Independent Communications Authority of South Africa
Pinmill Farm, 164 Katherine Street, Sandton
Private Bag X10002, Sandton, 2146

Quality of Service Report:

Gauteng

June 2011

Dr SS Mncube (Chairperson), NA Batyi, WH Currie, JM Lebooa, TLV Makhakhe, N Ndhlovu, FK Sibanda, Dr MM Socikwa, WF Stucke (Councillors), TTC Dlamini (CEO)

Contents

Abbreviations....2

Definitions....3

1. Introduction....4

1.1 Background....4

1.2 Objectives....6

2. Methodology....6

2.1 Drive Tests Methodology....7

2.2 Computational Methodology....8

3. Results and Analysis....9

4. Conclusion....18

Dr SS Mncube (Chairperson), NA Batyi, WH Currie, JM Lebooa, TLV Makhakhe, N Ndhlovu, FK Sibanda, Dr MM Socikwa, WF Stucke (Councillors), TTC Dlamini (CEO)

Abbreviations

2G	Second Generation Mobiles
CSSR	Call Set-up Rate
DCR	Drop Call Rate
GSM	Global System for Mobile communication
ICASA	Independent Communications Authority of South Africa
QoS	Quality of Service
SM&C	Spectrum Monitoring and Control

Dr SS Mncube (Chairperson), NA Batyi, WH Currie, JM Lebooa, TLV Makhakhe, N Ndhlovu, FK Sibanda, Dr MM Socikwa, WF Stucke (Councillors), TTC Dlamini (CEO)

Definitions

Completed Calls	These are calls that were successfully set up and received by the called party including the release failed calls.
Call Setup Rate	These are the percentage of calls that are successfully setup to a valid number, properly dialled and where called party busy tone, ringing tone or answer signal is recognized at the Network Termination Point of the calling user.
Call Drop Rate	A percentage of calls that are unintentionally disconnected in the middle of the conversation without the user's intervention.
Call Success Rate	Call success rate refers to the percentage of calls that are successfully set up and terminated as a percentage of the total call attempts. CSR excludes dropped calls or calls that experience no network condition, low speech quality calls and calls with a long set up time.
Call Block Rate	These are calls that are unsuccessful because of a lack of resources for connection due to congestion, expressed as a percentage of total call attempts.
Speech Quality	Refers to the clarity of the conversational speech without noise or echo interference. Based on ITU E.800 recommendation.
Congestion	Probability of not accessing the services (a traffic channel).
Call setup time	The call setup time is the time from when a send button is pressed or when the address information required for setting up a call is received by the network to when the called party busy tone or ringing tone or answer signal is received by the calling party.

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1. Introduction

1.1 Background

The Independent Communications Authority of South Africa has a critical mandate to protect the interest of electronics communications services consumers as stated in the Electronics Communication Act 2000.

Previously, the Authority relied on operators' returns on QoS performance reports, as that was dictated by the End-User Service Charter Regulations of 2009. It was however noted that the self-assessment submissions were not consistent with customer's experience. That led to the initiation of a Quality of Service Monitoring Unit within Spectrum Monitoring and Control (SM&C). QoS is defined as the collective effect of service performance which determines the degree of satisfaction of a user of the service. It refers to the capability of a network to provide better service to selected network traffic over various technologies.

The SM&C has conducted monitoring of Cell-C, MTN and Vodacom's networks in the Gauteng region. The monitoring measurements were taken in the period from 10/11/2010 to 15/11/2010.

The object of these QoS tests is to obtain a snapshot of an operator's network performance from the user's point of view. The Authority has measured the QoS of MTN, Vodacom and Cell-C using the TEMS Investigation Tool (version 10.1) supplied by Ascom.

As the aim of the survey was to assess the QoS provided by the mobile operators as perceived by the user, ICASA selected predominantly urban areas and major road arteries. The maps of the tested areas and routes are shown below:

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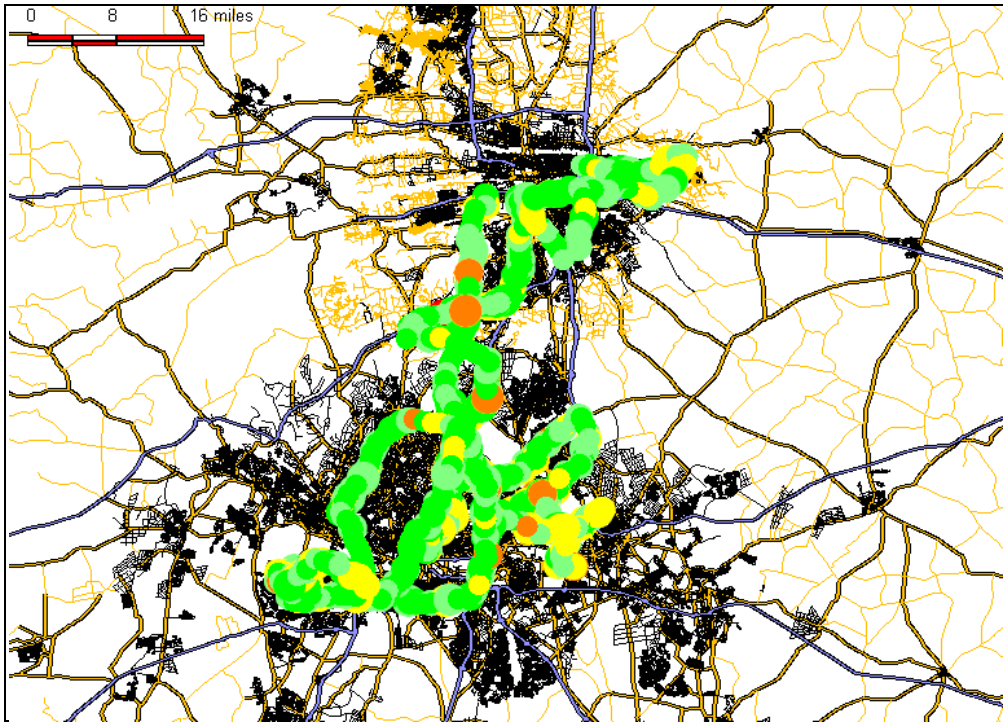

Figure 1: Drive Tests for Gauteng

A South African Bureau of Standards (SABS) Technical Committee 74 (TC74) meeting was held on the 25th February 2011 with the Mobile Operators, in order to standardise an acceptable test methodology for drive testing. It was decided that this process would be convened under the auspices of an SABS technical committee. The aim was to discuss the report and methodology used in conducting the Quality of Service measurements. Some of the concerns raised by the operators at this meeting are captured below. It should be noted that the drive tests occurred before the meeting. Hence, some of these concerns could not be incorporated in this report.

- The codec needs to be defined on a test tool in advance, before the measurements or QoS monitoring take place.
- The SIM-card's memory has an effect on call handling and call retention therefore it needs to be defined.
- The test numbers that ICASA are using should not be terminated on Telkom's network and should be on-net e.g. (083... to 083...).
- The short calls when testing the Call Success Rate should be set to be simultaneous rather than sequential, in the command sequences script. The on-time and off-time should be standardised.

Dr SS Mncube (Chairperson), NA Batyi, WH Currie, JM Lebooa, TLV Makhakhe, N Ndhlovu, FK Sibanda, Dr MM Sockwa, WF Stucke (Councillors), TTC Dlamini (CEO)

- The duration (on and off time) of long and short calls should be defined. The measurements of both should not be saved under one log file.
- The antenna length and spacing between antennas (when conducting the measurements) should be set according to ITU specifications.
- Network Coverage measurements should be based on Propagation and Prediction Models

1.2 Objectives

The objectives of QoS Monitoring were:

a) To assess the quality of the mobile networks as experienced by a user driving the selected route. It should be noted that there are several variables that affect the results obtained, and these results do not attempt to provide an overall view of the network. The objective of these tests was to simulate a user driving the selected route at a random date and time.
b) The tests are also not intended to be benchmark tests; rather they intend to provide valuable insight on the operator's network during the period under test.
c) The core network performance criteria that were tested were Accessibility and Retainability.

2. Methodology

Measurements were taken in the period from 10/11/2010 to 15/11/2010. A total of 419 test calls were made along the test route over in 10 days covering a distance of 2000 km. Only voice 2G or GSM measurements were performed, the mixture of Long calls and Short call were conducted. The Long Calls are used to measure the call's Retainability, the duration for the call is not defined and the call is maintained until it drops. Short Calls are used to measure the call's Accessibility and the duration is defined (10 -15 s).

The technical and methodological procedure followed here has a direct influence on the results, and therefore should be taken into account when analysing the results. The following aspects are particularly important:

Dr SS Mncube (Chairperson), NA Batyi, WH Currie, JM Lebooa, TLV Makhakhe, N Ndhlovu, FK Sibanda, Dr MM Socikwa, WF Stucke (Councillors), TTC Dlamini (CEO)

- The terminal equipment used was dual band with EFR. User terminal equipment that does not have these characteristics can reasonably be expected to obtain network performance which is poorer than the results of the survey suggest;
- The equipment used for testing was the TEMS Investigation 10.2, HP Elite Book 8440p and Ericsson Mobiles;
- The testing equipment used was automatic, eliminating the subjectivity inherent to the human user and ensuring equality of assessment conditions for all 3 network operators targeted by the QoS monitoring. The test equipment was set to full rate codec;
- Tests were carried out from moving vehicles with roof mounted antennas (the antenna spacing was not set);
- Our results do not permit us to extend conclusions for long calls because the duration of the long calls were not defined and standard. The ability of the networks to sustain uninterrupted conversation for longer calls will be assessed in a futures QoS monitoring;
- The results of the QoS monitoring reflect only the behaviour of the networks at the place and the time measurements were taken. It is understood that traffic volumes vary throughout the day, which affect the performance of the network. However these tests were designed to measure the operator performance randomly;
- Mobile to fixed calls were chosen for the test scenario. However, only parameters of the Radio Access Network of the operator under test were measured;
- 64K test SIM-cards were used during the testing;
- The measurements focused on the following network parameters:
  (i) Dropped Call Rate (DCR);
  (ii) Call Set-up Success Rate (CSSR);
  (iii) Signal Strength.

2.1 Drive Tests Methodology

Drive testing is the most common and possibly the best way to analyse Network performance by means of coverage evaluation, system availability, network capacity, network retainability and call quality. Although these tests only provide data on the downlink side of the process, it provides a perspective to the service

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provider about what's happening from a subscriber point of view. The drive testing is basically collecting measurement data with drive test equipment.

The Drive Test equipment consists of:

- TEMS Investigation Software
- Maps of South Africa
- TEMS phones
- GPS
- Laptops

2.2 Computational Methodology

a) Drop-Call Rate

The measurements of dropped call rate is described by the ratio of successful originated calls that were found to drop to the total number of successful originated calls that were correctly released. The formula to calculate DCR is shown below:

Drop Call Rate	
Successful Call Attempts	S
Drop Calls	D
DCR =	(D/(S+D)) * 100

b) The Call Setup Success Rate

The Call Setup Success Rate refers to the percentage of calls that are successfully set up and terminated as a percentage of the total call attempts. CSSR excludes dropped calls or calls that experience no network condition, low speech quality calls and calls with long set up time. The formula to calculate CSSR is shown below:

Call Success Rate	
Call Attempts	X
Call Success	Y
CSSR =	(X/Y) * 100

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3. Results and Analysis

The summary of the operators' overall performance arising from the specific quality of service parameters and the measured data is shown in a table below:

Table 1: Measurement Data

Network Operator	Call Attempts	Call Success	Failed Calls	Dropped Calls
Vodacom	131	131	0	7
MTN	153	120	33	6
Cell-C	129	126	3	9

a) Retainability

Retainability for voice is measured in terms of dropped calls. Figure 2 gives the dropped call statistics on Gauteng's network in the test area.

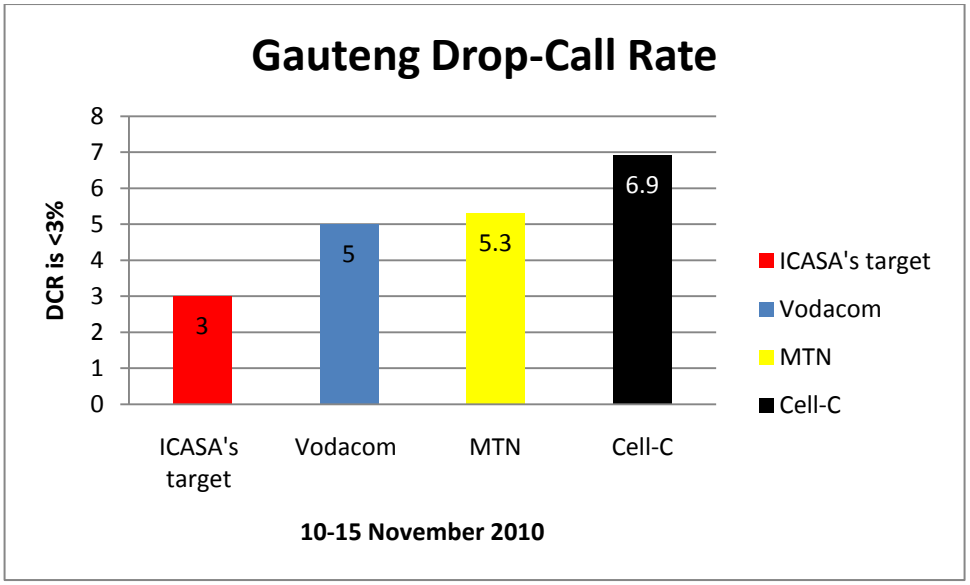

Figure 2: Retainability Statistics

The Drop Call Rate should be less than 3%, over 6 months. This parameter is regulated by the End-User and Subscriber Service charter regulations of 2009. Based on the results above the operators are all below the target.

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b) Accessibility

Accessibility statistics for the test area are given in figure 3 below.

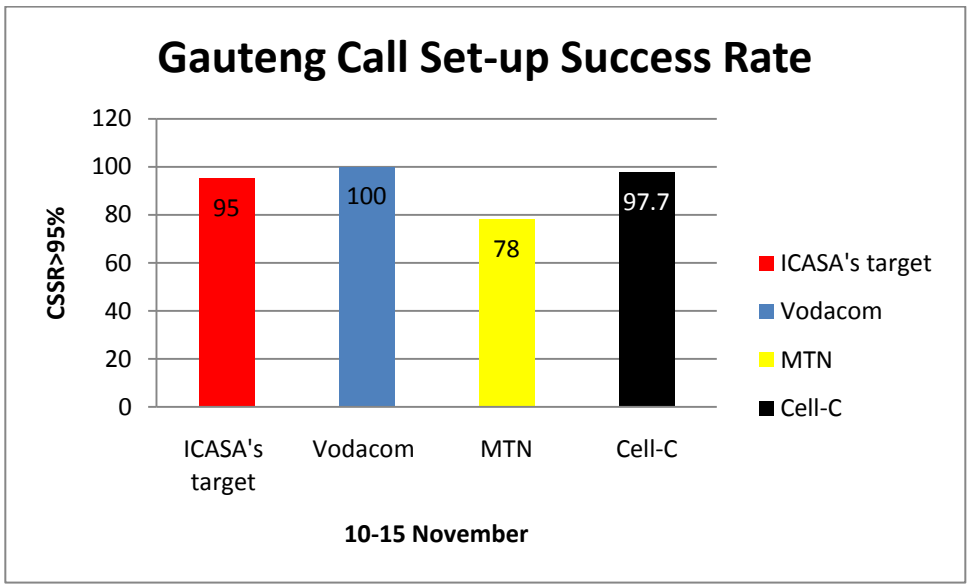

Figure 3: Accessibility Statistics

Based on the results above Vodacom and Cell C are above the target, while MTN is below the target. The Call setup Success Rate should be greater than 95%. This parameter is not regulated, but we have chosen it as a target based on ITU recommendations E.800 and G.1000

Dr SS Mncube (Chairperson), NA Batyi, WH Currie, JM Lebooa, TLV Makhakhe, N Ndhlovu, FK Sibanda,
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Gauteng: Maps of Signal Level

(i) N1, N3 and M2

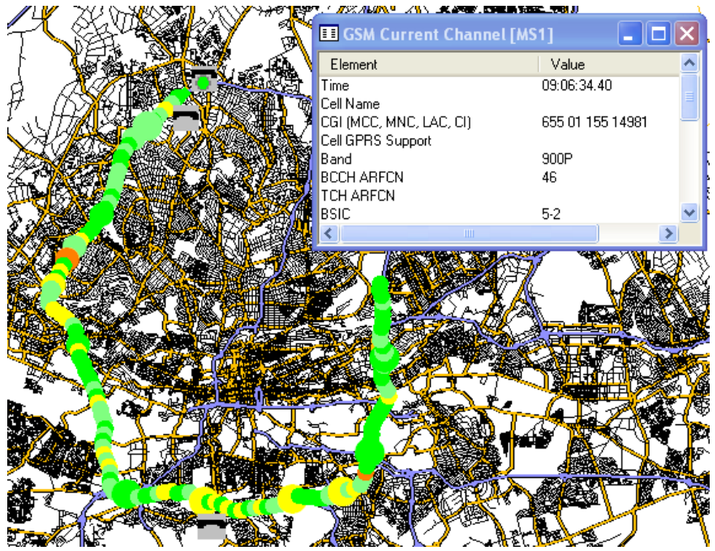
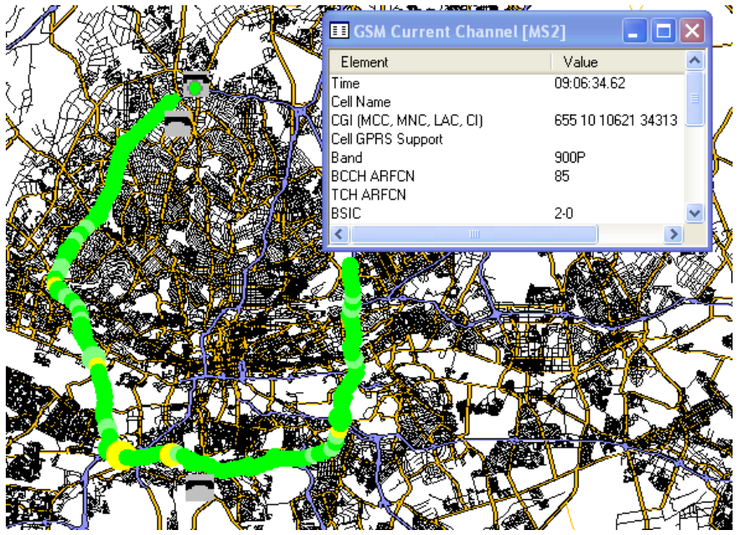
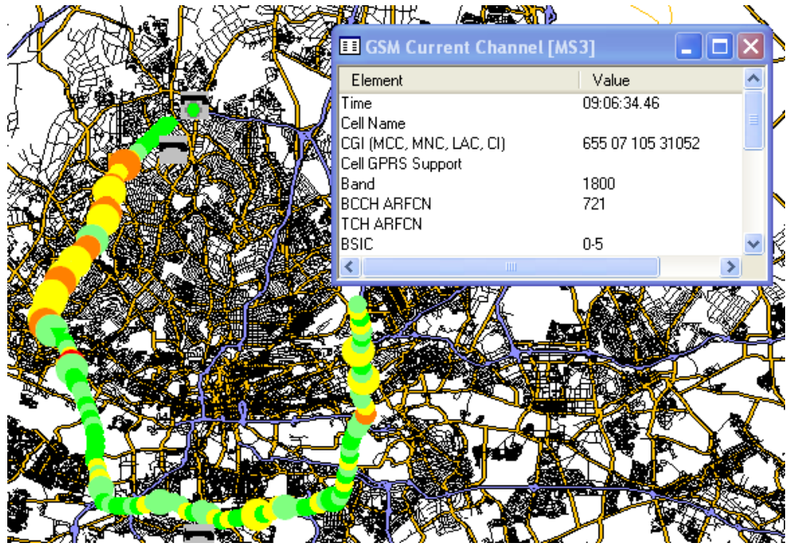
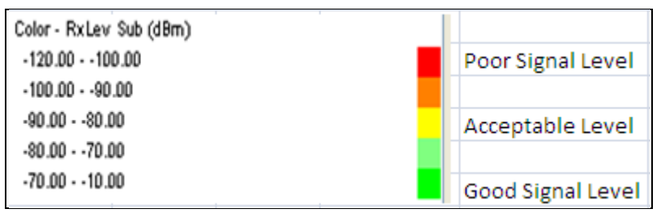
Vodacom	MTN	Cell-C
		

Figure 4: M2, N1 and N3 maps



(ii) Centurion

Vodacom	MTN	Cell-C

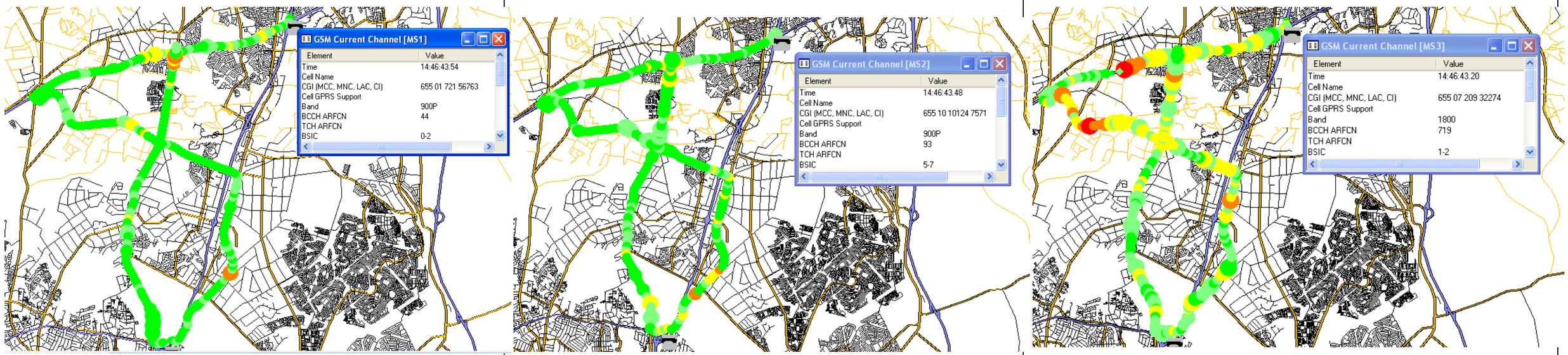
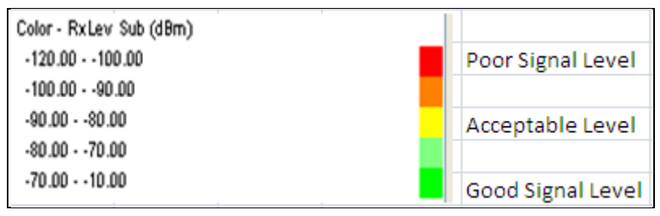


Figure 5: Centurion maps



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(iii) Pretoria

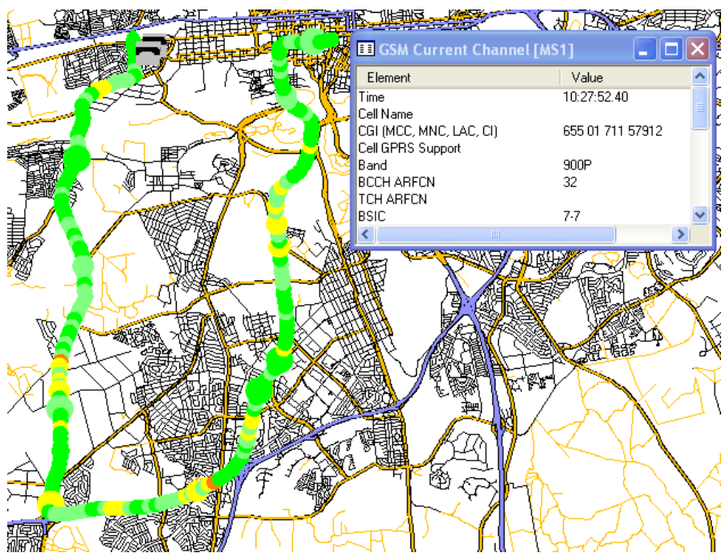
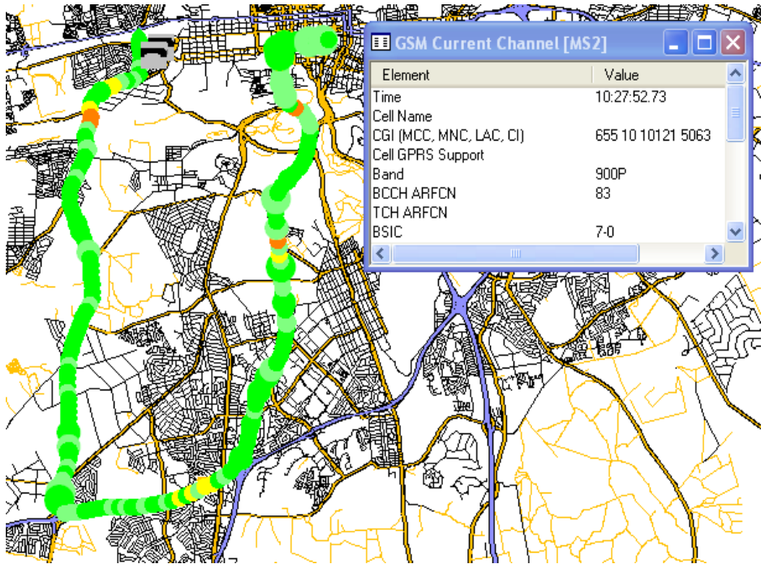
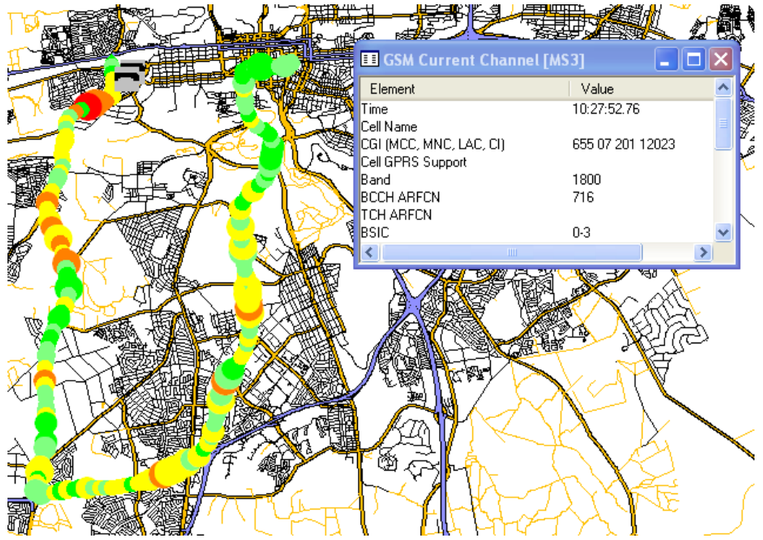
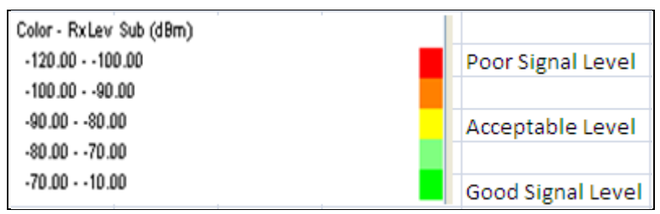
Vodacom	MTN	Cell-C
		

Figure 6: Pretoria maps



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(iv) Kempton Park

Vodacom	MTN	Cell-C

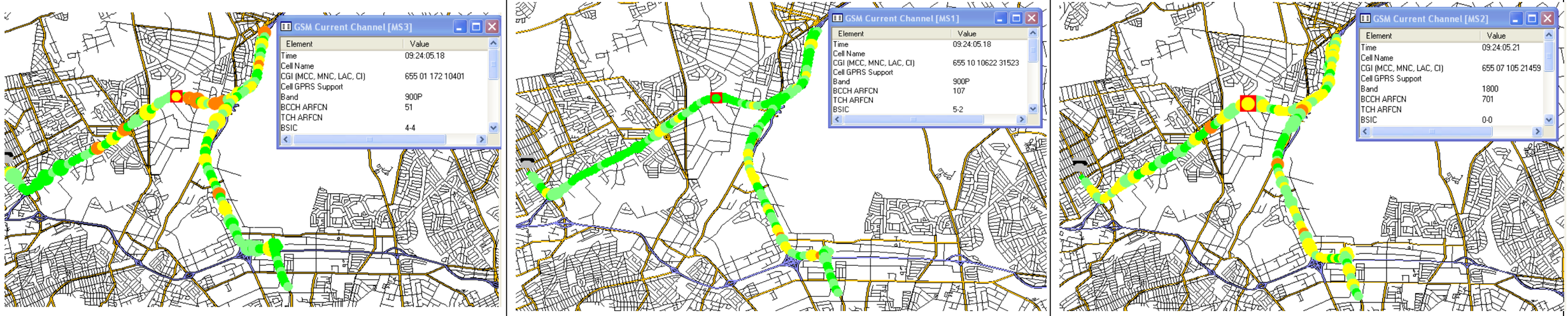
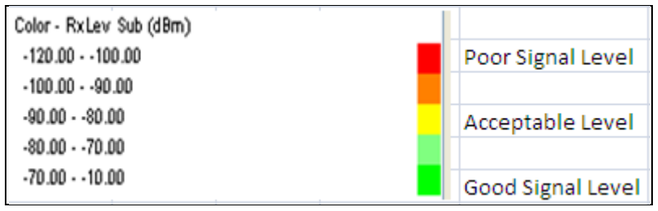


Figure 7: Kempton Park maps



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(v) R88 and JHB CBD

Vodacom	MTN	Cell-C

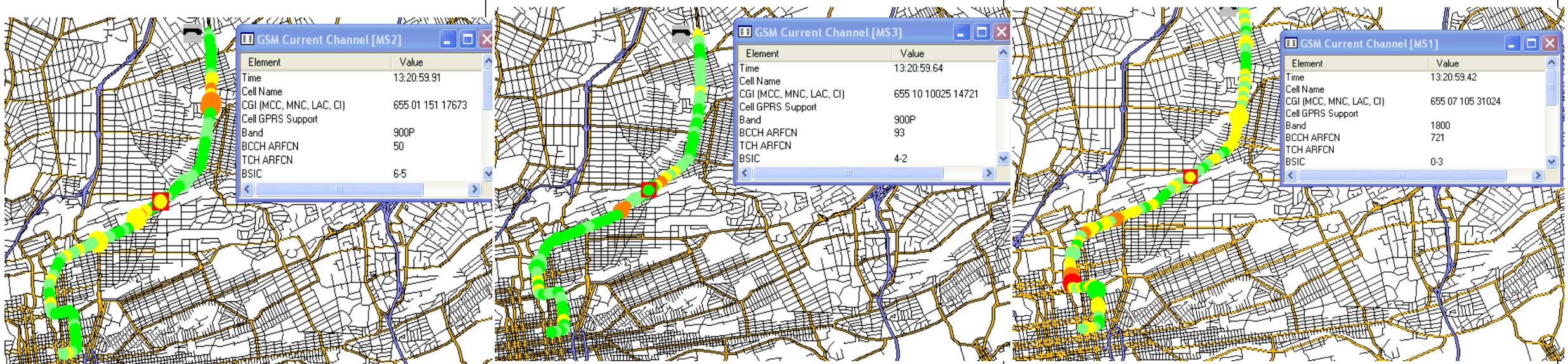
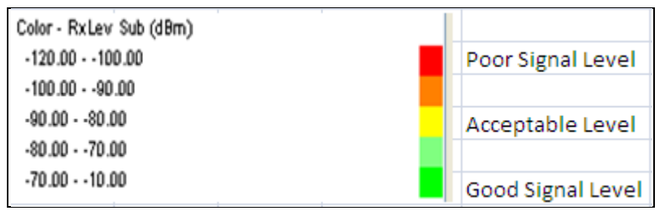


Figure 8: R88 and JHB CBD maps



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(vi) Mamelodi

Vodacom	MTN	Cell-C

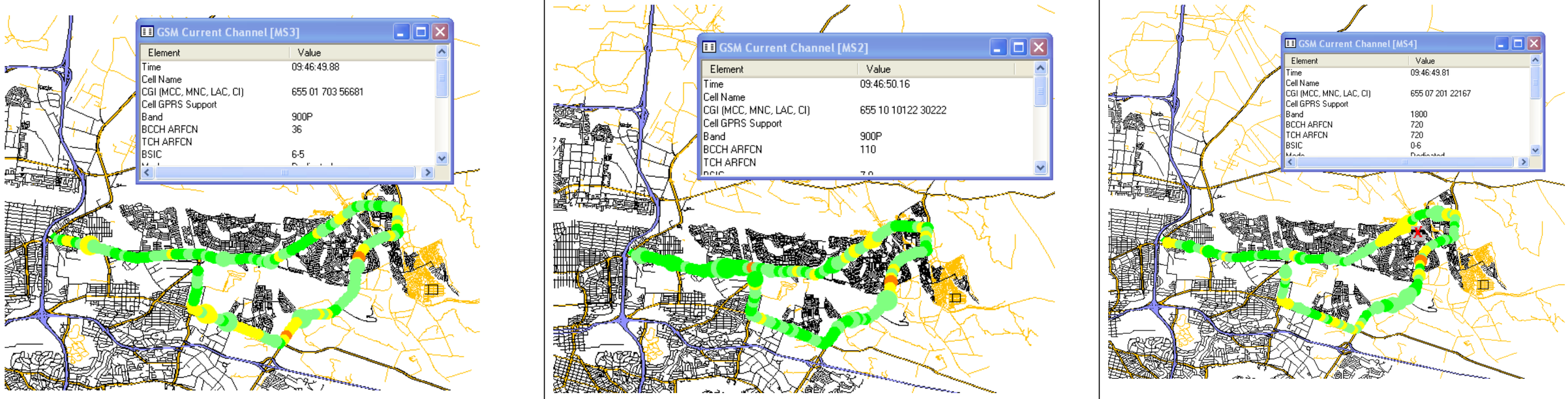
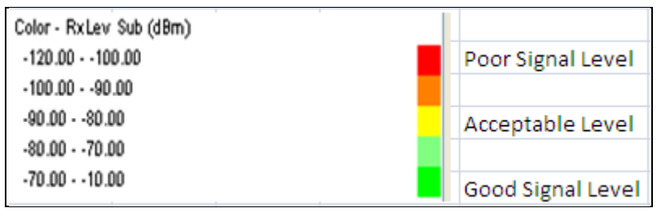


Figure 9: Mamelodi maps



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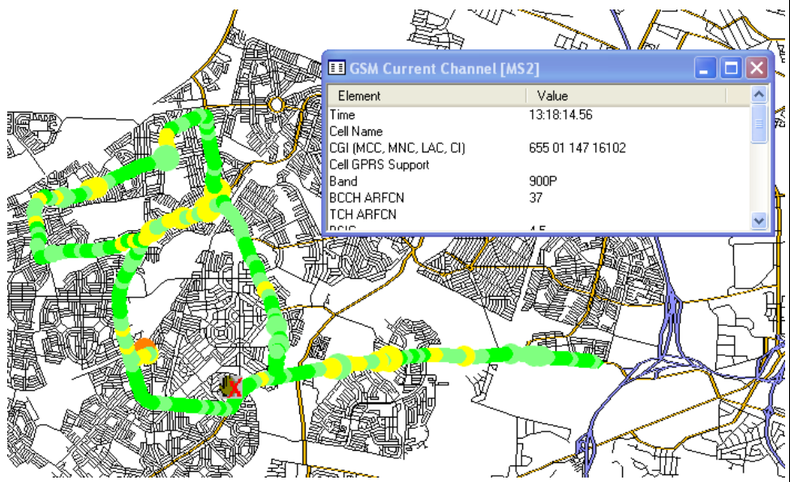
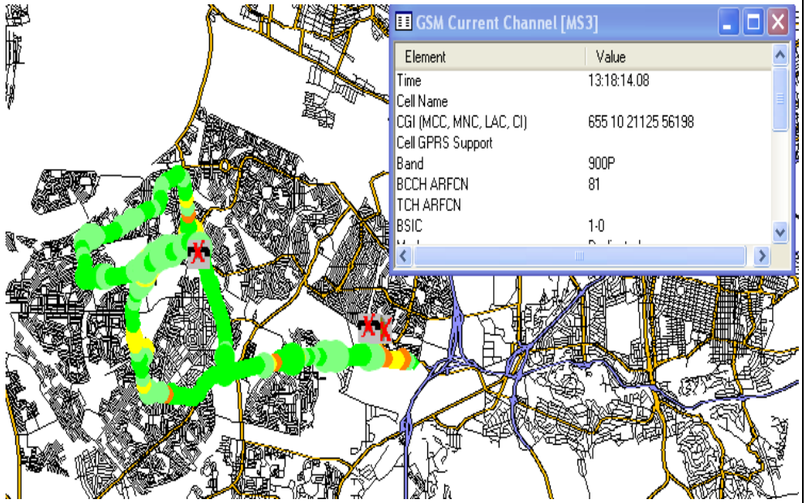
(vii) Soweto

Vodacom	MTN	Cell-C





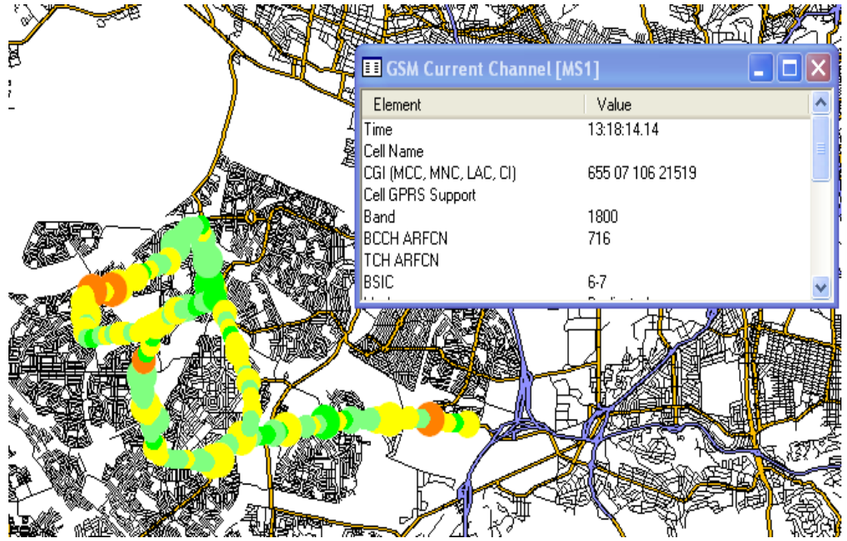
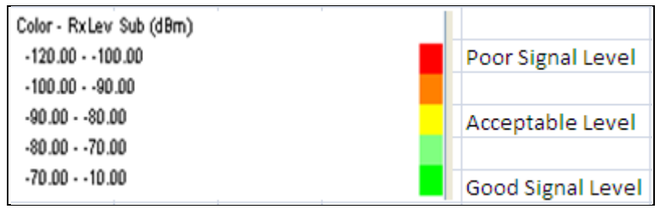


Figure 10: Soweto maps



4. Conclusion

The methodology followed allowed us to assess Quality of Service on the spot, giving us as realistic a picture as possible of network performance, from the user's point of view. The drive test results represent a snapshot of the mobile service provider's network performance, based on the specified routes during the time of day when the measurements were carried out and using a particular type of handset. The reported level of service quality may therefore not be exactly comparable with the consumer's own**.** These tests cannot be assumed to be representative, but are merely indicative. Further, more rigorous, tests will be conducted in future.