

The Trend to Digitization

by

Walter S Ciciora, Ph.D.
Vice President, Technology
American Television and Communications
Englewood Colorado 80112

The Message

The trend to the digitization of electronics is pervasive. Cable technology, which has traditionally had an analog and an RF emphasis, may soon come under pressure from this. HDTV will magnify the problem. The cable technologist should prepare by increasing digital skills. This will at least position him to judge the competition and perhaps, increase cable's competitiveness.

Introduction

There are solid technical reasons for the trend to digitization. In most applications, cost is reduced and quality of the product's performance is increased. Digital components are experiencing the most rapid cost decreases of anything electronic. The cost reductions are caused by a "learning curve" driven by the massive computer industry. Huge R&D expenditures and fierce competitiveness between large international corporations are behind this important trend. Communications technology is also capitalizing on the digital revolution. This adds to the driving forces which are propelling digital technology. The increase in quality comes from the almost limitless ability to regenerate a signal which has suffered modest distortion and noise pollution. A whole science has been created over methods of coding signals so that errors may be completely removed. Signal quality becomes distance and time independent.

Technology by itself is sterile. Marketing makes "digital" come alive in the consumers' mind. Digital is an almost magical word which the consumer has grown to equate with "modern" and "high quality". (The only way to gain marketing impact with things that are analog is to use the spelling: "analogue"!) "Quartz digital", "Digital tuning", "Digital audio tape", "Compact

digital disk", "Digital Television" are just some of the phrases which predispose the consumer to be favorably impressed when he first hears "digitally delivered video". "Digital" may become a marketing imperative.

In four short years, the Compact Disk, CD, has revolutionized the prerecorded audio business. The analog vinyl record is history. Digital audio is the standard. Broadcasters are seriously considering digital audio transmission schemes. The audio tape industry is bracing itself for the digital revolution brought by the Digital Audio Tape, DAT.

Yet cable's experience, training, and even culture is analog. The most important danger in this is that most cable technologists are ill prepared to evaluate the impact of the trend to digitization of electronics. It may be that there is little to be worried about. But that is unlikely. More than likely, there are important action steps to be undertaken to prepare for the digital future.

Competitors' Tools

Perhaps cable's two most important competitors are prerecorded video and telco. Both are moving down the digital trail. HDTV plays an important role in both of their plans.

Recording technology is the area of consumer electronics which has made the most dramatic progress over the last decade. It is also the area with the most potential for more progress. As recording densities increase, more and more signals of greater and greater quality will find their way to consumer tape machines. It is very likely that the next major trend in this arena is to digitization. Sony has demonstrated a two hour recording of video on 8mm tape. Special tape formulations and special techniques were used, but the size and form factor was that of the familiar 8mm tape format. The advantages are greater video quality and an almost immunity to tape wear. Digital recording will do for

video what it has done for audio; it will significantly decrease the consumers' tolerance for imperfections. Consumer expectations will dramatically increase. This will be especially true when HDTV prerecorded video is digitized. The consumer will be challenged to expect better quality.

The telco trend to digitization of telephony is nearing its end. It is an accomplished fact for most of the network. Its remaining step is into the home. The Integrated Services Digital Network, ISDN, will finish the job. ISDN can be implemented over nearly all of the existing copper twisted pair plant. In this form, ISDN's only threat to cable is for those businesses we tried and abandoned. Included here are residential security, meter reading, videotex, software downloading, etc. If the reason cable did not find success in these areas is because the consumer fundamentally does not want these services, telco will harvest the same bitter disappointment. But if the consumer was not ready when cable tried or if cable's technology or implementation was lacking, telco will reap new rewards. The good news is that if cable is alert and responds quickly, it can rejoin the competition.

The real concern over telco's trend to digitization is over B-ISDN, the broadband version of ISDN. B-ISDN is video capable. It has the bandwidth to handle video and even HDTV. B-ISDN cannot be delivered over the twisted copper pair plant. It requires fiber optic cable. This will significantly delay implementation in areas already served by relatively modern telco plant. However, in just a few years, all new construction to the home will be fiber.

One needs only to look over the roster of the various FCC HDTV advisory subcommittees to be impressed with the telco interest in HDTV. Reading the papers published in telco journals and trades and in the IEEE publications clearly reveals the telco interest in digital delivery of HDTV.

The Rapidly Crumbling Brick Wall

The brick wall separating the analog world from the digital world is made up of two components: cost and spectrum demands. Both impediments are rapidly crumbling.

The general technology is advancing in ways that reduce cost and increase reliability. Cost is being reduced because of the progress made in computers. Specific components such as

memory are enjoying dramatic cost reductions. This leads to broader application in communications and consumer electronics equipment. This in turn furthers the cost reduction. The cycle is endless. Digital television receivers and VCR's are transforming digital techniques into consumer electronics product design tools. It would be prudent for cable to find ways to tap into this process and capitalize on the massive development investments made by others.

The bandwidth impediment is being attacked on two fronts. Advances in signal processing have reduced bandwidth requirements while the move to fiber optics has increased the bandwidth available for digital transmission. These impediments have been reduced for both telco and cable. Telco is taking advantage of the opportunity. Cable must at least understand the significance of the telco initiatives. If possible, cable must find ways to apply these techniques to its advantage too.

Paperback Movies

There is a digital development which in many ways runs counter to most other trends and in some ways may be the most dangerous of all. The Paperback Movie project at MIT has as its objective the creation of a movie distribution business that closely parallels the paperback book business. The intention is to develop a medium which has costs similar to those of a paper back book. The economics and distribution methods for Paperback Movies would be very similar to those of paperback books. Just as the price of a paperback book is too low for anyone to be motivated to copy it, so the price of Paperback Movies will be too low to tempt copying. In fact the price would be so low that even loaning the Paperback Movie would be more trouble than its worth. Most readers buy their own paperback books. Relatively little loaning takes place.

The vision behind the Paperback Movie is of a digital bandwidth reduction technology which would allow a two hour movie to be placed on a five inch compact disk. This is an ambitious challenge, but not an unreasonable one.

A factor which mitigates the difficulty of compacting two hours of video onto a five inch disk is a willingness to take a reduction in video quality as a trade off in gaining the compression. The willingness to reduce the quality requirement stems from the fact that the Paperback Movies concept is complementary with another important trend in consumer

electronics, personal video. Small, portable, battery operated VCR's are already available with three to five inch diagonal measure liquid crystal color displays and TV tuners. The VCR's come in both the VHS and the 8mm formats. The 8mm devices are very small indeed. Portable CD players are also available. When the color liquid crystal display is added to the CD player, the ultimate Paperback Movie playback device is achieved. Personal, portable viewing of movies anywhere, anytime becomes possible. There is reason to be concerned that the way consumers enjoy movies may be changed by this technology.

Digital Downloading

Another digital technique which has received attention over the last few years is "digital downloading." There are two approaches to digital downloading. In one approach, the goal is to compress the video so its bandwidth is minimized, then it is sped up for transmission. The hope is to download a two hour movie in five minutes. The second approach hopes to reduce the video bandwidth adequately so it can be downloaded over ordinary twisted pair phone lines during the night in more than two hours if necessary.

While these concepts are technically possible, several daunting problems remain. The most important impediment is the question: "download into what?". At first thought, the ideal would be to download into the consumer's existing VCR. In the case of the five-minute-download, if we are to deliver a two hour movie, the speed-up ratio is twenty four times. The VCR head must rotate twenty four times faster and the tape must fly by the heads twenty four times as fast. Also, if the recording is analog, the bandwidth is increased by twenty four times to nearly 100 MHz. No consumer VCR exists which can do that. It is unlikely to be practical to accomplish this in any reasonable time frame. In the case of the phone line download, the consumer's VCR must be capable of recording one picture at a time while the next is downloaded over an expanded time period. Consumer VCR's simply don't do that now. A special VCR would be required. This second type of VCR is much more practical to consider building. But the usual chicken and egg problem remains. The build up of penetration of the special VCR will take years. Can a business be build on such assumptions? Likely not.

The usual assumption is that the consumer's home computer will provide the

computational power to process the compressed signals into the form required for recording. There are several things wrong with this assumption. First the number of home personal computers is a tiny fraction of the number of TV households. Further they are mostly of the wrong kind, more suited to games and very limited in computing power, speed and memory. Secondly, a dedicated consumer electronics product would be more efficient and cost effective. It too does not exist.

In both downloading scenarios, the temptation will be to take a reduction of quality in order to make the time constraints more manageable. HDTV is counter to these approaches because it greatly increases the amount of information that must be downloaded and challenges the consumer to expect high quality. In the case of the phone line download, planning for an overnight downloading is simply not in keeping with the American desire for instant gratification. It is not impulse pay per view.

Conclusion

The trend to the digitization of electronics is pervasive. The cable technologist should prepare for this trend by increasing his digital skills. This will at least position him to better judge cable's competition. Perhaps these new digital skills will also serve to increase cable's competitiveness. HDTV makes this all the more important.