COEXISTENCE OF ANALOG AND DIGITAL VIDEO

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Abstract

The coming introduction of compressed digital video delivery systems has caused many industry watchers to question the viability of alternate forms of signal security, including converter/descramblers and interdiction products. Some suppliers have backed off from plans to deliver new analog control systems to the industry, choosing instead to focus on digital delivery systems to support their business for the next several years.

This presentation will focus on the relationship between digital video and analog services. It will propose a scenario by which the two technologies may coexist on a network, making the new technology available to those subscribers willing to pay for new services, while keeping capital investment low for more cost-sensitive subs. The report will concentrate on the next five to ten years and how the new technology may be phased in over time instead of immediately dominating the market.

INTRODUCTION

Digital Video Compression for standard NTSC and High Definition Television (HDTV) has received a great deal of attention over the last few years. Subscriber service control and compatibility with consumer electronics are major issues to be considered for a new technology to be successful. As efforts progress towards making digital compression practical, issues such as compatibility with existing analog channels and consumer friendliness become ever more important. One of the major issues today with the analog converter is its inability to interface with consumer electronics like VCR and TV in a friendly manner. Since video compression is likely to result in some form of converter, we are looking at the possibility of compromising customer friendliness for more channels and more features. This article will propose a method for dealing with these issues.

AVAILABLE TECHNOLOGIES FOR SUBSCRIBER SERVICE CONTROL

Today subscriber service control exists in several forms. All of them share the same delivery system using analog channels on the cable. Existing service control systems fall into one of two major categories, either IN Premise (mostly cable converters) or OFF PREMISE (mostly traps). In either case, service control is either manual or addressable. Addressable converter-based systems offer flexibility at the cost of consumer (electronics) friendliness; theft of service prevention; and (in)accessibility of converter at customer's residence. Trap-based systems offer friendliness at the cost of flexibility; most trap systems are not addressable and are not easily adaptable to cable system growth in number of channels or channel reassignments. Traps, however, are transparent to analog and digital video channels. Subscribers interested in receiving enhanced services may be provided digital de-compression converters to augment their existing analog service.

NEW TECHNOLOGIES

Two new technologies that are receiving a great deal of attention in the recent days are the INTERDICTION and DIGITAL COMPRESSION SYSTEMS.

Interdiction systems are at a point where immediate market introduction is possible. Digital compression systems are at final stages of laboratory evaluation. At first sight interdiction and digital compression seem to be mutually exclusive technologies; however, a careful examination will show the merit of the combined technologies in offering the most flexible and consumer-friendly interface.

INTERDICTION TECHNOLOGY

Interdiction technology is typically employed outside the subscriber's residence - either on the pole or on the side of the house. In either case service control is accomplished by using frequency agile jamming sources in combination with subscriber drop switch under headend control. Interdiction devices, when used on the pole as tap replacement devices, can act as "active taps" resulting in longer reach or better signal quality or both.[1] The "active tap" configuration also makes bandwidth extension of the cable systems easier to realize and improves operational reliability by reducing the number of cascaded amplifiers. Interdiction offers both consumer friendliness and operator friendliness. It is transparent to digital signal delivery. Figure 1 shows an implementation of an Interdiction System.

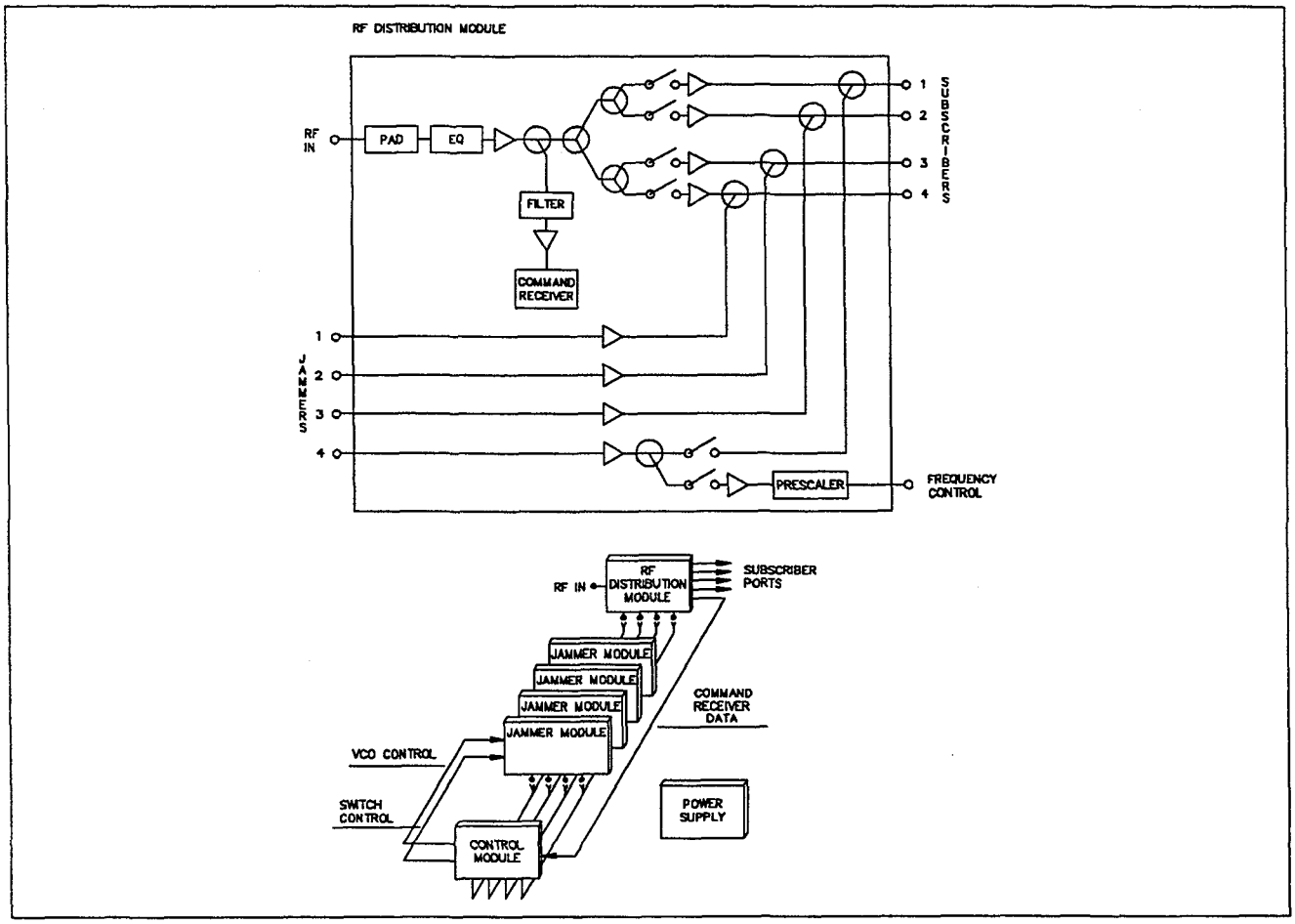

Figure 1.
Interdiction System

DIGITAL COMPRESSION TECHNOLOGY

Digital compression is accomplished in two ways. Source coding reducing the amount of information required to describe a video sequence by reducing or even suppressing both temporal (picture-to-picture) and spatial (horizontal sample-to-sample and vertical line-to-line) redundancies. Channel coding involves adding error correcting codes and a digital-modulation subsystem (e.g., QAM).[2] The digital coding and modulation techniques offer, in addition to increased channel capacity, the ability to transmit clean images with a lower carrier to noise than is practical with analog delivery. This allows carrier levels to be lower, stretching the reach of the distribution system.

The spectral efficiency of digital compression will depend on the desired quality of the received signal. In any case, multiple channel delivery at a single NTSC channel space is possible.

APPLICATION FOR COMPRESSION

For expanding the revenue stream, compression can offer expanded pay-per-view like near-video-on-demand; it will also offer HDTV signals when a commercial market develops for such signals.

Digital compression offers the ability to greatly increase the channel capacity of cable television systems. This provides an opportunity to add revenue-increasing services such as extend pay-per-view and near-video-on-demand. This will give system operators a chance to claim a portion of the revenues that are presently going to videotape rental stores.

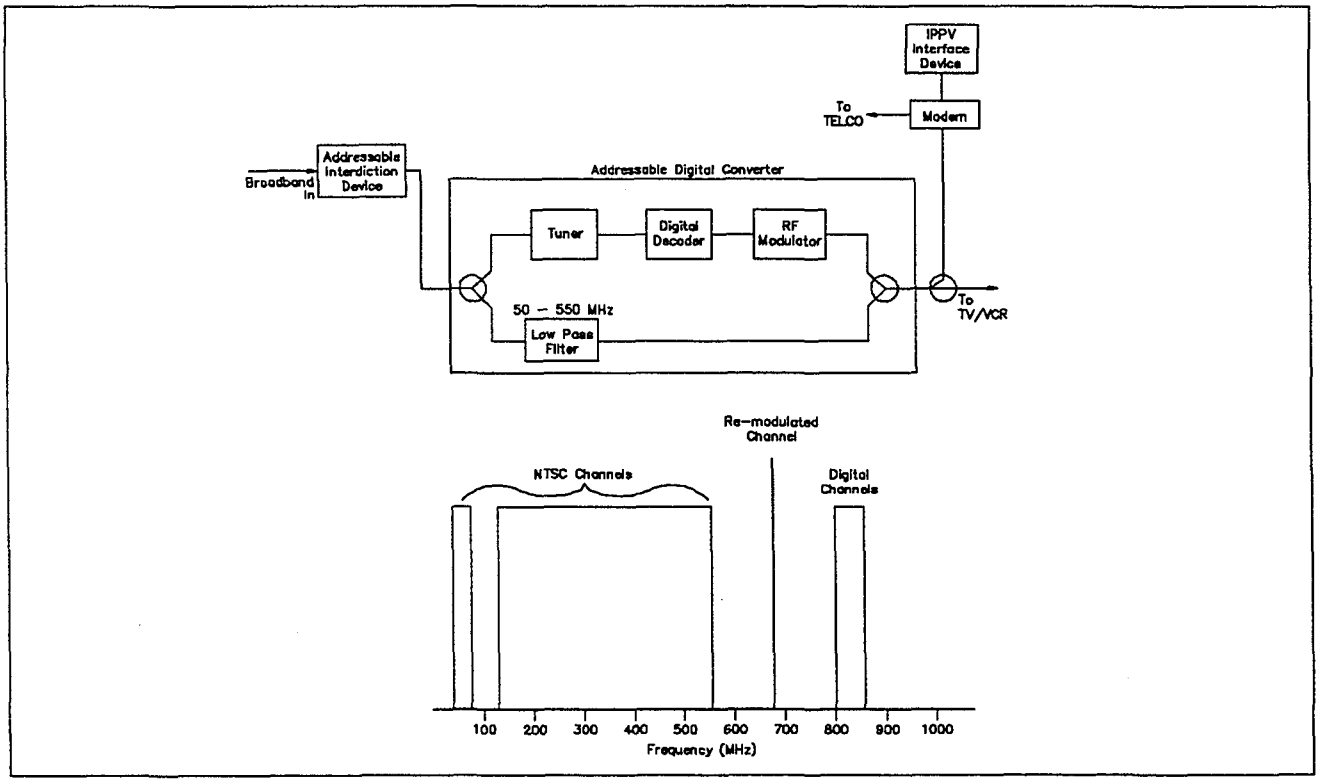

Figure 2.
Concept Digital Converter: Block Diagram

WHAT COMPRESSION WON'T DO

In the foreseeable future, compression cannot replace most of the current cable channels that are NTSC compatible. This is due to the fact that the compression technology is not capable of displacing millions of NTSC compatible television receivers and VCRs that have already found their place in households and are continuing to have an excellent market.

COEXISTING ANALOG AND DIGITAL VIDEO CHANNELS

With a clear picture on what compression can and cannot do, it is easy to see that cable will carry a significant number of NTSC compatible channels along with digitally compressed and HDTV signals. The proportion of NTSC to digital channels will depend on available cable bandwidth and compression yield along with other considerations such as the desired programming scenario. It is likely that in most cases the analog channels will remain between fifty and sixty channels while the number of digitally-compressed channels will keep increasing with increased bandwidth, penetration of near-video-on-demand and higher compression yields possible from technologies that continue to evolve. If we continue on the premise of consumer friendliness and near-video-on-demand using digital compression, then we have a scheme where the consumer continues to buy the analog channels that he is used to and adds to the revenue stream by purchasing programs using near-video-on-demand. If we treat near-video-on-demand as an event or a program and not a channel, we can arrive at the following scheme to provide consumer friendliness without compromising operator revenue and flexibility.

THE "UN-CONVERTER" CONCEPT

Figure 2 shows a concept digital converter (the "un-converter") working with an interdiction unit to provide the customer friendliness. The off-premise interdiction unit provides control for analog NTSC channels and subscriber drop control. The digital converter consists of tuner-decoder combination to tune and descramble the desire digitally-compressed channel. After decompression, the baseband output of the converter is modulated to a channel at a frequency higher than any NTSC channel on the cable. The output frequency of the converter can overlap the digital channels as a low pass filter can be used to pass analog channels and remove the digital channels. An analog version of this type of converter was previously proposed.[4]

In its base form, the "un-converter" has no user controls. It is controlled completely through the addressable data stream received from the access control system. This allows the decoder to be removed from the set-top and placed out of sight, behind the set, in the basement, or even outside. It is even possible that eventually the decoder and the interdiction device will co-exist in a common enclosure.[3]

As the analog channels are controlled by the interdiction unit, the consumer electronic interface is handled by the subscriber's own cable-ready TV and VCR. This "un-converter" concept does not compromise the cable operator's flexibility and can add to his revenue stream. The subscriber always gets the channels he is authorized for in the clear and whenever he purchases a program, it is added to his channel line-up always at the same frequency.

A typical interface the consumer needs for program control is simply a telephone modem with a remote control or better yet, just a touch-tone telephone. In normal operation, the special services channel displays information about the services that are available (what movies are playing and when they start). This channel could also contain previews of the current features. The subscriber orders a movie by placing a telephone call. The order is logged and verified via ANI

and/or ARU (Automated Response Unit) processing. The access control system then authorizes the decoder to receive the next available showing of the requested movie. This prompts the decoder to tune to the appropriate RF signal, decode the appropriate video service, and modulate it onto the output channel. The delay experienced between buying a movie and having it start is minimized by running multiple copies of a movie with staggered start times.

CONCLUSION

Digital compression technology will open the door to new revenue streams, but will not eliminate the need for distribution and control of analog signals in the near future. There will continue to be a strong demand for user-friendly means of providing secure service to the millions of television sets currently connected to cable. The combination of interdiction for control of the analog signals and the "un-converter" approach for delivery of digital services provides a cost-effective, user-friendly way to tap the potential of digital compression technology.

REFERENCES

[1]James A. Chiddix and Jay A. Vaughan "Upgrading Coaxial Distribution Networks with Amplified Taps: Exploring a Reliable Cost-Effective Approach to GigaHertz CATV Plant," *NCTA '91 Technical Papers*, 1991.

[2]M. Haghiri, "Digital TV Systems: A Tantalizing Perspective?," *Philips Research Bulletin on Systems & Software*, No. 4, July 1991.

[3]Walter S. Ciciora, "Scenarios for Compressed Video in Cable Practice," *NCTA '91 Technical Papers*, 1991.

[4]T. Martin, "The RF Bypass Converter: An Alternative Broadband Delivery Mechanism," *NCTA '91 Technical Papers*, 1991.