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Performance Analysis of DVB-S2X over Satellite Channels

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Abstract

In order to address the growing demand of new television standards like HDTV, 3DTV, UHDTV, and higher data rates for satellite systems, the extension of DVB-S2, DVB-S2X, has been introduced. This standard introduces new MODCODs and new technologies permits to reach much higher bit-rate and to have a more reliable communication. In this paper, DVB-S2X features and the satellite channel impairments like the characteristic of the traveling wave tube amplifier (TWTA), Input Multiplexing (IMUX) and Output Multiplexing (OMUX) filters response are analyzed. Three models of satellite channel are presented which are: Direct to Home (DTH), Very Small Aperture Terminal (VSAT) and Digital Satellite News Gathering (DSNG). Performance of DVB-S2X in these channels is evaluated with the Packet Error Rate (PER) versus the PSAT =N0, and the spectral efficiency of every different MODCOD, comparing two different values of roll-offs: 20% and 5%. The simulation result show that roll-off factor of 20% is better in terms of error performance while 5% roll off is better in terms of bandwidth and spectral efficiency.

Keywords: *DVB-S2X, DTH, VSAT, DSNG, Satellite, Channels*

1. Introduction

There is growing demand of data hungry applications like HDTV, UHDTV and higher data rates for satellite systems. Within applications such as Contribution and IP trunking, the efficiency requirements are already testing the limits of the DVB-S2 standard. Satellite bandwidth is an expensive resource and network operators are challenged to make the best use of their limited, costly supply. DVB-S2X is latest industry standard in satellite broadcast and broadband communications and introduces more options in use of FEC, modulation and roll off factor compared to its predecessor. DVB-S2X finds applications in different fields like broadcast contributions, IP professional access, disaster recovery and news gathering.

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In order to study the performance of DVB-S2X in different satellite environments, DVB-S2X transmission system and satellite channel impairments are analyzed and three different satellite channel models: Direct to Home (DTH), Very Small Aperture Terminal (VSAT) and Digital Satellite News Gathering (DSNG) have been realized in MATLAB and evaluation is carried out in terms of error performance, bandwidth requirement and spectral efficiency.

2. DVB-S2X TRANSMISSION SYSTEM

DVB-S2X uses combination of BCH and LDPC coding same as DVB-S2 but introduces higher order modulations: 64APSK, 128APSK and 256APSK and more FEC options to add more granularity. It also includes very low SNR MODCODs to support mobile applications. New filter roll off factors 15%, 10% and 5% allow smaller carrier spacing and hence contribute for higher data rates. In order to accomplish signal transmission, Square Root Raised Cosine filter is used. For performance comparison, roll-off factors 20% and 5% is considered in simulation.

3. SATELLITE CHANNEL IMPAIRMENTS

AWGN channel model cannot precisely represent the satellite channels as there are some impairments that affect with linear and non-linear distortion the modulated signal, attenuation and phase noise, which must be taken into account in the simulations in order to have precise and realistic system performance. Basic satellite channel model is represented in figure 1.

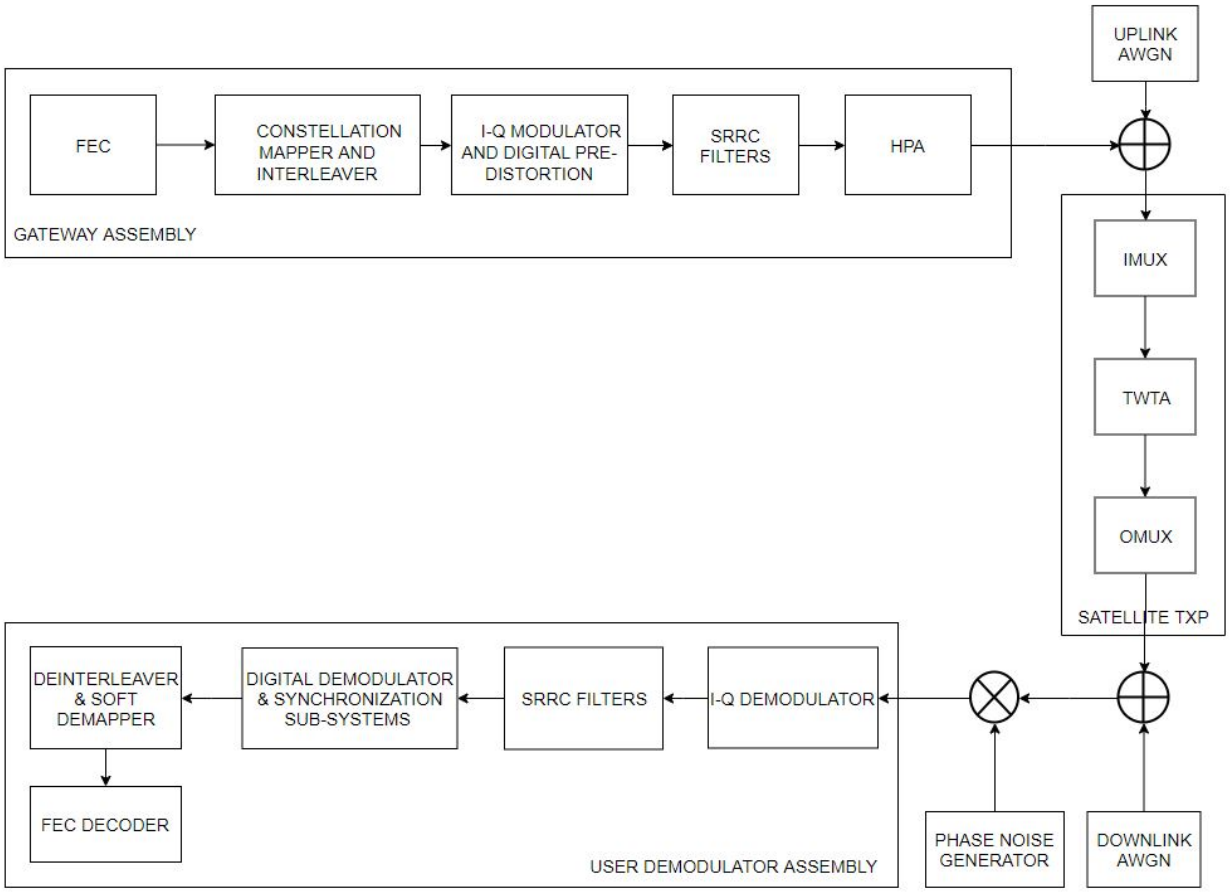
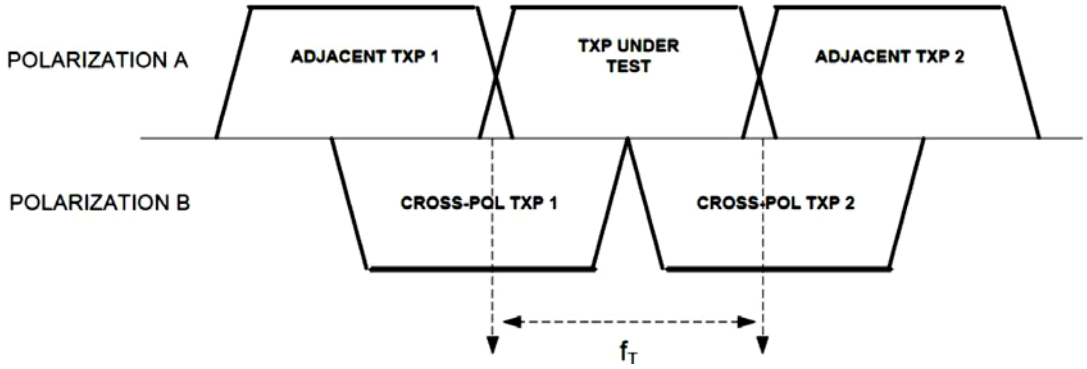


Figure 1. Basic Satellite Channel Scheme

The satellite transponder consists IMUX and OMUX filter, and the TWTA which allows the correct reception, the amplification, and the transmission of the radio signal. In the receiver side, phase noise introduced by non-ideal oscillator at the receiver and amplitude distortion is generated by coaxial system.

4. Satellite Channels and interference pattern

4.1 DTH



It is a broadcast scenario where Uplink signal is composed of three different signal from different Earth stations. In downlink the scheme presents mainly two contributions which are from the adjacent carriers and the cross-polar interference. The two adjacent carriers are realized by frequency shifting by the spacing frequency fT, and delayed for correlation reasons, like in the uplink segment. The Cross-Polar interference is due to the satellite antenna polarization discrimination, the depolarization due to the atmospheric channel and the terminal antenna polarization discrimination. The performance evaluation is accomplished focusing on two different outcomes, which are the PER and the spectral efficiency of the MODCODs versus the PSAT =N0 that allows the desired error threshold.

4.2 VSAT

Figure 2: DTH Interference Pattern

It is a multi-carrier scenario where six signals per transponder are considered. This corresponds to a situation in which there are multiple users that can for instance establish an IP connection. The downlink section is characterized by only the inter-beam interference. A non-correlated sequence is summed to the beam under test with frequency spacing.

4.3 DSNG

This is also a multi-carrier scenario with only two carriers per transponder. This setting is often used in news gathering that consists in point-to-point, or point-to-multipoint transmission with stable or moving Earth stations. In downlink there is an interference component given by the adjacent transponder, which has been delayed in order to introduce uncorrelation and shifted by a value according to the transponder spacing frequency. A cross-polar interference component is also taken into account.

5. Summary

Three different transmission scenarios were presented which are DTH, VSAT and DSNG, and the performance of DVB-S2X over such schemes were evaluated with different MODCODs and transmission settings. Simulation result show that roll-off 20% on the SRRC filter is always convenient in terms of PER, but in terms of spectral

efficiency the situation changes. As a matter of fact in a single carrier scenario like DTH, MODCODs spectral efficiency evaluated with roll-off = 20% is always higher with respect to the ones using = 5%. This is because the bandwidth allocation can be the equal for both roll-off values since the transponder amplifies only one signal. Conversely on a multi-carrier scenario, MODCODs using roll-off = 5% are more efficient as higher bandwidth is available with lower roll off factor.

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