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The DVB-H Standard: Comparative Analysis of the Results Obtained for Various Modulation Techniques and Different Code Rates

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Abstract

DVB-H happens to be the technical specification for the transmission of digital TV to mobile telephones and PDAs—handheld receivers. Published as a formal standard, DVB-H is a physical layer specification designed to facilitate the proficient delivery of IP-encapsulated data over terrestrial networks. The making of DVB-H, which is closely associated with DVB-T, also entailed modifications of some other DVB standards dealing with data broadcasting, service Information, etc. It can be used as a bearer in concurrence with the DVB-IPDC systems layer specifications. A non-proprietary open standard, DVB-H has broad support, and services are currently on air in more than ten nations. When the possibility of a dedicated DVB specification for broadcasting to handhelds was first discussed, it was in the context of the proven mobile performance of DVB-T, the widely adopted standard for digital terrestrial TV. The key applications considered were mobile TV, video streaming in general, and file downloads, all targeted at handheld receivers that would operate with limited battery life and in difficult reception conditions. This paper mainly concentrates on the comparative analysis carried out when DVB-H has been applied to random data types and the results obtained are compared for QPSK, 16, and 64 QAM methods along with various code rates.

Keywords: DVBH, OFDM, single frequency network, terrestrial networks, time slicing

INTRODUCTION

DVBT being an exceptionally better terrestrial standard, many commercial applications are choosing and using it as their preferred terrestrial television system. After it being popular, the need was to receive the broadcast services on portable devices and even in vehicles with mobility, and the mobile industry was intending to have a dedicated and modified standard [1]. Using a wireless point-to-multipoint link reaching all the mobile terminals while continuing to provide superior coverage to the wide geographical area just as DVB-T is doing has been the major research issue. Higher capacity of transmission also is one important need of the current time. The international DVB Project has responded to the industry interest by specifying a new transmission standard: DVB-H (Digital Video Broadcasting-Transmission System for Handheld Terminals). DVB-H is the latest standard mostly following the setup of DVB transmission standards and its simulation results are obtained using MATLAB [2]. The DVB-H technology is a spin-off of the DVB-T standard. It is to a huge extent similar and compatible with DVB-T but takes into account the specific properties of typical terminals which are expected to be small, portable, lightweight, and very much essential battery-powered. DVB-H

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offers a downstream channel at a very high data rate which is actually the enhancement to the existing mobile telecommunications network, accessible by most of the typical terminals. So, DVB-H merges a gap between the classical broadcast systems and the world of cellular radio networks. The broadband, high-capacity downstream channel works with a very high data rate measured usually in M bit/s especially for video and audio streaming applications in DVB-H. In the applications like file downloads and for many other similar grades of services also, the higher data rate is an important feature. The system offers greatly extended possibilities for content providers and network operators, and thereby introduces new ways of distributing services to handheld terminals.

FEATURES OF DVB-H

DVB-H which uses a mechanism called MPE (multi-protocol encapsulation), is an extension of DVB-T with some backward compatibility. Due to the use of MPE, it is possible to transport data network protocols on top of MPEG-2 transport streams. To improve the mobility and robustness of the signal, the feature of forward error correction (FEC) scheme is also used along with MPE. Moreover, a 4k mode has been added in the DVB-H standard whereas only the 2k and 8k modes were available in DVB-T which provides added flexibility for the design of the network. For 2k and 4k modes, a short "in-depth" interleave is also introduced that leads to better tolerance against impulsive noise (helps to achieve a similar level of robustness to the 8k mode) [3].

Time slicing is another essential element of DVB-H [4]. It is the main technique used to achieve the required power savings which are not available in DVB-T. Due to the FEC (Forward Error Correction), which is used in the DVB-H system, the transmission is much easier in conditions of mobility and portability which can be unfavorable conditions. Depending on the current transmission scenario (multipath propagation, Doppler's shift) [5], the DVB-H system allows wide possibilities of parameter settings for the needs of requirements for service operator:

- 3 possibilities of modulation (QPSK, 16 QAM, 64 QAM)
- 4 possible channel bandwidth (8, 7, 6, 5) MHz
- 3 OFDM carrier modes 2k (1705), 4k (3409), 8k (6817)
- 5 different FEC rates (1/2, 2/3, 3/4, 5/6, 7/8)
- Hierarchical/non-hierarchical modulation
- 4 possibilities of guard interval (1/32, 1/16, 1/8, 1/4)
- Native/In-depth (In-Depth) interleaving.

The only purpose of interleaving is the removal of burst errors. These four blocks serve as FEC, providing transmission error protection [6, 7].

Methodology

Figure 1 shows the basic block diagram of the DVB-H coder and modulator. The first phase performs the forward error check applying Reed-Solomon coding in the coder at the level of MPE-FEC, and outer interleaving is carried out byte level, inner FEC, using a convolutional encoder with the possibility of puncturing and outer interleaving, acting on both bit as well as symbol levels through interleaving [8].

The structure of the demodulator and decoder has to be the one which performs the reverse task of encoder so the manufacturer does it by proper design of the end device i.e., the set-top boxes. The receiver has to also perform the synchronization and correction process over the received signal [9]. The application includes blocks of coder and modulator as they are in the block diagram. It also includes transmission channel simulator and blocks of demodulator and decoder of the received signal and using them the BER (before and after Viterbi decoding) and MER (Modulation Error Ratio) enumerations are carried out [10].

The various results are obtained by implementing the DVBH block diagram on random data. In the applied methodology, initially for a constant modulation method QPSK, the code rates of convolutional coders are changed. The results are noted, and the tables and graphs are prepared. After that using the same methodology, results are obtained for 16 QAM and 64 QAM, and tables and graphs are included.

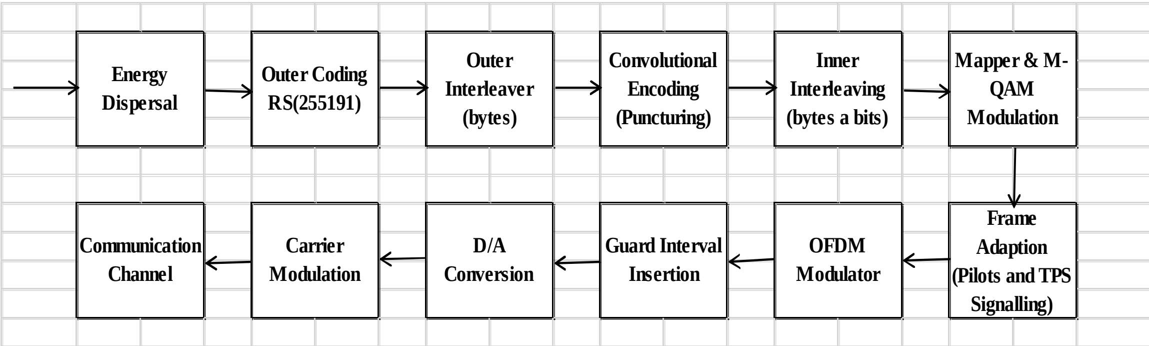

Figure 1. Block diagram of DVBH.

Every time the performance is measured on basis of the given signal to noise ratio and obtained BER—bit error rate.

Results Obtained for Applying DVB-H to Random Data with Different Modulation Techniques and Code Rates

The various results obtained by implementing the DVBH block diagram on random data are discussed in this section. Tables and graphs are included with modulation techniques like QPSK, 16 QAM and 64 QAM with convolutional coder rates 1/2, 2/3, and 3/4 are given. Tables 1 to 7 show the data of Es/No. with corresponding BER [1].

Table 1. QPSK rate 2/3.

EsN	BER	BER
10	1.342	1.342
11	0.982	0.982
12	0.1280	0.1280
13	0.097	9.7E-2
14	0.0051	5.1E-3
15	0.00221	2.21E-3
16	0.00087	8.7E-4
17	0.000066	6.6E-5
18	0.000026	2.6E-5
19	0.0000098	938E-6

Table 2. QPSK rate 1/2.

EsN	BER	BER
10	1.342	1.342
11	1.009	1.009
11.5	0.8856	0.8856
12	0.1280	0.1280
13	0.0098	9.8E-2
14	0.00070	4.58E-2
15	0.00032	9.8E-3
16	2.4e-3	7E-4
17	1e-3	3.2E-4
18	1.9e-4	1.9e-4
19	1.78e-5	1.78e-5

Table 3. 16 QAM rate 1/2.

EsN	BER	BER
10	1.342	1.342
11	0.9989	0.9989
12	0.1280	0.1280
13	0.00876	8.7E-3
14	0.00089	8.9E-4
15	0.00017	1.7E-4
16	0.000076	7.6E-5
17	0.000036	3.6E-5
18	0.0000098	9.8E-6
20	0.00000144	1.44E-6

Table 4. 16 QAM rate 2/3.

EsN	BER	BER
11	0.342	0.342
12	0.223	0.223
13	0.1280	0.1280
13.5	0.076	7.6E-2
14	0.0098	9.8E-3
15	0.00064	6.4E-4
16	0.00041	4.1E-4
17	0.00019	1.9E-4
18	0.00007	7E-5
20	0.000035	3.5E-5
21	0.00000675	6.75E-6
22	0.00000144	1.44E-6

Table 5. 64 QAM rate 3/4.

EsN	BER	BER
14	1.564	1.564
15	0.78	0.78
16	0.056	5.6E-2
17	0.0061	6.1E-3
18	0.00087	8.7E-4
19	0.00046	4.6E-4
20	0.0002	2E-4
21	0.000063	6.3E-5
22	0.000017	1.7E-5
23	0.0000047	4.7E-6
15	0.00000267	2.67E-6

Table 6. 64 QAM rate 1/2.

EsN	BER	BER
15	3.342	3.342
15.5	2.289	2.289
16	0.2280	0.2280
16.5	0.0890	8.9E-2
17	0.0078	7.8E-3
17.5	0.0054	5.4E-3
18	0.00091	9.1E-4
18.5	0.000024	2.4E-5
19	0.00000344	3.44E-6
20	0.00000221	2.221-6

Table 7. 64 QAM rate 2/3.

EsN	BER	BER
10	4.035	4.035
11	1.9098	1.9098
12	0.4576	0.4576
13	0.089	8.9E-2
14	0.056	5.6E-2
15	0.021	2.1E-2
16	3.4e-3	3.4E-3
17	5.46e-4	5.46E-4
18	3.55e-4	3.55E-4
19	7.8e-5	7.8E-5
20	1.22E-5	1.22E-5

For the Tables given, which consist of the values of BER for various Es/No., the graphs are plotted here. The curves obtained are the well-known ‘water fall’ curves.

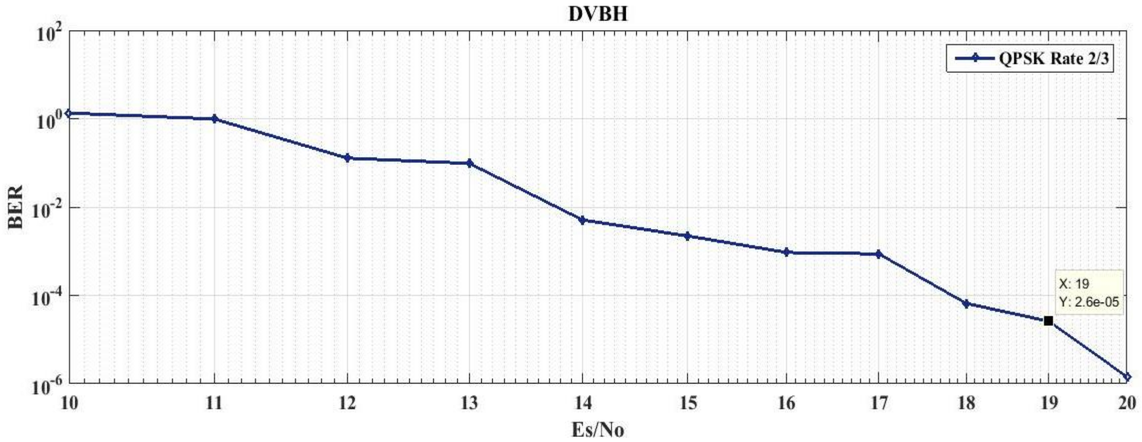

Figure 2. BER vs Es/No. for DVBH using QPSK code rate 2/3.

Figure 2 for DVBH using QPSK code rate 2/3, minimum BER 2.6e-05 is obtained for Es/No. equal to 19 dB.

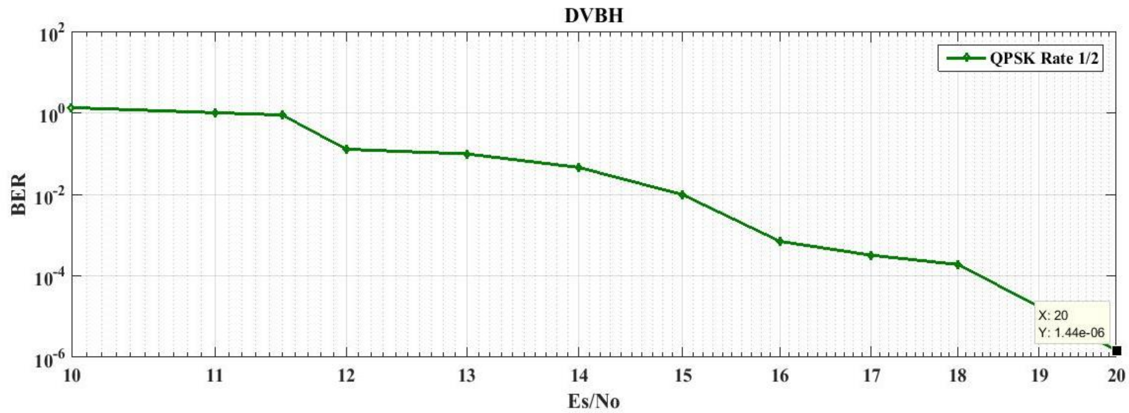

Figure 3. BER vs Es/No. for DVBH using QPSK code rate 1/2.

Figure 3 for DVBH using QPSK code rate 1/2, minimum BER 1.44e-06 is obtained for Es/No. equal to 20 dB.

Figure 4 for DVBH using 64 QAM code rate 2/3, minimum BER 1.22e-05 is obtained for Es/No. equal to 20 dB.

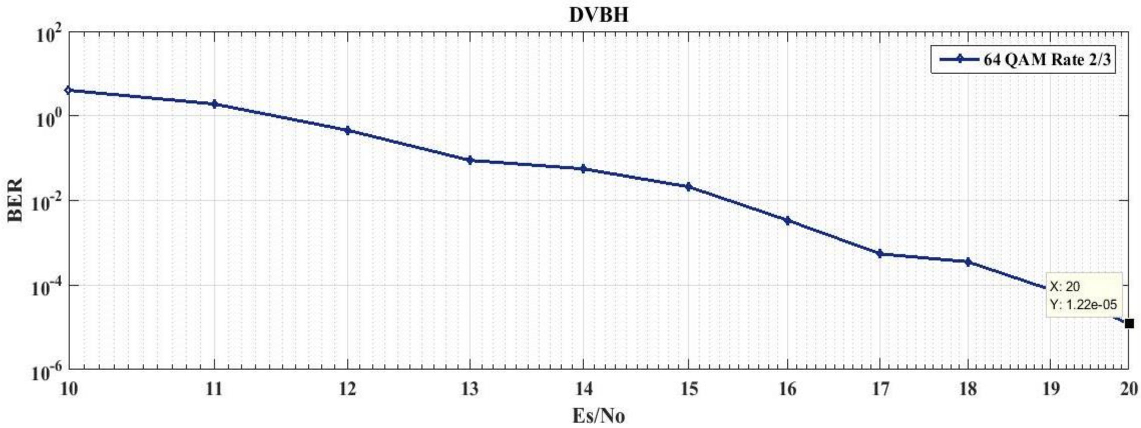

Figure 4. BER vs Es/No. for DVBH using 64 QAM code rate 2/3.

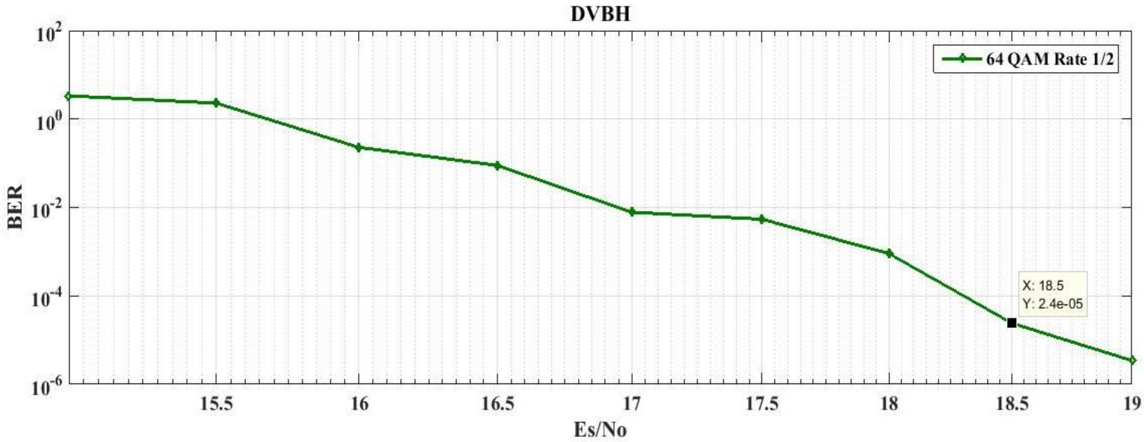

Figure 5. BER vs Es/No. for DVBH using 64 QAM-code rate 1/2.

Figure 5 for DVBH using 64 QAM code rate 1/2, minimum BER 2.4e-05 is obtained for Es/No. equal to 18.5 dB.

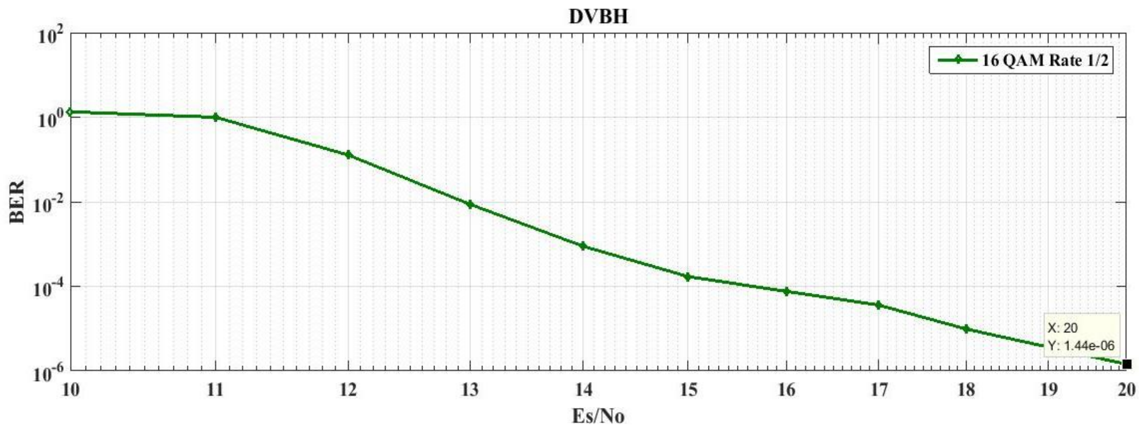

Figure 6. BER vs Es/No. for DVBH using 16 QAM code rate 1/2.

Figure 6 for DVBH using 16 QAM code rate 1/2, minimum BER 1.44e-06 is obtained for Es/No. equal to 20 dB.

Figure 7 for DVBH using 16 QAM code rate 2/3, minimum BER 6.75e-06 is obtained for Es/No. equal to 21 dB.

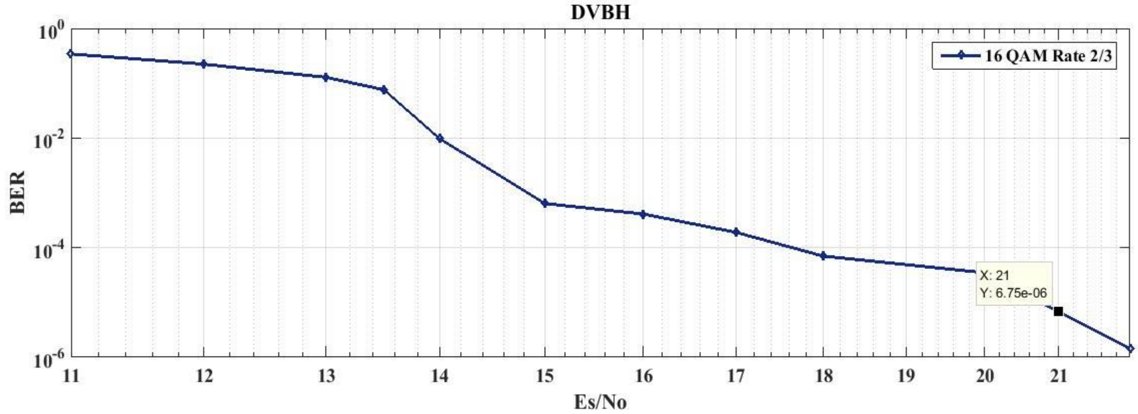

Figure 7. BER vs Es/No. for DVBH using 16 QAM code rate 2/3.

DVB-H—Various Modulation Schemes and Different Code Rates

The graph shown in Figure 8 is plotted for the DVB-H system using QPSK modulation method for various code rates and it can be observed that the best performance is obtained for 1/2 rate, and for 2/3 rate respectively, which means BER is minimum/least for the code rate 1/2 and increases when the value of ratio of the code rate decreases.

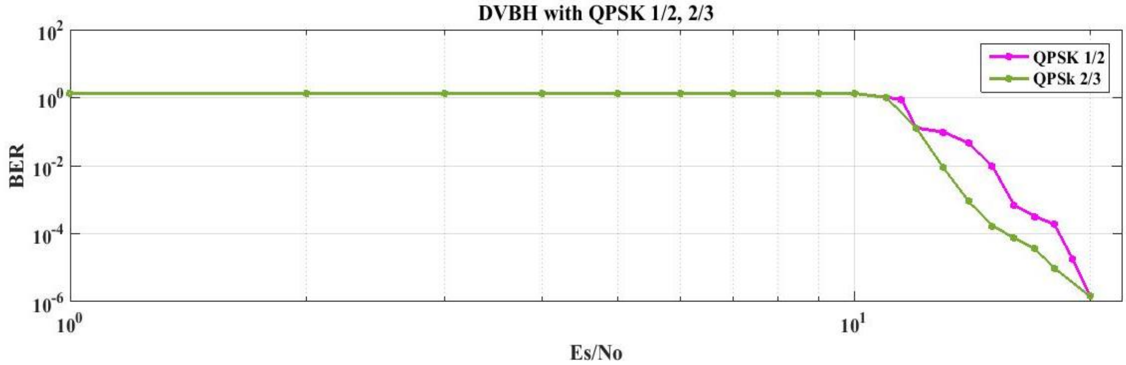

Figure 8. BER vs Es/No. for DVB-H using QPSK for various code rates like 1/2 and 2/3.

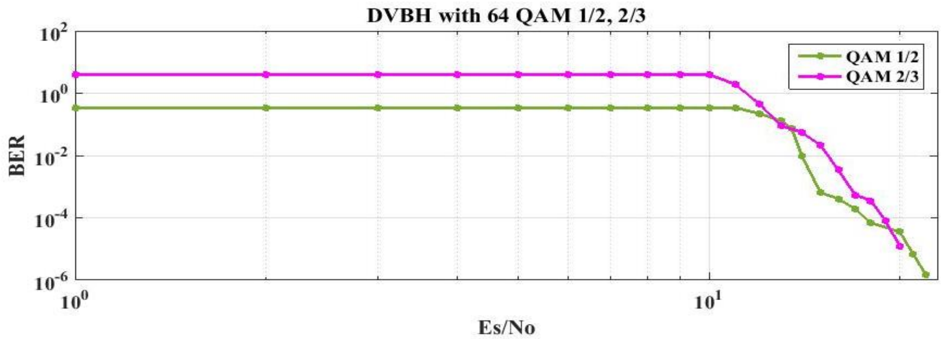

Figure 9. BER vs Es/No. for DVB-H using 64 QAM for various code rates like 1/2 and 2/3.

The graph shown in Figure 9 is plotted for the DVB-H system using 64 QAM modulation method for various code rates and it can be observed that the best performance is obtained for 1/2 rate and then for 2/3 rate respectively, which means BER is minimum/least for the code rate 1/2 and increases when the value of ratio of the code rate decreases.

The graph shown in Figure 10 is plotted for the DVB-H system using 16-QAM modulation method for various code rates and it can be observed that the best performance is obtained for 1/2 rate, then for

2/3 rate respectively, which means BER is minimum/least for the code rate 1/2 and increases when the value of ratio of the code rate decreases.

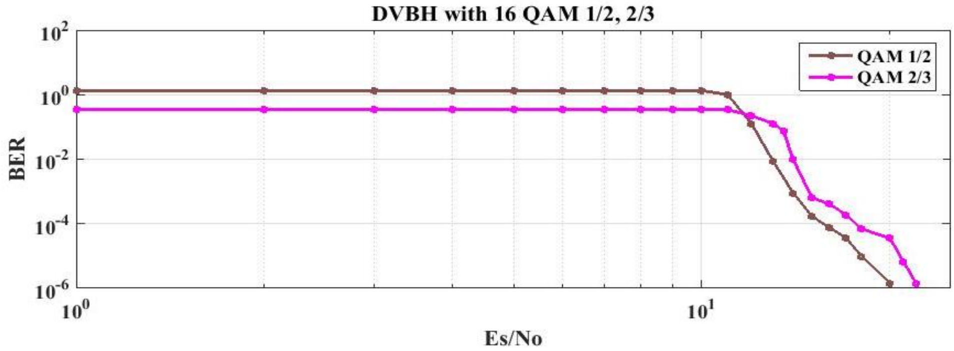

Figure 10. BER vs Es/No. for DVB-H using 16 QAM for various code rates like 1/2 and 2/3.

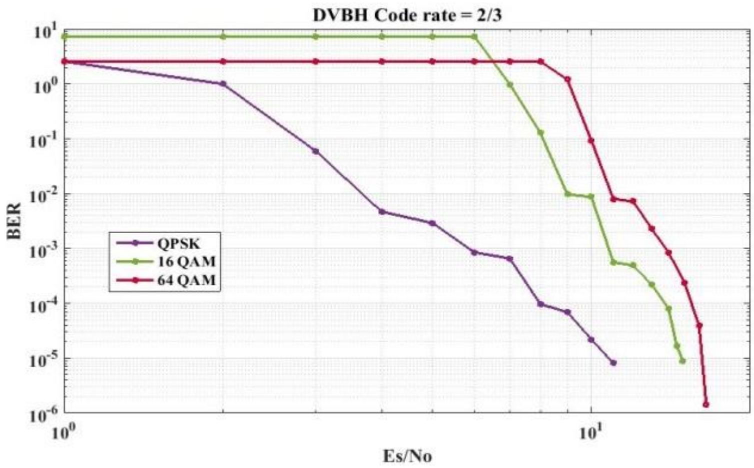

Figure 11. BER vs Es/No. for DVB-H using QPSK, 16 QAM, and 64 QAM code rate 2/3.

Figure 11 indicates a comparative graph which has been plotted for DVB-H system keeping the code rate constant at 2/3, various modulation schemes like QPSK, 16 QAM, and 64 QAM have been plotted. It can be observed from the plot that the results obtained are the best for QPSK, then 16 QAM, and 64 QAM.

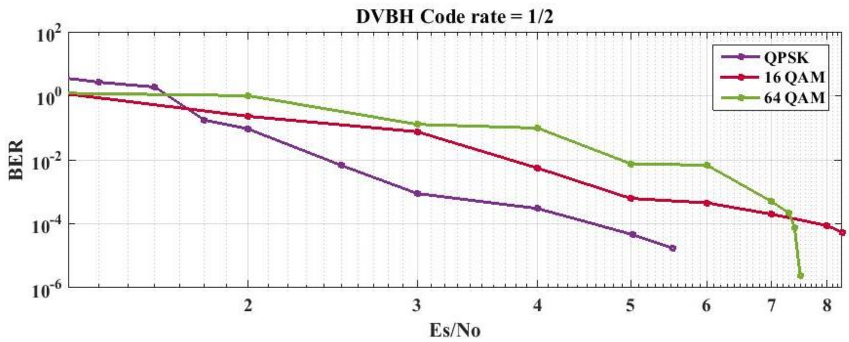

Figure 12. BER vs Es/No. for DVB-H using QPSK, 16 QAM, and 64 QAM code rate 1/2.

Figure 12 indicates a comparative graph which has been plotted for DVB-H system keeping the code rate constant at 1/2, various modulation schemes like QPSK, 16 QAM, and 64 QAM have been plotted. It can be observed from the plot that results obtained are the best for QPSK, then 16 QAM, and 64 QAM.

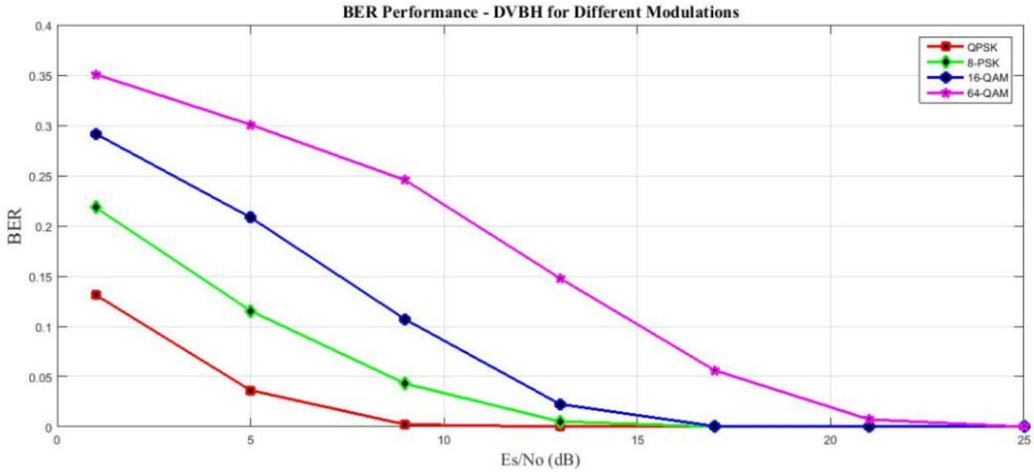

Figure 13. BER vs Es/No. for DVB-H using QPSK, 8 PSK, 16 QAM, and 64 QAM.

Figure 13 indicates a comparative graph which has been plotted for DVB-H system. Various modulation schemes like QPSK, 8 PSK, 16 QAM, and 64 QAM have been plotted. It can be observed from the plot that results obtained are the best for QPSK, then 8 PSK, then 16 QAM, and 64 QAM.

For reliable transmission in a poor signal reception scenario, an enhanced error-protection scheme on the link layer is introduced known as MPE-FEC (Multi-Protocol Encapsulation-Forward Error Correction) [11]. Not only that, the DVB-H standard features an additional network mode too, the 4K mode, offering additional flexibility in designing single-frequency networks (SFNs) which still is well suited for mobile reception and also provides an enhanced signaling channel for improving access to the various services.

CONCLUSION

Traditional broadcasting techniques are becoming outdated as the handheld devices like cell phones and PDAs are increasing in number and usage. So digital video broadcasting is undergoing a process of change as a consequence of the move towards an all-digital broadcasting environment. More programs, competition, and new distribution platforms mean that the television viewing experience will change. For television providers, the arrival of IPTV and the enhanced offering of cable and satellite providers have increased the competition from a unique competitive advantage—that of wireless mobility, the terrestrial platform is going to be benefited.

With DVBH results, it can be observed that the results obtained are the best for QPSK, then 8 PSK, then 16 QAM, and 64 QAM. Also, another major finding is that in the case of the convolutional coding applied, the result obtained is the best for rate 1/2, then for 2/3, and comparatively inferior for the rate 3/4.

The major issue in the hand-held devices is actually the battery life of the devices having the phenomenon of mobility. Also, the ideal spectrum available for the purpose of broadcasting in DVB-H would enable the broadcasters to retain a leading role while limiting their strengths into the provision of content.

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REFERENCES

1. Reimers UH. DVB-The Family of International Standards for Digital Video Broadcasting. Proc. IEEE. 2006; 94(1): 173–182.

2. Polak Ladislav. Simulation of the DVBH transmission in MATLAB. [Online] Available from https://www.fekt.vut.cz/conf/EEICT/archiv/sborniky/EEICT_2010_sbornik/03-Doktorske_projekty/01-Elektronika_a_komunikace/06-xpolak18.pdf.
3. Sneha Pandya, Charmy Patel. The DVB-H Standard: efficient energy utilizing standard compared to DVB-T2. International Journal of Research and Analytical Reviews (IJRAR). 2019; 6(2): 2019.
4. Masood F. A study on digital video broadcasting to a handheld device (DVB-H), operating in UHF band. Computing Research Repository—CORR. 2011.
5. James Clerk, Maxwell MA. A Treatise on Electricity and Magnetism. 3rd ed. Oxford: Clarendon; 1873.
6. Mobile Digital TV (DVB-H/SH) and 2nd Generation DVB Systems (DVB-S2/C2/T2). Laboratory Exercise [Online] Available from https://docplayer.net/21792262-Mobile-digital-tv-dvb-h-sh-and-2-nd-generation-dvb-systems-dvb-s2-c2-t2.html.
7. Kornfeld Michael, May Gunther. Broadcasting to handhelds, DVB factsheet. IEEE. 2007; 53(1): 161–170.
8. Kornfeld Michael, Reimers Ulrich. DVB-H—the emerging standard for mobile data communication. IEEE International Symposium on Consumer Electronics. Reading, UK. 2004, Sept 1–3.
9. Faria G, Henriksson JA, Stare E, et al. DVB-H: Digital broadcast services to handheld devices. Proc. IEEE. 2006; 94(1): 194–209.
10. European Telecommunications Standards Institute (ETSI). ETSI EN 302 304: 2004. Digital Video Broadcasting (DVB): Transmission System for Handheld Terminals. European Standard (Telecommunications Series) Sophia Antipolis Cedex – FRANCE. ETSI.
11. Borko A, Syed A. Handbook of Mobile Broadcasting, DVB-H, DMB, ISDB-T and MEDIAFLO. Boca Raton: Auerbach Publications; April 2008.

