Evaluation of Second Generation Digital Video Broadcasting

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Abstract

The techniques of video broadcasting are going through momentous changes. The purpose of this poster is to articulate and present some evaluation parameters of second generation digital video broadcasting that may lead to possible future improvements. Digital Terrestrial Television (DTT) is a digital technology that refers to the transmission and reception of video and audio information by means of digitally modulated signals. Contending alternatives of DTT technology are used around the globe and DTV broadcast standards vary in different parts of the world. In this poster, we are going to evaluate the insights of performance throughput and some core techniques of frame structure, coding and modulation scheme in DVB. This poster ponders on DTV-T2 standard. This will also enable us to compare with DTV-T, ISDB-T and other standards in terms of evaluated parameters.

The Digital Video Broadcasting Project (DVB) is an association of around 250 broadcasters, producer, network operators, software engineers, regulatory entities and development industries in over 35 countries designing open technical standards for the world wide need of digital video transmission.

The DVB consortium defined the second generation DVB or DVB T2 standard which is improvements of DVB-T that is an existing technology. The goal is to allow a better use of the spectral resources by integrating cutting edge signal processing technologies. It is evident which we will also explain later that for frequency bandwidth, the DVB-T2 bitrate is improved by 50%. Since the DVB-T2 is the extension of DVB-T[2], explanation of the basic architecture of DVB-T is shown below,

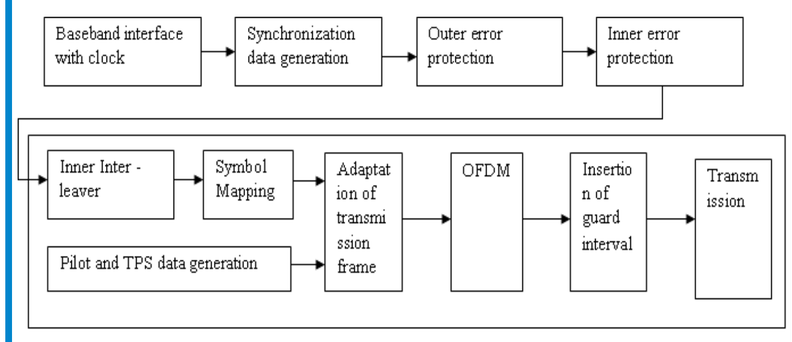

Figure 1: Basic architecture of DVB-T

The DVB-T signal uses Orthogonal Frequency Division Multiplex (OFDM) signal with any of 2k or 8k subcarriers. It depends on the operating mode. Here the symbols are mapped by symbol mapping/organizer and mapped into frames. Each DVB-T frame that is consisting of 68 OFDM symbols. In OFDM, a super-frame contains four frames that is taken to match the OFDM signaling with the framing for the error control coding for the system. Usually, the OFDM symbols carry data belonging to three different types. They are sequenced as, 1. The MPEG- 2 format video data stream, 2. The DVB-T TPS (transmission parameter signal) and 3. Pilots, which we will explain later.

Since the world of DVB is such an enormous field, evaluation is needed to understand the need for improvement, extensions and test for different features of second generation Digital Video Broadcasting to define the future of the technology.

Introduction

Developed in 2009, the second generation terrestrial transmission system, DVB T2 [4] allows simultaneous transmission of different and multiple DTT services in unique configuration with acceptable the quality of service. This scheme allows reception in both fixed reception and mobile devices. Reception mechanism for terrestrial handheld devices has been developed in DVB-H standard [3]. DVB-H is derived from the successful improvement of DVB-T standard for mobile signal reception.

To ensure that this technology compresses Digital AV (audio and video) in PLPs (physical layer pipes) to transmit by same OFDM used in DVB-T and also channel coding and interleaving offering more efficient data rate. The efficiency enable DVB-T2 to broadcast HDTV and even 3DTV on terrestrial channel. The basic system architecture of DVB-T2 is as follows,

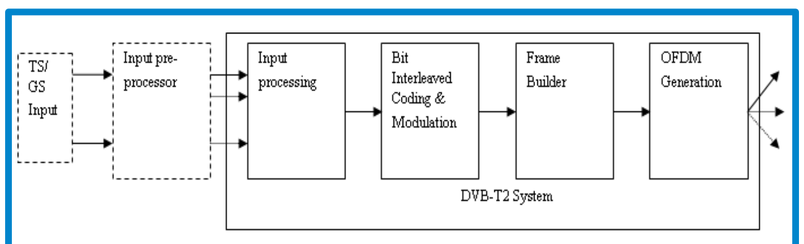

Figure 2: Basic architecture of DVB-T2

To evaluate the second generation of DVB, we will ponder upon system architecture and base features differences, frame structure of T2 and performance throughput of different standards.

Base features of DVB-T2

For both standards, DVB-T and DVB T2 employs Orthogonal Frequency Division Multiplex (OFDM) modulation. This results a solution space that include different numbers of carriers such as 1k, 2k, 4k, 8k, 16k, 32k, 16k extended, 32k extended and also modulation constellations like QPSK, 16 QAM, 64 QAM, 256QAM. For forward error correction, DVB T2 employs Low Density Parity Check (LDPC) and Bose-Chaudhuri-Hocquengham (BCH) coding technique. Another addition is Rotated Constellations[7] that has been employed to result robustness in output signal at receiver.

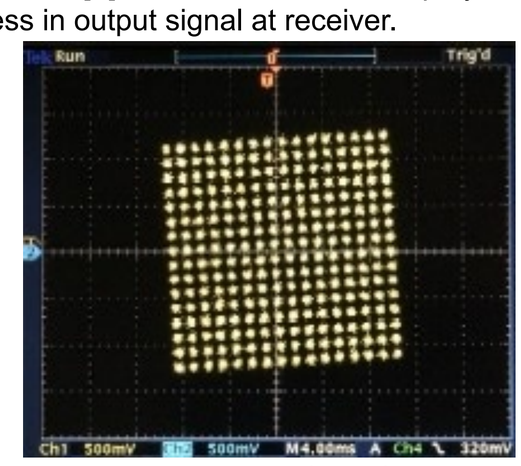

Figure3: Rotated constellation for 256 QAM at receiver

Moreover, Peak Average Power Ratio(PAPR) reduction has been used in DVB T2 to take care of transmitter devices to limit these peaks power without losing information.

DVB-T2 frame structure

Like DVB-S2, DVB T2 also employs the PLP or Physical Layer Pipe concept[4]. T2 Frames contains PLPs and a T2 Frame begins using preamble P1 and P2 in OFDM symbol modulation. The T2 framing structure is as below,

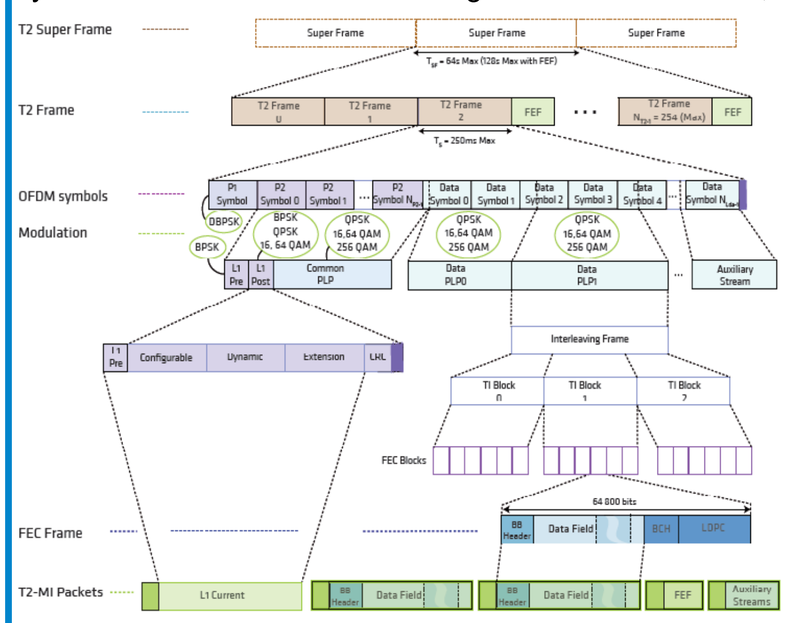

Figure 4: DVB-T2 framing

Then DVB-T2 encoder or gateway encapsulates data to BaseBand frames and then send to the DVB T2 modulator for interfacing.

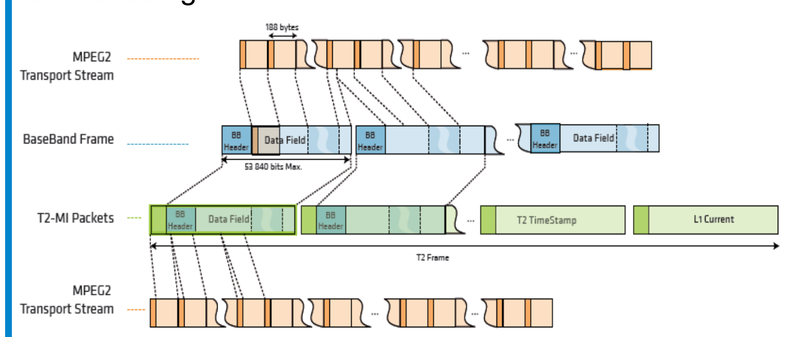

Figure 6: DVB-T2 modulator scheme

DVB-T2 comparison with DVB-T and ISDB-T

Compared to DVB-T, Code rate of DVB-T2 provides additional rates like 3/5 and 4/5. DVB-T2 has extra guard interval as 19/256, 19/128 and 1/128. Moreover additional FFT sizes are available such as 1K, 4K, 8K ext. 16k and 16K ext., 32K ext. Scattered pilots result also in 1%, 2% and 4% of total. Continual pilots are 0.35% of total. More options for Bandwidth are possible as 1.7 and 10 MHz and the Maximum bandwidth is 50.34 mbps where DVB-T supports only 31.66 Mbps. [5]

In addition, ITU-R BT.1877 shows DVB-T2 can deliver much greater net data rates than ISDB-T or DVB-T can in the same 8 MHz channel bandwidth.
With same transmitter power than either DVB-T or ISDB-T, DVB-T2 can deliver a net data rate 50% greater than what can be delivered via DVB-T and ISDB-T in the same 8 MHz channel bandwidth.

Generally, ISDB-T is neither the most advance technology, nor frequency efficient, affordable, interactive, nor more flexible, DVB-T2 poses a significant opportunity to leapfrog a technology generation for countries still to roll-out DTT networks.[4]. Moreover ISDB-T should also be modified to next generation considering the following demerits,
1. Supportable in 6 MHz .
2. Deployed only in Japan
3. Cost of STB is too high.

Moreover OFDM parameters and SFN implementation for next generation DTT technology is subject to investigation.

Data Throughput Performance: an Overview

DVB-T has a 2% data throughput performance edge on ISDB-T. The values of performance and corresponding parameters are given in the associated tables in the ITU-R BT.1306-4 documentation. [5]

$$C = B \log_2 (1 + S/R) \quad (1)$$

For Shannon limit for the DVB-T, ISDB-T and DVB-T2, we found that the standards also agrees with this argument indicating that DVB-T has a slight edge over ISDB-T and that DVB-T2 outperforms both with high degree. To calculate the upper limit using The Shannon formula shown in (1) above, the results are shown in figure below,

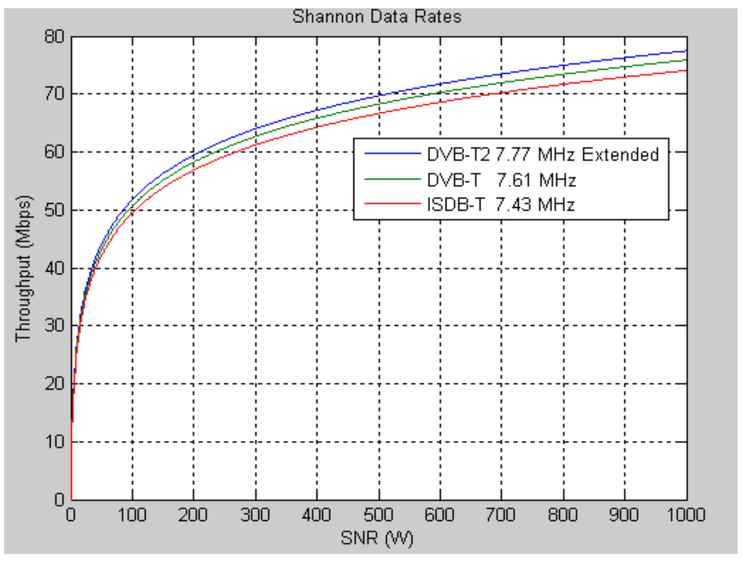

Figure 4: Shannon upper limit comparison between DVBT2, DVB-T and ISDB-T

Second generation DTT, DVB-T2 can be installed in much larger SFNs providing for far greater spectrum efficiency [6]. The advancement in DVB-T2 and feasibility to upgrade ISDB-T in such extent of advancement can also be investigated.

Conclusion

The opportunities and challenges of next generation Digital Video Broadcasting lies on the quality of service and implementation difficulties for various platform and also compatibility with different standard around the world. This study should bring the result of specification variation and implementation improvement for DVB-T2 from DVB-T or ISDB-T. The evaluation methodology of such standards should help future research works on next generation Digital Video Broadcasting standards to impact the world with a new dimension of service and quality.

References

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