

# Analysis of Data in Cell Planning in Term of Traffic Analysis and Grade of Service (GoS) During Hari Raya 2009 at Eastern Malaysia

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**Abstract-** The advancement in communication technology has witnessed by the developments of many different types of application. In communication system a lot of losses and issues are happen in term of capacity, coverage, cell planning, interference, and environment aspects. The analysis of data in term of traffic analysis and GoS is important to do cell planning. In this paper we use Microsoft Access's software to create database system and also use Matlab's software to do analysis of traffic occurring before, during and after Raya. Data base created to being easy to us to analysis the data to determine the system need new implementation such as upgrading Trx card, provide new site, provide new band channel, or provide new Bts in congested area that already identify using data analysis by database system.

**Keywords;**Grade of service (GoS), traffic analysis, cell planning, database system, Microsoft Access, Matlab

## I. INTRODUCTION

The tremendous growth in the demand for mobile communication services, with more and more carriers joining the market have triggered the need of cell planning improvement in order to give best performance in communication's field. Modern mobile network design involves several inter-dependent factors such as cell coverage, traffic, topography, propagation characteristics and system capacity. The selection of the number of cells, cell locations, power at base station and other design parameters have to be determined in the context of one another. The cell locations can be determined based on the number of cells, the coverage performance, traffic distribution, and propagation environments.. Finally, cell planning is not a onetime task as the design has to be continually updated based on the mobile network scenario. Many studies have

been carried out in the areas of mobile cellular network planning in terms of coverage analysis, channel assignment, routing and propagation, but relatively few studies [1]. In conventional cellular planning, the focus is mainly on the radio planning aspects which includes the optimal selection of cell sites, frequency channel allocation and antenna design. For example in, the authors have concentrated on channel allocation strategies and discussed how sectoring can be used to achieve better system performance [2].

## II. RELATED WORK

### Basic cellular system

A cellular network is a radio network made up of a number of radio cell each served by a fixed transmitter, normally known as a base station. These cells are use to cover different areas in order to provide radio coverage over a wider area than the area of one cell. Cellular networks are inherently asymmetric with a set of fixed main transceiver each serving a cell and a set of distributed transceivers which provide services to the network's users. Cellular networks offer a number of advantages over alternatives solutions:

- Increased capacity
- Reduced power usage
- Better coverage

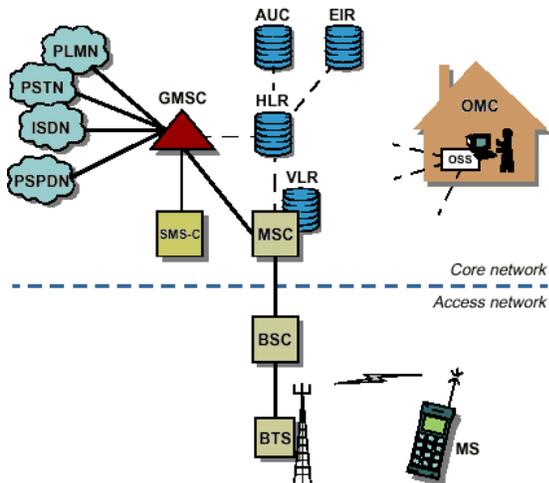


Figure 1: GSM Architecture

Network elements for (user) traffic

MS: A mobile station can be a mobile telephone, a fax having radio access or a laptop computer equipped with a radio modem.

BTS: A base transceiver station contains equipment for transmission and reception, antennas for one or more cells, plus equipment for encryption/decryption and signal strength measurement and for communication with the BSC.

BSC: A base station controller, also referred to as the radio switch, sets up the radio channels for traffic and for signaling to the MSC (see below) and monitors the access network portion of the connection. A BSC also performs traffic concentration and handles hand-over between the base stations that it controls [5]. BSCs are only found in the GSM standard. In other standards, the MSC also handles radio switch functions.

MSC: A mobile switching centre is a switching node having the specialized functions required by mobile networks, notably those relating to handover between MSCs and between different PLMNs. An MSC can be likened to the local exchange of a fixed network, although it does not have any fixed subscribers (at least not in the case of GSM) [3].

## Cell planning process

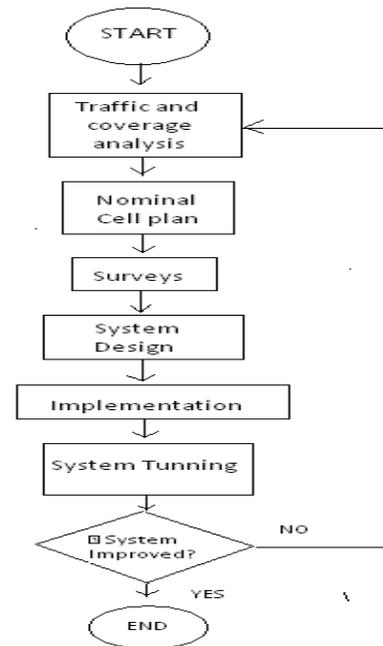


Figure 2: Flow chart of cell planning

### 1. Traffic and coverage analysis

Cell planning begins with traffic and coverage analysis. The analysis should produce information about the geographical area and the expected capacity (traffic load) [6]. The types of data collected are:

1. Coverage: The radio signal coverage must be guaranteed and holes in the coverage area should be avoided [6].
2. Capacity: In each cell, a sufficient number of channels must be available in order to meet its traffic demand for new calls and handoffs [6].
3. Transmission quality: The ratio of carrier to interference power (C/I) of radio channels must satisfy the requirements of transmission quality [6].
4. Cost: The deployment cost is, the cost of putting the required number of base-stations, cost of transmitting power [6].

### Calculation of required number of BTSs

To determine the number and layout of BTSs the number of subscribers and the Grade Of Service (GOS) have to be known. The GOS is the percentage of allowed congested calls and defines the quality of the service.

If  $n=1$  and  $T=90$  seconds then the traffic per subscriber is:  $A = 1 \times 90 / 3600 = 25mE$

If the following data exists for a network:

- Number of subscribers: 10,000
- Available frequencies: 24
- Cell pattern: 4/12
- GOS: 2%
- Traffic per subscriber: 25mE

This leads to the following calculations:

- Frequencies per cell =  $24 / 12 = 2$
- Traffic channels per cell =  $2 \times 8 - 2$  (control channels) = 14 TCH
- Traffic per cell = 14 TCH with a 2% GOS implies 8.2 Erlang per cell
- The number of subscribers per cell =  $8.2E / 25mE = 328$  subscribers per cell
- If there are 10,000 subscribers then the number of cells needed is  $10,000 / 328 = 30$  cells.
- Therefore, the number of three sector sites needed is  $30 / 3 = 10$

## 2. Nominal Cell Plan

A nominal cell plan can be produced from the data compiled from traffic and coverage analysis. The nominal cell plan is a graphical representation of the network and looks like a cell pattern on a map. Nominal cell plans are the first cell plans and form the basis for further planning. Successive planning must take into account the radio propagation properties of the actual environment.

## 3. Surveys

Once a nominal cell plan has been completed and basic coverage and interference predictions are available, site surveys and radio measurements can be performed [9].

### Site Surveys

Site surveys are performed for all proposed site locations. The following must be checked for each site:

- Exact location
- Space for equipment, including antennas
- Cable runs
- Power facilities
- Contract with site owner

In addition, the radio environment must be checked to ensure that there is no other radio equipment on site that causes problems.

## Radio Measurements

Radio measurements are performed to adjust the parameters used in the planning tool to reality. That is, adjustments are made to meet the specific site climate and terrain requirements. For example, parameters used in a cold climate will differ from those used in a tropical climate. A test transmitter is mounted on a vehicle, and signal strength is measured while driving around the site area [7]. Afterwards, the results from these measurements can be compared to the values the planning tool produces when simulating the same type of transmitter [7]. The planning parameters can then be adjusted to match the actual measurements.

## 4. System design

Once the planning parameters have been adjusted to match the actual measurements, dimensioning of the BSC, TRC and MSC/VLR can be adjusted and the final cell plan produced. As the name implies, this plan can then be used for system installation. New coverage and interference predictions are run at this stage, resulting in Cell Design Data (CDD) documents containing cell parameters for each cell [8].

## 5. System tuning and implementation

Once the system has been installed, it is continuously monitored to determine how well it meets demand. This is called system tuning. It involves:

- Checking that the final cell plan was implemented successfully
- Evaluating customer complaints
- Checking that the network performance is acceptable
- Changing parameters and taking other measurements, if necessary

## III. SCOPE OF WORK

The task of this study is to implement the database system using Microsoft Access to the first step of cell planning which is at traffic and coverage analysis to find out the congested cell after Hari Raya. Using the database system, the analysis of data will be more systematically and easier to allocate or to know the performance of the system during Hari Raya especially in eastern region of Malaysia. The data provided by Celcom is too huge and hard to do analysis without using the database system. Besides, this project used Matlab's software to do traffic analysis. With this analysis, we can know the

performance of the mobile system service whether it is enough capacity to support traffic exist during Hari Raya or not.

#### IV. METHODOLOGY

This project has begun with the research and understands the literature review of cell planning. Research the current information of cell planning will guide this project in right path. After all the information is gathering including all data of cell planning, do the analysis to find out the congested cell. At this stage, the implement of database system by Microsoft Access to make it easier in do analysis of huge data. All problems occur due to mobile system can be detected easily according to data analysis using database system. By using Matlab's software, the traffic analysis can be measure using graph created using simple programming. The final stage is recommendation after the data analysis due to problems occurs.

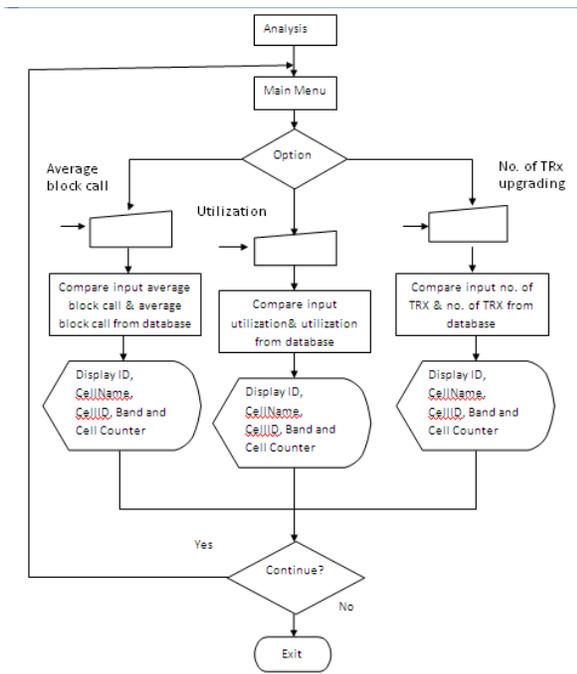


Figure 3: Flow chart of database system programming

The figure 3 show the flow chart of the system which divided to 3 main menus which is average block call, utilization and no of upgrading TRX. Use simple comparison between the inputs entered by user with the data from database. After that, the list of all data included ID, CellID, Band, cell counter and value of the specific data will display.

#### V. RESULTS AND DISCUSSION

##### AVERAGE\_BH BLOCK EXISTING

ID	CELL_NAME	CELL_ID	BSCID	BAND	BTS_TYPE	ABH_BLOCK
59	ldgbentapenjom_g30	AL_30283	BSE15_BKTMEN	900	MBO2	2.15
153	tmbatupapan_g30683	AL_30683	BSE16_BKTMEN	900	MBO2	2.18
240	dungun2_g32153	AL_32153	BSE12_BKTBAN	900	MBIS	3.45
242	kerteh_g32162	AL_32162	BSE08_BKTKEV	900	MBIS	4.29
249	cukaijabor_d32201	AL_32201	BSE14_BKTKEV	DB	MBIS	2.53
249	cukaijabor_d32203	AL_32203	BSE14_BKTKEV	DB	MBIS	5.36
254	pulauserai_g32282	AL_32282	BSE12_BKTBAN	900	MBIS	5.04
288	chukalmentok_g32781	AL_32781	BSE14_BKTKEV	900	MBO2	2.22
291	kgbesut_g32791	AL_32791	BSE14_BKTKEV	900	MBO2	2.58
293	kgbesut_g32793	AL_32793	BSE14_BKTKEV	900	MBO2	7.03
311	trnpaka_g32923	AL_32923	BSE08_BKTKEV	900	MBO2	5.18
312	paka_d32931	AL_32931	BSE08_BKTKEV	DB	MBIS	8.01

Figure 4(a) Analysis of average BH block existing after Raya

Figure 4(a) show the analysis done by using Microsoft Access database system where is all value of blocking call greater than 2% listed in table and the total number of cell greater than 2 is 205. It means the no of cell that congested after Raya is 205 cell at eastern region of Malaysia .

##### AVERAGE UTILIZATION EXISTING

ID	CELL_NAME	CELL_ID	BAND	A_UTILIEEXISTIN
46	lpt15_ltpkm18	AL_30152	900	82.24
61	bktmendi_g30	AL_30292	900	95.39
63	kotagelanggi2	AL_30311	900	89.66
84	tekal_g30401	AL_30401	900	95.21
86	tekal_g30403	AL_30403	900	90.66
88	jengka23_g304	AL_30412	900	93.74
92	jengka16_g304	AL_30433	900	95.76
103	celcomtemeric	AL_30491	900	85.23

Figure 4(b): Analysis of average utilization existing after Raya

Figure 4(b) show the analysis of average utilization existing after Raya that show all the value above 80% are listed in table. 80% utilization is on middle level and not to classified as congested. If the percentage utilization above 100 %, it is called congested.

Below 80%	Good level
80% - 90%	Middle level
90% - 100%	Critical level
Above 100%	Congested level

**Table 1: The utilization table**

$$Utilization\% = \frac{\text{Traffic Carried}}{\text{Traffic Offered}} \times 100$$

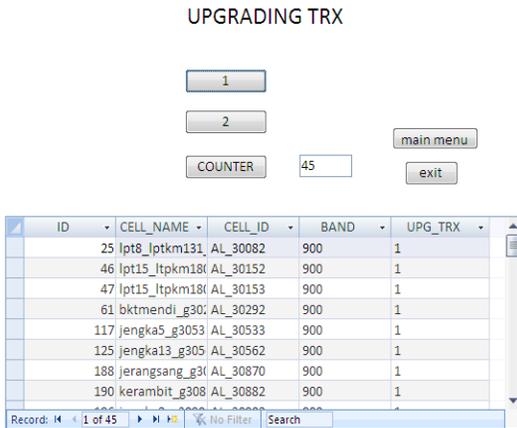


Figure 4(c): Analysis of upgrading Trx card

Figure 4(c) show the entire cell name that has been upgrading 1 TRx card during Raya. This analysis is important to identify which cell names upgrade 1 TRx because after Raya that TRx card need to remove back to avoid waste in channel capacity. The no of cell that upgrade 1 TRx in Eastern Region of Malaysia is 45 only. To find out the no of cell that upgrading to 2 TRx just click button to on database and the no of cell will listed.

**Result Using Matlab's software**

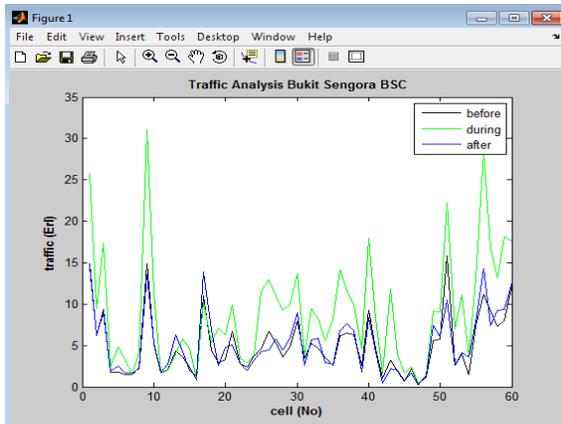


Figure 5(a): Traffic analysis for Bukit Sengora BSC

Using Matlab software, the graph can be created due to traffic occur versus number of cell in one BSC such as figure 5 (a). The legend green show the traffic occur during Raya, grey show the traffic occur before Raya and blue show the traffic occur after Raya. This analysis s is for Bukit Sengora BSC. The higher value of traffic occurs is about 32Erl.The graph before and after Raya is almost same to each other.

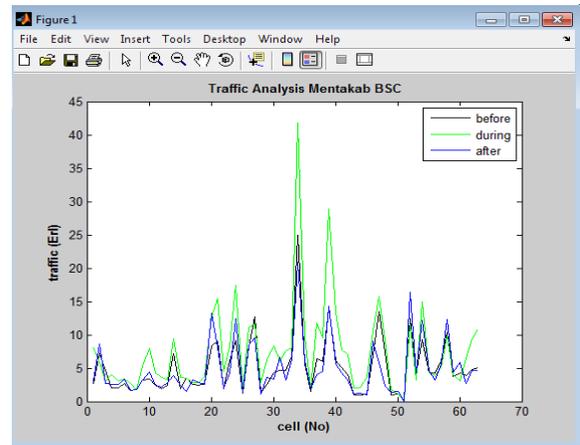


Figure 5(b): Traffic analysis for Mentakab BSC

Traffic anlalysis in figure 5(b) for Mentakab BSC is in stable condition except at the middle of graph. The values traffic is too high which is about 45 Erl.This is because of high activities occurs in that place.

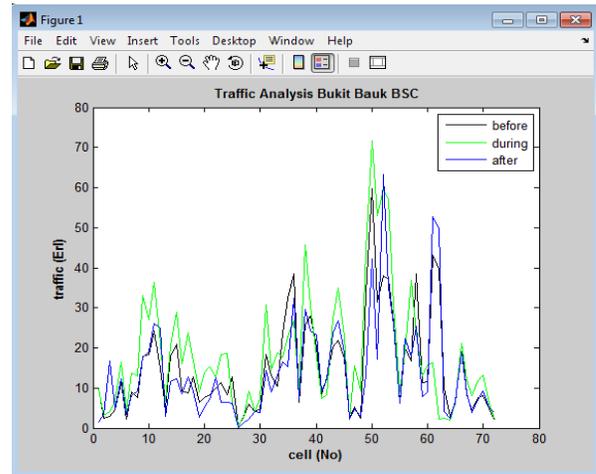


Figure 5 (c): Traffic Analysis for Bukit Bauk BSC

The highers traffic occur at Bukit Bauk BSC is about 72 Erl. It is very high traffic but the 3 graph show that is not have much different to each other. Eventhough it is very high traffic but it still in stable condition. These 3 graph line not have much different to each other it mean that BSC is normal and no need

of upgrading except certain cell that have much difference to each other such as at cell 8 or cell 38.

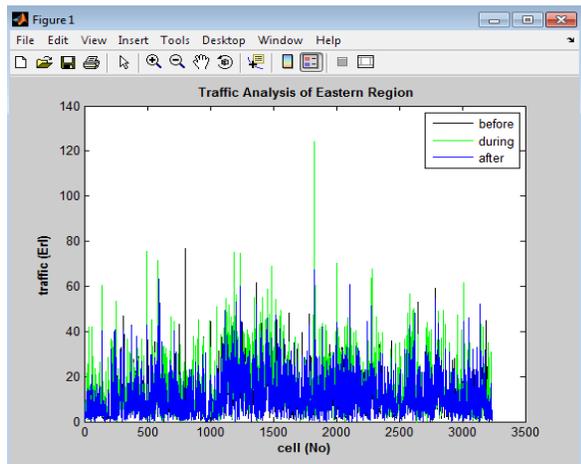


Figure 5 (d): Traffic Analysis for Eastern Region of Malaysia

Figure 5 (d) show that the traffic occur before, during and after Raya for Eastern Region. This is so huge data and the number of cell is about 3242 cells. The highest traffic occur is about 122 Erl. The graph showed the increasing of traffic during Raya and it is normal distribution. The average traffic occur for Eastern Region is about 20 Erl.

#### Recommendation from the result obtain

From the result, many solutions for the congested area can be implemented. The first one is implement half rate to the Trx card. Half rate (TCH/2) can transmit half rate speech (5,6 kbits/s). Two half rate TCHs can share one physical channel, thus doubling the capacity of a cell. Normally the full timeslot is used for one subscriber (Full Rate), but by allowing two subscribers to share one timeslot (Half Rate), the capacity can be increased. Besides, upgrading the Transceiver card (Trx card) can give more channel. 1 Trx card can support 8 channels. One base station can support up to 8 Trx card. Other solution for capacity requirement is by add the new GSM frequency band whether GSM900 or GSM1800. GSM 900 can provide 35MHz bandwidth with 175 radio channels while GSM 1800 provide 75MHz bandwidth with 375 radio channels. RAMO also can be used to support the traffic occur during Raya. RAMO is term used by Celcom to the place that needs to rent to place the cabinet that contain new frequency band.

#### VI. CONCLUSION

Utilization in different area can be seen clearly from the sample of data collected. To reduce the utilization level, TRx card can be upgraded by adding capacity in Erlang-B. In the case where the utilization level cannot be upgraded anymore, propose of new site and if still congest then need to add services such as add 1800 band and if still congest also then the new base station has to be built. A residential area with high population is not necessary to have high traffic, but an area where high activities are carried out is identified to be the factor of increasing the block call. From database system development, the number of cells that are congested can be displayed. This is good for cell planning purposes.

#### VII. FUTURE DEVELOPMENT

For the future development, the database system using Microsoft Access is the best to analysis huge data, but what can be improve is create database using others software such as SQL or PHP because it can link to internet or web and can handle large data. For the future, internet access is very important thing and not impossible if all cell planning data will link to internet access and all staff that responsible can do analysis more easily and more efficiently.

#### VIII. ACKNOWLEDGEMENT

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