LONG TERM COMPATIBILITY

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Abstract

Today's television receivers and VCRs tune the cable spectrum, however some consumers experience problems when connected to cable systems. The set-top decoder, when connected to a television receiver, reduces the functionality of a television receiver to a monitor, disabling most of the television convenience features. Despite the availability of other alternatives, for cable operators the technology of choice for tuning access, subscriber denial and control is the set-top addressable decoder. As television technology becomes more sophisticated the loss of these features creates frustration and anger with consumers. Congress responded to this frustration, as well as perceptions about cable operators, and the Cable Act of 1992 resulted. We shall review the history, causes, legislation and what can be done long term to alleviate this problem.

Cable History

Cable television originated in the rural areas of Pennsylvania, where mountains interfered with reception of terrestrial TV signals. In 1948, an enterprising appliance retailer built an antenna tower on a mountaintop, ran cable to his appliance store, and set a TV in his window. Residents nearby purchased TV sets and required cable from his store to their homes for reception.

Today, over 98% of television households are passed by cable and 65% of them are connected to cable.

FCC involvement in cable began in 1965, requiring cable systems to carry all local television stations. The FCC also prohibited duplication of local signals by importing signals from another city, and importation of distant signals into the top 100 markets. This latter prohibition was rescinded in 1972.

The 1975 launch of SATCOM I into a geostationary orbit offered a cost effective way for programmers to distribute software to cable operators. Later that year HBO initiated a premium pay movie service that was distributed nationwide to cable operators. Cable has evolved from simple delivery of terrestrial signals to remote areas to the dominant provider for television viewing. Today, there are over 90 different program providers offering choices for every taste.

Technology Developments

Tuning Access

The rapid expansion of cable programming choices quickly exceeded the tuning capacity of television receivers then on the market. Television tuners initially tuned only the VHF band, then after the FCC mandated all-channel tuning, UHF. These terrestrial channels

occupy discontinuous portions of the RF spectrum. Cable operators placed additional programming on channels in the gaps of the VHF spectrum, effectively adding channel capacity. Operators used RF block converters to translate these channels into portions of the RF spectrum that television receivers could tune.

These block converters served several purposes: additional programming was available despite television tuner limitations; reception of programming was denied to unauthorized viewers; DPU (direct-pick-up) problems were reduced when co-channel interference was present.

However, television tuner technology was evolving as well. Electronic tuners replaced mechanical tuners and the tuning range of tuners was easily extended to cover the "holes" in the VHF and UHF spectrum. Thus was born the "cable compatible" television receiver, to which the cable service could be connected directly without the apparent need for a set-top box.

Signal Denial

Cable-compatible tuning solved one problem, but created another problem. The extended tuning range of receivers, without the need for block converters, eliminated the means of denying signals to unauthorized viewers. It was necessary to use other techniques for signal denial. One method was the use of "traps" (RF filters) to prevent desired signals from entering the home. Traps are designed to filter out a single channel or a band of channels.

Traps are physically installed between the pole and the user's home. This was satisfactory for a time. However, as programming choices continued to expand, consumer interest became more volatile. This required frequent truck runs to physically change traps and an increasing operational expense for cable systems.

Control

The operational expense of physically changing traps became the impetus for a different technology. What was needed was technology that allowed control by remote authorization. The solution was the addressable converter. The basic technique attenuates the synch signal, confusing the television receiver signal processing circuits, which are unable to separate the synch signal from video. The resulting video is scrambled and not viewable.

The set-top cable hardware technology employed for control and denial is not designed to any industry standard. Each vendor has proprietary technology and there is little interchangeability among suppliers. This lack of a single standard allows innovation and serves to inhibit piracy because of no single target.

Control is achieved by sending a parallel signal, out-of-band or in-band, containing information which allows restoration of the synch signal. Using this technique, individual channels can be scrambled or unscrambled remotely from the system headend. Operationally, this was a success and initially met with user acceptance.

Television Developments

At first, cable customers welcomed the set-top addressable converters. The set-

tops brought new programming choices and convenience: remote control tuning, volume control and mute. In the 1970's and early 1980's remote control was available only in high end television receivers. These features represented retail increments of $100 to $150, the perceived value was high and the box was welcome at a small monthly rental fee.

However, the consumer electronics industry is dynamic, innovative and continually driving down costs with new technology. Remote control, cable compatible tuning, other features such as picture-in-picture, originally in high end models, were driven down into the product line, with smaller and smaller retail cost increments. By the 1990's remote control was already in 90% of 13 inch receivers.

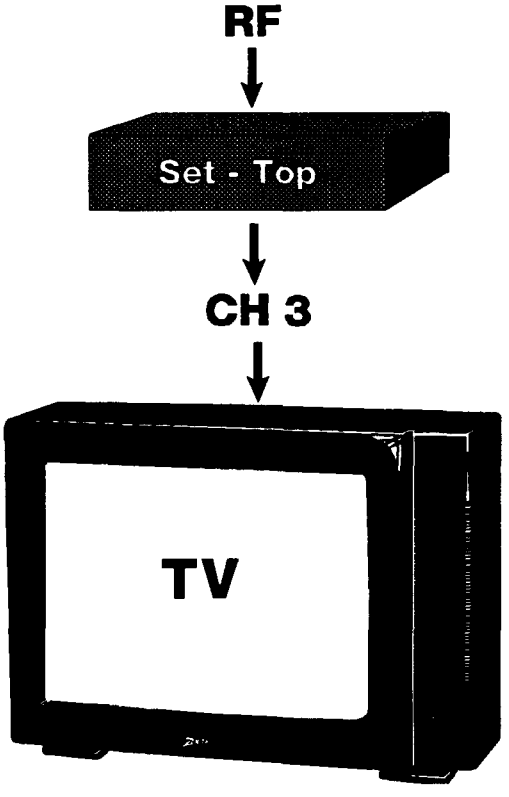

Figure 1

The rapid rise of VCRs increased the resentment against the set-top converter, especially when watching and recording two different programs. Traps, which physically removed channels, brought only in the clear signals into the home, were transparent to users and did not interfere with these features. The set-top converter did. When a set-top was placed between the cable and the television receiver, the receiver essentially was reduced to a channel 3 monitor. As television receivers became more featured the set-top began to lose its welcome. See Figure 1.

Regulatory Consequences

Despite the decreased use of set-top converters brought about by a decline in premium pay subscriptions and a greater preponderance of basic only customers user compatibility problems persisted. Cable vendors and operators made attempts to alleviate the user compatibility problems, but perceived progress was slow. By 1992 many of these user issues: -- loss of features, remote control rental, VCR problems and frequent rate increases—became political issues. The result was legislation reregulating the cable industry that survived a presidential veto. The Cable Act of 1992 not only reregulated cable rates—ultimately reducing rates by 17% and cutting industry revenues by $ 3 billion—but Congress also mandated that the FCC promulgate rules to resolve consumer cable and equipment compatibility issues. The cable and consumer electronics industries, under the auspices of the NCTA (National Cable Television Association) and the EIA (Electronic Industries Association) formed an

Advisory Group consisting of technical, administrative and marketing personnel from both industries. The Advisory Group, along with other commenters, assisted the FCC by recommending solutions for solving the compatibility problems. In particular, the Advisory Group recommended a set-back decoder interface allowing use of the television tuner and providing for communication between receiver and set-back.

The Cable Act of 1992, in order to preserve for consumers the full functionality of their deluxe TV and VCR equipment, calls for improving compatibility between consumer electronics and cable hardware while maintaining the cable companies' control over signal access and security. This section of the legislation is focusing attention on the considerable work done by both the consumer electronics and cable industries in recent years, in pursuit of solutions to these very problems. Predictably, each industry leaned toward solutions which put the major burden of performance on the other, but the Congressional mandate and FCC ruling have spurred progress.

Preferred Consumer Electronics Solutions

Solutions such as Interdiction and Broadband Descrambling promise clear, broadband signals being delivered to the consumer's video equipment, permitting full use of all the functions and features of that equipment. In this environment, the consumer electronics industry could continue to make and sell the highly-featured products that many consumers demand (and the products which generate better margins for a profit-starved Industry).

The cable industry cites high cost and limited security as substantial shortcomings of these approaches. Interdiction schemes add the cost of hardware even for subscribers not buying premium services, and the clear signals transmitted on the distribution system are especially vulnerable to theft in multifamily housing. Broadband descrambling reduces the number of security options available to the cable operator, and fails to block the audio on scrambled channels...a condition unacceptable to many local authorities. And in addition to these limitations in today's analog environment, neither approach will work in a future environment which includes compressed digital signals.

Preferred Cable Solutions

The cable industry desires that TVs and VCRs be made more truly "cable-ready," that is, having more resistance to interference, more channel capacity, and a setback device "interface" such as the ANSI Standard 563 "Multiport." The consensus is that the "Multiport" interface as originally defined is now no longer adequate because of changes in both industries. A new decoder interface has been proposed that offers users full enjoyment of all television receiver features, while cable signal access and security would be handled through a "set-back" (rather than "set-top") box.

The consumer electronics industry points out that these design changes, if required for all TVs and VCRs, substantially increases the cost of these products and places the burden of higher prices on all consumers, whether or not they subscribe to the cable services which drive the need for the enhancements. In addition, the

sorry track record of the consumer electronics industry in implementing price increases suggests it may not be possible to pass along even some of the increased costs. And finally, this approach does not improve the fortunes of the owners of the 180 million color TVs and 100 million VCRs already in service.

An Interim Solution

The new decoder interface offers a solution in keeping with the intent of the Cable Act: improvement in compatibility with consideration of the costs and benefits to consumers and with consideration of the control and security needs of cable operators:

- Establishes a new "cable-ready" specification for TVs and VCRs, incorporating an IF interface port, communication bus between decoder and television receiver and related tuner and performance improvements.

- Permit manufacturers to offer VCRs and additional TV models of this design at their option, as the marketplace.

- Cable operators make the appropriate interface decoders available to buyers of these "cable-ready" products, and offer those subscribers a reduction in their monthly rate.

"Cable-Ready"

Television receivers and VCRs labeled as cable-ready will have the following improvements as shown in Figure 2.

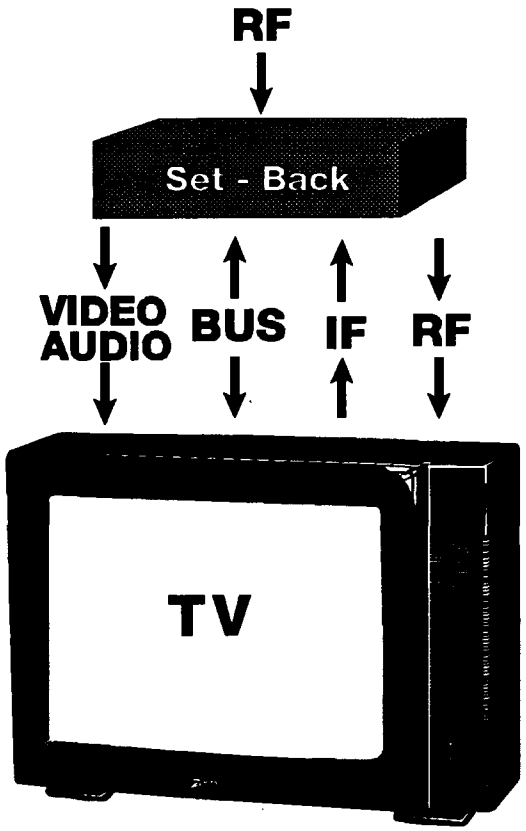

Figure 2.

- *Direct Pickup.* DPU are addressed by adding more shielding to the chassis and tuner and RF input(s).

- *Tuner.* To handle future advances in cable service such as digital compression, tuners with flat response and low phase noise oscillators will be needed.

- *Communication Bus.* The decoder Interface permits communication between the set back decoder and television receiver to provide tuning control by the decoder when needed. The television receiver retains full functionality of special features, while program access, descrambling and

decompression are performed by the outboard interface box.

- *IF Interface.* The unfiltered IF signal is fed to the set-back decoder for processing. This signal passes present analog scrambling signals and will pass digital compressed NTSC signals to a digital set-back decoder in the future.

Interface Decoders

The set-back decoder unit, which would interface with the port on the "cable-ready" product, would not include a tuner, display, keyboard or remote control as a conventional set-top cable box does today. Such decoders could be priced to the cable operator as much as $40 less than the $100-$120 per unit invested today.

Cable-Ready Advantages

The following are positive factors which provide cable operators justification for reducing the monthly rate for subscribers of new "cable-ready" product:

- *Less Capital Invested.* Applying the "rule-of-thumb" that $1/month of cash flow amortizes $50 invested, the lower-cost box may allow the operator to pass along savings of nearly $1/month to the subscriber.

- *Less "Churn."* The improved compatibility will keep the current subscriber happier and hooked up, and attract new subs. Each sub is a $1500-$2900 equity consideration, as cable systems are valued these days.

- *Higher Revenue per Subscriber.* The greater ease of use may stimulate increased Premium and PPV revenues.

- *Perceived value.* Subscribers could envision a "payback" of the premium paid for the TV or VCR in 18 months or so...thus making the selling of the higher-priced cable ready product much easier.

Long Term Solution

Digital Migration

Analog scrambling is a fragmented technology with brand-specific scrambling methods. It is anticipated that analog technology - and scrambling - will be replaced by digital technology. Digital technology holds promise for a long term solution through the adoption of a national digital standard.

The ATV proponents, joined in the Grand Alliance, have adopted as the ATV standard a system consisting of MPEG2 for compression and VSB modulation for transmission. For ATV transmission via broadcast, 8VSB trellis coded, and for cable, 16VSB.

There is no standard for SDD (standard definition digital or compressed digital NTSC). MPEG2, in some variations, is assumed to be the NTSC compression standard. There are two different transmission technologies under consideration for SDD transmission on cable: 64QAM and 16VSB.

64QAM, as embodied in brand specific proprietary technology, offers only a migration path from set-top to set-back decoder. Even in a digital world with HDTV television receivers, with 64 QAM the major portion of signal processing would remain outside the television receiver. Dual mode reception of both 16 VSB and 64 QAM is necessary if the signal processing is to be within the receiver. That accommodation forces the consumer to bear additional cost because of the additional complexity and hardware to accommodate both technologies.

Adopting 16VSB as the transmission standard for both HDTV and SDD signals on cable, would allow a migration path for eventual incorporation of SDD signal processing within the receiver. Initially digital decoding, demultiplexing and decompression would be accomplished in the SDD set-back decoder. See Figure 3. Eventually, decoding, demultiplexing and decompression would migrate to the receiver.

These functions would be incorporated within receiver circuits common to both SDD and HDTV signals. All that would remain external to the receiver would be conditional access and security functions. This would significantly reduce complexity because receiver tuners would be optimized for only one transmission technology.

The advantages of this to consumers and operators are significant:

- For consumers, compatibility would be assured
- and for cable operators a major capital expense transferred to subscribers.

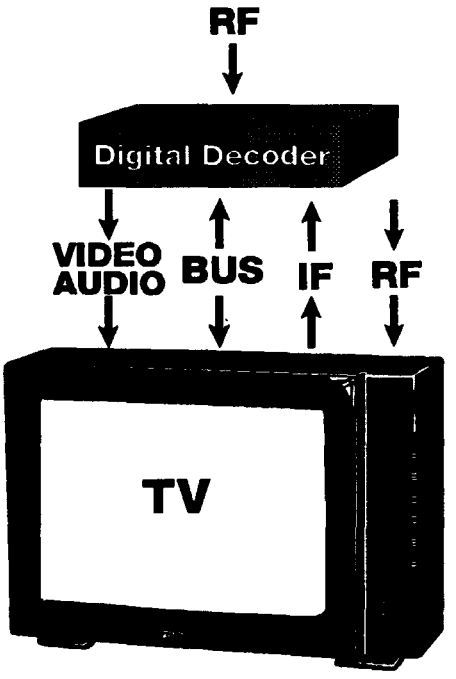

Figure 3.

Conditional access and security functionality would be available at much lower cost and replacement (if needed in a digital environment) less onerous. See Figure 4.

Another advantage for a common digital technology is the opportunity to provide access for other applications that are proposed for the "information highway". The decoder-television receiver command language is being written in a susbset of CEBus. This allows the interface to connect with other peripheral devices to provide new applications and services. A benefit for having these applications occur within the television receiver is that access to the display allows higher resolution graphics than would be available with additional processing in the set-back or set-top device. This is especially important with menus and other graphical interfaces

required for making consumer choices easier

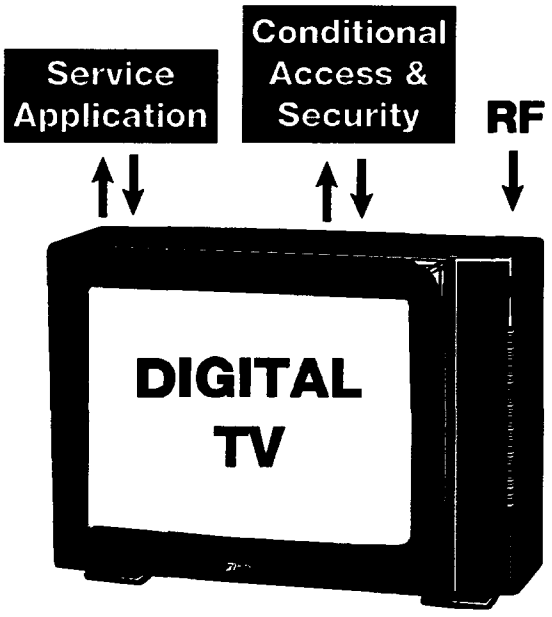

Figure 4.

Conclusion

There has been concern expressed that interface-port solutions fail to address the problems consumers are experiencing today. There are technically feasible enhancements to set-top cable converters which would improve, although not make perfect, the compatibility of cable with the "installed base" of TVs and VCRs.

For example, an active splitter and automatic A-B switch built into the set-top terminal can permit pass-through of all channels when the decoder is inactive, and thus enable the subscriber to use all the special features of his consumer electronics equipment except when watching a premium channel.

However, the IF interface port is a better long-term solution. It is capable of handling analog and digital signals and making the security and control functions of the cable operator transparent to the consumer. Thus permitting the consumer to enjoy full functionality of his TV and/or VCR. And it represents a system architecture capable of handling the compressed digital signals of both NTSC and HDTV.

A common transmission standard allows the decoder interface a ready migration path from analog to both SDD and HDTV signals. For the consumer it offers the promise of true compatibility