

# TUV SUD South Asia Pvt. Ltd.

Delhi City Independent Drive Test Report

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## 1. Executive Summary

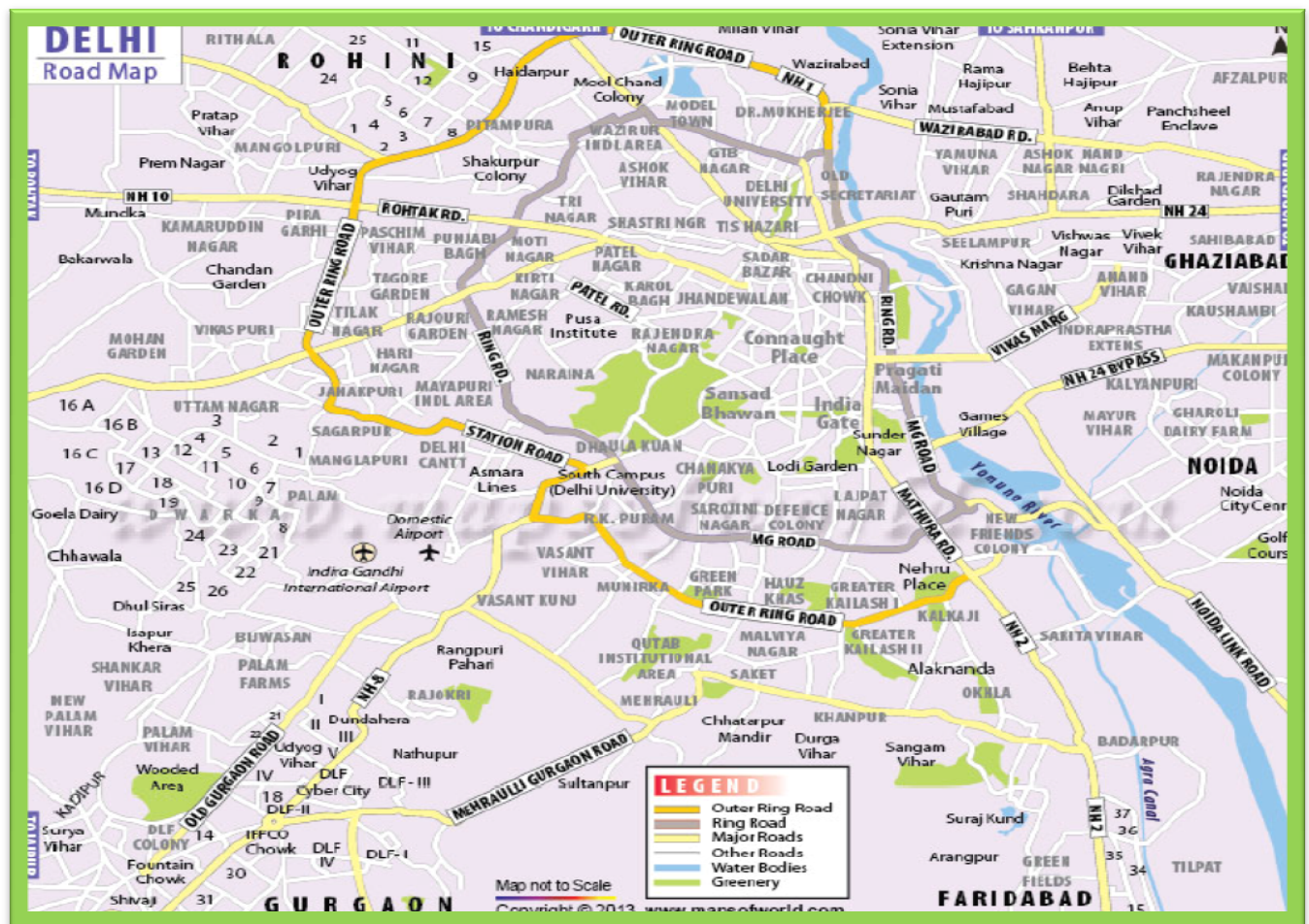
Target Network: Aircel, Idea, Vodafone, Airtel, Reliance (GSM) and Tata (CDMA)

Table 1.1 CITY DEMOGRAPHICS

Delhi Circle	Details
Population	1.68 Crores (Census 2011)
Area	1483 Square Km
Population Density	11,320 People per Square Km

Delhi City Map is shown as below

Table 1.2 Delhi CityMap<sup>1</sup>



<sup>1</sup> www.mapsofworld.com



## 2. Benchmarking Test Overview

### 2.1 Benchmarking Operators

The objective was to develop a holistic view of any competitive advantage or disadvantage of competing wireless operators in the area. For purpose of these tests, only 2G BTS were covered.

Total six Operators were benchmarked which is shown as below:

BENCHMARKING OPERATOR TABLE

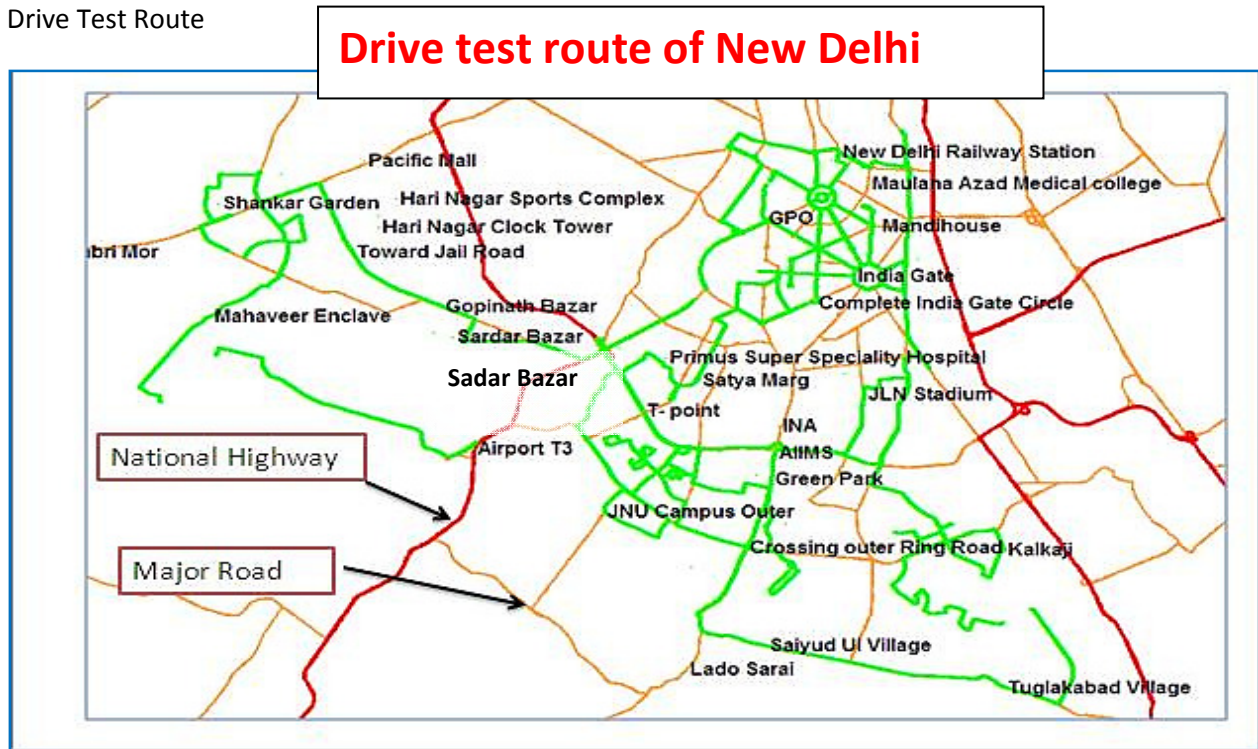
Operator	Technology	Band (MHz)	BTS Count	Subscribers* (Prepaid + Postpaid)	Subscribers / BTS
Idea	GSM	1800	4804	5930462	1234
Airtel	GSM	900 & 1800	5988	10395690	1736
Vodafone	GSM	900 & 1800	6115	9585884	1568
Reliance	GSM	1800	2494	5443345	2183
Aircel	GSM	1800	3749	5059783	1350
Tata	CDMA	800	1466	2634426	1797

\*Subscribers data of Delhi circle in 31 March 2015 taken from CSD audit.

## 2.2 Drive Test Route

In the following figure, the green route depicts the associated drive route. The total drive route covered is approximately 300 km over a period of 3 days using a vehicle. The drive test was carried out from 09:00 hrs to 20:30 hrs on 9<sup>th</sup> to 11<sup>th</sup> July 2015. In all about 3626 calls were made for all 6 operators.

Drive Test Route



### Area Covered

- |                             |                   |                     |                    |
|-----------------------------|-------------------|---------------------|--------------------|
| • New Delhi railway station | • Bhimrao Marg    | • Airport T3        | • INA              |
| • Mirdagmarg                | • Akbar Road      | • Uttam Nagar       | • Delhi hatt       |
| • LNJP Hospital             | • Teen Murti Marg | • Delhi Gate        | • AIIMS            |
| • C.P Outer/Inner circle    | • South Avenue    | • Bahadursah Marg   | • Sri Arvindomarg  |
| • R.K Ashram Marg           | • T Point         | • Mathura Road      | • JNU Campus outer |
| • Gol Market                | • ITC morya       | • Lodhi Road        | • QutubMinar       |
| • GPO                       | • CSD Road        | • CGO Interior      | • Saket Metro      |
| • RML                       | • Jail Road       | • BhismPitamah Road | • Batra Hospital   |
|                             |                   | • Nehru Place       | • Govindpuri       |

## 2.3 Benchmarking KPI Details

### Benchmarking KPI details table

KPI	Aircel	Idea	Vodafone	Airtel	Reliance	Tata (CDMA)
Coverage %	74.32%	87.42%	87.29%	91.26%	57.96%	58.07%
Accessibility %	97.05%	73.91%	95.31%	91.82%	89.55%	98.89%
Retainability %	94.82%	97.16%	95.72%	91.96%	82.71%	99.16%
Mobility %	97.85%	98.65%	94.15%	95.94%	96.86%	94.12%
Rx Quality %	82.69%	91.12%	90.67%	84.32%	85.36%	99.68%
C/I %	53.64%	60.30%	58.82%	43.82%	53.64%	79.96%

### **RF Coverage**

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 operator is calculated basis of % of samples in which the Rx level is better than -85 dbm.

### **Accessibility**

Accessibility is the ability of a service to be obtained within specific tolerances and other given conditions, when requested by the user. In other words, the ability of a user to obtain the requested service from the system. Accessibility is monitored by measuring Call Setup Success Rate (CSSR) which is defined as the ratio of Established Calls to Call Attempts.

### **Retainability**

Retainability is “The ability of a service, once obtained, to continue to be provided under given conditions for a requested duration.” For determining the Retainability the regulation prescribes three important parameters namely Call drop rate (CDR), Worst affected Cells having more than 3% TCH drop and Connection with good voice quality. The call drop and Connection with good voice quality were monitored by the drive test.

### **Mobility**

In a cellular system a base station has only a limited coverage area. Hence it is possible for a moving subscriber to be out of range of a base station while making a call. The process by which a mobile telephone call is transferred from one base station to another as the subscriber passes the boundary of a cell is called a handover. The Handover success rate (HOSR) more than 95% is considered to be good.

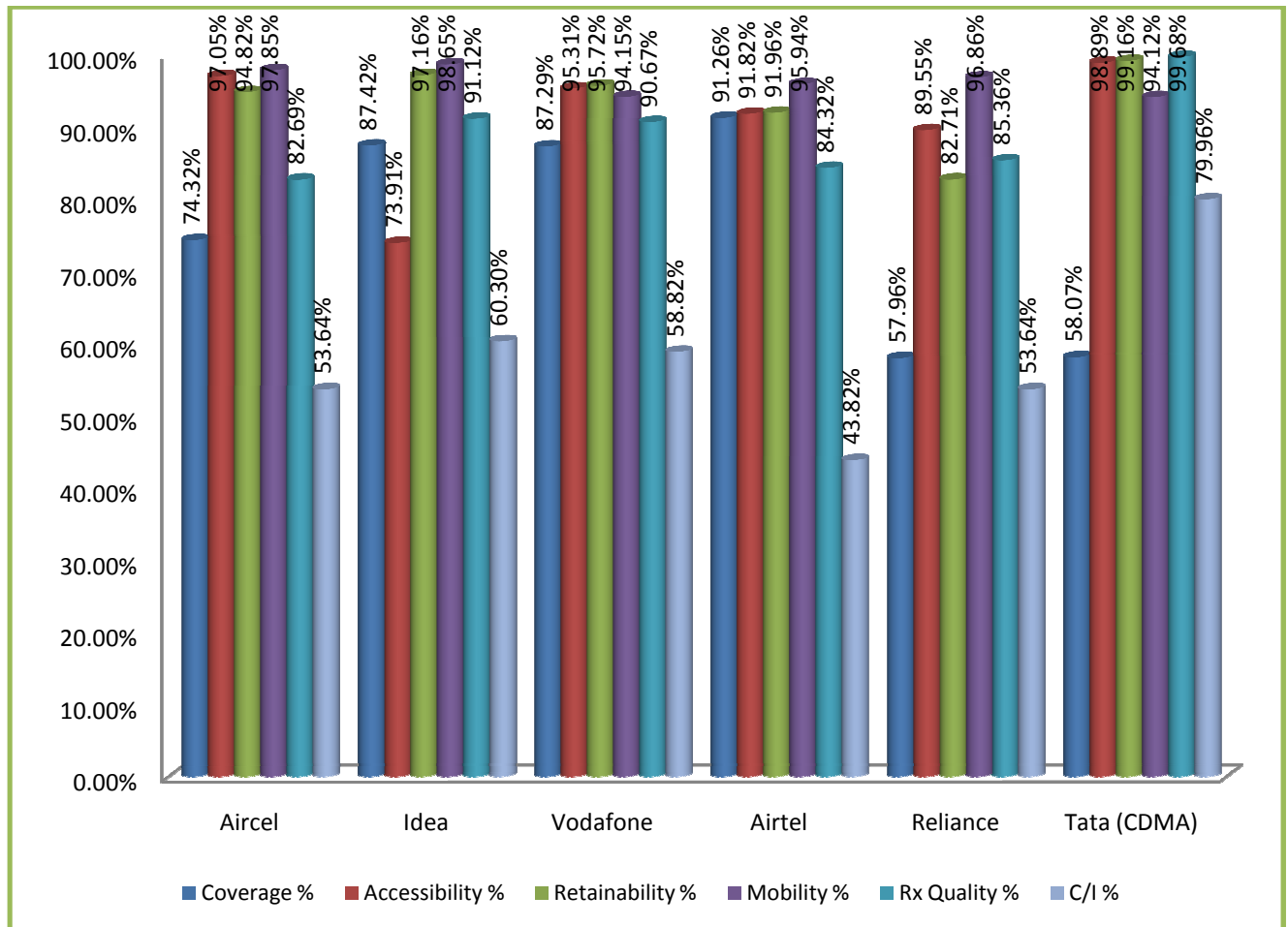
### **Rx Quality**

For measuring voice quality, Rx Qual samples on a scale from 0 to 7 for GSM operators and Frame Error Rate (FERs) for CDMA service providers are measured. As per the QoS norms, Rx Qual between 0- 5 for GSM operators and between 0-4% FER value for CDMA operators FERs is considered to be good, where as Rx Qual beyond this benchmark is considered to be bad.

### **Carrier over Interference (C/I)**

The carrier-over-interference ratio is the ratio between the levels of the signal strength of the current serving cell to that of the signal strength of undesired (interfering) signal components. The C/I should be more than 9 db i.e. between samples 15 to 30 are considered good.

### KPI distribution graph



## 2.4 Key Observation

The overall performance of all operators is mentioned in the table. Over 450+ calls were made per operator during the data collection period with more than 300 Km drive test covered.

We can explain the network condition in terms of coverage, quality, accessibility, retainability, speech quality Index and Carrier over Interference ratio of the various service providers on the basis of the values obtained. The TSPs are also ranked accordingly and tabulated below:

**Key observation table**

Operator	Coverage Rate	CSSR	CCSR	Rx Quality	C/I
Aircel	4	2	4	6	5
Idea	2	6	2	2	2
Vodafone	3	3	3	3	3
Airtel	1	4	5	5	6
Reliance	6	5	6	4	4
Tata(CDMA)	5	1	1	1	1

CSSR: Call Setup Success Rate

CCSR: Call Completion Success Rate

C/I: Carrier over Interference

### 3. Detail Result

#### 3.1 Voice Benchmarking

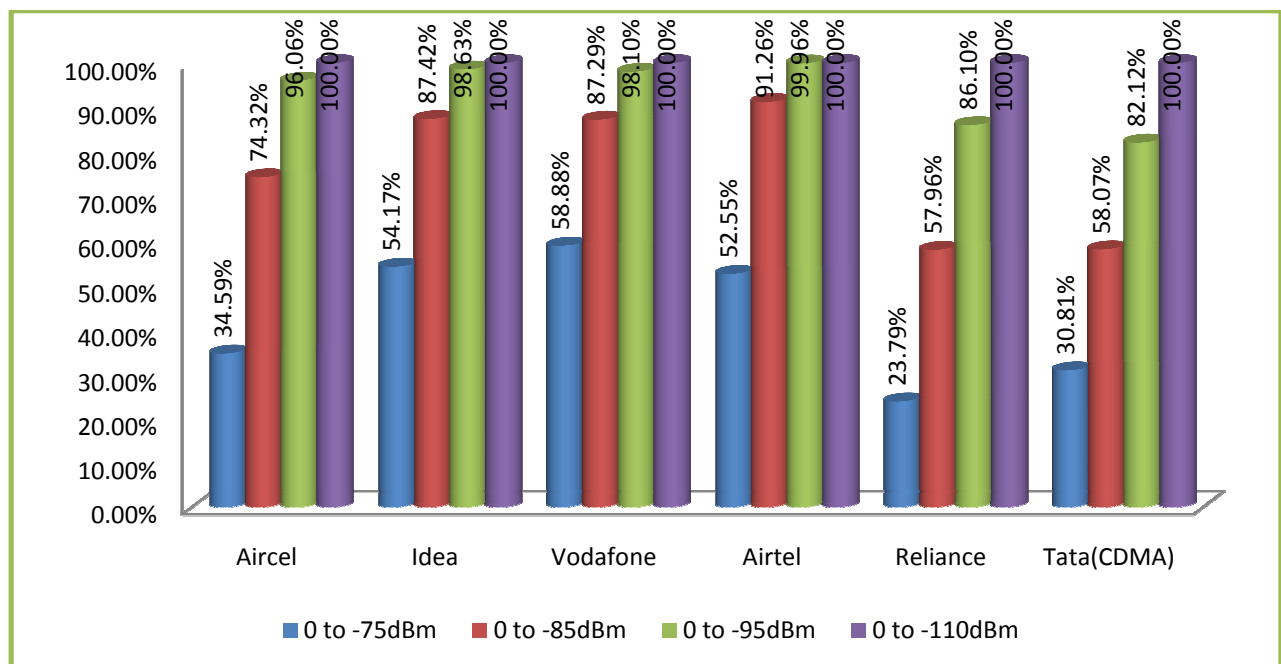
##### 3.1.1 Coverage Rate

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 operator is calculated basis of % of samples in which the Rx level is better than -85 dbm. The coverage rate varies from 91.26% for Airtel to 57.96 % for Reliance GSM. The details are as follows.

Table 3.1 Coverage Summary and Ranking

OPERATOR	Coverage Rate	Ranking
Aircel	74.32%	4
Idea	87.42%	2
Vodafone	87.29%	3
Airtel	91.26%	1
Reliance	57.96%	6
Tata(CDMA)	58.07%	5

#### Coverage Rate Details Graph



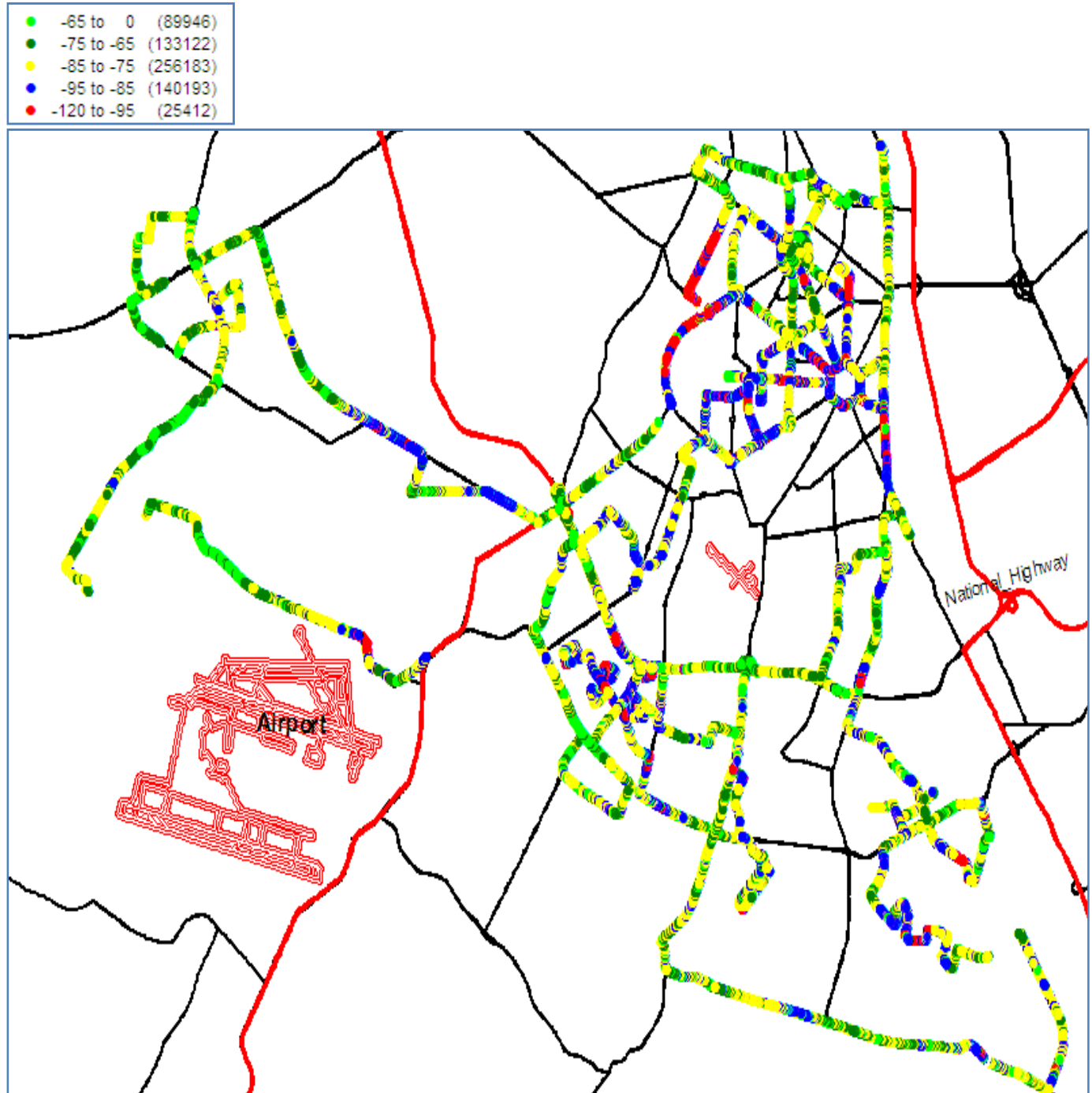


**Table 3.2 Rx Level for operators**

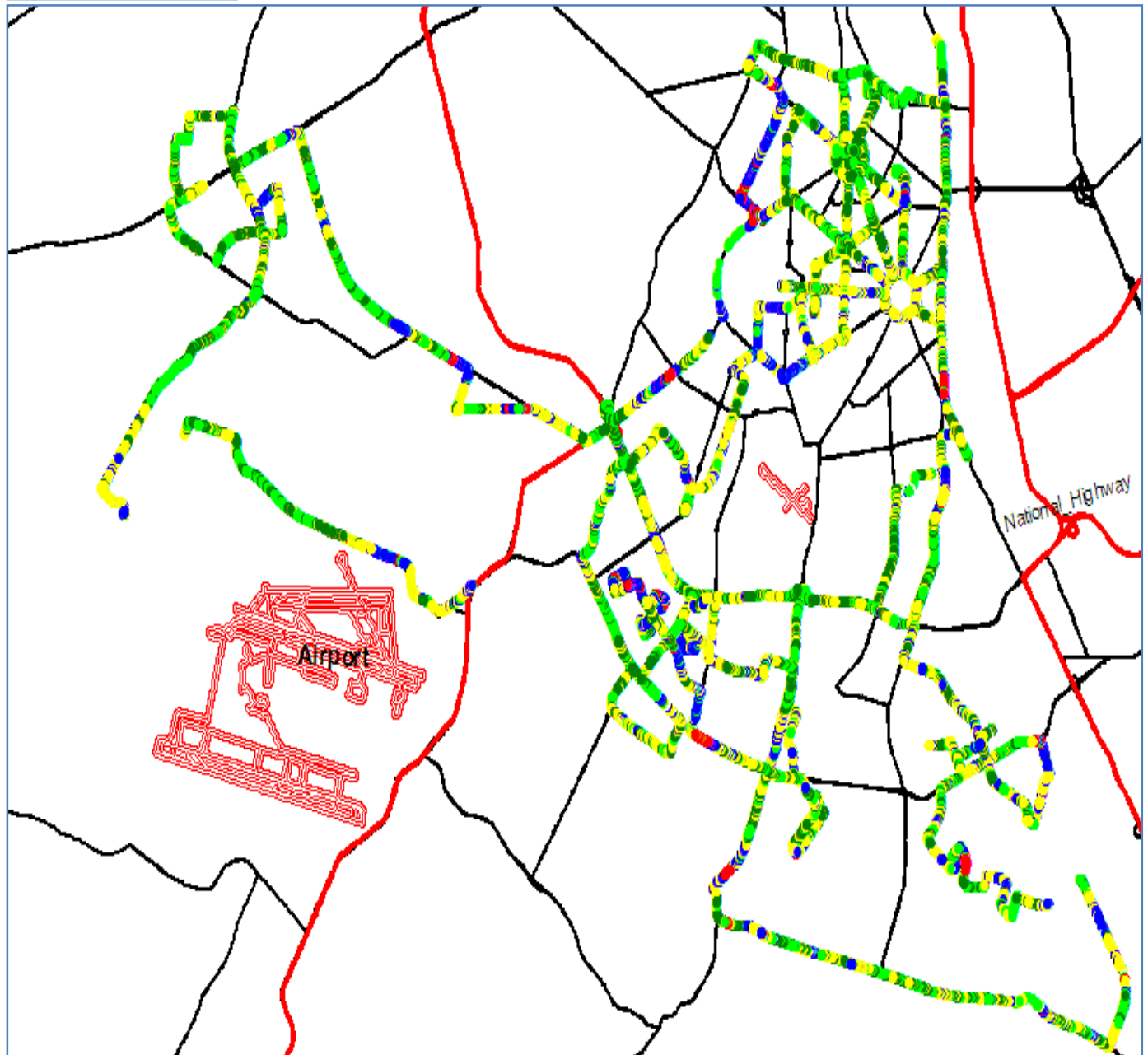
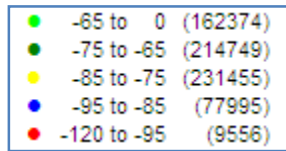
Operator	0 to -75dBm	0 to -85dBm	0 to -95dBm	0 to -110dBm
Aircel	34.59%	74.32%	96.06%	100.00%
Idea	54.17%	87.42%	98.63%	100.00%
Vodafone	58.88%	87.29%	98.10%	100.00%
Airtel	52.55%	91.26%	99.96%	100.00%
Reliance	23.79%	57.96%	86.10%	100.00%
Tata(CDMA)	30.81%	58.07%	82.12%	100.00%

## Coverage Plot

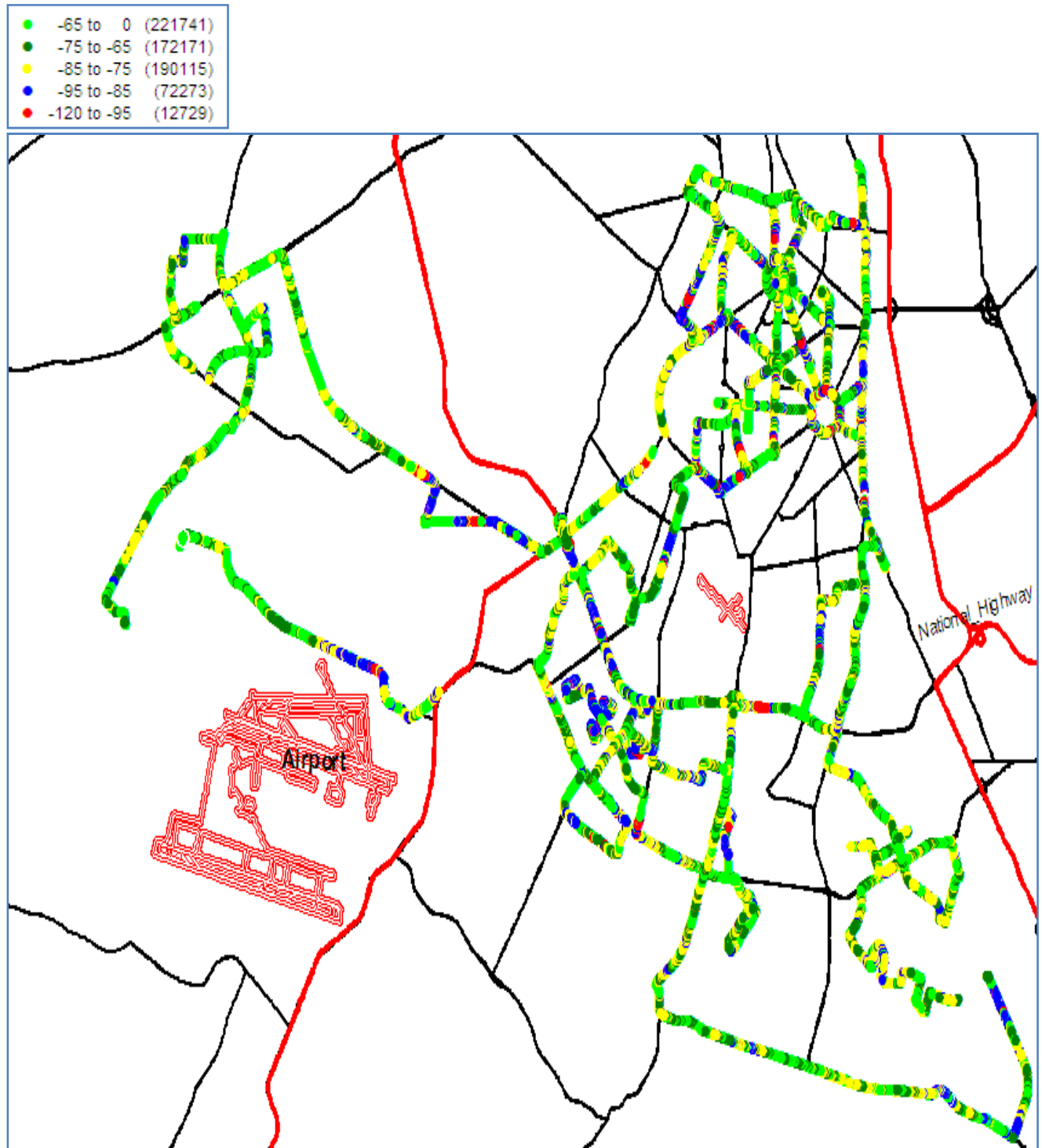
### Aircel Rx Level Plot



## Idea Rx Level Plot

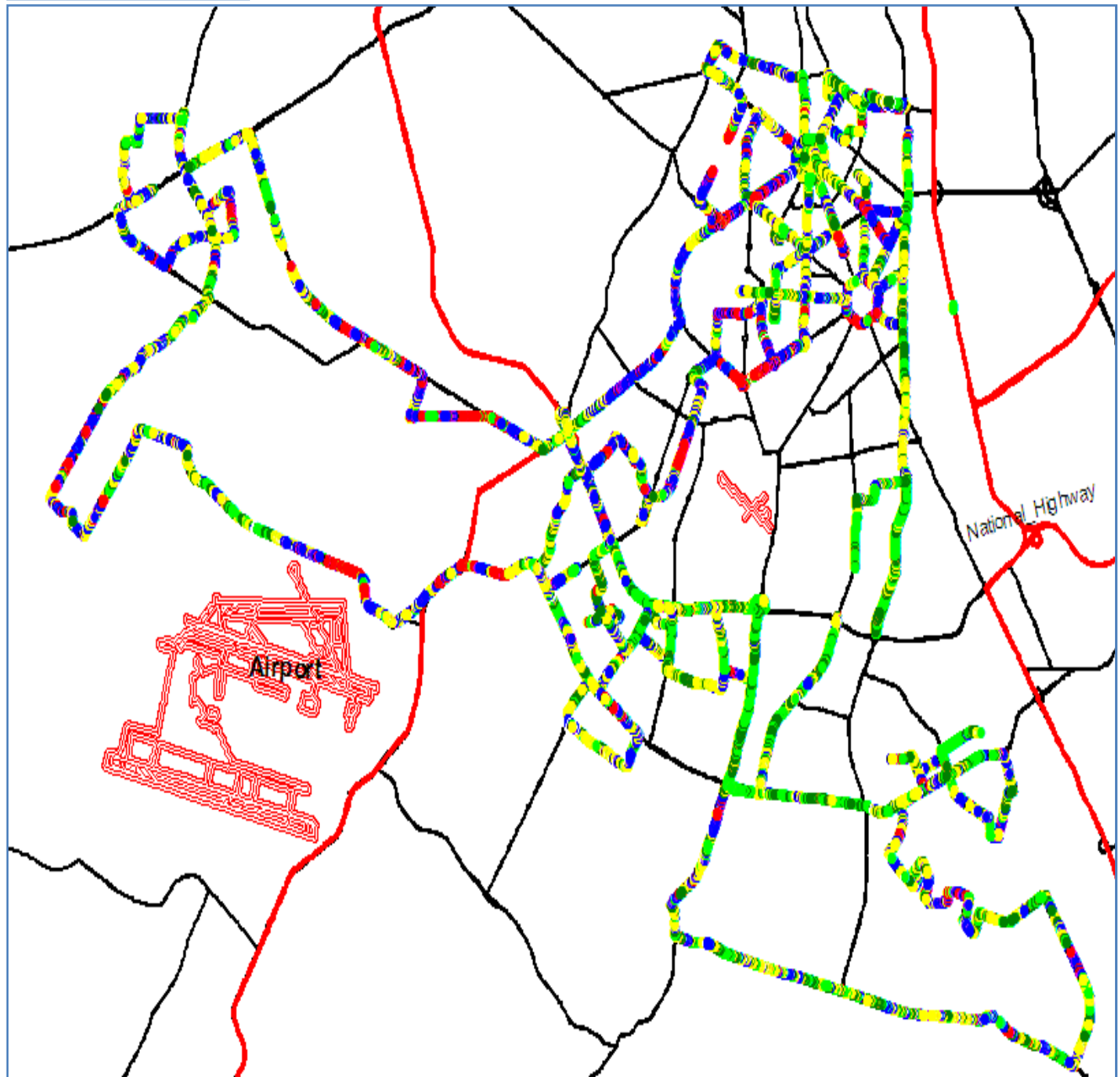


## VodafoneRx Level Plot

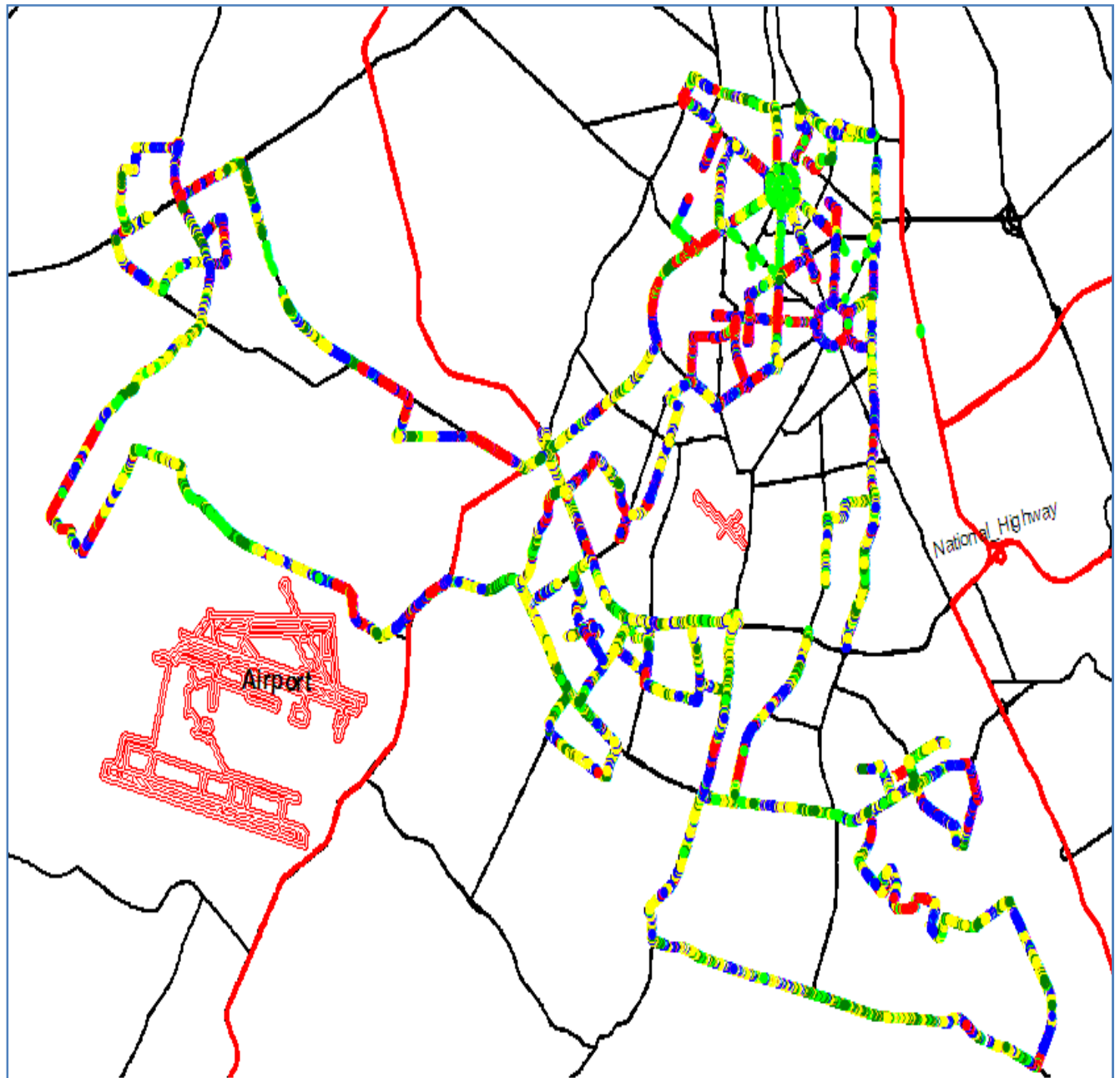


## Airtel Rx Level Plot

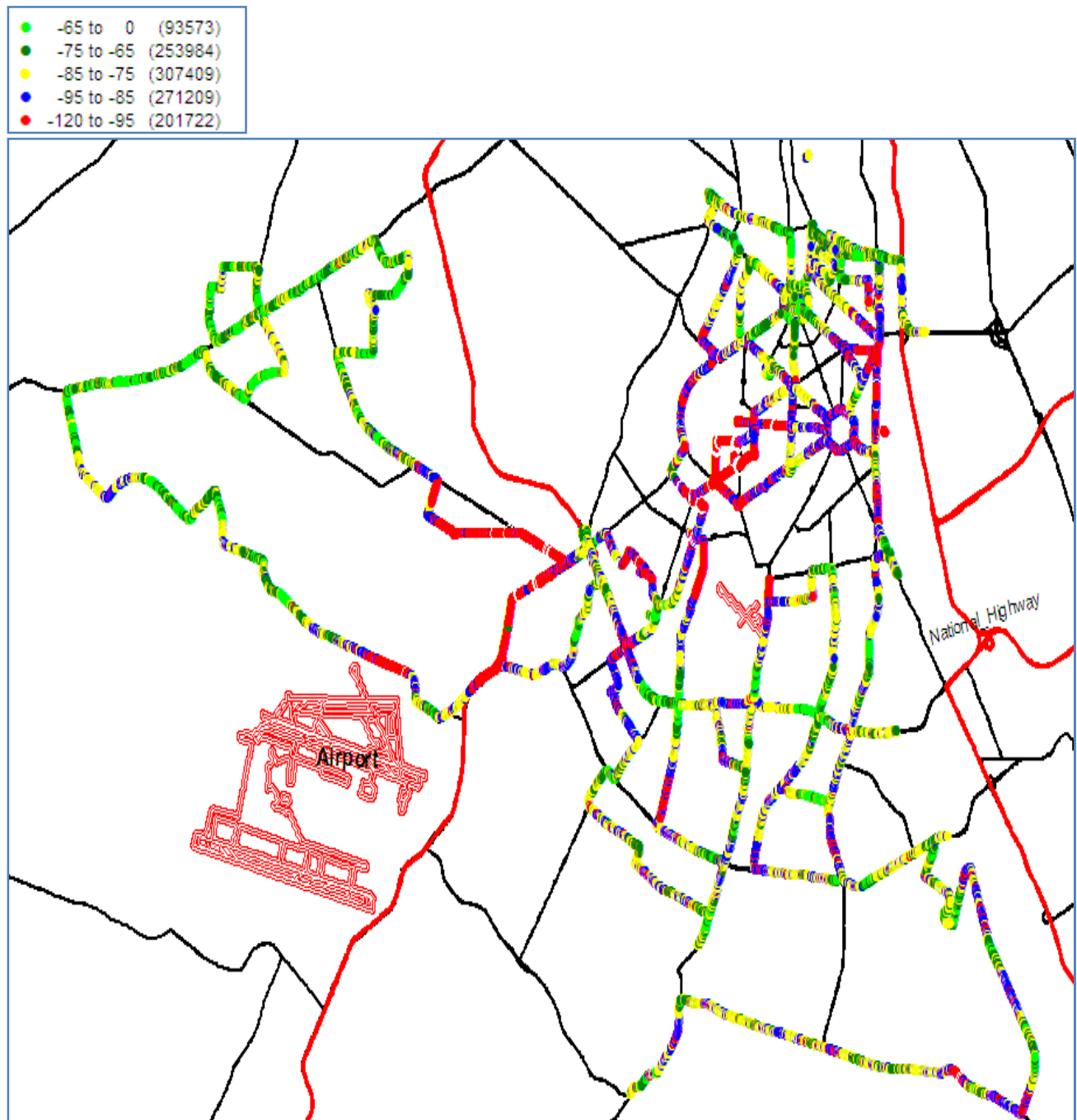
●	-65 to 0	(153313)
●	-75 to -65	(134074)
●	-85 to -75	(211698)
●	-95 to -85	(185936)
●	-120 to -95	(47566)



## Reliance Rx Level Plot



## Tata(CDMA) Rx Level Plot





### 3.1.2 Accessibility

For determining the accessibility there are three important parameters to be monitored, namely Call Setup Success Rate (CSSR), Standalone Dedicated Control Channel (SDCCH)/ Paging Channel and Traffic Channel (TCH).

#### Call Set-up Success Rate (CSSR):

Call Setup Success Rate is defined as the ratio of Established Calls to Call Attempts. Established Calls means the following events have happened in call setup:

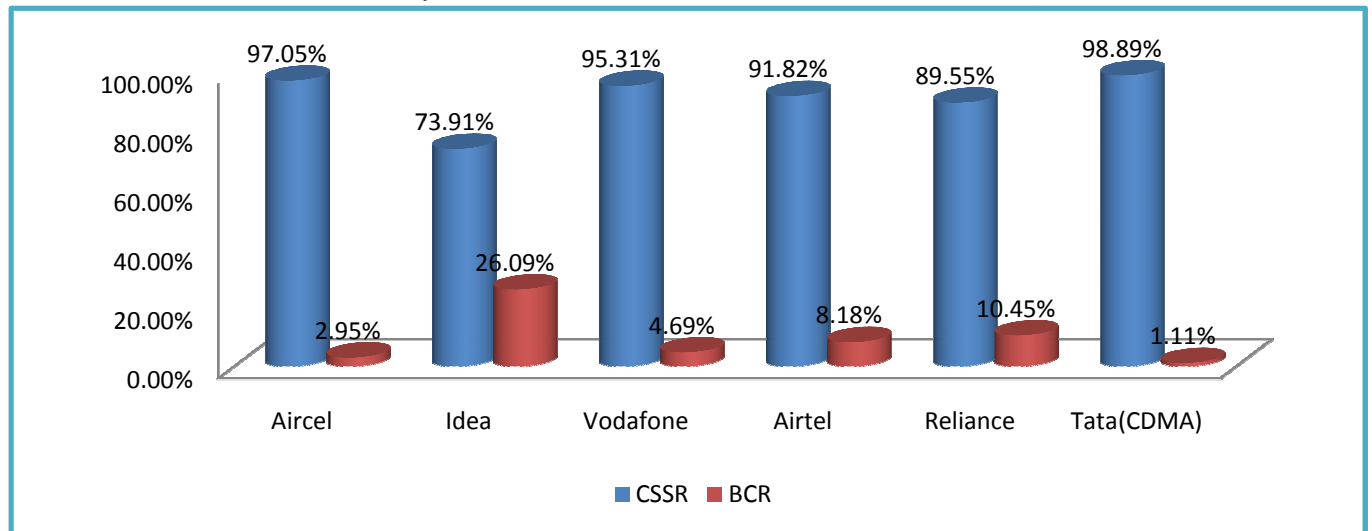
- i) Attempt is made
- ii) The TCH is allocated and
- iii) The call is routed to the outwards path of the concerned MSC.

#### Accessibility Summary

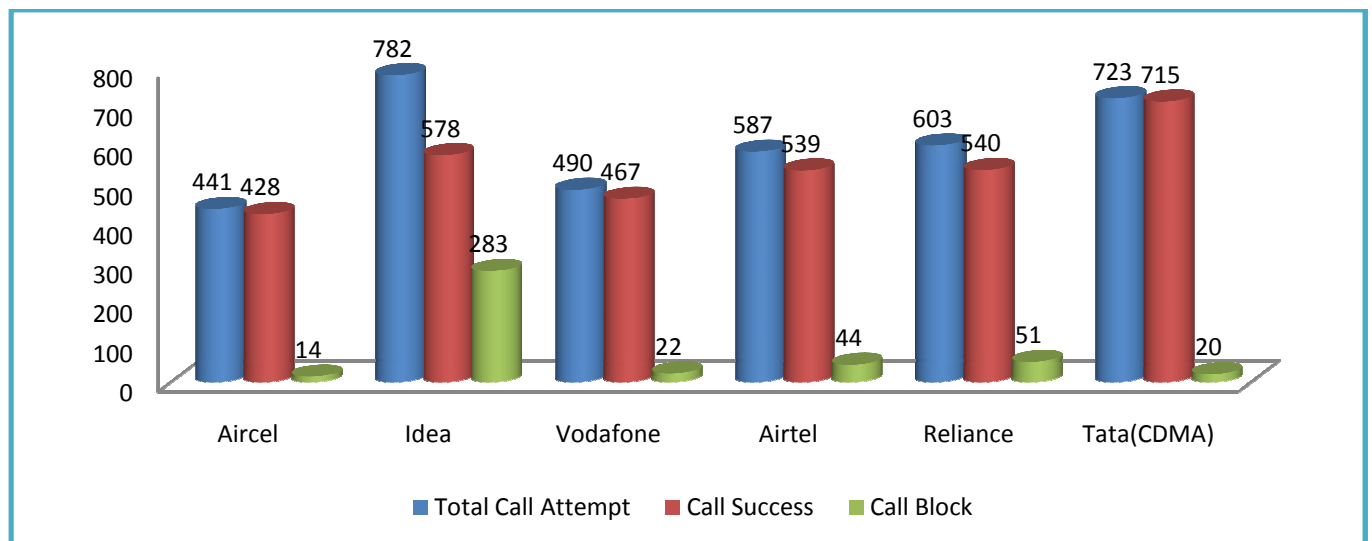
Accessibility is the ability of a service to be obtained within specific tolerances and other given conditions, when requested by the user. In other words, the ability of a user to obtain the requested service from the system. Accessibility is monitored by measuring Call Setup Success Rate (CSSR) which is defined as the ratio of Established Calls to Call Attempts. The benchmark is 95%. The performance of the operators varies from 98.89% (for Tata CDMA) to 73.91% (for Idea). The details are as follows:

Table 3.3 Accessibility Summary and Ranking

Operator	Total Call Attempt	Call Block	CSSR	Ranking
Aircel	441	14	97.05%	2
Idea	782	283	73.91%	6
Vodafone	490	22	95.31%	3
Airtel	587	44	91.82%	4
Reliance	603	51	89.55%	5
Tata(CDMA)	723	20	98.89%	1

**CSSR & Block Call Rate Details Graph****Accessibility Details Graph**

Operator	Total Call Attempt	Call Block	Call Success	CSSR	BCR
Aircel	441	14	428	97.05%	2.95%
Idea	782	283	578	73.91%	26.09%
Vodafone	490	22	467	95.31%	4.69%
Airtel	587	44	539	91.82%	8.18%
Reliance	603	51	540	89.55%	10.45%
Tata(CDMA)	723	20	715	98.89%	1.11%

**CSSR & Block Call Rate (BCR) Statistics**

### 3.1.3 Retainability

Retainability is “The ability of a service, once obtained, to continue to be provided under given conditions for a requested duration.” For determining the retainability, the regulation prescribes three important parameters namely Call drop rate (CDR), Worst affected Cells having more than 3% TCH drop and Connection with good voice quality. The call drop and Connection with good voice quality were monitored by the drive test.

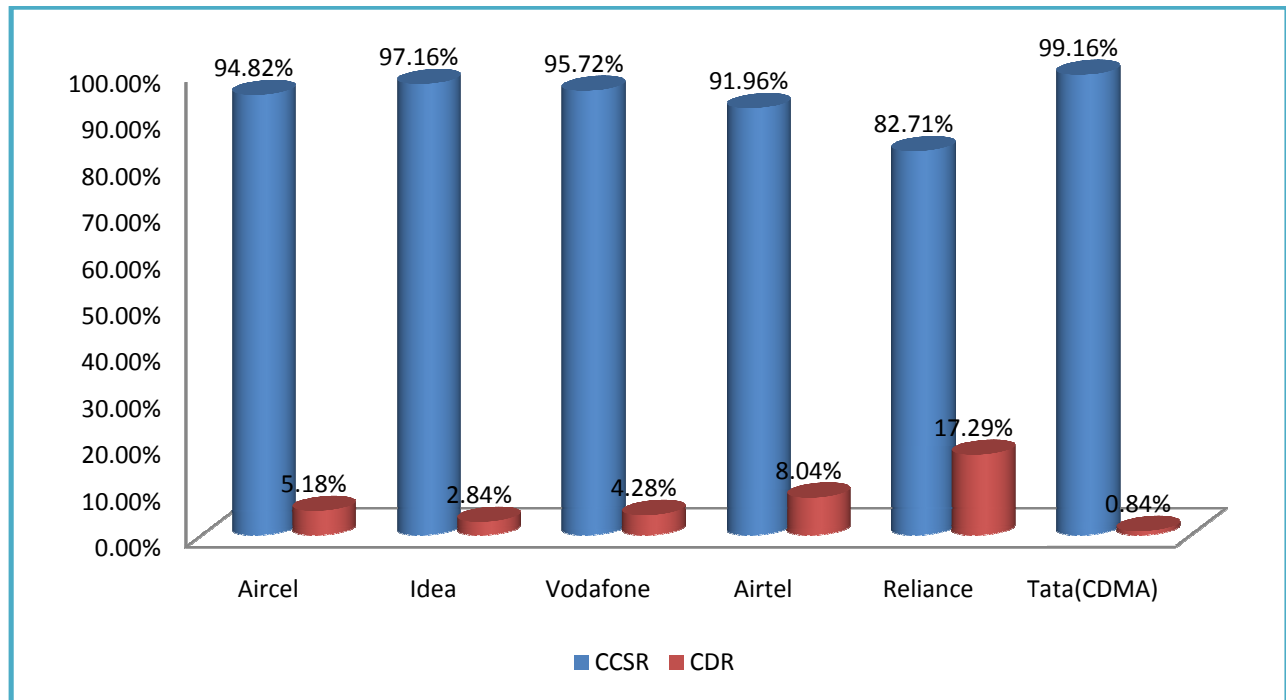
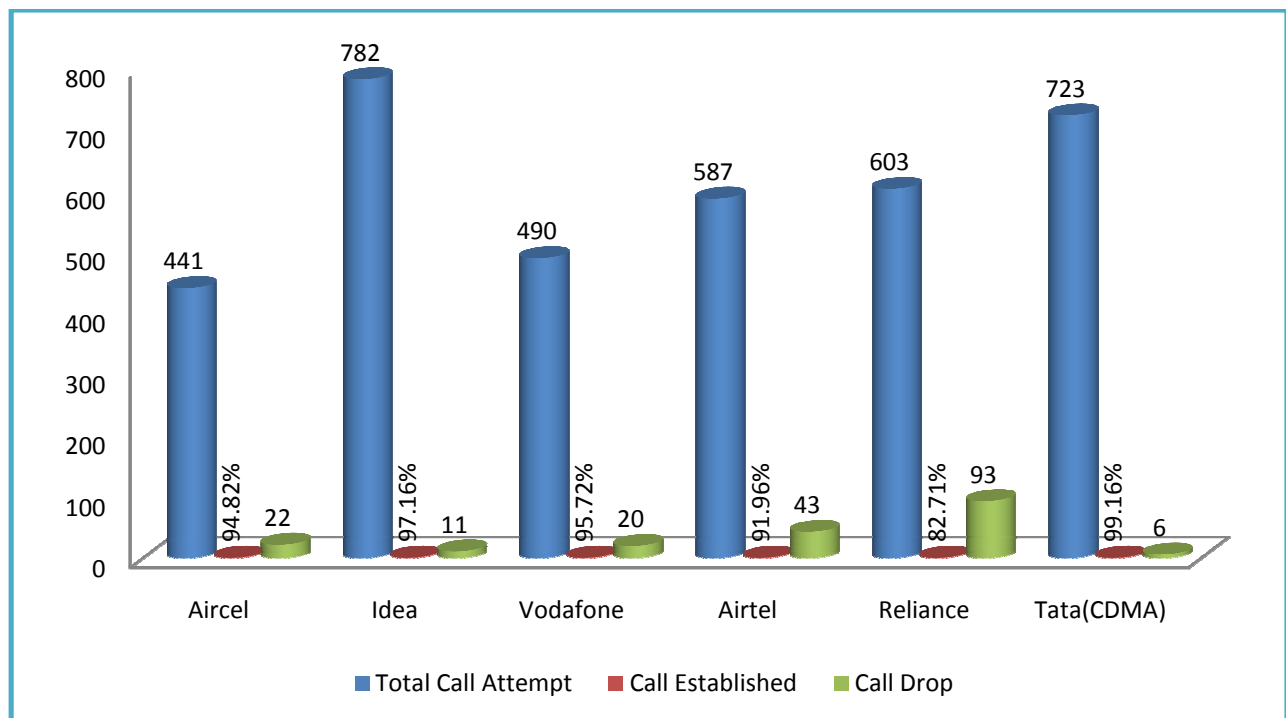
**Call Drop Rate (CDR):** The parameter gives a reliable measurement of the mobile network used by the service provider for maintaining a call once it has been correctly established. The Call drop rate of TSPs varies from 0.84% (Tata CDMA) to 17.29% (Reliance GSM) as shown below:

Table 3.4 Retainability Summary and Ranking

Operator	Total Call Established	Total Call Drop	CCSR	CDR	Ranking
Aircel	425	22	94.82%	5.18%	4
Idea	388	11	97.16%	2.84%	2
Vodafone	467	20	95.72%	4.28%	3
Airtel	535	43	91.96%	8.04%	5
Reliance	538	93	82.71%	17.29%	6
Tata(CDMA)	714	6	99.16%	0.84%	1

CCSR: Call completion Success Rate

CDR: Call Drop Rate

**Success & Call Drop Rate Details Graph****Success & Call Drop Rate Statistics Graph**

### 3.1.4 Mobility

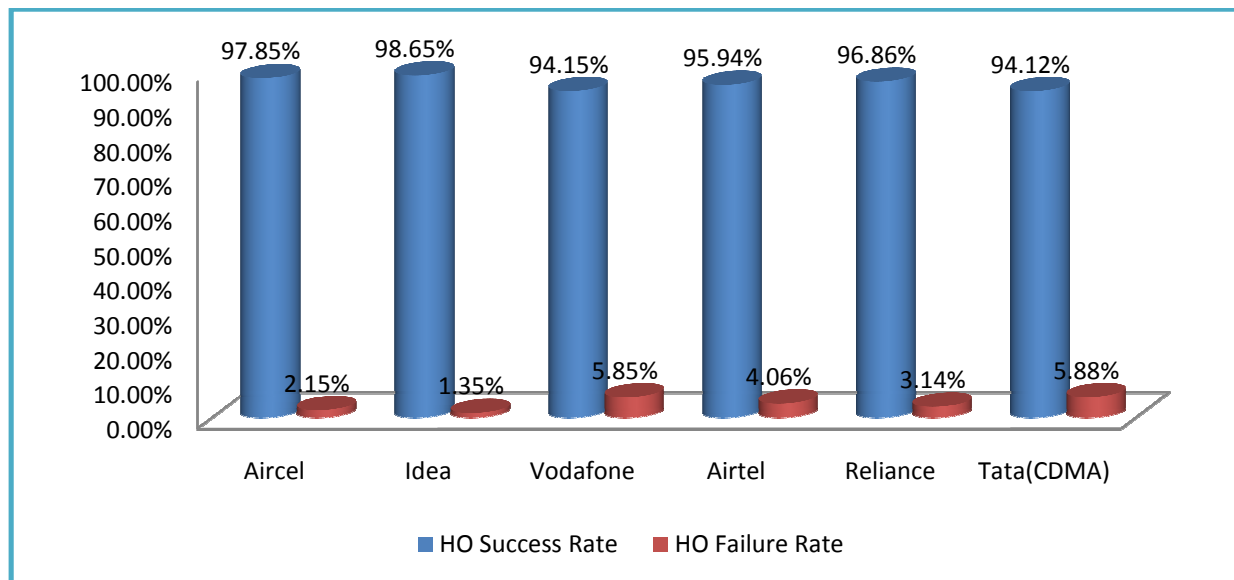
In a cellular system a base station has only a limited coverage area. Hence it is possible for a moving subscriber to get out of reach of a base station while making a call. The process by which a mobile telephone call is transferred from one base station to another as the subscriber passes the boundary of a cell is called a handover.

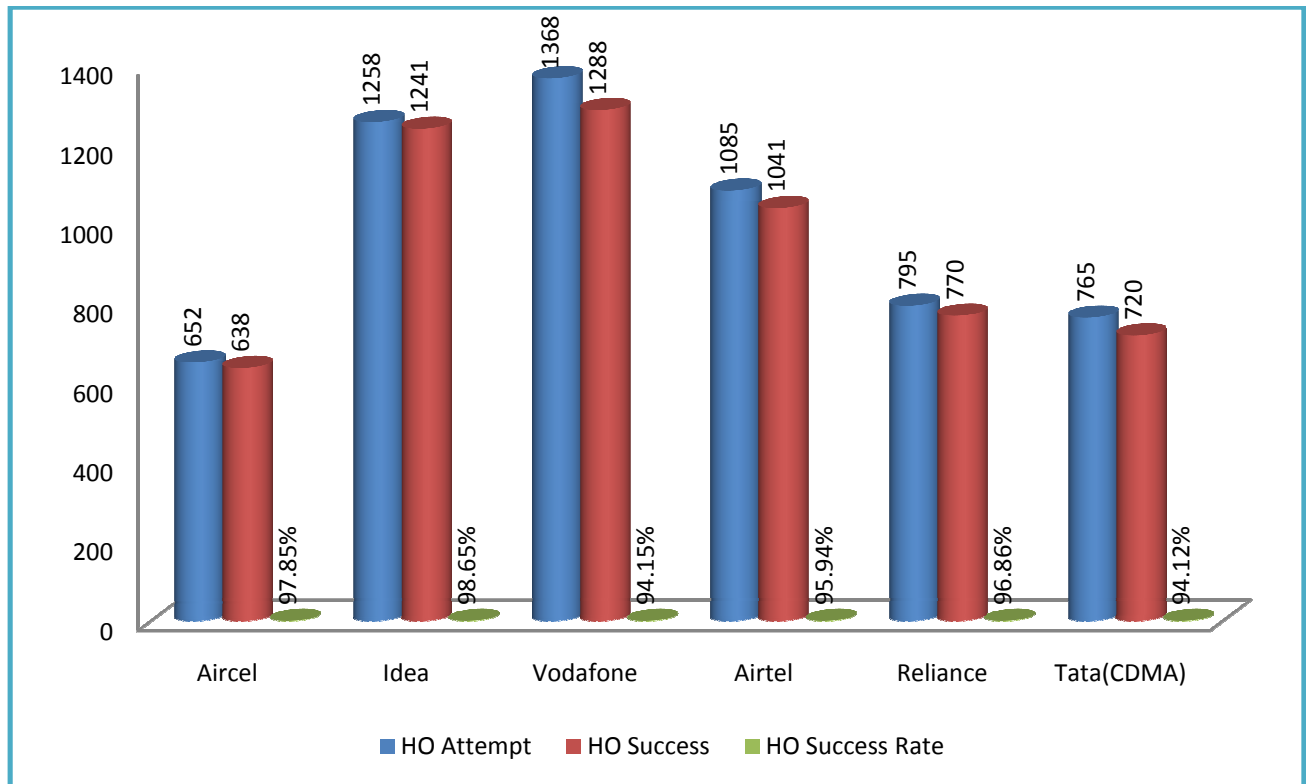
The Handover success rate (HOSR) more than 95% is considered to be good. The performance of the TSPs varies from 98.65 % (Idea) to 94.12% (Tata CDMA). The Operator's performance is as given below.

Table 3.5 Mobility Summary and Ranking

Operator	Total HO Attempt	Total HO Success	HO Success Rate%	Ranking
Aircel	652	638	97.85%	2
Idea	1258	1241	98.65%	1
Vodafone	1368	1288	94.15%	5
Airtel	1085	1041	95.94%	4
Reliance	795	770	96.86%	3
Tata(CDMA)	765	720	94.12%	6

Success & Fail Handover Rate Details Graph



**Success & Fail Handover Rate Statistics**

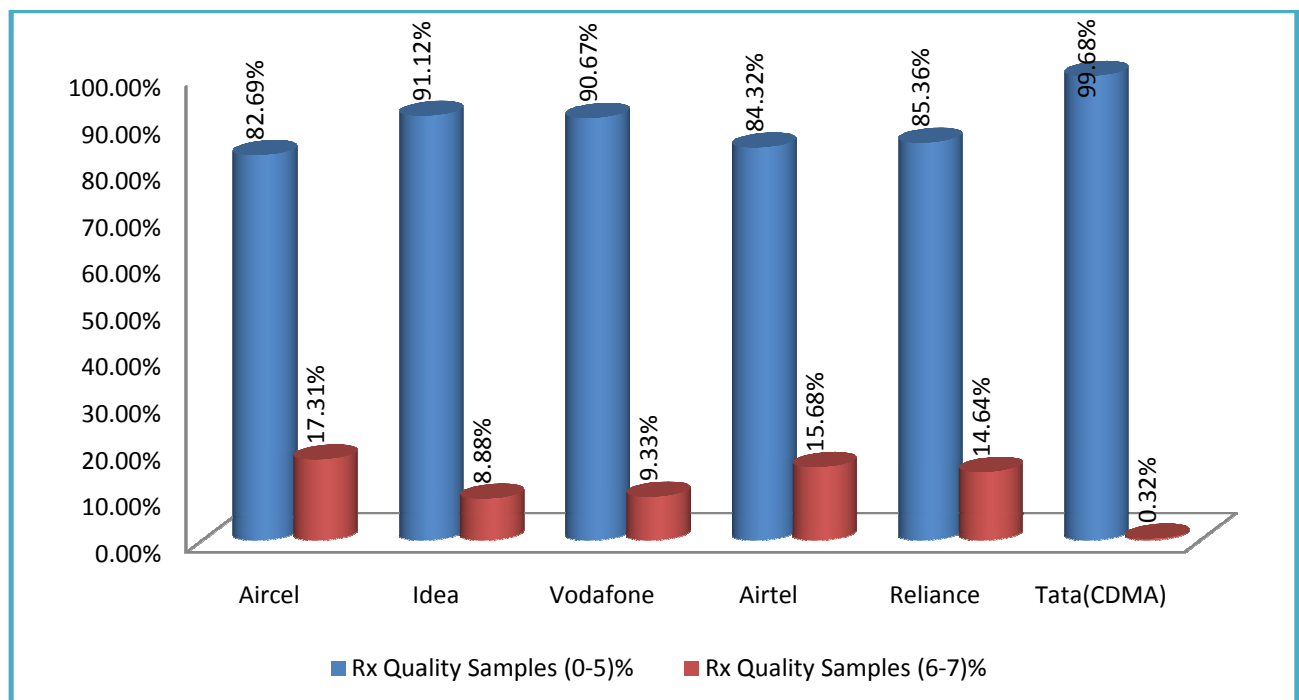
### 3.1.5 Rx Quality

For measuring voice quality, Rx Qual samples on a scale from 0 to 7 for GSM operators and Frame Error Rate (FERs) for CDMA service providers are measured. As per the QoS norms, Rx Qual between 0- 5 for GSM operators and between 0-4% FER value for CDMA operators FERs is considered to be good, where as Rx Qual beyond this benchmark is considered to be bad. The benchmark is > 95%. Accordingly the RF quality is determined and as can be seen from the table below the performance has varied from 99.68% (Tata CDMA) to 82.69% (Aircel).

Table 3.6 Rx Quality Summary and Ranking

Operator	Rx Quality Samples (0-5)	Rx Quality Samples (0-7)	Rx Quality Samples	Ranking
Aircel	481687	582511	82.69%	6
Idea	529115	580274	91.12%	2
Vodafone	499062	550272	90.67%	3
Airtel	507273	601609	84.32%	5
Reliance	415370	486637	85.36%	4
Tata(CDMA)	876877	879742	99.68%	1

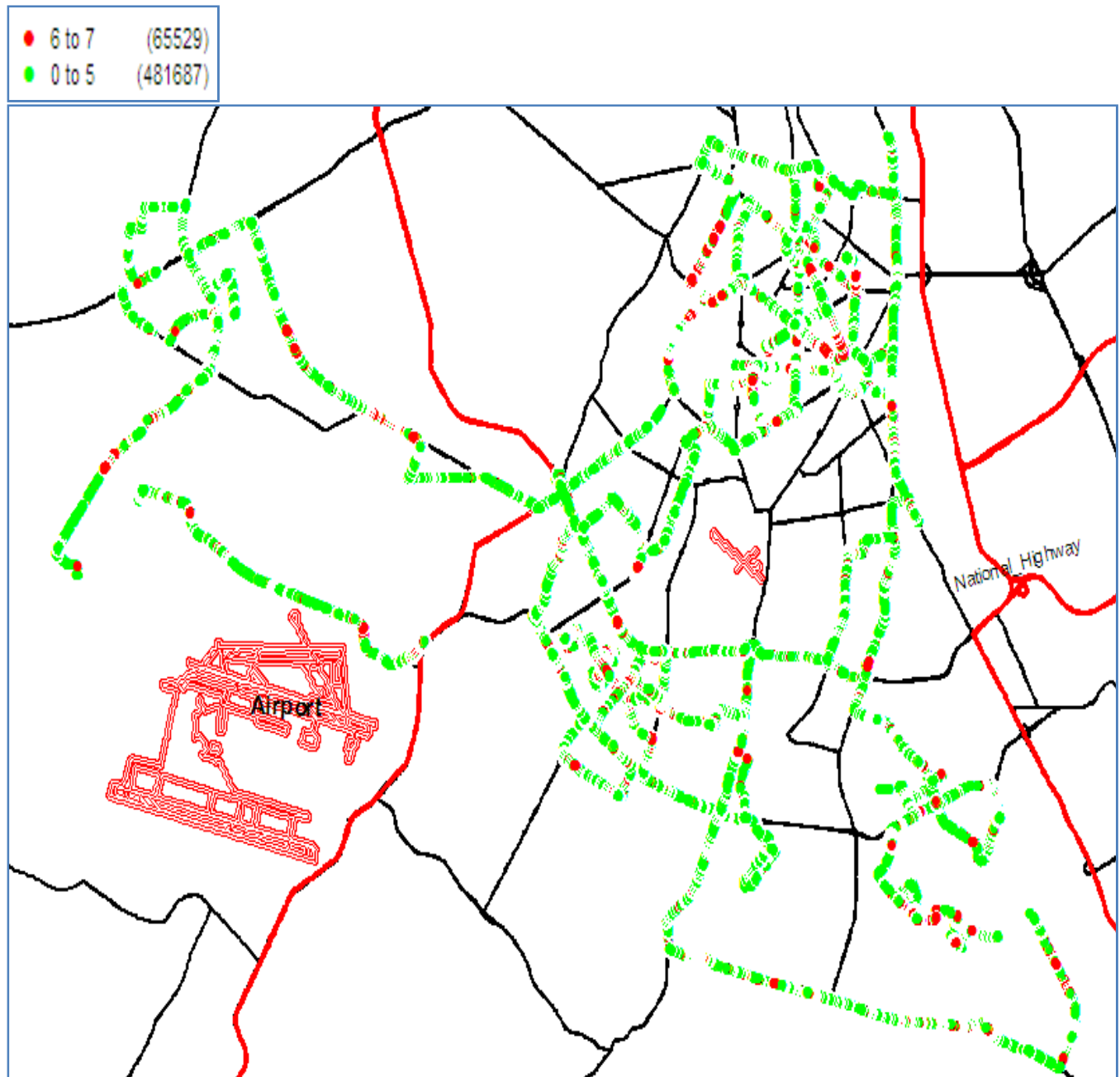
#### Rx Quality Details Graph



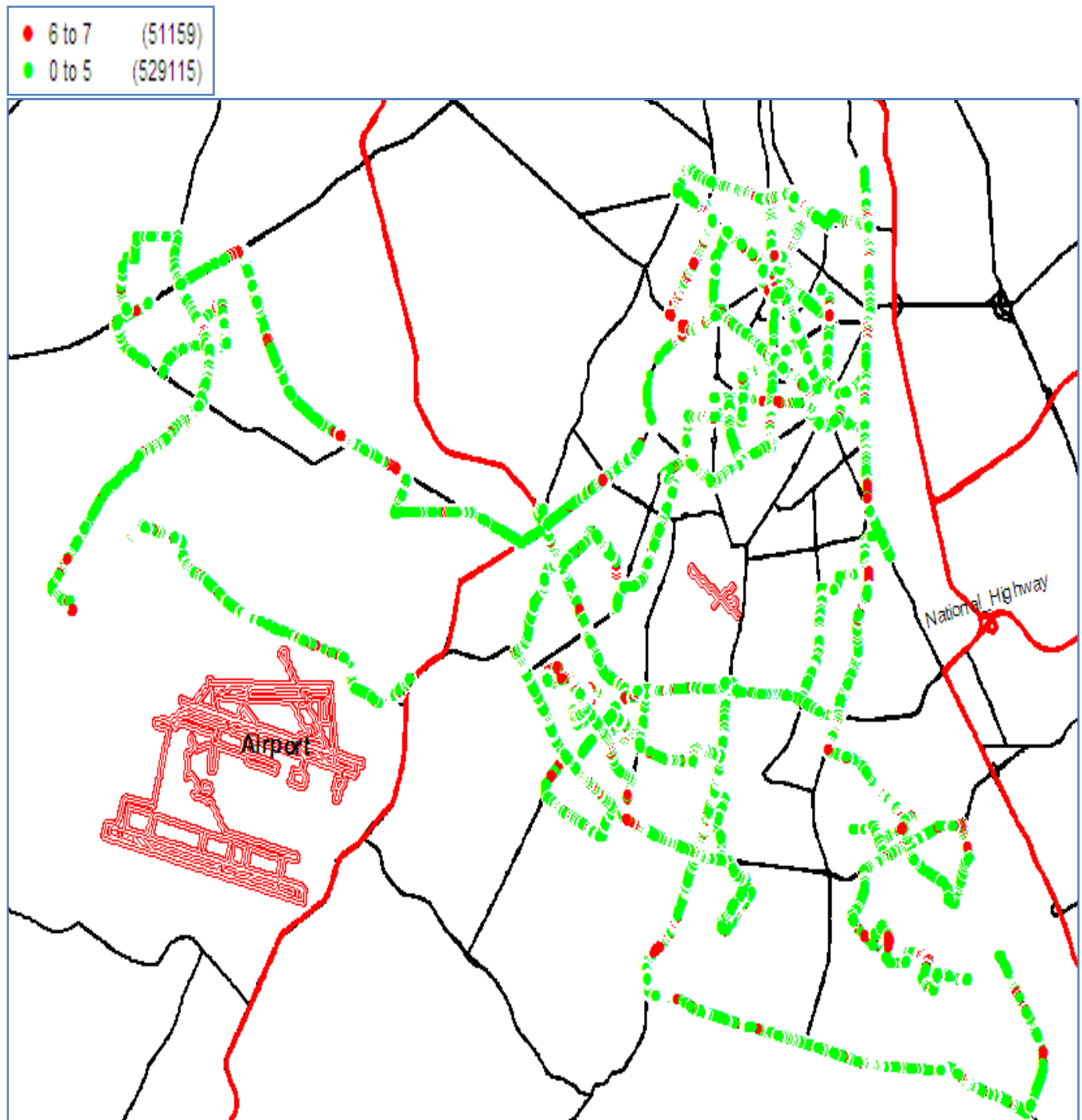


## RX QUALITY PLOT

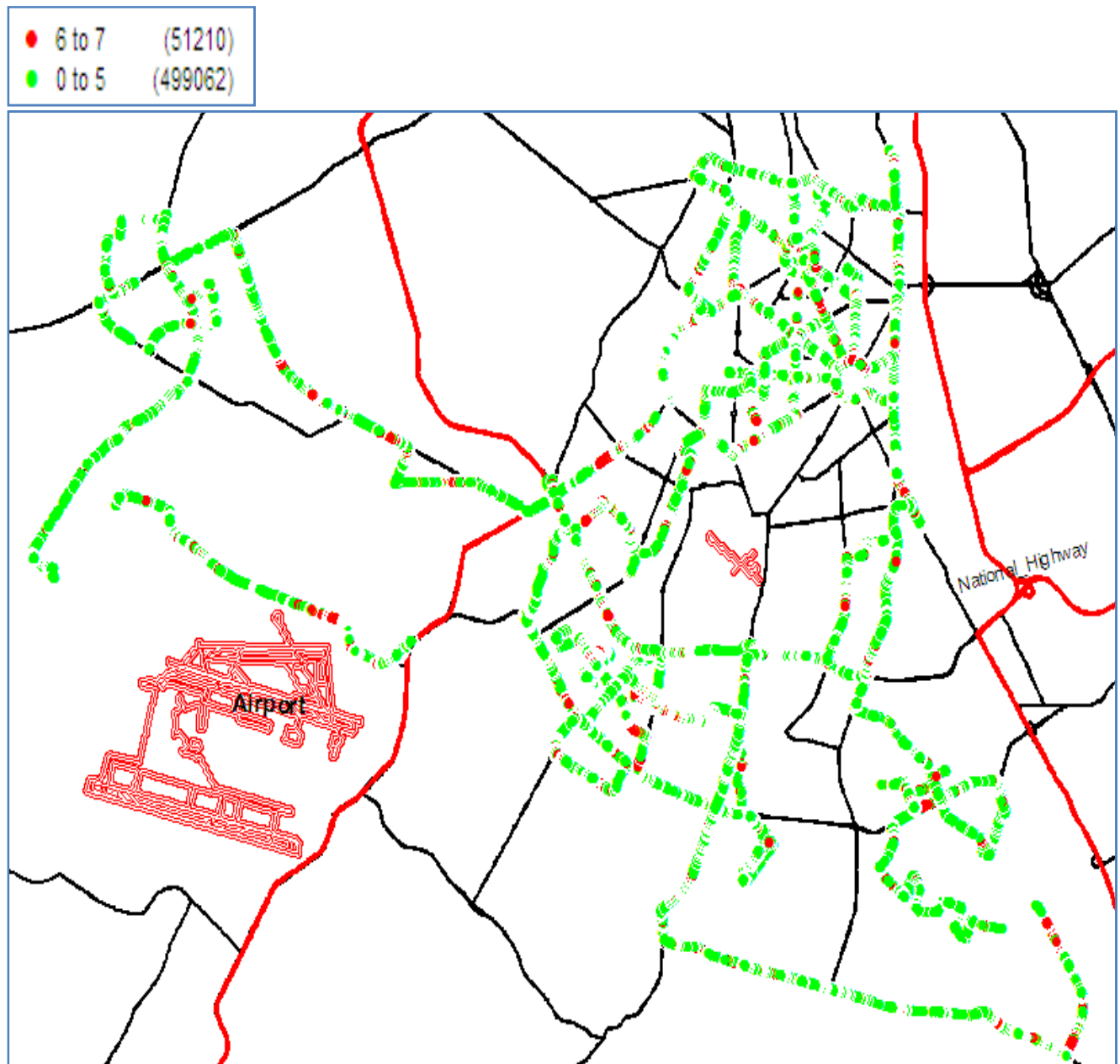
### Aircel Rx Quality Plot



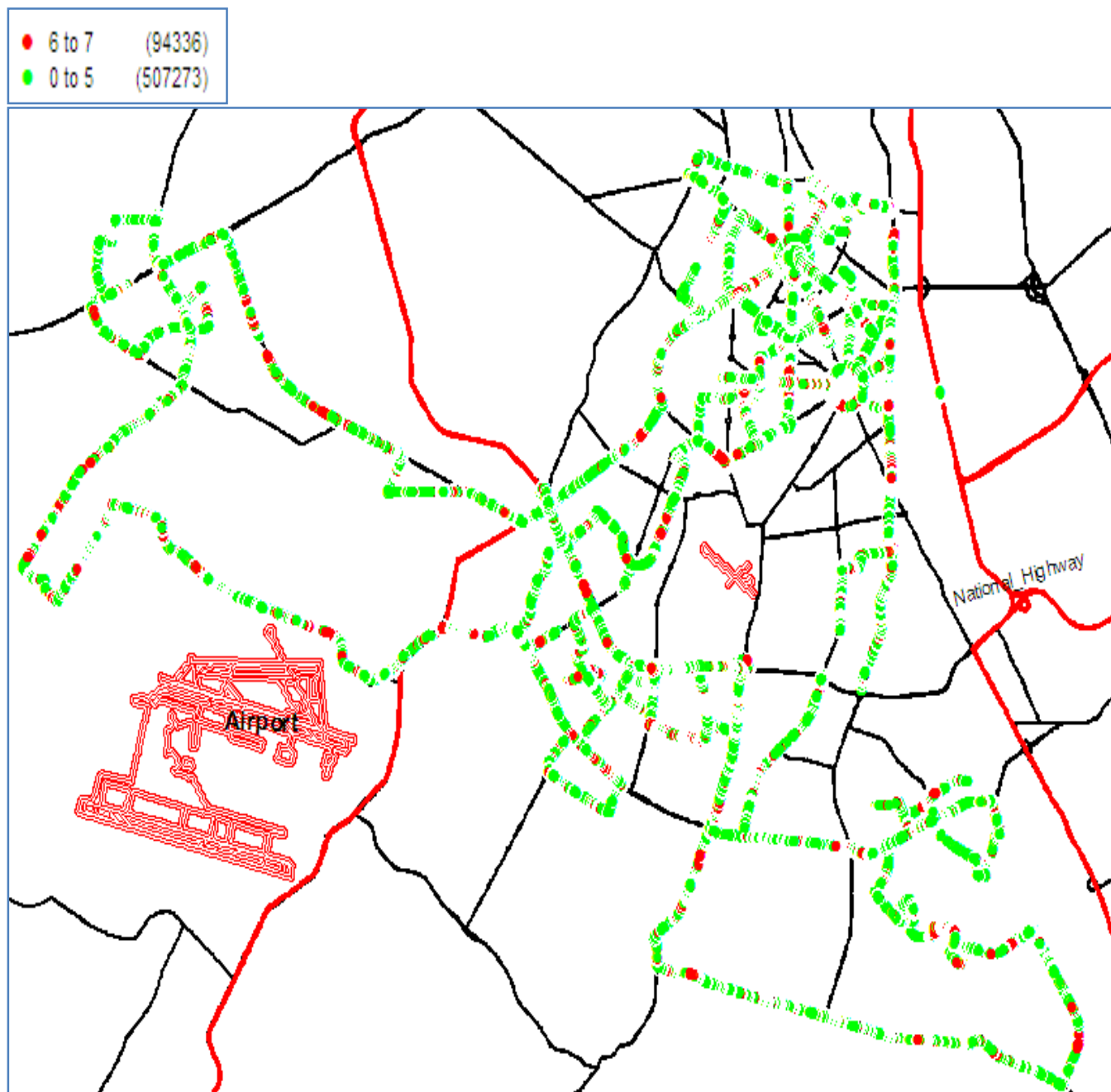
## Idea Rx Quality Plot



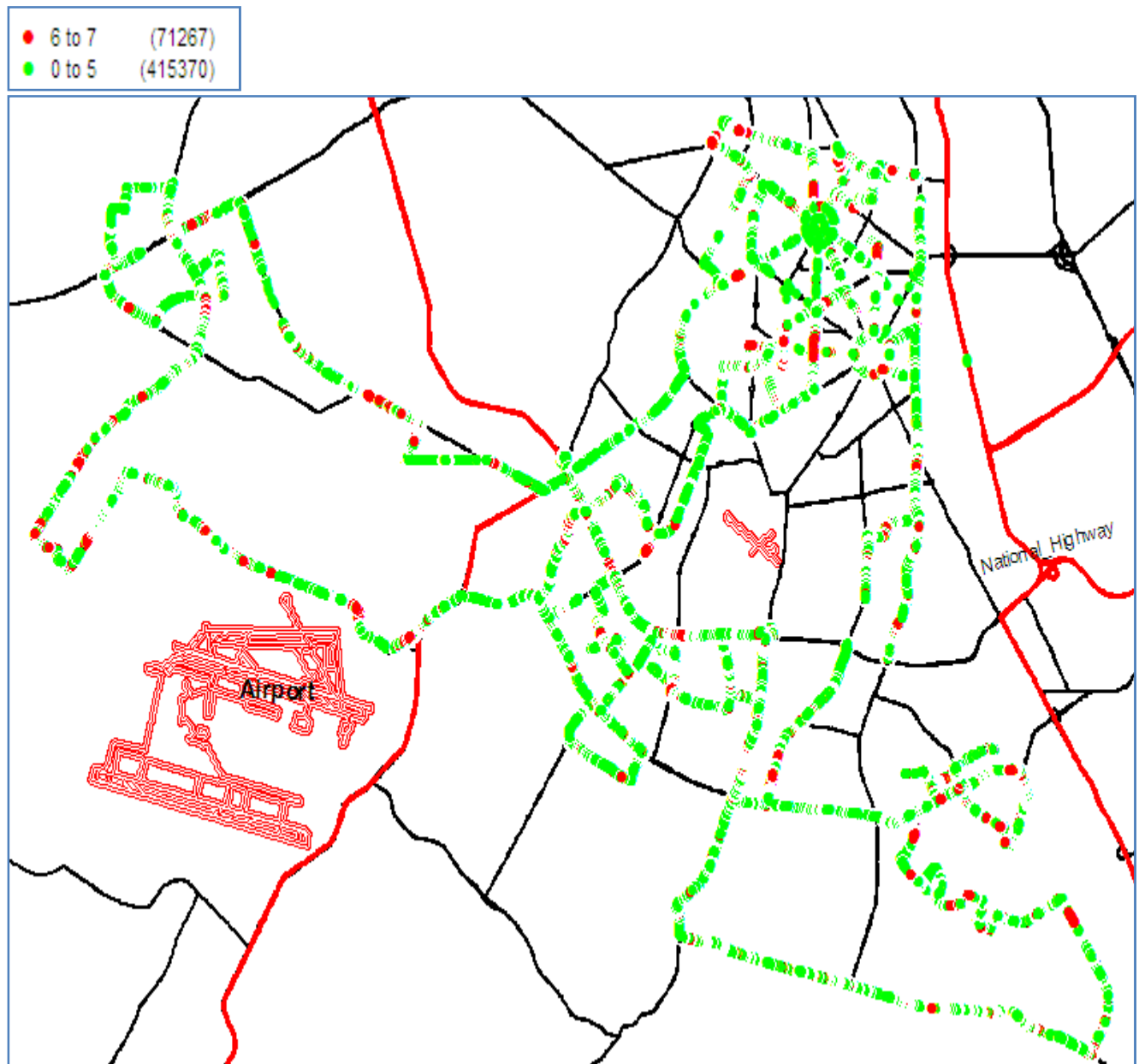
## Vodafone Rx Quality Plot



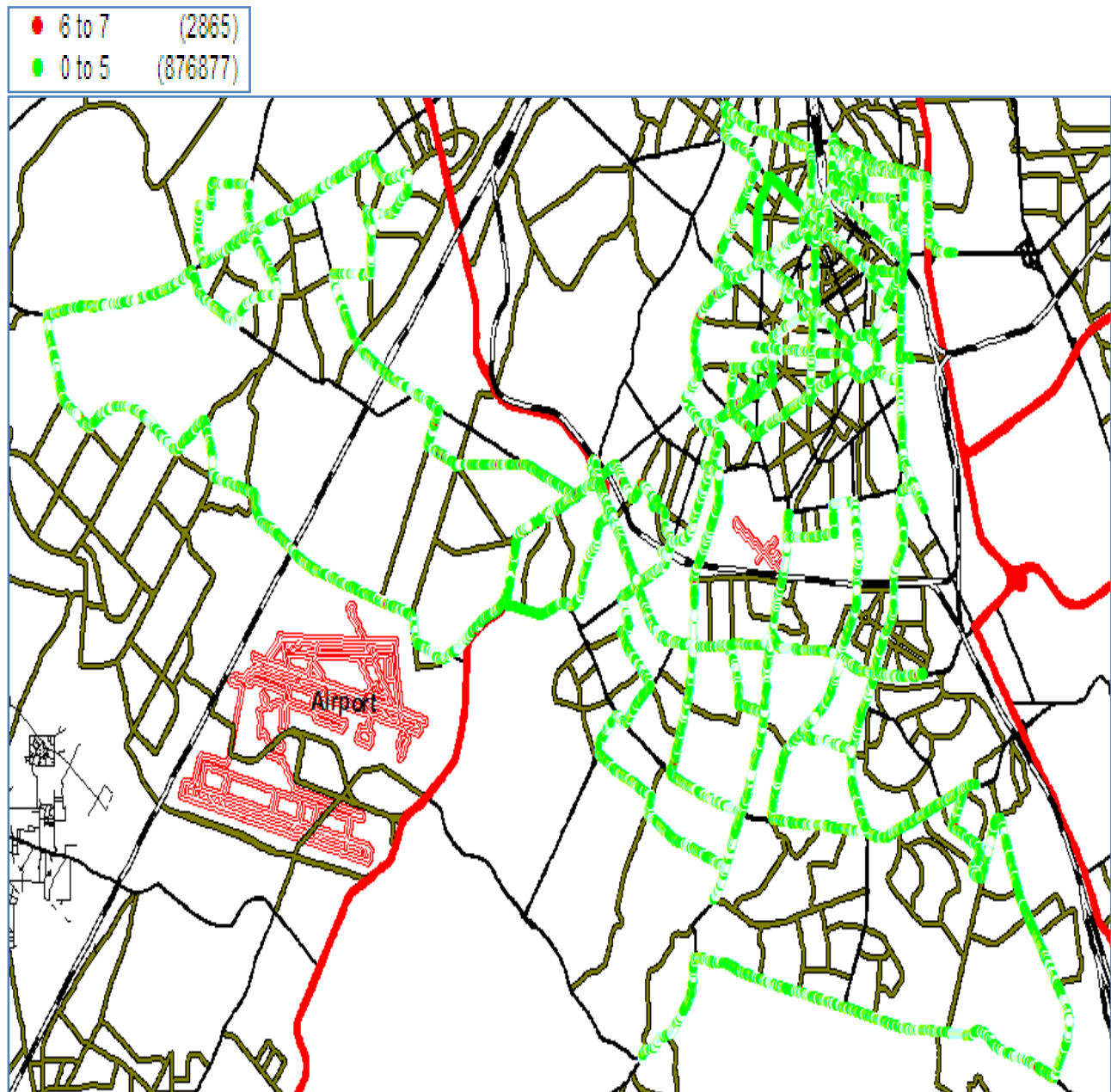
## Airtel Rx Quality Plot



## Reliance Rx Quality Plot



## Tata(CDMA) Rx Quality Plot



### 3.1.7 Carrier over Interference (C/I)

The carrier-over-interference ratio is the ratio between the levels of the signal strength of the current serving cell to that of the signal strength of undesired (interfering) signal components.

The C/I should be more than 9 db i.e. samples between 15 to 30 are considered good.

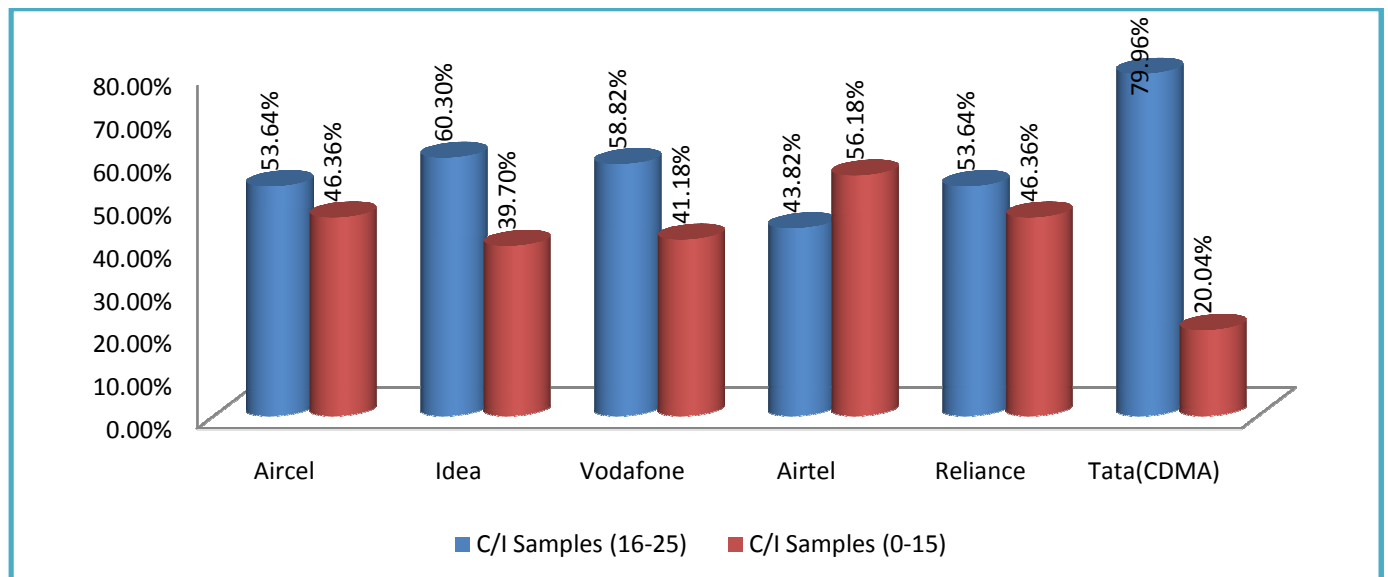
#### C/I Summary

Please refer to table 3.8 C/I Index.

Table 3.8 C/I and Ranking

Operator	C/I Samples (16-25)	C/I Total Samples	C/I Samples (%)	Ranking
Aircel	211576	394468	53.64%	5
Idea	207274	343713	60.30%	2
Vodafone	210290	357543	58.82%	3
Airtel	186808	426292	43.82%	6
Reliance	145012	270320	53.64%	4
Tata(CDMA)-Ec/Io	841916	1052948	79.96%	1

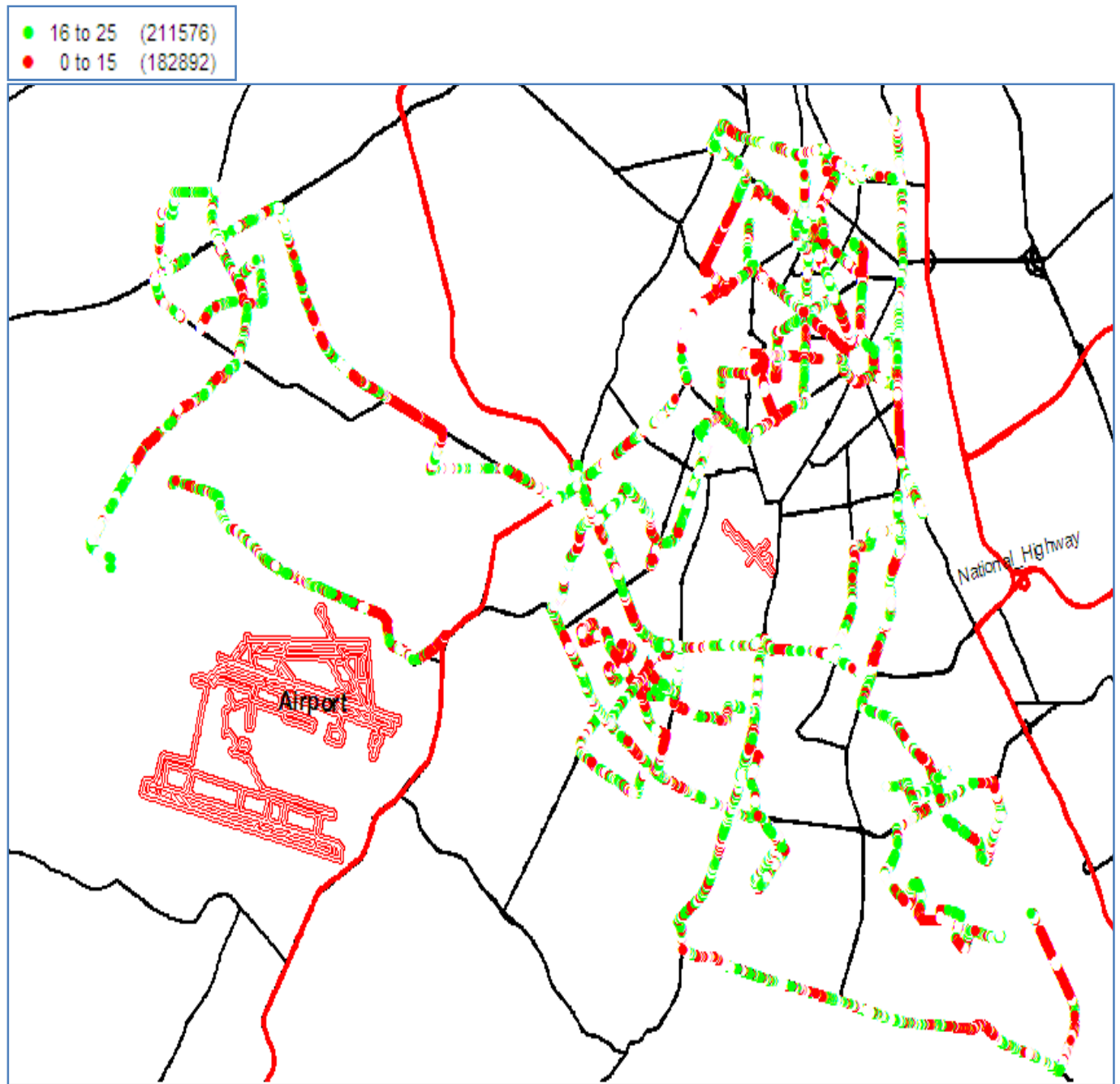
#### C/I Index Details Graph



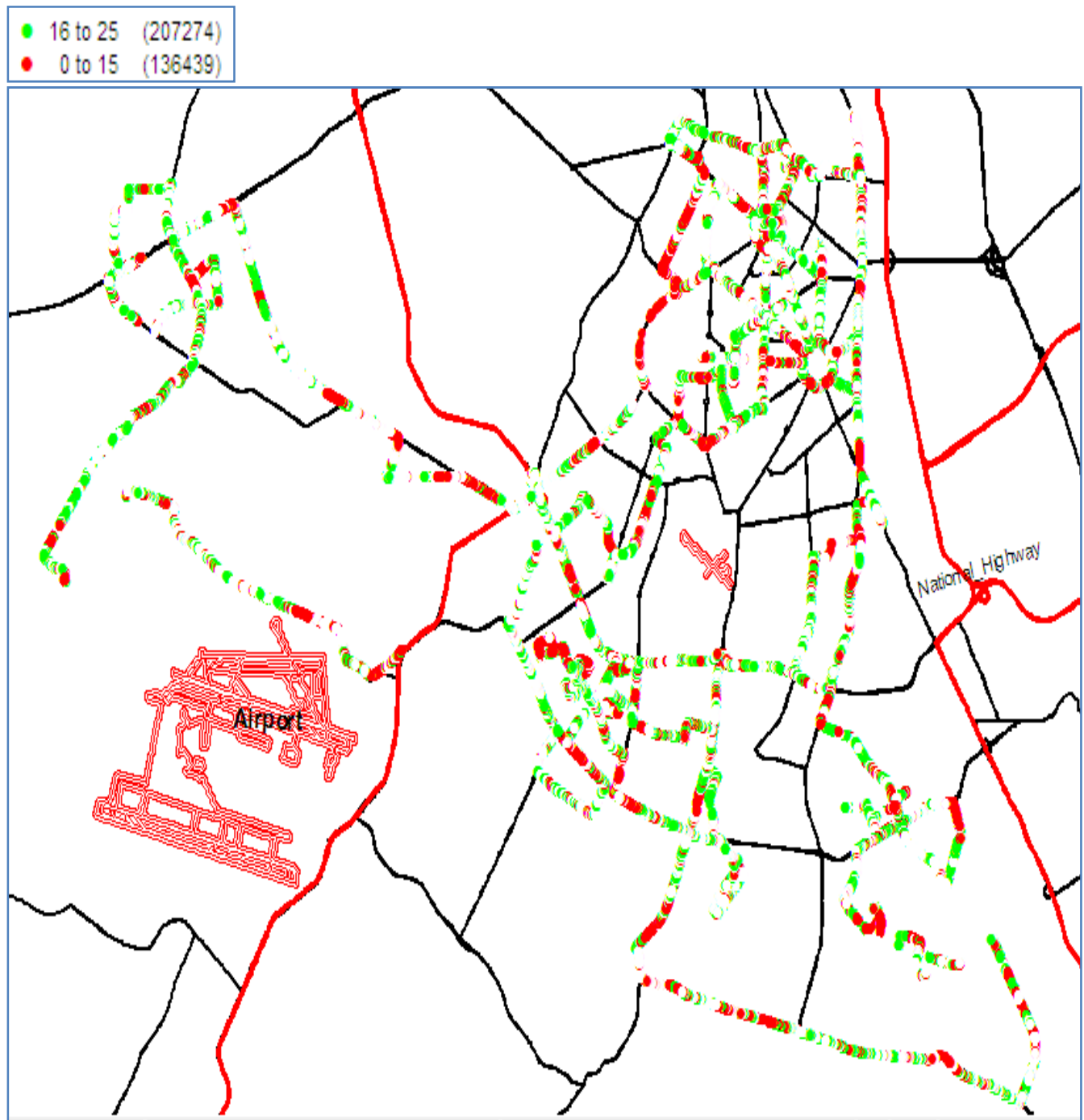


## C/I PLOT

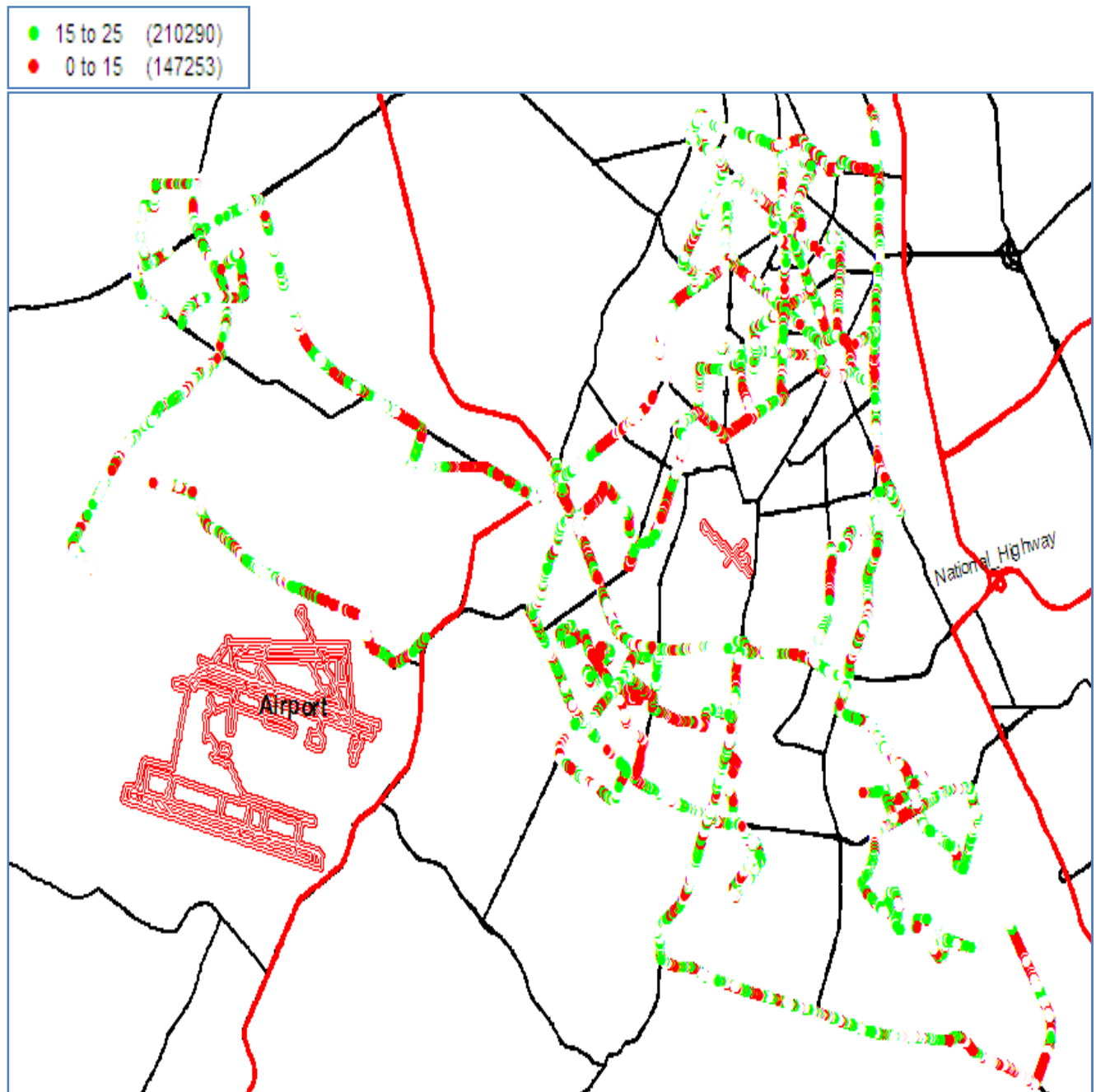
### Aircel C/I Plot



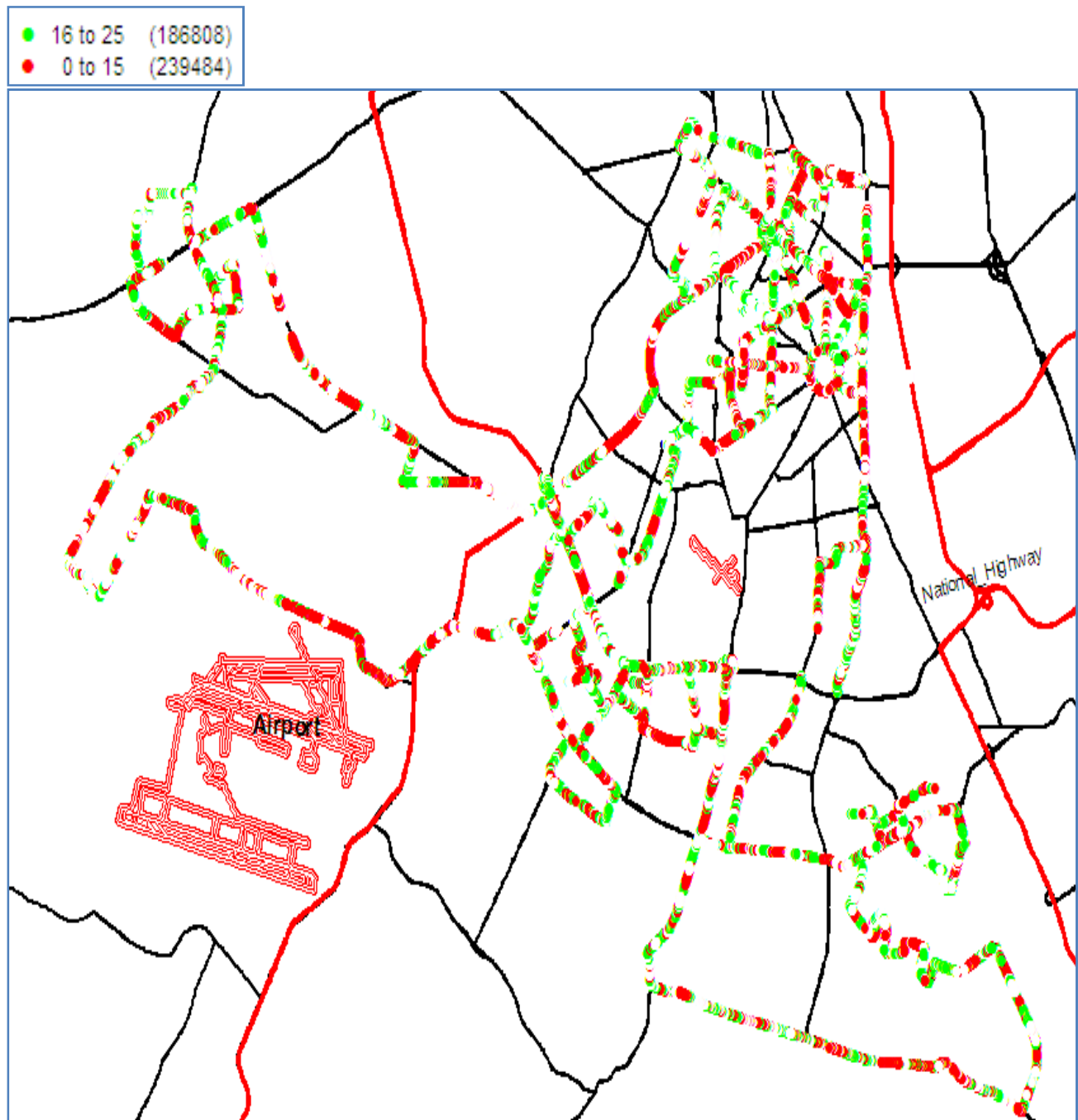
## Idea C/I Plot



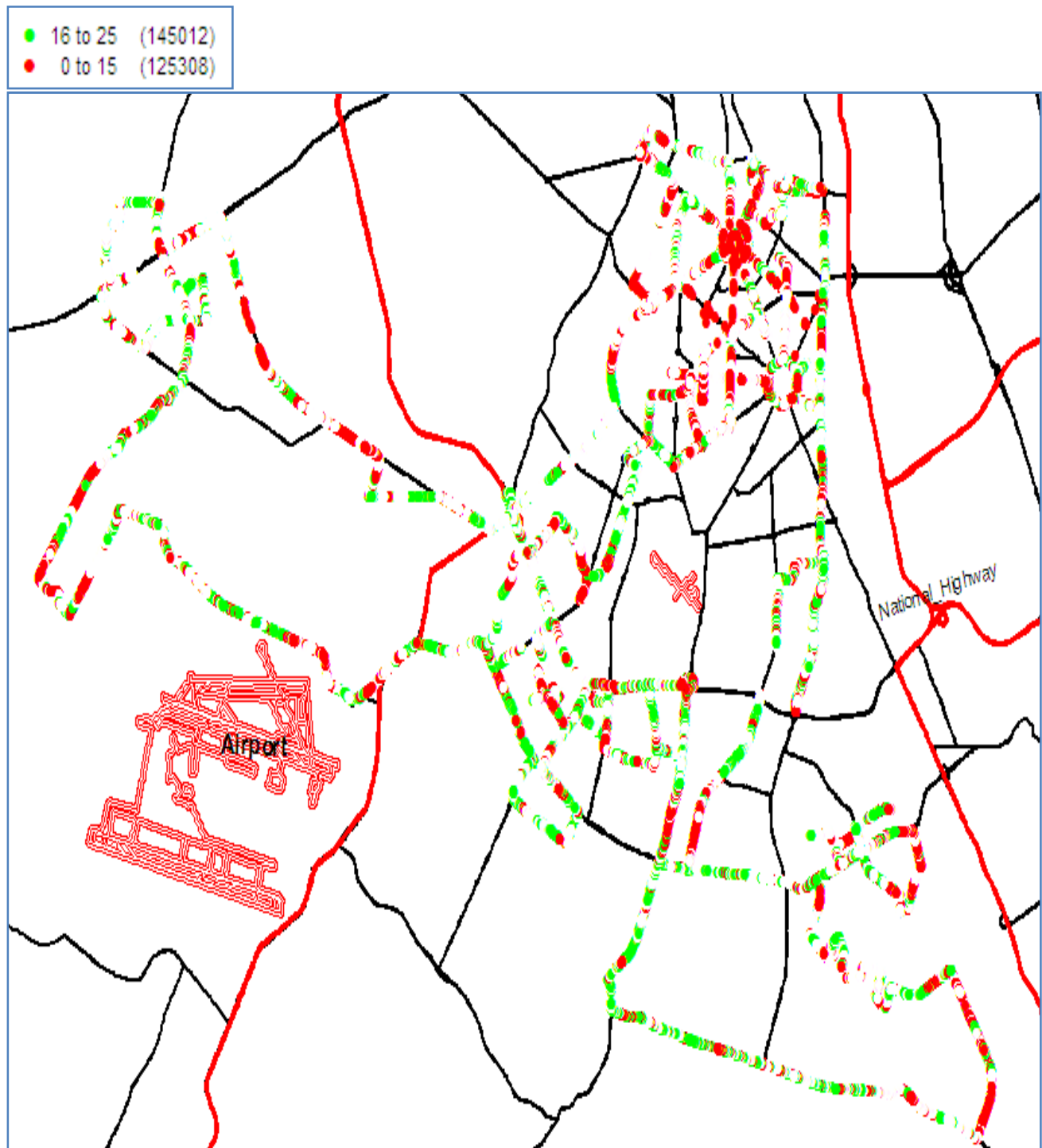
## Vodafone C/I Plot



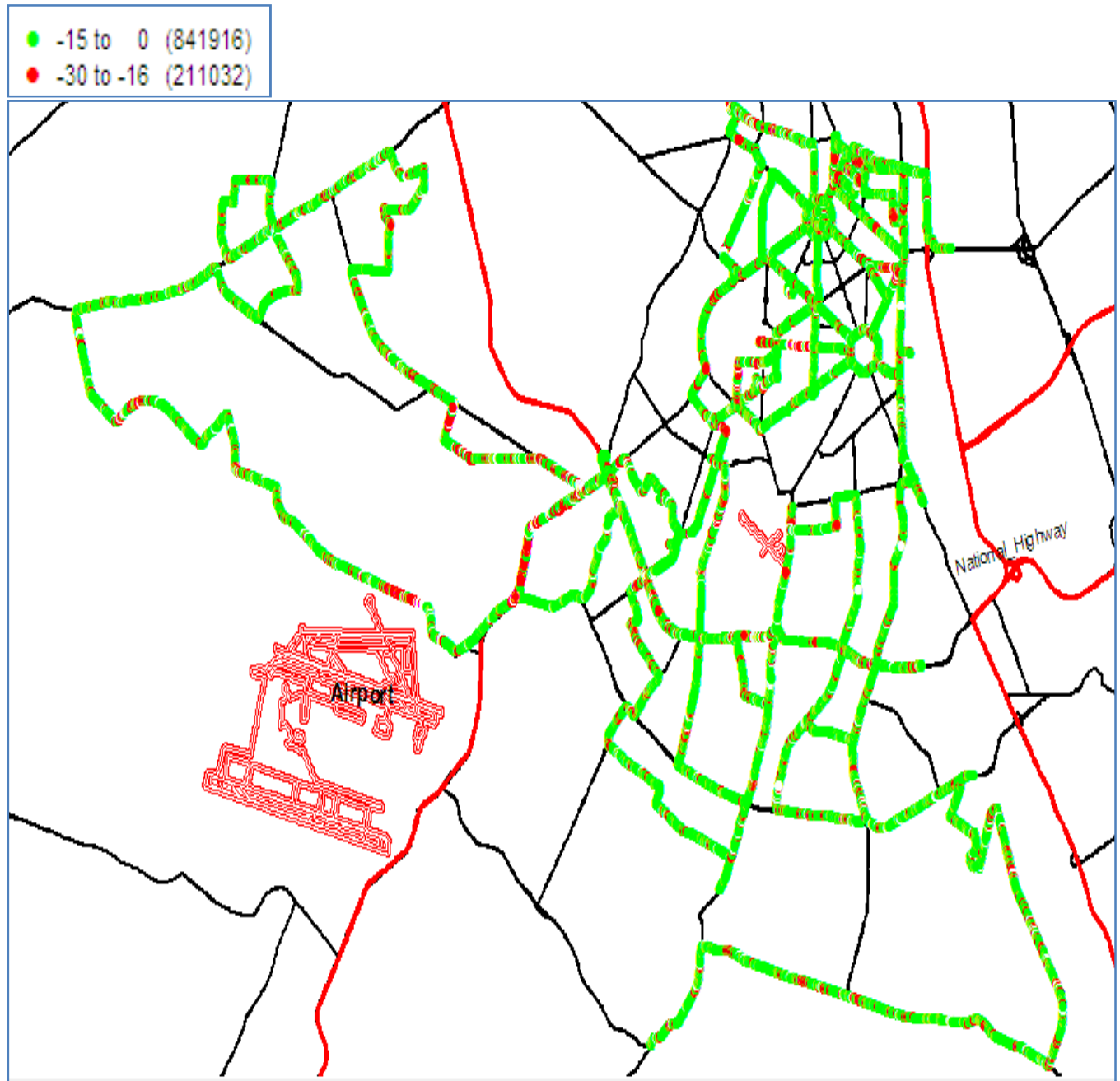
## Airtel C/I Plot



## Reliance C/I Plot



## Tata (CDMA)Ec/Io Plot



## 4. Overall Operator Analysis

KPI	Aircel	Idea	Vodafone	Airtel	Reliance	Tata (CDMA)
Call Attempt	441	782	490	587	603	723
Blocked Call Rate	3.27%	48.96%	4.71%	8.16%	9.44%	2.80%
Call Setup Success Rate (95%)	94.82%	97.16%	95.72%	91.96%	82.71%	99.16%
Dropped Call Rate (2%)	5.18%	2.84%	4.28%	8.04%	17.29%	0.84%
Rx Quality (0-5) (95%)	82.69%	91.12%	90.67%	84.32%	85.36%	99.68%
Handover Success Rate > 95%	97.85%	98.65%	94.15%	95.94%	96.86%	94.12%

### Analysis:

Independent Drive Test was conducted by TUV SUD on behave of TRAI for Idea, Airtel,Vodafone, Reliance (GSM),Aircel&Tata(GSM) in WestDelhi,South Delhi, and Central Delhi covering locations suggested by TRAI.

The Drive Test results revealed that the most of the operators were failed to meet benchmarks of network related parameters. They failed to achieve benchmark due to High Block Call Rate, High Drop Call Rate, Low Call Setup Success Rate & Rx Quality Samples.The Voice Quality observed was not satisfactory in some part of West, South and Central Delhias shown in respective plots.