CABLE TELEVISION (CATV) TO DIRECT TO HOME (DTH): CHALLENGES AND SOLUTIONS

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ABSTRACT

The world of communication is progressing everyday with enhanced multimedia services. Aim to DTH or Dish TV is to provide "studio quality picture at home". But, the authors, who are involved seriously in the spread of DTH services, are facing two major problems for the guaranteed DTH services. **Problem1** will highlight the real problem of alignment of a 0.5 meter dish antenna towards a Ku/Ka band satellite Transponder. The narrow beam width (2 to 3 degree) of such antenna and 4 to 7 db C/N ratios together make the alignment of such dish too critical. A new efficient technique of aligning Dish Antenna for DTH Satellite Reception has been experimented and suggested in this paper with the help of Spectrum Analyzer. The Procedure is based on received IF satellite spectrum in the range of 950-2050 MHz observed using spectrum analyzer. **Problem 2** will highlight the severe rain effects on DTH service**.** Rain has the effects of attenuation and scintillation of the radio waves propagating through it. The performance restoration even under heavy rain attenuation condition is relatively easy in comparison to rain scintillation. Several restoration techniques like adaptive power control (APC) of transmit power and/or receiver sensitivity controls through Automatic Gain Control (AGC) are tried for rain attenuation compensation. But best results are achieved towards rain scintillation restoration in a DTH receiver using Forward Error Correction (FEC) technique.

INTRODUCTION

A powerful Satellite NSS 6 is being used to uplink the DD DIRECT+ signal. Reception of the signal has been checked to be available throughout India. Salient features of the satellite are listed below: Orbit type: Geosynchronous Orbit allocation: 95°E. Service parameters of the bouquet of channels, which have been put into operation at present, are as follows:

Table 1 DTH Channel List

Transponder	Up/Down Pol.	Uplink freq. (MHZ)	Downlink freq. (MHZ)	Symbol Rate (MHZ)	FEC
C1 (36 MHz)	V/H	13778	12534	27.5	3/4
C3 (36 MHz)	H/V	13891	12647	27.5	3/4
C5 (36 MHz)	H/V	13973	12729	27.5	3/4

From these supplied data a spectrum of a DTH signal is theoretically computed and estimated. The Procedure is based on received IF satellite spectrum in the range of 950-2050 MHz which is generally available at the output of ODU (Outdoor Unit of DTH) on a Microwave spectrum analyzer as shown in Fig 1.

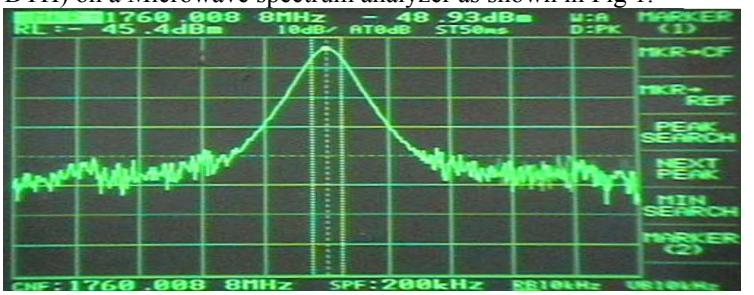

Fig 1 Ku Band spectrums of DTH received Signal as observed Spectrum Analyzer

FORWARD ERROR CORRECTION

A higher output power of a satellite signal has a beneficial effect on BER.. This is insufficient to achieve the required Bit Error Rate. If the satellite dish diameter has a given value & the BER turns out to be high. For example, a code rate of 3\4 indicates that the total data contains 25% error correction bits and 75% useful data. FEC VS C/N is shown below.

Table 2.Different FEC VS C/N for different types of DTH channels

FEC	C/N (dB)
1/2	4.1
2/3	5.8
3/4	6.8
5/6	7.8
7/8	8.4

Fig 2 shows a digital satellite channel having FEC = 7/8 so $(C/N)_{Th} > 8.4$ dB is required. So in the figure lower line channel having $(C/N)_{Th} < 8.4$ dB we can not see the picture on the TV set. Then by adjustment of the dish we can have $(C/N)_{Th} > 8.4$ dB as shown in the fig 6 upper line then we can see the picture on TV set.

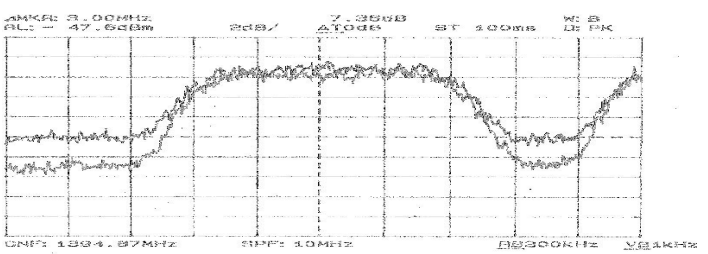

Fig 2 FEC level improvement for a satellite channel by observing the spectrum analyzer.

The bouquet spectrum of DTH is given in Fig 3 using Ku band, where 11510, 11550, 11630 and 11670 MHz are the bouquet-frequency bands. Each bouquet here consists of twelve channels.

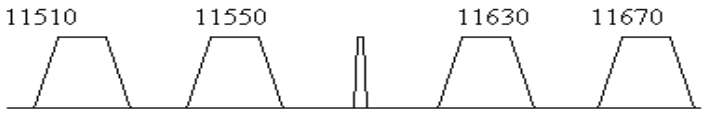

Fig 3.The total DTH spectrum in Ku band

Table 3 Calculation of IF for an typical Ku- Band (DTH) channel

Satellite	Channel name, RF frequency (f) & Polarization	Symbol Rate r_s (kbps) & FEC	IF=f – LO (MHz)	Elevation & Azimuth (Degree)
Insat 3B	Apnet 11575 & Horizontal (H)	2222 & 3/4	11575 –9750 =1825	62.5 & 192.6

Table 3 Satellite tracking parameters calculations

- Noise B.W. is calculated from the above data, using the relation

$B=(r_s/2)(1+\alpha)$ (α=0.35 for Satellite Reception), Hence B= (2222) /2(1+0.35) =. 675*2.222 = 1.481 MHz Double sided B.W. = 2* 1.481 = 2.92 MHz. This is used to recognize the actual signal.

- For this channel FEC =3/4 so $(C/N)_{th}$ = 6.8 dB (Available from Standard book)
- C/N Ratio Vs. IF frequency should be as follows

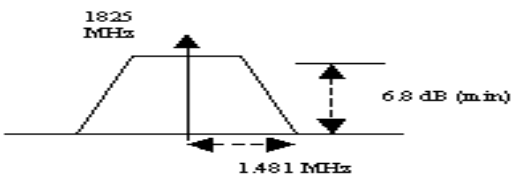

Fig 4. Ideal Spectrum for the channel having proper Bandwidth & C/N Ratio

So, during alignment, C/N ratio is to be monitored on spectrum analyzer & after getting the C/N values greater than this threshold limit, as shown in the Fig 4 we stop alignment of the antenna & tune the satellite Receiver & obtain the picture. The next Problem highlights the severe rain effects on DTH service. Dynamic Forward Error Correction (DFEC) technique is suggested for the solution of problem 2 for the restoration of performance in a DTH reception System during rain events. It is already noticed in a DTH receiver that the Forward AGC voltage of the receiver is directly proportional to the rain Intensity.

FIXED FEC IMPLEMENTATION IN AN EXISTING DVB(S) RECEIVING SYSTEM

The STV 0299B IC is used in our Digital Satellite Receiver and Set-top box. The schematic diagram of STV 0299B is shown in figure 5. A variety of configurations and behaviors can be selected through a bank of

control/configuration registers via an I^2C. The chip outputs MPEG Transport Stream and interfaces seamlessly to the packet demultiplex. Among the other control features, only the FEC schemes are described here in order to realize the working of the FEC blocks since the intention is to control the FEC to get better QoS.

VITERBI DECODER AND SYNCHRONIZATION

The convolution codes are generated by the polynomial Gx = 171 octets and Gy = 133 octets in modes DVB or DSS. The puncturing in Convolution codes allows us to produce codes of many different rates using just one simple hardware. The advantage of a punctured code is that the rates can be changed dynamically (through software) depending on the channel condition such as rain etc. For each enabled rate, the current error rate is compared to a programmable threshold. If it is greater than this threshold, another phase (or another rate) is tried until the right rate is obtained. The automatic rate research is only done through the enabled rates.

DYNAMIC FEC IMPLEMENTATION IN AN EXISTING DVB(S) RECEIVING SYSTEM

Presently, in the static FEC mode the control action to RF front end of the DTH system is taken by 32-bit microcontroller. We like to add a 8051 Microcontroller based I^2C Control after removing the I2C (Inter Integrated Control) control of the STV0299 from main microcontroller. The 8051 microcontroller will receive AGC voltage through a A/D Converter. Thus effectively the rain Intensity will be sensed by 8051 and with proper Calibration it will, in turn, control the different registers in the STV0299 I.C. and DEFC mode will be operated

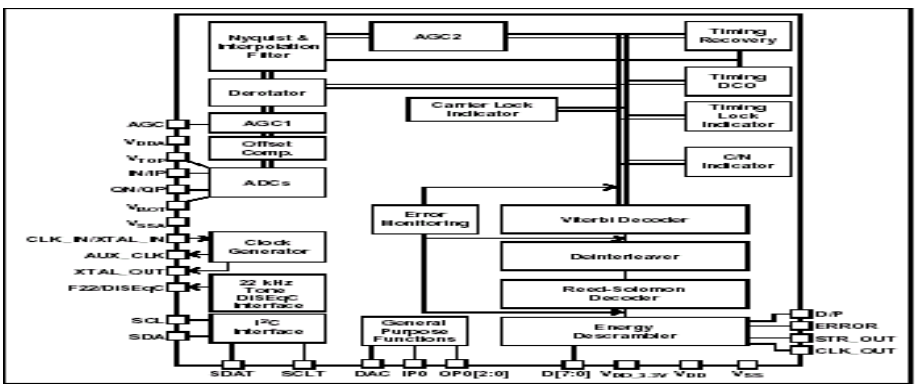

Fig 5: Internal Block Diagram of STV 0299B.

CONCLUSION

In near future Ka will be introduced in DVB-S path then the footprint will be narrower; so the alignment will be more critical. This technique will give a new horizon for future generation satellite tracking. The advantage of DTH over Cable Television is that better Qos by providing studio quality picture at home.