Measurement of Digital Video Broadcasting-Terrestrial (DVB-T) Signal in Malaysia

NorsuzilaYa'acob, Tarmimi Sahad, Azita Laily Yusof,
Ainnur Eiza Azhar, Suzi Seroja Sarnin and Nani Fadzlina Naim
Wireless Communication Technology (WiCoT),
Faculty of Electrical Engineering, Universiti Teknologi MARA,
404500 Shah Alam Selangor, Malaysia.
norsuzilayaacob@yahoo.com

***Abstract*—This paper presents an analysis of the measurement results of DVB-T (Digital Video Broadcasting Terrestrial) signals in Malaysia. In this project, a measuring vehicle equipped with measuring equipment and receiving antenna (directional) placed at the height of 10 m above ground level was used. Parameters quality of DVB-T: field strength, MER (Modulation Error Rate), BER (Bit Error Rate) before Viterbi and BER after Viterbi for100 test points in the coverage area were investigated and analyzed. The measurement shows 99% of the test point received a good DVB-T signal quality (reception possible).**

***Index Terms*—DVB-T; Field Strength; MER; BER.**

I. INTRODUCTION

DVB-T is a technical standard developed by the 'DVB Project' for terrestrial digital broadcasting. This standard was first introduced in March 1997, and 12 years after that, DVB-T is the most widely DTT (Digital Terrestrial Television) system used around the world. This system offers the flexibility of designing networks for the delivery of various services, such as HDTV (High Definition Television), multichannel SDTV (Standard Definition Television), fixed, portable, mobile and hand held reception [1].

DVB–T uses Coded Orthogonal Frequency Division Multiplex (COFDM). By using this type of modulation, the signal becomes more robust, meaning that the signal transmission is more stable even for portable sets and in certain situations, mobile reception. Multipath interference, which introduces ghosting or multiple images can be eliminated in DVB-T. It also offers noise free reception.

A combination of DVB-T parameters makes it possible to transmit the multimedia and HDTV signal, which is not practical if analog system is used. RF spectrum can be fully utilized where for example, a single DVB-T transmitter can broadcast six programs on a single frequency.

Besides, DVB-T transmitter consumes about 1/4 of the power needed by an analogue transmitter, which provides the same coverage [2]. The benefits that DVB-T offers are the key factor of choosing to adopt the DVB-T as a standard.

DVB-T services have been deployed in 68 countries and adopted in more than 47 countries. This figure in combination with advanced trials and serious deployment plans brings the total number of DVB-T countries to 120 [1].

According to the National Digitalization Master Plan, Malaysia will fully migrate to digital broadcasting in 2015, where analog transmissions will be switched off entirely during that year. The task of spearheading the digital broadcasting is given to RTM (Radio Television Malaysia), as the government broadcasting station. Accordingly, RTM has been running a pilot project in September 2006 using a standard DVB-T adopted in most European countries. This project involved 1,000 respondents in the Klang Valley [3].

The purpose of this project is to measure the parameters quality of DVB-T: field strength, MER (Modulation Error Rate) and BER (Bit Error Rate), and to analyze the measurement result. The rest of this paper is organized as follows: Section II gives an overview of the DVB-T parameters followed by the measurement setup in Section III. Selected measurement results are discussed Section IV. The conclusion is presented in Section V and future recommendation is discussed in Section VI.

II. DVB-T PARAMETERS

DVB-T has several technical characteristics that can be varied to meet the operator requirement. There are:

- 3 choices of modulation QPSK (*Quadrature Phase Shift Keying),* 16-QAM (16-Quadrature Amplitude Modulation), 64-QAM (64-Quadrature Amplitude Modulation)
- 5 different FEC (Forward Error Correction)
- 4 Guard Interval options
- 2k or 8k carriers
- 6, 7 or 8 MHz Channel bandwidths

A different combination of these parameters was chosen according to the needs of the network operators for the suitability between the robustness sand capacity [1]. For example, by using the lower level of modulation such as QPSK, the data rate was slower than if 64-QAM was chosen. However, the receiver could still receive the signal even when the signal is weak (robustness). Table 1 summarizes the main parameters of DVB-T System [4].

III. MEASUREMENT SETUP

The measurements for 100 points were carried out using measuring instrument and receiving antenna for DVB-T signal. Antenna height was set at 10 m height based on the Recommendation ITU-R SM.1875 [5]. The polarization of the measurement antenna has to be the same as the one used at the transmitter. The directional antenna is turned around

360º to get the maximum of the wanted field strength. At each measuring point, several parameters of DVB-T signals were measured.

Table 1
Choice of parameters of non-hierarchical DVB-T transformation

OFDM Mode		2K			8K		
Bandwidth of RF Channel		6 MHz	7 MHz	8 MHz	6 MHz	7 MHz	8 MHz
Guard Interval	1/4	75μs	64μs	56μs	299μs	256μs	224μs
	1/8	37μs	32μs	28μs	149μs	128μs	112μs
	1/16	19μs	16μs	14μs	75μs	64μs	56μs
	1/32	9μs	8μs	7μs	37μs	32μs	28μs
Carrier Modulation		QPSK, 16-QAM, 64-QAM					
Inner Code Rate		1/2, 2/3, 3/4, 5/6, 7/8					

Table 2
Basic parameters of DVB-T standard for RTM

Frequency Band	UHF
Bandwith	8Mhz
Modulation	64-QAM
Subcarrier Mode	8K
Guard Interval	1/4
Code Rate	2/3

Data, such as description of location and GPS coordinates, electric field strength, MER and BER before Viterbi and BER after Viterbi were recorded. Additionally, the reception of the DVB-T Signal was tested with a commercial DVB-T receiver. Then, the image quality on the TV screen was evaluated. The threshold value for the Field strength >56 dBμV/m and for BER after Viterbi $< 2 \times 10^{-4}$ were taken as quality threshold [6]. Figure 1 shows the flow chart of the project.

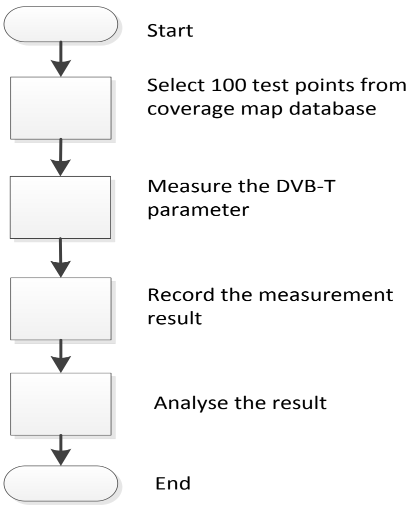

Figure 1: Project flow chart

A total of 100 test points was selected. At each point, several parameters of the digital television signals were measured. The measurement results were processed in tables. All measurements were carried out at the standpoint of the receiver from a transmitter located at Menara Kuala Lumpur.

From the test that been carried out for the 100 test points, the lowest measured level of the field strength was 36.4 dBμV/m for channel 44 and 34.5 dBμV/m for channel 46. The highest measured level was 89.4 dBμV/m and 87.7 dBμV/m respectively.

The median value for channel 44 was 65.8 dBμV/m, while it was 66 dBμV/m for channel 46. This means that the probability of the actual field strength at any location in this area is 50%, which is at least 65.8 dBμV/m for channel 44 and 66 dBμV/m for channel 46. There were a number of sites where the measured field strength was below the required level for a good reception, which is less than 56 dBμV/m, although a good quality TV signal (pictures and sound) can be received in almost cases.

Figure 2 shows the measured electric field strength values versus distance to transmitter. The field strength has very weak dependence on the distance to the transmitter. The DVB-T signal is very much affected by the terrain. A body of water, hills, buildings or aircraft in the area could obstruct or cause signal reflections and degradation of the signal [7]. This explains why the field strength value is lower at some points that are nearer to the transmitter compared to other points that are farther to the transmitter.

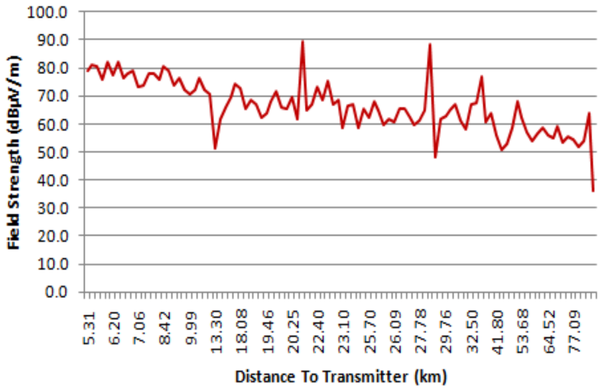

Figure 2: Field Strength vs. Distance to The Transmitter (Ch44)

In Figure 3, MER values show a very weak dependence on the distance to the transmitter. MER value can be lower at a longer distance compared to the test point, which is closer to the transmitter.

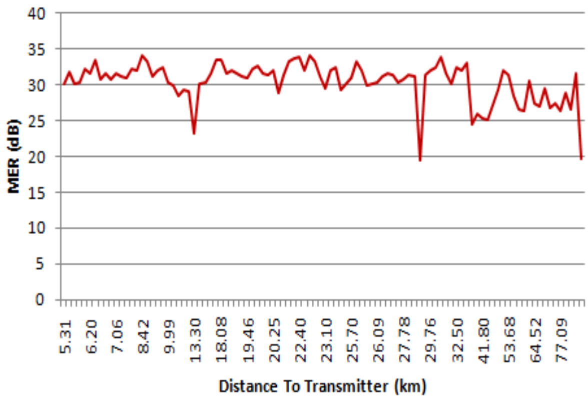

Figure 3: MER vs. Distance to The Transmitter (Ch44)

IV. RESULT

The BER before Viterbi versus the distance to the transmitter is shown in Figure 4. The result also shows a weak dependence on the distance to the transmitter, implying that the BER before Viterbi values can be lower at a longer distance in comparison to the test point, which is closer to the transmitter.

Figure 5 shows MER values versus the field strength. It can be concluded that the MER values depends on the field strength level, approximately linearly as the field strength increases. However, it shows a very weak dependence when the field strength level is above 61.1 dBµV/m. It shows that the reception quality of DVB-T is better when it is above the field strength threshold value.

Figure 6 shows BER before Viterbi versus the field strength. The higher field strength values, the lower the BER before Viterbi values.

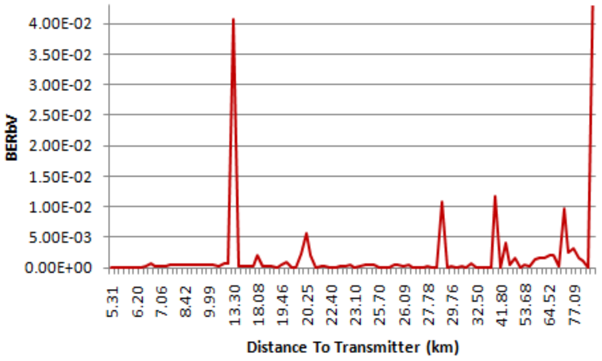

Figure 4: BER before Viterbi vs. Distance to The Transmitter (Ch 44)

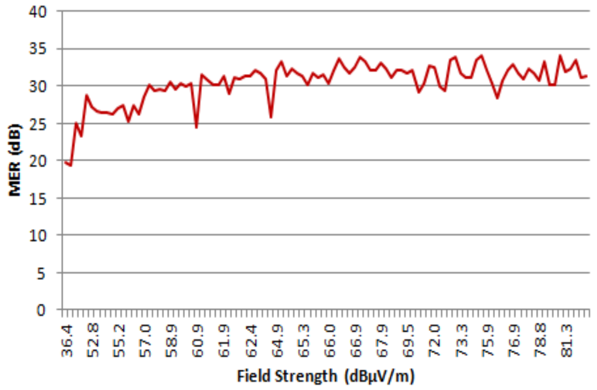

Figure 5: MER vs. Field Strength (Ch 44)

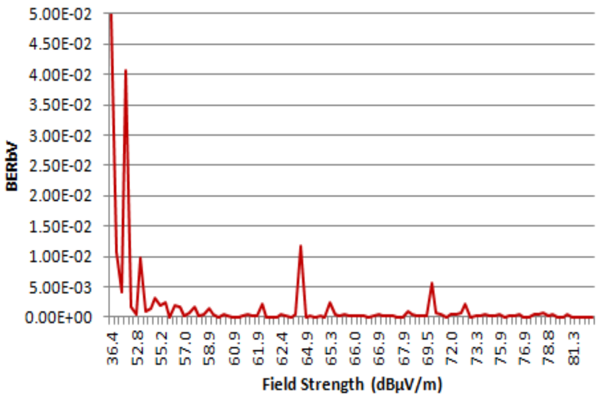

Figure 6: BER before Viterbi vs. Field Strength (Ch 44)

The BER before Viterbi versus MER is shown in Figure 7 It shows an inverse proportional relation between the MER and the BER before Viterbi. For MER values below 24.5 dB, an increase in MER causes a reduction of BER before viterbi values. BER before Viterbi changes randomly if the MER values are higher than 24.5 dB.

From the measured parameters of DVB-T signals for channel 44 obtained from 100 test points, the mean value of the field strength is 65.1 dBµV/m, and the standard deviation is 9.4. The mean value for MER is 30.4dB with a standard deviation of 2.8. The result also shows that the higher value of signal strength as well as MER means a better signal reception. The quality of signal received also depends on the value of BER before Viterbi. The lower value BER before Viterbi, the better signal reception.

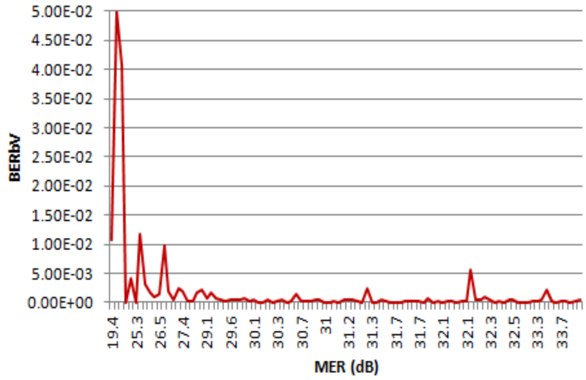

Figure 7: BER before Viterbi vs. MER (Ch 44)

V. CONCLUSION

The test that has been carried out demonstrates the performance of DVB-T in Malaysia (Klang Valley Area). DVB-T in Malaysia (Klang Valley Area) has been successfully implemented and is currently being used for the transmission of 4 TV channels.

It can also be concluded that the most important parameters for determining the signal reception quality are Field Strength, MER and BER.

Recently, the DVB-T in Malaysia transmitted from two transmitters located at Menara Kuala Lumpur and Gunung Ulu Kali functions to give a coverage for Klang Valley and adjacent area. Based on the performance of DVB-T, the coverage should be widened by locating more transmitter to cover other areas in Malaysia, in line with the National Digitalisation Master Plan Malaysia where Malaysia will fully migrated to digital broadcasting by 2015. Malaysia should adopt DVB-T2 as a standard for digital broadcasting in future [8].

ACKNOWLEDGMENT

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