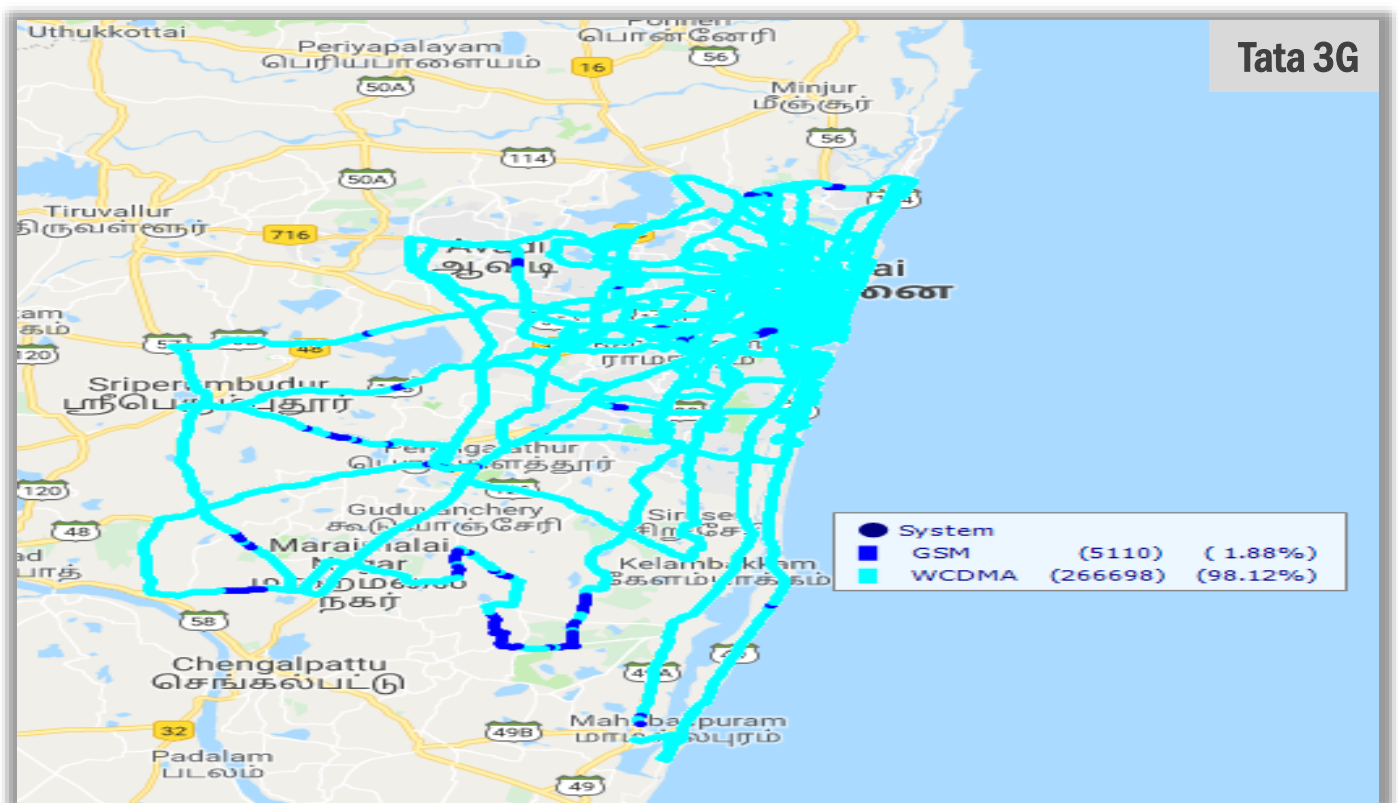
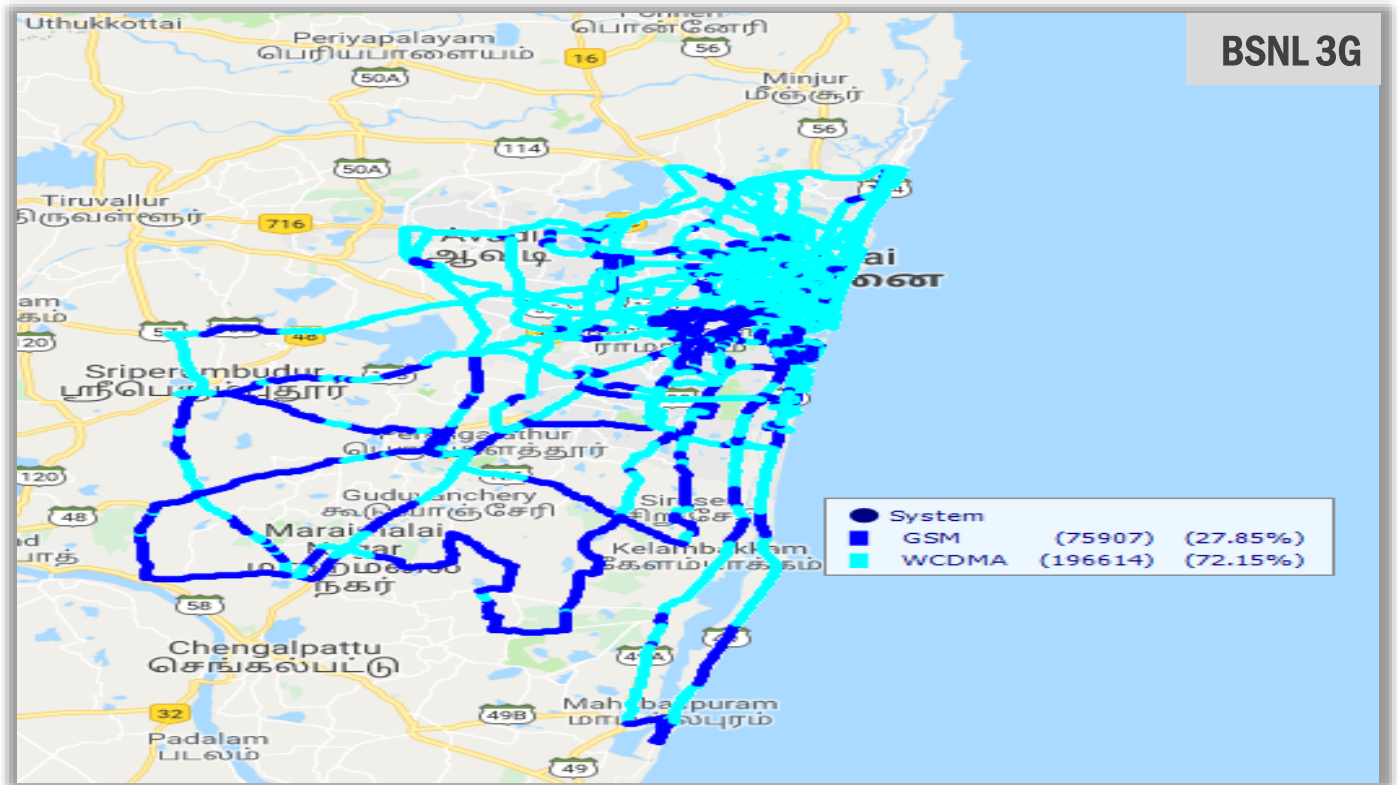


### III. Technology Details

TSP	% Time on 3G
Airtel 3G	85.16%
BSNL3G	72.15%
Tata 3G	98.12%
VIL(Idea) 3G	1.11%
VIL(Vodafone) 3G	77.67%



### III. Technology Details(contd.)



### III. Technology Details(contd.)

