Comparison of DVB-T/H and DVB-T2 in Mobile, Portable and Fixed TV Channels

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Abstract **— The paper deals with the DVB-T/H (Digital Video Broadcasting – Terrestrial / Handheld) and DVB-T2 (Digital Video Broadcasting - 2nd Generation Terrestrial) standards and their performance in multipath and fading TV channel models. For the comparison the overview information about DVB-T/H and DVB-T2 were taken from the DVB Facts Sheets and added with according references. Then parameters and models for mobile, portable and fixed TV scenarios were used for system analysis and simulation. Dependences of BER and MER on C/N ratio for all types of payload inner modulations are compared with focus on mobile, portable and fixed TV services availability. Comparison of these two standards performance in various channel models is the main novelty contained in this paper.**

Keywords **— DVB-T/H, DVB-T2, fixed, portable and mobile TV, fading channels, broadcasting, BER, MER.**

I. INTRODUCTION

THE DVB (Digital Video Broadcasting) Project [1] began its work in 1993 and the development of standards for the cable and satellite channels were prioritized. The development of a system for DTT (Digital Terrestrial Television) has presented more challenges with requirements to deal with a variety of noise and bandwidth environments, multipath interference and Doppler's shift in case of movement of the DTT receiver.

The DVB-T (Terrestrial) [2] is a technical standard that specifies the framing structure, channel coding and modulation for DTT broadcasting. The first version of the standard was published in March 1997. In the 12 years since then it has become the most widely adopted DTT system in the world. It is a flexible system that allows networks to be designed for the delivery of a wide range of services, from HDTV to SDTV, fixed, portable, mobile, and even handheld reception. The DVB-H (Handheld) [3] system for mobile TV was built on the proven mobile performance of DVB-T. Next generation of DVB-T2 (2nd Generation Terrestrial) [4], was designed to meet needs after the ASO (Analogue Switch-Off).

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TABLE 1: DVB-T/H VS. DVB-T2 COMPARISON (AWGN).

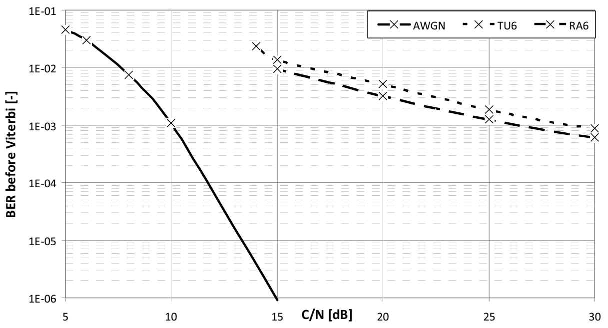
Parameter	*DVB-T/H*	*DVB-T2*
FEC	CC+ RS 1/2, 2/3, 3/4, 5/6, 7/8	LDPC + BCH 1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Modes	QPSK 16QAM 64QAM	QPSK 16QAM 64QAM 256QAM
Guard Interval	1/4, 1/8, 1/16, 1/32	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
FFT Size	2k, 4k, 8k	1k, 2k, 4k, 8k, 16k, 32k
Scattered Pilots	8 % of total	1 %, 2 %, 4 %, 8 % of total
Continual Pilots	2.6 % of total	0.35 % of total
Typical data rate	24 Mbit/s	40 Mbit/s
Maximal data rate (C/N ratio 20 dB)	29 Mbit/s	47.8 Mbit/s
Required C/N ratio (data rate 22 Mbit/s)	16.7 dB	8.9 dB

II. DVB-T/H STANDARD

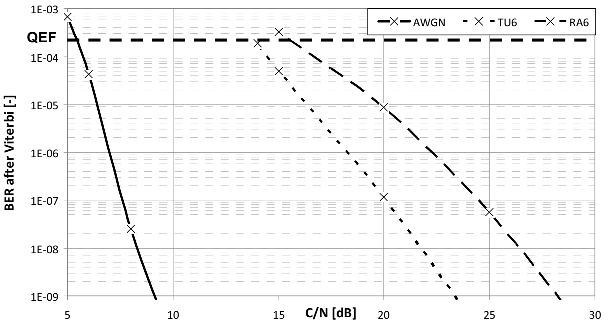
DVB-T/H [5] - [7] in common with almost all modern terrestrial transmission systems uses OFDM (Orthogonal Frequency Division Multiplex). This type of modulation which uses a large number of sub-carriers delivers a robust signal that has the ability to deal with very severe channel conditions. DVB-T/H has technical characteristics that make it a very flexible system: 3 modulation options (QPSK, 16QAM, 64QAM), 5 different FEC (Forward Error Correction) – RS code, convolutional code, inner and outer interleaving) rates, 4 Guard Interval options, choice of 2k (mobile scenario), 4k (portable scenario) or 8k (fixed scenario) carriers, and can operate in 6, 7 or 8 MHz channel bandwidths [8].

Using different combinations of the above parameters a DVB-T/H network can be designed to match the requirements of the network operator finding the right balance between robustness and capacity [9]. Networks can be designed to deliver a whole range of services: LDTV, SDTV, HDTV, interactive services, MPE (Multi-Protocol Encapsulation) and IPDC (IP Data Casting) [10].

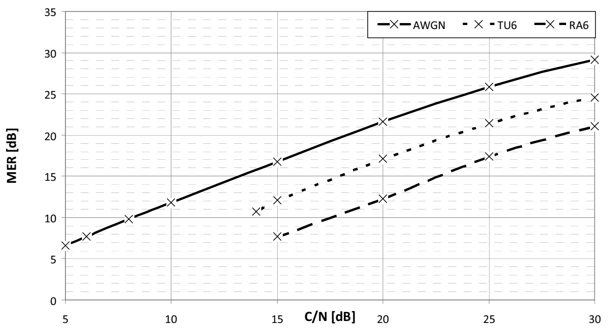
DVB-T performance is such that mobile reception is not only possible, but forms the basis of some commercial services. The use of a diversity receiver with two antennas



a) $BER_{\text{before Viterbi}} = f(C/N)$

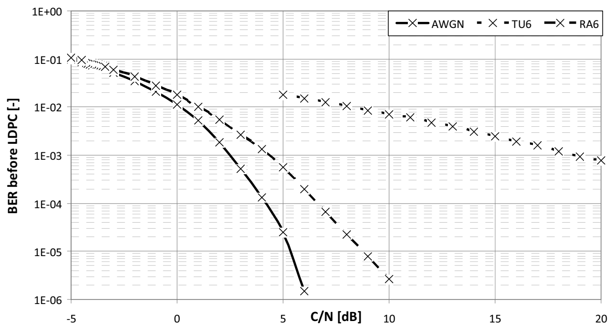


b) $BER_{\text{after Viterbi}} = f(C/N)$

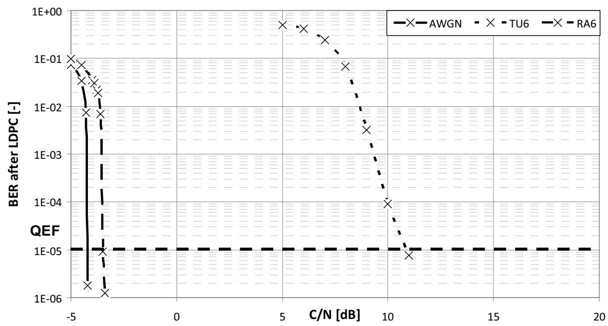


c) $MER = f(C/N)$

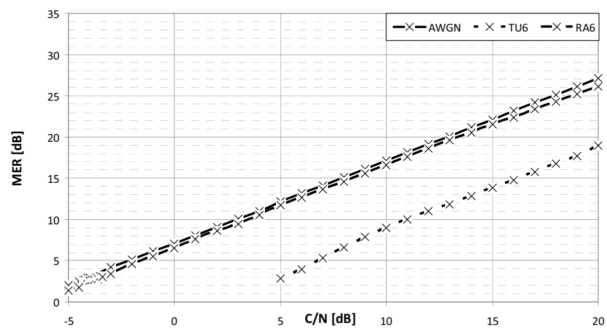
Fig. 1. Mobile TV scenario performance in DVB-T (QPSK, 2k mode , CC 2/3, GI 1/16).



a) $BER_{\text{before LDPC}} = f(C/N)$



b) $BER_{\text{after LDPC}} = f(C/N)$



c) $MER = f(C/N)$

Fig. 2. Mobile TV scenario performance in DVB-T2 (QPSK, 2k mode, LDPC 2/3, GI 1/16).

gives a typical improvement of 5 dB in the home and a 50% reduction in errors is expected in a car.

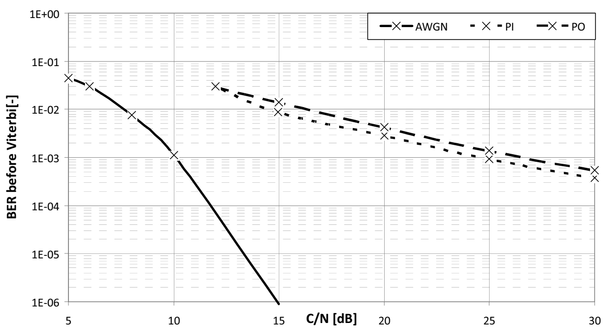
The use of OFDM with the appropriate GI (Guard Interval) allows DVB-T/H to provide a valuable tool for regulators and operators in the form of the SFN (Single Frequency Network). An SFN is a network where a number of transmitters operate on the same RF frequency. An SFN can cover a country or be used to enhance indoor coverage using a simple gap-filler.

III. DVB-T2 STANDARD

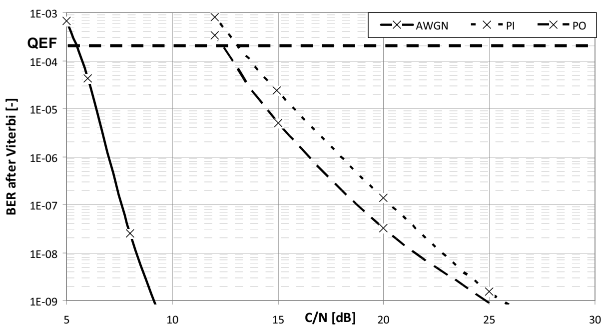
The DVB-T2 [11] is the most advanced DTT system offering higher efficiency, robustness and flexibility. It introduces the latest modulation and coding techniques to enable efficient use of valuable terrestrial spectrum for the delivery of audio, video and data services to fixed, portable and mobile devices. These new techniques make DVB-T2 at least 50% more efficient than DVB-T.

The DVB-T2 is based on carefully considered commercial requirements. Key requirements included an increase in capacity, improved robustness and ability to reuse existing reception antennas. The first version was published in September 2009. An updated version, which defines a DVB-T2 subset optimized for mobile and portable reception (T2-Lite) was introduced in July 2011 [12].

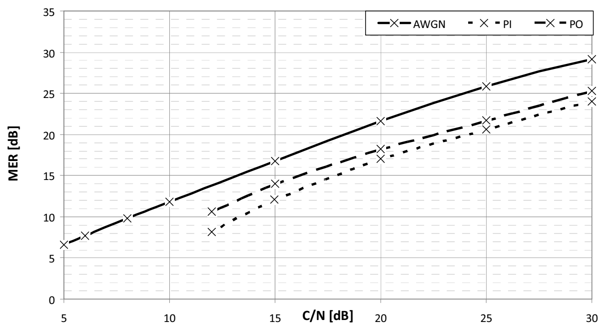
As with its predecessor, DVB-T2 uses OFDM with a large number of sub-carriers delivering a robust signal. DVB-T2 also offers a range of different modes, making it a very flexible standard. It uses error correction of LDPC (Low Density Parity Check) coding combined with BCH (Bose-Chaudhuri-Hocquengham) coding and offers a very robust signal. Several options are available in areas such as the number of carriers, guard interval sizes and pilot signals, so that the overheads can be optimized for any target transmission channel. A basic comparison of the DVB-T2 parameters is shown in the Table I (AWGN) [4].



a) $BER_{\text{before Viterbi}} = f(C/N)$

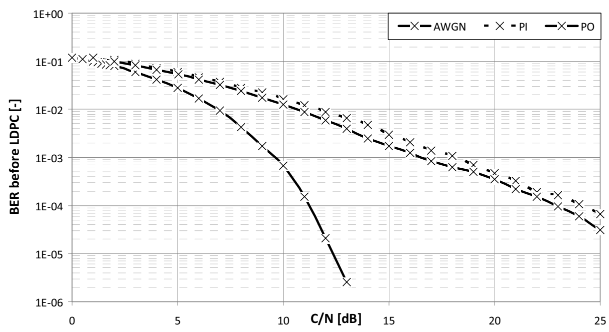


b) $BER_{\text{after Viterbi}} = f(C/N)$

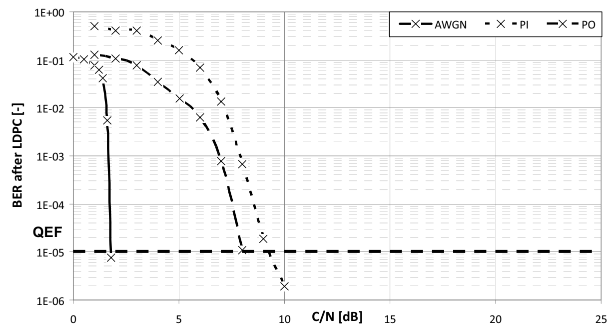


c) $MER = f(C/N)$

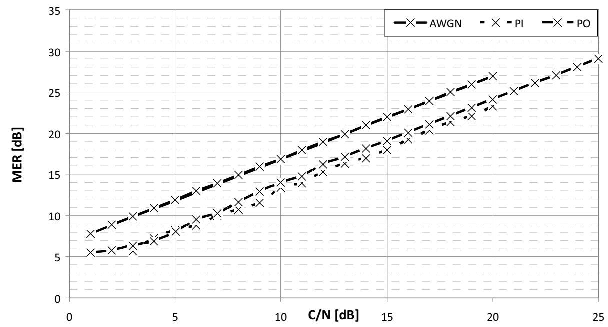
Fig. 3. Portable TV scenario performance in DVB-T (16QAM, 4k mode, CC 2/3, GI 1/8).



a) $BER_{\text{before LDPC}} = f(C/N)$



b) $BER_{\text{after LDPC}} = f(C/N)$



c) $MER = f(C/N)$

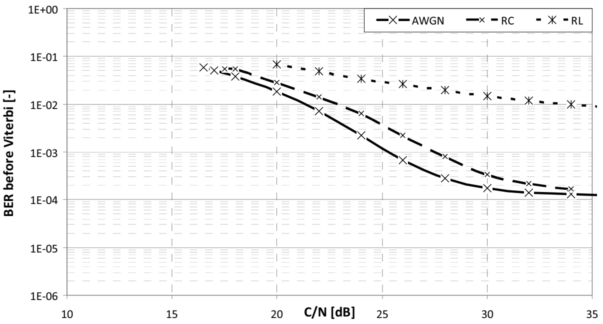
Fig. 4. Portable TV scenario performance in DVB-T2 (16QAM, 4k mode, LDPC 2/3, GI 1/8).

The key technologies are [4]: Multiple PLP (Physical Layer Pipes) allows separate adjustment of the robustness of each delivered service within a channel to meet the required reception conditions (e.g. indoor or roof-top antenna). It also allows transmissions to be tailored such that a receiver can save power by decoding only a single service rather than the whole multiplex of services. Alamouti coding for transmitter diversity method improves coverage in small-scale SFNs. Rotated Constellation provides additional robustness for low order constellations. DVB-T2 also uses extended interleaving, including bit, cell, time and frequency interleaving. The FEF (Future Extension Frames) allows the standard to be compatibly enhanced in the future. As a result, DVB-T2 can offer a much higher data rate than DVB-T or a much more robust signal.

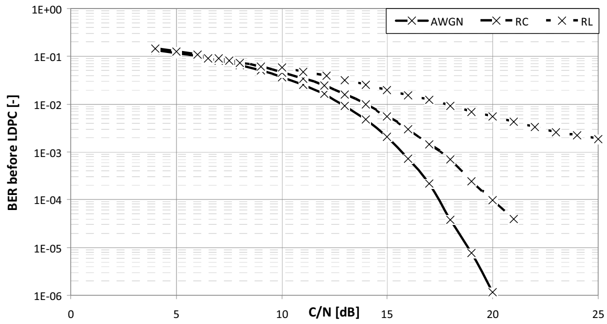
Mentioned T2-Lite is the first additional transmission frame type making use of the FEF approach. It is a profile that was introduced in July 2011 to support mobile as well as portable TV and also to allow for cost reduced implementation. The new profile is defined as a subset that adds two additional LDPC code rates to the main DVB-T2 specification. Since only elements relevant for mobile and portable reception have been included in the T2-Lite subset and the data rate is restricted to 4 Mbit/s per PLP, the implementation complexity has been reduced by 50%. The FEF mechanism allows that T2-Lite and T2-base can be transmitted in one RF channel [12].

IV. Simulation Results

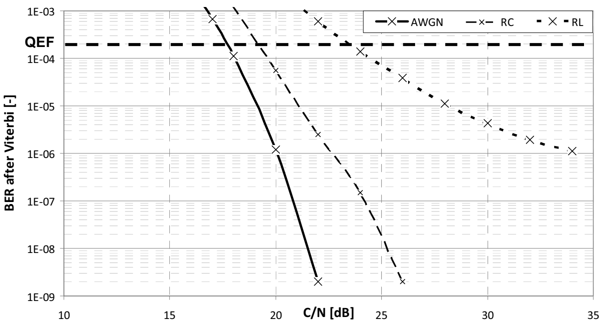
For the comparison the overview information about DVB-T/H and DVB-T2 were taken from the DVB Facts Sheets and added with references. The next technical part of this paper deals with the comparison of the standards performance in mobile (RA6 - Rural Area, TU6 - Typical Urban), portable (PI - Portable Indoor and PO - Portable Outdoor) and fixed (RC - Ricean, RL - Rayleigh) TV channels [5] – [7]. As a reference the AWGN was used.



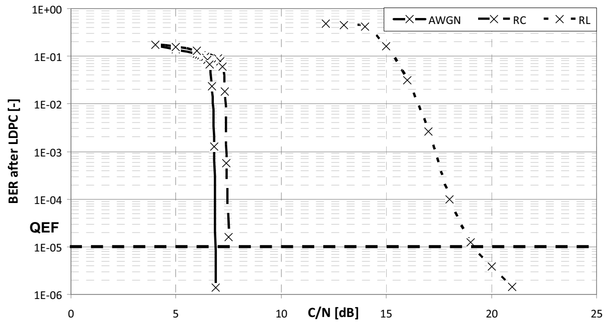
a) $BER_{\text{before Viterbi}} = f(C/N)$



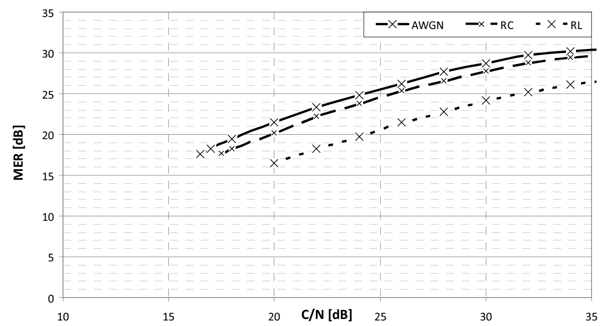
a) $BER_{\text{before LDPC}} = f(C/N)$



b) $BER_{\text{after Viterbi}} = f(C/N)$

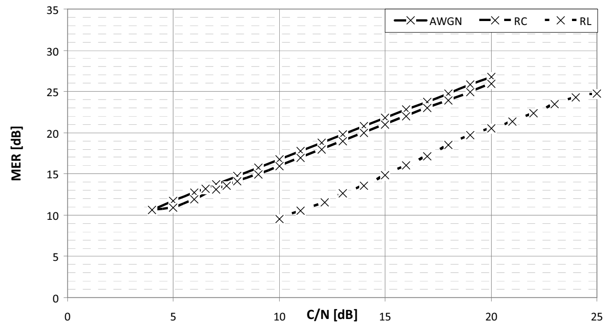


b) $BER_{\text{after LDPC}} = f(C/N)$



c) $MER = f(C/N)$

Fig. 5. Fixed TV scenario performance in DVB-T (64QAM, 8k mode, LDPC 2/3, GI 1/8).



c) $MER = f(C/N)$

Fig. 6. Fixed TV scenario performance in DVB-T2 (64QAM, 8k mode, LDPC 2/3, GI 1/8).

The results are shown in Fig. 1 to Fig. 6, where page by page and in figure pairs are mobile (using QPSK and 2k mode), portable (using 16QAM and 4k mode) and fixed (using 64QAM and 8k mode) scenarios in DVB-TH and DVB-T2 for possible comparison. In all Figures marked b) the QEF indication means “Quasi Error Free” transmission. In [6] and [11] it is situation when all errors after FEC corrections are almost removed and in the service of mobile TV the visible error occurs in maximum of every 1 hour.

V. Conclusion

Performance of the DVB-T/H and DVB-T2 standards was evaluated by using the same scenarios of OFDM mode, inner modulation and Guard Interval selection. Different error correction schemes were used to demonstrate higher efficiency of the second generation DVB-T2 transmission and useful bit rate increase in comparison with the first generation and DVB-T/H.

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