PRACTICAL ASPECTS OF HOME TELETEXT

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ABSTRACT

There have been many learned papers describing the detailed technical aspects of teletext transmission; most in language only understood by others with an intimate knowledge of the subject. This paper defines the requirements for the practical implementation of home teletext reception in the cable television environment.

Since data integrity is the measure of technical success, the items which effect data integrity are deliniated. Included are the satellite path, receive earth station, satellite receiver, cable modulators, AML link, and the cable plant itself. Results of various measurements and observations describing the effect of each subsystem have been made and the results will be described. Practical suggestions for achieving desired results in the most critical areas are presented.

INTRODUCTION

The first vertical interval transmission to the cable television industry was conducted at the NCTA Convention in Las Vegas in 1979. This demonstration, although only partially successfull, showed that data could be transmitted on the vertical blanking interval on a satellite signal. Since that date, knowledge has been obtained on the various parameters that affect successfull vertical blanking interval transmission to and through the cable environment.

During the last four years knowledge has been gained, various standards have evolved, equipment has been designed and services implemented using vertical blanking interval technology. Numerous degradation factors peculiar to satellite television transmission and to the cable environment have been identified. To offset these factors, error correcting techniques have been developed which give several orders of magnitude improvement in data integrity. With these improvements, home teletext is suitable not only for video display, but also for electronic mail and downloading of computer software and games.

HISTORY

It is generally acknowledged that the first commercial use of vertical blanking interval technology was by the British Broadcasting Company in Great Britain. The BBC Ceefax system which was designed specifically for the 625 line PAL television system in use in Great

Britain was not usable in the United States without significant change.

Two of the most significant differences are data rate and screen format. The 625 line system utilizes a data rate of 6.9375 Mbits/sec. which is faster than can be used in the NTSC system. The second difference is screen format. In the Ceefax system there is a fixed relation between the data byte's position in the transmit line and its position on the video display. In Great Britain, forty usable data bytes are transmitted on each vertical blanking interval line which correspond to a video screen format of forty character width. Depending on data rate, only 36 or 37 usable bytes can be transmitted in the NTSC system. In order to use a version of the Ceefax system in the United States these two parameters needed to be modified to fit the NTSC system. The basic incentive for using the Ceefax system is the availibility of LSI chips from several sources which make teletext decoders reliable and economically practical.

At the NCTA Convention in 1979, Southern Satellite Systems displayed a primitive implementation with a data rate of approximately 3.2 Mbits/sec using two vertical blanking interval lines for one display line. By late 1980 a data rate of 5.554 Mbits/sec was in use and the screen was formated with a 40 character by twenty row display. The mapping technique used was formulated by Mullard Labs.[1] In early 1983, the data rate was increased to 5.7272 Mbits/sec to be compatible with the proposed broadcast standard. At the same time, the video screen format was improved to allow the display of 24 rows of text instead of 20 rows.

CUSTOMER SERVICES

The initial services provided were the delivery of two news services to cable television headends. The equipment utilized was a video-in/video-out commercial quality teletext receiver. It was packaged in a rack mount chassis and specifically designed for direct interface to a satellite receiver. At this point in time, only problems inherent in satellite transmission and satellite receivers had been addressed.

Shortly thereafter a teletext transmission format was developed and a receiver designed featuring a data output rather than the video output. The initial purpose was to provide an interface between the vertical blanking interval and a character generator at a cable television headend. This provided the operator the opportunity to use his sophisticated character generator for both a national alphanumeric news channel and for local generated text or weather information. As is the case with the video output unit, the data output unit was packaged in a rack mount chassis with an interface specifically designed to interface with a satellite receiver. As may be noted, both of these units were designed for installation at a cable television headend or other commercial location where a baseband video signal was available.

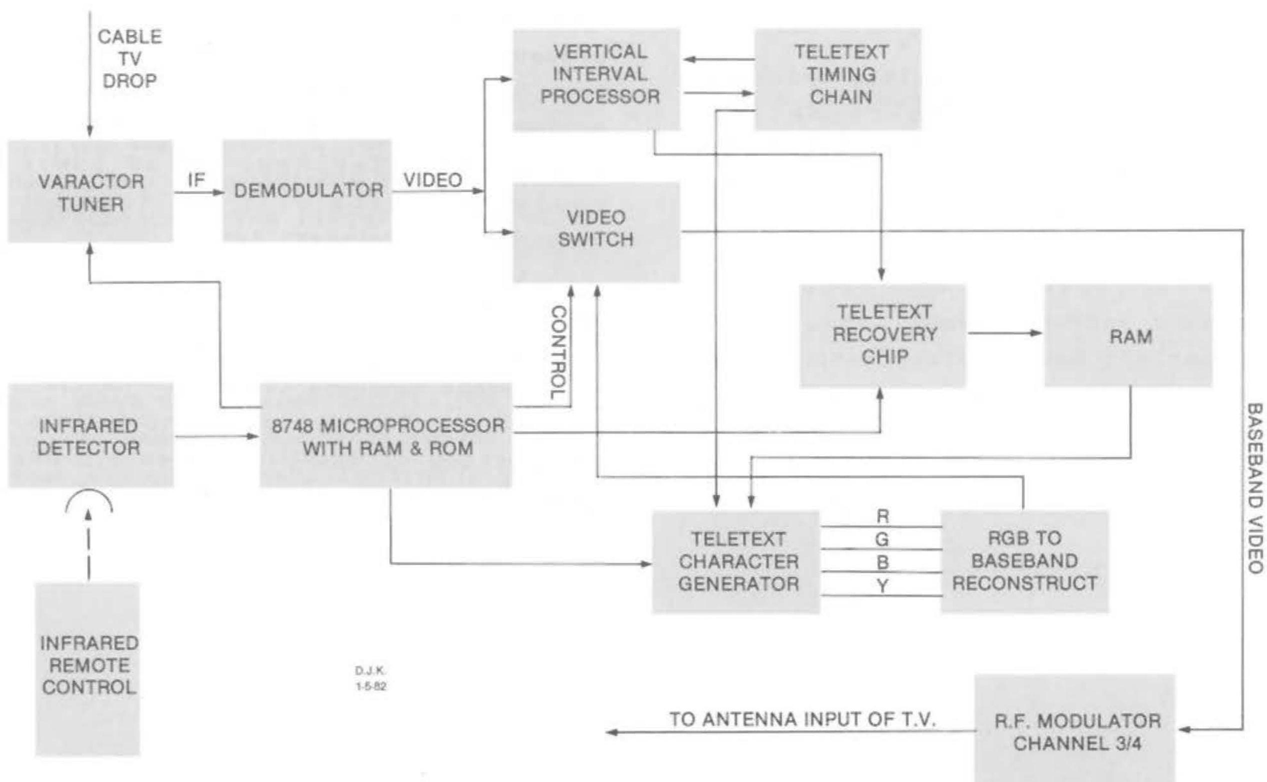
HOME TELETEXT

Recently Southern Satellite Systems has introduced Keyfax, a home teletext service. This service utilizes the United States proposed version of the BBC Ceefax standard which was proposed to the Federal Communications Commission.[2] The service features over one hundred video pages of text from which the viewer can select. This service is presently being transmitted on the vertical blanking interval of WTBS which is on SATCOM IIIR Transponder 6.

To implement this service, a set-top teletext decoder was necessary. The unit designed features a full cable television converter with infrared remote control and a built in teletext decoder. This unit can be used to replace existing converters in non-scrambled systems or as an add on unit where scrambling is used. A block diagram is shown in Figure 1.

As a companion to the above teletext decoder which has a typical Channel 3 or 4 output, a similar unit is being designed which has a standard RS232C data interface. This will be ideal for downloading information to printers and home computers. Its addressable funtion will allow specific users to get only the data to which they subscribe.

The data interface unit, combined with vertical blanking interval technology offers the ability to deliver one way data from a central point to thousands of locations simultaneously. This feature is particularly useful to the news services, commodity services, and financial information industries. It is presently being used by customers in these industries to deliver information to cable television headends and to home subscribers.



THE CABLE TELEVISION SYSTEM

There are numerous factors in the cable environment that effect teletext performance. At the headend, the earth station, satellite receiver, and the cable modulator all affect performance. In the cable plant, the AML microwave, the amplifiers, and the drops can also affect performance. Each item will be discussed separately.

1. Receive Earth Station

The quality of data received is directly proportional to the signal to noise performance of the receive earth station. A typical 3.6 meter with a 100 degree LNA in the central United States produced an error performance of 1 error in 10^6 bits transmitted. For some data applications this error rate may not be adequate. A larger receive dish would be necessary to lessen the number of bit errors. A 4.5 meter dish appears suitable for most applications.

2. Satellite Receivers

The quality of the satellite receiver can have a major effect on the performance of the teletext system. Of extreme importance is the IF bandwidth of the receiver. Tests indicate that a bandwidth of 30 mHz or greater is required for successful teletext operation. Some of the home quality receivers have an IF bandwidth of 25 mHz or lower; usually to improve apparant video threshold. The lower bandwidth will distort the data by limiting the frequency response of the system. This limiting will severely round the data pulses and cause both positive and negative overshoots in the data area. In one extreme case, the negative data overshoot exceeded 20 IRE units with the result being the television receiver's sync circuitry became erratic.

The test instrument required to measure and observe this effect is a full function waveform monitor, such as a Tektronics 1480. Alternately, a 50 mHz oscilloscope can be use if it features a television sync horizontal trigger.

For most purposes, most commercial quality satellite receivers that have been used in the cable industry over the last five years meet the 30 mHz requirement. However, due to cost pressure, several major manufacturers have been considering lower bandwidth products to be competitive with the home satellite offerings. These lower bandwidth units will not function properly on a teletext system.

A second effect inherent in the satellite receiver is video filtering. It is common practice today to incorporate bandpass filter on the video output which limits the band to 4.2 mHz. The portion of the band above 4.2 mHz contains the aural carrier at 6.8 mHz and most often numerous other subcarriers and/or noise. All receivers are equipped with either a 6.8 mHz notch filter or the low pass filter. However, those older receivers with only a 6.8 mHz filter will pass the energy of the additional subcarriers which will manifest itself as video noise. If an older receiver is to be used, an external low pass filter is recommended if the teletext decoding is to be accomplished at the cable television headend. For decoding on a cable system, the filter is not required as the modulator will provide the filtering.

3. Terrestrial Interference

One of the common problems that plauge many receive locations is interference from terrestrial microwave sources. Unless the interference is obnoxiously bad, it is frequently ignored. Unfortunately, with teletext it cannot be ingnored as it produces the same effect as if the system was operating at threshold. The best solution is shielding the receive dish from the interfering signal.

If shielding is not possible, filters are commercially available that have produced acceptable results in many applications. The filter is placed in the IF of the receiver and is either a 60 mHz or a 80 mHz center frequency filter, depending on whether the offending carrier is 10 mHz below or 10 mHz above the desired signal. The filter chosen needs to be optimized to remove just enough of the offending signal to provide optimum data reception. A filter with too deep a notch will cause as much degredation as no filter at all.

4. Modulators

The cable television modulator can damage the vertical blanking interval data. Fortunately, it is the adjustment of the modulator that is most often the problem, rather than the modulator itself. Of particular importance is preventing video overmodulation as well as maintaining the aural level at -15 to -19 db with respect to the main carrier. It is equally important to correctly maintain the aural level on the next adjacent lower carrier.

Modulators that do not have bandpass filters can allow harmonics to pass into the system. This is typical of the strip amp variety used in some older cable systems and most frequently used in apartment buildings, hotels, and other institutional systems. This type of installation frequently can be improved by adding filters or replacing the modulator being used for the channel carrying teletext.

5. Microwave Radio Systems

There have been no reported problems with FM microwave systems. The investigation of one reported problem with an AML system indicated the system was badly out of manufacturers tolerences. Numerous other operators have successfully passed the vertical blanking interval data over AML microwave systems. It can be concluded that a properly operating AML system will not affect teletext data.

6. The Cable Plant

A properly adjusted cable plant will correctly pass the vertical blanking interval. Typical problem areas are malfunctioning AGC amplifiers, DC power supplies with high AC ripple, and leaks in the cable system. The leakage is extremely significant for on-channel operation of off air signals with teletext. The leakage generates the same effect as multipath reflections, except the weaker signal is before the desired signal rather than after it. In some systems, channels 18 and 19 (E and F) are susceptible to two-way radio interference. This interference will destroy the integrity of teletext data.

A third cable plant problem is that of poor drops. This may be due to inadequate levels: teletext reliability is enhanced with a strong drop signal, typically between 5 and 10 dbmv. Installations subjected to high levels of RFI may also be unreliable.

It has been observed in conventional cable plants that certain channels are cleaner than others. This is generally a function of the many combinations that result from the addition and subtraction of the carriers and their harmonics. A spectrum analyzer is generally required to track this phenomena, however changing to a different channel is often easier and may solve the problem.

7. Test Equipment

The equipment used to test a cable plant can have an adverse effect on teletext performance. Of particular importance is the high level sweep equipment used on many systems. This type of sweep equipment will completely destroy teletext integrity. The newer low level sweep techniques can coexist with teletext data, however some degradation has been observed.

8. System Maintenance

It has been observed that proper maintenance and adjustment of the system is critical if low error rates are expected. Of critical importance is maintaining the proper levels between satellite receiver and modulator, and the correct modulation levels for both the video and aural level of all channels. It is common to find improper levels due to either misadjustment or subsequent unterminated or double terminated equipment. Care in headend setup and maintenance is mandatory for success in teletext transmission.

ERROR PERFORMANCE AND IMPROVEMENTS

Several techniques have been developed to improve the data integrity. The basic code structure provides for parity checks on all data bytes. The address codes are further protected by Hamming codes. This is a code where a single bit error in a byte will be corrected and a double error will be corrected. These methods are in current use.

For certain data a method of multiple transmission has been developed. For the video type of teletext unit, the second transmission overwrites the original transmission; however if a parity error is detected in any given byte, the byte from the first transmission is left on the display. This technique gave a significant improvement in data integrity and is used for critical transmissions.

The same technique has been used for the data output teletext unit. A control code is transmitted which tells the decoder whether it is receiving the first or second transmission of the identical data. Test have shown that this technique generates 100 times improvement in data integrity.

Another technique usable on the data output type decoders is that of longitudinal parity check or LPC. In this technique, a byte is transmitted at the end of each vertical blanking interval line which is the result of calculating parity on a bit by bit basis. From the LPC byte a single byte error can be corrected in any given vertical blanking interval line. The improvement is almost as good as the multiple transmission method when basic error rates of less than 1 x 106 exist. This improvement diminishes for worse error rates and improves at better error rates. Of significant importance is the added overhead is only 3% rather than the 2:1 overhead in the multiple transmission technique.

CONCLUSIONS

The use of the vertical blanking interval for delivery of information to the cable television headend and to the homeowner is now feasible and practical. Reliable equipment is available at reasonable costs. A well maintained cable system will be able to pass the vertical blanking interval information successfully. Small changes in other systems may be required, most often in the maintenance practices.

REFERENCES

1. G. O. Crowther, TELETEXT AND VIEWDATA SYSTEMS AND THEIR POSSIBLE EXTENSION TO EUROPE AND USA, IEEE Transactions on Consumer Electronics, July 1979 Volume CE-25 Number 3.

2. United Kingdom Teletext Industry Group Petition for Rulemaking before the Federal Communications Commission, March 26, 1981.