Measurement of Digital Video Broadcasting-Terestrial (DVB-T) Signal In Malaysia

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***Abstract*— This paper presents analysis of measurement results of DVB-T (Digital Video Broadcasting Terrestrial) signals in Malaysia. In this project, a measuring vehicle equipped with measuring equipment and a receiving antenna (directional) which is placed at height of 10m 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 for 100 test points in the coverage area is investigated and analyzed. Measurement shows 99% of the test point received a good DVB-T signal quality (reception possible).**

Keywords—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 that lets network to be designed for delivery of various services such as HDTV (High Definition Television), multichannel SDTV (Standard Definition Television), fixed, portable, mobile and handheld reception [1].

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

Combination of DVB-T parameters make it possible to transmit the multimedia and HDTV signal which is not practical if analog system is used. RF spectrum can be fully utilised 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 the DVB-T as a standard to adopt.

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

According to the National Digitalisation Master Plan, Malaysia will fully migrate to digital broadcasting in 2015, where analog transmissions will be switch-off entirely during that year. The task of spearheading the digital broadcasting is given to RTM, as the government broadcasting station. Accordingly, RTM (Radio Televisyen Malaysia) 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), BER (Bit Error Rate) and to analyse the measurement result. The rest of this paper is organized as follows: Section II gives an overview of the DVB-T parameters followed by measurement setup in Section III. Selected measurement results are discussed in Section IV. In Section V the paper is concluded. 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 option
- 2k or 8k carriers
- 6, 7 or 8 Mhz Channel bandwiths

Different combinations of these parameters is chosen to the needs of network operators, for suitability between the robustness and capacity [1]. For example, by using the lower level of modulation such as QPSK, the data rate is slower than if 64-QAM is chosen. But, the signal is still can be received by the receiver even when the signal is weak (robustness). Table 1 below summarise the main parameters of DVB-T System [4].

TABLE I : CHOICE OF PARAMETERS FOR NON- HIERARCHICAL DVB-T TRANSMISSION

OFDM Mode		**2K**			**8K**		
Bandwith of RF Channel		**6 MHz**	**7 MHz**	**8 MHz**	**6 MHz**	**7 MHz**	**8 MHz**
Guard	1/4	75μs	64μs	56μs	299μs	256μs	224μs

OFDM Mode		2K			8K		
Bandwith of RF Channel		6 MHz	7 MHz	8 MHz	6 MHz	7 MHz	8 MHz
Interval	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					

RTM has implemented DVB-T in the UHF (Ultra High Frequency) with 8MHz bandwith and transmitted from two transmitters which is at Menara Kuala Lumpur and Gunung Ulu Kali. More details are given in Table II.

TABLE II : 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

III. MEASUREMENT SETUP

The measurements for 100 points were carried out by using measuring instrument and receiving antenna for DVB-T signal. Antenna height was set at 10m height based on Recommendation ITU-R SM.1875 [5]. The polarization of the measurement antenna has to be the same as used at the transmitter. The directional antenna is turned around 360° to get the maximum of wanted field strength. At each measuring point several parameters of DVB-T signals were measured.

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 were tested with commercial DVB-T receiver. Then image quality on the TV screen were evaluated. The threshold value for Field strength >56 dBμV/m and for BER after Viterbi < 2×10^{-4} were taken as quality threshold [6]. Figure 1 below shows the flow chart of the project.

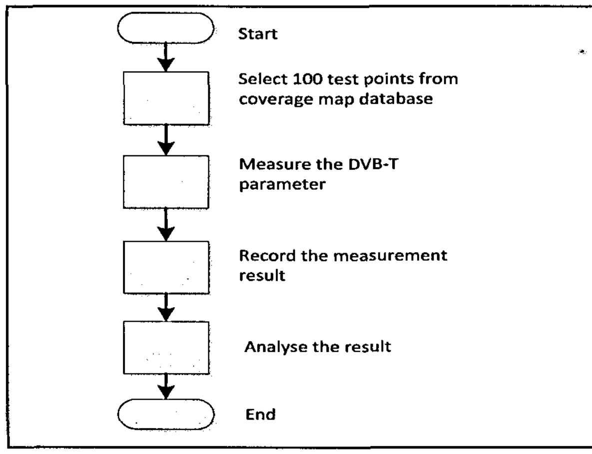

Fig.1. Project Flow Chart

IV. RESULT

Total 100 test point were selected. At each point, several parameters of digital television signals were measured. 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. Part of measurements data are shown in Table III.

TABLE III : PART OF MEASUREMENT RESULTS (CH 44)

TP	Dist (km)	Field Strength (dBμV/m)	MER (dB)	BERbV	BERaV
1	19.70	71.5	32.7	9.16E-06	0.00+00
2	43.50	50.9	25.1	4.10E-03	0.00+00
3	5.69	80.8	30.1	6.18E-05	0.00+00
4	5.63	81.3	31.9	5.95E-05	0.00+00
5	13.30	51.4	23.3	4.07E-02	1.78E-04
6	21.40	89.4	31.3	9.16E-06	0.00+00
7	32.36	61.1	31.6	3.13E-05	0.00+00
8	34.89	76.9	33.0	1.06E-04	0.00+00
9	26.40	65.3	31.7	2.90E-05	0.00+00
10	78.60	63.7	31.7	6.18E-05	0.00+00
11	21.00	62.0	28.9	2.11E-03	0.00+00
12	28.60	88.4	31.1	3.05E-06	0.00+00
13	22.40	73.2	33.8	0.00E+00	0.00+00
14	23.10	58.8	29.5	1.44E-04	7.96E-04
15	25.70	62.2	31.0	4.12E-05	8.78E-06
16	32.50	66.9	32.5	2.82E-05	0.00+00

TP	Dist (km)	Field Strength (dBµV/m)	MER (dB)	BERbV	BERaV
17	56.60	54.1	26.5	1.49E-03	0.00+00
18	56.30	57.0	28.5	3.07E-04	0.00+00
19	29.50	48.2	19.4	1.08E-01	0.00+00
20	37.50	64.1	25.9	1.17E-02	0.00+00

From the test that been carried out for 100 test point, 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 for channel 46, it was 66 dBµV/m. This means that the probability of the actual field strength at any location in this area being at least 65.8 dBµV/m for channel 44 and 66 dBµV/m for channel 46 is 50%. 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, but still a good quality tv signal (pictures and sound) can be received in almost cases.

Fig. 2. shows the measured electric field strength values versus distance to transmitter. The field strength 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 further to the transmitter.

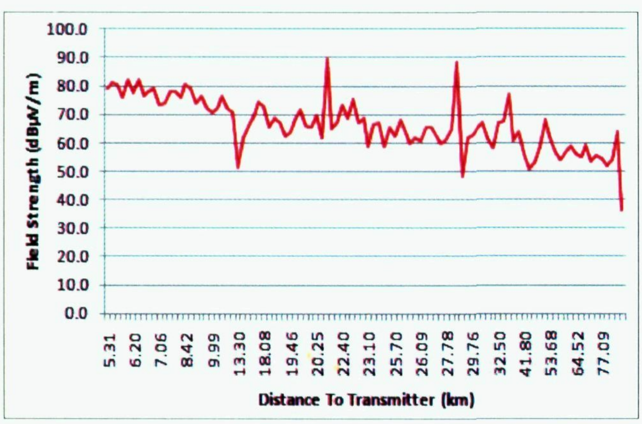

Fig.2. Field Strength vs. Distance To The Transmitter (Ch44)

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

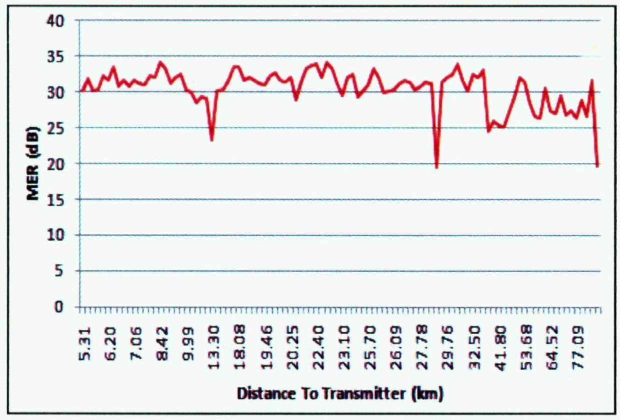

Fig.3. MER vs. Distance To The Transmitter (Ch44)

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

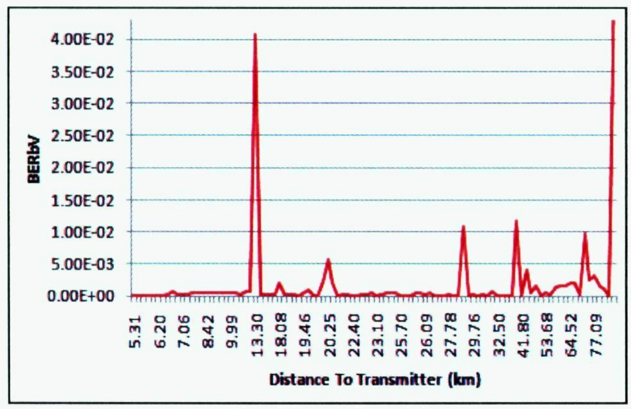

Fig.4. BER before Viterbi vs. Distance To The Transmitter (Ch 44)

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

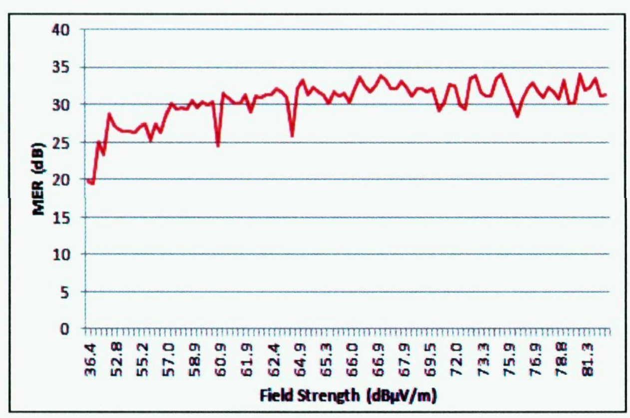

Fig.5. MER vs. Field Strength (Ch 44)

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

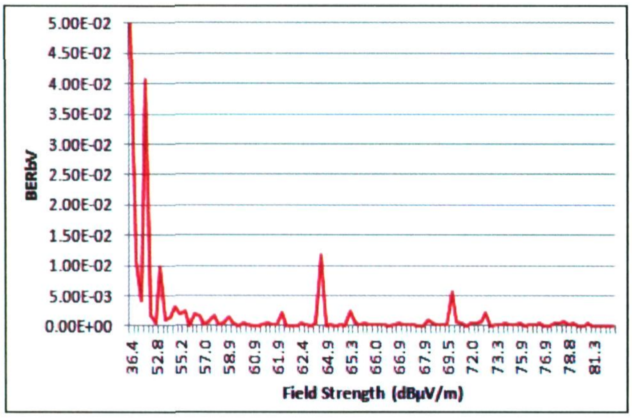

Fig.6. BER before Viterbi vs. Field Strength (Ch 44)

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

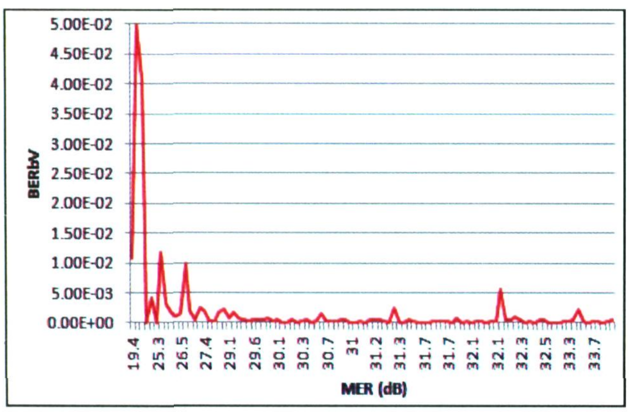

Fig.6. BER before Viterbi vs. MER (Ch 44)

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

V. CONCLUSION

The test that been carried out demonstrated 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 also can 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 is transmitted from two transmitter which are located at Menara Kuala Lumpur and Gunung Ulu Kali to give a coverage for Klang Valley and adjacent area. Based on the performance of DVB-T, the coverage should be widen by locating more transmitter to cover other area in Malaysia, in line with the National Digitalisation Master Plan Malaysia where Malaysia will fully migrated to digital broadcasting by 2015.

VI. FUTURE RECOMMENDATION

Some country has adopted DVB-T2 which is the second generation of DVB-T. Like its predecessor, DVB-T2 uses OFDM (orthogonal frequency division multiplex) modulation with a large number of sub-carriers delivering a robust signal, and offers a range of different modes, making it a very flexible standard. DVB-T2 can offer a much higher data rate than DVB-T and much more robust signal. As my recommendation based on the advantages of DVB-T2 can offer, Malaysia should adopt DVB-T2 as a standard for digital broadcasting in future [8].

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