

FIG. 1.1. Evolutionary paths converge on Internet TV.

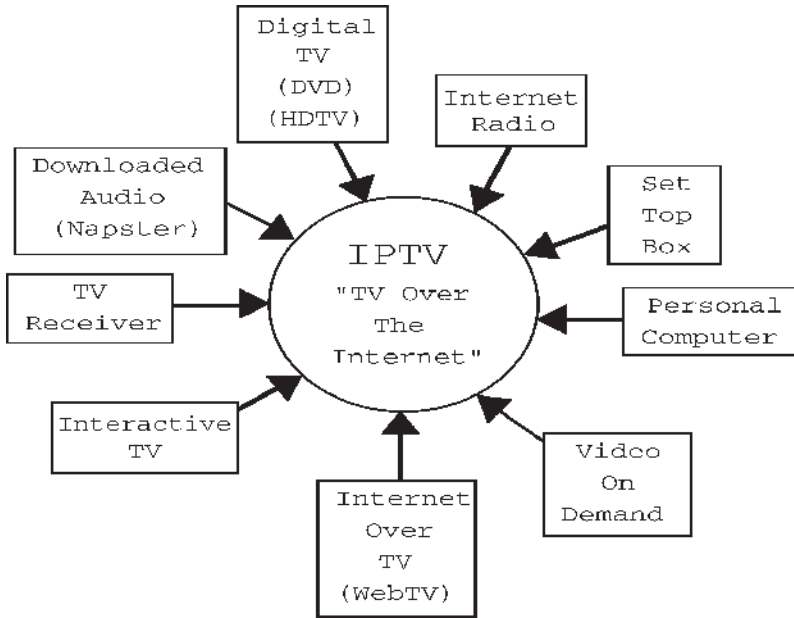


FIG. 1.2. All the forces and developments in computers and television centralize on Internet TV. Whether all these forces focusing their energy on Internet TV will cause an implosion or not remains to be determined.

all the activity might create so much confusion and diffusion that some real opportunities could be lost along the way.

INTERNET TV DEFINED

What is Internet TV? The definition depends on the definitions of television and Internet. Although the two terms might seem quite clear, they both are actually evolving with different meanings to different people.

In 1945, everyone knew that television was the broadcasting of moving images, along with sound, over the airwaves to homes for viewing on a television receiver. The content of these early days of television was news, movies, drama, sports, and variety shows. Later, television evolved to include the distribution of video content over coaxial cable, videotape, and videodisc. Although the distribution technology evolved, the content remained mostly unchanged.

Today, the media continually touts that “the Internet is everything.” With consumers routinely downloading audio recordings and programs over the Internet, the next wave will be the routine, widespread downloading of video in real time over the Internet—a technology known as video streaming. Alternatively, video could be sent as a large file transfer and viewed at a later time. Either way, this could be the death knell of conventional television broadcasting, the video rental store, and such physical media as the digital videodisc (DVD). Consumers would then be able to pick and choose any video and television program for downloading and viewing at their convenience. The old dream of video-on-demand (VOD) will finally be realized.

But the network capacity required to transmit lengthy high quality video material to tens of millions of consumers will be costly and complicated to develop. The Internet is already used to download video shorts and cartoons. Some of this new video material is interactive, creating a new form of interactive television (ITV).

The definition of Internet TV obviously depends on the definition of the Internet. At the lowest infrastructure level, the Internet is a packet-switched data network consisting of transmission links and packet routers, linking computers around the globe. The Internet also means the protocols used for specifying the transmission and routing of packets of information. The Internet is the browser, such as Microsoft® Explorer® and Netscape® Communicator™, used to access and display the information obtained from Web sites on a personal computer in a friendly and easy-to-use fashion. The Internet is the general concept of the hypertext markup language (html) that is used to allow easy linkages between different sources of information along with friendly display. And lastly, the Internet is the look and feel of the information

accessed and displayed in color and graphics from various Web sites. Clearly, the Internet is many things.

The various key features of the Internet are as follows: look and feel (color/graphics), browsers, hypertext markup language, Internet protocol for packet switching, and worldwide packet network for data transmission. What this all means is that the definitions of both the Internet and television are evolving. Hence, the definition of Internet TV, because it combines elements of both, is also evolving and is not yet clear. Therefore, the technology and future of Internet TV are somewhat speculative because of this unclear definition. If the definition of the "it" is unclear, then most consumers will not buy "it," and the "it" will have problems in the marketplace or evolve into an "it" that is less hazy and more clearly defined.

INTERNET TV CAN BE MANY THINGS

Internet TV is many things, or even a combination of things. In its most obvious implementation, Internet TV is conventional television obtained over the Internet. Rather than watching television programs broadcast over the air or over cable, television programs are accessed over the Internet and then watched in real time, using a technology known as video streaming. Not only conventional television, but also cartoons and video shorts, are sent over the Internet with video streaming. All this video is watched on the personal computer. Computer technology will be incorporated within future television sets to facilitate television access over the Internet. The television set thus converges with the personal computer.

Internet TV is the adoption of an Internet-like interface in accessing and watching television—a new form of video navigation over the Internet. Internet TV is a more interactive approach to controlling the television experience with the ability to obtain all sorts of ancillary information while watching television, as promoted by Wink Communications.

Internet TV is the use of the home TV set to view Internet sites, as offered by WebTV Networks, perhaps in conjunction with conventional television viewing. These kinds of applications of Internet TV create an interactive television experience called Internet-enhanced TV. Such Internet-enhanced TV could then evolve into Internet-delivered TV on a wide basis.

Internet TV is the use of the Internet protocol to store and transmit video, both at the TV studio and also to various locations. Rather than storing and transmitting digital video as a continuous stream of bits, the digital video is packetized into the packets specified by the Internet protocol.

EVOLUTIONARY CONVERGENCE

The personal computer is the device in the home used to access the Internet through a modem connected either to a telephone line or to a co-

axial cable. The personal computer is situated at the home work center. Television is watched on the home television receiver, physically placed at the home entertainment center. Will the personal computer evolve into an entertainment center? Will the home television receiver become the means to access the Internet, as promoted by Web TV? Or will television receivers of the future increasingly adapt digital technology for entertainment purposes, leaving the personal computer as a separate work appliance in the home?

LESSONS FROM WEB RADIO

Radio is being changed because of the Internet. Will similar changes occur to television? Consumers in rural areas now “listen” to the radio over the Internet. A colleague in rural New Hampshire accesses WQXR in New York City over the Internet to listen to classical music. Will radio stations return their broadcast licenses as they migrate to the Internet?

Indeed, there is growing evidence of a much broader market for radio stations beyond their local market. But there are more technologically efficient ways to extend this reach than the use of the packet-switched Internet. One way would be geostationary satellite transmission of all radio stations. Just two satellite transponders could handle 10,000 radio stations in a compressed digital format. But would small inexpensive satellite radio receivers be developed?

Internet TV could then simply evolve into a form of “world TV” in which all television programming from the entire planet would be transmitted by satellite to everyone on the earth. The capacity to do this would require only a few geostationary satellites.

A LITANY OF FAILURES, YET CAUSE FOR HOPE

An issue of *The Economist* characterizes “the digital revolution in entertainment ... [as] somewhere between a disappointment and a disaster” (Duncan, 2000). Indeed, much of the rhetoric of Internet television is very similar to the words of the recent past about such technologies as video dialtone (VDT), video-on-demand (VOD), interactive TV (ITV), and fiber to the home (FTTH). Unfortunately, these technologies are a litany of failures, along with such others as Web TV and high-definition digital TV.

The stereotypical image of the television viewer as a couch potato is based much on reality. Most TV viewers do not want to interact with their TV sets, other than to click the remote to change channels (Hansell, 2000). However, the British and many Europeans do interact with their TV sets via teletext—as yet, the only successful form of interactive television (Noll, 1985). Teletext transmits a few hundred frames of text and graphics during the vertical blanking interval of a television signal. Because of confusion

over standards, teletext never developed in the United States. The success of the Internet, which offers access to far more information than teletext, means that teletext has a dim future.

Interactive two-way television was pioneered decades ago by Warner Cable in Columbus, Ohio. The Warner QUBE system was initiated in 1977, but was later terminated in the late 1980s. Although all sorts of wild promises were made for its application, a major use of QUBE was to obtain instant audience reaction to new programs.

Web TV offers Internet access over the home television receiver using a keyboard that attaches to the telephone line and to the TV set for display. The service has met with very little consumer acceptance ("What-ever Happened to WebTV?," 2000). Yet, the predictions of a huge market for interactive television continue to be made, with Forrester Research predicting over 20% of TV revenue from smart set-top boxes by 2005 ("Microsoft's Blank Screen," 2000).

GTE offered all sorts of interactive, two-way, broadband video in Cerritos, California, from the late 1980s to the late 1990s. The consumer interest simply was not present for the video-on-demand (VOD) service. In 1992, Bell Atlantic promised to deploy optical fiber in the local loop for video dialtone (VDT) and predicted to have 1.2 million homes connected by end of 1995. Nearly 6,000 homes in Dover Township, New Jersey, were connected to an optical fiber system in 1996, only to be disconnected a few years later. The service was apparently far too costly to continue to offer. Bell Atlantic has never explained the reasons for withdrawing the service.

High-definition television (HDTV) doubles the number of scan lines of conventional television. HDTV is being used in the TV studio to capture video in a high quality format. HDTV is also being broadcast in a digital format in an additional channel in the UHF spectrum given to conventional VHF broadcasters. Consumers, thus far, have shown little interest in HDTV. A key issue will occur over what to do with all the UHF spectrum given to the broadcasters for a service that is little watched.

The telephone network is a switched audio network. It could have been used as a means to call radio stations to listen to programs on a switched basis. But the switched public telephone network is not used that way, perhaps because of the cost. Listening to radio programs over the telephone network at 5 cents per minute equates to \$3 per hour, which is quite prohibitive. The advantage of the Internet for doing the same thing is that the Internet is "free" to consumers and does not have usage sensitive pricing.

The concept of broadband to the home is not new and was first presented in the 1970s. The "broadbandwagon" keeps rolling along, reinventing itself every few years (Noll, 1989). A decade ago, it was fiber to the home (FTTH) and fiber to the curb (FTTC). Today, it is Internet TV, but there is a history of failures of this "highway of dreams" of an information superhighway (Noll, 1997a). Those who are able to maintain hope

against the overwhelming tide of failures will say the time is now, but it might be still just too soon.

UNCERTAINTIES ABOUND

There are technological challenges and hurdles that would need to be overcome for Internet television to become a reality. However, the real uncertainties are not technological in nature but involve consumer needs and behavior, industry structure, and finance. In addition, there are issues over copyright and ownership protection that would need to be resolved.

The Internet is mostly “free” except for a fixed monthly access charge paid to the Internet access provider. But if there were tremendous use of the Internet to send huge amount of video data, usage sensitive pricing might be needed (Noll, 1997b). Even a usage charge as low as $0.1 \mu\text{¢}/\text{bit}$ (0.1×10^{-6} cents per bit) adds up quickly when video data is sent continuously at 4 Mbps. A minute of such Internet high quality video would incur usage charges of 24 cents, which is prohibitively expensive. However, there are many other uncertainties about Internet television.

Are consumers demanding Internet television? Do consumers want to interact with their television sets? Is it possible to overcome the history of the past failures and false promises of video dialtone, video-on-demand, interactive TV, and fiber to the home?

Is Internet TV a revolution or will it become yet another evolution in the distribution of video programming in digital form? As bandwidth continues to become available, will consumers demand improved quality so that compression is no longer wanted or needed? Is Internet TV a way to be entertained or a way to obtain information? How will conventional broadcasters respond? Is Internet TV just an evolutionary enhancement of digital CATV? Will new unexpected applications evolve and change the Internet TV landscape? What will Internet TV cost, who will finance it, and who will afford it? The answers to these key questions are currently unclear. Thus far, Internet TV has been driven mostly by technology push. Will consumer pull develop, thereby leading to success? Only time will tell.

ACKNOWLEDGMENT

Many of the definitions of Internet TV presented in this chapter are a result of discussions with Darcy Gerbarg, and her contributions to this chapter are gratefully acknowledged.

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