# Analysis of Handover Data between Urban and Sub-Urban Area in Selangor

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*Abstract*— **This paper is on the handover data analysis between urban and sub-urban area in Selangor. The continuation of an active call is one of the important features of a wireless cellular system to provide such a facility by transferring an active call from one cell to another. The objective of this project is to present the study of successful handover and failure between two areas which is at Semenyih, Selangor and Jalan Kuala Selangor, Shah Alam, Selangor. Both these areas are representing the sub-urban and urban area respectively. The paper focused on data collection of 3G mobile communication by using NEMO drive test provided by Digi Communication Berhad. The collected data consist of strength of signal which is Received Signal Code Power (RSCP) and quality of signal which is Ec/no. Data will be analysis using Microsoft excel and will be export to the Matlab. This data will be presented by using Graphical Using Interface (GUI) create using Matlab software.**

***Index Terms – 3G, Handover, NEMO, Matlab, GUI***

## I. INTRODUCTION

UMPTS(Universal Mobile Telecommunication System) is a so-called "third-generation (3G),"offering a consistent set of services to mobile system and phone users no matter where they are located in the world [1]. In Malaysia, we know the 3G network is on growing throughout the country. This growth in filed of cellular communication has led to the increases intensive research toward and development toward cellular system[2]. We are also aware that there are several company that provide mobile services such as Celcom Axiata Berhad, Maxis Communication Berhad, Digi Telecommunication Sdn Bhd and U Mobile. These mobile network has their ongoing investments in network coverage, capacity and performance, and intends to maintain their technology leadership and position as the country's best mobile service provider. Although all of the companies uses the same system, but there are differences in the integrate of the mobility network. But, the important thing in cellular network is how to maintain the call while using the cell phones.

The handover is a method in cellular system to maintain a call while the user is using a mobility system. The handover process is a transferring mode of an active call from one cell to another. The transfer of a current communication channel could be in terms of time slot, frequency, band, or code word to a new channel of the neighboring base station(BS)[3]. If a new BS has some unoccupied channels then it assigns one of them to the handed off call. However, if all of the channels are in use at the time of handover there could arise two possibilities: either to drop the call or to delay it for a while until a new channel is available [4]. The successful and failure handover is depending on many factors such as Ec/No and Received Signal Code Power (RSCP). This paper focus on the handover data analysis between urban and sub-urban area in Selangor.

## II. Software

### *A.NEMO Analyzer*

Nemo Analyze is a highly efficient and fully scalable analysis tool for benchmarking, automated troubleshooting, and statistical reporting based on drive test data. Integrating Nemo Analyze with other Nemo tools provides a complete automated data processing chain from raw measurement data to automatically generated results in workbook format [5]. From the Nemo Analyzer, we can determine the value of RSCP, Ec/No, channel that was used, Transmitter power and scrambling code. This software also gives the user to know about where area and what time the drop call, handover attempt, success and failure happen and why this event happens.

### *B. Matlab*

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation [6]. Using Matlab, the various data will be analyzed using Microsoft excel and will be export to the Matlab. This software will determined this data in graph. The Matlab must program follow input data and what type of output or graph we need.

Graphical User interface (GUI) also can create using Matlab. Capabilities to make the program easier to use. Well-designed graphical user interfaces can free the user from learning complex command languages. On the other hand, many users find that they work more effectively with

a command-driven interface, especially if they already know the command language [7].

## III. METHODOLOGY

### A. *Drive Test*

For the drive test, the full equipment must complete. The equipment includes the scanner, User Equipment (UEs), Global Searching Position (GPS), laptop and RF cable. NEMO software is used for this drive test. Drive test requires a mobile vehicle outfitted with drive testing measurement equipment. This equipment's are usually highly specialized electronic devices that interface to OEM mobile handsets. This ensures measurements are realistic and comparable to actual user experiences.

Drive test equipment typically collects data relating to the network itself, services running on the network such as voice or data services, radio frequency scanner information and GPS information to provide location logging.

For this project, the location of the drive test is at Jalan Kuala Selangor, Shah Alam, Selangor representing the urban area and Semenyih, Selangor representing the sub-urban area. For that area, the drive test was done at 5.58 pm until 6.51 pm.

The data information was collected while the vehicle moving along the study area. To simplify this process, at least two people are needed which mean one to drive the vehicle while another is required to record all data collected. Vehicle is driven at speed 30 km/h to 50 km/h depending on traffic flow. After that, the data will be automatically saved in the mobile phone memory and it can be viewed later via notepad or Microsoft Excel when the data has been transferred to the computer.

### B. *Software Installation*

NEMO Analyzer can be obtained from the company that does the drive test. This software must be license from the vendor. For this project, Nemo Analyzer 5.0 is used.

This software can be installed normally and the users do not need to register or sign up to any website. After the installation is complete, and when maps file, BTS file and the log file is have been set up, this software can be used.

### B. *Parameter Measurement*

In this project, there are many parameters to be measured. The value of the parameter is important to compare the result at one location with the other location because every location has a different value of the parameter. One of the parameter is Received Signal Code Power (RSCP). RSCP is the collected RF energy after the correlation or descrambling process. This parameter indicated the strength of signal. The unit of RSCP is in dBm. The figure shows range of RSCP. Green color indicated the good value, Yellow for moderate and Red representing the low value of RSCP.

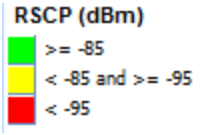


Figure 1: Range of RCSP

The other parameter is Ec/no. Ec/no is quality of signal level in cellular system. This parameter usually measure in unit Decibel (dB). The figure shows the range of Ec/no. The green color represented good value, yellow and Orange represented moderate and Red color represented for bad value of Ec/no.

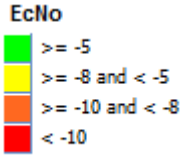


Figure 2: Range of Ec/no

### C. *Flow Chart*

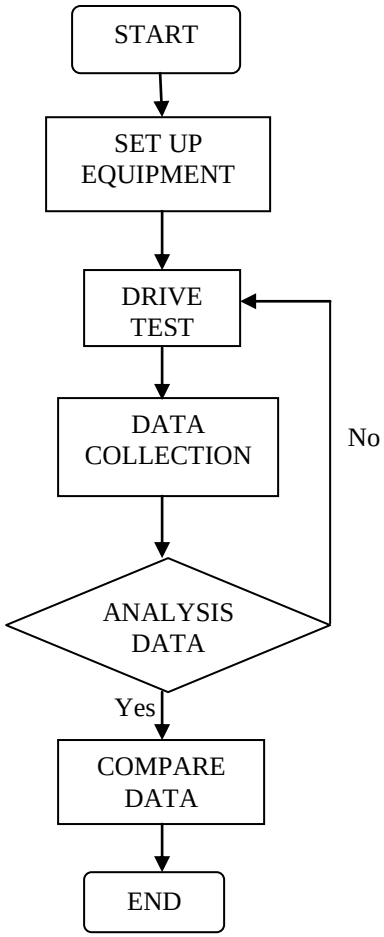


Figure 3: General flowchart represents of the project

Figure 3 shows the flowchart representing the project. This project starts from setting up the equipment to the drive test. During the drive test, the data will be obtained by scanner and save it into the laptop. After that, the data will be analyzed using NEMO Analyzer. From the analysis, if there is handover, the data is stored and ready to be further processed. If the data does not have any handover, the drive test will be performed again. Then, the successful data of the two areas will be compared using Matlab Software.

## IV. RESULT AND DISCUSSION

The drive test was done in two areas which are Shah Alam, Selangor representing the urban area and Semenyih, Selangor representing the sub-urban area.

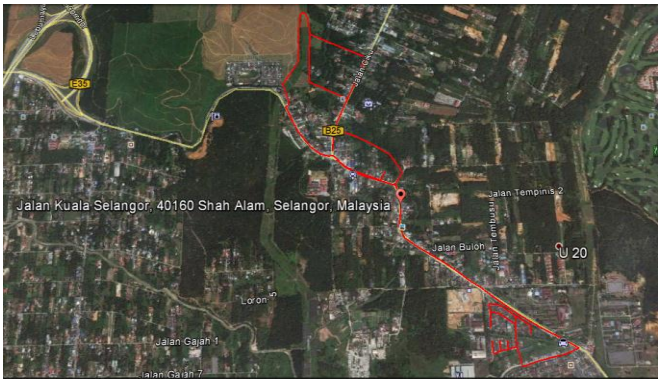


Figure 4: Shah Alam area

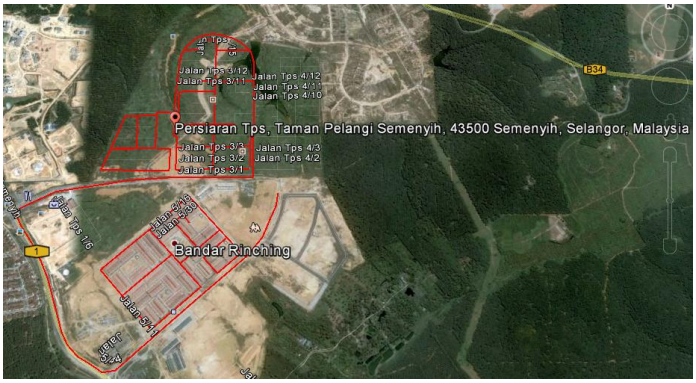


Figure 5: Semenyih area

The red lines in Figure 2 and figure 3 show the routes of drive test. These routes are drawn by using the Google Earth based of the route in NEMO Analyze Software.

### *A. Comparison for RSCP*

a. Shah Alam area

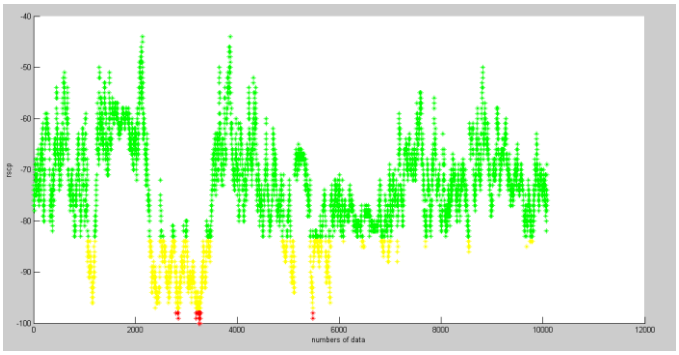


Figure 6: Graph of RSCP value using Matlab

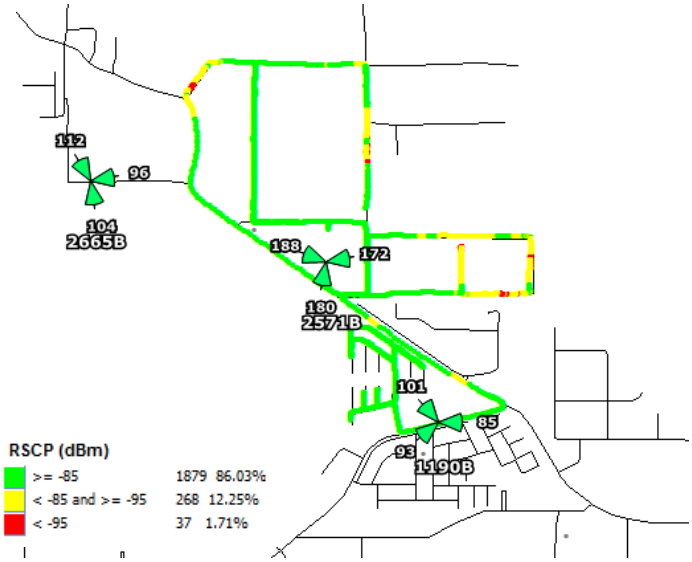


Figure 7: RSCP value using NEMO Analyzer

b. Semenyih area.

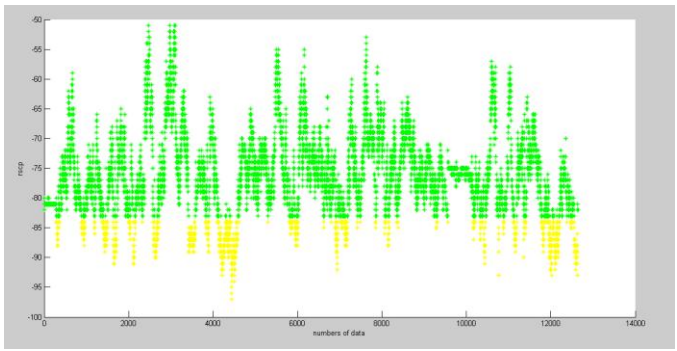


Figure 8: Graph of RSCP value using Matlab

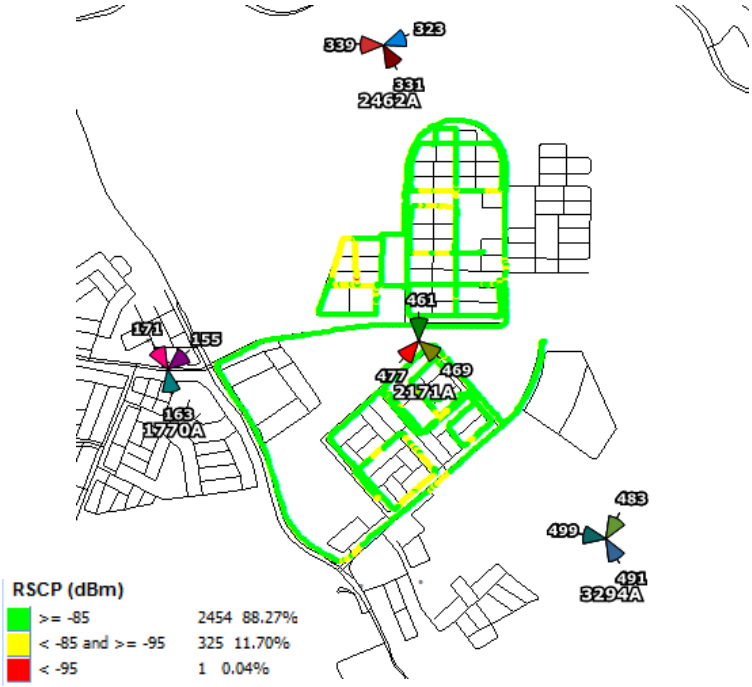


Figure 9: RSCP value using NEMO Analyzer

Figure 6 and figure 8 show the graph of RSCP value was using Matlab. Figure 7 and figure 9 show the value of RSCP using NEMO Analyzer. From the figure, it can be seen that the RSCP value obtained for Semenyih area is better than that of Shah Alam area. This is because in Semenyih area, the good range of RSCP is 88.27% of the area but in Shah Alam area, the good range of RSCP is just 86.03%. The bad range of RSCP for Shah Alam area is 1.71% compared to Semenyih area which is just 0.04%. This value will effect the handover process because the efficiency of successful handover will be high at the good range of RSCP .

*B. Comparison for Ec/no*

a. Shah Alam area

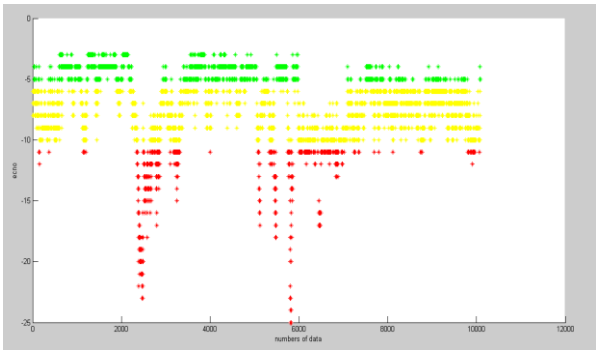

Figure 10: Graph of Ec/no value using Matlab

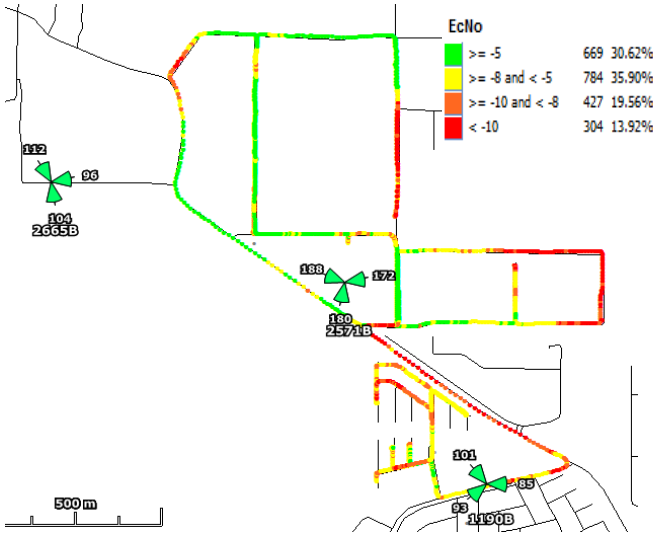


Figure 11: Ec/no value using NEMO Analyzer

b. Semenyih area

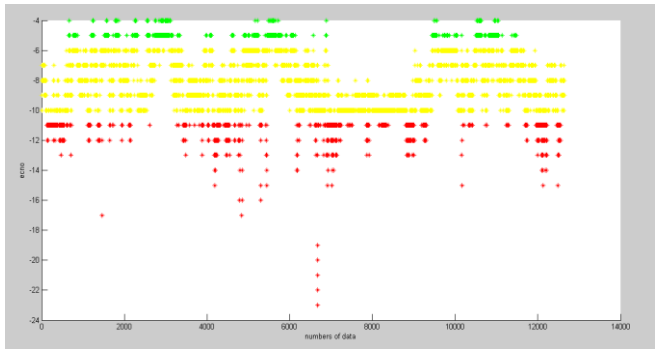

Figure 12: Graph of Ec/no value using Matlab


Figure 13: Ec/no value using NEMO Analyzer

Figure 10 and figure 12 show the graph of Ec/no value that was produced by Matlab while figure 11 and figure 13 shows the value of Ec/no using NEMO Analyzer. The Ec/no representing the quality of services during a call. The figure shows the value of Ec/no in Shah Alam area is better than sub-urban area which is at Semenyih area. From the figure, it also shows that the urban area have 30.62% of good value compared to the sub-urban area which is just 8.40% of the good value. This is because from the figure 5, the sub-urban area is covered by the jungles and hills. That area also has palm tree plantations and high trees. These obstacles will cause attenuation of signal and the users will receive bad signal. However, that phenomenon is not a problem to get high efficiency of success handover because the number of mobile users is low [8]. Thus, that area will still be getting a high efficiency of success handover compared to the urban area.

*C. Comparison for Scrambling Code*

a. Shah Alam area

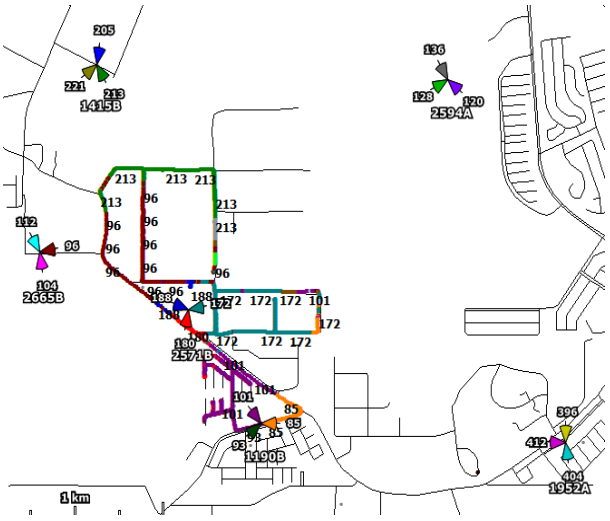


Figure 14: Scrambling code value using NEMO Analyzer

b. Semenyih area

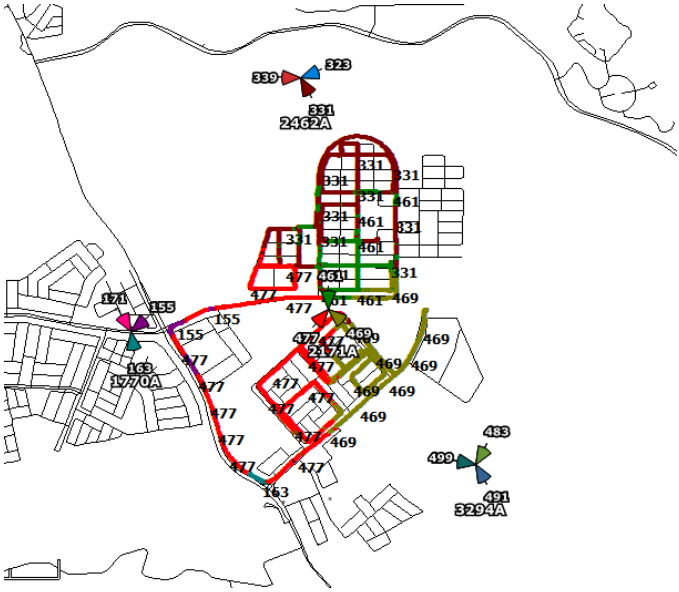


Figure 15: Scrambling code value using NEMO Analyzer

Figure 14 and figure 15 show the scrambling code value by using NEMO Analyzer. Scrambling codes are used to separate cells and UEs from each other, which is, each cell or UE should have a unique scrambling code. It means, every color at the drive test route representing a different scrambling code. The number in the figure shows the number of scrambling code which is serving that area based on the nearby BTS. This scrambling code will affect the handover process. If the scrambling code can serve the whole area at any place, the success efficiency of handover will be higher. But, if the scrambling code cannot serve the whole area, the success efficiency of handover will be lower. The figure 14 and figure 15 also shows the scrambling code serve the whole area based on the number of scrambling code at the route.

In the urban area, the number of BTS which serves the whole area is 5, but at the sub-urban area, there are just 3 numbers of BTS which serves the whole area. Although the number of BTS in urban area more than sub-urban area, but the efficiency of the success handover is still lower than sub-urban area. There is because many numbers of subscribers in the urban area cause channels are used up. In sub-urban area, the small number of BTS is not cause low efficiency of success handover. It is because, the subscriber in this place is small. So, the available channel is still enough to the other subscriber.

*D. Comparison for Handover Failure*

a. Shah Alam area

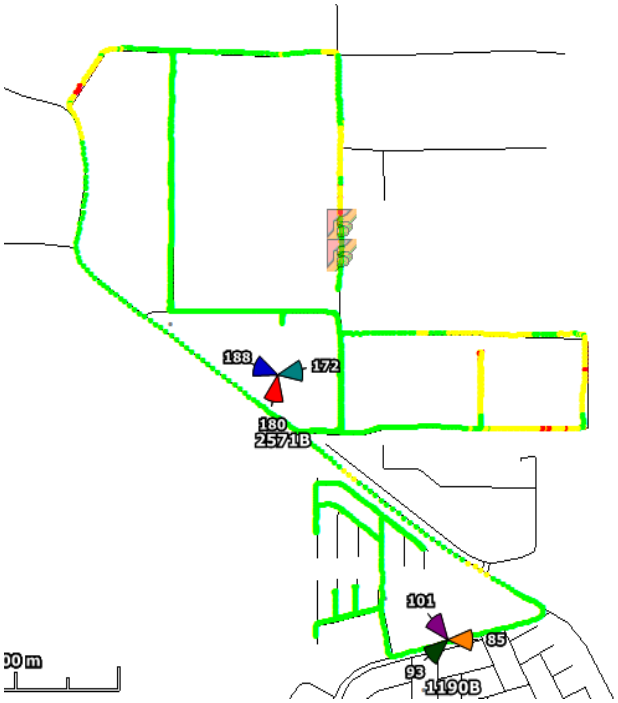


Figure 16: Handover failure symbol using NEMO Analyzer

b. Semenyih area

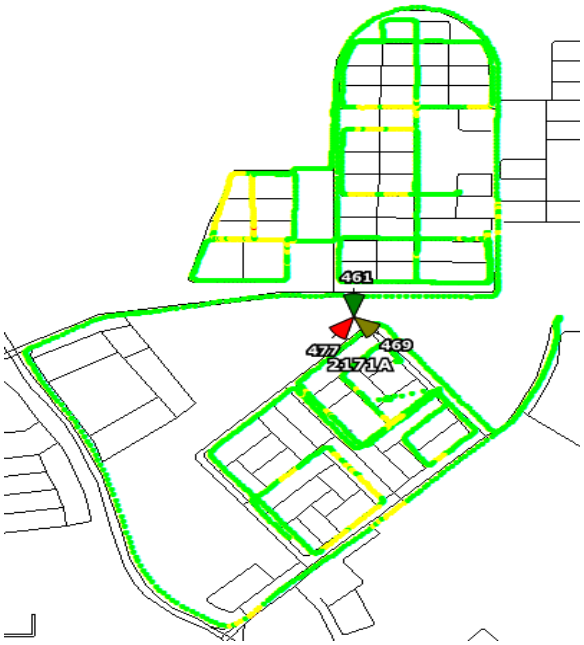


Figure 17: Handover failure symbol using NEMO Analyzer

Figure 16 and figure 17 show the symbol of handover failure at the route using NEMO Analyzer. This symbol will appear if the handover failure happens along the route. The symbol is just found at the Shah Alam area which indicating failure in handover. The event of the handover failure can be seen from NEMO Analyzer display as shown in figure 18.

| | Event ID | Event | Measurement | Time |
|---|---|---|---|---|
| 1. | HOF | Handover failure | 080113_2571B_3G_mobility_HSD_round1.2 | 18:17:13.017 |
| 2. | HOF | Handover failure | 080113_2571B_3G_mobility_HSD_round1.2 | 18:17:18.520 |
| 3. | CAD | GSM/UMTS call dropped (ETSI) | 080113_2571B_3G_mobility_HSD_round1.2 | 18:17:39.764 |

Figure 18: Handover failure event using NEMO Analyzer

The handover failure occurred at 6.17 pm and this event cause the call dropped. The NEMO Analyzer also shows the reason behind the failure based on figure19.

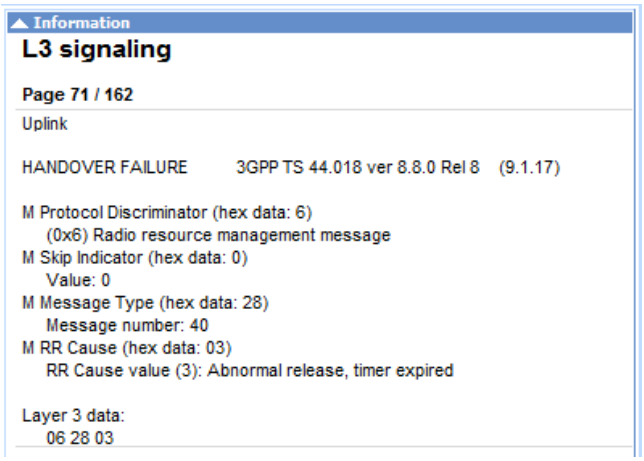


Figure 19: Reason for Handover failure event using NEMO Analyzer

The handover failure is due to the timer which has expired. This timer expired occurs when the traffic is congested at the destination cell and cause bad planning of the frequency and radio coverage. This will cause the Ping-Pong symptom. The waiting period set for the MS to move from the source cell to the destination cell in a handover may have been too short [9]. So, the handover will fail and call drop happened.

E. Graphical User Interface (GUI) of Handover

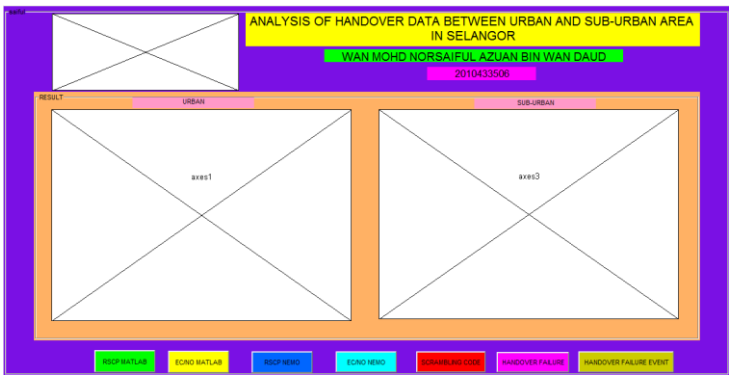


Figure 20: Display of GUI

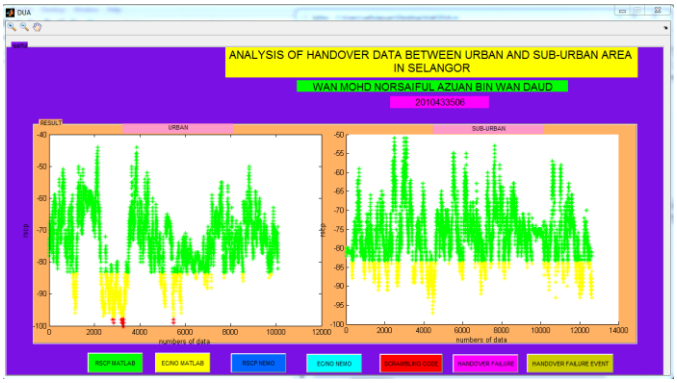


Figure 21: Example of GUI display

Figure 20 show the display of Graphical User Interface (GUI). Matlab Software is used for the purpose of the display. The main advantage of this GUI is that it is a user friendly software. It enables the user to find and explore which part they wanted to see.

From figure 21, the display has two axes. The axis is to display graph and input on what the users wanted to see. It also has seven buttons which is indicating RSCP Matlab, Ec/no Matlab, RSCP NEMO, Ec/no NEMO, Scrambling Code, Handover failure and handover Failure Event.

## V. CONCLUSION

As a conclusion, based on data obtained from drive test activities and analysis using NEMO Analyzer, the different area has a different handover event and a different efficiency of handover success. From the analysis, signal strength and signal quality for both urban and sub-urban areas are also different. The comparison of the handover event between two areas has been analyzed and it was found that the sub-urban area has a better efficiency of handover success. This is because, there was no handover failure happened in the sub-urban area. In term of signal quality which is Ec/no, the urban area dominated as they receive better quality of the signal than sub-urban area. This shows the effects of hills and big trees and other obstacles in that area. In term of signal strength which is RSCP, the sub-urban area has it better than the urban area. For better comparison of the urban and sub-urban area, the all result will display using GUI.

## VI. FUTURE RECOMMENDATION

Future work will be focused on the simulation work between test bed and simulation environment by considering the prediction of the channel and use's behavior. Further research is needed to find the most optimize handover procedure by comparing the test bed and algorithm with the handover decision criteria specific by the standard.

## VI. ACKNOWLEDGMENT

I would like to express my deepest gratitude and appreciation to Wireless Communication Sdn. Bhd for providing the handover data and guidance to finish my final year project entitled "Analysis of Handover Data between Urban and Sub-urban Area in Selangor". It is a privilege for me to complete my duration of 2 semesters as to fulfill my degree requirement.

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