IDENTIFICATION OF SIGNAL QUALITY AROUND UITM MAIN CAMPUS

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Abstract— **As 3G networks are becoming commercially available all over Malaysia, all of the network providers compete to serve their customer with a good quality and stable network. This project is to analyze the 3G's signal quality and strength that are provided by Maxis Sdn. Bhd around targeted area at UiTM Shah Alam. The collected data from the drive test by using NEMO outdoor network scanner was plotted using Microsoft Excel. The parameters that been focused for this project are Received Signal Code Power (RSCP) which relates to signal strength and Carrier to Noise Density ratio (Ec/No) that are representing the cell quality of the pilot channel (CPICH).[3] Based from the graph obtained, we can see the relationship between each of the parameters that are being investigated.**

I. Introduction

As we know, mobile telecommunications services has undergone many changes in line with consumer demand as for example; in Malaysia, the network system had evolve from 1G, 2G and the latest are 3G communications system. 4G communications system is still under development and has not been used extensively in Malaysia. The 3G system technology is more complicated compare to 2G system because it involves many aspects, especially overlapping cells, soft hand over, power control and also cell breathing.[1]

The most common deployment for 3G system are Wideband Code Division Multiple Access (WCDMA) which are commonly operated on the 2100 MHz band.[2] WCDMA is one of the new technologies in 3G telecommunications system which had been widely use in all around the world in order to replace the weakness of TDMA and FDMA technologies, such as GSM especially in data transfer and call traffic. [1] In order to ensure seamless coverage and overall good performance of the network, WCDMA is equipped with features which will perform a handover early enough to prevent the connection from being dropped. This feature is defined as soft handover or soft handoff where a cell phone is simultaneously connected to two or more cells (or cell sectors) during a call.[6]

The aim of this project is to study the effect of RSCP and Ec/No of the WCDMA system in term of quality variation. Basically Ec/No measurement defined as ratio of carrier or signal power to the underlying white-noise power spectral density (dB/Hz). Noise power spectral density,No is the noise power in a 1Hz bandwidth.[4] In WCDMA system, RSCP denotes the power measured by a receiver on a particular physical communication channel. It is used as an indication of signal strength, as a handover criterion to calculate path loss.[5]

As for this project, the measurements are produced from drive test in order to locate areas with poor coverage or other quality problems.This project been held during the peak time which are around 3pm. In the project, we use NEMO outdoor scanner in collecting the data around UiTM main campus. Collecting data work is performed by drive test procedure along the route that had been chosen according to the requirement. The figure below represents the equipment set up in order to perfom the drive test.

Figure 2.1: Drive Test Equipments Setting

Based from the figure 2.1, all of these equipments are been set in the car while performing the drive test analysis.User Equipment (UE) is representing user equipment that been use to make the long call. In this project, collecting data are been perform by using NEMO scanner. This scanner basically connected to the gps receiver and antenna that will detect the wireless performance signal during the drive test. Basically the long call that was made is up to be aprroximately 10 minutes using the NEMO software before the software terminate the connection automatically.

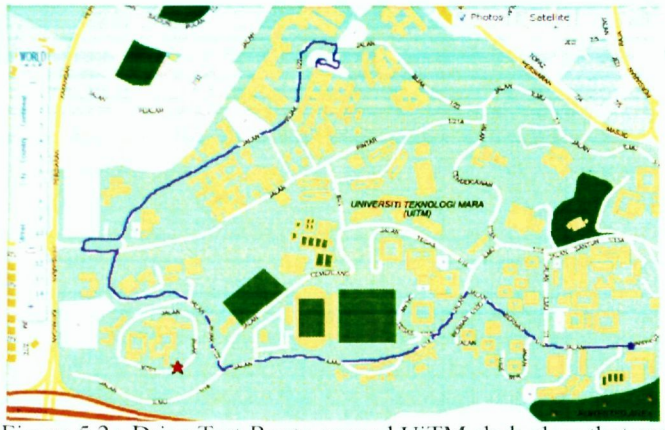
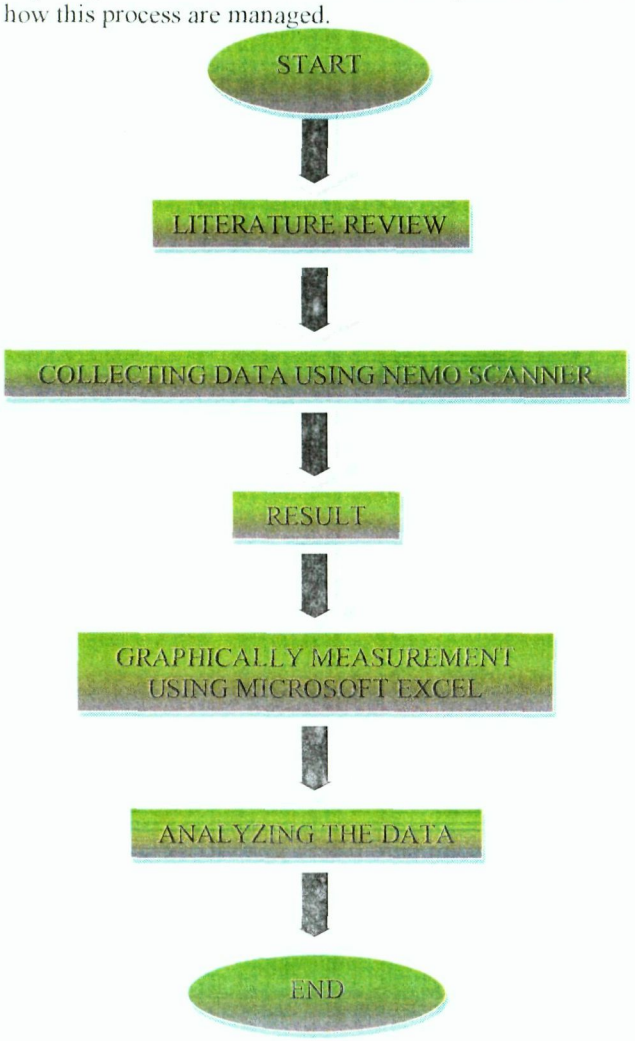


Figure 5.2 : Drive Test Route around UiTM shah alam that are focused on section 7.

The figure above represents the route that was used during the drive test session. Majority of the route folowed has high density subscribers.

II. Research Methodology

This chapter explains the process flow and the method being carried out at each process towards the performance analysis of WCDMA system. It is also to ensure that each phase will go through evaluation before proceeding to the next step. Figure shown below describe the process involve and how this process are managed.



1. LITERATURE REVIEW
   In accordance to the project title, literature review was carried out by studying available journal, books and articles that are related on signal quality measurements for WCDMA telecommunications system from trustable sources. The information from the internet provides the easiest way to access and gathering such sources. This process helps to broaden the perspective in gathering research ideas and to have a complete understanding of the relevant topics. In addition, these literatures have been the guideline to ensure that this project is streaming into the right focus as suggested by the project title.

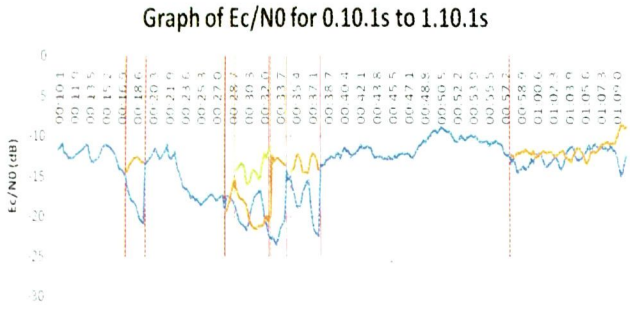
2. COLLECTING DATA
   In this project, the network performance data is gathered from drive test that was performed around UiTM Shah Alam. NEMO Outdoor scanner was used to detect variation of signals along the route that had been chosen. For this project, the long call that been made are set up to be approximately 10 minutes. Three parameters were collected, namely the RSCP, Ec/No and handover.

3. GRAPHICALLY MEASUREMENT
   This is the process where data were extracted and analyzed to look for performance solution. The collected data were divided into 10 segments and then been plotted using Microsoft Excel. Each of the segments shows the quality of signal according to each minute.

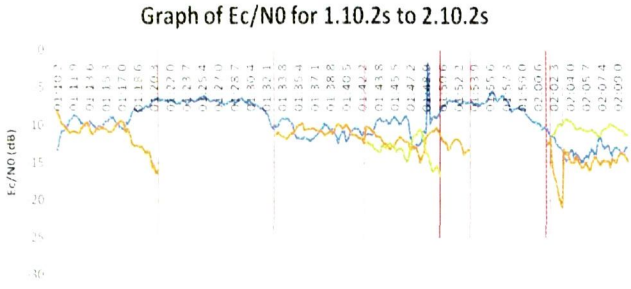
4. ANALYZING THE DATA
   The data are grouped based on the parameters in order to see the relationship between Ec/No and RSCP in term of quality measurement. From the plot, the quality for WCDMA signals at intervals of every minute can be observed clearly.

III. Results

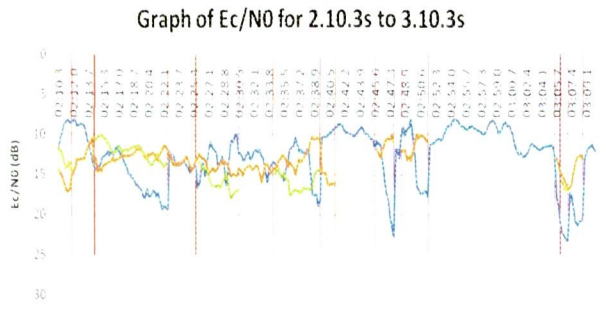
The project starts by collecting the data of traffic in 3G systems by performing drive test. Basically the data are based on long voice call performance which are been set for 10 minutes. The data then were plot on graph to see the relationship between each of the parameters that are been focused on this project that are received signal code power (RSCP) which are relates to signal strength and also carrier to noise density ratio (Ec/No) that are representing the cell quality of the pilot channel (CPICH) and its neighboring cells. The Microsoft Office Excel is used to plot all the data as the data been divided into 10 segments in order to observe the variation of performance clearly. All of the plotting is shown below.



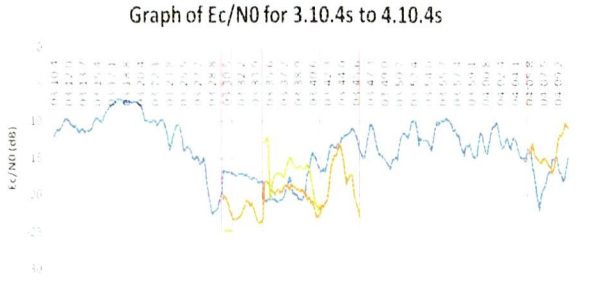
Graph 5.1 (a): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



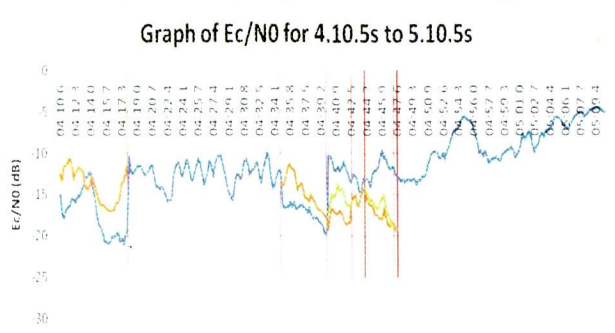
Graph 5.1 (d): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



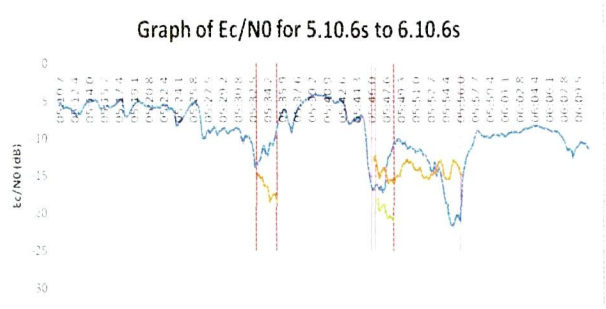
Graph 5.1 (g): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



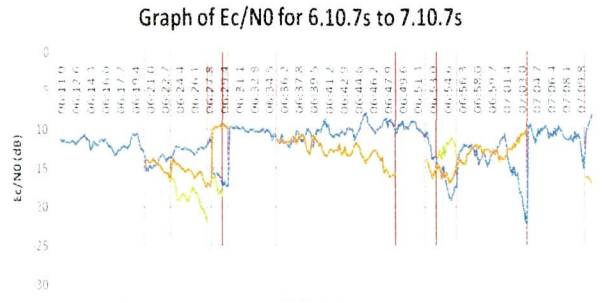
Graph 5.1 (j): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



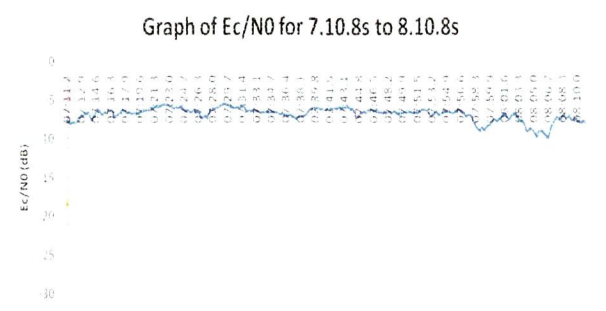
Graph 5.1 (m): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



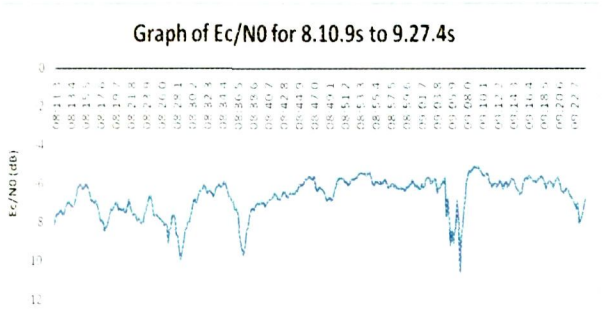
Graph 5.1 (p): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



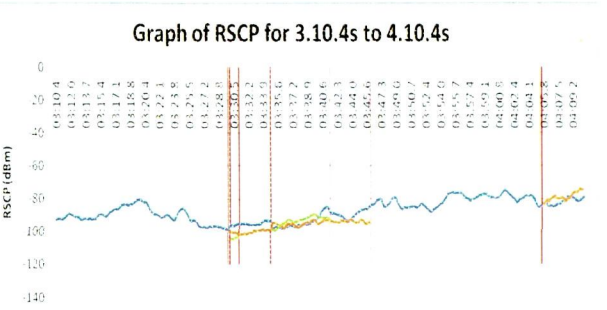
Graph 5.1 (s): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



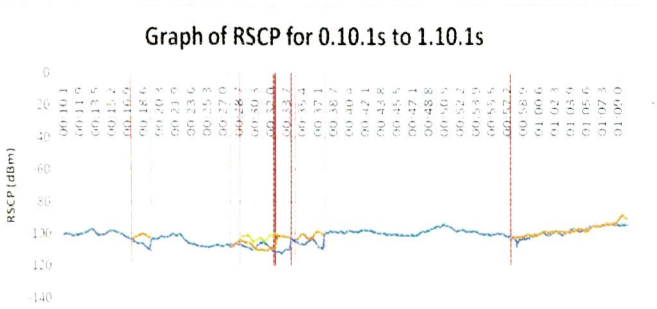
Graph 5.1 (v): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



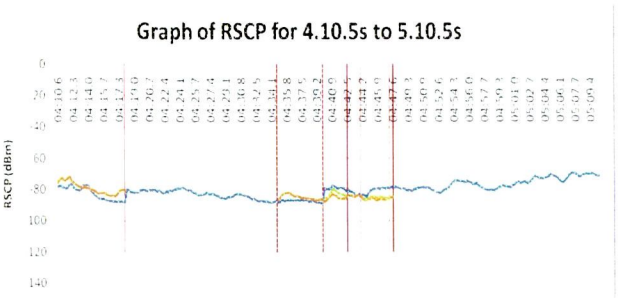
Graph 5.1 (y): Variation of Ec/No from pilot channel (CPICH) and its neighboring cells that are related to handover process



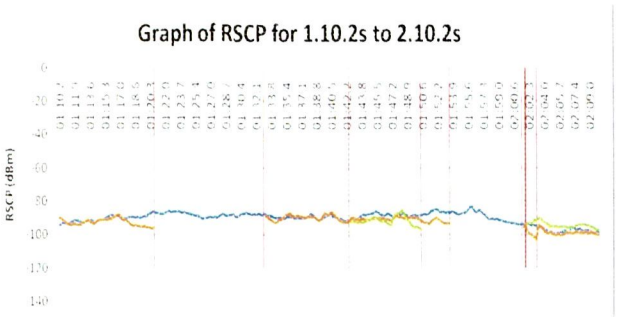
Graph 5.1 (k): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process



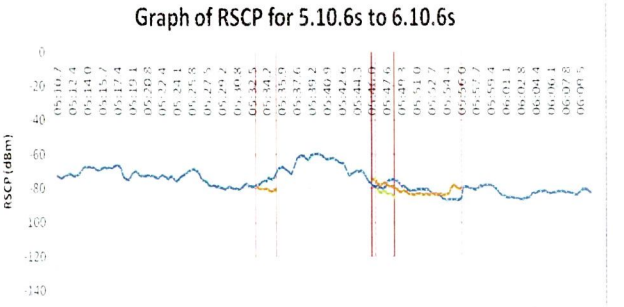
Graph 5.1 (b): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process



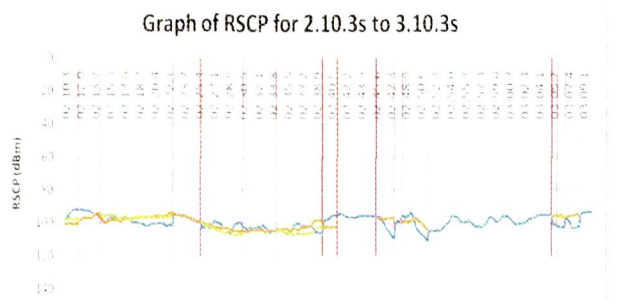
Graph 5.1 (n): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process



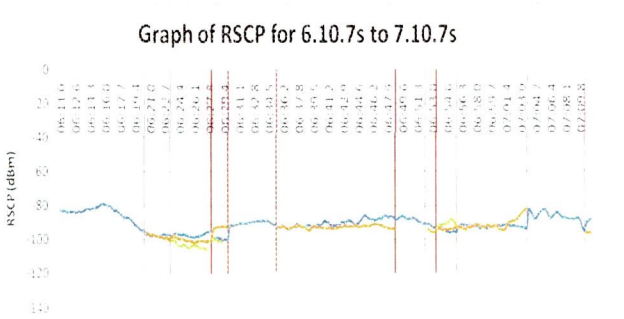
Graph 5.1 (e): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process



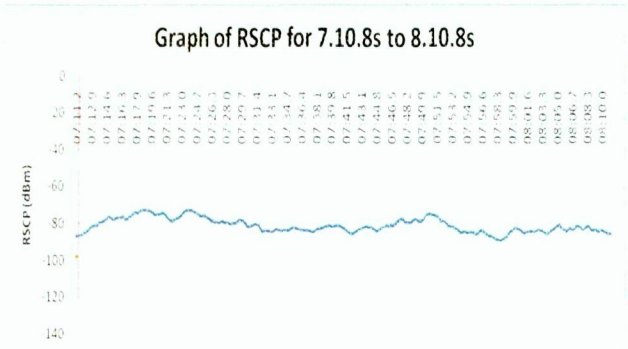
Graph 5.1 (q): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process



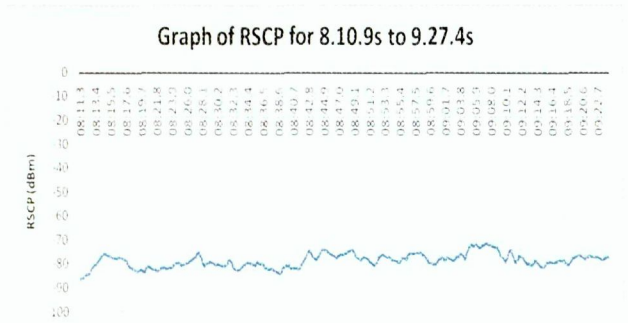
Graph 5.1 (h): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process



Graph 5.1 (t): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process



Graph 5.1 (w): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process



Graph 5.1 (z): Variation of RSCP from pilot channel (CPICH) and its neighboring cells that are related to handover process

Colour Line types	Indicator
	Primary Pilot Channel (CPICH)
	Second neighboring cell
	Third neighboring cell
	Handover process

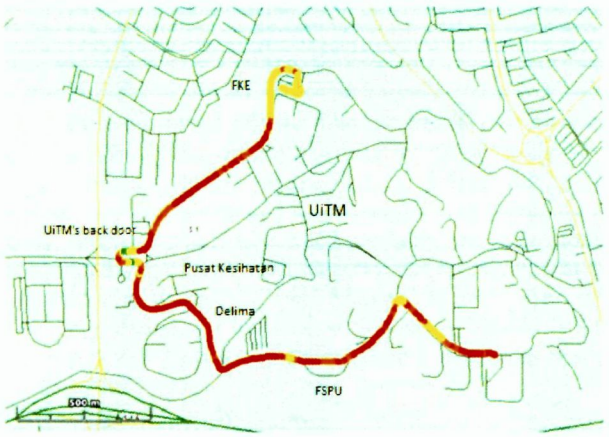


Figure 5.2 display the route that the car did during the measurements using a color code.

IV. Discussion

From this project, there are two major parameters that are been analyzed in order to see the performance of WCDMA telecommunications system. In this case, there are about 68 handovers happen in the long call drive test performed. All of the handovers can be categorized as soft handover.

Based from all of the plotted Carrier to Noise ratio (Ec/No) graphs, It is clearly show that the UE will receives more signals for maximal ratio combining, (soft handoff) from neighboring cell when the primary cell Ec/No reading drop below -16dB. The signal is said to be poor in coverage when it is in range between -14dB to - 24dB. Basically, handover process will happen when the signal measurement drop from the minimum required reading to maintain the traffic available. This is to avoid from drop call to happen when users use the system. From graph 5.1(a), we can see that there is a lot of short term handover process starting from the third soft handover. This is due to the previous cell's Ec/No reading had drop below -14dB. The traffic is said to be in good quality when the reading is higher than -5dB. For example, by looking at the 5.1(m) and 5.1(p), we can see that the Ec/No vary from -15dB to -4dB and there is no handover at this situation. Another important finding from this project is there is no coverage condition when the signal Ec/No reading is below -24dB. As a prove, the graph 5.1(j) show that the signal is poor but remain available due to the system cannot find any suitable neighboring cell to handoff the signal.

From all of the RSCP variation graphs, it is proved that the pilot channel (CPICH) will combine the signal with the neighboring cell, soft handover as the reading drop below -100dBm. The signal is consider as sufficient since the reading is more than -100dBm. If the RSCP signal drop below -115dBm, it can be said that there are no coverage and drop call will happen for this situation. As for this long call drive test project, the signal maintains to be higher than -115dBm since there is no occurrence of drop call during the drive test.

By analyzing the 5.1(v) to 5.1 (z) graphs, there is no occurrence of handover since both of the UE is stationary as the call connection is not terminated. After measuring these

two focused parameters, it can be said that degrading Ec/No reading is an indication of increased other cell interference.

The table 5summarized the level of performance for the WCDMA system based on the track from the drive test session.

Coverage level	*RSCP* [dBm]	E_c/N_0 [dB]
Good	$RSCP \geq -70$	$E_c/N_0 \geq -5$
Sufficient	$-70 \leq RSCP < -105$	$-5 \leq E_c/N_0 < -16$
Poor	$-105 \leq RSCP < -115$	$-16 \leq E_c/N_0 < -24$
No coverage	$RSCP < -115$	$E_c/N_0 < -24$

Table 5: Level of performance for the given WCDMA system

V. CONCLUSION

This work investigates the signal quality around UiTM main campus. Basically the drive test work had been performed during the peak time that is about 3pm. During peak time, there are many subscribers using the WCDMA system. Based from the plotted graphs, we noticed the WCDMA system that are available for the Maxis's subscriber in UiTM main campus is considered of sufficient quality since there is no occurrence of drop calls during the drive test despite the occurrence of many soft handovers. Important finding from this project is Maxis Company had planned the 3G system for their network based on capacity requirement due to large population of subscribers within this area. This is proved by the Ec/No reading which has been set low. In terms of quality, a high quality network plan is where a single pilot channel is detected over the majority of the cell area and transition between cells are done over clear boundaries or to word it differently. the less cell overlap with it.

ACKNOWLEDGMENT

First of all, I would like to thank my wonderful supervisor P.M Norhayati Ahmad for her constant support and guidance throughout this work, and for always being there whenever I needed his help. I would also like to thank Mr Kerr from NEMO Company for his help with the measurement work and analysis that we had, which have enhanced this work greatly. Special thanks to Puan Suhana, Master of electrical Engineering student for her help and support. Finally, I would like to thank my family and friends, who have been a source of tremendous inspiration and have always been there whenever I needed them.

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